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Technical faculty "Mihajlo Pupin"
Zrenjanin*



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INFORMATION TECHNOLOGIES**

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TECHNICAL FACULTY "MIHAJLO PUPIN"
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INTRODUCTION

Information Technologies and Internet as a part of Computer science creates new approaches and perspectives, new models and numerous services, which opens up and makes use of the world of information and symbolized knowledge. Advances in Information technology, including the Internet, have dramatically changed the way we collect and use public, business and personal information.

The 2nd **International Conference on Applied Internet and Information Technologies** is an international refereed conference dedicated to the advancement of the theory and practical implementation of both knowledge of Information Technologies and Internet and knowledge of the special area of their application.

The objectives of the **International conference on Applied Internet and Information Technologies** are aligned with the goal of regional economic development. The conference focus is to facilitate implementation of Internet and Information Technologies in all areas of human activities. The conference provides forum for discussion and exchange of experiences between people from government, state agencies, universities and research institutions, and practitioners from industry.

The key Conference topic covers a broad range of different related issues from a technical and methodological point of view, and deals with the analysis, the design and realization of information systems as well as their adjustment to the respective operating conditions. This includes software, its creation and applications, organizational structures and hardware, different system security aspects to protocol and application specific problems. The Conference Topics are:

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8. Computer graphics
9. ICT Support for decision-making
10. Management in IT
11. E-commerce
12. Internet marketing
13. Customer Relationship Management
14. Business intelligence
15. ICT practice and experience

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**President of the Organizing Committee
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Zrenjanin, October 2013

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“The Art of Modeling”: How Can AIIT Be Modeled?

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Abstract - The acronym AIIT stands for “Applied Internet and Information Technologies”. How can Internet and Information Technologies be modeled? Two of the main topics of the AIIT 2013 conference are (i) Communications and computer networks, and (ii) E-commerce. As two archetypal technologies belonging to these two categories, (i) Peer-to-Peer Live Video Streaming Systems and (ii) Web Based e-Commerce Shopping Systems are considered. Inspired by the title of Donald Knuth’s comprehensive monograph “The Art of Computer Programming”, we try to exemplify “The Art of Petri Net Modeling” through the use of Fluid Stochastic Petri Nets (FSPN) and Deterministic and Stochastic Petri Nets (DSPN), respectively.

I. INTRODUCTION

Stochastic timed Petri nets provide a good framework to model the dynamic behavior and examine the performance of concurrent and asynchronous systems. The classes of stochastic timed Petri nets that have been proposed for performance and reliability analysis of systems include Stochastic Petri Nets (SPN) [1], Generalized Stochastic Petri Nets (GSPN) [2], Extended Stochastic Petri Nets (ESPN) [3], and Deterministic and Stochastic Petri Nets (DSPN) [4]. In a SPN, a transition fires after an exponentially distributed amount of time (“firing time”) when it is enabled. A GSPN, instead, allows transitions with zero firing times or exponentially distributed firing times, and the stochastic process underlying both a SPN and a GSPN is a continuous-time Markov chain. ESPNs allow generally distributed firing times and exponentially distributed ones – under some restrictions the underlying stochastic process of an ESPN is a semi-Markov process. Finally, DSPNs allow transitions with zero firing times, or exponentially distributed, or deterministic firing times. As a result, the underlying stochastic process of a DSPN is neither a Markov, nor a semi-Markov chain [5]. However, DSPNs can be solved analytically with a restriction that at most one timed transition with deterministic firing time is enabled concurrently with exponentially distributed timed transitions. A steady state solution method for DSPNs appears in [6], and a transient solution method is given in [7]. Furthermore, in [8], the underlying stochastic process for a DSPN is shown to be a Markov regenerative process.

On the other hand, Fluid Stochastic Petri Nets (FSPN) [9] contain two types of places: discrete places containing a non-negative integer number of tokens, and continuous places containing fluid (non-negative real quantity).

Transition firings are determined by both discrete and continuous places, and fluid flow is permitted either with deterministic fluid rates through the enabled timed transitions, or in the form of fluid jumps (transportation of fluid in zero time) through enabled immediate transitions in the Petri Net. By associating exponentially distributed or zero firing time with transitions, the differential equations for the underlying stochastic process can be derived.

The remainder of this paper is organized as follows: in Section II we use FSPNs to model Peer-to-Peer Live Video Streaming (P2P LVS) systems, whereas in Section III DSPNs and GSPNs are employed to capture e-Customer’s online shopping behavior in a web based e-Commerce system. Section IV concludes the paper.

II. PART ONE: MODELING PEER-TO-PEER LIVE VIDEO STREAMING SYSTEMS

Nowadays, more and more visitors are attracted to web locations for live video content, which leads to sustainability issues when clients rise above the upload capabilities of the streaming server. Since IP Multicast failed to satisfy these requirements, in the last decade the science community intensively works in the field of P2P networking technologies for live video broadcast. In this paradigm every user (peer) maintains connections with other peers and forms an application level logical network on top of the physical network. Video stream originates at a source and every peer acts as a client as well as a server forwarding the received video packets to the next peer.

P2P live streaming is a relatively new paradigm that aims at streaming live video to large number of clients at low cost. Many applications already exist in the market, but, prior to creating such a system, it is necessary to analyze its performance via representative model that can provide good insight into the system’s behavior. Modeling and performance analysis of P2P LVS systems is a challenging task which requires addressing many properties and issues of P2P systems that create complex combinatorial problem.

A. General Assumptions

“The art” of modeling and performance analysis covers two simple aspects. First, the model should always be simple, intuitive and close to the designer’s intuition of what the modeled system looks like. Second, it should

account for as many features as possible, while providing accurate performance results without compromising its simplicity.

In this case, we consider a P2P LVS system that adopts mesh topology, where peers are randomly organized into groups or neighborhoods, and each group member communicates with all his neighbors exchanging video chunks. The model also incorporates peers' upload bandwidth (UB) heterogeneity that is implemented by classifying peers into several classes, based on their UB capabilities.

Peer arrival is described as a stochastic process with exponentially distributed interarrival times, with mean $1/\lambda$, where λ is the arrival rate. We assume exponentially distributed viewing times with mean duration of T minutes. Clearly, since each peer is immediately served after joining the system, we have an $M/M/\infty$ queuing model with infinite number of servers and exponentially distributed joining and leaving rates. For such a model, the mean service time is $T = 1/\mu$, where μ is the departure rate. Now, λ represents peer arrival in general, but the peers from different classes do not share the same occurrence probability (p_i). So, "Class 1" peers arrive with rate $\lambda_1 = p_1 * \lambda$, "Class 2" peers arrive with rate $\lambda_2 = p_2 * \lambda$, and "Class n " peers arrive with rate $\lambda_n = p_n * \lambda$, where $p_1 + p_2 + \dots + p_n = 1$. This way, the model with *peer churn* (peers join and leave the network at free will) is represented by several independent $M/M/\infty$ Poisson processes, one for each peer class.

As for the streaming part of the model, we adopt fluid flow, where bits are represented as *atoms of fluid* that travel through fluid pipes (network infrastructure) with rate dependent on the system's condition. We identify four separate fluid flows (streams) that travel through the network with different bitrates:

- main video stream – represents the video data that is streamed from the source to the peers, further stated as *video rate* (V_R);
- the play stream which is the stream at which each peer plays the streamed video data, further stated as *play rate* (Y_R);
- *control rate* (C_R), which describes the exchange of control messages needed for the logical network construction and management;
- the network infrastructure packet loss – an average of 15% of all traffic is lost and therefore needs to be resent. We denote this stream as *loss rate* (L_R) and the percentage of lost packets as *loss percentage* (L_P).

To satisfy the requirements of our models we define a *stream function* $\psi()$. The stream function is not the maximum, but rather the actual rate that is streamed to any individual peer at any given time.

B. FSPN Model

A general FSPN model of a P2P LVS system with buffering is shown in Fig. 1. The model has n discrete

places (single line circles), $n+5$ timed transitions (rectangles), n immediate transitions (short lines) and a single fluid place depicted by means of two concentric circles. Discrete places are connected with discrete arcs that are drawn with single lines through which tokens are transferred. Fluid arcs, through which fluid is pumped, are drawn as double lines to suggest a pipe. Peers are represented as discrete tokens and video stream is represented as fluid flow. Discrete tokens join and leave the discrete places via discrete arcs. The fluid is pumped through fluid arcs and is streamed to and out of the fluid place. The model's sole fluid place P_{BUF} represents a single peer buffer.

T_A is a timed transition with exponentially distributed firing times that represents peer arrival, which upon firing (with rate λ) puts a token in P_{CS} . P_{CS} (representing the control server) checks the token class (peer class) and immediately forwards it to one of the discrete places $P_1, P_2, P_3 \dots P_n$. These places represent the peer classes in our P2P LVS system. The transitions that forward tokens to the discrete places are $T_{J1}, T_{J2}, T_{J3} \dots T_{Jn}$. These are immediate transitions that (when there is a token in P_{CS}) fire with probabilities $p_1, p_2, p_3 \dots$ and p_n respectively. These probabilities multiplied by λ represent the rates of occurrence of a peer from a certain class, where $p_1 + p_2 + \dots + p_n = 1$.

Transitions $T_{L1}, T_{L2}, T_{L3} \dots T_{Ln}$ are enabled only when there are tokens in discrete places $P_1, P_2, P_3 \dots P_n$ respectively (Fig. 2). These are marking dependent transitions, which, when enabled, have exponentially distributed firing times with rate $\mu * P_i$ (i.e. μ "number of tokens in P_i "). Upon firing they take one token out of the discrete place to which they are connected. In addition, these transitions, when enabled, pump fluid through the fluid arc to the fluid place. Flow rates of $\psi()$ are piecewise constant and depend on the number of tokens in the discrete places and their class. The continuous place P_{BUF} represents a single peer's buffer. It is constantly filled with rate $\psi()$ and drained with rate $Y_R + L_R + C_R$. Transition T_S represents the streaming server functioning – it is always enabled (except when there are no tokens in any of the discrete places) which means that it constantly pumps fluid into the continuous (fluid) place P_{BUF} . Transition T_{PLAY} is also always enabled and constantly drains fluid from the continuous place P_{BUF} , with play rate Y_R . It tends to be equal to V_R except when the system works in *degraded service mode*. Other transitions that are always enabled are T_{LOSS} and $T_{CONTROL}$ and constantly drain fluid from the fluid place P_{BUF} , with rates L_R and C_R , respectively.

Priorities (pr_1, pr_2 and pr_3) are assigned to transitions $T_{LOSS}, T_{CONTROL}$ and T_{PLAY} , correspondingly, in descending order. T_{LOSS} has the priority over both $T_{CONTROL}$ and T_{PLAY} , whereas $T_{CONTROL}$ has the priority only over T_{PLAY} . The lowest priority (pr_3) assigned to T_{PLAY} , means that when the stream function $\psi()$ does not have the capability to fully support all these three streams, the play rate is, regrettably, the first to drop.

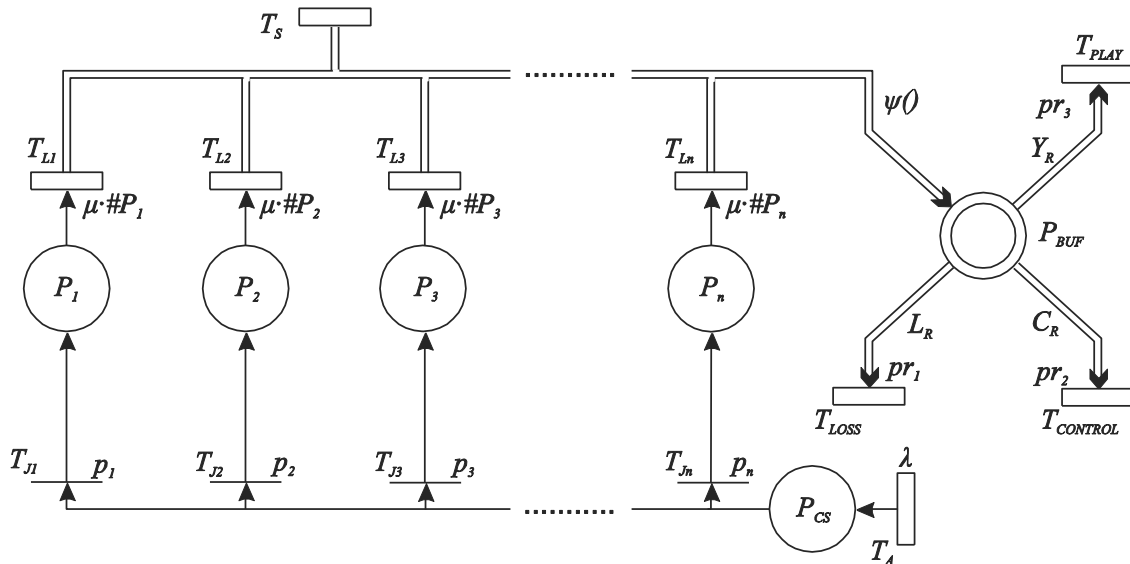


Figure 1. FSPN model of P2P LVS system

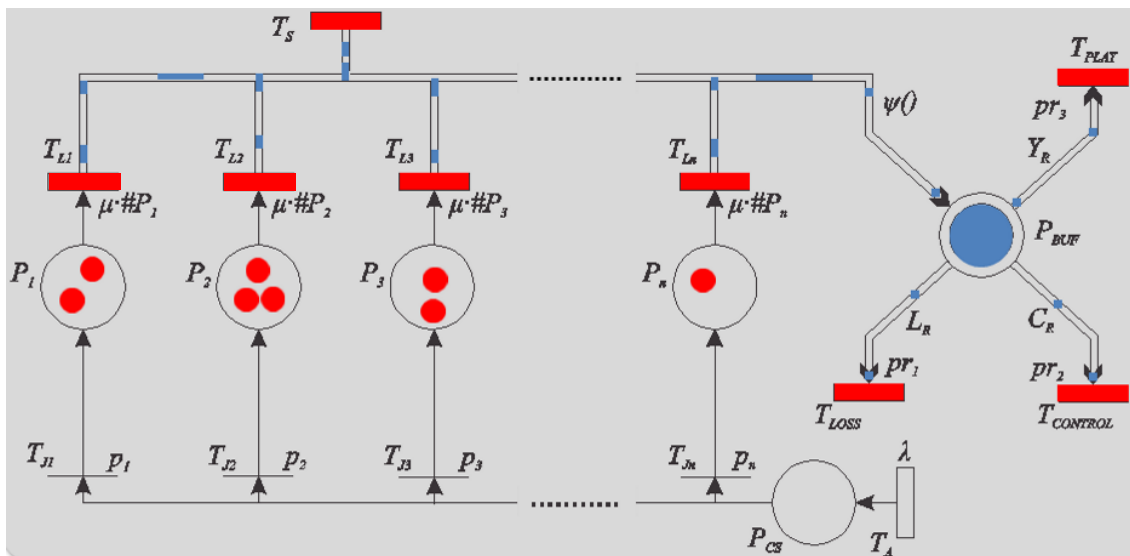


Figure 2. "Token game": eight peers (tokens) are present in the system, video is streamed (fluid is pumped through fluid arcs) and the buffer is full

It is important to note that due to extremely large state space of our FSPN model, analytical/numerical solution seems to be infeasible. Therefore we turned to discrete-event simulation [10]. Throughout our previous research [11–17] we discovered remarkable association between Petri Nets and the SimPy package. SimPy [18] is a discrete-event simulation package based on standard Python programming language [19]. It is an object-oriented, process-based discrete-event simulation language that provides the modeler with simulation components including "Processes" for active components (e.g. peers and video chunks), and "Resources" for passive components that form limited capacity congestion points (e.g. servers) [20]. It also provides monitor variables to aid in gathering statistics, whereas random variables are provided by the standard Python random module. For a comprehensive performance analysis of P2P LVS systems based on a hybrid fluid modeling approach, demonstrating

not only "the art" but also "the power" of Petri Net modeling, the reader is referred to [17].

III. PART TWO: MODELING WEB BASED E-COMMERCE SHOPPING SYSTEMS

"And now for something completely different": as e-Commerce becomes more mainstream, e-Commerce web sites become an essential necessity for almost any business. From developing the business plan to selecting the hardware and software, each step requires hard work, proper diligence, and large amounts of research. Owning and operating an e-business is a continuous developmental process. Some phases, such as domain registration, obviously need to be done only once (unless a merchant decides to register another domain name), but most of the other steps are part of an ongoing process to keep an e-business up to date [21].

A. Lifecycle of a Conceptual E-Commerce Application

The simplest description of a conceptual mainstream e-Commerce application is that a customer makes a search through the products catalogue and adds the desired items to the shopping basket. As soon as the customer decides to pay (checkout), he or she provides the system with the delivery address, supplies credit card information and places an order. The system verifies credit card authorization and soon sends the customer an e-mail confirmation regarding the purchase. If, at some point, the server is unable to process customer's last request due to the length of inactivity (maximum allowed time between requests elapsed), the session expires.

Later on, when the products become available, the system forwards the shipping package to a delivery company and updates order status (the customer is presumably off-line).

B. E-Customer's Behavior DSPN Model

The DSPN in Fig. 3 models the customer's behavior in a conceptual mainstream e-Commerce application [22]. The token in place P_{SEARCH} denotes that a customer is about to make a new search through the products catalogue, which is a time-consuming activity. The firing time of transition T_{END_SEARCH} is exponentially distributed with rate λ . The product is either found (firing of transition T_{FOUND} with probability P_{FOUND}), or not found (firing of transition T_{NOT_FOUND} with probability $1-P_{FOUND}$). In addition, it is the customer's decision to add the product to the shopping basket (firing of transition T_{ADD} with probability P_{ADD}) or not (firing of transition T_{NOT_ADD} with probability $1-P_{ADD}$). The firing of immediate transition T_{ADD} leaves a token in place P_{IN_BASKET} (removes all (zero or one) tokens and puts back one), just to indicate that the shopping basket is not empty (the number of products is irrelevant) (Fig. 4). Regardless of the search outcome, the customer can either (a) *make a new search* (probabilities $P_{CONTINUE_1}$, $P_{CONTINUE_2}$ and $P_{CONTINUE_3}$, respectively), (b) *end shopping* without placing an order (probabilities P_{END_1} , P_{END_2} and P_{END_3} , respectively), or (c) *proceed to checkout* provided that the shopping basket is not empty (probabilities $P_{CHECKOUT_1}$, $P_{CHECKOUT_2}$ and $P_{CHECKOUT_3}$, respectively). One can expect the probability of a new search to be the highest when no product is found, and the probability of ending without placing an order to be the lowest when the shopping basket is not empty.

Checking-out is also a time-consuming activity. The firing time of transition $T_{Review-Submit-Verify}$ is exponentially distributed with rate μ . The consumer *reviews* and *submits* delivery address and credit card information, credit card authorization is *verified*, and *order is placed* (token in place P_{ORDER_PLACED}). Right away, the system sends the customer an e-mail confirmation regarding the purchase (firing of transition T_{E-MAIL}) and the lifecycle of the e-Commerce application ends (token in place P_{END}).

In order to capture the mechanism of session expiration due to the length of inactivity, a timed transition $T_{TIMEOUT}$ with deterministic firing delay τ and *resampling* policy is introduced. Its *remaining firing time* (RFT) is *resampled* (set to τ) in each new tangible marking of the Petri Net. The firing of $T_{TIMEOUT}$ indicates

that the server is unable to process further customer's requests because the maximum allowed time between requests elapsed (token in place $P_{SESSION_EXPIRED}$).

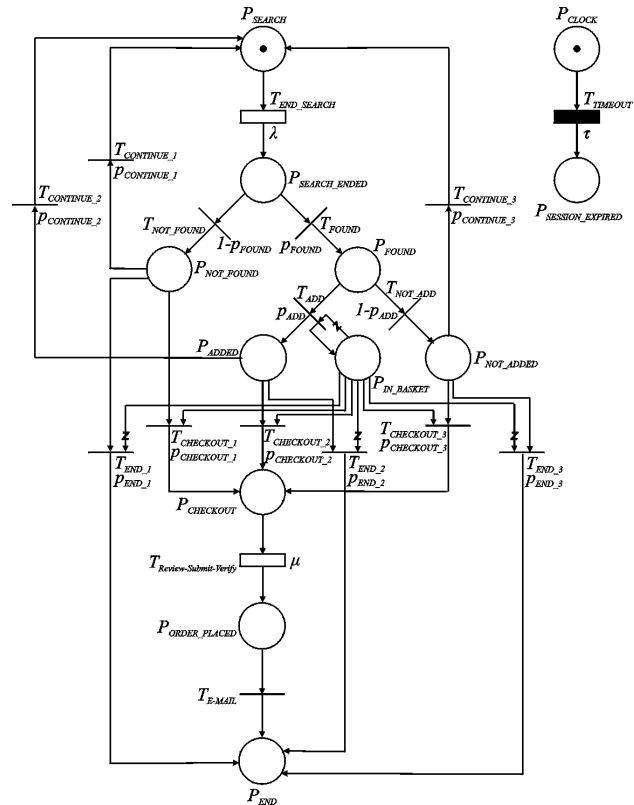


Figure 3. The customer's behavior DSPN model

C. GSPN Model of the Operational Environment

In an attempt to propose a new taxonomy, we have identified and qualitatively described *five* generic e-Customer's classes [23–26], which include: (i) *Passionate*, (ii) *Focused*, (iii) *Reluctant*, (iv) *Curious* and (v) *Selective* e-Customers. Each particular class represents a single typical online shopping behavior pattern. Fig. 5 shows the formal GSPN model of the operational environment: an e-Customer, represented by a token in P_{START} , is going to start his/her online session by firing the immediate transition T_{START} . The selection of the corresponding class is done when the token arrives in P_{SELECT} , when N immediate transitions T_{CLASS_1} , T_{CLASS_2} , ..., T_{CLASS_N} become concurrently enabled, each having specific firing weight w_1, w_2, \dots, w_N . The probability of firing the immediate transition T_{CLASS_i} represents the probability of occurrence of a "Class i " e-Customer.

When a transition T_{CLASS_i} fires, a single token appears in the place $P_{EXECUTE}$ (i.e. the "Class i " e-Customer can carry out his/her online session) and i tokens appear in the place P_{CLASS} (due to multiplicities of the outgoing arcs originating from the transition T_{CLASS_i} towards the place P_{CLASS}), thus identifying the corresponding class that the new e-Customer belongs to (Fig. 6). The row-vector $[w_1, w_2, \dots, w_N]$ represents the *operational profile*, whereas timed transitions in the DSPN model have *marking-dependent firing rates*, and immediate transitions have *marking-dependent weights* (i.e. they depend on the number of tokens in P_{CLASS}).

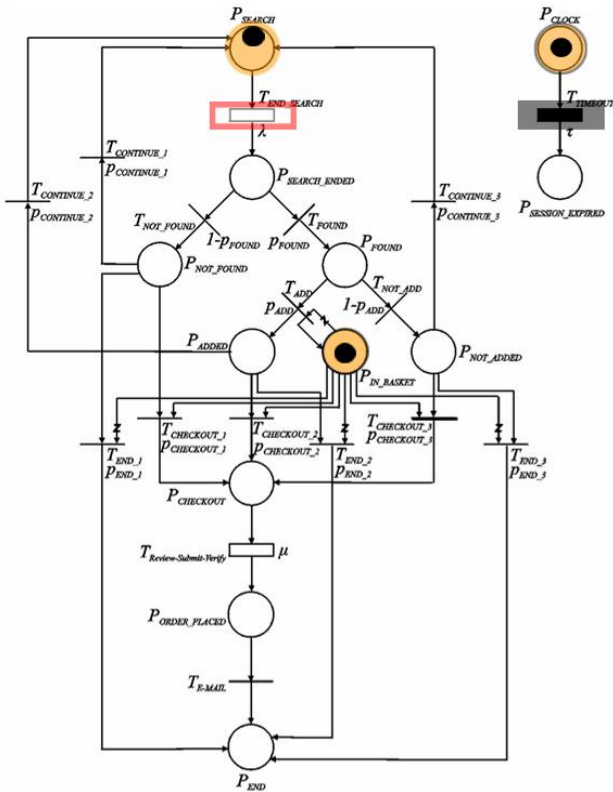


Figure 4. “Token game”: the shopping basket is not empty and the e-Customer continues shopping while the session has not expired

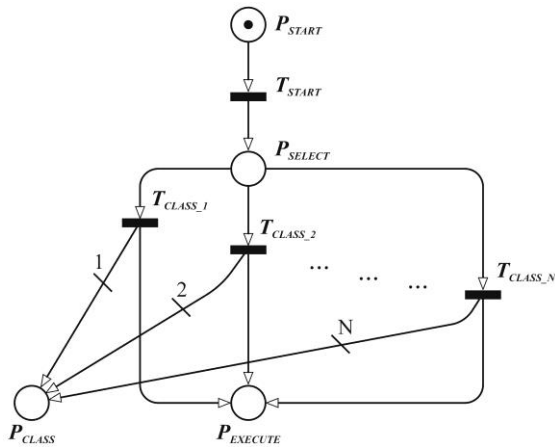


Figure 5. GSPN model of the operational environment

Yet again, in order to simulate e-Commerce client-server interaction for capacity planning (“as you increase the capacity of any system to accommodate user demand, user demand will increase to consume system capacity” – a corollary of Moore’s Law), as well as to obtain business-specific performance metrics, we turned to SimPy/Python discrete-event simulation [27–29]. For the complete story about performability modeling and evaluation of e-Commerce systems, the interested reader is referred to [30]. Namely, recognizing the fact that e-Customers’ online shopping behavior is the main underlying foundation affecting the conduct of e-Commerce systems and a basic building block for performability modeling and evaluation of these formations, this paper promotes a novel, e-Customer-centric, holistic and hybrid approach,

focused on the development of predictive models, usable for evaluating a range of performability measures of “general-in-nature” e-Commerce systems, utilizing the syntax and the semantic power of both DSPNs and GSPNs in conjunction with discrete-event simulation.

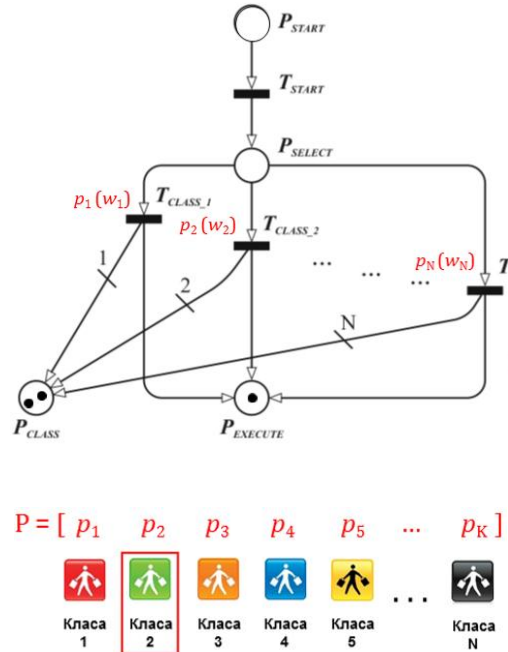


Figure 6. “Token game”: “Class 2” e-Customer has arrived and is about to make a new search through the products catalogue

IV. CONCLUSION

“The art” of modeling has been illustrated through the use of Fluid Stochastic Petri Nets for modeling the dynamics of mesh based peer-to-peer live video streaming systems, and the use of Deterministic and Stochastic Petri Nets for modeling e-Customers’ online shopping behavior in e-Commerce systems. Although Petri Nets inherently possess “the power” as well (i.e. an exact mathematical definition of their execution semantics, with a well-developed mathematical theory for process analysis), the focus in this paper was only on the graphical notation. Moreover, for presentation purposes, especially appealing is the so called “token game” of the Petri Net models, which is an interactive simulation of the model behavior – it visualizes the progress of a simulation run and thought-provokes into new dimensions of modeling.

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Comparison of Approaches to Energy Efficient Wireless Networks

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Abstract - ICT industry is an important and quickly growing contributor to energy consumption and CO₂ emissions. As an important part of ICT, wireless communications have become an essential part of the modern life and are responsible for energy saving. The spectral efficiency and energy efficiency becoming increasingly important for wireless networks. This paper describes research completed at the physical, data link, network, transport, operating system and application protocol layers that have addressed energy efficiency for wireless networks.

I. INTRODUCTION

The information and communications technology (ICT) industry is an important and quickly growing contributor to energy consumption and CO₂ emissions. Currently, 3% of the worldwide energy is consumed by the ICT infrastructures which cause about 2% of the worldwide CO₂ emissions. As an important part of ICT, wireless communications have become an essential part of the modern life and are responsible for energy saving. ICT industry produced 530 Megatons of CO₂ in 2002 and 830 Megatons in 2007. This is approximately 2% of global human CO₂ emissions and about equivalent to those of global aviation [16], [17].

Wireless communication systems have experienced tremendous growth, which continues unabated worldwide. The future success of wireless networks hinges on the ability to overcome the mismatch between the requested QoS (Quality of Service) and limited network resources. Radio spectrum is a natural resource that cannot be replenished and therefore must be used efficiently; that is where the significance of SE (Spectral Efficiency) lies. On the other hand, EE (Energy Efficiency) is also becoming increasingly important for small form factor mobile devices, as battery technology has not kept up with the growing requirements stemming from ubiquitous multimedia applications

During the past decades, much effort has been made to enhance wireless network throughput. However, high network throughput usually implies large energy consumption, which is sometimes unaffordable for energy aware networks or energy limited devices. How to reduce energy consumption while meeting throughput and quality-of-service (QoS) requirements in such networks and devices, is a very important task.

Power management is one of the most challenging problems in wireless communication, and recent research has addressed this topic. Wireless devices have maximum utility when they can be used anywhere at any time. However, one of the greatest limitations to that goal is finite power supplies. Since batteries provide limited power, a general constraint of wireless communication is the short continuous operation time of mobile terminals.

Additional, power savings may obtain by incorporating low power strategies into the design of network protocols used for data communication. This paper addresses the tasks of energy efficiency at all layers of the protocol stack for wireless networks.

II FUNDAMENTALS OF EE

In general, EE means using less energy to accomplish the same task. In case of wireless communication systems, the task to be accomplished could be a phone call, a data transfer and so on. Energy efficiency is commonly defined as information bits per unit transmit energy.

For an additive white Gaussian noise (AWGN) channel for a given transmit power P , and system bandwidth B , the channel capacity is:

$$R = \frac{1}{2} \log_2(1 + P/N_0B) \text{ bits} \quad (1)$$

Where N_0 is the noise power spectral density. According to the sampling theory $\Delta t = 1/2B$ and the channel capacity is $C = 2BR$ bits/s. Consequently, EE is [4], [8]:

$$\eta_{EE} = C/P = 2R/N_0(2^{2R} - 1) \quad (2)$$

The EE derived from equations (2) based on the information theoretic analysis might not be achieved in practical systems due to performance loss of capacity, approaching channel codes, insufficiently knowledge of CSI (Channel State Information's) [18], cost of synchronization, and transmission associated electronic circuit energy consumption.

Energy consumption the electronic circuit changes the fundamental tradeoff between EE and data rate. Taking circuit energy consumption into account, EE needs to be redefined not only for transmit energy than as information bits per unit energy.

Improving the EE of wireless communication systems must have some costs. In the following, the fundamental trade-offs to be considered when designing energy efficient wireless communication system is recalled.

A. Trade Off between Power and Bandwidth for reliable wireless communications

We can define for a different digital modulation scheme two resource utilization metrics:

- Power efficiency means the transmission with a specific bit/symbol error probability at the smallest received power levels. The received power level is usually measured in terms of the Signal to Noise Ratio (SNR) expressed as the ratio E_b/N_0 between the received energy per bit and the noise power spectral density. The power efficiency can be expressed as E_b/N_0 required to achieve a given bit error rate P_b .
- Bandwidth efficiency or Spectral Efficiency (SE) means the ability to transmit a specific amount Of data per second within a smallest bandwidth. The bandwidth efficiency η_{SE} is usually defined as the ratio between the data rate R_b and the bandwidth B required to transmit the data.

Since EE and SE are two important system performance indicators, the tradeoff between EE and SE for general networks should be exploited to guide system design.

III INDIVIDUAL LAYERED APPROACH TO THE EE

Spectral and energy efficiency is affected by all layers of system design, ranging from electronic circuit to applications. The traditional layer-wise approach leads to independent design of different layers and results in high design margins. Cross-layer approaches exploit interactions between different layers and can significantly improve system performance as well as adaptability to service, traffic, and environment dynamics. Recent efforts have also been undertaken to cross-layer optimization for throughput improvement and energy consumption at all layers of communication systems, from architectures to algorithms

In this paper we exploits traditional OSI protocol stack, for a generic wireless communication system which is presented in Table I. The application and services layer are on the top of the stack followed by the operating system, middleware, transport, network, data link, and physical layers [7]

The problems inherent to the wireless channel and issues related to mobility challenge the design of the protocol stack adopted for wireless networks. In addition,

networking protocols need to be designed with energy efficiency [8]

TABLE I PROTOCOL STACK FOR A GENERIC WIRELESS COMMUNICATION SYSTEM

Protocol stack layer		Layer functions
Application and Services		Source Coding Signal processing Context adaptation
Operating system and middleware		Management for Disconnection Power QoS
Transport		Retransmissions Congestion Control
Network		Rerouting Mobility Mgmt
Data link	LLC	Link Error Control Channel allocation Multiple Access
	MAC	
Physical		Modulation scheme Channel Coding RF Circuits

Energy efficiency can be reached over different protocol layers since they exploit the source of energy consumption in different ways: power amplifiers, processors, mixers, filters etc. Many mechanisms are proposed that aim to reduce energy consumption during both active communication and idle periods in communication. Following a hybrid protocol architecture based on the Internet and the IEEE 802 architectures, we can list some major energy saving algorithms located at different protocol layers [7] [11]. Efficient resource utilization is very important for the wireless environment over which radio-related resources (bandwidth, power) and device-related resources (battery energy, buffer capacity) are limited [6].

IV PHYSICAL LAYER

The physical layer consists of radio frequency (RF) circuits, modulation devices, and channel coding systems. From an energy efficient perspective, considerable attention has already been given to the design of this layer [2]. At the physical layer energy can be saved if the system is able to adapt its modulation techniques and basic error correction schemes to channel conditions and application requirements. Many approaches to dynamically changing the transmission power in wireless networks have been proposed. However, few of them were designed with consideration for the battery lifetime of mobile units. Most of them aim to guarantee limits on SNIR (Signal to Noise and Interference Ratio) or maximize cell capacities. From an energy efficient point of view it is important to use modulation schemes that are insensitive to nonlinearities which allow using more efficient power amplifiers.

A OFDMA modulation and multiplexing scheme

In OFDMA (Orthogonal Frequency-Division Multiple Access), system resource, such as subcarriers and transmit power, needs to be properly allocated to different users to achieve high performance. And two most commonly used classes of dynamic resource allocation schemes are RA (Rate Adaptation) that maximizes throughput and MA (Margin Adaptation) that minimizes total transmit power [3]. Therefore, RA aims at SE while MA targets on transmit power efficiency.

While OFDMA can provide high throughput and SE, its energy consumption is large sometimes. OFDM is the most important example of spectrally efficient transmission scheme, but on the other hand the power efficiency is low because of the high PAPR (Peak to Average Power Ratio) level. Energy-efficient OFDM (Orthogonal Frequency Division Multiplexing) systems, a special case of OFDMA, have been first addressed with consideration of circuit consumption for frequency-selective fading channels [3]. In contrast to the traditional spectral efficient scheme that maximizes throughput under a fixed overall transmit power constraint, the new scheme maximizes the overall EE by adjusting both the total transmit power and its distribution among subcarriers. Since EE and SE are two important system performance indicators, the tradeoff between EE and SE for general OFDMA networks should be exploited to guide system design.

B. MIMO techniques

MIMO (Multiple Input Multiple Output) techniques have been widely adopted in actual wireless networks. Although MIMO techniques have been shown to be effective in improving capacity and SE of wireless systems, energy consumption also increases. First of all, more circuit energy is consumed due to the duplication of transmit or receive antennas. Depending on the ratio of the extra capacity improvement and the extra energy consumption, the EE of a multiple antenna system may be lower than that of a single antenna system. Moreover, more time or frequency resources are spent on the signaling overhead for MIMO transmission. For example, in most of MIMO schemes, CSI is required at the receiver or at both the transmitter and the receiver to obtain good performance. [9]

V DATA LINK LAYER

The data link layer is responsible for establishing a reliable and secure logical link over the wireless link. The data link layer is thus responsible for wireless link error control, security, encryption and decryption, mapping network layer packets into frames, and packet retransmission.

A MAC (Medium Access Control) sub layer

The MAC is a sub layer of the data link layer which is responsible for providing reliability to upper layers for the point to point connection established by the physical layer. The MAC sub layer interfaces with the physical layer and is represented by protocols that define how the shared wireless channels are to be allocated among a number of mobiles subscribers. [4].

The MAC protocol can be used to define in advance when each wireless device may receive or transmit data. Each device is allowed to use power saving operational modes when it is certain that no data will arrive for it. Power management protocols manage the trade-off between energy and performance by determining when to switch between power save mode and active mode. Depending on the chosen MAC protocol, some energy may be consumed due to channel access or contention resolution. For example, in IEEE 802.11, the sender transmits a RTS (Ready To Send) message to inform the receiver of the sender's intentions. The receiver replies with a CTS (Clear To Send) message to inform the sender that the channel is available at the receiver. The energy consumed for contention resolution includes the transmission and reception of the two messages. Additionally, the nodes may spend some time waiting until the RTS can be sent and so consume energy listening to the channel.

The IEEE 802.11 standard recommends the following technique for power conservation. A mobile that wishes to conserve power may switch to sleep mode and inform the base station of this decision. The base station buffers packets received from the network that are destined for the sleeping mobile. The base station periodically transmits a beacon that contains information about such packets. When the mobile breakup a sleep mode, it listens for this beacon, and responds to the base station which then forwards the packets. [13]

B LLC (Logical Link Control) sub layer

The reliability of the single wireless link is provided by the LLC sub layer by using techniques for error control. The two most common techniques used for error control are ARQ (Automatic Repeat Request) and FEC (Forward Error Correction). Both ARQ and FEC error control methods waste network bandwidth and consume power resources due to retransmission of data packets and greater overhead necessary in error correction. Care must be exercised while adopting these techniques over a wireless link where the error rates are high due to noise, fading signals, and disconnections caused from mobility.

A balance needs to be maintained within this layer between competing measures for enhancing throughput, reliability, security, and energy efficiency. The energy

consumed for the transmission of a packet also depends on the number of times the packet has to be retransmitted.

VI NETWORK LAYER

The main functions of the network layer are routing packets and congestion control. In wireless mobile networks, the network layer has the added functionality of routing under mobility constraints and mobility management including user location, update, etc. Energy efficient routing is a wide field of research for ad hoc networks.

VII TRANSPORT LAYER

The functions of the transport layer are to provide a reliable end-to-end data delivery service to applications running at the end points of a network. Also at the transport layer, the increased number of packet retransmissions due to wireless link errors consumes energy and bandwidth. The most commonly used transport protocol for wired networks is the TCP (Transmission Control Protocol). However, due to wireless link properties, the performance of traditional transport protocols degrades over a wireless link. TCP and similar transport protocols resort to a larger number of retransmissions and frequently invoke congestion control measures, confusing wireless link errors and loss due to handoff as channel congestion. This can significantly reduce throughput and introduce unacceptable delays [9]. As stated earlier, increased retransmissions unnecessary consume battery energy and limited bandwidth. The same versions of TCP were studied in terms of energy-throughput tradeoffs. The results of simulation show that no single TCP version is most appropriate within heterogeneous networks, and that the key to balancing energy and throughput performance is through the error control mechanism

VIII APPLICATION LAYER

The application layer in a wireless system is responsible for such things as partitioning of tasks between the fixed and mobile hosts, audio and video source encoding and decoding, and context adaptation in a mobile environment. Energy efficiency at the application layer is becoming an important area of research. The techniques on application level can be used to reduce the amount of data to send and, the amount of energy consumed. Furthermore, multimedia applications processing and transmission require considerable power as well as network bandwidth.

A *Operating system and middleware*

One important advantage of wireless communication system is that it facilitates user mobility and connectivity to the network. Mobility, directly or indirectly, impacts the design of operating systems, middleware, file systems, and databases. It also

presents a new set of challenges that result from power constraints and voluntary disconnections. In general, the majority of the techniques used in the design of today's applications to conserve bandwidth also conserve battery life.

IX CROSS LAYER APPROACHES

The traditional approach based on layered protocol architecture allows splitting the complex problem of network design into smaller and easier to solve problems, but it does not efficiently exploit available resources and leads to a local performance optimization, hence providing a suboptimal solution to the problem of system performance improvement. In fact, it is recognized that optimum performance design is the opposite of architecture that leads to standardization.

On the other hand, in the cross-layer approach each protocol layer is optimized taking into account the knowledge of features and parameters of other protocol layers, not necessarily located at the bordering upper or lower levels. The cross-layer design approach provides better resource utilization and trade-offs solution with respect to a layered approach, but this can be achieved at the expenses of a more complex design which requires adaptability to the system changes by propagating modification on one protocol layer to all the others. The more general view of a cross-layer approach to the network design leads to achievement of a global optimization of the system performance.

The cross-layer approach can be categorized into explicit and implicit. In case of implicit cross-layer optimization, interactions between different protocol layers are taken into account, but there is no exchange of information between protocol layers during runtime. In case of explicit cross-layer optimization, the exchange of information regarding protocol parameters, user requirements or channel state is required with the aim at maintaining performance optimization and high level of efficiency even if the communication parameters change. Finally, the implicit optimization is not adaptive while the explicit one is adaptive to the channel conditions and the application/user requirements. The explicit cross-layer optimization relies on a bottom-up approach when the information flow from lower to upper layers, while it relies on a top-down approach when the information flow from upper to lower layers. In a full cross-layer optimization where information are exchanged between all the protocol layers, middle level protocols (e.g. network protocols) can be optimized by simultaneously using a top-down and bottom-up feedback [2].

A novel cross layer approach to optimize the energy efficiency of a short range wireless link is proposed, where a slow transmit power control is applied at the

physical layer and ARQ is considered. The proposed strategy implies that the SNR target of the transmit power control should be set accounting for the parameters at the MAC sub layer, hence following a top-down approach to the cross layer optimization.

The protocol architecture based on the hybrid reference model includes a cross layer optimizer. The cross layer optimizer is the entity that collects status information from any protocol layer, make optimization decision and send parameter change request to the protocol layers [1]. Cross layer design over many protocol layers requires a high level of interdisciplinary expertise.

X OTHER APPROACHES FOR EE

A Cognitive radio (CR)

Cognitive radio (CR) is one of the new long term developments taking place and radio receiver and radio communications technology. After the SDR (Software Defined Radio) which is slowly becoming more of a reality, cognitive radio and cognitive radio technology will be the next major step forward enabling more effective radio communications systems to be developed.

The idea for cognitive radio has come out of the need to utilize the radio spectrum more efficiently, and to be able to maintain the most efficient form of communication for the prevailing conditions.

By using the levels of processing that are available today, it is possible to develop a radio that is able to look at the spectrum, detect which frequencies are clear, and then implement the best form of communication for the required conditions. In this way cognitive radio technology is able to select the frequency band, the type of modulation, and power levels most suited to the requirements, prevailing conditions and the geographic regulatory requirements.

In a cognitive radio network, a SU (Secondary User) is allowed to communicate over the same bandwidth that has been assigned to an existing PU (Primary User) as long as they do not cause harmful interference to the PU. One commonly known technique used by the SU to protect the primary transmission is OSA (Opportunistic Spectrum Access), where the SU decides to access the channel of interest only if the primary transmission is detected to be off. Cognitive radio technologies have been proposed to improve the spectral efficiency.

However, in the concept of Green Cognitive Radio instead of trying to maximize the bandwidth efficiency and constantly increasing the complexity of the systems, the effort is spent to increase the power efficiency using low modulation techniques and get optimized bandwidth efficiency. [4]

B Introduction the picocells and femtocells

In case of cellular wireless networks, the base station is the key element in terms of energy consumption since the number of base stations is high and increasing and the energy consumption of a typical base station is very high. Therefore, the benefits arising from the coordinated use of communications and other non communications approaches should be considered.

The reduction of cell size in mobile cellular networks through the deployment of picocells and femtocells has many advantages. The capacity of the network is improved and the coverage is increased especially in indoor environments. Furthermore, the energy efficiency is improved as a consequence of the reduced distance between the network operator antennas and the subscriber phone. For instance, femtocells connect miniaturized, lower power base stations to wired backhalls with a very low transmit power compared to a full size base station. [15]

A joint deployment of macro cells and residential picocells can reduce the total network energy consumption by up to 60% in urban areas.

XI CONCLUSION

In this article, several wireless communication techniques have been reviewed from the point of view of the system-wide energy efficiency, from the information theoretic to the technique-oriented perspectives. The cross layer approach allows to fully optimizing the performance of wireless networks considering network parameters from several layers of the protocol stack as a whole.

The cross-layer approach allows better resource for power utilization with respect to the traditional layered approach. However, this is achieved at the expenses of a more complex system which requires adaptability to the system conditions. As for the information-theoretic aspect, most literature about EE mainly focused on point-to-point scenarios and the impact of practical issues on EE is not fully exploited. Today the advanced techniques that will be used in the further wireless systems, such as OFDMA and MIMO, existing research has proved that larger EE can be achieved through energy efficient design.

Cognitive radio is another approach which opens new strategies for the use of spectrum and power in wireless networks. Reducing the need of spectrum sensing, use of directional antennas can make cognitive radio networks, which aims to be spectrally efficient, also energy efficient.

As wireless services continue to add more capabilities such as multimedia and QoS, low power

design remains one of the most important research areas within wireless communication.

Research must focus on decreasing the amount of energy consumed by the wireless terminal. Power conservation has typically been considered at the physical layer. However, most of the energy savings at the physical layer have already been achieved. Therefore, the key to energy conservation in wireless communications lies within the higher levels of the wireless protocol stack.

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Method for Construction of All Bent Functions Based on Concatenating Functions of $n-1$ Variables

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Abstract - In this paper, method for obtaining all bent functions of n variables, is presented. Method is based on concatenation of functions of $n-1$ variables satisfying certain conditions. Necessity of fulfilling these conditions, on which construction method is based, is proven in this paper. As a consequence of proof for one of these rules, it is shown that every bent function of n variables is completely determined with two bent functions of $n-2$ variables and a certain combination of their elements.

INTRODUCTION

Boolean bent functions were introduced by Rothaus [1] and Dillon [2], and they have practical applications in coding theory, signal processing and cryptography. Bent functions also have interesting algebraic and combinatorial properties which makes them interesting to researchers from these fields. Several construction methods for bent functions are known and these are described in [3]. The oldest methods are due to Rothaus, Maiorana, McFarland, Dillon, and new methods have been described by Dobbertin [4], Tavares [5] and Carlet [6,7].

Finding bent functions of $n < 6$ variables is easy, quite fast and this can be done by a simple search of all Boolean functions of n variables. When $n \geq 6$, this task becomes complicated. Concerning number of functions, by simple search it is impossible to obtain all bent functions, so we need to use some method of construction. Because search of functions of n variables is too demanding, it is much simpler and faster to search functions of $n-1$ and $n-2$ variables from which needed bent functions are built.

In this paper we propose new method for construction of all bent functions based on concatenation. Some methods based on concatenation are presented in [3,8], but none of these methods offers construction of all bent functions. All bent functions of n variables can be obtained by concatenation of two Boolean functions of $n-1$ variables which must satisfy certain conditions. Corollary of one of these conditions is that every bent function of n variables is a combination of elements of precisely two bent functions of $n-2$ variables.

The remaining part of this paper is organized as follows. Definitions of nonlinearity and some

characteristics of bent functions are given in Section 2. In Section 3 some properties of boolean bent functions are analyzed. In Section 4 our method for construction of bent functions is described. In section 5 we discuss about corollary made in Section 4 and its further use. Conclusion is drawn in Section 6.

DEFINITIONS OF NONLINEARITY AND BENT FUNCTIONS

Next definitions are given in book [3]. Let V_n be the vector space of dimension n over two-element field F_2 . For two vectors in V_n , $a=(a_1, \dots, a_n)$ and $b=(b_1, \dots, b_n)$, we define the scalar product $a \cdot b = a_1 \cdot b_1 \oplus \dots \oplus a_n \cdot b_n$, where the multiplication and addition \oplus (xor) are over F_2 .

An affine function $l_{a,c}$ on V_n is a function that takes the form $l_{a,c}(x) = a \cdot x \oplus c = a_1 \cdot x_1 \oplus \dots \oplus a_n \cdot x_n \oplus c$, where $a=(a_1, \dots, a_n) \in V_n$, $x=(x_1, \dots, x_n) \in V_n$ and $c \in F_2$. If $c=0$, then $l_{a,0}(=l_a)$ is a linear function. To each Boolean function $f: V_n \rightarrow F_2$ we associate its sign function defined by $g(x) = (-1)^{f(x)}$.

The Walsh transform of a function f on V_n (with the values of f taken to be real numbers 0 and 1) is the map $W(f): V_n \rightarrow \mathbb{R}$, defined by

$$W(f)(w) = \sum_{x \in V_n} f(x) (-1)^{w \cdot x}. \quad (1)$$

The nonlinearity of f is determined by Walsh transform of f by

$$N(f) = 2^{n-1} - \max_{w \in V_n} |W(f)(w)| / 2 \quad (2)$$

where $w=(w_1, \dots, w_n)$ and $W(g)(w) = (-1)^{f(x) \oplus w \cdot x}$.

Hadamard matrix H_n [3] in each row contains one linear function $w \in V_n$. Let $WH_1(f), WH_2(f), \dots, WH_{2^n}(f)$ be the values of $W(f)(w)$ when w is linear function from the first, second, ..., 2^n -th row of Hadamard matrix respectively, then we can calculate Walsh transform coefficients of g by:

$$H_n f = \begin{pmatrix} WH_1(f) \\ WH_2(f) \\ \cdot \\ \cdot \\ \cdot \\ WH_2^n(f) \end{pmatrix}$$

Definition 1. A Boolean function f in n variables is called bent if and only if the Walsh transform coefficients $WH_i(g)$ of g are all $\pm 2^{n/2}$.

From definition 1. we can see that bent functions exist only for even dimensions, that is $n=2k$. Following theorem contains some characterizations of the bent property.

Theorem 1. If function f is bent, then its nonlinearity is $N(f)=2^{n-1}-2^{n/2-1}$, and f has $2^{n-1} \pm 2^{n/2-1}$ ones.

The proof for this theorem is given in [3].

PARTS OF BENT FUNCTION

Proposition 1. If Boolean function $f=(x_1, x_2, \dots, x_{2^{n-1}}, x_{(2^{n-1}+1), \dots, x_2^n})$ of n variables is bent, then first and second half of its bits are functions $f_1=(x_1, x_2, \dots, x_{2^{n-1}})$ and $f_2=(x_{(2^{n-1}+1), \dots, x_2^n})$ of $n-1$ variables and with nonlinearity $N(f_1)=N(f_2)=2^{n-2}-2^{(n-2)/2}$, which have half of Walsh coefficients equal to zero, and other half equal to $\pm 2^{n/2}$.

Proof. A Boolean function f is bent if and only if the Walsh transform coefficients are all equal to $\pm 2^{n/2}$. Hadamard matrix form is:

$$H_n = \begin{pmatrix} H_{n-1} & H_{n-1} \\ H_{n-1} & -H_{n-1} \end{pmatrix}$$

which means that for f_1 , Walsh transform coefficients from upper and bottom half of Hadamard matrix are the same, while for f_2 Walsh transform coefficients are the same but with opposite sign. Then, in upper half of Hadamard matrix we have $WH_i(f)=WH_i(f_1)+WH_i(f_2)$ and in bottom half $WH_i(f)=WH_i(f_1)-WH_i(f_2)$. From previous two equations we have that $WH_i(f_1) \pm WH_i(f_2) = \pm 2^{n/2}$ which implies that $WH_i(f_1)$ and $WH_i(f_2)$ only can have values 0 and $\pm 2^{n/2}$. When one is equal to 0, other must have value of $\pm 2^{n/2}$. ▲

This proposition gives basis for method for construction of bent functions of n variables from two functions of $n-1$ variables. From the set of all functions of $n-1$ variables (there is $2^{2^{n-1}}$ functions), we check only functions which satisfy mentioned conditions. As an example, for bent functions of $n=6$, with this method we check only about $2^{24} \cdot 2^{24} = 2^{48}$ (precisely $14.054.656^2$) instead of $2^{32} \cdot 2^{32} = 2^{64}$ functions.

Proposition 2. Functions f_1 and f_2 can have 2^{n-2} or $2^{n-2} \pm 2^{(n-2)/2}$ ones, in that way that if one of them have 2^{n-2} ones, then other must have $2^{n-2} \pm 2^{(n-2)/2}$ ones and opposite.

Proof. Boolean functions f_1 and f_2 of m variables ($m=n-1$) must have $2^{m-1} \pm 2^{(m-2)/2}$ ones in total. As their Walsh transform coefficients must be either 0 or $\pm 2^{m/2}$ from equation $Num1(f) = 2^{m-1} + 2^{-1} WH(f)$ [3] follows that f_1 and f_2 can have either 2^{n-2} or $2^{n-2} \pm 2^{(n-2)/2}$ ones, so it is $2^{n-2} + (2^{n-2} \pm 2^{(n-2)/2}) = 2^{n-1} \pm 2^{(n-2)/2}$. ▲

This proposition enables the division of the set of all satisfying $n-1$ bit functions into two sets, one with 2^{n-2} and other with $2^{n-2} \pm 2^{(n-2)/2}$ ones, because a function from one set can make bent function only with the function from the other set. In the example for $n=6$ we can see that instead of about $2^{24} \cdot 2^{24} = 2^{48}$, we need only $2^{23} \cdot 2^{23} = 2^{46}$ functions to check (precisely $7.027.328^2$).

Proposition 3. Boolean functions f_1 and f_2 , which are the parts of bent function, must have half bits equal and half different bits.

Proof. If $f_1=(a_1, a_2, \dots, a_{(2^{n-1})})$ and $f_2=(b_1, b_2, \dots, b_{(2^{n-1})})$, then, if $a_i=b_i$ bits of these two functions are equal on position i , otherwise they are different. Let us denote a set of equal bits from f_1 and f_2 with I and a set of different bits from (for example) f_1 with R and from f_2 with $-R$. Then we can write f_1 and f_2 as $f_1=I+R$ and $f_2=I-R$. As f is a bent function, Walsh transform coefficients are $WH(f)=WH(f_1+f_2)=\pm 2^{n/2}$. Because of Hadamard matrix form there is:

$$WH(f) = WH(f_1) + WH(f_2) = WH(I) + WH(R) + WH(I) - WH(R) = \pm 2^{n/2} \text{ in upper half}$$

$$WH(f) = WH(f_1) - WH(f_2) = WH(I) + WH(R) - WH(I) + WH(R) = \pm 2^{n/2} \text{ in bottom half from which we get}$$

$$WH(I) = WH(R) = \pm 2^{n/2} / 2 = \pm 2^{n/2-1} = \pm 2^{(n-2)/2} \text{ for all Walsh transform coefficients. From previous it follows that } I \text{ and } R \text{ are bent functions of } n-2 \text{ variables, and each must have } 2^{n-2} \text{ bits which is a half of the number of bits for } f_1 \text{ and } f_2. \blacktriangle$$

Corollary 1. Every f_1 from proposition 1. is built from combination of bits of two bent function of $n-2$ variables, and f_2 is built from bits of one of these two functions and complemented bits of the other.

Proposition 4. If f is a bent function of n variables, then Boolean functions f_a, f_b, f_c and f_d , which represent first, second, third and fourth quarter of f respectively, are bent functions of $n-2$ variables or $N(f_a)=N(f_b)=N(f_c)=N(f_d)=2^{n-3}-2^{(n-2)/2}$.

Proof. Boolean functions f_a and f_b are halves of f_1 , and f_c and f_d are halves of f_2 . When f_a, f_b, f_c, f_d are bent, then all Walsh coefficients are equal to $\pm 2^{(n-2)/2}$. It means that $WH_i(f_1) = WH_i(f_a) + WH_i(f_b)$ in upper half of Hadamard matrix will be 0 if $WH_i(f_a)$ and $WH_i(f_b)$ have different signs, and if they have equal signs then $WH_i(f_1) = \pm 2^{n/2}$. In bottom half of Hadamard matrix results are converse, which guaranties that half of Walsh coefficients will be equal to zero, and other half to $\pm 2^{n/2}$ so conditions from proposition 1. are fulfilled.

Suppose that $N(f_a) \neq 2^{n-3} \cdot 2^{(n-2)/2} \wedge N(f_a) \neq 2^{n-3} \cdot 2^{(n-2)/2-1}$. It means that there is Walsh coefficients of f_a which absolute values are from set $A = (0, 2^{n-2}) \setminus \{2^{n/2-1}, 2^{n/2}\}$. If $z \in A$ is "i-th" Walsh coefficient of f_a , in order to this function be half of f_1 , it is necessary to be $WH_i(f_b) = \pm 2^{n/2} \cdot z$ (or $WH_i(f_b) = 0 - z$). Then, in upper half of Hadamard matrix, condition $WH_i(f_1) = WH_i(f_a) + WH_i(f_b) = z + (\pm 2^{n/2}) \cdot z = \pm 2^{n/2}$ (or $WH_i(f_1) = 0$) would be fulfilled, but in bottom half of matrix it would be $WH_i(f_1) = WH_i(f_a) - WH_i(f_b) = z - (\pm 2^{n/2}) \cdot z = 2z \pm 2^{n/2} \neq 0$ (or $WH_i(f_1) \neq \pm 2^{n/2}$), which means that f_a, \dots, f_d can not have nonlinearity different from $2^{n-3} \cdot 2^{(n-2)/2}$ and $2^{n-3} \cdot 2^{(n-2)/2-1}$.

From previous we can see that $N(f_a) = N(f_b) \wedge N(f_c) = N(f_d)$, so it is necessary to prove that $N(f_a) = N(f_b) = N(f_c) = N(f_d)$. If $N(f_a) = N(f_b) = 2^{n-3} \cdot 2^{(n-2)/2-1}$ then all Walsh coefficients of f_a and f_b must be equal to $\pm 2^{(n-2)/2}$ and then for function $f_1 = f_a + f_b$ stands that $WH_i(f_1) = 0 \Rightarrow WH_{i+2^{n-2}}(f_1) = \pm 2^{n/2}$. When $N(f_c) = N(f_d) = 2^{n-3} \cdot 2^{(n-2)/2}$, then two cases can occur. First is when 2^{n-4} Walsh coefficients have value of $\pm 2^{n/2}$, and rest of them are all equal to zero. Then, for function $f_2 = f_c + f_d$ stands that $WH_i(f_2) = 0 \Rightarrow WH_{i+2^{n-2}}(f_2) = 0$ from which it follows that at least one of Walsh coefficients $WH_i(f_1 + f_2) = 0$ so it can not be bent function. In other case, half of Walsh coefficients has value $\pm 2^{(n-2)/2}$, then 2^{n-5} has value $\pm 2^{n/2}$ and others are equal to zero. Then, for at least one i stands $WH_i(f_2) = 0 \Rightarrow WH_{i+2^{n-2}}(f_2) = 0$ and we again get at least one Walsh coefficient of $f_1 + f_2$ to be equal to zero, so it can not be bent function. It follows that nonlinearity of all four Boolean functions which are parts of bent function must be equal. ▲

This proposition enables simpler search for satisfying functions of $n-1$ variables. This method can be very efficient if certain functions of $n-2$ variables, which satisfies conditions, are divided into three sorts of functions mentioned in proposition 4., because we can get suitable functions of $n-1$ variables only with combinations of functions from the same sort. Dividing functions of $n-2$ variables by the number of ones, speeds up the process even more.

THE PROPOSED APPROACH

The proposed approach has three steps:

1. Generation of suitable databases for functions of $n-2$ variables.
2. Generation of suitable databases for functions of $n-1$ variables.
3. Construction of all bent functions of n variables.

Generation of suitable databases for functions of $n-2$ variables

This step can be omitted, if n is small enough. It is necessary to find all Boolean functions of $n-2$ variables (not all, if we do not search for all bent functions of n variables) with nonlinearity of $2^{n-3} \cdot 2^{(n-2)/2}$ or $2^{n-3} \cdot 2^{(n-2)/2-1}$ (bent for $n-2$) which should be divided into three groups. First group, which we denote as A is made from bent

functions, second group B is made from functions whose nonlinearity is $2^{n-3} \cdot 2^{(n-2)/2}$ and they have half of Walsh coefficients equal to $\pm 2^{(n-2)/2}$. Third group is built from remaining functions.

Bent functions from set A can be divided by number of ones into two subsets A_1 of $2^{n-3} \cdot 2^{(n-4)/2}$ and A_2 of $2^{n-3} + 2^{(n-4)/2}$ ones. Functions from set B can be divided by number of ones into 5 subsets by following manner: B_1 of $2^{n-3} \cdot 2^{(n-2)/2}$, B_2 of $2^{n-3} \cdot 2^{(n-4)/2}$, B_3 of 2^{n-3} , B_4 of $2^{n-3} + 2^{(n-4)/2}$ and B_5 of $2^{n-3} + 2^{(n-2)/2}$ ones. Functions from set C we can divide into three subsets, C_1 with $2^{n-3} \cdot 2^{(n-2)/2}$, C_2 with 2^{n-3} and C_3 with $2^{n-3} + 2^{(n-2)/2}$ ones. Functions divided in this manner are initial point for obtaining suitable functions of $n-1$ variables.

Generation of suitable databases for functions of $n-1$ variables

From suitable functions of $n-1$ variables, it is necessary to build two databases, D_1 with $2^{n-2} \pm 2^{(n-2)/2}$ and D_2 database of functions with 2^{n-2} ones. Database D_1 is built from elements of sets $A_1, A_2, B_1, B_3, B_5, C_1, C_2$ i C_3 . Functions from A_1 and A_2 are combined with functions from the same set, functions from B_3 are combined with functions from B_1 and B_5 , and functions from set C_2 are combined with functions from C_1 and C_3 . "Combining" means concatenation of two functions and checking fulfillment of conditions from proposition 1. Database D_2 is built from elements of all previously mentioned sets. Functions from sets B_3 and C_2 are combined with functions from the same set, functions from A_1 are combined with functions from A_2 , functions from B_2 are combined with functions from B_4 , functions from B_1 with those from B_5 and functions from C_1 with functions from C_3 .

For example, if $n=6$, then A_1 and A_2 have 448 bent functions each (of 4 variables) of 6 and 10 ones respectively, B_1 and B_5 have 1680 functions each, B_2 and B_4 have 6720 functions each, B_3 have 10080 functions with 4,12,6,10,8 ones respectively and C_1 and C_3 have 140 each, and C_2 840 functions of 4, 12 and 8 ones respectively. In that case, for obtaining D_1 it is necessary $2 \cdot 448^2 + 2 \cdot 10080 \cdot 1680 + 2 \cdot 6720^2 + 2 \cdot 840 \cdot 140 = 124.822.208$ combinations to check, and for D_2 there is $10080^2 + 840^2 + 448^2 + 6720^2 + 1680^2 + 140^2 = 150.513.104$ checks needed, in total it is 275.335.312 which is significantly smaller than 2^{32} checks needed with simple search.

Construction of all bent functions of n variables

When databases D_1 and D_2 are created, we can begin to construct bent functions. One function from D_1 has been concatenated with all functions from D_2 each, and nonlinearity of functions obtained in that manner is checked. This process can be significantly accelerated by building databases with Walsh transform coefficients of functions from D_1 and D_2 . If W_1 is a database containing all Walsh transform coefficients of functions from D_1 , and W_2 database containing Walsh coefficients from D_2 , then elements of these two databases are compared. Because values of Walsh transform coefficients can be 0 or $\pm 2^{n/2}$, if sum of coefficients of f_1 and f_2 is different from $\pm 2^{n/2}$, the check for this pair of functions is stopped and next pair is

checked. If all Walsh coefficients fit, then that is a bent function.

OBTAINING BENT FUNCTION FROM TWO BENT FUNCTIONS OF N-2 VARIABLES

Corollary 1. is very important because it proves that every bent function of n variables is completely determined with only two bent functions of $n-2$ variables and one suitable combination of their elements. If $\varphi_1=(a_1, \dots, a_2^{n-2})$ and $\varphi_2=(b_1, \dots, b_2^{n-2})$ are bent functions of $n-2$ variables, then first half f_1 of bent function of n variables contains all a_i and b_i placed in suitable order. Other half f_2 of bent function is equal to f_1 , only b_i -s are complemented. Suitable order means that certain conditions must be fulfilled, in order for certain combination of elements a_i and b_i to make bent function of n variables.

Combinations in which f_1 is built from elements of two bent functions of $n-2$ variables in the same order, first φ_1 , and then φ_2 , $f_1=(a_1, \dots, a_2^{n-2}, b_1, \dots, b_2^{n-2})$ gives bent function of n variables. Applying linear transformations on f_1 (and f_2 also) we get different bent functions, but there are some nonlinear transformations of f_1 , whose number for larger n is much bigger than the number of linear transformations, which also gives bent functions. If we look at proposition 4, then we can say that for example $f_a=\varphi_1$, $f_b=\varphi_2$, $f_c=\varphi_1$ and $f_d=-\varphi_2$, when f_a, f_b, f_c, f_d are bent. When f_a, \dots, f_d are not bent, there is a question from which bent functions they originate and by which transformation. Very interesting question is, how many suitable combinations of elements of two bent functions of $n-2$ variables are there, which give bent function of n variables.

By experiment, it is established that number of suitable combinations depends on choice of two bent functions of

$n-2$ variables, so determination of method for construction of all bent functions from bent functions of $n-2$ variables is left for the following work.

CONCLUSION

A new method for construction of bent functions has been presented. This method practically accelerates search of all Boolean functions of n variables by using certain regularities. Instead of functions of n variables, functions of $n-1$ or $n-2$ variables are searched, from which are built bent functions by concatenation. As corollary of one of the propositions needed for establishing proposed approach, it is proven that all bent functions of n variables are composed of bits of two bent functions of $n-2$ variables placed in suitable order.

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Information Technology as a support of energy efficiency monitoring

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Abstract - Energy efficiency represents one of the key challenges of a modern society. Improvements in this domain cannot be achieved without a shift of peoples' awareness regarding the problem, as well as the change of consumer habits that would ensure equal quality of life with lower energy consumption. However, equally important is development and introduction of a lower cost system for monitoring current energy consumption, which is easy to handle and has transparent indicators for the evaluation of energy efficiency. The result of eNergyMon project is the solution for improved monitoring and tracking of energy consumption and energy efficiency in buildings - energy management information system eMIS. This paper describes two aspects of information technology as a support to the project realization. The first relates to the eMIS system. It describes the technology behind the developed solution, methods of data collection, way the data are being loaded into the database, as well as the functionality of the information system. The second aspect concerns the way information technology supports dissemination of project results through developed Content Management System - CMS. Paper describes and illustrates developed CMS.

I. INTRODUCTION

As member states of the European Union are increasingly dependent on external energy sources and increasing trend in emissions and greenhouse effects persist, efficient consumption of all forms of energy by end users is becoming increasingly important for the European national policies. Because of the limited natural resources, population has little influence on the energy supply, but it can affect the level of demand. One possible solution to both of the above problems is reflected in reduction of energy consumption through improved energy efficiency.

Energy efficiency involves the use of less energy (fuel) for conducting the same job or function (heating and cooling, lightning production of different products, driving a car, etc.). It certainly can not be regarded as an energy saving because saving always involves some kind of sacrifice as the efficient use of energy never violate the conditions of work and life. Improved efficiency of energy use is to reduce the consumption for production of the same volume of products or services which results in a proportional cost savings, [10].

Improving the energy performance of an object is one of the key activities to achieve the EU's objectives relating to climate and energy (EU Climate & Energy goals). According to the European Commission data, the

buildings are holders of 40% of energy consumption and 36% of carbon dioxide (CO₂) emissions in the EU. Potential energy savings in neighborhoods and commercial buildings are estimated to be approximately 27% and 30%, respectively. Because of the limited natural resources of the population has little influence on the energy supply, but it can affect the level of demand. A possible solution of this problem is reflected in the reduction of energy consumption by improving energy efficiency.

In order to achieve significant and sustainable energy savings it is necessary to develop technologies and products that will enable its effective use, as well as to change consumption habits of the population in order to achieve the same quality of life with less energy consumption. A key element in improving the efficiency of energy of the end-users is the introduction of a system for consumption monitoring and transparent evaluation indicators of energy efficiency. The effects of the measured efficiency of energy use can be readily monitored and evaluated.

Presented paper emphasis the role of information technology in each phase of project development. One aspect presented in the section IIA refers to the developed information system for monitoring of energy consumption, and the other aspect presented in the section IIB points out the importance of information technology for dissemination of information.

II. IMPORTANT POSITION OF INFORMATION TECHNOLOGY IN ENERGYMON PROJECT

In a world based on information and communication technologies, any progress became impossible without the support of modern technology. When we talk about improving energy efficiency, information technology can improve the control of energy through a variety of devices and systems.

The focus of eNergyMon project was the introduction of new, easily accessible, applications for monitoring of energy consumption and efficiency, thanks to which energy consumption is transparent. For this purpose web-based system was development that provides concrete and transparent information on energy efficiency available to all users. In addition, it was necessary to develop appropriate communication technologies, as well as technology for downloading data that will minimize the need for additional installations in buildings and maximize

the usefulness of the available data from existing measurement devices and control systems in the building. The key innovation is reflected in the development of advanced algorithms for the calculation of energy consumption efficiency data.

In addition to the use of ICT in achieving the aims regarding improved monitoring of energy efficiency:

- development of communication system for retrieving information on energy consumption and other relevant information on energy efficiency,
- development of information system for an easy and transparent access to the tools that evaluate energy efficiency;

During the implementation phase of the eEnergyMon project ICT was used for the purpose of disseminating information about developed information system, energy efficiency, and other topics of interest. Specifically, content management system was developed through which the target population could obtain relevant inform.

A. eMIS System

Developed energy management information system – eMIS comprise of hardware platform for remote data collection and software modules to monitor power consumption, evaluate efficiency of energy use in buildings, and optimize and manage energy supply.

Special attention is focused on the development and implementation of advanced algorithms to extract information about the energy efficiency from the limited set of available inputs. Information system has been developed as a web-based solution with data encryption and user authentication. The information system is installed on a central server and associated with the appropriate database.

Figure 1 illustrates the structure of e-MIS system. It may be noted that e-MIS system is comprised of three

main software modules for data management, energy efficiency and energy supply, as well as the two hardware modules intended for storing data and communicating with the database, and for data retrieval from existing measuring devices.

Software module for instantaneous data collection. A key part of this module is an integration interface that includes a platform for downloading data from various modules and data concentrator in the building, as well as various applications and external sources such as weather stations, distribution companies for electricity and such. All data coming into this module are subject to authentication.

In order for this module to be functional, it was essential to establish a data retrieving network which included network configuration for remote data acquisition of data on different types of energy and their consumption based on LPR (low power radio) wireless communication, PLC (power line communication) communication through the installed electrical network, and the introduction of the data concentrators in the building.

LPR modules that run on batteries with the appropriate inputs are used to retrieve data from existing measuring devices, from devices with pulse output values and other devices such as meters for gas, water, temperature and so on. These modules collect data and transmit measured values through LPR channel to the data concentrator in the building.

Data concentrator in the building, Figure 2, captures and collects data from individual LPR modules, receives data from the measuring devices, stores temporary data and sends them to the information system database according to pre-defined time intervals. Thanks to the integrated Ethernet communication and other applications (eg. SCADA), through a TCP/IP network data concentrator provides direct data retrieve from the meters and measuring devices.

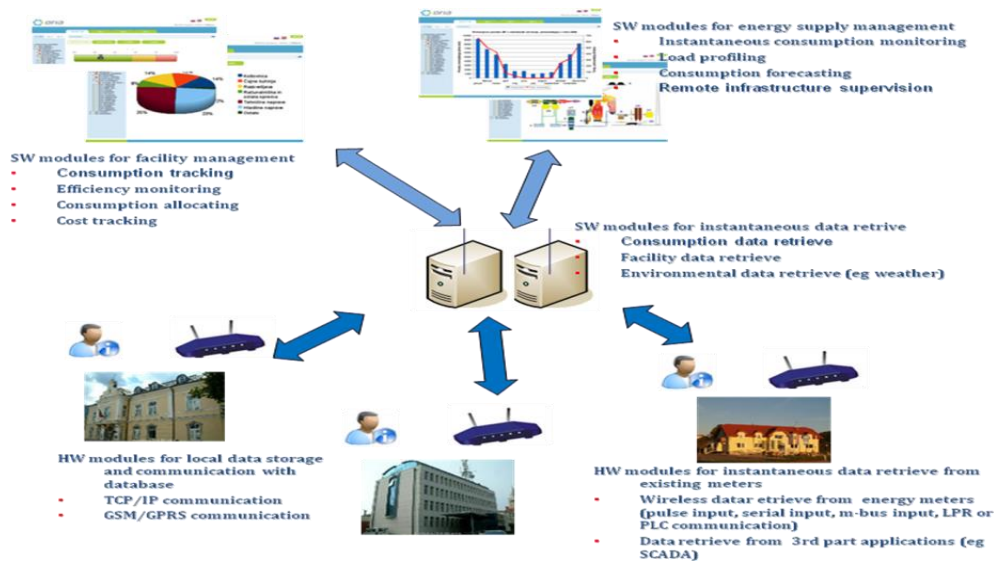


Figure1. Structure of e-Mis system



Figure 2. Data concentrator

Ethernet is a networking technology for local area networks, based on frame mode. This means that data is sent in packages that are adapted for transmission over a computer network. It defines networking and signaling for the physical layer, i.e. data layer of the OSI model. Ethernet has become the most widely used standard for data networks that began to rise in the early 1990s to the present day. Ethernet holds the primacy, and has almost completely replaced other network technology for LANs, such as Token Ring, FDDI, and ARCNET, [6].

TCP/IP protocol work on the transmission, i.e. network-layer of the OSI architecture. TCP (transmission control protocol) is designed to control data transmission and the exchange of data on the network. IP (Internet Protocol) is responsible for identifying devices on a network and Internet connection.

Software module for the management of energy efficiency includes algorithms for tracking energy consumption and its allocation to major loads (heating, refrigeration, ventilation systems, lighting, technology, etc.), specific indicators for consumption evaluation, correlation of degree-day indicators, forecasting the expected consumption and targeting, and costs monitoring.

Software module for the optimization and management of energy supply provides tools to communicate with the electricity distributors, such as automated readings of consumption from the device, the current consumption monitoring, profiling the critical points of load, forecasting consumption, and remote infrastructure management.

MiSMART is an integrated software suite designed to gather data from the data concentrator in buildings. Its primary function is to store data on energy consumption and facilitate its analysis. MiSMART represents a modern software solution that enables monitoring of a large number of meters and measuring devices which can be adapted to the needs of users (industry, commercial buildings, residential buildings, etc.). It works as an energy consultant. The main advantages of this package to customers are reflected in the reduction of energy costs, ability to analyze energy consumption by different energy groups, it saves time by eliminating the need for physical visits to monitoring points, enables prediction of the future energy consumption based on historical data, and the

instant alarming and informing on all problems or variations in consumption.

B. Content-management systems as a support to information dissemination

Information technology was given a significant role in the dissemination of the project results. Content Management System (CMS - Content Management System) is a computerized program that allows publishing, editing, and modifying the content as well as maintenance and content management by central interface. Its primary function is the presentation of information on the website. Characteristics and capabilities of CMS vary from system to system, but most include Web-based content publishing, format and content management, control and auditing of content, indexing, search and data retrieve. CMS can be used for storing, controlling, revising, semantic enrichment of content and for documentation publishing, [5].

For the purpose of the project a web-based CMS was developed that represents a stand-alone application for the creation, management, storage and use of the content on the site. Web content includes text and embedded graphics, images, video, audio, and application code that displays the content and allows you to interact with users. This way the control over HTML content, files, and documents is enabled, and the need for external administration of the site is eliminated. Figure 3 illustrates the home page of developed content-management system for eEnergyMon project.

CMS for eEnergyMon project on one hand enables the project partners conformal and simple content management through administrator pages, on the other hand allows visitors to learn about the project, including:

- *eEnergyMon* menu gives access to basic information about European Union funds, about the basic objectives of the project, as well as access to the archives of project activities.
- Menu *Project realization* provides an overview of the work packages and newsletters. Visitors of the site can subscribe for newsletters via the form available on homepage.
- On the menu *Partners* visitors can get acquainted with all institutions – project partners, and the menu *Project team* gives a list of biographies of all project participants.

In addition, the content is available in English, Serbian and Slovenian.

III. CONCLUSION

During the period of two years, a timeframe for eEnergyMon project, communication system for information retrieving on energy consumption and other relevant data for the evaluation of energy was developed, as well as information system which is easily accessible and transparently gives insight into energy consumption. This project resulted in a fundamental framework for the operational monitoring of energy efficiency, optimization of energy consumption and costs

Figure 3. Web site of eEnergyMon project (www.eurekaenergymon.org)

reduction, as well as reduction of emissions of carbon dioxide and other gases. Therefore, developed system significantly contributes to the implementation of the measures of the European energy and environmental policies, including measures of the Action Plan in terms of improving energy efficiency in buildings.

In addition, the resulting solution of eEnergyMon project can be extended to be used in other prominent sectors relevant to the energy and environmental policies of the European Union, i.e. to improve the production and distribution of energy, to reduce the impact of transport on energy consumption, to facilitate financing and investment in the energy sector, to encourage and strengthen the rational use of energy, and to strengthen international action on energy efficiency.

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Business Intelligence as a Support to Marketing Analysis and Decision-Making

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Abstract - Business Intelligence today is an important component of all business intelligent systems and its components, such as marketing. A number of technologies, such as business intelligence should provide excellent products and personalized services to customer. That is exactly the goal of marketing. Except for marketing and other parts of the system must support effective and efficient business intelligence. That is because only full understanding and integration of different parts of the intelligent system can achieve an overall cohesive business intelligent system. Information systems that support the overall business and certain parts of the organization and their activities, as is the case with marketing, serving continuously available processing of transaction. This paper presents the Balanced Scorecard method to support decision-making. One of the most successful applications is an application that contains performance analysis. The most successful companies want to know where it comes from their profits. Those who are less successful definitely want to know how to improve their results. Performance analysis is important in determining the rates and eased the promotion initiation, choice areas of investment and anticipated pressures from foreign competition. Such decisions are made on a daily basis to manage and to be more efficient. Each new company will be a challenge for those who are already on the market.

I. INTRODUCTION

Business Intelligence, BI is a set of methodologies and software tools that enable the use of data from a data warehouse (Data Warehouse) and conversion of information needed for decision making [2].

Business intelligence system is a system that stores information and knowledge about competitors, customers, suppliers, processes. It allows business negotiation and performance of numerically argumentative with customers and suppliers, good operational planning, monitoring competitive behavior, observation of certain market segments and predict future events. Also, business intelligence system provides a better understanding of their own knowledge of what customers and encourages them to certain behavior.

Business intelligence is intensely began to develop when companies automate their business processes and implement a variety of transactional systems, which were quickly shown to be generators of large amounts of data. On the technical side, business intelligence is the process of turning raw data into information. This information is then analyzed and used in decision-making in the company [3].

Business intelligence is the upgrading of information systems to support business. Information systems that support the business are constantly available to serve the transaction processing (on-line transaction processing, and for these systems is a common abbreviation OLTP). Business data that these systems generate can be used in the management, but its structure is far from ideal.

Such a system is a transaction, and its logic is built to process the transaction and provided adjusted for the individual business functions and provides results that are focused on specific business functions such as procurement. Management is still in need of complete business image; to that picture were adapted IT solutions, which are depending on the progress and development of information technology perfected.

First they created the first IT solutions tailored to business decision-making and to the forerunners of today's analytical system [4]. Since the process of making a business decision analytic process, created the continuous availability of analytical processing (analytical on-line processing, OLAP for short).

Since the beginning of business intelligence systems have been created above - OLTP and OLAP. Here we can say that the OLTP system requirement for building OLAP system. Analytical processing is not possible if there are no transaction data. In today's business intelligence features seemed important "migration" of processing power of computers to desks. As the peak business intelligence believes the arrival of the Internet business intelligence and creation of web applications for business intelligence.

II. CHARACTERISTICS OF BUSINESS INTELLIGENCE AND ITS SIGNIFICANCE

Business intelligence we cannot provide more than what is programmed into its system. There are efforts to include in it the greater power of reasoning, but still it all comes down to programming.

Business intelligence system collects data and extracts information from text sources, from databases and web pages, analyzes synthesizing them using the same analytical techniques, is objectification of ignoring irrelevant facts, assess the risk by being recognized by the decisions and directions of action and decision support received [5].

In this way we get the answers to certain questions which will focus the new features, how and where the growth of cost of sales, whether and where there are products that have quality problems, which will be the consequences of changes in prices and many other questions.

Business intelligence is becoming part of the organization which is used to raise awareness about the activity. Business intelligence requires and establishes collaborative environment and share the data model. Only the introduction of business intelligence in the current environment, however the information leads us to think about increasing the security of data [7].

The world market for years to offer complete business intelligence systems, made by renowned manufacturers. However, in recent years, there are also built-in RDBMS solutions or ready-made business applications [7]. The first who started this practice is Microsoft, by being installed MS SQL Server 2000 in a management system relational database. This example was followed by too many companies worldwide. The practice of installing business intelligence exists for domestic producers. Traditional manufacturers are present with us through representative companies, and we can say that the supply of business intelligence solutions is satisfactory. It may be useful to obtain insight into the market.

An abundance of data, powerful computers, high-quality networks and ever-present Internet looking for speed of action [10]. The reaction rate of change becomes the essential condition for survival in the market. Because it requires quick decision making, a decision to introduce such a system should always bring the highest management of a company or institution, which must follow the development of this project. Also, business intelligence system reflects the business environment in which it is implemented and the technical existence of a person who knows a great advantage in construction. Otherwise, choose a partner who will introduce such a system.

III. ANALYSIS OF SALES AND MARKETING

This type of application will apply primarily commercial companies and financial institutions such as banks and insurance. Selling the companies typically has a large number of products and a large number of offices with a high degree of change of both. Most often the data will be analyzed monthly, sometimes weekly, and rarely a day. The retail analysis will often be a day or even to the level of each customer. From the analysis results are expected to affect the competitiveness of the company, so we can talk about the most complex type of analysis. Appropriate technologies that will have a complex analytical procedures and the very large amounts of data. For retailers, where the complexity of the analysis will be used in smaller systems that allow analyzing the huge amounts of data.

Banks, insurance and similar institutions are relatively new users of such possibilities when analyzing sales. Problems of survival in the market or force them to analyze the individual service user, and thereby to follow the different risk factors [1].

Today there are legally prescribed financial statements of each company and institution has to have. That is why

accountants and financial analysts have long used multi-dimensional software products. Even the smallest units must have at least three dimensions, for example; chart of accounts, organizational structure and the time when made. This is done with real data and a comparison with calculations.

However, for large companies and institutions we have five or six dimensions. These analyzes were performed in the seventies, even mainframe computers, with at least four dimensions. Some of the tools of today trace their origins back to the popularity of those times. In this segment, applications, and today there is very specific products, adapted to specific dimensions that require financial analysis.

One of the methods here, but a lot of use as a decision support method is the balanced scorecard. It was created from the need to achieve their promise to the eighties provided information systems to support management. The creators of this method are Robert Kaplan and David Norton. It was created on the basis of a study in 1990 and it was funded by Nolan Norton Institute.

Balanced Scorecard can be explained as a balanced view of business performance measurement. With this method measures the performance of companies and forms the basis for strategic decision-making and long-term control of business processes [8]. It can be said that this method of contributing to the realization of the vision, strategy and company transformed into measurable qualitative and quantitative targets, including financial and non-financial parameters. This method treats the goals based on the vision and strategy from four perspectives: financial perspective (what results should be achieved in the interest of the owner?), customer perspective (how to deal with customers?), internal perspective (how to manage internal processes in order to create a competitive advantage?) and learning and development perspective (how to maintain the ability of learning and innovation?).

Building a Balanced Scorecard model is carried out through the following stages:

- Strategic analysis (analysis of the environment of the organization) - Strategic analysis involves forecasting of various movements, and events in the broad environment in which the company operates. At this stage of the analysis, and the company's ability to successfully respond to market changes, business challenges and achieve the desired position in the future. At this stage the important role SWOT analysis, and analysis of the collected parameters which are divided into four groups: the danger, opportunities, strengths, weaknesses.
- Determining the vision and mission - Vision is the most general representation of directions in which the organization seeks to develop in the future. The purpose of the vision is to lead, control and motivate the entire organization to achieve the common goals of the organization in the future. The vision of the organization should be clear, feasible, challenging, practical and future-oriented to identify critical success factors enterprise

that takes into account the priorities of stakeholders , to be permanent, but flexible [6].

- Defining the strategy - Defining the strategy is a complex process that consists of defining strategic objectives and criteria for their implementation, the planning and provision of resources. The process of strategy formulation is very complex due to the many aspects and variables that must be taken into account. The purpose of the vision is realized only operationalization and realization of the goals is only possible if the goals are realistic and measurable.

- The identification of perspectives and alternatives - After defining the strategy we need to make a choice perspective on which to build a balanced system of indicators of business performance. It is necessary to provide the perspective of the success criteria, and the balance of quantitative and qualitative, subjective and objective, financial and non-financial indicators. It is important to understand the indicators through the passage of time and care to notice the trend. The most commonly used "The concept of Kaplan and Norton", which recommends the use of the customer perspective, internal processes, learning and growth, and financial perspective. Every company has to start from their own specific situations in choosing the necessary perspective and if necessary expand the choice for additional perspective.

Identification of key factors, characteristics and values - Will it achieve strategic objectives depends upon the fulfillment of certain factors that in some literature are found under the term "critical success factors" or "performance" generators. Management of the company in all the options perspective is to identify the critical success factors. Recognition of these factors is a complex issue and requires well as knowledge of the current position of the company. Any shortcomings can result in severe consequences for the achievement of the vision and strategy. Factor of success is achieved when all its properties are set in the range. Critical success factors are identified, defined measurable characteristics that can be expressed in numerical values or descriptive variable (attribute) for each feature is required to provide a description and frequency measurement, the measuring instrument, the target value (limit) that should be used for comparison with the measured value [6].

Implementation - Effective implementation requires the existence of an information system that will facilitate the collection and storage of data and timely reporting of goals. The chosen criteria and target values within the critical success factors are periodically reviewed, and when necessary are replaced.

One of the most successful applications is an application that contains an analysis of performance, because the most successful companies want to know where it comes from their profits, while those that are less successful surely want to know how to improve your results.

Performance analysis is important in determining prices and discounts, promotions at startup, the selection of areas of

investment and predicted pressures from foreign competition. Such decisions are made daily in the management and will be better the more people will better know the profitability of each product and each customer. Each new company will be a challenge for those that already exist in the market.

IV. THE FUTURE OF BUSINESS INTELLIGENCE

Business intelligence is experiencing today and seeing great progress in terms of market growth, but also in terms of applicability. A change occurs in environments where business intelligence is being rolled out. It appears, however, a new challenge for business intelligence - to work with knowledge [2]. Workers who are working to inflict new business intelligence needs that must be met. The same analysis today macro trends such as globalization, deregulation, intensification of competition and micro-trends, such as the increasing role of service processes, changes in the way of decision making, shorten decision cycles, and increasing demands for insight and predictions. Based on these trends, knowledge workers perform research, taking the same results, interact with the environment, make suggestions, share opinions and ultimately decide or recommend decisions. To all this might be possible, we need appropriate products - business intelligence products. In the future, especially coming into the center of interest for application performance monitoring. Key performance indicators are set as input parameters for the development scorecard project, whose results again used as input data for analytical reports [9]. In this direction work Microsoft and other large companies.

V. CONCLUSION

The main aim of the application of business intelligence is to increase the availability of high-quality and reliable information to facilitate company business decision-making, resulting in lower costs and increase profits in the company [11].

The importance of business intelligence and its implementation in the organization, in the present context of changing environments and business with a very great amount of information is necessary for the survival of the company market.

Its importance as a growing part of their business strategy in a growing number of companies, as is evident by studies of the market that has great potential. This concept is most applicable in finance, insurance, and telecommunications, with the proviso that it is anticipated that it will find application in other areas of the business.

ACKNOWLEDGEMENT

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Building Ontologies in PROTÉGÉ

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Abstract - Paper describes creation of ontology in Protégé tool from Stanford University. Basic concepts of ontology and their applications are described. The main characteristics of this ontological editor are presented. An example of ontology for organizing conferences illustrates using this tool for creating ontology. Extended options for creating RDF and OWL files and their possible applications are described.

I. INTRODUCTION

Protégé [1] is one of the leading ontology development tools. It has been developed at Stanford University and it has evolved with many modifications and versions. It enables simple defining of concepts (classes) in ontology, attributes, taxonomies, variety of constraints, as well as class instances (data in knowledge base). It includes graphical tool for presenting of knowledge acquisition into a knowledge base related to ontology that could be used in solving different types of tasks. Protégé supports a variety of ontology languages: OWL, RDF(S), DAML+OIL, XMI (XML Metadata Interchange) and others.

In this paper, basic aim is to present basic characteristics of ontology and Protégé as an ontology development tool. Illustration of using this tool is presented with ontology related to organization of conferences. More advanced options of this tool are also presented and possibilities of using this tool are analyzed.

II. ONTOLOGY

According to [2] ontology has various meanings, depending on science that is creating definitions. Ontology originated in the fields of philosophy and metaphysics.

One of commonly used definition of ontology is given by Gruber as “a formal, explicit specification of a shared conceptualization” [3]. In this definition:

- Formal – refers to the need that ontology should be understandable, i.e. readable by machines [4]
- Explicit – all concepts and constraints should be explicitly defined [4]
- Specification - refers to the language and vocabulary terms that are used to specify the conceptualization.” [5]
- Shared – ontology should „capture” the knowledge accepted by the community where it is introduced and used. [4]
- Conceptualization - the set of concepts that are used to represent the part of reality or knowledge

that is of interest to a community of users.” [5] Conceptualizations refer to abstract model of phenomena from the real world and this model is created by identifying of relevant concepts of these phenomena [4].

Ontology includes both conceptualization and specification and those are formulated by ontology presentation [5] as follows:

- Ontology as a thesaurus (dictionary, glossary) – describes the relationships between words (vocabulary) that represent various concepts,
- Ontology as a taxonomy – describes how concepts of a particular area of knowledge are related, using structures similar to those used in a specialization and generalization of EER models.

Ontology [6], [7] is used to capture knowledge about some domain of interest. Ontology describes the concepts in the domain and also the relationships that hold between those concepts. According to [8], the basic characteristics of ontology are hierarchy of concepts/objects, which is established by using different semantic links.

The formal definition, according to [9], determines the ontology O as a set composed of five elements (C, I, R, F, A), where:

C - a finite set of concepts, abstractions that describe the objects of the real world,

I - a finite set of instances of concepts, i.e. real-world objects,

R - a finite set of relations between elements of set S,

F - a finite set of functions defined over the real-world objects,

A - a finite set of axioms formalized using first order predicate calculus, needed to determine the meaning of objects classes, relations between objects and functions defined over the objects of the real world.

An ontology elements and components can be formulated and presented in several forms:

- Graphically, as diagrams,
- By using of ontology languages,
- By using other formal languages – like first order predicate calculus.

Ontology formalizes semantics of the knowledge domain and explicitly describes their elements, i.e. concepts. They describe attributes and relationships of these concepts [10].

III. ONTOLOGIES IN INFORMATION TECHNOLOGIES

Ontology is defined as the set of concepts that are used to describe a domain, i.e. knowledge area. Ontologies are used by humans, databases and software applications for sharing information related to specific domain. Ontologies are used in information technologies and software engineering as a tool for presenting knowledge of some domain [2].

According to [11], ontologies could be classified in three categories, depending on the domain of modeling:

- Knowledge representation ontology – knowledge representing systems that unify ontology frameworks and enable knowledge exchange between computer programs,
- Upper level ontology – for presenting general world knowledge;
- Domain specific ontology – with primary focus on connecting structures and behavior.

Surveys that are conducted in the field of artificial intelligence, the notion of ontology linked to [2]:

- Reusability of knowledge,
- Sharing knowledge in a specific domain.

In information systems, ontologies are used for solving the problem of integration of information that are based on different classes with conceptual and terminology differences [2].

According to surveys in this field [2] [3] [5], the basic aim of using ontologies is to enable presenting and interchange, i.e. sharing of knowledge in particular domain.

IV. ONTOLOGY LANGUAGES

Some of ontology languages were developed in 90-ties within artificial intelligence research. First ontology languages belong to “pre-XML” era, while the latest ontology languages are based on XML standard. Development of ontology languages in recent years is very much motivated by Semantic Web development [12].

Some of worldwide common ontology languages are:

- KIF – based on first order logic,
- Loom – based on descriptive logic,
- Shoe – extension of HTML,

World Wide Web Consortium (W3C) has accepted ontology languages [12]:

- RDF - Resource Description Framework, primarily a language for semantic networks, for description of resources at Web,
- RDFS - RDF schema is an extension of RDF language,
- OIL – based on descriptive logic and include „frame-based“ primitives,

- DAML+OIL – combination of two languages,
- OWL - Web Ontology Language developed from DAML+OIL; now one of the most commonly used ontology language,

Latest ontology tools are based on XML. They must be compatible with industrial and Web standards, in aim to be readable by software tools and to enable software tools integration and knowledge sharing. Formal basis of all leading languages of Semantic web (OWL, RDF i RDF(S)) are based on classic predicate logic [13].

V. PROTÉGÉ

PROTÉGÉ is an „open source” ontology editor that could be used as a knowledge based systems development framework [1]. It has been developed at Stanford University, initially aimed as software to be used in medicine and biochemistry sciences. Now it is a leading ontology editor worldwide. It is developed in Java and is extendible for development of prototypes of systems based on knowledge. Protégé is accepted by academy, government and business users.

Protégé platform enables two basic ontology modeling methodology:

- Protégé Frames – implements model based on knowledge compatible with Open Knowledge Base Connectivity protocol (OKBC).
- Protégé OWL editor – includes „open source” API for development of user interface components and working with semantic web services.

Protégé OWL editor enables users to:

- Definition of concepts (classes), attributes, taxonomies and class constraints, as well as their instancing.
- Create, edit, load and save OWL and RDF ontology files.
- Visualization of ontology classes, attributes and relationships
- Define logical characteristics of classes and terms,
- Start and execute reasoning systems.

Protégé OWL editor user interface include a set of forms organized by tabs (Figure 1.). Graphical representation of an ontology (Figure 2, Figure 3) is enabled by Protégé extensions that could be downloaded from Internet and installed to extend basic Protégé with this visualization features. Some of these extension software are: ezOWL (Visual OWL) editor, OWL-S editor, Jess, GraphViz editor (used in this paper) etc.

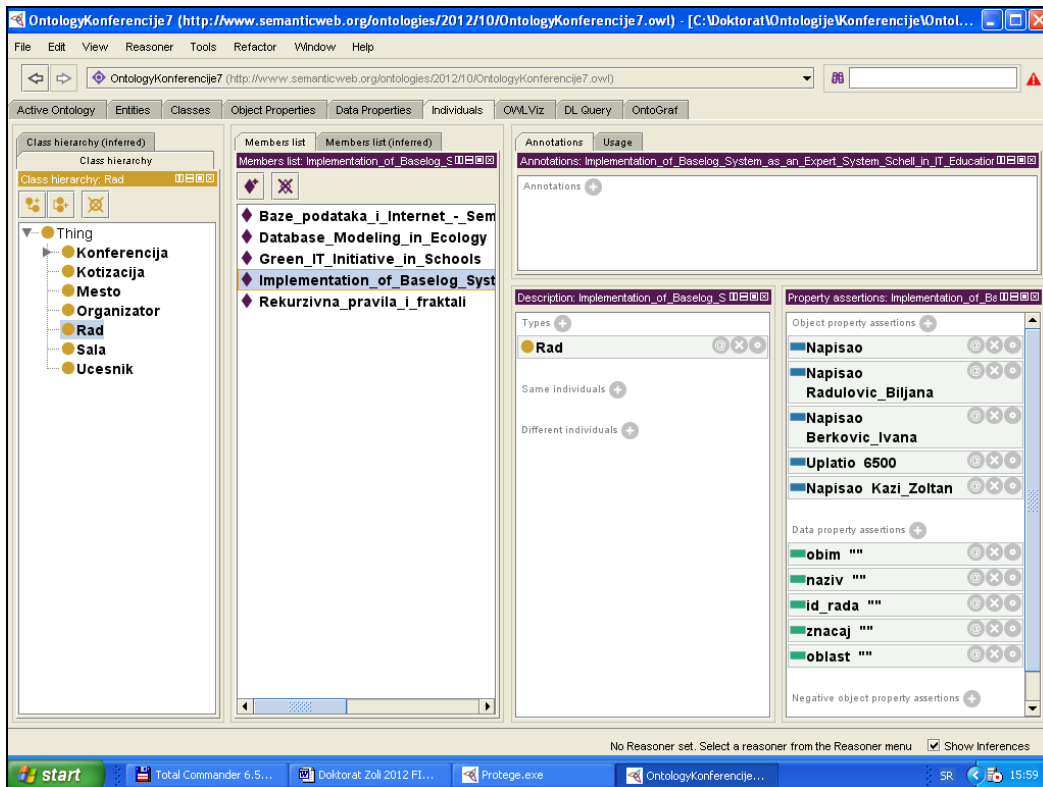


Figure 1.

Protégé Editor

Ontologies could be saved in variety of file formats such as: RDF(S)/XML, OWL/XML, MANCHESTER OWL, OBO 1.2, KRSS, LATEX, TURTLE.

VI. THE PROCESS OF CREATING AN ONTOLOGY - AN EXAMPLE

In this section a process of a creating ontology is illustrated with an example domain related to organizing a conference.

First step includes creating classes presented at Figure 2, organized as hierarchy.

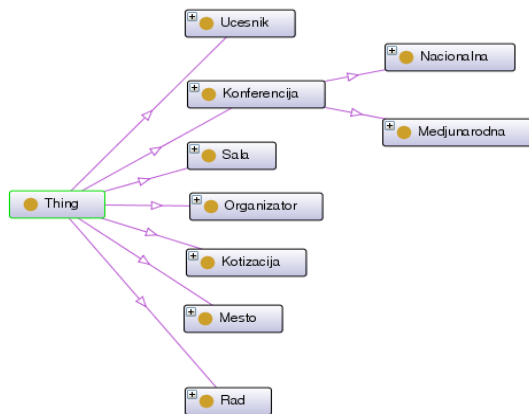


Figure 2. Class taxonomy

Second step includes organizing classes in taxonomy i.e. class conference is specialized to two subclasses: national and international.

Third step includes creating relationships among classes such as: «Izlaze», «Je iz», «Moze biti», «Nalazi se», «Napisao», «Odrzava se», «Organizuje», «Postoji», «Priedjuje», «Prisustvuje» i «Uplatio».

Fourth step includes attributes of classes: «naziv», «adresa», «drzava», «email», «datum izlaganja», «datum pocetka», «datum zavrsetka», «id konferencije», «id kotizacije», «id konferencije», «id organizatora», «id rada», «id ucesnika», «id sale», «prezime», «ime», «telefon», «ptt», «iznos», «kapacitet», «obim», «ozvucenje», «ministarstvo», «mobilni», «naucni odbor», «tip kotizacije», «ustanova», «kapacitet», «oblast», «tip kotizacije», «vreme izlaganja», «web adresa» i «znacaj».

Fifth step includes presenting instances of classes, i.e. objects (Figure 3).

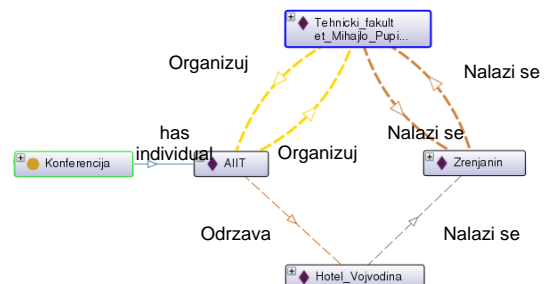


Figure 3. Ontology graph

Finally, after saving an ontology, a file content is an OWL/XML format of appropriate ontology graph:

```
<Declaration>
  <Class IRI="#Konferencija"/>
</Declaration>
<Declaration>
  <ObjectProperty IRI="#Odrzava_se"/>
</Declaration>
<Declaration>
  <ObjectProperty IRI="#Organizuje"/>
</Declaration>
<Declaration>
  <DataProperty IRI="#id_konferencije"/>
</Declaration>
<Declaration>
  <DataProperty IRI="#naziv"/>
</Declaration>
<Declaration>
  <NamedIndividual IRI="#AIIT"/>
</Declaration>
<ClassAssertion>
  <Class IRI="#Organizator"/>
  <NamedIndividual IRI=
"#Tehnicki_fakultet_Mihajlo_Pupin"/>
</ClassAssertion>
<ObjectPropertyAssertion>
  <ObjectProperty IRI="#Organizuje"/>
  <NamedIndividual IRI="#AIIT"/>
  <NamedIndividual IRI=
"#Tehnicki_fakultet_Mihajlo_Pupin"/>
</ObjectPropertyAssertion>
<DataPropertyRange>
  <DataProperty IRI="#id_konferencije"/>
  <Datatype abbreviatedIRI="xsd:positiveInteger"/>
</DataPropertyRange>
<DataPropertyRange>
  <DataProperty IRI="#naziv"/>
  <Datatype abbreviatedIRI="xsd:string"/>
</DataPropertyRange>
```

This file is readable by ontology tools or RDF/OWL parsers, that could extract elements, use them and transform to other necessary forms.

VII. CONCLUSION

Ontology in information technologies is used as a formal, explicit specification of a shared conceptualization, which means that it is representation of knowledge from a specific domain and is formally represented by languages readable by application software. Some of most commonly used ontology languages are presented. Protégé as one of the most commonly used ontology development tool is presented. Creating ontology by using Protégé is illustrated with an example of ontology for conference organization. Ontology is created by using Protégé ontology editor and visualized by Protégé extension tool named "GraphViz editor". Results of using Protégé editor, visual representation of created ontology, as well as ontology OWL file content are described.

Future research related to this field could include extension of using Protégé in reasoning related to ontology and integration of Protégé with other tools, such as reasoning systems and CASE tools.

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Web Integration of REST Enabled Wireless Sensor Networks for Fire Detection

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Abstract - The project described in this paper presents an early warning system for fire detection utilizing low-cost wireless sensor networks and web service technology. This research was motivated by the fact that sensor nodes can be viewed as RESTful resources that can be accessed and polled over the Sensor Web Enablement services. Advantage of the web-based WSN monitoring architecture for fire detection is that it provides a mechanism for authorized professionals to access sensed data remotely using Internet connection. In the case when a fire is detected, the fire department will be provided with a constant stream of information about the location and spread of the fire. Also it can provide the deployed firefighters with an initial location of the fire within the building and also an update of fire spreads development of smoke and other factors which may affect them. This paper describes the prototype design and development of a Web platform which integrates a REST WSN with a REST Web application and allows a user to visualize WSN measurements.

I. INTRODUCTION

A wireless sensor network (WSN) is composed of spatially distributed nodes equipped with sensing devices to monitor and to measure characteristics of the physical environment at different locations. WSNs are designed and deployed for different purposes by various organizations. The observations obtained from sensor networks may be helpful in many software applications like environmental, industrial, and meteorological monitoring, building and home automation, medicine, urban sensor networks, intelligent transportation, security, military defense, etc [1, 2]. Sensed data can be stored on the Internet using web-based technologies. Users can access data remotely as long as they have Internet connection. Many WSN applications developed today use smartphones as a gateway between the sensor network or the user, and the Internet. This allows the sensor network and/or the users to be mobile. Implementation of a web-based WSN architecture provides a scalable solution with applicability in many areas such as healthcare, environmental monitoring, border security, structural health monitoring, and etc. [3]. Security detection and surveillance based on web based WSN is becoming an increasingly important area of research. Advantage of the web-based WSN monitoring architecture for fire detection is that it provides a mechanism for authorized professionals to access sensed

data remotely using Internet connection. In the case when a fire is detected, the fire department will be provided with a constant stream of information about the location and spread of the fire while the deployed firefighters will have information about building plan, an initial location of the fire, its spread, development of smoke, presence of toxic gases and other factors which may affect them.

The challenge in achieving WSN interoperability with IP networks has been recognized, and so has the need for an open resource-oriented architecture for building web services in sensor networks. A Representational State Transfer (REST) [4] is an architectural model for how distributed applications are built. Systems built around the REST architecture are said to be RESTful. REST builds on three concepts: representation, state, and transfer:

- Representation: Data or resources are encoded as representations of the data or the resource. These representations are transferred between clients and servers.
- State: All of the necessary state needed to complete a request must be provided with the request. The clients and servers are inherently stateless. A client cannot rely on any state to be stored in the server, and the server cannot rely on any state stored in the client. This does not, however, pertain to the data stored by servers or clients, only to the connection state needed to complete transactions.
- Transfer: The representations and the state can be transferred between client and servers.

REST is an architectural model that can be efficiently implemented as a combination of the Hypertext Transfer Protocol (HTTP) and TCP/IP. With this instantiation of REST, HTTP requests are used to transfer representations of resources between clients and servers. Uniform Resource Identifiers (URIs) are used to encode transaction states.

The rest of this paper is organized as follows. The literature review is given in Section 2. Section 3 shows building of hardware prototype. Created RESTful API and RESTful client for a sensor node are presented in Section 4 and 5, respectively. Finally, Section 6 gives the conclusion.

II. LITERATURE REVIEW

In [1] authors formalized the main features of the web-based WSN monitoring architecture into a pattern which is an encapsulated solution to a problem in a given context. The pattern description includes information when to apply the pattern and how to apply it. The proposed pattern describes the general structure (Fig.1) including the components involved in sensing, data acquisition, storage, and consumption using UML class diagrams and the main interactions and communication between these components using UML sequence diagrams. The proposed architectural pattern has a considerable potential for use in areas such as healthcare, environmental monitoring, and transportations.

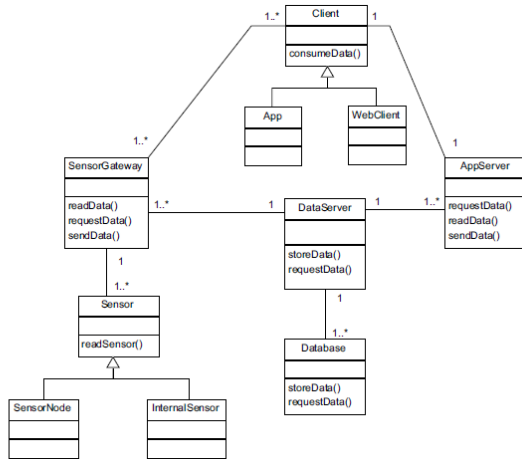


Figure 1. Class diagram for web-based WSN monitoring architecture

Paper [2] explores the problem of making observations obtained from sensor networks accessible to software applications. This work is based on standards developed by Open Geospatial Consortium (OGC) shown in Fig.2 [3].

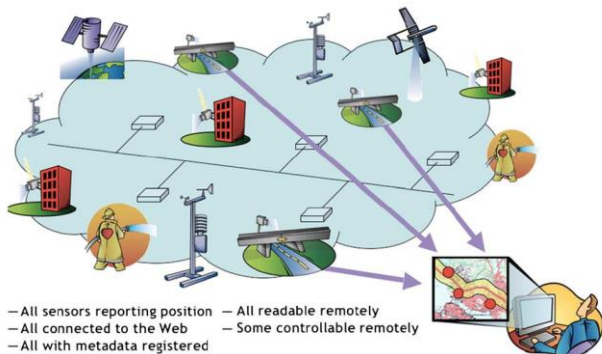


Figure 2. Vision of the OGC Sensor Web Enablement initiative

Authors of [2] explored roles of sensorML, Observations and Measurements (O&M), Sensor Observation Service (SOS), Sensor Alert Service (SAS), Extensible Messaging and Presence Protocol (XMPP) for Multiuser Chat Systems (MUC) and Event Stream processing (ESP) in developing a middleware which will seamlessly allow any application to fuse/consume observations from different sensors belonging to same or multiple networks. The work in [4] proposes a solution based on Session concept to capture, contextualize, and reuse, richer dynamic

interaction models to Web enabled WSNs, allowing their use across different application scenarios. In [5] authors address the problems related to the data format and the architectural style followed by the implementation of the Sensor Web Enablement (SWE) services. Authors propose to adapt the SWE services to the RESTful architecture as shown in Fig. 3.

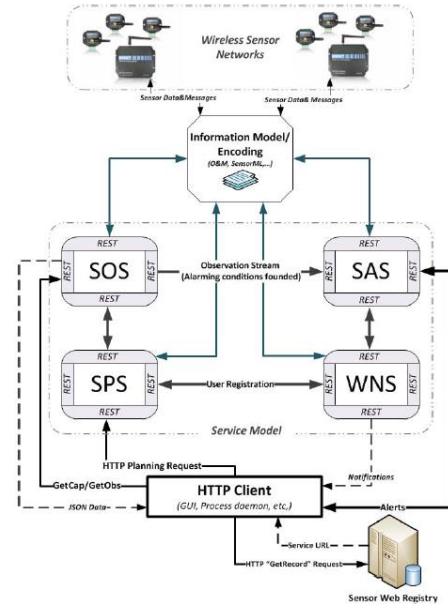


Figure 3. REST architectural style for SWE

They propose the adoption of the lightweight REST web services concept and the usage of JavaScript Object Notation (JSON) format as an alternative to the verbose XML one for the exchanged messages. The performance evaluation results have showed the effectiveness of their RESTful architecture as well as the efficiency of adopting the JSON format in terms of file size reduction and communication time. The authors in [6] discussed the integration of WSNs with the Web. This is being facilitated by the development of Constrained Application Protocol (CoAP) which offers the same methods for the resource manipulation as HTTP and supports additional functionalities typical of Internet of Things (IoT) and M2M applications, such as multicast, asynchronous communication and subscriptions. The application allows a user to access WSN data directly from a Web browser. In this paper the main building blocks of the gateway connecting the Web client with the WSN are described (Fig. 4).

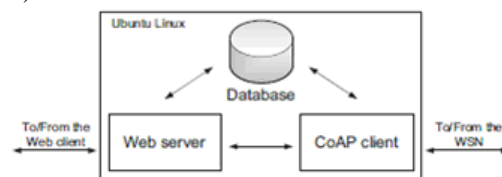


Figure 4. The main building blocks of the gateway

The work in [7] also describes the prototype design and development of a Web platform which integrates a REST/CoAP WSN with a REST/HTTP Web application and allows a user to visualize WSN measurements in the Web browser. Since the WSN Web integration relies on a

non-transparent gateway/server, authors also show how to provide transparent cross-protocol resource access by means of an HTTP-CoAP proxy. Authors in [8] demonstrated an approach for analyzing the choice of routing algorithms for a CoAP-UDP protocol stack for internet-enabled WSNs running an application for emergency monitoring and evacuation of people in a building. The work in [9] proposes a RESTful Web services mash up augmented coal mine safety monitoring and control automation using ZigBee WSN while in paper [10] author presented a web services-based approach to integrate resource constrained sensor and actuator nodes into IP-based networks. A key feature of author's approach is its capability for automatic service discovery. Based on the RESTful API, author introduced a plug-and-play approach, which enables the automatic discovery of sensor nodes in a wireless network, but also of the functionality they provide. Authors of [11] propose a solution towards richer interactions for Web enabled WSNs access. As an application scenario, authors consider a fire detection application supporting a fire department responsible for a critical geographical area.

In next sections a prototype of early warning system for fire detection utilizing low-cost WSNs and web service technology will be presented with aim to provide all spatial-temporal information needed for early and accurate residential fire detection which is important for prompt extinguishing and reducing damages and life losses. Thus, detection of a critical event should be delivered to the user as soon as possible. For that purpose, prototypes of sensor node and sensor web structure are created using RESTful services what makes remote access to sensor data via Internet possible.

III. BUILDING OF HARDWARE PROTOTYPE

Before creating a REST WSN prototype node, it is necessary to fulfill certain requirements. The typical sensor architecture is consisted of four basic elements shown in Fig. 5: the sensor unit, processing unit, communication and power units.

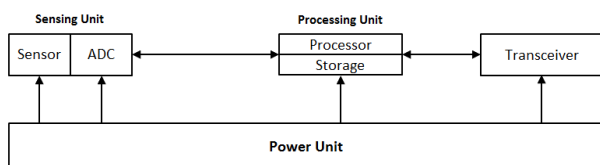


Figure 5. Typical sensor architecture

In this paper, attention will be paid to the processor and communication unit, which are crucial for creating REST WSN node. Sensor unit is a set of sensors elements with which the sensor node "feels" the environment and through which collects data. At the same time, the sensor elements can be digital or analog, where in the latter case AD converters must be used. The paper [12] considered the way of connecting an analog sensor with AD converter using a voltage divider with known resistance. For the purposes of testing REST services in this paper two analog temperature sensors (thermistor models:

B57045k10 [13] and 10kNTC [14]) and an 8-bit ADC (model: PCF8591 [15]) are used.

Communication units can be implemented in two ways; it may be part of the CPU, but also separated from it. In both cases, the basic requirement which sensor node need to fulfill to become a REST WSN node is to have a communication over IP. Most of today's hardware system provides wireless connection that uses the IEEE 802.11 standard [16]. Because of IP protocols spread, on which Internet is based, each sensor can become part of a global network, and thus gain access from any location. By fulfilling these conditions, the sensor node becomes Sensor Web [17].

Processing unit is a key element of REST WSN sensor node. In addition to sensor data processing it is necessary that processor unit has the ability to run and execute web server on which will be deployed REST services. Web servers can be lightweight, but also very heavyweight in terms of resource use in the CPU [18]. Depending on the needs of sensor node and CPU power, it may be desirable to perform server optimization.

To create a REST WSN prototype, in this paper is used Raspberry PI type B. In [19] is given a detailed description of the hardware and software capabilities of Raspberry PI. JAVA is chosen for the prototype implementation. Apache Tomcat 7 server that provides the ability to run Java services is preinstalled on processing unit and it is chosen because of its very simple configuration and optimal utilization of hardware. Framework Jersey 1.17 [20] is used for the implementation of RESTful services.

IV. RESTFUL API FOR SENSOR NODES

During the creation of web services for sensor node, it is necessary to define all the available resources and ways how to access them, as well as additional elements that affect the performance of the sensor and the whole system. As it previously mentioned, at the REST service each element represents a resource that has a unique URI address [21], the access method [22], the parameters and the type of sent data. At a sensor node side, resources represent sensors and the information they collect, but also resources can be aggregated from all sensors including information which are already processed at the sensor node.

Two temperature sensors are used in proposed prototype, thus a RESTful service that implements a method for obtaining data from individual sensors, as well as methods that can display data collectively from all sensors in the sensor nodes is created. As both sensors connected to the sensor node in the prototype do not require input parameters, but only read data, for all the methods GET access method is used. Requirement which is very important for the realization of sensor web node is reducing the amount of transferred data. This requirement, as the primary choice for communications between services and client, implies using JSON format.

Two methods for reading data from both sensors of sensor web node are given:

```
[server_address]/RPISensorWeb/sw/b57045k10
[server_address]/RPISensorWeb/sw/b57045k10/data
```

and

```
[server_address]/RPISensorWeb/sw/ntc10k
[server_address]/RPISensorWeb/sw/ntc10k/data
```

Although JSON is used for the information exchange, the reason for existence of two addresses is to reduce the amount of transferred data. When first address is called the client get JSON which contains only information about the measured value:

```
{"temp":"23.55"}
```

while when user calls the second address, a JSON with information of sensor type and sensor model are forwarded in addition to the measured value.

```
{"type":"thermistor","model":"b57045k10","temp":"23.87"}
```

Aggregated information about the sensors can be accessed via three addresses:

```
[server_address]/RPISensorWeb/sw/info
[server_address]/RPISensorWeb/sw/info/data
[server_address]/RPISensorWeb/sw/info/number
```

The first address sends to the client information of the sensor number, data of all sensors and the measured value.

```
{"sensor_number":2,"data":[{"type":"thermistor","model":
"b57045k10","temp":"23.23"}, {"type":"thermistor","model":
"ntc10k","temp":"23.07"}]}
```

The second address returns only information about sensors and measured values:

```
{"data":[{"type":"thermistor","model":"b57045k10","temp":
"22.58"}, {"type":"thermistor","model":"ntc10k","temp":
"22.37"}]}
```

while the third address provides data of sensor number in the sensor node:

```
{"sensor_number":2}.
```

Defined resources provide full support for the work and for reading values from two sensors and also reduce the amount of transferred data what increases the life of the sensor nodes with an autonomous power supply.

V. RESTFUL CLIENTS FOR SENSOR NODES

An important element of information systems, and systems for fire detection, is information processing. The analysis of fire detection information systems is primarily based on the collection and analysis of data collected from the sensor nodes. Very low tolerance to communication latency between the sensor nodes and information system is crucial for these systems. Therefore, the transfer of data and their analysis must take place in real time.

Since data from sensor node are obtained in JSON format, client application for visualization and data

processing is created to test prototype. In real-time, application access to sensor nodes through the Internet and reads data from sensors via RESTful services. Raw data are current information that has been read from the sensors. Depending on the nature of the problem to which observed sensor node belongs, it is possible to provide detailed data processing and analysis, as well as their collection and storage in the database with a purpose of subsequent processing and analysis. In prototype applications two components are created: Data Grapher - component that performs visualization of measured data in function of time and Data Processing - the component that performs processing of the sensor node measured data.

A. Data Grapher

Data visualization is the process in which computing and digital technology is used to display quantitative and qualitative information, mathematical or scientific models, and measured, statistical or calculated data [23]. The application of visualization in real-time systems has the role of translating the observed values into animated and interactive 2D and 3D graphical models. The importance of data visualization can be found in many different fields. Works [23, 24, and 25] consider the general importance of visualization in information systems while [26] and [27] present the applications of visualization in real-time systems and sensor networks. Fig. 6 presents the visualization of the measured data with the REST WSN sensor node using the Data Grapher component. As the data from the sensors are observed in real time, the primary goal was to set a time frame in which the measurement are done and shown as well as the definition of the measurement range and sampling interval. In order to cover different types of sensors, Data Grapher in its settings must be able to offer possibility of selecting sensor type. An essential element of visualization is also the choice of the ratio in which the measured data are presented and the selection of the visual identity of the chart.

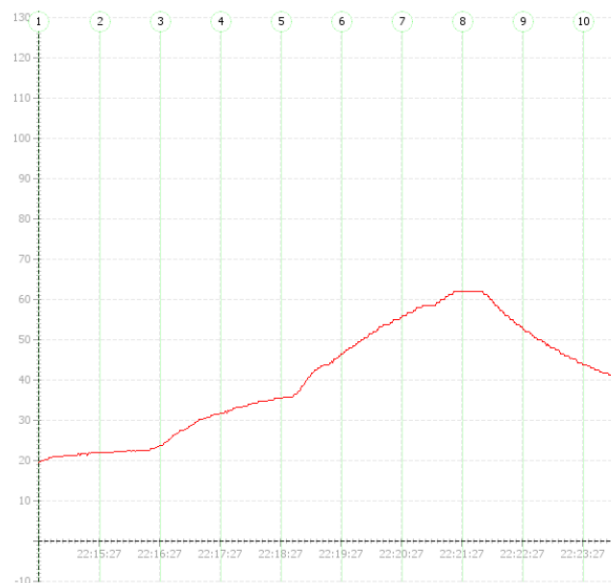


Figure 6. Data Grapher – Data visualization

As the prototype client was designed for the visualization of data from a given temperature REST WSN sensor node, with its primary application of fire system data analysis, logic that performs risk assessment of current situation is embedded into the data processing component. Due to the connection between Data Visualization and Data Processing components, the need for the introduction of additional visual elements that would provide greater readability and ease of data processing is appeared. Adding indexed markers to the measured data chart, the user can clearly see estimates making moments and to visually identify the cause that led to the above conditions (e.g. temperature increase), what greatly helps in analyzing the read data.

B. Data Processing

Unlike Data Grapher component, which has only the role of good visualization of measured sensor data, Data Processing component processes them. At the same time, data processing can be based on simple, predefined rules, but it can also be based on complex mathematical models or decision making based on rules in the domain of artificial intelligence.

Creating clients with different strategies of sensor node data processing implies the advantage of access where the processing unit and the sensor are located at the same place or are directly linked. Access to sensor data over the Internet - via REST services, provides competitive performance of more than one client where each can be based on a different strategy as discussed earlier.

Data Processing component of the created prototype collects information of previous and current measured temperature of the sensor. The resulting air temperatures are included in the system of decision making. Decision making is executed according to predefined algorithms for estimating the likelihood of fire and the results of both algorithms are presented. Fig. 7 shows the work of Data Processing components.

```

Legend:
##### - Very low critical
#### - Low critical
##### - Medium critical
#### - High critical
##### - Very high critical

Date of measurement: 01.08.13

No.:      Time:      PrevTemp: CurrTemp: Delta:      Appr.1:  Appr.2:
-----
Start at: 22:14:27
1.        22:14:28  19,40    19,40    + 00,00  19,98    25,00
2.        22:15:27  19,40    21,95    + 02,55  22,03    21,71
3.        22:16:27  21,95    23,87    + 01,92  23,96    23,84
4.        22:17:27  23,87    31,51    + 07,64  36,37    48,83
5.        22:18:27  31,51    35,44    + 03,93  40,35    41,01
6.        22:19:27  35,44    46,54    + 11,10  61,41    80,86
7.        22:20:27  46,54    55,49    + 08,95  75,53    86,78
8.        22:21:27  55,49    62,08    + 06,59  81,37    81,37
9.        22:22:27  62,08    53,17    - 08,91  69,49    70,45
10.       22:23:27  53,17    44,27    - 08,90  58,60    58,60
11.       22:24:27  44,27    38,47    - 05,80  45,83    46,08
12.       22:25:27  38,47    35,07    - 03,40  40,53    40,53
13.       22:26:27  35,07    32,56    - 02,51  37,57    37,55
14.       22:27:27  32,56    27,45    - 05,11  31,97    30,74
15.       22:28:27  27,45    22,58    - 04,87  22,85    25,00
16.       22:29:27  22,58    24,19    + 01,61  24,26    24,20
17.       22:30:27  24,19    48,96    + 24,77  64,17    83,25
18.       22:31:27  48,96    79,22    + 30,26  91,38    92,20
19.       22:32:27  79,22    84,84    + 05,62  92,20    91,96
20.       22:33:27  84,84    42,11    - 42,73  55,10    55,10
21.       22:34:27  42,11    32,56    - 09,55  37,57    37,57
22.       22:35:27  32,56    29,80    - 02,76  35,36    35,00
23.       22:36:27  29,80    28,45    - 01,35  32,70    32,52
24.       22:37:27  28,45    28,79    + 00,34  32,92    32,92
25.       22:38:27  28,79    25,16    - 03,63  25,51    25,52
26.       22:39:27  25,16    23,23    - 01,93  23,43    25,00
Stop at:  22:40:05

```

Figure 7. Data processing – processing data on REST WSN client

To make easier recognizing the moment when the decision is made, readings values are indexed, and the index corresponds to the index marker placed on the chart.

As the Fig. 7 shown, different colors marked the different conclusions of fire possibility occurrence. This presentation gives a detailed insight into the operation of the algorithm for decision making.

VI. CONCLUSION

In this work the prototype design and development of a Web platform which integrates a REST WSN with a REST Web application and allows a user to visualize WSN measurements is described. Combining two components, Data Grapher and Data Processing component, the client application gives users the possibility for a simple monitoring and analyzing sensors data in real time. By selecting the appropriate measurement range for visualization, and algorithms for decision making, users have complete control over the next steps that should be taken. Early detection of fire is crucial for life savings and reducing damages and in case that algorithm for estimating concludes that the probability of a fire is high then certain preventive actions should be taken immediately. If in the whole process Building Management System elements are included, then a tool that can provide firefighters information of situations before fire occurrence and situations at the time when the fire appears is obtained. Firefighters' knowledge of the terrain and other spatial-temporal data before their arrival at the scene, is an advantage and increases their efficiency. The REST WSN node communication over the Internet allows the realization of the above mentioned scenarios.

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IT Higher Education in India

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Abstract - The Information Technology is becoming an important part of our lives and it is also transforming lifestyles and habits of people all over the world. IT in India has played a key role in increasing work efficiency and enhancing public accessibility through e-governance. It can be also said that IT is the backbone of the economical growth of the India, It has helped to change the life style of the people. The IT is a specialized field and so academic as well as technical skills are very essential to stay in this field. In India a big number of colleges and institutes are engaged in imparting IT education. There are various courses available at different institutes and the country is rapidly developing through e-governance. In this paper the higher education system and particularly IT higher education system in India will be described. Especially Gujarat State education in the field of IT will be described. Analysis of IT higher education support to Indian IT industry will be presented in the context of educational support to development of the country, particularly illustrated with engagement in e-Governance systems development in Gujarat.

I. INTRODUCTION

The educational, professional and innovation skills are person's advancement in the competitive world. A country's higher education is of vital importance, acting as a powerful tool to build knowledge based society of the 21st century. India is proud of a highly developed higher education system which offers education facility and training in almost all fields. That indicates institutional capacity in terms of number of universities/colleges and faculties. They also provide to the students large access to post higher secondary education.

Information technology (IT) today is what runs businesses worldwide. It is what drives the industries and is an irreplaceable element of our routine lives. In this era of information technology, which has revolutionized the whole world, India has stood to the world standards and is being regarded the world over for its skilled IT professionals. Even the government [1] has recognized the promising future of this industry and has formed a new IT Ministry which will give a boost to this industry. It can't be denied that use of IT significantly facilitates work as well as learning for significant changes in education [2].

In this paper an overview of higher education system in India is presented. Particular focus is given to description of IT higher education and more precisely to higher education in this field in Gujarat State of India.

II. HIGHER EDUCATION IN INDIA

India's Higher education [3] [4] [5] is one of the largest and oldest systems of higher education in the world. As of now, there are 320 Universities, of which nearly 131 are of Affiliating Universities. Besides it, there are deemed universities, institutions of national importance, institutes and over 15500 colleges and together they offer a wide range of degree and diploma programs across the length and breadth of the country. India is enrolling nearly 22 million students in more than 46,000 institutions. India's 12th Five-Year Plan — the government's key policy document for economic development through 2017 — proposes a "steer and evaluate" role that enforces higher levels of accountability across the education system's institutes and allows a greater degree of self regulation.

A. Classification of Universities

The different types of universities are:

- Central or State Universities - while the former are funded directly by the Ministry of Human Resource Development, the latter are set up and funded by the various state governments.
- Deemed Universities - which enjoy the same academic status and privileges as a university..
- Institutions of National Importance - are university-level institutions that are established or designated by Acts of Parliament and funded by the Central Government. These include the Indian Institutes of Technology, Indian Institutes of Management and the all India Institute of Medical Sciences, etc.
- Most universities are 'affiliating universities', which prescribe to the affiliated colleges the admission criteria and courses of study, hold examinations and award degrees. University departments impart postgraduate education and conduct and promote research in a variety of disciplines. Undergraduate and, to some extent, postgraduate instruction is imparted by the colleges affiliated to a particular university.

B. Classification of Colleges

Colleges in India come under four different categories. This categorization is done on the basis of the kind of courses offered by them (professional/ vocational), their ownership status (Private/ Government) or their

relationship with the university (affiliated/university owned).

- University Colleges - These colleges are managed by the university itself and situated mostly in the university campus.
- Government Colleges - The government colleges are few, only about 15-20 percent of the total. They are managed by state governments. As in case of other colleges, the university to which these colleges are affiliated, conducts their examination, lays down the courses of studies and awards the degrees.
- Professional Colleges - The professional colleges are mostly in the disciplines of medicine, engineering and management. There are few for other disciplines too. They are sponsored and managed either by the government or by private initiative.
- Privately Managed colleges- About 70% of the colleges are founded by the privately owned trusts or societies. But these institutes are also governed by the rules and regulations of the university they are affiliated to. Though initially started up as a private initiative, the state government also funds these colleges.

III. IT CAREER OPPORTUNITIES IN INDIA

Career in IT is considered one of the most high-paying jobs and is full of opportunities. Moreover, depending upon the interest the career in IT can be chosen among IT fields such as programming, software testing, hardware engineering, system administration etc. In fact, IT sector is quite broad in terms of employment and job options.

Booming IT sector in India [7] [8] has plenty of jobs for fresh IT graduates. Candidates from top notch engineering colleges however get more attractive job offers from IT companies in comparison to not so known engineering colleges. Additionally, candidates with high percentage of mark and good communication skills as well as sound computer knowledge do not face problem in getting a job whether they are from a reputed engineering college or not. Computer engineers can get jobs in non-IT companies like universities, research, private and public industries, government departments, business organizations, commercial organizations and the manufacturing sector, etc. Besides it, the Computer Engineers have plenty of options to work in IT companies in departments such as design, development, assembly, manufacture and maintenance, etc. Working as programmer, web developer, and E-commerce specialist with telecommunications companies, automotive companies, aerospace companies, etc. can be a great deal of career option as well. Moreover, numerous national and multi-national computer manufacturing companies, computer hardware system and development companies, computer networking companies, software development companies, etc. require computer professionals in large numbers. Particularly India's professionals in IT industry are recognized across the globe. The pool of talented computer engineers working in

IT companies of the USA and Canada shows that IT can offer jobs worldwide. Numerous IT companies from India employ huge number of computer professionals in their Indian and overseas offices.

It is the attraction of higher salaries in IT sector which urges youngsters to decide to study courses in computer science. In comparison to other sector, computer science graduates fetch higher salaries in the beginning. After gaining +2 years of work experience, they can get a much higher salary. Candidates who get opportunities to work in overseas project get numerous benefits and incentives. However, the salary depends a lot upon some factors such as the state of the industry, work experience, qualifications and ability of the candidate. Computer Science graduates who are in teaching can have many additional benefits.

IT sector can truly be considered a global career in terms of its wide scope for professionals. More importantly India has been one of the leading exporters of IT talent and Indian computer engineers have played major role in the growth and development of IT sector in the USA, UK, Australia, and Canada. True to its global reputation, the Indian IT sector [9] [10] has lots of scope in terms of growth in employment opportunities. A huge requirement of trained IT engineers is expected in next years. The Indian IT exports are expected to expand to the tune of US\$ 175 billion by 2020 and the domestic sector will account for US\$ 50 billion in terms of earnings. Similarly, a huge quantum of profit is expected from the export and domestic IT sector which would be worth US\$ 225 billion. Widening scope for computer science professionals can be prophesied from the fact that after the recession is over, new jobs would come in large numbers in IT sector. Moreover, with low services cost, Indian IT companies have leverages over IT companies in the USA, Canada, and Australia. The low cost Indian IT service attract lot more business even during recession as companies in developed nations try to reduce their production cost and outsource their IT work to Indian IT firms. Indian IT companies such as Wipro, Infosys, TCS, Patni, HCL, etc. have been able to garner gains even during the recession and have hired a number of computer professionals.

IV. IT HIGHER EDUCATION IN INDIA

IT sector requires from employees to have specific personal skills, knowledge and practical skills. One should have the following personal attributes if one wishes to enter this field:

- Flexibility and willingness to learn new things, technologies and adopt new methods of work
- Logical thinking
- Ability to focus and concentrate
- Creativity
- Accuracy
- Organizational and administrative abilities
- Confidence
- Ready to work for long hours, work hard

- Ability to take decisions
- High intellectual capacity
- Ability to gel well with people and good communicational skills

More over, this is a specialized field and so academic and technical skills are very essential.

An IT engineer profession [6] is based on BTech or BCA/MCA diploma. These educational levels require classes in mathematics (2+ exams), as well as other IT related classes. It is possible to obtain various short term certification and diploma courses without mathematics classes, but they are not treated as a full IT engineer diploma. Candidates who are willing to excel in computer engineering should have sound command over mathematics and science to clear entrance exam conducted soon after 12th class. Advanced knowledge of chemistry and physics would help the candidates get through the entrance exam conducted by engineering colleges in India. Candidates who wish to do BE / BTech in Computer Engineering must have passed 10+2 or equivalent examination, with Physics, Chemistry and Mathematics. Similarly, those who wish to do Diploma in Computer Engineering must have passed 10 + 2 with Science Subjects.

Candidates may choose for M.E/ M. Tech in Computer Science for further specialization in Computer Science. However, there is a stringent selection procedure at place for computer engineers wherein admission to the BE/ BTech courses is very competitive. An internship program at various IT companies would garner practical knowledge and employability and it is a must and can be either after or during the course.

A number of engineering colleges in India offer BTech/BE in computer science and many of them are internationally acclaimed. Most of the engineering colleges are in public sector, which include IITs (International Institutes of Technology) and NITs (National Institutes of Technology).

Studying Information Technology can cost a lot in India in private engineering colleges. However, government sponsored engineering colleges charge comparatively low, but the fee depends upon the rank of engineering college and reputation. Diploma programs on the other hand cost less. A number of scholarships are available for computer science students. For instance, one such scholarship is the Paul Foundation Scholarships and is offered to study BTech and MTech in computer science. Candidates with outstanding academic records are eligible for it. The NTPC Scholarship for Disabled or Handicapped Engineering Students is also there for students who have some kind of handicap including of visual, hearing or orthopedic. Like wise Students who are willing to do research in computer science can apply for the Young Engineering Fellowship Program which is offered to students of BTech who are willing to do summer projects conducted by the Indian Institute of Science in Bangalore. Students in third year of any type of engineering degree are applicable for it.

V. IT ACADEMIC DEGREES AND JOBS IN INDIA

There are various courses available at different institutions, among which are diplomas and degrees courses such as:

- Bachelor in Computer Applications (BCA)
- Bachelor in Science with Computers (B.Sc)
- Master in Computer Applications (MCA)
- Master in Science with Computers (M.Sc in computers)
- Master in System Management
- Bachelor in Technology (B.Tech)
- Bachelor in Engineering (B.E)
- Master in Technology (M.Tech)
- Certification Courses
- Diploma in Computer Applications
- Post Graduate Diploma in Computer Applications.

Some of job positions in IT in India are described as:

- Software Developers - professionals who are concerned with facets of the software development process which involves activities such as design and coding, computer programming, project management, etc.

- Hardware Engineers - these professionals do research, design, develop, test, and oversee the installation of computer hardware which includes computer chips, circuit boards, systems, modems, keyboards, and printers.

- System Designer - professionals involved in system designing, logical and physical designing wherein logical designing can be enumerated as the structure and characteristics such as output, input, files, database and procedures, etc.

- System Analyst - computer engineers who work as systems analyst do research about the existing problems and plan solutions for the problem. They also recommend software and system related problems and coordinate development between business development teams.

- Networking Engineers - networking engineers are computer professionals involved in designing, implementation, and troubleshooting of computer networks.

- DBA (Database Administrator) - the professionals who are bestowed with the job to design, implement, maintain, and repair an organization's database. They are also known as Database Coordinators or Database Programmers in IT sector.

VI. IT EDUCATION AND E-GOVERNANCE IN GUJARAT

The education department in Gujarat [11] [12] [13] pays special attention to the improvement of elementary and higher education in Gujarat. Gujarat is also home of some prestigious educational institutes of the nation. A variety of universities can be found functioning in Gujarat

that offers both undergraduate and post graduate programs in different disciplines. Moreover Gujarat has both private and public universities, many of which are supported by the Government of India and the state government - Government of Gujarat. Apart from these there are private universities supported by various bodies and societies.

Information technology higher education in Gujarat is very much supported [14] [15]. Table I shows number of IT colleges and number of students available for study (“seats”) at these colleges in Gujarat State of India, presented by Gujarat State Zones.

Strong emphasis in higher education in Gujarat on information technologies lead to a number of professionals engaged in development of this Indian State [16]. One of the fields of engagement is development of e-Governance systems in Gujarat State, though many initiatives and projects [17] [18].

TABLE I. IT COLLEGES BY GUJARAT STATE ZONES

Zone	Colleges	Seats
Ahmedabad	10	720
Gandhinagar	14	960
Rajkot	12	690
Surat	4	225
V. V. Nagar	10	720
V.V. Nagar	1	120
Total	51	3,435

Figure 1. shows Gujarat e-Governance projects and initiatives, as well as developed e-Governance systems with Government-to-business (G2B) and Government-to-citizens (G2C) subsystems. The projects and developed systems are categorized as e-Health, e-Administration and Security, e-Agriculture and Environment, e-Revenue and e-Education.

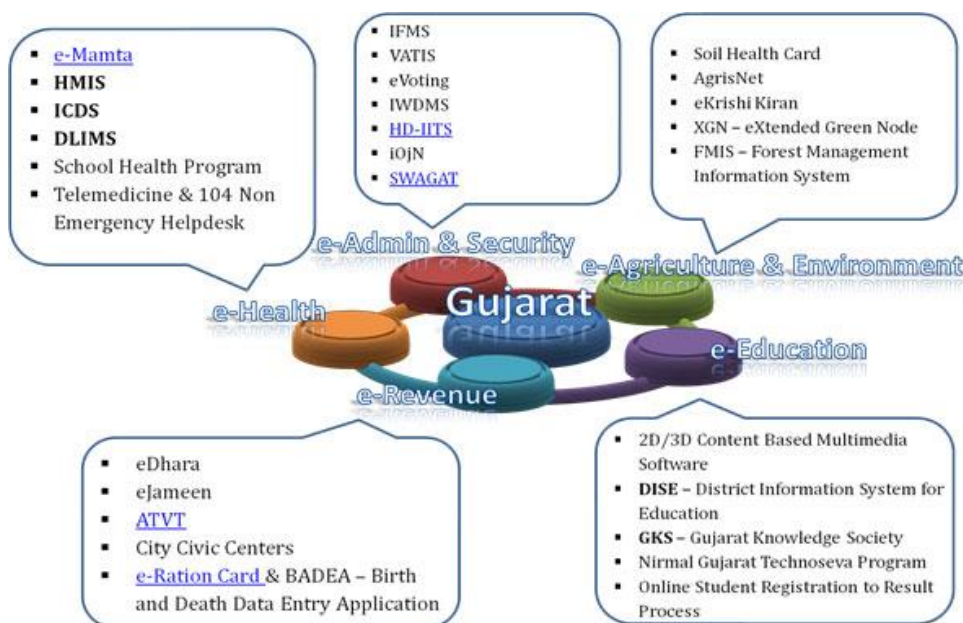


Figure 1. e-Governance projects and developed systems in Gujarat State of India

Good governance is the key to sustainable development. Gujarat has been constantly innovating, aiming at excellence in governance. Gujarat has been one of the early adopters of e-governance in the country. E-governance seeks to achieve: efficiency, transparency, citizen's participation, good governance, trust and accountability, citizen's awareness and empowerment, citizen's welfare, democracy, nation's economic growth.

In Gujarat State a number of applications developed in the state are being replicated elsewhere in India. E-Governance systems of Gujarat have been increasingly used to offer citizen-based services as per convenient location in aim to improve accessibility, to make services

more transparent and reduce response time with reducing costs. The Gujarat government is also proactive in its initiatives and is made progress to rank Gujarat as the first state in India to have made e-Governance functional in all its municipalities and municipal corporations. Gujarat is an aspiring leader with e-readiness initiatives with the IT Policy 2006-2011 [19] [20] [21]. Gujarat has been positioned at L2 stage in Information Communication Technologies (ICTs) which is categorized based on environment, readiness and usage of applications. It stands as an aspiring leader ranking to 31st Top Hotspots in the World.

Particular e-Education initiatives are presented at Figure 1 as:

- 2D / 3D content based multimedia software
- DISE – District Information System for Education
- GKS – Gujarat Knowledge Society
- Nirmal Gujarat Technoseva Program
- Online Student Registration to Result Process.

VII. CONCLUSION

Information technologies are a backbone of the world today. Higher education in this field aims to provide future professionals that will enable development of IT systems in many working areas of human activities. One of them is e-Governance.

In this paper description of higher education in India is presented. Higher education in information technologies in India and particularly Gujarat State of India is described. Special emphasis is given to development of IT higher education in this Indian State, which resulted in highly developed e-Governance system in this state and very high ranking of this system within worldwide standards.

Presented results of research show the importance of IT higher education for the development of a country. It is particularly important to put efforts to quality of education in this field. Especially is important to enable students to be involved in development of real-world problems IT support (such as e-Governance systems development) with modern technologies use early. This way students would be faced with knowledge and skills requirements, which would additionally motivate them in their efforts during their study process.

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Comparison of ICT Usage and Market Trends in Romania and Serbia

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Abstract - ICT technology and its utilization have the important part in the progress of a society. It has equally important part in business, government and administration, educational process and in private life of the people as well. The utilization of this technologies and its expansion gives clear identification of the progress and competitiveness of the society. This paper gives the analyses and comparison of ICT utilization and market trends in neighboring countries of Romania and Serbia.

To achieve this, we used statistical data from a certain period of time, using official world and national databases. The data were afterwards processed; the results of the comparison were used for describing the present situation and to suggest the ways to overcome detected problems.

Keyword: IC technology utilization, market trends, Internet usage

I. INTRODUCTION

There is no doubt that in today's world ICT technology and its utilization have the important role in the development and the progress of society. The readiness of the country to implement and utilize ICT and as well as their willingness to work on ICT sector development indicates its ability to be more competitive in today's world market. This also indicates the better prospect for the future of the same country and its possibilities for further development.

The development of ICT sector has important part in business, government and administration, educational process and in private life of the people as well. Also, the level of ICT utilization within this component itself gives more clear picture about the overall country ICT potentials and the segments that must be improved. This paper gives the analyses and comparison of ICT utilization and market trends in neighboring countries of Romania and Serbia.

To achieve this, the statistical data from a certain period of time, from official databases such as: Eurostat, World Economic Forum, World Bank, ITU (International Telecommunication Union), The National Authority for Management and Regulation in Communications (ANCOM - Romania), RATEL – Republic Agency for Electronic Communication (Serbia), Statistical Office of the Republic of Serbia, etc. are used. The data were processed and the results were used for describing the present situation in those two countries and to make suggestions and recommendation for future work.

II. THE COLLECTED DATA

In this section, the collected data are presented. The collected data originated from different sources. For the general data, e.g. the data about country economic, geography and population two sources are used. The data retrieved from national institutes and offices of statistics and Eurostat cover computer Internet usage for individuals (households) and companies as well. The data collected from international sources are used to present global impact of ICT on the country competitiveness. The major source for the collection of this data is GITR (Global Information Technology Report) published by the World Economic Forum for 2010-2013 period and Measuring Information Society 2013 published by the ITU.

A. General Data about Serbia and Romania

The general statistical data for Romania and Serbia were retrieved from international sources, mainly Central Intelligence Agency - Fact Book [1,2] and Internet World Stats [3] sites. The data for the same item are presented from the same source. The collected data covers geographical, economic and population statistics.

TABLE I. GENERAL DATA ABOUT ROMANIA AND SERBIA

	Serbia	Romania
Population	7,243,007 (July 2013 est. – WR 98)	21,790,479 (July 2013 est. – WR 56)
Area km ²	77,474 sq km	238,391 sq km
GDP - per capita (PPP)	\$10,600 (2012 est. – WR 114)	\$13,000 (2012 est. – WR 101)
Internet hosts 2012	1.102 million (WR 44)	9.642 million (WR 35)
Internet users	4.107 million (June 2010 – WR 57)** 56.2 % penetration, per ITU	7.787 million (June 2012 - 37)** 44.1% penetration, per ITU.
Facebook users 31-Dec-12	3,377,340**	5,374,980**

Central Intelligence Agency - Fact Book *

Internet World Stats **

Legend:

WR – World Rank

B. National data for Serbia

The statistical data for Serbia are retrieved from annual statistical report of ICT data retrieved from Statistical office of Republic of Serbia and Ratel. The focus on presented data was on computer and Internet usage and

its growth in 6 year period (2007-2012) and also on broadband and Internet users per 100 populations [4-12].

TABLE II. COMPUTER AND INTERNET USAGE GROWTH IN SERBIA 2006-2012

	BU	IU	HC	HI	EC	EI
2006	N/A	N/A	27%	19%	97%	90%
2007	3	17	34%	26%	98%	91%
2008	7	22	41%	33%	98%	92%
2009	9	23	47%	37%	98%	95%
2010	12	32	50%	39%	98%	97%
2011	17	53	52%	41%	98%	97%
2012	19	69	55%	48%	99%	98%

Legend:

BU – Broadband subscribers per 100 inhabitants

IU – Internet subscribers per 100 inhabitants

HC – Households with Computers

HI – Households with Internet Access

EC – Companies with Computers

EI – Companies with Internet Access

Also, the statistics and structure of technologies for Internet access are presented as well (Table III).

TABLE III. THE STRUCTURE OF INTERNET USERS IN SERBIA 2007-2012

	Dial-up	ADSL	Cable	Wireless	Mobile	3G	Rest
2007	692,905	132,359	87,731	36,059	0	257,379	2,276
2008	397,202	267,876	151,154	48,130	25,489	738,401	1,135
2009	252,195	351,252	187,923	45,864	100,628	762,307	5,547
2010	120,670	536,796	260,474	58,305	131,475	1,291,887	7,783
2011	60,694	623,611	285,413	53,754	249,542	2,550,038	5,669
2012	20,440	659,878	331,281	62,013	291,588	3,662,919	10,806

C. National data for Romania

The data for Romania are mainly collected from Eurostat databases, site and publications and from the World Bank. The collected data are presented in Table IV.

TABLE IV. COMPUTER AND INTERNET USAGE GROWTH IN ROMANIA 2006-2012

	BU	IU	HC	HI	EC	EI
2006	5.02	24.66	33%	25%	N/A	N/A
2007	8.87	28.30	38%	28%	N/A	N/A
2008	11.53	32.42	38%	32%	N/A	N/A
2009	12.95	36.60	44%	37%	N/A	N/A
2010	13.87	39.93	46%	40%	96%	79%
2011	15.21	44.02	48%	44%	94%	79%
2012	15.90	50.00	53%	50%	97%	79%

Legend:

BU – Fix Broadband Internet subscribers per 100 people [13]

IU – Internet users per 100 people [13]

HC – Computer Usage (% of individuals) [isoc_ci_cfp_cu] [14]

HI – Internet Usage (% of individuals) [isoc_ci_ifp_iu] [14]

EC – Enterprises with Computers [isoc_ci_in_en2] [14]

EI – Enterprises with Internet Access [isoc_ci_in_en2] [14]

D. Measuring Information Society 2013

One interesting indicator is ICT Development Index (IDI). This is a composite index combining 11 indicators into one benchmark measure. It is used to monitor and compare developments in information and communication technology (ICT) across countries. The IDI was developed by ITU in 2008 and first presented in the 2009. It was established in response to ITU Member States' request to develop an ICT index and publish it regularly. This section briefly describes the main

objectives, conceptual framework and methodology of the IDI [15].

The IDI includes 11 indicators. A detailed definition of each indicator is provided in [15]. The indicators participate in overall indicator with 40, 40 and 20 percent, respectively. Each sub indicator equally participates in its indicator. The indicators are:

ICT access Reference (40% of overall score)

1. Fixed-telephone subscriptions per 100 inhabitants (20% of indicator score)
2. Mobile-cellular telephone subscriptions per 100 inhabitants (20%)
3. International Internet bandwidth (bit/s) per Internet user
4. Percentage of households with a computer (20%)
5. Percentage of households with Internet access (20%)

ICT use Reference (40% in total in overall score)

1. Percentage of individuals using the Internet (33% in indicator score)
2. Fixed (wired)-broadband subscriptions per 100 inhabitants (33%)
3. Wireless-broadband subscriptions per 100 inhabitants (33%)

ICT skills Reference (20% in total score)

1. Adult literacy rate (33% in indicator score)
2. Secondary gross enrolment ratio (33%)
3. Tertiary gross enrolment ratio (33%)

The gross enrolment ratio is the total enrolment in a specific level of education, regardless of age, expressed as a percentage of the eligible official school-age population corresponding to the same level of education in a given school-year.

The IDI index value and Romanian and Serbian rankings are given for 2008, 2010, 2011 and 2012 in Table V [15-18]. In the third column is given European rank with number of indexed countries that year. For all years Serbia and Romania are in the bottom 7 countries in Europe. In the fourth column their ranking in the world is presented as well. Last column is IDI value.

TABLE V. ROMANIAN AND SERBIAN RANKING ACCORDING TO IDI

	County	European Rank	Global Rank	IDI
2008	Romania	32/38	44/159	4.73
	Serbia	35/38	53/159	4.23
2010	Romania	31/38	48/152	5.20
	Serbia	33/38	50/152	5.11
2011	Serbia	31/37	48/155	5.40
	Romania	33/37	52/155	5.13
2012	Romania	32/37	55/157	5.35
	Serbia	33/37	56/157	5.34

E. Global Information Technology Report 2013

The GTR (Global Information Technology Report) series has been published by the World Economic Forum in partnership with INSEAD (Institut Européen d'Administration des Affaires or European Institute of Business Administration) since 2002. The World

Economic Forum (WEF) is a Swiss non-profit foundation, based in Cologne, Geneva. It is an independent international organization working to improve the state of the world by engaging business, political, academic and other leaders of society to shape global, regional and industry agendas according to their own words. The Forum is best known for its annual meeting in Davos. INSEAD is one of the world's largest and most prestigious graduate business schools with campuses in Europe (Fontainebleau, France), Asia (Singapore) and the Middle East (Abu Dhabi). Academic offers include a full-time Master of Business Administration (MBA) programme, a Master of Finance programme, a PhD in management programme, and several executive education programmes (including an executive MBA).

The Report gives review of ICT advances over the last decade as well as raising awareness of the importance of ICT diffusion and usage for long-term competitiveness and societal well-being. The Networked Readiness Index (NRI) identifies the driving factors and impacts of networked readiness and ICT leveraging. The report also highlights the joint responsibility of all social actors — individuals, businesses, and governments [19-24].

The Global Information Technology Report 2013 gives an overview of the current state of ICT readiness in the world. In 2013 report 144 economies is covered, which represents over 98 percent of global GDP. The

Report also gives global rankings for the NRI's 54 indicators. [19]

According to [19] NRI provides decision leaders with a useful conceptual framework to evaluate the impact of information and communications technologies (ICTs) at a global level, and to benchmark the ICT readiness and the usage of their economies. NRI shows the impact of ICT to the competitiveness of nations. The index was originally developed by the Information Technology Group at Harvard University's Center for International Development until 2002.

It is built upon the three components: the environment for ICT offered by a country or community (market, political, regulatory and infrastructure environment), the readiness of the community's key stakeholders (individuals, businesses, and governments) to use ICT and finally the usage of ICT amongst these stakeholders.

NRI consists of 4 sub-indexes and 10 pillars: A. Environment sub-index (1st pillar: Political and regulatory environment, 2nd pillar: Business and innovation environment), B. Readiness sub-index (3rd pillar: Infrastructure and digital content, 4th pillar: Affordability, 5th pillar: Skills), C. Usage sub-index (6th pillar: Individual usage, 7th pillar: Business usage, 8th pillar: Government usage and D. Impact sub-index (9th pillar: Economic impacts, 10th pillar: Social impacts).

The overall and detailed score (by each pillar) for Serbia and Romania are presented in Table VI [19].

TABLE VI. COMPARISON OF ROMANIA AND SERBIA NETWORKED READINESS INDEX ACCORDING TO GITR 2013

	Serbia		Romania	
	Rank out of 144	Score 1-7 (best)	Rank out of 144	Score 1-7 (best)
Networked Readiness Index 2013	87	3.7	75	3.9
Networked Readiness Index 2012 (out of 142)	85	3.6	67	3.9
A. Environment subindex	106	3.5	89	3.7
1st pillar: Political and regulatory environment	115	3.1	106	3.3
2nd pillar: Business and innovation environment	85	4.0	70	4.1
B. Readiness subindex	67	4.7	52	5.0
3rd pillar: Infrastructure and digital content	54	4.4	47	4.6
4th pillar: Affordability	84	4.9	62	5.4
5th pillar: Skills	65	4.9	58	4.9
C. Usage subindex	78	3.5	69	3.7
6th pillar: Individual usage	55	4.0	57	4.0
7th pillar: Business usage	135	2.7	94	3.2
8th pillar: Government usage	104	3.6	96	3.8
D. Impact subindex	98	3.1	97	3.1
9th pillar: Economic impacts	105	2.8	94	2.9
10th pillar: Social impacts	93	3.4	97	3.3
The Networked Readiness Index in detail				
Indicator	Rank /144	Value	Rank /144	Value
1st pillar: Political and regulatory environment				
1.01 Effectiveness of law-making bodies*	92	3.2	127	2.5
1.02 Laws relating to ICTs*	100	3.5	88	3.7
1.03 Judicial independence*	129	2.4	114	2.7
1.04 Efficiency of legal system in settling disputes*	138	2.5	133	2.6
1.05 Efficiency of legal system in challenging regs*	133	2.6	128	2.7
1.06 Intellectual property protection*	116	2.8	114	2.9
1.07 Software piracy rate, % software installed	72	72	58	63
1.08 No. procedures to enforce a contract	56	36	28	32
1.09 No. days to enforce a contract	99	635	69	512
2nd pillar: Business and innovation environment				

2.01 Availability of latest technologies*	127	3.9	117	4.2
2.02 Venture capital availability*	126	1.9	76	2.5
2.03 Total tax rate, % profits	52	34.0	97	44.2
2.04 No. days to start a business	56	12	49	10
2.05 No. procedures to start a business	48	6	48	6
2.06 Intensity of local competition*	137	3.6	102	4.3
2.07 Tertiary education gross enrollment rate, %	51	50.4	40	58.8
2.08 Quality of management schools*	116	3.5	112	3.5
2.09 Gov't procurement of advanced tech*	115	3.1	114	3.1
3rd pillar: Infrastructure and digital content				
3.01 Electricity production, kWh/capita	43	5,111.3	70	2,688.1
3.02 Mobile network coverage, % pop	107	87.4	28	99.9
3.03 Int'l Internet bandwidth, kb/s per user	21	76.8	13	126.1
3.04 Secure Internet servers/million pop	65	28.9	59	53.7
3.05 Accessibility of digital content*	107	4.2	57	5.2
4th pillar: Affordability				
4.01 Mobile cellular tariffs, PPP \$/min.	41	0.18	124	0.57
4.02 Fixed broadband Internet tariffs, PPP \$/month	93	40.16	12	17.16
4.03 Internet & telephony competition, 0–2 (best)	98	1.43	1	2.00
5th pillar: Skills				
5.01 Quality of educational system*	111	3.1	108	3.1
5.02 Quality of math & science education*	60	4.1	55	4.2
5.03 Secondary education gross enrollment rate, %	61	91.5	45	97.2
5.04 Adult literacy rate, %	48	97.9	52	97.7
6th pillar: Individual usage				
6.01 Mobile phone subscriptions/100 pop.	38	125.4	63	109.2
6.02 Individuals using Internet, %	67	42.2	64	44.0
6.03 Households w/ personal computer, %	56	50.9	55	51.2
6.04 Households w/ Internet access, %	57	40.2	51	47.4
6.05 Broadband Internet subscriptions/100 pop.	51	11.3	40	15.2
6.06 Mobile broadband subscriptions/100 pop.	37	34.5	67	14.1
6.07 Use of virtual social networks*	134	4.2	73	5.4
7th pillar: Business usage				
7.01 Firm-level technology absorption*	142	3.6	116	4.1
7.02 Capacity for innovation*	120	2.5	77	3.1
7.03 PCT patents, applications/million pop.	52	2.8	55	1.8
7.04 Business-to-business Internet use*	118	4.2	86	4.7
7.05 Business-to-consumer Internet use*	123	3.5	41	5.0
7.06 Extent of staff training*	138	2.9	111	3.4
8th pillar: Government usage				
8.01 Importance of ICTs to gov't vision*	124	3.1	106	3.4
8.02 Government Online Service Index, 0–1 (best)	48	0.58	61	0.52
8.03 Gov't success in ICT promotion*	125	3.4	107	3.7
9th pillar: Economic impacts				
9.01 Impact of ICTs on new services and products*	130	3.4	105	3.9
9.02 ICT PCT patents, applications/million pop.	47	0.7	48	0.7
9.03 Impact of ICTs on new organizational models*	132	3.0	103	3.6
9.04 Knowledge-intensive jobs, % workforce .	45	28.7	64	21.8
10th pillar: Social impacts				
10.01 Impact of ICTs on access to basic services*	93	3.9	95	3.9
10.02 Internet access in schools*	92	3.6	64	4.3
10.03 ICT use & gov't efficiency*	111	3.6	107	3.6
10.04 E-Participation Index, 0–1 (best)	58	0.24	96	0.08

Indicators followed by an asterisk (*) are measured on a 1-to-7 (best) scale.

Comparing to the European countries, Serbia is worst ranked country and Romania is in bottom five countries in Europe. Between Serbia and Romania are only Moldova, B&H and Albania (Table VII).

In Table VIII the NRI and its changes are presented in 2007-2013 period, as well as the rank of Romania and Serbia for corresponding years.

TABLE VII. BOTTOM FIVE ECONOMIES IN EUROPE IN 2013

World rank	State	Score
75	Romania	3.86
77	Moldova	3.84
78	B&H	3.80
83	Albania	3.75
87	Serbia	3.70

TABLE VIII. NRI OF ROMANIA AND SERBIA IN 2007-2013 PERIOD

Year	No. of Countries	Romanian Index	Romanian Rank	Serbian Index	Serbian Rank
2013	144	3.9	75	3.7	87
2012	142	3.9	67	3.6	85
2011	138	3.8	65	3.5	93
2010	133	3.8	59	3.5	84
2009	134	4.0	58	3.6	84
2008	127	3.9	61	n/a	n/a
2007	122	3.8	55	n/a	n/a

III. DATA ANALYSES

For data analyses, the average NRI score for each of ten pillars are extracted by country. The average score is then calculated for world, Europe and for countries of CEE (Central and East Europe) region. The countries of CEE region are: Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Hungary, Latvia, Lithuania, FYR of Macedonia, Montenegro, Poland, Turkey and Romania and Serbia. Results are presented in Table IX.

TABLE IX. AVERAGE SCORE FOR EACH PILLAR SEPARATELY

Pillar	World	Europe	CEE	Serbia	Romania
1 st	3.86	4.31	3.61	3.10	3.25
2 nd	4.21	4.65	4.38	3.98	4.14
3 rd	4.01	5.43	4.52	4.39	4.62
4 th	4.74	5.46	5.39	4.87	5.36
5 th	4.55	5.34	5.02	4.86	4.95
6 th	3.59	5.04	4.18	4.01	3.97
7 th	3.65	4.12	3.34	2.70	3.24
8 th	4.11	4.41	3.97	3.64	3.76
9 th	3.43	4.06	3.29	2.83	2.92
10 th	3.84	4.41	3.79	3.36	3.31

For better visualization of data, the spider diagram comparing Romania, Serbia and Europe (Fig.1) and comparing Romania, Serbia and CEE region (Fig. 2) are made. The Fig. 1 shows significantly lower score comparing to European average score in pillars 1, 2, 3, 6, 7, 8, 9 and 10 for both Serbia and Romania. Serbia has also lower score in pillar 4.

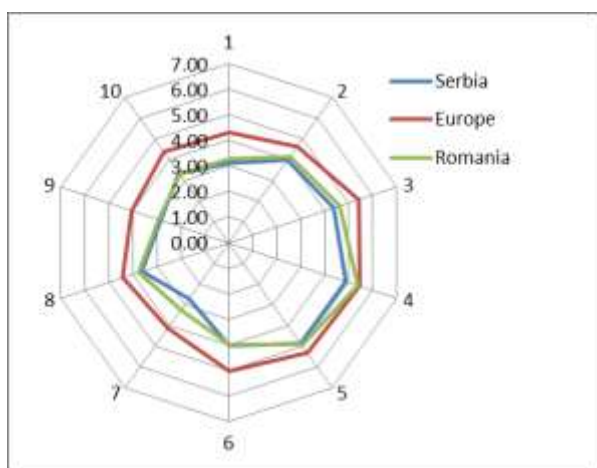


Figure 1. Comparison of Romania and Serbia with European countries

The Fig. 2 shows that Romania is slightly closer to CEE region average. Serbia has significantly lower result only in the case of pillar 7 and slightly lower results in

the case of pillars 2 and 4. Both Serbia and Romania have slightly lower results in the case of pillars 1, 9 and 10.

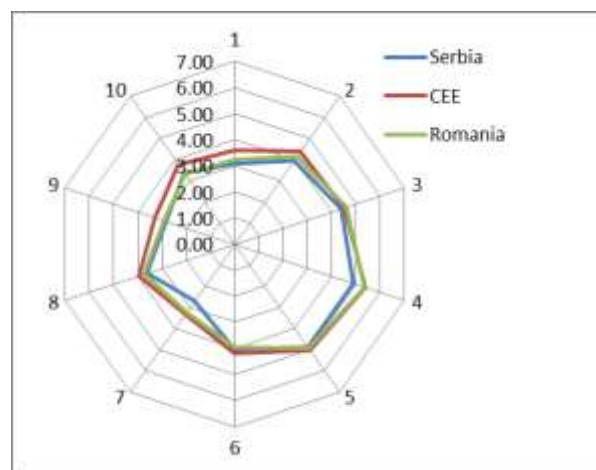


Figure 2. Comparison of Romania and Serbia with CEE region countries

IV. CONCLUSION

The data analyses based on mainly GITR 2013, shows that both Serbia and Romania are among the countries with lowest NRI score in Europe, which indicates that ICT in those countries could have only slight impact to their competitiveness.

The question is what can be done to improve this situation. The solution that is suggested here is in overcoming the gap that exists between Romania and Serbia and countries in closest surroundings – CEE region. To achieve this, the weakest components of the weakest pillars should be improved. E.g. the greatest priority for Serbia is improvement in 7th pillar (Business usage), after that, the priority is to overcome the gaps in 2nd pillar: Business and innovation environment and 4th pillar: Affordability.

Both Serbia and Romania have to work on improvements regarding the 1st pillar: Political and regulatory environment, 9th pillar: Economic impacts and 10th pillar: Social impacts.

By bridging the gap with countries in the region, Romania and Serbia will decrease the gap between countries in Europe and will make the better basis for further improvement. After the analyses of the new GITR data in following years, the strategy can be modified to ensure better places for these two countries in a competitive world.

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Gap Between Service Requestor and Service Builder

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Abstract - Current software development methodology separates roles and responsibilities and defines the roles of the analyst, architect, designer, and developers. Although different roles can be exercised by the same person, the requirement-gathering responsibility is in most cases separated from the development roles. Already signed documents are presented to developers. Even in situations of agile development, requirements gathered in separate process are executed by a different team. A development team can usually choose the story that will be implemented in the next sprint, or iteration, but requirements are already specified. At this point two kinds of issues can occur: unrealistic promises and insufficient details. Unrealistic promises are caused by technology limitations and non-functional requirements such as performance and reliability, and the underestimated complexity of a proposed solution. An insufficient details issue appears in cases when the requirement description does not contain a sufficient level of detail necessary for implementation. These issues can create huge communication overhead and affect project quality, duration, and budget. This paper, besides properly defining the problem, offers solution for these kinds of issues. While the “unrealistic promises” problem can be treated as a team-building issue, the “insufficient details” cure requires specialized tools.

I. INTRODUCTION

The Software Development Method (SDM) divides the process of software development into different phases, and the first phase is called Analysis. Even though Analysis is well known and well described in the available literature, there are different approaches and methods used to accomplish this phase that provide an understanding of the future software product, and specify software product features, characteristics, and properties. Correct and detailed specifications are crucial for the next software development phase that takes care of the architecture and design, immediately followed by the phase when all the specified are coded, tested, and implemented.

Correct and sufficient specification is required when it is used in Iterative and Incremental, Waterfall, Agile, or for any other software development approach.

Modifying requirements later in a project can become very expensive. In the Design Phase modifications could be three to six times more expensive. In the Coding Phase it is up to 10 times more expensive, and in the Development Testing Phase it is 15 to 40 times more expensive. In the Acceptance Phase, it is 30 to 70 times more expensive, and in Operation Phase it could be 40 to 1000 times more expensive. [1]

Another study shows that over a quarter of completed projects contain only 25% to 49% of the originally specified features and functions. [2]

This paper discusses two of the common issues that can occur while creating the software product specifications, problems that can be very expensive for all involved parties, the service requestor and service builder, which are unrealistic promises and insufficient levels of details.

II. RELATED WORK

In the 1950s software developers were already aware that the development of large computer programs was a challenge and suggested various approaches. Herbert D. Benington suggested applying an evolutionary approach when he worked on the SAGE computer program. [3]

In his papers from the 1970, Dr. Winston W. Royce writes about the challenges of designing a large software system: development iterations and the disruptive effect of software requirement changes. [4]

The history of the Waterfall development method started in 1956 when Herbert D. Benington presented his paper “Production of Large Computers Programs”. [3]

In 1970 Dr. Winston W. Royce presented his personal view about managing large software. [4]

While Herbert D. Benington indicates nine different development phases—calling the first phase, where broad requirements are defined, the Operational Plan phase—Dr. Winston W. Royce redefined them into seven software development phases, starting with the System Requirements phase.

These phases mentioned in this article are today known as Waterfall software development method: [4]:

1. System Requirements
2. Software Requirements
3. Analysis
4. Program Design
5. Coding
6. Testing
7. Operation

These seven phases are also known as the Software Development Method (SDM), and most often described as:

1. Analysis

2. Architecture & Design
3. Development
4. Test
5. Deployment & Maintenance

The similarity is obvious and unambiguous. If a software development process following these phases delivers software in one huge release after many months of the hard work, then it is called the Waterfall method. If the final software release is divided into a few releases, then it is called Iterative. If releases are delivered frequently, for example, every few weeks, then it is called Agile.

Even though the differences can seem small, they are significant in cases when requirements are not well known or are changed frequently. Another important difference is that frequent deliveries generate frequent test executions and feedback from clients and testers. Mistakes and failures are discovered earlier.

While the Waterfall method extensively documents and focuses on a thorough up-front design, the Agile approach considers time spent on documenting and detailing up-front design as wasted.

On February 11 – 13, 2001, seventeen remarkable experts for software development methods declared the “Manifesto for Agile Software Development” that describes the four basic Agile software development method principles [5]:

1. Individuals and interactions over processes and tools
2. Working software over comprehensive documentation
3. Customer collaboration over contract negotiation
4. Responding to change over following a plan

The “Principles behind the Agile Manifesto” describes an additional twelve standards behind the “Manifesto for Agile Software Development” [5].

Even though there is little doubt that these seventeen experts have a huge and long experience with software, and significantly contributed to the field of Computer Science and software development, some of their perceptions of the principles and their interpretation can create confusion among the less experienced developers. Some have claimed that the principle “Working software over comprehensive documentation” [5] is understood by Agile development teams as creating no documentation at all, and all questions shall be answered by looking into source code.

Experience shows that the impact of the requirement changes can be very significant to the project’s success. [4]

While most of the Agile manifesto principles make sense in the case of small development teams, when there are large development teams or multi-team projects, some principles cannot be easily implemented or can be directly counter-productive.

Other Agile manifesto principles, such as “Business people and developers must work together daily throughout the project” [5], seem to make a lot of sense and sounds good, but seldom work in the real life projects.

However, today there are iterative, incremental, and agile words everywhere, not only on the lips of software development experts but as a part of the method and process identification or definition.

Steve McConnell [6], in his famous and awarded book, *Code Complete*, points to the importance of proper software project preparation and prerequisites such as planning, requirements, architecture, and design.

Although McConnell advocates the construction phase as most important activity, and the only activity that cannot be avoided during software project development, he promotes iterative and incremental approach, and dedicated the first chapters, such as requirement management, architecture, and design, to software project prerequisites, and stressed an importance of upstream activities.

In the beginning of software development programmers communicated directly with service requestors, but now the advancement of computer technologies in both hardware and software have introduced role and responsibility separation. The Software Development Method (SDM) introduced the required skills and profiles of human resources in each SDM phase. The Analysis phase needed analysts, Architecture & Design required architects and designers, the Development phase uses developers and programmers, and the Test and Deployment phase requires testers and system integrators.

In the beginning most of these roles were recruited from programmers with coding experience; today the difference between an analyst and programmer can be very huge. While an analyst can be someone who does not have real coding experience, a programmer may be one who does not have real business experience. It is assumed that the software development process involves teamwork, and the roles will supplement each other and provide sufficient level of expertise to accomplish all software development project tasks.

III. GAP BETWEEN SERVICE REQUESTOR AND SERVICE BUILDER

Software Development roles, such as Business Analyst, Architect and Designer, Product Manager, Project Manager, DBA, Software Developer and Programmer, Q&A Manager, and Deployment Manager, are considered traditional software development roles.

Traditional software development models separate roles and responsibilities between service requestors and service builders, and introduces a middleman role.

The service requester communicates with the middleman. The middleman communicates with a team of technical professionals and inside that team there are defined roles that will communicate between the middleman and other technical professionals.

What does this mean? This means that a service requestor does not communicate directly to a service builder, but rather communicates through a middleman.

Human language is ambiguous. Different occupations use different terms. Some terms can use the same word, but the meaning can be quite different. The term's meaning depends on the context, and using the same term in another context can create quite different meanings. Communicating through multiple middlemen is the best way to create multiple understandings. [7]

Extreme Programming (XP) defines the different roles that are built around the Developer who is called "the cornerstone" [8]. The other roles defined by Extreme Programming (XP) are the Customer Representative, Tester, Tracker, Coach, Consultant, and Chief. [8]

Extreme Programming tries to close the gap between the service requestor and service provider by introducing the Customer Representative role. The Customer Representative is the person who knows what needs to be programmed. A Customer Representative is a development team member and communicates directly with the Developer who knows how to make programs. However, many who claim that they implement an Extreme Programming development method still have a very traditional Business Analyst role, middleman, who is responsible for communications with the Customer and for writing specifications.

The SCRUM development method defines the Product Owner role, the Developer Team Member role, and the Scrum Master role. [9] The role of SCRUM Product Owner has responsibilities and duties that are easy to map to the traditional Business Analyst or Product Manager role. [10]

The Feature Driven Development is a model-driven Agile method that promotes planning and documenting, and is built around the Chief Programmer role. [11]

The Chief programmer role [12] replaces the traditional Business Analyst and Product Manager roles, as well as the SCRUM Product Owner role, and tries to close the gap between the service requestor and the service builder.

IV. UNREALISTIC PROMISES

Communicating with a Customer is not an easy job, and choosing an Analyst is not an easy task either. In most cases the Analyst is recruited from the sales or marketing department. The Analyst should understand what the Customer needs and provide specifications for the development team. [10]

The Business Analyst from the sales and marketing department very often has obscured or outdated technical competence and promises solutions that can badly affect the development and future of the software product. The following categories can provoke such promises:

- Technical platform
- Legal issues
- Third-party software

- Interfaces and protocols
- Bonuses

A. Technical platform

The technical platform should not be underestimated and the development team's productivity can directly depend on the technical platform. For example, developing on Windows or UNIX platform, or using C/C++ and the C# or Java, can affect the efficiency of the development team. If an Analyst has only experienced program development on a Windows platform, there could be a problem estimating work effort and dates of completion, and what needs to be done if the development target platform is an UNIX or MVS platform.

B. Legal issues

Multinational companies such as IBM, Microsoft, or Oracle deploy their own resources across country borders. In this outsourcing era it is quite normal to use cheap developer resources from India. The Customers often require the use of cheap labor from outsourcing countries to reduce the overall development costs. In some countries, however, such resources cannot work with certain projects. For example, in England, in the event of military projects, it is forbidden to utilize developers who do not have British citizenship, even if they are from West European countries that are members of the NATO alliance.

Another example of when legal issues can significantly affect development is the "laws about collecting and protecting personal data", such as medical records or Social Security Numbers, called Det Centrale Personregister (CPR) in Denmark, or any other personal information. The European Union has a common law regarding this information, and each country can have their own regulations. It is a very common mistake to overlook that some kinds of data are protected by law; for example, a citizen who reports a crime, or calls an emergency center and informs the receiver about an illness or handicap. If this information is stored in local databases, the implementation of all mandatory levels of data protection can take an enormous amount of time, cause very unpleasant surprises for some analysts, and badly affect a company's reputation in cases of security breaches or data-leaking. Such laws can have a dozens or even hundreds of pages to read through for all situations.

C. Third-party software

The third-party software problem can create a lot of issues, especially when it is expected that the next release will provide the required functionality. Even in a best case scenario, when such functionality is implemented, compatibility issues can occur and affect the technical platform. Implementation technologies are subject to continuous changes, and new versions are based on emerging technologies. Even when the new solution can be a significant improvement, it can create a lot of issues. Some can be so unpleasant that implementation requires an upgrade of the operating system. An example of this would be Internet Explorer 11, where the development of software for Windows Phone requires the Windows 8 operating system. Another example would be the upgrade

of the SUN Storage System that requires also upgrading the new version of SUN Solaris OS.

D. Interfaces and protocols

It is very easy to promise everything to the clients, and take all responsibility for the development of interfaces to remote databases, assuming that remote access is implemented by using standard services or standard queuing technologies. It can be an unpleasant surprise when it is discovered that such interfaces are implemented using EdgeFrontier, Hexagon middleware, or Oracle Advanced Queuing. Regardless of whether it uses a standard IBM MQ interface, it can become an issue to get in touch with an experienced developer who is able to accomplish the necessary tasks.

E. Bonuses

In the sales department, bonuses can be huge motivators for making unrealistic promises. Besides a significant amount of money, there are also the seller's reputation and future promotions in question. All these and many other personal reasons are strong motivating factors that can lead to the acceptance of difficult tasks and conditions. Personal motivation should not be underestimated. Although the final contract can look bright and promising the allocation of a sufficient number of hours for proper software product maintenance can be forgotten or accidentally accepting unfavorable service contract conditions. This can be very expensive for a software development company should the service contract specify, for example, that each critical or severe defect has to be corrected within six hours, or system availability has to be at 98.5%. If the contract does not allocate a sufficient number of maintenance hours, it is impossible to allocate sufficient resources. If there is not one application, but ten or twelve different applications, all dependent on the three or four mutually dependent applications, then a software company can be in real trouble. If one of these critical applications is down, the whole system is down. A huge fine has to be paid, and costs usually increase exponentially after each hour, four hours, day, etc.

V. INSUFFICIENT DETAILS LEVEL

The problem of insufficient detail appears when specifications do not contain a sufficient level of details. Implementation cannot be completed without further communication to the service requester.

At this point, communication between the clients and the IT company can often be accomplished without middleman participation. After a few exchanged emails, the middleman quickly decides to delegate responsibility to the developer and asks the developer to address questions directly to the client.

This kind of communication can create confusion and can lead to implementation of requirements that are different from original specifications, with no one aware that this actually happened. Communication between the client and developer is accomplished through development and test cycles. The Client provides answers and the developer provides implementation and the working code.

As soon as the client sees the implementation, the client may have new ideas about what he wants and adapt further explanations to changed ideas. The middleman can read emails and notes, but even in less complex projects skimming, answering, and commenting on notes takes too much time. The client takes over the active role which is actually a positive effect, but the project inevitable departs from the originally specified requirements.

Because of this, the initial project estimations related to time, budget, and resources are affected without anyone on-board knowing what the real cause is from. The client's feedback and satisfaction is important for the developer, and the developer is happy to satisfy the client especially when the requirement changes do not demand complex technical solutions and can be implemented without too much trouble. However, regardless how simple the implemented solutions can be, it takes time and resources not allotted to these specifications, and this affects overall project duration.

Another very unpleasant consequence of altering specifications is changes are often undocumented, and a single point of contact quickly disappears. This happens even with small project teams when the client is communicating directly to more than one developer. Although this, from a client's point of view, can be considered temporarily as a positive effect, the project delay is probably not positive for any of involved sides. A project delay means a longer time to market, increased expenses, and unforeseen changes; for example, changed law regulations, financial crises, or other catastrophes. Each disaster, big or small, can affect the project, make the target market less attractive, or render the project completely useless.

On the other hand, a sufficient level of details necessary to successfully complete a project is also not easy to specify. The human brain is adapted to the big picture and missing details are most often discovered during implementation.

Prototyping is one method used for requirement clarification. In the case of traditional prototyping, the project first requires elicitation of the subset of the critical requirements and careful planning. Such projects can typically last anywhere from a month to three months. Within the prototype, the user requirements are translated to the computer language. Developing an executable version is the best way to discover insufficient details. However, this approach can also be most expensive.

The Agile approach is adapted from the evolutionary prototyping, and the differences between prototyping and Agile approach are today blurred. [7] The advantage of Agile, is its quick response. The Agile method does not wait and development starts as soon as it seems there are a sufficient number of details. Short two-week iterations are enough to quickly discover insufficient details and misunderstandings.

The Test Driven Development (TDD), also often called Test Driven Design, can be used as a fast version of prototyping. [13] The advantage of using TDD is the test-first approach where the test is created before implementation. In this case, the missing functionality is

replaced by empty objects and methods. Despite the fact that TDD uses empty implementation methods it is possible to create a reliable test case that can challenge the developer and quickly uncover what level of information detail is required in advanced model. The TDD has its own limitations and in practice uses a mostly hybrid approach where requirement gathering and design are done upfront. [14]

Although most projects still use a Word processor, spreadsheet, or dedicated mailbox, these are not effective tools for tracking a history of changes, or discovering conflicts and insufficient details. The available tools are not effective and searching and creating reports can be a challenge. For this purpose it is necessary to use specialized tools that store documentation in a database format. Such tools use all the advantages of database data management, as well as a dynamic creation of the complex reports. The changes are stored in one place, and enable easy access to comments and change log. Interactive tools, such as an interactive SQL, provide an environment where it is possible to create complex reports on the fly.

Such tools include the HP Quality Centre, IBM Rational Requisite Pro, or Borland Caliber. The disadvantages of using tools like these are mostly related to the high license prices, which can badly affect the budgets of small or even middle-sized projects, and prevent use among the small Agile development teams.

VI. CONCLUSION

While the human brain can deal with unrealistic promises and this issue can be handled by wise formulation and contractual clauses or previous experience, insufficient levels of details are a difficult task for the human brain. The human brain is adapted to seeing the “big picture”. In the big picture everything makes sense and has an undisturbed flow! Missing parts are not easy to spot, and it is assumed that everything will work fine. The details are most often left to the development and implementation phase.

When insufficient levels of detail in the development phase or the test are discovered implementation costs can be 10 to 40 times more expensive, and if discovered in the Operation Phase, costs can be 1000 more expensive. [1]

Communication overhead can be huge and human resources that were involved in the creation of initial specifications are no longer available or simply disappear. Replacing key people is a well-known strategy to redo negotiations and to blame those who are not more available and reachable.

The Service requestors can use any opportunity to change the original specifications and will probably want to redo all negotiations as consequences of IKIWISI (“I’ll know it when I see it”) syndrome. [15]

This issue can be solved by using prototyping, and creating demo versions to clarify requirements. Prototyping can be expensive and last too long, and still clarifies only a part of the requirements that are assumed to be critical.

A solution offered by the Agile development approach is a prompt start of development and implementation when only some requirements, or even just a part of a requirement, is assumed to be well known.

However, the Agile approach has its own limitations, and is most often criticized for a lack of documentation and design, high risk of scope creep, and the impossibility to estimate project size because it is not possible to see all requirements. Even when the project iteration starts quickly communication overhead related to the insufficient details level or conflicts can appear after next requirement is specified, can be huge, and still badly affect a project’s overall expenses and duration.

VII. FURTHER WORK

The future work shall identify other issues that can occur during system specification and propose how these issues can be avoided or mitigated.

In the system specification phase most of issues are related to the language ambiguity. Language ambiguity is not easy to spot in the big picture. It becomes visible first when development and testing starts.

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Analysis of Serbian Malware Statistics

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Abstract—The contents of this paper derives from the Kaspersky Security Bulletin 2012 and is based on data obtained and processed using the Kaspersky Security Network. It includes malicious programs on the Internet (attacks via the web): vulnerable applications targeted by malicious users, identification of the most active malicious programs involved in web attacks on the users' computers and statistical analysis of countries where web resources are seeded with malware. This paper is especially oriented towards data relating to Serbia. The analysis of local threats is also included, by forming a list of the most widespread local threats. The risk of online infection, which is the main source of malicious objects for users in most countries of the world, is of the greatest interest.

I. INTRODUCTION

Malware, short for "malicious software," refers to software programs designed to damage or perform other unwanted actions on a computer system. Malware is a general term used to refer to a variety of forms of hostile or intrusive software [1]. Common examples of malware include viruses, worms, trojan horses and spyware. A virus or worm is a computer program that can spread across computers and networks by making copies of itself, usually without the user's knowledge. Trojan horses are programs that pretend to be legitimate software, but actually carry out hidden, harmful functions. Worms are similar to viruses but do not need a carrier program or document.

Software such as anti-virus, anti-malware, and firewalls are relied upon by users at home, small and large organizations to safeguard against malware attacks which helps in identifying and preventing the further spread of malware in the network [2]. In order to prevent the intrusion of malicious software in a computer system, different methods are used. An intrusion detection system (IDS) generally detects unwanted manipulations to systems. The manipulations may take the form of attacks by skilled malicious hackers or using automated tools. An IDS is required to detect all types of malicious network traffic and computer usage that cannot be detected by a conventional firewall. Though they both relate to network security, an IDS differs from a firewall in that a firewall looks outwardly for intrusions in order to stop them from happening. Firewalls limit the access between networks to prevent intrusion and do not signal an attack from inside the network. An IDS evaluates a suspected intrusion once it has taken place and signals an alarm.

Malware creators started off writing viruses in the early 1980s. Until the late 1990s most of the viruses were just pranks made up in order to annoy users and to see how far a virus could spread. The writers were often young programmers, who did not always understand the vast consequences of their actions. In the late 1990s and early 2000s, virus writers and hackers began to put their talents to more professional and sometimes criminal use. The internet had become everyone's tool for information and businesses and banks were beginning to use it for commerce and transactions. As practical as online shopping and banking may be, they also opened a world of opportunities for economic exploitation of both corporations and the ordinary computer user. Today many experts believe that the amount of malicious software being released on the web might actually surpass the release of valid software.

II. MALICIOUS PROGRAMS ON THE INTERNET IN 2012

The data presented in this paper derive from the Kaspersky Security Bulletin 2012 [3] and are based on values obtained and processed using the Kaspersky Security Network (KSN).

The number of browser-based attacks in 2012 increased from 946 000 000 to 1 596 000 000 (69%).

Web-based attacks have increased at a similar rate in previous years. The number of attempted web-based infections in 2012 is 1.7 times greater than in 2011, while the number in 2011 was 1.6 times greater than in 2010. The main tool behind the browser-based infections is still the exploit pack, which gives cybercriminals a chance of infecting target computers that do not have a security product installed, or have at least one popular application that is vulnerable (lacking security updates).

The average global Internet threat level has grown over the last two years in a row and reached 34.7% in 2012 – 2.4% more than in 2011. Worldwide, one in three Internet users has been a target of a computer attack at least once during the year.

Vulnerable applications targeted by malicious users - While 2011 was the year of vulnerability, 2012 can justifiably be described as the year of the Java vulnerability, with half of all detected exploit-based attacks targeting vulnerabilities in Oracle Java.

Today, Java is installed on more than 3 billion devices running under various operating systems. Therefore, cross-platform exploits can be created for certain Java

vulnerabilities. During the year, both broad-scale attacks using exploit kits, and targeted attacks using Java exploits were detected that targeted both PCs and Mac computers.

III. STATISTICS OF THREATS IN SERBIA

Statistics of threats in Serbia refer to the time period of one month (5 July – 2 August 2013) and originate from Securelist [4].

Country ratings – global and regional ratings based on the probability of threats being detected in a country over a specific period.

Local infections:

Local infection statistics for user computers are indicators of critically important (indicator). These data points to threats that have penetrated a computer system through something other than the Internet, email, or network ports.

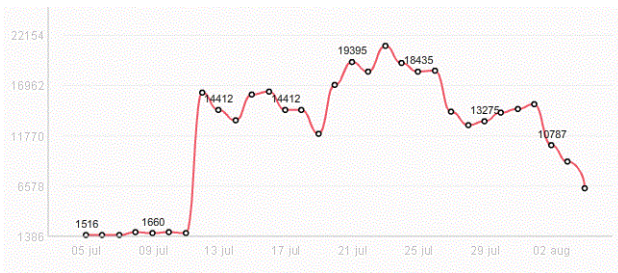


Figure 1. Local infections in the period of (5 July – 2 August 2013)

TABLE I Top local infections in the period of (5 July – 2 August 2013)

1. DangerousObject.Multi.Generic	18.3%
2. Trojan.Win32.AutoRun.gen	14.9%
3. Trojan.Win32.Generic	11.6%
4. Worm.Win32.Debris.a	7.1%
5. Virus.Win32.Sality.gen	5.0%
6. Net-Worm.Win32.Kido.ir	4.4%
7. Trojan-Dropper.Win32.Agent.hvnl	4.1%
8. HackTool.Win32.KeyFinder.i	2.8%
9. Virus.Win32.Generic	2.4%
10. Net-Worm.Win32.Kido.ih	1.8%

The country rating of Serbia and neighbouring countries in this category in July 2013 is (with the level of protection being higher, the percentage being lower): Serbia (10%), Romania (10%), Hungary (8%), Croatia (7%), Bosnia and Herzegovina (11%), Montenegro (10%), Albania (19%) and Bulgaria (10%). For example, corresponding values for other countries are: USA (6%), Russia (11%), Slovenia (5%), Switzerland (6%).

Online threats:

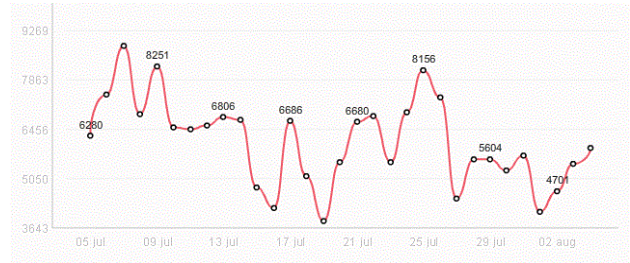


Figure 2. Online threats in the in the period of (5 July – 2 August 2013)

TABLE II Top online threats in the period of (5 July – 2 August 2013)

1. Trojan.Script.Iframer	35.4%
2. Trojan.Script.Generic	22.8%
3. Packed.Multi.MultiPacked.gen	15.6%
4. Trojan.JS.Iframe.aeq	3.1%
5. Backdoor.Win32.Clack.qlv	2.6%
6. Exploit.Script.Blocker	1.7%
7. Trojan.Win32.Generic	1.7%
8. Trojan-Downloader.Script.Generic	1.6%
9. Exploit.Script.Blocker.u	1.3%
10. Trojan-Downloader.JS.Iframe.dal	1.1%

The country rating of Serbia and neighbouring countries in this category in July 2013 is: Serbia (16%), Romania (22%), Hungary (17%), Croatia (20%), Bosnia and Herzegovina (16%), Montenegro (16%), Albania (15%) and Bulgaria (15%). For example, corresponding values for other countries are: USA (18%), Russia (43%), Slovenia (14%), Switzerland (19%).

Network attacks:

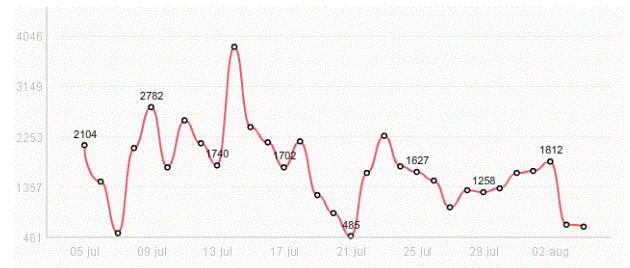


Figure 3. Network attacks in in the period of (5 July – 2 August 2013)

TABLE III Top network attacks in the period of (5 July – 2 August 2013)

1. Intrusion.Win.NETAPI.buffer-ov...	47.1%
2. DoS.Generic.SYNFlood	32.5%
3. Intrusion.Win.MSSQL.worm.Hel...	8.8%
4. Scan.Generic.UDP	2.5%
5. Scan.Generic.TCP	0.4%
6. Intrusion.Win.DCOM.exploit	0.1%
7. Intrusion.Win.HTTPD.GET.buff...	0.0%
8. DoS.Generic.ICMPFlood	0.0%
9. Intrusion.Generic.Banned.IP.j	0.0%
10. DoS.Generic.PingOfDeath	0.0%

The country rating of Serbia and neighbouring countries in this category in July 2013 is: Serbia (3%), Romania (5%), Hungary (4%), Croatia (2%), Bosnia and Herzegovina (3%), Montenegro (3%), Albania (2%) and Bulgaria (4%).

For example, corresponding values for other countries are: USA (1%), Russia (8%), Slovenia (3%), Switzerland (2%).

Vulnerabilities:

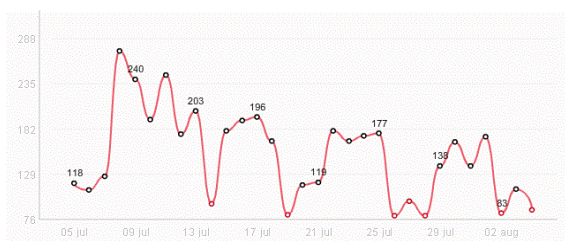


Figure 4. Vulnerabilities in the period of (5 July – 2 August 2013)

TABLE Top vulnerabilities in the period of (5 July – 2 August 2013)

1. Exploit.Script.Blocker	30.8%
2. Exploit.Script.Blocker.u	22.6%
3. Exploit.Java.Generic	5.8%
4. Exploit.Linux.Lotoor.p	5.3%
5. Exploit.HTML.Iframe.FileDownl...	4.2%
6. Exploit.Script.Generic	3.7%
7. Exploit.Win32.CVE-2011-3402.a	3.7%
8. Exploit.JS.Pdfka.auq	2.4%
9. Exploit.SWF.Agent.hm	1.8%
10. Exploit.Linux.Lotoor.ay	1.6%

The country rating of Serbia and neighbouring countries in this category in July 2013 is: Serbia (2%), Romania (3%), Hungary (2%), Croatia (2%), Bosnia and

Herzegovina (2%), Montenegro (2%), Albania (3%) and Bulgaria (3%). For example, corresponding values for other countries are: USA (3%), Russia (3%), Slovenia (3%), Switzerland (3%).

Finally, another revealing fact concerning the state of information security in Serbia. During Q1 2011, the lowest percentage of users' computers attacked while surfing the net were located in Japan, Germany, Serbia, the Czech Republic and Luxembourg [5].

IV. CONCLUSIONS

Having in mind the presented statistical data, it can be concluded that the current state of security against malicious computer programs in Serbia does not differ from that of most neighbouring countries. This fact should not be taken as a justification for the continuation of the current intensity of activities in IT protection, especially if the compared with countries where the level of information security is at a higher level.

It must be noted that the presented data should be taken with a certain reserve, since they derive from a single source.

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Tools for WLAN IEEE 802.11 security assessment

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Abstract - Despite the fact of its long presence in the market, the importance of the Wireless LAN IEEE 802.11 security issues grows together with the number of users of this technology. In the last few years this technology had a rapid expansion, bringing higher data rates, lower prices and a larger number of supported devices.

Considering the importance of this topic, this paper will analyze the efficiency of various tools for wireless network security assessment, together with the method of their usage. The most popular software tools will be presented with their important features and characteristics, as well as their specific format for storing and presenting data. At the end, methods for collected data analyses will be presented as well.

Keywords: IEEE 802.11 security, security assessment, wardriving

I. INTRODUCTION

Security of wireless networks IEEE 802.11 and its assessment don't lose its significance over the time. This phenomenon is the subject of constant research through the process known as a wardriving. Wardriving is the term originated from 1983 movie "War games" where hacker David Lightman, Matthew Broderick's character, used term Wardialing for the process of dialing a number of phones by the modem in order to locate computers connected on the other side and to achieve unauthorized access to computer networks. Wardriving uses similar method with the other technology, in this particular case – wireless technology [1, 2].

Wardriving also is a term for a process of scanning wireless networks in the moving vehicle. Beside this term, the other terms such as warcyling and warhicking are used in the situations when the cycling or walking is the method of moving during the network scan. Apparently, there is also a secret graphical language or walchalking, represented by the set of symbols drowned with chalk on the walls or on the asphalt in order to mark the places where the access to the open networks is possible. There are different symbols for networks with different characteristics. [3].

This activity gained popularity after the research of Peter Shipley, computer security consultant from Berkley University, California. During the fall of 2000, Shipley conducted an 18-month survey of wireless networks in Berkeley, California and reported his results at the annual DefCon hacker conference in July 2001 [15]. Wardriving

is a process for discovering access points allowing access to the wireless networks. This process allows data acquisition about wireless network security and its assessment. The collected data can help in recognizing the main problems connected with this topic as well as to help in wireless network market analyses.

The participants in these activities can be:

- Hobbyists,
- IT professionals,
- Malicious attackers.

Wardriving is very popular in the world. It starts to spread about 10 years ago. In 2002, the first worldwide event called WWD (WorldWide WarDrive) was held. In this event 9.734 access points were discovered and participants were from 6 countries and 2 continents all over the world. Next, WWWD2 event was held in September in the same year, when 24.958 access points were discovered. During the WWWD3 in 2003, 88.122 access points were discovered, and in WWWD4 in 2004, the number was 228.537 access points.

Today, in the world, there are a number of sites where wardrivers can find and send data about wireless networks collected with wardriving. The most famous sites are Wiglenet [5] and Wardriving-forum [6].

Despite the fact, that this activity is not new, it has its popularity all over the world [7-14]. The reason lays in rapid growth of wireless users. The wireless networks are used more and more in the business, but also in the home environments. Also, the cost of wireless equipment is rapidly decreasing, mobile phones support Wi-Fi technology and all of this affects the significance and popularity of Wardriving. The enormous growth of broadband Internet users, with expansion of cable and ADSL Internet connections, appearance of more types of wireless equipment such as printers, network access storage, also helps in growth of this phenomenon. The rapidly increased number of wireless technology users made gap in the wireless user security awareness. Users are not trained to protect their networks and equipment. Also, they are not prepared for the necessary hardware and software upgrades. All this, leaves a lot of space for potential malicious attackers.

In this paper various tools for wardriving will be presented. These tools are: Kismet for Linux, InSSIDer and Vistumbler for Windows and Wigle, G-Mon and

Wardrive for Android platform. The structure of collected data will be analyzed, as well as the way of its processing and usage. At the end, the results will be presented as well.

In this paper the data about wireless networks are obtained by passive scanning with usage of listed tools. This passive scanning is not a criminal act according to the criminal laws of Germany and Serbia. Some publicly accessible parameters that might endanger someone privacy such as SSID, MAC address and related encryption are not presented in this work, except the data from personal networks of authors. During the research and scanning of networks unauthorized access is not committed to any network.

Currently, it is not a criminal offense in Germany to detect wireless networks and add them to a map. However, the frequent and slow drive through streets violates against §30 Abs. 1 Straßenverkehrsordnung (Road Traffic Law). In addition, the use of cell phones, smartphones, and computers while driving is prohibited in §23 Abs. 1a Straßenverkehrsordnung. The legal basis for the use of open wireless networks is not yet fully understood. The Wuppertal Regional Court ruled in 2010 that the use of open wireless networks is not punishable. It was also decided that the owner of a wireless networks must protect its network with a password. Otherwise, he must be liable for all crimes which have been made on this network [19].

In Serbia, according to the criminal law (Article 302) it is forbidden to access network as an unauthorized person or by violating or bypassing security settings of the system and its protection. The passive scanning of the wireless systems is not an illegal activity [4].

II. TOOLS FOR WARDRIVING

The most famous software for Wardriving is Netstumbler (last stable release 0.4.0 from April 21, 2004). The typical usage of wardriving software is with a computer (desktop or more typical laptop) with integrated or external wireless card, with or without GPS. Instead of computer, a mobile phone can be used as well.

Today, the following tools are most popular and most widely used in the world for Wardriving process: Kismet, InSSIDer, Vistumbler, G-Mon, Wigle and Wardrive. In the following section, the data about enlisted software will be presented, as well as the form of collected data.

A. Kismet

Kismet is a free 802.11 wireless network detector, sniffer, and intrusion detection system. Kismet will work with any wireless card which supports raw monitoring mode, and can sniff 802.11b, 802.11a, 802.11g, and 802.11n traffic. The program runs under Linux, FreeBSD, NetBSD, OpenBSD, and Mac OS X.

Kismet also supports a plug-in architecture allowing for additional non-802.11 protocols to be decoded. Kismet identifies networks by passively collecting packets and detecting networks, which allows expose the names of hidden networks and the presence of non-

beaconing networks via data traffic. It can be downloaded from <http://www.kismetwireless.net/download.shtml>.

Kismet is capable to log data in variety of formats. The Logging-settings are in the kismet configuration file "kismet.conf", located in the /var/log/kismet directory. The possible file formats of Kismet are: raw packet dump that can be opened in Wireshark or other packet analyzers (.pcapdump), text file (.nettxt), CSV, XML formatted log (.netxml), weak Initialization Vector (IV) packets log in AirSnort format, log with Cisco Discovery Protocol (CDP) broadcasts and the log with GPS coordinates (.gpsxml).

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<!DOCTYPE      detection-run      SYSTEM
"http://kismetwireless.net/kismet-3.1.0.dtd">

<detection-run      kismet-version="2011.03.R2"
start-time="Thu May 16 13:42:01 2013">

<card-source      uuid="69340fd2-be2e-11e2-99cc-
1004761ce301">
  <card-source>wlan1:</card-source>
  <card-name>wlan1</card-name>
  <card-interface>wlan1mon</card-interface>
  <card-type>mac80211</card-type>
  <card-packets>31982</card-packets>
  <card-hop>>true</card-hop>
  <card-
channels>1,5,9,13,2,6,10,3,7,11,4,8,12</card-
channels>
</card-source>
<card-source      uuid="74a070d6-be2e-11e2-99cc-
0f04751ce201">
  <card-source>wlan0:</card-source>
  <card-name>wlan0</card-name>
  <card-interface>wlan0mon</card-interface>
  <card-type>mac80211</card-type>
  <card-packets>137660</card-packets>
  <card-hop>>true</card-hop>
  <card-
channels>1,5,9,13,2,6,10,3,7,11,4,8,12</card-
channels>
</card-source>
  <wireless-network      number="1"      type="ad-hoc"
first-time="Thu May 16 13:53:14 2013" last-
time="Thu May 16 13:53:35 2013">
    <SSID      first-time="Thu May 16 13:53:14
2013" last-time="Thu May 16 13:53:35 2013">
      <type>Beacon</type>
      <max-rate>11.000000</max-rate>
      <packets>4</packets>
      <beaconrate>10</beaconrate>
      <encryption>None</encryption>
      <ssid
cloaked="false">HP78B48C</ssid>
    </SSID>
    <BSSID>00:00:00:00:00:00</BSSID>
    <manuf>Unknown</manuf>
    <channel>10</channel>
    <freqmhz>2457 4</freqmhz>
    <maxseenrate>12000</maxseenrate>
    <carrier>IEEE 802.11b+</carrier>
    <encoding>CCK</encoding>
    <packets>
      <LLC>4</LLC>
      <data>0</data>
      <crypt>0</crypt>
      <total>4</total>
      <fragments>0</fragments>
      <retries>0</retries>
    </packets>
```



```

<datasize>0</datasize>
<snr-info>
  <last_signal_dbm>-84</last_signal_dbm>
  <last_noise_dbm>0</last_noise_dbm>
  <last_signal_rssi>0</last_signal_rssi>
  <last_noise_rssi>0</last_noise_rssi>
  <min_signal_dbm>-88</min_signal_dbm>
  <min_noise_dbm>0</min_noise_dbm>
  <min_signal_rssi>1024</min_signal_rssi>
  <min_noise_rssi>1024</min_noise_rssi>
  <max_signal_dbm>-79</max_signal_dbm>
  <max_noise_dbm>-256</max_noise_dbm>
  <max_signal_rssi>0</max_signal_rssi>
  <max_noise_rssi>0</max_noise_rssi>
</snr-info>
<bstimestamp>171468493558</bstimestamp>
<cdp-device></cdp-device>
<cdp-portid></cdp-portid>
<seen-card>
<seen-uuid>74a070d6-be2e-11e2-99cc-
0f04751ce201</seen-uuid>
  <seen-time>Thu    May    16    13:53:35
2013</seen-time>
  <seen-packets>4</seen-packets>
</seen-card>
...
</wireless-network>

```

Listing 1. The segment of Kismet netxml file format

During this research in Serbia Kismet is used with Kali Linux operating system and TP-Link TL-WN722N external USB adapter without GPS device. One of the most important data about discovered network is recorded in the encryption tag (Listing 1).

B. InSSIDer

InSSIDer is a free Wi-Fi network scanner software for Microsoft Windows, Apple OS X and Android developed by MetaGeek, LLC. The newest version InSSIDer 3 or InSSIDer Home is built for Win 7 and Win 8. The older version is InSSIDer 2 capable to run on Win XP and netbooks. As a main difference comparing to InSSIDer 3, version 2 allows saving and logging of scanned data. By default InSSIDer saves data to GPX file. GPX (GPS eXchange Format) is an XML schema designed as a common GPS data format for software applications. It can be used to describe waypoints, tracks, and routes. The format is open and can be used without the need to pay license fees.

```

<?xml version="1.0" encoding="utf-8"?>
<gpx>
  <wpt lat="45.384462" lon="20.377827">
    <ele>117.2</ele>
    <time>2013-05-12T20:06:6.0Z</time>
    <geoidheight>0</geoidheight>
    <name>Drache [00:1D:0F:A7:46:3F]</name>
    <cmt>2.426117904</cmt>
    <desc>Drache
[00:1D:0F:A7:46:3F]
RSSI: -19 dB
Quality: 100%
Channel 6
Speed (kph): 2.426117904
2013-05-12T20:06:6.0Z</desc>
    <fix></fix>
    <sat>3</sat>
    <hdop>24.4</hdop>
    <vdop>3.2</vdop>
    <pdop>24.7</pdop>
    <extensions>
      <MAC>00:1D:0F:A7:46:3F</MAC>
      <SSID>Drache</SSID>
      <RSSI>-19</RSSI>

```

```

<ChannelID>6</ChannelID>
<security>WEP</security>
<signalQuality>100</signalQuality>
<networkType>Infrastructure</networkType>

<rates>1/2/5.5/6/9/11/12/18/24/36/48/54</rates>
  </extensions>
</wpt>
</gpx>

```

Listing 2 The segment of InSSIDer gpx file format

In Serbia during this research the InSSIDer 2.1.6.1395 is used. This software is used on netbook with Windows 7 operating system, external USB wireless adapter TP-Link TL-WN722N with external 8dBi antenna and GPS external USB device Globalsat BU-232F. Usage of USB device allows logging data with GPS info which further enables conversion of GPX to KML files and presentation of collected data in Google Earth.

The InSSIDer 2 allows also export of data in NS1 (Netstumbler format).

C. Vistumbler

Vistumbler [17] is an open-source (GPLv2 License) software for scanning wireless networks written in AutoIt (Scripting Language). It supports Windows Vista and Windows 7 with GPS Support. It supports export/import of data from Vistumbler TXT/VS1/VSZ or Netstumbler TXT/Text NS1 formats. Also, it exports access point GPS locations to a Google Earth KML file or GPX file.

Vistumbler has a supporting website named Vistumbler WiFi DB with uploaded data. This site has 244.052 scanned wireless networks up to August 23 2013 with 326 supported users.

D. G-Mon

G-MoN is an Android application widely used for scanning wireless networks. It supports variety of actions from checking the signal level and security of a Wi-Fi network to complete statistics and analyses in a 2G/3G/4G networks. The screen of application is presented in Figure 1 [20].



Figure 1 Tool G-Mon on Android

E. Wigle

WiGLE, (Wireless Geographic Logging Engine), is a website for collecting information about wireless networks around the world. Its goal is to keep an awareness of the need for security of wireless networks [18]. It has data about 108,716,150 networks with September 8th 2013, and its first collected data dates back in September 2001, twelve years ago. Until this day this site has 141,267 registered users.

The site has Wigle Wifi supporting software for Android platform and for scanning wireless network. There is also JiGLE Java Client cross-platform version for running on Linux, Mac OS X, Solaris, OpenBSD, and Windows platform. There are also DiGLE (Windows native client) and TinGLE (Mac OS X client).

```
<?xml version="1.0" encoding="UTF-8"?>
<kml
xmlns="http://www.opengis.net/kml/2.2"><Document><S
tyle
id="red"><IconStyle><Icon><href>http://maps.google.
com/mapfiles/ms/icons/red-
dot.png</href></Icon></IconStyle></Style><Style
id="yellow"><IconStyle><Icon><href>http://maps.goog
le.com/mapfiles/ms/icons/yellow-
dot.png</href></Icon></IconStyle></Style><Style
id="green"><IconStyle><Icon><href>http://maps.googl
e.com/mapfiles/ms/icons/green-
dot.png</href></Icon></IconStyle></Style><Folder><n
ame>Wifi Networks</name>
<Placemark>
<name><![CDATA[POZNIM]]></name>
<description>
<![CDATA[BSSID: <b>94:0c:6d:a3:13:bc</b>
<br/>Capabilities:
<b>[WPA-PSK-TKIP][WPA2-PSK-TKIP][ESS]</b>
<br/>Frequency:
<b>2447</b>
<br/>Timestamp:
<b>137787496000</b>
<br/>Date:
<b>2013-08-30 17:02:40</b>]]>
</description>
<styleUrl>#red</styleUrl>
<Point>
<coordinates>20.38382069,45.38268941</coordinates>
</Point>
</Placemark>
```

Listing 3 The segment of Wigle Wifi kml file format

In the listing above, the segment of Wigle Wifi KML file format is presented. In the following section the display of KML file data in Google Earth software will be displayed as well.

F. Wardrive

Wardrive is another free scanning tool for mobile devices with an Android operating system. There are two variants, for Android 2.x and 4.x. An interesting feature of this tool is the ease of use and clear display of detected networks. The stored data can be exported in 2 ways: (1) Google Earth (KML file) and (2) WiGLE (KML file). The structure of the KML file corresponds to Listing 3.

III. COLLECTED DATA

Generally speaking, all presented wardriving software gives similar information with slight differences. The collected data includes: SSID (Service Set Identifier), MAC address, channel, security data, location, time data, RSSI (Received Signal Strength Indicator). SSID gives the name of access point. It may show the origin of the

access point, its user or institution it belongs. In some cases, SSID is not changed which may indicate that access point is not properly configured, or that only default settings are used. This may indicate the weak security settings for particular access point.

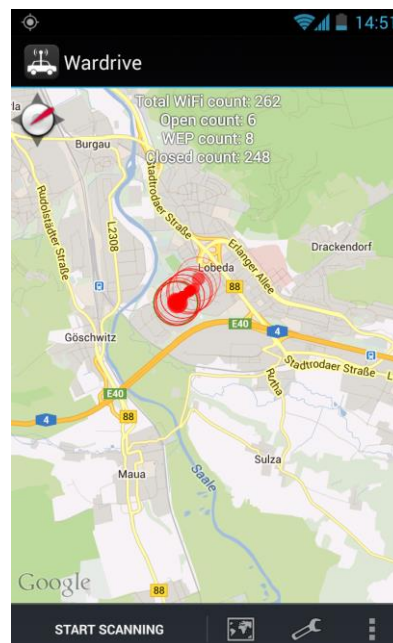


Figure 2 Tool Wardrive on Android

MAC address is physical address of network interface. It is an 48-bit address, represented with 6 pairs of hexadecimal figures separated by (:). The first 3 pairs are assigned to the particular vendor according to the IEEE policy [16]. Using logged MAC addresses, the analyses of market trends can be made. With the right data processing, the logged data can show the percentage of the wireless access point of certain vendors. The difficulties that can be encountered in these analyses are that some vendors use wider set of MAC addresses and also with the different variants of its registered name. E.g. Cisco uses: Cisco, Cisco Consumer Products, CISCO SYSTEMS, Cisco Systems, Cisco-Linksys, Cisco-Linksys LLC, and TP-Link uses following registered names: TP-LINK TECHNOLOGIES CO., TP-LINK Technologies Co., TP-LINK Technology Co. Another, much bigger constrains in successful usage of this statistic is a fact, that certain number of vendors use unassigned MAC addresses, as well as addresses space assigned officially to the other vendors. Several cases of such usage are determined according to the collected data in Serbia during this research. It was determined with default names of access points typical for one vendor that are found on access points with MAC addresses assigned to other vendor or unassigned at all.

The third typical data is operating channel of the scanned network. This channel shows the operating frequency of the access point. Security data may be considered as a most useful, since the main goal of wardriving software is security assessment. The various software tools represented security data differently.

InSSIDer differs six categories of security (open, WEP, WPA-Personal, WPA-Enterprise, WPA2-Personal and WPA2-Enterprise) networks. Open network are without encryption, the other ones use older and less secure WEP and WPA encryptions and last one use the safest WPA2 encryption. Kismet uses another approach in logging security data of access network. He differs following states: None, WEP, WPA+PSK WPA+TKIP, WPA+PSK WPA+TKIP WPA+AES-CCM and WPA+PSK WPA+AES-CCM.

The Wardrive software differs security types very detailly with the following states:

Open networks:

[ESS]

WEP networks:

[WEP]

WPA networks:

[WPA-EAP-TKIP]

[WPA-PSK-CCMP]

[WPA-PSK-CCMP][WPS]

[WPA-PSK-CCMP+TKIP]

[WPA-PSK-CCMP+TKIP][WPS]

[WPA-PSK-TKIP]

[WPA-PSK-TKIP][WPS]

[WPA-PSK-TKIP+CCMP]

[WPA-PSK-TKIP+CCMP][WPS]

WPA2 networks:

[WPA2-EAP-CCMP]

[WPA2-EAP-CCMP-preauth]

[WPA2-EAP-TKIP+CCMP]

[WPA2-EAP-TKIP+CCMP-preauth]

[WPA2-PSK-CCMP]

[WPA2-PSK-CCMP][WPS]

[WPA2-PSK-CCMP][WPS][P2P]

[WPA2-PSK-CCMP][WPS-AUTH]

[WPA2-PSK-CCMP][WPS-AUTH][P2P]

[WPA2-PSK-CCMP+TKIP]

[WPA2-PSK-CCMP+TKIP][WPS]

[WPA2-PSK-CCMP+TKIP-preauth]

[WPA2-PSK-CCMP+TKIP-preauth][WPS]

[WPA2-PSK-CCMP-preauth]

[WPA2-PSK-CCMP-preauth][WPS]

[WPA2-PSK-TKIP]

[WPA2-PSK-TKIP][WPS]

[WPA2-PSK-TKIP+CCMP]

[WPA2-PSK-TKIP+CCMP][WPS]

[WPA2-PSK-TKIP+CCMP-preauth]

[WPA2-PSK-TKIP+CCMP-preauth][WPS]

[WPA2-PSK-TKIP-preauth]

[WPA2-PSK-TKIP-preauth][WPS]

Mixed-Mode networks (WPA and WPA2 are accepted):

[WPA-EAP-CCMP][WPA2-EAP-CCMP]

[WPA-EAP-TKIP][WPA2-EAP-CCMP]

[WPA-EAP-TKIP+CCMP][WPA2-EAP-CCMP]

[WPA-EAP-TKIP+CCMP][WPA2-EAP-TKIP+CCMP]

[WPA-EAP-TKIP+CCMP][WPA2-EAP-TKIP+CCMP-preauth][WPS]

[WPA-EAP-TKIP-preauth][WPA2-EAP-TKIP-preauth]

[WPA-PSK-CCMP][WPA2-PSK-CCMP]

[WPA-PSK-CCMP][WPA2-PSK-CCMP][WPS]

[WPA-PSK-CCMP][WPA2-PSK-CCMP-preauth]

[WPA-PSK-CCMP][WPA2-PSK-CCMP-preauth][WPS]

[WPA-PSK-CCMP+TKIP][WPA2-PSK-CCMP+TKIP]

[WPA-PSK-CCMP+TKIP][WPA2-PSK-CCMP+TKIP][WPS]

[WPA-PSK-CCMP+TKIP][WPA2-PSK-CCMP+TKIP-preauth]

[WPA-PSK-CCMP+TKIP][WPA2-PSK-CCMP+TKIP-preauth][WPS]

[WPA-PSK-CCMP+TKIP][WPA2-PSK-CCMP-preauth]

[WPA-PSK-TKIP][WPA2-PSK-CCMP]

[WPA-PSK-TKIP][WPA2-PSK-CCMP][WPS]

[WPA-PSK-TKIP][WPA2-PSK-CCMP+TKIP]

[WPA-PSK-TKIP][WPA2-PSK-CCMP-preauth]

[WPA-PSK-TKIP][WPA2-PSK-CCMP-preauth][WPS]

[WPA-PSK-TKIP][WPA2-PSK-TKIP]

[WPA-PSK-TKIP][WPA2-PSK-TKIP][WPS]

[WPA-PSK-TKIP][WPA2-PSK-TKIP+CCMP]

[WPA-PSK-TKIP][WPA2-PSK-TKIP+CCMP][WPS]

[WPA-PSK-TKIP][WPA2-PSK-TKIP-preauth]

[WPA-PSK-TKIP+CCMP][WPA2-PSK-CCMP]

[WPA-PSK-TKIP+CCMP][WPA2-PSK-CCMP-preauth]

[WPA-PSK-TKIP+CCMP][WPA2-PSK-CCMP-preauth][WPS]

[WPA-PSK-TKIP+CCMP][WPA2-PSK-TKIP+CCMP]

[WPA-PSK-TKIP+CCMP][WPA2-PSK-TKIP+CCMP][WPS]

[WPA-PSK-TKIP+CCMP][WPA2-PSK-TKIP+CCMP][WPS-PBC]

[WPA-PSK-TKIP+CCMP][WPA2-PSK-TKIP+CCMP-preauth]

[WPA-PSK-TKIP+CCMP][WPA2-PSK-TKIP+CCMP-preauth][WPS]

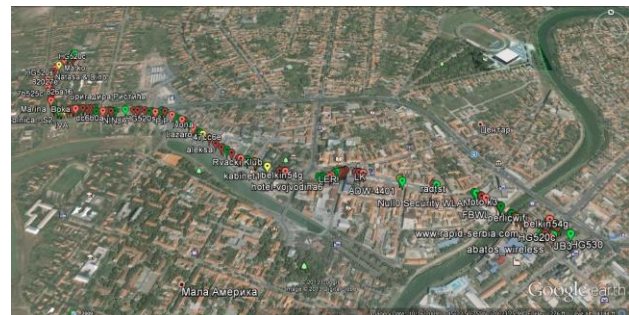


Figure 3 KML file from Wigle net presented in Google Earth

The RSSI data shows power present in a received radio signal. It depends of many things, mainly of the distance of the source, antenna gain, location, etc. Time records indicate the date and time of logged data and location data depends if the GPS locator is used together with software tools. This GPS data indicates about latitude, longitude, altitude and moving speed on the place and time when the signal is located. In the case of converting the GPX file to the KML, when more than one logged data for the same access point exists, the KML file represents only one set of data for one access point, with the strongest signal value. GPS location data can together with other collected data be saved in KML files and represented in Google Earth like it is shown on the figures 3.

IV. THE METHODS FOR PRESENTATION AND ANALYSES OF THE RESULTS

The analyses of the collected data can be made in several ways. On the Internet there are several sites that

host public online information about scanned networks. WiGLE (Wireless Geographic Logging Engine) host data about 108,721,747 unique networks out of which 107,179,569 networks with a recorded location. The statistics offered by this site are: SSID stats, IEEE OUI manufacturer/vendor stats (e.g. the most scanned access point are from CISCO-LINKSYS, LLC with 7,048,769 or 6.483% of total market, after that CISCO SYSTEMS, INC. with 4,756,476 scanned networks or 4.374% and so on), Wireshark Manufacturer stats, Octet stat, Channel stats, File stats, Android release, model, device, version display and brand stats, and at the end with geographical stat with the country, country region, postal code and security within country/region stats. Five countries with most records are US with 40,919,320 or 37.636%, Germany with 6,122,963 or 5.631%, UK with 5,276,351 or 4.853%, Netherlands with 4,231,233 or 3.891% and Canada with 3,465,025 or 3.187% out of total scanned networks.

The second big database is Wardriving-forum (Germany). It hosts SSID, manufacturer, channel for 2.4 GHz and 5 GHz bands, encryption, software used for scanning statistics.

Vistubmler Wi-FiDB host data about 244,052 sites collected by the 326 users.

The analyses of collected data are made by development of application for parsing either CSV files or XML like files. These applications are developed to parse log files and to summarize analyses results. In the research in Serbia conducted in past six months the data about 15,223 networks are collected. The parsing program WStat is developed in C# to parse InSSIDer GPX files. The program makes security, channel, vendor, data rate, SSID and network type statistics (ad-hoc or infrastructure network). The statistics are exported from WStat program separately in the form of CSV files. The example of exported file and data is presented in Table I.

Table I – Example of parsed statistics collected with InSSIDer

Security Type	Number	Percentage (%)
Rest	4	0.03
Open	3707	24.35
WEP	1149	7.55
WPA-Personal	2443	16.05
WPA-Enterprise	1	0.01
WPA2-Personal	7696	50.56
WPA2-Enterprise	223	1.46
Total	15223	

In Jena, the practical suitability of a tool was tested in an experiment. Used here was the Smartphone Samsung i9250 Galaxy Nexus with Android 4.2. The networks were recorded with the tool Wardrive and visualized with the help of ESRI webservice (Figure 4).

Table 2 – Results of the Wardriving-experiment in Jena (Germany) with the tool Wardrive

Security Type	Number	Percentage (%)
Open	671	3.30
WEP	761	3.75
WPA	1793	8.83
WPA2	6383	31.42
Mixed-Mode	10537	51.87
Rest (unidentified)	169	0.83
Total	20314	

The five most common values are presented in Table 3:

Table 3 – Five most common values obtained during the research in Jena

Security data	Number
[WPA-PSK-TKIP][WPA2-PSK-CCMP]	2442
[WPA2-PSK-CCMP][WPS]	2240
[WPA-PSK-TKIP][WPA2-PSK-CCMP][WPS]	1936
[WPA-PSK-TKIP+CCMP][WPA2-PSK-TKIP+CCMP][WPS]	1832
[WPA2-PSK-CCMP]	1671

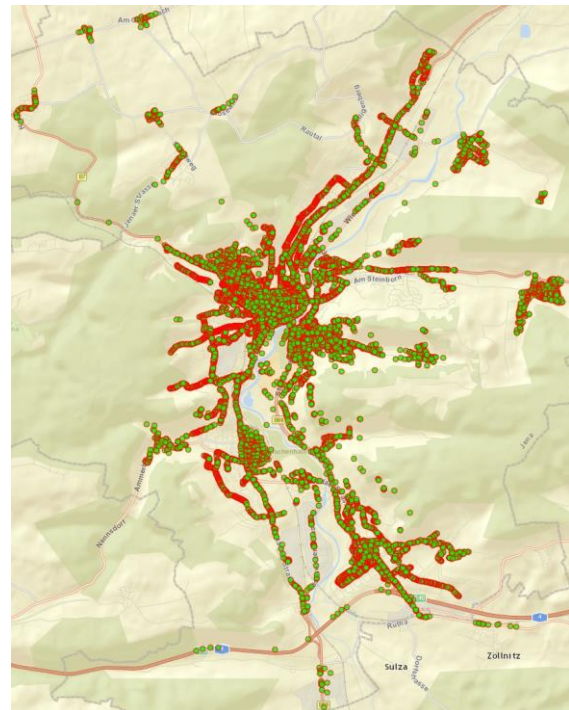


Figure 4 Results of Jena in ESRI Webservice

In Table 4 the results of vendor analysis are presented with top 5 vendors MAC addresses collected in Serbia, among 15223 scanned networks. The difficulties concerning the market trend analyses connected to usage of unassigned MAC addresses are visible here. The big percentage of unknown MAC addresses (7%), as well as the unrealistically high number of Askey Computers access points shows that MAC address space is not used properly. A large number of access points categorized in unknown or Askey Computer corp groups have the default SSID typical for other vendors.

Table 4 – Top 5 vendor of access points obtained during research in Serbia

Vendor	No	(%)
TP-LINK Technologies Co.	5635	37
ASKEY COMPUTER CORP	1882	12
Unknown	1138	7
Cisco	830	5
Huawei Technologies Co.	816	5

V. CONCLUSION

The wardriving is the process of scanning the wireless networks mainly used for wireless networks security assessment. Aside from security assessment, the wardriving can be used for analyses the other data such as market trends (vendors and data rates). The various tools developed for this process are presented in this paper. Together with these tools, the structures of collected data are presented as well. The legal issues of this research are described before the tool and data analyses.

The goal of this research is to point out the importance of wireless network security issues and its treats to global data and system security. This problem will be present in future in the greater extent and not only limited to IEEE 802.11 networks, but to the other wireless technologies as well. These wireless technologies such as Wireless Sensor Networks (WirelessHART, IEEE 1451, ZigBee/802.15.4, ZigBee IP, 6LoWPAN), Bluetooth and WIMAX are the technologies in a great expansion. In accordance with the growth of their implementation and the increasing treats in cybercriminal and cyber-terrorism the importance of scanning and sniffing tools for security assessment will grow as well.

Some of the most crucial problems of wireless security such as WPS (Wi-Fi Protected Setup or originally Wi-Fi Simple Config) are not mentioned in this paper. So, this might be the topic of the further works as well the methods for its improvement in order to overcome the security problems.

The other possible research direction are the analysis and development of laboratory exercises for inclusion in wireless computer security curricula in order to teach students how to protect and make wireless systems more secure.

The analysis of the tools has also shown that the art of wardriving also developed. So, now for wardriving a notebook, an USB adapter with antenna and a GPS receiver are not compellingly necessary. A smartphone combines all these facets in a small and compact device.

ACKNOWLEDGMENT

In this paper the data collection and wireless security assessment are conducted without violation of Criminal laws of Germany and Serbia.

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The Benefits of Standardization for Business Intelligence Tools

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Abstract – Implementation of standards for business intelligence in the company can result in significant cost savings, greater control over information, and better alignment with business users. All this, leads to increased competitive advantage of company by exploiting the benefits of the implementation of business intelligence systems. But the implementation of standards for business intelligence requires pragmatic phased approach, that takes into account the organizational structure of the companies and business value of existing applications for business intelligence. Sometimes standardization is seen from a negative aspect, because people think it means using only one tool and the exclusion of all others. Other terms that can be used for the standardization of business intelligence software is rationalization of business intelligence, business intelligence consolidation, but no matter which term is used in the end you get the same benefits. According to Forrester over 2000 global companies use between five and fifteen reporting and analysis tools. The purpose of standardization of business intelligence is to reduce the number of these tools and to build a portfolio of software tools for business intelligence that will overlap as little as possible. Gartner estimates that companies that provide resistance to standardization of business intelligence will be able to strategically deploy them and make 50% more cost for each additional tool (with a probability of 0.8).

I. INTRODUCTION

A. Business intelligence

The dynamics of the business changes, the unstoppable trend of globalization, the number of innovations, environment of companies and competition have a greater impact on the performance of companies. Today, if any company wants to learn about their opportunities for future growth and development, for which a quality business strategy adopted, must be able to collect all available and relevant data. Also, these data should be processed in order for them to get quality information and analysis on the received information to countenance its comparative advantages or disadvantages.

On the other hand, every day is a growing gap between the amount of data available and the ability of companies to analyze the data. According to research from Gartner only 20% of companies use more than 50% of the data that are available. This indicates that although the companies have huge amounts of data, but in them there is a lack of useful information. In such a situation often decisions are made on the basis of minimal and

unbalanced information, ie on subjective and intuitive basis.

Answer the question how to optimally use all available data, based on which will get quality information, which in turn will serve as a basis for strategic decision-making at all levels of the company, gives the concept of business intelligence. Business intelligence is very complex information system, the automated method for collecting data from various sources, transform and integrate processes which allows users quality information. By applying the concept of business intelligence will be enabled use of the remaining data and translate it into usable information.

Due to the growing needs of information, companies daily create large amounts of data about their operations and countless facts about their customers, products, operations, employees, etc.. Most of these data are literally "locked" in the thousands of computer systems. Only a small part of the data is collected, processed and stored are used by companies for making decisions. New information technologies, with a strong performance, enable storage of large amounts of data, processing and utilization of obtaining information that will serve to support decision making and will open great opportunities for improving business processes, ie will provide analysis and monitoring the performance of the business system. Business intelligence is a relatively new discipline which is still under intensive development and the basis for development mainly lies in the intensive development of information technologies and new knowledge about information needs companies. The concept of business intelligence is part of the answer, through information technology, to meet on these identified needs. It is simply a concept that can greatly contribute to the success and stability of the company, or the sustainability of the global market.

B. Standardization of business intelligence tools

Business intelligence becomes one of the top priorities because it offers:

- Relatively low cost and risk
- Provides a high return on investment
- Allows advantages of existing information systems

Because all of that, the business intelligence market shows continuous growth rates. This means that most large companies are in the process of initiating more new projects in the field of business intelligence. However

only a certain number of companies now have a comprehensive strategy for business intelligence or clearly defined standards for business intelligence, although increasingly faced with growing patchwork of different technologies for business intelligence. As projects continue to increase and the consequences are becoming more visible in:

- Increase the unnecessary costs in deployment, maintenance and training
- Growing inconsistency in reporting
- Frustrated end users, who can get answers to their business questions

Introducing standards for business intelligence in the company, can result in significant cost savings, greater control over information, and better alignment with business users. All this leads to increased competitive advantage of company by exploiting the benefits of the introduction of business intelligence systems. But the implementation of standards for business intelligence requires pragmatic phased approach that takes into account the organizational structure of the companies and business value of existing applications for business intelligence.

Sometimes people think that standardization means using only one software tool and the exclusion of all other. Other terms that can be used for standardization of software for business intelligence are business intelligence rationalization, consolidation of business intelligence, but no matter which term is used in the end you get the same benefits. According to Forrester over 2000 companies worldwide use between five and fifteen tools for reporting and analysis. The purpose of standardization of business intelligence is to reduce the number of these tools and build a portfolio of software tools for business intelligence that will overlap as little as possible. An example of how it would look overlapping of tools is given on the Figure 1 where is displayed overlapping of 5 tools that can be consolidated into three separate standards.

In practice there is a continuum of different levels of standardization of business intelligence, from the recommended vendor for one department to establish a

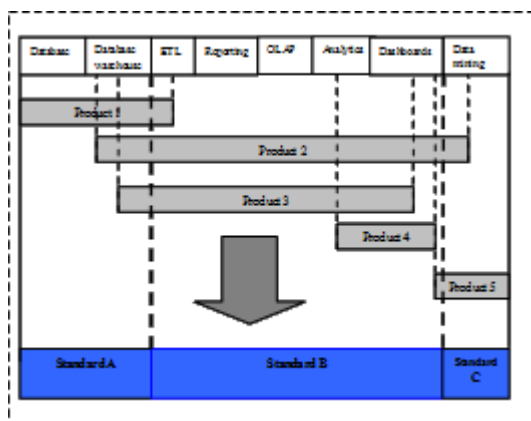


Figure 1. Standardization of business intelligence tools¹

¹ Elliot T., The benefit of business intelligence standardization, Business object, White paper, 2005

true standard. If companies fully comply with established standards for business intelligence, benefits of standardization will be greater. Most companies how many increase the level of standardization they become more mature in their use of business intelligence.

Today companies are fighting against unnecessary duplication of various applications for business intelligence, data inconsistencies, and against the frustrated end users. The problem is getting worse every day through uncoordinated new business intelligence projects that are undertaken within companies.

II. METHODOLOGY FOR IMPLEMENTATION OF STANDARDIZATION

For BI to be successful, information and analysis must be actionable. Associated decisions must have an effect on performance that is in line with the objectives and strategic plans for organization. To turn information into real business change, enterprise BI strategy must answers questions such as:

- What performance metrics have the highest impact on business strategy and objectives?
- Which people and processes have the highest impact on achieving business objectives?
- What applications and BI technologies do these people need to deliver the highest impact on business objectives?
- What information has the highest impact on business objectives?

In order to succeed in enterprise BI, is need to consider all facets of information environment for a holistic view.

To ensure that you receive the full benefit of BI, and to avoid the degeneration of chosen standards, it is essential to have a long-term BI strategy – including a BI competency center (BICC). Regardless of which functional area it reports to, BICC should be considered primarily a business initiative, working closely with the infrastructure teams and other departments. The BICC is responsible for:

- Optimizing the value of information assets, by developing and sharing BI best practices throughout an organization;
- Aligning BI initiatives around a framework: how BI should map to the technical, functional, organizational, and business needs of the organization;
- Implementing a formal BI methodology to ensure that BI projects bring the promised benefits. It should detail the roles of different groups (IT, business users, technical support, and so on), and cover both the technical and user-oriented phases of the project.

BI tools have had their own evolutionary cycles across platforms, data integration technologies, OLAP/reporting suites and packaged analytics. A single BI tool is not capable of addressing operational, tactical and strategic requirements. With every change in business requirement, organizations have purchased new BI tools for implementing various functionalities without factoring in

integration and future business needs. The result is multiple BI tools, increased cost in managing complex architectures, multiple vendors, training and maintenance of applications, data redundancy and tool specific meta data synchronization overhead. Although organizations have implemented BI, many of them are yet to demystify the framework in the context of organizational needs. BI tools standardization helps to use of a limited number of relevant and powerful BI tools that will reduce the “pain of reporting”, meet business needs across the board and scale up as the business grows. Question is why company should to standardize IT systems: because of the need to reduce costs, increase competitiveness or is forced to by vendor consolidation? Therefore need to prepare methodology for implementation of BI tools standardization.

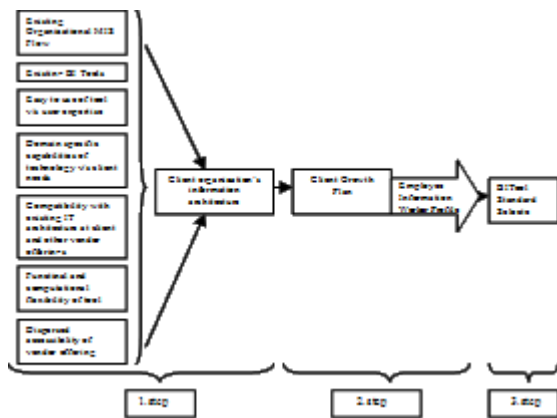


Figure 2. Methodology for implementation of BI tools standardization

This methodology include:

- Collaboration with client stakeholders and assists them to build a business case for the standardization and to form the right team for assessment. The business objective is to meet dynamic functional requirements and increase user comfort levels through a mix of tools that complement each other. The objective is to verify existing infrastructure, lower development and maintenance costs and eliminate redundancy the BI tool set deployed across the organization;
- Interacts with client teams to classify business and IT users by role and responsibilities and to understand their current technology usage. A matrix of current tools inventory and its usage by user groups helps to understand as-is scenario and tools utilization. Objectives are understanding expectations from standardization in terms of business requirements, architecture, security, support ability, supplier viability and reduction in total costs;
- Decision for tools standardization compatibility current and future techno-functional architecture, development, maintenance costs and vendor stability. Existing tool sets may be leveraged to build the components of application such as data acquisition, integration and presentation.

III. BENEFITS OF BUSINESS INTELLIGENCE STANDARDIZATION

First, the clearest and more obvious benefit of standardization is that it can save financial resources in each area of project implementation for business intelligence. You can avoid all unnecessary increase in costs for evaluating, purchasing, implementing and maintaining a large number of business intelligence tools. Also the difference between these costs will give savings that the company will achieve by applying standards for business intelligence.

Most large companies have already implemented IT standards for all aspects from databases operations and automated transaction systems to integrate data and data warehouse. Standardization of business intelligence is the next big opportunity for the company in terms of cost savings and a greater return on investment in information technology. Implementing standards allows companies to focus their energy towards better use of the opportunities offered by business intelligence and its practical application, rather than focusing on skills that are routinely repeated. The result of all this is reflected in the opening of opportunities for making new revenues, improved visibility of costs and better manage risk.

Reducing the number (optimal) of tools for business intelligence company can result in²:

- Lower cost of software through coordinated purchase agreements
- Lower administrative costs
- Less time and money spent on evaluation of business intelligence
- Lower cost of training for users to use the software for business intelligence
- Faster return on investment from business intelligence project
- Having a standardized system for access to business information can result in³:
- More reliable data for decision makers
- Easier comparing information from different departments in order to get "one view of the truth"
- Easier sharing of consistent information between different user groups and with customers, partners and suppliers
- Greater coordination in data security that helps to minimize unauthorized access to data

Changing the information culture in the company can be unrealistic goal in the short term, but there are a number of immediate and pragmatic steps that can prevent the rising cost of fragmentation of business intelligence. These steps would be:

- Review of existing business intelligence projects. The first step is to calculate the costs and benefits of each project for existing business intelligence. In the case of large companies with decentralized

² Understanding the value of business intelligence platform standardization, Business object, 2003

³ Understanding the value of business intelligence platform standardization, Business object, 2003

system for business intelligence, business intelligence suppliers of the company can be a useful source of information for finding the appropriate tools for business intelligence;

- Building the case of standardization. Based on research that will implement the company by building a feasibility study for standardization, it is necessary to provide adequate resources for the project;
- Develop explicit criteria. A key step is to define a set of business intelligence tools that are repeated for the company. Start of implementation of the standards. The choice of standards means that they should be applicable, by using mechanisms such formal review of the project or budget stimulations

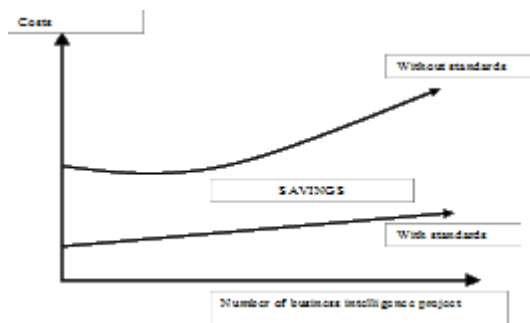


Figure 3. Savings by applying standards for business intelligence

To ensure the full benefit of the use of business intelligence, and to avoid the slow degeneration of selected standards it is important to have a long-term strategy for business intelligence.

IV. CONCLUSION

Business intelligence is often the area between IT (providing information) and business users (who need the information to perform their job). Besides allowing connection of goals, metric and people within the company, business intelligence helps companies to manage and optimize the information flows like other business processes leading to improved compliance, transparency and performance.

Many companies are already convinced in the benefits of the introduction of standards for business intelligence, but they still are not sure how to turn belief into reality. After the declaration of a software vendor for business intelligence as standard, or signing a contract to purchase a range of tools for business intelligence is no guarantee that it will provide the benefits that the company expects the use of business intelligence software.

In many cases, the implementation of the standardization of business intelligence may encounter a number of obstacles and problems. In addition, poor or inadequate communication is the main cause of failure in the implementation of standards for business intelligence. However, faced with the problems of fragmentation of business intelligence, companies often decide to introduce standardization. According to the latest survey of TDWI, respondents indicated that it would standardize its business intelligence tools in the next 12-14 months. Standardization of business intelligence include much cost and change management, but long-term benefits of such standardization anyway to overcome short-term problems of rationalization. Platforms of the world's leading companies for business intelligence software, providing an ideal balance of ease of use of these tools with the functionality that they provide the end users.

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Multi-Objective Automatic Calibration of the Distributed Hydrological Model

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Abstract - A physically-based distributed hydrologic model was applied in this research. The river basin, or watershed, was discretized with a square grid, where each square carried morphological data about a portion of the watershed, the vegetation, the soil composition, the hydrogeological layer, and the like. The effect of weather stations was defined by Thiessen polygons, including correction for altitude. The hydrological model was continuous, with a one-day time step. It was partitioned into three reservoirs: vegetation, snow and soil. Distributed hydrological model involves large number of calibration parameters. An automatic calibration routine is developed using the Non-dominated Sorting Genetic Algorithm II (NSGA-II) that has proved to be an effective and efficient multi-objective search technique in various applications. The result of the calibration process is a hydrologic model with greater precision that provides flow forecasts in the basin.

I. INTRODUCTION

The transformation process from precipitations into runoff water is a very complex natural process which is why its modeling is complex as well. A large number of input data is necessary for the hydrological models to work, the quality of the data determines the simulated basin runoff process. In the physics models, the hydrological processes are presented in mathematic equations that describe the nature's behavior. However, that behavior often cannot be described by a law of physics which is why the models use the empiric dependences of some values.

The present paper analyzes the physically based model with widespread parameters which is why the basin area has to be discretized, partitioned with an *HRU* grid where each unit carries data about the morphological characteristics of the basin, vegetation, pedological soil composition, hydrogeological layer, etc. It is necessary to define the influence of the weather stations on the basin using the Thiessen's polygons with altitude corrections.

A significant progress was made in the 20th century in the hydrological models field. The best known discovery was the unit hydrograph which tried to define the time position of the hydrograph peak [4]. The unit hydrograph presents a unit effective rain equally spread on the basin area, obtained when the total precipitations are detracted by the part that infiltrates underground.

Nowadays, the transfer functions are used to transform the precipitations into runoff (Transfer Function - TF)

[1,10]. The transfer functions are present in numerous science fields. In hydrology, the continuous time transfer functions models are used (Continuous-time TF model). Based on the hydrological process explanation, the transfer functions represent system models.

The largest problem when modeling the precipitation transformation into runoff is defining the effective precipitations on the basin. In order to simulate effective rain, which depends most on the soil moisture degree, the continuous hydrological models are used such as: SSARR [11], Stanford [12], Dawdy-O'Donnell [13], Tank, HBV, etc. The representatives of the distributed parameter models, on the other hand, are ILR and SWAT [11,4].

The quality of the hydrological model results depends on the model parameter quality, since this is the case of a basin area with parameters that cannot be precisely defined, hydrological model calibration is to be performed. Automatic calibration is usually performed for calibration of the hydrological models, due to a large number of parameters. Most of the complex engineering problems includes optimization of several non-linear criteria under certain limitations. The criteria can be in conflict so that the optimal solution for one can be absolutely unacceptable for other criteria. It is necessary to examine the group of Pareto optimal solutions and, based on the current situation, select the compromise solution from the group, which cannot be optimal by all criteria. The Pareto group of optimal solutions contains solutions that are superior for each target function comparing to all other solutions from the search space, but are also inferior for some target functions comparing to other solutions from the group [7]. The automatic NSGA-II (Non-dominated Sorting Genetic Algorithm II) calibration was used in the present paper.

II. METHODOLOGY

A. Hydrological model

The vertical *HRU* balance is obtained within the hydrological entities named *HRU* (Hydrological Response Unit). Through these unique entities the discretization of basin area is performed as shown in image 1. The *HRUs* represent parts of the basin that act similarly in the hydrological manner and are the basic elements of the system in which they are considered to be elementary components of the vertical water balance [2].

Calculated values of the surface runoff Q_{surf} and leaking W_{perc} , are poured out into existing reservoirs near each hydrograph grid profile and are part of the horizontal water movement system – vertical water balance component transformation.

The surface runoff Q_{surf} is discharged into one linear reservoir and is transformed in it into direct runoff Q_d on the adequate profile of the hydrograph grid. The leaking component W_{perc} is first discharged into the linear underground reservoir, characterized by a higher level of inertia than the surface linear reservoir. Sum of these two components represents the total underground runoff which ends in the suitable profile of the hydrograph grid. The runoff transformation diagram through the reservoirs is shown in Fig. 1. The algorithm for vertical balance component transformation Q_{surf} and W_{perc} , through linear reservoirs, is explained in this chapter. The horizontal balance is performed separately for Q_{surf} and W_{perc} , therefore different hydroprofiles can be defined for the direct runoff of Q_{surf} and for the leaking W_{perc} .

If the *HRU* is considered as an entity, the input data for the calculation of the vertical water balance components are as follows:

- R' – total precipitations,
- E_o – potential evapotranspiration

given in the form of flux (mm/day) on the terrain surface.

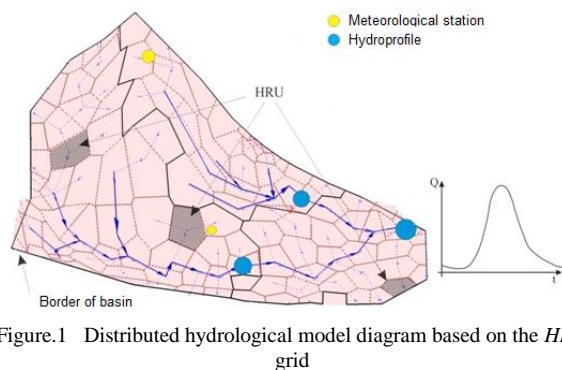


Figure.1 Distributed hydrological model diagram based on the *HRU* grid

The calculation results are the fluxes that represent the *HRU* ending point:

- Q_{surf} – direct runoff,
- W_{perc} – leaking,

and a summery change of water quantity in the reservoirs that form the *HRU*.

HRU consists of 3 basic reservoirs:

- Vegetation is the reservoir in which the interception is performed,
- Snow layer where the sublimation and snow melting processes take place,
- Soil is partitioned into several reservoirs (layers) where the runoff, evaporation, transpiration and leaking processes happen.

The *HRU* decomposition into basic reservoirs is shown in Fig. 2.

B. Horizontal balance calculation algorithm

The vertical water balance calculation begins with determining the potential evapotranspiration E_o and defining whether the precipitations given in the R'_{day} are in form of snow or rain. This can be performed in the pre-

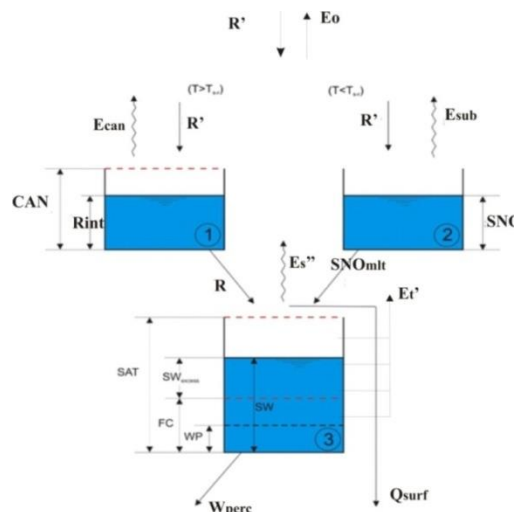


Figure 2. Schematic view of a distributed hydrological model based on the network *HRU*'s

processing and is shown in the paper [3]. The vegetation is considered to be a reservoir that accepts one part of the precipitations. The current capacity (*CAN*) depends on the vegetation development period and on the maximum capacity (CAN_{max}):

$$CAN = CAN_{max} \frac{LAI}{LAI_{max}} \quad (1)$$

where *LAI* is the leaf surface index and represents the relation between the leaf surface projection on the terrain and the terrain surface itself. The *LAI* value varies during the vegetation period and depends on the type of vegetation and the development phase. The LAI_{max} is the maximum value adopted based on the presence of some vegetation species on the *HRU* surface.

In the interception reservoir, the potential water evaporation calculation is performed for the water that stays on the plants' leaves, it is this phenomenon that was used to name the reservoir. The interception reservoir is a balance harmonization of the water supplies on the plants' leaves with the supplies quantity on the previous step and with the rain that falls on the given calculation step. If the interception reservoir capacity is exceeded, which depends on the vegetation layer, then the water flows, under or on the surface. The numeric procedure for determining all the values is shown in the paper [5] and the parameter in this reservoir is the current interception reservoir capacity CAN_{max} .

The precipitations are in form of snow when the temperature is below a certain border value (T_{s-r}) and in that case the total precipitations in form of snow R' are expressed in the equivalent height of the water layer (*mm* of water).

If the condition of the snow layer at the end of the period $i-1$ is marked as $SNO(i-1)$, then the snow layer after the precipitations is:

$$SNO = SNO(i-1) + R' \quad (2)$$

If the calculated value SNO does not exceed zero, the calculation for this reservoir needs to be skipped and the balance components have to equal zero. Fig. 3 shows all parts of the snow layer balance that include the accumulated snow SNO , snow evaporation E_{sub} and snow melting SNO_{melt} . The snow melting process is based on the previous balance equation applied in the hydrological model *SWAT* [4]. The snow reservoir basic parameters are the snow layer melting degree $bmelt$ and the snow melting temperature T_{melt} that is considered to be $0^{\circ}C$.

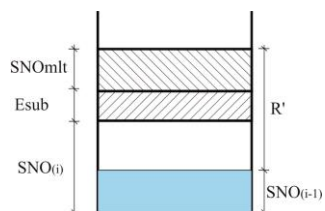


Figure.3 Snow layer reservoir diagram

The soil reservoir is divided into layers. The diagram is shown in the Fig. 4. There is a surface layer with thickness D_s (10 cm thick) in which the evaporation and runoff processes take place, and a limited number (n_j) of subsurface layers in which the transpiration and leaking processes are predominant. Each soil layer has its predefined characteristic values that define the moisture state of the reservoir SW at characteristic moisture values: STO —is the maximum capacity of the soil moisture, FC —reservoir condition calculated based on the field capacity moisture and WP — minimum water quantity in the soil defined by the permanent wilting point for humidity.

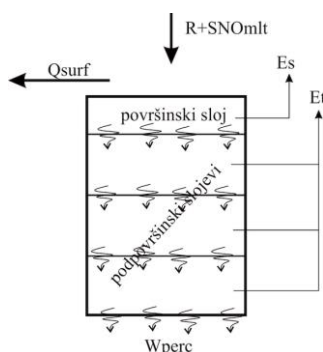


Figure.4 Soil reservoir diagram

The first step in the balance calculation for the vertical soil layer is the runoff calculation Q_{surf} . It is done using the SCS method:

$$Q_{surf} = \frac{(R + SNO_{mlt} - I_a)^2}{R + SNO_{mlt} - I_a + S} \quad (3)$$

S is the parameter that represents the maximum soil capacity and is calculated based on the CN number [4]. The characteristic value of the CN number for the *HRU* is adopted based on the surface purpose and the soil

characteristics that are described in table form in paper [5].

Value of the CN number depends on the soil moisture and the calculated value CN_2 refers to the case when the soil moisture is average [4].

Based on the CN parameter and the terrain slope, coefficients CN_1 and CN_3 are calculated on the *HRU*, which refer to the dry soil conditions (CN_1) at the minimum moisture WP and the field capacity moisture conditions FC (CN_3).

Now the maximum and minimum absorption potential can be determined in the following manner:

$$S_{max} = 25.4 \cdot \left(\frac{1000}{CN_1} - 10 \right) \quad (4)$$

$$S_{min} = 25.4 \cdot \left(\frac{1000}{CN_3} - 10 \right)$$

Maximum absorption potential corresponds to the permanent wilting point for humidity w_{WP} , while the minimum value corresponds to the field capacity moisture w_{FC} . These parameters are used to determine the total thickness of the soil active layer D_{sum_SCS} and participation of each layer in percentages p_j [2]. The real soil absorption S is calculated based on the soil moisture condition SW , and it is obtained by linear interpolation between the S_{max} and S_{min} .

After the runoff calculation, follows the percolation calculation, i.e. the leaking W_{perc} from the surface layer into the next, subsurface soil layer. Depending on the relation between the reservoir condition and its capacity, the percolation can be divided in two parts: saturated soil percolation W_{perc_sat} and unsaturated soil percolation W_{perc_unsat} . Total percolation is the sum of these two components.

Percolation is calculated in the following manner [2]:

$$W_{perc} = K_{sat} \Delta T_{sat} + (STO - WP) \left[S_r - \left(S_r^{(1-n)} + \frac{K_{sat}}{STO - WP} (n-1) \Delta T_{unsat} \right)^{\frac{1}{1-n}} \right] \quad (5)$$

where K_{sat} is hydraulic conductivity of the saturated soil, T_{sat} is time corresponding to the saturated soil percolation, ΔT_{unsat} is time corresponding to the unsaturated soil percolation, S_r is relation between the available and the maximum quantity of water for percolation in the unsaturated soil and parameter n is the calibration parameter that is strictly higher than 1 (from 2.5 to 3.5). After the percolation calculation, the reservoir condition reduction is done for the quantity of water that leaked into the previous layer.

The water that leaked from the upper, i.e. surface layer reaches the subsurface soil layer. The leaking is then calculated from that layer as well as the new reservoir condition (5). It is important to mention that the soil moisture is reduced by the quantity of water that evaporates E_s and that is consumed by the plants W_{up} .

C. Horizontal balance calculation algorithm

The vertical water balance components, surface runoff Q_{surf} and leaking W_{perc} are transformed into flow through

the system of linear reservoirs. Each *HRU* pours out into the downstream profile of the hydrograph grid with the adequate concentration period. These periods are different for the surface runoff (Q_{surf}) and for percolation (W_{perc}). Near each hydroprofile there is a linear reservoir for direct runoff and another linear reservoir for the base runoff. The flows in to the reservoirs are considered to be constant during the discretization period Δt .

The assumption on which the application of the linear reservoir is based is that there is a linear connection between the reservoir condition (S) and the flow out Q : $Q = S/K$, where K is the *HRU* parameter with time unit measurement, and S is the linear reservoir condition (m^3).

Into the linear reservoir of the analyzed hydrograph grid profile flows the entire runoff from all belonging *HRUs* (q_s) i.e. all *HRUs* with the "downstream address" that is the analyzed hydrograph grid, as well as some external flows in (Σq_j) if there are any.

The following differential equation is formed [4]:

$$\begin{aligned} q_s + \sum_j q_j - Qd(t) &= \frac{dS(t)}{dt}, \\ q_s &= \frac{Q_{surf} \cdot \Delta A}{\Delta t}, \\ q_j &= \frac{1}{\Delta t} \int_0^{\Delta t} Qd_j dt. \end{aligned} \quad (6)$$

By solving the previous equation, the following is obtained:

$$\frac{S(t)}{K} = \frac{S_0}{K} e^{-t/K} + (q_s + \sum_j q_j)(1 - e^{-t/K}). \quad (7)$$

Parameter K in the previous equation represents the linear reservoir parameter that refers separately to each *HRU*. It depends on the concentration period of the *HRUs* to the downstream hydroprofile, since the concentration periods for the surface and underground flows are different, the linear reservoir parameter for these cases differs as well.

D. Estimation of the validity of the results of calibration

The success of the calibration process mostly depends on the target function that is chosen as the calibration criterion. The evaluation of the degree of deviation from the measured value for the runoff that was calculated using the model was performed based on two criteria:

- root-mean-square error RMSE and
- logarithm errors LOGE.

The RMSE is the most commonly used calibration criterion:

$$RMSE = \sqrt{\frac{1}{N} \sum_{j=1}^N (O_j - S_j)^2} \quad (8)$$

O_j i S_j are the measured and calculated basin runoffs, in that order, while N represents the total number of data. The RMSE has values ranging from 0 (when the measured and calculated values match fully) to infinity. The RMSE has a tendency to underline the adjusting of

the higher (peak) runoffs. LOGE target function uses the algorithms instead of the original values for measured and calculated basin runoffs, this favors the lower (base) runoffs.

$$LOGE = \sqrt{\frac{1}{N} \sum_{j=1}^N (\text{Log}(O_j / S_j))^2} \quad (9)$$

The calculation of the root-mean-square error and the logarithm error was performed for each supposed combination of the eleven listed parameters. The hydrological model calibration includes determining the value for these eleven parameters that would have the lowest root-mean-square and logarithm errors. Since the goal is to minimize both errors, this is a multi-criteria optimization problem with two target functions. Mathematically formulated, it is necessary to determine potential solutions with form $\vec{x} = (x_1, x_2, \dots, x_{11})$. The range limitations from which some coordinates $x_i, i = 1, \dots, 8$ can obtain values create the allowed search space in which the solutions to the multi-criteria optimization problem can be found.

Since this is a highly non-linear system, the optimization of the given target functions cannot be reduced to a specific analytic form. For that reason, the genetic algorithms were used to minimize the errors in the distributed hydrological basin model. In the genetic algorithm terminology, the allowed search space is the population that consists of individuals or chromosomes that unambiguously match the solutions in the search space. Chromosomes are made of genes, so in this specific case, each chromosome is a series of 8 real numbers – genes, where every member of the series corresponds to the adequate solution vector coordinate \vec{x} . Further in the text, the terms solution, chromosome, unit and individual are used as synonyms.

To solve the calibration problem of the proposed hydrological model, a software for multi-criteria optimization was developed that applies the NSGA-II algorithm, which will be described thoroughly further in the text.

E. Multi-criteria optimization based on genetic algorithm

Genetic algorithms (GA) belong to the stochastic optimization method class that simulate the natural evolution process, i.e. they belong to the evolution algorithm class (EA) where the simulated annealing is also present, the optimization based on the ant colony, etc. The stochastic optimization methods include the existence of a group in which the candidates to the solution are present and are currently under consideration, as well as the existence of the selection and the variation processes.

The solution candidates are called individuals or chromosomes, and group of solution candidates is a population. Chromosome is the representation of a vector x for the given problem, where each coordinate x_i is a *gene* of the chromosome.

Among the numerous methods that apply the evolution algorithms, the NSGA-II method was used in the present

paper, which uses sorting based on the non-dominated solutions, introduced in the Deb and colleagues' paper [8].

NSGA-II is an abbreviation for Non-dominated Sorting Genetic Algorithm, while number II indicates that this is a modification of the NSGA algorithm that was proposed by Srinivas and Deb [7]. This method was created with purpose to overcome three characteristics of its predecessor that were criticized: (a) long execution period, (b) non-elitist approach and (v) need for the user to determine the parameter σ_{share} .

In the NSGA-II the selection operator forms a group of units to match by combining the parent population with the descendant population and selecting N of best solutions based on the validity of the quality function and the solution disposition in space target function, which provides the elitism. The simulation results for numerous difficult test problems show that the NSGA-II can find a much better solution range for most problems, as well as solutions that converge better to the real Pareto front comparing to PAES and SPEA (two elitist algorithms that pay special attention to forming a diverse Pareto front).

In order to obtain solutions equally spread on the Pareto front in the NSGA-II, the crowding distance is used. To define the density of the solutions around a specific solution x in the population, the size of the largest possible area surrounding the solution x , has to be defined, but one that doesn't contain any other solution from the population. This value is called the crowding distance, marked as $cd(x)$.

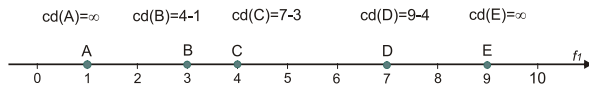


Figure.5 Example of crowding distance defining for five solutions in a one-dimensional case

Calculating the crowding distance requires that the solutions are sorted into an increasing series based on the value of each target function. To the first and last individual of each series a $cd(\vec{x}) = \infty$ is given. For all other individuals, the crowding distance is calculated as the difference between the target functions value of two closest neighboring individuals. Total crowding distance for the solution \vec{x} is calculated as a sum of single crowding distances of the solution \vec{x} for all target functions. The algorithm for determining the crowding distance:

- Over population that is not ranked by the dominated fronts F_1, F_2, \dots, F_R for each front $F_j, j = 1, 2, \dots, R$ perform steps 2. i 3.
- For each objective function k , sort solutions from front F_j in increasing order. Let l be a number of fronts $F_j, \vec{x}_{[i,k]}$ is i -th solution in the sorted list from the target function k . Set $cd(\vec{x}_{[1,k]}) = \infty$ and $cd(\vec{x}_{[l,k]}) = \infty$, for $j = 2, \dots, l - 1$ calculate:

$$cd_k(\vec{x}_{[i,k]}) = \frac{z_k(\vec{x}_{[i+1,k]}) - z_k(\vec{x}_{[i-1,k]})}{z_k^{max} - z_k^{min}}$$

- Calculate the total extent of accumulation of each solution \vec{x} : $cd(\vec{x}) = \sum_k cd_k(\vec{x})$.

The advantage of the crowding distance calculation approach is in the fact that, for determining the population density around a specific solution, it does not require the user to define the parameter, as is the case for the σ_{share} in the NSGA method.

The crowded comparison operator ($<_n$) directs further the algorithm in order to obtain solutions equally distributed along the entire Pareto front. It is used in binary tournament selection when it is necessary to determine who the winner is: if two solutions belong to the same front, the winner is the one that has the highest crowding distance, otherwise the lower rank solution is chosen. $\vec{x} <_n \vec{y}$ if $(i < j)$ or $(i = j \wedge cd(\vec{x}) > cd(\vec{y}))$, where it is applied that $\vec{x} \in F_i, \vec{y} \in F_j$.

The NSGA-II uses the fixed population size N . the beginning, a randomly chosen parent population is created P_0 . In order to form the descendant population Q_0 of size N a binary tournament selection is used, together with recombination and mutation. The elitism is introduced through comparison of the current population with the previously found best non-dominated solutions, therefore after the initial population, the selection procedure for the following generations is different. In the generation t from the parent population P_t a descendant population Q_t is created with size N and in the population $R_t = P_t \cup Q_t$, size $2N$ the quality function is determined for each solution - ranking equal to the level of the given non-dominated solution. Under the assumption that the target functions need to minimized, level 1 is the best and the non-dominated solutions are contained in it, level 2 contains solutions among which one solution is predominated, and so on.

The non-dominated fronts F_1, F_2, \dots, F_R are determined in this manner. The following population P_{t+1} is first filled with F_1 , front solutions, then with the ones from the F_2 i tako redom. Kako se u populaciji R_t contains all previous and current population members, the elitism is guaranteed.

The F_{l-1} is the last front from which all of the solutions become part of the population P_{t+1} , adding the solutions from the F_l front in the population P_{t+1} would exceed the fixed population size N . Then crowding distance in declining order is applied to the front F_l together with as many best solutions obtained by that order, as needed in order to provide the future population with the unit number N that are included in the future population. A further selection is performed in the population P_{t+1} , crossing of units and mutation in order to obtain a new descendant population Q_{t+1} .

NSGA-II algoritam (Fig.6):

- Create a population of randomly selected parents P_0 size N and set $t = 0$.
- From population P_0 by applying random mutation and crossover to form offspring population Q_0 size N .
- If the criterion is met for stopping the calculation, the algorithm stops and returns the population P_t .

- In population $R_t = P_t \cup Q_t$ using the algorithm for sorting the population by not dominated fronts across the fronts F_1, F_2, \dots, F_R .
- For each $i = 1, \dots, k$ perform the following steps. Calculate a measure of the accumulation of all solutions F_i . If $P_{t+1} = \emptyset$, as follows to create a population P_{t+1} . If $|P_{t+1}| + |F_i| \leq N$: $P_{t+1} = P_{t+1} \cup F_i$. If $|P_{t+1}| + |F_i| > N$: in population P_{t+1} , add first $N - |P_{t+1}|$ solutions of F_i .
- To select a group for the pairing of the population P_{t+1} use binary tournament selection based on the operator \prec_n . Apply crossover and mutation to form a population of offspring Q_{t+1} size N .
- Set up $t = t + 1$ and go to step 3.

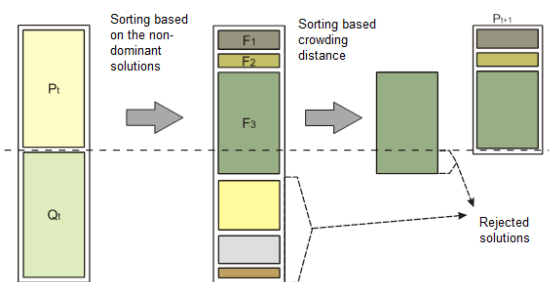


Figure.6 Diagram of NSGA-II algorithm

III. RESULTS AND DISCUSSION

The precipitations-runoff hydrological model is a parameter one, as most of the known models. Value of each parameter must be precisely determined before the use of the model. It can be noted that there are parameters that can be determined based on the data regarding the vegetation type or land usage in the basin, etc., while there are parameters that cannot be determined by observation or measuring the waterflow or basin characteristics. Basic calibration is based on the estimate of the optimal values for the most relevant parameters of the precipitations-runoff model, as well as of the open flow model. Considering that not all parameters of the precipitations-runoff model have the same importance for calibration, it is necessary to determine which parameters need to be calibrated based on the quality of the used data.

The systematic search of the best (optimal) value of the parameter is performed by the procedure shown in the following steps: Systematization of the necessary data, Selection of parameters to be calibrated, value range and initial values, Running the simulation, Evaluation and solution comparison, and Parameter correction and possible simulation re-running.

The calibration of the distributed hydrological basin is performed using the historical, registered data. For the selected characteristic periods, the measured temperatures and precipitations during those periods were given as input data for the model. The calculated basin runoffs were then compared to the measured values during the selected periods. Based on the obtained deviations,

corrections to some model parameters were made, in order to have a corrected model which gives results that match better the measured values.

The specification of the parameters that need to be determined includes identifying sensitive model parameters and allowed ranges for their values. During hydrological model calibration, 8 parameter corrections were made:

- Vegetation-hydrological complex (vertical balance) – CN ,
- Soil porosity (vertical balance) – p ,
- Soil filtration coefficient (vertical balance) – K_{sat} ,
- Maximum vegetation capacity (vertical balance) – $CANmax$,
- Leaking parameter (vertical balance) – n ,
- Surface linear reservoir constant (horizontal balance) – K_{sw} ,
- Underground linear reservoir constant (horizontal balance) – K_{gw} ,
- Snow melting temperature (vertical balance) – (T_{melt}) ,
- Snow melting factor (vertical balance) – $bmelt$.

Once the sensitive parameters are defined, the next step is to evaluate them with manual or automatic calibration methods. In this specific case, due to the calibration problem dimensions and due to the subjectivity of the manual approach, an automatic calibration method was developed that uses the evolution algorithm for multi-criteria optimization. The NSGA-II method was designed to find among the allowed model parameter values those for which the calculated basin runoffs are the closest to the observed runoffs. The evolution algorithm used here is based on the unit populations and heuristic search methods, so that finding the optimal solution, or a solution that is close to the optimal one is quite certain. The range of the corrections made to all parameters is $\pm 30\%$ of the initial parameter value.

The Prvonek reservoir on the Banjska River has a total basin surface of 86.3 km². Period from 1.10.2011 to 30.09.2012 was simulated. Three weather stations were used located in the Prvonek's basin (MS Jazbine, MS Soinci, MS Viti Bor), where air temperatures and

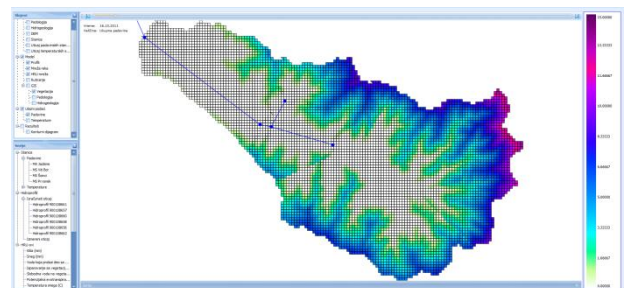


Figure.7 Basin of accumulation Prvonek

precipitations are observed. A balance model was formed

on the Prvonek reservoir profile where the natural flows were obtained that were later compared to the simulated flows. Fig. 7 shows the Prvonek reservoir basin within the software package developed on the Water management institute "Jaroslav Cerni".

The following table shows compared values of the average, maximum and minimum flows for the series of

TABLE I. COMPARATIVE OVERVIEW OF THE SIMULATED AND MEASURED CHARACTERISTIC VALUES

	$Q_{aver.}$	Q_{max}	Q_{min}	R	RMSE	LOGE
	(m^3/s)			$(-)$	(m^3/s)	(m^3/s)
Q	0.992	6.57	0.128	0.844	0.156	0.098
Q_m	0.956	6.97	0.098			

measured and simulated values in the period from 1.10.2011 to 30.09.2012. These results were obtained by

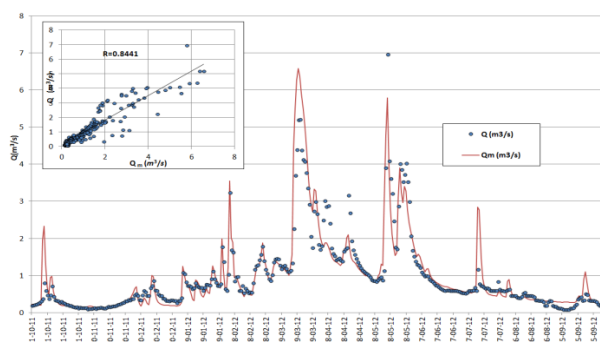


Figure.8 Comparative view of measured and simulated values of daily flow for the period of accumulation Prvonek 1.10.2011-30.9.2012.

the best solution selection for both criteria from the Pareto front, i.e. by selecting the most optimal parameters of the hydrological model.

Fig. 8 shows a comparison of measured and simulated values on the Prvonek's reservoir profile for the entire analyzed period. From the comparative overview of the measured and simulated values and from the comparative overview of the duration curves a relatively satisfying matching of the measured and simulated hydrograph can be seen in the low and average water periods and somewhat less matching in the high water periods which is probably a result of insufficiently precise input data (precipitations, temperatures, etc.) in the high water periods. All the characteristic phenomena were observed, such as snow melting and the base runoff in the dry period. It can be concluded that the basin calibration quality upstream from the Prvonek reservoir profile is satisfying both from the balance and for the runoff dynamic point.

IV. CONCLUSION

The applied distributed hydrological model showed a satisfactory match with the measured daily flows. The parameter calibration was performed with the multi-criteria optimization based on the genetic algorithm. The used NSGA II method with eight different model parameters with a 30% variation from the initial value gave a satisfactory solution. The vertical balance was

calibrated in this occasion with six parameters that affect the water balance. Furthermore, the horizontal water balance parameters were also calibrated, as well as the linear underground and surface reservoir parameters that affect the runoff dynamics. The hydrological model parameter calibration is evaluated as satisfactory, therefore the hydrological model can be used for the operative functioning of the Prvonek accumulation structure.

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Machine Learning Approach for Performance Based Cloud Pricing Model

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Abstract – The current pricing model that cloud service providers offer, charges the customers according to the amount of rented resources. Cloud service providers assure some quality of the pay-per-use model to the customers through defining service level agreements. However, high performance is almost never guaranteed. Therefore, in this paper, we propose a new cloud service provider pricing model that aims to charge the customers according to their performance demands, instead of charging them by acquired resources. Our model is based on machine learning analysis, which aims to perform accurate decisions when offering both performance and cost-effective configurations in the cloud. Hereupon, customers will gain maximum performance with minimum price, and providers will use resources more efficiently.

I. INTRODUCTION

Cloud computing is a new paradigm that enables ubiquitous, convenient, on demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or cloud service provider interaction [1]. The illusion of infinite computing resources available on demand and the ability to pay per use of computing resources on a short-term basis as needed [2], offers several advantages, as reduced costs, ability to scale up as the customer requires, etc. [3]. Computing services need to be highly reliable, scalable, and autonomic to support ubiquitous access. In particular, consumers can determine the required service level through Quality of Service (QoS) parameters and service level agreements [4]. The cloud service provider is required to execute service requests from a customer within negotiated quality of service requirements for a given price [5]. Even though service level agreements provide some level of guarantee of how much of the time the server, platform, or application will be available, the performance is almost never discussed [6]. To fulfill the customer's expectations of proportionality between the performance and the amount paid for resources, we believe that cloud service providers must confront the challenge of configuring their offers in maximum performance – minimum cost manner.

The first step towards the maximum performance – minimum cost concept, was to discuss the performance, i.e., to inspect if the current cloud service providers' business model is beneficial for the consumers. Therefore, in our previous research, we used the current linear pricing offers of the most common cloud service providers: Windows Azure [7], Google Compute [8] and Amazon EC2 [9], to investigate if the performance gain scales to the consumer's monetary costs for

TABLE I
VIRTUAL MACHINE (VM) INSTANCE TYPES AND PRICE SIMULATION FOR WINDOWS PLATFORM

Type	1VM	1VM	3VM	4VM
Windows Azure	0,090	0,180	0,360	0,720
Google Compute	0,145	0,290	0,580	1,160
Amazon EC2	0,091	0,182	0,364	0,728
Scaling factor	1	2	4	8

TABLE II
VM INSTANCE TYPES AND PRICE SIMULATION FOR LINUX PLATFORM

Type	1VM	1VM	3VM	4VM
Windows Azure	0,060	0,120	0,240	0,480
Google Compute	0,145	0,290	0,580	1,160
Amazon EC2	0,060	0,120	0,240	0,480
Scaling factor	1	2	4	8

rented resources. Following the configurations presented in tables I and II, which only differ in price depending on the platform, we created our testing environments. Hereafter, we tested web services with different demands in each of the cloud configurations we defined. The response time analyses of the different web services showed that the cost-performance relation depends on the web services' characteristics. The overall results showed that for a less demanding web service the customer will gain maximum performance for the particular investment, but when adding more characteristics to the web service this performance gain decreases. However, generally the performance gain stays positive [10].

After we proved that the performance scales to the price well enough, we continued our research to inspect the performance impact when sharing the same infrastructure resources among multiple tenants. As we obtained the response time from the testing, we came up with the idea to test its ability to distinguish between different multi-tenant cloud configurations in combination with other metrics as: transactions per second, bytes and bytes per seconds. Using a machine learning approach, we achieved satisfying overall response of 0.904 value of correlation between the outputs and the targets [11].

Hereupon, in this paper we propose performance based pricing model that aims to follow pay-per-performance manner instead of the current pay-per-use pricing scheme. Our approach is machine learning based and allows the cloud service providers to classify and map the customer's input load

into specific cloud configuration. Thus, it uses previous web services analysis in different cloud environments to model the configurations. Once the model is made, the cloud service provider is ready to offer the consumer a maximum performance- minimum cost configuration based on the customer's particular input load.

The rest of the paper is organized as follows. Section II presents recent work related to machine learning in the cloud. The new methodology based on machine learning is presented in Section III. In Section IV we present a case study and the experiments from the methodology implementation. Finally, in Section V we derive overall conclusion and we present our plans for a future improvement.

II. RELATED WORK

This section presents an overview of the recent related work to the use of different cloud behaviors in terms of performance for various resource allocations and several machine learning techniques used in the cloud. In our recent research, we analyzed several different scenarios of web service performance while scaling the resources in the cloud, by varying the client load for different types of applications. For example, the customers can achieve better performance if they utilize smaller VMs rather than by releasing a smaller VM and renting a greater VM, using the same total amount of resources [12]. The cloud achieves even greater performance than the scaled resources for CPU intensive algorithms [13]. The average CPU utilization also varies while scaling the resources and using the same amount of resources, which are allocated in different number of VMs [14].

Both customers and cloud service providers can benefit from intelligent virtualized resources. For example, SmartSLA is a machine learning powered solution for intelligent virtualized resources management [15]. Ganapathi et al. present a statistical driven modeling and its application to data intensive workloads is presented by [16]. By using the statistics, they predict the resource requirements for cloud computing application. This will allow the customers to implement job scheduling, resource allocation, and workload management in their applications. Bodik et al. [17] predict the performance of the system for future configurations and workloads with machine learning approach. Their control policy minimizes resource usage while maintaining the performance. Cloud computing is often hosted on energy consuming data centers. Therefore, energy consumption optimization is another cloud computing and data center issue. Chen et al. [18] adopted machine learning methods for data center workload, thermal distribution and cooling facilities management.

The prediction of the performance is also very important research challenge. For example, CloudProphet [19] predicts the response time of an on-premise web application that migrates to a cloud. Another example, CloudGuide [20] explores

a cloud configuration that meets the performance requirements.

III. THE MACHINE LEARNING APPROACH

In this section we present a methodology using machine learning, which is based on our infant proposal in [21].

A. Input Data Classification

We present a statistical procedure that suggests the best VM configuration for a particular input (load). To obtain a reliable suggestion, cloud service providers must ensure a realistic heterogeneous environment. Thus, an appropriate surrounding would be the one with various cloud settings, hosting web services with different characteristics, loading the servers with a variable load, and a tool to measure the performance in terms of response time and CPU.

According to the existing offers and pricing models on the market, the most common cloud service providers offer their resources organized in a VM with different amount of CPUs, RAM and storage space. Therefore, we propose to create the classes according to the VMs that the cloud service provider offers.

Their cloud resources are elastic and scalable. Upgrade option after releasing the existing "smaller" VM can be realized in two ways, either by renting a new "bigger" VM with more resources, or, by renting "smaller" VMs and balancing the load among them. Downgrade options are realized in opposite way, by releasing the more powerful VM and renting a less powerful VM, or, by decreasing the number of smaller VMs that configure a parallel organization of their solution.

These two approaches to use one VM or more VMs lead to a proposal of two classifications: Single-VM Scaling and Multi-VM Scaling Allocation classes.

1) *Single-VM Scaling Class*: - used if a customer wants to scale the resources by releasing the existing VM and instantiating a new more powerful VM. We classify the input data as C_i , where i denotes the number of scaled resources within a single VM. For example, according to the current market offer of VMs and the number of processor cores in each VM, the classes will be C_1 , C_2 , C_4 and C_8 ; and

2) *Multi-VM Scaling Allocation Class*: - used if a customer wants to scale the resources by instantiating smaller number of VMs instead of the existing number of used VMs. We assume that the customer is using a load balancing technique to activate (instantiate) or deactivate an appropriate VM. The input data should be classified as C_{ji} , where j denotes the number of scaled VMs and i denotes the number of scaled resources within each scaled VM. For example, according to the current VMs on the market, the classes will be C_{j1} , C_{j2} , C_{j4} and C_{j8} , where $j = 1, 2, \dots$ is the number of required VMs.

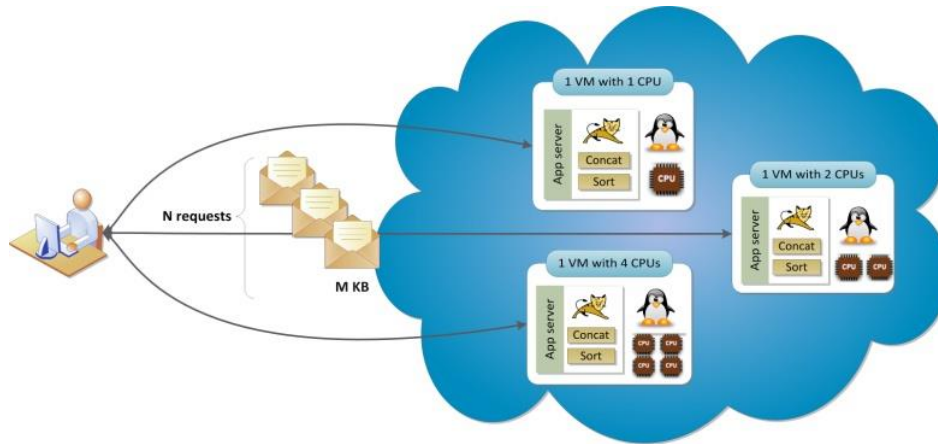


Fig. 1. Cloud testing environment

B. Classification Parameters

In order to compare the classification capabilities of the different metrics for performance evaluation, a customer and cloud service providers should define classification parameters. The classification parameters can be: average response time, throughput in bytes per second, throughput in messages per second, the customer's cost for leasing the resources, the cloud service provider's cost, server's CPU utilization, memory utilization and so on. We must note that some of these classification parameters will be the same since both customers and the cloud service providers are concerned, while other classification parameters will be used only by one side. For example, response time will be a common classification parameter, while the CPU utilization for a certain load will be mostly a parameter analyzed only by the cloud service provider.

Let's denote the customer's classification parameters with CC_1, CC_2, \dots, CC_p and the cloud service providers' with $CSP_1, CSP_2, \dots, CSP_q$. Classification parameters match if $CC_i = CSP_j$ for a certain value of $1 < i < p$ and $1 < j < q$. If there is no match for any value of i and j , then the classification parameters differ, either exist only for the customer, or, for the cloud service provider.

IV. CASE STUDY

In this section we present a simple case study according to our defined methodology in Section IV, which also can be adopted for all most common cloud service providers.

A. Input Load Simulation

As an appropriate testing environment we choose to use a client-server architecture deployed in the open source cloud platform OpenStack [22] using KVM hypervisor to instantiate VM instances. The client and server nodes are installed with Linux Ubuntu Server 12.04 operating system. Hardware computing resources consist of Intel(R) Xeon(R) CPU X5647 @ 2.93GHz with 4 cores and 8GB RAM. The VM instances consist of Linux Ubuntu Server 12.04 operating system and Apache Tomcat 6 as the application server. While preparing

the cloud testing environments we consider a single user case and followed cloud service providers' pricing schemes presented in tables I and II. Therefore, we defined three different cloud environments, i.e., three classes, to simulate realistic occasions when a customer rents different amount of resources:

- *Class 1* - C_1 - VM instance with 1 CPU (core);
- *Class 2* - C_2 - VM instance with 2 CPUs (cores); and
- *Class 3* - C_4 - VM instance with 4 CPUs (cores).

In order to test various web services, we used two document style Java web services. The first web service is a memory demanding web service and returns the concatenation of two strings (Concat web service - CWS). The second accepts two strings and returns their concatenation, but sorted alphabetically (Sort web service - SWS). It is computation intensive, besides the memory demanding feature. Each testing environment hosts the two web services.

The generation of variable server load was performed using the SoapUI [23] software. Each VM instance is loaded with N messages with parameter size of M KB each. The range of parameters M and N is selected such that the web servers in VM instances work in a normal mode, without replying error messages and avoiding saturation. The web services are loaded with $N = 12, 100, 500, 752, 1000, 1252, 1500, 1752$ and 2000 requests per second for each message parameter size $M \in \{0, 1, \dots, 6\}$ KB. The whole cloud testing environment is depicted in Figure 1.

Once we collect enough data from the various test cases, we can proceed to the preprocessing part and produce applicable data for machine learning analysis.

B. Data Pre-processing

The data obtained from the testing environment is raw and inclined to noise. The source of noise can be either the phenomenon that the same VM does not always achieve the same performance using the same hardware at different times among the other active VMs [24], or, due to some other causes as network latency, or, network throughput. To remove any unexpected variability and picks, the raw data needs to be preprocessed. Preprocessing is essential for transforming the parameter values into a new space of variables suitable for

classification. Each web service testing produced different results. Therefore, we organized the data in matrices for each test case specified in Section IV-A by merging the measurements for both web services according to the message parameter size M and the number of requests N . Furthermore, in order to compare the classification capabilities of the different metrics for performance evaluation, we defined three classification cases:

- *Classification case 1* - $CC_1 = CSP_1$ - The performance measured in terms of the Response Time;
- *Classification case 2* - CSP_2 - The performance measured in terms of the CPU utilization;
- *Classification case 3* - CC_2 - The performance measured in terms of Cost.

We choose these classification cases such that to have a common classification case (classification case 1), and at least one that concerns either the cloud service provider (classification case 2), or, the customer (classification case 3). The response time is actually the average response time, measured with the SoapUI tool. The CPU measurements were captured using a top utility tool running on the server side. In order to calculate the cost, in (1) we use the average response time, $T(n)$, and the total number of processors used, n .

$$C(n) = T(n) \cdot n \quad (1)$$

Once the matrices are constructed according to defined classification cases, we need to normalize the values in a particular interval. When selecting an appropriate normalization method, we take into account that the parameters are measured for different web services. Thus, we need a method which will normalize the values, but still preserve all the relationships in the data. Considering the response time matrix, we normalized the data by mapping the rows values to mean 0 and standard derivation to 1, whereas to normalize the CPU and cost data. We mapped the rows minimum and maximum values to $[-1,1]$.

Even though our problem does not handle hundreds of parameters, we believe that the principal component analysis may be advantage. Principal component analysis (PCA) is a multivariate technique that intends to extract the important information from the matrix, to represent it as a set of new orthogonal variables and to display the pattern of similarity of the observations [25]. After using the PCA, some message sizes have been removed as unnecessary parameters.

Once the raw data is preprocessed, it is prepared for the classification process.

C. Using the Machine Learning

Since the data is labeled and we know the desired output for each input vector, we can use supervised machine learning techniques. When using a supervised learning technique, the classifier learns from a training data. The training data needs to be carefully selected so that the overfitting classification issue must be avoided. If overfitting occurs, then the classifier is biased to the training data, and the classifier's accuracy decreases when new unknown data arrives. To prevent overfitting, we used a specially designed function in Matlab that randomly divides the input data into three non-overlapping sets according to specified ratio values. The training set was

used to train the classifier, the validation set was used to adapt the classifier, and finally the testing set was used to test the classifier's ability to discriminate between the three classes.

When choosing appropriate classification technique, we must be aware of the multiclass problem. Kotsiantis et al. [26] state that neural networks tend to perform well with multidimensions and continuous features. Therefore, we decided to use a probabilistic neural network (PNN), as a kind of radial basis network suitable for classification problems. After the classifier is trained, it is ready to classify new and unknown load inputs.

F. The Experiments

In this section we present the conducted experiments. We analyzed the web services' performance in the three cloud environments defined in Section IV-A in terms of CPU and response time. In order to measure each metric's capability of distinguishing the three cloud environments, we decided to use both of them independently in the classification process. Additionally, in order to make economy model of the classes, we calculated the cost using the response time for all three test cases with different number of VM instances.

All input data was normalized according to the normalization methods discussed in Section IV-B. After that the data is being divided into three non-overlapping sets of which 60% of whole data belongs to the training set, 20% belongs to the validation set and 20% belongs to the testing set.

After appropriate preprocessing of the training data, we used principal component analysis to find pattern similarities. The principal components that contribute less than 1% to the total variation in the data set were eliminated. Hereupon, we used probabilistic neural network with a spread of radial basis function of 0.01, to map the data into three classes, each with different number of CPUs.

As a classification technique, we used the two layers PNN depicted in Figure 2. In the training process we used batch training function with weight and bias learning rules. After the network was trained, we proceeded with its adaptation to the validation set. As an adaptation function we used a function that trains a network with weight and bias learning rules.

After the network was trained, we proceeded with its adaptation to the validation set. As an adaptation function we used a function that trains a network with weight and bias learning rules with sequential updates [27]. Eventually, the network has been trained in 50 epochs and adapted in 100 passes. The results show that the response time and the cost analysis perform the best classification. Hereupon, taking the results from these metrics, the cloud service provider can offer the customer both high demanding and economical VM configuration. For example, a particular load known to belong to class 1, according to response time was classified as it belongs to class 4. It means that once the cloud service provider gets the load, it will propose a VM with 4 cores to the customer. However, the classification according to the cost analysis proposed a VM with 1 core to be the appropriate cost-effective choice. Therefore, considering the high accuracy of the classifier, and also the real classes, we assume that this decision is reliable.

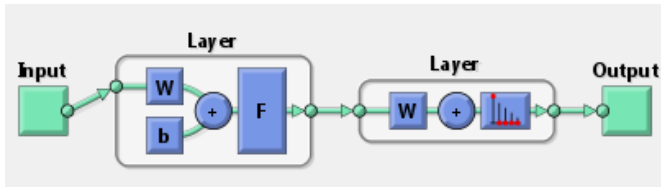


Fig. 2. Probabilistic Neural Network

V. CONCLUSION AND FUTURE WORK

The current cloud service providers business model charges the consumers according to the amount of rented resources. In this paper we propose a new cloud service provider pricing model that aims to charge the customers according to their performance demands. To obtain a realistic modeling we provided appropriate testing environments, each with different number of CPU cores. The testing procedure produced results for the response time and the CPU. We additionally used the response time to provide cost analysis. Hereupon, we implemented well defined methodology to preprocess the data and prepare it for machine learning analysis. In order to handle the multiclass problem we used probabilistic neural networks. The results from the classification showed accurate decisions when mapping the data into each cloud setting. That is, the cloud service provider should propose a VM with 4 cores to the customer in order to achieve maximum performance, and a VM with 1 core for the appropriate cost-effective choice.

In our future work, we aim to improve the presented methodology by performing more tests to obtain different performance metrics, and therefore, to build even more accurate classifier based on machine learning analysis.

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Learning Approaches Based on Information and Communication Technologies

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Abstract - In the last few decade, education has been developing in accordance with the progress of information and communication technologies (but not only in terms of using innovative digital devices), which first commenced with the emergence of personal computers in the 1980s and then the Internet in the 1990s. There are also some implications regarding perceptive approach to e-learning, starting from the behaviorism to the cognitive and social constructivism or more precisely, from the transfer of knowledge to its assimilation. From the theoretical point of view, this paper briefly discusses teaching and learning in the institutional education, starting from the introduction of traditional (technology-based) instructions to the contemporary, “web-based e-courses” – by means of associate and social activities.

1. INTRODUCTION

Nowadays, information and communication technologies (ICT) permeate all aspects of our lives. They significantly contribute to the areas of education and learning, operations performed at work, management, entertainment etc. They are identified as catalysts for changes referring to the work conditions, operation and exchange of information, teaching methods, approach to learning in scientific research and other areas. E-learning experienced a shift from linear to hypermedia learning, from teaching to construction and discovery, from the approach of teachers to vocational education of students, from absorption of learning material to the manner of progress and learning, from school to lifelong learning, from one universal dimension to the ever more adaptable learning, from learning hard to learning while having fun, and from a teacher who is a lecturer to a teacher who is a facilitator [12].

Different terms are in practice used as synonyms for e-learning, for instance: computer-based learning, instructions provided by a computer, web-based learning, distance learning, online courses, multimedia instructions, networked learning etc. [1].

E-learning technologies in education become powerful in terms of hardware, software and applications. New and conceptually different educational technologies keep emerging but computers, networking and hypermedia remain basic paradigms for different roles of e-learning. The Internet and web- based applications are most commonly used educational technologies in the system of e-learning.

The advancement of educational technologies based on the ICT enables experts to develop alternative learning

theories. Changes in education do not affect only pedagogy of traditional learning and education management but it is also characterized by changes within e-learning studying environment. Those changes are in this paper described from the progress perspective, starting from earlier and new communication technologies up to the emergence of ICT, and they are divided into three phases: traditional e-learning, integrated learning and contemporary virtual e-learning.

There is a correlation between technological advance in e-learning and the theories of learning, such as: behaviorism, objectivism, constructivism and cognitive and social constructivism.

2. CHANGES IN EDUCATION

Higher education has been moving towards constructivism ever since the emergence of the Internet in the 1990s and the universal networking via ICT, which enabled the global mass communication and access to the international knowledge resources. Bearing in mind the wider approach to the knowledge resources and platforms, contemporary theory suggests that the method of collaborative learning in digital environment is the most efficient and that teaching and learning are significantly facilitated by it. [2].

The technology of e-learning is constantly developing and changing and those changes do not only include the computer practice but also the society's perception of technology. This technological and economic paradigm perceives the users as the creators to a greater extent. Viewed from a broader perspective, the paradigm of changes in e-learning is characterized by objectivism, constructivism and social constructivism, which indicates different levels of e-maturity and scientific advance.

- **Behaviorism:** According to the behavioral approach, the process of learning is related to the formation of associations between certain stimuli and responses of the body. It indicates that support and reward have a very important role in the learning process. According to this theory, the evaluation of the comprehension level is measured by means of tests, tasks and exams. “At the turn of the 19th century, behaviorism emerged as a response to mind theories because it represents the idea that mental processes cannot be comprehended without objective, scientific methods, such as

observation and measurement as well as the stimulus-response experiment. In the traditional education, a teacher has a complete control over the curriculum, dictates the pace and guides learning, thus making it a sequential process with only one reality, understanding of which students demonstrate through declarative, procedural and conditional knowledge". Traditional e-learning influences the promotion of technical rationality grounded in objectivism [3]. In this sense, knowledge represents a set of actions and responses prompted by specific environmental stimuli and it does not exist in any way outside of it. In terms of knowledge delivery, these questions and answers also include exercises with gradual increase in difficulty and frequent feedback, mostly positive and encouraging [4]. Behavioral methods are commonly used in e-learning systems, for instance, in evaluating the acquired knowledge of certain students after a teacher's presentation of a lesson.

- **Constructivism:** This learning theory focuses on a student and is realized contextually on the basis of beliefs and opinions. The teacher encourages students to find their own solutions and to broaden their previous knowledge and experience. Students learn together, integrate new information into what they have already known and actively construct their comprehension. Instead of teaching and learning, in which students memorize and present the lessons learnt thus gaining the new knowledge, it is necessary to design learning and task environments in such manner that students could gain practical experience as much as possible so that they could independently study certain material, acquire new ideas and set hypotheses, work and cooperate in the projects in order to get the clearest possible picture of the real conditions in which they will put their academic skills into practice. Constructivism is a revolutionary shift in educational psychology. It was established on the works of Piaget, Dewey, Vygotsky, Bruner and Papert and it emphasizes the importance of active involvement of students in the construction of their knowledge. Constructivism defines learning as a process in which a student actively constructs new ideas or concepts based on the previous or present knowledge/experience. As a theoretical concept, it implies the construction of knowledge based on personal experience and it is unique for every student. The process of learning implies that a student independently chooses and processes information, sets hypotheses and makes decisions based on his/her personal mental models. The dominant opinion in the constructivist theories is that learning is achieved by active construction of knowledge supported from different perspectives within created contexts and social interaction. Using the ICT and resources which support unique learning objectives and knowledge construction, the appropriate e-learning environments are created in which substantial relevant experience is gained.

Constructivists believe that students have many versions of reality. As such, "learning depends on the

ability of a student for analysis, synthesis and information evaluation which are the basis for creating and personalizing knowledge" [2].

Constructivism emphasizes learning as a process of personal development and understanding of meanings, and it is regarded more as the construction of knowledge than memorizing of the facts.

Contemporary ICT offer numerous possibilities for the constructivist approach to learning. However, having in mind the fact that knowledge is constantly being enhanced, the principles of the design development should be in compliance with requirements and efforts of teachers and students. The trend in e-learning is the provision of cognitive instruments which could be adapted to the intellectual partnership between the teachers and the students and which could facilitate critical thinking about learning at a higher level. [3].

In the summary of a paper [5] it is stated that in ICT, 3D virtual worlds have an enormous potential for contributing to the design of education as constructivist learning environment. The technology of virtual worlds enables students to cooperate within 3D virtual environments, such as Second Life and Active Worlds, which support synchronized communication, 3D modeling and real-time design.

- **Cognitive constructivism:** In cognitive constructivism, the priority is given to the cognitive capacity of an individual. For example, the "learning style" of every student indicates his/her cognitive tendencies. E-learning developers are facing the challenge of creating systems which would support individual differences in students, such as gender, ethnicity, cognitive learning style etc. Expectations can be even greater since ICT could play the crucial role in learning if digital and adaptive cognitive tools or systems supporting constructivist learning are provided.

Learning based on a computer-designed environment has undergone a paradigm of shifting a student away from the instruction, which was considered to promote technical rationality based on objectivism, towards the use of computers in order to create cognitive tools used in constructivist environments [3]. Therefore, in terms of teaching, there is still the need for memorizing behavioral activities. Here, the focus is on a teacher's encouragement of students to evaluate their beliefs, to challenge them in the light of new evidence and to adopt new theories of the world which the presented facts better conform to [4].

Since students have different cognitive learning styles, teaching techniques advocating individual styles suit them better. Also, with the rapid development of digital technology in the information society, the user is ever more required to be involved and to manage the cognitive skills in the process of teaching and learning. Therefore, the cognitive learning is the end result of a student's creation and test of personal hypotheses on the real world, in which data is processed in accordance with the lesson on "style, desire and" in accordance

with the dynamic process of personal trials and mistakes [4] by actively engaging students and by cognitive participation of teachers.

- **Social constructivism:** Unlike cognitive constructivism, social constructivism emphasizes “collective learning” where the role of a teacher, parent, peer and other members of the community is most evident in providing mutual assistance. Social constructivism is based on the viewpoint that learning is an active, contextual and social process, that studying in groups gives best results and that the teacher has a role of a guide and moderator in the cognitive process.

In contrast to the traditional classrooms where teachers use the linear model and one-way communication, the contemporary learning becomes more personal, student-orientated, and the management of student activities becomes non-linear.

Cognitive constructivists believe that learning takes place only through the interaction with environmental stimuli while social constructivists claim that the culture also influences the design and development of learning models [4]. It is necessary to put e-learning behind the management systems and involve the students in active use of the web as the source of their independent problem solving based on joint activities, as it is the case with social software [6]. The concept of social constructivism emerged in the 1990s, with the beginning of research into transfer, design and the development of information systems based on computers. Also, researchers believe that the interaction with the computer is human and social, not para-social. However, there are few studies that investigate student-computer interaction, and therefore little is known about their social aspects. This is a variant of constructivism based on the assumption that learning is inseparable from its social context, while the cognitive constructivist theory suggests that learning only occurs through interaction with environmental stimuli.

3. TRANSFER AND ASSIMILATION OF KNOWLEDGE

The road from behaviorism to constructivism is characterized by changes in the way in which students acquire knowledge and skills. Objectivism implies the transfer of knowledge from a teacher to a student; cognitive constructivism emphasizes gaining knowledge through agreements, while social constructivism offers environments in which students assimilate knowledge from the beginning until the end by self-regulating the learning platform [7]. E-learning includes the integration of educational technologies, from applications such as PowerPoint, which slightly influence the teaching strategies and learning, to the virtual learning environments and systems for managing learning environments, which can have a significant impact on teaching strategies, organization, and the learning itself.

- **Traditional/objectivist knowledge transfer:** Programmes of the traditional e-learning represent a form of didactic approach to knowledge transfer with the passive acceptance of it, in which a well-prepared teacher uses the linear model. The transfer of knowledge is in the form of one-way communication.

- **Objectivist/constructivist approach to learning:** Since the 1990s, e-learning has been supplemented with new media, particularly e-mail and discussion groups / forums. For example, there were e-learning models with devices for monitoring the forum discussions where participants could read and send messages, engage in a debate and assist one another.

After the failure of the traditional e-learning, constructivist thinking emerged [3]. According to constructivists, knowledge is created through active cooperation and participation of students in the "discussions" on the content and context of knowledge, whereby each individual constructs their own knowledge and integrates it from the resident memory with prior experience. There are four main mechanisms for motivating and encouraging students and participants to take part in e-learning environments. The personal approach, personal reputation, sense of community (altruism) and agreement on flattering recognition are primarily in effect here [8].

- **Social constructivist approach to the knowledge assimilation:** In 1993, Lemke [16] predicted that in the near future, all libraries in the world would become a virtual library, that all databases containing information from various fields would be available via a common interface and would contain not only a great volume of texts and figures, but also every form of visual and audio information. Modern e-learning environments are loaded by means of very powerful models of digital devices, especially on the Internet, which has revolutionized the perception of the people who use it for interaction, exchanging messages and learning. The Internet contains millions of Web pages, sites, portals, archives, databases where students can independently develop or acquire knowledge and has many other means for identifying some kind of "harvested knowledge" [7].

Nowadays, e-learning is facilitated by Web technologies which deliver knowledge to the end user of a computer, thus creating the possibility of interconnecting teachers, students and information and therefore providing conditions for learning in a social context [9]. The authors highlight the fact that in recent years, e-learning has not just been another medium for the transmission of knowledge, and state the fact that the relationship between teachers and students has been changing as well. This requires new skills, abilities and attitudes from the planners, managers, teachers, and coaches, who will design and develop materials and online support to students [7].

By means of the Internet, students have access to a virtually unlimited amount of information. Web-based learning is available worldwide, maintenance cost is low, security is enhanced, platforms are independent, information is updated to a greater extent and there is also the possibility of adaptation to different learning styles.

4. A SHORT OVERVIEW OF THE PERSPECTIVE OF ELECTRONIC LEARNING

The transition from objectivism to constructivism is multi-dimensional, which means that deviations must occur: from collection to transfer of knowledge, from traditional e-learning to virtual learning, and from earlier technologies to new hardware [7], [10]. Transitions in the field of e-learning applications in higher education are accomplished through the following phases:

- Traditional e-learning: older technologies (i.e. e-mail) are used for the acquisition of knowledge, the transfer is conducted by means of the objectivist and behaviorist pedagogical models and learning is accomplished through one-way communication from a teacher to a student [2];
- Integrated (combined) e-learning: most institutions, especially in developing countries, are gradually going through a phase of integrated e-learning by combining the previous and new technologies (talks and discussion forums / groups). In both methods, two-way communication is predominant;
- Virtual learning: When there is a high level of cooperation between the stakeholders, there is a possibility for group learning, but also for creating environments for highly individualized teaching and learning. Through personalization and integration of technologies, each user individually adapts to the communication link types such as 'one to many' and 'many to many'.

Educational areas (primary, secondary and higher education) of developed, less developed and developing countries view these phases differently. Also, every higher education institution tackles with the pace of transition differently in comparison to other institutions and every single user of e-learning tools goes through different phases in comparison to their colleagues from the same institution. These differences between countries, sectors, institutions and individual users result from the contextual variations of the involved entities. The ICT resources, management and technical support, professionalism, digital literacy of programmers and users are different. The demographic characteristics (age, gender, level of education) should not be neglected as well.

There is no doubt that ICT are regarded as essential to the education in the 21st century, but the learning management will not be significantly facilitated [6]. Therefore, the design of e-education and e-learning should be based on the constructivist theory, in which the knowledge is acquired through active involvement of students who mutually cooperate and agree on the content

[11]. Constructivist learning depends mainly on the ability of students to analyze, synthesize and evaluate information in order to develop relevant personalized knowledge [2].

5. CONCLUSION

There is also an improvement in the area of computerized lessons, where students switch from learning by using technology to learning by applying cognitive tools and constructivist environments [3]. However, "there is a lack of a clear concept of education, for example, on the basis of social constructivism" [13].

Researchers believe that critical thinking skills must be strong and that constructivist pedagogical requirements must always be prerequisites for using computers in teaching [14]. However, this requires a broader study of teaching practice, user attributes and the development of e-learning environments [2].

Experience shows that traditional models of e-learning have not bridged the gap between theory and practice [3], which is why developers have to go beyond the paradigm of their field of expertise while designing the educational software, for which interdisciplinary cooperation with teachers and students is crucial [15]. Today, social constructivist pedagogical approaches "provide strong arguments to the contrary approach, according to which we consume structured knowledge" [10]. Social software supports social constructivist e-learning, providing in such way the possibility for personalizing tools for involvement in social networks.

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Data Gathering from Web Sites

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Abstract - In this study we have created the application which is able to collect data from websites. Application access to data stored on the internet over various locations. It is a Web Data Mining system realized by using .NET technologies. An initial set of sites is obtained by using the Google API. They are then parsed using the Html Agility Pack library. In the paper are analyzed different approaches in collecting the required content, as well as the time required for their completion. To obtain the correct information, the application has been tested on a large number of pages.

I. INTRODUCTION

World Wide Web is today present in almost all countries in the world. Success is based on its enormous size and the fact that there is no centralized control over its content. Those issues are in the middle of problem for locating information.

Web crawling is the process which collects pages from the World Wide Web in order to collect some useful information from them. Information Retrieval (IR) is the area of computer science concerned with retrieving information about a subject from a collection of data objects. This is not the same as Data Retrieval, which in the context of documents consists mainly in determining which documents of a collection contain the keywords of a user query [1]. In its survey Brooks [2] states that we could make difference between “closed Web”, which is consisted of high quality controlled collections on which a search engine can fully trust, and the “open Web”, which includes the vast majority of Web pages and on which traditional IR techniques concepts and methods are challenged.

In searching web pages, web crawler usually creates a collection which is indexed and searched. This type of design of search engine is called “cascade”. Web crawler is just a first stage in process of searching web. Second stage is indexing and third is searching. This process is shown in Fig. 1.

There are two main parts of Web search process: off line and on line. Off line process is used to download subset of the Web in order to create a collection. This process is usually executed periodically by search engine. The on-line part is executed every time when user executes its query. It uses index to select documents from the collection according to their relevance.

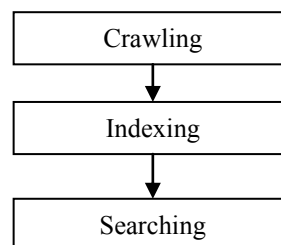


Figure 1. Architecture of search engines

Pages on the Web can appear in many different formats. The most often are HTML pages, plain text and PDF documents. The first stage for indexing Web pages is to extract a standard logical view from the documents. The most used logical view for documents in search engines are the “bag of words” model, in which each document is seen only as an unordered set of words. In modern Web search engines, this view is extended with extra information concerning word frequencies and text formatting attributes, as well as meta-information about Web pages including embedded descriptions and explicit keywords in the HTML markup [1].

In this research, we examined different approaches in collecting content from web sites which is then used in order to index those pages.

II. USED TECHNOLOGIES

As a main technology in this research, we have used Html Agility Pack library. It is an open source project created for parsing HTML pages. It is a .NET code library that allows parsing “out of the web” HTML files. The parser is very tolerant with “real world” malformed HTML. This library will help us to do HTML operation in a simple manner like we do with XML. .NET framework has classes for manipulating XML files as a collection of XML nodes. In the same way HTML Agility treat html contents as a collection of HTML tag nodes. We can do any type of operation on this node collection. This is an agile HTML parser that builds a read/write DOM and supports plain XPATH. Latest version supports Linq to XML, which makes usage of Html Agility Pack simpler.

A. XPATH

XPath is an expression language that allows the processing of values that are represented as trees in XML documents, as well as atomic values like integers, strings and Booleans. It is also capable of processing sequences that may contain both references to nodes in an XML

document and atomic values. The result of XPath expression may be selection of nodes, or some atomic value.

XPath is expressed through location path. A location path consists of a sequence of location steps, where each step has three components:

- an axis
- a node test
- zero or more predicates

An XPath expression is evaluated with respect to a context node. An Axis Specifier such as “child” or “descendant” specifies the direction to navigate from the context node (in or out). The node test and the predicate are used to filter the nodes specified by the axis specifier [3].

The XPath syntax comes in two different shapes. The first is abbreviated syntax, which is more compact and allows XPaths to be written and read easily using intuitive and, in many cases, familiar characters and constructs. The second is full syntax, which is more verbose, but allows for more options to be specified, and is more descriptive if read carefully.

The abbreviated syntax can be written in following form:

/A/B/C

Previous expression states that all C elements will be selected that are children of B elements, that are children of the A element, that forms the outermost element of the XML document. The XPath syntax is designed to mimic URI – Uniform Resource Identifier syntax.

The full syntax can be written in following form to match previous abbreviated syntax:

/child::A/child::B/child::C

Here, in each step the axis (child) is explicitly specified, followed by :: and then the node test, such as A.

B. Linq to XML

XML data has become ubiquitous in data-centric applications. Many commercial database management systems support XML storage. Yet, the problem of translating between XML and objects automatically is largely unsolved, due to differences in the expressive

power of their type systems [4] and the difficulty of translating object queries into an XML query language such as XQuery [5].

LINQ to XML is an approach to construct, write and read XML data in the .NET language such as C# in our work. This API simplifies working with XML data without having to resort to using additional language syntax like XPath or XSLT. LINQ to XML is a component of the LINQ project and is consistent with other projects such as LINQ to Objects and LINQ to SQL. LINQ to XML is a modernized in-memory XML programming API designed to take advantage of the latest .NET Framework language innovations. It provides both DOM and XQuery/XPath like functionality in a consistent programming experience across the different LINQ-enabled data access technologies.

There are two major perspectives for understanding LINQ to XML. From one perspective, LINQ to XML can be viewed as a member of the LINQ Project family of technologies, where LINQ to XML is providing an XML Language-Integrated Query capabilities along with a consistent query experience for objects, relational database (LINQ to SQL, LINQ to DataSet, LINQ to Entities), and other data access technologies as they become LINQ-enabled. From second perspective, LINQ to XML can be viewed as a full feature in-memory XML programming API comparable to a modernized, redesigned Document Object Model (DOM) XML Programming API plus a few key features from XPath and XSLT.

LINQ to XML was developed with Language-Integrated Query over XML in mind from the beginning. It takes advantage of standard query operators and adds query extensions specific to XML. From an XML perspective, LINQ to XML provides the query and transformation power of XQuery and XPath integrated into .NET Framework languages that implement the LINQ pattern. This provides a consistent query experience across LINQ enabled APIs and allows combining XML queries and transforms with queries from other data sources.

Just as significant as the Language-Integrated Query capabilities of LINQ to XML is the fact that LINQ to XML represents a new, modernized in-memory XML Programming API. LINQ to XML was designed to be a cleaner, modernized API, as well as fast and lightweight. LINQ to XML uses modern language features (e.g., generics and nullable types) and diverges from the DOM programming model with a variety of innovations to simplify programming against XML. Even without Language-Integrated Query capabilities LINQ to XML represents a significant stride forward for XML programming [6]. LINQ to XML is designed to be a lightweight XML programming API. This is true from both a conceptual perspective, emphasizing a straightforward, easy to use programming model, and from a memory and performance perspective. Its public data model is aligned as much as possible with the W3C XML Information Set.



Figure 2. Presentation of William Hill sports booker

III. EXPERIMENTAL RESULTS

In our work, we tested execution times for gathering content from web sites. Content was obtained in two different ways. First included usage of XPath technology, while second includes usage of Linq to XML technology. As a test case, we used web presentation of William Hill sports booker. We used this page because it consists of large number of links and tables, which can help us to assess real performance of different technologies. This page is shown in Fig. 2.

First test included execution time in gathering all links from William Hill home page. Links are defined as tags whose name is "a", without any other assumptions. Implementation of XPath and Linq to XML approaches are shown in following listing.

```

HtmlDocument doc = new HtmlWeb().
Load("http://sports.williamhill.com/bet/en-gb");

// XPath approach
timer.Start();
var node = doc.DocumentNode.SelectNodes("//a");
timer.Stop();

timer.Reset();

// Linq to XML approach
timer.Start();
var nodeLinq = doc.DocumentNode.Descendants().
Where(n => n.Name == "a");
timer.Stop();
    
```

Execution times are shown in table 1. The whole process was performed five times. Execution times for each technology are measured in seconds. Last row contains average time. By examine table 1, we can see that Linq to XML is much faster. Each execution retrieve 436 links, but Linq to XML performed that execution about 100 times more quickly.

The second test was a little more complex. It included obtaining execution time in gathering table data (<td>) tags whose ancestor is table row (<tr>) tag and who has attribute "class" whose value is "leftPad". Implementation of this, more complex query, is shown in following listing.

From listing, we can see that implementation of XPath approach is much shorter and easier to read. Execution times for both approaches are shown in Table 2.

TABLE I. EXECUTION TIMES FOR LINK GATHERING IN SECONDS

No.	Used technology	
	<i>XPath</i>	<i>Linq to XML</i>
1	0.0568046	0.0006088
2	0.0603919	0.0005907
3	0.0597061	0.0005792
4	0.0600868	0.0005895
5	0.0592557	0.0005935
Avg	0.05924902	0.00059234

```

HtmlDocument doc = new HtmlWeb().
Load("http://sports.williamhill.com/bet/en-gb");

// XPath approach
timer.Start();
var node = doc.DocumentNode.
SelectNodes("//tr/td[@class='leftPad']");
timer.Stop();

timer.Reset();

// Linq to XML approach
timer.Start();
var nodeLinq =
from item in doc.DocumentNode.Descendants("tr")
from tdItems in item.Elements("td")
.Where(k => k.GetAttributeValue("class", null)
== "leftPad").ToList()
select tdItems;
timer.Stop();
    
```

From Table 2 we can see that execution time for Linq to XML is faster even more comparing to XPath approach. This difference is now about 138 times.

IV. CONCLUSION

In this paper we presented two approaches for gathering data from web sites. The first approach is XPath, while the second is Linq to XML. Both approaches are very common and are applied in many real life applications. In this research we were interested in their performances when applied on same web pages. We took two tests. First involved gathering all links that are present on observed page, while second include gathering all table data tags, who are inside table row tags and whose "class" attribute has value "leftPad". By examine execution time, we concluded that Linq to XML is much faster. In first experiment it executes about 100 times faster, while in second, the execution was about 138 times faster. As a conclusion, we recommend usage of Linq to XML technology mostly because of its speed, but also because of its syntax which is widely used in other Language Integrated Query technologies (Linq to Objects, Linq to SQL ...).

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TABLE II. EXECUTION TIMES FOR TABLE DATA GATHERING IN SECONDS

No.	Used technology	
	<i>XPath</i>	<i>Linq to XML</i>
1	0.0879458	0.0006260
2	0.0874573	0.0006257
3	0.0869481	0.0006375
4	0.0870812	0.0006212
5	0.0850799	0.0006233
Avg	0.08690246	0.00062674

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Data retrieval from database

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Abstract - The database is a collection of interrelated data organized in tables and other data structures and is used by one or several applications. The main purpose of the database is to be data warehouse. Data can be of different types, text, numeric, image, audio, video, etc.. In this study we compared performance of the database when an application queries are created by using the Entity framework, and when queries are created by using the stored procedures. In the research, we used same tables with various data types. The research was performed over varying amounts of data in order to see the difference in performance.

I. INTRODUCTION

A database is an organized collection of data. The data is typically organized in such way to model some aspects of reality. Database management systems (DBMS) are specially designed applications that interact with the user, other applications and the database itself in order to allow definition, creation, querying, updating and administration of database.

The development of database technology can be divided in three stages. Those stages are navigational, SQL/relational and post relational.

Navigational stage in database development process included hierarchical model, presented by IBM's IMS system, and network model which was implemented in a number of products.

Relational database was first proposed in 1970 by Edgar Codd [1], but has reached its full potential in mid-1980s when computing hardware become powerful enough to allow relational systems to be widely deployed. Today, those databases are dominant in almost all large-scale data processing applications.

Object databases were invented in the 1980s to overcome the inconvenience of object-relational impedance mismatch, which led to the coining of the term "post-relational" but also development of hybrid object-relational databases [2].

The next generation of post-relational databases in the 2000s became known as NoSQL databases, introducing fast key-value stores and document-oriented databases. A competing "next generation" known as NewSQL databases attempted new implementations that retained the relational/SQL model while aiming to match the high performance of NoSQL compared to commercially available relational DBMSs.

In this paper we are using Microsoft SQL Server. It is a relational database management system which is developed by Microsoft. External interface to SQL server is implemented via protocol layer. All actions that can be performed by SQL server have to communicate with it via Microsoft defined special format that is called Tabular Data Stream (TDS). TDS is an application layer protocol, used to transfer data between a database server and a client [3].

Data retrieval from SQL Server can be performed in many different ways. In this paper, we are comparing data retrieval using Entity framework and stored procedures.

II. USED TECHNOLOGIES

A. Entity framework

The ADO.NET Entity Framework [4] is a technology designed to elevate the level of abstraction at which application developers work when creating and maintaining data-centric applications. To achieve this goal, it focuses on three main areas:

- a higher-level data model for applications to operate on
- an object services layer that exposes the application data through an object-oriented interface and processes create/read/update/delete operations on objects, and
- support for the language-integrated query (LINQ [5]) mechanism in the upcoming version of C# and Visual Basic [6].

The Entity Framework makes the conceptual data model concrete by a runtime that implements an extended relational model – the Entity Data Model, or the EDM - that embraces entities and relationships as first class concepts, a query language for the EDM, a comprehensive mapping engine that translates from the conceptual to the logical (relational) level, and a set of model-driven tools that help create entity-object, object-xml, and entity-xml transformers. The Entity Framework is part of a broader Microsoft Data Access vision supporting a family of products and services so customers derive value from all data [7].

B. Stored procedures

Stored procedures are subroutines available to applications that access relational database systems. Typical use for stored procedures includes data validation or access control mechanisms. Furthermore, stored

procedures can consolidate and centralize logic that was originally implemented in applications and that is going to be called often. Extensive or complex processing that requires execution of several SQL statements can be moved into stored procedures, and all applications call the procedures.

Stored procedures are stored in SQL server, which gives us many advantages

- Security due to encryption
- Being able to hold the code in a central repository
- Reducing the amount of data passed over a network
- Hiding the raw data by allowing only stored procedures to gain access to the data

When a stored procedure is created, it passes through several steps. First of all, the T-SQL is parsed and resolved, saved to the disk, and stored in SQL Server. The first time the procedure is executed, the procedure is retrieved and optimized, on the basis of any data queries and values passed through parameters. SQL Server will inspect the code and try to use the best indexes on the tables, which are referenced by checking the statistics that are held for those tables. The query plan is then cached within SQL Server, ready for any further executions.

When we run a stored procedure, Adaptive Server prepares an execution plan so that the procedure's execution is very fast. Stored procedures can:

- Take parameters
- Call other procedures
- Return a status value to a calling procedure or batch to indicate success or failure and the reason for failure
- Return values of parameters to a calling procedure or batch

III. EXPERIMENTAL RESULTS

In this paper, we want to compare execution performance between two widely used techniques in data retrieval from databases. Those techniques are entity framework and usage of stored procedures. Stored procedures are stored on server and can be called by entity framework or without it. This means that we have three

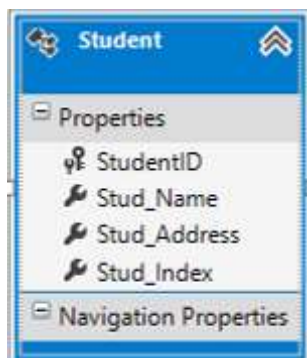


Figure 1. Table Student used in testing process

TABLE I. EXECUTION OF SINGLE ROW DATA GATHERING USING DIFFERENT TECHNOLOGIES IN MILLISECONDS

No.	Used technology		
	Entity framework	Entity framework & stored procedure	Stored procedure
1	73,7867	21,6379	3,0502
2	73,4613	33,4714	3,5064
3	74,5893	30,5651	3,2594
4	74,9494	26,3074	3,2383
5	74,8236	23,3980	3,2631
Avg.	74,32206	27,07596	3,26348

executions: data gathering by using entity framework, data gathering by using stored procedures throw entity framework, and data gathering by direct calling stored procedures. All execution times were tested on table Student that is shown in Fig. 1. Table contains four columns, where first column named StudentID is primary key. Table is populated with 10000 records.

A. Obtaining single record from table

The first experiment was to obtain single record from table. This record was selected according to its primary key value. The first execution was by using entity framework. Code for gathering data is shown in following listing.

```
timer.Start();
Student student = (from s in entities.Students
where s.StudentID == 6000
select s).FirstOrDefault();
timer.Stop();
```

From listing we can see that the goal is to obtain record whose id is 6000.

Stored procedure for obtaining the same data can be defined as follows:

```
CREATE PROCEDURE [dbo].[SelectStudent]
AS
Begin
    SELECT * FROM Student
    WHERE StudentID = 6000
End
```

This procedure can be called from entity framework, or without using it. Calling procedure SelectStudent from entity framework is implemented by following code:

```
timer.Start();
SelectStudent_Result student =
    entities.SelectStudent().FirstOrDefault();
timer.Stop();
```

Calling procedure SelectStudent without entity framework requires establishing manual connection to database and creating command that represents call to stored procedure.


```
string oConnString = @"data source=(LocalDB)\v11.0;
    attachdbfilename=|DataDirectory|\EntitySample.
    mdf;integrated security=True;
    MultipleActiveResultSets=True";
SqlConnection oConn = new SqlConnection(oConnString);
oConn.Open();
SqlCommand oCmd =
    new SqlCommand("SelectStudent", oConn);

timer.Start();
SqlDataReader rdr = oCmd.ExecuteReader();
timer.Stop();
```

All executions were performed multiple times. Five randomly chosen values and average values are shown in Table 1 and Fig. 2. From them, we can see that stored procedures are the fastest. When directly compare stored procedure and entity framework execution, we can see that stored procedure executes almost 25 times faster. Calling stored procedures from entity framework is much slower that calling it without entity.

B. Obtaining multiple record from table

The second experiment was to measure execution time when obtaining multiple rows from single table. Those records were also selected according to their primary key values. Code for getting those records using entity framework is shown in following listing.

```
timer.Start();
List<Student> students = (from s in entities.Students
    where s.StudentID >= 6000
    where s.StudentID < 7000
    select s).ToList();
timer.Stop();
```

From listing we can see that we are going to obtain 1000 rows and put those data in list. Those data has ID between 6000 (including that record) and 7000.

In order to test data gathering using stored procedure, we only need to change stored procedure, while the code that is used to call it, remains unchanged. Stored procedure is shown in following listing

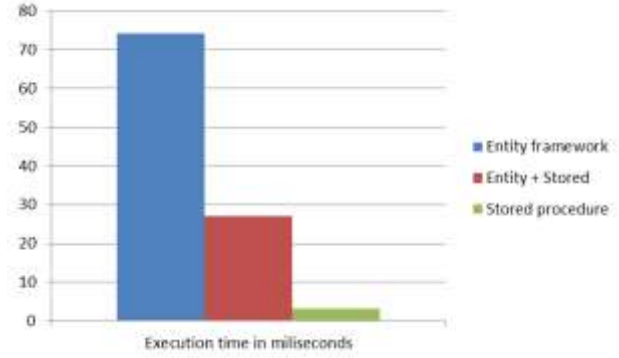


Figure 2. Execution of single row data gathering in milliseconds

```
CREATE PROCEDURE [dbo].[SelectStudent]
AS
Begin
    SELECT * FROM Student
    WHERE StudentID >= 6000
    AND StudentID < 7000
End
```

Execution times for usage of entity framework, stored procedure from entity framework and stored procedure are shown in Table 2 and Fig. 3. From them we can see that stored procedures remain the fastest way to retrieve data from database.

IV. CONCLUSION

In this paper we were testing execution times in three techniques for data gathering from database. The first approach is Entity framework, the second is usage of stored procedures, while the third is usage of stored procedures throw Entity framework. All approaches are very common and are applied in many real life applications. In this research we were interested in their performances when applied on the same table in database. We took two tests. First involved gathering single row from the table, while second include gathering multiple rows. By examine execution time, we concluded that stored procedure are fastest, especially when they are not called inside from entity framework. As a conclusion, we recommend usage of stored procedures when execution time is of primary importance. Usage of Entity framework is more elegant, which can be seen by examine the code. That is why entity framework is used in larger amount of applications even if its execution is in some cases almost

TABLE II. EXECUTION OF MULTIPLE ROW DATA GATHERING USING DIFFERENT TECHNOLOGIES IN MILLISECONDS

No.	Used technology		
	Entity framework	Entity framework & stored procedure	Stored procedure
1	78.2071	15.5869	2.8706
2	95.6054	37.2528	2.8199
3	74.8221	16.9310	2.7786
4	95.0153	29.0347	2.8691
5	76.2160	25.8238	2.9899
Avg.	83.97318	24.92584	2.86562

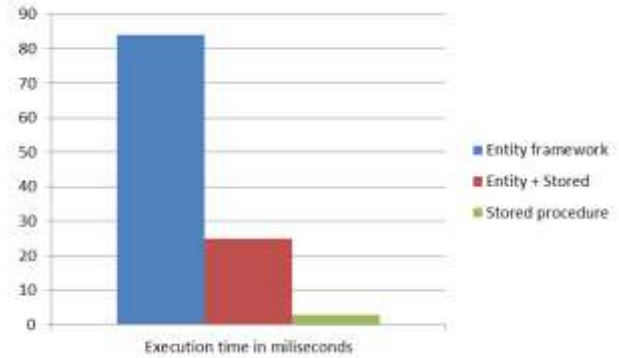


Figure 3. Execution of multiple row data gathering in milliseconds

40 times slower than stored procedures when applied on same database.

ACKNOWLEDGMENT

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Can Cloud Virtual Environment Achieve Better Performance?

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Abstract – Cloud virtual environment adds the virtualization layer, which is expected to decrease the performance. In this paper we address the performance of the dense matrix-vector multiplication (DMVM) executed on a virtual machine with Windows operating system and C# in the cloud compared to traditional bare-metal with the same runtime environment. Expected behaviour based on theoretical analysis prefers the classical environment, while the experimental research the cloud environment.

I. INTRODUCTION

Cloud computing is emerging to become the only platform for intensive applications and data. Its "pay-per-use" and "everything-as-a-service" models lower CAPEX and OPEX, allow easy access to highly scalable and elastic resources from everywhere, reduce maintenance expenses etc. However, web service performances are almost 30% lower while hosted in the cloud compared to traditional on premise while using the same resources [1]. Another cloud drawback is the performance unpredictability. Performance isolation is necessary in cloud multi-tenant environment [2]. One virtual machine instance behaves differently on the same hardware infrastructure at different times among other active virtual machine instances [3]. Also virtual machine instance granularity significantly affects the workload's performance for small network workload [4]. But cloud can reduce the cost at small performance penalty using thin hypervisors or OS-level containers [5]. Underutilization of resources by adding more nodes can considerably improve the performance implementing more parallelism [6], as well as using virtual machine load balancer [7].

Despite the additional virtualization layer, there are algorithms that sometimes can provide better performance while executed in virtual environment. Cache intensive algorithms run faster in virtual environment when problem size fits in the CPU cache memory, but the performance rapidly degrades when a problem size exceeds the dedicated cache per core [8]. Gusev and Ristov determine that there are regions where the best performance in the cloud environment is achieved allocating the resources among many concurrent instances of virtual machines rather than in traditional multiprocessors using API for parallelization (OpenMP) [9]. Most of high performance algorithms are analyzed while executed on Linux based operating systems using OpenMP or

MPI for parallelization. In this paper we analyze the performance of Windows operating system with C# and threading for parallelization. This platform can provide even superlinear speedup (speedup greater than the number of CPUs) for matrix multiplication while hosted in Windows Azure cloud [10]. We have chosen the DMVM as algorithm which is widely used in both scientific and commercial applications. We are not interested to find an algorithm which speeds up the DMVM execution in the cloud nor to speed up the execution using other faster algorithms, but to determine the platform impact on cache intensive algorithm performance when executed in Eucalyptus open source cloud and on bare-metal machine using the same hardware resources and the same runtime environment.

The rest of the paper is organized as follows. Section II presents the used testing methodology and Section III refers to theoretical analysis. Section IV shows the results of the experiments realized to determine the performance achieved by sequential and parallel implementation of DMVM using a particular platform. The platform impact on the DMVM performance is analyzed in Section V. Section VI concludes the work and presents the plans for future work.

II. TESTING METHODOLOGY

The testing methodology is based on two different environments and 3 test cases for each environment.

A. Testing Algorithm

DMVM algorithm $C_{N-1} = A_{N-N} \cdot B_{N-1}$ is used for testing. Matrix and vector elements are stored as double precision numbers with size $ME = 8$ bytes each. One thread multiplies the whole matrix A_{N-N} and vector B_{N-1} for sequential test cases. For parallel test cases, each thread multiplies the row block matrix $A_{N-N/c}$ and the whole vector B_{N-1} where $c \in \{2,4\}$ denotes the total number of parallel threads and used CPU cores.

B. Testing Environment

This section presents two analyzed platforms (cloud and bare-metal) as testing environments using the same hardware infrastructure and runtime environments.

1) *Hardware Infrastructure*: The hardware infrastructure is the same for each test case. It consists of workstation with shared memory multiprocessor Intel(R) Core(TM)² Quad

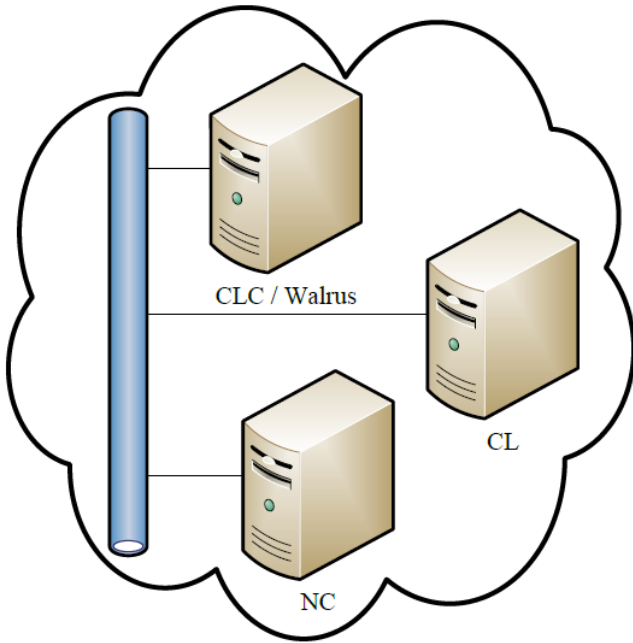


Fig. 1. Eucalyptus Testing Environment

CPU Q9400 @ 2.66GHz and 8GB RAM. The multiprocessor consists of 4 CPU cores, each with 32 KB L1 cache and 256KB L2 cache dedicated per core, and L3 cache with total 12 MB shared per two cores (two cores share 6MB L3 cache).

2) *Runtime and Operating System*: Windows Server 2008 R2 is installed on both machines; either virtual machine instance in the cloud or bare-metal host operating system. C# is used together with threads for parallel implementation.

C. The Platforms

Two different platforms are defined, i.e. bare-metal and cloud platform.

1) *Bare-metal Platform*: The Bare-metal platform consists of Windows operating system installed on the real hardware machine described in Section II-B1.

2) *Cloud Platform*: The cloud platform uses Eucalyptus open source cloud solution [11] deployed on three physical machines as depicted in Fig. 1. Nurmi et al. [12] outline the basic principles and important operational aspects of the Eucalyptus cloud solution. The Cloud Controller (CLC) is the entry-point in the cloud and the interface to the management platform. Walrus allows the customers to store persistent data. The Cluster Controller (CC) schedules virtual machine instance execution on specific Node Controller (NC). NC executes hosts virtual machine instances. All three nodes are installed with Linux Ubuntu 12.04. Kernel-based Virtual Machine (KVM) virtualization standard is used for instancing a virtual machine.

The cloud environment uses the same hardware as described in Section II-B1 for all nodes. A virtual machine instance is instantiated with all available hardware resources and it is installed with the same Windows Server R2 operating system as the bare-metal platform.

D. Test Cases

Three groups of test cases are realized during the experiments in both platforms:

- sequential execution on only one core
- parallel execution with two threads on two cores
- parallel execution with four threads on four cores

III. THEORETICAL ANALYSIS

We realize series of experiments in each test case by varying the matrix size $N \cdot N$ and vector size N from $N = 2$ to $N = 1400$ in order to analyze the performance behavior upon different overload and variable cache storage requirements, i.e. for each cache region L_1 to L_4 as described in [8]. However, cache regions are different for DMVM algorithm compared to dense matrix-matrix multiplication.

To analyze the behavior we start with definition of the cache requirements in (1), where variable P denotes the number of threads and cores.

$$\text{CacheRequirements} = (N^2/P + N) \cdot ME \quad (1)$$

Equation (1) can be rewritten as follows in (2), since the vector size $N \ll N^2/P$

$$\text{CacheRequirements} = \frac{N^2 \cdot ME}{P} \quad (2)$$

Execution Time $T(P)$ is measured for each test case and Speed $N(P)$ is calculated as defined in (3). $V(P)$ is expressed in GigaFlops, i.e. the number of floating point operations in second.

$$V(P) = \frac{2 \cdot N^2}{T(P) \cdot 10^9} \quad (3)$$

We repeat each test case up to 1.000.000 times and calculate the average $T(P)$ to achieve reliable test results, especially for smaller matrices since there are negligible effects on the performance for good comparison [13].

Normalized Speed $V_n(P)$ is calculated for parallel execution as defined in (4) to compare the DMVM algorithm behavior, i.e. the achieved speed per core and thread.

$$V_n(P) = \frac{V(P)}{P} \quad (4)$$

Speedup $S(P)$ is calculated as defined in (5). Index *Seq* denotes the sequential execution and index *Par* the parallel execution with P threads on P cores.

$$S(P) = \frac{T_{Seq}}{T_{Par}(P)} \quad (5)$$

We define two more parameters, i.e. Relative Platform Speed $RV(P)$ and Relative Platform Speedup $RS(P)$ in (6) and (7) to compare the platform impact on achieved speed and speedup.

$$RV(P) = \frac{V_C(P)}{V_B(P)} \quad (6)$$

$$RS(P) = \frac{S_C(P)}{S_B(P)} \quad (7)$$

Indexes C and B denote the cloud and bare-metal platforms, correspondingly.

Different algorithm behavior is expected for executing the DMVM algorithm in L_1, L_2, L_3 and L_4 cache regions. We define region L_1 as the region where the cache memory requirements fit in L_1 cache expecting the highest performance. L_2 and L_3 are defined as the regions where the cache requirements fit in L_2 and L_3 cache correspondingly. Finally, L_4 region presents the main memory region when the cache requirements are above the last level L_3 cache size and L_3 cache misses are generated.

Table I presents the values of N for each cache region as defined in (2).

TABLE I
CACHE REGION RANGES FOR MATRIX AND VECTOR SIZE N

Region	1 Thread	2 Threads	4 Threads
L_1	$N < 64$	$N < 91$	$N < 128$
L_2	[64, 181)	[91, 256)	[128, 362)
L_3	[181, 887)	[256, 1254)	[362, 1254)
L_4	$N \geq 887$	$N \geq 1254$	$N \geq 1254$

$L_1, L_2,$ and L_3 regions are different ranges for N since each CPU core possesses dedicated L_1 and L_2 cache and total available cache memory for parallel execution is greater than sequential execution. L_3 's upper limit is constant for each parallel execution since two L_3 caches are used.

IV. EXPERIMENTAL RESULTS

This section presents the results of the experiments to determine the impact of parallelization upon Speed $V(P)$, Normalized Speed $V_n(P)$ and Speedup $S(P)$ in a particular platform.

A. DMVM Performance on Bare-metal Platform

In this section we analyze the performance of the DMVM algorithm while executed in the bare-metal platform using different number of threads and CPU cores.

1) *Speed in Bare-metal Platform:* Fig. 2 depicts the results of the experiments on the bare-metal platform. $V(1)B$ identifies the curve for speed of sequential execution and $V(2)B$ and $V(4)B$ identify speed of parallel execution on bare-metal platform with 2 and 4 threads correspondingly.

We observe that sequential execution provides better performance for smaller N , i.e. for $N \leq 44$ since the operating system spends more time to create the threads and schedule the tasks instead of executing the operations. Better performance is achieved for $N \geq 100$ using 2 threads and $N > 44$ using 4 threads.

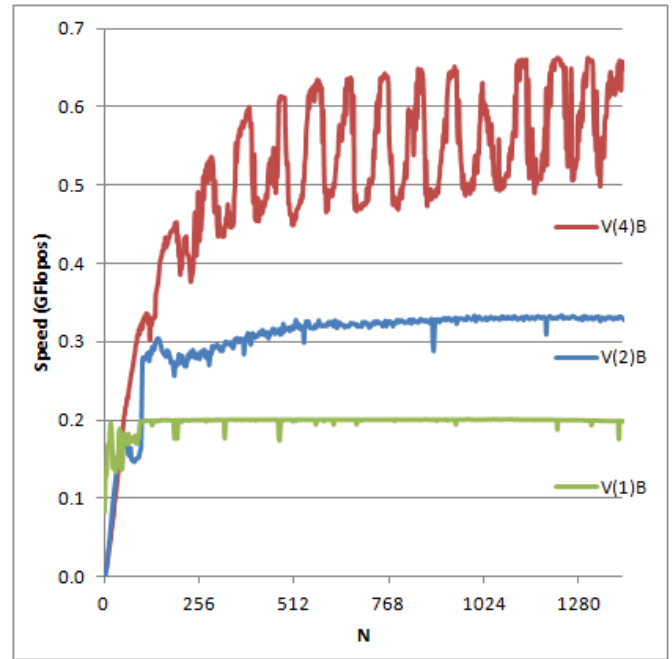


Fig. 2. Speed achieved on bare-metal platform

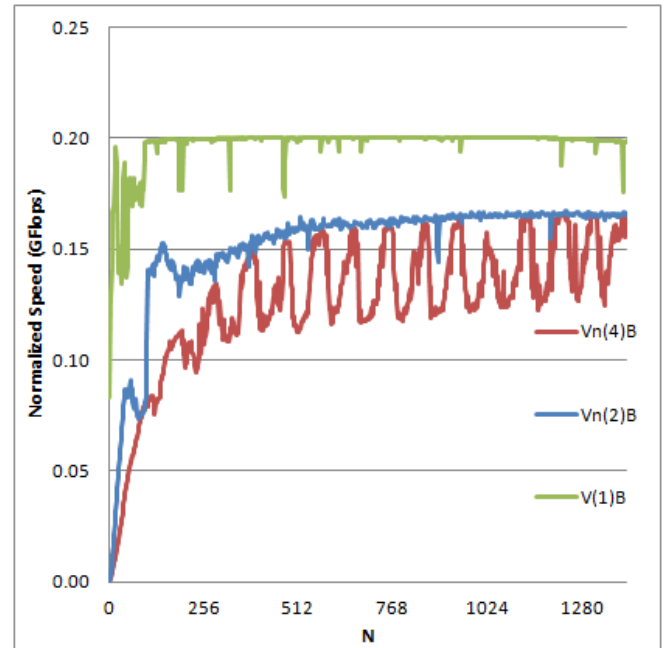


Fig. 3. Normalized Speed achieved on bare-metal platform

Two regions are observed for each test case. The speed increases proportionally in regions L_1 and L_2 as defined in Table I and saturates in regions L_3 and L_4 . Another unusual result is occurrence of speed variations for parallel execution, which are more emphasized for Speed $V(4)B$.

2) *Normalized Speed in Bare-metal Platform:* Better analysis can be realized analyzing Normalized Speed $V_n(P)$ depicted in Fig. 3. $V_n(1)B$ identifies the curve for normalized speed of sequential execution, while $V_n(2)B$ and $V_n(4)B$ identify normalized speed of parallel execution on bare-metal platform with 2 and 4 threads correspondingly. Sequential execution provides the greatest speed per core for each N in

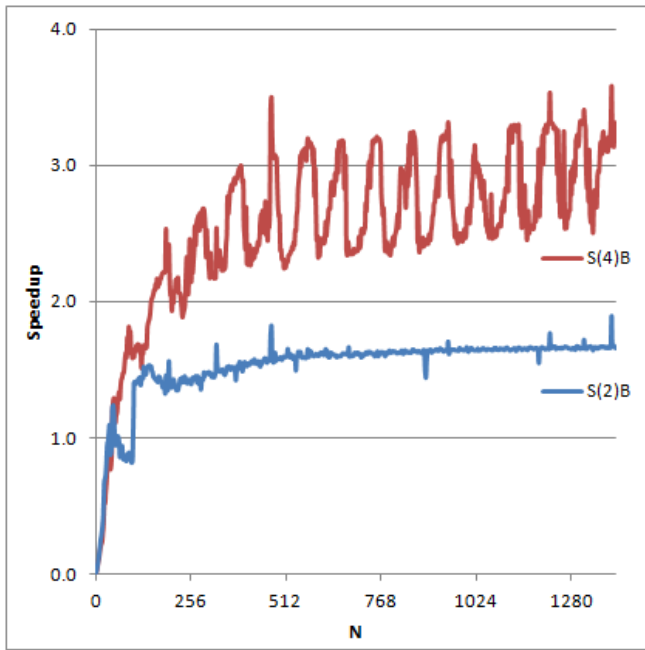


Fig. 4. Speedup achieved on bare-metal platform

front of parallel execution with 2 and 4 cores. This is emphasized for smaller N .

3) *Speedup in Bare-metal Platform*: Fig. 4 depicts the results for speedup in bare-metal platform. $S(2)B$ and $S(4)B$ identify the speedup of parallel execution on bare metal platform with 2 and 4 threads correspondingly.

We clearly observe the "slowdown", i.e. speedup smaller than 1 for regions described in Section IV-A1. The speedup increases enormously in regions L_1 and L_2 . The speedup increasement is smaller in L_3 region and it saturates in L_4 region. The Speedup $V(4)$ fluctuates, i.e. it climbs and descends similar to the speed $V(4)$.

B. DMVM Performance on Cloud Platform

In this section we analyze the performance of the DMVM algorithm while executed in the cloud platform using different number of threads and CPU cores.

1) *Speed in Cloud Platform*: Fig. 5 depicts the results of the experiments on cloud platform. $V(1)$ identifies the curve for speed of sequential execution, while $V(2)C$ and $V(4)C$ identify the speed of parallel execution on cloud platform with 2 and 4 threads correspondingly.

Similar to bare-metal platform, we observe that sequential execution provides better performance for smaller N . Better performance for parallel implementation is achieved for $N > 62$ using 2 threads and $N > 44$ using 4 threads. Also two regions are observed for each test case. The speed increases proportionally in regions L_1 and L_2 as defined in Table I and saturates in regions L_3 and L_4 . We also observe speed climbings and descents for parallel execution, which are more emphasized for Speed $V(4)C$.

2) *Normalized Speed in Cloud Platform*: Fig. 6 depicts Normalized Speed $V_n(P)$. $V_n(1)C$ identifies the curve for normalized speed of sequential execution, while $V_n(2)C$ and

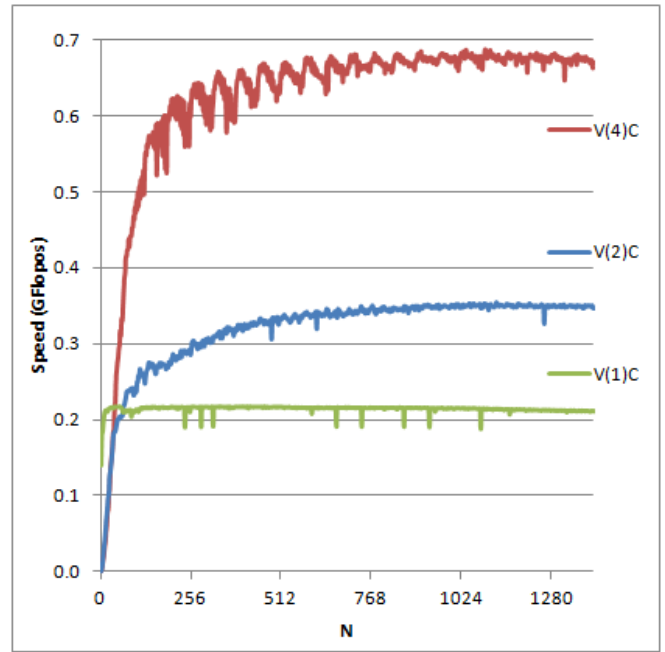


Fig. 5. Speed achieved on cloud platform

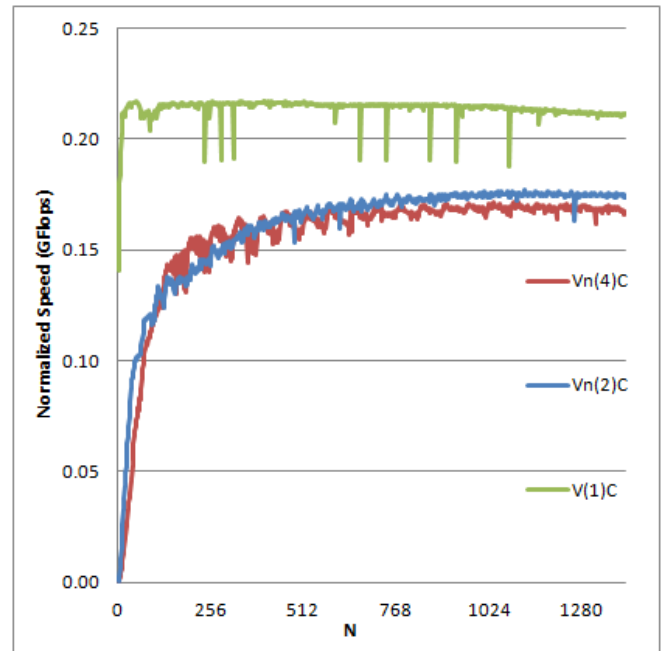


Fig. 6. Normalized Speed achieved on cloud platform

$V_n(4)C$ identify normalized speed of parallel execution on cloud platform with 2 and 4 threads correspondingly. Sequential execution also provides the greatest speed per core for each N in front of parallel execution with 2 and 4 cores, which are similar in cloud platform.

3) *Speedup in Cloud Platform*: Fig. 7 depicts the results for speedup in cloud platform. $S(2)C$ and $S(4)C$ identify the speedup of parallel execution with 2 and 4 threads correspondingly.

We also clearly observe the "slowdown", i.e. speedup smaller than 1 for regions described in Section IV-B1. The

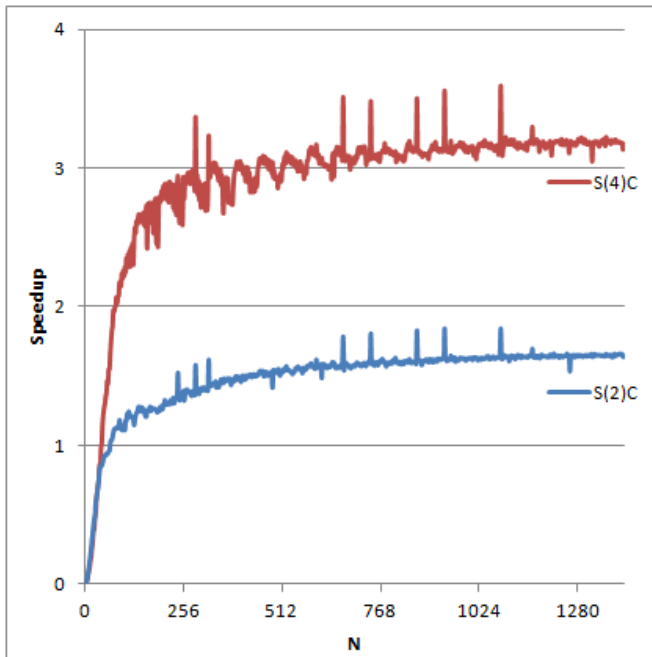


Fig. 7. Speedup achieved on cloud platform

speedup increasement and saturation is similar as in baremetal platform.

V. PERFORMANCE COMPARISON OF CLOUD AND BARE-METAL PLATFORMS

Although the speed and speedup curves obtained for both platforms presented in previous Section IV have similar trends, still there are differences worth to be analyzed. In this section we compare the platforms to determine which platform provides better performance (speed) and scaling (speedup) with particular number of threads and CPU cores. Therefore we calculate the parameters Relative Platform Speed $RV(P)$ and Relative Platform Speedup $RS(P)$.

A. Speed Comparison

Fig. 8 depicts the Relative Platform Speed $RV(P)$ i.e. compares the speeds of both platform for particular number of threads.

We observe a phenomenon, i.e. Relative Platform Speed $RV(P) > 1$ for each $P \in \{2, 4, 8\}$ and for each N . That is, despite the virtualization layer, the cloud platform provides better performance (speed) than bare-metal, both for sequential and parallel execution. We must note that there is a small region $106 < N < 186$ where $RV(2) < 1$.

B. Speedup Comparison

Fig. 9 depicts the Relative Platform Speedup $RS(P)$ to compare the speedups of both platform for particular number of threads. We observe that $RS(2) \ll 1$ in regions L_1 and L_2 , while $RS(2) \rightarrow 1^-$ in regions L_3 and L_4 . That is, the DMVM algorithm achieves smaller speedup in the cloud compared to

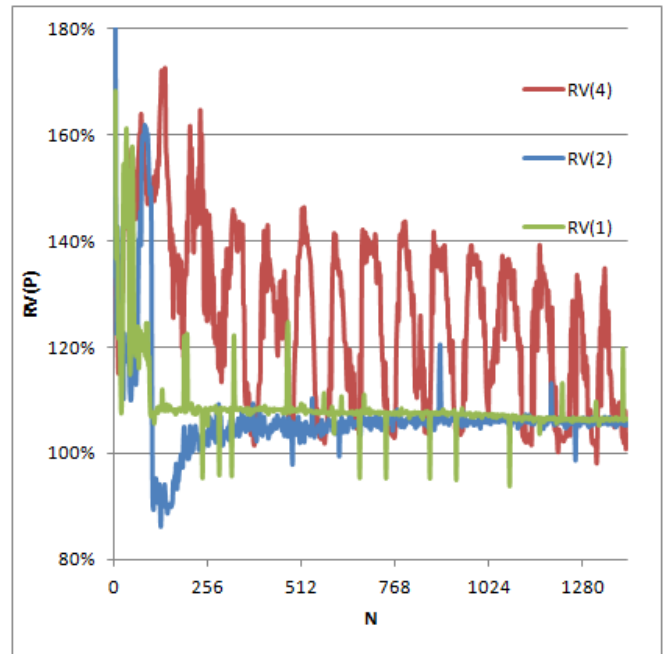


Fig. 8. Achieved Relative Platform Speed

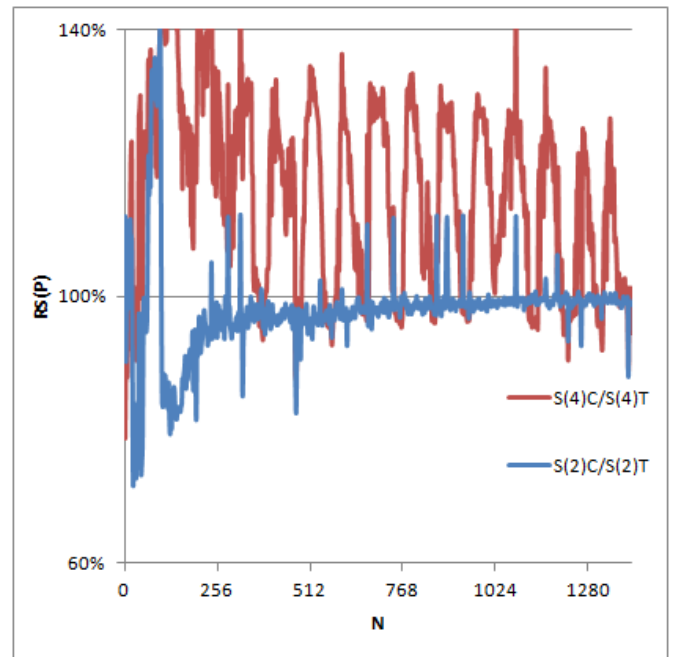


Fig. 9. Achieved Relative Platform Speedup for 2 and 4 threads

bare-metal platform cloud while other classification parameters will be used only by one side. For example, response time will be a common classification parameter, while the CPU utilization for a certain load will be mostly a parameter analyzed only by the cloud service provider.

Opposite to $RS(2)$, $RS(4) > 1$ in each cache region L_1 to L_4 . That is, the DMVM algorithm achieves greater speedup in the cloud compared to bare-metal platform. We also observe fluctuations (climbings and descents) for $RS(4)$.

VI. CONCLUSION AND FUTURE WORK

This paper analyzes the performance behavior of sequential and parallel implementation of DMVM algorithm while executed using the same Windows operating system with C# runtime environment, but on different platforms, i.e. bare metal and Eucalyptus cloud. The paper contribution is manifold since we obtained many unexpected results.

The main conclusion is that we proved experimentally that the DMVM algorithm provides better performance (Speed) while executed in the cloud compared to bare-metal with the same resources and runtime environment. The cloud platform also provides greater speedup using 4 cores, and smaller speedup using 2 cores.

DMVM algorithm achieves higher rate per processor when it runs with one thread instead of parallel execution for small N. Sequential execution also provides better speed per core. Using these results, we will continue our research in the cloud platform to analyze the hypothesis that dividing the problem and executing on several virtual machine instances with 1 core will improve even more the performance, instead of using threads for parallelization in virtual machine instance allocated with all CPU cores of physical machine. We also plan to analyze the speed variations with various climbings and descents for parallel execution of the DMVM algorithm.

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Triangulation of Convex Polygon: Parallel Programming Approach

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Abstract - When we need to solve many tasks that are repetitive, and that can be divided into several independent parts, by simultaneous multiprocessing (running multiple processes) it is possible to increase the processing speed. This is the case with convex polygon triangulation used in computer graphics. In this paper we present the convex polygon triangulation using the principle of parallel programming in PHP.

I. INTRODUCTION

The triangulation of a convex polygon means finding of all possible polygon splittings on triangles by its diagonals without gaps and overlaps of these splittings. This is the classical problem solved so far in a several ways.

Triangulation of a convex polygon with n vertices requires $n-3$ nonintersecting internal diagonals.

The polygon is convex if any line connecting two of its vertices lies entirely in it. For convex polygons, all diagonals are internal diagonals. In this case, the number of triangulations of a convex n -gon is independent of shape, and therefore, it can uniquely be characterized by the number of vertices n . It is well known that the number of triangulations of a convex n -gon is equal to the $(n-2)$ -th Catalan number [3, 4], i.e.

$$C_{n-2} = \frac{2(n-2)}{(n-1)!(n-2)!}, \quad (1)$$

Triangulation of a convex polygon with n vertices requires $n-3$ nonintersecting internal diagonals.

The polygon is convex if any line connecting two of its vertices lies entirely in it. This number grows rapidly. In the following section we describe our attempt to employ file storage to make this task less tedious and to eliminate the repetition of calculations. In this paper we try to get the $(n+1)$ -gon triangulations on the base of the n -gon triangulations.

Similar approach was used by Hurtado and Noy in [4] where the tree of the convex polygon triangulations is presented and proposed the algorithm to generate the triangulations of $(n+1)$ -gon on the base of n -gon triangulations. We will use this distinguished algorithm

for comparison purposes later in the paper. Because of this, we restate here Hurtado's algorithm.

II. TRINGULATAION OF CONVEX POLYGON

A. Hurtado - Noy Algorithm

In this section, we will mention the actual implementation of the algorithm for triangulating a convex polygon on the so-called. Hurtado-Noy hierarchy. This algorithm is described in the work of these authors [2].

Algorithm 1. Hurtado's algorithm from [2].

Require: Positive integer n and the triangulations of an n -gon. Each triangulation is described as a structure containing $2n-3$ vertex pairs presenting n -gon diagonals (here diagonals means both internal diagonals and outer face edges).

1: Check the structure containing $2n-3$ vertex pairs looking for pairs $(i_k; n)$, $i_k \in \{1; 2; \dots; n-1\}$; $2 \leq k \leq n-1$, i.e. diagonals incident to vertex n . The positions of these indices within structure describing a triangulation should be stored in the array.

2: For every i_k perform the transformation $(i_k; n) \rightarrow (i_k; n+1)$; $i_1 < i_2 < \dots < i_{n-2}$.

3: Insert new pairs $(i_k; n+1)$ and $(n; n+1)$.

4: Take next i_k , if any, and go to Step (2).

5: Continue the above procedure with next n -gon triangulation (i.e. structure with $2n-3$ vertex pairs) if any.

Number of the convex polygon triangulations is closely linked to Catalan's number.

The number of triangulations is equal to:

$$C_{n-2} = \frac{2(n-2)}{(n-1)!(n-2)!}, \quad (1)$$

where C_{n-2} denotes the $(n-2)$ th Catalan number.

Starting from the polygon, $n = 3$ to $n = 14$, the value of Katalan's number is: 1, 2, 5, 14, 42, 132, 429, 1430, 4862, 16796, 58796, 208012 and so on.

Hurtado-Noy Hierarchy is method who described in this paper [2] is a very inviting way to generate all triangulations, despite its very high time complexity, tending to be exponential. Let $T(n)$ be the complete set of triangulations of an n -gon. Every triangulation T belonging to $T(n)$ has a "father" in $T(n-1)$ and one or more "sons" in the triangulation $T(n+1)$. Given a $T(n)$, we can actually generate the triangulations of the $(n+1)$ -gon from every such T . The number of sons of T is dependent on the out-degree of the vertex V_n . Thus, the triangulation S_i which is a son of t , given the edge $E(i,n)$ in t , will consist of edges that are the union of the following [5]:

- Set of all edges $E(p,q)$ of t such that p and q are both unequal to n .
- Set of all edges $E(p,n+1)$ such $E(p,n)$ belongs to t , and p lies between 1 and i .
- Set of all edges $E(p,n)$ such $E(p,n)$ belongs to t , and p lies between i and n .
- The singleton set containing the new edge $E(n,n+1)$.

What we are basically doing is opening the parent polygon and adding in the $(n+1)$ th vertex. We keep all edges of the parent that did not involve V_n as they were. Next we remove all edges of the form $E(p,n)$ from the parent and add in $E(p,n+1)$ instead. Thereafter we add in all edges $E(p,n)$ of the parent, where p was a vertex numbered higher than 'i' (remember we are constructing the 'i'th son).

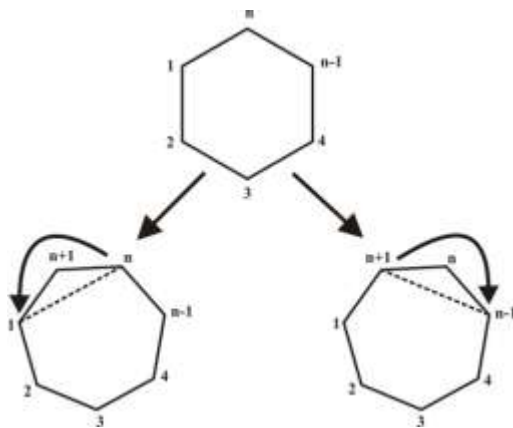


Figure 1. Nacin formiranja novih triangulacija za $n+1$ po Hurtadovom algoritmu

Indeed, we even need the triangulations of the $(n-1)$ th polygon ready. And then we generate 'd' sons for each of those, where 'd' is the degree of V_n of each triangulation. The process of union of those 4 sets would be an $O(n)$ operation. However the hierarchy is nevertheless important because of its inherent simplicity and also owing to the fact that it has a number of really exciting properties which we shall state below.

- If $t_1 \sim t_2$, then $Father(t_1) = Father(t_2)$ or $Father(t_1) \sim Father(t_2)$.

- If $t_1 \sim t_2$ and Edge (i,n) belongs to Intersection (t_1,t_2) , then the 'i'th son of t_1 and the 'i'th son of t_2 differ by a flip.
- If $t_1 \sim t_2$, then the first and also the 'n'th sons of t_1

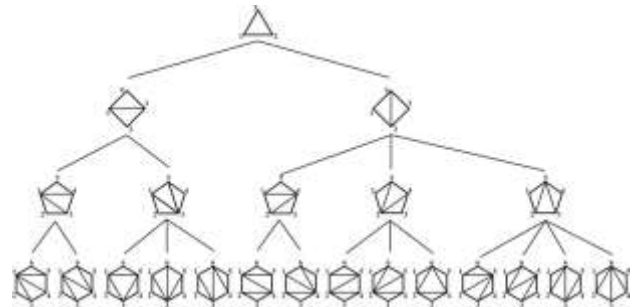


Figure 2. Levels three to six of the tree of triangulations – Hurtado Noy Hierarchy

and t_2 (if they exist) differ by a flip.

- If $t_1 \sim t_2$, then the number of their sons differs by at most one.

III. PARALLEL PROGRAMMING APPROACH

In this section, we will mention the actual implementation of the algorithm for triangulating a convex polygon on the so-called, Hurtado-Noy hierarchy. This algorithm is described in the work of these authors [2]. Number of the convex polygon triangulations is closely linked to Catalan's number. Starting from the polygon, $n = 3$ to $n = 14$, the value of Catalan's number is: 1, 2, 5, 14, 42, 132, 429, 1430, 4862, 16796, 58796, 208012, and so on.

When we need to solve a lot of repetitive tasks, that can be divided into several independent parts, by simultaneous multiprocessing (running multiple processes) the processing speed can be increased.

The first step in parallel programming is the identification of a set of tasks that can run simultaneously, and identify tasks that can be processed simultaneously. In practice, there are problems that can be solved quickly using parallel programming techniques, such as is the case with the triangulation of convex polygons.

If the same processing is necessary for each element of the array, and the array elements are interconnected, there is an ideal opportunity for the implementation of parallel programming techniques. In the parallel programming there is frequent use of the master / slave techniques. The Lord does the following: it divides array according to number of available slaves, to each slave sends and receives a subset of the results of treatment. Slave received a number of masters and processing of substring and returns the master.

In PHP, it is possible to use a parallel programming in several ways: fork, Curl, multithread, run in the background and so on. All the above settings are working under the Unix operating system.

Unix supports a process that allows the fork() function to a process which is presented as a parent and has the ability to be divided into several parts which represent his children. Before using the PHP function to control the process in the configuration file should be set configuration - enable - pcntl along with all other configuration options. You need to install additional libraries. Pcntl_fork function call() all variables and objects are copied from the parent process to a child process and represent a new copy belonging to the new process. Changes in the child process does not affect the value of the parent, or any other separate, processes. Parent process will have a value priced at \$pid, the process child will not have it. Parent process must wait until the child process completes, allowing pcntl_waitpid() function. Exit function call() in the parent process, disables some code intended for the child. Parameter \$status passed to pcntl_waitpid () stores the return value of the child process.

To use cURL functions you need to use a HTTP or FTP protocols. Multithread or running multiple threads is a process that involves simultaneously running multiple tasks. For the functioning of cURL function, on the server, you need to install the PHP 5.0 version [3].

Application of the principle of parallel programming is shown on the example of triangulations of convex polygons. The application of the parallel execution of the scripts is done by sharing files with triangulation into more smaller, then implement decomposition over them. In this way, processing time is being shorter. The essence of this type of programming is reflected in the launch of multiple scripts simultaneously wich are "working" in the background. In this paper we use the approach to parallel processing by running the script from the command line. In this way, the scripts are being paralely processed in the background. This technique only works when launching a script from the command line on Unix/Linux operating system. When PHP encounters a command it reads an argument and executes it. It is possible to redirect the output of a command to work in the background by entering an ampersand & at the end of the command

```
exec("ls - al"); (1)
```

so instead

```
exec("ls - al > delovi.txt &"); (2)
```

In this way, the script will create a new process that runs in the background, and then immediately move on to a new task. When you run a PHP script from the command line, it will always support superglobals of \$arg, which is a series of arguments that are used when the script is running. If we have triangl.php script we run it from the command line as follows

```
php triangl.php arg1 arg2 arg3 (3)
```

```
then the variable $arg represented by a array of
array(4) {
    [0] => string (11) "triangl.php"
    [1] => string (11) "arg1"
    [2] => string (11) "arg2"
    [3] => string (11) "arg3"
}
```

By combining the previous cases it is possible to create a script that will call itself repeatedly. In the case of convex polygon triangulation we have tens of thousands, even millions of triangulation that are stored in the database and that should be processed. Instead of using a script that processes all data from first to last, using the previous logic, this process can be divided into multiple areas that deal with individual pieces of data stored in the table. In the same way, we can process and data stored in a file by splitting file into several pieces that process them individually. Processing results are also placed in the file. Since the triangulation leads to the appearance of duplicates we must use the filter in the form of a database and a unique key in order to get a "clean" structure. Therefore, we will first divide file on as many parts as we also run scripts, by simply entering: file path, where we want to place the parts and the number of lines in a file. After dividing the file follows the launch of the same background and application of appropriate procedures.

IV. EXPERIMENTAL RESULTS

In order to shorten the time of calculation triangulation convex polygons, for large values of n, we divided input file into multiple parts. The following table shows the results of testing from which it is possible to see that the best results were achieved when the file is divided into two parts.

TABLE I. RUNNING PARALLEL N PARTS OF FILE

Num of part	n=13	n=14	n=15	n=16
1	25.532	81.357	393.420	1982.358
2	12.122	55.388	246.758	1342.577

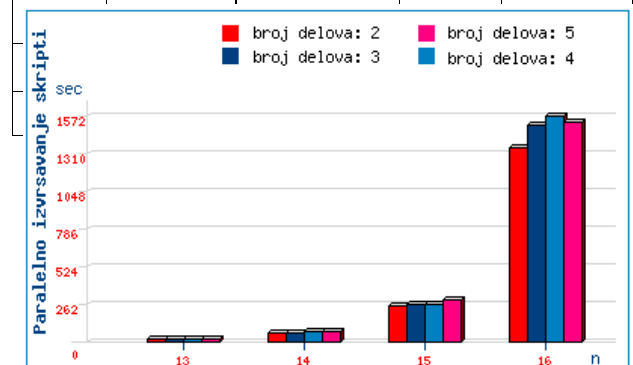


Figure 3. Parallel script execution

V. CONCLUSION

Application of the principle of parallel programming gives good results when there is a problem in which we can distinguish and separate sections that later merge into one entity and obtain a final solution. Such is the problem of triangulation of convex polygons. In this case we use PHP scrip language and Linux OS. Even better results would be obtained by using the server with more cores.

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The Role of Visualization in Building Management Systems

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Abstract - Building Management System (BMS) is an integral part of modern buildings. It is usually composed of several dedicated subsystems that cooperate in order to support the complete buildings mission. Besides data collection, data processing and monitoring of proper operation the visualization of building dynamics in real time, plays a very important role. Considering fire detection and monitoring subsystem, for the visualization of all relevant elements (rooms, corridors, sensor nodes, sensor locations, building materials used etc.) it is essential to be as realistic as possible. In this paper the basic visualization concepts of wireless Sensor Web elements, enriched by the information relevant for decision support, are presented.

I. INTRODUCTION

Building Management System (BMS) is a high technology system, embedded in building structure, that controls and monitors all parts of a building's systems, including sensors, controllers, and controlled devices, from usually an single location. BMS consists of software and hardware components and relevant interfaces that, via network interfacing components, integrate all building's subsystems.

BMS helps operators to easily monitor mechanical and electrical equipment of the systems, such as power systems, lighting, air heating and cooling systems, fire and security systems, and quickly make any adjustments if needed (Fig.1). The key driver of the building management system is the increased user comfort at low operation costs [1]. New features of building controls are being introduced every year, and design and build teams have access to a wide variety of technologies that can be used to maximize efficiency. According to [2] the key benefits of Building Management Systems include:

- Lower energy consumption and correspondingly lower costs;
- Limited wear and tear on building systems;
- Automatic alarms that alert occupants to safety issues and changing conditions;
- A more comfortable environment for building occupants;
- Minimization of repair and maintenance time and cost;

- Rapid availability of up-to-date status information of monitored systems.



Figure 1. Building management system [2]

Huge amount of BMS data is produced on a daily basis, making the visualization and animation a suitable way to comprehend such amount of data in order of better understanding of buildings dynamics. From that point of view BMS should have a project-specific graphical user interface to provide a complete overview of the entire system whenever required. The visualization should allow 24 hours system monitoring and operation targeting users without sophisticated computer skills enabling checking of all data points so that errors and control behavior can be determined even without referencing any history data. Some of the BMS visualization examples are presented in [3-6]. In this paper we considered a fire detection subsystem as an example of possible application framework.

The rest of this paper is organized as follows. The fundamentals of a fire protection system design are presented in Section 2. Section 3 presents a general way 3D modeling programs can be implicated in fire detection system. Blender - an open source 3D modeling program is shown in Section 4 while Data generation, exporting and further use are shown in Section 5 and 6. Finally, Section 7 provides conclusion remarks and outlines directions for future work.

II. THE CHALLENGES OF FIRE PROTECTION SISTEM DESIGN

From the point of view of property damage and personal injury, fire protection systems are one of the most important systems in intelligent buildings. Despite modern fireproof materials and new technologies fires still represent a large danger to people and property. There are various systems that are used inside of building for monitoring, control and protection in the event of a fire.

Detailed studies of fire related issues, the development of technology, and generally increase awareness of this problem, led to the need for developing of a significant number of commercial systems which are now getting easier to install in almost every building unit.

The fire detection system is not aimed to prevent an initial fire, but it enables serves early signaling in order to prevent further spreading of the initial fire. This early warning and response system can shorten the time for discovering the hotspots before them significantly endangers property and human lives. *The phase in which the fire starts and gets detected is significantly lower in facilities which are acquit with fire detection systems compared to those that don't have it and this results in much lower average level of damage, and rescued human lives.*

Some of the factors that influence the development of fire protection system are:

- Techniques for fire detection (smoke detection, heat detection, measuring the amounts of certain gases in the air, etc.);
- The architecture of Building;
- Techniques for fire prevention;
- Alarms and personal protection;
- Alarming public services (fire department, etc.);
- Visualization;

According to [7], when the fire is concerned, a building management system is composed of subsystems listed in TABLE I.

TABLE I. PROTECTION SYSTEM IN CASE OF FIRE

	Module	Function
1	Central control unit	<ul style="list-style-type: none"> • management of the entire system • intelligent decisions • integration of all subsystems and effectively exploitation
2	Fire detection	<ul style="list-style-type: none"> • fire detection with adequate sensors (sensor network)
3	Saving / elimination of fire	<ul style="list-style-type: none"> • effective fire • select the proper techniques for closure (if possible)
4	Management secondary functions	<ul style="list-style-type: none"> • control opening of the door / window • control of gas / electrical installations • alerting people (different levels of alerts) • connect to the subsystem to detect people in the building detecting electronic id cards • lighting control
5	Communication with public services	<ul style="list-style-type: none"> • information on fire service • sending useful information (number of people in the building, fire location)

	Module	Function
6	Independent power system	<ul style="list-style-type: none"> • ensure the smooth operation of the entire system event of interruption / malfunctioning household energy network
7	Other functions (related to the whole system)	<ul style="list-style-type: none"> • analysis of the structure of the building (fire regulations) • Plan evacuation of people + Useful tool that could be implemented

The fire detection subsystem is usually the most complex regarding technology but also the most expensive part of the whole system [8]. It has to detect fire with high reliability and accuracy and requires high-quality Sensor Web with usually complex topology incorporating: accessible sensors and sensory data.

Depending on the conditions inside the room/space detector selection includes: smoke, heat (fixed heat or the rate of rise sensors) or a combination of both types. One of the important issues in the design for the protection of an area is the arrangement of detectors inside the protected area. It is quite obvious that, at a higher density sensor setting, the speed of the reaction system potentially gets higher. Rapid detection while protecting affordable price is desirable. Of course it will depend on the density setting of fire risk building or area to be protected. For buildings at medium fire risk and regular construction characteristics it is necessary to determine the appropriate an algorithm for selecting the proper arrangement of fire detectors that will be compatible with the outlined requirements. Detectors topology visualization enables improved monitoring and operation of the system, constant stream of information about sensed data including errors and detectors fails.

In other words, visualization provides a powerful means of making sense of data. By mapping data attributes to visual properties such as position, size, shape, and color, visualization designers leverage perceptual skills to help users discern and interpret patterns within data [9].

III. USING 3D MODELING IN FIRE PROTECTION SYSTEMS

3D modeling in fire detection system may be used for two basic purposes:

- A simulation and a 3D animation of a fire spread inside the building. This is important for respond unit, so that fire department and firefighters can get visual information of the fire spreading through the building and can see the hot spots even before they arrive on the scene.
- The second purpose of using a 3D program, in this case Blender, is a creation of 3D model that contains: the building layout, the position of the windows and doors, materials etc.

It raises the following formal representation problems:

- How to represent the sensors inside of the building. This problem is solved by representing the sensor thought blender material. The sensors are represented as a separate simplified object

inside of a room. By simplifying the sensor it can be easily followed and analyzed.

- Gathering the building data in the form of building layout and joining it with the flammability index (TABLE II) of the construction materials. This is solved by dividing all the materials into five categories by their index of flammability (Hazard Rating Index: Flammability) which is a number from zero to four. [10]. All materials are graded by flammability and the assigned to a group, this group is assign one material of certain characteristic there for it is much easy to track the flammability trough the building when this data is exported to xml.

TABLE II. HAZARD RATING INDEX: FLAMMABILITY

Hazard Rating Index: Flammability	Material characteristics
4	<p>Materials which will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or which are readily dispersed in air, and which will burn readily. This degree should include:</p> <p>Gases; Cryogenic materials; Any liquid or gaseous material which is a liquid while under pressure and have a flash point below 73°F (22.8°C) and having a boiling point below 100°F(37.8°C). (Class IA flammable liquids.) Materials which on account of their physical form or environmental conditions can form explosive mixtures with air and which are readily dispersed in air, such as dusts of combustible solids and mists of flammable or combustible liquid droplets.</p>
3	<p>Liquids and solids that can be ignited under almost all ambient temperature conditions. Materials in this degree produce hazardous atmospheres with air under almost all ambient temperatures or, though unaffected by ambient temperatures, are readily ignited under almost all conditions. This degree should include:</p> <p>Liquids having a flash point below 73°F (22.8°C) and having a boiling point at or above 100°F (37.8°C) and those liquids having a flash point at or above 73°F (22.8°C) and below 100°F (37.8°C). (Class IB and Class IC flammable liquids);</p> <p>Solid materials in the form of coarse dusts which may burn rapidly but which are generally do not form explosive atmospheres with air;</p> <p>Solid materials in a fibrous or shredded form which may burn rapidly and create flash fire hazards, such as cotton, sisal and hemp;</p> <p>Materials which burn with extreme rapidity, usually by reason of self-contained oxygen (e.g., dry nitrocellulose and <i>many organic peroxides</i>); Materials which ignite spontaneously when exposed to air.</p>
2	<p>Materials that must be moderately heated or exposed to relatively high ambient</p>

	<p>temperatures before ignition can occur. Materials in this degree would not under normal conditions form hazardous atmospheres with air, but under high ambient temperatures or under moderate heating may release vapor in sufficient quantities to produce hazardous atmospheres with air. This degree should include:</p> <p>Liquids having a flash point above 100°F (37.8°C), but not exceeding 200°F (93.4°F); Solids and semi solids which readily give off flammable vapors.</p>
1	<p>Materials that must be preheated before ignition can occur. Materials in this degree require considerable preheating, under all ambient temperature condition, before ignition and combustion can occur. This degree should include:</p> <p>Materials which will burn in air when exposed to a temperature of 1500°F (815.5°C) for a period of 5 minutes or less;</p> <p>Liquids, solids, and semi solids having a flash point above 200°F (93.4°C);</p> <p>This degree includes most ordinary combustible materials.</p>
0	<p>Materials that will not burn. This degree should include any material which will not burn in air when exposed to a temperature of 1500°F (815.5°C) for a period of 5 minutes.</p>

Fig. 2 shows the layout of one office inside the building and the idea about the materials can be gotten.



Figure 2. Model of a office inside a building.

Fig. 3 presents the positioning of the sensors inside the building.



Figure 3. Office with a view of sensor positioning

IV. THE ROLE OF BLENDER TOOL

Blender is one of the most popular open source 3D modeling programs used for modeling, texture, animating and rendering. Official versions of Blender are released for Linux, Mac OS X, and Microsoft Windows. One of the limitations concerning Blender usage is the lack of complex examples that are distributed together with the installation, which is not the case with some other tools like. In spite of that it has almost all features that characterize high-end 3D software. Among its capabilities there are:

- Support for a variety of geometric primitives, including, polygon meshes fast subdivision surface modeling, Bezier curves, NURBS surfaces, metaballs, multi-res digital sculpting (including maps baking, re-meshing, resynchronize, decimation..), outline font, and a new n-gone modeling system called B-mesh.
- Internal render engine with scan line ray tracing, indirect lighting, and ambient occlusion that can export in a wide variety of formats.
- A path tracer render engine called Cycles, which can use GPU to assist rendering. Cycles supported Open Shading Language shading since blender 2.65.[11]
- Integration with a number of external render engines through plugging.
- Key framed animation tools including inverse kinematics, armature (skeletal), hook, curve and lattice-based deformations, shape keys (morphing), non-linear animation, constraints, and vertex weighting.
- Simulation tools for Soft body dynamics including mesh collision detection, LBM fluid dynamics, smoke simulation, Bullet rigid body dynamics, and ocean generator with waves.
- A particle system that includes support for particle-based hair.
- Modifiers to apply non-destructive effects.
- Python scripting for tool creation and prototyping, game logic, importing and/or exporting from other formats, task automation and custom tools.
- Basic non-linear video/audio editing.
- The Blender Game Engine, a sub-project, offers interactivity features such as collision detection, dynamics engine, and programmable logic. It also allows the creation of stand-alone, real-time applications ranging from architectural visualization to video game construction.
- A fully integrated node-based compositor within the rendering pipeline accelerated with OpenCL.
- Procedural and node-based textures, as well as texture painting, projective painting, vertex painting, weight painting and dynamic painting.

- Real-time control during physics simulation and rendering.
- Camera and object tracking.

Taking this into consideration it seems promising to orchestrate Blender with other tools, using the means of interoperability, in order to make its products more expressive.

V. EXPORTING TO XML, YAFARAY PLUG-IN

YafaRay is a free open-source raytracing engine. Raytracing is a rendering technique for generating realistic images by tracing the path of light through a 3D scene. A render engine consists of a "faceless" computer program that interacts with a host 3D application to provide specific raytracing capabilities "on demand". Blender 3D is YafaRay main host application at the moment [12].

For the purpose of this research Yafaray plug-in is used for exporting the 3D building models to XML file. This file consist information about the building, about coordinate of the building layout, the information's about the Hazard Rating Indexes and the coordinates of the sensors inside the building.

Data generated by exporting Blender 3D models into XML can be used for a variety of purposes. One of them will be discussed in next section.

VI. AN EXAMPLE OF USING DATA GENERATED IN BLENDER

Before the generated data can be used in any of the systems for fire detection, it is necessary to read and process them. From the generated data information about materials, Hazard rating index, sensors position, position of the walls can be find out. Next figure shows generated XML segment.

```

...
<material name="zid--9223372036850405968">
  <IOR fval="1.8"/>
  <color r="0.612067" g="0.545419" b="0.268487" a="1"/>
  <diffuse_reflect fval="1"/>
  <emit fval="0"/>
  <fresnel_effect bval="false"/>
  <mirror_color r="1" g="1" b="1" a="1"/>
  <specular_reflect fval="0"/>
  <translucency fval="0"/>
  <transmit_filter fval="1"/>
  <transparency fval="0"/>
  <type sval="shinydiffusemat"/>
</material>
...
<mesh id="6" vertices="482" faces="512" has_orco="false"
has_uv="false" type="0">
  <p x="-0.690665" y="4.52478" z="3.95539"/>
  <p x="-0.727667" y="4.52478" z="3.94417"/>
  ...
</mesh>

```

Figure 4. Generated XML data

To read data from XML it is necessary to use an XML parser which, based on the XML structure, provides simple operation and extraction of the desired data. After data parsing, it is necessary to normalize them, or

translate into a form that is suitable for further processing, including: setting the ratio of the real and virtual images and setting the origin.

Parsed data can be further used in fire detection design and analysis processes performed in next steps. The described model is based on the work [13] on a set of functional relations for the temperature and velocity of fire gases in a ceiling jet. This method takes into account the effects of ceiling height, radial distance between the detector and the fire, threshold fire size (critical heat release rate (Q_{CR})), rate of fire development, and detector response time index. The presented procedure can be used to estimate the response heat detectors for either design or analysis purposes. In this case, it is necessary to assume that the heat detector response can be modeled using a lumped mass heat transfer model [14].

1. Determine ambient temperature (T_a) ceiling height or height above fuel (H).
2. Determine the fire growth characteristic for the expected design fire: α - a constant for a particular fuel, or t_c - fire growth time to reach 1000 Btu/sec (1055 kW).
3. Define the characteristics of the detectors means that user must determine the fixed temperature (T_s) or rate of temperature rise ($\frac{dT_d}{dt}$) at which the detector will respond from the manufacturer's data [14].
 - Design - Establish system goals (t_{CR} or Q_{CR}) and make a first estimate of the distance $r[m]$ from the fire to the detector.
 - Analysis - Determine spacing of existing detectors and make a first estimate of the response time or the fire size at detector response (the heat release rate : $Q[kW]$ $Q = \alpha t^2$).
4. Calculate the no dimensional time at which the initial heat front reaches the detector:

$$t_{2f}^* = 0,813 \left(1 + \frac{r}{H} \right) \quad (1)$$

5. Calculate the factor A defined as:

$$A = \frac{g}{C_p T_a \rho_0} \quad (2)$$

where T_a is the initial ambient temperature of the room (before start of the fire), g is the gravitational constant, C_p and ρ_0 are the specific heat and density of air at the ambient condition, respectively [15].

6. Calculate the reduced time t_2^* :

$$t_2^* = \frac{t}{A^{\frac{1}{5}} \alpha^{\frac{1}{5}} H^{\frac{4}{5}}} \quad (3)$$

7. If $t_2^* > t_{2f}^*$ continue to step 8. If not, a new detector position $r[m]$ should be tried and returned to step 4.
8. Calculate the reduced gas velocity u_2^* :

$$u_2^* = \frac{u}{A^{\frac{1}{5}} \alpha^{\frac{1}{5}} H^{\frac{1}{5}}} \quad (4)$$

9. Calculate the reduced gas temperature ΔT_2^* :

$$\Delta T_2^* = \begin{cases} 0, & t_2^* \leq t_{2f}^* \\ \left\{ \frac{[t_2^* - t_{2f}^*]}{\left[0,188 + 0,313 \frac{r}{H} \right]} \right\}^{\frac{4}{3}}, & t_2^* > t_{2f}^* \end{cases} \quad (5)$$

10. Calculate the dimensionless gas velocity for t^2 -fires:

$$\frac{u_2^*}{(\Delta T_2^*)^{\frac{1}{2}}} = \begin{cases} \frac{3,87}{(9,115)^{0,5}}, & \frac{r}{H} \leq 0,3 \\ 0,59 \left(\frac{r}{H} \right)^{-0,63}, & \frac{r}{H} > 0,3 \end{cases} \quad (6)$$

11. Calculate:

$$Y = \frac{3}{4} \left(\frac{u}{u_2^*} \right)^{\frac{1}{2}} \left(\frac{u_2^*}{(\Delta T_2^*)^{\frac{1}{2}}} \right)^{\frac{1}{2}} \left(\frac{\Delta T_2^*}{RTI} \right) \left(\frac{t}{t_2^*} \right) D \quad (7)$$

$$\text{where: } D = 0,188 + 0,313 \left(\frac{r}{H} \right) \quad (8)$$

and RTI is the response time index $[m^{1/2}s^{1/2}]$ which is a measure of the thermal sensitivity of the detector.

12. A detector activation temperature for fixed heat detectors can be calculated using equation [16]:

$$T_d(t) - T_d(0) = \left(\frac{\Delta T}{\Delta T_2^*} \right) \Delta T_2^* \left[1 - \frac{(1 - e^{-Y})}{Y} \right] \quad (9)$$

A rate of temperature change for rate of rise detectors is given by next equation:

$$\frac{dT_d(t)}{dt} = \frac{\left[\frac{4}{3} \frac{\Delta T}{\Delta T_2^*} (\Delta T_2^*)^{\frac{1}{4}} (1 - e^{-Y}) \right]}{\left(\frac{t}{t_2^*} \right) D} \quad (10)$$

13. Obtained values are then compared to the fixed temperature or rate of change at which the chosen detector is designed to respond.

TABLE III. DECISION MAKING

If	Design	Analysis
$T_a < T_s$	A larger r [m]	A larger t_r
$T_a > T_s$	A smaller r [m]	A smaller t_r
$T_a = T_s$	$s = 1,41 \cdot r = __ [m]$	$t_r = __ [s]$

For fixed heat temperature detector with following parameters (ambient temperature - $T_a = 10^\circ C$, ceiling height - $H = 4m$, response time index - $RTI = 98m^{1/2}s^{1/2}$, system goals - $t_{CR} = 150s$ and $Q_{CR} = 5000kW$ and simulation time $t_{sim} = 600s$ with step of 10s) some of simulation obtained results using above described method are presented in next tables.

TABLE IV. OPERATING TEMPERATURE VERSUS HEAT RELEASE RATE

Operating temperature: T_s [$^\circ C$]	Heat release rate: Q [kW]	Response time: t_r [s]
57	2104	211,8
63	2332	223
71	2637	237,1
88	3299	265,2

TABLE V. CEILING HEIGHT VERSUS HEAT RELEASE RATE

Ceiling height: H [m]	Heat release rate: Q [kW]	Response time: t_r [s]
2,4	1762	193,8
3,3	1946	203,7
4,9	2326	222,7
7,3	3012	253,4

TABLE VI. DETECTOR SPACING VERSUS HEAT RELEASE RATE

Detector spacing: S [m]	Heat release rate: Q [kW]	Response time: t_r [s]
2,4	560	109,3
4,6	985	144,9
9,1	2104	211,8
15,2	4124	296,5

Previously explained steps constitute a complete mathematical description of the transient response of a thermal detector to a t^2 -fire based upon data generated in visualization process. This can be considered as the basis for all current designs and analysis of fire detection systems.

VII. CONCLUSION

This paper presents the basic problems that are imposed during BMS fire detection subsystem design. Visualization of the subsystems and the introduction of a 3D space model, benefits easier monitoring and collecting data from the sensors, or from the environment. Creating

3D models of environment and sensor nodes, with the help of open source tool Blender and extraction model in XML, while preserving all the necessary information about the structure of the object and the sensor nodes position, enables not only visualization, but also further processing possibility.

Information processing need not be in real-time but, depending on the problem being solved, it can be focused on the simulation of certain situations and parameter predictions. The experiences rose from performed simulations shows that proper visualization plays a key role in the analysis, processing and collecting data from BMS and its subsystems.

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Predicting the EUR/RSD Exchange Rate Using Wavelets and Neural Network

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Abstract - Predicting the exchange rate of a certain currency in today's global financial market plays an important role in economic calculations in every country and its future investments. Hence, it is vital to control a prediction that is precise enough for this type of time series. This paper describes the system containing wavelets and a neural network that serve as a predictor for macroeconomic time series. The first part of the system utilizes the wavelet decomposition package and noise removal, while the second part performs the prediction of a reconstructed signal aided by a multi-layered feed forward neural network. The analysis of obtained results indicates that the suggested model sufficiently satisfies characteristics of the financial predictor.

I. INTRODUCTION

The ability to predict a certain domestic currency exchange rate offers a wide array of economic opportunities for a country in the sense of financial investment, management of general business conditions, and function of national and international enterprises.

The exchange rates are nonstationary, noisy and chaotic time series [1], [2]. Hence, their prediction can present a true challenge [3], even moreso knowing that, because of their nature, traditional statistical methods are useless. Still, over the past years, much effort has been invested in exchange rate prediction and the most distinguished methods are those that consider that all important characteristics for the prediction process are contained in the history of the exchange rate and that those features are key factors in approximately predicting the trend of this crucial economic factor.

Artificial intelligence methods, especially Artificial Neural Networks (ANNs), have been widely used as black-box models in the prediction process. These networks present nonlinear computing approaches inspired by the learning process of the brain [4]. Although they have been accepted as effective tools for modeling complex exchange rate trends, their results are still unstable, leading to the questionability of their performance success [5]. Since the currency rate includes several frequency components, past research has come up with the idea of combining techniques in order to increase prediction performance [6]. One of them which has shown excellent performance in financial time series modeling is wavelet transformation. This data

preprocessing technique analyzes a signal in both time and frequency and captures useful information on different resolution levels. In this way, it overcomes the basic drawback of conventional Fourier transform. By designing a hybrid wavelet neural model, we combined the useful features of both techniques in order to increase the overall prediction result. We examined the applicability of this hybrid model for the prediction of the RSD/EUR exchange rate, while testing the impact of different combinations of parameters in the model's architecture on its performance.

In the proposed system, first, our currency rate is decomposed into wavelet sub-time series with the help of wavelet packet decomposition [7], [8]. After the process of noise removal is applied, the reconstructed time series constitutes the input of neural network. Based on the gained predicted values, a set of statistical parameters is calculated and the model is valued. We show that this hybrid model experiences sensitivity to certain architecture decisions but generally provides a robust and competitive forecaster.

II. METHODS

A. Wavelet packet transformation

Wavelet packet transformation [9] is a form of data-preprocessing technique where both detail and approximation coefficients are decomposed into wavelet sub-time series, without losing the information about the time moment of the element occurrence. Fig. 1 shows level 2 wavelet packet decomposition. In the case of the perfect filter bank, at the exit we get a signal identical to the one from the entrance of the filter bank. Having in mind that this type of decomposition produces 2^n different set coefficients (in the case of discrete wavelet transform we get $n+1$ set, where n is the decomposition level), this wavelet transform offers the most complex, most complete and most detailed view of the signal and therefore it is used in this paper.

B. Noise removal with wavelet packets

Noise removal is a very delicate process that needs to be carefully implemented in such a manner so to preserve useful information as much as possible [6]. Noise is mostly present in detail coefficients, i.e. the high pass signal components, and the goal is therefore to set these low-value coefficients to zero (although it is inevitable

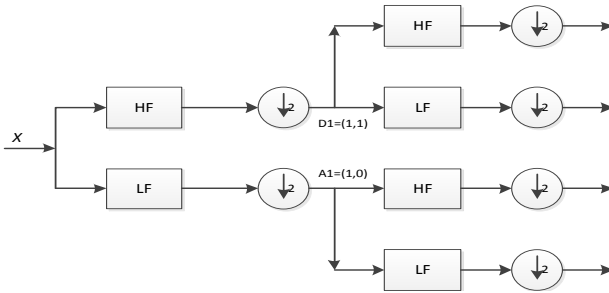


Figure 1. Wavelet packet decomposition.

that by this process the small part of the useful signal is also lost). One of the filtration methods that shows the best results is soft-thresholding [10]. With use of this method, the coefficient values are changed in the following way:

$$T_{\lambda}(x) = \begin{cases} x - \lambda, & x > \lambda \\ 0, & |x| \leq \lambda \\ x + \lambda, & x < -\lambda, \end{cases} \quad (1)$$

where λ is the threshold value.

C. Neural networks

Neural networks present nonlinear function approximators which in the past few years have gained wide application in time series analysis and prediction [11]-[14]. These mathematical tools consist of input, output and a certain number of hidden layers, and the design procedure includes correct choice of application parameters for this complex interior architecture. The basic principle is to design the network as simply as possible. Having this principle in mind, the number of hidden layer nodes, in general dependent from prediction subject, is taken to be half the sum of input and output nodes [15], [16]. The example of this kind of organization is given in Fig. 2.

The most common network architecture used for time series prediction is a *feed-forward* network [17] that can be trained with different backpropagation algorithms. In this paper, the ANN is trained with a *Scaled Conjugate Gradient* backpropagation algorithm, where the difference between the actual and desired output values is transferred in the back and weight factors are being accordingly updated while the entire network converges towards the minimal error.

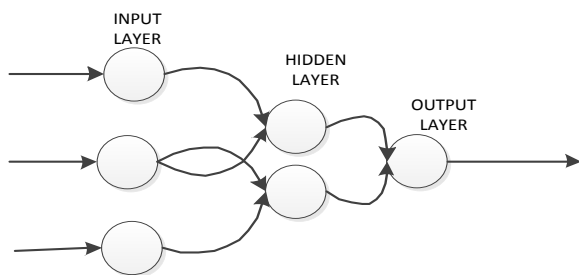


Figure 2. Feedforward neural network with three input neurons, one hidden layer of two neurons and one output neuron.

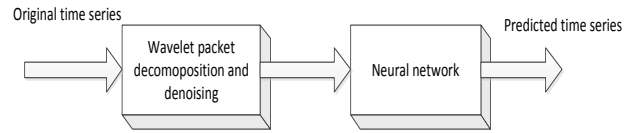


Figure 3. Hybrid model.

III. OVERVIEW OF THE SYSTEM MODEL

The system model considered in this paper is shown in Fig. 3. The input data is normalized in range [-1,1] (premnmx function was used), and it is afterwards decomposed into a certain number of sub-time series by using wavelet packet decomposition. The selection of the optimal decomposition level is one of the keys in determining the performance of the model in the wavelet domain. The decomposition level is generally based on signal characteristics and experiences to selection. While in Literature there is no general rule in choosing this parameter, most researchers agree that applying only one decomposition level is not enough to represent the process [6]. In our paper, we tested two, three and four levels, obtaining the best results by using two decomposition levels. One of the parameters that can also significantly affect the entire prediction process is the wavelet function. Although many researchers advise on using the Haar wavelet, which in fact is effective in capturing the localized changes [6], we discovered that in our proposed model the Db40 wavelet works best (Fig. 4).

As for the neural network used in the next phase of the proposed model in Fig. 3, the optimal number of neurons in the hidden layer can be determined in many ways. Although many researchers suggest using a trial and error approach by varying the number of neurons, we used the above mentioned principle where the number of hidden nodes is taken to be half the sum of input and output nodes. When applied, this principle gives the best results for input nodes varying from 1 to 4 (standard for determining the optimal number of inputs is the real mean squared error value). The output layer consists of one node. The design parameter which we also tested is transfer function for interior layers. In Literature,

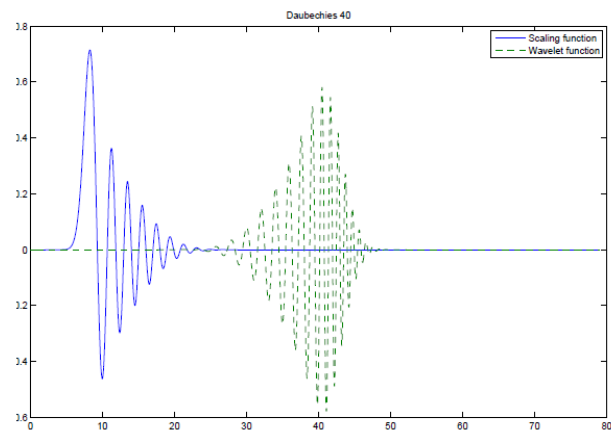


Figure 4. The Db40 wavelet [6].

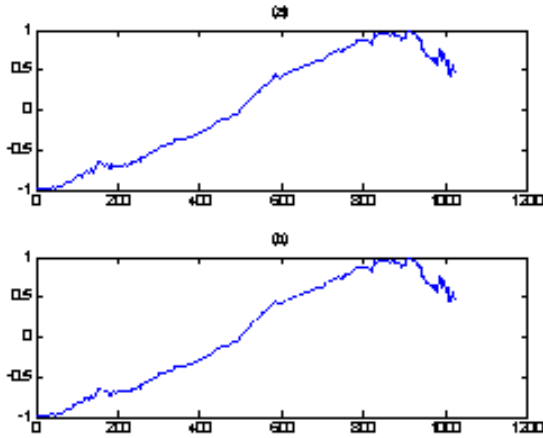


Figure 5. First level approximation coefficients (a) before denoising; (b) after denoising.

researchers namely use tangent-sigmoid, log-sigmoid and linear functions. Our model performed best when tan-sigmoid is used for hidden and linear for output layer function.

IV. RESULTS

In order to test the described model, we used the exchange rate of EUR/RSD during the period 2002-2006 (downloaded from www.nbs.rs) as input data. The process of wavelet packet decomposition and designed ANN with SCG backpropagation algorithm are prepared by a MATLAB code.

The input time series is processed with the wavelet packet decomposition and denoising is applied. Because the process of noise removal is quite complex, we noticed that the model performance is particularly sensitive to the threshold parameter and that it is very important to determine the correct threshold value and apply denoising to the detail coefficients. The process of soft thresholding has been tested for various values from 0.01 to 0.06 with step of 0.005, and the best results are obtained for threshold value of 0.02. After filtration, wavelet packet reconstruction is performed to obtain a denoised signal that will serve as an input signal in the next phase. Figs. 5

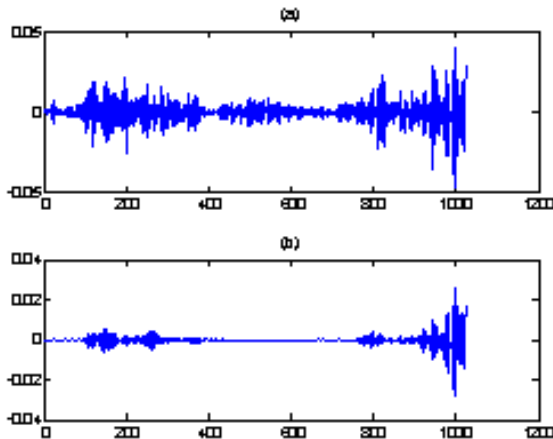


Figure 6. First level detail coefficients (a) before denoising; (b) after denoising.

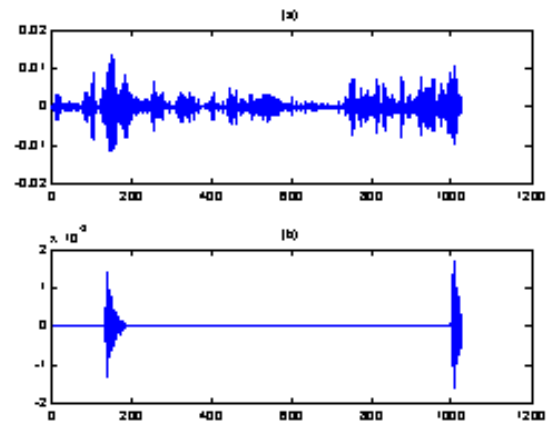


Figure 7. Second level approximation coefficients (a) before denoising; (b) after denoising.

to 8 show wavelet second level sub-time series before and after denoising, while Fig. 9 compares the processed signal with noise and the one without it. It can be noticed that the noise from the original time series is removed without the influence on sudden glitches which means that most of the original signal is preserved. This feature is the biggest advantage of wavelet packet method.

Samples of filtrated signal are used as input in the designed NN where the model was tested for 1, 2, 3 or 4 input samples. 80% of input data is used for training process and the model calibration and parameter settings are made based on this set of data. The remaining 20% is used for validation, i.e. for stopping the training process before the NN faces the underfitting or overfitting issue. There is no certain rule for data division between training and testing, but this kind of data division gives the best results for different performance measures in this case. The original input signal is used as a target during the training process. Fig. 10 shows a comparative view of the input denoised signal and simulated signal from the output. There is a large degree of overlap for both input and output values, with no major discrepancies.

Further, the testing is performed for a varying number of elements which we want to predict ($N=1, N=5$ i $N=20$). For a visual representation of model's performance, Fig.

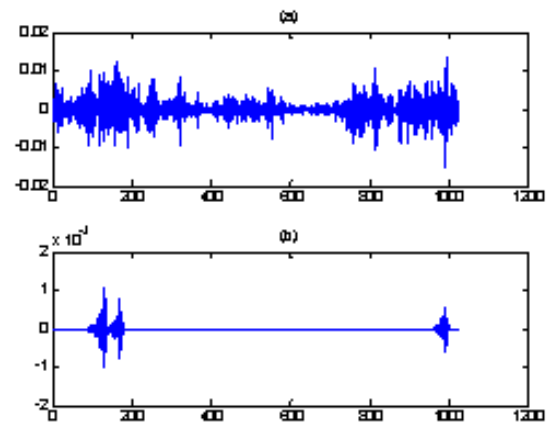


Figure 8. Second level detail coefficients (a) before denoising; (b) after denoising.

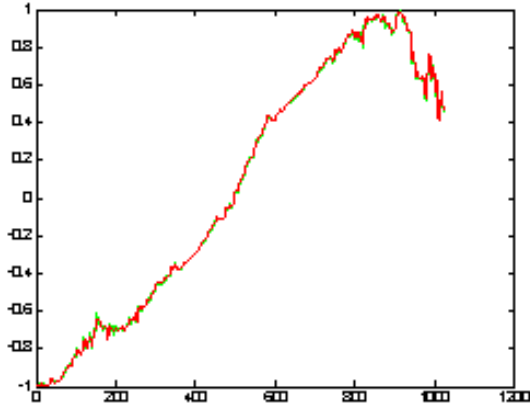


Figure 9. Processed input signal with (green) and without the noise (red).

11 presents comparative graph of $N=20$ samples of predicted and the actual signal values. Although some samples display a perfect match, others notably have certain deviations.

At the end of the whole process, and in order to gain insight in model's performance, certain statistical parameters are calculated, such as mean absolute error:

$$MAE = \frac{1}{n} \sum_{i=1}^n |y_i - \hat{y}_i| \quad (2)$$

mean absolute percentage error:

$$MAPE = \frac{1}{n} \sum_{i=1}^n \frac{|y_i - \hat{y}_i|}{y_i} \quad (3)$$

mean squared error:

$$MSE = \frac{1}{n} \sum_{i=1}^n (y_i - \hat{y}_i)^2 \quad (4)$$

and root mean squared error:

$$RMSE = \sqrt{\frac{\sum_{i=1}^n (y_i - \hat{y}_i)^2}{n}} \quad (5)$$

where y_i is real, and \hat{y}_i predicted value. Their values for prediction case of 1, 5 or 20 elements are shown in Table

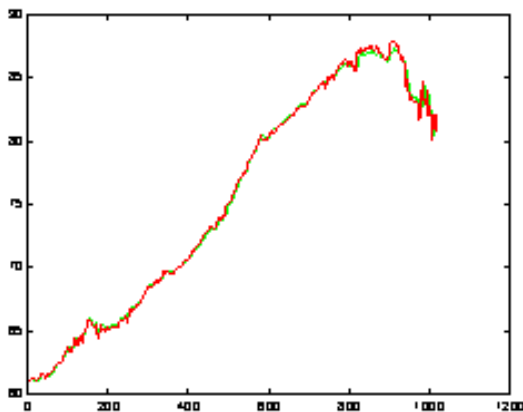


Figure 10. Signal from the input (red) and the output (green) of the neural network.

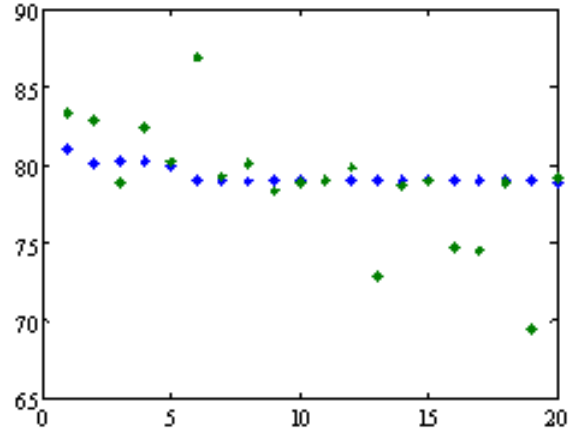


Figure 11. Actual (blue) and predicted (green) values ($N=20$).

I (In order to normalize these parameters, values were divided with actual exchange rate in that moment).

It can be concluded not only that the input training set of data has to be representative, but also that changing the parameters such as momentum speed, number of iterations, error value and number of inputs can affect the NNs performance and the entire concept of the proposed model as a result.

V. CONCLUSION

This paper presents the hybrid wavelet neural model for financial time series prediction. MATLAB code is used for implementation and the model itself is tested applying various decomposition levels, threshold values, series lengths, numbers of prediction samples, and sets of input data. In this paper, two decomposition levels and the Daubechies 40 wavelet is used, but it is advisable in future studies to test some irregular wavelets (Coiflet, Symlet etc.). The results also indicate that the wavelet packet method is an effective tool for signal processing, with better performances than those gained by conventional methods. Although the combined use of wavelet transform and a neural network is able to simulate complex and nonlinear relations in financial time series, the strategy and architecture are hard to determine and in most cases, trial-and-error approaches are used. Even though test results show certain mismatch between original and predicted values, this model presents a quite satisfactory predictor for one day ahead type of predictions. Moreover, having in mind the great number of parameters affecting financial series trends and the large number of scenarios which are taking place on a daily basis in global stock markets, this mismatch is quite

TABLE I. STATISTICAL PARAMETERS FOR THREE TEST CASES

	$N=1$	$N=5$	$N=20$
MAE	0.0014	0.0115	0.0279
MAPE [%]	0.0017	0.0143	0.0352
MSE	0.0001	0.0323	0.1559
RMSE	0.0014	0.0199	0.0439

reasonable. It leaves enough space for further research and development of prediction models, to which attention is yet to be devoted in order to adequately reach accurate solutions.

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Information Dispersal for Big Data Storage

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Abstract - This paper covers key Considerations for RAID Successors as the main Data Loss prevention system. It covers why RAID is dead for multi petabyte storage systems and why there is a need for immediate successor. Information dispersal comes in as one of the promising cost effective methods.

I. INTRODUCTION

Data is exploding, growing 10X every five years. In 2008, it was projected that over 800 Exabytes (one million terabytes) of digital content existed in the world and that by 2020 that number is projected to grow to over 35,000 Exabytes. What's fueling the growth? Unstructured digital content. Over 90% of all new data created in the next five years will be unstructured digital content, namely video, audio and image objects. The data storage, archive and backup of large numbers of digital content objects is quickly creating demands for multi-petabyte (one thousand terabytes) storage systems.

Big data is a term that is generally overhyped and largely misunderstood in today's IT marketplace. There are many definitions for big data technologies, one of them says:

Big data technologies describe a new generation of technologies and architectures designed to economically extract value from large volumes of a wide variety of data, by enabling high-velocity capture, discovery and/or analysis.

Unfortunately, this definition does not apply to traditional storage technologies that are based on RAID (redundant array of independent drives) despite the marketing efforts of some large, established storage providers. RAID and replication inherently add 300% to 400% of overhead costs in raw storage requirements, and will only balloon larger as storage scales into the petabyte range and beyond.

Current data storage systems based on RAID arrays were not designed to scale to this type of data growth. As a result, the cost of RAID-based storage systems increases as the total amount of data storage increases, while data protection degrades, resulting in permanent digital asset loss. With the capacity of storage devices today, RAID-based systems cannot protect data from loss. Most IT organizations using RAID for big data storage incur additional costs to copy their data two or three times to protect it from inevitable data loss.

II. RAID

A. Why RAID Fails at Scale

RAID schemes are based on parity, and at its root, if more than two drives fail simultaneously, data is not recoverable. The statistical likelihood of multiple drive failures has not been an issue in the past. However, as drive capacities continue to grow beyond the terabyte range and storage systems continue to grow to hundreds of terabytes and petabytes, the likelihood of multiple drive failures is now a reality.

Further, drives aren't perfect, and typical SATA drives have a published bit rate error (BRE) of 10⁻¹⁴, meaning that once every 100,000,000,000,000 bits, there will be a bit that is unrecoverable. Doesn't seem significant? In today's big data storage systems, it is.

The likelihood of having one drive fail, and encountering a bit rate error when rebuilding from the remaining RAID set is highly probable in real world scenarios. To put this into perspective, when reading 10 terabytes, the probability of an unreadable bit is likely (56%), and when reading 100 terabytes, it is nearly certain (99.97%).

RAID advocates will tout its data protection capabilities based on models using vendor specified Mean Time To Failure (MTTF) values. In reality, drive failures within a batch of disks are strongly correlated over time, meaning if a disk has failed in a batch, there is a significant probability of a second failure of another disk.

B. RAID Replication

IT organizations address the big data protection shortcomings of RAID by using replication, a technique of making additional copies of data to avoid unrecoverable errors and lost data. However, those copies add additional costs: typically 133% or more additional storage is needed for each additional copy, after including the overhead associated with a typical RAID 6 configuration.

Organizations also use replication to help with failure scenarios, such as a location failure, power outages, bandwidth unavailability, and so forth. Having seamless access to big data is key to keeping businesses running and driving competitive advantages.

As storage grows from the terabyte to petabyte range, the number of copies required to keep the data protection constant increases. This means the storage system will get more expensive as the amount of data increases (see Figure 1).

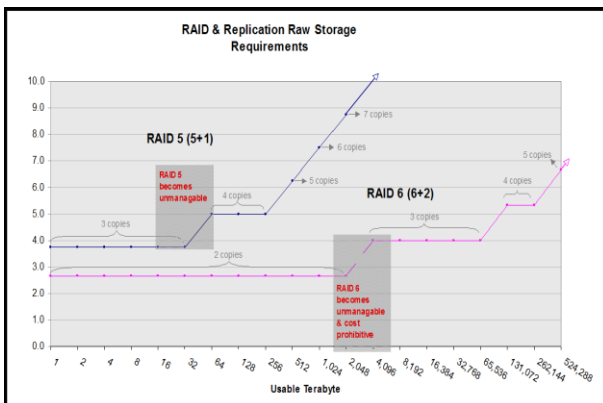


Figure 1. RAID and replication RAW storage requirements

IT Executives should realize their storage approach has failed once they are replicating data three times, as it is clear that the replication band-aid is no longer solving the underlying problem associated with using RAID for data protection. Organizations may be able to power through making three copies using RAID 5 for systems under 32 terabytes; however, once they have to make four copies around 64 terabytes, it starts to become unmanageable. RAID 6 becomes insurmountable around two petabytes, since three copies are not manageable by the IT staff of an organization, as well as cost prohibitive for storage in such a large scale.

(For assumptions for Figures 1, 2, and 3, please refer to endnote

C. Key Considerations for RAID Successors

In looking for a better approach to make big data storage systems reliable, there are key considerations that must be addressed:

Large-scale data protection – It is much easier to design a highly reliable small storage system than to design a highly reliable large storage system. The problem is that given the overall growth rate of data, today's smaller systems are likely to grow to be large systems in very short order. IT organizations must look for a solution that is as reliable storing terabytes as it will be in the

petabyte and Exabyte range. Otherwise, the storage system will eventually hit a failure wall.

Handles multiple simultaneous failures– RAID 6, based on parity, cannot recover from more than two simultaneous failures, or two failures, and a bit rate error before one of the failing drives is recovered. IT organizations must look for a solution that can be configured to handle multiple simultaneous failures that would match realistic outage scenarios in big data environments, provide seamless availability and automatically recover itself.

Large-scale cost-effectiveness – Keeping reliability constant, RAID gets more expensive as the amount of data increases. IT organizations must find a solution that doesn't multiply raw storage requirements as it grows, to avoid a storage problem that no amount of money can solve. The right solution must also allow the number of nines of reliability to be set versus having to live with the limitations of what is affordable..

III. INFORMATION DISPERSAL

Information Dispersal helps IT organizations address big data storage challenges and significantly reduce storage costs, reduce power and the footprint of storage, as well as streamline IT management processes.

Information Dispersal Basics - Information Dispersal Algorithms (IDAs) separate data into unrecognizable slices of information, which are then distributed—or dispersed—to storage nodes in disparate storage locations. These locations can be situated in the same city, the same region, the same country or around the world.

Each individual slice does not contain enough information to understand the original data. In the IDA process, the slices are stored with extra bits of data which enables the system to only need a pre-defined subset of the slices from the dispersed storage nodes to fully retrieve all of the data.

Because the data is dispersed across devices, it is resilient against natural disasters or technological failures, like drive failures, system crashes and network failures. Because only a subset of slices is needed to reconstitute the original data, there can be multiple simultaneous failures across a string of hosting devices, servers or networks, and the data can still be accessed in real time.

A. Realizable Cost Savings

Suppose an organization needs one petabyte of usable storage, and has the requirement for the system to have six nines of reliability – 99.9999%. Here's how a system built using Information Dispersal would stack up against one built with RAID and Replication

To meet the reliability target, the Dispersal system would slice the data into 16 slices and store those slices with a few extra bits of information such that only 10 slices would be needed to perfectly recreate the data – meaning, the system could tolerate six simultaneous outages

or failures and still provide seamless access to the data. The raw storage would increase by 1.6 (16/10) times the usable storage, totaling 1.6 petabytes.

To meet the reliability target for one petabyte with RAID, the data would be stored using RAID 6, and replicated two, three or even four times possibly using a combination of disk/tape . The raw storage would increase by .33 for the RAID 6 configuration, and then be replicated three times for a raw storage of four times, totaling four petabytes.

Comparing these two solutions side by side for one petabyte of usable storage, Information Dispersal requires 60% the raw storage of RAID 6 and replication on disk, which translates to 60% of the cost.v

When comparing the raw storage requirements, it is apparent that both RAID 5 and RAID 6 require more raw storage per terabyte as the amount of data increases. The beauty of Information Dispersal is that as storage increases, the cost per unit of storage doesn't increase while meeting the same reliability target.

To translate into real world costs, here's an example of storing one petabyte, with six nines of reliability (99.9999%). This also assumes the cost per terabyte is a commodity and the same for either a RAID 6 and replication or Dispersal solution, and set at \$1,000

TABLE I. COST EXAMPLE FOR STORING ONE PETABYTE

Petabyte Scenario	RAID 6 & Replication	Dispersal
Usable Capacity	1 petabyte	1 petabyte
Raw Storage Multiplier	2.67 (replicated 2 times)	1.6
Cost / Terabyte	\$1000	\$1000
Total Cost	\$2,670,000	\$1,600,000
Cost Savings		\$1,070,000

It quickly becomes apparent that an organization can save millions of dollars in the petabyte range, and that dispersal is 40% less expensive.

Now another real world scenario: suppose the storage is four petabytes, with six nines of reliability (99.9999%), and assume the cost per terabyte is again set at \$1,000.

TABLE II. COST EXAMPLE FOR STORING FOUR PETABYTES

4 Petabyte Scenario	RAID 6 & Replication	Dispersal
Usable Capacity	4 petabytes	4 petabytes
Raw Storage Multiplier	4 (replicated 3 times)	1.6
Cost / Terabyte	\$1,000	\$1,000
Total Cost	\$16,000,000	\$6,400,000
Cost Savings		\$9,600,000

In this example, it is clear that RAID 6 and replication are significantly more expensive from a capital expenditure perspective, and further, more costly to manage since there are three copies of data. In this example, Dispersal is 60% less expensive.

Clearly 40% to 60% less raw storage results in not only hardware cost efficiencies, but also additional savings. Using Information Dispersal, an organization realizes cost savings in power, space and personnel costs associated with managing a big data storage system.

B. Attainable Data Protection

Executives begin to fear permanent data loss or significant impact to their ability to analyze the big data under their watch as systems swell to petabytes. Just how likely is data loss using RAID versus Information Dispersal?

When looking at number of years without data loss, with a 99.99999% confidence level, RAID schemes on their own (meaning, without replication) clearly degrade as the storage amount increases to the point where data loss is imminent.

RAID 5 clearly wasn't designed for protecting terabytes of data, as data loss will be close to certain in no time at all. RAID 6 can prevent data loss for several years with lower storage requirements; however, at just 512 terabytes, there is a high probability of data loss in less than a year.

Information Dispersal doesn't even appear on the chart because even for a large storage amount like 524K terabytes, the confidence for years without data loss is not within anyone's lifetime. (It is theoretically over 79 million years.) Clearly, Information Dispersal offers superior data protection and availability as systems scale to larger capacities, and won't incur the expense of replication to increase data protection for big data environments.

C. Avoiding a Resume-Generating Event

Big data is here to stay. If an organization relies on RAID and replication, its storage systems will hit a wall in terms of becoming cost prohibitive (as illustrated in Figure 1), or having to sacrifice data protection to store all of its data, and inevitably experience data loss (as illustrated in Figure 3). At this point, many IT executives fear the resume-generating event of having to admit the data they are responsible for managing is not available for analysis or processing and the enterprise is no longer competitive.

Some IT executives may be in denial— “My storage is only 40 terabytes, and I have it under control, thank you.” Consider a storage system growing at the average rate of 10 times in five years per some estimates. A system of 40 terabytes today will be 400 terabytes in five years, and four petabytes within just 10 years (see Figure 2). This

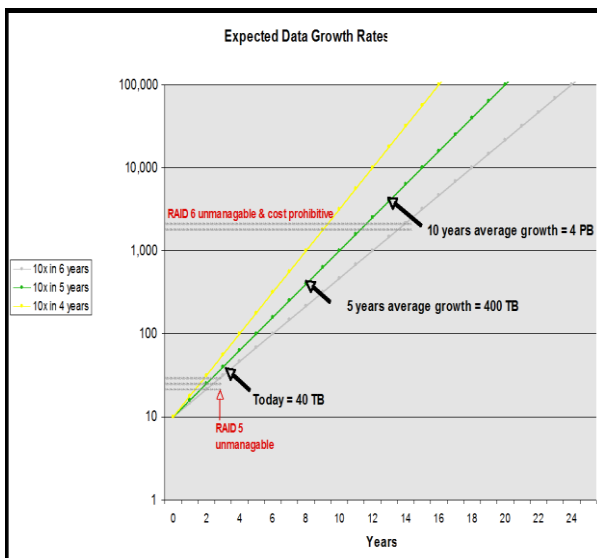


Figure 2. Expected data growth rates

illustrates that a system in the terabyte range that is currently using RAID will most likely start to fail within the executive's tenure.

Savvy IT executives will make a shift to Information Dispersal sooner, realizing it will be easier to migrate their data in a smaller range to the new technology. Further, they will realize significant cost savings within their tenure.

IV. CONCLUSION

Faced with the explosive growth of data plus challenging economic conditions and the need to derive value from existing data repositories, executives are required to look at all aspects of their IT infrastructure to optimize for efficiency and cost-effectiveness. Traditional storage based on RAID fails to meet this objective

Information Dispersal, a new approach for the challenges brought on by big data, is cost-effective at the petabyte and beyond levels for digital content storage.

Further, it provides extraordinary data protection, meaning digital assets are preserved essentially forever. Executives who make a strategic shift from RAID to Information Dispersal can realize cost savings in the millions of dollars for their enterprises with at least one petabyte of digital content.

END NOTES

- Disk drives are 1 terabyte.
- Calculated by taking the chance of not encountering a bit rate error in a series of bits.
For 10 TB: $1 - ((1 - 10^{-14})^{(10 \times (8 \times 10^{12}))})$
For 100 TB: $1 - ((1 - 10^{-14})^{(100 \times (8 \times 10^{12}))})$
- An annual failure rate (AFR) for each drive is set to 5% based on Google's research.
- For RAID 5, an array is configured with 5 data drives, and 1 parity drive.
- For RAID 6, an array is configured with 6 data drives, and 2 parity drives.
- Calculation for a drive's reliability: $(1 - \text{AFR})$.
- Disk failure rebuild rate: 25 MB/s
- Disk service time (hours to replace with new drive): 12 hours
- Calculations do not factor in bit rate errors (BRE), which would increase the storage cost for RAID 5 and 6 due to additional replication required. Dispersal would not increase because in the event of an encountered bit rate error, Dispersal has many more permutations than RAID 5 or 6 in which to reconstruct the missing bit, as well as lower probability of six simultaneous failures.
- Google's research on data from 100,000 disk drive system showed disk manufacturer's published annual failure rates (AFR) understate failure rates they experienced in the field. Their findings were an AFR of 5%.
- This model assumes the same cost per gigabyte of raw storage for a RAID 6 system and a Dispersed Storage system.
- This is a hypothetical price per gigabyte. Based on current research, this would be highly competitive in the market. Readers may adjust math by using a different price per gigabyte as desired.

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TYPESCRIPT, a New OpenSource Way to Program JavaScript

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Abstract - Over time, JavaScript has become so popular that it's now a mainstream language for any kind of app, from small marketplace apps to apps for the enterprise. TypeScript is a new language for application-scale JavaScript development. TypeScript is a superset of JavaScript that allows you to write compile and generate plain JavaScript code that acts more strongly typed and object-oriented, but retains all the flexibility of JavaScript. Any browser. Any host. Any OS. Open Source.

INTRODUCTION

Web applications such as e-mail, maps, document editing, and collaboration tools are becoming an increasingly important part of the everyday computing. TypeScript was built to meet the needs of the JavaScript programming teams that build and maintain large JavaScript programs such as web applications. TypeScript helps programming teams to define interfaces between software components and to gain insight into the behavior of existing JavaScript libraries. TypeScript also enables teams to reduce naming conflicts by organizing their code into dynamically-loadable modules. TypeScript's optional type system enables JavaScript programmers to use highly-productive development tools and practices: static checking, symbol-based navigation, statement completion, and code re-factoring.

TypeScript is a syntactic sugar for JavaScript. TypeScript syntax is a superset of EcmaScript 5 (ES5) syntax. Every JavaScript program is also a TypeScript program. The TypeScript compiler performs only file-local transformations on TypeScript programs and does not re-order variables declared in TypeScript. This leads to JavaScript output that closely matches the TypeScript input. TypeScript does not transform variable names, making tractable the direct debugging of emitted JavaScript. TypeScript optionally provides source maps, enabling source-level debugging. TypeScript tools typically emit JavaScript upon file save, preserving the test, edit, refresh cycle commonly used in JavaScript development.

TypeScript syntax includes several proposed features of EcmaScript 6 (ES6), including classes and modules. Classes enable programmers to express common object-oriented patterns in a standard way, making features like inheritance more readable and interoperable. Modules enable programmers to organize their code into components while avoiding naming conflicts. The TypeScript compiler provides module code generation options that support either static or dynamic loading of module contents.

TypeScript also provides to JavaScript programmers a system of optional type annotations. These type annotations are like the JSDoc comments found in the Closure system, but in TypeScript they are integrated directly into the language syntax. This integration makes the code more readable and reduces the maintenance cost of synchronizing type annotations with their corresponding variables.

The TypeScript type system enables programmers to express limits on the capabilities of JavaScript objects, and to use tools that enforce these limits.

I. TYPESCRIPT IN MODERN APPS

The original intent of JavaScript was for Document Object Model (DOM) manipulation in a small DOM tree. Over time, however, JavaScript has become so popular that it's now a mainstream language for any kind of app, from small marketplace apps to apps for the enterprise. As the popularity of JavaScript continues to grow, a rise in the number of tools and languages required to support its developers is inevitable, with TypeScript being one such language..

A. What Is TypeScript and How Does It Work?

```
function greeter(person) {  
    return "Hello, " + person;  
}
```

```
var user = "Jane User";
document.body.innerHTML = greeter(user);
```

TypeScript is a superset of JavaScript that allows you to write and generate JavaScript code that acts more strongly typed and object-oriented, but retains the flexibility that developers love (or sometimes hate) about JavaScript. TypeScript boosts the viable range of use of JavaScript into the realm of enterprise apps, Web sites and apps where JavaScript has historically run amok due to lack of tools in this space.

Tsc.exe, an open source TypeScript compiler/code generator, is available for download at typescriptlang.org. TypeScript is a standalone compiler, so you can open up a command prompt and execute tsc.exe with the proper arguments at any time, like so:

```
tsc.exe --out outputfile.js inputfile.ts
```

You write TypeScript code, then spin it through the compiler and out comes production JavaScript. Although TypeScript is a code generator, it doesn't output unnecessary code (as is often done for the sake of a visual design tool), mangle variable names or change the variable order. This means it's easier to debug the final product because it's straight-up JavaScript.

JavaScript is already an object-oriented language, but its prototypal syntax is off-putting to many developers. To solve this problem, TypeScript adds features to JavaScript such as classes and interfaces, which are proposed features of the ECMAScript 6 (ES6) standard. This makes TypeScript a code generator covered in syntactic sugar that in most cases cuts down the amount of JavaScript to maintain. For example, the following code uses the prototypal syntax:

```
function Animal(name, species, habitat) {
    this.name = name;
    this.species = species;
    this.habitat = habitat;
}
Animal.prototype.sayHello = function(){
    console.log("RAWR!");
}
var animal = new Animal("Fluffy",
    "Velociraptor ",
    "Everywhere. Run and hide.");
animal.sayHello();
```

The preceding sample starts with a constructor function, a heavily used JavaScript pattern without the surrounding class definition that you'd normally see in other object-oriented languages. You define what is similar to instance members of classes inside constructor functions by using the "this" keyword. Outside the constructor function lies the actual prototype method that binds JavaScript methods to classes. Classes in TypeScript

allow you to write the same code as in the preceding sample but with a more natural syntax, as shown below.

A TypeScript Class

```
class Animal
{
    name: string;
    species: string;
    habitat: string;
    constructor(name: string, species: string, habitat:
string)
    {
        this.name = name;
        this.species = species;
        this.habitat = habitat;
    }
    sayhello()
    {
        Console.log("RAWR");
    }
}
```

To many developers the TypeScript code sample above is more readable than the traditional JavaScript equivalent. Clearly, the code serves as a class definition and list of members, and it shows the types of arguments. TypeScript also provides type checking, interfaces, static compile-time checking, lambda-style expressions and goodies usually found in compiled—not interpreted—languages. These extensions to the JavaScript language are beneficial, as they keep you from falling into common coding pitfalls..

B. OPEN Source

TypeScript is being developed on CodePlex. The TypeScript compiler is implemented in TypeScript, and can be used in any JavaScript host..

C. Starts from JavaScript and Ends with Javascript

TypeScript starts from the syntax and semantics that millions of JavaScript developers know today.

With TypeScript, you can use existing JavaScript code, incorporate popular JavaScript libraries, and be called from other JavaScript code.

TypeScript compiles to clean, simple JavaScript code which runs on any browser, in Node.js, or in any other ES3-compatible environment.

Class Point {

```

    x: number;
    y: number;
    constructor(x: number, y: number) {
        this.x = x;
        this.y = y;
    }
    getDist() {
        return Math.sqrt(this.x * this.x +
            this.y * this.y);
    }
}

var p = new Point(3,4);
var dist = p.getDst();
alert("Hypotenuse is: " + dist);

```

D. Scalable

TypeScript offers classes, modules, and interfaces to help you build robust components.

These features are available at development time for high-confidence application development, but are compiled into simple JavaScript.

TypeScript types let you define interfaces between software components and to gain insight into the behavior of existing JavaScript libraries.

E. Strong Tools for Large Applications

Types enable TypeScript developers to use highly-productive development tools and practices: static checking, symbol-based navigation, statement completion, and code refactoring.

These types are optional, and type inference allows a few type annotations to make a big difference to the static verification of your code.

F. NODE.js

The command-line TypeScript compiler can be installed as a Node.js package.

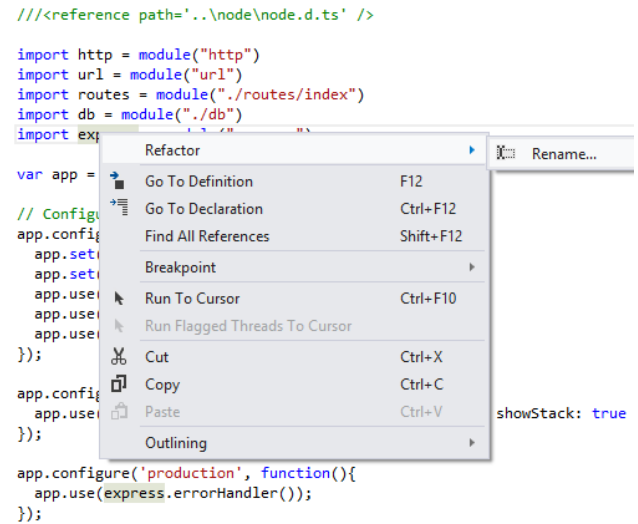


Figure 1 Strong Types of TypeScript

II. BASIC CONCEPTS

A. Ambient declarations

An ambient declaration introduces a variable into a TypeScript scope, but has zero impact on the emitted JavaScript program. Programmers can use ambient declarations to tell the TypeScript compiler that some other component will supply a variable. The following example declares the ‘document’ object supplied by browsers. Because the declaration does not specify a type, the type ‘any’ is inferred. The type ‘any’ means that a tool can assume nothing about the shape or behavior of the document object.

```
declare var document;
```

```
document.title = "Hello"; // Ok because document has been declared
```

In the case of ‘document’, the TypeScript compiler automatically supplies a declaration, because TypeScript by default includes a file ‘lib.d.ts’ that provides interface declarations for the built-in JavaScript library as well as the Document Object Model.

The TypeScript compiler does not include by default an interface for jQuery, so to use jQuery, a programmer could supply a declaration such as:

```
declare var $;
```

B. Function types

Function expressions are a powerful feature of JavaScript. They enable function definitions to create closures: functions that capture information from the lexical scope surrounding the function’s definition. Closures are currently JavaScript’s only way of enforcing data encapsulation. By capturing and using environment variables, a closure can retain information that cannot be accessed from outside the closure. JavaScript programmers often use closures to express event handlers and other asynchronous callbacks, in which another

software component, such as the DOM, will call back into JavaScript through a handler function.

TypeScript function types make it possible for programmers to express the expected signature of a function. A function signature is a sequence of parameter types plus a return type. The following example uses function types to express the callback signature requirements of an asynchronous voting mechanism.

```
function vote(candidate: string, callback: (result:
string) => any) {
  //...
}
vote("BigPig",
function(result: string) {
  if (result === "BigPig") {
    //...
  }
}
);
```

In this example, the second parameter to 'vote' has the function type

```
(result: string) => any
```

which means the second parameter is a function returning type 'any' that has a single parameter of type 'string' named 'result'.

C. Object Types

TypeScript programmers use object types to declare their expectations of object behavior. The following code uses an object type literal to specify the return type of the 'MakePoint' function.

```
var MakePoint: () => {
  x: number; y: number;
};
```

Programmers can give names to object types; we call named object types interfaces. For example, in the following code, an interface declares one required field (name) and one optional field (favoriteColor).

```
interface Friend {
  name: string;
  favoriteColor?: string;
}
function add(friend: Friend) {
  var name = friend.name;
}
add({ name: "Fred" }); // Ok
```

```
add({ favoriteColor: "blue" }); // Error, name
required
```

```
add({ name: "Jill", favoriteColor: "green" }); // Ok
```

TypeScript object types model the diversity of behaviors that a JavaScript object can exhibit. For example, the jQuery library defines an object, '\$', that has methods, such as 'get' (which sends an Ajax message), and fields, such as 'browser' (which gives browser vendor information). However, jQuery clients can also call '\$' as a function. The behavior of this function depends on the type of parameters passed to the function.

D. Classes

TypeScript emits consistent, idiomatic JavaScript code to implement classes and modules that are closely aligned with the current ES6 proposal. The goal of TypeScript's translation is to emit exactly what a programmer would type when implementing a class or module unaided by a tool. This section will also describe how TypeScript infers a type for each class declaration. A simple BankAccount class looks like this.

```
class BankAccount {
  balance = 0;
  deposit(credit: number) {
    this.balance += credit;
    return this.balance;
  }
}
```

This class generates the following JavaScript code.

```
var BankAccount = (function () {
  function BankAccount() {
    this.balance = 0;
  }
  BankAccount.prototype.deposit = function(credit) {
    this.balance += credit;
    return this.balance;
  };
  return BankAccount;
})();
```

This TypeScript class declaration creates a variable named 'BankAccount' whose value is the constructor function for 'BankAccount' instances. This declaration also creates an instance type of the same name

E. Modules

TypeScript modules provide a mechanism for succinctly expressing the module pattern. In TypeScript, programmers can combine the module pattern with the class pattern by nesting modules and classes within an outer module.

The following example shows the definition and use of a simple module.

```
module M {
  var s = "hello";
  export function f() {
    return s;
  }
}
M.f();
M.s; // Error, s is not exported
```

In this example, variable ‘s’ is a private feature of the module, but function ‘f’ is exported from the module and accessible to code outside of the module.

. If we were to describe the effect of module ‘M’ in terms of interfaces and variables, we would write

```
interface M {
  f(): string;
}
var M: M;
```

The interface ‘M’ summarizes the externally visible behavior of module ‘M’. In this example, we can use the same name for the interface as for the initialized variable because in TypeScript type names and variable names do not conflict: each lexical scope contains a variable declaration space and type declaration space (see Section 2.3 for more details).

Module ‘M’ is an example of an internal module, because it is nested within the global module (see Section 9 for more details). The TypeScript compiler emits the following JavaScript code for this module.

```
var M;
(function(M) {
  var s = "hello";
```

```
function f() {
  return s;
}
M.f = f;
})(M||(M={}));
```

In this case, the compiler assumes that the module object resides in global variable ‘M’, which may or may not have been initialized to the desired module object.

TypeScript also supports external modules, which are files that contain top-level export and import directives. For this type of module the TypeScript compiler will emit code whose module closure and module object implementation vary according to the specified dynamic loading system, for example, the Asynchronous Module Definition system.

III. CONCLUSION

JavaScript is here to stay and it’s more popular than ever, so those who move to JavaScript from the land of compiled languages now have TypeScript to help them write and manage application-scale JavaScript code. JavaScript developers benefit from extra type checking and compiler services to which they don’t normally have access when writing straight-up JavaScript.

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Tag-Based Collaborative Filtering in e-Learning System

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Abstract - The goal of this paper is to propose a system for giving recommendation in e-learning by using tagging technique and collaborative filtering. We plan to use PHP programming language for developing the system, and mysql database for storing information about users, learning items, tag lists and etc. Proposed system proposes and student grouping in virtual learning group, based on their knowledge and interests. Also, students can post tags for the learning materials. Collaborative filtering is using to present more relevant information to students based on how other students from the same virtual group have acted. In that content, tags posted from the students are very useful for the system to figure out which learning materials should be adequate for other students from the same virtual group.

Starting point of this paper is that students with similar interests might post similar tags and similar resources might have similar tags, especially when they belong to the same virtual group. Students participating in virtual groups will produce more precise suggestion recommendation for the students, based on tags on other students that belong to the same virtual group.

I. INTRODUCTION

Nowadays, e-learning systems contains huge amount of learning items and information from different learning area and subjects. That's why searching and browsing for relevant, useful and interesting information is quite difficult and often ineffective. It takes more time and student can't find the most adequate content. On the other hand, students come from different knowledge backgrounds and have different learning styles and preferences. To effectively meet these diversities, an e-learning system should be able to offer different learning experiences to different students. In that manner, the main goal of every intelligent e-learning system is to deliver the most useful learning material to the students, in format that is adequate to student learning style. It means that e-learning platform should be assembled from two important modules: selection of the most relevant learning content to students and to detect the most adequate learning style.

The most acceptable format can be detected by using some algorithm for learning style detection (VARK,

David Kolb's model, Peter Honey and Alan Mumford's model, etc).

There are several possible solutions and algorithms for selection the most relevant learning content. This paper proposes using tagging technique and collaborative filtering to select the most adequate content to the students.

Tagging represents an action of reflection, where the tagger sums up a series of thoughts into one or more summary tags, each of which stands on its own to describe some aspect of the resource based on the tagger's experiences and beliefs [1].

Marking content with descriptive terms, also called keywords or tags, is a common way of organizing content for future navigation, filtering or search. Though organizing electronic content this way is not new, a collaborative form of this process, which has been given the name "tagging" by its proponents, is gaining popularity on the web [2]

II. COLLABORATIVE FILTERING

Recommender systems aim at predicting items or ratings of items that the users are interested in. Collaborative Filtering algorithms are the dominant techniques applied in recommender system algorithms. To improve recommendation quality, metadata such as content information of items has typically been used as additional knowledge [3].

Collaborative filtering is a technology utilized primarily to predict individuals' preferences. The concept of collaborative filtering has its origin in information filtering, which guides a reader's choice by filtering a large amount of information and obtaining preferences collaboratively based on preferences shared by like readers [4]. In general, it is the process of filtering for information using techniques involving collaboration among multiple data sources. It is a traditional and widely used approach to recommend items to users based on the assumption that similar minded people may have similar taste or behaviors. In general, there are two kinds of collaborative filtering methods: user-based and item-based [5]. So far, collaborative filtering is the most successful technique in the design of recommender systems [6],

where a user will be recommended items that people with similar tastes and preferences liked in the past.

The similarity between pairs of items can be scored by using the Pearson correlation coefficient. It gives values to how reliably users' scores change together.

A commonly used collaborative filtering approach is based on the intuition that the best recommendation consists of tags attached to the resource by people similar to the user [7].

Traditional collaborative filtering systems have two steps. The first step is to look for users who share the same rating patterns with the active user whom the prediction is for. Then, the systems will use the ratings from those like-minded users found in the first step to calculate a prediction for the active user. Traditional collaborative filtering systems have two steps. The first step is to look for users who share the same rating patterns with the active user whom the prediction is for. Then, the systems will use the ratings from those like-minded users found in the first step to calculate a prediction for the active user [8].

III. TAGGING

With the increasing popularity of the collaborative tagging systems, tags could be interesting and useful information to enhance recommender systems algorithms. Unlike attributes which are "global" descriptions of items, tags are "local" descriptions of items given by the users [3]. Tagging represents an action of reflection, where the tagger sums up a series of thoughts into one or more summary tags, each of which stands on its own to describe some aspect of the resource based on the tagger's experiences and beliefs [1].

A tag can be defined as term or keyword assigned to some information (word, sentence, whole article, etc.). Tags help for describing an item and make items for visible and easy for finding. They are comments from users, comment or notes from authors of item. The tagging information implies user's important personal interests and preferences information, which can be used to recommend personalized items to users [5].

A tagging system allows users to create arbitrary tags that are not part from the content but are good enough to give some good suggestion for the content. Therefore, those user-defined tags can reflect user behaviors and preferences with which users can easily make acquaintance, collaborate and eventually form communities with others who have similar interests [9].

In e-learning, tagging can be defined as a way for aggregating information for articles available in e-learning systems.

Tagging is very useful for users to figure out other users with similar interests within a given category. Users with similar interests might post similar tags and similar resources might have similar tags posted to them.

Tagging allows ranking and data organization to directly utilize inputs from end users, enabling machine processing of Web content [10] and it is a process by

which users assign notes and labels to some learning content, to share and suggest that to other users.

On the another hand, tagging bridges some gap between browsing and search, because browsing enumerates all objects and finds the desirable one by exerting the recognition aspect of human brain, whereas search uses association and dives directly to the interested objects, and thus is mentally less obnoxious [11].

Recommending tags can serve various purposes, such as: increasing the chances of getting a resource annotated (or tagged) and reminding a user what a resource is about. Furthermore, lazy annotating users would not need to come up with a tag themselves but just select the ones readily available in the recommendation list according to what they think is more suitable for the given resource [12].

In this situation recommending tags assigned to a resource by similar users (collaborative filtering) should give similar results as recommending the tags frequently attached to the resource by any user.

IV. PROPOSED SYSTEM

The goal of this paper is to propose a tag-based collaborative system for e-learning. We plan to use PHP programming language for developing the system, and mysql database for storing information about users, learning items, tag lists and etc.

It's known that collaborative tagging systems are usually composed of users, resources and tags and allow users to assign tags to resources [12]. In that manner, in the proposed system, users are going to be students and teachers, resources are learning items that are posted to the learning system from the teachers.

The proposed system is going to has two types of users: students and teachers. Teachers upload new learning items and add tags for the items. Students can read the learning items and add tags. Each student belongs to some virtual group, based on their interest. It means that students need to select the learning area. That step will initiate update of student profile – will set his interest and set virtual group for the student.

To upload new learning materials, the teachers need to select adequate subject for the learning materials and to add one or several tags. In the proposed system, tags contains following parameters:

- Learning item unique number
- Virtual Learning Group
- The order in the list

These parameters are important in the process of retrieval the most adequate tags for learning contents.

While adding new learning material, she system will propose several tags that can be accepted or not from the teacher. Of course, teacher can add new tags that are not on the suggest list.

Tags will be suggested based on:

- Tags selected by learning title and learning content
- The most used tags

The title and abstract from the learning article are divided into words, which are then cleaned of non-alphabetical, conjunctions, contributions, non-numerical characters and etc. Then, the system assigns a score to each word, which represents the probability of being chosen as a tag – number of times being chosen as a tag divided by the number of occurrences. For instance, if the word occurred in the titles of previously entered resources less than 10 times its probability of being a correct tag is set to 0.01 which is an empirically estimated value for low-frequency tags [7]. The tags with the highest score will be proposed to the teacher.

Except tag score parameter, system will check and for the most use tags in other learning items from the same virtual group. It means that the system will execute a query to select the most use tags, limit up to 10. As a result, system will propose list with maximum 10 tags to the teacher. At first, system will find the most adequate content that is already in the system based on item title. Then, will get the added tags for selected items, order them by number of using and will generate tag list.

Proposed tag suggestion algorithm favors tags that have high rating - are used by a huge number of users. Second, it honors the high correlation among tags, e.g., if tags php and phpmyadmin tend to be used together by most users for a given object, they should co-occur in our suggested tags.

Except select tags from the lists, users can add their new tags. To be more effective, the system will use synonym list for the tags. It means that system have to check in the synonyms list and make relation between tagged learning item, the tag and the synonyms.

Uploaded learning items are available for registered students in the same virtual group. While reading learning items, they can add new tags for selected learning content. After they add new tag, the learning item owner (the teacher) will get notification about new tag for his learning material. Then, it can accept or reject the tags.

Other aspect of the system is recommendation the most adequate content to students, based on virtual group where they belong.

At first, student needs to select some learning item. At the same moment, the system will get the tag list for that learning item and make selection for other items, based on comparing the tag list of opened learning item and other learning items from the same virtual learning group. Based on tag similarity on learning items, calculated with Pearson correlation coefficient, system is going to propose new learning items, which are similar with opened one.

Each tag has own rating. If the value for X increase as Y increases, so a user that rates X highly also rates Y highly, even if they don't increase at the same rate, the score will be high towards 1. If one consistently decreases as the other increases the score will be negative, towards -1, and if there's no relationship it will be zero.

In the proposed system, we suggest using following PHP code for suggesting similar learning items:

```
$learning_items = array(
    'learning_item_1' => array(1,3,4,6),
    'learning_item_2' => array(2,3,4),
    'learning_item_3' => array(1,3,5,7),
    'learning_item_4' => array(1,2,3,4,5),
    'learning_item_5' => array(1,3,6,7)
);

function calculate_similarities($learning_items) {
    $similarities_array = array();

    foreach($learning_items as $item => $scores) {
        $similarities_array[$item] = array();

        foreach($learning_items as $item2 => $scores2) {
            if($item2 == $item ||
            isset($similarities_array[$item][$item2])) {
                continue;
            }

            $sim = calculate_pearson_coefficient($scores, $scores2);
            if($sim > 0) {
                $similarities_array[$item][$item2] = $sim;
                $similarities_array[$item2][$item] = $sim;
            }
        }
        arsort($similarities_array[$item]);
    }
    return $similarities_array;
}
```

In the code above, calculate_pearson_coefficient() is function for calculation of Pearson correlation coefficient from two list, passed as parameters. The coefficient is value will be between -1 and 1.

V. CONCLUSION

In this paper we proposed a system for giving recommendation for tag list and recommendation for useful learning item, in e-learning system by using tagging technique and collaborative filtering. Recommendation of tag list is useful while teachers adding new learning items. So, they can choose some of suggested tags or insert new tags.

On the other hand, students belong to virtual learning groups, based on the subject they selected. It means that students in the same virtual learning group require similar learning items. They are not just viewers, they also can add tags for the learning items.

Each learning item has own tag list (tags added by teachers and students). Based on tag similarity on learning items, calculated with Pearson correlation coefficient, system is going to propose new learning items, which are similar with opened one.

It's known that there are a huge number of recommendation techniques, but collaborative filtering recommendation is one of the most successful recommendation techniques. To be more effective process of recommendation, good idea is using combination of tagging and collaborative filtering. It means that by using

tags, users post their experience or opinion about some learning content from the e-learning system. Then, the system will make recommendation based on user's model similarity and their participating in the same virtual learning group.

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Game Development in Java NetBeans Platform – Sudoku Application

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Abstract - The game development has a long tradition and in accordance to this, there is a variety of approaches in development of software applications for all kinds of games. Among the wide range of various game types, the logic-based games occupy minds of researchers at universities. One of these games is Sudoku. In this paper is presented one approach in development of Sudoku puzzle games. Sudoku is logic-based, combinatorial puzzle with number placing. The application described in this paper is primarily developed to automatically generate and solve variety of Sudoku problems.

I. INTRODUCTION

One of the world phenomena are the video games. The games are widely present in the human civilization and variety of cultures throughout the world. So, this fact reflects also to the world of computer and other electronic devices. This paper deals with one portion of this phenomenon.

Video games and video games development have a long history. There is variety of video games, and they can be classified in several genres such as: action, action-adventure, adventure, arcade, role-playing, simulation, strategy, vehicle simulation, puzzle and traditional games. Some of these genres have several subgenres. Action games may be further classified as: single and melee combat games, platform and shooting games. Simulation games may be classified as: sport, business, construction, life simulation games etc. Strategy games cover also variety of subgenres like: “explore, expand, exploit and exterminate” empire games, real time strategy, real time tactics, tactical role playing game, turn based strategy, turn based tactics and wargames. Vehicle simulation games covers: flight simulators, car racing, driving simulators etc.

The traditional and puzzle games, despite their long history and existence long before computers, have great popularity today. Traditional board games like: Chess, Checkers, Back Gammon, Hnefatafl [26], Go, Shatranj, Shogi, Xiangqi, Chaturanga, etc.; are very popular and continuously improving games. The same is with puzzle games. Both of these groups

occupy the minds of the researchers throughout the world.

The common thing for these games is wide usage of artificial intelligence [5] and variety of algorithms used for creating or for solving the problems in particular games. Both groups of games are presented in a number of scientific papers and are the scope of many scientific researches. So, there is a number of papers related to puzzle games in general [1,2,3,4,6,7,8,9,10] and for Sudoku puzzle [11,12,13,14,15,16] as well. In the scientific paper database site ScinceDirect, the search with keyword Sudoku gives 12 results with paper published from 2006 and with 3 papers in 2013.

II. SUDOKU GAME

Sudoku is a logic-based, combinatorial number-placement puzzle. The puzzle was popularized in 1986 by the Japanese puzzle company Nikoli, under the name Sudoku, meaning single number. It became an international hit in 2005 and in United States it is called Number Place Game. There are many variants of the original Sudoku that include letters, different rules and so on.

The aim of the Sudoku puzzle is to enter numerals from 1 through 9 in each cell of a grid. Most frequently it is a 9×9 grid, made up of 3×3 sub grids, starting with various numerals given in some of the cells (the “givens”). The objective of the games is to fill, e.g. a 9×9 grid with digits so that each column, each row, and each of the nine 3×3 sub-grids that compose the grid contain all of the digits from 1 to 9.

Thus the same single integer may not appear twice in the same 9×9 playing board, row or column or in any of the nine 3×3 sub regions of the 9×9 playing board. Completed puzzles are always a type of Latin square. The grids are also called “boxes”, “blocks”, “regions” or “sub-squares”.

As it was said before, at the beginning of the game, the grid is partially completed (the “givens”), and this game setting has typically unique solution.

In this paper will be presented approach in developing Sudoku game. The Sudoku puzzle solver is under development in Java programming language and NetBeans IDE. This is ongoing student project in realization as a part of Java NetBeans User Group Serbia – Zrenjanin branch. The goal of this project is to develop Sudoku game where player can play Sudoku with automatically generated problem or to find the solution for already existing Sudoku problem (e.g. defined by user itself).

The number of classic 9x9 Sudoku solutions is $6.67 \cdot 10^{21}$. If one take into account that rotation, reflection and permutation can be applied to any solved Sudoku problem, the number of essentially different solutions drops down to $5.47 \cdot 10^9$, which still represents the great number [2].

		Box-columns			1			2			3		
		Columns within box-column			1	2	3	1	2	3	1	2	3
Box-rows	Rows within box-rows	Column	1	2	3	4	5	6	7	8	9	Row	
1	1	1	7	9	2	1	6	8	5	4	3		
	2	2	6	4	3	7	5	2	9	1	8		
	3	3	5	1	8	3	4	9	2	6	7		
2	1	4	4	5	1	6	8	7	3	2	9		
	2	5	9	3	7	4	2	5	1	8	6		
	3	6	2	8	6	9	1	3	7	5	4		
3	1	7	1	6	9	5	7	4	8	3	2		
	2	8	8	7	4	2	3	1	6	9	5		
	3	9	3	2	5	8	9	6	4	7	1		

Figure 1. Sudoku square with 9 rows, 9 columns, and 9 boxes

Fig. 1 one [21] show the Sudoku square with 9 rows, 9 columns, and 9 boxes surrounded by thick lines, and the codes of the rows, columns, and boxes. Fig. 2 shows a typical Sudoku problem for a 9x9 Sudoku puzzle with “givens”. On Fig. 3 there is a solution to the same Sudoku puzzle.

III. SOLVING SUDOKU WITH BACKTRACKING ALGORITHM

The central part of this computer game is application of backtracking algorithm for solving the automatically generated Sudoku problem. At the beginning of the application, the software generates the problem. For generation of problem solution backtracking algorithm is used.

One approach in finding solutions for problems is completion of a sequence of decision points in which

each choice leads further along path. In the case when a correct set of choices is used the solution will be found. In the case if the dead end is on the path, e.g. caused by the wrong choice in some time on the path, the process of solving the problem has to be backtracked to a previous decision point and to try different solution. This is the essence of backtracking algorithm. [22]

5	3			7				
6			1	9	5			
	9	8					6	
8				6				3
4			8		3			1
7				2				6
	6					2	8	
			4	1	9			5
				8			7	9

Figure 2. Example of a typical Sudoku puzzle

5	3	4	6	7	8	9	1	2
6	7	2	1	9	5	3	4	8
1	9	8	3	4	2	5	6	7
8	5	9	7	6	1	4	2	3
4	2	6	8	5	3	7	9	1
7	1	3	9	2	4	8	5	6
9	6	1	5	3	7	2	8	4
2	8	7	4	1	9	6	3	5
3	4	5	2	8	6	1	7	9

Figure 3. Solution for the puzzle in Figure 2

Backtracking is a general algorithm for finding all or part of solutions for particular computational problem. This algorithm incrementally builds candidates to the solutions, and abandons each partial candidate ("backtracks") as soon as it determines that candidate cannot possibly be completed to a valid solution.

The classic textbook example of the use of backtracking is the eight queens puzzle. This problem requests to make a program generating all configurations of eight queens on a chessboard of 8*8 squares such that no queen can take any of the others. This means that in the configurations sought, no two queens may be on the same row, on the same column or on the same diagonal. [23]

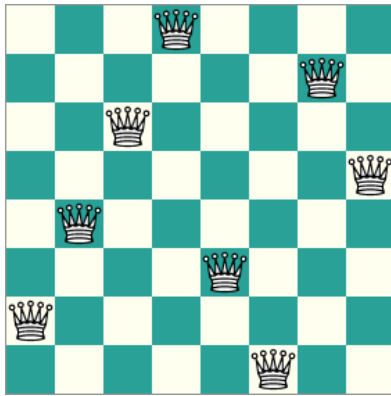


Figure 4. Eight Queens Solution

The problem solution consists of all arrangements of eight chess queens on a standard chessboard in the way that no queen attacks any other [24].

Backtrack is probably the most basic Sudoku solving strategy for computer algorithms. This algorithm is a brute-force method which tries different numbers, and if it fails it backtracks and tries a different number. This means that the backtrack algorithm does an exhaustive search to find a solution, which means that a solution is guaranteed to be found if enough time is provided. Even though this algorithm runs in exponential time, it is plausible to try it since it is widely thought that no polynomial time algorithms exists for NP-complete problem such as Sudoku.

One way to deal with such problems is with brute-force algorithms provided that they are sufficiently fast. This method may also be used to determine if a solution is unique for a puzzle as the algorithm can easily be modified to continue searching after finding one solution.

So, the algorithm can be used to generate valid Sudoku puzzles (with unique solutions) [25]. In [25] comparison of backtracking, rule-based and two Boltzmann machines algorithm is made on the example of solving Sudoku problems. The results with the following problems are shown in Fig. 5.

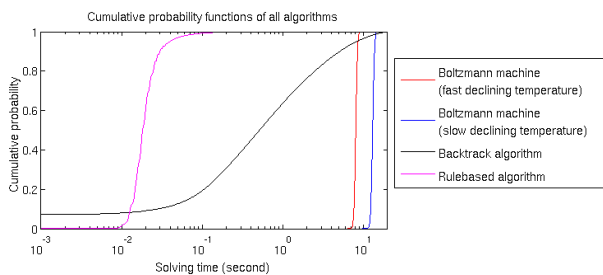


Figure 5. Solving time distributions for four algorithms

In this software the algorithm is implemented in a following way. It starts from the first empty field and

starts filling it with numerals from 1 to 9. If the numeral can be written, it writes it and goes on to the next empty field and starts doing the same. If no numbers can be written to one field, it then clears that field and backtracks to the previous field and increments that number by one. Then it goes on to the next field and repeats all the steps. It will backtrack any amount of times it is necessary to fill the fields correctly. It finishes when it fills the last field in the puzzle with the correct number.

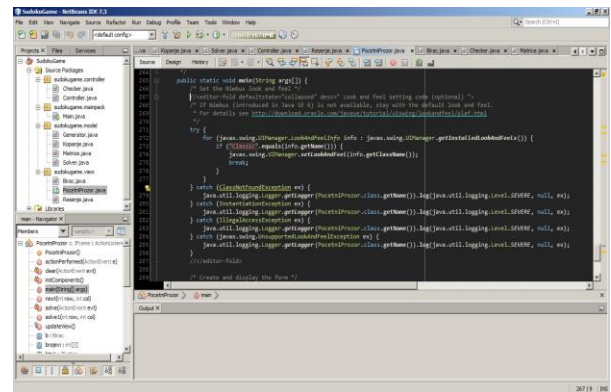


Figure 6. Developing environment Java NetBeans IDE

IV. DETERMINING THE UNIQUENESS OF THE ORIGINAL PROBLEM

For determining the uniqueness of the solution the digging holes algorithm [2] is used.

This algorithm contains several steps. First step is creation of solved grid. At the start, the fields should be filled diagonally. First 3 numbers on diagonal have to be different and this process have to be repeated 3 times. Second step is process of solving the grid. It is solved by usage of backtracking algorithm, which is already described.

The program now selects field randomly and tries “to dig a hole”. If the digged grid has a unique solution, digging will be confirmed. If not, the program tries to dig next field. This process is repeating until the grid satisfies certain level.

V. DEVELOPMENT ENVIRONMENT

This project was developed using IDE NetBeans [17,18] (Fig. 5) and Java programming language [19,20]. The project helped participating students in understanding Object Oriented Programming during the development of this game. The development process was not hard, but there were some setbacks. Several methods were used until satisfactory one was found.

NetBeans IDE provides first-class comprehensive support for the newest Java technologies and Java enhancements before other IDEs. It is the first IDE providing support for JDK 7, Java EE 7, and

JavaFX2. With constantly improving Java Editor, many rich features and an extensive range of tools, templates and samples, NetBeans IDE sets the standard for developing with cutting edge technologies out of the box.

The class diagram of Sudoku application is shown on Fig. 7 and screen layout is shown on Fig. 8.

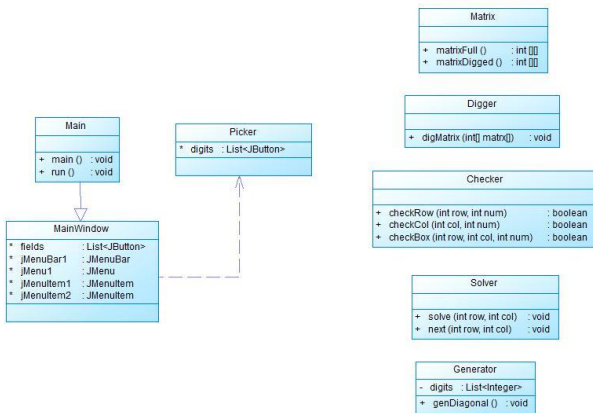


Figure 7. Sudoku application class diagram

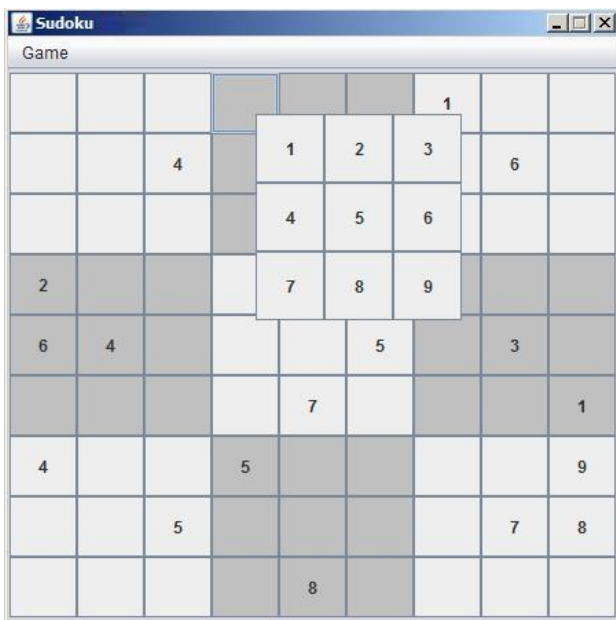


Figure 8. Screen layout of Sudoku application

VI. CONSTRAINS

During the development of this application, several problems were encountered. Most of them were able to be solved easily, and one them is still pending.

The hardest task in the development process was implementation of “digging holes” algorithm in the program. The problem was encountered in the case where the program does not “dig” the entire matrix, but only half of it. The core of the problem lies in

error in implementation of backwards backtracking solving algorithm.

VII. CONCLUSION

This paper presented the approach in development of Sudoku Game using Java in NetBeans IDE and the work on this project will be continued. First, the goal is to solve the problems with the “digging holes” and this requires further work on the implementation backwards backtracking algorithm.

After finishing the application, further expansion of application features will be next goal. Some of these expansions will be OCR scanning of Sudoku problems from newspapers with built-in cameras on smartphones or scanners.

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Cognitive Mapping in Robotics Using Genetic Algorithms

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Abstract - One of the most challenging and important problems in robot programming is cognitive robot mapping. To solve this problem it is necessary to define and detect problem space. This means to find a complete set of possible states, generated by exploring all the possible states or moves, which may, or not lead from a given start state to supposed goal state. This paper has a goal to investigate the possibilities of use Genetic algorithms as an effective technique of analyzing the problem space and exploring the space of possible solutions.

I. INTRODUCTION

When all known intelligent beings first explore a new environment, what they remember are fragments of knowledge, composed from information about distance and orientation for each point of visited places [1]. This fragmentary knowledge varies depending on the cognitive characteristics of the species. This way of forming some mental picture of physical or spatial environment, which depend from abilities to sense and collect necessary information, called "cognitive mapping", is defined and investigated by Tolman in 1948 [2]. According to human and animal ways of behavior, all robots are able to create a cognitive map of their environment. There are a few different way of using mobile robots to explore unknown environment, depending of kind of used sensors, selected techniques for analyze and programming solutions for software development.

II. COGNITIVE MAPPING PROCESS

Cognitive mapping process can be analyzed through several basic stages [3]. All of these solutions are given in general, and their realization in practice depends on the working robotic platforms:

A. Exploration

This phase consist of process of gathering and pre-processing the necessary informations using sensors. There are two way of space exploration for in robotics:

- Direct approach which mean use of real environment for the robot navigation, where the learning is performed using experiments (make or not to make mistakes when moving).

- Virtual approach which mean use of virtual environment, where the learning process is performed under simulated virtual environment.

B. Analysis

In this phase multiple different ways are used, depend of particular methodology for data collecting. In both approaches (direct and virtual) after phase of exploration, resulting behaviors are used for control and organization of moving processes on real robot. Independent of data gathering ways, process of data analyzing have a goal to form "cognitive map" of investigated environment.

C. Learning

This is the last stage of the cycle mapping environment, in which the cognitive map is created or revisited. The process of learning consists of different strategies used for mapping and re-mapping.

This paper describes an approach for analyzing and learning behavior of robots using genetic algorithms. Genetic algorithms are used to learn navigation in order to prevent collision of robots with elements of working environment. This given approach reflects a particular methodology where learning process is performed under simulation model, but resulting behaviors is used to control actual robots. The use of virtual simulation environment as a substitute for the real system has the advantage, because making mistakes on real systems may be dangerous and expensive. Also, that choice sometimes has its weaknesses - such as errors in mapping and imprecise predictability reactions and movements in complex environments. [4].

III. GENETIC ALGORITHMS PARADIGM

Creation of cognitive map depends of mobile robot path planning and ability of motion control. Motion control depends of path planning, and the best solution is when the motion controller is able to follow this plan as closely as possible.

A. Potential for problem solving using genetic algorithms

Problem space as set of solutions, generated by exploring all the possible states or move, depends of

features of environment, such as complexity and degree of correlation between tasks for motion control and path planning, the working environment can be:

- Static environment: physical space where the obstacles are fixed, in which case cognitive mapping process is relatively fast and simple. This situation is presented in this paper.
- Dynamic environment: the working space is created and composed by fast moving unknown obstacles. Many real-world mobile robots works in this type of environment.

In both cases, genetic algorithms can be used for solving auto-tuning mobile robot control depending of path planning tasks and type of obstacles [5]. Genetic algorithms are used as a path planning algorithms, tend to find collision free route that satisfy certain optimization parameters between two point, but when used in dynamic environments, every solution needs to be re-evaluated and adapted to changes of environment.

B. Genetic algorithm process description

Genetic algorithm is an evolutionary algorithm which models a form of evolution, that can be Darwinian or Lamarckian, depending on the way in which populations respond to changes in their environment. Each genetic algorithm have the following steps in a similar way: initialization of population, calculate fitness function, selection using fitness, use of genetic operators to make new generation, and repeat steps of calculation, selection and making new generation, unless given condition became satisfied.

Genetic algorithms use evolutionary approach in processes of finding an optimal solution exploring the population from all the possible solutions. The common name of this population is "solution space". There are differences between this "solution space" and previously defined term "problem space", which mean set of all possible states which may, or not lead to solution. The solution space is formed by parameters, where every possible solution is represented as an individual of a population. Furthermore, each gene of an individual represent parameter. This means complete set of genes can describe each individual of a population [6]. Every new generation is formed from the parent generation, using processes of selection of best individuals and applying evolutionary methods like recombination, mutation and crossover. When new individuals are generated, they pass the process of testing with fitness function. The best individual are chosen as the parents of the next generation, using $(\mu+\lambda)$ strategy, where μ represent the number of parents, while λ represent the number of generated children for the next generation. The best individuals are chosen as the parents of the next generation, using $(\mu+\lambda)$ strategy, where μ is the number of parents, while λ is the number of generated children.

C. Encoding process and fitness function

For the purpose of use genetic algorithms for path planning and space mapping it is necessary to encode path. Each individual represent a possible path who may or not lead from the start- point to end -point, which are

not part of that individual. The chromosome is composed from particular points(genes), and ends at the moment when robot comes in touch with some obstacle. According to that different chromosomes have variable length.

Fitness function is way how to count fitness value. For each different problem both of them represents how much an individual is suited to the environment. In this case of use genetic algorithms for path planning fitness value will present how long robot can move in the environment without touching obstacles.

IV. AN EXAMPLE OF COGNITIVE MAPPING USING GENETIC ALGORITHMS

According to previous discussions, an example is processed for a static environment, using virtual model based on an NXT Lego robot platform based on approach presented in [7]. Robot model is equipped with sonar sensors, Bluetooth, and two motors. Sonar sensors measures the distance from obstacles. The RobotC software is used for this example. According distance measured from obstacles, the data will be sent through Bluetooth. The data have format of one or four letter long message, stating which direction to move. Received data are used like constants in switch expression. Depending content of message, there are four combinations, each one for different direction: forward, backward, left, right. Furthermore, depend of direction, there a four combination for control power and direction of move of the two motors. Placed in real environment, this robot going to make some mistakes, and stopped every time when came in touch with obstacles.

According to previous discussions, virtual experiments, like another possibility of environment exploration opposite use of real robots, are only software concept. There are two basic concept of use genetic algorithms, depend of criteria which are used for evolution modeling process: Darwinian and Lamarckian evolution. They both are very similar, expect Darwinian algorithm stated that an individual does not evolve until offspring are born, but Lamarckian algorithm works with assumption that an individual can give directly own genes that is acquired during its lifetime to its offspring and fitness function is calculated twice in a generation for each gene.

A. Cognitive mapping and maze problem solving

Following example demonstrate one of possible solution when used Darwinian genetic algorithm for create a program, where environment for work is a virtual world, which is also explored using a virtual robot. In this program, the goal is to create virtual path for the robot. Every simulated path is an individual, which will evolve each generation to solve the maze. Evolving process consist in fact that each new generation of individuals will tend to have longer path, because the change of gene actually is kind of experience transfer and some kind of partial cognitive mapping. This process accompanied by changes of fitness function leads, step by

step, to final solution and cognitive mapping of whole environment.

B. Gene Encoding

To apply genetic algorithms to the maze problem, it is necessary to make strategy for encoding genes, which means making plan about values of genes and how to calculate fitness function. To simplify the process of finding solutions, it is assumed that each square for maze has a dimension that corresponds to the distance that exceeds the robot in the time interval between two Bluetooth messages about the direction of movements. In this case, conclusions from the virtual world can be used with acceptable precision in real environment. Every gene is composed by chromosomes. In this example, the genes have information for moving direction: Forward=1, Left=2, Right=3, Backward=4.

C. Initialization of the population

At the same beginning of the program, the first activity is to initialize a population, and place it into

Wall=9, Start=100, Stop=101
Forward=1, Left=2, Right=3, Backward=4,

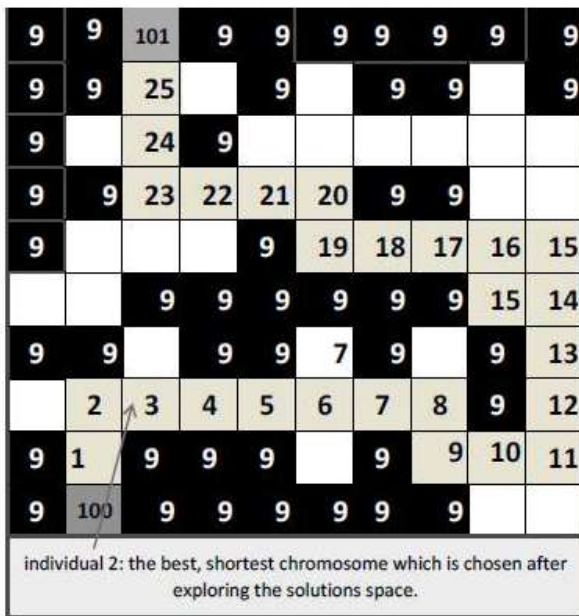


Figure 1. Numeric coding of Maze space and chromosome coding

maze. Figure 1. present the procedure of numeric coding of maze, also used to initialize the free path of the maze, which actually present the chromosome placement array.

This array is done using someone of iteration structures, to assigns random movement values (1, 2, 3 or 4). Array length is equal with the shortest chromosome which is part of solution space, formed from individuals who are passed the maze without making mistakes. The next part of the program is used to generate chromosomes.

D. Calculating the fitness function

According the real world, where the process of exploration is terminated every time when the robot crashes an obstacles, for each filled individual in the maze, fitness function give information about the number of passed squares before making mistake. Figure 2 represent the process of filling chromosomes for some individual in the maze and procedure of calculating fitness function. The process will end when individual are tested, or an endless loop is detected.

E. Selection of best individuals

Furthermore, after testing individuals and calculation of all fitness functions, follows the process of the selection of the best individuals. This mean use the fitness values as a sorting criteria, for choosing the best adapted individuals. Compared with behavior of robot in real world, fitness function shows how long length can robot pass in the maze before crashing some obstacles. After selection of best individuals using the genetic operators like mutation and crossover follow the forming of new generation. Figure 2. presents the comparison parameters used for selecting the best individuals. Basically, the process of selection and test individuals is the process of cognitive mapping of the environment too,

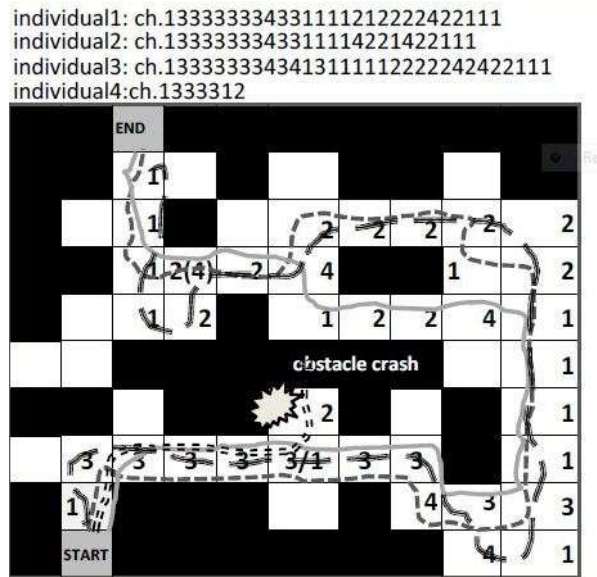


Figure 2. Selection and comparison of the individuals

which will end when the fitness function converges to the length of the entire maze. When the fitness function reaches the minimum possible value of 2, it means that mapped the entire maze, excluding the starting and final point.

After cognitive mapping process using genetic algorithms, the next step is to make connection between maps of environment, and activities for checking the movement of the real robot. For each mapped location must be planed and prepared control signals for direction of move. Figure 3 show connection between different programming activities where genetic algorithms are used, and real robot movement.

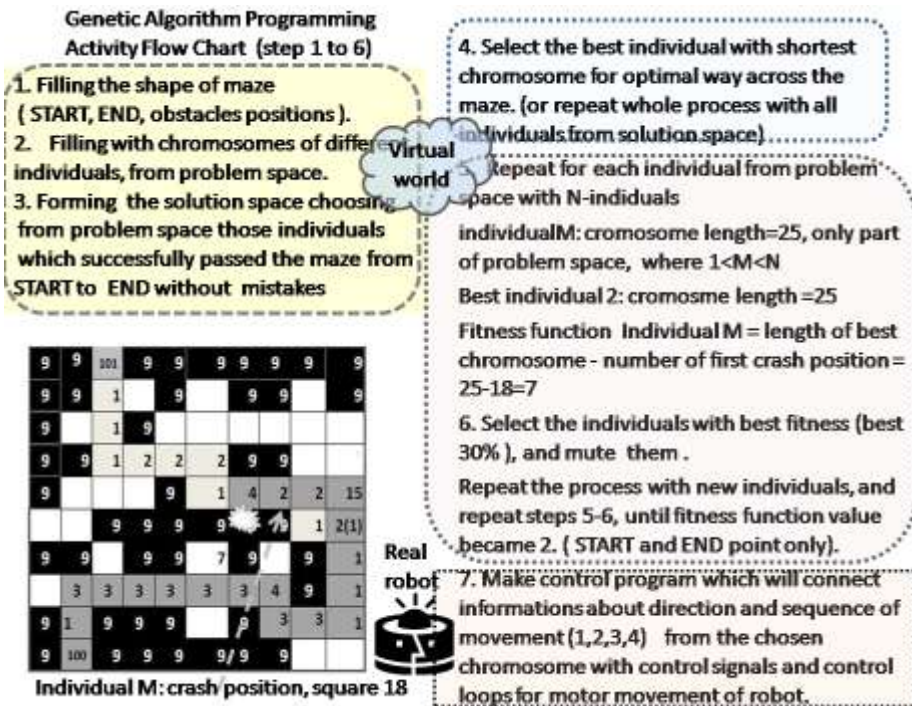


Figure 3. Genetic Algorithm programming activity description

Genetic algorithms are not the only way of planning time through evolutionary techniques for robot path planning. Other ways of cognitive mapping exist also, where the other kind of parameters are in use [8]. For this purpose, it is necessary to plan the future directions of movement for each mapped location in the space, with the aim to create a program for the control of robot motors. This is a point of convergence, among the virtual and real space in robotics, when information obtained by mapping space using genetic algorithm can be used for programming behavior of the robot in a real working environment.

V. CONCLUSION

This paper presented the principles of cognitive mapping using genetic algorithms, in virtual world using simulated robot, such alternative possibility for exploration of environment opposite use of real robots. Using virtual simulation environment as a substitute for the real system, has the advantage because making mistakes on real systems working with robots may be dangerous and expensive. Finally, working with genetic algorithm is a very imaginative process, because it provides a range of options to solve the same problem using the forms of experience using living organisms. This solution gives only an idea from a set of possibilities of combining and implementation techniques for solving real problems.

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Web Service and Mobile Application for Exam Registration

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Abstract - Higher education institutions contain many different business processes. From the students' point of view, one of the most important is the process of exam registration. Many faculties in Serbia have made online registration possible using different websites where students are able to perform this activity. However, the ever-growing smart-phone market is pushing traditional websites out of the picture. This is why the need for a more adaptable solution emerges. This paper describes the development process of web services for exam registration, which can be easily used on different platforms. SOA (Service Oriented Architecture) is used as a basis for developing an API (Application Programming Interface), which can be easily integrated in different types of applications (Android, iOS, Windows Phone, different web applications etc.). Furthermore, JSON is used as a data exchange format due to its simplicity and wide acceptance. As a proof of concept, the development of a multi-platform smart phone application based on this web service and Apache Cordova platform is described.

I. INTRODUCTION

Higher education institutions contain a large number of business processes. Among these processes, the most important from the students' point of view is the process of exam registration.

Many faculties in Serbia have made online exam registration possible by creating websites which students can use to execute this activity. However, the rising influence of mobile technology as well as its popularity are pushing classical websites out of the picture. This is why a need for a more adaptable solution emerges.

The Faculty of Technical Sciences has made a certain number of activities, important for students, available via a student web portal. The paper presents an approach to converting a part of these functions to a more adaptable solution, in our case a web service as a part of the future Faculty of Technical Sciences information system, based on SOA (Service Oriented Architecture) principles.

The paper consists of five chapters. The second chapter describes the requests and gives the use-case model for the implemented system. In the third chapter, the implementation of the web service is described, whereas the fourth chapter brings an insight to the implementation process for a multi-client mobile application. Finally, the fifth chapter brings some conclusions and a course for future work.

II. REQUEST ANALYSIS

The first task in the development of our web service was the request specification. Due to the existing online exam registration system, as part of the web portal, specification was practically just a minimization of functions available via the web portal. By removing unnecessary functions, the use case model for our web services displayed in Figure 1 was defined.

The model presents seven main functions in the exam registration process, which can be divided into three groups:

- Overview of passed/remaining exams
- Exam registration/deregistration
- Personal finances overview

The first group consists of two functions – overview of passed exams and the overview of all remaining exams. The second group consists of three functions – the registration/deregistration of exams and the overview of registered exams in a selected exam term. Finally, the third group consists of two overview functions – overview of a student's financial card and the overview of a personal deposit slip, with details for payment.

After this specification was made, the next step was the implementation of our web service.

III. WEB SERVICE IMPLEMENTATION

As it was stated earlier, due to the need for a more adaptable solution a decision was made to implement web services as a part of the future Faculty of Technical Sciences information system. This way the development

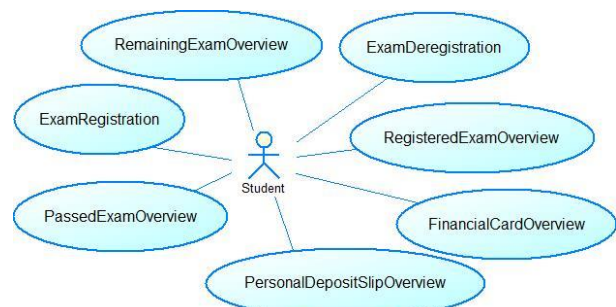


Figure 1. Exam registration system use-case model

of applications for multiple platforms is enabled [1]. The basis for this is the SOA (Service Oriented Architecture) approach.

SOA [2] is an architectural style oriented on services. A service is a logical representation of a repetitive business activity with a specified outcome. Services are self-contained software modules, optionally consisted of more services and represent a black box for the user, with no knowledge about the implementation details.

When we speak about services, most often we think of web services. Web services can be implemented in a large number of technologies, depending on the specific requests. In our case, a combination of PHP and JSON was selected.

PHP is a scripting language primarily developed for server-side scripting in the development of web applications. PHP possesses a number of plug-ins designed for working with databases, as well as some native functions for parsing data, and is thus adequate for the implementation of our system.

When it comes to the choice for the data transfer format, for most web services the choice is between XML and JSON as two standard message formats. The choice was JSON [3], due to its simplicity and good integration with PHP. Furthermore, JSON is a native format for JavaScript, which means there is no need for external libraries in order to parse data. Additionally, the lack of need for high level message encryption eliminates the need for using XML completely.

The messages used to communicate with the web services can be divided into requests and responses, and all messages from the same group share a similar structure, displayed in Figure 2.

As it can be seen, a request consists of two sections – the data field, which contains input data needed for the execution of the web service, and a token field, which will be more thoroughly described later on. The response message, apart from the data (which is now the service output data) field and token field, also contains a status field, with predefined values for different types of errors.

After the basic layout of services and messages has been set up, the most important issue is the communication security. After the security analysis, a decision has been made to handle security issues in two ways – using a data encryption protocol to encrypt communication and using a request generated token to enable authentication and authorization mechanisms. A similar approach is analyzed in [4].

REQUEST	RESPONSE
<pre>{ "data":{ . . . }, "token":"tokenValue" }</pre>	<pre>{ "data":{ . . . }, "token":"tokenValue", "errorCode":{ "code":"codeValue", "desc":"descriptionValue" } }</pre>

Figure 2. JSON request and response message format

Due to the fact that web services are accessed using the standard computer network protocols, the HTTPS protocol is used for the communication. HTTPS (Hypertext Transfer Protocol Secure) is the result of layering the HTTP on top of the SSL/TLS protocol, thus adding security capabilities to standard HTTP communication. This provides encrypted communication between the services and the client application.

The token, mentioned before, is a pseudo-randomly generated value, generated for after each request made to a web service. The token is generated for the first time on login, and then stored to the session. On every other web service request, the value of the token (token field in the JSON request) is compared to the stored value and if they match, access to the web service is granted. After that a new token is generated and stored to the session, and it is sent back as the token field in the JSON response. Using this mechanism only authenticated users are allowed to access the web services. Furthermore, because the token is request-based, it gives us a tool to protect from replay attacks.

IV. MULTI PLATFORM MOBILE APPLICATION

After the implementation of our web service, the next step was to create a multiplatform mobile application as a proof of concept. When it comes to developing applications for mobile devices, a choice has to be made between three types of applications [5]:

- Web application, which uses the mobile device's web browser to open a website, with no access to the platform API
- Native mobile application, which needs to be implemented for each supported platform, in the platform native language, but grants full access to the platform API
- Hybrid application, which is a combination of the previous two, where standard web technologies are used to create the visual part of the application, whereas the access to the platform API (usually not all of it) is provided using an additional layer.

After the analysis of these three solutions, a choice has been made to implement create a hybrid application due to the decreased implementation period, and on the other hand a satisfactory number of API functions available which could be needed for current and future development.

When it comes to developing hybrid applications, it is possible to create plug-ins, written most often in JavaScript, which communicate with the platform API. However, there are some platforms which provide a certain number of functions available for a large number of platforms. One such is the PhoneGap(Cordova) platform.

The PhoneGap (Apache Cordova) platform [6] is an open source hybrid application development platform based on HTML5, CSS3 and JavaScript. Applications implemented using PhoneGap are hybrid applications, as they have access to the API using JavaScript interfaces for

calls to native implementations of functions developed for each supported platform. Finally, applications developed using this platform can be packed as native applications for different platforms and put to the platform specific application stores.

The activity diagram for the communication with the web service and displaying data is presented in Figure 3.

The application prepares a JSON request, according to the format described earlier in the paper, and sends it as a Post request body parameter. A JSON response is received and parsed. If the response ErrorCode field contains a code that is different from 200, an error has occurred and an error message is displayed. If not, the data is formatted and displayed. All this is done using JQueryMobile and AJAX in order to make asynchronous requests to web service so the application would behave more like a native

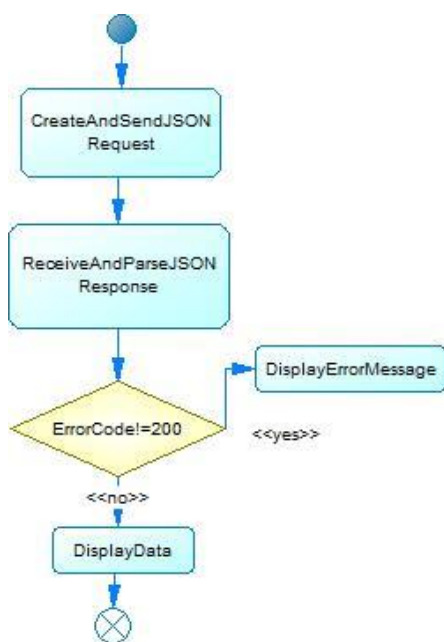


Figure 3. Application activity diagram

application.

At the moment, the device API is used only for storing



Figure 4. Preview of the application

the request token in a local key-value store.

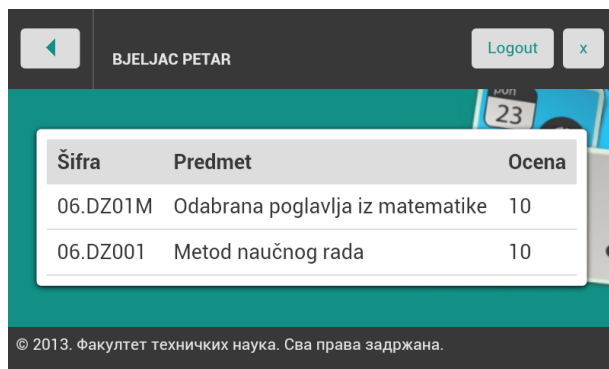


Figure 5. Passed exam overview page

A preview of the application home page on an Android mobile device is displayed in Figure 4.

Additionally, a preview of a passed exam overview page is displayed in Figure 5.

V. CONCLUSION

The development of a service based solution may cause additional effort in the starting fazes. However, with the future development of the IS a service based approach brings huge advantages thanks to increased reusability. In addition, the implemented services can be used in different platforms directly, with no need to integrate applications developed on these platforms with our IS, which decreases the development time and increases the multi platform availability. Using tools for developing hybrid multi platform applications can speed this process up even more, creating an environment where multi platform development no longer presents a problem.

When it comes to the future development course for our system, the implementation of many other functions, which are already available as part of the existing desktop or web based applications in the Faculty of Technical Sciences IS, presents a task for the future. Prior to that, an authentication-authorization mechanism needs to be developed independently from these services, in order to allow integration of multiple different services, whilst keeping the access control wrapped in one place.

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Concordances Based Linguistic Search Algorithm Applied on Old Serbian – Slavonic Language

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Abstract - Concordances in linguistic represent a classified collection of the different passages of a work with references to the places of their occurrence. This paper describes specific real time method for searching concordances in given texts, based on user input with detailed criteria. Criteria can be a word or complex grammatical form with all possible combinations. The text examples in this paper are given in its original old Serbian – Slavonic language form and orthography. The formation of a grammatically annotated electronic corpus is the language basis for the computer and future linguistic research. This paper aimed at detailed diachronic description of all aspects of Serbian language in terms of probabilities.

I. INTRODUCTION

In its original sense a concordance is a reference book containing all the words used in a particular text or in the works of a particular author, together with a list of the contexts in which each word occurs. Each context may be indicated by means of a precise line reference, or by a short citation, or both. Books have been in use since the Middle Ages, especially in Biblical scholarship [1]. The simple reason for this is that the labour of compiling a complete concordance for any sizeable text by hand is so colossal that it is worthwhile only if the outcome is expected to be of lasting usefulness. The earliest known complete concordance of the Latin Bible was compiled by the Benedictine Hugo de San Charo in the thirteenth century. Hugo, it is said, was assisted by no fewer than five hundred monks [1].

Historical sources on Serbian medieval libraries take the form of notes on books, monastery typika, the hagiographies (i.e. the lives of saints) and charts. These sources do not provide complete information about book collections, but rather about individual books, their transcription, protection, by whom they were donated, who read them etc. In medieval Serbia there were both monastery libraries and court libraries. The monastery libraries are to some extent preserved to our day, which was not the case with the court libraries [2].

In addition to the books used for church services (gospels, apostles, psalters, menologies etc.), monastery libraries also contained books for the spiritual development of the monks, as well as significant historical works: the lives of saints, chronicles, genealogies, juridical manuscripts and manuscripts on

medicine, astronomy, grammar, philosophy and other topics. Most of the libraries and books were destroyed in wars and migrations. On the other hand, a number of books were taken by investigators of old Serbian literature in the 19th and 20th centuries, such that the greater numbers of old Serbian manuscripts are now in European libraries (Moscow, St. Petersburg, Odessa, Prague, Vienna, London, Paris and the Vatican). In April 1941 during the German bombardment of Belgrade, the National Library was burnt and more than 1500 Serbian medieval books and charts were destroyed [2].

In the medieval Serbia two, not so distinct, languages were in use: Serbian, spoken by ordinary people which was to some extent used also in official documents (letters, charts, legislative acts etc.) and Serbian-Slavonic as used in literature. The latter is a version of the Old Slavonic, with some differences in phonology and to a lesser degree in morphology due to influence of Serbian.

Serbian medieval literature, written in Serbian-Slavonic, is characterized by variety of genres (the lives of saints, prayers, eulogies etc.). By preserving the firm structure of the Old-Slavonic language, Serbian-Slavonic had great expressive potentials (e.g. compounds and participial constructions). As noted, the influence of Serbian altered to some extent its phonetic properties, thus providing better communication between text and reader (listener). As a consequence, texts written in Serbian-Slavonic sounded familiar and were easy to understand. The other influence of Serbian manifests in vocabulary: Words used in popular language became part of standard Serbian-Slavonic vocabulary [2].

The Corpus of Serbian language from 12th to 18th ct. is part of the Corpus of Serbian Language which was initiated in the middle of 1950s by Đorđe Kostić as a segment of a broader project aimed at automatic text and speech recognition and machine translation. The project for machine translation was commenced at the Institute for Experimental Phonetics and Speech Pathology in Belgrade. The project included machine simulation of several elements of speech communication - speech recognition, automatic recording of speech into textual format, a language corpus, translation from one language into another and speech synthesis. Complete automatic translation from one language into the other was not

possible because language could not be totally formalized. Further, due contextual and extra linguistic factors, the machine would have to introduce real world knowledge in order to interpret the context correctly. For these reasons, the problem of automatic speech recognition was constructed on a probabilistic basis and formalizations were maximized. With regards to automatic speech recognition, in addition to knowledge about distinctive properties of phonemes, the computer memory would need knowledge of probabilities of phonemic co-occurrences. Automatic text recognition relied on the probability of grammatical forms, formalized morphology and syntax and lexemes and their grammatical forms [3].

All of these considerations lead to the conclusion that the problem of machine translation was limited to a rough rendition, with the idea of improvement by further research and technological advancement [3].

A group of experts of different profiles was formed by contacting several institutions, such as the Faculty of Electrical Engineering, the Federal Bureau of Statistics and the Institute for Serbian Language at the Academy of Sciences and in 1954 the project was inaugurated. The acoustic structure of all phonemes in Serbian language was spectrographically described in detail. Machine for speech recognition was constructed and connected to a phonetic typewriter. This system was capable of recognizing and reproducing all Serbian vowels and a few consonants. If the speech sounds were pronounced in isolation and clearly, the machine was able to recognize them without any mistake, while in everyday speech the error rate was about 30%. A speech synthesizer that could produce all Serbian vowels, a few consonants and make several sentences was also developed [2].

Today, it is very difficult to reconstruct the thinking behind which the architecture of machine translation was conceived. It is certain however, that the problem was approached from two directions – from linguistics and engineering science. The formation of a grammatically annotated corpus was to be the language basis for the machine. Besides word entry probabilities, the corpus would allow approximation of probability of all grammatical forms and probability of all grammatical forms for each word [3].

II. SAMPLE OF TEXTS

The sample of Serbian written language from the 12th to the 18th century consists of 369.093 words and is compiled from 18 literary works by seven authors, two manuscripts by anonymous authors and vast official and private correspondence of Serbian kings and noblemen. The language and orthography are in their original form (Serbian-Slavonic). The whole material has been transferred into an electronic format [2].

Practically all preserved manuscripts on lives of saints are included in the sample, meaning that all significant authors of that period are included in the Corpus (St. Sava, Teodosije, Domentijan, Archbishop Danilo II, Stefan Prvovenčani, patriarch Pajsije and

Grigorije Camblak). The lives of saints constitute a distinct genre of Serbian medieval written language and could be considered as an interesting (although not always reliable) historical source and precious testimony of Serbian literary language between the 12th and the 18th centuries [2].

The grammar (i.e. the inflected morphology) of Serbian-Slavonic is somewhat different from the grammar of the contemporary Serbian language, although those differences are not as great as might be expected given a time lag of almost eight centuries. The most conspicuous and common differences are in grammatical number (dual, which does not exist in contemporary Serbian language), use of participle and some pronouns. The constraint in the grammatical annotation of Serbian-Slavonic was that no radical change of coding system is permissible in order to enable comparisons with the contemporary language. Therefore, the system of tagging for the contemporary language has been projected on Serbian-Slavonic, with few minor changes that do not disturb the overall system. From 2000 work on lemmatization and proofreading of the Serbian-Slavonic texts was initiated and is still in progress [2].

Due to technological limitations in the late fifties, most of the work on the Corpus of Serbian language (CSL) was executed manually. The final goal was to compile a number of frequency dictionaries that would serve as a basis for automatic speech and text recognition and machine translation. Compilation of frequency dictionary consisted of 27 distinct operations. Here we outline the most important ones [2]:

- a) Within each book that was included in a sample, lines were tagged on each page.
- b) A4 sheet of paper was divided into 16 frames and within each frame a word from a book was transcribed. For a given word the page number and line number where a word appeared were tagged as well.
- c) Once the whole text was transcribed and lines and pages recorded, each word was specified for its grammatical status.
- d) Grammatical annotation was subsequently monitored by group of linguistic experts that randomly sampled about 10% of a text. In cases where there was more than a 2% error rate, the grammatical annotation was repeated until the required criterion was reached. Sometimes the procedure had to be executed 3 or 4 times to reach the required standards of reliability.
- e) Once grammatical tagging was complete, the A4 sheet was cut into 16 frames – one frame for each word. Word frames were then sorted into alphabetical order.
- f) Different grammatical forms (i.e. frames) for each word were sorted according to a specified order (e.g. for the word HOUSE, for example, all nominatives singular were put together, then all genitives singular etc.).
- g) Reliability for grammatical code sorting was monitored.


```

{
    rezultat *Prvi = NULL;
    rezultat *Poslednji = NULL;
    int pocetak = 0;
    int prva, druga;
    bool Success = false;

    while (1)
    {
        if (pocetak >= maxLength - 1) break;
        for (prva = pocetak; ((_stricmp(A[prva].r2, meta1) != 0)
&& (prva < maxLength - 1)); prva++);
            druga = prva;
            if ((_stricmp(A[prva].r2, meta1) == 0) &&
slicne_sifre2(meta1_vr, A[prva].sifra))
                InsertListNodeConcord(A, Prvi, Poslednji, prva,
druga, maxLength, Success);
                pocetak = druga + 1;
            }
        return Prvi;
    } // end concord_vr

int sortFunction( const void *a, const void *b)
{
    const freqr* prvi = (const freqr*) a;
    const freqr* drugi = (const freqr*) b;
    return (atoi(drugi->fo)-atoi(prvi->fo));
}

```

Dynamically allocated list:

```

void InsertListNodeConcord( pelir *(&AA), rezultat *(&f),
rezultat *(&l), const int x, const int y, const int z, bool& scss)
{
    int a=x, b=y;

    while ((a - 1 >= 0) && (AA[a-1].r3[strlen(AA[a-1].r3)-1] !=
33) && (AA[a-1].r3[strlen(AA[a-1].r3)-1] != 46) &&
(AA[a-1].r3[strlen(AA[a-1].r3)-1] != 63))
        --a;
    while ((AA[b].r3[strlen(AA[b].r3)-1] != 33) &&
(AA[b].r3[strlen(AA[b].r3)-1] != 46) &&
(AA[b].r3[strlen(AA[b].r3)-1] != 63) )
        if (b + 1 < z)
            b++;
        else break;

    if (f == NULL)
    {
        f = (rezultat*) malloc(sizeof(rezultat));
        f->freq = 1;
        f->pocetak = a;
        f->pozicijaA = x;
        f->pozicijaB = 0;
        f->kraj = b;
        f->Next = NULL;
        scss = bool(f != NULL); // was allocation successful?
        if (scss) l = f;
    }
    else
    {
        l->Next = (rezultat*) malloc(sizeof(rezultat));
        l = l->Next;

```

```

        ++f->freq;
        l->freq = 0;
        l->pocetak = a;
        l->pozicijaA = x;
        l->pozicijaB = 0;
        l->kraj = b;
        l->Next = NULL;
        scss = bool(l != NULL); // was allocation successful?
    } // end InsertListNodeConcord

```

IV. CONCLUSION

Linguistic search of historical texts are important because they show language transformation through time. First and very important step is text digitalization to electronic form is defining form of each word. That is slow process, but with good algorithm it is possible to speed up that process. As electronic corpus raises, process of automation is applicable. Concordance search can help in both ways. With these searches it is possible to get frequency of occurrence of specific word in form of lemma or other form with grammatical attribute. Linguistics scientist can trace 'life' of specific word through time. Language and society are constantly changing and adopting to space and time. Electronic corpus can help to get better translation between languages, thanks to the grammatical description of words. With frequency of used words in phrases program define better meaning of words and sentence.

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Plume Boundaries Extraction by Multiresolution and Least Squares Approximation

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Abstract – In this paper the problem of extracting plume boundaries is discussed. The plume rise of exhausted gases, containing a gas pollutant is investigated. The main goal is by using multiresolution and approximation to estimate the effective plume height from the plume central line in order to predict the plume behaviour.

I. INTRODUCTION

Many authors tried to define a precise algorithm for calculation of plume rise above the chimney at different conditions in the atmosphere. Accurate estimates of plume rise are required to predict the dispersion of continuous gaseous emissions [1]. The effective stack height is a very important characteristic, since it defines to a great extent the air pollution at the ground level [2]. The importance of the effective stack height makes its calculation one of the most important points in all mathematical models or software products intended for the air pollution assessment caused by existing or future sources of pollutants. The effective height is defined as a sum of the geometric height of the stack and the plume rise caused by the initial gas velocity and the gravitational force. The general situation is illustrated in Fig. 1.

This paper proposes the plume central line to be approximated through the approximated plume boundaries in the wavelet domain. There are many different techniques for edges detection in images published in the literature [3-5]. Edges in images can be mathematically defined as local singularities. Wavelet transform has received great attention in the last years, because it is especially suitable for time-frequency analysis [6], which is essential for singularity detection. With the growth of wavelet theory, the wavelet transforms have been found to be remarkable mathematical tools to analyze the singularities including the edges, and further, to detect them effectively.

In the paper, plume boundaries and plume central line are approximated by applying best fitting least squares approximation over the most important wavelet coefficients of the plume.

The paper is structured as follows. The wavelet theory is summarized in Section II. Section III presents the algorithm for plume boundaries extraction. The experimental results are presented in Section IV. Section V concludes the paper.

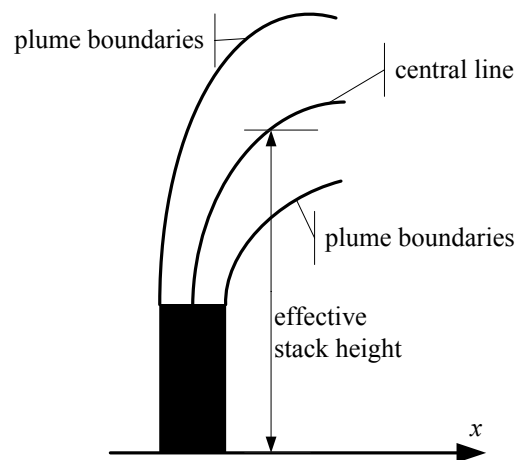


Figure 1. Plume rise in the atmosphere.

II. WAVELET THEORY

The Discrete Wavelet Transform (DWT) decomposes a signal into a set of orthogonal components describing the signal variation across the scale [6]. The orthogonal components are generated by dilations and translations of a prototype function ψ , called mother wavelet.

In analogy with other function expansions, a function f is presented for each discrete coordinate t as a sum of a wavelet expansion up to certain scale J plus a residual term, that is:

$$f(t) = \sum_{j=1}^J \sum_{k=1}^{2^{-j}M} d_{jk} \psi_{jk}(t) + \sum_{k=1}^{2^{-J}M} a_{Jk} \phi_{Jk}(t) \quad (1)$$

where ψ_{jk} and ϕ_{jk} denote wavelet and scaling function, respectively, the indexes j and k are for dilatation and translation, and a_{jk} and d_{jk} are approximation and detail coefficients. The approximation coefficients a_{jk} contain the signal identity while the detail coefficients d_{jk} can be processed for the purposes of denoising, compression, edge detection, etc.

Wavelet decompositions and multiresolution concepts are closely related to filter bank theory. For this reason, it is helpful to view the scaling and wavelet function as a low pass and high pass filters, \mathbf{H}_0 and \mathbf{H}_1 , respectively. The wavelet

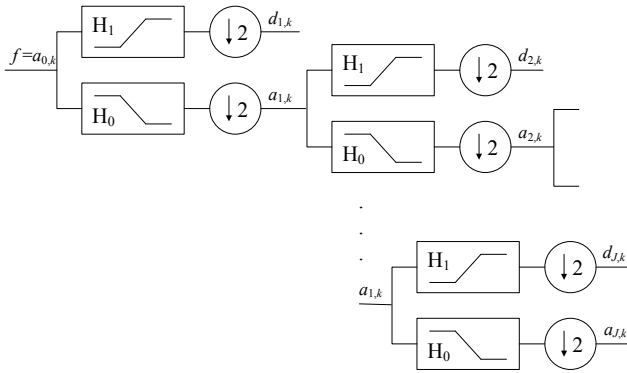


Figure 2. Discrete wavelet transform tree.

transform is applied to low pass results (approximations) as it is illustrated in Fig. 2.

The most popular form of wavelet-based filtering, wavelet shrinkage [7], is performed by weighting the corresponding detail wavelet coefficient by h_{jk} ($0 \leq h_{jk} \leq 1$) and calculating the inverse wavelet transformation. Conventionally, the filtration is performed either by using “hard threshold” nonlinearity

$$h_{jk}^{(\text{hard})} = \begin{cases} 1, & \text{if } |d_{jk}| \geq \tau_j \\ 0, & \text{if } |d_{jk}| < \tau_j \end{cases} \quad (2)$$

or by using “soft threshold” nonlinearity

$$h_{jk}^{(\text{soft})} = \begin{cases} 1 - \frac{\tau_j \operatorname{sgn}(d_{jk})}{|d_{jk}|}, & \text{if } |d_{jk}| \geq \tau_j \\ 0, & \text{if } |d_{jk}| < \tau_j \end{cases} \quad (3)$$

where $\tau^{(k)}$ is user specified threshold for the k -th level details.

III. BOUNDARIES APPROXIMATION

The main idea is to analyse and process the object of interest – chimney plume by using multiresolution in order to obtain its median line, important for calculating/predicting the plume direction. This is carried out through processing the plume’s wavelet coefficients and afterwards dividing the coefficients into two segments by applying best fitting approximation in the least squares sense. The obtained two segments correspond to the plume boundaries, which afterwards can be approximated by applying again the best fitting operation individually over the two segments.

The procedure of extracting the plume boundaries from an RGB image, starts with converting the RGB image to YCbCr colour space, where Y is the luminance (intensity) component and Cb (blue chrominance) and Cr (red chrominance) are the blue-difference and red-difference chroma components, respectively. Then, the wavelet transform is applied over the Y component and the wavelet detail coefficients are filtered with (4) in order to keep only the most important coefficients. Afterwards, only the coefficients positions (x, y) are used in a polynomial, logarithmic, power or other approximation in the least squares sense, while the coefficients values are not in the focus. With the approximation, a temporary curve S_i that best

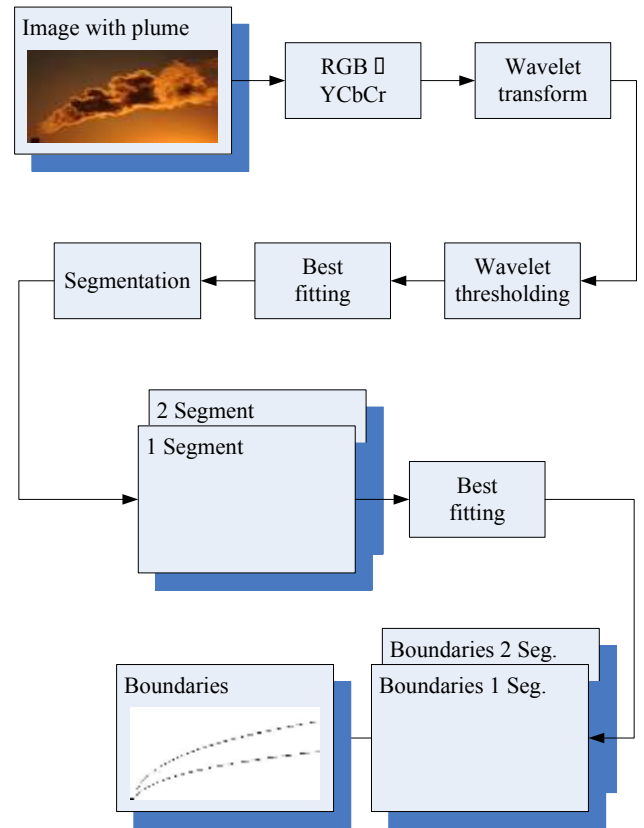


Figure 3. Block diagram of segmentation with the used algorithm.

fits coefficients positions is obtained and it is used in the process of plume boundaries segmentation to obtain two segments S_1 and S_2 . Segments S_1 and S_2 could be obtained by comparing y coordinates of the filtrated wavelet coefficients and the curve S_i for each coordinate x . Once segments S_1 and S_2 are obtained, the best fitting operation is repeated separately for segments coefficients positions and as a result approximation curves S_{11} and S_{12} are obtained. They correspond to the plume boundaries.

The process of approximating plume boundaries can be summarized with the block-diagram shown in Fig. 3.

IV. EXPERIMENTAL RESULTS

A number of experiments for approximating the plume boundaries are made with a dozen of images with different resolutions. Some of these images are shown in Fig. 4. The first part of the presented algorithm (approximation of plume centerline) was applied on all images and results are shown in Fig. 5. Approximation of the centerline is quite correct, but it is reasonable to calculate the plume boundaries only for well defined skewed cone shape of the plume visible shown on first three images.

The phases of the described process are illustrated in Fig. 6. The RGB image (Fig. 6a) is converted in YCbCr colour space. The haar wavelet transform is applied over the Y components and the most important pixels from the wavelet detail coefficients are kept (4% of pixels for the image in Fig. 6b). The obtained (x, y) positions take part in the best fit approximation in the least square sense. Experiments with



Figure 4. Experimental images.

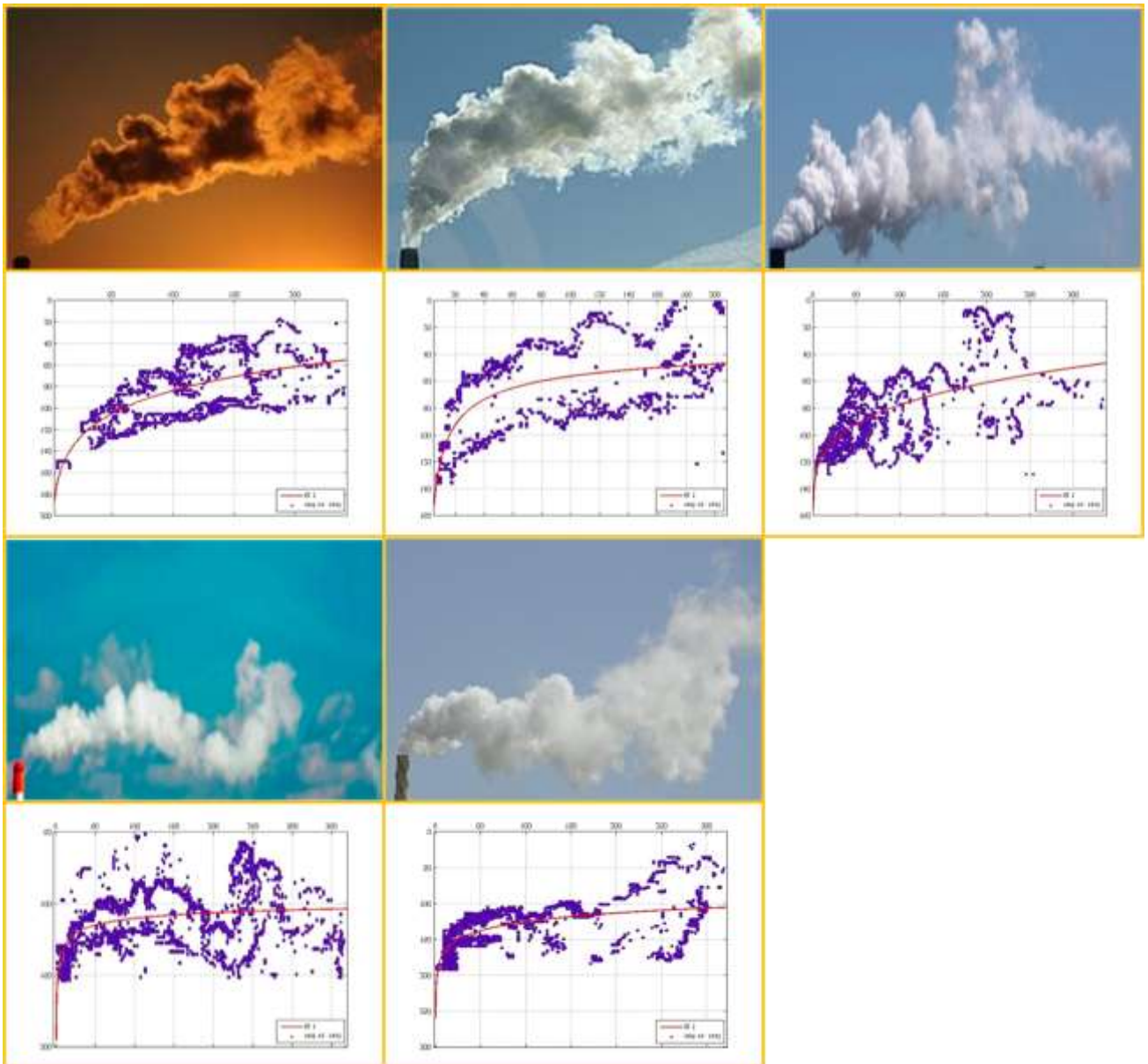


Figure 5. Results when the algorithm is applied over the experimental images from Fig. 4.

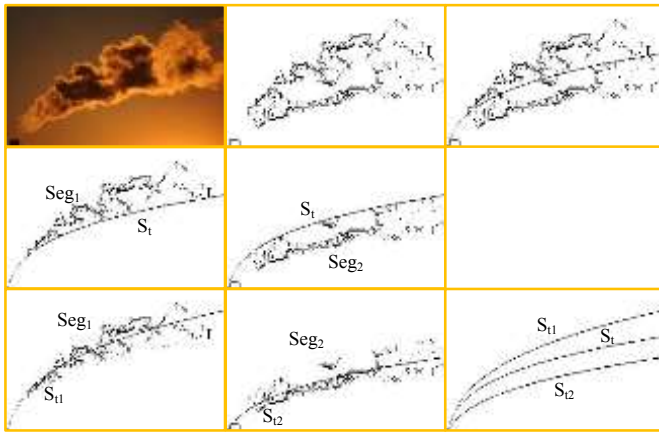


Figure 6. The process of segmentation through wavelet decomposition and approximation: (a) original image, (b) the most important wavelet coefficients, (c) curve that approximates the coefficients coordinates, (d-e) two segments, (f-h) approximated boundaries.

- i. cubic polynomial ($f(x) = a_3x^3 + a_2x^2 + a_1x + a_0$) approximation,
- ii. logarithm ($f(x) = \ln b + c$) approximation and
- iii. power ($f(x) = ax^b + c$) approximation

are carried out. Results of these three approximations over the image in Fig. 6a are shown in Fig. 7. Fig. 6c shows the temporary curve S_t that fits the coordinates of the wavelet coefficients by using the power approximation. The curve S_t is used to obtain two segments S_1 and S_2 (Fig. 6d-e) by comparing its y coordinates with the y coordinates of the filtrated wavelet coefficients (Fig. 6b) for each x coordinate. Next, the best fitting operation is applied again, now over the coefficients that belong to the segments S_1 and S_2 and as a result two curves, S_{t1} and S_{t2} , are obtained, that represents approximations of the plume boundaries (Fig. 6g-f).

V. CONCLUSION

The paper considers estimating plume central line by using wavelet transform and least squares approximation. The central line is important in order to calculate the effective stack height and to be able to predict the dispersion of continuous gaseous emissions.

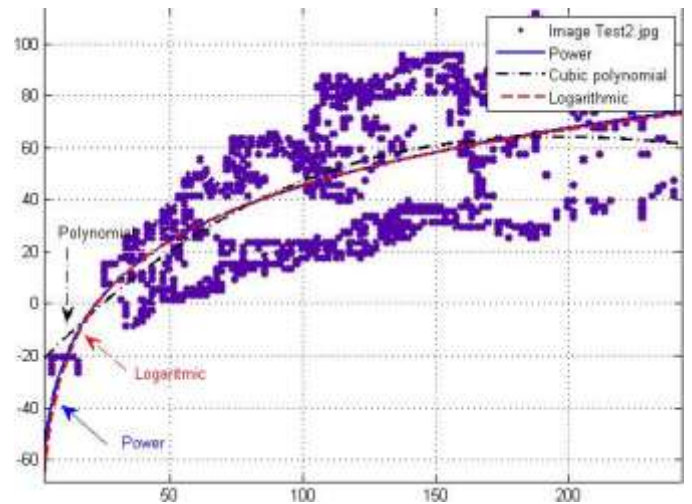


Figure 7. Best fitting curves in the least squares sense by using cubic polynomial, logarithmic and power approximations.

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Fuzzy Screening in Cryptography

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Abstract - The paper investigates possible applications of fuzzy based methods, as well as fuzzy screening methods in the domain of cryptography. The main issue discussed in the paper is the security of the cryptosystem, as well as possible application of the fuzzy screening procedure for increase of the security. The main contribution is the description of the method implementation for security increase. The paper also contains some simple example.

I. INTRODUCTION

It is evident that security is the main concern in communication in today's "mobile world" with constant growth in the number of mobile devices. Increase in volume of data transmitted through the communication channel, increases the difficulties concerning security. Insecure communication channels are "great opportunity" for cyber-criminals and malice users. Cryptographic algorithms are good basis for increasing communication security, so they are widely used for encryption/decryption process. Crypto-algorithm is used to cipher a message and to decipher it back to the original message. As the encryption/decryption algorithms are the mathematical procedures for performing encryption/decryption of data, the implementation of these algorithms can be very intricate [1, 2]. Crypto-algorithms must provide security communication channel but they have to be efficient in terms of power and time consumption. This is more prominent for mobile devices, for the reason that such devices are still relatively weak in terms of information processing power, although processing power of the mobile devices is increasing rapidly. Besides power/time consumption problems, there are many problems linked to real-time nature of communication channel, which is limited by the amount of information that can be transmitted in given time interval.

Main objective of the research presented in this paper is to increase the security of the communication channel via data encryption/decryption. The proposed implementation of the crypto-algorithm is based on encryption with a key. The key used is constantly changing over time. The main idea is related to determining the right situation based on environmental changes when to synthesize the cryptographic key, as well as the definition of the priority list based on environment. This kind of procedure is suitable for two-user communication via wireless network or for Wireless Sensor Network with multiple spatial-placed sensors.

The paper is organized as follows: section two

contains some basic facts about fuzzy logic and fuzzy screening procedure. Section three contains the description of the fuzzy screening procedure based on information collected from user and/or environment. Section four gives some information about fuzzy screening in cryptography. Final section five contains conclusions and future work guidelines.

II. FUZZY LOGIC AND FUZZY SCREENING

Fuzzy sets were founded by Lotfy A. Zadeh in 1965. The main idea behind fuzzy set is that every element of the universe belongs to the set with certain measure. The measure takes value from $[0,1]$ interval and is defined by the membership function. Membership function is simple function; most commonly used membership functions are: triangular, trapezoid, sigmoid, etc. Fuzzy set is defined as in (1).

$$A = \{x, \varphi_A(x) : \forall x \in X\} \quad (1)$$

So, every element x from universe X is a member of the fuzzy set A with the measure $\varphi_A(x)$. Fuzzy set theory defines fuzzy operators on fuzzy sets such as intersection, union and complement. Further development of fuzzy sets theory leads to fuzzy logic and fuzzy logic controllers. Important feature of fuzzy logic is implementation of logic *and*, *or*, *not* and *implication* operators in case when operands take value from $[0, 1]$ interval. Various method are used, but method based on *t-norm* for implementation of the *fuzzy and* operator and *s-norm* for implementation of the *fuzzy or* operator are widely accepted [3]. There are also numerous methods for implementation of fuzzy logic implication.

Great advantage of fuzzy logic in contrast to classical Boolean logic is that in fuzzy logic one can subjectively define fuzzy variable and their values. The values of fuzzy variable are linguistic terms, that are words of spoken language. If the fuzzy variable is *age* then possible values are: *young*, *middle-age*, *old*.

One of numerous trends in fuzzy logic development is fuzzy screening method proposed by R. Yager [4, 5, 6]. Fuzzy screening procedure is applied when there is a need to select an alternative from a set of possible alternatives. This procedure uses linguistic terms, as well as fuzzy implication. Each alternative is described by multiple criteria, while each criteria is described by linguistic terms. Usually five-point scale is applied: very-high (VH), high (H), medium (M), low (L), very-low

(VL), although it is possible to apply seven-point scale. The applications of n -point scale, where $n > 7$ are rare but possible.

Fuzzy screening procedure includes the rating of each criteria for every alternative, as well as the definition of the importance for each criteria.

If vector S is the score of an alternative and vector I is the importance of the criteria then S_j is the score of an alternative for j -th criteria and I_j is the importance of the j -th criteria, where $j=1, \dots, 5$ for five-point scale. Cumulative score U of an alternative is calculated by (2).

$$U = \min_j\{\text{Neg}(I_j) \text{ OR } S_j\} \quad (2)$$

In (2) $\text{Neg}(I_j)$ is the negation of the importance of j -th criteria and is calculated by (3).

$$\text{Neg}(I_j) = I_{p+1-j} \quad (3)$$

In (3) p is a number of points of the scale, so that, for five-point scale we have: $\text{Neg}(VH)=VL$, $\text{Neg}(H)=L$, $\text{Neg}(M)=M$, $\text{Neg}(L)=H$, $\text{Neg}(VL)=VH$.

Operator OR is defined as *max*. The *min* and *max* operators are satisfying the following properties:

$$\min(S_i, S_j) = S_j \text{ if } S_j \leq S_i,$$

$$\max(S_i, S_j) = S_i \text{ if } S_i \geq S_j.$$

Yager notes that the formula (2) can be seen as a measure of the degree to which an alternative satisfies the following proposition: *All important criteria are satisfied*.

Let us consider the following example: There are five criterion C_1, \dots, C_5 , each criterion has its importance defined by vector $I = (VH, VH, M, L, VL)$. An alternative score is defined by the vector $S = (M, M, H, VH, H)$.

Criteria:	C1	C2	C3	C4	C5
Importance:	VH	VH	M	L	VL
Score:	M	M	H	VH	H

The cumulative score U of the alternative is calculated as follows: $U = \min\{\text{Neg}(VH) \text{ OR } M, \text{Neg}(VH) \text{ OR } M, \text{Neg}(M) \text{ OR } H, \text{Neg}(L) \text{ OR } VH, \text{Neg}(VL) \text{ OR } H\} = \min\{VL \text{ OR } M, VL \text{ OR } M, M \text{ OR } H, H \text{ OR } VH, VH \text{ OR } H\} = \min\{\max(VL, M), \max(VL, M), \max(M, H), \max(H, VH), \max(VH, H)\} = \min\{M, M, H, VH, VH\} = M$.

III FUZZY SCREENING IN CRYPTOGRAPHY

Cryptographic algorithm must satisfy four main requirements: authentication, non-repudiation, integrity and confidentiality [1]. This is also true in case of wireless communication channel, when multiple mobile devices are used. In terms of security as well as power/time consumption advanced encryption algorithm executes on sender's side, while decryption algorithm executes on receiver's side. Encryption algorithm can generate environment dependent key, encrypt data and send encrypted text to the receiver. On receiver's side

decryption algorithm decrypts encrypted message using one-way function acquired on predefined web service. Environment variables used for key synthesis on sender's side are acquired by:

- The parameters of the user's environment (temperature, GPS coordinates, humidity, etc).
- The biometric data of the user (body temperature, galvanic skin response, heart rate, etc).

Two users can safely communicate via mobile devices.

However, in this paper an approach that is related to Wireless Sensor Network (WSN) is investigated. WSN is an array of multiple sensors which covers the wide spatial area, see Fig 1. Sensor stations are self-powered units based on arduino/xbee platform. In addition, it is possible that sensors change their position in time which leads to the mobile WSN. These sensors can measure temperature, air pollution, humidity, etc. According to [7], WSN has major constraints such as inadequate source of energy, restricted computational potentiality and limited memory. The Elliptic Curve Cryptography (ECC) which is a sort of public-key cryptography used in wireless communication, provides equivalent level of security like other existing public-key algorithm using smaller parameters than other. However, this traditional ECC does not take care of all these major limitations in WSN.

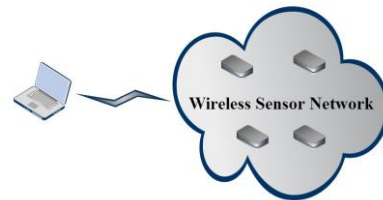


Figure 1. Wireless Sensor Network

The major issue which is investigated in this paper is event handler of WSN. This kind of event handler is capable to recognize the situation which is appropriate for key-synthesis or to choose between multiple sensor readings acquired by WSN and to establish the priority list of readings. The priority list is established by fuzzy screening procedure.

Every sensor in WSN generates data in time, so that if there are n sensors then there is n -dimensional vector. In another words, every sensor measures one particular type of data, e. g. temperature, humidity, oxygen level, etc. Every measurement is treated as one criterion in sense of fuzzy screening process. The procedure for WNS cryptosystem is as follows:

1. Array of n sensor included in WSN generates the n -dimensional vector M of n measurement. Every element in M is a real number. Step 1 is repeated m times in the time interval T , so that we have vectors M_1, \dots, M_m .
2. Every element of each $M_i, i=1, \dots, m$ is fuzzified.

3. Score vectors S_i , $i=1, \dots, m$ are generated for every M_i .
4. Vector I of importance is predefined by the user or acquired via web service.
5. Screening procedure is overtaken over S_i , after that the priority list is obtained.
6. First element in priority list is send to the receiver or is used in a key generation process of cryptosystem.

A. THE SIMPLE EXAMPLE

Previous steps are described in the following example with constructed values. For simplicity there are just two measurements: in time t_1 and time t_2 .

Let there are five sensors included in WSN:

1. temperature sensor (C1),
2. humidity sensor (C2),
3. oxygen level sensor (C3),
4. atmospheric pressure sensor (C4),
5. noise sensor (C5).

This means that every score vector S for a particular time t will consists of five elements described by linguistic terms. First element of every vector S corresponds to temperature, second element corresponds to humidity, and so on.

1. WSN output in a given time t_1 is the vector $M_1 = (x_1, \dots, x_5)$ so that x_1, \dots, x_5 are the real values – sensor outputs. In t_2 , M_2 is generated analogously.

2. This real values are fuzzyfied. Fuzzyfication procedure for temperature is described in the following example, see Fig 2.

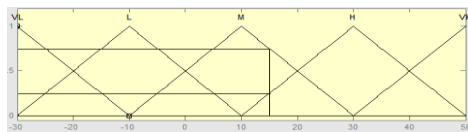


Figure 2. Fuzzyfication process

Let assume that temperature sensor has an output of 15 degrees Celsius. The temperature of 15 degrees Celsius is very low (VL) with measure 0, low (L) with measure 0, medium (M) with measure 0.75, high (H) with measure 0.25 and very high (VH) with measure 0. As $\max(0, 0, 0.75, 0.25, 0) = 0.75$, this measurement is associated with linguistic term medium (M). So real value x_1 that represents temperature is converted to linguistic term, medium (M). This is done for every real value.

3. According to some M_1 , let score vector $S_1 = (M, H, VH, L, VL)$, and according to some M_2 let score vector $S_2 = (H, VH, H, VH, L)$.

4. Let importance vector $I = (VH, VH, M, M, L)$.

5. Screening procedure is undertaken:

Criteria:	C1	C2	C3	C4	C5
I :	VH	VH	M	M	L
S_1 :	M	H	VH	L	VL
S_2 :	H	VH	H	VH	L

As $\text{Neg}(I) = (VL, VL, M, M, H)$ we have:

Cumulative score calculated by (2) for alternative 1 defined by S_1 is $U_1 = \min\{M, H, VH, M, H\} = M$.

Cumulative score calculated by (2) for alternative 2 defined by S_2 is $U_2 = \min\{H, VH, H, VH, H\} = H$.

6. As U_2 is greater than U_1 , WSN output in a given time t_2 is sent to the receiver in a form of five element real vector M_2 or five element vector S_2 of linguistic terms.

Previous procedure also works for a large number measured values (criteria) and for a large number of measurements in the time interval T .

IV. APPLICATION IN CRYPTOGRAPHY

As for cryptography, there are few new scenarios for increasing the security of data communication channel. In [8] is presented an original approach for security increase based on the assumption that the data can be distributed in vertexes, edges and weights of complete undirected weighted graph. Therefore, the graph with contained data will be hidden into a collection of weighted graphs with the same supporting un-weighted graph. In [9] neural networks synchronization process is used for synthesis of common cryptographic key by synchronization of the synaptic weights. Different approach is presented in [10] where biometric scan images are transferred by usage of DES encryption algorithm.

In this research, security increase is obtained via usage of the clueless agents and environmental key generation. In [11] Riordan and Schneier address the problem of environmental key generation: keying material that is constructed from certain classes of environmental data. As in [11] "Using these keys, agents could receive encrypted messages that they could only decrypt if some environmental conditions were true. Agents with data or executable code encrypted using such keys could remain unaware of their purpose until some environmental condition is met." These environmental conditions are defined exactly by cumulative score U which is sent by WSN and is environment dependent. The security of communication channel is increased by use of clueless agents. As in [11] "...an agent has a cipher-text message (a data set, a series of instructions, etc.) and a method for searching through the environment for the data needed to generate the decryption key". Only when the proper environmental information is located, the key is generated, the cipher-text is decrypted, as well as the resulting plain-text. It is obvious that without the environmentally supplied input, the agent cannot decrypt its own message. The clueless agents enable security increase because they can be made cryptographically resistant to analysis aimed at determining the agent's function. The simple clueless agents look for their activation keys on a fixed data channel:

- Usenet news groups.
- Web pages.
- Mail messages.
- File systems.

- Local network resources.

If condition U is met then data to be transferred via insecure channel is real vector M or vector of linguistic terms S (according to the user's preferences). Let assume that real vector M should be transferred via the insecure channel. Functionality of clueless agent is described by:

Random number (seed) N .

$K = H(M)$, where H is a one-way function.

$P = E_K(\text{action_string})$, where E is the encryption algorithm and action_string triggers desired action on receiver's side, e.g. key synthesis.

$O = H(N+M)$, where "+" is a bitwise XOR operator.

An clueless agent which scans through the database acquired from Usenet news groups, Web pages, etc, taking hashes of five word sequences in following manner:

```
for five word sequence (x) in the database do
{
    if  $H(N + (x)) = O$  then execute=  $D_{H(x)}(P)$ 
}
```

Here D is decryption algorithm.

The agent can now search through the database for references to M without actually carrying any information from which M could be derived. Obviously the security of communication channel is increased.

V. CONCLUSION

The paper investigates possibilities of communication channel security increase in a "mobile world" of mobile devices and users. The possibilities of environment based cryptographic key synthesis is theoretically studied and described. Environmental characteristics are observed via Wireless Sensor Network consisting of multiple spatially organized sensors. Sensors outputs are subject so fuzzy screening procedure which results in the priority list. This list determines which cumulative WSN output will be used for cryptographic key synthesis, so that generated key is environment dependable. The information necessary for key generation are posted on Usenet news groups, Web pages, emails, etc, and ultimately used by so called clueless agents which without the environmentally supplied input, cannot decrypt its own message.

The presented procedure enables:

1. The activation of processing procedure on receiver's side only when certain conditions are satisfied. This condition depends on information which were sent by WSN.

2. The usage of the clueless agents which increase the security level of insecure communication channel.

3. The reduction of resources needed for signal processing.

Future work will be directed toward inclusion of human body sensor array and further development of presented ideas in real world environment.

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Development of an Interactive Educational Game for Mobile Phones

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Abstract –This paper describes development process of an interactive educational game for windows mobile phones. The goal of this project is to raise the level of education, to make it more interesting for the next generations. Today's generations were born in a digital world, and tuition methods have to adapt to that. Education has to be improved with the use of interactive study methods.

I. GAMES FOR MOBILE PHONES

It can be said that the 21st century is ruled by technology. It is all around us and we cannot imagine our lives without it.

The most used electronic gadgets are called mobile phones. These small appliances have been with us since the last century, but these last couples of years have been a true catalyst for the mobile phone industry. We were introduced to smartphones. These machines changed our lives forever. People can do almost anything with these little technical appliances. That includes gaming.

Mobile games have become even more popular in the “smartphone age”. There are a lot of game types to choose from.

Unfortunately this market does not have enough educational games. People waste too much time playing these popular games. These types of games are mainly for entertaining purposes. They do not require many logic or creativity. That is what we are trying to change.

We know the best way to educate people while they are having fun. The answer is: Interactive Education.

II. DEVELOPMENT PROCESS

A. Planning

When we first thought about making a game we knew that we wanted to create something new and useful. That is why we decided to make a new and interesting quiz game. We didn't want to make some random game which has nothing new to offer. There are some things that people have never seen in a game until now.

They are the following:

1. There are multiple right and wrong answers.
2. The player can choose which category he/she wants to get the questions from.
3. The player can choose multiple categories at the same time

4. The game is full of interesting information so the player can learn new things while he/she is playing the game

We tried to make this game as fun and entertaining as possible. This game is educational and entertaining at the same time.

B. Graphic design

For the graphics we chose to use the Adobe Illustrator program. This software uses vector graphics. It is very easy to handle and we can create a cartoon-like feeling and that is what we were going for.

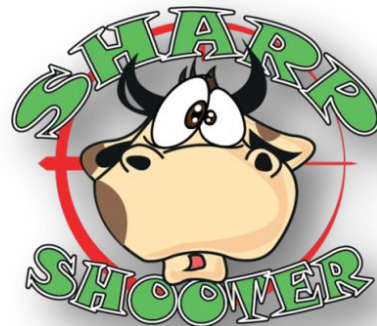


Figure 1. Logo of the game

Game was created mainly for the younger generations and that is why we decided to create simple, but nice looking graphics that appeal to children.

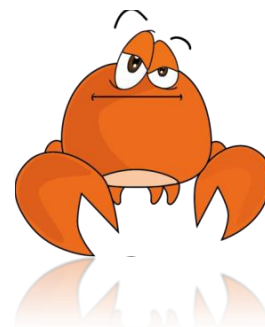


Figure 2. One of characters in game

C. Programming

This game was written in C# programming language. We are going to show you a code sample which animates the animals in the game:

```

class Animation
{
    Texture2D spriteStrip;
    float scale;
    int elapsedTime;
    int frameTime;
    int frameCount;
    int currentFrame;

    int spriteSheetColumn;
    int spriteSheetRow;
    int currentColumn;
    int currentRow;

    Color color;
    Rectangle sourceRect = new
Rectangle();
    Rectangle destinationRect = new
Rectangle();
    public int FrameWidth;
    public int FrameHeight;

    public bool Active { get; set; }

    public bool Looping { get; set; }

    public Vector2 Position { get;
set; }

    public void Initialize(Texture2D
texture, Vector2 position,
        int frameWidth,
int frameHeight, int spriteSheetColumn,
int spriteSheetRow,
        int frameCount,
int frametime,
        Color color,
float scale,
        bool looping)
    {
        this.color = color;
        this.FrameWidth = frameWidth;
        this.FrameHeight =
frameHeight;
        this.spriteSheetColumn =
spriteSheetColumn;
        this.spriteSheetRow =
spriteSheetRow;

        this.frameCount = frameCount;
        this.frameTime = frametime;
        this.scale = scale;

        Looping = looping;
        Position = position;
        spriteStrip = texture;

        elapsedTime = 0;
        currentFrame = 0;
        currentColumn = 0;
        currentRow = 0;
        Active = true;
    }

    public void Update(GameTime
gameTime)
    {
        if (Active == false)
        {
            return;
        }
        elapsedTime +=
(int)gameTime.ElapsedGameTime.TotalMillis
econds;

        if (elapsedTime > frameTime)
        {
            currentFrame++;

```

```

            currentColumn++;

            if (currentColumn ==
spriteSheetColumn)
            {
                currentColumn = 0;
                currentRow++;
                if (currentRow ==
spriteSheetRow)
                {
                    currentRow = 0;
                    if (Looping ==
false)
                        Active =
false;
                }
            }
            if (currentFrame ==
frameCount)
            {
                currentColumn = 0;
                currentRow = 0;
                currentFrame = 0;
                if (Looping == false)
                    Active = false;
            }

            elapsedTime = 0;

            sourceRect = new
Rectangle(currentColumn * FrameWidth,
currentRow * FrameHeight, FrameWidth,
FrameHeight);

            destinationRect = new
Rectangle(
                (int)Position.X -
(int)(FrameWidth * scale) / 2,
                (int)Position.Y -
(int)(FrameHeight * scale) / 2,
                (int)(FrameWidth *
scale),
                (int)(FrameHeight *
scale));
        }

        public void Draw(SpriteBatch
spriteBatch)
        {
            if (Active)
            {
                spriteBatch.Draw(spriteStrip,
destinationRect,
sourceRect, color);
            }
        }
    }
}

```

III. GAME DESCRIPTION

The complete game will have ten Chapters. Each Chapter consists of ten Levels. Each Level has one question and multiple right-, and wrong answers (as stated before, this is one of the innovations of the game). Each Chapter is a different country from all over the world. For the game's prototype we chose one of the states from the USA – California. This state has a lot of beautiful beaches which inspired our artwork.

At the beginning of each Chapter you will first see some fascinating information about the current country (not in game's Prototype):



Figure 3. Information about the current location

If you tap the "I Want To Learn More" button, the game will automatically open the country's Wikipedia site, so the user can learn more about the country.

If you tap the "Next" button you will see some useful facts about that particular country's most famous animals.

For the California Chapter we chose the Crab (also not included in the Prototype):

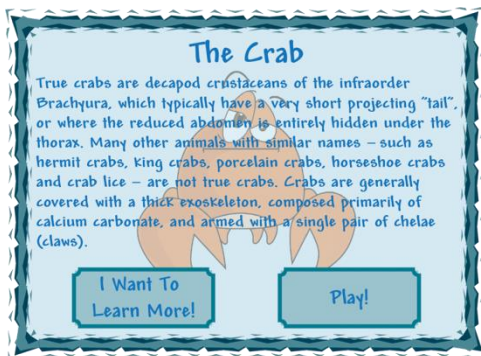


Figure 4. Information about the current location's chosen animal

Again, by tapping the "I Want To Learn More" button, the program will show the given animal's Wikipedia page. Useful, interesting information is always available.



Figure 5. SharpShooter gameplay

On top of the screen you will see current level's question. The user has to answer this question, but it's not as boring like other quiz games, because here you have multiple right and wrong answers. The answers are above the animals in thought clouds (these are the animal's thoughts). You have to tap the animals with the right answers above them (they do not get hurt, they get marked with paintball and disappear). The Level is

completed when the player has tapped the last animal with the right answer above it. Right below the question there are three boxes.

The left box is the "Weapon Box" which contains the three extra weapons that could come in handy if the player needs some help (this is similar to the "Lifelines" in the "Who Wants to Be a Millionaire?" game). The weapons are:

1. Injection - This removes one right answer for the player (the player gets the same points just as if he tapped it).
2. Flash bang - This allows the player to skip the current Level with the maximum points.
3. Hourglass: This help gives the player extra time to finish the level.



Figure 6. Lifelines

The middle box shows the time. The player has thirty seconds for each Level. If the time runs out, the current level ends.

The right box shows the player his/her current score. The player gets one point for every right answer, and one minus point for every wrong answer.

After each Level the game shows the player the current questions' right answers (this feature will also be available in the final game). This is for a more interesting higher-level education. In this example the task was to guess the African countries:



Figure 7. Screen with information of correct answers

The player feels proud that he/she answered the question correctly and the more information part feels like a reward to the player. This way the user wants to learn everything which is our goal – education combined with entertainment.

If the player taps the "I Want To Learn More" button, the program converts the right answers to links. These links lead straight to the answers' Wikipedia page which has a lot of interesting information about the answers (this feature will be available in the finished game). In

this example we can learn many new things about these African countries.

Tapping the “Next Level” button, the program starts the following Level with a new question and new answers.

IV. FUTURE PLANS

Our team has worked very hard on this game for several months, but there are still certain things that we would like to add to it to make it perfect.

We couldn't collect enough questions yet, so for now there are only random questions (there are multiple right and wrong answers, so we had to create them ourselves, because there hasn't been a game like this until now). As soon as we get enough questions we will make separate categories, so the player can choose which category he/she wants to get the questions from.

Our website will provide the opportunity for people to help this project and post new questions with right and wrong answers. We want to put as many questions in our database as possible, because we want to teach people, make them smarter and make the world into a better place.

We also want to increase the questions' difficulty as the game progresses.

There will be two more Menu buttons on the Main Menu. The “High Scores” “Settings” buttons. The High Scores will show the player his/her best scores which he/she can share with friends on different social websites. The “Settings” Menu will have basic adjustments which the player can customize. In that Menu the user can choose between various question “Categories” (History, Geography, Music...). The player will also be able to choose the game's “Difficulty” (Easy, Normal, and Hard). Effects and Music will also be able to be turned on and off in the “Sounds” submenu.

After each Chapter the player will be rewarded with the current country's traditional gifts based on how well he/she played (more points - more gifts). There will be the game's “Achievements”. The local people show their gratitude to the player for his/her hard work educating the country's population. The country's population became

smarter (because of the player's educating efforts) and they were able to solve their country's biggest problems (pollution, drought, overpopulation, diseases ...).

Global marketing is also part of our plans. We want to inform as many people as possible about this game. The best choice is online marketing. This type of advertisement usually does not require money and can reach out to a lot of people. We will start advertising our software with the three most popular social websites (Facebook, Twitter, Google+).

V. CONCLUSION

We think that innovation is one of the most important things today, because it is rarely seen. Unfortunately we can say the same thing about educational games. People can barely see any new interesting ideas out there and it is very sad.

Interactive education is immensely important today because we live in an advanced world full of electronic devices and it affects younger generations the most. They don't know what life was before these high-tech gadgets existed and now they can't imagine their lives without them. Innovators have to adapt to this situation and show them the learning world this way. We have to grab their attention and show them the beauty of this world.

Our aim is to make the learning world exciting and interesting for the new generations, and to take education itself to the next level.

The whole team put a lot of work and effort into this game, but it was worth it, because we have created something that is very useful, new and unique and we are very proud of it.

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Product Packaging Design with Harmony

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Abstract - This paper gives the description of harmony, regarding the points of color, similarity, function, symbol and typography. Furthermore, generic packaging design factors are shown. The way of using technology for generating harmony in graphic design is also demonstrated. Additionally, the paper provides an example explained in detail.

I. INTRODUCTION

This paper analyses the principles of harmony in packaging design and reviews the place of packaging design.

II. PACKAGING DESIGN

Packaging design is one of the most important moments in achieving product's success on market. It draws the customers' attention while shopping, and makes them interested. If the packaging does not look properly, the customer will most probably doubt the quality of the product inside.

The packaging is actually the producer's strategy to achieve the desired goal on market. First in shop windows, sales points, and propaganda, and later in buyers' houses, the first noticeable thing is packaging and this is why it has to be contemporary, functional and aesthetically appealing. Shaped in this way, it creates the sense of customer care, and consequently the customers' favour and trust towards the producer. A lot of customers find the packaging a status symbol [1].

Previously, the competition was rather weak, if present at all. Therefore, the packaging was not such an issue at the time. The products were sold by their quality, not the look. However, today's market has the situation where it is important to win over the competition, since there are a lot of uniform products with similar quality, but from different producers. Each company's aim is to make the customer want exactly their product. This is achieved through beautiful photographs and illustrations, newest fonts, colour, texture, as well as their mutual harmony. The design's aim is to create a unique image which will differentiate the company from its competitors and present it in the best possible way.

III. THE PRINCIPLES OF HARMONY

The notion of harmony comprises joining, composition, tune, concord. The elements have to be associated with one another in sets similar in a property. It represents the optical arrangement of harmony inside a

graphical space and lies halfway between contrast and monotony. The elements must be neither the same (monotony) nor opposite (contrast) in their similarity.

Harmony looks calm, peaceful, relaxed. It is manifested in various ways: harmony of similarity, harmony of function, harmony of symbols and harmony of typography [2].

A. *Harmony of similarity*

Comprises adjustment of elements similar in shape and colour.

B. *Harmony of function*

Is the adjustment of various shapes, different in function, but with shared function.

C. *Harmony of symbols*

Is the adjustment of various shapes different in function, form and purpose, but in the spiritual and abstract sense they build a meaningful unit. The example of this harmony can be seen in Fig. 1 [2].



Figure 1. Henri Matisse: The Dessert: Harmony in Red (The Red Room, 1909)

D. *Typography*

Attention should be paid to the look of letters as well: font size, letter spacing, use of lowercase and uppercase in a word etc [3].

The situation where the desired effect cannot be achieved by existing fonts is rather frequent, so the letters

and their spacing are being adjusted to look better, i.e. more harmonic.

IV. USING TECHNOLOGY FOR GENERATING HARMONY IN GRAPHIC DESIGN

By the end of 19th century, graphic design got the form we know today. In most cases, it includes the combination of typography, illustration, photography and text, so that an idea or a message could be transferred through visual communication, with the final goal to inform, assure or teach. The examples are newspapers, magazines, posters, flyers, calendars, advertisements, covers, billboards, business cards, product/service marketing campaigns and similar. This used to be assigned exclusively to painters and artists, but today, thanks to technology development, graphic design reached the level where the use of computers enables fast creation of real artwork, without previously required talent for painting. These pieces can then be applied in certain technologies and further production (screen printing, pad printing, regular printing, laser engraving etc.) [3].

Labels, business cards, posters, covers and other paper products, as integral part of the packaging, are often offered as templates in numerous graphical programs like Adobe Photoshop, Illustrator, In Design, Corel and other [4]. Important elements are: color, gradient, brush, button, symbol and other libraries which offer harmoniously assembled individual elements (Fig. 2).

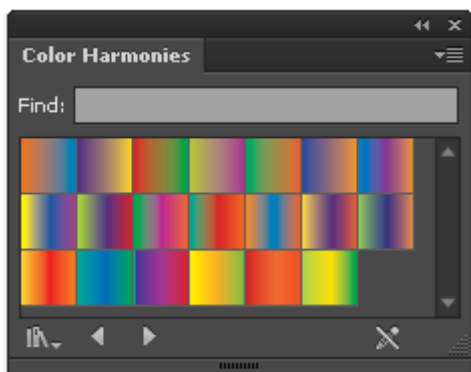


Figure 2. Illustrator - Swatch Library

V. AN EXAMPLE

When shopping, customers have only two seconds to recognize a product. This is why it is important for the packaging to be appealing, i.e. to have harmony between the design elements so as for the human eye to perceive the product correctly. If, on one hand, all design elements were treated equally regarding their size, shape, and colour, or, on the other, with the excessive difference, the customer would be confused and would not get the clear idea about the product.

Logical sequence of observation would be first to see the brand, then the sub-brand or product name, as well as the photo illustration or arrangement illustration.

As the example, the design of packaging for functional tea „Laku noć“ by FRUCTUS shall be taken.

A. Harmonic design

The design elements are placed so that the first customer's impression is the FRUCTUS brand, then the tea name itself (sub-brand „Laku noć“), the illustration of a tea cup and the photograph of a sleeping girl. Finally, the customer sees the plant arrangement. (Fig. 3):

- FRUCTUS – the brand is in the foreground since it has the strong contrast in comparison to the blue background and is treated larger than the other elements;
- The photograph of a sleeping girl – to indicate the function of the tea;
- The plant arrangement – to indicate the ingredients;
- The name „Laku noć“, placed over the white background to be visible and legible;
- The tea cup is also in the foreground so as to indicate that the content of the box is tea;
- Finally, there are necessary following product information.



Figure 3. Harmonic design

If this ratio of design elements were disarranged, the primary harmony would disappear and disharmony would occur.

B. Disharmonic design

If the FRUCTUS brand were of the same colour as the background, it would not be visible enough (Fig. 4).



Figure 4. Disharmonic design – case 1

If the plant arrangement were treated larger, it would come into foreground (Fig. 5).



Figure 5. Disharmonic design – case 2

If the sleeping girl's colour were not of the same colour as the background, the girl would be excessively highlighted and she would compete the plant arrangement, the tea cup and the brand, so the consumer would be confused and would not know where to look. Thus, the

product would not be clear and appealing and consequently, the consumer would not buy it (Fig. 6).



Figure 6. Disharmonic design – case 3

Fig. 7 shows the disharmony of all elements at the same time.



Figure 7. Simultaneous disharmony of all elements

Regardless of each element being perfectly assembled into a whole and nicely processed, compared to Fig. 2, this packaging does not have the required harmony.

VI. CONCLUSION

The importance of harmony application in packaging design was shown based on the analysed elements. The ways of harmonic composition of elements were presented, according to their size, shape, color, typography and function.

Additionally, the ways of disrupting the harmonic ratio between packaging elements were shown. In this way, the principles of harmony were explained in detail.

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Discretization Influence on Data Reduction

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Abstract - In the data mining field, many learning methods can handle only discrete attributes. Continuous features of the data can be discretized using different discretization methods. Replacing numeric value of a continuous attribute by a small number of interval labels thereby reduces and simplifies the original data. This paper presents the influence of different discretizations on data reduction. The relation between the discretization and data distribution is shown.

I. INTRODUCTION

In the data mining field, many learning methods can handle only discrete attributes. Therefore, before the machine learning process, it is necessary to substitute each continuous attribute in a discrete attribute constituted by a set of intervals. In this way, the original data are replaced with the similar. This process, known as discretization, is an essential task of the data preprocessing. This presents the preliminary condition of the learning process.

The importance of discretization, according to [1], reflected in the following:

- the data transformed in a set of intervals are more cognitively relevant for human interpretation;
- the computation process goes faster with a reduced level of data, particularly when some attributes are suppressed from the representation space of the learning problem;
- the discretization can provide non-linear relations: for instance, the infants and the elderly people are more sensitive to illness, and this relation between age and illness is then not linear;
- discretization can harmonize the nature of the data if it is heterogeneous: the attributes are a mixture of numerical values and occurrence terms.

The number of ways to discretize a continuous attribute is infinite. According [2] to partition a continuous variable, two important decisions must be made:

1. The number of discrete intervals must be selected.
2. The width of the intervals must be determined.

According to [1] an expert recognizes the best discretization method if the interval cuts can be adapted to the context of the study and if the transformed attributes make sense. In the majority of cases, it is then necessary to have an automated method which will discretize the predictive attributes and find the cut-points that are better adapted to the learning problem.

II. DISCRETIZATION TECHNIQUES

The two criteria unsupervised/supervised and univariate/multivariate – characterize the major discretization method families [1].

Specific cases have the third criterion as well: static vs. dynamic [3].

A. Unsupervised / Supervised Discretization

The simplest means of discretizing continuous features, unsupervised discretization, involves a class-blind approach where only knowledge of the feature to be discretized is required - here the user specifies the number of intervals [4]. The simplest discretization method, Equal Interval Width, divides the range of observed values for a variable into k equal sized bins (k is a user-supplied parameter). A related method, Equal Frequency Intervals, divides a continuous variable into k bins where (given m instances) each bin contains m/k adjacent values.

Supervised discretization makes use of the instance/class labels during the discretization process to aid in the partitioning. Prior knowledge of the class label of each instance is incorporated at each iteration so as for the partition breakpoint estimation of each bin to be refined [4]. According to [1] the intervals that are better adapted to a discrete machine learning method are the "pure" intervals containing only instances of a given class. To obtain such intervals, the supervised discretization methods are based on statistical or information-theoretical criteria and heuristics [5]. Some of the most frequently used methods are:

- Holte's 1R Discretizer - This method uses an error-based approach using error counts to determine when to split intervals [6].
- C4.5 Discretizer – Information gain theory is used to determine at which threshold value the gain ratio is greatest in order to partition the data [7].
- Fayyad and Irani's Entropy Based MDL Method – Exact cut off points for intervals are determined on the basis of the Minimum Description Length Principle (MDLP), which leans on a simpler theory explaining the same body of data and favoring the hypothesis which makes the probability of making a wrong decision, assuming a uniform error cost, minimal. An information entropy/uncertainty minimization heuristic is used to select threshold boundaries by finding a single threshold that minimizes the entropy function over all possible thresholds [5].

- The ChiMerge system provides a statistically justified heuristic method. This algorithm begins by placing each observed real value into its own interval and proceeds by using the χ^2 test to determine when adjacent intervals should be merged [8].

B. Univariate / Multivariate Discretization

When using univariate (local) method, a particular attribute is processed independently of the others. On the other hand, with multivariate (global) method, all attributes of the representation space are processed, so possible problems related to the interactions between the attributes can be fixed.

III. DISCRETIZATION AND DATA DISTRIBUTION

Success (the evaluation) of discretization is most frequently measured on the basis of the concrete algorithm using discretized data: the success rate of the test set.

A. An Example

Reference [3] used sixteen data sets from the U.C.Irvine repository. Figure 1 (retrieved from [3]) shows the accuracy of the C4.5 induction algorithm [7] using the different discretization methods. The continuity denotes running C4.5 on the undiscretized data; Bin-logE and Ten Bins use equal-width binning with the respective number of intervals; Entropy refers to a global variant of the discretization method proposed by Fayad and Irani.

Dataset	C4.5				
	Continuous	Bin-log ℓ	Entropy	IRD	Ten Bins
1 anneal	91.65±1.60	90.32±1.06	89.65±1.00	87.20±1.66	89.87±1.30
2 australian	85.36±0.74	84.06±0.97	85.65±1.82	85.22±1.35	84.20±1.20
3 breast	94.71±0.37	94.85±1.28	94.42±0.89	94.99±0.68	94.57±0.97
4 cleve	73.62±2.25	76.57±2.60	79.24±2.41	79.23±2.48	77.58±3.31
5 crx	86.09±0.98	84.78±1.82	84.78±1.94	85.51±1.93	84.64±1.64
6 diabetes	70.84±1.67	73.44±1.07	76.04±0.85	72.40±1.72	72.01±1.07
7 german	72.30±1.37	71.10±0.37	74.00±1.62	70.10±0.94	70.10±0.48
8 glass	65.89±2.38	59.82±3.21	69.62±1.95	59.31±2.07	59.83±2.04
9 glass2	74.20±3.72	80.42±3.55	76.67±1.63	71.29±5.10	74.32±3.80
10 heart	77.04±2.84	78.52±1.72	81.11±3.77	82.59±3.39	80.74±0.94
11 hepatitis	78.06±2.77	80.00±2.37	75.48±1.94	79.35±4.28	80.00±2.37
12 horse-colic	84.78±1.31	85.33±1.23	85.60±1.25	85.60±1.24	85.33±1.23
13 hypothyroid	99.20±0.27	97.30±0.49	99.00±0.30	98.00±0.43	96.30±0.58
14 iris	94.67±1.33	96.00±1.25	94.00±1.25	94.00±1.25	96.00±1.25
15 sick-cuthyroid	97.70±0.46	94.10±0.72	97.30±0.49	97.40±0.49	95.70±0.62
16 vehicle	69.86±1.84	68.45±2.19	69.62±1.57	66.80±3.39	68.33±2.12
Average	82.25	82.19	83.26	81.81	81.84

Figure 1. Accuracies using C4.5 with different discretization methods

The percentage difference between particular databases is notable: the ‘Iris’ database has the accuracy of about 95%, the ‘Hepatitis’ database – about 80%, while the ‘Glass’ database only about 60%. According to [4], the general effectiveness of discretization varies significantly depending on the shape of data distribution. Distributions that are highly skewed or have high peaks tend to result in higher classification errors.

B. Data Distribution

Further, the distribution was done for the selected databases from the previous example (‘Iris’, ‘Hepatitis’ and ‘Glass’). Determining the distribution was done using the EasyFit software. Fig. 2 – Fig. 5 show the results for the ‘Iris’ database in the form of the histogram. The distribution of its attributes is mutually similar in pairs:

distribution of the first and the second attribute, as well as the distribution of the third and the fourth attribute.

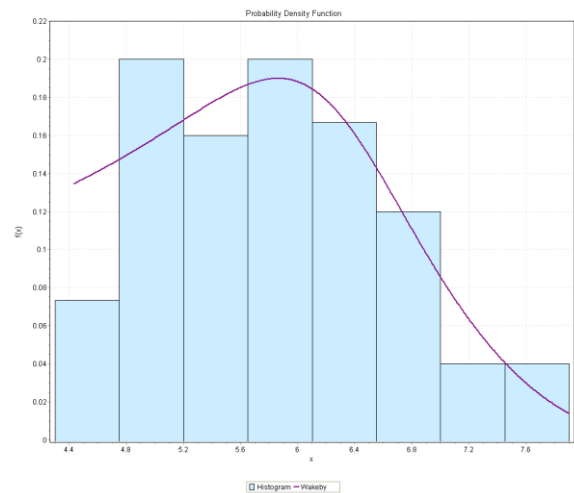


Figure 2. Iris – the first attribute

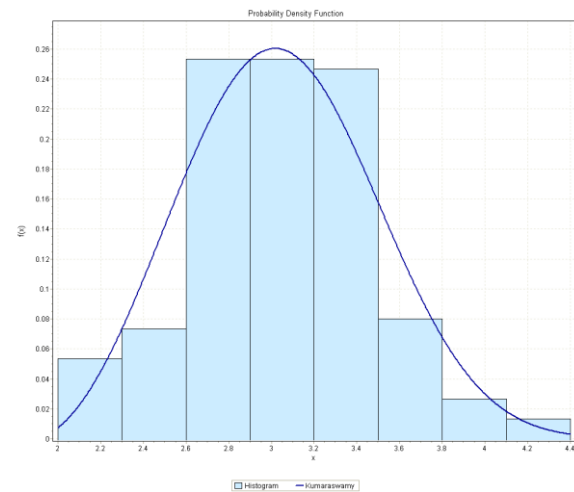


Figure 3. Iris – the second attribute

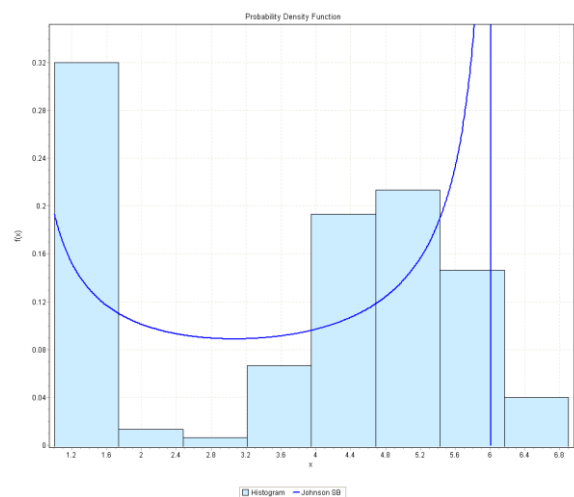


Figure 4. Iris – the third attribute

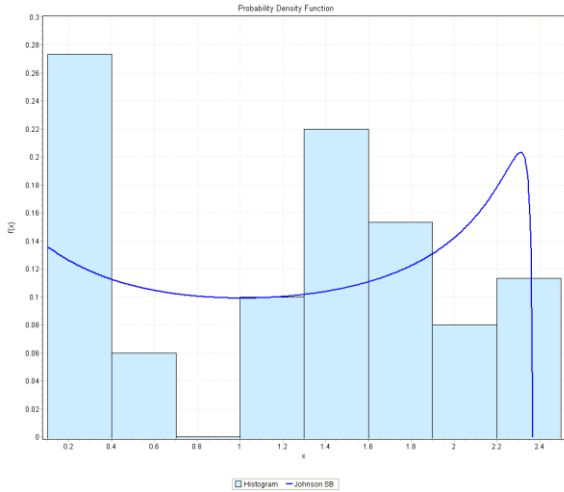


Figure 5. Iris – the fourth attribute

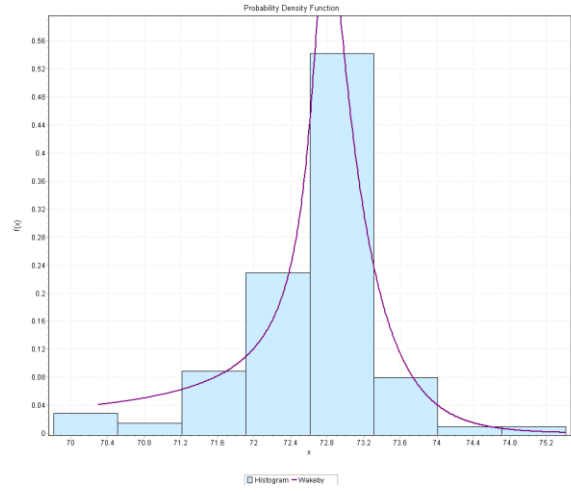


Figure 8. Glass – the sixth attribute

Attribute distributions in the ‘Hepatitis’ database, as well as in the ‘Glass’ database, are mutually very different. Out of ten attributes of the ‘Glass’ database, four are shown in Fig. 6 - Fig. 9. All the attributes of this database have the high peak distribution, which is, according to [4] the main difficulty when trying to apply discretization successfully.

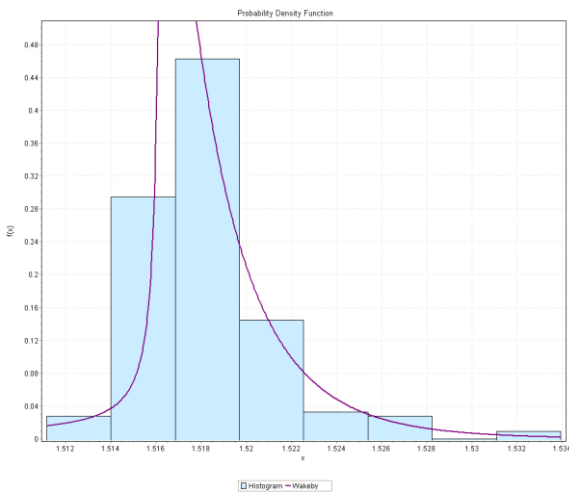


Figure 6. Glass – the second attribute

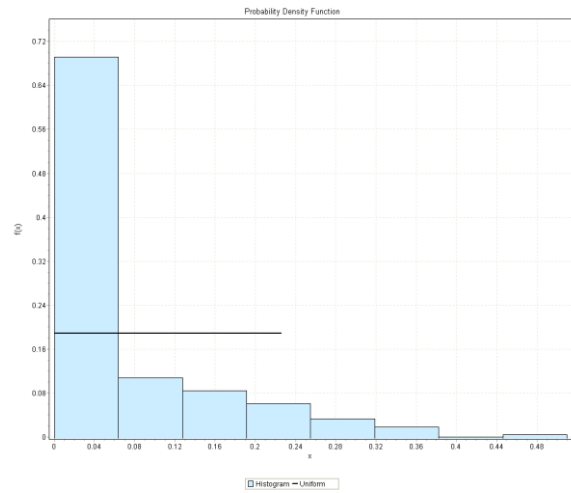


Figure 9. Glass – the tenth attribute

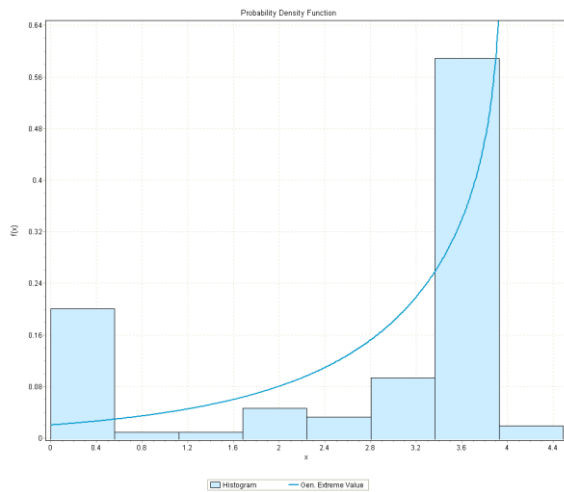


Figure 7. Glass – the fourth attribute

The shown distributions do not provide a complete overview of data interdependence. Further direction of research in this paper is the establishment of the relationship between the distributions and linear interdependence of two attributes’ values.

IV. CONCLUSION

This paper shows the basic categorization and techniques of discretization, as well as the relationship between the discretization and data distribution. In the example provided, the distributions were shown by a histogram and the artificially constructed research from [4] was confirmed. In this way, the influence of discretization on data reduction was presented.

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Tracking Failures of Auxiliary Mechanization in an Open-Pit Coal Mine

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Abstract – The paper presents a systematic approach to implementation of failure tracking process as an integral part of the Auxiliary Mechanization (AM) operations management system. The approach is based on integrated model of business processes and information system. The research, which included development of a software solution, was conducted at the “Thermal power plants and open-pit mines Kostolac”. Certain context-specific limitations were faced when considering the alternatives to the process improvements (computer-based maintenance information system could not have been considered in this phase of the research). The research findings confirmed the importance of defining and obtaining performance indicators related to machine failures and tracking corresponding statuses of machines for more effective and efficient planning on both, operational and top management level.

I. INTRODUCTION

The basic technological process in open-pit mines is executed using the basic mechanization (heavy machinery). However, there is a certain number of various auxiliary operations that are efficiently executed only by the specialized machines and vehicles, called auxiliary mechanization (AM) in mining terminology [1].

The efficiency of the coal exploitation greatly depends on the performance of auxiliary mechanization. Ensuring sufficient number of machines/vehicles for execution of auxiliary operations, their adequate selection based on type and technical characteristics, as well as their reliability and technical readiness, influence significantly exploitation of the basic mining mechanization. Therefore, managing auxiliary mechanization (its engagement in operations and its maintenance) is extremely important for the basic mining process [1, 2].

The improvement of the selected process entitled “Tracking failures of auxiliary mechanization”, which is described in the paper, was conducted within the project that aims to improve the overall auxiliary mechanization operations management system in an open-pit coal mine. The model of the system was developed based on an integrated model (IM) of business processes and information system (IS) [3]. Therefore, the applied systematic approach included business process analysis and computerized information system development. The approach is found relevant due to the increasing

dependency between services, and information and communication technologies (ICT) in the domain of services provided by motor vehicles in general. ICT also contributes to the integration of AM operations-related processes with other “end-to-end” processes, since process realization spreads across various sectors of an enterprise. Consequently, ICT supports the concept of sustainable development in terms of capability to support balance between three important domains: economy, ecology and society [4].

“Tracking failures of auxiliary mechanization” is one of the business processes identified in the described domain, which performance was found to be of utmost importance for the effectiveness and efficiency of the overall AM operations management system. Data on machine failures, repairs and routine upkeep that this business process provides are the necessary input for the calculation of some key performance indicators (KPI), such as availability and readiness [5, 6].

The paper presents the current results of the study addressing the implementation of the business process – “Tracking failures of auxiliary mechanization” as an integral part of the AM operations management system. The significance of the results for optimal decision making on both, operational and top management level is discussed.

After the introductory section, the study background is given in Section II. Section III presents an improvement of the specified business process first by introducing the problem definition, then describing the method, and finally presenting the solution. Section IV presents and discusses the specific results. The last section, Section V, concludes the paper.

II. BACKGROUND

A. Broader Problem Definition

A research that addressed defining a model and designing a solution in order to improve the AM operations management system at the “Thermal power plants and open-pit mines Kostolac” (further referenced as TE-KO) had been conducted within the realization of the project called “Development and implementation of auxiliary mechanization operations management system based on technical and economic indicators of operations

supported by modern IS/ICT". The project was realized by the Faculty of Mechanical Engineering, University of Belgrade and The Mihailo Pupin Institute, Belgrade. It relies on the bigger research conducted within the R&D project - TR35030 from the technological development program (2011-2014) of the Ministry of Education, Science and Technological Development of the Republic of Serbia. The TR35030 project is entitled "Development, design and implementation of modern strategies of integrated management of operations and vehicle and mechanization maintenance in auto transport, mining and energy systems". The title of the project communicates well its purpose and scope.

Although AM Management comprises AM operations management and AM maintenance management, the latter stayed out of the scope of the research that we address in this paper. These two subsystems could not have been both included in the scope of this research for financial constraints. Therefore, the AM operations management system was given business and methodological priority. However, common data and an interface have been defined.

B. Approach Applied

The approach applied is a systematic, process oriented approach based on Integrated model (IM) of business processes (BP) and information system (IS). This holistic approach involves three important dimensions of contemporary enterprise: process orientation, IT support to operations and quality system requirements. IM is an integration model of BP and IS which shows that BP and IS interact to realize a business goal [7, 8].

This approach and model emphasize that a business process (BP_i) and an information system (IS_i) have to integrate and simultaneously "participate" ("from input to output" of a business process) in a business goal (BG) realization. Furthermore, this integration is not possible without continuous interaction between PP_i and IS_i; that is ensured by adequate data exchange. In accordance with previously stated, the model of the business process PP_i and the information system IS_i includes:

- Definition of a business process goal
- Business process execution
- IS operations execution
- Interaction between a business process and an information system in process execution
- Achievement of a business goal
- Feedback for the business process improvement and in accordance to that, the IS adjustment (e.g. application software upgrade).

The basics to the approach presented here were used as a framework for the overall improvement of the AM operations management system in TE-KO.

C. AM Operations-Related Business Processes

Based on literature review, good practice worldwide, and system analysis of the AM operations management

system in TE-KO [7], business processes that needed urgent support by IS/ICT were identified:

- Record keeping on technical characteristics of machines and vehicles
- Annual scheduling of shift work and groups of workers
- Daily scheduling of machines and workers
- Support to fuel management
- Support to technical liquids and lubricants management
- Tracking failures of auxiliary mechanizations
- Calculation on machine engagement and other indicators
- Tracking machines and vehicles (IS, GPS/GPRS)
- Reporting on engagement of machines and workers (intended for operational and top management)

The identified processes (and sub-processes) were designed and implemented according to the described approach. The approach comprised the following activities: identification of business processes with measurable indicators of business goal achievement (that should be presented to the entire team in the realization of a process activity); identification of a process owner and responsibilities of each participant in the processes' main activities/sub-processes, business process analysis and design (including definition of working procedures for main activities/sub-processes, all in accordance with demands of the quality system); implementation of business processes, which included development of a corresponding software solution and implementation of working procedures, and finally, further improvement of business processes.

D. Software Solution

ICT support for the redesigned business processes, i.e. the computerized information system, comprised a set of technologies that will not be discussed here. However, it must be emphasized that the research included design and implementation of a software solution that directly supports the redesigned business processes to the extent which the scope and the limitations of the research project allowed. The solution was based on Oracle Database and web/php environment. Some of the provided features are: record keeping on general data of all machines and vehicles including their technical characteristics, annual shift calendar, daily schedules of machines/vehicles and workers, work order management, support for fuel management, predefined and on-demand reports.

III. IMPROVEMENT OF BUSINESS PROCESS: TRACKING FAILURES OF AUXILIARY MECHANIZATION

A. Problem Definition

"Tracking failures of auxiliary mechanizations" is one of the identified business processes of the AM operations

management system, selected to be redesigned and supported by IS/ICT in the research.

The captured ‘as-is’ process highlighted a number of problems and possibilities for improvements. The process did not have any software (IS/ICT) support. This means that data on applications on failures, diagnosis and resolutions of failures were not fully covered and existed only in paper form. This significantly hampered operational planning and coordination of a large number of participants in a variety of business processes, such as Daily scheduling of machines and workers.

Furthermore, business process “Calculation on machine engagement and other indicators”, and respecting this, “Reporting on engagement of machines”, were slow, strenuous and error-prone. Additionally, strategic management activities in such conditions were very limited.

The limitations that influenced the process improvement alternatives were related to the fact that the AM maintenance management system has remained out of the scope of the research. So, only a light-weight interface between these two subsystems might have been taken into consideration in the process redesign.

B. Method

The method applied to improve the specified process was derived from the previously described framework based on Integrated model of business processes and information system. The main activities that were undertaken were also listed above. However, a holistic nature of business process analysis and design should be emphasized, as well as an iterative nature of the overall method. The process entitled “Tracking failures of auxiliary mechanization” was analyzed and designed as an integral part of the overall AM operations management system. Special attention was focused on the problems of business process coordination in order to avoid or provide effective mechanisms for overcoming the potential gaps among the interdependent processes. After the conducted analysis of the current state business processes, business process analysis, design, implementation (included software development and implementation of working procedures), and adaptation were done iteratively, starting from the broader system context and then focusing to a specific process. Business process design comprised business process modeling using BPMN (Business Process Model and Notation) [9].

The method considered a multidisciplinary approach and close cooperation of experts in a wide range of engineering and management including mechanical engineers, software engineers, business analysts, mining engineers, and operations managers. Additionally, a special emphasis is placed on close collaboration with the customer team. Depending on the nature of the specific activity, the cooperation has been more (e.g., regular formal meetings with managers) or less formal (e.g., facilitated group sessions, modeling workshops, frequent informal interviews and consultations with domain experts / different participants in a process, providing intensive onsite support when implementing the new/renewed processes).

C. Solution

The redesigned business process “Tracking failures of auxiliary mechanization” is shown in Fig. 1. The process comprises the following activities: Inform about a machine failure (operator), Submit an application on failure (a responsible person in the AM operations management system), Consult the maintenance manager (the operations manager), Give your assessment (the maintenance manager), Decide on the status of the machine (the operations manager), Reject the application on failure (the operations manager), Accept the application on failure (the operations manager), Confirm that the repair process has been started (the maintenance manager), Submit a report on repair (the maintenance manager). Submission of a report on repair closes the application on failure. Therefore, it is the final activity of the process.

The BPMN diagram of the process clearly shows roles responsible for activities, as well as the interface between the AM operations management system and the AM maintenance management system. In addition, the activities for which software support was provided are highlighted in the diagram using green color. As it can be seen, minimal software support was also provided to the activities that are performed in the AM maintenance management system: Confirm that the repair process has been started and Submit report on repair. This was necessary to ensure that the statuses of the machines/vehicles in the system are up-to-date and available to the participants in a number of different processes, namely: “Daily scheduling of machines and workers”, “Support to fuel management”, and “Support to technical liquids and lubricants management”. Moreover, the specified process provides the highly important inputs for the processes: “Calculation on machine engagement and other indicators” and “Reporting on engagement of machines and workers”. In this way, the effective coordination of the corresponding business processes has been provided. As a result of this and the provided software support, the corresponding business processes are executed more efficiently.

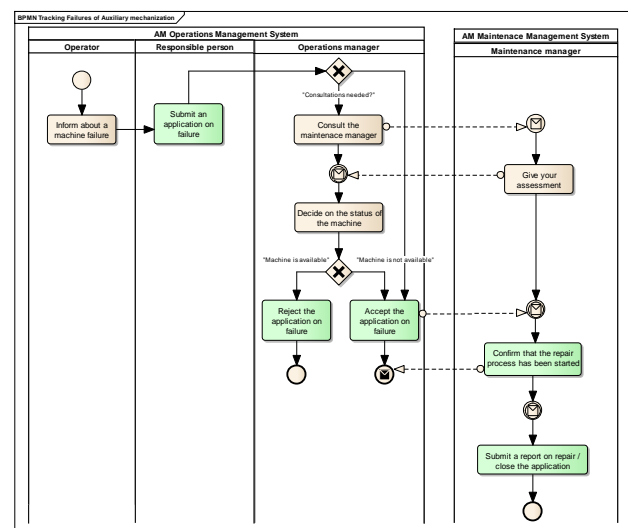


Figure 1. BPMN diagram of the process Tracking failures of auxiliary mechanization

Fig. 2 shows the relevant application submenu indicating some of the provided software features for supporting tracking of failures of auxiliary mechanization, namely: list of reported failures and routine upkeep (including ability to review an individual application on failure), submission of an application on failure, acceptance/rejection of an application on failure, submission of a report on repair (closing the application).

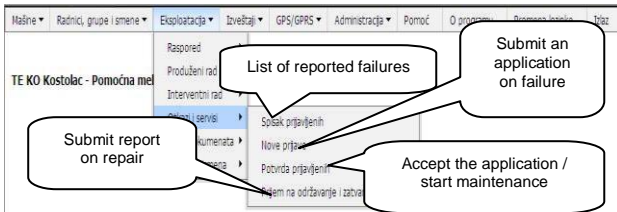


Figure 2. The application submenu indicating some of the software features for supporting tracking of failures

Additionally, Fig. 3 illustrates the provided software feature for submitting an application on failure, as well as for submitting a report on repair after the completion of the maintenance activities. Hence, this software feature supports one of two activates carried out in the AM maintenance management system. It also enables the status change of a machine/vehicle in a background (a machine/vehicle becomes available). Such a status change is visible across the software system to all authorized users by using the specific software features or reports.

For instance, the provided software feature for updating the last position of a vehicle/machine (which covers one of the activities of the business process “Daily scheduling of machines and workers”) also provides information on the status of a machine/vehicle (Fig. 4). As expected, red color indicates “unavailable” status. Additionally, yellow color indicates a backup machine/vehicle.

Furthermore, it has been ensured that all necessary data about machine failures, repairs and routine upkeep are in the system available for reports and analyses. The implemented reports provide timely much-needed information to operational and top management, inter alia, on current statuses of machines/vehicles (Available vs. Non-Available), history of a machine failures and routine upkeep, machine/vehicle failures related to a machine/vehicle operator, etc.



Figure 3. Software feature for submitting application on failure and report on repair

R.br.	Interni broj - model / tip	SP	12h	Status
Buldozer				
1.	A1 - TD40 / C	<input type="checkbox"/>	<input type="checkbox"/>	Raspoloživa
2.	A2 - TD40 / C	<input type="checkbox"/>	<input type="checkbox"/>	Nije raspoloživa
3.	A3 - TD40 / E	<input type="checkbox"/>	<input type="checkbox"/>	Nije raspoloživa
4.	A4 - TD40 / E	<input type="checkbox"/>	<input type="checkbox"/>	Nije raspoloživa
5.	A5 - TD40 / E	<input type="checkbox"/>	<input type="checkbox"/>	Raspoloživa
6.	A6 - TD40 / E EHTRA	<input type="checkbox"/>	<input type="checkbox"/>	Nije raspoloživa
7.	B01 - TD25 / H	<input type="checkbox"/>	<input type="checkbox"/>	Nije raspoloživa
8.	B03 - TD25 / H	<input type="checkbox"/>	<input type="checkbox"/>	Raspoloživa
9.	B04 - TD25 / H	<input type="checkbox"/>	<input type="checkbox"/>	Nije raspoloživa
10.	B05 - TD25 / M EHTRA	<input type="checkbox"/>	<input type="checkbox"/>	Nije raspoloživa
11.	B06 - TD25 / M	<input type="checkbox"/>	<input type="checkbox"/>	Nije raspoloživa
12.	B07 - TD25 / M	<input type="checkbox"/>	<input type="checkbox"/>	Raspoloživa
13.	B08 - TD25 / M EHTRA	<input type="checkbox"/>	<input type="checkbox"/>	Raspoloživa
14.	B09 - TD25 / M EHTRA	<input type="checkbox"/>	<input type="checkbox"/>	Nije raspoloživa
15.	B10 - TD25 / M EHTRA	<input type="checkbox"/>	<input type="checkbox"/>	Raspoloživa
16.	B11 - TD25 / M EHTRA	<input type="checkbox"/>	<input type="checkbox"/>	Raspoloživa
17.	B12 - TD25 / M EHTRA	<input type="checkbox"/>	<input type="checkbox"/>	Raspoloživa
18.	B13 - TD25 / M EHTRA	<input type="checkbox"/>	<input type="checkbox"/>	Raspoloživa
19.	B14 - TD25 / M EHTRA	<input type="checkbox"/>	<input type="checkbox"/>	Rezervna
20.	B15 - TD25 / M EHTRA	<input type="checkbox"/>	<input type="checkbox"/>	Rezervna
21.	K2 - CAT / D8R	<input type="checkbox"/>	<input type="checkbox"/>	Nije raspoloživa

Figure 4. Software feature for updating the last position of a vehicle/machine showing its status

By implementing the interface to the AM maintenance management system, the improved business process “Tracking failures of auxiliary mechanization” also provides a solid base for undertaking the analysis of incidence and causes of failures in each piece of auxiliary mechanization. This is especially important considering the fact that the improvement of the AM maintenance management system is yet to come. However, a basis for the analysis that can help that the identified common failure scenarios are adequately prepared or even avoided has been already established.

IV. SPECIFIC RESULTS AND DISCUSSION

Since planning and evaluation of effectiveness of auxiliary mechanization is based on technical and economic indicators, one of the research objectives is to provide the relevant indicators important for both operative and strategic planning, and consequently for improvement of the results of operations. Two particularly specific, but not only, indicators related to the specified business process are availability and readiness [2, 5, 6]. Therefore, the software system calculates these two important indicators and displays the results in both tabular and graphical forms. For example, Fig. 5 shows the report on availability of the bulldozers and Fig. 6 shows the histogram of readiness of all machines and vehicles by type.

PD "TE KO Kostolac" POMOĆNA MEHANIZACIJA		Raspoloživost			QZ.EKS.20 Dokument generisan 20.08.2013 10:26
Vrsta	Model i tip /	Ukupno	Ispravnih	U otkazu	Raspoloživost
Buldozer	CATD8R	1	0	1	0.00%
	TD25H	3	1	2	33.33%
	TD25M	2	1	1	50.00%
	TD25M EHTRA	9	7	2	77.78%
	TD40C	2	1	1	50.00%
	TD40E	3	1	2	33.33%
	TD40E EHTRA	1	0	1	0.00%
Svega za Vrsta: Buldozer (7 zapisa)					
SUM		21	11	10	
AVG					34.92%

Figure 5. Availability of bulldozers in tabular form

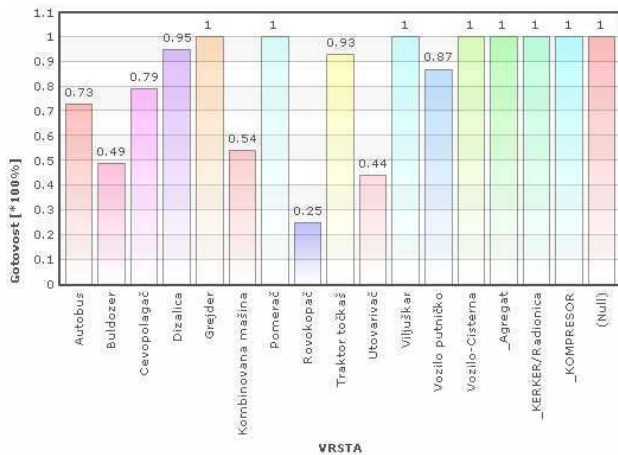


Figure 6. Readiness histogram

Machine availability is the probability that the machine will be able to work properly at any point of time, i.e. to start to operate. Fleet availability is expressed as the ratio of the number of operational machines and the total number of machines [10]. So, why is availability one of the KPIs in the AM operations management system? Based on this indicator, an achievable volume of operations can be assessed. For instance, if availability is satisfactory, it is assumed that all the operations are to be performed according to the plan (provided that the availability of operators is also satisfactory). Moreover, real-time and long-term availability monitoring is important for operative and strategic decision-making as it points to the need to take an appropriate management action (e.g. mechanization rental, purchase of new machines/vehicles or improved maintenance).

Machine readiness is the probability that the machine will successfully take effect and enter the domain of tolerance of the defined criteria function in the given conditions. It is calculated as the ratio of total “up time” and total “down time” for each machine, machine model and type, category (machines or vehicles) and total auxiliary mechanization in a given period of time [10]. In addition to availability, readiness also indicates an achievable level of operations in the AM management system. Furthermore, it may indicate the necessary capacity for maintenance of the machines / vehicles.

As expected, the following indicators of the AM exploitation have also been calculated and reported:

- Machine/Vehicle “up-time” (during a shift, daily, weekly, monthly, quarterly, yearly);
- Machine/Vehicle “down-time” (during a shift, daily, weekly, monthly, quarterly, yearly);
- Failure resolution time.

Health of machines and vehicles depends on the way they are handled by operators, their proper use for jobs for which they are intended, and the quality of maintenance (regular services, the quality of spare parts, licensed mechanics, special tools, and maintenance equipment). This requires investment of considerable effort (material resources, staff, and financial resources). However, the question is whether the invested effort can provide the

required levels of reliability, availability and readiness of auxiliary mechanization, i.e. sustainable level of operations. Not only are these and other indicators important for prognosis and planning of a sustainable level of AM operations, but also for prognosis and planning of the main economic results (the total volume of coal excavated).

Given the influencing factors previously noted, the targeted levels of availability and readiness, and other indicators can be achieved by implementing different strategies. Hence, tracking the corresponding indicators is highly important because it reveals the current position towards the target values, effectiveness and efficiency of the chosen strategy. Redesign of the specified business process (and the whole system) including the ICT solution (e.g. software development and implementation) has been greatly driven by the objective to define and provide the adequate KPIs in a way that is most useful to the users.

V. CONCLUSION

The redesigned business process “Tracking failures of auxiliary mechanization” improves operational and strategic planning thanks to the more complete and timely information, the defined and supported KPIs, the various predefined and on-demand reports and the potential for deeper analysis. This has been enabled by the organizational and procedural improvements including software development and implementation. Furthermore, the improved business process coordination in the AM operations management system and the implemented light-weight interface between this system and the AM maintenance management system had a positive impact on the efficiency of the corresponding processes and the potential for planning and decision-making. The authors believe that the applied integrated model of business processes and information system contributed greatly to the results achieved. It ensured synergy between the chosen organizational strategy and the applied technology under the identified constraints.

ACKNOWLEDGMENT

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Risk Assessment Concept in the New Approach Directives

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Abstract - The EU has developed original tools to remove barriers for free movement of goods, which existed because of differences in technical regulations of the Member States. Among them, the most important are The New Approach to technical harmonization and standardization and The Global Approach to certification and conformity assessment. A significant improvement in the approach to conformity assessment of products is achieved by integrating the requirements for technical products safety into the process of its designing. This means that in the design process preventive analyzing and quantifying of risk levels should be done. This paper presents the basis of EU New and Global Approach, the concept of standard ISO 31000 and provides the risk assessment in the New Approach directives. Special emphasis is placed on integrating risk assessment procedure in R&TTE Directive.

I. INTRODUCTION

Usage of technical products leads to various types of hazards and risk for operators. Technical products have to be safe for use and that can be realized by creating “inherently safe design structures” which is achieved by process of designing, by adequate manufacturing processes involving all testing and controls, and by adequate work processes in which they are used [1].

In the beginning of the nineties of the previous century, the EU developed The New Approach to technical harmonization and standardization and The Global Approach to certification and conformity assessment in order to remove barriers for free movement of goods. A significant improvement in the approach to conformity assessment of products is achieved by integrating the requirements for technical products safety into the process of its designing. In the directives for technical products, essential health and safety requirements have been set, which each technical product has to satisfy prior to place in the market. These requirements are defined in general form and the way of their implementation is given in the harmonized standards. The decision regarding level of safety measures is based on previously conducted risk analysis and assessment.

Risk assessment is the methodology through which risk levels are quantified with the objective of determining the scope of required safety systems, all aimed at protection operators and all others coming un-

contact with the technical products, from possible injuries and damages [1].

In November 2009, the International Organization for Standardization (ISO) released the first risk management standard titled ISO 31000:2009 Risk Management – Principles and Guidelines together with standard ISO/IEC Guide: 73: Risk management – Vocabulary. This international standard provides the principles for managing different types of risk, from many sources irrespective of the organizations size, type, complexity, structure, activities and location [2].

Among the basis of EU New and Global Approach and the concept of standard ISO 31000, this paper shows the risk assessment procedure in the New Approach directives. Paper also presents conformity and risk assessment in R&TTE Directive together with draft risk assessment procedure for products which do not fulfill the essential requirements.

II. THE BASIS OF NEW AND GLOBAL APPROACH

The mechanisms that enable removal of all technical barriers from the EU internal market are based on: preventing new barriers to trade, mutual recognition and technical harmonization.

A. *The New Approach to technical harmonization and standardization*

The Council Decision on New Approach in field of technical harmonization and standardization set a new regulatory scheme based on the following principles [3]:

- Harmonization is limited to essential requirements.
- Only products fulfilling these essential requirements may be enter the market.
- Harmonized standards are presumed to conform to corresponding the essential requirements.
- Application of harmonized standards is voluntary. Manufacturers may choose any solution that provides compliance with essential requirements.
- Manufacturers may choose whatever conformity assessment procedure provided in the applicable directive. Some of the procedures require engaging of conformity assessment bodies which now appear as the third parties.

European standards organizations (CEN, CENELEC, and ETSI) define harmonized standards within the definition of the New Approach and submit them to the Commission for their possible adoption.

New Approach directives apply to products to enter the commerce of the EEA (European Economic Area), including new, used, and products imported from third countries. A subject product can only enter the commerce of the EEA when it conforms to the provisions of all applicable directives and when conformity assessment has been carried out in accordance with all applicable directives.

In most of the New Approach directives manufacturers and their authorized representatives are obliged to affix CE mark to the product before put it on the market. CE mark gives information that the product conforms to all harmonizes requirements related to it.

Member States have to inspect whether the products on their market conforms to the essential requirements. This is achieved by the national surveillance authority.

B. The Global Approach to certification and conformity assessment

If the product is covered by the New Approach directives, the conformity assessment procedures are defined in the European Union Council’s Decision on introducing the Conformity Assessment Modules. These modules are shown in Fig. 1, as in [3].

Some of the modules of product certification, in their conformity assessment procedure, require involving an independent third party (Notified bodies). Usually, the conformity assessment procedures related to highly risky products, from the point of view of hazards for human health and environment safety, request engagement of notified body. It is very important that notified bodies perform their function with previously proven high levels of competence, integrity and professional attitude. Member States are responsible for nomination these bodies if their market requires so.

III. CONCEPT OF STANDARD ISO 31000

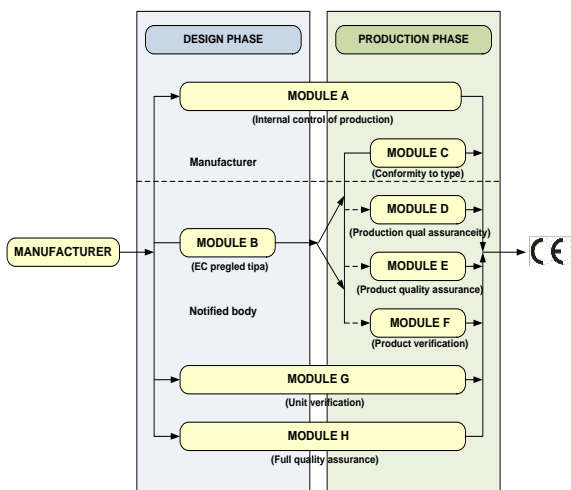


Figure 1. Modules of product certification according to Global Approach

In ISO 31000 standard risk is defined as the effect of uncertainty on acquiring organization’s objectives. It is effect of deviation from the expected outcome of an event that can be either positive or negative direction. Risk is often expresses as a combination of consequences of an event ant the probability of its occurrence [2].

ISO 31000 cannot be used for certification purposes. However, it does encourage organizations to compare their current risk management practices to the principles and processes in ISO 31000 and to develop strategies for improvement.

ISO 31000 introduces excellent explanation of the relationship between the principles for managing risk, the framework for managing risk and the risk management process.

A. The risk management principles

The standard ISO 31000 defines eleven explicit principles which are basic qualities needed for risk management to be effective. The principles are [4]:

- Risk management creates and protects value.
- Risk management is an integral part of organizational processes.
- Risk management is part of decision making.
- Risk management explicitly addresses uncertainty.
- Risk management is systematic, structured and timely.
- Risk management is based on the best available information.
- Risk management is tailored.
- Risk management takes human and cultural factor into account.
- Risk management is transparent and inclusive;
- Risk management is dynamic, iterative and responsive to change.
- Risk management facilitates continual improvement and enhancement of the organization.

B. The risk management framework

The “Plan, Do, Check, Act” cycle of continuous improvement is used as the basis for risk management framework. The relationship between components of the risk management framework is shown in Fig. 2, as in [4].

These components are:

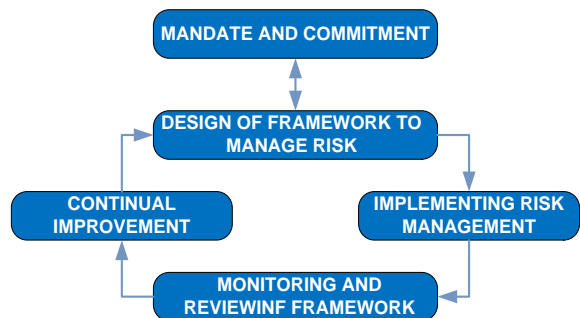


Figure 2. The relationship between components of the risk management framework

- Mandate and commitment;
- Design of framework to manage risk;
- Implementing risk management;
- Monitoring and reviewing framework;
- Continual improvement.

This framework is intended to assist the organization to integrate risk management into its overall management system. Therefore, organizations should adapt the components of the framework to their specific needs.

C. The risk management process

The risk management process defined in ISO 31000 is illustrated in Fig. 3 [4]. It consists of five key activities:

- Communication and consultation;
- Establishing context;
- Risk assessment (risk identification, risk analysis, risk evaluation);
- Risk treatment;
- Monitoring and review.

The risk management process should be an integral part of management, embedded in the culture and practices and adapted to the business process of the organization.

IV. RISK ASSESSMENT CONCEPT IN THE NEW APPROACH DIRECTIVE

A. Standards in the risk management field

Testing the product and checking the conformity to the EU legislation is the responsibility of the manufacturer. The requirements defined in the standards for products have been set on the basis of previously conducted risk analysis. In case for products for which there are no adequate standards, the manufacturer is obliged to conduct complete analysis, to evaluate the risk and to implement adequate measures. As the assistance in executing the risk analysis and assessment, there is a set of standards available to manufacturers as guideline in conduction this analysis [5].

The requirements for technical product safety

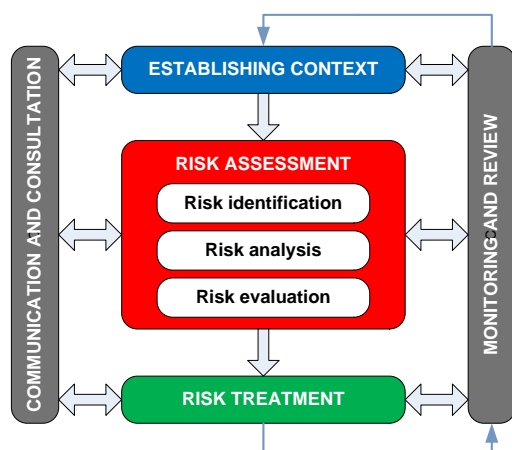


Figure 3. The risk management process

incorporated by the EU legislation are given in the New

Approach directives. They are defined in general form. From the risk point of view, the requirements defined in such a manner represent the risk management objectives in the process of product design related to safety of the products.

There is a big problem to determinate the safety of a non standardized product in case when there is no adequate reference to which it can be done. In some sectors, it is not practical or economically viable to standardize all product types because new types are continuously being developed. In response to this problem, European Commission with CEN has initiated the development of generic harmonized standards enabling the systematic approach and providing the guidelines for: identification of hazards, risk assessment due to these dangers and assessment of acceptability of the selected safety measures [5].

Some of generic standards ensured for risk assessment in New Approach directives are: ISO 14121-7 (Safety of Machinery–Risk Assessment - Part 1: Principles), EN ISO 14971:2000 + AC: 2002 (Medical devices - Application of risk management to medical devices), ISO TR 14798:2006 (Lifts - Risk Assessment and risk reduction methodology), etc. These standards serve as the guidelines used by designers and engineers in analyzing and assessing the level of safety of design solution in the courses of product development process [5]. Also, these standards are the tool for organization’s staff and notified body in assessment whether a product satisfies the requirements of directives and harmonized standards.

Together with ISO 31000 which provides the principles and guidelines for managing any time of risk, very important role takes generic standard ISO/IEC 31010:2009 (Risk management – Risk assessment techniques). This standard provides large number of techniques that can be applied in risk assessment. Also, organizations very often develop specific tools in which the risk assessment methodology given in some of the standards is adjusted to products and business practice present in that organization. Usually, these tools are given in form of various procedures, instructions or in the form of checklist.

B. The methodology for reducing risk in the New Approach directives

The New Approach directives require the technical products risks to be assessed in the phase of designing. Also, the legislation regulations define safety of the working space in which products are used.

The risk assessment in the New Approach directives is based on the following principles, as in [1]:

- It is the obligation of the manufacturer or its authorized representative to identify all the risks from technical products.
- There are no further activities for the risks which are covered by harmonized European standards.
- Risk analysis and risk reduced should be done in the phase of designing.

- Implemented protective measures are to be described so as to eliminate the identified hazards and to reduce risk.
- Residual risk, related to product, is to be pointed to in the instructions for use of the product.

For all technical products covered by New Approach directives it is very important to keep the risk from all hazards at low levels. The methodology for reducing risk in the New Approach directives, shown in Fig. 4, is based on following basic steps, as in [1]:

- The manufacturer or its representative determines, by using harmonized standard (e.g. ISO 14121-1:2007) through the risk assessment procedure, the level of risk for the identified hazards, taking into consideration the limitations of technical products perform. In case when risk level after risk evaluation activities exceeds the acceptable level, new measures are requested aimed at its reduction.
- The first step for manufacturer or its authorized representative in the risk reduction methodology is to undertake risk reduction by modifying the existing design solution. This risk reduction is so called “inherently safe design solution”.
- If the risk reassessment shows that the risk level is still high, the manufacturer or its authorized representative will take certain complementary protective measures.
- In spite of all previously taken measures there still remain certain risks. Because of that residual risks manufacturer or its authorized representative have to inform future users about all these tasks, on the product itself and in instruction for use.

Users of the technical product have to reduce additional risk on the basis of information received from

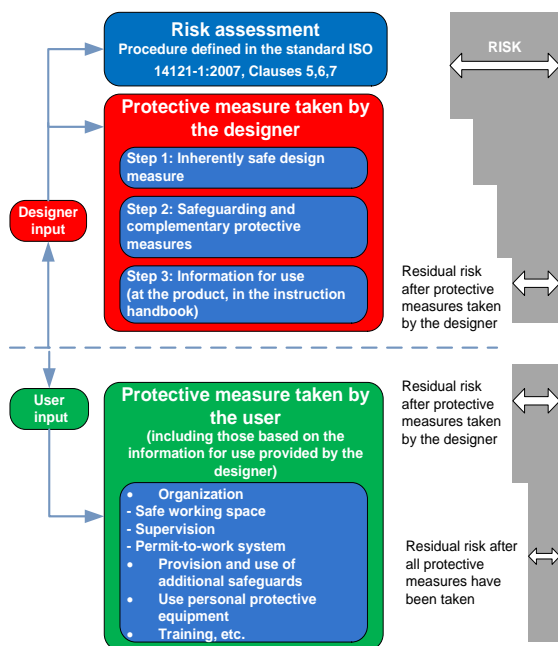


Figure 4. The methodology for reducing risk in the New Approach directives

the manufacturer or its authorized representative. In the risk reducing methodology users of technical product have to perform following operations, as in [1]:

- Establishing of adequate organization of work (adequate work procedures, supervising of the technical product operation, clear and explicitly defined authorizations and responsibilities);
- Use of additional protection measures;
- Use of personal protection means;
- Adequate trainings for operators, etc.

In case when several directives are related to the product, all essential health and safety requirements from all the directives have to be met.

V. RISK ASSESSMENT PROCEDURE IN R&TTE DIRECTIVE

A. The basis of R&TTE Directive

R&TTE Directive 1999/5/EC is intended to ensure that radio equipment and telecommunications terminal equipment meets essential safety and electromagnetic compatibility requirements and avoids harmful interference while harmonizing rules governing its sale within the EU. Additionally, R&TTE Directive allows for further requirements for R&TT equipment to be added over time, regarding interoperability, network interference and user privacy, access to emergency services and accessibility for disabled users [6].

The Directive defines telecommunications terminal equipment as a product enabling communication or a relevant component thereof which is intended to be connected directly or indirectly by any means whatsoever to interfaces of public telecommunications networks. Radio equipment is defined as a product or relevant component thereof, capable of communication by means of the emission and/or reception of radio waves utilizing the spectrum allocated to terrestrial/space radio communication.

The Directive applies to all R&TT equipment with the exception of certain specific categories listed in Annex I of the Directive. It also does not apply to infrastructure equipment for fixed networks, which is covered by Electromagnetic Compatibility Directive (2004/108/EC) and the Low Voltage Directive (2006/95/EC).

The presence of the CE marking on R&TT equipment is an indication that it meets these essential requirements and can therefore be sold anywhere in EEA. This also applies to products manufactured in third countries.

B. Conformity and risk assessment procedures in R&TTE Directive

There are different conformity assessment procedures for R&TT equipment depending on the type of product and on whether harmonized EU standards have been applied.

For telecommunications terminal equipment which does not use the spectrum allocated to terrestrial/space radio communication and receiving parts of radio equipment, manufacturers can choose between one of three procedures: an internal production control, an internal production control plus specific apparatus tests

accompanied by a technical construction file or a quality assurance procedure. Details of these procedures are placed in Annexes II, IV and V of the Directive [6].

For radio equipment making use of spectrum, the procedure to be followed depends on whether harmonized standards have been applied. One of three procedures can be followed: an internal production control plus specific apparatus tests as set out in Annex III, or the procedures set out in Annexes IV and V as referred to above [6]. If harmonized standards have not been applied, or have been applied only in part, manufacturers can only choose between the procedures set out in Annexes IV and V of the Directive [6].

Risk assessment is the constituent part of the development process and also the constituent part of conformity assessment. Apart from machinery products or medical devices, there is no adequate harmonized standard according to which to perform risk assessment for R&TTE products. In that case, manufacturer can use the general structure of the process for managing risks given in standard ISO 31000.

C. Risk assessment for R&TTE products which do not fulfill the essential requirements

This subsection is based on document issued by ADCO R&TTE (Group of Administrative Co-operation under the R&TTE Directive) and ADCO EMC (EMC Working Group on Administrative Co-operation) on 1st February 2012 [7]. These groups are currently developing an appropriate risk assessment procedure for products within the scope of the R&TTE and EMC Directives.

Guidelines for the management of the Community Rapid Information System (RAPEX) sets out the risk assessment method to be used by Member States authorities to assess the level of risks posed by consumer products to the health and safety of consumers and to decide whether a RAPEX notification is necessary. The RAPEX guidelines currently focus on the risk injury to persons. New Approach Directives are often much wider in the scope of the aspects that must not be put at risk. The SOGS/MSG (Senior Officials Group on Standardization and Conformity Assessment Policy Market Surveillance Group) has been requested by the Commission to further elaborate the risk assessment applicable for all 27 New Approach directives. A RATF (Risk Assessment Task Force) was installed to analyze the existing procedure and identified a suitable general assessment system.

Draft flow chart of the risk assessment procedure, which is from discussions of the RATF, is given on the Fig. 5. Proposed procedure has eight steps, as in [7]. This procedure isn't finalized and should be adopted by the SOGS-MSG. The goal of the risk assessment procedure is to determine the risk level of products which are not compliant with the Directive for radio equipment and telecommunications terminal equipment.

The first step in the risk assessment procedure is to identify the product. The entire product should be considered with all constituent parts. The product's name, brand and serial number should be identified. Also,

information about the instructions, any warnings and intended users is very important.

The second step is identifying the hazards. There are a lot of hazards for any given product. The ability to identify and understand the importance of these hazards is very much depending upon the experience and knowledge of the assessor. The RAPEX Guidelines takes an approach that categorizes a number of hazards to provide assistance to the assessor.

Next step is to identify the subject at risk. The scope of the RAPEX guidelines is limited to injury to persons, but the New Approach Directives require protection of other "subject". These "subjects" could include persons, but crucially they are not limited to persons.

The fourth step of this procedure is describing how the hazards harms the subject. When hazards and "subject" at risk are identified, they should be combined to develop a "harm scenario". Actually, this is a description of how the hazards affect the "subject". The description does not take into account any probabilities. It is very important to describe the key components of hazard, subject and product very carefully. This careful approach and description allows judgments and decisions to be made with greater confidence. The harm scenario may have great influence of the risk level. For example, a non-compliant radio product can completely disturb the radio communications of vital mobile communication network (e.g. police, ambulance, fire brigade, air traffic), but in another situation this non-compliance product will not disturb radio communications.

Next step represents the harm. ISO/IEC Guide 51 defines harm as physical injury or damage to the health of people, or damage to property or the environment.

Determining the severity of harm is next step. The level of harm to the subject must be assessed.

The most difficult area of the assessment procedure is determining the probability of harm. There are three possible options that can be considered to estimate the risk. The first option is multiplication of estimation of the probabilities of each step in the scenario to determine final estimation of probability. The second option presents a single estimated figure for the overall probability of the scenario, and the third option is a qualitative approach based on a descriptor.

The last step in risk assessment procedure is combining the severity and probability to determine the level of risk. Usually, a matrix system is used for this step. The severity of harm is identified on the horizontal axis and the probability is identified on the vertical axis. The intersection then determines the severity of harm.

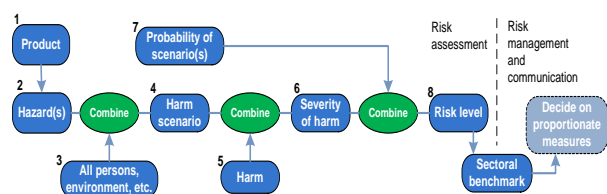


Figure 5. Proposed risk assessment procedure for R&TTE products which do not fulfill the essential requirements.

VI. CONCLUSION

In case when all risks are covered by the harmonized standards, there is no need for additional risk assessment and risk reduction. In other case, risk reduction should be attempted through a design solution and by applying some of other harmonized standards. After that, manufacturer should integrated adequate protection and safety systems. Finally, manufacturer has to inform users about all residual risks by issuing instructions of use.

There is no adequate harmonized standard according to which to perform risk assessment for R&TTE products. In information given by ADCO R&TTE on 30th May 2013 states that this group has worked on a tool and on a methodology on how to assess the risk, but they do not have found the correct methodology yet.

Authors of this paper consider that risk assessment procedure should be integral part of new revision of R&TTE Directive. Also, the methodology for reducing the risk taken from standard ISO 12100-1:2010 is applicable on R&TT products. Authors believe that ISO 31000 can be used as basic standard according to which risk assessment should be done. Also, authors think that ISO 31000 is a start point in finding the correct methodology for identifying non compliance products presenting a serious risk and which are requiring rapid intervention by market surveillance authorities.

Finding the best methodology for risk assessment of all products related to New Approach directives is very live and popular topic. Concept of risk assessment in New Approach directives and its integration into holistic approach of risk management in enterprises will be analyzed in future papers.

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The Application of the Polynomials in Cryptography

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Abstract - Polynomials have always occupied a prominent position in mathematics, but in recent time the usage of polynomials has become unavoidable in cryptography. The paper presents short description of various types of polynomials, as well as their possible usage in cryptography. The main contribution of the paper is the investigation of polynomial-based algorithms in RSA and deciphering in the McEliece scheme. The paper also contains an example.

I. INTRODUCTION

Cryptographic algorithms are nowadays commonly used in domain of data transfer security. The constant increase of data volume which is being transmitted over via insecure communication channel yield many problems related to unauthorized access to communication channel by a malice user or third party. Many types of "attacks" and "defensive procedures" have been studied and in most cases, successfully implemented in practice. The security of communication channels is evidently very important. Many different cryptographic algorithms are widely used, some of them are DES, 3DES, RSA, AES, etc [1, 2]. Recently, the domain of cryptography is also one of the most prominent application areas of the finite field arithmetic. It is almost impossible to fully understand practically any facet of modern cryptography and several important aspects of general computer security if you do not know what is meant by a finite field. The research presented in this paper deals with the application of polynomials, as well as infinite fields in cryptography.

The paper is organized as follows: Section two gives some facts and definitions of fields, polynomials over fields and finite fields. Section three gives the insight to polynomials when applied in domain of cryptography. As this is relatively new idea from purely practical point of view, the main intention of this section is to be informative in order to provide guidelines to the application of this mathematical theory in the field of cryptography. Main contribution of this paper is informative and motivational. Final, fourth section consists of conclusions and future work guidelines.

II. FIELDS

Any set of element is a field if the sets satisfies the field axioms for both addition and multiplication and is a commutative division algebra. Formal definition of the field is given in further text.

Definition. A set F with two binary operations $+$ (addition) and \cdot (multiplication) is called a field if:

1. $\forall a, b \in F, a + b \in F$
2. $\forall a, b, c \in F, (a + b) + c = a + (b + c)$
3. $\forall a, b \in F, a + b = b + a$
4. $\exists 0 \in F, \forall a \in F, a + 0 = a$
5. $\forall a \in F, \exists -a \in F, a + (-a) = 0$
6. $\forall a, b \in F, a \cdot b \in F$
7. $\forall a, b, c \in F, (a \cdot b) \cdot c = a \cdot (b \cdot c)$
8. $\forall a, b \in F, a \cdot b = b \cdot a$
9. $\exists 1 \in F, \forall a \in F, a \cdot 1 = a$
10. $\forall a, b, c \in F, a \cdot (b + c) = a \cdot b + a \cdot c$
11. $\forall a \neq 0 \in F, \exists a^{-1} \in F, a \cdot a^{-1} = 1$

The elements of F form an Abelian group with the operation $+$ (called the additive group of F). The non-zero elements of F form an Abelian group under the operation \cdot (called the multiplicative group of F).

A. Polynomials over fields

Let $f(x) = a_n x^n + a_{n-1} x^{n-1} + a_{n-2} x^{n-2} + \dots + a_1 x + a_0$ be a polynomial of degree n in one variable x over a field F . (namely $a_n, a_{n-1}, \dots, a_1, a_0 \in F$).

Theorem. The equation $f(x) = 0$ has at most n solutions in F .

Theorem. Let

$$f(x) = a_n x^n + a_{n-1} x^{n-1} + a_{n-2} x^{n-2} + \dots + a_1 x + a_0$$

and be

$$g(x) = b_m x^m + b_{m-1} x^{m-1} + b_{m-2} x^{m-2} + \dots + b_1 x + b_0$$

two polynomials over F such that $m < n$ (or $m = n$). Then, there is a unique polynomial $r(x)$ of degree $< m$ over F such that

$$f(x) = h(x) \cdot g(x) + r(x).$$

Polynomial $r(x)$ is called the remainder of $f(x)$ modulo $g(x)$.

B. Finite fields

A Galois field or a finite field is a field with a finite field order (number of elements). The order of a finite field is always a prime or a power of a prime.

Definition. A field $(F, +, \cdot)$ is called a finite field if the set F is finite.

Example: Z_p denotes $\{0,1, \dots, p-1\}$. We define $+$ and \cdot as addition and multiplication modulo p , respectively. One can prove that $(Z_p, +, \cdot)$ is a field iff p is a prime.

Let $(F, +, \cdot)$ be a finite field. There is a positive integer n such that

$$\underbrace{1 + \dots + 1}_{(n \text{ times})} = 0.$$

The minimal such n is called the characteristic of F , $char(F)$.

Theorem. For any finite field F , $char(F)$ is a prime number.

Theorem. For every prime power p^k ($k = 1, 2, \dots$) there is a unique finite field containing p^k elements. These fields are denoted by $GF(p^k)$, so named in honor of Évariste Galois (1811-1832). There are no finite fields with other cardinalities.

As in [4], every finite field is the vector space $GF(q) = GF(p^k)$ of m -tuples over $GF(p)$. The addition and multiplication operations in $GF(p)$ are modular operations performed in two steps:

1. regular integer addition or multiplication, and
2. reduction by the prime modulus p if the result of the first step is greater than or equal to the modulus.

The elements of the binary extension field $GF(2^n)$ can be represented as binary polynomials of degree less

than n if polynomial basis representation is used. Analogous to the odd prime used in $GF(p)$, a binary irreducible polynomial of degree n is used to construct $GF(2^n)$. The addition in $GF(2^n)$ is modulo 2 addition of corresponding coefficients of two polynomials. Since it is basically a polynomial addition there is no carry propagation and the degree of the resulting polynomial cannot exceed $n-1$.

Polynomial basis representation of $GF(2^n)$ is determined by an irreducible binary polynomial $p(x)$ of degree n . Given $p(x)$ all the binary polynomials of degree less than n , which has the form

$$(x) = a_n x^n + a_{n-1} x^{n-1} + a_{n-2} x^{n-2} + \dots + a_1 x + a_0,$$

are the elements of $GF(2^n)$. Multiplication in $GF(2^n)$ similar to multiplication in $GF(p)$ is performed in two steps:

1. polynomial multiplication followed by
2. a polynomial division of the result from step 1 by the irreducible polynomial $p(x)$.

C. Finite field $GF(4)$

For construction operation tables for $GF(4)$ we use [4].

The only prime polynomial of degree 2 over $GF(2)$ is $x^2 + x + 1$.

$$x^2 = x \cdot x, \quad x^2 + x = x(x + 1), \quad x^2 + 1 = (x + 1)^2$$

Therefore $GF(4) = \{0, 1, x, x + 1\}$ with arithmetic modulo $x^2 + x + 1$.

TABLE I. OPERATION TABLES FOR $GF(4)$ USING THIS POLYNOMIAL REPRESENTATION

+	0	1	x	x+1
0	0	1	x	x+1
1	1	0	x+1	x
x	x	x+1	0	1
x+1	x+1	x	1	0

×	0	1	x	x+1
0	0	0	0	0
1	0	1	x	x+1
x	0	x	x+1	1
x+1	0	x+1	1	x

Arithmetic modulo $x^2 + x + 1$ is equivalent to replacing all occurrences of $x^2 + x + 1$ by 0. In particular, over $GF(2)$

$$x^2 + x + 1 = 0 \Leftrightarrow x^2 = x + 1.$$

Thus x^2 and all higher powers of x modulo

$$x^2 + x + 1$$

can be replaced by a polynomial of degree ≤ 1 . Every nonzero element of $GF(4)$ is a power of x :

$$GF(4) = \{0, 1, x, x^2 = x + 1\}.$$

In other words, x is a primitive element.

Definition: A primitive element of a finite field is any α that is a generator of the multiplicative group of the field.

It is easier to understand $GF(4)$ if we replace the indeterminate x by α . Then every element in $GF(4)$ is a linear combination of the basis vectors, 1 and α :

$$GF(4) = \{0, 1, \alpha, \alpha + 1\}.$$

Therefore multiplication in $GF(4)$ is determined by the products of 1 and α .

TABLE II. PRODUCTS OF THE BASIS VECTORS DEFINE MULTIPLICATION (A BILINEAR FUNCTION)

×	1	α	⇒	×	0	1	α	α+1
1	1	α		0	0	0	0	0
α	α	α+1		1	0	1	α	α+1
				α	0	α	α+1	1
				α+1	0	α+1	1	α

Binary polynomials in α of degree < 2 (i.e., ≤ 1) can be represented by bit vectors (lsb first):

$$a_0 + a_1 \alpha = (a_0, a_1)$$

TABLE III. MULTIPLICATION TABLE FOR $GF(4)$ IN BINARY (LSB FIRST) AND 4-ARY:

\times	00	10	01	11
00	00	00	00	00
10	00	10	01	11
01	00	01	11	10
11	00	11	10	01

\times	0	1	2	3
0	0	0	0	0
1	0	1	2	3
2	0	2	3	1
3	0	3	1	2

Similar to binary extension fields, the elements of ternary extension fields $GF(3^n)$ can be represented as (ternary) polynomials of degree at most $n - 1$, whose coefficients are from the base field $GF(3)$. In order to utilize polynomial basis for ternary arithmetic, an irreducible ternary polynomial $p(x)$ of degree n is needed.

III. POLYNOMIALS AND CRYPTOGRAPHY

As in [6] polynomials are used in few cryptographic algorithms or procedures such as: Rabin and RSA transformations, elliptic curves, secret-sharing schemes, transformations in AES (see [1]), deciphering in the McEliece scheme, key distribution in consumer systems, error-correcting-codes for bio-imprints. In this research is given very brief insight to polynomials application in: transformations in RSA and deciphering in the McEliece scheme. A brief review of the use of this technique in the field of bio-imprints is also given.

As in [6], the Sub-byte transformation in RSA is applied to all rows of the data matrix:

- Polynomials over $GF(2^8)$:
- Data matrix row $X_i(x) = X_i0 + X_{i1}x + X_{i2}x^2 + X_{i3}x^3$
- Encryption polynomial
 $a(x) = a_0 + a_1x + a_2x^2 + a_3x^3$
- Encrypted row
 $X_i(x) \Rightarrow X_i(x)a(x) \text{ mod } (x^4 - 1)$.

Deciphering in the McEliece scheme is done by a public key which is given by binary $n \times k$ matrix $G = PGB$. Here, P is $n \times n$ secret permutation matrix, B $k \times k$ binary nonsingular secret matrix, G binary $n \times k$ secret generator matrix of a cyclic or Goppa ($n, k, 2t + 1$) code over $GF(2)$, while α is a primitive element of $GF(2^m)$, so that $n = 2^m - 1$.

Enciphering in the McEliece scheme is done by information vector x , error vector with t errors e and encrypted message $r = Gx + e$.

According to [6] deciphering is done by decoding the vector r , correction of t errors by:

- computation of the modified received vector
 $R = P^{-1}r$,
- computation of $2t$ syndromes
- computation of the error locator polynomial $\sigma(z)$
- error location: evaluation of $\sigma(z)$ in n points.

As mentioned before, polynomials in cryptography are useful to store or distribute bio-imprints. As in [7] "... images of the muscle cell imprints showed the micro- and nanostructures of the muscle cells, including cellular

fibers and structures within the cell membranes". It is important to keep the original bio-imprint secret, so it should be difficult to recover the original sample imprint from its stored version. The storage of bio-imprint is reportedly done by polynomials. Automatic recognition of bio-imprint related to patient's identity requires fast checking of whether the imprint taken is among a stored set of encrypted sample imprints. This task is very complex given that the taken imprint is often corrupted by sensor errors. Polynomials in cryptography are capable to "filter" corrupted bio-imprints in a fast and efficient way.

IV. CONCLUSION

Presented theoretical research belongs to boundary region of the polynomials in cryptography. More broadly, the research can be subsumed under the field of Biosemiotica. As the term suggests, it is an open field of research, without fixed boundaries, in which a plurality of approaches converge in the common interdisciplinary endeavor to explore the interfaces between biology and semiotics [8]. Detection of subtle differences in cell surfaces and morphology that may be indicative of diseases and abnormalities such as cancer has potential for the early diagnosis and treatment of disease and for use in biological studies. Presented theoretical research also has an impact to further development of the cryptographic algorithms and procedures.

Further research will be finding an upper bound to the multiplicative complexity necessary to evaluate a polynomial of degree n over finite fields.

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Multi-criteria Analysis of Data for Ranking in Construction of Regional Irrigation System in the Republic of Serbia

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Abstract - In recent years, a number of regional irrigation system are proposed for the realization whose located in the Republic of Serbia. Proposed irrigation systems occupy from 900 to 30,000 ha, differ in technical solutions, differ in water resources, types of irrigation, types of distribution networks etc. Making decision is complex solution with influence of economic and financial indicators such as investment, the price of irrigation water, springs, financing conditions and many others. Some of the indicators, such as, social impact, rural development and environment protection can only be expressed qualitatively. Under conditions of limited capital to finance them, the problem of the prioritization and sequencing of construction especially in this case are significant, caused by mixture quantitative and qualitative indicators. To objectively solve these problems, it is necessary to use methods of multicriteria analysis as a decision making support.

I. INTRODUCTION

Constructed irrigation systems represent the capital facility, not only for the region where they are located, but also for the Republic in general. As a rule, that is a multi-year investment, which means that the return of the invested funds will take a long time. Benefits of such systems are often hard to evaluate, and the simplified assessment of profitability, using only a few parameters, can lead to a conclusion that the irrigation system cannot be paid out. Having on mind the fact that the price of the investment is very high, hydro-systems are, in majority of cases, planned as multipurpose systems. Hydro-systems intended for water-supply of industry, population and agriculture, with constructed sport and touristic facilities have good chances for economic survival.

The modern agricultural production implies possession of irrigation systems, which enable high and stable outputs and eliminate the risk of drought. The climate changes, that we all witness nowadays bring decreasing quantities of rainfalls, and longer periods of droughts. Sometimes, in droughty years, it happens that irrigation represents an inevitable agro-technical measure, not only for the crops that have increased needs for water, but also for the basic agricultural cultures, which has been confirmed during the last couple of years.

In order to be able to start with the consideration of irrigation, it would be necessary to design and construct a hydro-system which would supply consumers with water.

It would be necessary to set the objective criteria which indicate to location where the construction of the hydro-system would be profitable. The investments (into infrastructure and equipment), investing into new employees, unit costs of exploitation, selling price of water, internal rate of profitability, minimum volumes of water for delivery ($m^3/year$), minimum selling price during the period of loan repayment, costs of electricity, annual operational costs, the level of the annual annuity, the subsystem area (ha) etc., are only some of the important criteria to be considered.

There is a great need for construction of the hydro-system in the Republic of Serbia. The limiting factor is the money, as it is impossible to construct all planned facilities, which results in logical question - which hydro-system should be the first one to build, that is, how to make the list of priorities? Normally, irrigation systems differ by the purpose, requirements in terms of water resources, labour force, energy, expenses, etc.

Selection of the best candidate for construction is not simple, and the wrong choice may have great negative financial consequences. It is clear that the decision made in the process of deciding, must be based on multi-criteria analytic methods, according to the model offering the group of favourable and unfavourable features. This decision support system (DSS) can include tools which help in solving operational problems. DSS is the instrument for processing, analysis and presentation of the information based on use of computers. Implemented programs help the decision maker to identify which information is relevant and which strategy or criterion has the biggest influence. DSS enables forecasts, planning, review of alternatives, evaluation of influences, ranking of alternatives, etc.

In order to provide the support in making decisions about complex problems, of which the features are hard or impossible to compare, there is a whole range of tools and program packages developed in order to provide the support. One of the software tools developed is based on the ELEKTRA method, and provides advice after entering only a few basic data. It is universal, of general purpose and there are only a few rules that need to be observed. If any rule is broken, the program sends a warning and asks for correction.

II. THE METODOLOGY OF WORK

Decision making is the procedure by which the decision maker finds out satisfactory solution, by all criteria, if possible. The terms such as "multi-objective", "multi-criteria", "multi-dimensional", which are used by many authors, are actually the synonyms. In order to be able to understand the structure of multi-criteria decision making (Multi Criteria Decision Making - MCDM), Zeleni (1982) and Romero and Rehman (1989) suggested the terms for defining of the segments of models.

- Variable: represents the resource which the decision maker will optimize. That is usually the volume of water distributed among various consumers, water quality standard, the level of expenses, etc.
- Attribute: an attribute is a parameter which represents any aspect of the given problem. It can comprise incomes, savings, debts, level of pollution, output, etc. It is expressed as a mathematical function.
- Objective: the objective is the direction (min or max) which the decision maker should follow as the attribute (profit maximization, reduction of pollution, cost minimization, etc.).

We have many methods on our disposal, including all their advantages and disadvantages. The most popular methods are ELECTRE (Goicoechea, et al, 1982), PROMETHEE (Brans and Vincke, 1985), TOPSIS (Hwang and Yoon, 1981, Srđević 2005) and AHP (Saaty, 1980, Srđević at al 2006, 2008, 2011).

This study gives a detailed presentation of the method ELEKTRA I.

III. THE RESULTS OF THE RESEARCH

The Republic of Serbia needs construction of several hydro-systems. It is planned to construct four hydro-systems by the year 2020 (Ada north, Ada south, Slankamen and Smederevo). According to the collected data and the project documentation, it is necessary to decide which hydro-system will be constructed. Out of many observed criteria, four were selected for this study:

1. Investments (in infrastructure and equipment), in EUR
2. Unit cost of exploitation, in EUR/m³
3. Selling price of water, for 6% discount rate
4. Subsystem area, in ha

The last one is the criterion, by which each feature is being ranked.

Operational costs include fixed (depreciation, insurance, maintenance, salaries) and variable costs (energy, water, seasonal labour force, costs of assembly).

Table I show main characteristic of observed hydro systems and criterion of characteristics.

TABLE I. MAIN FEATURES OF HYDRO-SYSTEMS COMPETING FOR CONSTRUCTION

	Investments (in infrastructure and equipment), in EUR	Unit cost of exploitation, in EUR/m ³	Selling price of water, for 6% discount rate	Sub-system area, in ha
AdaNorth	19115643.00	0.11	0.12	5317.00
AdaSouth	19803838.00	0.12	0.13	800.00
Slankamen	11199244.00	0.28	0.30	1700.00
Smederevo	6716970.00	0.30	0.31	900.00
Objective	min	min	min	max

The ELECTRA I method includes 9 steps.

Step 1: Calculation of normalized matrix for decision making (1).

The norm is calculated by formula

$$norm = \sqrt{\sum_{i=1}^m x_{ij}^2} \tag{1}$$

which would be for the first column

$$norm_1 = \sqrt{(19115643^2 + 19803838^2 + 11199244^2 + 6716970^2)} = 30465399.3$$

7

It is necessary to calculate the norms for all columns and to calculate the characteristics within the norms and the normalized matrix will be

$$N = \begin{vmatrix} 0.627454 & 0.244531 & 0.257366 & 0.931082 \\ 0.650044 & 0.278134 & 0.278813 & 0.140091 \\ 0.367605 & 0.632555 & 0.643415 & 0.297694 \\ 0.220479 & 0.680235 & 0.664863 & 0.157603 \end{vmatrix}$$

Step 2: Calculation of matrix normalized by complexity of making decisions

Decision maker will set the complexity of each criterion, by adding coefficients. The experts decided that the complexity of each characteristic is the following:

$$T = \begin{vmatrix} 0.3 & 0.2 & 0.3 & 0.2 \end{vmatrix}$$

The matrix normalized by complexity is calculated as TN=N*T as follows

$$TN = \begin{vmatrix} 0.188236 & 0.048906 & 0.077210 & 0.186216 \\ 0.195013 & 0.055627 & 0.083644 & 0.028018 \\ 0.110282 & 0.126511 & 0.193025 & 0.059539 \\ 0.066144 & 0.136047 & 0.199459 & 0.031521 \end{vmatrix}$$

Step 3: Setting of the accordance sets (S) and discordance sets (NS)

The accordance set is formed for the pairs of actions a_p and a_r and which enter the set if they meet the following criterion:

$S_{pr} = (j | x_{pj} \geq x_{rj})$ if that is the criterion of maximization type or

$S_{pr} = (j | x_{pj} \leq x_{rj})$ if that is the criterion of minimization type

Forming of discordance set is calculated in the similar way, only the criteria

$NS_{pr} = (j | x_{pj} < x_{rj})$ if the criterion is maximization and

$NS_{pr} = (j | x_{pj} > x_{rj})$ if the criterion is minimization.

The final table II show final accordance and discordance.

TABLE II. THE FINAL TABLE OF ACCORDANCE AND DISCORDANCE

	A	D
1,2	1,2,3,4	
1,3	2,3,4	1
1,4	2,3,4	1
2,1		1,2,3,4
2,3	2,3	1,4
2,4	2,3	1,4
3,1	1	2,3,4
3,2	1,4	2,3
3,4	2,3,4	1
4,1	1	2,3,4
4,2	1,4	2,3
4,3	1	2,3,4

Step 4: Setting of accordance matrix

The accordance matrix is established according to the set of accordance within the model. Their value is calculated (2) as the sum of complexity coefficients, which belong to elements of accordance sets. For the actions a_p and a_r , the accordance matrix is calculated as

$$MS_{pr} = \sum_{j \in S_{pr}} t_j \tag{2}$$

thus it will be

$$MS = \begin{vmatrix} 0.0 & 1.0 & 0.7 & 0.7 \\ 0.0 & 0.0 & 0.5 & 0.5 \\ 0.3 & 0.5 & 0.0 & 0.7 \\ 0.3 & 0.5 & 0.3 & 0.0 \end{vmatrix}$$

Step 5: Setting of discordance matrix

Discordance matrix for actions a_p and a_r is calculated by the formula (3).

$$MNS_{pr} = \frac{\max_{j \in NS_{pr}} |tn_{pj} - tn_{rj}|}{\max_{j \in J} |tn_{pj} - tn_{rj}|} \tag{3}$$

so the discordance matrix will be

$$M = \begin{vmatrix} 0.0 & 0.0 & 1.00000 & 0.78924 \\ 1.00000 & 0.0 & 0.77464 & 1.00000 \\ 0.22117 & 1.00000 & 0.0 & 1.00000 \\ 1.00000 & 0.89869 & 0.63478 & 0.0 \\ 0.0 & 0.0 & 1.00000 & 0.78924 \end{vmatrix}$$

Step 6: The matrix of accordant domination (MSD)

The matrix of accordant domination is formed (4) according to the threshold of accordance index by the formula

$$PIS = \frac{1}{m(m-1)} \sum_{p=1}^m \sum_{r=1}^m MS_{pr} \tag{4}$$

and has the value of PIS=0.5. The matrix of accordant domination is formed as

$$\begin{aligned} MSD_{pr} &= 1 \text{ if } MS_{pr} \geq PIS \\ MSD_{pr} &= 0 \text{ if } MS_{pr} < PIS \end{aligned} \text{ and will be}$$

$$MSD = \begin{vmatrix} 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 0 \end{vmatrix}$$

Step 7: Setting of the matrix of discordant domination

The average discordance index (5) is calculated by

$$PINS = \frac{1}{m(m-1)} \sum_{p=1}^m \sum_{r=1}^m MNS_{pr} = 0.7765462(5)$$

According to criteria

$$MNSD_{pr} = 1 \text{ if } MS_{pr} \leq PINS$$

$$MNSD_{pr} = 0 \text{ if } MS_{pr} > PINS$$

Forms the matrix of discordant domination

$$MNSD = \begin{vmatrix} 1 & 1 & 0 & 0 \\ 0 & 1 & 1 & 0 \\ 1 & 0 & 1 & 0 \\ 0 & 0 & 1 & 1 \end{vmatrix}$$

Step 8: Setting of the matrix of aggregate domination

According to position elements in matrixes of accordant and discordant domination, the fields which have value 1 in both matrixes will result with number 1 in the aggregate domination matrix, too. Thus, the aggregate domination matrix will be the following

$$MAD = \begin{vmatrix} a1 & 1 & 0 & 0 \\ 0 & a2 & 1 & 0 \\ 0 & 0 & a3 & 0 \\ 0 & 0 & 0 & a4 \end{vmatrix}$$

Step 9: Conclusion

According to the information of the aggregate domination matrix, the following can be concluded:

- a1 dominates over a2,
- a2 dominates over a3
- a3 does not dominate
- a4 does not dominate

Since a1 dominates over a2 and a2 dominates over a3, the conclusion is that the best choice is alternative a1, that is, the construction of the hydro-system No. 1.

IV. CONCLUSION

Decision making always carries the risk of making the wrong decision. The existence of several alternatives with different objectives, results in inability to find the best solution only by the common sense. Even the simple problem that we presented, with only 4 hydro-systems and only 4 characteristics for making decision, represents an unsolvable enigma. It would be necessary to implement some of the methods of support in making decisions, which will guarantee that the chosen solution is truly the best one. The software developed on ELECTRA method, which was presented to detail, enables us to come to the best solution, through implementation of 9 precise steps. The users only need to provide the basic information about the subject of deciding, to decide whether the criterion will be maximized or minimized and to assign the complexity factors for each criterion. That will result in an objective assessment of the best solution according to the given criteria.

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Review of the CFD Software Packages

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Abstract - Computational Fluid Dynamics (CFD) analysis represents the science of predicting fluid flows and related phenomena (heat transfer, mass transfer, chemical reactions) by solving numerically the respective governing equations. The results of CFD analysis are relevant engineering data that are used in conceptual studies of new designs, detailed product development and redesign. Nowadays, CFD is more and more used for industrial applications. This paper presents the possibility of CFD application, its advantages, modelling process and activities, as well as the review of the CFD Software packages. The paper also summarizes the features and application of the CFD Software packages like Phoenix, Fluent and CFX and discusses their structure features, special modules, mathematical models and successful application areas. At the end the paper it points out the possible research direction for CFD in the future focusing on the development of mathematical model, project transformation, new equipment and their matching application with technological software.

I. INTRODUCTION

Computational fluid dynamics, usually abbreviated as CFD, is a branch of fluid mechanics that uses numerical methods and algorithms to solve and analyze problems that involve fluid flows. Computers are used to perform the calculations required to simulate the interaction of liquids and gases with surfaces defined by boundary conditions. With high-speed supercomputers, better solutions can be achieved. Ongoing research yields software that improves the accuracy and speed of complex simulation scenarios such as transonic or turbulent flows.

The fundamental basis of almost all CFD problems are the Navier–Stokes equations, which define any single-phase (gas or liquid, but not both) fluid flow. These equations can be simplified by removing terms describing viscous actions to yield the Euler equations. Further simplification, by removing terms describing vorticity yields the full potential equations. Finally, for small perturbations in subsonic and supersonic flows (not transonic or hypersonic) these equations can be linearized to yield the linearized potential equations.

Historically, methods were first developed to solve the Linearized potential equations. Two-dimensional (2D) methods, using conformal transformations of the flow about a cylinder to the flow about an airfoil were developed in the 1930s [1]. The computer power available paced development of three-dimensional methods. The first work using computers to model fluid flow, as governed by the Navier-Stokes equations, was performed at Los Alamos National Labs, in the T3 group [2], [3]. This group was led by Francis H. Harlow, who is widely

considered as one of the pioneers of CFD. From 1957 to late 1960s, this group developed a variety of numerical methods to simulate transient two-dimensional fluid flows, such as Particle-in-cell method [4], Fluid-in-cell method [5], Vorticity stream function method [6], and Marker-and-cell method [7]. Fromm's vorticity-stream-function method for 2D, transient, incompressible flow was the first treatment of strongly contorting incompressible flows in the world.

The first paper with three-dimensional model was published by John Hess and A.M.O. Smith of Douglas Aircraft in 1967[8]. This method discretized the surface of the geometry with panels, giving rise to this class of programs being called Panel Methods. Their method itself was simplified, in that it did not include lifting flows and hence was mainly applied to ship hulls and aircraft fuselages. The first lifting Panel Code (A230) was described in a paper written by Paul Rubbert and Gary Saaris of Boeing Aircraft in 1968[9].

II. CFD APPLICATION AND ITS ADVANTAGES

Computational fluid dynamics or CFD is the analysis of systems involving fluid flow, heat transfer and associated phenomena such as chemical reactions by means of computer-based simulation. The technique is very powerful and spans a wide range of industrial and non industrial applications areas. Some examples are: chemical process engineering: mixing and separation, multiphase systems, aerodynamics of aircraft and vehicles, hydrodynamics of ships, power plants, turbo machinery, electrical and electronic engineering, external and internal environment of buildings, marine engineering, environmental engineering, hydrology and oceanography, meteorology, and biomedical engineering (blood flows through arteries and veins). Increasingly CFD is becoming a vital component in the design of industrial products and processes [10].

There are several unique advantages of CFD over experimental-based approaches to fluid systems design: substantial reduction of lead times and costs of new designs, ability to study where controlled experiments are difficult or impossible to perform, ability to study systems under hazardous conditions at and beyond their normal performance limits, and practically unlimited level of detail of results. The variable cost of an experiment, in terms of facility hire and/or man-hour costs, is proportional to the number of data points and the number of configurations tested. In contrast CFD codes can produce extremely large volumes of results at virtually no added expense and it is very cheap to perform parametric studies, for instance to optimize equipment performance

[10]. One of the advantages in using CFD Software is also the speed of the simulation. CFD simulations can be executed in a short period of time. Quick turnaround means engineering data can be introduced early in the design process. Also, what is very important is ability to simulate real and ideal conditions. Many flow and heat transfer processes can not be easily tested - e.g. hypersonic flow at Mach 20, nuclear accident etc; CFD provides the ability to theoretically simulate any physical condition. Among other, CFD allows great control over the physical process and provides the ability to isolate specific phenomena for study. For example, a heat transfer process can be idealized with adiabatic, constant heat flux, or constant temperature boundaries. One of the very important properties of CFD is that it can give comprehensive information. Experiments only permit data to be extracted at a limited number of locations in the system (e.g. pressure and temperature probes, heat flux gauges, LDV, etc.). CFD allows the analyst to examine a large number of locations in the region of interest, and yields a comprehensive set of flow parameters for examination [11].

But there are some limitations in using CFD modelling. Regarding physical models, CFD solutions rely upon physical models of real world processes (e.g. turbulence, compressibility, chemistry, multiphase flow, etc.). The solution that are obtained through CFD can only be as accurate as the physical models on which they are based. There are also limitations regarding physical boundary condition: as with physical models, the accuracy of the CFD solution is only as good as the initial/boundary conditions provided to the numerical model. Regarding numerical errors: solving equations on a computer invariably introduces some numerical errors such as:

- Round-off error - represents errors due to finite word size available on the computer;
- Truncation error - represents error due to approximations in the discretization schemes.

Round-off errors will always exist (though they should be small in most cases) and truncation errors will go to zero as the grid is refined. In that case mesh refinement is one way to deal with truncation error and/or schemes of greater accuracy are used [11].

III. SELECTING CFD SOFTWARE - MODELLING PROCESS FEATURES

There are many commercial CFD softwares used in engineering, such as PHOENICS (it is the first commercial CFD software), STAR-CD, ANSYS FLUENT/CFX and so on. All CFD softwares have three main structures which are Pre-Processor, Solver and Post-Processor [12].

No matter what kind of CFD software is, the main processes of simulation are the same. Setting up governing equations is the precondition of CFD modelling; mass, momentum and energy conservation equation are the three basis governing equations. After that, Boundary conditions are decided as different flow conditions and a mesh is created. The purpose of meshing model is discretized equations and boundary conditions into a single grid. A cell is the basic element in structured and

unstructured grid. The basic elements of two-dimensional unstructured grid are triangular and quadrilateral cell. Meanwhile, the rectangular cell is commonly used in structured grid. In three-dimensional simulation, tetrahedra and pentahedra cells are commonly used unstructured grid and hexahedra cell is used in structured grids. The mesh quality is a prerequisite for obtaining the reasonably physical solutions and it is a function of the skill of the simulation engineer. The more nodes resident in the mesh, the greater the computational time to solve the aerodynamic problem concerned, therefore creating an efficient mesh is indispensable. Three numerical methods can be used to discretize equations which are Finite Different Method (FDM), Finite Element Method (FEM) and Finite Volume Method (FVM). FVM is widely used in CFD software such as Fluent, CFX, PHOENICS and STAR-CD, to name just a few. Compared with FDM, the advantages of the FVM and FEM are that they are easily formulated to allow for unstructured meshes and have a great flexibility so that can apply to a variety of geometries [13]. Desired features in the modelling process in different CFD packages are divided in following groups according the modelling process itself [14].

Pre-processor. Pre-processor consists of the input of a flow problem to a CFD program by means of an operator-friendly interface and the subsequent transformation of this input into a form suitable for use by the solver. The user activities at the pre-processing stage involve: definition of the geometry of the region of interest: the computational domain, grid generation-the sub-division of the domain into a number of smaller, non-overlapping subdomains: a grid (or mesh) of cells (or control volumes or elements), selection of the physical and chemical phenomena that need to be modelled, definition of fluid properties, specification of appropriate boundary conditions at cells which coincide with or touch the domain boundary. The solution to a flow problem (velocity, pressure, temperature, etc.) is defined at nodes inside each cell. The accuracy of a CFD solution is governed by the number of cells in the grid. In general, the larger the number of cells it is the better the solution accuracy. Both the accuracy of a solution and its cost in terms of necessary computer hardware and calculation time are dependent on the fineness of the grid. Optimal meshes are often non-uniform: finer in areas where large variations occur from point to point and coarser in regions with relatively little change. Over 50% of the time spent in industry on a CFD project is devoted to the definition of the domain geometry and grid generation [15-18].

Solver. There are three distinct streams of commercial solution techniques: finite difference, finite element and spectral methods. In outline the numerical methods that form the basis of the solver perform the following steps: approximation of the unknown flow variables by means of simple functions, discretisation by substitution of the approximations into the governing flow equations and subsequent mathematical manipulations, solution of the algebraic equations.

Post-processor. As in pre-processing a huge amount of development work has recently taken place in the post-processing field. Owing to the increased popularity of engineering workstations, many of which have

outstanding graphics capabilities, the leading CFD packages are now equipped with versatile data visualization tools. These include: domain geometry and grid display, vector plots, line and shaded contour plots, 2D and 3D surface plots, particle tracking, view manipulation (translation, rotation, scaling etc.), colour postscript output. More recently these facilities may also include animation for dynamic results display and in addition to graphics all codes produce trustily alphanumeric output and have data export facilities for further manipulation external to the code.

One of the desired features is also the **user-friendliness**. The capability that the user is able to operate the software is determined by the design of the user interface. The more friendly a package appears, the shorter learning curve will be and the quicker users will be able to obtain meaningful results. The Graphical User Interface (GUI) provides a very easy introduction to the software and enables basic problems to be set up very quickly using both mouse and keyboard. Less problems can be defined using a command language which "sits beneath" the GUI. This enables files that are normally produced automatically using the top level menu, to be written (and edited) by the user using a very high level

IV. REVIEW OF THE CFD SOFTWARE PACKAGES

Several packages were chosen for investigation. These were considered according a list of desired features, that are presented above (Table I and II). Later further analysis considered the most widely used codes such as: CFX,

and logical language. The command language offers users much more freedom in defining geometries, meshes, boundary conditions, etc. However, if the command language is still not flexible enough, it is necessary for the user to access *User Fortran Routines*. These are sub-sections of the main CFD code in which users can write Fortran routines to run their simulation. For example, to define new physical models, specify complex boundary conditions, define additional output variables, etc.

User-support is also defined as feature that is crucial for selecting the CFD packages. When using CFD software to address difficult problems, it is helpful if good user support is available via an immediate, rapid response method, such as fax, email or telephone. Some vendors also set up email user groups which enable users to send an advice request to all current users of that CFD software packages. Most companies offer training courses to new and potential users enabling them to overcome some of the initial difficulties and get the most from the software in a shorter period of time. To gain an insight into the quality of user-support, there is much to be gained from visiting potential suppliers before selecting a software vendor [15-18].

FLUENT and PHOENICS in more detail (Table III), as well as comparison of the process features between top selling vendors Ansys CFD and SolidWorks (Table IV).

TABLE I THE NAMES AND THE DATA ON THE CHOSEN CFD PACKAGES THAT ARE TAKEN INTO CONSIDERATION IN THIS COMPARATIVE REVIEW [19-27].

Company	Code	Operating system	Hardware requirements
ANSYS, Inc. www.ansys.com	CFX 14.5	Windows, Linux, Solaris	Windows XP SP3 (min 2GB RAM) 100GB hard disk free space, 2GB additional hard disk space needed Windows 7 (min 4GB RAM) 5GB hard disk free space, 10GB additional hard disk space needed
	FLUENT 13		Windows XP SP3 (min 512MB RAM) 100GB hard disk free space Windows 7 (min 2GB RAM) 100GB hard disk free space
CHAM Ltd. www.cham.co.uk	Phoenics	Windows, Linux, Solaris	Windows XP (min 512MB RAM), Windows Vista/7 (min 1GB RAM) 1.2-2.2GB hard disk free space
Flow Science, Inc. www.flow3d.com	FLOW-3D/MP	Windows, Linux	both Workstations and clusters, Redhat Enterprise Linux (5 or 6) or SUSE Linux 11 large shared NFS disk
CD adapco Group www.cd-adapco.com	STAR-CCM+	Windows, Linux, Solaris	Cluster Platform: Windows or Linux
	STAR-Cast		
	STAR-CD 4.06		
SolidWorks Corp. www.solidworks.com	SolidWorks Simulation 2013	Windows, Linux	Windows 7 (32- or 64-bit), Windows 8 (64-bit) or Windows Vista 2GB RAM (min) 5GB disk space free (min)

TABLE II COMPARISON OF THE CFD PACKAGES ACCORDING TO DESIRED FEATURES [19-27].

Feature	CFX	Fluent	Phoenics	Star-SD
Discretisation technique	FEM	FVM	FVM	FVM
Mesh type	STR	STR	STR	UNS
2D and 3D	Y	Y	Y	Y
Friendly interface	Y	Y	Y	Y
Body-fitted coordinates	Y	Y	Y	N/Y
Turbulence models: <i>k - ε</i>	Y	Y	Y	Y
Multi-phase/species	Y	Y	Y	Y
Access to Fortran user-routines	Y	Y	Y	Y

FEM - finite element method, FVM - finite volume method, STR - structured mesh, UNS - unstructured mesh, Y - features are available, N - features are not available

TABLE III DETAILED ANALYSIS OF REQUIRED CAPABILITIES [19-27].

Code	Method	Thermal boundary conditions	Import			Batch mode	Temp. dependence	Phase change model
			Mesh	BC	IC			
CFX	FEM	Temperature, flux, convection, radiation, heat sourced	Y	Y	Y	Y	Y	Y
Fluent	FVM	Temperature, flux, convection, radiation, heat sourced	Y	Y	Y	Y	Y	E
Phoenics	FEM	Temperature, flux, convection, radiation	Y	Y	Y	Y	Y	E, L
FLOW-3D	FVM	Temperature, flux, convection, radiation, heat sourced	N	Y	N	Y	Y	E
Star-CD	FVM	Temperature, flux, convection, radiation	Y	Y	Y	Y	Y	E
COSMOSFlo Work	FVM	Temperature, radiation, heat sourced	N	N	N	Y	Y	N
COSMOSM	FEM	Temperature, flux, convection, radiation, heat sourced	Y	Y	Y	Y	Y	N
COSMOSWorks	FEM	Temperature, flux, convection, radiation, heat sourced	N	N	N	Y	Y	N
COSMOSDesign STAR	FEM	Temperature, flux, convection, radiation, heat sourced	N	N	N	Y	Y	N

FEM - finite element method, FVM - finite volume method, Y - features available, N - features unavailable, E - enthalpy-based phase change model, L - latent heat based phase change model

TABLE IV COMPARISON BASED ON POSSIBLE CAPABILITIES [19-27].

CFD Comparison		Ansys (CFX, Fluent)	SolidWorks (Simulation)
Fluid Flow Capabilities	<i>Internal/External</i>	Y	Y
	<i>Laminar/Turbulent</i>	Y	Y
	<i>Compressible/Incompressible</i>	Y	Y
	<i>Subsonic, Transonic, Supersonic</i>	Y	Y
	<i>Steady State/Transient</i>	Y	Y
	<i>Solidification (freezing)</i>	Y	Y
	<i>Evaporation</i>	Y	N
Heat Transfer Capabilities	<i>Condensation</i>	Y	Y
	<i>Conduction</i>	Y	Y
	<i>Forced/Natural Convection</i>	Y	Y
	<i>Conjugate</i>	Y	Y
	<i>Radiation</i>	Y	Y
Electronics Design Capabilities	<i>Solar</i>	Y	Y
	<i>PCB Characterizer</i>	N	N
	<i>Compact Thermal Models</i>	N	Y
	<i>Thermostat-controlled Fans</i>	N	Y
Motion Capabilities	<i>Thermoelectric Coolers</i>	N	Y
	<i>Motion-Driven Flow</i>	Y	N
	<i>Flow-Driven Motion</i>	Y	N
	<i>Free Motion with Collision Detection</i>	N	N
	<i>Rotating / Turbomachinery</i>	Y	Y
	<i>Translating</i>	Y	N
	<i>Orbital</i>	Y	N

Y - features available, N - features unavailable

V. CONCLUSION

The names and the data of the observed CFD packages, that are taken into consideration in this comparison analysis have been presented in Table I and II. In some cases one company has a few codes for modelling flow and thermal problems. It is especially true with ANSYS which offers a broad range of products suited for various applications. Some of them are fully-fledged CFD packages (CFX, Fluent) while other ones are more general-purpose but offer transient heat transfer as one of the options.

The numerical method employed by the developers of packages is either FEM method or FVM. It is believed that FVM method is superior to FEM in all those applications where flows play an important role. For example, Fluent software, a FVM package, is generally recommended for flow problems by Fluent representatives. Nevertheless, there are advanced FEM-based packages that have been successfully employed in flow problems (ADINA, Abaqus, ALGOR, or Marc).

The phase change models employed in the reviewed software are based either on enthalpy or latent heat. The latent heat approach, although popular, requires caution with implementation, and especially time integration

algorithms. This is due to the spike-shaped temperature/specific heat function. The enthalpy-based phase change models evaluate the effective specific heat directly from the enthalpy, and thus avoid using specific heat function with a latent heat jump.

The overall majority of the packages allow reading external files with data on mesh, initial and boundary conditions, which makes them good candidates for being used in the coupled system. Those that do not offer one of those features could be still applied, but it would require an extensive help from a humane operator making the simulation more difficult.

In this paper we have reviewed features of several CFD packages that are mostly used nowadays both in industrial and academic research. The goal of this comparison was not to reveal a winner, but to gather the data on various codes, and show possible choices. The main goal of this paper is to be used as a guide to help end-users in their vendor selection process.

Based on all above mentioned in this paper it can be concluded that the choice of CFD software packages depends on the needs of the user and the observed problem. One of the key factor of successful usage of CFD software solutions is also the financial resources.

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On The Performance of Scalable Video Coding in P2P Live Video Streaming

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Abstract - The two basic concepts of scalable video coding that are widely used in P2P video streaming are: layered video coding (LVC) and multiple description coding (MDC). With the LVC coding, the video stream is divided in several sub-streams (layers), out of which the first one is the base layer, and all other layers are enhancement layers. The base layer can be decoded independently, while decoding each enhancement layer requires its predecessor layer. MDC coding splits the video stream in several sub-streams (descriptions), where each description can be independently decoded, for the price of a certain coding overhead. The main idea of both techniques is to split the video stream and distribute it over multiple network paths, in order to ensure that at least one sub-stream is received error-free. In this paper, a discrete event simulation model that compares the performance of LVC and MDC coding schemes is developed. The model assumes mesh-based P2P live video streaming system using network path diversity for each of the generated sub-streams. The results obtained imply that MDC exhibits better performance compared to LVC under the same network conditions, but only to a point of 5% introduced coding overhead. When both these techniques are compared to a single description (SD) coding, it appears that SD technique offers better performance than the other two scalable coding techniques, but the downside of SD is that the service degradation is not that graceful compared to MDC or LVC.

I. INTRODUCTION

P2P live video streaming is an intriguing paradigm that has been in active development for almost two decades. Since its beginnings in the mid 90^s, large number of techniques and a variety of different approaches were implemented to improve the quality of the offered services. In this manner, two distinctive video coding techniques that are continuously used in such error prone systems are Layered Video Coding (LVC) and Multiple Description Coding (MDC), and represent specific implementations of a scalable video coding technique. In both these concepts, the video stream is split and coded into several sub-streams, which are usually sent through different paths in the P2P network. Each sub-stream contributes to one or more quality characteristics of the video content in terms of temporal, spatial and/or SNR/quality scalability. The multiple path network routing is the main reason for the stream division, because otherwise it would not be of greater use since it would not make much difference whether there is only one or more streams if the data travels through a single network path.

LVC technique divides the video stream in several sub-streams (layers). The first layer is the base layer and all other layers are enhancement layers. The base layer can be decoded independently of the presence of other layers and represents an essential level of quality. Decoding any other layer requires presence of its predecessor layer, i.e. the first enhancement layer requires the base layer, the second enhancement layer requires the first enhancement layer, and so on. The requisite of the base layer forms a very critical part of the scalable video representation which makes the systems that use LVC vulnerable to disruptions since they possess rather single point of failure. LVC technique was used at the very beginnings of P2P live video streaming, when in 1996, S. McCanne et al. [1] presented a P2P video streaming model with tree network structure that implements LVC coding technique. Even though LVC implementation dates at the appearance of P2P streaming systems, it gained higher popularity much later, thus in recent years a lot of P2P streaming protocols, such as [2, 3] use LVC and report substantial results.

MDC, on the other hand, splits the video stream in several description that can be independently decoded. In this case any description is sufficient to play the video, and any additionally received descriptions contributes to the video quality enhancement. In recent years many P2P streaming protocols, such as [4,-6], implement MDC.

If a brief comparison of the two scalable coding schemes is performed, their strengths and weaknesses can easily be inferred. The main advantage of MDC over LVC is that each description can be independently decoded, and the main advantage of LVC is that no coding overhead is produced, that is not the case with the MDC technique.

The research of J. Chakareski et al. [7] deals with performance evaluation of specific implementations of MDC and LVC for video streaming over error-prone packet switched networks. The comparison is performed using different transmission schemes and packet scheduling algorithms, and the main conclusions show that LVC performs better when rate-distortion optimized packet scheduling is implemented. There are several other research articles that deal with comparison of LVC and MDC, such as [8,-11], but none of them explores the stochastic aspect of the transmitted sub-streams considering the different nature of LVC and MDC as well as the introduced coding overhead when MDC is employed.

Regarding the MDC overhead, F. Fitzek et al. [12] have experimentally confirmed that the MDC offers solid improvement of video transfer over best effort networks, compared to a single description coded video, but that improvement comes with the price of generated coding overhead that generally depends on the number of generated descriptions as well as the complexity of the video content itself.

In this research we assume that each video sub-stream is sent over different network path, and we take on somewhat different approach compared to other researches that deal with performance comparisons of MDC and LVC coding schemes. Referring to the fore mentioned main strengths and weaknesses of LVC and MDC, there is a specific hypothesis suggesting that if no coding overhead was produced, MDC should perform better than LVC, since any single description is sufficient to play the video representation. Thus, we analyze the performance of both scalable video coding techniques from a pure probabilistic point of view, regardless of the network conditions and packet scheduling schemes. We also investigate the upper limit of MDC coding overhead that would still enable the MDC to perform better or at least equally to the LVC technique, if our forementioned hypothesis is correct.

II. THE DISCRETE-EVENT SIMULATION MODEL

In this section we present the Discrete-Event Simulation (DES) model for performance evaluation of LVC and MDC techniques, and briefly discuss the input parameters used in the simulations.

The considered P2P live video steaming system adopts mesh network topology where the users are organized in certain groups, and each group member communicates with all his neighbors exchanging video chunks. Since the users need to receive multiple sub-streams over different network paths, each of them becomes a member of as many groups as there are video sub-streams. Hence, the user dedicates his Upload Bandwidth (UB) equally to all the groups he has joined. In our previous research [13] we have determined the optimal range of average group sizes, thus in this research we apply an average group size of 60 peers, for each group of peers. The accounted network is asymmetric where peers have infinite download bandwidths. Concerning the peers' UB we implement UB heterogeneity defined by uniform probability distribution in the range from 100 kbps to 1000 kbps. On the basis of the research of K. Sripanidkulchai et al. [14], where it is experimentally confirmed that the arrival of new peers in P2P streaming systems follows an exponential probability distribution, we define peer arrival as a stochastic process with exponentially distributed inter-arrival times ($1/\lambda$), where λ represents the arrival rate. Further more, the research of Z. Ou et al. [15] provides strong arguments that justify the use of exponential distribution for the peer viewing (sojourn) times as well. Even-though in [14] the experiments have shown that peer viewing times follow heavy-tailed probability distribution, the research in [15] confirmed that the use of exponential, Pareto and Weibull distributions for sojourn times in P2P streaming systems exhibit little to no differences at all. Because the exponential probability distribution is the only continuous

distribution that has the property of no memory, which characterized many natural phenomena, it emerges as the best choice for representing the peer sojourn times. Since the peer arrival and departure follow an exponential distribution, the number of peers that are concurrently present in a single group has a Poisson probability distribution. This defines the peer churn (the joining and leaving of peers) in a single group as a Poisson process.

We imagine the system from a viewpoint of a single peer who, when joining the system, actually joins 3 groups of peers (one group for each video layer/description), since we have defined the video stream division into 3 sub-streams. Each peer group is independent of the other two and different peers join in these 3 groups (except the single user that we base our evaluation on). This way the concept of the sub-streams transmission over multiple paths is preserved.

In this manner, the system is modeled as a Queueing Network (QN) with 3 independent sub-QNs, each having exponentially distributed arrival and service rates and infinite number of servers.

Fig. 1. presents the DES (QN) model of the P2P video streaming system, from a viewpoint of a single user.

- λ_1 – Arrival rate of peers joining group 1
- λ_2 – Arrival rate of peers joining group 2
- λ_3 – Arrival rate of peers joining group 3
- μ_1 – Service rate of peers in group 1
- μ_2 – Service rate of peers in group 2
- μ_3 – Service rate of peers in group 3
- G_1 – Group 1 (distributing sub-stream 1)
- G_2 – Group 2 (distributing sub-stream 2)
- G_3 – Group 3 (distributing sub-stream 3)

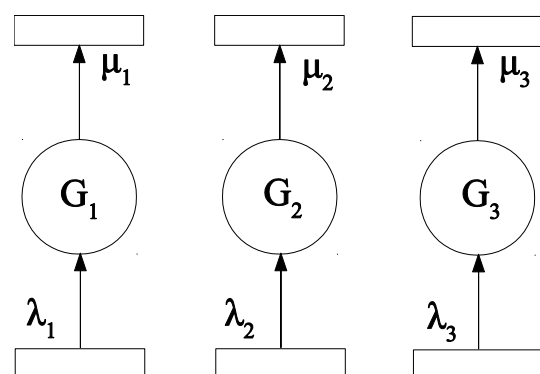


Figure 1. The DES model

For such a scenario, the fluid function “ φ ” defined by R. Kumar et al. [16] describes the maximum achievable rate that can be streamed to any peer in a certain group at a given time, and in this particular case is given by:

$$\varphi_i = \frac{G_{iUB}}{\#G_i} \quad (1)$$

where:

G_{iUB} – The sum of the UB of all peers in group i
 $\#G_i$ – the number of peers in group i

The performance evaluations reside on the basis of the Probability for Degraded Service (PDS) of the video sub-stream distribution. PDS occurs every time when φ_i drops below the value of sub-stream rate, i.e. when:

$$\varphi_i < V_{SR}$$

where:

V_{SR} – The rate of the sub-stream, which is equal to one third of the video rate ($V_R/3$).

More specifically, the first performance evaluations are performed on a probability to completely receive 2 out of 3 sub-streams. Clearly, these probabilities are Boolean expressions, described in the following lines:

PDS for 2 out of 3 sub-streams	
LVC	$\varphi_1 \geq V_{SR}$ and $\varphi_2 \geq V_{SR}$ $\varphi_1 \geq V_{SR}$ and $\varphi_2 \geq V_{SR}$ or $\varphi_1 \geq V_{SR}$ and $\varphi_3 \geq V_{SR}$ or $\varphi_2 \geq V_{SR}$ and $\varphi_3 \geq V_{SR}$
MDC	$\varphi_1 \geq V_{SR}$ and $\varphi_3 \geq V_{SR}$ or $\varphi_2 \geq V_{SR}$ and $\varphi_3 \geq V_{SR}$

In the second performance evaluations the probabilities to fully receive 3 out of 3 sub-streams, for both video coding techniques, are compared to the PDS of a Single Description (SD) video stream.

The solution to our model is provided via discrete event simulations (DES), which are performed using SimPy [17]. SimPy DES package based on standard Python programming language [18]. It is an object-oriented, process-based DES language that provides the modeler with simulation components including “Processes” for active components like customers, messages and vehicles, and “Resources” for passive components that form limited capacity congestion points like servers, checkout counters and tunnels. It also provides monitor variables to aid in gathering statistics. Random variables are provided by the standard Python random module.

III. PERFORMANCE RESULTS AND ANALYSIS

In this part we present the results of the performed analyses from which rather interesting conclusions can be obtained. Namely, the chart presented in Fig. 2 plots the probability for degraded service for a P2P video streaming system that receives at least 2 out of 3 video sub-streams. Clearly, as expected, MDC offers best performance, but only if the coding overhead is zero, which is never a case in the reality. Comparable performance of MDC technique, compared to LVC, can be expected if the MDC

coding overhead is kept under 5%. For all other percentages of coding overhead higher than 5%, MDC performance degrades gradually.

The results shown in Fig. 3 present performance comparison between single description video coding, on one side, and LVC and MDC techniques for 3 out of 3 received video sub-streams, on the other. As can be seen in the charts, single description video coding offers better performance than the other two techniques for scalable video coding, and the only difference in quality is the more graceful service degradation that scalable video coding offers compared to single description coding. This conclusion strongly supports our proposal, given in [13], that the use of compression throttled scalability and a single description video should be better explored. Namely, video scalability comes in three different concepts. Spatial scalability concept bases on video stream division in several sub-streams where each sub-stream adds to the video resolution. Temporal scalability extracts different frames of the basic video stream and packs each sub-stream with fewer frames per second, depending on the number of sub-streams.

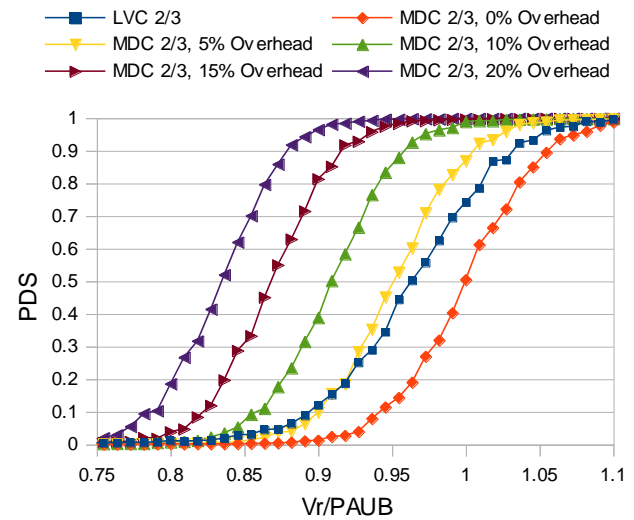


Figure 2. LVC vs MDC performance comparison for 2 out of 3 received video sub-streams

Last but not least, video scalability concept is the concept of SNR (Signal to Noise Ratio)/Quality scalability. This type of video coding regulates the compression intensity of the single description video stream, and hence it produces a single video stream with variable quality. If feedback information about the P2P network conditions is employed, it can easily be used for careful tuning of the compression intensity each and every time a change in the system occurs.

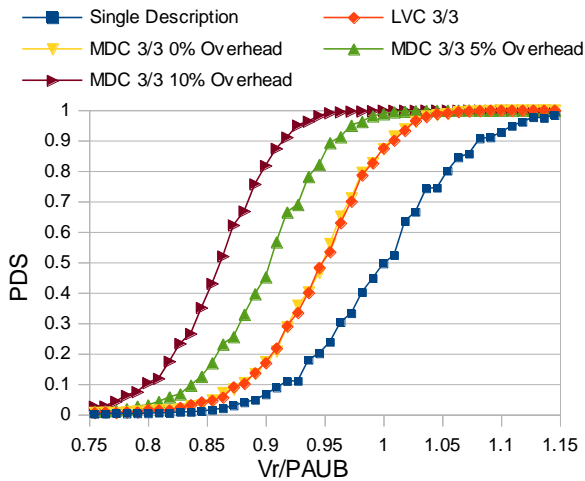


Figure 3. SD vs LVC vs MDC performance comparison for 3 out of 3 received video sub-streams

IV. CONCLUSION

In this research we have evaluated the performance of LVC and MDC techniques for use in P2P video streaming networks, where the separate sub-streams are sent over different network paths. We have also evaluated the performance of these types of scalable video coding techniques against single description video coding. These analyses concentrate on the probabilistic nature of sending multiple streams over multiple paths transmission, which plays an important role for the quality of offered services. The main conclusions imply that MDC technique performs better than LVC, but only to the point of 5% introduced coding overhead. Increasing the overhead (regardless of the nature for its generation, such as the number of sub-streams or the video scene complexity) induces fallback of the MDC performance behind LVC technique. When both techniques (MDC and LVC) are compared to a single description video coding it appears that SD technique offers better performance than the other two scalable coding techniques, but the downside of SD is that the service degradation is not that graceful as when scalable video coding is used.

As mentioned previously, our future research will be concentrated on the exploration of our proposal to implement a SNR/quality scalability to a single description coding and compare its performance to the other scalable video coding techniques implemented in the field of P2P live video streaming networks.

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Improving Performances of e-Commerce Systems by Vertical Scaling

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Abstract - As e-Commerce goes mainstream, the workload posed to e-Commerce Web sites increases continually on a daily basis. In order to maintain high QoS levels and keep pace with ever increasing service demands, e-Commerce systems have to be designed in a scalable manner. Within the paper, we present the results obtained by discrete-event simulations regarding the appliance of a vertical scaling technique on a generic e-Commerce system.

I. INTRODUCTION

The contemporary ways of doing business via Internet impose an immense pressure on e-Commerce Web site’s management teams to ensure high QoS levels of Web services being delivered to e-Customers. These include excellent performances and high dependability (i.e. reliability and availability) of e-Commerce hardware infrastructure. This is crucial, since big response times and/or frequent and unplanned downtimes always convert to significant financial losses. E-Customers have high expectations for the user experience when buying online and have little patience for poor performances, low responsiveness or frequent downtimes, especially during critical time periods like Black Friday or Cyber Monday, when online shopping bursts.

In order to achieve and continually retain high QoS levels, predictive models have to be built and evaluated on a regular basis, as a constituent part of the capacity planning procedure [1]. In general, by assessing relevant performability metrics, one can predict the behavior of the whole system as a function of the future workload levels, which, in turn, proved to be both highly dynamic and stochastic by nature. As the workload intensity grows on a daily basis, the hardware infrastructure is facing the necessity to scale in an appropriate manner, in order to keep pace with the ever increasing service demands.

II. SCALING E-COMMERCE WEB SITE

Generally, scalability can be defined as “the ease with which a system or component can be modified to fit the problem area” [4]. A scalable system has three main characteristics, including the following ones: (i) The system can accommodate an increased usage; (ii) The system can accommodate an increased data set; (iii) The system is maintainable and performs with reasonable performances.

In context of the e-Commerce paradigm, scalability is a characteristic of a system that describes its capability to cope with or perform under an increased or expanding workload. An e-Commerce system that scales well is able to maintain or even increase its level of performance or efficiency when exposed to larger service demands. The enhanced scalability means an ability to address and handle larger volumes of content.

In spite of the fact that the notions of performance and scalability differ from each other, they are mutually correlated, i.e. performances measure how fast and efficiently a given system can accomplish certain computing tasks, whilst scalability measures the trend of performances with an increasing workload. So, scalability refers to a system’s ability to give reasonable performance under growing demands (rising traffic or increased data volume). Scalability can be achieved both on the software and hardware level.

Deploying scalable e-Commerce Web site’s hardware infrastructure is ‘a must’ for Internet companies which opt to run business successfully. In fact, scalability is the key business issue that refers to the Web site’s ability to increase its size as service demand grows [10,12]. Some authors suggest that the hardware must be able to support easily the highest anticipated traffic, as well as 6-12 months of anticipated growth [2].

According to [3], scalability is the most significant advantage of the client/server (C/S) paradigm the Internet relies on. C/S architectures can be scaled either horizontally, or vertically, or diagonally (both) [11].

The need to address scalability issues of e-Commerce Web sites through scientifically based methodologies and research has increased during the last 15 years [17-23].

III. VERTICAL SCALING

Within the paper we have put focus on vertical scaling of e-Commerce system’s hardware resources. To ‘scale vertically’ or to ‘scale up’ means to add additional, or to upgrade the existing hardware resources (e.g. CPUs, HDDs, or RAM) of a single node in the system, in order to extend its processing capability by increasing its individual power. It means resource maximization of an existing unit(s) within a given system. Vertical scalability (VS) enables the existing system to use the virtualization technology more effectively, as it provides more resources

for the hosted set of operating system and application modules to be shared.

In the context of e-Commerce systems, VS means migration of servers to larger and faster ones, with a minimal impact on the C/S architecture, i.e. there are no major architectural redesigns. This technique assures good maintainability, since there is no increase of the number of deployed servers. In addition, there is no need to make any software-related changes. However, this approach is expensive, since the whole e-Commerce Web site becomes dependent on one (or few) powerful servers. Besides, there is a need of an extra downtime for upgrades to be carried out, whilst capacity has to be increased in large ‘chunks’. The addition of hardware resources results in diminishing returns instead of super-linear scale. The cost of expansion increases exponentially. In addition, if all of the e-Commerce Web services and data reside on a single machine which has been scaled up, it still does not guarantee high availability.

IV. A MODEL OF A TWO-TIER E-COMMERCE WEB SITE

What we are interested in within this paper is a typical 2-tiered medium-to-large e-Commerce system that hosts a Business-to-Consumer (B2C) e-Commerce Web site (Fig. 1). It consists of a single Web server (WS), an Application server (ApS), an Authentication Server (AuS), an e-Mail Server (MS), a Database server (DbS), as well as a Payment Server (PS), residing on two high-speed LAN segments.

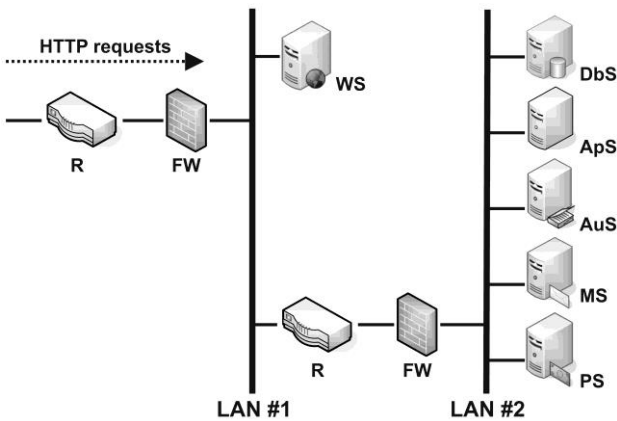


Figure 1. A schematic representation of a typical 2-tiered B2C e-Commerce Web site

Servers are dedicated to handle particular service functions. Each specific HTTP request, corresponding to a single specific e-Commerce function being invoked by an e-Customer (e.g. Login/Register, Search, Add-to-Cart ...), has being forwarded from the e-Customer’s browser towards the e-Commerce system via Internet. The processing of each of HTTP request usually involves multiple visits to various back-end servers before completing. Moreover, a single HTTP request may have to be processed more than once by a particular back-end server. Such an interaction can be depicted graphically and most properly by means of Client/Server Interaction Diagrams (CSIDs) [10]. For simplicity reasons, we have assumed that an e-Customer can invoke the basic seven e-Commerce functions, including: Login, Register, Search,

Browse, Add-to-Cart, Pay, and Logout. Fig. 2 (a-d) shows the CSIDs for each of the previously mentioned e-Commerce functions. Since modeling of the e-Commerce system has been done on a system level, rather than on a particular component level, Table 1 shows the stochastic parameters of the time needed to process a single HTTP request by a different server.

In addition, the messages’ transmission delays in LAN segments during inter-server communication, as well as LANs’ bandwidths and round-trip times (RTTs) have been neglected due to the usage of high-speed LAN segments, as well as propagation times in routers and firewalls. This is the reason why interactions among nodes in CSIDs (Fig. 2) include only the probability to reference a particular server by sending a message, and do not include the message size, as originally proposed. The processing time has been drawn from a Normal distribution $N(\mu; \sigma)$.

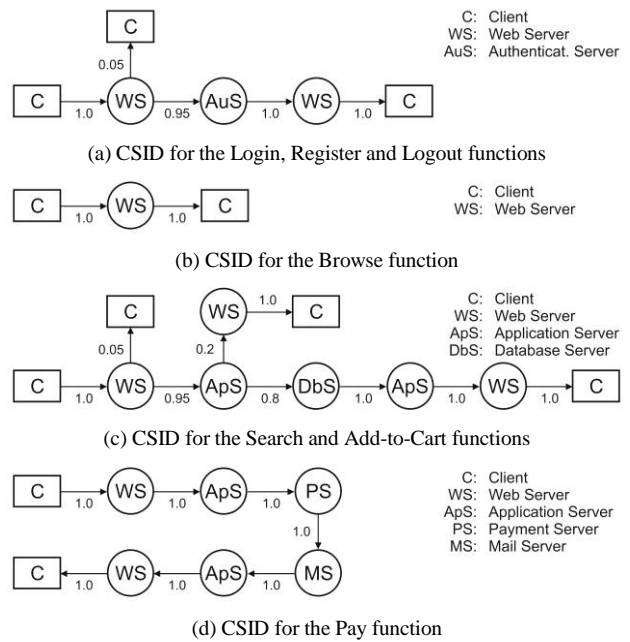


Figure 2. CSIDs for the seven most common e-Commerce functions (based on [10])

TABLE I. STOCHASTIC PARAMETERS OF A SINGLE HTTP REQUEST’S PROCESSING TIME BY VARIOUS SERVERS

Server	μ [ms]	σ [ms]	Range $\mu \pm 3\sigma$ [ms]
Web Server (WS)	15.00	0.50000	[13.5 ~ 16.5]
Application Server (ApS)	10.00	0.33333	[9.0 ~ 11.0]
Authentication Server (AuS)	10.00	0.33333	[9.0 ~ 11.0]
e-Mail Server (MS)	5.00	0.16666	[4.5 ~ 5.5]
Database Server (DbS)	10.00	0.33333	[9.0 ~ 11.0]
Payment Server (PS)	20.00	0.66666	[18.0 ~ 22.0]

We want to investigate how the vertical scaling technique, being applied on one of the servers, will affect the overall system’s behavior and operation, by running a

series of computer simulations. The basic idea is to assess the functional dependency of both the end-to-end response time and system throughput from the HTTP requests' arrival rate, for different scaling factors.

V. SCALING VERTICALLY THE WEB SERVER

In practice, scaling, be it either vertical, horizontal or both, has been usually applied on component(s) that slow down the whole system due to overloading, known as bottleneck(s). However, finding performance bottlenecks in an e-Commerce system is increasingly becoming one of the most critical aspects and most daunting tasks of any performance analysis and tuning procedure. So far, various studies have shown that different components can become bottlenecks, depending on specific circumstances and configurations, both software- and hardware-related. For instance, crestechglobal.com [6] have announced that in 38% of all cases, the Application server (ApS) has been identified as a bottleneck, whilst in 24% the Web server (WS) has been recognized as the main contributor to e-Commerce Web site's poor performances. Previously, the Web server (WS) has also been identified as being a bottleneck in a hardware configuration almost identical to that one depicted on Fig. 1, by using discrete-event simulation approach [5]. The database server (DbS) and the storage system have been identified as a bottleneck in [16]. No matter which subsystem is a bottleneck, some of the most usual symptoms of an overloaded e-Commerce system are the following ones: long response times, multiple errors returned to e-Customers (e.g. HTTP 500, 502, 503, and 504 errors), as well as refused or reset connections before any content is delivered to the client [2]. Identifying the bottlenecks within a given system and the exact conditions (workload characterization, system architecture, resource specifications, e-Customer arrival rates) under which they occur can lead towards better system provisioning, resource allocation, and QoS [16].

In this research we have supposed that the Web server (WS) is the bottleneck in the system, a subsystem that has to be scaled up. For simplicity reasons, we assume that VS has been accomplished by successive doubling of the number of CPUs being installed within the standalone Web server. Therefore, we investigate the cases when the WS has got double (2), quadruple (4), octuple (8) and sexdecuple (16) identical CPUs, working in parallel.

However, in theory, the maximum speedup gained by adding extra CPUs has been estimated by Amdahl's Law [7]. Let N be the total number of parallel processors in use, s - the fraction of time spent on executing serial parts of a program, and p - the fraction of time spent on executing code in parallel, for a single serial CPU. According to the Amdahl's Law, the maximum theoretical speedup is given by Eq. (1). Namely, the speedup of a program using multiple CPUs working in parallel is limited by the time needed for the execution of the sequential fraction of the program, s , given by $1/s$. In other words, even when the fraction of serial work is relatively small, say s , the maximum speedup obtainable from even an infinite number of parallel CPUs is only $1/s$ (Fig. 3).

$$\text{Speedup} = \frac{1}{s + \frac{p}{N}}, \text{ where } s + p = 1. \quad (1)$$

Despite many differing studies and reevaluations that challenge the interpretation of the Amdahl's Law [8,9], we will take advantage of it to determine the stochastic parameters of the time needed for processing a single HTTP request for the scaled Web server including variable number of CPUs. If the processing time of a single HTTP request in a single-CPU Web server follows the Normal distribution $N(\mu = 15 \text{ [ms]}; \sigma = 0.5 \text{ [ms]})$, then, using the expression (1), one can speculate the speedup and the processing time when multiple processors are being used in parallel. For $s = 5\%$ ($p = 95\%$), the stochastic parameters for the Web server are given in Table 2. Nonetheless, one should expect much lower value for the variable p (much higher one for the variable s) in practice.

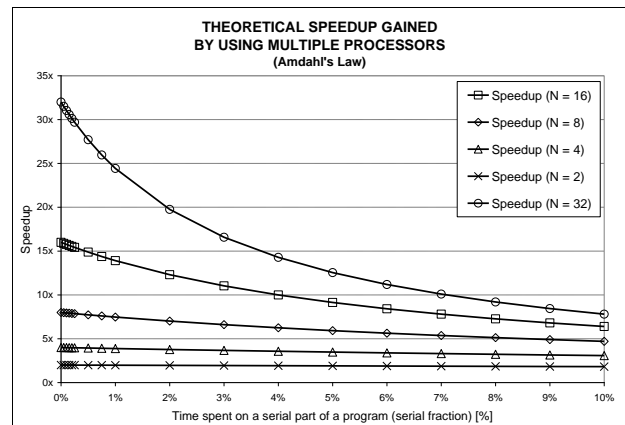


Figure 3. The speedup gained according to Amdahl's Law, as a function of the number of CPUs working in parallel, for different values of the serial fraction, s , $0\% \leq s \leq 10\%$

The parameters of the Normal distribution describing the HTTP requests' processing time have been chosen so it can fluctuate up to $\pm 10\%$ from its average value, which means that 99.97% of the values will fall within the interval of $\mu \pm 3\sigma$ [ms].

TABLE II. A SINGLE HTTP REQUEST'S PROCESSING TIME OF A VERTICALLY SCALED WEB SERVER, DEPENDING ON THE NUMBER OF PARALLEL PROCESSORS, N , GIVEN $s = 5\%$, $p = 95\%$

N	Speedup	μ [ms]	σ [ms]
1	1.00	15.00000	0.50000
2	1.90	7.89474	0.26316
4	3.48	4.31034	0.14368
8	5.93	2.52951	0.08432
16	9.14	1.64114	0.05470
32	12.55	1.19522	0.03984

VI. THE SIMULATION MODEL

The assessment of the performance gains with a vertically scaled Web server has been carried out using discrete-event simulation (DES) approach. Previously, simulation modeling to predict scalability of an e-Commerce Web site has been utilized in [17]. Our simulation model has been built in SimPy/Python. SimPy (an acronym from ‘Simulation in Python’) is an open-sourced, extensible, object-oriented, process-based, general-purpose discrete-event simulation programming language, based on the standard Python [13-15].

The monolithic simulation model is robust enough to encompass all important aspects of the e-Commerce paradigm, including:

- The server-side, i.e. the hardware configuration of a typical e-Commerce Web site, on a system level, as depicted on Fig. 1; since HTTP requests are being processed by a particular server in a FIFO (FCFS) manner, each of the servers has been modeled as a resource with an infinite queue length;
- The workload characterization, covering two aspects:
 - The workload intensity (the quantitative component), i.e. the generation of HTTP requests as a Poisson process, with an overall arrival rate λ , ranging from 0.0 to 30.0 [requests/s]; the inter-arrival times of a Poisson process comprise an independent and identically distributed (i.i.d.) random variable, exponentially distributed;
 - The workload specification (the qualitative component), i.e. the generation of different HTTP requests’ types, corresponding to the six, previously identified e-Commerce functions being invoked by the e-Customers during online sessions, in a proportion specified by a given operating profile; the operating profile is defined as a row-vector whose elements represent the HTTP request types’ probabilities to participate within the global workload mix;
- The propagation delays of HTTP requests being forwarded from clients’ browser towards e-Commerce servers and the delays of the corresponding responses, via Internet; the propagation time (transmission delay) via Internet WANs has been modeled as a random variable with a Normal distribution and parameters $N(\mu = 0.5 \text{ [s]}; \sigma = 0.13333 \text{ [s]})$, which yields 99.73% of the values within the interval $[0.1, \dots, 0.9] \text{ [s]}$.

VII. SIMULATION RESULTS

The simulation results have been obtained for HTTP arrival rates within the range $1 \leq \lambda \leq 20 \text{ [s}^{-1}\text{]}$, with a step of 1. For each single step, a time period of 2 [h] has been simulated. Several performance metrics have been assessed, including the end-to-end response time [s], the throughput of the Web server [HTTP requests/s], as well

as the Web server’s utilization [%], the service demand [ms/HTTP request], and the maximum queue length. The test operating profile is $[0.07; 0.03; 0.40; 0.20; 0.05; 0.15; 0.10]$ for the Login, Register, Search, Browse, Add-to-Cart, Pay and Logout HTTP requests’ types, respectively.

Fig. 4 depicts the average end-to-end response time as being a function of the arrival rate and the number of CPUs installed in the Web server. The functional dependency in both dimensions is non-linear; however, the shortening of the end-to-end response time is not proportional with the CPU speedup, at any arrival rate (Fig. 5).

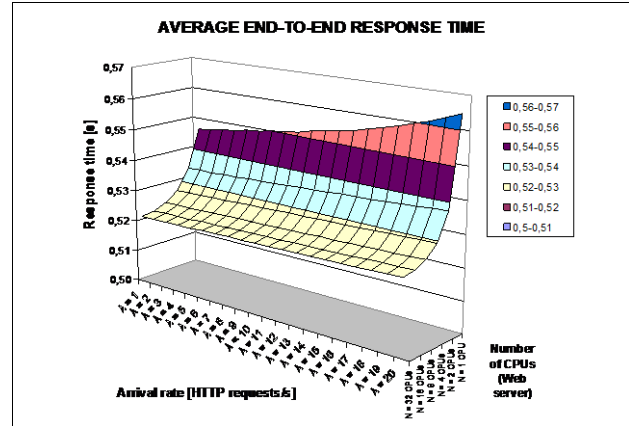


Figure 4. The average overall end-to-end response time [s], by various arrival rates [HTTP requests/s] and number of CPUs installed in the Web server

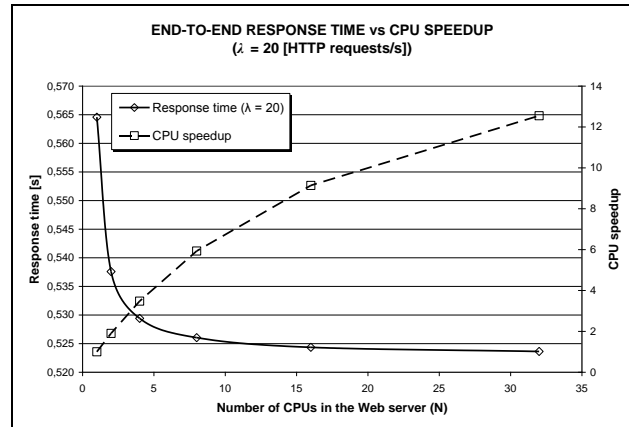


Figure 5. End-to-end response time versus CPU speedup, at a fixed arrival rate of $\lambda = 20 \text{ [HTTP requests/s]}$

A server’s throughput is the ratio between the total number of HTTP requests being processed by the server and the total observation time. The simulations have shown that it does not depend on the number of CPUs installed in the Web server (Fig. 6). It is rather a linear function of the arrival rate, which can be computed and specified in an analog form. For instance, the linear function, describing the Web server’s throughput, has been given by the equation $y = 1.7661 \cdot x + 0.0161$, where y is the server’s throughput, and x represents the arrival rate. Equivalent expressions can be derived for all other servers’ throughput functions.

However, the utilization of the Web server depends heavily on the number of CPUs being used (Fig. 7). The other servers' utilization values have not been affected by the number of CPUs installed in the Web server. A server's utilization is a product of the server's average service demand and the server's throughput.

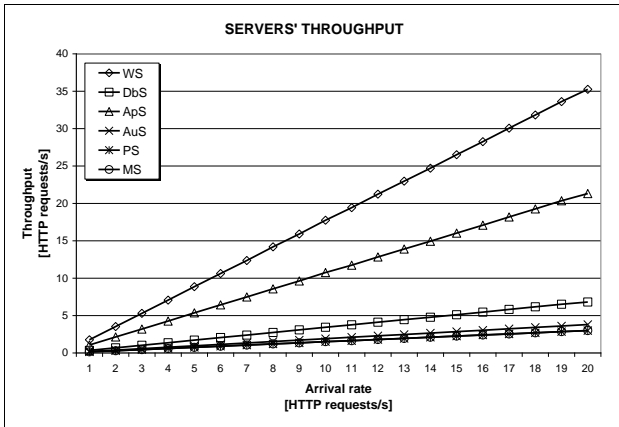


Figure 6. Servers' throughput, for various arrival rates

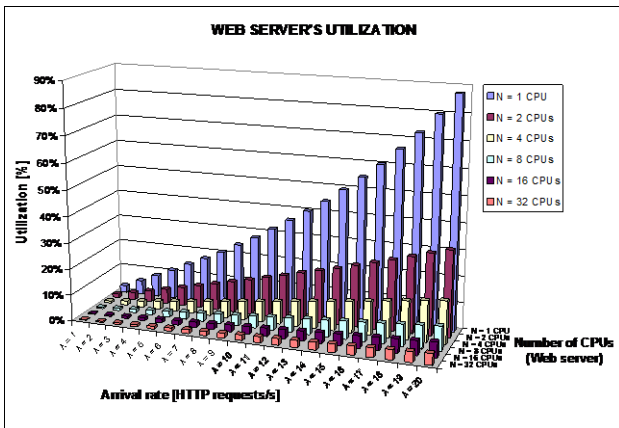


Figure 7. The utilization of the Web server, by various arrival rates and number of CPUs installed in the Web server

The average service demand has been assessed, too. Fig. 8 shows that the average service demand depends on the HTTP requests' arrival rate in a non-linear fashion, which is more evident at higher arrival rates.

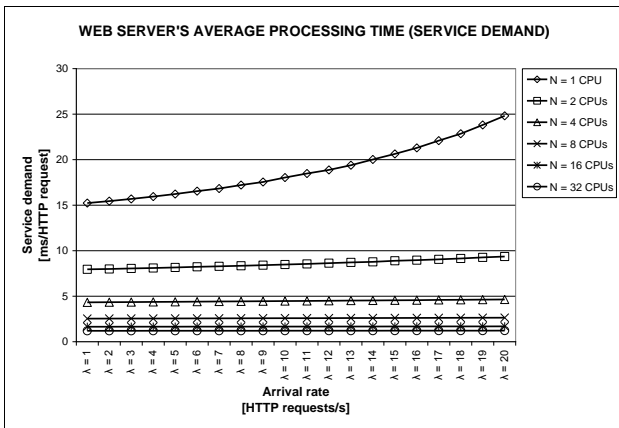


Figure 8. Web server's average service demand, by various arrival rates

As it represents the total time (a sum of both the waiting time in the server's queue and the processing time), spent by a HTTP request at each server, it can be evaluated either by measuring during simulations, or as a ratio between the server's utilization and the server's throughput.

However, as the whole system becomes more scalable by adding additional CPUs in the Web server, the maximum service demand at a given arrival rate can be reached by a different server. This is crucial, since the maximum throughput of the whole system is determined by the component or sub-system that is a bottleneck, i.e. the one with the maximum service demand. For instance, in the basic configuration (Web server with 1 CPU), the Payment server (PS) has got the maximum service demand for $1 \leq \lambda \leq 15$, whilst the Web server (WS) becomes a bottleneck for $\lambda \geq 16$. As the number of CPUs installed in the Web server grows, the Payment server continues to represent the single bottleneck in the whole system, for any arrival rate λ . So, after scaling up the Web server by adding 2 CPUs, the Payment server should be scaled up next in order to decrease its service demand.

In addition, the effects of scalability can be detected even if one considers the minimum service demand, i.e. the Mail server (MS) exhibits the minimum service demand when the number of CPUs in the Web server is $N = 1$ and $N = 2$, but the Web server takes over for $N \geq 4$.

The Web server's service demand decreases, as a result of its scaling up. This is a direct consequence of its queue length shortening. As Fig. 9 shows, its maximum queue length drastically decrease as the number of CPUs grows. In other words, scaling up the Web server has shortened the waiting time of HTTP requests in the Web server's queue.

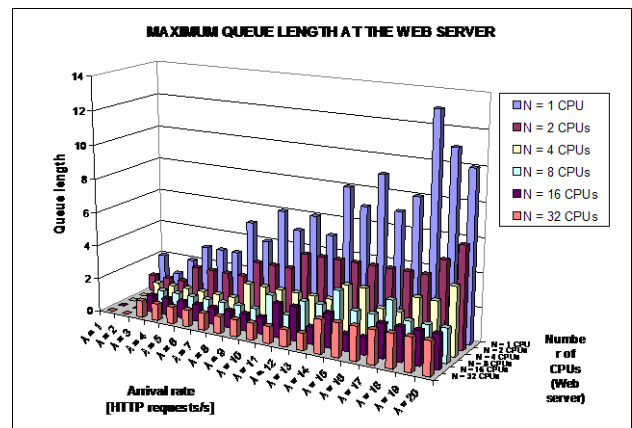


Figure 9. The maximum queue length at the Web server, by various arrival rates and number of CPUs installed in the Web server

Vertical scaling of the Web server has also affected the overall processing times for each HTTP request type. The highest average processing times have been detected with the Pay e-Commerce function across all arrival rate's range (Fig. 10). Fig. 11 illustrates comparatively the average processing times for all e-Commerce functions, for a fixed arrival rate ($\lambda = 20$ [HTTP requests/s]). The Search and Add-to-Cart e-Commerce functions need almost equal amount of processing time, as well as the Register, Login and Logout HTTP requests.

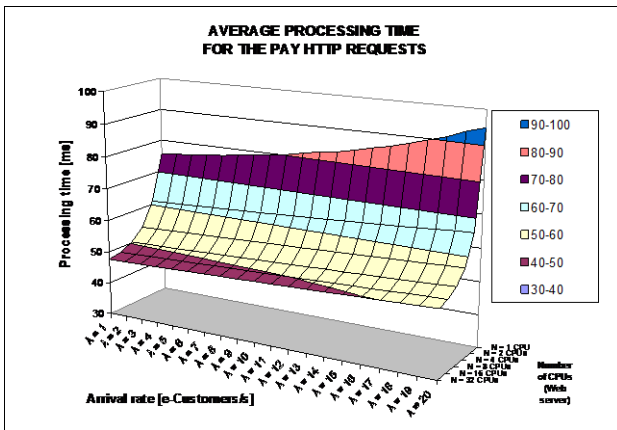


Figure 10. Average processing time for the Pay e-Commerce function

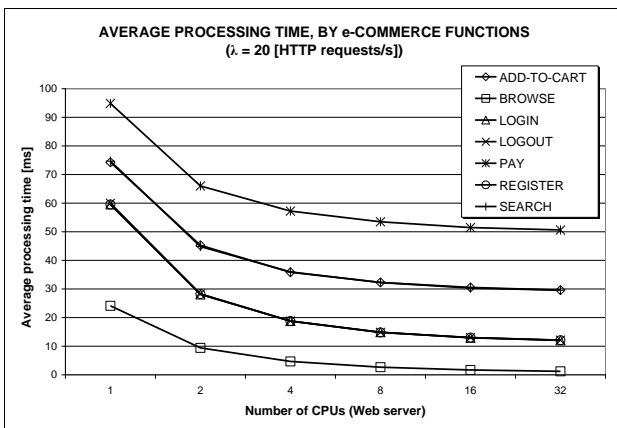


Figure 11. Average processing time, by e-Commerce functions, at a fixed arrival rate of $\lambda = 20$ [HTTP requests/s]

VIII. CONCLUSION

Simulations have shown that the technique of scaling up, being applied on a single server within the e-Commerce system (e.g. the Web server), can significantly increase both its own performances, and those of the overall system. In this particular case, the scaling up has been done by adding extra identical CPUs, under the assumption that the resulting speedup of the server has been acquired according to the Amdahl's Law. However, the biggest gains in all evaluated performance metrics have been evident for $N = 2$ and $N = 4$ CPUs, whilst further doubling of the number of CPUs does not have a significant impact on system's performances.

Regarding the software tools being used for carrying out a discrete-event simulation for performance evaluation, SimPy/Python has proven to be an extremely powerful and a flexible environment for modeling stochastic systems and/or processes like those already present with the contemporary e-Commerce paradigm. Still, the main disadvantage is that DES programming and evaluations are extremely time-consuming activities.

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Conceptual SWOT Analysis on e-Commerce in Terms of Services Marketing

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Abstract – Although both traditional commerce and e-commerce concern the buying and selling of goods and services, e-commerce performs a different way for marketing and purchasing. In real terms, e-commerce is more than a buying process that provides products or services to customer, it represent an experience, a virtual encounter with all that a product or a service means. The e-commerce offer to seller a lot of tools to make the product attractive or to materialize the service, in case of services business. This paper aim to demonstrate the important role and benefits of e-commerce in service business, especially in Services Marketing. For this purpose has been used SWOT analysis applied to e-commerce.

I. INTRODUCTION

Electronic commerce is generally considered to be the sales aspect of e-business. E-business is more than that - involves business processes spanning the entire value chain: electronic purchasing and supply chain management, processing orders electronically, handling customer service, and cooperating with business partners. Electronic business methods enable companies to link their internal and external data processing systems more efficiently and flexibly, to work more closely with suppliers and partners, and to better satisfy the needs and expectations of their customers.

This paper aims to highlight the advantages of selling services in e-commerce system. As is known, the services have a high level of immateriality, so they are difficult to perceive and understand before being delivered, which involves the use many ways of "materialization" of the service concept and those parts of it which are difficult to evaluate by potential customers.

II. METHODS

1. Mix marketing components analysis applied in the virtual environment

In service business, the Mix Marketing has an extremely important role in defining the service product, the service offer, and the sale and/or provision thereof.

The strategic approach of all these components, included direct the customer or service consumer.

Modern selling methods, such as the e-commerce, meet the need for service providers or sellers, to highlight the material elements of the services and materializing the service concepts characterized by high

immateriality, using complex presentation methods. (eg. graphics, text, photographs, audio and video).

Below we present the mix marketing components for services and the advantages of their approach in the context of e-commerce.

The Service Product / Service Offer

Understanding of what service offer means, from both the seller and the consumer perspectives, it is imperative for both the service provider and for its seller. Sasser, Olsen, Wyckoff [1] considered the service concept consists of three elements:

The material service components or the physical items, these are tangible (e.g. support goods, facilitating goods) can be presented in detail through images by service provider or clients, or described in words by the customers have already received the service.

Intangible benefits or sensual benefits - that can be defined by one or more of the five senses, can be evidenced by the accounts of those who had experienced service, in an unbiased manner, as would not be a service seller. This issue can lead to the discovery of new advantages in addition to those already identified at a personal level by the potential client.

Psychological benefits of a services purchased bundle. These are benefits which cannot be clearly defined and are determined by the client subjectively. These individual benefits can also be found to other customers who have already received the benefit of a service, which can describe their experience and the psychological perceptions. Also, by over imaginary, at individual level, the client can develop other potential psychological benefits of desired service.

All these components, which define the service concept, so the offer itself, can be highlighted and explained to potential customers through a predefined way (virtual gallery, virtual tour) or by customers contributing who have already received the service.

For service companies is important to understand the process by which customers evaluate the total service. Sasser et al (1978) suggests that initially customers rate the value of core service based on its ability to meet their current service needs.

There are a number of secondary needs, such as the need to have control, sense of security, confidence, fulfillment, all contained in a number of "visible"

attributes of services. Service providers compete in making offers that meet the client secondary desires, and be better than those of competitors.

The e-commerce system gives companies a tremendous chance to improve its service offer in a very short time, based on the experience of its customers, their suggestions and comments. A customer who has something to say, positive or negative, about the received service, will act more quickly and more freely in the direction of writing a review than to communicate directly with the service provider.

Physical evidence

Intangible nature of services, makes that potential consumers be not able to assess a service before being consumed, increasing the risk inherent in the purchase decision. Therefore, an important aim of marketing activity is to reduce the level of perceived risk, by providing material evidence about the service.

Through e-commerce, service provider or its seller can highlight, without saving space and time (which, in classic trade would impose significant costs: printed advertising materials, presentation spaces, trained personnel etc.) and without fear that first line personnel will make mistakes or omit something, all aspects of the physical environment dimensions of service, together with cognitive, emotional and psychological components.

Through e-commerce, service provider or the seller has the opportunity to apply and get the maximum benefit of Stimulus-Individual-Response model:

- a set of stimulus (different elements / material evidence of service);
- organic component - the individual (the receiver of stimulus from the interaction with the service, which can be both employees and customers);
- set of responses or results (customer response or behavior in response to the action of stimulus).

Personnel

For most services, the staff is the most important part of the product. In services, the human factor is viewed from two perspectives: service company personnel and customers.

The importance of the personnel as part of the services offer, result from their inclusion in it, through three specific ways:

Most of services production processes require that the own service company personnel to have an important contribution to its development, both at the place of service providing and at the activities that are not visible to customers. In many personal service, provider's own staff contribute as the most important component of total service offer.

Many service production processes require the active involvement of clients, so they become co-producers of the service.

People who simultaneously use mass-produced services may affect the benefits they receive from service provision. First, the characteristics of the other service consumers can affect the image of the service. For example, a service provider can build an exclusive image about its customers - people who spend a lot. Secondly, the presence of other customers in the service production process means that the quality of service received by each client is dependent on the performance of other customers. Under this effect they become co-producers of the service. Often, fellow consumers have an important role in improving the quality of services offer, where, for example, a large number of consumers make that the service provision be more attractive to everyone. On other occasions, fellow consumers may negatively contribute to the production of the service.

All these aspects can be highlighted through e-commerce, better than in the case of classic commerce when seller or service provider must "convince" the potential customer of its competence, the ability to meet his needs and to provide a quality service. Through e-commerce, the potential customer may experience the service before being bought, can read about the experiences of those who have already received a service benefit and so can form their own expectations, more real than in classic commerce.

Service price

In service business, consumers are those who give value to service and therefore to the activity itself. The value is a mental appreciation that service users do, assessing the capacity to satisfy their needs and desires.

Buyer's value perception is a rating system between the benefits of the service to be bought and effort required in terms of costs to be incurred.

The total cost to the customer include more than price (financial cost) paid for a service. Other costs included are time consumption, physical energy and mental consumption, which reflects the time and problems that the customer must incur to find and buy a service. Similarly, the total value to the client is extended over the product value and includes service value, personnel value and image value.

Selling service through e-commerce, allows highlighting of all total value components (product value, service value, personnel value and image value) and explain in detail all total cost (financial cost, time cost, energy cost, psychic cost). The potential client can analyze in depth all the price components and can compare them with other service price offers provided by the competition.

Service distribution

By selling, the customer receiving a service. The distribution as a spatial element of service mix marketing, which must ensure accessibility and availability of the service. Even if the one who sell the service is not the same with the one who provide the service, the two conditions (accessibility and availability) must be satisfied.

By e-commerce shall ensure a service reservations and a guarantee of its accomplishment, both for the customer and service provider. This will ensure an efficiency of the service activity, turning the spontaneous nature of the demand into a programmed demand, whose volume is known and according to this may also be ensured and programmed the service production capacity, while respecting the established quality level.

E-commerce, through virtual character of this form of selling, bring the service in front of a theoretically unlimited number of potential customers. So the efficiency of the "physical" distribution may be considered highest.

Publicity

Basically, through e-commerce, seller or service provider may bring before the potential client, at the same time, the messages of almost all communication channels specific to services activity: the service production process channels (first line personnel, service providing result), marketing channels (advertising, sales promotion) services company external channels (oral communication, editorial).

Potential customers can take advantage of these sources of information prior to service provision. E-commerce, by its physical support –the web site, may use a variety of means of presenting information and messages via text, graphics, picture, video and sound.

Process

The service as a process represents the activity itself analogous to material production process [2]. Service¹ process should consider the following:

- Customer role and participation of the process;
- Contact personnel;
- Technical skills: areas and buildings thereon, system, equipment, tools and other resources and facilities, if any;
- System management, coordination, data processing, other staff (those who do not come in direct contact with customers), internal circulation of information, internal networking organize their own company, corporate culture etc.

These components are often difficult to describe or present to prospective client in a first stage of (before service consumption). Through e-commerce, the client can discover alone these issues by attending freely or coordinated the web site content and may even benefit from a virtual experience of the desired service or just selected parts of the service, if such experience is considered useful by service provider.

The scenarios theory suggests that customers have their own scenarios which guide the thinking and behavior while interacting with the service. These scenarios contain a series of sequential actions that consumers follow in interaction with the service.

¹The service delivery system is a marketing concept that describes the process of creating a service. It was developed by P. Eiglier and E. Langeard in 1987 by combining the terms service and production.

Experts believe that these sequential actions or cognitive scripts, help interpret information, to form expectations and forming behavior routines.

By this, the potential customer can better understand the service, its quality and may reduce perceived risk associated with the purchase decision. By understanding the process, the customer becomes more efficient part of the production service process, thus being able to get maximum quality and of the highest level of satisfaction.

2. SWOT analysis on e-commerce in terms of services marketing

Strength of services business through e-commerce

- Services offer can be easily highlighted by all its components and all levels (core service that is or ensure central advantage, secondary service that is both the tangible product and the extended product).
- The service attributes can be more easily perceived by the customer.
- Customers can evaluate the service in a virtual manner, before being provided to them.
- Physical evidence, components of service offer or related to it, will be more easily understood by customers.
- Customers can appreciate and better understand the role of provider personnel and their role in the service provision.
- Customers can have a clearer perception on the total value to customer but also the total cost to customer.
- The service value will be better understood by customers.
- Customers can better understand the elements of accessibility and availability of the service.
- Customers can receive messages from all communication channels within specific service activities (from internal and external services firm).
- The service process and the service experience can be presented to potential customers, which is an advantage both for them and for service providing companies.
- By visiting different websites, potential customers can, within a short time, compare the price and buy services on the best deal.
- 24 hours a day, 7 days in a week service can be buy.
- Financial transaction through electronic fund transfer is very fast and can be done from any part of the world.
- Allows the business to maintain a higher level of consumer communication.
- Reducing the customer costs with service acquisition.

Weaknesses

- Lack of personal contact with the seller or service provider thereof, in the phase of pre-consumption. Therefore, the scope of convincing the customer does not exist.

- Many times, we prefer to buy the service by reaching personally to the market rather than purchasing through Internet.
- The uncertainty on the correctness of service characteristics presentation by service seller or its provider.
- The uncertainty about service reservation.
- The uncertainty about promised service quality.
- The uncertainty about validity of e-mail sand documents, by seller or service provider.
- The uncertainty on on-line payments.

Opportunities

- Clients can compare the price and buy on the best deal.
- Clients can discover new futures of service.
- Clients can discover new needs.
- Allows the service company to sell their services to a global market.
- Increasing the number of potential customers.
- New customer groups and markets can be accessed with less difficulty than before.
- Improved knowledge of real customer needs and desires.
- Increased possibility of service customization.
- Increasing possibilities of demand programming.
- Increase efficiency in the use of service providing capacities.
- Reducing waiting times.
- Personal encounters are substituted by virtual presence, and automated procedures; search engines and self-service information provision directly show the new quality of service provider-client interaction, that reduces the costs and increase the service quality.
- Costs can be reduced by referring to the internet for the investigative parts of service provision.
- Firms can use e-business to access information as an essential input more efficiently than before, they can use internal data management to automate search and conception procedures, and, thus, to standardize services.
- Marketing and administrative costs might become lower.

Threats

- Possibility of discovering better service offers.
- Privacy Concerns - some consumers prefer not to give any personal information out over the Internet because of fears that the information will be misused, lead to spam email or identity fraud.
- Fraud - come clients are leery of doing business online out of concerns of fraud and misuse of their financial data. This alienates an entire segment of the population from conducting business via the Internet

III. FINDINGS

As a result of SWOT analysis we can see many benefits and opportunities offered by the e-commerce in the service selling, compared to the weaknesses and threats identified. What is important is that the benefits

are both for the customers and service providers or sellers.

Considering that the e-commerce is not only the future, it is the now, the service business owners have to take into account the virtual market as a new place of doing business.

This new market is more efficient from all perspectives, providing the opportunity to apply and use new technologies by the new generation of consumers: e-consumers.

IV. CONCLUSIONS

The virtual environment is an excellent place for selling services. The experience before service delivery, that potential client can live, is more intense and complex than the interaction with service company personnel or service seller. This makes the buying decision easier to take, the total value to the customer to increase, and the purchase costs of service to decrease. Under these conditions, customer perception about service value will be positive.

The versatility means of presenting the service and its features, by using all available media tools, makes that the potential customer confidence in the company and in its services to increase, thereby reducing the risk associated with the service purchase decision.

E-commerce is an excellent way to materialize the service concept in the mind of the customer, makes it possible pre-viewing process performance through virtual tours, making to increase the customer's desire to purchase the service.

By e-commerce can be achieve a harmonization between customer expectations and what the service offers, between the expected satisfaction and the service potential to satisfy needs.

More than ever, without physical effort the customer can see and compare services as much as he wants, analyzing offers, features, prices and so on.

On website, any service become worldwide known, so a theoretically unlimited number of potential customers can access the service offer.

E-customer is a reality of now day's economy that includes anything that can be sell!

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Drools Rule Language – A New Approach to Building Business Layers

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Abstract - This paper compares a traditional approach to building business layers in development of software applications which is usually done programmatically, via code, against a rule-based definition language. Drools Rule Language (DRL) is a new Java based type of language, similar to SQL that implements Rete algorithm and defines business rules and logic for any application that requires some sort of business logic which are commonly needed in large number of informational systems, with clear accent on Large Distributed Information Systems. In this paper, a brief overview of Drools technology will be given, with accent on its advantages and disadvantages compared to a traditional approach to building business layers.

I. INTRODUCTION

JBoss Enterprise BRMS is an Open Source system for management of business rules, with emphasis on extremely easy development and management of business rules. JBoss Enterprise BRMS system is one of key components of the Red Hat service shown on Fig. 1. This system enables different organizations to define and manage their business rules. Business rules are the basis of decision making in every organization [10].

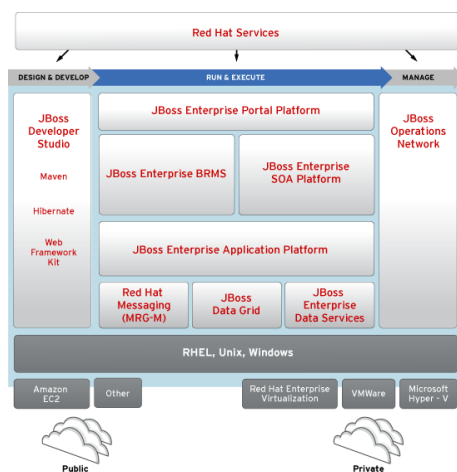


Figure 1. Structure of the Red Hat JBoss Middleware Service

JBoss Enterprise BRMS has a fast and very efficient engine for execution of business rules, as well as a simple system for development, i.e. writing and management of business rules with quality repository for their storage.

JBoss Enterprise BRMS facilitates work for an analyst or an auditor, whose task is to review and manage all your business rules that are a part of your IT application. Business analysts, as well as SOA programmers (Service Oriented Architecture) for applications and business rules may confirm that written rules are realizing certain business processes. JBoss Enterprise BRMS also supports certain tools, languages and tabular definitions of decisions, considerably facilitates quick changes of business rules if there is a need.

JBoss Enterprise BRMS enables companies to reduce time needed to update SOA components, business processes and application itself by latest business rules. For instance, implementation of the new system of billing services may be realized in a few hours, without or with only slight changes in application infrastructure.

Business rules management systems simplify applications by separating business rules or logic from the business process, infrastructure and logic presentation. This modularity enables business analysts, programmers who develop rules and auditors to easily develop, set changes and manage rules of the business process. Fig. 2 shows implementation of the JBoss Enterprise BRMS system on example of an Internet store [8].

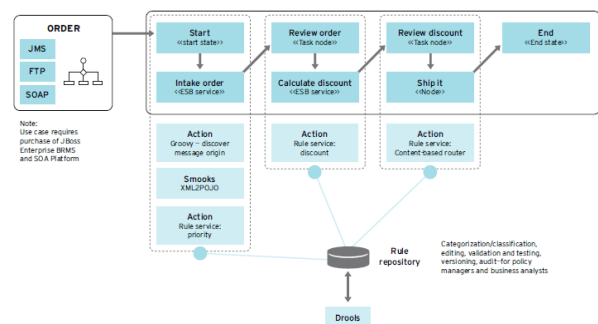


Figure 2. Implementation of the JBoss Enterprise BRMS system on example of an Internet store

II. COMPONENTS AND STRUCTURE OF THE JBOSS ENTERPRISE BRMS SYSTEM

Components and structure of the JBoss Enterprise BRMS system are shown in Fig. 3[10] [8]. This system comprises of:

- Rule Authoring and Management module
- Repository for storing business rules, control of their versions etc;
- Module for execution of business rules
- Temporal reasoning (CEP) module
- Container module – contains and enables approach to all abovementioned modules.

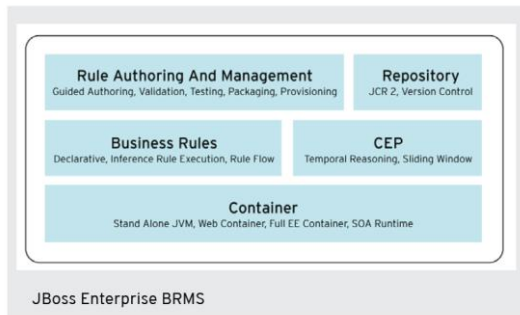


Figure 3. Structure of the JBoss Enterprise BRMS

The most prominent characteristics of the JBoss Enterprise BRMS are:

- System for execution of business rules (Business Rule engine) - the JBoss Enterprise BRMS system for execution of business rules implements Rete algorithm for fast indexing and optimization. This system support temporary business rules that are executed in certain intervals or within the certain interval framework.
- System for writing business rules – new interface JBoss Enterprise BRMS enables fast and easy development of business rules, as well as their changes and management. For Java programmers, Drools rule language (DRL) supports all these characteristics and uses Java language to define limitations, functions and consequences. DRL language is expansive and provides support for natural language by its mapped databases features. DRL and natural language (language from a certain domain) are supported by JBoss Enterprise BRMS Workbench. Users also may change decision tables using Microsoft Excel or OpenOffice programming package. JBoss Enterprise BRMS Workbench IDE, a part of JBoss Enterprise BRMS Studio, supports syntax coloring, code generating, display of structure and validation of business rules. By error report, debate and Rete browser, inner structure of rule execution system may be observed.
- System for business rules management - JBoss Enterprise BRMS has a repository for management of business rules and administrative console based on web

interface, makes it easier to programmers, business process analysts, administrators and other users of JBoss Enterprise BRMS system.

A. JBoss Enterprise BRMS, JBoss Drools, JBoss Guvnor and Application Server

JBoss Enterprise BRMS is a commercial OpenSource tool by RedHat group. It may be downloaded from the site of official RedHat presentation in evaluation 30-day mode, with a number of actions blocked or limited in execution. JBoss Enterprise BRMS package contains stable versions of programs/plugins from JBoss Community program [11][8].

- JBoss Developer Studio package contains:
- Eclipse environment
- JBoss Drools
- JBoss Guvnor
- Application Server

Every of those packages may be downloaded separately and configured in detail. If the structure of JBoss Developer is analyzed, it is clear that this solution is Eclipse environment with predefined configuration of JBoss Plugin, JBoss Guvnor graphic environment for JBoss Drools and Application Server. [9]

III. STRUCTURE OF JBOSS DROOLS RULE LANGUAGE RULES AND EXAMPLE

JBoss Drools technology will be presented by highly simplified example of student enrollment for next year of studies. This example realizes a very simple business rule, asking: whether the student has met the requirements to be enrolled for the next year of studies? Business rules are the basis of business processes, that is, business rules define logic of a business process. Description of a business rule, which will be used in following examples, is this: if a student has met the requirements to enroll for the next year of studies, he or she will be enrolled for the next year of studies and appropriate notification about that is shown.

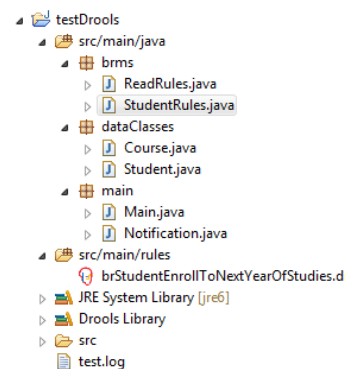
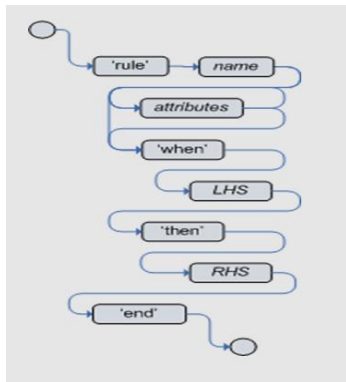


Figure 4. Structure of the Drools project

This process is modeled in Java programming language, in Eclipse IDE Juno 4.2 environment, relying to JBoss Drools rules in files with *.drl (**Drools Language**)

extension. Fig. 4 shows the structure of the testDrools Java Drools project, by which a simplified example of student enrollment for the next year of studies is realized.

JBoss Drools rules are located in separate files. These files have extension *.drl and are identical in structure to text files. Every Drools rule has so-called LHV (Left Hand Value) and RHV (Right Hand Value) part [6] as shown in Fig. 5. LHV part of the JBoss Drools rule is the conditional part of the rule in which conditions may be written and evaluated that this rule must fulfill in order to perform actions in RHV part of the rules. Actions of RHV part of the rule may be written in JBoss Drools rules syntax or in pure Java code. Having this in mind, content of the RHV part of JBoss Drools rules may be launching of another rule, launching of some static Java method, or any other part of Java code. Therefore, JBoss Drools rule has simple structure, identical to *if-then* structure of conditional ramifications in any programming language. Present concept, configuration and syntax of JBoss Drools rule does not support *if-then-else* logic conditional ramifications, i.e. it does not support defining of actions or launching a certain Java code in case that conditions that have been defined in LHV – in *if* part of rules – are not fulfilled. Solution that is currently in use in such a case is to write a complete JBoss Drools rule with the aim to make such a condition – or LHV – which will be activated, and consequently activate RHV, if the LHV of a particular rule is not activated [2].



```
rule "Business Rule Name"
  when
    // LHV - Left Hand Value
  then
    // RHV - Right Hand Value
  end
```

Figure 5. Structure of the JBoss Drools rule

```
rule "Did a student obtain enough ESPB points to enroll into next year of studies?"
  when
    // get object of type Student
    $student : Student()
    // calculate cumulative ESPB points count based on a list of completed courses
    $cumulativeESPB : Number() from accumulate ( Course( $espb : get_ESPB() ) from $student.get_courses() , sum( $espb ) )
    // count completed courses
```

JBoss Drools rules that are subject to these cases are most often grouped and placed in separate files, depending on a type of a problem that define it. Namely, since simplified example from above refers to checking whether a student has met the requirements to enroll for the next year of studies, realization of such business rule requires two rules to be written. One will define what will happen if a student has met the requirements to enroll for the next year of studies, and other will define what will happen if a student has not met these requirements. Both rules are placed in the same *.drl file, one beneath the other. Since rules from a *.drl file are called and executed sequentially, i.e. JBoss Drools rules are parsed and executed from the start of the *.drl file where they are placed, sequence of writing the business rules is extremely important, especially if a business logic of a complex process is described. Having in mind previously explained business process of enrolling students for the next year of studies, it may be concluded that this business process will be described using two business rules located in the same *.drl file.

This example highlights the key words of the JBoss Drools syntax for writing business rules. This syntax reminds of syntax of functional programming languages [3][5].

Keywords of JBoss Drools rules are:

- **rule** – Refers to start point of the business rule. It also defines the name of the business rule that may be written as a Java string with solely purpose of semantic identification of the business rule. It is also important to emphasize that a business rule, formally, has no header that would associate that it is actually a procedure. Launching and execution of a business rule, as well as sending objects to a business rule, will be explained in following sections.
- **when** – Refers to start point of the LHV section. LHV section is limited by keywords when and then.
- **then** – Refers to end point of the LHV section and start point of the RHV section. RHV section is limited by keywords then and end
- **end** – Refers to end point of a business rule.

Fig. 6 shows JBoss Drools rule that checks whether the student has fulfilled requirements to be enrolled for the next year of studies. Having in mind that in previous section a structure of the JBoss Drools business rule was explained, key words will not be repeated here.


```

    $coursesCount : Number() from accumulate( $p : Course() from $student.get_courses() , count( $p ) )
    // evaluate the condition, if a student has a score that is higher or equal to 10 ESPB points and
    // has completed at least two courses, allow enrollment to next year of studies
    eval($cumulativeESPB.intValue()>=10 && $coursesCount.intValue()>=2)
then
    // perform changes
    // notify user
    String message ="Student: "+$student.get_name()+ " " +
        $student.get_lastName()+" Student ID :"+
        $student.get_studentID()+" has obtained enough ESPB points to enroll into next year of studies.";

    main.Notification.Notify(message);
end

```

Figure 6. Business rule establishes whether the student has fulfilled requirements to be enrolled for the next year of studies

In this example of enrolling students for the next year of studies, the condition is rather simplified and it is required that a student has at least two examinations passed and ESPB points sum larger or equal to 10. During execution of the business rule that checks whether a student has fulfilled requirements to enroll for the next year of studies, first an object of Student type is downloaded and sent to the session that contains a business rule that is being executed. Next, a sum of ESPB points is calculated from the list of exams passed for the particular student, as well as the number of exams passed. In both instances, local variables are formed, and based on accumulate function from a list of exams for previously defined and downloaded object type Student, calculate the sum of ESPB points, and a number of exams passed. In this case, if exam is passed it will be included in the list so there is no need for complex checks; only a count function is being called, while for calculation of ESPB points a sum function is being called. Therefore, syntax of JBoss Drools rules is quite similar to functional languages, has elements of SQL language and in its structure is similar of LINQ language structures within the NET platform. After all required values are calculated as local variables, their evaluation is necessary so that LHV would take the value of logical true or false. If the LHV value is evaluated as true, RHV section will be executed, i.e. the code that is written in then section. In RHV section of JBoss Drools business rule, as mentioned before, there may be launch of another business rule or any Java code. In this example, user is informed using Java console print, that a particular student has fulfilled the requirements for enrollment to the next year of studies.

If a student did not fulfill requirements to be enrolled to the next year of studies, RHV part of rule "Did a student obtain enough ESPB points to enroll into next year of studies?" will not be executed. Since it was already explained that JBoss Drools rules at this time have no section that would emphasize what would happen if a certain rule is not successfully executed, a special rule is being written to check reverse proposition.

IV. EXECUTION OF JBOSS DROOLS RULES

Having in mind previously explained structure of JBoss Drools rules, relying on previously realized example of a business process where a student is enrolled to the next year of studies, in this section the execution process of JBoss Drools rules in Java environment will be described in detail.

In the Main class, within package src/main/java/main, Main method of realized example is located. This is the starting or the main method of the developed demonstration application. The task of the Main method is, as it may be seen from the Listing 3, to create an object of Student type with the list of exams passed, and to send it to the statistical method *EnrollStudentToNextYearOfStudies* of a StudentRules class.

```

ArrayList<Course> courses = new
    ArrayList<Course>();

Course course = new Course();
course.set_courseID(1);
course.set_courseName("Math 1");
course.set_score(72);
course.set_grade(7);
course.set_ESPB(6);

Course course2 = new Course();
course2.set_courseID(1);
course2.set_courseName("Math 2");
course2.set_score(84);
course2.set_grade(8);
course2.set_ESPB(5);

courses.add(course);
courses.add(course2);

Student stud = new Student();
stud.set_courses(courses);
stud.set_studentID("MBI 32/12");
stud.set_name("Predrag");
stud.set_lastName("Pecev");

StudentRules.EnrollStudentToNextYearOfStudies(stud);

```

Figure 7. Content of the Main method

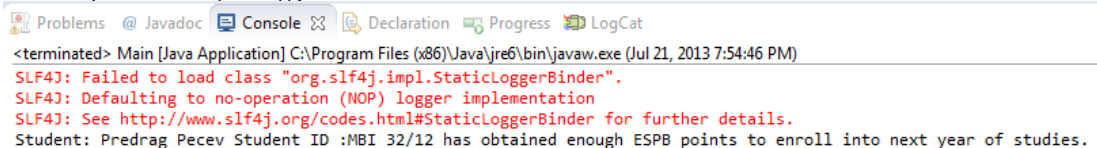
Method *EnrollStudentToNextYearOfStudies* from *StudentRules*, shown in Fig. 9, class calls static method *readRuleSet* from the *ReadRules* class that will, for a certain file name with business rules, form a knowledge base, or a KnowledgeBase object, which contains business rules defined in forwarded file. Namely, in this example,

name of file with business rules to check whether a student has fulfilled requirements to be enrolled to the next year of studies, is *brStudentEnrollToNextYearOfStudies.drl*. Fig. 8 shows the *readRuleSet* method from the *ReadRules* class.

After forming of knowledge base, containing rules defined in *.drl file, a session is created that follows the state of forwarded objects and applies certain rules as required. To such created session, an object is forwarded of a Student type. Insert object method *StatefulKnowledgeSession* accepts objects of any type, including a type list. Having in mind previously explained structure of the JBoss Drools rules, and the fact that this method accepts any type of objects, i.e. all objects formed by inheriting Object base class, it is concluded that within the JBoss Drools rules, forwarded object or a data set must be treated as a separate variable, created by casting forwarded object to the type of forwarded object. After allocation of object of Student type to the session that contains a set of business rules that should be executed on forwarded object, a *fireAllRules()* method is launched and it "fires" all business rules on the forwarded object. Ideally, business rules are executed over a particular data set, and the programmer defines a form of data set. Data may be grouped, as in this example, as objects, and a traditional dataset may be forwarded [1][7][4].

```
public static KnowledgeBase readRuleSet(String
ruleSetFileName) throws Exception {
    KnowledgeBuilder knowledgeReader =
KnowledgeBuilderFactory.newKnowledgeBuilder();

knowledgeReader.add(ResourceFactory.newClassPathResource(rule
SetFileName), ResourceType.DRL);
    KnowledgeBuilderErrors errors =
knowledgeReader.getErrors();
    if (errors.size() > 0) {
        for (KnowledgeBuilderError error: errors) {
            System.err.println(error);
        }
        throw new IllegalArgumentException("Rules could
not be read!");
    }
    KnowledgeBase knowledgeBase =
KnowledgeBuilderFactory.newKnowledgeBase();
```



```
Problems @ Javadoc Console Declaration Progress LogCat
<terminated> Main [Java Application] C:\Program Files (x86)\Java\jre6\bin\javaw.exe (Jul 21, 2013 7:54:46 PM)
SLF4J: Failed to load class "org.slf4j.impl.StaticLoggerBinder".
SLF4J: Defaulting to no-operation (NOP) logger implementation
SLF4J: See http://www.slf4j.org/codes.html#StaticLoggerBinder for further details.
Student: Predrag Pecev Student ID :MBI 32/12 has obtained enough ESPB points to enroll into next year of studies.
```

Figure 10. Successfully executed rule " Did a student obtain enough ESPB points to enroll into next year of studies?"

VI. CONCLUSION

RedHat JBoss Enterprise BRMS is a quality solution providing easy and efficient management of business rules on the level of information systems in small, medium and large companies. The main component of this solution is JBoss Drools language with a rule execution system and the Rete algorithm, as well as jBRM (Java Business Process Model). Graphic environment in which JBoss Drools rules are managed is JBoss Guvnor, a part of RedHat JBoss enterprise BRMS system.

In this paper, a work with JBoss Drools system is described, from the aspect of writing and executing business rules in JBoss Drool language, in non-distributed

```
knowledgeBase.addKnowledgePackages(knowledgeReader.getKnowledge
ePackages());
    return knowledgeBase;
}
```

Figure 8. Method *readRuleSet* from a *ReadRules* class

```
public static void EnrollStudentToNextYearOfStudies(Student
student)
{
    String ruleFileName =
"brStudentEnrollToNextYearOfStudies.drl";

    try
    {
        // make a knowledge base from a ruleset
        KnowledgeBase knowledgeBase =
ReadRules.readRuleSet(ruleFileName);
        // create a session based on a knowledge base
        StatefulKnowledgeSession session =
knowledgeBase.newStatefulKnowledgeSession();
        // pass an object which should be evaluated
        // through knowledge base containing business rules
        session.insert(student);
        // execute business rules over a send object
        session.fireAllRules();
    }
    catch (Exception ex)
    {
        Notification.Notify("Business rule did
not execute.");
    }
}
```

Figure 9. Method *EnrollStudentToNextYearOfStudies* from a *StudentRules* class

V. RESULTS OF EXAMPLE EXECUTION

Depending on a dataset that is being evaluated, result of business rules execution, described in previous section, is the message being shown on the Java console and notifies the user, that this particular student has or has not met the requirements to be enrolled to the next year of studies as shown on Fig. 10.

environment, without direct interaction to JBoss Guvnor tool, so it is presented in short. JBoss Drools system is described using representative example of a business process regarding student enrolment to the next year of studies if he or she had met requirements. This example clearly points to upsides and downsides of the JBoss Drools system.

Importance of business rules and RedHat JBoss Enterprise BRMS system is much more visible in distributed information systems and in GIS systems, where a number of computers that initialize certain business processes is large, or maybe in an mobile (Android, iOS) application that may have even more than 10 000 clients. In these cases, propagation of changed

business rules is important, since speed is of utmost importance. Such a concept demands from client applications to simply initialize business processes, by forwarding certain objects, while the server itself accepts these objects and demands, applies defined business rules on such objects or datasets, and depending on results obtained initializes the next business process, executes a certain set of actions, notifies client application etc. Therefore, in order to change business logic behind a certain business process, it is enough to change a business rule on the server using Red Hat JBoss Enterprise BRMS system, and usually it is not necessary to modify the client part of application. Having in mind the concept of n-tier application, with special emphasize on three-tier application - presentation tier (graphic interface), business logic tier and data tier – it is concluded that Red Hat JBoss Enterprise BRMS system belongs to the group of middleware solutions, i.e. solutions that provide adequate support to a business logic tier, i.e. replacing business logic tier in n-tier applications.

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Using Linear Regression for Estimating Useful Energy for Solar Collectors Based on Real Project Data and Data Available on Internet

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Abstract - The aim of this paper is to present an approach to development of mathematical models based on linear regression analysis that will calculate the potential of solar radiation. The correlations of different solar energy parameters have been calculated. The empirical data used for the global solar radiation were extracted from the database of Joint Research Centre, Institute for Energy and Transport for the period 2001 - 2012. Based on these data was formed a typical meteorological year (TMY). The analysis started with correlations established between the following empirical data: insolation on a horizontal surface (H_h), insolation on a vertical surface (H_v), insolation on an optimum surface (H_{opt}) and useful energy (Q_m). The useful energy was measured on the solar system implemented in Subotica (Serbia) by a small energetic company. The measurement was conducted in 2010. Results indicate that there is a strong correlation between measured insolation and useful energy, which allows precise estimations of useful energy for further projects in selected region.

I. INTRODUCTION

In many applications of solar energy, the solar irradiance incidents on the surface of the earth at the location of interest is an important input parameter. The temporal and spatial fluctuations of such irradiance necessitate a method to predict them. The systematic variation of solar irradiance outside the Earth's atmosphere makes it possible to introduce many models for such prediction [1].

However, at locations on the Earth's surface, the solar radiation is also a function of such variables as the nature and extent of cloud cover, the aerosol and water vapour content of atmosphere, etc. Good prediction of the actual value of solar irradiance for a given location requires, in principal, long-term, average meteorological data, which are still scarce for developing countries [2].

It is, therefore, not always possible to predict the actual value of solar irradiance for a given location. There are several formulae that relate global radiation to other climatological parameters such as sunshine hours, relative humidity, max. temperature, and average temperature. In this work, the first correlation is for estimation of solar irradiation to vertical surface, second to horizontal surface and third to optimal surface. Estimates refer to the average monthly insolation for selected location.

The rest of the paper is structured as follows. The second section provides an overview of studies that reported researches on solar irradiation and other relevant parameters of solar energy in different parts of the world.. The main part of the paper presents results of the linear regression analysis. Conclusions and further research directions are in the last section of the paper.

II. RELATED WORK

Research community and practitioners have shown significant interest for solar irradiation studies because of the importance of solar energy for humans. This resulted in a number of studies on solar irradiation and other relevant parameters of solar energy in different parts of the world. Majority of studies use databases available on Internet for developing models for estimating solar energy parameters. Some interesting studies will be outlined in this section.

Estimation of global solar radiation in the cities of Bulgaria (Sofia, Sandanski, Chirpan and Kardjali) is presented by Ivancheva and Koleva [3]. The average monthly solar radiation per day on a horizontal surface was shown. The following parameters were included in the analysis: the duration of solar radiation, diffuse radiation, minimum and maximum air temperature. These parameters were measured in the hydro-meteorological stations. The mathematical model developed in this study was also tested. The tests show that for summer and winter, different models developed in this study should be used to minimize the estimation error. The error determined in the study is about 5-8%.

Benghanem and Joraid [4] presented the potential of solar energy in Medina (Kingdom of Saudi Arabia) based on correlation between the different parameters of solar energy. The authors developed estimation models for different components of solar irradiation in order to evaluate the potential of solar energy in Medina. Data were extracted from database available at the National Renewable Energy Laboratory (NREL) website for the period from 1998 to 2002. Elimination of seasonal effects is done through homogenization of extracted data. The authors developed the correlation model between the global radiation (HG), diffuse irradiation (HD) and sunshine duration (SS) over the year, and correlation model between temperature and global irradiation.

TABLE I. EXTRACTED DATA FOR CORRELATION ANALYSIS

Month	Hh	Hopt	Hv	Qm/m ²
Jan	1070	1640	1620	49.5
Feb	1990	2890	2650	75.6
Mar	3390	4320	3390	131
Apr	4830	5390	3390	163
May	5850	5900	3030	187
Jun	6240	6000	2790	186
Jul	6200	6100	2940	193
Aug	5480	5940	3400	185
Sep	3920	4810	3500	142
Oct	2610	3760	3340	113
Nov	1460	2400	2430	67.9
Dec	1070	1550	1500	48.1

TABLE II. CALCULATED CORRELATION COEFFICIENTS AND COEFFICIENTS OF DETERMINATION

Analysis number	Correlation between	R	R ²
1	Hh-Qm	0.979884965	0.960174544
2	Hv-Qm	0.763201969	0.582477245
3	Hopt-Qm	0.998244784	0.996492648

Similar studies were reported for Croatia [5], Turkey [6], Northern Banat region in Serbia [7], and Pakistan [8].

III. ESTIMATION MODEL

Model for estimating useful solar energy requires relevant data on the sun's energy for the geographical area of interest and collection of empirical data for typical solar energy systems. Mathematical model is based on correlation between the useful solar energy measured on the selected system and the data about insolation in the observed place. Correlation is further used as a basis for linear regression model that can be used to estimate the useful solar energy on new systems.

The simple mathematical model for estimating the useful energy of solar irradiation is based on correlation and regression analysis. Analysis uses data about useful energy calculated from the project "Plant for the heating of water by solar energy" implemented by a small company in Subotica (Vojvodina, Serbia). The solar collectors were chosen by using AHP analysis [9]. Data used in the analysis are presented in Table I. Variables included in the analysis are:

- *Hh*: Irradiation on horizontal plane (Wh/m²/day),
- *Hopt*: Irradiation on optimally inclined plane (Wh/m²/day),
- *Hv*: Irradiation on vertical plane (Wh/m²/day),
- *Qm*: Measured value.

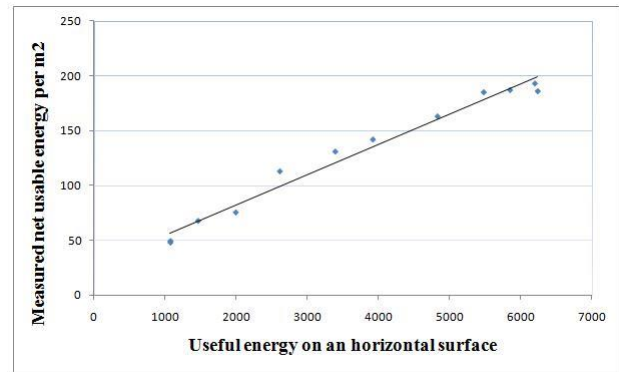


Figure 1. Scatter plot and regression line for horizontal surface

A. Data analysis

Correlation coefficients were calculated according formulas presented in [10]. Correlation was calculated between the values for usable energy obtained for the solar plant, and the values that are retrieved from the database for irradiation on horizontal, vertical and optimal (30 degrees) surfaces. Table II presents correlation coefficients and determination coefficients for all three positions of solar collector.

The regression analysis includes determination of correlation between selected variables, drawing of scatter plot for selected variables and calculating trend or regression line for the set of points in the scatter plot [11]. The correlation coefficients were calculated for the following parameters: global solar radiation on a horizontal surface and the measured value on the solar system, global solar radiation on the optimum surface and measured values on the solar system and global solar radiation on a vertical surface and measured values on the solar system. This means that the correlation coefficient R was determined for all three cases, and presented in Table II. The values for global solar radiation, as well as for the measured values of solar radiation, refer to the average values during a typical meteorological year (TMY), while the data for Q were measured in 2010.

Linear regression trend lines that comprise a model are: irradiation on horizontal surface, irradiation on vertical surface and irradiation on optimal surface. Correlation coefficient 0,979884 for horizontal surface indicates strong correlation between useful energy and irradiation on horizontal surface. In addition high value of determination coefficient 0,960174 ensures very good estimation of useful energy for horizontal surfaces determined by the regression trend line presented with equation 1. Regression line is defined as a trend line in scatter plot (see figure 1) with values for Hh and useful energy.

$$Y = 0,027x + 27,07 \quad (1)$$

For vertical surface (90° angle) is calculated correlation coefficient of 0,763201, which shows a weaker correlation between useful energy and insolation on a vertical surface. A relatively low value of the coefficient of determination 0,582477 indicates unreliable estimation of useful energy on a vertical surface. The regression line

for the case of the vertical surface is represented by the equation 2. The regression line is defined as a trend of line on a scatter diagram, with the values for H_v and useful energy (see figure 2).

$$Y = 0,059x - 40,61 \quad (2)$$

For the optimally positioned surface the correlation coefficient is 0.95284. This value shows a very strong correlation between the useful energy and radiation on the optimum surface. The value of coefficient of determination 0.907904 ensures a very good estimation of useful energy on the optimum surface using the equation 3. The regression line is defined as the trend line in the scatter diagram with values for H_{opt} and useful energy (see figure 3)

$$Y = 0,032x - 7,877 \quad (3)$$

B. Discussion of results

Equations 1, 2 and 3 present mathematical model for estimating useful solar energy. Each equation presents the estimation of solar energy for a particular angle of solar collector. The slope of the solar collector presents the angle which sunlight falls under.

Model assessment is based on the values of the correlation coefficients R and the value of the coefficient of determination R^2 for all three cases. Coefficient of determination is calculated because it reflects the reliability of estimation proposed by correlation coefficient and regression line [12] [13].

The coefficients of correlations for horizontal and optimal surface are very high and indicate a strong relationship between the variables for which the correlation is established. High values of determination coefficients enable very good estimations for future projects in selected region. The results of the analysis revealed that the most reliable estimation for further projects is for horizontal collectors, while the estimation for vertical collectors is not so reliable.

C. Validity and constraints of the study

Each empirical study has some constraints that influence the validity of the research findings. This implies that validity issues should be carefully investigated, or in other words, researcher should ensure that methods warrant research conclusions [14]. Assessing validity of the study refers to assessing internal and external validity.

Internal validity refers to the analytical process and validity of data. The analytical process is based on correlation and regression analysis that are well defined and regularly used in the research practice. However, more detailed analysis with additional parameters, or by using multivariable analysis like multiple correlation and multiple regression will improve the research findings and provide more comprehensive picture of the investigated issues.

External validity refers to applicability of this estimation model in other settings. In this type of study, the results are strongly conditioned by a geographical region and specific climatic conditions. Additional implementation of the model in nearby locations, and with

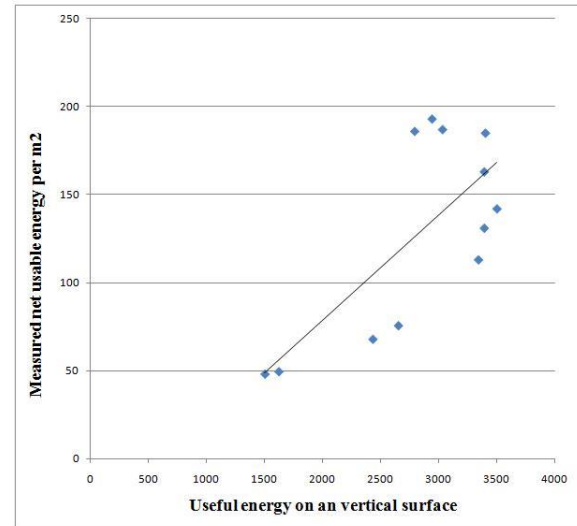


Figure 2. Scatter plot and regression line for vertical surface

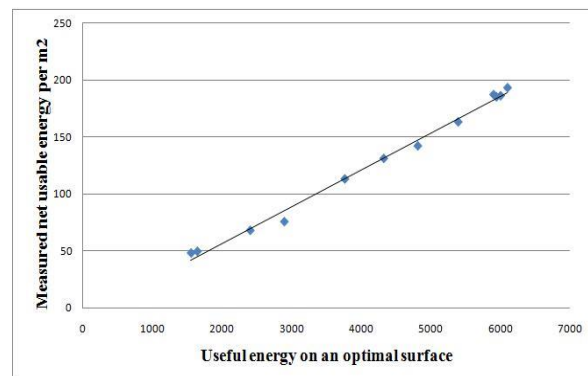


Figure 3. Scatter plot and regression line for optimal surface

data from several projects will provide the evidence about the validity of this model. This is the second study reported by the authors, and the results are very similar to results reported for Kinkinda [7]. This is confirmation of the applicability of the approach, but further studies are still welcome in order to increase the validity.

IV. CONCLUSIONS

This study, first of all, shows that the measured values collected from real project and empirical values available in databases on Internet can be used for estimating the global radiation in Subotica, Vojvodina.

Analysis revealed that the dependencies are very high, which indicates that the estimations can be made with a very good safety. This paper is of particular importance because there are no similar studies in this region, nor data for the radiant sunlight for most places in the region.

The proposed models enable very good estimations of the monthly average and daily global solar irradiation. Model is suitable and recommended to be used in the design and performance evaluation of solar applications in Subotica city and in other places having similar climatic conditions. And finally, the model facilitates engineers that design new systems to determine the effect of the solar system with more precision.

Further research will include conducting several studies that will validate this model. In addition, research will include development of more sophisticated models for the locations without known meteorological data on Internet.

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Predict the Outcome of Disease in Patients with Hepatitis Using Machine Learning Algorithms

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Abstract - This paper outlines the support systems that enable prediction of disease outcome of patients with hepatitis C using machine learning algorithms. The development of machine learning algorithms has always been based on complementary linking theory and experimental research so that future development requires broadening and consolidation of theoretical knowledge, especially mathematics, and knowledge of specific areas of application, as well as their proper formalization. Although we live in an information society in which the collection of data easily, and their storage is not expensive, the same ability to understand and use not in accordance with their increase. Machine learning provides the tools that large amounts of data can be automatically analyzed. This paper presents a problem that belongs to the field of medicine, and is predicting disease outcome of patients with hepatitis C. Presented try to solve the problem using a variety of supervised learning algorithms. To achieve greater forecasting accuracy and decision-making will use different filter methods to achieve greater accuracy of basic algorithms. It also presents the results of experimental study; we have collected during the research.

I. INTRODUCTION

Machine learning involves the development of programs that learn from previous data and as such is a branch of data. Machine learning has developed rapidly since its creation in the mid-seventies.

Machine learning is a field of artificial intelligence that deals with the construction of adaptive computing systems that are able to improve their performance by using information from experience. Machine learning is the discipline that studies the generalization and construction and analysis of algorithms that can generalize. The first theoretical discussion of machine learning has emerged in the works of Gold in the late 60's, but universal theoretical foundations began to consolidate during the eighties of the last century. In this area, the most important theoretical approaches is Gold's learning in the limit, Valiant's Probably Approximately Correct and probably the most complete model - statistical learning theory.

In machine learning have been achieved good results in many areas, such as speech recognition, hand-written text, driving a car, and so on. But as much as the applications of machine learning were diverse, there are tasks that are repetitive. Therefore, it is possible to talk about the types of learning tasks that often occur. One of the most common tasks of learning that occurs in practice is classification. Classification is an important recognition

of object types, for example whether a particular tissue represents malignant tissue or not. Regression is a machine learning task in which objects correspond to the values in the set of real numbers, such as forecasting demand for goods depending on the various factors that influence.

The main objective of this paper is to show that it is possible to improve the performance of the system for inductive learning rules for classification problems, using the filter methods and data dimensionality reduction techniques.

For this purpose we have organized the paper in the following way. In the second part of this paper we present a model of k nearest neighbor, in the third Bayes's model, and in the fourth model of support vector machine. In the fifth part of the paper we present a problem, forecasting cure patients affected by hepatitis C. The sixth part of the paper describes the methodology of the experiment. In the seventh part of the paper we will try to solve the problem using a variety of supervised learning algorithms. To achieve greater forecasting accuracy and decision-making we use filter method for reducing the dimensionality of data. Also, in the seventh section we present the results of experimental study, we have collected during the survey. In the eighth part of the paper, we discuss the obtained results and give directions for further research.

II. MODEL OF K NEAREST NEIGHBORS

Scheme k nearest neighbor was used in the fifties of the twentieth century [1], as the classification process appears ten years later [2], and most intensively used in the field of pattern recognition. Classification based on instances is one of the simplest techniques of intelligent data analysis, because it does not perform explicit generalization of the target concept on the basis of characteristics that are feasible from the learning set, it comes down to the storing a set of data for learning, or individual instances that it contains.

Classification of new instances is done according to the principle of nearest neighbor, where a new instance is compared to the stored instances from the learning set using the defined metrics. Metric defines the distance of instances based on the values of their attributes, and the corresponding intuitive understanding of the similarity of instances, so if instances are more similar, the distance is smaller. A new instance is classified according to the search for a set of learning with the aim of finding an

instance that is nearest distance. A new instance for classification receives classified instances.

Authors use a variety of metrics, and is commonly used *Euclidean*. If with $x = (x_1, x_2, \dots, x_n)$ denote a vector of arbitrary attribute values instance, the Euclidean metric is then defined as follows:

$$\|x\| = \sqrt{\sum_{i=1}^n x_i^2}$$

Euclidean distance of instances x and y can be represented as follows:

$$d(x, y) = \|x - y\| = \sqrt{\sum_{i=1}^n (x_i - y_i)^2}$$

In a similar way, we can define other metrics of varying coordinate vectors in the definition of Euclidean metric. In the above given expressions implicitly assume that all attributes are numeric, i.e. that the values of coordinate numbers, and to the definition of the Euclidean distance, could be applied to nominal attributes, it is necessary to define the operation of the differences to nominal values.

If with $a_i, a_j \in \text{Dom}(A_i)$ labeled two arbitrary values of nominal attribute A_i , then the difference in values of a_i and a_j is defined *0-1 distinguishing function*, as follows:

$$a_i - a_j = \begin{cases} 0, & \text{for } a_i = a_j \\ 1, & \text{else} \end{cases}$$

Because of different scales of measurements for different numerical attributes, there is a problem related to the use of different metrics. For example, an attribute whose value ranges within tenths units of measure will have a negligible impact on the final results in terms of attribute values with a range of a few tens of units. Therefore in the classification method based on the instances standard procedure of normalization of numerical attributes in the interval $[0,1]$, using the function is:

$$f(x) = \frac{x - x_{min}}{x_{max} - x_{min}}$$

where x_{min} and x_{max} means the minimum and maximum value of the observed attribute.

III. MODEL OF BAYES CLASSIFICATION

In classification problems are widely used Bayes's theorem. As a method of classification for the data set hepatitis we used Naïve Bayes classifier for the following reasons: small memory requirements, quick training and fast learning, simplicity and often works surprisingly well.

Naïve Bayes classifier is extremely fast classifier, suitable for classification because small requirement for memory. It is a simple statistical learning scheme and it is often used in classification problems, and sometimes it is

more successful than many of the more complex approaches. It is robust data for irrelevant data, because they will cancel each other, and also well demonstrated in areas where there are a large number of equally relevant data. The classifier is optimum if it is the correct assumption of independence of data. We conclude that the Naïve Bayes classifier has the following features:

Bayes's theorem allows the choice most likely hypothesis from a set of hypotheses H from a set of learning D , and with the impact of predetermined probability of each of the proposed hypotheses in the set H .

First, it is necessary to define the probabilities:

- $P(h)$ – initial probability of a hypothesis h , which allows us to present the initial knowledge of the probabilities of different hypotheses. If this knowledge does not possess all the hypotheses can add the same initial probability.
- $P(D)$ – initial probability of appearance of instance D , indicating the probability of occurrence D no matter which hypothesis is correct.
- $P(D|h)$ – conditions of probability occurrence D under the condition correctness of hypothesis.
- $P(h|D)$ – conditional probability correctness of the hypothesis h after the occurrence of instance D , and it is interesting from the viewpoint of knowledge induction because it allows assessment of correctness of the hypothesis after observing the appearance of new instances D .

This theorem allows us to calculate $P(h|D)$ through the expression:

$$P(h|D) = \frac{P(D|h)P(h)}{P(D)}$$

In many problems it is necessary to find the maximum a posteriori (MAP) hypothesis, that the most likely hypothesis h from H with the condition occurrence D . Applying Bayes's theorem to each hypothesis h from a set of H , and then choosing most probable we easily calculate the MAP hypothesis:

$$h_{MAP} = \arg \max_{h \in H} P(h|D) = \arg \max_{h \in H} \frac{P(D|h)P(h)}{P(D)} = \arg \max_{h \in H} P(D|h)P(h)$$

In the previous expression, we need $P(D)$ as the probability of a constant independent of h . If we assume that all the hypotheses in the set H equally probable, then we cannot ignore the impact of $P(h)$, and then estimate h_{MAP} only on $P(D|h)$. The hypothesis that maximizes $P(D|h)$ call ML (maximum likelihood) hypothesis:

$$h_{ML} = \arg \max_{h \in H} P(D|h)$$

IV. MODEL OF SVM

In machine learning, SVM is popular due to its good performance. As a supervised method to analyze the data and recognize patterns, it is strictly based on statistical theories of learning and at the same time reduces the training and test errors. SVM has enjoyed great popularity

due to the very good results obtained [3], [4], [5]. This is the reason why we use this method to predict the outcome of disease in patients with hepatitis.

Support Vector Machine (SVM) is a binary classifier which construction hyper-plane in high-dimensional space and creates a model that predicts which of the two classes is a new instance.

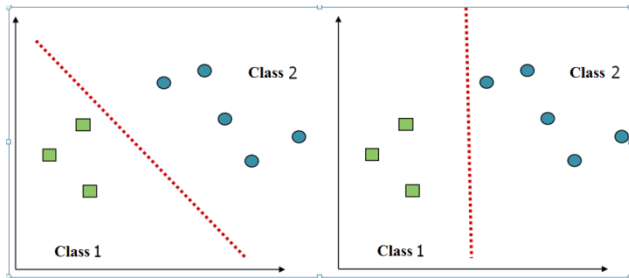


Figure 1: The task of the training phase: find the optimum plane which separates the data for training [6]

The basic idea of this method is that the vector space in which the data are presented, finds decoupling hyper-plane so that all the data of a given class on the same side of the plane, as shown in Fig. 1.

When using this method, the question is what the solution is better, and how to define "better" solution. If we assume that the data is linearly separable in a training phase should be find the optimal separating hyper-plane, or maximum "margin" (which represents the distance from training data). In this case, discovered the hyper-plane (i.e. its equation) is a model (Fig. 2). Then, based on the model calculates the distance from the hyper-plane and on that basis determine the class (above/below the plane).

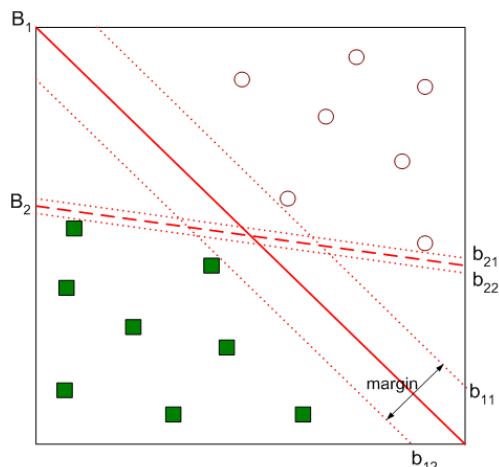


Figure 2: Find a hyper-plane that maximizes the size of margin \rightarrow B1 is better than B2 [6]

SVM determines the optimal solution that maximizes the distance between the hyper-plane and points that are close to potential separation line and is intuitive solution: if there are no points near the line of separation, it will be relatively easy classification.

In the case of non-linear problems parting, we use non-linear SVM, with the basic idea that the basic (input)

vector space copy in a multi-dimensional space in which a set of data for training linearly separable.

SVM constructs a hyper-plane or a set of hyper-planes in higher dimensional space, which can be used for classification, regression, or other problems. Many hyper-plane can be used for classifying the data, the best hyper-plane is the one that represents the largest separation, or margin between the two classes. Generally speaking, when a greater margin is then is smaller error of generalization of the classifier. The selected hyper-plane is with maximum margin for which valid that the distance from it to the nearest data point on each side is the maximum.

V. DESCRIPTION OF SELECTED PROBLEM OF LEARNING

In the following text we will give a presentation of the selected learning problem that we have used in this work. For the purpose of the experimental study, we used the real dataset taken from the UCI repository [7], which is intended for researchers who studied problems of artificial intelligence.

The main objective of the data set hepatitis (hepatitis - he) to predict whether hepatitis patients die or not. This prediction is based on the patient's condition: his age (by classes age: 10, 20, 30, 40, 50, 60, 70, 80), sex, use of steroids (value can be yes or no), use of antiviral drugs (value can be yes or no), the existence of tired (value can be yes or no), fatigue (value can be yes or no), anorexia (value can be yes or no), the size of the liver (enlarged liver or not), and the liver shape, spleen disease, bilirubin (values are classified into the following categories: 0.39 0.80, 1.20, 2.00, 3.00, 4.00), albumin (values are classified into the following categories: 2.1, 3.0, 3.8, 4.5, 5.0, 6.0), ALK phosphate (values are classified into the following categories: 33, 80, 120, 160, 200, 250), histopathology, etc. [8, 9]. Figure 3 shows liver tissue and pathological changes in it due to the presence of chronic hepatitis C. In this data set, there are two classes of prediction: first class, which provides that a patient will survive (123 instances) and the second class, which provides that the patient will die (32 instances). This data set contains 155 instances and 19 attributes with missing values for some attributes.

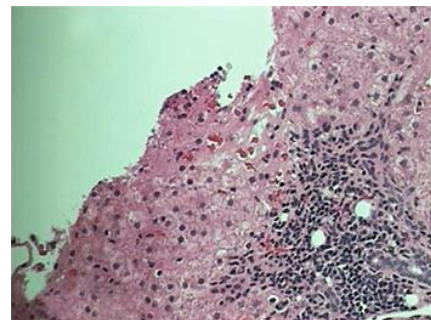


Figure 3: The liver and pathological changes in it due to the presence of chronic hepatitis C [10]

VI. DESCRIPTION OF THE METHODOLOGY

The experiment was performed using WEKA (Waikato Environment for Knowledge Analysis) tools for data preparation and research developed at the University of Waikato in New Zealand. When searching for the

model that best approximates the target function, it is necessary to provide measures of quality models and learning. Different measures can be used depending on the problem, in our experimental studies; we used the classification accuracy as a measure of the quality of the model.

To get a more reliable evaluation of the learned knowledge, we used the cross-validation, where we have a full set of data that we had shared to n approximately equal subsets. In doing so, we have a subset of the training carried out and pulled the other $n-1$ subsets, and after training, the quality of the learned knowledge assessed in a separate subset. Procedure described above are repeated for all other subsets extracted as a final quality score obtained by taking the average score for each of the subsets. In our experimental study we take the value of n is 10. Cross-validation was used in our experimental study, because the procedure gives stable quality evaluation, the advantage of this method is that each of the n steps of cross validation using a large amount of data in their training and all available instances at one time were used to test.

In experimental research we used filter methods to reduce the dimensionality of data: Information Gain (IG), Gain Ratio (GR), Symmetrical Uncertainty (SU), Relief-F (RF), One-R (OR) and Chi-Squared (CS). For these methods of reduce the dimensionality of the data is used the set of all possible solutions, which was then passed through IBk, Naïve Bayes and SVM. In all experiments is selected the solution with the number of attributes that will be used further in the study, which gives the highest classification accuracy. Our results provide the accuracy that is obtained as the average of ten repetitions each time with a 10-fold cross-validation.

VII. EXPERIMENTAL RESEARCH RESULTS

In further experimental research for the optimal number of selected attributes for each dataset and filter methods, classification accuracy was checked using different algorithms IBk, Naïve Bayes and SVM. In the following text are presented the obtained results.

TABLE I. IBK AND CLASSIFICATION ACCURACY, STANDARD DEVIATION FOR CLASSIFICATION ACCURACY, TRAINING TIME AND STANDARD DEVIATION FOR TRAINING TIME FOR ORIGINAL AND REDUCED SET OF DATA USING FILTER METHODS

Algorithm	Accuracy	St.dev. accuracy	Time	St.dev. time
IBk	81.40	8.55	0.00	0.00
IBk_IG	81.97	7.86	0.00	0.00
IBk_GR	83.78	8.10	0.00	0.00
IBk_SU	81.02	8.93	0.00	0.00
IBk_RF	83.33	10.05	0.01	0.01
IBk_OR	83.65	8.88	0.01	0.01
IBk_CS	81.91	7.99	0.00	0.00

For the classification accuracy of IBk algorithm we can see from Table 1 that all filter methods except one give greater classification accuracy than the basic classifiers. The standard deviation of the classification accuracy for IBk algorithm with the original and reduced

set of data using the filter methods are shown in Table 1. From the table it can be seen that the standard deviations generally do not differ a lot of between the standard algorithm and algorithms that use preselecting attributes. Table 1 shows the time required for training IBk algorithm with the original and the reduced data set using the filter methods, and the standard deviation of the time required for training (in seconds). Required time to train the data for basic IBk classifier and IBk classifier with filter methods is small, and also the corresponding standard deviation.

TABLE II. NAÏVE BAYES AND CLASSIFICATION ACCURACY, STANDARD DEVIATION FOR CLASSIFICATION ACCURACY, TRAINING TIME AND STANDARD DEVIATION FOR TRAINING TIME FOR ORIGINAL AND REDUCED SET OF DATA USING FILTER METHODS

Algorithm	Accuracy	St.dev. accuracy	Time	St.dev. time
Bay	83.81	9.70	0.00	0.00
Bay_IG	80.01	8.70	0.00	0.00
Bay_GR	83.77	8.12	0.00	0.00
Bay_SU	81.55	9.48	0.00	0.00
Bay_RF	82.12	10.38	0.01	0.01
Bay_OR	83.17	8.84	0.01	0.01
Bay_CS	79.95	8.80	0.00	0.00

We can be seen from Table 2 for Naïve Bayes algorithm and classification accuracy there are no filter methods which gives higher classification accuracy than the basic classifiers. We conclude that when the classifiers for the observed data set, used filter methods do not give better results. The standard deviations of the classification accuracy for Naïve Bayes algorithm and classification accuracy with original and reduced data set with filter methods are shown in Table 2. From the table it can be seen that the standard deviations generally do not differ a lot of between the standard algorithm and algorithms that use preselecting attributes. Table 2 shows the time required to train Naïve Bayes algorithm used original and the reduced data set with filter methods, and the standard deviation of the time required for training (in seconds). Required time for the training data for basic Naïve Bayes algorithm and Naïve Bayes algorithm with filter methods are small, and also the corresponding standard deviation.

TABLE III. SVM AND CLASSIFICATION ACCURACY, STANDARD DEVIATION FOR CLASSIFICATION ACCURACY, TRAINING TIME AND STANDARD DEVIATION FOR TRAINING TIME FOR ORIGINAL AND REDUCED SET OF DATA USING FILTER METHODS

Algorithm	Accuracy	St.dev. accuracy	Time	St.dev. time
SVM	79.38	2.26	0.01	0.01
SVM_IG	82.15	5.80	0.01	0.01
SVM_GR	83.70	8.29	0.01	0.01
SVM_SU	83.31	6.75	0.01	0.01
SVM_RF	84.09	7.57	0.02	0.01
SVM_OR	84.49	8.10	0.02	0.01
SVM_CS	81.97	6.13	0.01	0.01

For the classification accuracy of SVM algorithm, we can see from Table 3 that all filter methods provide greater classification accuracy than the basic classifier. The

standard deviations for classification accuracy of SVM with original and the reduced data set with the filter method are shown in Table 3. From the table it can be seen that the standard deviations are higher for algorithms which use preselection attributes. Table 3 shows the time required for training SVM algorithm using the original and the reduced data set with filter methods, and the standard deviation of the time required for training (in seconds). Required time for the training data of SVM classifiers for the original data set is slightly larger than for IBk and Naïve Bayes algorithm. We can see that all filter methods with SVM algorithm increase the execution time of the training data.

VIII. DISCUSSION OF RESULTS AND FUTURE RESEARCH

According to the obtained results, we can conclude that the basic hypothesis was proved - it is possible to improve the system performance of inductive learning rules in the problem of prediction outcome of the disease in patients suffering from hepatitis C, using the filter methods for reducing the dimensionality of the data. To prove the hypothesis, have been implemented and empirically tested filter methods for reducing the dimensionality of the data.

The experimental results show that these methods can quickly identify irrelevant or redundant attributes, as well as noise in the data, if it exists; also those attributes that are important for the studied problem.

In further research it would be interesting to apply other techniques to solve the problem of dimensionality reduction of data, such as wrapper method and extraction

of attributes and analyze and compare the effects of their implementation. These techniques could also improve the performance of classification learning algorithms.

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Implementation of Data Security Measures in Information Systems

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Abstract – Data protection and security is essential to the information systems, but many organizations have problems while fulfilling requests for data security. Physical security, security policies are sometimes difficult to implement for various reasons. In this work we will discuss problems related to the implementation of data security in reference to various aspects of it.

I. INTRODUCTION

When discussing data security most people think of software and hardware security. But data security does not depend on software and hardware configuration of the servers or workstations on which protected data is processed, but also on the persons who also process protected information. Data security also depends on physical distribution of computer equipment and on computer communications in case data is transmitted over the network.

As this is a complex issue, it is necessary to consider some of the factors that affect it and suggest methods and procedures in order to effectively implement data protection.

II. PHYSICAL SECURITY

Today, most of the applications in use are of client-server type, where data is stored on the servers and clients access data over the computer network. Data processing could also involve client side processing, when in some point in time data is temporarily stored in client's memory.

Server protection is important element in data security implementation procedures. It is necessary to secure the room with servers and/or communications equipment, and to provide controlled access into these premises by using electronic locks and video surveillance systems. Server room is recommended to be placed in the area of the building where only few people can have access to it and it should be protected by fire suppression systems [1]. Also, the server room should be protected from fires coming in from outside the room [2].

Fire protection assumes that protected equipment is rather expensive, so the system chosen for fire protection has to have the least impact on the equipment it protects when speaking of damages of the equipment. Another factor which should be taken into consideration is the possibility of flood, which also dictates server room placement. Because most equipment is placed into racks, it is

necessary for the equipment to be placed at some height from the floor in order to avoid flooding. Also, flooding from floors above the server room should be also taken into consideration. Server room should not be placed in the areas where there is plumbing above the room. Generally speaking, besides physical security best option is purchasing insurance policy for computer and communications equipment.

III. COMMUNICATIONS SECURITY

In case that data processing requires transmission over the network then network communications security should be a part of data security policy. Network security is necessary also when data is transmitted over the Internet.

In case that data is transmitted over the LAN, several approaches to communications security could be used. One of these is network segmentation, where network with sensitive data is separated from the rest of the network. This method relies on virtual LANs (VLAN), where VLAN comprises of computers and servers where sensitive data is processed [3]. In this case, data transmission is not encrypted, and it is also necessary to set port security on switch ports on which computers processing sensitive data are connected to. Port security prevents unauthorized access because it is possible to pair a switch port with MAC address of the computer requiring access to VLAN [4]. As a method of additional security Internet Protocol Security (IPsec) can be used [5]. IPsec is available in two types:

- transport mode, where data in network packet is encrypted (only payload is encrypted not IP header) and where mutual authentication between sender and receiver is optional,
- tunnel mode, where packet is completely encrypted with optional mutual authentication of sender and receiver. This mode is suitable for data transmission between geographically distributed LANs (Virtual Private Network, VPN).

IPsec transport mode is easier to implement because VLANs require routing between themselves which could lead to complex networking infrastructures.

When speaking about network security access to networking equipment should be limited as well as access to

software (like Cisco IOS) used to create configuration on networking equipment.

IV. OPERATING SYSTEM SECURITY

Microsoft Windows family of operating systems is dominant in today's business systems for which majority of exploits and hacking tools is created. Because of this, computer accounts and password policies has to be implemented. Computer passwords should be complex, containing special characters as well as lowercase and uppercase characters and numbers. Remembering complex passwords is difficult for users, but it is recommended using some terms in which some characters would be replaced by special characters, numbers and uppercase and lowercase characters. Operating system should be configured to prevent password repetition, and to provide password change at regular time intervals.

Another aspect of operating systems security is its configuration on a host machine. Offline access to hard disk drive by booting from removable media (USB, DVD) into another OS (Linux live distribution, for example) could enable data theft or modification. This problem could be solved by using encryption to protect hard disk files, or using network storage or file servers (in server room) for placement of user files or data. Also, network administrator account used to boot into safe mode and in general should be used carefully and use complex password. Access to CD/DVD or USB drives should be disabled on computers on which sensitive data is processed in order to prevent data copying or data theft.

Some of the software solutions (like Widows Rights Management Service) can prevent unauthorized altering of documents, unauthorized printing and mail forwarding. This solution enables administrator to define which users can edit documents or which users can forward it by email or which users can print them.

V. SOFTWARE SECURITY

Security policy implementation mostly implements security mechanisms provided by the operating systems and networking hardware. This means that software relies on these mechanisms. Software security depends on the measures implemented during its development phase. In case that software does not contain security mechanisms then it can be used to gain privileged access to the operating system (for example, buffer overflow) or to manipulate data from RDBMS (SQL injection, for example).

Contemporary RDBMS provide enough security methods which can be implemented in practice. In case that RDBMS is used in Windows domain then authentication and authorization can be coupled with Active Directory security policy. This makes database administration job easier because user account properties are changed only on one place, i.e. in Active Directory.

Data encryption at the database level provides additional security [6]. This prevents data theft or offline access to the database data or access to the database files on backup devices because data is transferred to backup device in encrypted state. Since this technology is built in into RDBM systems, it does not require modification of

the software used on the client side. By using data security at operating system level and at RDBMS level security is considerably improved.

VI. DATA SECURITY IMPACT ON HARDWARE RESOURCES

Data security requires encryption algorithms which use both hardware resources (CPU and memory) and networking resources (additional data transmitted for authentication, for example) which slows the systems and affects application software response. Because of additional load on the system, hardware components and their performance should be taken into consideration. This means that it is necessary to plan and acquire hardware components which could fulfill the requests for data security. For example, in case of networking equipment, equipment with additional processor(s) for data encryption performs better than equipment without additional processor(s). Also, a computer with better CPU or multiple CPUs and large amount of RAM will process encrypted files faster. Also, disk subsystem speed should be taken into consideration because data is read and written to it.

VII. SOCIAL ENGINEERING

Most users are not aware of the fact that they represent the weakest point in the implementation of the security policies or procedures. People will give out their passwords to other persons because majority thinks that other people have good intentions. Because of this fact it is recommended that users are trained on subjects like data security and social engineering [7]. It is also recommended to inform users on security policy, method of its implementation and their role in it. Also, users should be informed about choosing passwords in order to implement security policy successfully. Users should be advised not to put their passwords on stickers, not to write them on post-it, or desks which are case in real world.

VIII. CONCLUSION

Implementing data security involves both technical personnel and information system users. All users should be informed and trained to use information system with security in mind. Data security requires careful planning and deployment.

Computer and networking equipment should have built in data security mechanisms so the data security policy could be implemented. Also, equipment placement should be considered in reference to physical security and fire and flood protection. Software security is also an important part of every security policy and its characteristics should be considered too.

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Rendering 3D Graphics on Android Operating System using OpenGL ES

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Abstract – OpenGL ES is OpenGL-based standard application programming interface (API) for embedded systems graphics. Using OpenGL ES on Android systems provides great rendering performance and allows users to develop hardware accelerated applications. A variety of common tasks can be performed in this way, which includes configuring EGL (Embedded-System Graphics Library) and GL (Graphics Libraries), drawing and animating 3D objects and scenes, lighting a scene, and texturing objects. In this paper will be presented possibilities of OpenGL ES for rendering 3D objects on Android platform, as well as the handling with OpenGL ES threads using Android Development Tools (ADT V.22) plug-in for the Eclipse IDE environment.

I. INTRODUCTION

OpenGL ES is an application programming interface (API) for advanced 3D graphics used for embedded devices such as cell phones, consoles, vehicles, etc., based on OpenGL desktop standard. Since OpenGL API is very large and complex, the goal of the OpenGL ES is to create API suitable for constrained devices. This is done by removing redundancy from OpenGL API [1]. For example, only vertex arrays exist and immediate mode and display lists are removed.

Beside redundancy, compatibility with OpenGL is also maintained. OpenGL ES was designed in way that applications written to the embedded subset of functionality in OpenGL would also run on OpenGL ES.

Another aim of OpenGL ES is to ensure a minimum set of features for quality of image. Since most embedded devices have limited screen size, quality of the pixels drawn on the screen is essential.

The OpenGL ES specification implements programmable graphics pipeline and is derived from OpenGL specification. That means the corresponding OpenGL specification was used as the baseline for determining the feature set in the particular version of OpenGL ES.

OpenGL ES implements a graphics pipeline with programmable shading and consists of two specifications: Open GL ES API and OpenGL ES Shading Language Specification. ES graphics pipeline is shown on Figure 1.

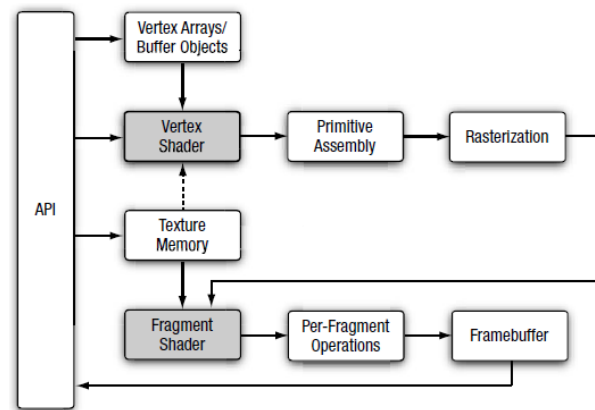


Figure 1. OpenGL ES graphics pipeline

Android operating system supports OpenGL ES both through its framework API and the Native Development Kit (NDK).

There are two fundamental classes within the Android framework that are used for creating and manipulating graphics objects with the OpenGL ES API: *GLSurfaceView* and *GLSurfaceView.Renderer* [2].

GLSurfaceView class is a *View* where you can draw and manipulate objects using OpenGL API and is similar to a *SurfaceView*. This class can be used for creating an instance of *GLSurfaceView* and adding your *Renderer* to it. For capturing touch screen events, *GLSurfaceView* can be extended to implement the touch listeners.

GLSurfaceView.Renderer interface includes the methods required for drawing graphics in a *GLSurfaceView*.

Implementation of this interface must be provided as a separate class and attached to *GLSurfaceView* instance using *GLSurfaceView.setRenderer()*.

The *GLSurfaceView.Renderer* interface demands implementing the following methods:

- *onSurfaceCreated()*: The system calls this method once, when creating the *GLSurfaceView*. This method is used to perform actions that need to happen only once, for example setting OpenGL environment parameters or initializing OpenGL graphic objects.

- *onDrawFrame()*: The system calls this method on each redraw of the *GLSurfaceView*. It is used as the primary execution point for drawing (and re-drawing) graphic objects.

- *onSurfaceChanged()*: The system calls this method when the *GLSurfaceView* geometry changes, including the size of the *GLSurfaceView* or orientation of the device screen. For example, the system calls this method when the device changes from portrait to landscape orientation. This method is used to respond to changes in the *GLSurfaceView* container.

II. DRAWING 3D OBJECTS

DRAWING THE VERTICES

OpenGL ES supports two primary drawing methods, *glDrawArrays()* and *glDrawElements()*. For both methods it is required to use vertex buffer assigned through a call to *glVertexPointer()*. Converting array to buffer should be implemented and the following helper method does exactly that:

```
FloatBuffer getFloatBufferFromFloatArray
(float array []) {
    ByteBuffer tempBuffer =
    ByteBuffer.allocateDirect (array.length * 4);
    tempBuffer.order (ByteOrder.nativeOrder ());
    FloatBuffer buffer = tempBuffer.asFloatBuffer ();
    buffer.put (array);
    buffer.position (0);
    return buffer;
}
```

Here is the example how to use this helper:

```
float[] vertices = {
-0.559016994f, 0, 0,
0.25f, 0.5f, 0f,
0.25f, -0.5f, 0f
};
mVertexBuffer = getFloatBufferFromFloatArray (vertices);
```

Now that the buffer is assigned the triangle can be drawn:

```
void drawTriangle (GL10 gl) {
    gl.glEnableClientState (GL10.GL_VERTEX_ARRAY);
    gl.glVertexPointer (3, GL10.GL_FLOAT, 0, mVertexBuffer);
    gl.glDrawArrays (GL10.GL_TRIANGLES, 0, 3);
}
```

GL_VERTEX_ARRAY state has to be enabled in order to draw any object with OpenGL ES. After that vertex buffer is assigned through a call to *glVertexPointer()*. At the end we call *glDrawArrays()* to draw the triangles using three vertices from the vertex buffer [3].

The result is shown on Figure 2.

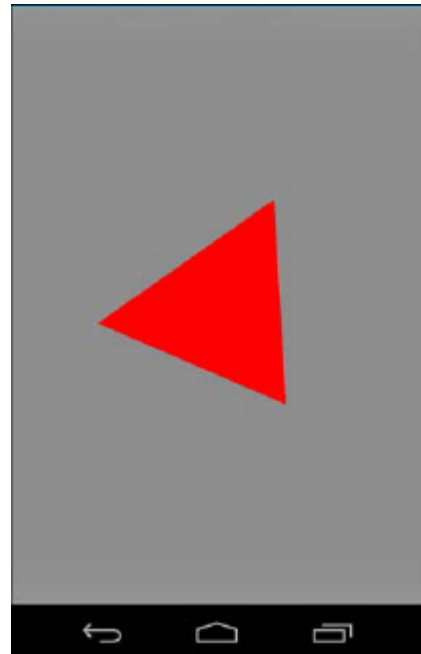


Figure 2. A red triangle rendered using OpenGL ES on Android emulator

COLORING THE VERTICES

In OpenGL ES, we can use an array of colors to individually assign colors to each drawn vertex. It is done by calling the *glColorPointer()* method, where the input parameter is buffer of colors. This is shown below.

```
float [] colors = {
1f, 0, 0, 1f,
0, 1f, 0, 1f,
0, 0, 1f, 1f
};
mColorBuffer = getFloatBufferFromFloatArray (colors);
```

After defining the buffer, it can be used to color the triangle, as shown below:

```
void drawColorful (GL10 gl) {
    gl.glEnableClientState (GL10.GL_COLOR_ARRAY);
    gl.glColorPointer (4, GL10.GL_FLOAT, 0, mColorBuffer);
    draw(gl);
    gl.glDisableClientState (GL10.GL_COLOR_ARRAY);
}
```

First, state for *GL_COLOR_ARRAY* is enabled. Next, color buffer is created with *glColorPointer()* method. After calling *draw()* we have the triangle shown in Figure 3.



Figure 3. A triangle with various colors vertices

RENDERING COMPLEX OBJECTS

For drawing complex objects OpenGL ES supports index arrays. An index array represents a list of vertex indexes from the current vertex array. This array also must be a buffer and its lists indicate the order that the vertices should be drawn after calling *glDrawElements()*. The color arrays are still relative to the vertex array but not the index array. This is shown in the next code:

```
float vertices [] = {
-1,1,1, 1,1,1, 1,-1,1, -1,-1,1,
1,1,-1, -1,1,-1, -1,-1,-1, 1,-1,-1
};
byte indices[] = {
0,1,2, 2,3,0, 1,4,7, 7,2,1, 0,3,6, 6,5,0,
3,2,7, 7,6,3, 0,1,4, 4,5,0, 5,6,7, 7,4,5
};
FloatBuffer vertexBuffer =
getFloatBufferFromFloatArray(vertices);
ByteBuffer indexBuffer =
getByteBufferFromByteArray(indices);
gl.glVertexPointer(3, GL10.GL_FLOAT, 0, vertexBuffer);
gl.glDrawElements(GL10.GL_TRIANGLES, indices.length,
GL10.GL_UNSIGNED_BYTE, indexBuffer);
```

These vertices are defined for creating cube shape. Index array is then used for defining the vertices order to draw the cube out of 12 triangles. Result is shown on the left side of Figure 4. If we switch *GL_LINE_LOOP* parameter of *glDrawElements()* method with *GL_TRIANGLES* line-drawing version of triangle will be produced, like shown on the right side of Figure 4. This approach is useful for defining multiple shapes with the same set of vertices and drawing them in different locations with transformation.

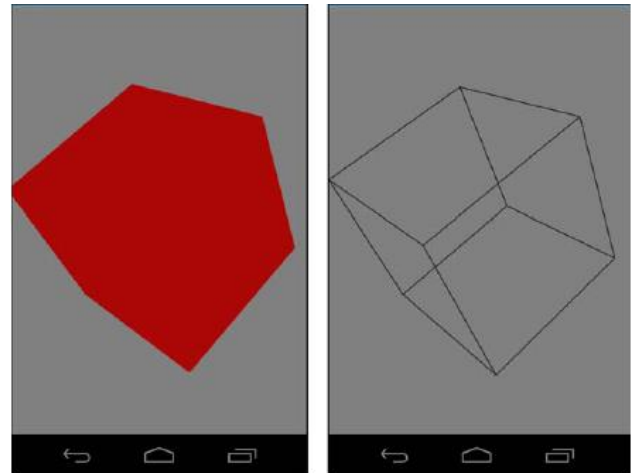


Figure 4. Cube without shading (left) and same cube line-drawn (right).

LIGHTING THE SCENE

For lighting the scene, for each vertex of each surface needs to apply a vector to define how the light reflects. Most often, this vector is perpendicular to the surface defined by the vertices.

Similar to the color array, the normal array is applied to each vertex inside the vertex array in order. The next code enables simple lightning [4]:

```
mGL.glEnable (GL10.GL_LIGHTING);
mGL.glEnable (GL10.GL_LIGHT0);
mGL.glLightfv (GL10.GL_LIGHT0, GL10.GL_AMBIENT,
new float [] {0.1f, 0.1f, 0.1f, 1f}, 0);
mGL.glLightfv (GL10.GL_LIGHT0, GL10.GL_DIFFUSE,
new float [] {1f, 1f, 1f, 1f}, 0);
mGL.glLightfv (GL10.GL_LIGHT0, GL10.GL_POSITION,
new float [] {10f, 0f, 10f, 1f}, 0);
mGL.glEnable (GL10.GL_COLOR_MATERIAL);
mGL.glShadeModel (GL10.GL_SMOOTH);
```

The code shown above enables lighting, *GL_LIGHT0* and then sets the corresponding light color and brightness. Enabling *GL_COLOR_MATERIAL* sets the lighting color same as one used for drawing. Smooth shading model is also enabled which removes the visual transition between triangles on the same face.

Next piece of code is used for drawing the cube, assuming that there is a full vertex array of all 24 points and index array defining their order.

```
gl.glEnableClientState (GL10.GL_NORMAL_ARRAY);
gl.glVertexPointer (3, GL10.GL_FLOAT, 0, mVertexBuffer);
gl.glNormalPointer (GL10.GL_FLOAT, 0, mNormalBuffer);
gl.glDrawElements (GL10.GL_TRIANGLES, indices.length,
GL10.GL_UNSIGNED_BYTE, mIndexBuffer);
```

Normal array and normal mode are turned on. If it is not the case the lighting will not work properly. This array has to be assigned through a fixed buffer in Java programming language, as shown below:


```
float normals [] = {
// front
0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1,
// back
0, 0, -1, 0, 0, -1, 0, 0, -1, 0, 0, -1,
// top
0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0,
// bottom
0, -1, 0, 0, -1, 0, 0, -1, 0, 0, -1, 0,
// right
1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0,
// left
-1, 0, 0, -1, 0, 0, -1, 0, 0, -1, 0, 0};
mNormalBuffer = getFloatBufferFromFloatArray (normals);
```

For each vertex must be defined one normal, as shown in previous code. Various lighting effects can be created by making the normal are not actually perpendicular to the surface. For accurate lighting it is better to add textures or increase the polygon count of objects. Figure 5 shows the cube rendered with previous code.

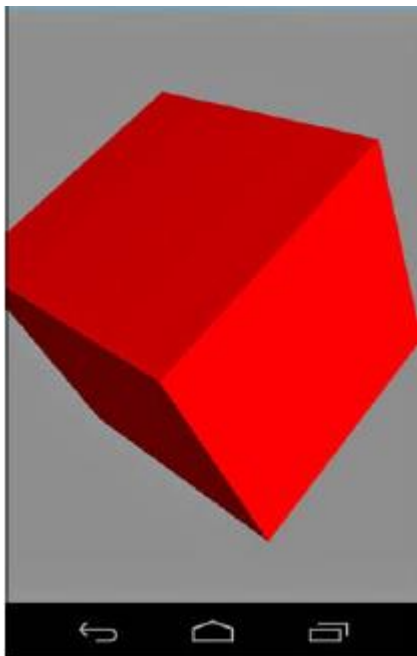


Figure 5. A cube with lighting from right

TEXTURING OBJECTS

Texturing surfaces or rendering images on surfaces is also complex logic. We will show this process on previously colored cube.

Texturing objects needs to be enabled, as shown in next piece of code:

```
mGL.glEnable(GL10.GL_TEXTURE_2D);
int[] textures = new int[1];
mGL.glGenTextures(1, textures, 0);
```

This code enables texturing and creates slot for one texture. Using this slot, OpenGL knows what texture to operate on with next block of code:

```
gl.glBindTexture(GL10.GL_TEXTURE_2D, textures[0]);
Bitmap bitmap = BitmapFactory.decodeResource(
c.getResources(), R.drawable.android);
Bitmap bitmap256 = Bitmap.createScaledBitmap(
bitmap, 256, 256, false);
GLUtils.texImage2D(GL10.GL_TEXTURE_2D, 0, bitmap256, 0);
bitmap.recycle();
bitmap256.recycle();
```

OpenGL ES needs bitmaps to use as textures [5]. In this purpose Android has *Bitmap* class which can read almost any format of image, such as PNG, GIF, JPG files. This can be done with *Drawable* resource identifier, as shown in the previous code. OpenGL requires square textures and have side's powers of two, 64x64 or 256x256. In case that source image might not be one of these exact sizes, the scaling needs to be done with one method call. If the source image is not squared, the original aspect ratio is not kept.

GLUtils.texImage2D() method assigns an Android *Bitmap* to an OpenGL ES texture. This image is kept internally, so the *Bitmap* objects can be cleaned up with *recycle()* method.

Then we need to tell OpenGL ES where to draw the texture. This can be accomplished by using texture coordinate buffer. This is similar to other buffer objects which are assigned to fixed Java buffer. The code below shows this:

```
float texCoords[] = {
1,0, 1,1, 0,1, 0,0,
1,0, 1,1, 0,1, 0,0,
1,0, 1,1, 0,1, 0,0,
1,0, 1,1, 0,1, 0,0,
1,0, 1,1, 0,1, 0,0,
1,0, 1,1, 0,1, 0,0,
1,0, 1,1, 0,1, 0,0,
1,0, 1,1, 0,1, 0,0,
};
mCoordBuffer = getFloatBufferFromFloatArray(texCoords);
gl.glEnableClientState(GL10.GL_TEXTURE_COORD_ARRAY);
gl.glTexCoordPointer(2, GL10.GL_FLOAT, 0, mCoordBuffer);
draw(gl);
```

This code creates a fixed buffer for the texture coordinates. The same ones are set for each face of the cube and each texture has its own texture coordinates (0,0) is the lower-left portion of the texture and (1,1) is the upper-right). Next, *GL_TEXTURE_COORD_ARRAY* state is enabled and after that we tell OpenGL which buffer to use. Method *draw(gl)* draws the cube. The output is shown in Figure 6, with enabled coloring (left) and without coloring (right).

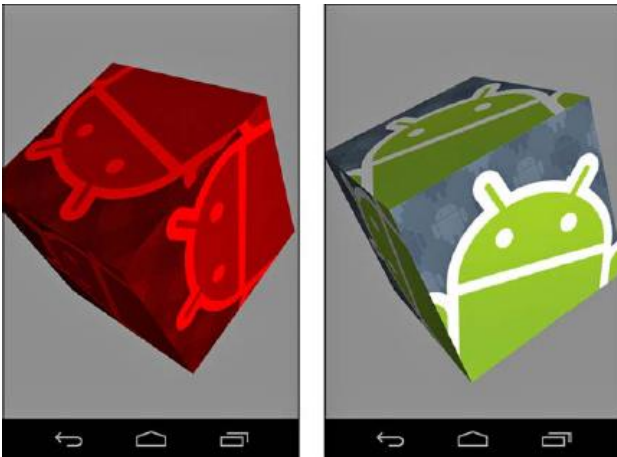


Figure 6. Colored cube with texture (left) and the same cube without coloring (right)

III. HANDLING OPENGL ES THREADS

On Android, 3D objects are drawn on *SurfaceView* which contains all typical attributes. These attributes are used to interact with other parts of applications. We will show how to send information from the OpenGL thread to main thread for performance monitoring and how to control animation on the screen by forwarding events from main thread to the OpenGL thread.

OPENGL THREAD TALKS TO APPLICATION THREAD

Android SDK provides a helper class for running piece of code on separate thread. This is *Handler* class and it allows us to run a piece of code on the thread that it is instantiated in. This is performed within the *Activity* class:

```
public final Handler mHandler = new Handler();
```

Calling the *post()* method of the *Handler* class enables that OpenGL thread to execute code on the Activity thread. For example, the frame rate of rendered scene is calculated inside OpenGL thread and then sent to the *Activity* thread [6].

The *calculateAndDisplayFPS()* method is called within the animation loop inside the OpenGL thread. The calculated result is posted to the *Handler* for the *Activity* thread. This is done by creating a new *Runnable* object that applies a string that holds current frame rate. The code is shown below:

```
public void calculateAndDisplayFPS() {
    if (showFPS) {
        long thisTime = System.currentTimeMillis();
        if (thisTime - mLastTime < mSkipTime) {
            mFrames++;
        } else {
            mFrames++;
            final long fps =
                mFrames / ((thisTime - mLastTime) / 1000);
            mFrames = 0;
            mLastTime = thisTime;
            mHandler.post(new Runnable() {
```

```
        public void run() {
            mFPSText.setText("FPS = " + fps);
        }
    });
}
}
```

APPLICATION THREAD TALKS TO OPENGL THREAD

If we want the main application thread to exchange information with OpenGL thread we can use *Handler* to post code to the OpenGL thread. If there is no need to execute any OpenGL code, key events handler is added to *SurfaceView*.

A *SurfaceView* needs to be the current focus in order to receive key events. Next method calls are used to enable this:

```
setFocusable(true);
setFocusableInTouchMode(true);
```

After that, within *SurfaceView*, key event handlers need to be implemented. For example, we will implement handler for toggling frame rate on and off:

```
public boolean onKeyDown(int keyCode, KeyEvent event) {
    switch (keyCode) {
        case KeyEvent.KEYCODE_F:
            mGLThread.toggleFPSDisplay();
            return true;
    }
    return super.onKeyDown(keyCode, event);
}
```

After pressing F key, *toggleFPSDisplay()* method is called within OpenGL ES thread. This changes the state of *boolean* flag. The *onKeyDown()* method is called multiple times if the key is held, toggling the display until the key is released.

IV. CONCLUSION

OpenGL ES is an API for advanced 3D graphics for embedded devices. OpenGL ES is a subset of desktop OpenGL, used for creating a flexible low-level interface between software and graphics acceleration. It includes profiles EGL specification for portable binding to native windowing systems. We saw how to draw, color, and light the objects using a variety of OpenGL and Android helper methods. It was also shown how application and OpenGL threads can interact with each other.

In this paper we investigated the advantages of using OpenGL ES on mobile platforms. It strips out APIs and features that are not needed and which are not suitable for mobile implementations. According to given results and examples we can see that it also provides interface to window manager and native graphics hardware which results in better system performances on mobile devices.

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Reflections on Some Validity and Ethical Issues in Mixed Methods Research on Investigating English Language Usage at IT Departments in Serbia

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Abstract - Reflecting on validity and ethical issues should be considered in any field research, especially if the research includes groups of participants and different locations. This paper presents the authors reflections on validity and ethical issues that were raised during the research on the needs analysis of IT students in EAP classes at IT departments in Serbia. Sharing first-hand experience, the authors point to several unexpected situations that influenced the level of the validity of the research and questioned ethical issues. Regarding this issue, the authors suggest relevant steps to be undertaken in order to avoid the validity to be affected in such a way.

I. INTRODUCTION

Mixed methods research, or multi-strategy research, involves the integration of quantitative and qualitative research methods in a single study. Although multiple methods can be combined, according to [1] the vast majority of methods employed in mixed methods research are survey methods and qualitative interviews. Greene et al. [2] proposed five justifications for combining quantitative and qualitative research: triangulation (methods, and data sources), complementarity (the results from one method with the results from another), development (results from one method influence decisions in using other methods), initiation (the recasting of questions or results from one method with questions or results from the other method) and expansion (extending the breadth and the range of inquiry through combination of various methods).

The main characteristic of mixed methods research is that any component of the research design can be reconsidered or modified during the research study. In practice, it is not feasible to predict in advance all components of the research design and logical strategy and to implement them faithfully because the research is influenced by many stakeholders (researchers, participants, organizations). Research process evolves during the research, and therefore, research design should be flexible even with the research goals strictly proposed in advance. Many activities that comprise the research, such as collecting and analyzing data, developing theories,

elaborating the research questions, identifying and addressing validity and ethical issues are usually going more or less simultaneously and influence each others [3]. Research design includes informed decision-making on what is the best solution/choice for specific context. Regarding the methodological research design O' Leary stated [4, p. 89]:

"Your design may be completely appropriate to your question and be within your comfort zone, but if you find yourself without ethics approval, enough time, adequate resources, or necessary access, your design won't be able to lead you to answers."

It is essential to have a detailed plan of research before embarking on one. The reason why a researcher contemplates heavily on the steps of the research is to get the most out of it in the end. One can read a pile of books on the research methods and relevant literature before setting out, but it does not guarantee success. The reason for this is when one starts research and the situation does not develop by the book, especially when research is done in different cities at institutions where barely anybody or nobody is known.

English in the age of globalization has a huge impact on education, especially on Technical Sciences Education. This paper is the result of cooperation between an ESP teacher (Tijana Dabic) and a professor from IT field (Zeljko Stojanov). Dabic has already reported on some issues concerning her research that deals with investigating the needs of IT students in English for Academic Purposes (EAP) classes in Serbia where Stojanov was one of many informants [5][6]. This paper exemplifies certain prolongation factors, which occurred during the very research, which influenced the validity and raised some ethical issues. Dabic explained how these unexpected factors occurred and how they had influenced the study, while Stojanov, as the author with greater experience in reporting qualitative research themes [7][8], provided theoretical background to support them.

The rest of the paper is structured as follows. The second section contains short overview of issues related validity and ethics related to empirical field studies. The

third and the fourth sections contain description of the research context and some examples where validity and ethical issues were disrupted. The fifth section contains some lessons learned from the study. The last section of the paper contains concluding remarks and further research directions.

II. BACKGROUND

Validity and ethical issues should be carefully examined in field studies with participants in order to increase credibility of the research. In the next subsections the main issues related to validity and research ethics related to field studies will be outlined.

A. Validity

Assessing the validity of research findings is particularly complex in mixed research, because it involves combining complementary strengths and non-overlapping weaknesses of quantitative and qualitative research [9]. Validity depends on research methodologies and paradigms that guide each particular research project. It refers to the *goodness* or *soundness* of a study. Validity is not fixed concept, but rather it is complex construct grounded in the processes and intentions of particular research [10]. Researcher is responsible for doing meaningful, trustworthy and valid research, which means that researchers should consider all conditions that influence research and also be aware of the limits of her or his knowledge [11]. Therefore, the researcher should frame validity in the context of his/her responsibility and decision-making during the research process, even when some circumstances disrupt the research. In Encyclopedia of Sociology Bohrnstedt stated [12, p. 3207]:

“Validity refers to the degree to which evidence supports the inferences drawn from a score rather than the scores or the instruments that produce the scores. Inferences drawn for a given measure with one population may be valid but may not be valid for other measures.”

Since this study uses mixed methods, validity refers to the validity of quantitative component, qualitative component of the research, and validity of the integration [9]. In quantitative research, validity is related to accuracy, relevance and reliability of measurement, and relies on rigorous adherence to methodological rules and standards [13]. In contrast to quantitative research, in qualitative research validity was concerned with understanding, representing or explaining a phenomenon that is researched [14]. In qualitative research, there is no single, static or objective truth because research is concerned with the meanings and personal experiences of individuals and groups. Therefore, the question with validity in qualitative research is: *How we can have confidence that we construct accurate representations of a phenomenon?*

Validity generally includes the following two aspects: (1) internal validity (design, collecting and interpreting data, drawing conclusions and presenting results), (2) external validity (generalizability of research findings, and possibility to repeat the study in similar settings, or in other fields).

Jick [15] discussed triangulation in mixed methods research. The most general definition of triangulation assumes combination of multiple methodologies to study the selected phenomenon. However, triangulation may be observed in many different ways. In practice, one can distinguish the following types of triangulation: (1) triangulation of various methodologies in the study, (2) triangulation within method, or using multiple techniques within a given method, and (3) triangulation of various data sources. Triangulation in the research study affects the complexity of research design. The most common case of triangulation is the use of survey methods and fieldwork in a single study. Although triangulation may increase the validity of the study, it can negatively impact the research process if some problems occur during the integration of research findings originated from different methods. Positive effects of triangulation are: (1) it allows researchers to be more confident of their findings, and (2) it stimulates the invention of new research methods.

B. Ethical Issues

Ethical issues are part of the everyday practice of doing research in all scientific fields. According to [16] the primary ethical principle is related to our responsibility for informants. In studies that include people with various roles, all possible threats that can violate ethical principles should be carefully examined. Researchers are responsible for the dignity, respect, and welfare of participants. The main ethical prerequisite for any research study is that no harm will come to participants [4]. In most studies, the following ethical issues have been addressed: (1) informed consent, (2) protecting privacy of participants and institutions affected by the research, (3) and willingness to participate in the research.

Although literature provides comments on ethical issues, detailed discussions about issues such as misrepresentation, informed consent or ethical principles that guide interaction with research participants are seldom explicitly considered, or are overlooked. Informants are usually considered only as a source of data and do not receive any information about research findings. Ethical issues that should any research consider are possible risks and benefits for all participants. Collecting and understanding participant reactions about the research study can help in assessing the quality of the study and promoting the scientific integrity of research findings.

Research subjects have the right to be informed about the nature and consequences of research in which they are involved. Two conditions that ensure proper respect for research subjects' freedom are: subjects must agree voluntarily to participate, and their agreement must be based on full and opened information. This information includes duration of research session (interview, observation, or experiment), methods, possible risks and the purpose of the research. Thorne [17] suggested that informed consent document should contain fair explanations of all issues relevant for protecting research participants.

Protecting people's identities and those of the research locations is one of the main concerns of ethics in

qualitative research. Confidentiality should ensure against unwanted exposure, which means that all personal data ought to be secured or concealed [18]. Qualitative field studies often contain rich descriptions of study participants whose confidentiality is of particular concern to qualitative researchers. The consequence is that researchers face a conflict between conveying detailed and accurate accounts of the studied phenomenon and protecting identities of the individuals who participated in their research [19]. According to Kaiser [19], confidentiality should be addressed during research planning and at three points during the research process: data collection, data cleaning, and dissemination of research results.

III. RESEARCH CONTEXT

The purpose of the research, the first author conducted, was to carry out a needs analysis of IT students in Serbia concerning the organization and the content of English subjects at IT departments in Serbia. The research was conducted from November 2011 to April 2012 at the IT departments at the following institutions of tertiary education in Serbia: Faculty of Organizational Sciences and Faculty of Electrical Engineering in Belgrade, Faculty of Technical Science, Faculty of Science and Higher Technical School of Professional Studies in Novi Sad, Technical Faculty "Mihajlo Pupin" in Zrenjanin, Faculty of Technical Science in Čačak and Higher Technological School of Professional Studies in Šabac. The instruments used were: a survey for students of the second and third year of IT departments, a survey for the professors and assistants teaching IT subjects at the IT departments and the structured interview for both students and teachers. The results obtained from the surveys were analyzed with SPSS Statistics software [20]. The interviews were recorded and later transcribed. To analyze the findings and opinions gathered from interviews the interpretive analysis typical for qualitative research methods was used.

The first author was interested in seeing whether there are any marked differences between the opinions of professors, assistants and students, likewise whether there are any differences between the opinion of the students of the second and third year studying at IT departments. There are two reasons for choosing the students to be from the second and third year: (a) students are more occupied with some general subjects during the first and second year; at the third year they are more focused to their particular field of study; (b) at Higher Schools of Professional Studies and at the Faculty of Technical Science in Čačak the last year of studying is the third year. The number of students who filled the questionnaire was 775; the number of professors and assistants who filled the questionnaire intended for them was 77. The interview sample includes 32 informants, 4 from every educational institution (1 professor, 1 assistant, 1 student of II year and 1 student of III year).

The author's plan had three clear goals (1) to finish the research during the winter semester of academic year 2011/2012; (2) to distribute questionnaires first, to collect them, analyze them and then do the interviews (3) to interview only volunteers.

IV. THE DIFFICULTIES FACED IN THE FIELDWORK

At the very outset of the research on 15th Nov 2011 at Faculty of Technical Science (FTS) in Novi Sad, the author was confronted with the first obstacle. The contact person was an assistant who was teaching the third-year students at Computing and Control Engineering department who arranged the distribution of questionnaires and found people willing to take part in an interview. The author thought to ask him to recommend a colleague who was teaching at the second year, but he had no one to recommend. The author ended up knocking at the doors of professors teaching at IT department looking for somebody who taught at the second year and who was willing to cooperate. The author found most of the doors locked or professors who were not teaching at the second year. Eventually, the author was given the mail of a professor who was allegedly teaching at the second year. The author contacted him, but was redirected to another professor who redirected her to some other and it happened three more times. Being devastated, the author wrote to the Head of IT department asking for help and got everything arranged in thirty minutes. The distribution of questionnaires to the second-year students took place on 7th Feb 2012, as well as the interviews with the students.

Experiencing the prolongation of the time needed to accomplish the research at FTS in Novi Sad the researcher decided to give up the intention of following the procedure to distribute the questionnaires first and do the interviews afterwards. The similar happened at other institution where the research was being conducted due to some different issues that arose. The motto became: *Go to the location of the research and do as much as you can.* Knock on every door, carry the questionnaires with you, do the interviewing, talk to the people you encounter about the topic, spend the whole day there.

The prolongation of the research period inevitably influenced the validity of the research. If the author had stuck to the plan to distribute and analyze the questionnaires before doing the interviews, she would have got the results of needs analysis by the means of statistical analysis and she would have been able to discuss significant data later with the interviewees. In that why, the author would have come to the valuable answers of domain experts and would not have to ponder about the possible explanations relying on herself and the relevant literature she had read.

The prolongation of the research period affected the validity in one more way. As it was mentioned at the beginning of the paper, the researcher had the goal to finish all the activities connected to the research by the end of the winter semester. There were several reasons for this. The first reason was that students' opinions could change as they progress during their studies. For example, during the third year they are gradually introduced to the subjects that are more connected to their future area of expertise, so it is not the same state of the students' mind at the beginning of the fifth semester and nearly at the end of the sixth semester. In the same way, their attitudes towards the importance of English classes can change as well as their idea what would serve them best concerning the content. The case of FTS in Čačak is an excellent

example to demonstrate this. The questionnaires were handed to the English teacher on 19th Nov 2011, and the agreement was made for the author to come in three weeks' time and do the interviews. The unexpected factor was serious medical condition of a close family member of the contact person. Very soon, the winter holiday started, in January there was reduced number of the staff so we agreed to meet at the beginning of the summer semester in February. The second unexpected factor was bad weather conditions in February 2012 covering Serbia in ice and snow. In March 2012, the author was occupied with conducting the interviews in Novi Sad, so that she went to Čačak on 4th April 2012, which was officially the last day of the research.

During the research, some ethical issues raised. In this particular case, they are related to the willingness of the informants to participate in the interview. If one is asked to participate in research, especially in an interview where their statements and opinions are recorder for the sake of the accuracy of the results, it is important to state whether they volunteered to share their opinions and beliefs or they were asked, told or ordered to do so. Informants usually volunteer to participate in an interview, which means that they are willing to share their piece of mind about a specific topic. However, we cannot always be sure whether it is their free will or not. An example from the undertaken research that can support this issue happened at Higher School of Professional Studies in Šabac. The contact person was the English teacher, an experienced and sophisticated middle-aged lady, who chose in advance a student from the third year. When the author was distributing the questionnaires to the second year students, the author asked who would like to take part in an interview. Nobody answered. In the end the IT professor, chose one student and he unwillingly followed the author to the library where the interview took place. The difference was significant regarding the way in which these two students expressed themselves. The former was open-minded and glad to share his opinions. The latter was anxious, like he was on a trial, did not know what to say nor could fully understand what he was asked. Nevertheless, the different attitudes towards the interviewer and the interview can also be related to the differences between the personalities of two students, but according to the interviewer's impression the major impact on the second student was the fact that he had been pushed into interviewing.

V. LESSONS LEARNED

As we can see, various situations can emerge during the period of research that can affect validity and raise ethical issues, but precautions should be taken to avoid this kind of situations as much as possible. Based on the experience gained during this research, the authors suggest several steps to be taken before starting the research (mostly applicable to larger size researches which usually include more than three locations): (1) always find the contact person at each research location/institution before starting the research, do not leave any relevant contact to be made when you already start research; (2) meet the contact person before starting the research because people are more willing to help you when they

see you in person; (3) arrange all the details of the research actions with the each contact person; (4) be sure that the contact person is well-informed what he or she is expected to do; (5) always count that you will need some extra time to finish the research so make sure that you do not start the research close to the big holidays or the end of a semester or a school year; (6) read thoroughly on the literature dealing with the validity and ethical issues before starting your research.

VI. CONCLUSION

As have been stated several times in the paper, when one embarks on the research journey they can encounter many unexpected situations to deal with. However, certain preparatory steps can be undertaken to avoid them or at least to lower the possibility of encountering them at all.

Nevertheless, in the case of unpredicted situations, the researcher is responsible to make right decisions, and to be aware of consequences. One way to do that is to be more reflexive and to collect all experiences during the research in order to increase the validity of the study, and to ensure that ethical issues will be satisfied.

Further work will be directed towards more detailed elaboration of validity and ethical issues faced during the mixed method research, based on the case studies conducted by the authors. In addition, some issues related to researchers reflexivity will be further investigated.

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Automatic Baum Tests Clasification

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Abstract - The present paper is an evaluation of the potential advantages of using a software application in order to interpret the information resulting from the drawings made under the Baum test. The trials of developing operational software as a tool for the interpretation of the tree drawings are also presented. The software can provide to the psychologist the data necessary to detect some significant traits pointing to personality aspects that should be approached. The Baum test is very popular due to the fact that it can be quickly administrated and it is a quite relevant when applied to children. If the software were used in school, where the psychologist has to interpret thousand of drawings in a relatively short period of time, it would confirm its value in rapidly detecting the problematic drawings. The main advantage is that the process of identifying the children who need counseling or psychological intervention will be much more rapid.

I. GENERALITIES

The Baum Test was developed and standardized by Charles Koch between 1952 and 1957, which makes it a rather old psychological and psychiatric technique. Even though its reliability has been contested, Baum tree is still largely applied to identify important aspects regarding the participant's affective condition, self-image, and, generally, emotional development [6]. The Baum Test is a type of projective drawing through which a person projects his inner states and needs, based on ambiguous, unstructured stimuli. As drawing is a pictorial language the test may be efficient when applied to children and to introvert or reticent people. The way of expression is subjective and the interpretation of the drawing may involve a great dose of subjectivity, too. This is the main reason the projective tests are considered questionable and obsolete and therefore their results invalid or unreliable. Yet, the Baum Test is still frequently used by psychologists, psychotherapists and psychiatrists as it has proven its value when used together with a battery of other psychological tests and evaluations [2].

The test presents some advantages that have maintained it in the clinical psychological practice: it is easy to administer as it takes short time and it requires little material base (an A4 blank paper and a pencil), minimal standard instruction and it can also prevent a defensive attitude. Yet, these advantages have counterpart drawbacks: a minute and time consuming interpretation which usually tends to lack objectivity. These problems can be diminished and maybe eliminated by developing a software application to be used as an instrument in administrating the Baum Test. The software can provide

the psychologist with the information necessary to detect some important traits, pointing to personality aspects that should be approached. The use of image processing techniques and pattern recognition methods to pre-classify Baum test results has the advantage of being time-effective and it also provides an objective base to the psychological interpretation, therefore increasing its reliability.

The Tree Drawing Test has proved efficient especially with children. Children feel secure when they draw, they usually enjoy this activity and their pictorial expressivity may be better than the verbal one. When in dialogues with an adult who they are not familiar with, children become shy or defensive and even frightened. That is why an investigation based on projective drawing is efficient with children and it is worth developing an instrument to make the assessment more rapid and objective.

Therefore, a computer application able to automatically sort the drawings of the children potentially manifesting abnormal psychological features represents a useful tool for clinicians. This application is not only time-efficient, and children-friendly, but it also cost-efficient because it reduces the number of specialists to be involved in testing a large number of subjects.

II. METHODS AND MATERIALS

A number of 152 projective drawings made by typically developing children, between 7-10 years old were administered. The children were firstly asked to draw a tree on an A4 blank sheet of paper, with a pencil, and afterwards, they had to draw a fruit tree on another sheet of paper. The subjects were instructed to draw a fruit tree in any way they like. The drawings were scanned and edited to improve the image quality in order to ensure optimal image processing.

The first stage of the described software program is of obtaining the ratios calculated during the structural analysis of a drawing involved in quantifying the results of the test. When assessing a tree drawing the clinician takes into account a set of objective indicators such as: the position of the tree on the sheet of paper (in the middle, to the left, to the top, to the bottom), the measurements of the tree trunk, roots, limbs or leaves as well as the ratio of trunk to crown, of the root to trunk and crown, and the ratio of left side to right side. If these measurements are precisely quantified they will represent reliable indicators of emotional disorders and the computer-assisted evaluation will rapidly and automatically draw the

psychologist's attention to a potentially emotionally or intellectually disturbed child.

After scanning and editing the drawings, the segmentation is performed, representing one of the most important steps in the processing of an image [1].

In Fig. 1, the image of the tree is shown with the pixels reversed, and in Fig. 2 its binary segmentation is displayed.

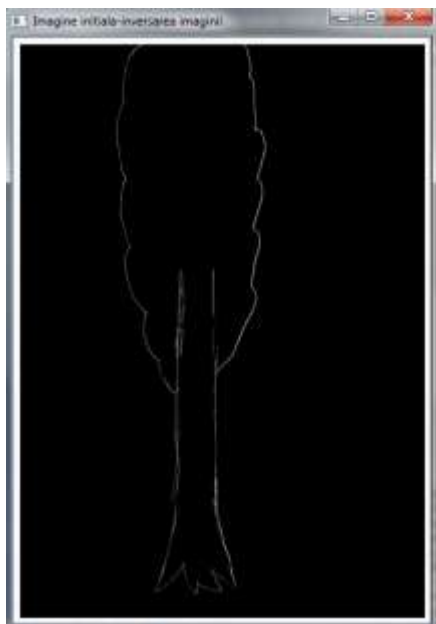


Fig. 1 The image of the tree

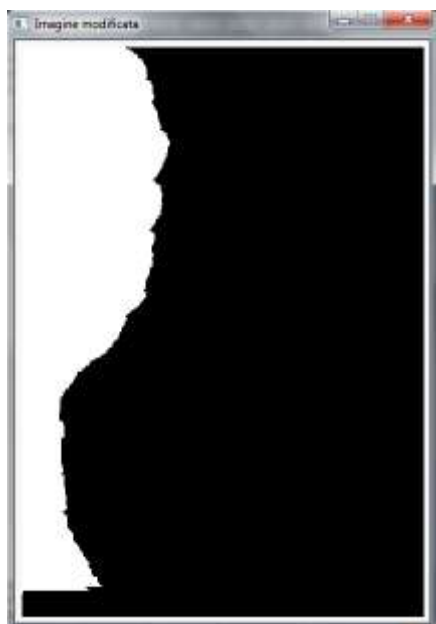


Fig. 2 Binary segmentation

The image segmentation refers to the partitioning of an image into its various components. As a result of segmentation, distinct objects are extracted from the image, regions that satisfy certain criteria of uniformity, or other elements [8]. For this segmentation the three main parts of a tree: the root, the trunk and the crown must be taken into account. The division will be followed by measurements in centimeters and by the calculation of the ratios between the three main parts of the tree. The parameters of the tree drawing and the placement of the drawing in the graphic space are the first priorities to be answered by our application. Both the position of the drawn tree on the page and the dimensions of its tree parts make important criteria in the clinician's decision concerning the classification of the subject as normal or suspect of psychic problems. For example, if the tree is placed on the left side of the page, this indicates self-censorship, adjusting difficulties and emotional conflicts. The application can signalize this to the psychologist automatically.

The positioning of the tree on the page is an indicator that may be rapidly noticed by a psychologist, yet the fact that by an automatic evaluation an abnormal or peculiar position may be quickly identified involves the advantage of a fast intervention.

A more difficult part in the assessment process of the applied Baum Tree is the establishing of the measurable parameters and of their ratios. The psychological significances of these parameters and proportions have been clearly and minutely defined [8]. In many cases a certain ratio can have a variety of interpretations. For instance, if the trunk height is smaller than the crown height this may suggest: idealism, need of valorization and self-valorization, self-consciousness, enthusiasm, passionate spirit, intellectualism, ambition, spiritual vivacity, pride, phobia, limited sense of reality, superficiality, versatility, and psychic retard [4]. It is obvious that after the computer application has identified the disproportion, it is the psychologist or psychiatrist role to identify the precise psychological significance of the proportion calculated by the computer [5].

The ratios to be calculated after segmentation and measurements are: the ratio of trunk to crown, the ratio of root to trunk and crown. For the presented work we have considered so far only the crown and trunk.

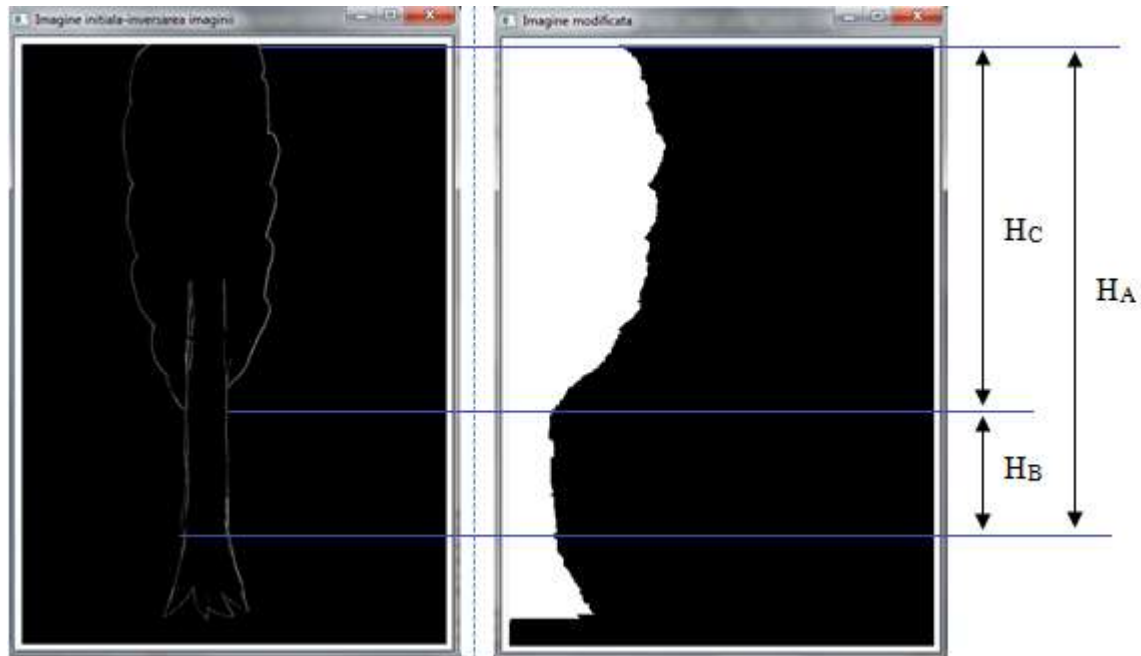


Fig 3. Detection of Crown height HC and total tree height HA

If the measurements indicate that the root height is bigger than the sum of the trunk and crown height a psychic disorder or illness should be taken into account.

Other measurement that may be done regards the dimensions of the tree, the width of the trunk, the width of the crown, their width to the left or to the right, all these parameters being indicators of a psychological significance. For example, if the tree is undersized this may signalize psychic immaturity or exhaustion. In any case it is a rare and abnormal representation which can be identified as early as possible through the software application.

Another aspect of the drawing which represents criteria in identifying potential psychological disturbances are related to the shape of branches (one-line or tubular branches), the end of branches (open, closed), the branch crossing and the visibility of the roots. All these parameters identified through a structural analysis of the drawing could be calculated by developing the software application described by the present paper. Developing a software application as an instrument in administrating the Baum Test may become a very useful tool in the early identification of children's emotional or psychic disorders, when applied to preschool or school toddlers by the psychologist of the educational institutions they attend. In Romania, a psychologist may have to assess the pupils from two or even three schools. It is almost impossible for one psychologist to correctly evaluate thousands of tests in a time short enough to efficiently identify the potentially disturbed children and to develop an intervention program to address the identified problems. A computer application based on image processing can provide the solution for a rapid and precise identification of the drawings displaying deviations from the normal patterns. It also increases the objectivity of the evaluation, based on ratios and figures which can be easily associated by the clinician with their psychological significance.

III. CONCLUSIONS

Since the Baum Tree is still frequently used in spite of the critics regarding its subjectivity, a software application to be an instrument in the drawings assessment can increase the objectivity of the results. The structural analysis of the drawn tree can be computer assisted which will increase the rapidity of obtaining the results and of identifying the potential problems.

The psychologist or psychiatrist can be given the exact parameters and ratios for thousands of scanned drawing in a short time. This is not only time-efficient, but also cost-efficient, not to mention the advantages of identifying potential disorder indicators in a drawing, which will result in an intervention program as early as possible with great benefits for the patient and his family.

The described application is only in its early stage yet it has proved its potential in becoming a valuable tool. The structural analysis will be followed by the development of a morphological analysis in order to transform the present application in a reliable and efficient instrument.

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Calculation of the Quality and (un)Availability of the RR Link

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Abstract - Designing an RR (radio relay) link is a methodical and systematic process that, among other things, includes the calculation of losses and attenuation, fade and fade margins, interference calculations as well as the calculation of quality and availability. The paper presents the results of a mathematical model for the calculation of quality and availability of microwave link and the results obtained through the use of the software package Pathloss.

I. INTRODUCTION

Planning radio relay systems involves determining the main parameters of the radio relay system [1]. The paper analyzes a radio relay link between the base transceiver station (BTS) point X and BTS point Y. The solution presented was designed to include a frequency plan for the radio relay link in relation to the existing conditions, the route and profile of the terrain of the radio relay link, and the calculation of the expected results of the route quality and the radio relay link availability.

The route analysis was completed with software tool Pathloss 4.0 while the calculation of the radio relay link quality was determined using the ITU-T and ITU-R recommendations and specific standards for link quality [2]. Methodological calculation of the radio relay link availability was completed taking into account the possibility of unavailability due to malfunction of the equipment, rain or multipath propagation [3]. The paper shows the results of the radio relay link quality and availability calculation based on presented mathematical models and input data for the analyzed route, antenna systems on the sites X and Y and device parameters. The software package Pathloss 4.0 was then used [4], the input data for the package were presented and the quality and availability calculation for the observed radio relay link was completed. The input data were obtained by actual measurements of the observed route.

Comparative analysis of the results obtained using both methods was done and it was concluded that the values obtained meet the standard radio relay link quality and unavailability requirements.

II. PROJECT REQUIREMENTS OF THE RR LINK

The paper provides an example of the process of the route planning for the transmission of signals between the BTS point X and BTS point Y. The project assignment defines the radio relay section at the default route of the minimum bandwidth rate of 170 Mbit/s with the possibility of simultaneous transmission $n \times EI$ and

Ethernet signal, which shares the overall bandwidth [5]. The system is designed to work in 1+0 configuration, which means that the RR transmission system is configured for transmission by one working channel with unprotected traffic. Linkage and multiplexing to the existing transmission system path to the end user is conducted at point B. The solution of planning the link should include:

- a) Frequency plan for a given RR link in relation to the existing conditions,
- b) The RR link route and terrain profile,
- c) Calculation of the expected results of the route quality and RR link availability,
- d) The equipment required to meet the results expected,
- e) Basic components for antenna installation (azimuth and elevation), the type and diameter of the antenna,
- f) Basic elements for the configuration of the device (power output),
- g) Instructions for equipment mounting.

Since the issues d), e), f) and g) exceed the scope of the paper and are related to specific situations depending on the type of the antenna supplied, antenna pole type and concrete requirements for the required services, they will not be analyzed in the paper.

The complete RR link quality calculation (flat fade probability, rain fade, and selective fade probability) was done in line with the ITU-R recommendations provided in the project assignment. The calculation result for the RR route quality was analyzed using mathematical models and software package for RR link quality and availability calculation. The software packages use the same mathematical models, with certain approximations in calculations related to the limitations of the computer using the software.

Frequency of the transmitting T_x and receiving R_x channels in point X are 12898.000 MHz and 13164.000 MHz, respectively, while point Y exhibits reversed frequency of 13164.000 MHz in the transmitting T_x channels and 12898.000 MHz in the receiving R_x channels. Polarization is vertical for all channels.

III. RR ROUTE ANALYSIS AND TERRAIN PROFILE BUILDING

Recording the terrain profile was necessary to determine the pole sites and the antenna height. Special attention was devoted to determining the line of sight between certain sites in order to avoid fading due to reflection and obstacles within the I Fresnel zone. The radio link path propagation profile is a vertical cross section of the terrain between the two points observed and referenced in relation to the sea level with the marked axis of propagation and I Fresnel zone.

The propagation axis shows the line-of-sight (LOS) between the observed sites [6]. In order for the RR route to be usable, I Fresnel zone should be unobstructed. Figure of the radio link profile path propagation shows there are no obstructions to the Fresnel zone (Figure 1)

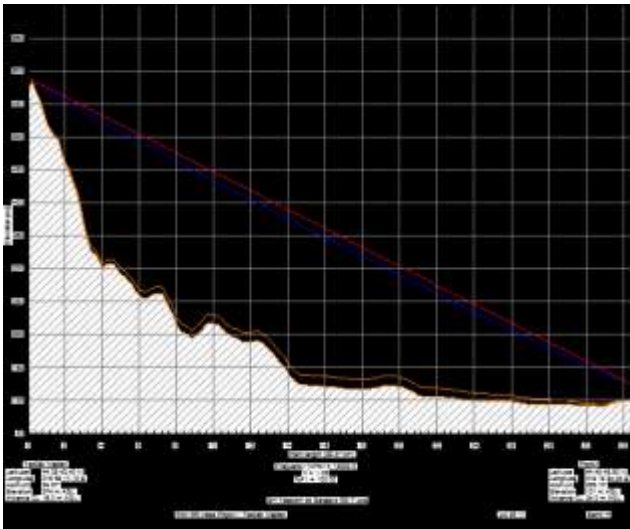


Figure 1 RR site A –site B route profile

Based on the analysis of the profile and the situation on the ground the antenna height is determined by applying a particular value of K-factor and 1.0 *FI* clearance over the highest obstacle in the radio link propagation path. It was necessary to calculate the new antennas' height which meets the *K* and *I Fresnel zone* value requirements in relation to climatic conditions. In case of temperate climate, the 0.0 *FI* clearance is applied if there is only one isolated obstacle in the route, or the 0.3 *FI* clearance if there is an obstacle that stretches across a section of the route. For tropical and subtropical climate the 0.6*FI* clearance is applied for the route over 30 km long.

IV. ESTIMATING RR LINK QUALITY AND (UN)AVAILABILITY

Calculation of the RR link quality was made in line with the set ITU recommendations. The norms of the link quality are defined in the ITU-T recommendation Rec. G.826 (12/02) and the specific quality standards for radio-relay links are given in Recommendation ITU-R Rec. F.1668-1 (01/07). This Recommendation takes into account the fact that the radio-relay links are transmission media subject to fading. The link quality defines standards for ESR (*Errored Second Ratio*), BBER (*Background Block Error Ratio*) and SESR (*Severely Errored Second Ratio*). ESR is the ratio of errored seconds to total seconds in available time during a fixed measurement interval. SESR is the ratio of SES to total seconds in available time

during a fixed measurement interval. BBER is the ratio of background block errors (BBE) to total blocks in available time during a fixed measurement interval, excluding all blocks during SES and unavailable measurements. Quality standards for real fixed wireless links for ESR depend on the capacity of the access point, unlike the BBER and SESR standards. Recommendations ITU-R F.1668-1 and ITU-T G.826 defines parameters ESR, BBER and SESR to evaluate system performance in terms of quality. Among them, the most important parameter is SESR. The calculation determines whether the quality standards defined for BTS Point X - BTS Point Y are classified as short-range links. In that case, quality standard is $SESR_{norm} (\%) = 0.015$ (which is equivalent to 389 SES/month). The calculation showed the SESR (%) for the worst month = 0.010633687 (which is equivalent to 308.82 SES/month). Given that the SESR (%) < $SESR_{norm} (\%)$, the standard requirement is met.

RR link unavailability calculation was made in accordance with the set ITU recommendations. Standards for unavailability are defined within the ITU-T recommendation Rec. G.827 (09/03), while recommendation ITU-R Rec. F.1703 (01/05) defines radio-relay links unavailability parameters. This Recommendation takes into account the fact that the RR links are transmission media subject to fading. Target AR (*Availability Ratio*) and OI (*Outage Intensity*) applicable to each of the directions of the fixed wireless link length L_{link} , can be estimated using the parameter values $B_5=0$ and $C_5=5 \times 10^{-4}$ for access links, $B_6=0$ and $C_6=4 \times 10^{-4}$ for short range and $B_7=1.9 \times 10^{-3}$ for $50 \text{ km} \leq L_{link} < 250 \text{ km}$ and $C_7=1.1 \times 10^{-4}$ for $50 \text{ km} \leq L_{link} < 250 \text{ km}$. The OI target value parameters are as follows: $D_5=0$ and $E_5=100$ for the access link, $D_6=0$ and $E_6=120$ for short range and $D_7=150$ for $50 \text{ km} \leq L_{link} < 250 \text{ km}$ and $E_7=50$ for $50 \text{ km} \leq L_{link} < 250 \text{ km}$. The results were obtained from the following equations for the AR, Mo. (*Mean Time Between Outage*) and OI (*Outage Intensity*).

$$AR = 1 - \left(B_j \frac{L_{link}}{L_R} + C_j \right) \quad (1)$$

$$Mo = \frac{1}{OI} = \frac{1}{D_j \frac{L_{link}}{L_R} + E_j} \quad (2)$$

where $j=5$ for access link, $j=6$ for short-range connection and $j=7$ for long-range connections. L_R is the reference length and $L_R=2500 \text{ km}$. The lower limit for the L_{link} is $L_{min}=50 \text{ km}$. Based on relations (1) and (2) the connection unavailability and outage intensity standards are obtained, as recommended by ITU-R F.1703 which are consistent with the general standards specified in Recommendation ITU-T G.827. Values are given in TABLE 1.

TABLE 1 LINK UNAVAILABILITY AND OI STANDARDS IN LINE WITH ITU-R F.1703/ITU-T G.827

Connect ion Class	Long range	Short range	Access
	$50 \text{ km} \leq L_{link} < 250 \text{ km}$		
US (%)	$0,011 + 0,000076 L_{link}$	0,04	0,05
OI	$OI = 0,06 L_{link} + 50$	120	100

Table 1 shows that standards for link unavailability for short-range links and access do not depend on the length of the path shares. Standards for the unavailability of long-

range links are proportional to the length of the link with minimal link length of 50 km. The calculation examines whether defined standards for link unavailability refer to the entire link. The calculation shows link unavailability of $US_{norm}(\%)=0.04$ (which is equivalent to 210 min/year). The calculation shows that the link unavailability $US(\%)=0.02008399$ (which is equivalent to 105.561 min/year) is less than the given standard, which means it meets the set requirements. Link unavailability is calculated as the sum of unavailability due to equipment malfunction $Ne(\%)$, unavailability due to rain $US_{rain}(\%)$ and unavailability due to multiple propagation $US_{gvp}(\%)$ (GVP- annual multiple propagation). Unavailability of a device module unit is estimated as follows:

$$N_1 = \frac{MTTR}{MTBF + MTTR}$$
, where MTTR refers to *Mean Time to Repair* (h), and MTBF refers to *Mean Time Between Failure* (h). For telecommunications devices $MTBF \gg MTTR$, with $N_1 \approx \frac{MTTR}{MTBF}$. Outage intensity

is $\lambda = \frac{1}{MTBF}$, with $N_1 = MTTR \cdot \lambda$. Unavailability of the parallel modules is calculated using the following

expression: $N = \prod_{i=1}^n N_i$, where N_i represents individual module unavailability, and N represents total unavailability of the system with parallel link modules. If the RR link is made up of several sections that make up a serial connection, then the unavailability due to equipment malfunction is calculated using the formula as follows:

$$N_s = 1 - A_s = 1 - \prod_{i=1}^n (1 - N_i) \approx 1 - \left(1 - \sum_{i=1}^n N_i\right) = \sum_{i=1}^n N_i$$

where: N_s represents total unavailability of modules linked, A_s represents total availability of modules linked, N_i represents unavailability of the module to the power of i , $i = 1, 2, 3, 4, \dots$. MTBF values in [h] for used ODU's (*outdoor units*) and IDU's (*indoor units*) in the project are the same and amount to 262968. Outage intensity is then:

$$\lambda = (\lambda_{IDU} + \lambda_{ODU} + \lambda_{ODU} + \lambda_{IDU}) = \left(\frac{1}{MTBF_{IDU}} + \frac{1}{MTBF_{ODU}} + \frac{1}{MTBF_{ODU}} + \frac{1}{MTBF_{IDU}} \right)$$

$$\lambda = 7,33 \cdot 10^{-6}. \text{ If } MTTR=4\text{h, then } N = 2,932 \cdot 10^{-5}.$$

Device unavailability is $N_e = 2,932 \cdot 10^{-5}$ (or 15, 41 min/year), that is, unavailability due to device failure is $N_e(\%)=0,002932$. For the purposes of high-quality transmission it is important to determine both the fade depth, which can occur in the route between the transmitters without the connection breaking, and the corresponding likelihood of fading exceeding the value of the reserves in the route [7]. The estimate calculations presented in the paper offer only basic formula used for quality and unavailability calculations of the BTS Point X - BTS Point Y link. The probability of overcoming fading reserves for $BER = 10^{-n}$ due to flat fading without diversity

$P_{ns}(\%)$ is expressed as: $P_{ns}(BER > 10^{-n}) = P_o \cdot 10^{-\frac{M}{10}}$ (%), where $n=3$ or $n=6$, P_o - fading occurrence indicator (%), M - fading margin (dB) for $BER 10^{-3}$ (ili 10^{-6}). This means that P_{ns} responds to *SES* (*Severely Errored Seconds*).

Depending on whether the features of the terrain s_a are known different versions of determining the fading occurrence indicator can be applied. The total propagation attenuation is added to attenuation due to atmospheric gases. Total attenuation in free space is L_{totfs} (dB) defined as $L_{totfs} = L_{fs} + A_a$. Total attenuation L_{tot} (dB) is defined as the sum of the total attenuation in free space L_{totfs} (dB), branching attenuation L_b (dB) and attenuation tolerance L_{tol} (dB), i.e. L_{tot} (dB) = $L_{totfs} + L_b + L_{tol}$. Signal level at the entrance into the receiver without fading (dBm) is defined as difference between the transmitter output impedance (dBm) and attenuation from transmitter to receiver without fading (dB). Fading margin (dBm) for $BER 10^{-3}$ or $BER 10^{-6}$ is defined as difference in signal level at the entrance into the receiver without fading (dBm) and receiver threshold level (dBm) for $BER 10^{-3}$ or $BER 10^{-6}$. The probability of overcoming the given BER value (10^{-3} and 10^{-6}) due to selective fading without diversity is

determined as follows: $P_s = 430 \cdot \eta \cdot sf \cdot \frac{(\tau_m)^2}{\tau_r}$ (%), where

η represents fading activity indicator

$$\eta = 1 - \exp \left[-0,2 \cdot \left(\frac{P_o}{100} \right)^{\frac{3}{4}} \right], \text{ } P_o \text{ is fading occurrence}$$

indicator (%), sf is signature equipment indicator derived from signature curve of the signature equipment applying

$$\text{equation as follows } sf = \frac{1}{2} \left(W_M \cdot 10^{-\frac{B_M}{20}} + W_{NM} \cdot 10^{-\frac{B_{NM}}{20}} \right),$$

where W_M is the signature width of minimal phase (GHz), B_M signature depth (dB), W_{NM} non-minimal phase signature width (GHz), B_{NM} non-minimal phase signature depth (dB), τ_m medium delay for reflection models times

two, $\tau_m = 0,7 \left(\frac{d}{50} \right)^{1,3}$, d is the route length in km, τ_r is

referent delay time (ns) $\tau_r=6.3$ ns. The total probability of overcoming error degree of 10^{-3} or 10^{-6} without diversity or $SES(\%)$ is the sum of probability of overcoming error degree of 10^{-3} or 10^{-6} due to selective fading without diversity $Ps(\%)$ and probability of overcoming error degree of 10^{-3} or 10^{-6} due to flat fading without diversity $Pns(\%)$. Rain attenuation also causes link unavailability.

Longitudinal rain attenuation γ_k (dB/km), at a given rainfall intensity R (mm/h) is a frequency and polarization function $\gamma_k = K \cdot R^\alpha$, where coefficients K and α are obtained from the table. Since the rain does not fall with the same intensity along the entire route section the concept of the effective length of the route section is introduced as $d_{eff} = d / (1 + d/d_0)$, where d_0 is the reference length of the route (km) with $d_0 = 35 \cdot e^{-0,015R}$ and R expresses the rainfall intensity (mm/h) exceeded within 0.01% of time (with the time integration of 1 min). The attenuation exceeded by 0.01% of the time is calculated as $A_{0,01} = \gamma_k \cdot d_{eff}$. Unavailability due to rainfall on the route section is described with a link between the fade margin M (dB) and the unavailability of U.S. (%): M (dB) = $0,12 \cdot A_{0,01} \cdot US^{-0,546+0,043 \log US}$, where US is unavailability due to rainfall (%). Unavailability due to rain can be determined as follows:

$$US_{rain} = 10^{11,628 \left(-0,546 + \sqrt{0,29812 + 0,172 \log(0,12 \cdot A_{0,01} / M)} \right)} (\%)$$

SES for the worst month (nm) without diversity is then calculated as $SES(\%) = P_{ns}(\%) + P_s(\%)$. Link unavailability parameters are defined at the level unavailability per year, so the probability results of the of overcoming error degree of 10^{-3} for the worst month is to be reduced to a whole year in accordance with Recommendation ITU-R P.530-13: $US_{gvp}(\%) = 10^{-0,1\Delta G} SES_{nm}(\%)$ where ΔG (dB) represents a logarithm geo-climate conversion indicator dependent of latitude and route inclination. Accordingly, $US_{god_uk}(\%) = US_{gvp}(\%) + N_e(\%) + US_{kisa}(\%)$.

V. CALCULATION RESULTS

The calculation results for the link quality and unavailability in aforementioned mathematical models are given in table 2 and table 3 (based on Recommendation ITU-R P.530-13 (10/09)), for the frequency band used (12.75 to 13.25 GHz). The tables show that the predicted transmitter power output is +20 dBm, and the expected level of the input signal into the receiver is -42.05 dBm.

TABLE 2 PART OF THE RR LINK QUALITY CALCULATION

Calculation		
Attenuation	L_{fs} (dB)	144,9752004
	A_a (dB)	7,98762
	L_{totfs} (dB)	152,9628204
	L_{tot} (dB)	153,9628204
	AttenuationTx-Rx without fading (dB)	69,96282041
	Signal level on entrs to receiver without fading (dBm)	-49,9628204
	M (dB)for BER= 10^{-3}	21,53717959
Flat fading	Inclination indicator e_p (mrad)	16,66153372
	Geo-climate indicator K	6,531E-04
	Fading occurrence factor P_0 (%)	1,4957
	P_{ns} (% time) for BER>> 10^{-3}	0,010498320
Selective fading	Selective fading activity indicator h	0,008517305
	τ_m (ns)	0,39935949
	sf [GHz, dB](BER 10^{-3})	0,00146
	P_s (% time) BER>> 10^{-3}	0,000135366
Rain fade	Reference route length d_0 (km)	18,6
	Effective route length d_{eff} (km)	11,8
	Length auttenation coefficient K_v	0,03266
	Length auttenation coefficient a_v	1,0901
	$A_{0,01}$ (dB)	22,74851761
	US rain (%)	0,01150722

TABELA 3 PART OF THE RR LINK UNAVILABILITY CALCULATION

Unavailability due to device failure	MTBF _{IDU} and MTBF _{ODU} (h)	262968
	Outage Intensity (IDU) I_1 i (ODU I_2)	3,80274E-06
	MTTR (h)	4
	N_e (%)	0,00608439
	SES worst month (seconds)	27,56251542
	ΔG (dB)	8,307147089
	US_{gvp} (seconds)	495,1944294

The estimated link quality and availability results obtained by PathLoss 4.0 program are provided in TABLE 4, for frequency band used (12,75 – 13,3 GHz).

TABLE 4 PART OF THE RR LINK QUALITY AND UNAVAILABILITY CALCULATION USING SOFTWARE PACKAGE PATHLOSS 4.0

Point X-Point Y.pl4	Point X	Point Y
TX power (dBm)	20.00	20.00
RX threshold level (dBm)	-71.50	-71.50
RX signal (dBm)	-42.04	-42.05
Worst month SESR	1.05E-05	1.05E-05
ESR – multipath	3.84E-05	3.84E-05
Worst month multipath Unavailability	3.73E-06	3.74E-06
Flat fade margin - rain (dB)	29.46	29.45
Rain attenuation (dB)	29.46	29.45
Annual rain outage (min)	18.88	18.90
BBER – rain	6.77E-06	6.77E-06
ESR – rain	2.78E-04	2.78E-04
Annual unavailability	3.65E-05	3.65E-05

VI. CONCLUSION

Based on the calculation results obtained through mathematical model derived from the ITU recommendation forms, data obtained from real radio-relay system equipment manufacturers and the results of the software package PathLoss 4.0, it can be concluded that in both cases obtained values meet the requirements of the ITU R-F.1668/ITU-T G.826 for RR link quality and ITU-R F.1703/ITU-T G.827 and ITU-R F.1703/ITU-T G.827 for RR link unavailability. The difference observed between the calculation results obtained through mathematical models and those obtained through Pathloss program is related to limitations of the SW package which does not include availability due to device failure in its calculations, nor does it calculate the specific attenuation due to atmospheric gases in the total attenuation in free space or approximations used in both cases. The results were obtained by initial measuring and subsequent periodic measurements under different climatic conditions, and it can be noted that the real results correspond with estimated values, which shows that proper selection of RR equipment was made and that antenna height was properly determined at both sites.

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The Role of Human Resource Information Systems in EU based on CRANET research

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Abstract - In the process of becoming strategic partner of the top management human resource management (HRM) function has to use Internet and apply adequate information system (HRIS) more and more. Human resource information system enables systematic processes for collecting, storing, maintaining, and recovering data required by the organizations about their human resources, their activities and organizational characteristics. In this paper author present the effect of Internet on HRM activities, analyze the operation of HRIS from the theoretical point of view, accompanied by empirical data analysis of Cranet data for European Union, from research period 2008/2010. The main goal of this research was to emphasize the importance, advantages and some limitations of HRIS, but also the usage of HRIS for main HR practices in the companies of EU. The methodology used in the research included exploration of the Cranet questionnaire, the sample presentation and application of statistical techniques, i.e. the application of the program SPSS Version 21.

I. INTRODUCTION

Contemporary organizations which understand the importance of human resources perform different and very specific practices to manage their people such as planning, staffing, training and development, performance management, compensations and benefits, retiring, working conditions, health and safety, employee relations, retention and policies on work-life balance, etc. As a result of technological progress and innovations, which are inevitable in modern age, HRM got one strategically important “partner” – the Human Resource Information System (HRIS). Also, beside information system used for HRM, the usage of the internet in modern business and managing is becoming more and more significant for successful performances. This can be understood as the second important change, called e-HRM. Recent studies attempted to identify the effectiveness and the importance of the usage of HRIS [10; 11; 12; 17] and E – HRM on the HR functions in the organizations [3; 5; 7; 14].

The main goal of this research was to emphasize the importance, advantages and some limitations of HRIS, but also the usage of HRIS for main HR practices in the companies of EU. The methodology used in the research included exploration of the Cranet questionnaire, the sample presentation and the application of the statistical techniques, i.e. application of the program SPSS Version

21. Authors presented the effect of the Internet on HRM activities; analyzed the operation of HRIS from the theoretical point of view, accompanied by empirical data analysis of Cranet data for European Union, from research period 2008/2010.

II. THEORETICAL BACKGROUND

At the beginning of the research, it is interesting to present to some main theoretical views related to the HRIS and E-HRM. Tannenbaum defined HRIS as a technology-based system used to acquire, store, manipulate, analyze, retrieve, and distribute pertinent information regarding an organization’s human resources [15]. Also, these systems are explained as systematic procedures for collecting, storing, maintaining, and recovering data required by the organizations about their human resources, personnel activities and organizational characteristics [2]. HRIS is a tool that helps employers in retaining the right employees. This can be done by paying them competitive salaries compared to the market, and training them to develop their skills and abilities to carry out their existing and future jobs [4]. Stone sees HRIS as more than just computerized records of employees – it is an integrated approach to procurement, storage, analysis, and control of the flow of information on human resources management throughout the organization [13].

In relation with the HRIS in foreign literature and practice of HRM one more interesting concept is the e-HRM. Namely, e-HRM is the (planning, implementation and) application of information technology for both networking and supporting at least two individual or collective actors in their shared performing of HR activities. This concept highlights several crucial aspects of e-HRM. At the outset, e-HRM utilizes information technology in a twofold manner: First, technology is necessary to connect usually spatially segregated actors and enable interactions between them irrespective of their working in the same room or on different continents, i.e. technology serves as a medium with the aim of connection and integration. Second, technology supports actors by partially – and sometimes even completely – substituting for them in executing HR activities. Hence, information technology serves additionally as a tool for task fulfillment. The planning aspect accentuates the systematic and anticipated way of applying information technology. The shared performing of tasks through at

least two actors' points out that the sharing of HR activities is an additional feature and underlines the aspect of interaction and networking. The consideration of individual and collective actors takes into account that e-HRM is a multilevel phenomenon; besides individual actors, there are collective actors like groups, organizational units and even whole organizations that interact in order to perform HR activities [14]. E-HRM has been defined as a way of implementing HR strategies, policies and practices in organizations through a conscious and directed support of and/or with the full use of web-technology-based channels [9]. It can be used for transactional activities (i.e. those that involve day-to-day transactions and record keeping); traditional HRM activities such as recruitment, selection, training, compensation and performance management; and transformational activities that add value to the organization [16]. The development of web-based technology has allowed firms to provide services directly to employees and managers through the use of self-service systems [6].

In the line with the definitions, it is interesting to mention several researches made in the past that show how HRIS and E - HRM can facilitate and help HRM process to:

- improve quality of information available,
- reduce administrative burden on the HR department,
- improve speed at which information is available,
- improve flexibility of information to support business planning,
- improve services to employees,
- produce HR metrics,
- aid human capital reporting,
- improve productivity,
- reduce operational costs and
- manage people's working time more effectively [1].

Pilbeam and Corbridge [8] presented the advantages of HRIS as:

- Speed - Computers can manage large amounts of complex data quickly.
- Reliability and accuracy - People are prone to errors, and manually generated information more open space for the occurrence of errors.
- Storage and retrieval - Storage of large amounts of data is expensive, and requires manually store data and physical space, and time. Computer data also occupy space or computer memory and time required for their entry and update, with the costs incurred as a result of a manual processing of data growing over time, while the cost of computer memory and processing decreasing.
- Consolidation - Manual data are often found in multiple locations. Often there is no complete picture of the individual employee in a single record. Usually in one company there are more of manual files pertaining to one employee.
- Making decisions - The main reason for the construction of an integrated system of data on

employees is to contribute to decision-making in the organization. Strategic decisions about the direction of development of the organization should be based on information concerning various aspects of HR, and HRIS can provide accurate and precise information about it.

- The role and influence on the office staff - Good HRIS can promote the participation and involvement of HRM professionals in the process of strategic planning and improve the profile management functions of the HR administrative roles to the role of a business partner.

Findings from one recent research in 2011 pointed several goals for the introduction of the E-HRM:

- Operational effectiveness;
- Service delivery;
- Manager empowerment;
- Strategic orientation;
- Standardization [7]

Beside many advantages, here it is also important to present main obstacles and challenges in HRIS implementation. According Stone the most important challenges of HRIS are *flexibility, confidentiality and legal problems* [13]. Also, voluntary acts of employees using their companies' Internet access and IT equipments for non-work-related purposes during working time is called "cyber loafing". Another similar problem is sending messages of the employees to disclose confidential information or intellectual property infringement. In order to put an end to such problems, about 75% of the largest U.S. companies decided to record and review employee communications (including telephone calls, e-mail and internet). Other organizations use special software to prevent access to unwanted sites. Primarily refers to the sites for shopping, gambling, pornography, etc. so they carefully set policy regulating the use of e-mail and the Internet. It is suggested creating written policies that advise employees that their e-mail messages are not private and can be read by managers, that the technology used in the workplace belongs to the company and that the company reserves the right to monitor the use of their computers. All employees must sign the rules, as a sign that they have read and understand them [12].

III. METHODOLOGY

In this paper it has been used CRANET methodology (www.cranet.org) to identify the level of usage of HRIS in companies from the European Union. This international organization organizes comparative researches on the policies and practices of human resource management, using a standardized questionnaire. The purpose of the research is to provide high quality data for academics, public and private sector organizations, as well as HRM students, and to create new knowledge about human resource management practice in different countries of the world. In CRANET research period from 2008 until 2010 there were involved 32 countries, but for this analysis authors decided to

explore only data for organizations from EU region, total of 20 countries.

In this research author used data from member countries of EU, where 3795 companies gave their responses about HRM practices. Questions about HRIS and e-HRM were constructed to obtain information about existence and level of the usage of IT and Internet in HRM. Respondents were asked to state weather they use (1-yes) or not (0-no) several elements of the HRIS and e-HRM. Methodology included the application of the program SPSS Version 21. The objectives of this analysis were to:

- Find out the kind of the HRIS that organizations from countries from EU use;
- Find out the level of usage of HRIS for HR activities in EU organizations;

- Find out the existence of HRIS managers' and employees' self-service options – deployment of E-HRM in companies in EU.

IV. RESULTS OF THE ANALYSIS

First part of the analysis obtained the exploration of the kind of HRIS used in companies which operates in the EU. According Figure 1 it can be concluded that organizations from EU usually have a single primarily independent HRIS (29.5% of total number of organizations) and separated stand alone tools (28.2%). Also, integrated HRIS, interfaced into wide MIS is used in 21.6% of the companies from the EU, while 20.7% of companies do not use HRIS at all.

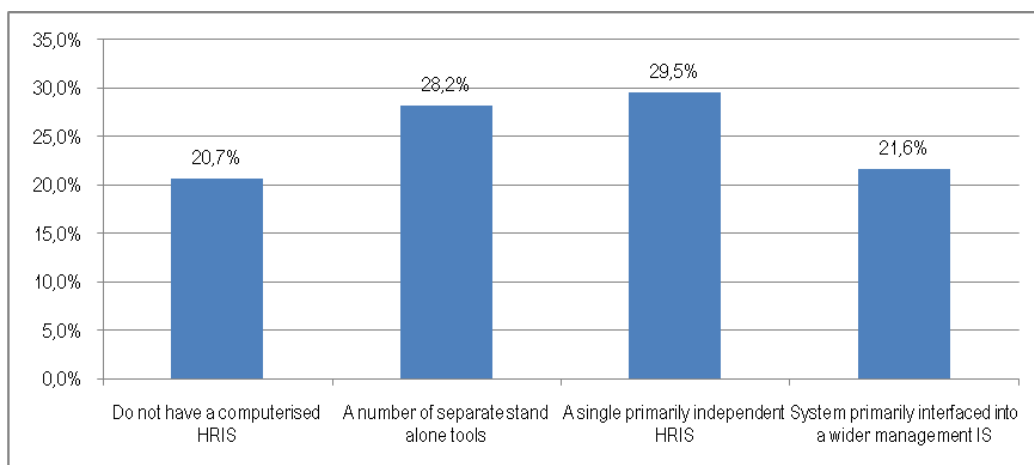


Figure 1. Type of HRIS in companies from EU
Source: Authors' research based on CRANET data base

Beside analysis of the HRIS in the EU, in total, it was interesting to explore the usage of the HRIS in several countries of the EU, since, from the table 1 below; it is obvious that there is a large diversity among countries when this issue is in question. Namely, it is obvious that there are no rules or patterns of the usage in this area. For example, some Central and Eastern Europe (CEE) countries, like Hungary and Bulgaria had a very large percentage of those companies which do not use HRIS (over 40% of companies). These are the highest

percentages of companies without HRIS. On the other hand, data from Czech Republic, also the CEE country, showed that all explored companies use HRIS at some level, since there were no companies without HRIS. Some companies from other CEE countries, Slovenia (9.2%), Estonia (9.7%), also have small percentage of those companies that do not use HRIS. It is interesting to point out that some developed countries, like France, Netherlands, Denmark, Finland and Ireland also have over 20% of those companies without HRIS.

TABLE I. PERCENTAGE OF THE USAGE OF DIFFERENT HRIS IN COMPANIES FROM EU

STATE	Do not have a computerized HRIS	A number of separate stand alone tools	A single primarily independent HRIS	System primarily interfaced into a wider management IS
Austria	6,6	28,8	40,9	23,7
Belgium	15,1	38,2	20,2	26,5
Bulgaria	44,4	8,5	32,7	14,5
Cyprus	31,8	23,9	21,6	22,7
Czech Republic	0,0	11,1	35,2	53,7
Denmark	25,5	32,9	16,1	25,5
Estonia	9,7	26,4	41,7	22,2
Finland	24,6	33,8	30,8	10,8
France	33,1	45,6	16,2	5,1
Germany	9,1	34,9	32,8	23,2
Greece	37,4	33,6	18,5	10,4

Hungary	43,7	15,6	20,0	20,7
Ireland	26,0	35,0	24,0	15,0
Italy	7,7	36,8	27,7	27,7
Lithuania	24,6	23,7	28,9	22,8
Netherlands	23,9	47,9	0,0	28,2
Slovakia	21,1	13,9	38,6	26,5
Slovenia	9,2	19,4	36,4	35,0
Sweden	12,1	27,4	45,6	14,9
United Kingdom	15,7	24,5	41,2	18,6
TOTAL	20,7	28,2	29,5	21,6

Source: Authors' analysis based on the CRANET data base

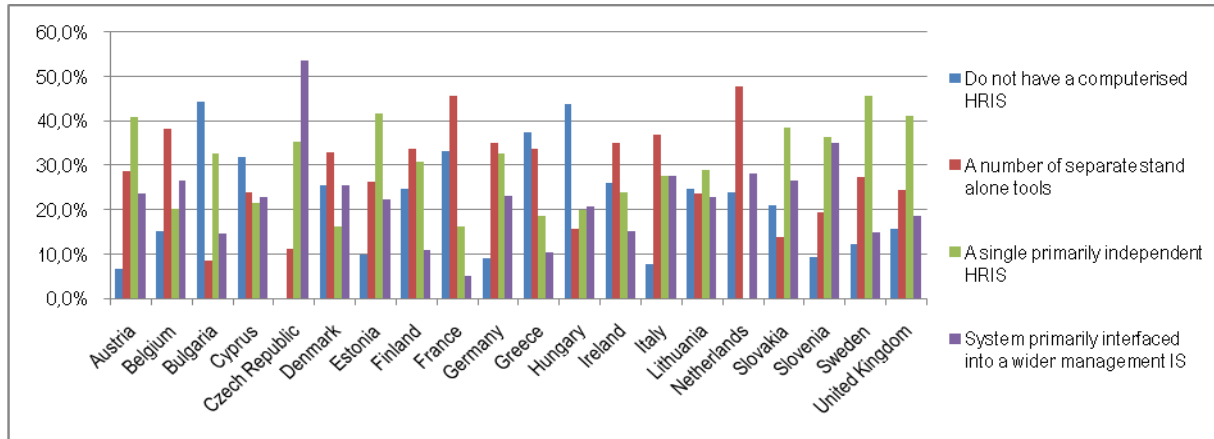


Figure 2. Type of HRIS in companies from EU – per country
Source: Authors' research based on CRANET data base

There were more companies that use HRIS in different kind, but here is also present diversity among countries in the EU. Czech Republic was the leading country in the case of the usage of the integrated HRIS. Around 54% of companies from Czech Republic use this kind of HRIS. Beside that country, in Belgium, Denmark, Italy, Netherlands, Slovakia and Slovenia there were found significant usage of integrated HRIS (over 25%). The lowest level of the usage of integrated system for HRM was found in companies from France (only 5%). The most common kind of HRIS is in term of

independent system or separated tools for each HR activity. The highest usage of independent system for HRM was in Austria (40.9%), Estonia (41.7%), Sweden (45.6%) and UK (41.2%). Only Netherlands' companies do not use this kind of HRIS, while all other countries use this kind from 15% to 40%. In case of Netherlands, while companies do not use HRIS as system, they use separated tools for HRM in 48%. Companies from France (45.6%), Belgium (38.2%), Denmark (32.9%), Finland (33.8%), Germany (35%) and Italy (36.8%) also showed higher percentage of the usage of HRIS as separated tools.

TABLE II. PERCENTAGE OF THE USAGE OF HRIS FOR DIFFERENT HR ACTIVITIES IN COMPANIES FROM EU

STATE	IPR	PAY	BNF	TRA	R&S	T&D	PM	CP	WS	H&S	HRP
Austria	44,5	97,8	74,0	88,1	38,8	57,1	25,8	15,0	35,7	16,1	12,4
Belgium	91,6	94,6	76,7	81,2	53,0	65,3	53,0	25,2	37,1	27,2	33,2
Bulgaria	99,3	98,5	78,6	88,6	44,3	50,0	32,2	33,9	70,1	49,2	41,4
Cyprus	46,4	96,7	89,8	66,7	30,9	53,4	34,5	9,3	40,4	31,6	20,0
Czech Republic	100,0	92,6	43,4	88,9	35,2	51,9	13,2	18,9	28,3	50,9	13,5
Denmark	90,0	85,8	57,9	78,5	48,3	51,3	35,2	24,9	29,5	17,2	18,0
Estonia	96,9	93,5	51,6	61,9	35,5	69,2	33,3	19,7	50,0	30,2	16,4
Finland	94,7	95,8	67,4	84,2	58,7	50,0	32,2	15,6	51,1	30,3	11,1
France	89,0	97,8	49,5	78,0	37,4	71,4	27,5	20,9	49,5	27,5	11,0
Germany	72,0	90,2	73,2	89,2	48,1	53,8	44,3	23,0	35,1	18,1	8,5
Greece	97,4	94,8	69,3	72,8	41,8	56,6	40,5	25,9	54,0	20,9	29,
Hungary	93,4	82,9	89,5	76,0	29,3	61,3	50,7	17,6	27,4	17,8	28,8
Ireland	90,3	85,9	57,4	73,2	40,0	63,2	52,2	26,5	36,8	30,9	32,8
Italy	69,9	80,4	53,8	94,4	52,4	69,9	53,1	21,7	20,3	38,5	49,0
Lithuania	95,3	89,5	39,5	87,2	25,6	39,5	27,9	17,4	68,6	37,2	26,7
Netherlands	96,0	89,9	75,8	43,4	28,3	42,4	20,2	22,2	35,4	26,5	21,2
Slovakia	97,7	96,5	45,1	79,8	32,9	52,6	35,3	19,7	34,3	34,1	34,7
Slovenia	99,5	94,8	67,6	71,4	22,9	53,0	48,9	20,1	54,3	59,7	15,8
Sweden	32,5	95,9	60,6	79,2	34,8	36,1	12,4	11,9	59,5	13,7	18,6
United Kingdom	94,1	77,5	62,2	54,5	45,2	64,3	43,9	19,8	25,8	23,6	36,6
TOTAL	81,9	91,5	65,0	78,5	41,0	54,8	37,0	21,0	41,5	27,5	23,2

Source: Authors' research based on CRANET data base

Next part of the analysis obtained the exploration of the usage of HRIS for HR activities like staffing, training and development, compensations, etc. In Figure 3 there are presented data of the usage of HRIS for each HR activity in the EU organizations. It can be concluded that

HRIS is used mostly for administrative activities such as time registration and attendance (78.5%) and personnel records (81.9%). Also, HRIS is commonly used for compensations – 91.5% of organizations use IS for payroll and 65% for benefits.

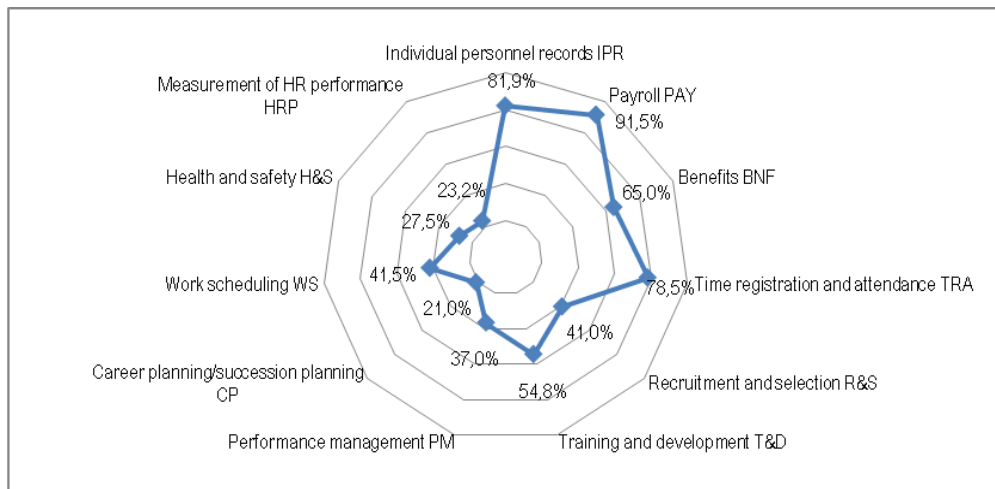


Figure 3. Percentage of the organizations that use HRIS for different HR activities in the EU
Source: Authors' research based on CRANET data base

Generally, in organizations from the EU HRIS is used at higher level compared to the past findings [18]. This usage is very low for HR performance measurement (23.2% of organizations), career planning (21%), health and safety (27.5%), etc. In case of training and development the usage of HRIS is around 55% (more than half of all organizations use this kind of HRIS).

Usage of HRIS for performance management (37%), and recruitment and selection (41%) and work scheduling (41.5%) is also at high level. This is a positive trend of the growth in the area of HRM, since new computer and internet technologies

The last part of the analysis was dedicated to the exploration of the e-HRM.

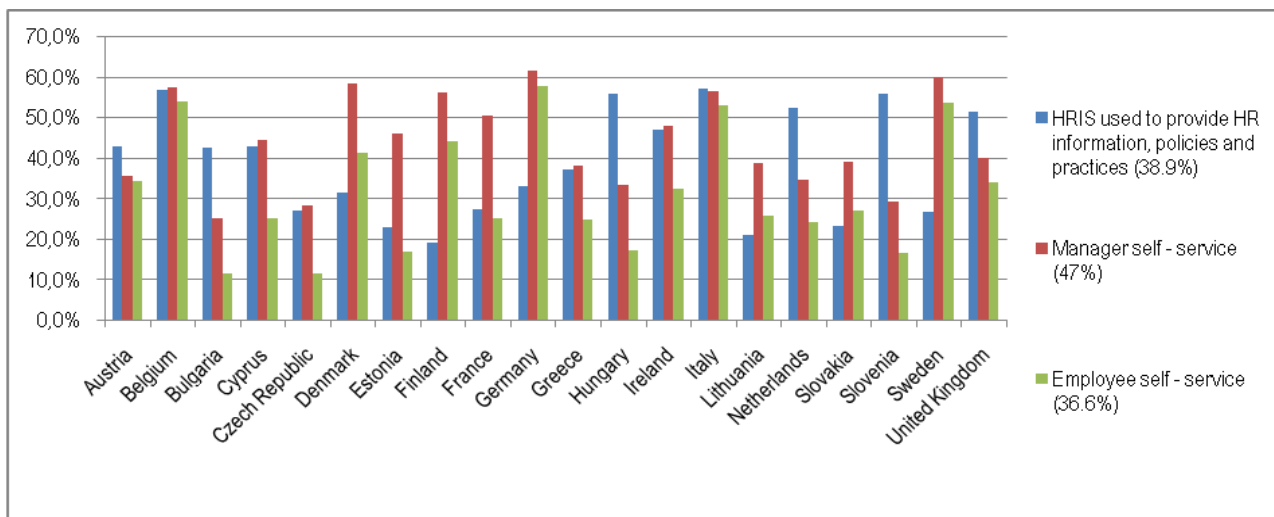


Figure 4. Stage of E – HRM in companies that operate in countries of the EU
Source: Authors' research based on CRANET data base

From Figure 4 it is seen that in organizations from the EU self – service options for managers, as online tools whereby managers can complete HR processes, exists only in 47% of all organizations. In case of employees this self – service options, as online tools whereby

employees can access personal information and perform simple HR tasks such as maintaining personal data, exists in 36.6% of all organizations. Generally, e-HRM allows for “self-service” functions to be accomplished, either by the manager or the employee. Also, HRIS is used for

providing HR information and practices in 38.9% of companies from the EU. The use of self-service e-HRM in Europe is very common in Sweden, Belgium, Denmark, Finland, Germany and Italy, countries with the higher penetration of the internet.

CONCLUSION

HRIS as computerized tool for systematic procedure for managing data about human resources, personnel activities and organizational characteristics, accompanies with the internet technologies have several advantages for the organization. Benefits of integrated HRIS include improvement of administrative but also and strategic HR activities, increase of the effectiveness, reliability and accuracy of information, etc.

In this paper authors made the analysis of the usage of HRIS in organizations that operate in the European Union. According to the objectives of the research, we have derived several conclusions:

- Organizations from EU usually use HRIS as a single independent system (29.5% of total number of organizations) and separated stand alone tools (28.2%).
- HRIS is used mostly for administrative activities such as such as time registration and attendance (78.5%) and personnel records (81.9%). Also, HRIS is commonly used for compensations – 91.5% of organizations use IS for payroll and 65% for benefits.
- Organizations from the EU use self – service options for managers only in 47% of all organizations. In case of employees this self – service options exists in 36.6% of all organizations.

In general, IT technologies for HRM in companies from EU are used at the higher level compared to the findings from the past period. Due to the faster and wider development of the information technologies and rapid changes in that area more companies have the opportunity to use these kinds of systems.

At the end of the research on HRM information system it is necessary to point out that the success of the implementation HRIS depends primarily on people – whether employees understand the importance and benefits of these changes. Manager' task at all levels is the construction of such organizational culture that supports changes and it is open to the proper implementation of the new technology.

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Security Aspects of the Social Network Facebook: Some Empirical Results

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Abstract – Social networks have their good and bad points. The good points are reflected in the entertainment available to users, as well as providing the opportunity to maintain contact with many people, regardless of physical distance. Disadvantages are the risks to which the user is exposed when using social networks. One of the main challenges of today's information society is the problem of data security that users leave on the social networking sites. In this paper we will discuss about the risks of information security in the social network Facebook providing some empirical results.

I. INTRODUCTION

Facebook is a social networking site (SNS) that opened its doors to everybody (of ages 13 and older) on the 26th September 2006. When subscribing in Facebook (FB), users can set up their personal profiles having in their disposal a number of functionalities. For instance, each user has a “Wall” in his profile, a kind of message board, where he can post messages and any other personal or contact information, such as hobbies, college, birthday, hometown, phone numbers etc. In addition, they can dress their profiles uploading photos and videos with the possibility to organize them in different albums. An interesting feature is that Facebook users can “tag”, or mark users in a photo. Every user can invite other users from Facebook in order to form “Facebook friendships”. Upon confirmation by the latter, Facebook friends can share their profile information, having the possibility to exchange instant messages. Also, they are allowed to make comments or express their interests enabling a tag with the name “Like” to any content of their profile and Facebook friends as well. It is noteworthy that Facebook notifies the users about their profile activity with regards to their Facebook friends. A quite useful characteristic of Facebook is the Mini-Feed extension. It is a detailed logging tool which presents to the users their 100 most recent actions into the Facebook. At each time, they can see at a glance the history of their activities, including any kind of interaction between common Facebook friends, and with third-party applications [1].

There were several activities that the majority of students did *not* use Facebook for, such as checking out the profile of a member of university staff (68% said they had never done this) [1]. Facebook is therefore currently used by students for communicating with each other, not with university staff. Moreover, when respondents were asked if there were any ways they thought Facebook

could be utilised to enhance teaching and learning at the University, 43% responded negatively, explaining that Facebook is a SNS, not a tool for academic work [1].

So what are the academic costs of spending substantial amount of time on SNS? To date, research on the academic implementation of Facebook or other SNS has been limited.

This paper is organized as follows. After introduction, security aspects of Facebook studied in the open literature are considered. The next section will describe empirical results obtained by the survey predominantly carried out with students of the Faculty of Transport and Traffic Engineering. Finally, some concluding remarks on regulation of security aspects of social networks are proposed.

II. SECURITY ASPECTS OF FACEBOOK

One of the biggest concerns in implementing Facebook into the classroom is student privacy. Many of the studies concerned with taking the faculty/student relationship online have focused on this specific student concern [2]. Some students are worried that faculty might form opinions about them based on their online accounts [3]. However, students, when presented with the option, did find a beneficial reason to use Facebook with faculty. Mazer et al. [4] found that if faculty members have Facebook accounts, students are likely to base decisions on whether or not to take a class from someone can be affected by the amount of information disclosed online by the faculty member [5].

Another area potentially affected by implementing faculty Facebook usage in the classroom is faculty/student communication. Sturgeon and Walker [6] found that students seem to be more willingly to communicate with their instructors if they already knew them through Facebook. Hewitt and Forte [2] similarly found that students liked the potential to get to know their professors better, and that Facebook interaction had a positive impact on how they perceived their professors. Additionally, Haspels [5] found that Facebook usage on a university also had a positive effect on the face-to-face faculty/student relationship.

But most importantly, the question is, does a faculty/student relationship in Facebook have an effect on student's performance? Studies have found different results. Yang and Tang [7] found that those networks which "consist of relations through which individuals share resources such as information, assistance, and guidance" are "positively related to student performance" both in face to face and online settings. Sturgeon and Walker [6] found what they termed an "indirect connection between faculty use of Facebook and academic performance". Their findings postulate that because of an increase in faculty/student familiarity, students feel more comfortable and therefore, are able to learn better.

Two observations stand out after examining the survey results, both having a relationship with Facebook usage and privacy concerns. First, in terms of privacy, there remain a large percentage of students who maintain their profile open to the public. Although some studies have lamented over the reasons for this disclosure needs, other studies have concluded that students simply do little to protect their own disclosures in SNS. However, the survey results may deviate from the literature. Selywn [8] found that Facebook serves as a supplement to pre-existing relationships and students typically do not use it to make friends whom they may not have met in person.

According to the company EUnet Internet in Serbia is being used by approximately 1.5 million people, or about 25% of the total population, while the European average of 50 to 70% of the population uses the Internet every day [9, 10]. About 50% of people in Serbia have never used the Internet and do not intend to because they feel they do not need it. Serbia, with as many as 2,716,340 open accounts on the social networks, is the first in the region, 17th in Europe, and from December 2009 to date the number of users in Serbia has increased by about 40 percent [11]. Research shows that FB in Serbia is used more by male (56%) than female (44%), and most of them are between 18 and 34 years (61%). However, surprisingly, the highest growth rate of users is in the age group over 65 years. Data on a large number of Serbian FB users, further gains weight when one considers that only one of three citizens in Serbia use the Internet, which is well below the European average (in developed countries the figure is more than 95%).

III. EMPIRICAL RESULTS

This study should provide preliminary data on the security-related use of FB by the students. The sample consisted of 30 subjects (67% female, 33% male), predominantly students of Transport and Traffic Engineering at the University in Belgrade, Serbia. The participants voluntarily agreed to participate in the study. Students completed a survey consisting of 15 multiple-choice questions, which, in addition to gender and age information, included information how many friends they have on FB, do they accept request for friendship of unknown persons, how much time they spend on FB, do

they leave any other except mandatory information, are they informed about the privacy policy of FB [12], did they adjust the privacy of their account, are they aware of risks when leaving information, do they think that information on FB is safe, has the security of their data ever been in danger, do they think that FB users in Serbia are aware of risks, which would be the most appropriate way to familiarize the users with risks as well as who should take care of informing users about the risks. Analysis of results included the calculation of basic parameters of descriptive statistics.

The survey was carried out on a sample of 30 subjects. In the present sample of respondents both genders are presented. Figure 1 provides a diagram of the structure of the sample by age groups.

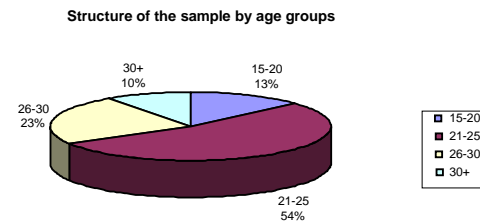


Figure 1. The structure of the sample by age groups

Figure 2 provides a graphic representation of the number of friends the respondents had classified by different age groups. The most respondents in the age group of 15 to 20 years have more than 200 friends on the social network Facebook. Half of the respondents in the age group of 21 to 25 years have more than 200 friends and only two patients in this group have less than 100 friends. The age group of 26 to 30 years also has respondents with the largest number of more than 200 friends. Only in the respondents' group over 30 years none of the participants has more than 200 friends.

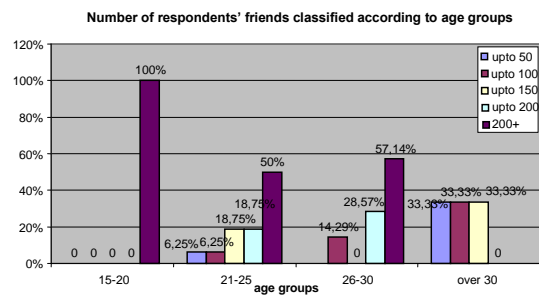


Figure 2. Number of respondents' friends sorted by age group

Respondents were also asked about accepting friend's requests sent by strangers and 50% of them said they do not accept such requests. However, even 43.33% of respondents sometimes accept these requests while 6.67% of the respondents accept always this request. Figure 3 provides a graph of respondents' attitudes of from different age groups to accept requests for friendship from unknown people.

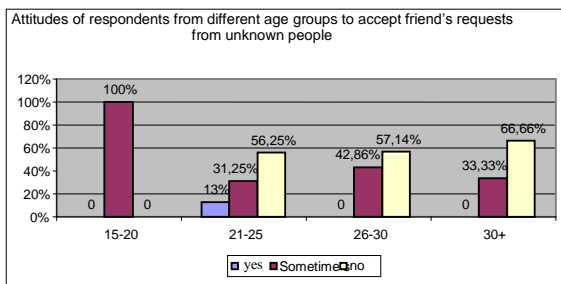


Figure 3. Attitudes of respondents from different age groups according to the request for friendship from unknown persons

In the age group of 15 to 20 years, in which the survey participants reported to have friends “mostly”, it can be seen that all of them sometimes accept friendship requests from strangers. In the age group of 21 to 25 years less than 13% of respondents would accept such a request; 31.25% of respondents would accept sometimes, while 56.25% do not accept these requests. On the other side, 42.86% of the respondents aged between 26 to 30 years sometimes accept it, while 57.14% of this group does not ever accept friend’s requests from strangers. A third of the age group over 30 years sometimes accepts this request while 66.66% (of this group) do not accept.

Based on the above diagram it can be concluded that the respondents in the age group of 15 to 20, and from 21 to 25 years are very careless because those groups have the highest percentage of respondents who sometimes accept the requests, and there are even respondents who always accept such demands. Accepting requests from strangers can significantly threaten the security of user’s information, as well as, their safety. Behind these claims may be an attacker who wants to get closer to the user to reveal some information or with the intention for physical attack on the user. Respondents from the age group of 26 to 30 years or more than 30 years are more cautious about accepting friend’s requests from strangers. None of the subjects in these two groups were ready to accept such a request while a small amount sometimes accepts such a request. The largest percentage of respondents in the two groups does not accept such requests.

As for the time spent on the social network Facebook respondents identified themselves as follows: 16 participants (53.33%) said they spend more than 30 minutes on Facebook, 9 of them (30%) spend more than 1h, 5 (16.67%) spend more than 2 hours, and only one respondent spends more than 3 hours on this network. The majority of respondents said they carried out for 30 minutes to 1 hour on this social network.

Respondents were also asked whether they leave some other information on Facebook, except the mandatory data, and the graphic representation of their responses was shown in Figure 4.

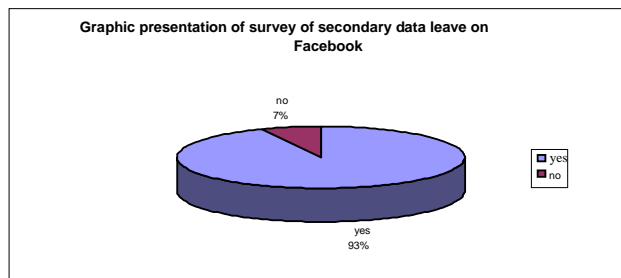


Figure 4. “Do you leave some information on Facebook other than the mandatory data”?

This issue refers to the attitudes of users towards leaving photos, videos, interests, etc., on the social network Facebook. The vast majority, 93% (28) of the respondents said that they leave secondary data on this network. Most respondents except profile picture inserted videos, interests, information about qualifications, status and so on. Almost all respondents indicate their friends in photographs and videos. Only 7% said that except for the information required for registration, leave no other information on social network Facebook.

However, the public account on the social network can easily lead to the alienation of the data. The attacker can take pictures from the profile and can even take control upon a user's profile.

Participants were also asked whether they are aware of the risks when leaving data on Facebook and also to exhibit the data on that social network. Figures 5 and 6 provide graphic representations of the respondents' opinions on these two issues. Figure 5 shows that only a third of the respondents (33.33%) are aware of the risks of allowing their data on Facebook. Over half of the respondents (57%) were partly aware of these risks, while 10% do not know what kind of risks exists when leaving their data on Facebook.

Awareness of respondents on risk of leaving data on Facebook

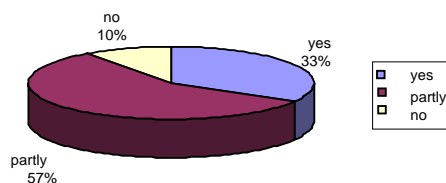


Figure 5. Awareness of respondents about the risk of leaving data on Facebook

From the Figure 5 it can be seen that the highest percentage (54%) of respondents thought that Facebook’s users in Serbia are only partially aware of the risks, thus it is necessary to raise collective awareness about the potential dangers that may arise on this social network. Also, near half of the respondents (43%) think that the users are not aware of the risks involved in entering data on this social network.

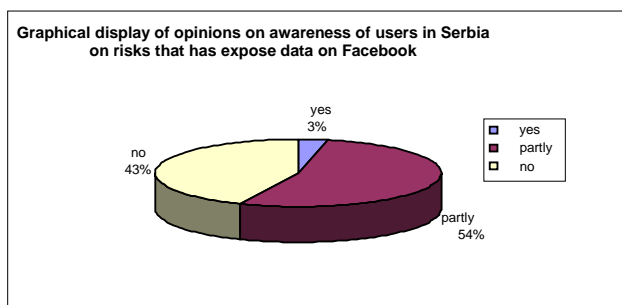


Figure 6. Opinions about the awareness of Facebook's users in Serbia on risks of leaving the data

Introducing the users to the dangers of leaving data on social networks is necessary. If the users of social networks would be more cautious when leaving data on social networks and would increase the privacy of their accounts, it would be likely to reduce the number of accounts that have been subjected to some kind of an attack.

The subjects participated in this study had the opportunity to give their opinion about the data security on Facebook. Figure 7 gives a graphical representation of respondents' opinion on the security of data on the social network Facebook. Answers are sorted by age groups. Most respondents were not completely sure that the information they have left on Facebook are totally safe and some respondents even think that the data are not safe at all. A small percentage of respondents felt that the information is completely safe.

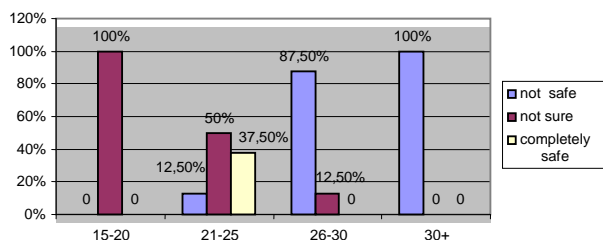


Figure 7. Respondents' opinions about the security of the information on Facebook

All respondents in the age group of 15 to 20 years have the same opinion that they are not sure if their information is safe. Most of respondents from the group of 21 to 25 years (50%) also believe that the data are not completely safe, and a small percentage (12.5%) thinks that the data are not safe at all. In this age group there are a fairly large percentage of respondents (37.5%) who think that their information are completely safe on social networking site Facebook. Respondents in the age group of 26 to 30 years are slightly more reserved to that issue and even, according to the survey, 87.5% of them think that the data they leave on Facebook are unsafe while 12.5% are completely sure that their data on Facebook are safe. Respondents in the age group over 30 years were not sure that their data are safe.

IV. CONCLUSION

Users of social networks mostly have information about the risks they are exposed on social networks and how to handle data that get through newspaper articles or television. However, information obtained in this way is often incomplete or inaccurate. In order to reduce attacks on user's accounts we need to appeal to customers to get more informed about the risks brought about by leaving data on social networks. It is also necessary that the owners of social networks appeal to users how to learn about the privacy policies of social networks and they should point to the fact that it is very important to set the privacy orders.

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Intelligent Organizations Instead of Rigid Organization Forms

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Abstract - Nowadays, if an organization wants to be competitive it needs to give quick and quality response to the demands of its environment. This requires recognition of those demands and combination of theoretical and practical knowledge in fulfilling them. Generative learning needs to be continuously used and it demands a new organization model "learning organization". As the organization is made up of multiple elements, their optimal combination gives optimal business results. Information technologies have become a vital part of every organization. They contribute to organization's productivity, enable the linking of individuals, organizations and their units and are indispensable aid in creating organization's response to changing market conditions. Paper indicates the need for research in order to structure the so-called intelligent organization, or the organization which is constantly learning - in the right way.

I. INTRODUCTION

Structuring of business organization is a persistent subject in the modern theory and practice. Efforts of Serbia to enter the EU show us the needs to deeper analyze the organization and functioning of companies. Structuring is done in order to view the elements of a business organization, such as departments, parts, funds and functions and to realize a business politic, or in other words a business goal. For those reasons we will show how can we measure whether our company is „smart“, „intelligent“- or capable to fight for its place on the market. The way of looking at capital is changing and from the traditional „concrete“ components (land, machines, capital, buildings, equipment, etc.) the main focus is shifted to the so-called „soft“ capital (learning, knowledge, implementation of new technologies, processes, procedures and business methods) [1].

The research in this paper, in our opinion, will give new impulses to the study of this exceptionally current organizational problem.

II. SITUATIONAL APPROACH IN THE FUCTIONING OF BUSINESS SYSTEMS

Modern day is characterized by the appearance by the growing number of small companies in the world, on one hand, and the growth of large business systems through various forms of organizational linking, on the other.

This results in the fact that the development of small and medium companies is impossible or very slow

without the existence of large companies. So, in Germany for example, several tens of thousands small and medium companies are closed every year, but at the same time an even larger number of new companies are founded. The lack of business development in Serbia is causing a drastic decrease and loss of industrial capacities, and so there is a different trend in Serbia.

The situation approach is actually the condition of the own structure which is adapted to the possibilities and specificities to the business. Basis of this concept can be reduced to (entrepreneurship effort) [2]:

- Seeking business opportunities on the market (effectiveness),
- Realization of business in the best possible way (efficiency).

Organization functions in accordance with the demands of the environment and its own structure, thus it seeks the optimal solution for the given conditions of business [3]. This theory was based on the teachings of Fidler (1979) and it is related to the combination of two sorts of factors in seeking the optimal structure and function:

- Organizational factors
- Situation factors.

In this matrix picture we combine situation factors (independent variables) with organizational factors (dependable variables), seeking the adequate form of the organizational structure for the given conditions – situation. Situation factors are relatively unchangeable (at least in the short timeframe) factors and in fact, the organization adapts to them. Here we have three problem areas:

1. It is necessary to explore and describe the organizational structures with unique terms which can be measured (performances) in order to compare the effects of different structure configurations;
2. How can we differentiate organizational structures (OS) one from another, with organizational factors (changeable variables) and situation factors (relatively fixed variables).

3. How can we connect: various structures (situations), behavior of organization members and effects (realization) of the target function by those OS?

Goals of the organization and changes in the environment determine also different OS which give optimal results in given situations or current situation factors.

Influence to the structure (Table 1.) can be expanded to the analysis of the following three problem areas [4]:

- a. influence of the size of the organization to the organizational structure;
- b. influence of the production technology to the organizational structure;
- c. influence of the environment to the organizational structure.

We should consider these elements when forming the organization structure.

III. INTELIGENT ORGANIZATIONS INSTEAD OF RIGID ORGANIZATION FORMS

In order for the organizations to create an advantage in the competition, they have to act quickly and with quality to the demands of the environment. This requires recognition of those demands as well as theoretical and practical knowledge to meet those demands. Those changes in the environment like the demand for product innovation, cost reduction, market expansion, etc. can be accomplished only by adequate knowledge to make such decisions and implement them before the competition. Knowledge as a potential, for the adequate reaction to the changes in the environment is created through the process of constant learning. Not going deeper in the problem we will address only two sorts and two forms of organization learning [5]. Adaptive learning relates to learning and expanding the knowledge, by relying on previously defined and adopted assumptions, the business philosophy. This learning is called “single loop learning”. The other sort of learning – generative learning is also called double loop learning because it explores new assumptions and changes existing premises, in order to find adequate advantages compared to the competition. The first sort of learning usually suits stable business conditions, while the other sort is important when the changes are radical and frequent and the business is unstable. In the other case, generative learning needs to be continuously used and demands a new organization model “learning organization”. With generic learning findings are obtained on your own trial and error. This represents an expensive and the hardest form of learning. In order for the organization to change from a classic model to the so-called “learning organization”, it is necessary for it to incorporate, adopt and continuously use different contents, characteristics and performances. Table 1 shows the transformation of the traditional organization into the so-called learning and knowledge organization.

TABLE I. TRANSFORMATION OF THE TRADITIONAL ORGANIZATION TO THE ORGANIZATION OF KNOWLEDGE AND LEARNING

<i>Traditional organizations</i>	<i>Learning and knowledge organizations</i>
mistakes are penalized	learning on mistakes
use of custom procedures	work procedure is adapted
playing safe	taking risks
experiments are discouraged	experiments are encouraged
managers have strict control of the people	managers work with subordinates
management is the source of all ideas	all employees are idea sources
lack of trust	mutual trust
„command management“	station power is not shown
suspicion based decision making	decision based on empirical data
work limited to one sector	sector and department cooperation
avoidance of questions	questions are encouraged
employees are an expense	employees are the most important resource
„learning is for beginners“	“learning is for everyone”
„learning develops an individual“	“learning develops the organization”
employees are sometimes sent to lectures outside of the company	specific and needed knowledge available at the work place
individual memory	corporate memory

Table 1 shows the comparison of the basic functions in manager work and the functioning of the traditional organization vs. “learning organization” (organization of knowledge and learning). The traditional organization shows rigid structure and manager control. “Learning organization” the subordinates work with the managers, ideas are enlisted from all employees, there is mutual trust and the so-called “command management” is replaced with the authority of knowledge and cooperation in team work. If we were to compare further, we could see that the organization which learns has a culture of information availability and not of its withholding, so learning is the most important element of that organization’s culture. Another important trade of the learning organization is the freedom of ideas and the possibility of failure as well as to enable adequate financial means for learning and education.

Previous content indicates that the organizational culture of the learning organization is changing, so the management of human resources (employment, training and rewards) represents the main process of organization learning.

IV. CAPABILITIES OF MEASURING THE INTELLIGENCE OF AN ORGANIZATION

Talking about an intelligent organization means moving the interest point from the so-called „rigid“ elements of an organization (machines, equipment, funds, land, etc.) to the so-called „soft“ organization elements,

primarily man and his work performance. Visually we could say that the whole or the most of Microsoft's capital goes home after work hours, and re-enters the company in the morning.

Organization intelligence is based on permanent learning, but also on the remembering and implementation of that knowledge in the realization of the target function. A logical question comes to mind – how can we measure the level of intelligence of an organization? Researchers from Germany give an example of such learning through the „intelligence matrix“, which we can see in Picture 1 [6]. This matrix takes 5 elements of the organization in vertical:

- Market,
- Customers (buyers),
- Product,
- Processes and

- Co-workers.

Horizontally, matrix sets five characteristics or components of knowledge, memory and applied intelligence in decision making:

- Response capability
- Problem solving capability
- Capability of learning/innovation/ creativity
- Memory and
- Emotional intelligence.

By answering the questions, they are scored by quality and we can judge the intelligence level of an organization in the final score. This is one possibility which gives us the push to realize this matrix in our own companies. The relevant demands of the environment, which are characteristic for the specific company and its position in the business, natural and social environment, should be inserted into the matrix. In order to classify the

		A Response capability	B Problem solving capability	C Capability of learning/innovation/ creativity	D Memory	E Emotional intelligence
1	Market / Competition	How quickly and in what degree do you react to the new products of the competition?		How quickly and in what degree do you learn from the market and the competition?		What are your client's contacts like to the relevant unions?
		1 2 3 4 5		1 2 3 4 5		1 2 3 4 5
2	Customers (Buyers)	Do you respond quickly and fully to a question?	Do you know your customers problems and do you solve them quickly and to the customer satisfaction?	How fast and in what degree do you learn from your customers?	How quickly can you have information about your customers in the past as in what you delivered them?	Are your relations to your customers trustworthy and open?
		1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
3	Products		Do you learn the production problems in time and do you solve them quickly?	Are your products special or ordinary? ("me-too")	Can you revise your product development after you identify the carriers of know-how?	
			1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	
4	Processes	Are you informed (questioner) with the current process management (e.g.: sales process or supply process)?	Can you easily recognize the process problems and solve them quickly and completely?	Do you fix your processes in a systematic way?	Do you have quickly accessible documented solutions form the past ("Best practice")	
		1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	
5	Co-workers	Does the management have complete answers to the employee's questions?	Do you know your co-worker's personal problems and do you help them in dealing with them?	Is dynamic culture of the learning organization present and is it advanced, along with the common opinion of all co-workers?	Do you facilitate the creation of systematic knowledge between co-worker generations?	Does a single firm connection of normal communication between the company and the employees exist?
		1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

Figure 1. Intelligent matrix of an organization

answers quality there is a key presented in Table 2.

This table helps us roughly estimate the position of our organization in its environment, so we can work on its better structuring.

TABLE II. SCORING KEY

<i>No. value</i>	<i>Organization score</i>	<i>Explanation</i>
1	Insufficient	Far below the average
2	Sufficient	Below the average
3	Satisfactory	Same as competition
4	Good	Above average
5	Very good	Leader in the market

V. CONCLUSION

Globalization and technological changes effect the structuring of organization in order to respond to the changes in the environment. Organization structures are no longer rigid and situation approach in one matrix combines organization and situation factors in order to build the organization structure in an optimal way.

Global market is enhancing the competition and demands constant battle for survival and development.

Traditional organization structures give way to the knowledge organizations (learning organization) which have a number of characteristics like: specialization, less hierarchy, communication, team work, etc. So-called intelligent organization changes the access to the capital, so instead of the current view of funds, equipment, land, etc. the focus is transferred to knowledge as the most important resource.

Article is also about considering the characteristics of the intelligent organization, which shows some of the possibilities for measuring the intelligence level of an organization (IQ-organization). Analyzing one intelligence matrix we can see the general score of intelligence, within the business or competition. This paper indicates the needs for research in order to structure the so-called intelligent organization, or the organization which constantly learns, in the right way.

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A Document Content Logical Layer Induction on the Base of Ontologies and Processing Changes

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Abstract – An approach to a document content representation on the base of ontologies is considered. The ontologies are written in popular RDF (Resource Description Framework) format and its variations. Technological aspects of document rendering in internet browsers are considered, as well as Chameleon template HTML generator improvement to support the rendering. Other aspects such as multiformat data representation, a modification-driven data and knowledge acquisition are presented. The technologies are applied in notary office automation for preparation new documents. Application of RDF and its processing algorithms allowed us to solve common problems of logical layer document representation and management of the document content.

I. INTRODUCTION

In 2001 Tim Berners-Lee proposed [1] a blueprint of further web development that is aimed at the development of network services with reasonable integration of logical layer of the information stored in the network. Information presented on sites is marked up semantically and program agents use the markup as the logical layer for the information consumption and processing. The blueprint is referred to as Semantic Web (SW).

One of the main problems of SW is the fact, that the regular users of the web resources are not fond of the technological aspects of Semantic Web. They are interested in their practical problems solutions. In order to involve users in SW content development we must completely hide the technological aspects from them. This results in the necessity to develop document content management software exploited within SW as knowledge acquisition systems, where user plays role of information source for decision-making engine.

The content of a legal document in most cases contains meaningful information for human that is usually passed to other documents in a derivative form. This suggests an idea to develop a form of the logical layer representation in a low level form, which can be rendered by means of context-dependent (in sense of document) templates. The SW approach could supplement the idea with data formats and technologies. SW represents logical layer as a network graph of notions and relations between the notions. For example, individuals mentioned in a

document relate to the document as “parts-whole”, unless to speak even more explicitly.

At present most of the ontology models of domains used for refining search results. Automatic procedures of ontology extraction from the documents are based on crawling documents in a warehouse and data mining procedures on the text bodies and metadata attributes of the documents. Simple observation on the human behavior in the process of a document preparation will result in the confidence that meaningful parts of the document are located at the points of document modifications. Hence, a programming system automating a document preparation can track the modifications and analyze them to extract ontology data, i.e., data and knowledge.

The logical layer is induced during content modification by means of data analysis and user interview. The context of the knowledge acquisition consists of the source document (its textual representation and the logical structure), its list of modifications in a transaction, user's action history and answers to the interview questions clarifying meaning of his/her actions. As a result new or modified triples <subject, relation, object> representing the domain are constructed. Collected data and metadata of the logical layer can also be crawled on a regular basis to figure out patterns and functional relations between triplet data. In the last case a relational table could be constructed to raise the efficiency of data storage and processing.

At present, there are two approaches for semantic text markup: a) joint use of HTML and RDF (Resource Description Framework) specifications (RDFa) for the semantic content definition; b) special interpretation of HTML attribute combinations without use of additional extensions of HTML.

The first approach is a result of theoretical development of the SW basis. A number of semantic representation language classes are formed according to the language expression abilities, complexity of the processing algorithms, and decidability of inference process in the corresponding description logics. The second approach is aimed at a guaranteed decidable algorithmic processing of the semantic markup. Technology of microformats [2] is the most widely known example of the approach. Microformats are processed with browser plug-in modules. The common element of the two approaches is the fact that HTML page, which is a

presentation layer of the document, is a carrier of the semantic (logic) layer of the data to be visualized.

The present trends of internet information system development shows that the systems become a web services and are oriented to support social networks [3]. The data flow processing here in most cases is input, storage, filtering and transmitting data (i.e., data integration) rather than aggregation and report generation. The usage of special design techniques for the middleware layer of the software, such as object-oriented design, is not a significant advantage. Social network are interconnected with common protocols and data structures, also in the environment

- there are no predominant common task to be solved with all the agents;
- each agent solves its special task, so the agent API's and supported data format must be strongly standardized;
- human users of the social network do the aggregation tasks personally including aggregation of unstructured information.

In the paper, we consider an approach to document content management and integration, including web-site content, based on RDF standards. The human user plays a role of a data source in the process of semantic data markup formation of the document content.

As a testing ground, we have chosen document preparation automation of a notarial office. Most of all operations over documents can be expressed as textual and logical layer modification, for example, data of the logical layer are copied from one document to another; sometimes roles of individuals mentioned in the documents are alternated; database collects client data for further reuse, etc.

A part of the paper devoted to consideration of organizational problems, such as involving knowledge engineers in a refinement process of generated parts of the ontologies; partial automatic ontology verification; implementing secure ways of personal data transfer and processing. The properties of the document exchange network will be similar to social networks, and, probably, can be further developed and investigated the same way.

II. DOCUMENT CONTENT REPRESENTATION

The RDF standard describes informational resources as triples <subject, relation, object> in a context. Each set of triples forms a graph (network) of data and relations reflecting knowledge. It is convenient to divide graphs to subgraphs and construct their hierarchic complexes [4], resulting a hierarchy of contexts. In a general case, a context affects to the interpretation of its set of triples. For example, family name and passport data are presented as texts in different parts of the document, but related to the single person in the context defined by the document.

In the discussed approach, all data for document rendering is also stored in the ontology graph. We represent with triples the views and algorithms

implementing controllers in the sense of MVC (Model View Controller) technique of user interface design model [5]. Let us consider an example of document context (contact data of an individual) and its rendering environment using FOAF (Friend of a Friend) ontology format.

```
<rdf:RDF
  xmlns="http://www.w3.org/1999/xhtml"
  xmlns:rdf=
    "http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:foaf="http://xmlns.com/foaf/0.1/"
  xmlns:s="http://www.w3.org/2000/01/rdf-schema#"
  xmlns:view=
    "http://purl.org/aquarium/engine/MVC"
  xmlns:tal="http://xml.zope.org/namespaces/tal">
  <rdf:Description rdf:about=
    "http://www.example.com/People/II/contact#me">
    <rdf:type rdf:resource=
      "http://xmlns.com/foaf/0.1/Person"/>
    <s:seeAlso rdf:resource=
      "http://www.exam.../People/II/contact"/>
    <foaf:homepage rdf:resource=
      "http://www.example.com/People/II"/>
    <foaf:img rdf:resource=
      "http://www.example.com/people/II.png"/>
    <foaf:mbox rdf:resource=
      "mailto:ii@www.example.com"/>
    <foaf:name lang="en">Ivan Ivanov</foaf:name>
    <foaf:name lang="ru">Иван Иванов</foaf:name>
  </rdf:Description>
  <!-- Render a Person into HTML+RDFa. -->
  <rdf:Description rdf:about=
    "http://xmlns.com/foaf/0.1/Person">
    <view:pt xml:lang="ru">
      <!--! Variable "subj" contains subject. -->
      <a href="." tal:attributes=
        "href rdf: subj s:seeAlso"
        tal:omit-tag="not: rdf: subj s:seeAlso">
        <span tal:replace=
          "rdf: subj foaf:name"/>
      </a><br/>
      Home page: <a href=""
        tal:attributes=
          "href rdf: subj foaf:homepage">
        <span tal:replace=
          "rdf: subj foaf:homepage"/>
      </a><br/>
      E-mail: <a href="mailto:me@example.com"
        tal:attributes=
          "href string:mailto:
            ${rdf: subj foaf:mbox}">
        <span tal:replace=
          "rdf: subj foaf:mbox"/></a>
    </view:pt>
  </rdf:Description>
</rdf:RDF>
```

Note, that the first part of the example defines an instance (a contact data of Ivan Ivanov) in the ontology. The second part of the example describes a view for the resources that are instances of class Person. A modified version of Cameleon rendering engine is used as document template subsystem. Chameleon transparently interprets object values and triples as replacement of the source HTML tree branches and leaves. The set of global

variables passed to a template contains variable `subj`, which defines subject to be rendered, `container`, which refers to context graph, and `template`, which refers to the view itself. In the example `subj` contains an instance of `Person` class, `context` contains document, where the instance is mentioned. The `template` reference is used to store, constant auxiliary data that helps rendering.

In order to support rendering triples Chameleon engine was improved also with new syntactic rules corresponding to description logic expressions influenced by RDF standard (standard identifiers, XML namespaces, *etc.*). The renewed engine marks up resulting HTML with the logical layer data by means of RDFa-structures. The improvement allows us to transfer the document and its logical layer in the single data stream, as well as supply the browser-side routines with necessary logical data. The transferred logical layer, then, is interpreted by context-dependent editing widgets. User points mouse to a subject of a triple in the displayed document and a corresponding widget appears. For example, pointing to family name of a person a string field appears to change the value. The result of a modification is immediately sent to the server.

In a general case, it is necessary to implement functional relations algorithmically for view. This is realized with programming language inclusions in the RDF definition of the view resource. In the following example, a function implementation for class `Person` is presented.

```
<rdf:RDF xmlns:html=
"http://www.w3.org/1999/xhtml"
xmlns:rdf=http://www.w3.../22-rdf-syntax-ns#
xmlns:foaf="http://xmlns.com/foaf/0.1/"
xmlns:s=http://www.w3.../rdf-schema#
xmlns:view=
"http://purl.org/aquarium/engine/MVC"
xmlns:tal=
"http://xml.zope.org/namespaces/tal">
<rdf:Description rdf:about=
"http://xmlns.com/foaf/0.1/Person">
<view:method html:id="nameUpcased">
<html:script
type="text/python" xml:lang="ru">
<!--! The instance defined as "self" -->
return self["foaf:name"][0].upper()
</html:script>
<html:script
type="text/javascript" xml:lang="ru">
<!--! The instance defined as "this" -->
return this.query("foaf:name")[0] \
.toUpperCase()
</html:script>
</view:method>
```

```
</rdf:Description>
</rdf:RDF>
```

Using these two definitions, template engines are able to take advantage of the method “`nameUpcased`” (implemented in various programming languages) to make a string argument as upper case. Role based access control can be implemented the similar way [6, 7] using RDF triples.

In the fig. 1 architecture of the document content management system is presented. The system reflects popular client-server architectures, where the server-side interprets Chameleon template (module “`Document Renderer`”). In order to render a template the data model instance should be loaded through module “`Loader of Triples`”. The instance is represented as a set of triples; the resulting document shows only data allowed to view to user. The data access is under control of “`Data Security`” module. The restricted triples are filtered out, and the fact is noted in a special document field. The purpose of “`Data Representation Broker`” module is to store triples in a format that is better support special tasks, such as aggregations. Three formats are supported – RDF, XML, and relational tables. In the backward direction, the broker restores triples from the storage as RDF entities. All these storage engines are implemented in OpenLink Virtuoso Universal Server [8] as well as its Open-Source Edition.

III. AN EXAMPLE OF APPLICATION

One of the applications of the technology under development is document preparation automation of a notary office. Notary office in Russia generate vast amount of printed documents. The documents contain both formalized and unformalized data. For example, formalized data are the passport data of individuals, registration data of vehicles. Data of this kind are passed from one document to other documents, raising a bindles of related documents. The document content structure significantly depends on entry fields’ data filled in: form of notary signature field depends on legal capacities of the individuals mentioned in the main document body. At present templates of the documents are prepared by a programming engineer with collaboration to a professional secretary. Unformalized data are various enumerations of legal empowerments of the individuals, article codes, and explanatory text.

Application of the semantic approach to the logical layer representation of the notary document content is aimed at involvement of the secretaries (people with low engineering skills) into the processes of the document instances preparation from the existing templates and into the development of the templates and constructing their hierarchical arrangement.

Logical layer of a notary document consists of hierarchy of subjects. The subjects relate to each other on various abstraction levels, e.g., in a letter of attorney there are at least two individuals, the first one is principal, and the second one is trusted (proxy). For each individual passport, data and place of residence are defined. The letter can contain other person data, e.g., for partially capable children. All the individuals are in explicit relation to the document. The triples `<letatt998`

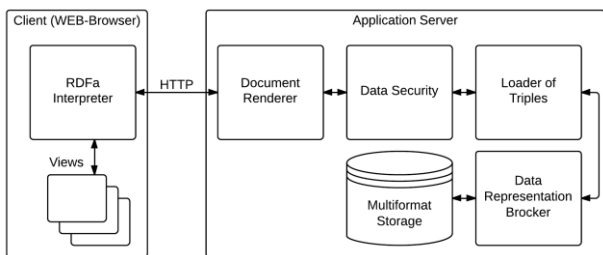


Figure 1. Program system architecture

containsPrincipal indiv_78> and <letatt998 containsProxy indiv_79> could define a principal and proxy to the document. The mentioned relations are specifications of abstract hasIndividual and structuralElement relations. This multilevel approach allows us visually represent hierarchical structures of the document, having interpreted the relations as structural elements, and in the same time to associate individuals with other roles in new documents, swap roles during editing. The swap function is implemented as user interface widget, which recognizes certain subject-to-subject relation patterns in the document body and interprets semantics of the relations as possible action. A general graph structure of the abstract level of a notary office automation ontology is drawn in fig 2.

Semantic markup can be used to define grammar transformation of natural language phrases, nouns and adjectives, including family names of individuals. For the purpose a structure view:decl (a shortcut of declination) was introduced, which each noun and adjective of the tag text transforms into required declination and form. For coordination of nouns and adjectives expressions of a form <... view:gender="EXP M F N">TEXT</...> are used. The interpreter appends to text TEXT string M if expression EXP is a masculine noun, string F if it is feminine, and N for neuter. Variables EXP, TEXT, M, F, N are string expressions, N is optional, M, F, N are divided by one space symbol or with “_”.

IV. CONTENT MANAGEMENT AND ONTOLOGY MARKUP CONSTRUCTION

One of the key moments of the research is semantic document markup techniques adaptation to the process of document editing. We suppose that a document body modification, in a regular case, alters the meaning of the document, hence, alters its logical layer. Examples of the modifications are the elementary error correction, a field value change (object of a triple), paragraph text editing that might imply its origin template correction. Each modification also will result to a new relation (triple) extraction between context subjects and old/new object value. The text modification analysis is aimed at data and knowledge acquisition, where the content management system plays an active role, and user is a source of complementary information.

The semantic layer enrichment is carried on in an environment containing logic information thanks to document is already supplied with a logical layer. The source data for an acquisition step is as follows: a) the source version of the document, b) a text modification

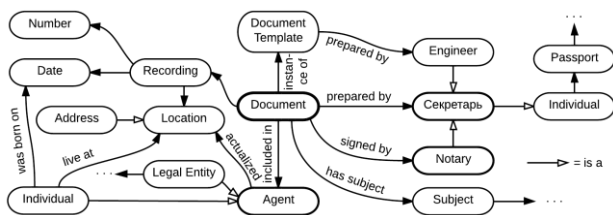


Figure 2. A general structure of notary document ontology

expressed in diff format [9]; c) user answers to the question asked by the system, which refine the semantics and structure of the modifications; d) user actions preceding the modification. If the modification corresponds to a value of an object of a triple then the modification means either error correction (subject is not changed) or creation of a new subject if user copied the document previously. Creation of a new document implies filling in a number of triples with new values representing a new subject (RDF resource) of the document.

If a field or a text is partially modified this can be interpreted as:

- again, an error correction without document meaning change;
- refinement of the logical structure of subject, extraction of a relation and an object; this corresponds to a new triple connecting the subject to the new object (changed value); the user must choose the subject of the new triple.

The new subject is chosen from a tree of all the subjects of the edited document. After the choice is made, a list of all available relation is constructed from all known relation of the subject, its class and parent classes. User must choose one relation to form the triple. In the case when the list contains no desired relation a new one must be defined. New relation is always a subclass of one that already exists in the system, which is also chosen from the list. New relations defined by inexperienced user must be periodically analyzed by knowledge engineers to get rid of semantic inaccuracy, contradictions, redundancy to the equivalents, and be, hence, refactored.

If a value of a triple is removed, then the triple is being removed too. The situation is acceptable if the minimal structural and semantic completeness of all the subjects of the documents are hold, otherwise either the user delete action is prohibited or the chain recursive deletion of the subjects is initiated. To control this behavior each subject class have to be accompanied with a list of minimal valuable triplets that define the basis of the subject sense. Partial text removal, if it is not an error correction, is processed analogously to modification, with removed part being the object value. Addition of characters to text is an action similar to modification, i.e., in a general case a new triple is constructed.

Addition of a triple might result in extending the document with new subjects and relations. For example, let construct a new tripartite agreement from an existing bilateral one. In new contract a third individual appeared, so the addition of a new family name of the individual results in construction of a subject for the individual, filling in the necessary triples, as well as definition of a new relation between document and the subject as a subclass of structuralElement relation.

A. Ontology consistency check

As in passing mentioned above the user will be a cause of ontology inconsistency. Class inheritance allowed in popular ontology formalisms may be the reason of contradictions, i.e., on an abstract layer it can appear that

an individual belongs to both of disjoint classes. Multiple inheritance may result to semantically incorrect relation inheritance: one can device a dish as subclass of pizza and ice cream [10].

To track the anomalies of the ontological descriptions, which appear as empty classes (which have to be non-empty), and contradictions as in the first case, a verification subsystem is being implemented. The subsystem is a SWI-Prolog [11] program importing a context graph or a subject as RDF triples and running a number of tests over the triples. The result of the verification is a list of potential problematic contexts, subjects and triples.

The verification subsystem is constructed by students as their laboratory works. As the test case a pizza ontology developed at the University of Manchester [10] is used. The correctness of the subsystem implementation is being compared with Java semantic checker integrated in last version of Protégé system [12].

V. RELATED PROJECTS AND FURTHER DEVELOPMENT

Among existing projects of ontology based document management the project "Semantic MediaWiki" can be emphasized. A basic Wiki text editing is extended with semantic annotations represented in a special markup format. The annotations are used by search engine of the Wiki pages [13].

In comparison to Semantic MediaWiki the project OntoWiki [14] obtained the similar results from an opposite starting point. OntoWiki is based on the predominantly usage of logical representation of the information as semantic network. The logical structure is edited with entry forms generated on the base of predefined vocabularies (term sets). User is allowed to change just one text property `lod:content`, which can contain HTML markup. The HTML markup does not relate to the logical structure of the subject to be visualized as web-document. The text is modified with WYSIWYG editor integrated into OntoWiki. The project is aimed at social networks developed under control of Linked Data technology.

Our project can be positioned as a further development if the OntoWiki engine to support a natural representation of the document content, visual editing of the content, conserving the logical layer; implementation of the data and knowledge acquisition on the base of modification analysis. The templates for OntoWiki subjects rendering are stored beyond the ontology and separately from the main content of the document. In our case the templates are auxiliary elements of ontology, it can be logically inferred from inheritance. Most of the interrelations between text content and its logical structure are expressed in RDFa.

A further development direction of the project is aimed at implementation of cognitive data mining (data analysis) in similar documents to reveal patterns between attributes that appear in the documents. The results of the analysis may be a basis of automation of document data storage technique decision. For example, if a set of attributes shows a strong correlation to an attribute than it

can be interpreted as a relation of a relational database. The set forms a determinant (the key set of a table) and the set of strongly correlated attributes forms rest of the table as described in the Method of Functional Dependency. The method used by database engineers in the process of a database design, the dependencies revealed from the analysis of the attributes' semantics. That is, the method could be used conversely, the dependencies can be revealed on the base of data mining.

The abstract layer of information modeling of the knowledge acquisition is a category of system complexes (configurations) [15], which is perfectly embody common metamodel of the ontologies as well as supply additional structural and functional properties. Developing the theory further one can connect the ontology devised during the document preparation process to the stage of UML-modelling of information system, which automates the processes of the domain.

Another directions of the system development is a reduction of HTML-rendering engines of the logical layer, so it could be completely realized on client side, as well as implementation for other programming languages and software platforms. Also we plan to develop a plug-in module for OntoWiki allowing editing Wiki interactively.

VI. CONCLUSION

An approach to representation of logical layer of a document based on RDF (Resource Description Framework) is proposed. The approach allows us to formalize the structure and semantic relation of the document, and also store data to render the document as HTML-page in the same data format - RDF. XML and RDF allow us to join logical and presentation aspects of the document within the same storage engine. The engine stores data as an onology, *i.e.*, set of triples `<subject, relation, object>`. A technique for HTML-rendering from the logical layer is described. The resulting document will contain the logical layer as a RDFa markup. The generated RDFa-markup is used at client side by web-browser for control of WYSIWYG-editing of the document. Text elements are modified with special widgets appearing in the user interface on an mouse event. A technique for organization of an interactive process of logical layer forming of the document content on the base of modifications analysis of the document content introduced by user. An example of application of the technologies under development in a notary office is presented. Thus, we shown that RDF format mixed with XML allows us to represent logical layer of meaningful information of a document, as well as sharing common data between documents.

On the base of the technology a network of document data exchange can be devised. The security of the document transmission can be provided as off-line data streams: each physical document is accompanied with its bar- or QR-code encoding the corresponding RDF-data of the transferred document. This can result in a semantic network analogous to nowadays social networks.

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LiveGraphics3D Potential Applicability in Primary School Geometry

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Abstract - Pupils in primary schools often have problems visualizing and comprehending geometric problems. There are problems with presenting even the simplest of three dimensional objects, and sometimes even some two dimensional figures. Due to limited funds and technology available, Serbian teachers hand draw these geometric figures. The pupils' ability to comprehend the problem is often dependant on the teachers' drawing skills. E-learning technologies can be used to enhance the pupils' understanding of elementary geometry. In this paper we will present how LiveGraphics3D can be utilized to visualize geometry problems and solutions. We will propose a prototype, localized for Serbian schools, which can be used as an additional learning tool in geometry classes for primary schools.

I. INTRODUCTION

Geometry is an important part of the Serbian primary school curriculum. Teaching geometry to pupils is a daunting task. Understanding and comprehending geometric problems represent a challenge to primary school pupils. Only a small number of them find it easy to comprehend and solve geometric problems, while the rest struggle. Due to limited funds and technology available, Serbian teachers hand draw geometric figures in attempt to visualize and explain geometry problems. Thus, the pupils' ability to comprehend the problem is often dependant on the teachers' drawing skills. A solution can be found in many mathematical/geometry software tools such as various types of dynamic geometry software (DGS) [1], *Mathematica* [2], *Matlab* [3] and others. Many of these tools are expensive or not available in the Serbian language. It is possible to find a solution to enhance the pupils' understanding of elementary geometry using e-learning technologies.

The purpose of this paper is to demonstrate the potential applicability of LiveGraphics3D in the visualization of geometry problems and their solutions for grades five to eight. For the purpose of the presentation we built a prototype, *LG3D primary geometry*, to demonstrate potential applicability of LiveGraphics3D.

LG3D primary geometry is not a replacement for more advanced and professionally built tools used in mathematical education of technologically more advanced countries. However, it represents a cheap and fast solution for building interactive presentations of two dimensional and three dimensional geometrical objects. It supports

simple interactive operations such as rotation and zooming. Also, it is possible to support simple parameterization of LiveGraphics3D scenery that allows manipulation of object attributes. So, users can change objects dimension, height, orientation, etc.

LG3D primary geometry is built using HTML and a Java applet, thus only a web browser and the Java plug-in are needed for its operation. It can be used online from home or in a classroom. First scenario is the most viable because there is the absence of presentational hardware such as overhead projectors and large scale touch screen display, and even computers in a typical classroom of Serbian primary school. Therefore, *LG3D primary geometry* is not intended as a companion tool to teacher's lectures. Its purpose is to help pupils understand geometry, and it represents an additional tool that should be used outside a classroom.

The organization of the paper is as follows. The background is described in Section 2. The LiveGraphics3D Java applet is described in Section 3. *LG3D primary geometry* and its potential applicability in primary school geometry are described in Section 4. Section 5 concludes the paper.

II. BACKGROUND

The problem of geometry visualization in education is assessed in literature [4]. There are different software tools developed aiming at solving this problem. Software tools differ in their complexity, price, audience, and whether they support e-learning or not. These tools are used infrequently in Serbian primary schools.. As it could be inferred from the previous text, the primary tool for geometry visualization is a drawing board with chalk, and a teacher drawing geometric objects.

One way to visualize geometric objects is to use tools such as *Mathematica* and *Matlab*. Both of these software suites are specialized computational software used in scientific, engineering, and mathematical fields and other areas of technical computing. However, these tools can be too complex, and their price is usually too steep for a primary school budget.

More often, DGS tools are used [1]. DGS are interactive tools which support creation and manipulation of geometric objects primarily in plane geometry. In most DGS tools, one starts construction by adding a few points and using them to define new objects such as lines, circles

or other points. After some construction is done, one can move the points one started with and see how the construction changes. There are tools which support only two dimensional geometry such as Euklides, GeoView, etc, and tools which support only three dimensional geometry such as GeoView, Geometria, etc. Some DGS tools, such as GeoGebra, support both two dimensional and three dimensional geometry. GeoGebra is a freely available. As it based on Java platform it supports exportation of geometrical objects for Web publishing. Users need to be familiar with GeoGebra syntax in order to produce geometrical scenes.

Beside these tools there is a plethora of custom made tools for Web or interactive books for primary school education such as *Math is fun* [5] and *Kids Math Games* [6]. However, these sites do not support interactive manipulation with two and three dimensional geometric objects.

There are sites with geometry topics which do support interactive manipulation with two and three dimensional geometric objects such as *Interactive Mathematics Miscellany and Puzzles* [7]. This site is based on Java applets used under license. Therefore, it is not free and it can't be customized for personal use.

It could be observed from this short background review that there is a place for a software tool which would support interactive manipulation of two and three dimensional geometric objects. This software should be free and customizable. LiveGraphics3D is good candidate for building such a software tool.

III. LIVEGRAPHICS3D

LiveGraphics3D is a Java 1.1 applet that supports interactive manipulation of two and three dimensional graphics on the Web [8]. It is freely available. Users can adjust the viewpoint and zoom, and it is possible to drag the objects with the mouse. Mathematical expressions are evaluated and automatically updated. Hidden surfaces, line rendering, and diffuse lighting of surfaces are supported. The support for displaying animations, calculating stereographic displays, integrating hyperlinks, and displaying bitmap backgrounds is also supported in LiveGraphics3D.

LiveGraphics3D applet operates in a very simple manner. A description of a three dimensional scene in *Mathematica* syntax is provided to the applet. The description can be generated in *Mathematica* or it can be entered manually. Everything else regarding the display and interactive manipulation is handled by the applet. The good side of this approach is that the scene is rendered very fast. However, it is not possible to customize the display and user interface because they are fixed.

Mathematica syntax is the only prerequisite. It can be embedded in a HTML code or it can be contained in a separate file imported into HTML code. Using LiveGraphics3D in a Web presentation requires inclusion of the path to the Java archive, *live.jar* in the HTML page [9]. The Java archive, *live.jar* includes the LiveGraphics3D implementation. An example code of the description embedded in HTML code is presented below:

```
(1)
<applet archive="live.jar" code="Live.class"
width="300" height="300">
<param name="input"
value="Graphics3D[
  {RGBColor{0.75, 0.75, 0.75},
  Polygon[{{1, 0, 0}, {0, 1, 1}, {0, 0, 1}}]
},
Lighting->False, Boxed->True, Axes->True,
ViewPoint->{0, -7, 0}, ViewVertical->{0, 0, 1}"/>
</applet>
```

The last line of the *value* string contains the directives to the applet concerning the display options. This code will generate one triangle in a three dimensional coordinate system, Fig. 1.

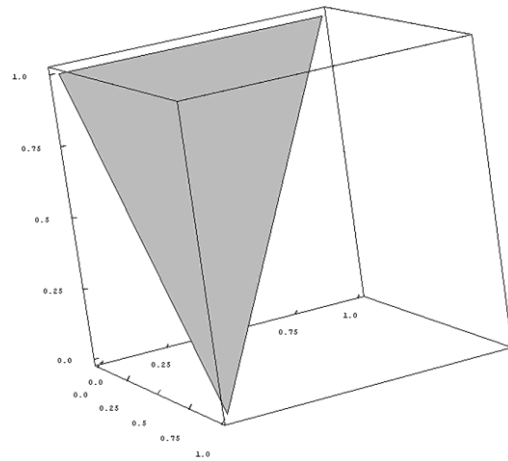


Figure 1. A LiveGraphics3D triangle

The parameter *input_file* will replace the *input* parameter if the description code is in separate file, like in the example presented next:

```
(2)
<applet archive="live.jar" code="Live.class"
width="300" height="300">
<param name="input_file" value="example.m" />
</applet>
```

Code contained in the value string from the first example is moved to the *example.m* file.

Parameterization is supported by the LiveGraphics3D applet. Display of primitives whose coordinates are not fixed is supported through independent and dependent variables. These variables can be adjusted through variables whose values are calculated based on some other variables. For example, let us assume that the coordinates of the second point in (1) are not fixed. Instead, they are described with variables *x*, *y*, and *z*. Variables *x* and *y* are independent and *z* is dependent from *x* and *y*. This dependency, for example, could have the next form: $z = x^2 - y^2$. The use of the independent variable and dependent variable parameters is described the next code example:

```
(3)
<applet archive="live.jar" code="Live.class"
width="300" height="300">
<param name="input_file" value="example.m" />
<param name="independent_variables"
value="{x->6, y->1}" />
<param name="dependent_variables"
value="{z->x^2-y^2}" />
</applet>
```

If the LiveGraphics3D scene is constructed in appropriate way, users can change values of independent and dependent parameters. Therefore, they can change the size and shape of the geometric object. For example, LiveGraphics3D code from (1) can be changed in the following next way:

```
(4)
<applet archive="live.jar" code="Live.class"
  width="300" height="300">

<param name="independent_variables"
  value="{x->1, y->0, z->0}">
<param name="dependent_variables"
  value="{x -> If[Less[x,0], 0, If[Greater[x,1], 1, x]],
  y -> If[Less[y,0], 0, If[Greater[y,1], 1, y]],
  z -> If[Less[z,0], 0, If[Greater[z,1], 1, z]]}">

<param name="input"
  value="Graphics3D[{
  {RGBColor[0.75, 0.75, 0.75],
  Polygon[{x, y, z], {0, 1, 1}, {0, 0, 1}}]},
  {RGBColor[0., 0., 0.],
  PointSize[0.01], Point[{x, y, z]} }
  ],

Lighting->False, Boxed->True, Axes->True,
ViewPoint->{0, -7, 0}, ViewVertical->{0, 0, 1}]">
</applet>
```

In (4) it was necessary to add a point, because points are elements of LiveGraphics3D which can be manipulated by users. Users' interaction with coordinates of the point is enabled through independent and dependent parameters. For each of the parameters (x, y, z) expression can be read as follows. If parameter value is less than zero, set the value of parameter to zero value. Otherwise, if the value of the parameter is greater than one, set the value of parameter to one. If value of the parameter is between zero and one, do not change the value of the parameter. These expressions are used to keep parameters values inside a given scope, which is, in this case, $[0, 1]$. User interaction with the triangle generated from code example (4) is demonstrated in Fig. 2.

When a cursor is placed over the point, a rectangle is drawn around it, signaling the possibility of interaction. It is possible to move the point in all three directions, x, y, and z. Shape of the triangle will change in the appropriate way.

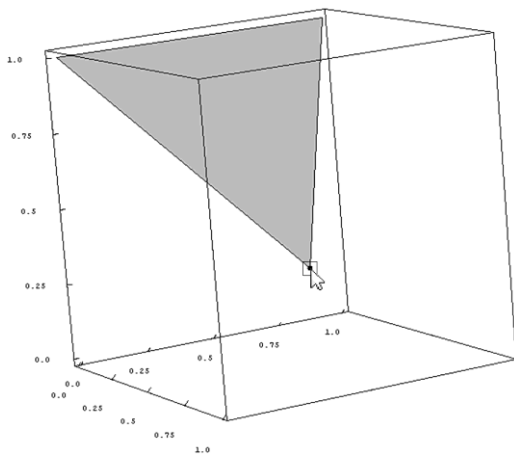


Figure 2. Interactive user manipulation of a point of a triangle in LiveGraphics3D

There are additional options which can be defined using the LiveGraphics3D parameters which are not used in our prototype. These options are described in [8, 9].

IV. PRIMARY SCHOOL GEOMETRY WITH LIVEGRAPHICS3D

There are several approaches to utilize LiveGraphics3D in *LG3D primary geometry*. These approaches for visualization of geometry problems and solutions differ in amount of content shown, level of interactivity, and type of LiveGraphics3D code (whether it is predefined or dynamically scripted and generated). We adopted three scenarios for *LG3D primary geometry*:

- *Textbook scenario*. Essentially, in this scenario examples from primary school textbooks are displayed with minimal interactivity (rotation and zooming).
- *Demonstration scenario*. In this scenario examples from primary school textbooks are enhanced with more interactivity allowing pupils to change the size of geometric objects and values of their elements such as height, radius, and values of the edges.
- *Test scenario*. In this scenario pupils solve various tasks; a geometric scene is generated according to their work and compared to the task solution.

Naturally, it is possible to find additional scenarios, but these are the focus of our prototype. Additional scenarios will be explored in the future. The prototype is in Serbian language as it is intended for the Serbian pupils. Therefore, the examples shown in this section are in Serbian language. However, this does not diminish their informational value, as the language of the accompanying text is not important for the proving of LiveGraphics3D potential applicability in primary school geometry.

One of the drawbacks of LiveGraphics3D is that not all of the elements can be parameterized. For example, the parameterization of color values is not supported, thus it is not possible to change the color of the nodes to signal that some conditions change. Also it is not possible to change objects in a geometric scene dynamically inside a LiveGraphics3D code. It is necessary to either reload predefined LiveGraphics3D code containing a geometric scene with requested objects or to generate it in accordance to user's description using JavaScript [10].

First two scenarios for *LG3D primary geometry* could be utilized with the use of predefined LiveGraphics3D code. Whenever the geometric scene changes a new external file with LiveGraphics3D description is loaded. However the third scenario requires more flexibility. It is not possible to know in advanced all the answers that pupils may come up with. Therefore, it is not possible to use files with predefined LiveGraphics3D code. Code has to be generated using JavaScript which will be explained later in this section.

In the *textbook scenario* geometric scenes are not simple interactive copies of examples from primary school textbooks. An example from *textbook scenario* is shown in Fig. 3. This is a typical example of a regular square

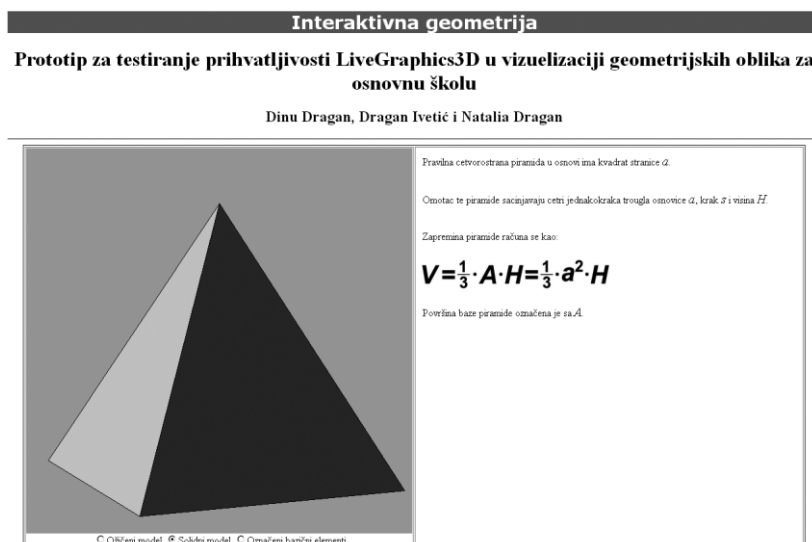


Figure 3. A primary school textbook example presented in *LG3D primary geometry*

pyramid from eight grade text book. Rotation and zooming is supported, but additional display modes are included. Users choose one of these modes by selecting the appropriate radio button. It is possible to choose filled, Fig. 3, or the wireframe display of pyramid polygons. In the wireframe display mode, it is possible to select the highlight display mode in which basic elements of the pyramid, such as height and edges, are highlighted in the geometric scene, Fig 4. Only the applet is shown in Fig. 4. If color is used, there are even more possibilities for highlighting. However, for this paper we used grayscale examples.

In the *demonstration scenario* pupils are allowed to interact with geometric objects. Beside rotation and zooming, pupils can change the values of the prominent elements of the geometric object. In the case of the regular square pyramid the height and edge value could be changed. There two ways to achieve this using predefined LiveGraphics3D code:

- *Continuous sliding*, points representing the elements changing can take any value from a given volume.
- *Discrete sliding*, points representing the elements changing can take discrete values from a given volume.

The *Continuous sliding* is demonstrated in Fig. 5. There are two points to support user interaction. The first

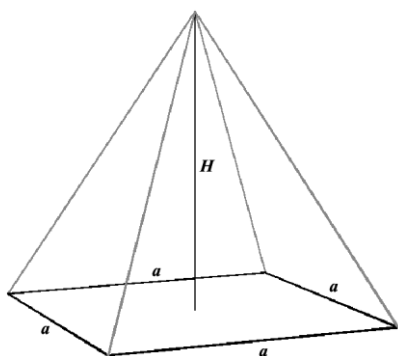


Figure 4. A wireframe model with highlighted values

point from Fig. 5 enables pupils to change the height of the pyramid, while the second point enables pupils to change the size of the base edges. Due to limitations in LiveGraphics3D applet, only one point of the base edges can be interacted with. In that way pyramid will remain a square one.

In the *discrete sliding* example the geometric scene is divided into a network of virtual cubes, Fig. 6. Pupils can slide the points only onto intersection points of the virtual network. The network is not shown to pupils. The limitation considering the base edges remains in this case also.

From an educational perspective it would be very informative to accompany the changes in a geometric object with the report on the objects volume, surface area, etc. Unfortunately, it is not trivial to synchronize values of geometric objects in LiveGraphics3D applet with external HTML code. A solution is to use JavaScript code to generate LiveGraphics3D in accordance with the values chosen by pupils, which will be called *JavaScript demonstration scenario*. Example of HTML page containing generated LiveGraphics3d applet is shown in Fig. 7. In this example, pupils clicking on the plus/minus buttons change the values of the height and base edges. By clicking on the *Izmeni* button, new LiveGraphics3D will be created and the values of the volume and surface will be reported to pupils.

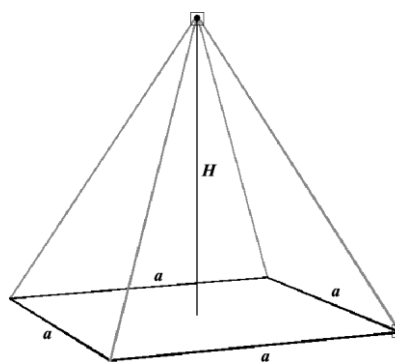


Figure 5. An example of *Continuous sliding* user interaction

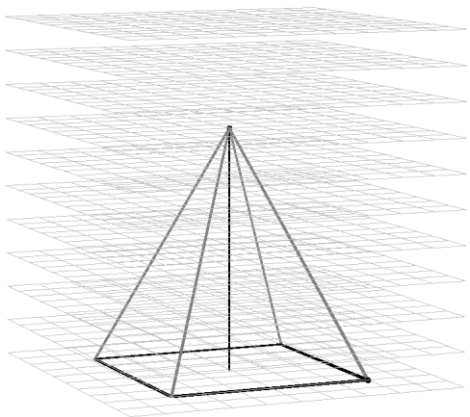


Figure 6. An example of *Discrete sliding* user interaction (virtual web is not shown to the user)

It is possible to use LiveGraphics3D public setGraphics3D method to change the *input* parameter of the code. This means that only the *value* string from (1) will be changed to encompass the changes in geometric object. JavaScript method *KreirajNovuPiramidu* for generating the new input for LiveGraphics3D applet is described in the next example:

(5)

```
function createLiveGraphic(a, H){
  LiveGraph = document.getElementById("LiveGraph");
  newInput = "Graphics3D{"
    + "{ Thickness[0.005], RGBColor[0.0, 0.0, 0.0],"
    + "Line[{{-\" + a/2 + \";-\" + a/2 + \",0}, {\" + a/2 + \";-\" + a/2
    + \",0}, {\" + a/2 + \";\" + a/2 + \",0}, {-\" + a/2 + \";\" + a/2
    + \",0}, {-\" + a/2 + \";-\" + a/2 + \",0}}],"
    + "{ Thickness[0.005], RGBColor[0.5, 0.5, 0.5], Line[{{-\"
    + a/2 + \";-\" + a/2 + \",0}, {0,0,\" + H + \"}}],"
    + "{ Thickness[0.005], RGBColor[0.5, 0.5, 0.5], Line[{{\"
    + a/2 + \";-\" + a/2 + \",0}, {0,0,\" + H + \"}}],"
    + "{ Thickness[0.005], RGBColor[0.5, 0.5, 0.5], Line[{{\"
    + a/2 + \";\" + a/2 + \",0}, {0,0,\" + H + \"}}],"
    + "{ Thickness[0.005], RGBColor[0.5, 0.5, 0.5], Line[{{-\"
    + a/2 + \";\" + a/2 + \",0}, {0,0,\" + H + \"}}],"
    + "{ Thickness[0.005], RGBColor[0.0, 0.0, 0.0], Line[{{0,0,0}
    + \", {0,0,\" + H + \"}}]}\"
    + \",\"
    + \"Lighting -> False, Boxed -> False,\"
    + \"ViewPoint -> {-3, -7, 1}, ViewVertical -> {0, 0, 1}}\";
  LiveGraph.setGraphics3D(newInput);
}
```

Every time pupils change the height or the edge size by clicking on the appropriate + or - button, *CreateLiveGraphic* method is executed with parameters describing the height of the regular square pyramid and the size of the base edge. This method generates a new LiveGraphics3D applet displaying the pyramid with the new height and base edge.

In the *test scenario* a geometric problem is presented to pupils. They have to solve it and submit the solution by clicking the *Resenje* button. JavaScript is used to generate the LiveGraphics3D applet corresponding to pupils' solution. Beside this applet, a LiveGraphics3D applet with the correct solution and values asked are also displayed. The same technique as in the *JavaScript demonstration scenario* will be used in the *test scenario*. A JavaScript method will be used to generate *value* string for a LiveGraphics3D applet based on the pupils' answers.

An example of the *test scenario* is described in Fig. 8. Pupils are tasked to answer which height will lead to a regular square pyramid with a volume of 270 cm³ when the edge size is 9 cm. Appearance of the web page after a pupil provided a wrong answer is shown in Fig. 8. It is possible to include additional information beside the ones shown in Fig. 8, such as volume corresponding to pupil's answer and the correct answer.

It should be noted that the Fig. 3-8 represent the prototype of the LiveGraphics3D based solution for visualization of geometry problems and solutions in geometry for primary school. It is intended only as a proof of concept. Therefore it does not have the refinement of the finalized product intended for public use.

V. CONCLUSION

In this paper we demonstrated the potential use of LiveGraphics3D for visualization in primary school geometry. We built a prototype called *LG3D primary geometry* as a proof of concept. We demonstrated three possible scenarios for using LiveGraphics3D applet. We used examples with predefined LiveGraphics3D code in external files and examples generated with JavaScript.

Interaktivna geometrija

Prototip za testiranje prihvatljivosti LiveGraphics3D u vizuelizaciji geometrijskih oblika za osnovnu školu
 Dinu Dragan, Dragan Ivetić i Natalia Dragan

© Obični model ☑ Solidni model ☐ Označeni bazni elementi

Pravilna četverostrana piramida u osnovi ima kvadrat stranice *a*.

Omotac te piramide sastoji se od četiri jednakokraka trougla osnovice *a*, krak *H* i visina *H*.

Zapremina piramide računa se kao:

$V = \frac{1}{3} \cdot A \cdot H = \frac{1}{3} \cdot a^2 \cdot H$

Površina baze piramide označena je sa *A*.

Primer kako se menja zapremina piramide kada se menja njena visina *H* i dužina osnovice baze

H =

Figure 7. A primary school textbook example presented in *LG3D primary geometry*

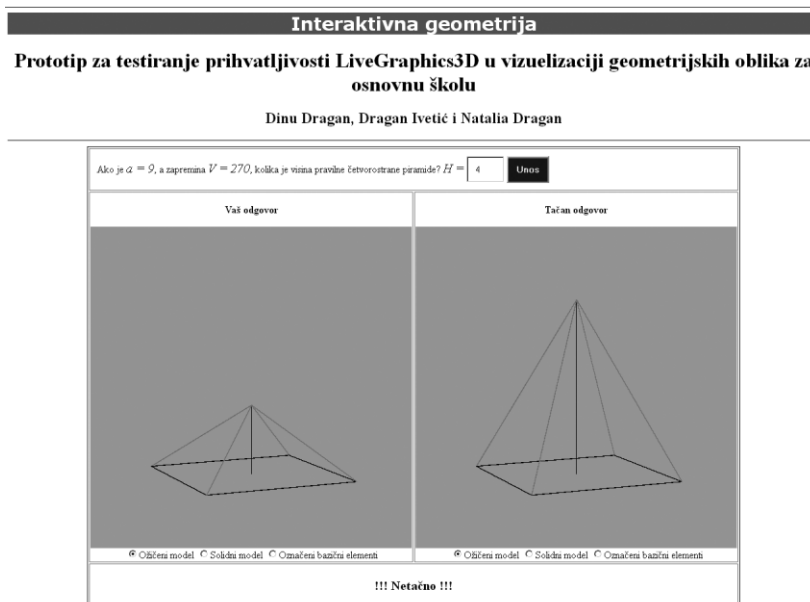


Figure 8. A primary school textbook example presented in *LG3D primary geometry*

The first type of example enables the presentation of textbook examples and basic interactivity, while the second type of example enables much more sophisticated interactivity and adaptability to pupils' actions.

This paper demonstrates that LiveGraphics3D has a potential as a tool for visualizing primary school geometry. It is possible to build a Web site based on LiveGraphics3D, JavaScript, and HTML. This site could be used as accompanying tool in geometry education for a primary school. The prototype presented is far from a finalized product. We plan to modify the examples shown, to include all the examples found in the primary school textbooks and to introduce them into the Web site. An extensive test of the proposed scenarios by primary school pupils is intended for the future.

ACKNOWLEDGMENT

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IIS based Remote Monitoring of Distributed Technical Systems in Real Time

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Abstract - The paper discusses the basic aspects of software and hardware platform developed for the remote monitoring of a distributed technical system. Entire platform is conceived towards reading parameters important for the technical system under the monitoring, data transfer by tunneling through the public network available with mobile operators and providing remote monitoring of the system parameters to the wide range of users – through the Internet Information Service (IIS). Special attention is dedicated to the system elements which are in control of the whole process. The developed platform is represented through example of heating power distribution system for communal area. Developed solution is shaped to be upgradable and flexible i.e. applicable for monitoring of various distributed technical systems.

I. INTRODUCTION

The growing consumption of energy and water is a global challenge. Both water and energy are scarce and they are becoming increasingly valuable. This challenge requires using the resources efficiently, especially if we take into account future generations.

It has become widely accepted that a living room should be heated and cooled to provide maximum comfort for the residents. Companies and governments have to meet these demands and they are designing distributed technical systems that facilitate and combine process of production, distribution and consumption (Fig. 1).

The basic idea of district heating is that the local heating plant is producing hot water (in some systems water vapor is used) that consumers use for heating residential space. In most cases, hot water is produced by burning fossil fuels, or the use of alternative energy

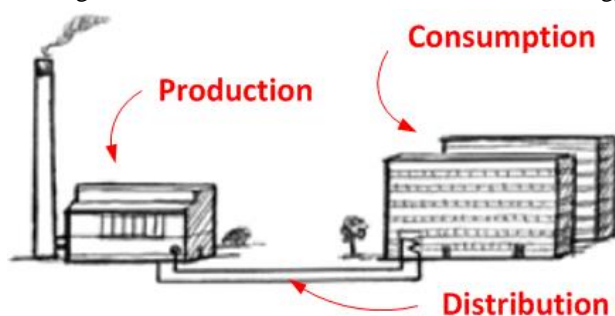


Figure 1. Distributed district heating system

sources, such as biomass, biogas, or geothermal reservoirs. Energy is distributed to the network through a closed piping system in which hot water is transported to the user, there it is cooled by circulating through heat exchangers located in the secondary district heating systems, and then transported back to the plants where it is heated again.

The main advantages of this method of distribution lies in possibility to create a centralized heat production outside of the city premises, which lowers the overall level of air pollution in the urban environment, and opens up space for the use of heat derived from industrial processes.

However, due to the large distance between producer and consumer distribution of heat is the biggest problem. Moreover, there are a number of other problems. Let us mention now only the time required for delivery, which typically ranges from 3 to 24 hours.

The factors that most influence the energy consumption can be classified into the following categories:

- Human factors - consumption of hot water depends mainly on the behavior of users,
- Weather conditions - about 70% of the energy is lost due to ambient temperature, humidity, solar radiation, wind speed and direction,
- Physical factors of the distribution networks - Factors such as length, insulation and pipe size determine the amount of losses in distribution. Approximately 10% of the energy goes to these losses...

If we think about control of the whole process, and if we think about how to rationalize energy consumption and at the same time increase the quality of service for a user, we must seriously address the development of solutions that will give us detailed knowledge of the state of the system and its components in real time. This will not only prepare the ground for servicing system flaws or its efficient operation and optimization, but also can be used for a variety of predictive models, allowing the whole system to stop being reactive and become proactive.



Figure 2. Substation

II. MEASURING THERMODYNAMIC VALUES

Many large companies have recognized the need to measure characteristic thermodynamic quantities in district heating systems. In response to this need they developed whole range of different products that are able to give us accurate information about the state of the distributed system components.

These measuring and control equipment has been installed at key points along the chain of distribution. As one of the key points of the system there are heat substations, which are usually located close to the user. One heat substation is typically equipped with heat exchanger, control valves, pumps, temperature sensors and flow meter. Thermal substation is shown in the figure (Fig. 2).

The only way to determine what is produced and what is delivered is to measure the amount of heat. This enables us to compute the efficiency of the system elements and is the basis for the consumption-based billing. Great demand on the market was caused by the devices that are used to measure the consumption of heat - calorimeters (Fig. 3). The calorimeter is an integrated microprocessor-based unit for calculating the thermodynamic properties of circulating streams in district heating systems. With the input values received from an ultrasonic flow meter and precisely matched resistance temperature detectors [1], the unit is doing calculations in real time and in its ROM memory module saves the measured values, as well as many other values that are important for the control of



Figure 3. Calorimeter

energy supply and protected transport of heat.

The calorimeter measures the temperature usually in the range from 20 °C to 150 °C and the flow rate up to 25,000 m³/h. Using the resistance temperature detectors temperature measurement accuracy is reduced to 0.01 °C. Manufacturers of calorimeters are integrating the circuit for optical interface, which is used, for example, to communicate with the specially developed software for parameterization. The calorimeter can have a variety of communication modules but it should be stressed here that the communication with all the modules, including optical scanners is based on the M-Bus protocol (EN1434).

With calorimeter users have access to the essential thermodynamic parameters of the substation, including:

- The total energy
- The total flow
- Inlet temperature of fluid
- Outlet / return temperature of fluid
- The temperature difference
- Current flow rate
- Instantaneous power
- Time and date of measurement
- Status module and error messages...

It is clear that these values are of great importance for the understanding of the status of the system. With these values we can go into detailed analysis of the functioning of the distribution network, start servicing its flaws, adapted heat production to heat consumption, make adjustments in supply and do a proper billing of course per exact consumption of energy.

However, for all that to be done, the operator of the remote distributed heating system must collect the information stored in each of the sub-stations and their number can range from dozens to hundreds and thousands and all of them are set up in the pipeline network that stretches maybe tens of kilometers. In each of these substations there is a calorimeter to measure the real-time values, so basically every second we have thousands of results that are mutually geographically scattered. The following text will discuss methods for the collection of these measurement results.

III. REMOTE READING METHODS

In today's district heating networks, operators often have little knowledge about the real state of the system and even less knowledge about its future state. The main problem for the engineers who control the operation of the system is to decide exactly how much heat to produce. Because of the large time gap needed for heat to be distributed from producer to consumer (up to 24 hours in big networks), an engineer must assess the future energy consumption. This estimation, in most systems today, is mainly based on the experience of engineers with little information about the environment, such as, for example, ambient temperature and some statistics. However, the

optimal method for the control of district heating systems cannot rely on the value of the ambient temperature. In order to provide sufficient heat tendency was to produce more heat than we need, and that's why we have a significant energy loss.

With monitoring and control of the thermodynamic parameters of the system we can overcome these problems. On today's technological level monitoring alone does not represent a significant obstacle, but if we take into account the configuration of the system we can see serious limitations. We have realized by now that the heating system is characterized by the big distance between spots/places where measurements of thermodynamic properties need to be performed. This fact and the fact that measurement values don't change very dynamically further complicate the situation.

Therefore, the solution must satisfy and integrate several very important criteria. This means that it must be:

- Rational - the acquisition of measured values are performed on demand
- Regardless of the distance - physical distance of measuring points have the smallest possible impact on the acquisition process
- Widespread - which means that the technology used is developed, verified and matured
- Flexible - This means that the solution can be expanded with minimal intervention, it can be easily upgraded, and it can simply be adapted to different configuration of distribution systems
- Low investment - which means that the costs for equipment (hardware and software) need to be as low as possible
- With low operating costs - this directly increases the effect of energy conservation
- Reliable - which means that the certainty of acquisitions is at a highest level, if errors occur in the process the appropriate alarms can react, and that there are mechanisms for servicing those alarm situations
- Safe - which means the integrity of measured values is maintained throughout the acquisition process and it can provide maximum data security

We can see that the design of the monitoring system for thermodynamic parameters that will satisfy all these criteria in distributed technical system is fairly complex task. Designing the system for remote monitoring of distributed system can be accomplished using different technologies. This refers to the different types of communication protocols and on different devices that enables us to use these protocols [2]. Some of the widespread protocols suitable for remote transmission of data are:

- RS232
- M-Bus

- TCP / IP
- MODBUS
- GSM
- GPRS
- And other wireless protocols...

During the acquisition of measured values quite often the case is that we have data transfer using multiple protocols. Devices that operate on these protocols can be wireless modems [3], optical readers, GSM/GPRS modems, or special devices that contain integrated hardware element to work according to the protocol.

IV. IIS BASED REMOTE MONITORING OF DISTRIBUTED TECHNICAL SYSTEMS IN REAL TIME

Well aware about the high demands placed before the system for remote monitoring of distributed technical systems in real-time professors and colleagues at the Technical Faculty "Mihajlo Pupin" in their professional relationship are constantly working on the development and improvement of various solutions in the field of CAM/SM (Computer Aided Measurement and System Monitoring).

The monitoring system for the thermodynamic properties of the distributed district heating system was developed as an upgrade to existing hardware installed on the user side (distributor of heat). If the heating system already have built in calorimeters with M-Bus protocol (EN1434), which is a standard solution for all manufacturers of calorimeters, it is only necessary to do this (Fig. 4):

- a. On each of the calorimeter planned for remote monitoring, we just add an optional module for communication through the GSM/GPRS network.
- b. On central monitoring site (central dispatch location) it is necessary to configure any existing computer to take the role of the Web server, using for example, Internet Information Services (IIS) technology and upgrade it with developed software packages for data acquisition, monitoring, control and analysis. To access services it is necessary to have a connection with

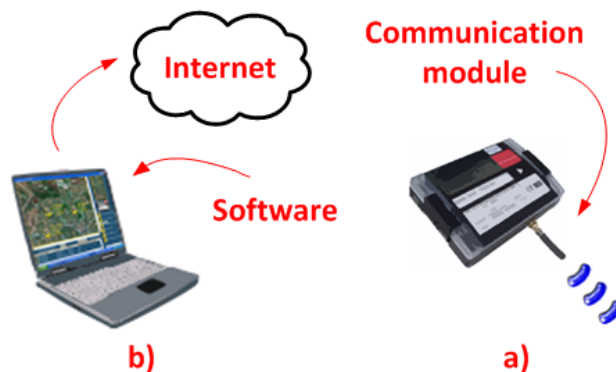


Figure 4. Minimum system configuration



Figure 5. Virtual instrument

the public Internet.

After installing the software for monitoring user interface elements become active. The interface has been developed on the basis of "VI" concept (Virtual Instrument), which allows the user to gain insight into the parameters in exactly the same way as it is on the substation (Fig. 5).

Graphical representation of the changes of thermodynamic values on the substations level and various other spreadsheets (periodic, monthly...) are also available as shown on picture (Fig. 6).

An important feature of the system is that it is possible to expand very easily and meet the needs of the users. Basically, the system can start to monitor just a few substations, and the final configuration of the system can cover all of the measurement spots including the plant of production. Expanding the system in practical terms means just adding new modules to each of the measurement spot that will be included in the monitoring system (Fig. 7).

In order to provide more use cases for software two levels of access are developed. Basic level - for the operator - is available to all users. Within it is maximally simplified monitoring of large systems serving tens or hundreds of remote substations. This is achieved by satellite image of the city and it shows the area in which

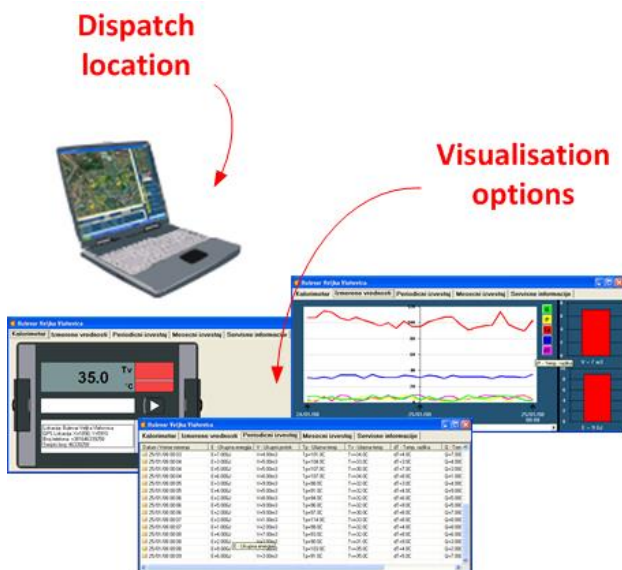


Figure 6. Different views of the monitoring results

measuring points are located. Double click on any location on the map and all information related to the place of measurement as well as all measured thermodynamic values will be presented and sorted by the time when the tests were performed.

If there is a need for broader comparative analysis, for example, if we want to compare the data in a variety of specific thermodynamic quantities obtained from any, and if necessary, from all of the substations, with the help of this software, the result of the analysis is very easy to get. The first step is to select substations we want to be analyzed in the dialogue for the preparation. The second step is to choose the parameters for which we do a calculation or just graphical representation. The third step is that we choose the appropriate option and call a routine for exporting data to Excel (Fig. 8). Practice has proved that using one of the most powerful and widely used tools for tabular and graphical calculations, or Excel, we get into a position where the limit in the number of specific values that incorporates tables, graphics and calculation is



Satellite picture

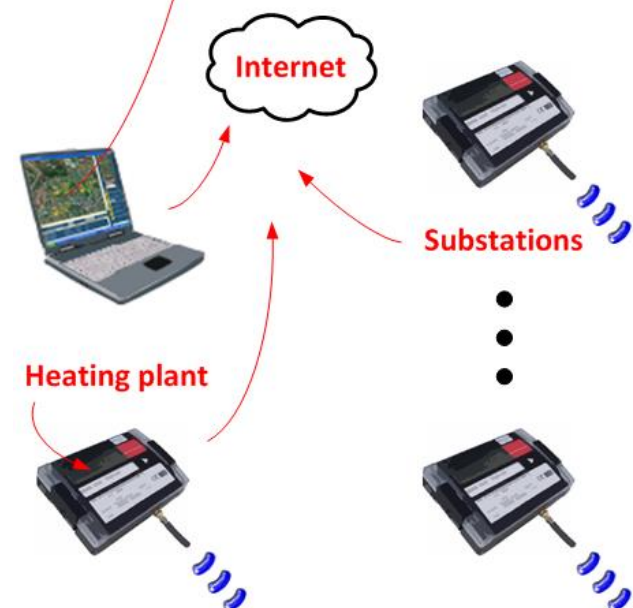


Figure 7. Maximum configuration of the system with a large number of substations and heating plant, showing the position of measuring points on the image of the city and the current values on each of them

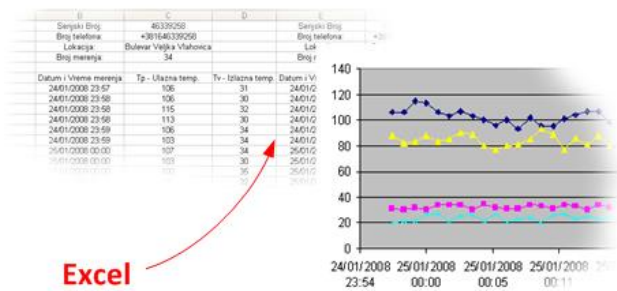
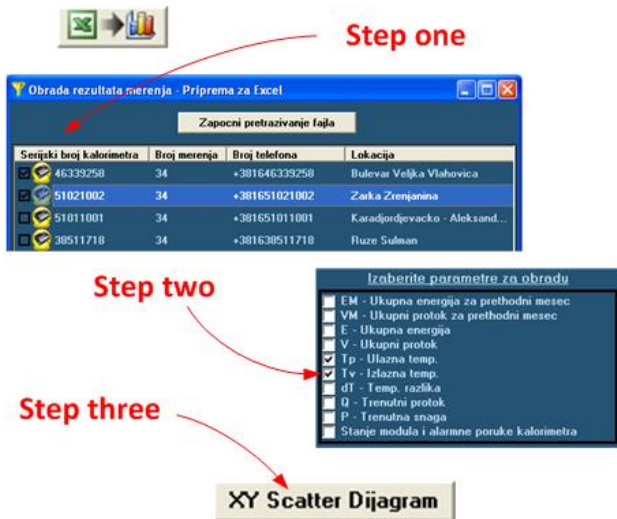


Figure 8. Prepare data for Excel and graphical representation of values expressed in millions.

The application contains another level of decision making and that level is designed for moderator of the system. For moderator a special separate monitoring page is reserved and it is accessed with pass code. Within it advanced options of a program are available. This includes for example unlocking options for changing satellite image of the area/city that contains the distribution system for district heating, manipulation (delete and add) new measuring points on the map as well as important segment related to the control of the communication modules (Fig. 9).

Taking into account that the software was developed to use the potential of GPRS/GSM network, adequate control of the communication modules had to be implemented. Each heating season has a beginning and an end, which of course affects the very need to perform data acquisition. In deeper perspective, during the heating season, there are cycles when the energy is not supplied so there is no need for monitoring the substations. In these situations, there must be a mechanism that will allow the operator of the distribution system to put the modules for communication in sleep mode. Another reason for the existence of this mechanism lies in the fact that we need to enable for the user to regulate the frequency of collection of measured values. The operator often has a legitimate need to do reading of the thermodynamic parameters, for example, every hour. When there is no need to perform remote measurement with that frequency separate software segment is activated and is responsible for control of the communication modules. That component is

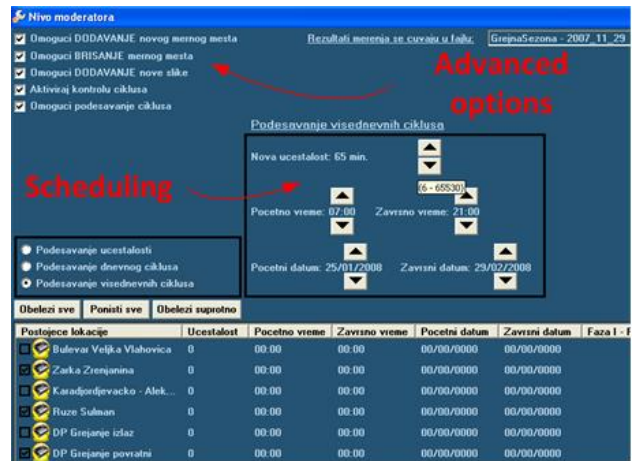


Figure 9. Moderator level

then assigned to adjust the frequency of acquisition of measured values, depending on operator and/or on the basis of some schedule. This subsystem is currently in the development stage.

V. CONCLUSION AND FUTURE WORK

General overview of the system for monitoring the thermodynamic properties using the GSM network can point us to the level of satisfaction of strict requirements that need to be achieved. On the basis of material provided we have a set of conclusions that characterize the selected method of monitoring.

The most important requirements that were set were related to the problems of a large distance between the measurement spots. Relying on the GSM infrastructure, we will not only provide permanent availability of measurement points, which is already at a satisfactory level, but will thereby ensure a steady growth of availability, for the simple reason that this sector is experiencing a huge investment. It is well known that this technology has already gone to the point where communication is enabled between two users who are located in different parts of the globe. The GSM network provides the highest possible independency for the acquisition process and the physical distance between the measuring devices.

Combined use of GPRS service, that is offered as a standard service by all mobile operators, and communication module with integrated programmable controller devices provide response when we want/need it (on demand). Thus, we further relieve the network and use its capacity efficiently. Communication modules spend most of their time in "sleep" mode and come out of them only when we need to send the measured values. Getting out of "sleep" mode is regulated by the control commands and the programmed schedules of response.

Since we are monitoring potentially large number of measuring devices it was placed as a request that used technology is well accepted and experimentally verified. GSM technology is by far one of the most accepted technologies on the planet and it is proved by the fact that the current user base counts more than six billion subscribers, and that number is growing every day [4].

An intervention in the existing district heating system means that the calorimeter is connected to the communication module on the side of the substation and to place the equipment on central dispatching location with web server and if needed also add a GPRS router. By installing the software on that location the remote monitoring system becomes operational. Expanding the system is then reduced to the insertion of the communication module in each calorimeter that we want to include in the system, while the operator's side of the work is performed in software, by entering basic information about the module. To transfer large amounts of data over the network providers offer services with high bandwidth. Taking these aspects into account the flexibility of the system is out of the question, even more, we can guarantee the acquisition of thermodynamic properties in large, branched systems.

With the aforementioned tendency to increase the number of users of mobile devices and with such a great need for these devices already in existence, investments in hardware elements of the system can only go down. Note that only the GSM technology is communication technology so far with the fastest growth ever recorded [5]. This forces manufacturers to constantly work on improving the equipment, thereby flooding the market and offering newer models. Increased supply inevitably leads to lower prices and that is the most appropriate for the consumers.

If the base for the remote monitoring is the GSM protocol it only means we have access to a broad variety of services. Such a long life and great diversity of GPRS technology are due to the quality of the service offered. Transfer of measured thermodynamic quantities over GPRS lowers operating cost, provides savings and greatly contributes to the quality of the acquisition of measurements.

If the GPRS service for some reason is not available an alternative is SMS service. Most of the known SMS service provides have a report on the status of sent messages (status report). Enabling this option can bring us in a position to know what happened with our request for remote measurement. If the validity period of text

messages ends, which by the way can also be set to different values, we are informed by the provider that the message is not delivered. This means that we can always know what the status of the sent request is. Proper implementation of this mechanism in the software and appropriate control of the cycles provides reliable reading and acquisition of parameters in the heating system.

Although no system of communication is completely secure several important details makes the system well secured for data transmission. GSM protocol provides a moderate level of data integrity. Each communication module has a unique number and a cryptographic key that was added to the subscriber's identification card (SIM card), which is never sent to the network. It also implements algorithms for protection (A3, A8, A5, etc.) with which to generate the encryption key for incoming traffic.

In the previous discussion we wanted to make sure that the requirements are met and exceeded. Important aspects of the system for remote monitoring of the thermodynamic parameters are met in the best possible way. Future work on this system will concern more extensive experimental verification of the developed solutions. A lot of attention should be paid to the development of the software segment for cycle control. Control of the cycles opens up a variety of methods for monitoring and testing the distributed district heating systems. In any case, raising the capacity of the entire distribution network for predicting energy consumption is an idea we always have in mind while working on improvements for the system.

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An Approach to Developing Information Systems with Service Orientation using Form Types

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Abstract - We propose an information system (IS) development approach to specifically deal with characteristics of service orientation. Since our approach is model driven, domain-specific modelling (DSM) plays a key role. Therefore, we specified a meta-model by extending the existing set of concepts of the IIS*Case tool for IS modelling and design with concepts essential for modelling services in a platform independent way. Given the fact that the form is one of the most common ways for users to access services and exchange data, we based our approach on the concept of 'form type', the main concept of the IIS*Case tool. Furthermore, we developed a model-to-code transformation in order to support practical application of the approach. The transformation currently generates segments of an IS and service artifacts. In this paper, we also briefly outline some arguments in favour of this approach and present a use case of developing an IS segment dedicated to scheduling oral exams at a university.

I. INTRODUCTION

Significant research efforts have been invested in defining different approaches in the area of model driven software development (MDSO). However, new methods that follow MDSO principles should be proposed in order to ensure a systematic approach to sustainable development and modelling issues associated with information systems with service orientation. They should enable business analysts and clerks to express requirements in a way that will help designers in bridging the gap between business requirements and a deployed services-based solution. Nowadays, this is becoming an increasingly important issue since services are recognized as a methodology for the integration of distributed systems. In order to facilitate the service design process, some approaches utilize platform independent concepts such as service, message, provider, consumer, service collaboration, etc. However, information systems that exist within document-centric business environments are more likely to be perceived through screen forms that correspond to business forms (documents). Since business forms are broadly used by clerks in organizations to conduct daily operations and to communicate with their affiliated entities, they have a propensity to be the most natural way for clerks to express business requirements. For this reason, in the area of MDSO, approaches based on the concept of form have been present for more than two decades [1].

By following the main idea behind form-driven modelling approaches, we defined a formal IS development approach that views service designs as a natural, evolutionary extension to the traditional IS development approach presented in [2]. The traditional

approach, with the form type as a central concept, is supported by the Integrated Information Systems*Case (IIS*Case) development environment. Consequently, we based our approach on the form type and other platform independent modelling (PIM) concepts that exist within IIS*Case. The form type concept is a semantically rich abstract representation of business and document forms. Hence, the form type allows designers of an IS to include average users in the design process and in such way narrow the gap between user requirements and the deployed solution. The process of defining the approach involved some of the typical activities present in Software Language Engineering (SLE) process such as domain engineering, capturing new concepts, and extending the existing set of PIM concepts and relationships with ones necessary for modelling services. As a result, we defined a meta-model for the development of information systems with service orientation and implemented it in Eclipse Modeling Framework (EMF) [3]. However, by defining the meta-model, we have only specified the abstract syntax of our language. In order to support practical application of approach and generate service artifacts, we developed model-to-model and model-to-code transformations. The model-to-model transformation, implemented using ATLAS Transformation Language (ATL) [4], is defined between our meta-model and Web Service Description Language (WSDL) [5] meta-model. Within our approach we defined two model-to-code transformations implemented in Epsilon Generation Language (EGL) [6]. The first transformation generates a XML schema definition (XSD) file containing data type definitions of information exchanged during web service calls. The second transformation generates a WSDL file based on a previously generated WSDL model. By defining such an approach, we made the most of the fact that logical properties of data remain approximately the same whether managed in a centralized or distributed fashion.

The rest of this paper is organized as follows. Section II offers a review of similar approaches and their comparison to our approach. The brief overview of defined meta-model and main PIM concepts is given in section III. The transformations and some of the mapping rules are presented in section IV. Section V looks into design of IS segment dedicated to scheduling oral exams. Section VI includes concluding remarks and ideas for further research.

II. RELATED WORK

Much has been done on defining form-based approaches utilizing the fact that the form concept is

semantically rich enough to significantly facilitate modelling of an IS. Hence, the generation of application prototypes and the underlying database schema is made possible. One such approach, supported by IIS*Case, a case tool, is aimed at design and generation of relational database schema and application prototypes [2]. By relying on the form type as main concept, it was designed to support the IS development process. Theoretical foundations and methodology of using IIS*Case along with main concepts and the way of their implementation is described by Mogin, Luković, and Karadžić in [7]. More recently, Luković, Mogin, Pavičević, and Ristić in [8] presented an approach to developing complex database schemas supported by IIS*Case. The approach encompasses steps necessary for gradual integration of independently designed subschemas into a database schema. In [2] Ristić, Aleksić, Luković, and Banović presented a form-driven application development approach. They defined a set of interrelated steps, necessary for generation of a transaction program and its screen forms using IIS*Case. Forms are also used in other approaches supported by tools (CASE or model-driven), such as *DeKlarit* [9], to automate application generation. The *DeKlarit* tool relies on the concept of a business component that corresponds to the form type concept in our approach. Unlike IIS*Case, *DeKlarit* does not allow specification of transaction programs and business applications. Its capabilities of automating IS development are limited to generation of relational database schema and SQL commands for various DBMSs. In [10-12], business forms are used as input data for the process of database schema design based on generating entity relationship (ER) diagrams. Moreover, Malki, Flory, and Rahmouni [13] proposed a form-based approach for reverse engineering of relational databases. This approach inspired later research on extracting a personalized ontology from data-intensive web applications [14]. Namely, S. M. Bensliman, Malki, Rahmouni and Dj. Bensliman based their approach on the idea that semantics can be extracted by applying a reverse engineering technique on the structures and instances of HTML forms which are the most convenient interface to communicate with relational databases within the current data-intensive web applications. By extending the approach supported by the IIS*Case tool we placed the form type concept in the context of modelling service architectures. Hence, we tackled the characteristics of developing information system with service orientation and set our approach apart from ones previously mentioned.

Recognizing the importance of reliable means for rapid information exchange, much effort is being invested in defining IS development approaches that view service-oriented architecture (SOA) as a natural, evolutionary extension to traditional approaches. In [15], Thomas and Weistroffer describe a new approach, the Service Oriented Systems Model (SOSM) that aligns information systems development with service orientation. By following the SOA principles, SOSM offers a development method to build an information system that can accommodate changes irrespectively of the middleware technologies. Its main strength with respect to our approach is the incorporation of business process modelling phase. This is important since SOA is primarily an approach that is

rather process driven than event driven. However, there is a conceptual difference between these two approaches regarding specification of IS components. By utilizing the fact that the form type concept is semantically close to business forms, we allow end-users to specify components that correspond to their external view of the system. On the other hand, specification of components within SOSM is the result of a detailed analysis of previously specified business requirements. By embracing paradigm shifts brought by model driven approach (MDA) and the recent popularity of domain specific modelling (DSM), more and more approaches tend to be model driven and consequently rely on code generation in order to speed up the development of an IS. One such approach is defined within the SHAPE project [16]. It revolves around the new Service oriented architecture Modeling Language (SoaML) [17] specified by Object Management Group (OMG). Furthermore, the approach incorporates the use of business modelling formalisms such as Business Process Model and Notation (BPMN) and provides mappings to SoaML. SoaML is a standardized meta-model and profile for the Unified Modeling Language (UML) that enables the modelling of SOA and their elements, i.e., services. Moreover, it enables a vendor-independent formalization of service designs and helps realize the potential of SOA independently of technology. SoaML supports designing and modelling of service architectures. Furthermore, it provides common modelling language to business and system architects. Gebhart and Bouras [18] gave an overview of mapping between service designs based on SoaML and web service implementation artifacts such as WSDL and XSD files. Additionally, they illustrated a usage of the mapping rules by means of a business process for organizing workshops at a university. In [19], Ali, Nellipaiappan, and Chandran presented an Eclipse plug-in that allows architects to graphically design SoaML models and to partially generate OSGi Declarative Services models. Namely, they implemented a SoaML meta-model as Ecore model using the EMF and transformation using ATL. Similarly to their solution, we followed MDSD principles and implemented the meta-model and the transformations using Eclipse facilities such as EMF, ATL and EGL. However, our approach is based on a different view of the system. We focus on external, the individual user, view of data, and thus make the initial development phase more open and understandable to an average user.

When compared to previously mentioned approaches, our approach is a model driven development approach for developing information systems with service orientation. Moreover, by extending the set of concepts that exist within the IIS*Case tool, the approach utilizes the fact that the form type concept is not only semantically rich enough to specify an external view of data but it can also be used to express service architectures in a platform independent way.

III. OVERVIEW OF MAIN PIM CONCEPTS

In this section, we briefly present the IIS*Case meta-model and newly added concepts specified by the Ecore meta-meta-model. In [20], Čeliković, Luković, Aleksić, and Ivančević present the IIS*Case meta-model in more detail. Concepts captured within the meta-model are close to the users' perception of data and distributed data

management. However, the modelling of service orchestration and choreography is not supported by this set of concepts. Therefore, as part of our future research, we intend to define transformation to a corresponding model that conforms to another meta-model with prerequisite concepts. Within our approach, everything that is designed during the modelling process is always stored in the context of a project (*IS Application Model*). Each IS Application Model may have zero or more instances of *Application System* and other concepts that inherit *Fundamentals*. As *Fundamentals* are defined on IS Application Model level they are independent of application systems. Fundamental concepts comprise:

- *Attributes,*
- *Domains,*
- *Program units,*
- *Reports, and*
- *Inclusion dependencies.*

Application Systems are organizational parts, i.e. segments of a project. They may contain an arbitrary number of form types and business applications. Each application system may have many previously defined child application systems. Child application systems are also previously defined application systems, just referenced in our application system as shown in Fig. 1. In this way, we may create application system hierarchies.

A. Domain

The *Domain* concept represents a specification of all possible values that an attribute is allowed to have. As in other languages, we distinguish user defined domains from primitive domains. Therefore, we provide two *Domain* subclasses: *PrimitiveDomain* and *UserDefinedDomain*. A primitive domain concept provides designers with the possibility not only to define primitive data types such as string, integer, char, etc., but also to specify their own primitive domains. Furthermore, they can create their user defined data types in order to raise expressivity of their models.

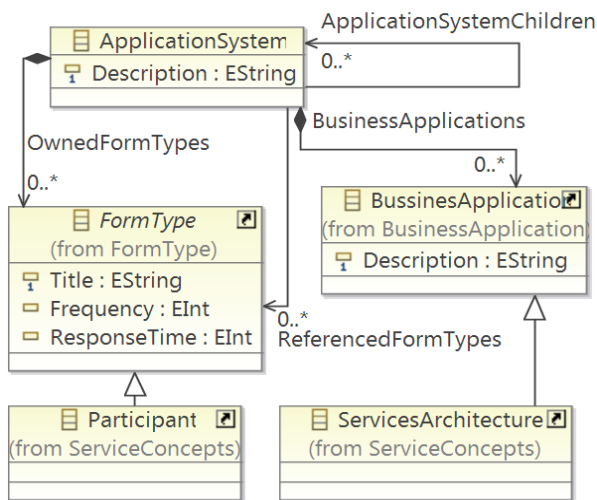


Figure 1. Application system meta-model

Similarly to other languages, we differentiate user-defined domains created by inheritance rule and complex domains, created by the tuple (record) rule, choice rule or set rule.

B. Attribute

Each attribute in the IS Application Model is identified by its name. By classifying attributes on whether they belong to a database schema or not, we were able to model a constraint that for each attribute non-included in database schema a derivation function must be specified. We consider this constraint useful when modelling services for exchanging messages that consist of one or more such attributes, as it can contribute to their derivation by providing us with linkage between service interface and implementation of service functionality.

C. Program Units

Complex functionalities can be expressed by using a meta-model of the Program Unit concept. This meta-model contains specifications of *Functions*, *Packages*, and *Events* concepts. Being specified on the IS Application Model level, functions can be referenced from various specifications such as domains when modelling domain check constraint or derived attributes. From the end-user point of view, the functions concept can be considered similar to service due to the fact that it represents an act and a result of providing some resources. However, in order to differentiate functions that can be invoked in a distributed manner, we introduced the concept of *ServicePackage*. Apart from modelling encapsulation of functions, the *ServicePackage* concept indicates that associated functions should be perceived as services. Moreover, within our meta-model we also distinguish database server packages, application server packages, and client packages. These IIS*Case concepts can be used to specify deployment location of associated, previously defined functions, in a multi-layered architecture. Each function can be associated to one or more packages.

D. Form Type

By generalizing document types, i.e. screen forms or reports through which users communicate with an IS in either distributed or centralized fashion, the form type is the main modelling concept. It is also a hierarchical structure of component types. Each component type is identified by its name within the scope of a form type and has non-empty sets of attributes and keys, a possibly empty set of unique constraints, and a specification of the check constraint. Consequently, the form type encompasses information concerning a subset of database schema attributes and a subset of schema constraints [7]. Besides modelling form types in an application system, a designer may reference them from other application systems. Therefore, we differentiate owned and referenced form types. Referenced form type is an applicable modelling concept in process of defining information carriers, whose contents are produced by one business function and used in another. Its link to parent

application system specifies the business form provider. Such information is considered as vital when observing a system in terms of service providers and consumers. For each form type the designer may specify a list of formal parameters. These parameters are used when designing calls between form types.

E. Business Application

Business applications are structures of form types. Each application must have one form type marked as the entry form type of the application. The execution of a generated application always starts from the entry form type. Form types in an application are related by form type calls. A form type call always relates two form types: a calling form type and a called form type. By defining form type calls, a designer specifies how values are passed between the forms during the call execution.

From the service design point of view, a business application is very similar to the concept of service architecture. Consequently, form types considered in business application may be seen as potential service interfaces whereas form type calls can be used to model service calls. In order to differentiate business forms managed in a distributed manner, we introduced the service architecture concept. Although it only inherits business application, we consider it substantial as it allows designers to specify which form types should be exposed as a service only by adding it to service architecture. Additionally, every form type call within service architecture is perceived as a service call. By relying on these PIM concepts, the designer is able to specify service architecture without considering means by which resources are delivered between form types.

IV. TRANSFORMING SERVICE DESIGN INTO IMPLEMENTATION ARTIFACTS

The defined transformation chain consists of three transformations, one model-to-model and two model-to-code transformations. The model-to-model transformation was implemented using ATL and it is defined between our meta-model and the WSDL meta-model. The transformation is summarized in Table I.

TABLE I. MAPPING BETWEEN OUR META-MODEL AND WSDL META-MODEL

The IS modeling concepts	Concepts from WSDL
Business application form type within service architecture.	Definition element with "targetNamespace" attribute + PortType + service
Called form type structure	Operation
Called form type parameters	Input or Output + Messages
Calling mode	Order of input and output parameters

By defining such transformation we restrict that a business application form type, within service architecture, is mapped onto one and only one WSDL document. Moreover, the called form type structures are transformed by model-to-code transformation to the XSD description of called form type parameters. Each input and output parameter is mapped onto an XML element. A type of the element is determined from the type of the parameter. Since the concepts from our meta-model, used to defined data types, are similar to ones used in the XSD language. Therefore, the defined transformation is straightforward.

V. CASE STUDY: EXAM SCHEDULER

In this section, we present a scenario of scheduling oral exams from users' point of view. Furthermore, we briefly illustrate the system design of IS segment dedicated to scheduling.

A. Scenario

The process of scheduling oral exams at University of Novi Sad has gone through various changes over time but some aspects remained the same. Firstly, a professor announces the name of course and information on date, time, and duration of exam. Such announcements were given in form of a document on the university bulletin board or in form of an article on the course web page. Based on provided information, students that were enrolled in the course can schedule an appointment for an oral exam. Scheduling requires providing information on course, student's full name, identification (student's index number), and date of exam. Furthermore, no later than 36 hours before the exam, they can cancel a previously scheduled appointment. Depending on the type of the announcement, scheduling can be done by entering the information into a timetable document or sending it by email message. Finally, the timetable for all scheduled exams is published by the professor on the faculty bulletin board or the course web page. Since particularities regarding the oral exam scheduling process tend to change, we consider that a segment of faculty IS design to support such process should be service oriented. In this manner, loosely coupled design would be much more flexible. Moreover, it could deal with changes within the process, just by changing the way an individual service interoperates with other services or by adding another service. For example, if scheduling would require a teaching assistant to review scheduled appointments, introducing new service would be much easier than redesigning the whole IS segment.

B. Design

As part of the design phase in our approach, we specified primitive and user-defined domains. Data type of attributes that contain information on date, time, and duration of an exam, was modelled by the tuple domain. Since all three information pieces are mandatory and used to define single term we believe that this modelling decision was justified. Specifying the tuple domain required referencing previously defined attributes whose values conform to date, time, and duration data types.

Besides domains and attributes on the IS Application Model level, we defined the *ExamScheduler* application system. The external views to this application segment were modelled by corresponding form types. The *ScheduleExam* form type represents a professors' view on the scheduling process. Modelling of this form type included specifying form type parameters. This specification is significant from the service design point of view, as these parameters correspond to messages exchanged during service calls. Therefore, we specified *ExaminerParam*, *ExamDateTimeDurationParam*, and *CourseNameParam* parameters. In order to model service calls we specified service architecture and form type calls between referenced form types.

VI. CONCLUSION AND FUTURE WORK

In this paper, we introduced an approach that may be used in developing information systems with service orientation. Since it relies on the traditional IS development approach supported by the IIS*Case tool, we focused only on the derivation of services. We extended the existing set of concepts taken from IIS*Case with ones necessary for designing services and service architecture. In the described approach, we relied on the form type concept as it is semantically rich. It allows us to include end-users in the IS design process and capture their external view on data and system. Furthermore, we implemented a transformation chain in order to generate service artifacts.

In our future work, we intend to extend our approach in order to support SOA design patterns. This would require providing capabilities for modelling service orchestration and choreography in a platform independent way. However, as SOA is primarily a process driven approach we may further modify existing approach to support document flow modelling capabilities. In order to allow more experienced users to observe system from different views, we intend to defined transformations between our meta-model and other languages used in the IS design process such as BPMN, SoaML, etc. As part of our future research, we also intend to upgrade the IIS*Case tool in order to support presented approach.

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Measuring the Performance of eXtremeDB Solutions in Gesture Recognition Systems

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Abstract - This paper analyzes the expected performance of eXtremeDB and related solutions in a gesture recognition system. The unique needs of such a system for storing gestures, recorded motion, and telemetry are explored, alongside its needs for permanent storage and rapid information access. A trial system is constructed, and then subjected to tests based on generated as well as actual sensor data. Measurements are taken and subjected to analysis and the acceptability of such a solution is then determined using this analysis. This acceptability is then discussed in the light of a proposed system for using gesture recognition in medical rehabilitation.

I. INTRODUCTION

The goal of this paper is to analyze the possible performance of the eXtremeDB[1] in-memory database system as applied to gesture recognition systems, specifically those based on the Microsoft Kinect sensor database platform. In measuring performance, special care is taken to analyze those cases that would be of greatest importance in a gesture recognition system: recording logs, recalling logs, and matching posture data to some template, i.e. looking up a posture. As a part of the task of measuring performance, the paper also considers the task of determining the values of certain parameters so as to achieve good performance.

Gesture recognition is a key component to the development of computer interfaces in a post-WIMP[2] (window, icon, menu, pointer) environment. This paper chooses to focus on gesture recognition using the Microsoft Kinect sensor. While gesture recognition is common on other platforms as well, it should be noted that the Kinect relies almost entirely on it, and that it lends itself to a wide array of applications ranging from HCI (human-computer interaction) research[3], to education[4], and health[5]. Furthermore, the Kinect is very affordable, highly compatible, well documented, and using it, like using many other pieces of entertainment-focused consumer electronics, allows for significant reduction in the problem of e-waste as detailed in[6].

The use of an in-memory database system in general and eXtremeDB in particular, is not an obvious step in the design of a gesture-driven system, but it is not as

unexpected as it might, *prima facie*, seem. A robust database solution is clearly required as there exists a large body of data that needs to be quickly recorded and/or replayed—this would be the logging functionality—as well as a somewhat smaller but more complex body of data describing the gestures themselves. Quick lookup based on flexible criteria in this latter corpus is of great importance. Therefore, a robust and high-speed database system is necessary. However, this system would not work with a very large amount of data, and, further, the relationships within the data set would not be complex. This means there is no need for the complexity of a relational database management system, nor its concomitant price in performance. Hence, a lightweight solution is needed, one that would allow for flexible indexing and quick storage, while permitting on-disk persistence as required. An in-memory database system fulfills these criteria without any difficulties. eXtremeDB was chosen instead of some other such system because it is a robust implementation, used successfully in certain high-performance applications[7], and has support for an very useful indexing system[8] with broad applicability in the field of spatial data. eXtremeDB is also quite affordable for research purposes and it integrates well with C# and the .NET runtime[9], which helped with interoperability with the prospective gesture-based solution.

This paper consists of five sections. The first is the introduction which briefly outlines the motivations and extent of the research and gives the structure for the rest of the paper. The second is an overview of the problem, specifically the function and operation of the Kinect sensor, the gesture recognition related problems we chose to focus on, and the format of the data the simulation of the system ought to work with. The third section details the measurements made and gives the most relevant results in the form of tables and figures. The fourth section consists of a brief analysis of the presented data with a specific focus on unresolved problems. The fifth and final section is the conclusion which details the conclusions that can tentatively be drawn from the analysis, the general acceptability of eXtremeDB as a solution, and suggested further avenues of study.

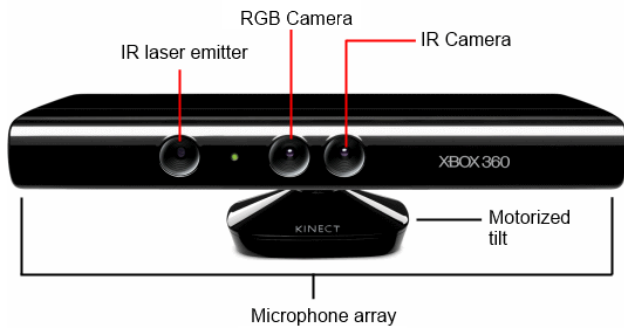


Figure 1. The Kinect Sensor

II. GESTURE RECOGNITION

A. The Kinect Sensor

The Microsoft Kinect sensor, Figure 1, is a consumer electronics product used to add a motion tracking dimension to the way a popular video game console, the Xbox 360, is controlled. The Kinect can also be used with a Windows PC and, indeed, there exists a version designed primarily with this in mind. The Kinect is, ignoring for a moment some voice recognition functionality it has, a pure motion sensor device. It employs outside-looking-in optical tracking using a hybrid optical-infrared approach. It consists of a microphone array, an RGB camera, an IR camera, a specialized IR emitter, an accelerometer, and a selection of firmware and drivers.

The microphone array's purpose is twofold. First, it can be used to record audio which is then fed through a voice recognition subsystem. Second, it can be used for rudimentary but effective acoustic tracking of the user. The accelerometer serves to detect if the Kinect is level, and if it isn't, it can affect the motorized tilt which quickly works to level out the sensor's field of view. The motorized tilt can also be used to bring an object that needs to be tracked into the field of view of the sensor.

The RGB camera captures a full-color recording of the sensor's field of view and this, together with the depth data, is instrumental in skeletal tracking. The IR

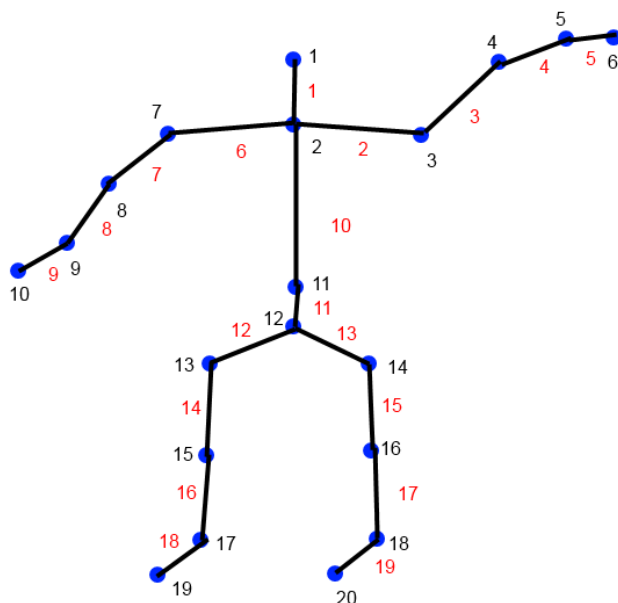


Figure 2. The Kinect skeleton, red numbers are bones, black joints.

camera/IR emitter combination provides the aforementioned depth data. The IR emitter produces a grid of regularly spaced illuminate points on the scene and the IR camera captures this. Using the way the geometry of the scene perturbs this grid, a detailed depth map of the entire scene in the sensor's field of view is captured. In this respect it can be said that the Kinect functions as a 3D camera of sorts.

Using the Kinect as a 3D camera, the firmware and drivers use a probabilistic model of human motion to track people—up to six at any one time—in its field of view by matching their movements to that of an articulated twenty-jointed, nineteen-boned skeleton, figure 2. This is commonly referred to as 'Skeletal Tracking' and it is the primary function of the Kinect.

B. The Problems

While a fully-developed gesture recognition system might use data in a number of ways, for the purposes of this evaluation, three will be sufficient. These are logging data, accessing logged data, and matching movements, i.e. doing posture lookup. Together these three are enough to form a coherent picture on the applicability of eXtremeDB in the field of gesture recognition.

Logging data mimics the need of a gesture recognition system to record the user's actions in detail. A good example to consider would be a medical gesture recognition system where recording and then, possibly, dispatching the recording of, say, the exercises as performed might be a vital part of this medical system's telemetry. To log data, all of the skeletal tracking data is packaged into appropriate records, tagged with identification data regarding the motion series recorded, the frame recorded, and possibly the timestamp, and then inserted into the database system. The limit here, clearly, must be the speed of recording. The refresh rate of the Kinect is thirty frames per second, which means that a single recording event cannot take more than one thirtieth of a second. Ideally, it would take much less, because as it records, the system must perform other tasks as well. Persisting the data to hard-drive is, of course, possible but it can be done programmatically in moments of no activity when prompt reaction is not important, and, hence, won't be considered.

Accessing log data is not normally a time-critical task, but it still must be done in considerably less than a thirtieth of a second, in order to make sure that any possible playback can proceed smoothly. Further, this is a good test to perform in order to ascertain the baseline lookup speed of the database system.

Matching movements is a crucial function, as it alone allows the system to recognize individual postures in an exhaustive dictionary of complex gestures. The system, as envisioned, will employ a number of techniques to match gestures, including those using RBF neural networks[10], but for the purposes of this evaluation only one possible method out of many will be evaluated: matching individual postures within a complex movement using the eXtremeDB's own indexing features, mainly the R-tree[8] based spatial indexing. An R-tree index is to be created for each of the joint specifications that form a posture, and

TABLE I. RESULTS OF THE FIRST TEST IN MS

Page size	Values	
	<i>MVCC</i>	<i>MURSIW</i>
64	4382	5585
100	4315	5781
256	4454	5473
512	4268	5260
768	4495	5797
1024	4518	5650
4096	4478	5500
16384	4833	5389
AVG	4468	5555

then a compound index made up of all the aforementioned R-tree indexes is to be created on the level of the posture as a class/entity. This will enable searching for the posture based on coordinates while retaining a robust level of error tolerance, since R-tree indexes permit the searching out of those regions—in our case cubes—that overlap or contain other regions. This means that, instead of relying on exact matching, a level of useful imprecision can be introduced.

The function of this system is not crucial for the acceptability of eXtremeDB in this context. If case tests show that the indexing mechanisms aren't flexible enough, the performance of this function devolves to the performance of sequential lookup for the relevant posture-library and the running of the relevant manual classifier. Even if the indexing mechanisms are flexible enough, it may be the case that they aren't fast enough. Gesture detection and recognition needs to be as close to real-time as it is possible, and while it is difficult to estimate what constitutes real-time to the given user in an arbitrary scenario, a useful upper bound may be established relying on the much more explored problem of audio/video synchronization. According to [11] the absolute maximum lag between video and sound is 45 milliseconds. Based on this, and with a fifteen millisecond safety margin, we decided that the upper limit on time for a single act of posture lookup is 30 milliseconds.

C. Data format and generation

The data used were to be formatted as simply as possible. Given the nature of the problems outlined above, little could be gained by increased complexity and much could be lost in the way of performance. Further, given the above outlined problems, it's clear that the data can be divided into two parts: logging data and posture lookup data.

The first is relatively simple. Logging data consists of a sequence of frames, each of which is identified by a series identifier and a frame count identifier and would be, in production use, time-stamped as well. Naturally BTree non-unique indexes are employed for these two identifying fields, as well as a unique compound BTree based on these two together. Within each frame, there are

TABLE II. RESULTS OF THE SECOND TEST IN MS

Number of Records	Values	
	<i>Total</i>	<i>Per Record</i>
400	36	0.090
2000	178	0.088
10000	956	0.096
50000	4782	0.096
AVG		0.092

also skeleton data consisting of a position, in three dimensions, of the tracked skeleton's centroid, an array of twenty joints, figure 2, each identified with a position in three dimensions, and an array of nineteen bones, each measuring the rotation of said bone, both in the absolute and hierarchical coordinate systems. The rotations are expressed as four real values, defining thus a quaternion.

The second, movement matching data, consists, for the purposes of this test, of a description of the relative positions of the joints of a skeleton with a certain amount of built-in uncertainty. Thus, each joint position also has a delta-x, delta-y, and delta-z value determining the permissible leeway. This is encoded in the form of a cube that contains at its center the relevant point, while the extent of the cube represents the extent of the leeway, as mentioned before. This is necessary for the operation of the R-tree index. Further, since the position is relative, it is determined as an offset from the central position of the skeleton. This means postures are insensitive to the place within the sensor's field of view where they began. For the purposes of this test, bone orientation is ignored, and postures are identified with an automatically generated serial value, what eXtremeDB calls an autoid.

Considering that, for the purposes of this test, there is no feature of naturally generated data that ought to influence measured performance in any way, there is no reason not to use automatically generated data. Indeed, automatically generated data provides a sample that can be arbitrarily large and free of edge cases, and hence a good source of bounds of the database system's performance. For this reason, as well as for reasons of greater efficiency, all the tests are performed using automatically generated data which is, in structure, indistinguishable from data acquired from the sensors.

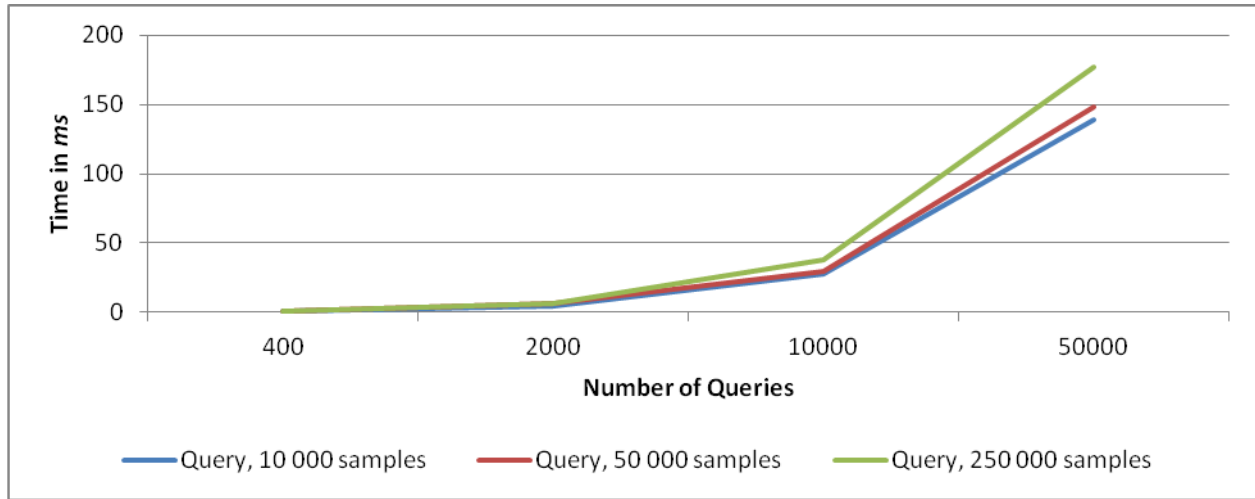


Figure 3. Interdependence between the number of queries and the size of the database.

III. MEASUREMENT

The measurements were conducted based around four tests. The first tries to estimate the influence on performance of the memory page size and the transaction management system used. The action used was input of records, specifically logs. The tests consists of two halves—one for the Multiversion Concurrency Control (MVCC), and one for the Multiple Reader, Single Writer (MURSIW)—each of which has eight measurements. Each measurement corresponds to a memory page size: 64, 100, 256, 512, 768, 1024, 4096, and 16384 bytes, to be precise. Within each measurement a hundred trials were undertaken, where each timed trial consistent of inserting 50 000 database records in a way which mimics log entry.

The second test measures input performance directly and sets the transaction manager and the page size to values determined by analysis of the first test. It consists of four measurements, each of which corresponds to the insertion of a certain number of records: 400, 2000, 10 000, and 50 000, to be precise. Each measurement consists of a hundred trials.

The third test measures read performance, and sets the transaction manager and the page size to values determined by analysis of the first test. It consists, again, of four measurements, each of which corresponds to a certain amount of queries: 400, 2000, 10 000, and 50 000, to be precise. Each measurement consists of a hundred trials. Queries are conducted on a databases with 10 000,

50 000, and 250 000 records in it.

The fourth test measures the lookup speed for posture lookup, and sets the transaction manager and the page size to values determined by analysis of the first test. It consists of one measurement corresponding to one lookup. Each measurement consists of a ten trials. Lookups are conducted on a database with 1000 recorded postures in it. The fourth test is somewhat limited because of technical difficulties with measurement, but still demonstrates a consistency of results that's sufficient to reach a conclusion.

IV. ANALYSIS

Table I makes two things quite clear: the page size does affect performance, but does so very weakly, and the choice of transaction manager, predictably, affects performance dramatically. The page size was worth considering because official documentation[12] dithers on how it should be set—a value of 100 is suggested as good for most cases, the value of 256 is used in some official samples, and it is, in other places, strongly suggested that the page size should be a power of two. A look at table I shows that, as long as the transaction manager is MVCC, pretty much any value for the page size is good enough. We chose to set page size to 512, because this value has shown the best results, if only by a slim margin.

The above is more-or-less the expected result. The page size is less than the suggested maximum of 800, while being a power of two. Furthermore, MVCC is the more “optimistic” of the two transaction managers and it is expected that it will be faster.

Table II demonstrates the results of the second test. The time required for insertion scales smoothly with the increase in the number of records that need to be increased, which means that the estimates based on these numbers are likely to hold. Further, the estimated time-per-insertion averages at about 92 microseconds, which is comfortably below the 33.33 millisecond—i.e. one thirtieth of a second—limit. It's clear, then, that the eXtremeDB system is sufficiently fast and scalable for purposes of logging in gesture recognition systems simulated here.

TABLE III. RESULTS OF THE THIRD TEST IN MS

Number of Queries	Number of Records in Database		
	10 000	50 000	250 000
400	1.16	1.21	1.25
2000	4.68	5.98	6.48
10000	28.10	29.37	37.84
50000	139.14	148.03	176.79

Table III shows the results of the third test. These results, in turn, are illustrated on figure 3. Reading is very fast, and it also scales more-or-less smoothly with the increase of the number of queries, and very smoothly with the increase in the database size.

Test four was also conducted and the results are encouraging: With ten trials and a thousand postures to search through, the average time it took to complete a posture lookup was 8.20 milliseconds with a standard deviation of 0.42. This is well below the 30 millisecond threshold suggested earlier.

The only negative result from test four was the level of instability of eXtremeDB when using multiple R-tree indexes. However, this seems to be a defect that is likely to be fixed rather than a problem with the approach itself.

V. CONCLUSION

As far as can be determined, eXtremeDB is mostly suitable for use in the demanding environment of a gesture recognition system. eXtremeDB is lightweight, provides easy access to persistence, and excellent indexing features. The measurements of its various operations indicate that it is acceptably quick, and that it scales so well that it is safe to assume a system based on it could cope gracefully with an increase in throughput. Its biggest failing is the low stability of the R-tree based search.

Further avenues of research present themselves as a direct result of what has already been said: an improvement in performance could perhaps be attained alongside an improvement in stability if a custom indexer is written for eXtremeDB, perhaps even one that employs R* trees[13] for improved performance. And, of course, a working prototype of a gesture system using eXtremeDB is yet to be built. It is likely that such an effort would succeed, given what's been said, but it is certain that such an endeavor would provide illuminating challenges.

ACKNOWLEDGMENT

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Promoting Robotics Education and Curricula

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Abstract - It is well known that robotics education prepares students for the skills necessary to work in the modern automated environment. Besides integrating mathematical, technological and engineering knowledge, robotics education develops teamwork and provides practical experience. The successful robotics curriculum is project-based and motivates students to use critical and problem solving thinking necessary to work effectively in the 21st century. During the last decade in the U.S. and in many other countries, offering robotics courses has become a standard not only in engineering and computer science programs, but in secondary and post secondary non-computer science schools as well. The aim of this paper is to promote robotics education in Serbia and to outline a curriculum for an elective robotics course that can be taught in high schools or as an undergraduate college level course.

I. INTRODUCTION

In the 21st century, the demand for professionals with skills in the field of robotics automation has been rising. Today's robots are at work in factories, hazardous environments, hospitals, laboratories and in homes throughout the world. [5]

Rodney Brooks, the pioneer in modern robotics and MIT professor who created the robot called Baxter, in his interview on CBS on September 8th, 2013, predicted that low cost robots will replace manual labor in the very near future, and that many new jobs will be created in the robotics field.

To meet the high demand of workers with skills in the area of robotics automation, robotics courses are being offered at the K-12 (Kindergarten through 12th Grade) education levels as well as in undergraduate non-science major programs. Universities such as Carnegie Mellon, MIT, NYU Polytechnic and others have played a large role in bridging the gap between academia and secondary education by developing interdisciplinary robotics curricula, conducting training for educators and organizing robotics competitions. For example, Carnegie Mellon University's Robotics Academy provides onsite training for teachers at the National Robotics Engineering Center in Pittsburgh. The courses developed by universities are research-based and aligned with the standards of the STEM (science, technology, engineering, and mathematics) education.

The mission of these robotics courses is the "development of 21st century skills; teamwork, problem solving, ideation, project management and communications". [1]

To meet the needs of the next generation's workforce, this paper will use the model of robotics education in the U.S. to promote and outline a robotics course designed to introduce real-life concepts by utilizing the LEGO Mindstorm NXT Robots.

II. ROBOTICS HARDWARE

There are many excellent educational robotics hardware kits on the market (Fig. 1): LEGO Mindstorms NXT, Parallax Boe-Bot, RoboticsConnection Stinger, VEX, Tetrix, etc.[6]

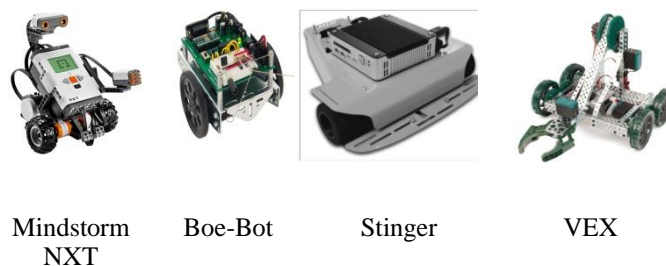


Figure 1. Robotics Hardware

In selecting the robot for this course, several factors have been considered:

- Cost
- Ease of assembling
- Support of different programming languages
- Independent controlling unit
- Types of sensors
- Number of motors
- Workstation control
- Bluetooth support

Based on the above criteria, the suggested robot type for this course is the LEGO Mindstorm NXT Robot.

The primary advantages of the LEGO Mindstorms NXT robot kit are:

- Relatively low cost.
- Ease of assembly.
- It has an open source firmware and supports different programming languages: Not Quite C, ROBOTC, C, Microsoft Robotics Developer Studio, Ada, Visual Basic, Forth, NXT 2.0, Python, Java, PbFORTH, Golog/Prolog, Perl, MATLAB etc. [2]
- It has an onboard controlling unit called the "Brick". The full hardware specifications for the NXT Brick can be found at: [4]

<http://mindstormsnext.blogspot.com/2006/08/whats-inside-nxt-brick.html>
- It has numerous sensors. The sound, ultrasound, light, color and touch sensors are included with the kit and others are manufactured by a third party.
- It has three motors, one for each wheel and one servo motor. The servo motor has a built-in rotation sensor (encoder) that measures speed and distance and reports the data back to the NXT Brick. Motors have internal encoders to measure rotations. The maximum resolution is 360 ticks per rotation. [3]
- It has built in Bluetooth.

A disadvantage of the LEGO NXT Brick is that it can only handle four sensors at a time. [3]

III. COURSE OUTLINE

The aim of robotics education is to teach basic programming skills and robot behaviors and to develop teamwork, logical thinking skills and project management skills. The outline for the suggested Robotics Course is project-based, with the mission to implement the general aim of robotic education. It can be taught at the middle school, high school or undergraduate college levels.

Resources:

- LEGO Mindstorm NXT kit for every two to four students.
- One computer for every student.
- Copy of the NXT 2.0 programming software or any OSS supported by the NXT.

- Either the NXT battery pack or 6 AA batteries for each robot.

Week 1

Introduction to Robotics - history of robotics, introduction to artificial intelligence, robot types, the effects of robotics automation on society.

Week 2

Introduction to Programming - the NXT programming environment.

Week 3

Going Forward - building the robot, programming the robot, running the basic Going Forward program.

Week 4

Wheels and Distance - relationship between wheel size and the distance travelled, programming the robot to travel a specific distance.

Week 5

Turns - creating programs which produce different types of turns.

Week 6

Measured Turns - learning about the relationship between geometry, motor degrees and the amount the robot turns.

Week 7

Robot Dance - Programming the robot to dance to the beat of music.

Week 8- 9

The Sound Sensor - finding a threshold for a sound sensor, programming the robot to stop and go controlled by the sound sensor.

Week 10

Independent Project - investigation of the properties of a sound wave.

Week 11

Follow the Path - programming the robot to follow a line.

Week 12

Obstacle Detection - programming the robot to respond to two different types of sensory stimuli: Ultrasonic and Touch Sensor.

Week 13

Field of View - the detection abilities of the Ultrasonic Sensor.

Week 14

Gears - programming forward moves with different gear ratios.

Week 15

Final Project - programming robots to perform a specific behavior such as to navigate a maze.

IV. CURRICULUM EXCERPT

The Robotics curriculum integrates science, technology, engineering and mathematics skills as it covers the programming of basic robot behaviors. The course utilizes the NXT 2.0 programming software due to its intuitiveness and free instructional support offered online. In the NXT 2.0 environment, students can easily program by using "Blocks". Each Block represents a command, and multiple commands are issued sequentially. The specifics of each command, such as setting the motor speed, are set in the Configuration Area. An example of a Configuration Area for a Light Sensor is shown in Figure 4.

Other suitable programming environments for the Mindstorm NXT robots are: ROBOTC, C, Microsoft Visual Programming Language and Microsoft Robotics Developer Studio.

The Robotics course has been designed to be offered over 15 weeks or 75 hours. In this period, through lecture and laboratory work, students will learn how to use feedback from sensors, applied mathematics and measurement to program their robot to navigate the environment.

For example, during Week 6, students investigate the relationship between geometry, motor degrees and the angle the robot will turn as they program the robot to execute left and right turns (Fig. 2). After setting up the procedure, students calculate how many motor degrees they need to set in their program to cause the robot to turn 90 degrees. Later, students modify the program to turn the robot by 120, 75 and 45 degrees. Students measure the turn by tracing it and analyzing the data to determine what factors may have caused the difference between their calculation and the actual result. As a last project step, students make judgments about the validity of a procedure based on their findings.



Figure 2. Sample from the NXT program for a measured turn. Motor C goes forward, motor B is stopped and the sensor is set to wait 720 degrees. After the turn, both motors are stopped.

Another example is the "Follow the Path" project, where students learn the basics of tracking a line and how to calculate and use light sensor threshold values to control the robot's behavior. Students also learn

how to program with Loops and Switch Blocks. The upper line of the Switch Block in Fig. 3 represents the motor behavior when the light is over the threshold. Motor C will go forward and Motor B will be stopped. The robot will turn to the right and go forward. If the light is below the threshold, motor B will go forward and C will be stopped. The robot will subsequently turn to the left and go forward.

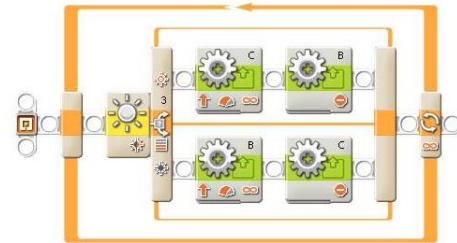


Figure 3. Sample for the "Follow the path" project.



Figure 4. Configuration Area to set the specifics for a Light Sensor.

In the "Sound Sensor" project, students learn how to calculate a threshold value of the sound sensor and how to control the robot's behavior by using the sound sensor. To calculate the threshold, students will read the values for "quiet" and "loud" sounds on the Brick (Fig. 5). After the data has been collected, students will calculate the threshold value and write a program that will start the robot on the sound of a clap and stop it on the second clap. In this program, the first block waits for the sound to exceed the threshold level and the second waits for the noise to fall below the threshold level (Fig.6). If the noise is below the threshold level, both motors will go forward. On the second clap the robot will stop.



Figure 5. The displayed value for "quiet" on the Brick.

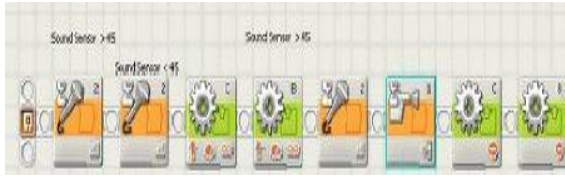


Figure 6. Part of the program for the robot to go and stop on sound

In the "Obstacle Detection" project, students will use the Touch Sensor and Ultrasonic Sensor to program the robot to stop once it has run into an obstacle. (Fig.7).

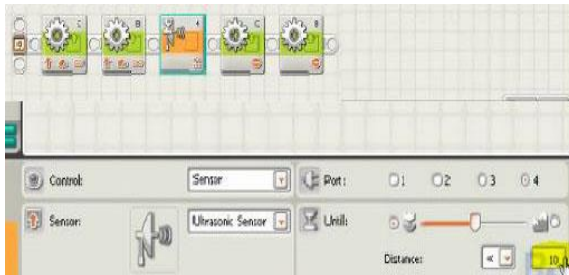


Figure 7. Sample program for a robot to go forward with both motors and to stop if an obstacle is closer than 10 centimeters.

Robotics education implements interesting and motivating topics for students. The very popular Robot Dance midterm project in Week 7 instructs students to program their robots to dance to their favorite song.



Figure 8. Marketing poster for the Robotics Expo

After the program is written and tested, students design costumes and a stage for a Robotics Expo. This project simulates real life experience where programming skills, project management, leadership, marketing, graphic design (Fig. 8) and teamwork skills are developed.

V. CONCLUSION

The robotics and automation revolution is already upon us. The implementation of a robotics course in Serbia's K-12 or undergraduate programs will promote robotics education and strengthen STEM education. Hands on, project-based teaching provides students an innovative learning experience and a good starting point to enter the modern workforce. Serbian universities can become a bridge between high schools and the industry by offering academic support and training.

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Refine Edge Method – the Analysis of Parameters for Hair Selection

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Abstract. This paper shows the Refine Edge method for modification a selection in Photoshop. The analysis parameters for hair selection problem are: Smooth, Feather, Contrast and Shift Edge. This paper presents the result of Refine Edge method applied on a picture with two different backgrounds around a person’s hair. It is supported by the processing of pictures. A comparison of the results was conveyed.

I. INTRODUCTION

Refine Edge is an interesting feature that is part of the Photoshop family, being one of the default options from Adobe Photoshop, version CS3. Before Refine Edge, Photoshop users found hair selection in pictures extremely difficult. However, this option not only speeds up the process of selection - it also offers a number of other possibilities.

Studies have shown that consumers often use Refine Edge, so the developers clearly put it in the Photoshop toolbox, below the menu. This speeds up the work significantly.

II. ALGORITHM

In the version of Photoshop CS5 Refine Edge card receives significant improvements, reflected in the creation of composite images. The main challenge of processing is editing color, especially on long, wavy, and flowing hair [1]. Until recently, the artists who were involved in processing images had great problems with cutting and moving models with long flowing hair because it did not seem real. Now, with improved tools, it is not a problem, and the results are impressive. The question is how to achieve the best results.

To be successful, it is necessary to process the image at a very high level. This is best done through clicking the background photo as much as possible, aiming at the most different tone or color of the hair model. Afterwards, the image processing using the Refine Edge card can begin. It should be noted that the universal order of execution of the operations does not exist - it is different for each image. Rough indication of the execution procedures of image processing operations as well as the impact of changes in parameter values will be explained and supported by examples in the following chapters.

III. REFINE EDGE TOOL

The important fact is that the Refine Edge can be used only once to select the portion of the image with tools for selection. Otherwise, it is impossible to access the window that is intended for Refine Edge.

Inside this window there are 4 sections: View Mode, Edge Detection, Edge Adjust and Output (Fig. 1).

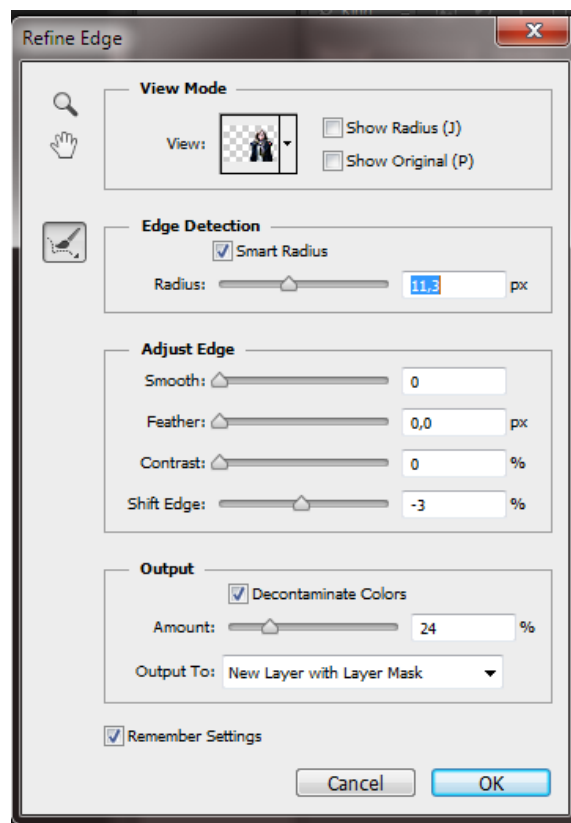


Figure 1. Refine Edge window

The window is adjusted so that it can be utilized in the best possible way, which means that the changes seen in it are processed together with all the options.

The first section of the View Mode shows the selected image, with the two options – “Show radius” and “Show original”. The View option shows the selected portion of the image and also has the drop-down menu which changes the look of the image. The user is offered more views, but the Layer view is used most frequently. Show radius option allows the user to see how to use the “Smart

Radius”, which is located in another section, while the “Show original” option shows the original selection.

The second section is devoted to Edge Detection, Smart radius. This option automatically adjusts the radius for the hard and soft edges found in the border region. If the border is uniformly hard-or soft-edged, or if the editor wants to control the Radius setting and refinement brushes more precisely, the option should be unchecked. Moving the cursor left and right makes the effect stronger or weaker. The text box shows the number of pixels which helps the user orient. In the left hand corner there is an icon with a brush which makes regulating pixels easier.

The third section, Adjust Edge, serves as a backing for the Smart Radius option, since the items are already relying on a select number of pixels from the Smart Radius option. Smooth improves smooth pixels between the selected images and pictures with the second layer. Feather makes it possible to adjust the transparency of the selected image. Contrast adjusts the percentage and its set-up adjustments affect how much of the border pixels to be seen. Fourth, the most important feature is Shift, which allows Edge to beg or collect border selected pictures. Shift Edge is the most used of these options.

The fourth section Output allows adjustment for the final part of the process. It can be selected whether the selected image will be a new document, a new layer or a new layer with a mask [2].

IV. ANALYSIS

This paper will analyze the parameters for hair selection for the following special case: sometimes the picture is not cut out precisely enough, but is nevertheless pasted on another background, and the entire image is flattened. In this way, the problem of selection becomes more complex since two hair backgrounds are present as the result of previous poor selection. This paper analyses the given problem and shows the way to optimize work with Refine edge to solve this case.

A well-known picture 'Autumn' [3] was taken as the background and an insufficiently precisely cut photograph of a person, taken from [4], was applied to it (the selection was done with polygonal lasso tool). The picture to process was obtained by flattening the image. It is shown in Figure 2.

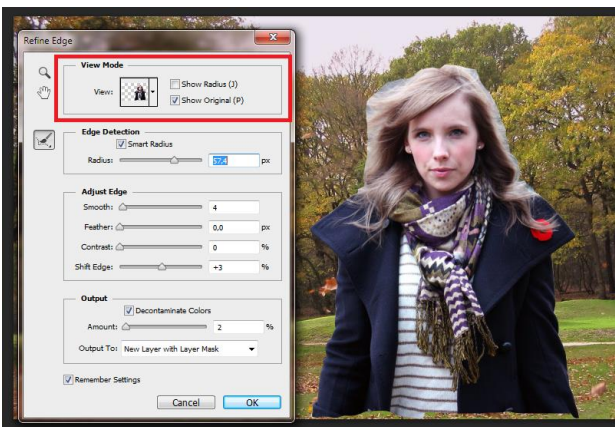


Figure 2. Show original

To achieve this effect the Refine Edge feature was used. Before this feature was available, users have used Photoshop to select the canal regularly, performing various selections, which complicated and prolonged the operation.

Figure 3 shows the Overlay view mode. In this view, user can easily manage the image processing.

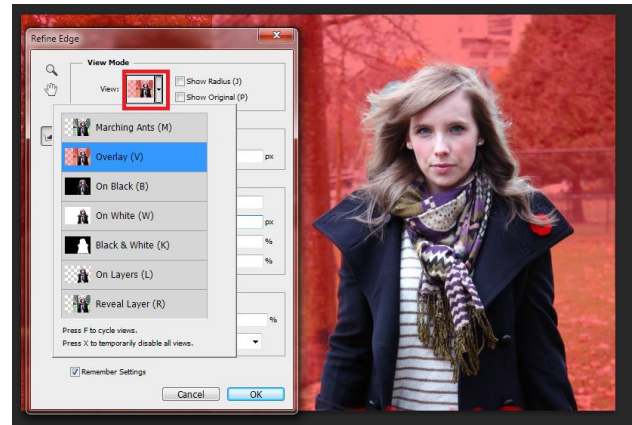


Figure 3. Overlay view mode

Figure 4 shows the Black & White view mode, which is the basis of working with Refine Edge tool. Photoshop users easily see the boundaries of the image through this mode. Thanks to the contrast between black and white, possible errors are easy to see.

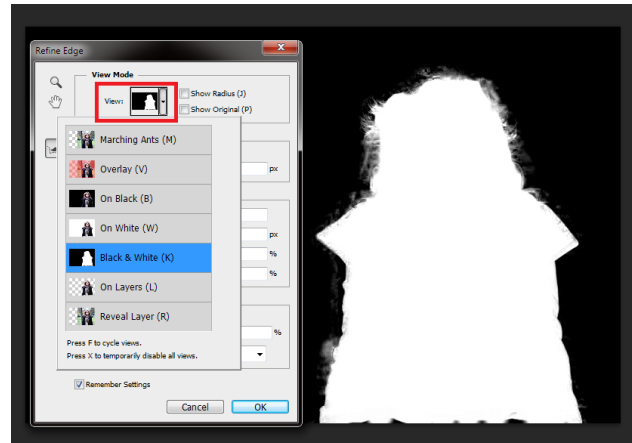


Figure 4. Black & White view mode

“Show radius” shows the view that allows the Photoshop user to manually adjust the radius (Fig.5). This is the beginning of the analysis provided in this paper. Pixels from both the original photo of the girl, as well as the autumn background pixels, are present in this pixel segment.

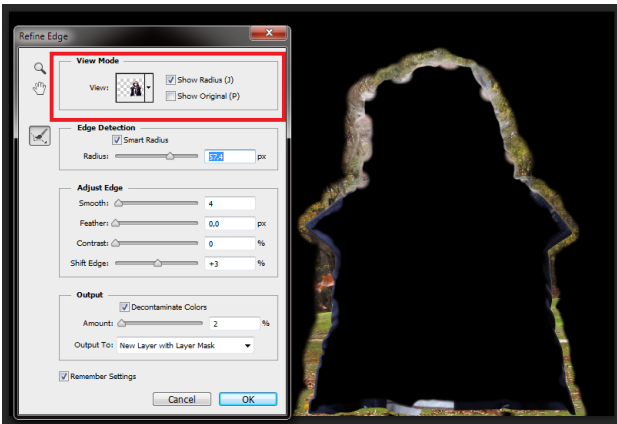


Figure 5. Show radius

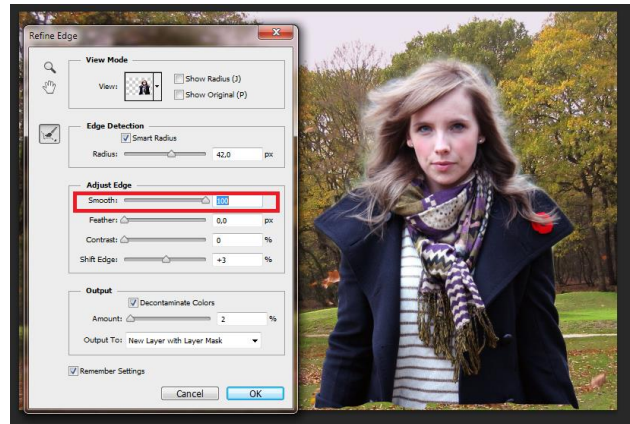


Figure 8. Smooth max

Defining the radius with smart radius option unchecked (Fig. 6) cuts out the excessive amount of hair pixels.

Feather option allows the selected part become transparent, such as seen in Figure 9.

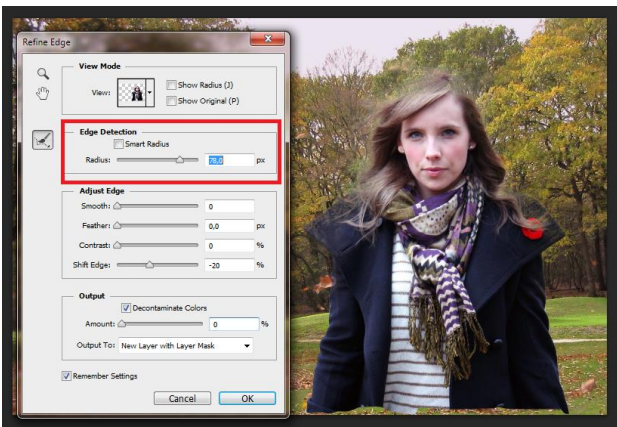


Figure 6. Edge Detection - Radius

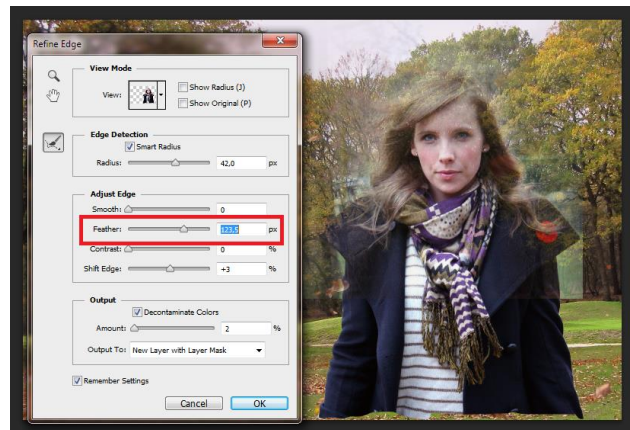


Figure 9. Feather max

Fig. 7 shows the Edge Detection section with the Smart Radius option checked. The processing is accurate as can be seen on Fig. 7, and significantly more hair pixels remain.

The contrast shows the pixels between the selected images and layers (Fig 10).

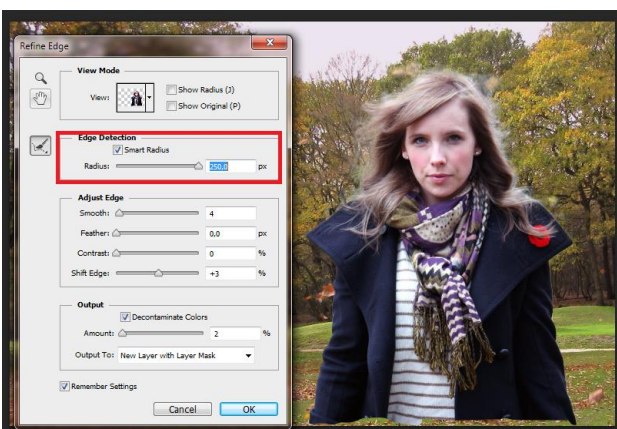


Figure 7. Edge Detection – Smart Radius

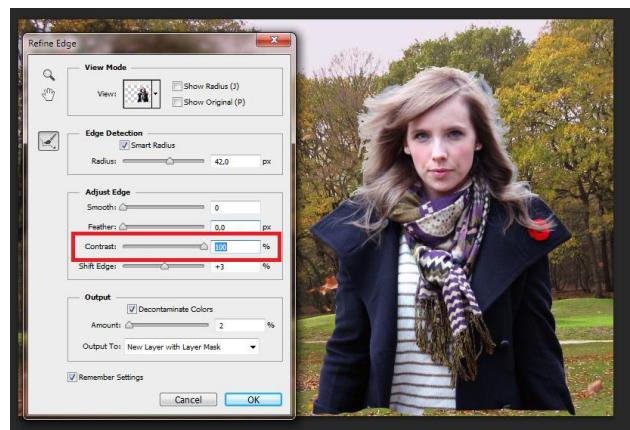


Figure 10. Contrast max

The following figures (Fig. 8-12) show the extreme values of analysed parameters.

Figure 8 shows the smooth option when set on 100. Smooth option improves smooth pixels between the selected images and pictures with the second layer.

Fig. 11 shows an example of processing Shift Edge, set to -100.

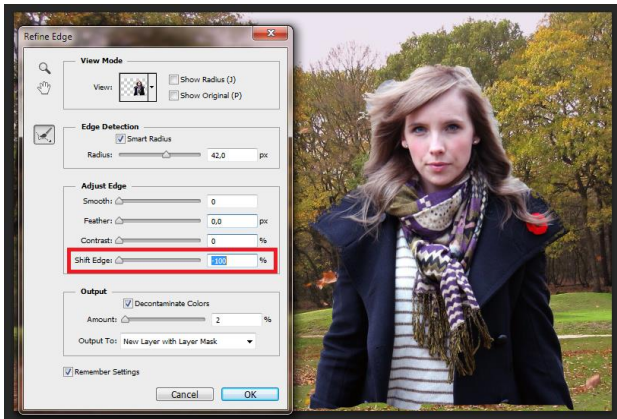


Figure 11. Shift Edge set at -100

The following figure (Fig. 12) shows the Shift Edge, set at +100. The conclusion is that the Shift Edge expands the pixels of the selected part of the picture.

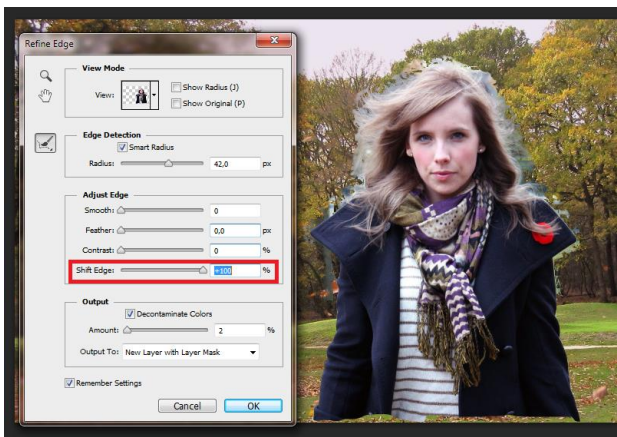


Figure 12. Shift Edge set at +100

This gives the basis to measure and compare the analysed parameters.

V. COMPARISON

Based on the encountered problems, several versions with various parameter combinations were made.

The first three parameters (Smooth, Feather and Contrast) had the satisfying result with small values:

Smooth: from 0 to 5

Feather: from 0 to 2

Contrast: from 0 to 1

Shift Edge is optimal when set to 30%-40%

This combination of parameter choices gives the result presented in Fig. 13.



Figure 13. Result

Analyzing a larger number of pictures would provide more precise results.

VI. CONCLUSION

This paper presents the analysis of Refine Edge features. Based on the defined problem, an analysis and comparison were conveyed on parameters of Smooth, Feather, Contrast and Shift Edge options for selecting hair of a person from the picture which has two different backgrounds. The result was shown in an example.

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Decision Support System for Management of the Forest Resources

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Abstract – An approach to Decision Support System (DSS) construction on the base of computer simulation and Automatic Theorem Proving (ATP) is considered. The proposed decision is presented to decision maker as a possible scenario of modeled object forecast data and corresponding criteria assessment. The scenarios are generated by a subsystem according to initial value combination. The mathematical model object representation is generated by means of the ATP, using knowledge base that implement a technique of the model construction. Results of DSS for sustainable consumption of forest resources of Irkutsk Region are briefly described. Further development directions of the DSS software are stated.

I. INTRODUCTION

One of the approaches of Decision Support Systems (DSS) construction is the use of mathematical models in the cycle of DSS information support. The models allow decision maker to manipulate more actual information and produce counterintuitive decisions. The approach is based on constructing a set of computer simulation scenarios of object under investigation and the analysis of the scenarios by means of a set of criteria. A set of Pareto-optimal scenarios is selected, and a multicriteria optimization is carried out over the set. As a result of modelling, a small set of the scenarios are presented to decision maker. Each stage of the modeling must be supported with necessary data.

Within the above-described conceptual approach to the DSS construction, we develop a DSS for decision maker to support sustainable forest resource consumption. The DSS is based on computer simulation of forest resource development in the future according to the identified model, the initial data, and a number of various scenarios of the forest resource consumption. Identification of the model is carried out under control of knowledge base, which constructs model state graphs, identifies constants, and computes the initial conditions for the concrete scenario prescribed by a scenario generator. The user interface allows defining criteria of scenario assessment, initial conditions intervals for the generator and query computer simulation results and model element sets as a Datalog subsystem. The DSS construction environment contains also instrumental means for derivative work development.

The environment is used to construct a prototype DSS for management of forest resources of Irkutsk Region, Russia. Model identification knowledge base and auxiliary algorithms construct a model at various source data specification and initial object scale, *e.g.*, for the whole Irkutsk region and detailed main forest species data, and for the set of forestry regions and more raw species data. Sustainable scenarios of the forest resource development are obtained.

In [1] calculi of positively constructed formulae (PCFs) were introduced. The logical first-order formalism is both machine- and human-oriented. As a consequence of the properties, logical inference search process in the calculi is well compatible with heuristics (as compared to popular resolution approach) related to the problem to be solved. These and a number of other properties of the calculi allow us to use the approach more widely in comparison to existing systems of automatic theorem proving (ATP).

Early, the ATP software based on PCFs was used in modeling of control of telescope guidance to the center of a planet in a partial phase [2], where simple temporal logical inference of a control has been implemented. The truth-value of some predicates were depended on a time moment; a ring buffer was used to store the truth-values for a number of past time moments.

The problem of decision support automation in sustainable development of an industrial region in a timber-harvesting field is a domain of the new ATP techniques application. For that purpose the further development of the ATP software is aimed at extended support of temporal reasoning (inference), *i.e.*, the truth value of most of the predicates are depended on the time moment. The control synthesis (a possible decision proposition for decision maker) is based on logically controlled computer simulation and model forecast analysis of the natural resource in a set of possible futures. The control is synthesized as a sequence of presumed actions in a future, which must be sound with respect to the prescribed constraints. The constraints account the properties of the potential control quality by measuring a set of criteria over a computer simulation results and application a logical comparison with a required level.

For adaptation of the PCF ATP software to the problem area of temporal reasoning and the domain

properties a following set of questions must be solved: implement a basis inference engine minimizing CPU and RAM consumption; develop a technique of equality processing; device and apply parallel schemes of inference; construct routines for efficient and convenient user-system interaction; implement techniques for programmable strategic control of the inference search process; test the ATP system on a set of logical problems; compare the system with existing ones; and device a general recommendation of ATP software usage in problem solving of various classes. These problems must be solved so as the main advantageous properties of the PCF language and its calculi must be conserved.

II. THE LANGUAGE OF POSITIVELY CONSTRUCTED FORMULAE

The language of the Positively Constructed Formulae (PCF) is a first-order logical language. In order to define the language let us consider a first-order language consisting of the formulas formed from atomic formulas with $\&, \vee, \neg, \rightarrow$ operators, \forall and \exists quantifier symbols and constants *true* and *false*. The notions of term, atom, literal are the same as usual.

Let $X = \{x_1, \dots, x_k\}$ be a set of variables, $A = \{A_1, \dots, A_m\}$ be a set of atoms (positive literals), and $F = \{F_1, \dots, F_n\}$ be a set of some first-order formulas, $k, m, n \in \{0, 1, \dots\}$. Then the following formulas $(\forall x_1) \dots (\forall x_k)(A_1 \& \dots \& A_m \rightarrow (F_1 \vee \dots \vee F_n))$ and $(\exists x_1) \dots (\exists x_k)(A_1 \& \dots \& A_m \& (F_1 \& \dots \& F_n))$ are denoted as $\forall_X A : F$ and $\exists_X A : F$, respectively. Here we imply that the \forall -quantifier corresponds to $\rightarrow F^\vee$, where F^\vee means disjunction of all the formulas from F , and \exists -quantifier corresponds to $\& F^\&$, where $F^\&$ means conjunctions of all the formulas from F .

If $F = \hat{0}$ (empty set) then the formulae have the form $\forall_X A : \hat{0} \Leftrightarrow \forall_X A \rightarrow \textit{false}$ and $\exists_X A : \hat{0} \Leftrightarrow \exists_X A \& \textit{true}$, since the empty disjunction is identical to *false*, whereas the empty conjunction is identical to *true*. The form $\forall_X A$ and $\exists_X A$ are abbreviations of formulas of above-mentioned form $\forall_X A : \hat{0}$ and $\exists_X A : \hat{0}$, respectively. If $X = \hat{0}$ then $\forall A : F$ and $\exists A : F$ are analogous abbreviations.

Let X be a set of variables, and A be a *conjunct*. Positively constructed formulas (PCF) defined as follows.

- $\forall_X A$ and $\exists_X A$ are \forall -PCF and \exists -PCF, respectively;
- if $F = \{F_1, \dots, F_n\}$ are \forall -PCFs, then $\exists_X A : F$ is a \exists -PCF;
- if $F = \{F_1, \dots, F_n\}$ are \exists -PCFs, then $\forall_X A : F$ is a \forall -PCF;
- any \exists -PCF or \forall -PCF is a PCF.

This form of logical formulas is referred to as positively constructed formulas (PCFs) as they are written with positive type quantifiers only. The formulae contain no explicit logic negation sign. Any first-order formula can be represented as PCF [1].

PCF that rooted from $\forall \hat{0}$ is called PCF in the *canonical form*. Any PCF can be represented in the canonical form by adding so-called fictitious nodes, which contain no variables and empty conditions.

The PCFs are usually represented as trees for more ease reading:

$$Q_X A : \{F_1, \dots, F_n\} \Leftrightarrow Q_X A \begin{cases} F_1, \\ \vdots \\ F_n. \end{cases}$$

Here Q is a quantifier. The three elements have conventional names: node, root, leaf, branch, *etc.* The quantifiers \forall correspond to disjunctions of formulae $\{F_1, \dots, F_n\}$, (quantifiers \exists correspond to a conjunction), then, in a general case, all \forall -nodes correspond a *disjunctive branching*, and for \exists -nodes correspond to *conjunctive branching*.

Some parts of a canonical PCF are named as follows:

- *root* of PCF, i.e., the root node $\forall \hat{0}$;
- all children nodes of the PCF root $\exists_X A$ are called PCF *bases*, conjunct A is called *base of facts*, and a PCF rooted from a base is called *base subformula*;
- the children $\forall_X B$ of the bases are called *questions* to the parent base. If question is a leaf of the tree then it is called a *goal question*;
- the subtrees of questions are called *consequents*. The consequent of a goal question is *false*.

The PCF calculus has one axiom and one inference rule.

Let us assume that a question $\forall_Y B : \Phi$ to a base $\exists_X A$ has an *answer* Θ if and only if Θ is a substitution $Y \rightarrow H^\infty \cup X$ and $B\Theta \subseteq A$, where H^∞ is Herbrand universe based on constants and function symbols that occur in corresponding base subformula.

Let $F = \exists_X A : \Psi$, and $G = \forall_Y B : \Phi$, where $\Psi = \{\exists_{Z_1} C_1 : \Gamma_1, K, \exists_{Z_m} C_m : \Gamma_m\}$ then split $(F, G) = \{\exists_{X \cup Z_1} A \cup C_1' : \Psi \cup \Gamma_1', \dots, \exists_{X \cup Z_m} A \cup C_m' : \Psi \cup \Gamma_m'\}$, where ' is a variable renaming operator. We say that F is *split* by formula G . It is obvious that $\text{split}(F, \forall_Y B) = \text{split}(F, \forall_Y B : \hat{0}) = \hat{0}$.

Inference rule ω . Consider some canonical PCF $F = \forall \textit{true} : \Sigma$. Let there is a question Q that has an answer Θ to appropriate base $G \in \Sigma$, then the following formula $\omega F = \forall \textit{true} : \Sigma \setminus \{G\} \cup \text{split}(G, Q\Theta)$ is an inference step.

The inference consists of the steps until all bases of facts will have *false* statements, in that case its base subformula can be eliminated, *i.e.*, the constructed inference process is a refutation.

III. THE ATP SYSTEM

To date, a new version of ATP system has been developed, which embodied a number of nowadays techniques [3, 4] of performance improvement and conserving of RAM usage. In particular, various functional components were implemented in the main subsystem of inference search. New ATP engine is based on data sharing of common structures in RAM, term indexing [5] for narrowing the search area, parallel variants of algorithms implemented on clusters [6], various restrictive strategies disallowing enormous branching due to the split operation, special structures organizing common features for inference watch and backtracking, lazy concretization of terms, *etc.*

Main advantage of the PCFs calculi are their controllability by means of microprograms and restrictive strategies, which modify the default complete strategy of an inference search. The microprograms are issued when a set of conditions satisfied in tracking structures of the inference engine. The running microprogram affects the orders of event processing in the main algorithms. At the higher level of the ATP system control, user can interfere into the process of microprograms, strategies and heuristics selection in a case of a task with special properties.

The developed algorithms and ATP software is being continuously tested on standard set of logical problems from TPTP library (<http://www.tptp.org>), which is *de facto* set of first-order problems for ATP systems testing. The results show that our system is useful in solving tasks of rating 0.2, *i.e.*, it is capable to solve tasks of average complexity. Tasks that are more complex contain equality predicate more frequently, and the ATP system must strongly support the predicate in order to deal with the task of higher complexity.

The realized means of the inference constructions were adapted with respect to the PCF language and its calculi properties. It appears that the techniques we already adapted are well suited to the properties.

A. DSS as a Field of Application of ATP

Good performance of the ATP system and the ability to compose of all above-mentioned techniques in the process of inference search is shown on formulae, which contain only variables bound in a conjunct. These formulae belongs to a class of technical application domains, *e.g.*, described in [1], as well as to a class of problems, which are well supported with structural and semantic heuristic data by user. The problem of forest resources dynamics prognosis is to provide the information for sustainable management of the natural resources is one of such problems.

In V.B.Sochava Institute of Geography SB RAS, a system of models of forest resources has been developed [7]. A model knowledge base has been constructed, where

the models are classified according to regional scale, modelled object, and problem to be solved. Model coefficients identification techniques taking into account regional peculiarities has been developed [7-10]. Model of "Forest Dynamics and Control" (FDC) allows one to forecast of forest resources development of a region or a forestry for decades as proportions of forest areas of predominant species of an age group (see in English in [10]).

IV. MODEL OF FOREST DYNAMICS AND CONTROL

The model [10] corresponds to a graph structure of states (the area proportions) and edges between states, which correspond to intensities of transition of area particles from one state to another. The graph describes forest growth, plantations, logging, burnout, and segregation under capital construction, arable lands, roads, *etc.*

FDC is a regional-level model and uses dynamic variables. The total non-forest area S_N of the modeled territory; the total area uncovered with forest S_0 ; the areas covered with forest of i -th species predominating, including young forest of the first S_{1i} and second S_{2i} age classes, average-aged S_{3i} , maturing S_{4i} , mature S_{5i} and overmature S_{6i} forest stands. These states are all time-dependent. The dynamics of these area parcels is described by the following formulae:

$$\begin{aligned} dS_N / dt &= -\lambda_{N0}S_N(t) + u_N(t); & dS_0 / dt &= \\ &= \lambda_{N0}S_N(t) - \lambda_{01}S_0(t) + u_L(t) + u_B(t) - u_{N0}(t) - \\ & & & - u_C(t); \\ \frac{dS_{Ci}}{dt} &= -\lambda_{C1i}S_{Ci}(t) + u_{Ci}(t) - u_{NCi}(t) - u_{BCi}(t); \\ \frac{dS_{1i}}{dt} &= \lambda_{C1i}S_{Ci}(t) + \lambda_{01i}P_{0i}S_0(t) - \lambda_{12i}S_{1i}(t) - \\ & & & - u_{L1i}(t) - u_{N1i}(t) - u_{B1i}(t); \\ \frac{dS_{2i}}{dt} &= \lambda_{12i}S_{1i}(t) - \lambda_{23i}S_{2i}(t) - u_{L2i}(t) - u_{N2i}(t) - u_{B2i}(t); \\ \frac{dS_{3i}}{dt} &= \lambda_{23i}S_{2i}(t) - \lambda_{34i}S_{3i}(t) - u_{L3i}(t) - u_{N3i}(t) - \\ & & & - u_{B3i}(t) + I_i; \\ \frac{dS_{4i}}{dt} &= \lambda_{34i}S_{3i}(t) - \lambda_{45i}S_{4i}(t) - u_{L4i}(t) - u_{N4i}(t) - u_{B4i}(t); \\ \frac{dS_{5i}}{dt} &= \lambda_{45i}S_{4i}(t) - \lambda_{56i}S_{5i}(t) - u_{L5i}(t) - u_{N5i}(t) - u_{B5i}(t); \\ dS_{6i} / dt &= \lambda_{56i}S_{5i}(t) - u_{L6i}(t) - u_{N6i}(t) - u_{B6i}(t) - I_i; \\ u_L(t) &= \sum_{i,j} u_{Lji}(t); & u_C(t) &= \sum_i u_{Ci}(t); \\ u_N(t) &= \sum_{i,j} u_{Nji}(t) + \sum_i u_{NCi}(t) + u_{N0}(t). \end{aligned}$$

Here, λ_{jki} is the intensity coefficients of transition of the area parcels from j -th category of lands or group of ages (state) to the other k -th forest state, with i -th species predominating, or to a definite category of lands (without the index i); p_{0i} is the share of the areas of uncovered with forest and populated with young forest of the first age group with i -th species predominating; $u_N(t)$ is an increase of the non-forest area due to capital construction on other categories of lands $u_{Nji}(t)$; $u_L(t)$, $u_{Li}(t)$, and $u_{Lji}(t)$, respectively, correspond to the annual area of logging as a whole, to crops of the i -th species, and in the forest stands of the i -th species and the j -th age group at time t ; $u_B(t)$, $u_{Bi}(t)$, and $u_{Bji}(t)$ respectively, are the annually burnt-over areas as a whole, of crops of the i -th species, and forests of the i -th species of the j -th age group; I_i stands for the growth rate of the area of average-aged forests of young growth of the i -th species as a result of species succession, and I_i is the decrease rate of the area of overmature forests as a result of the species succession.

B. The modelling scenarios and multicriterial optimizations

When performing computer simulation in terms of the model, the user can access (to make relevant changes) the parameters of the main felling volume, tending fellings, burnouts and tree planting. Each of these parameters are varied within 0% (none), 50% (a half of the volume), and 100% (total volume). Each scenario results of computer simulation are accounted using the following set of criteria:

1. $\max_j \min_i W^j(t_i)$, where $W^j(t_i)$ is standing crop (for all species and age groups) calculated in the j -th scenario at the year t_i (to find a scenario with the greatest volume of felled forest);
2. $\min_j \max_i S_0^j(t_i)$, where $S_0^j(t_i)$ is the uncovered in forest area, it is calculated from j -th scenario in the year t_i (forest areas are better to be covered with forest);

3. $\max_j (S_5^j + S_6^j)$, where $S_5^j(t_i)$, and $S_6^j(t_i)$, respectively, correspond to the area of mature and overmature forests of all species calculated from j -th scenario for the forecasted period (it would be better if ratios of the mature and overmature forest were greater);

4. $\min_j \max_i S_6^j(t_i)$, where $S_6^j(t_i)$ is the area of overmature forests of all species calculated from the j -th scenario in the year t_i (it would be better if areas of the overmature forest were smaller).

Each calculated scenario is assessed using this set of criteria. Due to the multicriteria nature of the best scenario choice problem, the principle of Edgeworth-Pareto is used to select scenarios as proposed variants to decision-making person.

V. APPLICATION OF PCFs IN DSS

In [7] the logical inference in PCFs' calculi was used to deduce the model FDC graph layout and calculate parametric identification of the model. The inference is constructed as satisfaction of a sequence of goals, which represent a general scenario of the model construction. In the process of the inference, the ATP system issued queries to the database of forest inventory with special predicates having side effects. The results of the queries are the identified coefficients and initial values of the model. The metainformation on the database structure and attribute meanings is represented as a part of knowledge base and defined for each data source separately.

The model construction subsystem formed a basis of an experimental decision support system for sustainable resource consumption control of forest resources [8]. The usage of logical inference allowed us to raise level of generality of the model graph construction and its identifications. The expressive logical language allowed us to synthesize graphs for regional and forestry scales using the same knowledge bases but different databases and corresponding metainformation. Source data are also were processed by a special parts of the knowledge base. The regional data is more specific and contain information on seven forest species and six age groups, whereas forestry data is more general: all species are combined into three classes (dark and light coniferous and deciduous

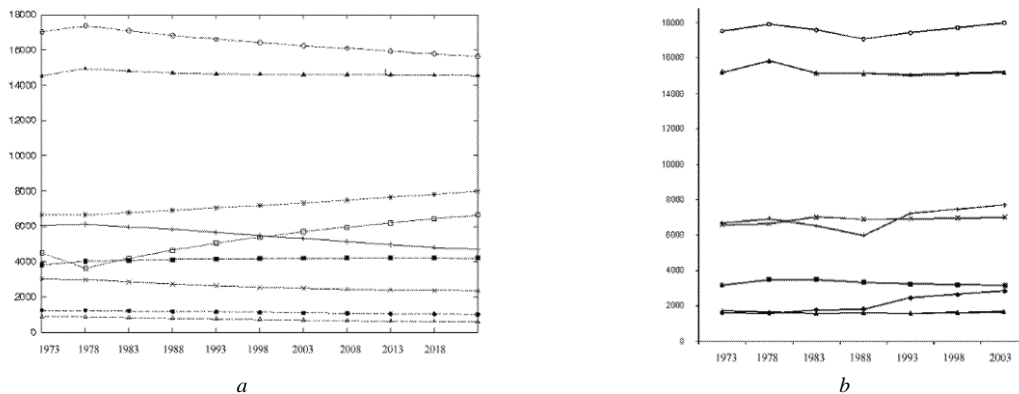


Figure 1. Verification of the Forest Dynamics and Control model

forests). Age groups are also generalized; there are only three age groups (combined young, middle-aged and maturing, and mature and overmature forest). The corresponding subset of rules reduced space of states of the graph to the sensible combinations and transition intensities are corrected in accordance.

The simulation software was verified using retrospective comparison. The year 1973 was chosen as initial time of calculations in the model, as that year a reliable information was supplied by forest inventory organizations.

The temporal dynamics of the forest resources (1973-2023) having regarded to natural species succession is shown in Fig. 1a., as well as fellings and burnouts (a constant increase in felling of coniferous forests is assumed), withdrawal of forests of the forest reserves as a result of capital construction, and the process of creation of forest crops and their conversion to young growth. The reference data of the verification is presented as graphics in Fig. 1b.

VI. LOGICAL SYNTHESIS OF A CONTROL DECISION

The further development of the technologies of forest resources modeling are focused on formalizing of forest resource policy within logical modeling of the decision-making process and logical synthesis of acceptable control decision. The task has a peculiarity: the aim of control cannot be formalized, but a set of qualitative criteria of rationality and sustainability of the resource development is defined. The criteria are defined as inequalities. Therefore, the approach is a variant of solving a Constraint Satisfaction Problem but in a temporal environment. In this situation, the logical inference cannot be constructed as a theorem proof. However, the inference engine of PCFs might be used to model the possible variants of future depending on an assumed decision.

Logical model is represented as a PCF, which include the following sections:

1. the qualitative constraints over the FDC scenarios' assessment criteria;
2. presumed control selection and identification (a model of decision-making);
3. FDC moduli description and programming interface;
4. the axiom generating new time moments (well ordered set of them) in a discrete time space.

The formalization of the logical model is based on predicates parameterized by the time moment variable. Logical inference constructs a tree of possible FDC model results, with initial condition being the root node, and branches being states of the alternative trajectories of FDC development of the forest system in possible futures. The hypothetical decisions are synthesized according to a predefined policy reflecting standards of forest resource consumption and restoration. The alternatives correspond to the assumed control variants, and the trajectories correspond to a possible resultant decision if it will be proved a sustainable rational development. If at any time

moment the set of conditions is not satisfied, then this variant of a future is considered unpromising and eliminated from the inference tree.

Our software for ATP allow us to develop a system of logical modeling of the decision-making process with only means of the language and calculi without inventing of a new *ad hoc* engine. We need only to refine the constraints to the inference search process to make it more purposeful, implement algorithmic parts of the systems such as FDC and criteria assessment routines. For example, for all the knowledge base sections a priority has been defined. The priority affects the CPU time allocated for processing the set of the rules and the order of rules application. The least priority is assigned to the axiom of the next time moment existence, it is activated if all the possible data about FDC model state is already obtained and all conditions satisfied. The higher priority is assigned to the rules that check conditions, the unsatisfied conditions stop the inference in the branch.

For restricting the number of base subformulae (*i.e.*, in the case of the problem at hand, the number of simultaneous model instances under consideration) the strategy of k,m -refutation is used. The strategy allows an application of the rule for generation of alternative futures if in next k inference steps there will be not more than m futures "survive" after constraint checks. Another variant of the strategy restricts the CPU resource allocation for the variants that are suspicious to be unpromising in sense of obtaining the longest possible trajectory. The last case implies the control that satisfies the longest possible forecast (in sense of number of the time moments it «survives» the set of the constraints) is a better one.

For parallel inference search and FDC simulation, Student cluster system of Irkutsk State University is used. The cluster was obtained from Hewlett Packard after winning a competition "University cluster" to support the project. The cluster has 40 computation Xeon-cores and Gigabit Ethernet technology as a connection resource.

VII. CONCLUSION

Results of development of an automatic theorem proving (ATP) engine for supporting logical modeling of control of natural processes is considered in the paper. The development is aimed at the raise of productivity of the existing ATP system software based on the calculi of Positively Constructed Formulae. For that purpose, nowadays algorithms and data structures developed for the resolution method was adapted to the calculi. Parallel strategies of the inference search for asynchronous multiprocessing cluster architectures was developed as well as special cases of memory conserving data structures. The software is continuously tested on standard set of logical problems from TPTP library.

The ATP software successfully applied in the solving of identification problem of a forest resources dynamics modeling and control for an industrial region, namely, Irkutsk region, Russian Federation. The usage of logical engines for model construction and its parametric identifications allowed us, in particular, to generalize the process of interaction with database under the control of its metadata and to adapt general techniques of model

construction to the database source data of various granularities. The logic layer becomes a basis of a prototype decision support system for sustainable forest resources development in the conditions of continuous industrial felling.

A problem of logical modelling of the behavior of a decision-making person is under development and investigation. The modelling will allow us to construct a sequence of counterintuitive decisions for decades as a result of logical inference and simultaneous computer simulation. The developed software thanks to its theoretical basis has especial properties to support the decision-making process by the logical inference engine without additional inventing of an *ad hoc* engine. The decision is synthesized as consequences of forward chaining temporal reasoning of the initial object state and presumed variant of control in the form of the logical formula.

ACKNOWLEDGMENT

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Identification and Evaluation of Pertinent Parameters used for Cost-Modeling of a Wide Area Network

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Abstract -Building a Wide Area Network is not a simple task – one has to go through several stages successively, in order to reach the final construction. The most important stages include: definition of the requirements which instate the network, its topological graph description, as well as identification and calculation of pertinent parameters, i.e. the creation of network traffic matrix, determination of the shortest path between nodes comprising the network, quantification of the effect of different levels of technical and technological development of urban areas that are included in the network, the cost of technology that will be used, and the cost of services for which the network is created. In this paper, we argue that values of these parameters vary wildly for WAN networks in different regions, since their calculation directly depends on the data “on the ground” where we aim to set the network: the number of inhabitants, the distance between settlements, network traffic density, technical and technological growth rate, etc. The rationale behind the identification and the evaluation of these parameters is very straightforward: to develop a model which will determine the exact cost of the network that performs within the limits set by the demands of prospective users.

I. INTRODUCTION

WAN is a network composed of Local Area Networks (LANs) or a collection of smaller WANs in one region [1,8]. Nevertheless, WANs do not just necessarily connect physically disparate LANs. A Campus (or Corporate) Area Network (CAN), for example, may have a localized backbone of a WAN technology, which connects different LANs within a campus. This could be to facilitate higher bandwidth applications, or provide better functionality for users in the CAN. Thus, these kind of regional networks represent an infrastructure through which are provided various services, simple or complicated. Internet as a global network uses the infrastructure created with regional and local networks in an efficient way. In the field there is a continuous growth in data volume, which also increases the necessity of their saving and distributing. All efficient and strong systems for data transfer grow and improve every day, whereas the technology perfection through regional networks increases even more the number of users. Creating such efficient networks, which fulfill the needs of a certain region with minimal cost, is still a challenge. For this reason, problems in this field are an object of study for researchers around

the world. In this paper, some pertinent parameters which could be indicators for creating a regional WAN network and defining its cost are reviewed.

II. THEORETICAL BACKGROUND AND METHODOLOGY

A. Identification of communication models

In certain regions and at certain point of time, the communication in the network is variable. For this reason, precursory calculations of the data communications in the network are necessary to be made. Afterwards, according to these indicators the networks' capacity borders could be determined. These indicators are helpful for a better analysis of the communication in the respective network.

B. Communication matrix

The graph theory helps for creating the communication matrix. A graph is created, whose nodes correspond with the network's nodes, respectively (i.e. cities). After designing the graph, the matrix is structured and its elements represent average value of quantity of data transfer between graphs nodes. This value is different between two nodes and in different points of time. The calculation of the communication matrix is based in the number of the inhabitants in a city (node), number of households, and time of using the network. By the term “household” we understand a collective family composed from a number of people that live together in a house or institution. In a city there are two types of households: residential and commercial. The usage of the network by these two categories is not the same based on the time of the usage and the volume of data transfer. The number of households for one node of the graph can be calculated by the following equation [2]:

$$T = \frac{P}{N} \quad (1)$$

- T: No. of households
- P: No. of city's inhabitants
- N: No. of inhabitants in one home (e.g. in Macedonia this number is 3.5) [2,4].

The total traffic in *erlangs* (E) for any city is calculated as:

$$TF = C * \frac{P}{N} * \frac{CC * CL}{24} + R * \frac{P}{N} * \frac{CR * RL}{24} \quad (2)$$

- TF: The total traffic for any city
 - C: Commercial households in percent
 - R: Percent of residential households
- P: No. of inhabitants per city
- N: No. of inhabitants per household
- CC: No. of calls per commercial household per day (24 hours)
- CR: No. of calls per residential household per day
- RL: Residential call duration (in hours)

TABLE I. THE TRAFFIC FROM VARIOUS CITIES

Cities	Population	N= 3,5 T	CT(15%)	RT(85%)	TC (CT*CL*4)/ 24, CL=1/2 h	TR (RT*RL*1)/ 24, RL=1/2 h	TF= TC+TR
Struga	63376	18107,43	2716,11	15391,31	226,34	320,65	547,00
Ohrid	55749	15928,29	2389,24	13539,04	199,10	282,06	481,17
Bitola	95385	27252,86	4087,93	23164,93	340,66	482,60	823,26
Debar	19542	5583,43	837,51	4745,91	69,79	98,87	168,67
Kicevo	47700	13628,57	2044,29	11584,29	170,36	241,34	411,70
Krushevo	9684	2766,86	415,03	2351,83	34,59	49,00	83,58
Prilep	76768	21933,71	3290,06	18643,66	274,17	388,41	662,58
Gostivar	81042	23154,86	3473,23	19681,63	289,44	410,03	699,47
Tetovo	86580	24737,14	3710,57	21026,57	309,21	438,05	747,27
Skopje	506926	144836,00	21725,40	123110,60	1810,45	2564,80	4375,25
Kumanovo	105484	30138,29	4520,74	25617,54	376,73	533,70	910,43
Kriva Pallanka	20820	5948,57	892,29	5056,29	74,36	105,34	179,70
Sveti Nikolle	18497	5284,86	792,73	4492,13	66,06	93,59	159,65
Shtip	47796	13656,00	2048,40	11607,60	170,70	241,83	412,53
Veles	55108	15745,14	2361,77	13383,37	196,81	278,82	475,63
Kocani	38092	10883,43	1632,51	9250,91	136,04	192,73	328,77
Radovish	28244	8069,71	1210,46	6859,26	100,87	142,90	243,77
Negotino	19212	5489,14	823,37	4665,77	68,61	97,20	165,82
Kavadarci	38741	11068,86	1660,33	9408,53	138,36	196,01	334,37
Strumica	54676	15621,71	2343,26	13278,46	195,27	276,63	471,91
Gevgelija	22988	6568,00	985,20	5582,80	82,10	116,31	198,41
Σ	1492410	426402,86	63960,43	362442,43	5330,04	7550,88	12880,92

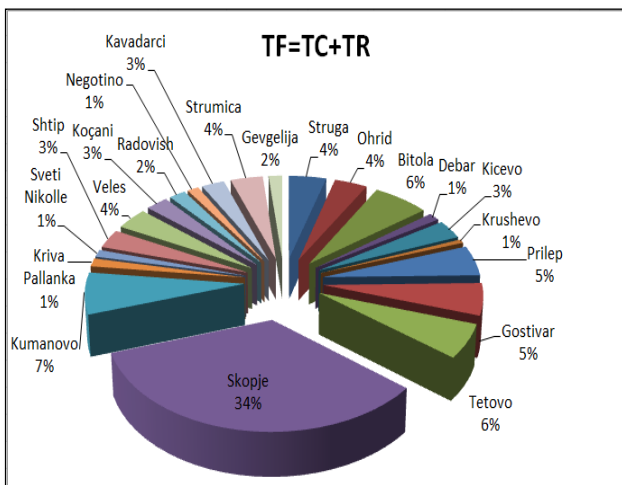


Figure 1. The traffic distribution between cities

The traffic between cities A and B is calculated by entering the respective values in:

$$T_{AB} = T_A * \frac{P_B}{P_T} \tag{3}$$

- T_{AB} : Traffic between cities A and B
- T_A : Traffic from city A with other cities
- P_B : Number of inhabitants in city B
- P_T : The total population for all 21 cities

TABLE II. TRAFFIC MATRIX BETWEEN 21 MACEDONIAN CITIES (UNIT: ERLANG)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Cities	Struga	Ohrid	Bitola	Debar	Kicevo	Krushevo	Prilep	Gostivar	Tetovo	Skopje	Kumanovo	Kriva Pallanka	Sveti nikolce	Shtip	Veles	Kocani	Radovish	Negotino	Kavadarci	Strumica	Gjergjelia
1 Struga		20,4	35	7,16	17,5	3,55	28,1	29,7	31,7	186	38,7	7,63	6,78	17,5	20,2	14	10,4	7,04	14,2	20,2	8,43
2 Ohrid	20,43		30,8	6,3	15,4	3,12	24,8	26,1	27,9	163	34	6,71	5,96	15,4	17,8	12,3	9,11	6,19	12,5	17,6	7,41
3 Bitola	34,96	30,75		10,78	26,31	5,34	42,34	44,70	47,76	279,64	58,18	11,48	10,20	26,36	30,39	21,01	15,58	10,59	21,37	30,16	12,68
4 Debar	7,162	6,301	10,78		5,39	1,1	8,7	9,2	9,8	57	12	2,4	2,1	5,4	6,2	4,3	3,2	2,2	4,4	6,2	2,6
5 Kicevo	17,48	15,38	26,31	5,39		2,67	21,2	22,4	23,9	140	29,1	5,74	5,1	13,2	15,2	10,5	7,79	5,3	10,7	15,1	6,34
6 Krushevo	3,549	3,122	5,34	1,094	2,6714		4,3	4,54	4,85	28,39	5,91	1,17	1,04	2,68	3,09	2,13	1,58	1,08	2,17	3,06	1,29
7 Prilep	28,14	24,75	42,35	8,676	21,177	4,30		36	38,4	225,1	46,8	9,2	8,2	21,2	24,5	16,9	12,5	8,5	17,2	24,3	10,2
8 Gostivar	29,7	26,13	44,71	9,159	22,356	4,54	36,0		40,6	237,6	49,4	9,8	8,7	22,4	25,8	17,9	13,2	9	18,2	25,6	10,8
9 Tetovo	31,73	27,91	47,76	9,785	23,884	4,85	38,4	40,6		254	52,8	10,4	9,26	23,9	27,6	19,1	14,1	9,62	19,4	27,4	11,5
10 Skopje	185,8	163,4	279,64	57,29	139,84	28,39	225,1	237,6	253,8		309	61	54,2	140	162	112	82,8	56,3	114	160	67,4
11 Kumanovo	38,66	34,01	58,19	11,92	29,099	5,91	46,8	49,4	52,82	309,2		12,7	11,28	29,2	33,62	23,24	17,23	11,72	23,63	33,35	14,02
12 Kriva Pallanka	7,631	6,713	11,49	2,353	5,7434	1,17	9,2	9,8	10,42	61,04	12,70		2,23	5,75	6,64	4,59	3,4	2,31	4,66	6,85	2,77
13 Sveti Nikolce	6,779	5,964	10,20	2,09	5,1026	1,04	8,2	8,7	9,262	54,23	11,28	2,23		5,11	5,9	4,07	3,02	2,06	4,14	5,85	2,46
14 Shtip	17,52	15,41	26,37	5,402	13,185	2,68	21,2	22,4	23,93	140,1	29,16	5,75	5,113		15,2	10,5	7,81	5,31	10,7	15,1	6,35
15 Veles	20,2	17,77	30,40	6,228	15,202	3,09	24,5	25,8	27,59	161,6	33,62	6,64	5,895	15,2		12,1	9	6,12	12,3	17,4	7,33
16 Kocani	13,96	12,28	21,01	4,305	10,508	2,13	16,9	17,9	19,07	111,7	23,24	4,59	4,075	10,5	12,14		6,22	4,23	8,53	12	5,06
17 Radovish	10,35	9,106	15,58	3,192	7,7914	1,58	12,5	13,2	14,14	82,8	17,23	3,40	3,021	7,81	9,001	6,222		3,14	6,33	8,93	3,75
18 Negotino	7,042	6,194	10,60	2,171	5,2998	1,08	8,5	9,0	9,62	56,32	11,72	2,31	2,055	5,31	6,123	4,232	3,14		4,3	6,07	2,55
19 Kavadarci	14,2	12,49	21,37	4,378	10,687	2,17	17,2	18,2	19,4	113,6	23,63	4,66	4,144	10,7	12,35	8,534	6,33	4,30		12,25	5,15
20 Strumica	20,04	17,63	30,16	6,179	15,083	3,06	24,3	25,6	27,38	160,3	33,35	6,58	5,849	15,1	17,43	12,04	8,93	6,07	12,25		7,27
21 Gjergjelia	8,426	7,412	12,68	2,598	6,3415	1,29	10,2	10,8	11,51	67,39	14,02	2,77	2,459	6,35	7,326	5,064	3,75	2,55	5,15	7,27	

III. USAGE OF THE ALGORITHMS FOR FINDING THE SHORTEST PATH BETWEEN VERTICES OF THE GRAPH

For finding the shortest path between vertices of the graph in this case, we use two algorithms: Dijkstra and Floyd-Warshall. Dijkstra’s algorithm finds the shortest path from one vertex (source) to all other vertices[3,7,10,12]. At each node(city) a router is placed

which processes the data of the value of graph’s branches(links). Thus, a database for branches value (Link-state database – LSDB) is created. Each router has information for every other router and it involves the Dijkstra algorithm. The graph in this case has 21 vertices which represent cities for a WAN network in a certain region.

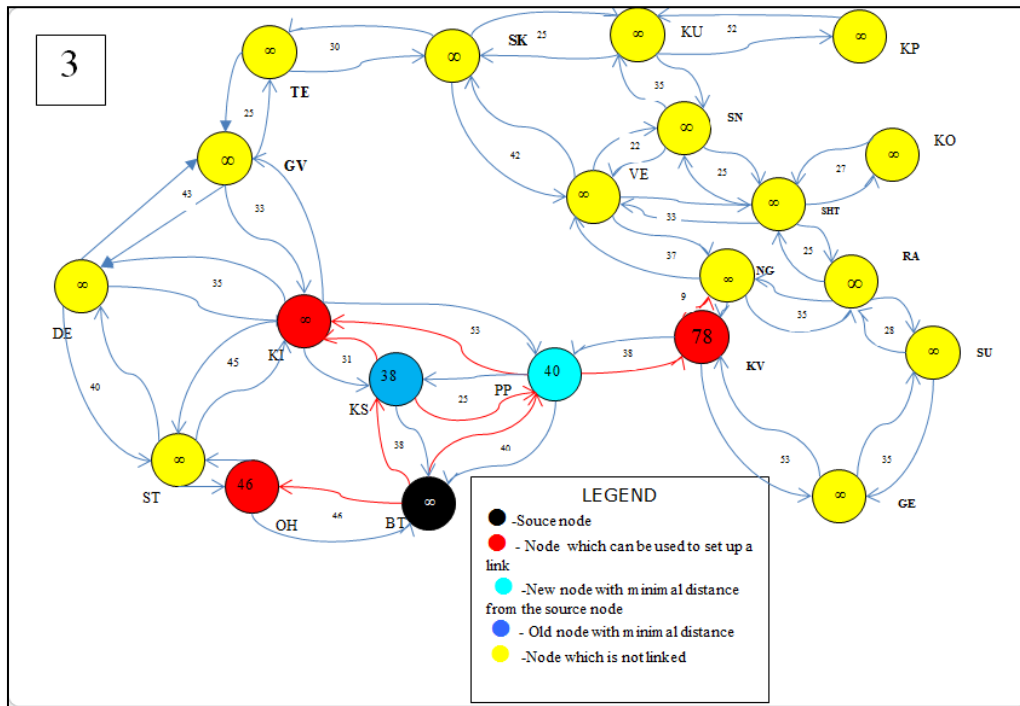


Figure 2. Graph with 21 nodes

The obtained data for the shortest path are registered in The router has another database called Adjacency routing tables which are called Forwarding Databases. Database[6].

TABLE III. GRAPH ADJACENCY DATABASE

ST	OH	BT	DE	KI	KS	PP	GV	TE	SK	KU	KP	SN	SHT	VE	KO	RA	NG	KV	SU	GE	
OH/13	ST/13	KS/38	ST/40	DE/35	PP/25	KI/53	KI/32	GV/25	KU/25	SK/25	KU/52	KU/35	SN/25	SK/42	SHT/27	SHT/25	KV/9	NG/9	RA/28	KV/53	
KI/45	BT/46	PP/40	KI/35	KS/31	BT/38	KS/25	DE/43	SK/30	VE/42	KP/52		VE/22	VE/33	SN/22		NG/35	RA/35	PP/38	GE/35	SU/35	
DE/40		OH/46	GV/43	GV/32	KI/31	BT/40	TE/25		TE/30	SN/35		SHT/25	KO/27	SHT/33		SU/28	VE/37	GE/53			
				ST/45		KV/38							RA/25	NG/37							
				PP/53																	

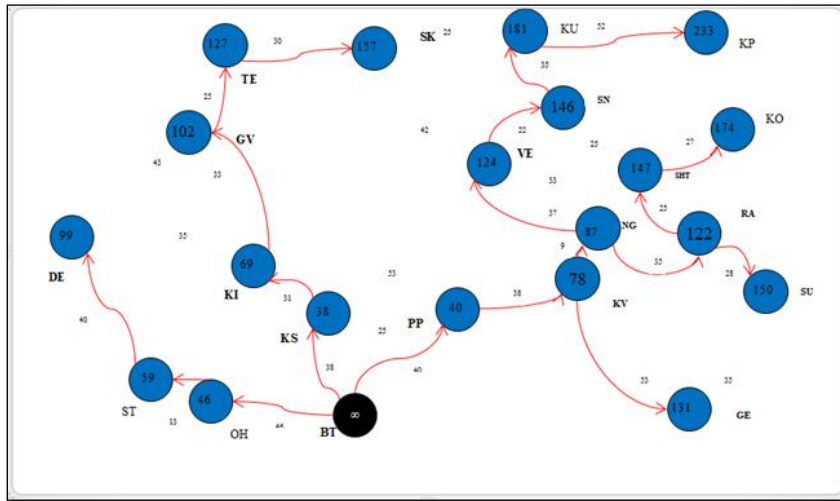


Figure 3. Shortest path from BT-node with Dijkstra

After the finalizing of all steps of the Dijkstra algorithm we will have the shortest paths from the base node (e.g. BT) with all other nodes of the graph.

In the following table we see the algorithm's steps for reaching the final stage where the shortest paths from the base node are found.

TABLE IV. STEPS OF DIJKSTRA'S ALGORITHM

steps	BT	KS	PP	OH	ST	KI	KV	NG	DE	GV	RA	VE	TE	GE	SN	SHT	SU	SK	KO	KU	KP	
0	0/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL
1	0/NIL	38/BT	40/BT	46/BT	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL
2	0/NIL	38/BT	40/BT	46/BT	∞/NIL	69/BT	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL
3	0/NIL	38/BT	40/BT	46/BT	∞/NIL	69/BT	78/BT	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL
4	0/NIL	38/BT	40/BT	46/BT	59/BT	69/BT	78/BT	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL
5	0/NIL	38/BT	40/BT	46/BT	59/BT	69/BT	78/BT	∞/NIL	99/BT	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL
6	0/NIL	38/BT	40/BT	46/BT	59/BT	69/BT	78/BT	∞/NIL	99/BT	102/BT	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL
7	0/NIL	38/BT	40/BT	46/BT	59/BT	69/BT	78/BT	87/BT	99/BT	102/BT	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL
8	0/NIL	38/BT	40/BT	46/BT	59/BT	69/BT	78/BT	87/BT	99/BT	102/BT	122/BT	124/BT	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL
9	0/NIL	38/BT	40/BT	46/BT	59/BT	69/BT	78/BT	87/BT	99/BT	102/BT	122/BT	124/BT	∞/NIL	131/BT	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL
10	0/NIL	38/BT	40/BT	46/BT	59/BT	69/BT	78/BT	87/BT	99/BT	102/BT	122/BT	124/BT	127/BT	131/BT	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL
11	0/NIL	38/BT	40/BT	46/BT	59/BT	69/BT	78/BT	87/BT	99/BT	102/BT	122/BT	124/BT	127/BT	131/BT	∞/NIL	147/BT	150/BT	∞/NIL	∞/NIL	∞/NIL	∞/NIL	∞/NIL
12	0/NIL	38/BT	40/BT	46/BT	59/BT	69/BT	78/BT	87/BT	99/BT	102/BT	122/BT	124/BT	127/BT	131/BT	146/BT	157/BT	150/BT	166/BT	∞/NIL	∞/NIL	∞/NIL	∞/NIL
13	0/NIL	38/BT	40/BT	46/BT	59/BT	69/BT	78/BT	87/BT	99/BT	102/BT	122/BT	124/BT	127/BT	131/BT	146/BT	157/BT	150/BT	157/BT	∞/NIL	∞/NIL	∞/NIL	∞/NIL
14	0/NIL	38/BT	40/BT	46/BT	59/BT	69/BT	78/BT	87/BT	99/BT	102/BT	122/BT	124/BT	127/BT	131/BT	146/BT	157/BT	166/BT	157/BT	∞/NIL	∞/NIL	∞/NIL	∞/NIL
15	0/NIL	38/BT	40/BT	46/BT	59/BT	69/BT	78/BT	87/BT	99/BT	102/BT	122/BT	124/BT	127/BT	131/BT	146/BT	171/BT	166/BT	157/BT	∞/NIL	181/BT	∞/NIL	∞/NIL
16	0/NIL	38/BT	40/BT	46/BT	59/BT	69/BT	78/BT	87/BT	99/BT	102/BT	122/BT	124/BT	127/BT	131/BT	146/BT	147/BT	166/BT	157/BT	174/BT	181/BT	∞/NIL	∞/NIL
17	0/NIL	38/BT	40/BT	46/BT	59/BT	69/BT	78/BT	87/BT	99/BT	102/BT	122/BT	124/BT	127/BT	131/BT	146/BT	147/BT	150/BT	157/BT	174/BT	181/BT	∞/NIL	∞/NIL
18	0/NIL	38/BT	40/BT	46/BT	59/BT	69/BT	78/BT	87/BT	99/BT	102/BT	122/BT	124/BT	127/BT	131/BT	146/BT	147/BT	150/BT	157/BT	174/BT	182/BT	∞/NIL	∞/NIL
19	0/NIL	38/BT	40/BT	46/BT	59/BT	69/BT	78/BT	87/BT	99/BT	102/BT	122/BT	124/BT	127/BT	131/BT	146/BT	147/BT	150/BT	157/BT	174/BT	182/BT	∞/NIL	∞/NIL
20	0/NIL	38/BT	40/BT	46/BT	59/BT	69/BT	78/BT	87/BT	99/BT	102/BT	122/BT	124/BT	127/BT	131/BT	146/BT	147/BT	150/BT	157/BT	174/BT	181/BT	233/BT	∞/NIL
21	0/NIL	38/BT	40/BT	46/BT	59/BT	69/BT	78/BT	87/BT	99/BT	102/BT	122/BT	124/BT	127/BT	131/BT	146/BT	147/BT	150/BT	157/BT	174/BT	181/BT	233/BT	∞/NIL

The Floyd-Warshall algorithm serves for finding the shortest path for all the couples of vertices in the graph, by utilizing matrices[3,5,7,9]. If A_k is an $n \times n$ matrix where $A_k[i,j]$ is the shortest path from i to j which goes through nodes $\leq k$, we define:

$$A_0[i,j] = \begin{cases} 0 & \text{if } i = j \\ \text{value} & \text{from } i \text{ to } j \text{ for } i \neq j \text{ and } (i,j) \in E \\ \infty & \text{if } i \neq j \text{ and } (i,j) \notin E \end{cases}$$

We are searching for the shortest path p from i to j which goes through nodes $1 \dots k$. For path p we have two possibilities:

- p does not go through k and in this case the path stays unchangeable: $A_{k-1}[i,j]$
- p goes through k and in this case branch's value in the graph will change: $A_{k-1}[i,k] + A_{k-1}[k,j]$ [5,11]. The lowest value of the branch in the graph will be:

$$A_k[i,j] = \min(A_{k-1}[i,j], A_{k-1}[i,k] + A_{k-1}[k,j])$$

This algorithm can also be used for the graph with 21 nodes which represent routers in cities with respective branches as can be seen in Fig. 4.

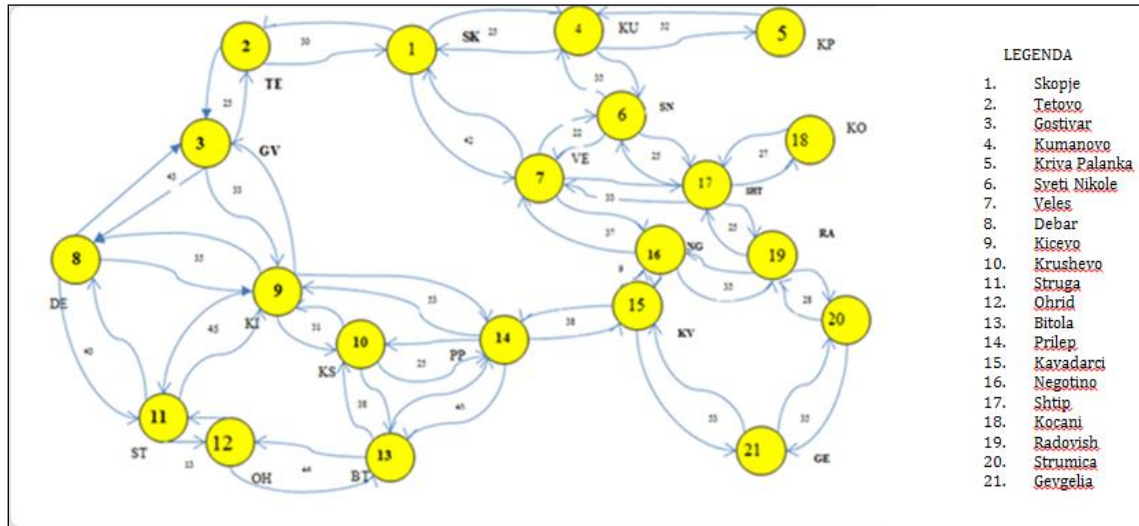


Figure 4. Graph where Floyd-Warshall algorithm is used

According to the graph, a table in form of a matrix is created. The elements of the matrix represent distance between nodes of the graph. In the case where $i=j$, the element of the matrix takes the value 0. In cases where the

link between nodes exists, this value is written as a value in the matrix element. If the link between nodes does not exist, the value of the element in the matrix is marked with the symbol ∞ .

TABLE V. THE MATRIX ACCORDING TO FLOYD-WARSHALL

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
1	0	30	∞	25	∞	∞	42	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	
2	30	0	25	55	∞	∞	72	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	
3	∞	25	0	∞	∞	∞	∞	43	45	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	
4	25	35	∞	0	52	35	67	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	
5	∞	∞	∞	52	0	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	
6	∞	∞	∞	35	∞	0	22	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	25	∞	∞	∞	
7	42	72	∞	67	∞	22	0	∞	∞	∞	∞	∞	∞	∞	∞	∞	37	33	∞	∞	∞	
8	∞	∞	43	∞	∞	∞	∞	0	35	∞	40	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	
9	∞	∞	45	∞	∞	∞	∞	35	0	31	45	∞	∞	∞	53	∞	∞	∞	∞	∞	∞	
10	∞	∞	∞	∞	∞	∞	∞	31	0	∞	∞	∞	38	25	∞	∞	∞	∞	∞	∞	∞	
11	∞	∞	∞	∞	∞	∞	∞	40	45	∞	0	13	∞	∞	∞	∞	∞	∞	∞	∞	∞	
12	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	13	0	46	∞	∞	∞	∞	∞	∞	∞	∞	
13	∞	∞	∞	∞	∞	∞	∞	∞	∞	38	∞	46	0	40	∞	∞	∞	∞	∞	∞	∞	
14	∞	∞	∞	∞	∞	∞	∞	53	25	∞	∞	40	0	38	∞	∞	∞	∞	∞	∞	∞	
15	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	38	0	9	∞	∞	∞	∞	∞	53	
16	∞	∞	∞	∞	∞	∞	37	∞	∞	∞	∞	∞	∞	∞	9	0	∞	∞	∞	35	∞	
17	∞	∞	∞	∞	∞	25	33	∞	∞	∞	∞	∞	∞	∞	∞	∞	0	27	25	∞	∞	
18	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	27	0	∞	∞	∞	
19	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	35	25	∞	0	28	∞	
20	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	28	0	35	
21	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	53	∞	∞	∞	∞	∞	35	0

After finishing the steps of the Floyd-Warshall algorithm we will have a matrix with elements which represent the shortest path between all couples of

graph nodes, respectively, i.e. the shortest path between cities which compose the WAN.

TABLEVI. THE SHORTEST PATH – FLOYD-WARSHALL

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	0	30	55	25	77	60	42	98	100	131	138	151	166	126	88	79	75	102	100	128	141
2	30	0	25	55	107	90	72	68	70	101	108	121	139	123	118	109	105	132	130	158	171
3	55	25	0	80	132	115	97	43	45	76	83	96	114	98	136	134	130	167	155	183	189
4	25	55	80	0	52	35	57	123	125	156	163	176	181	141	103	94	60	87	85	113	148
5	77	107	132	52	0	87	109	175	177	208	215	228	233	193	155	146	112	139	137	165	208
6	60	90	115	35	87	0	22	158	159	131	198	192	146	106	68	59	25	52	50	78	113
7	42	72	97	57	109	22	0	140	137	109	180	170	124	84	46	37	33	60	58	86	99
8	98	68	43	123	175	158	140	0	35	66	40	53	99	88	126	135	173	200	170	198	179
9	100	70	45	125	177	159	137	35	0	31	45	58	69	53	91	100	160	187	135	163	144
10	131	101	76	156	208	131	109	66	31	0	76	89	38	25	63	72	132	159	107	135	116
11	138	108	83	163	215	198	180	40	45	76	0	13	59	98	136	145	205	232	180	208	189
12	151	121	96	176	228	192	170	53	58	84	13	0	46	86	124	133	193	220	168	196	177
13	166	139	114	181	233	146	124	99	69	38	59	46	0	40	78	87	147	174	122	150	131
14	126	123	98	141	193	106	84	88	53	25	98	86	40	0	38	47	107	134	82	110	91
15	88	118	136	103	155	68	46	126	91	63	136	124	78	38	0	9	69	96	44	72	53
16	79	109	134	94	146	59	37	135	100	72	145	133	87	47	9	0	60	87	35	63	62
17	75	105	130	60	112	25	33	173	160	132	205	193	147	107	69	60	0	27	25	53	88
18	102	132	157	87	139	52	60	200	187	159	232	220	174	134	96	87	27	0	52	80	115
19	100	130	155	85	137	50	58	170	135	107	180	168	122	82	44	35	25	52	0	28	63
20	128	158	183	113	165	78	86	198	163	135	208	196	150	110	72	63	53	80	28	0	35
21	141	171	189	148	200	113	99	179	144	116	189	177	131	91	53	62	88	115	63	35	0

IV. CONCLUSION

The calculation of a set of parameters gives indicators which help planning and modeling WAN networks with adequate capacity and minimal cost. These include: the communication matrix for each city, the number of households, the number of network users, the total traffic for any city, the communication matrix between all cities, and the shortest path between nodes of the graph, found using respective algorithms like Dijkstra and/or Floyd-Warshall. The next step would be to estimate the traffic carried by various links in the shortest path, as well as to estimate the bandwidth required, assuming that each unit of traffic measurement (erlang) is equivalent to 64 kbps.

The rationale behind the identification and the evaluation of these parameters is very straightforward: to develop a model which will determine the exact cost of the network that performs within the limits set by the demands of prospective users, by including some socio-economic variables that capture different levels of technological development and presumably affect the values in the communication matrix, as the main concern of our future research.

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IT Jobs Market in Serbia

– a Preliminary Analysis

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Abstract – Education, research and industry are three areas that are tightly connected and influence each other. Particularly it is important in the field of information technologies, where new techniques, tools and methodologies are changing rapidly. The aim of this paper is to show the results of IT jobs market in Serbia analysis. A preliminary analysis is related to a small sample of jobs related to a single city – Novi Sad. In the analysis, data are captured from several job-offering web sites. The analysis is presented by using statistical and descriptive approach. Conclusions are related to overall results comments and future resarch guidelines.

I. INTRODUCTION

Quality of human resouces (HR) is one of key factors that influence quality of products and services [1]. Research, Education and Industry are three sectors that are tightly related and their close cooperation brings development in each of them. Each education institution goals must be adequate to research results and industry needs. Information technologies (IT) working area is particularly critical for its rapid development of new tools and methodologies and the need of human resources to keep up with knowledge and skills required in industry.

HR management includes activities [1] such as strategy and planning, recruitment, selection, success monitoring, motivation and awards, education, professional development of human resources. The model of human resources management information system, particularly dedicated to IT professionals, is presented in [2]. Such systems are partially supported within professional associations, such as Association of Computing Machinery - ACM [3] or United Informatics Asociation of Serbia - JISA [4]. Part of the proposed functionality [2] was developed as specific web applications - professional social networks, such as LinkedIn [5].

Aim of this paper is to show results of analysis of IT jobs market in Serbia, but only with small sample of data, taken from job-offering websites. This way, a preliminary analysis is performed, statistics and description of current state is presented and some basic conclusions are drawn. These results could be a starting point to more broader

analysis that could include more web sites and all towns/cities in Serbia, to have a more complete results.

II. RESEARCH METHODOLOGY

Research methodology is based on several research activities:

A. Definition of research goal and questions

Research goal is: »To determine current state of IT jobs market in Serbia within a small data sample«

Research questions are:

- What is the role of IT jobs in overall jobs market?
- What types of IT jobs are offered on the market?
- Which knowledge and skills are required for the specified jobs?

B. Data collection methods

The starting point was to identify data sources for the analysis. As a data source, we choose job-offering web sites.

TABLE I. JOB OFFER SEARCH FOR NOVI SAD – WEB SITES

http://serbia.xpatjobs.com/Jobs-In-Nov-Sad/151
http://poslovi.infostud.com/oglasia-za-posao#page=1&city[]=2&per_page=30
http://www.lakodoposla.com/index.php?mod=search&search=1&advanced=1&use_advanced_search=0&quick_search=1&radio_title_description=2&job_title_description=Novi+Sad&employer=-1&order=
http://www.poslovi.rs/index.php?hiddenSearch=1&cityListHdn=141&citySingle=true&cityList=%22Novi%20Sad%22
http://www.nsz.gov.rs/live/trazite-posao/svi-poslovi
http://www.nadjiposao.rs/search/?q=&l=Novi+Sad

- Selection of websites - we selected six job-offering websites ([6], [7], [8], [9], [10], [11]) and all websites were visited on 25th August 2013. We selected these websites, since web addresses of these websites were listed as first ones at Google web search engine. This means that they are most visited web sites for this search inquiry.

- Keywords in filtering – all of these job-offering websites have filters related to Town/city name and job category. For all websites keyword for Town/city was »Novi Sad«. We selected this city as one of fastest developing cities in Serbia. We performed two filtering: 1. all jobs (non-IT and IT) in Novi Sad; 2. IT jobs in Novi Sad.

C. Data collection

For each website all filtering results are presented at the specified website.

- For the first filter related to all jobs (IT and non-IT) in Novi Sad, each occurrence of job offer is counted and each work position name is registered.
- For second filter related to IT jobs in Novi Sad, each occurrence of job offer is registered with data related to name of work position, level of proficiency required and details related to knowledge and skills required for the work position.

D. Results and statistics

According to research questions, appropriate results and statistics are presented in graphical and descriptive approach:

- What is the role of IT jobs in overall jobs market? – Graph presenting total number of jobs in IT and non-IT sector.
- What types of IT jobs are offered on the market? – Graph presenting types of IT jobs on the market and total number of jobs offered within the specified type.
- Which knowledge and skills are required for the specified jobs? - Description of knowledge and skills required for particular types of job-offers.

III. RESULTS

Results of this research will be presented according to research questions that are previously defined.

A. What is the role of IT jobs in overall jobs market?

For all of six websites related to all job offers in the city of Novi Sad, Serbia, it has been shown that 41% of all job offers are related to IT jobs, as presented at Figure 1.

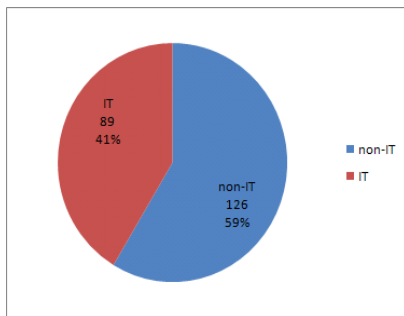


Figure 1. Number of IT and non-IT job offers for Novi Sad

Number of Non-IT job offers, by category is presented at Figure 2. and Table 2. It is obvious that categories of Sales is the most required, secondly these are technicians, while Finance and Laboratory/Health category are equally at third ranked.

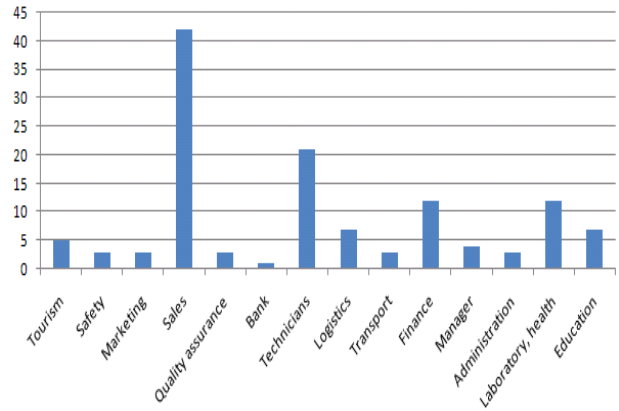


Figure 2. Number of Non-IT job offers in Novi Sad

TABLE II. NUMBER OF JOB OFFERS BY NON-IT CATEGORY

Non-IT category	Number of job offers	Non-IT category	Number of job offers
Tourism	5	Logistics	7
Safety	3	Transport	3
Marketing	3	Finance	12
Sales	42	Manager	4
Quality assurance	3	Administration	3
Bank	1	Laboratory, health	12
Technicians	21	Education	7

B. What types of IT jobs are offered on the market?

All job offers are categorized in eleven categories, as presented at Figure 3 and Table 3. It is obvious that the most offered job is in Java development, while secondly offered are PHP development and »Other«. Third ranked is system administration.

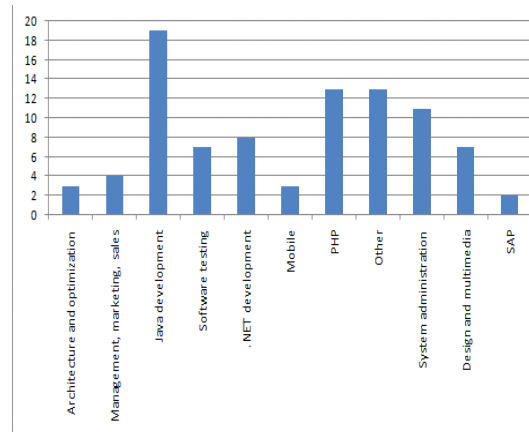


Figure 3. Number of IT job offers in Novi Sad by category

TABLE III. NUMBER OF IT JOB OFFERS BY CATEGORY

IT job offer category	Number of job offers
Architecture and optimization	3
Management, marketing, sales	4
Java development	19
Software testing	7
.NET development	8
Mobile	3
PHP	13
Other	13
System administration	11
Design and multimedia	7
SAP	2

Particular IT job category include job offers for positions:

- Architecture and optimization: Conversion optimization specialist, Product specialist, Search Engine Optimization Analyst
- Management, marketing, sales: IT manager, Sales manager for software sales, Sales engineer and customer support officer
- Java development include: Java Web developer, Java Junior Developer, Java Senior Developer, Junior/Senior Java developer, Java Developer, Java Architect
- Software testing: Java tester, Senior QA engineer / lead, Senior Test Developer
- .NET development: NET software developer, Junior/ Senior C/ASP.NET developer, Web programmer in VB.NET, C# programmer, NET programmer with experience
- Mobile: Web/ iPhohne/ Android Developer, iOS developer, Android programmer
- PHP: PHP developer / programmer, PHP programmer / web designer, Intermediate PHP developer, Senior PHP developer, PHP OOP programer, Front-end PHP/ MySQL programmer, Back-end PHP/MySQL programmer, PHP developer with webmaster skills
- Other: Senior Developer, Junior C developer, Junior Software Developer, Software engineer, Software developer, Front end developer, JAVA/ ASP.NET/ C# programer, Web programer, Junior Web developer, Ruby-on-rails programer, web master, Web designer
- System administration: Junior Computer Technician, System Administrator, Coordinator for system monitoring, Service technician for technical equipment, Computer network technician

- Design and multimedia: Adobe Flex / Action script developer, Web designer, C++/Unrealscript video game programmer, Graphical designer, 3D studio designer, Flash programmer, Streaming media application developer
- SAP: ABAP programmer, Coordinator of SAP center

C. Which knowledge and skills are required for the specified jobs?

In the names of job offer positions, there is variety of »knowledge level« prefixes, such as junior, senior etc. Figure 4. shows graph with »knowledge level« prefixes appearance in job offer positions. Obviously, most of job offers did not specify prefix such as junior or senior, but only a work position name. Equally are offered junior and senior knowledge level positions.

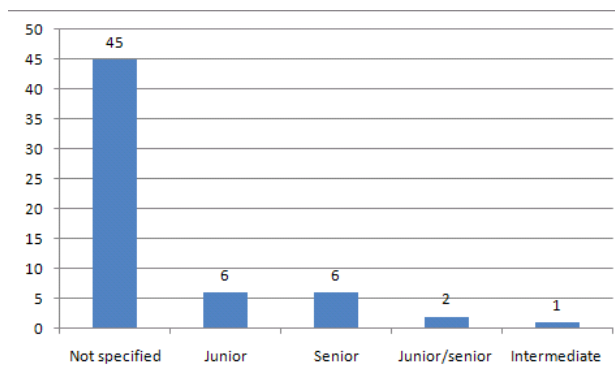


Figure 4. Number of knowledge level prefixes in job offer positions

TABLE IV. NUMBER OF KNOWLEDGE LEVEL PREFIXES IN JOB OFFERS

Knowledge level prefix in job offer position	Number of prefix occurence
Not specified	45
Junior	6
Senior	6
Junior/senior	2
Intermediate	1

General requirements for all IT job positions mostly include:

- Formal education - university degree in Computer Science or related studies
- Experience – of at least one to four years in professional experience in projects with using particular technologies
- Spoken languages - fluency in English language, other language (such as German, Italian...)
- Driving licence

- Personality (Soft skills) - Communicative and pro-active person; Ability to meet deadlines when it is necessary; Self organized and motivated person; Good interpersonal and communication skills; Ability to quickly adapt and learn new technologies; Communication and client facing skills; Ability to create specifications; ability to work to standard specifications; Ability to multitask and contribute to multiple projects; Ability work both as a part of a team and individually; Ability to work in an international team with international customers; Enthusiastic and independent; Open minded and pragmatic; Solution oriented attitude.
- Family conditions - open to travel on business trips.

Some of job offering include mandatory requirements related to professional certificates – Microsoft (MCTS, MCAD or MCSA), Cisco (CCNA, CCNP), PMI (Project management Institute) certificate and others...

Particular knowledge and skills related to IT technologies in some job offering requirements for some job-offerings include:

- Programming languages - Perl, C, C++, C#, Java, DELPHI/Pascal, LISP, Prolog, Python, Perl, PHP, Ruby
- Java - J2EE, HTML/SCC and Java Script, Java Enterprise Solutions, J2SE, Java web framework (JSP, Spring MVC, Struts2, Spring, Hibernate, Jasper), EJB, Java 1.6, JSP, JavaScript, JDBC,
- Architecture - OOP, SOAP, SOA, EAI, BPM, ECM (Enterprise Content Management), Document Management, UML, Design patterns
- Business analyst solutions - BPM and Workflow Management, OLAP, Oracle AS/BEA Weblogic, JBoss, IBM Websphere, MS SQL Server Reporting services, SharePoint Business Intelligence,
- Document management - IBM Maximo, EMC Documentum, Alfresco, FileNet
- Software testing - different test types (functional test, load test, stress test, regression test, etc.); business-driven, risk-based methodology (TMap Next); automated unit testing
- Databases -RDBMS and SQL (MySQL, Oracle, MS SQL server, MS Access, PostgreSQL), NoSQL
- .NET - WCF, MVC 3/4
- PHP – Open Source PHP frameworks (Symfony2, Zend)
- Web technologies – HTML4/5, CSS2/3, JavaScripts, XML technologies - XSD, XSLT, WSDL, Web Services, JQuery, Ajax, HTTP protocol, JSON file format, Adobe AIR, Web Forms, xHTML, Web Parts
- Application Server –Apache Tomcat, ...
- CMS systems - Typo3, Joomla, webEdition, Drupal, XTCommerce, Wordpress
- Development tools – Eclipse, Ant, SVN, Maven
- Operating system skills – Linux, Unix, Windows
- Development methodology - Agile Software Development, Test Driven Development, SCRUM framework
- Internet marketing - Google AddWords, MSN add center, Yahoo search marketing
- Design and multimedia – Adobe Photoshop, Corel, InDesign, Adobe Illustrator, Skechup, graphics APIs (DirectX & OpenGL-ES)
- Mobile - Android, iOS (iPhone/iPad), Objective-C, jQuery Mobile, HTML5 Codeigniter Flash/AS3, BlackBerry, Windows phone 7, Cocoa/Cocoa Touch Frameworks
- System administration - Active Directory, TCP/IP, mail, DNS, DHCP, virtualization technology (Vmware), Cisco IP telephony, scripting languages, Cisco networking (switching and routing), Citrix NetScaler (Access Gateway), Citrix Cloud Gateway (app controller, StoreFront), Citrix Merchandising Server, Citrix Branch Repeater, Storage DataCore, FC SAN networking, Mac OS X environment and Xcode development tools, Juniper or Arista network devices, RAID subsystems, and various hardware storage subsystems like Fiber-Channel, iSCSI, and various NAS protocols
- Source code versioning systems (Git, Perforce, Mercurial, SVN, CVS), Team Foundation Server, Application Lifecycle Management (ALM)
- Maps – LeafletJS, Open Street Map
- Additional languages/tools - Haskell, Shell, Maven, Alfresco, Liferay, JUnit, Selenium, Actionscript, Smarty, AngularJS, Mantis.

IV. CONCLUSIONS

Higher education institutions' primary goal is to enable development students knowledge and skills according to the needs of their future profession. Each higher education needs to adapt their curriculum according to the research results and industry standards and tools, according to the industry requirements. This is the main motivation of this paper.

This paper presents results of a limited data set preliminary analysis in IT jobs market in Serbia. This limitation of this research is related to number of websites used in data collection (six most visited job-offering websites) and in focus to only one city in Serbia. Therefore, this research is named »preliminary«.

One of the problems that this research was faced with is duplication of data in different websites. This duplication appears when one company submits one post

about job offer to many websites. This duplication is avoided in this research, i.e. duplicates are found and did not influence the overall statistics.

Future research could include broader set of web sites and towns/cities in Serbia to collect data from. This way, more complete research and results would be possible to present.

Contribution of this research could be in a short overview of the general job market in Novi Sad, analysis of IT jobs categories and statistics related to Novi Sad as well as in description of requirements in job offering. This way, a simple guidance to career development could be given to future IT students (i.e. high school pupils) and students of IT. These results could also be a basis for curriculum adaptation to the needs of IT industry in higher education.

Future brings new IT professions and their demands for knowledge and skills. Educational institutions need to adapt their curriculums and courses according to industry needs and future IT trends.

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Decision Making on Using Internet for WAN Platform: the Case of State-Owned Banks in Countries in Transition

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Abstract - The paper aims to support a decision - making process in respect to introduction of VPN technology as a „core“ WAN network platform in the banking industry in countries in transition. The results provided by this paper confirmed the hypothesis that the Internet as an alternative to the „core“ WAN for state banks in countries in transition is not only feasible, but it is the best alternative, thus maintaining safety and quality of services and significant cost savings. This research directly refers to the banks with state capital in countries in transition, which are reducing in numbers and are exposed to growing competition of foreign banks, as well as to all commercial banks in need of business cost savings.

I. INTRODUCTION

The introduction of the Internet as an alternative to „core“ WAN platform in a bank might sound very tempting, especially because of the price. The Internet, as a global network, has experienced the largest increase in comparison to all other forms of connectivity. When we speak about the „core“ WAN system, we think of a data communication system that connects the bank and its remote branches and offices. This system must be highly reliable, available and scalable as it brings into question the functioning of the bank, especially in cases of online applications with star topology.

A. The research topic

The two „legacy“ WAN technologies that are used today mostly in „core“ WAN system of banks (Leased Line and Frame Relay) are considered together in business case with a newer technology which is based on an Open VPN - based Internet connection. A special emphasis is given on the cost benefit analysis, where the results can be displayed in financial terms, which is best understood at the bank's management level.

We have used a business case, linked to the project that was supposed to be completed in early 2010, which included the joining of the two Bosnian banks (with the state capital), Privredna banka Sarajevo and Una bank Bihać under temporary administration. Three completely different WAN technologies will be used for comparison in this analysis, as typical representatives of these WAN technologies.

Privredna banka Sarajevo (hereafter referred as: the PBS) operates across the country with eight branches

(Sarajevo, Bugojno, Tešanj, Maglaj, Zenica, Mostar, Brčko, Goražde) and seven offices (Jajce, Donji Vakuf, Gornji Vakuf, Jelah, Jablanica, Konjic, Rahić). In early 2010 Una bank Bihać announced a public call for recapitalization or merger, or sale of bank assets with repurchase of obligations, to which PBS applied. PBS's offer was the most favorable and the procedure of merging Una bank Bihać and PBS started. In addition to all legal and economic activities, there were a lot of technical issues related to linking the two banks into one integrated and centralized system, especially in regards the WAN platforms.

Namely, the current WAN PBS is based on POTS (plain old telephone service) network, or dialup connection via modem, with a theoretical speed of 56 kbps. Furthermore, the data are not updated in the head office, but the same data are entered several times (in the branches and a head office), which is not the online system, but „end of day“, or a system of entering data when it is needed. Such an outdated network system is very inefficient and can cause various problems, and some of them are that the data are not current any more. Because of the need of entering one particular peice of data many times, there is a big possibility of making errors due to human factor. This would create even greater cohesion, if, for example, ten more branches of Una bank Bihać joined the system. This situation leads to the need for automated „online“ WAN centralized system.

The main goal of this study consists of collecting, presenting, comparative analysis and systematization of current scientific knowledge in the field of WAN technologies available to the banks in countries in transition for the connection, especially those in relation to the Internet, that is „IP technologies“, potential as the WAN technologies for use in the so called „core“ WAN networks of banks, considering that the application of these technologies for the creation of a basic network platform („core“ network) of banks in countries in transition is very small, and that this technologies can achieve substantial cost savings.

Starting from the problem and research objectives, the following research hypothesis has been identified:

H1. Using the Internet in order to create primary WAN networking platforms („core“ network) of banks in

countries in transition is feasible as in the case with „legacy“ WAN technologies such as Leased Line and Frame Relay, thus maintaining safety and quality of service and significant cost savings.

The research methods that will be used in order to confirm the hypothesis will be the following:

- Experimental analysis in investigating the WAN performances
- Cost benefit analysis
- Case method, a business case of merging a state - owned bank with its branches.

II. METHODOLOGY

A. Cost Benefit analysis

Cost benefit analysis in this paper is one of the main methods for the research, especially for testing the paper hypotheses, through the analysis of alternatives within a particular business case of inducing a new WAN system into bank. The methods which are included into the cost benefit analysis, and used in the study are:

- Payback Analysis
- Net Present Value (NPV)
- Return of investment (ROI)

All analysis results were then used for comparison of alternatives in the matrix of the feasibility study. In order to apply the cost benefit analysis, it was necessary to perform an experiment over all three alternatives in order to investigate the optimum performance of the WAN. After this experiment, the results will be utilized in order to define the project costs in case of all three alternatives, which is a prerequisite for a cost benefit analysis.

B. The experiment to study the optimal WAN performance

As already noted, before using the cost benefit analysis, there is a need to examine the speed at which the WAN link will be optimal. Then the results of these experiments will be used to define the costs and benefits in cost benefit analysis. This experiment will be carried out on all three alternatives in the business case and will be used to compare them, in regard to technical aspect of the feasibility study.

This experiment will be linked to the simulation through academic simulator „OPNET IT Guru“. Through several different scenarios, each network WAN option will be tested, based on a given business case for data exchange and telephony (VoIP) between the PBS head office in Sarajevo and all its branches and offices across the country (16 offices and 9 branches).

Option 1 would have a scenario called „Leased_Line“, option 2 „Frame_Relay“ and option 3 „VPN“.

Considering that the academic version of this simulator is limited to a maximum of 20 nodes, or routers or firewalls, and since this case includes 26 business units (16 offices, 9 branches and one central bank), plus an additional central bank in alternative 3 should have a firewall as well, what we count as a single node, the

simulation will first have to take a lower number of business units, primarily because of the main objective of the experiment (which is a comparison of performances). After that we shall mathematically calculate it with the increased number of users (belonging to the omitted business branch units), and determine whether it is technically feasible in reality to connect all business units that are in that business case, at a specific alternative.

The simulator will take nine connected business units that is eight branches across the country with the central office in Sarajevo, because the branches are the essential part of the network, offices consume significantly less traffic. The simulation will take 10 simulated minutes of work in the network, which is sufficient to simulate all the services. As for the services that will be used in the simulation of „core“ WAN, it will be a database access, file transfer (FTP), telnet and VoIP (G.729 codec). The simulation will be assigned in duration with 638 seconds, which is the maximum time allowed for this case, but there will be enough time to see the performance of the network.

C. Experiment of the Alternative 3 - connection between two distant points with a dynamic IP address on the client's side

The need for such an experiment is based on information published in the literature relating to Open VPN connection, and namely that the Open VPN connection is feasible in the case of dynamic IP address. The results of this experiment should in practice test whether it is feasible or not, in the case of BH Telecom provider. These results are very important in cost benefit analysis which follows, because the result greatly change the future cost of the project (the ADSL connection with dynamic IP addresses – one item per month for approximately 25€ and, ADSL connections with similar performance, only with a fixed / public IP address approximately 100€).

In the focus of this experiment there will be, in addition to the speed of service, above all, the network availability because it is a dynamic IP address on one side, and we are primarily interested in how many times Bihnet provider changes the IP address within 24 hours, and what is more important, how long will it take that the connections will decline (VPN tunnels), or how long it will take until it forms a new tunnel with a changed IP address on the remote branch in the case of Open VPN tunnel. This is very important for this business case in the study, because it is the real time application (terminal) for connecting branches and the central bank that does not suffer from considerable delays and connection declines, and VoIP as well. So in this case what is more important is the availability and reliability of the network service itself, but the speed of it. This means that in this phase of experiment, the first thing we will take into consideration is the availability of testing services, while in the phase of the experiment related to OPNET simulator, we will examine other factors of the Internet service quality.

Experiment lasted four weeks, and we constantly tested the availability of services and then the speed and accuracy through a network tool named „ping“, from one workstation at the location where the server is situated,

(central bank). Therefore, two batch files were created, one for testing of all these factors, and the other one for testing IP address changes. Batch file for testing these factors, called „testping.bat“ looks like this:

```
@echo off
date /T >>testunaping.txt
time /T >>testunaping.txt
ping 193.0.12.10 -n 1000 >>testunaping.txt
date /T >>testunaping.txt
time /T >>testunaping.txt
```

At the beginning of the test we can see that in the created TXT file „testunaping“ it is entered: the current date and time of the beginning of the test, then the test of speed is what follows with a network tool „ping“, and also accuracy and availability of the service, in a manner that it was sent a sample of 1000 IP packets to the remote computer (in this case the computer 193.0.12.10 – remote VPN gateway in the branch) that should be returned to the sender through the VPN tunnel, and after that the results have to be filed in testunaping.txt. The reason for this large number of sent packets is precisely because it is favorable to take a larger sample to test, in order to identify errors more easily, or the decline of the connection. At the end of the test the date and time of the end of the test are filed.

III. RESULTS

A. Results of the experiment of the alternative number 1

Based on the results of the simulation of a leased line, for a particular business case, a minimum speed of 128 Kbps is appropriate, in which case we have as slightly better performance than at 256 Kbps speed of VPN connection.

B. Results of the experiment of the alternative number 2

Based on the results of simulation, CIR (committed information rate) with a 128 Kbps in Frame Relay network is optimal for this business case. As might be expected, performances in the case of Frame Relay are somewhere in between, something better than a VPN and a little less good than leased lines, although we can approve a very good performance in all three cases.

C. Results of the experiment of the alternative number 3

Based on the results of the simulation for optimal speed link at the alternative number 3, we received: The most optimal speed links for a given business case, are:

- for branches and offices ADSL link (1024/256 Kbps)
- for the central bank DSL link (2 Mbps).

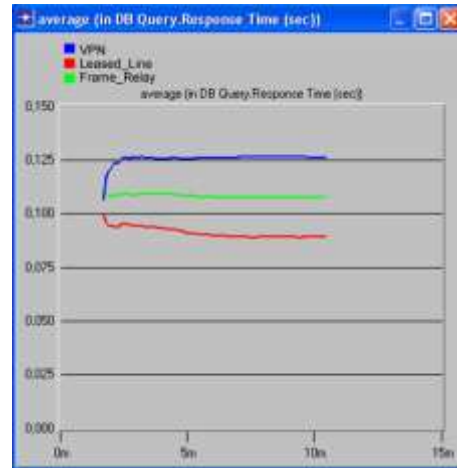


Figure 1. Comparison of the response time of queries to the database

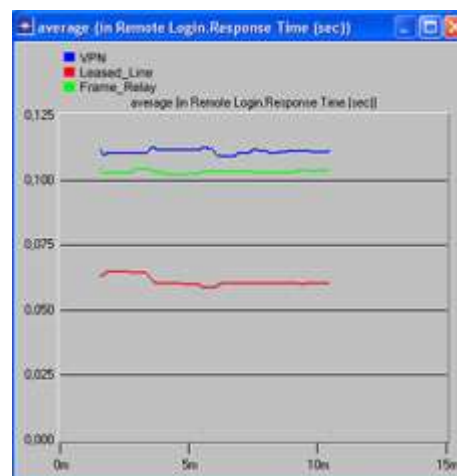


Figure 2. Comparison of response time when login to the server (Telnet)

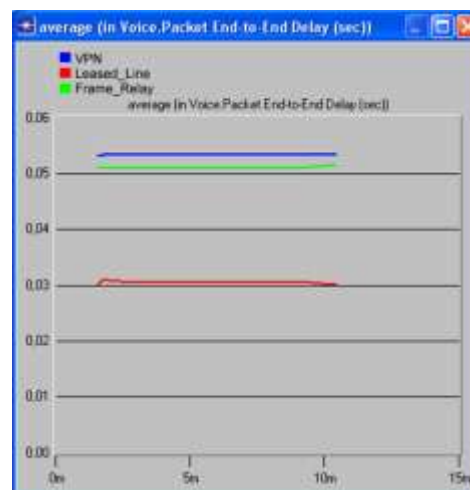


Figure 3. Comparison of time delay in the transmission of voice from end to end

As you can see from the pictures, all three alternatives of a given business case were compared, during the connection to the database server, the application server and VoIP. The results were expected, the „leased line“ alternative has the best performances of all, than Frame Relay and after that VPN too, although it should be noted

that in all three cases a very good performances (for example, response time to query in the database does not go over 0,125 seconds, and up to about 5 seconds is taken as desired).

D. Results of the experiment of the alternative number 3 – connection between two distant positions with a dynamic IP address on the client's side

In this experiment with a dynamic IP address on the client's side, it has been found that the WAN IP address changes every 12 hours, and also that the WAN IP address's period of changing varies every week. Also, due to these changes of the IP addresses the WAN connection (tunnel) is offline up to 10 minutes which is not suitable for this business case, or for the communication between central bank and its branches. So, on the basis of these results, it is suggested to take the Internet connection with a static/public WAN IP address on the client's and on the server's side.

E. Results of the Cost benefit analysis

Feasibility Criteria	Leased line	Frame Relay	Open VPN
Operational Feasibility	Score: 100	Score: 90	Score: 90
Technical Feasibility	Score: 100	Score: 90	Score: 90
Economic Feasibility			
Startup costs	247 450 KM	431 473,60 KM	424 802,70 KM
Payback period	6,07 year	1,86 year	1,32 year
NPV	22533	803986	1250628
ROI	65%	37%	503%
	Score: 2	Score: 64	Score: 100
Schedule Feasibility	130 days	175 days	183 days
An assessment of how long the solution will take to design and implement.	Score: 100	Score: 90	Score: 85
Total score	302	334	345

Figure 4. Comparing alternatives with a matrix of the feasibility study

Scores for the economic feasibility (cost benefit analysis) is derived on the basis of the classical calculation, with the rank scores from 1 to 100, the NPV (net present value) is taken in calculating as one of the most important factors in economic analysis, and then we have the following situation:

$$(22533/1250628) \times 100 = 1,8 \approx 2$$

$$(803986/1250628) \times 100 = 64$$

$$(1250628/1250628) \times 100 = 100$$

IV. CONCLUSION

Since all the results of the experiment are positive, and they support the implementation of the „core“ WAN network through the Internet (both speed and accuracy), we can recommend this alternative through the Internet, but only with a static / public WAN IP address on the client's and on the server's side. This is more expensive option but it guarantees better reliability and a constant connection without disruption, and yet it is much cheaper and quicker option than leased line connections for the same case.

Finally, the total sum of an alternative derivation in matrix in the Feasibility Study is as following: Leased line alternative: 302, Frame Relay alternative: 334, and Open VPN alternatives: 345, which leads to the conclusion and

recommendations in the business case that the best solution is the introduction of a new communication system and that the preferred alternative is Open VPN Internet connection, that is alternative number 3. Therefore, all these research results can prove the hypothesis that the Internet as an alternative to the „core“ WAN network for state banks in transition countries is not only feasible, but it is the best alternative, with maintaining safety and quality of service and significant cost savings.

Open VPN connection with its performance and reliability is almost equal with two other alternatives, but the charge is much lower. What is more, it is preferable to create secure tunnels between the server and the client's side at Frame Relay alternative too, which in terms of implementation is not so much simpler option than Open VPN. Also, Open VPN alternative is the most flexible concerning the changes within the WAN network in the future, related to the expansion or re-engineering, where it is much easier to exclude or add a location, or to connect to the Extranet with another organization. This is especially important because of the all present growing trend of merging the banks.

We can also conclude that there is no single solution for different organizations and different business cases, every major project should be preceded by cost benefit analysis which, based on preliminary studies should answer whether to go into the project or not, and which alternative is the best one for that particular case.

Considering that the academic version of the OPNET simulator is limited to a maximum of 20 nodes, that is routers or firewalls, we faced certain limits to create a simulation for an entire and complete business case, and although we do not believe that the results differ a lot than these (mathematically calculated for a part of simulation which was missing), it would be interesting to see a simulation for the entire WAN system.

The second recommendation in an attempt of decreasing a unavailability of Open VPN connection of about 10 minutes through dynamic dns (domain name system) service, would be creation of one's own dyndns service and then to repeat the experiment with a dynamic IP address on the client's side. What is important here to say is that one possible reason why the unavailability of connection is too long is not Internet provider's error, but because of the fact that Open VPN gateway is not updating regularly the new IP address, or because dynamic dns service does not publish a new IP address quickly enough. Although the goal was to examine the feasibility of a case of dynamic IP address with the standard dynamic dns service which is available to everyone, we could try to execute the same experiment with own dynamic dns service, because in the case of technical feasibility of dynamic IP addresses on the side of branches there would be even more significant advantage in the sense of cost benefit analysis for the Open VPN connection.

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Flow indicator broadcasting time TV show - as a mandatory part of the digital television

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Abstract - Watching television is a great obsession of millions of people around the world. A huge number of TV channels creates a huge dilemma when and what to watch or listen to. Choosing randomly selected channels largely depend on whether the beginning, middle or end of broadcast video that the viewer wants to watch. The proposed flow indicator airtime will enable television viewers-consumers easier and more convenient selection of the proposed program content in a given period of immediate moment digital information is a necessary part of a package of digital information that may be available to viewers.

I. INTRODUCTION

The term TV Information As with all other information includes data on the outcome of an event is about to happen or has already taken place, but the outcome was not known. Information, thus removing uncertainty. Information is a process and an activity of communication and interactivity between the donor and recipient information. Inform means to transfer knowledge-information to someone. Seeking information we actually satisfy his personal need for specific information complement their knowledge of an event or process. Everything that happens around us has a time component as a dynamic variable to which we have no influence in terms of adjustments but you can define other variables to it. Time factor has always been and will be dominant component of life for all people, and as such is of particular importance to our events and processes taking place in a controlled and regulated limited time.

Information is measurable, and is directly related to the probability of occurrence of the event which informs us. So we say that the notice carries a greater amount of information, if it is less likelihood of an event about which we are informed. Weather information in a relative sense (past and future times) is also essential for everyone participant in the TV-presentation of a game that redefines intervals in the viewing time and the time of receiving information through the information desk - TV.

This kind of communication is the exchange of information about the above all the time position of multimedia events that are happening and it is going through the process of sending and receiving messages.. However, the unlimited possibilities of interactive communication and rapid flow of information led to the saturation of media irrelevant information. Today, more than ever, it is important to identify reliable sources of information. In a world of modern technology and fast communication-timely information is invaluable. Instant access to important information can be critical to making

important decisions. In this case, it is our decision what we will and when you continue to look at our big screen - information desk. What is the offer of programs and channels more, the choice is difficult and ambiguous. The introduction of digital television user can easily obtain information on the display callback flow, because it is located in a package of digital information that brings along with the video file synchronization components. Extract information on the length of the file and information about the currently processed amount of information obtained qualitative data that provides information to potential viewers - the consumer of time dimension-the length of time (past and future) selected TV content.

Some of the general properties of information are:

- timeliness and topicality - temporal dimensions of information;
- timing means that information is available when it's needed, and the current contents of the gang;
- topicality of information is determined by reference to the time when the data was created
- relevance - matching information with the user's needs; accuracy, precision and reliability.

According to the most general division distinguish between two types of information:

- objective information
- subjective information

a reflection of individual consciousness of objective information.

Different types of information can be classified into four main groups:

- sound information;
- fixed and moving image;
- telemetry and remote signaling and data.

Seen from the point of view of all these divisions our temporal ruler as a pointer elapsed time of a broadcast TV content over the duration of that content is timely, current, accurate, objective signaling information.

II. INDICATOR INFORMATION ON TV

Television from its inception has experienced a number of technical and technological innovations and upgrading. The idea remains the same, image and sound make available to each viewer a world that has passed, that happens or will happen, this idea is now upgraded interactivity and active participation of the viewer in the program scenes happenings virtual or actual reality.

At the beginning, television has been available on several TV channels and program is a simple viewer. We watched the first and second black-and-white PROG and appear forward to the third channel of the rendered image in color. We knew then memorized the program schedule and schedule. Later there was a social deregulation in the area of television and this led to the first private television channels that have proliferated accelerator speed. One minute the nineties of the last century, the TV were a hundred channels (local, regional and national). The market of multimedia content has become aggressively competitive and it is best reflected in television. They flooded our movies, series, dramas, travelogues and research programs. Information program has become closer to the reality and truth. In all of content and quality have emerged dynamically and temporally very aggressive marketing promotion marketing in the form of advertisements that are temporally speaking, occupying more and more space in the program schedule of both local and national ones - state television.

Technologically speaking slowly but surely we have moved from the roof antenna and antenna systems common to cable television, which i brought along with high quality pictures and tons of software packages that are themselves contained by the dozen to hundreds of TV channels.

The viewer or the ultimate consumer how you look at it trading company grew steadily confused in order to find a quality and comprehensive program who will watch alone from start to finish, whether it be on the news programs, movies or documentary programs - shows. Program schedules are published in the media and on the television or tv text system through advertising program announcement for the next day or week. Many televisions today broadcast short news impact on the ticker which is in the top or bottom of the screen in an assembly line of text on the background of bright contrasting colors. Some TV stations broadcast information about the name of the show or movie that appears when you change the program or in the initial part of the time when we are on the specific channel.

The amount of information that is the ultimate user-consumer received grew steadily larger. Watching television for their content and multi callback propagation achieve obsession and even addictive to many that it was the only turnout in an increasingly complex world of reality and the imagination.

Announced timing issue inevitably has never been so synchronized and accurate for the simple reason that the television in your content and have dynamic undefined emergency facilities that were to be incorporated into daily programming broadcasting schemes.

The viewer - consumer television was suddenly faced with the problem of when and what to watch? Before him was a hundred TV channels from different time concentrated program content. For example almost all television broadcast movies, drama series or late in the evening. What do you see when you have missed the beginnings of advertising announced? Do you take your remote and start frantically search TV channels in order to find target content. Find yourself at the same time a dozen

channels that broadcast movies for example, what to see? Choose genre but there is a problem? Some movie at the beginning and one towards the end of which one to choose?

The issue is that television does not currently offer a precise answer.

This paper provides an answer to this question.

This small but lacking technical information-visual detail miserable to many viewers in their personalized search for quality content from selected themes and genres. This question may be in terms of technology was problematic when the program is broadcast with analog system-tape. Today, it is extremely simple technology to screen our window to the world-TVs get information how many percent have passed since the first issue and how many minutes are there until the end of the broadcast content since the play multimedia files from your computer that contain information on the length of the seconds and the calculated percentage of broadcasting.

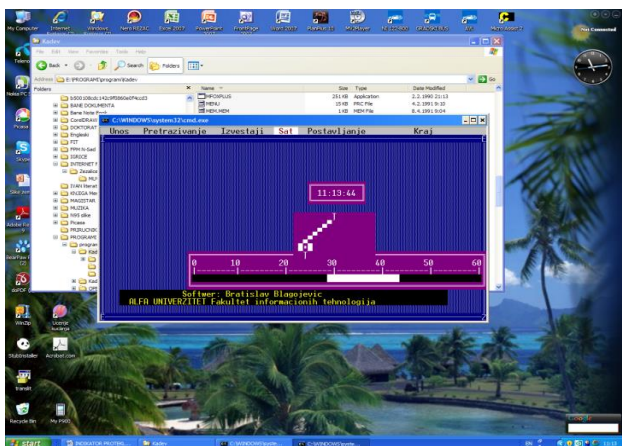
Such information could be viewers in the decision-making process to decide what to watch any time knowing how missed sequences in relation to the contents of which he offered to the other channels.

This visual and clear information about the time that has elapsed since the first issue of specific content - that percentage is called in the jargon of the time a meter ruler and the author of this article believes that it is completely customizable name a useful visual component emitted CONTENT.

Indicator can be displayed on the TV screen in various forms in analog or digital form, time clock, which runs from 0 to 100 or 0 minutes as Real-XXX is the broadcast content. At this point the computer is bold colored line that grows in one direction (usually right) showing how percentage is emitted or how percentage still have the broadcast or a handle (download, upload, unzip, storage, etc.). The picture above is shown on the screen where the bottom see Time ruler that shows how much the broadcasting of multimedia content.

Of course this information creates certain problems for the owners of private television viewers will be in a random search well as to identify TV channels give the channel where current results says Time Resource broadcast certain content but this is only apparent, statistically speaking, all participants have equal chances and opportunities as the percentage of certain television viewership. In the previous resembles the Time ruler shows analog and digital clock in a computer application that did the author of this work.

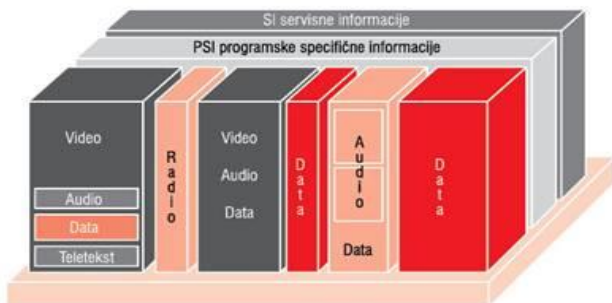
From all the above, I suggest that the Republic Broadcasting Agency adopted Ordinance and commit all TV broadcasters are required to broadcast the time meter - indicators that can be show in different forms (as analog or digital clock) as a vertical or horizontal display . This should particularly be applied in every new digital television that has a digital package allow extract the part of the information that defines the length and current spending.



Picture 1. Software generated time ruler

This obligation requires certain technical visually adjustments for each TV broadcaster so in this regard should be given a specific time (the author suggests a period of three months) to technical implementation the system of TV images.

In addition to information about the elapsed time of broadcast content can be precisely defined terms of broadcasting advertising and marketing content and in this respect it would be interesting to define a specific color intervals of time will cease to be the main content and broadcast advertising. In this way the viewer as an end user would be absolutely protected from the sudden interruption of broadcasting and undefined main content With the ability to plan useful when interruptions occur or broadcasting content that he does not want to watch.



Picture 2. DVB paket

Watcher which was the reason for their intended program of personalization and interactivity to be statistically non-defined approach to viewing the program, have the information on real- time broadcast on state media content and, in this sense, and this should be considered an innovation that is presented in this paper .

Note that is easy to conclude that the idea that led to the design of the second generation DVB standard is largely based on the development of the Internet and the standards

that are oriented toward it. It is supported by the generic encapsulation. On the other hand, IPTV, slowly but surely, it enters our homes. DVB is still at the beginning of a commitment to multi-media, and all have led to a new vision of digital television.

From the perspective of encapsulated information and data that bears DVB package is easily attainable proposed broadcasting time sequence that describes the flow of video at a time that can be visualized in the time ruler is proposed in this paper.

Finally, this complex network structure contains a very simple system with a common core based on IP technology. It brings the ability to use a set-top box device (STB) for different mediums. We are also very close to achieving the dream of home multimedia environment in which the concept of television is no different from their own multimedia resources, which makes it possible to have a lesson on the TV on the principle of distance learning and remote medical advice to institutions on request.

III. CONCLUSION

Watching television is a big obsession of millions of citizens around the world. A huge number of TV channels creates a huge dilemma, what to watch or listen. Selection of randomly selected channel largely depends on the fact that he beginning, middle or end of broadcast video that the viewer wants to watch. The proposed flow indicator will allow viewers-consumers of television easy and convenient selection of the proposed program content at a given point in time.

The viewer who was the reason for their intended program of personalization and interactivity to be statistically non-defined approach to viewing the program, have the information on real-time broadcast on state media content and, in this sense, and this should be considered an innovation that is presented in this paper.

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Storage systems: Comparing different MySQL types

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Abstract - In this paper we compared different storage systems of matrices in the view of MySQL types: BLOB, text, varchar. Several rational test matrices and randomly generated matrices are tested and CPU time is compared and discussed. The results show better results in cases where implementation is done using BLOB MySQL type as opposed to other types.

I. INTRODUCTION

Matrices are introduced in mathematics by English mathematician A.Cauley (1821-1895) in his work in 1857. Matrices represent systems of numbers that can be treated almost as well as numbers, so they in some cases generalize numbers. Many problems in applied science, mathematics, engineering, and general in practice, whenever possible, should be viewed through the prism of the matrix, because for the matrix there is known well developed mathematical tool. There are a number of algorithms for programming games using matrix operations.

There are many applications of matrix in mathematics and in other sciences. Matrices are discussed in game theory, economics, data mining and text mining. In the initial stage of encryption matrices are also used, but because of the linear nature of the matrix the encrypted passwords are relatively easy "smashed". The matrices are used in computer graphics to represent the properties and for the transformation and presentation of three-dimensional objects on a two-dimensional surface. The matrices are used in chemistry for various purposes, particularly in the field of quantum theory and spectroscopy. We meet them in solving Roothaan's equations that allow molecular orbital overlap in the Hartree-Fock-this method. Grevil's method is used as a benchmark for calculating the pseudo inverse. This method, because of its dominance, is extensively used in many mathematical areas such as statistical inference, filtering theory, linear estimate theory, optimization, analytical dynamics [1] and [10]. It is used in the direct approach for the calculation of the gradient of the pseudo - inverse presented in [4]. Also, this method has found wide application in databases as well as in calculations related to neural networks [1]. Sequential determination of the MP inverse by dynamic programming [11] is applied to the diagnosis and classification of electromyographic signals.

In [5] is given matrix representation on the application layer of the three- layer Web architecture and on the database layer. In this study, we went further and questioned in which MySQL data type should be stored the matrices in order as quickly as possible input in the memory and reading from it.

II. MATRIX REPRESENTATION

We tested two different matrix representations on the three-tier Web architecture application layer:

- one-dimensional arrays (1Darray) and
- to-dimensional arrays (2Darray)

A. One-dimensional array

Unlike variables, which keep individual values, arrays are used to store a set or a sequence of the value . Each array consists of two parts, the index and the element. Array index is used to identify and access the element.

PHP supports two types of arrays [3]:

- arrays with numerical indexing (vectors/ indexed) and
- associative arrays (on some platforms are known as "folders").

Also, the arrays may be one-dimensional or multidimensional. Arrays can be used in many ways for fast and efficient storage and organization of data. Array in PHP is actually a decorated folder. Folder associates key values. This type is optimized for several different solutions, and it can be treated as an array, list (vector), tables, dictionary, collection, stack, etc.. Array elements can be other arrays, trees and multidimensional arrays. The array may not be a simple list of keys and values, each element of the array can contain as a value another array. One-dimensional numerical sequence stores each array element with a numeric index. To access data in a one-dimensional array you must have data about the array: num name and index.

B. Two-dimensional array

In a two-dimensional array each element is actually a new array. Each such array has two elements: the index of rows and columns [3].

Such arrays are useful for working with data that have a matrix or table form. One of the benefits, which can be used when working with multi-dimensional arrays is the foreach () loop. This loop itself takes into account the size and position of the sequence during iteration, so it is good for some of the simpler operations. On the other hand, this approach reduces the control over a members themselves. These solutions are practical when we have a fixed number of subarrays (in this case, the columns of our table). However, if you want to shake some dynamic data, whose amount is not known in advance, these solutions are not good.

To choose a tool such as PHP to solve problems is a major challenge in the design, implementation, testing and maintenance of software. Matrix representation, on the application layer, in the form of one-dimensional (1D array) and two-dimensional (2D array) is a procedural programming technique. It is the programming by using procedures and functions. In contrast to a procedural programming there is an object-oriented programming, which represents a new paradigm for the design and implementation of software.

Object-oriented programming is a theory about the creation of software, or a way to write software.

III. PRESENTATION MATRIX IN DATABASE

Test matrices and matrices with a randomly generated elements are stored in a database format in the form of matrix rows R format, where all the elements of a matrix form a vector, or a string that contains the elements of the matrix. In addition to R-format and we also tested the browsing speed when the matrix is stored in the database in the format mR. This format is characterized by the property that the matrices are stored in the database where the number of entries in the table equals the number of rows in the matrix. We compared the speed of search for stored matrices using matrix team in both formats, R format and mR format. Based on the test results [6], we decided to store the matrix in the form of R formats. This storage system is used exclusively in order to save memory space in the database and to improve the tests speed.

Sparse unstructured matrices are matrices with the largest number of elements equal to zero and schedule of nonzero entries that do not coincide with any of the specific matrix model. There are many different storage schemes that reduce storage space and equipment for the calculation, storage and performing arithmetic operations only with non-zero elements. The simplest structures of the sparse matrix for storage is coordination format (COO) [10], where the matrix is stored in the way of the three vectors. Instead of storing the entire matrix, we store coordinates that represent rows and columns with the corresponding non-zero values. In this way we save memory resources. The first vector is the vector that stores the index of the order of non-zero elements. The second vector in the COO format is a vector that stores the column index corresponding nonzero elements. The third vector are non-zero elements of the matrix.

Example 1. In this example A is the test matrix from [2], matrix_B is symmetric and positively defined matrix_C is sparse matrix.

$$A = \begin{bmatrix} 11 & 10 & 9 & 8 & 7 & 6 & 5 & 4 & 3 & 2 \\ 10 & 10 & 9 & 8 & 7 & 6 & 5 & 4 & 3 & 2 \\ 9 & 9 & 9 & 8 & 7 & 6 & 5 & 4 & 3 & 2 \\ 8 & 8 & 8 & 8 & 7 & 6 & 5 & 4 & 3 & 2 \\ 7 & 7 & 7 & 7 & 7 & 6 & 5 & 4 & 3 & 2 \\ 6 & 6 & 6 & 6 & 6 & 6 & 5 & 4 & 3 & 2 \\ 5 & 5 & 5 & 5 & 5 & 5 & 5 & 4 & 3 & 2 \\ 4 & 4 & 4 & 4 & 4 & 4 & 4 & 4 & 3 & 2 \\ 3 & 3 & 3 & 3 & 3 & 3 & 3 & 3 & 2 & 1 \\ 2 & 2 & 2 & 2 & 2 & 2 & 2 & 2 & 2 & 1 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & -1 \end{bmatrix}$$

$$B = \begin{bmatrix} 282 & -11 & -206 & -39 & 84 & 94 \\ -11 & 241 & -80 & 129 & 121 & -86 \\ -206 & -80 & 306 & 4 & -113 & 2 \\ -39 & 129 & 4 & 394 & -19 & -219 \\ 84 & 121 & -113 & -19 & 119 & 15 \\ 94 & -86 & 2 & -219 & 15 & 184 \end{bmatrix}$$

$$C = \begin{bmatrix} 1 & 2 & 3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 4 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 4 & 0 & 0 & 0 & 8 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 2 \end{bmatrix}$$

SQL statement CREATE TABLE for creating data structures and tables in a MySQL database consists of the following parts:

- behind the CREATE TABLE is the table name. In our implementations we use two names: matrices_in and matrices_out, for the implementation of the fundamental operations of the matrices and the calculation of the generalized inverse,
- after the open bracket there is a list of the fields that contains attribute names, types and modifiers and
- After this list comes the list of keys.

The structure of a database table for the input matrices and the results of processing is shown with the following code:

```
CREATE TABLE matrices_in(
    id_in int(11) NOT NULL auto_increment,
    elements_in longtext NOT NULL,
    dimension tinytext NOT NULL,
    test tinytext NOT NULL,
```

PRIMARY KEY (id_in)) TYPE = InnoDB;

```
CREATE TABLE matrices_out(
  id_out int(11) NOT NULL auto_increment,
  elements_out longtext NOT NULL,
  operation tinytext NOT NULL,
  matrix_I int(11) NOT NULL default '0',
  matrix_II int(11) NOT NULL default '0',
  matrix_III int(11) NOT NULL default '0',
  r tinytext (4) NOT NULL default '0',
  s tinytext (4) NOT NULL default '0',
  p tinytext (4) NOT NULL default '0',
  q tinytext (4) NOT NULL default '0',
  PRIMARY KEY (id_out)) TYPE = InnoDB;
```

The fields used in the database tables are:

- behind the CREATE TABLE is the table name. In our implementations use two names: matrices_in and matrices_out, for the implementation of the fundamental operations of the matrices and the calculation of the generalized inverse,
- id_in or id_out: Identification number defined as auto_increment,
- elements_in or elements_out: string that contains the values of matrix elements, which are separated by commas. Thus, the dimensions of matrices and vectors used as arguments are limited by its length in the interval of $[0-2^{32}]$
- dimension: string that represents the dimensions of the matrix,
- test: the name of the test matrix [2] if it is a test matrix,
- sparse: tag for rarely possessed matrix which has one of the values 1, 2, 3, or 0 if the value is a dense matrix. This field is important for the matrices search that are already stored in the database,
- operation: defines the operations of the input array,
- matrix_I, matrix_II, matrix_III: contains the index (id - s) from the table matrices_in or has a default value of 0, in order to find a solution for the selected operation and entered matrix and
- r, s, p, q: coefficients used in the calculation.

IV. MYSQL TYPES

Since we are on the basis of test results [6] decided that the MatrixDBMS contains matrices in R format, to be a complete system, it was also necessary to test MySQL data type. There are three key groups MySQL data types: numeric types, date and time, and string (or character) type. We compared the different subtypes of string data

The general rule is to use data type that will adequately meet the needs of particular column in database. MySQL is known for having compact types that

are good for things like 0/1 values or very large types that can store up to 4GB of data in one field, [8].

There are three buckets of MySQL data types: numeric types, date and time types, and string (or character) types. In our application we compare string data types: blob, varchar and text. Blob is the string data type used for binary data. Any queries on a blob type result in a case-sensitive return.

This is opposite to the behavior of the text type. Text is the string data type used for character data. It works much like the blob data type; queries upon the text type will return case insensitive values.

The varchar data type works like the char type except for its data-storage method. The varchar type removes all trailing whitespace from inserted data. Designated by varchar(M) where M designates the field length, the maximum length of the varchar type is 255 characters [9]. For some systems, in considering space requirements, the varchar type should be used as opposed to the char type.

Table 3 shows the three enumerated MySQL data types and their possible values. M stands for the maximum number of digits displayed, and it is optional. Note: the CPU time for insert and searching data is much shorter when matrix stored in the database in the R format, [8], because we use it in that form.

TABLE I. MYSQL DATA TYPES

MySQL data types		
Data types	velicina	opis
varchar(M)	Up to M bytes	Variable in length. M must be ≤ 255 .
blob	Up to 64KB	blob is case-sensitive for sorting and comparison;
text	Up to 64KB	text is case-insensitive..
longblob	Up to 4GB	longblob is case-sensitive for sorting and comparison.
longtext	Up to 4GB	longtext is case-insensitive.

Analysis of the execution speed of the insert and search data when we have different MySQL data types, is given in [11]. Based on this analysis, we have the advantages of the BLOB type in relation to other MySQL data types.

V. EXAMPLES AND CPU TIMES

Testing was done on the local machine and from a client in a wireless network. We had an access to the web server using the infrastructure mode wireless networking with an access point. Testing was executed on the server machine with: Windows edition: Windows Vista(TM) Ultimate; Processor: Intel(R) Pentium(R) Dual CPU T3200 @ 2 : 00GHz; Memory (RAM): 2940MB; System type: 32-bit Operating System; Free Softwares: WampServer version 2.2 which contains PHP 5:3:8, MySQL 5:5:16 and phpMyAdmin 3:4:5.

In the next table, we compare the time for insert of data when we have different MySQL data types.

TABLE II. INPUT DATA IN MYSQL DATABASE

MySQL 2Darray INSERT			
<i>mxn</i>	<i>longtext</i>	<i>BLOB</i>	<i>VARCHAR</i>
30x30	0.151	0.078	0.106
50x50	0.162	0.079	0.117
60x60	0.156	0.075	0.119
70x70	0.162	0.079	0.122
80x80	0.165	0.068	0.140

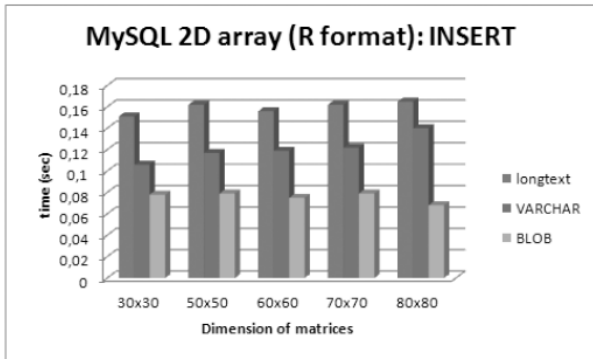


Figure 1. Insert data in different MySQL data types

In the next table, we compare searching of data time when matrices are stored in the MySQL database with different data types.

TABLE III. SELECT DATA FROM MYSQL DATABASE

MySQL 2Darray SELECT			
<i>mxn</i>	<i>longtext</i>	<i>BLOB</i>	<i>VARCHAR</i>
30x30	0.0089	0.0010	0.0085
50x50	0.0104	0.0017	0.0087
60x60	0.0145	0.0024	0.0104
70x70	0.0293	0.0025	0.0204
80x80	0.0444	0.0026	0.0324

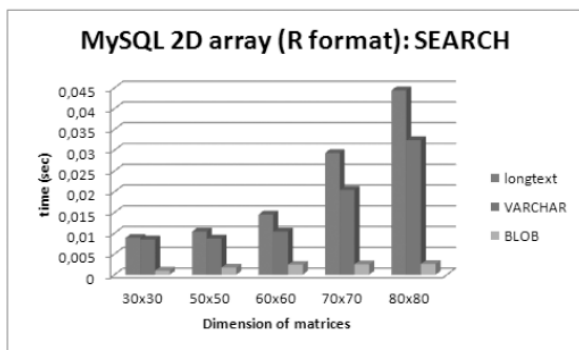


Figure 2. Select data from different MySQL data types

This testing is performed for dense matrices with randomly chosen elements. The best executing CPU time we have when insert and searching data in MySQL database with blob data type. We note that matrices are in the database in the R format, presented in [6].

VI. CONCLUSION

Several storage technics are discussed and tested in a different environment. We are tested different type of data in relation database MySQL and draw conclusions that the best result give blob type. Also, we tested and compare speed of insert and search data in relation database.

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Controlling Computer Games through Web Camera with Motion Detection

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Abstract - The paper describes an implementation of interface for playing chess game realized through motion detection and object tracking. User hand movements are recorded with a web camera and used to move chess pieces in a given board position. We are primarily concerned with the perception and identification of user movements compared to the chess playing strategies and the game logic. The interpretation of the chessboard position and the computer next moves are performed using standard chess engine. This work contributes to the development of more natural interfaces that enable communication via user motions and gestures instead of standard computer devices.

I. INTRODUCTION

Over the last decade games controlled by user motions instead of standard input computer devices like keyboard or mouse became more popular. Most of the techniques for motion detection, speech and gesture recognition become affordable to general market and enabled introduction of new modern techniques of human-computer interaction. These natural interfaces that enable communication via speech and gestures additionally require fast video-processing algorithms and affordable PC cameras [1].

Since 1999, when the first motion controlled game Play Me2Cam has been developed by Intel and Mattel [2], several new devices have been released, such as EyeToy camera for PlayStation [3], and game controllers Microsoft Xbox 360 Kinect, Sony PlayStation Move and Nintendo Wii Remote Plus.

Many studies describe methodologies for novel user interfaces, such as perceptual user interfaces [4], camera-based computer games [5], face tracking [6], camera tracking and hand held controller [7] or camera tracking and voice commands [8] and technologies for human motion detection [9].

Hämäläinen [8] describes a system “video mirror” for getting feedback during training martial arts where user can see his movements from different sides. Moeslund, and Granum in [9] present a survey of computer vision techniques for capturing human motion. Freeman et al. [10] propose several algorithms and create applications based on the proposed motion detection and control. Their methods use orientation histograms and optical flow analysis.

This paper describes an interface for playing chess that uses web camera to detect user movements. Interest in

chess playing machines started to grow when Deep Blue computer beat Gary Casparov in 1997 [11]. Majority of the existing chess playing machines use modified chessboard to simplify the recognition of the chess pieces and use fixed boards. For example, Revelation II chess computer system developed by Digital Game Technology and Phoenix Chess Systems uses sensory chessboard that recognizes pieces and movements [12]. Chess playing robot arms shown at the Maker Faire also use instrumented chess sets [13]. Novag 2 Robot Chess Computer uses special instrumented board and special chess pieces [14]. On the other side, there are systems, like robotic arm Gambit which can play with arbitrary chess sets and boards [15]. Gambit is an integrated system able to handle different kinds of chess pieces, to detect user actions, to perceive the chessboard and to play the game.

Two aspects have to be considered for a successful design of chess game controlled by detected user movements:

- Perceiving the environment with chessboard and chess pieces and recognizing user moves,
- Interpreting the state of the game and computing the next step.

This work is not concerned with chess playing strategies and game logic. We use standard chess algorithm to generate moves based on a given state positions. The next move is obtained by querying a standard chess engine. In motion controlled interface the system moves the piece based on user actions in front of the camera. The game has a predetermined set of actions that are appropriate in a particular position. So motion detector is used to classify the user’s actions.

The aim of this work is to solve the problem of perception and identification of user movements. Location of the chessboard and position of the changes in successive images are determined using processing techniques, such as line detection and edge detection [16]. Standard libraries from Adobe Flash Platform are used for implementation of the image processing techniques [17][18].

Next section describes the methodology used for perception and recognition of user hand movements. Then we present the steps for implementation of the chess video game following the chess rules and minimax algorithm. Paper ends with a brief discussion and conclusions.

I. MOTION DETECTION

The trivial way to detect motion is to compare two consecutive images representing the same situation taken in short time interval. The motion detector compares the two consecutive images and if differences are noticed, it gets to a pixel-to-pixel comparison of the images. Consecutively, images are classified in two categories: changed and unchanged. This comparison method is vulnerable to noise since even small changes or differences in illumination are considered as motion. To ignore the insignificant changes we used threshold value [18]. The detection of movement is based on the assumption that the moving objects have different color from their surroundings.

The threshold function in pseudocode is as follows:

```
if ((pixelValue & mask) operation (threshold & mask))
then set pixel to color
else if (copySource) then set pixel to corresponding pixel
value from sourceBitmap
```

As previously mentioned our application uses several classes from Adobe Flash Professional CS6, such as ColorMatrix, MotionDetection and MotionTracker. The system allows motion tracking of moving elements and extracting information about their position, rotation and scaling. The tracking point is represented with a little circle as Fig. 1 shows.

Function track from MotionTracker class is used to compare the old and new image. Function `getColorBoundsRect` determines whether a rectangular region fully encloses all pixels of a specified color within the bitmap image. It is used to set the coordinates of the tracking circle.

In order to develop a motion controlled interface the system has to recognize the user movement in front of the camera and to move the appropriate piece based on that movement. The program has a predetermined set of actions that the player can perform and hence the motion detector is used to classify these actions. The system follows the user's movements: if the user raises his hand the piece is moved up, if the user hand is moved to the left the piece is moved to the left, etc.

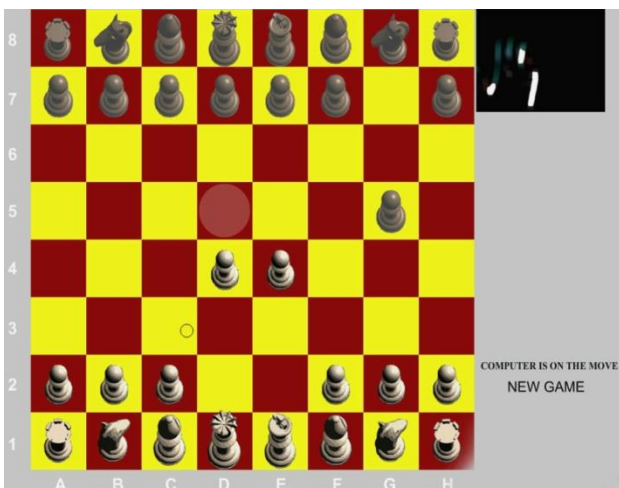


Figure 1. Moving pawn from field D2 to D4

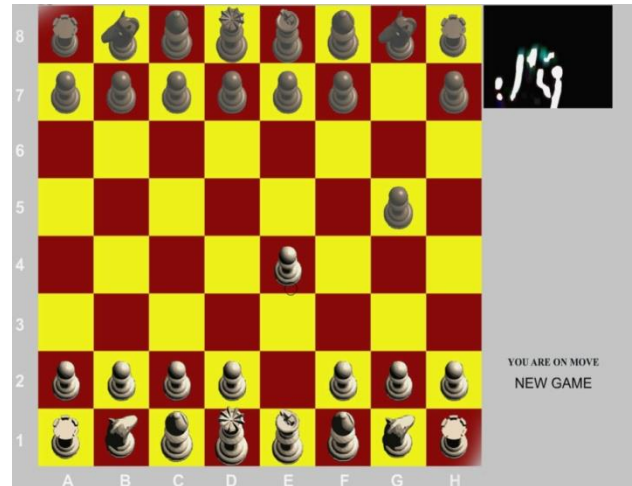


Figure 2. Computer response to user move

This video game is available at the following link <http://www.robotsonline.info/chess.html>.

Fig.2 shows a computer response to user's action that moves a pawn from E2 to E4. The upper right corner represents the user's hand movements that are used to control the game. The threshold function tests the pixel values against a specified threshold value and sets pixels that pass the test to new color values. This function is used to isolate color ranges in the image.

A. Connection between chess video game and motion detection module

The chess playing game with motion detection is realized with two separate ShockWave Flash files which communicate using the LocalConnection class of the Adobe Flash Platform. The object of LocalConnection class invokes methods in another object of the same class.

The communication can be performed within a single SWF file, between multiple SWF files, between content (SWF-based or HTML-based) in AIR applications and between content (SWF-based or HTML-based) in an AIR application and SWF content running in a browser.

ShockWave Flash file intended for motion detection can send commands to ShockWave Flash file that implements chess video game. For example, some of the commands send coordinates of the tracking circle.

II. IMPLEMENTATION OF THE CHESS GAME

Chess video game is implemented using existing chess engine. Chessboard is represented as an array with 64 elements. The movements of the pieces have to follow chess rules, such as "king can move one field in each direction" or "knight can move like L".

The evaluation of the position is done based on the structure of the pawns, the occupation of the center and other factors. Usually the computer generates a move tree to a certain depth and searches for the best move. A common algorithm that is used for calculation of the best move is minimax. In this algorithm each player tries to maximize his advantage and to minimize the advantage of the opponent.

Important part of chess video game is an user interface that enables communication with the user. This work uses user's hand movements instead of interactions with the mouse or the keyboard. The next step is coding a list of valid moves that serves to control the input from the user and to calculate the best move of the computer. Also the method for checking whether the king is in a check has to be implemented as part of the chess rules.

To reduce the calculations during the search of the move tree alpha-beta algorithm is used (Fig. 3). Search depth is set to a level 2, to speed up the calculation of the next move as an important characteristic of the interactive video games. At each step of the searching the function retains the best score it has found so far. When the maximizing player is searching a node and finds a path from that node having a higher score than the minimizing player's best score, then he knows that the node from which he is currently searching is too good to be true since the minimizing player will never give him the opportunity to play the move to that node.

```
function alpha_beta_search(real_side, search_depth, alpha, beta)
{
    var max_score = - 10000000; // initialization of best score
    var __reg3 = new Array();
    var catch_piece = null;
    var score_to_move;
    var moves_to_pc;
    var i = 0;
    while (i < 8)
    {
        var __reg1 = 0;
        while (__reg1 < 8)
        {
            if ((chessBoard[i][__reg1] & 1) ==
                side && chessBoard[i][__reg1] != VOID)
            {
                __reg3 = __reg3.concat(moves_to_calculate
                    (i, __reg1, side)); //concatenation of all moves
            }
            ++__reg1;
        }
        ++i;
    }
    var i = 0;
    while (i < __reg3.length)
    {
        catch_piece = moving_this(__reg3[i], side);
        if (depth == 0)
        {
            score_to_move = side == SIDE_COMPUTER ?
                pc_score : player_score;
        }
        else{
            score_to_move = 0 - alpha_beta_search
                (getOpponent(side), depth - 1, -1 * beta, -1 * alpha);
            // recursion of alpha_beta_search function
        }
        unmoving_this(__reg3[i], side, catch_piece);

        if (score_to_move > max_score){
            max_score = score_to_move; }
        if (max_score > alpha) {
            alpha = max_score; }
        if (alpha >= beta) {
            return alpha; }
        ++i;
    }
    return max_score;
}
```

Figure 3. Alpha-beta searching algorithm

III. CONCLUSIONS

This paper describes a novel approach to building interfaces for board games. In this sense the motion detection is used as a control mechanism in chess video game. The implementation of this interface does not impose any additional expenses because almost every computer has installed Flash Player and web camera. Using JavaScript the coordinates of the moving object can be transferred to any program that implements motion detection.

The implemented motion controlled interface is able to recognize user's hand movements in front of the web camera and to move the selected piece according to that movement. The predetermined set of actions that the player can perform following the chess rules enables simple classification of the performed actions and interpretations of the movements.

Standard chess engine is used to implement chess rules, to evaluate the board position during the game and to compute the next move of the computer.

This work contributes to the recent trend for creating games controlled by motion detection instead of standard computer input devices.

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Analyzing Web Server Access Log Files Using Data Mining Techniques

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Abstract - Nowadays web is not only considered as a network for acquiring data, buying products and obtaining services but as a social environment for interaction and information sharing. As the number of web sites continues to grow it becomes more difficult for users to find and extract information. As a solution to that problem, during the last decade, web mining is used to evaluate the web sites, to personalize the information that is displayed to a user or set of users or to adapt the indexing structure of a web site to meet the needs of the users. In this work we describe a methodology for web usage mining that enables discovering user access patterns. Particularly we are interested whether the topology of the web site matches the desires of the users. Data collections that are used for analysis and interpretation of user viewing patterns are taken from the web server log files. Data mining techniques, such as classification, clustering and association rules are applied on preprocessed data. The intent of this research is to propose techniques for improvement of user perception and interaction with a web site.

I. INTRODUCTION

During the last decade web is not only considered as a network for acquiring data, buying products and obtaining services but as a social environment for interaction and sharing information [1]. Web-based data mining can be used for knowledge discovery in recommendation engines, to personalize the Web pages displayed to set of users, for understanding communities or modeling user search [2].

Many works describe different implementations of web mining techniques with the intent to improve user interaction with a web site. For example, Perkowitz and Etzioni propose automatic adaptation of the indexing structure of a web site [3], Spiliopoulou describe a tool Web Log Miner for evaluation whether the expected navigation patterns between pages are met by the majority of the visitors [4], Mobaster et al. [5] describe a tool Web Personalizer for creating usage profiles using association rules and clustering.

Several commercial and free web server log analyzers are available which produce statistical data, like the number of visitors accessing the site, the browsers they use, the length of their sessions, pages with maximal hits, errors that occur while accessing the site, etc. Goel and Jha [6] provide a comparative study of several log analyzer tools. These summary statistics of web site activity can serve as additional data for discovering patterns in web data.

In this work we propose a methodology for web usage mining with the intent to increase the web server efficiency. Data collections that are used for analysis and interpretations of user viewing patterns are taken from web server log files of the Secretariat for European Affairs (SEA) for the process of integration of the Republic of Macedonia in the European Union and are obtained during the user web-based sessions.

Particularly we are interested to discover user access patterns and whether the topology of the web site matches the desires of the users and based on the results we plan to adapt the link structure to better meet the needs of the users. Experimental work is accomplished using WEKA [7].

II. WEB MINING

The appearance of the www service caused a need for analysts to aim their attention towards extracting useful information and knowledge using the techniques of data mining. Web mining represents the use of data mining techniques to extract knowledge from web data including web documents, hyperlinks between the documents, the use of web site logs and similar.

Figure 1 depicts the steps in the process of web mining, starting from preprocessing to identification of

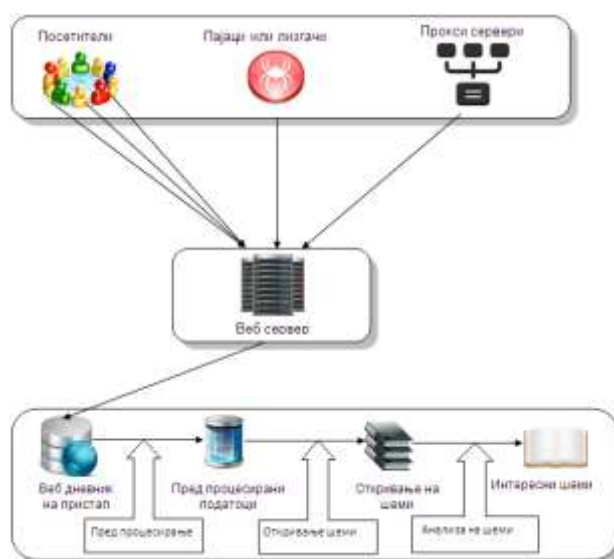


Figure 1. Steps of web mining process

useful patterns. The phase of preprocessing consists of

cleaning the data and user and session identification. The second phase, discovering patterns, involves algorithms and techniques of data mining. The last phase is analysis of the discovered patterns and evaluation of user interests.

Based on the primary type of data which are used in the process of data mining, the web mining can be categorized into three types: structure mining, content mining and web usage mining, depending on which part of the web is researched [8].

A. Structure mining

The goal of web structure mining is to discover useful knowledge from the hyperlinks which represent the structure of the web, i.e. a classification of the web pages can be made based on their organization. Structure mining can be used to categorize the web pages based on hyperlinks or document-structure. The content of a web page can also be organized in a tree-structured form, based on different HTML and XML tags on the page.

The structure of a web page can be represented on a typical web graph which consists of web pages as nodes and hyperlinks as edges which connect the connected pages.

B. Content mining

Content mining is a process of extraction of useful information from the content of web documents by application of the data mining algorithms. The contents of web documents are *true* data for which the web page is designed to transfer to the users. The pages can be of different types of data, so it results in existence of different categories of content mining. It is connected to data mining because many techniques of data mining can be used in content mining but at the same time it is different because web data are mainly semi-structured and/or unstructured while data mining mainly addresses structured data. It is also connected to text mining because a big part of the web content is text, but also different because the web is semi-structured while text mining is focused on unstructured texts.

C. Web usage mining

The third kind of web mining is user access mining. The user access logs enable monitoring the user's activity with the web site and improving the structure of the web site. If established by analysis that the visitors stay a long time it is a sufficient indicator of the need for restructuring of the web page in order to help the visitors to reach the wanted information quickly. By user mining based on information about user preferences, interesting content can be offered. To achieve this goal it is recommended to use adaptive web sites which use information about the access schemes of the user in order to improve their organization and presentation [5].

III. DATA PREPARATION

A. Filtering web access logs

As mentioned before, all records available as a result of user web access and browsing are stored in web

server log files generated by Microsoft IIS 6.0. Server log files provide information in Extended Log Format because web site of SEA is developed and hosted using Microsoft Windows 2003 platform. As Figure 2 shows the fields associated with the extended log format are date, time, request, host address, browser type, referring page, status and bytes. Data preprocessing is performed using Perl scripts from WUMprep tool [9] which is part of open source project HypKnowSys.

For data mining relevant log file fields are those fields that enable determining the sequence of clickstreams followed by each user as they navigate through the web site. It is important to create a session file, which contains sets of page-views requested by a single user from a single web server. A single page-view consists of one or more page files and is marked with a unique URI.

In the preprocessing phase the first step is elimination of irrelevant entries. Filtering of unnecessary elements, such as graphics or sound can be accomplished by checking the suffixes of URL names. Records of images and videos, records of servers inter-mediators, records with failed requests (non-existing pages, server failures) except requests with code 2/x/x and double records are not appropriate for the experiments and they are removed using the script LogFilter.pl.

```
#Software: Microsoft Internet Information Services 6.0
#Version: 1.0
#Date: 2012-11-05 07:57:01
#Fields: date time cs-method cs-uri-stem cs-uri-query cs-username c-ip cs-
version cs(User-Agent) cs(Referer) sc-status sc-bytes
2012-12-21 20:53:32 GET
/Content/Publications/Documents/Dogovor+od+Lisabon(1).pdf - - 77.19.26.111
HTTP/1.1 Mozilla/5.0+(Windows+NT+5.1)+AppleWebKit/537.11+
2012-12-21 20:57:17 GET /default.aspx ContentID=47 - 173.195.114.119 HTTP/1.1
"Mozilla/5.0+(compatible;+AhrefsBot/4.0;++http://ahrefs.com/robot/)" - 200
27256
2012-12-21 20:58:09 GET
/Content/Publications/Documents/Dogovor+od+Lisabon(1).pdf - - 89.205.15.152
HTTP/1.1
Mozilla/5.0+(Windows+NT+6.1)+AppleWebKit/537.11+(KHTML,+like+Gecko)+Chrome/23
.0.1271.97+Safari/537.11
http://www.pfk.uklo.edu.mk/index1.php?page=recutatatisgrad= 200 191331
```

Figure 2. A sample of web log in extended log format

Similarly, the records made by crawlers, spiders, indexers and other robots have to be discarded from the web logs. Web robots access the file "robots.txt" for permissions created by administrators which helps in the process of their identification. The script RemoveRobots.pl is used for removal of web robot accesses.

B. Session Identification

Creating a session file is not a simple task. Some problems related to identification of sessions are discussed in [10, 11]. To extract the individual server session one has to identify each user having in mind that several users may be accessing the site from the same host. Host address has to be combined with the referring page to distinguish one user session from another.

Several authors describe ways to identify sessions, as for example, using reference length [12] or maximal forward references [13]. In this work is used method named “time window”. When the period between two accesses from the single user is greater than a certain threshold then these accesses are considered as different sessions. The time period of 30 minutes is considered as appropriate threshold to identify the sessions. The session file in this work is created using the script Sessionize.pl.

Sessions that have at least 5 visited pages are considered as useful for data mining in this work.

C. Mining the data

Once the session file is created different techniques can be applied such as association rules or clustering methods. Several recent works describe web log analysis using data mining techniques [14, 15, 16].

Association rules give the instances (pages) that appear together in a single session record. If the direct link do not exist between these pages the rule may warrant modifying the indexing structure of a web by placing direct links between the pages.

Unsupervised clustering can be used to form clusters of similar instances in file sessions.

IV. EXPERIMENTAL RESULTS

The aim of this work is to find certain interesting patterns for the visitors of the web site of the Secretariat for European Affairs for the process of integration of the Republic of Macedonia in the European Union (SEA).

Figure 3 gives a hierarchical overview of the performed tasks for discovery of models in these experiments. Moreover, this figure shows the organization of the experiments. All the experiments are conducted using user access logs from December 2012. In total 3 experiments were conducted:

- Experiment 1: MKVsOutsideMK (visitors from Macedonia and visitors outside of Macedonia),
- Experiment 2: SEPVsOutsideSEP (visitors from SEA and visitors outside SEA),
- Experiment 3: SEPVsOutsideSEPWithinMK (visitors from SEA and visitors outside SEA but from Macedonia).



Figure 3. Organization of the performed experiments

For each experiment 4 data mining techniques are used: classification, association rules, clustering and attribute selection. From the processed data, 4 different groups of instances were separated: First3-Last2, First5-Last5, 10-Most-Frequent-TF and 10-Most-Frequent-Time. The above mentioned techniques are applied to each of these groups to discover potentially interesting patterns.

The experiments are performed using WEKA (Waikato Environment for Knowledge Analysis) software that implements a collection of machine learning algorithms for data mining tasks.

Using WEKA the following results were obtained:

Experiment 1: Visitors from Macedonia most often visit the root page of the web site but they also visit pages directly while the visitors outside Macedonia most often visit specific pages directly. This is most likely because they use search engines.

Experiment 2: Results show that visitors from SEA most often visit the root page, but also they also visit pages directly and this is due to the fact that the SEA employees know the structure of web site well.

Experiment 3: Some of the discovered patterns are in line with those discovered in experiments 1 and 2. The discovered patterns show that visitors outside SEA usually spend less time on the web pages compared to visitors from SEA.

Table 1 shows the data mining techniques used in the first experiment and for which groups of instances significant patterns were discovered.

TABLE 1. EXPERIMENT1: MKVsOUTSIDEMK - SUMMARY OF RESULTS

Data Mining Technique	Web Access Log File	Feature Set Used	Significant Patterns Discovered
Classification	access2012	First3-Last2	YES
		First5-Last5	YES
		10-Most-Frequent-TF	YES
		10-Most-Frequent-Time	YES
Association Rules	access2012	First3-Last2	YES
		First5-Last5	YES
		10-Most-Frequent-TF	NO
Clustering	access2012	First3-Last2	YES
		First5-Last5	YES
		10-Most-Frequent-Time	NO
Attribute Selection	access2012	First5-Last5	YES
		First3-Last2	YES
		10-Most-Frequent-TF	YES
		10-Most-Frequent-Time	YES

The classification results for the instances of different groups are obtained with OneR and J48 classifiers. These algorithms give sequences of visited pages. According to the obtained results visitors from Macedonia that access the root page as first page, also visit other pages which give information about reports and news from EU, pre-accession support, negotiation processes, the page that contain document register, the translation process, pages giving information about the structure, organization and work of the SEA, etc.

Visitors outside Macedonia which visited the root page also visited the Europe’s Bulletin and the page for pre-accession support.

The samples of 10-Most-Frequent-TF group are formed after selecting 10 most frequently visited pages.

The attribute for the page is T (true) if the page is visited in a particular session or F (false) otherwise.

The group 10-Most-Frequent-Time consists of the same instances as 10-Most-Frequent-TF except that the value of the attribute is time spent on a particular frequently visited page.

Figure 4 shows the decision tree obtained with J48 algorithm for 10-Most-Frequent-Time group.

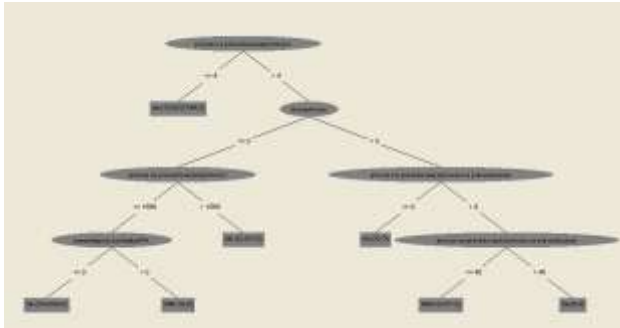


Figure 4. Decision tree obtained with J48 algorithm using 10-Most-Frequent-Time group of instances

Association rules are obtained using Apriori algorithm. As Figure 5 shows 7 rules are discovered for the group First 3-Last 2.

The interpretation of the first and fifth rule is as follows:

- if the first and next-to-last page is the root page then the visitor is from Macedonia.
- if the third visited page is the root page then the first visited page is also the root page.

Apriori
 =====
 Minimum support: 0.1 (54 instances)
 Minimum metric <confidence>: 0.9
 Number of cycles performed: 18

Generated sets of large itemsets:
 Size of set of large itemsets L(1): 4
 Size of set of large itemsets L(2): 5
 Size of set of large itemsets L(3): 2

- Best rules found:
1. F1=Home/home L2=Home/home 93 ==> Country=mk 88 conf:(0.95)
 2. L2=Home/home 107 ==> Country=mk 101 conf:(0.94)
 3. F3=Home/home Country=mk 106 ==> F1=Home/home 99 conf:(0.93)
 4. F1=Home/home F3=Home/home 106 ==> Country=mk 99 conf:(0.93)
 5. F3=Home/home 114 ==> F1=Home/home 106 conf:(0.93)
 6. F3=Home/home 114 ==> Country=mk 106 conf:(0.93)
 7. F1=Home/home 404 ==> Country=mk 367 conf:(0.91)

Figure 5. Partial output of the Apriori algorithm using First 3-Last 2 group of instances

Clustering is performed using EM algorithm. As expected two clusters are obtained: Cluster0 consisting of visitors outside Macedonia, that are 21% of the total number of visitors, and Cluster1 of visitors from Macedonia which are 79% of the total number of visitors.

Cluster1 which is formed of the visitors from Macedonia that start searching from the root page and also visit pages related to the organization and work of the SEA, news and procurements, advertisements and competitions in SEA. The users in this cluster have tendency to visit the following three pages: Home/home, Home/Novosti, Za nas/organizacija and NOK/Tenderi. Figure 6 shows partial output of EM algorithm for the group 10-Most-Frequent-TF.

```
EM
==
Number of clusters: 2
```

Attribute	Cluster	
	0 (0.21)	1 (0.79)
F1		
Home/home	24.1236	381.8764
F2		
za nas/organizacija	2.2247	49.7753
Home/Novosti	1.0803	43.9197
F3		
Home/home	6.5413	109.4587
za nas/organizacija	8.7708	32.2292
L2		
Home/home	6.6491	102.3509
NOK/tenderi	3.1326	21.8674
Home/Novosti	4.0535	20.9465
L1		
Home/home	2.4074	52.5926
Home/Novosti	2.7317	35.2683

```

Clustered Instances
0 113 ( 21%)
1 422 ( 79%)
Log likelihood: -14.16034
Class attribute: Country
Classes to Clusters:
0 1 <-- assigned to cluster
15 37 | NMK
98 385 | mk
Cluster 0 <-- NMK
Cluster 1 <-- mk
Incorrectly clustered instances : 135.0 25.2336 %
```

Figure 6. Partial output of the EM algorithm for the group 10-Most-Frequent-TF

The results show that visitors from Macedonia most often visit the SEA web site to access information about news, procurements, competitions and advertisements in SEA.

The results of Attribute Selection for the group First 3-Last 2 are obtained using “cfssetEval” attribute evaluator with “BestFirst” search method. According to these results attributes F1, F3 and L2 are pointed as the most discriminative and relevant attributes. F1 corresponds to the first visited page in the session, F3 to the third page and L2 corresponds to the next-to-last page in the session.

V. APPLIED WEB LOG ANALYSIS TOOLS

A. Deep Log Analyzer

In order to obtain statistical information about the activity on the web site we used Deep Log Analyzer. The reports generated with this tool contain information about all

accessed resources on the web site, the activity of the visitors and their navigation, web sites through which visitors have come to the analyzed web site, robots which accessed the web site, used search engines and operating systems by the visitors, errors on the web servers, etc.

Figure 7 shows one of the reports obtained by this web log analyzer for December 2012. The reports show the following information: number of total visits: 24428, average number of visits per day 788, average visit duration 22:28 min, top referring website http://www.google.com 3804, top search engine Google, Spider requests 21475, most popular browser IE 9.0, most popular OS Win7, most popular entry page /default.aspx, most popular exit page /default.aspx, most popular download /final_europa_A_DO_S.pdf, number of unique visitors 8568, repeat visitors 2320, visitors who visited once 6248, average visits per visitor 2,85 and etc.



Figure 7. Overview report for SEA web site obtained with Deep Log Analyzer

B. Aqunetix

Without adequate safety protection and efficient security management, web sites can be abused for attack of the data integrity of the information systems and network connections. Using the data mining techniques, attacks as well as attack profiles can be discovered.

There are several typical security attacks which show the weaknesses that are abused to perform the attacks, like Denial-of-Service, SQL injection, Cross-Site Scripting and HTTP GET attack.

The following weaknesses on the web site were discovered using the Acunetix WVS (Fig. 8):

(1) high level risk- weaknesses for two SQL Injection attacks and one for a possible attack through which one can access important files and folders which are usually not visible,

(2) medium level risk- a few error messages were found regarding the code of the application,

(3) low level risk – weaknesses were found out of which one regards the HTTP method Options through which the hackers can prepare and advanced attack, four regard the

possibility to discover sensitive folders and two more regarding session cookies, and finally

(4) information level signal – one weakness is found regarding searching of a page which does not exist i.e. the page with error returns information about the server version and the list of available modules.



Figure 8. Results of the scanning with Aqunetix

VI. CONCLUSIONS

Using the data mining techniques interesting access patterns were discovered as well as certain differences in the access patterns of the users from Macedonia, outside Macedonia and the employees of SEA.

Analyzing the web site with Deep Log Analyzer a complete statistics is produced regarding the use of the web site and information of the accessed resources, the activity of the visitors, sliders searching the web site, search engines and operational systems the visitor use, web server errors, etc.

Web log analysis tools do not provide comprehensive analysis and access patterns which can be obtained using data mining techniques.

Future steps in our project related to analyzing web log access files will be:

- analysis of the sessions with less than 5 visited pages, because in reality such visits exist and many interesting access patterns can be discovered,
- applying techniques of exact identification of locations, visitors and sessions with the goal to get meaningful information in the defining of patterns,
- optimization of the web site design based on the statistical data and data obtained using data mining techniques,
- improvement of the security and integrity of the web site, based on the discovered weaknesses.

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Protecting Critical Information Infrastructures by Increasing its Resilience

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Abstract – In this paper, the Critical Infrastructure concept and the most common way of modeling it through network theory are presented. As the networked critical infrastructures are subjected to cascade-based disruptions, the problem of infrastructure protection is discussed, with emphasis on the relation between optimization and protection. In the paper, a new way of making the connected infrastructures more resilient using topology-based cascade resilience tool is proposed.

I. INTRODUCTION

There are many definitions of the Critical Infrastructure - CI, but all of them in principle refer to assets which are essential to the economy and society. The CI is a subject within EU regulation too. In the EU Council directive 2008/114/EC following terminology is used [1]:

(a)“Critical infrastructure means an asset, system or part thereof located in the Member States which is essential for the maintenance of vital societal functions, health, safety, security, economic or social well-being of people, and the disruption or destruction of which would have significant impact in a Member State as a result of the failure to maintain those functions”.

(b) ‘European critical infrastructure’ or ‘ECI’ means critical infrastructure located in the Member States the disruption or destruction of which would have a significant impact on at least two Member States. The significance of the impact shall be assessed in terms of cross-cutting criteria. This includes effects resulting from cross-sector dependencies on other types of infrastructure.

The critical infrastructures within the county are a complex “system of systems.” The interdependencies between various CIs are very strong. Critical infrastructures interact at different levels, and failure in one infrastructure may impact the functionality of other infrastructures. [2]

The Information infrastructure of one country includes many technologies and services, which are owned by various entities (state, private companies) [3]. Information infrastructure includes wired, wireless, cable and broadcasting technologies, core networks based on internet protocol as well as internal information systems. Companies and institutions that owns and manage information infrastructure had mostly implemented various protective measures and so reduced the possible damage from natural disasters, attacks and other accidents. Protective measures are implemented within their own

architectures mostly from redundant nodes and systems, business plans and recovery strategies .

There is a great deal of interdependency between the Communication Sector and a number of the functionalities within the utility community. Almost all of the utilities have critical requirements for communications of any form. [4] Alternatively, the communications community has a number of instances where they are dependent on the utilities, what leads to the conclusion that communications is a key infrastructure, central to all others, so that understanding and modeling the risk due to communications disruptions is a high priority in order to enhance public safety and infrastructure resiliency.

In general, cascading across infrastructures can occur in almost any order, but communications have always been a central component surrounding the disruption and is especially important in mitigating the disruptive effects [5].

The significant importance of these infrastructures over the society and their interferences means that sufficient safety and security measures should be identified to reduce the risks of failure. [2] As a result of such complexity in infrastructure dependencies, the protection of critical infrastructures becoming a difficult task. To properly protect CIs, we should understand it in its all complexity, and in a proper way. Many authors deal with that topic, and one common thing is that all of them are defining critical interdependent infrastructures using network theory.

The paper is organized as follows: After the introduction, in the second chapter the network theory approach for modeling critical infrastructures is described. In the third chapter, authors discuss the relation between optimization and protection of networked elements. In the fourth chapter, the typical cascade-based disruptions of networked infrastructures are described. In the fifth chapter, the concept of active and topological cascade resilience of the network is explained. Finally, in the sixth chapter, the authors propose a new approach for the identification of critical nodes within the network, and therefore the guideline for critical information infrastructure protection.

II. CRITICAL INFRASTRUCTURE MODELING USING NETWORK THEORY

The interdependencies among different infrastructures are generally not well understood and disruptions in one infrastructure can propagate into other infrastructures.

In principle, the infrastructures are characterized by high levels of interdependencies among elements. That is especially the case with the information infrastructures. Different approaches are applied in order to define CII and its important elements. The most of them use the network theory and with measurements of network performance through a process of simulation evaluate the importance of infrastructural elements.

If we think of those elements as linked interdependent entities, we can visualize the networked structure. Elements could be regarded as the nodes (vertices) and the relations between them as the edges (sometimes referred to as arcs or links). Furthermore, the nodes and links could be given another property, and that is weight. In the case of the nodes, the weight could represent an initial importance level assigned by the network designer, and for the links, the weight could represent the influence (or level of dependency) of one node to another.

The infrastructure dependencies modeling relies on the network theory and the properties of the networks can be mapped to the real world infrastructures.

The ultimate goal of every network designer is to achieve a high level of network optimization, and in other hand to make it robust and resilient (properly protected). Very frequently, the process of optimization is mixed with protection. Those processes are in relation and very often, they are opposed to each other. This relation is discussed in the next chapter.

III. RELATION BETWEEN OPTIMIZATION AND PROTECTION

We can say that the network's resilience depends on the network's ability to "heal" itself, which means that the information or package can reach its final destination even if the initial route is disrupted.

As a consequence, we can say that the network with more possible routes is more resilient, which means that if we want to make network resilient, we should make as much connections as we can. So, the network with maximum number of edges is most resilient, e.g. most protected network. In order to be defined that the network is most protected, we should start from the assumption that each node has the same exposure to the external disruptions. There are two main perspectives on assessing vulnerability of the networked system which are derived from the answer to two questions for a given element or group of elements: What is the probability that the element is disrupted and what would be the effects for the system?. The answer of the first question refers to an exposure of certain elements. The answer on the second question is related to a measure of an importance. [6]

On the contrary, it does not mean that the network with more edges is the optimal one by any mean. The Braess's paradox is a typical example. [7] A natural measure for the performance of a network used by selfish agents is the common latency experienced by users in a Nash equilibrium. Braess's Paradox is the counterintuitive but well-known fact that removing edges from a network can improve its performance.

If the goal of network design is its resilience, the network should have many edges. On the other hand, the network designer should take into account the network optimization, which usually collides with previous goal. And finally, the design of the fully connected network is almost impossible to implement, as the costs of such network are very high.

An expected approach is to consider the multi-objective optimization problem in which optimization and protection are maximized simultaneously, where the network could be optimized for efficiency, for example. The multi-objective approach cannot find the optimal network but instead produces the Pareto frontier of each design the set of network configurations that cannot be improved without sacrificing either efficiency or resilience. The decision maker can use the frontier to make the optimal trade-off between resilience and efficiency. [10]

IV. NETWORK DISRUPTIONS - CASCADE-BASED

There is a great deal of interdependency between the Information Infrastructures and a number of the functionaries within the other CIs. Almost all of the infrastructures have critical requirements for communications of any form. [4] On the other side, the communications community has a number of instances where they are dependent on the other infrastructures, what leads to the conclusion that communications is a key infrastructure, central to all others, so that understanding and modeling the risk due to communications disruptions is a high priority for enhancing public safety and infrastructure resiliency. [2] In general, cascading across infrastructures can occur in almost any order, but communications have always been a central component surrounding the disruption and are especially important in mitigating the disruptive effects.

A fundamental property of interdependent networks is that if comes to the failure in some element of one network it may lead to failure of dependent elements in other networks. This may happen in series and can lead to a cascade of failures. In fact, a failure of a very small fraction of nodes in one network may lead to the complete fragmentation of a system of several interdependent networks. [8]

The classic literature on cascades includes two basic models: percolation cascades and capacity cascades. In percolation phenomena, nodes are assigned properties which are changed by the influence of their neighbors. For example, an infected node can pass the infection to its contacts in the network. The capacity cascades are characteristic of capacitated networks, such as power transmission systems and supply chains. Cascades occur when due to failures the flow can no longer be carried by the edges within their capacities or when some of the supply nodes fail [9-11].

It is shown that owing to the fact that diverse infrastructures such as water supply, communications, transportation, fuel and power stations are coupled together, interdependent networks are extremely sensitive

to random failure, such as a random removal of a small fraction of nodes. In many growing networks some nodes evolve to become much more important than others. From a global perspective, the important nodes are those whose removal may either cause the network to fragment or severely limit the communication between the other nodes. [6-8, 12]

V. ACTIVE VS. TOPOLOGICAL CASCADE RESILIENCE

Recently, a great attention is oriented to the analysis of the resilience of the various types of networks. Different networks behave differently in the case of removing nodes and links, and also there are various ways how nodes or links can be removed. It has been shown [13] that scale-free networks¹ are resilient to random failures, while fragile to intentional attacks. That means, intentional attack on the group of nodes with the largest degree will increase the average shortest path length greatly. On the other hand, random networks² show similar performance to random failures and intentional attacks.

The network robustness is usually measured by the average node-node distance, the size of the largest connected subgraph, or the average inverse geodesic length named efficiency as a function of the percentage of nodes removed. Efficiency has been used to evaluate how well a system works before and after the removal of a set of nodes. [14]

There are two types of cascade resilience approaches recognized: "active" and "topological". An active resilience is such that the network is monitored for cascades and if the cascade is detected, something or someone automatically making an attempt to stop it while in progress. For example, in case of human pathogens, health authorities may continuously monitor hospital records for contagious diseases. If the records begin to show anomalous increases, various responses are initiated, including distribution of medicines and alerts to the public. [10] Similar to that, special devices in power distribution systems can be installed to monitor the network and to search for the anomalies. After the identification of certain anomaly, the power system "relays" can automatically shut down lines or nodes and isolate them from the rest of the network.

Contrary to these two examples, there is another "topological" approach to resilience, where only the topology (i.e. the pattern of connections) is used to increase cascade resilience. For example, a network could be built from the group of modules, which are interconnected. As a result, a failure in one module might dissipate before it reaches any other module. The major advantage of the topological resilient network that is more simple and robust than "active" approach. The network protects itself, without the need for automated decision system.

¹ Many large networks are scale-free: including World Wide Web links, biological networks, and social networks. Their degree distribution follows a power law for large k .

² Random graph (random network) is defined as N nodes connected with n edges which are chosen randomly from $N(N-1)/2$ possible edges.

VI. A METHOD FOR CRITICAL INFORMATION INFRASTRUCTURE PROTECTION

In the paper a method for critical infrastructure protection which is based on the identification of the critical elements (critical routes within the network, and the recognition of the most important nodes) is proposed. This approach is based on the fact that dependencies on critical information infrastructures causing the network to behave on the rules of the percolation phenomena. Furthermore, this approach gives additional information on causes of certain importance of the nodes and provides the decision maker with more options for decreasing or increasing the importance of nodes, and therefore making the network more resilient.

This method uses network theory, specifically the determination of the longest routes between couples of nodes, and assessment of the importance of certain nodes in those routes. We started from an assumption that an important node is one that affects the most other nodes in the network. In this approach, three steps in the process of assessing critical elements are recognized: network defining, identification of routes, identification of critical nodes.

Network defining – The network of infrastructural elements can be denoted by the number of nodes and by the number of edges. The obtained graphs can be described by the adjacency matrix, whose entry is equal to 1 when there is an edge between nodes and 0 otherwise.

Identification of routes - In the second step we identify the longest routes between all couples of nodes which represent critical paths. It is assumed that the graph is directed and acyclic. There are many algorithms that can be used to solve this type of problem: Floyd-Warshall [15], Bellman-Ford [16] or Dijkstra [17]. Any of these algorithms can be used to solve the shortest paths problem. Although they are algorithms for finding shortest paths, they can be altered to find the list of shortest paths. So, when all shortest paths are found, the path which is the least "short" is actually the longest one.

Identification of critical nodes – in percolation phenomena, the node is affected by the state of its neighboring node³. Consequently, the most important node will be one that has most successors, or the nodes that his state could be transferred to. Using some of the algorithms for finding of the longest paths, we can list all longest paths between all pairs of the nodes. Regarding all the paths, the node that has the biggest number of followers is one that is most important. The importance of other nodes can be assessed in the similar way.

VII. CONCLUSION

The proposed approach for identification of critical nodes in the network has an additional advantage as it gives information on the reason of importance. In other words, the proposed method is not just an assessment tool, but an analytical tool that can tell the cause of network resilience level. It can give the hints to network designers

³ In this case, the neighbouring node is predecessor of certain node in one of the longest paths.

how to change links and regroup nodes making it more resilient.

For example, this method used in the assessment or design of certain infrastructure of connected elements, may help the network designer or analyst to discover that some elements have a large impact on others. In that case regardless of the type of elements (physical, cyber or human) an analyst can suggest changes in physical connections or business procedures, that make such system more resilient. The goal of potential changes is to reduce the long paths of dependencies among networked elements, and protect the system from collapsing when one or a small number of elements are disrupted.

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Integrating RFID-Based Classroom Management System into Quality Assurance System

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Abstract – Introduction of quality assurance standards and procedures in higher education creates new opportunities for improvement of educational quality, but also introduces new demands for data collection and analysis. In order to reduce administrative burden and automate certain routine but time-consuming tasks, higher education institutions use available technology to support their activities. In this paper we propose a system designed for automation of classroom management tasks using Radio Frequency Identification (RFID). Apart from the common features available in similar RFID attendance systems, the proposed system provides useful data to external systems and enables integration into quality assurance system at a higher education institution. The complete system was designed and tested at the Faculty of Electrical Engineering East Sarajevo. Preliminary results of testing showed proper operation of the system and introduced a possibility for its wider application in higher education environment.

I. INTRODUCTION

With increasing demands for data collection and reporting on teaching process quality, daily tasks of teaching staff at higher education institutions (HEIs) are being overwhelmed with more ‘administrative’ activities actually leaving less time for their primary job - teaching and research. In order to reduce administrative burden and automate certain routine but time-consuming tasks, HEIs use available technology to support their activities [1-4].

This paper presents a system designed for automation of daily tasks in higher education environment using Radio frequency identification (RFID). RFID is widely used today as a technology that enables identification and tracking of objects in different applications. The first commercial applications of RFID were introduced in the field of electronic article surveillance in the late 1960s [5]. At the beginning, RFID was mostly used as replacement for traditional bar-code technology for tracking objects in supply chains, manufacturing and logistics, but its application spread out to many other areas like health care, transport, access control and security, agriculture, libraries and education. One of the first applications of RFID in education was the automated students’ attendance register in elementary schools [6]. Today’s use of RFID in education include attendance recording, person identification, security and access control, e-money usage, tracking test booklets, reducing energy consumption and tracking assets. Beside the automated students’ attendance registration, which is a common application of RFID in education [1-4], the proposed system provides automated

recording and reporting on the number of teachers’ held classes and use of classroom resources. Apart from efficient classroom management, the system also provides integration into quality assurance (QA) system of a HEI and collaboration with other systems using web services.

Although some efforts have been done to integrate RFID into quality management systems in manufacturing [7] and construction material inspection [8], similar applications of RFID in education are not available in the literature. The goal of this paper is to present the concept of the system and intended use, its main components, and preliminary results of testing the system in one computer laboratory. The system was designed, prototyped, and tested at the Faculty of Electrical Engineering, University of East Sarajevo (FEE).

II. QUALITY ASSURANCE IN HIGHER EDUCATION

Quality assurance is a high priority issue in higher education worldwide. In the European Higher Education Area, QA is set as one of the main tasks for HEIs in the framework of the Bologna process. In order to improve the quality, HEIs are required to continually collect, process, and analyze huge amount of data from the teaching process, and to react upon results of the analysis.

Students’ attendance to classes is an important factor that could affect student success and academic performance. The attendance is usually incorporated into student grades, but it could also be used for deeper analysis of student progress and success, exam passing rates, and results of student evaluation of teaching quality. However, manual recording of students’ attendance is a tedious and time-consuming task. Beside the students’ attendance data, other data that could affect the quality are being collected and analyzed by HEIs, like teaching performance of the teaching staff, quality and availability of teaching resources, as well as employment rates of graduates [9, 10].

Information systems play crucial role in almost all the areas of human life. Higher education is not an exception, especially in the QA context. QA introduces new demands for information systems at HEIs since it requires continual collection and analysis of large amount of data from different sources and from different stakeholders. In order to save time and resources, this process should be highly automated, efficient, and supported by available technology. With the RFID-based system proposed in this paper we try to make a step forward in this direction.

III. THE SYSTEM DESIGN AND INTENDED USE

The proposed system was designed for integration into existing university information system (IS) and support to QA subsystems, but it also provides completely standalone operation. The main functions of the system are: (1) recording students' attendance to classes (2) recording the number of teachers' held classes (3) recording classroom resources use (4) providing reports on recorded data and (5) providing data to external systems. An architectural diagram of the system is shown in Fig. 1. The system consists of RFID readers, communication infrastructure, and RFID server. The RFID readers are placed at classrooms' entrances. They communicate over Ethernet Local Area Network (LAN) with the RFID server. The RFID reader is a microcontroller-based hardware device designed to perform following tasks: (1) reading teachers' and students' RFID tags (2) communication with the RFID server and (3) performing actions according to the RFID server response. The RFID server is a computer running software for communication with the RFID readers and recording received data into the database, providing web-based user interface to the system, and providing web services to external systems.

Students and teaching staff are provided with RFID tags for the purpose of recording their presence in classroom resources (e.g. classrooms, laboratories). Recorded data are used to provide a number of reports on students' attendance, teachers' work in class, and use of classroom resources. The reports are available to faculty administration, teaching staff and students through a web-based application.

An innovative application of the system is a possibility of its integration into QA system and support to special QA subsystems (QASs) of the IS. The role of the proposed system in this context is to provide additional data that could be used in QASs and correlated with data from these systems. For example, the Student Evaluation

subsystem is used at the FEE to conduct electronic student evaluation of teaching quality at the end of each semester. For deeper analysis of student evaluation results, it could be useful to take into account students' attendance to classes. However, the problem is that the students' attendance data are not available at the time of conducting student evaluation because the teaching staff record the attendance manually and there is no electronic attendance record at the faculty level. The data provided by the RFID system could be used to solve the problem. Similar applications are possible in other QASs, like Business Intelligence subsystem that is used for analysis of student success, exam passing rates, and many other teaching quality indicators.

The data on teachers' work hours in class and data on use of classroom resources could also be used to improve analysis of the teaching process quality and eventually identify shortcomings. Since the teachers' performance and classroom resources are subject of student evaluations, the data could be used to help in better understanding of the student evaluation results and to subsequently introduce appropriate measures towards improvement.

IV. IMPLEMENTATION DETAILS

A. Hardware

Hardware part of the system is composed of passive RFID tags, RFID readers, existing LAN infrastructure, and a server equipped with accompanying software. The RFID reader consists of microcontroller board, RFID reader module, and a power supply module. The RFID reader device (Fig. 2) was designed and prototyped at Embedded Systems Laboratory of the FEE. A special printed circuit board was designed and fabricated for the purpose of interconnecting the modules of the RFID reader, placement of the microcontroller and additional discrete components. A microcontroller that is used in the system is the PIC18F86J60 with an integrated Ethernet module. A 125 kHz RFID module is used for reading data from RFID tags. This module is a pre-built low-cost component that could be connected to external systems by serial interface. The system uses standard read-only 125 kHz passive RFID tags available in form of key fobs and RFID cards. The tags store 64 bits of data in common EM4100 format. The reading range of the tags is about 2-4 cm. Signalization is done by two LEDs mounted on the front plate of the RFID reader and a buzzer located inside the housing. Successful reading of an RFID tag is indicated by lighting the green LED and a short sound of 0.5 s length, while unsuccessful reading is indicated by lighting the red LED and two sounds of 0.5 s length. Successful reading of an RFID tag means that it was found in the system database and its owner was allowed to perform an action (e.g. open new class session, register student attendance). Existing LAN infrastructure is used for communication between the RFID readers and the RFID server. The RFID readers are assigned static IP addresses and registered in the properties of classroom resources in the database. Power supply for the RFID readers is provided through LAN UTP cables by Power over Ethernet (PoE) enabled Ethernet switches eliminating

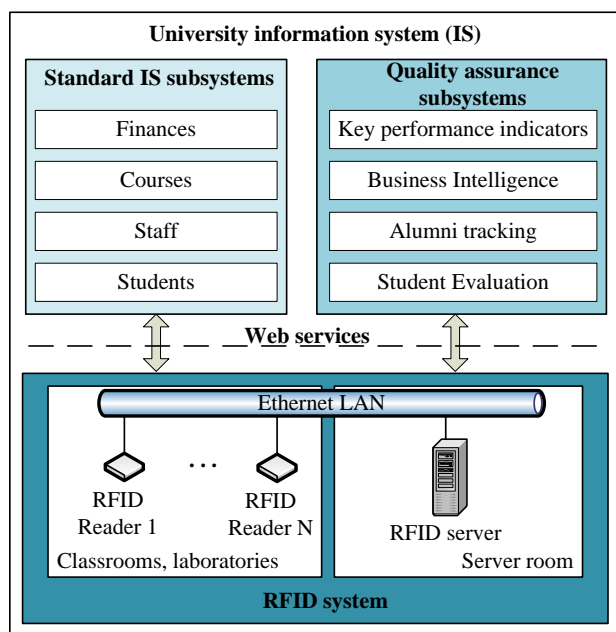


Figure 1. Architecture of the system



Figure 3. A prototype of the RFID reader mounted at computer laboratory entrance

the need for providing external supply for the RFID readers. A PoE adapter located inside the RFID reader housing is used to provide necessary supply voltage to the RFID reader. For the prototype implementation, a pre-built PoE adapter was used, but it will be replaced with the on-board PoE adapter in later phase. In case when a PoE Ethernet switch is not available close to RFID reader location, a PoE injector could be used to provide supply through a LAN UTP cable.

B. Software

Software part of the system consists of the server software (Linux operating system, MySQL database server, and Apache web server), the software for communication between the RFID readers and the server (Listener), the web-based application for managing the system, displaying recorded data and providing reports (Web GUI), and the web service component responsible for providing the data to external systems. The RFID server block diagram is shown in Fig. 3.

The Listener communicates with the RFID readers using UDP protocol on desired configurable port. A pair of UDP datagrams is exchanged between the RFID reader and the Listener every time an RFID tag is read. Based on the tag ID and the IP address of the RFID reader, the Listener performs appropriate actions (e.g. performs search or stores data into the database) and returns an

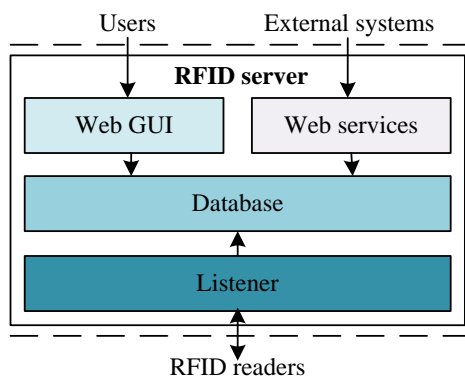


Figure 2. A prototype of the RFID reader mounted at computer laboratory entrance

answer to the RFID reader. The answer contains the status code that is used for performing actions by the RFID reader (e.g. sound and light signalization of success or failure).

The Web GUI was developed using PHP programming language and CakePHP rapid web application development framework. The main functions of the Web GUI are: managing classroom resources, managing users and RFID tags, providing reports on students' attendance, teachers' work in class, and use of classrooms and laboratories. The Web GUI also functions as a web service consumer and is capable of importing existing data from proprietary information systems.

The web services component was also developed using CakePHP framework. This component provides REST (Representational State Transfer) web services that are capable of returning various representations of resources, such as JSON (Javascript Object Notation), XML (Extensible Markup Language), or simple text. In this way, the data stored by the RFID system are easily made available for use in other systems.

V. PRELIMINARY RESULTS AND DISCUSSION

The system was tested during real operation in one computer laboratory at FEE that is used by students of the first two years of study and their teaching staff. The laboratory has a capacity of 24 workplaces based on one student – one PC approach. However, additional seats are available in case of even larger student groups. Students and teaching staff were assigned RFID tags and registered in the system using the Web GUI. Number of students that attended classes in the laboratory is shown in Fig. 4. It could be seen that in several cases the laboratory was used over its planned capacity. A total number of students that used the laboratory per days is shown in Fig. 5. Similar reports could be also generated for individual teachers, course units and students.

Results of the testing showed proper operation of the system, but also revealed some issues to be solved in the future. For example, the currently designed operation of the system supposes that teacher's RFID tag is used first to open new class session. Only after the class session was opened, students' tags could be registered. In many cases, students use classroom resources without presence of teachers, like in laboratories opened for students after working hours. In these cases, in order to register students' attendance and use of the resources, the logic of the system should be slightly modified to provide appropriate operation of the RFID reader according to properties of classroom resources. Other possible issues are related to acceptance of the system and misuse by students and teaching staff.

A limitation of the testing procedure was in the fact that only one RFID reader was used. It is planned to install RFID readers in all classrooms and laboratories that are used by students and to automate classroom management tasks at the faculty level. In this situation, multiple RFID readers will concurrently communicate

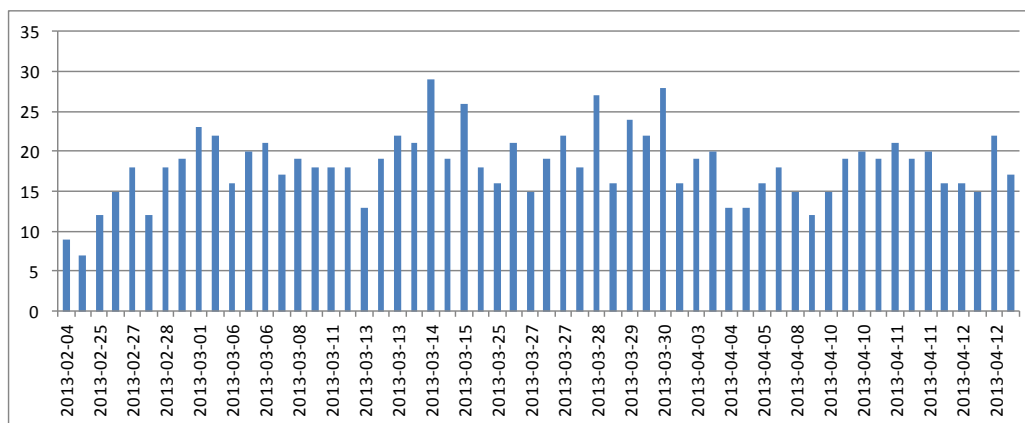


Figure 4. Number of students per classes

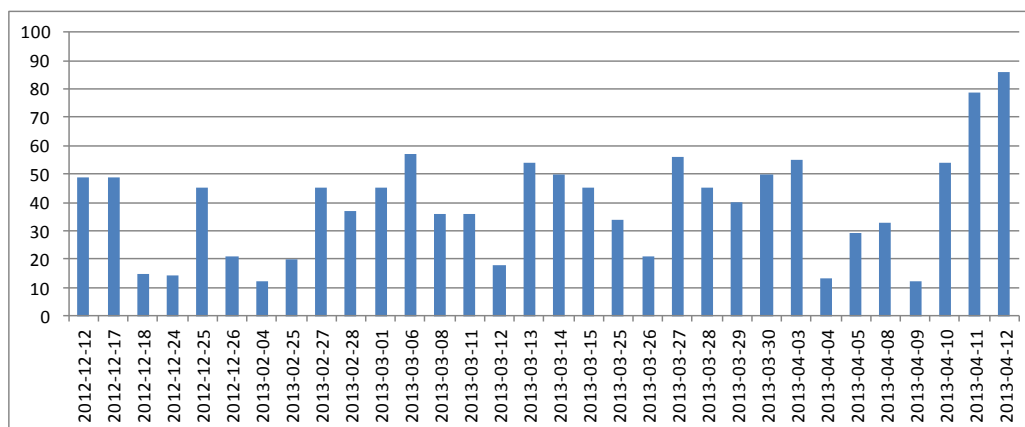


Figure 5. Number of students that used the laboratory per days

with the Listener. To assure proper functioning of the Listener software, separate software was developed to simulate operation of the RFID reader. The software generates test UDP datagrams based on the set of data registered in the database. The test traffic was generated from several instances of the test software running on different computers and simulating the real operation of RFID readers. The data on generated test traffic were saved into log files on each computer in order to compare it to the data received by the Listener. Results of testing showed successful operation of the Listener in a simulated environment during concurrent communication with software-simulated RFID readers. The test results suggest that the operation of the Listener should also be successful while working with multiple real devices.

VI. CONCLUSION

This paper presented an RFID system designed for automation of classroom management tasks and supporting quality assurance in higher education environment. The system hardware and software components were designed and prototyped at the FEE. Beside the common features available in similar solutions, the system enables integration into quality assurance system and interoperability with other systems by using web services. The system could significantly improve efficiency of daily classroom management tasks at HEIs.

It is also a low-cost, scalable, and flexible solution. Preliminary results of testing the system showed good operation of hardware and software and suggested that the system could be successfully applied in higher education environment. Plans for the future work include enhancement of the Listener logic and placement of main components of the RFID reader on a single board what will result in lower dimensions and even lower cost of the system.

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Technical and Regulatory Aspects of Vectoring Deployment

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Abstract – This paper deals with the deployment of vectoring as a possible solution implemented in the existing metal cable networks, in order to provide data bitrates required by end users. It gives definitions and technical characteristics of vectoring systems, compares performances of networks using and not using vectoring and shows the advantages and drawbacks of vectoring deployment. Finally, the paper discusses the experiences and regulatory approaches of several European countries and suggests the possibilities of implementing vectoring in the Republic of Serbia.

I. INTRODUCTION

The appearance of new broadband services (fast Internet access, video-on-demand, e-learning, e-business, on-line trade, media content distribution,...) requires faster data bitrates. Next Generation Access networks offer faster bitrates to the end users, compared to the classic access networks. Depending on technology, bit rates can be between several tens to a hundred and more Mbps. Figure 1. shows the services which can be realized, depending on the available bit rate and technology.

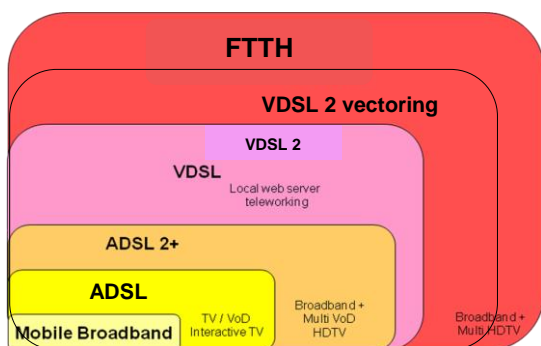


Figure 1. Access network technologies

Data bitrates, for each of the shown categories, depend on technology, subscriber line length and transmission medium quality, but they are subject to change due to the permanent enhancements of the mentioned solutions.

Access networks realized using optic fibre cables are considered as optimal solution for providing adequate

bandwidth in line with the demand of end users and the variety of offered services requiring high-speed data transmission. Examples of FTTx networks (FTTN – Fiber to the Node, FTTC – Fiber to the Cabinet, FTTB – Fiber to the Building and FTTH – Fiber to the Home) are shown in Figure 2.

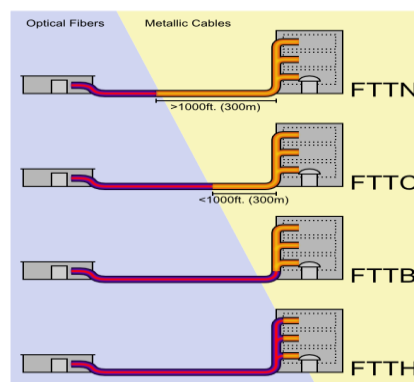


Figure 2. Examples of FTTx networks

FTTH (*Fiber to the Home*) is assumed to be the strategic solution for developing Next Generation Access networks. However, the deployment of this technology is often limited, for several reasons. Lack of room in the existing ducts and the need of significant investments are the most frequently encountered problems.

The existing xDSL (Digital Subscriber Line) broadband technologies enable increased throughputs of access networks based on metal cables, but crosstalk between the cable pairs prevents the maximum use of information capacity. If the crosstalk between the cable pairs can be cancelled, the bitrates can be significantly increased in case of short loops. The deployment of the transmission technology known as vectoring helped the metal cable based networks regain their importance. Vectoring offers several advantages over other technologies which enable data flow at similar speeds. Compared with the FTTH solution, vectoring can be implemented much faster, and with relatively lower deployment costs with respect to other technologies. Laying of optical cables all the way to the end users includes complex procedures and requires more time and significantly higher investments than vectoring applied in the existing network. Vectoring has been tested in several EU countries, and their experiences will be discussed in further text.

II. DEFINITION AND TECHNICAL CHARACTERISTICS OF VECTORING

A. Definition and Description of Vectoring

The International Telecommunication Union (ITU) ITU-T G. 993.5 Recommendation defines vectoring as a transmission method that employs the coordination of line signals for reduction of crosstalk levels and improvement of performance.[1]

Vectoring is a way to increase the access network (local loop) speed without investing into building an optical network. As shown in Figure 1., VDSL2 technology enabled the highest possible speeds over existing non-optical networks, until the introduction of vectoring. The disadvantages of VDSL2 technology are line length limiting (longer distance decreases the transmission speed) and the occurrence of crosstalk between cable pairs which disables the speed increase. When vectoring is applied over the existing VDSL2 lines, crosstalk (interference) between the lines is decreased, thus enabling much higher transmission speeds, comparable with the speeds achieved over optical networks. According to some estimates, the costs of introducing VDSL2 vectoring amount to one third of the FTTH solution implementation costs.

B. Technical Characteristics of Vectoring

The performances of VDSL2 links depend to a great extent on crosstalk, above all on Far End Xtalk. Crosstalk results from mutual electromagnetic interaction of twisted pairs, and its intensity increases with the increase in frequency and signal power. The effect of crosstalk on DSL lines is especially pronounced in case of higher frequency transmissions: for example, ADSL, which uses lower frequencies, up to 2.2 MHz, can be realized for longer distances than VDSL which uses much higher frequency bands, up to 30 MHz. Figure 3. shows the schematics of links for ADSL2 and VDSL2 lines. Using higher frequencies enables larger bandwidths, but the effect of crosstalk between lines is also more pronounced, so that, due to interference, the performances of VDSL2 lines can be degraded up to 70% with respect to the performances of the interference free lines. [2].

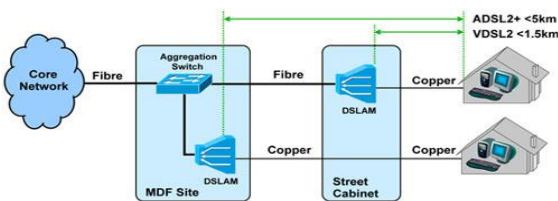


Figure 3. ADSL2 and VDSL2 lines

In the course of applying VDSL2 vectoring, the calculation of interference among all pairs is performed and noise suppression signals are generated for each single pair, which results in successful crosstalk

cancellation, Figure 4. [3]. The implementation of VDSL2 vectoring technology assumes that the DSLAM (Digital Subscriber Line Access Multiplexer) cabinet is connected to the existing metal cables.

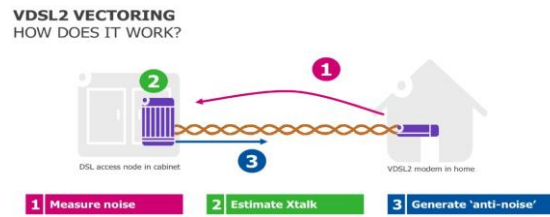


Figure 4. Vectoring implementation diagram

Software upgrading of the existing VDSL2 modems is necessary in order to avoid negative influence on the new vectorized lines. Each „nonvectorized“ cable pair (for which the crosstalk noise is not cancelled) can disturb other pairs and impair the functioning of the VDSL2 service. Maximum results are achieved if all cable pairs are „vectorized“. Figure 5. shows to what extent the presence of „nonvectorized“ cable pairs degrades the performance of vectorized VDSL2 lines.

From the diagram shown in Figure 5. it can be concluded that best results are achieved if all VDSL2 lines within the cable are monitored by the same vectoring system, which controls and cancels interference in all cable pairs.

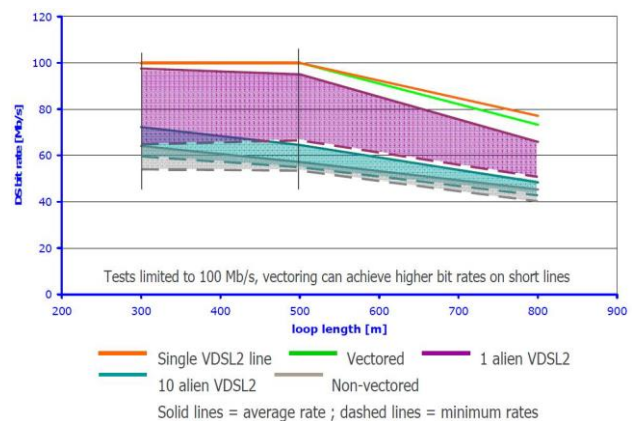


Figure 5. Dependence of the down-stream bitrate on the presence of nonvectorized lines

In that case, the bitrate over one vectorized VDSL2 line is almost identical to the bitrate achieved if there was only one user in the cable and there was no interference from other lines. Under the conditions of the unbundled local loop, the VDSL2 vectoring concept cannot be successfully implemented. It is impossible to cancel crosstalk, i.e. interference between VDSL2 lines of different providers which terminate on different DSLAMs, but are located within the same cable. The figure shows that only one „nonvectorized“ line decreases bitrate over „vectorized“ VDSL2 lines by 5 to 10%, depending on the distance. The greater the number of „nonvectorized“ lines, the greater the degradation of the

vectorization effect. 10 „nonvectorized“ lines decrease the bitrate down to 30% of the maximum possible.

III. VECTORING DEPLOYMENT AND REGULATORY APPROACH

In many countries where it is not possible to provide optical fiber to the subscriber, vectoring is now being considered as one of possible alternative solutions aimed at improving the capacity of the existing VDSL2 lines at significantly lower investment costs. The necessary infrastructure capacity is not a problem, since vectorization is performed over the existing metal cables. The limitation of the subscriber loop length is a problem, since, if optimal results are wanted, it should not be longer than 500 m in this case. Another extremely important problem results from obligations defined by the EU directives, *Directive 2002/19/EC of the European Parliament and of the Council of 7 March 2002 on access to, and interconnection of, electronic communications networks and associated facilities (Access Directive)* [4] and *Directive 2009/140/EC of the European Parliament and of the Council of 25 November 2009 amending Directives 2002/21/EC on a common regulatory framework for electronic communications networks and services, 2002/19/EC on access to, and interconnection of, electronic communications networks and associated facilities, and 2002/20/EC on the authorisation of electronic communications networks and services* [5]. Obligations imposed on the basis of the data and conclusions related to the analysis of wholesale access to network elements and associated facilities market (market 4), which stipulate Local Loop Unbundling (LLU) and Sub Local Loop Unbundling (SLU) are a limiting factor for vectoring implementation. It has already been mentioned and shown in figures that, if the local loop is unbundled and some subscriber lines are removed from DSLAM which is being vectorized, the quality and bandwidth of the remaining „vectorized“ lines are degraded. Regulatory bodies find themselves in a difficult position, having to decide between stimulating competition and open market by forcing loop unbundling, and promoting better quality of service to the end users over the existing infrastructure.

Experiences of several European countries will be discussed in further text, as well as regulatory and technical solutions implemented in Netherlands, Austria Germany, and Italy.

Netherlands

In the Netherlands, they started deploying VDSL2 via FTTC (Fiber-to-the-Curb) in 2008. In 2012 they started the exploitation of VDSL2 pair bonding from the central office to the end user, using 2 lines per household. In both cases they achieved bitrates of up to 50 Mbps. At the end of 2012, they initialized trials of VDSL2 line vectoring via FTTC, which resulted in achieving the bitrate of up to 100 Mbps. Bitrates between 150 and 200

Mbps can be realized by combining of vectoring with pair bonding, but it is still in the experimental phase.

The analysis of wholesale broadband access market (market 5) in the Netherlands showed that cable operators and FTTH and DSL providers shared the same market, without a dominant operator and with a satisfactory level of competition, so no regulatory measures were prescribed for this market. The deployment of vectoring initiated a question how to maintain the achieved level of competition without LLU and SLU. The regulator imposes on the network owner planning to deploy vectoring and the operator seeking local loop access to try to reach a commercial agreement about alternative solutions to LLU and SLU. In case they fail in reaching the agreement, the regulator resolves the dispute. The incumbent may only deny SLU access to entrants if at least they are offered appropriate and acceptable equivalent of SLU.

The dominant operator KPN is currently testing the implementation of vectoring on one location. There has been no commercial launch yet, and no demand for SLU access either. Interested parties are negotiating possible alternatives for SLU access, so that KPN can start offering vectoring services to the subscribers. [6]

Austria

In Austria, the operator A1 Telekom Austria is designated as SMP operator on market 4. Approximately 270,000 of all lines are fully unbundled [7], which is 10% of the total number of lines. The number of unbundled sub-loops is much smaller, approximately 200 lines. The explanation for the low usage of sub-loop unbundling is a rather low household density. Regulatory remedies to be carried out by the SMP operator on this market are, among other, local loop unbundling, sub-loop unbundling and shared use of copper lines, access to ducts and dark fiber, virtual unbundling for FTTC/B/H, price control, accounting separation and non-discrimination. According to the draft decision prepared by the Austrian regulatory body, A1 Telekom Austria is not obliged to provide SLU on locations/cables where VDSL2 with vectoring is already in use, or planned to be used within the 6 month period. This operator is obliged to offer a wholesale virtual unbundling product as an alternative to sub-loop unbundling. Any operator wishing to use vectoring has to reach an agreement with all other interested operators.

Figure 6. shows the percentage of Austrian households covered by the next generation access (NGA) networks and by vectoring. This coverage has reached 55% in 2013, 2% thereof using vectoring. The estimate for 2016 is that 60% of households will be covered by NGA networks, thereof 9% by vectoring. [7]

NGA Infrastructure Will Cover 60% of Households by 2016

Total Household Coverage
(In 000; in % of total households)

	2013		2016	
	Households	%	Households	%
FTTEx (completed 2012)	1,820	43%	1,806	42%*
FTTC, FTTB & FTTH	530	12%	740	17%
thereof Vectoring	80	2%	375	9%
Total	2,350	55%	2,550	60%

Figure 6. Current and planned NGA and vectoring coverage in Austria

Germany

Deutsche Telekom (DT) is the incumbent operator in Germany. During 2011 the market 4 regulatory remedies were imposed on the dominant operator and obliged him to unbundle local loops (LLU and SLU). Broadband access was primarily realized via ADSL and VDSL devices. In the period between 2006 and 2009 DT enabled the deployment of VDSL2 technology in 50 German cities [8], covering 10.9 million households. According to the available data [9], at the end of the first quarter of 2013, DT had approximately one million of VDSL subscribers, meaning that only 10% of the households which were offered this operator's VDSL technology used this type of access. Alternative operators currently use approximately 9.4 million LLUs, primarily offering ADSL devices. The number of leased SLUs is much smaller, estimated at 150 thousand lines, thereof 100 thousand using VDSL2 and 50 thousand using ADSL.

At the end of 2012 DT announced the 6 billion Euros investment in the period between 2014 and 2016, in order to connect 65% of German households with bandwidths up to 100 Mbps, by FTTC and VDSL2 vectoring. [8].

In April 2013, the German regulatory body, BnetzA, initiated public consultations about regulating the obligations of the SMP operator on market 4, with respect to the implementation of vectoring. On 29 August 2013, after the public consultations were closed, BnetzA adopted a decision which defined the rights, obligations and procedures for DT and alternative operators (ANO) to follow in vectoring implementation. The decision covers procedures and requirements for the following cases:

- DT deploys VDSL2 vectoring first,
- ANO deploys VDSL2 vectoring first,
- DT withdraws already granted access to frequencies above 2.2 MHz.

The decision also stipulates which requirements must be fulfilled in offering WBA (*Wholesale Broadband Access*) service, and that Deutsche Telekom's reference offer must be approved by BNetzA.

DT must maintain a Vectoring List, including all street cabinets where VDSL2 vectoring is already deployed or planned for the next year for DT and ANO,

and the access rights as well. The decision defines transitional provisions which set the procedures during the period allowed for the operators adapting to its requirements. [9]

Italy

Telecom Italia was designated as dominant operator on market 4 in 2001, and the obligation of both Local Loop Unbundling (LLU) and Sub Local Loop Unbundling (SLU) was imposed. The incumbent's market share is 98%. There are approximately 5 million LLUs, but there were no requests for SLU until 2012. During 2012, one operator applied for the activation of a small number of SLU lines, and another is in the negotiating process with the incumbent. Both the incumbent and ANO are developing NGA networks, but the percentage of activated lines is significantly different. *Telecom Italia* has covered 30 municipalities with 3 million households by its optic fibre network (mainly FTTC). The number of active lines is 5 thousand only. The alternative operator Fastweb is present with its, mainly FTTH, network in 20 municipalities with 2 million households, but with as much as 270 thousand active lines, a much higher percentage of activated lines than the incumbent.

During the III round of market 4 analysis, the regulatory body AGCOM took into consideration the impact of vectoring on metal cable based networks. The advantages of vectoring are creating a favourable environment for investing in new technologies, and thus accelerating the realization of NGA networks in order to make the planned capacities available in a shorter period of time. The disadvantages of this approach are curbing the competition and limiting the use of SLU by alternative operators. AGCOM has held preliminary hearings with the operators and main telecom equipment vendors, Alcatel-Lucent and Huawei Technologies, related to the possibility of co-locating several operators who use vectoring. For the time being, there is no multi-operator vectoring equipment available on the market, but the solutions which will ensure compatibility of equipment and DSLAM devices are expected in the near future, thus providing access to the copper sub-loop to more than one operator without affecting the performance of vectoring.

In April 2013, AGCOM prepared a draft decision, currently under public consultations. The draft decision confirms the incumbent's obligation to provide SLU, except for cabinet areas where *Telecom Italia* has announced its intention to implement vectoring, where there are no SLU active lines nor requests for SLU service and where *Telecom Italia* provides virtual unbundled local access (VULA) at the cabinet level at cost-oriented prices. *Telecom Italia* must also publish the list of cabinet areas where it plans to implement vectoring, at least six months before the implementation is scheduled. If the alternative operator promptly requires the SLU service in the same cabinet areas, it is

recommended that the parties find an agreement for a coordinated implementation of vectoring. [10]

IV. VECTORING IMPLEMENTATION IN THE REPUBLIC OF SERBIA

According to the Law on Electronic Communications of the Republic of Serbia, the SMP operator on market 4 is obliged to provide access to network elements and associated facilities, including LLU, to other operators. Following the market 4 analysis completed in November 2011, the Republic Agency for Electronic Communications (RATEL) adopted a decision which designated Telekom Srbija a.d. as dominant operator on this market and imposed appropriate remedies. [11]. Acting in accordance with RATEL's decision, Telekom Srbija a.d. published the Reference Unbundled Offer in May 2012 [12], which came into force on 1 June 2012. Sub-loop access, relevant for vectoring implementation, is not covered by the reference offer. If vectoring is considered as a transitory solution towards NGA networks, it is necessary to adopt adequate regulatory measures which will stipulate SLU obligation.

Bearing in mind the significant number of operators who offer media content distribution and Internet access at bitrates up to 100 Mbps, the regulator must take care of the fact that there is serious competition in providing broadband access, in areas covered by cable networks.

In the process of adopting measures, the regulator analyzes the following:

- advantages of implementing vectoring over Telekom Srbija's network, from the standpoint of broadband services users' requirements,
- availability and capacity of cable networks,
- development requests and establishment of conditions for investments in FTTH networks.

The above mentioned considerations lead to the conclusion that vectoring regulation is a new issue, and that regulatory bodies do not share the same opinion about it. They are expected to coordinate their approaches related to the use of SLU by several operators deploying vectoring in the near future.

CONCLUSION

Based on the experiences of EU countries in which vectoring is being introduced or planned, it can be concluded that this technology is intended for networks suffering from lack of duct capacity, where it is necessary to provide higher bitrates over the existing incumbent's infrastructure. Advantages of introducing vectoring are relatively low implementation costs, much lower than investments into new optic fibre networks, and the realization dynamics, better than for other solutions. Disadvantage is the inability of achieving satisfactory SLU performances based on currently available technical solutions, which has a negative impact on competition stimulation and market development. The overall conclusion is that optic fibre networks are the best quality

solution for building NGA networks, since they can provide necessary bitrates, while vectoring deployment can be considered in cases where timeframe, investment costs and available infrastructure capacities are limiting factors.

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Android Application for Data Acquisition

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Abstract - With the aim of expanding the methods for disaster prevention, the idea of utilization of smart phones and tablet computers for data acquisition is in the phase of development. Within The Disaster Risk Reduction Research Center at the Faculty of Technical Sciences in Novi Sad, Android application which could support data that concern location, text and image of the identified place of the potentially adverse situation is in progress. This application should be an extension of overall architecture for a disaster monitoring concept. In this paper, we present the basic concepts of the application and an example of its functionality.

I. INTRODUCTION

Every year, disasters of high severity occur that destroy lives and impoverish communities [1].

Identifying the risks of disaster occurrence and developing the strategies to reduce these risks has become one of the key tasks of the United Nations [2].

Disaster risk is a function of several parameters: hazard, vulnerability and exposure [3]. Spatial and temporal monitoring and analysis of these parameters is essential for disaster risk reduction. For this purpose we use variety of indicators.

Under the term indicators we comprise a number of data necessary for the disaster risk identification and assessment. These data can be obtained using several methods and sources including: satellite imaging, user-generated data, and ground sensing. The best results in disaster risk modeling are achieved by a combination of different sources and methods for data acquisition.

For example, within The Disaster Risk Reduction Research Center at the Faculty of Technical Sciences in

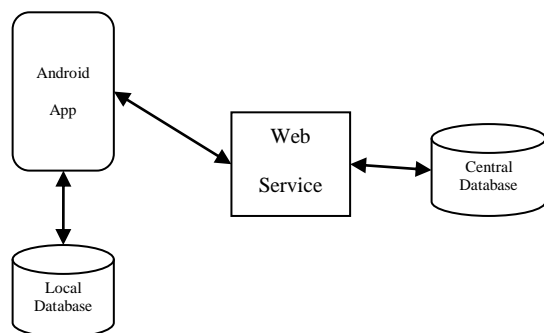


Figure 1. Overall system architecture

Novi Sad monitoring of indicators i.e. data acquisition is performed by remote sensing (fire indicators) and ground sensing (drought indicators). These data are automatically generated and stored onto the server.

With the aim of expanding the methods for disaster prevention, the idea of utilization of smart phones and tablet computers for data acquisition is in the phase of development. In fact, Android application which could support data that concern location (latitude, longitude coordinates), text and image data of the identified place of the potentially adverse situation is in progress. This application should be an extension of overall architecture for a disaster monitoring concept. This concept is comprised of experts (at least disaster risk and IT experts), server for data storage, technologies for data acquisition, web-based and mobile-based applications and on-field surveyors or experts. Main processes in the concept are acquisition, storage and sharing of data. Also, important aspect of the concept is the type and format of manipulated data. Because most of data in the context are location based it is necessary to respect prescribed standards for geospatial data in order to satisfy interoperability requirements. Utilization of up-to-date information technologies in the field of disaster risk monitoring and reduction provides a solid foundation for both experts in the field and public concerned. Also, reduction of time and costs for the above processes is not negligible.

II. APPLICATION DESIGN

The primary function of the application is data acquisition. The application is meant to be able to acquire data regardless of the status of the Internet connection. This is why the overall architecture of the system will look like shown in the Fig 1. Users will acquire some data. The data can be stored in a local database or transferred via Web service into the central database.

Users are volunteers/surveyors. The use case diagram for the user surveyor is given in Fig. 2. Surveyors have three options: to perform data acquisition, to manage acquired data (to preview, delete, update or upload it) and to preview the data they uploaded.

As mentioned earlier, surveyors have the option to perform data acquisition i.e. to document potentially adverse situations. The action diagram for this option is given in Fig. 3.

The surveyor receives the information about the potentially harmful event via the push notification service.

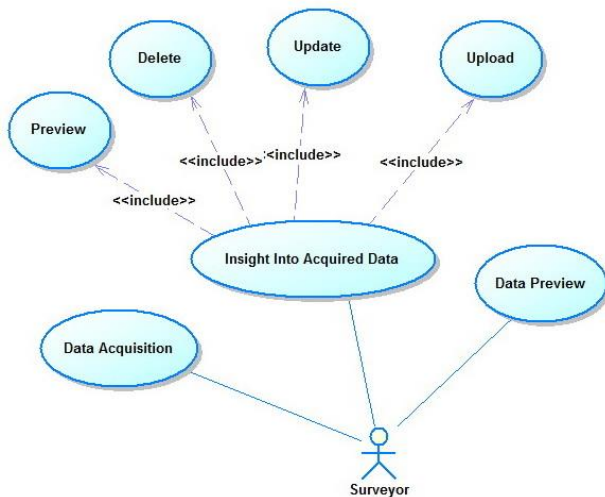


Figure 2. Use case diagram for the user surveyor

Within the notification, the event's coordinates can be found as well as the distance and directions how to get to the place of the event. When the surveyor gets to the indicated spot, he starts the application and chooses the data acquisition option. The user interface (UI) for this option should contain a button for acquiring coordinates, image uploader, text-box for the event's description and a "Submit" button.

When the surveyor presses the "Submit" button, JSON string is generated. Then, if there is an active Internet connection, this string is forwarded to the appropriate server. The surveyor gets the notification about the successful transaction and the URL with the acquisition result is opened in the device's default browser. It should be noted that the surveyor will not be able to see all the data he has entered, only the marked location. The rest of the data will become visible when the server administrator approves it.

In the case when there is no Internet connection, the application stores the string locally. The application will prompt the user to manage the unsent string next time when there is an active Internet connection.

Managing acquired data option refers only to strings that were not forwarded to the server. The UI should contain the list of unsent strings and buttons for previewing, deleting, updating and submitting the selected string(s). Unsent strings on the list will be named after the date and time of the creation. If the surveyor chooses to preview or update a string, UI for data acquisition will be opened with fields filled with the corresponding data.

The option for previewing uploaded data opens a map with all the uploaded data and the corresponding symbols. When the surveyor taps on one of the approved data, a pop-up should appear with supporting data (date, time, text and image). Unapproved data only have a static symbol.

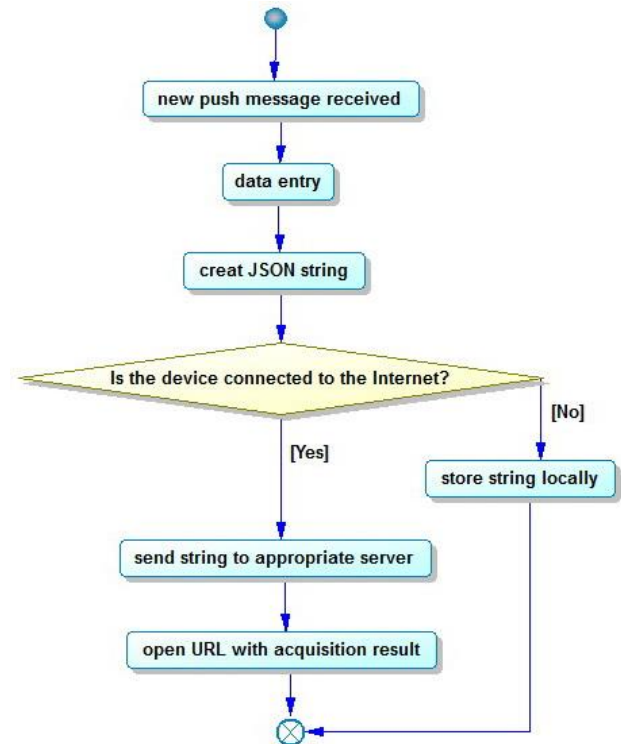


Figure 3. Activity diagram for performing data acquisition

III. APPLICATION IMPLEMENTATION

The targeted API level for the application is level 18, Android 4.3 Jelly Bean. Minimal API level is 8, Android 2.2.

For the purposes of data interchange, JavaScript Object Notation (JSON) is used.

JSON is a lightweight, text-based, language-independent data interchange format [4]. JSON defines a small set of formatting rules for the portable representation of structured data.

JSON syntax is a subset of JavaScript syntax, and it cannot represent all JavaScript values. This format is intended to serialize data structures and can handle JavaScript primitive values, arrays, and plain objects. It does not know about classes, and when serializing an object, it ignores the object's prototype and constructor. [5]

As mentioned above, JSON format supports two structured types: objects and arrays.

An *object* is an unordered set of name/value pairs also called members. A complete JSON data structure is always an object. For each member, the name is always a string. Member values can be primitive values, arrays or other objects.

An *array* is an ordered collection of elements where each element is a value as described above.

The reason why JSON format is getting more and more popular is the fact that it has a light format. It has a very simple syntax with no reserved words. It is a human readable text format that can be easy to write and to parse.

Since JSON syntax is a subset of JavaScript syntax, the JavaScript function `eval()` can be used to convert a JSON text into a JavaScript object. The `eval()` function uses the JavaScript compiler which will parse the JSON text and produce a JavaScript object [6]. The `eval()` function can compile and execute any JavaScript. This represents a potential security problem. It is safer to use a JSON parser to convert a JSON text to a JavaScript object. A JSON parser will recognize only JSON text and will not compile scripts. `JSON.parse()` is a global function for parsing JSON-formatted strings. Typically, you pass a single string argument and `JSON.parse()` returns the JavaScript value that the string represents [5].

The Android platform includes the `json.org` libraries which allow working easily with JSON files.

A. Data Interchange of Acquired Data

For the purpose of data acquisition, GeoJSON format for encoding geographic data structures is used. GeoJSON is a geospatial data interchange format based on JSON [7].

A complete GeoJSON data structure is always an object (in JSON terms) [7]. A GeoJSON object may represent a geometry, a feature, or a collection of features. In this case, feature object is used. Features in GeoJSON contain a geometry object and additional properties. Geometry object that is used for data acquisition is Point.

In the case of a Point geometry, the "coordinates" member of a geometry object is composed of one position. A position is represented by an array of numbers. There must be at least two elements and the order of elements must follow x, y, z order (longitude, latitude, altitude for coordinates in a geographic coordinate reference system).

The coordinate reference system (CRS) of a GeoJSON object is determined by its "crs" member. If no crs member is specified, the default CRS applies to the GeoJSON object. The default CRS is a geographic coordinate reference system, using the WGS84 datum, and with longitude and latitude units of decimal degrees.

In Fig. 4 is given the example of GeoJSON that will be generated as a result of data acquisition. For the purposes of the following example, default CRS is used.

B. Processing JSON within Android

In order to process JSON data from Android client to the database stored on the server, it is necessary to enable them to communicate with each other.

Representational State Transfer (REST) is a collection of guidelines for using the existing HTTP protocol to communicate information between a client and a server. REST takes advantage of the HTTP methods (POST, GET, and so forth), as well as statelessness and caching, to suggest a simple, scalable architecture suitable for a large number of web services [4].

Communication between our Android client and Web server will be based on REST. In our HTTP requests we

```

1  {
2    "type": "Feature",
3    "geometry": {
4      "type": "Point",
5      "coordinates": [
6        19.86,
7        45.158
8      ]
9    },
10   "properties": {
11     "created": "Fri Sep 13 13:10:19 +0100 2013",
12     "img": null,
13     "text": "TV toranj na Vencu.",
14     "verified": false
15   }
16 }
17

```

Figure 4. An example of GeoJSON

will include parameters of corresponding server, i.e. Internet Protocol (IP) address and a number of port reserved for this communication.

IV. CONCLUSION

In this paper, we presented the overview of the Android application for acquisition of data. This application is meant to be part of the system for disaster monitoring.

Whereas the application is in a phase of development, we presented the basic concepts of its design and implementation.

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Semantic Web Recommender System for e-Learning Materials

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Abstract – Recommendation systems help users find items they might be interested in. They are widely used in the products and services domain, but their benefits can be useful in other domains, such as e-learning. However, this domain has some specificities that should be considered when making a recommendation. In this paper we propose architecture for a Semantic Web recommender system for that uses user reviews of e-learning materials. The recommender system imports text user reviews from a Technology Enhanced Learning (TEL) portal, identifies useful information from them and stores data in a triple store. The background ontology provides support for modeling users, learning materials and reviews about them.

I. INTRODUCTION

The fast development of Internet and Web technologies has provided us with new ways to communicate, share information, shop and perform many other activities in our everyday lives. It is only natural that learning is included here. Although the old fashioned classroom approach has its advantages, Technology Enhanced Learning systems (TEL) can certainly help in the learning process and are especially useful in higher education [1]. TEL systems have many benefits, but the most important one is making knowledge available and accessible to a great number of users.

Due to the amount of available data on the Internet, finding the right information is becoming a difficult task. This is also true for TEL systems. They contain online courses on a number of subjects with multiple learning goals, each of which can have several attached materials. Finding the one that will fulfill the users need is difficult not only due the amount of data, but also because each user is different and has specific needs [2]. Recommender systems for TEL represent a potential solution for this problem.

Recommender systems [3] are a special class of information systems, whose basic purpose is to give recommendations about products or services the user may be interested in. They are usually based on using user feedback, i.e. rating that users give to selected products or services. One of the problems with this approach is the fact that users often can't give a precise rating in numerical form. They usually prefer free form for expressing their opinion. There are numerous researches whose aim is to develop a mechanism that will enable using these opinions in form of reviews to help users in

searching the catalogue or recommending and ranking offered products and services [3, 4].

The logic of recommender systems can be applied to TEL, only instead of product and services, the recommendations are about learning materials [5-8]. However, the TEL domain has some specificities that should be taken into consideration when making a recommendation. The relevance of a learning material is not determined solely by its topic and interestingness, but also by whether it enhances learning, i.e. its pedagogical features [9]. Therefore, reviews of learning materials should include ratings of pedagogical features and those ratings should be included into the recommending algorithm.

In this paper, we propose a recommender system for TEL that is based on user reviews. The background ontology describes the knowledge about the domain which contains information about e-learning materials, users and reviews. Text user reviews of learning materials are mapped to the ontology, with the option of extending the ontology with new classes of features that are detected in reviews. All information is stored in a triple store repository that includes a reasoner which enables easy searching of the information based on different criteria and inferring conclusions on dominant opinions about learning materials. The aim of the system is to recommend e-learning materials to a user, based on criteria defined in a search or his profile and on reviews about learning materials left by other users.

II. RELATED WORK

When we need to select one of multiple options in various aspects of our lives we rely on our own experience or ask someone for an opinion, i.e. recommendation. An excellent example is buying a new product, which is why many online shops include user comments about products they sell. Besides showing comments about selected product, they often also show the user recommendations of products similar to the one he is viewing, or products bought by similar users [10], i.e. other products he might be interested in. In TEL domain this is equivalent to recommending the user learning materials that might interest him – either highly rated materials that are similar to those he has viewed before or materials that were highly rated by similar users.

In the last decade there have been a great number of researches concerning TEL recommender systems, both

prototypes and full systems [11]. One of the first is the Alter Vista system [5]. Based on collaborative filtering, it recommends to its users resources and like-minded users as potential collaborators. QSIA [6] is a knowledge sharing system that enables ranking knowledge items and getting targeted suggestions of those items. Both instructors and students can rank knowledge items. CYCLADES [7] incorporates the service of automatic delivering of recommendations to the user. The recommendations can be collections, records, communities and users relevant to the user's specified topic of interest. ReMashed [8] provides a recommender system for Mash-up Personal Learning Environment. By matching users with similar opinions about different resources ReMashed creates personalized recommendations.

Standard collaborative filtering algorithms that are effective in the e-commerce domain perform relatively poorly in TEL domain [12]. Due to its specific purpose TEL recommender systems can benefit from including other aspects of the learning material except its rank and subject, the most important being pedagogical aspects [2, 9]. In [9] researchers include several factors: papers' overall-ratings, popularity, value-added, degree of being peer recommended and learners' pedagogical features such as interest and background knowledge.

In recommender systems, ontologies can have an important role in describing items that are recommended or profiles of users the recommendations are given to. Examples of these systems are given in [13-15]. What is common to all of these systems is the that they are all based on collecting historical information about behavior of the users and the ratings (usually numerical) the users give to items they select. As previously stated, the problem with this approach is that users often avoid this manner of rating items, i.e. they find expressing their opinion in free form much more appealing [4].

There exist a great number of forums and discussion groups in which users exchange their opinions. These opinions often become recommendations to other users in choosing a product or a service. [3] and [16] describe researches whose goal is to enable using users' opinions in some advanced recommender system. Examples of general structure of such systems are given in [4] and [17]. A mutual characteristic of these systems is the conceptual architecture where more attention is dedicated to modeling user opinions and determining reliability of opinions than specific system components. The following sections of this paper describe architecture of our recommender system which is based on using user opinions.

III. ONTOLOGY

Ontology is one of the basic concepts in Semantic Web and one definition describes it as "a formal specification of conceptualization" [18]. According to this definition ontology is a resource that represents a conceptual model of a specific domain, i.e. it provides a uniform set of concepts that are used in a domain.

Fig. 1 shows the classes and attributes of the Personal opinion ontology. The Personal opinion ontology was

created with the goal to model opinion about any kind of objects, but it can be specialized for a specific domain by adding appropriate classes and attributes. A specialization example for this ontology is described in [19]. Opinions are modeled as:

$$O = (obj, f, phr, per, rel, t) \quad (1)$$

where

- *obj* – object that was rated
- *f* – feature of the object that was rated
- *phr* – phrase that was used for rating in the opinion
- *per* – person that gave the opinion
- *rel* – relevance of the opinion
- *t* – time the opinion was given

When giving a textual opinion a person can rate multiple features of an object, in this case learning material. Rating of each feature is considered as a separate opinion. In accordance with the definition of an opinion, ontology contains appropriate classes and attributes.

Central class of the ontology is the *Opinion* class that represents an opinion and is connected to the classes that represent components of an opinion. The *Object* class represents an object that is rated and for each domain this class should be specialized. In this specific case the *Learning material* subclass, shown in Fig. 2, was created. The *Feature* class represents features of an object that are rated in an opinion and for each domain there should be appropriate subclasses of this class (Fig. 2). The *OpinionPhrase* class represents the phrase used in rating a certain feature. The *Person* class represents the person who gave the opinion. Foaf ontology [20] was used as basis for modeling persons in our system. The *Person* class is defined as a subclass of the *foaf:Person* class. The *Source* class represents the source of an opinion, i.e. the person or organization that entered the opinion in the system.

The *givenBy* attribute represents the connection between the opinion and the person who gave it. The

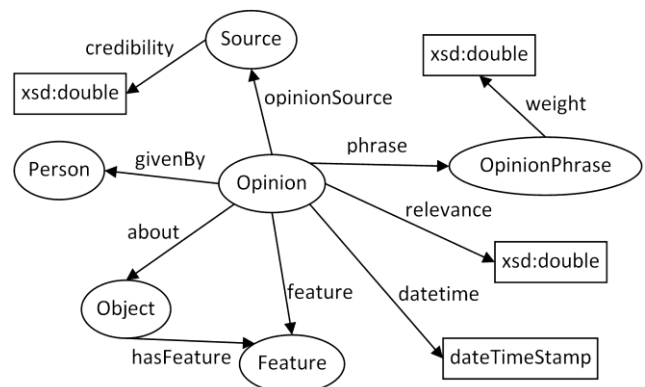


Figure 1 Personal opinion ontology

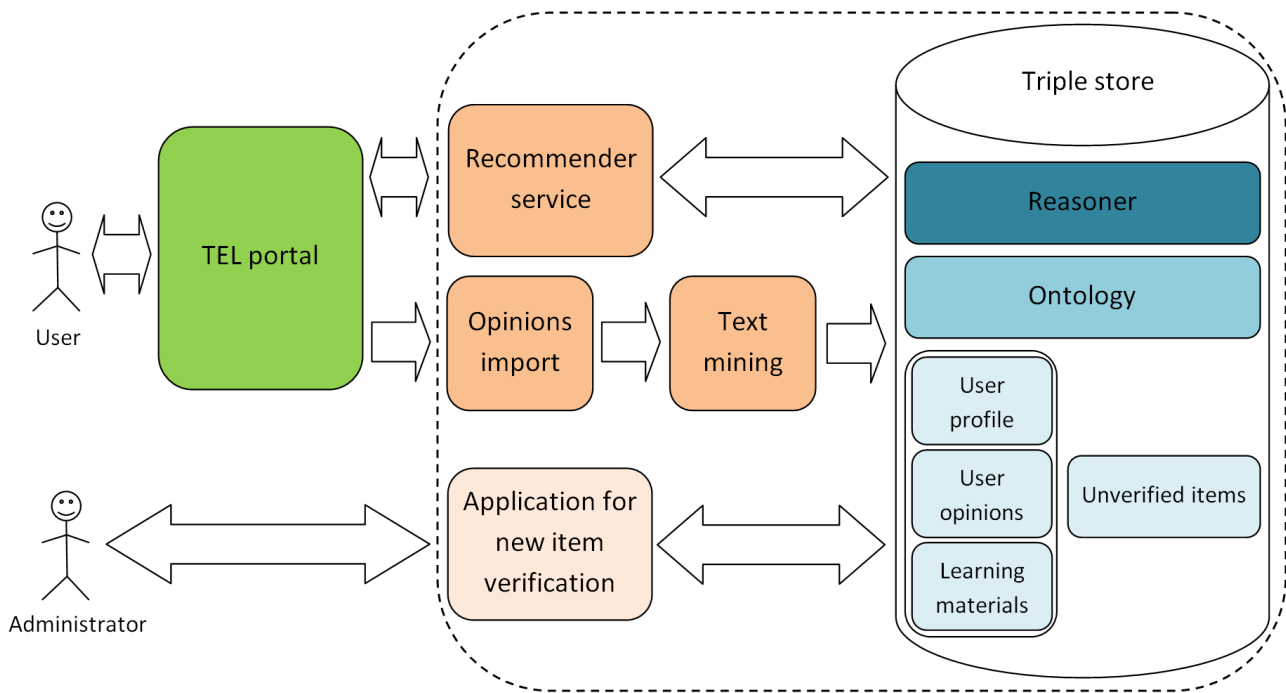


Figure 3 Architecture of the proposed system

As stated previously, ontology defines a conceptual model of the domain the recommender system is developed for. In order to benefit from all of the advantages of ontologies the use of a reasoner is necessary. Triple stores, data repositories optimized for storing RDF and OWL data, usually include a reasoner. When searching the data, reasoner uses all of the advantages of conceptualization, i.e. not only concepts defined in the ontology are considered, but also the complex relations that can exist between them (part-of, is-a, same-as...).

The central component of the proposed system is the triple store. All of the data necessary for functioning of the system are stored in it. Triple store contains the ontology that defines the abstract view of the system domain, consisted of a set of concepts and relations between them. The ontology provides inferencing rules and mapping between data available in the system. The reasoner can discover new relations between data based on inferencing rules and, using an algorithm, determine the rank for a learning material. Triple store also stores other data necessary for functioning of the system: information about learning materials, user profiles and opinions and unverified items.

In previous research we developed a recommender system for the products and services domain [20] and its architecture was the basis for the architecture of the proposed TEL recommender system. However, Opinions import and Recommender service module should be adapted for this domain and Text mining module has yet to be developed.

As mentioned before, the proposed system gives the option of utilizing textual unstructured user opinions about learning materials. Processing this kind of opinions and discovering useful information requires the use of text mining techniques. Opinions import module should

accept user opinions from the TEL portal, identify information that is provided by the portal, such as the user who gave the opinion and learning material the opinion is about, and then send the opinion to the Text mining module.

The task of the text mining module is to process the opinion, detects features of the learning material that are mentioned in the opinion and comments made about them and perform sentiment analysis. We have already performed some research in the field of Sentiment Analysis [22, 23], specifically in classifying Twitter posts. The main difference in this case is the usually well formed language in user reviews, compared to tweets. However, the Naive Bayes algorithm we used was also used in other researches concerning user reviews [24, 25].

Information collected by the Opinions import and Text mining modules is mapped to the ontology and stored into triple store, so it can be used for recommendation process. If some of the information discovered by the Text mining module cannot be mapped onto the ontology, it will require additional checkup. Because of this, unmapped information is first stored separate from other data, and the administrator can then verify or delete it by using the Application for new item verification.

Recommender service accepts user or portal queries, processes them and returns the results, i.e. recommendations to the user. Complete communication of the user with the system is performed through the TEL portal.

One of the main problems of recommender systems is the problem of the cold start. Unrated items will not be recommended, and if they are not recommended chances that someone will use and rate them are lower. An interesting approach to attributing rank to unrated items is

described in [26]. For printed material, such as books, some reviews may already be available on Amazon. The use of hybrid approach for recommendation, i.e. combination of content-based and collaborative filtering is another possibility [27].

V. CONCLUSION

This paper proposes architecture of a Semantic Web recommender system for e-learning materials.

The system uses ontology as a mean for defining the conceptual model of a domain for which the recommender system is developed. Ontology provides mechanisms for modeling products users, learning materials and opinions about them. This enables the system to give recommendations not only based on numerical ratings, but also based on textual comments, incorporating various important properties of learning materials.

Since this paper proposes architecture for a TEL recommender system, our plans for future work include implementing such a system, and evaluating its performance with student and teacher users during a college semester. Another potential direction for future research is the cold start problem and methods for bypassing it.

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Evaluation of Mobile Touch-Screen Devices as Media for Reaction Time Measurement

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Abstract - Although mobile touch-screen devices are becoming increasingly more popular across a diverse range of users and purposes, and despite the fact that they offer a novel cost-efficient way of measuring, response time in web-based experiments is an open research problem. To determine whether reaction time (RT) was affected in a systematic way by the nature of the device, a simple RT task in which participants press a key (stop button) as quickly as possible after the stimulus has been presented was used. Data were collected from 13 participants in a laboratory study. The results showed a significant effect of device display type on mean RT. Overall, the most effective input method in terms of speed was clicking on mouse, while touching the tablet screen was the slowest. There were no differences between right and left hand speed when working with all three type of devices. The study revealed that slower responses on touch screens involved more complex human cognition to formulate motor responses. Attention should be given to designing precise visual feedback appropriately so that distractions or visual resource competitions can be avoided to improve human performance on touch screens and to create inclusive user interfaces.

I. INTRODUCTION

The use of hands and fingers is critically related to human brain functioning and evolution. As is the case with the evolution of personal computers (PCs), mobile phones and tablets have evolved from simple communication devices to complex tools with a range of software and internet applications [1]. The human-machine-interfaces nowadays not only routinely utilize the visual and auditory stimuli modality, but also increase the use of tactile modality. These modality input/output channels are synonymous with ubiquitous computing, being found in an ever-widening array of devices, like in design of driving vehicle systems, military communication system, smoke detector alarm, lighting control system, and many other industrial applications for provision of timely alert information, at devices like bank ATMs, ticket vending machines in railway stations, electronic kiosks inside convenience stores, digital photo printers at mass merchandisers, library information terminals, photocopiers, and car navigation systems [2-5]. This is due in part to the ease-of-use of the interface, with collocation of the input and display; and an interaction mode familiar to even novice users [6-9]. Besides, tactile modality has also been found more useful to improve the reaction time of operators [10].

The use of mobile devices for scientific experimentation heralds a new era in behavioral sciences. The approach has wide multidisciplinary applications in areas as diverse as economics, social and affective neuroscience, linguistics, and experimental philosophy.

Previous attempts to make conventional laboratory experiments accessible to a wider audience, with use of internet-based technologies have not provided the necessary temporal precision for understanding the millisecond changes in cognitive processes [11]. In contrast, mobile technology offers high temporal and spatial resolution with built-in millisecond timing of stimuli display and touchscreen responses. Smartphones and tablets are tools that are portable, easy to use, multimedia-enabled and identical in every country and for each user, with ready Internet transfer of collected data. These properties render them as instruments ideally adapted to studying cognitive functions.

While a touch panel requires a wide range of characteristics, including display visibility above all, along with precision in position sensing, rapid response to input, durability, and installation costs, their characteristics differ greatly depending on the methods used to sense touch input [12].

A major factor driving the spread of touch panels is the benefit they offer in the way of intuitive operation. Since they could be used for input through direct contact with icons and buttons, they are easy to understand and use, even by people unaccustomed to using computers. Mobile devices with touchscreens are rapidly becoming the universal access point for computing, communication, and digital infrastructures. They are quickly transforming itself from a mobile telecommunication device into a multi-faceted information manager that can support not only communication among people, but also the processing and manipulation of an increasingly diverse set of interactions, providing faster performance and responsiveness even in high latency networking environments.

The technique for running experiments over the Internet is already in use, although not for accurate measurement of response times (RTs). Among the most ambitious applications of the Internet as a medium for running experiments are implementations in JAVA [13]. Java programming is designed to be platform independent, meaning that a Java application can run on any computer

that has a Java Virtual Machine (JVM) installed. Java applications can be developed as stand-alone programs or as Internet-based programs. Internet-based Java applications are called applets and they can be downloaded from a server and run on the resident computer by a Java-compatible Web browser. All Java applications when running resident utilize the system clock of a computer. The timing of a Java application will vary based on the JVM installed on the computer as well as the operating system regardless of whether the application is running through a store-and-forward method or as a "Real-time" Internet application [14]. Even though Java offers nanosecond resolution it can never be more precise than the underlying operating system. The store-and-forward method currently allows greater accuracy. The assessment tool can be downloaded and run as a stand-alone application separate from the Internet connection and at the conclusion of the testing the data can be uploaded for analysis.

While the benefits are obvious, computerized assessment presents a number of potential problems [15]. The large-scale deployment of wireless communication services and advances in handheld computing devices enable users to interact with one another from virtually any location. Such interactive distributed applications are particularly sensitive to the heterogeneity of the devices and networks used by the participants. Specifically, an application must accommodate devices with widely varying display characteristics and system resource constraints [16]. Besides the underlying network technology, there are many factors affecting network performance, like radio technology, mobile device hardware, or network settings.

Choices as to the amount of data that can be transmitted during a tolerable wait time depend on the latency and throughput performance of mobile device and network applications. Finally, web browsing, an application already becoming widespread, also has unique challenges in cellular environment.

In neuropsychological testing, the delay rate introduces a new source of error variance and may affect the reliability of the measurement. In essence, the operating system (OS) is continually introducing error in the duration of the stimulus display, the recording of responses, and the program execution, which can significantly impact response latency measurement. In addition to the above psychometric concerns, there are numerous technology-based concerns regarding the equivalence of computerized testing systems when implemented across various hardware configurations and OS.

Mechanical issues also must be considered in the deployment of computerized assessment. While electronic devices have simultaneously increased in computational power and decreased in size, human factors have not changed dramatically, e.g. our fingers have the same size as well as our average visual acuity has not changed.

The presentation of stimuli also is affected by the resolution of the display. The monitor type and size affects the resolution of the display, the same resolution will be sharper on a smaller screen. Some computerized

neuropsychological measures utilize touch screens as the user interface with the computer. For users with minimal computer experience or some level of cognitive impairment has proven to be easier to learn and more intuitive than a mouse. The touch screen has specific hardware, software driver programs, and application software that are required to successfully implement the system. The touch screen can detect the quickest possible tap made by the user (30 ms) and response time is perceived as immediate unless there is a conflict with the application software [16].

The variance of measured reaction times can roughly be divided in three components: variance due to internal sources of error, variance due to external sources of error and variance due to employed measurement method. The first of the three can be considered constant when the group of subjects remains unchanged. The latter two may change when using a new measurement method.

The more infield-applications of reaction time measurements are still somewhat limited by the cost of conducting. There is a clear demand for a simple and cost-efficient way to measure reaction times. Implementation of Tablet PCs, due to their highly interactivity, may offer such opportunities. Thus, the paper aimed to study feasibility of measuring reaction times using mobile devices – smartphones and tablet PCs.

II. MATERIALS AND METHODS

The purpose of this paper was to investigate response time to visual stimuli presented on three different media: PC monitor, smartphone and Tablet PC, to determine whether reaction time (RT) was affected in a systematic way by the nature of the device.

A total of 13 right-handed students (7 males and 6 females), aged 17 to 27 years took part in this study. A simple RT task in which participants press a key (stop button) as quickly as possible after the stimulus has been presented was measured. For the presentation internet-based Java application was run using a store-and-forward method. The participants are instructed to press the "Start" button, to begin the experiment. The background of computer monitor or touch screen of mobile device will change color after a certain delay. When the color changes, their task was to click, or press the "Stop" button. The subjects received immediate feedback upon their RT, recorded in seconds.

For computer settings the screen size was 21.5", and the resolution 1920x1080 dpi. The mobile device in the study was a Samsung I9300 Galaxy S3 cellular phone. The size of the screen is 4.8" with 720x1280 pixels resolution. Another mobile device was Tablet PC with 800x480 capacitive multi-touch 7"screen working in the Android operating system.

The counterbalanced cross-over study was performed. Within repeated measures design, in one experimental block the subjects used right, and in the second, the left hand fingers, whereby their own choice was which of the fingers to be used for response in case of mobile devices. For each conditions there were five trials registered.

III. RESULTS AND DISCUSSION

A series of paired-samples t-test were conducted to compare left/right handed response time for PC, smarthphone and tablet PC devices. Generally, the difference was found in the mean reaction times measured with computer and mobile devices. The slowest RT was obtained for tablet, than for smarthphone, while the fastest responses were for using computer mouse, regardless of which hand the subjects used (Table I). Overall, the most effective input method in terms of speed was clicking on mouse, while touching the tablet screen was the slowest. This difference reaches 805 ms. For mobile phone screen input, the mean task completion time across all trials was 922 ms. RT when using a smartphone compared to the tablet, showed the smallest difference (233 ms).

The responses with right hand were slightly faster for using computer mouse and interacting with tablet, while for mobile phone, left hand show shorter RT. However, there is no significant effect on left/right finger response time for each of the media. The data for females group show the same trend as the general differences (Table II).

TABLE I. DIFFERENCES IN FEMALES' RT AMONG THREE MEDIA FOR BOTH HANDS

Med	Mean	SD	t	df	Sig.
CR	.4199	.1080	1.575	5	.176
CL	.3947	.1118			
PR	.8718	.2943			
PL	.9186	.1922	-5.80	5	.587
TR	1.2303	.1983			
TL	1.3071	.1087	-1.246	5	.268
CR	.4199	.1080			
PR	.8718	.2943	-5.320	5	.003*
CR	.4199	.1080			
TR	1.2303	.1983	-11.987	5	.000*
PR	.8718	.2943			
TR	1.2303	.1983	-3.394	5	.019*
CL	.3947	.1118			
PL	.9186	.1922	-8.664	5	.000*
CL	.3947	.1118			
TL	1.3071	.1087	-17.985	5	.000*
PL	.9186	.1922			
TL	1.3071	.1087	-6.094	5	.002*

*The mean difference is significant

C – computer R - right
 P – phone L - left
 T- tablet Med - medium

TABLE III. AVERAGE REACTION TIMES FOR COMPUTER AND MOBILE MEASUREMENTS

Med	Mean	SD	t	df	Sig.
CR	.3256	.1225	-1.449	12	.173
CL	.3736	.1334			
PR	.9348	.3152	.532	12	.604
PL	.9088	.2218			
TR	1.1501	.2590			
TL	1.1603	.2268	-.199	12	.845
CR	.3256	.1225			
PR	.9348	.3152	-6.593	12	.000*
CR	.3256	.1225			
TR	1.1501	.2590	-13.630	12	.000*
PR	.9348	.3152			
TR	1.1501	.2590	-2.292	12	.041*
CL	.3736	.1334			
PL	.9088	.2218	-11.993	12	.000*
CL	.3736	.1334			
TL	1.1603	.2268	-16.118	12	.000*
PL	.9088	.2218			
TL	1.1603	.2268	-4.938	12	.000*

*The mean difference is significant

C – computer R - right
 P – phone L - left
 T- tablet Med - medium

The same stands for males, with one exception. Namely, the difference between smartphone and tablet when the answer was given with the right hand was not statistically significant (Table III).

Independent Samples t -test have shown that there was a significant difference in the RT between females (M =.4199, SD =.1080) and males (M =.2449, SD =6.153E-02), t(11)=3.666, p .004 when clicking with the mouse.

TABLE II. DIFFERENCES IN MALES' RT AMONG THREE MEDIA FOR BOTH HANDS

Med	Mean	SD	t	df	Sig.
CR	.4199	.1080	1.575	5	.176
CL	.3947	.1118			
PR	.8718	.2943			
PL	.9186	.1922	-5.80	5	.587
TR	1.2303	.1983			
TL	1.3071	.1087	-1.246	5	.268
CR	.4199	.1080			
PR	.8718	.2943	-5.320	5	.003*
CR	.4199	.1080			
TR	1.2303	.1983	-11.987	5	.000*
PR	.8718	.2943			
TR	1.2303	.1983	-3.394	5	.019*
CL	.3947	.1118			
PL	.9186	.1922	-8.664	5	.000*
CL	.3947	.1118			
TL	1.3071	.1087	-17.985	5	.000*
PL	.9186	.1922			
TL	1.3071	.1087	-6.094	5	.002*

*The mean difference is significant

C – computer R - right
 P – phone L - left
 T- tablet Med - medium

These results suggest that males were faster using their right hand in PC condition. Males also showed significantly shorter RT t(11) =2.646, p .023, when working with left hand on tablet PC (M =1.0345, SD =.2303) in comparison to females (M =1.3071, SD =.1087). The remaining gender differences were not statistically significant. Finally, we examined whether there are differences in mean RT across trials with regard to the medium, left vs. right hand usage and gender. Clicking the mouse with the right hand was slightly faster than with the left. At the contrary, when using smarthphone, responding with left hand was faster in most cases, while dealing with tablet, successive shifting in speed between hands occurred (Figure 1).

Males proved to be faster in clicking the mouse with right hand but when using smartphone the left hand showed the advantage. When using tablet there were intermittent shifts in speed between right and left hand. Females responded faster with right hand dealing with tablet, as well as using smartphone across the last three trials, whereas showed variable responses when clicking the mouse (Figure 2). None of the differences in mean RT across trials were statistically significant.

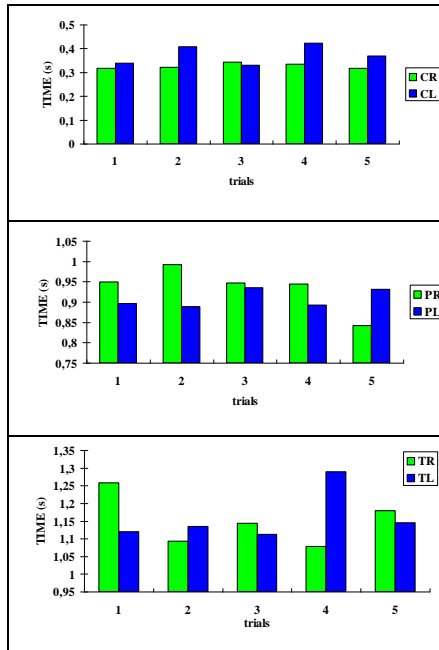


Figure 1. Differences in mean RT across trials with regard to the medium and left vs. right hand usage

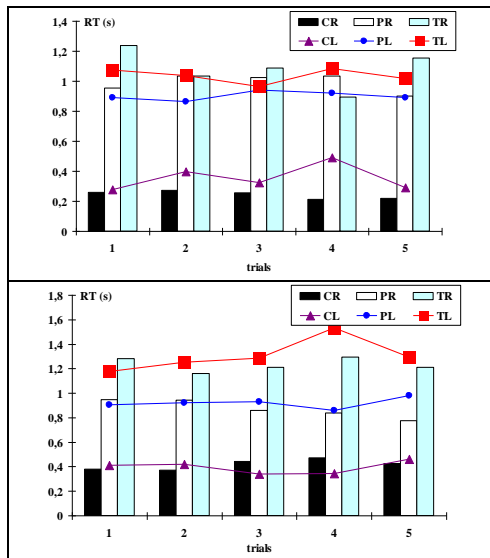


Figure 2. Gender differences in mean RT across trials with regard to the medium

Gender differences in reaction time have been demonstrated in several studies [17-19]. Males have faster reaction times than females and female disadvantage is not reduced by practice [20-22]. Women had slower

simple reaction times than men [17]. The significant difference was also found between males and females in left/right finger response time [23].

The right hemisphere controls the left hand, and the left hemisphere controls the right hand. This has made researchers to think that the left hand should be faster at reaction times involving spatial relationships (such as pointing at a target) [24-26]. Dane and Erzurumluoglu (2003) found that in handball players, the left-handed people were faster than right-handed people when the test involved the left hand, but there was no difference between the reaction times of the right and left handers when using the right hand [27]. Peters and Ivanoff (1999) found that right-handed people were faster with their right hand. However, the reaction time advantage of the preferred over the non-preferred hands was so small that they recommended alternating hands when using a mouse [28]. The same authors also found that right-handed people responded faster with their right-hand when using a right-handed computer mouse. The results from the present research are in accordance with the above mentioned studies, showing that males were faster using their right hand in PC condition. The results of these studies might be due to extensive right hand practice on keypad and mouse entries in the context of computer usage. In addition, the preferred hand muscle strengths are generally stronger than non-preferred ones [29], and a correlation was found to exist between muscle strength and reaction time [30]. On the other hand, males in our study also, showed significantly shorter RT when working with left hand on tablet PC in comparison to females. This fact could be the consequence of making specific different finger movements - gestures, to operate the touchscreen interface of mobile devices with both hands. All foregoing implies that these factors should be taken into account when designing new human-machine-interfaces with the use of visual, auditory or tactile modality stimuli in future.

The evolution of personal digital devices could not have been predicted but, obviously, increased personal usability (i.e., speed, memory, portability, convenience, individualization and security). As usability has increased, the relationship between hands and device has also increased [31].

Mangen and Velay (2010) suggested that “the switch from pen and paper to mouse, keyboard and screen entails major differences in the haptics (a combination of touch and movement perception) of writing, at several distinct but intersecting levels” (p. 385) [32]. In addition, the arm and hand position of the user with respect to touch screens will be more variable than with mouse or keyboard position with a standard monitor. This introduces the need for standard instructions with respect to orientation to the stimuli, orientation of the input/device, and hand and arm positioning.

With a pen and paper, only one hand is used; with a computer keyboard, two hands are used; with a mobile phone, one hand commonly holds the device while the other hand inputs; with a touchscreen, sometimes one hand is used and sometimes two hands are used depending on the user and the task. With a multi-tap mobile phone, vision is often extremely focused on the device but for a relatively short period of time; with a

touchscreen and new applications, visual perception and haptics are integrated into a vivid and control sensory experience [33].

Indeed, the most fundamental difference between personal computers, mobile phones and tablet computers may be the nature of input. While hardware features such as screen size and portability are cognitively-relevant, differences in mechanisms of input force reconsideration of the importance of touch in human cognitive processing [34].

Mobile phones of today are highly sophisticated small scale computers. They offer a novel cost-efficient way to measure reaction times. However, for the measurements to be feasible to experimental assessment, they have to fulfill certain requirements.

There is a difference in the reaction times measured with computer and mobile device in laboratory conditions. This difference has probably more to do with the changed visual angle and not properties of the mobile technology. Nevertheless, this difference in reaction times should be kept in mind when designing study paradigms taking advantage of the mobile technology.

IV. CONCLUSION

Regardless of the difference in reaction times, the results of our study seem to confirm the feasibility of mobile reaction time measurement technology. Even though ultimately we wish to use a mobile device to measure certain cognitive functions, we are using an indirect measure of reaction times. As a result, we have to evaluate the new mobile method by comparison with an established technique rather than with the true quantity. However, when two methods are compared neither provides an unequivocally correct measurement [35].

The difference in reaction times obtained by comparing measurements using computer and mobile devices, does not present any real problem for using a mobile device for reaction time measurements. One interesting fact seen from these results is that with relatively small number of repetitions we can reliably detect quite small changes in reaction times within an individual [35]. Even so, a further study concentrating on locating the source of this difference is highly recommendable.

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Automated Reasoning System Based on Linguistic Variables

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Abstract - The paper investigates an fuzzy automated reasoning system in the case when real-life experience is available. Historical data sample or knowledge, in form of the linguistic terms enables the implementation of the fuzzy inference system, as well as conclusion inference. The fuzzy inference process is based on fuzzy logic operators, aggregation operators and, especially on OWA operators originally proposed by R. Yager. The paper contains practical example of the fuzzy inference process. The main contribution of the paper is reflected in the variation of the automated fuzzy reasoning system.

I. INTRODUCTION

Decision making is one of the hardest and most important activities that humans must undertake in everyday life, as well as in business and corporate enterprises. The process of decision making is related to domains such as manufacturing, service, education, medicine, politics, etc. In another words, all aspects of our existence as intelligent and socially aware beings are not possible without decision making. As the importance of decision making process is clear, it is important to have an insight to some of many decision making processes. Decision making paradigms include multi-expert decision making, multi-criteria decision making and multi-expert multi-criteria decision making [1].

It is well known that real-world problems are rarely defined in exact and clear manner. Mostly, there are many disagreements about exact problem definition, let alone the solution of the problem. Humans are capable to manipulate with imprecise, non-exact or vague terms during the decision making process, but digital computers operate in an exact way. It is great challenge to transfer human decision making procedures to exact form that is suitable to be executed by the computer. First step in transferring process is formalization of un-formal knowledge. There are many paradigms based on mathematical principles: First order calculus is well know and widely accepted formalism to handle an un-formal knowledge. Approach to decision making based on first order calculus enables the definition of exact rules and inference engine; Resolution method is most commonly used, so that it is possible do design fully operative decision making system. However, Resolution based system is funded on Boolean logic and is too "rigid" to cope with uncertainty and vagueness of real-world problems.

As an opposite approach to the Boolean reasoning paradigm, there are variety of approaches, among them

the approach based on fuzzy logic which is often suitable and widely accepted. This paper deals with vague description of business process, as well as fuzzy inference system which is able to cope with imprecise, un-formal description of business logic [2,3]. The paper investigates formalization of knowledge in the fuzzy manner, but offers further upgrade of fuzzy inference by application of Ordered Weighted Averaging (OWA) operators.

The paper is structured as follows: Section two describes basic concept of fuzzy sets, fuzzy logic and fuzzy inference. In this section basic definition of OWA operator is given. Section three consists of real-life problem definition, and the solution based on fuzzy inference system. Fuzzy controller is used as a starting point in this particular case. Section four presents theoretical description of fuzzy controller which includes the OWA operators in inference process. Finally, fifth section contains conclusion and guidelines for future work.

II. FUZZY SETS AND OWA OPERATORS

Fuzzy sets were introduced by Lotfy A. Zadeh in 1965. This is generalization of classical set theory: instead of set $\{0,1\}$ in fuzzy set theory there is a whole interval $[0,1]$. Every object x of the universe X , belongs to fuzzy set A with certain degree or measure. Measure of belonging to the fuzzy set is defined by membership function: mostly, this is a simple triangular, trapezoid or sigmoid function [2,3]. Fuzzy set A is defined as in (1):

$$A = \{\{x, \varphi_A(x) | \forall x \in X\}\} \quad (1)$$

Every element x of universe X belong so fuzzy set A with measure $\varphi_A(x)$ which takes values from $[0,1]$. It is possible to define intersection, union and complement operations on fuzzy sets, but in this research it is important that fuzzy sets theory leads to definition of fuzzy logic. Fuzzy logic exploits the properties of t -norm in order to defined *fuzzy-and* logical operator, while *fuzzy-or* logical operator is defined by s -norm. There is also the definition of complement of fuzzy set. It is very important to define fuzzy implication as it is the framework to build fuzzy inference system.

Fuzzy inference system uses expert's knowledge who is able to articulate his or her expertise in form of If...Then rules. The variables used in fuzzy If...Then rules are linguistic variables, which means that they are words of spoken language. This is great opportunity to express

expert's knowledge in more natural way which is closely related to human reasoning. The values of linguistic variables are also linguistic terms exactly defined by fuzzy set. The example of fuzzy If...Then rule is:

IF

clarity of agreement is high
and project approval is high
and management commitment is high
and policy quality is high

THEN

probability of successful implementation of the project is high.

It is obvious that fuzzy rule is easy to understand as it is readable to the human.

A. OWA OPERATORS

The fuzzy reasoning system (fuzzy inference system) requires aggregation methods. In a standard fuzzy inference system, fuzzy propositions included in a fuzzy rule are aggregated by fuzzy-and, fuzzy-or operators or negated by fuzzy-negation. Detailed procedure could be found in [2,3]. The objective of aggregation is to combine individual experts' preferences or criteria into an overall one in a proper way, so that the final decision takes into account all the individual contributions.

In 1988 Ronald R. Yager [4-8] introduced a new aggregation technique based on the ordered weighted averaging operators.

Definition: An OWA operator of dimension n is a mapping $\mathcal{F}: \mathcal{R}^n \rightarrow \mathcal{R}$, that has an associated n vector

$$w = (w_1, \dots, w_n)^T \quad (2)$$

such as $w_i \in [0,1]$, $1 \leq i \leq n$. Also must be satisfied:

$$\sum_{i=1}^n w_i = 1 \quad (3)$$

OWA operator is implemented as:

$$F(a_1, \dots, a_n) = \sum_{j=1}^n w_j b_j = w_1 b_1 + \dots + w_n b_n \quad (4)$$

In (4) b_j is the j -th largest element of the bag:

$\langle a_1, \dots, a_n \rangle$.

Simple example often presented in literature references is:

Let assume that $w = (0.4, 0.3, 0.2, 0.1)^T$, now we have:

$$\begin{aligned} F(0.7, 1, 0.2, 0.6) &= \\ 0.4 \times 1 + 0.3 \times 0.7 + 0.2 \times 0.6 + 0.1 \times 0.2 &= \\ = 0.75 \end{aligned}$$

OWA operators enable an implementation of the variation of fuzzy inference system.

III. ERP FUZZY INFERENCE SYSTEM

Enterprise Resource Planning System (ERP) is a main factor in successful implementation of business process in a large enterprise such as NIS Gazpromneft. This section

includes the description of the implementation of fuzzy inference system. The implementation is done by MatLab software system. The fuzzy inference system is implemented according to expert's analysis. That is the reason for brief description of main factor of expert's analysis.

A. SWOT ANALYSIS AND ERP

SWOT methodology used in this case has been used for overall approach to business/IT implementation project. SWOT stands for S (Strengths), W (Weaknesses), O (Opportunities) and T (Threats). Using SWOT analysis can be a practical solution for analytical approach to internal factors (classification of strengths and weaknesses) and external factors (classifying the opportunities, dangers and threats to the market environment). The main goal of the model is setting a clear view and understanding of the situation, and connections of the internal characteristics of the organization and influences in the region. Thus identified strengths should be directed to the utilization of preferred opportunities and reducing risks, recognizing the weaknesses that should be minimized. The industry as oil and gas extraction achieved high profitability, which implies a business environment with a sharp, competitive marketing relations. As a part of the tax system of each country, petroleum industry regulated area that has significant budgetary revenues from excise duties and import tax. The owners of the oil companies bear more pressure and control from the state for its decision on the initiation of major infrastructure projects, as its development has long-term influence for the development of the companies in the industrial branch and society. Strategies and plans for company development include the competitiveness of the supply chain of the oil companies and the achievement of high standards in the field of logistics, in order to provide control of overall costs and continuous increase of customer services [9].

Establishment of ERP business system in oil company is the most important systematic step towards vertical integration of enterprises, the synchronization of activities and control of business processes in real time. Implementation of integrated information systems requires a variety of organizational and business changes. Once the project is successfully implemented, management is being provided with a high quality data, possibilities of integration and dynamic analysis in the financial flows, human resources management, logistics material flow and information flows.

The first step is to identify the variables that affect the implementation of ERP solutions [10]. The starting list of variables that affect the implementation of the implementation of:

- Equity-budgetary funds,
- Project duration,
- Marketing and internal communications [11],
- Internal human resources involved in the project [12] (employees delegated from branches)
- External human resources (consultants or contractors on behalf of implementation provider)

- IT hardware (servers and PCs)
- Network (elements, nodes, flow rate),
- Work-space with computers and reserved time for workshops and testing
- Space and time reserved for training
- The quality of the data from database (from previous information systems),
- Data on materials and supplies for Logistics support processes (NON-BULK)
- Data on materials and supplies of oil, gas, petroleum and petrochemical products in processing and distribution (BULK) and organizational elements of implementation (Project Organization, Board of Directors (Steering Committee), the Project Board (Project Management), Change Management (Change Management)

Organizational logistics elements [13]:

- Organization Project Office Logistics
- Controlling organization,
- Procurement organization, groups for procurement;
- Inventory Management Organization (plants and storage locations)
- Organizational Structure of Transport (shipping points)
- Organizational Structure of sales (transport planning)

The best chances to improve the quality of the process of implementing an ERP system in oil and gas company are in the area of human resources. The data showing the cost analysis of the implementation process estimate the most common relationship between the material and the cost of consulting services at approximate ratio: 30% hardware vs. 70% consulting services (depending on pre-project IT infrastructure development - NIS experiences). In the case of a parallel implementation of multiple ERP functionalities (modules) the value of the project increases and therefore the contribution of consultancy costs in the calculation of the expected total cost increases significance. Threats to the marketing environment are diverse but the major threat is possible disruption of basic business logistics functions as a result of poor implementation of ERP systems, hardware failure or inadequate speed of activities. Interruption in production or distribution of oil and gas would cause great harm to the image of company, distract distributors to consider alternative sources of energy supply and competitors to become more active in taking up market share. The effects of non-pecuniary damage would be evident in the long term.

B. PRACTICAL EXAMPLE

Fuzzy inference system is developed with the goal to assess probability of successful implementation of ERP (psi). Parameters which belong to opportunities and threats for successful implementation of ERP are analyzed. All fuzzy variables have values from set {high (H), medium (M), low (L)}.

Parameters affecting opportunities are: clarity of agreement (coa), project approval (pa), management commitment (mc), policy quality (qp). Fig 1 shows the definition of fuzzy variable "coa" and its values. All measurements are expressed in percents.

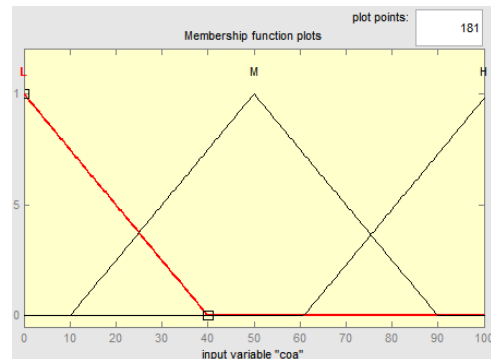


Figure 1: Variable "coa" and its values

All other fuzzy variables are defined analogously. Very important task is definition of fuzzy rules. This is done by expert or by a group of experts. In this case only fuzzy rules that tackle opportunities and threats are defined according to theoretical knowledge, as well as practical experience, (see subsection A).

Fuzzy rules that include parameters for opportunities are:
 IF coa=H and pa=H and mc=H and pq=H THEN psi=H
 IF coa=M and pa=M and mc=M and pq=M THEN psi=M
 IF coa=L and pa=L and mc=L and pq=L THEN psi=L
 IF coa=not(H) and pa=not(L) and mc=not(H) THEN psi=M
 IF coa=not(H) THEN psi=not(H)
 IF coa=H and pa=not(L) and mc=H THEN psi=H
 IF coa=not(H) and pa=not(L) and mc=not(H) THEN psi=not(H)

Parameters affecting threats are: frequent changes of executives (fce), frequent change of strategy (fcs), budget increase (bi), database compliance (dbc), legislation changes (lc).

Fuzzy rules that include parameters for threats are:
 IF fce=H and fcs=H and bi=H and dbc=L and lc=H THEN psi=low
 IF fce=H and fcs=H THEN psi=L
 IF fce=H and bi=H then psi=L
 IF fce=L and fcs=L and bi=not(H) and dbc=not(L) and lc=L THEN psi=M
 IF fce=M and fcs=M and bi=not(H) and dbc=not(L) THEN psi=M
 IF fce=L and fcs=L and bi=not(H) and dbc=not(L) and lc=L THEN psi=H
 IF fce=L and fcs=L and bi=L and dbc=H and lc=L THEN psi=H

Fuzzy logic inference system is constructed by Fuzzy logic toolbar which is a part of MatLab software system. After system implementation, it is possible to assess the value of probability of successful implementation of ERP (psi) according to variables that affect opportunities and threats. Fig 2 shows system output for the case when all input variables have value of 50%. Output (psi) of the system is 40.6%.

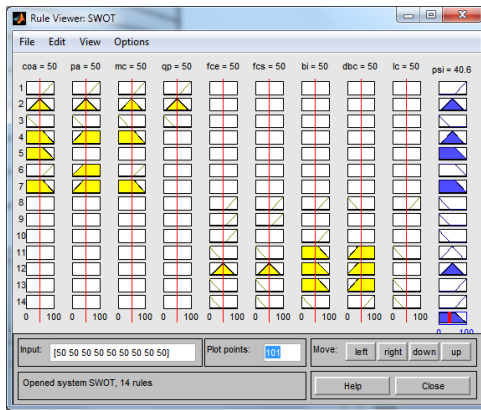


Figure 2. Fuzzy inference system

Presented system calculates the output for any combination of input values. It is useful as a predictor of the future state of the system, and may have an advisory role. Fuzzy inference system is easy to implement, as well as to change or adopt to ever changing environment.

IV. THE VARIATION OF REASONING SYSTEM

The proposed variation in functionality of fuzzy inference system is the application of the OWA operators as aggregation operators in the If part of fuzzy rule. The form of fuzzy rule is:

IF
 (fuzzy_proposition_1) and ... and (fuzzy_proposition_n)
 THEN
 (output_fuzzy_proposition)

It is possible to include fuzzy-or operator instead of fuzzy-and operator, but this is problem of less importance, because it is possible to tune the system in any case. Fuzzy-and operator acts as an aggregation operator: after fuzzyfication of propositions which results in a measure from $[0,1]$ interval, fuzzy-and operator aggregates calculated measures. Fuzzy-and as an aggregation operation is a mapping $\mathcal{F}: [0,1]^n \rightarrow [0,1]$. If fuzzy-and is implemented as *min* function we have:

$$\alpha = \min(\varphi(x_1), \dots, \varphi(x_n)) \quad (5)$$

In (5) α is the degree of satisfaction of the If part of fuzzy rule; $\varphi(x_i), i = 1, \dots, n$ is a membership function value for i -th proposition included in the If part of fuzzy rule; n is a number of proposition in the If part of the rule.

Mostly, fuzzy-and operator is implemented as *min* or *product* function. The main idea behind the implementation of the variation of fuzzy inference system is to use OWA operator as an aggregation operator instead of *min* or *product* function in order to calculate α . This requires the introduction of boundary condition so that the result of aggregation stays in $[0,1]$ interval:

$$\alpha = \min(1, F(\mu_i)) \quad (6)$$

The possible implementation of proposed variation is described via suitable example.

Let μ_1, \dots, μ_n are measures of fuzzy propositions calculated by fuzzyfication procedure; for details please

refer to [2,3]. OWA aggregation process will include additional constants according to (2) and (3). OWA aggregation process is conducted by (4).

Let assume that $w = (0.4, 0.3, 0.2, 0.1)^T$. If $\mu_1 = 0.2, \mu_2 = 0.8, \mu_3 = 0.5, \mu_4 = 0.6$, then by (4) we have:

$$\begin{aligned} F(0.2, 0.8, 0.5, 0.6) &= \\ 0.4 \times 0.8 + 0.3 \times 0.6 + 0.2 \times 0.5 + 0.1 \times 0.2 &= \\ = 0.32 + 0.18 + 0.1 + 0.02 &= \\ = 0.62 \end{aligned}$$

Further, by (6) we have: $\alpha = \min(1, 0.62) = 0.62$.

The result of aggregation by *min* function is 0.2 and by *product* function is 0.048. It is obvious that the If part of fuzzy rule is satisfied in larger degree in case of usage of OWA operator which is in contrast to *min* and *product* operator. This is partly because of suitable choice of the constants w_i .

V. CONCLUSION

As decision making process is very important, but hard to implement in an exact way that is suitable for digital computers, many approaches to solving this problem have been proposed. In this research an approach based on fuzzy inference system is used to define inexact, vague or imprecise terms in an exact manner. Fuzzy logic deals with linguistic terms that are usually used in every day spoken language. This is a great opportunity to describe vague or imprecise system in an exact way. Enterprise Resource Planning System (ERP) is a main factor in successful implementation of business process in a large enterprise such as NIS Gazpromneft, so successful implementation of the ERP via fuzzy inference system is a main theme of this work. It is shown that results of SWOT analysis can be formulated as inputs to fuzzy inference system. Practically, fuzzy inference system is implemented by MatLab Fuzzy logic toolbox. The system is useful as a predictor of the future state of the business environment, and may have an advisory role.

Furthermore, standard input aggregation of fuzzy inference system based on *min* or *product* function is replaced by OWA operator. Final conclusion is that OWA operator can be used as an aggregation operator. Main advantage is that OWA operator can be adjusted by suitable choice of aggregation constants. This has added another degree of freedom to fuzzy inference system.

Future work will include research of automatic calculation of aggregation constants in OWA type aggregation, as well as further experiments.

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Basic English Acronyms for Information Technology Students

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Abstract - The paper presents a research and its results related to IT (Information Technology) students' knowledge of IT acronyms. It also suggests a list of acronyms IT students should learn during their study. The list encompasses the most frequent IT acronyms that are in everyday use by people who use computers either professionally or privately.

I. INTRODUCTION

There are many reasons why people want to study foreign languages, in this case the English language. Teaching and learning English for general purposes encompasses many reasons why people want to learn the language. Some students study English as a compulsory subject for it is on the school curriculum. Others study it because they are convinced that they could get a better job, they could have a chance for advancement in their professional life. There are also people who study English just because they want to know more about the country and culture of the people who are native speakers. There are university level students who study English for Special or Specific Purposes (ESP). Some of the area of ESP includes English for Academic Purposes (EAP), English for Business Purposes (EBP), English for Occupational Purposes (EOP), English for Professional Purposes (EPP), English for Scientific Purposes (ESP), and English for Science and Technology (EST).

Students of science and technology should learn how to pronounce the English sounds, how to use rhythm and stress words correctly. They also have to learn how to read and write in English. Knowledge of grammar and vocabulary is also very important if students want to express themselves in English appropriately.

Teaching students ESP is a very demanding task for the teacher himself. Beside general knowledge of English, he has to know the registry of the scientific field the students study; in this case, it is Information Technology (IT). IT has become a scientific field that has one of the greatest impacts not only on professional life but also on private life of an individual. Computers are used 24 hours a day in almost every situation of human beings. Computer users have adopted IT terminology vocabulary together with the acronyms that are very often used. They use the acronyms properly but very often, they do not know what the acronyms refer to. Although IT students are aware of the meaning of acronyms, they frequently make mistakes giving the meaning of some acronyms.

II. ACRONYMS

A. Definition

An acronym is a word formed from the initial letters or syllables taken from a set phrase and are pronounced as a sequence of letters. Acronyms are meant to make the phrase easier to pronounce, remember, and use. With the rise and popularization of computers, new acronyms have been formed and used daily. The field of IT is now the most prolific source of acronyms. They have become an integral part of computer culture.

B. Rules of Acronym Usage

Acronyms are commonly used in technical communication and they are used so frequently that the reader or listener can feel lost in the alphabet jam. However, the correct use of acronyms enhances the communication process, fostering fluid and efficient comprehension. There are not many hard-set rules referring to the use of acronyms. Acronym user should take into account some rules in applying acronyms.

- All acronyms are in full capital letters and they should be spelled out on first use followed by the acronym itself written in capital letters and enclosed by parentheses: PC (Personal Computer).
- Articles and prepositions are not part of acronyms. If an acronym must be preceded by the indefinite article in a sentence, the use of either "a" or "an" depends on the first sound, not letter, of the acronym. If a vowel opens the acronym, the "an" indefinite article is used: an USB. If a consonant opens the acronym, the "a" indefinite article is used: a PC.
- Since acronyms are treated as words in English, they can be pluralized with the addition of a lowercase "s": Personal Computers (PCs).
- In order to express possessiveness, an apostrophe followed by a lowercase "s" is used: Use your PC's on-board diagnostic for troubleshooting.
- Acronyms referring to measurements are all lowercase, only a few are mixed: kHz.

III RESEARCH

A. The Aim of the Research

IT students should be acquainted both with General English and ESP. The IT scientific field is a

very vivid area for new terms, phrases and acronyms appear day after day. Relating to the topic of this paper a short research was carried out among IT students of Technical Faculty. The aim of this research was to define students' knowledge of the IT acronyms. Sixty students were given 15, one can say, the most frequently used IT acronyms. Their task was to state the definition for each of them. The acronyms were: IT (Information Technology), PC (Personal Computer), WWW (World Wide Web), FTP (File Transfer Protocol), CMC (Computer Mediated Communication), MIDI (Musical Instrument Digital Interface), LCD (Liquid Crystal Display), HDD (Hard Disk Drive), CPU (Central Processing Unit), MP3 (MPEG Audio Layer 3), CD (Compact Disk), ADSL (Asymmetric Digital Subscriber Line), ISP (Internet Service Provider), and Mhz (megahertz).

B. The Results of the Research

The results obtained were disastrous. Students' knowledge of IT acronyms is very poor; they do not know the elementary acronyms although they use them every day. Fig. 1 shows the distribution of correct answers; the correct definitions that the students gave to each acronym.

Analyzing the obtained results one can clearly notice that:

The acronyms CD and HDD were the only ones that more than a half of the questioned students knew. 43 (71,66%) students knew the meaning of CD, and 31 (51,66%) of them the meaning of HDD. CPU is familiar to 29 (48,33%) students. MHz, LCD and IT acronyms are known by 28 (46,66%) students. One would expect that the acronym PC should be known by any computer user but the research has shown that only 24 (40%) students know the meaning of it. The acronyms PIN and WWW are cited correctly by 18 (30%) students.

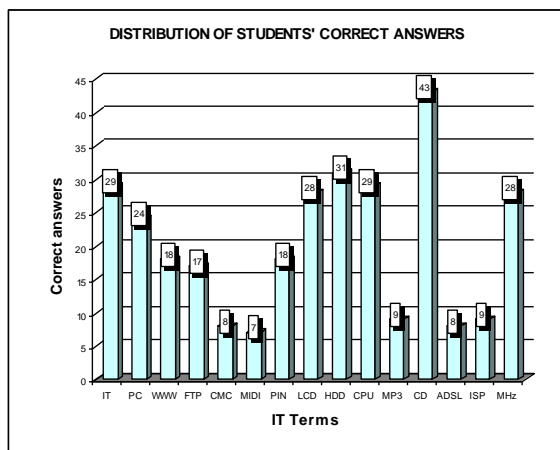


Figure 1. Distribution of students' correct definitions of IT acronyms

Only 17 (28,33%) students could state the definition of FTP although they use the Internet daily. 9 students (15%) knew the meaning of the acronyms ISP and

MP3. The meaning of ADSL and CMC is clear only to 8 (13,33%) students. 7 (11,60%) students are familiar with the acronym MIDI.

Analyzing the above noted research results it is high time to do something in order to enrich the IT students' knowledge of IT terminology, especially acronyms that are widely used every day.

IV BASIC IT ACRONYMS

It is very hard to make a broad list of words, terms, and phrases students should learn during their university study. The chosen vocabulary list should reflect the nature and aims of the study program. As a starting point, the aim of this paper is to make a list of acronyms students should learn obligatorily. Listing the acronyms in alphabetical order would be a normal way in a dictionary or glossary, but it is easier to learn and remember a list of words when they are grouped. The author has made four groups of acronyms according to their common references. It has to be noted that the author is not an IT professional, but an English teacher who teaches English to IT students.

A. General IT Acronyms

Many IT acronyms are very hard to put into any type of groups. So, these ones may be put into the group that covers the general terms related to IT.

Table I. shows the IT acronyms related to general IT terms, phrases and word:

TABLE I. GENERAL IT ACRONYMS

Acronyms	Definitions
IT	Information Technology
ICT	Information and Communication Technology
PC	Personal Computer
AI	Artificial Intelligence
I/O	Input/Output
HW	Hardware
SW	Software
PDA	Personal Digital Assistant
EAN	European Article Number
IEEE	Institute of Electrical and Electronic Engineers
ASCII	American Standard for Information Exchange
IBM	International Business Machines
ENIAC	Electronic Numerical Integrator Analyzer and Computer
ID	Identification Username
ISO	International Organization for Standardization
bit	binary digit
FAQ	Frequently Asked Questions
COMPUTER	Common Operating Machine Particularly Used for Trade, Education and Research

B. Hardware Related Acronyms

Table II. shows the most frequently used IT acronyms related to the hardware and architecture of computers.

TABLE II. HARDWARE RELATED ACRONYMS

<i>Acronyms</i>	<i>Definitions</i>
CPU	Central Processing Unit
LCD	Liquid Crystal Display
SVGA	Super Video Graphic Array
VGA	Video Graphics Array
HDD	Hard Disc Drive
PSU	Power Supply Unit
UPS	Uninterruptible Power Supply
RAM	Random Access Memory
ROM	Read Only Memory
AGP	Accelerated Graphics Port
VDU	Visual Display Unit
GUI	Graphical User Interface
NIC	Network Interface Card
CCD	Charged Coupled Device
DVD	Digital Versatile Disc
DVD-ROM	Digital Versatile Disc Read Only Memory
DVD-RAM	Digital Versatile Disc Random Access Memory
CD	Compact Disc
CD-MO	Magneto Optical Compact Disc
CD-R	Recordable Compact Disc
CD-RW	Rewritable Compact Disc
CD-ROM	Compact Disc Read Only Memory
RDRAM	Rambus Dynamic Random Access Memory
SDRAM	Synchronous Dynamic Random Access memory
RAID	Redundant Array of Inexpensive Discs
ECC memory	Error Code Correcting Memory
ALU	Arithmetic Logic Unit
IC	Integrated Circuit
ISA	Industry Standard Architecture
VRM	Voltage Regulator Module
LED	Light Emitting Diode
MMX	Multi Media Extensions
Modem	Modulate/Demodulate
LASER	Light Amplified by Stimulated Emissions of Radiation
HDV	Holographic Versatile Disc
DVI	Digital Visual Interface
AMD	Advanced Micro Devices

C. Software Related Acronyms

Table III. shows the most frequently used IT acronyms related to the software of computers.

TABLE III. SOFTWARE RELATED ACRONYMS

<i>Acronyms</i>	<i>Definitions</i>
OS	Operating System
SS	System Software
ASP	Application Service Provider
DOS	Disc Operating Software
BIOS	Basic Input/Output Services
MSL	Microsoft Software Library
DTP	Desktop Publishing Program
OOP	Object Oriented Program
OCR	Optical Character Recognition
DBMS	Database Management System
RDBMS	Relational Database Management System
OODB	Object Oriented Database
CAD	Computer Aided Design
CAM	Computer Aided Manufacturing
VR	Virtual Reality
JPEG	Joint Photographic Experts Group
DDE	Dynamic Data Exchange
RTF	Rich Text Format
PNG	Portable Network Graphics
PDF	Portable Document Format
GIF	Graphics Interchange Format
HTML	Hypertext Markup Language
WML	Wireless Markup Language
XML	Extensible Markup Language
PIM	Personal Information Manager
WYSIWYG	What You See is What You Get
BASIC	Beginners' All-purpose Symbolic Instruction Code
FORTRAN	Formula Translator
COBOL	Common Business Oriented Language
ALGOL	Algorithmic Language
CAI	Computer Assisted Instruction
OSS	Open Source Software
RAD	Rapid Application Development
SCM	Software Configuration Management
SSD	Software Specification Document
VB	Visual Basic
XM	Extreme Programming

D. Communication Related Acronyms

Table IV. shows the most frequently used IT acronyms related to communication and the Internet.

TABLE IV. COMMUNICATION RELATED ACRONYMS

<i>Acronyms</i>	<i>Definitions</i>	<i>Acronyms</i>	<i>Definitions</i>
LAN	Local Are Network	SDSL	Symmetric Digital Subscriber Line
WAN	Wide Area Network	ADSL	Asymmetric Digital Subscriber Line
GPRS	General Positioning Radio Service	IDSN	Integrated Services Digital Network
SMS	Short Message Service	UMTS	Universal Mobile Telecommunications System
WWW	World Wide Web	CMC	Computer Mediated Communication
IP	Internet Protocol	SNMP	Simple Network Management Protocol
ISP	Internet Service Provider	DCOM	Digital Communication
FTP	File Transfer Protocol	LNS	Local Network Server
TCP	Transmission Control Protocol	PR	Public Relations
URL	Uniform Resource Locator	SMTP	Simple Mail Transfer Protocol
DNS	Domain Name System	ATM	Asynchronous Transfer Mode

DSL	Digital Subscriber Line	STM	Synchronous Transfer Mode
WRAP	Web Ready Appliance Protocol	HCI	Human Computer Interaction
HTTP	Hypertext Transfer Protocol	IRC	Internet Relay Chat
PIN	Personal Identification Number		

V. CONCLUSION

ESP is a special branch of ELT. Students are exposed to language materials both of general and vocational, professional nature. It is very important to acquire appropriate vocabulary in the study field. English acronyms for IT students are very important for they use them every time they use their computers. The conducted research results among IT students showed that it was necessary to make a basic list of the most frequently and the most important IT acronyms in English. It would be very useful to enrich the list for new IT words and terms appear daily.

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PACS Systems Based on the Web

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Abstract - Modern medicine can not be imagined without diagnostic devices, ranging from ultrasound, various devices of chest X-variate to scan and MRI equipment. Information technologies are naturally found its application in this sphere of human activity. The use of computer and digital technology in medicine in the world is still a relatively new area, and its development is still in full swing. Computers in medicine and medical facilities (except for the purposes of scientific development and personal development) can be used in many ways. One, and probably the simplest and most common is the use of computers for administrative and evidentiary purposes. By this is meant the classical and specific financial and inventory accounting, patient records, medications, word processing, statistics, and the like. Another way is to use the computer for diagnostic purposes, where the computer (equipped with the appropriate hardware and software) is used in conjunction with devices for diagnostics. The third way is to use a computer to communicate, mostly using the internet as a medium.

I. INTRODUCTION

Medical informatics is formally defined as "the area that deals with cognitive information processing and communication tasks in medical practice, education and research, including information science and technology to support these tasks." Medical information includes computer science, artificial intelligence, decision theory, statistics, cognitive science, information management, health policy, and, of course, medical science. This interdisciplinary approach and the requirement that systems must have a clinical or administrative use is a characteristic of computer science. Indeed, medical informatics is perhaps one of the substantial use of the processing and manipulation of information conducted in a given context.

Medical practice is based on efficient, timely and correct medical decisions. Then it is not surprising that the great efforts of medical informatics are focused on the problem of making medical decisions in an automated medical practice. The challenge for the effective employment of computerized hospital or clinical information system is the presence of legacy systems with specialized functions in individual clinical or administrative departments. There are specialized systems formerly introduced for laboratory results, Pharmaceutical inventory, and other systems, as systems sp dictaphonic specialist or imaging systems for picture

archiving and communication (PACS-Picture Archival and Communications System).

PACS - Picture Archival and Communication System is a term used for systems

picture archiving and communication includes:

- Functionality input images in digital format
- Preservation and archiving of digital images
- Taking from the archive and display images on computer monitors where image analysis is possible
- The possibility of transmission of digital images
- requires fast network connection between the device and the appropriate radiological workstations for additional image processing between keeping files and computer screens end users-doctor
- They must be integrated into the hospital information system (HIS), and the final goal should be the electronic patient record that is. "Paperless hospital" [1].

II. PACS SYSTEMS (BASED ON THE WEB)

Although teleradiology services may be established in its simplest form, the principle of point-to-point, advanced form of their implementation can be achieved through the use of PACS systems based on web technology. PACS (Picture Archiving and Communication System) is a modern, computer alternative for paper and filmed archive. It is an integrated system consisting of devices for medical diagnostics, servers, workstations, data access, a computer network that connects the system components, databases and interfaces to other systems (eg, hospital and radiology information systems - HIS and RIS). Basing this system on web technology allows data to be accessed from different locations within a medical facility, as well as from remote locations outside the institution. Thus, the system combines the functions of teleradiology service and a system for archiving, searching and view of medical images and patient data.

System) must have an interface to the PACS system. Standard that allows it is the HL7.

There are six basic elements of such a system (Fig.1).

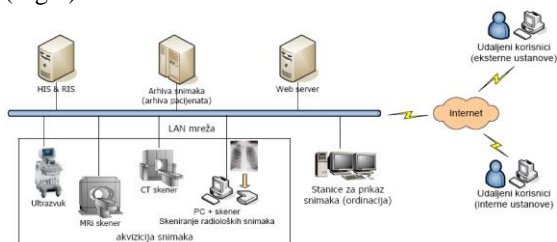


Figure 1. Architecture of Web-based PACS system

- The acquisition of images (Image Acquisition) - acquisition of digital images requires the existence of medical device and the interface to the PACS system. These medical devices are CT (Computed Tomography), MRI (Magnetic Resonance Imaging), film digitizer, etc.. and they must be in accordance with the DICOM (Digital Imaging and Communication in Medicine) standard. DICOM is an international standard for the definition and method of transmission of medical information and images that provides interoperability between different devices. If the standard is not supported on medical devices, then there must be a device for converting medical images.
- Communication network - as a basis of PACS communication there is a network to transfer images and associated data. Network structure influences the speed of the overall system. Network functions of PACS require LAN and WAN environment. Required network infrastructure of PACS system depends largely on the type of images that are used in this system.
- View snapshots - workstations for still images are commonly found in practice. They must meet certain quality. The quality of workstations is reflected in the physical characteristics of the monitor. They can be divided into two groups:
 - Stations low resolution (resolution 512 x 512 pixels);
 - station high resolution (resolution of the 1K x 1K pixels).

In addition to a quality monitor, it is necessary to ensure optimal lighting conditions in the room where the images are examined. The world must be a certain intensity, without creating reflections on monitor. In these cells is required interactive user interface with adjustable zoom, moving image and display patient data.

- Patient data - Hospital Information System HIS (Hospital Information System) and radiology information system RIS (Radiology Information

HL7 (Health Level Seven, 7th OSI Layer Protocol) is a standard for the electronic exchange of information between medical applications in the seventh layer of the OSI model. It is a protocol for data exchange that defines the content of the message that the application is used in the process of exchanging data with other applications. HL7 specifies data formats and their content, but does not specify how the messages will be transmitted through the network. For Message transfer TCP / IP protocol is used.

- Stock Footage - A system for archiving should be centralized, with support for DICOM and HL7 standards.
- Web server - An application on the web server should provide access to and adequate disclosure of information to employees in a medical facility and remote users who need to access to all or only to the data of the patients [2] .

III. DICOM STANDARD AND DICOM FILE FORMATS

With the development of medical devices for the generation of different types of shots and with increasing number of producers of the same, there was a major shift in the use of medical imaging in diagnosing diseases. This led to the creation of a basis for the use of the computer for processing and analysis of digital medical images. As this trend has been in the expansion the conflict occurred between data and devices, and methods for storing and transferring files, the rule of big problems to users, so in 1983, of the ACR (American College of Radiology) and NEMA (National Electrical Manufacturers Association) begun implementation of the standard that would resolve the conflict between the input devices for medical image acquisition, on the one hand, and equipment for the processing, review, storage and other features that users need, on the other hand. The result of hard work and research of these two organizations was the DICOM standard [3].

IV. DICOM FILE STRUCTURE

Regarding the structure of the DICOM file, it can be said that it, like other image formats that exist today, saves images in files which consist of 2 parts, the header and the data.

A. DICOM HEADER FILE

DICOM header file is specific because the amount and variety of data, which may be remembered, is much higher than in other image formats (BMP, JPEG, GIF). It remembers technical information about the image (number of rows and columns, number of colors, number of bits per pixel), data on the modality of images (CT, MRI, ultrasound ...), the place and mode (time and date,

location shooting , position of the patient, the camera position by which image is obtained ...), diagnosis, and others. In order to store such a large number of different data, the standards for each entry, which can appear in the header, a data type is defined, the position of the header, possible values, and it also gives a detailed description of [5], [6]. Since the number of different data can be large and can not know in advance which of them images contain and which do not, it is necessary to identify them uniquely. Therefore, all the data are divided into groups based on similarity, and within each group can contain one or more elements. Identification data is based on their tags (tag) consisting of a number of groups and the number of elements in the group, the group format: element, so for example the patient's name placed in section 0010.0010 [4] .

B. DATA IN DICOM FILE

The second part of the DICOM file consists of information about the image (pixel data). The data in this section are interpreted on the basis of appropriate data in the header. Under the picture, in this case include 2D, 3D image, a frame (such as recording of the heart). Pixels can be saved in the original format uncompressed or compressed. Type of compression is also listed in the header of DICOM files. The data are divided into a series of sequential Data Elements whose meaning needs to be understood correctly in order to decode the information contained in the video. Each group carries some type of information [5] .

V. IMPLEMENTATION OF PACS

The need for such a system on the one hand and specific local health facilities on other, have led to the implementation of specific PACS project which is successfully implemented and incorporated in multiple locations. Specifics were related to several key points:

- Lack of or poor functioning of the BIS / RIS
- Lack of computer equipment
- Poor level of networking and telecommunications
- The varied equipment
- Low funding [6].

On the other hand, it was necessary to comply with the (global) functionality and standardization requirements of the system and adapt it to each user. Also, scalability had to be provided, in relation to other modes of operation and future development of the project. The core of this system and its most critical part is the part related to the acquisition - taking pictures. Here we encounter the problem of different modes of operation and the different modalities of taking pictures. Generally, image acquisition can be divided into three very basic modalities depending on the equipment installation:

- Digital cameras - download image directly, using communication protocols

- Analog devices with video output - download pictures framegrabber
- cards high resolution
- Analog devices without video output - hardware solution, installation of digital CCD camera for taking pictures, the implementation depends on the type of device [7].

VI. HARDWARE SOLUTIONS

Depending on the type of connection to the device, different hardware solutions are applied. In digital communication, which is often the case in our medical facilities, DICOM protocol is used. The device is directly connected to a PC computer through a network or DICOM connection using the appropriate PC interface.

The largest number of appliances (traditional X-ray machines with TV SKOPIJA, CT, MRI, angiography, ultrazvulni devices) in our country and the world has a video signal that can be digitized. This signal can be classic (PAL / NTSC) or high resolution. For devices with conventional video output standard framegrabber card can be used, while the high-resolution signals must use the special. The high resolution framegrabber card used in this solution is Accura I-60, Foresight Imaging company, which is recognized by the ACR for the digitization of these types of imaging devices.

The special mode can be used for angiographic examination. In this mode, you can capture real-time dynamic views in high quality (1024x1024, 30fps), and subtraction in real time. Even the most equipped devices in the world do not have these performances . As for the classic framegrabber card, cards of manufacturers ELSA, Pinnacle and ATI are used [8] .

For us it is very often that the image of this type of apparatus is of insufficient quality, because of irregular assembly or poor service and lack of funds for the purchase of a new camera or image intensifiers. If the problem is bad TV camera tube (vidicon), it is resorted by replacement of the camera and the entire plant associated with analog electronics of CCD camera with appropriate lens, which is many times cheaper, and provides the appropriate picture quality. Depending on your financial capabilities, the camera selects the appropriate resolution and sensitivity (SANYO, SONY, DALSA). Depending on the type of camera used, we distinguish between taking pictures of digitizing video signals, or directly from a digital interface if one exists.

The third aspect of the product (eg fluorograf) has no ability to download images, so you first have to solve the issue of getting the video signal, and then the digitization is done as in the previous case. The issue of obtaining images can be solved by only high-resolution black and white cameras. Depending on the type of equipment necessary to install the appropriate optics to display images with luministic transferred to the CCD chip. Shutter speed is controlled by a software solution that provides always the same quality of downloaded images. In addition, exposure controlled in this way is 2-3 times

shorter than the standard, manually controlled. After receiving the video signal quality images can be obtained as in the second case [9] .

VII. CONCLUSION

The purpose of PACS (Picture Archiving and Communication System) is to connect different systems for data acquisition, processing, storage and display of medical images often presented in DICOM (Digital Imaging and Communications in Medicine) format in a single medical information system. In such an information system any digital medical image is uniquely identified and linked to the appropriate patient and a medical examination during which the acquisition of medical images is initiated, and the doctor who performed the acquisition and / or monitoring, and condition in which the acquisition is carried out. PACS is a unit consisting of several subsystems whose number and purpose may vary depending on the actual needs of technical and financial resources, and other factors related to medical facilities, environment and individuals who participate in the system. PACS systems are designed as a centralized database of medical information on the level of a region or an entire country. However, in order to realize the whole idea, it must be supported by adequate technical, financial, and educational opportunities to the participants in the system, so in many countries in the world PACS systems encounter problems and are very difficult to implement, as is the case with our country. Of course, there are a good number of countries in which these systems are widely used.

In this way, they and almost all the developed countries of the world have come to the conclusion that it is necessary to introduce PACS, KBIS and telemedicine systems, because they bring huge savings while increasing the quality and efficiency of health care. They are especially popular in poor countries, because they allow the realization of large permanent savings (eg PACS investments pay off in 1-2 years, the savings from the X-ray films, which means that from the third year onwards the system achieves great savings in the welfare budget protection).

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Ontology driven decision support system for scoring clients in government credit funds

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Abstract - In this paper, authors identify two main aspects for the risk management in the government development funds and propose model of the ontology driven decision support system. The first aspect of the proposed model deal with reducing the risk of the investments using classic commercial bank methods for client scoring. Second aspect of the proposed model deal with social, political and development component of investment in the government development funds. Presented Score ontology merge this two aspect and provides possibility for creating decision support system.

I. INTRODUCTION

This representation of the knowledge enables the creation of structured information collections and rules of inference to facilitate the automated reasoning; in this manner, the intelligent agents interpret and exchange information with semantic content for the benefit of the users. By organizing knowledge in for use by information systems, ontologies enable communication between computer systems in a way that is independent of the individual system technologies, information architectures and applications.

Decision-making is one of the main research themes of systems science, and decision support systems (DSS) were developed in many area; e.g., management decision-making, group decision-making, etc. DSS helps the decision-maker to gather information, generate alternatives, estimate the values of alternatives, and to make choice. [7] classified DSS as model-driven DSS, data-driven DSS, communications-driven DSS, document-driven DSS, knowledge-driven DSS, web-based DSS. In the most of DSS, decision-making may be regarded as a choice between alternatives based on the estimation of the values of the alternatives.

Predictive Analytics encompasses a variety of techniques from statistics, data mining that analyze current and historical facts to make predictions about future events. In business, predictive models exploit patterns found in historical data to identify risks and opportunities. Models capture relationships among many factors to allow assessment of risk or potential associated with a particular set of conditions, guiding decision making for credit candidate. One of the most well-known applications is

credit scoring. Credit scoring has become norm in modern banking.

The methods [4] generally used for credit scoring are based on statistical pattern-recognition techniques. Historically, discriminant analysis and linear regression were the most widely used techniques for building scorecards. Both have merits of being conceptually straightforward and widely available in statistical software packages. Typically, the coefficients and numerical scores of the attributes were combined to give single contribution, which are added to give an overall score. Logistic regression is now probably the most used technique for credit scoring.

Other techniques which have been used include are probit analysis, nonparametric methods , neural networks or conditional independent models.

In the government funds the basic commercial bank parameters are not sufficient for making decision because the government development funds are state interventionism tool and the funds must consider regional, social and other parameters in function of the scoring applicant.

In this paper author proposes a model of the decision system that is driven by ontology, which is initially generated from the historical data of the issued credits in government developments funds. The main advantage of the proposed model is a possibility of ontology queering for the merged economical and development aspect which have significant influence on the decision proposal.

The paper is organized as follows: the second section provides an overview of the method for the scorecard creation. The third section presents a methodology for the ontology generation. The fourth section shows the proposed model of the decision support system. In the final, fifth section, concluding remarks and directions for further research are given.

II. RELATED WORK

In recent years , ontologies are increasingly being used for different purposes . In this paper , an ontology is used to support the implementation of decision support systems. There is no standard way in which decisions can be implemented in the ontology . There may be some

works that have dealt with this issue. It is a systematic method of defining the decision-making process using ontology as the base, but does not use the ontology to improve the system for decision support in different places [10], there is a framework for ontology-based data integration and decision support using various heterogeneous resources data. No difficult to create ontologies, as found in previous references, but the latest phase of a merger of ontologies and ontology data warehouse.

III. CREATING SCORINGCARD

The quality and quantity of historical data available are the most important factors to determining what type of scorecard should be developed. According [1], first step in the creation scorecard is a determining the core characteristic of the client and analysis of the grouped variables by using a weight of evidence (WOE).

$$WOE = \ln(\text{Dist Good} / \text{Dist Bad})$$

Information Value (IV), or total strenght of the characteristic, comes from information theory, and measured using formula:

$$\sum_{i=1}^n (\text{Distr Good}_i - \text{Distr Bad}_i) * \ln \left(\frac{\text{Distr Good}_i}{\text{Distr Bad}_i} \right)$$

- less than 0,02 unproductive
- 0,02 to 0,1 weak
- 0,1 to 0,3 medium
- 0,3 + strong

Second step is calculating the regression coefficient using linear regression. Linear regression is statistical technique that can be used to analyze relationship between a single dependant variable and one or more independent variables(predictors).

Third step is a scaling scorecard. In general, the relationship between odds and scores is represented by a linear function:

$$\text{Score} = \text{Offset} + \text{Factor} * \ln(\text{odds})$$

If the scorecard is developed using "odds at a certain score" and "points to double the odds" (pdo), Factor and Offset can be calculated using the simultaneous equations:

$$\text{Score} = \text{Offset} + \text{Factor} * \ln(\text{odds})$$

$$\text{Score} + \text{pdo} = \text{Offset} + \text{Factor} * \ln(2 * \text{odds})$$

Solving the equations for pdo, you get the following results:

$$\text{pdo} = \text{Factor} * \ln(2)$$

Therefore $\text{Factor} = \text{pdo} / \ln(2)$, $\text{Offset} = \text{Score} - \text{Factor} * \ln(\text{odds})$

If a scorecard were scaled where the developer wanted odds of 50:1 at 600 points and wanted the odds to double every 20 points (that is, pdo = 20), Factor and Offset would be as follows:

$$\text{Factor} = 20 / \ln(2) = 28.8539, \text{ Offset} = 600 - 28.8539 * \ln(50) = 487.123$$

So, each score corresponding to each set of odds can be calculated as follows:

$$\text{Score} = 487.123 + 28.8539 * \ln(\text{odds})$$

For each attribute, the WOE and the regression coefficient are multiplied together. Then, a fraction of the regression intercept is added. Multiply this by -1 and by Factor and finally add a fraction of Offset. An applicant's total score is then proportional to the logarithm of the predicted good/bad odds of that applicant.

The points allocated to attribute i of characteristic j are computed by this formula:

$$(\text{WOE}_i * \text{beta}_j + a / n) * \text{Factor} + \text{Offset} / n, \text{ where}$$

- WOE_i is the weight of evidence for attribute i of characteristic j
- beta_j is the regression coefficient for characteristic j
- a is the intercept term
- n is the total number of characteristics

Typically, points are rounded to the nearest integer.

When the scoring card is developed next step is a creation an ontology.

IV. CREATING ONTOLOGY

According the authors [9] the public administration knowledge to be managed can be used for the following:

- Transformation of Governmental services and processes
- Composition of new services
- Training of Public Administration officials
- Setting up goals and metrics for measuring e-Government progress
- Achievement of Interoperability and onestop services composition
- Building or transforming information systems
- Assisting user access to electronic services
- Diffusion of new electronic services towards citizens and enterprises
- Setting up large initiatives (such as the Digital Strategy of a country, lighthouse projects involving Public Administration and IT companies)
- New research approaches in eGovernment

Building ontology is a complex work; in order to build ontology you need a domain expert to help you to declare all domain concepts and the relationship between them. Ontology web language (OWL) is a standard ontology language from the World Wide Web consortium. OWL ontology consists of individuals, properties and classes.

The implementation of the government development strategy in parallel with mathematical scoring models is a fundamental prerequisite for creating ontology. Basically, experts systems involve four concepts –facts, domain model, rules and strategies.

Facts are the data given as input and returned as output. The whole purpose of the expert system is to use given facts to infer others. Domain model and rules are used by the inference engine to deduce new facts from those that have been previously given or deduced (that is, in a forward reasoning process). Strategies act as higher-order rules, and are used to choose which rule have to be used. Strategies can be either hardcoded or, using successive layers of their inference engine, strategies can be given as rules of higher order.

From a knowledge representation perspective, ontologies are semantic networks that state what kinds of concepts exist and what abstraction-particularization relations hold among them. The process of developing ontology is iterative and ongoing. Our first task was to identify the relevant concepts to be included in the ontology. For each concept, we identified the set of attributes and relations with other concepts needed to make the structure of the body of knowledge explicit.

Social complexity merged with mathematical verity become rise point for creating our ontology.

In order to create ontology authors define two groups of questions that ontology should be able to answer:

1. In order to control credit risk

- a) is Client have possibilities for servicing credit
- b) is Client good or bad

2. In order to develop the region

- a) is Client from undeveloped region
- b) is Client from social endangered category
- c) What is the source of wealth
- d) The education level

To answer this list of questions, the ontology must include the information on various client characteristics.

A. Defining the core Ontology classes

Using statistical techniques described in chapter 3. Authors determine the core classes of an ontology. Fig. 1 determines core classes of generated ontology.

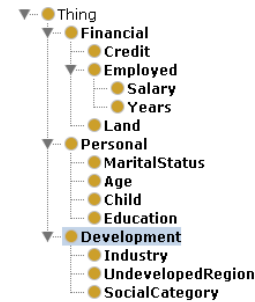


Figure 1. Core classes of the created ontology

As shown on Fig. 2, Authors determine three core classes:

- Financial – This class describes financial characteristic of the client. Those characteristic are chosen using statistical techniques described in chapter 3. Class *Financial* has the following subclasses: *Credit*, *Employed*, *Salary*, *Years*, *LandOwner*.
- Personal - This class contains personal characteristic of every client who applied for a credit: Age, Child, Education, Marital Status. Each of those characteristic assigned corresponding attributes with calculated number of scoring points.
- Development – This class define a government policy for development specifically region or type of industry depending of the defined development program. Local or central government defines development program.

B. Defining the relations

According to the results gather from the statistical data, every attribute of the defined characteristics have specific number of points as shown on Fig. 2.

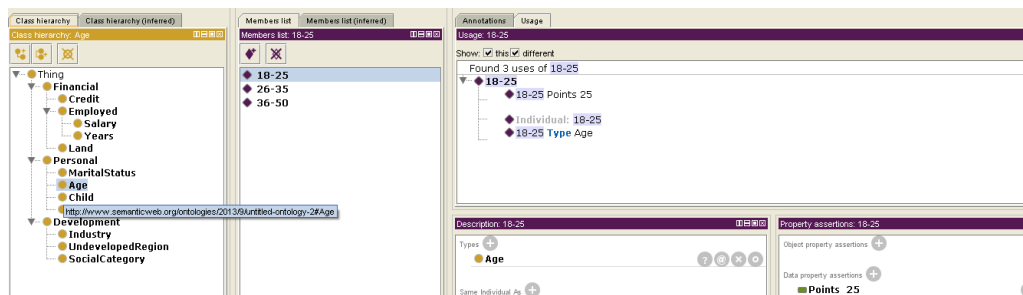


Figure 2. Relations

Individual *18-25* is a attribute of the characteristic *Age*. Every attribute have *DataProperty* value. Value of the *DataProperty* is result of the statistical analysis described in chapter 2.

Specificity of the created ontology is a class "Development". The values of the attributes defined by the client characteristics are given descriptive and present social, political and development component of the decision model.

V. THE MODEL

Decision support systems (DSSs) are information systems that support users and organizations in decision-making activities. DSSs have been applied in several diverse

application contexts, to help to take decisions in domains like the medical, legal, computer security, and power consumption management ones.

At an abstract level, we can identify three phases in a decision-making process [9]:

1. the formulation of the decision-making problem;
2. the gathering, storing, and fusion of the data relevant for the given problem;
3. the reasoning on the data to take a decision

The advantages of using a semantic (ontology based) representation of the main data structure of a DSS are many. First, differently from what happened in the past where DSS were closed systems, in the semantic web era most of the knowledge and data useful to support a decision is available (in heterogeneous formats) in the web. As one of the main objectives of ontologies is to define shared domain models, an ontology based representation of the knowledge in a DSS facilitates the integration of structured knowledge and data available in the web. Second, in the semantic services era we are now, a DSS can be seen as any other web-service and therefore it can be combined with other semantic services.

The OM GFAPV ontology [2] were taken as the basis for the creation decision support model. Fig. 3. Show a model of the ontology driven decision support system.

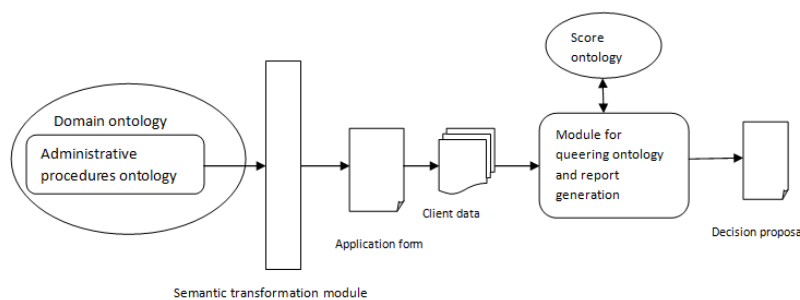


Figure 3. Model of the ontology driven decision support system

As described in [2], the annotation of the Administrative procedures ontology with elements of user interface elements is based on the rule that administrative tasks have input data. Input data is a series of variables that are filled with the resulting document template of the administrative task. The names of the input data are represented with dataProperties of the observed task. The descriptions of input data are defined in dataProperties – isDefinedBy property in the following form. Individuals of each class denote the template of the document that is filled with input data during the execution of the administrative task and when the final document is generated. The feature Data_Properties_assertion references a document that represents the template of the document. Data_Properties_ID defines the order of execution of the administrative procedures and/or tasks.

The Procedures concept represents taxonomy of the administrative procedures of the fund. This taxonomy is created based on operational procedures for issuing guarantees and procedures relating to the creation of planning acts of the fund. In addition, the taxonomy contains procedures related to utilization of the documents that define legal and regulative framework of funds within the state administration. The taxonomy is shown on Fig. 4.

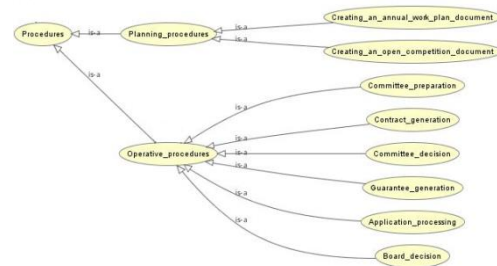


Figure 4. Procedure class from [2]

Authors propose three steps in generation decision proposal.

The First step in our approach is using the Module for transformation of the semantic and generating user interface. Created user interface is an application form which have Client attributes as input data.

The module for transformation of semantic content shown in Fig.5 represents the application that loads the created ontology and executes SPARQL queries. Parsing the query results generates two XML documents (*OntoClass, OntoForm*).

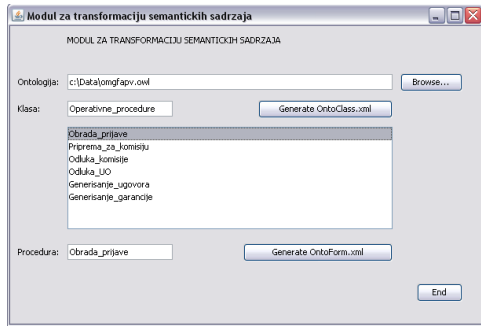


Figure 5. Semantic content transformation module

The semantic content transformation module provides the following functionalities:

- Selection and loading of the desired ontology
- Entering the names of basic classes of the ontology that describe the operative procedures of the business process of issuing guarantees and generating a list of administrative procedures in the process of issuing guarantees.
- Generating OntoClass.xml documents.
- Entering the name of administrative procedure for which it is necessary to generate a form of user interface

The Second step in our approach is a filling generated application form and using a associated services passing client characteristic in module for queering score ontology.

The Third step is a queering SCORE ontology and generating decision proposal.

VI. CONCLUSION

In this paper authors propose model for the ontology driven decision system. Authors analyzed two points of interest for the decision support. First is a generating a client scorecard according the classical commercial bank methods aimed to reducing a risk of investments. State development funds are interventionist mechanisms by which the state affects the development of small and medium enterprises whose activity is aimed at stimulating the development of small and medium-sized enterprises while reducing risk and transaction costs related to the implementation of stimulating instruments. Following this development component of the funds authors propose method for creating a descriptive component of the generated ontology which present social, political and development component of the decision model.

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Brute Force attacks on web applications

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Abstract - In this paper a basic idea and structure of the Brute Force attack will be presented. Brute Force attacks, based on web approach, most often attack login systems of remote systems as web sites, FTP or SMTP servers and so on, using HTTP, SMTP, FTP and other protocols. Attacks are realized using special tools as Brutus and THC Hydra (xHydra). Besides these, two new tools have been developed: XOR Brute Force and HTTP Brute Force – Submethod Dictionary Attack, which may be used for security testing in web applications.

I. INTRODUCTION

The Brute Force attack is a kind of cryptoanalytic attack that, theoretically, may be applied on any set of encrypted data in order to decrypt [1]. This kind of attack may be also used when it is not possible to find weaknesses of encryption system that is being attacked, if chosen encryption system has any. The basic idea behind Brute Force attack is to check, in orderly and systematic way, all possible values for keys until appropriate key is found. Illustration of the Brute force attack is shown in Fig. 1. Downside of the Brute Force attack is that it may take very long, depending on length and complexity of a key, and on complexity of the algorithm used for encryption of attacked data.

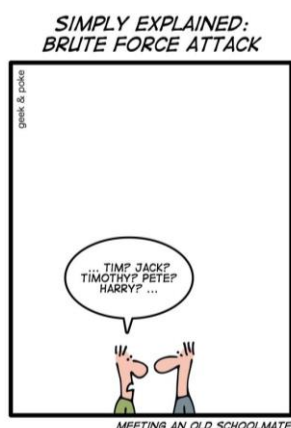


Figure 1. Illustration of the Brute Force attack

Length of a key used by coders determines whether use of Brute Force attack is affordable on the particular set of encrypted data. With the increase of a key length, time and resources that must be invested in order to decrypt encrypted data using Brute Force attack rise

exponentially. We may say that with key length increase exponentially harder to decrypt certain encrypted data using Brute Force attack. The coder with N bit length (where N is integer) might be decrypted by Brute Force attack, using all possible variations, i.e. by 2^N method; if the key length is 8 bit, 2^8 is 256 combinations. Nevertheless, practice shows that very often keys were found using Brute Force algorithm when about a half of all possible key variations is processed. [2][3].

If data are in some way modified before encryption, efficiency of Brute Force attack may be considerably lower. Modification of data may encompass extremely wide range of actions; if it is a text, it may be translated to another languages; bit sequence may be, in a cyclic process, moved step or two to left and/or right; or data to be encrypted by an encryption algorithm are previously encrypted by some other encryption algorithm. All these actions considerably aggravates for person using Brute Force attack to establish whether the attack was successful in decrypting data, i.e. whether the code is broken.

One of parameters describing how good is an encryption system is the measure predicting how much time, theoretically, would be needed for an attacker to decrypt data encrypted by this particular encryption system using the Brute Force attack [4].

II. BRUTE FORCE TOOLS

Brutus is one of fastest and most flexible tools for guessing passwords, i.e. realization of the Brute Force attacks. It works solely on Windows platforms and its function is based on use of dictionary – thus Dictionary Attack – and word permutation in order to guess the password. It supports HTTP, POP3, FTP, SMB, TelNet, IMAP, NTP and other protocols [5].

THC Hydra is a tool enabling user to realize a large number of fast Dictionary attacks on particular network login systems, including FTP, POP3, IMAP, NetBios, TelNet, HTTP Auth, LDAP NNTP, VCN, ICQ, Socks5, PCNFS etc. It also supports SSL and is a part of the Nessus system. This tool works on UNIX/LINUX operative systems and it is partially supported by the Windows operative systems [6].

In this paper two tools will be introduced: XOR Brute Force and HTTP Brute Force – Submethod: Dictionary Attack. The XOR Brute Force section describes use of XOR Brute Force program that, from cryptographic aspect, using Brute Force method, decrypts any text encrypted by XOR operation, using certain value as a key.

The HTTP Brute Force – Submethod: Dictionary Attack tool is formed in order to use HTTP POST or GET methods on login system of a remote service, and to realize a simplified dictionary attack.

III. XOR BRUTE FORCE

XOR or exclusively or, is not a cryptographic algorithm but logic operation, but it has broad application in certain cryptographic algorithms as DES and AES standards. This logical operation is executed on byte level, and brings true output only if one of two bits has value 1 or true. See Table 1. The basic characteristic of the XOR operation is that a content that had been XOR-ed by certain value, and then XOR-ed again by the same value, returns to previous state, or – from cryptographic point of view – certain content, encrypted by certain key, translates to encrypted content, while encrypted content is decrypted using the reverse process and the same key. This principle has rules of the symmetric cryptography. Having in mind

that this process is quite simple, it is easy to notice that XOR as an operation and as a part of cryptographic algorithm is extremely susceptible to Bruce Force attack.

Fig. 2 shows the main form of XOR Brute Force tool. Text to be encrypted is entered into Data to Encrypt field, Key field contains the key value, and in Encrypted Data field shows results of encrypting after one click to the Encrypt key.

The example of XOR encryption is shown in Fig. 3. Text in Data to Encrypt field is „danas je divan dan“, key is the word „ponedeljak“, and result of encryption is incomprehensible text. Fig. 4 shows decryption of this encrypted text, using the same key.

TABLE I. TABLE I. XOR DEFINITION AND EXAMPLE

Input		Output
A	B	
0	0	0
0	1	1
1	0	1
1	1	0

	Binary	DEC	ASCII
Data	00101101	45	-
Key	01001011	75	K

Encrypted	01100110	102	f

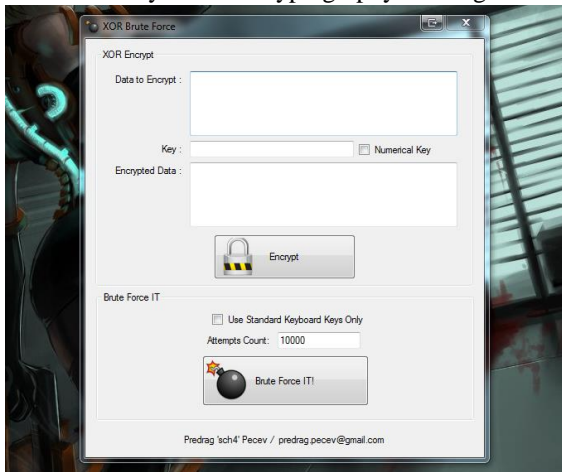


Figure 2. XOR Brute Force tool

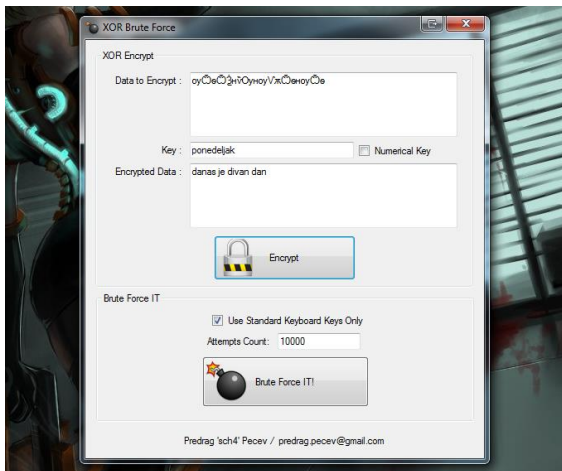


Figure 3. Example of XOR encryption

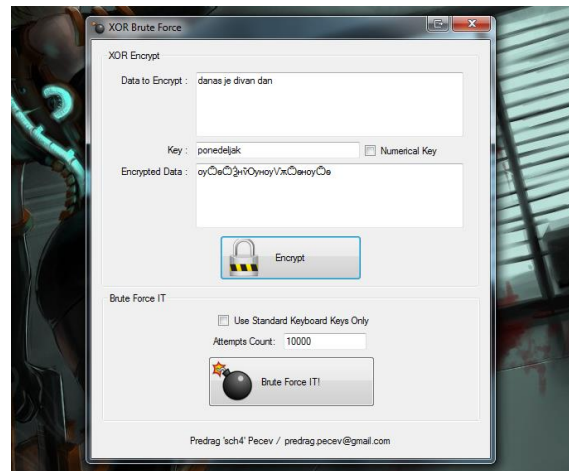


Figure 4. Example of XOR decryption

Brute Force IT section has the key to launch the Brute Force attack, field Attempts Count defining number of attempts/permutations of bits that will be used in order to generate a potential key, and selection the Use Standard Keyboard Keys Only option enables filtering decryption

results, in order to show only those combinations of keys and results that consists only from characters that may be found in a standard keyboard. Fig. 5 and Fig. 6 show process of Brute Force decryption, with and without such filter.

attacked. Fig. 9 shows appearance of the login form. During unsuccessful login attempt, a Login FAIL message is shown as seen on Fig. 10 that must be entered into the Failed Result field.

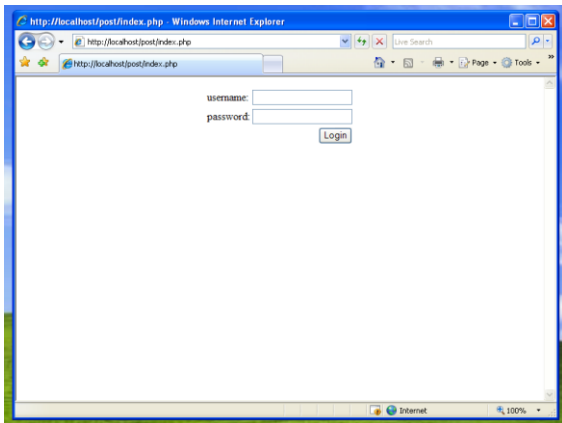


Figure 9. An example of a Login Form

Parameters necessary for initialization of Brute Force attack may be found by analysis of the markup code of HTML form. Modern web browsers have the View Source option, which shows markup of the HTML form as presented in Fig. 11. In this case, it is necessary to find form HTML tag marking the beginning of HTML form. Highlighted attributes of the form tag are name, method and action. Value for *name* attribute is the name of the form, while *method* attribute points out which method is being used for sending the entered form data, and it may have two values: POST and GET. *Action* attribute comprises of the name and the path for the script in which content of form will be sent. Inside the form usually there are controls, or fields to enter certain information that will be sent using that form. Since this is a login form, special attention should be paid to the element comprising username and password. These fields are input ones, declared by *type* parameter, and as all other elements of the HTML form they have their name, defined by the *name* parameter. Within the form from the Fig. 11 there are two HTML controls of input type, representing mnemonic user name and password. The form must have a control that will initialize sending data from input controls.

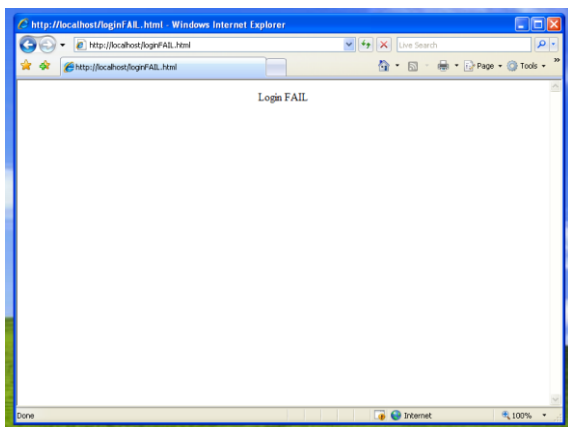


Figure 10. Result of unsuccessful login

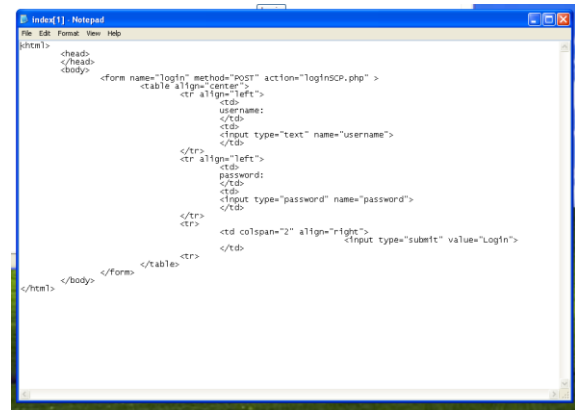


Figure 11. HTML markup for a page with the login form

Regarding this example, section of HTTP Brute Force Configuration now can be fulfilled. From the form tag of the login form, we may conclude the following:

- Value of *method* attribute is POST, therefore value of the Method field should be POST;
- Value of *action* attribute is loginSCP.php, therefore value of the URL field should be the complete URL path to the script mentioned, in this case http://localhost/post/loginSCP.php;
- The name of the input control comprising of username is "username", therefore in the Username field a value "username" should be entered;
- Name of input control comprising of password is "password", therefore in the Password field a "password" value should be entered.

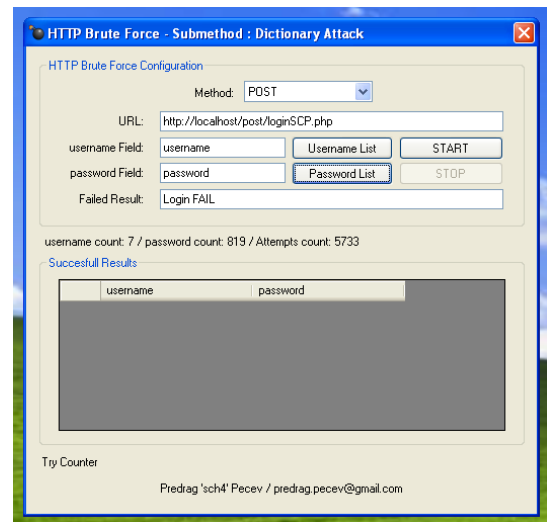


Figure 12. Appearance of the mainframe of HTTP Brute Force tool after analysis of the login form and after information entered correctly

By clicking the Username List key, a dialog box is opened, asking the user to choose text file with the username list, where usernames are listed one below the other. By clicking the Password List key, a dialog box is opened asking the user to choose a text file with the

QR Codes and Its Applications

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Abstract - QR codes are two-dimensional bar codes that can contain any alphanumeric text and often feature URLs that direct users to sites where they can learn about an object or place (a practice known as "mobile tagging"). Decoding software on tools such as camera phones interprets the code, which represent considerably more information than a one-dimensional code of similar size.

The QR codes are found in places such as product labels, billboards, and buildings, inviting passers-by to pull out their mobile phones and uncover the encoded information. Codes can provide tracking information for products in industry, routing data on a mailing label, or contact information on a business card. Small in size, the code pattern can be hidden or integrated into an esthetically attractive image in newspapers, magazines, or clothing.

I. INTRODUCTION

Quick Response (QR) codes are versatile. A piece of long multilingual text, a linked URL, an automated SMS message, a business card or just about any information can be embedded into the two-dimensional barcode. Coupled with moderate equipped mobile devices, QR Codes can connect users to the information quickly and easily. In this paper, we explore how QR codes function.

II. QR CODES

A. Understanding QR Codes

QR Code is a form of 2D bar codes. A sample is shown in Fig. 1. It was developed by Denso-Wave, a Japanese automatic data capture equipment company, in 1994. "QR" stands for "Quick Response." It is readable by mobile phones equipped with cameras and QR scanners. Information such as URL, SMS, contact information and plain text can be embedded into the two dimensional matrix. With smart phones, we can visit the Website linked by the URL quickly, we can send the SMS message directly or we can save the contact information onto the address book easily. This format of 2D bar codes is so popular in Japan and emerges gradually around the world because the patent right owned by Denso Wave is not exercised, its specification is disclosed to the public by the company so as the specifications, ISO 8859-1 (International Organization for Standardization) and JISC (Japanese Industrial Standards), can be formed (ISO, 2010; JISC, 0208). It has a large data capacity in a small printout size and high speed scan utilities via mobile devices are readily available. A QR code is capable of holding 7,089 numeric characters, 4,296 alphanumeric

characters, 2,953 binary bytes, 1,817 Kanji characters or a mixture of them. The data capacity is much higher than other 2D codes such as PDF417, Data Matrix and Maxi Code. Table 1 shows maximum character storage capacity of a QR Code.

TABLE I. MAXIMUM CHARACTER STORAGE CAPACITY

Input mode	Max. characters	bits/char	Possible characters, default encoding
Numeric only	7,089	3 $\frac{1}{3}$	0, 1, 2, 3, 4, 5, 6, 7, 8, 9
Alphanumeric	4,296	5 $\frac{1}{2}$	0-9, A-Z (upper-case only), space, \$, %, *, +, -, ., /, :
Binary/byte	2,953	8	ISO 8859-1
Kanji/kana	1,817	13	Shift JISC 0208

It stores information in both vertical and horizontal directions. A QR code can be read from any direction in 360° through position detection patterns located at the three corners as shown in Fig. 1. A QR code can be read even it is somewhat distorted by either being tilted or on a curved surface by alignment patterns and timing patterns. The error correction capability against dirt and damage can be up to 30%. A linking functionality is possible for a QR code to be represented by up to 16 QR codes at maximum so that a small printing space is possible. The size of a QR code can vary from 21x21 cells to 177x177 cells by 4 cell-increments in both horizontal and vertical direction.



Figure 1. QR Code Sample

QR code structure consists of the parts shown in Fig. 2.

- Finder Pattern - A pattern for detecting the position of the QR Code. By arranging this pattern at the three corners of a symbol, the position, the size, and the angle of the symbol can be detected. This finder pattern consists of a structure which can be detected in all directions (360°).

- **Alignment Pattern** - A pattern for correcting the distortion of the QR Code. It is highly effective for correcting nonlinear distortions. The central coordinate of the alignment pattern will be identified to correct the distortion of the symbol. For this purpose, a black isolated cell is placed in the alignment pattern to make it easier to detect the central coordinate of the alignment pattern.
- **Timing Pattern** - A pattern for identifying the central coordinate of each cell in the QR Code with black and white patterns arranged alternately. It is used for correcting the central coordinate of the data cell when the symbol is distorted or when there is an error for the cell pitch. It is arranged in both vertical and horizontal directions.
- **Quiet Zone** - A margin space necessary for reading the QR Code. This quiet zone makes it easier to have the symbol detected from among the image read by the CCD sensor. Four or more cells are necessary for the quiet zone.
- **Data Area** - The QR Code data will be stored (encoded) into the data area. The grey part in the code represents the data area. The data will be encoded into the binary numbers of '0' and '1' based on the encoding rule. The binary numbers of '0' and '1' will be converted into black and white cells and then will be arranged. The data area will have Reed-Solomon codes incorporated for the stored data and the error correction functionality.

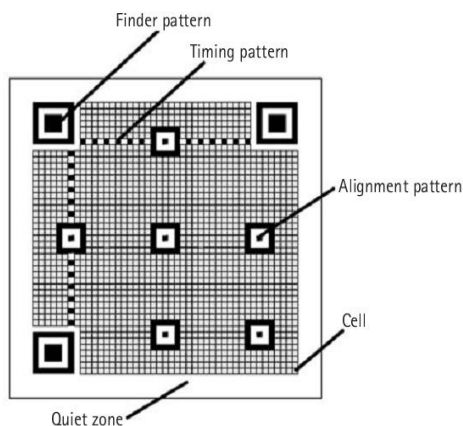


Figure 2. QR code structure

B. QR Code Error Correction

QR codes have ability to sustain “damage” and continue to function even when a part of the QR code image is obscured, defaced or removed.

This is achieved by using the Reed-Solomon Error Correction algorithm – a set of algebraic operations that happens in background when the QR code is created. The original data in the QR code is converted into a polynomial, the number of unique points required to uniquely define that polynomial is determined, and this point set is added back into the QR code so that it then also contains the original data expressed as a polynomial.

There are 4 error correction levels used for QR codes, with each one adding different amounts of “backup” data depending on how much damage the QR code is expected to suffer in its intended environment, and hence how much error correction may be required:

- Level L – up to 7% damage
- Level M – up to 15% damage
- Level Q – up to 25% damage
- Level H – up to 30% damage

A fundamental part of the way QR codes work is that the more data you put into them, the more rows and columns of modules will be introduced into the QR code to compensate for the increased data load. As the error correction level increases, this means there will also be an increase in the number of rows and columns of modules required to store the original data plus the increasing amount of backup code words. This is shown in the shown on Fig. 3. The QR code becomes denser as the error correction increases from Level L to Level H even though the QR codes contain exactly the same website URL.

Module down in the bottom left-hand corner of every QR code that display degree of the error correction level which is used in that QR code.

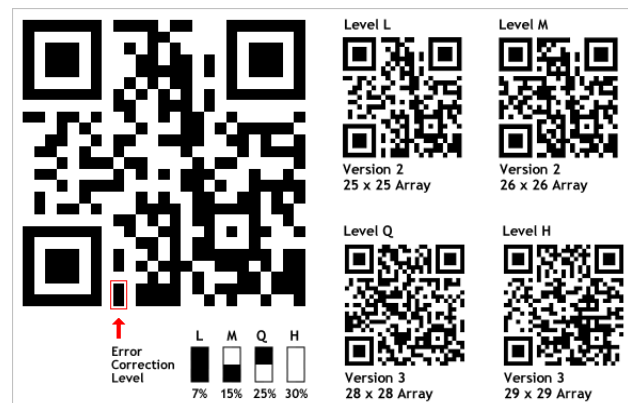


Figure 3. Error Correction Levels

Explanation about Error Correction Levels:

- The lower the error correction level, the less dense the QR code image is, which improves minimum printing size.
- The higher the error correction level, the more damage it can sustain before it becomes unreadable.
- Level L or Level M represents the best compromise between density and ruggedness for general marketing use.
- Level Q and Level H are generally recommended for industrial environments where keeping the QR code clean or un-damaged will be a challenge.

This is also one of the reasons why a QR code containing the same data will look different depending. It depends on the error correction level being used. Even though there is a single ISO standard for QR codes, there

are variables within the ISO standard (error correction level being one of them) that will result in a different looking QR code image based on that variable.

C. Business Cards

Although printed business cards are just as important as ever for networking purposes, electronic business cards also provide you with the same benefits and more. Standard business cards, as it may be obvious, are static presentation cards. When you show electronic business cards, the horizon is widened by the amount of additional media that you can include in your card.








Current trends, such as QR Codes, allow for much more. QR Codes, Quick Response Bar Codes, or Quick Response Codes allow smart phone users to exchange information easier than before. QR codes can be printed directly into a business card, thus allowing prospects to scan the code and receive further information with regards to the business card.

Unlike traditional business cards QR Codes, allow for electronic business cards to be seen immediately using the business card QR Code. So the user won't be redirected to a website to see further information, but rather see the image of the business card immediately. This is quite useful to cut down on the amount of paper and ink implemented on substantial amounts of business cards that inevitable end up in the trash.

D. QR Code type

There are several actions that can be found within the QR code. QR Codes can encode actions shown on Table 2.

TABLE II. TYPES OF QR CODE

Type	Explanation
	A website URL to which the user will be directed and where he will see the content made available for him.
	An email or a text-message ready to be sent.
	A business card which can be directly stored in your smartphone's contact list.
	An event that can be automatically added to your calendar.
	A phone number recognized by your Smartphone for dialing.
	A simple text to display.
	Wi-Fi access point's credentials to initiate a connection from your smartphone.

III. USES OF QR CODES

The possibilities of QR codes are infinite as they are changing the trends and methodologies of shopping, product selection, sales, and marketing. Many companies are using QR codes to expand their brands to consumers. It's an excellent way to introduce new products and services. On the other hand, QR codes also allow businesses to reach out and interact with their customers on a whole new level. It's a new concept and many businesses are trying to benefit from being the first ones to use QR codes to capitalize on the trend.

QR codes require a specific type of reader and it can be scanned either indoors or outdoors with the help of a reader device. Many websites offer free QR codes generation facilities which can be used to generate the images. Then, you can send it to users or viewers of the website.

Social QR codes is another feature specifically designed for social networking which helps users to gain Facebook fans, and restaurant QR codes can be used to inform customers about the special offers during a particular season. These uses of QR codes make it highly valuable and all these provisions help companies and the client to get connected in a better way, which optimizes online and offline marketing.

IV. CONCLUSION

In this paper we have explained how QR codes function and what they are. This technology exists a lot of time, but now it is coming to expression. Today, almost everyone has a mobile phone, and represents potential user of the QR code. Most people do not know what QR codes are, and do not exploit the ability of mobile phones to read QR codes.

By using QR codes it is much faster and easier to transmit textual content. Transferring of content from business cards into the mobile phone performs much faster than traditional rewriting. QR barcode can receive and display much more content compared to the other barcodes, and it also leads to error correction where QR code has been damaged up to 30%, so its content remains readable, regardless of the damage

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Software Support to Fashion Design

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Abstract – Many human activities are faced with the need for using information technologies. Fashion design is working area that needs support of appropriate software solutions in aim to enable creativity to be more free and more focused on ideas, rather than to technical issues related to materialization and construction. This paper gives a short overview of some software solutions in the field of fashion design. Case study of a Turkish garment production company shows possible directions of using fashion design software in this industry.

I. INTRODUCTION

Using software in visual arts and industry is particularly developed in recent years. Even it took lots of interdisciplinary efforts in teamwork to develop such solutions[1], fashion industry is well-equipped with appropriate software solutions. Starting with early prototypes that include computer graphics and databases integration [2], today these solutions include support to all phases of creation of a new product, from creative design phase to mass production phase. They increase productivity of many working positions, starting from designers, modelers to factory machine practitioners.

In the phase of design, it is very important for software to enable visual representation of design and detailed analysis related to implementation of designed artifact. As a support to design, many software products are developed to enable features such as 3D modeling [3, 4], virtualization and simulation [5]. Special attention has been made to the quality of software solutions user interface [6]. "A traditional fashion designer has to draw a large number of drafts in order to accomplish an ideal style. Better performance can be achieved if these operations are done on computers, because the designer can easily make changes for various patterns and colors." [7] Special problems in graphical programming of this software is related to colors processing [7]. Recent years bring closer artificial intelligence domain to computer-aided design, trying to formalize the issues of "design", such as to extract behavior of designer. One of these solutions introduce using genetic algorithm within computer-aided design software [8]. Another direction of software development is application in textile creation education, such as some sorts of educational software [9].

Aim of this paper is to present a short overview of software solutions that are commercially available for textile industry, particularly for the phase of creative design.

II. FABRICS AND GARMENT DESIGN SOFTWARE

Generally speaking, textile industry is based on fabrics and garment production. Design of fabrics and design of garment are two very important segments.

In the field of fabrics creation, some of available software solutions include Weaving design software "Fiberworks" (Figure 1).

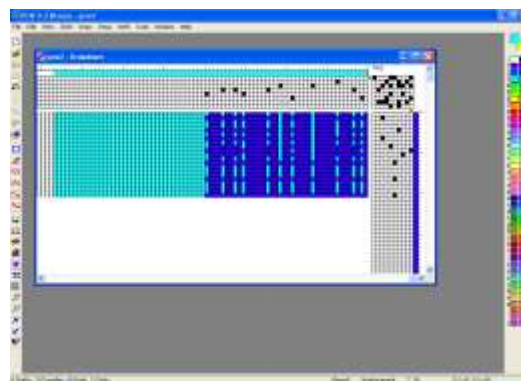


Figure 1. Weaving design software "Fiberworks" PCW [9, 10]

At the other hand, design of garment is "most commonly named – fashion design". Software support for garment design could be illustrated by software package "c-Design fashion" [11], as presented at figure 2.



Figure 2. Garment design software "C-design fashion"

III. CASE STUDY – FULEKS TEKSTIL

The simple case study of introducing software in textile industry will be presented with “Fuleks-Tekstil” company from Istanbul, Turkey.

This company started more than 15 years ago as a small family business in knitting. Today, there is a large factory with many export business. Some of their design is presented at Figure 3.

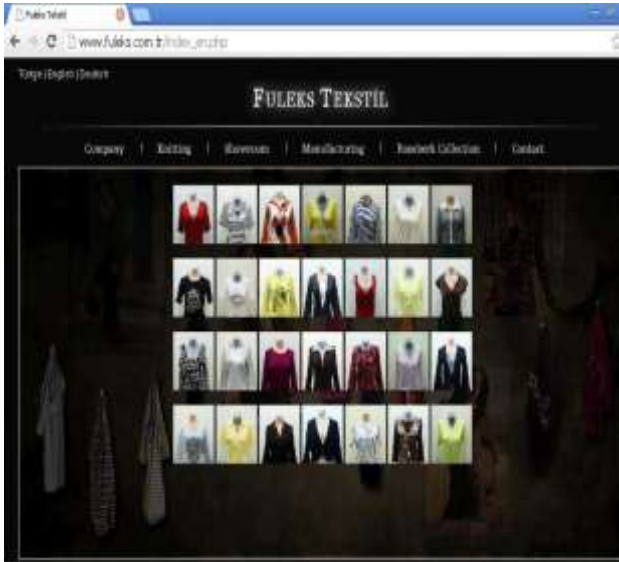


Figure 3. Example of garment design from “Fuleks –tekstil” company presented at the company website [12]

In this company, garment design software is used only in creative design phase, while this design is not connected automatically to other phases of mass production. Figure 4. shows production knitting machines in this company.



Figure 4. Knitting machines in Fuleks company

Figure 5. shows production of garment in Fuleks company.



Figure 5. Production line in Fuleks Tekstil company

This company presents a case study where traditional garment production is based on knitting machines and manual or semi-manual work on garment. Possible direction of improvements in this company could lead to including automatization of production process (according to previous computer based design) by connecting of computers with production machines. Costs of including new automatization should be feasible according to possible benefits.

IV. CONCLUSION

Fashion design is modern and creative activity that takes place not only in fashion studios, but at real companies. In this paper the brief history of fashion design software support is presented. Some of commercially available software solutions for fabrics and garment design are presented. A simple case study is described in aim to present actual problems of using fashion design software results in real company production.

It is concluded that existing companies in textile industry often use machines that may not be always computer –based and it could be difficult to implement computer based fashion design in mass production. Full automation and integration of design with production requires appropriate machines and their inclusion should be cost/effective and feasible according to potential benefits.

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The Potentials of Corporate Blogging

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Abstract - To remain competitive, companies are seeking ways to distinguish themselves from the competition and establish a competitive advantage. The traditional media are excellent medium for conveying corporate information to users /clients, but the trend of consuming media and corporate messaging, especially on the Internet, has increased dramatically. Robotic press releases, boring business jargon and a complete lack of personalization were the characteristics of media before the appearance of blogs. The aim of this paper is to present a corporate blog as an eye, ear and voice of the public, and to point to its powerful ability in breaking through barriers between companies and customers.

I. INTRODUCTION

As many practitioners suggest, a corporate blog might be defined as a web site where an organization publishes and manages content to attain its goals [1], or as a blog which is explicitly endorsed by a company and maintained by a person (or a group of people) affiliated with the company [2]. They have become an important marketing channel; they brought a significant level of personalization and the ability to easily fit into the media on the Internet and to connect to all social networks that occupy the time and attention of a huge number of Internet users. Blogs enable current and potential clients to connect with the person and personality of a company, bridging the gap between the "inaccessible" company and the "average" user. Weber, in reference [3] points out that the communications world is dramatically moving in a digital direction and those who understand this transformation will communicate much more effectively than those who do not. By the ability to connect with their audiences on a more personal level, companies manage to build trust, collect valuable feedback and foster strengthened business relationships. More importantly, these companies are enjoying tangible returns on their blogging investment in the form of increased sales, partnerships, business opportunities, press coverage and lead generation [1].

Besides direct communication with customers, there are many other uses of corporate blog including: profiling employees into leaders in their field, building brand awareness and customer loyalty, increasing brand visibility etc. According to reference [1], there is a broad array of benefits to starting a blog such as: quick publishing, thought leadership, building community, sales

and online PR. Cho & Huh in reference [4] point out that the boundaries between different forms of communication – intrapersonal communication, interpersonal communication, group communication, and mass communication blur in the blogosphere. That is because of the blogs' flexible, interconnected, interactive, personal and personalized nature that makes them an excellent communication channel and platform for delivering information to both highly specific, and at the same time, mass audiences [5].

II. TYPES OF CORPORATE BLOGS

Although there are many different types of corporate blogs, most can be categorized as either external or internal.

Internal blogs are written by people employed in a particular company and are available only to them. This type of blog usually allows all employees to entry their issues since its goal is internal communication, cohesion and expansion of a shared vision. For that purpose, companies used to have the corporate bulletins that often were not enough available and full of outdated information because of the time needed for their preparation, realization, and distribution throughout the company. Opportunity to leave comments on each post individually creates a sense of involvement and participation in decision-making process. Collective knowledge increases, and the atmosphere of free expression encourages the spirit of innovation. Feedback that the leadership gets from employees is invaluable. The content is classified by tags, so it can be easily found and this treasure of knowledge remains for future employees.

External blogs primary serve for company PR, making brand, and spreading corporate identity. They are divided into two basic types:

Product/service blogs (Fig. 1) allow users to find out more about product/service they intend to buy or some details they did not know before. The users can affect blog creators and future products by leaving comments that are valuable. These users' comments make free marketing and give company an opportunity to listen to the market. When customers start commenting, posting or tracking back to a blogging community, it can have a viral effect—spreading out across the blogosphere. In addition, companies that harness their customers' knowledge and

ideas find better ways to satisfy their needs and wants, thus facilitating goodwill in the community. Journalists, users and all stakeholders can get information about what

they may expect in the future. What is posted becomes something that matters and is the basis for creating greater noise in public.



Figure 1. General Motors product blog (www.fastlane.gmblogs.com) [6]

CEO (Chief Executive Officer) blog (Fig. 2) does not have to be only associated with the developments in the company and its business activities. The purpose of this kind of blog existence is more in building corporate identity. What CEOs say or do not say has taken on added significance. CEOs must more actively narrate their company stories with an “inline” approach that taps into both online and offline channels. Leaders must purposely manage their corporate and social reputations [7].

Stakeholders want to hear from business leaders— in particular CEOs— on a regular basis. They want to know what they are thinking, and not just about their own company, but about the larger industry they represent, the communities they serve, and the world they live in. When top executives appear in the blogosphere, their blogs generate instant traffic and can be an effective tool to establish a direct connection with stakeholders [8].

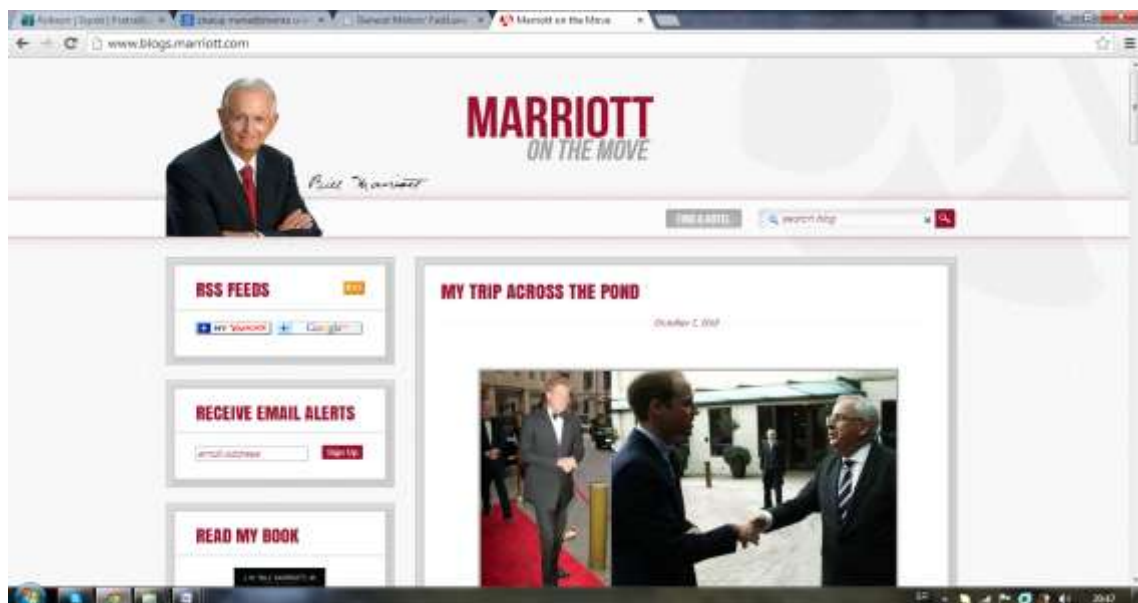


Figure 2. CEO Bill Marriott's blog (www.blogs.marriott.com) [9]

III. THE POTENTIAL OF CORPORATE BLOG

A. *Blog as a communication tool*

The potential impact of blogs on public relations and corporate communications is also phenomenal. Public relations in the digital age requires understanding how company's key constituents are gathering and sharing information and then influencing them at key points [10]. Website is an essential part of company's online marketing presence. It tends to be an online marketing brochure, with standard pages for information about the company, products, and services. If the Website is a marketing brochure of the company, then blog is its public relations representative. It is the face and voice of business and as the public relations representative, it talks about the company, answers questions, and puts some personality into company brand. More and more customers are demanding and rewarding companies who have a social media presence online. Blogging is a perfect platform for engagement; it's a safe place where company can manage the conversation and leverage the medium to drive business. Company can own the content, control the message, and respond effectively through a corporate blog [11].

Also, blog is a fantastic medium for discovering and developing individual capacities of human resources within the organization. The talented employees within the company are one of its biggest investments and the largest differentiator between the company and its competitors.

There are several mediums that companies may use to communicate with their audience including: websites, e-mails, forums, as well as social networks (Twitter, Facebook). Corporate blog, by its characteristics, surpasses all these mediums allowing the company to lead the conversation with a great blog posts and manage the conversation that follows. Companies use blogs to retain control over the messages and the discussions, rather than passively observe information that traditional media publish about them. The feedback generated by this two-way communications channel can help organizations shape their service products and future communications messages to more effectively meet the needs of consumers/target publics by responding almost instantaneously to consumer comment – negative or positive [12].

B. *Corporate blog and human voice in marketing communication*

Each blog post published on the corporate blog should provide some value to visitors and build up the authority of the company. To put a human voice on its communication through blog, company can publish blog posts that highlight employees, their interests and efforts, and talk about how the company and its employees contribute to the community. Also, promoting events and conferences organized or attended by the company are excellent ways to connect with readers. Following these rules, the company will eventually notice that some of the controversial topics, topics that go beyond the industry,

and blog posts that answer to the visitors' questions are content that attracts attention to its blog.

Participants viewed those companies who used blogs to communicate with their publics as more willing to engage in open two-way conversation than those who used traditional websites (people who read corporate blogs as opposed to other forms of corporate communications, were more likely to perceive the organizations 'conversational human voice), [13].

Each sector within a company may use blog in order to achieve its objectives and goals. Sales team do that to acquire leads and increase sale, leadership team to get opportunities to write and to speak at industry events, custom service team to answer questions for clients, PR team to get industry attention, marketing team to promote upcoming events, partnership and activities, and to acquire inbound marketing leads.

C. *Corporate blog and speaking to the audience*

Companies need to be aware that the corporate blog readers come from all directions. They can be:

- **Prospects** who find a blog from sites that are referring traffic or from search engines, therefore the blog posts should be written so that someone unfamiliar with company's products or services can still understand them.
- **Shareholders** who read a blog to better understand company's products, services, and vision.
- **Customers** who read a blog to keep up on releases, enhancements, new products, issues, and anything else that impacts their use of company's products or services.
- **Employees** who read a blog to keep up on company information and to learn more about the direction the company is heading.
- **Industry professionals** who read a blog looking for news and information that the company brings to the industry as a whole.
- **Competitors** who also read their competitors corporate blogs.

The more the blog content can relate to the audience, the stronger the message is to the visitor [11].

IV. UNDERSTANDING THE BASIC PRINCIPLES OF CORPORATE BLOGGING

As corporate blogs are becoming an increasingly important communications channel and mechanism for communicating to key stakeholder and publics, companies must understand the basic principles of corporate blogging in order to achieve the highest possible benefits of it.

A respected blogger and viral marketer Seth Godin [14], offers some useful guidelines for effective corporate blogging:

- Short and frequent entries should be used instead of longer more formal statements. The most

effective blogs are those that relate a clear, well-informed, topical message.

- Despite the casual nature of the medium, correct usage, grammar, syntax and spelling must be maintained at the highest standard to avoid losing credibility.
- The blogs should be personally written by the executive themselves, but carefully “massaged” into an appropriate and engaging piece of communications to suit the medium and intended audience.
- The blog should methodically cover clearly and previously defined topics at regular intervals which are relevant to the particular industry and key publics.
- The content must be well-organized with use of key words and subheadings to increase its readability (people scan information on the web – as opposed to read it) and to generate maximum search engine results.
- Entries must be updated and new ones posted regularly (at least two or three times a week). Otherwise, the advantage that the immediacy of blogging as a communications channel will be immediately lost, and target publics will not regard the blog as a credible information source and in fact may develop negative perceptions about the creator of the blog (the company) in terms of knowledge and willingness to engage with stakeholders.
- Contact information should be clearly listed in each blog to enable and indeed encourage feedback from key publics. This will facilitate a stream of continued dialogue between the corporation and its publics and help foster and maintain the organization-public relationship.

V. CONCLUSION

With the spectacular growth of blogging in recent years, the inclusion of companies in this medium was inevitable, because they realized a huge communicative potential that blogging has. Today, the companies use external corporate blog to establish and maintain communication with external factors, i.e. all those individuals and groups who are interested in them and contribute to their success, by making them informed and maintain dialogue on all its news and current affairs, planning, development, new technologies and products.

Corporate blog without a definite purpose and meaning, one that is not interesting to the internal or external readers, leads to results that contrast with what the company intended to accomplish. Blog with no clear purpose will give the impression that the management team of the company also lacks a clear goal and purpose. Corporate blog is a type of interactive, two-way media (as most readers are welcome to leave their comments), so if the company cannot provide good type of material from which the comments will be written, the blog will come down to pure formality, or will not be taken seriously.

Only well designed and well loaded external blog give all interested parties an opportunity to feel more connected with the company, making stronger relationship between them and improving stakeholder satisfaction which will result in increasing company profit.

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HMM Optimization Based On Genetic Algorithm In Speech Recognition: A review

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Abstract - This paper presents utilization of genetic algorithms for improving initial samples population coded using HMM and stored in vocabulary of automatic speech recognition systems. Stored Vocabulary consists of chromosomes that are reference tokens (e.g. Word or a phrase) that are normalized by prosodic and transitional cues so they consist of certain number of frames called genes, where each frame is a vector consisted of certain number of coefficients. Genetic algorithms are machine learning and optimization techniques that are based on biological concepts. Three basic genetic operators: selection, crossover and mutation were applied on frames to improve quality of reference tokens through generations, resulting in increased performance in speech recognition.

I. INTRODUCTION

This paper is intended to provide broad view on present techniques used on field of speech recognition. As for the progress of the speech recognition technique, a former recognition method is Dynamic Time Warping (DTW) that used dynamic programming to calculate the difference between the target speech and testing speech to recognize the testing speech. Then, Artificial Neural Network (ANN) was proposed to replace DTW for speech recognition. Because that the structure of ANN will be fixed after it is determined, the recognition rate cannot be improved by online learning with more additive speech signals. Recently, Hidden Markov Model (HMM) was widely applied on speech recognition. [7]

Automatic speech recognition (ASR) has achieved substantial successes in past few decades mostly attributing to development of various encoding technologies, prevalently hidden Markov modeling (HMM). This paper will provide review of current works that utilizes HMM encoding techniques and genetic algorithms in optimization of vocabulary in ASR systems.

ASR systems that are analyzed in this paper are consisted of four essential elements: feature extraction, the acoustic modeling, the construction of a language model and the search.

First numerical representations of speech information, or features, are extracted from the raw speech signal. These features describe spectral characteristics such as the component frequencies found in the acoustic input and their energy levels.

At second, acoustic modeling stage, an acoustic model is created for each recognition unit. In most current ASR systems, the acoustic models are based on the hidden Markov Model (HMM). ASR systems use language models to perform the search for the correct word or a phrase that are stored in vocabulary. [1]

In analyzed systems Genetic algorithms (GA) are used for improvement of acoustic model through application of genetic operators and measurement of recognition likelihood improvement.

II. HIDDEN MARKOV MODEL (HMM)

Hidden Markov model (HMM) is a stochastic process determined by the two interrelated mechanisms, an underlying Markov chain having a certain number of states and random functions. Each of these associated with one state. At each discrete time instant, the process is assumed to be in a state and an observation is generated by the random functions corresponding to the current state. The underlying Markov chain then transit to the next state according to the transition probability matrix of the current state. The observer sees only the output of the random functions associated with each state and cannot directly observe the states of the underlying Markov chain, as it is prefixed 'hidden'. [2]

The process is assumed to be in a state and an observation, and is stochastically generated in any time. An N-state HMM is usually represented by vector $\lambda = \{\pi, A, B\}$ and they are defined as follows:

π - The initial state probability matrix $\pi = \{\pi_i\}$, where $\pi_i = P[q_1 = i]$, $1 \leq i \leq N$, q_1 is the state at the initial time $t = 1$.

A - The state-transition probability matrix $A = \{a_{ij}\}$ where $a_{ij} = P[q_{t+1} = j | q_t = i]$ is state transition probability from state i to state j and it satisfies the constraints: $a_{ij} \geq 0$ and $\sum_{j=1}^N a_{ij} = 1$ ($1 \leq i, j \leq N$).

B - The observation probability distribution matrix $B = \{b_j(o)\}$, where $b_j(o)$ is the probability distribution function of producing observation o in state j . [3]

S.A. Selouani and D. O'Shaughnessy[8] propose a pseudojoint maximization over sequence of phones and transformation T that maps Λ into a transformed feature space, where the typical conventional HMM-based technique is used to estimate w (a sequence of phones), while an evolutionary algorithm (EA) based technique enhances noisy data iteratively by keeping the noisy features as close as possible to the clean data. This EA-based transformation aims to reduce the mismatch between training and operating conditions by giving the HMM the ability to "recall" the training conditions.

III. GENETIC ALGORITHM OVERVIEW

The concept of genetic algorithm GA was proposed by Holland (1975), which is based on the theory of evolution introduced by Charles Darwin. It can find optimum solutions to solve problems in a way similar to the evolution process of a species. In a GA, we encode the parameters of a solution into a numerical stream, where the numerical stream is called a chromosome. The basic element of a chromosome is called a gene. A GA uses a fitness function to calculate the degree of fitness of a chromosome. First, the system randomly generates a certain number of chromosomes to form an initial population, where the number of chromosomes in a population depends on the user's decision. Then, the (GA) repeatedly performs the selection, crossover, and mutation operations, until the result of evolution satisfies a predefined condition. [4]

IV. EXAMPLES OF GENETIC ALGORITHM USAGE FOR ASR IMPROVEMENT

S. Kwong et al. [5] utilized GA to extract HMMs (both topology and parameter values) that will construct the speech recognizer with the minimal recognition error for the training data set, for given N_i tokens available for the estimation of the i th HMM.

Encoding scheme is consisted of N state HMM with K mixtures/state which is represented by vector $\pi = \{\pi, A, C, U, R\}$. The default setting about the topology of the HMM is not explicitly defined in this representation. If M HMMs with different topologies are required, i.e. in recognizer $\Lambda = \{\lambda_1, \lambda_2, \dots, \lambda_M\}$, then model λ_i may have different topologies from λ_j ($j \neq i$).

Initial population is formed by determining the number of states and the number of mixtures of each state, and the second step is to initialize the model parameters $\lambda = \{\pi, A, C, U, R\}$. After defining the allowable ranges of states and mixtures, i.e. the number of states belongs to range $[N_{min}, N_{max}]$ and the number of mixtures per state falls in range $[K_{min}, K_{max}]$. The number of states of each HMM is defined by the number of sub-words in the word and each state has K_{max} mixtures. In our experiments, the maximum number of states of HMM for a word is the number of phonemes plus 2.

Three types of genetic operators are used to test the effectiveness of the proposed approach. They are mutation, crossover and heuristic local searching operators.

Mutation introduces local variations to the individuals for searching different solution spaces and keeps the diversity of the population. Mutation is performed with both topology and parameter. Topology mutation is designed to change the number of states and/or mixtures of states of a HMM, which aims to find the optimal structure of the HMM for a language unit.

Crossover recombines the genes of parents and reproduces new individuals, which may be very different from their parents. Besides one-point crossover, two-point crossover and uniform crossover, a heuristic crossover is designed to produce a super individual. The heuristic crossover constructs an individual with better genes (HMMs), it implies individuals with better performance. Heuristic crossover increases the number of better-fit genes, which results in a decrease of diversity of the population.

Heuristic local search operators are usually adopted to speedup the searching process. Domain specific knowledge and effective local search method could be combined into these operators. Since an individual consists of genes with different evaluation values, optimizing these genes with lower fitness should result in much better performance than optimizing these with higher fitness, because worse genes have much space for improvement. Based on such knowledge, the ML operator is designed to simulate the Baum-Welch iteration algorithm.

In other paper [6] Kwong et al. are using hybrid-GA in HMM training, that includes encoding mechanism, the fitness evaluation, the selection mechanism, the genetic operators, the hybrid operations and the replacement mechanism.

The hybrid-GA introduces problem specific knowledge to the GA evolution cycle. In this case, the Baum-Welch algorithm is used as a hybrid operator to re-estimate the chromosomes in order to enhance the convergence speed. Experimental results showed that the hybrid approaches can speedup the convergence time significantly.

The encoding mechanism is an encoding method used to transform the potential solutions into the form of chromosomes.

However, as the basic data type of the elements of the HMM is real number, real number string are used instead of bit-string as the representation of the chromosomes in GA.

The objective function is defined as the average of the logarithms of the probabilities of the observation

sequences, O_1, \dots, O_S generated by the given n^{th} HMM λ_n or n^{th} chromosome in the population and has the form:

$$lp_n = (\sum_{i=1}^S \log(P(O_i|\lambda_n)))/S \tag{1}$$

where lp_n is the fitness value of the n^{th} chromosome in the population, the likelihood $P(O_i|\lambda_n)$ is calculated by the forward procedure and S is the number of observation sequences in the training data.

The selection mechanism is used to select the parent chromosomes from the population and form the mating pool. The selection mechanism emulates the survival-of-the-fittest mechanism in nature.

S. Kwong et al. used The Roulette wheel selection as selection mechanism as it is one of the most common and easy-to-implement.

Each chromosome in the population is associated with a sector in the virtual roulette wheel. According to the fitness value of the chromosome, the sector will have a larger area when the corresponding chromosome has a better fitness value while a lower fitness value will lead to a smaller sector. After the sector allocation, zero radian is defined as a vertical line placed on the wheel by connecting the highest point on the circumference and the centre.

To select a parent, random angle, between 0 and 2π radian, is generated by a uniform random number generator. A chromosome will be selected if the marker is placed on the associated sector of the chromosome.

Genetic operations are performed by following genetic operators: state mutation, state crossover and mutation in order as specified. Each operator in this group is associated with a probability. These probabilities are the stochastic occurrence rates of the operators that are used to simulate the random occurrence nature of the natural genetic variations. Classical genetic operator is executed only if associated occurrence rate of that operator is greater than probability generated by a uniform random number generator.

Mutation adds variations of model parameters into chromosomes. Mutation is done by altering the model parameter $x_{\lambda n}$ by the equation

$$x_{\lambda n} = x_{\lambda n} * G(1.0, 0.001) \tag{2}$$

where $G(1.0, 0.001)$ is a Gaussian random number generator with mean "1.0 and variance"0.001. If the result is false, then the model parameter will not be changed.

State mutation is the only tool in our GA that can change the number states of the HMMs in the chromosomes. It aimed to explore the fitness of the chromosomes in different number of states. First step of state mutation is to determine the number of states in the offspring. A random number in between 0 and 1 is generated and if it is larger than 0.5, then the number of states N_o of the offspring will increase by 1 compared with the number of states N_p in the parent. Otherwise, N_o is equal to N_p minus 1, finding the fittest chromosome with the number of states N_o in the population. If the

chromosome is not found, a chromosome with the number of states of N_o is randomly generated, which is randomly modified by mutatuin, and used as offspring.

State crossover operator is a derivative of the standard crossover operator. It is a recombination operator that combines subparts of the parents to produce offspring that contain some parts of both parents genetic materials. A second parent is selected from the population pool by finding the fittest chromosomewhich has the same number of states as the first parent. Ifthe chromosome is not found, second parent isgenerated by mutation. Mutation is done by randomly selecting three states from the second parent and the offspring is produced by replacing the corresponding states in the first parent with the selected states.

Hybrid GA, unlike the traditional GA, applies the Baum-Welch algorithm with eight iterations to the chromosomes in the population pool every 10 generations such that the fitness value of each chromosome is improved. In addition, the re-estimation procedure is applied to the offspring in the subpopulation.

The Baum-Welch algorithm with three iterations is applied to the offspring and compared to the chromosomes in the population pool to make the replacement scheme work properly.

Shing-Tai Pan and Tzung-Pei Hong in their paper [7] are usingGA to train a codebook generated by discrete HMM. First, chromosomes are defined to meet the problem in hand. A real number gene encoding is chosen for this purpose, as all features of speech are real. Each generation of chromosomes is encoded as a set of 3D matrix where the dimensions are equal to number of classification \times number of features \times number of chromosomes. First generation of chromosomes is randomized, and tested with speech signals by using discrete HMM.The recognition rate is identified as the fitness of the chromosomes, and best chromosomes are selected based on natural selection. The selection method used is based on the Roulette Wheel Selection. Used genetic operators are linear crossover and mutation in order as specified. A new chromosome is randomly generated if the mutation probability is larger than a preset mutation rate. GA training steps are repeated until the fitness reaches the target recognition rate. The best codebook is then used to model the discrete HMM. During the training of weights by GA, the fitness function is defined as the reciprocal of the speech recognition error for the training speeches, which is described in following equations

$$fitness = \frac{1}{MSE+1} \tag{3}$$

$$MSE = \frac{1}{k_u \times i_u \times t_u} \sum_{k=1}^{k_u} \sum_{i=0}^{i_u} \sum_{t=1}^{t_u} |E_{k,i,t}|^2 \tag{4}$$

where $E_{k,i,t}$ means the output error for t^{th} record of i^{th} literal by k^{th} person.

Selouani and O'Shaughnessy [8] divided their implementation of GA in six

fundamental issues: the chromosome representation, the selection function, the genetic operators making up the reproduction function, the creation of the initial population, the termination criteria, and the evaluation function. Every individual or chromosome is represented by genes or variables from an alphabet of floating-point numbers with values within the variables' upper and lower bounds (resp., +1 and -1).

A common selection approach is used as a selection function, which assigns a probability of selection, P_j , to each individual, j , based on its fitness value. Normalized geometric ranking is used to assign probabilities to individuals. This method defines P_j for each individual by

$$P_j = q'(1 - q)^{s-1} \tag{5}$$

where

$$q' = \frac{q}{1 - (1 - q)^P} \tag{6}$$

where q is the probability of selecting the best individual, s the rank of the individual (1 being the best), and P the population size.

Two genetic operators are used – crossover and mutation. A float representation of the parents is denoted by \bar{X} and \bar{Y} . At the end of the search, the fittest individual survives and is retained as an optimal Karhunen-Loève transform (KLT) axis in its corresponding rank of $\{\lambda'_1, \lambda'_2, \dots, \lambda'_N\}$.

Heuristic crossover is used as crossover operator, that utilizes fitness information. Let a_i and b_i be the lower and upper bound, respectively, of each component x_i representing a member of the population (\bar{X} or \bar{Y}). This operator produces a linear interpolation of \bar{X} and \bar{Y} . New individuals \bar{X}' and \bar{Y}' (children) are created according to this algorithm:

1. Fix $g = U(0, 1)$, uniform random number
2. Compute fit $[\bar{X}]$ and fit $[\bar{Y}]$, fitness of \bar{X} and \bar{Y}
3. If $\text{fit}[\bar{X}] > \text{fit}[\bar{Y}]$
 Then $\bar{X}' = \bar{X} + g(\bar{X} - \bar{Y})$ and $\bar{Y}' = \bar{X}$
 Estimate feasibility of \bar{X}' :

$$f(\bar{X}') = \begin{cases} 1, & \text{if } a_i \leq x'_i \leq b_i \quad \forall i \\ 0, & \text{otherwise} \end{cases}$$
 x'_i components of \bar{X}' , $i = 1, \dots, N$
4. If $f(\bar{X}') = 0$
 Then generate new g ; goto 2
5. If all individuals reproduced then Stop
 else goto 1

As mutation operator a nonuniform mutation is used that consists of randomly selecting one component, x_k , of an individual and setting it equal to a non-uniform random number, x'_k formula

$$x'_k = \begin{cases} x_k + (b_k - x_k) f(\text{Gen}), & \text{if } u_1 < 0.5 \\ x_k - (a_k - x_k) f(\text{Gen}), & \text{if } u_1 \geq 0.5 \end{cases} \tag{7}$$

where the function $f(\text{Gen})$ is given by formula

$$f(\text{Gen}) = \left(u_2 \left(1 - \frac{\text{Gen}}{\text{Gen}_{\max}} \right) \right)^t \tag{8}$$

where u_1, u_2 are uniform random numbers between (0, 1), t a shape parameter, Gen the current generation, and Gen_{\max} the maximum number of generations. The multi-non-uniform mutation generalizes the application of the non-uniform mutation operator to all the components of the parent \bar{X} . The main advantage of this operator is that the alteration is distributed on all individual components which lead to the extension of the search space and then permit to deal with any kind of noise.

A review of genetic operators used by authors in this review is given in Table I.

TABLE I. OVERVIEW OF USED CODING PROCESS

Reference	Genetic operators used
[5]	Mutation, Crossover and Heuristic local searching operators
[6]	Mutation, state mutation, state crossover
[7]	Linear crossover, mutation, chromosome randomization
[8]	Heuristic crossover, Nonuniform mutation

V. CONCLUSION

In this paper we have presented major techniques for speech recognition based on genetic algorithms and hidden Markov model. As well as, from a literature overview, we conclude that application of genetic operators on initial population coded by HMM led to significant improvement of recognition rates in automatic speech recognition systems. Crossover, generating new individuals in population from existing genetic material provided by parent individuals and mutation introducing a new genetic material are most common genetic operators used. Heuristic approach to genetic operator implementation gave better results than classical approach.

VI. FUTURE WORK

In order to represent full literature overview and make improvement in ASR, future work will include evaluation of previous results and development of own methodology considering neural networks and genetic algorithms.

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Biological Modeling of Software Development Dynamics

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Abstract - Having in mind that there are certain similarities between evolution of a biological system and development of software, researchers in the field of computer science recently have made an attempt to adapt and utilize biological tools and paradigms for evaluation of a system and estimation of its parameters. In this paper, we briefly review some of the most important biological models with usage in computer science and discuss their applicability. In addition, we propose application of Kolmogorov-type model of predator-prey ecosystem for estimation of software quality and description of production process dynamics.

I. INTRODUCTION

Software development can be treated as an optimization problem where the task is to develop required features within limited resources – a certain time schedule, required technology and limited number of developers. Because of potential high cost, solving this problem requires careful analysis. On the other hand, combination of various nondeterministic factors makes this process inherently complex. It requires answering questions about optimal resource distribution for a particular time period and questions about software reliability, for example:

- How long it will take to complete a particular task?
- How long it will take to test a particular module?
- How many defects remain in a particular module after a release?
- At a particular time, what portion of resources should be devoted to testing as opposed to developing new features?

When answering these questions, helpful tool can be modeling of software development dynamics. Recently, significant effort in research community has been invested in building models which enable estimating number of defects in a system after a particular phase in software life cycle [1][2].

Modeling a certain system, in its essence, reduces to determining a set of variables of interests, which captures the most important properties of the observed system, and then, through the set of equation defining how these variables change and which kinds of relations exist among them. The main purpose of building a model is to *predict*,

explain, discover and guide. Therefore, if someone wants to perform any of these actions, creating a valid model should be the starting point. One way in creating a valid model is to start from scratch. The other way is to use analogy with some other systems as a starting point, and then, the developed model can be improved.

In development of a software product, one can observe several stages. Each stage results in some minor or major improvement of the previously developed system. The process can be described as the *evolution* of the system, which implies that, in certain regards, there are some similarities with the evolution process of biological systems. In this paper, we try to utilize this fact to build a model for describing development of a software product.

The rest of the paper is organized as follows. In Section II, we briefly describe previously known paradigms inherited from biology and successfully applied in computer science. The purpose of the section is to familiar the reader with this interesting cross-over and to present an introduction to the central topic of the paper which is presented in the subsequent sections. Section III is devoted to the formal description of the problem we want to model. We will deal with the issues of how software quality changes over time, which amount of effort is needed to reduce errors and what is a connection between these two variables. In Section IV, we will first present a simple bio-inspired model for answering the previous questions. Then, we will point out some of its issues and present an improvement which resolves them. In Section V, we give some final remarks about quality of the proposed models and possible directions for the future work.

II. BIOLOGICAL PARADIGMS IN COMPUTER SCIENCE

Despite significant advances in science and technology, we are still far from being able to replicate or mimic even a small fragment of processes which are part of natural world around us. The sophisticated design, efficiency, variety, adaptability and elegance of nature's "solutions" have been and continue to be an inspiration for researchers to provide original, sometimes unexpected, methods and algorithms. In addition, in research of a particular system, observed similarities between that system and some natural system can be helpful. It may enable direct usage of a tool-box already developed for the purpose of research that natural phenomenon. In this section, we will present examples of both lines of thought. It should be noted that the goal here is to illustrate the

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concepts, not to provide a comprehensive guide to this broad subject. An interested reader can find more details in provided references.

A. Bio-Inspired Optimization Algorithms

High-dimensional, non-linear problems with large number of constraints usually do not satisfy prerequisites of traditional optimization methods like linear programming, dynamic programming and gradient descent [3]. This inability of conventional approach to deal with such challenges of modern real-world problems is the main reason for development of bio-inspired optimization. These new algorithms can be roughly divided in three groups – *evolutionary computing* (EC), *swarm intelligence* (SI) and *artificial immune system* (AIS). EC is motivated by the concept of the evolution. It is based on reproduction, gene inheriting and Darwin's principle of natural selection [4]. On the other hand, SI is inspired by social behavior and collective intelligence of various animal species [5]. It is based on the observation that a swarm (like colony of insects or flock of birds) is acting like a new organism capable to perform tasks which exceeds power of simple sum of each individual's ability. The key principle in SI is decentralization. Each individual is an agent without global supervision, which has stochastic behavior dependent on simple local rules and its current local neighborhood [5]. AIS-type of algorithms is based on the mechanism of immune system in living organisms. This is relatively young field, with promising results in solving many practical problems. However, there is some reluctance in accepting it among computer science researchers. The reason might be the fact that if one wishes to fully exploit the power of these algorithms, he or she should inquire a fair amount of immunology knowledge. Below, we will present several examples of EC and SI. Comparative study of both types of the presented algorithms can be found in [3], for example. AIS type of algorithms requires too much field-specific terminology to be explained in limited space. For more details on this interesting topic, one could consult [6].

Genetic algorithm (GA) [4] is the oldest and the most popular example of EC with various improvements of the basic version. Although the approach has some issues with speed of convergence and local optima, it was quickly adopted in the research community and adapted to solving many practical problems. Basic GA starts with a randomly generated population of potential solutions – *individuals*. Each individual is represented by a *chromosome* consisting of *genes*, which are actually optimization variables. Expanding the search area is done through the process of generating new individuals from the existing ones, i.e., *reproduction*. During this process, two operations can be performed – *crossover* and *mutation*. Crossover is recombination of genes, such that offspring inherit characteristics from both parents. Mutations are rare perturbation of randomly selected genes performed to avoid stacking at a local optimum.

Memetic algorithm (MA) [7] is another example of EC. It follows GA in utilizing concepts from evolution for exploring a search space. In addition, MA introduces a

new concept – *experience*. The main steps are the same as in GA, except that after offspring is created, it gains experience by performing a local search. The procedure is performed with the intention to allow an individual to improve from the current position by itself, without interfering with other individuals. In GA, the only way to obtain an improved solution is through the reproduction process.

Particle swarm optimization (PSO) [8] is an SI-type of algorithm. It is developed as an attempt to mimic behavior of a flock of birds in discovering a good path to food or reaching a particular destination during the migration process. PSO shares some similarities with GA – a potential solution of the problem is represented with an individual (particle) and algorithm starts with a group of such individuals. The difference is that exploring the search space is not performed by applying evolutionary operators; there is no reproduction process which creates new individuals. Instead, individual is represented by its current position and search for the optimal solution is a result of changing individual's position in space. There is a local search when each individual explore quality of its current position, then communication among members of the swarm to detect which one is in the best position, and finally, moving toward that position with the appropriate velocity.

Ant colony optimization (ACO) [9] is another example of SI, mainly used for graph search. It is inspired by behavior of real ants in the process of searching for food. As an ant move through the space, it leaves pheromone trail, which can be recognized by other ants. Facing an obstacle, the ant has to make a decision how to avoid it, i.e., to choose a direction. At the beginning, these decisions are randomly selected. But later, new ants favor paths with more intense pheromone trail. ACO procedure starts the same way as the previously described algorithms – by randomly generating population of individuals (ants), which represent possible solutions. During exploration of searching space, each ant leaves pheromone trail which is proportional to the quality of the current solution it represents. Just as in nature, ACO supports pheromone evaporation over time, which reinforces shortest paths and prevents stacking at local optima.

The list of bio-inspired optimization techniques contains many more algorithms, e.g. bee-inspired optimization, shuffled frog leaping algorithm, etc. The latest trend in the area is to merge the best features of EC approach with SI approach. Also, it should be noted that each of the presented examples is developed in many variations and improved both in general, and for domain-specific applications.

B. Neural Networks

Another example of bio-inspired problem solving is artificial neural networks (ANN) [10]. A neural network is not an algorithm like the previously described examples, but rather a computational structure created as an abstract model of a brain and its functions. It consists of artificial *neurons* which are small processing units capable of calculating a simple function of input. One neuron's output is transmitted through *synapses* to the other neurons in the network.

Solving problem by ANN requires training of ANN. In other words, ANN does not have an algorithm for direct solution of a problem. Instead, it has an algorithm for “learning” by given examples. After enough number of examples, it is able to generalize and correctly process previously unseen data. The learning process is usually reduced to determining synapse weights, but can involve more complex tasks like learning the structure of the network. The degree of similarity between an ANN and a real brain structure is questionable. Nevertheless, nowadays ANN is recognized as one of the most powerful tool in modeling nonlinear dynamic complex systems.

C. Capture-Recapture Estimation Method

Previous examples show that problem solving in computer science can be obtained by observing a particular natural process, and then developing the appropriate analogue toolbox. Now, we want to present a different approach – the one where a solution for a problem in computer science can be obtained by using toolbox already developed for biological research.

In ecology, a common problem is to determine population size of a particular species. In most cases, it is not possible to identify, mark and count all individuals. Therefore, statistical tools for approximate estimation are developed. The procedure goes as follows – researcher A captures a group of individuals, uniquely marks each of them, and then releases them back. After a while, researcher B captures a new group of individuals. Some of them were already captured and marked by researcher A and that fact can be used to estimate population size. Under the assumption that, the population size is stable during the time of experiment and that each individual have the same chance of being captured, it is reasonable to assume that the following proportion holds:

$$M / F = S / N, \quad (1)$$

where N is total size of the population, F is number of individuals caught the first time, S is number of individuals caught the second time and M is number of individuals in caught both times. From the previous equation, it is easy to calculate the population size N.

In software engineering, one of the most important issues is to track number of faults in the developing software. It enables more efficient planning further activities and reduces total costs. The previously described capture-recapture method can be used during code inspections to estimate the number of remaining defects in the product [1]. The underlying principle of the model follows the intuition – the smaller the overlapping between sets of faults detected by independent testers, the expected number of remaining defects is bigger. It is possible to improve the model by incorporating assumptions that the probability of a fault being detected is not the same for all faults, and that the detection abilities of various inspectors are different. As in most statistical studies, effectiveness depends on the size of the population and it performs well only for reasonably large number of defects.

III. SOFTWARE DEVELOPEMENT DYNAMICS

Typical software development process consists of several stages – requirements, analysis, design, implementation, testing and production. Each phase can introduce faults into the system, but not all of them are equally costly. In fact, it is well-established that cost of changes rises as development cycle is approaching to production phase. Search for the most efficient way for handling changes in requirements and dealing with defects, lead to various software process models. Among the most popular are waterfall model, rapid application development, incremental model, spiral model and agile model. Although there are significant differences among various software processes models, one thing is common for all of them – resources, time schedule and quality are three highly correlated factors. Increasing one value necessarily means decreasing one or both of the other two.

Recent trends in IT industry are to abandon long development cycles in favor of faster releases in order to bring the latest features and fixes to end-users. This rapid releases (RR) methodology is lately accepted among most major software companies like Google, Facebook, Mozilla and Microsoft as a result of heavy competition and constant demands from customers [11]. Shorter periods for development and testing have impact on software quality. In order to make a decision if software is ready for a new release, teams which work under RR methodology require information about relationship between *number of defects* currently in the system and *effort* necessary to resolve them. The more effort is spent on defect resolving, the less time is left for developing new features. This is why modeling change of these two variables over time is of crucial importance for determining when a new release can be scheduled and which features should be included. In this paper, we propose one possible bio-inspired model for explaining connection between the two variables.

A. Case Study

For the purpose of this study, we collected data from a company which adopted RR methodology. Team of seven developers worked on a software for e-commerce during period of one year with a new release every month. The goal of the study was to establish mathematical relationship between the following two variables:

- $b(t)$ – number of bugs detected present in the system at time t ;
- $e(t)$ – effort invested in bug detecting and removal at time t .

The following observations are marked as being relevant for building a model:

- O1 – Increasing (decreasing) of $e(t)$ leads to decreasing (increasing) of $b(t)$:

$$e(t) \uparrow \Rightarrow b(t) \downarrow, \quad (2)$$

$$e(t) \downarrow \Rightarrow b(t) \uparrow; \quad (3)$$

- O2 – Increasing (decreasing) of $b(t)$ requires increasing (decreasing) of $e(t)$:

$$b(t) \uparrow \Rightarrow e(t) \uparrow, \quad (4)$$

$$b(t) \downarrow \Rightarrow e(t) \downarrow; \quad (5)$$

- O3 – As a result from the previous two observation, both $b(t)$ and $e(t)$ exhibit periodic oscillations. This can be explained in the following way. As the system grows, number of bugs grows. At certain point, number of bugs is big enough and requires increase in effort to remove them (4). As effort increases, number of bugs reduces (2), which allows reducing the effort (5). But, reduced effort leads to increase of number of bugs (3) and we are back at the beginning.
- O4 – The relationship from O1 and O2 is not linear.
- O5 – Small increase of effort can lead to significant reduction of defects number.
- O6 – Previous observation can be explained by Pareto principle. Majority of time is spent on small number of difficult bugs (approximately, removal of 30% of bugs requires 70% of time).
- O7 – Changes in code churn (number of added, deleted and modified lines of code) exhibits growth rate which can be modeled by sigmoid function.
- O8 – $b(t)$ increasing is steeper than decreasing.
- O9 – $e(t)$ decreasing is steeper than increasing.

Observations O1, O2 and O3 imply certain similarities with relationship between two species – predator and prey. In the next section, we will further explore this similarity.

IV. PREDATOR-PREY MODEL

In biology, there is a long history of modeling interactions among various species. The most common are models for two species – competition, cooperation (mutualism) and predator-prey [12]. Predator-prey models should account factors like, natural death of predators and preys, birth rate for both species, death rate of preys due to predation, etc. In our particular problem, as mentioned in the previous section, relationship between number of bugs in a system and effort necessary for reducing them has certain similarities with predator-prey relationship. Bugs can be treated as “prey”, and programmers/testers as “hunters” or “predators.” This analogy was a motivation for us to attempt to model $b(t) - e(t)$ relationship by a certain existing models developed for the purpose of biological research. We will analyze particular general models known as Kolmogorov models, which assumes differentiability of functions $b(t)$ and $e(t)$, and growth rate is given by the following differential equations:

$$\frac{db(t)}{dt} = bf(b, e), \quad (6)$$

$$\frac{de(t)}{dt} = eg(b, e). \quad (7)$$

From the previous two equations and observations O1-O9, we have the following conditions:

$$\frac{\partial f(b, e)}{\partial e} \leq 0, \frac{\partial g(b, e)}{\partial b} \geq 0, \frac{\partial g(b, e)}{\partial e} \leq 0 \quad (8)$$

The first inequality follows from (2) and (6), the second inequality follows from (4) and (7), and finally, the last one follows from (2), (5) and (7).

A. Lotka-Volterra Predator-Prey Model

One of the most influential Kolmogorov-type predator-prey model is given by:

$$\frac{db(t)}{dt} = b(\alpha - \beta e), \quad (9)$$

$$\frac{de(t)}{dt} = e(-\chi + \delta b). \quad (10)$$

It is known as Lotka-Volterra (LV) model and specifies the following relations:

- In the case $e(t) = 0$ (no hunt for bugs), $b(t)$ has exponential growth, which is easily obtained by solving $db(t)/dt = b\alpha$ from (9).
- The rate of detecting and reducing number of bugs by developers/testers is proportional to the number of bugs $b(t)$ and effort invested in bug reduction $e(t)$, which is specified by the factor βeb in (9). Intuitively, if there are more bugs in the system, it will be easier to detect and eliminate some of them. In addition, if more effort is invested in bugs reduction, the more bugs will be reduced.
- In the absence of bugs, i.e. $b(t) = 0$, effort exponentially reduces to zero, which can be obtained from $de(t)/dt = -e\chi$ from (10).
- The rate at which the effort $e(t)$ grows is proportional to the rate at which the developers/testers encounter bugs. This is specified by factor δeb in (10).

Although historically significant, the previously described model has several issues. It does not realistically describe relationship between species in nature, and for the same reasons it fails to capture some important characteristics of software development dynamic. First, the LV model is extremely sensitive to perturbations [12]. Secondly, it allows unlimited exponential growth of prey. In nature, maximum number of individuals from one species is limited by the environment – space, food, water. In software, number of bugs is limited by the size and complexity of the system. Recently, various studies show high degree of correlation between code churn and number of bugs in a system [13].

Using this fact, together with observation O7, it seems reasonable to modify LV model by introducing limited logistic prey's growth instead of unlimited exponential. It can be done by replacing (9) with the following equation:

$$db(t)/dt = b(\alpha - \epsilon b - \beta e). \tag{11}$$

However, such modified model still has issues. First, it only allows dumped periodic oscillations, which violates the observation O3 [13]. Another issue is that it doesn't appropriately limit ability of a single developer/tester to detect and eliminate bugs. The rate at which bugs are eliminated is $\beta e b$, therefore, a single developer/tester eliminates bugs at rate βb . While it is reasonable to assume that more bugs in the system means that it is easier to detect and eliminate some of them, there is no reason to assume that this ability increases unlimitedly. A possible solution is investigated in the following subsection.

B. Rosenzweig and MacArthur Predator-Prey Model

Rosenzweig and MacArthur in [14] proposed a model (RM) as an improvement of LV model. Its general form is given as:

$$\frac{db(t)}{dt} = \alpha b \left(1 - \frac{b}{K}\right) - \beta \frac{b}{b+k} e, \tag{12}$$

$$\frac{de(t)}{dt} = -\chi e + \delta \beta \frac{b}{b+k} e. \tag{13}$$

The proposed model resolves issues of LV model. In the absence of any effort to detect and remove bugs ($e(t) = 0$), growth of number of bugs is determined by the equation

$$\frac{db(t)}{dt} = \alpha b \left(1 - \frac{b}{K}\right), \tag{14}$$

Parameter K determines capacity of the environment. It is related to the size and complexity of the project. Obviously, bigger and more complex projects can contain larger number of faults. Solution of (14) is given by

$$b(t) = K / \left(1 + \frac{K - b(0)}{b(0)} \exp(-\alpha t)\right), \tag{15}$$

from which we obtain $\lim_{t \rightarrow \infty} b(t) = K$. In the absence of bug hunting, number of bugs does not grow unlimitedly by exponential law as in the LV model. Instead, it increases to a value limited by the size and complexity of the system.

Another issue of the LV model is that the rate at which a single developer/tester detects and removes bugs depends only on the number of bugs. In RV model that is given by $\beta b / (b + k)$. Since $\lim_{b \rightarrow \infty} \beta b / (b + k) = \beta$, the value is limited even for large values of b .

Finally, there is a question of stability. For detail analysis of stability of predator-prey models, one can see

[12], for example. Here, we will present only the results necessary to understand how RM model can be applied in the problem of software development.

By setting $db(t)/dt = 0$, we obtain nullclines for number of bugs:

$$b = 0, \tag{16}$$

$$e = (\alpha k K + \alpha (K - k) b - \alpha b^2) / (\beta K). \tag{17}$$

Similarly, solving $de(t)/dt = 0$ gives nullclines for effort:

$$e = 0, \tag{18}$$

$$b = \chi k / (\delta \beta - \chi). \tag{19}$$

From the derived nullclines, we obtain three possible equilibria. Two of them are trivial – $A(0, 0)$, $B(K, 0)$. The last one (C), obtained in the intersection of (17) and (19), is the most interesting. Possible cases for the third equilibrium are depicted in Figure 1.

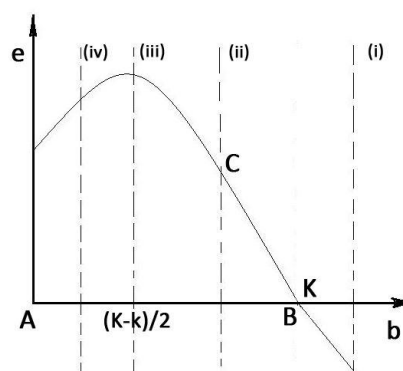


Figure 1. Nullclines of RM model.

We will start analysis from the case presented in Figure 1 (i). It corresponds to parameter values for which is satisfied

$$\chi k / (\delta \beta - \chi) > K. \tag{20}$$

In this case, C is unstable equilibrium and only B is stable equilibrium. This corresponds to situation when little or no effort is invested in detecting and removing bugs compared to number of bugs. As a result, effort vanishes and number of bugs reaches its theoretical maximum. Although in biology there is a real-life motivation for these values of parameters, in software application this situation is not realistic.

As vertical nullcline moves to the left (ii), equilibriums B and C replace roles. Now, C is a stable equilibrium and B is unstable as a result of trans-critical bifurcation. As a result, the model exhibits dumped oscillations. In other words, after some time period, effort becomes constant and number of bugs doesn't change either. This is situation when new code, as well as repairment of the old code, inserts new bugs. Effort invested in repairing is enough to prevent significant increase of number of bugs, but not enough to reduce them further.

The next case is shown in (iii). In this case, C is neutrally stable; trajectory of the solution is an orbit

around the equilibrium and both $b(t)$ and $e(t)$ exhibits periodic oscillations. This corresponds to situations when there is constant insertion of new bugs into the system, but each time appropriate increase in effort is invested to reduce them (not necessarily to zero, though). After the reduction of number of bugs is done, the effort drops, too. This is the most common situation in software development.

If the intersection of the two nullclines is on the left side of the maximum (iv), due to Hopf bifurcation, C becomes unstable again and the resulting trajectory spirals away from the equilibrium. However, it is possible to show that in this case exists a limit cycle [12]. As a result, $b(t)$ and $e(t)$ starts oscillating away from the equilibrium until they reach surrounding limit cycle, which brings us back to the previous case.

At the end, we will analyze what is happening as system grows and becomes more complex. Value at which parabola from (17) obtains its maximum plays important role in analysis of stability. The maximum is obtained for $b = (K - k)/2$. Thus, in order to model a system which keeps number of bugs at low level in a stable way, parameter k has to be close to K . The price is constantly high effort. As the system grows and becomes more complex, K becomes higher, maximum of the parabola shifts to the right and stability is lost. To regain stability, it is necessary to reduce parameter χ and, thus, shift the vertical nullcline to the right. It corresponds to decreasing of effort reducing rate. However, this results in increased minimum number of bugs present in the system.

Dynamic of the system we have studied is presented in Figure 2. For easier observing trends from observation O1-O9, in Figure 2 are depicted normalized values.

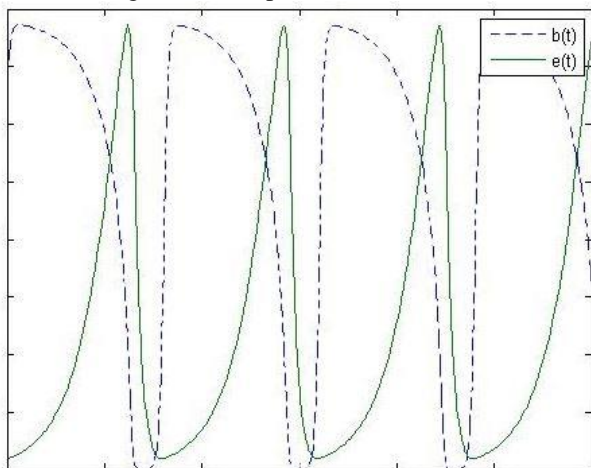


Figure 2. Normalized values of variables $e(t)$ and $b(t)$.

After empirically determining parameters of the model for equations (12) and (13), we obtained solution of these equations by Runge-Kutta method of order 4. The graph fairly accurate models observations O1-O9. According to observation O3, $b(t)$ and $e(t)$ exhibited un-damped periodic oscillations. This can be explained by the fact

that project was under constant development for the time being observed. As the system progress toward its completion, it is reasonable to expect both $b(t)$ and $e(t)$ to approach to zero.

V. CONCLUSION

In this paper, we discussed bio-inspired problem solving approach in computer science. The idea has been present in research community for a long time. As a result, many successful toolboxes have been developed, some of which we presented in this paper. In addition, we presented a new approach in modeling of software development dynamic, based on the observation that the faults and developers who hunt them are in similar relationship as prey and predator in nature. We investigated the degree of similarity and conclusion is that these kinds of models fairly accurately capture the main characteristics of software development dynamic. However, in interpretation of the results, there should be some reserve. During this study, all observations are taken from only one system. It remains to be seen if obtained conclusions can be generalized, which can be done only by investigating development dynamic of various systems with different characteristics.

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The Application of Customer Relationship Management in Customer Retention and Relationship Development

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I. INTRODUCTION

Today, many companies are rushing to become more customer focused, and the key component of many initiatives is the implementation of Customer Relationship Management (CRM) software. Customer Relationship Management (CRM) is an integrated approach to managing relationships by focusing on customer retention and relationship development. CRM is a combination of people, processes and technology that promises to maximize relationships with all customers, including Internet or "e-customers", distribution channel members, and suppliers. In this paper, the evolution and application of Customer Relationship Management (CRM) will be presented.

II. HISTORY OF DEVELOPMENT OF CRM

Precursors of today CRM systems were Personal information managers (PIM) and contact management systems (CMS) and they appeared in the mid-1980s [1]. The task of Personal information management (PIM) was to practice and study of the activities people perform in order to organize, maintain, retrieve, acquire and use personal information items for everyday use to complete tasks and fulfill a person's various roles. In information retrieval and database management, PIM had an important role. A contact management system (CMS) was usually used where single sales representative was responsible for multiple roles within a company. Both PIM and CMS enabled users to organize the names, addresses, and phone numbers for all of user's business contacts. In the late 1980s, Personal information managers (PIM) systems were replaced by sales force automation (SFA) systems. A SFA was a system that automatically records all the stages in a sales process and included a contact management system which tracked all contact that had been made with a given customer, the purpose of the contact, and any follow up that might be needed [2]. These systems, by the mid-1990s, have evolved into simple customer relationship management (CRM) systems.

When business leaders decided they need a better way to manage their contacts and customers through software, CRM (customer relationship management) became part of the business world. The idea of CRM is pretty straightforward: It's the management of customer interaction with a brand or company. Many people may think of CRM in the context of sales but today, CRM is touching almost every aspect of every major company. Customer Relationship Management (CRM) is an

integrated approach to managing relationships by focusing on customer retention and relationship development. CRM is a combination of people, processes and technology that promises to maximize relationships with all customers, including Internet or "e-customers", distribution channel members, and suppliers [3]. A primary motivation for companies to implement CRM applications is to track customer behavior to gain insight into customer tastes and evolving needs. Companies can design and develop better products and services by organizing and using that information [4]. By itself, the CRM is not something new, but due to technological innovation, has become an integral part of any company which aims to more rapid progress.

III. DELUSION: CRM IS EQUAL TO DATABASE

Even today, it is believed that the database is equal to CRM. A database is an organized collection of data. Companies collect data from a number of sources and then verify, clean, integrate and store that data on computers. They are then used for marketing purposes such as market segmentation, targeting, offer development and customer communication. Whereas most large and medium-sized companies do indeed build and exploit customer databases (database marketing is concerned with building and exploiting high quality customer databases for marketing purposes), CRM is much wider in scope than database marketing. Unlike database, CRM applications help answer questions such as "What products or services are important to our customers or how should we communicate with our customers or what is my customer's size [3]?" In particular, customers benefit from the belief that they are saving time and money as well as receiving better information and special treatment [5]. Unlike databases, CRM applications provide two-way communication: from the organization to customers, and vice versa.

IV. RELATIONSHIP DEVELOPMENT

Thanks to technological innovation, CRM applications rapidly collect and analyze information about clients and the ability to respond in a timely manner in order to better adapt communication. This information is of the greatest importance for the creation of products / services, consolidated views of customers, and calculating customer lifetime value [6]. Using technological innovation, companies can have a comprehensive view of customer needs and thanks to that can optimize future communication with clients [7]. Data about the effect of

CRM applications on a company's customer knowledge and customer satisfaction are limited. Customer relationship management applications help companies to collect and use customer knowledge through two mechanisms [8]:

1. CRM applications allow the company to retain all relevant information about transactions with their customers. To retain customers, of great importance is the preservation of such information. Stored transaction information may help the company, not only in future transactions with customers, but also in finding new customers and the need for the creation of new products.

2. Dividing the information collected from its customers, the company allows its users to define their own needs. With this act, the company better informs their clients and understands their needs and the clients get new knowledge about the company and its services.

V. CUSTOMER RETENTION AND SATISFACTION

What is certain is that customer satisfaction or dissatisfaction has an important and significant impact on all aspects of a company. For example, if a company has more loyal customers, the percentage of users of the product ensures the company's revenues in the future [9]. This leads to an important conclusion: Satisfied customers do not change the company until the same company shows concern for them. CRM applications enable companies to adapt their products to each customer. By collecting information about customer needs, can be seen hidden patterns which products can be customized to customers and the customers' point of view, improving the quality of the product. When a company improves the offer, the customer is more likely to perceive the quality of a product, which implies that CRM applications have indirect impact on customer satisfaction. Better informed customer, the customer who is convinced that he saved time and money, a customer who thought he got better (special) treatment (relative to other buyers) is a satisfied customer [5]. When customers think that their company is not paying enough attention, they are leaving the company and that directly affects the finances of the company.

Until now, concerning the impact of CRM applications on customer satisfaction, only a few studies have been done. One of these studies was done by Mithas, Krishnan and Fornell [8]. For this study, they used data from InformationWeek (one of the leading publications in the United States) and customer satisfaction data (American Customer Satisfaction Index) that was tracked by the National Quality Research Center (NQRC) at the University of Michigan. On the basis that:

- using of CRM applications is associated with an improvement in the customer knowledge that firms gain,
 - companies with greater supply chain integration are more likely to benefit from their CRM applications and achieve improved customer knowledge,
 - higher customer satisfaction is related to the use of CRM applications and
 - the effect of CRM applications on customer satisfaction is mediated through customer knowledge,
- they proved that CRM applications are positively associated with an improvement in customer knowledge,

CRM applications probably have a better association with customer knowledge when companies are electronically integrated in their supply chain and share customer-related data with their supply chain partners, that there is a positive relationship between CRM applications and customer satisfaction and that there is a positive relationship on customer satisfaction mediated through customer knowledge.

VI. CONCLUSION

Using CRM software companies optimize sales resources, reduce administrative costs and achieve consistent, customer-oriented business processes. Customers have access to an increasing amount of information. CRM helps establish closer cooperation between organizations and customers, providing excellent customer interaction and satisfaction in all channels. CRM applications enable employees to perform business functions and manage interactions with customers - anytime, anywhere. Using CRM applications can apply comprehensive, current view of all customer information to manage processes and supporting cooperation within the global business network. It also provides a simplified approach to CRM insight into customers, making it possible to plan the development of the organization and differentiate it from the competition, to meet customer needs and make the best business advantage. Customer satisfaction is in many ways directly and indirectly related to CRM applications. Some new studies will certainly better define interconnections between customer satisfaction and CRM applications but for now, it is sure that the knowledge of customers has a great role in this relation.

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Application of Multi Linked Lists Technique for the Enhancement of Traditional Access to the Data

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Abstract - This paper introduces the basic structures and techniques for building multi linked lists. We are presenting two types of sorting algorithms: first, based on the node size and the second, based on the data. This is followed by techniques for implementing structures that allow efficient search, insert, and delete operations. The language used in implementation was C.

I. INTRODUCTION

Linked list is a data structure consisting of a group of nodes which together represent a sequence. Under the simplest form, each node is composed of a data and a reference (in other words, a *link*) to the next node in the sequence. The number of nodes in a list is not fixed and can grow and shrink on demand. This kind of list is known as singly linked list (Fig. 1) [1].

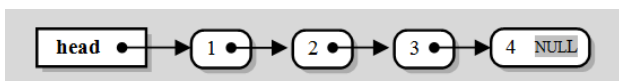


Figure 1. Singly linked list

Linked lists and arrays are similar since they both store collections of data. The terminology is that arrays and linked lists store "elements" on behalf of "client" code. The specific type of element is not important since essentially the same structure works to store elements of any type. Linked lists have their own strengths and weaknesses, but they happen to be strong where arrays are weak [2].

There are more types of linked list, such as: doubly linked list, multi linked list, circular linked list etc. In this paper we discuss multi linked list: definition, characteristics, operations and implementation.

II. MULTI LINKED LIST

In a multi linked list (Fig. 2), each node contains:

1. Data field – represents the useful data, usually realized in structure form;
2. One link field that points to the next node in the multi linked list (like in singly linked list). The last node points to NULL; and

3. Two or more link fields who are pointing to another lists called sublists. Sublist has a structure like singly linked list.

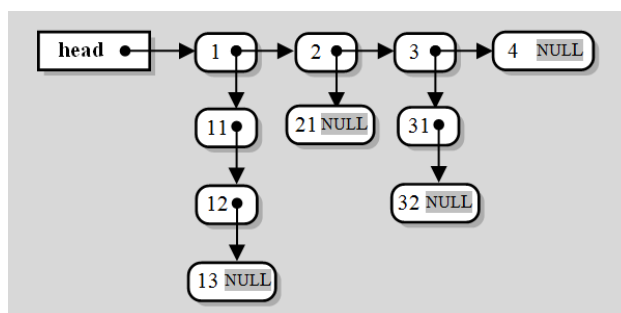


Figure 2. Multi linked list

The entry point into a linked list is called the *head* of the list. It should be noted that head is not a separate node, but the reference to the first node. If the list is empty then the head is a NULL reference.

The Fig. 3 shows definition of the simplest multi linked list that contains one data field and one sublist. This list is implemented in C programming language.

```
typedef struct subnode
{
    int data;
    struct subnode *next_sub;
}subnode;

typedef struct node
{
    int data;
    struct subnode *head_sub;
    struct node *next;
}node;
```

Figure 3. Multi linked list definition

As we can see from Fig. 3 there are two structures:

- *subnode* which contains data field and link to the next subnode, and
- *node* which contains data field, link to the head of sublist and link to the next node.

We can perform various operations on multi linked list. The most common operations are: *checking* whether the list is empty, *inserting* or *removing* a specific node or subnode, *writing* a list, *counting* the nodes of a list, etc.

Note that some of the operations above do not modify the list at all, some modify only the information field of a node, and some modify the structure of the list, by changing how the nodes are connected to each other.

First, we will explain and implement some basic operations, and then we will present some sorting and searching techniques.

III. OPERATIONS ON MULTI LINKED LIST

A. Inserting a node and a subnode

If the list is empty then the head is a NULL reference. When we are creating a list, main operation is inserting a node. To insert a node, first thing to do is allocate memory space for the node, then we assign data to data field [3]. When node is created, he has no subnodes; therefore head of sublist is NULL. Next, we concatenate the new node with the original list and make the newly created node the first one of the list.

Inserting a node is illustrated in Fig. 4 and C function that inserts a new node into the list is given in Fig. 5.

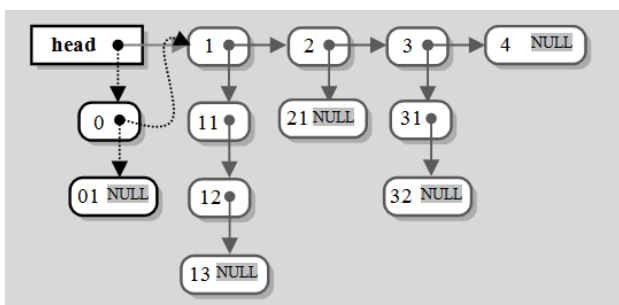


Figure 4. Inserting new node in the multi linked list

```
node *insert_node(node *head) {
    node *new_node=(node*)malloc(sizeof(node));
    printf("Data:");
    scanf("%d",&new_node->data);
    new_node->head_sub=NULL;
    if(head==NULL){
        head = new_node;
        new_node->next=NULL;
    }
    else
    {
        new_node->next=head;
        head=new_node;
    }
    return head;
}
```

Figure 5. Function for inserting a new node into the list

Inserting a subnode is similar to inserting a node. Function that inserts a subnode is given in Fig. 6.

```
node *insert_subnode(node *head, int name){
    node *pnode = head;
    while((pnode!=NULL) && (pnode->data!=name)) {
        pnode = pnode->next;
    }
    if(pnode==NULL){
        printf("Node not found!\n");
    }
    else {
        subnode *psubnode=
        (subnode*)malloc(sizeof(subnode));
        printf("Data:");
        scanf("%d",&psubnode->data);
        if(pnode->head_sub==NULL){
```

```
pnode->head_sub= psubnode;
psubnode->next_sub=NULL; }
else{
    psubnode->next_sub=pnode->head_sub;
    pnode->head_sub= psubnode;
}
}
return head;
}
```

Figure 6. Function for inserting a new subnode into the list

This function has a parameter *name* that represents a node. If node has only one data field (like in this case), this parameter represents that field. If node has more than one data field, then parameter *name* represents data field that is identifier of the node. When node was found, then function begins to insert subnode.

B. Deleting nodes and subnodes

Deleting a node of a list means to modify the list in such a way that the node is no longer connected to its predecessor and successor, while bridging the deleted node to maintain the connection of the other nodes. After bridging, programmer explicitly frees the memory occupied by those nodes that are not needed anymore. (Fig. 7). We say that the node is *logically deleted* after the first stage and that is *physically deleted* after the second [4].

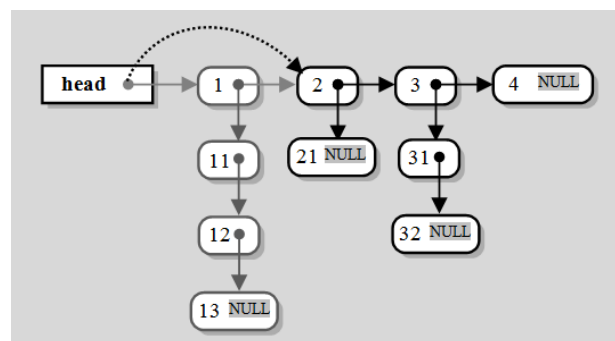


Figure 7. Deleting a node of a multi linked list

Function that deletes the first element of a list is given in Fig. 8.

```
void delete_sublist(node *head){
    subnode *psubnode=head->head_sub;
    while(psubnode){
        subnode *old=psubnode;
        psubnode=psubnode->next_sub;
        free(old);
    }
}

node *delete_node(node *head) {
    node *pnode=head;
    head=head->next;
    delete_sublist(pnode);
    free(pnode);
    return head;
}
```

Figure 8. Functions for deleting a subnode and a node

Deleting a whole list means deleting every node of a list, and then setting head of a list to NULL (Fig. 9).

```

node *delete_list(node *head){
    while(head) {
        node *pnode=head;
        head=head->next;
        delete_sublist(pnode);
        free(pnode);
    }
    head=NULL;
    return head;
}

```

Figure 9. Function for deleting whole list

C. Writing a multi linked list

To perform an operation on all nodes of a list, we have to reach each node starting from the first one, by following the *next* references. One way of doing this is through iteration [5]. In each iteration, we call function that writes node and his subnodes. The loop scheme to access all nodes of a list and write them to standard output is given in Fig. 10.

```

void write_node(node *head){
    node *pnode=head;
    subnode *psubnode;
    printf(" NODE %d \n",pnode->data);
    psubnode = pnode->head_sub;
    while(psubnode!=NULL){
        printf(" - Subnode %d\n",
            psubnode->data);
        psubnode = psubnode->next_sub;
    }
    printf("\n");
}

void write_list(node *head){
    node *pnode=head;
    while(pnode !=NULL)
    {
        write_node(pnode);
        pnode = pnode->next;
        printf("\n");
    }
}

```

Figure 10. Functions for writing nodes of a multi linked list

We start the iteration of the list by using *pnode* as a reference to the current node. We initialize *pnode* to the value of *head*, and then, at each iteration of the loop, we increment *pnode* to the next node through the statement *pnode=pnode->next*. Note that this statement does not modify in any way the list itself.

IV. SEARCHING AND SORTING MULTI LINKED LIST

A. Searching a multi linked list

There are many searching techniques that can be used in searching dynamic data structures. Sequential search is the most common search used on linked list structures.

In Fig. 11 we present sequential search function that searches multi linked list.

```

node *search_list(node *head, int value){
    node *pnode=head;
    subnode *psubnode;
    while(pnode!=NULL)
    {
        if(pnode->data==value)
            return pnode;
        psubnode=pnode->head_sub;
        while(psubnode!=NULL)
        {
            if(psubnode->data==value)
                return pnode;
            psubnode=psubnode->next_sub;
        }
        pnode = pnode->next;
    }
    return NULL;
}

```

Figure 11. Functions for searching multi linked list

This function takes two arguments: a pointer to the first element in the list and the value for which we are searching. Function searches the value in the nodes and in the subnodes. The function will return a pointer to the list structure containing the correct data, or will return NULL if the value wasn't found.

B. Sorting a multi linked list

Sorting a list means putting nodes of a list in a certain order. The most-used orders are numerical order and lexicographical order. Efficient sorting is important for optimizing the use of other algorithms (such as search and merge operations). There are many sorting algorithms that can be used for sorting multi linked list. In this paper we are presenting two algorithms: one based on the data, and one based on the sublist size.

Fig. 12 presents a function that sorts a multi linked list in numerical order based on the data in the node. Algorithm used for this sorting is Selection sort [6].

```

void swap_nodes(node *n1, node *n2){
    int data;
    data=n1->data;
    subnode *psubnode = n1->head_sub;
    n1->data=n2->data;
    n1->head_sub=n2->head_sub;
    n2->data=data;
    n2->head_sub=psubnode;
}

void sort_list(node *head){
    node *n1, *n2;
    for(n1=head; n1; n1=n1->next)
        for(n2=n1->next; n2; n2=n2->next)
            if(n2->data < n1->data){
                swap_nodes(n2, n1);
            }
}

```

Figure 12. Function for sorting multi linked list based on the data

First, we find the smallest node in the list and exchange it with the element in the first position (we use function *swap_nodes* from Fig. 12), then we find the second smallest node and exchange it with the node in the second position, and continue in this way until the entire list is sorted.

Second sorting algorithm that we are presenting can be used only in multi linked lists. This algorithm sorts list based on the sublist size. If we apply this algorithm on multi linked list form Fig. 2, then list gets new order shown in Fig. 13.

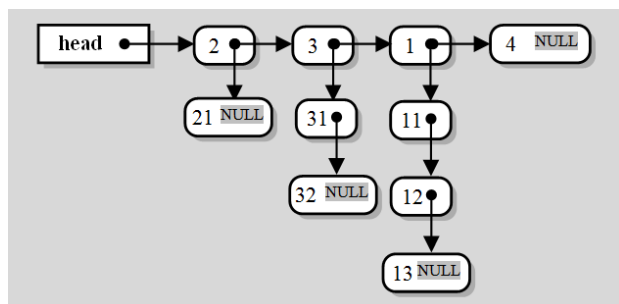


Figure 13. Sorted multi linked list

For this sort algorithm, we need function that counts subnodes [7]. This function takes a node as a parameter, then counts subnodes and return number of nodes. If node has no subnodes, then function returns 0. This function is shown in Fig. 14 with sorting function based on sublist size.

```

int sublist_size(node *head){
    int subnodes=0;
    node *pnode=head;
    subnode *psubnode = pnode->head_sub;
    while (psubnode!=NULL){
        subnodes++;
        psubnode = psubnode->next_sub;
    }
    return subnodes;
}

void sort_list2(node *head){
    node *n1, *n2;
    for(n1=head; n1; n1=n1->next)
        for(n2=n1->next; n2; n2=n2->next)
            if(sublist_size(n2) < sublist_size(n1)){
                swap_nodes(n2,n1);
            }
}

```

Figure 14. Function for sorting multi linked list based on the sublist size

V. CONCLUSIONS

This paper introduces the basic structures and techniques for building linked lists with a mixture of explanations, figures and sample code. Linked lists are useful to study for two reasons. Most obviously, linked lists are a data structure which you may want to use in real programs. Somewhat less obviously, linked lists are great way to learn about pointers. Linked list problems are a nice combination of algorithms and pointer manipulation. Traditionally, linked lists have been the domain where beginning programmers get the practice to really understand pointers.

This paper is useful if you want to understand linked lists or if you want to see a realistic, applied example.

ACKNOWLEDGMENT

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Review of Group Buying Websites in Serbia

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Abstract: Group buying Websites with interesting offers and very low prices have motivated people to buy online. In this paper we will analyze this business model theoretically with examples of Group buying Websites in Serbia. The purpose of this paper is to show the specifics of this type of buying and to present the current situation of these websites in Serbia.

I. INTRODUCTION

As one of the newest medium, Internet represents a key component of economic and social structure in contemporary world. Nowadays it is widely used in every segment of social life where trade tops everything else. [11] E- Shopping has already been present for over fifteen years. For its implementation high percentage of computer literate population and secure ways of payment are essential. Group buying Websites are becoming more and more popular because of their low prices, daily interesting offers, and 24 hour availability. Due to this popularity, general percentage of e-shopping users has increased. Group buying portals are emerging as intermediaries between companies and customers, providing companies with a considerable number of consumers and consumers with great deals at even better prices during a promotional period. In Serbia, the number of this type of sites is rising every day.

II. MARKETING ON SOCIAL NETWORKS

Internet marketing is developing in direction of marketing communication personalization. The great advantage of social networks to marketing is their tendency to propagate information virally. [9] Marketers around the world have recognized Social Media marketing as an important part of their marketing communication portfolio. [10]

Most marketers are using social networks to gain market place intelligence and therefore obtain loyal customers. Social media is changing customer loyalty programs also by identifying problems through monitoring what people are saying about their brands. [3] Being in touch with customers gives companies the

opportunity to track their purchasing behaviors and see patterns which are essential in providing the best (personalized) offers.

Marketing on social networks is all about building relationship between people, connecting them based on their interests on a global level. One of the top advantages of social media are fewer promotional costs in comparison to TV and radio announcements and that it is happening all the time. It keeps customers connected and engaged without time or location limitation. Good promotion strategy through social networks can have amazing marketing effect on a company.

Social networks are a form of communication. Consumers can voice their opinions about everything and companies, in order to keep them, have to respond in the right manner. Group buying Websites due to their need for large number of consumers, in order to justify their existence, use social networks extensively. Through social media, they can daily inform consumers about their offers and interact with them in case of some misunderstanding and/or elaboration, and in that way providing a best customer experience. In Serbia, Facebook is the most used social network for this purpose.

III. FACEBOOK TOOLS IN INTERNET MARKETING

In order to promote something via Facebook services we must determine which of available tools can provide the best result. Top five Facebook tools for successful marketing are [1]:

1. **Website Integration** is used for connecting Facebook with company's existing website;
2. **Pages:** Fan pages, Places pages, event pages, and more;
3. **Ads:** PPC and CPC option;
4. **Apps,** such as tabs and social widgets for driving fans on and off the Facebook page, with and without ads;
5. **Analytics** for estimation of the value of Facebook page.

FB Tolls	Description	Pros	Cons
FB Profile	<ul style="list-style-type: none"> Used for personal needs. Contains basic personal information (Education, Work, Contact, Interests, etc.). Provides a way of self-promotion and presentation. 	<ul style="list-style-type: none"> Control of visibility of given personal data. Possibility of representation of user's interests and connection with other users who share them. This information helps targeting interest groups which are essential for Internet marketing. Use of Variety of Applications. 	<ul style="list-style-type: none"> User can only have 5 000 friends and after that FB Profile can be turned into FB Group.
FB Group	<ul style="list-style-type: none"> Used for gathering people who are interested in the same topic and share similar interests. Picture and video sharing. FB Groups are places that connect unlimited number of members which enables fast information distribution. 	<ul style="list-style-type: none"> Possibility of mass joining. Closed or open groups and control of information availability. Member discussion, online collaborations, raising awareness, member control by administrators. Administrators of groups with less than 5000 members can e-mail members. 	<ul style="list-style-type: none"> Group content does not show in member's News Feed and it can only be seen on FB Group Wall. Applications are unavailable. Administrators of FB Groups that have more than 5 000 members lose their status and option of e-mailing members.
FB Fan Page	<ul style="list-style-type: none"> FB Fan Page are similar to FB Groups. Fan Pages are divided into two groups: the common (Community Page), and the official (Official Page). Community Page is a FB page that individuals can make and attach it to the individual fields on their FB Profiles. The Official FB Fan Page are maintained by the authorized representatives of a business, brand, celebrity or organization, and you can create and share contents of the entities they represent. Topic, Cause and/or Experience are the most common FB Fan Page forms. 	<ul style="list-style-type: none"> FB Fan Pages are visible to anonymous users and are thus indexed. Option <i>Insights</i> provides administrators with statistical data (demographics, age, gender, location, interests, etc.). FB Fan Pages can be advertised by FB Ads. 	<ul style="list-style-type: none"> There are a significant number of Fan Pages whose dullness or spam posts often drive away their "fans" and have no effect.
FB Paid Ads	<ul style="list-style-type: none"> FB Paid Ads appear on the right side of the Facebook page and are mainly targeted to a specific audience. When registering on the Facebook profile, the user enters their interests, hobbies, favorite movies, music, etc. – this data is used for targeting. 	<ul style="list-style-type: none"> Advertisers can choose the way they influence their target groups. Facebook can sort users by their gender, interest, age, location. 	<ul style="list-style-type: none"> Choosing the right type of Ad is tricky because, although, PPC (Pay per Click) and CPC (Cost per Click) have their advantages they do not provide universal results.

Table 1. Facebook most commonly used Internet Marketing Tools

When it comes to Internet marketing on Facebook (FB) we can see that most commonly used tools are: FB Profile, FB Group, FB Fan page, FB Paid ads.¹ FB Chat is a great asset as well because of the direct communication with present and future customers.

IV. GROUP BUYING CONCEPT

Group buying means the sale of coupons for various products/services with discounts. Group buying business model is based on the classic sales promotion, and it is a variant of the advertising business model where there are sales opportunities to purchase products/services with a defined discount (sold coupons/vouchers indicating the discount). Since the purpose of this business model is obtaining large discounts (more than 50%), the most varied products/services with high profit margins can be offered through Group buying Websites.

Group buying Websites obtain offers with discounts by providing interest for the offers and selling specific (large) number of discount coupons in order for the offer to be successful. Offer with a discount price can be limited by time or the number of sales, or it can be limitless. The concept of group buying is very simple; Group buying Websites negotiate deals with service/product companies which allow the Group buying Website to sell coupons on their behalf for products/services at promotional prices.

For every offer on the website there is a minimum number of coupons that needs to be sold for the offer to become active. In this way, interests of partner companies can be achieved, in the sense that they can grant a specific lower price for the product/service only if the Group buying Websites sell pre-defined minimum or maximum number of coupons.

Also, one can buy unlimited number of coupons unless otherwise is indicated in Offer description. With a few clicks on the website, one can buy a coupon that gives its holder up to 90% discount off the retail price. Purchased voucher is received in the form of code by e-mail or mobile phone. Every voucher has a unique code, expiration date and other terms for use.

Group buying portals are emerging as intermediaries between companies and customers. They provide companies with clients who are already interested in their product/service and customers with a desired product/service at a promotional price. Over an agreed period of time they sell coupons in the name and for the account of the company, and gather money from the sold coupons before the services/products are even provided.

Interest of Group buying portals is the commission earned from each coupon sold. Portals generally have a fixed fee charged by the coupon sold- the commissions are usually 20% to 30%. Some Group buying portals

have pricing policies that define different commissions for different contracts. The commission decreases with increasing discount given by the company. The goal is to motivate more companies to bring down their prices so that the final offered discount and the number of individual purchases gets higher. It can be said that the interest of the portals is the maximization of profits through economy of scale.

V. SERBIAN MARKET FOR GROUP BUYING WEBSITES

To define the market for the company that engages in internet sales in our area, it is necessary to set constraints in order to realize real market potential. The first constraint that arises relates to the fact that the computer literacy of our nation is extremely low compared to the rest of Europe. According to the data of the Serbian Official Statistical Office, listed in *Table 2* [2], 43.7% of the Serbian population have never used a computer, while slightly more than half of the population of Serbia uses the computer.

Computer usage Frequency	Republic of Serbia 2012.
Have never used it.	43,7%
In the last 3 months.	50,8%
More than 3 months ago.	2,0%
More than a year ago.	3,6%

Table 2. Computer usage in Serbia

Frequency of Internet use for online shopping	Republic of Serbia 2012.
Have never used it.	81,9%
In the last 3 months.	9,3%
More than 3 months ago.	5,1%
More than a year ago.	3,7%

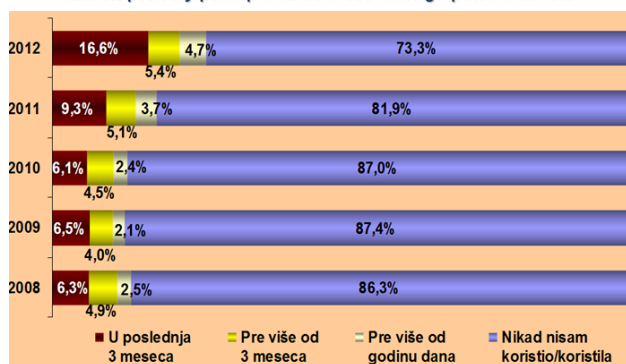
Table 3. Frequency of Internet use for online shopping in Serbia

In order to make a purchase over the Internet in addition to using a computer, one must use Internet. According to the data of the Serbian Official Statistical Office, 39% of the population have an internet connection, and 27% have a broadband internet connection. When these data translate into specific number, we get a figure of about 2 million potential customers on the territory of Serbia.

¹ Authors' findings obtained as a result of topic research.

Croatia and Romania are doing better than Serbia in the area of online shopping. However, revenue in the "virtual" stores is growing, and vendors do not hide the fact that this is profitable.

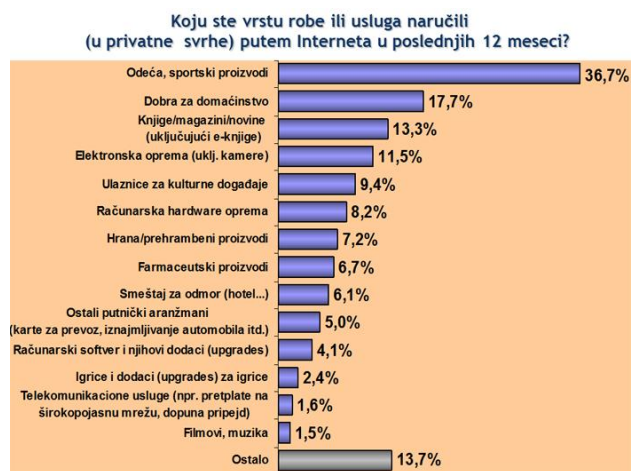
In Serbia, as 81 percent of people have never made a purchase online which is shown in *Table 3*. [2] The numbers are not surprising because half of the population does not even use computers at all and 42 percent of those who use it spend most time on social networks like



Picture 1. Frequency of Internet use for online shopping in Serbia 2008-2012.

Facebook.

However, if we compare statistical data from 2008-2012 we can see rising trend in online shopping which is shown in *Picture 1*. [5] The number of people who never used Internet for online shopping during the period of five years has decreased for more than 7%, and percentage of people who made online purchase has increased for more than 10%. This data is promising for Group buying Websites which depend of computer and Internet use.



Picture 2. Type of products/services bought online in the last year

According to research results presented in *Picture 2*. [6] – Clothes and sport goods are most purchased online in the

last 12 months in Serbia (36.7%); Kitchenware (17.7%), Books and e-books (13.3%), Electronics (11.5%) follow.

Internet has also been used for online ticket purchasing for diverse type of events (9.4%); computer hardware (8.2%); Food (7.2%); Pharmaceuticals (6.7%); Hotel booking (6.1%); Travel arrangements (5%); Computer Software (4.1%); Video games and upgrades (2.4%); Telecommunication services (1.6%); Music and movies (1.5%); something else (13.7%).

VI. GROUP BUYING WEBSITES IN SERBIA

The situation in our country represents a challenge for innovative Internet marketing companies. Group buying portals in Serbia, beside their initial duties have to actively think about how to approach people who are not familiar with this concept of purchase and in the same time provide them a sense of security in payment systems and distribution.

Currently there are over 40 Group buying portals [8] and most of them are primarily located in Belgrade and 95% of business is done there as well. In other cities offers are generally scarce and very small number of users is familiar with the concept of group buying. The best way for someone to believe that they will not be scammed and that they will get exactly what they paid for and at much lower price, is to hear experiences from someone who truly believes in the concept and provides positive feedback. This kind of promotion is maybe slow but is most effective.

Social Networks such as Facebook provide a sense of security to distrustful customers because on all FB Pages users can leave their honest comments and opinions. FB Fan Pages have been a favorite FB marketing tool for Group buying websites in Serbia. A vast majority of these sites actively promote themselves and their offers this way. Number of followers can be directly related to their popularity. *Chart 1*. Represents Group buying Websites in Serbia that are active on FB and the number of FB users who follow their offers. The *Chart 1*. Clearly indicates that there are a lot of these types of sites but that only a few stand out with the number of their followers and therefore their popularity. There are some beliefs that out of all these Group buying Websites not more than ten will keep running and that no more than five of them could be considered as leaders. [4] Therefore we can conclude that the sites with most followers have greater chance of surviving this tough competition and market conditions in Serbia because they reach more people who, by joining their FB Pages, have shown interest in their business concept and are one step away from becoming customers. According to present situation of Group buying Websites in Serbia we can assume that those five sites most likely are: Grupko.rs; Kolektiva.rs, Popusti.rs, Grupovina.rs; and Kupime.rs.²

² Results of Authors' conducted research.

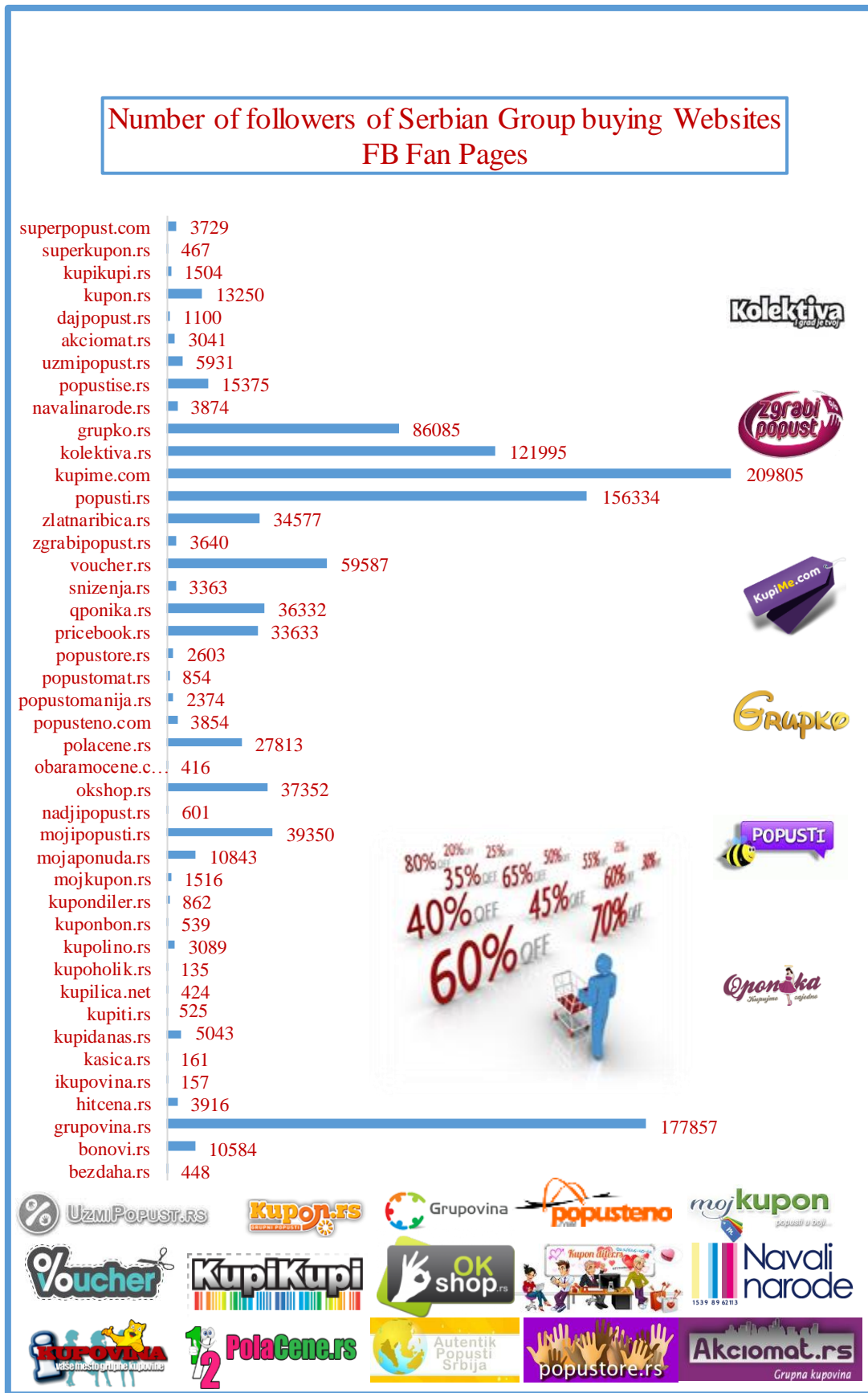


Chart 1. Number of Followers of Serbian Group buying Websites on Facebook Fan Pages on the day 15.09.2013.

VII. CONCLUSION

This concept of online shopping has not yet reached its full potential in Serbia. A great number of presently active Group buying Websites makes us believe that there is very active and profitable market for this business concept, however many factors which lead to profitability and survival are still questionable.

Main obstacles for the concept expansion are unawareness, disbelief, and methods of payment. None of the Group buying portals have engaged in serious promotion and user education of this type of online shopping. Pointing out advantages and possibilities of this concept is the key not only for success but for general survival as well.

Portal competition for the attention of active users is in full swing and an increase in the market demand is expected most because of the geographical allocation of the available offers, and with activation of the wider student population. This business concept could be win-win situation for all parties included:

- For companies- because they reach to already interested customers, obtain money before they even deliver service/product and for less money they can see the interest that their product/service has created.
- For customers- because they get their product/ service at a cheaper price and can experiment with different products/services that they usually would not have known about or would not be financial able to try.
- For the Group buying Websites- because they make a percentage of every sold offer and do not have to invest in products just in ways of promoting them and selling them to interested party- risk free. The best part for these portals is that their role ends when a coupon is purchased.

By raising awareness for necessity of Computer literacy and Internet use and providing secure ways for online payments we open doors to many possibilities that

technical advancements bring. Group buying Websites have many advantages which can only be enhanced by increased user number. This type of novelties are happening in every aspect of our lives regardless of our acceptance and they are happening in order to ease our way of living. Therefore, it is better to adopt the changes right away and enjoy the advantages they give us. Group buying Websites are definitely a positive trend in online shopping and we should embrace them.

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Decision Support System for Mechanical Engineering

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Abstract - Risk management in mechanical engineering is a continual process that seeks to apply the appropriate tools, procedures and methodologies to avoid that risk or to keep within certain limits. The paper advances the currently available formal models of risk management in mechanical engineering through the implementation of the system done in C#. Being used in the Bayesian network model whose evaluation is shown through examples. Proposed a Bayesian approach because they successfully solve problems that are characterized by risk analysis. The advantage of this method is to give an accurate answer always even when all data are not available. It is suitable for small and incomplete data set, the combination of various sources of knowledge, support for decision-analysis and rapid response. It is often applied to problems of diagnosis, prediction, and control output. There are three ways to incorporate Bayesian model in risk analysis. The first way is to take full assessment and decision making. Another "forcing" Bayesian model [1][2] only be used for assessment of risk allocation. Finally, the third method, using Bayesian model as a means to select or input distribution parameterization for model risk. The aim of this work is work also has for aim to highlight the advantages and disadvantages Bayesian models.

I. INTRODUCTION

In real life sometimes happens that the true hypothesis is not valid. This fact is not consequence of bad theory needed for withdrawal. The rules based on the probability come from some assumptions and based on them conclusions are made. If the assumptions are not regular set the conclusion is wrong. Probabilistic reasoning is not monotonous: probability of B, under condition A, may be different from the probability of B, under conditions A and C. Bayes networks represent one of the mechanisms for the resolution of these problems.[3][4]

The work is divided into several parts. The whole will be the second to point out the specification of machine for filtering transformer oil. The 3 will be a Bayesian model is shown to be. In part 4 specifically applied to the problem and will be discussed through concrete results. The discussion will give an overview on the possibilities of expanding and improving the model.

II. MACHINE FOR FILTERING TRANSFORMER OIL

A. About the machine:

From storage of crude oil in underground Barrel, Size 50 tons, draws the oil pump with the help of an overhead tank. The overhead tank size is 2 tons. From the tanks the oil pump draws the machine where filtering occurs circular filtering process. [5][6] In a circular process of participating circulator pumps, centrifugal pumps, vacuum pumps, unit for degassing, heaters, filters and water cooling. When someone takes the cycle, refers to the maximum flow from the reservoir of 2 ton, filtering through the machine and back into the tank. When you filter out everything, the oil is drained into containers for use.[7][8]

- 1) Warehouse crude oil in underground barrel, size 50 tons. (The pump draws up to overhead tanks)
- 2) The overhead tank size 2 tons
- 3) From the tanks the oil is drawn into the machine where the filtering takes place filtering process (pump)
- 4) Unit for degassing
- 5) Rough vacuum pump
- 6) Fine vacuum pump,
- 7) Filters for the separation of mechanical purity,
- 8) Heaters,
- 9) Water tank for cooling

III. BAYESIAN MODEL

Bayes network represents a graphical model whose elements are nodes, the arrows between nodes and connection probability of two nodes. Finite set of nodes together with a number of arrows (directed links) between nodes form a mathematical structure called a directed graph. If there is a arrow from node X to Y it is said that X is the parent of node Y, and Y is a child of node X. Bayes networks provide a compact representation of relations between the parameters involved. A key feature of Bayesian networks is the fact that they provide a method of decomposing the joint probability of variables in the set of local distributions. This facilitates the investigation of relations among variables in a given problem.[7]

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connection probability of two nodes. In mathematics, the formalization of this model is called a directed graph. If there is an arrow from node X to Y it is said that X is the parent of node Y, and Y is a child of node X. Bayes networks provide a compact representation of relations between the parameters involved. A key feature of Bayesian networks is the possibility to provide a method of decomposing the joint probability of variables in the set of local distributions. This facilitates the examination of relations among variables in a given problem.

Building a BM for a domain of application involves three main steps:

- A) Identify the variables that are of importance, along with their possible state values.
- B) Identify the relationships between the variables and express them in a graphical structure.
- C) Assess the probabilities required for its quantitative part.

The above three steps are, in principle, performed one after the other. However, building a BN usually requires a careful trade-off between the desire for a large and rich model on the one hand and required effort for construction, maintenance, and probabilistic inference in the network on the other hand. In practice, therefore, building a BM is a creative process that iterates over these steps until a desired network is achieved.

• Derivation of Bayes' rule

For two events A and B, having probabilities P(A) and P(B) ≠ 0 respectively, the definition of the conditional probability of A given B is

$$P(A|B) = P(AB) / P(B) \tag{1}$$

where AB denotes the event where both A and B occur and P(AB) denotes that event's probability. The quantity P(A|B) describes the chance that event A will occur, given the fact that B has already occurred. Consider the Venn diagram below. So long as neither A nor B is impossible, i.e., if P(A) ≠ 0 and P(B) ≠ 0, then symmetry implies that the probability of the conjunction AB is equal to two things,

$$P(A|B)P(B) = P(AB) = P(B|A)P(A) \tag{2}$$

which must therefore equal each other. Rearranging a little bit, we see immediately that

$$P(A|B) = P(A)P(B|A) / P(B) \tag{3}$$

which is Bayes' rule. It is just a way of converting a probability like P(B|A) into one like P(A|B), that is, the probability that B occurs given A has occurred to the probability that A occurs given B. This means, for instance, that the probability that you have a disease given that you've tested positive for it can be computed from the probability that you'd test positive for the disease if you had it. The confusion of these two quantities is not only common among beginning students of probability theory, but has found its way into the publications by some of the greatest names in its history,

including de Morgan, Boole, and even Laplace himself. Bayes' rule converts from P(B|A) to P(A|B) simply by multiplying by P(A) and dividing by P(B).

Model used to calculate the probability was carried out in the Bayesian model is:

For variables X_i ($i=1, \dots, n$) given $\pi(X_i)$, X_i is conditionally independent on all non-parents nodes, a joint distribution probability of n variables can be decomposed according to a chain rule as shown in

$$P(X_1, \dots, X_n) = \prod_{i=1}^n P(X_i | X_1, \dots, X_{i-1}) = \prod_{i=1}^n P(X_i | \pi(X_i))$$

Where $\pi(X_i)$ is marginal probability of X_i , $P(X_i)$. [9]

Let X and Y be two stochastic variables, and suppose that evidences are $X = x$ and $Y = y$. Before considering the evidence $Y = y$, the prior probability of the event $X = x$ or $P(X = x)$ should be estimated first. After taking into account of the evidence $Y = y$, according to Bayes theorem, the posterior probability $P(X = x | Y = y)$ can be calculated as

$$P(X = x | Y = y) = P(X = x, Y = y) / P(Y = y) = P(X = x) P(Y = y | X = x) / P(Y = y)$$

where $P(X=x|Y=y)$ is the probability of the joint event $P(X=x$ and $Y=y)$. If X, Y are independent, then $P(X=x|Y=y) = P(X=x)$.

Bayesians use probability distributions for both the data and the parameters of their models. In contrast, frequentists do not permit distributions to be used as models of fixed quantities, so they usually cannot use distributions to represent their model parameters. Frequentists can only consider only the probabilities for random data they collect. As a result, frequentist models and inferences have to be fashioned in a way that seems contorted to many. Another important advantage of the Bayesian approach is that it allows peeking at the data. Bayesian methods are tailored to decision analysis which in principle could allow analysts and decision makers to construct a consistent set of decisions about the risk assessments and their proper management.

The Bayesian approach formalizes—and to some extent legitimizes—the explicit use of subjective information, including personal judgments made by the analyst and expert opinions that the analyst may elect to adopt. It gives the analyst a way to factor subjective judgments into the objective equations. This is an extremely attractive feature to risk analysts because, in many practical assessments, most of the available information is partly or entirely subjective. A seminal advantage of Bayesian methods over frequentist methods is that Bayesian methods can in principle always yield an answer, even in situations where frequentist methods cannot be used. Specifically, they can produce answers even when there is no sample data at all.

IV. RESULTS

Bayesian model was applied to the problem machine for filtering transformer oil. The model is implemented in C# and tested on real problems. Some different scenarios

were tested and the results are shown in Tables 1, Table 2 and Table 3.

	Bayesian network	Historical conclusion
The oil is filtered out A	91%	90%
The oil is not filtered out B	9.8%	10%
The oil is slowly filtered out C	29%	30%
The oil is poor filtered out (with errors) D	10.2%	10%
Canceled a total installation X	9.9%	10%

Table 1. Showing results historical conclusion of parts machines and the results obtained by Bayesian approach.

The failure probabilities of a subsystem if the outcome is known									
The final outcome / Actuator	1	2	3	4	5	6	7	8	9
The oil is filtered out A	100%	100%	90%	0%	0%	0%	0%	0%	10%
The oil is not filtered out B	0%	0%	10%	0%	0%	0%	90%	80%	10%
The oil is slowly filtered out C	0%	0%	0%	90%	90%	90%	10%	20%	10%
The oil is poor filtered out (with errors) D	100%	100%	100%	0%	0%	0%	0%	0%	20%

Table 2. Representation the failure probabilities of a subsystem if the outcome is known

Furthest probability outcome if it happens multiple failures simultaneously					
	A	B	C	D	X

1, 2	2%	10%	1%	0%	4.5%
2, 3	87%	11%	3.2%	0%	4.8%
7, 9	89.8%	8%	5.2%	10%	9.7%
4, 5, 6	9%	0.01%	0.02%	12.9%	0.01%
1, 9, 5	81%	5%	0.9%	4%	3.6%

Table 3. Showing furthest probability outcome if it happens multiple failures simultaneously

V. DISCUSSION

Bayesian networks to obtain the key advantage of large storage savings in situations where only approximate answers are needed. In this paper, we focus on solving problems machine for filtering transformer oil using Bayesian network. One of the main results obtained in this study is comparative analysis between the results obtained by BN and historic probabilities and it is concluded that there is no significant difference between them. The other result is development of the modern software for prediction in the area of mechanical engineering and decision making even when there is no enough information. The extension of this work in the future is developing of an expert system for automation of the production process in order to reduce the failures, all based on Bayesian probabilities.

ACKNOWLEDGMENT

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NoSQL Databases – Example of Use in a Lost and Found Website

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Abstract – NoSQL (Not Only SQL) databases represent a type of database different from the traditional relational databases. This type of databases provides a mechanism for data storage and retrieval with less consistency demands. The main advantages of this database type include design simplicity, good scalability and fast reading and insertion of data. Furthermore, these databases introduce different types of indexes intended to simplify and accelerate operations with specific types of data (geospatial, text etc.). All this makes them a quality choice for a data layer for specific types of websites. The paper describes the implementation of a Lost and Found website using a NoSQL database as a data layer. MongoDB has been selected due to good geospatial and textual data storage support, as well as the possibility of applying different types of indexes in order to speed up searches specific for our website.

I. INTRODUCTION

The WorldWideWeb expansion in the last decade has made a huge impact on the nature of applications. More and more websites and online applications keep emerging, rising data storage issues. Many specific requests are made during the design and implementation of websites, causing the one-size-fits-all traditional relational databases to slowly get pushed aside by different types of databases, which are more suitable for the specific needs. This is the reason for the expansion of a different type of databases, called NoSQL databases.

This paper presents the process of developing a simple Lost and Found website using a document-oriented NoSQL database for data storage and handling. The paper brings the advantages of using such a solution in specific systems such as our.

The paper consists of 6 sections. The second section describes the requests and gives the use-case model for the implemented system. In the third section, a quick

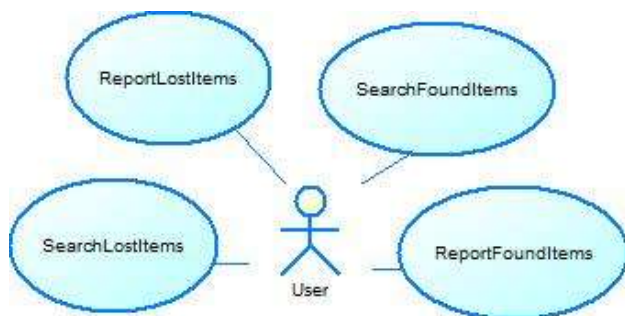


Figure 1. Use case model

introduction to NoSQL databases, document-oriented databases and the MongoDB database is given. The fourth section describes different types of indexes available in MongoDB, while the fifth section gives a usage example in our website. Finally, in the sixth section we give some conclusions and a course for future work.

II. PROBLEM AND REQUEST SPECIFICATION

Lost and Found websites are a type of website where users can report lost or found items, or browse through the items already reported. This type of website has two main characteristics: a continuously rising amount of data and precisely specified search parameters, used to narrow the list of items for browsing. Some of these parameters are of a specific type, which, in combination with the first characteristic, makes huge influence on the choice of the database system to be used. More details about the choice of database will be given in section V.

The first step in the development of our website was to make a request specification. Analyzing similar software solutions [1] [2], we have come across a small set of functions needed for our website. A use case model of these functionalities is displayed in Fig. 1.

The functionalities can be divided into two groups, based on the data needed and the results they produce:

- Item report
- Item search

The first group consists of lost and found item submission functions, where users provide details about the lost or found items. The second group consists of search functions for lost and found items, where the user provides several search parameters and gets a list of items found in the database.

A. Report Submission

When a user wants to report a lost/found item, he is redirected to a input form, displayed in Fig. 2, where he provides several details:

- **Title** – a title under which a lost/found item report appears in the browsing list.
- **Short description** – a non-mandatory short text displayed under the title in the browsing list.

- **Description** – report text with a detailed description for the item, later referenced by the search module.
- **Category & Subcategory** – a predefined list of item categories.
- **Date** – day when the item was lost/found
- **Location data** – data about the **state**, **city**, address and a detailed description where the item was lost/found (for example “the third row in ComputerLab1”).
- **Pointer on the map** – location where the item was lost/found, picked on the world map. The location can be narrowed by choosing the state and city and then refreshing the map. The coordinates are stored in a field called MapLocation.

The bolded fields are mandatory, and are a minimal set of information for a report to be made.

B. Item Search

Through the analysis of aforementioned websites, and adding our own experience, we have comprised a set of fields by which searches are made on similar sites and which are offered to our users to search our database:

- Category & subcategory
- Date from & date to
- Keywords – used for searching the Title and Description fields
- Region – selected point on the map and desired maximum distance

The nature of the data, focus on insert and select operations and the lack of need for complicated queries, as well as specific types of queries difficult to make using traditional relational databases all are reasons for searching for a more suitable solution.

III. NOSQL AND MONGODB

The expression NoSQL [3] was first used in 1998 for a relational database that omitted the use of SQL. It was reused again in 2009 in a conference about distributed databases by advocates of non-relational databases. Unlike the first time it was used, the name NoSQL started to be used for non relational databases. There were several factors for the emergence of NoSQL [4]:

- New web trends (cloud-computing)
- Big data
- Horizontal scalability
- Avoidance of expensive object-relational mapping
- Data read and write performances etc.

Furthermore, the ACID (Atomicity, Consistency, Isolation, Durability) principles, which relational databases rest on, may be redundant. In NoSQL database

solutions, these principles are replaced by the less consistent BASE (Basically Available, Soft-state, Eventual-consistency) model. These principles are applicable to a large extent of systems, which do not need full time consistency, unlike financial systems which do.

There are four types of NoSQL databases:

- Key-value stores which store key-value data pairs
- Wide column stores, which store columns, instead of rows
- Document-oriented databases, which store data encapsulated or encoded in a certain format (JSON, XML)
- Graph databases

For the implementation of our system, a document oriented database was selected, in our case MongoDB

A. MongoDB

MongoDB [5] is a document oriented database which uses BSON (Binary JSON) as a data storage format. It has the following data structure:

- A MongoDB instance can contain zero or more databases
- A database consists of collections, which are the equivalent of tables in relational databases
- Collections contain documents, which can be thought of as a row
- Documents contain fields, which are like columns
- Indexes function much like their RDBMS counterparts

These concepts, although similar, are not identical. MongoDB does not force structure on the collection level, as fields are defined on document level. This means that documents with different structure can be found in the same collection. MongoDB also introduces some new types of data and indexes, which are described in more detail in the following section.

IV. INDEXES IN MONGODB

Indexes represent a data structure used to provide high performance read operations. Without using indexes, MongoDB must scan every document in a collection in order to select those that match the query statement, which is inefficient and requires huge amounts of data to be processed. The choice of indexed fields can be of crucial value for the speed of queries made. MongoDB provides several different index types to support specific data or queries[7]:

- Index on the `_id` field – a unique index that exists by default
- Single field indexes – indexes on a single field of a document

- Compound index – indexes on multiple fields, which behave like single field indexes. The order of the fields in the index has significance, as that is also the sort order.
- Multi key index – used to index the content stored in arrays
- Geospatial index –used to support efficient geospatial data queries
- Text indexes – used to support string searching in a collection.
- Hashed indexes – used to support hash based sharding

In our work, the most important types of indexes are the geospatial and text indexes.

A. Geospatial Indexes

There are two types of geospatial indexes, depending on the type of surface used to perform calculations: spherical (2dsphere) and flat (2d). The spherical type of indexes calculates geometry over an Earth-like sphere and data is stored in GeoJSON format. This type of indexes allows not only points, but also lines and polygons to be stored.

The flat index type calculates geometry on a Euclidean plane, and data is stored as legacy coordinate pairs. Another difference is that flat indexes can only make distance calculations, whereas the sphere index allows geometric calculations to be made.

In our case, 2dsphere index is used, so we present the types of queries available for this type of index:

- GeoJSON objects bounded by a polygon – returns all points and shapes that exist entirely within a GeoJSON polygon
- Intersections of GeoJSON objects – finds all points and shapes intersecting a GeoJSON polygon
- Proximity to a GeoJSON point – returns points closest to the defined point and sorts them by distance
- Points in a circle defined on a sphere – selects all grid coordinates in a “spherical cap” on a sphere, with the radius measured in radians.

B. Text Indexes

Text indexes support text search of string content in documents of a collection. They are case-insensitive and can include any field whose value is a string or an array of string elements. Text indexes drop language-specific stop words and use language-specific text stemming.

Text indexes need to be used with care, as they come with several data storage and performance costs: they can be large, take a long time to build, impact insertion throughput.

The next section displays an example for using these index types in our website.

V. NOSQL IN OUR WEBSITE

As mentioned in section II, in time, Lost and Found websites may increase in size. Relational databases can not easily cope with large amounts of data and tend to decrease in query speed. On the other hand, as stated in section III, NoSQL databases are intended to work with large amounts of data, as they are easily scalable. Furthermore, the simple data structures and no need for complex queries (only simple select/insert/update queries) brings document oriented databases as a solution, instead of a relational database. Also, several fields needed for our website have specific types (geospatial, textual), which are not supported by default in relational databases, which can make a performance decrease when queries need to be made based on these fields. These are all the reasons for choosing a NoSQL database for our implementation, in our case the MongoDB database.

As it was mentioned before, our website allows only strictly defined simple queries on several fields, which is where indexes, described in the previous section, fit perfectly in order to speed up the search process.

The search fields specified earlier can be divided into three groups:

- Geospatial – point on the map and maximal distance
- Full text search fields – keywords
- Standard search – date, category and subcategory

For these three types of search fields, different index types are used. Now we will describe the way indexes are used in our system.

A. Single Field and Compound Indexes

For searches made based on the category, subcategory and date fields, the simplest type of indexes is used. A single field index is declared on the Date field in the LostItem(FoundItem) collection. A compound index is declared on the Category and Subcategory fields, in that order, because the Subcategory depends on the Category, so when a query is made, the results are sorted first by Category and then by Subcategory. The creation of these indexes is displayed in Fig. 2.

B. Text Index

The field Keywords on the search page is meant to be used for making full text searches on two fields: Title and Description. This is why a text index is declared on these two fields. The creation of this index is displayed in Fig. 3.

When a query is made, the text search process looks like this:

- tokenizes and stems the search terms
- assigns a score to each document that contains the search term in these two fields.

This score determines the relevance of a document to our search query

```

db.lostItems.ensureIndex(
  {
    Category: 1,
    Subcategory: 1
  }
)

db.lostItems.ensureIndex(
  {
    Date: 1
  }
)
    
```

Figure 2. Single field and Compound index

```

db.lostItems.ensureIndex(
  {
    Title: "text",
    Description: "text"
  }
)
    
```

Figure 3. Text index

C. Geospatial Index

Often, searches need to be made by the location an item was lost at. This is why we introduce a Geospatial index in our database and declare it on the MapLocation field. The search is made as follows: a point is selected in a map (OpenSourceMap is used) and combined with a maximum distance value, which is also set by a user. These are used to execute a geoNear query on the indexed field. This query returns all documents which have a MapLocation field within the defined maximum distance from the specified location, ordered by the distance. The creation of this index is displayed in Fig. 4

```

db.lostItems.ensureIndex(
  {
    MapLocation: "2dsphere"
  }
)
    
```

Figure 4. Geospatial index

development of websites intended for quick reading and writing of data, with no need for complex data processing and querying, pushes relational databases to the side, leaving space for more flexible and better applicable solutions to take place. The development of our website points out multiple advantages of using NoSQL databases in such systems.

As our website is still in the development process, the next step is to put the website online and test the performance of the database and indexing in a real environment.

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VI. CONCLUSION

The changes in web technologies, as well as the rising amount of data, are putting pressure on the traditional data storage techniques (relational databases). New approaches are emerging to cope with these changes. The

Analyzing the Impact of Administrative and Demographic Data on Students' Performance

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Abstract - Educational data mining (EDM) can be defined as the application of data mining techniques to data that come from educational environments. EDM analyze data generated by any information system used in educational institutions to collect information about students. The main objective is to extract implicit and useful patterns or to obtain useful knowledge from large datasets. This paper presents an analysis of administrative and demographic data impact on students' performance in the course Introduction to Programming at Faculty of Electrical Engineering in East Sarajevo. The goal of this research is to analyze which classification algorithm generates better predictive model in order to better understand current educational practice.

I. INTRODUCTION

Data mining is commonly defined as the process of discovering useful patterns or knowledge from data sources [1]. The patterns must be valid, potentially useful, and understandable. Data mining involves techniques for finding and describing structural patterns in data, as a tool for helping to explain data and make predictions from it [2]. Input data for applying data mining techniques are presented in the form of a set of examples, and the output can be expressed in the predictive or descriptive form of the analyzed data structure. Data mining is a multi-disciplinary field involving machine learning, statistics, databases, artificial intelligence, information retrieval, and visualization [1]. There are four the most common tasks used in data mining applications: supervised learning (or classification), unsupervised learning (or clustering), association rule mining, and sequential pattern mining. Each of them is characterized by different styles of learning.

Data mining process involves three main steps:

- Pre-processing – the raw data must be cleaned in order to become suitable for mining. Data cleaning includes removing noises and abnormalities, handling too large data, identifying and removing irrelevant attributes, and so on. Data cleaning is procedure that usually consumes a lot of time and it is very labor-intensive but it is absolutely necessary step for successful data mining.
- Data mining – the process of applying data mining algorithm that will produce patterns or knowledge.
- Post-processing – Among all discovered patterns or knowledge, it is necessary to

discover ones that are useful for the application. For making the right decision there are many evaluation and visualization techniques that can be used.

Data mining can be applied to explore and analyze data that come from different types of educational environments. Educational data mining is an emerging discipline, concerned with developing methods for exploring the unique types of data that come from the educational context [3]. EDM analyzes data generated by any type of information system supporting learning or education. These data are not restricted to interactions of individual students with an educational system but might also include administrative data (e.g., school, school district, teacher), demographic data (e.g., gender, age, school grades), student affectivity (e.g., motivation, emotional states), etc. [4]. The main objective is to extract implicit and useful patterns or to obtain useful knowledge about the ways students learn and factors that influence their learning. Applying data mining methods and techniques on data that come from educational systems it is possible to discover new and useful knowledge. That knowledge can be used to provide feedback for teachers in order to easier guide students in learning and to improve educational outcomes.

In recent years a lot of research in the field of educational data mining has been conducted and various types of mining algorithms have been proposed. Comparative analysis of various data mining techniques and algorithms has been shown in [5]. The goal of the paper was to explore suitable data mining algorithms applied on educational dataset. An investigation of data mining techniques for evaluating quality of a course and analyzing a connection between course learning material and the test for the final exam has been done in [6]. Applying different data mining classification techniques for predicting the marks in the final exam of a course has been shown in [7]. An educational data mining model for predicting student performance in programming courses has been presented in [8]. The authors tried to identify variables and factors that influence predicting programming performance of students. Using clustering analysis compare of two algorithms for measuring the potential of students' academic skills has been done in [9]. In [10] the factors influence analysis to the students' performance in final examinations and a suitable data mining algorithm for predict the grade of students has been done. The obtained results reveals that type of

school does not influence student performance and parents' occupation plays a major role in predicting grades.

II. DATA PREPARATION

In experiment shown in this paper administrative and demographic data of two generations of students (2010/11 and 2011/12) has been taken into account and their impact on student' performance in the course Introduction to Programming at Faculty of Electrical Engineering in East Sarajevo. Open source data mining tool WEKA [11] was used to apply the learning methods to a dataset and analyze its output to extract information about the data. Used attributes include city from where students came (*city*), high school they graduated (*school*), average mark of subject mathematics (*matav*) and informatics (*infav*) in high school, graduated average mark in high school (*hsav*), points obtained on the faculty qualification exam (*test*) and *Obtained mark* in the course Introduction to Programming. The last attribute was used as a class attribute with values *five*, *six*, *seven*, *eight*, *nine* and *ten*. In another experiment class attribute has 3 distinct values (*five=weak*, *six*, *seven* and *eight=good*, *nine* and *ten=excellent*). Excel .csv file is formed of these data and than exported to WEKA data mining tool.

III. CLASSIFICATION ALGORITHMS IMPLEMENTATIONS

Supervised learning or classification is type of machine learning analogue to human learning from past experiences to gain new knowledge in order to improve our ability to perform real-world tasks [1]. Computers using machine learning learns from data which are collected in the past and represent past experiences. In most cases classification is used for learning a target function that can be used to predict the values of a discrete class attribute, e. g. classification is one type of predictions methods. The goal of prediction is to infer a target attribute, predicted variable, from some combination of other aspects of the data, another attribute. Classification here means the problem of correctly predicting the probability that an example has a predefined class from a set of attributes describing the example. In classification learning, the learning scheme is presented with a set of classified examples from which it is expected to learn a way of classifying unseen examples [2].

There are many methods and measures for estimation the strength and the accuracy of a classification/predictive model [1]. The main measure is the classification accuracy which is the number of correctly classified instances in the test set divided by the total number of instances in the test set. Some of the common methods for classifier evaluation are holdout set, Multiple Random Sampling and Cross-Validation. In applications with only two classes two measures named Precision and Recall are usually used. Their definitions are:

$$P = \frac{TP}{TP + FP} \quad (1)$$

$$R = \frac{TP}{TP + FN} \quad (2)$$

TP, FP, TN, and FN used in Eq. (1) and Eq. (2) are the numbers of true positives, false positives, true negatives, and false negatives, respectively. These measures can be also used in case of larger number of classes, which in this case are seen as a series of problems with two classes. It is convenient to introduce these measures using a confusion matrix. A confusion matrix contains information about actual and predicted results given by a classifier. However, it is hard to compare classifiers based on two measures, which are not functionally related [1]. If a single measure to compare different classifiers is needed, the F-measure is often used:

$$FM = \frac{2 \cdot P \cdot R}{P + R} \quad (3)$$

Another measure is the receiver operating characteristic (ROC) [2]. It is a term used in signal detection to characterize the tradeoff between hit rate and false-alarm rate over a noisy channel. ROC curves depict the performance of a classifier without regard to class distribution or error costs. They plot the true positive rate on the vertical axis against the true negative rate on the horizontal axis.

It is also important to note that choosing Select Attributes tab it is possible to evaluate given attributes. Info-Gain Attribute Evaluation evaluates attributes by measuring their information gain with respect to the class. It discretizes numeric attributes first using the MDL-based discretization method (it can be set to binarize them instead). This method can treat missing as a separate value or distribute the counts among other values in proportion to their frequency. Gain-Ratio Attribute Evaluation evaluates attributes by measuring their gain ratio with respect to the class [2].

For this experiment Naïve Bayes and Neural Network data mining algorithms were used.

Bayesian classifier is statistical classifier which can be used to predict class membership probabilities. Bayesian classification is based on Bayes theorem [5]. The Naïve Bayes classifier is based on Bayes' rule and "naïvely" assumes independence - it is only valid to multiply probabilities when the events are independent. For each class value it estimates the probability that a given instance belongs to that class. Naïve Bayes gives a simple approach, with clear semantics, for representing, using, and learning probabilistic knowledge and it can achieve impressive results [2].

The area of neural networks probably belongs to the border line between the artificial intelligence and approximation algorithm. A neural network is a collection of neurons like processing units with weighted connection between them. It is composed of many elements, called nodes which are connected in between. The connection between two nodes is weighted and by the adjustment of this weight, the training of the network is performed [5]. The Neural network classifier uses the backpropagation algorithm to train the network and its accuracy does not depend on the dimensionality of the training data [2]. There are many advantages of neural

networks such as adaptive learning ability, self-organization, real time operation and insensitivity to noise. The Neural network classifier is used for many pattern recognition purposes. There are several Neural network algorithms such as Back Propagation, NN Supervised Learning, and Radial Base Function (RBF) Network etc [5].

For evaluation of classifier 10-fold cross validation testing techniques are used. During the process the data set is divided into 10 subsets. Then the classification algorithms are fed with these subsets of data. The left-out subsets of the training data are used to evaluate classification accuracy. When seeking an accurate error estimate, it is standard procedure to repeat the cross-validation process 10 times - that is, 10 times tenfold cross-validation and average the results. This involves invoking the learning algorithm 100 times on datasets that are all nine-tenths the size of the original. Getting a good measure of performance is a computation-intensive undertaking [2].

IV. SIMULATION RESULTS

Using above mentioned algorithms, simulation obtained results are shown in Table I.

TABLE I. CLASSIFIER EVALUATION

	CCI (%)	ICI (%)	TP	FP	P	R	FM	ROC
NB	27.6	72.3	0.276	0.155	0.259	0.276	0.263	0.614
NN	25.7	74.2	0.257	0.168	0.244	0.257	0.248	0.564

From Table I it can be seen that Naïve Bayes classifiers predict model accurately than Neural Networks classifier. It generated a model with 27.6% correctly classified instances (CCI), a precision of 25.9% (0.259) and the classification above the ROC curve area (0.614 > 0.5).

In multiclass prediction, the result on a test set is often displayed as a two-dimensional confusion matrix with a row and column for each class. Each matrix element shows the number of test examples for which the actual class is the row and the predicted class is the column. Good results correspond to large numbers down the main diagonal and small, ideally zero, off-diagonal elements [2]. Six cases of class attributes Obtained mark are indicated by letters a=five, b=six, c=seven, d=ten, e=eight and f=nine. The results are shown in Table II.

TABLE II. CONFUSION MATRIX

Predicted class							Real class
Naïve Bayes							
a	b	c	d	e	f		
11	5	3	0	3	4	a=five	
5	6	2	0	0	4	b=six	
3	5	2	1	5	8	c=seven	
1	1	0	7	0	1	d=ten	
4	1	4	2	0	3	e=eight	
3	0	2	3	3	3	f=nine	

Predicted class							Real class
Neural networks							
a	b	c	d	e	f		
10	5	4	0	5	2	a=five	
6	4	4	0	1	2	b=six	
5	5	5	2	4	3	c=seven	
2	0	0	6	1	1	d=ten	
4	1	4	3	1	1	e=eight	
2	2	3	3	3	1	f=nine	

Attributes evaluation is performed using Info-Gain Attribute Evaluation and Gain-Ratio Attribute Evaluation (Table III). Table III shows that only attributes *city* and *school* have influence to *Obtained mark*.

TABLE III. ATTRIBUTES EVALUATION

Attribute	InfoGainAttributeEval	GainRatioAttributeEval
city	0.783	0.19
school	0.308	0.184
matav	0	0
infav	0	0
hsav	0	0
test	0	0

Originally generated models have shown unbalanced distribution of examples per class variables, what indicated that the data were not well prepared.

In the case of unbalanced data sets, examples of small classes are more difficult to train. The problem with unbalanced data arises because learning algorithms tend to overlook less frequent classes (minority classes), paying attention just to the most frequent ones (majority classes). As a result, the classifier obtained is not able to correctly classify data instances corresponding to poorly represented classes. One of the most frequent methods used to learn from unbalanced data consists of re-sampling the data [7]. To solve this problem, in this paper resampling was performed using Resample Weka filter for supervised learning with or without instance replacement. The result of applying this filter shown that the difference in the values of attributes decreased. Before resampling attributes had next number of distinct values: *city*-26, *school*-10, *matav*-19, *infav*-13, *hsav*-22 and *test*-38. When the data is sampled a number of attributes different values is reduced: *city*-21, *school*-10, *matav*-17, *infav*-12, *hsav*-20 and *test*-31. The generated models are re-sampled data what enable more precise predictions. Results obtained by applying above mentioned algorithms on resampled data are shown in next tables. Table IV shows the predictive accuracy of the classifier on the re-sampled data. Obtained results show that both classifiers applied on re-sampled data have significantly better accuracy on re-sampled data compared to results presented in Table I. Neural Networks classifier in this case obtained better results than Naïve Bayes classifier. It generated a model with 77.1% correctly classified instances (CCI), a precision of 78% (0.78) and the classification above the ROC curve area (0.588 > 0.5).

TABLE IV. CLASSIFIER EVALUATION (RE-SAMPLED DATA)

	CCI (%)	ICI (%)	TP	FP	P	R	FM	ROC
NB	62.8	37.1	0.629	0.083	0.627	0.629	0.622	0.813
NN	77.1	22.8	0.771	0.064	0.78	0.771	0.769	0.588

Confusion matrix was used for a more detailed analysis of the class attribute distribution.

TABLE V. CONFUSION MATRIX (RE-SAMPLED DATA)

Predicted class							Real class
Naïve Bayes						Real class	
a	b	c	d	e	f		Real class
12	4	1	0	7	0	a=five	
6	10	3	0	4	0	b=six	
3	5	8	0	7	0	c=seven	
0	3	0	5	2	0	d=ten	
2	1	1	2	12	0	e=eight	
2	0	0	0	5	0	f=nine	

Predicted class							Real class
Neural networks						Real class	
a	b	c	d	e	f		Real class
17	4	2	1	0	0	a=five	
0	19	3	1	0	0	b=six	
2	4	12	2	2	1	c=seven	
0	1	2	6	1	0	d=ten	
2	1	1	1	11	2	e=eight	
0	0	0	0	1	6	f=nine	

From tables IV and V it can be seen that resampling of data significantly improves the balancing of data distribution, which affected on the results of applied algorithms.

Attributes evaluation performed on re-sampled data shows that now attributes *hsav* and *test* beside attributes *city* and *school* have influence to *Obtained mark* (Table VI).

TABLE VI. ATTRIBUTES EVALUATION AFTER RESAMPLING

Attribute	InfoGainAttributeEval	GainRatioAttributeEval
city	1.174	0.296
school	0.459	0.252
matav	0	0
infav	0	0
hsav	0.194	0.282
test	0.22	0.692

The second experiment again compared the Naïve Bayes and Neural Network classification algorithms using all the available data but now applying pre-processing discretization data task on the class attribute. Discretization divides the numerical data into categorical classes that are easier for the teacher to understand. There are different discretization methods [7]. Concretely, the

manual method (where cut-off points have to be specified) has been applied to the *Obtained mark* attribute, where three intervals and labels have been used (*weak*: if value is 5; *good*: if value is 6, 7 and 8 and *excellent*: if value is 9 and 10).

Repeating above performed simulation obtained results on unbalanced data set are presented in Tables VII and VIII.

TABLE VII. CLASSIFIER EVALUATION

	CCI (%)	ICI (%)	TP	FP	P	R	FM	ROC
NB	46.6	53.3	0.467	0.338	0.481	0.467	0.469	0.632
NN	48.5	51.4	0.486	0.35	0.49	0.486	0.487	0.595

In this case of unbalanced data set, both of classifiers shown more accurate prediction models than ones presented in Table I. Neural Networks classifier again generated a better model than Naïve Bayes with 48.5% correctly classified instances (CCI), a precision 49% (0.49) and the classification above the ROC curve area (0.595 > 0.5).

TABLE VIII. CONFUSION MATRIX

Predicted class			
Naïve Bayes			Real class
a	b	c	
10	13	3	a=weak
9	27	19	b=good
2	10	12	c=excellent

Predicted class			
Neural networks			Real class
a	b	c	
10	15	1	a=weak
15	31	9	b=good
4	10	10	c=excellent

Performing attributes evaluation in this case results presented in Table IX, just like in Table III, show that only attributes *city* and *school* have influence to *Obtained mark*.

TABLE IX. ATTRIBUTES EVALUATION

Attribute	InfoGainAttributeEval	GainRatioAttributeEval
city	0.309	0.0751
school	0.174	0.1041
matav	0	0
infav	0	0
hsav	0	0
test	0	0

However, accuracy is known to be unsuitable to measure classification performance with unbalanced data. After data resampling, both classifiers show more correctly classified data instances (Table X).

TABLE X. CLASSIFIER EVALUATION (RE-SAMPLED DATA)

	CCI (%)	ICI (%)	TP	FP	P	R	FM	ROC
NB	67.6	32.3	0.676	0.299	0.671	0.676	0.671	0.742
NN	77.1	22.8	0.771	0.151	0.781	0.771	0.774	0.837

Table X shows that Neural Networks classifier with 77.1% correctly classified instances (CCI), a precision 78.1% (0.781) and the classification above the ROC curve area (0.837 > 0.5) generated better predictive model than Naïve Bayes classifier.

TABLE XI. CONFUSION MATRIX (RE-SAMPLED DATA)

Predicted class			
Naïve Bayes			
a	b	c	Real class
14	10	0	a=weak
8	48	6	b=good
1	9	9	c=excellent

Predicted class			
Neural networks			
a	b	c	Real class
17	5	2	a=weak
9	49	4	b=good
1	3	15	c=excellent

Performing again attributes evaluation on re-sampled data results show that now attributes *city*, *school* and *matav* have influence to *Obtained mark* (Table XII).

TABLE XII. ATTRIBUTES EVALUATION AFTER RESAMPLING

Attribute	InfoGainAttributeEval	GainRatioAttributeEval
city	0.523	0.131
school	0.239	0.144
matav	0.102	0.139
infav	0	0
hsav	0	0
test	0	0

V. CONCLUSION

The choice of the classifier for generating predictive model is a complex task. The whole data mining process is almost always iterative: it usually takes many rounds to achieve final satisfactory results. The selection of a correct data mining algorithm depends on not only the goal of an application, but also on the compatibility of the data set.

This paper describes the analysis of the Naïve Bayes and Neural Network classifiers for creating models for predicting students' final grade in the course Introduction to Programming at Faculty of Electrical Engineering in East Sarajevo. Experiments were performed on two types of the values of class attribute, with and without the applied method of discretization. Several experiments

were performed using available administrative and demographic data about students to try to obtain more accuracy. Rebalance preprocessing techniques have also been used on the original data to test again if better classifier models can be obtained. The standard measures for evaluation of the accuracy of the predictive model (the number of correctly and incorrectly classified examples, TP, FP, recall, precision, F-measure, the area of the ROC curve) were applied. Confusions matrix was used for a more detailed analysis of the class attribute distribution. Attributes evaluation analysis of used dataset shows that attributes *city* and *school* have the highest influence to students' final grade in the course Introduction to Programming. From the obtained results it can be seen that generated predictive models with re-sampled data enabled more precise predictions. Comparative analyses of the classifiers shows that Neural Networks classifier gives better results than Naïve Bayes model, e. g. using Neural Networks classifier it can be created more precise model.

The aim of future research is to explore the possibility of including the additional parameters in the analysis by which it could be achieved better predictive results and use of other classification algorithms for creating more precise predictive model.

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Benefits of Establishing Project Management Office in an IT Company

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Abstract - Recent years, the Project Management Office (PMO) has become the most important thing in defining software company's business processes. 87% of the world companies have established a PMO, and half of the companies that have not established PMO plan to establish in the following year. The paper points on PMO roles and responsibilities, PMO models, as well as the advantages and disadvantages of establishing PMO in the software company. Research reveals that the main reasons for the establishing PMO are reducing project duration and cost of project implementation while increasing its quality.

I. INTRODUCTION

“Project in a business environment is a finite piece of work, undertaken within defined cost and time constraints and directed at achieving a stated business benefit”[1].

Since, Project Management becomes more readily accepted, even popular, within organizations, there is a need to formally integrate the discipline and process with organizational business strategy. In this research, aspect of this integration is the function of Project Managers (PMs) within an organizational structure. The idea of a Project Management Office (PMO) has begun to develop fuelling debate as to what responsibilities such an entity should carry within an organization. This paper is about what are benefits of successful implemented PMO structure that fits within the existing organizational hierarchy and performs functions which can add true value (value which is consistent, measurable and profitable for business) to an organization: This paper addresses (1) Definition, types and responsibilities of a PMO; (2) A metrics for successful measurement; (3) Benefits by the science, benefits by the practice; and (4) Recommendations for implementing a successful PMO.

II. ABOUT PMO

The acronym “PMO” is used in three different ways, each defining different levels of the same idea of governance enforcement. It may be found referring to a Project Management Office, a Program Management Office or to a Portfolio Management Office. Each definition is a variation of the same function, differing only in the scope of the described responsibilities. In this paper we will concentrate on Project Management Office.

The Project Management Office is an unit that defines and maintains the standards of process

generally related to project management, within the organization.” [2].

A Program Management Office is defined as “A centralized unit within an organization or department that oversees and improves the management of projects” [3].

And, a Portfolio Management Office is described as a function that oversees all projects and treats them in the same manner as a portfolio of financial investments with an eye towards maximizing the received value while minimizing risk to the organization[4].

A. Definition of Project Management Office

The Project Management Institute (PMI) describes the Project Management Office in the Body of Knowledge as: A Project Management Office (PMO) is a management structure that standardizes the project-related governance processes and facilitates the sharing of resources, methodologies, tools, and techniques. The responsibilities of a PMO can range from providing project management support functions to actually being responsible for the direct management of one or more projects [5].

The PRINCE 2 methodology makes no specific reference to the term PMO. Rather it refers to the concept of program management and describes it as: A vital component in the delivery of change; whether change to public or customer services, or change within an organization [6].

There seems to be a general consensus on the following components of the PMO definition:

- PMOs are central bodies, acting in line management structures to govern PMs and report to decision makers.
- PMOs may govern and coordinate multiple projects, across the organization, through review and monitoring.
- PMOs can act in the capacity of mentors or centers of best practice, as a Project Director may mentor PMs through a project. Their functional purpose is frequently to improve project management capabilities within an organization [7].

B. Types of Project Management Office

In many literatures, the definition of PMO representation varies in the name, model and by functions, but it is essentially a centralized office that coordinates and oversees the management of projects and programs.

Gartner analyst in their survey report of 2000 identified three main models for PMOs [8]:

- Project repository – a library of templates, guidelines, and project histories and serves as a source of information on project methodology and standards.
- Project coach – acts as a trainer, consultant or mentor, a source of information on project processes and helps in project setup and post-project deliveries.
- Enterprise project office – provides direct management, oversight of projects throughout the organization and acts as a contracted project manager, assessing scope, allocating resources and verifying time, budget, risk, and impact assumptions.

Based on specific roles and functions, there are three models for the structure of a PMO [9]:

- Storing PMO model – serves as the central project management body in the organization to influence over the standards and processes that govern projects in the organization. Acts as a knowledge organization that maintains project libraries and lessons-learned, and builds knowledge - bases of organizational best practices.
- Consulting PMO model – plays a mentoring role by assisting with troubled projects, providing training and development opportunities for project managers and project staff, or publishing best practices throughout the organizations. Acts as consulting organization to establish standards for project management processes, managing PM software, managing staff augment staff for certain project efforts.
- Blended PMO model – plays a more active role with direct responsibility for managing the execution of some key projects within organization. In addition, it also provides consulting services, training, standards-setting activities and project support services as mentioned in other two models.

Besides these models, we could introduce an experiential model, called the "Deliver Value Now Model".

- Deliver Value Now model – put organizational goals first, which provides a strong well-balanced projects portfolio that identifies up-to-date project workload, sponsorship, tactical progress, health status and current data gaps.

C. Responsibilities of Project Management Office

A primary function of a PMO is to support project managers in a variety of ways which may include, but are not limited to [10]:

- Maintain repository: All projects(proposal, work plans, status reports, changes),
- Provide oversight: Insure project are conducted in compliance to standards,
- Drive the project update and status reporting process,
- Provide portfolio level status reports to management,
- Provide guidance and tools to PMs,
- Conduct post project reviews and performance score cards,
- Facilitate improvements to the project conduct and management process.

Project managers and PMOs pursue different objectives and, as such, are driven by different requirements. All of these efforts are aligned with the strategic needs of the organization. Differences between the role of project managers and a PMO may include the following [11]:

- The project manager focuses on the specified project objectives, while the PMO manages major program scope changes, which may be seen as potential opportunities to better achieve business objectives.
- The project manager controls the assigned project resources to best meet project objectives, while the PMO optimizes the use of shared organizational resources across all projects.
- The project manager manages the constraints (scope, schedule, cost, quality, etc.) of the individual projects, while the PMO manages the methodologies, standards, overall risks/opportunities, metrics, and interdependencies among projects at the enterprise level.

III. METRICS FOR MEASUREMENT OF SUCCESS

There are a number of answers that need to be explored, but given the highly individual nature of each PMO, it is difficult to provide a definitive list of failure points. However, an issue that pervades nearly every PMO across the board is a problem of metrics. Too many PMOs do not measure their success with the appropriate key performance indicators (KPIs), and due to this

failure, high-level executives can easily question the PMO's worth, particularly the results-driven chief financial officer. The PMO, with its emphasis on measuring process and protocols, can fail to focus on KPIs that are relevant to the overall progress of the business. Because of this failure to properly document its success, many otherwise productive PMOs are being shut down [12].

A. Time to Market

Time to Market= Elapsed Time from Idea Conception to Delivery (1)

Alternate Time to Market= Actual Completion Time – Budgeted Completion Time (2)

The PMO can improve a product's time to market in two ways. First, it can increase the speed at which projects are completed. The benefits here are obvious, as a project that is completed faster generally means greater customer and company satisfaction as it will be available for distribution sooner. The PMO also improves time to market by promoting better adherence to project schedules. Doing so promotes customer satisfaction, improved trust in the project team, and a greater ability to accurately predict future project lifecycles. More importantly, it ensures that a time-dependent product, such as a video game with a pre-Christmas release date, will not miss a deadline that would result in drastically reduced or nonexistent sales. PMOs that consistently improve time to market can streamline processes. For example, projects can be rolled out on time without having to hastily skip steps in the development process.

B. Service Availability

Service Availability=Actual Start Time-Optimal Start Time (3)

Service availability (3) refers to the time it takes to start a project compared to the desired start date. It differs from time to market in two ways: first, it can measure the time that is allotted for specific tasks as opposed to only referring to the completion date of a final product and second, it can be measured at numerous points during project development. As a reference point for a business, it makes sense because it measures the capacity to complete more projects or allocate more time to valuable projects. Further, having a good measure of service availability allows the PMO to divert resources to critical path tasks should the need arise. The PMO specializes in increasing service availability by streamlining tasks and accurately scheduling future projects. If the above equation has a lower number, that means a higher service availability. However, a business must be careful not to have such a high amount of availability that resources are being benched. Wasted resources can drain just as much

money from a business as a poorly managed service schedule.

C. ROI

ROI= (Revenue-Investment)/Investment*100 (4)

The PMO contributes to a company's ROI (4) by making sure that projects are successfully completed according to the specifications laid out by the parent company and other key stakeholders. Because of this, examining ROI as a KPI offers an incomplete view into the productivity of the PMO. This is because the PMO does not generally influence financial returns directly. Rather, it provides the framework upon which success can be built. ROI, then, must be looked at in combination with other metrics to determine the specific influence of the PMO on the overall performance of a business. ROI can be used to measure success, but it should be looked at on a per-project basis to determine the actual impact of the PMO.

D. Sales Growth

Sales Growth= (Current Sales- Previous Sales)/Previous Sales (5)

The PMO contributes to sales growth in much the same way that it influences ROI. It does so by providing an environment that allows sales to grow more effortlessly, often by improving the other metrics in this list, such as time to market and service availability. Still, measuring sales growth does not specify the PMO's role in the improvement of that growth. Nonetheless, improving sales growth will likely appeal to high level executives, and in particular CFOs, because it is something savvy investors look for in a company. As such, and despite its obvious limitations, sales growth is an important metric because improvement in this area creates more financial opportunities for a business, and can convince many nonbelievers of the importance of a PMO.

E. Service Utilization

Service Utilization= Billable Hours/Total Hours (6)

In addition to streamlining tasks by increasing service availability, service utilization allows a PMO to ensure that time is being used efficiently. Here, service utilization means looking at the resources assigned to a project, and in particular, the human resources. An advanced PMO will not only be able to decrease the number of people who are over or underworked, but they will be able to assign people to the tasks that they are best at, thus maximizing the value of their time. Increasing the quality of service utilization means a better quality

project outcome in the same amount of time. This will optimize customer and employee satisfaction, and will guarantee that a business is getting the most value out of their hires and contracted labor.

First, as previously mentioned, the role of a PMO is (and should always be) very specific to the needs of a particular company. One should not try to apply these KPIs directly. Rather, they should be tailored to reflect the PMO's prescribed role. Second, too many KPIs can lead to a muddled sense of where accomplishment truly lies. Like having too many gauges on the dashboard of a car, measuring too many indicators of success can be tricky and confusing. It is better to pick a couple of KPIs that fit your company well and focus attention on those rather than trying to measure a plethora of indicators that will lead to hazy results.

IV. BENEFITS

A. Empirical benefits

Research into initiated projects at over 500 companies concludes that:

- 34 % come in over budget,
- 13% fail to meet the goals established,
- 60% fail to meet return on investment targets.

In contrast, 86% of respondents who use a project management office (PMO) stated that the PMO leads to more successful projects [2] .

PMOs contribute in 2010 directly to the following performance improvements [13]:

- Decrease in failed projects.....31%,
- Projects delivered ahead of schedule.....19%,
- Projects delivered under budget.....30%,
- Cost savings per project (% of total project cost) 17%,
- Improvement in productivity.....21%,
- Increase in resource capacity.....13%,

In 2012 PMOs contribute directly to the following performance improvements[14]:

- Decrease in failed projects30%,
- Projects delivered ahead of schedule.....19%,
- Projects delivered under budget25%,

- Improvement in projects aligned with objectives 39%,
- Improvement in productivity22%,
- Cost savings per project (% of total project cost) 15%,
- Increase in customer satisfaction31%.

B. Real benefits

Therefore, based on collected data and practical experience (in IT company “Lanaco”, with more than 250 employees), we are free to specify the benefits that are associated with the establishing of PMO:

- Better Efficiency in Delivering Services: Project management provides a “roadmap” that is easily followed and leads to project completion. Once you know where to avoid the bumps and pots holes it stands to reason that you’re going to be working smarter and not harder and longer.
- Improved / Increased / Enhanced Customer Satisfaction: Whenever you get a project done on time and under budget, the client walks away happy. And a happy client is one you’ll see again. Smart project management provides the tools that enable this client/manager relationship to continue.
- Enhanced Effectiveness in Delivering Services: The same strategies that allowed you to successfully complete one project will serve you many times over.
- Improved Growth and Development Within your Team: Positive results not only command respect but more often than not inspire your team to continue to look for ways to perform more efficiently.
- Greater Standing and Competitive Edge: This is not only a good benefit of project management within the workplace but outside of it as well; word travels fast and there is nothing like superior performance to secure your place in the marketplace.
- Opportunities to Expand your Services: A by-product of greater standing. Great performance leads to more opportunities to succeed.

- **Better Flexibility:** Perhaps one of the greatest benefits of project management is that it allows for flexibility. Sure project management allows you to map out the strategy you want to take see your project completed. But the beauty of such organization is that if you discover a smarter direction to take, you can take it. For many small-to-midsize companies, this alone is worth the price of admission.
- **Increased Risk Assessment:** When all the players are lined up and your strategy is in place potential risks will jump out and slap you in the face. And that's the way it should be. Project management provides a red flag at the right time: before you start working on project completion.
- **Increase in Quality:** Goes hand-in-hand with enhanced effectiveness.
- **Increase in Quantity:** And increase in quality is often the result of better efficiency, a simple reminder regarding the benefits of project management.

V. ADVICE FOR SUCCESS

There is no magic formula for success of the project and the PMO, but there are rules and advices which should be followed in order to be closer to success. Here are some of the important advices:

- **Establish a PMO Vision and Mission** - In discussions with providers and through independent research, we have identified that establishing a vision for the PMO early is a critical factor for success. Senior or executive leadership should develop the vision with the organization's goals in mind.
- **Align the PMO with Organizational Culture** - A successful PMO will require a variety of infrastructure components be put in place. While there is always some level of organizational flexibility, project stakeholders may resist doing things in a prescribed or dictated way. To overcome such resistance there must be support from senior management and the organization should rely heavily on input from its project managers and stakeholders when developing the PMO. Taking these initial steps during PMO development will help ensure organizational

support of the provision of necessary resources to meet project demands.

- **Link PMO Strategy with Organizational Strategy** - PMO strategy, like business strategy, is the high-level roadmap that describes how the PMO will achieve its mission. Strategic alignment between PMO and business strategy is a two-way process in which overall business strategy shapes the direction of organizational project planning, and, in turn, project success impacts enterprise success. Strategic alignment of a PMO and/or a project must take into account strategic focus, operational efficiency and team leadership. The extent to which a project is focused on each of these dimensions determines the project's level of "strategic maturity". Research has shown that higher levels of strategic maturity are associated with higher levels of project success [15].
- **Define the Methodology** - Project management methodology is the fundamental concept used to define, plan and execute a complex project or activity. In short, it is the framework and materials that will allow the PMO to conduct their work as project managers and successfully deliver projects on time, within scope and within budget. These materials might include process documents, best practices, guidelines, policies, and tools and templates.
- **Identify Appropriate Metrics** - Transparency is tantamount in today's health care environment. This is also true in project and PMO reporting. The flow of information from the PMO on project status and overall PMO benefit should be clear, consistent and constant. The PMO should establish and collect metrics that demonstrate its effectiveness at delivering projects as well as metrics that clearly demonstrate how the overall organization benefits from its work.
- **Train PMO and Organization Staff** - Training is a core service that the healthcare PMO can offer to the organization; however, the first step for the organization is to ensure that the employees who are staffing the PMO are adequately trained.
- **Manage Intellectual Property** - The PMO will develop, purchase and/or create a significant amount of intellectual property (IP) during the development phase and even more IP when fully functional. A large part of the PMO's job involves managing this knowledge and providing project leaders and team member's easy access to it.

VI. CONCLUSION

We have defined and described different types of PMO that exist across various organizations, the type of activity undertaken by these PMOs and the degree of influence they can have on key aspects of project, program and portfolio management.

To conclude, we would like to reinforce the fact that "Establishing a PMO is not a simple solution to a complex problem". Having a PMO does not, by itself, increase project success. It's what the PMO does that makes the difference; and that should depend on how successful you already are in delivering projects and programs, what problems you expect the PMO to address and the aspects of portfolio, program and project management you want to improve.

In this paper, I have demonstrated that success and value of a PMO requires strong links between effort expended at an individual project level and achievement and alignment with business objectives. I would suggest that a structured metrics program is fundamental in measuring success and value of a PMO. The relevance of the collection data is greatly enhanced if a baseline measurement is taken before implementation, and then subsequent measurements taken during implementation and post implementation of the PMO. The three key indicators for success are:

- Improved performance of individual projects.
- Alignment of project and business strategic objectives.
- Building project management capabilities .

The right development of a PMO will improve the caliber of project management within an organization, but developing a successful PMO requires:

- Support of senior leadership,
- Commitment of resources (human, financial and technology),

- Strong organizational commitment to its success.

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Concepts of Private Cloud Computing Solutions in Public Sector

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Abstract – In this paper we will try to present the concept of private cloud solution which can support needs for establishing widely available, responsive and secure national (or local) public service for citizens. This solution is expected to provide better data flow, access control, data protection service with better geographical coverage and overall protection of information relevant to both individual citizens and public services in general. On the other hand, development of software component of cloud layer in the form of PaaS and SaaS solutions. leads to the reasonable question why any application development intended for public services in the form of cloud solutions needs to be on some private cloud instead on already established public cloud solutions, and we will also try to answer this question.

I. INTRODUCTION

At the moment, cloud computing is the leading paradigm of ICT development, with the industry leading companies fighting for a better position on this new market. They even offer a higher level of integration of infrastructure, networking, hardware and software as a base for solutions designed for cloud computing. The latest announcement coming from Microsoft that, in addition to Office for clouds, they plan development of their Windows 10 operating system as the future cloud operating system clearly indicates this tendency.

We can say that cloud computing is one of the main research IT areas in this century, although, there was no commonly accepted definition of cloud computing until 2011, when the US National Institute of Standards and Technology (NIST) came up with its definition [24] which states:

"A model for enabling convenient, on demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction".

To put it simply, cloud computing is relatively new IT paradigm involving advanced network (and computing) resources that make it easier for users to access shared computing resources through internet-on-demand.

Cloud computing has emerged as a novel technology, in the paradigm shift from the traditional "desktop as a platform" to "internet as a platform" model. As the Internet becomes more available and widespread, users can access shared IT resources through internet on demand, and they will be charged only on the basis of the amount of consumption, which will allow them to use the cloud at their own convenience. At the same time, the users will be unaware of where the services are hosted and how they are delivered in the cloud environment [1]. Since the growth of solutions based on cloud computing becomes very fast, people can acquire the necessary software and computing facility at a faster rate. This helps bring tremendous improvements in the IT business infrastructure and has become the modern trend in computing environment.

Cloud computing has evolved from grid computing. The on domain resource provisioning is a distinguishable feature that gives improved environment over grid computing. In their papers Shuai Zhang, Shufen Zhang, Xuebin Chen, and Xiezheng Huo [2] provide a comparative study between Cloud Computing and grid computing and discuss the advantages of cloud over grid. Hence cloud computing is expected to be the most preferred choice in computing world.

Many research areas including technologies and infrastructure for cloud computing have been previously explored by academicians and researchers [3]. One of such anthologies has been provided by Rajkumar Buyya, Chee Shin Yeo, Srikumar Venugopal, James Broberg, and Ivon Brandic [4], and in their work a few noticeable outcomes of the above are Abicloud (a CC platform developed by Abiquo, a company in Barcelona Spain), OpenNebula (an open source cloud service framework) and Nimbus (an open tool set and also a CC solution providing infrastructure as a service). Similarly, industrial organizations have created several cloud computing platforms, such as EC2 (Elastic Compute Cloud, which enables users to run Linux based applications), from Amazon, from Microsoft comes Azure platform (aims to provide an integrated development, host and control CC environment), AppEngine (allows a user to run web applications written using the Python programming language) from Google, Oracle integrates in its portfolio (after acquisition of Sun) the

whole palette of services from hardware to private and finally public cloud offering through (enables the user to run Solaris OS, Java, C, C++ and FORTRAN based applications). Since each platform has its own characteristics and advantages, it is a real challenge for users to make an unbiased choice.

In several papers we can find comparative studies between platforms, as in paper written by Junjie Peng, Xuejun Zhang and Zhou Lei, Bofeng Zhang, Wu Zhang, Qing Li et al. in [1], who analyzed several platforms and provided findings.

In short, various mentioned research material have shown advanced features of cloud solutions compared to grid (for example in [11]) so that future cloud users will benefit.

The proposed design concept will try to take best from both solutions in order to get most benefit from their stronger sides and avoid weaknesses.

II. CLOUD COMPUTING

As mentioned, cloud computing infrastructure should provide foundations for creating a service-oriented infrastructure by combining a set of products, technologies and best practice knowledge.

Cloud computing architecture can be divided in two categories regarding the ownership of base infrastructure that hosts services:

- Private cloud

Is an organisation's internal service-oriented environment optimized for performance and cost and controlled service delivery; deployed inside organisations' data centers.

- Public cloud

Is usually provided by (external) service providers who offer customers the ability to deploy and consume services without need to possess their own necessary hardware/software infrastructure, and relying on internet as connecting network infrastructure.

Focus of our interest will stay on private cloud, because it allows organisations to scale up their ICT services according to their needs, quickly and cost-effectively while holding control over the system in-house. This approach enables dynamic, flexible services while benefits include the ability to:

- Deliver scalable applications and workloads.
- Enable federated services across the full cloud continuum.
- Manage the data center fabric as a single pool of resources.
- Focus on the management of the data center service and its dependencies.

III. CONCEPT OF DESIGN

As an example, we will examine a concept of design of private cloud architecture compared to classical multi-

tier architecture (with local servers in branch-offices connected to central servers), the architecture that could be used for the purposes of public services at national level

A. Example in the education sector

Within the public education sector there is a need for ICT platform that should provide lots of services for a variety of applications ranging from support to e-Learning and services for exchange of teaching materials (sharing documents between students and teachers and between teachers themselves) to the services intended to keep records on students' achievements, employees and management of system resources.

Some of these needs in the field of documents and information exchange can be satisfied by using web portals (which has been done).

But the complex needs, such as providing services in the form of fully functional systems for keeping electronic school diaries, as well as legally required records, and for managing resources of the entire education system based on current facts requires a fully functional information system with the actual facts in real time (Full support for management based on facts). For years, good ideas for establishing advanced educational services in the form of electronic diaries, educational records, student and teacher repositories and other useful things have been abandoned due to lack of resources needed to provide coverage of at least 80% of educational institutions at the very beginning. Each of these ideas have been approached from the standpoint that it requires some additional resources, at central location and at local level, and all big issues that have emerged have been reduced to a single denominator - "price". Even so, there remains an urgent need for a comprehensive platform designed to provide more complex solutions than the web portal and file sharing service.

Also, with the Law on education, i.e. in 2009, this need became a legal requirement for the existence and use of a single unified information system in education as a basis for keeping electronic educational records. The system should provide a hierarchy of access rights depending on authority of participants in the educational process and protection of private information about students, parents, teachers and other staff in education system. Besides, it should be open for interconnection with external software implementations or software solutions developed/customized by educational institutions. Taking into account the number of over 3,300 school objects, millions of students and nearly 100,000 employees that, as in any commercial company, must be recorded, the extensive system requirements become clearer. Because of them, the scope of the first comprehensive project of information system implementation in educational institutions has been reduced to the equivalent of ERP solution with monitoring of educational parameters roughly in semi-annual cycles. In several projects dating back to the beginning of 2000s there were attempts to solve the problem by developing information system as a centralized multi-tier application and reducing its scope

to manageable segment. That solution can be found in the form of the EIS system developed for the Ministry of Education, Science and Technological Development of the Republic of Serbia in the period between 2003 and 2006, and in the 2009 preliminary project design of the JISP (Unified Information System in Education). These attempts resulted in limited scope and possibility of establishing a single comprehensive educational information system. Further limitations came from the diversity of needs of various educational institutions at different levels of education.

The new project launched in 2010 and based on the JISP design would have the same problems and limitations as the abovementioned EIS if it were targeted implemented, as proposed, as limited service of information system with multi-tier architecture. Regardless of the application of advanced web-service architecture to provide support for a variety of clients (win.Forms and WEB) and FrontEnd, due to inadequate infrastructure connection, this would still be an information system based on hierarchically linked infrastructure that would include the existence of local, regional and central databases (as proposed in the conceptual design of the project from 2009). On this basis, for the successful implementation, it would be necessary to provide significant hardware resources that go beyond the financial frame of the entire project.

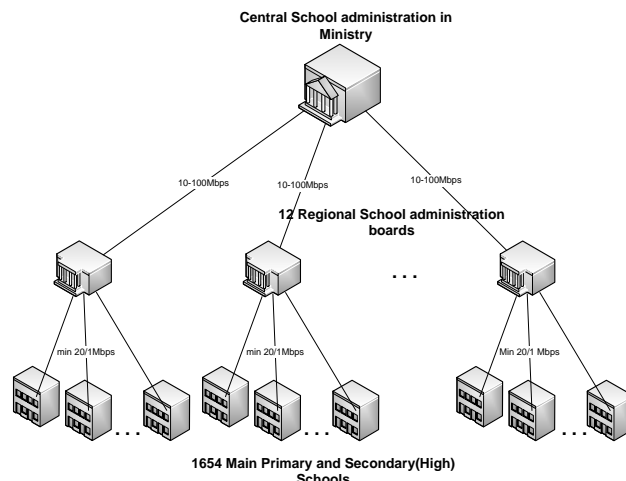


Figure 2: Network Topology of Hierarchically Linked Educational Institutions

Similar examples of the need for establishing information system as a service over the extensive hierarchical organisational structure can be also found in other public services, such as health care, social services, etc.

As in large corporations, which also have geographically dislocated regional centers and branch offices with a large number of employees, and which face with the same problems, the question that has come up is how to establish a service that will be equally available in large area, but still open, modular and enough flexible to make it possible to allocate resources where they are most needed.

B. Concept of Private Cloud Solution

Assuming that the existing infrastructure, if needed, can be upgraded and optimized to provide end users with faster and better telecommunications links, we would be able to displace the whole application logic from the local level to the regional, or even the central level. This would significantly reduce the necessary local hardware infrastructure investments, the amount of required servers and extent of human involvement in the establishment and regular maintenance of such a diverse system. On the other hand, complete transition to a centralized position carries risk of performance degradation in peripheral geographical areas and risk of accidental disaster or disaster caused by some catastrophe. If we assume that there is a need for complete inside control, management and protection of the system performed by authorized and responsible persons, it is clear that such a solution must be private by its nature and not leased or rented to/from other entities outside the public sector. Also, what has been said before clearly shows that these demands would be met by some form of private cloud.

If, instead of a centralized DC, we establish several data centers that correspond with the positions of regional telecommunications hubs, and the distance between them

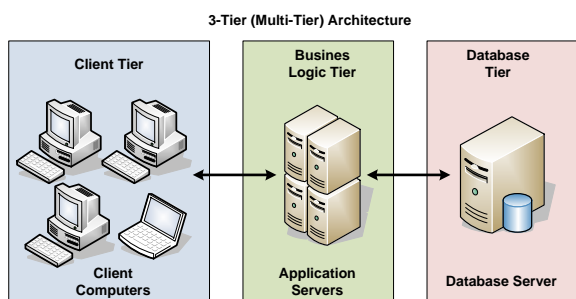


Figure 1: Classical Multi-Tier Architecture

Figure 1 illustrates an example of classical three-tier concept.

If we pay close attention to the figure 2, we can find out by simple calculation that the establishment of this kind of system only at the level of investment in server hardware would require purchase of at least 1,654 local servers (with supporting equipment and local infrastructure), as well as building (virtual) DB and application servers. At the regional level, 12 x 3 (+1), i.e. about 48 large servers would be needed to provide data collection, renewal (update) and data backup on the level of school administrations. Also, at the level of the Ministry it would be necessary to establish a data center of higher capacity as a fully functional system.

is not longer than 200km (max 240km¹), the following can be achieved:

Significantly better response time and availability of the services at regional and local level

The possibility of synchronous data replication between neighboring data centers interconnected in a network (grid computing)

Increased system reliability and energy savings since every DC in one grid is a sort of geographically distant disaster recovery site.

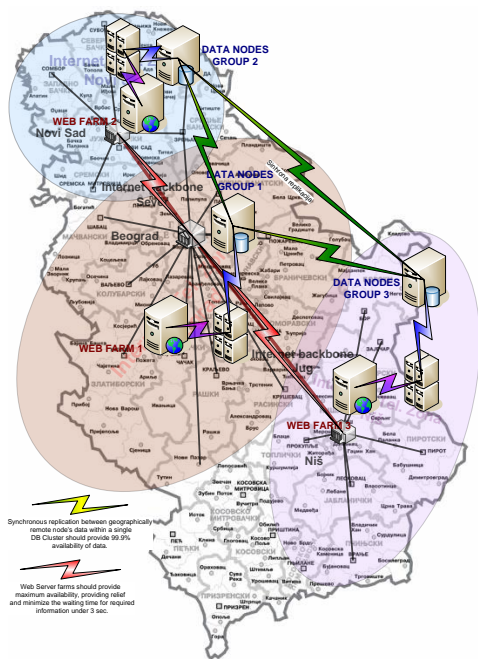


Figure 3.1 - Concept of Three Data Centers - web farms resting on the telecommunications backbone

In the figure 3.1 we can see the concept of the three data centers located near major telecommunications hubs in the country, which would host web server farms. In the illustration, each of the data centers is decomposed, so that one can see multiple layers, as well as possible interconnectivity, load balancing of architecture layers and the replication database connectivity.

Another variation presented in Figure 3.2 takes into account manufacturers' current limitations regarding the length of fiber optic cable and data transmission latency which can guarantee the synchronous data replication (EMC suggests that maximum distance should be less than 200km²).

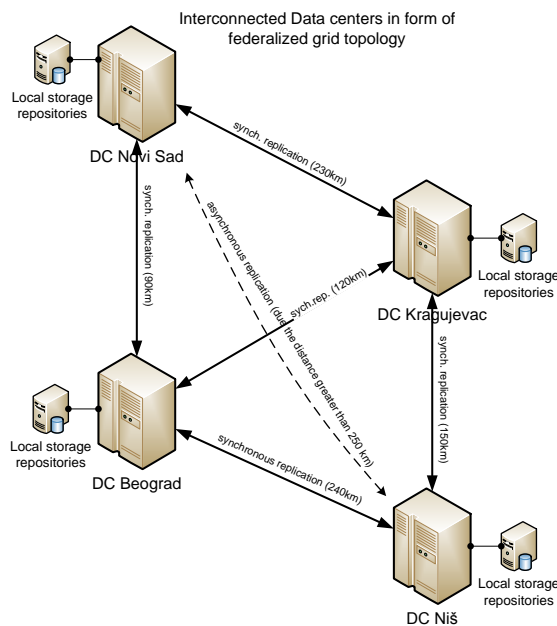


Figure 3.2 - Concept of Data Centers as Part of Private Cloud Forming Grid Federation for Data Replication

In our case, this limitation could be somewhat overcome by introducing the fourth data center. All four would be formed in the key state university centers in the country which already have their own academic optical network infrastructures. These DCs would be connected to each other in form of federalized grid topology. This way, and with synchronous replications of storage contents in real time, our future private cloud would not miss a special disaster recovery (DR) site, and along with better regional coverage it could provide better system load balancing.

Even if we assume that the proposed method provides the basic infrastructure which, thanks to the availability, modularity and scalability for users becomes a form of service, and which is known in cloud computing as IaaS (Infrastructure as a Service), this is just a starting point for developing the required solution.

Created infrastructure (physical / virtualized servers, storages and networks) allows establishment of different platform services (Platform as a Service) that will create the appropriate application development ecosystems as a basis for application development that ultimately should provide software solutions (Software as a Service) to end-users.

This vertical is shown in figures 4 and 5, where platform contains application framework for software solutions functioning.

¹ Even if will rise tolerance for low latency by 20% as some suggest on <https://community.emc.com/thread/104126?start=0&tstart=0> suggest even more

² EMC@SRDF: Zero Data Loss Solutions for Extended Distance Replication ,Technical Note REV A04 ,June 2, 2010

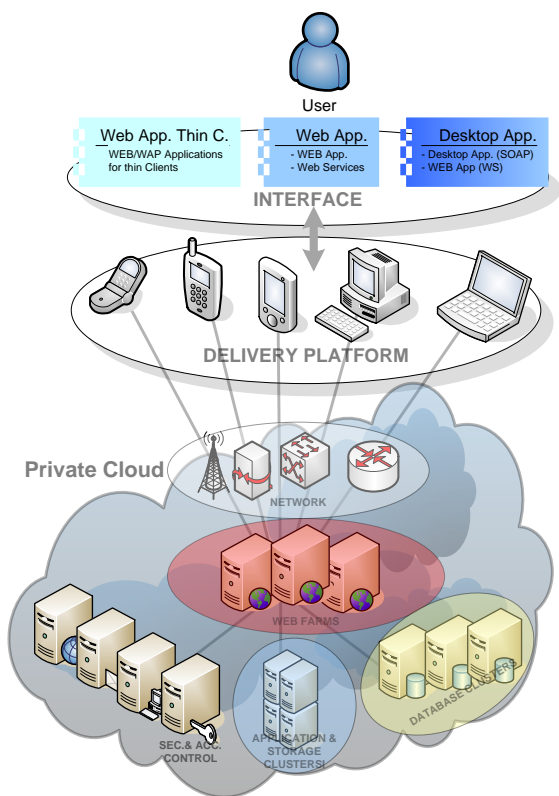


Figure 4. Private cloud dissected from IaaS to SaaS

This way, private cloud architecture enables support not only for one software solution but also for the existence of different development ecosystems. Instead of developing one software service in the form of the ERP information service with supporting infrastructure, we have the possibility to create open modular platforms for development and scalable support for various application solutions and services.

Private cloud solution is, in its essence, a solution that is developed within network and hardware infrastructure of an organization, so in our case of the state education sector, each organization can regulate issues of security and protection of the system.

The possibility of having your own network LAN and WAN resources within a closed network system is an advantage, but not particularly important because the use of public networks by setting up VPN channels is as real alternative as the control over placement, access and employees' working with data warehouses. Recent years have seen some attempts to minimize the importance of these benefits in order to favor public cloud solutions of large global companies, but they come to nothing because of recent discoveries.

IV. CONCLUSION

The proposed private cloud design of system infrastructure could provide much more flexibility than currently offered multi-layer single-purpose service solution. It would become a lot more than a support for single service functioning, and would be a platform for developing solutions based on a service-oriented

architecture (SOA) as a form of support for the future public e-Government cloud.

Providing at its beginning the necessary infrastructure IaaS (Infrastructure as a Service) support, it would also create foundations for developing and establishing the future SaaS (Software-as-a-Service) and SASSI (Secure Software as a Service) designed solutions (as can be seen in figures 4 and 5)

The major advantage of this development would be reflected in the fact that it creates a scalable basis for developing new solutions and services in accordance with needs which cannot be predicted at present.

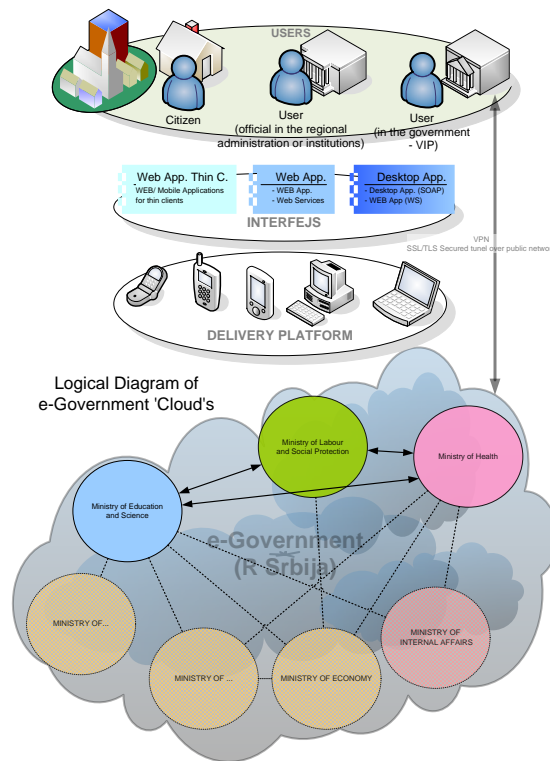


Figure 5. Concept of e-Government Cloud that emerges from the Base of a Private Cloud

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Advanced Programming Techniques for Data Validation in Excel

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Abstract - Data validation has become a very important step in software development, because it ensures the usefulness of the data. This paper shows how the Excel's mechanism for data validation is not efficient enough for complex software solutions. Data input through user forms allows the use of many VBA programming techniques for efficient data validation. The advantages of these techniques are shown in this paper through some examples in Excel.

I. INTRODUCTION

The immense popularity of Microsoft Excel throughout the business world today for processing quantitative data and developing analytical solutions is widely acknowledged. Excel is the tool of choice in the business world for data analysis and financial modeling, and employers increasingly expect business students to have a working knowledge of Excel and an ability to perform financial modeling.

The quality of a large real world data set depends on a number of issues [1][2], but the source of the data is the crucial factor. Data entry and acquisition is inherently prone to errors both simple and complex. Much effort can be given to this front-end process, with respect to reduction in entry error, but the fact often remains that errors in a large data set are common. Unless an organization takes extreme measures in an effort to avoid data errors the field errors rates are typically around 5% or more [3].

Data validation is the first step in assessing data quality. Data validation is a process that consists of an examination of all the data collected, in order to identify and single out all the elements that could be the results of errors. Data validation rules constitute the constraints that data input and processing must adhere to in addition to the structural constraints imposed by the data model.

Four essential kinds of data validation are [4]:

1. *Value well-formedness rules* define the syntax of values of particular entity properties. Value properties are typically stored as strings, but may have to satisfy additional well-formedness constraints. For example, email addresses and zip codes cannot be arbitrary strings, but must conform to a particular syntax;
2. *Data invariants* are functional constraints of single properties that cannot be expressed as syntactic constraints of single values, or coordination constraints between properties. For example, uniqueness of a primary key property;

3. *Input assertions* are checks based on input data that is not connected (directly) to persistent data, and hence cannot be specified as constraints on the data model. For example, a double password entry field requires the user to enter the same password twice to prevent typos;
4. *Action assertions* are checks on the execution of operations. For example, the conclusion of an operation might notify the user by email. An assertion may require the notification to succeed.

II. THE EXCEL DATA VALIDATION FEATURE

The Excel data validation feature allows us to set up certain rules that dictate what can be entered into a cell.

For example, we may want to limit data entry in a particular cells (E4:E7) to time between 07:00 and 14:00. If the user makes an invalid entry, we can display a custom message, such as the one shown in Fig. 1.



Figure 1. Displaying a message when user makes an invalid entry

Excel's data validation options include creating a drop down list that limits the data that can be entered into a specific cell to a pre-set list of entries.

When a drop-down list is added to a cell, an arrow is displayed next to it. Clicking on the arrow will open the list and allows us to select one of the list items to enter into the cell. The data used in the list can be located:

- on the same worksheet as the list,
- on a different worksheet in the same workbook, or
- in a different workbook.

In this paper we will create a drop down list using a list of entries located on a different worksheet in the same workbook.

The first step to creating a drop down list in Excel is to enter the data of a list. We enter the data on *Sheet2*, renaming it to *List*. The entered data are on range A1:A5 (Fig. 2). We name that range as *Courses*. A named range allows us to refer to a specific range of cells in an Excel workbook.

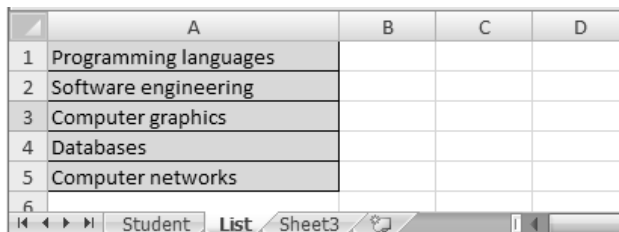


Figure 2. Elements of a list

Next, we rename *Sheet1* to *Student*, and in that worksheet we create a list with Excel's data validation feature, whose elements are in the *List* worksheet from Fig. 2. Worksheet *Student* is shown in Fig. 3.

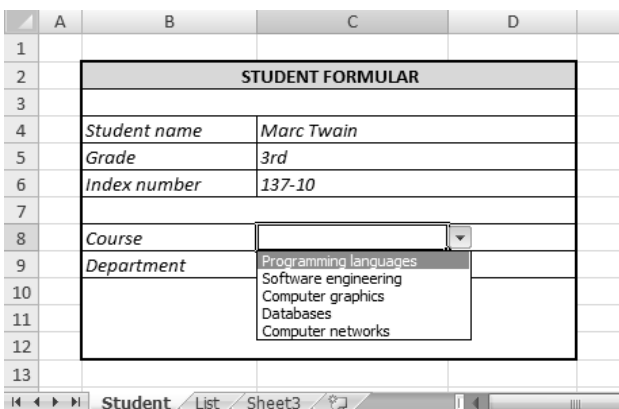


Figure 3. Using a list for entering the data

Since our data is on a different worksheet from the drop down list two options available for protecting the list data are:

1. Hide the worksheet containing the data (*List*)
2. Protect the worksheet which involves locking cells A1 to A5 on *List*

The benefits for using a drop down list include:

- Making data entry easier;
- Preventing data entry errors;
- Restricting the number of locations for entering data.

But, using a drop down list has a big disadvantage – modification of a list. To keep the drop down list up to date with changes in our data, it may be necessary to periodically change the choices in the list. Since we used a *named range* as the source for our list items rather than the actual list names, changing the *courses* names in the named range located in cells A1 to A5 on worksheet *List* immediately changes the names in the drop down list.

III. ADVANCED DATA VALIDATION WITH VISUAL BASIC AND USER FORMS

Visual Basic for Applications (VBA) allows us to create user forms for data input. A User form is a custom-built dialog box that we build using the VBA Editor [5].

If we need to require users to enter data in a well-defined format, such as a telephone number or a part number, we can accomplish this quickly and with minimal code by using the *MaskedTextBox* control. A mask is a string made up of characters from a masking language that specifies which characters can be entered at any given position in the text box. The control displays a set of prompts to the user. If the user types an incorrect entry, for example, the user types a letter when a digit is required, the control will automatically reject the input.

VBA has many functions for format checking. In the next example we will show how VBA can be used for data validation. In Fig. 4, we have list of Important world dates. It is necessary to enter the date in the correct format. VBA function for checking the date input is shown in Fig. 5.

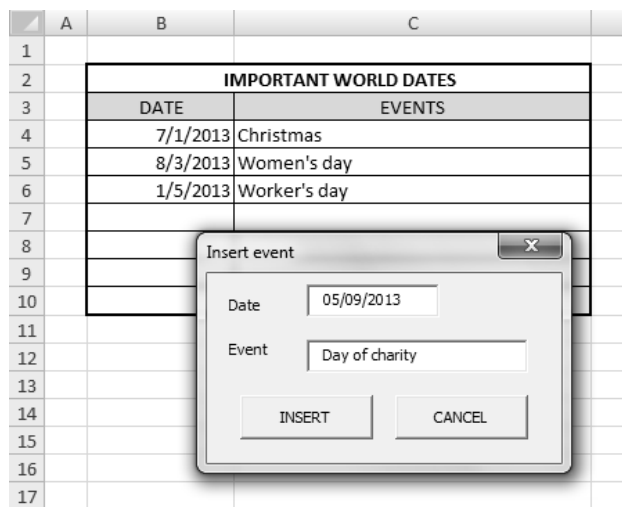


Figure 4. Using user form for inserting important world date

```
Private Sub btnInsert_Click()
If Not IsDate(TextBox1.Value) Then
MsgBox ("Please insert the date in
appropriate format dd/mm/yyyy !")
TextBox1.Text = ""
TextBox1.SetFocus
Else
Call WriteRecord
End If
End Sub
```

Figure 5. Function for checking date input

If the user tries to insert date in a wrong format, message box will appear and tell him that he must enter the date in a correct form (Fig. 6).

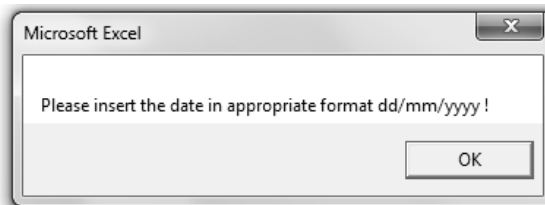


Figure 6. Message box that informs a user about incorrect input

In case the user enters the date in the correct format, then the record will be written in the Excel's worksheet. Function for writing a record is shown in Fig. 7.

```
Public Sub WriteRecord()
Dim lngWriteRow As Long
Dim ws As Worksheet
Set ws = Worksheets("Sheet1")
lngWriteRow =
ws.Cells(ws.Range("B4:B10").Rows.Count, 2)_.
End(xlUp).Offset(1, 0).Row
If lngWriteRow < 4 Then lngWriteRow = 4
ws.Range("B" & lngWriteRow) = TextBox1.Text
ws.Range("C" & lngWriteRow) = TextBox2.Text
MsgBox "One record written!"
response = MsgBox("Do you want to enter
another record?", vbYesNo)
If response = vbYes Then
TextBox1.Text = ""
TextBox2.Text = ""
TextBox1.SetFocus
Else
Unload Me
End If
End Sub
```

Figure 7. Function for writing a record

If we want full programmatic control over data validation, or need to perform complex validation checks, we should use the validation events built into most Windows Forms controls. Each control that accepts free-form user input has a Validating event that will occur whenever the control requires data validation.

Validating events can be:

- Implicit (validates data as the user enters it);
- Explicit (validates data at one time).

Let us now consider more complex data validation. In Fig. 8 is shown a datasheet that contains table of employees in some company and user form for inserting an employee.

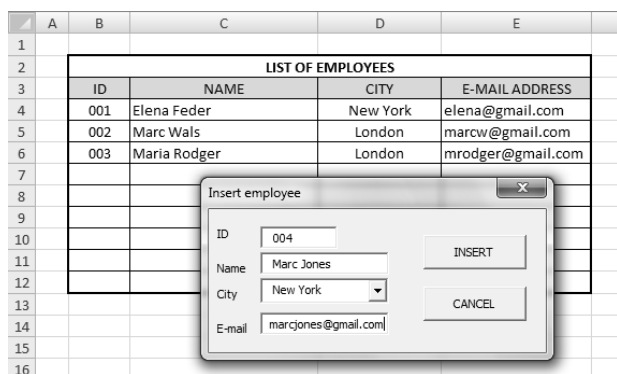


Figure 8. User form for inserting an employee

In this example we need complex data validation:

- ID field must be a number;
- Name field cannot be empty;
- City field must be a text;
- E-mail field must be in correct format.

For these requirements, it is obvious we cannot use Excel's Data validation feature. Instead, in Fig. 9 we show some VBA functions for data validating.

If the user tries to insert an employee with incorrect input, an error message box will be shown to him (like one in Fig. 6). If the input is correct, then the record about employee will be inserted in datasheet by code similar to one in Fig. 7.

```
Private Sub btnInsert_Click()

If Not IsNumber(id.value) Then
MsgBox ("ID must be a number.")
id.Text=""
End If

If name.Text.Length = 0 Then
MsgBox ("Name is required.")
name.Text=""
End If

If Not IsText(city.value) Then
MsgBox ("City must be text.")
city.Text=""
End If

If emailAddress.IndexOf("@") > -1 Then
If Not (emailAddress.IndexOf(".",
emailAddress.IndexOf("@")) >
emailAddress.IndexOf("@")) Then
MsgBox ("E-mail address must be valid
e-mail address format.")
End If
End If
End Sub
```

Figure 9. Function for checking employee input

IV. CONCLUSIONS

Excel's Data validation feature is very useful, but it has a serious flaw: It is easy for a user to accidentally (or intentionally) delete the validation rules. For example, we copy a range of cells and then paste them to a range that contains Data validation; the Data validation will be destroyed.

VBA user forms are a critical part of Microsoft Excel programming in that they provide a surface that is totally under programmer's control with which they can interact with a user. This makes it possible to build complex data validation rules.

In this paper we tried to show true power of VBA user forms and how they can be used to collect and validate data from a user before it's entered into a worksheet.

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Heron Web Data Mining System

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Abstract – The studies of modern trends have indicated that progress is based on the use of new ideas, information and knowledge, and less on material resources. Knowledge is imposed as the main "generator of success." The existence of the knowledge itself has no relevance. Great problem nowadays is that knowledge becomes obsolete with each passing day. One of our main objectives was to create an automated system that will gather relevant data and help people to connect through their interests. Initial purpose of the system is oriented towards collecting and providing information about scientific conferences around the world. The core of the Heron system is the web data mining platform responsible for web crawling and data extraction. System also includes a small social network and a Windows 8 user application. The main goal was to provide users with an alternative for larger and more expensive web data mining solutions. This paper will summarize architecture and main functionalities of Heron system.

I. INTRODUCTION

Great technological leaps in the last decade have transformed the ways in which we generate, transport, store and process digital information. Dynamic nature of the Internet impedes automatic information gathering and analysis. The greatest problem is the need for processing enormous amount of unstructured data in the environment that is constantly changing. One of the possible solutions for abovementioned problems is development of automated agents which functionality is based on artificial intelligence and machine learning [1]. Conventional methods, in most cases, can't be used for extracting quality data because of the unstructured nature of potential information sources. Usable tool for this kind of work must have high level of automation in order to lower the need for human interaction because of the sheer amount of data that need to be processed [2]. Heron is envisioned as a system, platform that will enable extraction, categorization and storing information about international scientific conferences. With minor structural changes it is possible to use Heron for information extraction based on parameters and search rules entered by users.

II. WEB DATA MINING SYSTEM ARCHITECTURE

The core of the Heron project is the web data mining platform responsible for web crawling and data extraction. It's consisted of three base components: universal web crawler, website classification module and data ex-

traction module. Each of these components is completely autonomous and can be used independently. Results gathered by the web data mining system are stored in cloud database where they can be accessed by web applications. Figure 1 shows Heron's data mining system organizational structure.

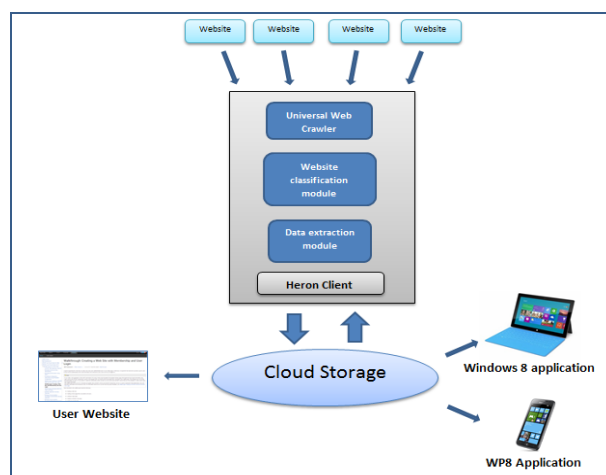


Figure 1. Heron system organizational structure

In order to initiate web crawling process, it's necessary to supply web crawler with starting seed websites [3]. These websites are obtained by using a Bing Search API. Every seed website is scraped for links. Content from each of these links is downloaded in form of html. It's important to note that before accessing any of the websites, crawler check whether the website is on one of the several public blacklists that we are using for security evaluation. If URL is not marked as potentially dangerous, crawler checks for the robot.txt file existence in the server root. Based on instructions found in robots.txt file, crawler is accessing only parts of a website that are publicly viewable. Website pages are combined into one document based on which will be decided whether the site contains useful data.

Received documents needs to be classified in one of the predefined categories. There are three methods used for document classification: naïve Bayes, tf-idf and neural network. Classification process takes several steps. Every document is represented as an array of words. Every word gets an associated value obtained by weighting algorithm [4][5]. In order to get usable neural network input data, we analyze the ratio between the different word group participation in the document. That enables us to accurately represent website content using only 5 parameters. These parameters are forwarded as a multilayer perceptron inputs. Perceptron output is then compared to naïve Bayes and tf-idf outputs. By cross-

referencing the results of three completely different classification systems we are able to compensate for individual component shortcomings. That means that we can classify websites and categorize their content with high efficiency. Categorized websites are then forwarded to data extraction module.

There are several categories that are common to all scientific events. At the moment, system extracts information about event's title, venue, contact email, important dates, and topics. Also, the content of every website is summarized in a few sentences. The content of each of these event related categories is extracted by using combination of extraction methods, most notably the neural networks. These data should provide our website users with some fundamental information about the particular event. In order to work, evaluation algorithms need a point of reference in form of knowledge base. Knowledge base contains a list of keywords and the most commonly used phrases.

Collected entries are sent to Azure cloud database where they can be accessed by system administrator. Administrator can run through data and check for any extraction errors. Every change made by administrator is logged. Logged data contains previous state that was marked as unsatisfying, and the new state moderated by the administrator. By analyzing the changes between these two states, we can generate training data for our neural networks and, at a same time, update classification documents and knowledge base used by naïve Bayes and several other algorithms.

Heron is very flexible. With every encountered error Heron learns how to adapt and by doing that it becomes more proficient and more reliable. This kind of organization allows us to devise new categories of events very easily. All that needs to be done is to generate new keyword database. Everything other than that can be modeled by our software. Currently, we are having scientific conferences in our database, but the software that we developed is in no way restricted to conferences only. Our website is used just as a proof of concept.

III. CLIENT APPLICATION

We are all witnessing the rapid technological development. The computers are getting faster and faster with each passing year and the Internet is becoming more accessible, even in the undeveloped countries. That means that we have large number of interconnected personal computers. From our perspective, the enormous amount of computational power is just lying out there. Heron client is an application can be installed on personal computers and turn them into a part of Heron computational network. Our goal is to develop lightweight application that can work in background, using only minimal amount of processing power. Based on computer hardware, user can set the amount of computing resources available to Heron client application.

By using only small amount of computational resources, application uses your personal computer as working station that categorize and extract information from received websites. Gathered data will be used for

updating and maintaining centralized database of all scientific and educational events in the world. Figure 2 shows Heron application home window.

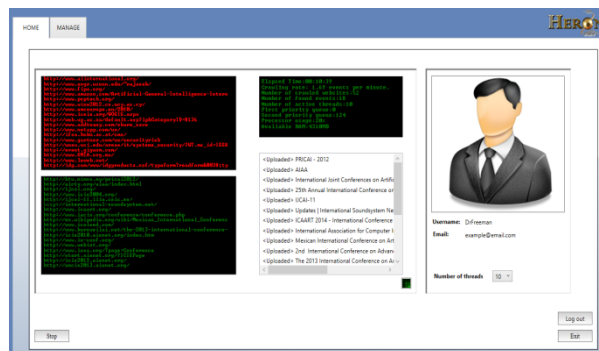


Figure 2. Heron client application home window

Figure 3 shows extracted conferences. Administrator can examine data and make changes in case of extraction error. Every user action is logged in order to generate training data for neural networks [6].

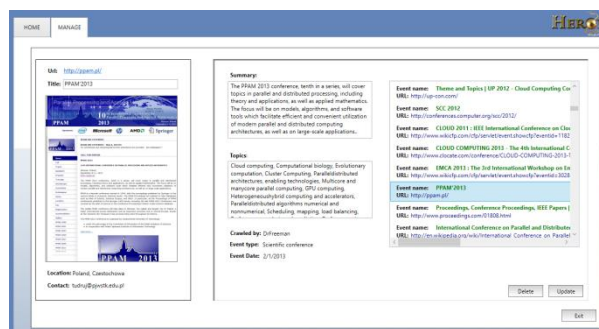


Figure 3. Heron client application administration window

Just to clarify, system is completely operational without the help of the community. But, the Internet is constantly growing and our goal is to provide the users with the most recent data available. With every new contributor, we are one step closer to making ultimate goals of Heron project a reality.

IV. MOBILE APPLICATION

The world has become mobile. Rapid development of touch capable devices such as tablets and smart phones caused that today we have a personal computer that can fit in our hand. These devices record increase in sales by every day. Predictions indicate that the number of mobile device users will overtake traditional PC users by the end of the 2013. We are aware of that and that is why we built Heron mobile application.

Our mobile platform consists of Windows 8 application and Windows Azure web service application. Windows 8 is meant to be used on a vast number of devices with different screen sizes. With that in mind, we have covered a great number of potential users. By using unique features of that platform such as Live Tiles, our users will always be up to date with information about newest events added to the Heron database.

For data access and user authentication, we have used the latest ASP.NET MVC Web API technology. We expect a large number of users in the following months, and as a result, our service will be constantly loaded. We need infrastructure that can ensure great performance, responsiveness and scalability. That is why we have chosen the Windows Azure platform. By using latest Microsoft technologies, we are able to bring great performance and experience to all our users.

The application starts with Home page shown in figure 4. This application consumes data from the Internet and that is why Internet connection is needed.



Figure 4. Mobile application home page

On top navigation bar you can see the home button which takes you to the home page. Bottom app bar consists of two commands. Synchronize allows users to refresh the information about events shown on this page. Figure 5 shows Event details page.

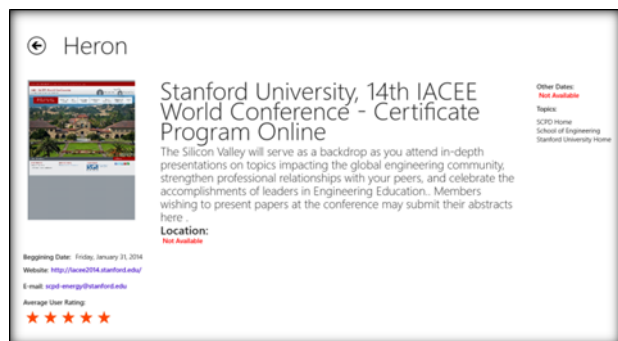


Figure 5. Event Details page

Heron mobile application also supports semantic zoom feature shown in figure 6.

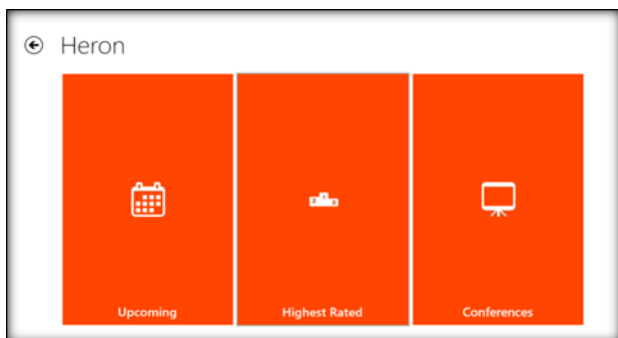


Figure 6. Semantic zoom view of the Home page

V. HERON WEB APPLICATION

Heron web application is the bridge between the Web data mining system and the final user. Its task is to represent the data collected by the Heron. Heron web application is an ASP.NET MVC4 web application based on the Windows Azure powered cloud service and the Entity Framework 5. Heron web application user interface is shown in figure 7.



Figure 7. Heron web application user interface

The navigation bar offers following navigation options: Home, Advanced search, Reflections, Contact and Suggest.

- ❖ The Home page is shown every time when the user visits the Heron web application. On the left side you can see the Highly Rated Events with their rating score, and the Latest Events.
- ❖ On the Advanced search page, the user can search the database for specific event using multiply criteria such as title, date, countries and topics.
- ❖ Reflections page is the social network part of in the Heron website. Every user who visits this page can read the registered users public Reflections.
- ❖ If the registered user wants to suggest some new event, he can do it by using the Suggest dialog. This option is unavailable for the not registered user.

Heron web application also offers dialogs for user login, user registration, managing user profile and password change. After successful authentication, the user is redirected to the Profile page. The profile page displays information about the user on the left side and the latest activities of the followed users at the center of the page. New user dialog is used for new user profile creation. The user enters the required information (username, password, first and last name and a valid e-mail address); system validates that information and creates a new profile. After successful registration user will be redirected to the Edit profile page where he can further edit information about his profile. Edit profile page offers managing user profile information and privacy settings. To avoid that the Heron web application only hosts the data collected by the Web Crawler, our goal was to build a

social network, for the people who have interest towards science, to help them connect.

After successful login, every user is redirected to profile page. If the user likes a Reflection, it can be reflected to the other users, and they can reflect it to the users who follow them and so on (figure 8).

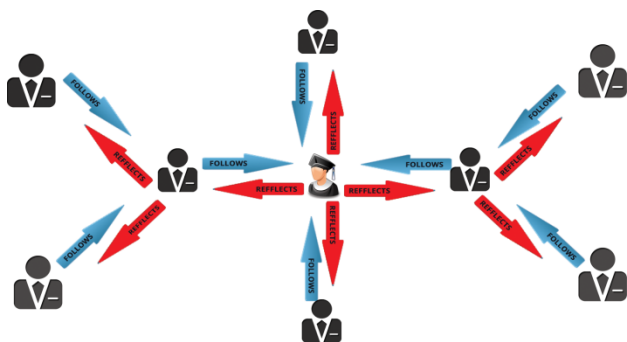


Figure 8. How a reflection spreads through a network

Profile page allows user to navigate reflection page where reflections can be manipulated. By checking the “Make this reflection public” checkbox, the new reflection is going to be marked as a public reflection. Public reflection will be accessible to all website users.

On the Event details page the user can add, edit or remove comments. Registered users can also rate the selected event on the same page by moving the mouse across the stars which is shown in figure 9.

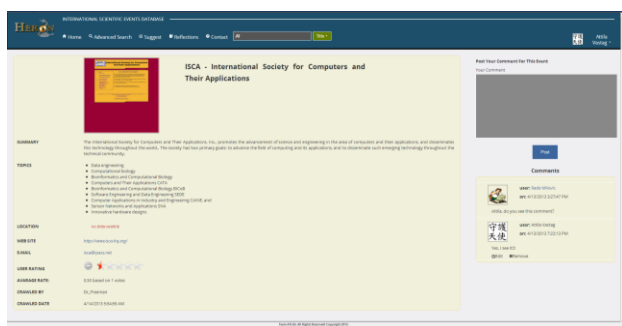


Figure 9. Event details with comments and rating

VI. MARKETING PROGRAM

Bearing in mind the current orientation of the project, we may share targeted market on two groups:

- I. People interested in informing
- II. People interested in connecting

The first group consists of scientists, researchers, professors, students, etc. We foresee that this group of people is looking for current, accurate, overall information about upcoming scientific events. We assumed that these people are looking for information about date, place and event topics. According to that, search engine is offering filtered data by the following categories: title, dates, countries and topics. On the other side, we have our second target group, people interested in connecting. Repre-

sentatives of this group could be common people, equally as scientists. For all of them, Heron offers system of reflections. From previously presented, we find that our target market includes the majority of the population, regardless of age or professional orientation. With this number of targeted users, we can see the potential of Heron to affect many people and institutions.

While we searched the internet, we have found several websites devoted to providing information about scientific events. Basis of their advantage is solely on the time of their existence. Our advantage lies in the fact that our project will provide our users with all information available on the internet. Another advantage consists in automatic data collection. When potential users get to know Heron, there is no doubt that it will become more acceptable than others are. Heron’s strength lies in its uniqueness. All we need to get better results from the competition is the time for people to get to know our offer.

Our primary target markets are people interested in science. Precisely, at this point, we target people interested in scientific conferences. Among these people, we have conducted research based on survey. Focus of our questions was on collecting data about accessibility of information about scientific events to these people, and on their interest in our product. We gained following results:

- 57.8% of the respondents are using the Internet to access to this information (49.54% via Internet browsers, and 8.26% via e-mail subscription), 11.01% are using scientific journals, and their friends, acquaintances, colleagues, are informing 31.19% of them.
- 91.74 % of the respondents are interested in finding all information at one place.
- 87.16 % of the respondents are interested in communication and information sharing with people of similar interests.
- 79.82 % of the respondents are interested to contribute to the development of such a system.

We consider that previously mentioned numbers indicate that reaction of public on our idea is generally positive. By analyzing this information, we have concluded that our system is indeed required. The respondents that are already using internet to collect scientific information would be our primary users, since our product will be available on the Internet. Percentage of respondents interested in finding all information about scientific events at one place tells us about the need for such a system, which is very high. From this we can conclude, that our system will be highly accepted by users. Respondents interested in communication and information sharing tells us about their need to connect with the people of similar interests

and share their thoughts. After all, sharing thoughts is what science is all about. Reflections are here to cover this area of user's demands. Our main concern was user's interest to contribute to development of the system. Despite our concerns, the results of the research have shown that most users have willingness to contribute.

VII. CONCLUSION

What we hope to achieve is not just to inform people, but to change their perspectives, to help them grow intellectually and academically. Project Heron provides information and new experiences that can help people develop their intellectual selves. Heron is really a unique piece of software. Its uniqueness comes from the fact that it is not restricted only to scientific events but also for many other subjects. If we take into consideration the fact that the vast majority of potential Heron client application users will be institutions and companies with already existing computer departments, infrastructure expenses will be reduced to minimum.

The first working version of Heron system is completely operational, but there is a lot of room for improvements. After code optimisation which will boost the information extraction speed, we plan to add a possibility of running our software on graphical processing units using GPGPU concept. This kind of modification demands significant changes in architecture of several program modules. However, by using GPGPU approach, the speed of information extraction will be multiplied.

The current version of the Heron system is only the first step in the development of more advanced and sophisticated Web data mining platform.

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Persons with Disabilities Evacuation - Pathfinder Application

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Abstract - Disaster risk management represents a relatively new topic and in the Republic of Serbia it has been implemented through law regulations. For the purpose of integrated disaster risk management realization it is necessary to achieve coordinated cooperation between institutions and academic public. Also, there is a necessity of information technologies integration in disaster risk management strategies with the aim of achieving prompt and interoperable exchange of information at all management and implementation levels. Identification of the spatial distribution of hazard realization risks as well as identification of the most vulnerable population represents important steps in disaster risk management. Particularly vulnerable population in this context is persons with disabilities. Within the ratification of the UN Convention on the Rights of Persons with Disabilities, since 2009 Republic of Serbia is obliged to enforce the necessary safety and protection measures for persons with disabilities in different situations. Using information technologies enables creation of 3D simulations of evacuations from buildings of persons with different cognitive and physical capacities. This paper describes the use of "Pathfinder" software application for the creation of evacuation models, as well as for determination of the time difference between the evacuation time of persons with and without disabilities from the same physical environment.

Key words: disaster risk management, persons with disabilities, evacuation, Pathfinder application

I. DISASTER RISK MANAGEMENT

The term disaster management, also called emergency management, replaced the term civil defense after the II World War which referred to the protection of civilians against military actions. Today official term in the European Union is civil protection and refers to protection of the population in a case of natural and man-made disasters. However, the term disaster risk reduction is used in the context of disaster management, and refers, mainly, to prevention, mitigation and preparation for the catastrophic events.

Disasters risks that people might be exposed to can be viewed as a causal combination of vulnerability and

hazard. Vulnerability is represented as the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of a hazard [1], while a hazard can be defined as a potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation [2].

Holistic management of a disaster risk requires diverse actions to reduce impacts of extreme events before, during and after they occur, including technical preventive measures and aspects of socioeconomic development designed to reduce human vulnerability to hazards [3]. The initial phase of creating a disaster risk management strategy includes identification of possible hazards realization specific to the area of interest and identification of particularly vulnerable population. Regarding hazards realization in urban areas (fire, military intervention, terrorist attacks) most vulnerable populations are the elderly, children and, most of all, persons with disabilities. Therefore, consideration of the possibilities and limitations for the rescue and evacuation of people with disabilities from the public buildings in the case of catastrophic events, as well as creating 3D evacuation scenario simulations, leads us to the successful implementation of preventive measures in disaster risk management strategy.

II. LEGISLATION CONCERNING THE RIGHTS OF PERSONS WITH DISABILITIES

One of the proactive action methods for reducing the effects of catastrophic events in the rescue and evacuation of people with disabilities is to establish and implement appropriate legislative regulation. At the General Assembly of the United Nations, held on the 13th December of 2006, the Convention on the Rights of Persons with Disabilities [4] was adopted. The purpose of the Convention was to promote, protect and ensure the full and equal enjoyment of all human rights and fundamental freedoms by all persons with disabilities, and to promote respect for their inherent dignity [4, Article 1].

The Convention was enforced on the 3rd May of 2008 [5], while the National Assembly of the Republic of Serbia ratified the Convention in May of 2009, with a Law on Ratification of the Convention on the Rights of Persons with Disabilities [6]. The Convention does not create new rights for people with disabilities, but provides mechanisms for the application of existing ones [7].

In the Republic of Serbia, the Law on Prevention of Discrimination against Persons with Disabilities [8] was enacted on 17th April of 2006 and represents the basis for development of other laws in this domain [9]. The Law on Prevention of Discrimination against Persons with Disabilities defines persons with disabilities as those with congenital or acquired physical, sensory, intellectual or emotional disability that because of social or other barriers are unable or have limited opportunities to engage in social activities at the same level as others, regardless if they can perform such activities with the use of technical aids or support services [8, Article 3].

One of the key principles for equal participation in the activities of all social life forms [9] is the principle of accessibility that is in detail promoted and regulated in Article 9 of the Convention. Article 9 declares that the States Parties are obliged to ensure the access for persons with disabilities, on an equal basis with others, to the physical environment, transportation, information and communications [4]. It could be achieved by implementing technical solutions in the design process of constructing the buildings where people with reduced mobility and persons with disabilities could access, move, reside and work, on the same level as other people. These technical solutions should also increase their safety. [9] Except an access problem, in the process of public building design it is necessary to keep in mind limited possibilities of people with disabilities evacuation from buildings in the case of catastrophic events.

Safety of persons with disabilities in the case of catastrophic events is elaborated in the Article 11 of the Convention, which states that States parties have to take all necessary measures to ensure the protection and safety of persons with disabilities in situations of risk, including situations of armed conflict, humanitarian emergencies and natural disasters. At the national level, the Law on Emergency Situations of the Republic of Serbia [10] in the Article 57, states that, among other population groups, ill persons, persons with disabilities and others in need of assistance and care are subject to the evacuation. In addition, the Law on Emergency Situations of the Republic of Serbia specifies rescue forces: emergency staff, fire and rescue units, police, the Serbian Army, the Red Cross of Serbia, Serbia Mountain Rescue [10, Article 8] that represent the services that are required to actively participate in the rescue and evacuation of affected populations in the case of catastrophic events. With the aim of raising the level of safety for persons with disabilities in emergency situations, previously listed staff and officers should undergo through special training, as well as to participate in creating a strategy for rescue and evacuation of people with disabilities in public facilities during the disaster occurrence.

III. POSSIBILITIES AND CONSTRAINTS OF PEOPLE WITH DISABILITIES EVACUATION FROM FACULTY OF LAW BUILDING IN NOVI SAD

In accordance with a considered legislative framework, local government is obliged to provide safe and accessible environment for people with disabilities, in order to satisfy their rights to evacuate in the case of emergency [11]. They must meet spatial and technical requirements for evacuation of citizens with disabilities [11] especially from the public buildings that members of considered population visit daily. Identification, data collection and mapping of these places in Novi Sad have been done for the purpose of research in the Disaster Risk Reduction Research Center [11]. With the aim of expanding the scope of the research, this paper considers the possibilities and constraints of the evacuation of people with disabilities from the building of the Faculty of Law, University of Novi Sad. Also, 3D simulation of the considered situation is created for the purpose of disaster prevention.

Within the building of the Faculty of Law, the office of the Students with Disabilities Association of Novi Sad (NSUSI) is located. NSUSI is a non-governmental organization of students with disabilities. Organization's members are trying to improve the study conditions, provide learning aids and literature in an appropriate form, ensure assistance during the lectures and personal assistance for the students who have difficulties in reading, writing, communicating or moving. The office of the Association is located in the right wing of the first floor of the Faculty of Law building. The office has been assigned to the Association at the time of the establishment (year 2001) because the Faculty of Law, at that time, represented the only building without architectural barriers (accessible to people with disabilities) within the University Campus. Except by the stairs, the office can be accessed from the ground floor, by two elevators. On working days in the office there are, at least, two people with disabilities who are on-duty from 10 h to 14 h, while during this period all assistive technologies that Association owns are available for the members of the Association.

In the case of the catastrophic event (fire, terrorist attack) within the observed building, students with disabilities are the most vulnerable population in the terms of immediate response and evacuation from the building. Although the Faculty of Law building is accessible to the people with disabilities, during the evacuation planning it is necessary to keep in mind that people with different categories of disability are characterized by different capabilities and limitations. The most common categories of disability of NSUSI members can be identified as motor and sensory inabilities. For people with motor disabilities, who use wheelchairs as an aid in the movement, during the evacuation from the office of the Association to the exit of the Faculty, the assistance of at least two people is required. People with sensory difficulties (such as hearing problems), due to the lack of visual signalization, could be left within the office, if not otherwise informed about the event.

In general, evacuation can be considered in three phases: leaving of the affected areas or office, passing through the evacuation routes and moving outside of the evacuation routes in a safe environment. With the aim of creating the best possible evacuation scenario, the 3D evacuation model from the office of the Association has been designed.

IV. THE 3D SIMULATION MODEL OF EVACUATION

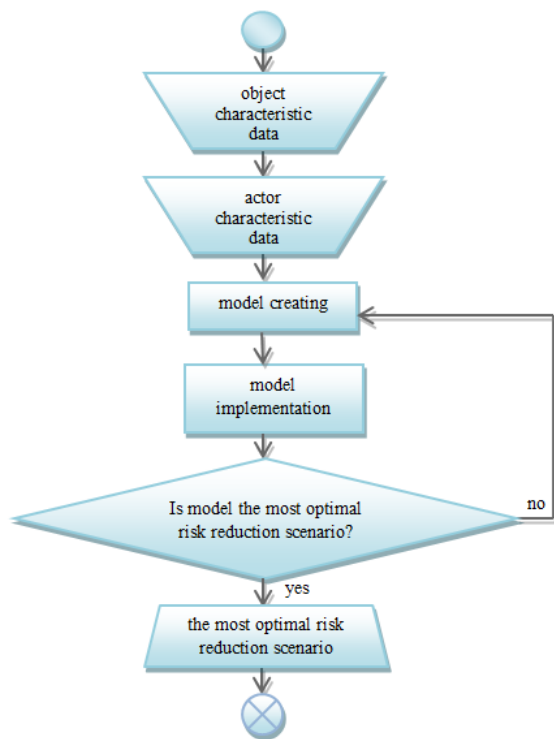


Figure 1. Model and simulation realization diagram

The 3D simulation model of evacuation from the office of the Association was created using Pathfinder software application. The Pathfinder is an agent based egress and human movement simulator. It provides a graphical user interface for simulation design and execution as well as 2D and 3D visualization tools for results analysis [12]. The graphical user interface is used primarily to create and run simulation models. A second program is designed specifically for high-performance visualization of 3D time history. In addition to 3D visualization, Pathfinder also provides output in the form of 2D time history plots of CSV out files and a text summary of room clearing times and doorway flow rates. [13]

The application offers the possibility of joining the corresponding properties for each person evacuated (actor), as well as the ability to manage their characteristics through the system profiling. In the profile, you can define the speed, the initial delay, the size and appearance of persons. Defining the profile of actors' characteristics and their motion directions in the model is performed with the aim of acquiring accurate data about necessary time to evacuate the group of interest.

In creating an evacuation simulation model for the building of the Faculty of Law in Novi Sad, special attention was devoted to defining characteristics and directions of movement of NSUSI members. Actors' motion was defined under steering mode option which is based on the idea of inverse steering behaviors. In accordance with the identified categories of inability of the Association's members (motor and sensory constraints) and the possibilities of the software, the profile that best describes these evacuation participants were defined. Within the profile the initial delay and the speed of the participants have been defined. Assigned values of these parameters (initial delay and speed) were determined on the basis of measurements carried out in the real system.

In order to achieve the desired information i.e. to identify the most optimal scenario, it is necessary to analyze the output data of the created models. Analysis has to be conducted by an expert (disaster risk manager), by comparing obtained outcomes. If the results do not represent a best-case scenario approach, it is necessary to perform changes within the created model (to modify the characteristics and directions of movement of the participants) with the aim of determining the most optimal risk reduction scenario. Diagram of the model and simulation realization is presented in the Figure 1.

V. CONCLUSION

According to obtained results from the real system and from the model simulation it is possible to compare and analyze defined parameters with the aim to create the best disaster prevention strategy. Real system measurements provided evacuation time for a person with movement difficulties of 1 min 11 s and for a regular student 45 s. Simulation output resulted with a values of 3 min 24 s (person with disabilities) and 2 min 23 s (regular student). Real system examination have been performed in the August when there is low students' frequency at the faculty, while model results included high students' frequency that is usual situation during the lectures realization.

Applied information technology for the evacuation examination represents useful tool for designing disaster risk strategies, especially in the case of raising the level of persons with disabilities safety during disaster occurrence. In order to cope with such a delicate topic it is essential to achieve cooperation of the stakeholders with a different background and to apply contemporary IT tools.

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E- Commerce and the Importance of Electronic Data Interchange (EDI)

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Abstract - In a global economy, the development of modern technology has influenced the transformation of the entire business into related activities and processes based on information. New business opportunities are increasing in accordance with a number of business information available through the World Wide Web, which allows the flow of information between the companies, enterprises and their customers and between different departments in the company. In the modern world, the rate of technological change is so rapid that affects every aspect of the business. E-commerce, as a form of commerce based on the use of modern technology becomes more present form of trade both between businesses and consumers, as well as among the companies. There is a large number of challenges facing e-commerce. One of the key challenges is an electronic data interchange (EDI). EDI is a system that allows electronic transmission of business data, such as purchase orders and invoices between trading partners. Electronic data interchange is a cornerstone of many successful companies. The paper highlights the importance of electronic data interchange for the development of e-commerce.

I. INTRODUCTION

In a global economy, we are witnessing a revolution in Information and Communication Technology (ICT) and e-commerce. This revolution changed the way people conduct their business. ICT is transforming all business into information-based activity. There is a big potential of the networking technologies in business. Managers predict that the size of on-line trading revenues in the next few years will vary from a few hundred billion to a few trillion dollars for some economic sectors. Today, the "e" before words such as commerce, business, marketing, etc., indicates a philosophy that must be followed by companies and organizations that want to keep their competitiveness and efficiency. The phenomenon of e-business is still quite new, and it presents an interesting field for research. It is necessary to examine the impact of ICT on e-commerce [1]. E-commerce, especially B2B e-commerce requires participating businesses to exchange business forms such as purchase order and invoice electronically without human intervention. This is called electronic data interchange (EDI). EDI is of great importance for the further development of e-commerce.

II. THE DEVELOPMENT OF MODERN TECHNOLOGY AND E-COMMERCE

The internet market is undergoing an explosive growth. The world-wide web may transform a small company into a global distributor. Many trade companies, in addition to traditional commerce, use e-commerce in order to increase sale and profit. E-commerce encompasses the activities of internet service providers, internet access providers, telecommunications operators and other providers, including the providers of publishing initiatives and advertising. In recent decades the world's economy has been characterised by increasing globalisation. The markets are now global, and all firms, small and large, have access to global market. For example, a consumer in Europe interested in rare books may order a volume from a specialist supplier in North America, paying by credit card; the order and details of the credit card can be conveyed on the internet, so the transaction can be completed in seconds [2]. The explosion of e-commerce in the early 1990s has been strongly associated with the rapid diffusion of the Internet and World Wide Web, which has made business over the Internet cheaper and easier. The Internet can be simply described as the „network of networks“, linking independent computer networks. The Internet, and new technologies, are considered to be powerful marketing, transaction and coordination paradigms which offer significant benefits to e-commerce.

There are many definitions of e-commerce. Depending on whom you ask, it may mean using a credit card to buy something from a Web site. The other person may say that e-commerce is electronic data interchange (EDI). A third person may say that e-commerce supports all aspects of trading, including the sending and receiving of electronically signed documents. There are optimistic forecasts on how fast the e-commerce market will grow. Most of them predict that the e-commerce market will grow to hundreds of billions of dollars by early next century [3]. It is necessary to understand the nature of e-commerce and how it differs from traditional commerce. There are many definitions of e-commerce. E-commerce includes buying and selling of information, products and services via computer networks. E-commerce transactions are usually classified according to the partners involved. The main partners are comprised of: consumers (C), business (B), and government (G). Thus, six practical combinations are made possible [1]:

- Business to consumer (B2C)
- Business to business (B2B)
- Business to government (B2G)

- Consumer to consumer (C2C)
- Consumer to government (C2G)
- Government to Government (G2G).

E- commerce introduces many complex areas such as dealing with multinational transactions, and the services used to support such trading relationships. As a result, products and services need to accommodate not only the legal framework associated with such trade, but also any regulatory regimes that may impose requirements on an element of the service [4]. In order to achieve a fully functional e- commerce environment, the following is the minimum required [5]:

- full integration between the electronic catalogue and the seller's back-office,
- full integration between the buyer's back-office and the electronic catalogue ordering environment,
- the ability to electronically pass invoice and statement information between the seller's and buyer's backoffices.

The High Level Strategy Group for ICT (HLSG) defined e- commerce as a set of tools and services which: reduce the cost of creating, moving, managing and processing the documents on which are built relationships between trading partners, improve business entities processes by reducing the cost of operating business and improving overall quality, increase revenue by opening new market channels.

A fully functional e- commerce system must minimally support three functions [5]:

- Interactive transactions- Interactive transactions refer to a human/computer interaction. Today, this interaction usually uses a Web browser interface. The browser interface may be used for selecting items from an electronic catalogue or for completing a form. The form may be used for interacting with a database or application.
- Database transactions- Database transactions refer to computer/computer interaction. Traditionally, this approach could be viewed as two computer systems passing commercial transactions between themselves. These transactions frequently were predefined, formatted EDI messages that were usually transmitted over an X.400 or specialist EDI value-added network.
- Secure messaging- Secure messaging utilises security services such as privacy, integrity, authentication, and non-repudiation. Many of these security services would be provided by an electronic notary.

E- commerce covers a wide variety of perspectives. Several dimensional perspectives are:

- Technology- E- commerce is made possible by the global networks where business processes, inter-organization transactions, and market trading take place. The Internet, but other communications networks, such as value-adding networks for carrying out electronic data interchange, play a great role.
- Marketing and "new consumer processes"- E- commerce is the new channel to connect with customers

and a new media to promote products. E- commerce expands the boundaries of enterprises to reach out directly to their customers.

- Economic- E- commerce is a new economy that is information-based. E- commerce creates new markets and economic activities.
- Electronic linkage- E- commerce provides new linkages to achieve more efficient economic activities, including: the interface between businesses to consumers; the linking of a business to its channel; and the coordination of different units within a business.
- Information value-adding- E- commerce accelerates the separation of the informationbased value chains from the physical valueadding chains.
- Market-making- The global networks supporting electronic commerce have provided opportunities to form electronic markets to match buyers and sellers [6]. This new market space features real-time information transmission, interactive communication, wide reach and connectivity, and rich content.
- Service infrastructure- E- commerce needs a variety of services to support all potential functions, activities and applications. These services need a coherent infrastructure to ensure integrity, uniformity and effectiveness.
- Legal, privacy, and public policy- All the structural, institutional, process, and technological changes brought by e- commerce necessitate a new framework for addressing the legal, privacy, and public policy needs. This is the one dimension that needs to be taken into account early in the development of EC to protect the interest of the general public.

Electronic commerce provides unprecedented opportunities to integrate different types of communication networks: Intranet (for process, knowledge, and internal communication management), Extranet (for external coordination and information sharing with channel partners such as suppliers, distributors, and dealers) and Internet (for setting up electronic storefronts, providing customer services, and collecting market intelligence). There is a constant need for new business models suitable for the new products (e.g., digital ones), new industrial organizations (e.g., virtual organizations), and new industrial organizations (e.g., information intermediaries). The Web provides the infrastructure for collecting, distributing, and sharing information. Web integrates the information organization for managing activities on all levels of the company and provides new electronic links to reach out to the customers and supply-chain partners [3].

III. ELECTRONIC DATA INTERCHANGE (EDI)

EDIs are systems that allow the electronic transmission of business data, like orders and invoices, in a standard format among business partners. Traditionally, EDI systems have been one-to-one technology, usually

between one big enterprise and its partners. That is why the first EDI systems were used in closed and expensive Value-Added- Networks (VANs) and their standards and communications protocols were different. Through the time, the need for flexible interorganizational cooperations and globalization lead to the creation of Internet-EDIs or Open-EDIs. This new EDIs have the ability to be connected through the Internet and to be much cheaper than traditional EDIs [1]. The major advantages of using EDI are [7]:

- Handling of paper documents is eliminated.
- There is no need to manually re-key data in documents such as purchase orders, invoices etc., by participating businesses.
- Elimination of manual data entry reduces cost, improves accuracy and reliability.
- Time is saved due to elimination of manual handling and also due to direct application-to-application movement of data at electronic speeds.

EDI is the longest established standardised technology in the field of e- commerce. There are 3 types of EDI [4]:

- Simple EDI- This is a new approach to EDI messages. Instead of repeating all the information in every message, 'static' information (information that does not change) is held in a common database. This simplifies the messages and reduces implementation costs.
- EDI over Internet- This considers the appropriate ways for conveying EDI format messages over Internet network technologies. This provides a way forward for companies with large investments in current EDI.
- XML/EDI- This format is looking towards the use of EDI to convey the information gathered by Web forms to remote database systems, and vice versa.

Successful implementation of e- commerce requires that the parties have confidence that their messages are being exchanged with the right partner and that their messages are reaching the destination without modification. The EDI transaction flows generally follow those of the equivalent paper process. For EDI to be successful in a whole industry sector there is a need for standards.

- National standards- At the beginning, EDI took place independently in the major industrialised countries and this led to different national message standards. For example, in the UK a number of companies agreed to use EDI and developed message standards known as 'TRADACOM'. Similarly, in the USA the ANSI X.12 EDI standards have become almost universal, and in Europe the motor manufacturing industry has adopted the ODETTE standards.

- EDIFACT- UN/EDIFACT was established by the United Nations (UN). Regional message- definition bodies were created to support message development and ratification. While message development is time-consuming, the result is that a single message set may be used by a company for trading with its global partners. One aspect of using global EDIFACT message standards is that message sets and sequences have to be devised to

support various national and international legal requirements. At a lower level, each message defines data elements for virtually every eventuality and most trading activities are able to leave many of them empty. Specific industry sectors have thus adopted sub-sets of EDIFACT known as 'trade conventions.' These conventions identify which messages will be used and which fields are required; but, the fact remains that EDI messages reflect the requirements of real business processes and information flows. For this reason, the data flows and content should ideally be reused by any alternative electronic trading environment such as the Internet.

With the arrival of the World Wide Web, the focus was on the Internet. The Web's ability to transmit multimedia documents has allowed the Internet to become the new advertising and purchasing mechanism for products and services. The worlds of Internet and EDI currently have quite different characteristics. While typical EDI users have computerised operations with interconnected databases sharing details of orders, invoices, etc, the typical Internet user has a home or office PC which interacts with a database. Existing differences arise mainly from the way in which e- commerce is used by companies and individuals. The Internet browser mechanism used for Web ordering has largely been developed to satisfy the needs of individuals rather than corporations. It is a simple matter for individual users to decide whether or not to buy, and then to submit an electronic form detailing their requirements. In most cases, no local database is needed to record the transaction. In contrast, generally accepted accounting principles require that the ordering process be subject to controls and checks. Some of these controls and checks include that the appropriate authorisation was granted and that all transaction details are entered in the financial systems or databases. So, the Web ordering mechanisms must be modified to link into corporate databases at the buyer's end, including processes to obtain internal authorisation. Although these two worlds do not yet interact to a significant extent, it is inevitable that they will converge as technology develops [5].

IV. THE IMPORTANCE OF EDI FOR E-COMMERCE

Business-to-business e-commerce is expensive and complicate to set up and maintain, due to disadvantages in the design concepts underlying standard EDI. The standard EDI protocols are of long-standing and effective use. The first trade problem associated with EDI are costs of initial setup which involve significant investment in legal services, management and staff time, and software. When an EDI system is up and running smoothly, the incremental costs can be quite low and the incremental benefits very high. There are a large fixed cost because of the problem of getting the first messages sent and working properly [8]. Electronic data interchange addresses a crucial business problem, the exchange of data between the computer systems of organisations. It is currently the cornerstone of a number of successful global companies. This business-to-consumer model is spontaneous, using

sessionlevel security protocols, such as secure sockets layer (SSL) and secure hypertext transfer protocol (S-HTTP). The customer just asks for goods, offers a payment method (credit-card or a cyber-cash), the goods are supplied (in the case of 'soft' goods immediately), the payment settled, and the customer may never be seen again. The order/ invoice/delivery cycle can all be exchanged using EDI/ XML, and will dominate the high-volume exchange of documents between businesses and multiple trading partners. These transactions will include customs and shipping needs, both of which are big users of EDI. The actual payment can be achieved by sending electronic payment requests via the SWIFT network just like BACS is used today [9]. The fundamental issue that EDI addresses is the need for businesses to exchange documents, such as orders and invoices, without human intervention. The proposition is obviously attractive to large corporations which want to centralize their operations and reduce the huge amount of paper they operate, but it can be just as attractive to smaller enterprises. There are a lot of benefits from using EDI, especially for trade. The two types of benefits are the most important: Strategic and operational benefits. Strategic benefits are:

- Faster trading cycle- This benefit is particularly important where speed and accuracy of the ordering/invoicing system is vital.
- Just-in-time manufacturing- JIT manufacturing refers to the ability to produce minimal sized batches of finished goods only when needed, i.e. responding to market pull; in an extended supply chain it leads to minimal stock holdings by all parties, and reduced operating costs.
- Dictating terms of trade- In a competitive market, the ability to offer significant cuts in delivery time may be a considerable competitive advantage.

On the other side, there are operational benefits:

- Reduced costs- EDI enables minimal stocks to be held with resultant savings in the costs of storage, insurance, warehousing and security. Improved audit trails lead to better stock management and accountability. Reduction in manual processing enable the reallocation of staff to more beneficial areas.
- Improved cash flow- Payment on time is one of the benefits of EDI. There is a direct correlation between reduced stock handlings and cashflow.
- Security and error reduction- Sata quality is key to getting things right first time, and reducing the cost of failure. A feature of many EDI systems is automatic confirmation of receipt of the electronic document [9].

Electronic Data Interchange (EDI) is a type of inter-organizational electronic commerce (EC) that allows organizations to exchange business documents electronically. In today globalised world, companies have to adopt EDI to conduct international electronic businessto- business trade. The Internet offers a number of

new communication possibilities, and its few geographical constraints and large-scale connectivity make it the most feasible channel for EDI. Companies percieve e-commerce as a new opportunity to create a product, provide a service and increase market share. There are factors affecting EDI performance, which include organizational support (user involvement and training), implementation success, and implementation capability (planning, evaluation and championing) [10].

V. CONCLUSION

In the twenty-first century, the importance of e-commerce is huge for companies, policy makers and researchers alike. E-commerce becomes the dominant way of trading in today modern globalized world. The markets are now global, and all firms have access to global market. Many trade companies, in addition to traditional commerce, use e-commerce in order to increase sale and profit. EDI can be considered the grand-daddy of e-commerce. In fact, EDI solves one of the major business problems, especially in commercial enterprises, exchange of data between computer systems of company. For EDI to be successful in a whole industry sector there is a need for national and global standards. There are a lot of benefits from using EDI, especially for trade. The most important benefits of EDI are: strategic and operational benefits. It can be concluded that EDI is of great importance for the further development of e-commerce.

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The Implications of Adopting E-Commerce Technology for Rural Business in Serbia

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Abstract - Adoption of e-commerce technology and wide use of internet has introduced new possibilities of conducting business in rural areas. It is argued that disadvantages of remote rural areas such as high costs of marketing and communication may be reduced while on the other hand, adoption of e-commerce business strategy contributes in enhancement of supply chain management, increase of sales, widening geographical scope and improving sustainability of the business. Taking into consideration the given context, main aim of this paper is to elaborate on positive implications of e-commerce business strategy in use for rural economies and to indicate competitive threats of entering the global market via electronic commerce, in order to assist in decision making processes for rural businesses in Serbia.

I. INTRODUCTION

Boost of internet and development of digital world in nineties has dramatically changed the way we conduct our business in the years to come. Development of internet based business has been particularly dynamic since 1993, when the first Web browsers became generally available. Such changes have been enhanced by a number of structural factors, including: continuous development of higher speed internet, lower-cost computers, rapid expansion of networks and accelerated distribution of digital applications over a broadening range of economic sectors [1]. Harmonization of standards and development of common framework has also played a key role, helping to bridge differences in language and operating systems worldwide. Nowadays, the use of internet plays significant role in business planning strategy of small and medium enterprises. Basically, sharing business information, maintaining business relationships, and conducting business transactions by means of telecommunications networks is what is referred to as electronic commerce [2]. E-commerce may also be defined as process of buying, selling, transferring or exchanging products, services, and/or information via computer networks, including the internet [3]. Adoption of electronic commerce as part of business strategy brings both opportunities and threats. We are witnessing today that Internet has changed the way people buy, sell, hire, and organize business activities in more ways and more rapidly than any other technology in the history of business [4]. It is why most of the small and medium enterprises in rural areas and elsewhere are in still in process of adapting to the changes brought by information and

communication technology. When it comes to classification of e-commerce common categories are business-to-business and business-to-consumer.

In context of identifying determinants for adopting e-commerce business strategy and its implications on business conducted by enterprises in rural areas of Serbia, e-commerce will be considered in its wider definition while focus of analysis will be on technology and resources available and in use.

II. E-COMMERCE BUSINESS STRATEGY: KEY DETERMINANTS FOR ADOPTION BY RURAL ENTERPRISES

A. Structuring E-commerce business activities

For purpose of specifying e-commerce business activities, classification on basis of nature of transaction or interactions of the participants will be presented in this section. In general three categories are essential to structure of e-commerce being, business-to-business (B2B) - businesses sell products or services to other businesses, business-to-consumer (B2C) - businesses sell products or services to individual customers and transactions and business processes in which companies, governments and other organisations use Internet technologies to support selling and purchasing activities [3]. Considering the relationships of businesses, consumers, governments and other organisations, a wider classification of e-commerce activities may also be presented. Beside basic models of B2B and B2C, following types are also present, business-to-business-to consumer – a business provides a product/service to a client business that provides the product/service to its customers without adding any value to it, consumer-to-business – involves individuals who are using Internet to sell products/services to organizations and individuals, mobile commerce – electronic commerce activities conducted in wireless environment (known as m-commerce, usually mobile devices are used) and other forms involving government such as government-to-business, business-to-government [2].

All models presented rely on two participating subjects in e-commerce which may also provide the analytic framework of structuring the strategy for adopting the e-commerce technology, person and computer. Significance to this classification is given in group of processes (communication and exchange of data) needed to be conducted in order to successfully implement our business activities. Person-to-person

(P2P) interaction in e-commerce shows no fundamental difference to the traditional trade where persons are communicating in order to buy/sell the products/services. Despite the similarities, e-commerce technology offers wider range of communicating possibilities. Person-to-computer (P2C) is the most common way of communication and interacting in e-commerce environment. Computer-to-person (C2P) represents the communication between the computer based application to the person (consumers, employees, etc.) usually to conduct automatically generated inquiries or requests. Computer-to-computer (C2C) considers exchange of data and information which excludes human participation. In terms of standard procedures between two subjects such as integrated procurement system which may allow access to suppliers stock, C2C may be introduced [4].

B. Advantages and disadvantages of e-commerce strategy

Use of Internet and computers has undoubtedly brought changes in way we conduct our business. Complexity of interactions among participants shown only makes it more difficult to analyze the effects of a decision to adopt the e-commerce business strategy. Like any other business strategy, adopting electronic commerce bears advantages and disadvantages.

Although there are certain advantages and disadvantages for the buyers in the e-commerce, within this section we will focus on benefits and constraints of business in e-commerce and adoption of e-commerce business strategy without implications consumers. Use of e-commerce over the years has shown possibilities for significant cost reduction and increase of sales as result of adoption of e-commerce strategy thus increasing the profitability of the business. What are the advantages of e-commerce to supporting these findings? EC enables the global reach to the customers; it reduces use of all resources in locating and interacting with the customers, world wide. Business is always available via Internet without use of additional labor or excessive use of any other resources. EC offers variety of customization and specialization options for customers and developers; feedback and consumer wishes may be addressed fast at reasonable cost. Use of customization inventories also reduces the cost. Communication over Internet is more cost-efficient. On the other hand, major disadvantages of e-commerce identified so far can be divided on basis of use of technology as either technological (software quality and availability, security issues, standardization, internet accessibility, integration options and similar) or non-technological (lack of trust, legal and policy issues, lack of skills and knowledge, behavioral factors favoring traditional trade, etc.). Known barriers are also resistance to change (new technology), implementation difficulties, security concerns, lack of technology skills, lack of potential customers and cost. Disadvantages and barriers for electronic commerce may be seen as sectoral barriers (e.g., government, private sector and international organizations), internal barriers (e.g., lack of skills and knowledge, lack of resources) and external barriers (e.g., lack of government support).

C. TOE Framework – technology adoption theory

In order to study adoption of general technological innovation, a compact Technology-Organization-Environment (TOE) framework was developed by Tornatzky and Fleischer (1990). This framework describes the process of technological innovation adoption and identifies three elements of a firm's context that influence the process by which it adopts and implements technological innovation: technological context, organizational context and environmental context. First element is technological context which refers to internal and external technology available to the firm. Technology is separated from organization and environment to show how the technology features can influence firm to adopt the technology. It has been pointed out that technology is physical tool which involves human interaction in form of knowledge, how to use it, its purpose and impact [5]. This includes existing technologies inside the firm, as well as the pool of available technologies in the market [4]. Organizational context is defined in terms of several descriptive measures: firm size; the centralization, formalization, and complexity of its managerial structure; the quality of its human resource; and the amount of slack resources available internally. Besides the formal linking structures of the management, the organization context also covers the informal decision making and communication process between employees. Environment context represents firm's business surroundings, in which a firm conducts its business and interacts with other organizations which may represent the external threat or the opportunity when it comes to adoption of technology innovation. In environmental context of TOE, the business environment refers to entities such as clients, suppliers, competitors, obligations from government regulatory bodies and other external pressures within the industry.

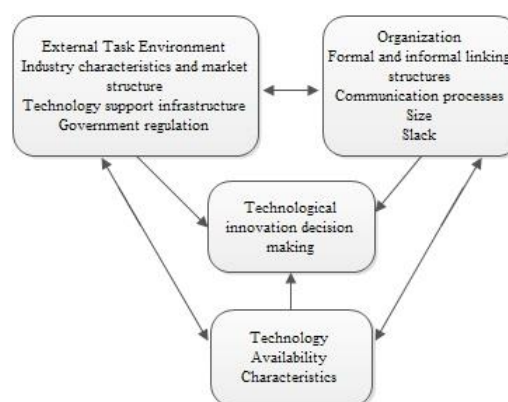


Figure 1. TOE Framework, Tornatzky and Fleischer 1990

The TOE framework is consistent with the other organization-level innovation diffusion theories and it can be combined in order to explain process of adoption of innovation technology by organizations, firms more closely. Diffusion of Innovation (DOI),

also known as Innovation Diffusion Theory (IDT) is one of the main theories widely used in combination with TOE to predict innovation adoption. Institutional theory is another theory that is combined with TOE framework to explain technology adoption. Institutional theory is an organizational theory that highlights the institutional (organization) environments are important in determining organizational structure and actions [6]. The theory complements the environmental context of TOE framework by adding external pressures (pressures from competitors, trading partners and clients) influencing the actions of the organization, firm. It has been argued that decision to adopt a technology might not purely depend on internal factors of organization to achieve efficiency and effectiveness but could be also driven by social and cultural factors. In order to survive, organizations must conform to the rules and belief systems prevailing in the environment [7].

III. CHALLENGES AND OPPORTUNITIES OF E-COMMERCE TECHNOLOGY FOR RURAL BUSINESS IN SERBIA

A. Rural business in Serbia

Prior to analysis of implication of adopting e-commerce technology and applying the methodological framework described above, we will briefly present the rural Serbia and its economy. Rural areas in Serbia cover 85% of the territory in which lives 55% of total residents in Serbia and forming 41% of GNP. Rural households with modest potential for development nominally make up the majority of the overall number of households in Serbia. In rural areas of Serbia (defined according to the OECD methodology), there are 1,365 million households, which is 54% of the total number of households in Serbia. The economic structure of rural areas is still based on natural resources exploitation and primary sector business operations while tertiary sector shows low use of its potential due to the lack of diversification of rural economy. Level of diversification is similar to the countries in the region and it is limited by unfavorable policies towards rural and agricultural development. A majority of natural resources (arable land, woods, water etc.) are located in rural areas abounding in ecosystems and biodiversity [8]. In order to effectively address the issue of rural development, diversity of rural areas in Serbia has been recognized in National Rural Development Programme 2011-2013. Classification resulted in four types, regions of rural areas in accordance to various indicators used by OECD, EU and other relevant bodies: Highly productive agriculture and integrated economy (Region I), Small urban economies with labor intensive agriculture (Region II), Natural resources oriented economies mostly mountainous (Region III), High tourism capacities and poorly developed agriculture (Region IV) [9].

B. TOE framework and adoption of technology by rural business in Serbia

Taking into consideration the characteristics of rural economy in Serbia and based on the similar studies that have applied TOE and other methods is use, we have enlisted possible determinants for adoption of e-commerce technology. Determinants are categorized in technological, organization and environmental factors in accordance with the mentioned framework. In order to answer what makes business to adopt the e-commerce as strategy we start with technological determinants. Technology context includes internal technologies and external, available technologies in the market [10]. Internally, e-transformation relies on competent employees who can manage an appropriate technical infrastructure. According to available data, technology competence does not represent the strength for rural business in Serbia. Despite the fact that 99.7 percent of enterprises in Serbia are connected to Internet only 38.2 percent of small enterprises, such as in rural areas have used the Internet to order goods/services. Only 20.7 percent of enterprises that are connected to Internet have received the online order for goods and services. Adoption of e-commerce technology is dependant on technical skills and competence. Technological aspect also may consider the infrastructure and e-business know how in general. In organizational context several different factors may influence the adoption of e-commerce such as firm size, strategic orientation, managerial structure and global orientation on the adoption of e-commerce. Adoption of e-commerce represents the significant change in business strategy and consequently implies a change in organizational behavior. Therefore organizational context of e-commerce technology adoption may be described by organizational culture and readiness to adapt to the changes in e-transformation of the business. Rural businesses in Serbia are mostly traditional agricultural households accounting for 45% of employed rural population. Apart from agriculture, rural workforce is engaged in food processing industry (over 16%), wholesale and retail trade (10.2%), building construction (5.8%) and transport (4%). When it comes to education of rural employment structure, nearly 50% of the employed have secondary education. Workforce with such qualifications and organization management will be subject to limited opportunities for e-commerce technology adopting due to the lack of skills and expertise to adapt to e-transformation process. An organization's industry, competitors, access to resources, and dealings with government are part of the environmental context. Overall it reflects in consumer readiness and competitive pressure [5]. Organization interacts with its surrounding business environment, namely clients, suppliers, competitors in industry and government. These entities may act as constraints and/or opportunities for organization's technological adoption. Consumer readiness reflects the potential market volume determining the extent to which adoption of e-commerce may be translated into profitability. Competitive pressure refers to the degree of pressure from competitors that influence the

decision to adopt new technology in order to avoid competitive decline. The regulatory governmental environment can both promote and slow e-commerce adoption. Government regulations can force resources to be allocated for compliance.

C. *Opportunities and possible implications of e-commerce technology for rural business in Serbia*

Although current situation analysis has shown less favorable position for e-commerce adoption by rural enterprises in Europe it does not exclude the discussion on possible positive implications of such e-transformation. Known positive implications of e-commerce adoption applicable to rural enterprises in Serbia can be described as following: efficiency improvement through lower costs, improved effectiveness in terms of widening market potentials and better meeting of customers' need, enhanced product and service innovation through customer-supplier interaction, raising competitiveness and employment possibilities [11]. Adoption of e-commerce technology puts use of information and communication with potential customers and suppliers in different perspective. It enables firms to interact with significant reduction in cost, speed and without limitations to geographical location. Businesses in remote rural areas can use the cost effective potential of e-commerce technology for expanding and targeting markets. Adoption of e-commerce also brings new, on-line competitors such as large Internet stores and companies with standardized sales. In such competitive environment rural enterprises should focus on niche marketing targeting specific market needs and reducing the on-line competitive pressure. Use of information technology enables the firms to collect specific data on their consumers' needs, sales, costs, advertising efficiency and services. Overall it provides efficient and cost effective customer relationship management. As a result of e-commerce adoption and improved accessibility increase in sales in highly expected which needs to be accompanied with adequate production and distribution strategy. Opportunities of agribusiness as core economic activity in rural Serbia are increased export competitiveness of agricultural products, global accessibility of products and profit margin expansion [12].

IV. CONCLUSION

Internet has changed the business environment and its use has brought both advantages and disadvantages to the firms that have decided to adopt e-business strategy. Adoption of e-commerce technology is influenced by various determinants that have been described within the technology-organization-framework in order to analyze which of the factors may contribute to development of rural economy in Serbia. Serbia is mainly rural country and economy in rural areas is predominantly agricultural with lack of skilled and qualified labor which has put business in rural areas in less favorable position for use of benefits of adoption

of e-commerce technology. Nevertheless, it has been argued that e-commerce adoption to rural business will contribute in lowering the costs, increase of sales and enhancement of supply chain. From aspect of customers' relations, in both B2B and B2C model of e-commerce, information management and communication with target group is being simplified, accessible and cost effective providing the relevant data for product development, market research and promotion. Global markets and Internet has also delivered new level of competitors and has increased the vulnerability of small firms to the large scale companies active on-line. Rural enterprises should seek specific target groups and focus on niche marketing in order to avoid conformation with global online companies addressing the needs of the available market share.

Given the characteristics of rural economy in Serbia it needs the support of governmental presence and appropriate policy measures in order to overcome the barriers to e-commerce adopting thus enabling the rural business to take part global on-line market and increase export of agricultural goods and services along with non-farm activities such as tourism or food industry.

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The Role of Internet Marketing in the Creation of Product and Company Image

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Abstract - Modern business conditions, intensifying competition, and a rapid progress of technology lead to the emergence of new trends in all areas of business, including marketing. Companies that wish to survive in the market and build a positive image must monitor these changes and adapt their operations in order to maintain existing and gain new customers. In accordance with the above, a modern marketing approach in the market must be characterized by flexibility, monitoring the effects of own businesses on target consumer groups, as well as feedback and consumer opinions about the company's business. For these reasons, companies are increasingly turning towards internet marketing and the use of interactive media that allow them access to customers 24 hours a day, 7 days a week. Interactivity, two-way communication, possibility of immediate response, offering special benefits, dynamism and individual approach to each customer provide companies with the opportunity to demonstrate to consumers that they deserve their trust and thereby build a clear and positive image in the eyes of consumers. The aim of this paper is to highlight the growing importance of internet marketing in establishing and maintaining trust and communication with customers, whereas its survey will depict consumers' opinion about its impact on creating a positive image of the company and its products.

I. INTRODUCTION

The modern way of life is hard to imagine without the use of computers and the Internet. In most countries, primarily developed ones, as in almost all areas of the business, its use and usage has long ceased to be a luxury and become an essential part of communication and establishing relationships with customers. Accordingly, the growth and development of the global economy, i.e. the elimination of the importance of geographical boundaries through the development of information technologies, including electronic commerce, gave impetus to the increasing use of internet marketing by companies around the world. New information technologies that involve the use of the Internet as a medium have a strong influence to the sphere of marketing, especially marketing communications.

Effective communication, dialogue and building long-term relationships with customers, personalization and mass customization are some of characteristics of Internet marketing that directly reflect the image that is created with the consumers about the company and its products.

Thus, under the influence of new technologies comes a change in the relationship with customers who operate on an interactive basis to create a more flexible, responsive, long-term relationship with the target market segments. In this way, the focus is on long-term approach to developing relationships with target segments, creating a foundation for creating positive image in the eyes of consumers, and a positive and a clear image is a goal pursued by each company.

II. IMAGE - COMMUNICATION OBJECTIVE OF COMPANY

"A company like a man, develops his character and builds its reputation in the minds of others!" [1]

Regardless of the activity of company, the goal of every company is of economic and communication character. The economic objective is to maximize profit, while communication one refers to the establishment and maintenance of a positive and clear image. It is important to note that a clear and positive image of the company at the same time contributes to the achievement of economic objectives, namely profits.

Perhaps the most important task of companies today represents building, maintaining and improving their image. In fact, before making decision about purchasing, consumers gather information about a specific product, but also about its manufacturer. A positive image of the company and its products provide security to consumers regarding the quality contributing to the achievement of customer satisfaction and loyalty of target segments.

The image is an opinion or idea that forms on the market and in public about the company, the business model or specific product and service [6]. It is a perception that the environment has on the company. The perception is related to the quality of products and services offered by the organization and the way of communicating. It is the image of the company in the public eye. Reputation is build on image through years of stability and consistency values. A good reputation of company attracts investment, new workforce and new consumer markets. It also keeps them, thus creating a loyal customer base, which is now increasingly treated as an asset of the organization [11].

The image is a multidimensional concept. It is formed in two ways, the effects of which can be expressed simultaneously [8]:

1. Direct method - based on own experience, ie. contact with the company or products;
2. Indirectly - on the basis of indirect impressions, attitudes, and beliefs about brands.

Companies must take into account the fact that the image is a relatively permanent category, and that it is necessary to consciously plan it and to manage it because a spontaneously created image is rarely positive. Also, once accepted image is difficult to change, since consumers often judge about a company and its products on the basis of existing knowledge and information that they have. However, this does not mean that the information will remain unchanged forever, but eventually comes to the observations and obtaining new information which leads to an increase, peculiar movements, and sometimes even a complete change of knowledge. However, one should bear in mind that consumers rarely completely forget key association with the company or products, and image building should go towards fixing and maintaining positive associations to the particular company and its products are found among alternatives when consumer decides on purchase.

III. INTERNET MARKETING

"It's easy to see, hard to foresee." Benjamin Franklin

Intense competition and the global business environment has led to a remarkable growth and expansion of activities based on the use of the potentials of internet marketing worldwide. Today this form of marketing is high-ranked as a mean of communication of companies of different profiles which on this basis have already built or want to set up business orientation for the future.

Internet marketing can be seen as the process of planning and executing the conception, prices, promotion, distribution of ideas, goods and services, under condition of adjustment to communication aspects of the Internet, in order to create exchange that satisfies the objectives of consumers, businesses and society [4]. David Siegel says: Internet marketing is not about building a web sit, but building a web business ... harmonising the power of customers [7]. Internet marketing can help create a business where the customer participates - through a constant dialogue, exspressing interests, requesting products and services, suggestin improvements, giving feedback and where ultimately, the customers drives the business.

Principles and methods of Internet marketing comes from traditional marketing, and the main difference is interactivity. Namely, the consumers can be engaged in dialogue, forming of communication content information structure, and adaption of products and services to meet

costumer's own needs and requirements. In this way it can be established long-term relationships with customers, ensured their loyalty, as well as strengthen the ability for marketers to create a positive image

Although large part of the promotional campaigns still goos through traditional media marketing such as television, newspapers, magazines, etc.. Internet is taking an increasing role in the positioning and the continued strengthening of the brand. Personalization technology can help companies to understand the needs of their customers and to their marketing campaigns direct towards very specific market segments, achieving high response rates [3]. Therefore, internet marketing has provided businesses with new tools and benefits that can increase the success of marketing efforts, and can be reasonably considered to be one of the most important factors that influence the construction of the image of the company and its products, which will be discussed below.

IV. INTERNET MARKETING AND IMAGE CREATION

„Dreams create the future.“ Victor Hugo

In the last 15 years, the Internet has become one of the most important medium of communication of companies with consumers. Moreover, the Internet has become a tool of business, of building of familiarity and image, the instrument of socialization, a great place for fun, endless encyclopedia and database ...

The eternal fight over customers, attracting their attention and creation of a clear and positive position in their minds, mean that appearing on the Internet must be a creative, interesting and constantly subject to changes. The four pillars of internet marketing provide companies exactly with that [9]:

- **Content** – content on the Website, its setting, organization and conception are the basis of successful appearance and creation a positive image among consumers.
- **ClickStream** – observation of each action of presentation visitors, where he came from, where he moved on the site and where he went from it; provides information for improving interaction with potential customers.
- **Communication** – communication on the Web site should be directed to the interactivity with the user.
- **Conversion** - if the previous elements are done in a quality manner it is possible to accurately calculate the direct effects of performance (conversion of site visitors into customers). The goal, of course, is to improve the degree of conversion, since it implies that it is created a positive image among consumers.

The following figure shows the four pillars upon which Internet marketing is based and which

represent an attempt to present the challenges faced by the companies during image creation using the Internet.

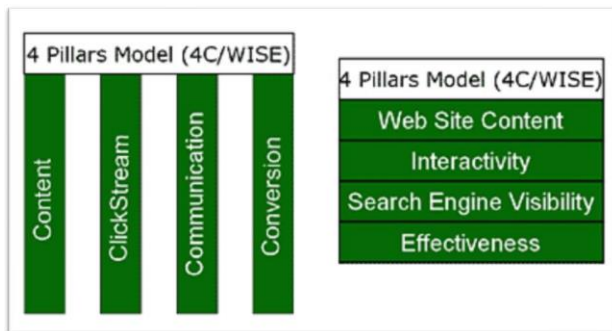


Figure 1. – The Four Pillars of Internet Marketing

By implementing Internet marketing campaigns, especially the part that relates to communicating with consumers through new information and communication technologies, companies can expect certain benefits from impact on both economic and communication objective. These are [2]:

1. The potential of increase in revenues resulting from owning a large database on consumers and encouraging repeated purchases and building loyalty of existing customers.
2. Reducing costs through the possibility of reaching consumers and providing information and services via the Internet
3. Increase the competitiveness by improving the level and quality of services, and personalization of content directed to consumers, which directly affects the creation of the image of the company.

Their performance on the internet, companies must plan carefully considering a number of different providers of information. It is necessary to pay attention to the intensity of visitor traffic, quality, and compatibility with other content on the Web site advertising, availability of the location and size and structure of a particular market area. The presence on the Internet in the form of advertising is used in order to encourage visitors who are surfing the Internet to pay attention to the promotion of the company and based on these advertisements build an opinion and get in contact with the company [5].

Internet marketing has to be creative, interesting, and subjected to constant changes due to the abundance of information that can serve customers. In addition, the information about the company and its products, consumers can get not only on their official websites, but also through blogs, social networks (Facebook, Twitter, MySpace, etc.), exchange of e-mails with other consumers, etc. Because of the large number of information that consumers are getting and that are not under the control of the company, it must be taken into account that on the network it is relatively easy to create a

positive image, as well a negative impression about the company.

By virtue of the Web, the network is almost unlimited, and there is a possibility of the constant presence and establishing contact with potential customers worldwide, independently of space and time. However, despite the loss of importance of temporal and geographic boundaries, there are clearly defined rules of conduct on the Internet and if one does not adhere to these rules, it quickly gets out on the network. The mentality is such that the user feels a strong community spirit and the consequences of ignorance can be long-term [5].

Also, companies that use internet marketing must take into account the expectations of the online consumers, which can be directly reflected in the creation of the image with target segments. Namely, online customers have raised expectations. They expect higher standards in terms of service, convenience, speed of delivery, competitive prices and choice. They also want to be in control, secure and safe. The problem with raised expectations is that first, they are crushed more easily and second, they can damage the image if not fulfilled. For example, online customers expect fast service and fast delivery. The Internet and everything associated with it suggests speed. If online businesses do not deliver speed then online customers are disappointed, annoyed, angry and sometimes vociferous [7].

A large number of companies realized the benefits of the development and use of Internet marketing, but its increasing application also led to many problems that lead to the construction of a negative image of both company and its products. Disadvantages of Internet Marketing are most evident in the lack of legislation, as well as a number of ethical issues that directly affect the image that consumers make about the companies. The darker side of internet marketing and ethical issues that need to minimize include the following issues: invasion of privacy and use of personal data of consumers, fraud and deception by companies and retailers, irritation and aggressive sales, spam, etc.. When a company pays little attention to ethical issues in the Internet marketing, consumers likely to create a negative image of it.

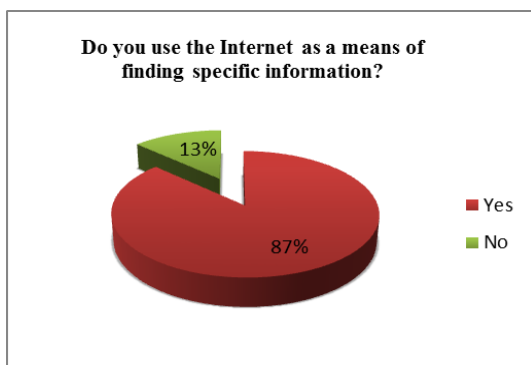
Companies and marketers are trying to find answers to these questions and solve potential problems. They are aware that the neglect of these and similar problems lead to an increase in negative attitudes and consumer dissatisfaction, lower response rates, as well as the increasing demand for more precise and stricter government regulations. In the end, companies want the same as consumers - a fairly and well designed marketing offers, which will provide satisfaction to consumers and a positive image and long-term partnerships with target market segments to companies.

V. RESEARCH RESULTS

*„It is important to never stop asking questions!
Albert Einstein*

In order to arrive at the answer to the question of whether Internet marketing and communications with customers through this medium influence the creation of certain impressions about the company and its products, during the winter 2013, the research was conducted on this topic. The survey was conducted in Novi Sad, and included 200 subjects, which were distributed surveys. Care has been taken to be involved in research different age groups, with respect that their views on the researched topic may be different. The research results are presented below.

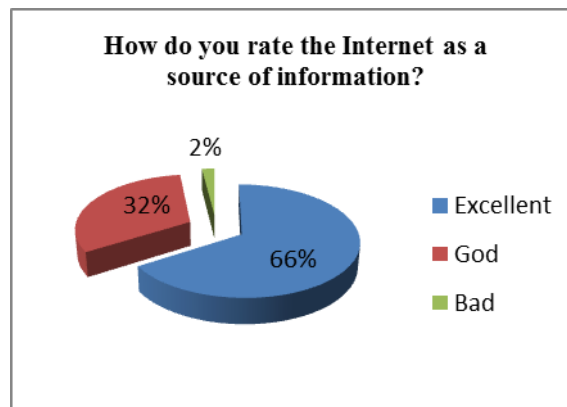
When asked whether the use of the Internet as a tool for finding specific information, most consumers, over 80% responded positively, while the small number is of those who don't use the media. By age, the population between 18 and 30 years old mainly use it , and if you take the education criterion most users were among those with university or higher education. When it comes to non-users of the Internet mainly we speak about older respondents (older then 50 years) or respondents whose education is lower than secondary and who are not interested in new technologies and do not have or do not want to set aside funds for this type of communication.



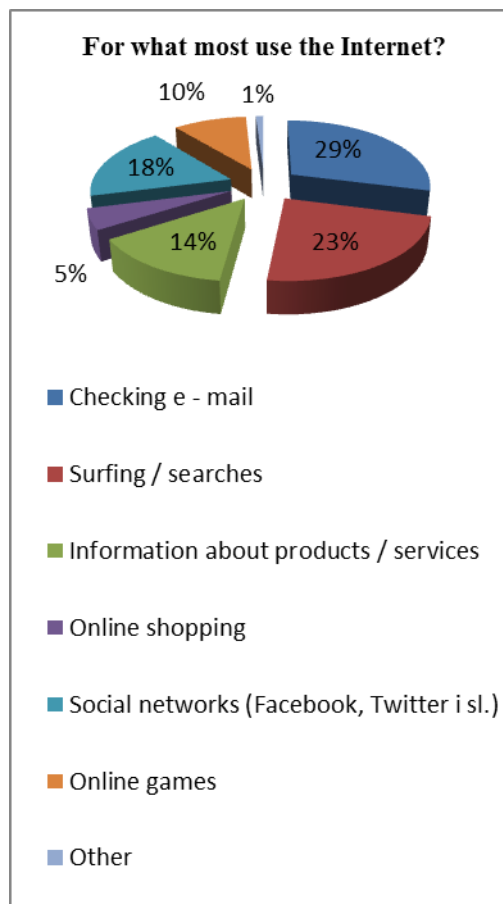
The fact of the great use of Internet is also confirmed by studies conducted at the end of 2012 by the CIA, which states that in view of the Internet use, encouraging fact is that does we do not lag so much behind the most developed countries in the world: in Serbia Internet is used in more than a million homes, which puts us at 44 place of 233 countries [10].

The next question concerned the trust that consumers have in the Internet as an information source. In this case, 66% of respondents considered it an excellent source of information, 32% of respondents expressed the view that on the Internet can find adequate information, while only 2% are dissatisfied. These assessments somewhat are unsurprising given that the main characteristics of this medium, active participation of consumers in the search for and selection of information, the ability to post questions and receive answers both from companies and

other consumers, share experiences with users of specific products or services of a specific company and the like. This ability to establish contacts with current and former costumers leads to the respondents well rated the Internet as a source of information, considering that consumers continue to have the biggest trust to the information they receive from family, friends, acquaintances and other consumers. The importance of consumer advertising and "word of mouth" advertising should encourage companies to continuously work to minimize customer dissatisfaction and creating a positive image of themselves and their products.

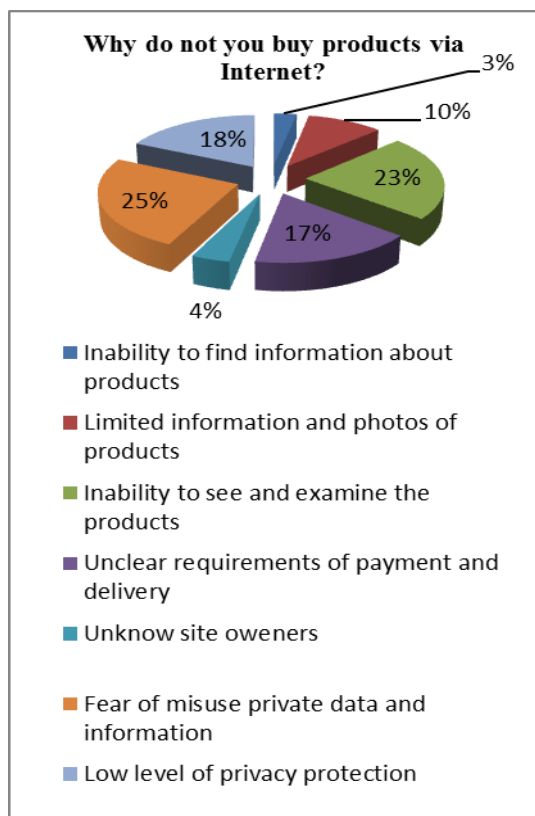


When asked about the use of Internet, respondents gave answers that are presented in the following graph.



It can be concluded that the dominant is use of the Internet to check e – mail and web browsing or performing searches, while visits to social networks are in the third place, and collection of information about the products and services of the companies is in fourth place. It is important to note that the visit of social networks is most used by respondents in the younger population (18 - 30), while with increasing age, use of the Internet for other purposes increases (checking e - mail, surfing and collecting information on companies and products njihovim). Also, respondents with higher education often use the Internet to check e - mail and perform various types of searches. All these types of Internet can be a indications to companies in which ways are possible to communicate with customers and to build positive impressions.

Although the growing importance of Internet marketing is demonstrated by the fact that 87% of consumers use this medium for finding various types of information and establishing contacts with suppliers of products and services, the percentage of those who choose to shop online is still very small. In fact, only 38% of respondents so far order goods through the Internet, while other 62% have still not bought anything online. The reasons for this are varied, and respondents ranked those as follows: the fear of misuse of personal data and information (25%), inability to see and examine the product (23%), low levels of privacy protection (18%), unclear requirements of payment and delivery (17%), limited information and photos of products (10%), unknown site owners (4%) and the inability to find information about products (3%).



Although the Internet and the Web revolutionized the market performance of the company and reaching consumers, and although lives of consumers are even almost unimaginable without the Internet as a means of obtaining information, there are still a number of problems faced by consumers, which may undermine their confidence and directly affect the image that is created on the enterprise.

V. CONCLUSION

Achievement of economic objective (profit) and communication goal (image) of the company is highly dependent on its promotional efforts and strategies. Modern marketing approach requires continuous flexible approach to the market, making surveys, monitoring operations and the echoes the company's operations have on the target segments and of course, the impact of the effect of consumer reviews on the company and taking action to remove potential problems and improve customer relationships. Therefore, the marketing approach in the field of Internet services has taken a special place and role in the business.

Improving corporate image and product image, more efficient, faster, and adequate marketing communication, faster response to market needs and rapid feedback from consumers, personalization and adaptation of information preferences and interests of consumers, as well as going out to meet consumer demands for information are just some of the many intangible benefits that use of Internet marketing gives to companies. What businesses need to consider is to adhere to the Code of Conduct on the Internet, to minimize the number of ethical problems that may be encountered, with a view to establishing partnerships with consumers and creating a clear and distinctive position in their minds.

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Wrapper Method and Supervised Learning Algorithms Applied to Diagnosis Parkinson's Disease

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Abstract - This paper outlines the systems that provide decision support, which are based on the technology of artificial intelligence. The paper discusses the challenges of supervised learning, presents the model of decision tree, artificial neural networks and support vector machine. In this paper we present the problem of diagnosing Parkinson's disease based on the analysis of speech. The main hypothesis of this study is that it is possible to significantly improve the system performance of inductive learning rules in the problem of diagnosing Parkinson's disease by the application of wrapper method for dimensionality reduction of data. To prove the hypothesis, we implemented and empirically tested wrapper method for dimensionality reduction of data.

I. INTRODUCTION

Artificial intelligence includes two approaches of artificial learning [1]. The first is motivated by the study of mental processes and says that the artificial learning is study of algorithms contained in the human mind. The goal is to discover how this algorithm can be translated into formal languages and computer programs. Another approach is motivated from a practical point of computers and there is less grandiose goals. It involves the development of programs that learn from previous data and as such is a branch of data. Machine learning, as well as above mentioned other artificial approach to learning, is rapidly developing since its founding in mid-seventies.

Machine learning is a field of artificial intelligence that deals with the construction of adaptive computing systems that are able to improve their performance by using information from experience. Machine learning is the discipline that studies the generalization and construction and analysis of algorithms that can generalize. The first theoretical discussion of machine learning have appeared in the late 60's in the works of Gold, but universal theoretical foundations began to consolidate until the 80s of the last century. In this area, the most important theoretical approaches are Gold's model of learning in the limit, Valiant's Probably Approximately Correct (PAC) model and probably the most complete - statistical learning theory.

The machine learning has been achieved good results in many areas, such as speech recognition, hand-written text, driving a car and so on. In machine learning, there are two main formulations of learning problems, including:

- Supervised learning is a learning approach which relates to situations where it gives the desired output with the algorithm and the data from which it learns.
- Unsupervised learning is a learning approach which relates to situations where the algorithm learns only from provide data with no output, and it is expected that the learning algorithm noticed some regularities in the data given to it.

As an example of supervised learning, we will mention the classification of malignant tissue and those that are not. An example of unsupervised learning is the so-called clustering and identifying groups of similar objects when you do not know in advance how many groups there are and what are their characteristics. In this case, the tissue can be clustering according to their similarities.

The main goal of this paper is to prove that it is possible to improve the performance of the system for inductive learning rules in problems of classification using the wrapper method to reduce the dimensionality of the data.

For this purpose we have organized the paper in the following way. In the second section of this paper we present wrapper method, in the third decision tree, in the fourth artificial neural networks, and in the fifth method of support vector machine. The sixth part of the article considers the problem of diagnosing Parkinson's disease based on speech. The seventh part of the article describes the methodology of the experiment research. In the eight parts of work we will try to solve problems by using different supervised learning algorithms to achieve higher classification accuracy, also using the wrapper method to achieve better accuracy for these algorithms. Also, in the eighth section we present the results of experimental research. In the final part of this article, we discuss the obtained results and give directions for further research.

II. WRAPPER METHOD

A variety of techniques of ranking and selection of attributes have been proposed in the literature. The purpose of this technique is to discard irrelevant or redundant attributes from a given set of attributes.

Methods for selection attributes are divided into: filter method, wrapper method and embedded method.

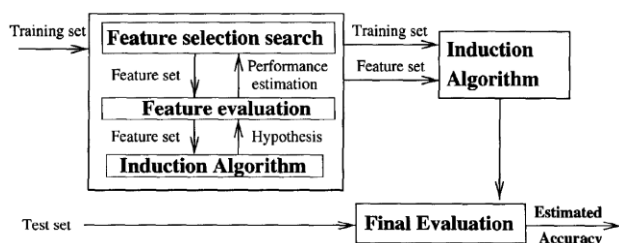


Figure 1. Wrapper method [2]

In the wrapper method a subset of attributes is selected from the estimation accuracy of the prediction given by the chosen classifier after learning the rules for each considered subset. Learning the rules is done after selection of the best estimated subset. Exhaustive testing of all possible subsets is acceptable for a small number of attributes, because the complexity of the procedure is NP-hard [2].

In wrapper method we use certain algorithms for modeling in order to evaluate subsets of attributes in terms of their classification accuracy. When using these methods in practice there are three questions:

- how to search the space of all possible subsets of attributes,
- how to evaluate the success of the algorithm for modeling with respect to search a set of attributes,
- which the modeling procedure used as a black box for wrapper method.

In wrapper method the value of a specific set of attributes is expressed by the degree of accuracy of classification achieved by the model constructed using these attributes. This means that these methods are closely related to the selected machine learning algorithm. For a given subset of attributes, the classification accuracy is evaluated using sampling techniques, such as cross-validation. By these methods for each monitored attribute subset is build the model and evaluate its performance, so that the performance of some models suggests a better choice of attributes from which the model was created. Graphical representation of wrapper method is shown in Fig. 1.

In wrapper method attribute selection procedure is computationally very demanding because of frequently repeated execution of machine learning algorithms. It is necessary to obtain an appropriate evaluation of performance models for each observed subset of attributes, and methods for evaluating the validity of the model generally require averaging the results for a number of constructed models. By these methods for each monitored attribute subset is being built models, and the total number of subsets grows exponentially with the number of attributes.

Exhaustive search subsets of attributes can be implemented only for a small number of attributes. Therefore, we used a variety of search techniques, such as: best-first, branch-and-bound, simulated annealing, genetic algorithms, etc. [2]. The practice shows that greedy search techniques give good results, which means that they never verified already decisions made on whether attribute to include (or exclude) from the group.

In wrapper method the most important disadvantage is the slowness in the execution caused by calling the target machine learning algorithm multiple times, which is why these methods do not correspond to extensive sets of data to study with a larger number of attributes.

It is believed that wrapper method enables achieving something better classification performance, because of close links with the target machine learning algorithms. This however, may pose a risk for excessive adjustment of the target set for the learning algorithm can highlight its weaknesses.

III. REPRESENTATION OF THE MODEL OF DECISION TREE

Decision trees are used in the diagnosis of Parkinson's disease for the following reasons: ability to generate comprehensible models, explicitly extract the important attributes for a given classification problem, relatively small demand for computing resources (time and memory), the ability to use all types of attributes (categorical and numerical).

Decision tree is a method of discrete approximations of the target function in which the learned function is represented as a tree where each node of the tree corresponds to a test attribute instance, branches out from node different values of the attribute, and the leaves correspond to the value of the objective function. Instances are described with values of its attributes. The classification procedure is performed starting from the root, then descending down the branch corresponding to the value tested attributes that classify instances when it comes to the list, the class instance is assigned.

If a decision tree assigns a class instance, this means that the instance meets all requirements defined path from the root to the corresponding leaf and tree forms and the attribute value. Paths through the tree are the conjunction of these terms and conditions of each class can see the path ending leaves corresponding to that class. Disjunction of such conjunctions defined instances that belong to a certain class to a given tree.

-
1. Check for any base cases
 2. For each attribute a
 3. Find the normalized information gain from the splitting on a
 4. Let a_{best} be the attribute with the highest normalized information gain
 5. Create a decision node that splits on a_{best}
 6. Recur on the sublists obtained by splitting on a_{best} , and add those nodes as children of node
-

Figure 2. Pseudocode for the C4.5 algorithm [3]

In the decision tree we distinguish two types of nodes connected branches: an end node - which ends any branch of the tree and it defines its class examples that satisfy the requirements of that branch of the tree; decision node - this node defines a condition in the form of a specific attribute value, which leads branches which meet certain values of the attribute.

For the classification of examples, a decision tree can be used to move from the first decision node at the root of the tree and moves by those branches of the tree that example to their values meet until the final node that classifies an example of one of the existing classes of problems.

The search procedure is guided evaluation function, which depends on the accuracy of classification, and the size of the resulting tree. The effect of evaluation function is based on concepts from information theory, and it is reflected in the choice of branching in the construction of decision trees.

In a decision tree, with a similar accuracy of classification, it seems more likely that the simpler (i.e. less) decision tree better classify previously unseen examples. The general algorithm for building decision trees in pseudo code [3] is shown in Fig. 2.

IV. REPRESENTATION OF THE MODEL OF RBF NEURAL NETWORK

On a more serious classification problems, the classification of neural networks proved to be very good just for those problems where it is difficult or impossible to use the classical technique. Besides, neural networks are well suited to work in conditions of noise in the data.

From a structural point of view, depending on the model used to build neural networks, neural networks can be divided into static and dynamic. From the point of view of a layered mode of organization of neurons in the network, the network can be divided into single-and multi-layered. The first layer is called the input layer, the last layer output, and all other layers are called hidden layers. As a rule, each layer receives inputs from the previous layer and sends their outputs on a next layer.

The main characteristic of static neural networks is that the neurons are organized beforehand, so that neurons connected in a way with no form of feedback. These networks can not contain dynamic members, making them structurally stable. Since there are no dynamic members, static response of the neural network depends only on the current state and input values of the network parameters. Static neural networks are commonly used in the identification process, process management, signal processing and pattern recognition. The most common types of static neural networks are MLP and RBF neural networks. In this paper we are used the RBF neural network.

Dynamic neural networks are used much less frequently than static neural networks because their stability is not guaranteed. The learning process of the dynamic neural networks is much more demanding than learning static. Another shortcoming is that the output dynamic neural network depends on its initial conditions making it difficult to study because of poorly selected initial conditions may give poor results.

In the case where the application of static neural network does not give good results it is reasonable to use the dynamic neural network. The most common types of dynamic neural networks are the Hopfield, Elman and

NARX dynamic neural network. Pseudo code for RBF training [4] is shown in Fig. 3.

```

trainRBF (in, out, width, MaxError, data) {
hidden = 0;
net = initRBFNetwork (in, out, hidden);
do {
// find the vector data that produces the highest
error
i = findMaxNetworkError (data, net); // i =
index vectors
// add a layer of RBF neurons in the
same place where the vector data
addRBFNeuron (net, width, data (i)); //
data (i) = midpoint
// find the overall network error
NetError = trainOutputWeights (net, data);
} while (NetError> MaxError);
}
    
```

Figure 3. Pseudocode for RBF training

V. REPRESENTATION OF THE MODEL OF SVM

In machine learning, SVM is popular due to its good performance. As a supervised method to analyze the data and recognize patterns, it is strictly based on statistical theories of learning and at the same time reduces the training and test errors. SVM has enjoyed great popularity due to the very good results obtained [5], [6], [7]. This is the reason why we use this method to diagnosis Parkinson's disease.

Support Vector Machine (SVM) is a binary classifier which construction hyper-plane in high-dimensional space and creates a model that predicts which of the two classes is a new instance. The basic idea of this method is that the vector space in which the data are presented, finds decoupling hyper-plane so that all the data of a given class on the same side of the plane, as shown in Fig. 4.

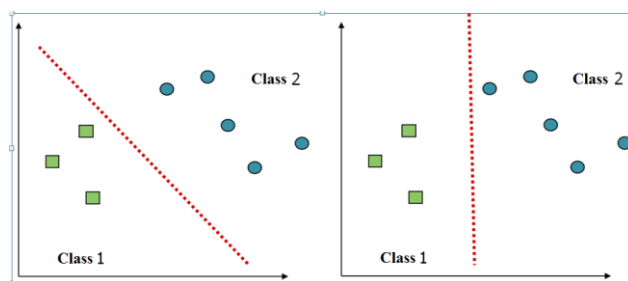


Figure 4. The task of the training phase: find the optimum plane which separates the data for training [8]

When using this method, the question is what the solution is better, and how to define "better" solution. If we assume that the data is linearly separable in a training phase should be find the optimal separating hyper-plane, or maximum "margin" (which represents the distance from training data). In this case, discovered the hyper-plane (i.e. its equation) is a model (Fig. 5). Then, based on the model calculates the distance from the hyper-plane and on that basis determine the class (above/below the plane).

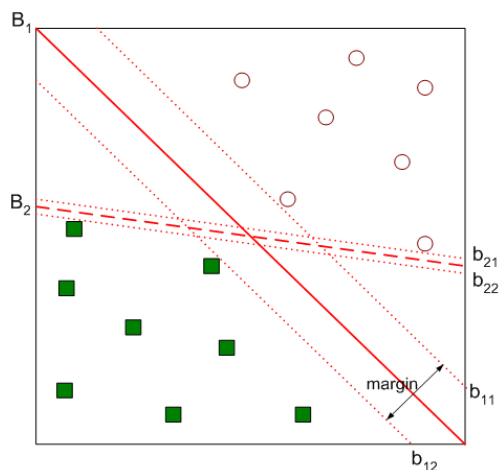


Figure 5. Find a hyper-plane that maximizes the size of margin \rightarrow B1 is better than B2 [8]

In the case of non-linear problems parting, we use non-linear SVM, with the basic idea that the basic (input) vector space copy in a multi-dimensional space in which a set of data for training linearly separable.

Many hyper-plane can be used for classifying the data, the best hyper-plane is the one that represents the largest separation, or margin between the two classes. Generally speaking, when a greater margin is then is smaller error of generalization of the classifier. The selected hyper-plane is with maximum margin for which valid that the distance from it to the nearest data point on each side is the maximum.

VI. DESCRIPTION OF SELECTED PROBLEM OF LEARNING

In the following text we will give a presentation of the selected learning problem that we have used in this work. For the purpose of the experimental study, we used the real dataset taken from the UCI repository [9], which is intended for researchers who studied problems of artificial intelligence.

Parkinson dataset (pa) created Max Little from the University of Oxford, in cooperation with the National Center for Voice and Speech, which is located in Denver, Colorado. The original study was published for the purpose of extracting attributes from speech signals in people with speech disorder. Fig. 6 shows two examples of the speech signal: (a) healthy subjects, (b) people with Parkinson's [10]. This data set consists of a series of biomedical voice measurements of 31 persons, 23 of them suffering from Parkinson's disease [10]. In this data set there are 195 instances and 23 attributes. Attributes of this data set are: average fundamental voice frequency, the largest primary speech frequency, minimum basic voice frequency, jitter, absolute jitter, several measures variations in the fundamental frequency, several measures variations in the amplitude ratio of two measures of tonal noise components in the voice, the two nonlinear dynamic measures signal fractal and nonlinear three basic measures of frequency variation.

Each column in the table is a particular characteristic of voice, and each row corresponds to one of 195

recordings of voice. The main objective of this dataset is to separate healthy people from those people who are suffering from Parkinson's, based on the "Status" column that has a possible value of 0 for healthy adults and 1 for people with Parkinson's disease.

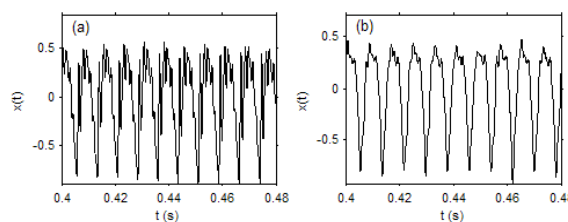


Figure 6. Two examples of the speech signal: (a) healthy subjects, (b) people with Parkinson's [10]. The horizontal axis represents time in seconds; the vertical axis shows the amplitude of the signal (no unit of measure)

VII. DESCRIPTION OF THE METHODOLOGY

The experiment was performed using WEKA (Waikato Environment for Knowledge Analysis) tools for data preparation and research developed at the University of Waikato in New Zealand. When searching for the model that best approximates the target function, it is necessary to provide measures of quality models and learning. Different measures can be used depending on the problem, in our experimental studies; we used the classification accuracy as a measure of the quality of the model.

To get a more reliable evaluation of the learned knowledge, we used the cross-validation, where we have a full set of data that we had shared to n approximately equal subsets. In doing so, we have a subset of the training carried out and pulled the other $n-1$ subsets, and after training, the quality of the learned knowledge assessed in a separate subset. Procedure described above are repeated for all other subsets extracted as a final quality score obtained by taking the average score for each of the subsets. In our experimental study we take the value of n is 10. Cross-validation was used in our experimental study, because the procedure gives stable quality evaluation, the advantage of this method is that each of the n steps of cross validation using a large amount of data in their training and all available instances at one time were used to test.

In experimental research we used a wrapper method to reduce the dimensionality of data. For this method of reduce the dimensionality of the data is used the set of all possible solutions, which was then passed through the J48 classifier, RBF network and SVM. In all experiments is selected the solution with the number of attributes that will be used further in the study, which gives the highest classification accuracy. Our results provide the accuracy that is obtained as the average of ten repetitions each time with a 10-fold cross-validation.

In our experimental research, we used Paired t-test, where the level of significance was set to a value of 0.05. If we have a simultaneous determination of the accuracy of the classification of different data sets using two methods to determine whether the value obtained by different methods differs significantly we use Paired t-test.

Paired t-test test the significance of the mean differences pairs d according to the following equation:

$$t = \frac{\bar{d}\sqrt{N}}{s_d}$$

where s_d is standard deviation of the obtained differences. If the calculated value of the parameter t is greater than tabular (critical value), the null hypothesis is rejected and it is said that d is significantly different from zero, or that the difference in pairs statistically significant.

In the tables below for the classification accuracy of different classifiers presents the "+" and "-" to indicate that a statistically better result (+) or worse (-) than a basic level of significance of the classifier that specified the value of 0,05. In the tables of classification accuracy of different classifiers "+" indicates a significantly higher value for classification accuracy, while "-" indicates a significantly lower value for classification accuracy.

In our experimental research, whenever we compare two or more algorithms, we give a table of classification accuracy. Comparison is such that the second algorithm is an algorithm in which was performed pre-selection attributes, and the first algorithm is a standard algorithm without pre-selection of attributes.

VIII. EXPERIMENTAL RESEARCH RESULTS

In further experimental research for the optimal number of selected attributes for each dataset and wrapper method, classification accuracy was checked using different algorithms J48, RBF and SVM. In the following text are presented the obtained results.

TABLE I. CLASSIFICATION ACCURACY, STANDARD DEVIATION FOR CLASSIFICATION ACCURACY, TRAINING TIME AND STANDARD DEVIATION FOR TRAINING TIME FOR ORIGINAL AND REDUCED SET OF DATA USING WRAPPER METHOD

Algorithm	Accuracy	St.dev. accuracy	Time	St.dev. time
J48	84.74	8.01	0.01	0.01
J48_W	86.24	7.53	3.87 -	1.58
RBF	81.22	7.37	0.02	0.02
RBF_W	87.47 +	7.44	19.36	4.52
SVM	79.36	4.46	0.02	0.01
SVM_W	97.64 +	3.37	62.12	15.40

In all the algorithms that they used a wrapper method is obtained higher classification accuracy compared to the baseline algorithm, which are shown in table 2. In two cases of three, the results are statistically better. We conclude that for all classifiers for the observed data set, the wrapper method gives good results. The standard deviation of the classification accuracy of an algorithm for the original and the reduced data set using the wrapper method is shown in Table 1. From the table it can be seen that the values for the standard deviation did not differ significantly when used wrapper method. Table 1 shows

the time required for the training of the algorithm used in the original and the reduced data set using the wrapper method, as well as the standard deviation of the time required for training (in seconds). Required time to train data with wrapper method was significantly greater in all cases than the basic algorithms. The values of the standard deviation of the time are significantly higher than the basic algorithms.

IX. DISCUSSION OF RESULTS AND FUTURE RESEARCH

According to the obtained results, we can conclude that the basic hypothesis was proved - it is possible to improve the system performance of inductive learning rules in the problem of diagnosing Parkinson's, using the wrappers method for reducing the dimensionality of the data. To prove the hypothesis, have been implemented and empirically tested wrappers methods for reducing the dimensionality of the data.

J48 algorithm incorporates a method to select attributes in the basic algorithm. However, using independent selection with wrapper method, classification accuracy is increased. RBF and SVM algorithms not incorporate a method to select attributes in the basic algorithm, which is why wrapper method significantly improves outcome.

In further research it would be interesting to apply other techniques to solve the problem of dimensionality reduction of data, such as filter methods and extraction of attributes and analyze and compare the effects of their implementation. These techniques could also improve the performance of classification learning algorithms.

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Methodological Approach to Software Development Process

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Abstract - The paper describes some of the basic characteristics of C programming language. This is done by a simple Guessing Game example. The program is developed in Code::Blocks environment. The main contribution of the paper is the methodological approach to software development process. The paper contains the examples of source code, as well as methodologically based description of it. The aim of the paper is simple and methodologically correct presentation intended for software development beginners.

I. INTRODUCTION

C is a general-purpose programming language with features economy of expression, modern flow control and data structures, and a rich set of operators. C is not a "very high level" language, nor a "big" one, and it is not specialized to any particular area of application. But its absence of restrictions and its generality make it more convenient and effective for many tasks than supposedly more powerful languages.

C was originally designed for and implemented on the UNIX operating system by Dennis Ritchie [1]. The operating system, the C compiler, and essentially all UNIX applications programs are written in C. C program language is not tied to any particular hardware or system, however, and it is easy to write programs that will run without change on any machine that supports C.

The good thing about C is that you can write code which runs quickly, and your program is very "close to the hardware". By that I mean that you can access low level facilities in your computer quite easily, without the compiler or run time system stopping you from doing something potentially dangerous. The use of compiler directives to the pre-processor make it possible to produce a single version of a program which can be compiled on several different types of computer. In this sense C is said to be very portable. The function libraries are standard for all versions of C so they can be used on all systems [2].

II. PROGRAM SOURCE CODE

Methodological approach to software developing process in C program language is displayed through simple program which is assigning the combination from four signs (+, -, *, /).

When the program is started the user enters his name, surname and username. Those data must be written in file znacko.txt. "znacko.txt" is a file which is generated by the program itself so data could be written to it, and used when needed. If you want your program to be properly useful you have to give it a way of storing data when it is not running. We know that you can store data in this way, that is how we have kept all the programs we have created so far, in files. A file is a structure which holds information about a particular stream. We do not create or manipulate this structure, that is done by the input and output routines that come with our version of C. All we have to do is maintain a pointer to a FILE, so we can tell the C functions which we want to use. If you are really interested, you can find out what a FILE is made of by looking in the file STDIO.H [2].

If the user is already in the database, he only has to enter his username and the program will find him in the file znacko.txt and input it in program. The only declaration needed for a file pointer is exemplified by:

```
FILE *fp;
FILE *fopen(char *name, char *mode);
```

This says that fp is a pointer to a FILE, and fopen returns a pointer to a FILE. Notice that FILE is a type name, like int, not a structure tag, it is defined with a typedef.

The call to fopen in a program is fp = fopen(name, mode); The first argument of fopen is a character string containing the name of the file. The second argument is the mode, also a character string, which indicates how one intends to use the file. Allowable modes include read ("r"), write ("w"), and append ("a"). Some systems distinguish between text and binary files; for the latter, a "b" must be appended to the mode string [1].

String Function: int strcmp(cs,ct) - compare string cs to string ct, return <0 if cs<ct, 0 if cs==ct, or >0 if cs>ct, cs and ct are of type const char * [3].

Listing 1.

```
printf("Unesite korisnicko ime\n");
scanf("%s",&kriterijum);
while(1)
{
```

```
fscanf(f,"%s %s %s %d %d\n",
&korisnik.ime,&korisnik.prezime,&korisnik.korisnickoime,
&korisnik.ukbr, &korisnik.pobede);
if (strcmp(kriterijum,korisnik.korisnickoime) ==0)
{
printf("\n\t%s %s %s %d %d\n",korisnik.ime,korisnik.prezime,korisnik.korisnickoime,
korisnik.ukbr, korisnik.pobede);
```

The combination must contain this four signs which can be repeated.

Listing 2.

```
srand(time(NULL));
for (i=0; i<4; i++)
{
npr[i]=zadatakomb[rand()%4];
}
```

The user has six tries to guess the combination. After each try the program is displaying how many signs are guessed in right place, and how much is guessed but not on its right place.

Listing 3.

```
printf("\nPogodaka van mesta: %d", P);
printf("\nPogodaka na mestu: %d", S);
```

After each game played, if the player guess the combination the program must increase the total number of played games and increase the victory number.

File Positioning Function - fseek sets the file position for stream; a subsequent read or write will access data beginning at the new position. For a binary file, the position is set to offset characters from origin, which may be SEEK_SET (beginning), SEEK_CUR (current position), or SEEK_END (end of file). For a text stream, offset must be zero, or a value returned by ftell (in which case origin must be SEEK_SET). fseek returns non-zero on error [4].

Listing 4.

```
fseek(f,-7,SEEK_CUR);
korisnik.ukbr++;
fprintf(f,"%d",korisnik.ukbr);
if (korisnik.ukbr>9)
{
fseek(f,1,SEEK_CUR);
korisnik.pobede++;
fprintf(f,"%d",korisnik.pobede);
}
else
{
fseek(f,2,SEEK_CUR);
korisnik.pobede++;
fprintf(f,"%d",korisnik.pobede);
}
fclose(f);
system("pause");
system("color 0B");
break;
}
```

If the combination isn't guessed only the total number of played games should be increased. It must be allowed to display the content of the (name, surname, username, total number of played games, the number of victory) in main menu.

Listing 5.

```
case 3:
f = fopen("znacko.txt","r");
system("CLS");
if (f==NULL)
{
printf("Greska u otvaranju fajla za citanje\n");
break;
}
printf("Ime/Prezime/Korisnicko ime/Ukupan broj partija/Broj pobeda");
while(1)
{
fscanf(f,"%s %s %s %d %d\n",korisnik.ime,korisnik.prezime,korisnik.korisnickoime,&korisnik.ukbr,&korisnik.pobede);
printf("\n\t%s %s %s %d %d",korisnik.ime,korisnik.prezime,korisnik.korisnickoime,korisnik.ukbr,korisnik.pobede);
if (feof(f))
{
fclose(f); break;
}
}
printf("\n\n");
system("pause");
break;
```

For solving this program should be used following libraries:

Listing 6.

```
#include <stdio.h>
#include <string.h>
#include <conio.h>
#include <stdlib.h>
#include <windows.h>
```

structure "igrac" which contains ime, prezime, korisnickoime, pobede, ukupanbroj;

A structure is a collection of one or more variables, possibly of different types, grouped together under a single name for convenient handling. Structures help to organize complicated data, particularly in large programs, because they permit a group of related variables to be treated as a unit instead of as separate entities [1].

Listing 7.

```
typedef struct igrac
{
char ime[maxime];
char prezime[maxprezime];
char korisnickoime[maxkorime];
int ukbr;
int pobede;
}igrac;
```

file znacko.txt;

Listing 8.

```
f = fopen("znacko.txt","r+");
system("CLS");
if (f==NULL)
{
    printf("Greska u otvaranju fajla za citanje\n");
    break;
}
```

rows for setting the combination;

The switch statement for choices in main menu;

The switch statement is a multi-way decision that tests whether an expression matches one of a number of *constant* integer values, and branches accordingly.

Functions that are called multiple times for saving the memory;

Functions break large computing tasks into smaller ones, and enable people to build on what others have done instead of starting over from scratch. Appropriate functions hide details of operation from parts of the program that don't need to know about them, thus clarifying the whole, and easing the pain of making changes.

C has been designed to make functions efficient and easy to use; C programs generally consist of many small functions rather than a few big ones.

A program may reside in one or more source files. Source files may be compiled separately and loaded together, along with previously compiled functions from libraries. We will not go into that process here, however, since the details vary from system to system.

Functions are identified by name and can return a single value. They act on parameters, which are used to pass information into them. We need to tell the compiler the name of our function, what parameters it has, and the type of information it returns.

Listing 9.

```
void proveravanmesta1()
{
    if (s1==0)
    {
        if (s2==0 && znak1==npr[1]) {p2++; return;}
        if (s3==0 && znak1==npr[2]) {p3++; return;}
        if (s4==0 && znak1==npr[3]) {p4++; return;}
    }
}

void proveravanmesta2()
{
    if (s2==0)
    {
        if (s1==0 && znak2==npr[0]) {p1++; return;}
        if (s3==0 && p3==0 && znak2==npr[2]) {p3++; return;}
        if (s4==0 && p4==0 && znak2==npr[3]) {p4++; return;}
    }
}
```

```

}
}

void proveravanmesta3()
{
    if (s3==0)
    {
        if (s2==0 && p2==0 && znak3==npr[1]) {p2++; return;}
        if (s1==0 && p1==0 && znak3==npr[0]) {p1++; return;}
        if (s4==0 && p4==0 && znak3==npr[3]) {p4++; return;}
    }
}

void proveravanmesta4()
{
    if (s4==0)
    {
        if (s3==0 && p3==0 && znak4==npr[2]) {p3++; return;}
        if (s2==0 && p2==0 && znak4==npr[1]) {p2++; return;}
        if (s1==0 && p1==0 && znak4==npr[0]) {p1++; return;}
    }
}

void citajsahom()
{
    int n=0;
    while(n<=1)
    {
        a1=getch();
        switch (a1)
        {
            case '/':
                printf("/");
                n++;
                return;
            case '*':
                printf("*");
                n++;
                return;
            case '-':
                printf("-");
                n++;
                return;
            case '+':
                printf("+");
                n++;
                return;
        }
    }
}

void koordinate(int x, int y)
{
    COORD coord;
    coord.X = x;
    coord.Y = y;

    SetConsoleCursorPosition(GetStdHandle(STD_OUTPUT_HANDLE),
    coord);
}

void tekst(int argc, char *argv[])
{
    char cText[300];
    strcpy(cText, " ");
    strcat(cText, "ZNACKO ");
    strcat(cText, " ");
    int d, i, j, l;
    l = strlen(cText)-125;
    for (i=0;i<l;i++)
        for (j=0;j<80;j++)
        {
            koordinate(j, 1);
            printf("%c", cText[i+j]);
        }
}

```

```
    for (d=0;d<200000;d++);  
  }  
  return 0;  
}
```

III. CONCLUSION

The program “znacko” is written in education purposes. To assembly this program, middle-level knowledge of programming language C is needed, as well as basic math operations.

Our aim is to show the essential elements of the language in real program, but without getting bogged down in details, rules, and exceptions. In any case, experienced programmers should be able to extrapolate from the material in this paper to their own programming needs. Beginners should supplement it by writing small, similar programs of their own.

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Fuzzy Classification of Knowledge of Experts to Assess the Quality of Machine Tools

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Abstract –An approach to a classification of expert knowledge of quality characteristics assessment of machine tools by means the fuzzy inference system MATLAB is considered. The initial matrix data of the quality assessment of the machine tools (objects) is loaded from a database of the application "Qualimetric Expertise", which creates a hierarchy of properties of any subject area and maintains quality evaluation by experts on each property, forming an integrated assessment. The matrix is processed using the taxonomy that divides the objects into disjoint classes. A decision tree constructed from the results of the taxonomy allows us to implement a fuzzy inference system. This needed for performing the taxonomy of new of new examples of the machine tools Thus form an integrated approach, where the quality control, the taxonomy and the fuzzy inference are used jointly for prediction of the class of a new machine tool according to a quality assessment of additional experts.

Qualimetry is the science of measuring and quantifying the quality of all sorts of objects and processes. Qualimetry is a part of the science of the quality of objects. It is a complex science of quality and the quality management, which addresses a variety of methods and means of influencing the quality of the objects in order to increase their ability to meet current and future needs of the people.

In order to conduct their qualitative expertise, specialists within the peer group have to make a simulation model that estimates the quality of the object. The computational model that estimates the object is represented as a tree or a table of properties of an object.

The concept of the fuzzy inference is central in the theory of the fuzzy control. It is based on the concept of a linguistic variable that is different from a numeric variable because its values are not numbers, but words or sentences of a natural or formal language. Since words are less precise than numbers, the concept of a linguistic variable enables us to approximately describe the phenomena that are so complex that they defy the description in conventional quantitative terms. In particular, the fuzzy set, which is a constraint associated with the values of linguistic variables, can be considered as a set of characteristics of the various subclasses of elements of the universal set.

The fuzzy subset is different from the usual one for the elements of X do not give a single answer "no" regarding the properties of R . In this regard, the fuzzy subset A of the universal set E is defined as the set of the ordered pairs $A = \{m_A(x) / x\}$, where $m_A(x)$ is a membership function that takes the value in the ordered set of M (e.g., $M = [0, 1]$).

The membership function indicates the degree of membership of x to the subset A . The basis for the operation of the fuzzy inference is a rule base containing fuzzy statements in the form of "if-then" and the membership functions for the corresponding linguistic variables. In this case there are the following conditions:

1. There is at least one rule for each linguistic term of the output variable.
2. For any term of the input variable, there is at least one rule in which this term is used as a premise.

The result of the fuzzy inference is a clear value of the variable y^* based on the clear set of values x_k , $k = 1, \dots, n$.

I. INTRODUCTION

An approach to classify by means of the fuzzy inference system (MATLAB) the knowledge of experts assessing the quality of machine tools is considered. The initial data on quality assessment of a machine is converted from the database established in the application "Qualimetric Expertise". The matrix is processed using the taxonomy that divides objects into non-overlapping classes. A decision tree constructed from the results of the taxonomy allows you to create a system of the fuzzy inference. This integrated approach when jointly are used the quality control, the taxonomy and the fuzzy inference will help predict on the assessment of additional experts what particular class of quality a machine tool belongs to.

II.

A. The Formalization of the Knowledge on Quality

Quality, as a characteristic of the essence of objects and their properties, has always been of great practical importance for the people. Therefore, issues of quality assessment of everything that concerns a man are still significant.

Attempts of formalizing the human knowledge on quality are often faced with the problem of describing it. There are several methodologies for the formalization of data, of which we consider qualimetry and fuzzy inference system.

In general, there are four stages: the introduction of fuzziness (fuzzification), the fuzzy inference, the composition and the leading to clarity or defuzzification.

The fuzzy inference system is a development of an expert system based on a clear logical conclusion.

The classification problem is to perform the conclusion like this:

$$X = (x_1, x_2, \dots, x_n) \rightarrow y \in \{d_1, d_2, \dots, d_m\}$$

that is, to match one of the numbers d_i of the predetermined classes $\{d_1, d_2, \dots, d_m\}$ to each object specified by the vector of the informative features $X = (x_1, x_2, \dots, x_n)$.

B. The Stages of the Algorithm for Constructing the Fuzzy Inference System

The development and application of our proposed algorithm involves a number of stages:

1. The preparation of the input data
2. The data classification
3. The designing of the rule base
4. The defuzzification of the output variables

B1. The Preparation of the Input Data

The initial values of the data used to assess the quality of a machine tool are in accordance with GOST15467-79"Quality Management". The estimates of these parameters for the two machines 6P13 - 6P13-1 and 6P13-2 are given by the experts in the field of the development and use of machine tools and are stored in the database being designed in the application "QualimetricExpertise"[4]. The assessments can be measured in different ways:

The integers ranging from 0 up to some maximum number;

The real numbers in the range [0,1];

The numbers in a qualimetric scale where values are obtained according to the formula:

$$k = \frac{val - ng}{vg - ng}, \quad (1)$$

Where val is the value of the assessment of property, vg is the upper limit, ng is the lower limit of the property.

The main software system selected is MATLAB. This is a software package for technical computing. It includes the computation, the visualization, and the programming in a comfortable environment. MATLAB is widely used in many fields of research, due to the large number of toolboxes that extend its functionality. A toolbox is a collection of functions written in MATLAB to solve a certain class of problems. The properties from the database of an application "Qualimetric Expertise" are

imported into MATLAB as a matrix(Fig. 1). The rows in the matrix correspond to the experts, and the columns to the marks of features.

Every property of the machine had been evaluated by an expert in a qualimetric scale and the values were computed in [0,1]. Thus, the estimates take on the values 0, 0.25, 0.5,0.75, 1.

B2. The Data Classification

The matrix of data is processed by the classification program kmean, which assigns the class number to each row of the matrix. The number of classes is a set equal to 2 since we consider the estimates of two machines.

According to the results of the classification a decision tree is formed that determines what range of the property values belongs to a particular machine. The decision tree is used in statistics and data analysis for predictive models. The tree structure is made of leaves and edges. On the edges of the decision tree there are written conditions that determine the membership in a particular class, the leaves of the tree are marked with the names of the classes. To classify a new case, it is necessary to go down the tree to a leaf and get the corresponding value of the class number. In case of each node, the left branch means that the condition is true, and the right one – that the condition is false.

Fig. 2 shows a rendered tree. It is evident that it involves only 7 properties out of 37, which means that the remaining ones are uninformative.

B3. The Designing of the Rule Base

The rule base of fuzzy productions is a finite set of rules agreed upon with the reference to the use of linguistic variables. The most common rule base is in the form of the structured text:

RULE_1: IF condition_1 then conclusion_1
 ...
RULE_n: IF condition_n then conclusion_n

With the help of the tree we can construct a system of the fuzzy inference; each branch of the decision tree corresponds to one rule of the fuzzy inference. Fig. 3 shows how these rules look in the main command window of MATLAB

B4. The Defuzzification of the Output Variables.

The defuzzification is a process of bringing the output variable y to the crisp value corresponding to the machine1 and the machine2. For the visualization of the created fuzzy inference system there was designed the GUI - application. It consists of two files with the same name and extension .fig (visual form) and .m (program file). The view of the designed form is shown in Fig. 4.

When you press the button "Choice", the selected values are sent to the program, where the input parameters of the system are formed.

When you press the button "Machine", the output variable is calculated on the basis of the Sugeno fuzzy inference system.

After starting the application, you can see the window (Fig.5), which shows

Figure 1. The matrix of data that are the experts' assessments of properties of machine tools

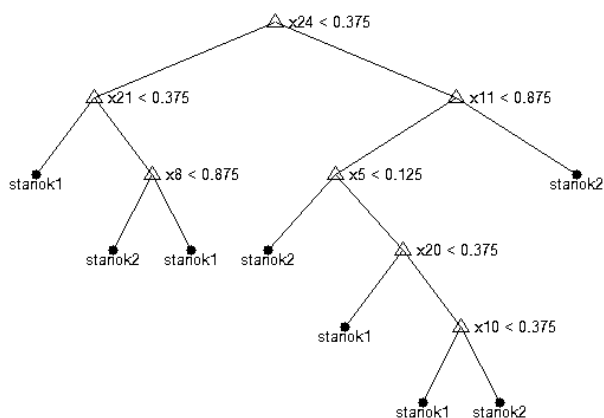


Figure 2. A decision tree based on the results of the classification

```

1. if (x5 is less than 0.125) and (x11 is less than 0.875) and (x24 is more than 0.375) then (y is machine2);
2. if (x5 is more than 0.125) and (x11 is less than 0.375) and (x20 is more than 0.375) and (x4 is more than 0.375) then (y is machine1);
3. if (x5 is more than 0.125) and (x11 is more than 0.375) and (x11 is less than 0.875) and (x20 is more than 0.375) and (x4 is more than 0.375) then (y is machine2);
4. if (x5 is more than 0.125) and (x11 is less than 0.375) and (x20 is less than 0.375) and (x4 is more than 0.375) then (y is machine1);
5. if (x11 is more than 0.875) and (x24 is more than 0.375) then (y is machine2);
6. if (x5 is less than 0.875) and (x21 is more than 0.375) and (x24 is less than 0.375) then (y is machine2);
7. if (x5 is more than 0.875) and (x21 is more than 0.375) and (x24 is less than 0.375) then (y is machine1);
8. if (x21 is less than 0.375) and (x24 is less than 0.375) then (y is machine1);
    
```

Figure 3. The MatLab command window with the established rules of the fuzzy inference system

the result of the fuzzy inference system.

C. Checking the Fuzzy inference System

The fuzzy inference system should in the future classify properly any set of estimates of an expert. To check the efficiency of the formed fuzzy inference system there were generated on 20 rows that satisfy each of eight rules. On the basis of these data there was carried out the fuzzy inference and the calculation of results which determined how many observations yield the result in agreement with the expected one. The output matrix displayed in Fig. 6 gives the scan statistics of the fuzzy inference rules.



Figure 4. The form of the GUI -application of the fuzzy inference system

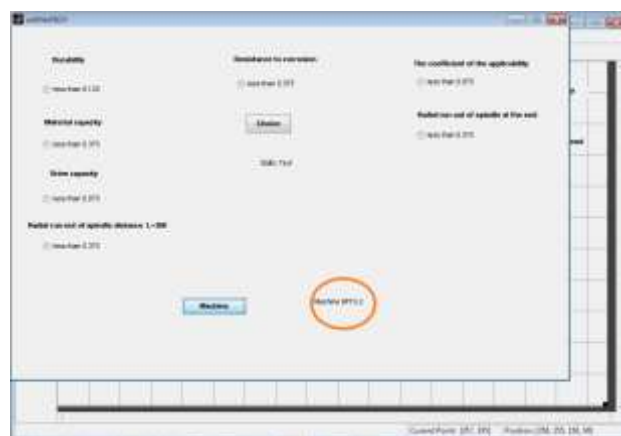


Figure 5. The window of the GUI-application in progress

	1	2	3	4	5	6	7	8
1	20	20	20	20	20	20	20	20
2	20	20	20	20	20	20	20	20
3	20	20	20	20	20	20	20	20
4	20	20	20	20	20	20	20	20
5	20	20	20	20	20	20	20	20
6	20	20	20	20	20	20	20	20
7	20	20	20	20	20	20	20	20
8	20	20	20	20	20	20	20	20
9	20	20	20	20	20	20	20	20
10	20	20	20	20	20	20	20	20
11	20	20	20	20	20	20	20	20
12	20	20	20	20	20	20	20	20
13	20	20	20	20	20	20	20	20
14	20	20	20	20	20	20	20	20
15	20	20	20	20	20	20	20	20
16	20	20	20	20	20	20	20	20
17	20	20	20	20	20	20	20	20
18	20	20	20	20	20	20	20	20
19	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20

Figure 6. The test results of the fuzzy inference system

The rows in the matrix correspond to the individual experiments, the columns –to the numbers of rules of the fuzzy inference system, The cells contain the number of cases of the coincidence of the fuzzy inference with the class corresponds to this rule. There is a complete agreement on the values in case of all rules of the inference, which confirms the validity of applying the proposed approach to the construction and use of the fuzzy inference system.

III. CONCLUSION

There was for the first time considered the joint application of the qualimetric expertise and the fuzzy inference system for evaluating the quality of machine tools. Based on two methodologies of the formalization of data there was established the software system for the fuzzy classification of the expert's knowledge on machine tools.

In the future this software package will help predict according to the entered data which machine complies the introduced expert's estimates.

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Visualization of 3D Structural Analysis Data

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Abstract - This paper presents development of procedure for visualization of structural analysis input and output data. Analysis of prismatic shells is performed using the finite strip method. Model of the structural system is divided into fine mesh of polygons. Color mapping technique is applied for stress field visualization. Programming is done using the Mathematica language. Results are images of deformed structure along with isosurfaces of stress field. Examples of buckling mode shapes and geometrical nonlinear structural response are given.

I. INTRODUCTION

Visualization is recognized as an essential tool in science and engineering. Accurate representation of input and output data is an important task for the computer modeling of engineering structures [1]. Today there exist a large number of powerful computational tools for simulation of different physical phenomena. For complex structures, these tools usually produce a large amount of information as an output. Obtained data is difficult to interpret without the proper visualization. This is especially true for nonlinear analysis, where the behavior of structure throughout complete equilibrium path is of interest to researchers.

Finite element method (FEM) is a recognized as the most powerful numerical procedure which can accurately describe complex physical phenomena. FEM software systems are usually enhanced with postprocessors which allow simulation experts to examine results visually. Hence, visualization of structural displacement and stress field from FEM results is a common procedure. Many commercial packages have facilities for performing such visualization in the form of three-dimensional (3D) maps, isoline or isosurface plots, animation pictures, etc. Most prominent of them are: Abaqus, SAP2000, ANSYS, ADINA etc. Example of isosurface stress field visualization obtained with Abaqus is given in Fig. 1

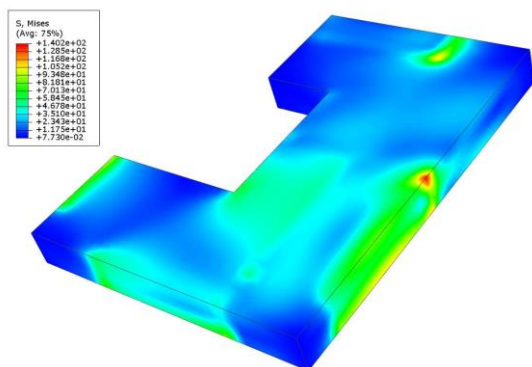


Figure 1. Isosurface visualization of 3D solid structure stress field

A general method for the post-processing treatment of high-order finite element fields is discussed in [2]. The visualization of dynamic response is studied in [3] while the importance of visualization for engineering education is emphasized in [4].

The finite strip method (FSM) is a popular structural analysis technique suitable for analysis of prismatic shell structures [5]. It is less versatile than the FEM but more computationally efficient for some classes of structures. This is the method of semi-analytical nature, contrary to FEM which is purely numerical. There is not a great deal of literature dedicated to visualization of FSM input and output data. Some efforts for automatic visualization are presented in [6].

Scientific visualization using computer graphics gained in popularity as graphics matured. Primary applications were scalar and vector fields obtained from computer simulations. The primary method for visualizing two dimensional (2D) and 3D scalar fields is color mapping. 2D and 3D vector fields are visualized using glyphs and streamlines, while 2D and 3D tensor fields are often resolved to a vector fields. Visualization of numerical results is a very convenient method to understand and assess a solution which is calculated as a set of great number of numerical values.

The term 'field' is used herein to refer to a process which associates a physical quantity with each point in a region of space.

Aim of this paper is to present achievements of the visualization of FSM input and output data using the Wolfram Mathematica as a tool. Brief description of adopted FSM strip, its displacement field and solution procedure are given in the next section. Visualization techniques used here are shortly explained, and at the end, two illustrative examples are given.

II. FINITE STRIP METHOD

Basic idea of FSM is to discretize 'long' regular structure into mesh of finite strips. Unlike the FEM, where the elements are connected at the nodes, in FSM strips are connected at nodal lines, Fig. 1. Due to this fact, FSM is more efficient than FEM for some specific structures with regular geometry, such as: thin-walled beams, bridge slabs, box girders, roofs consisting of plane elements, etc.

Classical rectangular LO2 strip given in Fig. 2 has eight degrees of freedom [5]. Kirchhoff-Love thin plate bending theory is used for modelling of the strip structural behavior. This classic theory provides simplification such that displacement components of 3D plate become functions of only the displacement of the middle plane.

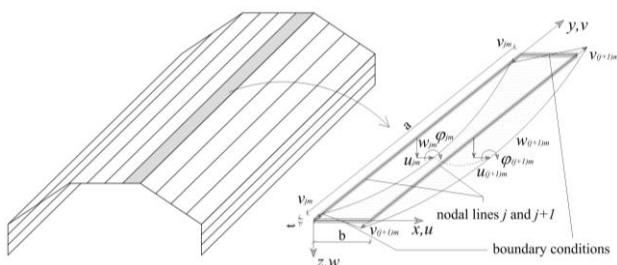


Figure 2. FSM discretization of structure using LO2 finite strip

The general form of the approximative displacement functions is adopted as series of products of polynomials and trigonometric functions:

$$u_0(x, y) = \sum_{m=1}^{nst} u_{0m}(x)Y_m(y), \quad v_0(x, y) = \sum_{m=1}^{nst} v_{0m}(x)Y_m^v(y), \quad (1)$$

$$w(x, y) = \sum_{m=1}^{nst} w_m(x)Y_m(y),$$

where *nst* is the number of series terms considered in analysis. Functions $Y_m(y)$ are chosen as the free vibration eigenfunctions of Bernoulli-Euler beam. For simply supported boundary conditions, $Y_m(y) = \sin(m\pi y/a)$. In order to satisfy boundary conditions $v(0) \neq 0$ and $v(a) \neq 0$, function $Y_m^v(y)$ is usually taken as $\cos(m\pi y/a)$, and here it is used only for buckling analysis. This function cannot adequately describe end-shortening when the nonlinear effects are considered. Hence, the other function is used for this type of analysis:

$$Y_1^v = \frac{a}{2} - y \quad Y_m^v = \sin\left(\frac{(m-1)\pi y}{a}\right), \quad m = 2, 3, \dots, nst. \quad (2)$$

Polynomials chosen here are linear for in-plane and cubic for out-of-plane displacement components:

$$u_{0m}(x) = (1 - \xi)u_{jm} + \xi u_{(j+1)m} \quad \xi = x/b \quad (3)$$

$$v_{0m}(x) = (1 - \xi)v_{jm} + \xi v_{(j+1)m}$$

$$w_m(x) = (1 - 3\xi^2 + 2\xi^3)w_{jm} + (x - 2b\xi^2 + b\xi^3)\phi_{jm} + (3\xi^2 + 2\xi^3)w_{(j+1)m} + (-b\xi^2 + b\xi^3)\phi_{(j+1)m}.$$

According to adopted approximation of displacement field, total potential energy of a system is calculated and stiffness matrices and load vectors are obtained [5].

After the derivation of required matrices, computer implementation starts. Simplified flowchart of FSM program is given in Fig. 3.

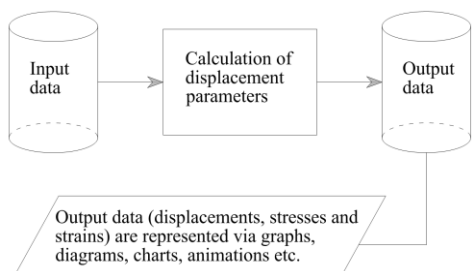


Figure 3. Simplified flowchart of FSM program

Calculation of displacement parameters is essential step in structural analysis. Depending on the problem, this part of the code deals with the solution procedure for linear or nonlinear system of equations, and it is explained elsewhere [5]. This paper emphasizes the final step - representation of output data.

III. DATA VISUALIZATION

Approach to data visualization significantly depends on the available tool. Wolfram Mathematica, which is chosen here, provides unified graphics support for 2D and 3D polygons, allowing all standard colors and transparency to be used for both faces and edges. Main graphic element used in presented research is simple *Polygon[]*, which is graphic primitive that represents filled polygon. In order to get whole assembled structure image, *Graphics3D[]* function is used. It represents 3D graphical image with a range of modifiable parameters.

Discretization approach of the FSM makes possible specific and efficient visualization by adequate morphing and coloring of the strips themselves. However this is quite complex task for programming and the simpler approach via polygons is used at the moment. Each strip is divided into desired number of polygons which are appropriately positioned or colored.

Before the visualization of output data, it is necessary to graphically show input data, in order to check model geometry, mesh, loading, boundary conditions etc. This is achieved by rendering image of structure via coordinates of undeformed configuration. These coordinates are defined as a function of given geometry and desired number of polygons used for rendering. Graphic primitive *Polygon[]* takes these coordinates as arguments. Using the table of defined polygons and function *Graphics3D[]*, structure image is rendered with all other necessary data. Since the presented FSM models thin-walled structures, no polygon thickness is needed.

There are three types of output data which are of interest in structural analysis: scalar, vector and tensor fields. In this research only displacement and stress fields are visualized. Displacement is a vector, and the stress is a tensor field. Both of these fields are three-dimensional because their value depends on the position in the space. Unfortunately, tensor fields are very difficult for visualization. For example, complete stress tensor for 3D problems has six different components which are almost impossible to present in one image. Therefore, only separate stress components are visualized here, and they can be considered as scalar fields.

For 3D scalar fields, one of the primary visualization methods is *volume rendering*. This method is a set of techniques used to display a 2D projection of a 3D discretely sampled data set. One of the volume rendering techniques, namely *texture mapping*, is suitable for FSM stress field representation. This method adds surface texture or color to a polygon [7]. In this research, only the appropriate colors are mapped to each surface of polygon, which further simplifies procedure. This method is known as *color mapping*.

Color is chosen according to maximum and minimum value of the considered field. *Rainbow* gradient is used here. Coolest hue is assigned to minimum value, while

the warmest hue is assigned to maximum value. All other values are associated with colors determined with linear interpolation. Color map is applied as a function of the field value in the center of each polygon. Due to non-uniform stress distribution through shell thickness, different colors are applied on outer and inner polygon surface. In this way, every polygon becomes appropriately colored which gives clear picture of the stress field. As the mesh of polygons becomes denser, smooth isosurfaces becomes evident. Since the thin plate stress field consists of three components, it is necessary to plot three images.

Displacement field of the structure is visualized via simple addition of displacement vectors to the undeformed coordinates of structure. In this way, coordinates of the deformed structure are calculated and positions of polygons are defined. Obtained image gives appropriate visualization of structure displacement field.

IV. EXAMPLES

Presented FSM procedure and data visualization approach are implemented in Wolfram Mathematica. Although not the most efficient programming environment, this software is very convenient during the developing phases. After the code is completed, it can be translated to some low-level programming language. On the other hand, Mathematica is perfectly suited for visualization of output data because of wide range of its powerful built-in graphic functions [8].

A. Buckling of thin-walled beam

Simply supported I-section beam, as in Fig. 4, is subjected to uniform compression. Intensity of the load which causes loss of original equilibrium configuration is known as *buckling load*. Appropriate new equilibrium configuration is called *buckling mode shape*. They are obtained as a solution of eigenvalue problem.

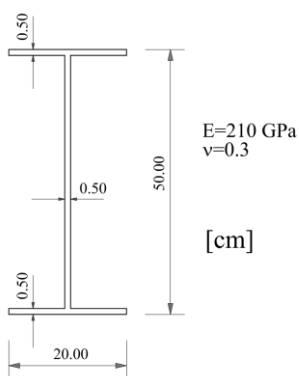


Figure 4. Geometric and material properties of I-section beam

Figs. 5, 6 and 7 show visualizations of obtained buckling mode shapes. The first three modes are calculated for three different beam lengths, from 6 to 12 meters. It is of immense interest for engineer to carefully examine the mode shapes, and to determine the influence of length and cross-section properties in order to carry out safe and efficient design. In this example, influence of length on appearance of local, global and torsional mode

shapes is obvious. It is observed that as the length increases, mode shapes are changing from local to global.

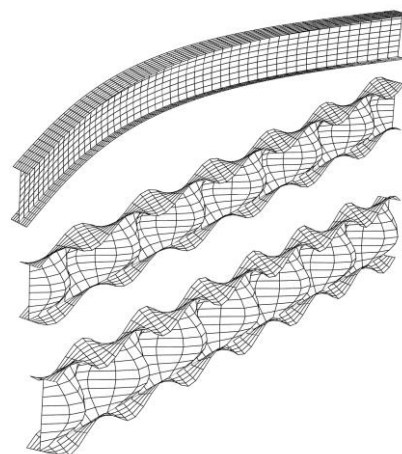


Figure 5. Visualization of the first three buckling modes for L=6 m

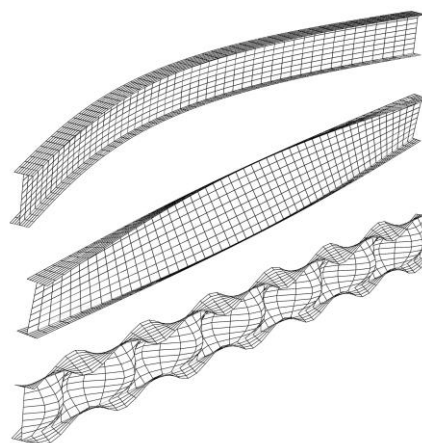


Figure 6. Visualization of the first three buckling modes for L=9 m

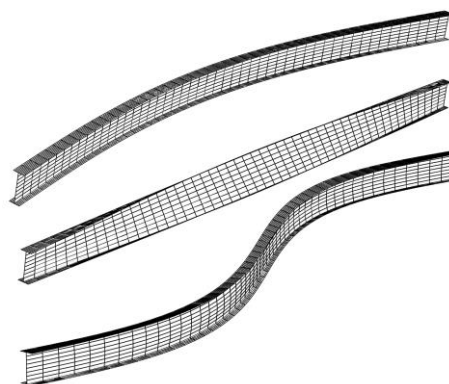


Figure 7. Visualization of the first three buckling modes for L=12 m

B. Circular shell

Cylindrical shell with circular cross-section is subjected to uniform transverse loading, Fig. 8. Shell is 40 meters long. Geometric nonlinear static analysis is

performed. Results are given just for the last increment of loading.

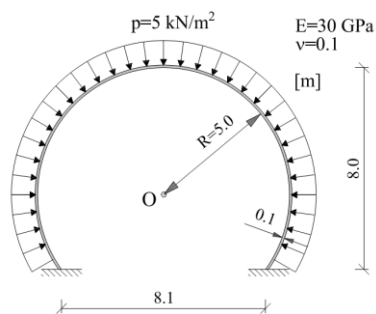


Figure 8. Circular shell cross-section and load disposition

In Figs. 9, 10 and 11, visualization of obtained output data is shown. Deformed shape is given in Fig. 9, while the stress distributions are presented in Figs. 10 and 11. Mathematica provides convenient options to zoom, pan and rotate 3D graphics. Animations are also relatively easy to implement. All of these enable detailed examination of each structural part. Analysed example is relatively simple, but presented approach is also applicable to structures with more complex geometry.

This kind of representation of stress field enables engineer to carefully check the influences of geometry, load disposition and boundary conditions on structural response.

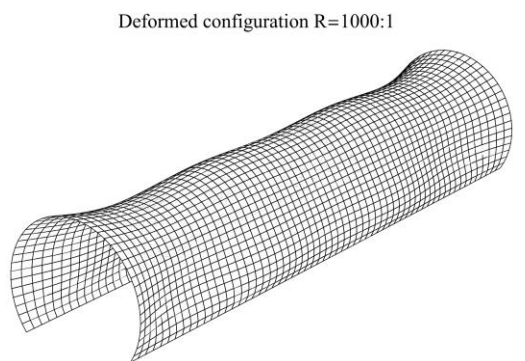


Figure 9. Visualization of deformed shape

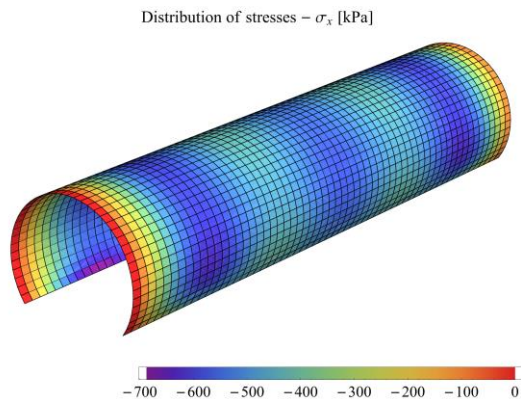


Figure 10. Visualization of x stress component

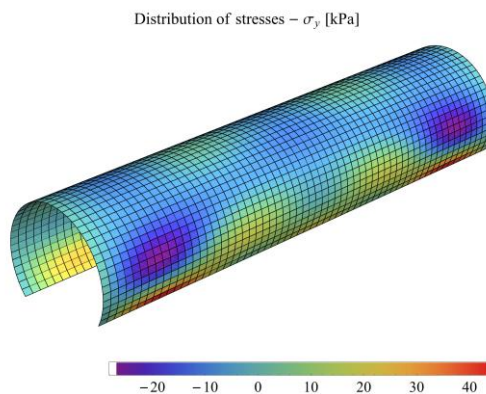


Figure 11. Visualization of y stress component

V. CONCLUSION

Design of complex structures by the means of numerical methods gives rise to amount of output results. Hence, appropriate visualization of structural analysis data is of great importance. Well-presented detailed data helps engineer to perform good design.

Presented approach is well-suited for visualization of FSM output data. Animations, which are of interest in dynamic analysis of structures, are also implemented in the code. Next improvements will lead to introduction of tools which should enable simple real-time simulations of structural behavior.

ACKNOWLEDGMENT

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Importance of UML in Modelling as Part of Information Systems' Development

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Abstract - Information systems play a big part in today's day-to-day business of companies worldwide. Most of the companies invest high amounts in information systems which will enable right decisions in dynamic business environment. The development of information systems is a long process which has its own life cycle and depends in high amount from project manager, user's demands and communication between both sides. Two most important phases in life cycle of information systems development are user's demands analysis and modeling of the information system. In this article will be considered the importance of modeling of the information system with the use of MDA and UML through an overview on the state of the art and detected trends in the development of the field based on Google Scholar research database.

I. INTRODUCTION

Life cycle of software development consists of several phases: user's demands gathering, demand analysis, design, implementation, testing [1]. All of the phases have a crucial role in completing software. Mistakes in any of the phases can make enormous expenses, especially when using agile or iterative method of software development. Monitoring and indexing this kind of documentation that follows these phases are quite intense and require a special kind of the solution for fast finding of artifacts using key words[2].

At the end of the last century, with the appearance of UML, things changed dramatically. UML is a tool for modeling, visualization and documentation of information system elements [3] [4]. UML was created in 1995, by Grady Booch, Ivar Jacobson and James Rumbauch [5]. This tool represents a foundation for many other theories, standards and specifications for document analysis and software design. UML consists of 2 main parts:

- Structural part, which is used for defining of basic model structures. That is the basic class model.
- Behavioral part, which is used for modeling of activities, call sequences and dealing of behavioral demands in general.

The use of UML as a tool in software development is wide and in constant improvement. For example, some UML profiles could be applied on different virtual machines, such as in [2], [6], and [7].

A meta language called Meta Object Facility (MOF) [8] has been created on the foundations of the UML. It's purpose is definition and description of the group of

languages, which can be used for modeling of information systems. MOF is a project which came into being inside the OMG (Object Management Group), with the intention wider than describing of UML. MOF is a standard which defines a framework for meta data management and a group of services for modeling tools development[9].

MDA (*The ModelDriven Architecture*) initiative, under the leadership of OMG, was created in 2001. MDA is a part of MDE (*Model Driven Engineering*) movement in software development. In MDE approach, the model of considered system on a high level of abstraction is treated like a part of implementation. This is done because of the automated procedures, who translate it on the programme code through one more more transformations. This programme code is executed directly on the goal platform. With model- based approaches outside the MDA, model is used just for analysis, better understanding and documentation of the sistem [Stahl06].

Basic idea of MDA is the use of language for modeling as a programming language instead of software design tools. Basic part of MDA is a procedure of model transformation with diferent abstraction levels. MDA defines three tipes of models, whose transformations give programme code on the selected platform.

CIM (Computation Independent Model) represents a model which does not represent structure details of the system.

PIM (Platform Independent Model) represents a perspective on a system independent from platform on which the system will be implemented. Indenpendency from the platform is defined like independent from a specific platform, e.g. a model independent from the system for database management. UML is a language which is, in general, independent from platform on which the sistem will be executed.

PSM (Platform Specific Model) is a combination of specification from PIM and details about how a specific system uses a specific implementation platform.

MDA initiative defines a framework for software development in which central place is taken for model on the high level of abstraction, which is independent from a specific implementing platform. Mission of a project

team is to describe their system inside the PIM, after which are used tools for generation one or more platform dependent models based on predefined rules for transformation. PSMs, after eventual manual adjustments by project team, are used for automatic generation of the programming code or direct execution [10].

Beside fast development which can be achieved with intensive use of the tools, MDA is trying to solve problems in software development which still exist, like: transfer on different platforms, problem of interoperability, problem of documentation and upkeep [11]. It is expected several years of growth is needed to achieving the maximum stage of maturity, when an improvement in assembler's language software development is expected.

The goal of this paper is an overview of the basics of software development lead by a model with the focus on MDA approach and the use of UML and presentation of an overview on the state of the art in the field. Based on selected literature, we are able to describe the different areas of research within the field of software development process support on the model to detect trends in the development of the field.

II. RESEARCH

The importance of modeling in software development based on UML tool will be discussed similar as Koch and Hagglund [12] have proven the importance of health informatics.

Based on a review of existing scientific literature in the area, analysis shows the cover of modeling with UML in informatics science. UML use analysis must be covered with the Model-driven architecture scientific literature, as a general subject above UML. The research of the scientific literature is done with Publish or Perish, a program that retrieves and analyses academic citations [13].

General citation search - Perform a general citation search

Author(s):
 Publication:
 All of the words:
 Any of the words:
 None of the words:
 The phrase: Unified Modeling Language
 Year of publication between: 1995 and: 2012 Title words only
 Data source: Google Scholar

Results

Papers:	896	Papers/author:	609.15	h-index:	37	Unified Modeling Language from 1995 to 2012.
Citations:	22816	Cites/year:	1200.84	g-index:	147	Query date: 2013-09-29
Years:	19	Cites/author/year:	799.56	hc-index:	23	Papers: 896
Cites/paper:	25.46	hI, annual:	1.47	hI, norm:	28	Citations: 22816
						Years: 19

Cites	Per year	Rank	Authors	Title	Year
9487	1054.11	3	G Booch	The Unified Modeling Language User Guide, 2/E	2005
3783	252.20	2	J Rumbaugh, I Jacobson, ...	The unified modeling language reference manual	1999
2535	158.44	14	G Booch, J Rumbaugh...	The Unified Modeling Language (UML)	1998
413	24.29	4	G Booch, J Rumbaugh, I.J...	The Unified Modeling Language For Object-Orient...	1997
402	33.50	5	N Medvidovic, DS Rosenbl...	Modeling software architectures in the Unified Mo...	2002
357	22.31	35	JD Furlan	Modelagem de objetos através da UML-the unifie...	1998
346	24.71	6	T Fischer, J Niere, L Torun...	Story diagrams: A new graph rewrite language ba...	2000
242	13.44	7	G Booch, J Rumbaugh, I.J...	The unified modeling language	1996
206	12.12	79	H Elmqvist, F Boudaud, J.B...	ModelicaTM-A Unified Object-Oriented Language f...	1997
199	11.71	10	G Booch, J Rumbaugh, I.J...	Unified modeling language user guide	1997
193	11.35	9	R Brey, U Hinkel, C Hofma...	Towards a formalization of the unified modeling la...	1997
190	12.67	11	G Booch, J Rumbaugh, I.J...	The unified modeling language user guide	1999

Figure 1. An example of using Publish or Perish Windows application

Publish or Perish is a software program that retrieves and analyzes academic citations. It uses Google Scholar to obtain the raw citations, then analyzes these and calculates a series of citation metrics [13]. A Google Scholar Universal Gadget which enables users to search for the total number of citations of author(s). It provides a total citation count, total number of cited publications and Jorge E. Hirsch's H-Index [14].

The **h-index** is an index that attempts to measure both the productivity and impact of the published work of a scientist or scholar. The index is based on the set of the scientist's most cited papers and the number of citations that they have received in other publications. The index can also be applied to the productivity and impact of a group of scientists, such as a department or university or country, as well as a scholarly journal. The index was suggested by Jorge E. Hirsch, a physicist at UCSD, as a tool for determining theoretical physicists' relative quality and is sometimes called the Hirsch index or Hirsch number [15].

According to [13] Publish or Perish calculates the following citation metrics:

- Total number of papers
- Total number of citations
- Average number of citations per paper
- Average number of citations per author
- Average number of citations per author per year
- Average number of papers per author
- Average number of authors per paper
- Hirsch's h-index and related parameters, shown as h-index and Hirsch
- Egghe's g-index, shown as g-index in the output
- The contemporary h-index, shown as hc-index
- Three variations of the individual h-index, shown as hI-index, hI,norm, and hm-index in the output
- The average annual increase in the individual h-index, shown as hI,annual
- The age-weighted citation rate
- An analysis of the number of authors per paper.

Publish or Perish is designed to empower individual academics to present their case for research impact to its best advantage [13]. Because of all of the possibilities and advantages of this program, it is the most suitable tool for any kind of research on the state of the art in any field.

The study is based on the literature published from 1995 to 2012 using the key words: "Unified", "Modeling", "Language" in one query and "Model", "Driven" and "Architecture" in other. Query showed 889 academic publications which contained first three key words in the title and 778 publications about Model-Driven Architecture.

Result of the query showed a number of papers which didn't have information about year of publication and publisher and weren't available for any further analysis.

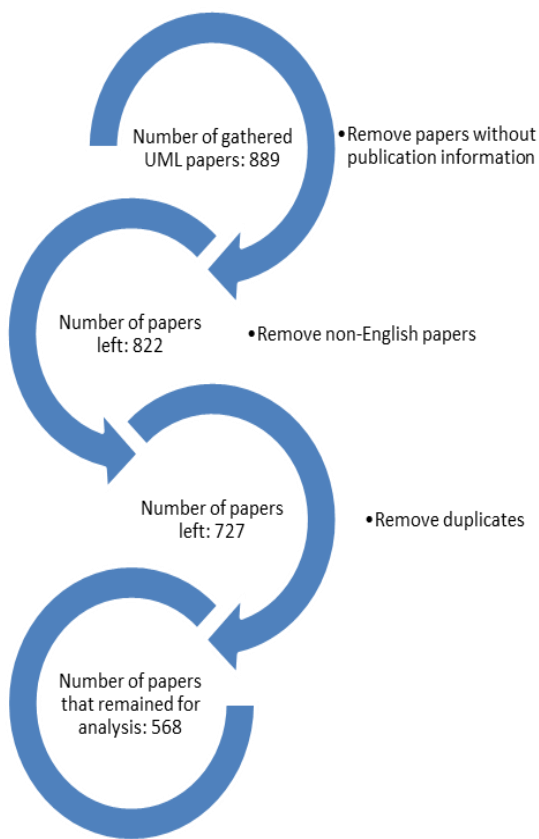


Figure 2. Selection process for UML papers

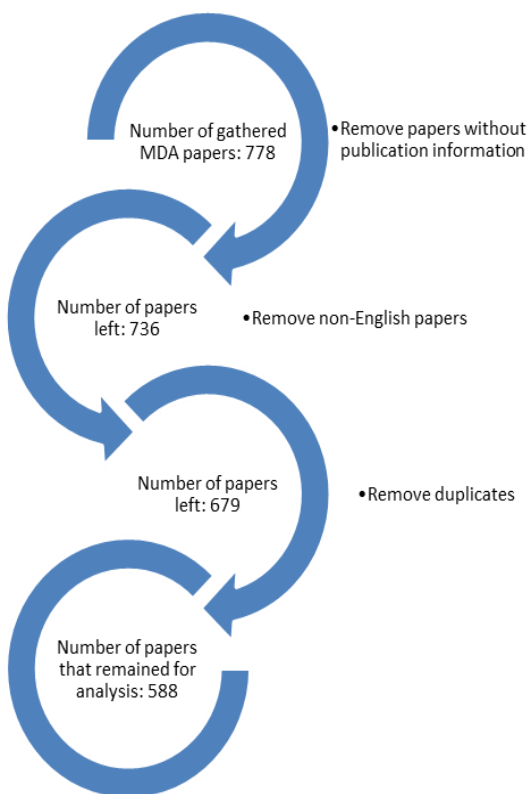


Figure 3. Selection process for MDA papers

Publications written in languages other than English were left out because of lack of understanding and possibility of analyzing the publications. Duplicates were also left out in order not to blur the results of the research. This leads to the number of 588 MDA papers and 568 UML papers. The selection process has been presented in the Fig. 2 and 3.

III. STUDY SELECTION

This section describes the research methodology. For a first selection, the titles of all articles were overviewed to decide if they were within the interest area.

To be included, articles had to focus on either:

- Development of computer modeling tools and programs, new models and algorithms, software development technology and review on the existing methods of software development such as Model-Driven Architecture (MDA), Use-case as the evaluation of the above-mentioned technologies and methods, or other user' demands analysis methods or modeling support tools.
- Unified modeling language original papers, reviews, comparison with other modeling tools and guides.

Original articles were then categorized according to the following criteria:

- publication type,
- year of publication,
- topic covered with the paper

Publication type (Table 1) included the following sub-categories:

- *Description*— the description of the UML,
- *Analysis*— mainly explorative studies to analyze pros and cons of the UML comparing to other tools, thesis considering the UML and resolving common issues with or about UML,
- *Method description*— the development of new methods using UML,
- *Evaluation*— includes all studies that evaluate the effects of implemented technology.

TABLE 1. PUBLICATION TYPE ANALYSIS

UML papers:	
Description	210
Analysis	96
Method description	94
Evaluation	168
MDA papers:	
Description	113
Analysis	62
Method description	150

Analysis of publication type showed highest number of description UML papers, such as guides and manuals, also introductions and tips. Evaluation papers mostly rely on evaluation of results that UML-based implemented technology achieved in specific software development.

On the other hand, the highest number of MDA papers was evaluation of achieved results when applying MDA in software development. It is important to emphasize the number of new technologies developed on the foundations of MDA, the number of 150 papers.

Year of publication (Fig. 4) analysis should show the interest for this subject and also show the importance of UML and MDA from the scientific perspective.

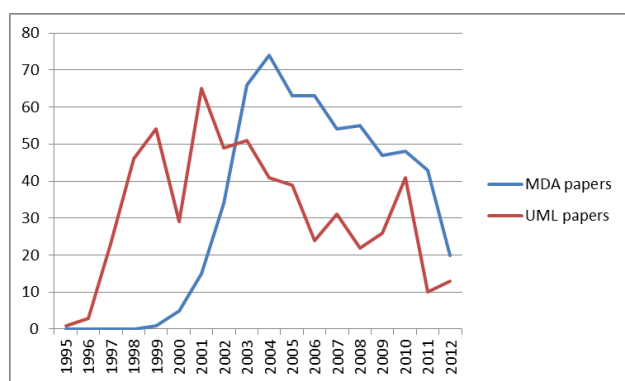


Figure 4. Year of publication analysis

Looking on the real numbers (Table 2), we can notice better interest in the last 10 years for the MDA, and opposite moving of the interest for UML as a subject for a scientific paper.

TABLE 2. YEAR OF PUBLICATION ANALYSIS

Year of publication	MDA papers	UML papers
1995	0	1
1996	0	3
1997	0	23
1998	0	46
1999	1	54
2000	5	29
2001	15	65
2002	34	49
2003	66	51
2004	74	41
2005	63	39
2006	63	24
2007	54	31
2008	55	22
2009	47	26
2010	48	41
2011	43	10

Results show increase of interest until 2001 when it reached its maximum and then a slight fall until 2009 when UML 2.0 had appeared and got back the interest in this subject. As for the matter of MDA, there is no major interest for this subject in scientific papers until 1999 when the interest had started to rise and reached its maximum in 2004, and since then the interest has been decreasing, but less than interest in UML. As for the record, current number of written papers about this subject in 2013 follows the trend with decreased interest and number of published works.

Topic covered with the paper analysis (Table 2) has been consisted of several major topics. A paper belongs to a general topic:

- Information system, when papers includes UML or MDA in information system development,
- Emerging technologies, when new approach to the UML or MDA is set in the paper,
- Informatics methods, when a paper describes a method of using UML or MDA,
- General, when a paper describes UML or MDA in a general way.

Analysis shows highest number of general papers, which is the widest topic. Except general papers, information system in UML and emerging technologies in MDA papers is highly represented.

TABLE 3. TOPIC COVERED WITH THE PAPER ANALYSIS

UML papers:	
Information system	175
Emerging technologies	94
Informatics methods	32
General	267
MDA papers:	
Information system	116
Emerging technologies	150
Informatics methods	85
General	237

IV. CONCLUSION

With all the data Publish or Perish provided and all the analysis of the data, we can conclude that Unified Modeling Language is a wide spread subject in scientific papers in the area of information technology. Since the information technology is the fastest developing science, there is no wonder why was it so difficult to narrow the research under one thousand papers, which is program's query limit.

Even in the fastest developing science, UML and MDA managed to stay in interest area of many scientists for 18 years, which means that there were always

unexplored perspectives and ways of improving of these tools. In addition, UML and MDA were a foundation to many other tools and software development solutions which lead to high number of new approaches and methods for software development.

The UML has become a standard tool in software development, and with its improvements it is being used by more and more software developers. Today, when talking about modeling, it is impossible to do it without talking about Unified Modeling Language and its parts, as well as MDA in modern development environment.

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Terminal for Remote Sensing in Tax Administration

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Abstract - Reform and modernization of tax administration based on the extensive use of ICT is one of the key elements of the overall transition of the Republic of Serbia into the modern information society. The introduction of modern information systems increases the quality of services and improve efficiency, transparency, accountability and effectiveness of tax administration, all in order to ensure effective collection of taxes. Information technology allows the tax administration to more easily manage the tax system, through the establishment of rapid access to important information about the risks of managing and providing a higher degree of transparency of internal processes, thereby reducing risks to the administration. With a terminal for remote sensing, it is possible to get in a relatively short period of time information on all taxpayers who have not timely filed tax return or made a payment of tax.

Keywords: Information technology, Tax Administration, terminal for remote sensing

I. INTRODUCTION

Law on Tax Procedure and Tax Administration provides for the fundamental rights and obligations of taxpayers and tax administration as well as key business processes in tax administration, including the important role monitoring of tax liability, risk management, control and investigation of taxpayers. [6] The overall aim of the control is to taxpayers through efficient control and effective mitigation of tax risks provide a fair tax regime in the country. In order to achieve this it is necessary to (a) establish a system for monitoring the settlement of tax obligations and risk assessment, (b) defining the adequate approach taxpayers based on a detailed risk assessment and segmentation of taxpayers, and (c) the design and implementation of an effective system for the collection debt.

Program performance inspection, checking and verification of the legality and regularity of meeting tax obligations performed by the Tax Administration, is usually based on different data sources with the use of control methods. The control program it is important that the scope of the taxpayers who are subject to a control procedure based on selective, quantitative and comparative criteria, and the process begins by checking the tax returns and payments due from the taxpayer in the prescribed time.

Information technology is facilitating the efforts of the Tax Administration to administer the tax system, through

the establishment of rapid access to important information about the risk management and ensuring a higher degree of transparency of internal processes, thereby reducing risks to the administration.

II. TAX ADMINISTRATION REFORM

Tax reform after the 2000th has contributed to a significant increase in the transparency of the tax system, its decentralization and adaptation needs of the market economy, but it is nevertheless necessary that the trend continues, primarily to ensure effective tax collection. The current information system of the Tax Administration was not developed to a degree that would enable the desired level of support for all key business processes, including the control and management functions.

For all core business processes, it is necessary to collect the minimum amount of data to achieve efficiency and effectiveness of the process. [2] Data collected at a common place (Data Warehouse) should be available to managers at all levels of the Tax Administration. Also, the data should be available and the organizational units and agencies within the Ministry of Finance for the purpose of performing a variety of analyzes, particularly analyzes the macroeconomic and fiscal developments with the assessment of the effects of laws and other normative acts and measures of economic and fiscal policy. The primary goal is to develop a data warehouse infrastructure (EDW), and providing interfaces for key business processes in order to achieve communication with the EDW, which should make an integrated and consolidated data Tax Administration and other government agencies and organizations that provide unlimited opportunities for analysis data. Data analysis to support risk analysis process in tax administration, which are a prerequisite for the control of the taxpayer and more efficient use of internal resources.

In addition to providing management information for Tax Administration, Ministry of Finance, it is necessary to provide a system for risk analysis that provides a new approach to control the activities of Tax Administration based on risk analysis and automation of the election subject to control. The development of profiles of taxpayers according to the level of risk, impact on

reducing the time required to administer the revenues and the number of tax evasion or fraud. [3]

Through simplified administrative procedures attempt to provide timely and quality data management and control of public revenues [1] and thus contribute to the modernization and efficient operation of the Tax Administration.

Management at all levels of Tax administration based on planning business processes and resources needed for different time horizons and different activities. Management processes should have comprehensive information on what is happening in the Tax Administration in management information systems.

Management information system should make the following changes: [4]

- Establish a new approach to planning and conducting control activities Tax Administration implementation of the control system based on risk analysis and segmentation of taxpayers and the development of profiles of taxpayers according to the level of risk,
- Strengthening of tax control and increase the efficiency of tax inspections,
- Strengthen the function of the tax police in the detection of tax crimes and their perpetrators,
- Reduce the time required for the administration of public revenue and reducing tax evasion and fraud,
- Speeding up decision-making through the provision of high-quality reports on operational management,
- Improve business process planning tool availability of quality data about the performance of business processes with the ability to obtain quality analysis and statistical review.

The goals of management information system related to improve the overall performance of Tax administration by collecting information about the activities of various business processes, providing access to information to all responsible managers at all levels of management.

III. THE IMPORTANCE OF THE TERMINAL FOR REMOTE SENSING

Terminal for remote sensing is used for wireless transfer of data of daily reports from the cash register, for a given period, to the server in the Tax Administration, through the GPRS mobile phone network. On the basis of data transferred will be easy to determine which of the taxpayer failed to comply with its legal obligation, and therefore will reduce the need for direct control by the Tax administration.

GPRS terminal for sensing the cash register has two basic functions: (a) connection to server Tax Administration for wireless transmission of daily reports and (b) the relationship with the owner of the cash

register work of updating the list of items, tax rates and the like. [5]

Communication between the server and client side is authenticated and encrypted, protecting the system from abuse. Communicator occupies the same area as the cash itself, is under the counter and it makes a whole. The system components are:

1. Client side:

- Cash register,
- Communicator ITGcc-0x,
- Controller ITGcc-03A,
- Controller ITGcc-03B,
- Controller ITGcc-03C with built-in GSM / GPRS modem.

2. Server side:

- The central computer equipped with the program administrator,
- Communication subsystem with the required number of GSM or standard modems.

The communicator over fiscal report at the request of the operator panel. This report, as well as reports on the volume of sales, delivery server application that can come at any time. In the same way, a server at an arbitrary time table items delivered communicator which then updates the cash register.

Basic features of this solution are the following:

- Download daily fiscal reports,
- Download daily reports on sales volume for sold items and operators,
- Database update items in the cash register (adding and deleting, and changes in prices and tax rates of individual items),
- Generate fiscal reports requested by the server without the active participation of operators,
- Receipt of reports on the volume of sales of all items from the last day of the fiscal reports to the moment generating requirements,
- Getting reports of a certain volume of sales items from the last day of the fiscal reports to the moment generating requirements,
- Minimum commitment and skilled operators to trot,
- Currently up to date sales information at the cash register,
- Communicator can store in its memory up to 7 daily fiscal reports and 7 daily reports on sales volume. [5]

The communication between server of the Tax Administration with the terminals is carried out in several steps. Cashier daily report form to be entered in the fiscal memory and then pressing the button on the terminal before the expiration of a specified period for sending daily reports. Terminal automatically activates visual indication no. 1 and thus the need to remind the cashier pressed, at least 12 hours before the date and time for sending daily reports, which are received by the previous

command (manually activate the daily reading of the report of the fiscal memory). If it comes to automatic reading the daily reports from the fiscal memory terminal automatically detects the completion of the formation of the daily report at the end of each working day. After that, the terminal sends the fiscal cash register command to read the daily reports from the fiscal memory (via RS232), based on any kind of activation read daily reports from the fiscal memory.

Terminal reads the fiscal memory (RS232 interface) (a) if the cash register allows reading the last daily report of the fiscal memory, then at the end of every working day reading the last daily report of the fiscal memory and writes to memory terminals, (b) the cash register allows reading of all daily reports in a given period of time, then just read these daily reports and saved in the terminal, and (c) inhibit the cash register just read the entire fiscal memory, then read the entire fiscal memory, wherein the terminal ignores all readings daily reports are not intended to send, and allocates the read daily reports in a given period of time, which are intended to be sent. During Fiscal memory triggers a visual indication no. 2, which means that reading the fiscal memory is in progress.

Terminal formatted readings daily reports that are designed to send in unique formats, identical for all cash registers which includes turnover of the tax rates, data resetting and specify tax rates, and keeps them in memory buffer for sending via GPRS networks. During formatting and submitting daily reports via GPRS activated visual indication no. 3, which indicates that daily reports are not received correctly in the server of Tax Administration. All terminals in the network of mobile operator to pay a single IP address, which may be the address in server of the Tax Administration or a router that forwards traffic to the server Tax Administration.

Due to the large number of terminals to communicate and dynamic addressing, server of the Tax Administration connects directly to the GPRS logical node and is in the network service provider. Terminal at a given point in time given the date activated PDP context using the recommended standard FTP commands and sends the formatted sections daily reports as files over GPRS network to the server Tax Administration, according to the previously received command. Terminal reads the ftp message that consists of server response code and the Tax Administration with additional explanatory text file containing commands to define the next sending daily reports. Recommended batch file is immutable and contains a command to send daily reports of all starting from a daily report from the last daily report is sent correctly, the number of days between two successive sending data in server of the Tax Administration, and the time starts sending data.

If the terminal does not convey the correct information in the given point in time (due to, for example, system updates), the terminal after a predefined time (eg. 2 minutes) again sends daily reports, and not

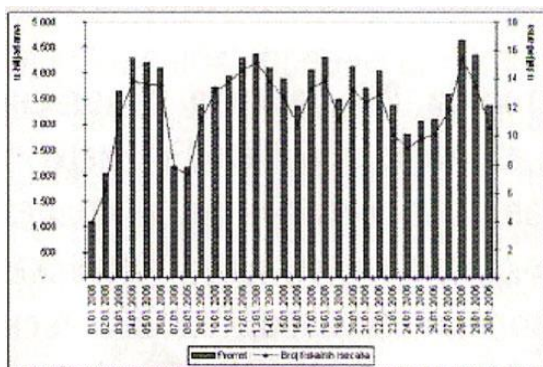
more than 2 times. If you send daily reports or were not properly received, the terminal will attempt to send daily reports on the following day at the same time. After successful communication with the Tax Administration server, terminal disables visual indication no. 3.

TABLE I. THE MINIMUM GENERAL TECHNICAL REQUIREMENTS

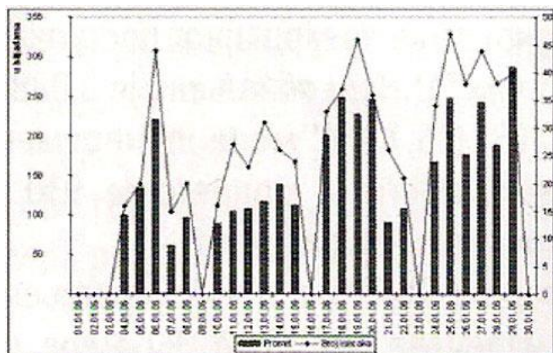
Request	Meaning
Type of wireless network	GPRS
Real-time clock	Yes
Connection with fiscal cash registers	RS232
At least one connection to enhancement	RS232, so the additional device logically related to the fiscal trot when the terminal is not communicating with fiscal cash registers
Visual indication no. 1	Request for pressing the terminal, if it exists
Visual indication no. 2	Fiscal memory is in progress
Visual indication no. 3	Daily reports are received correctly in the server IRS
Reset	Delete command in the terminal
External Antenna	Connection option for areas with weak signal
Sealing	The seal prevents unauthorized access to the hardware and software of the terminal and SIM card
Update software terminal	Replacing the EPROM memory or through the internal connector or through external connectors in combination with an internal jumper in the case Flash or EEPROM memory
Mains supply	220 V - 15 % ... 220 V + 10 %
Temperature range (min)	0 °C ... 40 °C
Range of storage (min)	-10 °C ... 50 °C
Humidity	(90 ... 95) % at (40 ± 2) °C

Based on the received data via GPRS terminals on recorded transactions at cash registers, can reliably determine a taxpayer who does not record all traffic through the cash register and not issued fiscal snippets. Data on registered taxpayers traffic arriving on the same day to the central tax administration, regardless of where the cash registers in Serbia. After collecting data on recorded transactions at the cash registers, the Tax Administration the selection of taxpayers to be subject to tax control. Example of using GPRS data in the Tax Administration can be seen in the comparative data of three different taxpayers from certain groups of activities, based on which we can see the trend of recording over cash registers and issuing fiscal clippings, within a period of one month.

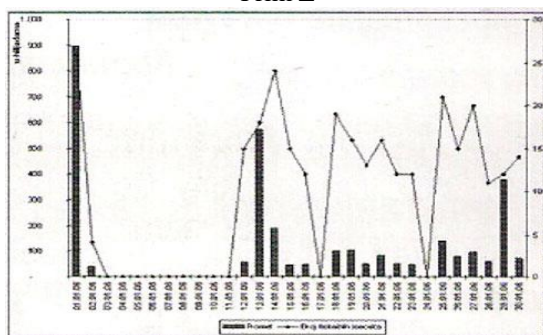
Firm X



Firm Y



Firm Z



IV. CONCLUSION

Management information system of tax administration contributes to improving the capacity of the tax administration relating to the activities of control and collection of tax revenue, as well as the capacity relating to the affairs of detecting tax crimes and their perpetrators, and performed by the Tax Police. Improving the management of the budget and fiscal management, capacity building control and collection of tax and customs administration contributes to the consolidated revenue collection for the consolidated budget of Serbia, it seems coherent tax policy at central and local levels and improving cost management.

The main objective of the introduction of fiscal cash registers to create level playing field for all who are engaged in the trade of goods, reduction in the level of underground economy and increase revenue in the budget of the Republic of Serbia. In addition, the terminal for remote sensing provides the taxpayer wireless remote commands to fiscal cash register, such as the unit of measurement of price changes, update the database, read the list of products sold or services performed, etc.

The introduction of cash registers and terminals for remote sensing data is completed fiscal process in Serbia and thus are able to be more efficient and cost-effective way to conduct audits of taxpayers.

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The taxpayer is required to terminal for remote sensing at the time of the cash register keeps attached to the fiscal coffers through its interface. It is also necessary that the taxpayer provide the reading of all daily reports from the cash register during the given period using a terminal for remote sensing. It is particularly important to stress that the presented trends likely to find a taxpayer that is not recorded in the cash register and not issued fiscal snippets.