NEW ERA OF M-LEARNING TOOLS
Creation of MPrinceTool a Mobile Educative Tool

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Abstract: M-learning is an exciting art of using mobile technologies to enhance learning skills. Mobile phones, PDAs, Pocket PCs and the Internet can be joined together in order to engage and motivate learners, anytime anywhere. The society is entering a new era of m-Learning, which makes important to analyze and innovate the current educational tools. This article proposes a new tool that aims to improve the deficiencies identified in the usual analysis. The proposed tool, is called MPrinceTool, provides a new means to interact via mobile technology by using web services that facilitate users to participate in educational activities and communication with working groups, synchronously: where students can participate in class and communicate with the teacher and the other students, also they can realize exams and exercises which needs the teacher presence; or asynchronously: Which allow students to feel free in realizing there educational activities out of school time. These advantages will be clearly adapted by our tool and part of it will be explained in the "use case" proposed in the paper. Also we present a brief explanation of the used methodology and technology, in developing this tool by presenting its system architecture, deployment and class models.

1 INTRODUCTION

By the end of 2009, there were an estimated 4.6 billion mobile cellular subscriptions, corresponding to 67 per 100 inhabitants globally (ITU, 2010). This is more than three times the number of personal computers (PCs), and today's most sophisticated phones have the processing power of a mid-1990s PC.

These facts, and the range of computer-like functionality offered by top-of-the-range devices, are leading some observers to speculate that many people in the near future will start to see the mobile phone as an alternative to a PC. So it is normal to think that all teachers and students (university and school) make a use of it in their daily life.

The application of mobile technologies in the learning process is basically named mobile learning.

So, from a pedagogical perspective, mobile learning provides a whole new dimension to support either traditional or novel educational processes.

Some characteristics of this type of applications are described by Chen et al. (Chen 2002) which include: the urgency of learning need, the initiative of knowledge acquisition that allows different searching requests of information in knowledge contents as it presented by Cakula et al. (Cakula, 2009), the mobility of learning setting, the interactivity of the learning process, the "Situation" of instructional activities and the integration of instructional content.

These characteristics make mobile learning quite different compared to traditional classroom learning environment, where all the educational activities are carried out at a designated time and place. Although the use of laptops extends the range of education to places where wired connections are available;

mobile technologies go beyond wires and take education possibilities to places where wireless connection is feasible.

Another issue to take into account is the adaptation of mobile technology to contextual life-long learning, which is defined as the knowledge and skills enhancement of people that need to prosper throughout their lifetime. These activities are not confined to scheduled times and places as traditional education requires, which are so difficult to achieve when people finishes formal learning.

Thus, mobile technologies became an effective means to support appropriate life-long learning, by being highly mobile, individual, unobtrusive, adaptable to the context of learning, so that learners can evolve their skills and knowledge (Sharples, 2000).

Our proposal can be seen as an interaction improvement to m-learning systems inheriting m-learning advantages, as long-life learning is. So, mobile learning liberates users from being anchored to a specific space, providing the possibility to explore the environment and interact with the world outside the desktop. This is an interesting point to highlight because it restricts student explorations to a fixed place limiting one of the most meaningful ways of building knowledge from a constructive point of view that encourages the idea of "discover to learn".

Therefore, the main idea of this proposal is to present an innovated interaction way where users are able to interact with the environment to build knowledge from relationships acquired from the ambient.

In this paper we present the MPrinceTool as a new education tool (right now in a beta version) which is a combination of two existing tools the "Interactive Learning Panel" (Tesoriero, 2009) and the "WallShare" (Gonzalez, 2009), with several modifications that enrich the classroom study allowing students to work in a collaborative way as it is indicated in European Higher Education Area (EHEA, 2010).

The structure of the paper is as follow: first we describe the system (server and client functionality and exhibit its architecture), secondly, the state of art of the two tools that we merged together is presented, thirdly, the motivation of the creation of this tool by this way is discussed, fourthly, the tool implementation. At the fifth point a case study that represents a view of the use of our tool is demonstrated. And finally, the conclusions that have been observed and obtained after using the tool and the future work upon it will be presented.

2 STATE OF ART AND MOTIVATION

There are more and more educational tools for mobile device use, and each is specialized in a particular field. Here, the two tools that we developed and merged together, mentioned above, will be introduce.

2.1 Interactive Learning Panel

Using this device, the students can relate information that is presented by the mobile application to a physical region of a panel. It is based on the idea of relating concepts with lines, or multiple choice questionnaires.

Concretely, they have implemented a PDA web based application where users have to relate a flag to a region on a map. For instance, if a flag is given on the PDA screen, students have to relate it to the country depicted on the map and vice-versa.

These panels are equipped with RFID tags that represent concepts on the panel and the PDA is equipped with a RFID reader that is able to read these tags and detect how user relate these concepts through their readings. So, to relate the concepts exposed in the PDA screen to those on the panel, users have to put the reader (mobile device) over the graphical representation in the panel.

2.2 WallShare

Is a system based on a shared zone that is projected on a wall or screen, which is clearly visible by the participants of the meeting.

In order to interact with the system, each participant connects his mobile device to the system.

Once the connection procedure was accomplished successfully, a pointer representing the participant is shown on the wall or screen.

An interesting aspect of WallShare is the possibility of providing each participant with the capability of controlling the movement of his cursor on the screen by performing dragging gestures on the mobile device screen. Thus, users can use the mobile device as an enhanced X-Pointer device.

Therefore, connected participants can download and upload all kind of resources from and to the shared zone.

Thus, participants are able to share a resource just by uploading it to the shared space. To perform this task, users select a resource on the mobile device through the client application and upload it performing a simple gesture. When the re-

source was uploaded, it is shown on the screen.

In order to download a shared resource from the shared zone, a participant has to point the resource with the cursor and select it. Once the object was selected, the user has to perform a double click on the mobile device screen. As result of this action, the user receives the selected resource in the mobile device.

Following, the explanation of how we have developed the combination of these two tools in order to create MPrinceTool. So we present its specific models and how it was deployed and created by describing its software functionality and its system architecture.

3 SYSTEM DESCRIPTION

MPrinceTool system is presented in a projected area onto a wall or large screen, which is clearly visible to students who use the system. The functionality of the system can be divided into two parts. First, we have the functionality of the client and, second, we have the server functionality (see Figure 1).

3.1 The Server Functionality

The server application (MPTServer) is responsible for controlling the customer interaction and display all the information that students and teachers need.

MPTServer shows, or projects, in a split screen the questions that teachers asked to students, who are connected to the system; they make use of the chat room to comment on the requied question at a given time and about the resources that the teachers share with their students.

Thus the shared area that is projected is divided into four parts as shown in Figure 1.

The upper left region is the reserved area for the presented question by the teachers. It shows the formulation of the question and all its possible answers.

One of the uses of the tool is that, next to each answer there is a counter that indicates the number of students who have selected this response. Each user can select from his mobile device the answer that he think it is the correct choice using his associated pointer in the shared pool.

The upper right region is reserved to indicate students who are currently online at MPTServer. Each student, who is connected to the server, is represented by his name and an image in this region. So the participants can easily identify each other.

The bottom left corner contains the resources

(images, video, audio, or other file type) that teachers and students share; these materials are usually uploaded to help them in answering the questions.
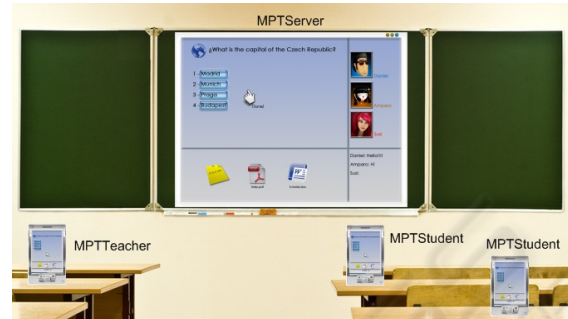

Figure 1: MPrinceTool, general view.

Finally the lower right region is a chat room where students can talk to each other to interchange ideas or to explain their opinion from the current question in order to answer the question correctly. Each instant message that is sent by the student is marked with the name of student that is sending the message. In addition to this server-side functionality, it also offers other options in order to manage the look of the shared zone. The customization of shared zone wallpaper, the chat enabling/disabling function, the resource relocation functionality avoids resource overlapping and the shared zone clean function sends shared resources to the recycle bin.

3.2 The Client Functionality

We have two client applications, a version that offers the functionality that the student can make (MPTStudent) and the other version includes additional functionality that only teachers can do (MPTTeacher). Both versions are developed to be used within mobile device applications which are connected to MPTServer.

In order to access the system, participants (students or teachers) download and install the client application into a mobile device from the MPTServer. This application is automatically updated whenever a new version is released in the server.

In order to interact with the system, participants connect their mobile devices to the server application. When participants get connected to MPTServer, they receive a double feedback, a sound from the server machine, and a pointer representing each user on the screen.

An interesting aspect of MPrinceTool is the possibility of providing each participant with the

ability to control the movement of a cursor that represents him/her on the screen just by performing dragging gestures on the mobile device screen. Thus, users can use the mobile device as an enhanced X-Pointer device.

Both applications, MPTStudent and MPTTeacher, have the general functionality that has been discussed above. The specific functionality of each is explained as follow: Starting with MPTStudent, where the objective is to enable students to perform exercises proposed by the teacher. To do this, MPTStudent consists of a login screen through which students access the application. Once login is performed, a screen displays the main region of questions and the shared materials of MPTServer.
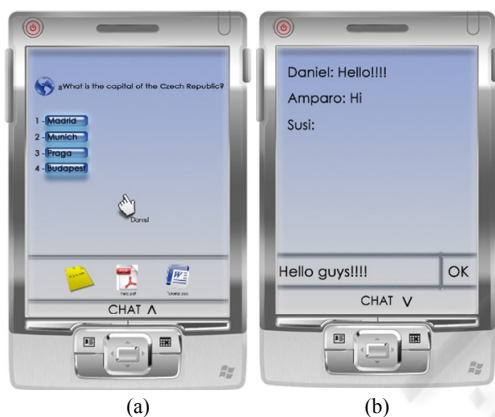

Figure 2: MPTStudent interface. (a) main screen. (b) chat screen.

In this main screen Figure 2.a, students can answer the questions that the teacher assigns for them, by simply selecting the answer with the allocated pointer. Each time, only the selected students can answer the question posed by the teacher. In MPTServer, it makes appear only the pointer of the students who can answer the question, all other pointers are disabled. Also they can download the shared resources (Help material) by double-clicking on it.

At the bottom of the screen there is a tab, by clicking it, there will display a panel that appears in the chat area through which students can discuss and resolve inquisitions (Figure 2.b). In the other side, there is the teachers application; MPTTeacher. The purpose of this application is to give the teacher the necessary functionality to monitor and assess students through a series of questionnaires, in a comfortable way using their mobile devices. MPTTeacher consists of a login screen where the teacher is identified to access the system. The main

screen displays the questions region of MPTServer offering the teacher a navigation option to select the questions and earmark the student/s to answer it.

Clicking the tab located in the bottom of the main screen; it displays a panel with the chat, similar to MPTStudent. Using the chat resource teachers can resolve any inquisitions that the students make. Also it can be used as a FAQ or a discussion area. On the right side we can find another tab, which displays the file panel. The teacher uses this file browser to select the file/s he wants to share with students so they can download it/them. The shared resources by the teacher appear in the lower left region of the MPTServer Panel.

3.3 System Architecture

The MPrinceTool system is a client-server application (see Figure 3). Therefore, MPrinceTool is based on three systems, as can be seen on Figure 4. The server, and two client systems (MPTTeacher and MPTStudent).

The server system runs on a desktop computer that is connected to a wireless network via a Wi-Fi or Bluetooth connection. It is also connected to the visualization system, i.e. a projector or large screen, which supports the shared zone visualization by the participants (Figure 3).

The server system is composed by two basic components; the resource sharing component and the shared zone visualization component.

The resource sharing component is in charge of performing resource transferring between the clients and the server applications. The resource transferring is performed when clients download/upload resources from/to the server. This communication is performed using Web Service technologies.
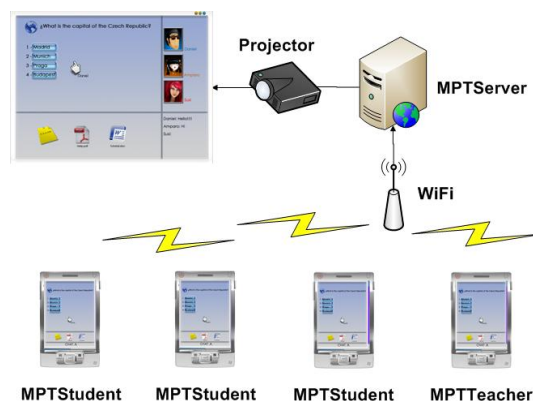

Figure 3: Funcionality of MPrinceTool system.

While the shared zone visualization component is in charge of synchronizing and displaying client actions, such as cursor moving on the shared zone. Besides, it is responsible for displaying resources and actions which is sent to the resource sharing component on the shared zone.

In order to improve performance, it has been decided to implement the communication between the clients and the shared zone component through sockets.

The client applications run on the user mobile device and it is connected to the server application through a wireless network via a Wi-Fi or Bluetooth connection.

The client is connected to the server components according to the task to be performed. To upload (teacher) or download (student) a file, the client connects to the resource shared component of the server system to transfer the file via Web Services.
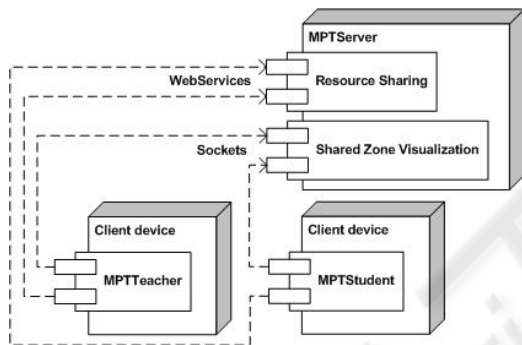

Figure 4: MPrinceTool Deployment Diagram.

However, to perform actions of the shared zone (i.e. move the cursor on the wall, answer a question, send a chat message, etc.), the client connects to the shared zone visualization component of the server system via socket based connection to improve system performance.

3.4 System Implementation

This section presents how the MPrinceTool prototype was implemented.

Thus, the MPTServer application model is composed of the following classes as can be seen on Figure 5:

MPTServer: the MPTServer class manages shared resources, the movement of the user's pointer, questions asked by the teacher, student's connection and Chat messages.

Resource: the Resource abstract class represents every resource that can be shared by the MPTServer.

Specific classes are Image and OtherResource.

Image: the Image class represents an image resource.

Other Resource: the OtherResource class presents every resource that it is not a picture. Image is different from OtherResources because Image shows the picture and OtherResouces shows the application icon that it is usually used to open the resource.
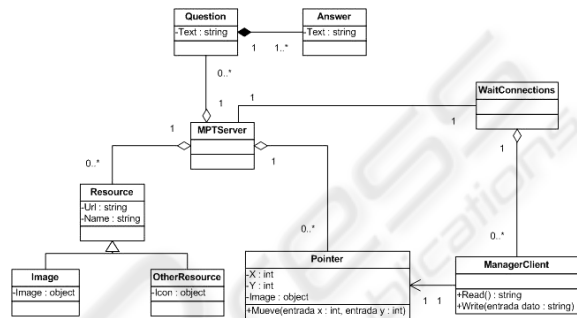

Figure 5: MPTServer Class Diagram.

Pointer: the Pointer class represents each pointer controlled by the user. A pointer is defined by its position (X and Y) and a hand icon.

WaitConnections: the WaitConnections class waits connections from the client application after that it creates a ManegerClient for each connection.

ManagerClient: ManagerClient class is the responsible for sending and receiving data to and from the client applications.

Question: the Question class represents all questions that the teachers ask.

Answer: it must be associated to a question, there are several answers for each question, but there is only one correct answer.

The prototype has been implemented using mobile devices running Microsoft Windows Mobile and Microsoft Windows XP operating systems. The desktop application has been developed using the Microsoft .NET Framework 3.0.

4 CASE STUDY

When it is the time to select a case study it is only necessary to focus on a learning situation conducted by the teacher and his students in an electronic learning environment, in order to achieve a complete collaborative task. Specifically, this will explain a

very common situation where the teacher offers to students a set of test questions to do, for example, as a review of the most important concepts of the last explained subject. The teacher assigns a range of questions for each student, or group of students, to answer and explain them.

Normally in these situations the teacher makes the student read each question that corresponds to the range earmarked to him, either from a common screen (usually showing a projector signal) or from the book notes that have been previously provided. Once the student read the question, he chooses or selects an option, from all the presented ones, that he thinks that is the correct one and explains his decision. Subsequently, the teacher corrects the answers of student if it is necessary. All this, of course, is done in an environment where all students are present, so they can acquire a feedback from the subject content. To facilitate these activities, an application like MPrinceTool seems necessary. By using this application, the situation would considerably become better, since students and also teachers will have a major, visual and simple, interactive environment.

In this new context, the teacher launches the application, MPrinceTool, from his mobile device introducing his username and password. Once he is identified, the teacher can access the appropriate interface to his role in which he can see all the test questions (which are displayed individually), the connected student, the offered resources and the chat event. Later the system reloads the questions list and assigned each student a range of relevant questions.

In addition, each student will connect to the application using his mobile device, identifying himself by introducing his username and authenticating with his password. In this case, he enters the system with the student role; he can access the options that are specific to this type of role: chat and test questions that he has to answer individually and in a personalized manner.

The questions to be resolved by the students will be automatically selected by the system based on the subject to review, and depending on the number of the connected students and to the difficulty level that the teacher selects.

At this point, the application has been distributed over three interfaces: the projector which displays all, and both interfaces on the teacher and student mobile device.

Students interface displays a screen with two zones, one that will be used as a mouse (and includes the same view of the projector), which is used to select the answer that they consider as a correct one, in the case that where the viewed question corresponds to him. The other area is composed of the chat that allows him to communicate with other members of the class.

Taking into account the described interfaces, the needed environment that defines the situation is created; at this time the teacher indicates the start of the collaborative activity. Once the review is completed, i.e. once all students have answered all the questions, the teacher concludes the event. Finally, the application save a historical review of what has been accomplished, storing two sets of data:

- Specific to a particular student: questions and answers that the student has worked, and also a statistical study of correct and incorrect answers.

This information is essential because it allows assessing student's knowledge individually.

- Specific student group: all questions and all answers that have been done with a comprehensive statistical study.

This information allows assessing the knowledge of the class as a whole.

After completing the review, and closing the application from the teacher interface, the entire system will shutdown, which means that students instance will be closed too, and at the time the finalization of the interface that is seen through the projector.

5 CONCLUSIONS AND FUTURE WORKS

This paper presents a solution for the classroom education, by presenting the educational tool, MPrinceTool which make use of the high technology, like the mobile devices, Wi-Fi connection, as presenting collaborative environments.

This tool also helps students to participate more in class and join each other in the educational activities. It allows them to interact with the learned subjects, and teachers can have more detailed information about student's progress.

Also we are developing this tool in a way that students who are out of classroom can participate in the class work. And we are studying the method that can develop it, so it can be work in another platforms and operating systems.

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REFERENCES

Cakula, S.: *M-Learning: new way to access knowledge library online.* IEEE Multidisciplinary Engineering Education Magazine, Vol 4, No 1 (2009).

Chen, Y. S., Kao, T. C., Sheu, J. P., Chiang, C. Y., 2002: *A Mobile Scaffolding-Aid-Based Bird Watching Learning System. In: Milrad, M., Hoppe, H.U. (eds.) IEEE International Workshop on Wireless and Mobile Technologies in Education,* pp. 15–22. IEEE Computer Society, Los Alamitos.

EHEA, European Higher Education Area. Last access 01/01/2010. http://ec.europa.eu/education/lifelong-learning-policy/doc62_en.htm

Gonzalez-Villanueva, P., S. Romero, R. Tesoriero, J. A. Gallud., 2009. *WallShare: A Collaborative Multi-pointer System for Portable Devices. Universidad de Castilla-La Mancha. Departamento de Sistemas Informáticos.* DIAB-09-10-1.

ITU. International Telecommunication Union. *Measuring the Information Society.* 2010. Last access 12/04/2010. http://www.itu.int/ITU-D/ict/publications/idi/2010/Material/MIS_2010_Summary_E.pdf

Tesoriero, R., Fardoun, H., eta., 2009. *Human-Computer Interaction. Interacting in Various Application Domains.* ISBN: 978-3-642-02582-2. 236-245. Pages 236-245.