

M-LEARNING INTEGRATED SOFTWARE SYSTEM FOR LEARNING MANAGEMENT USING COURSES AND LABORATORIES ACCESSIBLE VIA MOBILE COMMUNICATION DEVICES

Sorin-Aurel Moraru, Catalin Bujdei, Delia Ungureanu

Automatics Department, "Transilvania" University of Brasov, M.Viteazu Street, no.5, 500174,
Brasov, Romania, phone/fax: +40 0268 418836,
smoraru@vision-systems.ro, cbujdei@vision-systems.ro, delia@deltanet.ro

The paper presents some achievements in the e-learning domain by widening the access possibilities to electronic learning. The purpose is to extend the variety of equipment and information transmission environments through which the content of electronic learning platforms becomes accessible. In the paper we pursue the capitalization of some researches, done by the members of our team, regarding the creation of e-learning systems and their applications for mobile phones.

These researches generated real results and represent a very strong theoretical support as well as a good starting point for the implementation of the needed software modules. One of the most important goals is to create a learning management system, which can be accessed by mobile phones. Another objective is represented by the adaptation of courses and laboratories for being usable on mobile phones.

Keywords: M-learning, integrated software system, Java, mobile communication device

1. INTRODUCTION

The purpose of the proposed work is the improvement of e-Learning domain by developing an access system to the existent resources within the systems of content management. This will be accomplished by extending the variety of equipment and ways of information transmission used for the access of electronic learning platforms. The existing electronic materials developed during the pilot project *Virtual Electro Lab RO/01/B/F/PP 141024* [1] from *Leonardo da Vinci* programme with the title *Using Informatic and Communication Technologies for Developing a Virtual Lab Dedicated to Initial and Continuous Teaching in Electrical Domain* must be accessed also through mobile devices by developing a dedicated platform.

1.1. Actual knowledge stage in the area related

At the moment, the concept of distance learning was barely implemented at country level in comparison with Western Europe and North America (USA, Canada).

Until few years ago, the distance learning was done only by typed courses sent by mail. There were two main disadvantages:

- Lack of interactivity which was not suitable for student centered learning;
- Difficult access to learning materials (required long time and the materials were updated after long periods).

Some Romanian Universities have recently developed electronic learning platforms as a result of international projects with European finance. An e-Learning system is in the final development stage at *Transilvania* University Brasov through *Leonardo da Vinci* programme [2]. The electronic learning system could be accessed by Internet (<http://www.ecampus.it>, <http://vlab.unitbv.ro/velab>) and is offering to the students interactive electronic materials and virtual labs dedicated to distance learning.

There are three directions for distance learning in Europe:

- Courses distribution in digital format;
- Development of virtual European campuses;
- E-twinning of various European schools and continuous professional development of teaching staff.

Mobile Learning (m-Learning) is the e-Learning component, which uses mobile computing equipment: Palm, PocketPC, even mobile phones.

The actual vision on mobile computing equipment has the following components [3]: high interactivity, total connectivity and increased computing power. An equipment with small dimensions permanently connected to a network and operated by a pencil and / or voice, keyboard offers the opportunity to visualize images with high resolution and listen to quality sounds.

The mobile equipment is a pocket computer with personalized applications allowing the connection of auxiliary equipment (such as digital camera). It should also have an advanced browser and a learning application.

It could be said that m-Learning is the results of combination between e-Learning and mobile computing equipment: the resources could be accessed irrespective of the place where is the user, powerful searching capability, pronounced interactivity, powerful support for personalized learning and storage based on performance. M-Learning is independent of space and time.

2. PDA VS MOBILE PHONE IN M-LEARNING

The majority of authors referring to m-Learning give as example the PDA as the electronic instrument allowing the access of learning materials and the mobile phone are mentioned as a possible tool for the future.

The Romanian economy with low living level is generating a different situation than developed countries: PDA is a luxury not widely used but we are among the first countries in the world regarding the number of mobile phones reported to the number of inhabitants. Therefore the m-Learning systems dedicated to PDA users will not be immediately implemented in our country.

The technological progress on PDA market is reflected also on the mobile phones market. These have performance and functions similar to PDA and offer the support for mobile communications using various protocols (WAP, GPRS, CDMA, WCDMA).

The equipment becomes common and its quality and capacity increases while the price decreases. There are some limitations of PDAs and mobile phones in comparison with the PCs:

- Not all of them allow the permanent connection to Internet / Intranet but they have the capability of dial-up for intermittent connections;
- The screen has small dimensions;
- The computing power is reduced;
- The storage capacity is limited (it is necessary to access data from a storage place through a LMS – *Learning Management System*).

We can say that the mobile phones offer real mobile communications in comparison to PDAs. The mobile phones use the mobile phone networks and are permanently connected to the whole telecommunication network. So using the mobile phone for accessing the mobile learning systems will ensure a very good management of time because the user could be connected to the system even when he is traveling by train for example.

An essential element for the implementation of m-Learning system is the information organization in the learning software system. The emphasis is on the standards implementation at international level.

A series of studies and experiments have been performed within *VirtualElectroLab* project regarding the use of terminals for mobile communications for labs applications that were distance controlled.

2.1. Using Mobile phones in m-Learning

The m-Learning future is bright because more than 1.5 billions people have mobile phones. PDAs are beginning to be less used due to the implementation of their technology into the latest generation of mobile phones. The software support for mobile phones contributes to the development of complex applications such as those based on Java 2 Mobile Edition. The mobile phone is permanently connected to a communication network so it was transformed from a simple instrument commanded by voice to a mobile computer. Recent mobile phones have sufficient resolution to use materials for m-Learning.

The actual technology implemented into mobile phones allows web pages access from the mobile phones (even HTML format). Also the transmission of an electronic content is not a problem anymore. This is easily done for static learning materials that can be displayed in order to be read on a screen. There are interactivity problems specific for desktop computers and not for mobile equipments. Electronic learning involves experiments and requires users' feedback so there could be some problems from technical point of view. Editing learning materials on the Internet could be easily done but the implementation of on-line experiments could be a problem that has to be analyzed by the m-Learning systems developers [4].

Recent studies reveal that the students using mobile devices in the learning process become more creative and register great progress due to the emotional attachment to their mobile and the feeling of privacy because the screen cannot be

seen by the others (like in the case of PCs). The people' desire for collaboration and the socialization power is increased due to the mobility and lack of physical connection cables (wireless technology). The students can walk around so the lack of physical exercises is eliminated – an important aspect for the people working a lot with digital equipment. Other benefits refer to lifelong learning and learning during free time in a pleasant place so the pressure over modern people could be eased off. At the same time, the idea of learning during spare-time, into a pleasant environment, outside the office, even while moving, starts to get a clear shape. Although the technological advancement in IT was supposed to ease our lives, it created more work and pressure upon the human society, so learning during spare time has become a modern trend of the society, towards which the concept of m-Learning comes.

2.2. Models of learning towards using mobile phones in M-Learning

The conclusion of research studies was that the information technology is improving the learning experiences therefore the efficiency is increased and the costs are reduced. They were focused on the analysis of learning methods and techniques most appropriate for IT medium. The comparison of class learning with student centered learning showed following aspects:

- The progress of various students during learning period was measured with coefficients with values between 3 and 7 [5];
- A Student answers in the class to an average of 0.1 questions per hour [6];
- The student-centered learning facilitates the direct communication between the instructor and student so it could be reached the ratio of 120 questions / answers per hour [6];
- The students' performance is increased from 50% to 98% in the case of learning based on tutorials [7].

Classical learning model based on typed courses and presented in the classroom is challenged by the new methods. Recent estimations show that the formal courses give less than 25% of information necessary at the workplace. We have the wrong approach because we dedicate 80% of effort to reach 20% of workplace requirements. This discrepancy can be removed by alternative solutions. Efforts are made at workplace to generate useful results from the learning process. The initial approach was the digitized learning through CBT (Computer Based Training) and WBT (Web Based Training) as alternative to classical course so the students did not deal with inconveniences and great expenses of classrooms. The next solution was the division of learning materials dissemination by classical and electronic means. Then the learning materials were divided in small modules, which could be studied based on students' needs. All these learning methods have the tendency to become mobile eliminating the spatial and temporal problem of electronic learning based on fixed equipments [8].

3. JAVA TECHNOLOGIES ON MOBILE PHONES

Java programmers are using Java2 Mobile Edition (J2ME) to develop applications for devices with limited memory and reduced computing power such as:

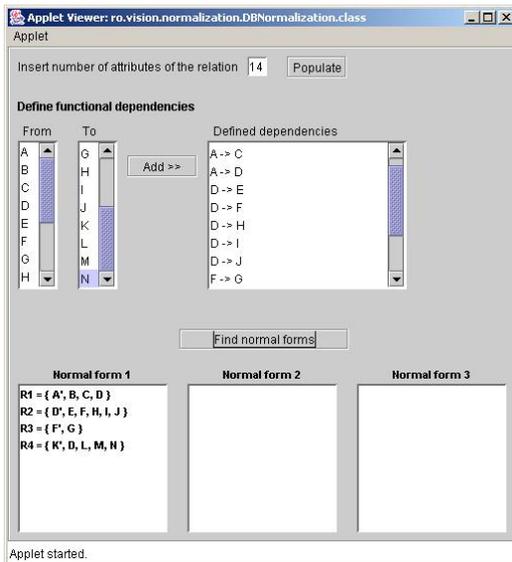
mobile phones, PDA and similar electronic devices. J2ME is a platform dedicated for small devices replacing the software products based on JDK 1.1 by a superior solution based on Java 2. Desktop and server systems are based on J2SE and J2EE but the world of electronic mobile devices is so varied that it is impossible to have only one software package that is appropriate to all of them. J2ME includes a collection of specifications defining a set of platforms for various electronic devices. The functions available for a certain device are defined by one or several profiles extending the configuration domain. The configuration and profiles of a certain electronic mobile domain depend on its hardware implementation and the targeted market segment.

Because there are a wide variety of GSM terminals, it is necessary to design an adaptive content formatting system for the teaching materials, depending on the audio-video capabilities of the device. The importance of using these elements is vital to achieve a system usable on a large scale, by the most mobile phone owners.

3.1. Software system architecture

The system of learning management together with the module of course and lab applications access constitute an application distributed on 3 levels, interconnected into an architecture of 3-tier type:

- **Driver** level - programs that collect data from the laboratory and/or send commands to the laboratory on one hand; they communicate by a local network or Internet to Server level on the other hand;
- **Server** level – contains applications responsible with data centralisation, users management and access rights, courses and laboratory management, learning management, connections between Driver and Client modules.
- **Client** level – represents the applications composing the user interface and are in



principle the applications that run on mobile phones, accomplished with Java Midlet technology or other characteristic technologies.

3.2. Some results

The didactical applications created by the research team from the VirtualElectroLab project consist of e-learning courses and virtual / distance laboratories in the following domains: *Electrical Drives, Automated measurements, System Theory and Automatic Control, Domatics, Databases with Applications in the Electrical Domain, Electronic Circuits, Electric Circuits, Electrotehnic Materials, Electrical Machines.*

Fig.1. The database laboratory web interface

We exemplify (fig. 1) by presenting the interface for a distance experiment included in the module of *Databases with applications in the electrical domain*, treating the database normalisation.

4. CONCLUSIONS

The paper presents innovative contributions in e-Learning domain (particularly m-Learning area) for improving the educational software. An innovative approach is proposed by integrating significant domains of university research (electrical engineering, information technology, applied informatics). The theme brings a significant contribution to cognition development proposing contributions to:

- The development of a software applications system allowing the management of learning by accessing the interactive e-learning materials through mobile platforms (mobile phones, PDA). This system will give mobile interactive applications to students who will be able to access online laboratory resources.
- The development of laboratory/course applications for mobile phone using technologies type Java Mobile. These will contribute to the development of open and distance education through accessing a virtual laboratory with the possibility to realise experiments directly on the mobile phone, independently of space and time.

5. REFERENCES

- [1] Moraru S.A., I. Diaconu, A. Pelcz., S. Leahu, *The Database and Architecture of Virtual and Remote Laboratories*, 1st International Conference on Informatics and Control, Automation and Robotics, p. 38-42, ISBN 972-8865-14-7, Aug. 2004, Setubal - Portugal.
- [2] Moraru S.A., A. Pelcz, C. Bujdei, L. Perniu, *Web-oriented applications of databases used in electrical domain*, The 14th International Scientific and Applied Science Conference ELECTRONICS ET'2005, ISBN 954-438-519-3, Sept. 21 - 23, 2005, Sozopol – Bulgaria, Technical University Sofia & Technical University Delft.
- [3] Alexander B., *M-Learning: Emerging Pedagogical and Campus Issues in the Mobile Learning Environment*, EDUCAUSE Center for Applied Research (ECAR) Bulletin, vol. 2004, no. 16 (August 2004), a publication of ECAR (<http://www.educause.edu/ecar>).
- [4] Wagner E.D., R. Robson, *Education Unplugged: Mobile Learning Comes of Age*, presentation at the Annual Meeting of the National Learning Infrastructure Initiative, New Orleans, Louisiana, January 24, 2005; Colleen Carmean, blog entry, January 24, 2005, <<http://blog.educause.edu/carmean>>.
- [5] Gettinger M., *Individual differences in time needed for learning: A review of the literature*. Educational Psychologist, 19,15-29, 1984.
- [6] Graesser A.C., N. K. Person, *Question asking during tutoring*. American Educational Research Journal, 31, 104-137, 1994.
- [7] Bloom B.S., *The 2 sigma problem: The search for methods of group instruction as effective as one-to-one tutoring*. Educational Researcher, 13, 4-16., 1984.
- [8] Fletcher J. D., *Evidence for Learning from Technology-Assisted Instruction*. In H. F. O'Neil Jr. and R. Perez (Eds.) *Technology Applications in Education: A Learning View*. Hillsdale, NJ: Lawrence Erlbaum Associates, 2003.