

BLINDSHOPPING: NAVIGATION SYSTEM

The QR Trail

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ABSTRACT

The QR trail is an android application that designed to encourage visually challenged person to participate in more normal activities as normal person does. Moreover, this application can be used by normal person as well to navigate around places when the person lost in a way. The main purpose of the project is to provide a navigation system for the visually challenged person to move around autonomously in supermarkets or hypermarkets and do some shopping. The application will provide a guidance for visually impaired person through voice command from the smartphone as the user need to scan QR codes on the floor which contains the details of current location and instruction to move from one point of the shopping mall to another point. The development of this application will use Eclipse development tool. The programming language that will be used the development process in Java language and ZXing library. The rapid application development methodology is applied in development process of this application which consists 4 stages which are system design, prototype cycle, system testing and implication. This system will be further enhanced if it is necessary to meet the objective of this project.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

Visual impairment is one of the common disability largely found. According to 2013 World Health Organization (WHO) survey 285 million people are estimated to be visually impaired worldwide which 39 million are blind and 246 have low vision. Moreover, about 90% of the world's visually impaired live in developing countries.

In Malaysia this disability is commonly known and there are large number of people affected by it. As Malaysia going through modernization phase, more visually impaired persons are trying overcome their disability and want to have a common man's life. This been a positive change on visually impaired society since there been a lot of measures taken by government and non-government organization to improve their lifestyle. Currently there are more number of visually impaired person are moving within the streets as normal people with help of white cane with a red tip; the international symbol of blindness.

However, in Malaysia the most common and major problem faced by the visually impaired persons is mobility. Currently, there been only few measures taken in the capital city of Malaysia which is the Kuala Lumpur on helping the visually impaired people on mobility. For example, blocks are installed mainly at rail, subway, LRT and monorail stations and the surrounding sidewalks. In some locations warning and directional blocks are installed while in other locations directional indicators are carved into the pavement and warning blocks are installed where direction markers intersect and where pedestrians are to stop. Due to this architectural improvement, number of visually impaired people mobilization highly concentrated within the Kuala Lumpur streets compare to any other part of Malaysia.

Tactile paving proved to be one of the effective way on helping the visually impaired people but it is expensive and for already built buildings or pathways it is not cost effective to restructure it. Besides that, there been many devices developed by many researches and inventors on helping

mobility of the visually impaired people and it did not accepted largely in Malaysia either due to high cost of purchasing it or too techy for Malaysia culture.

Since smartpone become a big leap in human culture currently, many researches focused and developed application is many platforms for visually impaired people. Smartphone is a common technology device owned almost by most of the people include visually impaired people. In that case, it is the most effective method to develop app which help visually impaired people to moving around or improve their mobility chance. So, there are many apps can be found on market currently and many to come more. Each have their own unique functionality, scope and method. There have been few invention on devices and apps so far for visually challenged people to go shopping and buy things. But, it either being expensive to purchase by Malaysians or not compatible to use it in Malaysia.

1.2 PROBLEM STATEMENT

Visually challenged people are facing hard time to moving around. This cause them to not having a normal lifestyle as a common man or as they wish. This issue can be related to many daily activities. Author have focused on solving the issue of visually impaired person on moving around supermarkets to buy things. At the same time people who are new to a place having difficulties in getting to the intended destination and may get lost in moving around on their own. Therefore the author came out with the idea to develop a mobile application in android platform called QR Trail – app for visually impaired person mobilization. This mobile will help to overcome the problem of moving especially within the supermarket and hypermarkets. At the same time, author planned to develop the app to be easily implemented with less cost and compatible with Malaysian environment. Besides that, author will use QR code technology on developing this app which will be a platform to increase the usage of QR code technology more in Malaysia.

1.3 OBJECTIVE

The author has set three objectives that need to be achieved which is:

1. Visually challenged person find difficulties in moving autonomously without the help of someone else around in shopping malls.
2. People who are new to a place having difficulties in getting to the intended destination and may get lost in moving around on their own.
3. To develop an app with an inexpensive solution and easily deployable in smart phones in Malaysian environment.
4. To increase the usage of QR code and NFC technology within Malaysians.

1.4 SCOPE OF STUDY

The scope of developing QR Trail Mobile Application is defined specifically for the visually impaired or partially impaired smart phone users with age range from 13 years old till 30 years old. This mobile application will be developed on Android platform. Besides that, author's app requires a part implementation process from the supermarket side. Therefore, the scope of study includes the supermarkets and hypermarkets where this app going to be use by the users. The focus will be on supermarkets and hypermarkets own by big organization where it is big space to explore by visually impaired people and big organization will keen to implement such practices where social responsibility is part of their business model.

Moreover, author have planned if this app is successfully implemented and used; using the same concept can be implemented in streets of Malaysia. Scope of study required more on capability of QR code and how it can be used in moving visually impaired people.

1.5 LIMITATION

The limitation of the application is to keep the smartphones to stay connect with internet connection through 3G or 4G. Since, GPS navigation requires internet connections whereas in

Malaysia some of the places the 3G or 4G connections are still unavailable or weak. Besides that, it is will challenging for visually impaired people to find the QR code to scan it.

1.6 FEASIBILITY STUDIES

1.6.1 Technical Feasibility

There are a lot of benefits when doing a project based on Android Smartphone. This is proven by the research done by Gartner whereby the worldwide Smartphone sales are reaching 468 million units in 2011, increasing 57.7% from 2010. Android is becoming the most popular operating system (OS) worldwide and building on its strength to account for 49% of the Smartphone market. Therefore, there will be a good point to develop this project for Android as more people are using it. Besides that, QR code technology is an easy technology which have high potential and can creatively make use of it.

1.6.2 Economic Feasibility

The application is builds in android platform. All the software and coding is open source so and no cost occurs along the development time. This application is upload in Google Play and can be download for free into all smartphones that running android operating system. Moreover, QR code can be generator free from many sites and services. As overall, this project is considered economic feasible.

16.3 Organizational Feasibility

This system will be an introduction for every supermarket and hypermarkets in Malaysia. This app is meant for blind or visually impaired to navigate within the premises and ease them in shopping. Besides that, implementation of the app will be accepted and welcome by most of the supermarket and hypermarket in the form corporate social responsibility. From the perspective of the supermarkets and hypermarkets the system is organizational feasible.

1.7 SWOT ANALYSIS

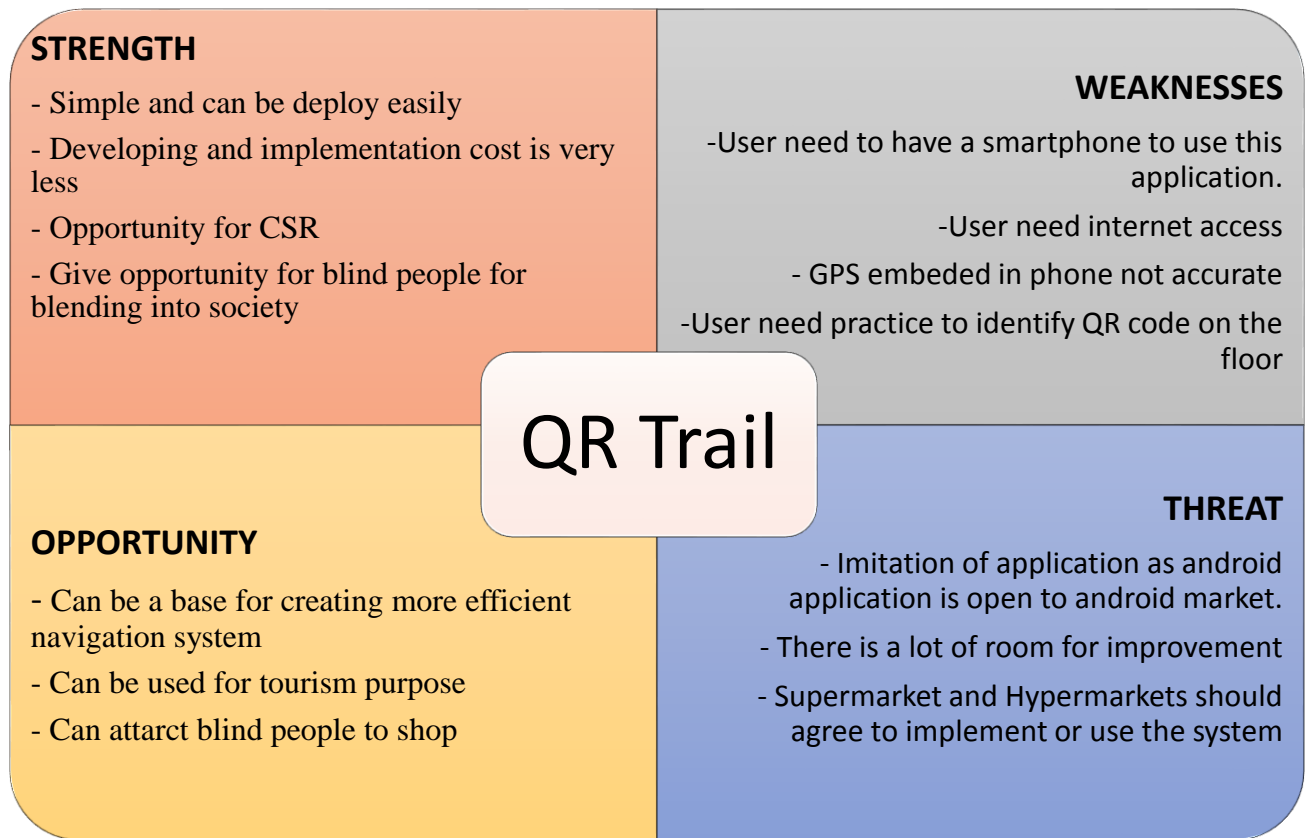


Figure 1: SWOT Analysis for QR Trail

CHAPTER 2

LITERATURE REVIEW

2.1 MANUVERING OF VISUALLY IMPAIRED PEOPLE

People who are blind rely on their other senses-smell, touch, hearing, taste-to help them manage in the world. Blind people have to memorize identifying features, like sounds and smells, of the places that they often go. They also have to pay close attention to where things are located in their homes in order to get around safely, always putting objects in the same places after use so that they can be found again.

Some blind people use canes or guide dogs to get around. A white cane indicates that the person using it is visually impaired. Blind people tap their canes on sidewalks, floors, and streets. They learn to identify the locations of things-like steps, walls, or doors-simply by the different sounds that their cane taps make. Various high-tech devices have been invented, including laser canes, that use sound or light waves that bounce off objects and send signals to the user about where these objects are located, what they might be made of, and how big they are. Guide dogs, or seeing-eye dogs, are specially trained to lead blind people about. The dog and the person work as a team, with the dog following commands that help the blind person go about her day. The dog, in turn, signals the person when she is approaching a curb or when it is safe to cross a street.[1]

Besides that, visually challenged people are given Orientation and Mobility (O&M) training to ease them more on moving around. Visually impaired people who graduated from O&M training have special skills and are more capable in moving. Orientation is the ability to use one's remaining senses to understand one's location in the environment at any given time. While mobility is the capacity or facility of movement. Orientation and mobility defined as teaching the concepts, skills and techniques required by the visually challenged people to travel safely, efficiently, and gracefully through any environment and under all circumstances. There are many modules taught during the O&M training. There important modules that involves visually impaired people's

moving are predicates to independent mobility, basic long cane and self-familiarization skills, and indoor and outdoor orientation and mobility skills.[2]

Moreover, there are proper way of using and handling the white cane. Visually impaired people will use the cane as per taught to them and the guidance are universally accepted and practiced. The proper way is that the wrist will settle to somewhere between the belly button and waist, slightly to one side, and cane will be gently swing from side to side. The tip will be always stay in contact with the ground, swinging approximately the width of shoulders. When walking, the swing will be alternate with the steps. As the visually impaired person steps with the right foot, the cane will go to the left, and vice-versa. If the cane is swinging in the wrong direction, the cane will be stopped in that general direction and fix it with next few steps. The head be held high and shoulders kept relaxed. This will allow to use any remaining vision and whatever hearing to aid mobility.

2.2 NAVIGATION SYSTEM

Navigation system is most crucial part of this project. This is most important for guiding the visually impaired person throughout the supermarkets or hypermarkets because the lack of visual disability. Navigation will ease them to moving and make them faster reach the destination they wish to reach. At the same times, it will boost their confident that they are in right path. There been a lot of studies, research and invention in blind shopping.

2.2.1 RFID

Radio-frequency identification (RFID) is the wireless non-contact use of radio frequency electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects. The tags contain electronically stored information. Some tags are powered by and read at short ranges via magnetic fields. Past years RFID have been the primary technology used by many researchers in developing innovation in blind shopping. In Utah State University, Robocart a robotic supermarket assistant in the form of a custom built market cart with a laptop, laser range finder and RFID reader was developed. They uses the RFID reader attached to the cart and passive RFID tags scattered at the different points in a supermarket for the navigation part. Navigation part been challenge for many of the inventions. Even RFID been a successful breakthrough and promising, but it presents problems such as cost of tags and readers

remain prohibitive for tagging all but high-value products.[3] Moreover, technical problems, environment hazards and consumer perception of trust, privacy and risk, mixed with fear remain significant acceptance barriers to RFID item-level tagging. Most of the inventions still depend on usage of the white canes in their products such as Tinetra. Meanwhile, Carnegie Mellon University presented GroZi where they use a verbal feedback for navigation. [4]

Beside that another successful way of using RFID to help the visually impaired person to moving around supermarkets or hypermarkets is by white cane augmented with an RFID reader at its tip. It provides through a headphone connected to the smartphone simple verbal navigation instructions. It combines a white cane with a portable RFID reader attached to its tip, a set of road mark-like RFID tag lines distributed throughout the corridors of the supermarkets and hypermarkets. This approached was used by the same Utah State University researchers in a product called ShopTalk. Besides that, iCare another innovation where they still relied on RFID reader embedded in a hand glove to detect the location. When the user mover the hand along the shelf, the system will indicate the user what location are you passing or in. But still for more effectiveness iCare still use white cane enhanced with an RFID reader. [5]



Figure 2: Navigation using white cane augmented with RFID reader

2.2.2 NFC

Near field communication (NFC) is a set of standards for smartphones and similar devices to establish radio communication with each other by touching them together or bringing them into close proximity. Communication is also possible between an NFC device and an unpowered NFC chip called a "tag". NFC standards cover communications protocols and data exchange formats, and are based on existing radio-frequency identification (RFID) standards.

With the growing number of NFC-equipped phones, NFC tags are becoming an increasingly popular way to take advantage of this sprouting technology.

NFC is another promising technology that enable use in inventing shopping for visually impaired people or replace RFID in process of creating this system. This is due to, the simplicity transactions are initialized automatically after touching a reader, another NFC device or NFC compliant transponder. This simplicity allow many NFC enabled application and services are developed which are operating in three different modes which are reader/writer, peer-to-peer and card emulation. So far, NFC only been used in payment, ticketing, loyalty services, identification, access control, content distribution, smart advertising, peer-to-peer data/money transfers and set-up services. NFC technology is a promising technology and a booming technology. More application and services can be relied or developed using NFC.

But, there are some setbacks in NFC that RFID is providing such as NFC readers work at a maximum range of about 4 inches (10 centimeters). NFC readers are not suitable for RFID style inventory tracking; their range is too short. NFC is more up-close-and-personal type of wireless.[6]

2.2.3 QR CODE

QR Codes, “QR” abbreviated from Quick Responses, are rapidly growing marketing phenomenon currently. The QR code is a two dimensional (datamatrix) barcode that is designed to be scanned by smartphone camera, in combination with a barcode decoding application.



Figure 3: QR Code

Data are translated into a QR code by QR generators which are available in online for free. The decoding software available in smartphones interprets the code and the hand phone will display the text or launch a browser to display specified web page.

QR code technology is another promising technology that can be used in navigation and replace RFID. Even though the usage of the QR code still focused on product tracking, item identification, time tracking, document management and general marketing, but still the capability of the QR code technology is high. This is because QR code's storage capacity is greater than standard UPC barcodes. At the same time, QR code is free to generate and free to scan. Unfortunately, the set back is to scan a QR code the device, smart phone need to be connected to internet or stay online.

2.3 INTERACTION BETWEEN SYSTEM AND USER

Interaction is another crucial part for the system where the communication, interaction and delivery from the system or between user and system must be smooth and successful. The system must be user friendly to the visually impaired person. The system must be easily navigated within the smartphone and ease to handle the system. The more easy the system to be used or handled by the user the more the user friendliness of the system.

2.3.1 Interface

The interface designed to the system must focus on the ability and capability of the visually challenged people. The interface is not important to be attractive with objects, animation or colors. The higher priority should be given to the functionality and usability. The buttons on the smartphone screen should be in appropriate size which will be bigger than normally created in apps and easily navigated by the user to be identify by them. The hard part of the designing of the interface is that the smartphones available in markets are vary in sizes. So, the optimal design need to be identify so that the created design is suitable to be used in all devices.

2.3.2 Input

Input by the user into the system can be done through clicking the created the buttons, gesture interface and voice command. Each have it is own advantages and weaknesses.

2.3.2.1 Buttons

Buttons are something fixed in the system, where the user visually impaired user can memories after several usage. But, there are possibilities of user make mistake by clicking wrong buttons and not knowing it. Besides that, user also can make mistake if the smartphone is hold in different direction. The tendency of the user to make mistake is button type of input is very high.

2.3.2.2 Voice Command

Input through voice command is very convenient where can be done without hand movement and through headphone embedded with microphones. It is easy for user to send desirable commands to the system even without taking out smartphone from the pocket. But the problems arise when the system cannot identify the command due to interference such as crowed

supermarkets and hypermarkets, announcement made in supermarkets and songs or advertisement played in supermarkets. Moreover, there are chances where the system cannot understand the user's command due to the user's dialect or slang. There possibility that the user need to voice out to give command where it will get unnecessary attention of other people around which most of the disable people not comfortable with.

2.3.2.3 Gesture Interface

Input through gesture interface is most suitable because the user can write anywhere on the screen of their smartphone. There no need to navigate to find buttons and it can be done silently without getting attentions. For example, user can write "F" on the screen to get direction to the fish market section in the supermarket. The disadvantage is the user need to hold on their phone.[5]

2.3.3 Output

Since the possible logic state that visually impaired people are not visible to colors, objects and animations, it most appropriate to use voice/sound and vibration as output. The system must communicate or send information through sound to the user via voice instructions or short music. The command will be heard through headphone for clearness and avoid unnecessary attentions. Vibrations also can be a good output to notify the user discretely where the only the user can receive the notification.

2.4 USAGE OF SMARTPHONE WITHIN VISUALLY IMPAIRED PEOPLE

There been study conducted on rate of usage of smartphone by the visually impaired people and the purpose of their usage by J. Liimatainen.[7] Questionnaires have been given to the visually impaired people consists of group of eleven. There were 6 blind and 5 low vision people in that group. The questionnaire covered the usage of the smartphones in everyday tasks and special questions about the mobile applications for physical activity. Figure 3 shows the results of the questionnaire conducted.

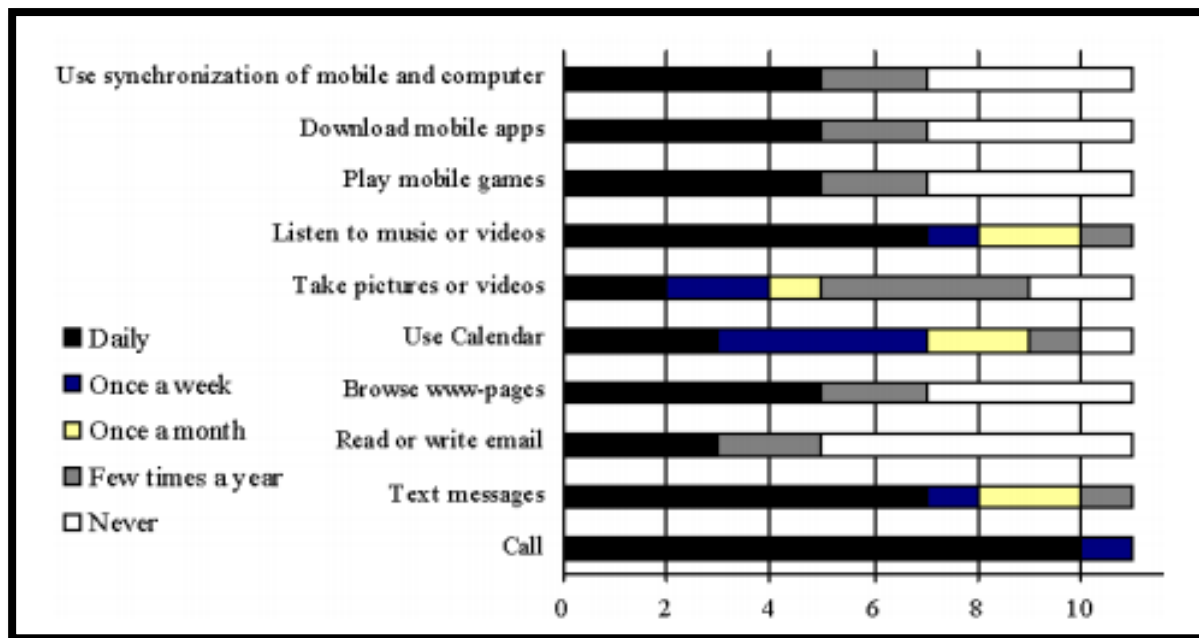


Table 1: Results of the Questionnaire Conducted

The results shows, most of the people either owned (36.4%) or had tried (54.5%) smartphones or feature phones with touch screen. The average experience of using mobile phones was 6-9 years. More than half (54.5%) of the people had experience with mobile game application. One of the person from the group had tried physical activity or health-related computer or mobile application before. Mostly the daily usage of mobile phone been for calling, text messages and listening music or radio. This study shows the usage of smartphone within visually impaired people are high and the eagerness of using it for their daily purpose or task are also high. [7]

2.5 ANDROID AS A MOBILE DEVELOPMENT PLATFORM

There are two most popular operating system (OS) that operate almost in all smart phones that available today which are iOS from Apple and Android, an open source mobile operating system. The best to choose android operating system as the platform to build system for the visually impaired people to do shopping in supermarkets or hypermarkets. One of the main reasons on why to choose Android platform is because the tendency for android application to crash is lesser compare to iOS. Below are the data gathered from the Crittercism, a mobile app. monitoring startup.

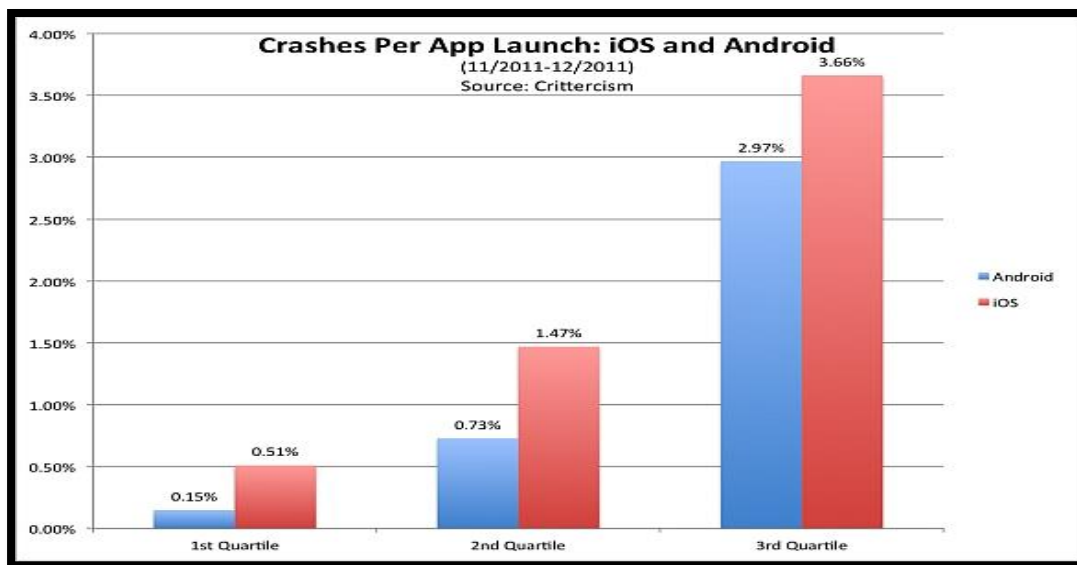


Table 2: Data of crashed per app launch compared between iOS and Android

Basically the data shows that iOS apps crashed more frequently than comparable apps on Android. As you can see in the data presented, iOS apps on iPhone, iPad and iPods Touch make up nearly 75% of total crashes in the period that the data was gathered. The researchers suggests that the reason why Android apps see far less crashes than iOS apps is because the Android platform allows developers to send out updates faster and users are able to set their Android devices to auto-update apps which allow bugs to be fixed much faster than can be done on iOS. On iOS developers pushing updates have to go through an approval process which can take weeks and there is no auto-update for users using iOS. On a day-to-day basis we do see more app crashes on iOS than on Android.

Besides that, the Android gains a lot of user because technology platform markets tend to standardize around a single dominant platform like Windows in PCs, Facebook in social, and Google in search. The developers are strongly support Android platform by building their apps and provide it to the Android. There are also two most popular Android application stores, GetJar and Google Play. Both GetJar and Google Play offer the user free and paid Android applications, and users can choose what type of applications they want to download.

CHAPTER 3

METHODOLOGY

4.1 RESEARCH AND PROJECT DEVELOPMENT METHODOLOGY

4.1.1 Methodology

In developing QR Trail app, the type of methodology to be used is Rapid Application Development (RAD) method. As the time given to develop the complete working prototype is only 10 months, RAD method is the suitable methodology because it enables the system to be developed faster. RAD is a concept of method that can help develop the system faster and of higher quality.

This methodology is also chosen as RAD could allow developer to do a lot of testing during the development phase. QR Trail App is a new type of navigation system that uses a smartphone for visually impaired person; therefore developer need to start develops this system from scratch. For these reason, developer is expected to face some error during developing this system. By using RAD methodology, developer able to fixed the system if an error is found during testing phase.

Besides, as the budget to develop this system is small, RAD could help reduce the development cost of this project as it provides flexibility to completely develop the system. [8] In order to satisfy the customer, developer might need to upgrade the system in future. Therefore, by apply the RAD method, developer can able to do the changes in the system faster and more efficient.

Under this methodology, the whole system development will be divided into four main phase of Rapid Application Development such as below:

- I. Requirement analysis and System design
- II. Prototyping cycles
- III. Testing
- IV. Implementation

3.2 Key Milestone

1. Final Year Project 1

Activities \ Week	1	2	3	4	5	6	7	8	9	10	11	12	13
Finding Supervisor	x												
Research on propose title		x	x										
Propose final chosen title			x										
Project analysis				x	x	x	x						
Planning system design							x	x	x	x			
Project Testing										x	x		
Market Survey							x	x	x	x	x		
Analyze data												x	x

Table 3: Key Milestone Final Year Project 1

2. Final Year Project 2

Activities \ Week	1	2	3	4	5	6	7	8	9	10	11	12	13
Development	x	x	x	x	x	x	x	x					
Design Interface	x	x	x										
System Function				x	x	x	x	x					
System Database						x	x	x					
System Testing									x	x			
Internal Testing									x	x			
Review complete prototype with supervisor											x		
Maintenance												x	x

Table 4: Key Milestone Final Year Project 2

Table below shows the key milestone that the author needs to achieve during entire timeline of from Sept 2013 until April 2014 in Final Year Project (FYP).

Key Milestone	Date
Project Proposal	29 September 2013
Extended Proposal (10%)	30 November 2013
Proposal Defense (40%)	11 December 2013
Interim Report (50%)	18 December 2013
Progress Report (10%)	06 February 2014
Pre-SEDEX (10%)	24 March 2014
Dissertation (40%)	30 April 2014
VIVA (30%)	22 April 2014
Technical Report (10%)	7 April 2014

Table 5: Final Year Project Milestone

3.3 Gantt chart

		2013				2014			
2	Task Name	September	October	November	December	January	February	March	April
3	Propose the project title								
4	Plan the project								
5	Feasibility analysis								
6	Create work plan								
7	Analysis								
8	Information and data gathering								
9	Requirement gathering and analysis								
10	Design								
11	Develop UML								
12	Develop Interface								
13	Develop a prototype								
14	Implementation								
15	Test the system								
16	Gather users feedback								
17	Iteration 3,4,5								
18	Delivery the project								

Figure 4: Gantt chart for Final Year Project 1 and 2

3.4 Project Activities

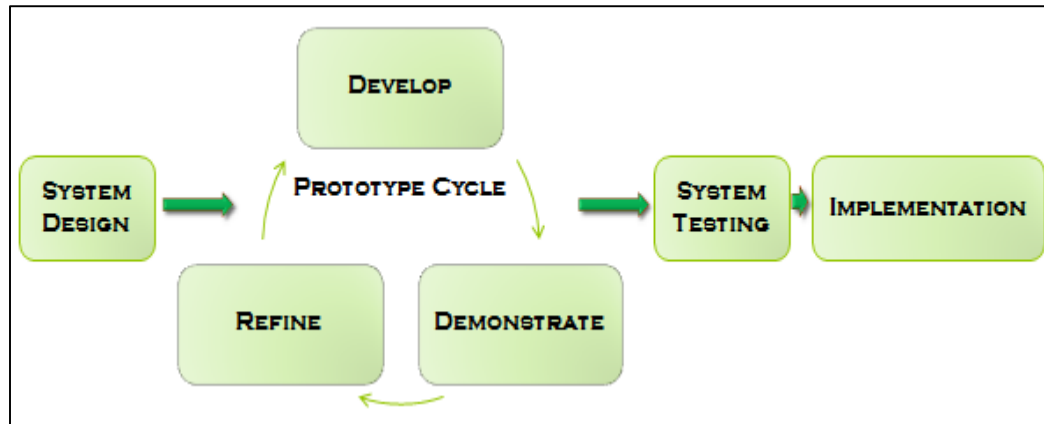


Figure 5: Rapid Application Development Cycle.

1. Requirement analysis and System design

This is the first phase of system development. Firstly, author have analysis and discover the important requirement needed based on the functionality of this system so that the system able to achieve the objective of this system.

QR Trail App to implement for usage, it requires a QR code to be generated and must content the audio file of the current position and instruction for moving to next position. The QR code that contains the audio file will be stick on the floor for the user which is the visually impaired person to track or identify it. The audio file which have created will be stored in some free servers or paid servers. Multiple QR code will be stick on the floor in each department.

Tracking and identifying the QR code that been stick on the floor will require a white cane which the visually impaired person often possessed and used for his moving purpose. The white cane usage which author believe mastered by the visually impaired person need to be function as the identifier for the QR code stick on the floor of supermarkets or hypermarkets.

Once identified and scanned, the instruction will be played and user will choose for desired location where the app will guide the user using GPS. The app will guide to desired location chosen by the user where another QR code on the chosen department will be end point. So, user can choose either stop and shop or continue scan and move again.

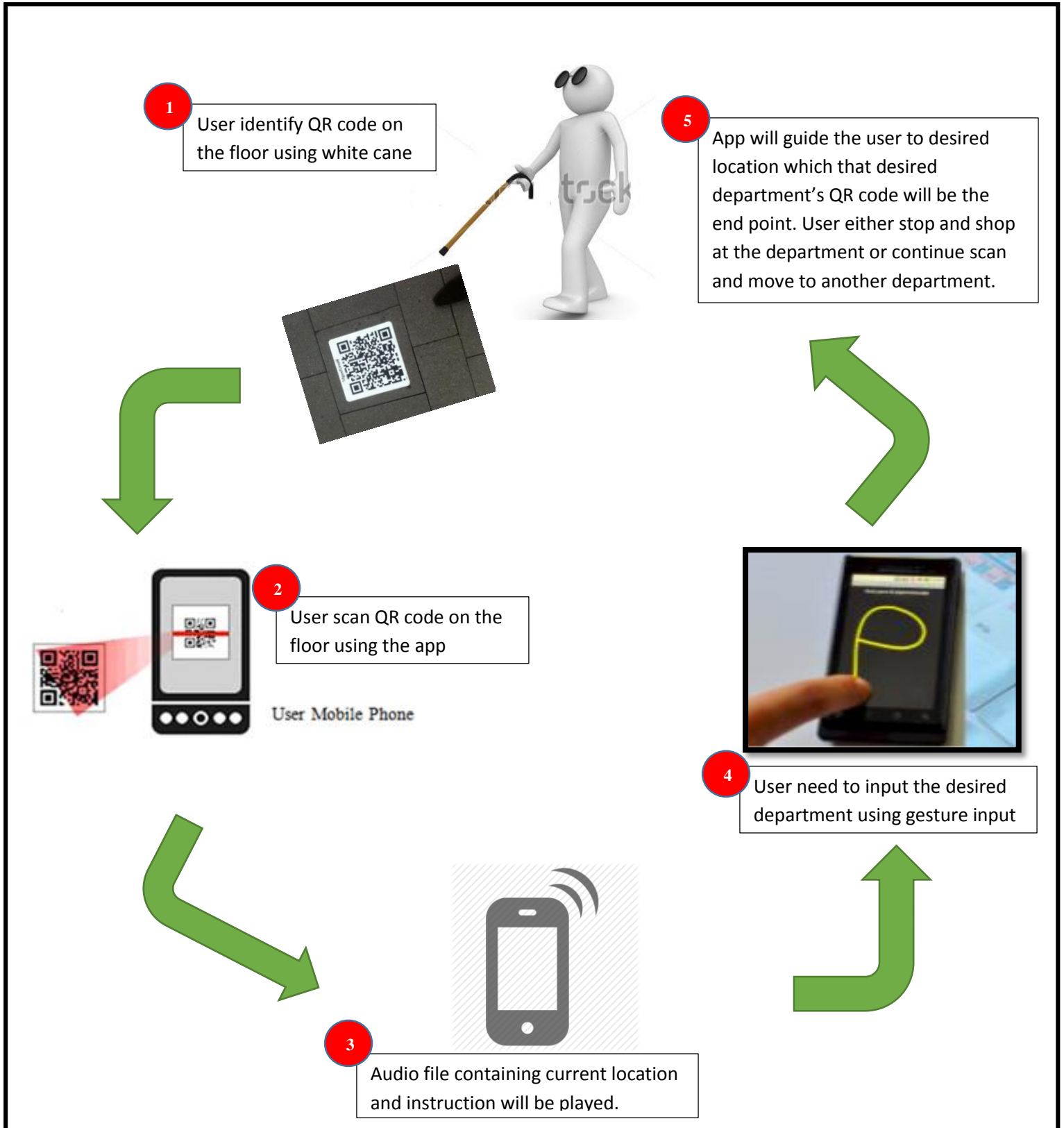


Figure 6: System design of QR Trail App

I. Process Flow of QR Trail App :

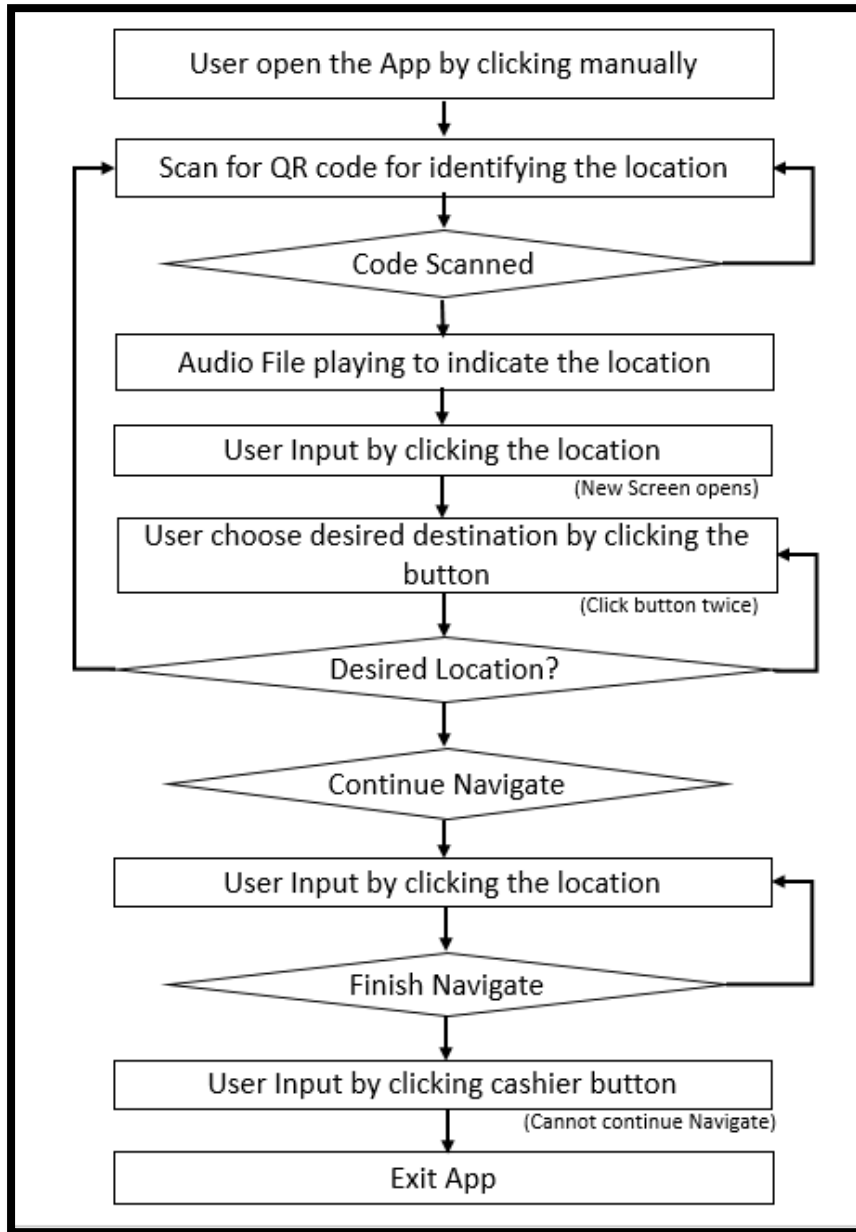


Figure 7: Process Flow of QR Trail App

II. Technologies to be applied in the QR Trail App:

a) Quick Response (QR) code:

- Quick Response or QR code is a two dimensional code design to encode information. The QR code is a trademark for a type of matrix barcode which different it is fast readability and have large storage capacity. The information encoded can be made up of four standardized kinds ("modes") of data (numeric, alphanumeric, byte/binary, Kanji), or through supported extensions, virtually any kind of data. QR Code carries information both horizontally and vertically, QR Code is capable of encoding the same amount of data in approximately one-tenth the space of a traditional bar code

Process Flow of QR code:

- Process 1: Converting the information into a QR code:

The process of converting the information into a QR code is to be done by an application called QR code generator.

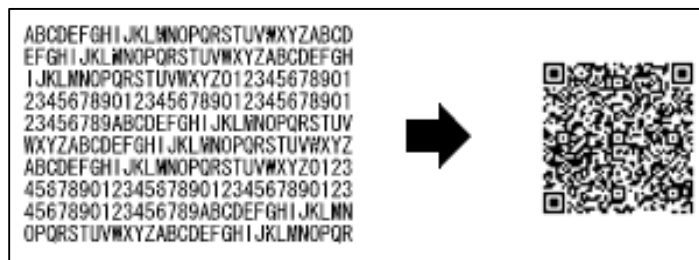


Figure 8: Converting process of information into a QR code

Retrieved from: <http://archive.is/20120915/http://www.qrcode.com/en/qrfeature.html>

The process involved in converting audio file into QR code:

1. Recordmp3.org, used to record the instruction online.
 2. It then saves the recording to the web.
 3. It supplies with a URL that will take anyone who has it to your audio file. This link copied and create your QR Code.
 4. URL created for your audio file from Recordmp3.org pasted to any QR code generators
 5. The QR code ready to be printed.
- Process 2: Translate the information in the QR code:

The process of translating the information in the QR code is to be done by a QR code reader function within the QR Trail App. The device that will be functional as the QR code translator must be equipped with a camera because the device needs to capture the QR code image. After the image has been captured, the QR code reader will process the QR code image and then translate all the information stored in the QR code image. In this case, the information is the URL which will link to audio file.

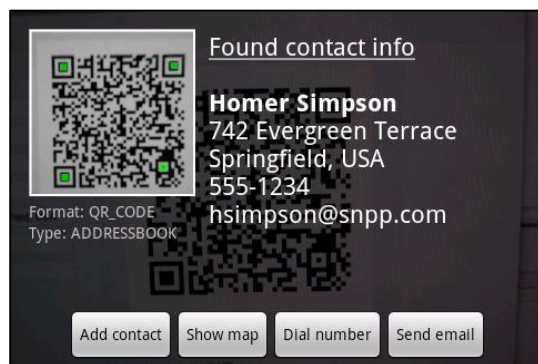


Figure 9: Translating the information stored in the QR code image

Retrieved from: <http://theitechblog.com/1552/11-best-qr-bar-code-reader-scanner-apps-android/>

b) The White Cane

There are many different kinds of tip and not all of them may be suitable for the kind of cane used for certain purpose. If using a particular tip is important to understand and then make sure it is compatible with the cane visually impaired considering before making a final decision. Some cane tip options are:

- The pointer tip. This is like a finger on the end of the cane. It's tapped over the ground so may give less information about the terrain. This tip is traditionally used with a guide cane.
- The ball tip. This is a ball the size of a small apple which is rolled over the ground in front of the user. It provides much more information about the terrain and has become a very popular choice for long cane users.

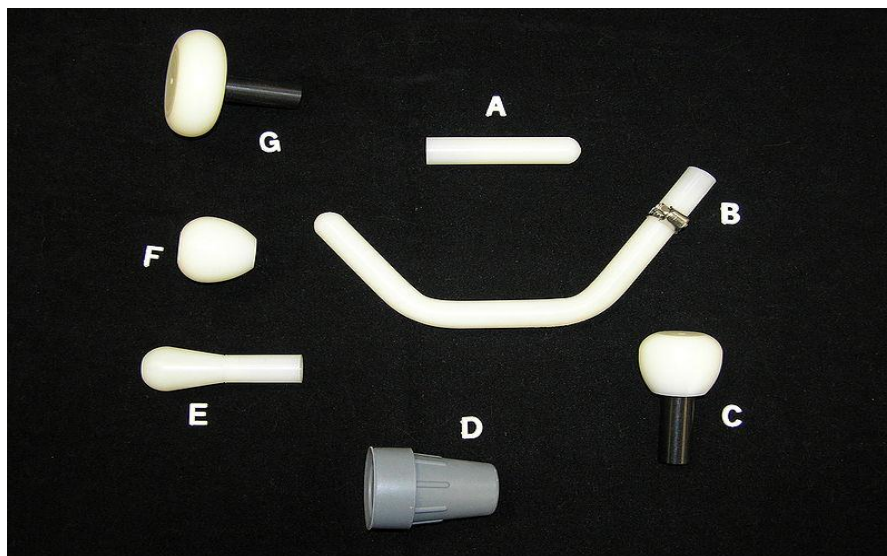


Figure 10: Variety of Cane tips

A = Pencil Tip, B = Bundu Basher Tip, C = Ball Race Overfit Tip, D = Rubber Support Cane Tip, E = Pear Tip, F = Rural Tip, G = Jumbo Roller Tip

c) Global Positioning System

These days most Android smartphone have AGPS (Assisted GPS) chips installed which takes the help of network towers and WI-FI hot spots to quickly determine the location nearby and help the Android GPS enabled smartphone to get a lock with GPS satellites. Android smartphones with AGPS chips can also have a lock with GPS satellites without the need of data plan or network but require clear sky view and some time to have a lock with GPS satellites. After user chose the desired location or department to go, these GPS functionality will be used to guide the user to move from one department to another department. The starting and the end point of each movement will be the QR codes. The QR code scanned will act as the starting point will the QR code at chosen location or department will be end point.

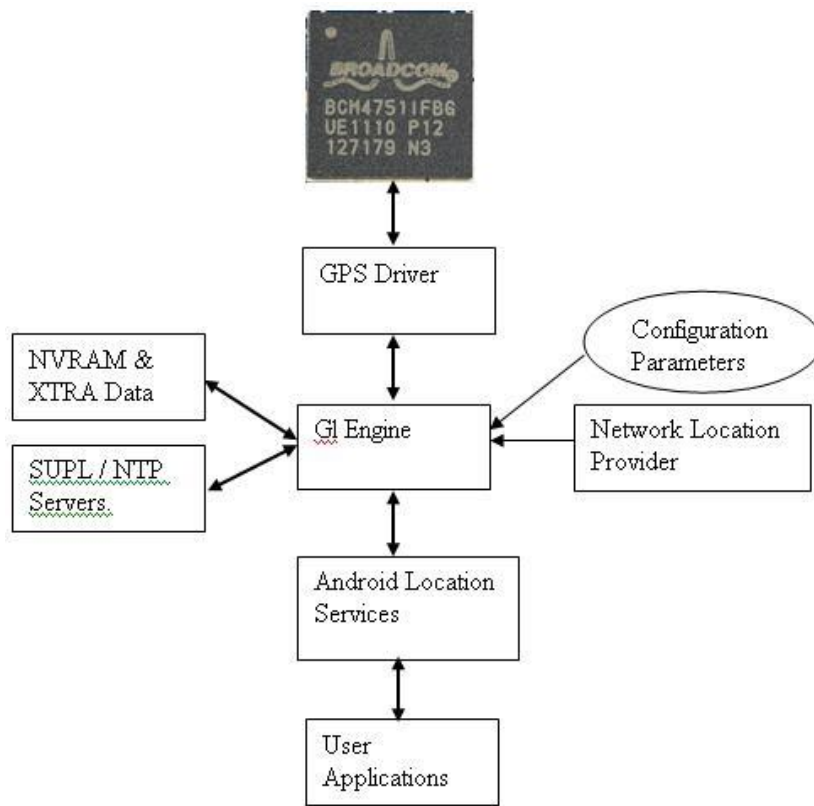



Figure 11: Android GPS Architecture

III. QR Trail App requirement:

- a. Mobile Phone
 - i. Built on mobile operating system : Android
- b. The smartphone have back camera.
- c. The smartphone must have built in GPS
- d. The visually impaired user must have a white cane

Current progress in system design:

The initial interfaces of QR Trail application have been completed. The development of the real interface will base on this initial interface.

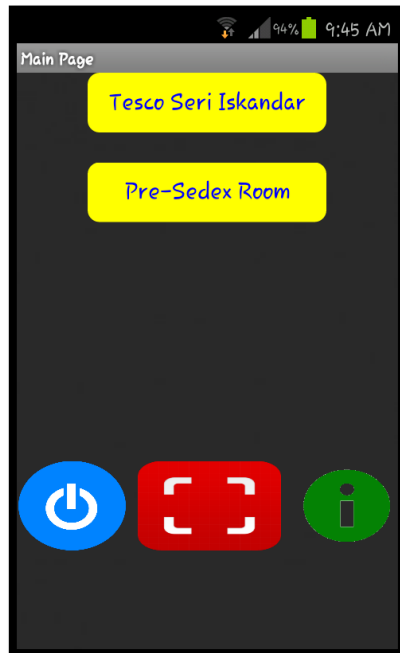
Interface	Information
<p>Process 1</p> 	<ul style="list-style-type: none"> ❖ Once the App is clicked, the first screen will be the QR code scanner. ❖ Using the phone’s camera ❖ The interface will be the camera

Process 2:



- ❖ After QR code scanned, the app straight away go to audio player to play the current location and the instruction.
- ❖ The audio will be played until user tap on the screen.

Process 3:



- ❖ After user tap the screen on the audio interface, gesture input interface will come out for user to input the desired location
- ❖ For example, in the instruction tells 1 for grocery, 2 for bread and 3 for cashier; user now have to write 1 or 2 or 3 on this screen.

Process 4:



- ❖ Once the user input the desired location using gesture input, now the app will guide the user to the location using voice command.
- ❖ There will no activities will be done on the screen as interface just points arrow which to indicates that guiding process going on

Process 5:



- ❖ Once the user reach the desired location, the app automatically switched to QR code reader screen.
- ❖ Now user either can exit the app or continue using the app by scanning QR code again.

Interface for QR code on the floor

Figure 12: QR Code Proposed Interface

2. Prototyping cycles

In the prototyping cycles, there will be three main steps which are develop, demonstrate and refine. After the system design process has been finalized, the system prototype built. As been planned in the key milestone, the prototype development started in Final Year Project 2. However, the initial design of the system interfaces has been done during Final Year Project 1.

The development of this system started on the first week of Final Year Project 2. From the key milestone, the development process took eight weeks to complete. There were three activities in the development process. The first activity is to design the real interface for the system. The interfaces design based on the initial design that has been done during the Final Year Project 1. The real interfaces design process is expected to complete in three weeks.

After the interfaces have been completed, author start to develop the system function. The development of system function took five weeks to complete. Author used Eclipse IDE development tools. In Eclipse IDE, author used Java language to code the QR Trail app function. ZXing (Zebra Crossing) library is used to code QR code scanner. Can call on the resources in this open source library within our app, retrieving and processing the returned results. By importing the ZXing integration classes into QR Trail app, can make user scans easier and focus our development efforts on handling the scan results.

In the demonstrate process, author used android emulator to test run the system prototype. The aim of this process is to check the system prototype. If the system prototype is completely functional and meets the entire system requirement, then the prototype is ready to proceed with system testing stages. However, if the system prototype is fail during the demonstration process, the prototype undergo the refining process.

In the refining process, author re-built the system prototype and fix the problem found in the previous system prototype. The prototyping cycles continued until the complete working prototype is done and ready to the next stages.

Development Tools:

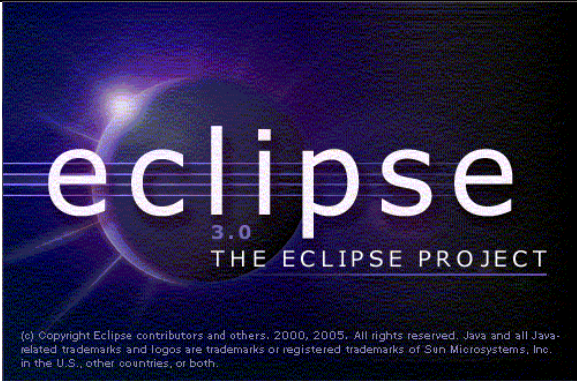

1	Eclipse IDE	
2	Android Emulator	

Table 6: Development tools

QR Coder Scanner Application for QR Trail App

In order to read the QR code placed on the floor, the QR Trail app need a QR code reader. Rather than creating a new QR code reader application inside the QR Trail app, author decided to integrate an existing QR code reader. This is because, existing QR code reader have a vast database of barcode list, have very few crashing incident and have the highest verdict compare any other scanner.

Author have chosen Zebra Crossing well known as ZXing barcode and QR code scanner. ZXing allows a user to scan single dimension or two dimension graphical barcodes with the camera on their Android devices. ZXing is an open source app which allow author to integrate with QR trail app without any fees.

Steps involves in integrating ZXing App into QR trail App

- **Step1:** Obtain the ZXing source code

ZXing source code can be obtain from many resources, since ZXing is commonly used many programmers and it is an open source. Author obtained from following resource:

<http://code.google.com/p/zxing/source/browse/trunk.>

- **Step 2:** Build ZXing core using Apache Ant

Author build the core project into a jar file using apache ant which was downloaded from here: <http://ant.apache.org/ivy/download.cgi>

- **Step 3:** Build ZXing Android using Eclipse

Create a New Android Project and name it to ZXing. Then, add the core.jar file into our project.

- **Step 4:** Include ZXing Android into your project.

These are the methods taken for integrating the ZXing into QR trail for scanning the QR code.

3. System Testing

The testing of the QR Trail App conducted by continuously tested on the ease of usability. Once a problem is identify, the app undergo further development to rectify the issues rose. The preliminary test conducted using visually well users, then the test go next level where the visually well users e tested by covering their eyes. This will helpful to understand which part of the app need to be improve for users ease on using the app

Once the app is tested and satisfy, then the testing done using the visually challenged person. This is to ensure, the app first easy to use by the normal people then he can brought to test by visually impaired person. This will ensure the success of the testing.

4. Implementation

After the prototype has been finalized, the implementation stage started. Before the system is ready to be implementing, the final prototype version review by supervisor. The system is expected to be review by supervisor during Final Year Project 2 in week 11.

The system prototype implemented in the chosen target user which is TESCO Seri Iskandar, Perak. The reason to choose TESCO Seri Iskandar, Perak is because this hypermarket has a big space, near to author's university and less crowded where the implementation will be easy for test trial. Author also believe can find easily volunteers for the test trials around this area.

During the implementation process, author tested the app prototype whether this app can deliberate the function for the visually impaired person to move autonomously around the hypermarket. If the app able to deliver the function successfully and accepted by the users it is mean the app prototype is successful.

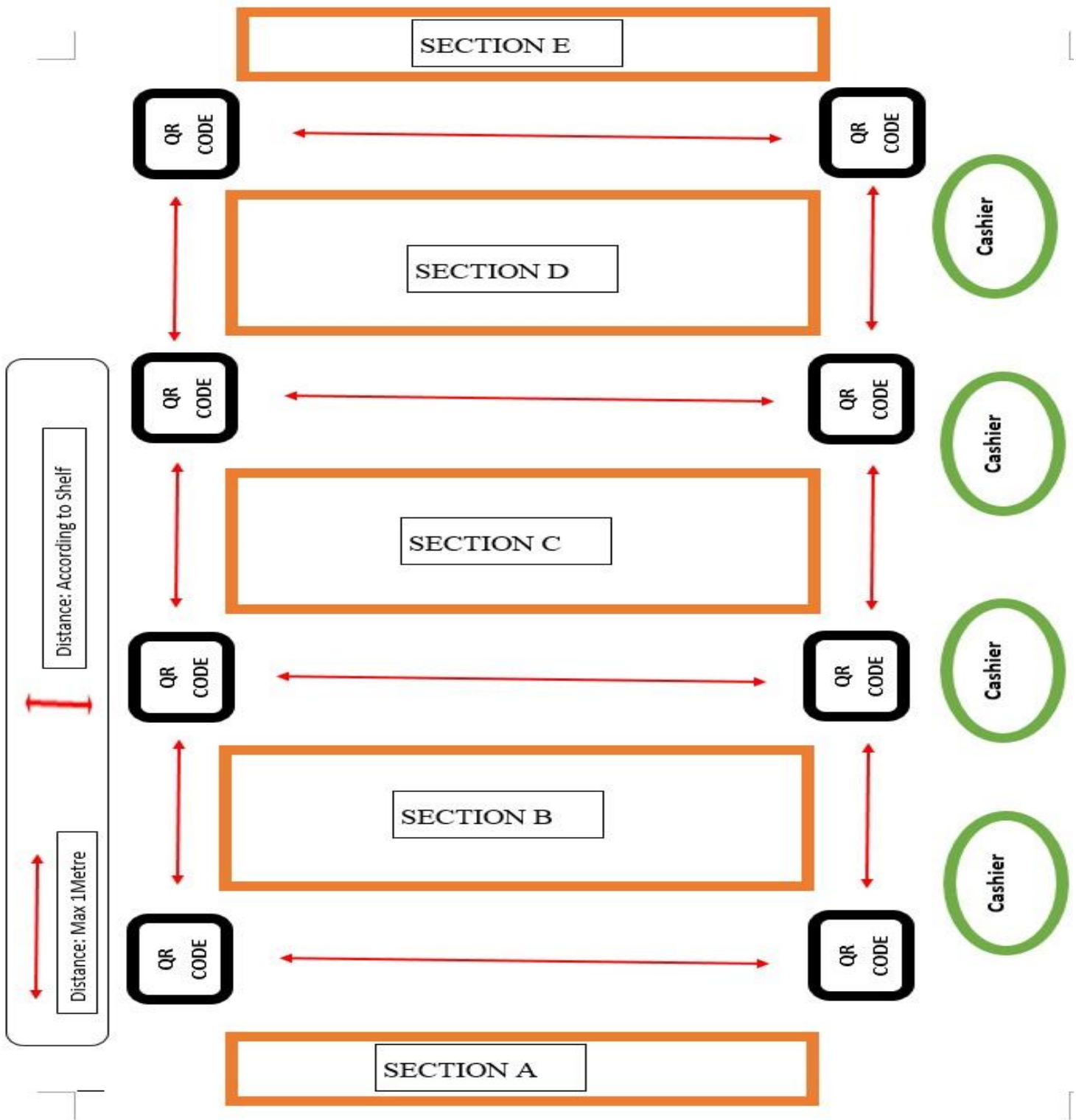


Figure 13 Layout of Shopping Complex

Figure 13 above showing the common layout of particular shopping malls or hypermarkets. In the layout above we could notice the position of the QR code placed between each section's ends. One at an end and another at other end point without regards to which QR code is starting point or end point. The distance between each QR code will be within 1 meter for each section and the distance between QR code of same section will be depends of shelf size of each sections.



The red arrow also indicates the distance or walk path the user of QR trail have to move with the help of navigation function within the QR Trail. This is the time, where QR trail will guide the user to move from one QR code to another.

The reason for allowing distance for each QR code is to avoid the user from confused scanning which QR code. So, the QR trail actually uses the distance between QR codes to reduce the fault. The distance will be used as fault tolerance factor.

CHAPTER 4: RESULT AND DISCUSSIONS

4.1 Market Survey

Market surveys have been done to make a survey on the necessity of QR Trail app in the target market. The surveys have been conducted and have been divided into three different categories which are:

- i. Smartphone user
- ii. Shopping
- iii. Supermarkets or Hypermarkets

1. Smartphone user

For the smartphone user survey category, there are 5 selected visually impaired citizens of Malaysia that was chosen randomly to be involved in this survey. Malaysia citizen was chosen because the QR Trail application will be implemented in a local Malaysian supermarkets or hypermarkets. This survey is conducted in Dato Keramat, Kuala Lumpur where there is school for disables. Below are the groups of age and profession for the selected visually impaired person that answer this application:

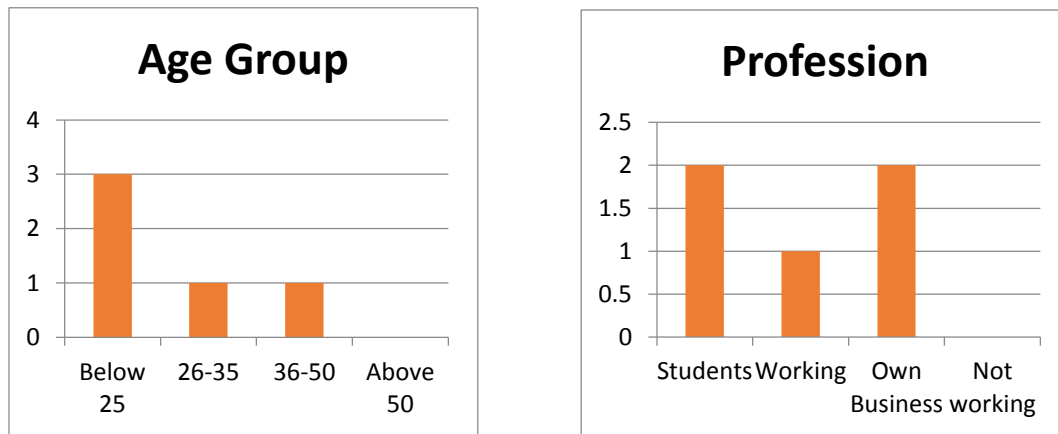


Table 7: Graph of respondent group age and profession.

The survey conducted on the visually impaired person is to check on the statistic of smartphone user in within visually impaired people. Besides, we also make a survey on the QR code technology whether the visually impaired people aware or unaware of this technology.

They are four questions to be asked in the questionnaire under this category. Only two main questions are included in this documentation.

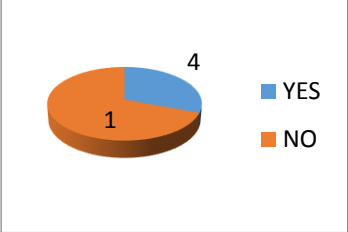
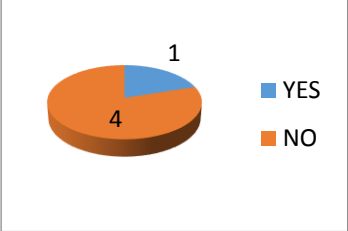
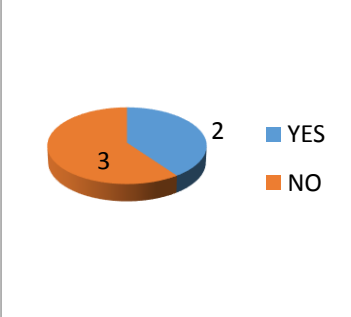
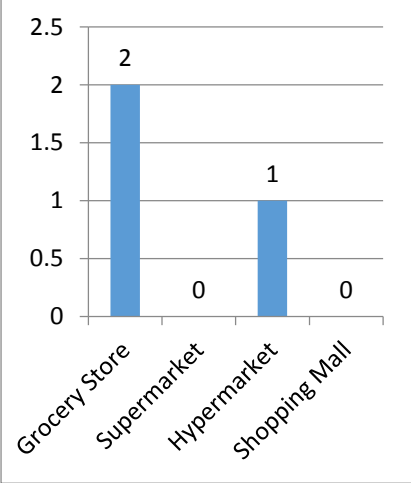
Result	Conclusion
Question 1: Are you using a smartphone?	
 <p>A 3D pie chart with a legend. The legend shows a blue square for 'YES' and an orange square for 'NO'. The pie chart has a blue slice representing 4 and an orange slice representing 1.</p>	<p>4 out of 5 selected visually impaired people are using a smartphone. We can say that QR Trail is suitable to be implemented in Malaysia as most of the visually impaired people are using a smartphone. Even there are possibilities where there is some visually impaired person still not using a smartphone, developer believe with the effort of Malaysia government to provide a smartphone subsidiaries, perhaps the percentage of citizen that have a smartphone will be increase.</p>
Question 2: As a smartphone user, do you aware of QR code technology?	
 <p>A 3D pie chart with a legend. The legend shows a blue square for 'YES' and an orange square for 'NO'. The pie chart has a blue slice representing 1 and an orange slice representing 4.</p>	<p>4 out of 5 selected citizen were not aware on the existence of QR code technology in a smartphone. Developer is believed that by introducing a QR Trail, the visually impaired people will be more aware on the potential of QR code technology and many usage of it which can ease their life.</p>

Table 8: Result surveys for smartphone user category.

2. Shopping

For the shopping survey category, the same 5 visually impaired person chosen and been asked the questionnaires under this survey. They are four questions to be asked in the questionnaire under this category. Only three main questions are included in this documentation.

Result	Conclusion										
Question 1: Do you go for shopping?											
 <table border="1"> <caption>Data for Question 1: Do you go for shopping?</caption> <thead> <tr> <th>Response</th> <th>Count</th> </tr> </thead> <tbody> <tr> <td>YES</td> <td>2</td> </tr> <tr> <td>NO</td> <td>3</td> </tr> </tbody> </table>	Response	Count	YES	2	NO	3	<p>From the result of this survey, 2 out of 5 visually impaired person told they will go for shopping. But they added that, it is once in a blue moon. 3 others said they never went as the things they needed they get in other way.</p>				
Response	Count										
YES	2										
NO	3										
Question 2: Where do you go for Shopping?											
 <table border="1"> <caption>Data for Question 2: Where do you go for Shopping?</caption> <thead> <tr> <th>Location</th> <th>Count</th> </tr> </thead> <tbody> <tr> <td>Grocery Store</td> <td>2</td> </tr> <tr> <td>Supermarket</td> <td>0</td> </tr> <tr> <td>Hypermarket</td> <td>1</td> </tr> <tr> <td>Shopping Mall</td> <td>0</td> </tr> </tbody> </table>	Location	Count	Grocery Store	2	Supermarket	0	Hypermarket	1	Shopping Mall	0	<p>Since, only two respondent can answer this questions, both of the respondents have shopped for things in grocery stores where they familiar with the owner and one respondents shopped in supermarket quite few times. They said, they never been to any shopping mall due to big space or area and crowded.</p>
Location	Count										
Grocery Store	2										
Supermarket	0										
Hypermarket	1										
Shopping Mall	0										


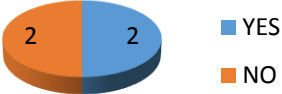
Question 3: Do you go shopping alone?	
 <p>■ YES ■ NO</p>	<p>Again this question also can only answered by the two respondents who have shopped before. For this question both answered that, it depends on the place. For grocery store which they familiar they will go alone while for new place or hypermarket they certainly need a companion.</p>

Table 9: Result surveys for shopping category.

3. Supermarkets and Hypermarkets

For the supermarkets and Hypermarkets category, I have conducted survey in Tesco Seri Iskandar, Billion Seri Iskandar Tesco Seri Alam and Today’s Market Masai. There were three simple questions asked to the Human Resource in charge person. Below is the documentation of the three questions was asked.

Result	Conclusion
Question 1: Do you usually have visually impaired person as your customer?	
 <p>■ YES ■ NO</p>	<p>From the result of this survey, 2 out of 2 places said they have noticed or had visually impaired person as their customers but is something rare. They added that, they never seen single visually impaired person do the shopping, it always been with a companion.</p>

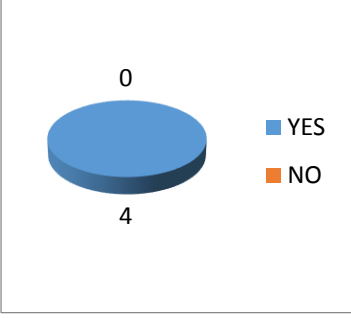
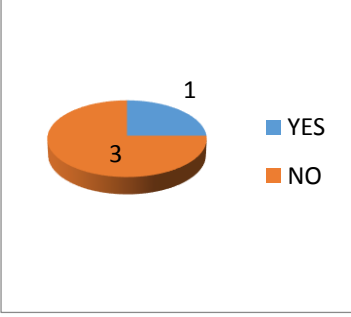
<p>Question 2: If there is a system for blind people to do shopping, could you implement?</p>	
 <p>A 3D pie chart showing the results for Question 2. The chart is almost entirely orange, representing 'NO' responses, with a value of 4. A very small blue slice represents 'YES' responses, with a value of 0. A legend to the right of the chart shows a blue square for 'YES' and an orange square for 'NO'.</p>	<p>All of the places, 4 out of 4 places agreed and they could encourage such initiative where it will be promotion for them. They also express their concern if the system implement can cost them, they will rethink on the implementation.</p>
<p>Question 3: Do you agree to stick QR code on the floor?</p>	
 <p>A 3D pie chart showing the results for Question 3. The chart is mostly orange, representing 'NO' responses, with a value of 3. A small blue slice represents 'YES' responses, with a value of 1. A legend to the right of the chart shows a blue square for 'YES' and an orange square for 'NO'.</p>	<p>Tesco Seri Alam agree to stick the QR code on the floor where it been practice for that place to stick promotional ads on the floor. But other three places showed some hastiness and they told to refer to higher management regarding this.</p>

Table 10: Result surveys for supermarkets and hypermarkets category

4.2 QR Code Experiment

An experiment conducted to determine the optimal size of QR code to be printed and to be stick on the floor. Therefore, it will be easily detected and scanned by the QR code scanner.

There are two factors that is important in this experiment which are:

- **The distance between the QR code and the scanning device** – which determines the size of the QR code in the viewport of the phone camera.
- **The size of the dots in the code** – the more data you put into the code the smaller the dots become.

Scan Distance

To effectively scan the QR code it should appear to be at least 1cm (0.4 inches) across in the viewport of the scanning device, and as the distance between the camera and the QR code increases, the size of the QR code will need to increase to compensate. Most smartphones the relationship between scan distance and minimum QR code size is approximately 10:1.

Simple Formula:

Minimum QR Code Size = Scanning Distance / 10

Calculating the size

The recommended minimum size of the QR code image is determined by the scanning distance and the size of the data dots in the QR code, and can be calculated by first determining:

- **Distance Factor:** Start off with a factor of 10 then reduce it by 1 for each of poor lighting in the scan environment, a mid-light colored QR code being used, or the scan not being done front on.
- **Data Density Factor:** Count the number of columns of dots in the QR code image and then divide that by 25 to normalize it back to the equivalent of a Version 2 QR code.

Better Formula:

Minimum QR Code Size = (Scanning Distance / Distance Factor) * Data Density Factor

Based on the Formula:

Scanning Distance = 914.63mm (3 ft.)

Distance Factor = $10 - 1$ (for poor lighting) = 9

Density Factor = $25/25 = 1.0$

Minimum Size = $(914.63\text{mm} / 9) * 1.0 = 101.62 \text{ mm} / 11 \text{ cm}$



Figure 14: 11cm x 11cm QR Code

4.3 Interfaces

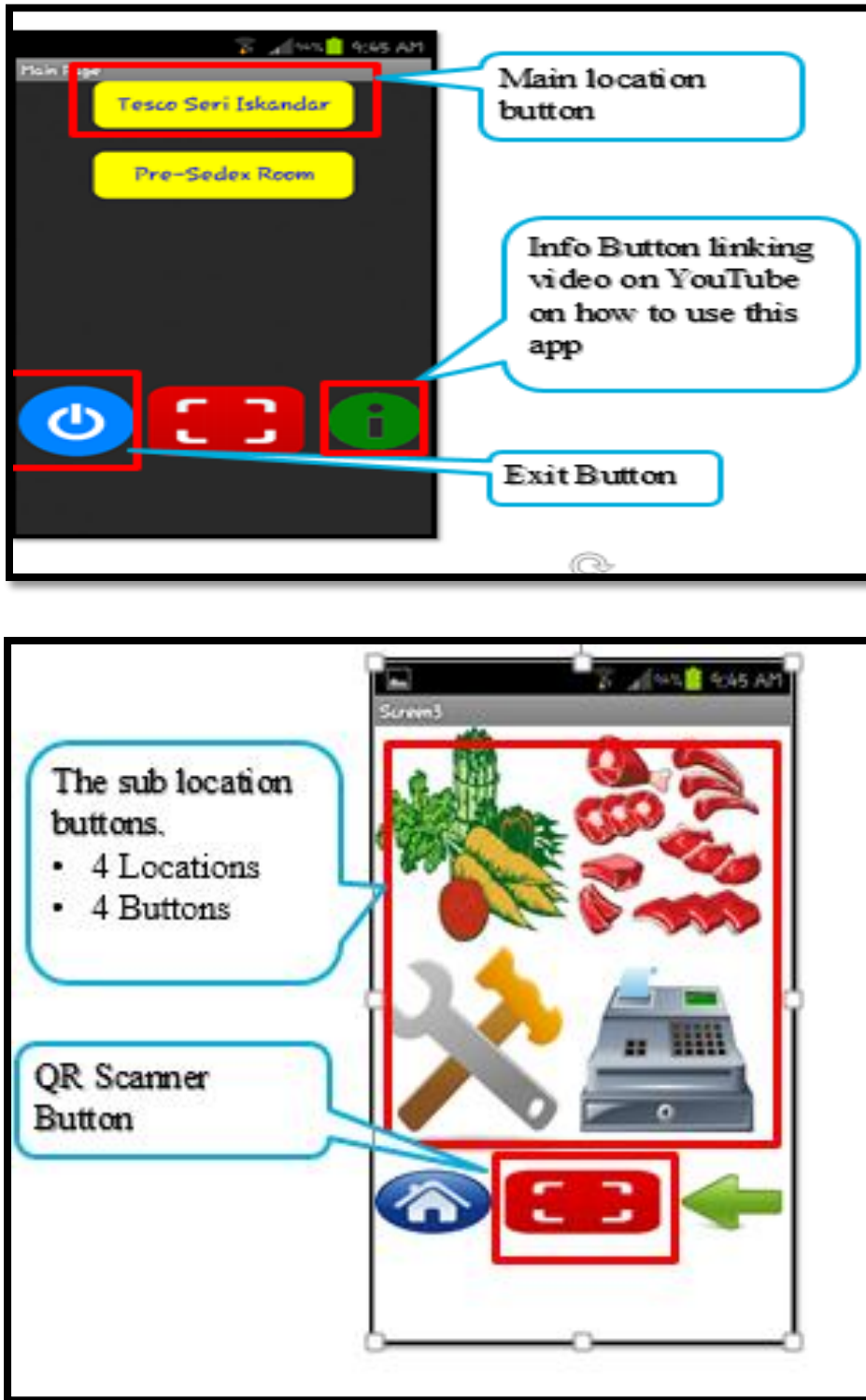


Figure 15 App Interfaces

4.4 Price Differentiation Between using RFID Tags and QR Code

1) Using RFID Tags System

Requirements	Price Range
RFID Tags	RM 1.00 each (Passive Tags)* (100 Units)
RFID Reader	RM 150 each device
White Cane	RM 30 / given free my Government
Smartphone	RM 500 and above
Total	RM 780 (Least)

*Price Varies According to Supplier and Quantity

2) Using QR Code

Requirements	Price Range
Printed QR Code	RM 3.00 each (10 Units)
White Cane	RM 30 / given free my Government
Smartphone	RM 500 and above
Total	RM 560 (Least)

Table 11 Price Comparison between RFID and NFC tags Usage

CHAPTER 5: RECOMMENDATION

In the previous proposal defense presentation, developer has got positive and also negative comments on the project idea from the internal and external examiners which are Mr Izzatdin B Abd Aziz and Prof. Dr. Alan Oxley. Both examiners found that the idea of creating an app for blind people to navigate around supermarkets or hypermarkets is good and noble.

However, both examiners also found that there will be some technical issues on the QR Trail application. The technical issue is that the QR Trail application uses the GPS which sometimes will be not accurate and precise. The examiner has issue that it will be a troublesome for the user who are blind to move around without correct guidance. Besides that, another issue is the blind user to identify the QR code stick to the floor. Examiners concern on whether they will have difficulties in finding the QR code. Therefore, they also suggested for me to look into the degree of the blindness of the user for using the QR Trail app.

As a developer, a propose solution need to be provided in solving this issue. The developer has been providing a solution where in the initial stage of implementation, the developer will try to create the guidance part to navigate the user in offline mode where the smartphone does not need a built in GPS or internet access. This way, the app can be functional properly with accurate and precise results. Moreover, developer will study further on the QR code design to be stick on the floor to develop a design that easily can identify, no one step on it, easily scan able and stick nicely on the floor. Moreover, to increase the effectiveness of detecting the QR code, NFC tags can be placed on each QR code stick on the floor.

CHAPTER 6: CONCLUSION

In this documentation, it explained in detail the starting idea on this project which is QR Trail, an application that provides a navigation system for visually impaired users to moving around supermarket or hypermarket autonomously. There are four main part which are abstract, introduction, literature review, methodology, result and discussion.

By taking the initiative of latest technology such as smartphone and QR code, this system could help the visually impaired person to bravely come out of their comfort zone and blend with normal society as doing normal things like a normal person does. This system also could promote the android smartphone among visually impaired Malaysian people as this system will develop in android application and can lead to creative usage of QR code.

The development of system will be using the Rapid Application Development (RAD) method. There will be four main phases in the RAD which are Requirement analysis and system design, prototyping cycles, system testing and implementation. The system will be developing using Eclipse, an application development tool.

As a conclusion, perhaps this system could solve the problem for the visually impaired people to moving around supermarkets or hypermarkets autonomously and do some shopping.

REFERENCES

- [1] 'Blind', in Goldstein, S., and Naglieri, J. (Eds.): 'Encyclopedia of Child Behavior and Development' (Springer US, 2011), pp. 263-263
- [2] Ballemans, J., Zijlstra, G., van Rens, G., Schouten, J., and Kempen, G.: 'Usefulness and acceptability of a standardised orientation and mobility training for partially-sighted older adults using an identification cane', *BMC Health Serv Res*, 2012, 12, (1), pp. 1-14
- [3] Gharpure, C., and Kulyukin, V.: 'Robot-assisted shopping for the blind: issues in spatial cognition and product selection', *Intel Serv Robotics*, 2008, 1, (3), pp. 237-251
- [4] López-de-Ipiña, D., Lorigo, T., and López, U.: 'Indoor Navigation and Product Recognition for Blind People Assisted Shopping', in Bravo, J., Hervás, R., and Villarreal, V. (Eds.): 'Ambient Assisted Living' (Springer Berlin Heidelberg, 2011), pp. 33-40
- [5] López-de-Ipiña, D., Lorigo, T., and López, U.: 'BlindShopping: Enabling Accessible Shopping for Visually Impaired People through Mobile Technologies', in Abdulrazak, B., Giroux, S., Bouchard, B., Pigot, H., and Mokhtari, M. (Eds.): 'Toward Useful Services for Elderly and People with Disabilities' (Springer Berlin Heidelberg, 2011), pp. 266-270
- [6] Vauclair, M.: 'NFC', in van Tilborg, H.A., and Jajodia, S. (Eds.): 'Encyclopedia of Cryptography and Security' (Springer US, 2011), pp. 840-842
- [7] Liimatainen, J., Häkkinen, M., Nousiainen, T., Kankaanranta, M., and Neittaanmäki, P.: 'A Mobile Application Concept to Encourage Independent Mobility for Blind and Visually Impaired Students', in Miesenberger, K., Karshmer, A., Penaz, P., and Zagler, W. (Eds.): 'Computers Helping People with Special Needs' (Springer Berlin Heidelberg, 2012), pp. 552-559
- [8] Fitzgerald, B.: 'A Preliminary Investigation of Rapid Application Development in Practice', in Wood-Harper, T., Jayaratna, N., and Wood, B. (Eds.): 'Methodologies for Developing and Managing Emerging Technology Based Information Systems' (Springer London, 1999), pp. 77-87

Smartphone User Category Questioner

Name: Ahd Hazim bin Suffian

Age: 20

Profession: Student

1. Are you using the Smartphone?
 a. Yes b. no

2. If you not using now in future are you going to use?
a. Yes b. no

3. If yes, what smart phone are you using now?
Samsung S Advance

4. Do you know what QR code technology is?
a. Yes b. no

Shopping User Category Questioner

5. Do you go for shopping?
 b. Yes b. no

6. Where do you go for shopping?
Ampang Mall / Kedai Runcit

7. Do you go for shopping alone?
 b. Yes b. no

8. What you buy usually when doing shopping?
Kegunaan Harian / normal daily using things.

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Figure 16: Questioner Smartphone and Shopping

Supermarket & Hypermarket Category Questioner

Name: Ms. Rosdah bint Abd Rahman

Position: HRM dept

Name of the place: Tesco Seri Alam

QR Trail is and smartphone app for visually impaired person to do shopping in supermarkets and hypermarkets on their own without any guidance. Due to this, this survey conducted to increase and improve the app for better use.

- Do you usually have visually impaired person as your customer?

a. Yes b. No
- If there is a system for blind people to do shopping, could you implement?

a. Yes b. No

Why?

This something good and can help the blind people do shopping. Other customers think of our place as a good place
- Do you agree to stick QR code on the floor?

a. Yes b. No

Why?

We practising it for promotional purpose. But we usually get paid by the product promoters. It is temporary.

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Figure 17: Questioner Supermarkets and Hypermarkets