VOLUME 6 NUMBER 1 BANJA LUKA, JUNE 2016 (1-48) ISSN 2232-9625 (Print) ISSN 2233-0194 (Online) UDC 004

Journal of Information Technology and Applications

(BANJA LUKA)

JITA

Exchange of Information and Knowledge in Research

APEIRON

THE AIM AND SCOPE

The aim and scope of the Journal of Information Technology and Applications (JITA) is:

- to provide international dissemination of contributions in field of Information Technology,
- to promote exchange of information and knowledge in research work and
- to explore the new developments and inventions related to the use of Information Technology towards the structuring of an Information Society.

JITA provides a medium for exchanging research results and achievements accomplished by the scientific community from academia and industry.

By the decision of the Ministry of Education and Culture of the Republic of Srpska, no.: 07.030-053-160-4/10 from 3/3/2010, the journal „Journal of Information Technology and Applications“ Banja Luka is registered in the Registry of public organs under the number 591.
Printed by Markos, Banja Luka in 300 copies two times a year.

Indexed in: LICENSE AGREEMENT, 3.22.12. **EBSCO** Publishing Inc., Current Abstracts

ebscohost.com
indexcopernicus.com
citefactor.org/contact
scholar.google.com
doisrpska.nub.rs
crossref.org
road.issn.org
citefactor.org
cosmosimpactfactor.com

Printed on acid-free paper

Full-text available free of charge at http://www.jita-au.com

UDC 004

ISSN 2232-9625 (Print)
ISSN 2233-0194 (Online)

JITA

VOLUME 6 NUMBER 1 BANJA LUKA, JUNE 2016 (1-48)

Contents

GORDANA RADIĆ, PhD
EDITOR-IN-CHIEF

ZORAN AVRAMOVIĆ, PhD

DUŠAN STARČEVIĆ, PhD

Dear Readers,

The content of this JITA issue consists of five papers covering different areas of information processing.

In the first paper, named "Cluster Formation Techniques in Hierarchical Routing Protocols for Wireless Sensor Networks", by Goran Popovic and Goran Djukanovic, a brief description of the techniques used for hierarchical organization of cluster heads in wireless sensor networks is presented, based on modifications of Low Energy Adaptive Clustering Hierarchy (LEACH) routing protocol. The aim of the paper is to present ideas that have been introduced in these protocols as a basis for further research.

In the second paper, named "VirtualSign Translator as a Base for a Serious Game", Paula Maria de Sá Oliveira Escudeiro, Nuno Escudeiro, Marcelo Norberto and Jorge Lopes outline the development of a game aimed at making the process of learning sign language enjoyable and interactive, using the VirtualSign Translator. In this game the player can control an avatar and interact with several objects and Non-player characters in order to obtain signs. Through the connection with VirtualSign Translator, the data gloves and Kinect support, this interaction and the gestures can then be represented by the specific character.

The third article named "Online Evaluation of Recommender System with MovieLens Dataset", by Asmir Handžić, explores the advantages of recommender systems based on the matrix factorization in respect to classical first neighbor recommender systems to real users through A/B test. The results presented in this paper confirm the hypothesis that the recommender systems based on the models of matrix factorization are superior in relation to classical nearest-neighbor recommender systems.

The fourth paper named "Model of Processing and Selling Insurance over the Internet", by Dragan Mihic, Branko Latinovic, and Tomislav Vujinovic, introduces a new model of processing and selling insurance over the Internet. The new model has been developed with the aim to eliminate imperfections of the previous processing system, having in mind that most of current selling insurance models contain manual processing.

In the last paper named "Road Safety Management in Local Communities", by Milenko Čabarkapa and Zoran Ž. Avramović, the road safety management in local communities is presented, using Montenegro as a case study. The paper compares changes in the state of road safety in the period before and after the adoption of the Global Plan for the Decade of action for road safety, given by World Health Organization. The statistical analysis of changes showed that the improvement or deterioration of the state of road safety at all levels of management can be directly associated with the achievement of coordination of activities and sharing of responsibilities for the state of road safety.

Cluster formation techniques in hierarchical routing protocols for Wireless Sensor Networks

Goran Popovic, Goran Djukanovic

popovic.goran@yandex.com, djukanovicg@gmail.com

Critical review

DOI: **10.7251/JIT16005P** UDC: **004.771:004.65**

Abstract: Wireless sensors are an irreplaceable link in the chain of global networking today. There is almost no area of human activity where they are still not used, and they will be used in the near future almost everywhere. Wireless sensor networks consist of a large number of sensor nodes that are arranged (usually randomly) in an area. The main problem is the limited power supply. Sensors are usually powered by the battery which is not possible to replace. The lifetime of the network depends on the duration of battery power of sensor nodes. The largest part of the consumed energy goes for communication with the rest of the network. Therefore, the selection of good routing protocol is essential for the long life-span of the network. There are a large number of proposed protocols and they can be divided into several groups, depending on the approach to the problem. In this paper we present a family of hierarchical protocols, their common features and specific implementation, we will present advantages and disadvantages as well as possible directions of further development.

Keywords: LEACH, CH, Clustering, Wireless Sensor Network.

Introduction

Sensors listen and gather information from the environment and send them to the base station (BS). Energy consumption is a major problem given that spent batteries are very difficult, expensive and usually impossible, to replace. Therefore, it is necessary to save energy wherever it is possible [8], [20]. That is the reason why the routing protocols, which take into account energy efficiency, are a constant object of researching. There are different approaches to this problem. One large group of protocols is hierarchical protocols. In these protocols, there is no direct communication of BS with each sensor node. There are selected nodes that play a special role in communication in hierarchical networks. These protocols start from the clustering concept. The whole network is divided into a certain number of smaller groups, called clusters, and each cluster has one node with special assignments – Cluster Head (CH). Only CH has the ability to directly communicate with the BS. This method reduces the number of nodes which send data to BS. BS is usually located at a relatively large distance and thus performs a significant energy saving. Additional energy saving is achieved by aggregating data in CH. In fact, one CH receives data from the belonging nodes which are usually located at a short distance from each other. For this reason, the data which represent sensed physical phenomenon are quite similar. The redundant data are discarded. This reduces the amount of data that will be sent to the BS, without losing important information. This structure represents a network of multi-hop connections from the nodes to the BS. For this reason, we define such protocols as hierarchical. Topology of hierarchical network is shown in Figure 1. The oldest protocol in this family is the famous Low Energy Adaptive Clustering Hierarchy (LEACH), presented in [14]. Thereafter, a large number of other protocols have been proposed, most of which are modifications

of the basic concept LEACH [19]. Some of them are designed as multi-tier, consisting of two or more levels of hierarchy, as presented in [7]. In this work, we briefly introduce the idea of LEACH and then describe the proposed modifications in other similar protocols.

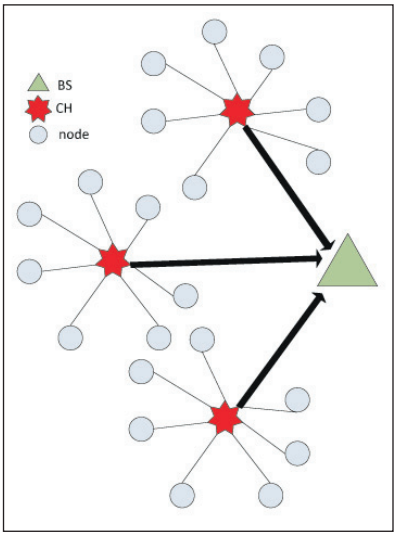


Figure 1. Model of hierarchical network topology

LEACH PROTOCOL

LEACH was proposed in 2000. It is still the basis for the development of other models of hierarchical routing. Since power consumption depends on the distance from the sensor node to the BS, the goal is to reduce the number of connections that are realized over long distances and the number of transfer operations. The LEACH is divided into rounds, where the role of CH rotates in a random manner. In each round there are two phases: setup and steady state. In the setup phase, each node first chooses a random number between 0 and 1. The number is compared to a threshold value T(n) calculated by the expression (1), where P is the desired percentage of CH in the network, r is the number of the current round, G is a set of nodes which were elected as CH in the last 1 / P rounds.

$$T(n)=\begin{cases}\dfrac{P}{1-P\times(r \bmod \frac{1}{P})} & if \quad n\in G\\ 0 & otherwise\end{cases} \qquad (1)$$

If the randomly selected number is less than the threshold, this node becomes CH. Each of the CHs creates the corresponding clusters and the TDMA schedule for communication with each of its nodes. In the steady state, nodes sense environment and send data to the CH in time slots allocated to them. CH performs aggregation of all data and forwards them to the BS. In LEACH protocol and in all its successors, a simple radio model is used, as shown in Figure 2. This model describes the power consumption in the network. It is assumed d^2 energy loss due to channel transmission. If the BS is far away from the CH, communication will require a large amount of transmit power.

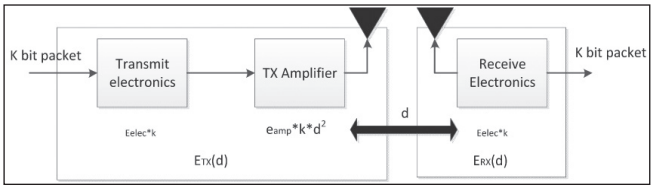


Figure 2. Radio model of energy dissipation

Advantages of LEACH are numerous. It is fully distributed approach without central management of network. It reduces the number of energy-demanding links, since only CH communicates with BS, which is usually at a large distance. At any time, most of the sensors are in passive mode. Through the data aggregation in CH, it reduces the amount of data to be transmitted. Rotation of CH roles evenly distributes energy to all nodes. Furthermore, the localized coordination scheme used in LEACH provides better scalability for cluster formation. LEACH, on the other hand, has a whole range of unresolved issues. Problems arise if the sensors do not have the same initial energy and that is often the case in practice. Then, sensors with less energy have the same chance to become CH as the others with more energy. This allows sensors with a few of residual power to get the role of CH, quickly spend the remaining energy and die while they are in the CH status. This leads to losing of all the data collected by sensors in the corresponding cluster for that round. CHs may also be sensors that are very far away from BS. These CHs will consume very large energy to communicate. Implementation of LEACH is limited to static sensors. If the sensors are mobile LEACH cannot be used. At the same time, there may be very large and very small clusters in the same network. These are the reasons why many authors have tried to improve LEACH with new ideas. These tendencies have cre-

ated more than a thousand modifications. We outline below some of typical.

Modifications of LEACH protocol

LEACH -B (Balanced) [6] does not take into account the aggregation of data into CH, since it is not usable in all applications of wireless sensors. Protocol calculates energy dissipation for sending broadcast packets to other nodes. With these packets CHs inform all nodes about their new role. The number of clusters per round is not constant. Belonging of node to the CH is not calculated on the basis of the minimum energy path, from node to a potential CH, as in the original LEACH, but on the basis of minimum energy consumed in the entire path from the node to the BS, when the link is established through potential CH.

LEACH-C (Centralized) [13]. In the basic LEACH, clusters are unequal. This results in a difference of energy consumption of individual nodes. This is detrimental to the efficiency and lifetime of the network. LEACH-C uses the centralized clustering algorithm for achieving a better distribution of nodes and similar sizes of clusters. During the set- up phase, each sensor sends data about its current position and the available energy to the BS. BS calculates the average energy of the entire network. The sensors with energy below this value cannot be CH in the next round. In the steady state phase it uses the same algorithm as in LEACH. LEACH-C is in all features beyond the original LEACH, but it is difficult to implement it in practice because of the need for a central management system. In addition, this protocol is not suitable for large- scale networks because nodes on very large distance do not have the ability to send information to the BS about its status.

LEACH-E (Enhanced) [10]. This protocol uses algorithm for the selection of CHs that have global information about all nodes in the network. The main factor affecting the performance of the network is the number of the CH. If the number of CHs is relatively small, then each CH covers a large area, and nodes that are located at a large distance consume a lot of energy to communicate with CH. If the number of CHs is relatively large, the network has a larger number of nodes that consume a lot of energy to communicate with the BS. These are contradictory requirements and both of them affect the lifetime of the network. Communication between CH and BS requires a higher power than communication of CHs with other nodes. Therefore LEACH-E, in the selection of CH, in the first round acts as LEACH. After that, the residual energies of all nodes are different. Because of that, each cluster after each round chooses the node with the highest residual energy for CH and the other nodes are cluster members.

LEACH-F (Fixed number of cluster) In this protocol, clusters are formed in the initial stage. They have that role until the end of the life of the network. In this way, protocol avoids the formation of clusters at the beginning of each round. In this formation of the clusters centralized approach is used, in the same way as it works in LEACH-C. BS uses annealing algorithm to form clusters. BS broadcasts messages which includes cluster ID for each node. Position of nodes in the list indicates the order to become CH in the upcoming rounds. The role of CHs in the next rounds rotate within the nodes of the cluster. The first node listed in the cluster becomes the CH in the first round, the second node listed in the cluster becomes the CH for the second round, and so forth. The advantage of this approach is that there is no setup overhead at the start of each round. The disadvantage of this protocol is that there is no possibility to join the new cluster nodes. In addition, the fixed nature of the cluster creates a situation where the nodes are often closer to other CH than to CH of its own cluster.

I-LEACH (Improved) The sensor field is divided into equal sub-regions [5]. In each of them CHs are elected in the same way as it works in LEACH. This produces a large number of smaller subclusters. The goal is to uniformly distribute CHs on the basis of x-coordinate of the nodes. There is no possibility here that all CHs will be concentrated in one part of the network. This reduces the length of the connections of the ordinary nodes to the CHs , data frame is shorter but the number of frames to reach the BS is increased. Instead of probability, as a criterium for the selection of CH, the residual energy is used.

K-LEACH (K-medoids) [3]. This protocol also tries to make more uniform distribution of the clus-

ters and nodes in them. In the basic LEACH, it is possible that some clusters contain a large number of nodes and some very small number of them. The proposed K- LEACH protocol uses the K-medoids clustering algorithm. For the first round, clusters are formed using K-medoids cluster formation algorithm and CHs are selected as a node which lies at the center or nearer to the center of the cluster using Euclidian distance. For the rest of the rounds, nodes nearest to the CH of the first round selection are chosen as CH. There are variants with re-using existing clusters and with a choice of new clusters in the upcoming rounds.

L-LEACH (Energy balanced). CH is selected based on a threshold which is a function of residual energy and distance [21]. This algorithm measures normal distance between the node and the BS and compares this distance to the distances from the node to the CH. If the node is closer to the BS, no optimal CH will be selected. This node will send directly controlling packages to the BS and then transmit data packages. Otherwise, CH whose distance to the node is smaller than the distance from the node to the BS are regarded as candidate CH. Then, the node chooses the optimal one among the candidate CH, according to the cost function. If the cost function value is the least, it will be chosen as the optimal CH. The energy of the nodes may be heterogeneous.

LEACH-M (Mobile). In this protocol authors take into account the mobility of nodes during the transfer phase [17]. Node with minimum mobility and lowest attenuation power is selected as CH. Mobile nodes can leave the cluster before they send their data to the CH in a given round. It is necessary to check if a node is able to communicate with associated CH in accordance with the TDMA schedule. At the beginning of each TDMA slot, CH sends a test message to the appropriate node. CH waits for a response during the two consecutive slots. If there is no reply then CH concludes that the node is outside the range and removes it from the list. It is possible that CH leaves its own cluster. In this case, the nodes are joined to the other CH.

LEACH-ME (Mobile enhanced) [18]. This protocol is the enhanced version of LEACH-M. The CH rotation process considers the nodes mobility. Mobility factor is calculated based on the number of times a node changes from one cluster to another or on the basis of remoteness. Every node sends a number of the transitions to the CH during its CH TDMA slots. CH counts the average number of transitions for its members over the last few cycles. For the role of CHs, nodes that are less mobile in relation to its neighbors are selected.

LEACH-S (Solar) [14]. In this protocol, some nodes have solar power supply. During set-up phase only those nodes are selected for the CHs. They send their status and amount of the residual solar energy to the BS. Nodes with the highest residual energy are chosen for the CHs. Increasing the number of sunny days directly affects the lifetime of the nodes and the whole network. The principle is applicable as an upgrade for centralized and distributed LEACH. On the basis of this proposal, many new protocols have been proposed.

T-LEACH (Treshold based) [15]. This method minimizes the number of CH choices using threshold for residual energy. As long as a CH has a residual energy greater than a given threshold, it retains its role from round to round. The thresholds are set especially for each node in the network. They are different since each CH has a different number of nodes. After the residual energy of CH becomes less than the threshold, new CH is elected. Reducing the amount of CH selection and replacement cost, the lifetime of the entire networks can be extended.

TB-LEACH (Time based) [16]. In the basic LEACH, number of the CH may vary from round to round, due to the random selection of number for comparison with the threshold. In this protocol in each round constant number of CH is elected, exactly 4 % of all nodes. They are chosen on the basis of randomly given timer. At the beginning of each round, all nodes generate random timers. The value of the timer is not affected by the residual energy of the node . When the timer expires, the node checks the number of received CH advertisement messages. If this number is less than four, it declares itself for the CH. The rest of the process after the election of the CH is the same as LEACH.

V-LEACH (Vice) [4]. In each round, in addition to CHs, vice CHs are elected. Their role is to replace the CH in case that it dies during the round. In this way, all collected data is delivered to the BS even if CH died, and there is no need to elect a new CH (See Figure 3).

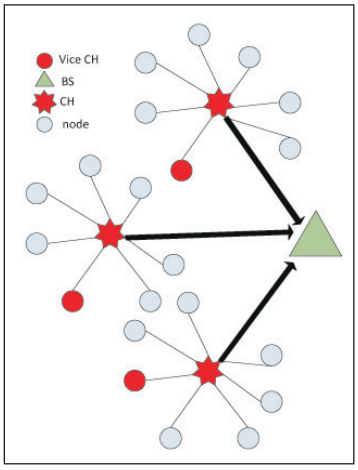


Figure 3. V-LEACH topology

W-LEACH (Weighted) [12]. In the setup phase, the algorithm first calculates value of weight Wi for each sensor. P is a percentage of the maximum number and not the actual number of CHs as defined in the original LEACH. CH is selected on the basis of weight values, regardless of whether the node was CH previously. The decentralized version of the same algorithm [1] introduces the idea that if the sensors are close together there is no need to send all data to the CH. Sensors in each round are divided into sleeping and alive sensors.

PEGASIS (Power-Efficient Gathering in Sensor Information Systems) [19]. There is no clustering in this protocol. The basic idea is forming a chain so that each node communicates only with nodes that are closest to him. Chain can be formed by the nodes themselves using the greedy algorithm or can be established by the BS. To locate the closest neighbor node, each node uses the signal strength to measure the distance to all neighboring nodes, and then adjusts the signal strength so that only one node can be heard. Construction of chain begins with choice node that is furthest from the BS. It selects a node that is the second farthest from the BS for the next member, etc. When some node died, chain is reconstructed in the same way by avoiding dead node. During steady state phase, each next node in the chain combines the received data with its own data. The last node in the chain is called the leader. Only the leader can communicate directly with the BS and send all data from the chain to the BS. In each subsequent round, a new leader is chosen and a new chain is formed. The nodes that are located at a large distance from the BS cannot be selected for leaders.

TL-LEACH (Two-level) [23]. This protocol uses PEGASIS to improve basic LEACH protocol. It consists of three phases. The first phase of CH selection is composed of two secondary phases: Selection of the CHs on the first and selection of the CHs on the second level. CHs on the first level are selected using a modified expression for the threshold value (2):

$$T(n)=\begin{cases}(r+1)\bmod(\frac{1}{P})*\mathrm{P} & if \quad n\in G\\ 0 & otherwise\end{cases} \qquad (2)$$

Clusters are formed in the same way as it is done in basic LEACH. The algorithm chooses N*P CHs of the first level. After that, it selects the CHs at the second level. It chooses N'*P second level CHs of the previously selected first level CHs. Only the second level CHs can communicate with the BS. They receive data from the first level CHs and, together with their own data, forwarded them to the BS. Data fusion is performed on the secondary and the primary level. TL-LEACH significantly reduces the number of nodes for data communication over long distances and decreases energy consumption of entire network. Topology of TL-LEACH is shown in Figure 4.

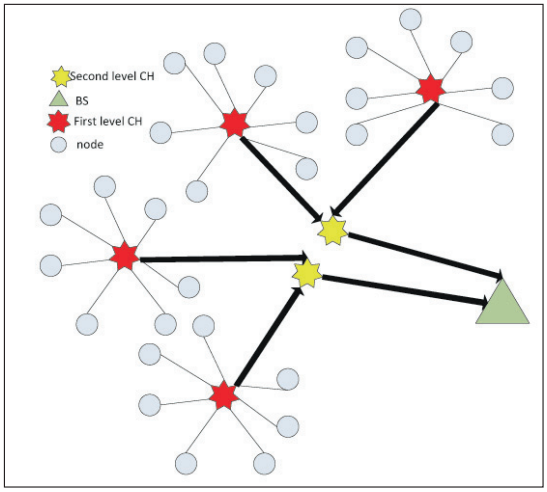


Figure 4. TL-LEACH topology

SEP (Stable Election Protocol) [22] takes into account the heterogenity of the network. The probability of the selection of node as CH depends upon its residual energy. The nodes are heterogeneous and divided into normal and advanced. Differences in energy can be initially set or can be result of the work of sensors in previous rounds. Both types of nodes are randomly distributed throughout the field. Advanced nodes are elected for CH more often. Algorithm avoids a situation in which all normal nodes will die and only advanced nodes will remain, regardless of the spatial distribution.

A-LEACH (Advanced) [2]. This protocol was created from the idea to extend the time before the death of the first node in the network (stable period). The nodes are divided into group with higher residual energy (called CAG) and group whose energy is lower. In the setup phase, basic LEACH is performed for all nodes, regardless of the available energy. If CH belongs to the group of CAG nodes it sends data directly to BS and everything takes place as in basic LEACH. If CH is among the nodes that have less energy it identifies the closest CAG and selects it for its gateway node. It establishes a connection with the BS through this gateway. (See Figure 5)

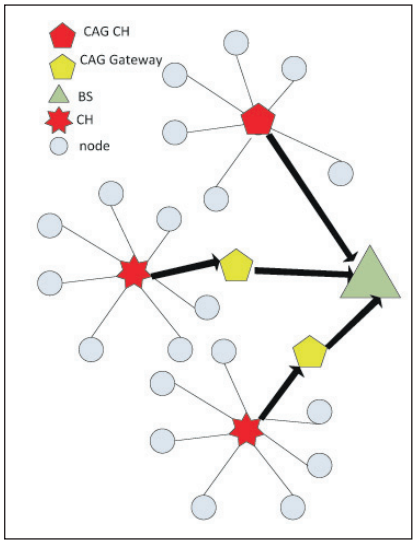


Figure 5. A-LEACH topology

CONCLUSION

A hierarchical model of organization of wireless sensor networks has many advantages compared to other models, especially in the case of large-scale networks, mobility nodes, node failures, insertion of new nodes and removal of existing nodes. However, the hierarchical organization of the network also brings many problems. Basic LEACH, which remained a role model to all subsequent protocols inherently, has significant shortcomings and unresolved issues. Removing these defects is the aim of a large number of researchers for decades. From this tendency, they created a large number of modifications to the original LEACH. Each of these versions overcame results of LEACH to some extent, but did not cancel the basics of protocol. This paper provides a brief description of the techniques used for clustering and selection of CHs in some typical protocols. The aim was not to present the improvements that have been already introduced in these protocols, but to present ideas on which they are based. These ideas should serve as a basis for further researching. Hierarchical networks are definitely the best concept for organizing wireless sensor networks, but researchers have to do more to reduce power consumption of the network to the minimum.

Goran Popović
Goran Popović earned his PhD at the Faculty of Computer Sciences, John Naisbitt University Belgrade. He is Head of Department for Acces Network Operations and Maintenance at Mtel, a.d. Banja Luka. Goran is Assistant Professor at the Faculty of Polytechnical Sciences of International University of Travnik and at Technical Faculty of European University Kallos Tuzla, where he teaches graduate and undergraduate level courses on telecommunications. His primary fields of interest are: Dynamic spectrum management and Wireless sensor networks.

Goran Đukanović
Goran Djukanovic, PhD works in Mtel a.d. Banjaluka in Strategy Management Office, with responsibilities in activities such as strategic management, introduction of internationally accepted Standards and Business Process Management. He earned his PhD on the Faculty of Electrical Engineering in Banja Luka in 2012. In Mtel he has led two important Projects in last 3 years: Implementation of Information Security Management System (ISMS) ISO / IEC 27001: 2013, and Implementation of Quality Management System (QMS) ISO 9001: 2015. He is certified external auditor for ISO / IEC 27001: 2013 and for ISO 9001:2015. He published more than twenty scientific papers mostly in ICT research area. His area of scientific research is in the ICT, in general regarding allocation, management and control algorithms in the conditions of limited resources, especially in Wireless Networks and Wireless Sensor Networks, cyber-physical systems and Internet of Things (IoT). He is a member of IEEE for 12 years, with participation in Communication Society, Computer Society and Internet of Things Community.

References:

[1] Abdelhalim, H., Abdellah, E., Mohammed, F. & Abdelmajid, H. (2014) W-LEACH: Decentralized: Weighted LEACH with a Decentralized way. *IOSR Journal of Computer Engineering (IOSR-JCE), 16*(2), 32-39

[2] Abdellah, E., Benalla, S., A. Hassane, B. & Lahcen, M. (2010) Advanced low energy adaptive clustering hierarchy. *International Journal on Computer Science and Engineering (IJCSE)*, 2491-2497.

[3] Bakaraniya, P. & Sheetal, M. (2013) *K-LEACH: An improved LEACH Protocol for Lifetime Improvement in WSN. 4*(5) 1521-1526

[4] Bani, Y. M., Al-zou'bi, A., Khamayseh, Y. & Mardini,W. (2009) Improvement on LEACH protocol of wireless sensor network (VLEACH). *International Journal of Digital Content Technology and its Applications, 3*(2), 132-136

[5] Dembla, D. & Shivam, H. (2013) Analysis and Implementation of Improved - LEACH protocol for Wireless Sensor Network (I-LEACH). *IJCSC,IJ, 4* (2), 8-12

[6] Depedri, A., Zanella, A. & Verdone, Z. (2003) An Energy Efficient Protocol for Wireless Sensor Networks. *In: Proc. AINS,* pp. 1-6

[7] Đukanović, G. & Popović, G. (2013) Applying FMEA to multi-tier converged M2M-WMSN. International scientific conference (UNITECH), Gabrovo, Bulgaria.

[8] Đukanović,G. & Popović,G. (2015) Budućnost bežičnih senzorskih mreža i mogućnost primjene teorije igara, ITeO - Zbornik radova, Apeiron, Banja Luka.

[9] Đukanović, G. & Vasiljević, D. (2014) IoT i pametne senzorske mreže budućnosti: mogućnosti i izazovi. ITeO - Zbornik radova, Apeiron, Banja Luka.

[10] Fan, X. N. & Song, Y. L. (2007) Improvement on LEACH protocol of wireless sensor network. In Proc. *International Conference on Sensor Technologies and Applications, Sensor Comm.Valencia,* 260-264

[11] Gongben C., Shaorong.W. (2009) A Novel Node Deployment and Clustering Scheme in Wireless Sensor Networks. In: Second International Symposium on Electronic Commerce and Security, ISECS '09, Nanchang, China, pp.499 – 503

[12] Hanady, M. & Bader, A. (2013) W-LEACH Based Dynamic Adaptive Data Aggregation Algorithm for Wireless Sensor Networks. *Hindawi Publishing Corporation International Journal of Distributed Sensor Networks, Vol. 2013, Article ID 289527*, 1-11

[13] Heinzelman, W., Chandrakasan, A. & Balakrishnan, H. (2002) An application-specific protocol architecture for wireless micro sensor networks. *IEEE Transaction on Wireless Communications*, *1*(4), 660–670

[14] Heinzelman, W. R. & Chandrakasan A. (2000) Energy efficient Communication Protocol for Wireless Microsensor Networks. *IEEE Computer Society Proceedings of the 33rd Hawaii International Conference on System Sciences (HICSS '00), Hawaii, Vol. 8,* pp. 8020.

[15] Jiman, H. & Joongjin, K. T-LEACH (2009) The method of threshold-based cluster head replacement for wireless sensor networks. *Springer Inf Syst Front,* 513-521

[16] Junping, H., Yuhui J. & Liang D. (2008) A time-based cluster-head selection algorithm for LEACH, *IEEE International Symposium on Computers and Communications (ISCC)* 1172-1176.

[17] Kim, D. S. & Chung Y. J. (2006) Self-organization routing protocol supporting mobile nodes for wireless sensor network. *First International Multi-Symposiums on Computer and Computational Sciences, Hangzhou, China*

[18] Kumar, G. S., Paul, M. V. & Jacob, K. P. (2008) Mobility metric based leach-mobile protocol. *16th International Conference on Advanced Computing and Communications, ADCOM*

[19] Lindsey, S. & Raghavendra, C. S. (2002) PEGASIS: Power Efficient GAthering in Sensor Information Systems. *IEEE Aerospace Conference*, 1125-1130.

[20] Mahapatra, R. P. & Yadav, R. K. (2015) Descendant of LEACH Based Routing Protocols in Wireless Sensor Networks. *Procedia Computer Science, 3rd International Conference on Recent Trends in Computing (ICRTC), 59*, 1005–1014

[21] Qian, L. & Zhu, H. (2013) An Energy Balanced Clustering Algorithm Based on LEACH Protocol. *Proceedings of the 2nd International Conference On Systems Engineering and Modeling (ICSEM-13), Paris, France,*72-73

[22] Smaragdakis, G., Matta, I. & Bestavros, A. (2004) SEP: A Stable Election Protocol for Clustered Heterogeneous Wireless Sensor Networks. *Second International Workshop on Sensor and Actor Network Protocols and Applications (SANPA 2004)*

[23] Zhixiang, D. & Bensheng, Q. (2007) Three-layered routing protocol for WSN based on LEACH algorithm. *IEEE Communications conference on Wireless, Mobile and Sensor Networks (CCWMSN),* 72-75.

Submitted: June 2, 2016.
Accepted: June 10, 2016.

VIRTUALSIGN TRANSLATOR AS A BASE FOR A SERIOUS GAME

Paula Maria de Sá, Oliveira Escudeiro, Nuno Escudeiro, Marcelo Norberto, Jorge Lopes

pmo@isep.ipp.pt, nfe@isep.ipp.pt, matno@isep.ipp.pt, jolbl@isep.ipp.pt

Case study

DOI: **10.7251/JIT16012S** UDC: **004.738.5**

Abstract: The goal of this paper is to present the development of a game aimed at making the process of learning sign language enjoyable and interactive, using the VirtualSign Translator. This game aims to make the process of learning sign language easier and enjoyable. In the game the player can control an avatar and interact with several objects and Non-player characters in order to obtain signs. Through the connection with VirtualSign Translator the data gloves and Kinect support, this interaction and the gestures can then be represented by the character. This allows for the user to visualize and learn or train the various existing configurations of gestures. To improve the interactivity and to make the game more interesting and motivating, several checkpoints were placed along game levels. The game has as an inventory system where the signs are kept and can be checked allowing for the user to visualize and learn or train the various existing configurations of gestures. A High Scores system was also created, as well as a History option, to ensure that the game is a continuous and motivating learning process.

Keywords: VirtualSign, Serious Games, Portuguese Sign Language, Kinect.

Categories and Subject Descriptors

H.5.2 [User Interfaces]: *Graphical user interfaces (GUI); Interaction styles; Theory and methods; User interface management systems (UIMS)*

General Terms

Information Interfaces and Presentation

Conference'10, Month 1–2, 2010, City, State, Country.

DOI: http://dx.doi.org/10.1145/2808580.2808618

INTRODUCTION

Currently, games and simulations create remarkable opportunities to overcome the scarcity of educational digital content available for the hearing impaired community. Playing a game as the name suggest has a great leisure aspect that cannot be found in conventional educational means. Educational game researcher James Gee [3] shows how good game designers manage to get new players to learn their long, complex, and difficult games. A well-designed game entices players into the "reality" of the game world and keeps them there until the goals of the game have been met [10]. Making these opportunities available to those who endure handicap and disabilities is a core concern in today's society and a must to promote equity and inclusion. In this work we propose a new approach by using a game to make the process of learning sign language enjoyable and interactive. In this game the player controls a character that interacts with various objects and non-player

characters with the aim of collecting several gestures from the Portuguese Sign Language. The game is played in first person view in which the player controls a character on one of several maps. Each map represents a game level each of which has several objects that represent signs scattered through the map for the player to interact with. All objects gathered by the player will be stored in his inventory and can be accessed at any point during the game. With these objects the players can then mimic the gestures at the checkpoints using the VirtualSign translator. In case the players chose to play without the translator the avatar will be the one performing the gestures.

State of the art

Our research showed that there are some projects related to this theme/area but none of them implies an automatic bi-directional translation process in a game as this does, therefore, making this project very innovative. There is a rising number of serious games projects. Some of the most relevant related work within the sign language scope is described below.

The game CopyCat is the most similar project in comparison to ours. It consists of a game where sign language gestures need to be executed properly in order to proceed. The movement analysis is done through gloves with sensors. However, the researchers from the CopyCat project have published a video where they show their intention to use Kinect for movement detection. Their current research platform is a custom system that uses computer vision, colored gloves and wrist-mounted 3-axis accelerometers to collect data as users sign and machine learning to recognize the signs for game play. That system was built on top of Ubuntu Linux and uses the Kinect system as input for the computer vision, which replaces the gloves and sensors.

ProDeaf is an application that does the translation of Portuguese text or voice to Brazilian gesture language. This project is not a serious game but it is very similar to one of the main components used on the VirtualSign game, which is the text to gesture translation. The objective of the ProDeaf is to make the communication between mute and deaf people easier by making digital content accessible in Brazilian gesture language. The translation is done using a 3D avatar that performs the gestures. This software is already used by over 130 000 users.

Kinect Sign Language Translator is another project that is similar to the VirtualSign translator. The project was a result of collaboration, facilitated by Microsoft Research, between the Chinese Academy of Sciences, Beijing Union University, and Microsoft Research Asia, each of which made crucial contributions. Dedicated researchers in China have created the Kinect Sign Language Translator, a prototype system that understands the gestures of sign language and converts them to spoken and written language—and vice versa. The system captures a conversation from both sides: it displays the signer and renders a written and spoken translation of the sign language in real-time, and it also takes the non-signer's spoken words and turns them into accurate, understandable sign language. An avatar on the screen represents the non-signer and makes the appropriate sign languages gestures.

VirtualSign

VirtualSign aims to contribute to a greater social inclusion for the deaf. Its main motivation comes from a team of university teachers that have realized the difficulties in communicating with deaf students in the context of a class. The creation of a real time bi-directional translator between PSL and text is expected to facilitate the communication with students who have hearing disabilities. In addition to the bi-directional translator, this paper also presents a serious game directed to assist in the learning of the Portuguese Sign Language.

The project bundles three interlinked modules:

Translator of PSL to Text (Figure 1): module responsible for the capture, interpretation and translation of PSL gestures to text. A pair of sensors gloves (5DT Data Gloves) provides input about the configuration of the hands while the Microsoft Kinect provides information about the orientation and movement of the hands.

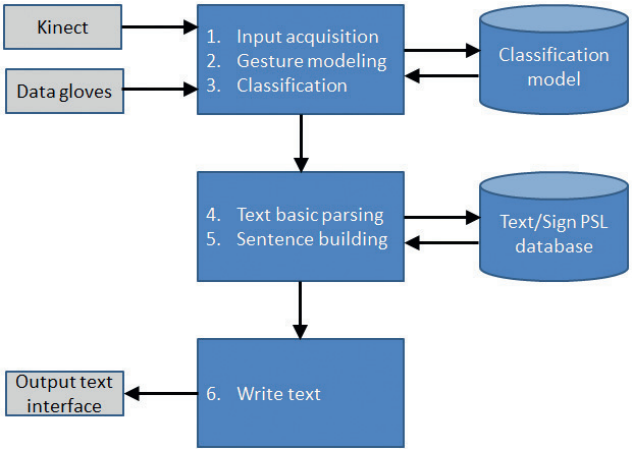


Figure 1. PSL to text translator

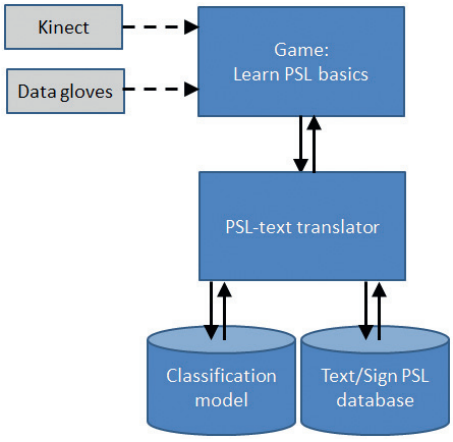


Figure 3. VirtualSign game and translator

Translator of Text to PSL (Figure 2): this module is responsible for the translation of text to PSL. The 3D models and animations used in this application to mime PSL were created in Blender. A MySQL database is used to store animation data. The main code is written in C# and all features are merged together with Unity.

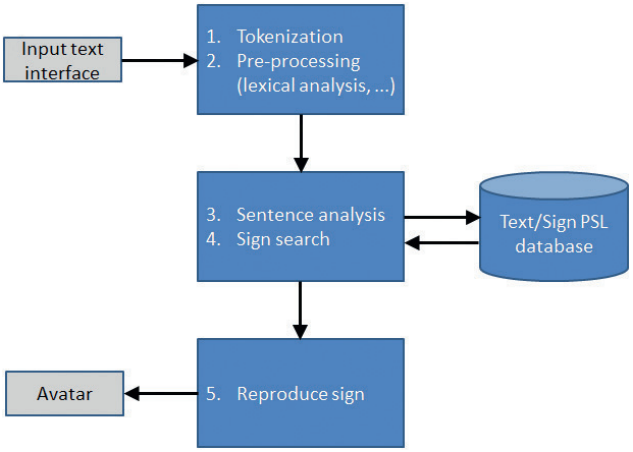


Figure 2. Text to PSL translator

Serious Game (Figure 3): Module responsible for the didactic aspects which integrates the two modules described above into a serious game. This adventure game has several challenges that bring the basics of PSL to the scene introducing the player to the PSL alphabet, commonly used words and sentences.

Gesture Classification

Once having ensured stability of the data, we proceed with the classification of the configuration. During a preparatory stage we have compared the performance of six classification algorithms, namely Random Trees (RT), Boost Cascade (BC), Neural Networks (NN), K-Nearest Neighbours (KNN), Naive Bayes (NB) and Support Vector Machine (SVM). For all these algorithms we have used the default configuration of the respective implementation available in the Open Source Computer Vision Library (OpenCV). To evaluate their performance we have used a dataset composed of 40 samples for each hand configuration (1680 samples in total). To reduce the variance of our estimates we have used 10-fold cross validation. In Table 1 and Table 2, the results of the evaluation for each glove (right and left glove) are presented.

Table 1. Classification results of the 1680 samples, obtained with the use of the left glove

%	RT	BC	NN	KNN	NB	SVM
Precision	98,6	82,0	98,1	98,8	97,5	98,6
Accuracy	85,5	95,4	78,1	97,3	97,1	100,0

Table 2. Classification results of the 1680 samples, obtained with the use of the right glove

%	RT	BC	NN	KNN	NB	SVM
Precision	98,8	86,1	97,2	98,0	98,0	98,1
Accuracy	87,3	96,6	80,4	98,2	96,8	100,0

From these results, Boost Cascade algorithm was discarded, by far the worst of all. Neural Network was

also discarded due to the high computational cost when compared to the rest. This is a serious drawback since we need a classifier to use in real time. The remaining four algorithms, present a high precision and accuracy. Based on these results we have opted to use SVM classifiers. For each configuration we have kept the top three instances and their associated probability, meaning that the application will take into consideration the tree configurations with the highest probability and their probability will be used in the classification to increase the accuracy. These instances were used later to build the classification model for word recognition.

The game

The VirtualSign game aims to teach Portuguese Sign language (PSL) in the most enjoyable and motivational way. Therefore the creation of the game had a series of factors to consider on how the gameplay should be in order to this goal and which structure the game should have. Below we describe the most important aspects of the game.

Gameplay

The gameplay is the most important part of the game. This aspect can increase or decrease how much the user will play the game, as the game designer David Perry said: *Keep the gameplay challenging, but don't let players get lost or blame the game for their problems. A good game designer always knows what the player is thinking and looking over their shoulder every step of the way.* [9]

In order to keep the game challenging there is a score system as well as a storyline so that the player feels motivated when performing a task. The score is based on the time user spends to achieve a goal, which may be clearing a checkpoint or finding a sign. The signs are spread out around the scenes and the player will need to find them with the help from the Non-Player Characters (NPC) and a map with hints. There is also always a minimap in the corner of the screen to help the player stay oriented. There are two types of checkpoints, the first type is the one required to gain access to the next area of the scene and usually requires a set of signs. The other type only requires a single sign and is used to gain another different sign. The second type of checkpoint is required to finish a level but the user can choose the order in which to clear it. Some of the gestures will also trigger minigames with score systems as well where the user will acquire a gesture depending on his score [2].

The game starts by showing the user an interface explaining the basics of the game and introduces the story where our character is told by a friendly NPC that he must find someone and in order to do so he will need to collect all gestures. Then, after introducing his name the player can start his adventure in an open world scene. All interactive items always give feedback and this feedback is always either hints for the player or a part of the story. The story has a relevant mysterious aspect to it. We tried to make sure that the story gives hints so that the player starts to realize what is happening in the virtual word but never being clear enough so that he loses interest in the story [11]. When the player acquires a sign, that sign is added to his inventory, this inventory is where the user can access and see all his gestures at any time. To see the avatar performing the gesture, the player simply needs to click the desired gesture. After each level, there is an evaluation scenario where the player knowledge will be evaluated to check if the information is being retained by the player. In those scenes, there is a NPC that will ask the player to perform certain signs, however, contrary to the checkpoints in the level, the user will not be able to access his inventory and check which gesture represents what.

Figure 1. Avatar in the first level, the score can be seen in the top, and in the corners there is the timer ***(top)*** and the minimap ***(bottom).*** The image also shows the inventory containing three gestures ***(three square images with hand configurations)*** and the avatar is performing the C sign

Scenarios

The game has three main scenarios as well as three evaluation ones. The scenarios were built in accordance to the game plot [8]. The first one is the one where the player can obtain letters and numbers and

it takes place in a desert. There are three main checkpoints where the player must perform the gestures and only after passing those checkpoints the player can access the next area of the scenario.

The second scenario is where the player starts to learn words and has to use them to acquire new gestures. It also has checkpoints, however, unlike the first where there were three checkpoints where the player had to perform six gestures in each, in this second level the player only has to perform one word per checkpoint.

As for the third and last scenario, we used the scenario provided by one of Unity assets and added what NPCs and objects needed, the logic of this scene is just as the second level except that instead using words we are now using full sentences.

Other than these three main scenes there is the starting menu, the evaluation levels and mini-games.

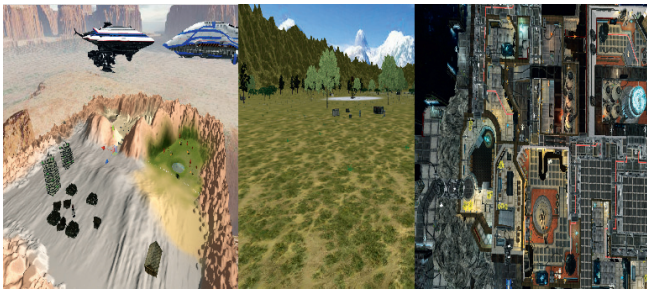


Figure 2. Three main scenarios of the game. The alphabet ***(left),*** word ***(middle)*** and sentences ***(right)*** scenarios generic view

Minigames

As mentioned before, minigames were developed within this game in order to keep the user interested and assure his motivation. Minigames are known for having a short period of playing; it has a simple set and reduced content compared to larger games. These factors make them very useful within the scope of serious games. For instance, the fact that the game has less content also means the user has fewer distractions and can focus on the content being displayed which may ease the process of learning. However, there is the need of finding the balance between the serious and leisure aspect of the game. Therefore, several mini games were developed within the main game of this project, some of those like the following memory game:

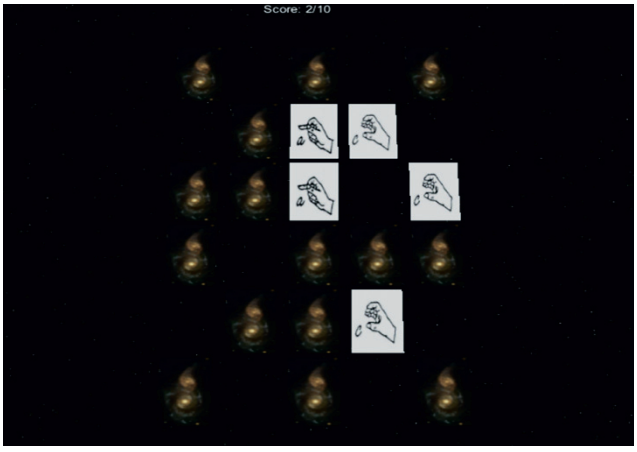


Figure 3. Gameplay of the memory minigame, the cards will turn when clicked and when a matching pair is turned the score will be increased and the cards will stay turned

This memory game has educational content as the cards represent gestures the user has previously acquired during his game and these cards have the associated letter on them. However, having educational minigames within a serious game could be overwhelming to the user. Therefore some minigames that are meant fully for leisure were added to the game, such as the following 2D shooter.

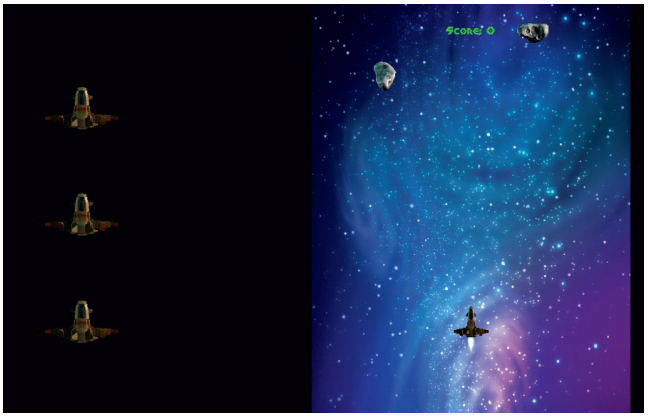


Figure 4. Gameplay of the shooter minigame, the user has to destroy objects and survive as long as he can. With each object destroyed, points to the user score are added

Technical aspects

Several technical aspects had to be taken into consideration to successfully develop this game as it involves a number of different technologies and a connection to the VirtualSign translator application. Below, there is a more deeply insight on those aspects.

Requirements

The functional requirements identified early in the project were:

- Start Menu where the player can choose the type of game he wants (with or without Kinect), consult the options or exit;
- Menu options where you can change the graphics quality, volume, save or load the game and see the table of high scores.

The game requirements within the levels are:
- Handling and control of the character;
- Interact with NPCs (Non-Player Characters);
- Consult the inventory and use the items in it;
- Interaction with map objects;
- Access to the above menu options;
- Access the mini-games.

As for the Non-Functional requirements, the usability [5], adaptability and performance were the main focus. This project aims to be fairly intuitive, allowing easy adaptation and learning. The interfaces were developed with the care to enable a pleasant interaction. The character controls were also structured to present a simple usage. Along the game, there are several short explanations of how the player should act to fulfil the objectives and surpass the levels. Every interactive object or NPC gives the player some kind of feedback. The gaming performance is a factor of the utmost importance, any perceptive delay can affect the gameplay making the game annoying rather than fun. To maintain the performance, this game was tested to never run less than 60 frames per second on an optimal computer. The ideal frame rate for a game must be around 40 frames per second [1]. The essential functions are constantly executed and the code is optimized to avoid the waste of resources.

Besides the code, all factors that constrain the performance of the game are taken into account, such as textures, bumps, number of vertices of the 3D models, among others. As for the gesture recognition, the VirtualSign translator works in real time with no delay. There is also no delay in the connection between the translator and the game, so the input from the player performing the gestures is instantaneous and can be seen on the interface at the checkpoints. In terms of adaptability, the scripting was considered and created as templates so that they can be changed in case there is the need to increase the sign count or even adding a new language. The only issue with the adaptability is the animations for the new words and new language that must be created and imported. However, this was also considered so the avatar animations are separate from the avatar itself and animation created with a similar skeleton can be played by it.

Game Layers

Given its high degree of complexity, the game was divided into layers. At the top level there is the interface. All functionalities of the project can be accessed through this layer by the user. This layer is responsible for the transmission of actions of the user for the following layers. On the lower level, there are three layers: the sockets layer which is responsible for linking Unity to the Virtualsign translator application, the game engine layer that represents Unity [4] and the business layer.

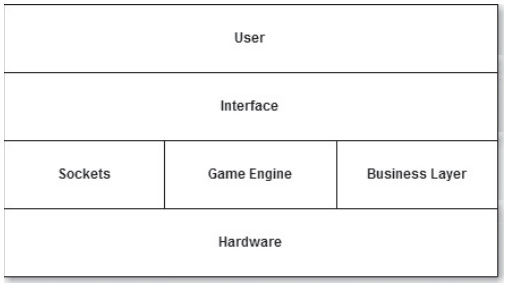


Figure 5. Application architecture layers

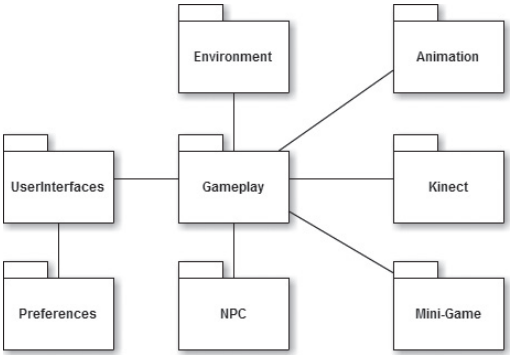


Figure 6. Package Diagram

As shown in Figure 6, the project has 7 main packages that contain the scripting for each section of the game. The environment represents the scripts for the random events within the scene, the animation as the name suggests has the base for all animations, the Interface has the user interfaces such as the main menus, inventory and quest windows. The Kinect is where the connection scripts based on sockets are stored. The NPC (non-player character) contains the scripting for the events that each NPC triggers. The

gameplay is where the basic functions are, such as the inventory, movement, interaction and highscore. The preference is very linear as it is where the audio, graphics and saves are stored and finally the Mini-games which contains all information and scripts.

Scripting

All scripts were developed considering the performance and adaptability [7] of the game. Some of the main functionalities are described below. One of the most important scripts is the inventory one, the inventory contains a list of signs, each sign contains an id and the string of the sign meaning. The inventory icons on the interface are obtained based on the id of each item therefore making the inventory adjustable. Example of the method used to add items to the inventory:

```
public void addItem(int ID, string gesture){
Item item_ = new Item(ID,textures[ID],gesture);
GameObject item = (GameObject)
Instantiate(inventoryItem);
Button b = item.GetComponent<Button>();
b.onClick.AddListener(() => ItemClicked(ID));
RawImage raw = item.GetComponent<RawImage>
();
raw.texture = textures[ID];
itens_gui.Add (item);
itens.Add(item_); inv.score.setScore(inv.
CheckTimer,timer.getTimer());
inv.CheckTimer.setTimeC(timer.getTimer());}
```

The score is incremented when the user finds a gesture as it can be seen on the code above. The information containing the current time (timer) and the time where the last gesture was found (CheckTimer) are sent to a setScore method that will calculate the score based on the difference of times. After the score is set, the checkTimer is updated to the current time.

Another crucial part of the scripting is the connection to the VirtualSign translator.

The following script shows how the text is received from the translator into the game and how it is kept and used at the checkpoints.

```
if(kinectChars.Length<passcode.Length){
kinectAtempt=kinectChars;
}else{
if(passcode==kinectChars){
correct=true;
setUnlock(true);
kinectChars="";
}else{
kinectAtempt=kinectChars;
kinectChars="";}
}
```

Since the gesture to text translator is a separate and complex application developed in C, it was easier to connect to it than to integrate it in the game as the game is being developed in Unity 3D using C#. Therefore a socket based connection was created between the game and the translator. The connection is only created at checkpoints where the player will be asked to perform the gesture. The translator sends the translated information to the game in real time, there was never any noticeable delay. On the game side, as soon as the string containing the detected translation arrives it is shown in the checkpoint interface.

The other of the main components is the translation from text, which in the game corresponds to the items the player acquires, into gestures. To assure the adaptability of the game, the avatar has a list of animations and those animations are sorted by the id of the corresponding sign. The animations are separate from the avatar and they can be simply dragged into the list of animation of the avatar and it will have access to them. The only restriction on this matter is that the animation must be created with a similar skeleton structure to the one from the avatar. As for the interaction within the game with the virtual world, all the interactive items and NPCs have colliders and when the player enters them it will show an option to interact by pressing the E key. If the players press the key, there will be always some kind of feedback. This happens because we developed template scripts that can be adjusted so new information can be added easily.

CONCLUSION

With this project, a larger support to the deaf and mute community was created and the sign language learning process now has an extra tool to support it. Since there are no many completed projects in this field, this project becomes even a greater asset for the development of Portuguese sign language. The implications for understanding the relationship between

games and learning are that games need not to be defined as an essential instrument or a type of content, but as contemporary human creations whose forms and meanings are strategic for education, more specifically concerning the hearing impaired community. The selection of this target population is due to the growing number of students with special needs, who complete the elementary and high school and enroll at the universities of higher education. This situation demands for new means that allow these individuals to have easy access to educational digital content. In order to motivate them towards the learning process, we have created a game that combines the sign language learning process with the pleasant feeling of playing a digital game. We believe this is a great time to take on the challenge of adopting new digital media, serious games and interactive simulations. However, the development of a game is always a complex task and many adversities were faced along the way. A lot of effort and time were needed to face challenges and solve problems, but a fair amount of knowledge was acquired during this process. As for future work, the game can be adapted for mobile platforms [6]. Also, as the game is in its final stage of development, a quantitative evaluation framework has been created and the next step will be to fill it based on the tests from users.

ACKNOWLEDGMENTS

This work was supported by Engineering Institute of Oporto and GILT (Graphics, Interaction and Learning Technologies) under Grant Nos. 60973089.

Paula Maria de Sá Oliveira Escudeiro

PhD in Computer Science -Information Systems and Technologies in Education Multimedia Systems, Adjunct Professor in Instituto Superior de Engenharia do Porto, in the Department of Computer Science, where she teaches disciplines of the Degree's course in Computer Engineering and Master's course in Computer Engineering - specialization in Graphics and Multimedia. Director of the Post-graduate course in Technology and Informatics Applied to Education.

Nuno Escudeiro

Teacher at IPP-ISEP and a researcher at LIAAD INESC Tech - Laboratory of Artificial Intelligence and Decision Support. PhD in Informatics from the Faculty of Engineering of the University of Porto and a MSc in Data Analysis and Decision Support Systems from the University of Economics of the University of Porto. Research activity focused on text mining and active learning.

Marcelo Norberto

Degree in Computer Engineering from the Instituto Superior de Engenharia do Porto, and attending the Masters in Graphics Systems and Multimedia at ISEP. With general interests in Game Developing and 3D Applications. Currently working in the VirtualSign more particularly in the game design.

Jorge Lopes

Degree in Computer Engineering from the Instituto Superior de Engenharia do Porto, and attending the Masters in Graphics Systems and Multimedia at ISEP. With general interests in video-games development. Currently working in the VirtualSign project with special focus in the modeling and animation.

References

[1] Claypool, K. T., Claypool, M. (2007). On frame rate and player performance in first person shooter games. Multimedia systems, vol. 13(1), pp. 3-17

[2] Creighton, R. H. (2010). Unity 3D Game Development by Example: A Seat-of-Your-Pants Manual for Building Fun, Groovy Little Games Quickly. Packt Publishing Ltd.

[3] Gee, J. P (2003). What video games have to teach us about learning and literacy, New York: Palgrave Macmillan

[4] Goldstone, W. (2009). Unity Game Development Essentials. Packt Publishing Ltd.

[5] Holm, I. (2006). Ideas and Beliefs in Architecture and Industrial design: How attitudes, orientations, and underlying assumptions shape the built environment, Oslo School of Architecture and Design.

[6] Jie, J., Yang, K., Haihui, S. (2011, October). Research on the 3D game scene optimization of mobile phone based on the Unity 3D engine. In: Computational and Information Sciences (ICCIS), 2011 International Conference on pp. 875-877. IEEE

[7] Ketfi, A., & Belkhatir, N. (2003, July). Dynamic interface adaptability in service oriented software. In: 8th International Workshop on Component-Oriented Programming (WCOP'03), Darmstadt, Germany

[8] Mariais, C., Michau, F., & Pernin, J. P. (2010). The use of game principles in the design of learning role-playing game scenarios. In: ECGBL 2010 Proceedings, pp. 462-469

[9] Perry, D. (1999). Saltzman p. 24

[10] Salen, K., Zimmerman, E. (2004). Rules of play: Game design fundamentals. Cambridge, MA: MIT Press

[11] Schell, J. (2005). Understanding entertainment: story and gameplay are one. Computers in Entertainment (CIE), vol. 3(1), pp. 6-6

Submitted: December 8, 2015.
Accepted: May 10, 2016.

ONLINE EVALUATION OF RECOMMENDER SYSTEM WITH MOVIELENS DATASET

Asmir Handžić

Faculty of Information Technologies Pan-European University "APEIRON" (PhD Student)
E-mail: asmir.handzic@handzic-it.com

Case study

DOI: **10.7251/JIT16020H** UDC: **004.652.8**

Abstract: The purpose of this paper is to explore the advantages of recommender systems based on the matrix factorization in respect to classical first neighbor recommender systems to real users through A/B test, as these studies are more significant. The results presented in this paper confirms the hypothesis that the recommender systems based on the models of matrix factorization are superior in relation to classical nearest-neighbor recommender systems.

Keywords: Recommender systems, online evaluation, MovieLens, A/B test

INTRODUCTION

The recommender systems are created with a purpose of assisting users in dealing with problems arising from information overload by building a prediction model which will evaluate the preference rate that a user will give to each recommended item [17].

The recommender systems have become extremely popular in short amount of time, as in the research as well as in the business sector. By 1996, several companies had marketing recommender systems in place ("Agents Inc" originating in "Ringo" project, and "Net Perceptions" originating in Group Lens project), and the first exploratory workshop in this field was held in Berkley in March 1996.

Since its beginning, this area has had a significant progress, both in science and in business application so that today the recommender systems are built-in in many commercial and other applications, many articles and books [9], [18], have been published, many universities are offering courses in this field, and there is an annual conference dedicated to this subject (the ACM Recommender Systems Conference). To attest today's popularity to use these systems in the e-commerce is the fact that out of 100 % series/sitcoms and movies which Netlifx users choose more than 75 % has been selected based on the recommendation from the system.

Research topic

When introducing the recommender systems there are certain problems: the problem of cold start and the selection of appropriate algorithm. The problem of cold start appears in cases where there is not enough data on a new user or a new item, therefore the system cannot create the prediction of preference. The other problem is related to the selection of appropriate algorithm which will, within the given system or business case, offer the good-quality recommendations to users.

Having in mind that the recommender systems are modern technology and are constantly evolving, there are datasets and open source algorithms which are developed by the academic community and are offered for the purpose of further scientific research.

Such dataset and the recommender system is used by a portal/site pogledajfilm.info, which is newly in-

troduced non-commercial portal for the purpose of scientific research and to provide recommendations as to which movie to use to users. Using the MovieLens 10M dataset the problem of cold start at the aforementioned portal/site has been dealt with (10 000 000 votes for 10 000 movies by 72 users). Still there is a problem of selecting the appropriate algorithm from a variety of modern and complex algorithms from MyMedia lite package.

The process of evaluation is highly important when validating/selecting the recommender systems. The evaluation can be offline and online. Offline evaluation is generally conducted when the system has not yet been implemented and we have more algorithm candidates, while online evaluation with implemented varieties of the system which are valid with real users of the system, where results are recorded and compared. The real value of these systems is online evaluation, where the system is used by the real users performing the real actions. In some cases these experiments are risky. For example if the test system offers irrelevant recommendations this can discourage test users and turn them from ever using this system. Therefore the experiment can have negative effects on the system, which may be undesirable in commercial applications. For this reason it is best to do the online evaluation after offline evaluation which will confirm that the candidates were reasonable.

In addition, most of the research results are given on bases of offline evaluation, less on the online, especially from the commercial systems which do not provide results due to competition. This further supports the need for the research conducted in this paper, as it will be conducted on the real users on the real (online) system, which is the best indicator of the system's quality. The results of this research will be used to support the decision on which of the algorithms will be used as the main algorithm in making the personalized recommendations to the users of a portal pogledajfilm.info, and which algorithm is better for the given dataset, that is the given case, which can help someone who uses the same dataset as a bases for research but also for commercial purposes (commercial systems). On basis of results from offline evaluation research, the online evaluation will be conducted with the real users of algorithms which have better results of offline tests.

Various studies and literatures [13] give advantages to recommender systems that are based on matrix factorization that is the dimensionality reduction, especially for the sake of performance and an increase in prediction's accuracy. This has been demonstrated with Netflix Prize competition [13], where they have been far superior, and it is a movie domain as well as a domain which the portal pogledafilm.info is using. With the increase of matrix, the classical collaborative filtering systems suffers from synonymy, performance declines (more computer power is needed with the increase of matrix) and sparsity, hence the prediction is logically worse. Systems based on dimensionality reduction, according to the latent factors research are easier at revealing connections between users and items and, with the more compact matrix, have better performances.

On basis of the problems and research objectives we can identify hypothesis:

H1. Recommender systems based on the matrix factorization model are superior compared to classical nearest-neighbor recommender systems, and expecially with an increase of matrix.

The main objective of this study was to choose the good-quality algorithm of the recommender systems out of many which are available online, based on the rating by the users, since such studies are less common but more important bearing in mind validity of the system, and that the research results serve as basis for the selection of the main algorithm, which will be used at pogledajfilm.info. Furthermore, the aim of this study is to test the hypothesis that the models based on the matrix factorization (matrix reduction) are far superior to the classical nearest-neighbor algorithms (user-user, item-item algorithm). Aforementioned research results [13] which give advantages to the matrix factorization models are mostly based on using offline evaluation. The offline metrics only assess the ability to "recommend" items that have already been consumed or rated. Real recommenders should usually be suggesting new items not already known to the user. Hence, something with low of-

fline metrics might actually be better at finding new items of interest. Therefore the main research method is the online evaluation.

METHODOLOGY

Offline test

Since the algorithms will be tested on the accuracy of predicting of how much a user will like the movie (by appointing 1-5 stars) the following tests will be used:

- RMSE (root mean square error)
- MAE (mean absolute error)

In essence, both tests indicated the deviation of the mean value that is how much of an error/deviation the system has made. The system is better if MAE and RMSE are smaller.

Online test

Online test is performed on the actual system users, and during the work A/B test will be used. A/B test operates in a way to implement two recommendation variants; the users are given recommendations for both of them, than the results are compared through (through feedback information, site visitation, sales, etc.)

The testing will be conducted on portal/site pogledajfilm.info, where registered users, who voted for at least 20 movies, will be given two options of the personalized recommendation (in forms of 10 movies with the highest prediction) and will be asked to rate the option which appeal to them more, not knowing which system algorithm (candidate) is the in question. The minimum of two candidate algorithms will be taken for the online testing, one of the most contemporary representative of algorithms based on the matrix factorization (Biased Matrix Factorization [13]), and the other classical closest-neighbor algorithms, Slope One[14]. Slope One is a simple implementation of item-item recommender system, which is efficient and accurate as many more complicated algorithms, and will therefore be interesting to research as an alternative to A/B test.

Recommender systems algorithms, which will be used, are part of My MyMedia lite tool. It is an open source tool which is available for use and development for non-commercial purposes and contains the most contemporary algorithms of collaborative filtering. MyMedia lite system comes as an open source based on C# programming language or as a batch file, which generates text file with the prediction/recommendation. During the work, the batch file "RatingPrediction.exe" will be used, which offers prediction (users_id, movie_id, rating) based on the standard of explicit rating from 1-5.

RESULTS

Results of offline test

Results of offline test have confirmed the thesis that the matrix factorization models are superior to classical nearest-neighbor technics. This is visible in two different offline tests, that is, with the increase of difference reciprocated with the increase of dataset.

BiasedMatrixFactorization:
RMSE:0,95
MAE:0,74
MatrixFactorization:
RMSE:0.97
MAE:0.75
Slope One:
RMSE:0.95
MAE:0.74
ItemKNN
RMSE:0.94
MAE:0.74

Figure 1. Results for offline validation on the 100K dataset

Both test methods have low RMSE and MAE and are close to each other at MovieLens 100K (100 000 votes) dataset, although at a significantly smaller dataset from the base one, Biased Matrix Factorization method provides significantly better performance. Test indicates that the classical Item KNN algorithm give good predictions at a smaller dataset (alongside others) but is the slowest in the performance. Classical Matrix Factorization algorithm is slightly worse than the advanced Biased Matrix Factorization algorithm which was expected.

Metod	RMSE	MAE
GlobalAverage	1.117	0.934
UserAverage	1.036	0.827
ItemAverage	0.983	0.783
SlopeOne	0.902	0.712
UserItemBaseline	0.908	0.719
ItemKNNPearson	0.871	0.683
FactorWiseMatrixFactorization	0.860	0.673
MatrixFactorization	0.857	0.675
BiasedMatrixFactorization	0.854	0.674
SVDPlusPlus	0.851	0.668

Figure 2. Results for offline validation on the 1M dataset

On a larger dataset (1 million of ratings) again we see confirmation of the thesis that is the increase of matrix increases advantages of the Biased Matrix Factorization method. In this example we have for 0,003 slightly less error of SVD PlusPlus method in comparison to Biased Matrix Factorization, however SVD PlusPlus will not be tested in the online evaluation because Biased Matrix Factorization through Netflix prize is more accurate, which is proved (Netflix prize award-given methods), and is more contemporary method which also incorporates biases (circumstances and prejudice). If we take the indicator of precision of Biased Matrix Factorization model from this example (Figure 1) and compare it to Netflix Prize data, Netflix's big award demanded RMSE to be 0.8563, while here RMSE is 0.854, hence we speak of very precise methods at the given dataset, at least as far as offline evaluation is concerned. Considering results of 100k and 1M datasets there is no need to make an evaluation with 10M dataset, but the online evaluation will be conducted, which is at the same time the main method of the research in this paper.

Results of online test – A/B test

The evaluation was carried out on 19 registered users in the system, from user ID 71568 to user ID 71586. The users had to have at least 20 explicit ratings. The users were then given, based on the outcome of their voting, two generated options of recommendations on 10 movie titles which had had the highest assumption that the user would personally like (with the highest prediction). The option 1 was personalized recommendation generated by Biased Matrix Factorization model, and option 2 by Slope One model. Than the user should have voted for the option which was more appealing to him, and to grade it from 1 to 5. Out of 19 participants in the analyses, 15 participated till the end of the analyses, which leads to conclusion that the users find it hard to explicitly participate in the evaluation of the system. Out of 15 participants, 10 voted for option number 1, and 5 for option number 2, thus individually graded option number 1 with the average grade of 4.11. In addition it was noted that the Matrix Factorization model (option 1) has a far better performance than Slope One at the given dataset. Option One training time is about 5 minutes, while option 2 takes 39 minutes.

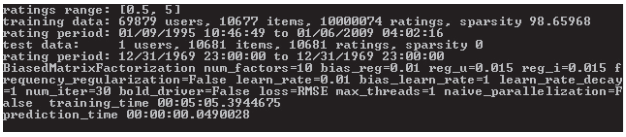


Figure 3. Biased Matrix Factorization training time

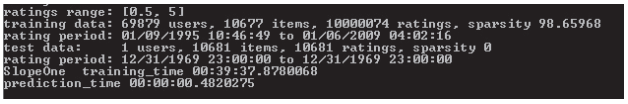


Figure 4. Slope One training time

CONCLUSION

Based on the research results of this work, confirmation of the thesis that the recommender systems based on the Matrix Factorization models provide better preferences to users than the classical nearby-neighbor recommender system models can be concluded. Furthermore, it is noted that the Matrix Factorization model (option 1) has far better performance than Slope One at a given dataset. Training time of the option 1 is about 5 minutes, while the option 2 takes 39 minutes, and here we can conclude how significantly advanced the Matrix Factorization Model is and that in the following phase of development of portal pogledajfilm.info the option 1 will be used to generate personalized predictions to site users. In addition, from the research conducted on the users, it can be also concluded that the users will harder agree to participate in the evaluation of the system explicitly, and this may be a reason why these studies are few and far in between but of a very high importance because they provide the overall picture on the system evaluation.

The study was carried out in the same domain as was the domain used as a basis to form the hypothe-

sis, which is to recommend the movies, but not using the same dataset. The recommendation is for further research study is to be conducted, to repeat the same study but in some other domain, regardless whether it is commercial or non-commercial.

Biography:
Asmir Handžić Senior Teaching Assistant at University of Bihac. PhD student in Informatics from the Faculty of Information technology of the University ''APEIRON'' Banja Luka and MSc in Informatics from the Faculty of Information technology of the University ''Dzemal Bijedic'' Mostar. Research activity focused on recommender systems and human-computer interaction.
Faculty of Information Technologies Pan-European University "APEIRON" (PhD Student).

REFERENCES

[1] Burke, R. (2002). Hybrid Recommender Systems: Survey and Experiments. User Modeling and User-Adapted Interaction., 331-370

[2] Bennet, J. and Lanning, S. (2007). "The Netflix Prize," KDD Cup and Workshop; www.netflixprize.com.

[3] Claypool, M., et al. (2001). Implicit interest indicators. In Proceedings of the 6th international conference on Intelligent user interfaces (IUI '01). ACM, New York, NY, USA, 33-40

[4] Eckhardt, A., Vojtáš, P. (2009). Combining Various Methods of Automated User Decision and Preferences Modelling, MDAI '09 Springer-Verlag Berlin, Heidelberg, 172-181.

[5] Eckhardt, A., Vojtáš, P. (2009). How to learn fuzzy user preferences with variable objectives. In proc. Of IFSA/EUSFLAT Conf. 2009: 938-943

[6] Freyne, J., et al. (2011). Recipe recommendation: accuracy and reasoning. In Proceedings of the 19th international conference on User modeling, adaption, and personalization (UMAP'11). Springer-Verlag, Berlin, Heidelberg, 99-110

[7] Gunawardana, A., Shani, G.A. (2009). Survey of Accuracy Evaluation Metrics of Recommendation Tasks, Jorunal of Machine Learning Research 10, 2935-2962

[8] Hu, Y., et al. (2008). Collaborative Filtering for Implicit Feedback Datasets. In Proceedings of the 2008 Eighth IEEE International Conference on Data Mining (ICDM '08). IEEE Computer Society, Washington, DC, USA, 263-272

[9] Jannach, D., et al. (2011). Recommender systems: an introduction. Cambridge University Press, New York

[10] Jawaheer, G., et al. (2010). Comparison of implicit and explicit feedback from an online music recommendation service. In Proceedings of the 1st International Workshop on Information Heterogeneity and Fusion in Recommender Systems (HetRec '10). ACM, New York, NY, USA, 47-51

[11] Konstan, J. and Riedl, J. (2012). Recommender systems: from algorithms to user experience. User Modeling and User-Adapted Interaction,, 22, 101-123

[12] Konstan, J., et al. (1997). Applying collaborative filtering to usenet news: the GroupLens system. Commun. ACM 40(3), 77–87

[13] Koren, Y., et al. (2009). Matrix Factorization Techniques for Recommender Systems, IEEE Computer Society

[14] Lemire, D. and Maclachlan, A. (2005). Slope One Predictors for Online Rating-Based Collaborative Filtering. SIAM Data Mining

[15] Maxwell, F. H. and Konstan, A. J. (2015). The MovieLens Datasets: History and Context. ACM Transactions on Interactive Intelligent Systems (TiiS) 5, 4, Article 19 (December 2015), 19 pages. DOI=http://dx.doi.org/10.1145/2827872

[16] Mukherjee, R., et al. (2003). A Movie Recommendation System\—An Application of Voting Theory in User Modeling. User Modeling and User-Adapted Interaction 13, 1-2 (February 2003), 5-33. DOI=10.1023/A:1024022819690

[17] Peska, A., et al. (2011). UPComp - A PHP Component for Recommendation Based on User Behaviour. In Proceedings of the 2011 IEEE/WIC/ACM International Conferences on Web Intelligence and Intelligent Agent Technology - Volume 03 (WI-IAT '11), Vol. 3. IEEE Computer Society, Washington, DC, USA, 306-309. DOI=10.1109/WI-IAT.2011.180

[18] Ricci, F., et al. (2011). Recommender Systems Handbook, Springer

Submitted: April 5, 2016.
Accepted: May 5, 2016.

Model of the Processing and Selling Insurance Over the Internet

Dragan Mihic, Branko Latinovic, Tomislav Vujinovic

Pan-European University "APEIRON", Banja Luka (Bosnia and Herzegovina)

dmihic@yahoo.com; branko.b.latinovic@apeiron-edu.eu; tomo.vujinovic@yahoo.com

Case study

DOI: **10.7251/JIT16025M** UDC: **004.738.5:004.65**

Abstract: The growing demands in providing better services to customers, as well as reducing the cost of the insurance companies; while processing insurance quotes require the use of modern technologies such as the methodology of comparing prices and buying policies through the internet. There is a demand for providing a better customer's quality of shopping, saving customers time and money and integrate all parameters in insurance companies that are important in calculating and creating insurance price.

The current way of exchange - search as integration of data, such as an incident book, would be replaced by a modern automatic search of the database, and use processes that meet all insurance standards. The institutions such as insurance supervisor authorities, state tax office and other institutions will be able to access the data in real-time and receive relevant and accurate information about the insured, the vehicles and the policy.

The research and developing model is based on study of regulation laid down by the Agency for supervision of insurance in Bosnia-Herzegovina and the collection of business data from insurance companies. Although tariffs and prices of vehicle insurance are unique for all insurance companies, there are differences in how the businesses are carried in insurance companies. [1]

Based on these studies and research the new model is developed and proposed for further development and improvement, integration, processing and sale of insurance policies through the Internet.

Keywords: Insurance, insured, bonus, malus, accident, premiums, insurance quote, insurance premium, damage.

The aim of the research

The aim of this research is to learn about methods of the sales of insurance policies, to identify the problems associated with the current methodology of buying and selling vehicles insurance policies and to give a proposal for the modernisation of contemporary models, the design and implementation of which will fully meet the insurance market in Bosnia-Herzegovina.

In terms of Integration with European Union law, the contribution of this paper is to provide better protection to the buyer when purchasing policy as well as a better quality of supply and choice of products including vehicle insurance.

Review summary

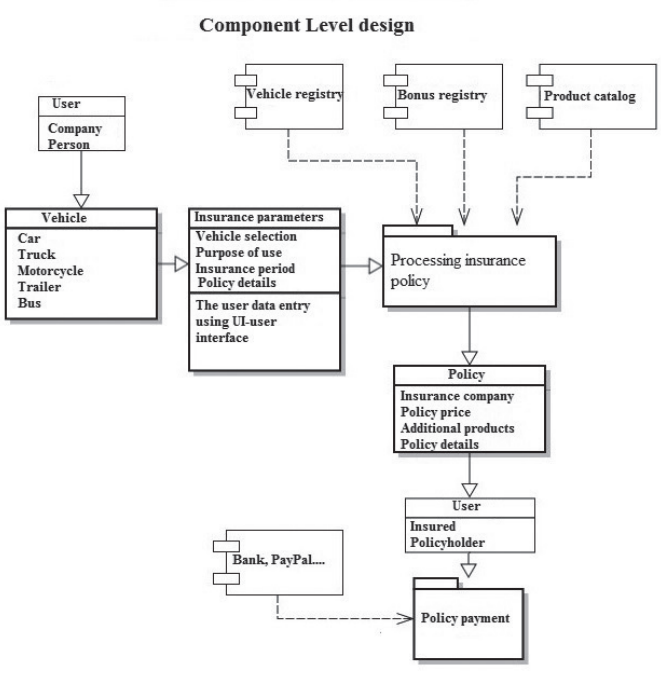
In Bosnia and Herzegovina there is currently no insurance company with a developed integrated system for the sale of vehicle insurance policies over the Internet. Most insurance companies are based on systems that are made in house, within the organisation, with the aim of calculating the prices of insurance policy which could be printed out for a customer at the same time. These systems are not fully integrated and often require duplicated work that causes errors, and are time consuming. In addition, insurance companies consider these systems as a business secret and so there is no possibility of the exchange of information in terms of improving the processing and sale of vehicle insurance. [3],[4],[5]

The backlog in the development and implementation of these systems in Bosnia and Herzegovina are the result of the following factors [3],[4],[5]:

1. Partially caused due to lack of computer usage and computer education in Bosnia and Herzegovina.
2. The Support of the financial institutions with the possibility of payment through Internet transactions, use of credit cards, PayPal and other Internet payment methods.
3. Access to technical data of vehicles and other elements relevant to the operation of applications and information systems. The Agency for Identification Documents, Registers and Data Exchange of Bosnia-Herzegovina is a state institution that controls and updates the records of motor vehicles as well as providing access to registered vehicles. At the moment, access to the registry of motor vehicles is partial without the vehicle registration plate number. The partial registry is available only via downloading the data in Excel format. These data are updated once a month, causing a delay in the availability and accuracy in the process of buying insurance. Control and access to the registry is limited by many factors such security vehicle owners, protection from theft and so on. However, access to this data, such as in the European Union, should be available to all businesses and legal institutions to which these data are essential for the development and operation of their organisations.
4. Agencies for supervision of insurance companies do not have or have very limited regulation and written instructions that regulate the sale of insurance policies through the Internet. For these reasons, the formation of an insurance company that sells insurance for vehicles via the internet is difficult and faces a number of bureaucratic obstacles.
5. Access to the register of insurance bonuses and malus is limited and partial. When searching for a driver›s current bonus the Insurers currently use the so-called Book of bonuses (Microsoft Excel spreadsheet). Based on the information of the damage caused to the vehicle and a third party, the bonus and malus could be determined. Register of bonuses and malus is updated once a month. Every insurance company updates its own data related to damages and emails it to the agencies for supervision of insurance companies, where data is migrated and sent back to all the insurance companies. This causes delays in access to this critical data.
6. Tariffs and insurance premium vehicles are the responsibility of the agency for the supervision of insurance companies. At the moment they are fixed and identical for all insurance companies. Price liberalisation would allow better quality of insurance product supply in the market of vehicle insurance. It would allow competition and prestige in insurance companies in order to attract new customers and retain existing customers of vehicle insurance.

THE DEVELOPMENT OF A NEW MODEL OF SELLING INSURANCE

Bearing in mind all the things mentioned in the previous chapters, such as: the impossibility of selection and purchase of insurance policies via the



Figures 1. Models of insurance policies sale [1]

The new model of selling insurance over the Internet is designed with the satisfaction of all the principles of software engineering such as design, development, maintenance and testing of the new model.

Internet, the incomplete integration of information relevant to the calculation of policy prices, manual processing of policy prices, and the possibility of making mistakes, etc., a new model of selling insurance policies via the Internet has been developed.

The following Figure 1 shows the diagram and the concept of a new model of insurance policy sales, which is the process of comparison and choice of the product, which is vehicle insurance in this case. [1],[8],[9]

The new model of development is systematic and worked out in order to be operational and not exposed to the high costs of maintenance and use. The new model meets the economic principles of reliability and effectiveness in the use of computer equipment. [8],[9]

For the start, the model is developed for the following insurance types: passenger cars, trucks, trailers, motorcycles, tractors and buses. There is a possibility of further extension such as life, travel, property and other insurances.

This model is integrated with the register of vehicles, register of driver's bonuses and catalogue of products.

The new model is modular and consists of the following modules [1]:

1. User register
2. Insurance parameters
3. Processing insurance
4. Overview of insurance data
5. Insurance payment

Administration model consists of the following modules [1]:

1. Admin modules e-osiguranja.com
2. Admin modules police (MUP-a)
3. Admin modules insurance company

The catalogue of additional products

In addition to selling motor insurances, insurance companies are able to sell additional products that are in some form related to motor insurance. These additional products are optional when buying vehicle liability insurance (AO). [1]

The main reason for including these products is to provide better service to the customer and to provide insurance with better coverage. In order to attract customers to buy the policy, the insurance company gives a better deal with better conditions of insurance coverage. Therefore, insurance companies can be recognised on the insurance market in order to offer better prices and quality products, in this case the insurance of motor vehicles. Additional products vary by type of vehicle.

The catalogue of additional products currently includes seven products that may be included with the mandatory insurance offered as a package for motor insurance [1]:

1. Voluntary excess

This is the total amount the driver needs to pay towards the cost of the claim. Compulsory excess which is set by the insurer, and a voluntary excess which is amount driver agree to pay towards a claim in addition to the compulsory excess. This excess is paid by the mandatory addition and volunteer allowance. The Voluntary access reduces the price of insurance.

2. Legal assistance

Provides legal expenses cover in the event that the driver needs to take legal action following a motor accident that is not their fault.

3. Courtesy car

Provides the driver with a courtesy car if the insurers approved repairer is used, subject to availability. This cover normally excludes fault claims where the vehicle is written off or a theft claim is made.

4. Windscreen cover

Coverage for repair of damaged or cracked windscreens, if it is possible to repair or replace the damaged windshield.

5. Personal accident covers

Coverage for the insured if they are injured in an accident and which is considered to be their fault.

This coverage is usually up to a maximum of (the sum of KM).

6. Breakdown cover

It includes roadside assistance, vehicle back on the road and start the vehicle at home if needed.

7. Bonus protection

The bonus is protected in the event of a driver's fault.

The parameters and data of add-on products from the catalogue are related to the insurance company. Updates of additional products are carried out by an insurance company that has an active contract with e-osiguranja.com.

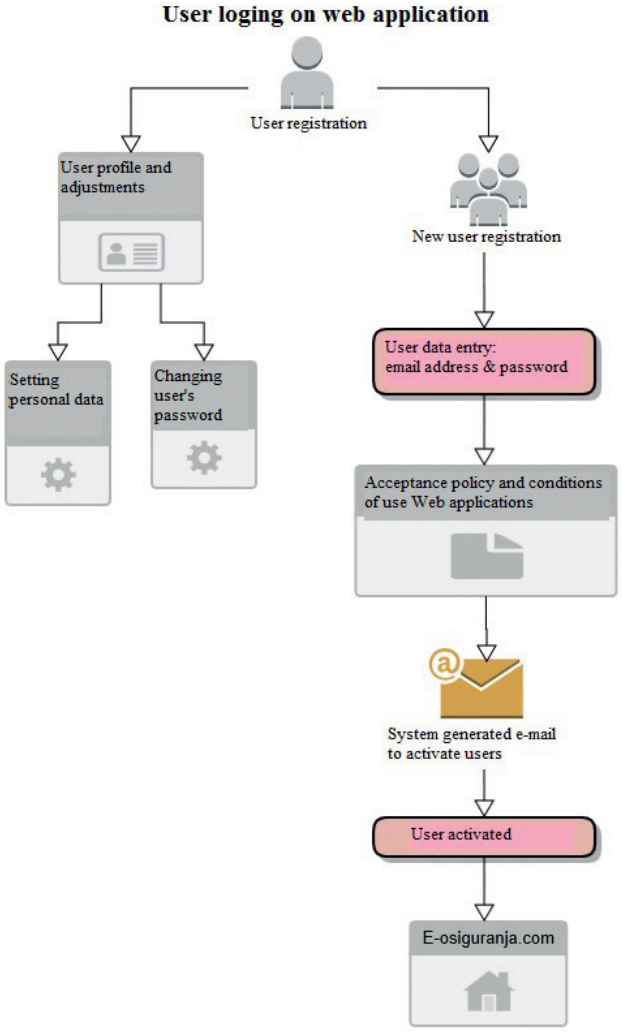


Figure 2. The process of logging in, registration and user setup [1]

The data that could be updated:

1. Availability of the product (Active)
2. Type of additional products
3. The price of additional products

Figure 2 shows the process of user registration and of users set up on the insurance portal. Registration of a new user on the portal is the standard procedure used by most web applications. The user must have a valid email address and access to the email inbox. The checking of the validity of email addresses is accomplished after the registration on the portal. The user must accept the privacy and terms and conditions of use the portal in order to complete the registration. In the event that the email address has been used in the past, user registration is disabled. The user cannot make the registration using the same email address. After accepting the terms and conditions of use of the portal, an email is sent to user with instructions on how to activate account and complete the registration. After the successful registration of a user account, the user is able to log on to the web portal. [1],[8],[9]

When user log-on on e-osiguranja.com web portal the user is able to [7]:

1. Change password
2. Change user data
3. Change user profile (first name and last name)
4. Change the address (Street and number, city, postal code, phone)
5. Check-out from the portal

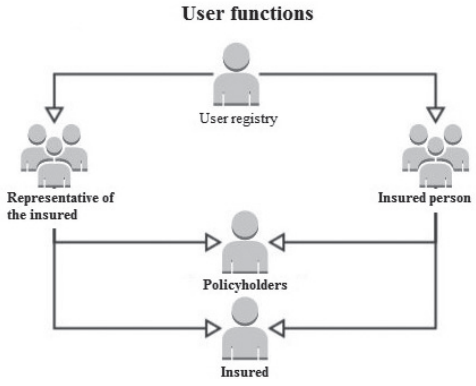


Figure 3. The user functions in the application [1]

ADMINISTRATIVE MODULES

The basic and most important administrative module is a module of the application eosiguranja.

com (Portal). This module regulates and sets other modules. User login to the admin module is done by the same principle as logging by insurance. [1]

Administrative modules are divided into three groups:

1. E-osiguranja.com module
2. The police (MUP) module
3. The insurance company module

The basic functions of the modules are [8],[9]:

1. Module E-osiguranja.com portal
   - Creating and setting up users of other modules
   - Installation and adjustment of parameters of insurance companies
   - Regulate (activate) the contracts with insurance companies
   - Sets the vehicle registers and a catalogue of bonus and malus
   - Managing and regulates accounting and profit distribution
   - Create and produce various reports

2. The police (MUP) Administration module
   - Search for the vehicle by policy number
   - Search for the vehicles by license-plate number
   - A search for the driver by driver name, surname or personal identification number (JMB)

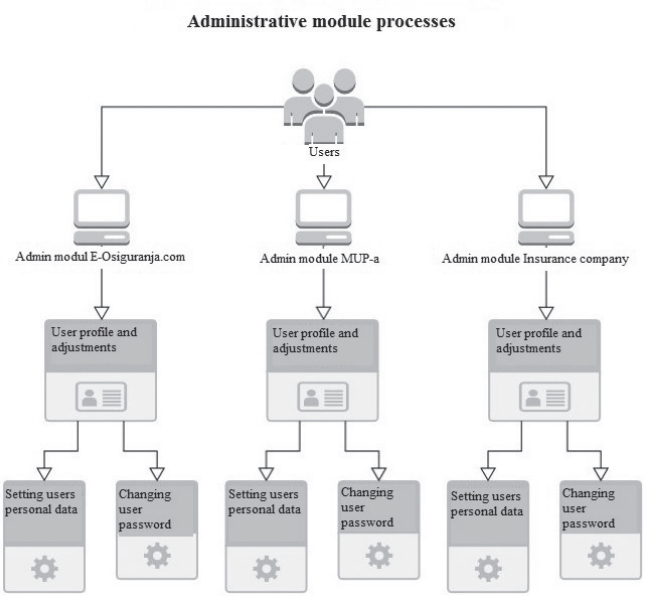
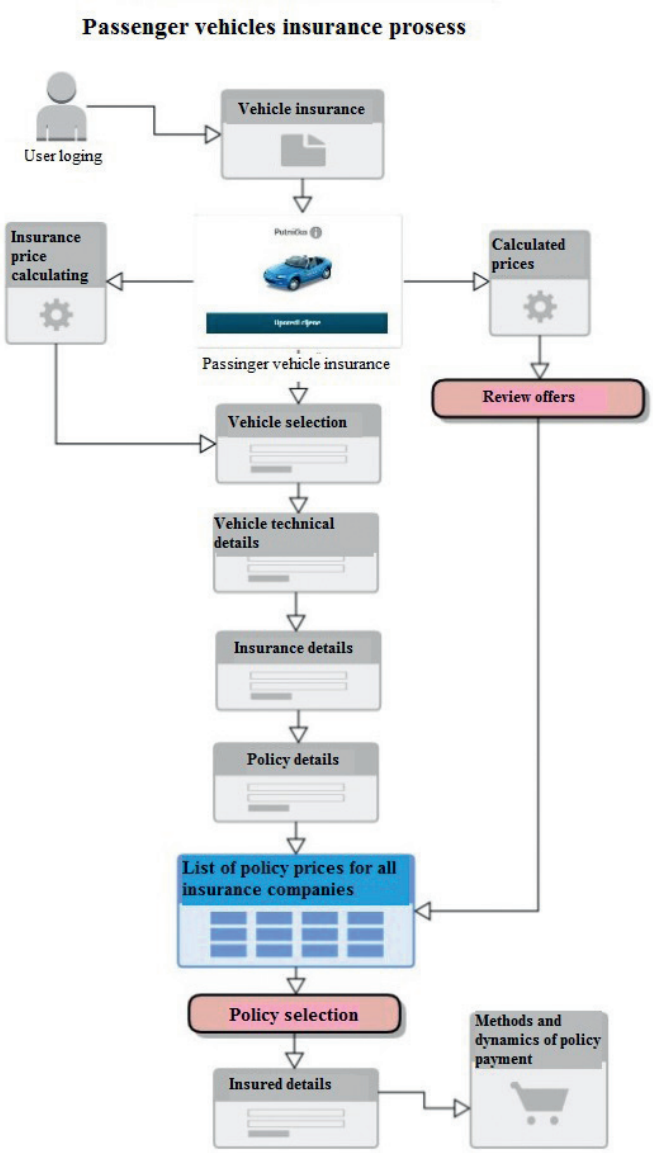


Figure 4. The process of data flow in administrative module [1]

3. The insurance company module
   - Set up the parameters and data related to own organization (policy prices, the prices of additional products and other information for the policy sale)
   - Set up the contract parameters
   - Create reports related to the own organization

Possibility of functions extension and adding new modules is unlimited. Each module has the same principles of setting up user data as well as logging on to the web portal.

When logged on the insurance web portal the user can choose the type of insurance that is inter-



Figures 5. The process of passenger vehicles insurance [1]

ested in. In this paper is shown only creating and buying vehicles insurance.

Vehicle insurance is divided into the following categories [3],[4],[5]:

1. The passenger's car
2. Cargo truck
3. Motorbike
4. Trailer
5. Buses

The web portal users can calculate the new price of the vehicle insurance and views already calculated prices for each vehicles category within the period until the quote expire.

In calculating the new vehicle insurance prices, web portal guides the user through the selection and enter the necessary vehicle technical details (parameters). The application is designed to enable easy data entry and guiding the user with a logical flow of entering information. The information related to the selection and the technical data of the vehicle are [3],[4],[5]:

1. Vehicle type
2. Vehicle technical details
3. Insurance period
4. Policy details

After entering the data into required fields, the application checks the data format in the field and the accuracy of entered data. In the case of error the application prompts the user and returns to the field where the error was made. Each field is hooked up with the information button that gives concise information about the entered the field.

After entering the necessary vehicle technical data, the application performs the calculation of the policy price and generated quote overview including the additional products prices for each insurance company that has a valid contract with e-osiguranja.com.

The user is able to look at all of the entered data and the calculated policies prices for each insurance company. The application generates and sends an email to the customer with all calculated prices.

After selecting the policy to buy, the user must enter the data of the insured person. The user could be insured representative or insured person.

The last process is buying the policy and payment. Depending on the insurance company and their settings, the buyer will have the option of choice the dynamics of policy payment. After selecting payment dynamics (yearly, half-yearly, quarterly or monthly)

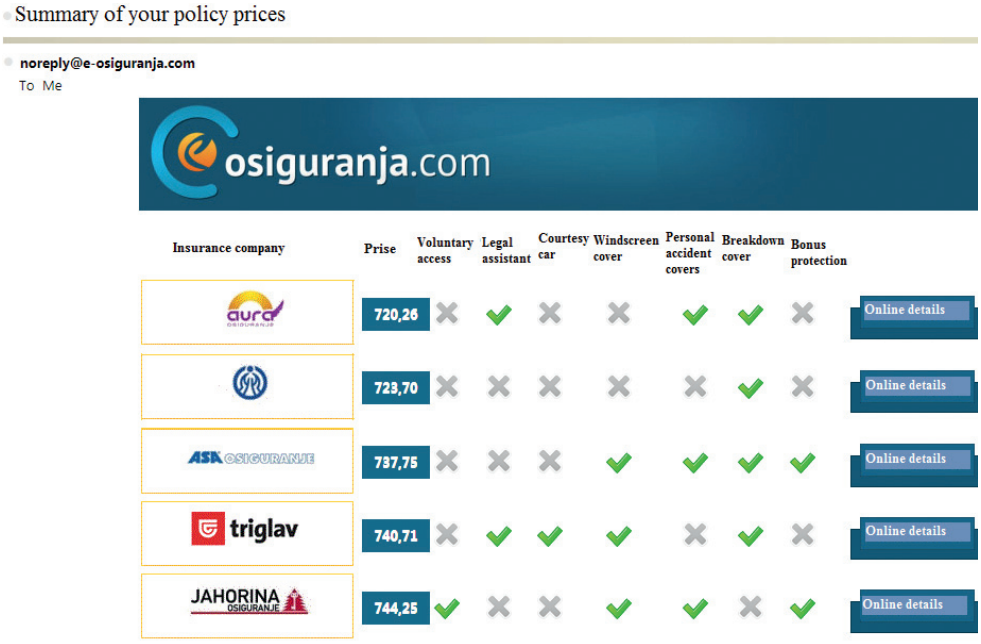


Figure 6. Email with a review of insurance policy quotes [1]

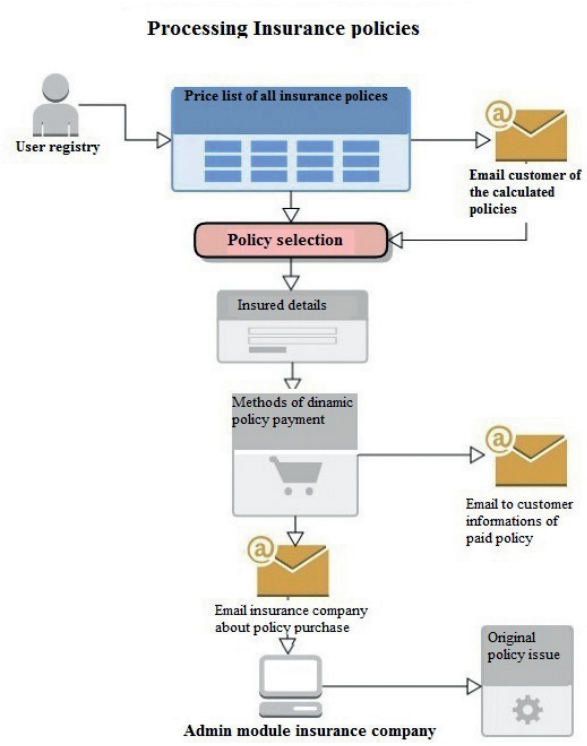


Figure 7. Process of generating insurance quotes [1]

user has is prompted to payment. Policy payment is web link to the Bank through protected connection. However the user must own a valid credit card to complete policy payment. [8]

REVIEW INSURANCE POLICIES QUOTES

When transaction payment is successfully completed, the buyer will receive an email with payment information as well as information about the purchased policy.

If the insurance company set the parameter for automatically getting email with information about the sold policy will receive the email that the customer has purchased policy with all relevant data, including the customer and policy details. In addition to this when the insurance company log into the insurance portal can see all sold policies with all the data, customer details and prices.

The insurance company will then make its original policy, and within seven days send to the customer by mail. The insurance company will then register in the web application admin module that the original policy was sent to the customer.

In application all quotes are saved for each user (customer) and insurance company separately. The users have possibility to access their policy prices and quotes in the past (the historical policies data) and even buy a policy if the quote is still valid. The user can update the same data, create a new quote and buy a policy based on past data in valid quotes. Every insurance company can set the valid quote period. After a while, the insurance quote expires and become invalid but user can still view the quote with details. The user can delete a quote from the historical data if is no longer interested in the quote. [8],[9]

Figure 8. Calculated insurance policy price [1]

PROCESS OF PASSENGER VEHICLES INSURANCE

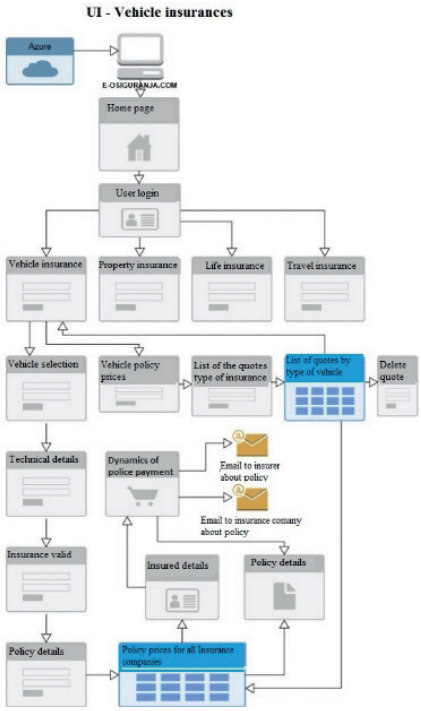


Figure 9. The model of passenger vehicles insurance [1]

THE CONCLUSION

The new model has been developed with the aim to modernize and eliminate all the failures of the old system and enabled the purchase insurance over the Internet, the incomplete integration of the essential data for the policy prices calculation. Mostly of current models selling insurances have manual processing of the insurance policy prices, and therefore there is high chance of possibility of making mistakes, data duplication and the lapse in interpretation of legal regulations in insurance industries, etc.

The new model using modern method of comparing prices and quotes and the insurance quote is created in one place and at one of essential data entry for all insurance companies. In developed countries this method selling on internet is widely used on the market for selling various products including insurance policies.

With this modern technology which is used in the development of this model led to the account of the buyer to gain as a better offer with high quality services when buying insurance policies. The insurance companies increased the quality of their services when selling insurance policies and at the same time drastically reduced their administrative processes and the costs within their organizations. This model for the start includes the insurances for passenger cars, commercial vehicle, trucks, motorcycles and buses and left the possibility of further extensions on life, travel and property insurance and other insurance. In addition to the sale of the motor vehicle insurance policy insurance companies are able to sell additional products that are in some form attached to the motor vehicles insurance (product catalogue). Additional products catalogue currently contains seven products that can be included with the obligatory insurance (AO) as motor insurance package deals. The model allows for full integrations and share data between insurance companies and the agency for supervision of insurance companies. Integration with AZORS [3] and the NADOS [5] is accomplished by using web service as well as the ability to access insurance policy data by signing up to the application. Integration with IDDEEA [2] could be through a web service for the purposes of access to the vehicles register and vehicle technical data. Integration with damage registry allows you to specify the premium grade and could be established via a web link. [11]

The methodology of comparing and buying products online, such as insurance policies brings many advantages in the modern mode of sales.

REFERENCES:

[1] Mihic D. (2014). Development of a model for the process of selling insurance over the Internet in BiH. Master work at the University of Mostar. 6-7, 22-23, 46,53,71,73,77, 92-94. URL: http://e-osiguranja.com/

[2] The Agency for Identification Documents, Registers and Data Exchange of Bosnia and Herzegovina (IDDEEA) was established by the Law on Agency in June 2008 ("Official Gazette of BiH",No.56/08). URL: http://www.iddeea.gov.ba/

[3] Insurance Agency of Bosnia and Herzegovina was established pursuant to the Law on Insurance Agency of Bosnia and Herzegovina (Official Gazette of BiH, number 12/04). URL: http://www.azobih.gov.ba/

[4] Insurance Agency of the Republic of Serbian established by the Law on Insurance of 2006 , as an independent and non-profit institutions of the Republic of Serbian as a legal entity and based in Banja Luka , which reports to the National Assembly of the Republic of Serbian. (Official Gazette of RS, number. 2/15 year 19.01.2015.). URL: http://www.azors.rs.ba/azors/

[5] The Agency for supervision of insurance of the Bosnia and Herzegovina. (Official Gazette FB&H, No.7/9). URL: http://www.nados.ba/

[6] Dan Grossman, developed and maintained.1999-2016 Awio Web Services LLC. The Benefits of Search Engine Optimization for Website. URL: http://www.websitegoodies.com/

[7] Kieran McCarthy, SimDif. How to write the home page of your website. URL: http://write-for-the-web.simdif.com/a_good_home_page.html

[8] Scott W. Ambler, (1998-2014), Ambysoft Inc. User Interface Design Tips, Techniques, and Principles. URL: http://www.ambysoft.com/essays/userInterfaceDesign.html

[9] McGraw-Hill Education (2016), Software engineering concepts. URL: http://catalogs.mhhe.com/mhhe/home.do

[10] Microsoft (2016), Windows Azure SQL Database Architecture. URL: http://azure.microsoft.com/en-us/documentation/
[11] Digital Vertebrae (2015), Web site development and introduction. URL: http://www.digitalvertebrae.com/webdev/
[12] Microsoft (2016), SQL Server 2016. URL: https://www.microsoft.com/en-gb/smb/products/sql-server-2016/

Submitted: May 5, 2016.
Accepted: May 29, 2016.

ROAD SAFETY MANAGEMENT IN LOCAL COMMUNITIES

Milenko Čabarkapa
Faculty of Transport, Communications and Logistics, Budva, Montenegro
e-mail: milenko.cabarkapa@fskl.me, +382 67 240-609

Zoran Ž. Avramović
Paneuropean University Apeiron, Banja Luka, Republika Srpska, BiH
e-mail: zoran.z.avramovic@apeiron-uni.edu.eu, +387 65 224-604

Case study
DOI: **10.7251/JIT16027C** UDC: **656.08:352.07**

Abstract: The research of coordination of activities and responsibility-sharing at the appropriate level of road safety management, conducted by analyzing responses from the prepared Questionnaire, in the period before and after the adoption of the Global Plan for the Decade of action for road safety 2011-2020, showed that the improvement or deterioration of the state of road safety at all levels of management, particularly at the local level within Montenegro, can be directly associated with the achievement of coordination of activities and responsibility sharing for the state of road safety. The aim of the paper is to encourage the development of the road safety system in local communities, basing on a vertical coordination in national and local activities and horizontal coordination in activities at the local level, with the establishment of a responsibility sharing system for the state of road safety in local communities.

Keywords: activity, coordination, responsibility, road safety, level of territorial organisation, local community.

INTRODUCTION

After recognising in 2004 that road safety is a global problem [24] the World Health Organisation declared in 2009 that it is time for activities for road safety [25]. In 2010 United Nations declared a Decade of action for road safety 2011-2020 [20]. The goal of the Decade is to stabilize and then reduce the forecast level of road traffic fatalities and thus save 5 million lives in the world by 2020. For the international coordination of national activities to achieve the goals of the Decade, a Global plan for the Decade of action for road safety is adopted [26]. By the Global Plan for the Decade of action for road safety 2011-2020, an overall framework is formed, in which are the five pillars for activities at national level: road safety management, safer roads and mobility, safer vehicles, safer road users and post-crash response [26].

Encourage the creation of multi-sectorial partnerships and designation of lead agencies with the capacity to develop and lead the delivery of national road safety strategies, plans and targets, underpinned by the data collection and evidential research to assess countermeasure design and monitor implementation and effectiveness, is the first pillar of national activities recommended by the Global plan for the Decade of action for road safety 2011-2020 [26], based on the recommendations of the World report on road traffic injury prevention, proposed by the Global Road Safety Commission (2009).

This can be achieved through:
- encouraging the establishment of coordination groups,
- building partnership coalitions, by involving different sectors (traffic, health, police, judi-

ciary, urban planning, etc.),
- creating partnerships with development banks, national governments, civil society, educators and private sector,
- promoting responsibility for road safety, by shifting a major share of the responsibility from the individual road users to those who design the road transport system: road authorities, architects, urban planners, the automotive industry, police, government and legislative bodies, health services, the judicial system, schools, and nongovernmental organizations,
- establishing the legal responsibility of authorities responsible for designing the road system and individual road users for non-compliance with laws and regulations.

In this paper, the road transport safety is analyzed as a product of management system based on coordination of activities and responsibility sharing. This paper analyzes the changes in the state of road safety in the period before (2007 and 2010) and the period after (2013 and 2014) the adoption of the Global Plan for the Decade of action for road safety [26], at global level within the world, regional level within WHO regions, national level within Montenegro, and local level within local communities of Montenegro. The improvement or deterioration of the state of road safety at all these levels can be directly associated with the achievement of coordination of activities and sharing of responsibilities for the state of road safety, as the Global Plan for the Decade of action for road safety [26] is adopted for the international coordination of national activities and promoting accountability for the achievement of the objectives of a Decade of action for road safety 2011-2020 [26], to stabilize and then reduce the forecast level of road traffic fatalities.

Road safety management

The accepted approach is that road safety is produced [15, 10, 18, 13, 6]. To achieve this goal, a management system is required, in which the management function promotes interventions, which in turn produce results [1]. It is a management system based on the standards of road safety [8], with a focus on results, which product will be the continuous improvement of road safety.

Institutional management function includes: coordination, regulations, financing and allocating resources, promotion, monitoring and evaluation, research, development and knowledge transfer [2].

Coordination refers to the orchestration and coordination of interventions and other related institutional management functions to achieve the desired focus on results.

In general, coordination of institutional management function of road safety is reflected in: [2]
- horizontal coordination,
- vertical coordination,
- partnership, and
- parliamentary relationship.

A characteristic of the road safety management is that it allows a universal use at all levels and in all countries, regardless of their size or developmental performances of road safety [19, 2].

To achieve an efficiency and effectiveness of road safety management, the coordination of activities must allow responsible decision making at higher institutional levels and responsibility for the improvement of road transport system at lower institutional levels, especially in the area of roads, vehicles, behaviour and health care [22, 7, 16, 5, 9, 17, 14, 23, 30].

Research method

Changes in the state of road safety are analyzed in the period before and the period after the adoption of the Global Plan for the Decade of action for road safety [26], adopted for the international coordination of national activities and promoting accountability for the achievement of the objectives of a Decade of action for road safety 2011-2020.

Basic indicators of road safety, which were used in the analysis, are the number of fatalities and the public risk (deaths per 100,000 population).

Space research includes: at global level - the world, at regional level - WHO regions, at national level – Montenegro, and at local level – local communities-municipalities in Montenegro.

The research covered the period from 2007 to 2010, for the period prior to adoption, and from 2013 to 2014, for the period after the adoption of the Global Plan for the Decade of action for road safety.

The study is based on data published in the Global status report on road safety [25] and the data published by Monstat for Montenegro [11].

The research of coordination of activities at the appropriate level of road safety management is conducted by analysing responses from the Questionnaire (Table 1).

on the world's roads is reduced from 1.3 million in 2007 to 1.25 million in 2013, while in 2010 it amounted to 1.24 million, which means that it has remained fairly constant from 2007 to 2013, despite an increase in global motorization and population. At the same time, the public risk is reduced from 18.8 to 17.5 died per 100,000 population (Figure 1). This indicates that interventions to improve global road safety prevented an increase in the overall death occurring, which would certainly occurred without the interventions. The goal of the Decade to, first, stabilize the number of road traffic fatalities in the world, is achieved in the first two years of implementation.

Table 1. Questionnaire. Research of coordination of activities at the appropriate level of road safety management

Questions	Yes	Partial	No
Are interventions being coordinated horizontally across competent bodies to achieve the desired focus on results?			
Are interventions being coordinated vertically between competent bodies to achieve the desired focus on results?			
Has coalition partnership been builtbetween competent bodies to achieve the desired focus on results?			
Have Parliamentary committees and procedures supporting the coordination process been established to achieve the desired focus on results?			
Has responsible decision making at higher institutional levels been established, and has legal responsibility of competent bodies to design road transport systems at lower institutional levels been established to achieve the desired focus on results?			

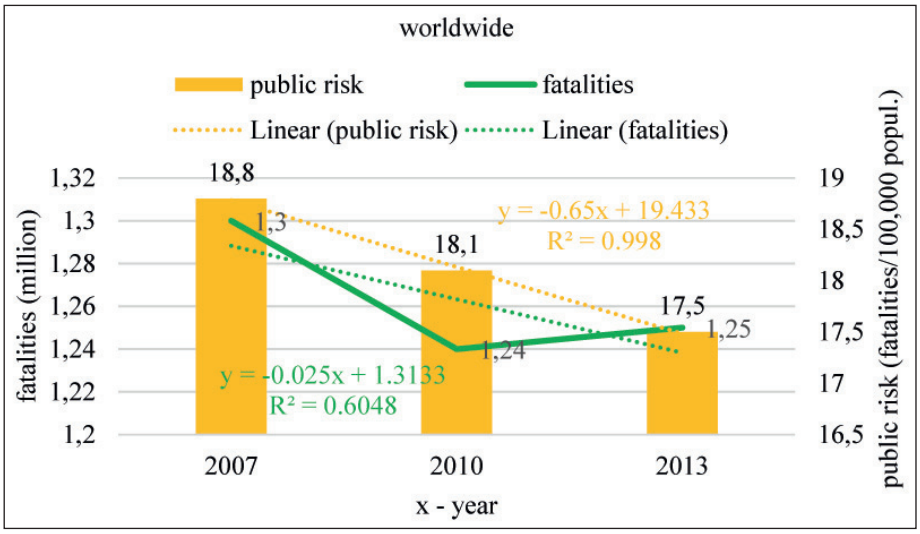


Figure 1. Changes in the number of fatalities and the public risk at the global level

STATE OF ROAD SAFETY

Global level - world

According to the Global status reports on road safety for 2007, 2010 and [25], the number of deaths

The research of coordination of activities at the global level of road safety management, conducted by analyzing responses from the Questionnaire (Table 2) shows that further improvements in road safety are possible and that they will be generated by

Table 2. Questionnaire. Research of coordination of activities at the global level of road safety management

Questions	Yes	Partial	No
Are interventions being coordinated horizontally across competent bodies to achieve the desired focus on results?	United Nations World Health Organisation World Bank Global Road Safety Partnership		
Are interventions being coordinated vertically between competent bodies to achieve the desired focus on results?	Second UN Global Road Safety Week, 6-13 May 2013 Third UN Global Road Safety Week, 4-10 May 2015 2nd Global High-Level Conference on Road Safety results in "Brasilia Declaration", 18-19 November 2015		
Has coalition partnership been built between competent bodies to achieve the desired focus on results?	UN Road Safety Collaboration Global Road Safety Partnership		
Have Parliamentary committees and procedures supporting the coordination process been established to achieve the desired focus on results?	On 10 April 2014 the UN General Assembly adopted a resolution on "Improving global road safety".		
Has responsible decision making at the global institutional levels been established to achieve the desired focus on results?	United Nations World Health Organisation World Bank Ministers and heads of delegations gathered at the Conference in Brasilia		

the road safety management, based on coordination of activities and responsibility sharing.

Regional level - WHO regions

The public risk in road transport varies considerably across WHO regions, with no change in the order, in the period before (2007, 2010) and the period after (2013) the adoption of the Global Plan.

However, in the African region, there has been a deterioration of road safety by increasing the rate of public risk from 24.1 in 2010 to 26.1 in 2013, while in all other regions, in this period, there was a decreasing of public risk (Figure 2), which is linked to the level of road safety management system, based on coordination of activities and responsibility sharing.

National level - Montenegro

According to the Status reports on road safety in Montenegro for 2007, 2010 and 2013 [15], the number of traffic fatalities on the roads of Montenegro declined from 122 in 2007, to 95 in 2010, to 74 in 2013, according to the linear legality. At the same time, the public risk is reduced from 19.8 in 2007, to 15.3 in 2010, to 11.9 in 2013, according to the linear legality (Figure 3). This indicates that interventions to improve national road safety achieved the goal to reduce the number of road traffic fatalities in Montenegro.

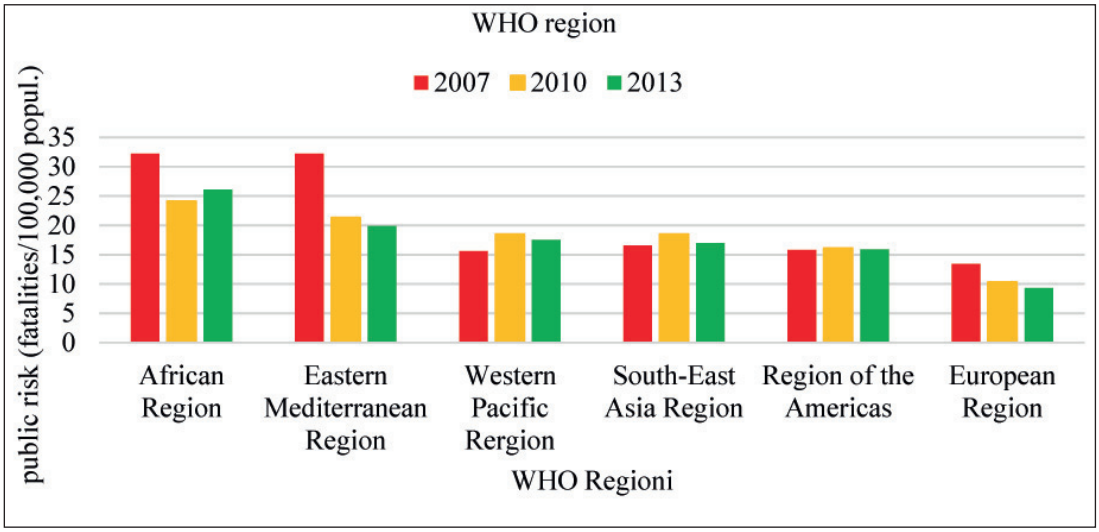


Figure 2. Changes in the public risk at the level of the WHO regions

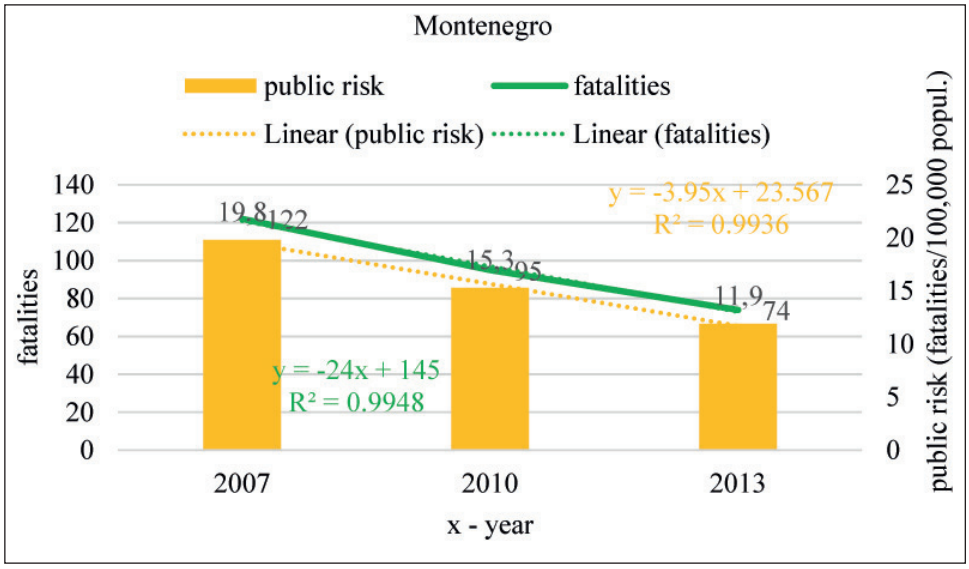


Figure 3. Changes in the number of fatalities and the public risk in Montenegro

The research of coordination of activities at the national level of road safety management in Montenegro, conducted by analyzing responses from the Questionnaire (Table 3), shows that further improvements in road safety are possible and that they will be generated by focusing on the road safety management system, based on coordination of activities and responsibility sharing.

Local level - local communities-municipalities in Montenegro

For the local communities-municipalities in

Table 3. Questionnaire. Research of coordination of activities at the national level of road safety management in Montenegro

Questions	Yes	Partial	No
Are interventions being coordinated horizontally across competent bodies to achieve the desired focus on results?	Coordination body for supervising the implementation of the Strategy for improving the safety in road transport Ministry of the Interior Ministry of Transport and Maritime Affairs Ministry of Education Ministry of Health		
Are interventions being coordinated vertically between competent bodies to achieve the desired focus on results?		Government-municipalities Ministry of the Interior- Security Centres	
Has coalition partnership been built between competent bodies to achieve the desired focus on results?	Coordination body for supervising the implementation of the Strategy for improving the safety in road transport Ministry of the Interior Ministry of Transport and Maritime Affairs Ministry of Education Ministry of Health	Development banks NGOs	
Have Parliamentary committees and procedures supporting the coordination process been established to achieve the desired focus on results?	Law on Road Traffic Safety (2012, 2014) Law on the Bar-Boljare highway (2014) Status report on road safety(2015)		
Has legal responsibility of competent bodies to design road transport systems at the national level (area of roads, vehicles, behaviour and health care) been established to achieve the desired focus on results?	Law on Road Traffic Safety (2012, 2014) Law on Roads (2004, 2009, 2011) General Law on Education (64/2002) Law on Health Care (39/2004)		

Montenegro it has been analyzed only the period after the adoption of the Global Plan (2013 and 2014) [11], because in the Status reports on road safety in Montenegro for 2007 and 2010 there is no data for local communities-municipalities.

The public risk in road transport varies dramatically by municipalities in Montenegro, reaching unbelievable rate of 262.5 in Kolasin municipality and 193.2 in the municipality of Savnik, in 2013 rates of 92.4 in the municipality of Pluzine, and 47.8 in Kolasin municipality in 2014 (Figure 4 and 5).The rate of public risk of 262.5 in Kolasin, in 2013, was realized due to the tragedy of Romanian bus in the canyon Platije, where in one accident 18 people died and because Kolasin has 8,380 inhabitants [11], and in the municipality of Savnik due to the tragedy in the tunnel Ivica, where in one accident all four people died and because Savnik has 2,070 inhabitants [11].

The research of coordination of activities at the local level of road safety management in Montenegro, conducted by analyzing responses from the Questionnaire (Table 4), shows the coordination of activities at the

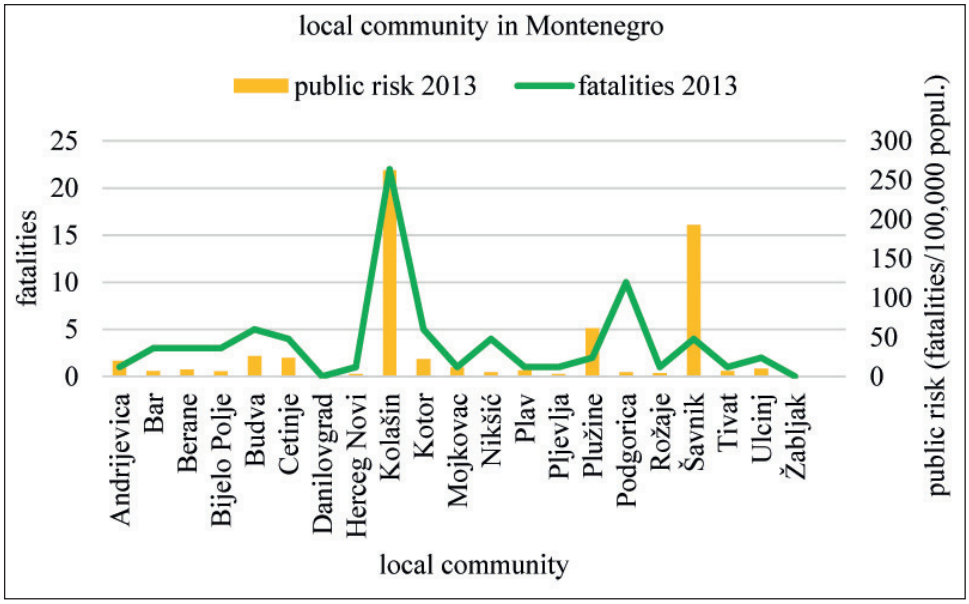


Figure 4. Changes in the number of fatalities and the public risk at local communities of Montenegro in 2013.

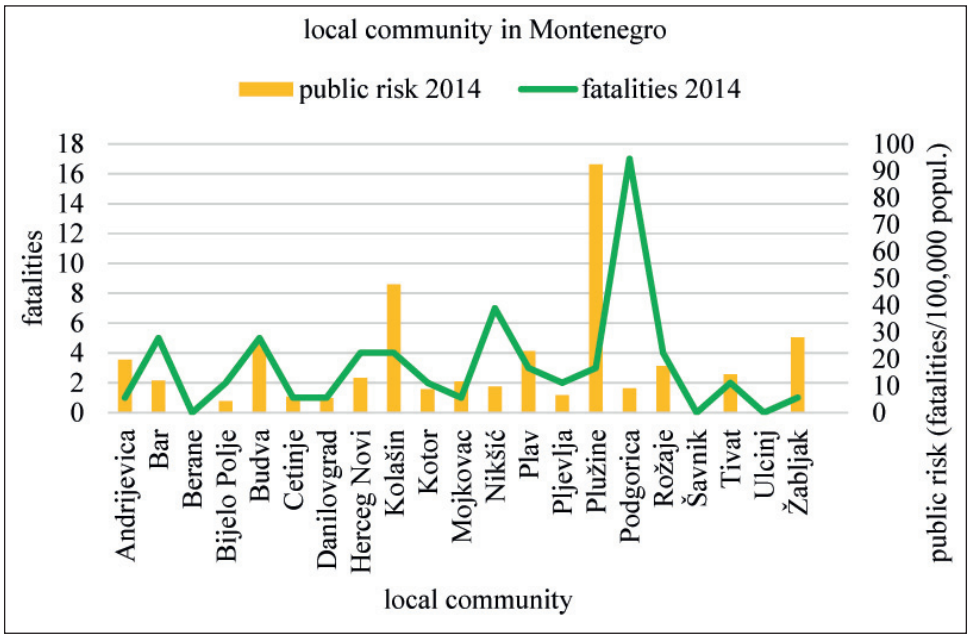


Figure 5. Changes in the number of fatalities and the public risk at local communities of Montenegro

Table 4. Questionnaire. Research of coordination of activities at the local level of road safety management in Montenegro

Questions	Yes	Partial	No
Are interventions being coordinated horizontally across competent bodies to achieve the desired focus on results?	Capital city	Larger municipalities	Smaller municipalities
Are interventions being coordinated vertically between competent bodies to achieve the desired focus on results?	Capital city	Larger municipalities Control of the traffic flow	Smaller municipalities
Has coalition partnership been built between competent bodies to achieve the desired focus on results?	Capital city	Larger municipalities Nongovernmental organizations	Smaller municipalities
Have Parliamentary committees and procedures supporting the coordination process been established to achieve the desired focus on results?		Decision on municipal and unclassified roads in the territory of the capital - Podgorica (2009)	Smaller municipalities
Has legal responsibility of competent bodies for roads at the local level been established to achieve the desired focus on results?		Decision on municipal and unclassified roads in the territory of the capital - Podgorica (2009)	Smaller municipalities

level of the capital city, a partial coordination in larger municipalities and a lack of coordination of activities in small municipalities. The establishment of the body for road safety at the community level, which would constantly upgrading the road safety on its territory, is not normatively regulated in Montenegro. However, road safety management at the local level can be set analogous to road safety management at the national level, so as to, for those purposes at the level of local communities, establish local institutions with the necessary resources, in the form from local agencies to advisers, depending on the size of the local community and the development of road traffic in it. By establishing of such a body, the local community would have an authority solely responsible for the area of road safety at the local community level, with a defined concrete tasks of continuous status monitoring, planning, organizing and coordinating activities, control of their implementation and effectiveness, to achieve the goal of improving road safety in the local community.

CONCLUSION

The analysis of changes in the state of road transport safety in the period before (2007 and 2010) and the period after (2013 and 2014 years ago) the adoption of the Global Plan for the Decade of action for road safety 2011-2020, at global level within the world, regional level within WHO regions, national level within Montenegro, and local level within local communities of Montenegro, and the research of coordination of activities and responsibility-sharing at these levels of road safety management, conducted by analyzing responses from the prepared Questionnaire, showed that the improvement or deterioration of the state of road safety at all these levels of management, particularly at the local level within the local communities of Montenegro, can be directly associated with the achievement of coordination of activities and sharing of responsibilities for the state of road safety.

By encouraging the development of the road safety system in local communities,and by establishing a local institution with the necessary resources, in the form from local agencies to advisers, depending on the size of the local community and the development of road traffic in it, the local community would have an authority solely responsible for the area of road safety at the local community level.

By developing a road safety system in local communities, basing on a vertical coordination in national and local activities and horizontal coordination in activities at the local level, with the establishment of a system of responsibility sharing for the state of road safety in local communities, a further reduction of mortality in road transport would be generated, because 2016 and coming years are the time to achieve results to improve road safety.

Bibliography

Milenko Čabarkapa was born on April 4, 1956 in Bijelo Polje (Montenegro). He finished Elementary School and High School in Bijelo Polje. He graduated from the Faculty of Transport and Traffic Engineering, Belgrade in 1981 at the Department for road and urban transport, Traffic regulation. His average grade at the Faculty was 8.10, while for the graduate thesis he received grade 10.

He completed post-graduate master studies at the Faculty of traffic, communication and logistics, Berane/Budva in 2013, with an average grade „A" (10.00) and defended his master thesis titled „State and trends in road safety in Montenegro", by which he gained the MA degree.

He passed the professional exam prescribed for the work in state administrative bodies.

In the professional and work engagement, he performed the following duties, among others:

- Since 1998, Founder and Director of the company for consulting, traffic and trade „Signal M", Ltd. Bijelo Polje.
- Since 2012, teaching assistant for the scientific area of safety in road traffic at the Faculty of traffic and communications management, Berane/Budva.
- Since 1982, permanent court expert. Since 2005, permanent court expert of Montenegro.
- Since 2002, member of the Chamber of Engineering of Montenegro.

He published and announced over 20 scientific and professional papers in country and abroad.

As a coordinator, he participated in drafting of: municipal spatial plans, general urban plan of municipality, detailed urban plan of city central zone, city traffic study and a number of urban plans and urban and traffic projects for the municipality territory.

As a court expert for the area of road safety, he drafted over 6,000 traffic accident expertises.

Zoran Avramović was born on September 10, 1953. He finished Elementary School and High School with honors. He finished the Faculty of Electrical Engineering, University of Belgrade with an average grade 9.71. He defended master thesis and PhD thesis at the same Faculty in 1988.

He is academician of:

- Russian Transport Academy,
- Russian Academy of Natural Sciences,
- Engineering Academy of Serbia,
- Academy of Electrical Engineering Sciences of the Russian Federation.

He is a professor at the following universities:

- Faculty of Transport and Traffic Engineering, University of Belgrade,
- Faculty of Electrical Engineering, University of Belgrade,
- Pan-European University "Apeiron", Banjaluka and
- Faculty of traffic, communication and logistics, Berane/Budva.

He is the Head of the "Joint Department for Railway Management" at the Faculty of Transport and Traffic Engineering, University of Belgrade and the Head of „Department for information and communication technologies"at the Faculty of traffic, communication and logistics, Berane/Budva.

He is a professor (by invitation) at the following universities:

- Technical Faculty "St. Clement of Ohrid" in Bitola,
- University "Vitez" in Vitez, Travnik,
- University of East Sarajevo, Faculty of Transport and Traffic Engineering in Doboj and
- American University in Skopje.

Awards (some)

- International electrical engineering congress held in Moscow awarded him with a Gold Medal of the Academy of Electrical Engineering Sciences of the Russian Federation (АЭН РФ) for merits in the field of electrical engineering.
- He was included in the edition "Who is who in Bosnia and Herzegovina", 2015.
- Pursuant to the decision of the Union of ICT Societies of Serbia and Montenegro (JISA), he was proclaimed as an ICT expert (information-communication technologies) of Serbia and Montenegro and he was included in the ICT experts internet database.
- On the basis of his patents, he was included and presented by biography in the "Monography of inventors", issued by the Yugoslav Association of inventors and innovators.
- He was awarded with the "Vuk Stefanović Karadžić diploma", High School in Loznica.
- In order to mark an anniversary of the Faculty of Transport and Traffic Engineering, he was awarded as a sign of „recognition for the contribution to the development of the Faculty of Transport and Traffic Engineering".
- He was awarded with a plaque of the Faculty of Transport and Traffic Engineering from Zagreb „as a sign of special recognition for the outstanding personal contribution to the development of scientific research in the field of transport and traffic".
- He was included in the 7th edition of the "International Directory of Distinguished Leadership", according to the choice of the American Biographical Institute, Inc. (Raleigh, North Carolina, USA).

REFERENCES

[1] Bliss T. and Breen J. 2009. Implementing the Recommendations of the World Report on Road Traffic Injury Prevention. Global Road Safety Facility, World Bank, Washington. http://siteresources.worldbank.org/EXTTOPGLORO-ASAF/Resources/traffic_injury_prevention

[2] Bliss T. and Breen J. 2013. Road Safety Management Capacity Reviews and Safe System Projects Guidelines, updated edition. web.worldbank.org › ... › Global Road Safety F

[3] Commission for Global road safety 2009. Make Roads Safe - A Decade of action for road safety. http://www.fiafoundation.org/our-work/make-roads-safe

[4] DaCoTA 2012. Road Safety Management, Deliverable 4.8p of the EC FP7 project DaCoTA. London.http://safetyknowsys.swov.nl/Safety_issues/pdf/Road%20Safety%20Management.pdf.

[5] Dupont E. et al. 2012. Needs for Evidence-Based Road Safety Decision Making in Europe. https://www.researchgate.net

[6] Elvik R. 2012. Does the use of formal tools for road safety management improve safety performance? In the Proceedings of the 2012 TRB. Annual Meeting. Transportation Research Board. Washington DC. https://www.toi.no/staff/elvik-rune-article17618-27.html

[7] ETSC 2001. Sharing responsibilities for road safety.http://archive.etsc.eu/documents/bri_road4.pdf

[8] ISO 2012. RTS–Road Traffic Safety: ISO 3901:2012. http://www.iso.org/iso/catalogue_detail.htm?csnumber=44958

[9] Jahi H. et al. 2012. Investigating road safety management processes in Europe. https://www.researchgate.net/2015.09.15

[10] Koornstra M. et al. 2002. SUNflower: a comparative study of the development of road safety in Sweden, the United Kingdom, and the Netherlands. SWOV, Dutch Institute for Road Safety Research. Leidschendam. ec.europa.eu/transport/roadsafety_library/.../sunflower_report.pdf.

[11] MONSTAT 2015. Montenegro Statistics. www.monstat.org. Montenegro Gazzete 2015. Law on Road Traffic Safety, No. 33/12, 58/14; Law on the Bar-Boljare highway, No. 52/14; Law on Roads, No. 42/04, 40/10, 36/11; General Law on Education, No. 64/02; Law on Health Care, No. 39/04; Decision on municipal and unclassified roads in the territory of the capital – Podgorica, No. 11/09

[12] Muhlrad N., Gitelman V.and Buttler I. 2011. (Ed). Road safety management investigation model and questionnaire. Deliverable 1.2 of the EC FP7 project DaCoTA. www.dacota-project.eu/.../DaCoTA.

[13] Muhlrad N. et al. 2014. Analysis of road safety management systems in Europe. http://tra2014.traconference.eu/papers/pdfs/TRA2014_Fpaper_18440.pdf

[14] New Zealand. National Road Safety Committee. Land Transport Safety Authority. 2000. Road Safety Strategy 2010: A Consultation Document.

[15] www.imvia.co.nz/.../mot_safer_journeys_discussion (5th may 2016)

[16] OECD/ITF 2012. Sharing Road Safety - Developing an International Framework for Crash Modification Functions. http://www.oecd-ilibrary.org/transport/sharing-road-safety_9789282103760-en

[17] Papadimitriou E. et al. 2012. Analysis Of road safety management in the European countries. D 1.5 DaCoTA.http://www.dacota-project.eu/Deliverables/Dacota_Deliverable1.5_Vol.2_final.pdf

[18] SafetyNet 2009. Road Safety Management. http://ec.europa.eu/transport/road_safety/specialist/erso/pdf/safety_issues/policy_issues/07-road_safety_management_en.pdf

[19] The World Bank 2013. Global Road Safety Facility, Strategic Plan 2013-2020. web.worldbank.org › ... › Global Road Safety F

[20] UN GS 2010. Improving global road safety. A/RES/64/255. http://www.who.int/violence_injury_prevention/publications/road_traffic/UN_GA_res

[21] UN GS 2014. Improving global road safety. A/RES/68/269. http://www.who.int/violence_injury_prevention/publications/road_traffic/UN_GA_res

[22] Wegman F. 2001. Sharing responsibility - central and local government partnership. https://www.researchgate.net

[23] Wegman F. et al. 2015. Evidence based and data driven road safety management. https://www.researchgate.net

[24] WHO 2004. World report on road traffic injury prevention. Geneva. http://whqlibdoc.who.int/publications/2004/9241562609.pdf

[25] WHO 2009, 2013a, 2015a. Global status report on road safety. http://www.un.org/ar/roadsafety/pdf/roadsafetyreport.pdf

[26] WHO 2011. Global Plan for the Decade of Action for Road Safety 2011-2020. http://www.un.org/en/roadsafety

[27] WHO 2013b. Second UN Global Road Safety Week. http://www.who.int/violence_injury_prevention/road_traffic/en/

[28] WHO 2015b.Third UN Global Road Safety Week. http://www.who.int/violence_injury_prevention/road_traffic/en

[29] WHO 2015c. 2nd Global High-Level Conference on Road Safety. http://www.who.int/violence_injury_prevention/en

[30] Yannis G., Laiou A. and Piccoli G. 2015. Road Safety in South-East European Regions.https://www.researchgate.net

Submitted: June 1, 2016.
Accepted: June 7, 2016.

INSTRUCTIONS FOR AUTHORS

The *Journal of Information Technology and Application (JITA)* publishes quality, original papers that contribute to the methodology of IT research as well as good examples of practical applications.

Authors are advised that adherence to the Instructions to Authors will help speed up the refereeing and production stages for most papers.

- Language and presentation
- Length of submissions
- Submission
- Contact details/biographies
- Title of the paper
- Abstract and keywords
- Figures and tables
- Sections
- Footnotes
- Special characters
- Spelling
- References
- Proofs
- PDF offprint
- Copyright and permissions
- Final material
- Correspondence
- Publication ethics

LANGUAGE AND PRESENTATION

Manuscripts should be written in English. All authors should obtain assistance in the editing of their papers for correct spelling and use of English grammar. Manuscripts should have double spacing, with ample margins and pages should be numbered consecutively. The Editors reserve the right to make changes that may clarify or condense papers where this is considered desirable.

LENGTH OF SUBMISSIONS

Papers should not normally exceed 12 Journal pages (about 8000 words). However, in certain circumstances (e.g., review papers) longer papers will be published.

SUBMISSION

Manuscripts must be submitted through the JITA online submission system.

Please read the instructions carefully before submitting your manuscript and ensure the main article files do not contain any author identifiable information.

Although PDF is acceptable for initial submission original source (i.e. MS Word) files will be required for typesetting etc.

CONTACT DETAILS/BIOGRAPHIES

A separate file containing the names and addresses of the authors, and the name and full contact details (full postal address, telephone, fax and e-mail) of the author to whom correspondence is to be directed should be uploaded at the time of submission (you should select Contact details/Biographies as the file type). This file is not shown to reviewers. This file should also contain short biographies for each author (50 words maximum each) which will appear at the end of their paper.

The authors' names and addresses must not appear in the body of the manuscript, to preserve anonymity. Manuscripts containing author details of any kind will be returned for correction.

TITLE OF THE PAPER

The title of the paper should not be longer than 16 words.

ABSTRACT AND KEYWORDS

The first page of the manuscript should contain a summary of not more than 200 words. This should be self-contained and understandable by the general reader outside the context of the full paper. You should also add 3 to 6 keywords.

Figures and tables

Figures which contain only textual rather than diagrammatic information should be designated Tables. Figures and tables should be numbered consecutively as they appear in the text. All figures and tables should have a caption.

Sections

Sections and subsections should be clearly differentiated but should not be numbered.

Footnotes

Papers must be written without the use of footnotes.

Special characters

Mathematical expressions and Greek or other symbols should be written clearly with ample spacing. Any unusual characters should be indicated on a separate sheet.

Spelling

Spelling must be consistent with the Concise Oxford Dictionary.

References

References in the text are indicated by the number in square brackets. If a referenced paper has three or more authors the reference should always appear as the first author followed by et al. References are listed alphabetically. All document types, both printed and electronic, are in the same list. References to the same author are listed chronologically, with the oldest on top. Journal titles should not be abbreviated.

Journal

Avramović ZŽ (1995) Method for evaluating the strength of retarding steps on a marshalling yard hump. *European Journal of Operational Research*, 85(1), 504–514.

Book

Walsham G (1993) Interpreting Information Systems in Organizations. Wiley, Chichester.

Contributed volume

Huberman AM and Miles MB (1994) Data Management and analysis methods. In Handbook of Qualitative Research (Denzin NK and Linkoln YS, Eds), pp 428-444, Sage, Thousand Oaks, California.

Conference Paper

Huberman AM and Miles MB (1994) Data Management and analysis methods. In Handbook of Qualitative Research (Denzin NK and Linkoln YS, Eds), pp 428-444, Sage, Thousand Oaks, California.

Unpublished reports/theses

Nandhakumar JJ (1993) The practice of executive information systems development: and in-depth case study. PhD Thesis, Department of Engineering, University of Cambridge.

Proofs

Proofs of papers will be sent to authors for checking. Alterations to diagrams should be avoided where possible. It will not be possible to accept major textual changes at this stage. Proofs must be returned to the publishers within 48 hours of receipt by fax, first-class post, airmail or courier. Failure to return the proof will result in the paper being delayed.

PDF offprint

Corresponding authors will receive a PDF of their article. This PDF offprint is provided for personal use. It is the responsibility of the corresponding author to pass the PDF offprint onto co-authors (if relevant) and ensure that they are aware of the conditions pertaining to its use.

The PDF must not be placed on a publicly-available website for general viewing, or otherwise distributed without seeking our permission, as this would contravene our copyright policy and potentially damage the journal's circulation. Please visit **http://www.apeiron-journals.com/JITA/authors/rights_and_permissions.html** to see our latest copyright policy.

Copyright and permissions

The copyright of all material published in the Journal is held by Paneuropean University APEIRON. The author must complete and return the copyright form enclosed with the proofs.

Authors may submit papers which have been published elsewhere in a foreign language, provided permission has been obtained from the original publisher before submission.

Authors wishing to use material previously published in JITA should consult the publisher.

Final material

All final material must be submitted electronically in its original application format (MS Word is preferred). The file must correspond exactly to the final version of the manuscript.

Correspondence

Business correspondence and enquiries relating to advertising, subscriptions, back numbers or reprints should be addressed to the relevant person at:

Paneuropean University APEIRON
Journal JITA
Pere Krece 13, P.O.Box 51
78102 Banja Luka
Bosnia and Hercegovina / RS

Publication ethics

We take an active interest in issues and developments relating to publication ethics, such as plagiarism, falsification of data, fabrication of results and other areas of ethical misconduct. Please note that submitted manuscripts may be subject to checks using the corresponding service, in order to detect instances of overlapping and similar text.

JITA

PUBLISHER
Paneuropean University APEIRON,
College of Information Technology
Banja Luka, Republic of Srpska, B&H
www.apeiron-uni.eu
Darko Uremović, Person Responsible for the Publisher
Aleksandra Vidović, Editor of University Publications

ISSN 2232-9625

Journal of Information Technology and Applications VOLUME 6 NUMBER 1 JUNE 2016