Original published at: Proceedings of E-Learn 2008, Las Vegas, p. 777-782, 2008

Mobile Information Access in Higher Education

Martin Ebner
Computing and Information Services / Social Learning
Graz University of Technology
Graz, Austria
martin.ebner@tugraz.at

Nikolai Scerbakov
Institute of Information and Computer Media (IICM)
Graz University of Technology
Graz, Austria
nsherbak@iicm.edu

Christian Stickel
Computing and Information Services / Social Learning
Graz University of Technology
Graz, Austria
stickel@tugraz.at

Hermann Maurer
Institute of Information and Computer Media (IICM)
Graz University of Technology
Graz, Austria
hmaurer@iicm.tu-graz.ac.at

Abstract: This paper describes the implementation and integration of a m-Learning interface into the existing University-wide e-Learning System. Thereby existing content and information from the e-learning environment is automatically styled and provided in a way, which is accessible for most mobile devices. Incompatible content is filtered out. The system has been developed at the Institute of Information Systems and Computer Media (IICM) of Graz University of Technology with a special focus on the needs of engineering students. The approach integrates the possibilities of current mobile and wireless computing technology with the efficient delivery of information, content and interaction.
This paper will describe the system as well as encourage discussion, although far from m-Learning scenarios - how this kind of mobile access to information and content can be used to support students in higher education.

Mobile Learning

Mark Weiser (Weiser, 1991) announced in 1991 that "the most profound technologies are those that disappear. They weave themselves into the fabric of everyday live until they are indistinguishable from it". With other words, if we are getting familiar with devices, they begin to pervade our daily life in a way that we don't notice them anymore as something remarkable – they simply disappear.
Only some years ago mobile phones were rarely used, but nowadays in Germany and in Austria there are more mobile phones than inhabitants (Springer, 2006). According to the Austrian Central Bureau of Statistics (Statistics Austria, 2007) in 90% of all private households mobile phones were available in 2007. These results are of high interest for us, as at Graz University of Technology we strive to support mobile learning (m-Learning).
Further studies pointed out that PDA/mobile phone sales would outstrip PC sales, with the majority switching to wireless networks by 2008 (Ellis, 2003). In a pilot study of Evans it is reported that 74% of his students owned an iPod (Evans, 2007). Motiwalla pointed out that mobile computing devices have become ubiquitous on today's colleges and influence the daily behavior of higher education (Motiwalla, 2007).
However the increasing problem is that the learning and teaching market is not growing appropriately. Some small-scale projects try to use mobile devices in experimental settings and pronounce mobile learning as future expectation. But what means m-Learning? The definition itself seems to be still unclear: "Some advocates of mobile learning attempt to define and conceptualize it in terms of devices and technologies; other advocates define and

conceptualize it in terms of the mobility of learners and the mobility of learning, and in terms of the learners' experience with mobile devices." (Traxler, 2007). In Germany along with mobile learning, also the use of laptops and notebooks increased, where as in the US only the use of mobile devices increased (Pätzold, 2006).

Kukulska-Hulme & Traxler restricted mobile devices in teaching and learning to the following various forms (Kukulska-Hulme & Traxler, 2005):

- Connectivty for spontaneous communication and collaboration amongst learners
- Beaming of stored information from device to device
- Location-awareness, giving instant information about project sights
- Portable sound-recording and voice-recording
- Cameras for taking photos and video clips

There are lots of attempts to define m-Learning, but from our point of view it must be taken a short look back to the beginning of e-Learning itself. In the early stage of e-Learning often the famous expression A3 has been used to express the advantage of online learning: anywhere, anytime and anybody. Anybody and anytime was fulfilled by a computer with Internet access, but learners where still bound to the place of the device – they were not able to use the WorldWideWeb anywhere. From this point of view mobile devices with Internet access may be a first step to independency of location. Bearing in mind that a good infrastructure is necessary, especially in Middle European countries this requirement seems to be fulfilled by now.

In this paper we will discuss a university-wide solution for mobile access of e-Learning materials and information concerning teaching issues, with mobile devices.

m-Learning Environment at Graz University of Technology

Introduction

M-Learning environments enhance e-Learning solutions, which are emphasized to have the main advantage in the independence of location and time (Holzinger et al, 2005). Actually there are only a few m-Learning environments, which strive to simplify advanced training courses and change learning to a more interactive, efficient and active process. The functionality of these systems is comprehensive and the potential of m-Learning environments has been enhanced enormously by now (Motiwalla, 2007).

At the same time possibilities of mobile devices increase and if designed with the user in mind, this technology can enhance motivation, which is vital for learning (Holzinger, 1997). Today's society can be said to be a "Knowledge society" as it's possible to get access to diverse information through mobile devices even on the street. The question remains, why these systems still lack user acceptance (Motiwalla, 2007). We suppose the inhibition threshold for teachers is too high who are at the same time lacking necessary technical skills to use M-Learning environments properly. As mobile content has to follow special rules for broader accessibility (Holzinger et al, 2005), so existing e-Learning content needs to be rearranged and teachers need to be trained in e-Learning as well as in M-Learning systems. One needs to keep this kind of problems in mind, when introducing a system supporting mobile access. Especially from a university wide view the question of how to support an m-Learning system is of high interest. According we suggest to distinct clearly between two paradigms:

- m-Learning System: A system, which can be used with a mobile device and which provides learning material and information, e.g. as a number of online lectures.
- m-Learning Content: the accessible content of the system which is specially designed and prepared for mobile use and -devices, e.g. the content of lectures.

At Graz University of Technology some experiences in m-Learning content have been gained with animations and visualizations for mobile devices (Holzinger & Ebner, 2005). It has been shown how such possibilities are working and how learners are able to work with it. However the situation for the learners was not satisfying, because apart from the learning objects all other online facilities did not support mobile devices. This situation can be found very often – m-Learning content not embedded in an m-Learning system. Universities are confronted with a very complex situation when integrating m-Learning into an existing e-Learning solution. Usually an e-Learning system is used with a lot of facilities and components, which were never designed for mobile devices, furthermore with a huge number of content for learning on screen at best.

However the research question we like to address here concerns, how to bring a proven, running e-Learning system on mobile devices in a way, that it will fit perfectly to the end users – lecturers and learners.

Requirements

Graz University of Technology, in particular the Institute of Information Systems and Computer Media (IICM) has great and long experiences of using e-Learning systems (Helic, 2004). By running a huge number of online courses and teaching modules we were able to determine the most important ones from the learners view:

1. Up- and Download possibility of learning materials
2. Information about the lecture itself
3. Possibility of making announcements
4. Possibility to contribute to discussion forums

Bearing in mind that these tasks are the most important and thus the most used ones, all can be summarized to one particular thing: Learners need information, about all changes, new contributions, new announcements and so on. So the first step towards an embedded m-Learning system should be the visualization of the information flow of a course. Then the second step is the adaption of the most important channels for the display on mobile devices (Figure 1).

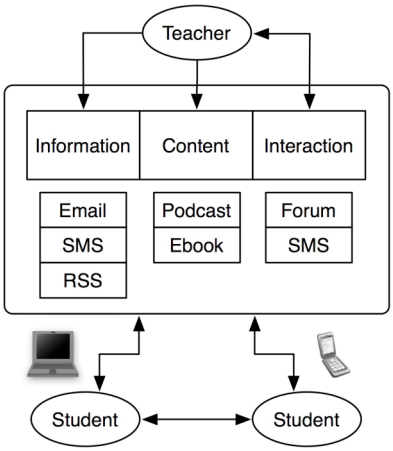

Figure 1: A simplified scheme of information channels in our embedded e-Learning / m-Learning solution.

The next chapter will outline the technical issues.

Prototype

Figure 1 shows the usual view of a typical online course of Graz University of Technology. Each supported lecture offers such a surface. Course announcements, course materials or additional features can be provided via the powerful and user-friendly interface. Collaboration tools like discussions forums, chats, email or instant messaging are available as well.

Figure 2: Typical online course

Figure 3 shows the same lecture as Figure 2 but with the mobile viewer. The same information is placed within a user-friendly environment where navigation is possible with controls of the mobile device. The navigation through the course material is very easy – just by clicking "forward" the next link is chosen. This way information concerning the lecture can be selected very fast and in accordance to the generalized browsing paradigms for mobile devices.

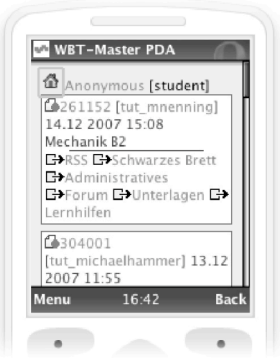

Figure 3: Online course with mobile viewer

Technical Implementation

Unfortunately, the implementation and integration of an m-Learning solution also means a significant constraint and even a step back in using recent technological solutions. Needless to say that an architecture of Internet Based Information systems recently was essentially reconsidered in a direction of using rich browser facilities for data processing. Ajax architecture (Lauriat, 2007), Web-Services (IBM, 2007), Dynamic HTML and MeshUp technologies (Merrill, 2006) are just a few samples. At the same time, modern mobile browsers do not support all these innovations. Further it is not clear yet whether these technologies will be supported in future.

From technological point of view, the Figure 1 shows a highly interactive application that uses

- DHTML for the user interface,
- Ajax as a data delivery solution and
- Web Services as sources of the information.

The mobile browser shown on the Figure 2 does not have the technical possibility to use any of these technologies; nevertheless it basically provides the same functionality due to the following simple, but powerful solution. Each mobile browser accessing the server creates an instance of a special Class "Mobile Browser". This instance emulates a functionality of advanced "desktop" browsers and uses a mobile device as just a "virtual screen". This solution allows supporting compatibility between functionality provided by mobile devices and "desktop" browsers. As soon as a new functionality is available for a desktop browser, it becomes available for mobile devices via the instance of the class "Mobile Browser".

Obvious disadvantage of this solution is a volume of data that needs to be transferred from such server-side "Mobile Browser" to a mobile device to emulate the virtual screen. Currently, we use ordinary HTML encoding that needs to allocate a sufficient portion of traffic for transferring visualization details (fonts, colors, tables, etc.). Since such visualization details can be separated from actual content by using XML and especially elaborated XSL specifications, we are intensively working in this direction, and thereby got positive results with newest versions of portable devices. At the same time, we got started to experience well-known problems of mobile browsers compatibility. Some of the newest browsers are capable of XML transformation, using XSL specifications, some – not.

Actually we found only one working solution to support XML transformation in most of the browsers. We transfer a virtual screen of server-side "Mobile Browser" in two formats either HTML, or XML + XSL depending on settings in the user profile. Basically, the virtual screen is always emulated as an XML file, but the XML transformation is done either on the server or on the client depending on user profile settings. This solution allows to have just one class "Mobile Browser" that is suitable for any portable devices independently whether they support XML transformation specifications or not.

Another important technical issue is adaptation of course contents to restricted capabilities of mobile devices, concerning some sort of files. Thus, even downloading of big textual .doc files can create sufficient technical problems for some mobile devices. We could not find an ultimate technical solution for this problem yet, besides setting so-called device profiles. The device profiles serve as filters of files that potentially can create problems for a

portable device. Simplest sample would be filtering out any ".avi" files, or even replacing them with ".m4v" files, filtering out ".doc" files, etc.
Fig 4 shows an overview about the whole concept.

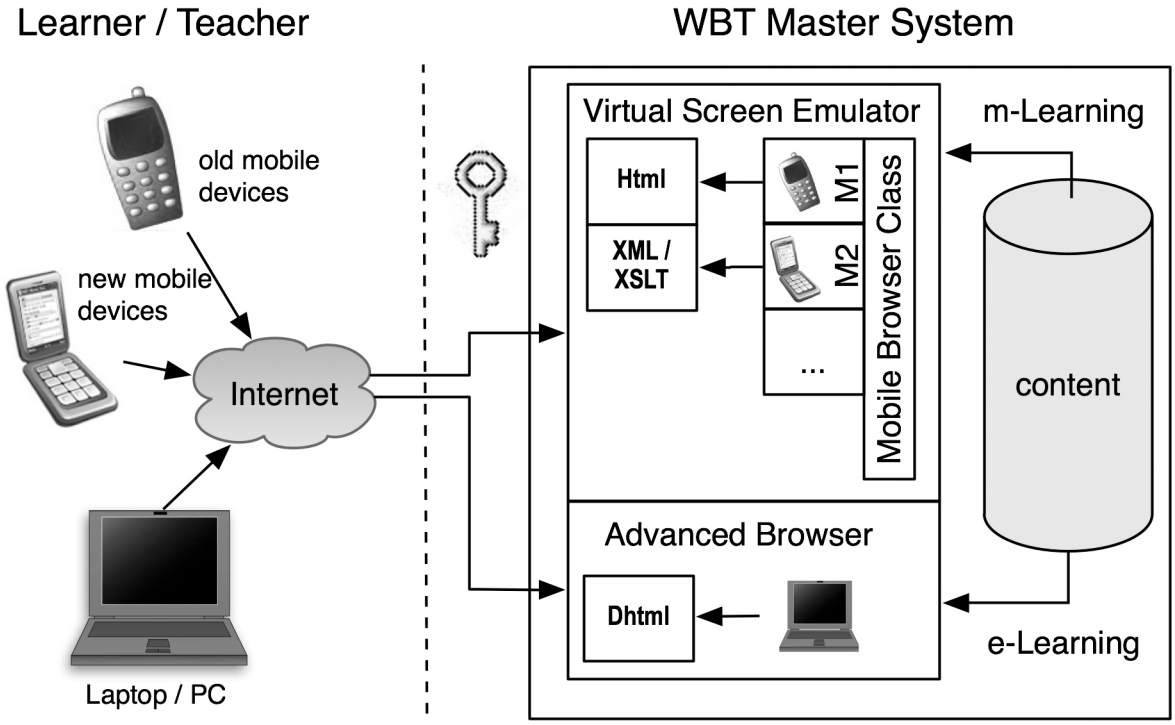

Figure 4: System Overview

Discussion and future work

The aim of this research work was to investigate if it is possible to embed an m-Learning system into an existing e-Learning system, using the same content up to a certain extent. Due to the fact that from a very technical view the system provides a special viewer for mobile devices, granting mobile information access to some part of the LCMS this goal has been accomplished. Although we are aware of the fact that the term m-Learning includes much more interactivity than presented in this paper, mobile information access is an important part of it.
In this first step the e-Learning system can also be turned into an additional m-Learning system, with very powerful possibilities. All announcements, changes of course materials, contributions in discussion forums can be followed easily. Students in the same way as teachers use the new possibilities for consuming information on the fly, independently from place and time.
Very interesting seems to be the possibility to subscribe to an RSS –Feed. Smartphones automatically indicate and display the Feeds within their on-Board Readers. With other words, subscribers can be informed without any logon if the lecturers allow such access. In the end it must be expressed that currently also an automatic course aggregator has been implemented. For each user a special RSS-Feed from all his booked courses is created. This subscription shows every change in one of his/her lectures without any further click.
However all these developments can be only a first step towards real m-Learning, because all measures can be categorized into improvement of information flow. Interaction of end-users is limited to a mainly passive consumption through click and read. Bearing in mind that most of online lectures are providing exactly this scenario a less amazing situation. A further problem of mobile devices is also the restriction of input possibilities. A lot of research will be necessary to improve this.
It must be concluded that an existing e-Learning environment can be enhanced by mobile possibilities to improve the daily "teaching" work by adding mobile views. Changes or new announcements can be easily transported to the end-user and support the communication of the participants. Bearing in mind that up-to-date information is a

precondition for a good learning process mobile information access will play an very important role in the future of technology enhanced learning.

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