

# *Towards Building Novel Educational System for School Students Using Smart Phones and QR Codes*

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**Abstract**—With the increase of using smart phone devices, these devices can play important roles in many life fields, education is one example of these fields. Smart phones can be used to read QR codes, which can link physical objects into electronic resources. In this project we propose a novel educational system for school students that use QR codes and smart phone devices or tablet computers. We aim to link the physical school books to additional electronic resources allowing students to reach educational games, multimedia resources and online experiments. Our educational system allows communication between students and teachers and even between parents and teachers through educational server. Also the proposed system gives the students' parents the ability to access all their children information using one account.

**Keywords**— QR Codes, Smart phones, E-Learning; Educational System

## I. INTRODUCTION

Quick Response (QR) code is a two dimensional barcode that stores data in two dimensions and can be read using an imaging device, such as: smart phone, tablet computer or specific scanning device [1]. Nowadays smart phones are becoming more and more popular and important, they offer a lot of features that make our life much easier than ever before. These features include voice communication, accessing the Internet any time and everywhere, using digital cameras and viewing multimedia resources. One more important feature is that smart phones can be used as scanning devices for QR codes.

QR codes allow the reader application to complete an action. It links physical objects (books, posters or advertisements) to specific electronic encoded data (web page

address, email, SMS message or text information). The reader application can decode this data and read some text, get specific parameters, redirect browsers to a specific web page or use contact information [1]. QR codes can contain any type of information with a specific size. According to QR code standard [2] the encoded data can be numeric, alphanumeric, binary and Kangi data, with a size up to 4296 characters for alphanumeric data. Figure (1) shows a QR code that contains a link to Yarmouk University website.



Fig. 1. QR code contains a link to Yarmouk University website.

QR codes are increasingly used to cover various fields, such as: product tracking, item identification, contact information and general marketing [1]. One interesting field is using QR codes with mobile phones in the class room environment for educational purposes. QR codes can be used to provide students with just in time resources [3] [4].

The rest of this paper is organized as follows: Section two presents a brief of the related studies. Section three explores the proposed educational system importance. System structure and algorithm are shown in section four. Section five explores the advantages and challenges of the proposed system and finally section six presents the conclusion and future work.

## II. RELATED WORK

The study of [3] aims to improve college classes to use smart phones and QR codes. Improvements include developing a system that allows college students to answer questions about the class and send their comments or suggestions to their teachers and classmates during classes. The system was developed using smart phones and QR codes in the middle of each class.

The study of [4] explores the evolution of smart phones into a powerful tool for education, providing a literature review on the usage of smart phones in higher education for both professors and students and how smart phones can be useful inside and outside the class room.

The study of [5] is a report study on the potential of using QR codes in learning and education, providing several scenarios of QR code usage in presentations and class room feedback, with survey results for university students asking them about QR codes and smart phones usage in education.

Objects identification system to help blind and visually impaired people was developed in [6]. The study propose objects identification system for blind people using QR codes and smart phones, the study shows how QR code can be used usefully in real-time interaction with different environments. Where in [7] a novel educational information system for Holy Quran was developed using QR codes, linking hard copies of Holy Quran with electronic resources for audio, translation and interpretation for Holy Quran learning process.

## III. PROPOSED SYSTEM IMPORTANCE

In this part we propose the importance of building novel educational system for school students depending on QR codes and smart phones (or tablet computers) that are connected to the Internet. Our goal is to improve the educational process in general and allow school students to access online materials including multimedia resources and educational games. Also the proposed system allows the students and their parents to contact with school teachers through educational server.

To determine the importance of building such a system we did a survey for school students. The survey contained nine questions in Arabic language, with a sample size of 180 students who are between 12 and 17 years old. The survey was printed and applied in Jordan National Schools (Irbid – Jordan). In our survey we ask students about their usage of smart phones and QR codes, Table 1 shows the survey results.

TABLE I. SURVEY RESULTS

Question	Students who answered yes - percentage	Students who answered no - percentage
Do you have a smart phone device?	122 – 67.7%	58 – 32.2%
Do you have Internet connection on your mobile device anytime and everywhere? (of those who have smart phones)	63 - 51.6%	59 – 48.3%
Have you heard about Smart phones usage in educational field?	95 – 52.7%	85 – 47.2%
Have you heard about QR code?	70 – 38.8%	110 – 61.1%
Do you use the URL links printed in school books to get more information about lessons?	54 - 30%	126 - 70%
Do you use the internet to access extra resources and experiments?	54 - 30%	126 - 70%
Do you prefer using multimedia resources in the educational process?	117 - 65%	63 - 35%
Do you prefer to have communication with your teachers outside class rooms?	117 - 65%	63 - 35%
Do you check your marks online on the e-learning system?	98 – 54.4%	82 – 45.5%

Survey results showed that the majority of the students use smart phones and Internet but they are not aware of what QR code is. It is important to use this wide spread of smart phone devices that are connected to the Internet in a beneficial way. The students can gain great benefits with electronic resources, educational games, multimedia resources and online experiments. Survey results showed that the usage of smart phones can play important roles developing the educational process.

## IV. PROPOSED SYSTEM STRUCTURE AND ALGORITHM

Our proposed system contains three main components: QR code label, Smart phone and Educational server.

QR codes are used to link physical papers of student books with the corresponding electronic materials and educational

resources. Smart phones are used as scanning devices; they read the QR code contents and use them to connect to specific educational server that contains the educational resources.

In order to manage these operations we propose a specific structure to encode data in QR codes, this structure is important to define common well known rules so the scanner devices (mainly smart phones) can handle these data and use them efficiently. Figure (2) shows our proposed system components.

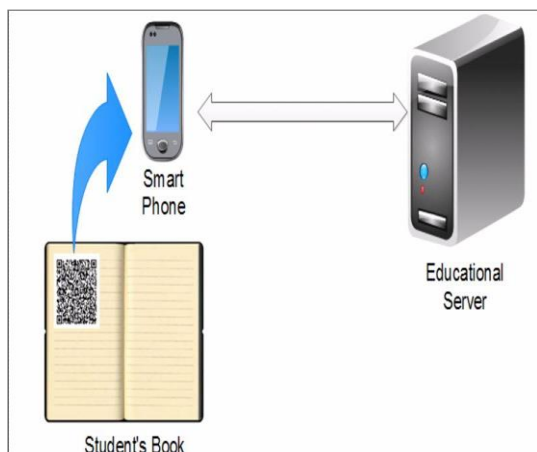


Fig. 2. Main components of the proposed system.

Our proposed structure uses the concept of Extensible Markup Language (XML) tags. XML is a markup language that aims to define data encoding rules in a format that is both human-readable and machine-readable [8].

For student books we need to add QR code label to each lesson page. QR codes will contain specific parameters that give full definition of the lesson such as: grade, course subject, unit number, lesson number, title and even extra URLs that support the materials. Also QR codes should contain educational server information (domain name or IP address). This information will be encoded in XML; two main tags are used to encode these parameters; lesson info tag and server info tag. Figure (3) shows an example of data encoding in tags.

```
<lesson_info>
  <grade>ninth</grade>
  <course>chemistry</course>
  <unit>5</unit>
  <lesson>2</lesson>
  <page>56</page>
</lesson_info>
<server_info>
  <domain_name>www.example.com</domain_name>
</server_info>
```

A square QR code is positioned to the right of the XML code block, representing the encoded data.

Fig. 3. Example of data encoding in tags.

Our proposed system algorithm steps are:

- Encode the parameters (as defined in system structure) of each lesson in QR code and print this QR code on the corresponding student book paper.
- Students and parents will use specific reader application that is installed on their smart phone devices to scan QR codes.
- Reader application is responsible for data parsing and understanding the encoded parameters.
- Reader application will use server information to establish a connection with the corresponding educational server and will send the parameters that identify the lesson.
- Educational server will handle student accounts with user name and password and these accounts will contain all the needed resources, educational games, multimedia resources, marks, experiments, extra materials and teachers contact information such as email or phone number.
- Educational servers may handle parents' accounts that contain full information about their children and contact information with teachers.
- Educational server will regulate the communication process between students and teachers and between parents and teachers. This can be done using messaging system running on the educational server, or simply the server will provide information about the subject teacher including his/her name and contact information such as phone number or email.

Through the connection between the smart phone and the educational server, students will be able to use the educational server services. Figure (4) shows the proposed educational system.

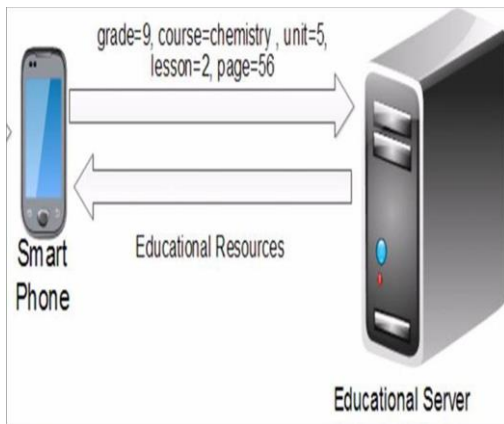


Fig. 4. The proposed educational system.

## V. SYSTEM ADVANTAGES AND IMPLEMENTATION

### A. Advantages and challenges

Our proposed system offers important features and services to the educational process. Main advantages are:

- It is easy to implement.
- There is no need to type URLs or key words to access extra information.
- All educational resources are collected in one place (educational server).
- It solves the problems of danger or costly experiments by supporting multimedia resources.
- QR codes are free to use and easy to generate.
- It offers (student - teacher) and even (parents – teacher) communication.

Although the proposed system offers important services, barriers and challenges appear such as:

- Not all students have smart phones. According to our survey 32.2% of the overall number of students does not have smart phone devices, especially for those who are less than 15 years old.
- Not all students have Internet connection on their smart phones and not all schools are covered with Wi-Fi Internet connections. Our proposed system needs Internet connection between the educational server and the student who use smart phone. According to our

survey 48.3% of the overall number of students who have smart phones do not have Internet connections.

### B. Implementation and Experiments

The algorithm was implemented using Java server and Android mobile application, figure 5 shows the main interface of the application.

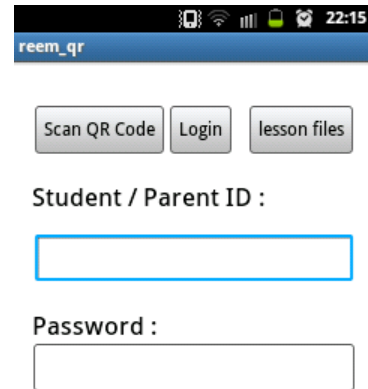


Fig. 5. The main interface of the android mobile application.

The application has 3 main buttons and two text fields. The first button allows the user to scan a QR code; figure 6 shows the contents of QR code that was used as experiment.

```
<lesson_info>
<grade>11</grade>
<course>computer</course>
<page>13</page>
</lesson_info>
<server_info>
<ip>192.168.0.101</ip>
</server_info>
```

Fig. 6. The QR code contents that was used in the experiment.

We have used an online QR code generator to encode these contents, QR stuff website [9] which offers free QR code generation service. The generated QR code is shown in figure7.



Fig. 7. The QR code that was used in the experiment.

Using the first button “Scan QR code” the user can read QR code contents using his smart phone camera. This step is shown in figure 8 and figure 9.

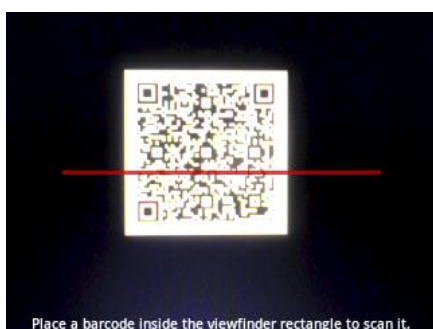


Fig. 8. Scanning the QR code.

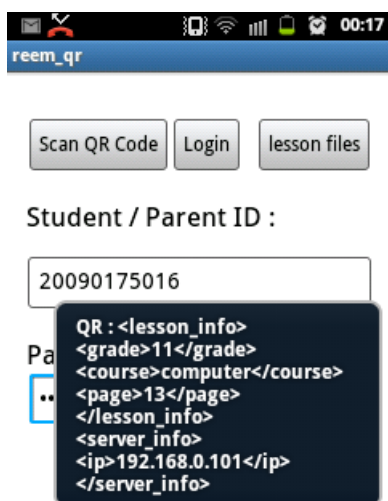


Fig. 9. Reading QR code contents.

The users are asked to enter their student ID (or parent ID) and login to the educational server, parents can access information about all their children in one account.

The educational server will verify user id and password then provide the user with the needed information such as marks, exams, external links that contain more educational resources, multimedia experiments and educational games. Also it will provide teachers' contact information or special messaging system to handle student-teacher and parent-teacher. Figure 9 shows an example of extra resources provided by the educational server.



Fig. 10. Reading QR code contents.

The educational server can be used to access the E-learning system that is used by the Jordanian ministry of education [10]. The E-learning system is used to access students' accounts, marks and courses.

## VI. CONCLUSION

In this paper we proposed novel educational system for school students using QR codes and smart phones. We have applied a survey for school students to determine the importance of developing such system, survey results showed that the majority of school students have smart phones but they do not use them in education. Our proposed system offers beneficial use of smart phones in the educational process by defining specific structure for data encoded in QR codes, then using these QR codes to link physical books to electronic educational server which provide students with extra resources, multimedia experiments, educational games, and many other services. Also the system offers great features for students' parents include viewing students' marks and communicate with school teachers.

In the future we are looking to apply this system for schools, take feedback from students, parents and teachers to add more educational services.

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