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# An M-Learning System Based on Mobile Phones and Quick Response Codes

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**Abstract: Problem statement:** Many instructors in academia wish to know how much their students understand the content of the lecture; however, doing this manually will be very difficult and time consuming. Similarly, most students have communication problems with their instructors and they wish if they can ask their questions without any fear. So a need for a technology to bridge these gaps is becoming apparent in our rapidly changing world. **Approach:** The development and implementation of a Mobile Snapshot Response system, which uses the camera integrated within mobile phones and QR Codes to leverage student interaction in the classroom. The potential objective of the system is to increase the connectivity between the instructor and the student by offering the student the opportunity to evaluate the lecture content and send inquires to the instructor after class. **Results:** The Mobile Snapshot Response system has been developed, implemented and tested and user evaluation has proved the system's ease of use. **Conclusions:** The mobile snapshot response system can help in improving the communications between teachers and their students and in providing students with the ability to raise questions and comments without embarrassment. Moreover, the students will be able to answer short assessments at the end of each class in an easy and convenient way. Thus, our system will benefit the teachers as well as the students and improve the delivery of lectures by getting a timely feedback and by automatically analyzing student's answers.

**Key words:** M-Learning, mobile phones, classroom assessment, Quick Response (QR), mobile interface, mobile snapshot response system

## INTRODUCTION

Mobile phones and Internet have become an important aspect of our lives. The comfort and convenience they provide certainly made our lives and our learning in particular much easier than ever before (Nasiri and Deng, 2009). One important feature in mobile phones is the ability to access the Internet anytime and anywhere, thus, enabling us to seek information when we need it. M-Learning (Mobile-Learning) is a new learning approach that benefits from mobile phones to create comfortable learning environments for learners. Some of these environments use the built-in digital cameras found in mobile phones to scan a Two-Dimensional bar code and resolve the bar code into a webpage that contains information about the scanned object. Two-Dimensional barcodes such as SemaCode and Quick Response (QR) System are two well-known ways used to reach internet resources. These systems work by generating a "tag" that contains an embedded URL used to reach a specific web page. They store information by embedding several types of data into it like characters, music, images, URLs, emails or others. Data can be encoded into QR code by using a special generator and derive the data from it by using a special reader installed in a camera mobile phone. Mobile phones equipped with digital cameras are then used to scan the tag and display the corresponding web page.

Barcode technology according to Wikipedia is a representation of information that can be easily read by a machine. In this representation, the binary system is used for encoding and decoding. In addition, the information embedded in the barcode can be read by optical scanners called barcode readers. Moreover, it can be recognized by processing a scanned image by special software such as the one utilized in our system.

Barcode technology has been around since the early 1950s. Now, it replaces the human interface for the fact that it captures data accurately, faster and more efficient than humans (Alzaza and Yaakub, 2011).

The barcode system is very flexible with a range of barcodes available to suit a wide range of needs. There are many different barcode symbologies, or languages. Each symbology has its own rules for encoding characters, printing, decoding requirements and error



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checking. Some require a specific number of characters, or allow only numbers and others can include the full ASCII set. In general, barcodes are categorized into two categories, namely: 1D (linear) and 2D.

**One-dimensional barcodes (1D):** Usually, a 1D barcode is a license plate or identifier for an item in a database. It also presents the information throughout vertical elements. If the number of characters is increased, the barcode will expand horizontally but not vertically and that is space-consuming. The most common codes are Code 39(used in industrial applications), Universal Product Code (invented for the supermarket industry), Code 128 and Codabar (used in Blood Banks) as shown in Fig. 1.

**Two-dimensional barcodes (2D):** 2D barcodes were developed to overcome the information limitation in linear barcodes, i.e., the 1D space-consuming problem. In addition, it took advantage of the horizontal and vertical dimensions. 2D barcodes can act like identifier (like in 1D) but takes less space. Alternatively, it can function as the database itself.

QR code (Fig. 2) is the most popular type of 2D barcodes. The "QR" is derived from "Quick Response", as the creator intended the code to allow its contents to be decoded at high speed. It can encode characters, music, images, URLs, emails and others.

**M-Learning system and QR codes:** There are many M-learning projects that concentrated on the use of camera phones such as the HELLO project (Chu and Liu, 2007). At "HELLO" (Handheld English Language Learning Organization) the project team integrates the 2D barcodes, camera phones, the Internet, mobile computing and database technologies. The aim of the system was to enable the students to perform mobile context-aware learning to improve their English effectively at anytime and anywhere. In a further extension of the HELLO project, (Liu *et al*., 2010) used handheld Augmented Reality (AR) supported mobile learning (m-learning) system to link information between context-aware materials and learning zones using QR codes. "The detected information is then sent to the learning server to request and receive context-aware learning material wirelessly".

Another example is Fujimura and Doi (2006) project, in this project the team developed a system for students to answer questions about the class using mobile phones and QR codes in the middle of each class.

Fig. 1: Examples of one dimensional barcodes

Fig. 2: QR sample

Similarly, (Chaisatien and Akahori, 2007) used QR codes to support the communication among students in a larger classroom environment.

Finally, (Rivers, 2010) conducted three task-based instructional activities using mobile phones along with QR codes in a Japanese university English as a Foreign Language (EFL) classroom. The results show students fun and enjoyment with such activities.

The idea of utilizing the capabilities of modern mobile phones with QR codes is very promising especially in the educational field. Therefore, in this study, we present the idea of an M-Learning system that uses the technology of QR code with the capabilities of Camera-equipped mobile phones. The system will help educators and instructors evaluate students' degree of comprehension, by giving out short assessments and allowing feedback on the overall course evaluation at the end of each semester. Also, the system will help students send their inquiries directly to the instructor after each lecture.

## MATERIALS AND METHODS

Figure 3 shows the total system configuration. The system consists of the server which contains the database, a web interface for instructors and mobile interface for students.

The system is further divided into two subsystems that communicate with each other: (1) instructor web interface system and (2) student mobile interface system.

Instructor web interface system: When the instructor want to use the system for the first time s(h)e must register to create an account by using the web interface, this account allows the instructor to create a short assessment about the lectures and the system will automatically store it in the database, for future editing or deleting of a particular assessment (Fig. 4).



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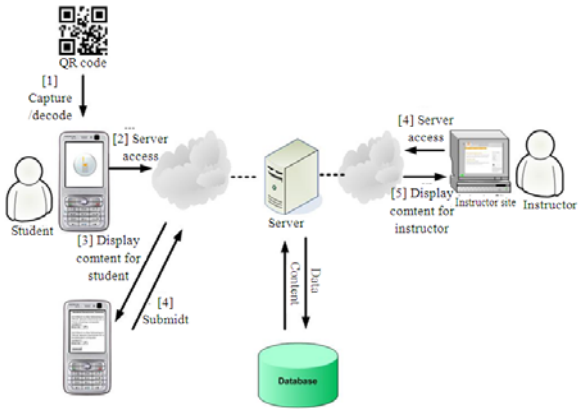


Fig. 3: System configuration

Fig. 4: Creating assessment

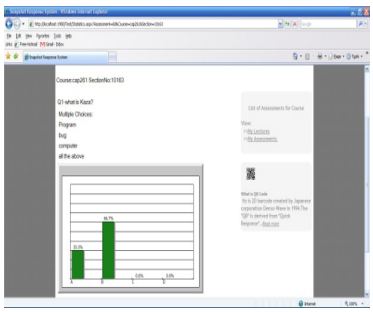

Fig. 5: Displaying results

Fig. 6: Log in page in the student system

The system will calculate the result of students' answers for the short assessment and produce statistics in graphical charts so that instructors can evaluate students' degree of comprehension (Fig. 5).

The instructor can also view students' inquiries about the lecture to answer them in the next lecture. At the end of the course the system gives the instructor an overview of the course evaluation.

The instructor will use the system to generate a unique QR code for the lecture which will be scanned by the students' mobile phones to access the lecture assessment sheet and to send inquires.

The instructor system was implemented using IIS web-server, SQL server 2005 Database connected to ASP.NET pages.

The Student System: it consists of the mobile interface system, where the student can use the system for the first time to register and create his/her username and password using mobile interface (Fig. 6).

After each lecture, the students will scan the QR code printed in their lecture notes which will direct them to the lecture assessment sheet. When the students submit their answers, the system will correct them and calculate statistics. The model answer will also be displayed on the student mobile phone screen. Moreover, the system allows the students to send their inquiries about the lecture directly to the instructor.

The student system operates using a camera equipped 3G mobile phone with QR reader software installed.

## RESULTS

The mobile snapshot response system was thoroughly tested using black box testing technique, in an attempt to test the system externally and to deduce errors. About thirty test cases were performed on the server side and the mobile side to insure that the system was functioning as expected. The server side tests include adding/deleting courses, sections and lectures, creating/editing assessments, generating QR codes, answering inquires and analyzing results.

From the mobile side, a pilot usability evaluation was conducted using different mobile handsets on a small number of students (N =7). The students accessed the service, answered the assigned assessments and then sent their answers and inquiry to the system.

The System Usability Scale (SUS) questionnaire, a well-known usability instrument, was used to measure the usability and user satisfaction of our system.

Question items included in the SUS survey has a five-scale Likert scale ranged from strongly disagree (1) to strongly agree (5). The items are:



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- I think that I would like to use this system frequently
- I found the system unnecessarily complex
- I thought the system was easy to use
- I think that I would need the support of a technical person to be able to use this system
- I found the various functions in this system were well integrated
- I thought there was too much inconsistency in this system
- I would imagine that most people would learn to use this system very quickly
- I found the system very cumbersome to use
- I felt very confident using the system
- I needed to learn a lot of things before I could get going with this system

The questionnaire was distributed among the students. The students were asked to rate their agreement to the statements from strongly disagree (1) to strongly agree (5). In summary, the mean ratings of students' satisfaction were high; it was 83%. Even though, the initial feedback from the students was satisfactory; however, a pragmatic evaluation of the system on a large number of students is proposed.

## DISCUSSION

In this study we showed how mobile phones, as one of the most readily accessible technologies within the students reach, were used to increase the interaction inside the classroom.

Our system focused on utilizing QR codes to break out of the traditional classroom and to immerse students in the communication process.

Factors that might affect the experiment result can be attributed to the quality of the QR reader software found on some mobile phones and the reliability of the internet connection.

A further expansion of this project will be to increase the functionality of the system and broaden the functionality of its services beyond the technology of QR Codes and somehow make the system adaptable to new mobile features.

## CONCLUSION

Recent interest in M-Learning applications has greatly increased. One of these applications is the utilization of mobile devices in student evaluation and education. We envision the potential of using our proposed system, in improving the communications between teachers and their students and in providing students with the ability to raise questions and comments without embarrassment. Moreover, by using our proposed system, the students will be able to answer short assessments at the end of each class in an easy and convenient way. Thus, our proposed system will benefit the teachers as well as the students and improve the delivery of lectures by getting a timely feedback and by automatically analyzing student's answers.

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