Tempus JEP Workshop:"Development of M.Sc. curricula in the framework of TEMPUS"

INTRODUCTION

Workshop titled "Development of M.Sc. curricula in the framework of TEMPUS" is a joint workshop for three currently running TEMPUS JEP projects from Serbia and Macedonia. It is integral part of The 14th National Conference on High Education "Effects and Quality of Bologna Studies" - TREND 2008.

Workshop is organized according to TEMPUS JEP _41016_2006 project proposal activities for ratifying draft curriculum of new master studies in E-Learning and also subsumes dissemination and intercoaching role for all three TEMPUS JEP projects.

Workshop participants are consortium members of the following TEMPUS JEP projects:

- JEP_41016-2006 “M.Sc. Curriculum in E-Learning”, grant holder UM_FERI, University Maribor, Slovenia; grant coordinator Technical faculty Cacak, University of Kragujevac, Serbia

- JEP_41048-2006 "Master Studies in DSP Based on Blended learning Approach“ , grant holder FACULTY OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE, University of Maribor, grant coordinator Faculty of Electrical Engineering and Information Technologies, University Ss Cyril&Methodius, Skopje, Macedonia

- JEP_41112-2006 “Development of Master Study Programmes in Telecommunications and Control“, grant holder National Technical University of Athens (NTUA), Greece, grant coordinator Faculty of Electronic Engineering, University of Nis, Serbia

Workshop includes presentation of papers concerning variety of topics covering curriculum development issues and also round table for comprehensive discussion about ratifying draft curriculum of new master studies in E-Learning.

INTRODUCING STUDY PROGRAMS IN E-LEARNING IN SERBIA

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1. INTRODUCTION

Along with the worldwide proliferation of e-Learning as the *means* and the *way* of studying, many educational institutions have undertaken efforts in their courses and study programs to cover e-Learning as a *topic* of study. As a result, a number of universities now offer degree programs in e-Learning, typically at the MSc level. Such study programs focus on the use and application of Information and Communication Technologies (ICT) in the specification, design, development and deployment of systems supporting e-Learning. The objective of such a degree program is for students to acquire advanced understanding of the main theories, principles and concepts of e-Learning, develop specialist design and evaluation skills for doing this, and gain experience in using advanced techniques in developing and deploying e-Learning systems [1].

Although such study programs are results of recent developments, and in spite of skeptic views of proclaimed benefits of e-Learning (e.g., see [2]), there are good reasons to believe that these study programs are here to stay. The demands from the market are increasing, and the reaction of various funding agencies in developed countries is appropriately supportive. For example, one of the high-priority areas of ICT research and development supported by the EU's Seventh Framework Programme (FP7) is that of Technology Enhanced Learning, or TEL [3]. Within FP7, over 100 M€ grant is provided by the European Commission to support TEL development projects proposed only in the first year of the 5-year framework.

Universities in Serbia have begun to realize the importance of e-Learning, although by now the achievements were not impressive. What is still largely lacking is a coordinated effort towards a more systematic approach to e-Learning study programs.

This paper is a contribution to the specification of mission and vision of e-Learning study programs in Serbia. It starts from a brief survey of some of the current practices and ongoing efforts in e-Learning at Serbian universities, and then discusses the needs and perspectives of e-Learning and e-Learning study programs in Serbia.

2. CURRENT PRACTICES IN E-LEARNING IN SERBIA

E-Learning is interactive learning in which the learning content is available online and provides automatic feedback to the student's learning activities [4]. Unfortunately, this definition is often largely misinterpreted in Serbia to mean something drastically reduced, like:

a. putting on the Web the PowerPoint slides for a course;
b. putting on the Web the videos recorded during face-to-face (F2F) lectures;
c. putting on the Web digital books, possibly augmented by a narrated presentation of the course contents;
d. enhancing any of the above three by exercise materials;
e. enhancing any of the above by the course administration information, like the list of the students enrolled for the course, the news, and the assessment schedules;

The other important parts of the quoted definition, i.e. interactivity, tracking the student's activities, and providing automatic feedback, are typically ignored. If assessment is supported at all, it usually comes in the form of preparing simple multiple-choice tests.

Some university departments in Serbia have gone a step further by integrating a few of the above listed issues by using an open-source course management system (CMS) such as Moodle [5]. However, a closer insight shows that in such cases CMS capabilities related to organization of and access to the learning content, which are central to e-Learning [6], are often largely underused. In other words, such uses of a CMS are reduced to just putting all the courseware in a single place that provides very little functionality other than a set of ordinary multimedia Web pages.

There is also evidence of various other initiatives. For example, at The University of Novi Sad and The University of Belgrade departments of Medicine efforts have been made to offer e-Learning courses integrated over several disciplines (for example, see [7]). Some private universities in Serbia and in neighboring Montenegro (e.g., Faculty of Information Technology, Belgrade, Serbia, and Mediterranean University, Podgorica, Montenegro), have put a lot of effort deploying CMS technology to put all of their courses online. A notable effort of the Singidunum University, Belgrade, is their investment in development of an advanced proprietary CMS. It is supposed to be integrated with the university's Learning Management System (LMS) that covers administration of study programs and courses [8].

The Technical Faulty Čačak, University of Kragujevac, and the Faculty of Electronics, University of Niš, have realized the need to provide an appropriate infrastructure for e-Learning first (i.e., labs, equipment, communication infrastructure, software), and only then put up online courses. University of Belgrade has made an initiative to coordinate e-Learning efforts across its departments by establishing the e-Learning office at the university level.

Still, one fact is certain – e-Learning in Serbia did not gain momentum yet. Teachers are not yet ready to do it professionally, typically due to the fact that state universities do not put much stress on e-Learning, the lack of appropriate understanding of e-Learning, the lack of training, and also due to the huge efforts required to put up a course online in a professional way. Students are reluctant to enroll for e-Learning courses, except at some private universities. The reasons are also the lack of understanding, the lack of confidence, the fear that the degrees earned will be different from those obtained in traditional study programs, the lack of appropriate communication infrastructure, and the like. To this end, an interesting phenomenon has been observed at the Faculty of Organizational Sciences in Belgrade. In the first generation of students enrolled for an e-Learning study program, there were only 8 students. In the second generation, there were about 60 students. However, nearly all of them have quickly converted to the same study program delivered F2F!

3. PERSPECTIVES

The EU-funded SCORE project [9] has recently come up with an important document on the initial strategic research agenda for ICT research priorities for Serbia in the period 2007-2013. The document stresses e-Learning as one of the priorities. It coincides with the EU priority of TEL, stressed in FP7.

However, the e-Learning experiences at Serbian universities so far, briefly overviewed above, clearly indicate the need for relevant institutions in Serbia to provide education and training *on* e-Learning, and not only to offer e-Learning courses. Isolated elective courses on e-Learning (or, even more frequently, just parts of such courses), offered at a few university departments and colleges in Serbia, are not sufficient.

The TEMPUS CD_JEP_41016-2006 project *MSc. Curriculum in E-Learning* (*MSCEL*) [10] is the first coordinated response to this need. Obviously, the idea of the project is to initiate the establishment of degree programs in e-Learning at the MSc level. The targeted implementers of such degree programs are Serbian universities. This section makes an attempt to summarize the mission and provide a vision of these study programs in Serbia, in an informal way.

The mission of e-Learning study programs should be two-fold. First, any such a study program in Serbia should educate specialists in the field of e-Learning to carry out the design,

development, and deployment of e-Learning systems in educational institutions, in companies and institutions that need to provide training of employees, end users, and partners, as well as in all other environments pertaining to life-long learning with the extensive use of ICT.

Second, a study program in e-Learning should support the raise of awareness of the benefits and potentials of e-Learning for further development of Serbia and its people. To this end, it is absolutely essential for such a study program to focus not only on educational and technological, but also on pedagogical and cultural aspects of open and flexible e-Learning environments. Whenever possible, any such a program should be developed and implemented in collaboration with international teams of experts, to help the students to relate the latest developments in the relevant areas of technology and pedagogy to their workplaces or career paths. Any such a program should also introduce and stimulate the use of virtual learning environments that enable students and teachers to work collaboratively with participants from other countries and other educational settings in a unique learning community [11].

A vision of study programs in e-Learning should indicate the answers to the questions like who are these programs for, who should implement them, what are the implementation strategies, what kind of infrastructure and support is needed to implement them, what should their curricula focus on, and what is the expected recognition.

Study programs in e-Learning in Serbia are for professionals in the field of e-Learning and multimedia, focusing on education and training. They are for teachers in schools, teachers in further and higher education, those involved in other education and training, and instructors in companies. They are also for public authorities and other institutions from museums to hospitals, which should make use of e-Learning and multimedia strategies for communication, information, education, training, and recruitment.

The implementers of such study programs, at least in the foreseeable future, should be universities and possibly colleges (both state and private ones). It is not likely that these programs will shortly gain attraction at the undergraduate level.

Since e-Learning in Serbia is still in its infancy, and study programs in e-Learning are still to be implemented, an important strategic decision for their implementation should be to make extensive use of experiences of implementers from other countries, both worldwide and neighboring ones. Tight collaboration with universities and other educational institutions with a considerable experience in e-Learning is a must. International projects are a proven avenue in this direction. For example, in the already mentioned TEMPUS MSCEL project the partners from Slovenia, Austria and United Kingdom already have a remarkable experience and are sharing it with Serbian partners extensively. Another good example is bilateral projects in the area of e-Learning that have been carried out by the Faculty of Organizational Sciences, University of Belgrade, the Association of Universities and Colleges of Canada, and the University of British Columbia and Simon Fraser University, Canada [12], [13]. All these projects were extremely important for Serbian partners in terms of the knowledge transfer and learning from the partner institutions from developed countries.

Likewise, study program implementers from Serbia can benefit from experiences of the neighboring countries such as Montenegro [14] and Croatia [15]. For example, the Croatian E-Learning Academy (ELA) [15], implemented by the Croatian Academic Research Network (CARNet), offers a few study programs related to e-Learning and has already walked a line quite similar to the one that Serbian implementers of e-Learning study programs have to walk.

It is also strategically important to complete the establishment (at the national level) of an e-Learning center to serve as a dissemination point for online learning and technology-based education. The formation of this center was initiated as the result of a bilateral project with Canadian partners [13], but has never been completed.

As for the infrastructure needed to support the implementation of study programs in e-Learning, note that equipment alone is not sufficient. Courseware development tools and a variety of simple utility software tools, as well as a start-off availability of teachers who already master the tools and keep up with rapid changes in ICT, are also necessary. The costs can be

cut down tremendously if the orientation towards open-source software is taken. It goes without saying that the institutional support for implementation of these study programs is a must.

Curricula of study programs in e-Learning at Serbian universities should be fully in line with similar curricula offered by universities with longer tradition in this field, and should be constantly adapted to reflect the new developments in both technology and pedagogy. Nowadays, this means the focus on three major issues: a) theoretical and methodological foundations of e-Learning, b) instructional design and pedagogical models in course development, and c) technology of learner-centered design tools, multimedia, and social/multicultural networking. Electives should certainly include topics like e-Learning project management, course and curricula management, life-long learning, e-Training, and course quality assurance.

A mandatory prerequisite for these study programs in e-Learning to become successful if that the national committee for accreditation of university programs clearly supports both the programs themselves and the recognition of degrees earned by completing them.

4. CONCLUSIONS

There is a need for better understanding at educational institutions in Serbia of what e-Learning really means. This understanding can be developed over time by implementing study programs to educate specialists in the design and development of e-Learning systems. One should have no big expectations though – the efforts needed to put such study programs to life are huge and time-consuming, since they include a considerable shift in mindsets of students, teachers, and university managers alike. The accreditation bodies should take e-Learning study programs seriously and provide appropriate support.

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STRUCTURING M. Sc. CURRICULUM IN E-LEARNING

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1. INTRODUCTION

There is a significant lack of studies in e-learning at universities in Serbia. At the same time there is a growing need for e-learning, not only for higher education, but also at any level of education, within the program of life-long learning and finally for industrial and organizational purposes.

Therefore, it is major need for Serbian universities to establish studies leading to a M.Sc. degree that will educate future experts for design and implementation of e-learning. Those experts will be highly specialized in the planning, budgeting, development, delivery, and support of e-education and distance training programs. These experts will be required to be active advocates for e-learning in their organizations and need to manage significant change processes that affect the entire organization and society as a whole.

The new M.Sc. curricula in e-learning must be in line with those used at the world's leading universities in the relevant fields of study.

In order to accomplish this it will be necessary to create a number of new courses in the field of e-learning following the Bologna declaration, and to retrain teaching staff.

The urgent needs for e-learning are recognized by Serbian government, Serbian Ministry of Education, all universities in Serbia, and also at all lower educational levels, stating the following:

-At the end of 2005, the Serbian goverment passed the document: "Strategy for the Development of Information Society in the Republic of Serbia" where one of the important goals is the development of e-Education [1].

- Since Serbia has signed the Bologna declaration and is therefore committed to it, the need to reform both undergraduate and graduate curricula of all Serbian universities is evident. Those reforms have already begun at almost Serbian universities.

- The new Law of Higher Education in Serbia which was passed in September 2005, recommends universities to implement e-learning [2].

- In October of 2006 the Ministry of Education proposed that all Serbian universities create new curriculum for masters studies, so that university institutions have an urgent task to develop new master study curriculum according to Bologna principles.

- At some universities in Serbia, centers for e-learning have been established with partial equipment for video-conferencing. The common interest of these univesity institutions is educating specialist in e-learning area. The laboratory equipment should be improved to meet teaching needs for the new curricula, as well as, the retraining of the teaching staff.

- The coordinating group, "eLearning Task Force" was formed in Belgrade on the February 3rd 2005. The coordinating group, which was formed from representatives of three universities of Serbia, gave recommendations for the improvement of the application of ICT and establishing e-learning at all levels of education [3].

2. REVIEW OF CURRENT E-LEARNING CURRICULA

In order to establish basic principles of M.Sc. studies in e-learning: duration of study; needed prerequisites and prerequisite knowledge; introduction of credit system and basic election-course policy, a review is perfomed using several case studies on existing M.Sc. curricula concerning distance education [4].

The following M.Sc. programs are analyzed:

- **Master of Distance Education**, Athabasca University, Athabasca, Canada
- **Master of Education in e-Learning Technology and Design**, Jones international university, Spain
- **Master of distance education**, University of Maryland University Collage, Carl von Ossietzky University of Oldenburg, Germany
- **Master's in eLearning Design and Implementation**, University of Colorado Denver, USA
- **Master di I livello in Open Distance Learning**, Università degli Studi di Udine, Italy

The major analyzed aspects are program outcomes, credit system, the way of courses delivering, program structure, admission requirements, duration of studies, corses organization and career options.

Regarding to program outcomes, it can be noted that all curricula provide students with common knowledge and skills for designing educational and traning programs, implementation, evaluation and management of distance courses. Also, all programs include a number of courses on state-of-the–art technology for distance content delivering.

It can be noted that the election-course policy varies accross the programs concernig the percentage of core modules, electives (or specialization) and final theses. Some examples are:

- (58% core, 42% specialization courses), Jones University
- (42% core, 58% specialization courses), University of Maryland
- (55% core, 9% electives, 36% theses), Athabasca University
- (55% core, 45% electives), Athabasca
- (50% core 50% specialization courses), University of Colorado

The M.Sc. studies at the University in Udine lasts one year, and at the other analyzed universities studies last two years or until required credit number is collected.

Among five master programes, four of them deliver courses on distance and there is no face-to-face meetings with students. Only at Athabasca university, a blended delivery model of independent study with online interaction is applied. Also, at the University of Udine a practicum and final testing is done at the institution.

Program structure of all analized M.Sc. studies (except University in Udine) is divided on core (obligatory) courses and elective or specialization courses. Number of core courses are six or seven and only three core courses at University of Colorado. Number of elective courses at Athabasca University is one (for thesis route program) or five (for course-based route program) and it can be elected from list of eighteen elective courses. Specialization courses are offered at Jones international university, University of Maryland University Collage (two different specialization) and University of Colorado. M.Sc. studies program at University in Udine is organized trough six modules.

Regarding to admission requirements students applicants at the analyzed USA universities must have bachelor's degree at least. Also students can transfer credit (equivalent two or three courses) from their prior learning or non-academic experience that match learning objectives in a specific M.Sc. course. Admission requirements at University in Udine are different: the master program can enrol those candidates who have graduated from a three-year study programme, have a university degree, masters degree, or degree according to the old regulations (four or five-year education).

Additional requirements regarding to computer hardware and software that students have

access also given in frame of Program Prerequisites. For M.Sc. studies at University of Maryland University Collage and University of Colorado some skills,and abilities are required such as: critical thinking, judgment, reflective learning, ability to concisely distill key points within a specified word or page limit, knowing how to seek clarification, drafting materials in advance of deadlines, and reviewing and revising your assignment before submitting it. Students have to be online consistently and frequently due to their contribution to the online community via discussion, peer review, and product collaboration.

Some of career options for graduates at these M.Sc. studies: students which graduated in the field of the Distance Education Technology specialization, depending on their background, can find positions such as: tecnical director, technical expert/advisor, coordinator of online instruction, online course support specialist, online teacher/tutor/trainer in a management or supervisory, pedagogical expert (online learning), coordinator of online instruction, online librarian/resource manager, program evaluator/educational consultant, subject matter expert (SME) for DE, etc.

3. PROGRAM DESCRIPTION

Outcomes:

Students will be able to:

- design, implement, evaluate and manage educational and training online programs
- have a practical knowledge of a range of applications and environments for delivering online learning
- apply learning theory and research methods to improve learning
- develop technical skills, including web page design and using e-learning development tools
- develop strategic goals and business plans for distance education within an organization
- function effectively as leader, manager and team member within a distance education or training organization
- master graduates aiming for a research career can continue directly with their doctoral studies, which takes three years

STRUCTURE OF THE CURRICULUM:

- The value of master studies will be 60 ECTS credits
- The studies will be organized into two semesters.
- One academic year consists of two semesters and is lasting for 30 weeks (1 semester = 15 weeks).
- Coursework delivered via Moodle, with „on-campus“ meetings, practical work and final testing
- First semester: Core (obligatory) modules
- Second semester: Elective modules and Final theses
- Graduate degree: "Master in E-Learning”

COURSE STRUCTURE WITH LIST OF CORE AND ELECTIVE COURSES SHOWN ON THE FIGURE 1 IN DETAIL.

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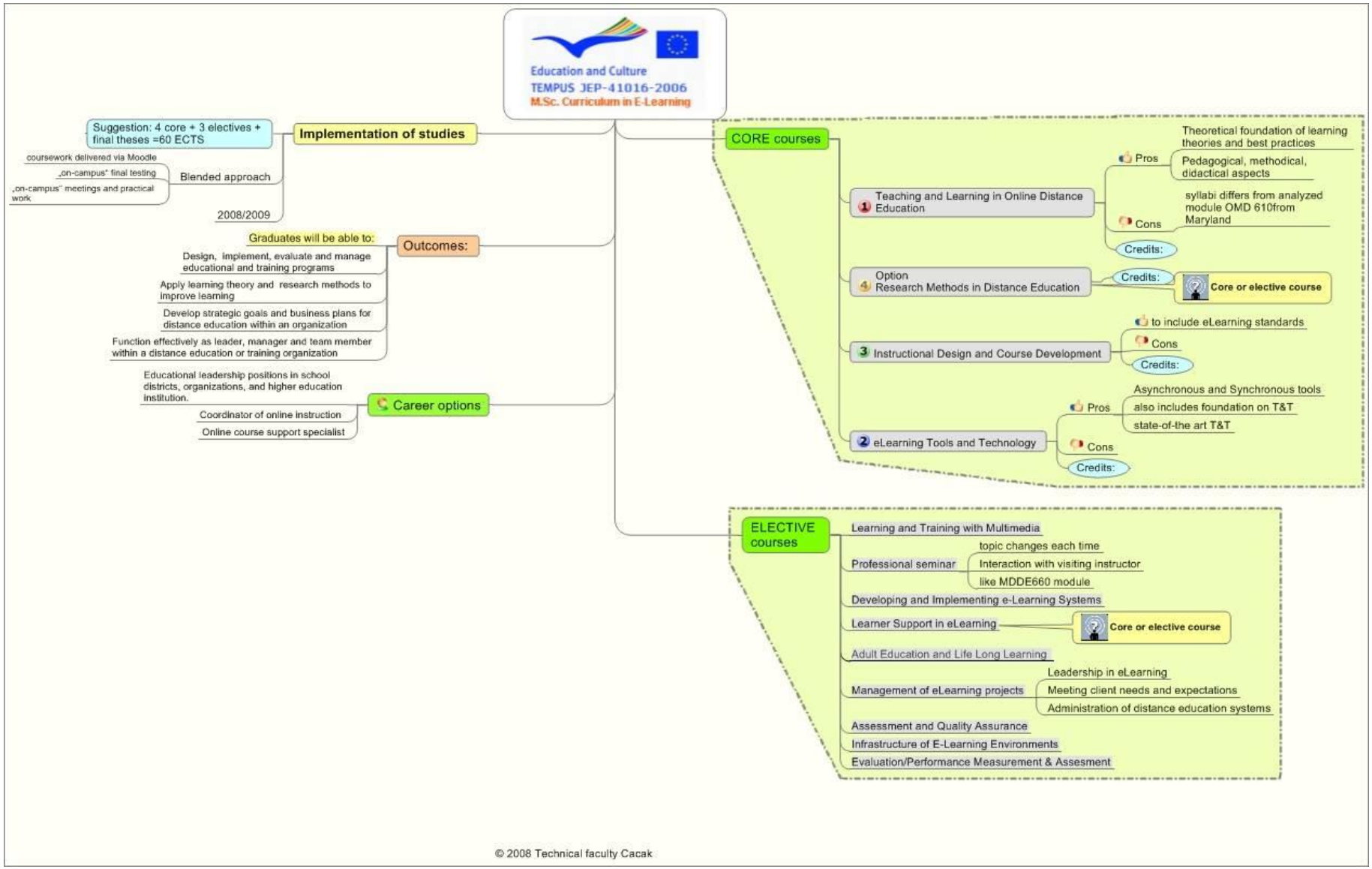

Figure 1. Structure of M. Sc. Curriculum in E-Learning

QUALITY ASSURANCE AND CONTROL OF DEVELOPMENT OF M.SC. CURICULUM

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1. INTRODUCTION

The main aim of the Bologna Declaration, signed originally by the Education Ministers of 29 European countries in June 1999, was to create a European Higher Education area, through achieving the following six objectives:

- Adoption of a system of easily readable and comparable degrees,
- Adoption of a system essentially based on two main cycles, undergraduate and graduate
- Establishment of a system of credits,
- Promotion of mobility for students and staff,
- Promotion of European co-operation in quality assurance,
- Promotion of European dimensions in Higher Education.

In the Berlin 2003 meeting the Ministers of the Bologna Process signatory states invited the European Network for Quality Assurance in Higher Education (ENQA) through its members to develop "an agreed set of standards, procedures and guidelines on quality assurance". ENQA prepared report for the meeting in Bergen (2005). In that report the standards were presented in three parts covering internal quality assurance of higher education institutions, external quality assurance of higher education, and quality assurance of external quality assurance agencies.

For implementation of the E-learning curriculum (which is the main goal of our Tempus project *M.Sc. Curriculum in E-Learning*) the main ENQA standards and guidelines for internal and external quality assurance are relevant and will be discussed in the next section. After that, some concepts for quality assurance in the M.Sc. Curriculum for e-Learning will be proposed.

2. MAIN EUROPEAN STANDARDS AND GUIDELINES FOR QUALITY ASSURANCE

The standards and guidelines for internal and external quality assurance, which follow, have been developed for the use of higher education institutions and quality assurance agencies working in the European Higher Education Area, covering key areas relating to quality and standards, [1].

As main standards and guidelines for internal quality assurance are pointed:

- **Policy and procedures for quality assurance**: Institutions should have a policy and associated procedures for the assurance of the quality and standards of their programs and awards. They should also commit themselves explicitly to the development of a culture which recognizes the importance of quality, and quality assurance, in their work. To achieve this, institutions should develop and implement a strategy for the continuous enhancement of quality. The strategy, policy and procedures should have a formal status and be publicly available. They should also include a role for students and other stakeholders.
- **Approval, monitoring and periodic review of programs and awards**: Institutions should have formal mechanisms for the approval, periodic review and monitoring of their programs and awards.
- **Assessment of students:** Students should be assessed using published criteria,

regulations and procedures which are applied consistently.

- **Quality assurance of teaching staff**: Institutions should have ways of satisfying themselves that staff involved with the teaching of students are qualified and competent to do so. They should be available to those undertaking external reviews, and commented upon in reports.
- **Learning resources and student support**: Institutions should ensure that the resources available for the support of student learning are adequate and appropriate for each program offered.
- **Information systems**: Institutions should ensure that they collect, analyze and use relevant information for the effective management of their programs of study and other activities.
- **Public information**: Institutions should regularly publish up to date, impartial and objective information, both quantitative and qualitative, about the programs and awards they are offering.

Following main European standards for the external quality assurance are proposed:

- **Use of internal quality assurance procedures:** External quality assurance procedures should take into account the effectiveness of the internal quality assurance processes.
- **Development of external quality assurance processes:** The aims and objectives of quality assurance processes should be determined before the processes themselves are developed, by all those responsible (including higher education institutions) and should be published with a description of the procedures to be used.
- **Criteria for decisions:** Any formal decisions made as a result of an external quality assurance activity should be based on explicit published criteria that are applied consistently.
- **Processes fit for purpose:** All external quality assurance processes should be designed specifically to ensure their fitness to achieve the aims and objectives set for them.
- **Reporting:** Reports should be published and should be written in a style, which is clear and readily accessible to its intended readership. A decisions, commendations or recommendations contained in reports should be easy for a reader to find.
- **Follow-up procedures:** Quality assurance processes which contain recommendations for action or which require a subsequent action plan, should have a predetermined follow-up procedure which is implemented consistently.
- **Periodic reviews:** External quality assurance of institutions and/or programs should be undertaken on a cyclical basis. The length of the cycle and the review procedures to be used should be clearly defined and published in advance.
- **System-wide analyses:** Quality assurance agencies should produce from time to time summary reports describing and analysing the general findings of their reviews, evaluations, assessments etc.

3. QUALITY ASSURANCE TROUGH DEVELOPMENT OF THE CURICULUM

According to principles and standards accepted by European countries quality assurance and control are extremely important for the success of any educational and training curriculum [2,3]. To this it is necessary to establish a series of protocols that ensure the attainment of the highest level of quality to *E-learning Curriculum* which will be developed. According to the ENQA proposal, it is important to address the following basic components: *Curriculum description*, *Curriculum validation, Course development, Course assessment, Selection of students, Quality assurance of teaching staff, Quality of the equipment and learning resources and Learning Management System and Web publishing.*

Curriculum description: After decision about goals and content the curriculum should be defined and well documented. The documentation will consist of:

- *Curriculum handbook* : description of the whole curriculum and all resources issues,

- *Detailed course templates handbook:* specification of all courses in the curriculum,
- *Staff handbook:* description of teaching staff (CVs, competences, etc.),
- *Student handbook:* content of all informations relevant for the students, organization of the teaching process, Academic calendar, Study guide, etc.

Curriculum validation: Validation is the process by which the partner academic institutions will establish that a new curriculum is academically viable, that academic standards have been appropriately defined and that the students have the best opportunity to learn.

A validation event will be organized as a **validation panel** of academic peers scrutinizes the proposed curriculum. A panel must have external members (from academic institutions and business oriented).

Courses Development: Every fully developed course will be described by the **study pack** that contains the following:

- **detailed course description** according to the uniform template with following parts:
  - General information about course implementation,
  - Objectives of the course,
  - Core contents of the course,
  - Requirements for completing the course,
  - Information about stady materials,
  - Evaluation criteria for the course,
  - Estimate as a percentage of the implementation of the course (Contact teaching, Distance teaching and independent work in percentages),
  - Prerequisites,
  - Important links
- supporting literature for lecturers;
- presentation material preferably slides in PPT format;
- lecture notes, separate or attached to slides, explaining the way in which slide contents can be delivered to students;
- Material for theoretical exercises (assignments, rules, solutions…);
- Material for practical exercises (assignments, rules, solutions, tools…);
- Description of the student projects;
- Supporting literature for students (the reference list and/or actual reading material).
- Supporting equipment necessary for implementation of the course.

For each course, the project consortium will establish an **editor** (expert in particular field), who will be reviewer of the prepared study pack.

Study pack and any changes in the course must be approved by the editors.

Courses go through revisions on an annual basis.

Courses have **course feedback form** where students are asked to fill at the end of each delivery. These are collected, analysed and reported to the editor.

Every course must be evaluated by the teaching team at the end of each delivery.

The evaluation should take into consideration achievement rates, student views, external examiners comments and the observation of the teaching team. Course evaluation should lead to action for enhancement where problems are identified.

Course Assessment: Course requirements may vary depending on the course. Some courses are lecture-based and there is an examination at the end of the course. In addition to the lectures and an exam, the course requirements may also include problem-solving exercises, laboratory work and individual or group projects.

Selection of students: Being an advanced master in e-learning, the recommended target intake group is as follows:

- Current practitioners with adequate relevant experience; new graduates of computer science, informatics and other technical fields;
- Students wishing to embark on a research curriculum, at a PhD level, in e-learning. There are no restrictions regarding the average grade mark in previous education

unless stated otherwise in national laws or university regulations.

- As the general guidelines for those who wish to attend the e-learning curriculum, we provide the following competencies that are expected from every student.
  - fundamental knowledge in basic fields of mathematics and informatics; ability of logical thinking, ability to understand and formulate problems;
  - practical skills in using of programming environments, database management systems, and computer-aided tools;
  - understanding of current trends in the development of informatics;
  - ability to adapt to new circumstances, i.e., ability to learn new models, techniques and technologies as they emerge and appreciate the necessity of such continuing professional development;
  - appreciation of basic ethical and social responsibilities of information technology.

Quality assurance of teaching staff: Teachers are the single most important learning resource available to most students. It is important that those who teach have a full knowledge and understanding of the subject they are teaching, have the necessary skills and experience to transmit their knowledge and understanding effectively to students in a range of teaching contexts, and can access feedback on their own performance. Trough teachers training and visits of partner institutions with experience in organization of e-learning curricula, teaching staff will give opportunities to develop and extend their teaching capacity and should be encouraged to value their skills

Quality of the equipment and learning resources: All partner institutions should ensure that the resources available for the support of student learning are adequate and appropriate for offered M.Sc. program. Learning resources and other support mechanisms should be readily accessible to students and designed with their needs. Students should be asked about provided services and this feedback will be used by institutions to review and improve the effectiveness of the support services available to the students.

Learning Management System and Web publishing: The higher education institutions, providers of the E-learning curiculum, will provide on-line information trough Web sites, about the curriculum they are offering, the intended learning outcomes of the program, the teaching, learning and assessment procedures used, and the learning opportunities available to the students. This information will be accurate, impartial, objective and readily accessible and will not be used simply as a marketing opportunity. The teaching process will be supported by Learning Management System.

4. CONCLUSION

Quality assurance is not a static but a dynamic process. It should be continuous and not “once in a lifetime”. It does not end with the completion of the formal follow-up procedures or with the first review. It has to be permanently monitored and periodically renewed and all participant in this process must be permanently involved and active.

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THE REVIEW AND INTRODUCTION OF ECTS SYSTEM

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1. INTRODUCTION

During the last decades, European sector has been included in the much broader European reforms. Since the late 1990s three key documnents has influenced the changes. The Sorbonne and Bologna Declarations (1998, 1999), whose objectives are to make study programmes more compatible across European systems and the Lisbon Strategy (2000), which seeks to reform the continent's still fragmented systems into a more powerful and more integrated, knowledge based economy. The Sorbonne Declaration of 1998 was the first signalled major European countries' (France, Germany, Italy and the UK) preference for a more compatible and comparable set of European higher education systems. In Bologna one year later, 25 other European countries joined the original four. By 2005 the total number of countries reached 45.

The Bologna Process aimed to establish a European "higher education area" by 2010, and while undersigning countries originally interpreted the Declaration in their own ways, the process rapidly achieved a degree of unregulated homogeneity. Focusing at first on reforming degree programmes into the two cycle 'Bachelor-Master' structure, soon concerns were re-focused to quality assurance and accreditation and degree recognition. Bologna's perspective broadened in Berlin with the inclusion of the third phase (PhD) and did so again in Bergen (2005) through the explicit mentioning of "the importance of higher education in further enhancing research and the importance of research in underpinning higher education for the economic and cultural development of our societies and for social cohesion" [???].

2. THE EUROPEAN CREDIT TRANSFER SYSTEM

The European Credit Transfer System (ECTS), today is the most commonly used basis for measuring student workload in European higher education. ECTS credits describe only student workload in terms of time employed to complete a course or a course unit. This represents an approach to European learning and teaching which places the student at the centre of the educational process.

ECTS was originally tested and perfected as a transfer system to make it possible for Universities in different European countries to describe the amount of academic work necessary to complete each of their course units and hence to facilitate recognition of students' work performed abroad. Therefore, at the beginning the assumption was made that a complete year's work in any European higher education institution for the students was equivalent to 60 ECTS credits. Credits were allocated to each assessed activity on the basis of a judgement as to the proportion it represented of the complete year's workload.

The basis for allocation of credits is the official length of the study programme. For example the total workload necessary to obtain a first cycle degree lasting officially three or four years is expressed as 180 or 240 credits. The single course units which must be taken to obtain the degree each can be described in terms of workload and hence of credits. Credits are only obtained when the course unit or other activity has been successfully completed and assessed. Credits measure only workload and the elements like quality of performance, contents or level are described in other ways.

As more and more countries adopt systems compatible with the Bologna declaration/Prague communiqué there has been a convergence and consensus around ECTS credits as a common measure of student time. In practice 1 ECTS credit is equal to roughly 25-

30 hours of student work (that is, including contact hours, independent or guided study, etc.)

3. CURRICULUM DESIGNING ACCORDING TO ECTS SYSTEM

ECTS credits today are increasingly used as a tool for **designing curricula**. Because they express student workload measured in time, they allow higher education institutions to plan the most effective way to achieve desired results within the time constraints of the length of their degree programmes. ECTS credits also provide a useful means for monitoring results and improving teaching/learning performance.

Since the *Sorbonne Declaration* (1998) and the *Bologna Declaration* (1999) also a debate has been initiated about the structure in cycles of the higher education sequence and about the desired length of the study programmes. A consensus appears to have developed in Europe about the following general structure: first cycle or undergraduate: 180-240 credits; second cycle or (post)graduate: 60-120; third cycle or doctoral (180 to 240 credits).

In the quantitative framework assured by the use of credits, it would seem beneficial to develop course programmes on the basis of desired learning outcomes. Learning outcomes can be defined as statements of what a learner is expected to know, understand and/or be able to demonstrate after completion of a learning programme. Experience with this approach has been built up by the *Quality Assurance Agency (QAA)* in the United Kingdom. By designing programmes in this way, more transparency and coherence can be achieved. This approach makes it possible to develop *cumulative* programmes, with specific *entrance requirements* for each of the cycles, the study years and levels as well as the course units. The learning outcomes foreseen for the first cycle and the second cycle must be clearly distinguished.

Although the final outcomes and the competences to be acquired should be discipline/programme related, more general objectives can be formulated also. In practice two types of learning outcomes can be distinguished: general competences (transferable skills) and subject specific competences (theoretical, practical and/or experimental knowledge and subject related skills). Both should have a recognisable place in the course programme and should be verifiable at the end.

Generic and subject-specific competences include capacity for analysis and synthesis, general knowledge, capacity for independent learning, co-operation and communication, tenacity, capacity for leadership, organisational and planning abilities. The subject related skills are the relevant methods and techniques pertaining to the various discipline areas, e.g. analysis of ancient scripts, chemical analyses, sampling techniques and so forth, according to the subject area. The same learning objectives and competences can be reached by using different types of teaching and learning methods, techniques and formats. At first glance, it seems reasonable that the more general learning outcomes should be pursued in the first cycle. [2]

The completion of the first cycle functions as entry requirement for the second cycle. The second cycle usually is the phase of specialisation, although this is one of the possible models. The student who graduates must be able to execute independent (applied) research. It seems that, with regard to the learning outcomes of the second cycle the student should have a good command of a specialised field within the discipline at an advanced level. This means in practice being acquainted with the newest theories, interpretations, methods and techniques; be able to follow critically and interpret the newest development in theory and practice; have sufficient competence in the techniques of independent research and to be able to interpret the results at an advanced level; be able to make an original, albeit limited, contribution within the canons of the discipline, e.g. final thesis; show originality and creativity with regard to the handling of the discipline; have developed competence at a professional level. Not all the mentioned learning outcomes or level indicators are of the same relevance for each discipline.

Modular and non-modular systems. For some the introduction of a credit system automatically implies the introduction of a modular system, that is, course units or modules, to which are allocated a limited/reasonable number of credits in more or less standard multiples. The

modular system has obvious advantages, because in some countries it might prevent too much fragmentation and therefore avoids too many examinations. It also makes the transfer of credits easier. The negative aspect of a modular system is that it decreases the teaching freedom, when the amount of contact hours within the module is limited, but the positive aspect is that it increases the flexibility insofar as it becomes possible to build different curricula having points of contact between them. While in a non-modular system (i.e. when a large amount of credits is given to a course unit taught by a single teacher) the choice of the material is given priority, in a modular system it is the structure of the over-all curriculum which will constitute the primary consideration.

In any kind of system, modular or non-modular, the question of the allocation of credits can be approached from two sides: from the bottom and the top. In a bottom-up approach the course unit or building brick is the central point of attention. In that situation the position of the specific course unit within the overall curriculum is not clear. The risk involved in this approach is that teachers overestimate (or underestimate) the role of the course units they teach. This is reflected in the amount of work that a student is asked to do for a course. For students this might mean that they will not be able to use their time in the most profitable way because their total workload is too heavy (or too light).

Distribution of credits. When we talk about desired learning outcomes or competences, we refer to factual knowledge, analytical skills, practical skills, etc. Special attention should be put in avoiding the inclusion of inappropriate learning outcomes (e.g. too much detailed coverage of a given topic). After the desired learning outcomes have been formulated, the next step is to decide how much time is required to reach each of these learning outcomes.

The total number of credits needed to complete a degree or a single academic year can be divided in various ways, to facilitate the definition of courses of study and of the degree of flexibility allowed. For example, the necessary credits needed to complete a degree could be divided into different categories: e.g. those pertaining to mandatory core courses, auxiliary courses or complementary course units or the like. Such a distribution into categories of course will vary quite a bit from institution to institution. Indeed institutions differ greatly as to the available teaching resources and as to the preparation of their students at entrance, and hence will need to distribute credits in an appropriate way to *optimise the use of resources* and the efficacy of the teaching learning activities.

4. CREDITS AND LEVEL

While there is no suggestion within ECTS that credits measure level, it is apparent that, when credits are used within an accumulation system, the rules relating to the award of a qualification generally specify not only the number of credits required for the specific qualification but also a set of sub-rules in relation to the level at which those credits must be obtained as well as the type of courses. Currently, such issues are resolved on an ad hoc basis.

A possible path forward could be to introduce extra descriptors, which go along with ECTS as an accumulation and transfer system. A pre-condition for such a European wide system is that it should be transparent and easy to understand and to implement. The consequence is that credits will be distributed over levels and type of courses. Levels we can distinguish the following ones: basic level course (meant to give an introduction in a subject); intermediate level course (intended to deepen basic knowledge); advanced level course (intended to further strengthening of expertise); specialised level course (meant to build up knowledge and experience in a special field or discipline).

With regard to the type of courses the following ones can be distinguished: core course (part of the core of a major programme of studies); related course (supporting course for the core); minor course (optional course or subsidiary course) [???].

The levels and types of courses offer us additional crucial descriptors. To make clear and immediately evident what learning experience the credits represent one can imagine that a *simple code system* could be introduced. This system would include not only the amount of

work done by the student in terms of credits, but also descriptors which give an indication of the level and the type of course unit. To give an example: The code 5-I-R might tell us that the unit has a load of 5 credits, is offered on an intermediate level and is related to the core.

5. CALCULATION OF CREDITS IN TERMS OF WORKLOAD

The actual calculation of credits in terms of workload has proven to be a difficult issue. First of all it should be clear what is meant by credits. The following definitions seem to be workable: Credit is a measure of student workload based on the time necessary to complete a given teaching/learning unit. In ECTS terms, 60 ECTS credits measures the workload of a typical student during one academic year. The number of hours of student work required to achieve a given set of learning outcomes depends on student ability, teaching and learning methods, teaching and learning resources, curriculum design. These can differ between universities in a given country and between countries. Since credits are only a measure of workload within a curriculum, credits can only be used as a planning or monitoring tool when the curriculum itself has been defined.

It is often argued that the *typical* student does not exist. How to determine the average standard of brightness? There is a consensus though, that it takes time and a certain standard of preparation/background to acquire certain knowledge and skills. Therefore, time employed and personal background are the two elements that can be identified as variables in learning achievement with respect to a particular course or study programme. In this context, pre-requisite knowledge when entering a given recognised qualification is a basic element. Its actual level/amount may measurably influence the workload of the student during the course programme. Teaching staff normally has a rough idea of what it can ask a student to do in a certain amount of time in a certain programme. Furthermore, teaching staff has a clear notion about quality standards. However, it is commonly accepted that if a *typical* student puts in more effort into preparing an examination the grade will probably be somewhat higher. Similarly, if a good student spends the expected amount of time to prepare an examination, he or she will be rewarded with a good grade. If less time is spent, the grade will probably be lower. In other words, there is a relationship between the effort and the results of a student. Accepting the fact that the actual time that any particular student needs to spend to achieve the learning outcomes will vary according the capacities of the individual student and be influenced by the degree of prior learning and to the mode of learning, the so-called *notional learning time* can be defined. The notional learning time is the number of hours which it is expected a student will need, on average, to achieve the specified learning outcomes at that level.

In practice different approaches are used to calculate the student workload. Although there are differences due to the subject, common denominators can be identified also. In the calculation of workload the following items play a role: the total number of contact hours for the course unit (number of hours per week x number of weeks); preparation before and finalising of notes after the attendance of the lecture / seminar; the amount of further independent work required to finish the course successfully.

The last item is the most difficult one to calculate and depends largely on the discipline concerned and the complexity of the topic. Independent work can contain the following items: the collection and selection of relevant material; teading and study of that material; preparation of an oral or written examination; writing of a paper or dissertation; independent work in a lab.

The calculation of workload in terms of credits is not an automatic process. The professor has to decide on the level of complexity of the material to be studied per course unit. It goes without saying that prior experience of the staff plays an essential role. One of the main contributions of the process of credit allocation is that it leads to more reflection on curriculum design and teaching methods on the part of the teaching staff.

6. THE FRAMEWORK OF QUALIFICATIONS FOR THE EUROPEAN HIGHER EDUCATION AREA

The Bergen Conference of European Ministers Responsible for Higher Education 19-20 May 2005 adopted the overarching framework for qualifications in the EHEA, comprising three cycles, generic descriptors for each cycle based on learning outcomes and competences, and credit ranges in the first and second cycles. Ministers committed themselves to elaborating national frameworks for qualifications compatible with the overarching framework for qualifications in the EHEA by 2010, and to having started work on this by 2007.

Qualifications that signify completion of **the first and the third cycle** can be found in [???]. Qualifications that signify completion of **the second cycle** are awarded to students who:

- have demonstrated knowledge and understanding that is founded upon and extends and/or enhances that typically associated with the first cycle, and that provides a basis or opportunity for originality in developing and/or applying ideas, often within a research context;
- can apply their knowledge and understanding, and problem solving abilities in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study;
- have the ability to integrate knowledge and handle complexity, and formulate judgments with incomplete or limited information, but that include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgments;
- can communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and nonspecialist audiences clearly and unambiguously;
- have the learning skills to allow them to continue to study in a manner that may be largely self-directed or autonomous.

7. ECTS AS TOOL FOR QUALITY ASSURANCE OF CURRICULUM REFORM

The quality of higher education has emerged as a key element in the establishment of the European Higher Education Area and as a driver of national progress and competitiveness. Thus quality assurance is one of the main action items of the Bologna Process. In the Berlin and Bergen Communiqués the European Ministers of Higher Education stressed that the primary responsibility for quality assurance in higher education lies with each institution itself and this provides the basis for real accountability of the academic system within the national quality framework.

The EUA proposes a coherent QA policy for Europe based on the belief that institutional autonomy creates and requires responsibility, and that universities are responsible for developing internal quality cultures. With the active contribution of students universities must monitor and evaluate, in a systematic fashion, all their activities, including study programmes, research productivity, innovativeness, competitiveness, management, funding systems and services.

For the EUA, as for the Ministers of Education, the key elements in a QA process are: self-assessment by the unit being evaluated, review and site visit by peers including external peers, publication of the peer review report, effective follow-up on recommendations for improvement, minimal bureaucracy, quality improvement, and involvement of students and other stakeholders.

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PEDAGOGICAL AND DIDACTICAL ISSUES OF TRANSFORMATION THE TRADITIONAL LEARNING CONTENT INTO THE ELECTRONIC CONTENT - COHA MODEL

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1. INTRODUCTION

Few years ago, only traditional learning materials such as books and workbooks were used in schools, but later the development of the television started, which offered new, more attractive dimensions for education with sound and live video shown on TV display (including multimedia content). Educational shows have been available either synchronized via television or on video tapes. With the development of Internet, the transfer from broadcasting systems, where exact transmission date and time needed to be known, onto WEB (e.g. hypermedia systems) systems on demand, which allows transmission at any time according to student's needs, begun.

The fundamental objective of e-learning is to provide effective and efficient learning on demand and to assure a student a good learning experience. However, teachers need to be able to evaluate educational software so that they can make decisions about what software to purchase and how to use software in classrooms (Squires et al., 1999). Furthermore, teachers and other authors need to be able to create effective and efficient e-contents (e.g. e-learning materials). Inadequate to the importance of the issue, there are relatively few studies addressing evaluation and efficiency of eLearning contents (Lanzilotti et al., 2006, Quinn et al., 1999, Squires et al., 1999, Parlangeli et al., 1999).

Therefore the important question is how to prepare didactically efficient and appropriate e-learning materials that motivate students and satisfy their needs.

In this paper, we propose a new framework for quality assessment of e-learning content, called **C**OHA model (Course, Content, Unit, Communication, Interactivity, Hypermedia, Adaptivity, Accessibility), which focuses on the most important pedagogical and didactical aspects to be considered in e-learning content design and implementation. COHA provides an option to explicitly define the content of e-learning material with minimal user activity.

2. COHA MODEL FOR ELEARNING MATERIAL DEVELOPMENT

The experiences have shown that the developers require system model, which would enable fast and easy overview of all required activities in eLearning system. It is very important for the e-material to be created and evaluated on well defined criteria and methods that are specific to eLearning (Lanzilloti, 2006).

Our innovative model, shown on figure 1, presents definition of eLearning system, consisting of didactical and methodological e-course aspects, including e-content and e-unit as smallest unit in the system. Following the system in this didactical dimension are hypermedia, interactivity, communications, adaptivity and accessibility. The model, created in this way, offers aspect for the development of satisfactory eLearning material to the students and teachers.

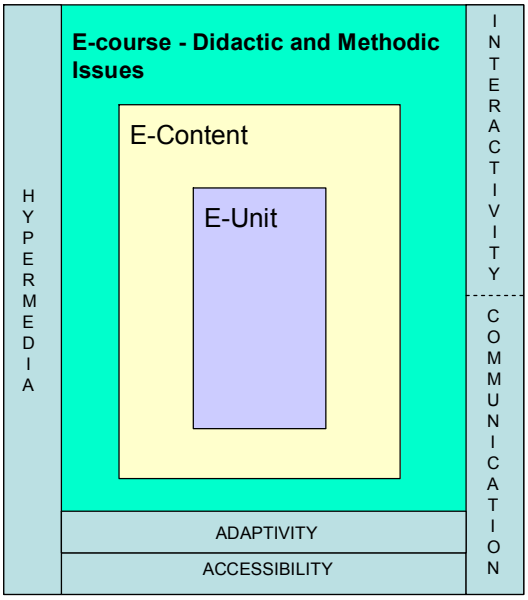

Figure 1: COHA model of eLearning system

3.1. E-course – didactic and methodic issues

The term course is used to describe the collection of elements that make up training on a given subject. E-courses are provided via various media, like internet, interactive TV or mobile media. The e-contents are the main knowledge containers of the e-course. E-course can be self-directed or led (e.g. e-course is led by the teacher, instructor or other facilitator).

Self-directed e-course is a sequence of learning contents that students should follow to achieve the desired knowledge of the subject. However, facilitated e-course is more than that. As e-content is the essential part of each e-course, we will discuss only didactical and methodical issues of e-content development and avoid various methodologies of e-course design. Didactical and methodological aspects of e-course define the effectiveness of learning.

3.2 E-Content

E-content is forwarding the basic knowledge on the subject to the student. While developing the content, didactical and methodological aspects, such as previous knowledge, scaffolding, activity support and support of self regulative processes need to be considered. Moreover, the technical capabilities and the limitations of eLearning system must be considered. E-content material is divided in three main areas: introduction, core and conclusion. E-content consists of e-units (e.g. learning pages). Recommended learning path within the e-content is determined with the sequence of learning pages. In any case the learning path must not restrict the student, in the contrary it must be structured so that different paths can be chosen.

3.3 E-Unit

E-unit represents the smallest part of the e-content and presents basic learning environment, where student is present at some point of time, while working within eLearning system. These can be descriptions, instructions or experimental environments.

3.4 Hypermedia

The term hypermedia describes interactive multimedia. Hypermedia system is upon the definition a computer-based information retrieval system that enables a user to gain or provide access to texts, audio and video recordings, photographs, and computer graphics related to a particular subject. As such, it represents a system that constructs the frame of e-course and follows it in whole, as seen also on figure 1.

3.5 Interactivity

In e-course interactivity presents the dialog that occurs between a student and an e-learning system. Interactivity occurs when a change of system's state happens based on changes within the status of another system. In an eLearning system, students do not only interact with the e-learning system, but also with the pages inside of the e-unit that the system brings to you. The implicit invitations that link students to other pages or media elements provide the most common form of interactivity when using the e-learning system.

3.6 Communication

Communication within the e-course concept is referring to the exchange of ideas by verbal, written or other way of signal interchange, which not necessary lead to the change of other state as it is in interaction. In facilitated e-courses the communication between students and the mentor (e.g. tutor, teacher, and instructor) should also be enabled.

3.7 Adaptivity

Adaptivity is the capability of the system to independently offer adaptivity of working environment to the user, by following user procedures and actions and automatic or on demand offering adaption or optimal path option. The ideal adaptable education system would offer an automatic and individual adaption of not only the content but also user interface of the system.

3.8 Accessibility

The e-content is said to be accessible, if it is accessible and can be used by everybody, including people with special needs. The developers of e-content must keep in mind that the users of the material might be people with special needs and develop the content according to their needs. Therefore it is necessary that additional development guidelines are used, such as Web Content Accessibility Guidelines (WCAG) (Kelly et al, 2005).

4. E-COURSE PLANNING, DESIGN AND DEVELOPMENT

Pedagogical and methodical planning is an important step in the process of the e-course and e-content development. The planning will ensure that the author remains focused not only on the learning objectives, but also on scaffolding learning. Planning also contributes to minimizing potential problems.

4.1. E-Course and e-Content methodical planning

The process of e-course methodical planning includes four main steps: definition of educational design (instructional, project, open, practical or workshop design), designing the student's and the teacher's activities, type of interact ional definition, which supports activities (e.g. student-teacher interaction, student-student interaction) and defining technologies, used for supporting activities (e.g. e-mail, chat, forum, collaborative tools, interactive web sites).

4.2. E-Course and e-Content pedagogical planning

Experiences at the design and development of eLearning courses has showed that *teachers and trainers are the only people who have the skills* to choose the educational models best adapted to specific forms of knowledge, identify particular training situations, and select the most appropriate forms of evaluation and maintain relationships with (and among) students (Brugia et al, 1991).

Therefore, teachers and trainers should pay attention to the following activities: preparing eLearning materials, providing learning support and motivation, developing self-regulated learning, stimulating group work, promoting the transfer of learning to the concrete working situations and evaluating the learning process. The eLearning material (e.g. e-content) should not be a book translated into a web page format. However, it should contain at least following three elements: presentation, interactivity and communication and collaboration.

4.3. Communication issues

Communication and learning activity of the participant is important during execution of eLearning course. Passive participation should be avoided – passive following and reading from the display with no interaction from users' site is not motivating. eLearning material must consist of interactive and communication elements, which support learning activities of education participants. Participants can use synchronous and asynchronous communication tools, audio and video sequences (at most 2 or 3 minutes), animations, pop-up pages, links and simulation applets, which are supporting participant's activity. As additional features, use of virtual and remote laboratories is increasing and these encourage the use of remote laboratory exercises regardless of the laboratory location.

4.3.1. Types of assessment in eLearning course as a communication issue

Students need prompt feedback from the teacher. The technology enables automatic or partially automatic feedback. The knowledge evaluation should be formative and summative. For knowledge assessment we use various techniques such as online tests, online tasks, individual or group projects, discussions.

5. CONCLUSION

Teachers with experiences in e-learning content design are well aware of hardness of design of different interactive content, functionality and services and know that finding sufficient balance of content to be used in as simpler and clearer form is sometimes almost impossible. The COHA model presented in this paper explicitly stresses the meaning and role of pedagogical and didactical issues while planning and implementing quality e-courses and e-contents. By well informing of teachers on the demands and chances for the learning content, the development of high quality products, ensuring successful eLearning, would be much easier.

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DIZAJN HIPERMEDIJSKE UČIONICE ZA POTREBE eOBRAZOVANJA

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1. UVOD

Razvoj informacijskog društva i promjene u svim aspektima ljudskog rada nameću potrebu za prilagođenjem i poboljšanjem postojećeg sistema visokog obrazovanja. Informacijske i komunikacijske tehnologije (ICT) nude nove mogućnosti poboljšanja kvalitete na svim nivoima obrazovanja. Primjena novih tehnologija u obrazovnom procesu, kao što su videokonferencija, prijenos predavanja putem Interneta uživo ili na zahtjev, upotreba multimedije i hipermedije, podižu dramatično kvalitetu nastavnog procesa, i konkurentnost obrazovne institucije na tržištu obrazovanja.

U posljednjih 10-tak godina videokonferencijska tehnologija je prešla put od tehnologije budućnosti do tehnologije koja je danas opće prihvaćen način isporuke obrazovanja na daljinu [1]. Danas su videokonferencijski sistemi široko dostupni zbog poboljšanja kvalitete prijenosa (napredniji algoritmi kompresije, povećanje prijenosnog opsega), te prihvatljivije cijene videokonferencijskih uređaja [2]. Upotreba videokonferencije u obrazovnom procesu omogućava uštedu na troškovima putovanja i uopšte eliminira potrebu za putovanjima profesora koji sada nastavu održavaju na daljinu. Cijeli proces obično započinje sa osnovnom instalacijom videokonferencijske opreme, ali to je samo početak dužeg procesa koji uključuje organizacijske, tehničke i socijalne aspekte [3].

Hipermedija, koja je nastala spajanjem hipertekst tehnike i multimedijskih sadržaja, unaprijedila je raznovrsnost obrazovnog okruženja. Hipermedija/hipervideo je danas jedan od najnaprednijih pristupa u upotrebi videa za potrebe daljinskog obrazovanja putem Interneta. Hipervideo [4] se može opisati kao interaktivni video, gdje se interaktivni elementi nalaze unutar *streaming* video zapisa i predstavljaju hiperlinkove do drugog sadržaja, slično kako tekst i slike predstavljaju hiperlinkove na web stranicama. Video podatkovni tok na zahtjev je opremljen sa područjima (*hot-spots*) koji predstavljaju hiperlinkove prema drugom sadržaju [5].

Streaming tehnologija (tehnologija protočnog videa) uključuje kreiranje, isporuku i pregledanje multimedijskih sadržaja putem mreže bez potrebe za čekanjem da se učita kompletan multimedijski zapis. Audio i video sadržaj se često kombinira sa sinhroniziranim prezentacijskim podacima u obliku slajdova ili Flash animacije. Korištenjem *streaming* tehnologije moguće je vršiti isporuku predavanja putem Interneta u realnom vremenu ili na zahtjev, pri čemu udaljeni korisnici trebaju imati samo pristup Internetu na svom kompjuteru, i odgovarajući preglednik sadržaja.

Hipermedijska učionica integrira videokonferencijsku opremu, interaktivnu *streaming* video tehnologiju i virtualno hipermedijsko okruženje, formirajući na taj način novo obrazovno okruženje [6]. Razvoj ovakve učionice, osim odgovarajućeg namještaja i cjelokupnog uređenja, zahtijeva nabavku velikog broja strojne i programske opreme. Glavna prednost ove učionice je da nastavniku stoje na raspolaganju skoro sve raspoložive tehnologije potrebne za realiziranje predavanja na daljinu i daljinske komunikacije sa studentima. Osim toga, moguće je raditi prijenos predavanja putem Interneta u realnom vremenu ili na zahtjev, stoga hipermedijska učionica treba biti opremljena brzom Internet konekcijom. Video uživo omogućava studentima da direktno prate šta se dešava na udaljenoj lokaciji, npr. udaljenom laboratoriju, koja može biti

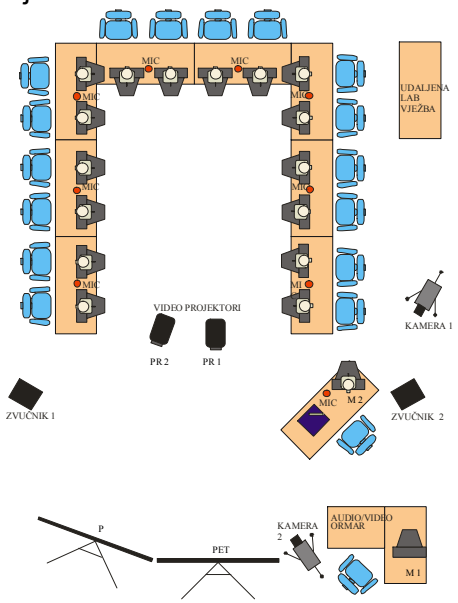
bilo gdje na Internetu, i simultano razgovaraju sa asistentom u laboratoriju korištenjem videokonferencije. Realizacija hipermedijske učionice bi trebala ispuniti očekivanja obje strane, nastavnika, i posebno studenata.

U okviru ovog rada načinjen je prijedlog dizajna hipermedijske učionice na Tehničkom fakultetu u Čačku, za potrebe daljinskog obrazovanja.

2. DIZAJN HIPERMEDIJSKE UČIONICE NA TEHNIČKOM FAKULTETU U ČAČKU

Danas su veoma popularna obrazovna okruženja koja se oslanjaju na videokonferencijsku komponentu hipermedijske učionice, te se često nailazi na nazive kao što su *Conference room, Multimedia Room, HypermediaRoom, Smart Classroom, Learning Center of the Future* [7,8,9]. Ove visoko tehnološki opremljene prostorije se najčešće koriste na univerzitetima, za potrebe kontinuiranog i obrazovanja na daljinu, kao i u kompanijama za potrebe održavanja sastanaka i iznajmljivanja klijentima.

Na slici 1. je predstavljen primjer hipermedijske laboratorije na Univerzitetu u Mariboru, koja predstavlja integraciju videokonferencijske sobe i interaktivne video tehnologije, tvoreći na taj način novo obrazovno okruženje.



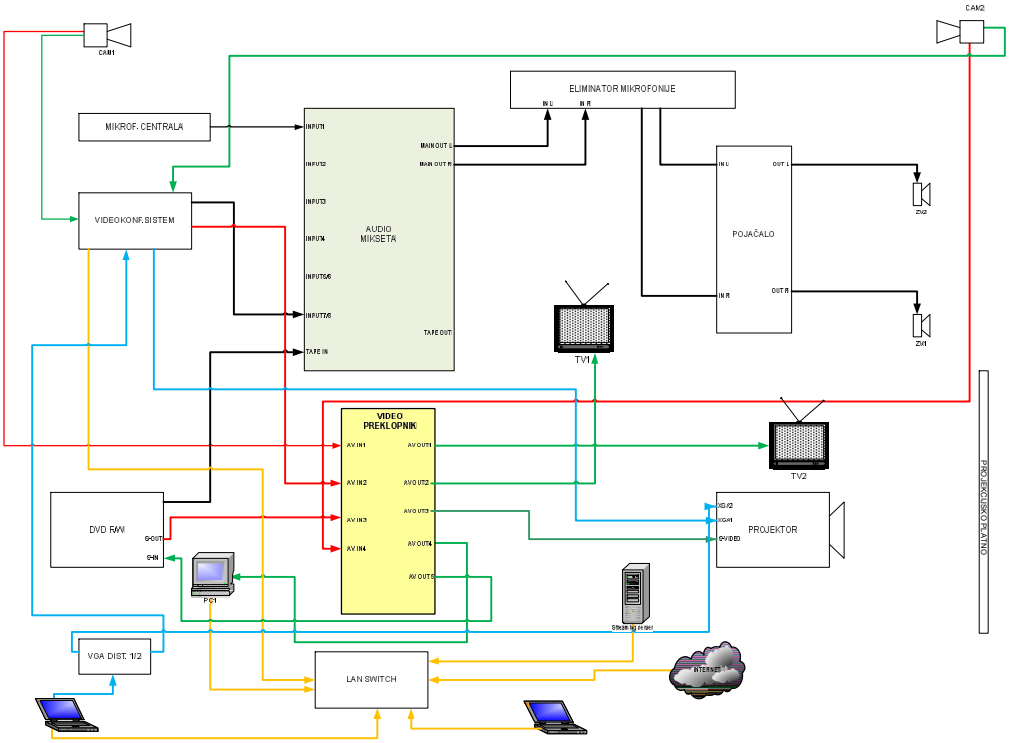
Slika 1. Hipermedijska laboratorija Hipulab, Univerzitet u Mariboru

Slika 2. prikazuje multimedijalnu salu Univerzitetskog centra za razvoj daljinskog obrazovanja - UCDED na Univerzitetu u Tuzli, u kojoj je integrirana audio, video, prezentacijska, videokonferencijska, mrežna i oprema za simultani prijevod u jedinstveni, lako upravljivi sistem.

Slika 2. Multimedijalna sala na Univerzitetu u Tuzli

Na osnovu navedenih iskustava, u okviru ovog rada je načinjen dizajn hipermedijske učionice za potrebe daljinskog obrazovanja na Tehničkom fakultetu u Čačku.

Realizacija ove hipermedijske učionice zahtijeva integraciju šest modula u jedinstven sistem, slika 3: videokonferencijski (VC uređaj), *streaming* (*streaming* kompjuter, *streaming* server), audio (mikrofonski sistem, zvučnici, tonski pult), video (video kamere, S video/audio matrica, VGA preklopnik, VGA distributor, DVD R/W), prezentacijski (TV monitori, projekcijsko platno sa projektorom, interaktivna bijela tabla) i modul kompjuterske mreže (mrežni priključci, prespojni panel, mrežni preklopnik).



Slika 3. Dizajn hipermedijske učionice na Tehničkom fakultetu u Čačku

Za potrebe videokonferencijskih predavanja koristi se sobni videokonferencijski (VC) uređaj koji omogućava dvosmjernu audio/video/podatkovnu komunikaciju u realnom vremenu. Na VC uređaj se spajaju dvije PTZ (*pan-tilt-zoom*) kamere, kamera CAM1 se pozicionira tako da snima predavača, a kamera CAM2 lokalni auditorij. Lokalni učesnici mogu vidjeti sliku udaljene lokacije na monitoru TV1, a lokalnu sliku na monitoru TV2. Monitor TV2 može da služi i kao kontrolni monitor za predavača, gdje uz pomoć PIP (*picture-in-picture*) opcije može da promatra i sliku udaljene lokacije, i lokalnog auditorija, ili vlastitu. Korištenjem projektora i projekcijskog platna moguće je prikazati obrazovni sadržaj, bilo da se on prezentira sa kompjutera sa udaljene lokacije, ili lokalno. Interaktivna bijela tabla se može koristiti tokom lokalnih, ili predavanja na daljinu, kada se njen sadržaj prenosi putem videokonferencijskog sistema do udaljene lokacije. Za prihvat lokalnog zvuka koriste se mikrofoni spojeni na mikrofonsku centralu, koja je dalje spojena na tonski pult. Za reprodukciju zvuka koriste se zvučnici, također spojeni na mikrofonski pult. S video/audio matrica se koristi za preusmjeravanje S video i C video signala (video kamere, VC uređaj) na više različitih odredišta (*streaming* kompjuter, projektor). VGA distributor služi za distribuciju dolaznih VGA signala prema više prikaznih i drugih uređaja (projektor, VC uređaj). VGA preklopnik omogućava izbor VGA signala između više izvorišta. Kompjuter PC1 služi za video *streaming* predavanja, prihvata sliku sa kamere CAM1 preko S video preklopnika, putem LAN mreže je povezan na *streaming* video server, odakle se može raditi prijenos predavanja putem Interneta uživo, ili kasnije na zahtjev.

3. ZAKLJUČAK

Razvoj informacijskih tehnologija je omogućio digitalnu prezentaciju znanja i povećanje brzine kojom se informacije mogu prihvaćati i procesirati. Komunikacijske tehnologije su učinile mogućim pohranjivanje, prijenos i dijeljenje informacija preko velikih udaljenosti i čak različitih vremenskih zona. Prihvat i korištenje ovih tehnologija vode ka novim alternativama za implementiranje obrazovnog procesa na daljinu.

Elektronski mediji, kompjuterske tehnologije i komunikacijske tehnologije čine zajedno snažan novi medij koji omogućava razvoj aplikacija daljinskog obrazovanja kroz poboljšanje mogućnosti komuniciranja, zajedničkog rada, kreiranja i manipuliranja, modeliranja i simuliranja, računanja, analize i vizualizacije, koje ruše vremenske i prostorne barijere. Ove promjene donose niz prednosti ali i nedostatke, od kojih je primjetna potreba za dodatnim kvalifikacijama i treningom nastavnog osoblja. Obrazovne institucije koje odgovore ovim mogućnostima će se u narednim godinama izdvojiti od ostalih kroz poboljšanja u kvaliteti svojih obrazovnih programa, a koje su omogućene kroz inovativno integriranje različitih informacijskih i komunikacijskih tehnologija.

Tokom dizajna i izgradnje hieprmedijske učionice, kao primjera upotrebe savremenih ICT tehnologija u obrazovnom procesu, moraju se razmotriti različiti aspekti, tehnički, didaktički i psihološki. U ovom radu su razmatrani tehnički aspekti dizajna hipermedijske učionice. Nakon izgradnje ovakve učionice i instaliranja potrebne opreme, potrebno je napraviti niz testiranja sa ciljem podešavanja parametara cjelokupnog sistema i prilagodbe zahtjevima korisnika.

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E-LEARNING APPROACH IN CONTINUOUS EDUCATION OF INFORMATICS TEACHERS

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1. INTRODUCTION

Iinformatics is probably the fastest changeable scientific area in last decade. Amount of knowledge rapidly grows each year and each engineer has a need for permanent education. The most specific situation is with informatics teachers because they have to improve their knowledge continuously and fastly. Faculty of Electronic Engineering in Niš and Microsoft have made good collaboration over the years on the subject of improving programming teaching of university students. From 2005 the collaboration expanded to educating informatics teaching staff. In June 2004 Memorandum of Understanding was sign between Serbian Ministry of Education and Sports and Microsoft in which both parties made a commitment to promote, among other things, digital literacy as a part of educational curriculum and the development of IT-capable work force. Organizing free courses intended for continuous education of teaching staff is one of the main activities of Microsoft and it represents the realization of good intentions set forth in the Memorandum in practice.

Series of training courses were organized by the Faculty of Electronic Engineering and Microsoft during 2005/06 school year and they gave good results. However, a small number of teachers attended the training courses, because of the problems they were faced with. Namely, they needed to leave their work places and families for a couple of days and pay the expenses of traveling to Niš and stay there for several days etc. Therefore, first e-learning course was designed for the 2006/07 school year, intended for continuous education of informatics teaching staff in VB.NET programming environment. It lasted from October 2006 to February 2007. Good results of this course were enough good reason for organization another two e-learning courses. This paper provides an overview of the assumptions adopted before realization, the overview of realization and the e-learning courses results. Also, it gives some concluding remarks significant for future works.

2. THE NEED FOR CONTINUOUS EDUCATION OF INFORMATICS TEACHING STAFF IN SERBIA

In Serbia, informatics is an elective subject in elementary schools, and it is taught from the first until last 8th grade of elementary school. In the 8th grade of elementary school, the basic concepts of programming are explained to the students using the Visual Basic programming language as an example. In high school education, informatics is present as a regular subject (state approved program) with various concepts of programs (different programs and the number of classes depending on the educational profile, but generally dedicated to learning of programming and the implementation of specialized software packages in vocational subjects). In grammar schools and vocational high schools, the scope of programming teaching is different and relies on different programming languages depending on the current curriculum and the needs of the vocation: Pascal, Delphi, C, C++, Visual C#, Basic and Visual Basic.

The Republic of Serbia educational statistics [1] and [2] shows that there are 37,372 full-time job teachers employed in elementary and high schools in Serbia. Although it is presumed that there are 2,000 informatics teachers in Serbia, there is no publicly available data regarding

the number of teachers who teach subjects related to Informatics and Programming, nor are there data about the formal professional qualifications of the informatics teachers. Following the European examples Serbian Ministry of Education and Sports in its Education Development Strategy for the period from 2005 to 2010 defines that the concept of continuous education of teaching staff represents a part of the policy and strategy of training process and vocational education development [3]. Continuous education of informatics teaching staff is necessary because of the frequent changes in Informatics curricula, following the changes in the field of informatics.

Another important fact about need for continuous education of informatics teacher is the fact that percentage of exam passing at faculties is significantly less than it is required in Bologna declaration. One way for improving success of students is to prepare pupils better for studying at faculties. This process requires higher level of knowledge of informatics teacher i.e. continuous education.

3. PROPOSITIONS AND RISKS OF E-LEARNING USE IN THE CONTINUOUS EDUCATION OF INFORMATICS TEACHING STAFF IN SERBIA

Given the professional qualifications and nature of work they do at school, informatics teachers belong to the category of innovators, technological leaders, or at least they represent an early minority among teachers in the acceptance of e-learning, according to the theory of innovation diffusion by Everett Rogers, which can also be applied to e-learning [4]. The proposition of e-learning implementation in continuous education of informatics teachers is based on the assumption that the computer literacy of informatics teaching staff is above average and that they are familiar with all the possibilities of information and communication technologies implementation in learning (at least at the level of employing the given technologies as a teaching aid). Therefore, they are interested and motivated to pursue their own continuous education through one of the e-learning methods.

Implementation of e-learning in continuous education represents a flexible system that supports easy customization and modification of electronic multimedia learning objects. From the economic point of view, transportation and accommodation expenses of teachers outside the place of residence can represent greater expense than the investment in the program of continuous education itself. Implementation of e-learning method means that there are no such expenses or the expenses of classroom rental and computer equipment because teachers learn at home (or school where they work). The practical problem of teachers organization of their daytime is more easily solved if teachers, who have numerous business and family obligations, can choose when they will learn.

The risk involved is the poor infrastructure in Serbia, that cannot provide most teachers with Internet connection with more than 56 kbps (both in school and at home), and therefore the multimedia materials made for the course are in the form of text without pictures (without demanding video files). E-learning course was for the first time implemented for continuous education of teaching staff, but unfortunately the accreditation system of continuous education of teaching staff in Serbia does not yet recognize the remote training method. Therefore, teachers who attend an e-learning course cannot obtain certificate that provides them with continuous education acknowledgment and there lies a potential risk that some teachers won't be motivated to attend such online course.

4. LMS IMPLEMENTATION

LMS (*Learning Management System*) implementation enables easy remote distribution of electronic educational content that can be employed in many ways and can form individualized courses for continuous education of teaching staff. Due to the unknown level of knowledge and qualifications of teachers, and the large number of teachers who applied for the course, it was

not possible to individualize teaching materials and tasks. The results of learning were tracked and recorded in the database of continuous education of teaching staff and can be analyzed. The system supports two-sided asynchronous communication between the mentor and the teacher attending the course, as well as communication between the teachers who learn together and form the learning community for sharing experience online. The implementation of LMS for the needs of continuous education of teaching staff online course enabled cost-effective distribution of high-quality educational contents for broad usage, with relatively small material investment. Regarding hardware and software, the infrastructure investments for the implementation of learning management system were not significant since the Electronics Faculty in Niš already had a server system established, with Moodle platform as LMS, which is connected to the Internet via gigabyte academic network (see http://www.pil-vb.net).

5. GOAL AND REALIZATION OF THE COURSE

The goal of the online course was to train informatics teachers so that they can provide quality programming teaching in VB.NET programming language. One of the project goals was to provide high-quality teaching materials that should be free and broadly available for all students and teachers in Serbia. Therefore, VB.NET learning materials were made, and uploaded to the Web site available to students and the accompanying teaching materials were made available for teachers. Moreover, during the online course, Serbian teachers made a collection of solved programming tasks in VB.NET that can be used in the teaching process, which was uploaded to the Web site dedicated to this course [5].

Using LMS, teachers conducted a research on the teaching material split in 12 units that accompanies 12 student lessons, with dynamics of one unit per week. Apart from the teaching material, teachers had the task of discussing each of the 12 units on the forums dedicated to the student lessons and they took knowledge test related to the content covered in the unit. The teachers were in no obligation to test their knowledge and participate in the forum, but in order to obtain the certificate they had to complete all the tests and to write the final work. The participation of teachers in the forums was also taken into account for the final assessment. For their final work teachers had to design and build applications for the online collection of tasks for students.

Out of 368 teachers that attended the VB.NET online course, most of the teachers just focused on learning and did not take any tests. They mostly browsed the forums, but did not actively participate. Only 77 teachers passed all the tests and built the final application, which entitled them to receive the certificate of the completed course (this certificate is not accredited in the system of continuous education of teaching staff in Serbia so that might be one of the reasons why teachers were not interested in testing their knowledge).

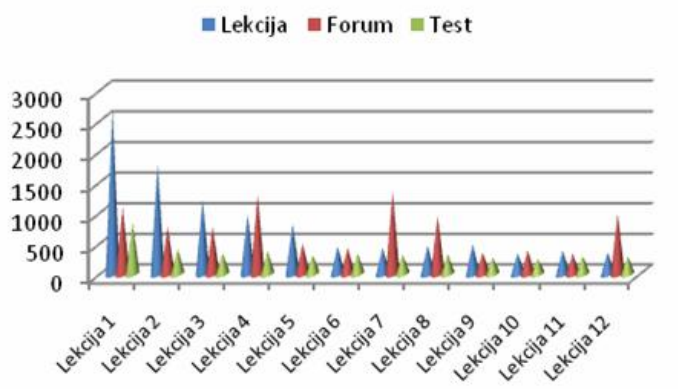

Figure 1. Number of viewings of the 12 course unit parts

The number of viewings that the twelve course units had shows that the greatest interest was expressed for the first unit. The interest decreases and becomes stable around the middle of the course. The number of forum viewings is the highest for the seventh and twelfth unit which indicates that they are the most difficult.

The course was based on constructive idea of learning as an active process, where teachers can offer examples of good practice by themselves, participate in solving selected problems and develop critical opinion regarding the methodology of informatics teaching through the exchange of opinions with colleagues and mentors. For that reason, the exchange of opinions between teachers in forums was encouraged, but in spite of that, the number of forum posts remained low (15 topics for each forum in average with a couple of replies in each topic), although the number of viewings was much greater. The number of posts and viewings in forums was the greatest for forums that were directly related to the 12 lessons (9,242 viewings in total), and it was smaller for forums that dealt with common programming questions and methodology of informatics teaching (5,931 viewings in total).

Cumulative number of viewings for the twelve course units shows that the teachers primarily browsed and downloaded the lessons (10,454 viewings), browsed the forum discussions (9,242 viewings) and that the number of test viewings by the teachers was the lowest (4,387 viewings). The evaluation of the course by the attendees was performed through a survey. 94.5% of the teachers that participated in the survey said that they were satisfied with the organized course, but only 54 teachers filled up the evaluation questionnaire (all the teachers that filled the questionnaire belong to the group of teachers that obtained certificates). The teachers that were dissatisfied with the course point out that the course was long and strenuous. They also said that they did not receive enough information about the structure of the course at the beginning. The teachers that were satisfied with the course pointed out that forum discussion was especially encouraging for their learning and that they were very comfortable due to the possibility of working at home, and choosing the time and place of the learning.

The collection of tasks created by teachers who actively participated in this course which is intended to be used in programming teaching, represents an exceptional value. Along with other teaching materials related to this course, this collection is free and available at the Web site dedicated to programming in VB.NET.

Based on good results of VB.NET e-learning course we have organized another two e-learning courses: “Fundamentals of generation of Web presentations” and “Computer networks security”. The latter is approved by Ministry of Education of Republic of Serbia (2007/2008 Catalogue, No 55, area – mathematics and informatics). Results of these two courses were better than the results obtained in the first course. The total number of attendance in all three e-learning courses was 1145.

6. CONCLUSION

Beside from the fact that being the technological imperative is closely related to the work they do, continuous education of informatics teaching staff through e-learning represents the opportunity to improve teaching skills, opportunity to exchange opinions and initiate new cooperation with colleagues. For educational system in Serbia, introduction of e-learning represents the economically most cost-effective way of organizing and performing quality continuous education of informatics teaching staff. The initial proposition that all informatics teachers are capable of attending the e-learning course proved to be true, and therefore this kind of courses can be organized in future for this category of teachers who possess digital literacy and motivation to attend e-learning courses. The teachers were not motivated for obtaining the certificate that is not acknowledged by the accreditation system for teachers in Serbia. The course duration of 4 months, with 12 units together with the tests and multiple working tasks (around 40 hours of work for teachers) was too long.

In order to increase attention and acceptance of the materials by the attendees, and strategies for content structuring and learning contextualization should all be considered in the designing process. Available material assets intended for course design and performance should include the use of cognitive strategies for material design and strategies for content structuring and learning contextualization in order to increase attention and acceptance of the material by the attendees. If possible, the elements of the course individualization and also the elements of Keller's ARCS method [6] for establishing motivation should be incorporated.

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MASTER STUDIES IN DSP BASED ON BLENDED LEARNING APPROACH

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1. INTRODUCTION

Digital signal processing (DSP) techniques are used in a wide variety of modern electronic and information systems, in application areas such as communications, computer systems, robotics, remote sensing, industrial inspection, medical imaging, and many more. The rapid development in the provision and use of these systems has created the requirement for engineers with the theoretical knowledge and design skills to develop and research new advanced systems and techniques. Currently, there are no studies that adequately train staff for DSP in MK. The subject is only represented by a few courses in the area of electronics at the FEIT. This is insufficient for training staff that satisfies the real needs of the ICT industry.

The main goal of the TEMPUS project *Master studies in DSP based on blended learning approach* is to introduce regular master's studies in DSP. The DSP master programme (structure, content and methodology) will be designed in a way to reflect the current requirements and in anticipation of future needs of the ICT sector.

Besides involving graduate students, the proposed masters' program in DSP could also appeal to engineers who already work in ICT and need to upgrade their knowledge and skills in DSP. The need for and difficulty in educating employees is not new and is evident in many engineering disciplines. Traditional university courses or specialized short courses can be effective but may also disrupt an employer's working schedule, and there may be the added inconvenience (and increased cost) of travel. In addition, retention may be poor because typically a large amount of material is covered in a short time. A possible solution for this problem is the blended learning system. Classroom teaching is reduced, since the portion of a course that learner can do alone is offered online. Also, learners can explore and work with the content wherever and whenever it is convenient for them. In the last few years, blended learning, where e-learning is used together with traditional teaching, has become a very popular approach for continuous education. The most important part of the project should be developing the educational material for DSP courses based on the blended learning approach. Developed educational materials will contain short tutorials that explain the basic theory for each course. Besides short tutorials, each course material will contain interactive demonstrations that will explain the basic concepts in every course.

Through the DSP curricula definition, more emphasis will be put on teamwork by students so that they can develop skills needed for the job market. In this context, the establishment of a state-of-the art DSP Laboratory is one of the main objectives of the proposal. Among other things, in this laboratory students will have opportunity to implement practical signal processing algorithms on a state-of-the-art DSP board in real-time. In this way, the student will obtain hands-on experience of the practical elements of DSP development and design.

2. BLENDED LEARNING APPROACH

Recent advances in multimedia technologies enable alternative learning approaches in addition to traditional face-to-face learning. Nowadays practitioners can choose among many

different types of training media. Will it be e-learning? Or one of the older but tried and true methods: self-study, face-to face, videos, computer-based training, or workshops? How about teleconferencing or web-based seminars, use of a course management software system, placing reference material online, e-mail, synchronous instant messaging and chat rooms, online testing, web based video conferencing? With all these options, it is hard to know which delivery method is the best choice for students.

Blended learning is a customized approach that applies a mix of training delivery options to teach, support, and sustain the skills needed for top performance. With blended learning, the tried-and-true traditional learning methods are combined with new technology to create a synergistic, dynamic learning structure that can propel learning to new heights [1].

A blended learning approach is flexible, using the most effective training delivery option (or combination of options) for each stage of learning. It is more effective than any single form of learning at creating the results you want: sustained behavioral change that increases the return on training investment.

The key is to know how to make the choices that will provide the best blend of skill enhancement and sustainability to ensure long-term competitive advantage.

There are few models of blended learning [2]:

• *Supplemental model* – adding out-of-class computer-based learning activities to traditional educational content delivery

• *Replacement model* – only selected face-to-face interaction and traditional teaching methods are replaced by their online equivalents

• *Emporium model* – self-paced use of online material is introduced that eliminates classroom teaching and tries to best serve individual student needs through personalized online and offline interactions

• *Fully online model* – all course material is delivered online and the interaction with students is also entirely online

• *"Buffet" model* – there is no "fixed menu" of teaching strategies and learning environments; students can choose among online and offline content delivery, various instructional methods, as well as between online and offline contacts.

If the model is chosen wisely, the instructor comes away from the table more satisfied, with improved results and a much higher return on training investment. If the model is chosen unwisely, there are consequences that may slow down the selection of choices that will provide the best blend of skill enhancement and sustainability to ensure long-term competitive advantage.

The following factors should be taken into consideration when developing blended learning systems: specific attributes of the course content, available resources, level of faculty competence to develop online educational material, the number of students, and their readiness to access, adopt, and effectively utilize online course materials.

Within the framework of TEMPUS SCM Project "Initiation of blended learning system", the blended learning approach was introduced in MK. "Buffet" blended learning model was developed for Digital Signal Processing (DSP) course. The model is a hybrid of traditional teaching and learning methods. In the process of development the main accent was given to web-based tools for visualization of basic concepts in signal processing (http://www1.etf.ukim.edu.mk/dsponline). Also, short course notes and solved examples from auditory exercises were prepared and posted on the course web page. Evaluation showed that students following the intensive course found the tools beneficial for visualizing some of the concepts and achieving a better understanding of signal processing course. Moreover, this type of instruction motivates the students to actively partake in the learning process. The seminars that were held to disseminate the results showed that the teaching staff also welcomes the new type of instruction.

3. DSP MASTER PROGRAMME

Digital signal processing (DSP) is the study of signals in digital representation and the processing methods used for these signals. This field studies the representation, transformation and manipulation of signals on a computer or on specially designed hardware. After half a century of significant advances, DSP has become an important field, and has penetrated a wide range of application systems. Examples of digital signals include speech in mobile phones, digital audio in CDs and mp3-players, biomedical imaging in digital tomography, images and video in digital cameras, and measurement in industrial devices. Digital signal processing is useful in situations where the physical world and computers meet, which means that there are many applications, and new ones should emerge as the methods used in the field are further developed. With the dramatic increase of the processing capability of special purpose microprocessors, it is expected that the importance and role of DSP will accelerate and expand.

The DSP master programme is designed to reflect the above requirements and needs. The new concept of master studies preserves the basic structure of the former system: Each student has an individual mentor that coordinates the advising by faculty from different research fields relevant to the project. Most of the courses in the new model existed in some form in the former one. However, the blended learning model adopted as a main teaching and learning methodology will help modernize these courses. From the perspective of their role in education, the courses offered in the program can be divided into three groups:

- **Differential courses**, which are meant to provide the necessary background for prospective students who do not have any basic knowledge of DSP.
- **Basic (core) courses** covering the most advanced methods in many DSP areas such as the design of a DSP system, discrete transforms, multirate DSP and filter banks, and statistical signal processing. These core methods have a central role in many advanced applications in multimedia, telecommunications, electrical engineering, biomedicine, and bioinformatics. This kind of a background is useful for students that are interested in DSP applications and is a good basis for innovative development of methods and theory in an industrial or academic environment. The basic courses are mandatory.
- **Elective courses** intending to cover specific areas of application as: image and video processing, modern algorithms and applications in digital image and video processing, speech and audio to give students a good basis for the design and implementation of new methods in mobile phone and entertainment electronics industries, and a course in multimedia technologies and provide the student with an ability to combine knowledge of signal processing, telecommunications, and software engineering in development of multimedia systems.

At the time of proposal writing postgraduate studies at FEIT are mentor-based. They take four semesters for courses and two semesters to prepare a master thesis. As the studies are mentor-based, no lectures and other classical educational forms are organized for the students. The current rules and conditions for enrollment in postgraduate studies are not compatible with undergraduate studies (in the process of adopting the ECTS system) as well as with modern approaches to the educational process.

Starting in December 2007, the postgraduate program is subject to an intensive overhaul in order to establish new master programs as well as new rules and criteria for enrollment in master studies. According to the new rules, the mentor-based system is abandoned in favor of regular coursework. The duration of masters' studies is two semesters and 60 credits are required for completiton (20 for M. Sc. thesis, 24 for core courses, and 16 for electives).

Following the new rules and criteria for enrollment, we have modified our proposal and prepared the following list of courses for Master studies in DSP. The type of course (mandatory or elective), their credits, the semester in which they are offered as well as number of teaching units and project work are presented in the table 1 (for mandatory courses) and table 2 (for elective courses).

Table 1 – Mandatory courses

	course	semester	number of credits	hours per week
1	Statistical signal processing	9	5	3+1
2	DSP in transform domain	9	5	3+1
3	Filter banks and wavelets	9	5	3+1
4	Real time DSP	9	5	2+4
5	Project	10	4	1+5

Table 2 – Elective courses

	course	semester	number of credits	hours per week
1	Image processing and analysis	10	4	2+2
2	Image and video compression	10	4	2+2
3	Data hiding	10	4	2+2
4	Multimedia systems	10	4	2+2
5	Digital audio and speech analysis and processing	10	4	2+2
6	Biomedical signal analysis and processing	10	4	2+2
7	Biomedical image processing	10	4	2+2
8	Applications of neural networks in signal processing	10	4	2+2
9	DSP microcontrollers	10	4	2+2
10	Advanced topics in DSP	10	4	2+2

The selection of courses was a result of extensive analysis of master studies in DSP that have proven successful at several universities worldwide and in Europe, and also the experience from our visit at PUT in Poznan and the workshop organized there. We are in the process of completing the list of courses and their individual contents. In March of this year we are planning to publish a brochure that will inform students about our new program of study.

4. CONCLUSION AND FUTURE WORK

In this paper our initial experience from implementation of the project *Master studies in DSP based on blended learning approach* was presented. Up to now, the DSP master study programme is defined. However, it is our opinion that the establishment of a new study program without changes in the teaching and studying methodologies will not be sufficient to train staff adequately for the current job market. Therefore, main accent in our future work will be given on developing educational material for proposed courses based on the blended learning approach.

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THE USE OF DIGITAL SIGNAL PROCESSING KNOWLEDGE FOR IMAGE REGISTRATION

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1. INTRODUCTION

In this paper we will present a student project, where the used of signal processing knowledge, which is obtained in the second year of study, is used in order to implement the image registration. Image registration is a technique, where a part of the image is cut from the original image. This part of the image can have arbitrary size, rotated and scaled and the goal of registration technique is to insert rotated and scaled part of the image back into the original image. The technique can be used for object recognition in the original image.

The registration method is based on correlation methods implemented with Fast Fourier Transform (FFT). The presented method was first presented in [1], where Fourier approach was used to match images that are translated, rotated and scaled. The extension of the phase correlation technique is presented here.

2. IMAGE REGISTRATION USING FAST FOURIER TRANSFORM

The advantage of shift theorem of Fourier transform is presented. If two images f_1 and f_2 are displaced for coordinates (x_0, y_0), the corresponding Fourier specter will be shifted for (x_0, y_0) and it can be written as:

$$f_2(x_0, y_0) = f_1(x - x_0, y - y_0)$$

The Fourier transforms can be written as

$$F_0(\xi, \eta) = \exp(-j2\pi(\xi x_0 + \eta y_0))F_1(\xi, \eta)$$

The cross power spectrum of two images with its Fourier transforms

$$\frac{F(\xi, \eta)F^{'*}(\xi, \eta)}{\left|F(\xi, \eta)F^{'}(\xi, \eta)\right|} = \exp(j2\pi(\xi x_0 + y_0\eta)$$

The phase of the cross power spectrum is equal to the phase differences between two images.

The goal of the image registration is to find the rotation and scale of the template that will be inserted in the image. Therefore, the scale of the image is found by log-polar transform and the Fourier properties of scaling the variables. Let image f_1 is scaled for scalars a and be and it is replica of the image f_2. The Fourier specter can be written as:

$$F_2(\xi, \eta) = \frac{1}{|ab|} F_1(\xi / a, \eta / b)$$

If the scales are transformed using logarithm the translation movement can be written as

$$F_2(\log \xi, \log \eta) = F_1(\log \xi - \log a, \log \eta - \log b)$$

$$F_2(x,y) = F_1(x-c, y-d)$$

where

$$x = \log\xi, y = \log\eta, c = \log a, d = \log b$$

The translation (c,d) can be found by correlation of the phase in the cross power spectrum, therefore the scaling a and b can be represented by the translation:

$$a = \exp(c), b = \exp(d)$$

The rotation of the template image can be found using polar coordinates, The scaling in the polar coordinated is:

$$\rho_1 = (x^2 + y^2)^{1/2}$$
$$\Theta_1 = \tan^{-1}(y/x)$$
$$\rho_2 = ((x/a)^2 + (y/a)^2)^{1/2} = (1/a)(x^2 + y^2) = \rho_1 / a$$
$$\Theta_1 = \tan^{-1}((y/a)/(x/a)) = \tan^{-1}(y/x) = \Theta_1$$

The scaled and rotated image f1 can be represented using Fourier magnitude spectra:

$$M_1(\rho,\Theta) = M_2(\rho/a, \Theta - \Theta_0)$$
$$M_1(\log\rho,\Theta) = M_2(\log\rho - \log a, \Theta - \Theta_0)$$
$$M_1(\xi,\Theta) = M_2(\xi - d, \Theta - \Theta_0)$$

where

$$\xi = \log\rho$$
$$d = \log a$$

The scale factor *a* and the rotation Θ_0 can be found easily as translation. The translation that represents the rotation should be converted in values that represent angle. The image that is rotated and scaled is rotated and scaled using the estimated values. Once the image is scaled and rotated, the scaled and rotated image is placed into the original image, where the phase of the cross power spectrum has the highest values.

3. EXPERIMENTAL RESULTS

The registration method is tested on optical image, Shown in Fig. 1

Fig. 1: Original image

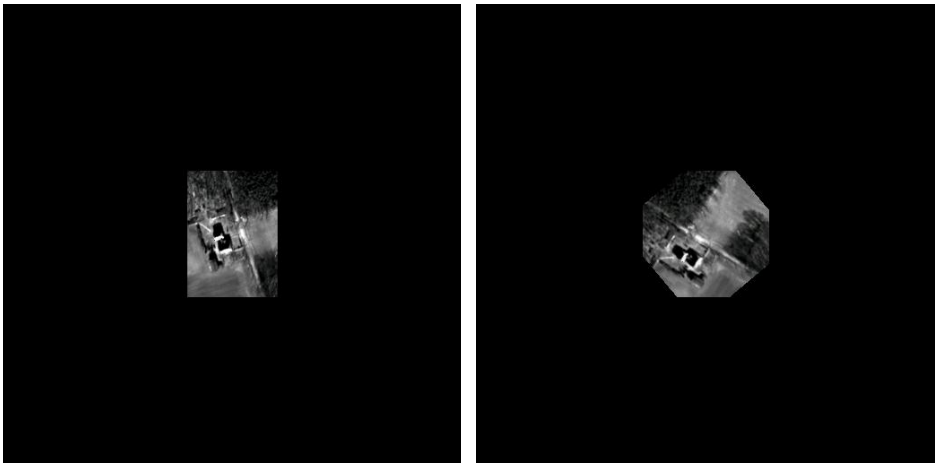

Fig. 2: Part of the image (left), rotated image for 40 degrees (right)

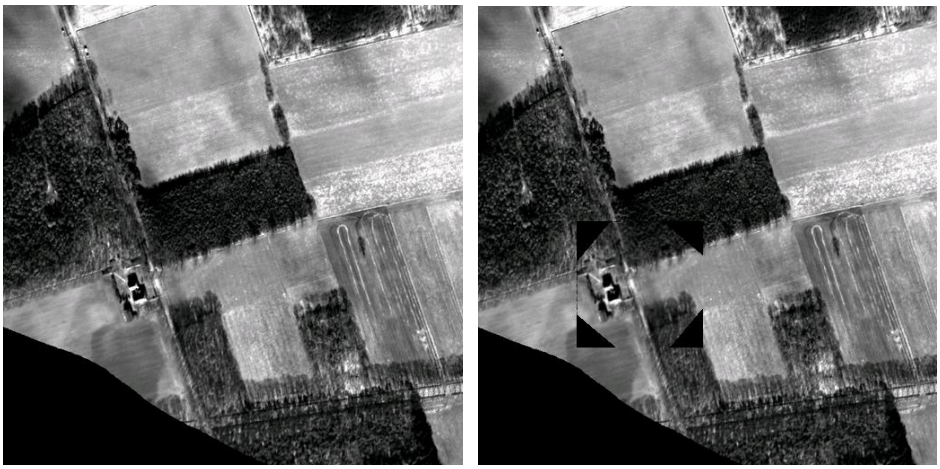

Fig. 3 Registrated images

The algorithm returns parameter of the scaling 1 and angle 0 for the first example and scaling factor 1 and angle of 39.95 degrees and the coordinated of the insertion (110, 240). Second example is shown in Fig. 4, where the template was scaled using a=1.6 and rotated for 40 degrees. The registration algorithm scales, rotates and inserts image on the right spot.

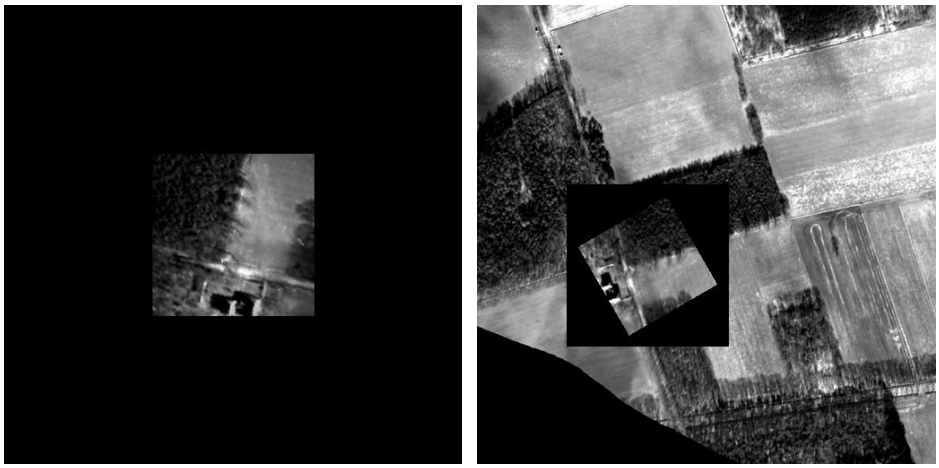

Fig. 4: (left) Scaled template a= 1.6 and rotated for 40 degrees. (right) Registrated images.

4. DISCUSSION

In this paper, we have demonstrated the knowledge acquired by better students in their second year of graduate study at the course “Digital signal processing”. The presented registration algorithm was proposed in [1] and can be efficiently used for object recognition in the original image. Through this problem students are shown the usefulness of the digital signal processing techniques.

Our experiences show that the knowledge necessary to solve the described registration algorithm can not be acquired in the “classical” teaching manner as we know it now, especially not within Bologna programs, where teacher lecture and exercise time is mostly reduced for one third. As a solution to absorb the knowledge required and at the same time make this, one of the most abstract and difficult topic in electrical engineering, more attractive, we use the results of Tempus SMC project “Web-based lecturing/learning tools”, accomplished at Ss. Cyril and Methodius University, Skopje, Macedonia.

Additionally, we encourage individuals or team of students to “learn-by-doing” in our lab. We engage them to participate in our on going projects by solving simpler tasks. For this purpose, we prepare basic literature, offer individual explanation if necessary as well as help them use programming tools.

An important observation over this kind of studying is that such professor-student collaboration intrigues only the best students. We estimate that the majority of M.Sc. degree students will be one of those students. Consequently, we are stimulated to put additional effort to attract higher numbers of excellent results. Based on these results we now develop curriculum for advanced studies of digital signal processing at the Bologna M. Sc. level study.

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System administration training: e-learning approach

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6. INTRODUCTION

In last decade Internet technology became part of our daily lives. Mobile phones, PDAs, notebooks and personal computers are not only the luxury but every day need for many of us. New global communications (3G, WiMax, WiFi…) allows accessing our private files, e-mail messages and other information's practically from every part of the world. For supporting such technologies new types of specialists is needed. General computer experts now have to be specialized in narrow areas such as Web programming, system administrations, database designers. These profiles are just few of a many, which are necessary for supporting "technology oriented community" [1].

We are facing global lag of some specialist, especially the system administrators [2]. While Microsoft is offering their MSCE, MSCA and similar courses and certificates, education of computer engineers even in Bologna programs are still mostly oriented to general computer science. This is usual justified with facts, that the task of study is obtain general knowledge enabling to quick learning "firmware" at company where the young engineers get a job.

To help them in field of aforementioned specialization, we are developing web based course for system administrators. This course in difference to MSCE, MSCA and similar courses and certificates only offers education. Users have access to internal library, white papers and PDF's. They can also test their theoretical knowledge on internet via teaching portal based on ASPX technology. Practical knowledge training and testing can be done remotely on virtual laboratory where we offer five virtual workstations and two virtual servers. Education portal is windows operating system oriented (Microsoft).

7. OVERVIEW

We mentioned before that there is a lack of some special oriented computer specialist in Slovenia. Particularly we are talking about system engineers or system administrators for different computer operating system: FreeBSD, Linux, UNIX and Windows. In Slovenia we have a lot of certificate agencies which are running curses and offering exams for certificated specialist (UNIX and Windows).

Our goal is not to compete with such agencies, but to offer free of charge fist steps in knowing the narrow computer science field. Currently we are aiming in supporting first steps of the system administrators for Microsoft windows environment (Windows XP, Vista, Windows server 2003, Windows server 2008) for our faculty students. Of course, previous basic knowledge about computers and operating system is needed [3].

First contact that user will have with us will be through web page where all the basic information's about the training are available. Users have to register throught student index number via valid faculty mail (x.y@uni-mb.si). System first checks if the student is member of our faculty and then send confirmation mail for completing the registration. When user is authenticated it can use five different tools:

1. *Study planer* is a tool for course planning.

2. *Digital and classic library* where we offer documents sorted in four categories: must read, recommended, more information's and advanced.
3. *Interactive "Show how"* web page on the portal.
4. *Web exam* web page on portal with questions and answers (similar to MCSE, MCSA training).
5. *Virtual class room* with PCs (running on Virtual-Server and Virtual PC software).

We basically recommend to all our users to use Study planer for planning the course but it is not a rule. Student can "book" and use virtual class room without any other activities on the portal.

3. STUDY PLANER

Study planer is a tool for planning the courses and sorting reading material. When you are using study planer you first select the topic(s) and your current knowledge level of the topic. For example: If you select Active directory (AD) topic, system will assign you all the material about AD. Later on you will be asked if you want to learn about DNS server or LDAP services in AD. Depended on your selection study planer will fill out your "notes" with reading material and links. At the end study planer will propose your time plane for mastering the topic.

Currently we are discussing about knowledge intersection. Question arises: how much knowledge does one need to know about sub topic if there is a single course available for that topic. For example: how deep the knowledge of the DNS servers should be if the user wants to learn about AD? Such and similar topics are yet to be discussed.

Karl BENKIC *User type* : *Administrator*		Course: *DNS services (AD integrated)* Level : 3		
Topic	Must read	Recommended	More info.	Advanced
Introduction	*What DNS is?* *DNS zones*			
Deployment	*DNS in AD* *Forward zone* *Reverse zone* *DNS records*	*DNS resolvers* *Dynamic DNS*	Address resolution how-to	Security issues Round Robin DNS

Figure 1. Study planer GUI

4. DIGITAL AND CLASSIC LIBRARY

In classic library we are using books, master thesis and similar material for mastering theoretical aspect about selected topic.

In the virtual library there is a large number of white papers (from Microsoft and other), tutorials, and PDF's selected and sorted by the tutor. Currently only two tutors are active so the digital library is not as rapidly grooving in size as we want.

Of course there is a big question about copy right material on the internet. What material should be used and how? The other question arises when talking about tools for material preparation. Many times Moodle and similar tools were in consideration but is it appropriate teaching Microsoft technology on open source or it is more appropriate to use ASPX technology?

5. INTERACTIVE »SHOW HOW «

Show how is flash based interactive teaching tool where user first reads introduction and theory and then interactive with clicking on the flash objects follows the course. Interactive learning tools are widely used so we will not discuss it here [4,5].

6. WEB EXAM

Web exam represents a tool for self evaluation. It uses SQL data base with level marked questions and answers. Question level represents question difficult. With higher level complexity of the question rises (there are levels 1 – 15). Web exam offers three types of questions: Questions with one right answer, questions with multiple right answers and one word answer.

There are many similarities between Web exam and MCSE or MCSA courses. Mainly because the Microsoft approach is good and we want to get close to professional self evaluation tools [6,7].

For right answers users point increases and for wrong answer there is a penalty (point decreases), depending on question level and type.

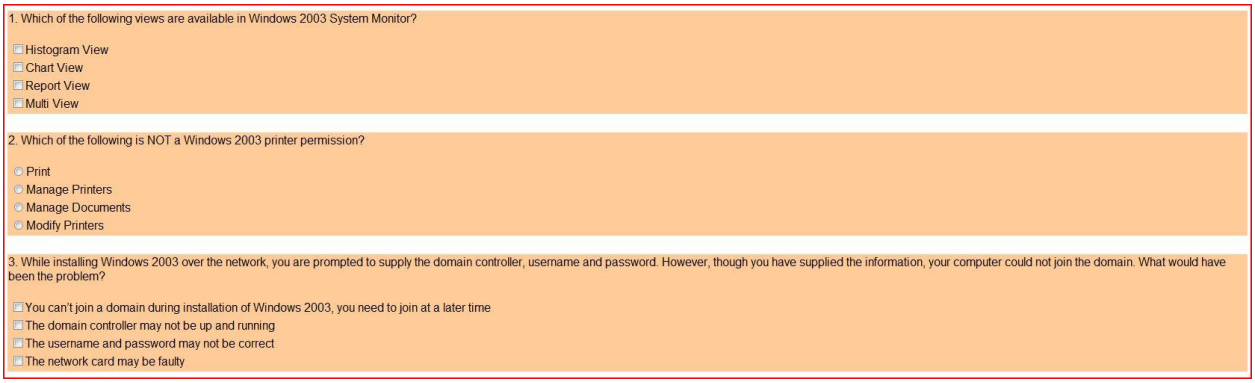


Figure 2. WebExam GUI (Windows 2003 basic exam)

7. VIRTUAL CLASSROOM

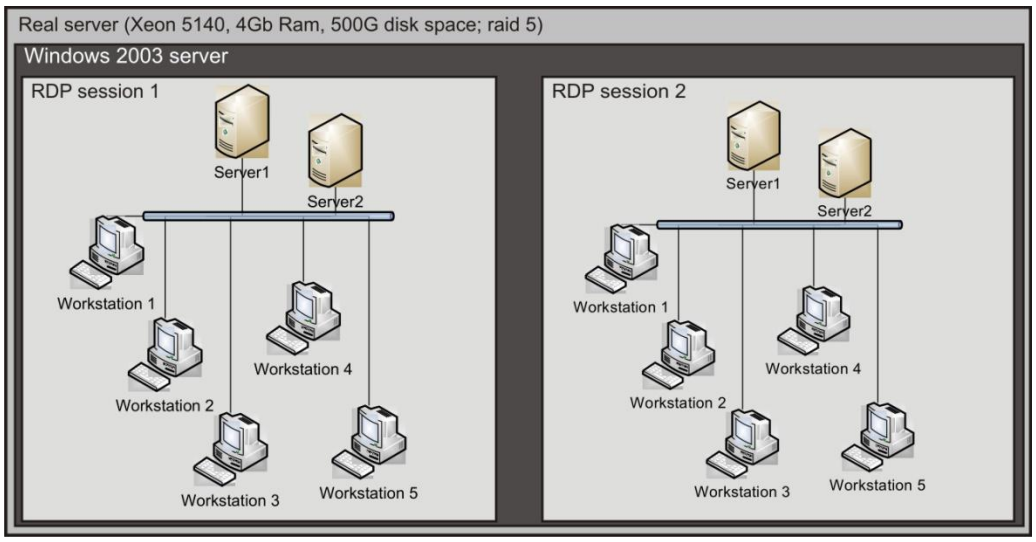
Represent our main contribution. Virtual class room is set of virtual computers running inside RDP session on real windows 2003 server. Virtual class room runs on two servers (in case of increasing interest there will be need for server farm) and allows up to 6 users working in parallel.

Users reserves virtual class room via web portal where they can get all the information and instructions how to use Virtual class room. When reservation is confirmed user receive Remote Desktop Connection (RDP) user name and password for its session (user name and password is active only inside reservation time slot). Moment before user reservation time slot starts system (precisely Virtual class demon service) creates new RDP user inside real server for RDP access and sets appropriate right to that *user*.

Virtual class demon service is special program (service) written in C#. Its primary task is preparing *RDP user* names and connections for users who reserved virtual class room. When user reservation time slot ends *Virtual class demon service* deletes temporary *RDP user* and starts log off process. If there are no more reservations *RDP user* stays active until user logs of or next reservation is in place.

Inside RDP session there are 2 servers and 5 workstation virtual machines available. Virtual machines are connected through internal hub. Servers and workstations are currently

running on the Virtual PC 2007. In future we are planning testing VmWare and similar tools.



Picture 3. Virtual class room on real server

8. CONCLUSION

Project is currently in development phase so we can't draw any particular conclusions about the success of it.

In the technology aspect, the project is nearly finished. Some graphical and programming work in web portal must be done to complete user interface, modern improvements of virtual class demon and migration on Windows 2008 are planned from technology point of view.

On other hand there are many open issues for discussion in the project. There are two main contributions in the project that has to be realized soon: teaching and content (managing) aspect. First aspect defines how the material is presented to the users and second aspect defines what the teaching material is and how it is built and what tools should be used.

At the end virtual class room must be mentioned. We believe that theoretical knowledge with practical support is best learning method possible.

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ADVANCED METHODS OF NETWORK SIMULATIONS WITH OPNET MODELER

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Abstract: This paper represent the advanced methods of network simulations with simulation tool OPNET. This is one of the most widespread simulation tool for network simulations, properly, as for teaching, as also for research of new devices and protocols. Basic package, is indented for simulations of communication networks and developments of protocols and devices. There are also additional dedicated modules, such as module assigned to simulation of wireless networks, ACE module for analysis of applications, 3DNV module for visualizing networks on virtual terrain and "System in the loop" module for simulating the networks with real communication equipment in the loop in real time.

Key words: simulation tools, communications, teaching, networks, modeling, OPNET

8. INTRODUCTION

In last few years a network simulations tools are becoming indispensable tool that help in process of construction and upgrade communication networks. OPNET offers an area of simulation tools for many solutions:

- Application performance management (ACE, ACE Live, OPNET Load scalar, OPNET Commander, SLA Commander)
- Network operations (IT and SP Sential, IT and SP Netcop)
- Capability management (IT and SP Guru Network Planner, IT and SP Guru SystemPlanner)
- Network R&D (OPNET Modeler, OPNET Modeler Wireless suite, OPNET Modeler Wireless suite for Defance)

One of the most advanced tool from OPNET products palette is OPNET Modeler. Together with additional modules, such as Wireless for defense, 3D network visualizer (3DNV), Application Characterization Environment (ACE) and system in the loop (SITL) modules allow advanced simulations methods for wired and wireless communication networks. They also represent indispesable tool for teaching and researching new communications devices and protocols.

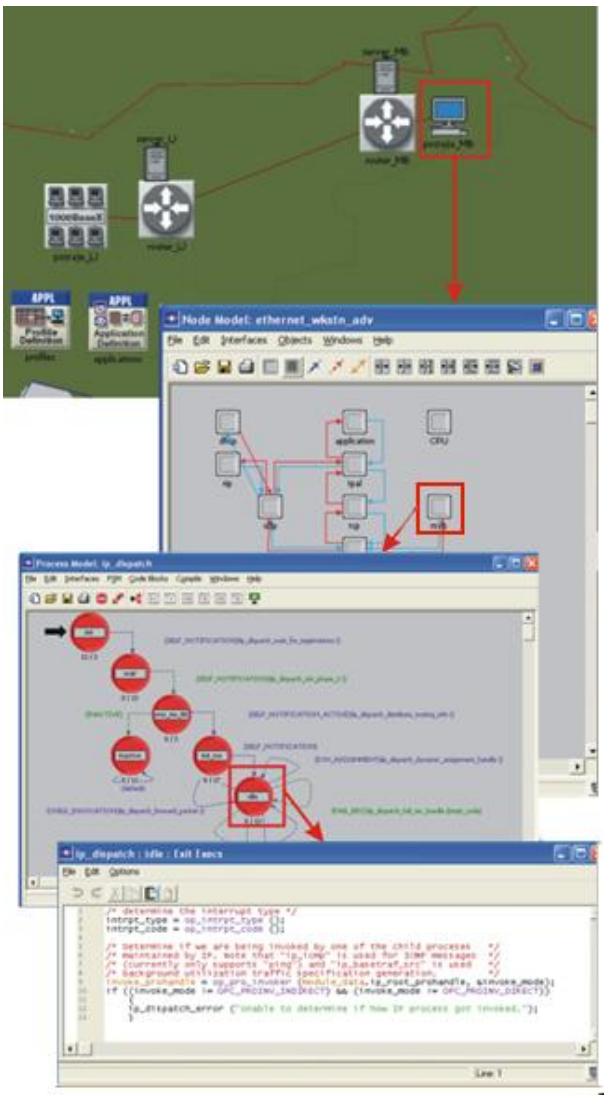
9. OPNET MODELER FOR TEACHING AND RESEARCH PURPOSES

OPNET make it, through special University program, his products for simulation tools are available also for nonprofit purposes such are teaching and academic research. There are about 20000 students and professors around the world who use these products. Available are also numerous text books and accompanying lab examples. There exist two options of using OPNET University program [1]:

- Full-featured software OPNET Modeler, which include an extensive model library with around 800 protocols and vendor device models. These models are also supported with source code. They also provide the technical support at discount prices.
- The second option is the free OPNET IT Guru Academic edition, which provides a feature set for use at networking level (without possibilities for modeling of new process and protocols as in OPNET Modeler case). IT GURU academic edition provide the solution testing different protocols and network technologies: studying various wired and wireless routing protocols, visualizing TCP/IP mechanisms and variations, understanding LAN/WAN/MAN network architectures, designing reliable wireless networks and implementing efficient network security.

10. OPNET MODELER

OPNET Modeler is one of the most powerful communications simulations tool. Especially is useful on R&D (research and developed) area for developers of communication devices and protocols. Planners and communication network operators has possibilities to use this tool for network efficiency analysis, optimization, growth analysis, etc.OPNET modeler is conceived on series of hierarchical user interfaces, which are shown on Figure 1.



⇒ **The project editor** is the main user interface. It allow graphically representations of communication network topology with components from rich library of devices and models, defining communication links, configuring the models parameters, defining, editing and running simulations scenarios, checking and comparing results etc.

⇒ **The node editor** enables editing of network device models, which are consisted from process modules linked by signal and data paths. Each of this process module can generate, sends, receives and processes packets from other modules. In typical model, there is visualization of communication device with all protocols layers (from application to the physical layer), accordingly to ISO/OSI communication model.

⇒ **The process editor** is intendment to process modeling with the help of FSM (Finite State Machine). With this editor we can approach supported specifications on any level (also on the level of details), which are related to communication protocols, data sources, applications, algorithms, queues etc. Every state in process model includes **C/C++ code**, supported by expanded functions library, which are intended for programming communication protocols.

Figure 1: Formation of basic network model (project editor), detail with workstation model (node editor) and process coded level (process editor)

There are different possibilities for simulations results visualizations. One of them is shown on Figure 2, where the numerical labels represent:

1) chooses statistics for visualization in right window,
2) chooses manners of graphs showing (individually or more statistics in same graph),
3) chooses of numerical operation or chosen statistics (average value, logarithmic scale, distributions)
4) display a graph in the independent window.

11. ADVANCED S METHODS OF SIMULATION

OPNET Modeler Wireless package for wireless networks modeling. Wireless links are simulated by using open concept called transceiver pipeline. Transceiver pipeline enables delays computations at spreading of radio waves, closing radio links, consideration of aerials emissive diagram, background noise, modulation effects, interferences, bit error rate, forward error corrections, etc. Very important task of transceiver pipeline is also consideration of effects caused by field influences over modeled terrain such are fading, diffraction, reflections, atmospheric absorption etc. These are considered in propagation models such are Free Space, Longley-Rice, and most sophisticated TIREM. Virtual field is modeled in form Digital Terrain Elevation Data (DTED) maps. It is possible to simulate various wireless's communication technologies like MANET, 802.11, 3G/4G, Ultra Wide Band, WiMAX, Bluetooth, ZigBee etc.

ACE (Application Characterization Environment) package allows virtualization, analysis and foreseeing of network applications' problems. It also helps us with analysis at phase of developing new applications. Module allows importing of real traffic, and analysis of captured traffic. It allows diagnostics for properties' such are information concerning blockages and delays in networks. The user interface of this module is shown on figure 3.

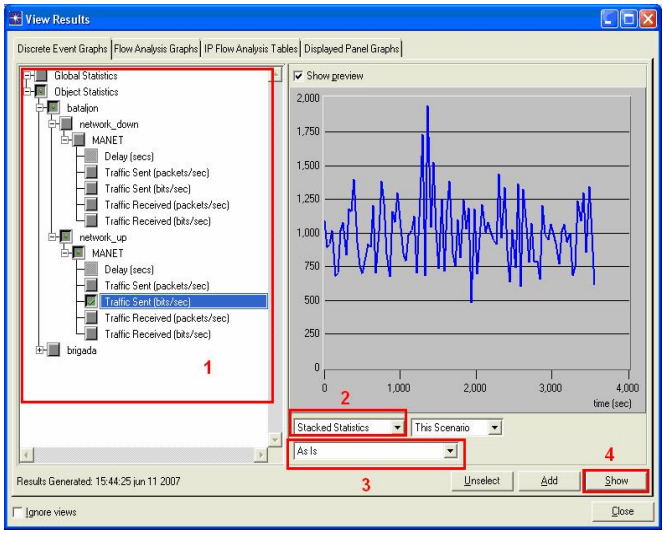


Figure 2: Window "View Results" with simulation results

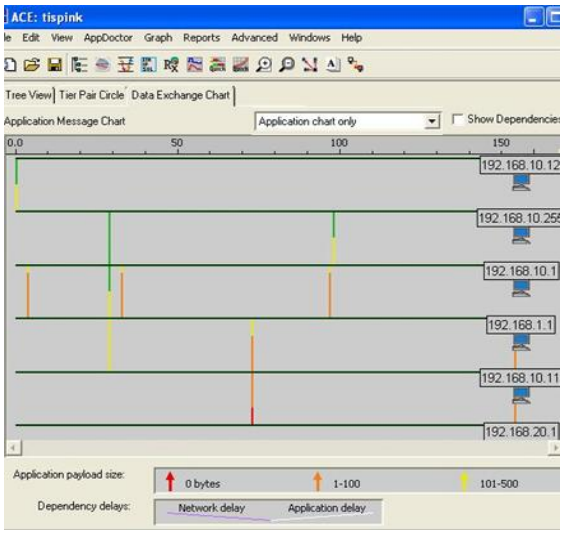


Figure 3: Packet flow analysis with ACE module.

3DNV module, shown on figure 4, in combination with OPNET Modeler, enables playing of 3D animations of simulated mobile network. Every communication device in OPNET Modeler is possible to illustrate by 3D models, in 3DNV environment, by vehicles, soldiers, planes, helicopters, satellites, etc. This tool enables interactively directing of viewpoints of observation 3D scene similarly as video game consoles.

System-in-the-loop - SITL module adds, to OPNET Modeler, ability of simulation in real time, with real communication equipment in the simulation loop. Module of SITL is suitable for

- studies how simulated network impact real network and opposite,
- using OPNET simulator as traffic generator which loads real network,
- testing of new protocols and devices prototypes,
- scalability testing by adding virtual (simulated) devices to real network etc.

Simulated network can influence on real network trough parameters as are packet loss packages, delays, jitter, packet doubling on receiver side, etc.

Externally device are connected to simulation loop over SITL gateways, which are bridges between communication simulation environment and with host computer Ethernet interfaces in one of typical configurations [1]:

- Real-Sim-Real: Real network with real network over simulated network. Example is shown on figure 5.
- Sim-Real-Sim: Simulated network with simulated network over real network.
- Sim-Real: Simulated network with real network.

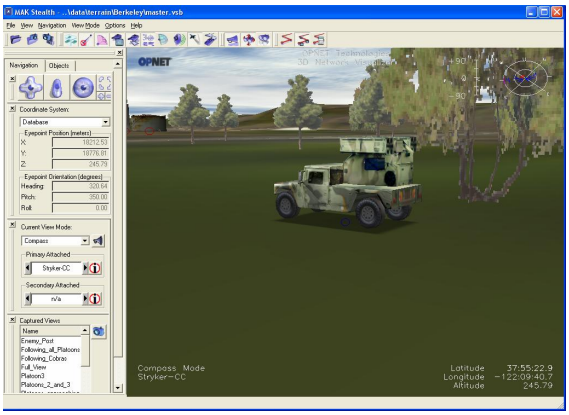


Figure 4:3D visualization of communications unit on virtual field

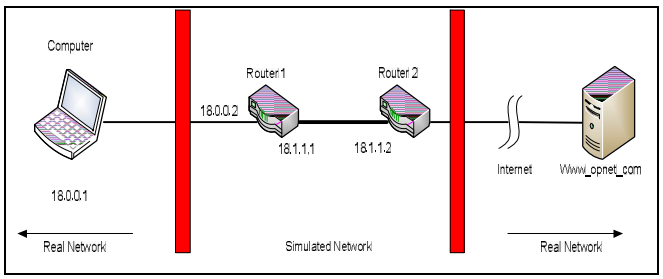


Figure 5:Use case for "Real-Sim-Real" SITL simulation

12. CONCLUSION

From rich experiences, that we gained from using OPNET Modeler over few years can claim, that OPNET Modeler is appropriately tool to using on communications research activitys [3, 7, 8] and teaching objectives on under-graduate [5, 6] and post-graduate [2, 4] programs.

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EXERCISE AT COMMUNICATIONS IN AUTOMATION CAN BE FUN

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1. INTRODUCTION

In nowadays communications in automation play very important role. It has some specific [1], which require special course about it. We developed such course about two decades ago; it is called "Communications in automation". At this course students learn telecommunication basics (ISO/OSI reference model, modulations, protocols, computer networks, etc) and the specific solution, networks and requirements which have to fulfil any kind of communication involved in automation.

Our experiences show, that "classic" teaching and learning approach is to the most of the students to "static" and consequently "boring". To make lessons and especially exercises more attractive, we renew exercises on such a way, that student can "learn by doing". Make a lot of fun as well as they can be partly shown remotely, for example over internet at lessons or at home but sustain student's effort in performing of course obligations. Assignment is expected to be done as team work.

To achieve aforementioned we upgrade car-toys with electronic which enable their remote control over personal computers (PC). Student's assignments are to make: wireless interface on the PC, user interface on the PC, and developed appropriate wireless and standard networks protocols as CAN, SPI. Some parts of the project are made in Labview, others in Code Composer studio.

2. CAR-TOY AS LEARNING EQUIPMENT

For basis we took very low cost remote controlled car-toy and removed original remote controller. We replaced it with a DSP (Digital Signal Processor) board and wireless interface. Power H-bridge, camera and analog video transmitter were also added. The equal DSP board, wireless interface, and analog TV camera receiver are appropriate connected to the PC.

DSP and wireless transceiver

The heart of the car toy new electronics is DSP TMS320F2812 from Texas instruments. We have chosen this DSP for three reasons:

6. Students are familiar with it from previous courses.
7. This DSP is designed as microcontroller, i.e. it has integrated a lot of periphery blocks such as SPI (Serial Peripheral Interface), CAN (Control Area Network), PWM (Pulse Width Modulation), etc.
8. Spectrum Digital company offer development starter kit, which contains DSP board with some additional periphery and connectors, power supply, JTAG adapter and Texas Instruments powerful IDE (Integrated development environment), called Code Composer Studio *(Fig. 1 left).*

Code Composer Studio enables programming, debugging and simulating an application. Programming is possible in assembler as well in the C/C++ program language.

For wireless communication we have decided to build own radio link, which enables use of different modulation and protocols. For frequency band we select the ISM (Industrial, Scientific and Medical) and SRD (Short Range Device) frequency band at 2400-2483.5 MHz [3]. For this purposes the low power, low cost RF integrated transceiver CC2500 from Chipcon (now Texas Instruments) is showed to be a good choice. This integrated circuit can be controlled via SPI. Main operating parameters can be controlled, e.g. modem in CC2500 supports 2–FSK, GFSK and MSK modulation and bit rate up to 500kb/s.

Implementation of the wireless interface

CC2500 need for normal operating few additional passive components. Instead of external 50Ohm antenna we implemented folded dipole PCB (Printed Circuit Board) antenna. Since the impedance of the folded dipole is matched directly to the impedance of the radio no external matching components are needed [3]. External antenna supports longer range than folded dipole but complexity of circuit grows.

Dimensions of folded dipole are very important, so we took dimensions from manufacture data sheet. If we consider all recommended parameters for designing printed circuit board, we achieve optimal antenna radiation characteristic.

When constructing PCB it is very important to put decoupling capacitors close to power supply pins. It is recommended to cover all PCB with grounded plane *(Fig.1 right.)*. To achieve smaller module we decided to use SMD technology.

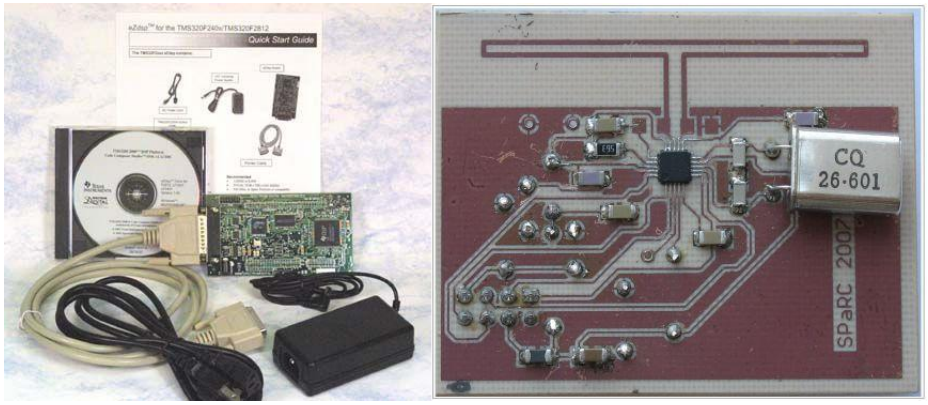

Fig. 1. Starter kit from Texas instruments (left), Finished wireless module (right)

Configuring of the wireless interface

In CC2500 many parameters can be configured for optimal deploying in different applications (e.g. bit rate, type of modulations, output power etc.). All parameters are configured via SPI. SPI consist of four data and control wire, SI (Serial In), SO (Serial Out), SCLK (Serial Clock) and CS (Chip Select). Since the configuring of CC2500 and SPI on DSP is very time consumption task, we prepared all basic function (in C program language). Student's task is to use this function in their own applications.

Controlling the car

A car-toy has two DC motors, one for driving and one for steering. For DC motor control we used PWM (Pulse Width Modulation) controlled H-bridge. PWM is generated by DSP. With PWM we can continuously control the speed and acceleration of DC motors.

Car-toy is remotely controlled over wireless link. Hardware, which enables this link, is on PC site equivalent to this one built in car-toy. It consist equal DSP board and wireless interface and is connected to PC over JTAG. Additionally, the PC is equipped with wireless camera receiver connected to USB port.

Car-toy can be controlled on twofold manner:

1. Over graphic user interface by use of keyboard or mouse.
2. By joystick intended for games and graphic interface, where are presented data in image from car-toy.

RTDX and LabView

If we want keep sending real-time data from PC to car we should use properly real-time interfaces. For this purpose we used Real-Time Data Exchange (RTDX) [2], a technology developed by Texas instruments. RTDX is a communication protocol that establishes data pipes for sending and receiving data to and from a DSP device while code is running. This protocol allows communicating directly to DSP code in real-time without interrupting the execution of code.

LabView [5] is a graphical environment which helps create scalable and flexible design, control, and test applications. With LabView we can interface real-world signals with PC and then processing them. LabView has one advantage: we can easy made user interface for controlling our device without writing programming code. LabView offering graphical programming language to easy create applications *(Fig. 2).*

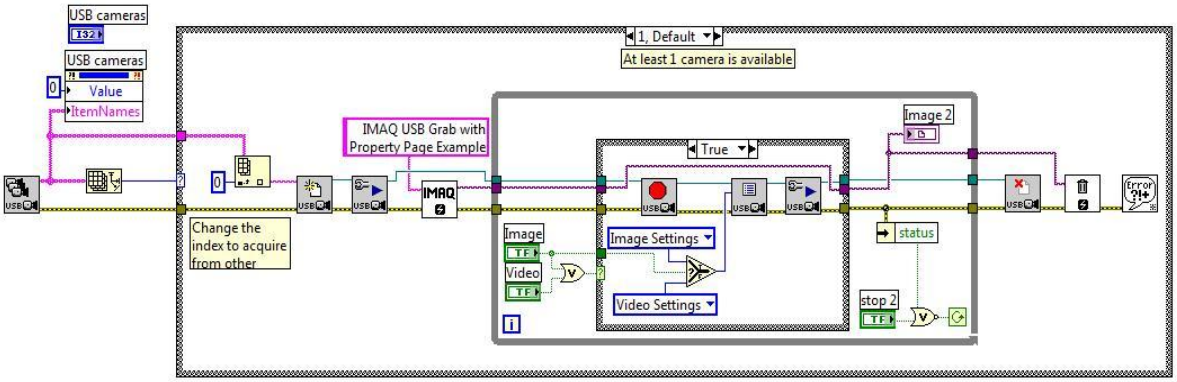

Fig. 2. Graphical programming interface

RTDX from Texas instruments is supported by LabView. So we can connect LabView and DSP via RTDX. With LabView students must implement steering control for car which means sending and receiving this data to and from the car. Further students must connect analog video receiver via USB TV card. LabView supports capturing video via USB *(Fig. 3 right).*

3. EXERCISES AND LEARN-BY-DOING

In previous chapters we described all parts of our remote controlled car. Student task is to put all described parts together, design the communication strategy, wrote communication protocols and user interface. Through exercises students meet at least two communications protocols: SPI and selected wireless protocol.

For the average students the main goal of exercises is to combine those communication protocols together, from advanced ones, who compete for excellent grade, is expected to write protocols from the scratch. For performing exercise, students can obtain exercise instruction and necessary data of components from lab WEB page.

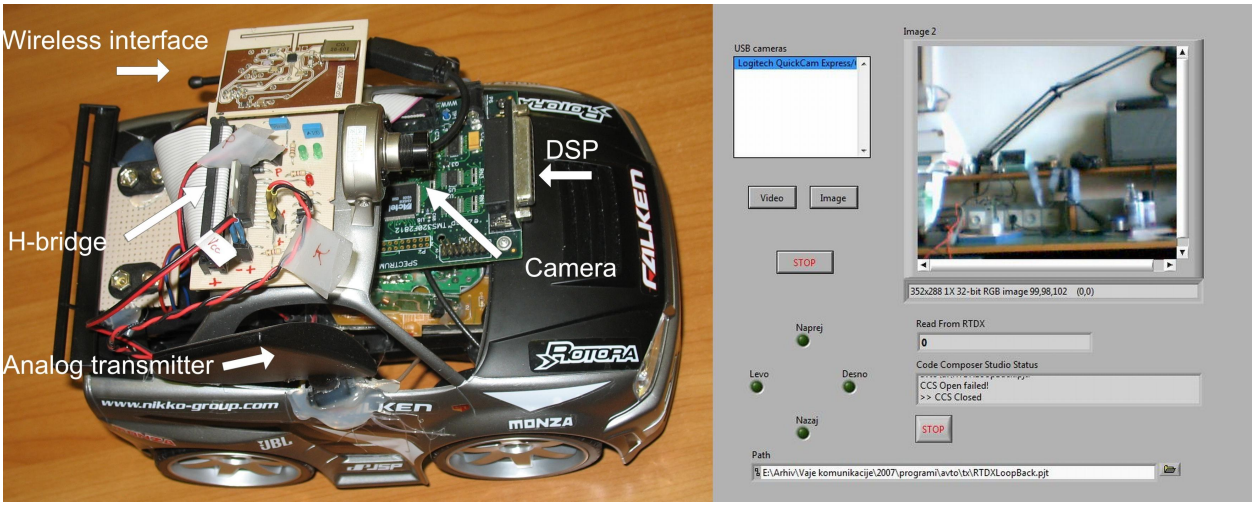

Fig. 3. Upgraded car (left) and user interface for controlling the car (right)

The PC, which is equipped hardware and program tools for remote control of car-toy, is also reachable to the students over Internet. This enables e-learning support in preparation to exercises as well to following to lessons and make the final exam. On the same way it can be used for illustration of communication theory at lessons in a classroom.

Student car racing competition

When all students groups finish their exercise application, they compete in car racing. It is performed in lab, where for competition we prepare ad-hoc racetrack by colour tapes. In the same time we artificially make the wireless link less reliable, so the quality of protocol design becomes the most important part of competition.

4. CONCLUSION

The renewed exercises showed that even students can easier learn trough game and competition. After introduction of the exercise all problems with participation of students on exercises as well on lessons disappear. The knowledge in communication system arises, the best students now able to design their own communication system.

In future we plan to make electronic kits for students who will be willing to construct own remotely controlled toy.

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SIMULATION TOOLS IN TELECOMMUNICATIONS EDUCATION PROCESS

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Abstract: This article contains a brief overview of suitable simulation tools available for education and research on network technologies and protocols. Our attention is directed towards the advantages and disadvantages of available tools, and the help to available educators or researchers when simply picking suitable simulation tools for their own needs. Among the mentioned tools is an introduction to OPNET IT Guru Academic Edition from OPNET University program, which is well-supported and freely available for teaching purposes.

Key words: simulation tools, communications, teaching, networks, modeling, OPNET

1. INTRODUCTION

Computer network development began in the late 1960's, arising from massive mutual linking needs between computer units into entire local networks. The first ideas and requirements came from companies, the military and educational institutions. The main concern was simple information exchanges', mass data transfers, and greater data-source exploitation. Such aspirations have many advantages, some of which are: reliability, alternative sources and cost efficiency, which nowadays represent capital driving wheel.

In order to study, understand, and exploit network properties or research new protocols, behavior etc, we need a computer tool, by which we can model, simulate and evaluate computer networks well as wired and wireless. Such a tool is also an excellent means when e-learning system forces students to "learning-by-doing". We will refer to this tool as a 'Simulator' in the remainder of this paper.

2. REQUIREMENTS FOR NETWORK SIMULATION TOOLS

A simulator must fulfill certain individual requirements, which can be combined into the following groups: general demands, implemented modules, statistical capabilities, outlet reports, manufacturer help and support for end-users.

General demands

Modeling flexibility is the ability to construct and define new communication protocols, hubs, links, data frames, stations, units, and so on.

Model development simplicity requires friendly and an easy to use interface. It should be possible to construct new model elements from small modifications of existing ones.

Fast modeling is an essential property in cases where models reach huge dimensions or in cases where the number of events is huge. This property clearly has economic roots. It is also important in critical situations which need cautious intervention into a real system.

Animation represents a basic element in the simulation procedure, which helps us to locate any faults and errors in a simulation model by changing icons color, position etc.

Automatic simulation execution with a changeable parameter enables observation of dependences between different parameters, e.g. dependence on delays in a local area network comparison with the number of network users. It requires multiple simulations, where each run has its own parameter [4], [5].

Needs upon implemented modules

Different kinds of implemented components have an effect on a smaller model's construction time. Components must be in complete accord with choosing real elements, available on the market (routers, switches, hubs, servers, computer units, protocols, token-rings, Ethernet, FDDI…). It is desirable, that we in simulation can use those specific elements, produced by certain manufacturers. For example, if we want to use Cisco's router series 7507 it should be available in the simulation library.

Component adaptability is the ability to create a new component, by changing parameters in accordance with our needs, or of an existing similar component.

Creating new components. In regard to the above statement it could happen that a similar component is unavailable. In this case we have to create a new one if this is supported by a simulation tool. In those cases where such a possibility is impossible, we are forced to use cognate components, but this decision can have an effect on any results' reliability [5].

Static capabilities of a simulator

Random numbers generator. The majority of events in networks have coincidental sources, for which we need a good generator for generating random numbers. It is desirable therefore; that they contain more-independent random flows with separately defined probability distribution.

Standard probability distributions. Most well-known probability distributions should be implemented into a simulator. Typical examples of probability distribution are: Gaussian, Poisson, exponential, equalization, Weibull distribution, and so on.

Empirical distribution is a characteristic that is closely connected to capability, where we can simulate individual sources with real measured values.

Random shut-out of individual components in a simulation process. This property is useful in cases where we want to observe rare events in system architecture, especially when a specific part of a network deviates from the normal operating manner. Rare-event simulation is useful for sensitive systems, such as military communication systems, bank transfer systems, and security systems [5].

Outlet reports

Calculations. The tool must included a function which can calculate averages, trust intervals, standard deviations, minimums, maximums, sum, count, etc. All acquired data must enable save possibilities in many different formats.

Standard reports. After network simulation, is interesting for us to note that that some network parameters such as end-to-end delay, equipment utilization, link utilization, queuing delay, dropped packets etc., are available in easily scanned standard reports.

Accommodation reports. Possibilities for their own design and creative reporting, looking at it from the content and form aspect, should be available to end-users.

Graphs. It is desirable that different graphical possibilities are available for data presentation, such as histograms, curve-graphs, circular-graphs, time-diagrams and so on. The tool's mechanism should also enable mutual comparisons between graphs for dissimilar simulation repetitions [5].

Manufacturers' help and support for end users

Today end-users support's a very important part of those program packets available on the market. Support can include advice at the point of sale, software installation guide, education process, technical support, online consultation etc.

Seminars. Software manufacturers must provide educational processes for customers at different seminar sessions if possible at the costumers abode.

Technical support about those errors, warnings, and faults, concerned with specific software packets.

Quality documentation enables easier use of software and greater utilization of all the possibilities offered by the program. Documentation should include a user's manual, a maintenance manual, described and illustrated examples, reference guides, video presentations, animations, model support with voice and pictures, demo presentations, online help, etc.

Upgrades and updates. These must be attainable and not too expensive. Updates, free of charge are usually similarly to software testing or software demonstrations [5].

3. TOOLS FOR NETWORK SIMULATIONS

OPNET Modeler is a graphically oriented simulation tool, which uses project e, node and process editors for building communication models. The project editor offers graphic topological description, whilst in the meantime the node editor is used for describing protocols. The process editor is an upgrade of C language, which uses a finite-state machine for algorithm and protocol descriptions. OPNET includes many standard communication models for constructing wired, radio, optical and satellite communication structures [7].

Network II.5 simulator is designed for the simulation of computer systems and networks. The main constructed parts are devices and programmable modules. In the device classes can be found process elements (CPUs), transfer mediums (bus, LAN), and storage units (hard drives, RAM). All elements are represented by icons, which afterwards must be mutually connected between each other, as in OPNET modeler case. A programmable module consists of an instructions sequence, and running and executing on process elements. They can be executed at different times using random distributions. Global variables (semaphores) are also available, which increase simulation flexibility [2].

SES/Workbench represents a graphically supported, electrical engineering simulation tool which also supports computer systems and communication modeling. The main components for communication modeling are nodes, links and transactions. A transaction represents message, forwarded with by oriented graphs. An oriented-graph is composed of nodes, links and special formulation which define hubs' and arts' behavior. These nodes are not the true nodes in the network, they just represent the activities on messages, for example, creating or destroying transactions, resource handling, and so on. The results are available in both graphical and numerical forms [3].

BONeS Designer, Plan Net and SatLab. (Block, Oriented Network Simulator) is also a graphically supported tool with the general intention of modeling communication networks. The main building blocks of these models are data structure, and a block diagram. The first of these represents messages and the second defines how the messages travel though the network. Results are available in both, graphical and numerical forms. SatLab is an additional software packet for satellite systems modeling [6]. BONeS Plan Net is a specialized simulator for local area network simulations.

COMNET III. It is an object-oriented simulator for LAN and WAN network architecture. The main parts (nodes, links and traffic sources) are represented by icons. The user must connect hubs with links and put traffic sources onto certain such linked-nodes. Properties are defined through dialogue boxes. Reports are available in all forms. Flexibility can be achieved by Object-Development which allows the creation of new parts or changes the existing [1].

4. OPNET IT GURU ACADEMIC EDITION

OPNET IT Guru Academic Edition [8], as shown in Figure 1, is a free-of-charge simulation tool, offered from the manufacturer of OPNET, and is intended for educational University programs. It is useful within education process concerned with communication technologies through practical simulation examples. With Opnet IT, we can acquaint under graduate or

postgraduate students with the basics of different communication architectures, such as PSTN, ISDN, cable networks, xDSL technologies, fiber networks, and also wireless like Wi-Fi, GPRS and UMTS. Within the widely-supported construction parts' library can found computer workstations and servers, routers, switches, bridges, stars, access points, links, firewalls, gateways, servers etc. Software is user-friendly, because the whole application can be constructed in a graphical project editor. There are also buttons for observing chosen statistics, graphs, and buttons for running simulations. Each component has changeable attributes, such as; name, queue length, traffic statistics, routing protocols etc. With special components, such as "Application Config", we can define the behavior of traffic source generators, according to the required applications, such as video conferencing, VoIP, FTP, web browsing, base access.

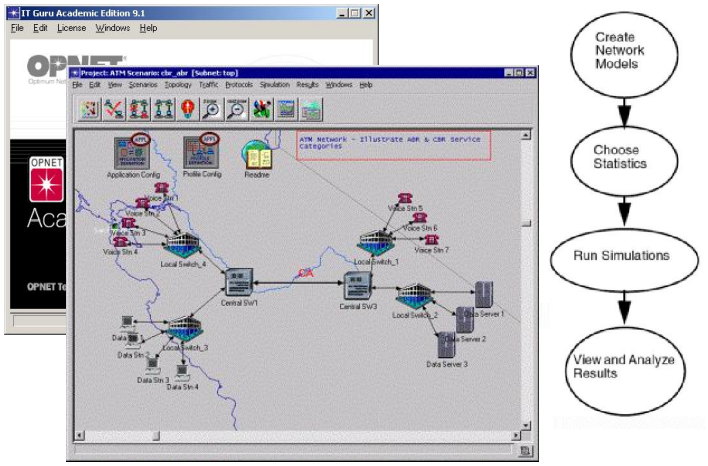

Figure 1. Simulations in OPNET IT Guru. Left: example scenario. Right: Simulation procedure

5. CONCLUSION

OPNET IT Guru is very similar to an OPNET Modeler, as described in section 3. The main differences are, that it does not include a process editor and the possibilities of editing code level in C language. From that aspect, we cannot change existing communication models or create new components. Maximum network expanse, which can be simulated, is also bounded in OPNET Guru. In spite of this entire Guru is especially suitable for educational processes during Faculty undergraduates programs. For research proposes and educational processes for post graduated study programs the OPNET Modeler is a more suitable choice. This Modeler is also available through the OPNET University program but is not completely free of charge like IT Guru.

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MOTIVATION FOR STUDYING BIONANOTECH AS FUTURE PRODUCTION TECHNOLOGY

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Abstract

Generally speaking, bionanotechnology, abbreviated as BioNanoTech, represents a spectacular combination of natural sciences with already established production technologies in various applicable fields, as chemical, pharmaceuticals, electronic and mechanical industry. More in-depth definition of bionanotechology is formulated as novel technology with promising potentials to plan, fabricate and utilize functional structures with typical nanometer dimensions. An enormous interest in the preparation and utilization of nanometer size materials is constantly growing since they can exhibit better or even thoroughly new properties of great industrial importance. Additionally, bionanotechnology is oriented toward the benign production of harmless nanostructures with no serious consequences on the environment and human health with the emphasis on improving our everyday life. Within the most common nanomaterials produced are selected the following: nanoparticles, nanofibres, nanotubes and nanofilms, also composite nanomaterials are very much appreciated. Altogether they can serve to different purposes, as drug carriers, biomimetic surfaces or even building blocks in modern microchips.

The research in nanotechnology field is supported by almost every developed country in the world, especially by the United States that are doing huge investments to fully develop this rapidly growing technology. Some nanomaterials, as polymers with inteligent properties, are highly represented also in Slovenian private companies, opening future possibilities for development of nanotechnologies in thorough Slovenian territory. Anyway, the implementation of NanoTech studies into under- and post-graduate studies is quite difficult due to its interdisciplinary nature. However, despite its starting developments it is becoming a promising future production technology.

Key words: bio- nanotechnology, nanomaterials.

1. INTRODUCTION TO BIO- NANOTECHNOLOGY

Nowadays, bionanotechnology is becoming a powerful tool for creation of tiny synthetic structures, named nanometer size materials, at the molecular level only by combining properties of biological-like materials with basic rules of physics and chemistry, respectively. Due to its ability to produce highly functional systems at nanoscale dimensions, its applications have spread to different fields of engineering and science in recent years. Besides, the promising development of biomedical technology based on nanotechnology means, even it is still in its infancy stage, has to be mentioned herein.

Nevertheless, there are several advantages of nanometer size materials that shall justify the enormous interest for preparation of nanomaterials at industrial scale. Mainly the properties related to the increased surface reactivity of nanometer size materials have bring a lot of

benefits to the application of nanomaterials in industrial and scientific fields. Furthermore, the reduced size of nanostructures generates other beneficial properties that are fundamental for proper application of nanometer size materials as simple, cost-effective generation processes and especially the fact that the produced nanomaterials are lighter in comparison to normal materials. On the other hand the properties of a specific type on nanometer size material can be additionally controlled, depending on its preparation process and application, respectively [1,5].

It is claimed that the nanotechnology market will be increasing drastically in the next years since the usage of nanometer size materials can be implemented successfully in almost every industrial branch as chemical, pharmaceutical, mechanical, even in the fields of energy and electronics. A list of current and future applications of nanotechnologies is summarized in the table below (Table 1).

Since the area of nanotechnologies, comprising advanced materials and new production technologies, is part of the European priorities in the 7. Framework program, it is obvious that Europe is paying a lot of attention in developing a well qualified research personnel with good expertise and skills in the nanoscience field [1].

Table 1 – Insights into current and future nanotechnology applications [1].

		Production	
	Massive	**Starting**	**Up-coming**
Application in			
Materials	Autocatalysts	Nano-composites, Catalysts, Textile resistant to spots, Inteligent polymers	Colors without pigments
Electronics	Sensors	Microscopes, CNT/P -lamps	CNT-brushes and displays, superconductors CNT, SiO_2, Si, Cu
Computers	-	Magnetoresistance head for HD, Lifelong memory	Faster computers
Optics	-	Optic fibres	Lenses
Automobile	-	Lighter materials for bumpers, windshield	Long life tire
Medicine/ Biomedicine	-	Cell labeling, MRI Imiging	DNA detection, nanoimplants, diagnostics: tumor detection, magnetic particles for cancer therapy
Pharmacy	-	-	Drug delivery, nanoparticle formation
Safety	-	Mine detectors	Balistic protection based on CNT
Ecology	Water filtration	Dehalogenizer based on Ni chemistry	-

CNT: Carbon nanotubes; P: Polymer; HD: Hardware; MRI: Magnetic Resonance Imaging; DNA: Deoxyribonucleic acid.

2. PRODUCTION OF NANOMATERIALS

Nanomaterials are classified according to the number of dimensions that lie within the nanometer range. Usually, it is assumed that nanomaterial is defined as a nanoproduct that should have at least one dimension smaller than 200 nm, even if smaller value than 200 nm is preferable. Generally three types of nanostructures exist, those confined in three, two and one dimension, respectively. Following this statement, nanoparticles are typical three-dimensional nanostructures, whereas systems that confined in two dimensions include nanofibres, nanowires and nanotubes. Within nanostructures exhibiting only one-dimensional confinement are nanofilms and other nanolaminated materials [5,6].

A wide variety of nanosized structures of high industrial relevance can be obtained by applying different production processes. All of them obey two main approaches in the production of nanomaterials: top-down and bottom-up approach. Currently, top-down or degradation-based processes are much in use, where the production of nanomaterial is followed by controlled degradation of normal size material as lithography or sol-gel technology for nanoparticles generation. On the contrary, bottom-up or generative technology actually represents the self-assembly of small building blocks at the molecular scale into nanosized material as the self-formation of particles by precipitation from a fluid phase. The production of nanomaterials can be various. Different production processes are used: chemical synthesis, molecular self-assembly, sol-gel processes, plasma processes, laser application, electrodeposition, gas and water atomization, lithography and others [1].

Recently, supercritical fluids (SCFs) based processes have also been proposed as media for nanomaterials production. Supercritical carbon dioxide (SC-CO_2) as the most widely used supercritical fluid is heralded as environmentally benign and cheap. Furthermore, the easily tunable solvating power of SC-CO_2 facilitates relatively easy separation of reactants and products at the end of the process. Supercritical fluids are suitable particularly for nanoparticles production by applying different operating processes. These include the rapid expansion of supercritical solutions (RESS), the particles from gas-saturated solution processes (PGSS), the gas antisolvent process (GAS), and the supercritical antisolvent process (SAS). Furthermore, it is possible to produce particles by precipitation from pure biodegradable substances or rather by techniques involving coating of particles that contain bioactive components [2,5,6].

The use of supercritical fluids in high pressure range is becoming more and more important in the pharmaceutical field. In recent years, processing of pharmaceuticals with supercritical fluids, especially with supercritical carbon dioxide, has gained increased attention, since its use in material, extractive, chromatographic and biochemical applications is recognized as environmentally friendly reaction media. For pharmaceutical use, PGSS method is more recommendable over other SCFs methods as RESS processing technology since it requires lower operating pressures, also the CO_2 consumption is significantly lower [2]. Despite all, supercritical fluids assisted techniques are becoming an important ready-to-use formulation of particles in micron- and nano- region [4].

3. NANOTECHNOLOGIES IN SLOVENIA

In Slovenia the research in nanotechnology is actually following the European investigation trends concerning the generation of nanoparticles and polymers with intelligent properties mostly for biomedical purposes. The interdisciplinary nature of nanotechnologies has forced many of the Slovenian research institutes and faculties to cooperate jointly in order to improve and integrate the research based on nanotechnologies in Slovenia. Undoubtedly, nanoscience in Slovenia is outstandingly well established resulting in its progressive growth and participation in European research projects regularly. With the help of Technological platform for Advanced materials and technologies or NaMat, coupled to European technological platform or EuMat, seems that huge investments are being made in the field of advanced materials and production technologies with the common aim of all participants to fulfill all research and developmental priorities, regarding advanced materials, fully and successfully [1,7]. NaMat is currently covering all life cycle segments of highly engineered materials, including highly functionalized materials and responsible production technologies. The development of new materials for different purposes in engineering, electronics and microelectronics, also the development of polymeric materials, especially elastomeric polymers, are becoming important investigation routes also in the Slovenian research sphere.

The development, production and application of advanced materials are well supported by many Slovenian research companies of big reputation as Magneti Ljubljana, TECOS, Veplas, Iskraemeco, Sava, Plasttehnika, Poilieko, Kolektor, Feriti, Isokon, ETI Izlake and others.

Moreover, some research and educational institutes which are working on development and production of advanced materials are Institute Jožef Štefan, National Institute of Chemistry, Nanotesla Institute, University of Nova Gorica, Faculty of Mechanical Engineering, Faculty of Electrical Engineering and Computer Science and Faculty of Chemistry and Chemical Engineering [2,3,4] at the University of Maribor, respectively. As seen, Slovenian research and industry are well prepared to accept nanoscience as potential production technology.

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STUDENT PRACTICES CONNECT BETWEEN FACULTY AND PROFESSIONAL

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1. INTRODUCTION

Student Practices are very important part of higher education teaching process. Teaching is delivered outside of the traditional classroom. Students, mentor at company, tutor at faculty are collaborating in higher education practice. We can divide student practice in tree time periods: pre teaching time, core teaching time and past teaching time. In each time period all participants need specified information to perform your job. We have been planning Student Practice Information System since 2000. At the beginning we didn't have regular information system for this part of education process. The new information system has been basing on future oriented technology and we have been opened our project for all new idea. In perform practice education is delivered through the use various media components. Structure refers to service methods that convey information and allows interaction between professional and students. A good tutor-mentor seeks as many ways as possible to present information and ideas to students – that is a point of our work. The system is being helpful for students and companies to find all information over student practice. At the beginning of use information system presented only 20% companies on Internet and mentors at companies were much more closed with phone as with Email and Internet. The first experience wasn't excellent, but nowadays the situation is much better. Nowadays we estimated that in Slovenia are over 90% companies presented on Internet and much more companies are closed with new IT technology. We introduced in information system new information parts that are not usually in classical education information system: on-line practice exchange system and on-line internet graphical analysis. These new parts are important for today student practices; it has to be fast and successful.

2. INFORMATION STRUCTURE

The company's managers find on web site teaching programs and formal E contract. Also they can put practice offer in to practice exchange system. The E connection between company and faculty are established. Online resources on web server help students to search for free practice place. The most useful aspect of on line delivery is its search potential and communication features it offers. For example, student find free place on web and it can online communicate with his company manager. Administrations have graphical statistical data over practice progress in real time. The information system stores student exercises and reports. Practice work coordinator can help students by performing remote educations. All-important teaching event are sorted in ascending order in database.

Secondary product of practice semester is big knowledge base, which consists of practice student's reports. Every student writes after practice detailed report. People can access over Internet to various technical knowledge data – this is very good for faculty public relation.

3. INFORMATION ON INTERNET

The Internet part of information system is a web site that is a collection of web services. This means that web services are active web pages and his content manager has been changing of information in active server pages. Web practice exchange include major web pages: Companies offer, Company activities, New Company and For Partners. For Partners is secure web page and allow you to create or edit various class data information that is presented on web page Companies offer. Content manager for web page Company activities are database section Students and Companies. It exist a graphic layer between the classic web pages you read and services web pages. This is a powerful concept: The exchange web services need an access to central database and classic internet pages enables web designers to produce sophisticated, full-featured sites in minutes without big programming. Active web pages created by expert, but his content can be change only over database – is has been happen automatic in information system.

Figure 1 practice exchange system on web

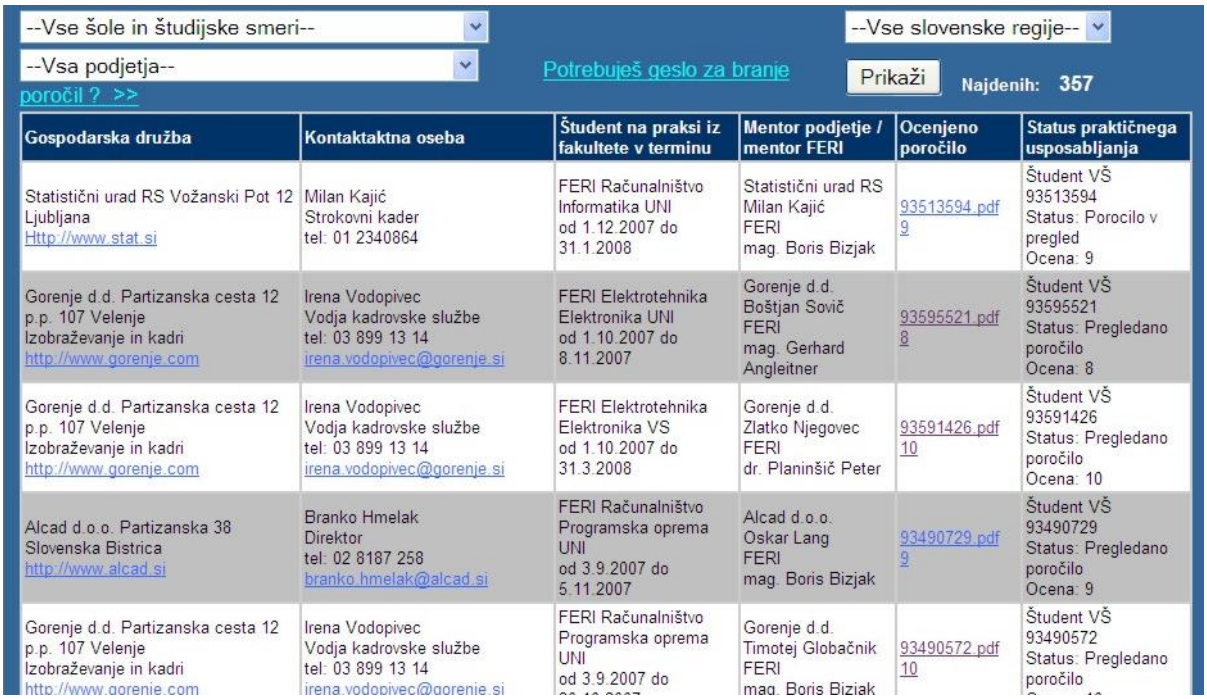
4. LOCAL INFORMATION

The classic part of information system is windows forms connected to database. We have been using relational database Microsoft SQL Server. In general, windows forms are design to be use from local area network, but today users can access to windows forms remote any ware, windows remote services made this possible. Client software for remote access is a simple terminal program. Way we use windows forms? The reason is historical aspect. Windows developer has been having all time powerful tools to develop multimedia windows forms. Internet server sides applications haven't been advanced developer tool to comfortable develop applications for six years. Nowadays the situation is different. Here are powerfully developer's tools like Java and NET. Form Students and Practices cover a general student's data, exams and practice semester performer. In form Company and Practices are stored general companies data and related (linked) practice educations data. Event log window are read only form and presented important information about changes in database. It has been filling after events (changes) in sections Companies or Students. Application is forming for multi user usage, for example: If write teacher estimated value for exam to form Students and Practices going to add one record to redundant database.

5. STUDENTS AND PRACTICES

In this form have been annotating all data about our students. We stored all usual students' data in formats and structure that allow data presentations on maps – it is innovate to classical personal data structure. The section is designed to support education curses and to register sensitive events in education process. We have introduced new education performer – that is a mentor at company and tutor at faculty. The implementation of new technological elements has been making information system ready for multimedia use. It is possible to store technological different types of information in database – not only text and number. Multimedia files have been stored in database embedded or linked.

Internet and windows part of information system use the same database. It is important to say, that windows forms or better information on this windows forms are accessible on Internet part of information system.



--Vse šole in študijske smeri--

--Vsa podjetja--

--Vse slovenske regije--

Potrebuješ geslo za branje

Prikaži

Najdenih: 357

poročil ? >>

Gospodarska družba	Kontaktaktna oseba	Študent na praksi iz fakultete v terminu	Mentor podjetje / mentor FERI	Ocenjeno poročilo	Status praktičnega usposabljanja
Statistični urad RS Vožanski Pot 12 Ljubljana Http://www.stat.si	Milan Kajić Strokovni kader tel: 01 2340864	FERI Računalništvo Informatika UNI od 1.12.2007 do 31.1.2008	Statistični urad RS Milan Kajić FERI mag. Boris Bizjak	93513594.pdf 9	Študent VŠ 93513594 Status: Porocilo v pregled Ocena: 9
Gorenje d.d. Partizanska cesta 12 p.p. 107 Velenje Izobraževanje in kadri http://www.gorenje.com	Irena Vodopivec Vodja kadrovske službe tel: 03 899 13 14 irena.vodopivec@gorenje.si	FERI Elektrotehnika Elektronika UNI od 1.10.2007 do 8.11.2007	Gorenje d.d. Boštjan Sovič FERI mag. Gerhard Angleitner	93595521.pdf 8	Študent VŠ 93595521 Status: Pregledano poročilo Ocena: 8
Gorenje d.d. Partizanska cesta 12 p.p. 107 Velenje Izobraževanje in kadri http://www.gorenje.com	Irena Vodopivec Vodja kadrovske službe tel: 03 899 13 14 irena.vodopivec@gorenje.si	FERI Elektrotehnika Elektronika VS od 1.10.2007 do 31.3.2008	Gorenje d.d. Zlatko Njegovec FERI dr. Planinšič Peter	93591426.pdf 10	Študent VŠ 93591426 Status: Pregledano poročilo Ocena: 10
Alcad d.o.o. Partizanska 38 Slovenska Bistrica http://www.alcad.si	Branko Hmelak Direktor tel: 02 8187 258 branko.hmelak@alcad.si	FERI Računalništvo Programska oprema UNI od 3.9.2007 do 5.11.2007	Alcad d.o.o. Oskar Lang FERI mag. Boris Bizjak	93490729.pdf 9	Študent VŠ 93490729 Status: Pregledano poročilo Ocena: 9
Gorenje d.d. Partizanska cesta 12 p.p. 107 Velenje Izobraževanje in kadri http://www.gorenje.com	Irena Vodopivec Vodja kadrovske službe tel: 03 899 13 14 irena.vodopivec@gorenje.si	FERI Računalništvo Programska oprema UNI od 3.9.2007 do	Gorenje d.d. Timotej Globačnik FERI mag. Boris Bizjak	93490572.pdf 10	Študent VŠ 93490572 Status: Pregledano poročilo

Figure 2 all important data for students are on web

6. COMPANIES AND PRACTICES

The form companies present basic information from companies, managers and employee. The core information is the same that we know from much business information system, bath we add same information that are related to specific function of company in practice semester. We add two specific info's: free practice places and linked educations to company. Information on this form is directly connected to Internet pages Company Offer and For Partners. The database structure at information system are partitioned in many small tables and relationships are complex, bath this is a way to easy working with information. The reports are printed forms and have been based on two different types of filter: filter by form and filter by selection. How do you compose reports with multimedia files? It is dependent from media, but nowadays we use

embedded formatted text. Same reports presented on line statistical data with graphs at Windows and Internet.

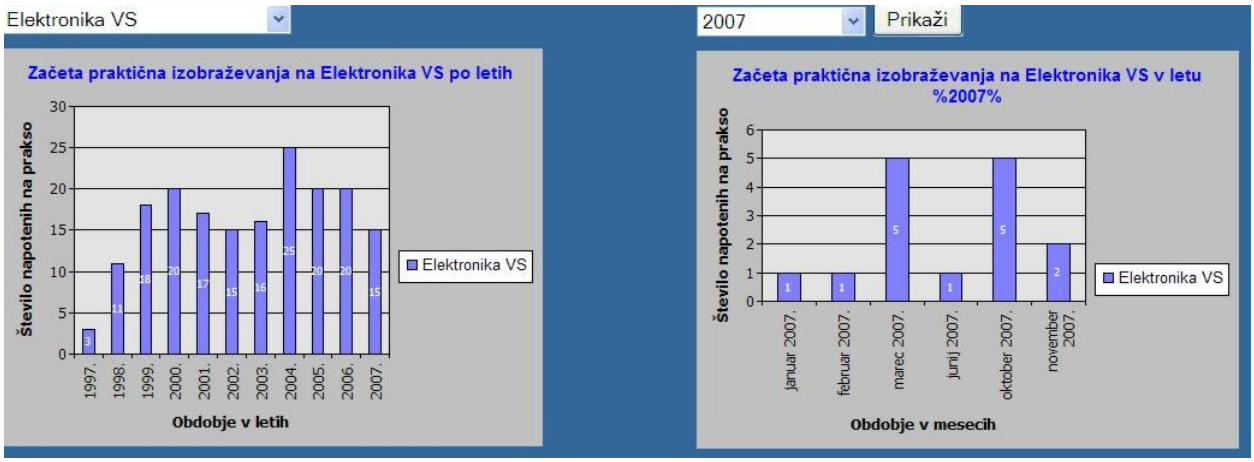


Figure 3 on-line statistic on web

7. CONCLUSION

This paper discusses practice of distance education and explains the main issues involved in planning, developing and using resources for distance educations. In practice semester teachers are separated from their students. Workplace trainers provide counsel and guidance. Professional or business people provide useful training and schools have to provide access to information resources. The central point of distance education is an information system.

If you are tutor in practice semester you have been hearing students question: How I find a company for start a career. Second question has been sending company: How we find developers for a firm. We will answer questions with use of Information Technology. The perspective of use Internet and multimedia in education are big, but other wise this paper proposes that an effective multi media education requires careful planning and teaching by experienced educator. You can test Internet part of information system at **http://praksa.uni-mb.si**.

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INTERACTIVE SAR PROCESSING LEARNING WITH POLSARPRO

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1. INTRODUCTION

SAR processing was first introduced by the Apollo 17 lunar mission and later on updated with SeaSAT Atlas in 1978, which was launched primarily for monitoring the global oceans [1]. SAR is a form of radar with intensive and sophisticated post-processing of radar data and this processing responds as a very narrow effective beam. This technique can be used for detection of still and moving objects [2], but it is also present in remote sensing for instance soil characterization and in construction of 3D digital elevation models [3]. Because this processing require extensive knowledge in SAR processing field, it is convenient to show simple example on our chosen educational tool where the whole processing can be done with just a few clicks and poor understanding of the entire SAR processing course.

2. SAR PROCESSING TECHNIQUES

Synthetic aperture radar needs sophisticated post-processing in order to retrieve precious information from collected radar data. To get good spatial and radiometric resolution one has to remove platform motion imperfections with onboard captured data from inertial systems and GPS sensors.

a. Basic operation

Typical SAR processing system [4] will include a single antenna mounted on a platform. This platform can be an aircraft, satellite or even antenna mounted on bar where one can only watch static scene. On the flat terrain it takes a certain amount of time for bear to travel from platform to terrain and this can be interpreted as intensity of image pixel. A series of captured emitted pulses of same ground area can be put together to form seemingly larger antenna, which creates synthetic aperture larger than the actual length of the antenna.

b. Interferometry

Phase information can be extracted from SAR images [5]. Two slightly different observations of the same terrain improve resolution as if it were collected by an antenna as large as the separation of two observation points. In literature this technique is called interferometric SAR or InSAR.

This technique is very popular, because with two different observations one can estimate ground topography in 3D space. If the SAR images capture the same ground segment, but in different time, one can estimate the ground motion from the phase difference. The detectable phase difference corresponds with used wavelength. With along track polarimetry it is possible to monitor traffic on roads [2]. This is very convenient way of determining traffic jams on roads, which are suffering from a lack of traffic monitoring sensors.

c. DEM generation

As mentioned above the terrain height can be estimated with interference effects [3]. This technique using SAR interferometry is widely used for digital elevation models generation. However, the height resolution is strongly dependent on the platform geometry and baseline at the time of acquisition.

SAR interferometry produces phase difference from two different observations of the same ground spot. Computed coherence presents correlation between these two images and represents fundamental data for DEM generation.

d. Differential Interferometry

Differential interferometry (D-InSAR) [6] image is constructed from DEM and two additional images. These images must be taken some time apart unless the change in motion will not be apparent. Minimal number of images is 3 where the first interferogram is created from first two images (reference interferogram) and the second one from the last two images and captures topography with ground motion. Subtraction of these two interferograms produces differential fringes which are proportional to ground movement.

3. AVAILABLE SAR PROCESSING SOFTWARE

There exists quite a few SAR processing software with their pros and cons. Some programs fall under general public license and are free of charge, but on the other hand specialized SAR processing software can be quite expensive. Our goal is to present a few available software packages that are in common use in SAR processing.

a. SARscape

For ENVI software package an add-on product named SARscape [7] is available. This package is specialized for processing of SAR/InSAR data sources and goes hand in hand with ENVI. It was developed for ENVISAT or RADARSAT data processing applications, but the latest version also adds support for TerraSAR-X satellite. This add-on gives users the ability to process spaceborne SAR data, topography extraction information, analysis of temporal changes, production of georeferenced information and forms of data classification.

This software package contains almost all desired functions for SAR processing, but there are only three directly supported platforms. SARscape is not for free and this brings inevitable costs for effective lectures. It is worth mentioning that ENVI is commercial software and needs a license, which brings even more expenses.

b. Radar tools

RAT or Radar Tools [8] is very powerful open-source software, which falls under Mozilla public license. This software also includes many different algorithms for processing SAR remote sensing data. However, this program is still under development and therefore includes only basic and limited SAR functionality. RAT is only intended to bring modern SAR algorithms to the public and thus having simplified data handling and complex data processing.

Pros of this software package are public license and free distribution. This means that more and more algorithms will sequentially be added to this tool. There is also a step-by-step description of included algorithms, which makes program less complicated for newer users. Cons can be found in software environment, which demands ITT IDL virtual machine (can be downloaded and used free of charge), but if we want to take full capability or even contribute to development, we still need commercial IDL software package. A major drawback is also a user interface, which is constructed with IDL API function calls to graphic object classes.

c. PolSARpro

PolSARpro [9] is a free of charge educational tool intended to SAR data processing and learning algorithms such as PolSAR segmentation, surface characteristics estimation, speckle filtering etc. It includes a large and descriptive help not only how to use program, but it has lectures on polarimetry SAR, descriptions about the effects of algorithms used in processing and even lecture slides. Therefore it can be interactively used as a supplement to ordinary lectures. Therefore undergraduate or postgraduate students get acquainted with different SAR polarimetry processing techniques and their algorithms through simple testing data sources acquired with different SAR platforms without extensive understanding of SAR processing

theory. With this tool students can handle SAR data sources obtained by airborne platforms, such as AIRSAR, SAR-580, EMISAR, E-SAR, Pi-SAR and RAMSES. Software package also includes handling with space-borne platforms, which are ALOS PALSAR, Envisat, RADARSAT 2, TerraSAR-X and SIR-C. Software is user friendly, because the program is designed in tcl graphical language in which user can process data with just a few clicks and parameters. This package even has the ability to represent user with pictures of platforms and their names, so the user does not hesitate in selecting which processing branch to use with obtained data. Each selected platform opens up a new menu, which is constructed only with algorithms and procedures applicable to desired data source. In this way it's impossible to mix up algorithms and produce rubbish segmentation results.

3.3.1 Simple example in PolSARpro

Our example will show how to import and process data taken from AirSAR over San Francisco. The main program menu is shown in Fig. 1.

Figure 1: Main PolSARpro menu

Then the user has to click on the AirSAR button and point to data source file. This example source file is in a single complex look format. After that the full extraction of [T3] matrices is done on the source data and the Pauli color coded image is automatically generated during full extraction process. This image can be seen on Fig. 2.

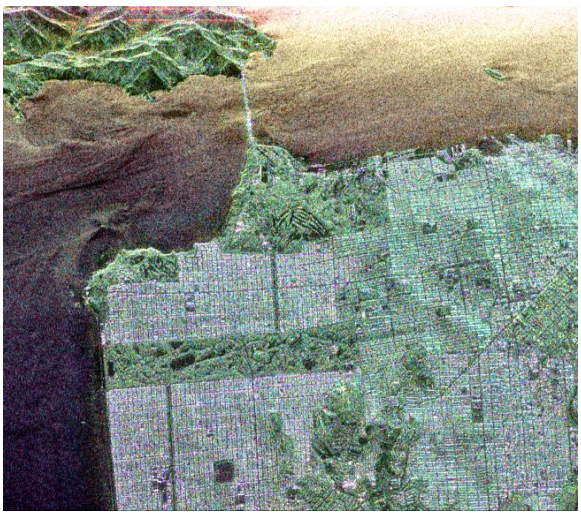

Figure 2: Pauli color coded image of San Francisco

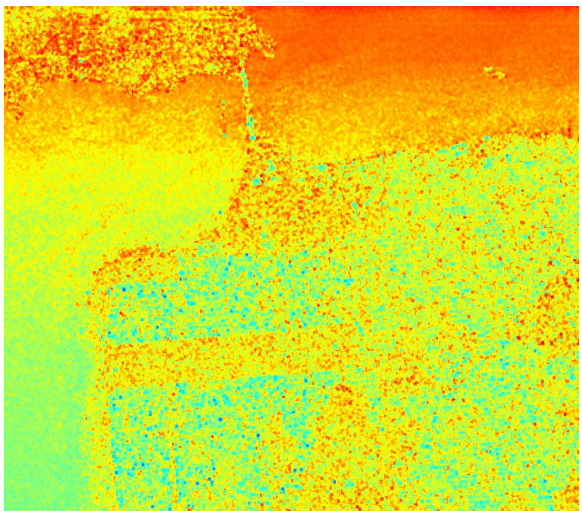

Figure 3: Extracted aplha channel parameters

The image parameters such as alpha, beta, gamma, delta, lambda, entropy and anisotropy can be extracted. These parameters are needed for further polarimetric segmentation. Therefore the user has to extract parameters, where the result of the alpha channel can be seen on Fig. 3. The window size was set to 5 pixels. Moreover the segmentation result obtained with polarimetric H/A/Alpha segmentation technique can be observed at Fig. 4.

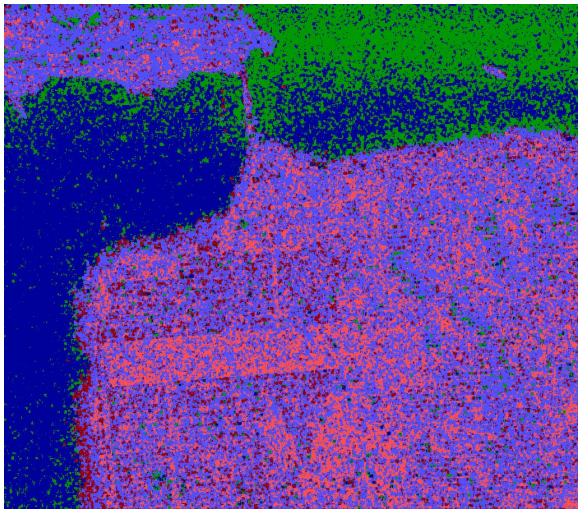

Figure 4: H/A classification result

Figure 5: Refined Lee filter applied on Fig. 2

It is also possible to filter original Pauli color coded image of San Francisco with different speckle filter algorithms. These include Box car, Gaussian, IDAN and J. S. Lee refined filters. The demonstration result shown in Fig. 5 was obtained with refined Lee filter with number of looks equal to one and window size 7.

4. CONCLUSION

PolSARpro is really the best choice in polarimetric SAR data processing and learning branch. Its unique graphical user interface makes it easy to interact with all supported data sources and their algorithms. The processing of different data sources is limited by the number of supported platforms, but the program is still under development and every now and then new tools or algorithms are added. This educational tool makes it possible to see source code of desired algorithms, which is in fact impossible in professional alternatives. Therefore it is quite popular by students visiting polarimetry lectures and is easily accessible over the internet.

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WEB Classroom for Protel Design learning course

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6. INTRODUCTION

Distance learning, is a field of education that focuses on the technology, and instructional systems design that aim to deliver education to students who are physically away. Teachers and students may communicate at times of their own choosing by exchanging printed or electronic teaching material, or through technology that allows them to communicate in real time.

Distance education courses that require a physical on-site presence for any reason including the taking of examinations is considered to be a hybrid or blended course or program. There are many private and public, non-profit and for-profit institutions offering courses and degree programs through distance education. In the twentieth firs century, the Internet is the medium for further distance education. The increasing popularity of mp3 players, PDAs and Smart Phones has provided additional mediums for the distribution of distance education content, and some professors now allow students to listen or even watch video of a course. Distance education has trouble when students have to the tests materials. Technical engineering education is very practical oriented and because of that we are presenting possibilities of distance learning in some application using implementation.

7. LAB SERVER APPLICATION

Protel 99 SE is a complete 32- bit electronic design system for Windows platforms. It provides a completely integrated suite of design tools that lets you easily take your designs from concept through to final board layout. Protel 99 SE brings the new level of integration to the EDA desktop. Unlike other tool suites that provide separate applications for each phase of the design process, all Protel 99 SE tools run within a single application environment – the *Design Explorer*.

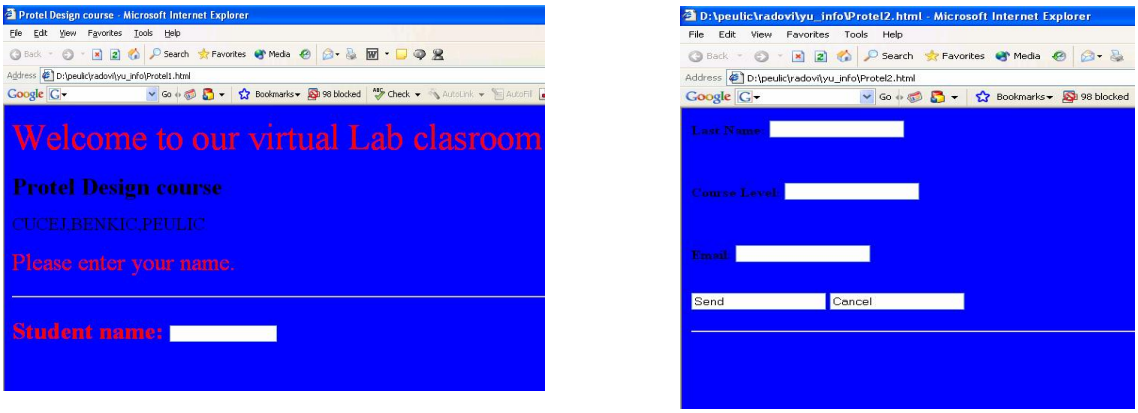

Figure 1. (a) Welcome page, (b) Filling form

When you start Protel 99 SE the Design Explorer opens, putting all your design tools at

your fingertips. You benefit from a single, consistent, customizable user environment – no need to grapple with different applications for different design tasks.

We are poposing a server application for a distrance learning Protel 99 training course. Fig 1a. shows a welcome page where students loging in th course entering the Student name. The Student name is a real name or allias and at the next page (Figure 1b) student fills a course form: last name, a course level: beginer, midle, high and email address. Finally the send button is pressed. If student is registered the course can stars.

9. NEW DESIGN START

Clicking BEGIN will start installation guide. Installing Protel 99 SE will offer you all the tools you need to produce sophisticated designs with unprecedented speed and ease.

To start Protel 99 SE and open the Design Explorer, select Protel 99 SE from the Protel 99 SE Program Group in the Windows Start menu – the Design Explorer will open, ready for work. Working in the Design Explorer is just like working in the Windows File Explorer – if you are familiar with the Windows Explorer then you are ready to go. Create a new design database by completing the following steps: Close any design databases that are currently open, select File „New“ from the menus. The *New Design Database* dialog will appear, Figure 2a. Two types of design storage options are available – a MS Access Database, where all the design documents are stored within the one database file on the disk drive (Windows File System), where the design documents are stored separately on the disk drive.

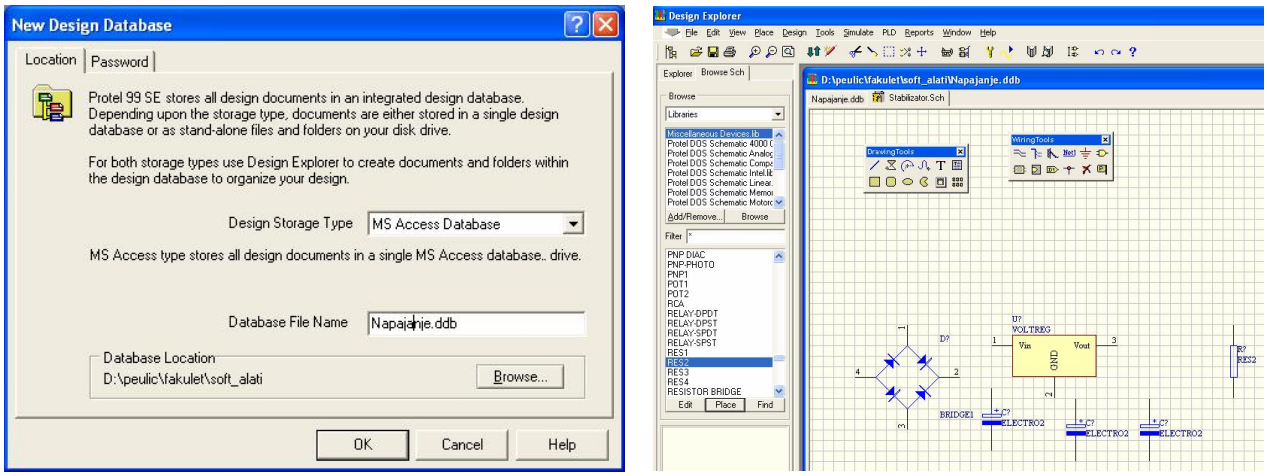

Figure 2. (a) The New Design start, (b)The Schematic Editor

10. SCHEMATIC DESIGN

To create a new blank schematic sheet, in the *New Document* dialog click on the Schematic Document icon to select a new schematic sheet, Figure 2b.

When the blank schematic sheet opens you will notice that the workspace changes. The main toolbar includes a range of new buttons, two new toolbars are visible, the menu bar includes new items, and the Panel changes to include schematic component library management tools.

You can customize many aspects of the workspace. For example, you can reposition the two “floating” toolbars. Simply click-and-hold the title area of the toolbar and move the mouse to

relocate the toolbar. To "dock" the toolbar, move it to left, right, top or bottom edge of the main window area. To find out how to customize other aspects of the workspace, see the topic, *Using the Design Explorer*, in the main help file.

Before placing the part on the schematic, first edit its properties. While the component is floating on the cursor, press the TAB key. This opens the *Part* dialog for the component. In the Attributes tab of the dialog set the following values: for Footprint, Designator. Leave all other fields at their default values. Click the OK button to return to placement mode. You are now ready to place the part. Move the cursor (with the transistor symbol attached) to position the component a little left of the middle of the sheet. Once you are satisfied with the component's position, left-click or press ENTER to "place" the component onto the schematic. Wiring is the process of creating connectivity between the various components of your circuit.

Schematic diagrams in Protel 99 SE are more than just simple drawings – they contain electrical connectivity information about the circuit. You can use this connectivity awareness to verify your design. To do this, perform an Electrical Rules Check (ERC).

11. PCB DESIGN

To create a NEW Printed Circuit Board (PCB) click Begin at NEW PCB START and PCB guide page shows, Figure 3a. Before you transfer the design from the schematic editor to the PCB editor you need to create the "blank PCB".

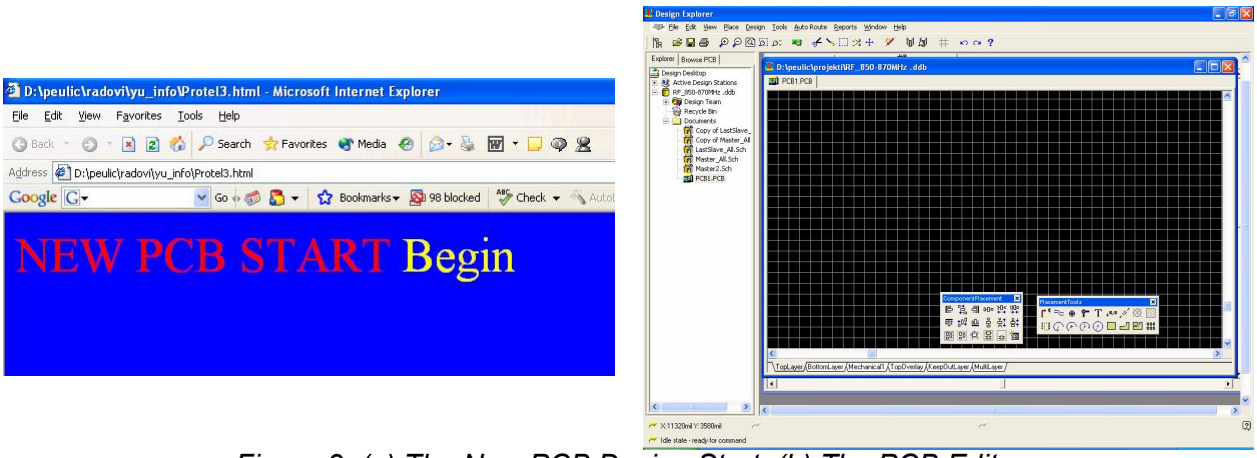

Figure 3. (a) The New PCB Design Start, (b) The PCB Editor

The easiest way to create a new PCB design in Protel 99 SE is to use the PCBMaker Wizard, which allows you to choose from over 60 industry-standard board outlines as well as create your own custom board sizes. Before Protel 99 SE knows how to handle the various schematic components you have used in your circuit, it needs a representation or "footprint" for each part. The text we typed into the footprint fields indicates which footprint to use in the PCB design. Protel 99 SE comes supplied with over 35 PCB footprint libraries, including a number of IPC standard libraries. Before we begin our PCB design we need to make sure the appropriate footprint libraries are available.

12. CONCLUSION

Project is still in demo phase and works only in our laboratories. Currently we are using

demo or evaluation version of Protel. Still much work is needed for finishing the project. New approaches (PHP or ASP.NET) are in consideration. Finally we have great hopes for Windows Server 2008 which will offer remote application execution over Internet explorer. Some beta tests are already in motion on FERI faculty.

Although we are convinced that almost all areas in Electronic Printed board design can be covered via distance learning if the course is well prepared.

13. LITERATURE

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