Android-based Quick Response (QR) Code Attendance System (QRCAtS)

By

Fazrul Reza Mohd Yunos

Dissertation submitted in partial fulfillment of
the requirements for the
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(Information and Communication Technology)

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CERTIFICATION OF APPROVAL

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A project dissertation submitted to the
Information and Communication Technology Programme
Universiti Teknologi PETRONAS
in partial fulfillment of the requirements for the
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(INFORMATION AND COMMUNICATION TECHNOLOGY)

Approved by,

_____

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UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK
November 2012

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

FAZRUL REZA MOHD YUNOS

ABSTRACT

Android -based QR Code Automated Attendance System is system that utilizes QR Code to track student's attendance during lecture hour in UTP. By scanning individual QR code issued to students using an Android smartphone, attendance marking and checking will be conducted by the app without human intervention. Scanned QR code contains student's information and will be compared with information stored in database during pre-deployment phase. The software solution is mainly targeted to prevent attendance fabrication by students besides reducing the dependency on paper material thus reaching a greener approach. Database are available in both online and offline mode for the sake of attendance evidence and mobile viewing. Lecturers can store the attendance list in their smartphone and later upload it to the online server. Attendance sheet stored in database can be viewed and printed out when necessary. Throughout the document, detailed documentation on the project is explained including the prototype of the app, the results of user testing along with the analysis of the feedbacks, and recommendations for future developments.

ACKNOWLEDGMENT

First and foremost, the author would like to take this opportunity to express his greatest gratitude and appreciation to project supervisor, Dr. Low Tan Jung, who had continuously monitored the project's progress throughout the duration of the project. His constructive comments, advices, and suggestions had guided the project towards its successful final outcome.

This gratitude also dedicated towards Universiti Teknologi PETRONAS (UTP) especially the committee of Final Year Project of Computer Information Sciences (CIS) department for excellent organization and management of this course.

The author would like to extend his upmost thanks to friends and families who had been great motivators in author's project. Their help and moral supports helped the author to strive forward and keep him focused on the goal throughout the journey.

Last but not least; the author would also like to express his acknowledgement to the participant of testing phase for their feedback and kind cooperation which have helped a lot in developing, improving and implementation of the system prototype.

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ABBREVIATIONS AND NOMENCLATURES

API	Application Programming Interface
CPU	Central Processing Unit
DNA	Deoxyribonucleic acid
EPC	Electronic Product Code
FYP	Final Year Project
JMF	Java Media Framework
OS	Operating System
QR	Quick Response
RAD	Rapid Application Development
RFID	Radio Frequency Identification
SDK	Self-Development Kit
SMS	Short Message Service
URL	Uniform Resource Locator
UTP	Universiti Teknologi PETRONAS

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CHAPTER 1

INTRODUCTION

1.1. BACKGROUND

The first attendance system was introduced in 1888 to record the time when a worker enter a workplace and the time a worker exit the workplace [1]. The system utilized a heavy paper card which are be stamped by a specialized time clock with date, time, and other related information. The attendance system evolved from time to time and its scope of usage are no longer limited to track and confirm the work hour of an employee for payroll purposes. Nowadays, attendance system is also used to track absenteeism of students in higher learning institute whether during lectures, laboratory sessions, or examinations.

Current system still utilizes the usage of paper for the purpose of recording student's attendance. However, this approach is not considered secure and reliable as students are able to fabricate their colleague's attendance such as signing on behalf of them. Even though lecturer's are able to detect the irregularities in the attendance, it will consume a considerable amount of effort and time to check for it and can results in frustration especially lectures that consist a large amount of students. Furthermore, a paper can be easily damaged or lost and could lead to heavy consequences to both lecturers and students regarding the proof of attendance especially attendance list that stores all the attendance from day 1 of the semester.

In order to counter the problem, various systems are introduced which enable a paperless approach and prevent attendance fabrication. However, systems such as barcode, Radio Frequency Identification (RFID) tag, and biometric approach involves the usage of specifically engineered devices that are not cost effective to the administration and requires both administrators and users to learn on how to use the system which could cost a lot of time.

Therefore, there is a call for a cost effective attendance system that does not require any extra devices, paperless and can be learned in short amount of time to replace the traditional approach of using paper to record student's attendance. The new approach suggested is by implementing Quick Response (QR) code to record and keep track of student's attendance. Instead of paper signing and name calling techniques, lecturers will scan the individual QR Code issued to students and allow the system to determine the status of the student by comparing the scanned data with data stored in database. The system can also print a report when necessary.

1.2. PROBLEM STATEMENT

- The traditional system of signing attendance on a piece of paper is no longer considered reliable in recording attendance as attendance fabrication can be easily done and papers can be easily destroyed leaving lecturers with no evidence for absenteeism especially when the attendance list contains the attendance for the whole semester.
- In order to check for irregularities in the attendance, a considerable amount of time and effort are used and therefore results with lesser time for lectures and sometimes lead to stress and anger due to dishonesty found among students.
- Implementing a robust system of attendance system may not be a cost effective approach as current advanced attendance system utilizes devices that are specifically engineered for the system only.

1.3. OBJECTIVE OF PROJECT

- To develop and implement a QR code attendance system with database access and automated attendance checking capability using Android platform.
- To reduce the number of students caught fabricating other's attendance.
- To reduce the dependency of paper material for attendance checking
- To enhance the importance of matric card among Universiti Teknologi PETRONAS (UTP) students.

1.4. SCOPE OF PROJECT

- The project focuses on Android mobile application development.
- The project is built around UTP attendance system as current system for students are still relying on traditional paper approach.

CHAPTER 2

LITERATURE REVIEW

2.1. BACKGROUND

There are numerous related studies on attendance system that had been conducted in the past using various approach and technique such as RFID tag and biometric scanner. In order to provide a clearer picture on them, the studies had been categorized according to sub-topic below.

2.2. RFID TAG

An RFID tag is a microchip attached to an antenna in a very small package similar to the size of rice grain. Each RFID tag has a unique hexadecimal Electronic Product Code (EPC) that contains information of an item. The data are transmitted via radio waves. An RFID tag requires an RFID reader in order to enable user to read the information inside the microchip. There are two types of RFID tag which are passive tag and active tag. Passive tag requires external power source from an RFID reader in order to transmit data and only allow short distance transmission. Active tag on the other hand does not require external power source as it has a built-in battery and therefore allow for long range data transmission.

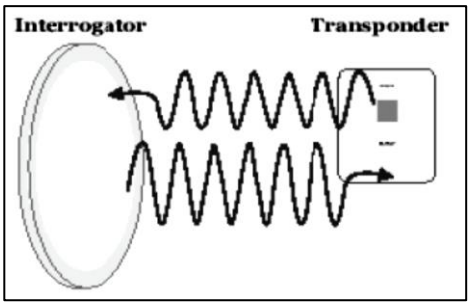

Figure 1: Passive RFID tag [4]

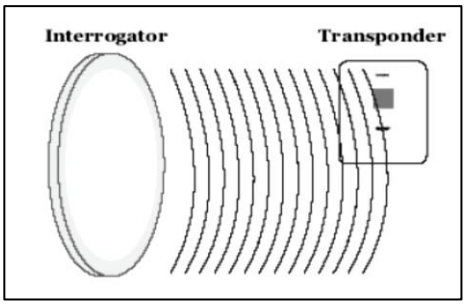

Figure 2: Active RFID Tag [4]

Singhal and Gujral [2] combined the conventional RFID scanning technique with a remote monitoring feature. By utilizing Microsoft Visual Basic 6.0 and Microsoft Access as a functional database, the system are able to alert the administrator if there are an increment in number of students in a class using SMS via a GSM network allowing long distance transmission. Students need to place their matric card on the RFID reader and the system will automatically mark their attendance along with the time stamp. The studies focus on both hardware and software developments as all hardware components are assembled by the authors and does not heavily relied on other source.

Qaiser and Khan [3] on the other hand use an interrogation field in order to scan and read an active RFID tag. The authors highlighted advantages of RFID tag over barcode such as reading even without line of sight on the tag, significant reading distance and allow multiple reading at the same time. The system proposed offers wider range of use than attendance and unauthorized entry marking such as probation and warning calculation and notification to all parties involved which are student, lecturers and parents. The main advantage of the proposed system is that it requires no human intervention as everything is automated. Administrator can access the data via provided website.

Ansari et al [4] proposed a system where every room in the university is equipped with an RFID transponder in order to monitor the location of students in real time rather than for attendance marking purposes. In order to prevent impersonation by carrying two matric cards with RFID tag embedded in it,

student's attendance are only finalized and accepted after a fingerprint scan at the end of the day at a designated post. The system are able to inform technicians when a transponder failed to work and capability to locate students based on their roll number via SMS and website interface allowing parents to track their child's location.

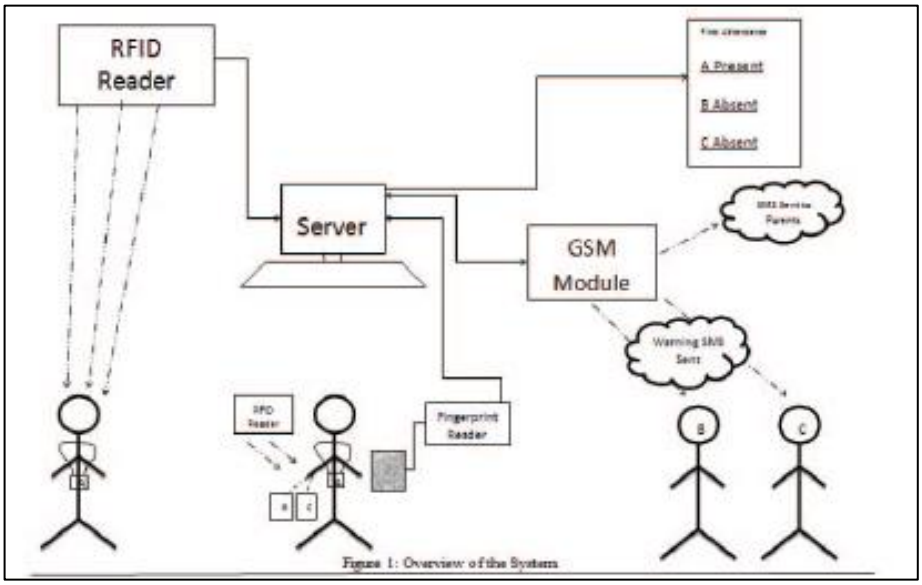

Figure 3 : Overview of the Ansari et al System [4]

2.3. BIOMETRIC

Biometrics [5] is studies on measuring and analyzing human biological data based on science and technology. A biometric system is a system that utilizes biometric data for various purposes and focus mainly on authentication. Biometrics includes DNA, fingerprints, facial patterns and other biological data on human that are unique and measureable. Biometrics data are difficult to be fabricated as human patterns are different from one another. A lot of company had introduced various types of biometric authentication device and software for attendance marking.

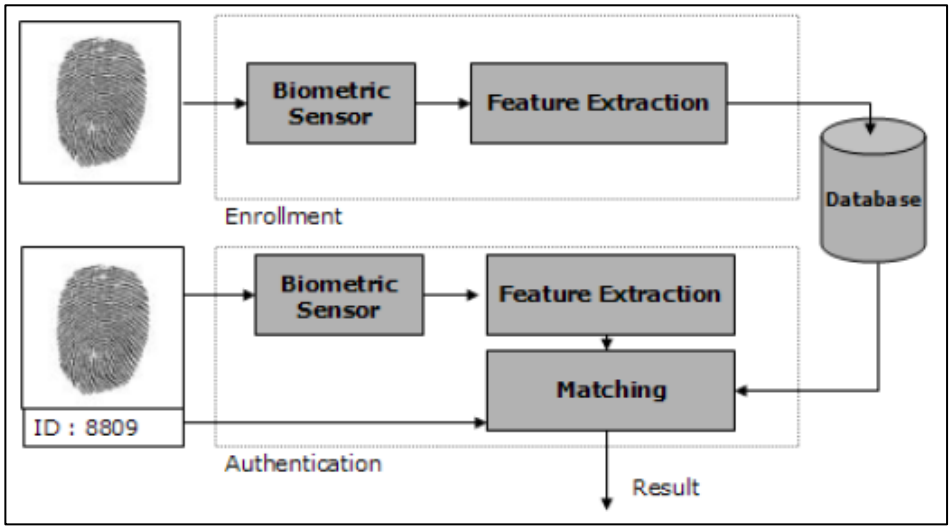

Figure 4 : General Architecture of a Biometric System [6]

Shoewu and Idowu [6] suggested that a fingerprint scanner attendance system are more secured and faster compared to manual attendance system. In the paper, the authors tested the success rate of the proposed attendance system where the system is able to match scanned ID with ID stored in database and compare the time taken for the proposed system to check the attendance with the manual attendance system. Based on their implemented system using manufacturer's fingerprint scanner Self Development Kit (SDK), C# and

Microsoft SQL, the system lead the manual system by an average of 12 seconds with 94 percent percentage of success.

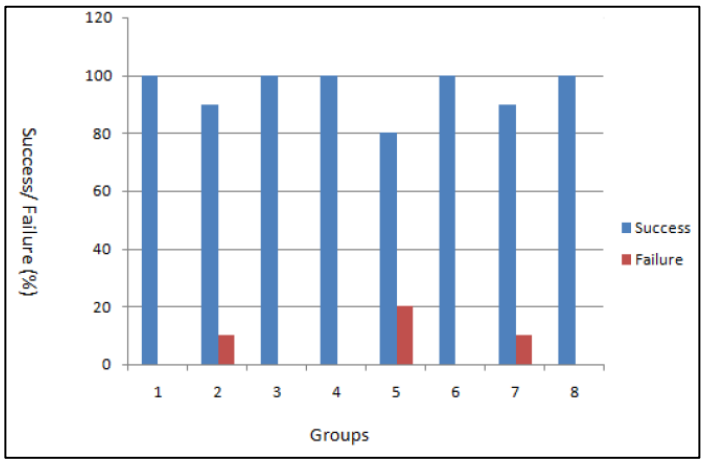

Figure 5 : Shoewu and Idowu: Comparison of success rate and failure rate [6]

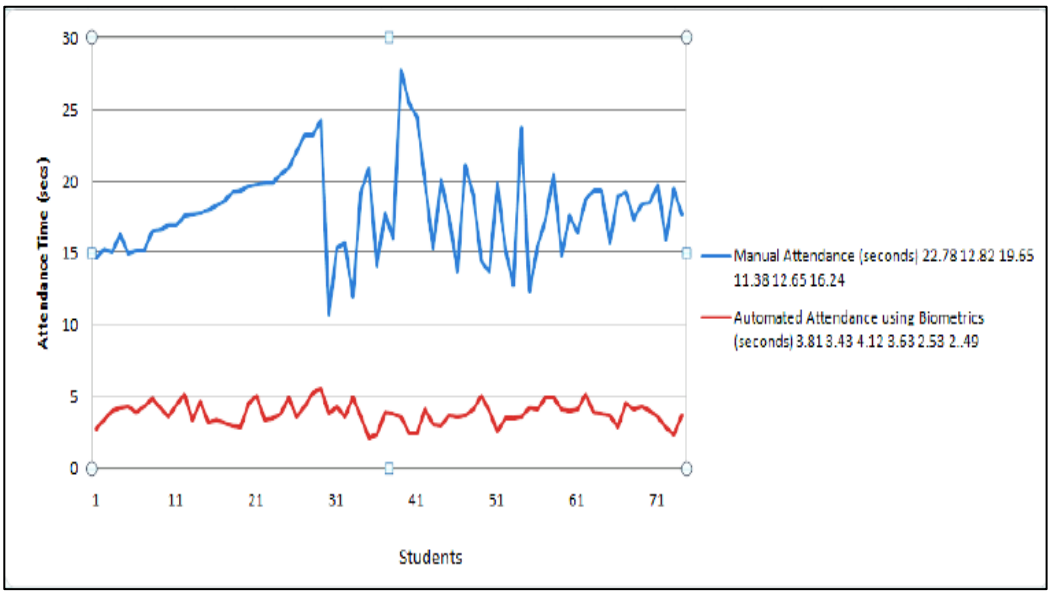

Figure 6 : Shoewu and Idowu: Comparison between manual attendance system and the proposed system [6]

Yohei Kawaguchi et al [7] introduced a new approach on facial recognition attendance system. Rather than using one time pass for facial recognition, the authors proposed a continuous observation to amplify the attendance's estimation performance. The system utilized two set of cameras; one fish-eye

camera for processing student's position based on seating and another one to capture images of student's face. The method practiced was proven effective as there was significant increment in attendance estimation in preliminary limited experiment.

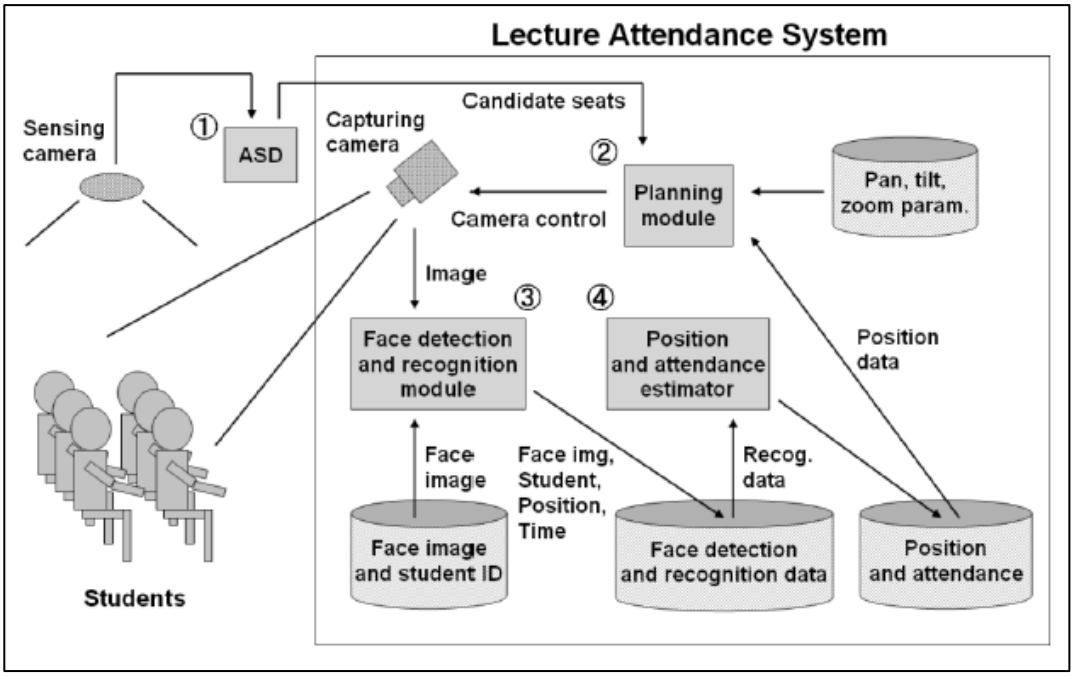

Figure 7 : Yohei Kawaguchi et al: Architecture of the Proposed System [7]

2.4. BARCODE

Barcode [9] or also known as one-dimensional barcode is a sequence of small vertical bars and spaces to represent information of a particular item. The line and space thickness and variation make each code unique although same code can be used to represent a certain type of item such as in supermarket and inventory. A barcode reader utilizes the use of reflection-sensitive laser beam to read the code. Since barcode data transmit via optical signal, a direct and flatten code is compulsory in order to read the code. Barcodes are commercially used nowadays due to its simplicity and universality in many areas such as retail business, inventory and even education.

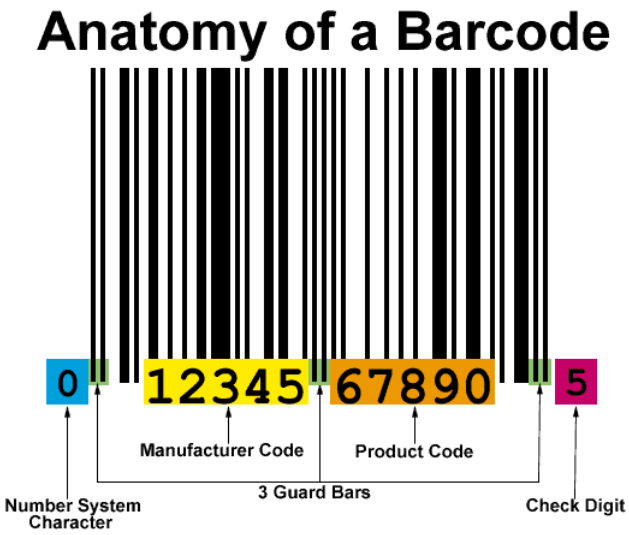

Figure 8 : Anatomy of a Barcode

Kizildag et al [10] demonstrated the efficiency of a barcode attendance system for students attending numerous seminars in their university. The problem occurs when a large group of students need to empty the seminar room as soon as possible in order for them to attend their lectures. Using both online and offline attendance system using barcode reader, 300 students attendance manage to be recorded within 15 minutes instead of 35 minutes of stamping student's attendance card. The proposed barcode system not only proven to reduce time

for large group's attendance purposes but also enable administrators to confirm the validity of the attendance and check the details of the event attended by a particular student or group.

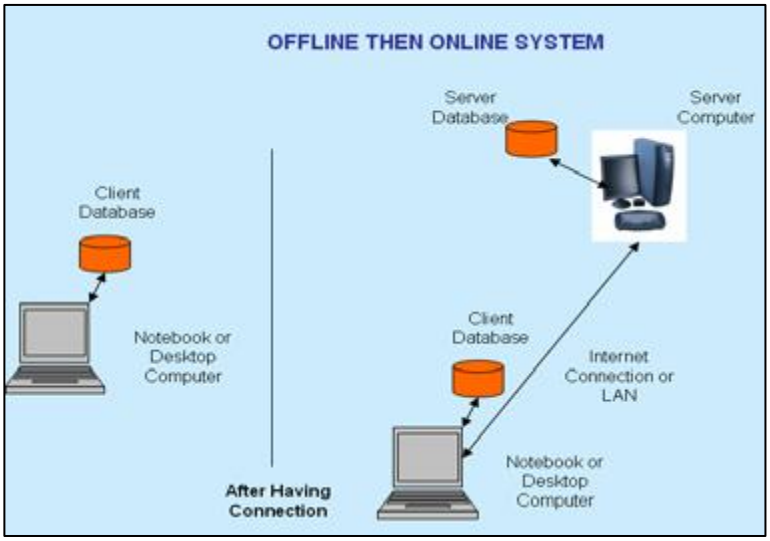

Figure 9 : Kizildag et al: Proposed Offline then Online System [10]

2.5. QR CODE

Quick Response (QR) code [11] is a 2D version of barcode created in 1994 by DENSO, a subsidiary of Toyota. A 2D barcode is a graphical image where data are stored both vertically and horizontally. This allows storage up to 7,089 characters instead of 20 characters in one-dimensional barcode. It has fast readability and large storage capacity compared to standard barcodes and does not require a barcode scanner in order to read it. Instead, a webcam attached to a CPU unit or a smartphone are sufficient enough for the purpose. QR codes are widely used today for various purposes such as business cards alternative and a marketing strategy.

Figure 10 : QR Code

2.5.1. Desktop Software

Agusta [12] implemented an attendance system using QR code for a company for the purpose of work hours and absentees tracking. Using Java Media Framework **(**JMF**)** and ZXing, the QR codes were being read by a webcam attached to a CPU unit and compared with data in MySQL database. The system portrayed the example of the simplest attendance system organization using QR code with extensive capability such as absent tracking and reporting.

2.5.2. Mobile Application

An Android developer known by username Android for Academics has developed an attendance system application called Attendance for Android smartphone [13]. The application utilizes Google Docs for data storage. Attendance allows users to track the total number of absence and late of students in a class and provide a date stamp for each absence and lateness. User need to manually link the app to Google Docs and tutorial are provided for the purpose. User also need to manually checks for attendance, select appropriate status and submit to database at the end of lecture. However, user can only track the total number of absence by a student in a limited view and the app still depends on user input which is similar to the effort of calling names in class for attendance. Developer on the other hand manages to develop a paperless attendance system.

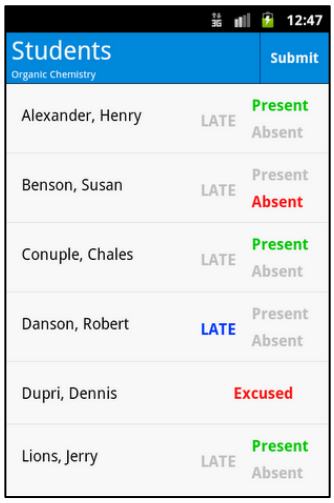

Figure 11 : Attendance by Android for Academics

2.6. CONCLUSION

Based on the literature reviews, the main components that had been chosen for this project are:

i. QR code as it does not require any special device in order to translate information embedded in it compared to barcode, RFID and biometric approach. The special devices are not cost effective. In this case, it is assumed that all lecturers in UTP own an Android smartphone which is sufficient enough for QR code translating purposes.

ii. Android platform as Android devices are cheaper compared to other devices. Android's vast developer's tools allow me to build my own QR code reader to cater the project purpose. Prototyping the application has minimal procedure compare to other platforms.

iii. Google Drive will be the first choice as it allows cloud storage therefore does not consume smartphone and CPU hard drive space. However, an internal database within the application is introduced for offline work purposes.

CHAPTER 3

METHODOLOGY

3.1. INTRODUCTION

This chapter covers the methodology adapted in developing Android -based QR Code Automated Attendance System which includes the phases for the project with detailed overview of each phases. This chapter also includes the tools required in developing the system and the key milestones for the project.

3.2. RESEARCH METHODOLOGY

3.2.1. Planning Phase

During this phase, the backbones of the project are analyzed and identified in order to provide a clear picture on the project feasibility and significance besides serving as the basic guideline throughout the project. The backbones refer to:

- Problems that need to be addressed throughout the project.
- Scope of project in order to enable completion of project within duration provided.
- Main goals of the project and criteria for the successful goals.
- Potential tools for developing the solution.

3.2.2. Data gathering and analyzing phase

Upon project approval, data gathering and analysis is executed in order to support the initial planning outcome and provide opportunities to discover additional information related to the project.

3.2.2.1. Research on current system

Details on current attendance systems are researched, analyzed and documented into the report. Researches are done via article and journal reading on attendance system using e-resources provided and qualitative open-ended interview. The purpose of the action is to identify the details below:

- Differences and similarities between current system and proposed system.
- System architecture of current attendance systems that can be adapted into the project.
- Potential features that can be implemented in the project such as mobility and both offline and online storage.
- Identify tools and components for developing the proposed attendance system.

3.2.2.2. Lectures

Series of Final Year Project (FYP) lectures are conducted by UTP in order to help students throughout their FYP course.

Table 1 : List of FYP lecture series

Lecture topic	Date
FYP briefing	30th May 2012
Data Collection Methods, Sampling, Data Analysis	20th June 2012
Report Writing	27th June 2012
E-Resources	11th July 2012

3.2.3. Development phase

For this project, the main methodology used is Rapid Application Development (RAD) methodology using incremental prototyping approach. RAD focuses more on prototyping and less on planning thus allowing a faster application development and refining. The methodology is chosen after a thorough research on potential methodology for this project after consideration of project's limitation and consultation from expert.

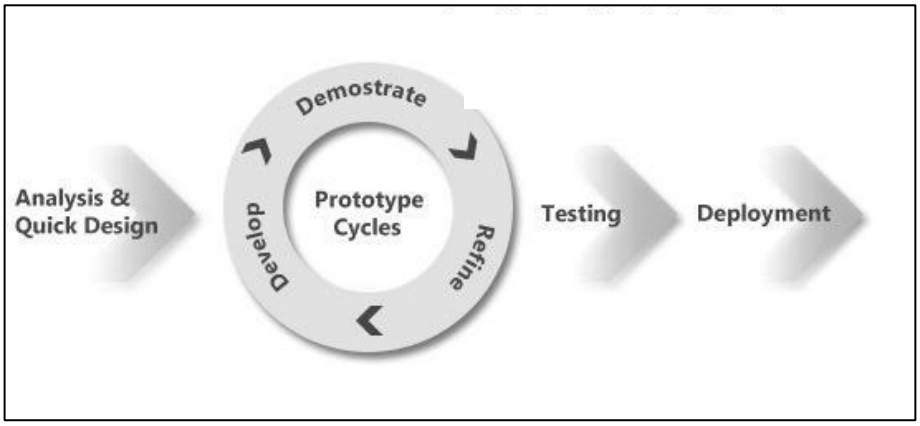

Figure 12 : RAD life cycle

3.2.3.1. System architecture design

Figure 13 shows the final system architecture for the project. The system overview will serve as the core structure for the system for future enhancement and feature implementation.

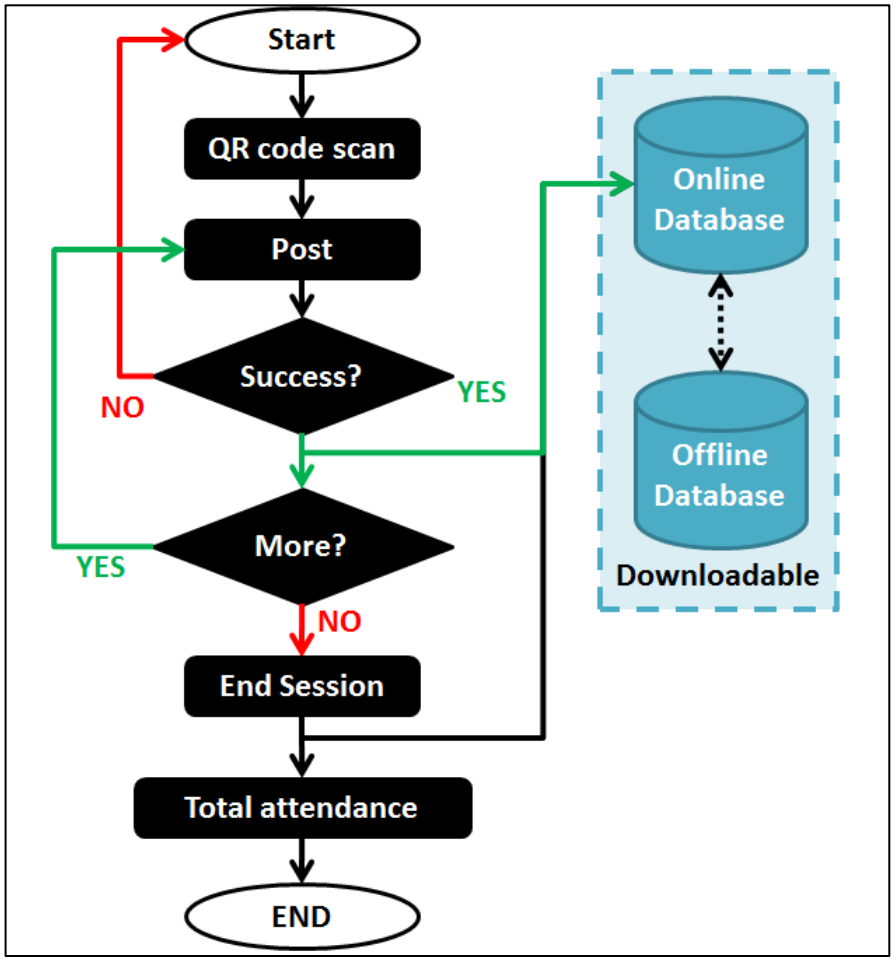

Figure 13 : System architecture

3.2.3.2. Development Methodology

As the system adapted RAD with incremental prototyping approach, project is divided into three (3) main component prototypes which are:

a. QR code reader.
b. Android application.
c. Offline and online database.

Each component is developed one at a time and undergone individual test to satisfy the criteria determined. At the end of a prototyping cycle, all prototypes will be merged and linked together and tested.

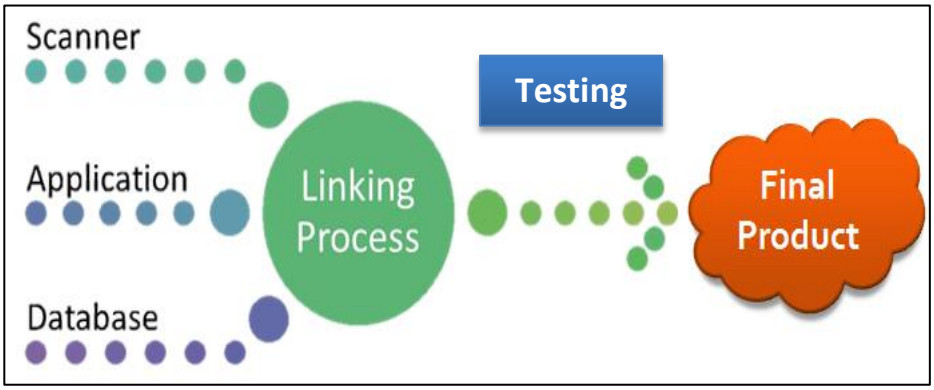

Figure 14 : Development Approach

3.3. TOOLS

3.3.1. Software

Multiple development tools had been discovered and analyzed in order to complete the app within the time constraint. After a thorough research, the tools selected for each component are:

- Android application development – AppInventor [14]
- QR code scanner– Zxing [15] Barcode Scanner
- Database – Google Drive (Spreadsheet and Form)
- Online QR code generator for testing purposes

The details on the selection of the tools are discussed in Chapter 4

3.3.2. Hardware

- Android smart phone with camera function and internet connectivity

3.4. FYP II KEY MILESTONES

Table 2 : FYP II Key Milestones

Week	Milestone	Date
4	Progress Report	10th October 2012
11	Pre-EDX	28th November 2012
11	Dissertation	26th November 2012
12	Viva	5th December 2012
14	Final Dissertation	19th December 2012

3.5. PROTOTYPES

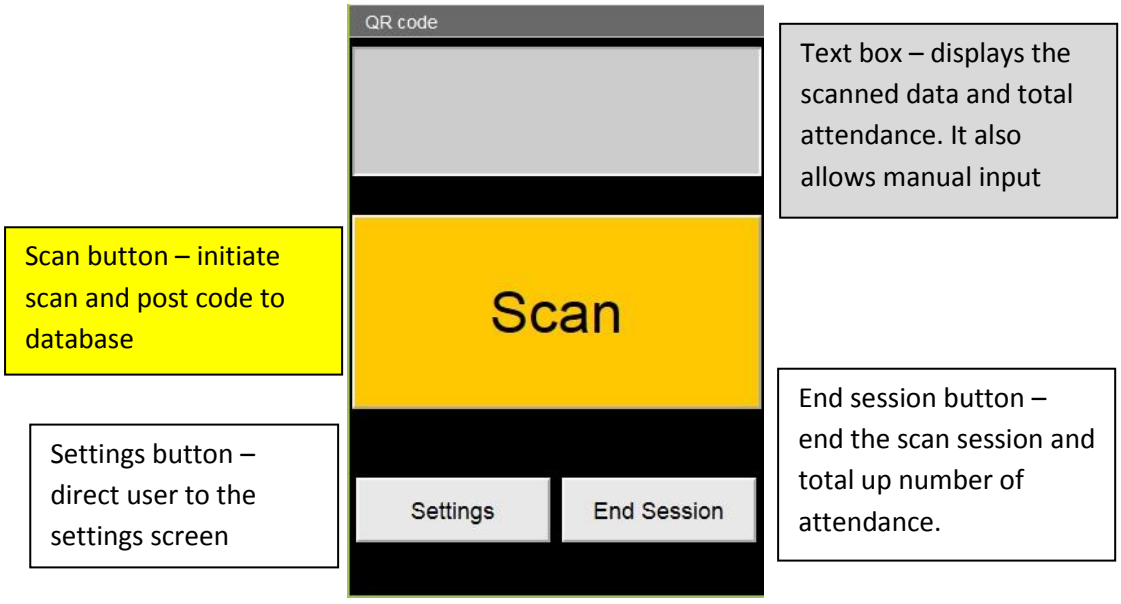

Figure 15: Main Screen

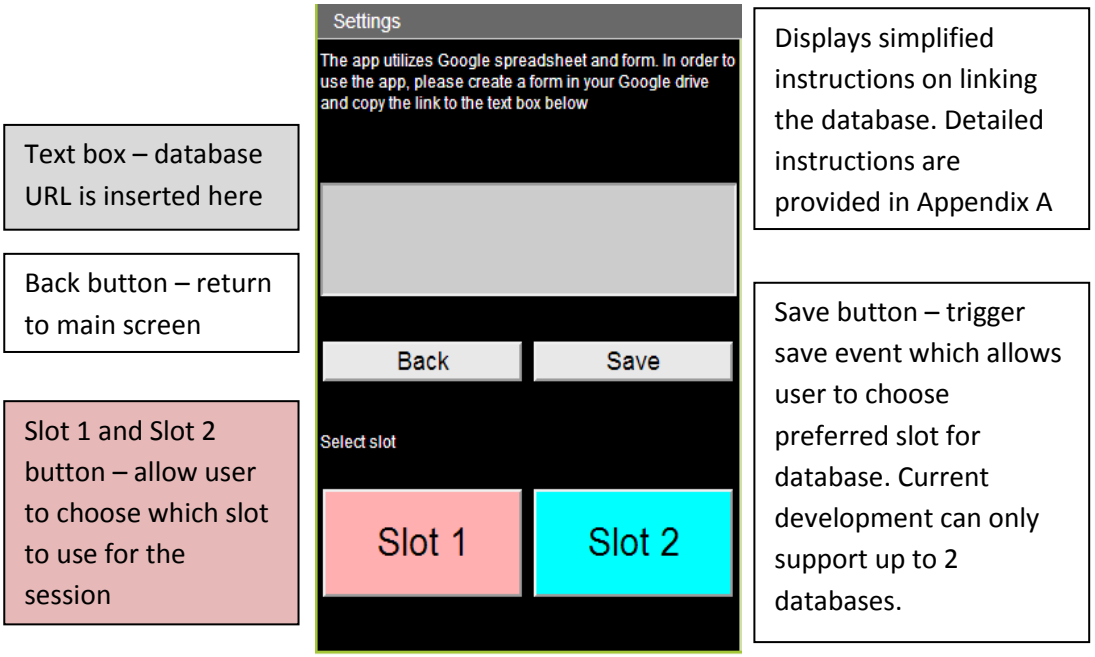

Figure 16: Settings Screen

CHAPTER 4

RESULT AND DISCUSSION

4.1. RESULT OF TESTING

Adapting RAD with incremental prototyping implies that the application is rapidly tested for error for each version/component completion. After a thorough test by the developer, the prototype was tested with a group of 10 volunteers on its functionality.

The first part of the testing was to determine the time difference between conventional attendance marking and QRCAtS app. In order to simulate the conventional method, volunteers wrote down their name and signature on a single paper and the time was recorded as in Table 3. QRCAtS app on the other hand was given the task to scan and store 10 different QR codes and the time taken was recorded as in Table 3. The test was being conducted 3 times and the average is calculated.

Table 3: Test results

Method	Session 1	Session 2	Session 3	Average
Conventional	108s	134s	120s	121s
QRCAtS	118s	152s	127s	132s

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Based on the results recorded, time taken for QRCAtS app to log the attendance is slightly longer by less than 10%. The conventional method was proven to be faster and had its workload distributed to 10 people instead of a single person on QRCAtS. However, the time recorded was not including the time taken to check the attendance which had been covered by QRCAtS app while recording the attendance. Furthermore, distributing the workload means a slight increment in the probability of attendance fabrication which was eliminated in QRCAtS. Current app version is deemed practical for a class with student less than 40.

The second part of the test focuses on the usability of the app. All volunteers were given the chance to test the app with proper guidance. Each feedback on the app was noted and analyzed. Based on user's feedbacks, the major concern of the app is the database such as the type of information that can be extracted and the difficulty in handling it. Since the app is utilizing Google Form and Spreadsheet, the data stored can be utilized similar to a normal spreadsheet application. In order to help users to utilize it to the fullest, a document had been included to guide the user in using the app which include setting up the database and using the app for the first time.

Another main concern is on the time and effort allocated in using the app. It was proven that conventional attendance system has advantages on time taken to completion and workload size. However, the test was conducted under a controlled environment where volunteers were focusing on signing their attendance and was not distracted with other activities. In an unofficial test, time taken by 5 people for signing their attendance is nearly equal to the time taken for 10 people to sign their attendance under a controlled environment. Furthermore, QRCAtS has its own advantage as it is an electronic attendance system that eliminates attendance fabrication and reduces dependency on paper. The offline and online storage further increases the reliability of the system. Current limitation for the system is there is a need to have a stable internet

connection for the data to be posted. Since UTP had implemented Wi-Fi hotspot in each academic block, the limitation is rectified.

Through the feedbacks, various bugs and issues had been discovered and fixed before the final product. There were difficulties in eliminating errors since AppInventor function is not as vast as Java language but most of the errors found had been rectified or eliminated. General feedbacks on the app show that user had no major problem in using the app.

4.2. PROPOSED USAGE SCENARIO

The discussion on the usage scenario of the app had been conducted and below steps had been proposed:

i. Student hand their matric card to the lecturer when they enter the lecture.

ii. Lecturers scan the QR code and post it to online database.

iii. Lecturer ends the scan for the session using "End session" button.

iv. Students take their matric card back at the end of the session.

The purpose of the usage scenario listed above is to accomplish one of the project's objectives which are eliminating attendance fabrications. The lecturers have the option to pass their smartphone to the students rather than students passing up their matric card in order to promote practicality as workload will be divided among the students instead solely by the lecturer and reduce the time taken. However, this increases the probability of attendance fabrication. Furthermore, an alternative scanner approach had been proposed for future app development in order to reduce the time taken for attendance marking as for current development, the main limiter in speed is the scanner itself. Thus, accomplishing project's objective had been prioritized for the usage scenario.

4.3. TOOLS SELECTION ANALYSIS

The project had a undergone a few changes in tools for developing the application. Details of the changes are as follows:

i. Tools for developing the application

The initial tools to develop the Android application are Eclipse software and Android SDK from Google. However, due to the unconvincing developer's learning curve on Android development using the tools mentioned, it was decided that an alternative method need to be taken in order to successfully complete the application within the time period. After a thorough research and consultation from various sources, it was decided that AppInventor will be utilized for the development of the application onwards.

ii. Online and offline database

The initial tool for the purpose mentioned is by utilizing Google Docs functionality that allow both online and offline file storage. In 2012, Google had integrated Google Docs with its cloud storage service known as Google Drive. Google Drive has its own Android application that allows users to retrieve their files from the cloud storage, store it within their Android smartphone and automatically synchronize selected files stored within the device with the cloud storage. By outsourcing the online and offline storage service to Google Drive application, the development phase will be focused more on the interaction between documents and the scanned QR code as assigned attendance list are automatically synced with the cloud storage. Attendance list is assigned using database URL in form of Google Forms and Spreadsheet which can be downloaded for offline preview.

iii. QR code reader/translator

Based on initial plan on developing the QR code translator, ZXing library is the first option on the subject. However, since the project main tools of development shifted from using Eclipse and Android SDK to AppInventor, there was a need for an alternate method for developing the QR code translator. ZXing group had developed their own barcode scanner that can translate QR code and allow integration with other application. By using the barcode scanner, the project eliminates two (2) problems which are finding an alternative method for translating QR code and reduce the work on developing a QR code translator.

4.4. RELATED ISSUES

Prior to this document, a number of issues regarding the implementation of QR code attendance system and the proposed solutions for each issue had been discussed with experts in the field. After a thorough discussion, a set of solutions had been introduced as below:

i. Manual attendance marking

Since the possibility of the failure of the app exists, it was decided that a manual attendance marking is introduced in case failure occurs. This solution also caters the problem where a student does not bring their matric card. However, it is advisable that the function is not used for that purpose in order to emphasize the importance of matric card among students.

ii. Offline database (In phone storage)

QRCAtS does not implement offline database integration yet. However, Google Drive offers file downloading from their cloud storage for offline viewing through apps offered. Synchronization with the cloud storage will be handled by Google Drive apps which are offered for both desktop and smartphones.

iii. Simplifying the app

Previous prototype used 2 buttons to post the data to the database which are “Scan” and “Post” button. After a recommendation by experts on the system, the app had been changed by implementing a single button to scan and post the data instead of 2.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1. CONCLUSIONS

An attendance system is as important as the lecture itself as it allows educators to monitor their student's absenteeism and act properly on it. Conventional attendance system is no longer considered reliable due to the fact that students are able to fabricate their attendance with the help of others. Electronic attendance system is the future of attendance system. However, current electronic systems require specifically engineered devices that may not be cost effective to a learning institute. Hence, QRCAtS are the software solution for the problem. QRCAtS targets to improve the reliability of UTP attendance system by providing an alternative electronic way for monitoring attendance. The approach taken also leads to a reduced dependency on paper as attendance medium and enhance the value of matric card. Feedback from users who volunteered to test the app shows that QRCAtS is capable to replace current attendance system even though it shows a slight increment in time taken for attendance marking. The disadvantage had been compensated by eliminating the time for attendance checking making QRCAtS the practical and systematic solution for UTP academic system.

5.2. RECOMMENDATION

As the project reaching completion, there are a number of suggestions and recommendations proposed for future development of the system.

- **App development using Java language**

  The main reason of the migration is to expand the app development functions due to limited functions provided in AppInventor. Current APK file can be imported to Eclipse software using Java Bridge. By using Java language for app development, it is possible to refine and enhance the feature of the app while discovering the opportunity to make the app faster and lighter. Suggestion for enhancement may include:

  - Automate spreadsheet processing such as filling up formula.
  - Allow data to be classified according to academic week for ease of analysis and viewing.
  - Offline database storage and increase number of slots.

- **QR Code Scanner development**

  Current prototype is considered practical for class with less than 40 students due to the increased amount of time taken to mark the attendance which is caused by the scanner's limitation. Therefore, it is recommended that a fast or a multiple code scanner is developed for the app in order to allow a faster attendance marking.

- **Port to other smartphone operating system (OS)**

  QRCAtS can be ported to other mobile OS such as iOS (Apple) and the upcoming Windows Phone 8 (Microsoft) in order to expand the user group and increase availability of the product.

- **Security enhancement**

  Even though the app eliminates attendance fabrication, the app was not developed with a robust security feature. Thus, a security feature such as encrypted translation can greatly improve the app.

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APPENDICES

APPENDIX A

1. Setting up the app

i. Download the latest app from http://code.google.com/p/android-qr-code-attendance/

ii. Download these 2 files from Google Play.

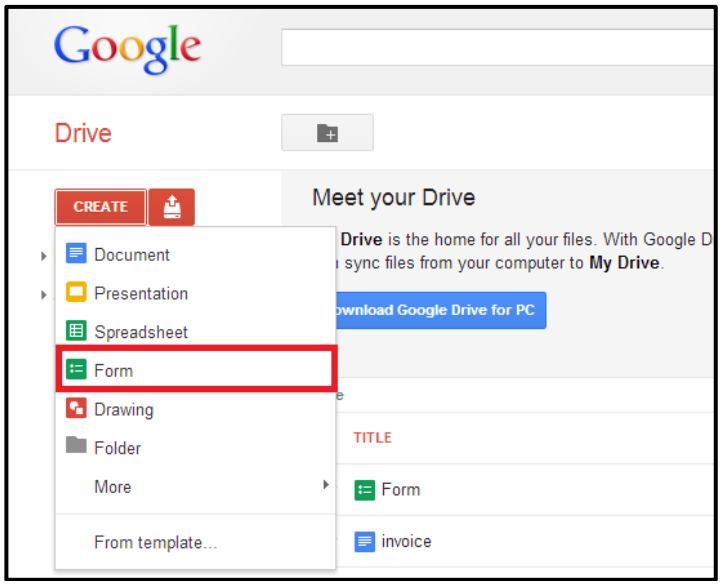
	ZXing Barcode Scanner https://play.google.com/store/apps/details?id=com.google.zxing.client.android&hl=en
	Google Drive https://play.google.com/store/apps/details?id=com.google.android.apps.docs

iii. For first time users, it is required for you to create a Google Spreadsheet database using Form function as all the scanned data will be stored in the spreadsheet

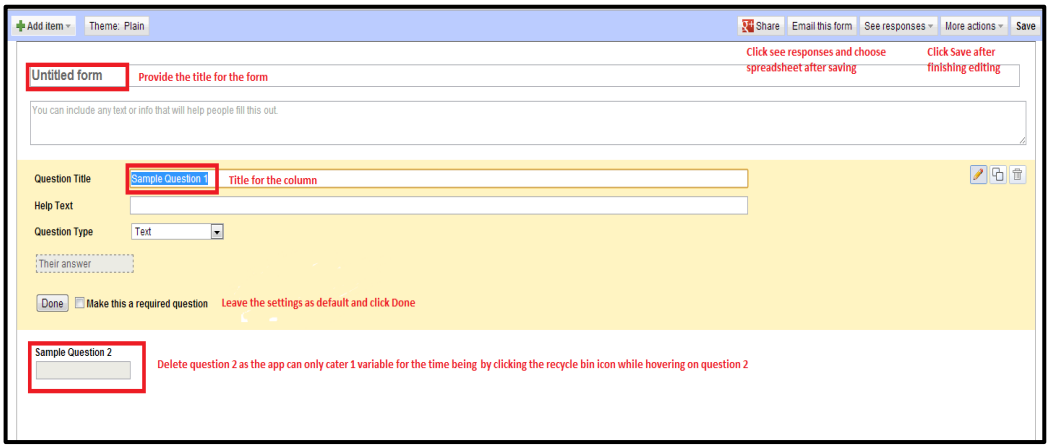
iv. Go to Google drive page via web and log in using your Google account

v. Create a form by following the steps below:

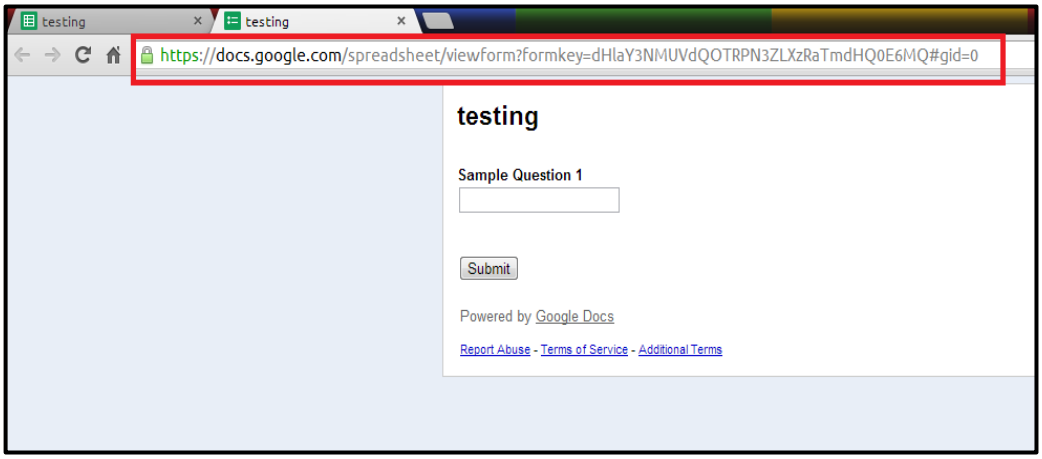
1. Create a form



2. Give a suitable title for your form and “Sample Question 1”.
3. “Sample Question 1” is the name of the column that will hold the scanned value. You can name it with register, log, or any preferences that you like.
4. For current development, we will only use 1 question. Therefore you can delete “Sample Question 2” by clicking the recycle bin button while hovering you
5. Leave the settings to default and click “Save” button on the upper right corner.



6. A link will appear at the bottom of the screen. Click it to go to the live form
7. Copy the link in the address bar



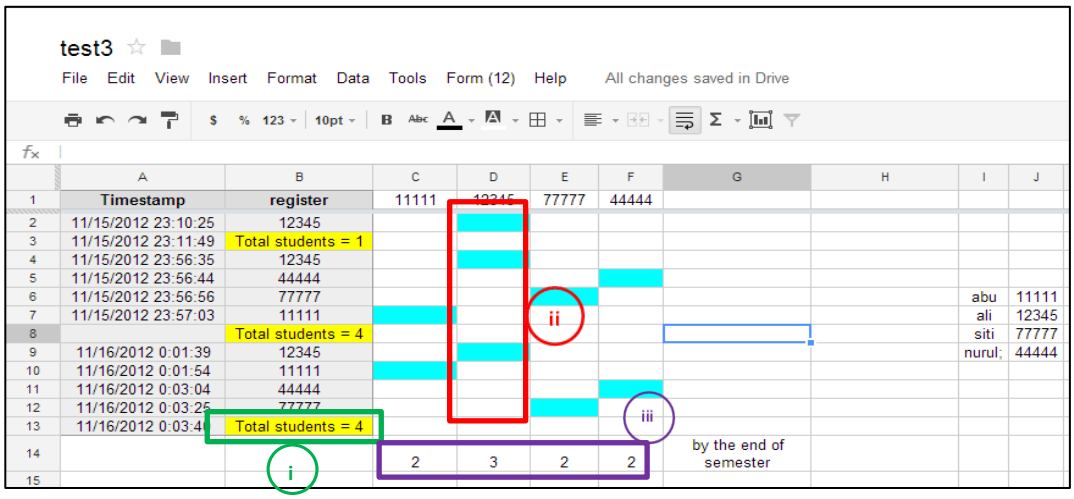
8. There are a few ways to transfer the copied link to your phone such as
    a. Convert to QR code using website eg: http://zxing.appspot.com/generator/
    b. E-mail the link to your account

9. Click "QRCAtSv2" icon to launch the app
10. Click settings
11. Paste the copied links of your database to the text area (refer 1.Setting up the app)
12. Click save and the app will ask you to save in either slot 1 or 2
13. Choose the preferred slot for your database. A popup message will appear on successful saving of the link. For current development, only 2 database slots are offered.
14. Choose slot for current session by clicking the preferred slot button. A popup message showing the slot chosen will appear after the selection.
15. Click back and you will be directed to the home screen back. Note that the background colour of the text area will be the same as the colour of the chosen slot button

2. How to use the app

i. Click “QRCAtSv2” icon to launch the app
ii. Click “Scan” button to start scanning QR code. The barcode scanner app will be launched.
iii. Point the camera to cover all the area of the QR code. The app will automatically capture the code.
iv. The translated data text will appear in the textbox area for a brief moment. The app will then post the translated data to the database.
v. Repeat steps (ii) until (iv) to scan more codes
vi. After scanning all the codes, click “End Session” button. Text “end” will appear in the textbox for a brief moment. The app will post the total number of attendance on the database and display it in the textbox.
vii. In order to see the result of your scan, log in to your Google Drive account and click the Form title.
viii. For the ease of use and searching record purposes, it is recommended to view the spreadsheet in list form. This can be achieved by selecting “List” in the “View” tab.

3. Tips for using Google Spreadsheet to the fullest



Screenshot above shows the suggested database template for the attendance system

i. Highlight total number of students to show the number of students in every session by conditional formatting for column "register"
E.g.: Change background colour to yellow when text contain word "total"

ii. Define other columns as Student ID and highlight their attendance by

1) Entering a spreadsheet formula for each cell in the column which are **=EXACT (*respective register cell*,*student id*) .** The formula will show true when the both cell compared contains same value.
E.g.: =EXACT (B2, 12345)

2) Conditional formatting where the text and background are using the same colour
E.g.: Change both background and text colour to blue when text contain word "TRUE"

iii. Total up each students attendance at the end of semester by entering formula **=countif (*first cell of the column*:*last cell of the column*,"TRUE") at the end cell of each student id column.** The formula will count the number of "TRUE" words in the array defined and return the total to the cell
E.g.: =countif(F2:F13,"TRUE"

Android-based Quick Response (QR) Code Attendance System (QRCAtS)

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Android -based QR Code Automated Attendance System is system that utilizes QR Code to track student's attendance during lecture hour in UTP. By scanning individual QR code issued to students using an Android smartphone, attendance marking and checking will be conducted by the app without human intervention. Scanned QR code contains student's information and will be compared with information stored in database during pre-deployment phase. The software solution is mainly targeted to prevent attendance fabrication by students besides reducing the dependency on paper material thus reaching a greener approach. Database are available in both online and offline mode for the sake of attendance evidence and mobile viewing. Lecturers can store the attendance list in their smartphone and later upload it to the online server. Attendance sheet stored in database can be viewed and printed out when necessary. Throughout the document, detailed documentation on the project is explained including the prototype of the app, the results of user testing along with the analysis of the feedbacks, and recommendations for future developments.

Keywords: *Attendance, UTP , QR code*

I. INTRODUCTION

The first attendance system was introduced in 1888 to record the time when a worker enter a workplace and the time a worker exit the workplace [1]. The system utilized a heavy paper card which are be stamped by a specialized time clock with date, time, and other related information. The attendance system evolved from time to time and its scope of usage are no longer limited to track and confirm the work hour of an employee for payroll purposes. Nowadays, attendance system is also used to track absenteeism of students in higher learning institute whether during lectures, laboratory sessions, or examinations.

Current system still utilizes the usage of paper for the purpose of recording student's attendance. However, this approach is not considered secure and reliable as students are able to fabricate their colleague's attendance such as signing on behalf of them. Even though lecturer's are able to detect the irregularities in the attendance, it will consume a considerable amount of effort and time to check for it and can results in frustration especially lectures that consist a large amount of students. Furthermore, a paper can be easily damaged or lost and could lead to heavy consequences to both lecturers and students regarding the proof of attendance especially attendance list that stores all the attendance from day 1 of the semester.

In order to counter the problem, various systems are introduced which enable a paperless approach and prevent attendance fabrication. However, systems such as barcode, Radio Frequency Identification (RFID) tag, and biometric approach involves the usage of specifically engineered devices that are not cost effective to the administration and requires both administrators and users to learn on how to use the system which could cost a lot of time.

Therefore, there is a call for a cost effective attendance system that does not require any extra devices, paperless and can be learned in short amount of time to replace the traditional approach of using paper to record student's attendance. The new approach suggested is by implementing Quick Response (QR) code to record and keep track of student's attendance. Instead of paper signing and name calling techniques, lecturers will scan the individual QR Code issued to students and allow the system to determine the status of the student by comparing the scanned data with data stored in database. The system can also print a report when necessary.

A. Problem Statement

- The traditional system of signing attendance on a piece of paper is no longer considered reliable

in recording attendance as attendance fabrication can be easily done and papers can be easily destroyed leaving lecturers with no evidence for absenteeism especially when the attendance list contains the attendance for the whole semester.
- In order to check for irregularities in the attendance, a considerable amount of time and effort are used and therefore results with lesser time for lectures and sometimes lead to stress and anger due to dishonesty found among students.
- Implementing a robust system of attendance system may not be a cost effective approach as current advanced attendance system utilizes devices that are specifically engineered for the system only.

B. Objective

- To develop and implement a QR code attendance system with database access and automated attendance checking capability using Android platform.
- To reduce the number of students caught fabricating other's attendance.
- To reduce the dependency of paper material for attendance checking
- To enhance the importance of matric card among Universiti Teknologi PETRONAS (UTP) students.

C. Scope of Project

- The project focuses on mobile application development.
- The project is built around UTP attendance system as current system for students are still relying on traditional paper approach.

II. LITERATURE REVIEW

A. RFID tag

Singhal and Gujral [2] combined the conventional RFID scanning technique with a remote monitoring feature. By utilizing Microsoft Visual Basic 6.0 and Microsoft Access as a functional database, the system are able to alert the administrator if there are an increment in number of students in a class using SMS via a GSM network allowing long distance transmission. Students need to place their matric card on the RFID reader and the system will automatically mark their attendance along with the time stamp. The studies focus on both hardware and software developments as all hardware components are assembled by the authors and does not heavily relied on other source.

Qaiser and Khan [3] on the other hand use an interrogation field in order to scan and read an active RFID tag. The authors highlighted advantages of RFID tag over barcode such as reading even without line of sight on the tag, significant reading distance and allow multiple reading at the same time. The system proposed offers wider range of use than attendance and unauthorized entry marking such as probation and warning calculation and notification to all parties involved which are student, lecturers and parents. The main advantage of the proposed system is that it requires no human intervention as everything is automated. Administrator can access the data via provided website.

Ansari et al [4] proposed a system where every room in the university is equipped with an RFID transponder in order to monitor the location of students in real time rather than for attendance marking purposes. In order to prevent impersonation by carrying two matric cards with RFID tag embedded in it, student's attendance are only finalized and accepted after a fingerprint scan at the end of the day at a designated post. The system are able to inform technicians when a transponder failed to work and capability to locate students based on their roll number via SMS and website interface allowing parents to track their child's location.

B. Biometric

Shoewu and Idowu [5] suggested that a fingerprint scanner attendance system are more secured and faster compared to manual attendance system. In the paper, the authors tested the success rate of the proposed attendance system where the system is able to match scanned ID with ID stored in database and compare the time taken for the proposed system to check the attendance with the manual attendance system. Based on their implemented system using manufacturer's fingerprint scanner Self Development Kit (SDK), C# and Microsoft SQL, the system lead the manual system by an average of 12 seconds with 94 percent percentage of success.

Yohei Kawaguchi et al [6] introduced a new approach on facial recognition attendance system. Rather than using one time pass for facial recognition, the authors proposed a continuous observation to amplify the attendance's estimation performance. The system utilized two set of cameras; one fish-eye camera for processing student's position based on seating and another one to capture images of student's face. The method practiced was proven effective as there was significant increment in attendance estimation in preliminary limited experiment.

C. Barcode

Kizildag et al [7] demonstrated the efficiency of a barcode attendance system for students attending numerous seminars in their university. The problem

occurs when a large group of students need to empty the seminar room as soon as possible in order for them to attend their lectures. Using both online and offline attendance system using barcode reader, 300 students attendance manage to be recorded within 15 minutes instead of 35 minutes of stamping student's attendance card. The proposed barcode system not only proven to reduce time for large group's attendance purposes but also enable administrators to confirm the validity of the attendance and check the details of the event attended by a particular student or group.

D. QR code

Agusta [8] implemented an attendance system using QR code for a company for the purpose of work hours and absentees tracking. Using Java Media Framework (JMF) and ZXing, the QR codes were being read by a webcam attached to a CPU unit and compared with data in MySQL database. The system portrayed the example of the simplest attendance system organization using QR code with extensive capability such as absent tracking and reporting.

An Android developer known by username Android for Academics has developed an attendance system application called Attendance for Android smartphone [9]. The application utilizes Google Docs for data storage. Attendance allows users to track the total number of absence and late of students in a class and provide a date stamp for each absence and lateness. User need to manually link the app to Google Docs and tutorial are provided for the purpose. User also need to manually checks for attendance, select appropriate status and submit to database at the end of lecture. However, user can only track the total number of absence by a student in a limited view and the app still depends on user input which is similar to the effort of calling names in class for attendance. Developer on the other hand manages to develop a paperless attendance system

III. METHODOLOGY

A. Software Process Model

For this project, the main software process model used is Rapid Application Development (RAD) methodology using incremental prototyping approach. RAD focuses more on prototyping and less on planning thus allowing a faster application development and refining. The methodology is chosen after a thorough research on potential methodology for this project after consideration of project's limitation and consultation from expert.

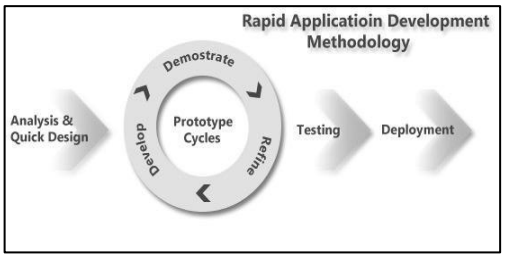


Figure 1: Rapid Application Design (RAD) Model

As the system adapted RAD with incremental prototyping approach, project is divided into three (3) main component prototypes which are:

- QR code reader.
- Android application.
- Offline and online database.

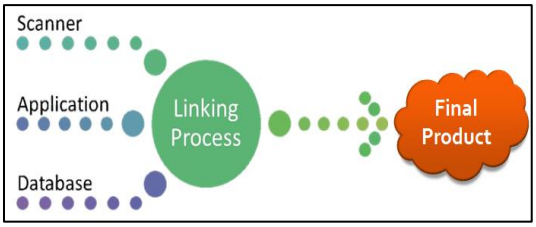
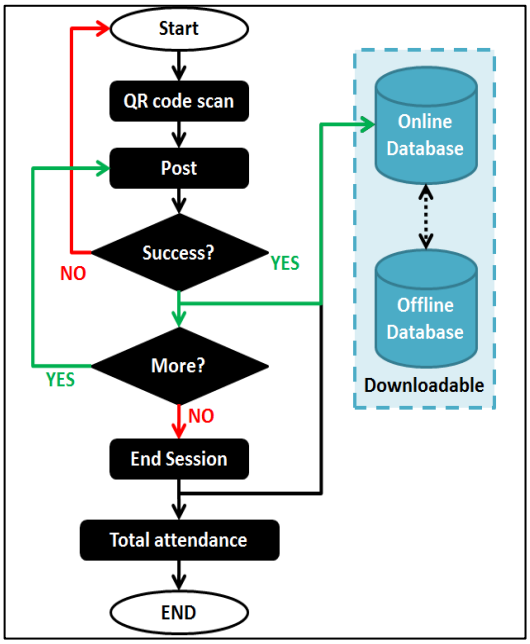


Figure 2: Development Approach

Each component is developed one at a time and undergone individual test to satisfy the criteria determined. At the end of a prototyping cycle, all prototypes will be merged and linked together and tested.

B. System Architecture



C. *Development Tools*

- Android application development – AppInventor
- QR code scanner– ZXing Barcode Scanner
- Database – Google Drive (Spreadsheet and Form)
- Online QR code generator for testing purposes
- Android smart phone with camera function and internet connectivity

IV. RESULTS AND DISCUSSION

A. *Testing*

After a thorough test by the developer, the prototype was tested with a group of 10 volunteers on its functionality.

The first part of the testing was to determine the time difference between conventional attendance marking and QRCAtS app. In order to simulate the conventional method, volunteers wrote down their name and signature on a single paper and the time was recorded as in Table 3. QRCAtS app on the other hand was given the task to scan and store 10 different QR codes and the time taken was recorded as in Table 3. The test was being conducted 3 times and the average is calculated.

Table 4: Test results

Method	Session 1	Session 2	Session 3	Average
Conventional	108s	134s	120s	121s
QRCAtS	118s	152s	127s	132s

,

Based on the results recorded, time taken for QRCAtS app to log the attendance is slightly longer by less than 10%. The conventional method was proven to be faster and had its workload distributed to 10 people instead of a single person on QRCAtS. However, the time recorded was not including the time taken to check the attendance which had been covered by QRCAtS app while recording the attendance. Furthermore, distributing the workload means a slight increment in the probability of attendance fabrication which was eliminated in QRCAtS. Current app version is deemed practical for a class with student less than 40.

The second part of the test focuses on the usability of the app. All volunteers were given the chance to test the app with proper guidance. Each feedback on the app was noted and analyzed. Based on user's feedbacks, the major concern of the app is the database such as the type of information that can be extracted and the difficulty in handling it. Since the app is utilizing Google Form and Spreadsheet, the data stored can be utilized similar to a normal spreadsheet application. In order to help users to utilize it to the fullest, a document had been included to guide the user in using the app which include setting up the database and using the app for the first time.

Another main concern is on the time and effort allocated in using the app. It was proven that conventional attendance system has advantages on time taken to completion and workload size. However, the test was conducted under a controlled environment where volunteers were focusing on signing their attendance and was not distracted with other activities. In an unofficial test, time taken by 5 people for signing their attendance is nearly equal to the time taken for 10 people to sign their attendance under a controlled environment. Furthermore, QRCAtS has its own advantage as it is an electronic attendance system that eliminates attendance fabrication and reduces dependency on paper. The offline and online storage further increases the reliability of the system. Current limitation for the system is there is a need to have a stable internet connection for the data to be posted. Since UTP had implemented Wi-Fi hotspot in each academic block, the limitation is rectified.

Through the feedbacks, various bugs and issues had been discovered and fixed before the final product. There were difficulties in eliminating errors since AppInventor function is not as vast as Java language but most of the errors found had been rectified or eliminated. General feedbacks on the app show that user had no major problem in using the app.

B. *Proposed Usage Scenario*

The discussion on the usage scenario of the app had been conducted and below steps had been proposed:

1. Student hand their matric card to the lecturer when they enter the lecture.
2. Lecturers scan the QR code and post it to online database.
3. Lecturer ends the scan for the session using "End session" button.
4. Students take their matric card back at the end of the session.

The purpose of the usage scenario listed above is to accomplish one of the project's objectives which are eliminating attendance fabrications. The lecturers have the option to pass their smartphone to the students rather than students passing up their matric card in order to promote practicality as workload will be divided among the students instead solely by the lecturer and reduce the time taken. However, this increases the probability of attendance fabrication. Thus, accomplishing project's objective had been prioritized for the usage scenario.

C. *Related Issues*

- Manual attendance marking

Since the possibility of the failure of the app exists, it was decided that a manual attendance marking is introduced in case failure occurs. This solution also caters the problem where a student does not bring their matric card.

- Offline database (In phone storage)

QRCAtS does not implement offline database integration yet. Synchronization with the cloud storage will be handled by Google Drive apps which are offered for both desktop and smartphones.

D. Screenshots

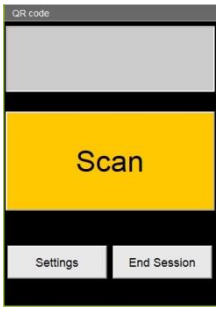


Figure 3: Main Screen

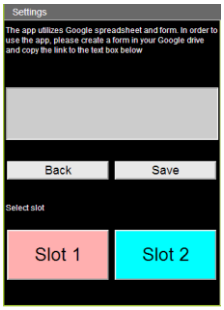


Figure 4: Settings Screen

V. CONCLUSION

QRCAtS targets to improve the reliability of UTP attendance system by providing an alternative electronic way for monitoring attendance. The approach taken also leads to a reduced dependency on paper as attendance medium and enhance the value of matric card. Feedback from users who volunteered to test the app shows that QRCAtS is capable to replace current attendance system even though it shows a slight increment in time taken for attendance marking. The disadvantage had been compensated by eliminating the time for attendance checking making QRCAtS the practical and systematic solution for UTP academic system.

VI. ACKNOWLEDGMENT

First and foremost, the author would like to take this opportunity to express his greatest gratitude and appreciation to project supervisor, Dr. Low Tan Jung, who had continuously monitored the project's progress throughout the duration of the project. His constructive comments, advices, and suggestions had guided the project towards its successful final outcome. This gratitude also is dedicated towards Universiti Teknologi PETRONAS (UTP) especially the committee of Final Year Project of Computer Information Sciences (CIS) department for excellent organization and management of this course. The author would like to extend his upmost thanks to friends and families who had been great motivators in author's project. Their help and moral supports helped the author to strive forward and keep him focused on the goal throughout the journey. Last but not least; the author would also like to express his acknowledgement to the participant of testing phase for their feedback and kind cooperation which have helped a lot in developing, improving and implementation of the system prototype.

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