Promoting Mobile and Interactive Learning through the use of MMS Over Wireless LAN

Authors:

Sintiani Dewi Teddy, Nanyang Technological University, Singapore, pm705998@ntu.edu.sg
Heng Yeow Peng Alvin, Nanyang Technological University, Singapore, s7904922j@ntu.edu.sg
Yow Kin Choong, Nanyang Technological University, Singapore, askcyow@ntu.edu.sg

Abstract — *This paper aims o n introducing the new platform for mobile and interactive learning developed in Nanyang Technological University (NTU), which is targeted as an effective communication medium between the lecturer and students during lectures. The idea is to combine the adv antages of mobile computing and messaging service to bring an interactive learning experience into classes. For this purpose, we have developed a system that allows instant feedback on teaching using Multimedia Messaging Service (MMS) on the NTU's campus -wide 802.11b Wireless LAN. In the overall picture, students and lecturers will be equipped with an MMS -capable device (which may be PDAs, Laptops, or Tablet PCs). During lectures, students can ask questions, response to questions or give immediate feedback on the lecture simply by composing an MMS message and sending it to the lecturer. The lecturer himself can choose to immediately respond to the comments so as to adjust to the learning needs of the students, or to delay his response so as not to disrupt th e flow of the lecture, and reply to the questions at the later stage. Using this technology, immediate assessment on courses can also be done. Interactive quizzes for example, can be carried out during lecture simply by having the lecturer sending out the question to students in MMS format. The students' answers will be sent back to the lecturer and the average results can be calculated, tabulated and reviewed on the spot. The main advantage of this learning system is that MMS messaging is easily extensible to the mobile GSM networks, so students are not restricted to use it only on campus. Sending MMS messages on the Wireless LAN will be free to students on campus, and only at a low cost outside. This system is particularly beneficial in engineering educati on, since engineering students are generally tech -savvy, and therefore can easily adapt to this medium. This learning system will also encourage students to be more participative in the learning process, since usually students tend to be shy to speak up in large groups.*

Index Terms — *interactive learning, internet naming service (iName), MMS, wireless.*

INTRODUCTION

Today we are standing in an era of global mobile communication, in which instant communication and information transfer are the major driving forces of the society. Keeping up with the advancement of technology, the learning process and system has gone through rapid changes too. The introduction of internet, online learning, and e-education have changed the way knowledge and education being transferred to students all over the world. In this paper, we are going to describe a new learning platform developed by students in Nanyang Technological University which utilizes the most current technologies in order to bring a mobile interactive learning into classes. This learning platform is targeted as an effective communication medium between the lecturer and the students, in attempt to enchance the quality of the learning process.

There are two key problems identified with current learning system. They are:

- Lack of interaction
  The current learning systems are mostly of one-way communication, in which the lecturer is giving lectures for hundreds of students in a class. As a consequence to the one-to-many relationship between the lecturer and the students, there is lack of interaction between the students and the lecturer. As such, we seldom hear feedbacks, comments or questions arise in classes.
- The need to be physically present
  Presently, the students need to physically attend the class in order for them to follow the lectures.

On the other hand, in the vision of the 21st century classroom, students are equipped with portable wireless devices connected to an infrastructure, which enables the following interactive classroom activities:

- Polling: lecturers can elicit students feedback through handheld to enable lecturers to gauge understanding and set pace of class under a real-time environment.
- Question Queue: students can pose questions to lecturer during presentation through portable devices.
- Slide presentation synchronization: Annotations and new information can be updated to student's portable devices live through downloads.
- Remote access: live lectures can be beamed to portable devices.

However, such interactivity restricts the students to be connected to the same infrastructure. Students connected to other infrastructures may still be able to access information in the server but will lose the interactivity in the class. This is mainly due to non-standardization of the way information is sent over the different infrastructures.

This situation restricts the mobility of the students in many cases. Several Wireless classroom projects have been implemented [1]–[5] and tested with encouraging results. However, the implementation is restricted to a Local Area Network (LAN) coverage, making it impossible to carry out such interactive learning when a student is outside the LAN.

On the technology side, Multimedia Messaging Service (MMS) has announced a new era of mobile-way of communication and is believed to be the one of the key driving forces of mobile data service business for 2.5G and 3G. Major advances in technology of instant messaging and the rapid evolution of the capabilities of mobile devices has made it possible to provide multimedia rich messaging application to mobile users. The project described in this paper made use of the MMS technology and wireless LAN infrastructure, to build a mobile learning platform.

NTU'S MOBILE AND INTERACTIVE LEARNING SYSTEM

To overcome the above mentioned problems, a wireless mobile interactive learning solution is proposed with the following objectives in mind:

1) to provide interactive learning capabilities in classroom environment by allowing instant communication between the lecturer and the student through messaging services.
2) to extend the mobile learning opportunities in NTU to include the Wide Area Network (WAN) coverage provided by telephone companies.
3) to make wireless mobile interactive learning available to all students both on and off campus without having to incur costly hardware.

Our solution is based on two new wireless technologies, namely (1) Multimedia Messaging Service (MMS), and (2) Internet Naming Service (iName). The key idea is to make use of MMS service as the interactive communication medium during a class. Lecturers can check the understanding of students by posting a question during a class and the students will reply by MMS over the University's WLAN network. An application on the lecturer's console will then receive and be able to parse these responses and summarize them for the lecturer. When satisfied with the response, the lecturer can then proceed to the next part of his/her lecture.

Students can also post feedback messages to the lecturer during the class (e.g. to inform the lecturer that he/she is too fast and needs to slow down on his explanation). These messages will appear on the lecturer's console and the lecturer can decide whether or not to respond to them. One of the advantages of using MMS is that this interaction can easily be extended to students who are not physically present in the classroom. The same data format can be used over WLAN or a wide-area network such as GPRS.

Live audio streaming of the lectures can be performed which allows the student to participate in a class even though he/she is not physically present in the classroom. The student can be on-campus and connected via WLAN, or be off-campus and connected via circuit-switched data or GPRS. The wireless devices used can even be a MMS-enabled mobile phone, thus reducing the need to depend on expensive laptop or tablet PCs.

The iName technology serves to provide address abstraction for the whole service. With iName service, the students' portable device can communicate with the lecturer's console without the need to know specific IP addresses. The student only need to enter an intuitive text-based name such as "SC205Lecture" and the iName server will map it to a valid IP address. Similarly, the lecturer can instantly communicate with all his students no matter whether they are physically present in the classroom. The iName server will host the current dynamic IP address for connected laptops or PDAs, or phone numbers to mobile phone connections so that all students can be reached via the MMS messages.

Overall Picture

The overall architecture of the NTU Wireless Mobile Interactive Learning framework is shown in Figure 1. Client devices

such as PDAs, Tablet PCs, will be connected to the NTU LAN via wireless access points. The MMS sent by the students (e.g. lecture feedback) during a lecture will go through the iName server to determine the forwarding address of the lecturer. An application residing on the lecture console can then pick up the MMS and display it to the lecturer.

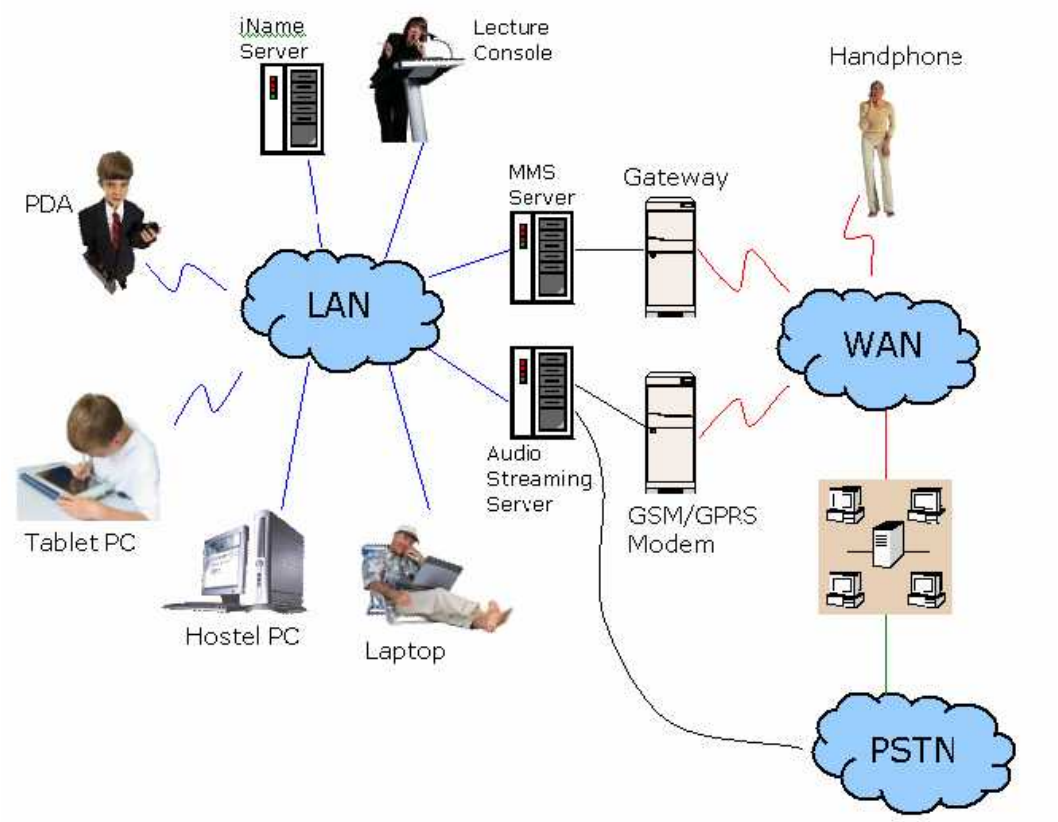

FIGURE. 1
THE OVERALL ARCHITECTURE OF WIRELESS MOBILE INTERACTIVE LEARNING FRAMEWORK

The lecturer may send out a pop quiz to its students via MMS. The MMS sent by the Lecture console will go through the iName server to determine the forwarding address of the students' client devices for all the students registered for his/her class. If the clients are on the WLAN, the iName server will return the client's dynamic IP address. If the clients are outside the WLAN, it will return a handphone number and the MMS server will send it out to the student's handphone on the GSM/GPRS telephone network (WAN).

The lecturer's vocal presentation is recorded live on an Audio Streaming server and will be streamed out to a conference call centre hosted by the telephone company. Students who are not in the campus WLAN may dial in to the conference call centre via a PSTN line or even through their GSM handphones. In this way, students who are outside campus can listen and interact with the class during a lecture.

Key Components

Multimedia Messaging Service

MMS [6], as its name suggests, is the ability to send and receive messages comprising of a combination of text, sound images and video to MMS capable handsets. The WAP-forum [7] and the the 3GPP[8] are the groups responsible for standardizing MMS. MMS employs the Wireless Application Protocol (WAP) and therefore it is bearer independent – supporting either Circuit Switched Data or General Packet Radio Service (GPRS). MMS should also eventually supports bearer such as Enhanced Data rates for GSM Evolution (EDGE) and 3G too.

MMS presentations are different from email presentations. MMS provides advanced layout and timing for multimedia contents in the message., which is not provided by email message. And also, neither IMAP3 not POP3 provide a standard technology to notify a non-connected client of an incoming mail.

The MMS-enabled device (e.g. PDAs, laptops, tablet PCs) must be able to compose, send, receive and play an MMS message over the 802.11b WLAN. The MMS server sitting in the infrastructure network will serve two purposes: (1) MMS Centre (MMSC) that stores and forward the MMS messages, and (2) MMS Proxy/Relay that will send/receive MMS messages to the Wide-Area network through the gateway.

Internet Naming Service

iName [9] is an internet naming service which translates a name query into network addresses such as IP address or mobile phone numbers. iName is designed to be a physically independent way of referencing any user in the system. All the components in the project address a particular user in the system with their respective iName. This frees the system from the need of knowing where and how the user is logged on to the system. To consolidate information regarding connectivity, each student's connection is passed through an iName server to identify current network connection type. The iName server then serves as a host to store the current dynamic IP address for connected laptops or PDAs, or phone numbers to handphone connections. Hence, if the established connection is through a handphone, the e-slides/video or audio transmission will be modified to MMS format and transmitted through the telecommunication network; while for LAN devices, the relevant information would be transmitted through the net.

The iName server consists of several protocol layers to communicate with the infrastructure network. It accesses an SQL database to store as well as to retrieve the current dynamic IP addresses of all its registered clients.

Figure 2 shows the message transaction flow schema of the overall system. The communication between the lecturer and the student will be done through MMS-formatted messages. Both Lecturer Console and the Student Client are the client-type device in the system. The MMS Server is sitting in between the clients and serves as to store and routs messages among clients. The iName Service serves to provide address mapping to all entities in the system.

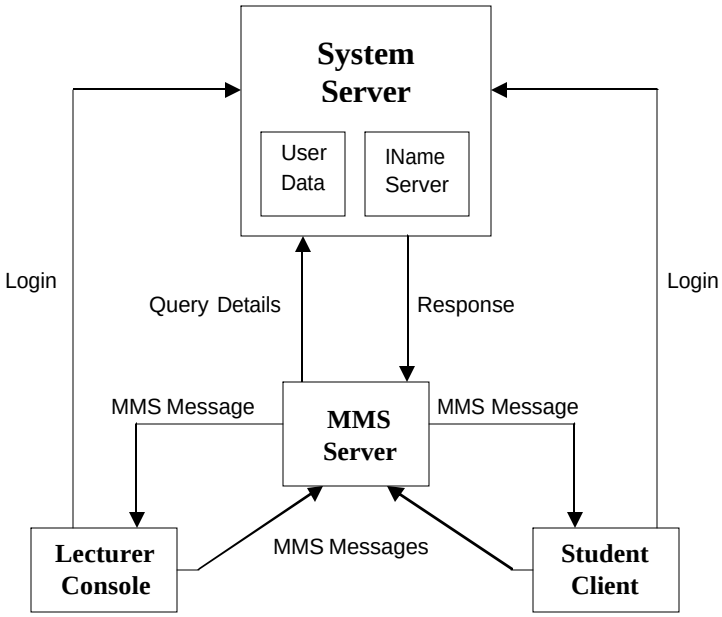

FIGURE. 2
THE TRANSACTION FLOW DIAGRAM OF THE SYSTEM

USAGE SCENARIOS

In this section we discuss the usage scenarios of our proposed solution. The following lists the key situations where students will benefit from our wireless mobile interarctive learning.

Embarrassment-free Instant Lecture Feedback

During the course of the lecture, students can send feedback in the form of MMS messages to the lecturer to indicate that they do not understand certain part of the lecture or to request the lecturer to slow down or speed up. This could be initiated by the student or as a response to the lecturer's query. The lecturer can see all these messages on the console and he/she can determine whether or not to respond to them. Students with questions that need the help of a diagram can pull up a figure from the lecture slides, annotate on it and send it to the lecturer.

Catch a lecture in a bus while you are late

Suppose a student is late for class and he/she is still on the bus journey when a particular lecture starts. Instead of missing the first part of the lecture, the student can use his/her handphone and dial in to the lecture. The student only needs to type in the name of the lecture he/she wants to listen to and the iName server will map it to the appropriate conference call number. While listening to the lecture over the handphone, the student may view the lecture slides over MMS or from a hardcopy if the student had printed it out earlier.

Avoid wastage of waiting time at official functions

Students (especially student leaders) sometimes have to miss lectures due to official functions in the University (e.g. Visits by International Accreditation Panel, Meeting of Overseas Student Delegates, etc.). These students usually have to report to the meeting venue well ahead of time and thus lose valuable time waiting for their guests. Since these students are still on campus they can participate in the lecture they had to miss over the WLAN. They can listen to the lecture's voice, view lecture slides and even send their queries over their WLAN-enabled PDA.

No more missing of lectures due to illness

Students who are ill and had to stay at home will not need to miss their lectures. From their home, they can dial in to the lecture from their PSTN phone and listen to the lecture. They can still interact with the class through their MMS-enabled handphones.

Paperless Assessment

The lecturer can conduct paperless tests and assessments during class. The questions can be projected on the classroom screen and students can submit their answers using their portable devices. If a diagram is needed in their answers, they can draw it on their touch screen panel and send it as a bitmap image. For the purpose of assessment, the student cannot opt to take the test outside of the classroom. We can therefore assume that every student has a touch screen device that is provided in the classroom.

SYSTEM TESTING RESULTS

The first version of the system has been rolled out and tested on students in real classes. The test groups consist of two groups of the size 150 students, comprising of first year Computer Engineering students, in the subject of Engineering Mathematics. This section will discuss about some good and bad points arising from the use of the system.

Some of the direct advantages observable from the test results are:

- Students are more active in giving feedbacks. From the test conducted we can actually see the increment in the level of participation of the students in class. Students who are shy to feedback are also able to participate interactively.
- The lecturer can get a feel of students' needs and the their understanding level. The comments posted indirectly reflect the understanding level of the student, and therefore based on the comments, the lecturer can adjust the pace of learning.
- Whenever the lecturer receives multiple and different responses, he/she can query the class to get a consensus.

However, there are also some bad points noticeable from the testing:

- Overwhelming replies which makes it difficult for the lecturer to address all of the student's needs.
- The lecturer will have to be able to split his concentration between the subject and the reponses coming from students.
- Irresponsible remarks can be found posted by the students.

The overall responses shown favorable results. Students in general finds this beneficial and are eager to make use of the system. The main advantage of this learning system is that MMS messaging is easily extensible to the mobile GSM networks, so students are not restricted to use it only on campus. Sending MMS messages on the Wireless LAN will be free to students on campus, and only at a low cost outside. This system is particularly beneficial in engineering education, since engineering students are generally tech-savvy, and therefore can easily adapt to this medium. This learning system will also encourage students to be more participative in the learning process, since usually students tend to be shy to speak up in large groups.

CONCLUSION

In this paper, a new mobile interactive learning system developed at Nanyang Technological University is presented. A system that allows instant feedback on teaching has been developed using MMS on the campus-wide Wireless LAN. The system made use of two new wireless technologies, namely MMS and iName. The proposed system enables instant lecture feedback to be delivered and direct student assessment to be conducted in classes. This learning system is intended to encourage students to be more participative in the learning process. Sending MMS is free on campus, and it is easily extensible to GSM networks.

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