

ANDROID BASED MOBILE ENVIRONMENT FOR MOODLE USERS

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ABSTRACT

This paper is about the development of a platform that eases, throughout Android based mobile devices, mobility of users of virtual courses at Technological University of Panama. The platform deploys computational techniques such as “web services,” design patterns, ontologies and mobile technologies to allow mobile devices communicate with Moodle CMS. This creates a collaborative and customized environment of interaction and alerts that allows an efficient, flexible, and transparent communication. The environment is based on service oriented client server architecture, achieved through the Service Oriented Architecture (SOA) methodology that eases reuse. The client will have alerts, file downloads, forums and chats, grading, quizzes, and calendar, among other functionalities.

KEYWORDS

Mobile devices, Android, Moodle, mobile learning, Service Oriented Architecture.

1. INTRODUCTION

Nowadays, many mobile devices can be used in the learning process such as smartphones, tablets and multimedia players. Among these, smartphones are the most promising given its large target audience all over the world, no matter age or economic background of users. Another important factor is the huge computational power of these devices which in many cases over reach processing and storage capabilities of desktop computers of some years ago. On top of that, it is possible to use software that has been adapted for them, such as text editors and PDF readers, originally designed for desktop computers. Integrating mobile devices into education aims development of networks that include new working and collaborative learning methodologies.

Data networks foster resourceful communication environments that allow the exchange of experiences from students in the same site and from diverse geographical contexts. Many countries have developed Wi-Fi networks along complete cities which facilitates combining learning environments with the mobility that comes from such devices. This combination of educational environments with the mobility from smartphones, tablets, multimedia players and this kind of devices to build mobile learning strengthen and increase cooperation and interaction among users. This way, mobile Internet allows creating means for accessing resources everywhere and any time.

Moodle is a Course Management System (CMS) that allows professors create online learning scenarios. According to (Felizardo et al., 2007), the main strengths Moodle has are its communication tools, creation and management of learning objects. Whereas Moodle as well as other educational platforms count on these advantages, they don't provide a collaborative environment of interactions and alerts for Android based mobile devices.

Under this perspective, this paper presents MLEA (Mobile Learning Environment Adapter), a mobile environment based on Android for users of virtual courses on Moodle at Technological University of Panama. MLEA facilitates integration of several educational resources that support mobile learning, throughout an innovative and modular mobile solution able to adapt to every need by deploying all communication facilities that Information and Communications Technologies (ICTs) provide nowadays. This collaborative environment is defined not only under the professors' perspective but also of students. There will be several communication means and alerts for both (professor and student) as well as interaction ways with Moodle tools.

The decision of developing for Android operating system is based on the fact that is an Open Source architecture available in the 3G market place and given the great number of research and developers creating new features for its hardware. Android platform is based on Linux and was created specifically for mobile devices.

The next section presents some background information. It deploys the main concepts that inspired developing MLEA, including mobile learning and its characteristics. Section three is about related work, development of mobile technology and mobile learning. Section four describes MLEA architecture model from the perspective of Service Oriented Architecture (SOA) paradigm; the client which represents the application for Android mobile devices; and the server where the integration with Moodle is explained. In section 5 are presented the feature of custom alerts so users keep updated about activities related to their courses. Finally, section six is used for conclusions and future work.

2. BACKGROUND

The beginnings of the Virtual University Program of Technological University of Panama (UTP) are in 2000, when talking about virtual education or e-learning was a novelty term in this country and there was no evidence of local actions of this kind. The program started as a “shy” project aimed to using ICTs in teaching and learning processes among six departments and seven branches of UTP along the country.

According to (Clunie, 2008), in 2003, UTP, aware of its role and responsibility with Panamanian society and lined up with its vision and mission, created Virtual UTP (UTP virtual), taking advantage of hyper-technologies (Clunie, 1995), in response to the needs of specialization and continuous education of people that due to work, schedules, distance, family responsibilities and/or physical despairs did not have possibilities to attend on site education. Virtual UTP emerged as a democratizing element of higher education as well as an alternative to on site education aimed to offering equal learning opportunities for those constrained to attend school.

2.1 Motivation

As in other areas or domains of knowledge, mobile learning applications are not isolated from each other and, although many have been created for specific purposes, today it is common the integration of applications (Hansen and Crespo, 2003). Meanwhile, connecting software requires the creation of processes that integrate individual applications in a consistent and efficient manner. Today, we observe the increasing proliferation of research and work done in the area of mobile learning from simple communication, evaluation and support tools for inclusive environments, which, from a single site, become available various resources and tools to meet major needs that arise from activities of teachers and students (Hansen and Crespo, 2005). The integration provided by Internet brings a significant change in the position of users toward educational software. The problem is no longer how to produce the necessary software? Now the problem has become where to find and how to use the necessary software? Thus, to find a resource that meets their needs, the user often finds a collection of pieces of software that are incompatible and, furthermore, do not have mechanisms of integration, that is why MLEA attempts to fill this gap, identifying Moodle functionalities that can be easily used in mobile devices, taking advantage of its characteristics.

2.2 Mobile Learning

Mobile learning is defined by (Pan et al., 2010), as any type of learning that occurs when the student is not in a fixed, predetermined, place, or when the user obtains advantages of the opportunities offered by mobile technologies. In addition, mobile learning can be seen as complementary approach to traditional distance education, which gives students freedom of time and space (Georgiev et al., 2004), through the use of mobile devices like smartphones and tablets (Wains and Mahmood, 2008).

The main feature of mobile learning is the ability for students to study anywhere and anytime, in accordance with the needs of combining study with work, family and social life.

Within the mobile devices that can be used for mobile learning, cell phone emerges as the most promising. Some factors that demonstrate this condition are:

i) ubiquity: cell phones are an important part in the lives of people, those who carry them everywhere. Some data show that the number of cell phones sold in Brazil in 2010 was over 180 million, which represents a little more than 95 phones per one hundred (100) people (Anatel, 2010). In the case of Panama, the annual rate of mobile phones per 100 inhabitants, for the same year was estimated at 185.4 and 90.7% coverage of the population (ASEP, 2010);

ii) performance: the processing and storage capacity of these devices exceeds the capacity of computers of a few years earlier (Prensky, 2005);

iii) GPS: integration between cellular and satellite positioning technology provides new educational opportunities based on the location of students. For example, it is possible to recommend the formation of working groups for discussions, debates and other activities, according to their physical locations.

A very important aspect, when talking about of mobile learning, is that it does not have to be treated as a substitute to the usual paradigm of distance education provided by the computer, but as a complement, in the sense that it offers more freedom (and sometimes greater motivation) to students in their learning activities. Based on the above, the architecture developed is appropriate, given that aims at the integration of a learning platform (Moodle) with the new trend of mobile teaching-learning.

2.3 Literature Review

Several papers discuss advances of mobile technologies and the concept of m-learning as a complement of distance education. This section presents a brief description of some works that have similarities with our project.

(Colazzo, 2003) presents a course management system adapted to mobile users' needs, using web services to define the communication interface between a CMS and mobile extensions. In (Wains and Mahmood, 2008), there is a framework for integrating a mobile learning environment with an e-learning environment, where, from SMS chat rooms, learning is fostered through forums and debates to discuss problems, thoughts and ideas; also voice calls can be made as well as radio and television transmissions. However, almost all content can be accessed through cellular phones' Internet connections, without any customization of learning objects, which can be quite inefficient.

Technical literature also reports work related to mobile communications and distributed services. (Ibrahim and Zhao, 2009) present a conceptual model of a framework for mobile devices' communication that supports mobility and distribution of services among multiple platforms. This model is based on ubiquitous communication requirements, such as: spontaneous interoperability, mobility, and software adaptability. Many of these principles, among them client-server communication and mobile agents, are a referent to our project; but unlike ours, the proposed architecture (Ibrahim and Zhao, 2009) is designed for Java Virtual Machines (JVM).

The first formal proposal by Moodle (Module Object-Oriented Dynamic Learning Environment) has some screen shots for the development of an implementation of Moodle 2.0 on iPhone and Android. It includes eight features: uploading files, student course information view, sending and receiving messages, platform resource view and downloads, seeing or assigning grades, attendance, forum view and posts, calendar, and survey. As mentioned above, this project is still at the proposal stage, with only some screen designs (Moodle, 2011).

2.4 MLEA Architecture Model

Figure No.1 shows MLEA environment organization, from a client-server model architecture perspective. In the right side, it is shown the client which represents the application developed for mobile devices based on Android operating system; meanwhile, in the left side it is shown the server, the infrastructure that makes the link with Moodle environment.

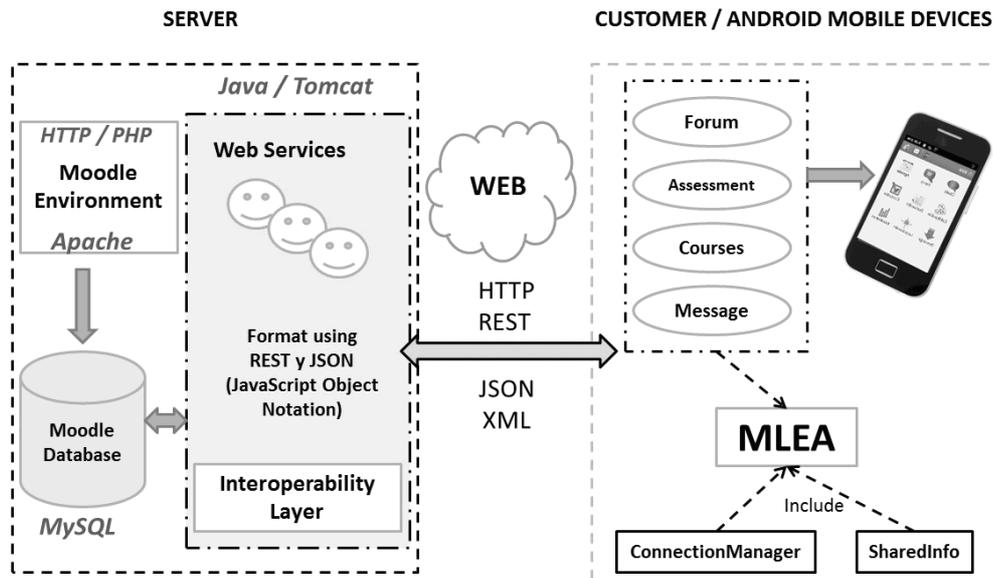


Figure 1. MLEA Architecture.

In the server side, a group of web services act as communication interface between clients and the server, which make it possible to provide clients with integrated features. A web service is a software component defined by an independent interface available through a data network. Operations defined in this interface, deploy business functions (Hewitt, 2009). Through web services clients have access to main resources on Moodle, such as forums, evaluations, messages, chats, file download, location, alerts, announcements, grading, and course, among others. At a request, a web service accesses Moodle data base to retrieve and/or manipulate the data needed to respond to that specific request. In the client side, implementation is based on Android development pattern: for each application screen, there is a Java class responsible for controlling actions of that screen.

2.4.1 Service Oriented Architecture (SOA)

MLEA is based on SOA (Service Oriented Architecture), an architecture that assists fast development of processes in complex environments and facilitates module reuse. It defines the use of services to support business requirements providing a methodology and a framework for building highly scalable information systems, at the time that offers a clear and well defined way to expose and invoke services, which as a result facilitates interaction among different systems.

2.4.2 Client

The client side, meaning, the Android application, uses Façade project pattern (Gamma et al., 1995) to make communication between screens and the class responsible for invoking web services. Each screen in this Android application holds an associated class. This way, for each functionality (i.e. forum, evaluation, courses, messages, chat...) provided there is a group of screens, therefore, a group of Java classes, represented in the architecture by the use of packets.

Figure No.2 illustrates the use of MLEA class that acts in the application like a façade to provide communication between classes and it is used by all the deployed requirements. In this image, it can be seen that the created modules (i.e. Forum, Evaluation, Course, Messages...) are clients of MLEA class, which defines an interface between ConnectionManager and SharedInfo classes, isolating them from the rest of the application. SharedInfo class manages the mobile device's database, where user information is stored such as authentication, connected users' ID, and chosen course, likewise cache data. This image shows only some of the modules developed. The architecture is made up of the following modules: login, forum, evaluation, messages, chat, file download, localization, alerts, grading, course selection, survey, forum evaluation, forum statistics, and view of connected users.

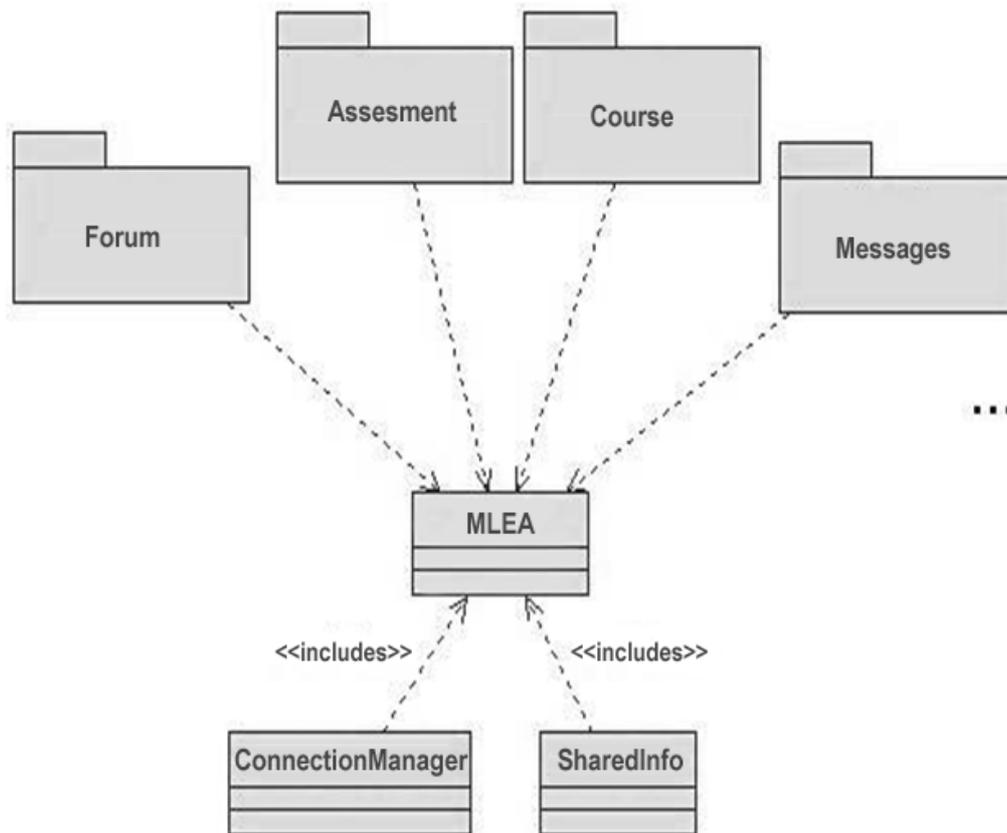


Figure 2. Client View.

2.4.3 Server

The server side relies on two design patterns to respond to client requests. First of all, web services use the project pattern DAO (Data Access Object) (Alur et al., 2003) to access and manipulate Moodle database. For each data type used there is a DAO interface that defines the operations that can be performed with it. The layer of the application model has the following data types, each with a specific DAO interface: login, forum, evaluation, messages, chat, file download, localization, alerts, grading, course selection, survey, forum evaluation, forum statistics, and view of connected users. In order to provide higher flexibility, DAO classes are not instanced directly by web services; but a factory is used to create DAO classes. This practice corresponds to the use of the project pattern FactoryMethod, which assures the complete application uses the appropriate DAO according to a chosen setting. Figure 3 presents the use of design patterns, where a group of web services uses DaoFactory to create interfaces' instances, which are used to access and manipulate information in Moodle database.

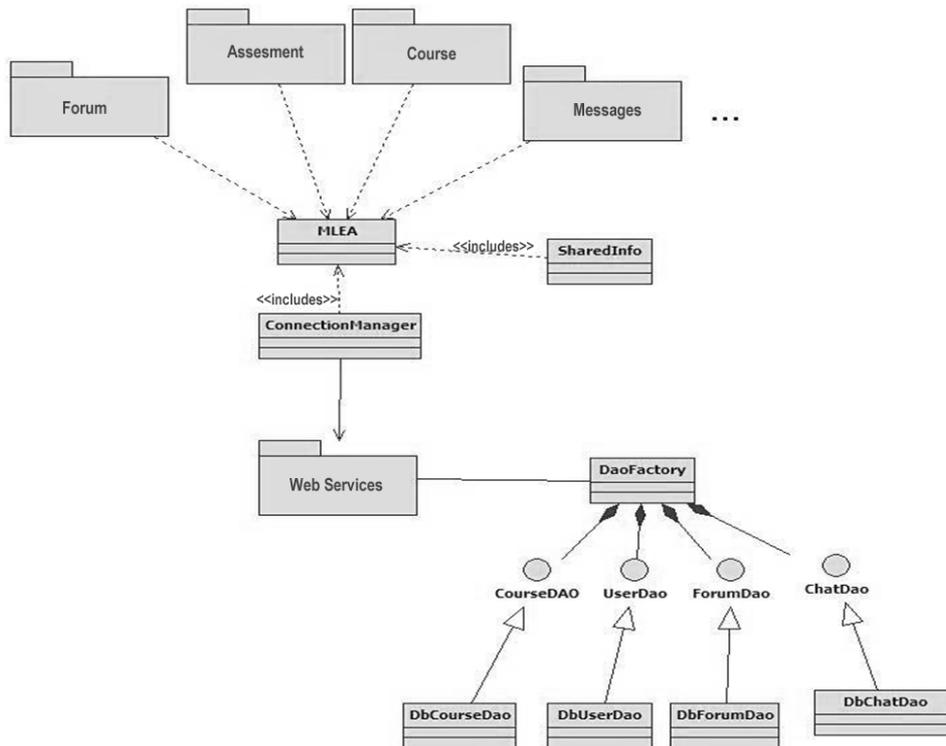


Figure 3. Server View.

2.5 Custom Notifications

An important aspect of the presented architecture is that it offers a tool to provide custom notifications for students and professors, allowing them to be updated about the activities related to their courses. Users that want to receive notifications are provided with a web interface to define, for each course, individually, every event they want alerts from. To be able to make use of this feature, users must be authenticated. Figure four presents the authentication screen, where users must enter the same information used for authentication in the Moodle environment.

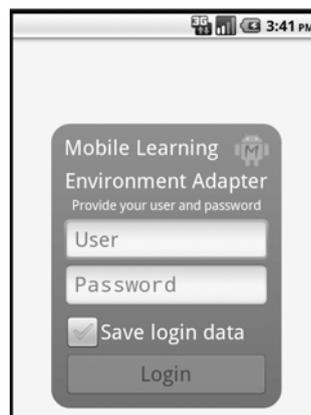


Figure 4. Authentication Screen.

Figure 5 presents the configuration screen for notifications, where users define parameters to receive the notifications they want. Users, depending on their role in the course, have the possibility to customize them as professor or student.

Figure 5. Notification Configuration Screen.

i) Students: they can set notifications to know about the occurrence of the following situations: creation of new discussions in forums, any news from professor, evaluation of a student's activity, creation of new activities (chat, quiz...), or when another student or the professor is online. Meanwhile, configuration capabilities for students can be restricted by professor.

ii) Professors: they can customize notifications for the following situations: when a student answers a question, sends information or starts a new discussion. Professor can monitor and being notified (alert) about actions taken by students. Moreover, professor can set students to be notified – mandatorily – about any important action he decides. For instance, professor can define all students to be notified whenever a new activity is created; this way, students cannot configure this alert, but keep control on other alerts they have defined previously.

3. CONCLUSION

By the use of computational and software engineering techniques such as web services, design patterns, ontologies, and mobile computing technologies, MLEA platform solves a variety of needs of users of virtual education programs. Moreover, MLEA impacts by offering an architecture that makes it possible to integrate several educational resources, which allow users, choose the most convenient for them in a given situation. Such an architecture offers a mobile learning environment that can be accessed anywhere, there is wireless connection to Internet, through smartphones, tablets, multimedia players and similar devices based on Android operating system. MLEA is based on SOA, an oriented service architecture that facilitates fast development and module reuse in complex environments as well as the creation of highly scalable systems while offering a clear and well defined exposition and invocation of services that eases interaction among different systems.

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