FINAL YEAR PROJECT 2
DISSERTATION – FIRST DRAFT
DROID QUEUE MANAGEMENT SYSTEM
(DQMS) – User Module

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CERTIFICATION OF APPROVAL

DROID QUEUE MANAGEMENT SYSTEM (USER MODULE)

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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 expect 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.

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(TAY ZHI WEI)

ABSTRACT

Nowadays, there are many businesses which are using the queue management system to help assist in smoothening the queue they have in their office. With the awareness of paperless community at the rise, the society is trying to cut down on the usage of papers nowadays. The Droid Queue Management System (DQMS) is an Android application is an application which supports the paperless community idea by replacing paper tickets with digital form of queue tickets besides providing the alert system service for the customer's convenience. DQMS will be serving as an alternative for the current queue management system which dispenses paper tickets and lacks of alert system in the phone. The method which DQMS will be using is by capturing the QR Codes on to the users' smartphones and sending the QR details to the database server and the numbers will be updated in the server itself. Notifications will be sent out from the queue management system to the users when the queue number of user is approaching. To develop DQMS, rapid application development methodology is being applied which consist of planning phase, analysis phase, design phase, prototyping phase and implementation phase. As for the development of this application, Android SDK development tool will be used while the programming language involved will be JAVA and Google Chart API library. In order to gather data and information from the public, surveys and distributions of questionnaire was being done to collect their opinions and feedback on the current system.

ACKNOWLEDGEMENT

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1. INTRODUCTION

1.1 Background Of Study

In this modernized era of technology, cellphones are now a necessity to users in the whole world as the public now uses mobile phones to stay connected. According to the article published by International Data Corporation, IDC (2013), it shows that in the year 2012 itself, a total of 722.4 million units of smartphone has been shipped in the whole world. As for Android platform smartphones, there is an increase of 104.1% in shipment volume from 243.5 units to 497.1 units. Through figure 1 shown below, we are able to view the market share of different smartphone operating system from year 2011 and 2012.
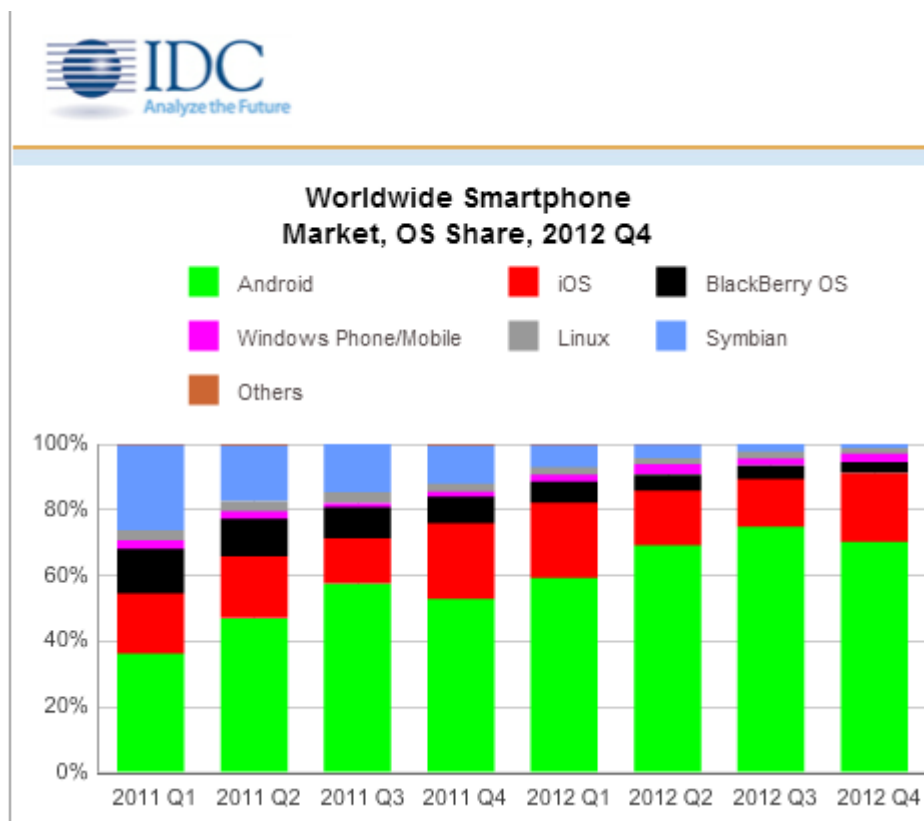
Figure 1 : Worldwide smartphone OS market share. (Retrieved: Jun 29, 2013.From: International Data Corporation (2013).Android Worldwide Smartphone OS Market in 4Q12 and for the Year. Retrieved from: http://www.idc.com/getdoc.jsp?containerId =prUS23946013)

As for the queue management system which is being used in many places nowadays such as the post office, banks and government offices, it provides convenience and it

helps out in sorting the queue when there are a lot of customers in the place. This system is currently getting more popular as many other places such as restaurants and amusement parks are trying to inculcate this system to their business to help cope with the queue problems.

Droid Queue Management System (DQMS) is a project which was done by Muhammad Ikmal bin Hamid as a Final Year Project in Universiti Teknologi Petronas. DQMS is basically an Android based mobile application which applies the idea of green computing technology and provides more convenience for the public. This project will be a continuation of the DQMS project where it will cover the development of the user's mobile application and further improvement of DQMS product.

This DQMS system will be serving the same functionality as the current queue management system which uses the paper ticketing system. The difference of this new system and the current system which is being used is instead of using paper for the tickets, queue number for customers will be in an alternative form that is the digital copy of QR code.

By using the application, customers will be able to go to their post office of their choice and take their queue ticket with the phone without needing to take their paper ticket. A QR code will be generated from the system and being captured by the customers' phone which symbolizes their digital ticket number. After obtaining the QR code, the customers need not stay at the designated waiting area as they will be notified from the application of DQMS when their number is reaching.

1.2 Problem Statement

In the current queue management system, there is a large amount of papers being wasted. This is because the paper number tickets which are being used currently are disposed and not recycle. This scenario can cause a huge wastage of paper. The usual case of customers which visits the post office is where they take the paper ticket and throws the ticket away instead of putting them into the recycling bin when their number is called. After a long period of time, this action will leads to a lot of environmental issues such as greenhouse effect due to deforestation process.

Based on the statistical data gathered from the survey done at post office of Seri Iskandar, it shows that an average post office in Malaysia uses around 250 pieces of

paper ticket every day. As for the whole Malaysia, there are 710 post offices which are currently in operation and in one day, an amount of (250*710) = 177,500 pieces of paper are being used. As for one year, the paper usage will be a value of 365*177,500 = 64,787,500 pieces of paper. Table 1 shows' the statistics of how many trees are being cut down to produce these amounts of papers.

Particular	In Metric Unit
Type of paper	Copying Paper
Dimension of Single sheet of paper	A4 (210x297 mm)
Weight of paper	70 gm/m^2
Weight of single sheet	70*0.21*0.297 = 4.366 gm
Type of tree	Pine
Dimension of tree	25 m high & average diameter is 30 cm
Volume of one tree	3.146*0.15^2*25 = 1.7696 m^3
Density of pine (dry weight basis)	600 Kg/m^3
Weight of the tree	600*1.77 = 1,040 Kg
Yield of pulp (pulp produced)	50%
Pulp produced	0.5*1040 = 520 Kg
Number of sheets produced	520*1000/4.366 = 119,100
Number of Paper Ticket produced	119,100*12 = 1,429,200

Table 1: The number of A4 size paper produce by one tree (Retrieved April 26, 2013, from: http://www.paperonweb.com/A1011.htm)

In order to accommodate to the usage of paper ticket, a total of 45 trees (64,787,500/1,429,200) needs to be cut down in one year. Bare in mind the amount of paper mentioned above is only for all the post office in Malaysia. Imagine if all others places which implements queue management system, such as banks, government counters etc. were included in this survey, the amount of paper wastage every year will end up being a very huge amount. All this paper wastage will end up causing environmental issues due to the cutting down of trees to produce these papers.

Besides wastage of paper, there are also a lot of customers which are complaining about the amount of time they have to spent on waiting at the post office as the queuing time is very long. A statistical data which is gathered from the post office in Seri Iskandar shows that usually a customer needs to wait for around 15 to 20 minutes before being

served. Unfortunately, this is not the case for most of the other bigger post office in Malaysia as through the survey results which I've collected, around 28% of the respondent said that they need to wait an average of more than 30 minutes in their queue line. Besides through the findings which I've got online, there are also several complains which are being made in http://www.aduanrakyat.com/ website where customers lodge their complaints on Pos Malaysia's due to the long waiting time needed before they are being serviced. A customer also complained that he waited for more than an hour just to pay his bills at the counter and he also complained that he should have been given the option to spent the time wasted there doing some other things while waiting for his turn.

Customer needs to stay at the waiting area at all times as they will need to monitor their queue number from the LED screen and therefore customer cannot move around while waiting for their queue. This is because customers do not receive any notifications or alert currently when their queue is approaching besides looking at the queue board in the waiting area.

Currently, the public are not really aware about the amount of paper which is being wasted everyday just for the purpose of the queue management system. Most of the time, these papers are being thrown into the rubbish bin instead of being put into the recycle bin. Besides, the waiting time required in some of the main branches of post office during peak hours are extremely long and customers are left to wait for a long period of time without being able to leave the waiting area of the post office.

1.3 Objective

Droid Queue Management System is going to be the future for the current queue management system as it will revolutionize how the queuing system operates in todays' modern era. Objectives which are being targeted for this project are as follow:

> ➢ to develop an Android application to reduce the usage of paper ticket in current queuing management system by replacing them with QR codes captures in the form of digital ticket using Android smartphones.
> ➢ to provide an alert system to users when their queue number is approaching via the application. This function provides the convenience and flexibility to users when they visit places which use queue management system.

1.4 Scope of Study

The main scope of this project is to help develop an environmental-friendly android application to replace the current queue management system which uses ticket papers in post office. Besides it will also serve as an alert system to the customers by replacing the paper usage with QR codes. Basically, this system is being targeted for the POS MALYSIA BERHAD which currently runs on the conventional queue management system using the paper ticket distribution. POS MALYSIA BERHAD will be a good starting platform for this system as they have more than 700 branches in Malaysia which the system can be implemented. Since user normally throws' away the ticket paper after being served at the counter, the papers are not being decomposed in a proper manner and it contributes to a lot of side effects towards the mother-nature. This system will serve as a digital ticket for the system replacing the paper ticket which is currently being used.

Furthermore, due to the huge amount of crowd which visits the post office every day for the services, long queues are always expected at major post office in cities. The alert system which provides notifications will also help the users have the convenience and mobility to move around when queuing for their turn instead of staying at the waiting area without being able to move around.

1.5 Relevance of the Project

This project is being targeted to solve the problem of paper wastage and also long waiting time spend on queuing in the current queue management system. To help reduce the dispense of paper tickets, DQMS will be replacing the paper tickets with QR Codes. These QR Codes will serve as digital ticket which can be stored in customers' smartphones. Besides that, in order to solve the problem of long waiting queue, DQMS will provide the customers flexibility and freedom to move around while waiting for their queue by providing the functionality of alerting system which sends notifications to the users personally when their queue number is approaching. The project will also be looking at the relevance of the project in several other perspectives.

a) Society

DQMS is able to contribute to the society by providing more convenience through the alert system. People visiting places using the queue management system will not need to waste their time waiting at the waiting area instead they can choose to

do other activities while waiting. Furthermore with the increase in Android smartphone users in the public, they will be able to take advantage of the smartphone to help provide more convenience to their life.

b) Businesses

By implementing DQMS in businesses, businesses are able to provide a more satisfying service to their customers besides reducing the paper usage being used. By using DQMS, customers will be able to know they estimated time until their queue reaches and this will increase customers' satisfaction level towards the business.

1.6 Feasibility of Project within Scope & Time Frame

The scope chosen for this project will be focused on the queue management system being used in the post office in Malaysia. Instead of focusing on all businesses which provides queue management system, we will only be looking into the post office situated in Malaysia as it is easy for us to carry out surveys and distribute questionnaire to collect feedback.

As for the time frame for the project, it is well planned as this project will only be focusing on the development of the mobile application and connection towards the database server instead of the whole project. Furthermore, with part of the research already done by the former owner of this project, there will definitely be enough time to complete this whole project on time.

2. LITERATURE REVIEW

This literature review is to study and discuss the current information and details available in a particular subject area. The subject areas which will be studied and researched on in this project will include "Digital Ticket Versus Paper Ticket", "Current Queue Management System", "QLess Companies' Queue Management System" and the "QR Code Technology".

2.1 Digital Ticket Versus Paper Ticket

According to the Urban Dictionary, Digital Ticket means a virtual instance of a ticket which represents the digitization of rights to claim goods or services. In this case the project will be referring to the QR code which is generated by number station application to be captured by DQMS mobile application. The difference between digital ticket and paper ticket is paper ticket is physically being printed on a piece of paper while digital ticket can be stored in user's mobile devices in a digital format.

Due to the current advancement of technology in mobile devices, digital tickets are getting in trend and more demanded by the public. According to Crosby T, (2010) from Discovery Channel Company, all airlines available in the market are now offering electronic ticket which is also a form of digital ticket as it is more convenient for customers to purchase the tickets online from the website. Furthermore according to Clifford (2011), most of the major retailers such as Whole Food Market, Nortstrom, Gap Inc, Anthrolopologie, Patagonia, Sear and Kmart have started offering electronic receipts through emails or password protected websites. This statement shows that customers nowadays prefer digital copies of tickets or receipts as it is more convenient for them to keep track with the record.

As for the scenario in Malaysia, the public transportation company in Malaysia, Rapid KL is trying to reduce the amount of paper usage by using digitalized tokens. Based on the announcement on MyRapid website, Rapid KL has also come up with a rebate system for commuters which use their Rapid Card as shown in figure 2 with the concept of electronic ticketing to reduce the usage of paper.

Figure 2: Rapid Card (Retrieved Jun 26, 2013. From: http://visit-malaysia.yinteing.com/2012/02/01/avoid-queues-when-travelling-in-public-transport/)

Paper ticket is not encouraged as it is very wasteful since the paper which serves as a paper ticket with your number on it will be thrown away into the rubbish bin after customers are served. There are usually no recycle bins provided at the post office which contributes badly towards the paper waste management. The disposal of these paper tickets symbolizes that the current society are not really interested in the usage of taking their numbers in paper anymore as it is of no use to them after their number is being called. Customers nowadays would only want a simple method which notifies them about their number and how long they have to wait before they are actually being served.

To conclude, digital ticket is easier to be stored and it is more convenient for the customers as all data can be kept in their mobile devices instead of having them on paper tickets. Furthermore, digital tickets also reduce the cutting of trees as less paper is now required.

2.2 Current Queue Management System

Based on the explanation by Gosha (2007), queue management system is a system which helps manage customer flow and organize queues at places which are facing problems with the queue. The queue management system which is being implemented currently in the post office is similar to all other queue management system which are being implemented in banks or government offices which provide services to the public. According to the explanation by the company MurniSolusindo on the how queue management system operates, the customer which wants a queue ticket number

will press on the button and the device itself will print out the paper ticket containing details such as the customers waiting number and also the current number being served. When the customers press on the button, it will also trigger the device database to insert the customers' number into the waiting list. Above the counters, usually, there will be an LCD board which displays the queue number of the customers being served currently. Once the customers' number appears on the LED board, he or she will be directed to the counter number displayed and carry out the transactions required.

Current QMS can be divided into 2 types which are proactive and also reactive (Gosha, 2007). For reactive system, it will help out in organizing the current existing queue present at the place of implementation of QMS whereas for proactive system, it will help gather queue management statistics to identify the trend. As for the benefits being published by Online System Technology Ltd. (2010), it is able to help organize the queue at the areas besides helping prevent the problem of cutting queues from customers. As for the downside of QMS, it consumes a lot of paper and customers face the problem of tracking the current number being served at counter. Besides customers also needs to stay at the designated waiting area to make sure that they don't miss out their queue turn.

Components used by the current system being published by Rsiconcepts (2008) is made up of 4 important components as shown in figure 3 which are the touch screen kiosk with ticket generating machine, LED queue number display unit, web terminal for agents and also queue management server software. For the touch screen kiosk with ticket generating machine, it is responsible to print and dispense the paper ticket for customers so that customers know their number. The LED queue number display unit will show the current queue number which is being served and the counter number. These numbers on the display board will be updated when the officers behind counters press on the next customer button. As for the queue management system, it will be responsible in integrating the numbers being dispense and also the number being displayed on the LED board with the buttons the counter officers have. These components will all be linked with local area network to integrate all of them to make sure that everything runs on real-time and no delay will occur in the system.

Figure 3: Example of some of the important devices required in the current QMS.

(Retrieved from: http://www.queuemanagementsystem.com.pk/contactus.html)

As a summary, the current queue management system still needs some improvement as there are several downsides with the system. It actually consumes a lot of paper and it is not environmental friendly in the long run if this system continues to operate. More trees need to be chopped down in order to accommodate to the demand of producing these tickets. Besides that, the customers will need to be physically there to take the number and wait till their number is called as they are not able to take their number before-hand or through the website. This can be very time consuming if the queue at the post office is very long.

2.3 Qless Queue Management System

QLess is basically a system developed to replace the physical lines and waiting rooms with virtual, mobile lines. Currently, this system is implemented in several industries at countries such as America, United Kingdom, China, Spain and France. The industries involve are banking, casinos, call centers, restaurants, post office and theme parks. Besides the industries mentioned above, the company operating this queue management system is also providing customization of systems for any systems which are having problems with the current queue management system implemented.

What makes QLess standout from other queue management system is users are given the mobility to move around while waiting for their number. According to Pamperin, T. (2011), when the customers' feels anxious, the waiting time in the queue seems to be longer. The feeling of anxiety is usually being triggered by the fear of their waiting number being skipped, fear of going to the wrong line, or a fear of line jumpers which cuts their queue. The waiting will feel even longer if the waiting time is not certain or when it is not explained.

In companies which uses QLess system, consumers of the place will only need to key in their phone number into the system and details such as the current number being served and estimated waiting time before being serviced will be displayed on the screen. Besides being able to see the estimated time they need to wait, they will also receive a notification from the system to their mobile phone to inform the customers that their queue number is next in line. Other than the consumers, the company which uses this system will also benefit greatly from the system as they are able to keep track of their current queue count and it will not be necessary for the employees to monitor the system as the whole system is automated and it's user-friendly. Figure 4 and figure 5 shows some of the screen shots of the application being sold by QLess.

Figure 4: QLess Merchant Display (Retrieved July 7, 2013. From:
http://www.qless.com/demo/)

Figure 5: QLess Customer Kiosk Display (Retrieved July 7, 2013. From:
http://www.qless.com/demo/)

If a comparison is made between QLess and DQMS application, DQMS application will have an advantage against their system as firstly DQMS uses the QR code technology which is available in all major smartphone platform. Furthermore DQMS application will be cost friendly notifications will be send to the customers through the

application itself instead of text message which cost 10 cents each. Lastly, the users of the application can also check the current queue number of the place and keep track of the time so that they will not miss out on their turn.

2.4 QR Code Technology

According to Lyne, M. (2009), QR code originated from Japan being invented by Denso-Wave a subsidiary of Toyota Group at the year of 1994. It is a short form for Quick Response and it can take a piece of information from a transitory media and put in into the cell phone. The QR Codes are two-dimensional barcode which can be read through our cellphones and also QR readers. This QR Codes are able to link users directly to text messages, emails, web pages of companies, advertisements and many more. If users were to browse through the magazine nowadays, users are able to see that there are lots of advertisements and articles which are using QR codes as an attraction to attract customers to go on to their webpages online.

Based on the explanation given by Andrew, M. (2010) QR Codes is being differentiated from the normal 1D/UPC barcode as the data in 1D barcode is only being stored in the collection of vertical lines while QR Codes data is stored in horizontal and in vertical form as shown in figure 6. Furthermore, QR Codes are able to store up to 7000 numbers as compared to ID barcode which can only store 30 numbers as their data.

Figure 6: Example of a QR Code being generated by the machines. (Retrieved July 28, from: http://searchengineland.com/what-is-a-qr-code-and-why-do-you-need-one-27588

If this project were to make a comparison, definitely QR Code should be the selection as it is able to store way more data besides being convenient as it can be read by all smartphones devices currently in the market.

2.5 Conclusion

Based on the literature review on several topics, it can be concluded the current queue management system needs improvement in order to keep up with the advancement of technology. By improving the queue management system with the current technology trend, it will be able to reduce the usage of papers and also provide more convenience to customers.

Most of the current queue management systems which are used in Malaysia include the usage of papers. With the advancement of technology nowadays and the increase of smartphone user's population, usage of papers can be replaced with QR Codes technology. QR Codes are paperless and it is able to store way more information compared to papers.

Besides, with the advancement of technology customers' satisfaction level will be higher if the current queue waiting time can be shortened. This can be accomplished with the sending of notifications to users of the application to their smartphones as an alert via the internet.

In this project, the proposed idea will be to develop an eco-friendly application which helps to save papers and provide alerts to customers who are using the queue management system. Droid Queue Management System (DQMS) will be applying the digital ticketing technology besides providing the alert system using internet instead of text messages used by QLess.

3. METHODOLOGY

In this methodology, there will be studies carried out on the method of research methodology used, design methodology of the whole project, project activities which are going to be carried out in FYP1 and FYP2, requirement analysis, Gantt charts and also the key milestones of the project.

3.1 Research Methodology

In this project of developing DQMS, constructive research method is being used to try out the theories and proposed methods to find out which are best methods in order to come out with a solution to the problem of wastage of paper and reduce the time spent on queuing in post office.

In the research design phase, quantitative research and also qualitative research method is being used where quantitative research consist of systematic empirical investigation of social phenomena via statistical, mathematical or computational techniques while qualitative research aims to gather an in-depth understanding of human behavior and the reason that govern such behavior. Below are some of the quantitative research and qualitative research methods which are used in this project.

Quantitative Research

- ❖ Distribution of questionnaire
  A set of questionnaire is being distributed to a group of customers which go to the post office. In this set of questionnaire it will consist of questions which will enquire customers on their awareness of how the current queue management system in the post office functions, the amount of paper used in this queue management system every day and the time taken for them to be serve after taking their number.
- ❖ Survey on the QMS of post office
  A survey will be done at a few post offices to find out the amount of paper ticket being dispense by the machine in an hour and also the time taken before the customers are being served at the counter. Several survey will be done at different time of the day to find out the peak hours for the post office.

Qualitative Research

- ❖ Interview session

To understand more in depth about the current queue management system of the post office, an interview session is being arranged with the supervisor working in the post office branch. By having this interview, a lot of information can be obtained as the person in charge will be able to share his or her experience with the system and mention what are the advantages and disadvantages in the system which needs to be improved on.

❖ Group discussion

To obtain some feedbacks and opinions of the public on the current QMS and the idea of DQMS, a group discussion among several customers which visit the post office frequently is being conducted. In this discussion, opinions and feedback of customers on the queue management system being implemented currently is discussed and important points are recorded. The information collected is very important as this information is all obtained through the experience of these customers which can be very useful for the project.

3.2 Design Methodology

The proposed method which will be used in this project to develop our DQMS product will be Rapid Application Development (RAD) method. Basically, this method emphasizes on the minimal usage on planning as it is in favor of a rapid prototyping process.

Since the duration being allocated for the project is very short period which is less than 8 months, the method being chosen must be suitable due to the lack of time given. RAD will definitely fit this projects' time line as the process in RAD enables the application to be developed in a tight constraint of time given and of high quality.

Since DQMS is going to be a new application which the public has not been exposed of, it will be a good move for us to use RAD to develop this application. This is because through RAD process, the project will be able to gather more customers' feedback about the application during the development phase for the prototype. For these reason, developer will be able to make changes towards the prototype and improve the product before finalizing the finalized product.

Furthermore, since the budget allocation for this application is not big, RAD method can help the development process as it provides flexibility to develop the application

with the limited resources the project has. Besides that, it will also be easier to improve or further enhance the application half way through if further allocation is being handed to upgrade the system to a higher level.

In this RAD methodology method, it will be divided into 4 different main phases as shown in figure 7.

Planning

Analysis

Design

System
Prototype

Develop
Demonstrate
Refine

Implementation

Complete
System
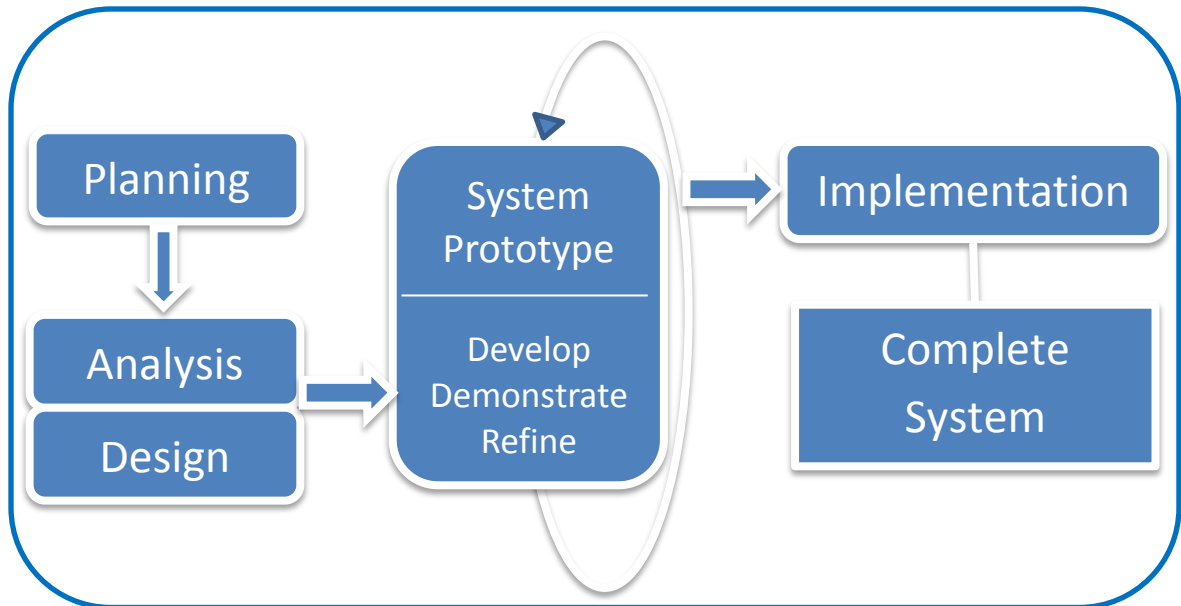
Figure 7: 4 main phases included in RAD methodology (Retrieved July 28, from: http://www.tdaxp.com/archive/2007/07/28/dreaming-5gw-part-iii-lessons-from-software-development.html)

3.3 PROJECT ACTIVITIES

3.3.1 Activity 1 – Project Planning Phase.

In this first phase of project, there will be planning for the whole project involved. The planning phase will include activities such as identifying the area which this project will be focus on and understand how the system in that area works. From the area of study, the problem being faced in the area which needs improvement needs to be identified. Then through the problems itself, the objective for the whole project can be identified as aligned to the problems statements of the project. Besides that, the scope of study for the whole project will need to be identified and have a general idea of how this whole project will be. In this phase, it will also be necessary to have a rough idea on what are the solutions which are required for the problems as it will be implemented in this project as well.

The area which is being chosen for this project will be the queue management system currently being used in many places such as the post office, government offices, clinics, banks and many more. The main issues which are being found out in the current queue management system being used in all this places are the wastage of papers being dispensed from the number machine and also the lack of alert system to the customers to notify them that their queue number is reaching.

In order to help overcme this problem, the idea of developing an Android application Droid Queue Management System to help solve the current problems being faced is being introduced. The objective of this application is to help solve the current problems being faced in the current QMS by using the leveraging on the technology in trend which are mobile application and also QR Code technology. With the current trend of increase in Android smartphone users, smartphones will be a necessity in the next few years.

To make sure that the scope of the whole project is able to be controlled, this project is also being scoped to the QMS used in post office only. The reason why post office is being chosen is because the post office has the volume of customers visiting it every day and it will be easier to gather data from for the analysis.

3.3.2 Activity 2 – Project Analysis Phase.

In this analysis phase, all the research, data collection and also analysis are being done. For the research, studies are being conducted towards some of the areas concerning the current queue management system and also some of the methods which are able to be used to help solve the problems. As for the data collection, several methods such as questionnaires, survey and also interview sessions are being conducted to obtain information for the project. After collecting data through the methods mentioned above, the data is being analyzed and interpreted to extract information needed for the development of the DQMS application. In this phase, the author will be able to identify all the key features and also the functionalities required to be included in the DQMS System.

In the research phase, studies are being conducted on a few areas which are related to the project. Studies which are being carried out will include the study on the current queue management system and how it operates in the post office, the study on digital ticket and the industries which are using them, current existing companies which are

offering the alert system service in their queue management system and also the study on QR Code technology.

As for the data collection methods, the distribution of questionnaires is being done in the post office situated in Bandar Seri Iskandar to collect some of the feedback on the queue management system and to find out their usage of smartphones in their daily activities. From these data collected from questionnaires, the author will be able to analyze the data and come out with some suggestions on the functionalities which are required. Besides questionnaires, the author will also be carrying out interview sessions with some of the customers waiting in line for their queue number and also the officers working at the post office to get their feedback and opinions on the idea of DQMS. This feedback and suggestions of their ideas will be able to help generate ideas for the features which needs' to be included into the DQMS application.

The features which have been identified to be included in DQMS will include the functionality of capturing the QR Code generated by the ticket kiosk and saving the QR Code as the digital ticket for the user as a verification when their queue turn reach. By implementing this feature, the conventional paper ticket can be replaced and this will reduce the wastage of paper. Besides the feature of alert system for notification purpose when the queue number is approaching is also being chosen to be included in this project. User will be receiving their alert notification sent to them by the QMS through the internet or they can check for themselves the estimated time when their queue number will be served on the application itself.

The software which has been identified to be used for the development of DQMS will consist of a few android development tools which are AppInventor, Android SDK and also Google Chart API libraries. As for the coding part to develop and customize the functionalities, Eclipse software will be used for coding purposes. The web programming will be using PHP language to assist in the connection of mobile application to web server. For the designing of the interface, the assistance of Photoshop and Indigo Studio will be used to help out in creating the buttons and also the overall interface of the whole system.

As for the technologies which are required in the development of DQMS are the Quick Response (QR) Code technology and Android operating system not less than version Ice-Cream Sandwich 4.0. These technologies are required to ensure that the application will be compatible to function smoothly without any problems arising. As for the

hardware required, it will include an Android smartphone, a laptop/computer and also a printer. The minimum requirement needed for the smartphone will include a back camera which is able to capture the QR Code generated and analyze the information.

3.3.3 Activity 3 – Project Design Phase

After identifying the features, the system requirement is being identified followed by the system design and prototype design being developed. In order for customer to fully benefit from this DQMS, users are required to own a mobile smartphone of Android Platform in order to install the application which is being developed under the Android Platform.

For the system requirements needed for DQMS, it will be shown and explained through the system architecture as shown in Figure 8.
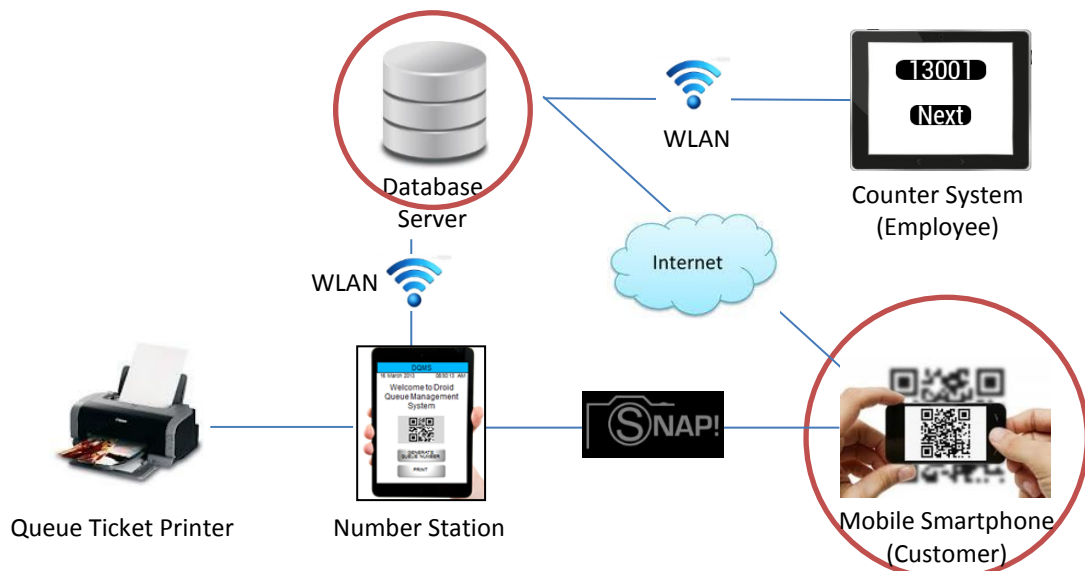
Figure 8: System architecture of the whole DQMS Project which includes the Number Station Kiosk, Server, Queue Management System, Counter System and also DQMS users' smartphones.

The focus of this project will be on the development of the DQMS Android mobile application which will be used by the customers which visits the post office and the development of the function which retrieves and updates data from the server towards the smartphone application of the users. As for the customers who do not own an Android smartphone the queue ticket printer will be set up and still be available for customer's usage. As for the connection of the counter system towards the queue management system, it will be handled by colleague in this project, Ms. Nasiratul. The

table below will give a thorough explanation on the connection for the DQMS system which this particular project will be focusing on.

Device	Connection	Device	Explanation
 Number Station	 Smartphone Back Camera Functionality	 Mobile Smartphone	In order to retrieve data from the QR Code generated on the Number Station Kiosk, users using the Android Smartphone must have the DQMS Application and a functional back phone camera to capture the QR Code to retrieve the queue number.
 Mobile Smartphone	 Internet Connection	 Database Server	In order for the user to actually update the most current number for the person which is in queue, he or she will need to refresh the queue number to get the latest queue number from the server and the application will be sending notification alert functions to users when their queue number is approaching.

After designing the system architecture, the whole system will be divided into several modules based on the functionalities which will be available in the application. As shown in figure 9 below, the whole project will be broken down into number station application, mobile application and also the web server. In the DQMS Number Station, the module which is being mentioned will be the generating of ticket module. This module will be responsible in getting the most updated queue number and display or print the information the number ticket in the form of a QR Code or paper ticket. The information regarding the queue number will all be updated to the retrieve module in the

web server section. This update module will be responsible in retrieving the latest queue number which has been issued and update the database with the latest number. These two functions will be connected using internet connectivity.
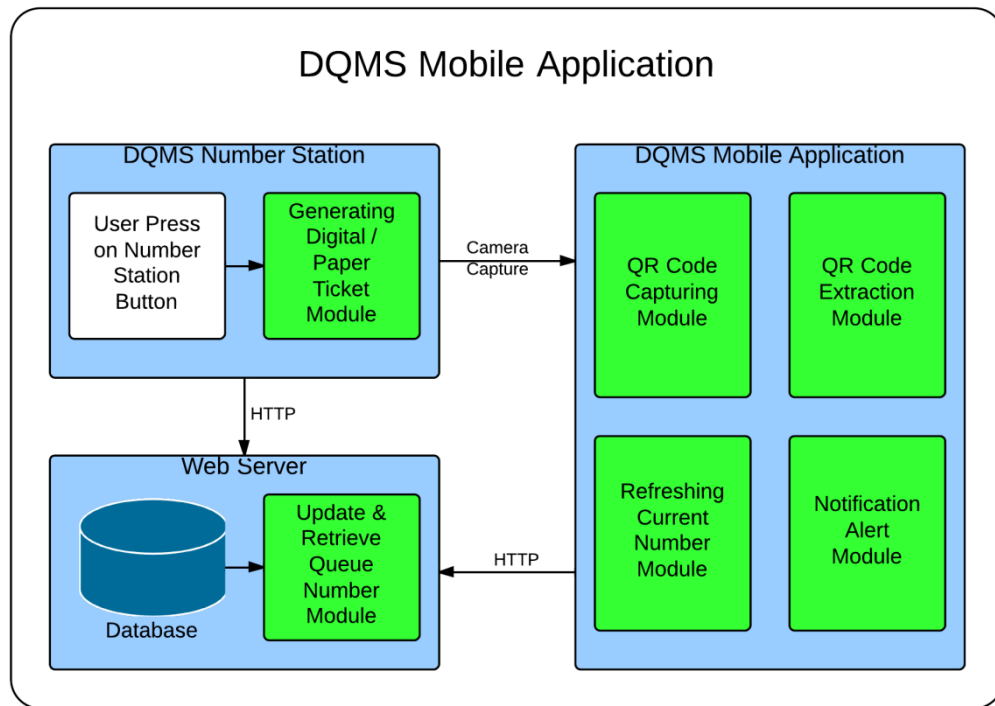
Figure 9: DQMS Modules used in the DQMS mobile application and number station.

On the other hand, the DQMS mobile application will have the QR Code Capturing Module where it will function as a QR reader which captures the QR code generated from the number station. From this QR code captured, it will proceed to the next module which is the extraction module where information from the QR code will be extracted and displayed on the queue number page of the application. From the numbers extracted, customers will be able to view information such as their queue number, the current queue number, customers ahead of the customer and also the time left until the customer is being served. The next module which is included will be the refresh current number module. In this module, users will refresh the application to update the current number, customers ahead and also estimated time left. In order to check for the latest current number, it will connect to the web server retrieving module which will retrieve the latest current queue number from the database. The web server will be responsible to return the current number every time the mobile application request for the current number. As for the notification alert module, the application will be providing notification pop ups to users when there is less than 5 customers left ahead. This module

will be responsible in sending alert messages to the customers when their queue number is approaching to serve as a reminder.

As for the user interface of DQMS mobile application, the whole application will be split into 4 different pages. These screens will consist of the Login screen where users will be greeted when the application start's up. After that, users can proceed to the QR Reader Page where the queue number of the customer will be captured and information such as the customer's queue number and current queue number will be extracted from the QR code. After that proceeding to the queue number page, the customer's queue number will be displayed above followed by the current queue number, the amount of customers ahead and the estimated time to reach user's queue number. After carrying out the transaction, users will just need to click on the back button on their phone and they will be able to capture another queue number on their phone. The last page in this application will be the Help page which features the FAQ and step by step guide to use the application.

3.3.4 Activity 4 – Project System Prototype Phase

In this project prototyping phase, it will include three main stages which will cover development, demonstration and refinement as shown in Figure 7. This 3 process will be involved in an iteration process until the desired prototype is being developed.

In the development phase, it starts off with the development of the interface for the mobile application which is being mentioned in project design phase above. The interface will firstly be sketched on Adobe Photoshop software to get a rough idea of how the application's interface will be like. After sketching out the whole interface, the development will proceed to developing the interface using Eclipse with the help of Android SDK tools. After the development of the interface, a round of demonstration is carried out to enable the users to give their feedback on the interface of the application. Their opinions regarding the application's interface will be used to help improve the user experience as users will ultimately prefer interface which are simple and user-friendly.

After refining the interface based on the opinions, the functionalities of the application will be included into the application. The main functionality will include the capturing of the QR code, retrieve of data from QR code, refreshing the current queue number and also notifications pop-up when queue number is approaching. The development of

capturing QR code functionality will require the smartphone to align the camera to the 3 buttons around the available at the QR code. After the functionality of QR code capturing is developed, the functionality of analyzing the QR code and extracting of information from the QR code to be displayed in the queue number page is being developed. As for the functionality of refreshing the current queue number, the mobile application will be connected to the web server using HTTP. From the web server, the mobile application will be able to retrieve information regarding the latest current queue number from the system. Lastly, the notification system functionality will serve as an alert system to notify users when their queue number is approaching. The function will calculate the difference between the customers queue number and also the current queue number and when the difference is 5 or less than 5, the notification will pop up and notify the customer that their turn is approaching. After all functionalities for this stage is being developed, another round of demonstration and testing of the application is carried out. In this testing round, users will be trying out the functionalities for the application and find out whether the application functions according to the requirements of the functionalities. All results which are being collected from this testing will also be recorded and improved on in the application. The print screens of some of the processes in the development phase can be seen in the Appendix of this report being attached below.

In the demonstration and testing phase being mentioned in the paragraphs above, the applications will be shown and demonstrated to the users using the developers' Samsung Galaxy S2. Besides that, this testing phase will be done using a simulation where the scenario of the application will be similar to the real life system where which includes the number station counter, the mobile application and also the link of the application towards the web server. The feedbacks and opinions given by the users after trying out the application's simulations will all be recorded down in the survey form prepared for them. Survey from which is distributed can be seen in the Appendix section below. Besides user testing on this application, software testing will also be done towards the application. The application will be tried out for a 100 times and the number of failures or error occurrence is recorded down.

The last process occurring in the iteration process will be the refinement process where all feedback and opinions given by users during user testing will be analyzed. After the analysis done, there will be further review and adjustment will be done towards the whole project in order to improve the final product from this application.

This iteration process will carry on until the final prototype is being finalized for the project as there should be no further modifications done towards the system after finalizing the model.

3.3.5 Activity 5 - Project Complete System Phase

After the prototype has been finalized, this project's proceeds to the complete system phase of this project where the system will be ready to be presented to the public and implemented for trial run in some of the post office in Malaysia.

To make sure that this project provides improvements and enhancements as compared to the current queue management system, a comparison is done between DQMS and the current queue management system.

Figure 10: Paper ticket dispenser being used in the current queue management system. (Retrieve at: Nov 30, 2013, Retrieve from: http://www.qtechqueueingsystem.com/ products-and-services/thermal-ticket-dispenser.html)

The current queue management system uses the paper ticket concept as shown in figure 10 where the paper ticket displays information of the queue number of the recipient and also the current number which is being served at the counter. To request for the number, customers will request the paper ticket by clicking on the transactions which they would like to perform and the paper ticket will be dispense from the machine. After getting the queue number, customers will be able to view the queue numbers being called through the LCD panel which displays the queue number being served at each counter.

As for DQMS, the paper ticket will all be replaced with digital ticket where instead of emitting paper ticket, the ticket machine displays a QR code and users will keep a

digital copy of the digital ticket by using their smartphone to capture the QR code. As for the current queue number, customers can check them through the mobile application instead of just viewing the current queue number from the LCD screen.

The similarities, differences, advantages and disadvantages between DQMS and the current queue management system can be seen from the table 2 below.

Droid Queue Management System	Current Queue Management System
Similarities between both systems	
- Providing queue ticket number to the customers - Queue number being given out based on the first come first serve concept - Customers will proceed to the counter when their queue number is being called - The number ticket dispensers are connected to the database server which stores the current queue number and the number in line.	
Difference between both systems	
- Provides digital ticket - Use QR Code technology and Android smartphone for identification of queue number - Viewing of current queue number through mobile application - Notifications alert when customer's queue number is approaching on customers smartphones	- Provide paper ticket - Ticket number dispenser will give out paper ticket for identification of queue number - Viewing of current queue number through LCD display - Notifications every time the current queue number changes on the LCD screen. - No individual notification alerts.
Advantages of these two systems	
- Reduce paper wastage with the usage of QR Codes. - Provide personal notifications alert to users when their queue number is approaching.	- Simple procedure of getting the queue number and user-friendly. - Reliable and do not require any additional devices to use the system.
Disadvantages of each of the system	
Requires the usage of smartphones and mobile data connectivity	Wastage of papers for the purpose of paper ticket

• Occurrence of customers cutting queue by forging the QR code generated by the DQMS	• Limitations on the movement of customers when performing their transactions

<div align="center">Table 2: Comparison between current queue management system and DQMS</div>

3.4 Requirement Analysis

The users for DQMS product will be mainly focused on the users of the current queue management system and in this project scope of study, it includes the officers operating the counter system and also the customers queuing up to carry out their transactions. Besides that, in order to be one of the users of DQMS, users will need to own an Android platform smartphone since the application is supported by it.

As for the functionalities which are being provided by the DQMS application, it will be divided into main functionalities which are the capturing of QR Code as a digital ticket function to replace the usage of paper ticket in the current queue management system. As for the other functionality will be the alert system notification being send to users when their queue number is approaching. Users will be able to receive their notifications when their queue number is approaching through the internet and users can also check on the current queue number being served to make sure that they do not miss their queue later on.

The limitations which are present in this situation will be users' needs to own an Android smartphone to be able to utilize the application since the DQMS application will be developed under the Android operating system. Besides that, users will need to have internet connection to use this application since the sending of confirmation and receiving of notifications are all being transferred between the user and queue management system through the internet.

3.5 Gantt Chart

3.5.1 Gantt Chart Final Year Project 1

Activities / Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
FYP Project Planning Phase														
- Research on Prospective Titles	X	X	X											
- Scouting for Supervisors	X	X	X											
- Propose FYP Title			X											
- Confirmation on FYP Title & SV				X										
- Project Planning			X	X	X	X								
FYP Project Analysis Phase														
- Research and Analyse Project Topic			X	X	X	X								
- Perform Market Survey, Interview and Data Mining							X	X	X	X	X	X		
FYP Project Design Phase														
- Identify System Requirements							X	X	X	X				
- Planning System Design									X	X	X	X		
- Planning Prototype Design									X	X	X	X		
FYP Project Prototype Phase														
- Develop Interface & Coding													X	X

Table 3: Gantt Chart for Final Year Project 1

3.5.2 Gantt Chart Final Year Project 2

Activities / Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
FYP Project Prototype Phase														
- Develop Interface for DQMS	X	X	X											
- Develop Functionalities				X	X	X	X							
- Develop Database and QM System					X	X	X	X						
- Carry out Testing on Prototype								X	X	X				
- Further Improvement / Adjustment on Prototype								X	X	X	X			
FYP Project Review by SV										X	X			
FYP Project Maintainence / Recommendation											X	X	X	X

Table 4: Gantt Chart for Final Year Project 2

3.6 KEY MILESTONE

Project Activities	Target Date	Milestone	Project Deliverables
Project Initiation, Project Planning,	Week 1 – 6 (FYP 1)	Determine Project Title, Determine Project Scope, Rough Sketch on Whole Project	Project Proposal (W3)
Project Analysis	Week 3 – 12 (FYP 1)	Identify Constraints, Perform Requirement Gathering, Perform Data Mining & Research,	Extended Proposal(W6) Proposal Defense (W11)
Project Design	Week 7 – 11 (FYP 1)	Identify System Requirement, Planning System Design, Planning Prototype Design	Application Architecture Design
Project Prototype	Week 10 – 14 (FYP 1) Week 1 – 11 (FYP 2)	Develop Interface & Coding, Develop Functionalities Develop Queue Management System Carrying out Testing on Product Further Improvement on Prototype	Application and Project Prototype
Project Completion	Week 13 (FYP 2)	Review by UTP SV Identify Recommendations Product Maintenance	Product Prototype Project Viva
Documentation	Week 4 – 14 (FYP 1) Week 1 – 14 (FYP 2)	Gather all Documentation to be Documented	Interim Report Progress Report Dissertation Report

Table 5: Key Milestone for Final Year Project 1 and 2

4 RESULTS AND DISCUSSION

In the results and discussion section, all the results and findings which have been done in the research and analysis is being displayed in this section. The sections which will be included will include system prototype model, system design, discussion on results obtained from initial survey and system testing survey and software testing.

4.1 System Prototype Model

In the system prototype developed in the project, there will be four pages of interface being included in the whole DQMS mobile application. Figure 11 to Figure 14 below shows some of the screen interface which are being developed.

Figure 11: DQMS interface Login Page   Figure 12: DQMS interface QR Reader
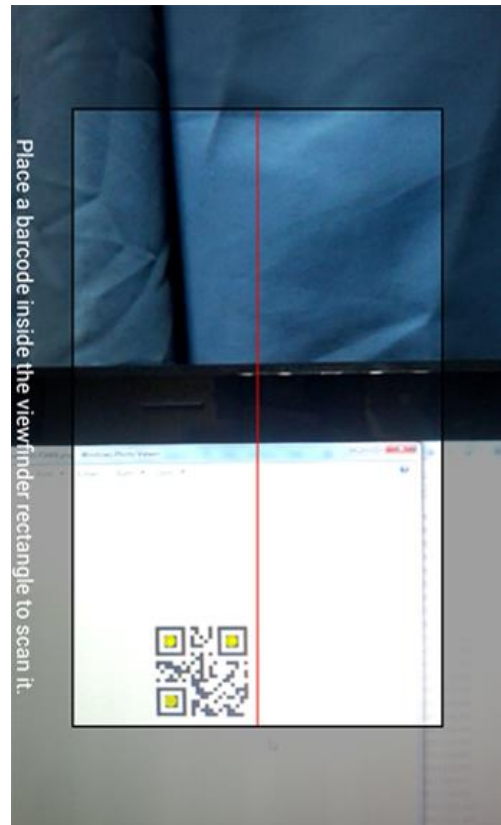
When the customers open the application, they will be greeted with this login page for the application as shown in Figure 11. In this login page, there will be the logo for the application together with the loading symbol. After the login page, DQMS application will proceed to the QR reader page as shown in Figure 12 where the camera for the phone will be turned on and the page where it will capture the QR code will be displayed. The functionality of QR reader will be used in this page as the camera will

try to locate the three square boxes located at the edge of the QR code and capture the QR code to be used in the following process.
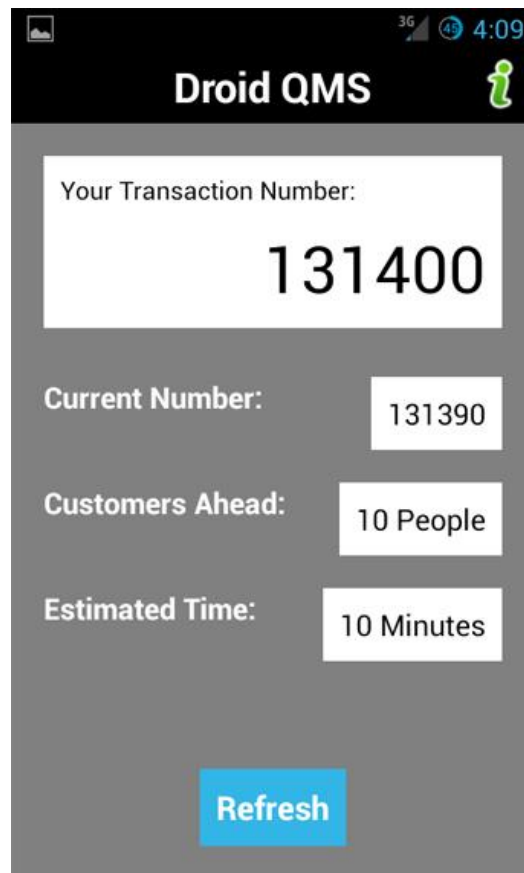

Figure 13: DQMS Queue Number Page

After successfully capturing the QR code, the application will move on to the queue number page where the functionality of extracting the information from the QR Code will retrieve all information which are required and display these information on the queue number page as shown in Figure 13. If no QR Code is being captured by the QR Reader function, users will not be able to proceed to Queue Number page as an error message will pop out and notify users about their mistake. In the Queue Number page, users will be able to view the details of their transaction number, the current queue number, customers ahead of their number and also an estimated time before their queue number approaches. Customers can also activate the Refresh functionality by pressing on the 'Refresh' button on the screen to check for the latest current queue number. This queue number will be retrieved from the web server which returns the value to the mobile application by using internet connectivity. Furthermore, when there is 5 customers ahead of you, the notification function will be activated and it will trigger the application to return a pop-up notification to the customers to notify them that their

queue number is approaching and they should be getting back to their waiting area or risk losing their queue number to the person in line.


Figure 14: DQMS HELP Page

As for the last page of interface of HELP for the DQMS application as shown in figure 14, there will be the frequently asked questions being included there in case the users have any enquiries on how to operate the system. Besides that, the contact details of the developer is also being attached in the application to enable users to send their feedback or queries about the application.

The interface and functionality which have been design for this mobile application are all basically very simple and plain. The reason behind this simple interface is to make sure that the application is user-friendly to all age-group of users besides being able to look good and attractive. DQMS is able to be used by users of all ages and it does not require much knowledge from the users regarding the application as there will be instructions being attached at page for the application. Although the design interface may look simple, the developer is able to include all features required by the project to be packed in a 4 screen application.

4.2 System Design Architecture

1. Activity Diagram
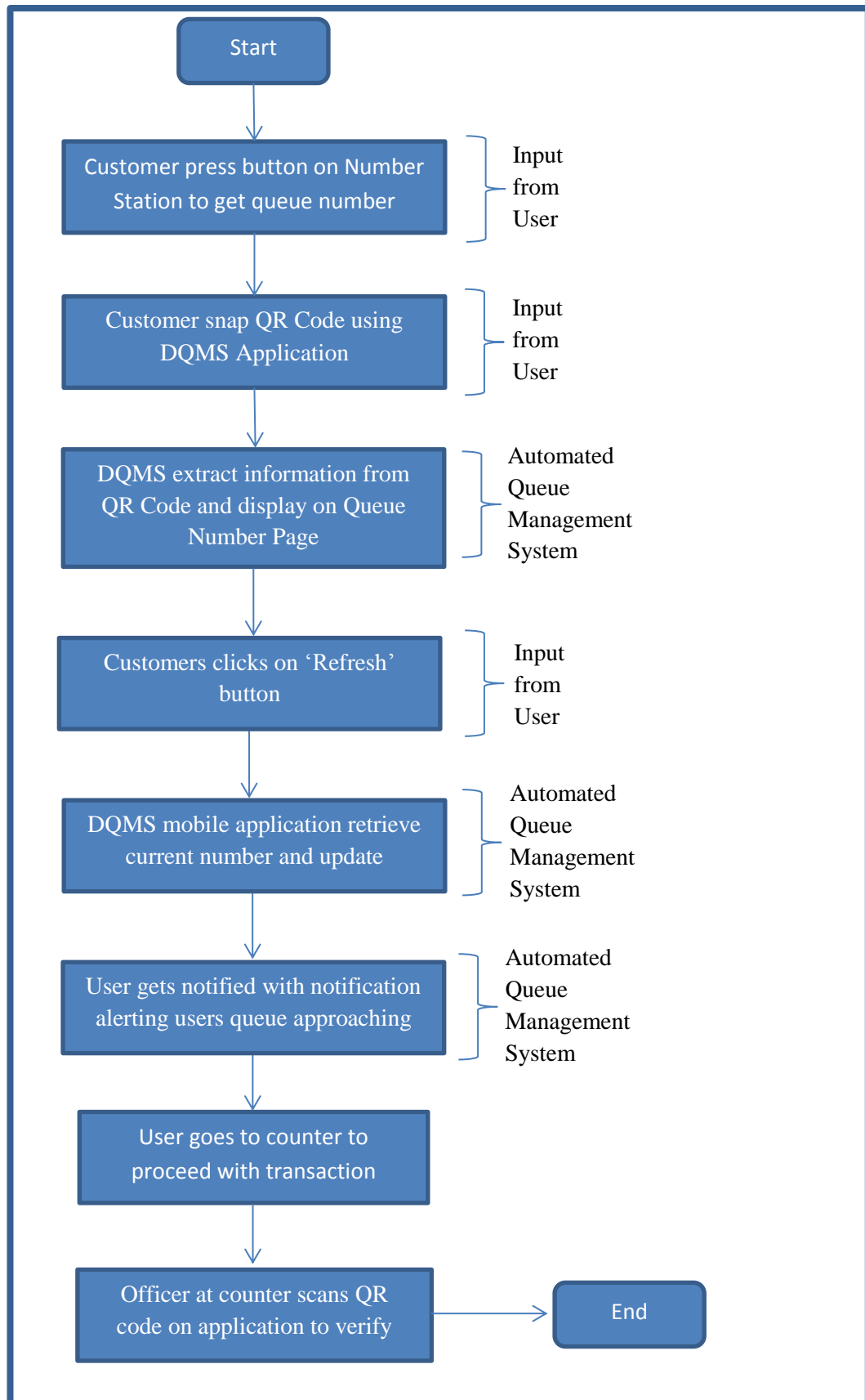
From the activity diagram being shown above, users are able to see how the system functions as the process flow of the whole application is being shown.

At the start of the process flow, it will require input from the user as they will be pressing on the Number Station to generate a QR Code which contains details such as their queue number and also the current queue number being served. After the number station generates the QR Code, the user will use his or her own Android smartphone to capture the QR Code with the Droid Queue Management System (DQMS) application. Remember that the application needs to be installed before-hand.

After capturing the QR Code, the mobile application will extract all information available from the QR Code and display the queue number of customers and current queue number on the next page of the application which is the queue number page. In the queue number page, the users will be able to check for the amount of customers still ahead and the estimated time before the queue number reaches. Besides the information displayed, users can also refresh the current number to the most updated queue number by pressing on the 'Refresh' button. This button will trigger the mobile application to update the current queue number by retrieving the value from the web server using internet connectivity. Lastly, when the queue number of users' is approaching, the users will be notified with pop-up notifications alert on their phone indicating that their queue number is approaching.

Users which have received their notification will then proceed to the waiting area and their number will be called to counter and they will be able to perform their transactions. When they reach the counter, the officer in charge will verify the queue number being saved on the user's phone to make sure that no customers is cutting queue. After scanning, the users can end their transaction on the DQMS application by pressing on the back button on their phone.

After clearing off the QR code, users will now be able to proceed with the next transaction they would like to perform at other outlets using DQMS service.

4.3 Findings and Discussion on Initial Results

4.3.1 Distribution of Questionnaire & Results

Distribution of questionnaire is done to make a survey on the feedback and opinions of the public towards the necessity of Droid Queue Management System (DQMS) in the target market. To obtain this data, the questionnaire is being distributed in the Bandar Seri Iskandar post office and being conducted online to customers which have visited the post office before.

From the questionnaire being distributed, the author is able to get 90 respondents to help out in answering the questions. There is no age limit for this questionnaire and it is only open to Malaysians to answer since it involves the post office service in Malaysia only. The figures 15 below shows the age group and the job professions of the respondents which have answered the question.
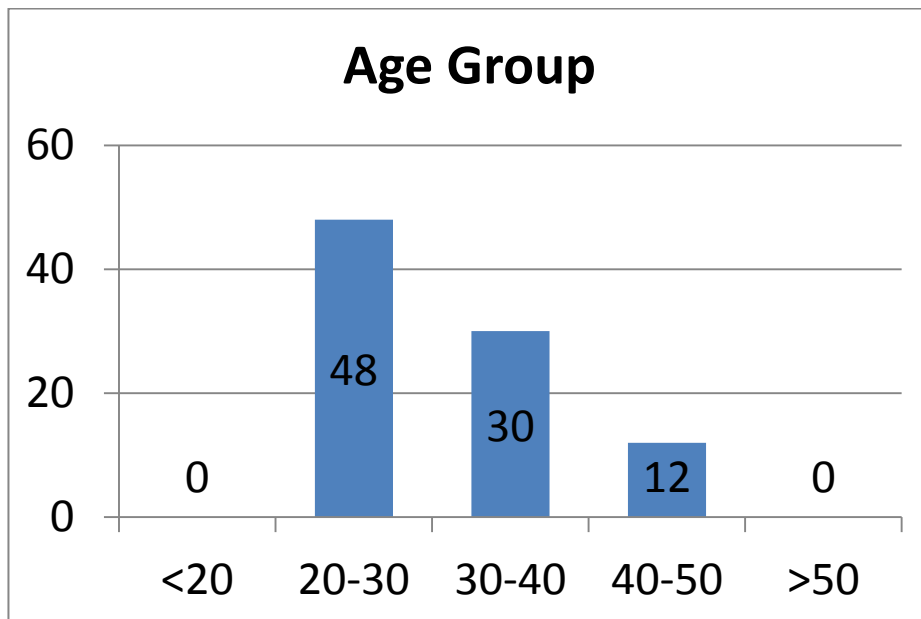

Figure 15: Graph of the age group for the respondents of questionnaire.

List of Occupation of the respondents of questionnaire		
Undergraduate Student	Postgraduate Student	Bank Executive
Engineer	Internship Students	Sales Administration
Accountant	Teacher	Lecturer

Figure 16: List of occupations for the respondents of questionnaire.

As seen from the age group graph in figure 15, the author is able to see that there is a majority of 20-30 years old respondent followed by 30-40 years old and lastly the least amount from 40-50 years old. As for the job description in figure 16 shown, the respondents are from several different fields of work with some of the respondent still studying or having internships. Some occupations of the respondents will include bank executives, engineers, sales administrations, accountant, lecturer and also teachers.

In this questionnaire being distributed, the main purpose is to understand the current situation of the queue management system in the post office and to find out the feedback of customers towards the idea of DQMS. There are seven questions being asked in the questionnaire but only four main questions will be included in this documentation to be emphasized on.
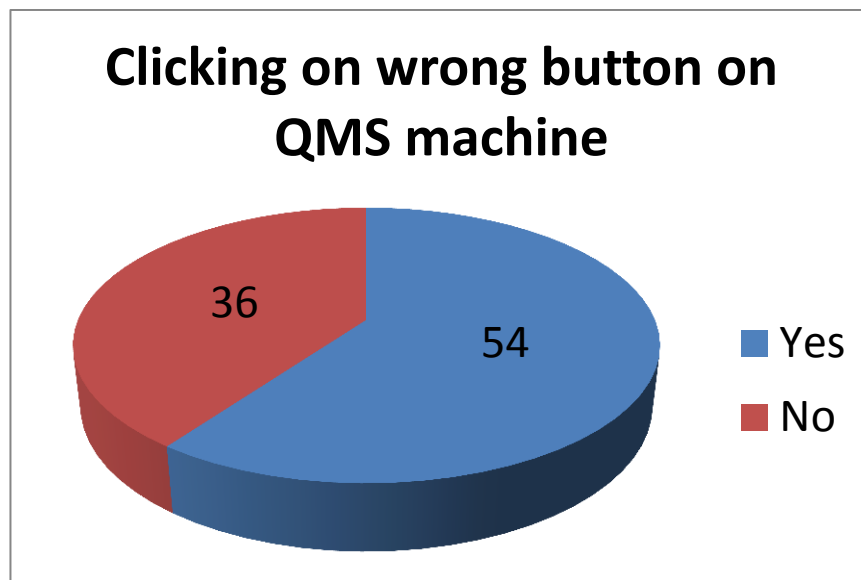
Figure 17: Pie Chart of number of respondents which has experienced clicking on the wrong button on QMS machine for the respondents of questionnaire.

Based on figure 17, out of the 90 respondents, more than half of the respondent (54) has experienced pressing on the wrong button on the paper ticket dispensing machine. This shows that the users are sometimes not sure about the buttons which they should press at the number machine. All this wrong pressing of number tickets will lead to more wastage of papers being used as all the paper tickets which are being dispensed will not be used and they will be thrown into the rubbish bin.
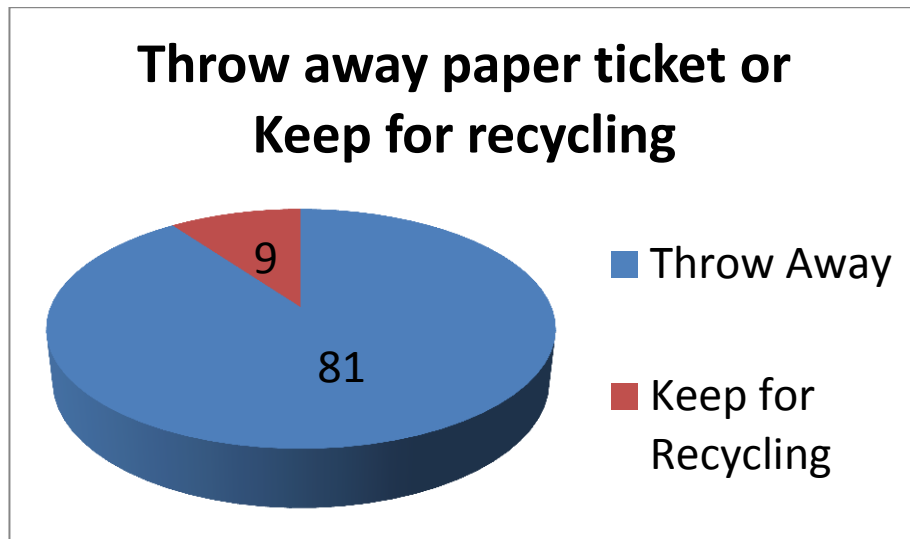
Figure 18: Pie chart showing the number of respondents which throw away their paper ticket or keeping them for recycling for the respondent of the questionnaires.

From the statistics shown in figure 18, it is obvious that 90% (81 Respondent) actually throw away their paper ticket into the rubbish bin instead of throwing the paper ticket into the recycling bin. This statistics shows that out of the 90 papers which are being dispensed out for paper ticket purpose, only 10% of it will be recycled and reused again. As for the rest they are all being discarded and this contributes to more deforestation as more papers need to be produced for the usage of paper tickets.

Figure 19: Pie chart showing the average waiting time for customer before being served in the post office for the respondents in the questionnaire

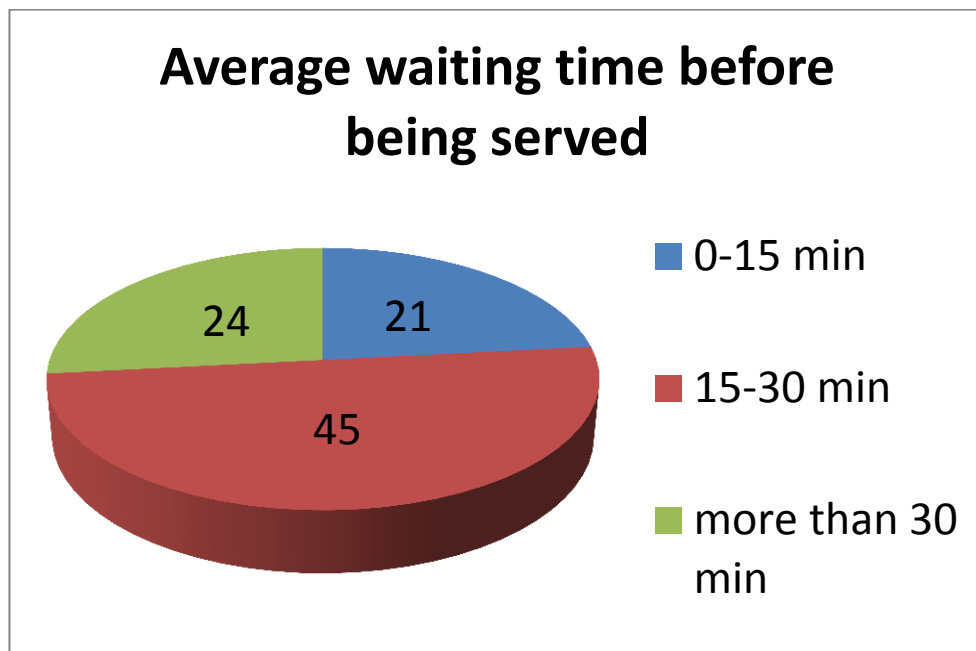According to figure 19, half of them (45 respondents) are being served after waiting for an average time of 15 – 30 minutes. The issue arises when there are more than a quarter of respondents (24 respondents) which needs to wait up to 30 minutes or more before they are being serviced. These respondents which need to wait for more than 30 minutes are not able to move around and they need to wait at the designated waiting area or else they will risk missing out on their queue number. This can be very troublesome at times as there will be a lot of time being wasted in waiting for the queue and not being able to do any other things as the current queue management system does not provide any alert systems which sends notification to customers when their queue is approaching.

Will you give DQMS application using QR Technology to replace the current QMS a try?

9
81
■ Yes
■ No
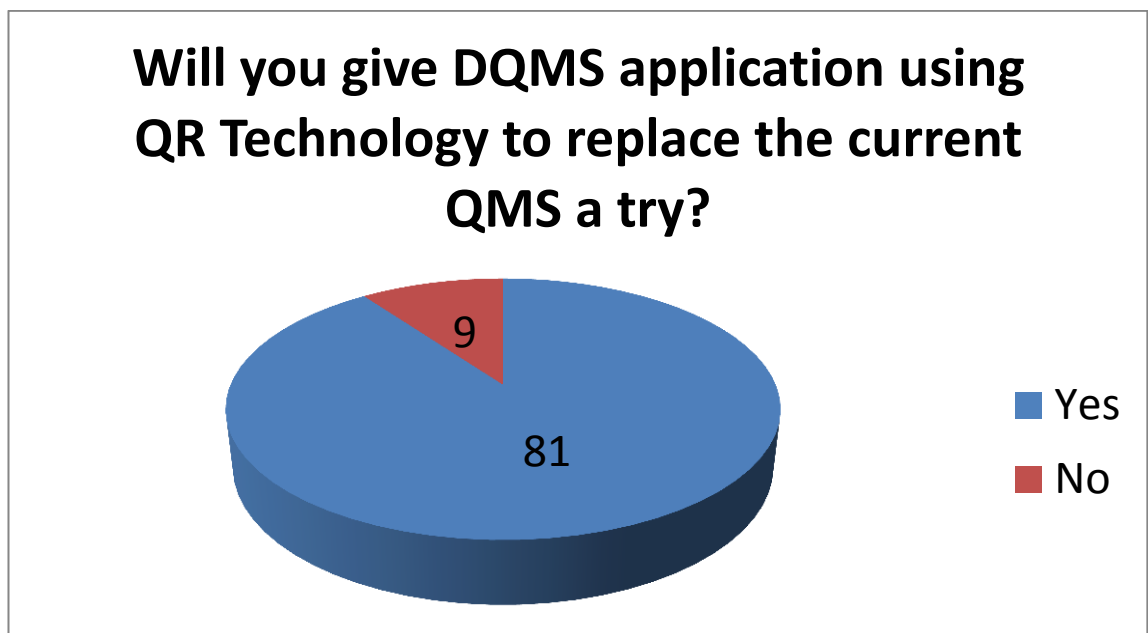
Figure 20: Pie chart showing the results of respondents from the questionnaire which will give DQMS a try if it is being developed.

In figure 20, it shows that currently, 90% (81 respondents) mentioned that they would want to give DQMS a try if this application is being developed while the other 9 respondent are not interested. With the majority of 90% of the respondents eager to try out this new application which will be able to reduce the usage of papers and solve the problem of long waiting queue lines, it shows a good indication that the idea of DQMS is widely being accepted by the general public. Therefore, this project will proceed with the objective of solving the problems faced in the current queue management system.

4.3.2 Conducting of Interview

In order to get some of the feedbacks from one of the staff in the post office of Bandar Seri Iskandar regarding the current queue management system being used, an interview session is carried out with him. The interview as shown in table 6 below.

Staff's Name	Muhammad Hasbullah bin Muhammad Iskandar
Staff's Position	Branch Supervisor
Branch Name	Pos Malaysia Bandar Seri Iskandar
Interview Description	At the beginning of the interview session, Mr. Hasbullah was asked on his opinions regarding the queue management system being implemented in the post office. He mentioned that the current queue management system is user-friendly and easy to operate as it does not require much maintenance for the system and neither does the machine breakdown frequently. Furthermore, he also emphasize that with the implementation of queue management system, it helped the staff deal with the problem of queuing as customers are required to line up and wait for their turn when QMS was not implemented. Besides the advantages of the system, Hasbullah also realize that all this convenience comes with a price as there will be paper wastage caused by the queue management to produce papers tickets. Furthermore, he also realize that with the increase in numbers of visitors during peak hours, it will be hard for the post office to accommodate all their customers since the unit for the post office isn't very large in size. As for the idea of the DQMS, he is satisfied with how the idea and concept of the application to use QR Codes as digital tickets and providing notifications on phones instead of relying on the numbers displayed on the LCD screens only. He thinks that the idea of using digital ticket will be able to solve the current problems which are being faced in the current queue management system besides providing more flexibility to the customers which will be visiting Pos Malaysia's office in the future.

Table 6: Interview results and discussion with supervisor in charge of Pos Malaysia Bandar Seri Iskandar branch

4.4 Findings & Discussion on Feedback from System Simulation Testing.

In the system testing phase, the mobile application for DQMS is being shown and demonstrated to the prospect users. In order to make sure the testing is done in the best condition, a simulation of the real DQMS is being set up. Users will have the experience of using the number station to generate the QR code and the mobile application which has all the functionalities are working. This experience enables user have a hands-on experience with the mobile application to understand how the system functions and to know what the limitations of the current application are. After users test out the applications simulations prepared, the testers are requested to answer the questionnaire prepared for them which enables users to voice out their feedback and opinions on the application.

Through the questionnaire distributed to all 30 user testers, half of the testers consist of students as the testing was carried out in a post office near the university while the other half consist of workers from the factories around the area of Bandar Seri Iskandar. The results obtained shows that all respondents which have answered the questionnaire have the experience of using the current queue management system in the post office and they understand how the current queue management system functions.

Does DQMS solve the problem of paper wastage?

- 3% No
- 97% Yes

Does DQMS provide notification alert for users?
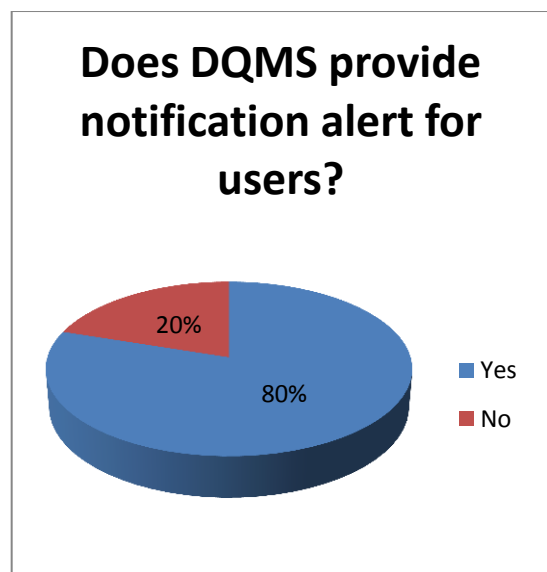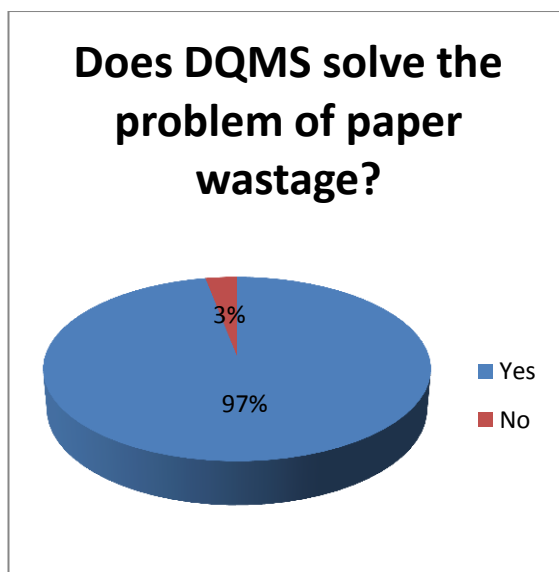
- 20% No
- 80% Yes

Figure 21: Pie chart showing results for the opinions of users on the ability of DQMS to help solve paper wastage issues

Figure 22: Pie chart showing results for the opinions of users on the ability of DQMS to provide notifications to users.

As for the opinions of users on the ability of DQMS to help save paper usage, from figure 21 it shows that 97% of the respondent responded positively as they agree that DQMS will be able to help the current queue management system cut down on the paper wastage to produce paper ticket. On the other hand, in figure 22 the functionality of providing a notification alert system to alert users when their queue number is approaching received a 73% positive response while the remaining 27% of respondents do not think that DQMS actually fulfill the requirements of providing the notification.

Based on the results shown in figure 23, out of the 30 respondents which helped out in the system testing for the application, 24 testers (80%) thought that DQMS should be implemented in the current queue management system. The reasons given on the matter is because DQMS is able to help reduce paper wastage besides being able to provide convenience to the customers when they visit the post office in the future. Other respondent which disagreed with the idea of DQMS thought that the idea of using the application is not feasible. The justifications being regarding the matter was not all smartphone users have data connection on their phone and therefore they will not be able to get the latest number on the queue list. Other respondent think that it is very troublesome as users will need to install the application on the smartphone before being able to use the application.

Is DQMS feasible to be implemented in the current queue management system?

6 Respondent (20%)
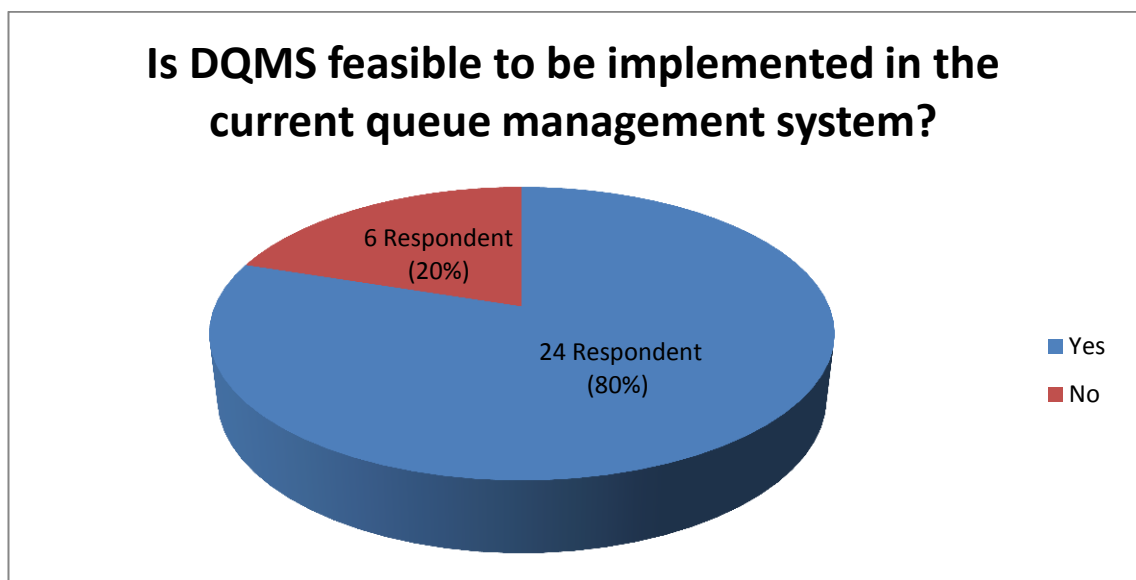
24 Respondent (80%)

■ Yes
■ No

Figure 23: Pie chart showing the results for the opinions of users on whether DQMS is feasible to be implemented in the current queue management system.

In the final part of the system testing, the testers are asked what other features and functionalities which they would like DQMS mobile application to have and the results obtained are as shown below:

i. DQMS application should be developed for other operating system instead of just Android platform
ii. The application should enable users to take their queue number from the phone itself instead of having users go to the place itself
iii. Provide other alternative post office if the current queue in the post office is too long.
iv. Allow users to make an appointment for the time slot which they would want.
v. Increase the security of the system as users will be able to forge the QR code themselves and cut in the queue when the queue is long.
vi. Ability to withdraw their queue number half way through the queue.
vii. Application able to refresh the queue number automatically without requiring users to press on the 'Refresh' button manually.

These feedbacks gathered are analyzed and some of the opinions are being considered in the further recommendation for the system.

4.5 Findings and Discussion for Average Waiting Time Spend on Current QMS and DQMS

	Current QMS	DQMS
Average time to generate paper/digital ticket	2.5 s	1.7 s
Average time before queue number approaches	1200 s	1200 s
Average waiting time spend at waiting area	1200 s	300 s
Total time spend waiting for queue	1202.5s	301.7s
Total time saved while in queue	0 s	900 s = 15 Minutes

Table 7: Comparison between the average time spend on the current QMS and DQMS

In the simulation testing done for the DQMS system, the waiting time required by the users to spend at the waiting area before their queue number approaches is being analyzed and the average time for the current queue management system and DQMS are both being recorded.

In table 7 shown above, we are able to see that the average time taken for the current queue management system to generate a paper ticket at the number station is 2.5 seconds while on the other hand, DQMS system takes an average of only 1.7s to generate the digital ticket in the form of QR Code on the screen. As for the average time before the customers queue number is being called in both systems are clocked in at 1200 seconds which is equivalent to 20 minutes. The time recorded for both systems are similar since the improvement being made on DQMS project does not affect the amount of time a customer is being served at the counter.

As for the waiting time spend by the customers at the waiting area, the current QMS clocked in at 1200 seconds while DQMS has a shorter time which is only 300 seconds. The difference of time by 900 seconds or 15 minutes is because customers in the DQMS environment are able to move around and have the freedom to do the things they would want to do and come back to the waiting area when they receive the notification from the application stating that there is only 5 customers ahead of them left. This will provide the customers their freedom to move around unlike the current QMS which limits the movement of the customers as they are required to monitor the current queue number from the LCD screen or risk losing their queue turn.

Through this comparison between the current QMS and the simulations of DQMS, it is obvious that DQMS is able to provide the customers the flexibility to move around and notify the customers when their queue number is approaching by sending notification alerts.

4.6 Recommendations for DQMS

By reviewing the results and analysis done in the system testing above, it is shown that the final product of DQMS is able to deliver the functionalities and requirements required in this project. The DQMS application is able to function well without errors occurring during the simulation and testing done. However, the application has its' own limitations as it can only be used with phones which are Android operating system compatible. Taking this into consideration, DQMS needs to improve itself by

developing the product for other smartphone users such as IOS and also Windows operating System.

Other recommendations which can be included for the future development of the project will be to include the functionality which enables users to check the length of the queue for each post office around the area before they even reach the venue as it will enable users to have the choice of choosing the post office which has the shortest queue and less crowded. This functionality will not only help the users as they will be able to save their waiting time on queuing but also spread the crowd which visits the post office evenly and not cause congestion of customers at any single post office. Furthermore, another functionality which will be useful is to replace the retrieving method of current queue number from server using internet to using the technology of near field connectivity (NFC). Since this technology is still new and it is only available in selected models of smartphones, it will take some time before this technology is applicable to the public.

Besides the functionality mentioned above, there is another recommendation which should be done for the future enhancement which is to provide statistics of the number of customers on the day and the time of the day which has the most number of customers. This functionality will gather the data and tabulate all the information available in a form of graph to be shown to the admin staff when requested to the system.

5 CONCLUSION

Currently, they are a lot of businesses which are implementing the queue management system service to keep their queues in order. Due to the rise of number in the usage of queue management system, several issues have been brought up in the current system. Problems which are being faced by the current queue management system are the wastage of papers when paper tickets are being dispensed to customers and the lack of an alert system for customers when they are queuing up in the long waiting queue.

In this project, the development of Droid Queue Management System (DQMS) will be replacing the paper tickets being dispensed from the ticket number kiosk with QR Codes which will be captured using customer's smartphones in the form of a virtual ticket. By replacing the paper ticket with the QR Codes, it will be able to reduce the usage of papers being dispensed from the number kiosk. Besides that, DQMS will also be providing another functionality which will provide the alert system to customers where notifications will be sent out to the users when their queue number is approaching. By doing this, the users will be able to take advantage of the waiting time to carry out other task instead of spending their time waiting for the number at the waiting area.

All the features and functionalities which are going to be developed in DQMS will be targeted to help improve the current queue management system being used. With the expanding of the current Android smartphone market, DQMS application will be feasible to be implemented in public areas and it will impact the society as users will receive the alert systems on the phones which will be more convenient besides helping mother-nature by reducing the paper wastage.

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APPENDIX

Questionnaire for Target Audience of DQMS

Age: *

Occupation *

Which Post Office branch you frequently visit?

How many times do you visit the post office in a month? *
- 2 or less
- 3 to 5 times
- more than 5 times

Does the post office you visit use the queue management system (QMS)? *
- Yes
- No

Do you have the experience of clicking on the wrong button on QMS machine? *
- Yes
- No

Do you throw away your number ticket or you keep it for recycling after performing your transaction? *
- Throw Away
- Keep for Recycling

What's the average time you need to wait before being served at the counter of post office? *
- 0 - 15 Minutes
- 15 - 30 Minutes
- More than 30 Minutes

Do you own an Android platform smartphone? *
- Yes
- No

In your opinion, can the current QMS in post office be improved on to help reduce paper usage? *
- Yes
- No

If a mobile application using the QR Technology is being developed to help solve the current issues faced by QMS in post office, are you willing to give it a try? *
- Yes
- No

Questionnaire for User System Testing

1. Occupation _____

2. Had experience using the queue management system?

    ☐ Yes

    ☐ No

3. Does DQMS mobile application fulfill the purpose of paper saving?

    ☐ Yes

    ☐ No

4. Does DQMS mobile application fulfill the purpose of providing alert system to users?

    ☐ Yes

    ☐ No

5. Is DQMS feasible to be implemented in the current queue management system?

    ☐ Yes

    ☐ No

6. Please justify your reasons for the selection you made in Question 5.

_____

_____

7. Please specify your opinions on the application and what other further functionalities which users would expect more from the DQMS application.

_____

_____

_____

_____