Learning Environment Using Smart Phones

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Dr. Juneja's research is interdisciplinary and collaborative. She is focused on improving health, safety, and performance in work environments, be it indoors such as offices, classrooms, or outdoors such as construction sites. Her overall research objective is to facilitate strategic alignment between work environment and goals of high performance and overall well-being for occupants, thereby, optimizing the whole life cycle costing of the respective environment. She believes that in informed decision-making, an informed trade-off analysis is performed and the decisions are not restricted due to cognitive limitations of information processing of human brains.

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Abstract

This paper discusses about the Quick Response (QR) code learning environment which allows the students to use their smart devices and engage them in active learning process. Smart phone became an integral part of students' life. One of the new challenges the instructors face with smart device savvy students is to engage and involve them in active learning process. A learning environment which encourages the students to use their smartphone for active learning is needed. This type of learning environment can be accomplished by using World Wide Web and QR code technology. This new teaching style encourages usage of smart phones in the classroom. This increases students' engagement and also helps them to focus on learning. This facilitates more interaction and personalized contact time between students and instructors. It also encourages students to take more responsibility for their own learning process. This paper discusses about the different components of the QR code learning environment framework. It also discusses the steps involved in the deployment of the framework for development of prototype smart lab.

Key Words: QR code, smart phone, learning environment, smart device

Introduction

Smartphone became an integral part of students' life. Students using the smartphone for school related work will continue to grow in future [3 & 8]. Traditional lecture is one of the styles which is widely used for teaching construction engineering and management (CEM) courses. Traditional lecture mode teaching include less interaction and less personalized contact time between students and instructors. Through this teaching style, students who miss class or who need extra review get left behind. In addition to these, one of the new challenges the instructors face with smartphone savvy students is to engage and involve them in active learning process. The differences in teaching and learning styles result in problems such as disengagement of students and loss of learning aptitude. Some of these challenges can be addressed by using a learning environment which encourages the students to use their smartphones for active learning. This type of learning environment can be accomplished by using World Wide Web and Quick Response (QR) code technology. Researchers explored the potential of QR code technology in various engineering applications. For example, QR code was used for developing automated facility management system[7]; for developing automated shop drawing system[12]; and for tracking and control of engineering drawings, reports and specifications[10]. QR code technology was used to access information about buildings and other artifacts for pedestrians[9]. This paper explores the potential applications of QR code technology in education. The goal of the study is to develop QR code learning environment that engages the students in active learning process. This new teaching style encourages usage of smart phones in the classroom. This increases students' engagement and also helps them to focus on learning. This facilitates more interaction and personalized contact time between students and instructors. It also encourages students to take more responsibility for their own learning process. Since the entire course contents are posted on web, students who miss class or who need extra review do not get left behind. This paper

discusses about the different components of the new learning environment framework. It also discusses the steps involved in the deployment of the framework for development of prototype smart lab.

The study will be conducted in two phases. The first phase focuses on the development of framework for QR code learning environment. The second phase focuses on the deployment of this learning environment in teaching the courses. This is a part of a research project, which is in progress. The paper presents an overview of the framework development involved in the first phase of the research and pilot study conducted in the second phase. The following sections discuss about QR code learning environment components and information flow among them.

QR Code Learning Environment Framework

The different components of QR code learning environment framework includes: Knowledge repository, Object hyperlinking, and Interactive display unit.

Knowledge Repository

This section discusses the methodology adopted for the development of a knowledge repository. The interaction to the knowledge repository is provided through three dimensional (3D) model. This was accomplished through Building Information Model (BIM). The two steps in the development process include: (a) 3D model development and (b) integration of information to the 3D model elements[6]. The ease of integration depends on the availability and type of parameters in the BIM software[4]. The information associated with the 3D model elements can be retrieved through parameters of the elements. These parameters establish the links between respective files and elements in digital format. Information used to develop the knowledge repository can be classified as semi structured data files (HTML and XML files), unstructured data files (MS Word or plain text files), and unstructured multimedia files (photographs, audio, and video files)[5]. Since BIM requires information in a digital format, the information repository development duration can vary and depends upon its availability form. For example, when the information is available in paper format, it needs to be converted into digital format.

Object Hyperlinking

The process of extending the internet to real world objects is called object hyperlinking[13]. This can be achieved by attaching tag with URL to the real world object. The QR code with URL can be used as a tag. QR code stands for Quick Response Code. It was invented by Denso Wave in 1994[14]. It is a two dimensional bar code. It can be read by using smartphone or touch pad or computer camera. QR code is used to store text, URL, and contact information. When the user reads the QR code depending upon the type of information stored, it may display text, opens URL, and saves the contact information to address book. QR codes are now used for wide range of applications such as commercial tracking, product marketing, product labeling, and storing organizational and personal information. QR code can be static or dynamic[1]. In static QR code the initially created information cannot be changed, whereas in dynamic QR code the information can be edited after creating the code. With the advent of smart phones QR codes became popular as each smartphone can read the QR code with appropriate QR reader app.

Interactive Display System

The display system can be smart device display unit, desktop display unit or large format display unit. Smart device display unit devices include smartphone screen, touchpad or tablet. Desktop display unit includes monitor and can be made interactive by using mouse and keyboard. Large format display unit includes non-interactive screen or interactive screen and projector. The non-interactive screen can be made interactive by using mouse and keyboard. An interactive screen includes touch sensitive interactive whiteboard units.

Information Exchange in QR Code Learning Environment

QR code learning environment involves four components. *QR code tagged Object:* QR code with URL is tagged to the object; *Smart device:* Smart device which has means to read the QR code and display the information; *Open Wireless network:* An open wireless network such as 3G or 4G network for communication between the smartphone and server containing the information linked to tagged object; *Server:* A server to store the information related to the real world object. An automated flow of information among different components of the QR code learning environment is shown in Figure 1. Smart device scans the QR code of the real world object. When the scanning is completed, it establishes the connection with server and a web page is displayed. Based on user selection, more instructions will be provided for further navigation.

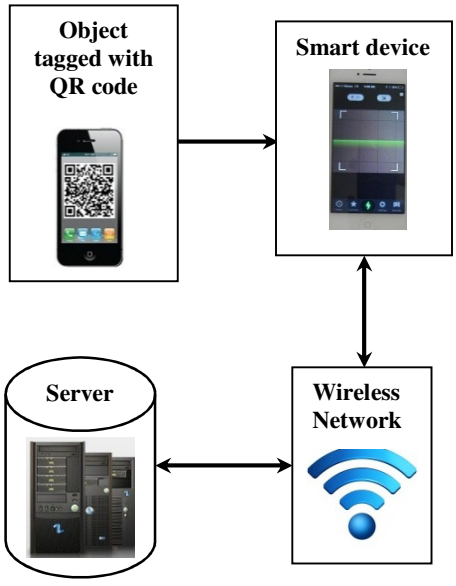

Figure 1: Automated information flow in QR Code Learning Environment

Pilot Study

A pilot study has been conducted to demonstrate the feasibility of implementation of proposed QR learning environment framework at Construction Management department, Southern Polytechnic State University. It was implemented for Architecture and Construction Management lab by using QR codes. The study included five steps: (a) knowledge repository development; (b) demo units' hyperlinking; (c) interactive display unit set up; (d) automation of information flow and (e) usability study. Overviews of these steps are discussed below.

Knowledge Repository Development

The steps included for the lab knowledge repository development were 3D model development, creation of new parameters and association of the information to these parameters. A 3D model of the lab was developed using Autodesk's Revit 2014 software as shown in Figure 2. In Revit, each element is associated with predefined parameters and these are categorized into type parameters and instance parameters. The type parameters control properties of elements of that type while the instance parameters control the instances properties. The type and instance parameters are further categorized into different groups. The data format stored in each parameter is of type: text, integer, number, length, area, volume, angle, URL, material, and yes/no. In this project, since the predefined type or instance parameters are inadequate, new parameters with URL data format are added to the elements. Required new parameters such as were added to the different elements of the 3D model. These parameters were made to appear under the group name 'Other' in the type parameters list. The URL data format was used for each parameter. This format is useful to establish the link between the respective files and component. The association of information to the model elements was accomplished by assigning the file paths of the information to the parameters. This link between the documents through the path stored in the parameter allows easy access to the required information. The information needed was collected through paper format and digital format from various sources. Since the information is needed in digital format, the paper-based information was converted into digital format (PDF files) by scanning. Once the information was associated the model was converted into PDF file. This file format facilitates the user to interact with types of smart devices.

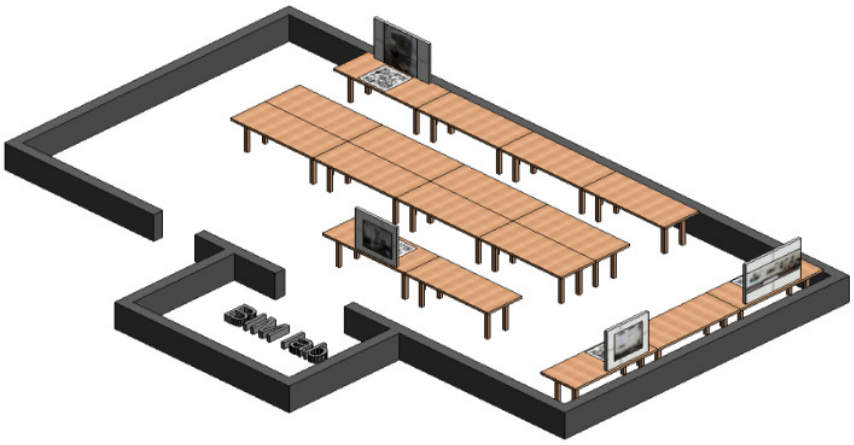

Figure 2: 3D Lab Model

Demo Units' Hyperlinking

In this step, webpages for each demo unit in the lab were developed and these pages were hosted on a server. Various static QR codes with URL for different demo units in the lab are created. These QR codes are tagged to the physical objects in the lab as shown in Figure 3.

a) Refrigeration and Air conditioning unit

b) Friction Losses unit

Figure 3: Demo Units' tagged with QR code

Interactive Display System

In addition to the portable smart device, large screen interactive display system shown in Figure 4 is also used for this study. It consists of three SMART Board 600i2 interactive whiteboard units. Each unit is equipped with interactive white board and SMART Unifi 45 wall mounted short throw projector. Each unit interacts with host computer through USB interface[11]. The whiteboard has durable hard coated polyester touch sensitive surface. These three units interact through single host computer connected to the server through the Ethernet port.

Figure 4: SMART Board Interactive Display System

Automation of Information flow

In this step, the communication among real world object and server was established. The tagged real world object establishes communication with the server through the smart device using the wireless network. When the user scans the QR code, main menu webpage as shown in Figure 5 is displayed. Depending upon the selection, the user will be able to navigate different modules. The different screens are shown in Figure 6 and Figure 7.

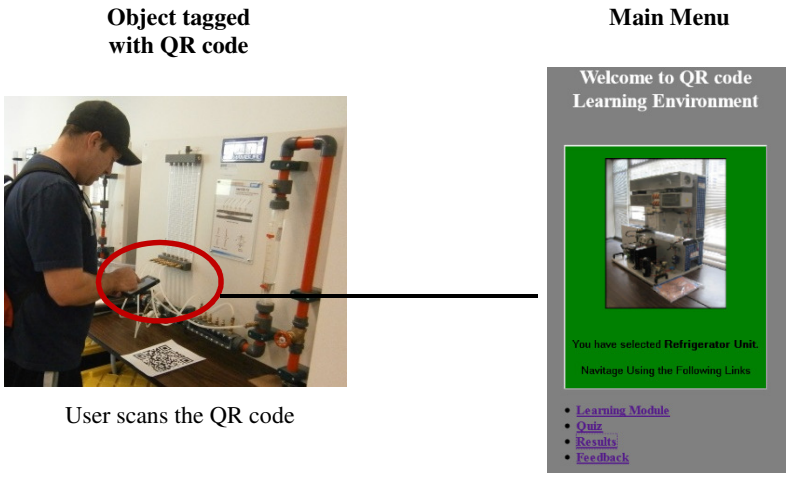

Figure 5: User interacting in QR code learning environment

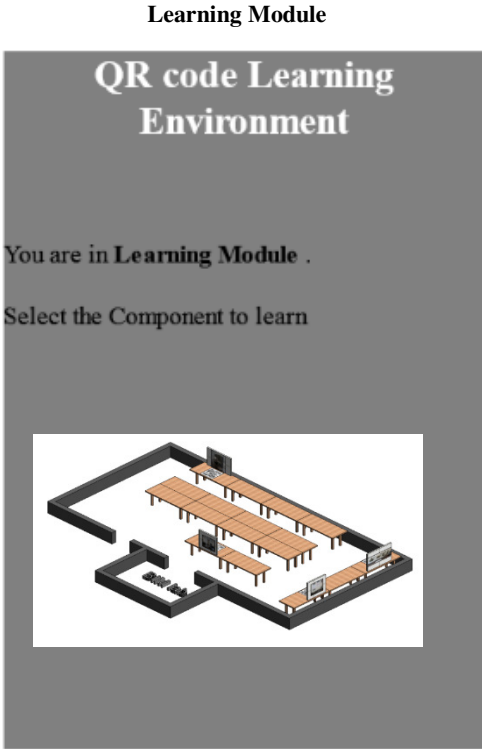

Figure 6: Learning Module Window

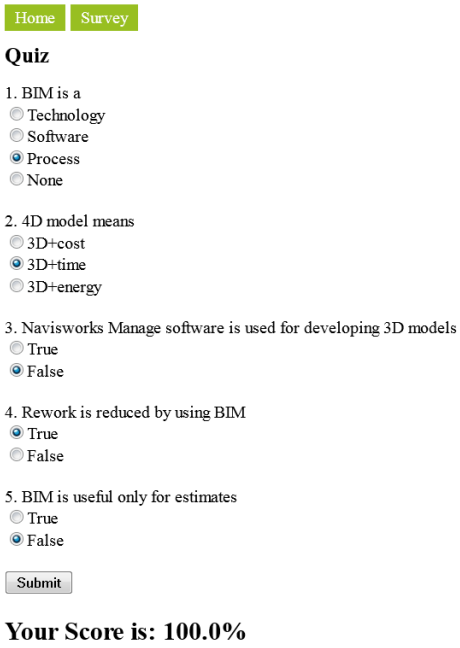

Figure 7: Quiz Module Window

Usability Study

Students from Construction Management Department were asked to use QR code learning environment developed for Architecture and Construction Management lab. After using the system, the students were asked to express their satisfaction on usefulness, ease of use and ease of learning of QR code learning environment with 5-point Lykert-type scale (1= Strongly Agree, 2 = Agree, 3=neutral, 4= Disagree, and 5=Strongly Disagree). The analyses of the results are shown in Figure 8. Most of the students were satisfied with the usefulness of QR code learning environment and expressed their agreement with the statement "Overall, I am satisfied with usefulness of the QR code learning environment" (65% strongly agreed and 22% agreed). Most of the students were satisfied with ease of use of the QR code learning environment and expressed their agreement with the statement "Overall, I am satisfied with the ease of use of the QR code learning environment" (51% strongly agreed and 43% agreed). Most of the students were satisfied with ease of learning through QR code learning environment and expressed their agreement with the statement "Overall, I am satisfied with ease of learning through QR code learning environment" (51% strongly agreed and 43% agreed). Most of the students enjoyed learning through QR code learning environment and expressed their agreement with the statement "Overall, I am satisfied with QR code learning environment" (51% strongly agreed and 43% agreed).

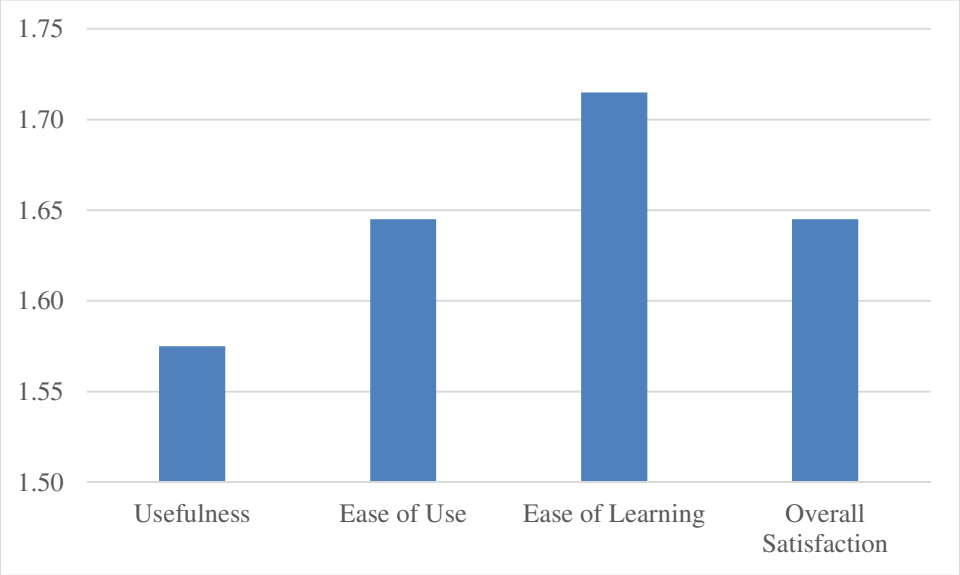

Figure 8: QR code learning environment usability results

Conclusion

The preliminary survey results conducted during pilot study revealed that students are very excited to use QR code learning environment. The students expressed high satisfaction on ease of using it and ease of learning through it. As the number of students using smart phone is on rise, QR learning environment has the potential to make a paradigm shift in teaching. The methodology discussed in this paper serves as an initial step to develop an integrated QR code learning environment for teaching digital age students.

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