A System to Strengthening the Relationships between Actors in Educational Environments

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Abstract: - Nowadays there are a vast number of devices and technologies available for the common citizen to improve their communication with others. This fosters the design and implementation of systems that explore the available features of these devices. This paper presents a system that allows to inform, on a personalized way, the actors of an education institution on a free way using popular communication standards. Features like the system's architecture, prototype and system's evaluation are explained in the paper. Results show that this system can be an important complement to other popular systems in education environments (e.g. e-mail, chats, Wikis, forums, e-learning platforms etc.).

Key-Words: - e-schools, e-learning, personalized information, mobile learning, interactive spaces, Bluetooth.

1 Introduction

Students of high education institutions have now access to technology that was unthinkable ten years ago. Cellular phones, PDA, audio/video digital players, etc, are common gadgets to all of them. The majority of these devices possess, apart from the computational power, several embedded features and of course, connectivity is one of them. Bluetooth and Wi-Fi are present and in some cases both. Using these links of information, we present a developed application that allows to inform the actors (students, teachers, administration, etc.) of an education institution on a free way using these communication standards. The developed application allows creating special interest groups (SIG). A SIG can be related to a course, a subject, a class or even a faculty or event. All depends on the system administrator (that configures and defines SIG) and the SIG administrators (that is the administrator of certain SIG). Features like the interface on the mobile device (client side), or the web interface (server side) of the administrator's, will be explained in the paper. This is also a case were the education space becomes interactive. This means that once within the institution's physical space, any actor can become informed about issues related to his/her SIG. This holistic and ubiquitous view of information also improves the usability of the gadgets with useful information about the academic life and becomes an attraction to compel students to the learning space.

The remainder of this paper is structured as follows: in Section 2 we discuss the related work. In section 3 we briefly describe the architecture of our system. Section 4 describes our prototype. Section 5 presents the system evaluation and early results. In section 6 and in section 7 we discuss results and we present proposals for future work. Finally, in section 8 we present the general conclusions of this work.

2 Related Work

Recently many researchers focus their works on the use of mobile and ubiquitous technology in education. Here we put special attention in two specific areas. Firstly, on social software that is used to facilitate the communication in learning environments. Secondly, on the usage of Bluetooth identification for supporting personalized information delivering.

Social software, including wikis, web feeds, chats, forums, blogs, or email are common examples of social technologies that have been used to enhance learning in education environments. Wikis (e.g. [1]) are a collaborative medium designed to promote content sharing. They facilitate collaboration, offering a simple tool for content creation and, organization. Web feeds allow content-authors to syndicate their posts to subscribed readers. Blogs, where students can organize and exchange experiments, reflect on their learning experiences create and post up-to-date learning contents and that can be accessed through their mobile devices. Chats and forums provide an important medium for interaction between all education stakeholders. Our approach presents some differences when comparing to the use of traditional social software applications. It provides different means to deliver personalized information through personal mobile devices or public displays. Additionally, information is immediately delivered to users that are present in the system zone and it is only delivered to users that are interested to receive it.

With respect to works that have their main focus on delivering personalized information to users we next analyze three related works that also use Bluetooth identification as main support for personalization.

BlueZone [2] presents a Bluetooth based communication service which is used to complement SMS text messaging to offer an alternative communications platform to students. The aim of the BlueZone service is to facilitate the delivery of localized and personalized messages to students in Lancaster University. The service consists of two distinct phases, an initial registration phase followed by the communication phase. The infrastructure consists of a number of BlueZone communications servers spread across the University campus which are able to deliver messages to handsets without charge. Each BlueZone Communication Server continuously searches for new Bluetooth devices in range using the standard Bluetooth device discovery mechanism. If a device is detected, the server communicates with the BlueZone registration database in order to establish whether there are any pending messages for this end-user. If there are pending messages, BlueZone attempts to transfer them via OBEX. The BlueZone services logs all sightings of Bluetooth devices across the network and we are currently using this to help make the service more intelligent.

The Campus News [3] is a Bluetooth-based mobile information network. The information which will be sent is filtered by the mobile device according to a profile set by the user. Users have the opportunity to build their individual interest profile. The user profiles and the semantically annotated messages are based upon the same ontology. Two different kinds of frontends were implemented, one for each group of users. The system includes an administration interface for the users which want to offer the information to the public. Here messages can be added to all or specific nodes. There is also a flexible statistics tool, as finding the ideal location for service nodes needs statistical data as a foundation. It also includes a user interface for students. After logging in with the campus wide student login credentials the type of mobile phone and a target Bluetooth friendly name have to be selected. In the next step interests can be selected from a tree menu.

The BlueScreen [4] is an intelligent public display, which selects and displays adverts in response to users detected in the audience. It uses Bluetooth-enable devices for identifying users and explores history information of past users' exposure to certain sets of adverts. Advertisements are preferentially shown to those users that have not seen them yet. The main goal of BlueScreen is to select the best content to maximize exposure to the current audience. A repetitive second-price sealed-bid auction is used as a selection mechanism to determine which advertising agent will display its advert on the next time slot, and its corresponding payment. Each time an advertising has to make a decision about its valuation for the next cycle, it has two types of information on which to base its decision: i) history observation of exposed devices which were collected during the advertising cycles it won in the past, ii) the current set of detected devices which were in front of the screen.

There are many proposed systems for provide personalized information to users' specific needs. However, our proposal presents some particularities. Firstly, it combines into the same system two types of devices for delivering information: mobile devices and large public displays. Secondly, it is based on a hierarchical profile structure and takes into consideration the identification and positioning of users to define two distinct interaction zones and thus it uses this information to select the most appropriate way to deliver personalized information. Thirdly, the user only receives information of interest from his point of view, as member of a SIG, and the information is delivered through the most convenient device, this is a new feature, over the other presented works.

3 System Architecture

In this section we present the application's architecture. This is a client-server architecture. The client application was implemented in J2ME, and requires the use of the KVM or CLDC-Hi virtual machine. The use of J2ME fosters the definition of configurations and profiles depending on the target devices and on the Java features needed for the software application. Some API are also required according to the application's specificities. The main blocks of the software architecture are presented on Figure 1.

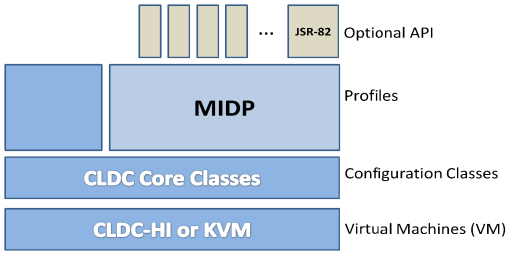

Figure 1 - Software architecture.

The development of applications using Java ME depends on the target devices. The application runs over a VM that can be parameterized to define the features that must be available for the target machine. Some parameterized features are I/O, memory or processing power.

The configuration classes, Figure 1, define the required libraries that are fundamental to make available the minimum requirements of the VM. These allow to setup: Java language supported features; VM features; Java libraries and supported API.

Presently there are two types of Configurations: one for devices with powerful HW resources - *Connected Device Configuration* – and other for simple HW devices - *Connected Limited Device Configuration.*

Profiles are java based API that allow to add new features to Configurations, such as wireless communication among others. Profiles allow access to the device properties. The most used profile is the MIDP (see Figure 1). This profile allows to define/control the network hardware, the display of the device, read the keyboard input, among other features. This allows defining a significant amount of interactive actions.

Other more specific API can also be used, if more concrete actions are required for a configuration. In our case we use the JSR-82 API [5] to implement the search for available BT devices, data exchange using the RFCOMM protocol. Other features like OBEX (Object Exchange) protocol can be implemented using this API.

4 The Prototype

In terms of client-server layout, we can have several application servers, a web server and several clients. The web server stores all the information about the user's data, group settings, etc. The application server has a BT interface, and is located on the building area where users can interact with the systems. The client is a mobile device with BT interface and the client application running over the VM previously described.

In terms of features allowed to the system actor´s, some of the implemented features are:

– Actor: main administrator
  Allowed Features: create/remove groups of interest (SIG), create/remove administrators for the SIG.
– Actor: SIG Administrator.
  Allowed Features: Manage contents for the SIG, accept/reject SIG user´s subscriptions.
– Actor: regular user
  Allowed features: register for a SIG, consult information, define interests and define devices, among others.

These user's features are defined according a hierarchy where there are three levels of responsibility and rights: Main Administrator; SIG Administrator and Regular users.

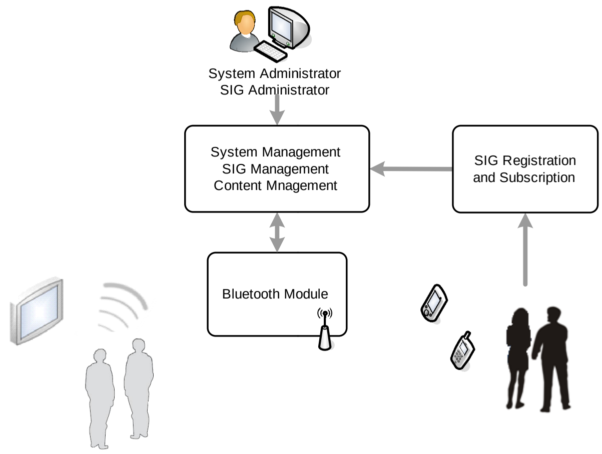

Figure 2 - Solution Scheme.

The dynamic of the system is based on the following sequence of actions done by the actors. Initially, the users must register themselves in the system. This is done by selecting their SIG and identifying their Bluetooth devices (iMAC). The data related to each SIG and user is stored in a database at the database server.

The Bluetooth module of the application server is continuously scanning for Bluetooth devices. Every time a new device is detected the system verifies in the database if it is a registered device. In positive cases the system verifies if there are new data (messages, alerts, notifications, etc.) for this target user.

Every time some data is sent to a specific user, information about this action of the system is stored in a way to avoid multiple alerts of the same information.

5 Initial Evaluation and Results

To evaluate the system we have conducted and experiment for 3 weeks. The system was installed in the main research lab of the Informatics Engineering Department and its interaction zone embraced the main entrance of the department and reaches out a zone of approximately 50 meters wide. People that frequent the interaction zone were mainly teachers, staff and students in technological areas.

We've invited three teachers to use the system as a favorite mean for interaction with their students. Each teacher was responsible for manage both content and actors of his class/SIG and they were also responsible for motivating their students to subscribe and use the system. Students that wanted to subscribe the service should access to the system and define their profile (which SIG he is interested in) and their Bluetooth identification (iMac). After this process they were able to receive their personalized information.

23 students subscribed the system. 4 of them subscribed only one SIG, 12 of them subscribed two SIG and 7 of them subscribed 3 SIG. The students' mobile phones models were various and included: Nokia 5320 XpressMusic, Samsung M610, Sony Ericsson W595, Nokia 6600, etc.

For the experiment period, collected data is restricted to the period 8 am to 8 pm, and weekend days are excluded. Table 1 presents a summary of devices and messages processed by the system.

Students registered in the system	23
Detected devices (during the experiment)	103
Served devices	23
Messages from teachers	14
Messages delivery to students	62

Table 1 - System statistics: users and messages.

After 3-weeks of experiment, the system detected 103 distinct mobile devices with Bluetooth and 23 of them are registered in the system. The ratio of detected devices/devices that received messages was at 22.3%. During this period the system delivered 62 messages, corresponding to 14 distinct messages, to 23 distinct students.

Some examples of messages that are delivered by the system were: "slides for the next class are already available on the class website" or "Next Wednesday the class will be on the lab".

To evaluate users' acceptance of the system, after the experimental period, we asked users to fill a questionnaire where they were able to express their opinion. The questionnaire is distinct for teachers and students. Table 2 presents a summary of the analysis questionnaire filled by teachers.

How simple is the class/SIG management in the system?	
Very simple – 66,7% (2)	Not simple – 0% (0)
Simple – 33,3% (1)	Difficult – 0% (0)
Don't know/Not respond – 0% (0)	
Is there any benefit of this system over common online software for support teacher/student interaction (e.g. e-mail, chats, e-learning platform)?	
Yes	66,7% (2)
No	0% (0)
Don't know/Don't respond	33,3% (1)
Do you notice significant improvements on the interaction with your students?	
Significant improvement	33,3% (1)
Some improvement	66,7% (2)
Don't know/Don't respond	0% (0)

Table 2 - Teachers acceptance and benefit.

Although the reduced number of teachers involved in the evaluation process, these results show that they were able to successfully manage their class and improve the interaction with students. Additionally, they identified as a benefit the usage of this system when comparing to the usage of traditional online software like e-mail, chats, e-learning platform, etc.

Regarding the students' questionnaire it embraces two main evaluation topics: system usage and acceptance (table 3); and users' privacy (table 4). All the 23 students answered the questionnaire.

How simple is the subscription task in the system?	
Yes	73,9% (17)
No	17,4% (4)
Don't know/Don't respond	8,7% (2)
Is there any benefit of this system over common online software for support teacher/student interaction?	
Yes	73,9% (17)
No	8,7% (2)
Don't know/Don't respond	17,3% (4)

Table 3 - Students acceptance.

Would you activate the Bluetooth functionality specifically for this service?	
Yes	17,4% (4)
No	73,9% (17)
Don't remember	8,7% (2)
The benefit obtained through this service overpass the cost of making your device identification visible to everyone?	
Yes	52,2% (12)
No	17,4% (4)
Don't know/Don't respond	30,4% (7)

Table 4 - Students privacy and benefit.

Students classified as simple the system's registration task. Furthermore, more than 73% of them refer that the system presents some benefits over common online software to support students/teachers interaction.

Additionally, the questionnaire includes two more questions related to users' privacy and benefit of the system usage.

Only 17,4% of students activated their Bluetooth functionality specifically for this purpose. With respect to the need of expose their device as a requirement for the system usage, more than 50% of students refers that the benefit obtained through the system usage overcomes the cost of the Bluetooth identification exposure.

6 Discussion

One of the conclusions of the data analysis is that students feel motivated to explore the features of their mobile devices using this system. Privacy is assured because the subscription is optional, they only receive useful information for their SIG, and they can deactivate their Bluetooth connections whenever they want.

The impact factor of the system over the case study population was very encouraging according to the feedback obtained from the teachers. The students' acceptance was also very successfully.

The results reported on previous section show that this system is an important complement to other popular systems in education environments (e.g. e-mail, chats, Wikis, forums, etc.).

7 Future Work

The system presented in this paper has not been realized with a complete instance. We proposed and implemented a number of modules and have developed a prototype for these modules. It does not fully comply with our system design. As a consequence, our plan for the future work is to construct such a system by developing and integrating all modules. This implies a number of tasks: 1) refine and adjust different software modules considering the two interaction zones (display zone and mobile zone) and the optimization of both communication means. For this case we will use two distinct Bluetooth scanners in a way to identify users location and thus selecting the most appropriate mean for delivering information; 2) deploy a full functionality module for selecting contents to be presented in the display; 3) improving algorithm for content selection on the display considering that multiple users profiles may be detected at the same time; 4) deploy a fully working prototype of the system to evaluate users' participation and acceptance.

8 Conclusion

In this paper, we propose a Bluetooth-based interactive system for delivering personalized information in high education institutions. With this scenario we promote in the paper mainly focuses on learning environments, although the framework is also applicable in other shared public and semi-public spaces such offices, homes, companies and many others.

The most important contribution of the work is to combine public displays and personal mobile devices for delivering personalized information according to the student's location. A prototype has been built and discussed with demonstrative user scenarios. Early results show that teachers and students found some advantages in this system comparing to traditional approaches.

As described in the previous section, as future work we plan to integrate all modules of the system and run a final evaluation using both, public display and mobile devices as information delivers.

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