

Towards a Multi-Vendor Mobile Learning Management System

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Abstract: The paper presents Porta-bile, a project under development that intends to investigate the use of mobile computing technologies to support the learning processes in an educational context. The project focuses on the technological aspects of mobile learning on their integration with e-Learning systems, and more generally, with the information systems of the academic institutions. An interesting aspect of the project is the experimentation of the integration between the two most used development frameworks for web application available on the market today, i.e., SUN J2EE and Microsoft .NET. The interaction between the two will be granted by web services technology.

Introduction

E-learning systems and Learning Management Systems (LMS) in particular are nowadays a key element in the learning processes that take place at Universities. They are widely investigated in literature and several commercial implementations are available on the market. In recent years the quick advance of mobile technologies has given rise to a new twist: mobile learning. M-learning is a field which combines two very promising areas – mobile computing and e-learning. It is intended as any form of learning and teaching that use mobile devices. It is often considered as the future of learning, or as an integral part of any other form of educational process in the future. In this paper we present Porta-bile, a portal for m-learning that is under development at the University of Trento (UT). The main goal of the project is to experiment m-learning technologies in real learning processes taking place in a higher education institution. The paper is organized as follows: in section 2 we describe the LMS and the adaptation needed for interoperability with the mobile extensions. Section 3 discusses the properties of the mobile platform. Section 4 gives a brief overview of the related work. Conclusions and References follow.

Adapting a Learning Management System to Infomobility

In order to support the experimentation of any tool or technique of m-learning, a rather complex information system is necessary. Its role includes distributing didactic material, identifying and authorizing users, gathering data relative to the user-system interaction, provisioning mobile services etc. E-learning is always more integrated in the information systems of academic institutions, and is now more proper to speak about Learning Information Systems (LIS) rather than LMS. Besides the e-learning in strict sense, LIS support administrative and back-office processes of a Faculty (e.g. exam registration, didactic design, theses management, bookkeeping of teachers' activity, University marketing etc.). The Porta-bile project makes a further step, interconnecting mobile computing with LIS. The aim is to allow the different actors (students, teachers, administrative personnel etc.) to have a mobile platform that keeps them in touch wherever they are, and that allows e-learning as well as management operations. Many are therefore the possible applications: for instance a secretary can communicate with mobile-technology enabled students, and mobile collaboration among teacher and students within a course framework can be enabled. The idea of a LIS integrated with mobile technology is still unexplored, especially regarding the integration of the typical reporting/managing activity of an information system with mobile devices.

Our project is based on significant experience in e-learning processes, and on the availability of two LMS developed in previous projects at UT. The first LMS [1] has been used for three years on all courses of the Economics school of UT. The new UT LMS called e-leaf has a modular infrastructure with a clean separation between data, business logic, presentation logic and actual presentation. It is built on J2EE technology, and in particular it has an EJB layer that abstracts the data from their actual database implementation and contains the business logic. On top of that, a layer based on the Struts framework contains the presentation logic, and exposes a set of JSP custom tags. Web designers are therefore offered a conceptual extension of HTML, i.e. a set of e-learning

specific tags that can be used and composed to build the actual presentation. The goal of such architecture is to allow “external” customization and maintenance of the system without knowing about programming, and maintaining a high level of freedom in the presentation choices. Also, e-leaf can be adapted to different data architectures without breaking the upper levels. In two different implementations we were able to integrate data coming from different administrative systems (one being the one of UT that takes care of enrollment, taxes, student’s career etc., and the other administrative system of a specific research program).

Two of the main modules of eleaf are identification and authorization: the first checks user’s identity (against a LDAP system, with a fallback on to a proprietary database for users not registered in the LDAP but for which access has to be allowed), and the second maintains (conceptually) the matrix that associates users with resources, allowing or denying access to each single resource. This happens with a fine-grained access control mechanism that has been described elsewhere [5]. The other modules are relative to the main e-learning businesses: they offer services to communities, like chats, forums and shared spaces. Shared spaces can be used for uploading and downloading material and can be organized in several ways so as to offer the most useful views that the community administrator (typically the teacher) desires. An interface to e-leaf data and services is provided through web service technology (based on XML and SOAP), so that a vendor-neutral door is opened to external systems or to subsystems that take care of some particular functionality (as in the case of Porta-bile).

The Mobile Extensions

Since e-leaf has been built as a web services provider, it exposes to the world a set of interfaces that allow external modules to access it in different ways. The mobile extensions to the portal are being constructed in .NET environment, and will interact with the core LMS system using web services. Interaction among mobile devices and mobile extension will be once again guaranteed through web services. In fig.1 the system is presented.

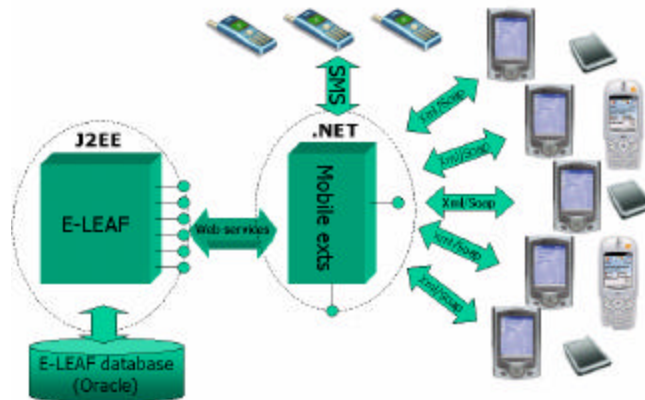


Figure 1: The architecture of the mobile portal

As first activity, we decided on which devices to focus. Since the market is continuously changing with new products emerging everyday, it is practically impossible to have a general mechanism for involving all possible devices currently available. The list of potentially useful devices includes: GSM/GPRS/UMTS cellular phones; smart-phones; various flavours of PDA; Tablet PCs. We decided to focus on the platforms based on Symbian OS (covering most of the GSM/GPRS cell phones market), and on PDAs based on both Windows CE and on Palm OS. We choose both the main PDAs environments because we want to extend as much as possible the experiment, and most of all we want to create a self-assessment mechanism that must be generalized as much as possible with respect to technological platforms, due to the extreme volatility of the market. Such PDAs also have the advantage of having access to all the educational material that is currently published in the format of Microsoft™ software tools, like PowerPoint, either natively (Windows CE) or through optional tools (like Quickoffice™ for Palm). In any case, the modular structure of e-leaf and the web services will provide a sufficient grade of extensibility of our portal for any platform. A test of the system will consist in some lessons conducted using Learning Objects distributed via LMS and accessed by students and teachers through PDAs. Part of these educational materials will be available only through mobile devices. Students result, feedback and motivation will be thoroughly examined (with various techniques like self-evaluation, partition into groups that will use different devices, etc.). For this purpose, a dedicated forum will be activated, and tutors will help students to solve practical or technical problems.

As regarding the use of specific tools available with mobile technology, the most evident problem we faced in the design phase was the choice of the technology by which building the tools provided to the client in order to use our services. The current project provides several different classes of services to mobile users that will allow to access the data commonly included in the database of the LIS, support the distribution of news (like alerts, results of exams, tax balance, etc.). As a first choice, we decided to concentrate initially on two services:

- The management of SMSs sent by teachers to students or by administrative staff to teachers and students when particular events happen (meetings, reminder for expiration dates etc.)
- The consultation of a common agenda (we call it organizer) that will be available on the mobile device and will keep all the important dates for the actor (mainly students and teachers)

The first of these is simple to build but not so easy to manage: since the exchange of messages among different mobile devices and the system has a cost, it is necessary to include in the model control and accounting of the offered services. These in turn must be defined based on the actors of the system (teachers, students, personal staff etc.). At present, we have almost concluded the adaptation of the e-Leaf system to the needs of managing SMSs messages. The main problem has been found in allowing the right person to send and receive SMSs, and in granting this permission inside correct boundaries, in terms of number of SMSs sendable by the user. The agenda service is more complex, as it involves one of the most difficult tasks to manage inside a LMS, i.e., time management. We are currently building a system that allows students and teachers to connect with their mobile device and consult their agenda, dynamically built with all the events that happen during a normal university activity. This implies a great effort of abstraction and integration between the LMS platform and the mobile devices.

We considered five different alternatives to build the interaction between the PDA (the platform chosen for the experimentation) and the central database. The problem is related to the way the client (the PDA) interrogates the remote server module requesting the update of the events since last connection. These are the alternatives we evaluated and tested, from the simplest to the most complex:

- Using the PDA embedded browser to navigate through the “normal” web pages. This solution is straightforward. It is only necessary to pay attention to screen design, in order to concentrate the most important information on the left-uppermost part of the screen and to avoid the necessity of frequent scrolling. The web page can be created using device-specific tags and languages, like the .NET™ mobile toolkit, in order to allow navigation through the data available on the server. However, we decided not to follow this solution as the primary one, because of the necessity for the user to have a costly permanent connection to navigate through the organizer. Both GPRS and UMTS are very costly at the moment, and WI-FI technology with wireless LAN is still in its infancy. Other short-range connection solutions have been excluded as we want this service to be used also outside the campus.
- Using a client database application, built specifically for mobile devices, that interrogates the server DB through the internet, synchronizing the data on the mobile device. This is a proprietary solution bounded to the back-end DB used and the availability of an Internet connection on the PDA that requires settings that are complex for the end-user. However, from our tests, this solution has the advantage of dramatically boosting performance thus reducing connection times.
- Synchronizing the PDA with the central database and the agenda of the user by using cradles and database synchronization: this solution will solve a lot of issues, but creates a problem in terms of cradle availability around the campus, and especially the problem of supporting different cradles for different models of PDA.
- Building a client/server application in which the client (on the PDA) uses traditional RPC/RMI mechanisms to invoke server methods in order to receive data. This has the advantage of requiring short-time connection to the central system, and could be personalized to the PDA device. The disadvantage of this solution is the proprietary mechanism of communication between server and client, and also the necessity of using particular TCP/IP – UDP ports that could complicate the management of security on the server side due to firewalls.
- Building a web application that requests a web service. This is the best solution we found, as it provides the access in short time to the central database through the use of open technology like XML/SOAP, uses a port that is already opened for web access, and finally will guarantee the extension of the client part to other PDAs simply by creating the new client interface to the web service. We will therefore provide the agenda synchronization through a web service that will recognize the user, verify the state of his/her agenda, and will send an XML-formatted packet of data regarding last events in the system. The client side of the application, specific for the device, will format this data for the display: after that, the connection with the server will be closed and the navigation on the agenda will be completely off-line.

Related Work

M-learning is quite a new domain and a lot of work and research is presently going on [7]. The current state-of-the-art in mobile learning research is strongly conditioned by the available devices. Different devices that exist, and every new device that is coming up on the market, with its limitations and advancements, provoke different ideas for applying it to learning: thus any device can mean different ways to “m-learn”. People are trying to understand:

- Which learning models can help obtaining better learning processes when communication is mediated by mobile devices, and how the student mobility affects her/his learning process.
- How it is possible to evaluate efficiency and effectiveness of learning processes based upon mobile technologies, given the physical limitation of mobile devices.
- Which services are useful for mobile devices, and which enabling technology can affect the wide diffusion of mobile learning.

Similar to our research is the exploration of messaging (SMS, EMS) as a supporting tool for education. Few different educational bodies made experiments in this area (e.g. [3],[6]). The findings of these experiments are overwhelmingly positive, with students perceiving the system to be ‘immediate, convenient and personal’. Still these systems differ from our approach as they don’t propose integration with the LMS or LIS.

Few publications refer to development of m-learning platform or framework. The authors in [4] discuss possible m-learning scenarios in respect of e-learning platforms, and what functionalities an m-learning platform is best suitable for. Also the characteristics of the mobile devices are discussed and how they impact the foreseeable learning scenarios. In [2] an Open Abstract Framework is proposed and the authors emphasize the need of interoperability between mobile learning and the services provided by different parties. They strive to focus on the interfaces between different layers in their architecture. In their approach reusability of software is based on object-oriented approach. Our approach is instead based on web services.

Conclusions

The main objective presented in this paper is the adaptation of the LMS currently used by UT to the needs of a portal for infomobility. This system is currently in an advanced state of progress and we are adapting it to the mobile-computing needs required by using web services technology. This will imply the creation of teacher-system-student interaction tools mainly based on SMS messages concerning the activities of these actors in the system. Moreover, the portal will provide an access point to the system’s actors, in order to download the educational material and the self-evaluation tests produced according to the objectives of the project. Besides, different structures will be created to support the research activities, like forums usable via mobile devices, mailing lists for the various users. As a second step, we will build a specific agenda application for the mobile devices that will use the web services technology to synchronize its data with the central database. We will conduct tests on the main platforms that currently equip the most widespread PDAs on the market. Further stages are in a planning state.

References

- [1] Colazzo L., Molinari A. (2002) An alternative system to deliver and manage on-line courses through the World Wide Web. In Proc. ED- Media 2002., Denver, USA, June 24-29, 2002. (vol. 1)
- [2] Da Bormida G., Bo G., Lefrere P., Taylor J. (2003) An Open Abstract Framework for Modeling Interoperability of Mobile Learning Services, European Journal of Engineering for Information Society Applications, vol.5, issue 1
- [3] Garner, I., Francis, J., Wales, K. (2002) An Evaluation of the Implementation of a Short Messaging System (SMS) to Support Undergraduate Students. Proc. of the European Workshop on Mobile and Contextual Learning, 2002, (pp. 15-18). Birmingham, UK.
- [4] Hamza, M. (2002) Requirements for a mobile eLearning Platform. Proc. IASTED International Conference on Communications, Internet, and Information Technology; St. Thomas, US Virgin Islands; November 2002, pp. 467-471.
- [5] Ronchetti, M. (2003) Achieving a low granularity access control in an e-learning management system. In Proc. ED-Media 2003., Honolulu, Hawaii, USA June 23-28, 2003
- [6] Stone, A., Briggs, J., Smith, C. (2002) SMS and Interactivity – Some Results from the Field, and its Implications on Effective Uses of Mobile Technologies in Education. Proc. of IEEE International Workshop on Wireless and Mobile Technologies in Education, 2002, (pp. 147-151), Växjö, Sweden
- [7] Trifonova A., Ronchetti M. (2003) Where is mobile learning going? Proceedings of E-Learn 2003 Phoenix, AZ, USA