m-LTE: A Mobile-Based Learning and Teaching Interactive Environment

W. Yan, C. Li, J. Ma, S. Ma, and H. Truong
School of Computing and Mathematical Sciences
Auckland University of Technology
Auckland, New Zealand
wyan@aut.ac.nz

***Abstract*—With the Apple iPads and iPhones hungrily being sold, the new technologies such as 3G/4G mean the mobile devices could be used anytime and anywhere, the relevant research is becoming very significant. This paper presents the research outcomes of our m-LTE project (mobile learning and teaching interactive environment), we adopt novel multimedia and communication technologies to create an m-Learning environment with voice center, slides center, SMS center and video center. We conduct the research by using software engineering techniques such as user requirements analysis, system design, implementation and test.**

***Index Terms*—mobile learning; assessment; evaluation**

I. INTRODUCTION

Mobile is a small and portable device, because of wide applications of 3G/4G communications, a mobile could be used for voice communication, text anywhere at any time [7] and its screen [6] is up with inertia resolution and is able to show real time videos via broadband communication. Some smart phones can even access the YouTube and run software such as the Skype. Some students have brought the new generation of mobile phones into our classroom for learning [5].

In a traditional classroom, students need to physically turn up to listen lectures and engage in discussions; they need to occasionally check the white or black board, or projected slides. They may also need to ask questions, write down notes or have discussion with their classmates. Correspondingly, m-Learning should encompass all these teaching components mentioned above. The reason is that a mobile could send/receive SMS/MMS/IMS, speak to and listen from others. Some mobile devices such as iPhone, iPad or Tablet PC could watch live videos. Our m-LTE project (mobile teaching and learning interactive environment) has taken all of these components into consideration. In addition, we have also used multimedia technologies (video, audio, text, graphics, etc.) for mobile teaching and learning.

The success of this m-LTE project undoubtedly will be very helpful in achieving the best possible learning outcomes. The mobile services effectively utilize the students' usually wasted time during bus waiting or riding, unwillingly staying at home due to illness, or at a computer without Internet service, etc. The convenience could help students to approach their learning outcomes in a more productive way.

The outcomes of this m-LTE project include a mobile-based learning and teaching prototype. The specially designed interface and functionalities guarantee the system could be easily used. Relevant design and development documents and user manual could be provided. Courseware over a mobile platform has been implemented. So the education psychology of mobile learning and teaching could be extended. We are confident that this system will benefit the mobile learning and teaching in the long run.

We present the relevant work in Section II, user requirement analysis in the Section III. System design and implementation are provided in Section IV and Section V. System evaluation is addressed in Section VI. Conclusion and discussions will be stated in Section VII.

II. RELATED WORK

As we know, a mobile phone has a small screen with limited bandwidth though they could show photos and videos; for most non-smart mobiles, SMS and voice communication are still the fundamental functions. Multimedia simplification [5] is a transcoding technology that could be applied in Multimedia Messaging System (MMS) of mobile for audio and video transmission. In video transmission, we only send those important frames or part of video streams to a receiver that will greatly save the receiver's time and communication resources. Based on our previous research experiences [2], we proposed this m-LTE project.

In mobile communication, voice and Short Message System (SMS) [7] are the two fundamental functions of traditional devices. In earlier years, people used these for mobile teaching and learning [3], [5]. Nowadays, with smart phones becoming popular in our mobile market, most users have changed their mobiles to smart phones. Within our campus, we could see many students are using their smart Phones, tablet PC or iPads.

In m-Learning [8], the emerging new technologies such as Web 2.0 and iCloud technologies have been adapted for teaching and learning [11], [12]. Correspondingly, the teaching starts moving from the traditional way to this emerging area.

978-1-4673-2418-2/12/$31.00 ©2012 IEEE

Our purpose in this m-LTE project is to use multiple channels such as SMS, audio, video, image, picture and Internet technologies for teaching and learning. For example, the messages sent to our center will be automatically forwarded to all users including the sender; the users will receive all the information from all senders. All information will be stored in the shared online system like iCloud. This online mechanism is simulating the traditional classroom based teaching. In addition, m-Learning is a free and open space for teachers and students discussing their course related materials using mobile devices. It is different from a closed video-conferencing system which has only one media channel and this is the reason why our system is novel.

III. Design of the System

A. Design of the System

The planning and designing of this project: m-Learning is built on existing knowledge [1]–[3], [10]. Our goal is to deeply investigate the mobile-based learning and teaching interactive environment, and enhance our teaching practice and therefore contribute to the best educational outcomes. After the project, we expect the lectures could be broadcast live on the mobile platform no matter where the students are. In the meanwhile the students could ask questions via mobile phones. The courseware for mobile learning and teaching will be developed. The experience about how to deliver mobile-based courses will be obtained.

The detailed design includes:

1) *System architecture design.* A mobile-based learning and teaching center for data management will be built;
2) *System databases design.* Based on the resources, we will develop our new versions of database to match the requirements of this mobile system;
3) *System GUI design.* The display resolution, memory size and system response speed, other display features, capability and quality of mobile devices will be taken into account;
4) *Interface design.* Especially the interfaces such as database and functions between the mobile system and other potential system will be taken into consideration;
5) *Mobile courseware design.* The adaptability and the scalability of the courseware to be shown on the mobile will also be fully considered.

The quality of the project is ensured by using the standard software engineering approaches such as design of class diagram, mobile-based GUI, system implementation and systematic test [13].

B. Design of the Voice Center

We design a voice center for students and teachers communicating mutually. We design the voice center and take the users' costs into consideration. For smart phone or iPad users, we could dial the numbers using the installed Skype software so as to save the costs by connecting to Wi-Fi. The installation of the Skype software for iPad and iPhone is free. Usually local landline service is free for use in most countries.

We design such a voice center that the users could dial the numbers so as to connect the class, the course (or paper) ID is required to verify the user's authenticity and check whether he/she has registered into the system.

IV. System Implementation

We designed a web-based system to demonstrate the mobile teaching and learning environment. The design is complete for all students and teachers regardless of what they use: a cellar phone, a mobile phone, or maybe an iPhone or iPad which can be connected to Internet and access our system from anywhere in any time. We are able to provide a good learning experience of real-time lecturing.

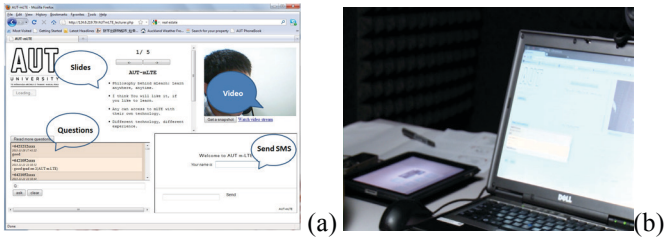

Figure 1. Our prototype. (a) shows our web based GUI and the main functions, and (b) shows the hardware we used to test our system. The interface shows our developed voice center, slides center, video center, question and discussion board. Students could use the interface to conveniently carry out the relevant operations during lecturing time.

A. Voice Center

For the voice center design, we could use smart phones and iPad to call the center. If it is a call from a landline, it will be free locally. A user will be asked to type the course (paper) ID to access the voice communication. Everyone logged into our system could listen to the lecture simultaneously. Everyone could use a normal mobile phone to call the center even if they could not access the Internet using Wi-Fi or 3G/4G. We allow up to 70 students to call the center at the same time no matter whether they call from a landline, a mobile phone or a computer via Internet.

B. Slide Center

Our lecture slides are specially designed for iPhone and iPad. It is without doubt that mobile version of these slides is very crucial for m-Learning. When a student is learning at a mobile environment, the slides must be read very frequently. Thus it requires the file size be extremely small and very fast to be surfed. This is a practical issue and it could help in being suitable for mobile usages. Usually a student does not need too much information shown on his mobile. They only need the key information which can be easily found and also they can follow the teaching points.

The general requirements for mobile slides design are that the slides should include a proper number of characters and graphics that are clear enough on a small screen, the slides can

be projected to a big screen and zoomed in or out in both horizontal or vertical directions. The detailed criteria include:

1) *One arm distance:* The design allows users to watch slides very clearly within one arm distance like most Apple apps;

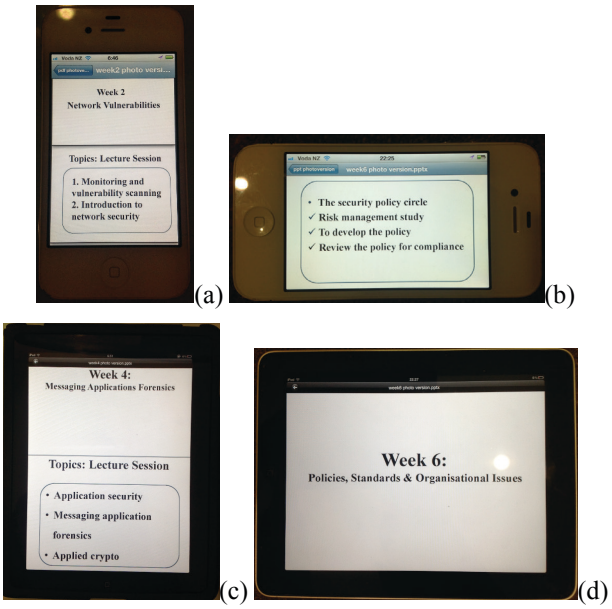

Figure 2. Our sample slides: (a) & (b): Slides on an iPhone horizontally and vertically; (c) & (d): Slides on an iPad horizontally and vertically.

2) *No dental edge:* The slide displays have not distortions, dents or aliasing;

3) *Quick response:* The response speed should be fast enough, long wait times would not be accepted;

4) *Smaller file size:* Every slide of per week should not be too big. It allows students to easily download by mobile device taking the broadband factor into consideration.

This design has some advantages. Firstly, the whole file is a very tight design, it is picture based PDF file format. Secondly, the design makes the slides very universal. The slides could be used in most of current operating systems such as Ubuntu (Linux), iOS (Apple) and Windows (Microsoft) on any hardware platform such as tablets PCs, mobiles and desktop PCs as well.

C. Video Center

We have two options in this video center: streaming video and interval frame based video. Communication bandwidth will decide which video will be shown on the interface. We have tried the mobile stick having 3G communication. The video quality is very good and satisfactory. We have provided the frame-based video only for some cases, most of the time we used stream broadcasting instead. When we move our hand before the camera, the motion is shown in real time and no delay was found. For the framing video, each frame has been set to be updated at the rate of 20 seconds.

D. Question and Discussion Board

This question board is developed for students sending/receiving short messages using their registered mobile phones, email or browser. If students send messages, all questions will be archived and shown in the center, the teacher could read and answer them using his/her mobile, email or browser. We also have the relevant discussion board in this center where all students online could discuss the assigned topics.

V. Conclusion and Discussion

This paper has introduced our m-LTE project and discussed the different aspects of the design and implementation of the system. Students and teachers will benefit from the enhanced methods of communication. Students are encouraged to engage in m-Learning environment and enjoy the modern teaching using the cutting-edge technologies, especially for the important courses and assessment information from anywhere in any time. Students only need to register their mobiles in our system so that they could get all the information on the courses. Students can share their comments on a particular topic using the online discussion board. Teachers can receive students' questions, provide prompt feedback and update their course information in time.

Last but not least, students can contact their classmates or teachers for assessment and evaluation, they can talk live to their classmates or text messages. All the information shared online will be archived and must closely relate to the courses or else it has to be deleted, or the users will be kicked out by the control center.

References

[1] W. Yan and M. Kankanhalli, "Multimedia simplification for SMS optional sysnthesis," *ACM Trans. Multimedia Comput., Commun. & Applicat.*, vol. 3, no. 1, 2007.

[2] C. Smith, "Computer remote control using mobile," Bachelor's thesis, Queen's University, Belfast, UK, 2008.

[3] C. Li, "SMS-based vocabulary learning for ESL students," Master's thesis, AUT University, Auckland, New Zealand, 2009.

[4] B. Kitchenham and S. Eeger, "Software quality: The elusive target," *IEEE Softw.*, vol. 13, no. 1, pp. 12–21, 1996.

[5] E. Tremblay, "Educating the mobile generation – using personal cell phones as audience response systems in post-secondary science teaching," *J. Comput. Math. & Sci. Teaching*, vol. 29, no. 2, pp. 217–227, 2010.

[6] N. Maniar et al., "The effect of mobile phone screen size on video based learning", *J. Softw.*, vol. 3, no. 4, pp. 51–61, 2008.

[7] K. Masters and D. Ngambi, "After the broadcast: Disrupting health sciences students' lives with SMS," in *Proc. IADIS Int. Conf. Mobile Learning*, Lisbon, Portugal, 2007, pp. 171–175.

[8] K. Masters, "Low-key m-learning: A realistic introduction of m-learning to developing countries," in *Proc. Mobile Inform. Soc. Conf.* (Seeing, Understanding, Learning in the Mobile Age), Budapest, Hungary, 2005.

[9] T. Clear, "A 'potted guide' to quality assurance for computing capstone projects," *ACM Inroads*, vol. 2, no. 2, pp. 14–15, 2011.

[10] T. Cochrane, "m-Learning praxis: A pragmatic guide to implementing mobile learning," presented at Int. Conf. E-learning Futures, Auckland, New Zealand, 2011.

[11] T. Cochrane et al., "iPadagogy: Appropriating the iPad within pedagogical contexts", in *Proc. 10th World Conf. Mobile and*

Contextual Learning. Beijing, China: Beijing Normal University, 2011, pp. 146–154.

[12] T. Cochrane and J. Oldfield, "iPadagogy 2.0: Exploring the affordances of the iPad for student-generated media production," presented at 28th ascilite Conf., Hobart, Australia, 2011.

[13] H. van Vliet. *Software Engineering: Principles and Practice*, 3rd ed. Chichester, UK: Wiley, 2008.