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The Use of Technology for Promoting Learner Autonomy in English Language Classrooms

M.A. Avan Kamal AZIZ, doc. PhDr. PaedDr. Jiri DOSTAL, Ph.D, and M.A. Xiaojun WANG

Abstract — This study highlights the use of technology to improve learning autonomy in English Language (EL) classrooms. Simultaneously, it enables the learner to take full control of their learning process, which leads to a better understanding of the studied material and learn EL. This paper will be drawn on educational researches and emerging new practices of technology in teaching and learning processes, to investigate the use of technology for promoting learner autonomy in EL Classrooms.

I. INTRODUCTION

Technology is a very economic and helpful tool that teachers can make use of to improve learning autonomy in their EL class. According to Ju Kim (2014) “learners can control their learning processes as much as possible and can become quite independent of teachers when they work with computers”. Many research acknowledges that if technology is used appropriately in the teaching context, it will raise students' motivation and emboldens active participation that they have positive impacts on the learning process. Additionally, it stimulates students' active role, offers opportunities for modifying teaching and learning approaches to more learner-centered ones and has learners to control their learning independently. Hence, technology endorses a positive learning environment for the learners as long as their motivation and interest endure [14].

II. LEARNER AUTONOMY AND ITS IMPACT ON LEARNING IN EL CLASSROOM

- According to Holec (1981) learner autonomy is “the ability to have responsibility of one's own learning” [12].
- In agreement with Ryan and Deci (2000) “Autonomy enables learners to gain the experience of being self-determined rather than being controlled” [17].
- In autonomous classroom language learners are likely to be more passionate about learning because they are able to control and take the responsibility of their own learning.
- Learning in such a classroom will be more intensive and focused which will guide learners right toward the objectives they are targeted to achieve [5].
- Learning autonomy is quite essential in EL classrooms since it enables a learner to make an effort to carry out self-direction strategies, to find resources for their own learning.

III. IMPACTS OF TECHNOLOGY ON PROMOTING LEARNING AUTONOMY

- Computer and Internet technology tends to promote autonomy for learners by enabling learners to choose the time, place, and circumstances that are conducive to their learning.
- Computers and the Internet increase the level of motivation of learners in language education by providing learners with topics that are of interest and by introducing a range of study methods.
- The Internet will contribute to the advancement of learners' language learning strategies through introducing learners to a digital social network with many native speakers to whom students in their local community do not have access.
- Learners who learn with computers can work at a relaxed speed independently, so they are more likely to take personal accountability for learning both in and out of classroom [20].
- Technology-based teaching exercises inspire language learners to read more actively. Surveys indicate that multimedia technology-assisted teaching is a helpful component of SL learning and can inspire encouragement for SL learning because multimedia can offer several types of media forms and activities as much as possible and minimize learning anxiety. Moreover, it helps learners to learn by themselves. The variety of media, such as graphs, videos and photographs, is provided to learners, which can help learners transform complicated or abstract concepts into simple explanations and generalizations. Multimedia technology seems to assist learners through constructing background knowledge on a certain subject.
- Technology, and the Internet in particular as a source of information, provide learners the opportunity to have unrestricted access to authentic materials in the target language. That is to say, it allows them to access a wide range of out-of-class learning opportunities that may promote greater autonomy for learners. A wide variety of opportunities have been developed for self-directed learning.
- Emerging mobile devices such as smartphones and tablets have not only resulted in a greater wealth of tools accessible to language learners, but have also doubled as a platform for out-of-school contexts. Therefore, as a result of raised opportunities for interaction and underpin for learning outside the classroom.

VI. CONCLUSION

- With the use of technology teachers can play a crucial role in providing online educational platforms to promote learning autonomy and achieve desired learning in students.
- Teachers in EL classrooms can use computer and internet-based resources and activities as an intention of developing learning autonomy.
- Based on the learners' levels of autonomy, teachers can encourage learners to explore and search for online activities depending on the topic to improve the target language.
- Teachers can use technology to create online social learning platforms to promote learning with each other. Learning and interaction in such a group work has a great impact on boosting learners' motivation, since they are undertaking their own learning, so they attempt to find the precise way for their own learning.
- With the teachers' instruction technology can be used as an effective tool to improve learning autonomy in our class which is quite essential if we want our learners to become effective EL users.

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elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Transfer of Knowledge of Product Configurator in the Educational Process

A. Behúnová, L. Knapčíková, M. Behún, E. Lumnitzer



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elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — Education is a comprehensive process of personality development, which includes cognition, practice and teaching. The aim of the paper is the transfer of new acquired experience, skills and knowledge and especially the change of work behaviour through learning and application of new methodologies. For the student himself, subsequently, the graduate, as well as functioning on the labour market, achieving competition ability, prestige, or obtaining various awards is an influential motivating factor. In the case of the introduction of a new product, it is crucial to cultivate the maintenance and increase of the company's market share and thus satisfy customer demand. Not every product has to satisfy every customer, and therefore the definition of the target market is a critical part of the product at the beginning of the life cycle. Quantitative market research should be carried out at all stages of the design process. Product development is a creative discipline that requires a systematic approach to managing the operations needed to bring a new product to market. The result of innovative concepts and the use of product configurators is applied in almost every single sphere, not excluding the education market itself and the implementation of new methods.

I. INTRODUCTION

Modern society requires the continuous development of knowledge by education (Fig.1). Due to continuously and rapidly changing circumstances, such as extended knowledge and potential to maintain the qualification level. New methods of education are always introduced in educational institutions and subsequently, in companies in connection with development trends and market requirements. The process of educating student-managers should be included in the same strategy of the functioning of the organization. The organization achieves the set goals in individual steps. From an economic point of view, it is crucial to invest the funds that the organization has at its disposal in the field of executive education, which increases their performance, as well as self-realization and satisfaction in the workplace. The paper aims to create a transfer of theoretical knowledge in the field of management, to connect it with computer skills and thus create a bridge between science and practice.

II. RESULTS AND DISCUSSION

The emergence of product configurators has achieved the possibility of configuring different types of products. Every year the traffic of product configurators increases, therefore, the sellers offer the chance to customize - to adapt the product to their requirements. Most vendors have individually created configurators, which differ in technical perfection and functions provided, which makes them diverse. The configuration options are adapted to the possibilities of mass and automated production in the company. Configurators help users to get acquainted with the range of product features through a graphical display, to adapt the product to their ideas and to facilitate shopping. In marketing, it is especially important to monitor how other competing companies communicate with the customer, where they invest their marketing budgets, how they build a relationship with the media. For a company to be successful in the market, it must differentiate itself from the competition, but this is only possible if it knows the match well. Based on the research that was carried out on selected products, we found that it is crucial to implement investigation indirect competitors, in terms of:

- Marketing resources, investments and where these investments are directed.
- How competing companies profile their brand, especially the image of the company?
- What information they communicate to their customers and through which communication channels?
- What kind of public relations activities do they use and what relationship with the media?
- What does the overall presentation of them look like?

Of course, we can assume that some information is not easy to get. The easiest way is to get information about how the company presents itself through websites or social networks. It is more challenging to get information about the expenses for these campaigns and the overall budget of the marketing company.

III. CONCLUSION

The conditions for effective education are met if the education process is systematic and closed, and its phases follow each other and take place in a continuous cycle. In this case, each subsequent stage starts after the end of the previous one. The training cycle takes place according to the following model of activities - identification of real training needs, planning staff training, implementing educational activities with the help of the most appropriate educational methods, monitoring and evaluating the effectiveness of education. Based on our research, we can say that product configurators are an exciting form of adapting the product to customer requirements. With the growing progress on the Internet, online stores and mass customization, the demand of customers for the possibility of adjusting the product to their conditions, after tailoring the product, is growing. The transfer of the learning process, its level and intensity, can be different and depend on the specific needs of the student.

ACKNOWLEDGMENT

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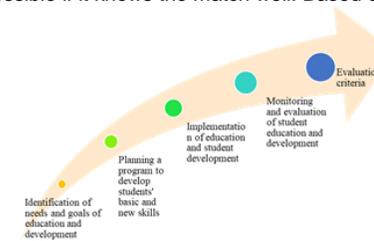


Figure 1. The educational process in the scheme



Figure 2. The process of product configurator implementation

The usability of computer simulations and blended learning to understand the curriculum and consolidation of knowledge

Mi. Beňo, M. Ölvecký, I. Dirgová Luptáková

Abstract — The purpose of this paper was to measure the impact of computer simulations and blended learning on university students. Especially nowadays are computer simulations and also distance learning methods broadly widened and they are supporting the learning process in an important way. This paper points to possibilities of how to improve the quality of cognitive abilities by students especially in the way of understanding the curriculum and consolidation of knowledge by Niemiérko's taxonomy of learning objects. Our experiment results also demonstrate a good positive impact of the proposed learning methodology focused on the usability of computer simulations with good multimedia textbooks partly integrated into the electronic course by LMS Moodle in improving understanding of the curriculum and consolidation of knowledge.

I. INTRODUCTION

A lot of researcher outcomes showed that blended learning with the support of computer simulations enhances collaboration and performance of the students. It exists 7 principles of good learning with understanding which consists of some ideas which have usability for our pedagogical experiments: Principled Conceptual Knowledge (learning texts were structured and mediated by professional teachers); Prior Knowledge (if students want to be successful in advanced study in science at the main, applied informatics or any applied science, students must have self-motivation); Metacognition (students need to be metacognitive if they want to solve new problem situations); Differences Among Learners (some students achieved excellent outcomes when they work under pressure and vice versa); Motivation (different connections between learners' beliefs about their own abilities); Situated Learning (well-prepared problems to solve with students in lessons); Learning Communities (discussion about learning outcomes with the teacher).

Origin Dale's visual model is composed of eleven stages that starting from concrete experiences at the bottom of the cone then it becomes more and more abstract as it reaches the peak of the cone (fig. 1). The results of some researches shown that strong memories by students may depend on "top-down processing of learning," in which students select and elaborate on what they perceive, actively shaping their learning as it takes place. The next learning process "Bottom-up processing of learning" allowing perceptions to occur and hoping to automatically construct a field of knowledge from them is more commonly tried, but far less effective; it tends to result in weaker memories. Students would remember information better when something is meaningful to them.



Figure 1. The revised version of cone of learning [4]

II. BLENDED LEARNING AND NIEMIÉRKO'S TAXONOMY OF COGNITIVE ABILITIES

Blended learning is primarily based on a combination of e-learning and face to face learning with the support of ICT tools. Research results presented in this paper conducted with an understanding level of student's knowledge. The understanding of the selected curriculum is mainly to perceive the meaning, grasp the idea, and comprehend the meaning. The teacher has to be active by the student's new knowledge which is related to the previously acquired knowledge. The main hypothesis was: Students of the experimental group taught by the proposed teaching methodology will achieve higher performance in the cognitive area focused on understanding the curriculum and consolidation of knowledge at the end of the pedagogical experiment than students taught in the traditional way

III. RESULTS OF THE PEDAGOGICAL EXPERIMENT

In the research#1 we achieved the result follows: $Z = 2.04375$, $p = 0.038932$, $p < 0.05$, the difference between observed groups is statistically significant. The difference in understanding the curriculum and consolidation of knowledge between the groups was 7.13%. (fig. 2)

In the research#2 we achieved the result follows: $Z = 4.58$, $p = 0.000015$, $p < 0.05$, the difference between observed groups is statistically significant. The difference in understanding the curriculum and consolidation of knowledge between the groups was 20 %. (fig. 2)

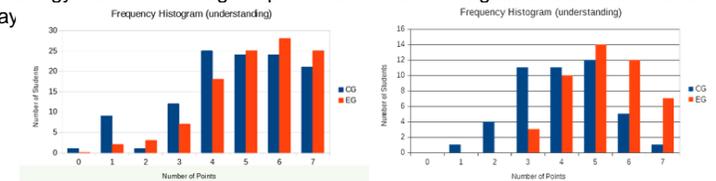


Figure 2. Research#1 and Research#2 in understanding the curriculum and consolidation of knowledge

IV. CONCLUSION

Both in research#1 and research#2 was the post-test results demonstrate that computer simulations with the suitable combination of learning texts partly integrated into multimedia textbooks significantly increase the understanding curriculum and consolidation of knowledge by students in the subject of Mechanism and Electromagnetic induction. The basis for a good understanding of physical phenomena and principles is memorized knowledge, which is consolidated and fixed in memory by the influence of blended learning. However, we must add that the research did not address the direct comparison between real experiments and computer simulations, but only the impact of blended learning in the field of understanding curriculum and consolidate knowledge.

For future research interests, we had created a suitable interactive learning environment that consists of available computer simulations with appropriate learning texts partly integrated into LMS Moodle. Our main effort will be on creating computer simulations consists of game-based learning principles that could be more attractive to students to support their other senses and metacognition.

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Park Komenského 7,
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Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Versioning Data During Migration Processes in Cloud Environment

R. Ceresnak, K. Matiasko



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elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia
tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — Nowadays, big data influences many aspects of human life. They help in medicine with diagnosing different illnesses, in traffic with watching of traffic accidents, and of course, they have a crucial role in supporting decisions. It is appropriate to test another database, respectively, another database type, in every operation's unsatisfactory performance by using a set database. A transformation process is needed in this case. Big Data entering this database has a different structure and size, which influences the set transformation process's time difficulty. The transformation process changes the data structure, from relational to nonrelational, respectively nonrelational to a relational database, making it possible to stop the process or an error that can end up with an incomplete change of a data structure and the data this process must have been repeated. "Version" system we created in this paper is, in the case of incomplete data change, respectively failure of transformation process during the transformation of a relational database to a nonrelational or nonrelational database to relational, capable of continuing from the error point of the previous approach, and so it can erase necessity to perform whole transformation process from the very first beginning.

I. INTRODUCTION

Amazon, Tesla, Microsoft belong to the most popular companies, which could not work without big data or could not work in the way as effective as with them. Banks, telecommunication and energetic companies, chain stores, and many other companies commonly use big data for marketing analyzes, decreasing customer outflow, optimizing stocks, offering products based on watched products, and many other purposes. Big Data has already been developed for some time. Two definitions were added to the three V, which define the right data term and volume, velocity, and variety. These also begin with the letter V, and they are veracity and value. Volume – as seen from the name, big data means significant data volume. By significant data volume, we also name such amount of data that cannot be processed and mainly analyzed by common resources (therefore by relational databases) or excessively expensive. So-called big data technologies are used when it is more effective to use massively parallel processing on common (commodity) servers (in the order of hundreds or thousands) to use giant supercomputer or supercomputer grouping. Big data today, therefore, means hundreds of terabytes or petabytes or even more. Velocity: Big data do not always must mean only a significant volume. It is also a characteristic of big data, they are overgrowing, and transversal processing is needed. Variety: Big variety of data is typical for big data. It is structural and semi-structural data such as text documents, information statuses, logging records, and nonstructural data such as video records,

II. Our contribution

The main idea is creating a versioning system capable of returning to the point of possible error effectively or working with various data versions saved in the nonrelational database MongoDB. The transformation process, in which a data change from relational database MySQL to MongoDB, with a larger number of tables and data, can last from some minutes until some hours. In the case of an error that occurs during the transformation process, it could have been necessary to delete all values from the nonrelational database and benefit sub-programs and subsequently start this process. We developed a solution capable of working similarly with version systems Github, BitBucket, or Gitlab. These systems work on comparing specific source code versions with a local repository, placed in the computer, and the repository on a server containing source code

The algorithm may be implemented through the following steps:

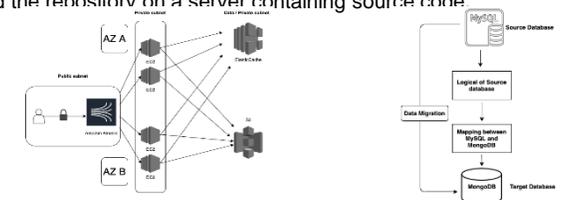
1. Algorithm monitor the cpu utilization
2. If the utilization is higher than set value, algorithm create new EC2 instance
3. If the utilization is lower than set value, algorithm create new EC2 instance

VI. CONCLUSION

The access we defined in this paper clearly shows our asset in this direction and indicates the trend in what we will continue in the second part of the research for us. The possibility of versioning of data caused the decrease of the time needed for real data to change for the transformation process. The data change from relational database MySQL to nonrelational database MongoDB, happened. For the change saving of objects in the collections, we used The Document Versioning Pattern, preserving an authentic version of the object and complete objects' changes during the whole process of particular object existence. This method helps the object compare and detect if the particular object or his previous version already was the same as the object that is supposed to be again inserted into the database. The main idea of *versioning system* was defined in the method object comparator. On the basis of unique values, entering the process and already exist in the process decision, if incoming record into the process has to be further processed in the case, that record already was or was not there. It is the so-called "comparator" of further record processing. The experiments we designed signalize that when data are in the database, the method object comparator is profitable regarding time shorting of transformation process and avoiding duplication in the nonrelational database. In the next research, we will deal with an improvement of the object comparator method, mostly with a situation of the empty target database and the possibility of versioning data and the whole transformation process.

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Synchronization Barrier in Database Migration processes

R. Ceresnak, K. Matiasko



ICETA 2020
Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — The systems helping us nowadays in some sectors, including health service, transportation, medicine, and many others, have one common thing: data. The data in the mentioned sectors help with the support of decision making, to manage systems, and to prevent dangerous situations. To the increasing amount of the data, a growing demand was related. In the current modern era, the data has become a commodity, and the data are traded like goods in many cases. The systems, working with the massive amount of the data, do not only with values already in the system but also with the system's data in real-time. So, they influence many evaluation systems, respectively, they modify various statistics. The real data play a crucial part during transformation processes and the mutual affecting of the data. This article will create a synchronization barrier that will be used to influence the data during the data transformation from a relational database to a nonrelational database. The purpose of this barrier is to reduce the time needed for a data change from source database to target database and, by this, to reduce the number of operations that would be required to do after finishing the process just with incoming values..

I. INTRODUCTION

Every day many companies around the world create the data about the size of exabytes, petabytes, and a growing claim to database systems, and quick data manipulation is related to this, too. With company development, demand for the looser structure was growing and growing demand for nonrelational databases in 2000. We know some types of nonrelational databases, such as column-oriented databases, key-value databases, document databases, graph databases, and many others. MongoDB is considered as a primary representative of the nonrelational databases.

II. OUR CONTRIBUTION

The data change from relational database MySQL to nonrelational database MongoDB and back from MongoDB database to MySQL database. The data entering the running cycle are captured by the synchronization barrier, which modifies the transformation process during its change. Therefore, it reduces the time of their modification after the finishing of the transformation process. The main goal of the transformation barrier is to monitor two types of data. The first type is data that has been in the system for a long time. The data are stored in the MySQL database. During this process, they can be influenced by the values that enter the system at the time of change or transfer of values from one type of database to another. During this process, there may be certain collisions that would need to be made after the transformation process, which would negatively affect the time needed to transform the values. The synchronization barrier solves the influence of data accumulated in the system with the system's values. Here is a simple situation that clearly describes the importance of the method we created:

The algorithm may be implemented through the following steps:

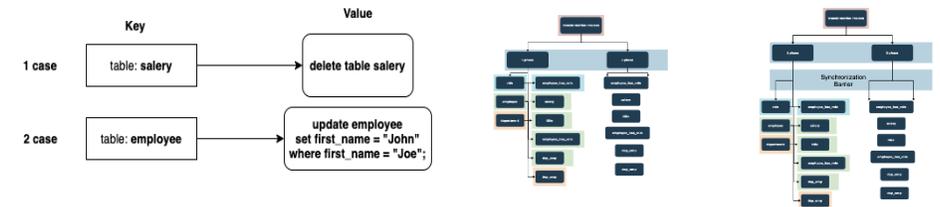
1. Sort table by the count of primary key, foreign key and composite key
2. Put as much as possible database table to migration process
3. Check the parallel processes
4. Run another groups of parallel processes

VI. CONCLUSION

With the increasing demand for effective manipulation with the data created by many applications every day, the databases' need to ensure individual data flexibility appeared. In many cases, all records are in the traditional databases in the table structure, which are not appropriate for data management in real-time. Some companies did not realize the advantages and disadvantages of conventional databases. With the increasing popularity of the nonrelational databases, we think about relational databases. With relatively new databases, we think about the nonrelational databases. In a particular situation, it is necessary to ensure the data migration from one type to another, respectively, in reverse. Using one sort or another style, a vast amount of the data could be accumulated in the databases. The length of the migration process running is related to the data amount. During the running data change, it is necessary to ensure access to the data for users and always provide actual data. During the data transformation into the running process, new data can enter the process in a random moment, capable of affecting the values, transforming the migration process. Various models, frameworks, and layers for the data, captured in the transformation process, were designed in the last steps, capable of effectively manipulating the real data without increasing costs and overloading one or another database type. This document shows the method of manipulating the data entering the system during the data structure change from relational database MySQL to nonrelational database MongoDB. However, this method can also work effectively and capture the data transformation from the nonrelational database MongoDB to the relational database MySQL. By introducing the synchronization barrier into the process, we could reduce the operation amount needed to do after the data transformation, from the relational database to the nonrelational database, respectively, the modification in the opposite way. By introducing the mentioned barrier, we were also able to reduce the time and again to decrease the overloading of both database types, in many cases. In further research, we want to focus on making the synchronization barrier more effective and reducing the time needed for the searching of the values between the synchronization barrier and the importance of the migration process.

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Private cloud security architecture

M. Drozdová, I. Brídová, J. Uramová, M. Moravčík



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Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — Cyber security is a current topic of the cyberspace, which includes Cloud Computing (CC) systems. Current use of CC and its expected development require strong security measures. The reason is the fact that data with sensitive information from several users enters the CC system and the disruption of the system or the leakage of such information is unacceptable. As how in building architecture, it is necessary to dimension the foundations, retaining walls and other parts of the building so that as a whole they form a fixed structure, in the architecture of ICT systems we must look at all components of each partial system too. Security architecture is one viewpoint of development in CC systems. Each deployment model and each CC service model in a particular implementation environment requires its own security framework. The authors of the article used them in processing the Architecture description of the OpenStack private cloud in a university environment.

I. INTRODUCTION

Cloud Computing systems, like all ICT systems, require security against cyber attacks. This is due to growing threats and abuse of the current online environment. Cyber security is addressed these problems. Cyber security is a state in which networks and information systems are able to resist, to a certain degree of reliability, any action that threaten the availability, authenticity, integrity or confidentiality of data stored, transmitted or processed, or related services provided or accessible through those networks and information systems. There are currently many cybersecurity solutions is a global dynamic open system of networks and information systems, made up of activated elements of cyberspace, persons those performing activities in this system and the relationships and interactions between them.

II. OPENSTACK PRIVATE CLOUD ISMS ARCHITECTURAL FRAMEWORK

To solve the security of the private CC system operated at the Department of Information Networks, Faculty of Management and Informatics, University of Žilina (KIS FRI UNIZA), we generated an architectural framework of ISMS development, respecting the recommendations and standards related to the CC system.

III. CONCLUSION

The security architecture description elaborated in this paper is a Plan phase of the ISMS development according to Deming's cycle. It contains implementation environment context, risk assessment and treatment and risk management plan. Implementation of the risk management plan - phase Do, continuous risk monitoring and assessing - phase Control, maintenance and improvement of the information security risk management process - phase Act are activities of the next solution. The research team at the Department of Information Networks, Faculty of Management and Informatics, University of Žilina go about three issues related to ISMS The first problem is the development of a software system for ISMS management, mainly for security risk assessment, the second problem is security risk assessment methods and the third problem is the monitoring of assets and their evaluation by machine learning methods.

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Table 1: Stakeholders, interest and roles

Asset	Risk	Degree of risk
Data	Compromise of services	Extremely high
	Network infiltration	Extremely high
	Conflicts between security procedures	Extremely high
	Harmful cloud user	Very high
	OpenStack interface compromise	Very high
	Loss of encryption keys	High
	Resource isolation failure	High
	Data capture during transmission	High
	Data leakage	Medium
IaaS	Dangerous / inefficient data deletion	Low
	Compromise of services	Extremely high
	Network infiltration	Extremely high
	Harmful cloud user	Very high
	OpenStack interface compromise	Very high
	DDoS	Very high
Network	Resource isolation failure	Low
	Network infiltration	Extremely high
	Harmful probes / scans	Extremely high
	Modification of network operation	Very high
Cloud management	DDoS	Low
	Network infiltration	Extremely high
	Modification of network operation	Extremely high
Virtualization	Resources depletion	Medium
	Compromise of services	Extremely high
	Network infiltration	Extremely high
	Harmful probes / scans	Very high
	Resources depletion	High
Backup	Loss of encryption keys	Medium
	Network infiltration	Extremely high
Logs	Loss / theft of backups / logs	Medium
	Network infiltration	High
	Loss / theft of backups / logs	Low

Web application for graph visualization purposes

A. Dudáš, J. Janky, J. Škrinárová



ICETA 2020
Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — Graphs are one of several abstract topics presented in teaching of computer science at university. Graphs are part of various subjects such as optimization, compilers, networks, etc. Main objective of this paper is to present online application aimed at graph visualization. Implemented tool can be also used as a translator between various formats of graph description – adjacency matrix, graph6 format and diagram of graph. The greatest emphasis was placed on functionalities which are lacking in other online tools for similar purposes – mainly method of graphical representation of graph, possibility of various forms of input for graphical representation and possibility of multiple graphs on the input for simultaneous visualization of set of graphs. Presented application is first part of Moodle course project which is focused on graphs and parallel computing.

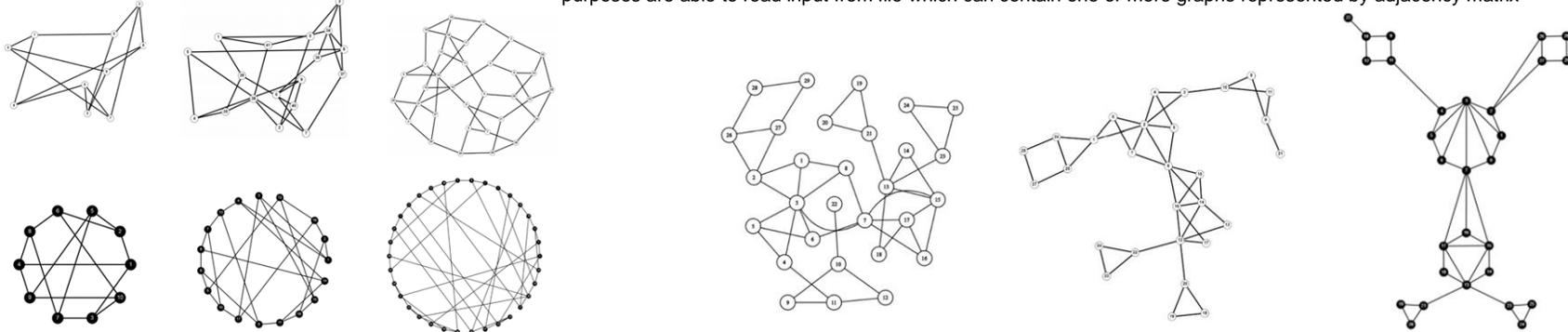
I. INTRODUCTION

Main objective of this paper is to design and implement online tool for graph visualization purposes which emphasizes symmetrical diagrams of graphs, possibility of various input formats and possibility of multiple graphs as an input for application. This online application can also be used as a translator between chosen formats of graph description – adjacency matrix, graph6 format and diagram of graph. Our application for graph visualization purposes is first part of eLearning course focused on parallel and distributed computing in the area of graph problems.

These are functionalities we are focusing on in presented application:

- Symmetry of diagram – unpaid tools for visualization of graphs rarely use algorithms for effective and symmetrical graph visualization. This leads to diagrams of graphs which are hard to read, interpret and work with.
- Possibility of various input formats – even though adjacency matrix of graph is standard way to describe graph in computer, it is not effective. Matrices of graphs with high number of vertices are large and in most cases sparse. Most of online tools are able to create diagram of graph from adjacency matrix input into application by user (either typed or copied to the given field).
- Possibility of multiple graphs as input – none of online tools for graph visualization purposes are able to read input from file which can contain one or more graphs represented by adjacency matrix

II. APPLICATION I



III. CONCLUSION

Aim of this paper was to present online application focused on graph visualization. Implemented tool can be also used as a translator between various formats of graph description – adjacency matrix, graph6 format and diagram of graph. The greatest emphasis was placed on functionalities which are lacking in other online tools for similar purposes – mainly method of graphical representation of graph, possibility of various forms of input for graphical representation and possibility of multiple graphs on the input for simultaneous visualization of set of graphs.

ACKNOWLEDGMENT

Computing was performed in the High Performance Computing Center of the Matej Bel University in Banská Bystrica using the HPC infrastructure acquired in project ITMS 26230120002 and 26210120002 (Slovak infrastructure for high-performance computing) supported by the Research & Development Operational Programme funded by the ERDF.

The research was partially supported by the grant of The Ministry of Education, Science, Research and Sport of the Slovak Republic – Implementation of new trends in computer science to the algorithmic thinking in subject of Computer science in the secondary education, project number KEGA 018UMB-4/2020.

E-learning Can Reduce the Negative Impact of COVID-19 in Teaching Mathematics

J. Fialová, M. Pokorný

Abstract — Blended learning represents a combination of face-to-face instruction in a classroom and e-learning. In several studies, we proved that it is a suitable method for teaching mathematics at our faculty. However, in a summer term of the academic year 2019/2020, it was not possible to have face-to-face lessons due to a pandemic situation caused by COVID-19. Thus, we have to use only e-learning. In the paper, we compare the results of the students taught by blended learning and e-learning and we prove that e-learning helps to reduce the negative impact of COVID-19 in teaching mathematics. Moreover, we declare that there is no significant difference between the results of daily and external students in the final tests.

I. INTRODUCTION

Modern technologies have significantly influenced the way of mathematics teaching in the last twenty years. It is well-known that mathematics should be learned by an active work of students, not by a transmission of knowledge from a teacher to students. A proper integration of modern technologies into mathematics teaching can make the learning process more active, which leads to the increase of the level of students' knowledge. There are many studies about efficiency of e-learning, blended learning, and mobile learning. However, the conclusion of their efficiency is not clear. As for mathematics teaching, our research, as well as the research of other authors, reveal that blended learning is a proper way to teach mathematics at secondary schools and universities.

II. DESCRIPTION OF THE RESEARCH

At our faculty, we also prepare future teachers at primary schools. During their study, they have to complete several courses from mathematics. These courses are usually taught by a combination of e-learning activities and face-to-face lessons.

During the master study, the students of Primary Education Teaching have to complete the subjects Mathematics in Elementary Education 1 and 2 (MEE1 and MEE2). MEE1 was taught in a winter term by blended learning. In the final assessment, 70 points could be obtained for the final test and 30 points for homework. MEE2 started similarly as MEE1, but after three weeks the face-to-face lessons were canceled as a result of the pandemic situation caused by COVID-19. In the final assessment, 70 points could be obtained for the final test and 30 points for a report of a praxis and a report about selected topic of didactics of mathematics.

At the end of each term of the academic year 2019/2020, the students have to pass the final test, which is a part of their final assessment. The average score in MEE1 is 51.89 and the standard deviation is 11.09. The average score in MEE2 is 52.24 and the standard deviation is 10.47. Using the parametric t-test with paired samples, we accept the null hypothesis, which states that 'There is no significant difference between the results of the students from the final tests from MEE1 and MEE2'. Using the same method, we compare the final assessment of the students from MEE1 and MEE2 and we accept the null hypothesis, which states that 'There is no significant difference between the final assessment of the students from MEE1 and MEE2'. Since the statistical analysis does not prove any significant difference between the results of the students in the winter term (taught by blended learning) and in the summer term (taught by e-learning), we can say that the omission of the face-to-face teaching and its replacement with e-learning activities has no negative impact on the level of students' knowledge.

In our country, it is often mentioned that there is a significant difference in the level of knowledge of daily and external students. From 64 students in our experiment, 33 of them are daily students (group D) and 31 of them are external students (group E). Using statistical analysis, we accept the null hypothesis 'There is no significant difference between the score of the group D and E in the final test from MEE1.', as well as the null hypothesis 'There is no significant difference between the score of the group D and E in the final test from MEE2.' To conclude, it is not possible to say that our external students have lower level of knowledge from the subjects MEE1 and MEE2 than their daily classmates.

III. CONCLUSION

The pandemic situation connected with COVID-19, which caused the change of teaching methods from face-to-face instruction into on-line or off-line forms in a very short time, caused a lot of problems at all types of schools, from primary schools to universities. A lot of teachers, who were used to teach only by face-to-face instruction did not know how to efficiently use the modern technologies to change the way of teaching without a negative impact on the level of students' knowledge.

We prove that the change of teaching methods from face-to-face instruction into utilization of modern technologies does not have to automatically mean the reducing of the level of students' knowledge. The statistical analysis of the results of our students reveals that e-learning can be as efficient as blended learning, if the students have a well-prepared teaching materials. We are convinced that our experiment was successful thanks to the fact that we had taught our students by a combination of face-to-face instruction and e-learning, so both we and our students had been used to utilize ICT to reach teaching aim. Thus, we recommend to increase the share of subjects, which are taught by blended learning, also in times when schools are open.

ACKNOWLEDGMENT

Our research was supported by the Cultural and Educational Grant Agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic (KEGA) under the projects KEGA 001UMB-4/2020 entitled Implementation of Blended Learning into Preparation of Future Mathematics Teachers and Future Computer Science Teachers and KEGA 003TTU-4/2018 entitled Interactive Applications for Teaching Mathematics at Primary Schools.



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Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Encryption Riddles as a Tool to Motivate Students in Math Class

J. Fialová, R. Horváth



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elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — In the paper, we briefly introduce some methods of message encryption such as transposition cyphers, substitution cyphers, polyalphabetic cyphers or asymmetric-key cryptography and consider their applicability in school practice. We verified the applicability of this topic on a sample of 14 students of teaching within the subject – elementary number theory. We gradually gave students four riddles. Their task was to decrypt the message without knowing the key or encryption method. The e-learning environment LMS Moodle was chosen as a tool for communication with students about the tasks. The riddle was published in the LMS Moodle at the agreed time. The students entered the correct solutions into the forum, so it was possible to find out who solved the puzzle correctly first, and at the same time, all classmates saw this solution. During the experiment, students showed great interest in such riddles, so they were offered the opportunity to create their riddle encrypted using a different encryption method. Four students took advantage of the opportunity to create unique encryption methods, which we describe in detail in the article.

I. INTRODUCTION

However, cryptography is such a valuable part of mathematics; representation in school mathematics is isolated. That is a shame because cryptography has a vast potential to enrich math education. It brings adventure, excitement, mystery, joy of discovery. It provides a way to counterbalance the impression that there exists a formula for any problem in mathematics. Moreover, cryptography provides an excellent opportunity for interdisciplinary projects.

II. METHODOLOGY

The research was carried out on the research sample of fourteen students of teacher training in academic subjects in the combination of mathematics and other subjects. They were in the second grade in the school year 2019/2020 and attended a subject – elementary number theory. Since the subject is focused only on some elementary methods in number theory, there was not time enough for dealing with unique cryptography methods in depth. The semester was a bit affected by the COVID-19 pandemics since from 11 March 2020 the study form was changed to distance. The course proceeded by LMS Moodle system, where the students became actively involved. During the semester, students were given several encryption tasks. The tasks were called riddles and were additional; students are not required to solve them. The single external motivation was the possibility to get some additional points to their classification of the subject – elementary number theory. All riddles were published at the agreed time on LMS Moodle bulletin board. Students have much time to solve the task, and the first one, who posts the correct answer with the explanation was the winner. Solutions of the first two riddles were also discussed in the following math classes.

The given encryption tasks:

1. „FOCVA UOK PK SKU V TGAKTGAORK. KZAK PK AB IVRVSGJG.“ The first riddle was encrypted by a simple method called Caesar cypher with a right shift of six in the alphabet of 24 letters.
2. „2560265989 5332511 1 6460 1655447845 5332511 111400933 11509 160325213 104114015.“ The second riddle is based on non-decimal number systems, which we were considered in the class. Numbers replaced all letters in the message. To message to be decrypted, it is necessary to rewrite all numbers from decimal number system to the number system with base 24 and then use letters instead of digits.
3. „(M = 38, a = 5): 000100 011001 010101 011000 001001 010010 100011 010101 001010 000001 001000 000101 010110 001001 000101 001111 001000 010101 001101 001001 000111 000101 000111 010011 010101 011001 010001 000101 010010 000001 000101 100100 010101 000100 010100 010010 010011 100011 001000 000101 001101 010010 001001 010011 000111 010001 001111 001100 000101 100001 010101 011100 001010 010001 001111 001100 000101 001111 001100 010001 100000“ In the third riddle, apparently, a binary number system is used. Each number is a letter in 24 letters alphabet with a space numbered as 25. A commonly used RSA cryptosystem encrypts these numbers.
4. The fourth riddle was a simple Morse code with | as letters separator, || as word separator and ||| as sentence separator.

III. CONCLUSION

The experiment shows that encryption riddles as additional tasks are appropriate, especially for homework because much time has passed by experiments during decryption. The first riddle was resolved in 1 hour and 2 minutes; the others needed several hours. The discussion about solving the first two riddles in class showed that not only these two successful students tried to decrypt the message, but others also failed or were a little bit slower. The discussion about the process of solving a riddle was very fruitful and could be strongly recommended for the sake of learning how to solve any math problem.

Some students expressed a request to have a chance to solve such additional tasks, although they are not able to be the first ones. So, they were given the opportunity to create their riddles based on qualitatively different method than was used in the given riddles. Up to six students out of 14 took part in solving the additional tasks. Three students resolve a given riddle; four students (including one of the successful decryption students) created the encryption riddle.

ACKNOWLEDGMENT

This work has been supported by the Cultural and Educational Grant Agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic (KEGA) and the contribution was elaborated as the part of the projects KEGA 001UMB-4/2020 entitled Implementation of Blended Learning into Preparation of Future Mathematics Teachers and Future Computer Science Teachers and KEGA 003TTU-4/2018 entitled Interactive Applications for Teaching Mathematics at Primary Schools.

Yrobot extension module for educational and marketing purposes

L. Formanek, O. Karpiš



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Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — At the Faculty of Management Science and Informatics, of University of Žilina an initiative was created to support the increase of interest in the study of hardware oriented programmees, such as the Computer Engineering programme which we offer. This paper focuses at further explanation of one of the additional modules of the open-source platform Yrobot. Yrobot is a modular education robotic platform which is dedicated to support the teaching of robotics and other hardware subjects in high schools and universities. The extension module based on Bluetooth technology enables wireless work and control of Yrobot, which can be used and extended at the robotics lessons in teaching.

I. INTRODUCTION

In recent years, the topic of more intensive education of students with focus on the development of individual, specific abilities, which is based on student activity, has become an increasingly topical issue. Due to the fact that (not only) in our country the interest in studying technical fields has significantly decreased, while the market demand for graduates of technical schools is constantly high, and ending students (grammar schools) very often lack the so-called "technical thinking", it is necessary to find and use methods that could arouse students' motivation and interest in technologies. For these reasons, several projects and challenges have emerged in Slovakia supporting education in the field of information and communication technologies.

The relatively poor state of popularization in the field of "Computer Engineering" led us to develop a set of simple devices that would allow us to create interesting tasks in the field of Informatics and Computer Engineering. This is how the "Yrobot" kit was created and later "MYrobot". The MYrobot kit is designed especially for high school students and allows them to develop various applications. The Yrobot kit is intended for secondary schools, where students encounter programming in C or C ++, but also for universities.

II. Yrobot PLATFORM

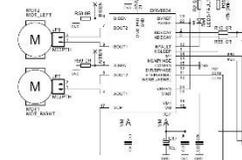
Yrobot is a learning system built on a modular architecture. It was developed at the Department of Technical Cybernetics, Faculty of Management and Informatics, University of Žilina. The developed system is an Open HW platform on which students can learn the basics of electronics, computer science and computer engineering. Over time, the design of the platform has been revised to meet current needs and a fourth revision is currently available. The hardware of the Yrobot includes a printed circuit board containing four signaling LEDs, two 7-segment displays, an acoustic buzzer for sound signaling, two motors with integrated gearbox (1:48) and wheel angle sensing circuits based on CNY70 reflective sensors as well as push-button sensors and obstacle detection sensors. The system is powered either via a 7.5V-10V DC adapter or two Li-Pol 3.7V 2200mAh batteries of size 18650.

The Yrobot system can be programmed via the integrated USB AVR ISP programmer. The wireless controller can be seen at Fig. 1. So far, several extensions have been created for the Yrobot platform, we consider the most interesting:

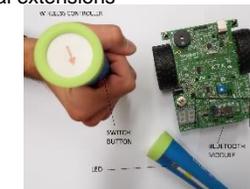
- Y-WiFi module - communication via WiFi, or even signal strength measurement
- robot movement controlled wirelessly
- measurement of air quality and CO2 concentration
- audio-communication subsystem



Figur e 1



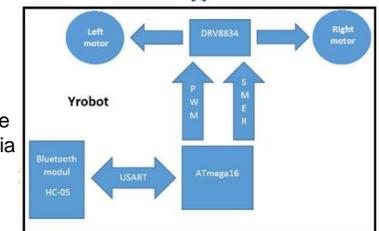
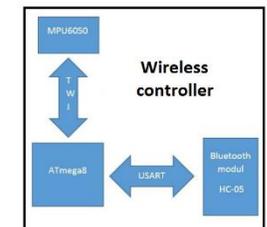
Figur e 2



Figur e 3

III. IMPLEMENTATION OF OPEN-SOURCE INTERACTIVE MOVEMENT CONTROLLER

The implementation of a wireless movement controller (Fig. 2, Fig.3) for the Yrobot platform is based on the 8-bit ATmega8 microcontroller using the Bluetooth module HC-05 and the movement interactive control by the sensor MPU6050 in which are combined three-axis gyroscope and a three-axis accelerometer. The communication with the sensor is provided via two-wire communication interface or called TWI and I2C. The microcontroller processes the data coming from the sensor and sends it to the Bluetooth module via the USART communication unit. After the initial establishment of communication with the second module HC-05, which is located on the Yrobot platform, information are send to this module. The second HC-05 module sends data to the Yrobot's microcontroller which is the ATmega16 microcontroller. Based on the incoming data, the main MCU generates signals for the direction of rotation of the motors and PWM signals, which control the speed of the motors using the integrated circuit DRV8834. The block diagram of the solution is shown in Fig.4.



Figur e 4

VI. CONCLUSION

In the future, the wireless controller may not only be used to control the movement of the Yrobot platform. As it has an implemented three-axis accelerometer and the gyroscope can serve together with the integrated Bluetooth wireless module for a wide range of interactive applications. It depends only on the motivation and abilities of students not only in the field of computer engineering but also high school students where they learn to handle and understand programming and robotics.

An overview of neighbor discovery issues in vehicular V2X networks

I. Dolnák and J. Litvík



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Conference Office

elfa, s.r.o.

Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839

fax: + 421-55-726 5195

e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — The following article is focused on an overview of the neighbor discovery issues identified in wireless vehicular V2X networks based on the IPv4 and IPv6 protocol. The article identifies the causes of these problems, and the consequences of which are reduced efficiency and errors in communication among individual network nodes – moving vehicles, pedestrians, and standing roadside units. The different nature of network nodes mobility in relation to the wireless networks and the IPv4/IPv6 protocol determines specific use of current network technologies. The following overview also highlights higher complexity of IPv6 communication across the wireless vehicular V2X network.

I. INTRODUCTION

Vehicular networks are a type of wireless ad hoc networks intended for communication among vehicles, pedestrians, and transport infrastructure. The commonly used term – Vehicle-to-everything (V2X), describes a set of communication technologies (hardware and software) in which information is spread among network entities mentioned above and the purpose of this communication is a continuous exchange of information originating mostly from sensors and subsequent activities of network entities based on predefined algorithms, protocols and services.

There are also used more specific self-explanatory terms like: Vehicle-to-vehicle (V2V), Vehicle-to-infrastructure (V2I), Vehicle-to-network (V2N), Vehicle-to-pedestrian (V2P), Vehicle-to-device (V2D), Vehicle-to-grid (V2G).

Internet Protocol version 4 (IPv4) is currently the dominant Internet Protocol (IP), forming the current predominant Internet. It is responsible for addressing and routing data packets among network nodes. Internet Protocol version 6 (IPv6) is the recent version of the Internet Protocol (IP) with the same functionality as its predecessor – IPv4 protocol. IPv6 protocol was developed with intention to replace currently widely used IPv4 protocol in the global Internet network. In the emerging networks, such as vehicular V2X networks, it is the expected approach to focus only on technologies based on the IPv6 protocol [3]. IPv6 protocol is generally considered to be an already well accepted, standardized protocol and dominant for future communication among entities in road transport.

II. V2X NETWORK SERVICES

The nature of V2X communication is formed by typical communication patterns created by services that determine the mentioned algorithms. Very often is mentioned the enormous dynamics of the road vehicles and the nature of the rapidly established and terminated P2P (Point-to-point) connections in V2X networks [1]. Of course, this property implies technical requirements for the principles of operation of the wireless networks, which will be used to communicate network nodes to each other.

First, it is necessary to mention the basic network services, which determine the algorithms and demands placed on network technologies and, in essence, the overall nature of the operation of V2X networks. According several case studies describing future purpose of vehicular V2X networks [1, 2], some of the promising applications were specified as [12]: platooning, context-aware safety driving, emergency vehicle warning application.

III. NEIGHBOR DISCOVERY ISSUE– SITUATION IN IPV4 NETWORKS

There is issue with asymmetric communication generally resulting from the direction of information dissemination among network nodes. In a wireless vehicular V2X network, it may not be possible to create a reliable bidirectional link and only one-way transmission could be possible. Bidirectional connectivity is generally needed which is not always the case for wireless links.

ARP address resolution is usually performed on-demand, as packets for a neighbor arrive from the higher layer. Many ARP implementations derived from the original BSD Unix ARP buffer only a single packet for each neighbor while AR is ongoing. Additional packets that arrive for this same neighbor will replace the buffer contents until the AR process completes. Collisions in this single-packet buffer becomes a problem in ad hoc networks, since ad hoc nodes tend to communicate through a greater number of neighbors than infrastructure network nodes do.

VI. CONCLUSION

In this article, was presented the topic of neighbor discovery in IPv4 and IPv6 networks, which are fundamental service of any network. An idea of the most outbreaking problems and the causes of their occurrence was outlined. Principally, there is a discussion of two potential directions – usage of ARP protocol in IPv4 networks and usage of ICMPv6 in IPv6 networks. It is still not clear which of the wireless technologies will be used in next V2X networks, but more or less it is clear that they will be based on IPv6 protocol. And because of the fact, whether WLAN-based or cellular-based networks will be used for in V2X networks, all the specifics outlined in the article can be generalized and further solved on an academic as well as a practical level.

ACKNOWLEDGMENT

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Exploring the correlation between students' satisfaction and learning outcomes they achieved

D. Gecášek, M. Solanik, J. Genčí, Z. Bilanová



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Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — The article aims to present modern approaches in the teaching of programming subjects, to evaluate how students perceive them and to assess whether the given methods objectively improve the level of knowledge acquired by students. This research was carried out within the exercises of the subject Operating Systems taught in the bachelor's study of the Department of computers and informatics at the Technical University in Košice. For four years, students' satisfaction with the way they were taught was measured through polls, based on which the teaching was constantly modified. The purpose of this article is to verify whether the satisfaction of students was reflected in their study results and achieved better grades than students in the past, whose opinion was not taken into account in teaching.

I. INTRODUCTION

To engage students and future researchers in technical fields, it is necessary to constantly update the curriculum and use modern teaching technologies. These are one of the options (in addition to emphasizing the link between industrial practice and private providers with universities), which will allow higher education institutions to remain sustainable in the future..

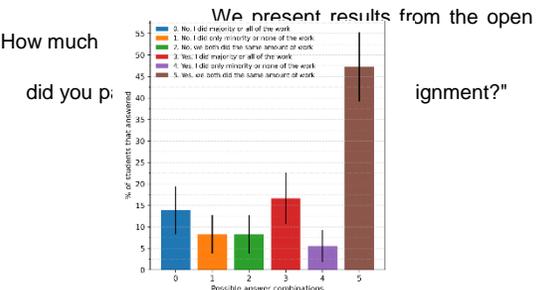
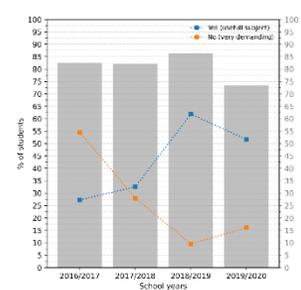
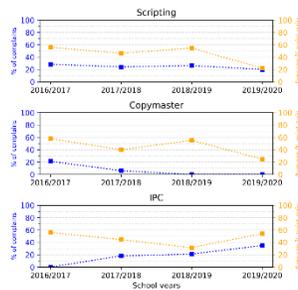
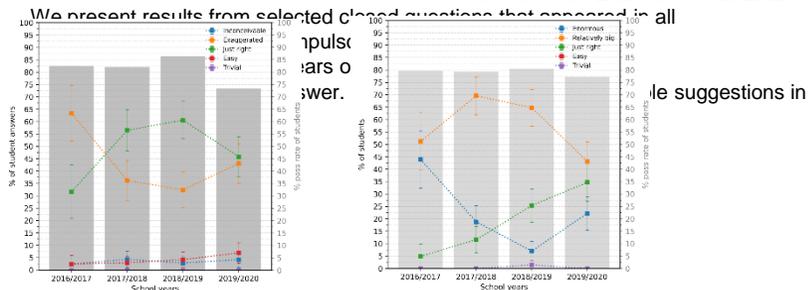
II. OPERATING SYSTEMS

The course Operating systems allows students to understand the principles of operating systems. The teaching of seminars is project-oriented - students test their knowledge while working on three assignments. They also learn to work in a team, as some of the activities they do are dealt with in small work teams. Students are systematically prepared for the exercises using materials in the form of scripts, a web-based learning interface, and preliminary tests, thanks to which, before completing the seminars, they find out whether they correctly understand the issues being discussed. After the seminars, when the students have already had a phase of memorizing and understanding the curriculum, students are guided to develop sets of programming tasks that allow them to apply and analyze the acquired knowledge. Their abilities are verified by means of two tests and they complete the course by passing the final exam.

III. PRESENTATION OF RESULTS FROM CLOSED QUESTIONS

IV. PRESENTATION OF RESULTS FROM OPEN QUESTIONS

V. OPINIONS ON TEAM ASSIGNMENTS



VI. CONCLUSION

From the polls, it is clear that students always had trouble with the assignment Scripting. Assignment Copymaster was improved to the point that students do not complain about it anymore. Last year it was not a compulsory assignment and we can see that this was reflected in percentual point gain. Students are complaining about assignment IPC more and more every year but this is not reflected in their percentual point gain from this assignment. When we examined the correlation between student recommendation rate and student pass rate, we found that there is a positive correlation between pass rate and students' good opinion about the course and vice versa. We also found that no matter how much of the work on assignments students actually do, they all prefer team assignments. Based on our findings we decided to not use the Scripting assignment next year. We are going to make the Copymaster assignment compulsory. We also plan to improve the specification and automated evaluation system of the IPC assignment. IPC will remain as a team project.

ACKNOWLEDGMENT

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Data science tools in the analysis of developing inquiry skills and computational thinking within the "IT Academy" Project

J. Hanč, M. Hančová, V. Jurková, D. Šveda

Abstract — We present our ideas how to apply modern data science technology and methodology to effectively prepare and statistically analyze large educational datasets which in our case map Inquiry skills (IS) and computational thinking (CT) developed by students in primary and secondary schools at the Slovak national scale, within the project "IT Academy - Education for the 21st Century". Combining the top two open-source data science tools, Python (within Jupyter notebooks) and R (within R studio software), we illustrate some of results from data preprocessing (cleaning, wrangling) for the diagnostic primary-school test of Inquiry skills where Python tools (e.g. Pandas library) became more advantageous. As for the subsequent intensive statistical analysis, R environment was more suitable. We demonstrate summary results of the statistical analysis of the computer thinking diagnostic test for primary and secondary schools, finally cross-checked in SPSS software. Due to the current COVID-19 situation, we are still collecting data from ITA project impacts for which we finally show how we plan to implement further methods for data collecting, analysis and implementation in collaboration with our colleagues – education researchers.

I. INTRODUCTION

- IT Academy — the national educational project: 450 primary and secondary schools, 33 000 students, 2100 teachers and pedagogical staff
- The field experimental study of developing student' IS and CT after implementation of innovative lesson methodology as Inquiry-based science education (IBSE)
- Our problem: How to effectively process and analyze obtained large educational datasets from the study?

II. METHODOLOGY

Selecting and implementing ICT tools for data manipulation and analysis

- Data preparation (preprocessing) – Python (Pandas) within Jupyter
- Statistical analysis – R within R studio
- Deeper didactic interpretation



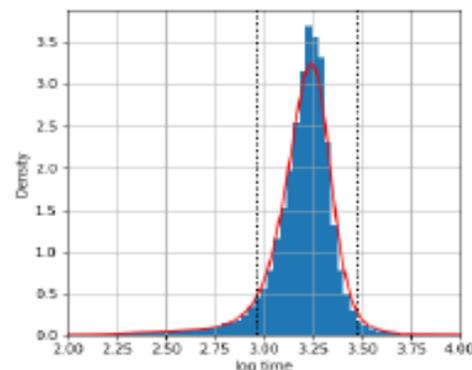
pandas



III. SOME OF RESULTS

Data preparation phase in Pandas

- Data cleaning: detection of corrupt, inaccurate data records, irrelevant data, inconsistencies, identification of outliers and what to do with them
The modern robust outliers' detection technique not suffering from masking called the MAD-Median rule – the results for IS test data for primary schools in Figure. The method reasonably marked the values as outliers if the spent time was less than about 10 minutes (corresponds to student's random guessing of answers without reading comprehension) and more than about 60 minutes (corresponds to violating the precisely defined conditions of test administration).
- Data wrangling: transformation cleaned data for further statistical analysis (scoring test questions – sophisticated techniques, e.g. fuzzy text/string matching or graph theory)



Statistical analysis in R

Pre-test results of computational thinking

- Input characteristics of the CT test in Table; Mean value 47% (SD=18%)
- the simplest concept for students – the concept of abstraction 53.74% (SD=20%);
- the most complex concept – the concept of evaluation 43.62% (SD=21%).

Post-test results of computational thinking

- after implementation of new IBSE lesson methodologies; mean value 51% (SD=18%)
- the simplest concept for students – the concept of abstraction 55.92% (SD=20%);
- the most complex concept – the concept of evaluation 48.22% (SD=22%).

Post-test – pre-test preliminary analysis for computational thinking

Implementation of new IBSE analysis

- all students – statistically significant improvement 5.3%; paired t-test ($t = 19.73$, $df = 3105$, $p < 0.001$), 95% confidence interval for the mean gain: (0.048, 0.059)
- grammar schools – statistically significant improvement 3.7%; paired t-test ($t = 6.88$, $df = 873$, $p < 0.001$), 95% confidence interval for the mean gain: (0.026, 0.047).
- technical secondary schools – no statistically significant difference ($p = 0.642$), 95% confidence interval for the mean gain: (-0.030, 0.019)
- primary schools – statistically significant improvement 6.6%. Paired t-test ($t = 20.72$, $df = 2046$, $p < 0.001$), 95% confidence interval for the mean gain: (0.060, 0.072)

VI. CONCLUSION

Since post-tests' data collecting was abruptly due to COVID-19 pandemics, the presented results can be considered only as preliminary. A deeper didactic interpretation is planned after completing the data collection supplemented by further methods of data collection (e.g. PISA algorithm random sampling) and analysis (e.g. effect size statistics). However, our experience confirmed right choice of ICT tools for data manipulation and analysis. Python in Jupyter notebooks and R in R Studio gave us really reproducible and effective reports in every step of our analysis.

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elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: +421-55-625 3839
fax: +421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk



IT AKADÉMIA – VZDELÁVANIE PRE 21. STOROČIE



Analysis of Network Traffic in CLOUD Environment

M. Hasin, B. Madoš, J. Palša, A. Janitor



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Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — The article focuses on the research and design of the infrastructure used for data collection from the network traffic of the CLOUD platform. The aim was to identify the structure of network traffic that occurs in the CLOUD platform. From the mentioned data it is possible to evaluate network security of the protocols used in communication and subsequently compare the obtained data with the security standards introduced in the experimental platform. When implementing the measurement, the NetFlow protocol was used, enabling data collection directly on virtual machines located in the CLOUD platform. The measured data was then stored in the non-relational database Elasticsearch. The selected database is intended for the analysis of a large amount of data. The most important part is the creation of an interactive web environment in order to interpret the measured data in a user-friendly form. The next step in the processing of measured data involves the application of artificial intelligence methods to evaluate and predict the existence of potential security problems.

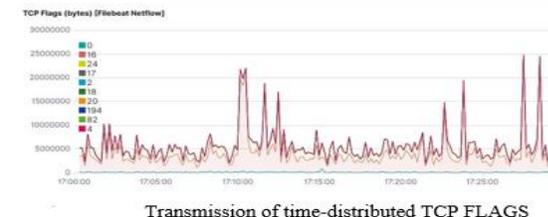
INTRODUCTION

Monitoring network flows in the CLOUD platform is an important security tool. This type of monitoring evaluates data to increase the availability and performance of the CLOUD platform. The CLOUD platform changes the view of network monitoring from the point of view of administrators as the exact number of assets reserved for their applications or calculations is no longer determined. Instead of fixed assets we have the computing power available which can be obtained on request if required. Traditional infrastructure monitoring models use network management systems. These systems use SNMP, ICMP protocols, etc. When using the CLOUD platform it is necessary to evaluate the measured data using advanced systems. These systems provide system monitoring, intelligent real-time reporting and subsequent intervention in the infrastructure based on artificial intelligence. Intelligent measurement is the use of tools that analyze network traffic. This analysis can be created using different tools based on different platforms...

II. ANALYSIS OF SOLUTIONS FOR MEASUREMENT OF NETWORK TRAFFIC PARAMETERS

Network traffic is recorded by means of these technologies using a port that mirrors network traffic from the entire infrastructure [4]. This method is demanding on system requirements. The biggest drawback is the need to have a device that allows you to analyze large amounts of data. The most prone device for measurement errors is the mains adapter. Selecting a less powerful adapter results in the loss of network packets, the so-called Packet Drop. The disadvantages of the above-mentioned tools which are described are solved by the NetFlow protocol. This protocol can be used to capture network traffic parameters already on the VMware platform. This platform allows you to measure data directly on the virtual device and then send this data to the database. The Elasticsearch database was chosen in this work. The advantage of this database over others is the possibility of implementing the KIBANA WEB environment. Subsequently, the possibility of using artificial intelligence which on the basis of stored data creates various models for predicting network infrastructure failures.

In TCP connections, TCP FLAGS are used to indicate a specific connection status or to provide additional information. Based on this information it is possible to solve emerging problems or to monitor a given network. The most commonly used TCP FLAGS are "SYN", "ACK", "FIN". Each of these FLAGS corresponds to 1 bit of information. The number of detected FLAGS in the CLOUD network was 14 during the measurement. Figure shows how the given FLAGS were used during communication over time. FLAGS ACK was used for the most requests and FLAGS ACK-PSH was the second most used. Using this data it is possible to quickly identify devices on the network that are being attacked by ACK-PSH Flood. This attack manifests itself in the constant sending of ACK-PSH requests to the server. A large number of these messages can prevent the server from responding to new requests.



III. CONCLUSION

In this work we proposed a solution that analyzes network traffic in the CLOUD portal. When analyzing a suitable solution we chose to use non-relational Elasticsearch databases which allow the processing of a large amount of measured data. The measured data is stored in a database and evaluated by the Kibana graphical WEB tool. In this way it is possible to create easy-to-understand data and then interpret it in real time. The future development of the infrastructure for network traffic analysis will mean the expansion of data storage by creating an Elasticsearch cluster. The cluster can be extended by two types of nodes, namely a data node and a computing node. By increasing the number of nodes it is possible to increase the storage capacity and search speed in the collected data. Using multiple nodes also increases the stability and redundancy of the created Elasticsearch cluster. The extension of artificial intelligence is possible by creating block lists of IP addresses that are spreaders of SPAM or other types of unwanted software. In this way it is possible to block the access of known botnets to the infrastructure or communication with their control servers already in the initial phase. The data connection can be extended with a connection to the Check Point firewall API.

ACKNOWLEDGMENT

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Use of Mobile Applications in Education

J. Hlaváčová, L. Vojtaško, M. Timkovič, D. Tometzová and E. Kornecká



ICETA 2020
Conference Office
elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — The submitted paper deals with hiking and sports mobile applications and their use in the university education. The paper provides information on the most used hiking and sports mobile applications and their individual parameters for measuring tourism and sports activities. It acquaints with used freely available mobile applications for university students. The applications are used to record physical activities during the distance form of education. It states the usability of applications in study programs of geotourism.

I. INTRODUCTION

Digital technologies have become part of today's life. The new generation of young people is called the "Online generation" because they use these technologies in every area of their lives and take them as part of their future. The use of latest technologies can also have a positive effect on the learning process. The submitted paper deals with the issue of the mobile technology use, which is highly topical at present, as it brings various limitations in all aspects of life. It also brings changes in teaching process, mainly due to the transition from the full-time form to the distance form of teaching. Mobile applications aimed at promoting physical activity and a healthy lifestyle are becoming a phenomenon today. This phenomenon is one of possible options how to compensate the negative trends associated with a lack of physical activity.

II. MOBILE APPLICATIONS

A mobile application is a specific software application requiring installation mainly for smartphones, tablets or other mobile devices. An overview of the most used paid and free hiking and sports mobile applications in Slovakia is provided by the Website www.appannie.com.

The most downloaded free hiking and sports application in Slovakia is Strava. During the distance teaching at TUKE, the use of mobile applications in the context of physical education was introduced. After analyzing the functions of available paid and free hiking and sports mobile applications in Slovakia, it was proposed to include the following applications in the distance form of teaching: Strava, Sports Tracker, MapyCZ, Endomondo. The students of Technical University in Košice with compulsory physical education completed physical activities, the implementation of which they sent weekly records by email to the teacher. They had a choice of 5 physical activities (walking, running, cycling, inline skating, hiking). The conditions, namely time limit and minimum distance for individual physical activities, were set. The collected data showed a strong preference for walking activity, in the number of 960 hours, over other activities. Running and cycling were 2nd and 3rd choice of students. Hiking and inline skating had a much smaller number of hours. Among the hiking and sports mobile applications which have been selected for testing were most used Strava and Sports Tracker with the number of 277 or 260 users. Applications Endomondo, Mapy.cz, Mi Fit, Samsung Health were ranked in other places.

MODERN EDUCATIONAL

Hiking and sports mobile applications in the physical education
Procedure on how to record physical activity through mobile applications
Interest in the proper workout routine and active lifestyle
Usability of given applications in study programs of geotourism

NON-TRADITIONAL EDUCATION

Individual performance of physical activity within physical education
Individual implementation of field trips within geotourism

VI. CONCLUSION

The aim of the presented paper was to provide the teaching process of physical education at the Department of Physical Education, Technical University, Košice in the distance form of teaching, through the use of mobile applications.

The survey presents partial results of the most downloaded mobile applications that students used in performing physical activities and students' preferences for the selection of given activities.

The assumption was that in addition to meeting the requirements for the course credit, we will provide students in the educational process with added value in the form of interesting indicators: pace, time, distance, route, energy consumption, pulse frequency and others. Students could also compare their performance with other mobile app users.

Results from the practice-based study indicated the possibility of arousing students' interest in their health, proper workout routine and active lifestyle through mobile applications. The experience from the survey pointed out the possibility of using the given applications also in the study programs of geotourism.

ACKNOWLEDGMENT

This publication is the result of the implementation of the project Historical Mining – tracing and learning from ancient materials and mining technologies, EIT/RAW MATERIALS/SGA2019/1 supported by EIT.

Pohybová aktivita					
Počet hodín					
chôdza	beh	cyklistika	turistika	inline k.	iné
960	257	147	58	45	30

Performed physical activities of TUKE students. [compiled by the authors].

Mobilná aplikácia	Počet používateľov
Strava	277
Sports Tracker	260
Endomondo	58
Mapy.cz	40
Mi Fit	30
Samsung Health	16
Iné - Kondícia	8
Zdravie	10
Runkeeper	6

The most frequently used mobile applications by TUKE students [compiled by the authors].

The influence of the proposed educational computer games on the development of various skills in children

A. Holešová, P. Sýkora, D. Tichá



ICETA 2020
Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — Over the last year, distance learning has become a hot topic of research due to the emerging pandemic situation. It is therefore more than desirable to create various new alternative and interactive ways of educating children of all ages. In this paper, we propose a set of educational computer games aimed at developing various skills in children. Moreover, we monitor the improvement of these skills in several individuals achieved through repeated play over a period of three months. We have observed a great advance in abilities such as working visual memory, reflexes, coordination between hand and eye, or hardware-utilization skills. We can also report that the children showed the most significant progress from the first to the last test session on the game SuperRobot, which is designed for improving the keyboard skills, hand-eye coordination and reflexes.

I. INTRODUCTION

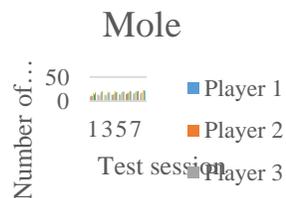
Due to recent global events causing health risks, many educational institutions are forced to switch to distance learning via various platforms supporting large-group video-conferencing or assignment and submission of homework. This way, however, teachers almost completely lose control of student engagement in individual lessons. It is known, that interactive education expands the scope of learning from the basic instruction to the practical application of knowledge, which facilitates the process of memorization. Learning games are one more step further in increasing student engagement with the subject being taught. One of the greatest challenges in designing learning games is the tradeoff between the fun factor and the educational value. In this paper, we propose a set of 4 well-known types of computer games intended for developing and improving certain skills in children. We have programmed our own version of each game to better meet our requirements. Among other things, we have reduced the unnecessary distractive elements to get a better balance between the fun-factor and the educational value. The aim of our research was to find out how children's skills develop as they play the proposed games. Specifically, we focused on monitoring children's short-term visual memory, reflexes, coordination between hand and eye and hardware-utilization skills. This was done by employing certain built-in game features. The long-term experiment involved 6 children in ages from 10 to 15 years with different level of computer skills. For the period of three months, they played all the games on daily basis. During this time, each of the children participated in 8 supervised testing sessions, where their progress was recorded.

II. GAMES DEVELOPMENT AND EXPERIMENTAL RESULTS

We utilized Unity real-time development platform in combination with Adobe Illustrator for development of the application containing all the proposed games. Adobe Illustrator was used to create all the visual elements, while Unity served as an environment for the object-oriented programming.

A. Mole

The Mole game was designed to train the reflexes of the players, and partly also the coordination of the hand and eye. Players improved by an average of approximately 6 hit moles between the first and last test session.



III. CONCLUSION

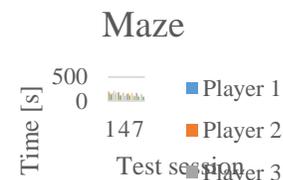
In this paper, we proposed 4 educational games aimed at improving skills such as working memory, concentration, hand-eye coordination, fine motor skills, reflexes and keyboard skills in children. To verify the effectiveness of these games, we conducted a long-term experiment in which 6 children participants were asked to play on daily basis for 3 months. Within this period, 8 individual supervised test sessions were arranged for each child. The results of the experiment proved that all the monitored skills of each child improved to a certain extent. Children made the greatest advance in the SuperRobot game, designed for keyboard skills training, followed by the Maze game intended for strengthening the hand-eye coordination and fine motor skills. We acknowledge, that conclusions drawn from this research are only preliminary and that more extensive experiments are necessary, which is a future goal of our research.

ACKNOWLEDGMENT

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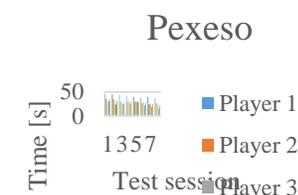
B. Maze

The Maze game was developed to test and train children's hand-eye coordination and fine motor skills in the hand. The time required to finish all the game levels decreased by approximately a third on average compared to the first test session.



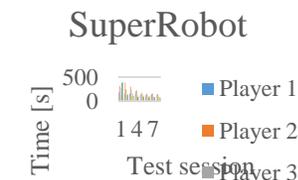
C. Pexeso

By playing the Pexeso memory game, children improved their memory, concentration and patience. The finding of all corresponding card pairs by the player took approximately 10 seconds less in the final session, than at the beginning.



D. SuperRobot

SuperRobot was designed primarily to help develop keyboard skills in children. Of all the games, progress from the first to the last testing was the most evident in this one. The time required to complete the game decreased on average from 278 to 109 seconds.



Web-application based system for automated testing of network-devices configurations

M. Holý, D. Macko



ICETA 2020
Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — Manually checking the configuration of manageable network devices is a time-consuming process, that should be automated. This automatization is especially needed in the school environment with many students, where a teacher must effectively evaluate the students' results. This paper describes a proposal of a web system for testing configuration of network devices. The proposed system enables students to easily upload and evaluate configurations of network devices. When a student uploads configurations files, the system compares them to golden-model configuration files, uploaded by the teacher. Based on these comparisons, the system is able to evaluate students' configurations and display the results. The system was designed in such a way that the students cannot access the golden-model configuration files – i.e. answers uploaded by the teacher. The proposed system also makes organization of configuration files easier for students and teachers by grouping them into tasks and courses.

I. INTRODUCTION

To make the teaching process more efficient, automation tools are utilized. We can meet them mainly in assessments of students' gained skills, such as final exams. However, the automation is required even for weekly laboratory works, where a single teacher is required to check and evaluate the results of many students. This is especially challenging when students work with some real hardware equipment, such as configurations of real manageable network devices. Therefore, one of the existing works proposed an automation tool that makes the comparison of a student configuration to a golden-model configuration faster by comparing exported configuration files. Another work proposed to use an encrypted golden-model configuration file and compare only the hash values of the configuration commands for students to check their results without accessing the answers. The challenges we address in this paper are distribution and usability of the automation tool, administrative-purpose logging, and an organization of the tasks and courses. The proposed tool is implemented as a web application that is able to upload student's configuration files for evaluation to the server and provide the evaluation results to the student. The web-application basis ensures no need for installation and thus easy distribution of the automation tool. The comparison on the server side ensures that the students do not have access to the golden-model configurations. On the other side, the computing capacity of the server has to be adjusted to the expected number of students to simultaneously use the application.

II. WEB APPLICATION FOR AUTOMATED EVALUATION OF CONFIGURATIONS

The proposed web system is based on the client-server architecture, in which the client is implemented as a single-page Javascript application using the React framework and the server is implemented in Java using the Spring framework and the PostgreSQL database. The abstract component diagram of the server application is illustrated in Fig. 5. The server contains the REST API end points to handle the request from the client application. The proposed system enables users to log in and provides a list of courses. After selection of a course, the user is provided by the list of available tasks. The system distinguishes two user roles: a student and a teacher (an administrator). According to the role of the user, the system provides further functionality. A student can see a list of configuration files for the selected task. The student can insert (copy-paste or drag-and-drop), delete, modify and save the configuration files. After all necessary configuration files are inserted, the student can evaluate them, and the system provides the results. Besides the functionality available for a student, a teacher can insert, modify, and delete the golden-model configuration files, while creating a task. The teacher can also assign or modify points to individual commands from configuration files. The teacher can view complete configuration files and detailed logs from the evaluation. The teacher can create, modify, and delete available courses, and in each course create, modify, and delete individual tasks. The teacher can also assign students to individual courses available in the system. To test the proposed system thoroughly, we have used the system to evaluate real students' configurations samples from the configuration exam within a study course. The tests were firstly evaluated by a teacher manually. Afterwards, we have used the system for automated evaluation and compared the results. The data (see Table II) show that the results of the automation system are usable.

VI. CONCLUSION

In this work, we have proposed a modification of existing desktop-application system for evaluation of network-devices configurations to a web-based application. We have enhanced the tool for authentication, authorization, organization, and logging capabilities. The resulted application enables students to test their resulted configuration by themselves using an online environment and see the results of the evaluation, without access to correct solutions (the golden model). Thus, the system is suitable to automate checking of students' work not only in final exam, but also during weekly laboratory works. In the future, the evaluation algorithm can be refined to eliminate some identified weaknesses. Also, integration with the academic information system could help to use the existing student accounts and to automatically assign students to courses.

ACKNOWLEDGMENT

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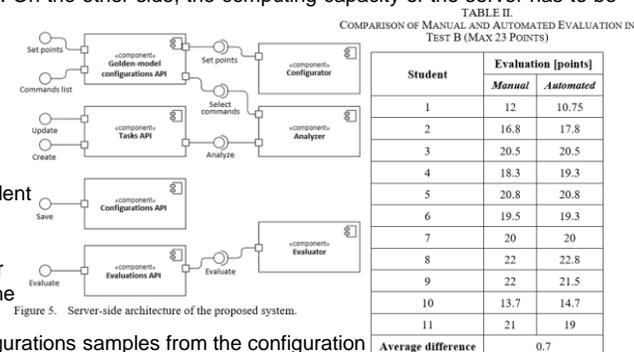


TABLE II
COMPARISON OF MANUAL AND AUTOMATED EVALUATION IN TEST B (MAX 23 POINTS)

Student	Evaluation [points]	
	Manual	Automated
1	12	10.75
2	16.8	17.8
3	20.5	20.5
4	18.3	19.3
5	20.8	20.8
6	19.5	19.3
7	20	20
8	22	22.8
9	22	21.5
10	13.7	14.7
11	21	19
Average difference		0.7

The Creation of Simulation with an Algorithm Optimisation in Java for the Teaching Process

Roman Horváth – Jana Fialová



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Conference Office

elfa, s.r.o.

Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839

fax: + 421-55-726 5195

e-mail: iceta@elfa.sk

www.iceta.sk

Abstract—At the Faculty of Education, we decided to use the current situation related to the spread of the COVID 19 virus. In one of the subjects whose syllabus corresponds to this topic, we included the creation of a simulation of the spread of the disease. While creating the sample example we describe in this article, we found that some original Java algorithms used in our programming framework are not as efficient as they could be. So, we focused on optimising these algorithms (a pair of related algorithms in the field of analytical geometry). Since it was an activity performed as a part of the creation of this simulation, we decided to publish it in this paper as well.

I. INTRODUCTION

The subject of MSS is taught in the study programme CS at the FoE TU. The current situation gave us the idea of including a simulation of the spread of viruses in this subject. Often the SIR (or SIRS) model is used. This model divides the individuals into three groups or states S – susceptible, I – infected, and R – removed. The susceptible subjects are those who were not infected, and the removed might be those who were healed (or died). The last S in SIRS model means that removed subjects may return to the susceptible state and be infected again. The simulation was ready to run after setting and implementing a series of rules of how to transit between the states. Mostly the solution was to define a set of values (constants or variables) that express the ranges of probabilities for a change to occur. The significant advantage (due to its good visual representation) is to implement the subjects (persons) as moving particles and take the probability value ranges into account according to the distance of particles.

II. THE SIMULATION IMPLEMENTATION

The most common in use is the SIR model. The first phase of our implementation included adopting the model to our needs. We had set the rules slightly different from the original model. It is more like the SEIR model, but it distinguishes more states: susceptible (clean), exposed (infected, but not sick), sick (infected1), quarantined (infected2), healed (removed1), and deceased (removed2). The exposed ones cannot be quarantined because there is no knowledge that they spread the virus at that time. They will become sick after incubation time. The sick and quarantined may heal or die; the sick ones, though, become quarantined after some delay needed to “lock them down.”

Each person (particle) is represented by dot with a specific colour that expresses its state. The circle around the dot indicates that the person is isolated (in the quarantine or at home) and cannot move or affect other persons. In parallel with the movement of the persons on the screen, a graph is drawn placed underneath the dots. It expresses the ratio of changes in the simulated persons’ states in time. The horizontal axis of the graph (x) is time, and the vertical axis (y) reflect the persons’ state ratio. The simulation can be restarted by clicking the mouse.

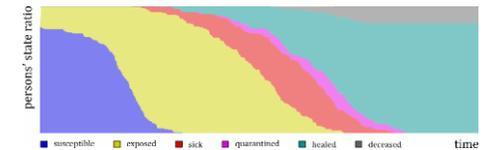
In the last phase, we worked on interactive adjusting the simulation parameters and automatic save/load of the configuration. See the figures aside that show various situations of the simulation. We can compare situations where people have no movement restrictions on situations where these measures are gradually introduced. If we look at the graph showing high restriction of movement (as we witnessed in spring '20 in Slovakia), we will see that the grey area is completely missing (this is the area of the “deceased particles”). It was for us a somewhat surprising result, given that nothing that should significantly help to get this state was explicitly included in the simulation – no additional increase in the resilience of persons based on their staying at home, or anything like that. It emanated from the simulation naturally. Although this simulation is primarily intended to serve as an example in class (the simulation parameters are not perfectly tuned to COVID 19), it shows certain behaviour – we think that this shows off the effectiveness of this regulation quite well (if people follow it).

III. CONCLUSION

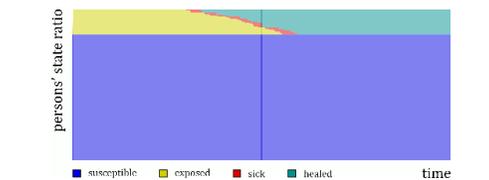
In conclusion, we can state that testing the behaviour and functionality of the didactic simulation as well as the series of tests verifying the time efficiency of the optimised algorithms described in this paper proved the success of our efforts. We included the optimised algorithms in our programming framework, and the didactic simulation will become a part of the teaching content of the MSS subject that is part of the CS teacher’s study programme at our faculty.

ACKNOWLEDGMENT

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Graph showing changes in persons’ status ratios over time when setting up no time of staying at home.



Graph showing changes in persons’ status ratios over time when setting up a long time of staying at home.

Agile Project Management – What is It?

H. Hrablik Chovanova, R. Husovic, D. Babcanova, H. Makysova

Abstract — We present a qualitative study in the form of a literature review concentrated on agile project management methods for the management of product development. The demand for managing projects with agile methods is increasing, especially in the sector of information technology. The accurate method and approach to project management are crucial; however, proper project management can lower the stress level and increase the constant efficiency to keep it distributed during the project continuation. Therefore, this article is focused on a comprehensive evaluation of agile methods, adjusted on its elementary description via a literature review. In the state of the literature review, we describe the main identification signs of each method, followed by its application.

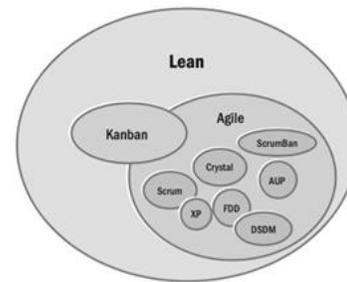
I. INTRODUCTION

Interconnection of educational process and practice is one of the key competitive abilities of organizations in current difficult situation in which the online space is where activities are carried out predominantly. Implementation of decision is (must be) very fast and accurate. Agility is the ability of organizations to adapt to constant changes, to adapt, to change rapidly, and to succeed in a rapidly changing, uncertain, and turbulent environment. The first signs of agile methodologies appeared in the late of 80's, when it was observed by certain researchers that projects when using small and multidisciplinary teams, combining with Toyota's production, by others called Lean [3], allowed to reduce the number of developed systems that were ultimately not used and also increased the perception of the quality of customers. But it was in 2001 that Agile Methodologies officially emerged [5]. We have to tell that the term agile was not used for the project management, but the Kanban method was designed and then the agile project management was born [1].

II. AGILE METHODS

Agile management is a set of methods and methodologies that help our team to think more effectively, work more efficiently, and make better decisions [6]. According to the Project Management Institute and Agile Alliance, agile approaches and agile methods are umbrella terms that cover a variety of frameworks and methods. As we can see in figure 3 below, places agile in context visualizes it as a blanket term, referring to any kind of approach, technique, framework, method, or practice that fulfils the values and principles of the Agile Manifesto.

Figure 3 also shows agile and the Kanban Method as subsets of lean. It is because they are named instances of lean thinking that share lean concepts such as: "focus on value," "small batch sizes", and "elimination of waste" [7].



The probability of a project being successful is bigger in agile methodologies than in traditional ones [31] said that agile projects are 28 % more successful than traditional ones. In one other article [34], it was made a study, that collected information from approximately 10 000 software development projects. This study reported that around 39 % of agile projects are successful, while only 11 % of traditional projects are successful too. It also compared the successful rate for different project sizes, as it is possible to see in Figure 7. In all sizes, agile wins traditional.

SIZE	METHOD	SUCCESSFUL	CHALLENGED	FAILED
All Size Projects	Agile	39%	52%	9%
	Waterfall	11%	60%	29%
Large Size Projects	Agile	18%	59%	23%
	Waterfall	3%	55%	42%
Medium Size Projects	Agile	27%	62%	11%
	Waterfall	7%	68%	25%
Small Size Projects	Agile	58%	38%	4%
	Waterfall	44%	45%	11%

Figure 7 CHAOS Resolution by Agile versus Waterfall [34]

VI. CONCLUSION

There are a lot of advantages of implementing an agile methodology. According to [38], the top 3 advantages are:

1. Flexible Management Philosophy: Agile provides a broad spectrum of techniques applicable during the management of a project, providing a flexible philosophy that adapts to the constant changes undergone by projects of any type. Flexibility allows the companies to improve available resources and maximize results.
 2. Fully Adaptable Planning: Under an agile approach, a project is executed based on interactions and planning is fully adaptable to new requirements that arise as it progresses.
 3. Use of the Most Modern Technological Tools: The present advance of the technological tools used in the development and management of projects is an added value. In working groups, it is usual to use project management platforms, where, for example, prototypes are shared, opinions are exchanged, tasks are prioritized and meeting are scheduled, such as Trello, Asana, Ice scrum, and others.
- In a quantitative aspect, some studies suggest that agile methodologies reduce 77 % of costs, 62 % of effort and also 80 % of critical failures. In addition, it improves 91 % of the meeting schedule, 97 % of productivity and increases 400 % the satisfaction [39]. According to Project Management (PMI), companies that apply agile approaches in the management of their projects increase total benefits by up to 30 % and increase profit by 37 % faster than those who don't [38]. An agile approach is about speed, overcoming barriers and using common sense. Continuous development towards simple but sustainable result with a positive impact is the key. Agility penetrates into various parts of organizations and it is necessary to include it in the educational process at universities to prepare graduates for the new challenges that await them when entering practice.

ACKNOWLEDGMENT

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School Information System

M. Hrínová Durneková, M. Kvet



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Abstract — Education is an important area of development and electronics. There are several systems that are used to manage school processes. However, each system covers only a certain part of school processes. Within my diploma thesis, I worked on development of complex information system, that covers all processes in the school facility. These processes include leisure activity management, canteen and management of educational system, which consists of electronic grade book, class register, attendance, excuses, timetable, substitution, evidence of employees, subjects and subject plans.

I. INTRODUCTION

We live in a period of rapid technology development that seek to make people's daily lives easier at a work or in a private. Documents, forms, tickets, statements, are being replaced by their digital form. No sector has avoided digitalization. Information system is an important tool which helps within digitalization. Thanks to it, it is possible to search, process and store various kind of data. It enables simple work and clear data management. However, we can consider memory consumption or speed of data retrieval as a shortcoming.

Education is an important area of development and innovation. It is the area, which should be an example in the progress and use of systems. There are several information systems that are used to manage class register, grade book, students' and employees' evidence and make processes more effective and easier. Nevertheless, paper forms of class register, grade book, attendance or excuses are integral part of each school. Why? It might be due to the licensing costs, insufficient technical support, insufficient technical equipment of the school, lack of clarity and complexity of using system or the number of existing systems with different functions might cause confusion in the choice of the right system. The main aim of this information system is to eliminate shortcomings, ensure a uniform environment, functions necessary for each school and their simple management.

II. IMPLEMENTED SOLUTION

The School information system is system which offers users simple environment supplemented with functions according to their rights. It was necessary to divide system into smaller modules that will cover individual processes to ensure the complexity of the system. Developing school information system is divided into three basic modules. Each of these modules covers a different part of the school processes and contains different types of users. Determining users' groups in individual modules is important to ensure, that they perform the functions they are responsible for.

A. School facility module

Within *The School facility module*, the system provides various functions for users. The **electronic grade book** is implemented to store grades and students notes. It is a picture of paper grade book. One of the improvement of the system is the efficient searching of the students by QR code. Within the **electronic register book**, the teacher can manage activities of the class, he is teaching. The **attendance** of students and **management of excuses** are part of register book too. The **timetable evidence** and **substitution** are another functions which are accessible to users. All these functions are designed for students, parents and teachers. The **management of the evidence of employees and subjects** is provided by the school administrator.

B. Leisure activity management module

The school is an institution that educates children in individual school areas. The school should also lead them to improve skills and develop skills through leisure activities. Therefore, the school information system contains *The Leisure activity management module*, which is focused on management of leisure activities. The administrator is responsible for leisure activities management. The leisure activity leader has a list of leisure activities that he teaches. He can create plans for them. Furthermore, he can report the current activity in the section of the register book for leisure activities, in which the attendance of registered students is also recorded. The timetable of leisure activities is also part of the system. Students and parents can register or unregister from the leisure activity and have an actual information.

C. Canteen module

To ensure a more effective and easier operation of the canteen, the school information system has been extended with *The Canteen module*. The canteen manager provides the entire canteen management. The system allows her to add and modify meals in the menu, she has an overview of the number of registered boarders to lunch on a given day. The boarders can register or deregister from lunch within the canteen module

VI. CONCLUSION

The aim of this school information system was to create a clear and user-friendly environment that will make work more efficient, simpler and faster for all actors in the school facility. The advantage of this school information system is that there are integrate all functionalities that we encounter in the school facility. In addition, it covers the area of leisure activities and canteen management.

Like any system, the School information system could be further developed. In the future, it could be extended to include automatic notifications for parents, teachers and students within electronic grade book, register book, attendance and excuses. A calendar of events, in which could be an overview of tests, notices and other activities of class, could be another possibility to extend the school facility module. Another possible extension could be to add to the class teacher the ability to print school reports and register book. The canteen module could be extended to include payment system.

Grades preview - 100101 Anna Rumlová

Subject number	Subject name	1. half a year	Grade
BVWFQH	Biology	1 2 3	2
FCSDGF	English conversation	1	1
Q3APAU	English language	-	-
W1YCH	Mathematics	-	-
WPPWGT	History	-	-

Fully Immersive Web-based Collaborative Virtual Environment for Upper Limb Rehabilitation Purposes

M. Hudák, B. Sobota, Š Korečko, M. Sivý



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040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — Web-based collaborative virtual reality is emerging as platform-independent technology that permits developers to produce fully immersive and interactive virtual environments accessible through web-browsers. The use of collaborative virtual environments can be helpful in situations when therapists and patients are unable to meet personally. This work introduces an extension of the LIRKIS G-CVE system with web-based interfaces for remote management of the upper limb rehabilitation process. Concerning the quality and safety of web technologies, we consider distant virtual training to be efficient for ordinary people.

I. INTRODUCTION

In the field of medical applications, the VR / MR offers a variety of interaction techniques rendering effective for treatment and rehabilitation of human movement disorders. Upper limb rehabilitation process, practiced using HMD with other equipment based on the rehabilitation needs can serve as a commendable example. In a virtual environment, it is possible to simulate different conditions of a virtual hand, visualize different situations for the user and assign them tasks to perform utilizing virtual hands. Due to the pandemic situation, it is difficult to perform personal rehabilitation and training of patients. Novel science-based treatments are considering remote therapy options, where a physician can communicate with a patient and oversee the training process. As a result of the VR technologies coming to easier accessibility to ordinary population; remote therapy can be beneficial especially when the doctor and the patient are unable to meet personally. Bringing the clinical therapy into patients' homes through VR / MR might show convenient, when the social contact is limited to the online form.

II. Web-based Collaborative Virtual Environment

The web-based CVEs possess several strengths that improve its usability and demands for Virtual Reality (VR). The utilization of CVE can depict training situations that may be physically more demanding and difficult to realize than a virtual simulation. In 2019, the LIRKIS G-CVE (Global Collaborative Virtual Environments) was designed as a web-based globally accessible VR/MR system over the internet. The system includes Entity-Component-System pattern that allows the rapid development of virtual environments with various extensions and features. All CVEs in LIRKIS G-CVE are accessible via web browsers. The rendering of the entire 3D content is performed on the client side (Client-Side Rendering). The communication between the system and users is employing the client-server model to share data over the network. The whole LIRKIS G-CVE system contains: Remote Web Server, Web-client interface and Additional interfaces and modules.

LIRKIS G-CVE was extended by implementation of a 3D Arm Remote controller as an additional interface, visible in Figure 1. The 3D Arm Remote Controller provides a management tool for a therapist with full access to experimental settings. The interface offers several features responsible for: device management, streaming patient visual output, animation management and some 3D arm parameters.

After completing the rehabilitation parameters, the patient is notified that the training will begin. For training purposes, it is essential that the patient sits at the table and perceives the 3D hand model (e.g. using VR helmet, Figure 2). After starting the training, several hand animations are performed. If the patient feels uncomfortable, the rehabilitation process is stopped and then continues later. Given that each patient can perceive the 3D hand differently, we decided to extend the interface with user profiles. These profiles store data on training, hand configuration in space, and its color.

VI. CONCLUSION

In this study, we focused on creating interactive interfaces for collaborative virtual reality. We've found that using web-based virtual reality is suitable for rapid prototyping of virtual environments and interactions that can be shared by a group of users in real-time. Unfortunately, due to limitations due to the pandemic situation, a large-scale experiment to test MS HoloLens could not be performed. However, in future research, we assume that multiple user testing will provide measurable data to help us optimize the system. We consider user feedback to be necessary.

ACKNOWLEDGMENT

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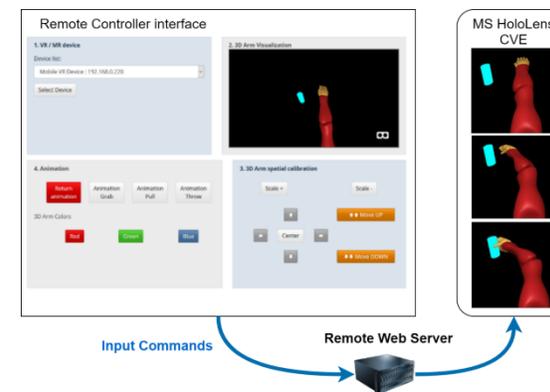


Figure 1. 3D Arm Remote controller screen.

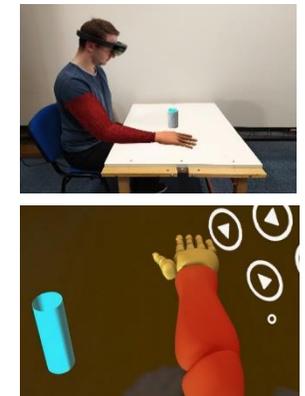


Figure 2. Testing of Upper limb rehabilitation process with utilizing MS HoloLens device

Internet of Things as tool for cognitive process in Computer Science study program

L. Huraj and M. Hostovecký



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Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839

fax: + 421-55-726 5195

e-mail: iceta@elfa.sk

www.iceta.sk

Abstract — IoT devices are becoming a common thing in everyday life. Students also encounter them at home or at school. The inclusion of IoT devices in teaching can make the learning process more interesting and interactive, having a greater impact on the cognitive process. Learning with IoT devices better demonstrates the application domain to students and brings the problem closer to their daily lives. The article demonstrates how one IoT device can be used for teaching in different areas of the Computer Science field. The Fibaro Starter Kit with sensors was used for the case study and its applicability to three different CS subjects was shown.

I. INTRODUCTION

IoT devices are increasingly appearing not only in smart homes, but are also finding their place in the educational process. Their low affordability, as well as rapid development in key areas of processor design and web and network technologies, make these small devices tools for computing and communication in areas that were once only available on large platforms. IoT devices can be found in households such as smart thermostats, smart bulbs, smoke/fire alarms, motion sensors/cameras, door/window sensor, even weather stations or smart speakers. The basic features of IoT devices include ability to collect and transmit information, work together and solve problems in everyday life. In general, IoT devices consist of a computer platform, communication and sensing capabilities, and an activation device [1].

IoT brings change not only in technology and industry, but it can affect change throughout society, including higher education institutions. However, there is a lack of a deeper focus on some open issues such as the implementation of the Internet of Things in modern educational practices; overall use of the Internet of Things in education; and the development of methods important for the effective teaching of the Internet of Things as a separate subject [5]. Curricula from the field of Computer Science (CS) have not yet included the teaching of the Internet of Things as a separate subject.

II. CASE STUDY

The article presents some efforts to incorporate IoT into the CS curriculum, as well as a case study focused on a specific IoT device Fibaro Starter Kit and its use in some subjects in the field of Computer Science. The aim was to point out that it is possible to use the same IoT device in different subjects. These subjects are: (A) Programming and Algorithms (Figure 3); (B) Information assurance and security, Figure 4; and (C) Multimedia, Figure 5. Naturally, it is possible to use IoT equipment directly in a course focused on teaching IoT but the aim of the article is to show other uses of IoT equipment in computer science subjects.

(A) Programming and Algorithms: While working with the IoT device, students became acquainted with simple algorithmic structures. They understood the principles of controlling IoT devices using scenarios. On the positive side, the result of their program is realistically visible when running the IoT device scenario.

(B) Information assurance and security: The students became acquainted with the principles of DDoS attack. They understood the vulnerability of IoT devices and how easily they could be disabled by an attack, and how easily they could be misused to carry out an attack. On the positive side, the students became acquainted with the effects of the DDoS attack directly on the tested device.

(C) Multimedia: The students got acquainted with the process of comprehensive creation of the resulting video. They were forced to use the IoT device directly in real conditions and record their functional deployment.

It should be emphasized that the main role of the teacher in the development process is to organize the individual cognitive work of students. He or she manages the cognitive process and analyzes the individual work of students, strives to develop the skills of individual cognitive activity of the personality.

The whole process requires the teacher to have high professionalism and skill [7].

III. CONCLUSION

The IoT device can be used as an aid and support for teaching various subjects in the Computer Science field, as evidenced by the activities performed in the case study. These activities can be used not only at the university, they can also be used with modifications at lower levels of schools.

IoT makes it much easier for students to demonstrate the application domain and bring the problem closer to their daily lives. This makes the learning process more interesting and interactive and with a greater impact on the cognitive process. IoT also acts as a stimulator of interesting learning, which is rich in experiments and solving interesting scientific and practical problems. Using IoT will encourage students to work independently in their own mode. In addition, it gives students space for their own creativity. The implementation of IoT in education will play an increasingly important position in the future, as simpler devices incorporating this technology will increasingly enter the market. This will force more educational institutions to incorporate this technology into their educational programs and to adapt educational activities for students. Because IoT connects the virtual and physical worlds, new teaching methodologies will need to take into account not only the hardware, network, but also the software aspects of this technology.

ACKNOWLEDGMENT

The work was in part funded by the grant KEGA 011UCM-4/2018 *The impact of serious games on the cognitive process*, and the grant APVV-17-0116 *Algorithm of collective intelligence: Interdisciplinary study of swarming behavior in bats*.



Figure 3. A rain block scene alerting the user to an open door in the event of rain.

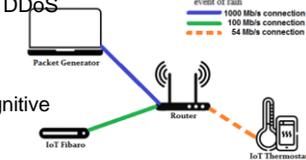


Figure 4. The topology and components in testing DDoS attack using IoT device.



Figure 5. Video preview of the flood sensor from the Fibaro Starter Kit.

Research and design of virtual simulation experiment learning interaction for embodied cognition

Chen Wang and Fuan Wen

Abstract — At present, virtual simulation experiment is commonly used in teaching practice, greatly enriching students' learning experience. However, students still face the problems of less interactive experience, poor participation and a low degree of freedom in the process of interaction through virtual simulation experiment. Based on the theory of embodied cognition, this paper constructs a virtual simulation experiment interaction model based on the theory of embodied cognition. The purpose of this model is to emphasize the embodiment of cognition and the embeddedness of cognitive environment, enhance the immersion of students, effectively stimulate students' interest in learning, and realize the dynamic interaction among students, learning resources and teachers in virtual environment. The construction and development of the real experimental resources can be used for reference.

I. INTRODUCTION

As a powerful way to promote the combination of theoretical knowledge and practical application, experimental teaching has become an essential link in the teaching arrangement of various science and engineering courses. However, due to the lack of education experience and guidance of relevant research, experimental teaching in virtual environment can not support students to interact effectively with learning content effectively, and can not meet students' personalized learning. This interaction model gives full play to the important role of the body in learning activities from the aspects of imaginary embodiment and physical embodiment, integrates students' interactive behaviors and cognitive goals in each link of "embodied practice -- situational experience -- Guidance and improvement -- knowledge construction", students can preset learning goals and participate in immersive learning situations through virtual reality terminal devices with multiple senses, so as to realize physical embodied interaction under virtual scenes. The result of behavior is internalized in perception. After the reorganization of perception, new learning behaviors are stimulated, and the cognitive level and skills are improved continuously. Embodied experience is the key of embodied cognition theory.

II. INTERACTIVE MODEL CONSTRUCTION OF VIRTUAL SIMULATION EXPERIMENT FROM EMBODIED COGNITION PERSPECTIVE

The autonomous interaction of virtual simulation experiment must be a dynamic situational learning process with uncertainty. To design the learning interaction based on embodied cognition, we should fully mobilize physical activities to participate in the whole learning process, and construct knowledge through the interactive process of cognition, body and environment. Virtual simulation experiment is a network learning resource developed on the basis of teachers' curriculum plan and teaching experience. The content of each experiment link is relatively fixed. The role of teachers is changed from "teaching knowledge" to "guiding inquiry", which solves the limitation of time, space and equipment. In this paper, a series of model design principles are proposed for the factors affecting virtual experiment interaction, and a virtual simulation experiment interaction model is proposed on the basis of interaction model hierarchy tower based on the dynamic mechanism of embodied cognition theory. The system needs the support of behavioral intervention, data tracking analysis and other technical means to provide timely guidance, feedback and assessment. In this way, students are encouraged to realize the dynamic two way interaction between teachers and students, between students and students, and between students and learning resources through visualization, so as to complete the learning of theoretical knowledge, the accumulation of practical experience, as well as the construction and internalization of deep knowledge.

Considering the relevant factors affecting the interaction of virtual experiments, the following principles are followed in the design of the model:

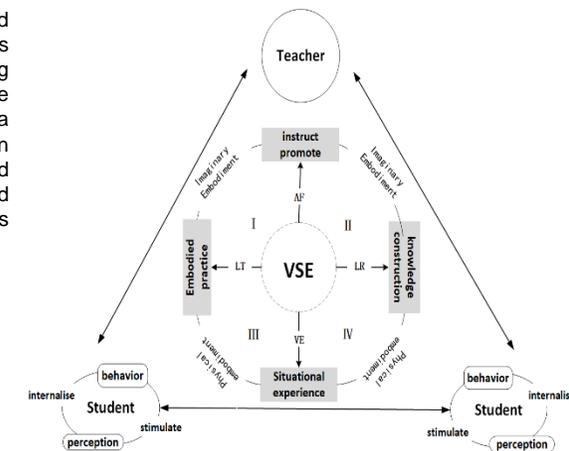
- 1) The principle of students' subjectivity.
- 2) Promote the principle of multi sensory participation and interaction.
- 3) The principle of contextualization of interactive processes.
- 4) Interactive content matching principle.
- 5) The principle of trustworthiness of interaction results.

III. CONCLUSION

Under the guidance of distance learning teaching interaction hierarchy tower and embodied cognition theory, which emphasizes the close connection between body, environment and cognition, this paper combines with the characteristics of virtual reality technology environment to analyze the factors affecting students' effective interaction, and constructs a virtual simulation experiment interaction model oriented to embodied cognition theory. It is expected to provide a comprehensive and effective interactive theoretical framework for the construction of virtual simulation experiment resources and provide guidance for the subsequent virtual simulation experiment teaching practice. However, there are still some shortcomings in the model, and needs to undergo more tests and practices to optimize and perfect. In the future, I will continue to conduct in-depth research on the aspects to be improved, pay close attention to the frontier of the field, and jointly promote the construction of virtual simulation experiment resources and teaching reform.

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A Survey of Low Power Wide Area Network Technologies

M. Chochul, P. Ševčík

Abstract — The concept of Internet of Things (IoT) is ever-growing and is becoming integral part of our life and industries. As each application differs in connectivity requirements it is essential to keep track about possible solution. Low Power Wide Area Network (LPWAN) is a category of network technologies, that possess the ability to offer low-cost connection for large number of low power devices distributed over large area. This paper presents leading LPWAN technologies called Sigfox, LoRaWAN and NB-IoT.

I. INTRODUCTION

Even though the term Internet of Things (IoT) is not current, its concept is attracting enormous interest from scientific and industrial communities. IoT technologies are used in various application fields from smart cities to agriculture. As some IoT applications required long range communication and low power consumption, technologies like Bluetooth or ZigBee were lacking transmission range and cellular technologies were lacking long term power efficiency, Low Power Wide Area Network (LPWAN) emerged. It provides long range transmission, plus low power consumption in price of low data rate. During practical exercises, laboratory work or project, students are usually introduced to technologies like Bluetooth or Wi-Fi, which are commonly available. In order to introduce students to LPWAN technologies, suitable infrastructure needs to be available. As LPWAN is a category that consists of multiple technologies, aim of this survey is to introduce to the most popular ones, Sigfox, LoRaWAN and NB-IoT.

II. Sigfox

Sigfox company was founded by L. Le Moan and C. Fournet in 2010. Network, named after the company itself, is dedicated to the IoT based on low power consumption, long range and small data [6]. The Sigfox technology is based on patented Ultra Narrow Band (UNB) wireless modulation on the physical layer. The network operates on unlicensed sub-GHz ISM band carrier using 868 MHz in Europe, 915 MHz in North America and 433 MHz in Asia. In regards of data transmission, Sigfox is capable of providing depending on region 100 bps / 600bps in Europe / America. Sigfox limits communication on 4 messages per day for downlink and 140 messages for uplink. Payload length is 12 bytes per message. Coverage range is 10 km in urban areas and 40 km in rural areas. In short, Sigfox provides proprietary network solution and is capable of delivering long transmit range, long battery lifetime and infrequent communication data rate.

III. LoRaWAN

LoRaWAN is a low-power long-range wide area network, which specification is developed and maintained by the LoRa Alliance, an open association of collaborating members. The aim of LoRaWAN is to standardize LPWAN network, suitable for large scale deployment, mainly concerned with the long-range transmission and low power consumption [14]. LoRaWAN technology is based on LoRa (Long Range) modulation technique that enables the long range transfer of information with low data rate. As Sigfox it operates on unlicensed ISM bands. Usage of this technology does not limit number of messages per day, the limitations are dependent on administration of network. Maximum data rate is 50 kbps, with available payload length of 243 bytes per message. Coverage range is 5 km in urban areas and 20 km in rural areas. Only for this technology it is possible to create private network. For LoRaWAN certain factors are dependent of administration of the network, nevertheless, it still provides long range transmission at lower data rate, while ensuring low power consumption.

IV. NB-IoT

Narrow Band-IoT is a standards-based low power wide area technology developed by the Third Generation Partnership (3GPP) to provide communication between end-devices and services using cellular communication. The aim of NB-IoT is to improve the power consumption of user devices, system capacity and spectrum efficiency. Unlike Sigfox and LoRaWAN it operates in licensed frequency bands, same as LTE. As design of NB-IoT is based on existing LTE functionalities, it is possible to reuse the same hardware and also share spectrum without coexistence issues [22]. Transmission data rate is highest of the three, 200 kbps. Number of messages is not limited, for each message payload length is limited to 1600 bytes. Although in order to achieve 10 years of battery operation, it is advised to transmit 200 bytes per day on average [15]. Transmission range is 1 km in urban areas and 10 in rural. NB-IoT is not a low cost solution, but is very suitable for those IoT application that are willing to pay for low latency and high quality of service.

V. CONCLUSION

The aim of this survey was to introduction of LPWAN technologies, Sigfox, LoRaWAN and NB-IoT. Each discussed technologies has its advantages regarding IoT factors and of course it disadvantages. However, in case of practical education, in form of either laboratory assignments or projects, one deciding factor is more important and that is cost. In this regard, most suitable choice is LoRaWAN network, as it is the only one, that support private network management. This way educational institute can hold its own servers and providing this service to its students free of charge. As the servers' software is open-source and therefore free, and it is possible to run it on any spare computer with internet connectivity, gateway equipment cost is the only necessary price to pay. Thus creating infrastructure for new IoT applications students can learn and benefit from.



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Analysis of Logs in the Environment of Email Services M. Chovanec, M. Havrilla, E. Chovancová



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elfa, s.r.o.
Park Komenského 7,
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Slovakia

tel.: + 421-55-625 3839
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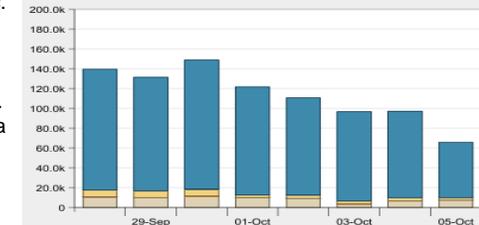
Abstract — The work deals with the analysis of logs and audit records from email services. The growing trend of using email services as well as other electronic communication creates the need and emphasis on ensuring the reliability of these services. In the presented proposal, the work uses modern methods of log analysis and then interprets them into a visual form, uses knowledge from non-relational databases, methods of analysis and processing of audit records and uses a number of tools that participate in creating outputs. Among non-relational databases such as Elasticsearch, Apache Kafka, Redis, Splunk and MongoDB, the work selects the most suitable database for its purposes. It also discusses methods of data collection as well as their subsequent analysis and visualization. The work also uses the tools of third parties or protocols covering the collection and creation of outputs from audit logs, such as NXlog or Syslog-NG. Finally, the work focuses on the evaluation of possible safety as well as functional risks.

INTRODUCTION

At present, more and more emphasis is being placed on quality of the provided email services. Even in the university environment there is an increasing demand for the number of sent or received email messages. Therefore, there is a need to monitor the flow of email messages in order to streamline their transmission, detect deficiencies and apply new technologies in the field of email services. The main areas of monitoring email services include processing logs from Message tracking protocols, IMAP and SMTP protocols, or IIS services. Current trends do not only require simple processing of received data, but also emphasize accurate interpretation and detailed graphic processing. It should be noted that the obtained data must be processed with high accuracy in real time and then interpreted in a suitable form. For data collection from the university's email services environment it is possible to use the internal functionality of the Microsoft Exchange server for storing logs of internal processes as well as the logging functionality from Internet Information Services (IIS) which is covered by the operating system itself, Microsoft Windows Server. The processing of logs and their subsequent analysis from email services will currently find application in the detection of security risks of the offered service. Another parameter is the usability of other side services that the email server offers, such as calendar, automatic processing of emails, etc.

IV. DATA PROCESSING AND ANALYSIS

The non-relational database Elasticsearch in the stack with Logstash was used for the processing and analysis of the obtained data. As one of the conditions was the processing of data with high accuracy in real time, this platform provided us with a good basis for the implementation of the experiment. Kibana provided us with a suitable environment for human-friendly interpretation of data and also for their practical visualization. The block diagram of data processing and analysis.



VI. CONCLUSION

The aim of the work was to create a theoretical basis but also a practical solution for the analysis of email server logs. The main benefit of this work was the evaluation of security and functional risks from the perspective of the email server but also the user of email services. Among the facts that were found from the analysis can be included, e.g., the fact that most of the email messages sent to the researched server were sent from the Košice area from the point of view of geoip location. The benefit is the fact that from the point of view of the client's response to the email server, high time values are not expected and therefore it is not necessary to solve the problem with high responses.

The next part of the analysis was focused directly on email servers, on their use during working and non-working days where it was found that during non-working days, the use of email services is very low and therefore is a good time to implement complex updates during service windows. The work also focused on finding the balance of computing power distribution in email servers where it was found that the performance is relatively evenly distributed and therefore it is not necessary to adjust the load balancer settings. Among the security analysis of logs, the work focused on the analysis of port usage for the IIS service where it was found that the unencrypted, i.e., http protocol is used only by a negligible number of users and therefore we can say that the audit in terms of security of encrypted communication was successful.

The work also focused on the most common operating systems and web browsers used by users of email services. It has been found that most users use Microsoft Windows as their operating system and also that they use the Mozilla Firefox or Google Chrome web browser. In conclusion the work focused on the evaluation of security incidents of incoming emails, it was found that more than 90% of emails are stopped by a reputation filter and also that a large number of emails are marked as SPAM. Only 7.5% of emails passed through the Cisco Ironport Filter. The research results can be implemented in the Security and Data Protection category.

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An Overview of Automatic Speaker Recognition in Adverse Acoustic Environment

M. Jakubec, E. Lieskovska, R. Jarina



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elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — In the last 50 years, the task of automatic speaker recognition has undergone intense development and is still a popular topic. New ways are also being sought to implement speaker recognition tools in order to improve the educational process. These include support systems and services, such as recommendation and personalization-based content delivery, personalized speech assistant for human-computer interaction, or improved speech recognition systems based on speaker adaptation. Applications in the real environment stress upon technological issues such as dealing with acoustical environment variability, background noise, simultaneous speech or speaker's behaviour. In this paper, the review of the state-of-the-art techniques for automatic speaker recognition with focus on its deployment in real and adverse acoustic conditions is presented.

I. INTRODUCTION

The Automatic speaker recognition (ASR) systems have become an important part of technological progress trends. In today's world, the interaction of people with technology is constantly increasing and most devices are becoming "smart" for working effectively with people. State-of-the-art procedures in ASR make it possible to achieve excellent accuracy in acoustically controlled conditions. However, in a real environment, speaker recognition becomes a challenging task. Speech signal degradation caused by interfering factors (interfering speech, background sounds, transmission channel distortion, reverberations) significantly reduces the performance of ASR systems. A key issue in deploying real-world recognition systems is robustness against noise interference. Thus, reducing the impact of adverse acoustic conditions is the task of robust speaker recognition. The aim is to compensate for the effects of additional noise while preserving speaker information.

Speaker recognition is widely used in various areas, such as identity verification (e.g. telephone and banking services), surveillance and forensic (e.g. telephone fraud). Another use is in the educational sector for computer based learning. These include support systems and services, such recommendation and personalization-based content delivery, student's identity verification, personalized speech assistant for human-computer interaction (interactive tests, questionnaires, pronunciation learning) or improved speech recognition systems based on speaker adaptation.

II. ROBUST SPEAKER RECOGNITION TECHNIQUES

Speaker Recognition is defined as the process of recognizing a human depending on the unique characteristics that are included in his/her speech signal, but also emphasize the differences between individuals. ASR systems can also be divided into identification and verification tasks. The basic block diagram of the general ASR systems is shown in Fig. 1. In general, a speaker identification and verification system consists of three main components, including front-end processing (feature extraction), speaker modeling and decision-making.

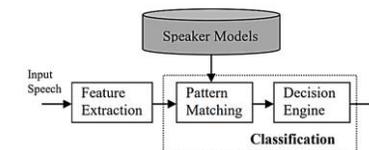


Fig. 1: A General Speaker Recognition System.

The state-of-the-art techniques used to increase speaker recognition performance focus on features extraction and statistical modeling of speaker recognition. In the proposed paper, the advantages and disadvantages of these techniques are described. These techniques can be divided into 3 basic categories:

1. methods for speech enhancement,
2. noise-resistant features extraction methods,
3. methods based on robust modeling.

The speaker recognition system must be robust to interference in order to function properly in real acoustic conditions. Therefore, the speaker recognition mechanism should take into account many factors (Fig. 2). The system should be accurate, easily extractable and measurable, the variability between speakers should be low, the system must not be affected by emotional states. When designing the system, it is therefore important to take into account the individual techniques of increasing performance, which were presented in the work and look for ways to use their good properties in one complex system.

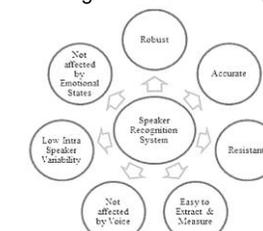


Fig. 2: Factors influencing speaker recognition in real conditions.

VI. CONCLUSION

The goal of presented research was to describe the development of speaker recognition techniques with a focus on their use in real and adverse acoustic conditions. The paper describes several important ways of implementing speaker recognition tools in order to improve the educational process. We also focused on the analysis of current trends in deep neural networks and their use in the field of speaker recognition research. Another part summarize the basic principles of techniques used to increase the performance of systems for speaker recognition in adverse acoustic environment. There are many issues in this area that still need to be addressed, as there is currently no general and the best way to recognize speakers.

ACKNOWLEDGMENT

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Parametric audio quality estimation models for broadcasting systems and web-casting applications based on the Genetic Programming

M. Jakubík, P. Počta



ICETA 2020
Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract —The COVID-19 pandemic has been one of the biggest disruptions to education that the world has ever experienced, affecting the most of the world student population. As a consequence, throughout the globe there has been an increasing trend among the students to use different broadcasting systems and web-casting applications for the purpose of online learning. Therefore, a machine learning technique, i.e. Genetic Programming, is used in this work for the purpose of assessing audio quality using an objective approach. A design and performance evaluation of the parametric models estimating the audio quality perceived by the end user of broadcasting systems and web-casting applications are presented in this paper.

I. INTRODUCTION

We propose machine learning based parametric audio quality estimation models for broadcasting systems and web-casting applications in this paper. Based on our analysis of audio broadcasting systems and web-casting applications, we compiled a list of the most commonly used codecs and their bit rates nowadays. Because subjective testing is time-consuming and expensive, we have used objective perceptual audio quality models to predict MOS values in an automated and timely manner. The proposed models formulate audio quality estimation as a regression problem and use Genetic Programming (GP) approach to find a mapping between audio features and quality score. The models are supposed to help the broadcasters and web-casters to either choose the appropriate settings of their systems and services or monitor a quality perceived by the end users.

II. METHODOLOGY

The machine learning approach, which we chose was the Genetic Programming (GP). Genetic programming (GP) is part of the family of evolutionary computational approaches used to solve problems of optimization that are difficult to solve by conventional methods. We focused on input parameters that could potentially reduce audio quality for broadcasting systems and web-casting applications. To sum up, the following sets of the input parameters were considered in a design process of the parametric audio quality estimation model:

- broadcasting systems: type of audio signal, audio codec type and bit rate.
- web-casting applications: type of audio signal, audio codec type, bit rate, stalling and initial delay.

III. DATABASE

The intention was to have the widest possible database of unique recordings that reflect the diversity of the audio distributed over broadcasting systems and web-casting applications to the audience. In order to create a database we used 3 hours long studio recording of uncompressed audio from the Slovak Radio and part of the reputable database EBU SQUAM which contains lossless recordings for subjective audio quality tests. A version described in the EBU Tech 3253 [19] was used. So, the resulting database in terms of diversity contains 27 types of signals which is 17 280 samples, where the length of each sample is approximately 10-15 seconds. To assess a quality experienced by the end user when it comes to the degradations induced by the audio codecs, we have decided to use POLQA Music model as this model according to [1] has achieved a sufficient accuracy in this context.

VI. CONCLUSION

In this paper, we presented the design and performance evaluation of the parametric models for non-intrusive estimation of the audio quality based on machine learning technique, namely GP. The proposed parametric models (see Fig. 1 for more detail) estimate the audio quality of broadcasting systems and web-casting applications perceived by the end user. By comparing the estimations provided by the proposed parametric models with the true MOS values (see Fig. 2 for more detail), we can say that the proposed parametric models represent promising candidates for the estimation of audio quality perceived by the end-user of broadcasting systems and web-casting applications. Keeping the COVID-19 scenario in mind, nowadays, parents, students and teachers are adapting to the 'new normal' with education from a distance. We presume that it is a crucial aspect for the new normal to understand the audio quality provided by these different broadcasting systems and web-casting applications in the context of e-learning process. Assessing the audio quality of the e-learning sessions will be a key to understand the end user satisfaction levels in such an environment.

ACKNOWLEDGMENT

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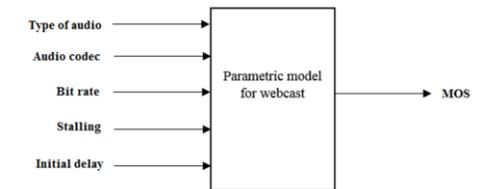


Figure 1. Diagram of the designed parametric model for webcasting systems

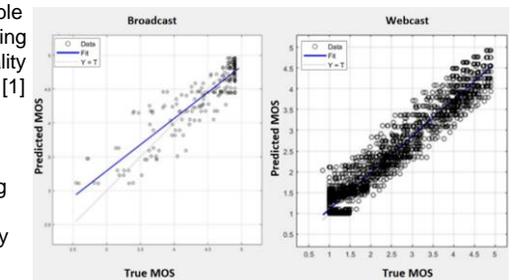


Figure 2. Scatter plots of the true MOS values versus predicted MOS values obtained by the GP approach

Abstract — This work briefly introduces the Collaborative Doctoral Program (CDP), which fosters collaborations between the Joint Research Centre and Universities, in order to provide a European qualification framework to doctoral students, who are trained to be at the intersect of science and policy through multinational projects. Secondly and in the focus of the poster, this work provides an example of research conducted in the context of the CDP in the field of energy modeling. A topic of increasing interest is nodal pricing as an alternative to zonal pricing-based electricity markets in Europe. This work is giving an overview of different formulations of optimization problems in power systems. We focus on two different aspects being the type of optimization problem and the representation of the transmission network. In this context, the trade-off between modeling accuracy and computational efforts is the topic assessed in this study. We find that computational times increase drastically when employing unit-commitment, but remain rather moderate when sticking to economic dispatch using DC- as well as AC-OPF. The representation of networks in terms of aggregated node systems show that power flows within zones are difficult to predict.

I. INTRODUCTION

In the context of the European Commission's push to integrating the electricity market and exploring novel market designs, nodal pricing is gaining increasing attention as an alternative to the currently in place zonal pricing.

What gives rise to nodal prices are congestions in branches, thus there is a need for sound modeling of the electricity system that takes the physical network into account in great detail. An approximation of these flows will affect price outcomes, nodal as well as zonal prices.

This work is focusing on two aspects in this modeling endeavor being the type of optimization problem: DC-OPF, AC-OPF or unit commitment DC-OPF on the one hand; and the network representation on the other hand.

II. METHODOLOGY & CASE STUDY

We introduce the formulation of the optimization problem and the cases studies conducted. We used MIPS an interior point solver of Matpower of Matlab to perform power flow calculations. 2 case studies see Table 1.

Optimization Problem Formulations

A network consists of: nodes N , generating nodes G , consuming nodes D . $N(i)$ is a subset of N of nodes connected to node i through lines. Node i is described through: active power p_i , reactive power q_i , voltage magnitude v_i and voltage angle θ_i . Lines have physical properties: conductance g_{ij} , susceptance b_{ij} , and capacity limit F_{ij} .

The full AC the optimal power flow (AC-OPF): and the approximation DC-OPF

$$\underset{p_i, q_i, \theta_i}{\text{minimize}} \sum_{i \in G} f_i(p_i) \quad (1) \quad \underset{p_i, q_i, \theta_i}{\text{minimize}} \sum_{i \in G} f_i(p_i) \quad (8)$$

Subject to

$$p_i = \sum_{j \in N(i)} p_{ij} = \sum_{j \in N(i)} v_i v_j (g_{ij} \cos(\theta_i - \theta_j) + b_{ij} \sin(\theta_i - \theta_j)), \forall i \in N \quad (2) \quad p_i = \sum_{j \in N(i)} p_{ij} = \sum_{j \in N(i)} b_{ij} \cos(\theta_i - \theta_j), \quad \forall i \in N \quad (9)$$

$$q_i = \sum_{j \in N(i)} q_{ij} = \sum_{j \in N(i)} v_i v_j (g_{ij} \sin(\theta_i - \theta_j) + b_{ij} \cos(\theta_i - \theta_j)), \forall i \in N \quad (3) \quad F_{ij} \leq p_{ij} \leq F_{ij}, \forall i \in N, j \in N(i) \quad (10)$$

$$p_{ij}^2 + q_{ij}^2 \leq F_{ij}^2, \forall i \in N, j \in N(i) \quad (4) \quad \underline{p}_i \leq p_i \leq \bar{p}_i, \forall i \in G \quad (5)$$

$$\underline{q}_i \leq q_i \leq \bar{q}_i, \forall i \in G \quad (6)$$

$$\underline{v}_i \leq v_i \leq \bar{v}_i, \forall i \in N \quad (7)$$

where (1)&(8) are the objectives of cost minimization; (2)-((3) & (9) are power balances;

Modeling aspect	Variations	Evaluation	Case study
(i) Type of OPF	DC-OPF, AC-OPF, UC DC-OPF	Computational time (number of nodes)	41 test cases
Network			IEEE 118 node case &
(ii) representation	Full number of nodes,	Number of congestions aggregated	12 cluster

Evaluation of Modeling Differences of Nodal vs. Zonal Pricing Based Electricity Markets: Optimization Models and Network Representation

L. L. Jansen, L. Buzna

III. COMPUTATIONAL EXPERIMENTS

(i) Type of OPF

- Fig. 1: Computational times different OPF formulations
- For cases with less that 1,000 nodes: DC- and AC-OPF lie around 1 s
- For cases with more that 1,000 nodes AC-OPF increase more than DC-OPF
- UC DC-OPF has longer run times already for 10s of nodes, times increase significantly from ~1,000 node cases and go up to almost 3 h for ~10,000 node cases
- Computational times vary for cases with ~1,000s of nodes; differences in computational times depend largely on OPF.

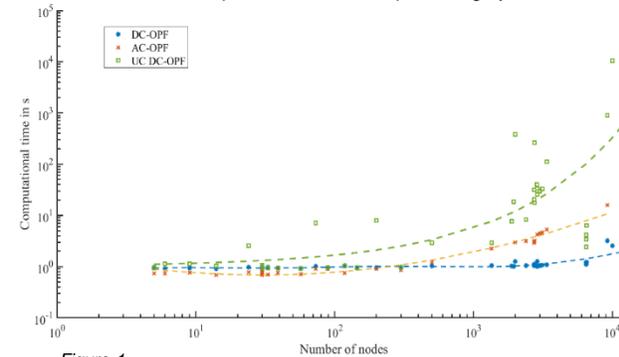


Figure 1

(ii) Network representation 118 node and 12 node case

- Fig. 2 : LMP for 118 case ordered by clusters
- Prices fluctuate between 39.5 and 40 \$/MWh
- Differences originate from 9 congested lines

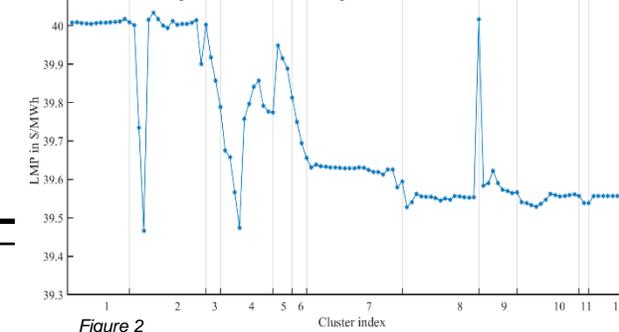


Figure 2

- Fig. 3: LMP for 12 cluster case and load-weighted average prices for 118 case with bars for min and max price in clusters
- Prices fluctuate and are not well aligned

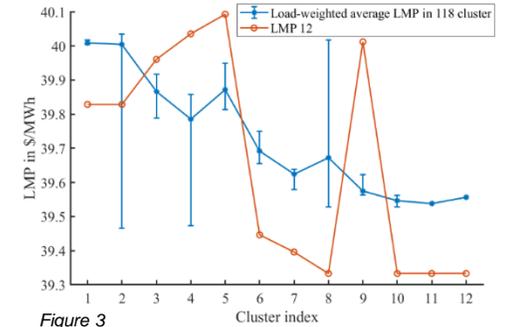


Figure 3

- Fig. 4: Several load states of 12 and 118 node cases: no of congestions (inter- and intra-cluster), max relative error in LMP
- No of congestions: inter cluster: differ in low load cases and get more inline for higher load factors; intra cluster: increase sharply for higher load factors (are undetected in 12 node case)
- Max erro until 3.4%

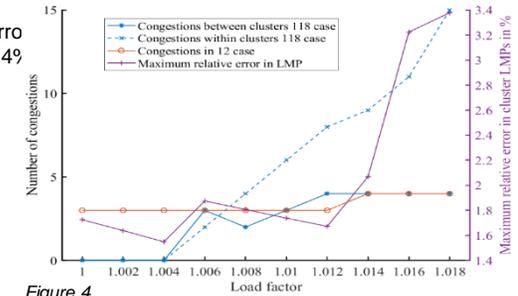


Figure 4

VI. CONCLUSION

Comparative studies in this area need to rely on different representations of the same network in order to be able to assess two pricing schemes.

Our findings indicate that there can be a large discrepancy between LMPs and identified congestions, which calls for improved methods to aggregate nodal systems for comparative purposes and to improve accuracy. Though, one needs to bear in mind the increased computational costs to solve problems with many nodes, especially when it comes to unit (de)-commitment.

Project Oriented Teaching in Internet of Things Education

D. Jarinová, A. Kanáliková, D. Tichá



ICETA 2020
Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — In the paper, a fundamental IoT framework with focus to its utilization in teaching in engineering study programmes is discussed. In the second part, outcomes of the selected successful student projects carried out at the Faculty of Electrical Engineering and Information Technology of the University of Žilina (FEIT-UNIZA), are presented. The solutions are based on simple low-cost microcontrollers and single-board minicomputers such as Arduino, Raspberry Pi and Sigfox cloud-based application platform, among others. Experience has shown that these projects markedly help students to improve skills in developing both HW and SW solutions. Even by developing simple IoT applications, students are able to transfer, in very short time, their theoretical knowledge into practical solutions for everyday life or industry.

I. INTRODUCTION

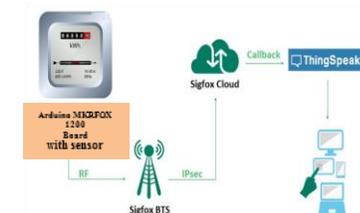
The Internet-of-Things (IoT) technology can be simply defined as a network of physical objects connected to Internet and the communication between these objects. IoT based solutions are especially attractive for young generation, because they inherent support wireless connection anytime and anywhere. There are many technologies and platforms for network connectivity within IoT (e.g. WiFi, ZigBee and Sigfox, LoRa). Thus, project-oriented teaching is becoming very effective, whether they are individual or group projects. Here we present outcomes of the selected successful student projects carried out at FEIT-UNIZA. Even simple IoT-based projects have the potential to make a significant impact on the skills of engineering students as well as young professionals.

One of the well-established practices of IoT project supervision is division of the students projects into the following three phases:

1. Development of simple IoT device/sensor - design a simple HW architecture to connect sensors and/or other peripherals to microcontroller (e.g. Arduino) and programming to enable read the data from the sensors.
2. Students are asked to implement any value-added service to the system. E.g. it can involve microcontroller programming to enable storing and displaying the readouts from the sensors.
3. Bringing networking functionality to the IoT device – The students are engaged in design and implementation of the other parts of the IoT system, so that the data from the sensors can be accessed from multiple locations and aggregated with data and/or services provided by other systems.

II. IoT SMART HOME APPLICATIONS

- *Contactless deduction of electricity consumption from electricity meters and gas detector* – These two simple applications are created on Arduino platforms together with Sigfox wireless connectivity modem, ThinkSpeak, and Sigfox Backend. The device is designed to deduct the consumed electricity from the induction electricity meter. Due to legislation restriction, data reading is possible only in a visual way using infrared sensor. The gas detector uses a photoelectric smoke sensor, with KD-5810 microcontroller.
- *Intelligent container for municipal waste* – based on Sigfox/Arduino module and the ultrasonic sensor.
- *Smart home project* - HW components are: NodeMCU microcontrollers, indoor/outdoor temperature and humidity sensors (DS18B20, Si7021), MQ2 flammable gas sensor. The software part consists of scripts: for connections to the ThinkSpeak portal (via WIFI using POST/http protocol) and to the local MySQL database (for data evaluation).



III. IoT INDUSTRIAL APPLICATION

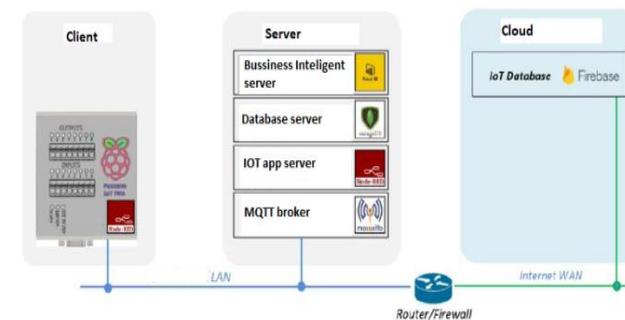
Implementation of the student diploma project was carried out with an industrial partner (LCD screens production). The IoT solution is a part of the complex system IWA - an Intelligent Workstation Assembly line - the aim was to measure the efficiency of the production process in real time and to support the decision-making process in the production flow. The IoT part (client) is based on Raspberry Pi3+ platform. For illustration, the following components have been connected to the IWA IoT inputs: Inductive sensor for sensing the presence of a mounting pallet, and camera. And relays for conveyor control are connected to the IWA IoT outputs.

VI. CONCLUSION

The paper presents several practical student projects oriented to IoT technology, implementation of which was carried out at FEIT of the University of Žilina. The experiences with the supervision of the IoT based projects have shown great concern about such practical solutions among students in engineering programmes. These projects markedly help students to improve skills in developing both HW and SW solutions. Even by developing simple IoT applications, students may transfer, in very short time, their theoretical knowledge into practical solutions for everyday life or industry.

ACKNOWLEDGMENT

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Level and Ways of Educating Future Teachers in the Use of Digital Technologies: Basic Results of a Questionnaire Survey

Tomas Javorcik, Tatiana Havlaskova



ICETA 2020
Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — The paper describes partial results and findings of an extensive questionnaire survey, which took place among students of teaching disciplines of the Faculty of Education, University of Ostrava. The aim of this questionnaire survey was to find out what knowledge, skills and overview students of various teaching disciplines have in the use of digital technologies in the educational process. We conducted the questionnaire survey at a time of several key changes in education. These changes affect all subjects and levels of education making the use of digital technologies in the Czech school environment inevitable for all those involved – teachers, pupils and students. For this reason, we consider it necessary to map whether future graduates of teaching disciplines are sufficiently prepared for these changes.

I. INTRODUCTION

Czech education at all levels is undergoing a (r)evolution. The subject of this (r)evolution is above all a greater degree of meaningful use of digital technologies across the entire content of teaching. Guiding pupils and students to make meaningful use of these technologies should take place through the development of their digital literacy. The goal is a graduate who is fully prepared for life in today's society, fundamentally affected by the so-called fourth industrial revolution. We all have also felt the need to implement these changes during the ongoing pandemic situation, where most schools have relied on electronic means of communication and online teaching. If we want to educate current pupils and students to become graduates using current technology to solve various problems in practice, it is necessary to meet two conditions:

1. To adapt the content of the curriculum through framework educational programs across all subjects so that digital technologies can be used in these subjects.
2. Properly prepare teachers, both current and the future, for the possibility of applying digital technologies in a specific subject so that such use of technology is meaningful and facilitates the development of digital literacy of pupils and students.

In our research, we are looking at how effective and meaningful the present training of the future (and current) teachers is in the ability to develop digital literacy in pupils and students in their respective subjects.

II. RESEARCH

The questionnaire in our survey contained 30 questions of various types and was divided into three sections according to the focus of the questions: 1) Relationship to digital technologies; 2) Use of digital technologies in teaching; 3) Identification questions. A total of 834 students studying various teaching disciplines of the Faculty of Education of the University of Ostrava were addressed by an electronic questionnaire. Of this number, a total of 178 students completed the questionnaire.

Results of the questionnaire survey - a few examples

The Figure 1 shows what respondents like about digital technologies. The Figure 2 shows what respondents do not like about digital technologies. The Figure 3 shows how respondents perceive the integration of digital technologies into education. The Figure 4 shows at what phase of teaching respondents would most often use technology.



Figure 1



Figure 2

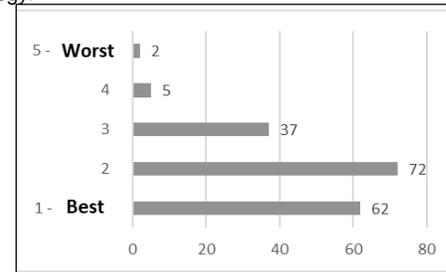


Figure 3

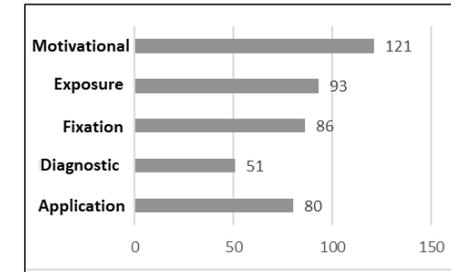


Figure 4

VI. CONCLUSION

With the increasing use of technology in both everyday and professional life, the social demand for graduates who can use these technologies effectively and meaningfully is growing. This demand puts pressure on the education system that should train such graduates. Adequate training of new (but also current) teachers is associated with changes in the education system (especially its content). Czech education is accompanied by a number of changes related to the development of digital literacy in the teaching of general education subjects in both primary and secondary education in the context of the planned revision of national curricular documents. From our position as the Faculty of Education, it is important to respond to these changes through the training of future teachers. In our research, we decided to map the preparation (that is, the application of ICT in teaching) in various teaching disciplines, identify possible shortcomings and propose possible solutions so that the graduates can be fully prepared. In this paper, we present only a part of the research focused on the relationship of future teachers to digital technologies. Furthermore, we want to monitor and map the acquisition of their new skills during their studies over a long period of time.

Development and application of the teaching tool of design thinking collaboration based on UCD methods

J. Xu

Abstract — There are many "poor cooperation" problems in the process of design thinking collaboration of college students' teams, and usually a lot of process data such as student interactions and specific discussion processes are generated. The limitations of offline classroom scenes make it impossible for teachers to carefully guide all student groups on the one hand, and to collect process data on the other hand. The presented research attempts to develop and apply an online teaching tool of design thinking collaboration based on the UCD methods. By collecting data and preliminary analysis, it provides teachers with new ideas for the process evaluation (such as scoring, problem discovery, feedback, etc.) of students' design thinking collaboration.

I. INTRODUCTION

Although there exist some design thinking tools that provide the possibility of quality optimization for collaborative design, these tools usually focus on improving the quality of user collaboration, rather than being closely related to the teaching activities of engineering colleges. After interviews with relevant course teachers, there is a corresponding demand for design thinking tools for classroom group collaboration in the teaching of innovative method courses in engineering colleges. The presented research attempts to use an online teaching tool of design thinking collaboration applied to innovative method courses, using online advantages and data analysis techniques to provide teachers with a new idea for the process evaluation of students' design thinking collaboration.

IV. TEST RESULTS AND ANALYSIS

Analysis based on the data of the design thinking collaboration process can help teachers to give new solutions to the process of teamwork evaluation. We take an activity test of design thinking collaboration in an innovative method class as an example. In this test, a total of 27 people from 8 teams generated 1989 historical records and 289 post-it notes. Among them, "historical records" includes login, registration, logout; opening and closing the tool page; creating, deleting, moving, commenting, "passing" and other related behaviours of post-it notes. Examples of some evaluations given for this test are as follows.

A. Interactive feedback frequency graph (partial)

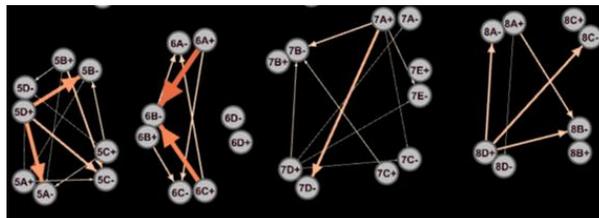


Figure 3. → The frequency graph of interactive feedback produced by 8 groups during the completion of the sympathy map.

B. Individual activeness score within the group
TABLE I. → STATISTICS TABLE OF BEHAVIOUR TIMES OF 3 MEMBERS IN A GROUP.

User	1A	1B	1C
Times of creating	21	5	19
Times of commenting	3	3	1
Times of passing	13	29	0
Times of deleting	10	1	4
Times of recycling	0	0	0
Times of moving	13	7	13
Times of cancelling passing	4	6	0
Weighted sum score	125	96	77
Standardized score (Full score:20)	20.0	19.2	15.4

VI. CONCLUSION

Through data analysis, the online tool can help teachers to make process evaluations of team collaboration status and give new solutions, which is explained using some evaluation examples in this research. To draw a conclusion, the online tool can help teachers discover problems in student collaboration, give them a reference score for evaluating the design thinking collaboration process of students, and create conditions for them to provide reasonable feedback to students.

ACKNOWLEDGMENT

This publication is the result of the project implementation: using the online tool to assist in lectures of design thinking methods in engineering colleges, supported by Mobile Life and New Media Laboratory, Beijing University of Posts and Telecommunications, China. It has been applied in several teachers' lessons.



ICETA 2020
Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Virtual laboratories and their usage in university environment

J. Jurc, M. Sterbak, M. Kontsek



ICETA 2020
Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — In today's digital age there is a great need for smart and experienced networking professionals. In order for someone to become a network expert, in addition to theoretical knowledge, it is necessary to acquire practical skills. One way of acquiring practical skills is to use real facilities in a specialized network laboratory. Such laboratories are being built to provide a variety of network equipment and technologies that specialists can encounter in practice. However, building network laboratories is too timeconsuming and, last but not least, costly. Although working on real facilities brings many advantages, we will ultimately find a few limitations in most laboratories. The constraints associated with a network laboratory may vary, but the biggest problem is in terms of flexibility, financial requirements, and overall sustainability of the operation of such a laboratory. For several years, the replacement of physical devices, whether computers or network devices, through virtualization has been developing intensively. Virtualization itself provides additional possibilities for more efficient use of hardware resources, allowing the development and deployment of new types of network laboratories and thus virtual network laboratories. It is sufficient to use general computer hardware with virtualization software to operate such a laboratory. We are convinced that virtual laboratories will become an integral part in studying and improving networking. Based on these facts, in the article we will focus on the analysis and description of available solutions of virtual laboratories, focusing on teaching process of the network subjects in college. The article offers an insight into how such laboratories are used in daily teaching process, as well as the experience or requirements of the laboratory that we have gained in their use.

I. INTRODUCTION

As network technologies are of great importance in the world, the popularity and need for experts with this knowledge is growing. In addition to theoretical knowledge, a network expert needs to have practical skills. This requirement is in great demand by employers in the field of practice. Therefore, a few years ago in our university, we implemented the education system model known as 'learning-by / when-doing' [1]. When using this model in education, it is assumed that teachers and their laboratory exercises will guide students in solving practically focused tasks, which they solve individually or in groups, on real network devices. Due to the limited number of devices in the physical network laboratory and the complexity of the assignments, students work in groups. Proof of this teaching process success and working in groups, is the research from 2016, which took place at the National Central University in Taiwan. In the research, they placed great emphasis on collective learning, either attendance at school or online, using the HVLab virtual laboratory. The goal of the research was to compare the tasks between the two groups, namely the number of correct and incorrect commands in the configuration of the virtual router from Cisco, the correctness of homework and the final test. The result of the test was that the group using the HVLab virtual laboratory had better results in the number of correctly entered commands, elaborated homework and also results during the exercises. Based on the findings of this research, the authors recommend the use of a virtual laboratory in teaching process and also in self-study, where they noticed an increased interest of students in learning this form [2]. Second point of this article focuses on the classifying of laboratories as a physical laboratory, a virtual laboratory and a hybrid laboratory. In the next part we describe individual virtual laboratories and the method of their implementation either in the form of a simulator, emulator or simulated-emulated type. We will describe the existing virtual laboratories, their functionality, design and possible usage and deployment in teaching process. At the end of the article, we describe our findings and recommendations for the functionality of a networked virtual laboratory used in teaching process.

III. VIRTUAL LABORATORIES

From the types of laboratories described in the previous chapter, we use primary physical laboratories in our organization to teach network technologies. This teaching process is supplemented by virtual laboratories for subjects that require more modern hardware or if it is necessary to provide more equipment for one student, where the resources of the physical laboratory are not sufficient. In virtual labs, primary devices are created using software or virtualization technologies. As mentioned, the practicality and efficiency of virtual laboratories in teaching network technologies is increasingly proving itself. Therefore, we will divide and describe the subcategories from which virtual laboratories are made. These subcategories are of the simulation type, the emulation type and the simulation-emulation type.

V. CONCLUSION

With the advent of virtualization and the idea of creating virtual laboratories, new possibilities have opened up in the field of network technologies as well. Since only a person with sufficient practical skills can become a successful networking expert, the use of virtual networking labs greatly helps. As many studies have shown, the use of virtual networking labs brings a number of benefits in studying and acquiring practical networking skills.

The main benefit of this article is to describe the virtual laboratories we have selected, which are interesting for us, whether from the point of view of the student or the teacher. Also point out the differences between these laboratories in the functionality from which their use and deployment in teaching derives. One of the most important functionalities that we require is the possibility of deploying more users who have the roles of student and lector / administrator, where they have rights based on these roles. Another important feature would be a reservation system, where students could reserve hardware resources to run their topology outside of class. For a virtual lab administrator, the user management feature and monitoring of system resources would be appropriate. In group work, students would certainly get acquainted with the function of sharing topologies with each other, or cooperation on one topology and for communication group or private chat.

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Enhancing Attention through the Eye Tracking

M. Gera, O. Kainz, R. Petija, M. Michalko, D. Cymbalák, R. Vápeník, F. Jakab



ICETA 2020
Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — The contribution describes an implementation of a system capable of measuring and possibly improving the human attention through the use of eye-tracking techniques. The used techniques achieve high accuracy for non-head mounted cameras with low resolution in visible spectrum. In order to achieve this, an analysis of existing methods was carried out. The implementation of the system is created through the utilization of Python-compatible library for face detection as well as using Timm and Barth algorithm for pupil detection. The main focus of the testing phase is the accuracy of the face detection and pupil detection algorithms in various lighting conditions as well as under different view angles. Additional tests are performed on participants with different eye-colors. The experimental solution may be used also for tracking of the attention of students or in various educational games.

I. INTRODUCTION

The use of computer algorithms for object detection has been a highly targeted goal for many decades. In the recent years the importance of such methods increased even more drastically. This has happened due to the fact that people acquired easier access to hardware capable of efficiently utilizing the benefits of said algorithms. Whether we take into consideration the ever-improving cameras, mobile phones and speed of calculating abilities of hardware. Some of the most influential methods, and those which this contribution focuses on, are the methods of eye tracking and detection.

II. EXPERIMENTAL SOLUTION FOR EYE TRACKING

The implementation of the system has been designed in the Python programming language and has been specifically tailored for Windows operating system. The system relies on the use of dlib library for constrained local face detection based on HOG and SVM. This is followed by pupil detection using the Timm and Barth algorithm. Using this data, it is possible to calibrate the system for the use on a computer screen which allows the system to predict the specific gaze location, or gaze point, of a user. This can in turn be used to compare the gaze point location to the expected gaze point location and measure the accuracy of a user's gaze.

A. Implementation of the facial landmark detection

The face detection is implemented as a part of the main detection cycle, which is continuing to process new frames from the camera for as long as the calibration or the attention enhancement game is active. This was achieved through the use of OpenCV library video capture as well as frontal face detector contained in dlib library. In order to acquire the facial landmark positions, a 68-point predictor has been utilized. This, in short, means that it assigns 68 different facial landmark points to a single face in an image, as partially seen in Fig. 1. The landmarks are stored as an array of points, which allows a program to use them as reference points in order to only select the necessary part of the image. The predictor presupposes a mostly frontal view of the user's face through the camera.

B. Implementation of the pupil detection

As previously mentioned, the pupil detection algorithm of choice for this contribution is the Timm and Barth algorithm. It uses gradients of color intensity to differentiate between dark and round objects, for example the pupil, and the surrounding eye area. In order to make sure that the detected point is indeed the pupil, an eye region is first selected using the landmark points around the eye as a reference. The region is best selected based on the leftmost and the rightmost points of the eyes. Vertically the topmost and the bottommost points may be used.

C. Direction offset calculation

After the detection of the face landmarks and subsequent detection of the eye pupils, it is necessary to select an efficient way to calculate the gaze direction of the user

VI. CONCLUSION

The experimental system for eye tracking, attention measurement and enhancement was proposed. Face detection using dlib face detector followed by Timm and Barth pupil detection algorithm was utilized for the purpose of eye tracking. Furthermore, an original system for gaze direction calculation and calibration was developed. Combination of these steps has allowed the fulfillment of the main goal, providing a simple and effective program capable of working with low resolution cameras in visible spectrum. The system is capable of calibrating, measuring and displaying attention metrics.

Due to its robustness, the program can provide a good alternative to other, mostly commercial and expensive, methods of eye tracking, all the while having virtually no special requirements for computational and recording hardware. Further, it may be used for educational games or for tracking of the students' attention.

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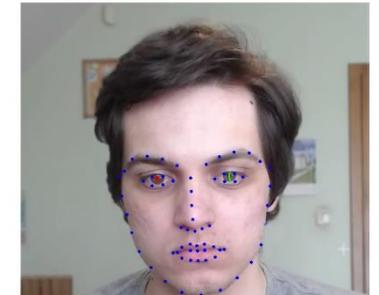


Fig. 1. Example of landmark assignment in blue color.

Data analysis in WSN and draft of system for data analysis

A. Kanaliková, University of Žilina, DCIS, FEIT

Abstract — This paper deals with the student projects in engineering and bachelor studies with the topics - sensors techniques and sensor network, statistic and data analysis in sensor network. The introductory part of this paper deals with student projects and their possibilities to expand students' practical skills. The next part of the paper describes projects that dealt with the creation of a small existing sensor network and its applications for data collection. The main part of the paper deals with the results of the projects that dealt with the analysis of data from sensors, specifically from the sensor that scans the Bluetooth signal. The sensor network was created on the campus of the University of Žilina. As part of the data analysis, they were realized basic statistical, exploratory analyzes and simple localization data analysis were performed using cluster methods of data from the Bluetooth sensor. These analyzes were the inspiration for the design of a new data analysis system and system for locating mobile devices on university parking place. The next expansion of future system for localization mobile objects will be by using the machine learning methods. Preliminary design of the system to analyze sensors data was created as part of a student project and the survey of various research works in the field of sensor data analysis and of localization the mobile objects via Bluetooth signal strength.

I. INTRODUCTION

In the engineering and bachelor study of the field of automation, students deal with sensor networks and their applications within the subject of sensor technology, similarly within the subjects of artificial intelligence and statistics students deal with data analysis and applications of machine learning methods. Engineering and bachelor student projects are practical assignments in which students expand their theoretical knowledge and practical skills and combine knowledge from various subjects. Within the student projects, a small WSN network, a web portal with a database was created. Through student projects, data from the Bluetooth signal sensor in mobile devices were analyzed. Each implemented project brought an extension of WSN and its applications and new knowledge and information through data analysis. Data analysis has brought new impetus to the hardware expansion of the sensors network and the creation of a system that will analyze data and locate mobile devices using a Bluetooth signal. Machine learning methods are also planned to be used to locate mobile devices.

II. SENSORS AND DATA WSN

The WSN network was created based of Libelium technology. Network consists of two Meshlium and several sensors. Meshlium is a Linux router that works as a gateway for a sensor network composed of Waspnote sensor elements. Meshlium stores data from sensors in a MySQL database. Data from Meshlium Bluetooth Scanner 868-PRO-APwere available for data analysis. Bluetooth Meshlium Scanner 868-PRO-AP detects the signal strength of Bluetooth, especially mobile devices, respectively all devices with Bluetooth signal. Data from the Meshlium Scanner of Bluetooth signal has been stored on the MYSQL database and were displayed through the tables and graphs o

1. Modification of variables in source data.
2. Data preprocessed.
3. Selection data variables.
4. Statistical evaluation.

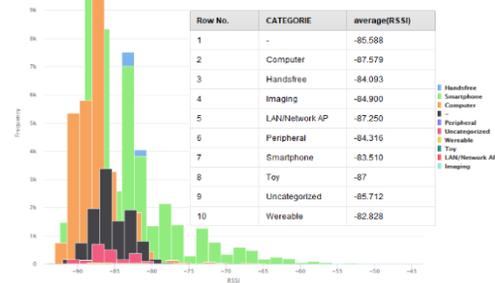


Figure 2 Data of sensors statistical analysis

IV ANALYSIS LOCALIZATION VIA BLUETOOTH SIGNAL

Based on the value of the RSSI signal, it is possible to localization mobile devices (persons, vehicles or other mobile devices) with signal Bluetooth indoors or outdoors e.g. public buildings, public outdoor areas, etc.

The data obtained from the scanner were divided into groups - clusters using the K-means method and its modifications in the RAPIDMINER tool. The Division the data into individual clusters does not allow us to determine the exact distance of the mobile device, but allows us to determine the strength band of the Bluetooth signal (still applies, the closer the mobile object is, the stronger the signal). After evaluation, it was found that the X-means algorithm and K-means fast algorithm methods performed a more suitable and more even division of data into clusters.

TABLE I. CENTROIDS OF CLUSTERS K-MEANS

Method	CI 0	CI 1	CI 2	CI 3	CI 4
K-metoids	-72	-83	-79	-89	-87
K-means	-82	-60	-76	-87	-69
K-means fast	-88	-66	-76	-82	-86
X-means	-88	-66	-76	-82	-86

Via Bluetooth signal, resp. RSSI signal strength indicator it is possible to recalculate the distance, resp. position of the mobile devices (handsfree, mobile, etc.). The distance is calculated:

$$d = 10 \frac{Pr - Pr}{10 \times n}$$

Where Pr is the receiving RSSI signal (power) and n is a constant characterizes the environment where the Bluetooth signal is transmitted. For obtaining the exact distance from the RSSI signal scanner there are other models for example the Trilateration algorithm or Min Max theoretical - empirical models of geometry - based [14,15]. Other models for determining the distance of a mobile object from a scanner using RSSI signal values include models that work on the base of artificial intelligence.

V THE DRAFT SYSTEM FOR SENSORS DATA ANALYSIS

As already mentioned through student projects, we plan to expand the WSN network with additional scanners and create a software system for analysis and localization of data in the exterior (campus) of the university, or on parking places of university. The software system will consist of an application for data analysis and localization with output to a web portal. The new application will perform: data cleaning, statistical data analysis with optional filters and exploratory data analysis. In the next phase we plan to create a model based on Machine learning methods, e.g. clustering or classification.

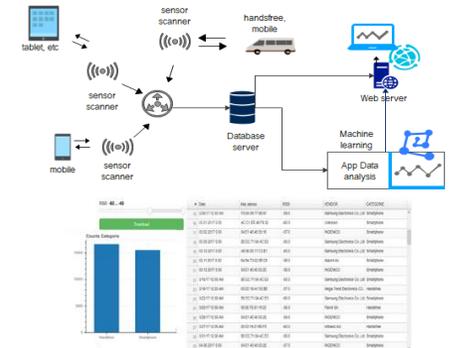


Figure 3 Draft data analysis system

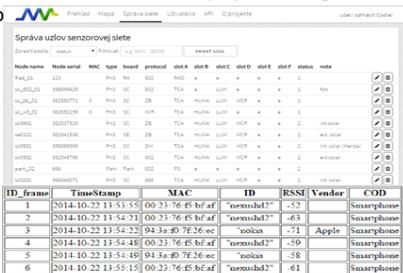


Figure 1 Data of sensors displayed on web portal [3]

III. DATA ANALYSIS

The data of the Bluetooth Meshlium Scanner from the database were analyzed. The data analysis was performed on data from two years 2017 and 2018, each year separately. There were more than 70,000 recorded data in each of the data sets by year. The Rapid Miner tool was chosen for the initial data analysis. The data were analyzed according to the following procedure :

VI CONCLUSION

Projects focused on the creation of a small university sensor network, its applications and analysis of data from this network expanded the practical skills and theoretical knowledge of students. Data analysis at the same time gave the opportunities to create new challenges for new projects. The expansion of the WSN network, the implementation of a software system - data analysis applications, the implementation of the location of mobile devices using a Bluetooth signal, as well as the use of machine learning methods are challenges for new projects or tasks.

ACKNOWLEDGMENT

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HIP-based security in IoT networks: A comparison

P. Kanuch, D. Macko, L. Hudec



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Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — A huge amount of cybersecurity attacks discovered in recent years, moreover in the last one associated with the pandemic situation, where intruders are trying to exploit the hospitals and research centers. It can be dangerous as nowadays a lot of IoT devices are connected in that area of life. It is one of the several points of our motivation to secure IoT devices or data in Healthcare. In our article, we discussed several approaches dealing with the classification of security attacks. In the next part, we analyzed and compared HIP-based security protocols also used in IoT networks. We also ran experiments to show that it is crucial to bring energy-efficient lightweight, optimized protocol for using in IoT networks within sufficient security strength.

I. INTRODUCTION

The term security, especially security in information technology and the area Internet of Things, spreads rapidly. It is related to the number of connected devices to the Internet and numbers of IoT attacks. Moreover, security itself is fundamental when we talk about machines that interact with humans and can compromise their health and safety in case of an attack or equipment failure. IoT devices are a great example of these devices. According to the classifications of devices [1], we can say that Actuators and Hybrids can be included in the group of potentially dangerous devices for a human being in contrast to Sensors, in which only measurements are performed. A breach of safety by exploiting one of IoT device's vulnerabilities can ultimately cause huge damages, such as power outages, punishing industrial production processes, environmental destruction, and, last but not least, injury or even death of a person [4]. In the paper, we analyzed different approaches of the classification security threats in IoT network and compared the optimized HIP-based security protocols.

II. SECURITY THREAT CLASSIFICATION

There are several existing classifications of the security threats made by different approaches. However, some intersection can be found in each. One of the most basic classifications of the attacks or threats, which can be exploited is classification into four groups, according to [5]:

- 1) physical attacks or attacks on the physical layer are related to activities like stealing, replacing the original device with the malicious one, or its dysfunction itself,
- 2) software attacks usually caused by code injection or malware infiltration, authors also included DoS (Denial of Service) attacks in this group,
- 3) network attacks, where many different types of attack vectors exist, such as spoofing, replication, flooding, etc.

III. COMPARISON OF HIP-BASED SECURITY PROTOCOLS

Host Identity Protocol (HIP) is one of the network security protocols enabling security association and key exchange between devices to safely transmit data. There is still some research, and new optimized modification of this protocol are invented. Protocol HIP has certain features, such as separate identifier and locator, end-device anonymity and mobility support, so it can be declared it is suitable for use not only in a classical wired network, but also in the area of IoT. In the paper, we compared the existing modifications of the protocol HIP, the main difference in optimizations, and used algorithms. We put some protocol information into Table V (T means True / contains, dash - not used, and na stands for not available). It is quite easy to determine used approach of optimization, the number of transmitted messages in the initialization phase of the protocol, the used algorithm (RSA or ECC, DH), or the need of pre-shared key. Overall optimization of energy-efficiency compared to OpenHIP can be found in the table.

We have decided to compare OpenHIP protocol and his optimized version E-HIP. Both of them are based on public-key cryptography for key agreement and a digital signature of the message. It is not recommended to use the 1024-bit key size by NIST organization [9], and the public key is one of the biggest parameter sent in the HIP messages. Therefore, we have compared the message sizes of these protocols by using different sizes of the RSA keys (from 1024 to 4096 bits size) in Table VI.

IV. CONCLUSION

This is the comparison of the several existing optimizations of the HIP-based security protocol, which can be used in the area of IoT due to several features, such as separate identifier and locator, ownership of the identifier, the anonymity of the end-user or mobility of the device. We proposed experiments based on different public-key sizes. It is necessary to use a minimum length of a 2048-bit key, because of security requirements. Still, on the other side, it can lead to enormous power consumption within the non-optimized version. The experiments show the importance of optimization in this field of informatics.

ACKNOWLEDGMENT

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TABLE V
Number of message exchanged in the initialization phase

Protocol	RSA	ECC	PSK	DH	Number of message exchanged (initialization phase)	Message compression	Computational reduction	Overall optimization (compared to OpenHIP)
OpenHIP	T	T (HIP-2)	-	T	4	-	-	-
E-HIP	-	-	-	-	4	-	T	na
Shmfit	-	T	-	T	4	T	-	25%
D-HIP	-	-	-	T	6	-	T	22%
HIP-TEX	-	-	-	T	6	T	T	na
CD-HIP	-	T	-	T	7	T	T	48%
E-HIP	T	T (HIP-2)	-	T	4	T	-	20%
F-HIP	-	T (ECQV)	T	T	4	T	T	80%

TABLE VI
OPENHIP AND E-HIP MESSAGE SIZE COMPARISON FOR DIFFERENT RSA KEY SIZES

Key size / Packet	1024 bits		2048 bits		3072 bits		4096 bits	
	OpenHIP	E-HIP	OpenHIP	E-HIP	OpenHIP	E-HIP	OpenHIP	E-HIP
I1	88	88	88	88	88	88	88	88
R1	664	496	920	624	1176	752	1432	880
I2	720	704	976	960	1232	1216	1488	1472
R2	264	264	392	392	520	520	648	648
Close	256	256	384	384	512	512	640	640
Close_Ack	256	0	384	0	512	0	640	0

Advanced ICT for Access of Visual Impaired People to Computers, Knowledge, Education and Culture

D. Karastoyanov, D. Chikurtev, S. Gyoshev, A. Chikurteva and N. Stoimenov

Abstract — paper presents methods and tools for tactile access of people with visual impairments to a graphical computer interface, cultural and historical heritage and temperature in the home. Different size of graphical Braille screens on the base of linear electromagnetic micro drives, tactile graphical tiles and thermometer for visual impaired are described. The presented devices give access of visual impaired people to graphical computer interface (Windows), objects of cultural and historical heritage, as well as give possibilities for better education and perception of knowledge.

I. INTRODUCTION

People with visual impairments do not have access through vision-based methods for human-computer interaction and therefore do not have access to computers, education, scientific knowledge, cultural and historical heritage. These people need special devices and tools for interaction and working with electronic devices like tablets, smart phones, computers and more. The most common method for human-computer interaction is voice interfaces. But in public and noisy environment voice interfaces are not enough accurate and convenient. Therefore additional and alternative methods have to be researched to provide different choices for the visual impaired people. Special buttons were developed for the visually impaired and Braille symbols were used. Here we present the methods and tools we have developed to provide this access for visually impaired people (with reduced sight or blind).

II. GRAPHICAL BRAILLE SCREEN

The team have a prototype of a Braille Screen/Display (Fig. 1), based on the 5 Bulgarian patents. Here we present the research on design, optimization and development of magnetic based linear actuator (Fig. 2), in order to show advantages of this. The Braille Display represents a matrix comprised of a base with fixed electromagnets. They are arranged thereon, including an outer cylindrical magnetic core, in which a winding magnetic core locking up the cylindrical magnetic core at the top side. The actuator is a linear electromagnetic micro drive. The mover is a permanent magnet. Its magnetization direction is along the axis of rotational symmetry. The upper and lower coil are connected in series. This connection is realized so that the flux created by each of them is in opposite directions in the mover zone. Thus by choosing proper power supply polarity, the motion of the mover will be in desired direction.

III. GRAPICAL TACTILE TILES

All tactile plates have a strip with title and key in Braille so that each image segment, marked with Braille symbols, can be read and interpreted. The visitors could move their fingers back and forth, trace the contours corresponding to a Braille key, and explore the plates with whole hand. The next invention relates to a Tactile graphical tile for visually impaired, which will find application for the presentation of objects of cultural and historical heritage for users with impaired vision, who by touch can "see" and imagine the corresponding picture, icon, photo, tapestry and more fig. 3.

IV. 3D SCANNING AND MODELING

3D models of various objects can give a clear idea to visually impaired people of what real objects really are. The process of creating 3-dimensional objects is realized in two stages: creating a digital model of the object and transforming the digital model into a real one. In our case we consider the creation of a digital model through some methods and its transformation into a real model through a 3D printer. We have used the RecFusion application, RealSense D435i, and a laptop with NVidia GTX 850M. The scan process is focused on creating a model of a small flowerpot. In figure 4 is illustrated the initial preparing for scanning.

IV. TACTILE THERMOMETER

The invention THERMOMETER is designed to serve visually impaired people and will find application in industrial and household appliances such as boilers, irons, hotplates, kettles and more. The thermometer (Fig. 5) includes a hub 1 and a spiral bimetal plate 2. The inner end 3 of the spiral bimetal plate 2 is mounted to the hub 1 and the outer end 4 of the spiral bimetal plate 2 is free, with the tip 5 of the outer end 4 being tapered. Above the outer end 4 of the spiral bimetallic plate 2 are tubular beds 6 with springs 7 and movable elements in the beds 6 - buttons 8 of different lengths. The bases 9 of the buttons 8 are tapered and the tips 10 of the buttons 8 are rounded.

VI. CONCLUSION

People with visual impairments are a large group of citizens who have so far been denied access based on visual communication. Voice assistants are used as a means of perception. Higher tactile sensitivity is used through Braille books. So far, dynamic tactile perception has only been available via Braille terminals for Braille symbols - letters and numbers. Here we present three innovations – screen, tile and thermometer, helping visual impaired people have access to computers, knowledge, education and culture..

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elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

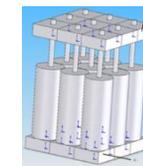


Figure 1 Braille Screen/Display

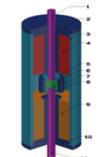


Figure 2 Linear actuator



Figure 3 Tactile graphical tile



Figure 4 Scanning process



Figure 5 Tactile thermometer

Music information retrieval for educational puposes – an overview

P. Kasák, R. Jarina, M. Chmulík



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Conference Office

elfa, s.r.o.

Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — Connection between technologies and education process is closer than ever before. There are requirements for designing applications, which can be used for teachers and students to improve educational conditions, mainly in today's forced trend of distance E-learning, due to pandemic situation. This overview paper introduces topic of music information retrieval (MIR), specifically parts of musical source separation (MSS), automatic music transcription (AMT), and their integration in development of educational tools for musical students.

I. INTRODUCTION

In today's world, the imaginary boundary between arts and modern technology is vanishing gradually. Creative professions are no longer dependent on dogmatic and conservative thinking, and they are increasingly more open to the use of interactive tools created by various areas of signal processing. The field of musicology is no exception, and modern teaching tools penetrate to study of music and training in playing instruments. On the other hand, designers of these platforms stop relying just and only on technological methodologies, and they use knowledge from musicological disciplines, that tend to fill the gap between. An example is the procedure of score-informed source separation of music recordings (SISS), which uses scores of pieces, for greater segregation robustness of individual sources from the mixture. Development of these applications is associated with the field of audio processing known as Music Information Retrieval (MIR), and this article offers a brief introduction to methods which fall into this category.

II. MUSICAL SOURCE SEPARATION

There is a request for education materials appropriate for students to practice instrument while playing along the accompaniment. Possible way to avoid expensive creation of this materials, can be found in signal processing called musical source separation. Ideal scenario for this type of separation can be described as follows: extraction of individual instruments from mixture, without crosstalk of the other instruments presented in the complex mixture. In this context, separation must be oriented to quality of perception (AQO).

Approaches to segregation according to principle of source estimation:

- Statistical approach (ICA)
- Beamforming approach (TDOA, DUET)
- Matrix decomposition approach (NMF, RPCA, REPET)
- Deep learning approach (RNN, CNN)

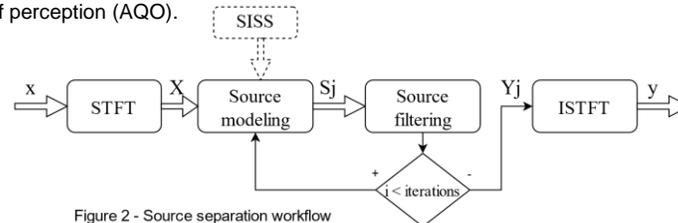


Figure 2 - Source separation workflow

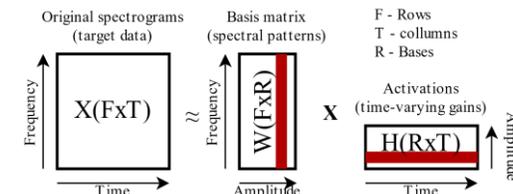


Figure 3 - NMF decomposition

III. MUSIC TRANSCRIPTION

Thanks databases and streaming platforms, we have access to amount of musical content. A lot of this content don't have relevant sheet music. Writing of music notation by humans is very time demanding task. However, music students often need to have access to this type of educational material. In this case, we can involve automatic music transcription (AMT) for creating this type of music representation.

AMT can be divided into 4 categories according to their abstraction:

- Frame level transcription
- Note level transcription
- Stream level transcription
- Notation level transcription

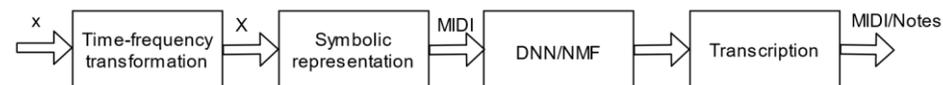


Figure 5 - AMT block diagram

IV. CONCLUSION

In this paper was presented brief introduction to MIR task for education purposes. Even though recent years have brought great progress in MSS and AMT, there are remaining challenges for future research in these interdisciplinary areas. Separation models became more complex and more robust in recent years. However, there is remaining challenges especially in AQO segregation. Every approach introduces audible artefacts from interfering sources. There is still long way to automatic transcription of complex audio signals toward highest level of abstraction. However, existing systems can be already beneficial for music students and teachers.

ACKNOWLEDGMENT

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Improving the Spatial Ability of First Year Civil Engineering Students by Using Interactive Geometry and Models from 3D Printer

I. Katrenicova, J. Cabala and R. Baskova



ICETA 2020
Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — There has been a lot of research on what is needed to prepare students for careers in engineering and technology. The basic skill they need to have is a critical skill known as spatial ability. The education in Descriptive Geometry is a training of the students' intellectual capability of space perception. But the question is: How to teach the students to reach this goal? Modern technologies have been a great help in the teaching process in the recent years. This paper reports on one possibility how you can use software applications and 3D visualization to improve teaching and increase students' understanding

I. INTRODUCTION

Spatial visualization skills are very important in engineering studies. Teaching descriptive geometry in the time of information and communication technologies is challenging. Descriptive Geometry is a method to study 3D geometry through 2D images thus offering insight into structure and metrical properties of spatial objects, processes and principles. The task of the subject Descriptive Geometry is not just to learn to draw objects in various screenings, but also to make students understand the relationships that apply in space and also in projections. The presented approach is used in the course Descriptive Geometry at the Faculty of Civil Engineering at the Technical University of Košice. This subject has a very demanding content in terms of time and content of the curriculum. Therefore, it is essential to speed up students' understanding using illustrative and concise visualizations.

II. SPATIAL VISUALIZATION ABILITY

Spatial imagination became the object of interest of psychologists and didactics in the first half of 20th century. Some sources distinguish between the ability a person is born with and a learned skill that can be perfected through experience [1]. Because in practice it is very difficult to separate the learned ability from the innate ability, under the term of spatial imagination we understand both of these components inseparably. There is no uniform definition of this term in the professional literature, therefore, we state here what we understand under the term Spatial Imagination: spatial imagination is the ability to imagine a solution of visually specified problem.

Advocates of the importance of spatial thinking as part of education have created a model which consists of three parts: what we see, what we imagine and what we sketch [2]. People with developed spatial thinking use all components of the imagination simultaneously interacting.

The categorization of spatial imagination most recognized by the professional society consists of five parts [3]:

- Spatial perception - the ability to realize size, shape, movement and orientation objects;
- Spatial visualization - the ability to mentally represent and manipulate two and three-dimensional objects;
- Mental rotation - the ability to imagine what the object will look like if it is turned;
- Spatial relations - the ability to realize the location of the object in space in relation to the specified object;
- Spatial orientation - the ability to move in the environment using a sense of direction.

VIII. CONCLUSION

Coping with the growing demands on teacher training is a difficult task. The need for visualizations of downloaded objects and relationships is demanding on the software equipment and computer skills of the teacher. The aim of this paper was to point out the possibilities of creating teaching aids through 3D visualizations and 3D printing. Teaching stimulated by these tools can give students the opportunity to increase the level of technical literacy, facilitate the receipt of information, increase motivation, support consolidation of curriculum, student activity and attention, increase clarity and imagination. The specific benefit is in the offered materials, which the reader/teacher can freely download and use in their preparation for teaching. The materials are divided into two parts, an applet in GeoGebra [8] and materials for 3D printing [9].

ACKNOWLEDGMENT

The article presented a partial research result of projects: KEGA No. 038TUKE-4/2020 "Supporting the platform Construction 4.0 through adoption of digital technologies in the learning process".

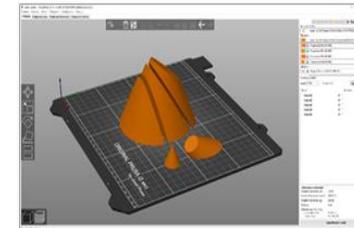


Figure 2. A view of the cone and setting parameters in the PrusaSlicer software.

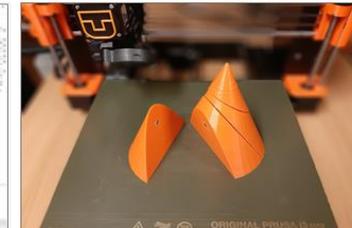


Figure 4. A view of the separated cone on the Prusa printer.

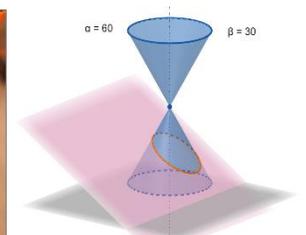


Figure 11. A perspective view of the cone and its intersectional parabola.

The Role of Hearing Screening Using an Audiometry Application in the Education of Children with Hearing Impairment

E. Kiktová, J. Zimmermann, S. Ondáš, M. Pleva, J. Juhár, V. Šoltéssová



ICETA 2020
Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — This paper describes the process and the role of the hearing screening of children with hearing impairment in education using the interactive audiometry application that offers the easiest and most comfortable and attractive way for rapid daily (self)testing. The proposed audiometry application looks like a game that enables the effective measuring of hearing capabilities of child patients in home environment. Besides the description of the audiometry application itself, the paper is focused also on the selection of appropriate words and information about the processing of related sound stimuli. This work brings a possible scenario for daily testing using this audiometry application. It discusses also an alternative Ling 6-sound test that can effectively verify the working of a hearing aid. The information provided clearly indicates the need for regular hearing measurements to support permanent education and personal development.

I. EDUCATION OF HEARING-IMPAIRED CHILDREN

The hearing ability is the crucial one to the acquisition of education and communication capability. Problems in education and social interaction may be related to hearing loss. If such a child is in a normal hearing class for a long time, the misunderstanding between him and other children may increase to such an extent that the child eventually begins to resist the hearing society. Diagnostic advances would clearly be helpful to children who have fluctuating and/or progressive sensorineural hearing loss (SNHL), and to children with unilateral hearing loss as well [9, 10, 11]. For a child in primary school, it is important to adjust the hearing aid repeatedly. Morning self-service hearing measurement for children can significantly enhance learning. The independence of the hard-of-hearing (DHH) students helps in the preparation for the profession later [12]. Serious inner ear disorders are solved surgically by inserting a cochlear implant. Due to the fact that the sound perception can vary, the hearing aids need to be adjusted repeatedly. Appropriate setting of the hearing technology is the basis for its acceptance by the patient (especially for the pediatric patient.) In the case of school children, several studies (see [13, 14] describe the benefits of simplified hearing testing (Ling 6-word tests) [15] each day before the start of teaching. Unfortunately, specialized tools for daily hearing testing did not exist for many years for Slovak children. The first tool for a hearing problem detection in the home environment was designed and developed in 2019 (see [16]).

II. AUDIOMETRY APPLICATION

The speech audiometry application for pediatric patients in the Slovak language is based on Conditioned Play Audiometry (CPA) principles. The web-based application is a game, where children help the virtual robot Thomas assign words to pictures. The words are presented to the user in a form of prerecorded audio files. The application performs speech recognition testing. It enabled to measure the word recognition score (WRS) in a free field scenario and each ear separately using headphones. During the measurement with headphones the speech signal is presented in the tested ear. The proposed user-friendly audiometry application (see Figures) can run on any device with an internet connection (mobile phone, PC, tablet). Speech stimuli reflects children's vocabulary. An important condition for including a word in the list of test words was that each word represented a specific object, animal or situation and could be clearly identified by the picture. Selected words/phrases create the Slovak Kindergarten Word List (SKWL) [18]. A picture test form is very suitable for children up to 10 years old or for people who prefer more pictures than written expressions.

III. DAILY HEARING SCREENING SCENARIOS

Each audiometry measurement should

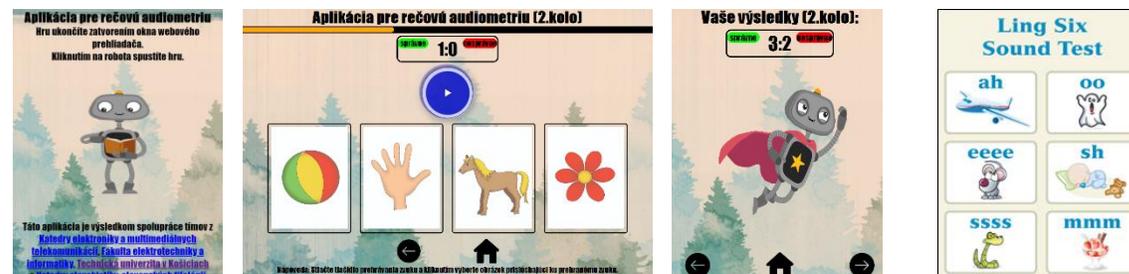
- be performed in a quiet environment.
- is preceded by verification hearing aid correct settings.
- lips reading should be excluded.
- eye contact during the test is counterproductive (can serve as an indicator of sound presence)

IV. CONCLUSION

The ability to hear significantly affects the process of personality development, especially with regard to the educational process. A unique audiometry application for measurement of hearing skills, designed like a game, where children assign spoken words to pictures were proposed together with important notes towards daily scenarios. The application allows identification of hearing problems in home conditions. Parents can objectively verify their suspicion about possible hearing loss of their children. Getting a low score of correctly recognized words a hearing problem can be indicated. Due to a large number of Roma patients, we would like to focus on creating a Roma version of the application in the future. We are currently working also on Bulgarian version of the application [27].

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Energy and Economical aspects of Implementation of virtual reality in Robotized technology systems

I. Klačková¹, I. Kuric², I. Zajačko³, K. Tucki⁴



ICETA 2020
Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract—The energy aspects and economic benefits of virtual technologies are also directly reflected in technological manufacturing practice. The virtual scene is imported and presented through information technology by applying standard computer operations. As a result, in addition to the economic benefits, the application of new environmental aspects and related knowledge is applied.

I. INTRODUCTION

The organization and its IT environment passed today under the influence of the development of information systems (IS) and information technology (IT) major changes. It IS and IT have become the basis of system integration integral part of business processes and enterprise resource tool for effective management. Into an integrated information system / IIS / undertaking should be systematically incorporated and processes, resources, services and products related to the tasks of design. It should be further addressed by this in terms of both institutional as well as in terms of professionalization and education process. This requires cooperation with the technology and management departments involved in building the IIS. From capturing current trends in IIS building that extend system integration by integrating business knowledge and IS and IT depends on the further development of enterprise information bases.

II. BASIC ECONOMIC PRINCIPLES OF ORGANIZATION

Integration of business process management with IS / IT management is a prerequisite for successful business management with IS / IT. The tool of this integration is the system integration of the company - a complex of activities that lead to the integration of individual components of IS and IT and external services into the integrated information system (IIS) of the company. It aims to support management and decision-making at all levels of the enterprise. The basis of business IS integration is the integration of business and integration strategy, which takes place at several levels: 1. vision integration, 2. business integration with the environment, 3. integration of internal business processes, 4. technological integration.

- A. Basics of organizational processes management
- B. New information environment of the organization
- C. Professional designers and their preparation for business practice
- D. New trends in the use of IT in the field of teaching vocational subjects

III. VIRTUAL ENVIRONMENT FOR CONTROL SYSTEMS

Virtual control systems associated with virtual models of controlled processes represent an effective solution to these problems. The scientific results achieved so far and the prospects for further development of virtual control systems implementation are supported by the VRML (Virtual Reality Modeling Language), designed to describe interactive 3D objects and worlds.

- A. Example of the implementation of the Virtual Reality Modeling Language in a real project.
- B. Format for importing objects to a virtual scene.

IV. KINEMATICS OF ANGULAR ROBOT AND ITS IDENTIFICATION ON THE VIRTUAL SCENE

The objective of object management in the virtual scene is a fully functional virtual production system with an industrial robot controlled as in practice. Because of its ease of operation as well as the ease of access to individual functions in the user mode, the virtual industrial robot is particularly suitable for teaching NC machine control and programming systems at various levels of operator training. It is also possible to use the virtual automated system of the technological workplace in laboratory conditions for training and training of operators and programmers of continuous operations.

- A. Forward kinematics
- B. Inverse kinematics
- C. Selection of simulation algorithm

V. CONCLUSIONS

Tendency is the development of intelligent robots whose properties and capabilities are usually tested on a model. Given the sufficient capabilities of today's commonly available computers, robot modeling and simulation can be performed in a virtual environment. The creation of a virtual model of the robot is conditioned by the correct selection of the geometric model and graphics library. At a sufficiently determined transfer rate, it is possible for the student or operator to practice the handling procedure directly at the remote workplace. This results in cost savings when it is not necessary to build several physical models of automated manufacturing systems, but simply model them on the virtual scene and connect them to software simulators. The fact remains that acquiring information on the real technical means of control systems is economically expensive. Refresher training is economically, but also limited, but sufficient is at the customer's existing management system. Economically advantageous virtual control systems associated with virtual models of controlled processes represent an effective solution to these problems.

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Wearables: Educational Projects Made with the BBC micro:bit

N. Klimová

Abstract — BBC micro:bit is becoming more and more spread in Slovakia last years. As it is spreading around the world, extensions allow to be more creative. One of extensions for BBC micro:bit is wearables. Wearable technologies in general can be smartwatches, fitness trackers, VR. As a BBC micro:bit extension it means to make wearable technologies from the very beginning. It is an opportunity for pupils to understand how things work in our everyday life. The article deals with BBC micro:bit and its extension, wearables, to create projects such as plushie toy, headband and postcard.

I. INTRODUCTION

The presented research is focused on wearables. Wearable electronics are similar to wearable computers. The difference is in executing multiple tasks, where wearable electronics are mainly produced for a set of tasks. Most of them are worn on the body or linked to the wearer's body or clothes, e.g. with a conductive thread. One of universities pioneering in wearable technologies was Massachusetts Institute of Technology (MIT). When connecting wearables and BBC micro:bit, there are some components which differ from elementary project lessons used with BBC micro:bit. They are electrically conductive thread, LED diodes, MI: Power Board.

II. EDUCATIONAL MATERIALS

We would like to present our "lessons" which are educational tutorials based on project-based learning with the focus on constructivism, project-based learning and creative thinking. Projects are called postcard, headband and plushie:

1. The postcard can have a different shape, our shape is heart (Fig. 1). Then, we connect the LED diode by sewing from the GND crocodile clip to the negative part of the LED and end sewing with a knot. In a programming part, we want the micro:bit to do something only when the postcard is opened. So we have to measure the intensity of the lighting. We can also simulate the heart palpitations with the use of the cycle in cycle.
2. The headband is a luminous headband with a neopixel strip (Fig. 2). The NeoPixel strip is a sequence of consecutive LEDs in parallel current. When programming, we can program the gradual symmetrical lighting of the LED strip. We want to light up the LED strip so that we start from the first and last LEDs, then they will light up along the following line and the last LEDs will light up in the middle.
3. The third educational material is called plushie (Fig. 3). We use 2 wearable LED diodes with already built-in resistors and connect it to the micro:bit in parallel. The clear objective of the program is: When we shake the toy, it will generate random music for us and at the same time it simulates a blinking through LED flashing.

III. Workshops

We presented our workshop in two events in October 2020. It was called Wearables and designed for the pupils from the school in Nitra as described in Methodology. The objectives were given. Due to the coronavirus, each workshop must be online. We created two videos and upload it to the forum.python.sk. Videos were created for the pupils to pause it when they need and during events, we were online in chat where the pupils could ask or answer. The first event was to create a postcard. In total, there were 20 messages in chat and 71 views. The next week we created another video about headband and plushie. In total, there were 35 views.

IV. CONCLUSION

With the focus on project-based learning and creativity, we decided to make educational material on the topic of wearables with the BBC micro:bit. We created three lessons, postcard, headband and plushie, where conductive thread or other wearable electronics were implemented. We made an online workshop where the pupils created these projects and we focused on cognitive, affective and psychomotor objectives. The photos of created projects and discussion we elaborate that all of the objectives were achieved. We would like to continue with the topic of wearables with BBC micro:bit in the future with focusing on creative thinking. Codes represented in the mentioned tutorials were based on reproductive creativeness. In the future, we would like to focus on productive creativeness in coding.

ACKNOWLEDGMENT

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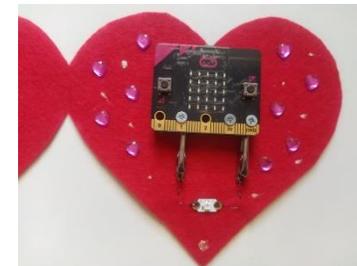


Fig. 1 The postcard



Fig. 2 The headband



Fig. 3 The plushie



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elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Survey of the monitoring tools suitable for CC environment

M. Kontsek, M. Moravcik, J. Jurc, M. Sterbak



ICETA 2020
Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — The paper deals with the necessity of the system monitoring, especially in large distributed deployment such as Cloud Computing platform. In several chapters the paper surveys several widely used monitoring protocols such as SNMP, IPMI and also custom solutions and later discuss several scalable monitoring platforms which incorporates described monitoring protocols and provides operator of the monitoring system with lucid visualization tools.

I. INTRODUCTION

Nowadays, network and systems monitoring is a widespread concept in the whole IT industry. It is a critical process in which all network components, such as routers, switches, servers, and other devices connected to the network, are monitored and continuously evaluated to maintain and optimize their availability. One of the important aspects of network monitoring is its proactivity. The search for shortcomings and critical points helps to identify problems in the initial phase. Effective monitoring can significantly prevent unwanted network outages or failures.

Problems usually occur when we are least prepared to solve them, so we turn to network monitoring software. Such software usually allows us to constantly monitor events that occur on a computer network using one or more methods and to notify those responsible if problems occur.

In private Cloud Computing platform used and deployed by our department mainly for education and research tasks, which was described in previous paper [1], we face similar issues with availability and health of the individual servers and network devices. It is therefore vital for us to be notified about the most important errors and the ability to view cloud health on demand is also useful. That's why we present several ways of cloud computing health and monitoring tools we came across during our platform deployment

PROMETHEUS

Prometheus is a comprehensive monitoring system platform that provides not only the gathering of monitoring values, but also data storage, display of the stored data in form of graphs, and also subsequent reporting of problem situations based on received data. Prometheus, similar to the TICK stack is one of the newer monitoring platforms and when compared to Zabbix or Nagios, it is considered "bleeding edge". In 2016, Prometheus become part of the Cloud Native Computing Foundation as a second project after Kubernetes, which signifies its orientation towards Cloud Computing and Containerization platforms. Most of the Prometheus components are written in Go language, which ease the deployment of the final system as it allows deployment as several static binaries. One of the main features of this monitoring system is the real-time metrics collection and their storage into integrated time-series database.

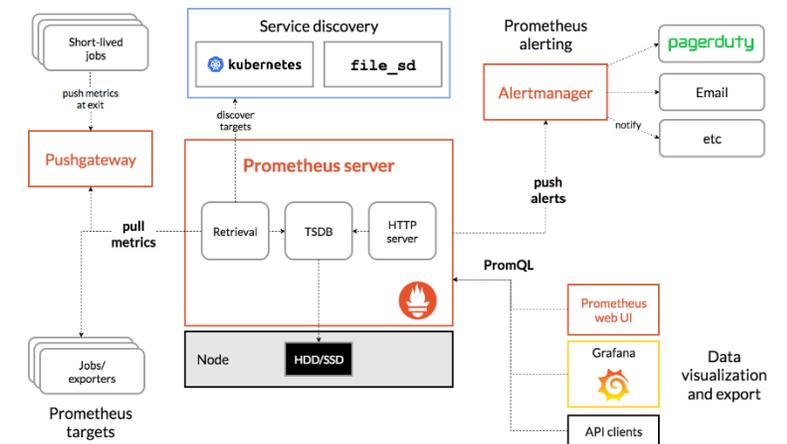
Data collection is mediated through so-called Exporters or the Pushgateway component. The Pushgateway component is intended for the collection of data that can only be obtained in a short period of time, and therefore Prometheus would not be able to obtain it using classical polling. There are also special-purpose exporters for many services available. The most notable categories of software providing special exporters are Databases, Storage, Hardware, Continuous Integration, Issue tracking, HTTP servers, Logging and also exporters from other monitoring systems. Some third-party software exposes metrics directly in Prometheus native format, so no special exporters are necessary.

IV. CONCLUSION

In this paper we have presented the importance of infrastructure monitoring, whether it is small, consisting only of several networked devices, or large distributed infrastructure such as Cloud Computing platform. In the following section we described several most used protocols for remote device monitoring with their pros and cons. In last chapter we have presented a few all-in-one monitoring platforms which are suitable for large scale deployment and allows the administrator relative ease of implementation, management and also user-friendly interface for monitoring operators. From our point of view, each of the described monitoring platforms is very versatile and can be used without any issues in Cloud Computing environment. That's why it is up to integrator to choose one, which suits the deployment the best or which he is the most familiar with.

ACKNOWLEDGMENT

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Testing of Visuospatial Cognitive Functions in Virtual Reality Environment

Š. Korečko, B. Sobotka, M. Hudák, R. Fedorco, M. Sivý



ICETA 2020
Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — Visuospatial cognitive functions play a crucial role in human cognition. In recent years, these functions have sparked interest among researchers, neuroscientists and psychologists, focusing on their training, assessment and restoration. Virtual reality (VR) provides an immersive environment, which can be used for stimulation of these cognitive functions and its effects that can be measured afterwards. The experimental procedure, described in this paper, brings us closer to understanding how a VR experience, in a gamified form using a tower defense genre game, may improve our visuospatial cognitive functions. An incremental development, described in this paper, is a shift from the use of a unique but expensive VR CAVE to a more flexible, smaller and cheaper solution - a VR headset. The development utilizes a progressive mix of web and VR technologies. The presented approach can contribute to a new method of experiment participants testing, even outside a laboratory environment.

I. INTRODUCTION

The experiment consists of cognitive tests and a training part. These are divided into several tasks and take about 10 days for each participant. The experiment was designed to evaluate how an experience in an immersive VR environment can stimulate selected cognitive functions, working visual memory in particular. As a matter of fact, although our visuospatial capacities allow us to understand and infer relationships of three dimensional (3D) objects in space (real or virtual), these 3D aspects of visuospatial processing are profoundly neglected in laboratories. The experiment sees VR as an experimental condition that aims at maximally exploiting an immersive 3D environment, used for the training part. Regarding the cognitive tests, the standard computerized ones are used. These are two dimensional and follow the current standards, focusing on measuring targeted visuospatial functions. A unique VR CAVE installation, called LIRKIS-CAVE and built at the authors' laboratory, was used to create a virtual environment for the first run of the experiment. For a planned second run, the Oculus Quest VR headset is about to be used with a software solution based on the LIRKIS Global Collaborative Virtual Environment, (LIRKIS G-CVE). LIRKIS G-CVE is another original development of the laboratory. Unfortunately, the first run has been interrupted by the pandemic situation and the experiment wasn't completed for all the participants. This situation confirmed our decision to develop the VR headset-based alternative, which is partially applicable even under pandemic-related restrictions.

II. Testing of Visuospatial Functions

During the experiment, participants visited the LIRKIS laboratory several times to perform the following tasks:

- 1 test for CDT ("Change Detection Task"). CDT is an activity, where visual short-term memory is trained using an EOG (electrooculogram) measuring device. This occurs on the first day.
- 3 CDA tests (CDA-like method using EOG and EEG (electroencefalogram)) during the second session, in the middle of the experiment and at its end,
- 10 sessions of 30 minutes duration, during which the participants played the Tower Defense game. Game difficulty was automatically adjusted according to the performance of the participants.

The game consists of levels, which are further divided into episodes. This means that a given level has multiple episodes with increasing difficulty. The difficulty in the game is determined by the duration of the episode and the number of objects. The length of an episode is defined by the speed of moving objects. These objects are different in shape. For certain period of an episode, the objects are marked with a red or green aura – an indicator. The purpose of the indicator is to inform the game participant that the object is a target (red aura) or a distractor (green aura)-

The player sees the game environment using a dedicated VR headset or a VR headset with a mobile device in VR mode (Figure 1). This mode evokes the same experience for the player as in the real world thanks to the stereoscopy utilization (Figure 2). Observation and movement of the camera is ensured by sensors and controllers of a VR helmet or a mobile device. These sensors affect camera rotation and perspective imaging.

The player's result depends on his or her score. The score calculation is implemented directly in the game and it is based on the number of shot down objects. The higher number of shot down targets represents the higher player's score and consequently it increases his or her overall result. The score also includes the number of shot down distractors. However, this number affects the score negatively. At the end of each level, the following information is displayed to the player: player name, number of shot down targets and number of shot down distractors.

VI. CONCLUSION

The experimental procedure, described in this paper, should bring us closer to understanding how VR experiences may improve our visuospatial cognitive functions. The procedure and the tower defense game are results of several testing trials, performed with the corresponding prototypes. A significant advance is the shift from the use of a unique but expensive VR CAVE to more flexible, smaller and significantly cheaper solutions - VR headsets and mobile devices. The web technologies usage is also a progress. This method can thus contribute to a remote way of testing participants during a pandemic situation. The development of the software presented here is strongly bound to the educational process at the home institution of the authors: Most of the implementation is carried out by students, utilizing knowledge from several courses, primarily from Web Technologies, Computer Graphics and Virtual Reality Systems. The experiment participants are students, too. And the participation itself gives the students a unique experience in virtual reality systems usage.

ACKNOWLEDGMENT

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Figure 1. User with Oculus Quest in LIRKIS laboratory during test



Figure 2. Example of stereoscopic display on a VR headset screen during test

System thinking competence and smart devices in programming education

Korom Szilárd, Illés Zoltán



ICETA 2020
Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — External programmable devices getting more and more popular in programming education. Those devices are mainly robots, but not necessarily like Arduino or Raspberry Pi. In this article, we try to prove that the general-purpose external devices open a completely new possibility to improve system thinking in different levels through the programming education.

I. INTRODUCTION

Nowadays, more and more smart devices are included into informatic curriculums. Many studies and articles are about the advantages of teaching programming with robots, external devices instead of the standard console-based applications. On the other hand, it is not that hard to collect disadvantages as well. In this article, we try to show what opportunities we have if we include some smart devices into the curricula, what we can teach by using them and what is the main reason why we should bring them in. We would like to focus on the informatics competences, not the technology-based knowledges. In this article, we talk about teaching programming, and not “programming thinking”. We use “smart” rather than using “external” word, because we are talking about those devices, that are not the classic personal computer, but not works for a dedicated function either. For example, Lego WeDo or Lego Mindstorms EV3 robot are programmable computers, but they are not “general computers”, we don’t have that much possibilities. By “smart devices”, we mean general purpose external computers, that provides many options during development.

II. System thinking and smart devices

The common part in these smart devices are the GPIO (General Purpose Input/Output) pins. That means you can connect any type of input/output things to them like LED, sensors, motors, buttons, Bluetooth shield, WIFI shield, 4g module or even some ready to use boards like Sense Hat. Basically, the robots are specialized smart devices, which means we can easily build a programmable robot by using Arduino board for example .

All in all, we have a small device with some input/outputs connected to it with algorithmically small programs. We created a figure, which shows what can be taught, what are the key modules in a hierarchical order in a smart device-based curricula. We used the term “IoT” which refers to “Internet of Things”.

The aim of figure 3 is to show the possibilities. It shows that many technologies, knowledge elements and competence can be touched if we put a curriculum in this context. Of course, it is not necessary to teach everything, that mentioned in the figure, but it shows, that systemic thinking competence can be improved because:

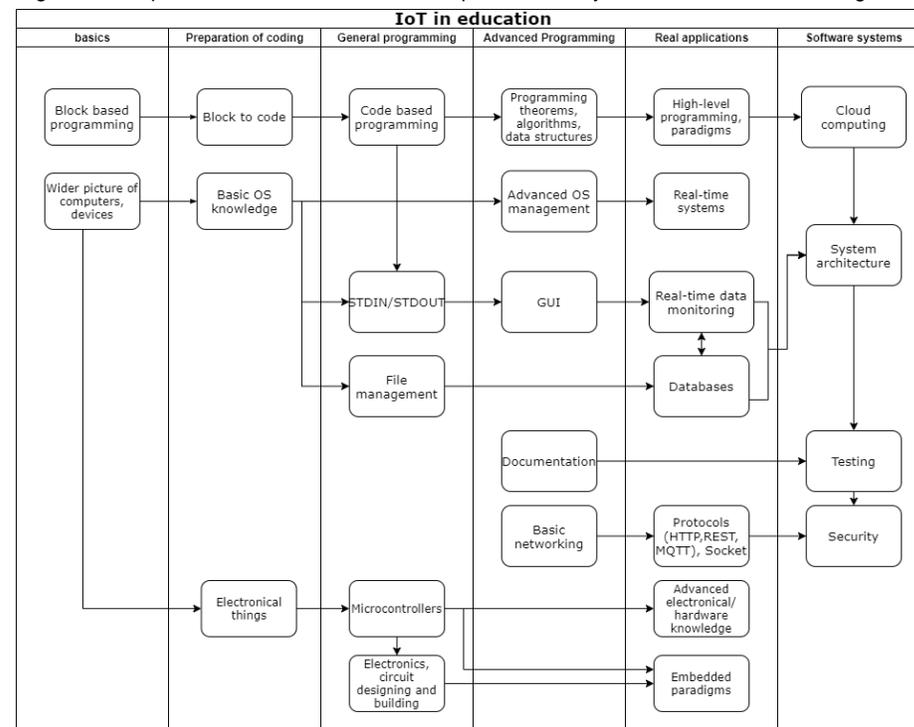
1. A project is either has multiple components that communicate with each other, or part of a larger project by definition.
2. Different types of technologies must be used at the same time including programming languages, data storages, operating systems etc.
3. Because it is smart device based, therefore we will soon get into the real-time world with multiple components that have non-linear relationships
4. If we have multiple devices in a project, the system must be dynamic, so we can easily add or remove an existing device (like they do it in real life)
5. The system must be designed and understood. By implementing the separate functionalities, we not necessarily get a working, whole system

III. CONCLUSION

It seems, that programming external devices for educational purposes is really close to improve system thinking and not just programming- or algorithmic thinking. Of course, there are many other advantages to use them, but this article wanted to show a general concept and high-level structure to help creating new curriculums.

ACKNOWLEDGMENT

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API for Communication between Motion Sensors and Raspberry Pi

O. Kováč, E. Pietriková



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Conference Office

elfa, s.r.o.

Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839

fax: + 421-55-726 5195

e-mail: iceta@elfa.sk

www.iceta.sk

Abstract — Motion sensors have been used in a number of diverse applications recently. They can be found in aviation, virtual reality, robotics, medicine, advanced scientific research or even on our bodies. With this growing presence of motion sensors in the field of information technology, problems related to working with them seamlessly have appeared. One of major issues stems from technological differences between sensors and requires their users to implement sensor specific software logic independently. This paper aims at solving the problem by integrating this logic into an application programming interface for straightforward work with motion sensors. As a convenient platform for education, Raspberry Pi was selected.

I. INTRODUCTION

The aim of this work is to create simple application programming interface (API) on the Raspberry Pi platform designed for unified data collection from BerryIMU and Myo Armband motion sensors, RCWL-0516 Doppler radar and their preparation for further use, so the API or data can be easily and non-invasively integrated into end systems. Creation of such an API is expected to bring considerable progress in practice in the context of developing systems for sets of motion sensors. At a minimum, it allows validating the benefits of this approach, evaluating its effectiveness, identifying areas that will need to be further addressed in the future, and designing potential future directions.

III. PROPOSED SOLUTION: SOFTWARE DESIGN

The primary intended use of the API is to integrate it into enduser applications of external user entities in different areas of focus. A potential way of using the solution is also monitoring movement activity without integrating it into a specific end application. Based on this, the following features are defined for this interface:

1. Simultaneous and continuous acquisition of motion data from several sensors.
2. Displaying collected data in a uniform format.
3. Saving all data collected in this format in a suitable data structure.
4. Obtaining current motion data values at a given time from a desired sensor.

The API, as a target software system, handles communication with supported and connected motion sensors, and at the same time processes data it receives from these sensors. This interface is therefore logically divided into several functionally specific parts or modules.

IV. RESULTS

The most important result representing the practical output of this thesis is the software solution of the API. It presents a synthesis of the related analysis, problem solving requirements and processed architectural and functional design of the target system. This solution appropriately addresses the core of the problem being solved - providing software for working with multiple motion sensors in a simple and uniform manner, regardless of the differences between them. In two modes, it allows direct programmer access to motion data from supported sensors or their continuous storage in text files that can be further processed in various ways.

The system represents an integration node of 3 functionally specific motion sensors and overlaps their differences by determining a uniform usage structure. For this purpose, and also for the purpose of formalizing and enhancing implementation homogeneity, it uses a form of abstraction specifying 3 common types of motion sensors and provides a solid logical form of implementation for its further expansion. I.e. it also emphasizes maintaining the clarity of the source file structure by separating software communication logic with sensors and algorithms directly related to API into dedicated file folders.

V. CONCLUSION

The process of experimental verification has shown that this solution greatly simplifies and streamlines work with motion sensors. The API covers implementation specifics of the sensors supported by it, separates them into dedicated modules, and defines a standard and unified way of extending the solution by supporting other motion sensors with its own abstraction layer. It provides two usage modes to increase usability levels, allowing it to be used in real-time applications, but also deployed in data collection, batch analysis, or motion data monitoring solutions.

ACKNOWLEDGMENT

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November 13, 2020



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EDUCATION WITH PHYSICAL DEVICE BBC MICRO:BIT

R. Krnáč, M. Cápaj, Š. Koprda, Constantine the Philosopher University
in Nitra, Slovakia

Developing Modular Information System with Microservice Technology

M. Kromka, P. Fidek, J. Kostolny



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elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — In The development of information systems has undergone significant changes in recent years. Systems tailored to society are required while maintaining some variability in the development of new extensions. This article presents the design and development of an information system divided into modules using micro-services. Individual modules are individual services. Such a proposal you pass modern requirements for information systems as are simple scalability and sustainability. Lastly, the presented design provides increased system reliability compared to conventional solutions on the market.

I. INTRODUCTION

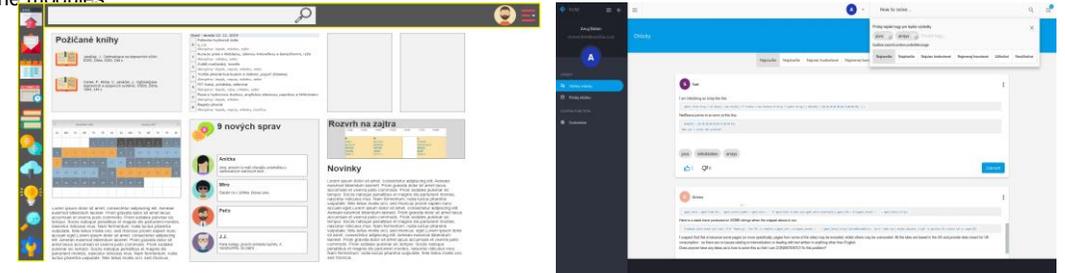
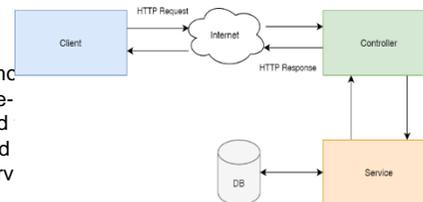
Information Society gives people the amount of data with which they may possess and operate. It also allows them to perform various electronic devices - computers and smart devices, from ordering goods to the household to handling official tasks. A transparent information system requires a suitable information system that can deliver information quickly and submit it correctly. For the overall reliability of the proposed system, the microservices architecture will be used, which provides increased reliability in the system [1]. The application of microservices has a significant advantage for the modularity of the system. It allows current and future project developers to develop individual modules in different programming languages, according to the programmer's preference or the requirements for the technologies used in the modules. At the same time, it will be possible to deploy new services without shutting down the system. We apply the proposed system to the Department of Informatics of the Faculty of Management Science and Informatics as information system. The system is divided into several main modules.

II. SYSTEM ARCHITECTURE

The design of the architecture of the system is using microservices. The main goal of the proposal is to provide the availability of individual services - modules. Compared with the classical architecture of monolithic applications and microservice, there are several differences. Monolithic architecture is usually designed as a three-tier and have main disadvantage which is the failure of one part - the function is unavailable for the whole system. Microservice architecture on the outside works the same as the client-server architecture where the client is running the required module. This module communicates using the controller with the service itself and its database. By applying the microservice architecture to our system, it is necessary to design the modules themselves so that they can communicate with the kernel and, at the same time, have their database.

The system is divided into several main modules:

- the core of the information system;
- administration module;
- module for communication with remote module for sending and analyzing e-
- module for preparation of forms and
- module for schedule generation and
- module for managing additional serv



VI. CONCLUSION

This work presents a solution for the design and development of a modular information system, which is based on a microservice platform. The structure of the system allows the addition and removal of services - modules as needed. It is also unnecessary to pay attention exclusively to one programming language during development because each module can be created in the language according to the developers' needs and skills.

A uniform template across the modules is applied to ensure uniformity and professional design. The first module implemented according to this specification in the system is the Student Questions and Answers module (Fig. 9). Using the design, we were also able to ensure increased reliability of the system and services availability. Due to the modularity, it is possible to implement the system on different servers. Thus, in the event of a failure of one assembly, only the service that was located on the defective server is unavailable. It is expected to complete the individual modules to start the test operation of the system in the future. It is also possible to extend the functionality of the system with a notification service for mobile devices.

ACKNOWLEDGMENT

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elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Improving learning step in artificial intelligence with categorization

E. Kršák, T. Kello

Abstract — the aim of this paper is to improve learning stage of machine learning. Input data are the main engine and first step in learning. Every small quality defect in the beginning can cause huge difference in result. There are two possible strategies to correct or filter. To correct data need to have some more knowledge about relations. For filtering we can calculate threshold and eliminate anomalies. It reduce amount of input data, what is also unwanted phenomenon. So we will mainly focus on correcting them and filling missing features in records. We expect more effective learning step which should result in better final (predicting) step of machine learning.

I. INTRODUCTION

Our research is focus on predicting train driving times between stations. Prediction is based on historical railway data, so in this paper we explain, how we improved learning step. Railway company provided data, which included specific track, train number, type, engine, length, weight, number of wagons, axles, planed and real departure and arrival time.

II. GROUPS

Based on correlation matrix, we set two related groups. We used their dependence to correct or fill values. First group contain train identification and engine type. Second group contain weight, length, axles and wagons count. Most common mistake in filling these values by railway operator were:

- Switched columns
- Default number "1"
- Typo - doubled number accidentally

We used machine learning, to find exact relation and dispersion for every value. Our program is implemented in python, framework TensorFlow and algorithm Mini-Batch K-Means. It is a modified version of k-means, that update to the cluster centroids using mini-batches of samples rather than the entire dataset. It should be also faster for bigger dataset and for our data noise more robust in computation.

IV. RESULT

To confirm quality of input data, we created machine learning model to predict output variable - real driving time. It is decimal numeric value which can be predicted by Linear regression model. We implemented it in the same TensorFlow framework and get better output, when used processed Input data.

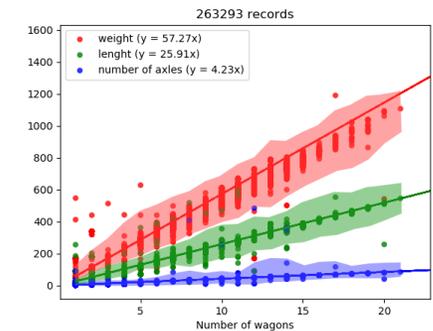
To compare, we used RMSE and R2 evaluation metric for prediction error. It shows quality of output. RMSE represent square error, and lower value is better. For R2 is number in range from 0 to 1, where higher value is better.

V. CONCLUSION

Machine learning algorithms are highly depending on input data, that's why we should make a lot of effort on analyzing them. Often it can result to lower error then experimenting and improving machine learning algorithm. First step should be correlation matrix and his positive or negative values. Machine learning model needs input features correlated with output feature and not correlated with other inputs. This all information shows correlation matrix and can choose which variables are best to use as input and which are not suitable for that. We found group of high correlated features. Number of wagons, axles, weight and length. We used combination of them to correct errors or missing values and finally we represent them as one input feature for predicting real driving time. This gave us significant quality improvement of machine learning model.

ACKNOWLEDGMENT

The authors would like to thank to University of Žilina, which supported us during research and also thanks to Ceske drahy company, who allowed us to use their data with a lot of features. Thanks to great dataset we could analyze and find hidden relations between train properties and we hope it will help for future for better predicting driving time and train management system.



	Model	RMSE	R2
All data	RAW	180,41	0,527
	Processed	47,87	0,769
Passenger trains	RAW	148,83	0,624
	Processed	23,02	0,931
Cargo trains	RAW	238,47	0,530
	Processed	42,56	0,874

Table II
PREDICTION ERROR

Use of Apple iPad in Education in Primary Schools in the Czech Republic

M. Kuneš, M. Dosedla, J. Hrbáček, K. Picka

Abstract — This study focuses on the use of Apple iPads in lessons in primary schools in the Czech Republic. Despite the fact that in Western countries, both the manner and the efficiency of the use of iPads in various educational stages are already being researched, there are no such studies thin the context of the Czech Republic. In this regard, this study provides yet unpublished and innovative findings.

I. INTRODUCTION

The development of digital competencies is continuously being emphasized, which is proven among others by the constant efforts of the Czech Ministry of Education, Youth and Sports (MEYS) in the field of development and innovation of digital education strategies. In its promotional materials, Apple [1] boasts about the positive influence of their iPad devices in teaching – both upon the degree of involvement of students into education and their academic results. Our goal is to create an exploratory study focused on the very manner of use of Apple iPad tablets in the Czech primary school environment.

III. METHODOLOGY

We have determined the research problem in the following way: “How often and in what manner do primary school teachers use Apple iPad devices?” Using the qualitative approach upon the aforementioned problem, we tried to create a complex holistic representation of the situation in natural conditions of primary schools [9]. O1 has been selected as the main research question: In what manner are Apple iPads used in student education in primary schools? The final sample consisted of 5 respondents (ISCED 1 / ISCED 2 Teachers). Selected data collection method - semi-structured in-depth interviews with the respondents. Data analysis took place after a complete transcription of the interviews and it was performed using open coding analytical technique.

VI. RESULTS

A total of 4 categories, 11 concepts and 361 primary codes was identified.

A. iPad as a Teaching Aid - iPads can be classified as a didactic aid in schools. Displayed in table 1.

Using	Subject				
	A	B	C	D	E
Mirroring the content	✓	✓	✓	✓	✓
Playing videos	✓				✓
Exams	✓		✓		
Tasks and exercises for students	✓	✓			✓
On-line web activities	✓	✓		✓	
Application in teaching	✓	✓	✓	✓	✓

B. iPads Outside of Teaching in School Processes: funding aspect, motivation for purchase, professional trainings. Apart from teaching, the respondents have used the iPads mostly for administrative tasks

C. iPad and Students in Lessons: All the interviewed respondents have iPads for teachers and not directly for students at their schools, which limits the options of their use. Generally, teachers agree on possible benefits of using iPads.

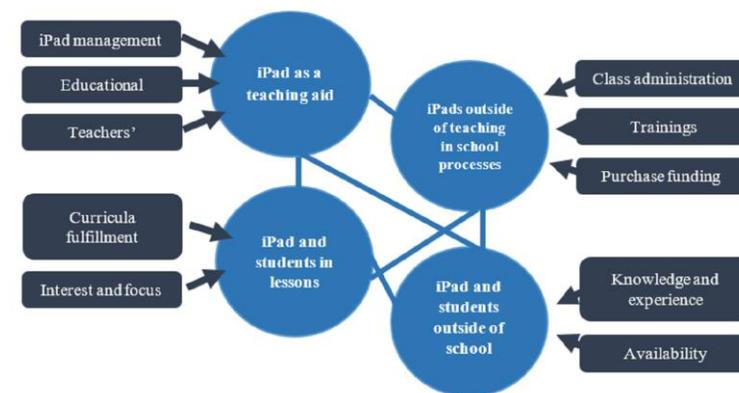
D. iPad and Students Outside of School: Most student a problem using the tablets and they also have practical experience from home. The teachers do not agree that the children would massively use the tablets for their own education.

VI. CONCLUSION

In general, we can state that within primary schools, there are significant differences both in the intensity and in the manner of use of the iPad devices. Limitations: financial condition of primary schools, high purchase price of iPads, paid programs within the Apple platform, IT literacy of teachers, the willingness of the teachers to introduce new technologies into established teaching programs. Implication into practice: all the interviewees agree that Apple products really actively contribute to improvement and diversification of the lessons and the course of teaching. If the number of iPads in primary schools could be increased, it could realistically be assumed that the quality of teaching would improve, and the students would acquire the discussed subject matter in a simpler and more interactive manner.

ACKNOWLEDGMENT

Authors would like to express our sincere thanks and acknowledgement of the efforts made by respondents for their advice in preparation of this study.



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Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Energy Harvesting for Wireless Embedded Systems

V. Kunštár, T. Krajčovič



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elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract – This paper discusses the selection of equipment for collecting energy from the environment. Different types of energy cell are compared from different perspectives, the performance and efficiency of the devices are analyzed. In general, we focus on the most well-known types of devices, such as photovoltaic panels. The reason for choosing these devices is their frequent use. We try to find the most suitable type of photoelectric panel for WESPEH.

I. INTRODUCTION

Wireless embedded system powered by energy harvesters (WESPEH) are energy autonomous, self-sustaining, maintenance free devices equipped with wireless interfaces. Those systems do not depend on battery or line power since they use energy harvesters as a source of energy. Enough energy can be harvested from a 5N force generated by pressing a button, a 5K temperature differential, or 400-lux luminance from a light source to power these devices. The term WESPEH has been defined in the work „Wireless Embedded System Powered by Energy Harvesting“. A WESPEH device includes an energy conversion component, in which an energy harvester transforms ambient energy to electricity. The energy management block feeds the converted electrical energy to long-term energy storage (like a gold cap capacitor) that powers the rest of the system. The microcontroller is the central processing unit of the WESPEH system. It controls all peripheral devices, interacts with the environment through sensor and actor interfaces and handles a radio communication with the RF interface.

II. CHOSEN ENERGY HARVESTING DEVICES

Choosing energy harvesting devices for WESPEH is an important step. The choice of energy harvester depends on the area of use and determines the successful implementation of the WESPEH system. For any electrical equipment to work, it must be powered by a particular power source. Usually, the devices are plugged in or powered by batteries. We can also use another type of energy to electrical power equipment, which we convert into electrical energy. An example of such a conversion of energy is the use of photovoltaic panels where solar energy is converted into electricity. In experiments, we will compare different types of photovoltaic panels and choose the most suitable type for us. The table below provides a general comparison of the efficiency of each type of photovoltaic cell from the values reported by the manufacturers.

Photovoltaic cells operate on the physical principle of electric current flow between two interconnected semiconductors with different electrical properties and based on the photoelectric effect. A photovoltaic cell is essentially a semiconductor diode, having a single P-N junction. The incident photons eject electrons from the N-type semiconductor, and there are free holes in the P-type semiconductor. The punched electrons and the free holes form an electron-hole pair between them, creating a voltage between the opposite poles of the cell. Photovoltaic cells are divided into three generations. First, second and third generations. From the point of view of production technology, we distinguish monocrystalline, polycrystalline and amorphous photovoltaic cells. With the advent of the third generation, new technologies for the production of photovoltaic panels, such as artificial photosynthesis, arise. We have verified three types of photovoltaic cells and their performance in artificial lighting inside the room. The photovoltaic cells were measured using artificial lighting with a chromaticity temperature of 6300 K and the spectrum in the Figure 1. The measurements were carried out by placing the individual panels in a black box placed in a dark room. The box size was 395mm x 570mm. Luxmeter was connected to the photovoltaic panel, by which we measured the lighting in the box. The panel was illuminated with a bulb having a chromaticity temperature of 6300 K. Parameters were measured with the digital measuring devices. The measurement was performed at a light intensity of 1200 lx. We wanted to find out how the photovoltaic panels behave in interior lighting. The table 1 shows the measured values for individual photovoltaic panels.

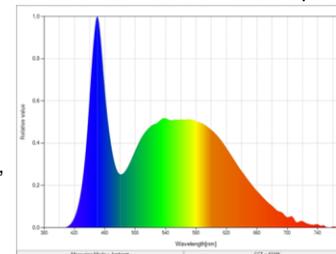


Figure 1. Artificial light spectrum

TABLE I. DATA VALUES OF INDIVIDUAL PHOTOVOLTAIC PANELS

	Monocrystalline	Polycrystalline	Amorphous
Type	MAXX	ESP-20	TPS-103
Isc (A)	1.19	0.0075	1.16
Uoc (V)	22.58	15.23	22.2
Um (V)	18.82	12.7	18.43
Iim (A)	1.08	0.0072	1.09
Ac (cm ²)	1746	1638.8	1652
Pm (W)	20	0.091	20
Cena (€)	32.99	19.9	33.99

III. CONCLUSION

From the above measurements and graphs a single crystal photovoltaic panel seems to be the best choice. However, measurements of power dependence on light intensity produced quite large errors that could not be corrected at the moment. When changing the light intensity, the 100% position of the photovoltaic panel and the light source could not be guaranteed (rays could reach the photovoltaic panel at an angle different from the previous setting). The measurement was influenced by fluctuating ambient temperature. Ultimately, in view of the area of use, area, cost, and power of the photovoltaic panel, it is most advantageous to use an amorphous photovoltaic panel. In the future, further measurements will be carried out comparing different types of amorphous cells in exterior and interior light.

ACKNOWLEDGMENT

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E-Health device for remote health monitoring

J. Lenický, M. Hradský, M. Kalina, J. Erdelyi, P. Čičák



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Conference Office

elfa, s.r.o.

Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839

fax: + 421-55-726 5195

e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — These days, E-Health became a very interesting domain. We can use this domain to improve health in every job. We can remotely monitor the health of different subjects. In this paper, we presented an E-Health device for remote health monitoring on humans. We created a device, where a human can measure his heat, heartbeat, and blood pressure, and then send this data to the server. This device was developed to monitor student health. With this device, we want to find out the health difference between standard learning processes and E-Learning processes. At the end of the experiment, we want to improve both learning processes.

I. INTRODUCTION

E-Health is an important part of the Internet of Things environment. With E-Health solutions, we can improve the health of many people. These days, many people use E-health applications or devices to monitor some health parameters – usually heartbeat. Most common health monitoring (except for people in hospital) use athletes. They monitor almost every health parameter to improve their health for sports performance. We can apply this monitoring in the E-learning process. We can monitor students for the whole day. Read their health data. Examine health data. Identify which E-learning process is most difficult for their health. Improve this process. This monitoring can be provided in the standard learning process, then we can compare both processes from a health perspective

III. PROPOSED SOLUTION

Our solution has three main components: A monitoring device, Smartphone, and a Server. We have secured communication between all parts. The monitoring device is an Arduino device for data gathering. This device takes patient data. We collect blood pressure, temperature, and heart rate. This data is transfer to a smartphone through a secure connection. A smartphone device takes data from a monitoring device and processes them to a JSON file. A smartphone attaches GPS data to JSON files and sends data to the server. At the server, data is stored in the database. The server provides a web portal for patients and doctors. At the web portal, doctors can see medical data and remotely monitor his patients.

V. FUTURE WORK

In the future, we want to improve our solution with new features and expand testing at people. First, we want to add some more sensors for patient monitoring. We consider the use of EKG monitoring sensors. With EKG monitoring, we can get more patient health data for analysis. We want to change the heartbeat sensor for the heartbeat and oximeter sensor. With one sensor, we can monitor two medical value. We also work on a better case for battery and Arduino devices. It is for comfort reasons. The patient should be able to better walk with a new cover. We consider implementing a real-time measurement system in our solution. With a real-time monitoring option, we can better evaluate patient health state in case of an emergency state. Our solution also needs more testing solutions and an increasing number of volunteers. First, we need to expand the testing time. In the beginning, we consider increasing nonstop testing time to at least 4 hours. Our ending goal is continuous testing time up to 12 (maybe 24) hours. With system and user experience testing, we will implement more languages into our solution, increase text size, refactor some functionality, and improve some user interfaces with a tutorial/help option.

VI. CONCLUSION

With the Internet of Things usage increase, we can make many application solutions. These solutions can be available at a lower price and can be used in inaccessible places. Internet of Things can be placed in many domains. E. g. Smart City, Smart Home, Logistics, E-Health, etc. These days, the E-Health domain is rapidly increasing. With the Internet of Things, patient monitoring can be less problematic. We can use the sensor and device to make easy remote patient monitoring. We created a remote wireless patient monitoring solution. Our solution was designed for E-Learning purposes to monitor the health state of students to improve learning processes. Our solution has many features. We can track patients, measure his health data, and analyse them at the server. Based on comparison and testing, we want to improve our solution in the future. We want to add new features, add new sensors, improve user interfaces, make a better battery and overall testing, and improve implementation details. In the future, we need to compare our solution to more commercially available solution.

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Speech Emotion Recognition Overview and Experimental Results

E. Lieskovska, M. Jakubec, R. Jarina



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Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839

fax: + 421-55-726 5195

e-mail: iceta@elfa.sk

www.iceta.sk

Abstract — Nowadays, speech emotion recognition is a promising area of research mainly for human-computer interaction. Emotions play significant role in educational process. E-learning such as online classes or student-computer interaction setting may require monitoring of emotional state of students, due to the maintaining of quality of provided education. Thus, automatic speech emotion recognition represents a powerful tool for this purpose. The following paper provides an overview of speech emotion recognition and related works. A comparison of various forms of recurrent networks (LSTM, LSTM with peephole connections, GRU) and recognition accuracy on IEMOCAP database is also presented.

I. INTRODUCTION

Emotions play significant role in educational process, therefore the affective state of students continued to be a subject of attention. In this challenging time, where online learning become normal part of education process, it is important to recognize emotional state of students during e-learning. The joy and curiosity are obviously preferred over boredom, anger and stress. In the online classes, we might often experience voice-only lecture and therefore the speech may be the only indicator of student's emotional state. In order to implement emotion recognition system, various methods of machine learning are usually used. In the past the speech emotion recognition (SER) systems consisted predominantly of acoustic features extraction and classifiers such as Support Vector Machines or Hidden Markov Models. In recent years, both the traditional and novel neural network architectures have been applied. Convolutional neural networks (CNN) are able to represent emotional speech directly from its spectrum. Recurrent neural networks (RNN) are capable of retrieving temporal dependencies between frame-level speech sequences. A combination of convolutional and recurrent networks exploit the advantages of both architectures in an end-to-end manner. Different kinds of modalities such as face motions and text transcripts have been used in order to improve recognition accuracy.

II. PROPOSED SPEECH EMOTION RECOGNITION SYSTEM

A comparison of various known forms of recurrent networks for speech emotion recognition is presented in the paper. RNNs are successfully applied on sequence data type in various tasks such as speech recognition, video classification, machine translation etc. Due to inability of RNN to capture dependencies in long sequences, other structures such as LSTM and GRU were proposed. These recurrent cells consist of gates, which shape the input sequences. Long Short-Term Memory (LSTM) and its modification with peephole connections, contain memory unit so that long term dependencies can be modeled. Gated recurrent unit (GRU) doesn't contain cell state unlike the LSTM. In our experiment, four sessions from IEMOCAP database were used for training and one session was used for testing. General approach is to choose 4 emotion for recognition (anger, happiness, sadness and neutral). Both scripted and improvised recordings were used. The basic set of low-level features from OpenSmile IS09 was selected for the audio samples parametrization: (12) Mel-frequency Cepstral Coefficients, energy, zero crossing rate, fundamental frequency, voicing probability and their delta coefficients. Proposed recurrent based system consists of 2 recurrent layers with 128 and 64 units with dropout set to 0.2. The same initialization setup was used in all experiments, so that the training variability does not occurs. An average pooling layer was applied for capturing general information from emotional utterance. Various recurrent layers were tested, namely the LSTM, LSTM with peephole connections and GRU. The system was implemented in Python by using TensorFlow library. The best recognition results obtained LSTM model (see Table I.). LSTM also had higher accuracies towards larger batches. The confusion matrix of LSTM system with 64 batch size is shown in Table II. Rows are actual class and columns are predictions. Classification accuracy for underrepresented class Happiness is the worst of all. Sometimes Excitement category is merged with Happiness to achieve better results.

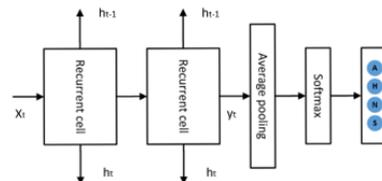


Figure 1. Block scheme of proposed recurrent architecture

TABLE I. EMOTION RECOGNITION ACCURACY OF THREE RECURRENT STRUCTURES

Batch size	32	64	128	256
LSTM	73.3% WA 68.8% UA	73.6% WA 68.9% UA	72.8%WA 68.5% UA	70.1%WA 68.2%UA
LSTM_p	69.9% WA 68.3% UA	68.7%WA 67.8% UA	67.1% WA 64.4% UA	61.9%WA 64.0 %UA
GRU	70.6% WA 66.6% UA	69.8% WA 67.1% UA	63.4% WA 66.2% UA	62.8%WA 65.9% UA

TABLE II. CLASSIFICATION ACCURACY OF PARTIAL EMOTIONAL CATEGORIES

	A	H	N	S
A	90.8 %	4.4 %	4.8 %	0 %
H	10 %	28.1 %	56.67 %	5.24 %
N	5.17 %	7.38 %	83.39 %	4.06 %
S	0 %	3.41 %	22.95 %	73.64%

(A= Anger, H=Happiness, N=Neutral, S=Sad)

VI. CONCLUSION

A review of modern speech emotion recognition systems is provided in the given paper. In this era of online learning, integration of SER system into educational process can improve quality of e-learning. A comparison of various known forms of recurrent networks for SER is also proposed. According the experimental results, LSTM based neural network achieved the best recognition accuracy, when compared to LSTM with peephole connections and GRU. There still exists issues need to be dealt with, e.g. improvements of recognition of underrepresented class Happiness. The bidirectional form of recurrent layers should be also compared.

ACKNOWLEDGMENT

This work is results of implementation of the projects: ITMS 26220120050 and ITMS 26210120021, co-funded from EU sources and European Regional Development Fund.

E-learning course as a space of a "virtual atelier" in art education

L. Liparová*, R. Pondelíková** and P. Voštinár

Abstract — The paper deals with using the electronic environment of LMS Moodle for supporting the art education in the preparation of the future teachers of art and pre-primary and primary level. During our research, we tried to find a qualitative way how to use the cyberspace of electronic course - to create a kind of virtual „atelier“ where students expose their realizations, experiences, opinions and attitudes.

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elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

I. INTRODUCTION

As a part of the project KEGA 003UMB-4/2019 Strategies in Art Education 2 - Continuity and Development of Didactic Competences of Students in Study Programs PF UMB (2019-2021) the research aims are to improve the didactic competencies of students - future teachers of arts and art competencies of preschool and elementary pedagogy. The partial goal is the implementation of electronic support for education, which we have been continuously verifying since 2016. It is an applied research that we carry out in several subjects. We have created a space for our students, which we call a "virtual atelier" [6], because it allows the submission of works of art online, their publication among course participants and providing space for discussions on works related to process reflection and evaluation of artistic and didactic outputs. The paper aims is to show how we use the electronic environment LMS Moodle in the training of future art teachers.

II. METHODOLOGY AND RESULTS

At the beginning of the course, we ask students (183 respondents) to think about the objectives of the course and identify those that seem important to them for their future practice. At the end of the course, we ask these students again to evaluate the course and indicate those goals that they think they have achieved in the course. We received answers from 109 respondents.

The comparison shows that the goals to which the students attached more importance (5th, 6th, 11th, 12th) also received higher scores in the final evaluation. Such an outcome can be seen as a positive assessment of the course by students: because their initial expectations have been met. The basic expectation from the subject was that students understand children's drawings and be able to interpret it and practically try different art techniques. At the same time, students had the opportunity to realize the importance of the ability to engage children for artistic activities as well as to be able to provide children with an evolving assessment that does not discourage them from creating.



Základy výtvarnej edukácie 1

Výtvarná hra

1. Princíp hry v umení a v predprimárnom vzdelávaní



Land art

Pracovní listy

Pracovní listy

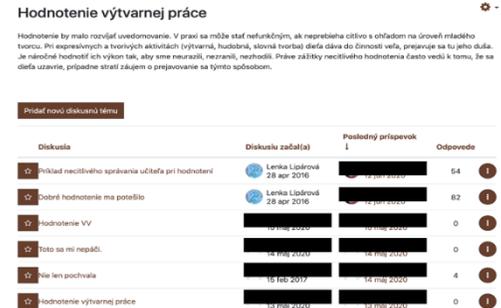
Pracovní listy



Anketa: Aká je dobrá hodina výtvarnej výchovy?

Pracovní listy

Pracovní listy



Hodnotenie výtvarnej práce

Príspevok	Diskusia začala(a)	Posledný príspevok	Odpovede
Príklad hodnotenia správania učiteľa pri hodnotení	Lenka Liparová 28 apr 2016	[Redacted]	54
Zabrá hodnotenie má pomôcť	Lenka Liparová 28 apr 2016	[Redacted]	62
hodnotenie VV	[Redacted]	[Redacted]	0
Toto sa mi nepáči.	[Redacted]	[Redacted]	0
ne ľem pochviala	16 feb 2017	16 mar 2020	4
hodnotenie výtvarnej práce	[Redacted]	[Redacted]	0

VI. CONCLUSION

In the contribution we describe the electronic environment of LMS Moodle as a tool for support the art education in preparation of future teachers of art for pre-primary and primary level. We described the way in which we use the penetration of practical experience and targeted reflection in the electronic environment in the subjects of art education. Virtual space is proving to be a very suitable support for teaching even in such a subject as art education. It is necessary to further improve the courses and adapt them to the current needs of students.

ACKNOWLEDGMENT

This contribution has been processed as part of the grant project KEGA 003UMB-4/2019 Strategies in art education 2.

A Survey on Robot Behavior and Distance Estimation in IndoorGML Maps Implementation. Mohd Aaqib Lone, Owais mujtaba khanday, Aadil Ganie Gani

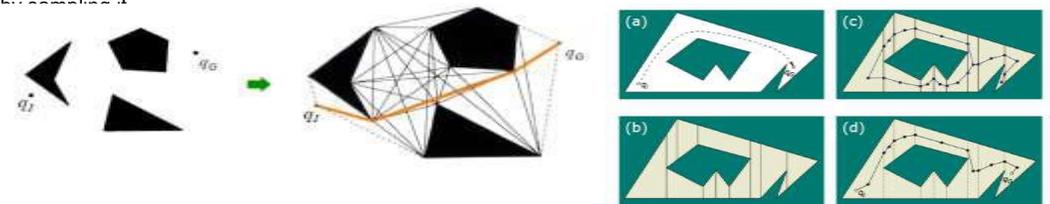
Abstract — The significance of behavior-based robots and the indoor navigation system has increased significantly over the past few years in its monitoring and wayfinding, taking into account the existence of robot behavior in various fields of social interest. The basic strategy of the overall behavior tasks in a behavior-based system is divided into smaller independent behaviors that focus on the performance of specific tasks such as the behavior of a robot for indoor environments. One behavior will concentrate on the wall, while the other focuses on avoiding obstacles, etc. Indoor navigation is the main concern since almost a lot of individuals spend more time in the indoor climate. In different fields such as hospitals, transportation, marketing, and military purposes, it becomes a very essential thought. The main goal of this paper to give a survey of distance estimation in IndoorGML, behaviors system, and the questions of their robotic implementation possibilities. In this essay, we define robot activities and two basic approaches to distance estimation, such as combinatorial planning and sampling-based planning. These two planning strategies are the principles of motion planning. Combinatorial planning is used for finding the path over the continuous configuration space without restoring it to approximations. The most used concept in planning is sampling based planning, it provides a successful solution in wayfinding path planning and because of this it is performed in different robotics fields. Therefore, for distance estimation in IndoorGML maps, we apply combinatorial and sampling-based approaches.

I. INTRODUCTION

These days, navigation and way-finding are becoming essential tasks because people spend much of their time in the indoor setting where way-finding might be difficult. Navigation in a hospital, for instance, where each floor is equally arranged, and the atmosphere is rather monotonous, for inexperienced workers, wayfinding and guidance are difficult tasks. Widespread smartphones will allow us to provide reliable indoor navigation and wayfinding services that are rarely used in indoor environments such as hospitals, airports, shopping centres, etc. Behaviour-based robotics is introduced for situated robots, enabling robots to adjust for the dynamics of real-world environments based on animal behaviour and also providing robots more computational capacity and expressivity. The behaviours are patterns of the activity of the robot that emerges from an external spectator's contact with the robot and its environment. Distance approximation is vital for way-finding. Although IndoorGML defines the structure of the building, it does not contain functions for distance estimation. The IndoorGML model may contain distance between the objects, but it has to be set manually, which is time-consuming. Hence there is a need for an automatic distance estimation method for IndoorGML.

II. OPEN CV LIBRARY

Indoor spaces are those spaces within one or multiple buildings which consist of architectural components such as rooms, doors, stairs, corridors, etc. IndoorGML can be defined in two parts, core data model and data navigation model. The core data model is used to describe the topological connectivity, geometry, and different contexts of indoor space. The data navigation model provides semantics for the navigation process and establishes a methodology to classify spaces and their indoor characteristics. Behavior-Based Robotics is a behavior what an external observer sees a robot doing. Robots are programmed to display desired behavior. For example behavior of a robot, one behavior task can focus on traversing a path from start to goal state, while the other one focus on avoiding obstacle. Deliberative control method in this the robot is going to uses all its internally stored knowledge and available sensory information to reason regarding what actions to be taken next. Reactive control method for tightly coupling sensory inputs and effector outputs, usually including no intervening reasoning to allow the robot to respond very immediately to developing and unstructured environments Hybrid control method merges the advantages of both reactive and deliberative control: such as the real-time reply of reactivity and the rationality and optimality of deliberation. Combinatorial planning is an approach of motion planning algorithm [15]. The motion planning algorithm can be expressed such as a robot is given with its initial state, final state, and geometric description of the robot and world. Then determine a path or sequence of valid configurations that move the robot gradually from an initial to the final state without hitting any obstacle. Translation and rotation are the main ideas in robot motion planning that is required to move a robot. Sample Based Planning (SBP) is the fact that planning occurs by sampling the configuration space. The responsiveness of the sampling-based planning approach is to try to catch the connectivity of the C-space by sampling it.



VI. CONCLUSION

Initial achievement in planning is to develop deterministic planning techniques. A robot is given with its start state, goal state, and geometric description of robot and world, and then find a path or sequence of valid configurations that move the robot gradually from start to goal while never touching any obstacle. After determining these methods it is required to try to connect the connectivity of start to goal state to find the valid optimal path using some graph searching algorithms such as Dijkstra. Simple based planning produces essentially in the configuration space (C-space). Configuration space is a space of all possible transformations such as free space and obstacle space. Combinatorial planning algorithms could be applied in a static environment where the obstacles are stationary while Sample-based planning methods are more complex and can be used dynamically changing environment. Because the layout of the building never changes, the usage of Combinatorial Planning algorithms is suggested. Visibility Graph yields a path which approaches the obstacles as close as possible. Hence the Visibility Graph method would give a good approximation of natural movement. The result of the Voronoi Diagram based method is quite the opposite of the previous one because it creates a route that is as far the obstacles as possible and this method seems to be quite useful for autonomous devices.



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Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Wrist Rehabilitation in Carpal Tunnel Syndrome by Gaming using EMG Controller

P. Lukács, E. Pietriková

Abstract — Technological progress brings many significant benefits but also new obstacles. Increasingly widespread sedentary jobs and computer work contribute to various health problems, such as carpal tunnel syndrome. This disease can be successfully treated or prevented through rehabilitation exercises. However, patients often do not enjoy these exercises and they are not determined to perform them precisely. The aim of this paper is to present a rehabilitation game application, as an interesting student-help project, providing more entertaining form of rehabilitation exercise.

I. INTRODUCTION

The aim of this paper is to create an interactive rehabilitation game, intended to facilitate the rehabilitation of patients suffering from carpal tunnel syndrome. These patients have problems with fine motor skills of the hand that make it difficult for them to perform routine activities, such as tying shoelaces or preparing food. Thanks to rehabilitation, they have the opportunity to regain control of their motor functions, but they often do not see enough progress in a certain time interval, they do not enjoy exercise, or it is painful for them. As a result of that they do not exercise to the extent and intensity they should. In contrast to the classic rehabilitation exercise, the interactive rehabilitation game provides a more entertaining and engaging form of exercises for the patient and allows to store data from rehabilitation exercises, thus enabling analysis of the progress and effectiveness of individual exercises.

II. PROPOSAL

The system consists of two parts, a game application and a gesture recognition program. The controller in the game application is a wearable Myo Armband sensor, which the user places on the forearm of the hand he wants to practice. Subsequently, the sensor connects to the computer and initiates communication with the application. Each user must log in so that the current measurement can be assigned to him and, if necessary, his progress can be evaluated on the basis of the stored data. The next step is the rehabilitation exercise itself. The sensor sends electromyographic data sensed from the user's forearm to the application at regular intervals via the Bluetooth protocol. These data are then interpreted as gestures and stored in a database at the end of the exercise for later analysis. Some gestures can be identified directly, but others must be sent to the gesture identification process. This process is located in a separate application, due to the use of another programming language that better supports machine learning methods. The main application sends the measured data to the application to identify the gesture and waits for a response. After identifying the gesture, the user receives a response in the form of the corresponding movement of the avatar in the game. The level of the game is adjusted to include a series of exercises used in rehabilitation.



III. EXPERIMENT

In addition to testing the functionality, we also performed user testing to verify the created solution. In the first phase of user testing, participants were introduced to rehabilitation exercises and performed exercises without the application. Next, they did the same exercise using a rehabilitation application. The evaluation of the usability and overall impression of the participants was obtained through feedback from the participants, which consisted of a commented completion of the tasks and the completion of a questionnaire. Seven people between the ages of 23 and 68 participated in the testing. Although test participants did not suffer from carpal tunnel syndrome, most of them spend more than 8 hours at the computer on a daily basis and are therefore potentially at risk for this problem. Four participants reported that they had experienced wrist pain or tingling in the past after long-term computer use. One of them even sought medical help.

VI. CONCLUSION

This form of rehabilitation provides a more engaging and entertaining exercise experience than the classic form and increases the patient's motivation to perform the exercise. Before testing the application, test participants had to practice the same series of exercises in the classic way. Many participants found this way of exercising boring and with increasing time tended not to perform it precisely. The application ensures that the exercises are performed precisely and evenly throughout the length of the exercise. In addition to motivation in the form of a more interesting way of exercise, the user is motivated to complete the exercise on a given day in the form of graphical recording of daily progress.

ACKNOWLEDGMENT

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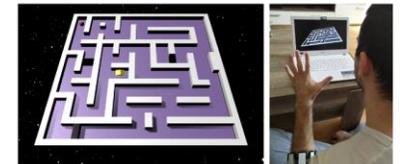


Fig. 3: Rehabilitation game – Primary settings and gameplay

Evaluation of Pointerless Sparse Voxel Octrees Encoding Schemes Using Huffman Encoding for Dense Volume Datasets Storage

B. Madoš, E. Chovancová, M. Hasin

Abstract — The paper deals with the problematics of the volume datasets representation using pointerless sparse voxel octrees hierarchical data structure. While this data structure, and derived hierarchical data structures based on the use of directed acyclic graphs, are popular in representation of the geometry of the three-dimensional scenes, their efficiency in the representation of other properties of voxels, e.g. color, is lower, due to the lower success in the lossless compression of the data. One of the solutions is to decompose volume dataset that comprises multi-bit values of its voxels, into bit planes and to use classical approach of their encoding to the sparse voxel octrees hierarchical data structures. The paper evaluates this approach along with the different encoding schemes of pointerless sparse voxel octrees.

I. INTRODUCTION

Popular data structures for the representation of three-dimensional scene geometry are hierarchical data structures, including sparse voxel octrees (SVOs) and directed acyclic graphs (DAGs). Ability of those data structures to lossless compression is especially high, in case of voxelized three-dimensional surface models. When other properties of voxels are taken into account, e.g. color, lower success of finding common subtrees lowers compression ratio. That is why we examine the possibility to decompose binary representation of dense volume dataset voxels into bit planes and to use sparse voxel octrees to encode each bit plane separately. Five different encoding schemes are evaluated in the paper in this context, when classical approach to the SVO representation is extended by the possibility of carving out of subtrees homogeneously filled by symbol 1; fixed-length of header tags of child nodes and variable-length of header tags (Huffman encoding) are examined along with the influence of permutations of header tags binary code assignment.

II. VARIOUS ENCODING SCHEMES OF POINTERLESS SPARSE VOXEL OCTREES

Test results show, that PSVO hierarchical data structure that uses Huffman encoding with the shortest 1b code used for header tags that indicate decomposition of the node into child nodes and 2b codes for carving out empty and filled subtrees, referenced in the paper as the PSVO V (Table I), yielded the best results regarding lossless data compression of all tested dense volume datasets (Figure 1). PSVO V allowed the size of the binary representation of volume datasets that represented from 30.91% to 61.45% (Figure 2) in comparison to the size of original volume dataset, stored in the raw format without any compression. It represents compression ratio from 1.63 to 3.24 in comparison to original data. Compression ratio of the PSVO V encoding, in comparison to the PSVO I, was, in performed tests, higher in all cases from 1.02 to 1.82 times.

PSVO I	PSVO II	PSVO III	PSVO IV	PSVO V
PSVO_I ::= <NODE> <LNODE> <NODE> ::= (8) <HT> HT ::= "0" "1" <NODE> "1" <LNODE> LNODE ::= (8) <BIT> BIT ::= "0" "1"	PSVO_II ::= <NODE> <LNODE> <NODE> ::= (8) <HT> HT ::= "00" "01" "10" <NODE> "10" <LNODE> LNODE ::= (8) <BIT> BIT ::= "0" "1"	PSVO_III ::= <NODE> <LNODE> <NODE> ::= (8) <HT> HT ::= "0" "10" "11" <NODE> "11" <LNODE> LNODE ::= (8) <BIT> BIT ::= "0" "1"	PSVO_IV ::= <NODE> <LNODE> <NODE> ::= (8) <HT> HT ::= "10" "0" "11" <NODE> "11" <LNODE> LNODE ::= (8) <BIT> BIT ::= "0" "1"	PSVO_V ::= <NODE> <LNODE> <NODE> ::= (8) <HT> HT ::= "10" "11" "0" <NODE> "0" <LNODE> LNODE ::= (8) <BIT> BIT ::= "0" "1"

VI. CONCLUSION

The paper dealt with the problematics of dense volume datasets representation using Pointerless Sparse Voxel Octrees (PSVO) hierarchical data structures. Five different encoding schemes of child node mask header tags were described along with the principle of decomposition of voxels into bit planes that allows more efficient encoding of multi-bit scalar values of voxels into PSVOs. Another approach that was examined was carving out not only subtrees homogeneously filled by the symbol 0, but also subtrees homogeneously filled by the symbol 1. Fixed-length and variable-length of header tags encoding was also examined. Medical volume datasets, obtained by various non-invasive medical imaging techniques, including CT and MRI, when each voxel was represented by scalar value, were used for testing purpose.

ACKNOWLEDGMENT

This work was supported by the Ministry of Education, Science, Research and Sport of the Slovak Republic under the contract No. VEGA 1/0327/20.

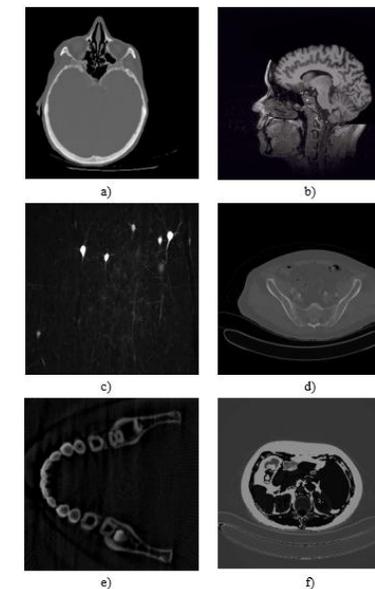


Figure 1 Slices of volume datasets used for testing purpose.

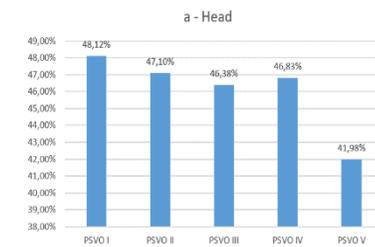


Figure 2 Share of compressed volume dataset size of original volume dataset.



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040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
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Recognition of Hate or Offensive Tweets in the Online Communities

K. Machová, D. Suchanič, V. Maslej-Krešňáková



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elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — In this paper, the research on the classification of texts into categories as hate speech or offensive language is presented. Such toxic posts represent unhealthy phenomena complicating learning and communication in online space. This classification was achieved by training a model using a deep neural network. The network was tested with different amounts of neurons in the hidden layer, with three distinctive optimizers and with various learning rates..

I. INTRODUCTION

The recognition of an antisocial behavior (hoax, fake, hate, ...) became more and more important nowadays, in the era of CoVID-19, when the most learning and communication activities are providing in the online space. Manifestations of a hate can be defined in several ways. "The speech, which is used to express a hatred towards a group or to insult, to ridicule and to embarrass members of a group of people" [1] is the definition we will work with. For these reasons, social networks are under a pressure to regulate these manifestations in some way, or to prevent certain users to use them. Facebook recently released an information about ways of regulation of the hate expression. Approximately 7 million contributions were removed during the quarter, of which 80% were marked by artificial intelligence and the rest were reported by users. In this paper, we deal with the classification of the hate content on Twitter, as a freely available data on HateBase are mostly Tweets.

II. LEARNING OF THE DEEP NEURAL NETWORK MODEL FOR CLASSIFICATION OF OFFENSIVE AND HATE POSTS

The artificial neural networks, or mostly called only neural networks, are massive parallel computing systems, which in their function and structure resemble biological neural networks. Summa of neural network inputs is processed using an activation function that generates output. The possibilities for simulating neural networks are currently extensive. We have used the Deep Learning Toolbox available in Matlab. This toolbox is Keras-like. The data was preprocessed, normalized and divided into training and testing sets (70/30%). Neural network topology was following:

1. *Input layer* – was represented in the form of 2 layers "sequenceInputLayer" and "wordEmbeddingLayer".
(These layers are used specifically for working with text.)
2. *Hidden layer* - Matlab provides 3 different hidden layers for work with text, namely: GRU, LSTM and BiLSTM.
3. *Output layer* - consisted of 2 layers namely "softmaxLayer" and "classificationLayer". "SoftmaxLayer" represents an activation function.

III. TESTING AND EVALUATION

We have tested three optimizers: ADAM, RMSProp and SGDM. The best results were achieved by LSTM network using SGDM optimizer with learning parameter $\delta = 0,5$ (see Table VII.).

These combination (LSTM + SGDM + $\delta = 0,5$) was used for training NN model for recognition of offensive and hate posts.

The final model achieved 95% of Precision and 94% of Recall in recognition of offensive posts (see Table VI.).

IV. CONCLUSION

The goal of presented research was development of a solution for identification of offensive and hate posts.

Our model based on neural network LSTM achieve the best performance using SGDM optimizer in recognition of offensive posts.

On the other hand, the model was not successful in the case of Hate posts.

For future, we would like also to use the same neural network to classify content on a dataset created in Slovak.

The automatic recognition of hatred can help teachers to teach an information literacy and a critical thinking.

ACKNOWLEDGMENT

The work presented in this paper was supported by the Slovak Research and Development Agency under the contract No. APVV-16-0213 „Knowledge-based approaches for intelligent analysis of big data" and No. APVV-17-0267 „Automated Recognition of Antisocial Behaviour in Online Communities".

TABLE VII.
RESULTS OF LSTM NETWORK USING THE SGDM OPTIMIZER.

Learning parameter δ	Accuracy	Loss
0,01	77,44%	0,60
0,05	89,02%	0,33
0,10	88,74%	0,33
0,20	89,83%	0,27
0,50	90,60%	0,30

TABLE VI.
THE CONFIDENTIAL MATRIX FOR 3 CLASSES – HATE, OFFENSIVE AND NEUTRAL TWEETS

	Hate	Offensive	Neutral	Precision
Hate	48	37	0	56,5%
Offensive	70	1807	26	95,0%
Neutral	25	75	390	79,6%
Recall	33,6%	94,2%	93,8%	90,6%

Visualization of noise shaping through models of a first-order $\Sigma\text{-}\Delta$ modulator with single-bit quantizer

D. Maljar, V. Stopjaková, D. Arbet

Abstract — The main goal of this work is to visualize one of the basic properties of the Sigma-Delta analog-to-digital converter ($\Sigma\text{-}\Delta$ ADC) - noise shaping. For this purpose, two models of the $\Sigma\text{-}\Delta$ modulator were analysed - the model using an integrator without delay and the model using an integrator with delay. Both of these visualizations are based on the principle of superposition, since two input signals (the useful input signal and the quantization noise) are considered in the models. Visualizations are shown in the z-plane as well as using the magnitude vs normalized frequency graphs constructed in Matlab environment.

I. INTRODUCTION

A very important aspect of any scientific field is being able to imagine various statements, definitions, equations, etc. Pictures, sketches, graphs, models and everything related with them are irreplaceable tools. The visual imagination can reveal various possibilities of solving a given problem. In the theory of signals and electronic systems, a complex plane is very often used. We use s-plane for continuous time signals and z-plane for discrete time signals. The truth is that the complex function cannot be realistically visualized, but the dependence of the magnitude vs the complex plane is also very useful for describing different phenomena occurring in the electronic systems.

Analog-to-digital converters (ADCs) are ones of the most important and most frequently used electronic circuits. In general, each ADC consists of the anti-aliasing filter for fulfilment of the sampling theorem, a sampler and a quantizer. Due to the quantization of the sampled signal, quantization noise is generated in the ADCs. One of the characteristic processes for the elimination of quantization noise is *noise shaping*, which can be achieved by including an $\Sigma\text{-}\Delta$ modulator to the general block scheme of the ADC.

II. GENERAL MODEL OF $\Sigma\text{-}\Delta$ MODULATOR

To visualize noise shaping, it might be sufficient to model only the $\Sigma\text{-}\Delta$ modulator. Since there is a sampler in the ADC system connected in front of the modulator (in terms of the input signal path), the model can be created in the frequency domain by z-transform. The most important prerequisite for creating a usable model is its *linearization*. It is necessary to choose the proper transfer function of the low-pass filter (integrator) as well as the transfer function of the 1-bit DAC which will have an effect on the quantization noise transfer function and the useful signal transfer function.

III. MODEL USING INTEGRATOR WITHOUT DELAY

In this case, the integrator is modeled by a delay element connected in the feedback and by a summator that subtracts this feedback value from the useful input signal. The 1-bit DAC is modeled by a delay element connected in the feedback of the whole $\Sigma\text{-}\Delta$ modulator. The noise shaping can be observable in the individual magnitude dependences in the z-plane. The zero in quantization noise transfer function in $z = 1$ is compensated by pole in the integrator transfer function in the same point. The same analogy exists between the pole in the quantization noise transfer function in $z = 0$ and zero in the integrator transfer function in the same point. It is important to note that this visualization is realized in logarithmic scale of mentioned magnitude dependences.

IV. MODEL USING INTEGRATOR WITH DELAY

The integrator is modeled by a delay element connected in the direct way of the useful signal and unit feedback connection subtracted by a summator from the useful signal. The 1-bit DAC in the main circuit feedback loop is modeled as an ideal one. The zero in quantization noise transfer function in $z = 1$ is compensated by pole in integrator transfer function in the same point. Pole in quantization noise transfer function in $z = 0$ is not compensated but it has no effect on the magnitude dependence of transfer function of useful signal. Again, as in the case with the integrator without delay, it is important to note that this visualization is realized in logarithmic scale of mentioned magnitude dependences.

V. CONCLUSION

Visualization models presented in this paper can help students of IC design better understand the issue of noise shaping at a higher level of abstraction. One can directly observe the compensation of the noise spectrum through the spectrum of the integrator from magnitude vs z-plane dependences. As for IC design field, it can help to properly model the $\Sigma\text{-}\Delta$ modulator based on high mathematics - visualized complex analysis. Moreover, the proposed models can be adapted to the specific requirements of a complex circuits and systems.

ACKNOWLEDGMENT

This work was supported in part by the Slovak Research and Development Agency under grant APPV 19-0392 and by Ministry of Education, Science, Research and Sport of the Slovak Republic under grant VEGA 1/0731/20.

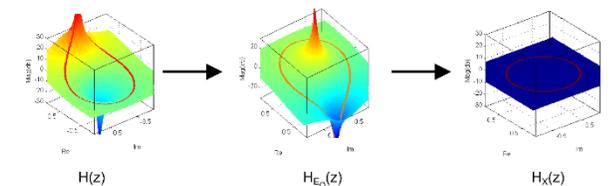


Fig. 1 - Noise shaping visualized by magnitude vs z-plane dependences of integrator (without delay), quantization noise and useful signal transfer functions

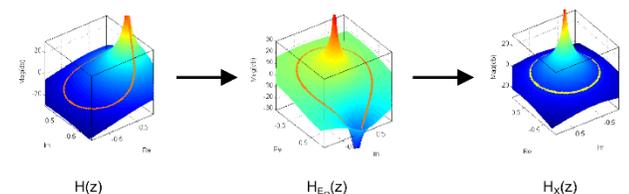


Fig. 2 - Noise shaping visualized by magnitude vs z-plane dependences of integrator (with delay), quantization noise and useful signal transfer functions

The Knowledge Competencies and Digital Competencies of Project Managers in Life Cycle Cost Management

T. Mandicak, P. Mesaros, M. Spisakova, M. Behun and A. Kanalikova



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elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — Training of project managers and their development of knowledge competencies and digital competencies is one of main attributes of success performance results in each sector. The use of digital and knowledge technologies can be a prerequisite for effective life-cycle cost management in context of development of digital and knowledge competencies. Life Cycle Cost Management is an important part of cost management and approach in each industry. The construction industry is an important sector of the country's economy. It is the relationship between project managers and their level of use of knowledge and digital competencies that can be key concerning effective cost management in construction. Acquisition of digital and knowledge competencies and skills through the use of digital and knowledge technologies is a process for increasing managerial competencies. This research addresses the relationship and how to acquire knowledge and digital competencies using knowledge and digital technologies in Life Cycle Cost Management. It is the relationship and use of digital technologies, the level of knowledge and digital competences and the level of lifetime costs that is the subject of research. The main goal of the research is to point out the relationship between the acquisition of knowledge and digital competencies and the amount of life cycle cost management in individual phases of the life cycle of a construction project.

I. INTRODUCTION

Knowledge and digital technologies represent a new alternative and opportunity for development of knowledge competencies and digital competencies and education of managers use in cost management in every sector. Knowledge time requires a different approach to development of digital skills and competencies and education process for cost management. The development of knowledge and digital technologies is moving significantly. A process approach to cost management is beginning to be required in every segment. Life cycle cost management requires a different perspective and established cost management practices. It is the perception of these competencies with the context for increasing competencies that seems to be one of the key aspects. According to several studies, the perception of life cycle cost management and the acquisition of digital and knowledge competencies seems to be closely related. Life Cycle Cost Management and knowledge is possible discussed through digital competencies.

II. METHODOLOGY

The research question: What is the relationship between the use of knowledge and digital competencies, the development of digital and knowledge competencies for project managers and, last but not least, the development of costs in individual phases of a construction project. The main aim is therefore to analyze these relationships. The research sample can be viewed from several perspectives. As we obtained more detailed general information about the research sample, we were given the opportunity to make a more detailed analysis and correlations between them. Data collection was ensured by a questionnaire survey.

III. RESULTS AND DISCUSSION

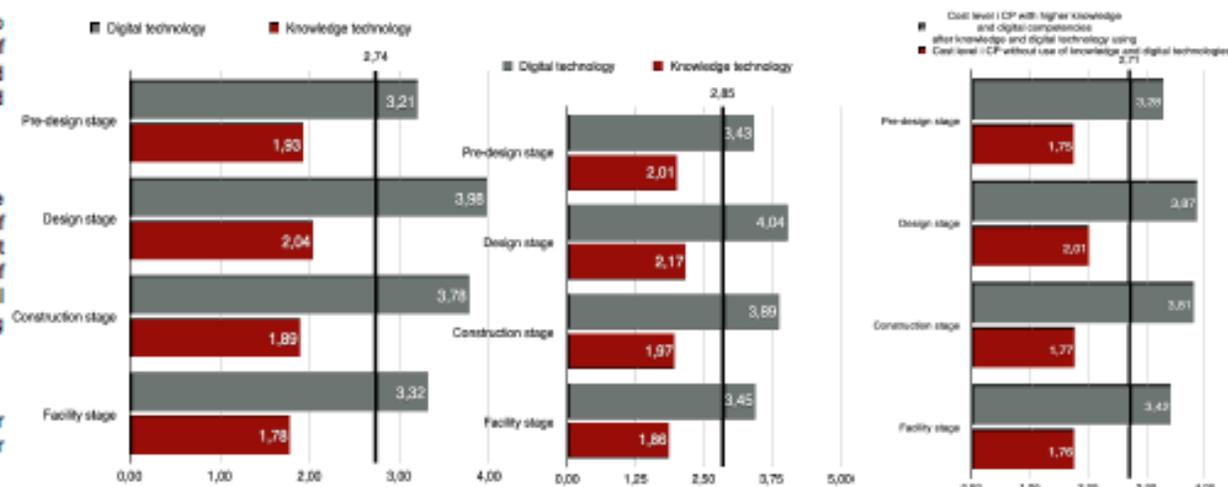
Managerial competencies represent a complex of competencies which, based on a theoretical overview, can be divided into several groups. The presumption that the use of knowledge and digital technologies is linked to the acquisition or level of knowledge and digital competences. This relationship has been extended to the relationship between the level of knowledge and digital competencies of project managers and cost management. This is an assumption that the higher the level of digital and knowledge competencies of managers, the better the results will be recorded at the cost of the CP throughout the life cycle.

VI. CONCLUSION

The issue of knowledge and digital competencies is very important from the professional growth of project managers. The implementation of digital technologies in the CPM in each phase has several advantages. One of them is the acquisition of knowledge and digital competencies of managers. The increase in these skills is a prerequisite for better performance. When it comes to performance parameters, then costs are clearly among the key performance indicators. The implementation of knowledge and digital technologies, their use by project managers to increase managerial competencies and achieve optimal cost management. Digital and knowledge technologies also represent the future in gaining experience and developing competencies.

ACKNOWLEDGMENT

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Proposal of Virtual Classroom Network's concept based on VXLAN's in the COVID-19 context

A.B. Mbacke, G. Mendy, S. Ouya and D. Seck



ICETA 2020
Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — As covid-19 lockdown forced education institutions to find solutions to maintain pedagogical activities while respecting safety measures. We here share a proposal from Ecole Superieure Polytechnic of Dakar based on the application of VXLAN technology to educational network systems, in order to provide to each class a specific virtual classroom network. Using Wireguard to create a VPN connection, devices are dynamically set to a specific class VXLAN and Zeroconf used for Autodiscover between terminals. The solution integrates multiple services to offer a virtual space for social constructivism based pedagogic interactions.

I. INTRODUCTION

Academic institutions are facing technical challenges to continue their teachings while respecting safety measurements in the Covid19 context, physical distance being the main one. In Senegal, some management rules have been published by the Higher Education Ministry for universities to follow, including[1]: A minimal distance of 2 seats, avoidance of equipment and learning material sharing between students, use of collaborative digital solutions as much as possible to replace physical courses. In this paper, we share the Ecole Superieure Polytechnique's experience and solutions, through the proposal of a logical and technical architecture inspired from VXLAN cloud concept.

II. PROPOSAL DESCRIPTION

Technical Architecture : In the protected area of the network, are installed: a radius server, a database server and a Wireguard Server for VPN connections. When connecting from within, users naturally pass by the intranet authentication portal before being affected to a specific VXLAN. Therefore, on each internal device are installed Zeroconf User and Service agents and a Collaborative tool used for a course.

When connecting from the internet, users go through the VPN server to be identified and then affected to their specific VXLAN. To do so, they have access to multiple tools that can be installed easily from an online public source (a git public repository). After installation, they will have the necessary VPN pre-configured client, the Zeroconf agents, and connection/disconnection programs. (See Fig. 1 et Fig. 2)

III. RESULTS AND DISCUSSION

The application and usage of the architecture will be described using two scenarios (see Fig. 3):

- a- An indoor situation, where teachers and students are separated into multiple rooms, but all connecting from the intranet;
- b- A hybrid situation where some participants (either teacher or students) are connecting from internet to a course session.

For each situation, the connection process, the result of the connection in the user device, and the usability of collaborative tools is proven.

Limits and extensions of the proposal

The post analysis of the solution's usage lead to three kinds of remarks : technical qualities of the system, (compared to existing solutions), pedagogic and social qualities, and possible improvements.

- **Technical Qualities** : **Hybrid**: the solution works in extra and intranet at the same time + **Adaptability**: working at OSI's level 3, its independent from the application level + **Number of virtual classes networks**: with more than 16 millions subnetwork supported + **Local bandwidth usage**: once in the intranet of the school, all interactions are done using optical fiber network + **Low cost**: no additional elements are needed + **Autonomy**: the institution is independent from cloud services if needed
- **Social and Pedagogical qualities**: **With the possibility from working at home** or separately from students + **Social constructivism learning interactions**, in case of technology training, can be implemented more easily + **Being independent from networking protocols**, a more diverse range of applications can be used for practical labs + **A new kind of virtual resource is provided to the education system**: a virtual classroom network, available 24/7 + **Safety measures**, concerning equipment sharing, is more easily respected because their access is remote and digitalized.
- **Improvements** : **Graphical interface needed**, **Lack of bandwidth dimensioning model**, **Need of high scale performance validation**, **Need of security policies development in case of access to the VXLAN**

VI. CONCLUSION

Ecole Superieure Polytechnic of Dakar, hereby share its experience with the concept of Virtual Classroom Network. Using cloud technology concepts, and applying them to a pedagogic environment, we have been able to connect students and teachers from within our building or outside from the internet, in a singular protected network unit. With auto discovery services they don't need to adapt their configuration to interact and collaborate in a course or to realize a lab. Now they can keep on doing the same interactions and using the same software in a new manner, without the need of a specific training.

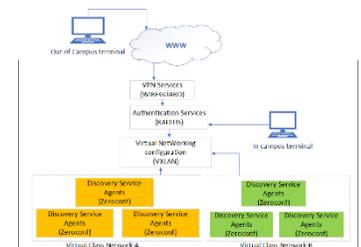


Figure 1. Logical Architecture

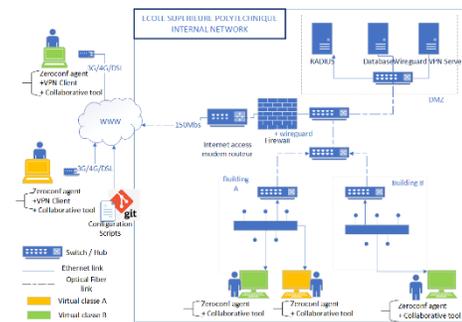


Figure 2. Technical Architecture

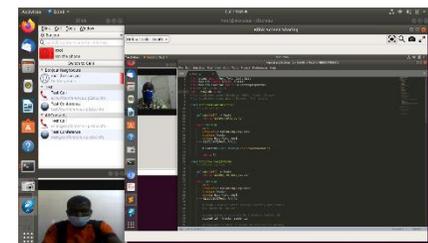


Figure 3. Technical Architecture

The Level of Digital and Communication Competencies of Students at Faculties with a Construction Focus in the Distance Learning Form

A. Kanalikova, P. Mesaros, A. Behunova, T. Mandicak and M. Spisakova



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elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — For education, 2020 became the year of distance learning and online communication in the teacher-student relationship, but also in the student-student relationship. This teaching system brings many challenges for both parties and the need to improve the communication and digital competencies of all involved. It also requires increased demands on the hardware and software provision of teaching on both sides of the teaching process. This article focuses on the issue and description of communication and digital skills needed for distance learning. The main goal of the research is to compare and map the communication and digital ICT competencies of faculty students with a construction focus during full-time and distance learning. The results of the research are analyzed in the article using methods of descriptive as well as analytical statistics.

I. INTRODUCTION

2020 will be recorded as the year of the COVID-19 pandemic. While from the beginning the pandemic affected mainly the medical sectors, now the consequences of its spread permeate all sectors of ordinary and working life of each of us. We are also seeing huge changes in the field of education. Communication itself is one of the most important parts of the educational process. While this communication took place in physical space during full-time teaching, it moves to online space during a pandemic. During distance learning, online communication takes place not only in the teacher-student relationship, but also in the student-student relationship.

II. THEORETICAL BACKGROUND

During the first wave of the COVID-19 pandemic, the students themselves communicated via various social networks, such as Twitter, Facebook, Instagram, Slack, Youtube, which offer not only asynchronous but also synchronous communication options. When creating training courses during distance learning, the educator must consider the need for individual ICT tools and then choose the platform that will best help him during online education and at the same time will be available to his students. Table provides an overview of communication platforms based on the features and tools they contain.

III. METHODOLOGY

Research is focused on digital competencies associated with the use of communication and presentation platforms of university students with a construction focus during distance learning in the first wave of the COVID-19 pandemic. The main goal of the research is to compare and map the communication and digital ICT competencies of faculty students with a construction focus during full-time and distance learning. We used the methods of descriptive as well as analytical statistics to evaluate the research.

III. RESULT

The pandemic period and the associated transition to distance learning brings an increase in the number of students using synchronous communication during teaching. Students still prefer Face to face learning, up to 50% of the interviewed students. 19% of students chose distance learn. Based on the main goal of the research, we set the null hypothesis H_0 : The rate of use of synchronous communication platforms of students of faculties with a construction focus during the full-time and distance form of teaching is the same. The H_A hypothesis was set as an alternative hypothesis: The rate of use of synchronous communication platforms of students of faculties with a construction focus is higher during the distance form of teaching than during the full-time teaching. Both hypotheses focus only on student versus teacher communication. When calculating according at the selected level of significance we can reject hypothesis H_0 and accept hypothesis H_A .

VI. CONCLUSION

From the research, we observe an increased frequency of the use of synchronous communication platforms by students, not only in interaction with the teacher but also outside the teaching process in interaction with other students. Our hypothesis that the rate of use of synchronous communication platforms of students of faculties with a construction focus is higher during the distance form of teaching than during full-time teaching has been confirmed. We are also seeing an increase in the level of use of presentation software in education, as distance learning requires a greater degree of feedback as well as increased demands on evaluation. Many subjects at universities with a construction focus include, as one of the forms of control and evaluation, the creation of home assignments through various construction software. The presentation of these assignments during the face to face learning form uses mainly the verbal presentation of his work. During the distance learning form, students thus reach for various presentation software to a greater extent and subsequently present their work to the teacher.

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Platform	Sharing	Evaluation and testing	Feedback	Videoconferencing	Chat
Big blue button	✓	✓	✓	✓	✓
Class Webex	✓	✓	✗	✓	✓
EduPage	✓	✓	✓	✗	✓
Google classroom	✓	✓	✓	✓	✓
LMS (Moodle)	✓	✓	✓	✗	✓
Messenger	✓	✗	✗	✓	✓
Microsoft Teams	✓	✓	✓	✓	✓
Pol Everywhere	✗	✓	✓	✗	✗
Schoology	✓	✓	✓	✓	✓
Skype	✗	✗	✗	✓	✓
Seaview	✗	✓	✓	✗	✗
WhatsApp	✓	✗	✗	✓	✓
Zoom	✗	✗	✗	✓	✓

Advanced Biometric Systems Utilizing Neural Networks in Identity Evaluation

M. Messerschmidt and M. Pleva

Abstract — Neural networks have become a staple of today's day and age. Its data classification usage is very pronounced in biometrics. Its use can be seen notably in the fingerprint, iris, or facial recognition biometrics. However, the fact is that neural networks are intrinsic to biometrics in their authentication capabilities. This is not to say that every biometric system must employ these methods; rather that they are applicable to any biometric method. For this reason, in this paper, we will expand upon the presented biometric methods. In this paper, we will be presenting more advanced techniques such as finger vein and retina recognition; and alternative methods such as ECG and odor biometrics. We will converge on showcasing these methods as well as exhibiting their current usage in today's climate.

I. INTRODUCTION

In our previous paper [1], we managed to explicate the three basic biometric methods utilizing Neural Networks. These methods were the most prevalent biometric methods currently practiced. We described the basics in fingerprint recognition, iris recognition, and facial recognition. Nevertheless, there are many more biometric methods on which we will expand. First, we will focus on more advanced biometric systems – for example finger vein scanners in ATMs (see Figures). We will concentrate on the most popular ones, such as finger vein recognition and retina recognition. Both of these are forms of vein biometry, usually accomplished by casting a ray of low-energy infrared light. In the second part, we will focus on alternative biometric systems. Among the presented methods is ECG, also known as an electrocardiogram and odor biometrics.

II. ADVANCED BIOMETRIC SYSTEMS

A. Finger Vein Recognition

Many external factors, such as cuts, scars, and dry skin, can often prevent fingerprint readers from reliably identifying an individual. They can also be very vulnerable to spoofing when used as an authentication method solely by themselves. Nevertheless, vein scanners resolve these concerns by capturing images of the vein patterns inside the human finger. Similar to fingerprint recognition, most vein biometric systems consist of four modules: image acquisition, image pre-processing, feature extraction, and feature matching. Image acquisition is made by casting a beam of near-infrared (NIR) lights combined with a special camera to capture the finger vein patterns' image. This can be achieved with multiple techniques, as demonstrated in Figures below. The near-infrared light is absorbed by deoxyhemoglobin, which is present in the human blood; thus, the vein patterns emerge as a sequence of dark-colored lines. These patterns (like other biometric patterns) are unique, and because they are inside the human body, finger vein patterns are quite difficult to damage or replicate.

B. Retina Recognition

Claimed to be one of the most secure biometric methods, a retinal scan is a biometric technique that first emerged in the 1980s [10]. Its core principle, similar to any vein biometric system, functions by scanning vein patterns. These patterns that are present on the optic nerve's ending are unique identifying traits for each individual. Each eye has a unique pattern; this also includes twins [11]. However, unlike iris or finger vein recognition, capturing these patterns can prove a lot more complicated because the retina is internal and relatively small.

The most common way to capture a vein pattern is to use a small NIR light. The subject has to position itself close to the sensor and stare directly at it while remaining completely still. This process can be quite tricky and can be considered invasive because, unlike in other biometry methods, NIR is beamed directly into the individual's eye. A less invasive approach is possible with the use of digital non-mydratric retinal cameras; though, these are even more expensive than the aforementioned NIR sensors.

III. ALTERNATIVE BIOMETRICS

A. Odor Recognition

Every human individual produces a unique odor regardless of diet; body odor can be a unique identifier [18]. The body is capable of this because it emits volatile organic compounds (VOC), differentiating the odors [18]. These compounds can then be considered as a unique identifier. Many studies have examined the relationship between the major histocompatibility complex (MHC) genes and an individual's odor signature [19]. These findings indicate that the MHC gene somehow influences human odor production, rendering the odor of individuals distinct from one to another. These findings suggest that we can use odor as a biometric pattern.

B. ECG Recognition

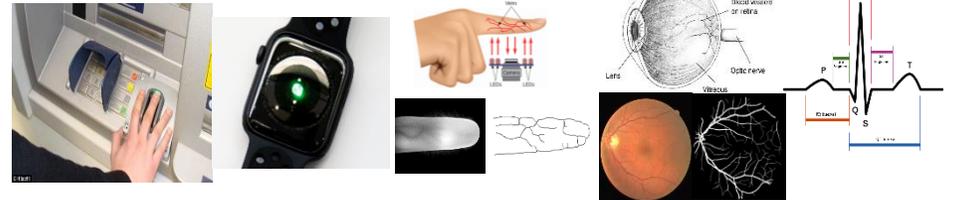
ECG is the measurement of electrical activity within the human heart. The heart's electrical activity has been used for medical analysis for years but can also be used in a biometric scenario. The recording device itself consists of an electrode, the number of which can range from two to ten or more [23]. These are then applied to different parts of the body. The usual setup would persist of a single diode applied to each limb and six on the chest near the heart. These diodes are then used for continuous measurement of the electrical activity within the heart. ECG biometrics' main challenge is using fewer diodes for practicality's sake, resulting in less accurate readings.

IV. CONCLUSION

This paper presented four different biometric methods: finger vein, retina, odor, and ECG. These biometric methods were also presented with an identity evaluation method, such as verification or identification that utilized neural networks such as CNN or Deep CNN. As we can see from the results in the paper, the neural networks solutions mostly outperform the current algorithmic approaches and bring promising directions.

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elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Blended Learning as a Way of Teaching in the Pandemic Period

A. Michalíková, M. Povinský



ICETA 2020
Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — Blended learning is a formal education program in which a student learns at least in part through online delivery of content and instruction with some element of student control over time, place, path, and/or pace and at least in part at a supervised brick-and-mortar location away from home. We present an example of use of blended learning education for the university courses, specifically for the Fuzzy sets courses. These courses are taught on Matej Bel University, Faculty of Natural Sciences, Department of Computer Science. The presented example is being used in the teaching of external students. Since this period is affected by the COVID-19 disease it is useful to be prepared for teaching all of the students with the use of these methods.

I. INTRODUCTION

The presented research is focused on the use of blended learning education for the university courses. Many countries invest huge amount of money into integration of modern information and communication technologies into education. They believe that the integration can increase the quality of the education, as well as the level of knowledge of the students. This trend can also be observed in the Slovak Republic. One of the tasks for the faculties at Slovak universities is to prepare students for efficient utilization of modern technologies into the real life. To fulfil this aim it is necessary to create new e-learning courses for chosen subjects, update and enrich the existing courses with new interactive elements, create electronic tests to the e-learning courses and analyse the efficiency of teaching with the use of blended learning methods.

II. LMS MOODLE AND COURSES OF SUBJECT FUZZY SETS

At Matej Bel University, Learning Management System Moodle is being used since the year 2011. It allows teacher to prepare different types of materials for teaching and also assigning of tasks, tests and projects for students. We present an example of the use of blended learning education for the university courses, specifically for the Fuzzy sets courses. The mentioned courses are taught on Matej Bel University (MBU), Faculty of Natural Sciences, Department of Computer Science. The presented example is being used in the teaching of external students. In Department of Computer Science of MBU, subject Fuzzy sets is divided into two semesters. The first part of subject, Fuzzy sets 1, is placed into the first year of master studies. In this course students gain the basic mathematical theory of fuzzy sets. Later, in the second part of the course, Fuzzy Sets 2, students use obtained knowledge and create different projects with the use of fuzzy sets. This course is taught in the second year of master studies. Materials for the courses are stored in the Learning Management System Moodle (LMS Moodle). Moreover, university level textbook "Fuzzy množiny v informatike" (Fuzzy sets in computer science) was written for the purposes of this subject. The content of this textbook was created on the basis of these courses.

III. COURSE OF SUBJECT FUZZY SETS 2 IN LMS MOODLE

In the course Fuzzy sets 2, we are using the principles of blended learning. The course Fuzzy sets 2 is practically oriented course. It is focussed on different fuzzy systems which are used in real life situations. For example, some of explained topics contain:

- different kinds of fuzzy inference systems,
- principle of fuzzy clustering analysis,
- possibilities of using fuzzy relations and so on.

While the internal students have these courses each week at school, the external students have combined studies divided into home studying of the basic theory, acquainting themselves with specific requirements and creating the proposed systems in school and preparing their own solutions of chosen problems of real life situations again at home. In each part of learning, students have the possibility to communicate with the teacher.

VI. CONCLUSION

We could conclude that after the end of the semester, we were not able to find any differences between the knowledge of internal and external students. Both groups of students prepared high quality solutions to the problems. The students were very satisfied with the possibility to choose their own areas of interest and create the systems in these areas as real life situations. In this course, it was confirmed that the idea of students studying the needed theory by themselves leads to ability of preparing correct solutions of the problems. On the other hand, if the students study the theory and prepare the solutions of some problems correctly, they need to get the feedback on the level of their knowledge. The teaching by using blended learning principles represents the right way to teach the students in the case of limited options to teach students regularly at school.

ACKNOWLEDGMENT

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Curriculum guidelines for new Fintech Master's Programmes

Bálint Molnár, Ádám Tarcsi, Francoise Baude, Galena Pisoni, Chan Nam Ngo, Fabio Massacci



ICETA 2020

Conference Office

elfa, s.r.o.

Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839

fax: + 421-55-726 5195

e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — The advancements within the field of computer science in the last years has been enormous. AI cloud services, crypto currencies, 5G, autonomous vehicles, smart homes, quantum computing, affective computing. The traditional organizational model for preparing computer science educators should be also following this fast pace and study programs should be aligned with recent developments and the latest trends in industry. The aim of this article is to present to future educational designers examples of one new program in the domain of Fintech, and how 3 technical Universities in Europe prepared their Fintech Masters degrees. We give further suggestions and guidelines for universities how to develop such programs.

I. INTRODUCTION

Recently advances have been made in studying how to adapt the existing model for teaching computer science to meet the requirements of the 21st century labor market. Educational strategies need to be adapted to promote self-regulated learning, problem solving, collaboration, and teamwork. How to develop such programs remains a challenge. This paper is focused on a pedagogical model of an academic Fintech academic program and provides three examples of universities already planning and implementing such curriculum. The methodology employed for implementing it at the different Universities, aims to promote and focuses on lifelong learning and development of the skills needed for the students in the Fintech domain. We reflect on the courses offered in our network of Universities and reflect how Universities can implement such programs.

II. DESIGNS OF FINTECH MASTERS DEGREES

Financial Technology (FinTech) is a cross-disciplinary subject that combines Finance, Technology Management and Innovation Management. FinTech initiatives often lead to new business models or even new business. Although the emergence and development of FinTech and the demand for FinTech talents and skills have widely been discussed, examples of such degrees designs are lacking as well as concrete guidelines on how one can develop such degrees for educators who want to launch corresponding education and training programmes in the sector.

Therefore in this paper we explain the experience three technical Universities had in designing such Masters in Europe

A. UNITN, In the FinTech master at Trento, ICT Innovation course is regarded as an important center pillar. The two remaining pillars, Technology and Management, revolve around the center pillar of ICT Innovation and provides the students with theoretical background in a wide range of ICT technologies: distributed systems, network security, machine learning, and web architecture; and specific knowledge in the financial domains: markets and economy, accounting and finance, risk management, models simulation, and intelligent optimization. As such, the curriculum is suitable for both students with background in ICT or in Management.

B. ELTE, ELTE (Eötvös Loránd UNiversity, Faculty of Informatics) MSc and BSc degree programs are dedicated to Computer Science and Software Development/Engineering with several tracks in English language. The tracks are as follows: Software Development, Artificial Intelligence, Digital Manufacturing, Cyber Security, Data Science, and finally Financial Technology Services. These tracks are the majors and there is module of Innovation and Entrepreneurship that is the minor for a specific set of students. The MSc program allows that students can enroll from various educational background as Computer Science, Telecommunication Engineering, Information Systems, Mathematics, Statistics, Electrical / Electronics Engineering, Information Technology, Business Information Technology, Software Engineering, Business Informatics, Business Administration and Finance.

C. UCA, Each student should acquire at least 60 ECTS during the first year of Master FinTech. The lectures and ECTS are distributed as follows: Compulsory technical courses (27 ECTS), Elective technical courses (select 9 ECTS, plus additional ones if you wish, in the lists below, Innovation and Entrepreneurship courses (24 ECTS). The Second year specialization provides content oriented towards Financial or Insurance institution's needs, related to their common B2C activities but also to their investment activities on financial markets.

III. CONCLUSION

The courses chosen were usually from the available courses of the Universities. Some of the commonly reported difficulties observed across the different Universities for inclusion of the courses into the Fintech Masters were the following ones: technical, finding courses with right and relevant technical depth, and organizational: incubators visits and hackathon participation is difficult to propose and integrate with tight schedules of the technical courses. Computer science is a rather dynamic area in which new technologies and new approaches change literally with the speed of light, thus constant adaptation in the instruction method is needed and is important to sustain this development. This paper is one example how Computer science departments can work on development of curriculum's in line with the latest trends and develop degrees in Financial technology.

ACKNOWLEDGMENT

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Overview of Docker container orchestration tools

Marek Moravcik, Martin Kontsek

Abstract — The main goal of this paper is to analyze current options of Docker container orchestration. Currently, there are three widely used orchestrators - Docker Swarm, Kubernetes and OpenShift. In the paper, we analyzed all three of them, we highlighted their advantages and disadvantages and compared them.

I. INTRODUCTION

Nowadays, the Docker containerization platform is used more and more often. Docker enables containerization of individual processes. These containers can be freely placed and moved between physical (and virtual) servers without any change observed by the administrator or the user of the application running in the container. Because usually each process is a single container, the application is usually divided into multiple containers. As an example, we will mention a simple web CMS portal, where there could be three containers: a web server, a database and a PHP. With larger applications, the number of containers will increase. Container administration thus becomes complicated.

At department of information networks we are using private Cloud Computing system OpenStack for education, which can provide Docker containerization platform for our students. In this paper, we performed an analysis of Docker orchestration systems, which we would like to offer to our students, as they are less compute resources intensive as IaaS service, which we offer now.

II. CONTAINER ORCHESTRATIONS

Docker Swarm thus provides a way to configure and manage containers, which can be individual containers, but also a large number of containers grouped in clusters and distributed over the network [4][15]. It ensures the mutual cooperation of containers, as Docker containers are designed for individual operation and cannot cooperate with each other on their own. The planning features of this orchestration engine make it possible to select suitable nodes in the container cluster, on which the given containers are subsequently deployed.

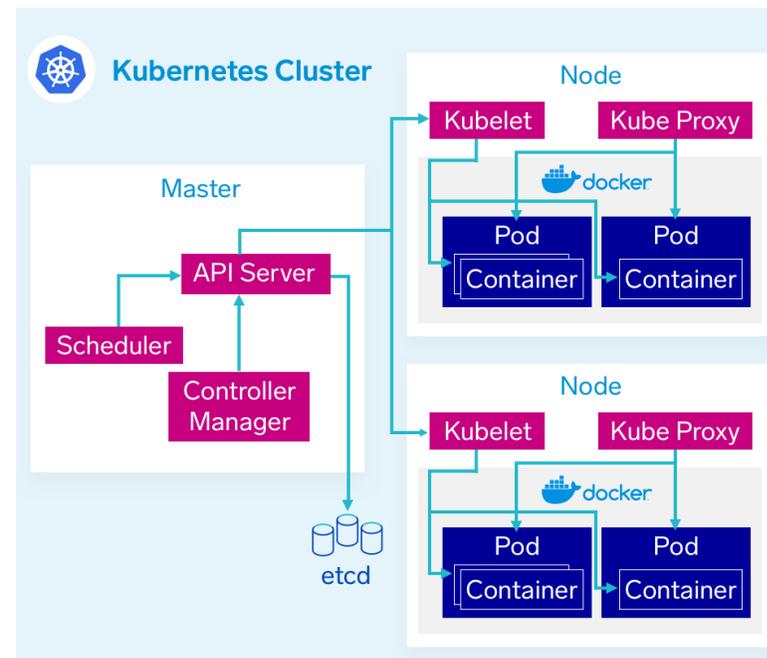
Kubernetes consists of many components that communicate with each other, but may not know about each other because they communicate with each other through an API server. Each of the components performs its own function and in addition produces data that can be used for monitoring. It is therefore a system with a very modular architecture. Kubernetes differs from other container orchestration engines (Docker Swarm, Apache Mesos) mainly by the concept of so-called pods, on which the containers are grouped together, thus forming a service

III. CONCLUSION

In this paper, we have presented the tools for orchestration of Docker containers, their comparison and both their advantages and disadvantages. According to the available literature, the Kubernetes orchestrator is currently the most widely used, followed by OpenShift and Docker Swarm. Based on this article and the performed analysis, we can state that all three solutions are full-featured orchestration platforms.

ACKNOWLEDGMENT

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fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
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Comparison of LXC and Docker technologies

Marek Moravcik, Pavel Segec, Martin Kontsek, Jana Uramova, Jozef Papan



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Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — The paper deals with problem of separating computer applications into logical namespaces called containerization. It compares and inspects two world leading Linux container platforms - Linux containers (LXC) and Docker. In the first part, it compares virtual machines and containers. Then the paper analyzes LXC and Docker technologies in depth, highlights their pros and cons. An integral part is also an overview of the various tools used within the technologies.

I. INTRODUCTION

The topic of containers and containerization has grown enormously in the world in recent years. Containerization has become one of the main trends in DevOps as a more advantageous alternative to traditional virtualization. More advantageous because the use of virtualization in production environments brings with it a number of complications and disadvantages, which containerization eliminates.

At department of information networks we are using private Cloud Computing system OpenStack for education, which was described in our previous paper. Currently, we are using IaaS service, by which we provide virtual machines to our students. In this paper, we performed an analysis of the two currently most used containerization platforms, Docker and LXC. We would then like to offer these platforms to our students, as they are less compute resources intensive.

II. CONTAINER PLATFORMS

Many terms are currently used in connection with containers, with Docker, Kubernetes, LXC and others being the most commonly used. However, it should be in mind, that not all of these concepts are equivalent, and therefore it is not correct to think of them on one level. The terms Docker and Kubernetes are very often considered equivalent, but each provides a different approach and view of containers. It is important to be aware of the fundamental differences between the container platform and the container orchestration engine (COE).

The containerization platform is used for packaging the application into a container and for its subsequent distribution. However, this still does not solve the problem of monitoring the status of these containers while the application that is packaged in them is running. For this, a container orchestration engine / orchestrator is used, which, in addition to monitoring containers, also ensures their creation, launch, discard, as well as launching the application, updating the application without interrupting running services, monitoring its status and restarting it if an error occurs.

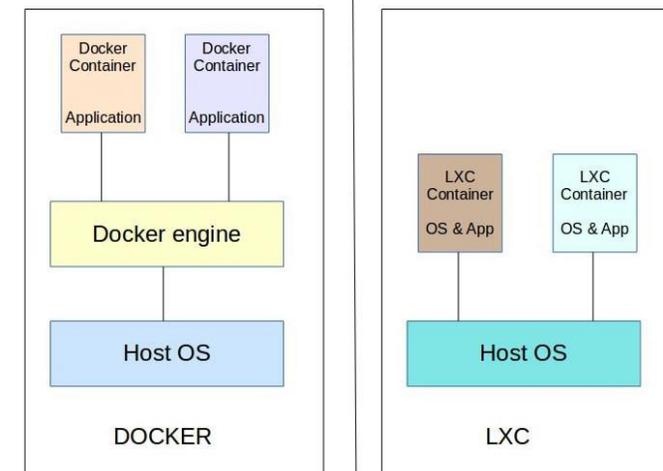
III. CONCLUSION

In this paper we have presented comparison of two most used containerization platforms - LXC and Docker. The comparison consists of technology overview, it's pros and cons. Part of comparison was also overview of tools used within these technologies.

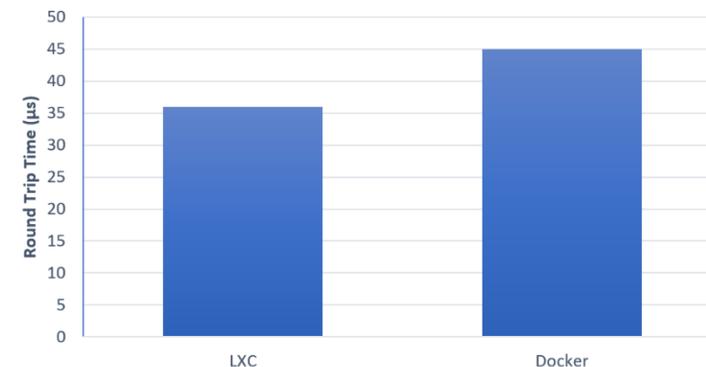
From our point of view, both technologies are usable and almost equivalent. However, the developers had their own intent with each one and that's why each technology is more suitable for different use-case.

ACKNOWLEDGMENT

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Network latency



Software Library for Teaching Applications of Binary Decision Diagrams in Reliability Analysis

M. Mrena, M. Kvassay, R. S. Stankovic

Abstract — Analysis of system reliability is a challenging task, especially in case of systems composed of many components. Main issues in this case are efficient representation of the system and fast computation of basic reliability characteristics. The first issue can be solved by using special data structures and the second one by implementation of existing algorithms using these data structures. A Binary Decision Diagram (BDD) is one of the most prospective data structures that can be used for this purpose. It is a graph structure that allows representing Boolean functions in an efficient way. In reliability analysis, it can be used to represent structure of the system. However, manipulation with bigger BDDs and their application in computation of basic reliability indices usually requires good computer support in a form of specific software tool. The core of such a software tool should be a software library implementing operations that allows fast manipulation with BDDs. In this paper, we present one such library. The library is primarily intended for the development of software tools used in a course on reliability analysis at the Faculty of Management Science and Informatics of University of Zilina.

I. INTRODUCTION

One of the principal characteristics of almost any technical and non-technical system is reliability. Because of that, technically oriented universities and their faculties should offer courses dealing with basic terms of reliability analysis and explaining how reliability of a specific system can be evaluated. For this purpose, a course on reliability analysis also exists at the Faculty of Management Science and Informatics of University of Zilina. The course focuses on explanation of general terms of reliability analysis and explanation of methods that are used to evaluate reliability of complex systems. However, illustration of these methods and their application in the analysis of real-world systems requires a software tool that is able to represent systems containing many components. The core of this tool should be a software library that would allow efficiently representing structure of such systems and manipulate with it. In this paper, we present such a library developed by us. Application of this library in reliability analysis assumes that the structure of a system can be represented using a Binary Decision Diagram (BDD), which represents a graph structure used for storing Boolean functions (Fig. 1).

II. BDD LIBRARY

BDDs are very useful in evaluation of dependability of a system via measures as availability or unavailability (Fig. 2) and can also be used in investigation of influence of individual components on system operation using Boolean derivatives. For the purposes of the reliability analysis, it is important to allow storing data on edges and in nodes (vertices) of a BDD because they are essential in algorithms quantifying various aspects of system dependability. Several software libraries implementing operations for manipulation with BDDs, e.g., CUDD or BuDDy, exist. However, they usually do not have such a possibility, therefore, they are not entirely appropriate for implementation of methods of reliability analysis. The library developed by us and presented in this paper has such functionalities. For its implementation, we have chosen a simple approach in which we represent vertex of a BDD by a standalone object that has pointers (arcs) to his sons. For manipulation with vertexes, the following principal classes are responsible (Fig. 3):

- **bdd** – represents a single diagram by storing information about the root vertex and implements all technical operations like copy constructor, move constructor, assignment operator and swap;
 - **bdd_creator** – is responsible for the construction of a diagram from other representations of a Boolean function;
 - **bdd_manipulator** – is responsible for transforming existing diagrams and implements four basic operations that are *apply*, *negate*, *reduce*, and *restrict*.
- The library is implemented in C++ programming language. In the paper, we also compared it with some of the existing ones (Table I).

III. CONCLUSION

The library presented in this paper contains all principal operations that are needed for fast creation and evaluation of a BDD of a Boolean function. According to the comparison with existing libraries, which are based on C programming language, we can state that the speed of our library is comparable with them. The library is accessible at the following url: <https://github.com/MichalMrena/DecisionDiagrams>. We would like to note it is designed in such a way that it can also be used for manipulation with decision diagrams representing multiple-valued logic functions. Based on the library, software tools for reliability analysis used in education at the Faculty of Management Science and Informatics will be further developed.

ACKNOWLEDGMENT

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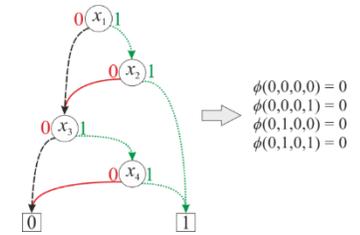


Figure 1 Binary decision diagram representing Boolean function $\phi(x) = (x_1 \wedge x_2) \vee (x_3 \wedge x_4)$ and points corresponding to the black dashed path.

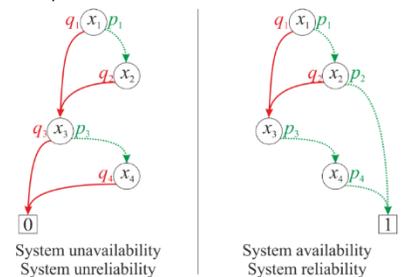


Figure 2 Computation of basic attributes of system dependability using probabilistic binary decision diagram.

Table I Time needed to transform sum of product representation into binary decision diagram.

Benchmark	Our library [ms]	BuDDy [ms]	CUDD [ms]
16-adder_col	45,098	56,877	37,900
15-adder_col	18,410	13,488	14,521
14-adder_col	5,481	1,862	3,653
13-adder_col	2,319	823	1,590
12-adder_col	959	344	597
apex1	63	27	23
apex3	14	16	6
apex5	11	17	10
seq	449	72	113
spla	95	46	80

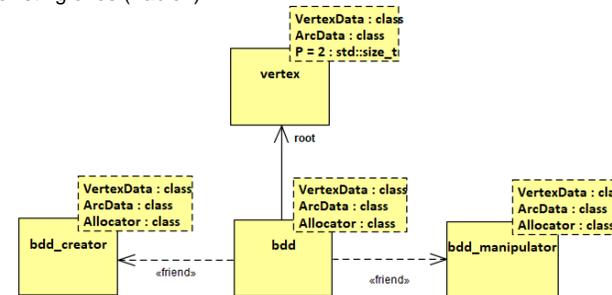


Figure 3 UML class diagram of bdd classes.



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e-mail: iceta@elfa.sk
www.iceta.sk

Review of Fast ReRoute solutions

J. Papán, P. Segeč, J. Dobrota, L. Koncz, O. Yeremenko, O. Lemeshko, M. Yevdokymenko



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www.iceta.sk

Abstract — The Fast ReRoute (FRR) is an area that addresses issues of network recovery in the event of crucial devices or line failures in the network. During the event of a failure in the ISP network, the process of network convergence starts. This process may last unpredictable time and traffic affected by the failure may be inevitably lost.

FRR mechanisms work mostly on the principle of a pre-calculated backup route. After a failure at one of the protected nodes in the network, the FRR mechanism will use a specific backup route to redirect traffic away from the location affected by the failure. By using FRR mechanisms in the Internet Service Provider (ISP) network, we can minimize the time required for network recovery to the order of tens of milliseconds and thus ensure immediate recovery of communication after a network outage.

I. INTRODUCTION

In recent years, IP networks have made significant progress in the field of video and voice services (VoIP). During the pandemic, it can be said that most companies, universities, and the general population moved to virtual space and began to use the mentioned services. In this direction, however, with the increase in users, the load on the equipment of internet providers also increases. This can result in an unexpected failure of the line over which hundreds or thousands of users have just been communicating. The result is the beginning of the convergence process in the ISP network, after which a new route to the destination will be found. However, during the convergence period, all packets to the destination are lost, which results in a user failure of the currently used IP services. The convergence process can last from a few milliseconds to several tens of seconds, depending on the routing protocol used in the network and the size of the ISP network. The solution to the described problem is to use FRR mechanisms. FRR mechanisms are intended for the rapid detection of line failure and subsequent provision of an alternative route to the destination for affected packets. By using the FRR mechanism, we can provide an alternative route to minimize loss of packets. The average FRR network repair time of current mechanisms is up to 50 ms.

II. SURVEY OF FAST REROUTE MECHANISMS

The well-known Fast ReRoute mechanisms according our analysis done in recent years are: Loop Free Alternates (LFA), Remote Loop Free Alternates (R-LFA), Directed LFA, Topology-Independent LFA (TI-LFA), MRC, Multicast Repair (M-REP), and FRR mechanisms based on redundant tree approaches.

The TI-LFA mechanism is designed to provide node protection and adjacent segments within Segment Routing (SR). The TI-LFA principle is based on the basic IP FRR mechanism LFA, Remote LFA (RLFA), and Direct LFA (DLFA). The TI-LFA mechanism uses Segment Routing technology to provide a loop-free alternative FRR backup path, that is not dependent on the topology used in the network. This provides a significant improvement over the LFA and Remote LFA mechanisms, which in some topologies cannot provide complete network protection, because of inappropriate metrics of links

The SWIFT is an FRR mechanism that is designed for Exterior Gateway Protocol (EGP) protocols especially for Border Gateway Protocol (BGP). SWIFT is the first FRR mechanism that works with EGP on the principle of remote failure detection. Remote failures are complex because they can happen on any network at any time and can affect any number of targets. Cancellation notifies messages (withdrawals) may contain thousands of prefixes.

The M-REP is an FRR mechanism designed mainly to protect a specific unicast flow. The M-REP IPFRR mechanism is based on the IP multicast and utilizes Protocol Independent Multicast - Dense Mode (PIM-DM) with the modification of internal Reverse Path Forwarding check (RPF). The M-REP IPFRR mechanism does not depend on any particular routing protocol type (distance-vector or link-state), requires less system resources because of its precomputation-less character, but still provides immediate reaction on failure appearance. The PIM-DM floods data at the beginning of multicast transmission to all multicast capable routers inside of a policy domain. The M-REP uses this specific behaviour to find alternative route. In case of failure the

VI. CONCLUSION

In this paper, we have described the FRR mechanisms that respond to a network failure either by a pre-calculated backup route (proactive approach) or by finding a backup route after a failure (reactive approach). The TI-LFA FRR is the advanced version of classic LFA and Directed LFA mechanisms. To overcome the disadvantages of its predecessors, TI-LFA uses Segment Routing functionality to reach 100% Repair Coverage. The M-REP FRR mechanism uses a well-known multicast PIM-DM protocol to create an alternative backup path using modified RPF an interface of the first Arrival. In Theory, for a large network, it would be appropriate to use a reactive access mechanism so that we do not overwhelm FRR-enabled routers by calculating backup paths to each destination network. In a smaller topology, we could therefore use the FRR mechanism with a proactive approach.

ACKNOWLEDGMENT

This publication was realized with the support of the Operational Programme Integrated Infrastructure in the frame of the project: Intelligent systems for UAV real-time operation and data processing, code ITMS2014+: 313011V422 and co-financed by the European Regional Development Found.

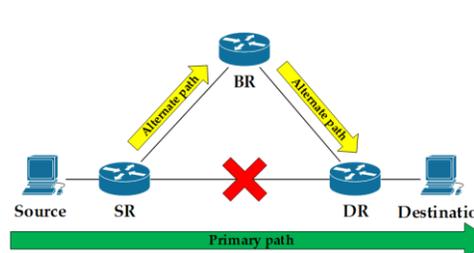


Figure 1 The Principle of FRR mechanism

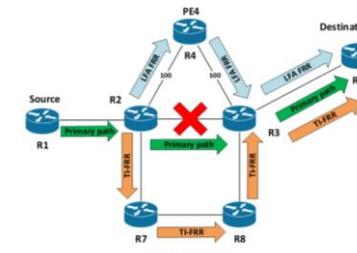


Figure 2 The TI-LFA FRR mechanism

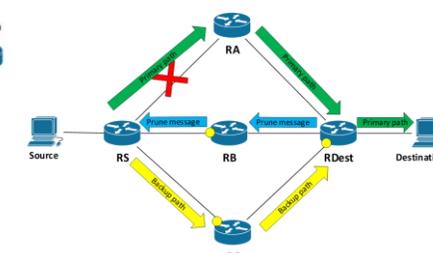


Figure 5 The M-REP FRR mechanism



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e-mail: iceta@elfa.sk
www.iceta.sk

Another Tool for Structural Operational Semantics Visualization of Simple Imperative Language

J. Perháč, Z. Bilanová

Abstract — Teaching formal methods, especially semantics of programming languages is an important aspect of theoretical informatics. The learning process often includes a lot of mathematics and learning different notations, which appears to be very difficult for students. In this paper, we present a new interactive tool for visualization of the structural operational semantics of a simple imperative program. We demonstrate our approach on the example of a simple program, where we visualize the inference process of small steps semantic method.

I. INTRODUCTION

An operational semantics is one of the category semantical methods. In this paper, we work with structural operational semantics (SOS), sometimes also called "the small steps semantics". This method provides an exact description of the behavior of programs. In our approach, we work with simple imperative language (SIL) that contains five Dijkstra's statements, together with arithmetic and boolean expressions. The subject "Semantics of programming languages" is taught for many years at our faculty using a standard mathematical approach. This approach is often making a lot of problems for students with less knowledge of mathematics. Therefore, we have decided to create some tool, that will make the learning process less formal, and more interactive. We have created a web application that takes as an input a program of SIL and its initial state, and it will compute its semantics using the structural operational semantic method.

II. STRUCTURAL OPERATIONAL SEMANTICS OF A SIMPLE IMPERATIVE LANGUAGE

As we have mentioned before, we use a simple imperative language for teaching purposes. This language contains five basic statements: assignment command, skip command, a sequence of commands, conditional command, and cycle command, with basic arithmetics and Booleans. For simplification of the teaching process, we only work with integers and Booleans. Here we present a syntax of a used language in a Backus-Naur form (BNF).

$e ::= n \mid x \mid e + e \mid e - e \mid e * e$
 $b ::= true \mid false \mid e = e \mid e \leq e \mid \neg b \mid b \wedge b$
 $S ::= e := x \mid skip \mid S; S \mid if\ b\ then\ S\ else\ S \mid while\ b\ do\ S$

Here we present only semantics of statements. We start with basic notions of structural operational semantics. Statement $\langle S, s \rangle \Rightarrow \alpha$, expresses transition from a configuration $\langle S, s \rangle$ (of a statement S , in a state s) to α , where α can obtain two forms: $\langle S', s' \rangle$, if a statement S in state s is not executed in a one step, or s' , if a statement S in state s is executed in a one step. Semantics of a program P in an initial state s_0 can be computed in SOS by sequence of configurations, that is created by applying of appropriate inference rules. Now we can define semantic of *statements*. We specify a semantic function as follows: $S_{os}: Statm \rightarrow State \rightarrow State$, and we define it as follows

Now, one can define $iS_{os}[[S]]s = \begin{cases} s' & \text{if } \exists \langle S, s \rangle \Rightarrow^* s' \\ \perp & \text{otherwise} \end{cases}$ and of the language (all rules are described in our paper). An assignment command will be executed in one step and will update a state s . $\langle x := e, s \rangle \Rightarrow s[x \mapsto E[[e]]s]$.

III. VISUALIZATION TOOL FOR STRUCTURAL OPERATIONAL SEMANTICS

We demonstrate our solution on the simple motivation example. We have chosen the following simple program P of the language:

$y\ do(x := x + 3; y := y - x)$,
 in the initial state s_0 , where $s_0 = [y \mapsto 10]$.

We have inserted a code and an initial state into a tool, with results depicted in figures at right side of poster.

IV. CONCLUSION

In this paper, we have presented basic notions from used methods i.e. structural operational semantics of SIL. Then, we have described the design and implementation of a new teaching tool for visualization of the computation process of SIL programs' semantics. In the future, we plan to include our solution in a teaching process of the subject "Semantics of programming languages" taught in the first semester of master level studies at our department.

ACKNOWLEDGMENT

This work has been supported by the Faculty of Electrical Engineering and Informatics at the Technical University of Košice under contract No. FEI-2020-70: "Behavioral model of component systems based on coalgebras and linear logic", and by the project KEGA 011TUKE-4/2020: "A development of the new semantic technologies in educating of young IT experts".

Nástroj pre výpis odvodzovacej postupnosti

Počiatkový stav

y:=10;

Kód

x:=y - 5; while x ≤ y do (x:=x + 3; y:=y - x);

Vykonať

Počiatkový stav : $y = 10$
 $P = x := y - 5; \text{while } x \leq y \text{ do } (x := x + 3; y := y - x);$
 $\alpha_1 = \langle P, s_0 \rangle \Rightarrow$
 $\alpha_2 = \langle \text{while } x \leq y \text{ do } (x := x + 3; y := y - x); s_1 \rangle \Rightarrow$
 $\alpha_3 = \langle \text{if } x \leq y \text{ then } (x := x + 3; y := y - x); \text{while } x \leq y \text{ do } (x := x + 3; y := y - x); \text{else } (\text{skip}); s_1 \rangle \Rightarrow$
 $\alpha_4 = \langle x := x + 3; y := y - x; \text{while } x \leq y \text{ do } (x := x + 3; y := y - x); s_1 \rangle \Rightarrow$
 $\alpha_5 = \langle y := y - x; \text{while } x \leq y \text{ do } (x := x + 3; y := y - x); s_2 \rangle \Rightarrow$
 $\alpha_6 = \langle \text{while } x \leq y \text{ do } (x := x + 3; y := y - x); s_3 \rangle \Rightarrow$
 $\alpha_7 = \langle \text{if } x \leq y \text{ then } (x := x + 3; y := y - x); \text{while } x \leq y \text{ do } (x := x + 3; y := y - x); \text{else } (\text{skip}); s_3 \rangle \Rightarrow$
 $\alpha_8 = s_3$

$s_1 = s_0[x \mapsto 5]$	$\mathcal{R}[x \leq y]s_1 = \text{tt}$ $\mathcal{R}[x \leq y]s_3 = \text{ff}$
$s_2 = s_1[x \mapsto 8]$	
$s_3 = s_2[y \mapsto 2]$	
$s = s_3 = [x \mapsto 8, y \mapsto 2]$	

s_0	$y \mapsto 10$
s_1	$x \mapsto 5, y \mapsto 10$
s_2	$x \mapsto 8, y \mapsto 10$
s_3	$x \mapsto 8, y \mapsto 2$

Stiahnuť obrázky Späť

Experimental implementation of TinyIPFIX protocol for Arduino and Raspberry Pi platform

R. Petija, M. Glevaňák, M. Kucan, P. Fecilák and F. Jakab



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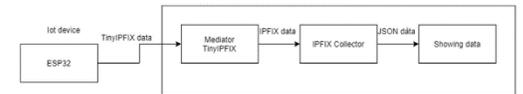
Abstract — The aim of this article is to implement the TinyIPFIX protocol for the Arduino and Raspberry Pi platform using the Python programming language. This protocol is derived from the IPFIX protocol and is used to enable efficient communication between devices within the Internet of Things environment. At the beginning, this article deals with the analysis of related communication protocols, the analysis of criteria for the TinyIPFIX protocol for its possible operation and the analysis of the TinyIPFIX message format, of which parts such a message consists. Subsequently, the architecture design procedure for the TinyIPFIX protocol is discussed. The main part is the experimental implementation of the TinyIPFIX protocol for Arduino and Raspberry Pi platforms. At the end of this work, experimental testing is evaluated, according to which the benefits of the implemented TinyIPFIX protocol are clarified.

I. INTRODUCTION

Data transfer among constrained devices in IoT environment is complicated due to hardware and technological limitations [1]. Effective Internet protocols that try to address the shortcomings and constraints in given area are being built. The focus is to implement protocols which can save energy and reduce overhead but conserve informative value. The main goal of this work is to implement the TinyIPFIX protocol according to the official documentation RFC 8272 [2]. This motivation arose from the lack of suitable Internet protocols in the application layer for IoT devices and devices that lack memory and computing power. There are two other commonly used application protocol, MQTT and CoAP.

II. IMPLEMENTATION OF TINYIPFIX ON ARDUINO PLATFORM

As part of this work, a system that allows data to be transferred from ESP32 devices in TinyIPFIX format was created. The system consists of four main components. The first part sends data in the form of TinyIPFIX. The second part of the system, Mediator, will process this data and send them in the form of IPFIX to the IPFIX Collector. This IPFIX Collector processes the data and forwards them to a server which was implemented based on official documentation. There will be transferred data that was generated by ESP32 displayed in real time. This procedure was chosen to confirm that the implementation of the protocol was successful and enable transfer of data from device A via the Internet, to device B on the Collector resp. Mediator. In addition, we would be also able to prove that the TinyIPFIX and IPFIX protocols can work together. The designed and constructed system is shown in the following figure.



III. IMPLEMENTATION OF TINYIPFIX ON RASPBERRY PI PLATFORM

The implementation of the TinyIPFIX protocol was targeted and tested on a Raspberry Pi 3 Model B. Therefore, the hardware recommended requirements for running this system are: 1.2 GHz CPU, 1GB RAM, at least 8GB microSD memory card, microUSB power supply with a minimum consumption of 2 A, network connection via Wi-Fi or Ethernet, keyboard and monitor. The operating system used was Raspbian Lite. The software running on the PC that was used to install the OS into microSD memory is Raspberry Pi Imager. Required python packages are msgpack (serialization of data), gpiozero (interface for managing GPIO devices) and BeautifulSoup4 (parsing of HTML and XML file).

IV. CONCLUSION

We can say that our experiment was successful. In this experiment we proved that the TinyIPFIX protocol can work in real environment. We were also able to link the two protocols which are TinyIPFIX and IPFIX. We did comparison of TinyIPFIX protocol and protocols CoAP and MQTT and illustrated why TinyIPFIX is so suitable for use in the IoT devices. Until the future it would be desirable to implement support for TCP protocol or SCTP protocol. Because the UDP protocol does not guarantee that the transmitted TinyIPFIX message and the template file will really be delivered to the collector, as well as according to the RFC standard one of these protocols is suitable for the TinyIPFIX protocol. Thus, it would be ensured that the TinyIPFIX message would be delivered. It is also desirable to implement support for more than one set in the transmitted TinyIPFIX message, whereas this implementation addresses support for only one set. It is also desirable to implement support for the 6LoWPAN communication protocol in the future. This implementation does not use it for several reasons, mainly due to the high price extension module for Raspberry Pi that supports 6LoWPAN and due to complicated and tedious configuration of software support for 6LoWPAN. This work can also be used in the teaching process. It can serve as a sample example of how to implement various application protocols for IoT constrained devices based on standard definition.

ACKNOWLEDGMENT

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Eyes on roads – Collecting and managing data about roads' infrastructure

D. Piovarči, T. Kováčik



ICETA 2020
Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — In cooperation with Public Roads Administration of Trnava self-governing region (SUC TTSK) a web application has been created which aims on reporting, collecting and displaying data about roads' and their accessories' defects. This project enables public to participate in public space improvement via crowdsourcing data acquiring process, thus e.g. students of schools can be attracted to their bigger civic engagement. The web application also enables management of SUC TTSK to allocate human resources to reported defects on roads in administration of SUC TTSK which have been reported by public. There are two main goals we've marked out in our project. The first goal is to design and develop a web application to get overview about the defects by collecting notifications about them from people-public. The second goal of the project is to create a system which helps administration person to manage workers' groups effectively in order to realize repairs of roads' defects and defects of roads' accessories which have been reported by public. Received data is collected and subsequently reviewed by roads administration. Afterwards reported problem is assigned to specific worker which should repair it. Also future work on the project can bring effective semiautomatic planning of work of workers.

I. INTRODUCTION

One of the many problems, which Public administrations must deal with are roads' and their accessories' defects like potholes, damaged roads, broken road signs, blind traffic signs, overgrown trees and greens, corrupted crash barriers etc. SUC TTSK decided to engage citizens to help them identify these defects on roads and its' infrastructure by collecting data and monitoring their repairs. This method is called crowdsourcing and is well suitable also for purpose of attracting youth and students into their bigger civic engagement. Students can be motivated by their desire to better their neighborhood also in this area of public life. The web application has been created in cooperation with SUC TTSK that allows citizens to report roads' defects by creating Road Defect Report. Administration workers of SUC TTSK collect and analyze data that helps them to effectively manage processes of maintenance and repairs of reported defects.

II. Functionality of web application

The application is serving for two user groups: Enduser (registered and unregistered user) and SUC TTSK office workers, who are split into 3 roles (administrator, dispatcher, manager). Each group consists of different roles which are allowed to perform a specific set of actions, defined based on user's access rights. Endusers' main role is to create a Road Defect Reports and also they're able to view all reported defects via interactive map provided by Google Maps. Issued Road Defect Reports are assigned to Dispatchers by Managers. Dispatchers are responsible for planning and finalizing repairs of the assigned problems. Dispatchers are allowed to edit problems, e.g. change or specify the problems' attributes, change progress status (received, in process, finalized, suspended) of the Road Defect Report and add a Closure description to the problem. Manager has access to Road Defect Report database (short DB). Manager may use filtering to display specific data by applying filter parameters on DB and also can filter reports or activities done by Dispatchers in the past. Managers' task consists of allocating newly created Road Defect Reports to the selected Dispatcher and supervising Dispatchers' work. Administrators have all rights to all system modules. Admin's job consists of keeping system working correctly and doing CRUD operations above all system accounts. Administrators have permission to users' database and have rights to change system role to chosen user.

VI. CONCLUSION

In cooperation with SUC TTSK a web application has been created which aims on reporting, collecting and displaying data about roads' and their accessories' defects. The web application enables management of SUC TTSK to allocate human resources to fix reported defects on roads in administration of SUC TTSK which have been reported by public by crowdsourcing method. Chosen approach can also bring students of schools to their bigger civic engagement. In the future it is planned to add more functional features to the project, which will ease and motivate Endusers to report roads' defects like user actual location tracking for making easier to find the exact spots of defects as well as shorten time period for End-users to create Road Defect Report as well as motivate them to report road problems more regularly.

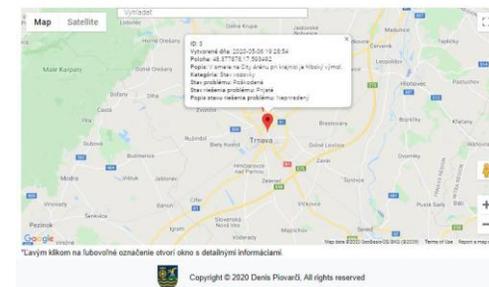
ACKNOWLEDGMENT

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Oči na ceste

Ak si našiel problém na ceste alebo v jej okolí (stav vozovky, dopravné značenie, kvalita opravy alebo zeleň), daj nám o ňom vedieť!



Deep Learning Powered Class Attendance System Based on Edge Computing

L. Pomsar, E. Kajati and I. Zolotova



ICETA 2020
Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — While digitalization of the education sector has been going for years, most monotonous administrative tasks are still being performed manually. One of those tasks is class attendance tracking. On all levels of the Slovak educational system, teachers still spend several minutes trying to figure out who is absent from the class. This, mostly manual work, can be easily automatized with the help of the modern technology. We present an edge-based deep-learning powered class attendance system based on the Dlib machine learning framework and NVIDIA Jetson Nano platform to tackle this problem.

I. INTRODUCTION

Since at least 1788, the class attendance was registered in the area of what is now Slovakia. This attendance registration is often tedious, manual, time-consuming, and still was not appropriately addressed in the current digitalization wave in education. We decided to introduce a system based on NVIDIA Jetson Nano, a local database, and a webserver to automate the registration. While the general architecture is highlighted in work, in the testing phase, we only deal with the feasibility study of face detection and recognition on the edge device and performance measurements.

II. PROPOSED SYSTEM

The proposed system is component-based, allowing for big versatility. Smartphones, computers, and IP cameras can be used as inputs to the systems. These are used to capture the class's image and transfer it to the Nano, alongside the class information. Subsequently, the image is resized in Nano and used for face detection and generation of the 128-dimensional vector describing each face. Afterward, the vectors are sent to the server, where the k-NN (k-Nearest Neighbours) algorithm is trained with all the possible students' faces. Depending on the distance reported by the k-NN, each face will be identified as a specific student or as an unknown person. In the end, information about present students is transmitted to the webserver, where an attendance sheet is created, which can be viewed and edited by the teacher.

III. DLIB

Dlib is an open library for the creation of complex software written in C++. In this library, two different approaches for face detection are implemented. The first one, used in our experiments, is based on the combination of the histogram of oriented gradients (HOG), linear classifier, image pyramid, and sliding window. The second one is based on a convolutional neural network (CNN). A deep learning approach based on CNN is also utilized for the generation of face feature vector – this can achieve accuracy of up to 99.38% on the Labeled Faces in the Wild dataset.

IV. NVIDIA JETSON NANO

NVIDIA Jetson Nano (also known as Nano, pictured on the right) is a small AI edge accelerator. It features a quad-core ARM processor, 2/4GB of RAM, and 128-core, CUDA enabled, GPU. It can operate in two modes – 5 and 10W mode. We have selected this accelerator due to its low cost, low power draw, and CUDA support, allowing for high performance. Most other AI edge accelerators would require to change/quantize the dlib's model we don't have access to. As dlib has built-in CUDA support, all we had to do is compile it with CUDA flags enabled.



V. TESTING

As there is no dataset emulating the class environment available, we resorted to usage of 3 photos with 6, 8, and 18 faces respectively in 4 different resolutions – 320 x 240, 640 x 480, 1280 x 960, 2560 x 1920. In general, the Nano + dlib approach was able to detect and generate vectors for faces in all the cases in 640 x 480 resolution or higher. In 8 faces scenario, one of the faces did overlap, resulting only in the detection of 7 faces. This problem is an inherent limitation of HOG face detection approach. The longest time taken by detection + recognition phases was around 12 seconds in the 2560 x 1920 18 faces. While HOG + CNN approach did allow Nano to detect and recognize faces on images greater than 24 MPx, the CNN based face detection approach did fail on images bigger than 320 x 240 pixels as Nano run out of memory and wasn't able to utilize the 10GB increased swap file.

VI. CONCLUSION

In this work, we evaluated the combination of Jetson Nano and dlib as a platform for the implementation of the class attendance system. In general, we proved that Nano could be used as a low-power, low-cost platform for such a system on the edge of the network. On the other hand, unless dlib will introduce a smaller and lighter CNN model for face detection in the future, the system will be constrained to using HOG based face detection algorithm with its inherent flaws such as the problem with angled or overlapping faces.

ACKNOWLEDGMENT

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Comparison of Algorithms for Fuzzy Decision Tree Induction

Jan Rabcan, Patrik Rusnak, Jozef Kostolny, Radomir S. Stankovic

Abstract — The objective of the classification is to assign a class label to a data sample based on previous, learned experience. Despite the long tradition of classification algorithms research, there is not a unique technique that yields the best classification performance in all scenarios. Many real-world problems are uncertain. In this case, the crisp classification can be difficult to perform. The usage of fuzzy logic can be useful to describe real-world problems with higher accuracy. In this paper, we describe and compare algorithms of Fuzzy Decision Trees (FDTs), which are an extension of traditional decision trees. These algorithms are popular for their easy understandability and interpretability. But today there are many algorithms for FDT induction. These algorithms differ in many aspects. The most common difference is in information measures for selecting splitting attributes. Generally, the goal of decision tree induction is to create the smallest tree which is the most accurate as possible. In this paper, we use various information measures to induct FDTs and compare the accuracy and size of obtained FDTs. In comparison, information measures that are based on a generalization of the Shannon entropy and cumulative mutual information are included. The comparison shows that FDTs based on the cumulative mutual information acquired the best results. These results will also be included in a course on data mining that is taught at Faculty of Management Science and Informatics of University of Zilina.

I. INTRODUCTION

Decision trees are one of the predictive techniques used in data mining. The goal of decision trees is to assign objects described by different attributes to classes. The main objective of this study is to compare fuzzy decision trees induced according to different information measures. The reason for this comparison stems from the fact that there is no general information measure that can be the best for all scenarios of FDT applications. The choice of the information measure can affect the accuracy, number of tree nodes, and depth of the tree. Thus, the right information measure can reduce the tree induction time as well as the memory required to store the tree, and can increase the performance of the tree classification. The goal of the tree induction is to create the tree with the biggest classification accuracy and smallest size. Therefore, the investigation of these information measures is relevant and can be done by experimental analysis. Our investigation is based on the datasets from the UCI Machine Learning

II. Comparative analysis of FDTs induction algorithms

We perform comparative experiments between FDTs induced with different information measures. One of this measure is based on the generalization of Shannon entropy, the second is based on gain ratio and third is based on the CMI estimation. FDTs are examined for different datasets from the UCI machine learning repository.

As Table shows, FDTs based on GR and CMI produce smaller trees with bigger accuracy than the information measure based on the Shannon entropy. It indicates that CMI and GR are more robust and more suited for real applications. The smaller size of the tree requires smaller memory requirements and also smaller trees are faster in classification itself because the branches of the tree are shorter.

The accuracy of classification is in most cases the main criterion for the choice of the classification algorithm. According to the accuracy, FDTs that use information measures based on CMI and GR are better in all datasets included in the experiments. This indicates that CMI and GR are superior to information measures based on the Shannon entropy in most cases. However, the difference between the CMI and GR is not so obvious and both information measures obtained very good results. The results presented in Table II show that FDTs based on the CMI measure give better results in four cases while GR is better in three cases. Although, we can notice that results obtained with these two information measures are almost identical in terms of accuracy, the CMI may produce smaller trees, which are better interpretable from visual point of view.

VI. CONCLUSION

This paper presents comparison of FDTs induced with different information measures. The comparison shows that trees based on fuzzy generalization of the Shannon entropy produce trees with larger size. In some cases, this can be a undesired effect because if the size of the tree is very large, the classification speed can be affected. Also, the requirements on memory raise with a larger decision tree. The FDTs based on this information measure have also worse accuracy in comparison with the other two used measures. The information measures based on the CMI and gain ratio produce FDTs with similar accuracy and size. The obtained results indicate small advantages in accuracy in case of the CMI. Nevertheless, this paper shows that FDT itself is a powerful classificatory which can solve various problems.

ACKNOWLEDGMENT

This work was supported by the Slovak Research and Development Agency under the contract No. SK-SRB-18-0002 and by Grant System of University of Zilina No. 8108/2020.

DATASET	IM	Alpha	Beta	Count of Nodes	Accuracy
Nursery	Entropy	0.000	1.000	1671.980	0.945
	GR	0.000	1.000	1136.520	0.979
	CMI	0.004	0.903	818.960	0.977
Iris	Entropy	0.150	0.850	12.360	0.967
	GR	0.248	0.954	15.194	0.973
	CMI	0.250	0.950	15.120	0.974
Flowmeter	Entropy	0.003	0.954	1547.720	0.938
	GR	0.102	0.804	73.160	0.948
	CMI	0.102	0.801	13.400	0.948
Cars	Entropy	0.000	0.951	417.840	0.891
	GR	0.000	0.852	337.830	0.901
	CMI	0.000	0.850	335.140	0.901
Sonar	Entropy	0.001	0.950	4743.420	0.830
	GR	0.001	0.961	1429.340	0.835
	CMI	0.001	0.949	1401.301	0.835
Vowel	Entropy	0.003	0.903	1892.560	0.817
	GR	0.010	0.803	1749.214	0.819
	CMI	0.016	0.803	1745.800	0.820
Tic tac toe	Entropy	0.000	0.950	347.620	0.866
	GR	0.000	0.903	347.620	0.877
	CMI	0.000	0.901	305.380	0.876

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e-mail: iceta@elfa.sk
www.iceta.sk

Biometric Technologies for eLearning: State-of-the-Art, Issues and Challenges

C. Rathgeb, K. Pöppelmann, E. Gonzalez-Sosa

Abstract — In the recent past, the use of learning management systems has increased as these enable remote education via electronic media, i.e. eLearning. The use of such platforms was further elevated by needs for eLearning due to the COVID-19 pandemic. In order to achieve secure and reliable identity management in eLearning systems, biometric technologies are increasingly deployed for remote student authentication. Numerous researchers proposed concepts and methods on how to effectively integrate biometric recognition into eLearning. This work provides a conceptual categorization and survey regarding the state-of-the-art of biometric technologies for eLearning along with a detailed discussion on open issues and challenges in this emerging field of research.

I. INTRODUCTION

Biometric recognition refers to automated recognition of individuals based on their biological characteristics or behavioral characteristics. In order to avoid misuse of eLearning systems and hence strengthen trust in them, it has been suggested to apply biometric technologies for (continuous) identity verification as well as further tasks such as emotion estimation. However, several issues and challenges remain concerning the incorporation of biometric technologies in eLearning systems. This work categorizes and revisits scientific literature regarding the use of biometrics in the area of eLearning. In addition, open issues and challenges as well as potential future research directions are discussed.

II. BIOMETRICS FOR eLEARNING

The following topics are covered in the paper:

- Application Scenarios
- Biometric Characteristics
- One-time vs. Continuous Authentication
- Literature Review
- Operational Systems

IV. Conclusion

Biometric technologies represent an integral part of modern identity management systems. Remote biometric authentication has been identified as viable means of identity verification in eLearning systems. In the past years, numerous researches have proposed approaches for integrating biometric technologies to eLearning for different purposes such as (continuous) identity verification and attention estimation. Different researchers attempted to survey the state-of-the-art in biometrics for eLearning. However, according publications only briefly summarize selective achievements in this field of research. In contrast, this work provides a categorization and comprehensive review of published literature in this field, along with a critical discussion of open issues and challenges. It is intended to serve as a point of reference for future research activities devoted to the application of biometrics in eLearning systems.

ACKNOWLEDGMENT

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(a) face



(b) fingerprint



(c) iris



(d) voice



(e) online signature



(f) keystroke/mouse



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Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Dynamic System Parameter Identification Based On The Acceleration Data

P. Šarafín, L. Formanek, M. Chochul

Abstract — The dynamic systems are in many cases complicated to effectively control. Specifically, when talking about devices with movable parts, we can often find undesired vibration on system output. To suppress these vibrations, various techniques are used. This paper is dedicated to the identification and simulation of weakly damped discrete systems and input shapers.

I. INTRODUCTION

The term weakly damped dynamic system is often used in conjunction with systems containing elastic elements, e.g. lifts or gantry cranes. To control the movement of such devices the method called input shaping is properly used. This method is usable in the applications focused on the positioning systems with flexible elements. In practice, there are some limitations that need to be taken into account in the theoretical design of the input shaper, most prominent ones, relatively low resolution of the output power elements and the limitation of the action quantity [1]. The purpose of the input shaper is to adjust the controlled system output in such way, it modulates the frequency spectrum of the control signals so that in the region of the resonant elevation there are no residual vibrations. Based on this fact, we can state that the proposal of input shaper can be seen as a proposal of a series correction member whose task is to modify the frequency characteristics of the controlled system

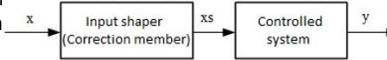


Figure 2. The involvement of the input shaper

II. UNDERSTANDING THE INPUT SHAPER BASICS

Input shaping is a process that adjusts the control signal to prevent the undesired resonant output of the system. Input shaper is meant to be designed so the response of the system corresponds to the desired resonant characteristic. Different applications have found a use for a wide range of input shapers. A commonly used input shaper is the Zero Vibration (ZV) shaper. This input shaper has the shortest time required to execute the arithmetic operations of the system only by positive pulses. Since the convolution of the control signal with the input shaper extends the control time according to the transition time of the input shaper, it is important to keep this time as short as possible. In an ideal case, the ZV shaper is designed with a perfect model and so it eliminates all vibrations. If there is an inaccuracy in the model, some oscillations occur [6]. When it is necessary to provide resistance to modelling errors, a Zero Vibration Derivative (ZVD) input shaper may be used. This shaper forces the derivation of the function with respect to model errors equal to zero. By adding this condition, the time of realization of the arithmetic operations of the input shaper increases and likewise the calculation delay of the system.

In practical applications where the system with flexible elements is controlled, undesired oscillations often occur. In the department of technical cybernetics, we have also encountered the problem of moving the mechanical arm to the required position. As we know the applied control signal and it is possible to measure system output, it can serve as a good example for system identification and input shaper proposal. To suppress these vibrations, we have decided to investigate the dynamic properties of the system and then apply such an input shaper that suppresses the residual vibrations. Accelerometer was set to measure acceleration in all three axes, with sampling frequency set to 800Hz. The gathered data were analyzed with Matlab. Using the already mentioned identification method,

we can determine the zeroes and poles of the investigated system, and thus the actual resonance frequency and damping of the system. Knowing these parameters allows us to design an input shaper with the required properties. By applying the ZV input shaper, we have acquired a new input signal to control the movement of the motors. Based on the model, the set of control signals was prepared. To confirm the model accuracy, the test in the real application was provided. System responses to the step control signal were compared. The measured results are represented in figures.

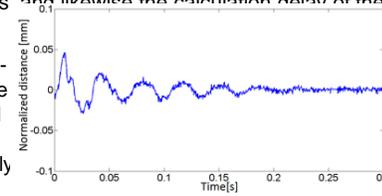


Figure 8. Response to the need to change the position of the arm - no shaper used

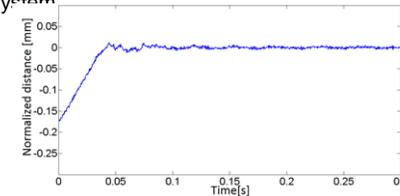


Figure 9. Response to the need to change the position of the arm - user ZVD3 shaper

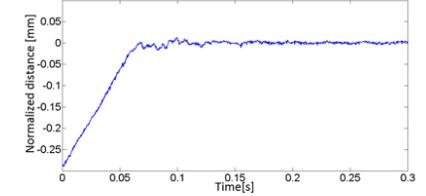


Figure 10. Response to the need to change the position of the arm - used ZVD5 shaper

III. CONCLUSION

Mechanical systems with flexible elements interfere with undesired vibrations. In systems where these vibrations are suppressed with the use of appropriate control signals, input shaping approaches have proven to be appropriate and effective. In order to design a suitable correction element, it is necessary to identify the system and to estimate system parameters. Estimating the correct model of the controlled system serves as a basis for eliminating the resonant output of the system. However, some restrictions need to be foreseen in the theoretical design of the input shaper in practice. These restrictions include in particular the relatively low resolution of the output power elements and the limitations of the action quantity. The robustness of the resulting shaper to the errors can be increased by raising the number of zeros of the transfer function of the correction member. Especially, when the actuator sampling period is comparable to the required transition time, the poles are suggested to repeat in order to achieve the desired behavior. For this case, the method for calculating the pole multiplicity is proposed. Choice of the appropriate number of pole repetition ensures that the required properties will meet by both the actuator and the user. Using the input shaper of the highest possible order that meets the design limitations is desired because the conditions set for the input shaper are met and simultaneously, the system will be most resistant to the model errors concerning system time constraints. Input shaper design was compiled and system response on various modified inputs have been simulated. The solution accuracy and suitability was also verified on a real device, using data obtained from an accelerometer.



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Park Komenského 7,
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Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Annotated dataset for the fake news classification in Slovak language

M. Sarnovský, V. Maslej-Krešňáková, N. Hrabovská



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Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — Fake news detection currently presents an active field of research. Detection methods based on natural language processing and machine learning are being developed to automatically identify the possible misinformation contained within the news articles. To successfully train these models, annotated data are needed. In English language, multiple human-annotated datasets already are available and are being widely used in the research. The main objective of the work presented in this paper, was to create similar dataset consisting of articles in Slovak language. We collected the data from the various local news portals including reputable publishers as well as suspicious conspiratory portals. To obtain the annotations, we used crowdsourcing approach. Annotated dataset was used in preliminary experiments, in which neural network classifier was trained and evaluated.

I. FAKE NEWS DETECTION

In the recent years, the fake news are becoming a very popular term, however, there is no common definition of the term present. Many definition can be found, for example, defines the fake news as: "Fake news is a news article that is intentionally and verifiably false". To identify the fake news, multiple techniques were explored, including the intelligent methods utilizing the data from the social networks. More recently, the detection of fake news is a very active field of research, leveraging the methods of artificial intelligence, machine learning and natural language processing.

II. DATA COLLECTION

Our main objective is to create a dataset for training of the fake news detectors in Slovak language, we needed to collect both, news articles from the reputable source. To choose the source of the unreliable articles, we utilized the list of suspicious and controversial content, compiled by the public initiative www.konspiratori.sk. We focused on data collection from three selected topics, for each of the we used following sources: Home news, World news and Economic news.

To obtain the class labels for the collected articles, we used crowd-sourcing approach using Doccano platform. The annotation projects were then submitted to a group of annotators. the annotators had to answer the given query for each article processed: Do you think, that the article represents a fake news, or not? The annotator were able to select an answer from the following options: Strongly yes, Probably yes, I do not know, Probably no, Strongly no. During the process, the 20 registered annotators took a part in the project, each one annotated average 350 articles. Resulting dataset consists of 840 articles containing fake news and 695 regular articles. Collected data was in the next step used to train neural network classifier.

III. FAKE NEWS DETECTION USING NEURAL NETWORKS

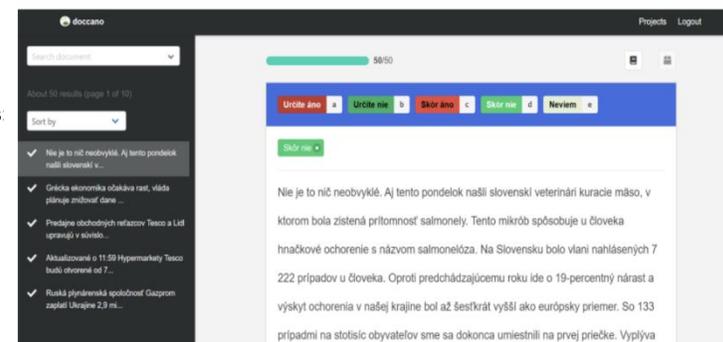
We used the created dataset for the training of the feedforward neural network. We used Adam optimization, binary cross-entropy loss function, ReLU activation function on the input and hidden layers, sigmoid activation on the output layer. We took the first 200 words from each article text for training purposes. We used Word2vec embeddings as for the text representation and standard text pre-processing (tokenization, lowercasing, punctuation removal). We divided the dataset into training and test data in the 80/20 ratio. After the training, we evaluated the model on the testing split. The model achieved a 78% accuracy on the testing set. The results are summarized in following table.

IV. CONCLUSION

This paper presented the collection of the data and creation of the labelled dataset for the fake news detection in Slovak language using crowdsourcing approach. We have utilized the Doccano crowdsourcing platform to obtain the annotations for 1535 articles. The annotations from 20 human annotators were summarized and we used the labelled dataset to train the neural network classifier during a set of preliminary experiments.

ACKNOWLEDGMENT

This work was partially supported by the Slovak Research and Development Agency under the contracts No. APVV-16-0213 and No. APVV-17-0267..



Class	Precision	Recall	F1 score
True news	0.69	0.86	0.77
Fake news	0.88	0.72	0.79
Accuracy			0.78
Macro avg	0.79	0.79	0.78
Weighted avg	0.80	0.78	0.78

Software Visualization Application for Threads Synchronization Handling in Operating Systems

Peter Sedlacek, Marek Kmec and Patrik Rusnak



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Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — In order to increase effectiveness of computing, solved problem is divided into parallel executable parts. This technique also brings some problems, that has to be solved, such as starvation or deadlock. In case these problems are incorrectly solved, software reliability can decrease or even whole computing can fail. In order to prevent such mistakes, these problems have to be understood correctly by programmers. As this topic can be difficult to understand, we have decided to implement tool to visualize common synchronization problems, such as producer-consumer, reader-writer or dining philosophers. This software tool is written in C++ language and allows user to visualize these problems, change their parameters, such as number of producers, and manage whole simulation of selected problem. This application will be used as support tool in teaching process of parallel programming at Faculty of Management Science and Informatics of University of Zilina.

I. BACKGROUND

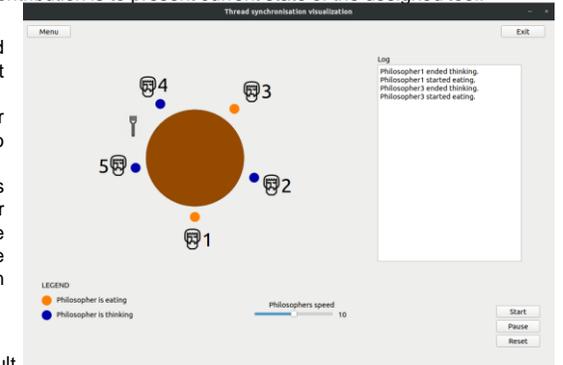
In order to increase effectiveness of computing, the solved problem can be divided into multiple parts and execute these parts parallel. This is carried out using threads or processes. But dividing problem into parallel executable parts brings also several problems with it, that can lead to unexpected behavior or even failure of whole software. System reliability is one of the important characteristics of any system and software is no exception to it, as consequences can be fatal in some cases. Therefore it is necessary to take it into account in process of design and implementation. From reliability point of view, software can be classified as non-coherent system so the whole process of reliability analysis is more complex compared to classical technical systems. Parallelization in computers brings some common problems, that have to be solved. The first one is undefined/unexpected behavior of application. This problem occurs in case when multiple threads/processes are accessing the same memory in the same time. This can for example lead to incorrect results of calculation. Therefore parallel execution of threads have to be synchronized and accessing of the same memory has to be managed. Memory shared between multiple threads/processes accessing of whom have to be managed is called critical section of application. The next problems with parallelization is deadlock. This problem can occur in case, there is a cyclic waiting between threads/processes and all of these threads are waiting for action from this group of waiting threads. For example one thread has exclusive access to shared memory, therefore, no other thread can access it but this thread is waiting to other shared resource owned by a different thread that is waiting for the first one. The last common problem with parallelization is starvation. In this problem some threads/processes cannot access critical section for long time or cannot access at all. This is mostly caused by low priority of that process/thread or because there is large amount of other processes. Mentioned synchronization problems are not usually easy to detect and fix. However, the fact that parallel programming is unavoidable in these days, it should be taught at higher schools offering study programs in field of informatics. For students of these study programs, this topic can be difficult to understand. In order to simplify it to them, we have decided to implement a software tool that visualizes the basic synchronization problems for them. The main goal of this contribution is to present current state of the designed tool.

II. SYNCHRONIZATION PROBLEMS VISUALIZATION

Producer-consumer is one of the most common synchronization problems. Synchronization in this problem is ensured using mutex from standard library. Each producer and consumer can be in two possible states: Locked - thread/process locks mutex and therefore has exclusive access to shared buffer and Waiting - thread/process doesn't locks mutex and therefore is waiting for other process to leave critical section.

The second common synchronization problem is *reader-writer* problem. Synchronization in this problem is ensured using shared mutex from standard library. In case writer is accessing critical section, unique lock is used. This ensure exclusive access to shared memory. Readers on the other side are using shared lock, that allow all readers to access shared memory in the same time.

The last synchronization problem we decide to implement in our application is *dining philosophers problem*. Implementation of this problem is slightly different to previous two problems. Forks are implemented as list of mutexes. Philosophers are implemented as individual class and each of them receive two mutexes - forks. As philosopher can eat only with both forks, dining function uses scoped lock allowing him to lock both mutexes or neither of them. This prevent possible deadlock. In the center area, there is table with philosophers and forks. In case fork is free, it is visible. Actual state of philosophers (if they are eating or philosophising) is represented by blue or orange circle next to them. Changes of their states are also logged into center left panel. Bottom panel contains legend, sliders to set philosophing speed and buttons to control simulation



VI. CONCLUSION

Parallelization of calculation brings some problems with it that have to be solved, such as unexpected behavior, deadlock, and starvation. All of the mentioned arise as a result of incorrectly implemented synchronization. In order to minimize this incorrect implementation and help students of informatics to understand synchronization problems, visualization tool was proposed. Before implementation of this application itself, existing applications was analyzed considering requirements set for achieving our goal. As non of them was sufficient, new application was designed and implemented. The proposed software application implements and visualize most common

and well-known synchronization problems, that are producer-consumer, reader-writer, and dining philosophers problem. Application is written in C++ language with usage of QT framework and MVVM design pattern. This tool allows users to set specific parameters of each synchronization problem, for example, maximum buffer size for reader-writer problem. Application also allows users to manage the whole simulation of a selected synchronization problem and in any time user can see, which thread is currently accessing shared resources (either exclusively or shared - depending on specific problem itself). This application will be used as a support tool in teaching process of parallel programming at Faculty of Management Science and Informatics of University of Zilina. In the future, we plan to improve this tool with new features, for example, with possibility to allow user not only to observe the current behavior visually, but also to see how the synchronization can be implemented in the source code. This will help students even better understand how and why the synchronization works that way.

ACKNOWLEDGMENT

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SD-WAN – architecture, functions and benefit

P. Segeč, M. Moravčík, M. Kontšek, J. Uramová, J. Papán, O. Yeremenko



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Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — SD-WAN is currently considered as a technology that has the potential to revolutionize the use of WAN services. It supports a new concept known as Application-driven networking, where the network is expected to meet the needs of applications, services and customers. In short, SD-WAN is a centralized management of WAN networks, usually with a close connection to Cloud computing and security. This way, customers can easily manage their networks regardless of the connectivity provider. SD-WAN is currently one of the most current topics with a real impact on CC services and WAN environments. SD-WAN influences thinking about how we have used network services so far. More importantly, it has great potential to change the way we use communication services in the future. There are several industries that are interesting in terms of SD-WAN deployment. Based on our analyzes, we can include the education sector among them.

I. INTRODUCTION

The direction of today's digital world can be described by term „cloud-based everything“. From application to network communication, Cloud Computing (CC) pushes out traditional solutions at a fast pace. Of particular interest is how CC transforms the WAN environment with the emergence of an approach known as Software-Defined WAN (SD-WAN). SD-WAN is directly characterized by the application of so-called "Cloud-centric" access to the network area, making strong use of the principles defined for Software Defined Networks (SDN). SD-WAN is today one of the most current topics with a real impact on CC and WAN services. And thus also their users, to which we can currently include the public sector and education. This article focuses on the introduction of SD-WAN technology, its architecture, entities and offered functions

II. SD-WAN ARCHITECTURE

Planes:

- Data plane
- Control plane
- Orchestration plane

III. APIS

- Southbound API
- Northbound API
- East-west API

IV. SD-WAN DEVICES AND ENTITIES

A. Customer CPE devices: is entity of network infrastructure plane, which is typically placed on headquarters, branch office or in Cloud environment of particular SD-WAN customer.

B. SD-WAN controller: is a standalone physical or virtual device that provides control of the CP

VI. CONCLUSION

SD-WAN is a very current topic, as indicated by various studies (IDC, Gartner, IHS Markit, Ovum, Quadrant, etc.) and the scientific community has not yet responded to it, as has been the case with SDN. It is not a topic that is its basis, but responds to the needs and trends of user development. There is a very strong interest of the organization to build cost-effective solutions for secure and guaranteed communication services (encrypted as well as with advanced security features), operated over the public Internet. At the same time, there is a significant trend of migration and use of virtualized and cloud services. From the point of view of potential SD-WAN customers, it is possible, according to our analyzes, to include organizations that plan to use Cloud services intensively. Multi-branch companies and companies offering mobility to their employees (or the use of teleworking), which have to deal with WAN connectivity, network and equipment management at branches / SOHO, application optimization, security and the growing complexity of this. Organizations and companies that record an increase in the use of real-time video communication and the associated increase in communication volume and connection speed requirements. All with the increase in security requirements. Based on these characteristics, we can easily include the education sector among future users of SD-WAN. Healthcare is a similarly identified as an interesting sector too.

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and other entities, e.g. CC gateways, in SD-WAN

C. Orchestrator (manager, director): The orchestrator in many SD-WAN solutions is a multi-tenant, cloud-based, centralized management for configuring and monitoring SD-WAN services in real time.

D. Cloud gateways: Cloud gateways are entities, mostly with multitenancy support, deployed in top-tier networks and cloud data centers around the world that provide an extension of SD-WAN technology as close as possible to entering the cloud services environment

V. SD-WAN FUNCTIONS

1. Active/Active work model
2. The use of CPE
3. Support for a secure hybrid WAN architecture (VPN)
4. Flow visibility, prioritization and application

management

5. High availability and resiliency
6. Interoperability on L2 and L3 ISO OSI.
7. Management dashboard / portal
8. Controller with open API support.
9. Zero Touch Deployment (ZTD).
10. Valid FIPS 140-2 certificate
11. Automated device discovery, provision registration
12. Automated tool for configuration
13. Unified controller and control protocol physical and virtual appliances
14. Baseline Policy Manager
15. A mechanism for sharing network status
16. Integrated monitoring

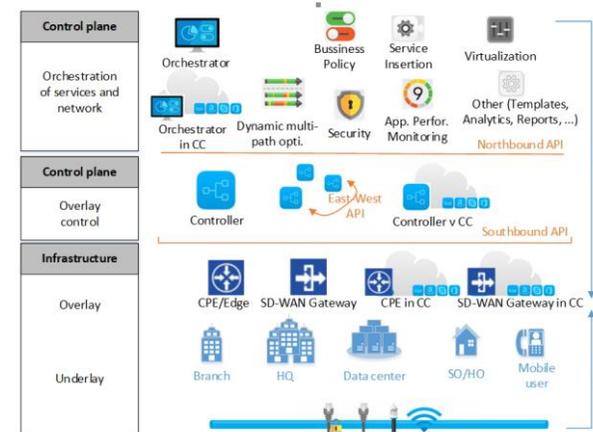


Figure 3 SD-WAN architecture

Perspective of hybrid cloud computing in higher education

P. Segeč, M. Moravčík, M. Kontšek, J. Papán

Abstract — Cloud computing along with virtualization, offers an excellent tool in IT education to support presence learning. However, what is the most common in today's situation, they excellently support online distance teaching. Cloud offers simplified access to computing resources, services and applications that support modern approach to learning. Therefore, several universities in Slovakia have built their own cloud solutions using their local computing resources. However, their employees also use the services of public cloud providers in their daily teaching practice. This situation thus opens up and supports the transition from the use of isolated private and public CC services to the construction and use of hybrid-based solutions.

I. INTRODUCTION

What are the possibilities of using CC from the education point of view and the necessary resources? What about the use of CC by academia institutions in the Slovak Republic? The situation is very diverse, and not different to other universities worldwide due to the different environments, approaches and ways of managing and innovating the ICT environment of individual schools and universities. One of the limitations is probably the same in all academia institutions, and that is to obtain adequate funding for building their own CC solutions or a model of sustainable financing of CC services of public providers. Another aspect, drawing on our own experience, is the understaffing of IT departments in higher education institutions (HEI), which limits the introduction of new and progressive technologies. Given the undersized funding, this leads to the preference for Do it Yourself (DIY) solutions of technology enthusiasts, based on the application of various open-source projects. However, this requires complex technological knowledge and the time of implementers and future administrators. The presented article is focusing on area of CC understanding, what CC is able to offer, what are common misunderstandings. From the perspective of an academic institution providing education, and which also provides of CC services, we will look at the analysis of the possibility of integrating various CC solutions leading to a hybrid (multi) CC environment.

II. HYBRID/MULTI CLOUD COMPUTING FOR EDUCATIONAL SECTOR

Benefits of HCC:

- **Flexibility** in choosing the optimal infrastructure for each of the different services together with improved resource allocation.
- **Scalability** with the growth of additional cloud options.
- Ability to **unify security** policies across different CC environments.
- Ability to choose the best **security** model as the mixture of different CC properties and options.
- **Interoperability** between different cloud types.
- **Mobility/portability** that offers the ability to move applications back and forth across clouds of partners.
- **Fault tolerance** and **high availability** thanks to distribution and component replication.
- Ability to choose the best **cost** model for each service or workload.
- Prevention from **vendor lock-in** and balanced approach where customer does not depend on one CC vendor or a solution.
- Possibilities for **technological innovation** towards digital transformation (including education).

Evolution of education towards cloud-related study programs preparing technical experts.

Challenges:

- HCC is **more complex** than other CC deployment models with higher integration complexity. The integration will require cooperation between multiple partners and multivendor orchestration.
- HCC places increased demands on the service **design**, which must carefully determine the HCC service as a workload separation between the public and the private components of the HCC coalition.
- **Manageability** issues of the complex multidomain HCC infrastructure addressing the correct redistribution of computing resources and satisfying service requirements with end-to-end visibility in mind.
- Adequate level of **inter-cloud security** and a way how to manage different CC platforms from a security perspective.
- Required **knowledge, skills**, and their availability to build up HCC services.

- **Security challenges** regarding of the amount of sensitive information exposed to the public CC.
- The **risk** of outsourced services, that are out of organization control.
- The level of trust between involved providers that form the HCC, the type of offered resources.
- The size of involved CC in terms of resources and the number of coalition members.
- **Accounting and billing.**
- Adequate Service Level Agreement (SLA) issues of involved parties to **ensure a certain level of service reliability and availability.**
- Quality of provided services (QoS) and the quality of user experience (QoE).
- **Policy regulation** that can determine what, where and how can be processed and stored.

III. CONCLUSION

Hybrid cloud is a powerful combination of several CC deployment models. The establishment of HCC/MCC is not a simple task, it raises more challenges as single CC deployment models. Challenges cover many aspects of HCC members cooperation including description of services, types of resources, distribution of resources, interworking, portability, security, and many others. Therefore, there is a lot of research effort focused on different aspects of HCC deployment.

On the other hand, HCC can also offer many benefits and is identified by the research community as well as the commercial community as an increasingly important model for CC deployment. HCC should therefore not be lost in the search for solutions suitable for academia, as it will of course also have an impact on the CC services used. At the same time, however, it has potential and can contribute to improving the quality of education, research and will lead education towards cloud-related study programs preparing technical experts in the field.

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Park Komenského 7,
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Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

SMART environment control in virtual and mixed reality based on cognitive user abilities

M. Sivý, B. Sobota, Š. Korečko, M. Hudák

Abstract — This paper focuses on the description of the interface design of a backend server and the design implementation of a user interface suitable for the visualization of virtual and real objects/appliances controlled in a SMART environment, for example in the home, with regard to the cognitive abilities of the user. Client applications will be able to use the REST API and communicate through this API using requests, use implemented logic, and store objects and their states in the database. The server is deployed in the cloud to be accessible outside the local network. The solution is universal and offers a generic standard to support different types of appliances using a generic form. Task scheduling is also an important function. In virtual reality, it is possible to quickly test the cognitive abilities of the user and thus adapt the user interface to his needs.

I. INTRODUCTION

The purpose of this paper is to make a unified user interface for all types of appliances and merge them into one user application, of course, it is necessary for smart device manufacturers to implement such or a similar standard of communication among the devices, server and frontend. Focus is also given to suit user interface for specific users and their cognitive ability, such as disabled people, old people, or children. For all this category of the people user interface is affected by their needs. Creating a virtual reality user interface should provide users with a better imagination in managing their homes without having to move to concrete devices. The environment that will be created in virtual reality should be as accessible as possible, and therefore the technology chosen to create it should be able to support users connected not only by computers and mobile phones, but also by VR headsets, such as Oculus Quest. Another advantage of the provided solution should be that it is cross-platformed. Also, the selected solution does not need to be installed, it runs fully in 3D VR using a web browser and using devices sensors for movement in 3D space. The user only needs to navigate to the web page and he can use the application. The solution will also use a mixed reality where the user can freely move in real space using a Microsoft HoloLens device or use a marker in the form of QR codes. Using these QR codes, it will be possible to load individual user interfaces of smart appliances.

Using the interface, it is possible to create a 2D user interface with all common web-based graphical elements such as labels, pictures, radio buttons, checkboxes, lists, and also these elements contain styles and positions in the application form. These forms are by default in the appliances and are sent using the server API to the end-user device. This solution is also suitable for teaching subject Graphical User Interfaces of Software Solutions at TUKE, where students can learn how to prototype graphical user interfaces in virtual reality specialized for different types of users. It can also be used for subject of Virtual Reality Systems, where students can create various 3D scenes or objects (Fig. 1, Fig. 2), and interact with them.

II. CLIENT APPLICATION

The aim of this work is also to design and create an application for the user a smart environment in virtual reality. The user interface can be extended to a mixed reality. It should also be able to support the creation of generic forms for newly connected smart devices.

This solution is web-based and cross-platformed, it means that it does not need to be installed and can run on any device which can run a web browser with access to DeviceMotion and DeviceOrientation data. It can be connected to the global server but also a local server, so the internet connection is not needed for simulation purposes.

In this smart environment, more users can collaborate because all requests are computing on the backend server and using web-socket technology. They have actual data from all sensors and the status of smart appliances.



Fig. 1 Virtual House environment



Fig. 2 Virtual House with more online users

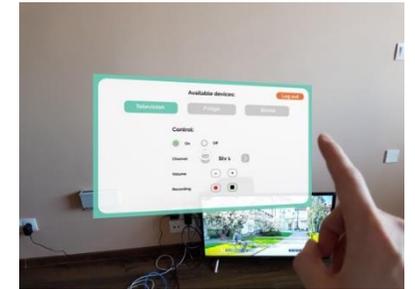


Fig. 3 Controlling television using Microsoft HoloLens

III. CONCLUSION

The current state of the smart environment is used as a mixture of many types of applications and procedures, which depend mainly on the manufacturer and are not focused on specific user needs. A functional communication interface and database model were successfully implemented, which provide back-end support for any upcoming systems and user interfaces. It provides universal support for any graphical representation of form. For training the cognitive abilities of users, custom user interface can be made and tested. We are also working on using new VR technologies in the process of teaching subject at Technical University in Košice. This solution is also suitable for the Virtual Reality Systems and Graphical User Interfaces of Software Solutions subjects at TUKE.

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Slovakia

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fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Use of Different Channels for User Awareness and Education Related to Fraud and Phishing in a Banking Institution

Ivan Skula, Jan Bohacik and Michal Zabovsky

Abstract — Each person faces the risk of falling to fraud not only as an individual but also as a customer of a bank, an insurance company, a mobile operator, government services, and many others. To tackle the fraud risk holistically, it is not enough to implement fraud-risk related processes into daily operations and deploy fraud detection and prevention tools and systems. Usually, the weakest point is the person, an employee or a customer, especially an uneducated one. Therefore, it is essential to complement the above-mentioned measures with awareness and education. In this paper, different channels available for fraud prevention awareness campaigns are reviewed with the inclusion of characteristics impacting their applicability such as reach, relative costs, age group, and supported message format. It also contains an analysis of historical occurrences of fraud-related messaging as well as fraud awareness posts distributed by the banks in the UAE through the Twitter social network, which is one of the latest channels. The tweets of some UAE banks are analyzed so that it is observed how they use this channel for communication with their customers and how they use it for fraud awareness purposes.

I. INTRODUCTION

Fraud is an ever-present phenomenon which is gaining more and more attention not only from the professionals in the field of security but also from the general public. We all are possible fraud victim as the fraudsters are not targeting only certain groups of people or industries anymore. This research taps into this area, by looking at the current trend and primary impact factors behind the observed increase in fraud. It looks more specifically into fraud prevention through awareness campaigns. It reviews all the relevant media channels that can communicate the campaign message to desired audience. All types of organization are susceptible to fraud, but at the top of the risk list, we usually see the organizations where the money are their core business - the banks. In the part focused on data analysis, we narrowed our focus to specific geography - United Arab Emirates.

II. CHANNELS USED FOR FRAUD AWARENESS

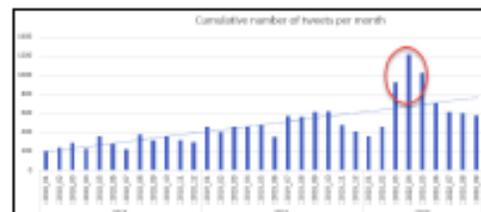
Research reviews different communication channels and their use for fraud awareness campaigns. As different channels have different characteristics, we defined 4 distinctive measurable metrics – reach, relative cost, primary audience and supported media format by each channel. All available channels commonly used by the banks were categorized through the selected metrics to visualize and allow for easy comparison of benefits of each channel for the fraud awareness.

III. ANALYSIS OF FRAUD AWARENESS COMMUNICATION THROUGH TWITTER

From all the available communication channels used for fraud awareness by the banks we chose one – social media, more specifically Twitter to find answers to following questions:

1. Are the banks using social media(Twitter)? And if yes, what is the trend?
2. Are the banks using social media(Twitter) for fraud awareness and what is the trend?
3. Has there been any visible impact as a result of COVID19 in the use of social media in general and in using it for fraud awareness?

Analysis was performed on the data from two periods: 1st period for data from 01/2018-09/2020 and 2nd period from 01/2020-09/2020.



VI. CONCLUSIONS

Research reviewed and categorized all commonly used communication channels across 4 different categories – reach, relative costs, primary audience and supported media format. This categorization allowed easy comparison between the channels applicability based on specific requirement of given awareness campaign. Further on, through analysis of Twitter messages on the accounts of the major banks in UAE we answered questions related to general use of social media by the banks as well as more detailed view on using this channel for fraud awareness and what the current trends are.

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Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk



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OF THE SLOVAK REPUBLIC

PCA Tail as the Anomaly Indicator

O. Škvarek, M. Klimo, J. Kopčan

Abstract — Nowadays, tools based on machine learning (ML) becomes an integral part of education. Education usually focus on ML systems principles and correct system setup. Our article suggests another important educational step – estimation of ML system suitability for particular data analysis. Proper application of these ML tools brings benefits, but misuse can be dangerous. The pattern recognition system always indicates the class most similar to the submitted pattern based on the features extracted from the training set. Designers optimise recognisers for specific training set classes. Still, users may not be familiar with its preparation methodology, and thus, they may apply the recognition system to samples incompatible to the training set (outliers, novelties, anomalies). This paper analyses a tail remaining after linear principal component analysis as an anomaly indicator. A nonlinear approach based on generative adversarial networks (GAN) is also presented. In addition to the result of the recognition, the user also gets a level of its credibility categorised into three classes: accept, do not decide, reject. For example, Fashion-MNIST queries were submitted to the recogniser trained on the MNIST database. The proposed linear misuse detector refused all of them; the neural network-based detector failed in 4.81% of queries. For a more detailed analysis, MNIST samples corrupted by Gaussian noise were admitted presented to the misuse detector trained on the noiseless MNIST dataset. The experiments revealed a sharp border between acceptance and non-acceptance (no decision or rejection) decisions..

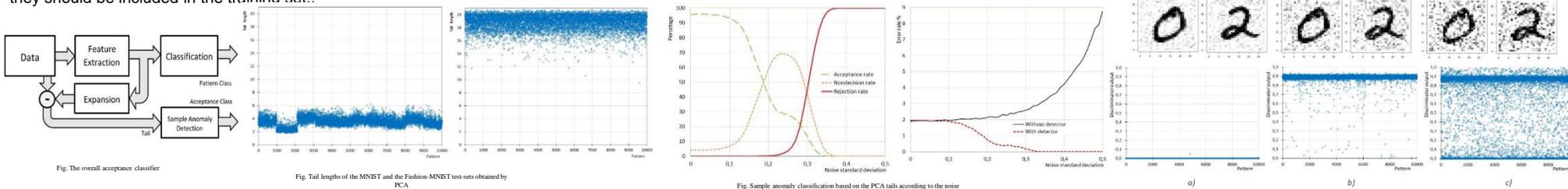
I. BASIC CONCEPT

We use PCA as linear features extractor to explain the basic concept. If W is the eigenvector matrix based on the covariation matrix, then the Karhunen-Loève transform gives $y=Wx$. The idea behind PCA is based on the fact that eigenvalues give the average Euclidean errors of the x reconstruction if the corresponding component is missing. This means that if the eigenvalues are descending, the first K components can be used as classification features and the tail length would give the reconstruction error. Therefore, we can expect a short tail for the sample, similar to the training samples. Conversely, samples far from the training set may have features similar (or even the same) to the training samples, but their tails are long.

II. RESULTS

The demonstrated sample inconsistency detector was trained on the MNIST dataset of handwritten digits and tested against the Fashion-MNIST database and the MNIST corrupted by the noise. We saw that the PCA-based sample anomaly detector was overtaking the neural GAN-based detector in the Fashion-MNIST test. We have seen that a good separation of similar samples (in GAN) does not necessarily mean an excellent separation of completely different samples. Using the GAN as a nonlinear transformer of the feature space seems to be a suitable solution for more complex criteria than tail length, and it will be studied in the future.

The noise test shows quite a sharp border around which the proposed detector distinguishes between acceptable and non-acceptable queries. If we expect the recognition of the samples corrupted by noise to take place, they should be included in the training set..



III. CONCLUSION

Pattern recognition systems are still designed as black boxes. Their performance is validated on test sets that are similar to the training sets. There is no chance to test them on anomalies due to dimensionality curse phenomenon. However, when the anomaly sample occurs, the system classifies it into one class of the training set. To avoid this situation we proposed to place in front of the pattern recognition system a filter that warns of anomaly pattern danger. Now, the challenge lies in avoiding all queries not compatible with the training set as they are unknown. We train a training data compressor, and we assume a good approximation for samples compatible with the training set. Outstanding queries were expected to produce a poorer estimation, i.e., the distance (a tail length) between the original sample and the reconstructed sample to be higher. This tail length was used as an indicator of sample anomaly, and two boundaries were set to decide whether the result of the pattern recognition should be accepted, ignored, or rejected. The boundaries were tuned for each class separately, using one-versus-rest classification on the training set.

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Software Tool for Importance Measures Computation Used in Reliability Analysis

D. Smalik, P. Rusnak, P. Sedlacek. and N. Brinzei



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Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — In Reliability analysis, there are four main steps to perform. These steps are selection of the mathematical model that represents system states, selection of the mathematical representation that represents the operation of the system, quantitative and qualitative reliability analysis and to conclude the obtained results. In Faculty of Management Science and Informatics, there is a course called Reliability engineering in which reliability analysis is taught. During the course, the students are taught about the basic of the reliability engineering and reliability analysis. During this process, there are various topics that can be more challenging for a student, such as computation of the Importance measures. Thanks to this, we developed a software tool for such computation and this tool is also usable for the research activities in our faculty. By implementing this software tool in the teaching process in subject of the reliability engineering the students can better understand, how these measures can be computed and how can they be used for localizing weak spots in the system. Results from this tool can be then used in term projects and assignments by students of in research activities that uses these measures in reliability analysis.

I. INTRODUCTION

Nowadays, there are many phenomena that can only be described using two values, namely 1 or 0; true or false. In order to be able to work fully with such values the Boolean algebra was developed and it can be found in mathematics, computer science, but also in electronics and reliability theory. In reliability theory, these values can describe the state of the system and its components. The influence of the change of the state of the component on the change of the state of the system can be described in more detail by means of importance measures, which give a more detailed view of this issue. Importance measures represent an important approach in the reliability analysis of system. They can be used to analyze the effect of the failure of one or more system components on the failure of the entire system. The results of each importance measure are used to improve the functionality of the system or to plan its maintenance. However, the calculation of individual importance measures requires a number of numerical calculations, which is time consuming and there is a possibility that a calculation error may occur. This is especially true when these calculations are performed by students within the subject of reliability engineering, which is taught at the Faculty of Management Science and Informatics. Therefore, a software tool was developed at the faculty for the calculation of importance measures of the system, the functionality of which is described by a structural function. The developed software tool is able to calculate 3 basic importance measures, such as a structural importance, Birnbaum importance, or a critical importance and to represent the results graphically. This software tool is therefore a support material for solving tasks and assignments in the reliability engineering.

II. THE SOFTWARE TOOL FOR IM COMPUTATIONS

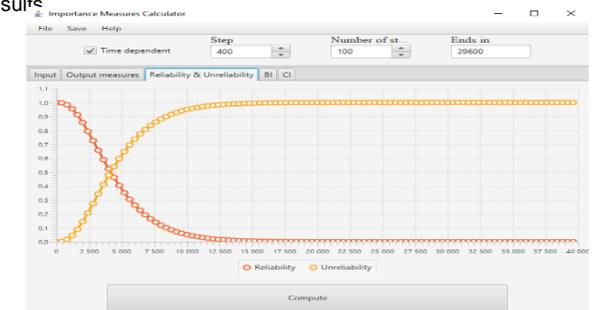
The software tool was created mainly for the needs of the subject of reliability engineering and for research tasks. In it, it is possible to set the type of system analysis - time-dependent or time-independent analysis. In the case of time-dependent analysis, it is necessary to set the size of one step and the number of steps, on the basis of which graphs will be drawn for individual significance indicators. After loading the file with structure function, the application detects the number of components and adds the option to set input values for each component. For each component it is possible to set one of four probability distributions describing the operation of the component together with the parameters of the selected distribution. The following probability distributions are available: exponential, Weibull, normal, and log-normal probability distributions. As a next step, the calculation will start and the results will be displayed. In the case of choosing a time-dependent analysis of the system, the following data are presented in the form of graphs: system reliability and unreliability function, time-dependent BI and CI. If a time-independent system analysis is selected, all data are presented in the form of a table.

III. CONCLUSION

In this article, a software tool for calculating IMs and system reliability and unreliability functions based on a structural function was introduced. It was developed mainly for the needs of the subject of reliability engineering at the Faculty of Management Science and Informatics and also as a support tool for research activities. This tool can be used to perform calculations for quantitative analysis in the context of reliability analysis. The software tool has many other functions, such as saving output data in csv format or saving the resulted graphs in PNG format. The software tool is already used in teaching and its use has proven successful in solving practical tasks and for term projects. In future development, it would be appropriate to expand the software tool with other functionalities, such as those that would allow the calculation of other significance indicators such as Fussler-Vesely Importance.

ACKNOWLEDGMENT

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One-parameter Methods for Recognizing DDoS Attacks

J. Smieško, J. Uramová



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Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — In this article we deal with the use of one parameter machine learning methods for the recognition of DDoS attacks. At the same time, we want to present the implementation of research focused on cybersecurity in the curriculum of our study engineering program Applied Network Engineering. We focused on the autoregressive coefficient and on the Hurst coefficient, which expresses the degree of self-similarity of the observed flow. We tested the ability of the coefficients to detect a change in the structure of the IP flow during a DDoS attack in time on simulated data and subsequently on several recorded real DDoS attacks.

I. INTRODUCTION

One of the biggest benefits and at the same time one of the biggest risks of today's society is the rapid modernization.. In recent years, cybersecurity becomes one of the priorities of every state. One of the most commonly used cyberattacks are DDoS attacks. The most common methods of detecting DDoS attacks are performed using statistical methods. Statistical or correlation measures are useful for analyzing network traffic and are also effective in distinguishing offensive behavior in network traffic as opposed to normal behavior [4]. These methods can be referred to as machine learning methods with a teacher. We decided the other way in our research. We are searching characteristics of network traffic that would be able to respond in a timely manner to a significant change in the nature of the flow that occurs in the event of a DDoS attack. We first monitor the normal network operation for some time, during which the considered characteristics are calibrated to standard values. Consequently, in the case of a DDoS attack, the values of the characteristics change significantly, thanks to which we recognize the upcoming attack. We will therefore deal with one-parameter methods of machine learning without a teacher.

II. AUTOREGRESSIVE ANALYSIS AR(n)

The AR (n) autoregressive model assumes that the considered random process $X_t = \beta_1 X_{t-1} + \beta_2 X_{t-2} + \dots + \beta_n X_{t-n} + \varepsilon_t$. If we denote the matrix of all N values of the dependent variable $\{X_t\}$ as y and e as a vector of measured errors, we can describe the autoregressive model using a standard model of multidimensional linear regression: $\mathbf{y} = \mathbf{X}\boldsymbol{\beta} + \mathbf{e}$. Estimates of unknown parameters are obtained by the least squares method (LSM). The solution has the form: $\hat{\boldsymbol{\beta}} = (\mathbf{X}^T \mathbf{X})^{-1} \mathbf{X}^T \mathbf{y}$. Our goal is to find a simple characteristic describing the change of IP traffic. We will deal only with the First Order Autoregressive Analysis, AR (1): $X_t = \beta \cdot X_{t-1} + \varepsilon_t$. For all N values we get a matrix notation

$$\begin{pmatrix} x_{n+1} \\ \vdots \\ x_N \end{pmatrix} = \beta \cdot \begin{pmatrix} x_n \\ \vdots \\ x_{N-1} \end{pmatrix} + \begin{pmatrix} \varepsilon_{n+1} \\ \vdots \\ \varepsilon_N \end{pmatrix}$$

The solution of this form obtained using the least squares method is denoted as c and is called as the autoregressive coefficient:

$$c = \hat{\beta} = \frac{\sum_{k=n}^{N-1} x_k x_{k+1}}{\sum_{k=n}^{N-1} x_k^2}$$

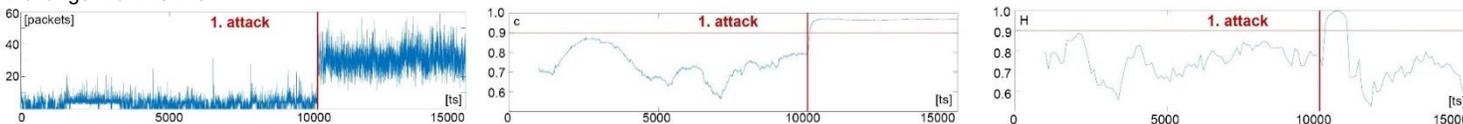
III. HURST PARAMETER

Hurst coefficient is a statistical measure for the analysis of time series, measures their long-term trend and expresses the degree of self-similarity of the observed process [5]. One of the most commonly used methods how to gain Hurst parameter H is R/S analysis, $(R/S)_n \approx C \cdot n^H$. To estimate the Hurst parameter, $(R/S)_n$ values of the statistic approximates a regression line. $\ln(R/S)_n = \ln C + H \ln n$. The Hurst parameter represents the tangent of this line.

IV. DETECTION OF DDOS ATTACKS ON REAL DATA

We show only one attack. The first packet capture we used is from ISCX 2012 Intrusion Detection Evaluation Dataset [8]

The record contains seven streams, each with a length of 24 hours. The flow we used for our experiments combines real operation with DDoS attack triggered by IRC Botnet. The section we used for our experiments is 150s long, with the attack occurring in 100th second (Fig. 9).



VI. CONCLUSION

We dealt with the use of the autoregressive coefficient AR (1) and the Hurst parameter for the purpose of detecting DDoS attacks. We tested their response to a change in the flow structure, to the occurrence of sudden burst periods, but mainly to the transition of normal operation to flood operation. The advantage of the AR (1) coefficient is its very simple and fast estimation, but it has not been able to detect flood traffic in every circumstance. The estimate of the Hurst parameter is much more complicated and longer, but Hurst was able to more clearly detect an adverse change in flow. Both parameters tended to take values close to 0.9 to 1.00. In the future, our effort will be to create some comprehensive function for these coefficients so that they complement each other in the detection of DDoS activities, or to enrich this function with additional parameters for the detection of DDoS attacks. At the same time, we presented our efforts to implement current scientific knowledge into the study of future network engineers [13], [14], [15], [16], [17].

ACKNOWLEDGMENT

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Measuring the driver's driving style

B. Sobota, M. Guzan, Š. Korečko, M. Hudák, Z. Racz, M. Sivý



ICETA 2020
Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — The paper describes an alternative use of some smartphone sensors to determine the characteristics and driving style. Two applications have been designed and built. These applications enable the collection of data from the sensors of smartphones while driving and the evaluation of these measurements aimed at detecting the driver's driving style. The test measurements of various types of vehicle starting were performed and evaluated using the proposed applications. Finally, the way of using this solution after certain modifications for disabled people on wheelchairs is presented

I. INTRODUCTION

Each driver controls his vehicle in his own style. The differences may be in the way of an acceleration, a braking, a speed control, a clutch control, a reaction time or a driver aggression. According to several studies, three main categories of driving style have been identified: 1. calm (economical), 2. average and 3. aggressive driving style. The most problematic style is the aggressive driving style, which is often the cause of accidents. From this point of view, the control of the wheelchair does not differ in any way, either in the classic form, although slower or at the level of an electric car. Therefore, a scanning application was designed for measure speed and acceleration.

II. SOLUTION DESIGN

The most important are the kinematic characteristics of the vehicle when measuring driving quality, namely: speed and acceleration. Designed app has following functions: a) to measure and record data from smartphone sensors, b) to provide views allowing the evaluation of the measured route. A standard programming environment for Android in Java was selected for the development of the application (classes) e.g.: a) MainActivity - is displayed when the application is started. The activity displays a form for obtaining basic adjustable parameters and a button for starting the measurement, b) MeasureActivity - is responsible for initializing the accelerometer and displaying real-time measurement information, c) BaseActivity - is an abstract class. Other activities in the application are inherited from this class, d) PositionData - stores geographical location data, namely: latitude, longitude, speed and time of data acquisition or e) AccelData - stores magnitude of the acceleration data on the three spatial axes and the time of data acquisition.

III. APPLICATION FOR ANALYSIS AND EVALUATION OF MEASUREMENTS

Figure 1 illustrates the effect of different starting modes to acceleration values. The curves are created by smoothing the instantaneous values on the y-axis using an exponential floating average. The red curve represents a very smooth start. The blue curve - slight start, rapid start is green curve and black curve indicate very aggressive start and shifting to higher gears.

On Figure 2a is the route drawn using colored lines - there are assigned based on the average driving speed. Figure 2b shows the same part of the map as on the left. The difference is that the colors of the lines representing the route are determined by the average size of the acceleration vector on the given line instead of the average speed. It is possible to proceed to the next step after capturing and evaluating the data. This is a driving simulation in a virtual environment (Figure 3). This part was realized in the environment of the virtual cave LIRKIS-CAVE available at the authors' department. This can be used in two ways: a) the immersive playback of the driving style in the visualization environment of either a virtual cave or using a data helmet and b) direct measurement and real-time visualization in this environment.

IV. CONCLUSION

The driving style in the car or on a wheelchair either in the real traffic or in the simulator can be determined using the described solution. The solution controlling is simple and intuitive. The usage of the application to evaluate the driving style (not just for a car drivers) or to handle more difficult maneuvering concepts even for wheelchair users, segway or electric scooters users is possible by changing the range of some parameters, e.g. acceleration speed (speed of movement). The immersive playback of driving style using virtual reality technologies will allow to practice some cognitive habits of drivers and thus optimize their driving style in the future. This will increase the training capabilities of this solution. The benefit will be also a safe and inexpensive solution, especially for wheelchair users. This will open up new possibilities of use for this type of disabled people.

ACKNOWLEDGMENT

This work has been supported by the KEPA grant No. 035TUKE-4/2019: „Virtual-reality technologies and handicapped people education“.

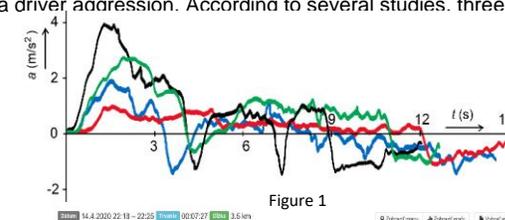


Figure 1

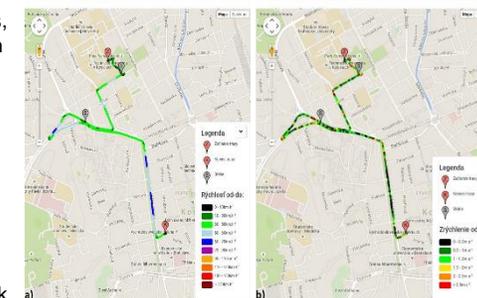


Figure 2



Figure 3

Disabled People and Pictogram-Text Application with Gesture Displaying Extension

B. Sobota, F. Ondra, Š Korečko, M. Hudák, M. Sivý



ICETA 2020
Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — This paper describes a development of a software solution for disabled users on symbol (pictogram) - text interface level. The solution is extended by a gesture visualization, which works with a sign-language. A symbol (pictogram) represents an idea encapsulated into a simple drawing. Its purpose is to better understand given situation. When teaching children to read, deaf-mute children and children with multiple disabilities in particular, it is required that the text used is not impersonal. The purpose of the text is not only to give information; it should also “touch” the child and provide understanding. The paper offers a description of the software solution implementation. It also provides selected examples of the solution utilization and its evaluation.

I. INTRODUCTION

Development of software applications or solutions for disabled users can be a challenge, even for experienced user interface designers. The fact that disabled children usually read less than ordinary ones makes the development of such software more difficult. They read less because of limited understanding of words meaning, text length and the amount of abstraction. In this paper we describe a didactic software application, which uses a symbol (pictogram) – text interface and a gesture visualization to support easy understanding of taught subjects. The application has been implemented for the most recent version of an original interactive school desk. The desk itself has been developed at author's home laboratory (the LIRKIS laboratory). The application implements a unique pictogram-text method used in a special pedagogue at Pavol Sabadoš special boarding school in Prešov. However, the pandemic situation has so far interrupted the evaluation process, so some expected results are not presented in this paper.

II. Pictogram-Text Application

The implementation of the application has been carried out in four phases, corresponding to its components: implementation of word prediction for keyboard input, implementation of audio and video support, implementation of gesturing support and implementation of gesticulation inputs processing from the sensors.

The API is used for registration of users and it is the introductory part of the application. There is a choice of several activities in a form of games, as the application provides the ability to add new learning alternatives. The main part of the application primarily contains implementations of the games (game logic). An integrated SimText game works as a learning simulator. From a system point of view, this is a multi-modular *Maven* project using the *Spring Boot* application with a built-in *Servlet container* and the *Vaadin* web framework. The database is provided by the object-relational *MYSQL*, accessed via the *Hibernate* plugin. The application also includes support for multiple languages through the W3C internationalization (i18n) and localization, for possible future expansion to other countries around the world.

The student's task is to learn new pictograms, representing words, and compose sentences from them. This is made possible by various representations of pictograms in verbal, visual and sound form, but also in the form of sign language. The student can perform a self-test or he can be tested, in a form of gamified exercises (Fig.1).

The next important part is the pictogram screen, accessible from the navigation bar, allowing to create a pictogram. The mandatory components of a pictogram are the image and names or meanings of corresponding word or phrase in Slovak, English, Romani and Russian. If all required fields are filled in the pictogram can be saved to a database.

III. Novel Features

The most recent version of the application features word prediction and alternative representations of pictogram meanings, including sign language gestures. To make it easier for students (pupils) to learn words and understand pictograms, when writing a word, they have the option of word prediction. This feature works in real time and it makes easier for them to choose a word from the list. In order to develop their knowledge of naming things, the pictogram is represented in addition to the image by audio and video. The student can hear how the word is pronounced and speechless students will learn to read words from their lips.

A very interesting feature is the representation of the pictogram as a sign language gesture, where the gesture is performed by a 3D model of the avatar, using inverse kinematics. The avatar shows the gesture in a smooth motion of the hands, fingers and head. The biggest advantage is that it is a web based application and not a desktop one. So students can access it from anywhere with internet connection.

IV. CONCLUSION

The paper presented possibilities of integration of users with disabilities by means of an educational application, utilizing contemporary information technologies. The application developed is intended for users with disabilities, such as an impaired perception and concentration, cognitive impairment, and thus mild stages of retardation. The final product is a web application with the possibility of managing users. The teacher is allowed application tests to be created to further put pressure on students to test. To facilitate learning, word prediction is available when writing text and the ability to learn using audio and video clips, as well as sign language display. This solution presented in the paper creates a chance to really understand the needs of people with disabilities, especially children and an adaptation of these tools to their needs. We hope that evaluation and utilization in the pedagogical practice will start again after the pandemic situation will get under control and we will try to bring newer solutions and software applications, adapted for handicapped children, in the meantime.

ACKNOWLEDGMENT

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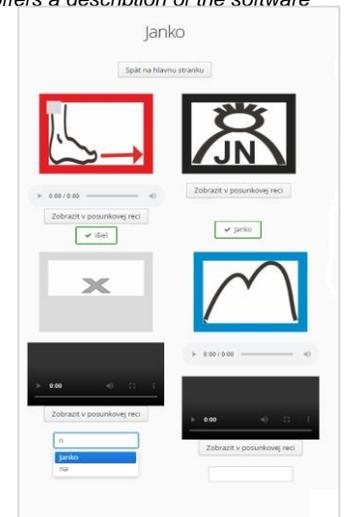


Fig. 1. Exercise screen of the application, displaying a grid of sentence components (labels are in Slovak)

On-Chip Digital Calibration for Analog ICs Towards Improved Reliability in Nanotechnologies

Michal Šovčík, Viera Stopjaková, Lukáš Nagy, Miroslav Potočný and Daniel Arbet



ICETA 2020
Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract —Proposed paper presents a digital method of calibration for analog integrated circuits (IC) as a mean to extend the lifetime of ICs and maintain their reliability over long term. Proposed solution is robust against ageing, electrical stress and process, voltage and temperature fluctuations (PVTa). The digital calibration was utilized in an integrated variable-gain amplifier (VGA). Calibration is aimed at cancellation of the VGA input offset voltage. This technique does not require additional setting or test, and therefore, it can be fully autonomous. For this purpose we propose utilization of Ping-pong method. The whole system is implemented on a chip and it was fabricated in 130nm CMOS process. Following verification opened space for involvement of students. In a form of team project they analyzed the measurement setup and developed automated measurement software in MATLAB. The whole calibrated system is supplied with voltage of only 600 mV. After fabrication, prototyped chips were verified by experimental measurements over 10 packaged samples. Obtained results fit well between corners of simulation. In essential specifications such as voltage gain, the VGA closely meets the nominal values, which proves the effectiveness of the digital calibration.

I. MOTIVATION

Downscaling of IC's process nodes brings alongside its tremendous benefits also downsides in form of increasing stochastic variations of IC electric parameters. These are driven by variations in PVTa. As this trend grows stronger across scaled technologies, the proper form of calibration will be mandatory for sensitive analog circuits in future.

II. DIGITAL CALIBRATION FOR DIFFERENTIAL AMPLIFIER

The digital method of calibration was implemented to cancel input offset voltage (V_{INOFF}) in VGA. The design was fabricated in CMOS 130 nm technology (Fig. 2) and it was experimentally verified in collaboration with students. The calibrated VGA key parameters are:

- Fabrication technology 130 nm CMOS
- Ultra low $V_{DD} = 0.6$ V
- Residual measured $V_{INOFF} < 170$ μ V

For fully autonomous operation of calibrated system we propose utilization of Ping-pong method in Fig. 1.

III. VERIFICATION AND INVOLVEMENTS OF STUDENTS

The realized method was verified through comparison of simulation (Monte Carlo analysis) and experimental results (10 packaged chips). The plot in Fig. 3 displays this comparison on best and worst case of magnitude frequency characteristic.

Histograms in Fig. 4 shows reliable cancelling of V_{INOFF} by digital calibration (green) in comparison to uncalibrated VGA (red) and Chopper stabilization (blue). Measurement results were obtained using automated measurement setup, which was developed by students. These collaborated on our research in form of team project.

V. CONCLUSION

This work proposed a digital method of calibration usable for analog integrated circuits as reliable alternative to other used methods. The proposed method was implemented for VGA in 130 nm CMOS technology. Experimental measurements at 27 °C proved solid effectiveness in compensation of V_{INOFF} . These reveal the residual V_{INOFF} of calibrated VGA between 13 μ V and 200 μ V instead of ± 10 mV in uncalibrated version. The VGA measured magnitude characteristic well corresponds to nominal design. The automated measurement setup was developed by students, collaborating in our research.

ACKNOWLEDGMENT

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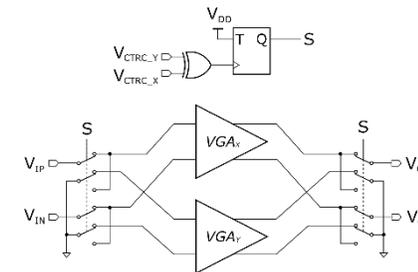


Fig. 1. Autonomously calibrated VGA.

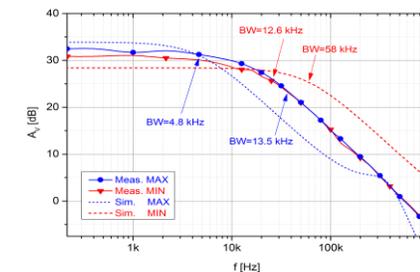


Fig. 3. Magnitude characteristic after calibration.

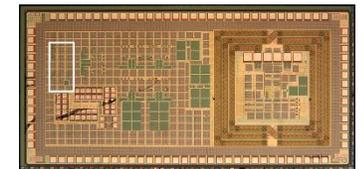


Fig. 2. Micrograph of realized system.

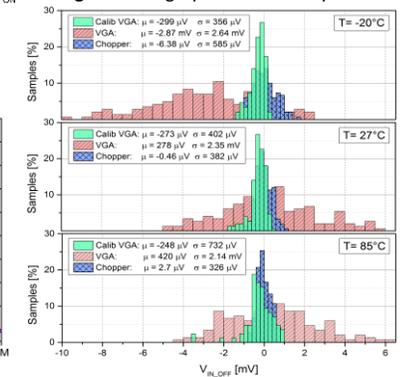


Fig. 4. MC analysis of residual V_{INOFF} .

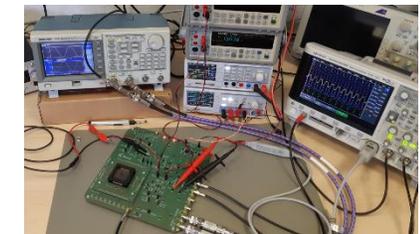


Fig. 5. Automated measurement setup.

The Importance of Generation Z Personality and Gender Diversity in the Development of Managerial Skills

A. STARECEK¹, D. CAGANOVA¹, E. KUBISOVA¹, Z. GYURAK BABELOVA¹, F. FABIAN¹ and A. CHLPEKOVA¹

Abstract — The issue of formal and non-formal education of young people (Generation Z) is currently quite challenging. Generation Z significantly differs from the previous generation, in terms of personal values and motivational composition. Gender majorly affects the personal structure of individuals and the development of managerial skills at the same time. The main goal of the paper is to analyse the composition of personality, motivational characteristics of Generation Z from the perspective of gender diversity, with a focus on the development of managerial skills. The research sample consists of $n = 150$ respondents (students of Generation Z). Standardized psychodiagnostics questionnaires (NEO questionnaire and DMV questionnaire) were used for data collection. Gender diversity has an impact on the development of managerial skills due to different personality assumptions. The authors of this paper consider the identified statistically significant differences between genders in personality characteristics (neuroticism and conscientiousness) and identified statistically significant differences in motivational characteristics (motivation to perform and anxiety supporting performance) between genders of Generation Z members as the most important results of the research. These findings can be used not only in the development of managerial skills, but also in the fields of formal education at universities and colleges.

I. INTRODUCTION

People referred to as Generation Z were born and raised in different conditions than their predecessors, they were influenced by different social and political events that surrounded them and especially technological progress. The specification of Generation Z as born 1996 – 2010 is used in the presented paper. Various authors call the analysed generation different names such as: Switchers, Online Generation, iGeneration, Youngest generation or Digital generation. Online education, e-learning and outdoor education can be considered as effective methods for education of Generation Z. Their easy availability and access make them an effective educational forms. Research on gender differences in cognitive abilities suggests different assumptions for the managerial skills development. Representatives of both genders are self-confident, what make them suitable for managerial positions. The preconditions for the development of managerial skills differ for the female and male gender, for example care, selflessness, and compassion.

III. RESULTS OF THE RESEARCH

Evaluation of a Research Question 1:

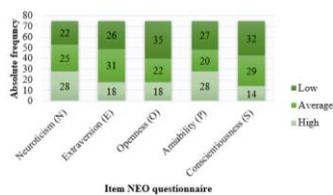


Figure 1: The results of the NEO questionnaire – Men (Own processing, 2020)

Figure 1 is composed of five items, which are divided into three parts according to the height of the percentile score achieved. Men from Generation Z have high scores for Neuroticism and Friendliness (28). Negative finding is that respondents of the male gender got a low score for the item Openness (35). Figure 2 shows that the most significant differences are for Neuroticism (38) and Conscientiousness (34), where women achieved much higher scores as mans.

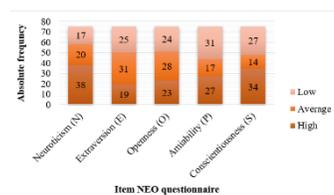


Figure 2: The results of the NEO questionnaire – Women (Own processing, 2020)

IV. CONCLUSION

The authors of the paper have identified that there are revealed some differences in the personalities of women and men of Generation Z by analysing the theoretical background. We identified the strengths and weaknesses of Generation Z by evaluating the first research question. Gender diversity has been demonstrated for neuroticism, which has a negative impact on communication, interpersonal relationships, and individual performance. Furthermore, there was a difference between women and men, demonstrated in the items of conscientiousness and openness. Conscientiousness as a part of personality affects teamwork, especially in relation to colleagues and superiors. The differences between women and men of Generation Z was demonstrated in terms of motivational characteristics, too. Subsequently, statistical testing showed statistically significant differences between selected personal and motivational characteristics. All these findings can be used not only in the managerial skills development, but also in further formal and non-formal education of Generation Z.

II. RESEARCH METHODOLOGY

Research methods used for processing research data were: descriptive and quantitative statistical analyses, histograms, pie charts, supplementary analyses in a tables, parametric and nonparametric statistical tests. Research sample consisted of 150 respondents. The two standardized questionnaires were used, the NEO and the DMV questionnaire.

RQ1: Which of the selected personality and motivational characteristics of Generation Z can be used in the development of managerial skills with regard to gender diversity?

RH0: There is no significant difference between genders in selected personality characteristics of Generation Z.

RH1: There is a significant difference between genders in selected personality characteristics of Generation Z.

RH0: There is no significant difference between genders in selected motivational characteristics of Generation Z.

RH2: There is a significant difference between genders in selected motivational characteristics of Generation Z.

Figure 3 shows that Generation Z has high scores on the Motivation to Performance scale (28), which is a positive finding. Conversely, respondents show low scores (32) on the Anxiety Performance Support Scale and we can conclude that anxiety does not have a positive effect on an individual's performance. Figure 4 presents the results of the evaluation of the DMV questionnaire for groups of female respondents. We can state that 38 women show a high score on the Motivation for Performance scale, which is desirable for performing at work. Women achieved high score (29) on the Anxiety which inhibits performance scale. All three items of the questionnaire portray different values compared to the respondents of the male gender.

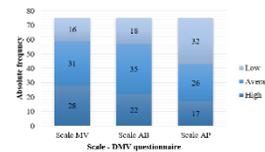


Figure 3: The results of the DMV questionnaire – Men (Own processing, 2020)

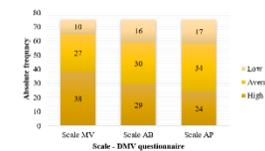


Figure 4: The results of the DMV questionnaire – Women (Own processing, 2020)

Evaluation of a Research Hypotheses:

Interpretation of the results for the first research hypothesis: Based on the statistical testing and verification the first research hypothesis, we can reject the established H0 and confirm the established H1. Therefore, we can say that there is a statistically significant difference between selected personalities (Neuroticism and Conscientiousness) and gender of Generation Z.

Interpretation of the results for the second research hypothesis: Based on the statistical testing and verification of the first research hypothesis, we can reject the established H0 and confirm the established H2. Therefore, we can state that there is a statistically significant difference between selected motivational characteristics (performance motivation and performance support anxiety and conscientiousness) and the gender of Generation Z.

Support for online teaching of the Semantics of Programming Languages course using interactive software tools

William Steingartner, <https://orcid.org/0000-0002-2852-9403>



ICETA 2020
Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — Importance of online education has grown mostly in time of the world pandemic of coronavirus disease 2019. All types of schools must start to teach using online technologies. Very often, using some kinds of teaching software tools can markedly simplify the teaching process. Those software modules are used for simulation, visualization or animation of processes, computations, program behavior, or simply, as help for study, experiments and projects. This paper aims to present a teaching tool for emulation of constructing the transition relations and visualization of computational sequences for the method of structural operational semantics applied to programs written in an abstract language Jane. The presented software works as a compiler that transforms an input code to a computational sequence of transitions.

I. INTRODUCTION AND MOTIVATION

The presented research is focused on how to effectively model and visualize the application of semantic methods on imperative programming languages. Many theoretically oriented courses often require a deeper knowledge of mathematics to make the problem easier to understand. We often encounter the fact that mathematics is a point with which students studying IT technology are not identified or not familiar. The teaching of such courses, therefore, requires greater teacher-student interaction, clear and illustrative methods of interpretation and a deeper discussion in the process of teaching and interpretation. We report on a software tool for visualizing and emulating the transition sequences for the structural operational semantics. This software tool was prepared for the course on Semantics of Programming Languages for supporting the teaching process. This software can dynamically produce particular steps of the transition sequence for an input program and data. It can be freely used by students (in process of self-study), by teachers (for a better demonstration of applying the semantic methods, for lectures and laboratory exercises) even during the on-line education.

II. VISUALIZING SOFTWARE FOR TEACHING

One of the practical outputs of the educational project „A development of the new semantic technologies in educating of young IT experts“ is an application which serves as an emulator providing a visualization of particular steps for structural operational semantics. The main goal was to provide this application for students and teachers of the course Semantics of Programming Languages. Application is ready to provide a compilation of an input code written in a toy language Jane used for teaching the abstract syntax and semantics of programming languages and based on input values for a program to visualize in particular steps each transition in structural operational semantics.

- For the implementation of a grammar for the Jane language, the ANTLR tool was used, a well-known parser generator that uses LL parsing.
- Tool provides standard lexical and syntax analysis for the input code. Then, tokens for visualization of computations in structural operational semantics are provided.
- After providing the input sequence of commands and the initial state of the variables, a parsing of the input code starts, which is performed by the ANTLR tool according to the grammar that has been defined.
- At the end of a successful emulation, the program also allows saving the result of a computation. There are several options of how the result can be stored: the whole output as a complete report, or only state table in csv format, or the output sequence as source code for LaTeX.

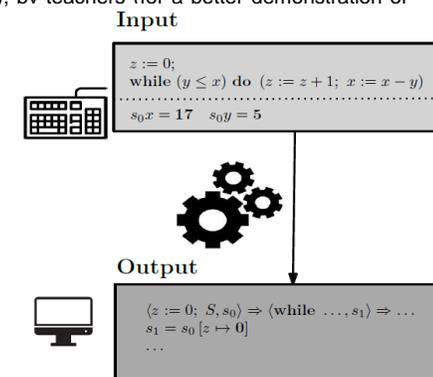
VI. CONCLUSION

The goal of presented research was a design and the use of an emulation tool for providing the computational sequences in structural operational semantics of imperative languages. This tool is a part of educational project „A development of the new semantic technologies in educating of young IT experts“. Moreover, the results gained during the research and development can also be usable in research within the project „Semantic Modeling of Component-Based Program Systems“ under the bilateral program Aktion Österreich-Slowakei, Wissenschafts- und Erziehungskooperation in cooperation with the Research Institute for Symbolic Computation, JKU Linz, Austria where similar semantic technologies and teaching tools are used. The application is ready for use in the teaching process in classes and during the online teaching for both teachers and students. In future, we would like to integrate this application into more complex software package that will contain animation tools for other semantic methods that are taught within the course on Semantics of Programming Languages.

ACKNOWLEDGMENT

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educating of young IT experts“; and

bilateral program „Aktion Österreich-Slowakei, Wissenschafts- und Erziehungskooperation“



(1) project KEGA 011TUKE-4/2020: „A development of the new semantic technologies in

(2) Initiative project „Semantic Modeling of Component-Based Program Systems“ under the

Editor of the Monte Carlo Method for Special Purpose

Veronika Stoffová – Roman Horváth



ICETA 2020
Conference Office

elfa, s. r. o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: +421-55-625-3839
fax: +421-55-726-5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract—The contribution describes an interactive computer implementation of the Monte Carlo method for particular purposes – to diagnose the foot condition according to the footprint of a person, to recognise the flat foot. Monte Carlo method, with a combination of computer graphics and numerical mathematics, allows us to calculate an unknown area where a direct analytical solution does not exist, or we do not know it. It is widely used, for example, in quickly finding approximate results of various calculations, such as calculating a definite integral, determining the probabilities of events, empirically determining the value, cost estimates in certain situations, and so on. It is an empirical-numerical method based on the use of values of random variables and probability theory. Our goal was to implement a general-purpose interactive software that will allow by the Monte Carlo method to determine the content of any irregular area in the form of a digital image. The presented software is implemented in Java using the programming framework GRobot. The graphic user interface is characteristic of this framework and is suitable for this type of applications. The Monte Carlo method forms a thematic unit of the subject of modelling and simulation at universities. It is often also the topic of students' semester, competition, and final theses. The beginnings of the editor described here also goes back to the semester, later diploma thesis of a student of computer science teacher programme at the Faculty of Education of the Trnava University in Trnava. The mentioned projects were developed under the guidance and significant help of the authors of this article.

I. INTRODUCTION

Monte Carlo methods (MCM) are a class of computational algorithms that rely on the results of repeated random trials to calculate an unknown value. Use of this method is not possible without using a computer. Is suitable for problems that can be presented graphically, simulations, approximations of problems that cannot be solved using an analytical approach and similarly. The accuracy of the calculation using the MCM may be affected by various factors like the quality of the random number generator – its even distribution over the selected interval; distinguishing level – setting of numerical values of the regular formation that can be used to delimit the area of the searched formation and likewise. The article describes the examination of the influence of the method of determining the regular shape and the number of experiments based on the generation of random points on the accuracy of the calculation.

II. Software for Evaluation of a Flat Foot – Editor of Monte Carlo Method

In our work, we deal with the evaluation of the condition of the foot using the MCM according to the footprints. The aim is to find a connection between the percentage value and the condition of the foot diagnosed with the help of other methods, which we mention in another work. Our software can both: diagnose the footprint using plantographic methods and determine the percentage occupied by the footprint space using the MCM. The features of our application are available both through the set of buttons and the application Tools submenu. Most of the buttons work like radio buttons. The tenth button (having keyboard shortcut F12) is used to perform the essential Estimate function. However, first, the function Measurement area (having keyboard shortcut F11) must be used to define the measurement area for the MCM.

The MCM (in the way we use it) is based on the generation of random points, which we classify into different categories according to predetermined criteria: clearly belonging (belonging), clearly not belonging (discarded), and those for which it was not possible to decide (unclassified). The examined image must be prepared in advance (in an external graphic editor) so that the points clearly belonging to the drawing are black and the points clearly not belong to the drawing are either completely transparent or white. We defined three variants on how to define the bounding shape of the footprint area. In the first two cases, the footprint is placed in the rectangular shape. In the third case, the shape is trapezoidal. We marked the variants from A to C. In a variant A, the user defines a rectangular area so that the fingers of the footprint overlap the rectangle as little as possible (we call it “without fingers”). Variant B includes the entire footprint (including the fingers). Variant C also includes the entire footprint but is trapezoidal.

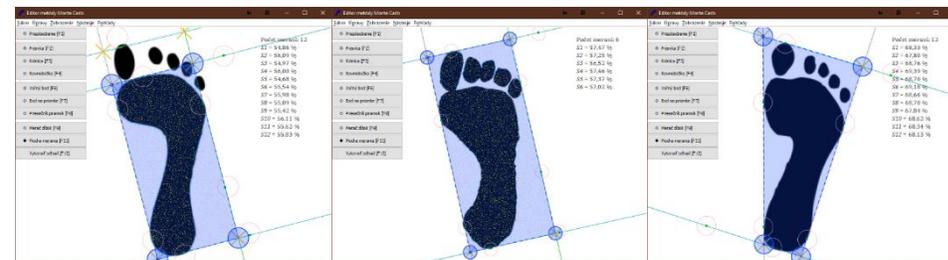
The aim was to verify whether we find a significant difference between the measurements.

III. CONCLUSION

The designed editor of the MCM addresses the possibilities of its general use. The issue of planography and flat foot analysis is not its only intended use. This issue was used to develop the early prototype software. The process of developing and debugging the software is time-consuming, and the space for further development of the application, therefore remains open. We want to add more useful features to the editor that would expand the possibilities of its universal use. The implemented editor will find its application in research and education, specifically in the subject of modelling and simulation of systems, for example, based on simulation experiments calculating the analytically accurate calculable area that are compared with the results. In this way, we want to increase not only the clarity and quality of teaching but also the active involvement of learners in acquiring new knowledge.

ACKNOWLEDGMENT

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Examples of the bounding area shapes for the individual variants (A – C).

Innovating instruction of communication theory with machine learning and speech analysis

O. Šuch, R. Fabricius, M. Klimo, J. Juhár



ICETA 2020
Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — Foundational work of Claude Shannon in 1950's provided direction for theory of communication for many decades thereafter. Emphasis of research was on development of new coding and decoding techniques in order to make effective use of all available bandwidth. With the advent of Internet, and especially of Internet commerce, security aspects of communication theory became much more important. As research in these questions enters a mature stage, the challenge for teachers of communication theory is to find novel ideas, new applications and new interdisciplinary topics in order to engage students as well as to prepare them to tackle challenges they will encounter in their engineering careers later on. In our paper we propose to apply to teaching emerging connections of information theory with two other scientific disciplines: machine learning and analysis of speech.

I. MOTIVATION

We have been teaching various courses on theory of communication at different levels for many years. In this paper we present our view and experience in innovating the teaching of communication theory in a master level engineering degree program at a technical university. The key point is that with the ubiquity of computers in our environment and increased interaction with robots in everyday life the importance of speech analysis with machine learning will increase dramatically.

II. GENERAL DESIDERATA FOR ENGINEERING CURRICULUM

Preparation of curriculum content is a task that needs to be optimized according to multiple criteria. In this section we describe several key goals that need to be taken into account. Alongside with these general goals we present an evaluation of the potential for new connections between communication theory and the fields of machine learning and speech analysis.

Criterion	General description	Machine learning	Speech analysis
A. Introducing students to key technological and scientific concepts and integrate them with methods and algorithms that incorporate the concepts	Perhaps the most important outcome of learning is formation of mental representations of key concepts. Students can build the representations using applications of the concepts within algorithms. Concepts present in algorithms that cleverly simplify difficult problems may be easier and more useful to remember.	Information theory concepts permeate machine learning. Two commonly used concepts in construction of a decision tree, a simple machine learning algorithm, are Gini index and information gain, both belonging to the theory of information. Another key concept from information theory, cross-entropy, is commonly used for training neural networks.	Speech is an ideal medium to introduce students to multiple aspects of Fourier analysis. Consider the basic task of computing the spectrum of a vowel. It is impossible to accomplish it without gaining firm grasp of such key concepts as discrete Fourier transform, convolution theorem, decibels, or spectral leakage.
B. Allowing students to try out methods and algorithms for themselves in novel settings	Lab work nurtures problem-solving skills of students, reinforces theoretical knowledge and often demonstrates the finer points of theory. Often overlooked aspect of lab work is novelty. Students appreciate if assignments in a course are novel rather than repeating year-over-year.	We use a logistic model fitted by cross-entropy as an example which converts analog multi-dimensional signal to a discrete representation. This model can be presented for a classification task in the lab setting with a variety of datasets, chosen corresponding to contemporary societal topics.	We have started using convolutional neural networks for analysis of speech. We first transform the analysed speech into spectrograms and then feed these spectrograms into the network as images.
C. Cultivating cooperation with local companies	There is a potential for multiple synergies, when curriculum is built in accordance with the structure of local technological companies. Students may be employed on internships at more advanced positions during their study and it can help jump start their careers.	Machine learning, despite its relative novelty, has been quickly adopted by the industry. In our experience students adept in machine learning are highly sought after by several local companies, and have no trouble finding highly-skilled positions straight after graduation.	Multinational companies often overlook smaller languages, such as Slovakian. Nevertheless, with ready availability of frameworks to build ASR models, it becomes economically feasible to develop systems even for less widespread languages and we see increasing tech investment in this area.

analysis. Larger exposure of students to machine learning can be beneficial in related classes that study topics in cybersecurity. Similarly, the introduction of topics related to speech can widen engineering students' horizons with a healthy dose of humanities. Arguably, this improves their future career prospects as much as it benefits our society as a whole.

ACKNOWLEDGMENT

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Vulkan in C# for Multi-Platform Real-Time Graphics

D. Szabó, Dr. Z. Illés



ICETA 2020
Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — Nowadays almost every computer device contains a graphics processor. Large desktop PCs have dedicated graphics cards, laptops and even mobiles have integrated graphics units inside the CPU. To use and program these graphics units we need special libraries, the Graphics APIs. Usually these APIs are made in C or C++ to ensure low-level capabilities and high performance. In the meantime, the .NET supported C# language evolved greatly in the past years. C# is now a fast, powerful and multi-platform language.

The main goal of our research is the merging of these two worlds: We're examining the possibilities of the real-time graphical programming in .NET C# using the modern Vulkan graphics API.

This paper presents methods of creating multi-platform real-time graphical libraries using Vulkan in .NET C#. We provide solutions for rendering onto common .NET UI frameworks with Vulkan and techniques for dealing with the low-level memory management required by the API. Furthermore, we determine the functional and performance differences between multiple runtimes and compilers.

I. INTRODUCTION

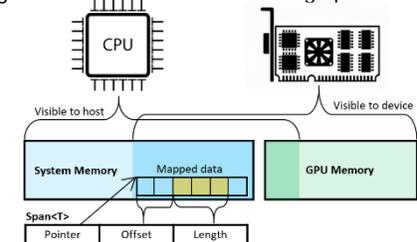
The Vulkan Graphics API is presented by The Khronos Group in 2016 as a possible replacement for their previous OpenGL API. OpenGL have been used, and still being used in many graphical applications, yet its development has been stopped and soon it will become a deprecated API on all platforms (it's already is, on Apple systems). Also, its specification contains many limitations and restrictions that were insignificant few years ago, but soon they will obstruct the implementation of newer applications. At this state, Vulkan could be the only modern cross-platform graphics API that could replace OpenGL.

This topic could be interesting from a teaching perspective as well. I think in the computer scientist education it's a serious problem that students learn programming practices from different courses and usually they fail to connect these experiences. By programming a real-time graphics application with such a low-level API in C#, students can learn the C#-like languages' memory management and high-performance techniques in practice. They could utilize the methods of parallelization learned from parallel or distributed programming courses. These applications could be mixed with applications implemented on event-driven programming or on similar courses. Finally, the students can learn about the GPU and implement rendering algorithms.

II. VULKAN IN C#

Because Vulkan is a C API we need so called binding libraries to start implementing a Vulkan application in C#. The C interfaces and structures for interacting with the video driver are available for in the Vulkan DLL. From these interfaces there are a few generated binding libraries for C#, in which we can find Vulkan's C structures defined in C# and static methods for invoking all the functions in these DLLs. Usually the main differences between these bindings are the version of the Vulkan specification that was used to generate the bindings, naming and namespace conventions and the way of parameter passing in the generated functions. Swap-Chain is the resource that let us present our rendered images on the user's screen or window. The way of presenting can differ between platforms and the used window or UI frameworks as well. In Vulkan, we must construct the Swap-Chain manually. This requires a many line of additional code, but in the end we're able to control the image's (Framebuffer's) configuration, number and the algorithm for swapping and presenting these images. This also means that we can construct Swap-Chains from UI frameworks' controls as well and we can present real-time graphics alongside with regular UI controls. We can render graphics onto WinForms and WPF windows, onto Android Views etc.

Because Vulkan is so low level, in most of the cases we must use pointers or references to pass objects into functions, instead of passing the object itself. This is straightforward to do in a language like C or C++, but in C#, where our memory is supervised by the Garbage Collector accessing the bytes beneath an object can be tricky. In Vulkan we must manage the memory allocations, buffer assignments, memory mappings and transferring between different kind of GPU memories manually. We can allocate memory in different parts of the GPU RAM. There are parts which are visible to host, which means we can map this memory into the system memory and acquire a pointer to it to transfer data from/to the GPU. Also, there are parts of the GPU RAM which are visible to device, which means only the GPU can access it. We can use Marshalling methods to transfer single structures onto the mapped memory. Also, we can utilize the new `Span<T>` structure in C# to map the bytes of the mapped GPU memory into an array like structure.



III. CONCLUSION

This paper proposed C# tools and solutions for developing multi-platform real-time graphical applications in Vulkan. Majority of the application's codebase can be implemented into a shared library that can be compiled for every supported .NET platform. The platform specific code snippets are minimal.

Among the inspected .NET Core and .NET Framework runtimes .NET Core is slightly more suitable for real-time graphical application development on Windows. Also, we've measured that Vulkan can perform better than OpenGL in GPU heavy or CPU parallelizable tasks in these environments.

ACKNOWLEDGMENT

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Reducing Data Access Time using Table Partitioning Techniques

V. Šalgová, K. Matiaško

Abstract — Data are used in a large number of different fields. Large databases with huge amounts of data come to the fore. They are a very important part of many of information systems, from commercial systems, through technical and technological systems, the web, and mobile applications to the management of scientific data in various fields. Fast access to data is, therefore, becoming increasingly important today and great emphasis is placed on improving it. Initially, the data access time may be only slightly increased working with smaller tasks, but with a larger number of larger tasks, there is a significantly higher data access time that needs to be reduced. From the point of view of efficiency, it is not appropriate or necessary to access all data, and therefore it is necessary to divide this data into smaller parts and thus create partitions, which will facilitate the execution of certain operations and bring efficiency, whether in terms of time or performance. This paper discusses partitioning, its various techniques, methods, and the benefits it brings. It compares access times to tables with and without partitions, regarding various numbers of table parts that are accessed.

I. INTRODUCTION

Storing and managing data in databases is a necessary and very efficient way. An important indicator is the time required to perform basic operations to retrieve data. Reducing data access time is becoming increasingly important and it receives a lot of attention. A large amount of data is used in many areas. Higher data access times bring undesirably higher costs. Accessing a smaller group of data instead of going through all the data can bring great efficiency. It is well known that a large problem is better resolved when divided into smaller parts and the partitioning technique works in the same way.

II. PARTITIONING

A powerful technology that physically divides certain large objects of relational databases into smaller parts based on the logical division of the data is called *partitioning*. With this technology, it is possible to divide tables, indexes, and index-organized tables into smaller sections. These database objects are then enabled to be managed and accessed at a finer level of granularity [5]. A subdivided part of a database object is called a *partition*. The main advantages of creating partitions in databases are their manageability, higher performance, availability reasons, or a load balancing [2].

- *Increasing performance* is provided by working only on the data that is relevant.
- *Improving availability* is performed on the basis of individual partition manageability.
- *Decreasing costs* is done by storing data in the most appropriate manner [7].

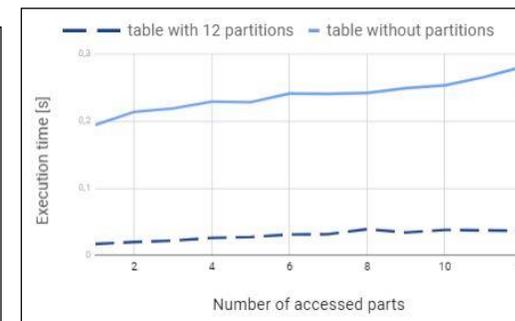
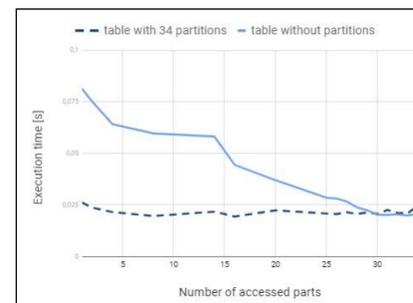
VI. RESULTS

To compare the data access time, two tables were created. Both tables had identical data and contained 1,000,000 rows with 3 columns. One table was created without partitions and the other was divided into 34 partitions according to the **range partitioning technique**, where each partition represented one month of the specific year. Data were generated into partitions evenly, so each partition had approximately the same number of rows. The experiment consisted in selecting data from such date intervals that the data were selected only from a certain number of partitions. We started consecutively accessing one part of the table, then added other ones, until we finished accessing data from all parts of the table. The graph in Fig. 8 was constructed, according to which it is obvious that the table with the 34 partitions created had a significantly shorter data access time from the beginning. It was only 0.0261 seconds, which represents 32.1% of 0.0813 seconds of the access time of the table without partitions.

In an experiment aimed at comparing data access times of a table without partitions and a table with partitions according to list partitioning, two tables with identical data were created. Each table contains 1,000,000 rows with 3 columns. One table did not contain any partitions and the other was divided into 12 partitions according to the listed values of the state names, where each partition was described by three values. Thus, the **list partitioning technique** was used. The experiment consisted in selecting data from such date intervals that the data were selected only from a certain number of partitions. The graph of Fig. 9 shows a significantly improved access time to data from the table with 12 partitions using the list partitioning technique.

VII. CONCLUSION

The efficiency of data access is one of the most important tasks in ensuring system performance. When using large amounts of data, great emphasis is placed on access time. For this reason, the creation of partitions and the subsequent division of data into them can bring a significant improvement in the time of access to the data. In the experiments, the access times for the data in the tables with the created partitions and tables without any partitions were compared. The results significantly showed that access to data stored in partitions can significantly reduce the time of access to data and thus bring greater efficiency. The use of the range partitioning technique provided a significantly improved access time when less than 30 of the 34 partitions were accessed. With access to 30 or more partitions, data storage without partitions has proven to be more appropriate. When using list partitioning, there was an even more significant improvement in performance time, and this improvement persisted even when accessing multiple or all partitions. In conclusion, it can be evaluated from the results that partitioning can significantly improve data access time.



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Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Tourism Research and Application of New Knowledge Using Latest Technologies in Educational Process

D. Tometzová, M. Lukáč, J. Hlaváčová



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Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — The study presents the possibilities of using the latest research results created in a computer environment and connected with the new forms of tourism in Slovakia for the educational process through two learning management systems platforms, namely Chamilo and Google Classroom. After a brief introduction of the two platforms, the paper further focuses on the content analysis of the selected recent scientific studies (published after 2016) dealing with ecotourism, speleotourism, mining tourism, geotourism, dark tourism and nature tourism. The analysed content covers computer outputs and the possibilities of their immediate online dissemination for students.

I. INTRODUCTION

Nowadays, when the mass tourism does not have suitable conditions for further development due to the COVID-19 virus situation, the individual (soft) and shared (virtual) tourism forms are proving to be the solution for the state that is critical in many regions. The first and irreplaceable step is the research of modern tourism forms and their subsequent application in the education of university students and practitioners which could revive the current stagnant forms of mass tourism. However, the insurmountable problem of the inability to use full-time teaching in classrooms comes to the fore. It is necessary to advance and solve this problem with the use of distance teaching and learning by implementing the new technologies in the educational process. In recent years, special virtual environments called learning management systems (LMS), were created for the purposes of distance learning or different kinds of meetings "at a distance". Many forms of special LMSs have become part of e-learning and provide a comprehensive educational process, cooperation and virtual contact between teachers and students. Currently, the traditionally used forms of education, not only at universities and scientific or professional conferences, include LMS resources, such as: LMS Chamilo, Google Classroom, Moodle, Microsoft Teams, Edmodo, Schoology, Netventic, Easy LMS and others.

II. CHARACTERISTICS OF LMS PLATFORMS

In our study 2 LMSs (Fig. 1,2,3) were tested by teachers at several Slovak universities as part of the process of teaching either tourism professionals or professionals from other related fields.

LMS Chamilo

- easy creation and extension of tasks, lessons, online tests and project assignments,
- immediate, automatic evaluation of tasks
- 2 functionally different but interconnected interactive environments (The "teacher" view and the "student" view)

LMS Google Classroom

- easy presentation of computer deliverables from scientific studies
- reliability of the LMS environment (important factor for users)
- can be used especially for activities related to education and research, such as making observations, posing questions, examining books and other sources of information to see what is already known, planning investigations, reviewing what is already known, using tools (computer software) to analyse the data and interpret data, proposing answers, explanations, and predictions a communicating the results.

III. RESEARCH OF LATEST TOURISM FORMS USING COMPUTER TECHNOLOGY AND THEIR APPLICATION IN THE EDUCATIONAL PROCESS

In recent years, a relatively large number of original scientific papers and studies, the content of which (or its parts) originated in the computer environment and covered the research of new (individual) tourism forms, has been published in the Slovak scientific environment. In the paper we focused on the research of latest tourism forms (ecotourism, mining tourism, geotourism, speleotourism, dark tourism, nature tourism, etc.) using computer technology in the educational process.

IV. CONCLUSION

Modern LMS platforms are gradually gaining their stable position in the scientific sphere, business sector, educational process and among general public. Recently, the possibilities of virtual tourism have also appeared, for which the first applications, websites, etc. are already being created. The latest research results in tourism, especially its modern and new forms based on individuality, can be presented through LMS platforms. Professional computer reconstructions of the landscape or various cultural and historical attractions from the latest studies available online, which are increasingly finding their place in tourism, are presented on the websites of various institutions such as universities, museums, archives, galleries and libraries. These are visualizations in the form of images, 3D models, or even movies or holograms, which virtually transport clients into a real environment which is referred to as shared reality. Modern digital computer modelling allows us to travel not only in space but also in time and, most importantly, through LMS platforms, which are highly interactive.

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Fig.1,2,3 Testing of LMS Chamilo and LMS Google Classroom

Comparison of Augmented Reality Apps and Their Ability to Develop Communication Skills

D. Tran, M. Pytlík, K. Kostolányová



ICETA 2020
Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — The paper is aimed at augmented reality mobile apps that could be used to help students develop their communication skills. Such apps could serve as both a main and support tool for developing these competencies. The paper aims to provide a detailed comparison of iOS and Android apps. The first part of the paper provides a theoretical background. The second part of the paper is centered on the mobile application market, with 5 Android and 5 iOS apps being analyzed in detail, focusing on key criteria for selecting an appropriate app. This paper may be used as the basis for further research into augmented reality mobile apps and the development of communication skills.

I. INTRODUCTION

The education process is constantly changing, mainly due to modern technology that makes learning easier for students, saves teachers' time and can even make the entire learning process more effective, i.e. improve knowledge/skill retention. Mobile technology has become an integral part of education. It is as popular as desktop computers, laptops and interactive whiteboards. The paper is aimed at augmented reality apps, focusing on those that could potentially be used for developing communication skills. The authors analyzed the mobile app market, selecting 5 iOS and 5 Android apps, which they then analyzed in detail. At the end of the paper, the authors discuss the two platforms (iOS and Android), focusing on which apps are better suited for educational purposes.

II. RESEARCH – DEVELOPING COMMUNICATION SKILLS THROUGH AUGMENTED REALITY APPS

Modern education aims to prepare an individual for professional life. Communication skills are one of the most important skills an individual should master during their education. A 2011 study supports this statement, showing that communication skills are one of the key competencies in a number of countries, such as Great Britain, New Zealand, Ireland and the Czech Republic [1]. Communication is an integral part of an individual's life. Mobile technology can help students develop these competencies. Mobile technology, mobile devices in particular, is now widely used in education and so-called m-learning. Both mobile phones and portable gaming consoles are used in m-learning. Mobile learning allows the learner to be mobile while learning (irrespective of the device used) [2].

The research was aimed at analyzing the mobile app market, focusing on augmented reality apps. The authors were interested in iOS and Android apps. These two platforms were chosen because they are the two most popular platforms, with the general public as well as in education. During the first research stage, the authors searched for augmented reality apps in general, obtaining data on the number of available apps, the average price (or if they are free), the average user rating and the educational areas in which the app can be used. They selected 5 Android-based and 5 iOS-based apps which were then analyzed in detail – the developer, the name of the app, its price, compatibility, the user rating, the author rating, pros and cons, description and possible use for educational purposes. In the iOS market, the authors analyzed these apps: CoSPaces EDU, Catchy Words AR, Display.Land, Phobos AR, Assemblr. In the Android market, the authors analyzed these apps: ROAR Augmented Reality App, Vuforia Chalk, WallaMe – Augmented Reality, TeamViewer Pilot, Mind Map AR. According to the authors, these apps can have a positive effect on the development of communication skills. The analyzed apps can be used at all levels of education. Having analyzed and compared iOS and Android apps, the authors were able to determine differences between them. iOS devices are generally considered to be of higher quality, providing better support. However, they are also more expensive. Android devices are more variable, from both the technical and price side. The Android platform offers approximately 600,000 more apps than iOS. Both platforms offer a large number of high-quality augmented reality apps that can be used for educational purposes as they help develop communication skills. Many apps are iOS and Android compatible, with minimal differences between the two versions. The table shows the main differences between iOS and Android devices.

III. CONCLUSION

The authors learned that both platforms offered a wide range of augmented reality apps that can be used for educational purposes and can help learners develop their communication skills. The app market (both iOS and Android) offers apps that are aimed at various educational areas. A large number of apps support both iOS and Android devices, and are often available as a web app. Therefore, there are minimal differences between the two versions of the apps. The differences (technical, price, performance) in devices and operating systems can play a bigger role. The choice of an augmented reality platform goes hand in hand with the requirements users have on their device. In education, it depends on what platform the school uses, i.e. what platform the teacher has at their disposal. The authors consider both iOS and Android augmented reality apps to be of high quality and useful. Augmented reality can have a positive effect on learning as it can help learners develop their communication skills and even motivate them to study. However, the way in which the teacher uses this technology and how often they use it is also extremely important. This paper is part of the authors' long-term research on computer graphics, mobile technology and the development of communication skills. It will be used as the basis for further research.

[1] Š. Kocourková and M. Pastorová, *Pojetí klíčových kompetencí v kurikulech vybraných zemí*, 1st ed. Prague: Výzkumný ústav pedagogický v Praze, 2011.

[2] J. Taylor, M. Sharples, C. O'Malley, G. Vavoula, and J. Waycott, "Towards a task model for mobile learning: a dialectical approach", *International Journal of Learning Technology*, vol. 2, no. 2/3, 2006.

TABLE I
COMPARISON OF iOS AND ANDROID AUGMENTED REALITY APPS

iOS	Android
iOS apps are quality products with outstanding user support. Community of developers is highly professional and productive. New apps are constantly coming to market and actualizations for old apps are published on daily basis.	A wide range of technical and price options.
Devices are more expensive (from 330€).	Devices are affordable (from 55€).
There are fewer iOS apps on the market.	More apps on the market.
Some augmented reality apps require a newer device to work. There could be some problems with compatibility with older devices and newer apps where the only solution is purchasing new device.	Augmented reality apps require only a camera and the latest version of the operating system.
Augmented reality apps are of high quality. Usually developed for exact educational purpose and designed for students and teachers.	The majority of apps (even the AR apps) are free (or offer a free version).
Many apps can be used for educational purposes. Most of schools are already working with iOS devices and students/teachers are already familiar with his kind of operating system / devices.	A large number of augmented reality apps that can be used for educational purposes.
The majority of augmented reality apps can help develop communication skills. The market with educational apps contains many useful applications for self-education using augmented reality.	A large number of augmented reality apps can help develop communication skills or can be used as a communication tool.

SNACK-based Improvement of TCP for Wired and Wireless Networks

P. Truchly, R. Repka



ICETA 2020
Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — Wireless networks and systems are an inseparable part of current communications systems and we use them almost every day to connect to the Internet (via local networks or public hot spots) from fixed and mobile devices. Analogous to satellite networks they are based on wireless links characterized by higher bit error rates. A higher level of bit errors in a network causes packet losses and together with packet losses due to network congestion these losses degrade overall performance of reliable transport protocols. The Transport control protocol (TCP) is one of the most used transport protocols in the current Internet and is used by various services including e-learning. TCP based on its original definition manipulated various packet losses in the same way as if they lose due to network congestion. This method of treatment is not suitable for packet losses due to link bit errors and degrades the performance of TCP. In this paper, we present a modification of TCP (Sni2Wi-TCP) we proposed. In order to increase TCP performance, we integrated a selective negative acknowledgement as well as a loss differentiation algorithm to classify types of losses.

I. INTRODUCTION

Reliable communication transport protocols such as the Transport control protocol (TCP) are sensitive to packet losses because they need to deliver all data coming from higher layer protocols successfully to a destination.

It considers packet losses in a network as a signal that part of a network is full (congested) and the congestion window must be decreased. However, TCP treats all packet losses as losses due to congestion even though they can be lost due to bit errors. In this case, it is not suitable to decrease the congestion window because the communication path will not be utilized effectively. In order to solve this TCP behavior, various methods have been proposed for TCP: link-layer solutions, split-connection methods and end-to-end TCP solutions. Since end-to-end solutions directly modify congestion control algorithms that cause problems of TCP in wireless networks we decided to concentrate on this type of methods to improve the end-to-end performance of TCP.

II. SNI2WI-TCP

Our TCP modification is based on two functional components:

- **Selective negative acknowledgement (SNACK) option** – using this option, the TCP receiver informs the TCP sender about lost segment or segments. They are attached to duplicate ACKs. This option can particular segments which have been lost. When the TCP sender receives an ACK with a SNA immediately retransmits all segments announced by the TCP receiver.
- **Loss differentiation algorithm (LDA)** – this algorithm tries to differentiate between two possible reasons (types) of the segment loss in a network:
 - network congestion-based loss,
 - loss due to transmission bit errors.

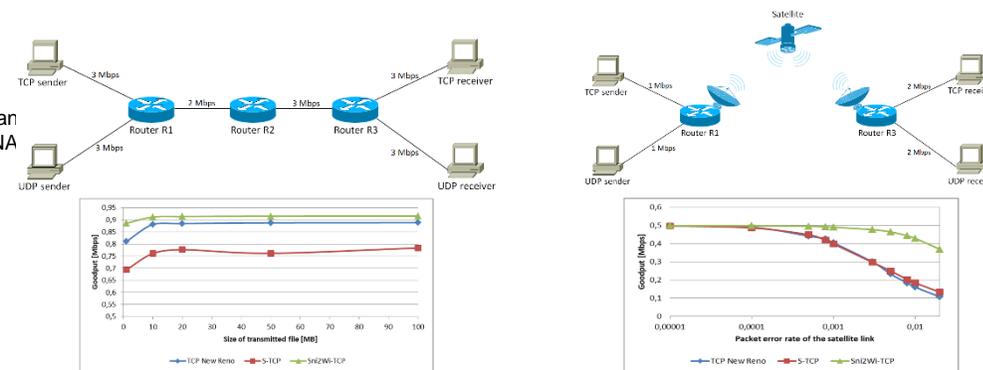
Sni2Wi-TCP sends SNACK options every time the TCP receiver detects a loss of one segment or group of consecutive segments no matter what was the reason for its/their loss. The TCP receiver sends a SNACK option to the TCP sender together with information about a type of segment loss. This information allows the TCP sender to apply different actions during the Fast retransmit algorithm. In order to cope with losses of retransmitted segments, the TCP receiver implements a timer.

VI. CONCLUSION

This paper presents performance results for a new modification of TCP New Reno we proposed. Our TCP modification (Sni2Wi-TCP) is based on a SNACK option originally proposed for a transport protocol over satellite links. This TCP option allows the receiver to inform the sender about segments lost in a network. Our modification also integrates a loss differentiation algorithm to allow the receiver to identify a type of segment loss. This knowledge is also sent to the sender that can prevent congestion window from an unnecessary decrease in the case of segment losses due to link bit errors. In this phase, we decided to investigate performance of our TCP modification with the implementation of an ideal loss differentiation algorithm. Our TCP modification was tested in various network topologies (wired, wireless and hybrid) to investigate its performance in situations with only congestion packet losses, only wireless losses (due to bit errors) and both types of packet losses. Simulations showed increased performance of our TCP modification in all proposed scenarios. The future work will concentrate on the selection of a suitable LDA for our modification and analyzing various special network behaviors (e.g. packet reordering).

ACKNOWLEDGMENT

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Usage of the Arduino and other embedded systems in secondary vocational education in Slovakia

D. Tuček, Š. Koprda, M. Magdin, Z. Balogh, J. Reichel

Abstract — Using the Arduino embedded system in secondary vocational education in Slovakia is still a fresh phenomenon. Study plans of vocational schools with profession in technics, information technologies and industrial automation are being outdated and do not contain modern solutions in their educational process. Our research was about to find out the actual state of awareness about these modern systems among teachers and educators in vocational schools in Slovakia. A questionnaire was created and sent to secondary vocational schools with a profession aiming at technological industry which showed us the real actual status of the usage of modern technologies and embedded systems in education.

I. INTRODUCTION

The presented research is focused on the awareness and usage of embedded systems in secondary vocational education in Slovakia. Our country is considered to be evolving, yet the education system still lacks many of modern technologies and improvements required by the labor market. Study plans at vocational schools tend to be, sometimes really outdated, which dreadfully impacts the quality of absolvent's knowledge. One of these requirements is the general knowledge about wide range of embedded systems, such as the Arduino, Raspberry Pi and their copies. These embedded systems are used in variety of appliances starting from smart wearables, security devices, communication devices to many other fields of application. Our research was mainly focused on this problem and we wanted to find out the actual state of teaching embedded systems in secondary vocational school with professions in industrial services. Our research was aided by the help of survey systems, SurveyMonkey, to be exact. Following the data collection, we analyzed all the received information from schools and created summaries about the results of individual questions asked.

II. EMBEDDED SYSTEMS IN GENERAL

A completely new phenomenon appeared in the recent decade representing a new era of autonomously operating devices that has completely changed our lives and daily tasks. These autonomous devices are collectively called "smart devices". They can be found everywhere nowadays, even in our fridges, moreover, they check the status of our groceries and report if something is running low. All these smart devices rely on a microprocessor and a system built around it, the microcontroller. As these microcontrollers are mainly created purposefully (not for generic use), they get embedded into the product, hence the name, embedded systems. One of the most popular and successful development kits for embedded system is without doubt the Arduino. No wonder it is so successful since its design was created with cost-effectiveness and simplicity in mind, the most popular one is the UNO, based on a 16 megahertz, 8-bit AVR microcontroller from ATMEL. There is one different breed of embedded systems that can extend beyond the capabilities of a microcontroller, the Raspberry Pi, a compact and full-blown computer. The Raspberry Pi utilizes an ARM based processor, just like our smartphones, which is capable to run any Linux-based operating system; this opens a whole new world of capabilities that lifts the Raspberry Pi on a higher level and gives it a broader spectrum of applicable fields.

V. SELECTING THE SURVEY SERVICE AND QUESTION ANALYSIS

The selection of schools was a tricky part since multiple types of vocational secondary schools exist with different aim of profession, some would not have been ideal for our research. We had to narrow down our aim of schools to vocational schools with the aim of profession in industrial services and information technology. The questions were focused mainly on finding out the education and skill levels of teachers in the particulars schools. There was a total of 10 questions, including the informative ones. The results were affected by the critically low response rate. Based on the collected data we get an image of the status of embedded system awareness in vocational schools in Slovakia.

VI. SUMMARY

To summarize our research, vocational schools in Slovakia are somewhat aware of the growing demand of specialists in this field, yet this level is far from ideal. The subject is taught only marginally with very little time spent going through the details and mastering the work with it. Students have minimal knowledge and practical experience, insufficient to work in this field and they are forced to participate in additional courses about embedded systems usage to reach the levels of skills and knowledge companies require. It is highly recommended to update the study plans and apply a broader space for teaching embedded systems, both theoretically and practically. With this approach, students will be introduced to the world of embedded systems in the beginning, they will keep a steady income of knowledge and skills throughout their studies and finally leaving the school as qualified specialist. The rate of embedded systems growth on the market is alarming, therefore schools should adapt new technologies and start teaching them sufficiently as soon as possible.

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Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Development of web-based crowdsourcing framework used for video quality assessment

M. Uhrina, A. Holesova



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Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — Crowdsourcing as a new approach in the field of Quality of Experience (QoE) and an alternative to the traditional subjective laboratory testing has become popular and gradually expanded. In recent years several crowdsourcing web-based frameworks have been developed. In this paper we present a web-based crowdsourcing framework developed by multimedia team at Department of Multimedia and Information-Communication Technology. The paper also deals with a description of term crowdsourcing in a general form as well as in a context of quality assessment. Furthermore, in the paper some differences between laboratory and crowdsourcing approaches are written as well as several of the well-known existing frameworks are described.

I. INTRODUCTION

A new trend that is gradually expanding into the field of image and video quality assessment is crowdsourcing. Generally, this term describes the acquisition of a large amount of arbitrary data from a significant number of people. In case that crowdsourcing is used to evaluate image or video quality, it falls under the category of subjective methods, involving a larger and more diverse group of respondents while being less costly and time consuming.

II. WEB-BASED CROWDSOURCING FRAMEWORK

For assessment using crowdsourcing approach, a web-based crowdsourcing framework by multimedia team at our Department of Multimedia and Information-Communication Technology was developed. This framework allows to collect data from an image or video quality assessment. It is worth noting here that this framework is available on Windows as well as on Linux operation system. The framework allows the evaluation of images or video sequences by the SS (Single Stimulus) method, but it can also be modified for other methods. When a respondent wants to take part in an image/video quality test, he/she has to visit the webpage which is intuitive divided into five sections:

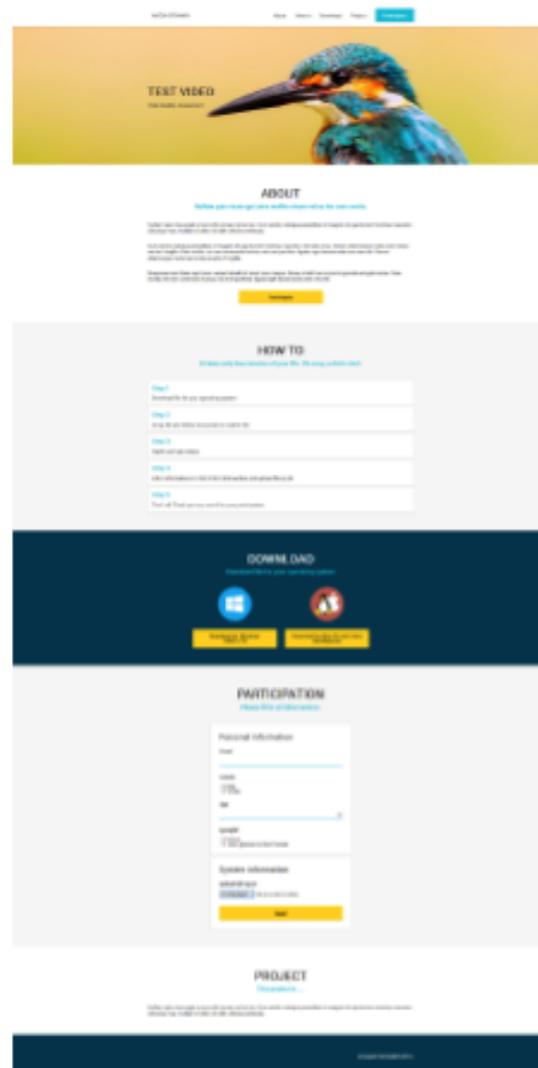
- 1) "About" (Description) section acquaints the visitor with the issue of quality assessment and evaluation requirements.
- 2) The "How to" section deals with a short instruction manual which consists of following steps:
 - I. A respondent should firstly download appropriate file depending on operation system used by the respondent.
 - II. After that, the respondent extracts (unzip) the appropriate file and opens the Readme text file containing detailed information on how to proceed with the assessment. It is important to read this information carefully to do the assessments relevant and avoid inattention errors.
 - III. In the next step, the respondent launches an application named "ps.exe". This program starts playing all test images or video sequences sequentially through the FFmpeg tool. After each image/video sequence, the program appeals the respondent for rating the quality of the image/video sequence being played on a scale from 1 to 5, where 1 indicates poor image/video sequence quality and 5 excellent quality. The respondent always has 10 seconds to enter his/her rating. After testing and evaluating of all images/video sequences, the program generates a "vq.txt" file on the desktop which contains information about his/her PC performance, namely operating system, resolution, processor and other necessary information. This saved file also contains his/her assessments of all test images/video sequences.
 - IV. The last task of the respondent is to go back to the webpage where he/she finds a form needed to be filled out containing personal information as an e-mail address, age, gender, and vision status - whether he/she wears glasses.
 - V. At the end the respondent uploads the generated file "vq.txt" as an attachment and sends the form. After the submission the form, his/her personal information together with the file "vq.txt" containing respondent's rating and device information are uploaded and stored in the database for further processing.
- 3) In the "Download" section, links for downloading a file for Windows and for Unix as well as the Readme text file are available.
- 4) In "Participation" section, an information about the user is entered and as well as a file containing important information about the system and the results of the assessment of images or video sequences are uploaded.
- 5) At the end of the webpage, a "Project" section with more information about the project, acknowledgments, news and changes to the page is situated.

III. CONCLUSION

In this paper we presented a web-based crowdsourcing framework developed by multimedia team at Department of Multimedia and Information-Communication Technology. The paper also dealt with a description of term crowdsourcing in a general form as well as in a context of quality assessment.

ACKNOWLEDGMENT

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Management of Cybersecurity Incidents in Virtual Lab

J. Uramová, P. Segeč, J. Papán, I. Brídová



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elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract— Article provides guidance on how to implement an introductory course at university during one semester for future cybersecurity analysts, built based on the Cisco Certified CyberOps course. The article presents the implementation of the course Management of cybersecurity incidents in the virtual laboratory in GNS3. Topologies in virtual laboratories are actual in today's covid-19 pandemic times, because many universities have to use live online or hybrid teaching.

I. INTRODUCTION

Global IT security skills shortages have now surpassed four million, according to (ISC)2. We started to react to this unfavorable trend 5 years ago, and we offer several courses focused on different aspect of cybersecurity now with topics as cryptography, LAN and WAN security, next-gen firewalls and incidence detection, response and handling. The last one from this list is the newest one, with the title Management of cybersecurity incidents. Our course is inspired by Cisco Cybersecurity Operations course, but we strengthened and deepened experiments in laboratory. The objective was to prepare students better for the position of operator for cybersecurity incidents response and handling.

II. MODIFIED AND CONCENTRATED LABORATORY EXERCISES FOR VIRTUAL LAB

The aim of the Cybersecurity Operations course is to acquaint students with the tasks of cybersecurity analyst. Concept of cybercurity incidents management, which we specified in our article, is included in this course, but also with a wider scope within these thematic blocks:

- Characteristics of Windows and Linux OS to support analysis within cybersecurity
- Analytical operations within network protocols and services, network infrastructure operations
- Attacks classification
- Monitoring tools and tools for the prevention of malicious access to computer networks
- Cryptography
- Identification of alarming messages in the context of network security
- Analysis of data that enters the network illegally and application of reaction models for incidents

These thematic blocks are divided into 13 chapters. There are 3 assignments on average for laboratory exercises in each chapter (min. 0, max. 9), together 43 assignments in total. In the academic environment, where the semester lasts 13 weeks, it was necessary to prepare assignments with concentrated content (10-13 assignments). Another goal was to prepare the content in such a way as to skip topics that are more suitable for secondary schools or have already been taken up by students in the past. In the article, we present our modification of assignments with implementation in the GNS3 virtual environment.

Our modified topology created in GNS3 can be seen in Figure 1. The devices were downloaded from the Cisco Certified CyberOps course and then uploaded to GNS3 server. The original topology in the course was intended for a virtual environment in the VirtualBox program, but we wanted to use our GNS3 server for all students for online (live) teaching. Our topology, unlike the official one, is divided into three subnets, namely DMZ, Inside and Internet, which we consider better from a didactic point of view. Table I illustrates our laboratory exercises. There are 27 official cisco labs which we didn't use at all, one lab which we used partially, and 15 labs which we used almost complete with some customization for our scenario and topology in GNS3. Some exercises from these were moved as part of another exercise. Compared to the Cisco Certified CyberOps course, we decided to change the order of the chapters. We have merged chapter 4 (Network Protocols and Services) and chapter 5 (Network Infrastructure) into one, because these chapters are already taken over in three other subjects focused on computer networks at our faculty. We moved chapter 9 (Cryptography and the Public Key Infrastructure) to our new exercise 7, because the exercise created for this chapter is related to the SQL Injection and XSS Web Attacks exercise, and it is a good idea to follow it.

VI. CONCLUSION

The article provided guidance on how to implement the Cisco Certified CyberOps course at university as an introductory course to teach future cybersecurity analysts. When creating laboratory exercises, we focused on the practical skills of using tools for monitoring and managing network security incidents and incident response models. We also considered the preparation of such scenarios to be equally important, where students can also try out tools for generating attacks, using vulnerabilities in network protocols and services.

ACKNOWLEDGMENT

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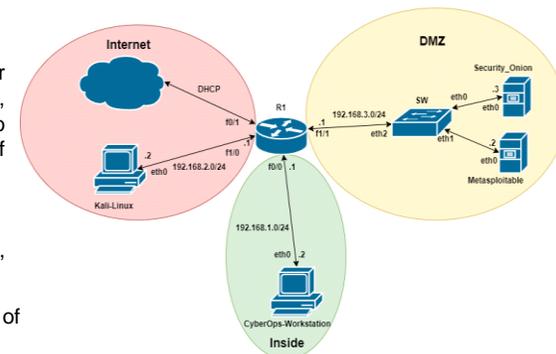


Figure 1. Our CyberOps topology in GNS3 virtual lab

Table I. List of our laboratory exercises

LAB number	Name of our assignment (LAB)	Cisco CyberOps chapter
1 (A)	Basic configuration and work with devices in GNS3 topology	Cybersecurity and the SOC
2 (B)	Managing processes, services and resources in Windows	Windows Operating System
3 (C)	Logs and services in Linux	Linux Operating System
4 (D)	Scan the network using Nmap	Network Protocols and Services & Network Infrastructure
5 (E)	Bruteforce and DoS attack	Principles of Network Security
6 (F)	SQL Injection and XSS web attacks	Network Attacks: a Deeper Look
7 (G)	Data encryption and decryption	Cryptography and the Public Key Infrastructure
8 (H)	Vulnerability scanning with OWASP-Zap	Protecting the Network: Endpoint Security and Analysis
9 (I)	Vulnerability scanning with OpenVAS	Security Monitoring
10 (J)	Device infiltration (None, included in previous labs)	Intrusion Data Analysis Incident Response and Handling

Teaching Course on Algorithms and Data Structures during the Coronavirus Pandemic

M. Varga, M. Kvassay, M. Kvet



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elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — At the beginning of spring 2020, the life in Slovakia and in other European countries has slowed down due to coronavirus disease 2019 caused by SARS-CoV-2. During the second half of March 2020, most education institutions in Slovakia were closed to the public. Students and teachers could not visit them, and the process of education had to shift from a physical space to a virtual space. Universities and other types of schools challenged to problems how the distance learning should be realized. In this paper, we present how some of the challenges and issues related to fast transformation of face-to-face education to education based on distance learning were solved by us within a course on algorithms and data structures taught at the Faculty of Management Science and Informatics of University of Zilina. The results indicate that a course requiring active participation of a student in the learning process by solving real world problems can be taught effectively using distance learning and the quality of education and knowledge grasped by students do not suffer from absence of face-to-face lectures and practical classes.

I. INTRODUCTION

The bachelor course of algorithms and data structures is taught in the summer semester of the second year of the informatic oriented study programs at our faculty. It is divided into 13 weeks of the semester, and each week students should participate in a two-hour lecture and a two-hour practical class. Lectures explain theoretical principles behind data structures and algorithms realized on them and are common for all students enrolled in the course, i.e., just one lecture is organized in a week. The aim of the practical classes is to understand the principles explained within lectures by their implementation in a programming language with manual memory management. Within a week at least 11 practical classes are organized. An actual number of the classes per week depends on the number of students enrolled in the course because one practical class can be visited by at most 20 students at once. This number is mainly determined by the capacity of rooms that the practical classes are organized in and a limited time that a teacher can explain content of the covered topic and interact with students. A student participates in a specific practical class according to his/her timetable. During the semester, the students have to work actively to meet criteria to register for a final exam. Passing the final exam is obligatory for obtaining the final grade. Since the course is obligatory, each graduate of the respective bachelor study programs has to pass this course and the final exam from it.

II. ADMITTED CHANGES

The principal changes performed during the semester are summarized in Table I. They involve:

- change of number of practical classes;
- decrease in importance of theoretical tests;
- increase in influence of semester projects;
- increase in influence of home assignments;
- addition of extra seminars used for explanation of possible solutions to semester projects.

The main aim of all these changes was to increase the importance of continual practical work and to decrease importance of theoretical tests whose realization can be quite complicated in a virtual space during the problems with cheating.

III. CONCLUSION

The impact of the changes we applied in the semester because of the COVID-19 can be summarized as follows (Fig. 1 – Fig. 3):

- the number and results of excellent students are consistent over the years;
- extra seminar focused solely on design of semester project was helpful and appreciated by students;
- home assignments in sufficient amount help students with better management of total work;
- if the exam is individual with the possibility to choose its date by students, the number of exam terms students need to take to get a grade is significantly lower and the grades are better.

ACKNOWLEDGMENT

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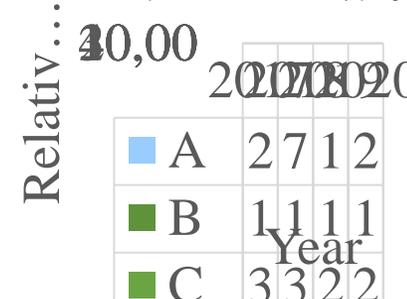


Figure 1 Relative grades distribution in years 2017 – 2020.

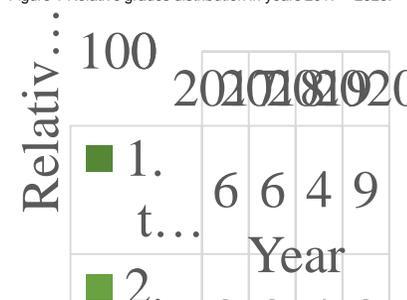


Figure 2 Ratio of examination terms where grade was given in years 2017 – 2020.

Table I List of admitted changes during the semester.

Indicator	Traditional education	Distance learning
Lectures per week [h]	2	2
Practical classes per week [h]	At least 20	4
Online education support tool	Moodle	Microsoft Teams
Theoretical tests per semester [count]	4	1
Theoretical tests per semester [points]	20	5
Semester projects [count]	2	2
Semester projects [points]	110	90
Home assignments [count]	5	3
Home assignments [points]	10	22
Minimal number of points to register for final exam	61	61

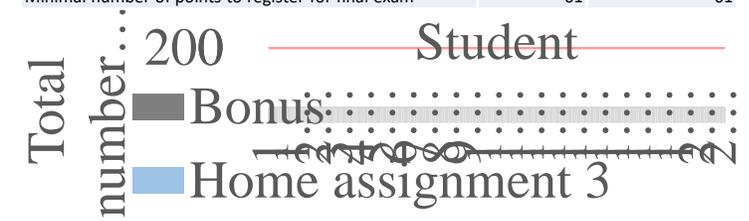


Figure 3 Students' points distribution in year 2020.

Metrics for Student Source Code Analysis

I. Vehec, E. Pietriková

Abstract — Source code quality is undoubtedly very important, yet usually forgotten aspect of software development process. This study shows different approaches to analysis of student codes, mainly in Java. By comparing different widely-used tools and our solution, we are able to get precise results from such an analysis, and thus to improve the code quality. The analysis results can also be used to determine knowledge and skills of novice programmers (students). Analysis of source codes may be as simple as counting the occurrences of language constructs or as complex as design pattern detection. Different approaches and solutions, i.e. measurements of language construct occurrences, copy-pasted code and design pattern detection, or source code quality, are discussed and subjected to evaluation by being executing on source codes of students as novice programmers.

I. INTRODUCTION

Source code analysis can be defined as a way of extracting information about the program from its source codes. The source codes used can be either the ones written directly by the programmer or the code that is generated by the compiler and later executed by the computer, e.g. Java byte-code. Source codes can be analyzed in a different ways in order to get the desired results. Different aspects of the program can be described by the analysis results including, but not limited to clone detection, debugging, quality assessment etc. It is important to find problems in a program quickly, so the necessary tools are used in early stages of the development process. Students are often encouraged to use these tools to prevent getting used to bad practices. The analysis of source codes is generally divided in two types - static and dynamic. To get the best results, they are often used together.

IV. EXPERIMENT

Results of student code analysis were compared to the grades and the automated assignment grading tool. With almost two hundred students, it is almost impossible for the teacher to thoroughly go through every single assignment. By performing this experiment it is possible to get the most common mistakes made by students and later use this knowledge to possibly alter the curriculum and improve the whole grading process.

- 200 Java student codes (Assignment 1: object-oriented principles, i.e. encapsulation or inheritance; Assignment 2: custom storyline and design of students' own classes, and creation of State, Observer and two additional design patterns.)
- Used tools: Flava (presented analysis system), including extensions of Checkstyle, PMD and SonarQube.

V. RESULTS

- The main purpose of Checkstyle is to find issues with the source code style and formatting. The most common problem, even with the usage of different ruleset, was the white space around the operator or brackets. The more severe issue is the missing Javadoc comments in the code. Also, students often use the same numeral literals at multiple places.
- Absence of Java documentation was noted also by PMD. Most of the students do not use brackets around the if-else statements. Local variables or method parameters that do not change during the method execution should be declared as final. This is often overlooked by students. The number of issues grows, as expected, with the program size. Every student leaves empty method bodies in their program. PMD also defines the maximum length of the comment within the source code.
- SonarQube marks every project with three grades (A–E). Each of the grades represents a certain aspect of the program: reliability, security and maintainability. Every student's assignment was graded with grades D, A, A for Assignment 1 and E, A, A for Assignment 2. It should be also noted, that while there were few thousands of Checkstyle or PMD violations in each of the assignments, SonarQube reported only a few hundreds or even less than one hundred issues in the source codes.
- Analysis of Assignment 1 showed that most students created an average or worse object-oriented design, mostly because of big depth of the inheritance tree. Only best graded students contain methods of average complexity. Rest of the students tend to write complex methods.
- Most of the assignments did not contain any duplicated code. Even if there was a certain occurrence of copy-pasted code, it was a relatively small percentage ranging from 1.1% to 1.6% of the program size.

VI. CONCLUSION

By comparing our solutions and different today widely used tools for code analysis, Checkstyle, PMD and SonarQube, we were able to get a very good insight on the quality of the source codes of the students' assignments. Since we the tools detected flaws that were very common in almost all of the student programs, we are able to alter the curriculum to address these common issues, for example encouraging students to write Javadoc comments or to write a more readable and maintainable code.

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Teaching programming through the Arduino workshops at secondary schools

P. Voštinár, M. Melicherčík and M. Vagač



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Slovakia

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fax: + 421-55-726 5195
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www.iceta.sk

Abstract — The State Education Program does not prescribe use of any particular programming environment in Slovak schools. It is up to each school or teacher which programming language or environment he/she decides to choose. Nowadays the most preferred programming languages at Slovak secondary schools are Python and Lazarus (some schools also use C/C++ or Java). However, these programming languages do not bring enough motivated students. Our Department of Computer Science at FNS UMB offers motivational workshops for secondary schools in region of Banská Bystrica. We would like to motivate students to proceed with study of Computer science in the future, because Slovakia reports a lack of IT professionals (but problem is worldwide). Main idea of these workshops is to show practical usage of programming for the students to increase the interest of IT with respect to interdisciplinary applications to the STEM subjects. In this article, we present our experiences with workshops in three different secondary schools with programming microcontroller Arduino.

I. INTRODUCTION

The development of first Arduino started in 2005, when the Italian employees from Interaction Design Institute in the town Ivrea decided to create simple and cheap educational set for students. Arduino has enjoyed great popularity since its launch. The founders of Arduino decided to share Arduino architecture for everyone. Since there Arduino is very popular open source project.

II. METHODOLOGY AND RESEARCH

Our research was held at the school year 2019/2020. In our research we used microcontrollers Arduino for teaching Computer Science in secondary schools Gymnázium Jána Chalupku in Brezno, Gymnázium Ľudovíta Štúra in Zvolen and Gymnázium Františka Švantnera in Nová Baňa. The main aim of our research was to find out, whether we can motivate students to study Computer science by using a real-object programming like the microcontroller Arduino. We used the semi-structured questionnaire at the end of the workshops for collecting data for our research. We didn't use pre-test, because the main aim was to motivate students - show them that computer science could be interesting. Measuring motivation could be done with observation or simple questionnaire after workshops. The questionnaire contained 9 questions and was filled in by 35 students. In the first workshop in Brezno we did not give the questionnaire to students (in this workshop there were 35 students). In this workshop we worked with students after workshops and feedback from the teacher.

```
/** ** PROGRAM 6 ** */  
#define PIN A0  
#define BUZZER 3  
  
void setup() {  
  pinMode(BUZZER, OUTPUT);  
}  
  
void loop() {  
  int value = analogRead(PIN);  
  if(value > 0)  
    tone(BUZZER, value);  
  else  
    noTone(BUZZER);  
  delay(10);  
}
```

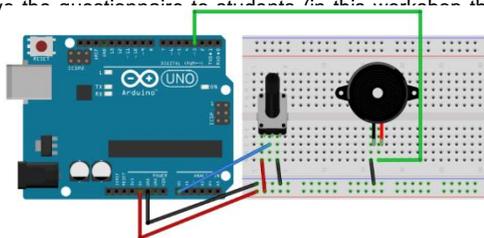


Figure 1. Schematics of Arduino circuit with potentiometer and buzzer

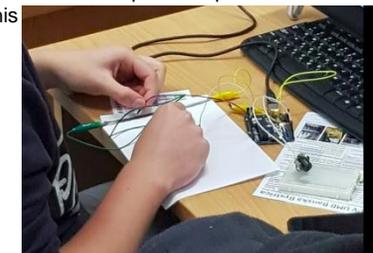


Figure 2. Experiment with the graphite potentiometer

VI. CONCLUSION

By this article we wanted to point out that real-object programming could be very interesting and attractive for students in the schools. We focused on using very popular and cheap microcontroller Arduino. In this article we described selected workshop activities, which we used to teach basic programming stuff and electric circuits. Besides that other subjects knowledge, like Physics, Chemistry, Mineralogy or Biology, can be used or verified to emphasize the STEM nature of these experiments. Our research has shown that students liked these workshops and they would like to continue with similar workshops. By these workshops we would like to motivate students to continue with studying computer science. Because of Covid-19 we cannot continue with these workshops, but we would like to improve our lectures and continue in the other secondary schools.

ACKNOWLEDGMENT

This work was supported by the Slovak Grant Agency KEGA contract No. 003TTU-4/2018 and 040UMB4/2019.

Impact of Formal Education on the Age Management Concept in Industrial Enterprises

N. Vranakova, A. Chlpekova

Abstract — The current situation at the labor market is associated with the negative trend of the demographic curve and related with the aging of the workforce and lack of young labor force. One of the ways that allows to deal with mentioned problem is the concept of Age management. Age management deals with the management of the workforce with regard to the age and potential of employees and it is comprehensively based on the eight pillars that form the framework of the whole concept. The main aim of the article is to present the results of the impact of formal education on the Age management concept in industrial enterprises. The research sample consisted of $n = 275$ respondents. The respondents were employees of industrial enterprises located in Slovakia. The collected data were evaluated using available tools, especially in MS Excel software using histograms and pie diagrams and through the evaluation of pairwise comparisons. Research has shown that employees who have completed different levels of formal education perceive the importance of the Age management pillars in different ways. Employees who have completed high school (with and without graduation) and employees with university master degree perceive "Satisfied life" as the most important pillar. Employees with university bachelor degree perceived as the most important pillar "Ensuring good work ability and motivation". Pillar "Good organization of work" is perceived as the most important among employees who have completed university doctorate degree.

I. INTRODUCTION

Various authors described the importance of employee's formal education and the impact of formal education on the enterprise. The aging of the population and the lack of young labor force are currently a serious problem at the labor market. One of the solutions is the implementation of the Age management concept into the practice of industrial enterprises. The framework of Age management consists of 8 pillars: Pillar 1 – Knowledge of age issues; Pillar 2 – Age-friendly attitude; Pillar 3 – Management that understands individuality and differences; Pillar 4 – Functional age strategy; Pillar 5 – Ensuring work ability and motivation; Pillar 6 – High level of competencies; Pillar 7 – Good organization of work; Pillar 8 – Satisfied life.

Diversity management is a tool for managing the differences that arise from the composition of the workforce. Diversity can be understood in terms of demographic characteristics (gender, age, race, nationality) or in terms of human capital (education, job position, length of employment). In our understanding and also for the purposes of this article, the authors of the paper will analyze the impact of formal education (as diversity in terms of human capital) on the Age management concept (as diversity in terms of demographic characteristics) and determine whether the importance of the pillars of Age management is different between employees who have achieved different levels of formal education.

II. MATERIALS AND METHODS

The main aim of the research was to identify the impact of formal employee education on the Age management concept with regard to the pillars of Age management and the perceived importance of the pillars of Age management in industrial enterprises in Slovakia. The object of the research was employees of industrial enterprises in Slovakia. A questionnaire was used as a data collection tool. In the research, the authors of the paper used methods such as analysis, deduction, comparison and generalization. In order to evaluate the results from the research, we used MS Excel software, histograms, pie charts, tables and also, in mentioned software was evaluated the pairwise comparison. Within the research problem, the authors of the paper set the following research questions: **RQ1:** What is the structure of employees in industrial enterprises in Slovakia in terms of formal education? **RQ2:** What is the current situation in the field of perception of the importance of the Age management pillars depending on the formal education of employees in Slovak industrial enterprises?

III. RESULTS OF THE RESEARCH

Evaluation of **RQ1:** 41% of employees with university master degree; 32% of employees with a high school with graduation; 20% of employees with university bachelor degree; 4% of employees with university doctorate degree and 3% of employees with high school without graduation. Evaluation of **RQ2:** Results of pairwise comparison following table:

Type of completed education/ Importance of Age management pillars	1 – most important	2...	3...	4...	5...	6...	7...	8 – least important
High school without graduation	Pillar 8	Pillar 7	Pillar 6	Pillar 5	Pillar 1	Pillar 4	Pillar 3	Pillar 2
High school with graduation	Pillar 8	Pillar 5	Pillar 7	Pillar 6	Pillar 4	Pillar 3	Pillar 2	Pillar 1
University bachelor degree	Pillar 5	Pillar 8	Pillar 6	Pillar 3	Pillar 7	Pillar 4	Pillar 2	Pillar 1
University master degree	Pillar 8	Pillar 5	Pillar 6	Pillar 7	Pillar 4	Pillar 3	Pillar 2	Pillar 1
University doctorate degree	Pillar 7	Pillar 8	Pillar 6	Pillar 4	Pillar 5	Pillar 3	Pillar 2	Pillar 1

IV. FINALLY SUMMARY

An important finding is the fact that for all groups of employees is the most important Pillar 8, which deals with occupational health care. For a group of employees with university bachelor degree, the most important is good work environment. Management of the work and related flexible forms of work are most important for employees with university doctorate degree. On the other hand, within all categories of employees according to formal education, Pillar 1 and Pillar 2 are the least important, representing non-discriminatory approach in job selection and in employment and intergenerational cooperation. The authors of the paper consider the above results as important for enterprises facing a negative demographic curve.

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Performance of High Order Modulation Formats in Coexistence of Gigabit (GPON) and Next-Generation Passive Optical Network (XG-PON)

J. Litvik, I. Dolnák, J. Dubovan

Abstract — The continually increasing of transmission capacity demands are not only matter of a core and metropolitan optical networks but nowadays also local access networks too. Although the transmission rates of first passive optical networks were 622 Mbit/s the current technologies support more than 10 Gbit/s. The rapid development in the last decade opens problem with utilizing of already installed infrastructure and coexistence older standards with new one. The modulation formats like differential phase shift keying and differential quadrature phase shift keying appear to be potential for increasing performance of nowadays used gigabit passive optical networks and next-generation passive optical networks. The simulations show improvement of bit error rate estimation approximately 2 dB.

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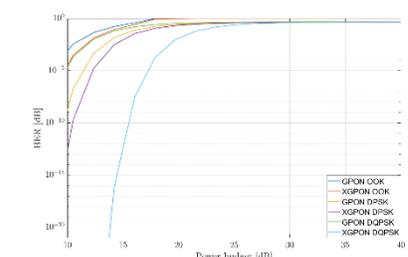
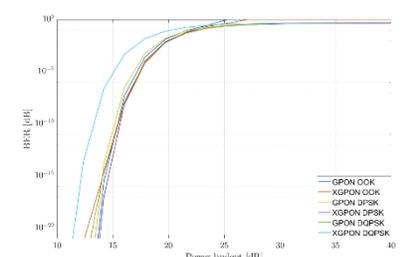
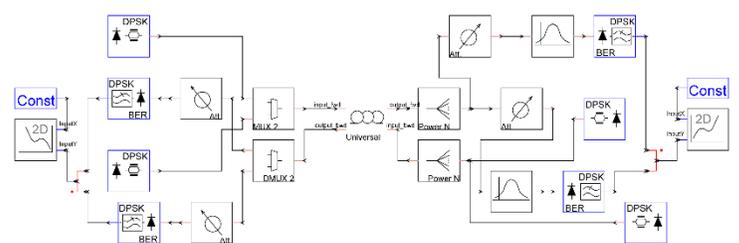
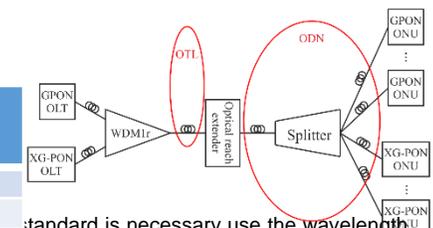
I. INTRODUCTION

The fast growing of data network traffic results in increasing demands on data rate and capacity of already existing networks. The constantly increasing of Internet users confirm this global trend. While in 2018 were registered 3.9 billion Internet users, in 2020 it is approximately 4.5 billion and with an expected increase about 6%, it is assumed 5.3 billion global users in 2023 [1].

II. PASSIVE OPTICAL NETWORK STANDARDS AND COEXISTENCE OF XG-PON WITH GPON

	Year of approval	ITU recommendation	Transmission mode	Transmission speed in downstream direction	Transmission speed in upstream direction	Transmission band in downstream direction	Transmission band in upstream direction	Maximal split ratio	Transmission medium
GPON	2003	G.984	GEM	max 2488.32 Mb/s	max 1244.16 Mb/s	1480-1500 nm	1260-1360nm	1:64	G.652
XG-PON	2010	G.987	X-GEM	max 9953.28 Mb/s	max 2488.32 Mb/s	1575-1580 nm	1260-1280nm	1:256	G.652/G.657

The standard is necessary use the wavelength division multiplexer that multiplexes different wavelength bands into one optical fibre. It guarantees economic effective utilization of already built infrastructure and increase network capacity simultaneously [2, 3, 4]. Simulation scheme of GPON and XG-PON with utilizing higher order modulation formats: the OLT consists from transmitters and receivers for GPON and XG-PON. Similarly, it is on the ONU side, where the same simulation blocks are used. On the side of OLT (downstream) were used wavelengths 1490 nm and 1577 nm for GPON and XG-PON respectively. In the opposite direction from ONUs (upstream) were used 1310 nm (GPON) and 1270 nm (XG-PON). Laser sources on both sides had set with 1 mW average power and linewidth 1 MHz. The maximal transmission rates were set under recommendations G.984 and G.987. The simulations were performed in the simulation software VPIphotonics and were examined the numerical estimation of bit error rates (BER). The used optical fibre corresponds to the ITU recommendation G.652 with length of 20 km.



VI. CONCLUSION

DPSK and DQPSK appear to be suitable candidates mainly in the case when upper level of power budget is reached. However, this modulation formats are more sensitive on phase changes due to chromatic dispersion and spectral and noise characteristics of active devices mainly optical sources of radiation. With increasing of transmission capacity per user is necessary to take into account the compensation of chromatic dispersion and linewidth optical sources.

ACKNOWLEDGMENT

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Education of Video Classification Based by Neural Networks

R. Vrskova, R. Hudec, P Sykora, P. Kamencay, M. Radilova

Abstract — In this paper an artificial neural networks for video classification were presented. After introduction to the topic, basic theory about architecture neural networks for video classification continues. Firstly, the 3D Convolution Neural network (3DCNN) using UCF50-action recognition database was applied. Next the Convolutional Long Short-Term Memory (ConvLSTM) on the same dataset was used. Finally, these neural networks using confusion matrix were compared. The all experimental results using UCF50-Datataset were performed. The achieved experimental results demonstrate the effectiveness of neural networks (3D CNN and ConvLSTM) in educational process.

I. INTRODUCTION

The focus of scientific community has been on classifying and operating with videos, for example classification of abnormal behavior, in last years. The video contains more important information than a normal image. Time coherence is significant part of the information contained in videos. Many experiments are built on this issue, which only proves relevance in the education process. Understanding the basic neural networks used for this issue is necessary from the point of view of research and teaching of future scientific researchers. The main goal of this article is to simplify the understanding and learning of video classification based on neural networks. The most widely used neural network architectures, which are used for classification are including LSTM (Long Short-Term Memory), 3DCNN (3D Convolution Network) and ConvLSTM (Convolution LSTM) principles.

II. UCF50-ACTION RECOGNITION DATABASE

In this article the database called UCF-50 is used. This database is an action data set based on 50 different action categories, which consist of realistic videos taken from YouTube. We are classifying on first 10 classes. We used classes as 1) Baseball Pitch 2) Basketball Shooting, 3) Bench Press, 4) Biking, 5) Billiards Shot, 6) Breaststroke, 7) Clean and Jerk, 8) Diving, 9) Drumming, 10) Fencing.

III. EXPERIMENTAL RESULTS

Accuracy ConvLSTM was 88% and overall precision was 90%. We can see its confusion matrix on Fig. 1. Next, the accuracy of 3DCNN is 72% and precision is 72%. The results based on confusion matrix can be seen in Fig. 2. After the correct interpretation of the results, the conclusions can be made. Accuracy and precision were clearly higher in the case of ConvLSTM than 3DCNN. On the confusion matrix it can be seen, that during the classification into the first-class (baseball pitch) neural network was wrong and classified 6 videos into the Biking class. In other types of classes, the neural network has usually mistaken only one or two videos. In the case of the classification of billiards, ConvLSTM was wrong in three videos, which he included in the category of bench press. In the final understanding, however, it can be assessed that the overall accuracy of the classification was 90%. In the results for the 3DCNN neural network, the neural network was mistaken more often, as evidenced by the confusion matrix. 3DCNN was most often wrong in classifying of the basketball class, where it included 3 videos in baseball pitch category, 6 videos in biking, 2 videos in breast stroke, 3 videos in clean and jark, 4 videos in diving and 6 videos in fencing category.

VI. CONCLUSION

In this paper artificial neural networks for video classification were presented. Neural networks are more and more used in the applications for video classification, it is desirable to introduce them in the educational process. We only used first 10 classes for classification from UCF-50 dataset. We mention neural network architectures used in this paper. We discussed in more detail principles of describing given architectures (3DCNN and ConvLSTM). In the results, we found that ConvLSTM had better accuracy and precision. The reason for better video classification in the case of ConvLSTM was that ConvLSTM has better time continuity processing and we also used the time distribution layer in this architecture. In future work we plan to test described artificial neural networks on crime dataset created for classification of abnormal behavior in public area.

ACKNOWLEDGMENT

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		Predicted									
		1	2	3	4	5	6	7	8	9	10
Targeted	1	23	0	0	0	0	0	0	0	0	1
	2	1	31	0	2	0	0	2	0	0	1
	3	0	0	18	0	3	0	0	0	0	1
	4	6	1	0	25	0	0	2	2	0	1
	5	0	0	0	0	25	0	0	0	0	0
	6	0	0	0	0	0	11	0	0	0	0
	7	0	0	0	0	1	0	21	0	0	0
	8	0	0	0	1	0	0	0	15	0	0
	9	0	0	1	0	0	0	1	2	28	1
	10	0	0	1	0	0	0	0	0	0	19

Figure 1. The result from classification by ConvLSTM (confusion matrix)

		Predicted									
		1	2	3	4	5	6	7	8	9	10
Targeted	1	18	3	0	2	0	0	0	0	0	1
	2	3	19	0	3	0	0	1	0	0	1
	3	0	0	9	6	0	0	0	0	7	0
	4	1	6	0	25	0	0	2	0	7	3
	5	0	0	0	0	24	0	1	0	0	0
	6	0	2	0	0	0	10	0	0	0	0
	7	0	3	0	5	0	0	14	0	0	0
	8	0	4	0	3	0	0	0	25	2	0
	9	0	0	0	2	0	0	0	0	31	0
	10	0	6	0	0	0	0	0	0	0	14

Figure 2. The result from classification by 3DCNN (confusion matrix)



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On Teaching of Computer Networks using Novel Methodologies

O. Kainz, M. Michalko, F. Jakab, R. Petija, J. Uramová, M. Moravčík



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Abstract — In this study, we focus on the methodologies that were created as a part of the national IT Academia project. We describe the standardized format that each methodology follows, making each methodology quickly understandable for the instructors. As another goal, we deploy the methodologies on the course taught at the local university. The created methodologies have proven to supply adequate output, both for the instructors and students. Outputs of the testing yield positive feedback from the side of students and render methodologies usable in the real practice, as is also proven by the feedback from the secondary school teachers who teach Computer networks courses.

I. INTRODUCTION

Education is not important but essential element that drives our existence and progress. There are various forms of education and it is mostly dependent on the educational system in specific country, political establishment or even belief. Our goal, as solvers, of the IT Academia project was to enhance this educational process and promote new forms of learning of the specific course. Specifically, we are focused on the Computer Networks course that is being taught at multiple educational bodies within Slovakia. Many methodologies, along with hundreds of additional materials was created within the project's duration.

II. TEACHING USING DEVELOPED MATERIALS

IT Academia National Project enabled creation of support material for the teaching process of the Computer networks course. Such material is offered not only to instructors (role of teacher) but also to students. Thus, the whole management of the course is more effective, while also students get extended support. Several methodologies that contain such support material were created. Next, we will present sample methodology created as a part of the project. Standardization of methodology format may be useful not only to current but also future teachers or instructors.

A. Example of Methodology

Methodologies usually include multiple tasks developed for the better understanding of specific topic. The main document of the topology is the methodical letter. Which includes the most important and information relevant for the teaching process. The standardized structure always includes: **Topic category / Topic, ISCED / Recommended grade, Knowledge gained by the students, Developed skills, Requirements for input knowledge and skills, Solved didactic problem, Dominant teaching methods and forms, Teaching aids**, Other parts of the methodology include **Introduction**, which provides general introduction to the specific topic. Then, in case of Computer Networks courses, the structure of the teaching process is: **Evocation, Awareness, Reflection**.

B. Feedback from the Lessons

Selected methodologies were tested in the real environment on a sample of university students, even though the main target group are the secondary school pupils. Group consisted of 15 students and the whole testing process was carried out at the Technical university of Kosice on the Computer networks course. Overall feedback on the content of methodologies was rather positive (see Fig. 1).

Materials that were created as a part of the methodologies were also provided to students using Learning Management System (LMS). These materials were used, both the during the lecture and also in a form of a homework. Materials included: premade topologies in Cisco Packet Tracer simulator; exercises focused on subnetting etc.

VI. CONCLUSION

In this study we focused on the educational form of presentation through the methodologies. Standardized approach to creation of the methodology focused on the Computer Network courses was presented. This approach yielded good results both for in the teaching process carried out at the secondary school as well as at the university.

University course focused on Computer Networks was used to test the methodologies and received very positive feedback in terms of material and the overall approach of the methodology. Students utilized the created materials also as homeworks and for self-study. Also, multiple instructors appreciated the standardized approach of all the methodologies created as a part of national IT Academia project. These methodologies, however, are primarily aimed to be used by the secondary school students. In fact, several implementations were already carried out and based on the feedback it can be concluded that the secondary school teachers will also utilize these methodologies in their educational practice.

Except for already available material, also new material is being created. It will contain up-to-date curriculum, providing the latest knowledge from the field of computer networks. These new methodologies will be then made available for other instructors. Also, other novel techniques may be deployed as part of the future research, e.g. making software solution that will contain students' knowledge profiles and enable their comparison or find out the behavior of students using automated testing. Some of the described features are, however, already incorporated to an existent Learning Management System focused on Computer Networks.

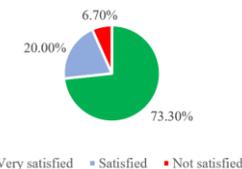


Fig. 1. Overall satisfaction with the used methodologies.

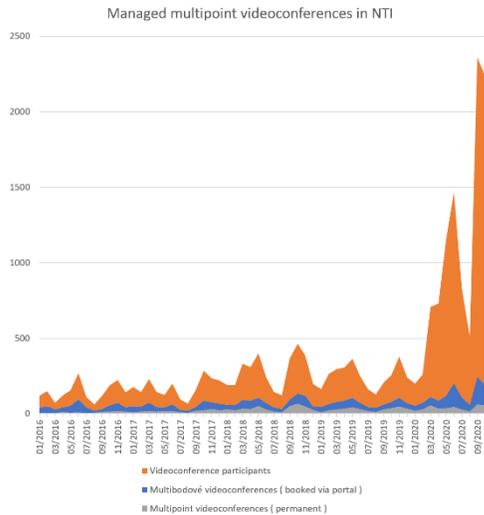


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Technical Challenges and Vision of Slovak National Telepresence Infrastructure during The Covid-19 Pandemic

F. Jakab, D. Cymbalak, R. Vápeník, P. Hrčka, J. Kováčová



Abstract This paper introduces technical challenges with National Telepresence Infrastructure in Slovakia during COVID-19 Pandemic. Rapidly increasing demand for videoconference technology from academic and research institutions is calling for quick sometimes not yet stable solutions during these days. Paper should be a summary of operational and innovative rapid development activities of large telepresence infrastructure. There will be also a vision for transforming telepresence technology regarding current situation into more effective digital tool not only for communication, but also for remote work, digital traveling etc.

INTRODUCTION : Slovak National telepresence infrastructure (NTI) under Slovak Centre of Scientific and Technical Information was developed in 2015 to support research, development and technology transfer in Slovakia [1]. Nowadays it consists of over 240 videoconferencing and multimedia rooms [2] with multifunctional telepresence and live-streaming ability [3].

During the COVID-19 Pandemic NTI CVTI SR was approached from several institutions to provide communication solutions in times of crisis, which affected its current state. Some telepresence devices have been relocated for crisis staff purposes, some have been disabled for releasing and prioritizing the resources. The CORE infrastructure was also extremely used for encrypted communication via SIP registration from mobile platforms. The streaming gateway has been redesigned to allow video conferencing to be securely distributed to a passive web stream to thousands of online viewers. These changes have affected the provision of NTI services - the original purpose of NTI to support science and research was extended and prioritized to provide tools to battle COVID-19 situation. An example is the large 3-screen telepresence NTI system located at University of Pavol Jozef Safarik, which is in the current situation regularly used by the Slovak Society of Infectious Diseases as a central entry point for videoconferencing between infectological clinics connecting from hospitals in the Slovak Republic. These collaboration channels with the involvement of first-line infectologists have a direct and fundamental impact on the fight against COVID-19 pandemic through the distribution of treatment procedures and the sharing of experience. Many of these connections are made via the NTI videoconferencing gateway with interconnection to various software videoconferencing solutions.

Due to the prioritization and allocation of some components for the above-mentioned crisis staffs, NTI works for the original purpose - videoconferencing between universities and research institutions in a more limited alternate mode and therefore some services have not been automatically available (automatic scheduling via calendar, automatic recording and broadcasting). Almost all requirements have been solved manually with a lot of effort (Fig 1.) with NTI Central Management Office (PCM NTI CVTI SR).

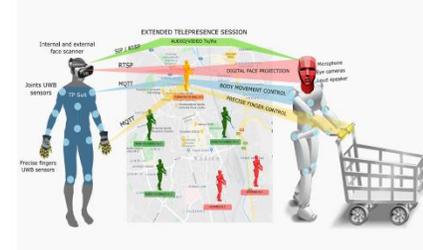
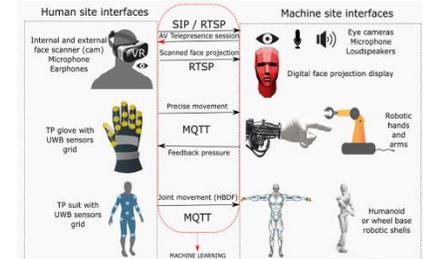
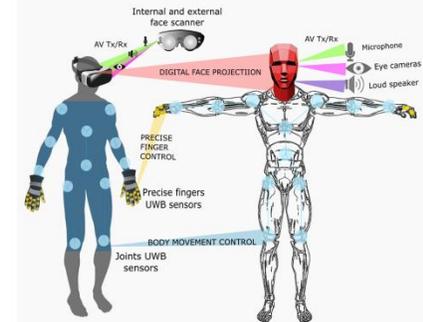
Challenges and Visions Based of NTI Usage to Extended Telepresence Technology: In Oct 2019 we published the paper: "Extending Telepresence Technology as a Middle Stage between Humans to AI Robots Transition in the Workplace of the Future. " [9]. It was written before any mention of COVID-19 pandemic and the main theme was using telepresence technologies with robotics in remote work in many professions. Now, after the year, it is unbelievably relevant paper in current situation. Standard usage of current videoconferencing technology is usually limited to transfer camera image, microphone sound or presentation. This is satisfying in the field of remote education or communication based of visual experience. Digital communication of future needs elements of physical interaction. Many fields are depending of physical present of human and it is necessary for performing activity.

During the situation like COVID-19 Pandemic we can extend the telepresence technology for example with proper remotely controlled medical devices to develop a reliable remotely controlled examination table by medic located anywhere in the world. There is a way to integrate telepresence solution in the ambulance vehicles for providing the examination from distant medical specialist during the transportation.

Pandemic is also affecting the first contact offices (bureaus, receptions, kiosk), which will be more effective and safe with telepresence device extended with printing, scanning and physical signature collecting features [10]. Last mile problem in the uprising delivery business could be solved by remotely controlled telepresence robotic system operated controlled from central office.

Telepresence solution with virtual reality live experience with physical remotely controlled elements can bring a new way of digital transportation and open doors for share-economy concepts like shared robotic shells (analogy to bike sharing). For example, there will be hundreds of robotic shells located over the city and you can pick the one on map to remotely connect, move and operate via VR extended telepresence technology from your home. In the time of worst possible pandemic situation, it will be the most safety way to do various physical activities (f.e. remote physical shopping in mall, visiting the post office, door to door delivery staff, physical meeting with persons etc.).

This technology could benefit not only during pandemic times, but it can be also a tool for improve physical condition of disabled people, which could be connected by VR with extended telepresence technology to the robotic shell located in specific location of for achieve a free walking in real world with physical interaction. Mentioned model (Fig. 11) for extending the telepresence technology in the vision of robotic shells with remotely controlled output mechanisms (artificial arms with finger joints [11], working tools, lasers, wheels, etc.) interconnected with relevant input interface (VR, grid gloves sensor, bodysuit sensor grid, EMG sensors [12] etc.) could be adapted in future almost in any profession.



COLORS PERCEPTION IN OBJECT DETECTORS

L. Vokorokos, M. Hulič, M. Štancel, M. Knut, Technical University of
Košice, Košice, Slovakia

A comparative study of the most perspective radio access technologies for vehicular V2X networks

A. Jantošová, J. Morgoš, I. Dolnák and J. Litvik



ICETA 2020
Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — The following article provides an overview of currently the most perspective radio access technologies designed for vehicular V2X (Vehicle-to-Everything) environment, mainly for mutual communication among vehicles, and also for communication between vehicles and infrastructure. Principally, the goal of the article is to summarize general knowledge about radio access technologies designed for vehicular V2X networks, which are mainly WLAN based communication technologies and communication technologies based on cellular V2X technologies. In the context of described vehicular V2X communication technologies, the end of this article compares selected communication technologies that could bring a new perspective not only for scientific research but also for the reader who is interested in the issue of the vehicular V2X networks.

I. INTRODUCTION

In the future, the area of vehicular V2X (Vehicle-to-Everything) networks will consist of intelligent vehicles equipped with a lot of technology like sensors, RADAR, LIDAR (Light Detection and Ranging), localization technologies mainly based on the GPS (Global Positioning System) system, etc. The main idea of the V2X networks will undoubtedly meet elementary social goals such as ecologic, safe and economically efficient driving. Vehicular V2X network is a special type of network which is focused on the automotive environment. The main characteristics of this network are mainly dynamic changes in the network environment, high mobility of network nodes, short connection duration, asymmetric communication, ad hoc network structure, limited security, personal data protection, etc. Thanks to these features of the mobile V2X network, it is not possible to use the principles and functionalities of conventional networks, but it is necessary to make several modifications and improvements. In the field of vehicular radio access technologies, there are several potential technologies, in particular, WLAN-based wireless technologies, and the second significant group is based on cellular technologies (Cellular-Vehicle-to-Everything - C-V2X). These two potential technologies form the core of the following paper and they are discussed and described in more detail in the article.

II. IV. COMPARISON OF SELECTED ACCESS TECHNOLOGIES FOR V2X NETWORKS

Cellular technologies for in-vehicle networks are specified in individual Releases issued by the 3rd Generation Partnership Project (3GPP), whereas the 802.11p standard is issued through the IEEE (Institute of Electrical and Electronics Engineers) standardization organization. In terms of specification release time among the four candidates, the oldest edition is the IEEE 802.11p standard, on the contrary, the most recent edition is Release 16 concerning NR-V2X.

Regarding the operation in the 5.9 GHz band, which belongs to the ITS system, all of the mentioned standards can operate in the ITS 5.9 GHz band.

In terms of the range of individual technologies, the highest range has the NR-V2X cellular technology, the range of which is not limited to cell coverage, as communication between vehicles can also take place via the sidelink channel via the PC5 interface. All of the compared technologies can work outside the network (cellular) coverage, while with IEEE 802.11p technology, individual vehicles represent AP devices.

The modulations used in individual technologies are BPSK, QPSK, 16-QAM, 64-QAM, in Tab. 2 there is a more detailed assignment of individual types of modulation to the given technologies. Regarding coding, Turbo codes are used in LTE-V2X Release 14/15, LDPC (Low-density parity-check code) codes are already used in the next release NR-V2X Release 16. In contrast, the IEEE 802.11p standard uses convolutional codes.

Regarding possible communication between vehicles, between vehicles and infrastructure, all of the presented technologies envisage support for both vehicle-to-vehicle and vehicle-to-infrastructure.

VI. CONCLUSION

In this article, the topic of vehicular radio access technologies, which are generally considered to be the core technologies of V2X networks, has been analyzed and summarized. Principally, there is a discussion of two potential directions for radio access technologies which were been compared in this article. It is still not clear which of the technologies will win, but more or less it is clear that they will be either WLAN-based wireless technologies or cellular technologies. Regardless of the fact whether WLAN-based or cellular-based networks will be used for in V2X networks, all the specifics resulting from node mobility should be taken into account. One of the aims of such a new infrastructure is to provide security and safety-enhancing services for citizens.

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Parameter	LTE-V2X (Rel. 14/15)	NR-V2X (Rel. 16)	IEEE 802.11p standard
Year	2016/2018	2020	2010
Standardization organization	3GPP	3GPP	IEEE
Ability to work in ITS 5.9 GHz band	Yes	Yes	Yes
Reach	Tens of meters to 30 km	Within/outside the cell coverage	Up to 1000 m
The functionality even outside the network coverage	Yes	Yes	Yes (via AP)
Multiplex	SC-FDM	OFDM	OFDM
Modulation	QPSK, 16-QAM	QPSK, 16-QAM, 64-QAM	BPSK, QPSK, 16-QAM, 64-QAM
Coding	Turbo codes	LDPC codes	Convolutional codes
Support for V2V/V2I communications	Yes	Yes	Yes

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Digital Transformation of Education at School

V. Hubeňáková*, D. Šveda, A. Mišianiková, M. Kireš



ICETA 2020
Conference Office

elfa, s.r.o.
Park Komenského 7,
040 01 Košice
Slovakia

tel.: + 421-55-625 3839
fax: + 421-55-726 5195
e-mail: iceta@elfa.sk
www.iceta.sk

Abstract — Digital transformation of education at schools is inevitable condition for digital transformation of educational system. In the paper, we discuss features of "digital school" from the perspective of school as a community of actors and from the perspective of school as an educational space.

I. INTRODUCTION

The aim of the transformation of education is to improve it in the context of the demands placed on the current generation of students after completing formal education and their needs. From the point of view of a specific pupil, it is most important that the school to which it belongs acquires this quality. Therefore, it is necessary to name what features the school has, which has well grasped the significant change in the mentioned demands. With regard to them, we characterize the features of the "digital school" and point out the specific possibilities of how digital technologies enable the transformation of the school in the desired way.

II. TRANSFORMATION OF THE SCHOOL AS A COMMUNITY OF ACTORS

A. Transformation of the school in relation to students

<p>(1) Taking adequate responsibility for the student's own learning ... by applying inquiry-based education in science, mathematics, and computer science (or another alternative based on constructivist learning theory) ... by working with social sciences subjects with open access to information ... by creating a space for formative assessment in all subjects</p>	<p>(2) Preparation of the student for the needs of practice ... by developing computer thinking in students in the subject of informatics ... by placing sufficient emphasis on the development of mathematical competencies ... by the fact that students who are prepared to communicate in one of the foreign languages ... by naturally developing digital competences and other soft skills in all subjects ... in that the summative assessment is an objective report on the level of student understanding</p>
<p>(3) Students are educated in accordance with their personalities and in accordance with their current possibilities and limitations ... by teachers working together to understand the student's strengths and weaknesses ... by emphasizing interdisciplinary project and teamwork ... because the current physical absence from school does not mean that the student is not learning</p>	<p>(4) Pupils become an active part of the (school) community ... by allowing them to work in teams outside of class</p>

B. Transformation of the school in relation to the teacher

- (1) Teachers are part of the professional community at school
- (2) Teachers network across regions
- (3) Teachers have national support for the full development of their profession

C. Transformation of the school in relation to school management

- (1) The school management has adequate support for the acquisition and development of leadership competencies
- (2) The school management is focused on building CPD The functioning of the teaching staff as a purposeful team is a priority for the management of the "digital school". This is reflected
- (3) The school management takes an active approach to cooperation with parents
- (4) The school management is focused on creating networks with other entities

III. TRANSFORMATION OF THE SCHOOL AS AN EDUCATIONAL SPACE

- A. Process management and school organization
- B. School environment and its technological equipment

VI. CONCLUSION

The digital transformation of education at schools needs to be supported via systematic national action plan and implemented via the school action plan. Each school can be digital in the measure which is actually appropriate. What is the most important, each (digital) transformation should never be the aim. The aim is high quality education provided at each school.

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