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MLEA: A Solution for Users of Android in UTPVirtual

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Abstract: This paper describes a design of an educational platform for a mobile learning architecture, which is a state of the art topic in distance education. The product will allow users to interact in an efficient, flexible, and transparent fashion with a web-based education environment, in this case Module Object-Oriented Dynamic Learning Environment (Moodle), using Android mobile devices. In order to provide a strong and lasting architecture, the Service Oriented Architecture (SOA) methodology is used given that it allows easy software re-utilization as well as integration of heterogeneous services. The architecture is based on web services implemented with Representational State Transfer (REST), as it has been demonstrated to be lighter and less consuming than other protocols, for devices with limited resources such as mobile devices. Web services provide the communication means between the server side and the client side of the architecture, whereas agents are used to deliver the services itself. The authors propose the development of an environment that facilitates the integration of various educational resources to support m-learning. An important aspect of the proposal is the offering of a tool to provide customized alerts for students and teachers, enabling them to remain updated about activities taking place in the courses.

Key words: Distance learning, virtual education, m-learning, service oriented architecture (SOA), mobile learning, mobile computing, interoperability, representational state transfer (REST).

1. Introduction

The developing of mobile computing and its widespread use have driven the creation of mobile applications aimed at the educational field, through the integration of several services favoring the emergence of a new category of distance learning known as mobile learning or m-learning. According to PAN et al. [1] `mobile learning is defined as any kind of learning that occurs when the student is not in a fixed, predetermined place or when she takes advantage of the opportunities provided by mobile technologies.

The combination of an educational environment with the mobility of personal digital assistants (PDAs), smartphones, and similar equipment for mobile learning, strengthens and enhances the collaboration and interaction process among users. Therefore, the potential of mobile internet opens a window to create easier access to resources, from anywhere and at anytime.

From this perspective this article proposes the development of an environment that facilitates the

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integration of various educational resources to support m-learning, with the intention of changing the paradigm of distance learning through an innovative, mobile, modular, and adaptable solution to every need, allowing maximum use of communication capabilities that information technology offers nowadays. The next section presents the beginnings of the Virtual Education Program at the Technological University of Panama, which increased the scope of higher education for Panamanians who could not attend a regular classroom. Section 3 highlights the problem that distance education faces in light of the huge proliferation of isolated educational tools, and a possible solution through the integration of necessary tools for users to make the most of their experience on the platform. Section 4 addresses the Service Oriented Architecture (SOA) working paradigm, which allows integrating heterogeneous services in different work environments in a flexible manner and through re-utilization. Section 5 describes the main benefits of creating a learning platform accessible from mobile devices. Section 6 addresses the system architecture which consists of four layers—ontology, components, interoperability agents, and service coordination. The expected results would be the ability of the system to allow users to exchange information with the environment; this is described in section 7. Finally section 8 presents conclusions and future work.

2. Background

Back in 2000, when talking about virtual education or e-learning was something new in Panama and when there was no evidence of this kind of experience, the Technological University of Panama started its Virtual University Program. It was conceived as a small and humble project aimed to use information and communication technologies (ICTs) in the learning process. The project included all six faculties and the university's seven regional centers through-out the country.

In 2003, the Technological University of Panama aware of its role and responsibility in the Panamanian society, and in keeping with its mission and vision, created Virtual UTP (UTPVirtual) [2], taking advantage of benefits offered by hyper technologies [3] to meet the needs of education and higher education for people who because of time limitations, work schedules, distance, family responsibilities, and physical disabilities among other reasons could not benefit from higher classroom education. UTPVirtual emerges as a democratization element in higher education and as an alternative to traditional classroom education which seeks to provide equal learning opportunities to those who usually find it difficult to attend a regular classroom. Having a global scope, its presence throughout the country, may strengthen national and local development.

3. Problem

The development of mobile computing and its widespread use, have encourage the creation of mobile applications aimed at the education field developing a new category of distance learning called mobile learning or m-learning.

Just as in other areas or domains of knowledge, distance learning applications are not isolated from each other, and even though many have been created for specific purposes, integration is common nowadays [4]. Meanwhile, connecting software is more than just the simple exchange of "bytes," which consequently requires the creation of processes to integrate single applications in an efficient and consistent fashion. On the other hand, the development methodology used by application interfaces usually consists on the creation of point-to-point direct interfaces.

Today, there is an increased proliferation of research work in the distance education arena, starting from single communication tools, assessment and support for integrating environments, which from a single site can make several resources and tools available to address the main needs resulting from the activities of students and professors [5].

The integration provided by the internet brings about a significant change in users stance towards educational software. The problem is no longer how to build software, but where to find it and how to use it. Although there is a lot of educational software on the Internet, we frequently see one of the following: discussion of many aspects for the same problem or the same problem under different perspectives. Thus, to find a tool that meets their needs, the user often finds a collection of software components that are neither compatible nor have integration mechanisms.

This proposal intends to change the paradigm of distance education through an innovative solution by developing a mobile, modular, and adaptable system adaptable to every need making great use of communication capabilities offered by information technology at the present time.

4. Related Work

The first formal proposal by Module Object-Oriented Dynamic Learning Environment (Moodle) presents some screen shots for the development of an application for Moodle 2.0 on iPhone and Android phones. It includes eight features: uploading files, viewing course information for students and teachers, attending courses, sending and receiving messages, activities calendar, and survey. This is the first formal proposal by Moodle for developers to take any mobile application as a template for Moodle. As mentioned earlier this project is still in proposal stage, and there are only some screen layouts [6].

Meanwhile, the members of Moodbile and Moodle4iPhone have announced collaboration on a project called Moodle to Mobile, M2M, which aims to create a plugin for Moodle in order to allow any kind of mobile device to access services. However, no progress has been published so far. It is not an application for the mobile device, but for the Moodle server [7].

There are some other projects out there addressing the same issue. Softwarelivre is a project in Portugal to create an application that will allow Android devices to access resources in a Moodle server. However, due to the use of Simple Access Oriented Protocol (SOAP), the application is heavier compared to Representational State Transfer (REST) for web services [8].

MBOT is a free original application for Android. It allows the user to: store session data for an automatic connection, it remembers all activities such as classes visited by the user, homework done, forums, and more. This also allows the user to add classmates, Google contacts, and finally to open and store files in Word, Power Point, and PDF, if a viewfinder is installed. The drawback is that when the user clicks on any application or activity it opens to a web page, which is not formatted for a mobile device, in other words as if the user had accessed them through the Android web browser [9].

Mobile LearningEngine (MLE) Moodle is a free application that is primarily programmed for devices running Java 2 Platform, Micro Edition (J2ME), however, there is a version for Android version 1.0, which does not work in current phones because it is obsolete. This integrated system for learning from mobile phones, is designed as a plugin for LMS-Moodle (Learning Management System). It transfers the automated study based on multimedia learning (known as eLearning) to a mobile environment (to a mobile phone). The user can also access the platform from the mobile phone; the user can use his own phone browser to access a formatted version MLE-Moodle. For this application to work properly the user needs to configure the Moodle server [10].

MoodleTouch (mTouch) is developed for the IPhone Operating System (IOS), but the development team is working on an alternative version for Android. The application interface is well developed and very intuitive. All resources and activities are formatted for viewing on a mobile device. This application does not require any configuration to the Moodle server in order to work, so it is compatible with version 2.0 of Moodle. This is not a free application [11].

As we have seen, there is a lot of work in this field, however, all of them are in the early proposal stage and those that most closely resemble our project are not free applications. On the other hand, none of these projects include activity notification alerts, which is an important contribution from our proposal.

5. Service Oriented Architecture

The development of the application will be based on SOA, a software development approach in which services are built as reusable components [12]. A service is a component that solves a specific business need for customers. Requests are received and it responds by hiding all processing details. SOA offers low-coupling, interoperability, discovery abilities, change management, and business service operations in a well managed environment. The guiding principle of SOA is to support business requirements, usually implemented through Web Services, although this architecture can be implemented in other ways. It's a perfect paradigm for heterogeneous environments given that services are its developing units. Therefore, they can be executed in several domains. In the context of this proposal, this paradigm will more efficiently break new compositions of services that will be developed during and after the project delivery. This allows great flexibility and large-scale reuse for new components to be integrated in the proposal.

REST will be used to implement web services given its efficiency exploiting existing technology and protocols in the WEB such as Hyper Text Transfer Protocol (HTTP) and Extensible Markup Language (XML) [13]. Due to the fact that those protocols already have a rich vocabulary that can be used, there is only the need to determine resources in order to describe the interface. REST is simpler than other protocols such as SOAP because there is less need for coding and interaction with the server. Services in SOAP require knowledge of the method name and procedural conventions for any particular service while that is not the case for REST. Our main focus is to avoid mobile devices having to use lots of resources, which in fact are limited, while uploading, downloading, or interacting in general with the Content Management System (CMS); therefore, REST is the most suitable choice.

6. Architecture

The architecture of the application uses a client/server model, in which mobile phones play the role of the client and the server is represented by the environment where Moodle is installed. Fig. 1 reflects this architecture.

The MLEA architecture (Mobile LEArning) is divided into two layers:

- Server side—responsible for providing the functionalities that will be used by clients. This layer is made up of the following elements: (1) an ontology using Web Ontology Language (OWL) that formally describes the Moodle data model; (2) a group of software agents, where there is an agent for each functionality (e.g. chat, forum), which also use an ontology for communication among them and to perform queries as well as to update the Moodle data base; (3) Mediator, which is the responsible for the communication between the client side and agents in the server side;
- Client side—corresponding to mobile devices that will use the functionalities offered by the server. It comprises the same ontology on the server side so that agents in both sides can understand each other, and a mediating agent, which is also responsible for managing the communication. Moreover, both teachers and students can configure a set of steps to create agents and to detect actions, with the intention of receiving information relating to their courses.

6.1 Architecture Scalability

After many tests performed with the Window 7 and Linux operating systems, it was found that the maximum number of simultaneous agents is around 7,000 for Linux and 6,500 for Windows 7. The JADE

tool was used to perform the simulation model.

With this in mind, we established an architecture to use the minimum possible number of agents simultaneously. This can be seen with the use of two walls which act as software agents. These agents reduce the number of agents created for applications selected by the user, which allows communication of agents on the mobile phone with required agents be made in a range of 1:1 between the mobile phone and the server. Otherwise it would be an n: n communication which could exponentially increase the number of agents running on the Moodle server.

6.2 Features of MLEA

MLEA will offer the client (mobile phone) the ability of doing the following:

(1) Forums: Students will read and create new discussions and teachers have the opportunity to evaluate students' participation (posts) while they read them (Fig. 2) presents an example of a student checking a discussion created by her teacher;

(2) Assessment: Students can take surveys and tests in the way of multiple-choice and true or false short questions;

(3) Messages: Users can exchange asynchronous (non-instant) messages similar to e-mails;

(4) Chat: Students can establish open conversations with the teacher, mentor, or other students who are available to answer concerns as soon as they arise (Fig. 3 shows a chat conversation between a professor and a student);

(5) File: It is possible to download files to the mobile phone, so that students can study/learn/carry out their activities, even if they are at places with no internet connection;

(6) Tracking: Access to GPS technology on mobile phones to suggest making up study groups for students with common interests and who are physically nearby;

(7) Alerts: An important aspect of the proposal is the offering of a tool to provide customized alerts for students and teachers, enabling them to remain updated about activities taking place in the courses.

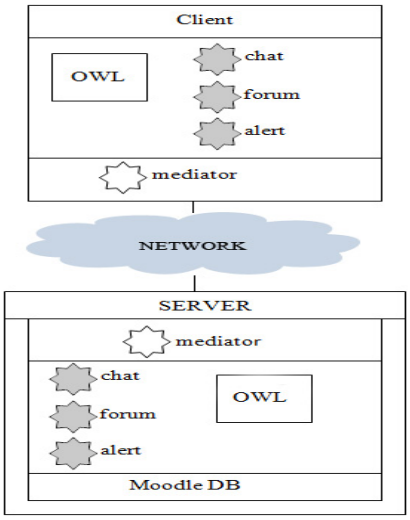

Fig. 1 MLEA Architecture.

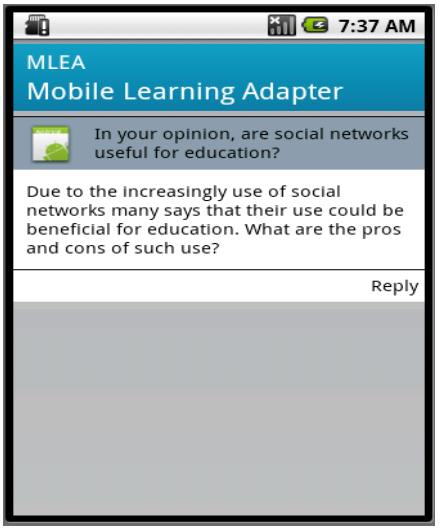

Fig. 2 Example where student check a discussion created by professor.

Fig. 3 Example of a chat conversation between a student and her teacher.

All these features will be implemented through agents, for example, there will be a software agent on the client side for the forum or chat. These agents communicate with the server side through the figure of a mediating agent; and similarly, there is an appropriate agent for each function on the server side and there is also the presence of a mediator. Client requests are received by the mediator, which sends them to the appropriate agent which access the Moodle's data base for editing, queries, inclusion, or deletion of data (Fig. 1).

The agents will be developed under the vision of web services, standard of technology used for integration between applications and open systems. Thus, developing it as a service allows to add it to other applications regardless of the language in which they were implemented and platform in which they are being executed. In this way the agent has the role of carrying out a process of mapping between applications.

7. Benefits

By unifying educational environments with the mobility of Personal Digital Assistants (PDA's), Smartphones, and similar equipment to create mobile learning, it strengthens and enhances the process of collaboration and interaction between users [14]. In this way, the potential of Mobile Internet allows easier access to resources, from anywhere, and at any time. The following direct benefits have been identified for this proposal:

(1) It fosters the generation of responses to demands for training and continuous education for people who cannot regularly attend traditional classrooms;

(2) It establishes a professional and specialized contribution between institutions involved and society, in adherence to national plans for the advance of science, technology, and innovation;

(3) It is based on synergy, embracing the status and experience of UTP through UTPVirtual as well as UNISINOS through its software engineering and programming language teams;

(4) It enhances the country´s capabilities regarding the development of online distance education by promoting innovative solutions.

The main beneficiaries of the project will be [15]:

- UTP students all over the country who are enrolled in VirtualUTP;
- Society in general given that results will be effective solutions for those enrolled on online distance educational programs.

The results of this project, which makes use of computational techniques and software engineering such as web services, design patterns, ontologies, and mobile computing technologies, solve the issue of options to access platforms faced by all participants who benefit from online education.

Moreover, it makes an impact in the educational technology arena given the creation of an architecture that makes possible integrating several educational resources, which will allow users to define, in a modular and integrated way, the most convenient resources for them, and to be accessible through PDA´s, anywhere there is Internet access.

8. Expected Results

We expect developed clients, based on the proposed architecture, to exchange data and information between software agents based on web services which will be transparent to users, so that there will be an adaptation layer between UTP´s virtual education environment (UTPVirtual) and a strong infrastructure that will support execution and software simulation (computational grid).

9. Conclusions and Future Work

This project allows us to enter the circle of research made by developed countries, defining areas of research and development so far, unexplored in Panama. It represents an innovative proposal in our country, which emerges on the initiative of this research team.

UTPVirtual has contributed to increase the number

of people who can access higher level education or to finish their university degrees, regardless of their physical location. Obtaining a university degree has been a key factor for new professionals to explore new and better positions in the job market, at the local and international level. It has also allowed alumni to enroll in specialized studies that complement their professional careers.

Based on the completion of the project, validation experiences are expected to be performed in diverse scenarios and locations all over the country that were involved in its development. This will allow us to identify situations and special cases directed toward the ongoing improvement/adaptation of the project.

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