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A Management Service for Student Examination Results with Nomadic Access

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Abstract – The paper subject is related to the fields of e-learning and distance learning. We are proposing an electronic classbook with nomadic access and SMS notification. The idea is to integrate a result management system with a publishing and a notification system in order to facilitate the management of examination results and students' presence. In order to build such a system, a distributed architecture is proposed. For the implementation, several software technologies are used: J2ME, jSMSEngine, WAP-WML, VXML. Our proposal is an example of mobile and fixed terminals utilization in the educational field.

Keywords: electronic classbook, nomadic access, mobile devices.

I. INTRODUCTION

During the latest years we have witnessed a large number of mobile technologies developing very fast. This implies the existence of a large variety of mobile phones, PDAs, and also a large variety of communication solutions such as GPRS, Bluetooth, WLAN and others. Users are nomadic by nature and they frequently need the same service in different places at different moments. We call this *nomadic* access.

One of the potential fields for nomadic services is education. Lately, the interest for e-learning and distance learning is increasing. Mobile devices have their own place in this field. These new technologies can help the actors in the educational field to communicate much better; actors like: pupils, students, teachers, professors and even parents.

In this paper we are interested in developing a nomadic access system that will help teachers manage the examination of the students, and the students to find out their results by using fixed and especially mobile devices.

This paper is organized as follows: the next section presents some existent solutions related to our subject; the third section presents our architecture and its components; the fourth section presents the implementation and some screenshots and the last one concludes the paper. We consider that the main contribution of the paper is the integration between e-learning, m-learning and the nomadic access and it is materialized in the proposed architecture.

II. EXISTENT APPROACHES AND SOLUTIONS THAT ARE RELATED TO OUR SUBJECT

In this section we intend to make a short overview of the research fields related to our subject. These fields are: educational portals, e-learning, m-learning (m from mobile) and nomadic access architectures.

A. *Educational portals*

In the latest years numerous educational portals can be seen on the market. The goal of an education portal is to offer an integrated environment dedicated to the educational field. For instance, in Savoie, France, an education portal [3] was implemented. It provides a virtual environment for students, professors and administrative staff, where they can use individual tools such as: e-mail, news, agenda, address book, and the most important, a virtual desk where each user can manage different objects as documents, images, etc. It also provides groupware tools: forum, chat, and a virtual team desk very useful for team projects. Anyway, this portal is available only on the Web and does not enable nomadic access.

B. *E-learning and m-learning platforms*

In "Blended Learning, Mobility, and Retention: Supporting First Year University Students with Appropriate Technology", [2], Andy Stone illustrates how an SMS-based notification system may be used for the first-year students to update their schedule and "how and where to collect marked coursework from the department office for the first time".

A very interesting approach is the one of Jo Colley and Geoff Stead that proposes a collaborative mobile board. The mobile user can access its content through the web and fill it, from the mobile terminal, with short and multimedia messages (SMS and MMS), [5].

The idea of multiple accesses to learning information is present in the paper "A System for

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Adaptive Platform-Independent Mobile Learning", [7]. Here the SMS-based interaction is supplemented by a voice-based one, using the H323 Gateway and an Interactive Voice Response.

C. *Nomadic access architectures*

The nomadic access architecture is an architecture that allows user access to a service from different terminals and through different networks. The most important problem to solve here is the integration of different constrains and technologies.

Our attention was focused on user interface integration solutions because we want to offer access for the same service using different user interfaces. The idea is to have a unique description for the user interface that can be automatically transformed into platform specific user interfaces. Several languages have been developed to allow a platform independent description of the user interface: UIML (User Interface Markup Language) [8], XIML (eXtended Interface Markup Language) [1], SunML (Simple Unified Natural Markup Language) [4] and others. These languages allow us to describe the user interface in a platform independent manner. Several *renderers* create a concrete terminal dependent user interface.

III. OUR PROPOSAL

A. *Objective*

As we have seen in the previous section, there are several field specific solutions for educational services, mobile learning services and nomadic access services. In our case we need something that integrates all these solutions. In this paper we intend to propose an integrated solution for educational nomadic services, in particular we want to develop a system that will help the evaluation and publishing of students' grades. For high school or gymnasium it is possible to involve the parents by sending them instant notifications about the pupil's activity.

B. *Functions*

Basically, this system must perform the following functions:

- For the teachers or professors: mark absences and observations for the laboratory courses, edit the examination results.
- For the pupils or students: check up the notification results and the number of accumulated absences.
- For the parents: check the pupils grades and absences and be instantly notified about the absences

The system will integrate all this functions, will check the allowed absence number, will send a notification to the parent who wants to know whether the pupil is at school.

C. *Architecture*

The proposed system architecture is described in figure 1. It contains several components:

- The rendering components: HTML, WML, VoiceXML. A renderer [4] transforms a UIML or SunML user interface description into a concrete user interface. This gives us the possibility to have only one interface description for several platforms and we are using it for the publishing of the examination results.
- The J2ME client is a MIDlet, dedicated to absences and observation management. The professor/ teacher is the one who uses it. The connection can be wired or wireless.
- The SMS Notify is an interface to the GSM that allows the system manager to send notifications to the parents. The parent must subscribe to this service first.
- The Database contains basically all the persistent information related to the users: user account information, examination results, absences, etc. Different users are authenticated using this database, and they have access to services based on their status.
- The User Interface description contains the unique description for the examination results and absences publishing service. This fact reduces the design effort for all the required interfaces.

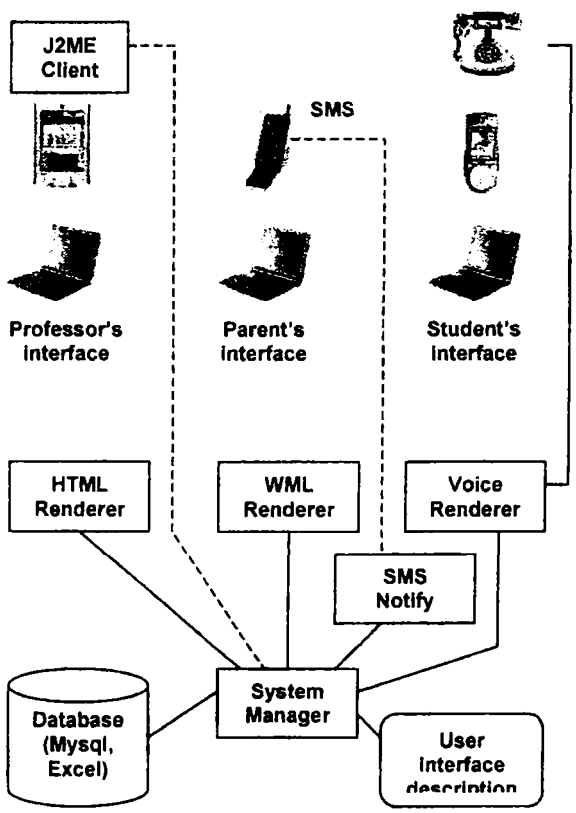

Figure 1. The overall system architecture

- The System Manager links all the other components and contains the business logic. It uses the user interface description and the renderers in order to interact with the user according to his particular interface. At this level we have the application algorithm and the task (user – machine dialog) description and succession. The manager implementation can be based on a workflow engine for instance.

IV. IMPLEMENTATION

A. *Technologies*

Several technologies were used in order to build this prototype:

- *J2ME*: represents a highly optimized Java runtime environment, which specifically addresses the vast consumer space, which covers the range of extremely tiny commodities such as smart cards, phones or a pager all the way up to the set-top box, an appliance almost as powerful as a computer.
- *Java Servlet*: a Java technology that offers a fast, powerful, portable environment for creating dynamic content for all the XML based technologies as HTML, WML, VoiceXML.
- *JSMSEngine*: is an API package, written in Java, which allows sending or receiving the SMS messages from PC, by using a mobile phone or a GSM modem.
- *UIML*: is an XML language for defining user interfaces. It can be used to define buttons, menus, lists and other controls that allow a program to function in a graphical interface. It also defines actions to take when certain events take place.
- *kXML-RPC*: is a RPC (Remote Procedure Call) middleware implementation for the mobile phone. The advantage of using this communication protocol is the high abstraction level. Aversion for J2ME mobile phones exists. This protocol encodes the method calls using the XML syntax and send this messages over the HTTP protocol.

B. *Prototype description – components and use cases*

A prototype was implemented using the technologies described above. The architecture components were implemented as follows:

- The HTML, WML and voice rendering components are UIML renderers based on LiquidUI [8] software distribution
- The J2ME client is a small MIDlet application with a simple user interface that communicates with the System Manager using the HTTP protocol. This client application allows the professor to mark the absences and to introduce comments for each student. The user interface is based on the java.microedition.lcdui package. A screenshot of this client is shown in figure 2.
- The SMS Notify component is based on JSMSEngine package. This component needs a physical interface that is a mobile phone or a model connected by a serial interface with the machine that runs the SMS Notify component.
- The Database is partially based on MySQL and partially on Excel. It was easier to use MySQL in order to store information such as username, password, status and absence number. Figure 3 shows a screenshot of the MySQL database interface. The advantage of using Excel was the compatibility with the existent list used by the professors and it is also easy to configure the algorithm to compute the final result for a student. A dedicated connector is used in order to connect Java with Excel.
- The User Interface description is a UIML file. This represents the user menus and they will be transformed into different concrete implementations by the renderers.
- The System Manager is a complex Java application that implements the system's workflow. For instance, the first user action is the authentication then he should see the main menu, the functions and so on.

C. *Screenshots*

In figure 2 we show the mobile user interface that allows the professor to mark the absences.

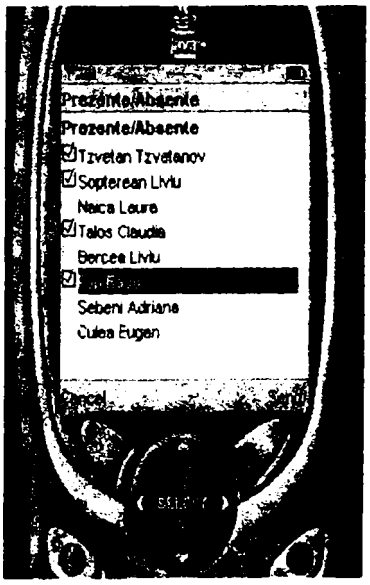

Figure 2 The mobile client

The mobile client was tested with the J2ME Wireless Toolkit simulation environment. The client size is about 56Kbytes and the kXML-RPC connector takes about 24Kbytes.

The communication can be based on GPRS, WLAN, IrDA, Bluetooth or even cable. Anyway, because of the price, it is not recommended to use GPRS.

a solution may be to try to automatically generate the platform dependent elements.

Another problem is the ergonomics of the automatically generated user interface. Anyway this is another research direction and we intended just to reuse this existent technology in order to prove our architecture.

In figure 3 we show the MySQL database interface.

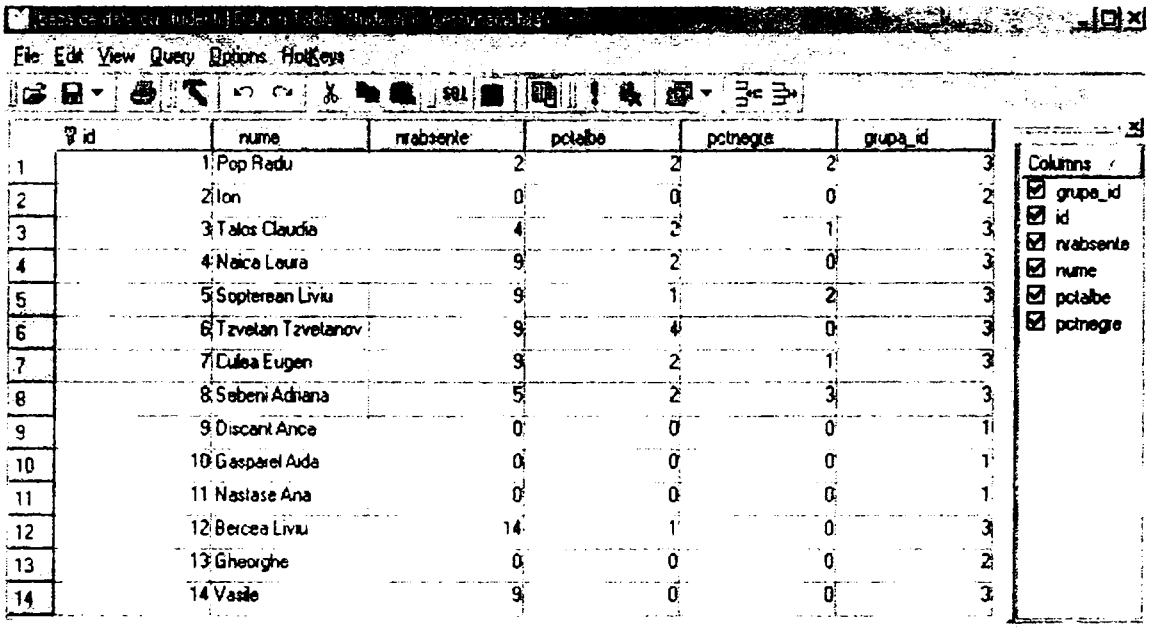

Figure 3. The MySQL database interface

In figure 4 we show an UIML code sequence from our application.

```
<?xml version="1.0"?>
<!DOCTYPE uiml PUBLIC
        "-//Harmonia//DTD UIML 2.0
Draft//EN""UIML2_0g.dtd">
<uiml>
<interface>
<structure>
<part id="Main" class="Wml">
<part id="Welcome" class="Card">
   <style>
   <property name="title">Bine ati venit
!</property>
   </style>
     <part id="newP" class="Paragraph">
           <part id="titletxt" class="Text">
               <style>
                <property name="content">Ati
accesat pagina catalog al sectiei de
comunicatii al universitatii tehnice din clu
napoca</property>
                </style>
            </part>
     </part>

</part>
```

Figure 4. UIML code sequence.

Even if UIML wants to be platform independent it has platform dependent elements. This is a drawback and

The records correspond to the absences and observation statistics. The grades are stored as one Excel file for the reasons explained in the section IV.

V. CONCLUSIONS

This paper has presented an integrated system that allows actors involved in an educational process - professors, students, pupils and parents - to manage the student results and absences. We consider this proposal a contribution to the e-learning and m-learning fields.

We are focusing on the nomadic access for the educational services because, as we have seen in chapter II, this field is less approached in literature. The proposed system is available not only on the Web but also on mobile devices and even on very simple terminals like fixed phones. This can be done by using an automatically generated user interface.

A prototype was implemented in order to test our proposition. Numerous software technologies were used because the nomadic access implies extended platform diversity.

The implementation has also some limitations that come basically from the user interface automatic

generation, which is not optimised, and, as we have seen, the platform independence is not always complete.

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