Online Student Attendance System Using QR-Code for Kolej Komuniti Segamat

Mohd Nizam Saad[(✉)], T. Zalizam T. Muda, Nanthini Oulaganathan,
and Ramithran Kaliappan

School of Multimedia Technology and Communication, Universiti Utara Malaysia, 06010
Sintok, Kedah, Malaysia
`nizam@uum.edu.my`

Abstract. This study discusses the design and development of student attendance using QR-code for Kolej Komuniti Segamat (KKS). The current or manual attendance system in KKS requires lecturers to keep track of students' attendance using timesheets, manually evaluate the percentage of student attendees and by hand, send a warning letter to the student. Various issues have raised when lecturer used the ageing process to record the attendance, such as misplaced or damaged attendance sheets, significant paper consumption, time constraints, and incorrect attendance calculations. Sometimes these manual timesheets are inaccurate since students can cheat. In order to solve the problems, we developed a system to capture the attendance systematically. Three objectives are set to the system which include minimizing paper usage, generating a QR code for attendance and record student attendance. Furthermore, various design methods and implementation phases were carried out to develop the system. We also conducted a usability test using five Likert scale questionnaire among 35 respondents from various users in the collage to evaluate the system. Overall, result from the usability test indicated that the system is usable to capture the attendance where the average mean score for each component is 4.16.

Keywords: Attendance system · QR code · Iterative development models · Usability test

1 Introduction

Nowadays, it is crucial to complete a task quickly, discover something new, and get better results as quickly and efficiently as people can. According to [1], each sector, especially the education and business environment, requires management systems to ensure proper monitoring and control over their learning and job growth. Because of all these strengths and benefits, we thought that an online student attendance system is required, particularly in terms of student education. Attendance in the whole education system is one of the primary and most relevant criteria. As a result, if the attendance requirement is not met, the student will forfeit the right to sit an exam. Students who have exceeded the maximum number of permissible absences will not be eligible to sit

for final examinations in that semester. This practice has been applied in many education institutions because the attendance is a compulsory component that each student must fulfilled throughout the semester.

Although the technology has advanced, there are still institutions which record the students' attendance manually either manually marked by the teachers or the attendance sheets are passed among students. Although these methods are quite accurate but ones have to realize that given that the manual approach leaves more space for measurement mistakes and prune to dishonest attitude. Hence, to assist in overcoming such problems, this web application was developed and introduced. It is entirely open to users of any computer system, smartphones and laptops. It is possible to acquire immediate and easy access to complete group or individual student attendance details using the proposed methodology, which protects data confidentiality. Additionally, the report is created automatically by lecturers. The student attendance system's goal is to computerize the conventional registration process and to a more straightforward and thoughtful way to monitor the attendance. In this paper, we are going to share our experience developing an attendance system using QR codes among student from Kolej Komuniti Segamat (KKS). This proposed system would reduce the need for a manual attendance method and a time-consuming and inefficient approach. Using the proposed system, students can check in to the system, and the lecturer can control all of the student attendance records stored on the database.

2   Problem Statement

The pipeline of general enterprises needs to record the attendance of personnel, which has become a basic requirement of the company [2]. According to the current procedure used at KKS, it was cumbersome for both admins and lecturers to gain access to student attendance records. Because attendance at KKS is recorded on paper sheet, it takes time to locate the students' attendance.

Since lecturers are required to preserve the attendance sheets for 14 weeks throughout one semester, the attendance sheet may be misplaced or mishandled mainly because of human errors. As a result, the lecturer will no longer be able to track the overall attendance record of the students during the study period. In order to automate the students' attendance record, many prior researchers have developed systems to capture the attendance systematically especially via computer or handheld devices. These systems functioned perfectly to handle the work that they are designed however when it comes to evaluating these systems, most of the evaluation done only involved the system performance and very few put the effort to evaluate the system acceptance among users [3].

Presently, every time a student attends a class at KKS, he or she is required to sign an attendance sheet provided by the lecturer. Student dishonesty is a concern in this case since they can perjure themselves when it comes to class attendance by having their buddies sign on their behalf when they did not attend. When a lecturer is dealing with large numbers of students in an auditorium or tutorial class, they will not recognize the students who are not present, even though their names have been marked as presently enrolled students.

It is a challenging job for the lecturer to keep track of how many times a student has missed class. In order to be eligible to take the final exam at KKS, students must present in class for at least 80% of the overall class attendance for the session. To discover absenteeism as early as the process, each lecturer needs to keep track of his or her students' attendance records daily. Because the attendance procedure is done manually, the lecturer must count each student individually to calculate the attendance percentage for each class, which very prone to error.

3 Related Works

This section discusses related works regarding the attendance system.

3.1 Automated Student Attendance System

Biometrics technologies have started influencing people's daily lives as they transition to the digital era accelerates. Fingerprints, QR codes, faces, irises, retinal patterns, speech, and other biometrics characteristics are used to validate individuality. According to [4], physical data-based approaches are gaining popularity as a more appropriate form of personal authentication than the traditional method. In marketable and science research, it is critical to determine the proper methods to use. Bluetooth, barcode readers and Radio Frequency Identification (RFID) systems, are only a few examples of such tools [5]. They were costly and thus used for a limited purpose only when first announced. These methods are now more affordable and can be used in different applications such as recognition, monitoring, positioning and many more. In markets, QR codes are widely used to classify the sales product.

3.2 The QR Code

The QR code, also known as the "Quick Response" code, is a 2D matrix code developed with two factors. It must hold a massive volume of data when opposed to a 1D barcode, and it must be decrypted quickly using any portable device such as a mobile. QR codes have several advantages, including omnidirectional accessibility, high memory capacity, rapid scanning, and various other features, such as error correction and a wide variety of variants. These days, a QR code is used in various application streams, including security, academia, and marketing, which is gaining in popularity at an alarmingly rapid rate [6]. Many individuals are becoming aware of this technology and utilizing it appropriately. The popularity of QR codes is overgrowing in tandem with the development in the number of smartphone users, and the QR code is rapidly gaining widespread acceptance around the world.

According to [7], while QR Codes are easier to use, they cannot be used without technological prerequisites; thus, QR Code use will develop in lockstep with the growth of related devices such as tablets and smartphones. Smartphones and tablet PCs may eventually be the leading choice for surfing and scanning QR codes. The study's findings conducted by [8], a QR Code based Attendance Management System can expedite collecting attendance, hence saving adequate teaching time and reducing errors. Moreover,

he emphasized that this approach assists students in avoiding the repercussions of low attendance, which should be specified in the school's attendance policy and academic standards.

3.3   Similar Existing System

Numerous such systems are already available on the market for tracking a user's study student attendance via a web application. Six existing example systems technology were compared to seek their features, strengths, and weaknesses as shown in Table 1.

4   Methodology

The developed system goes through seven stages in the incremental and iterative development model: Planning, Analysis, Design, Implementation, Testing, Evaluation, and Deployment. In this section, every phase in this methodology will be discussed in detail. Figure 1 highlights the particular methods taken to meet the project's objectives while Table 2 summarizes the particular methods taken to meet the project's objectives.

It will be necessary to collect all information about the existing system to select the most appropriate purpose and benefit for the student attendance system. Based on the research, this system can be implemented. The comparative analysis concluded that eliminating buddy signing, accurate and efficient attendance records, saving time, affordable price, report generation, and student lateness detection were the most used elements in the web application. It indicates that the elements are important features for such a web application.

An interview session was held with several administrators and lecturers at KKS to gather all relevant information for the project's development during the planning phase. An open-ended question is used in the interview session because it encourages the interviewee to respond spontaneously and provides unstructured answers. The interview process yielded information on the current state of operations and a list of problems to be addressed.

In terms of analysis, interviews with the target audience involve the development of an improved problem definition, system requirements, and user requirements. It helps in describing the user's expectations of the system. This phase also entails establishing the scope and circumstances under which the attendance system is designed and developed. A few main actions were carried out during this phase. i.e. 1) comparative analysis of web applications, 2) interview developers to understand more about the functional and non-functional requirements of the project.

In the design phase, several processes of design and system interface designs were created in this project. That was emphasized on the interrelated procedure of student presence. Diagrams such as the Unified Modelling Language (UML) diagrams, Wireframe and Storyboard. These diagrams are created for the design phase, with the knowledge gained during the analysis phase serving as the guide.

The attendance system interface design consists of QR code class, monitoring of student attendance, confirmation of student attendance, and many other functions. The process of creating those diagrams provides a clear picture of how the system operates

Table 1. Comparison of features between existing similar systems

Existing system	Features					
	Real Time Face Recognition System For Time & Attendance Applications [9]	Attendance Control System based on RFID technology [10]	Fingerprint Recognition Student Attendance Management System [11]	Dual Authentication Mechanism Based on Bluetooth and NFC Technologies [12]	Using Barcode to Track Student Attendance and Assets in Higher Education Institutions [13]	Scandence: QR Code based Attendance Management System [14]
Eliminate Buddy Signing	✔	X	✔	✔	X	✔
Accurate and efficient attendance records	✔	✔	✔	X	✔	✔
Student lateness detection	✔	✔	✔	✔	X	✔
Save time	✔	✔	✔	✔	✔	✔
Affordable price	X	X	X	X	X	✔
View attendance	✔	✔	✔	✔	✔	✔
Report generation	✔	X	✔	✔	✔	✔

from start to finish. Thus, the Fig. 2 shows the use case diagram of the student attendance system. The figure shows three actors that are the admin, lecturer, and student. The admin actors can manage lecturer and student details. Register courses for lecturer and student and manage student attendance reports are part of admin actors. Then, the lecturer actors can generate QR code sessions for students, manage student attendance and report. At the same time, student actors can only scan QR codes and view attendance records.

The goal of the implementation phase is to create a system with the features needed that adheres to the requirements collected during the analysis process. Following that comes testing and evaluation; 35 respondents have evaluated the system via questionnaire to ensure it meets all of the requirements and is feasible. The system has solved the problem statement, and functions work as intended in the deployment stage. Therefore, the system is ready for deployment and used by the user. The whole development process
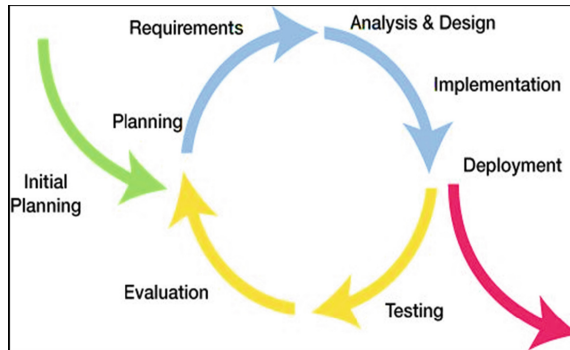
Fig. 1. The seven stages of incremental and iterative development model

must be documented so that the system can be easily maintained in the future. At the same time, it would also help the user to understand how the system can be operated.

5   Results and Discussion

5.1   Student Attendance System

The student attendance system has been built to use three primary users: administrators, lecturers, and students. Each user has a unique set of privileges and perspectives within this system. Table 3 shows the lists the system functionality that is available to the users.

Figures 3 depict screenshots of the system that demonstrate taking attendance and recording the attendance for all classes. When a session is created, the lecturer can display the QR code, read the daily attendance report, and view the overall attendance report.

At the same time, students can scan QR codes to record attendance and check their attendance records.

5.2   System Testing and Evaluation

We applied quantitative analysis method to conduct a usability test for the student attendance. Five Likert scales questionnaires are used to record 35 respondents' feedback towards the system. The respondents came from various users demography such as students, lecturers and administration staffs. Table 4 shows the result from the usability test. The overall mean is higher than 4. It implies that most responders are satisfied with the system's usability and functionality. In Table 4, the overall user evaluation for five components: ease of use, interface design, content, functionality, and satisfaction. In general, when it comes to usability, administrators, lecturers, and students gave the platform composite mean ratings of 4.3, 4.09, and 4.1, with an overall grand mean rating of 4.16, indicating that the system is effective.

Table 2. Summary of incremental and iterative development model

Phases	Activities	Outcomes

Phase 1 - Planning	1. Brainstorming ideas and analyzing the data collected.
	  i. Interview session with few admins and lecturers in the KKS.
	  ii. Distribute questionnaire through social media.
		1. Research background and objectives.

Phase 2 - Analysis	1. Identify target users, scope, survey and interview	1. Problem statement of the current process, user requirement and system requirement.
Phase 3 - Design	1. Design and build the storyboard and prototype of the system 2. Use Case Diagram 3. Design ERD 4. Context Diagram 5. Wireframe	1. Storyboard 2. Use Case Diagram 3. ERD 4. Context Diagram 5. Wireframe
Phase 4 - Implementation	1. Apply all principles, coding and transform the design into execution.	1. Online Student Attendance System using QR Code
Phase 5 - Testing	1. Create a test plan for web application in order to validate its functionality.	1. Pretest or post tested system
Phase 6 - Evaluation	1. Conduct summative and formative evaluation	1. Evaluation results 2. Feedback from experts and users
Phase 7 - Deployment	1. Produce report for the web application.	1. A completed report of web application

The evaluation means for the ease of use of the system interface were 4.43, 4.06, and 4.25, respectively, with a composite mean of 4.25. The ease of use of the system interface was assessed as highly agreed by the respondents. Both groups of respondents, admins and students, strongly agree, and lecturers agree on the dimensions of the web application. As a result, most respondents strongly agree that the system is simple to control, user-friendly, and uncomplicated to use.

Respondents rated interface design as strongly agree and agree with evaluation means of 4.5, 4.16, and 4.14, respectively. The QR platform was scored as strongly agree with the mean of 4.27 on the level of interface design. It indicates that the user interface displays the proper labelling and relevant data. The visual themes of the web application are aesthetically pleasing to the eye, and colour combinations are not unpleasant. More
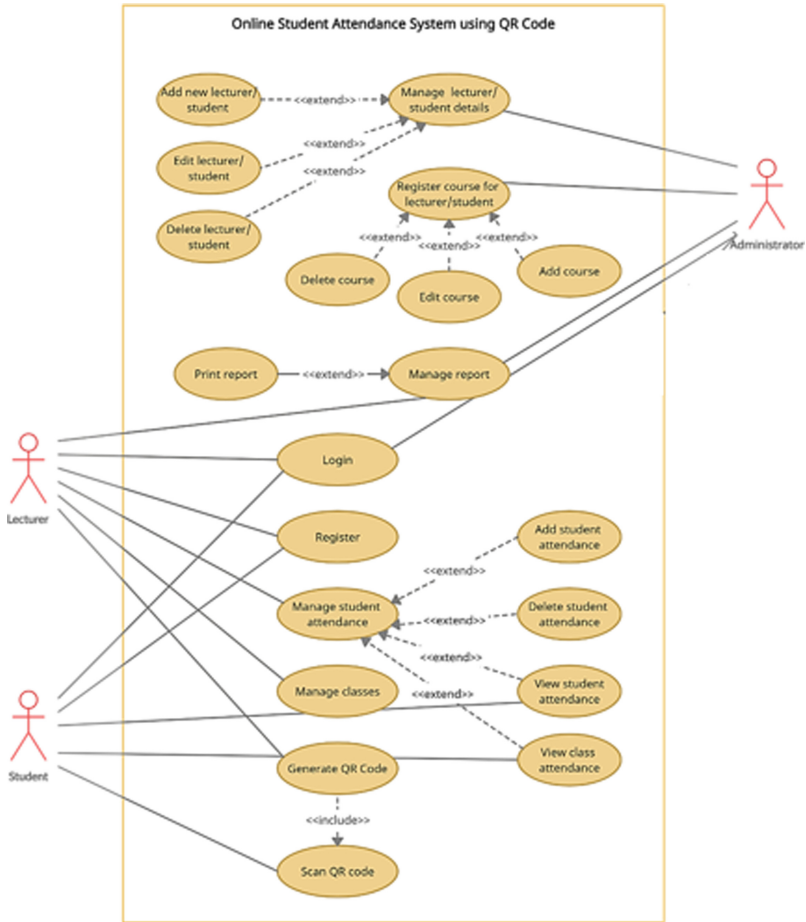
Fig. 2. Use case diagram of online student attendance system using QR code design.

importantly, mobile devices enable easy navigation through touchscreen press buttons, while QR codes create data based on attendance records that are automatically recorded.

With averages of 4.28, 4.08, and 4.03, respectively, with a total mean of 4.13, the respondents' judgement of the amount of substance of the QR evaluated the system as agreed indicates that the QR code database interface is providing an up-to-date attendance report. It can also be noticed that the respondents' perceptions of the data placed into the QR code database interface were correct, legitimate, consistent, and up-to-date, as evidenced by their responses. The information of the web application is well arranged and presented logically. It indicates that users could quickly grasp the web application interface easily.

In terms of functionality, respondents rated the web application as agreed with evaluation means of 4.08, 4 and 3.92, respectively, and a combined mean of 4. The three groups of respondents, admins, lecturers and students, agree with the dimensions of the

Table 3. System Functionality for User

Users	Functionality
Administrator	1. The system shall be able to login/logout. 2. The system shall be able to manage lecturer/students details. 3. The system shall be able to manage courses for lecturers/student. 4. The system shall be able to manage subjects for lecturers/student 5. The system shall be able to manage classes for lecturers/student. 6. The system shall be able to manage student attendance report.
Lecturer	1. The system shall be able to login/logout. 2. The system shall be able to generate QR code session to students. 3. The system shall be able to manage attendance records. 4. The system shall be able to manage classes.
Student	1. The system shall be able to login/logout. 2. The system shall be able to register new user. 3. The system shall be able to scan QR code to record attendance. 4. The system shall be able to check attendance records. 5. The system shall be able to view class details with date and subject.
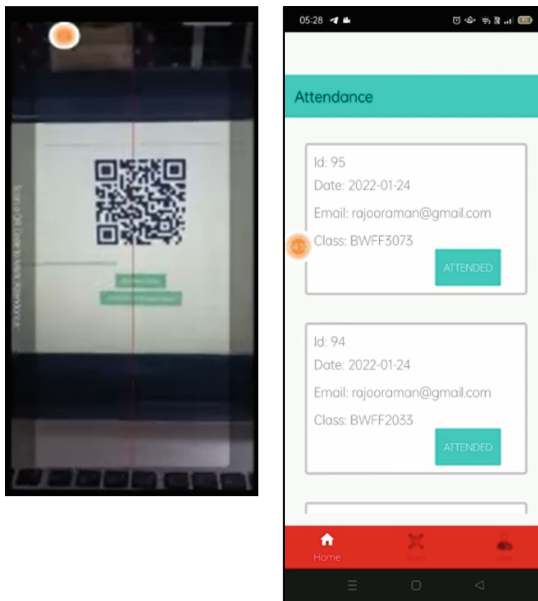
Fig. 3. Snapshot of the attendance system

web application. In this case, it appears that the users did not experience any difficulties. It is accurate to say that the data is continuously running and consistent, reducing the likelihood of data redundancy.

Table 4. Level of Usability of Student Attendance System using QR Code

Components	Mean			
	Admin	Lectures	Students	Total Mean
1. Ease of use	4.43	4.06	4.25	4.25
2. Interface design	4.5	4.16	4.14	4.27
3. Content	4.28	4.08	4.03	4.13
4. Functionality	4.08	4	3.92	4
5. Satisfaction	4.22	4.15	4.16	4.18
Composite Mean	**4.3**	**4.09**	**4.1**	**4.16**

The respondents rated the satisfaction of the web application as strongly agree and agree with evaluation means of 4.22, 4.15 and 4.16, respectively, and a combined mean of 4.18. One group of respondents, which is admin, strongly agree, and both groups of respondents, lecturers and students, agree on the dimensions of the web application. Overall, the target users were satisfied with the system. The student attendance system using QR codes meets the respondents' needs as they would recommend it to others.

6   Conclusion and Suggestion

In conclusion, the use of a QR code-based student attendance system has enhanced the current attendance management process at KKS. It also has resolved all of the issues that have arisen while using the manual way of taking attendance in classes. The implementation of this system is intended to assist admins and lecturers in managing student attendance. Based on the usability study conducted to the system, we can conclude that the system has successfully fulfilled the requirements to capture the students attendance. This situation is shown by the excellent mean score derived from the study. The study findings have offered a constructive signal that the attendance system can be improved in the future. We recommend future researchers develop similar attendance system but used different input capture technologies such as face recognition, thumb print or smart card. Then, a comparative study on the user acceptance via usability test can be conducted. The comparison result would be very interesting to report since we can compare the effectiveness attendance system using different input devices.

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