Interactive Wallet for Visually Impaired People

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Declaration

We declare that this thesis is our own work and has not been submitted in any form for another degree or diploma at any university or other institution of tertiary education. Information derived from the published or unpublished work of others has been acknowledged in the text and a list of references is given.

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Name of Student (s) Signature of Student (s)

Date:

Supervised by

…… ……

Name of Supervisor(s) Signature of Supervisor(s)

Date:

Dedication

As we all know, every challenging work needs the love, support and guidance of our elders who have really sacrifices a lot for our growth, and development. I therefore dedicate this dissertation to my loving

Mother

Whose affection encouragement, support and dedication with love towards my work made me able to complete this research successfully; I also acknowledge the dedication & hard work of

My Lecturers

Thank you all for your prayers and support

Abstract

There are more than 39 million people in the world who are blind. In the majority of cases blindness is caused by conditions that are preventable. Many of the people sufferers live in remote areas with little or no access to services and treatment. Asian countries such as Sri Lanka are increasingly implementing the latest technology and developing challenging projects especially for differently abled people.

Now-a-days there are millions of people who have mobile devices with the latest applications installed on it, which are helping them with day to day life.

But compared with developed countries, there are fewer applications for differently abled people in developing countries; particularly because of a lack of technology and the resources available for differently abled people.

Social media is going from a "nice to have" to an essential part of every body's life. The aim of the project is to give the experience which others having also to the differently abled people. This application has integration of the social media.

New technologies such as Augmented Reality, Near Field Communication (NFC), and voice recognition, are used to develop effective and efficient applications. In 2003 NFC introduced smart cards that are capable of storing data securely and designed to perform more secure, offline transactions without any requirement to contact a backend server. These are becoming more popular in Sri Lanka as well as in other countries. Augmented Reality can be used, so that a Visually Impaired Person can obtain more information from a person standing in front of him or her using a phone.

Voice to Text (**Speech recognition**) is also applied in this app, because the main difficulty for the visually impaired person is 'reading a text' or on-screen instructions. SMS and various instructions can be reading using this technology for the visually impaired person. Barcode readers can also play a major role in item recognition and Google APIs, (Add geotags in Picasa, Google, 2014) Facebook SDKs, and Braintree SDKs and APIs also have major impact in the app development.

This combination of various technologies mentioned above is used to create an attractive solution. Features which are not implemented are also mentioned. Sequences diagram and Data Flow Diagrams helped to implement the software.

Admin portal of the application implemented as website and could be able to access by authorised person. It helps to add items for recognition, and returns required details. This helps to show this prototype level applications works. Some part of the admin panel indicates the real time data from the shop/retailers sites.

According to the observation and study more than half of the Visually Impaired Seniors also has a Hearing Impairment. This application is having a unique feature which will help to read SMS/news using Morse code technology. This integration will take the big part in future development. Voice to Text, Text to Voice feature takes the big part of this application, but morse code will replace this and will be useful for the visually impaired people with hearing aid problem.

Combination of different technologies with appropriate integration will help to create the successful application. This application also has the much different integration, such as GPS, NFC, Morse code, Speech recognition, etc.

The mobile solution has been tested by 20 selected users with visual impaired. They were each given a mobile phone with enabled required features. This application indicates how clients satisfy with the features and how it will help in their day to day activities is done using evaluation. Participants were asked to complete questionnaire a take part in formal interviews to indicate how satisfies they were with features and how helpful the application was. The results show that the solution produces a 60% accuracy rate, with many features showing in prototype level.

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List of Abbreviations

API	-Application Programming Interface
AR	-Augmented Reality
NFC	-Near Field Communication
RFID	-Radio Frequency Identification
VIP	-Visually Impaired People
AT	-Assistive Technology

1. Introduction

1.1 Background of the Project

The popularity of mobile apps has rapid rise, as their usage has become increasingly prevalent across mobile phone users. Public demand and the availability of developer tools drove rapid expansion into all the areas in human day to day life. But there is a huge gap which is not filled yet for differently-able people, who wish to do their day to day work like other person, but when it comes to a software most of the voice recognition or other software mainly focusing the normal people with ability to see the item. Most of the apps are designed for kids (Graphics oriented) and are built to do activities faster and bring the entire world to the hand of the well able people.

"Differently-abled persons are entitled to the realization of all human rights and fundamental freedoms on equal terms with others in society, without discrimination of any kind", so here they should have the rights to access thing and place and also should be able to live independently. Disabled people should stop hiding in the comfort of their own homes.

Disabled persons shall enjoy rights without any exception whatsoever and without distinction or discrimination.

The normal apps available in the phones are in English Language. But In Sri Lanka there are many people lives without knowing English so it would be better that the app available in Sinhala/Tamil and English.

1.2 Problem

Visually impact people can't recognize the item unless they touch and feel. Even they touch they can't find the item exactly. There are some iPhone apps found in the market than Android apps.

They find very difficult to visit anywhere independently, even with white cane. The people who are around him should know that there is a visually impact person nearby. So they will be aware of him and could help him, also if anybody wants to know about him (Visually impact person), they just can find full details without hearing full details from him.

Visually impact person should receive alerts if there any strange things around them. There is a need to make their shopping very effectively. Touching the buttons and giving commands are very difficult for the virtually impact person, also most of the voice recognition software is in English, it's being very difficult for the people they can't understand the English commands.

If they go for shopping, they find very difficult to get to know the details (including price) of the product and its qualities, so do shopping independently has been a very difficult activity for them till to date.

Current research applications done for the visually impaired persons with latest technology is very limited and has only few apps for free. This research application work is an attempt to enhance the future developments for the visually impaired people using latest technology available.

1.3 Aim and Objectives

Aim of this research work is 'Enhance daily life for a person with a disability'.

Visually Impact person should be able to live independently, when they are going out or within their house just a '**Smart Object (phone) – Interactive Item**' should be able to fulfil their most of the needs. Furthermore the objectives would be as follows.

- Identify when a strange object exists around him/her.
- When appropriate, inform a person that he is visually impaired and needs assistance.
- Without asking for assistance identifies and recognizes an item when needed.

- Without asking for assistance walking on the road or visit to any place independently.
- Without asking for assistance identifies and recognizes an item when needed.
- User satisfaction
- Ease of use.
- Able use in their mother tongue
- Person who is able to see or listen also should be able to use most of the features,

  e.g.: if they want to know about the particular place where he visited, can listen without reading about that. Opponent may get to know the person who is differently able person

1.4 Scope

The following points can be pointed out as the scope of this research.

i) **Item Recognition**: Software will recognize the item and it out will come as voice

ii) **Make aware the opponent**: Software will detect the opponent device and make aware of the visually impact person.

iii) **Take the tour**: Software will get the direction and location of the place, and guide the user (Differently-able person)

iv) **Shopping Interface**:
   a. Application in the Mobile will show item details, details will be converted to voice.
   b. Payment gateway will be implemented using open source.

v) **Voice Recognition**: Most of the commands (the place he wish to go or what he wants to do?) will be given by voice.

vi) **Voice and Morse Code output**: all the put will either voice or Morse code

1.5 Novelty of Research Application

The applications available using latest technology and the other resources are restricted on certain things,

Develop methods to register the two distinct sets (real, virtual) of images and keep they registered in real-time. This often reduces to finding the position of a camera relative to some fiducially markers. David Jonson (Year Unknown)

In the Augmented Reality, the palmtop implementation of the MU, the user can see augmented pictures, read related information, and listen to audio commentary through a pocket web browser. No tracking of his location is available and he is responsible for selecting the material of his interest.

It should be noted that all the multimedia material is downloaded from the SIS database unless it already exists in the MU database (e.g. downloaded by the previous user of the device).

The securities of NFC based transaction systems exist today are mainly controlled by the secrecy of Access Keys. Once keys are leaked, the whole system may easily become compromised. This is why, there are evidence where NFC based applications were hacked. How it was done is, by reverse engineering the card circuitry and discovering a flaw in the cryptographic algorithm stored and used in card. [1]

Applications available for visually impaired persons problems will be addressed such applications were not found when doing the literature review. Refer the literature review on next chapter for similar solutions reviewed.

1.6 Report Overview

Following headings will provide a brief description about what part of work is covered and explained in this report.

Background

This chapter covers the background information and the literature review of existing solutions available today. Comparison of similar solutions for their pros and cons will be mentioned here.

Analysis

This chapter covers the Analysis stage of this research project and the tools which have been used, and how important of each technology and how to enhance the ease of use and efficiency of use for the different able people using this application and its architecture will be discussed in this chapter. Technology adaptation & Approach also show in next two chapters respectively, these chapters explains how and what technology has been adopted and will match to develop this app.

Design

This chapter will cover the DFDs, sequence diagram and the architecture of server, client and mobile applications, card format structure, and process flow of the applications.

Implementation

How this entire technology is implemented as mobile application.

Evaluation

This chapter covers how the tools and other resources of the application being evaluated, in terms of developer and System.

Conclusion and future work

This chapter summarizes and conclude the on-going process and work to be compete.

2. Background: Literature Review

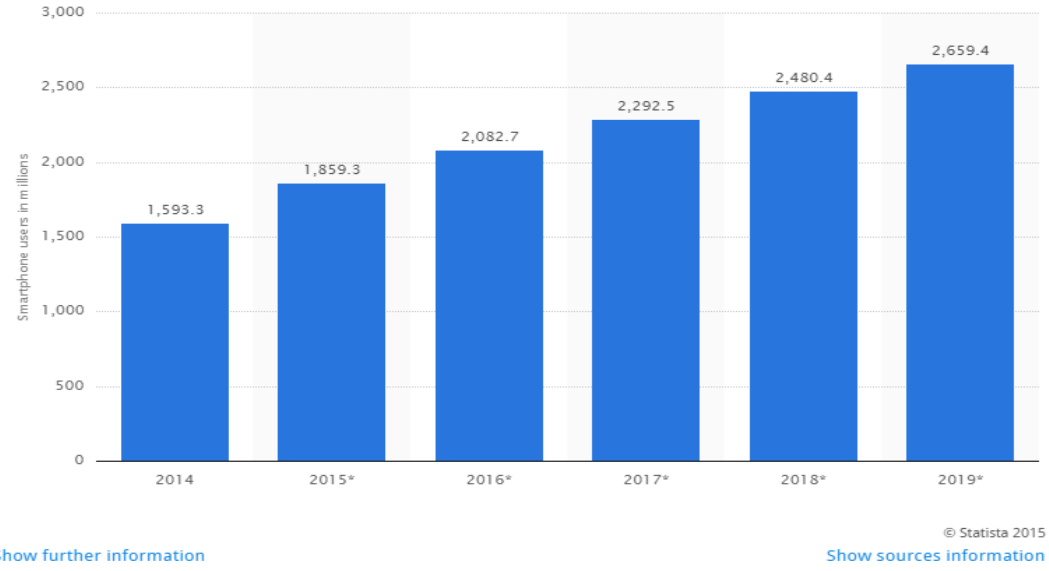
According to the World Health Organization, there are approximately 314 million visually impaired people around the world, a majority of who live in developing countries [2]. To lead their life independently and effectively the need of assistive technology is very much important and useful [3], but according to **United Nations Industrial Development Organization**, technologies used in developing countries are lesser than developed countries by VIP, but need of the software is very high, economy growth of the country defines this. There are many researches have made on this issues. The expenses of the AT are fallen in the range from inexpensive from expensive devices [3]. Mostly of the advanced AT is available in expensive devices (iPad, iPhone, etc), Choice of appropriate assistive technology and output formats (visual, auditory or tactile) will depend on the user's level of functional vision [3]. The very important thing required for VIP, is identifying the locations of where they are standing or the nearest positions, and this is done by the technology called GPS (Graphical Positioning System), though this features is widely used by many applications, this can be used to create useful application for VIP which are currently not available many. The success of a system for use by the visually impaired will depend on the accessibility of the interface design and the value of the information imparted to the use [4]. The review of the research on statistical software for VIP is conducted by Douglas and Loots states some crucial needs of the software for visually impaired people, such as important of the access of the graphics generated by statistical software state by Loots and van Staden (2007). Interestingly this research is done by two blind people. According to them there are issues in style in presenting existing software output in screen, paper size, format (when it interpret output visually for bind people (Douglas et al., 2009).

There are some important points stated by the reviewers that according to the Literature review there are many apps found free for visually impact people, but unfortunately all of them are not combined together, and it's difficult for them for to open each apps for different purpose, also not easy to operate them as well (Douglas et al., 2009). The limitation on these study are, the software mostly available for web users (not mobility), and most of them needed internet access, and not so many things

grouped together to access many do traction in one place (Mobile). Though there are many researches made on their accessibility and how much they can effort do things but, there when it comes to how to make visually impaired people to their day to day life as normal people such as travelling, shopping, receiving alerts from unwanted things So this research will be continuing on how they (Visually impaired people) can live independently.

The studies reviewed in above have mentioned the expenses of the devices such as iPhone, iPad, but nowadays Android devices with the supporting features can get for very less price. The studies of AT for VIP are comparatively very less.

2.1 Smart phone users



Smart phone user will be increase lot more in coming years (Statista Inc, 2016).

Figure 2-0: Smart phone users

2.2 Record of Visually Impaired People around World

There are four levels of visual function available, statistic on no of visually impaired as follows(World Health Organisation, 2014),

- 285 million people are estimated to be visually impaired worldwide: 39 million are blind and 246 have low vision.
- About 90% of the world's visually impaired live in low-income settings.

- 82% of people living with blindness are aged 50 and above.
- Globally, uncorrected refractive errors are the main cause of moderate and severe visual impairment; cataracts remain the leading cause of blindness in middle- and low-income countries.

There is more risk for visually impaired people in developing country, who do not get many facilities.

The global response to prevent them

Data over the last 20 years shows that there has been significant progress in preventing and curing visual impairment in many countries. Now technology is joined with other process for the development and helping them to improve their life style (World Health Organisation, 2014).

2.3 Visually Impaired people and important of the technology in their life

This not clearly observe others performing tasks, so may not be aware that the tasks even exist or that other children attempt them in play and real situations, and Children with visual impairment may not be given enough opportunities to practice new skills until they become fluent. Sandra Lewis (2012).

"I think the worst thing that you can do to a blind person is to define them by their disability and nothing else. They want to be treated like everyone else" says Johanna El Attar-Hill. and she further added that blindness somehow affects his/her intelligence [5].

Many blind people have trouble maintaining a proper circadian rythm due to the lack of visual input to their brains. Specialized ganglion cells can provide information some information about light levels independent of whether you are blind or not, but they are not as powerful if they're not working in tandem with the visual input from the rods and cones.(Jens Mowatt, 2014)

2.3.1 Continuing a commitment to digital excellence

The smartphone versions of these patient apps won the prestigious European Excellence Award in 2014, the first year they were available. Downloaded over 6,700 times during the first two months after launch, these apps allow users to retain and in some case regain their independence and have been praised both for innovation and for real-life impact.

According to a blog writer, Kim Paulk (2016), few needs are listed below

- Access to Information - mail, computers, media, warning systems
- Access to transportation - to get anywhere at all
- Locating and obtaining blind services and training for Braille, shopping, cooking, and other independent living skills
- Obtaining or maintaining employment
- Lack of inclusive or accessible social activities and venues
- Insufficient finances for necessary adaptive devices, both technical and non-technical
- Challenges due to lack of counseling support to cope with vision loss
- Societal stigmas
- Often living in isolation
- We sites an software applications which are not designed or coded to work with assistive technologies, such as screen readers or screen magnifiers

2.4 Technologies Available for Mobile Development and its comparisons

2.4.1 Near Field Communication

During the last decade, Near Field Communication (also known as NFC) has become widely available on the market offering convenient services by simply touching NFC enabled card in the proximity with commodity mobile readers. Payments, ticketing solutions and access control are some of the applications build upon this technology. In NFC, the communication occurs when two NFC compatible

devices are brought together less than four centimetres, or simply by touching themselves. It operates at 13.56 MHz and can transfer data up to 424 Kbits per second. [5] In an NFC model two devices are involved in the communication, which are called initiator and target. Initiator is an active NFC device which is responsible for starting the communication. Also it has an embedded energy component whereas target can be either a tag, RFID card or a NFC card.

One of the advantages of NFC technology is that mobile devices can also be used for information storage or as an NFC reader. They can read information from NFC cards, tags and display that information on the screen with an ability to make additional processing. Also they can be used as a digital storage. For example, storing credit card information, business card details etc… But when it comes to mobile based NFC products, security has to be maintain in software level or either in a SE which is kind of a leg pull in NFC based mobile solutions.

Initially the research papers were reviewed to understand how offline transactions are handled in existing solutions. In one such research paper they have mentioned that all sensitive data are kept in a Secure Element with limited access for non-authorised users [6] . The report also mentioned that in order to achieve secure offline payments, a highly secured architecture had to be developed. When doing offline transactions the main concerns they have pointed out were lost transactions, value duplication, reproduction, increment values and avoid unauthorised card usage on offline modes. Here the keys were stored in a secure element (SE) [7] and body content were stored in the application layer encrypting the content.

Although the SE is designed to protect against a certain level of attacks. Designing a system in which SEs have the power to generate value, would possibly attract well-funded hackers, deploying advanced hardware attacks such as chip de-capsulation, probing, focused ion beam cutting and drilling at microscopic levels [6] were considered as threats and weaknesses limited in this research work.
Their attempt was to write a java applet and store it in the 65KB memory space in SE. The applet was installed using GP Shell which enables and disables applet installations. They have used the java Card Development kit [8] for implementation.

Comparing the above research work it is clear there implementation of this system is limited to OS level running on mobile device. Whereas today, most smart phones have discarded providing the support for java card based developments. Users also require a NFC enabled phone with SE to use this service. Those mobile devices disregard the use of JCD will not be able to provide this service to customers. Also the SE supports digital algorithms such as 3DES, RSA for encryption leaving more secured AES symmetric key encryptions. Since the content to be stored in application layer, a more secure approach would have been preferred to handle offline transactions. Table 2.1 are a contrast of this research work findings.

Advantages	**Disadvantages**
Support offline transactions	Require an NFC enabled phone with a Secure Element installed.
3DES encryption support	More secured AES is not supported
More storage space as content is stored in memory space in mobile device	Less secured and ability to wipe off with effort.
Application managed by device OS	Without power, cannot access the service.

Table 2.1: Evaluation on research work against [6]

2.4.1.1 Google Wallet

Google wallet [9] is a service provided by Google where users can tap their Android phone on a NFC reader writer placed in a retailer shop and make payments. For this to work, Google Wallet requires Near Field Communication (NFC) technology available, which unfortunately is only available on certain smartphones and tablets [10]. Google wallet also requires users to sync their debit or credit card details to their google account in order to do payments. This implies an offline transaction is not possible with google wallet.

Another limitation identified in Google Wallet is, not every smart phone user can use Google Wallet as this service is only available to android OS running devices with NFC enabled. These will limit the usage of this service in numbers as there are a considerable amount of non-android mobile users as well. Since there will be no

offline transactions, the security is guaranteed. A high level contrast on google wallet is given in **Error! Reference source not found.**.

Advantages	**Disadvantages**
Transactions are made by existing credit/debit account synced to google account. No need to maintain a separate account.	Require data connection, NFC enabled phone, Android OS with a synced google account
Secured and well established.	Offline transaction not supported
Approved and used in majority of countries. [11] See reference for available countries.	Not all countries have approved the service.

Table 2.2: Google Wallet evaluation

2.4.1.2 The London Oyster Card

Oyster is a plastic smartcard which can hold pay as you go credit, Travel cards and Bus & Tram Passes. We can use an Oyster card to travel on bus, Tube, tram, DLR, London Over ground, Tfl Rail and most National Rail Services in London (Transport for London, 2016).

2.4.1.3 Types of NFC Tag.

NFC Type comparison				
	***Type* 1 Tag**	**Type 2 Tag**	**Type 3 Tag**	**Type 4 Tag**
Compatible Products	Broadcom Topaz	NXP MIFARE Ultralight, NXP MIFARE Ultralight C, NXP NTAG203	Sony FeliCa	NXP DESFire / NXP SmartMX-JCOP
Memory Size	96 Bytes	48 Bytes / 144 Bytes	1, 4, 9 KB	4 KB /32 KB
Unit Price	Low	Low	High	Medium I High
Data Access	Read/Write or Read-Only	Read/Write or Read-Only	Read/Write or Read-Only	Read/Write or Read-Only

Table 2.3: NFC Type comparison table

2.4.1.4 Communication Protocol of Contactless Cards

Every contactless IC card has three levels of communication. They are;

- Physical Layer
- Data Layer
- Application layer

It feature comparison of MIFARE contactless cards with Sony FeliCa

Characteristics	**MIFARE ULTRA-LIGHT**	**MIFARE CLASSIC**	**MIFARE DESFIRE**	**MIFARE DESFIRE EV1**	**MIFARE DESFIRE EV2**	**Sony FeliCa**
Introduced	2009	1994	2002	2008	2013	
Interface	Type A	Type A	Type A	Type A	Type A	Type C
Tag type	Type 2	-	Type 4	Type 4	Type 4	Type 3
Memory size	64bytes	320bytes-4KB	4KB	2,4,8KB	2,4,8KB	2,4,8KB
Authentication	-	Proprietary	3DES	3DES +AES	3DES/AES	AES
Data encryption	-	Proprietary	3DES + file system	3DES + file system	3DES + file system	Proprietary+ service system
Price	cheap	cheap	expensive	Expensive	expansive	expensive
Usage	Medium	Very High	Medium	Medium	Low	Low.

Table 2.4: MIFARE and Sony FeliCa Feature Comparison

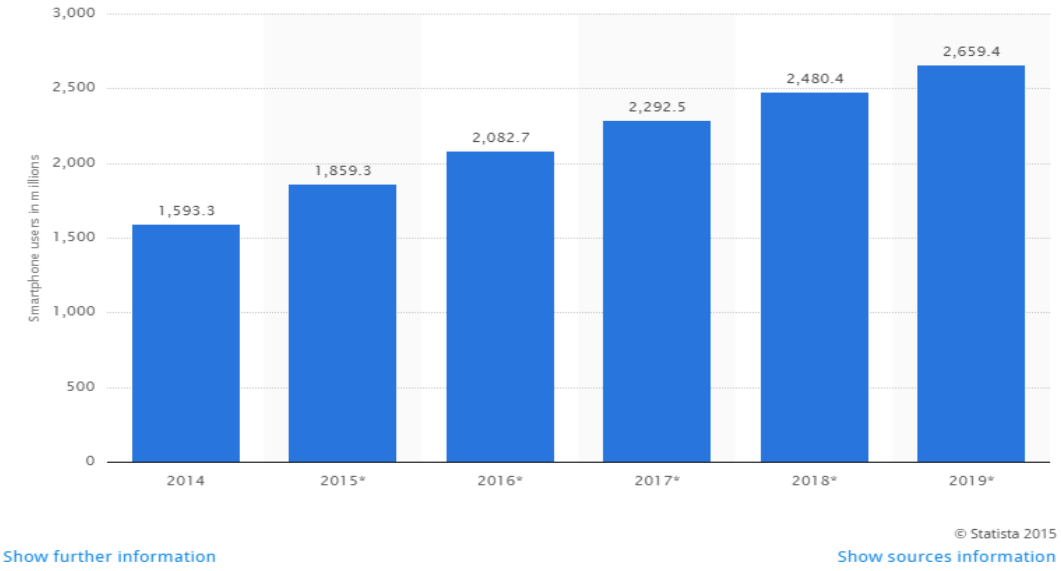


Figure 2-1: Smart Card Distribution in World taken from [12]

By observing the above Figure 2-1, it is clear that MIFARE Classic being the most widely used contactless card in the world. Since its security layer also being compromised, it was decided to review further more on MIFARE classic card structure in details.

Table 2.4 is a comparison of security mechanism manufacturers have taken to improve the security aspect of NFC based products along with their advantages and limitations.

Attempt	**Advantages**	**Disadvantages**
SAM (Secure Access Module)	Generate application keys based on master keys stored in a SE. Comes as SIM card that can externally be inserted to a device Quick response time	Not every device support SAM modules Require advance technical and development skills on SAM Expensive and difficult to replace
Remote Access Keys	A More Secured approach by not keeping access keys inside the device. Easy to develop and maintain. Required secure connection to transfer keys over networks.	Supports only online transactions. Offline transactions not possible. Transactions are time consuming and depend on network speeds, Therefore cannot get full benefit of NFC technology.
Hard coded keys	Easy to implement, Does not require advance key management tools such as SEs. Offline transactions ready.	High vulnerability of key theft as keys can be recovered by decompiling code files. Key management is difficult and require re-compilation of source codes for modifications.

Table 2.5: Advantages and disadvantages of existing solutions

It shows a comparison on how developers have considered maintaining the security in NFC based developments in existing systems.

Mechanism	Security level	Response time	Device dependency	Key management	Offline transaction	Implement cost	Development cost	Customer satisfaction
SAM	high	high	yes	poor	yes	high	high	high
Remote access keys	high	low	no	easy	no	low	medium	very low
Hard coded keys	low	high	no	poor	yes	low	low	medium

Table 2.6: Comparison of security attempts

The aim of this research work will be to design an algorithm to overcome those limitations found in existing systems providing a better, easier framework so that developers will be able to focus on business logic leaving the framework to do all the tedious NFC card access and key management roles securely, providing only an abstract view for developers.

2.4.1.5 Features of NFC

Applications are not allowed to directly set the device into read/write mode

1. Register NFC tags of interest (in the AndroidManifest.xml)
2. NFC Service selects and starts the registered app whether a tag is discovered (apps can also ask preference when in foreground mode)

Tags are discovered by the NFC, which polls the magnetic field

1. The tag protocol and technology is determined
2. An NFC message is sent from the NFCC to DH with tag details
3. The DH (or NfcService) handles the message and fills a Tag object
4. The NfcService creates and emits an Intent with the EXTRA_TAG field with the Tag Object
5. Android registered application receives the Intent and the Tag object. Damien McFerran(2012).

2.4.1.1 NFC Usage

Tourism has been one of the fastest growing industries in south Asian countries like Sri Lanka. Although there are many research papers on tourism, relatively a very few number of research papers were published for both 'Tourism and NFC'. Research papers were found on NFC technology from a more scientific approach. Some are slightly coupled with other transaction based applications whereas Tourism with NFC is almost nowhere to be found.

One research paper found on Tourism and NFC, explains how NFC can assist a tourist easily by prototyping a NFC based mobile application. The part they have focused is to how to capture details of locations easily instead of taking notes down of places they visit. The prototype they explain of going to locations and take photos from their NFC enabled mobile phones and simply taping their phone on NFC tags located in the location. The application will save those information to the photos taken from the NFC enabled phone. [13] Another feature of this proposed application is to use NFC devices to store electronic tickets to NFC enabled phones. Tourist can purchase tickets from a counter and transfer them to NFC enabled phone. The evaluation of this research work is given below (see Table) on its features.

Feature	Process	Advantage	Disadvantage
Capture extra details on places visit	Tap NFC enabled phone on NFC tags placed on locations	Amend details to photos taken from NFC enabled mobile phone	Require a NFC enabled phone.
Electronic tickets load to NFC enabled mobile phone	Purchase tickets from a counter and transfer them to NFC enabled phone.	Cashless transaction	Service highly depends on mobile data network. Mobile phone should have NFC. Application will not function on dead battery.

Table 2.7: Evaluation of Tourist applications made easier using NFC

The above research work mainly describes a way to minimize the burden a tourist has to go through to remember details of locations they visit. Such information

can easily be tagged to photos by using a free geo tagging software like Picasa [2]. So why go through all this hazel just to gather a few extra details? This research paper also mentions about e-tickets on NFC enabled phones. This will be beneficial if every foreigner visits our country brings their own NFC enabled mobile phone with them. Along with that, the tourist also needs to have a mobile data working connection to use the services, whereas if data connection is not available the service has to wait.

2.4.1.5.1 Tourism And Problems Encountered.

It is clearly stated that tourist who visit developing countries has to face a lot of trouble when it comes to traveling in public transport [14]. Unexpected expenses, fake ticket prices, safety and security threats, robbery are the ones she has highlighted in her report that require attention.

Another reason why NFC smart cards are recommended over NFC mobile apps is cards are much cheaper and easy to use than a mobile application. The biggest advantage of NFC cards over NFC enabled mobile devices is one does not need to have a NFC enabled phone to use the service.

2.4.1.5.2 Security feature in NFC

Some NFC tags provide some form authentication-based access control that can be used to restrict write-access tag memory, e.g.

- MIFARE Ultralight C: mutual challenge response authentication using 3DES
- NTAG21x, MIFARE Ultralight EV1, my-d move NFC: password based "authentication" with clear-text password. Be warned that a clear-text password may have sever security implications.
- MIFARE DESFire (EV1): mutual challenge response authentication using DES, 3DES or AES

2.5 Augmented Reality (AR)

Augmented Reality in definition

It's an interactive 3D environment that blends with our physical reality, usually through a webcam, or in this case, a phone camera. AR is to create sensation the sensation that virtual objects are present in the real world. To achieve the effect, software combines virtual reality (VR) elements with the real world. Obviously, AR is most effective when virtual elements are added in real time. Because of this, AR commonly involves augmenting 2D or 3D objects to a real-time digital video image. The simplest example of visual AR is overlaying a 2D image on digital video. And AR can add 3D object also (Snehlata Barde, 2013). AR objects components can be categorise by lens and marker, and when use the AR how it displays, and view point object are important should consider about that when developing.(Vlahakis et al., 2001)

2.5.1.1 Augmented SDK comparisons

By comparing sdk this section of literature review will give the technology to create the right product, thus there are many SDKs found on net, but comparing and giving its features better SDK can be selected.

Product	**Features**
ARLab SDKs(Commercial) Supports in Android, iOS	With AR Browser SDK We can add and remove POIs independently from the scene in real time, interact with them (e.g. touch them or point the camera to them) and perform actions on them (e.g. send SMS or share on Facebook). Image Matching SDK allows us to create our own local matching pool with thousands of images (loaded both from local resources and remote URLs), and use it to match any image without any connection to the internet, while it also supports QR code and barcode recognition. Available for android and iOS.
DroidAR (Free and Commercial) Supports in Android	It adds location-based AR functionality to Android apps. Gesture (e.g. full turn) detection, support for static and animated 3-D objects (using the model loaders from the libGDX game development framework) that the user can interact with (e.g. click on them), and marker detection are part of the functionality that

	DroidAR offers and that is only shaded by the poor documentation that exists for the project.
Metaio SDK(Free and Commercial) Supports in Android, iOS, Windows PC, Google Glass, Epson Moverio BT-200, Vuzix M-100, Unity	Metaio SDK supports among others 2-D image, 3-D object, face, SLAM and location tracking, barcode and QR code scanning, continuous visual search (both offline and online through Metaio CVS), and gesture detection. Metaio has also designed their own AR scripting language, AREL (Augmented Reality Experience Language) that allows us to develop our AR apps using common web technologies (HTML5, XML, Javascript) and deploy them everywhere. Metaio SDK can be used to develop AR apps for Android, iOS, Windows PC, Google Glass, Epson Moverio BT-200 and Vuzix M-100 or using Unity.
Vuforia SDK(Free and Commercial) Supports in Android, iOS, Unity	Multi-target detection, target tracking, virtual buttons, Smart TerrainTM, and Extended Tracking are some of the features of Vuforia SDK. Vuforia supports the detection of several kinds of targets (e.g. objects, images, English text). Especially for image recognition purposes Vuforia allows apps to use databases that are either local on the device or in the Cloud, The platform is available for Android, iOS and Unity.
Wikitude SDK(Commercial) Supports in Android, iOS, Google Glass, Epson Moverio, Vuzix M-100, Optinvent ORA1, PhoneGap, Titanium, Xamarin	Wikitude AR SDK supports image recognition and tracking, 3-D model rendering and animations (supports only the Wikitude 3-D format), video overlays, location-based tracking and image, text, button, video and HTML augmentations. Wikitude AR SDK is available for Android, iOS, Google Glass, Epson Moverio, Vuzix M-100 and Optinvent ORA1, and as a plugin for PhoneGap, a module for Titanium and a component for Xamarin.

Table 2.8: Comparison of SDKs from

2.5.1.1.1 Crafter SDK

The Augmented Reality SDK (AR), the Cloud Image Recognition SDK (Cloud IR), and the On-device Image Recognition SDK (On-device IR) for both iOS and Android provide the following features:

Feature

Support to AR, Cloud IR, On-Device IR, Camera capture management, Abstraction of the camera capture and preview. Cloud Image Recognition, Action taken when an image is sent to the CraftAR Cloud Image Recognition Service via API. Upon recognition, the SDK automatically requests the necessary assets from the CraftAR service. Those assets are the Tracking data and the AR content. Processes the information stored in the JSON of the AR content. The parser can load the AR content automatically into the AR view, and display them when the item's reference image is tracked correctly(Vlahakis et al., 2001).

2.6 Comparison between iOS and Android

	Android	**iOS**
Developer	Google Inc	Apple Inc
Source Model	Open	Closed with open source component
Customizability	A lot. Can change almost anything	Limited unless jailbroken
Easy media transfer	depends on model	with desktop application
App store	Google Play – 1,000,000+ apps. Other app stores like Amazon and Getjar also distribute Android apps. (unconfirmed ".APKs")	Apple app store – 1,000,000+ apps
Widgets	Yes	No, except in NotificationCenter
Device manufacturer	Google, LG, Samsung, HTC, Sony, ASUS, Motorola, and many more	Apple Inc

Table 2.9: Comparison of iOS/Android

2.7 ScanLife Barcode and QR Reader

It read stuff and display the details such as

- Price (oline, local prices)
- Reviews, deals, accessories

The app runs on any Android phone, and it is cheaper than those expensive item readers out there on the market. The app is simple to use and all it needs is for the user to take a picture and let the app do its magic. ScanLife Barcode and QR Reader can read UPC and QR codes. Once a code is scanned, the app reads the embedded string as a QR code. This is certainly useful for people who have a hard time shopping for items or buying stuff due to their impairment (Antonio Wells, 2014).

2.8 Review of Others Work

2.8.1 Android and iOS apps

Android smart phones are increasing and smart phone users using and seeking for more smart applications, the need for the smart applications needed mainly for the different able peoples who can't access stuff normally like others, there are many apps found for voice to text applications

- ShoutOut
- Evernote Voice – to Text Extension.
- Money Reader, Color Identifier, Taxi Magic
- ViaOpta Daily and ViaOpta Nav - Cutting-Edge Technology

According to the David Epstein, Head of Pharma Division, and Novartis Pharmaceuticals, Novartis is committed to providing innovative solutions which go beyond medicine (Stella, 2016), like these apps for the visually impaired which benefit their daily quality of life. In today's world important and cool features of Android Voice to Text conversion (Viral, 2012), specially it will require mostly for VIPs

Highlights of these applications mentioned by Domonic (2015) are,

i) ViaOpta Navigation

The user able to see Points of Interest nearby, divided into categories, find information on them and set a navigation to a specific point of interest, and this includes information on specific accessibility facilities around them, such as tactile pavement and crossings, traffic lights with sound (provided that this information is available on OpenStreetMaps for the area which the user is in)

ii) ViaOpta Daily

New Object Recognizer Feature: Identifies objects in the user's field of vision when user points the camera of the device at an object.

Addition of Scene Recognizer Feature: The user will be able to point the camera of the device at a desired direction or place and the voiceover will tell the user what is in front of them to help them navigate unfamiliar environments.

AR started its rise with the development of Head Mounted Displays (HMDs) which superimpose images over the user's field of vision. Tracking sensors allow these graphics to be modified in response to the user's head movement. But AR received its biggest boost with the appearance of mobile devices containing cameras, GPS, accelerometers, wireless internet connection, and more. Applications are starting to appear which allow user to simply point a camera phone at something (e.g. a shop window, a theatre) and the on-screen display will be augmented with information (e.g. sales offers, discounted tickets), customized to the interests, at that time and place (Gauthier Damme, 2012)

Conclusion

It's obvious that there are lots of people suffering from visually impaired and they desperately need assistance for many day to day activities. And have functional problems in independent living (Thomas, 1981).

Though limited resources found because this empirical research based on the observation is related to the latest technology, but in this review of literature section we can see the importance of **effective application** for **visually impaired people** to run their day to day life effectively, and the **Android OS** could be better in terms of cheap and user friendly of operations for the users using latest available features such as AR, Voice to text, NFC, etc.

3. Technology adapted

In 3rd chapter we discussed about the available technology and the resources which have been used since them introduced. This chapter will further discussed about adaptation of the technology which has been available and which will be used in the proposed system.

3.1 Augmented Reality

6nxIn the palmtop implementation of the MU, the user can see augmented pictures, read related information, and listen to audio commentary through a pocket web browser. No tracking of his location is available and he is responsible for selecting the material of his interest.

It should be noted that all the multimedia material is downloaded from the SIS database unless it already exists in the MU database (e.g. downloaded by the previous user of the device).

Augmented Reality:

It’s a hot topic in mobile right now, Shane Conder & Lauren Darcey (2011). Shane & Lauren have stated many interesting and useful details about AR in his article and summarised in this section below.

Defining Augmented Reality

Before we start discussing how to write augmented reality applications, let's take a step back and define what it is. Wikipedia defines augmented reality as such: "Augmented reality (AR) is a term for a live direct or indirect view of a physical, real-world environment whose elements are augmented by virtual computer-generated sensory input, such as sound or graphics. It is related to a more general concept called mediated reality, in which a view of reality is modified (possibly even diminished rather than augmented) by a computer. As a result, the technology functions by enhancing one’s current perception of reality."

Recently mobile developers have begun leveraging augmented reality techniques by taking input from the camera and overlaying images in real-time, usually meshed up with the image to either show where something real-world is (such as an icon for a restaurant) or perhaps a virtual sign or object.

3.2 Voice to Text

Compared to Android, iOS offers much more fine-grained control over voice dictation. However, there's still no "backspace", "delete", or "undo" command that user can speak to undo any mistakes user make while speaking. User will have to go and edit user's message afterwards to perform any corrections.

Android comes with an inbuilt feature speech to text through which user can provide speech input to his app. With this user can add some of the cool features to users app like adding voice navigation (Helpful when user targeting disabled people), filling a form with voice input etc.,

In the background how voice input works is, the speech input will be streamed to a server, on the server voice will be converted to text and finally text will be sent back to our app.

3.3 NFC

It's a method of wireless data transfer that detects and then enables technology in close proximity to communicate without the need for an internet connection. It's easy, fast and works automatically. Cameron Faulkner (2015). More details about this is analysed in the Literature review and Evaluation sections.

4. Approach

4.1 The SDKs and Libraries have been used for the application.

This application contains several technology collected together, such as,

1) Augmented Reality: this not for the visually impaired person, this could guide to the opponent regarding that person.
2) Voice to Text : this is only for English to Text, and Google API will be used here.
3) NFC Reader: This is for many purposes such as identify items, purchase items, tickets etc.

All these latest technologies will be merged into one app, developing using Android Studio. Some of the interfaces have mentioned here.

This will have more attractive features and mostly free SDKs will be used. To test the app, NFC enabled android phone will be used.

- Import third party sdks such as OpenCV and then download NDK to integrate with OpenCV and Android.
- Google voice to text technology into the android studio and other code and logic will be implemented.
- Facebook (FB) sdk has been used to integrate with FB application, and have access to communicate with taggable friends by using voice command.
- ksoap library is used for SOAP services with PHP wsdl file
- NFC enabled phone and NFC tags
- Barcode reader – Camera option enabled (used deprecated files), ZBar has been used.
- Installed Braintree SDK via gradle file

4.2 How libraries and SDK have been used in the app.

4.2.1 Facebook Integration

Registered with Facebook developer portal and got the appID. Used appId in Android application and using facebook sdks connected with webservices and send and received required files and data.

4.2.2 Braintree Integrations

This is sample interface used to show how VIP can integrate with payment gate using NFC card without entering their details.

- Braintree libraries have been downloaded.
- Created test account – Braintree Sandbox for testing purposes
- with the help of Braintree developer guidance interface has been created and payments have been made

4.2.3 Barcode reading

Using files from ZBar libraries, scanning interface (Camera) is implemented then barcode is read and displayed. – used for item recognition. Used freehost.tigrimigri.com server for testing purpose.

Created table to store item details, and after scanning the item pass barcode and retrieve details (via PHP – SOAP webservice), and then implement the speaker to translate voice to text.

4.2.4 NFC

These options used to show how RFID technology with wireless link features is helping to store necessary details and used them for various needs. Implicit intent is used to detect NFC tag in the interface. MiFare card is used for the testing purposes.

4.2.5 Voice to Text technology

Now for English Google feature (Existing one is used) and using Musicg library have tried for localisation.

5. Analysis

5.1 Overview

The analysis of this research work is done against the existing solutions and research papers reviewed in the previous chapter. According to the literature review done there are many applications available and using latest technologies, but none of them have easy navigation and combined features.

After the rapid growth in technology especially in Mobile development there are various applications can be found for free as well cash, but each has only one particular feature to help different able person. It would be better only one application handle may things (Wallet), According to the literature review done, both Android and iOS has many applications done for the visually impaired people.

5.1.1 iOS and Android applications

As per the literature review, there is app already available for payment and other apps using some of the mentioned features. In android there are few ‘free’ high technology items available which iOS don’t have.

When iOS version changes there is a need to change the

5.1.2 Features analysis

It’s not better idea to use different applications separately also no many shot buttons available for to use different actions

And different able person has less hearing power as well, so Morse code would help to identify the result/reaction than voice

According to the meeting had with different able person, he was having main issue in reading books, so in future there would be a scanner which scans books word and convert into voice (or Morse code).

- Short keys for all the instructions
- Payments with more secure and efficient

Voice to text technology is not being handled very well. Interface is very difficult to go to that particular interface and use that service.

According to the literature review, visually impaired people cannot see all the colors and interfaces and can't read the text properly, and some people have hearing aid problem also, so it's better use **Morse code** technology as well.

5.1.3 NFC Tag

When it comes to NFC, both Sony and NXP card manufacturers have already taken measures to increase the security aspects of their NFC based products. No matter what encryption methods these card manufactures follow and use, if the keys are leaked or stolen by poor programing practices, anyone with the right background will have access to card data corresponding to those access keys.

Based on the outcome of the literature review, the following features were identified and compared. This research would be to eliminate the negative findings in these mechanisms and provide a more robust framework that will have an overall positive output at a fraction of cost. Implementation of applications using the proposed framework should be easy to develop and maintain without needing to worry about the security layer. The feature comparison with existing solutions is given in Table 5.1.

Mechanism	**Security level**	**Response time**	**Device dependency**	**Key management**	**Offline transaction**	**Implementation cost**	**Development cost**	**Customer satisfaction**
SAM	high	high	yes	poor	yes	high	high	high
Remote access keys	medium	low	no	easy	no	low	medium	very low
Hard coded keys	low	high	no	poor	yes	low	low	medium
Proposed tool	high	high	no	easy	yes	low	low	high

Table 5.1: Feature comparison with the prosped tool

The soul intention of this research work is to implement a strong secured offline transaction handling system using an NFC card. Hence following approaches mentioned below are considered when designing the framework.

5.2 Security and capacity features

There are security guard is available for NFC tag to protect from illegal access. (rfid-nfc, 2012). Some type of the tags uses protection mode for writing and reading.(Diffen, 2014).

- MIFARE Classic - It's memory sector is protecting using 2 keys and one key is used to configure protect from writing, for read-only, the other can be used to write the memory, but only some android devices can access them.
- MIFARE Ultralight C, ICODE SLI(X)-S - These types of tags use the password to protect from overwriting.
- MIFARE DESFire - multiple authentication keys and access rights can be configured, including read-only access without keys.

5.3 ZBar - Bar Code & QR-Code scanner

Using this option both BarCode and QR code can scan but alike other SDKs this option also has some drawback (Bryan Herbst. 2016).

Camera view option is deprecated after API 21 level but still has it won't give problem.

5.4 Why the development of this application in android is better than?

When version changes iOS application needs updates frequently, but android can be compatible in almost all latest versions. Android Lollipop was a BIG update for Google.

The search giant completely redesigned the look and feel of Android under the banner of Material Design, creating a unified "Google Experience" across all platforms including PC, Apple and Microsoft products. Android Marshmallow, however, will be slightly different.

5.5 Review & Analysing others work

As per researches and programs done by the others have analysed and observed well in the Literature review section.

Mainly the software done by Dragan Inc and Google Inc have analysed well [24]. Also iOS, web applications have reviewed along with the android apps[25]. Paul Nuñal(2012) states many features of the apps and listed below.

5.5.1 ScanLife Barcode and QR Reader

Figure 5-2: Barcode reader application

It reads barcodes and identifies certain items. The app runs on any Android phone, and it is cheaper than those expensive item readers out there on the market. The app is simple to use and all it needs is for the user to take a picture and let the app do its magic. ScanLife Barcode and QR Reader can read UPC and QR codes. Once a code is scanned, the app reads the embedded string as a QR code. This is certainly useful for people who have a hard time shopping for items or buying stuff due to their impairment.

5.5.2 TalkBack

TalkBack is an application that is part of Google's Android Accessibility Service, designed to help blind and visually impaired users with using their mobile devices. In a nutshell, TalkBack will greatly help blind people hear what they are trying to do with their mobile phone as the app will tell them the item that they have just selected or picked. The app can also read texts aloud and every movement the user makes on her or his phone is carefully being monitored and spoken by the app.

5.5.3 IDEAL Accessibility Installer

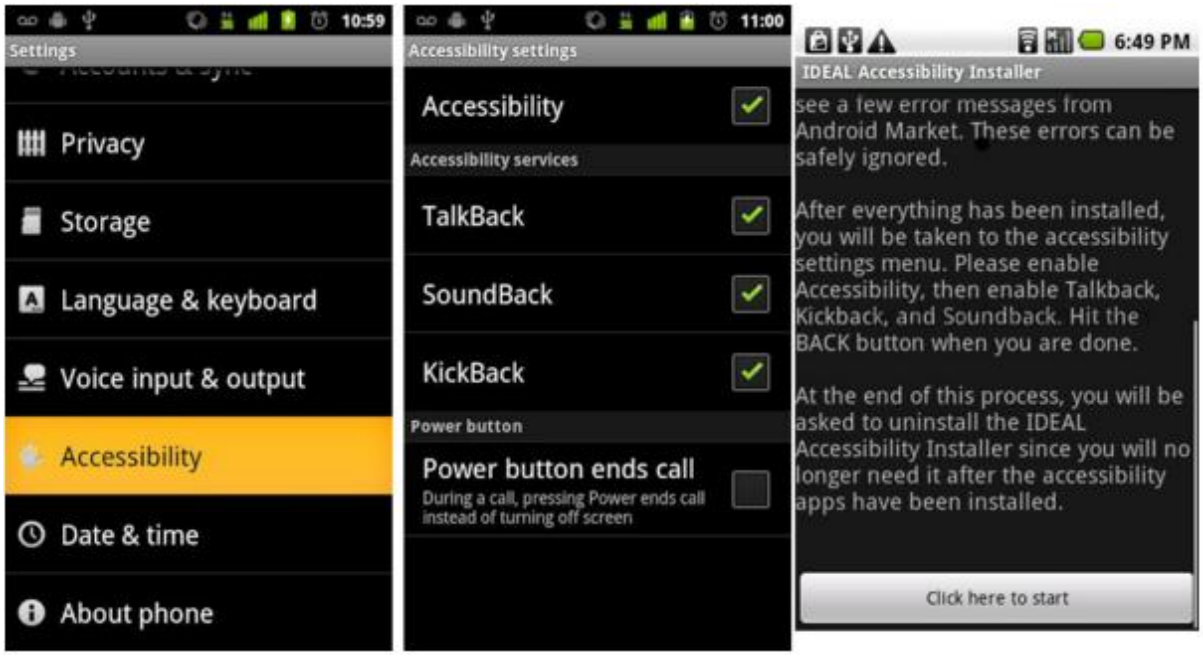


Figure 5-3: Barcode reader application

And other apps also available such as Font Installer Root, Magnify and some more

5.5.4 ACB Link

It connects members and friends of the American Council of the Blind. With ACB Link, user can:

- Access valuable resources offered by the American Council of the Blind
- Get push notifications designed to keep user in the know about late-breaking news items of value to ACB members and friends
- Easily and conveniently connect to the state and special-interest affiliates of the American Council of the Blind via the app's affiliate tab
- Be informed and entertained by the programming available from ACB Radio's various channels via the radio tab
- Play ACB podcasts on demand so user never again has to miss information that enhances user’s life and increases user’s independence
- Gain valuable information that focuses on dealing with sight loss, whether user is facing vision loss himself/herself or have an elderly parent or relative who is.

6. Design

6.1 Overall Architecture of each component

6.1.1 Braintree integration

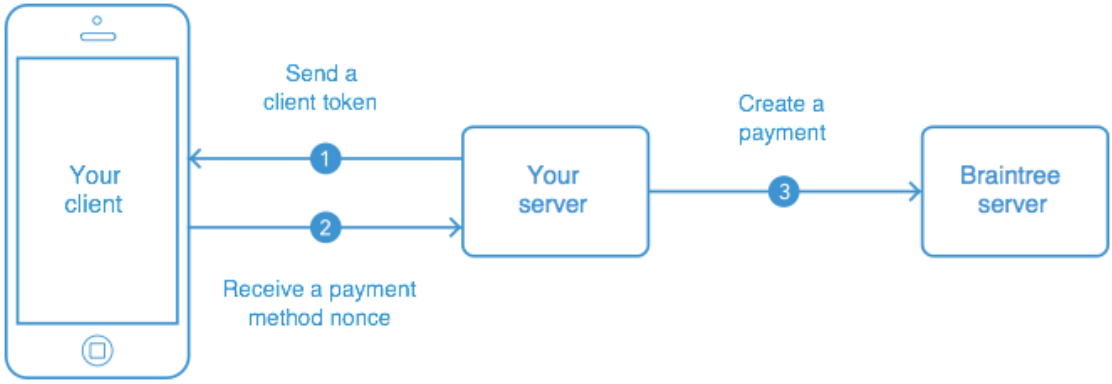


Figure 6-1: Identify item using NFC

6.1.2 Context Level Diagram

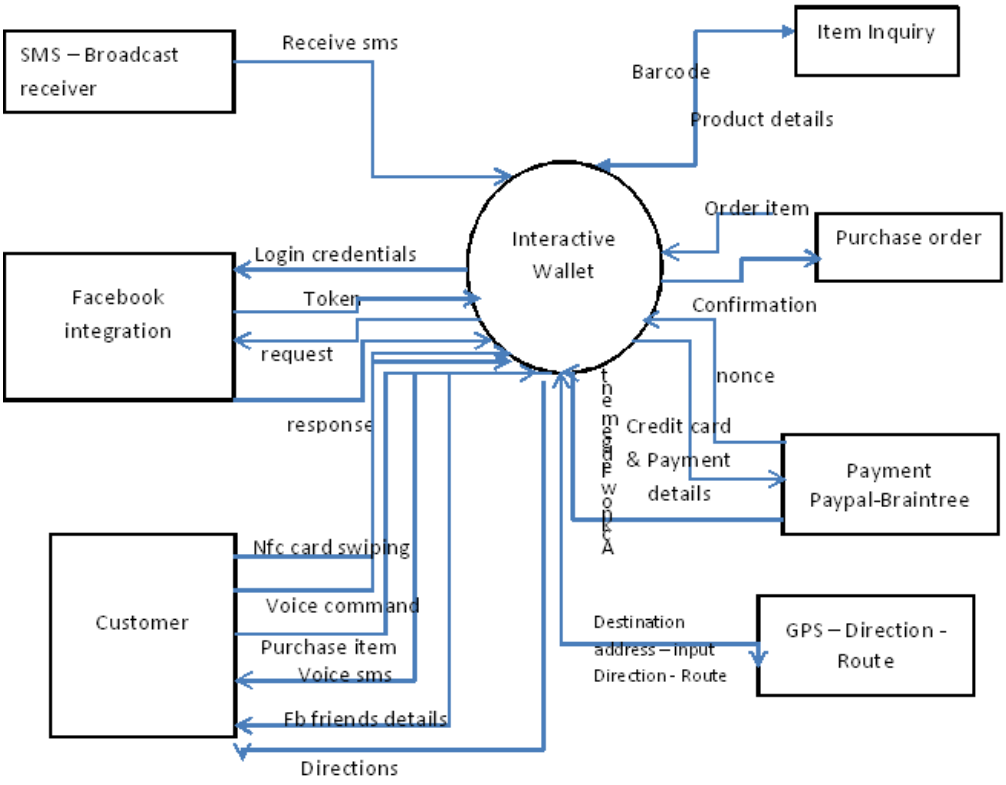


Figure 6-2: Context diagram

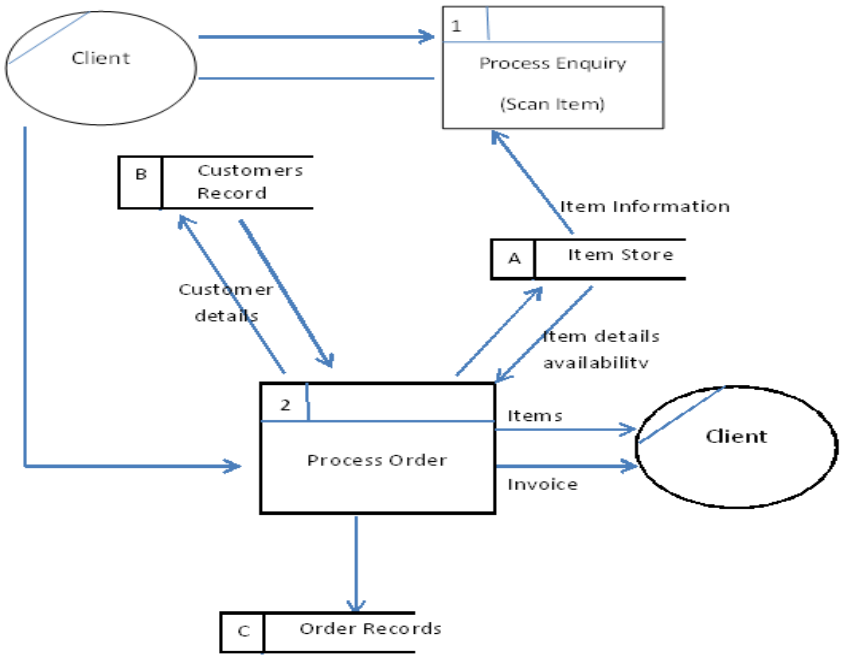


Figure 6-3: Data Flow Diagram for Sales

6.1.3 Main Server

The main server is the heart of the system. It is design to handle multiple client request from mobile client. It may store sales, payment, item, and customer details, other integration with Braintree; Facebook will be handles by its own server.

LAMP Bundle & APIs

For the server LAMP model domain server is used, LAMP stands for Linux, Apache, MySQL, and PHP.

Tables will be created according to the design and PHP will be used as a middle layer software tool and webservices will be created using that to communicate with (data transfer) in front-end, wsdl files URL will be used as APIs.

6.2 Text to Voice

Speech TTS SDK from android will used to implement this option. TextToSpeech class will handle to convert the text to voice.

6.3 Voice to Text

For English built in classes will be used (`speech.RecognizerIntent`).

For the localisation the algorithm will

Step1: record word using a MediaRecorder

Step2: add the header to that record and save as wave file and name(words name as files name) it (store in the server)
Eg:
Table name: AudioFile
Columns: id, audioname, fileformat, size

Step3: then when using that file from front end, send the file
Record->add header-> convert to wave file

Step4: retrieve audio files stored in the server and compare with currently recorded file (converting fingerprints bytes and compare)
Then return the filename of matched audio

6.4 Item recognition

This can be implementing in both way such as scanning bar codes or tags (MiFare cards or other tags) and after reading that the information will be sent to the server (request) and the response will be converted to the voice

Step1: Barcode scanning library ZBar will be install in the android, and implement the code to camera preview and scan the image.

Step2: for the SOAP service ksoap.jar will be used for the integration (send and receive) in android.

Step3: Results (Barcode) will be passed to the server and response will be return (details with its descption) and will be converted to the voice using the above speaker class.

6.5 Payment Integration

Step1: get nonce from the Braintree server (integrate using php file located in our server)

Step2: send the card details and other details such as payment and items

Step3: receive the acknowledgement

6.6 UML Diagrams and High Level Diagrams for some functions

6.6.1 Scanning an Item – Activity Diagram

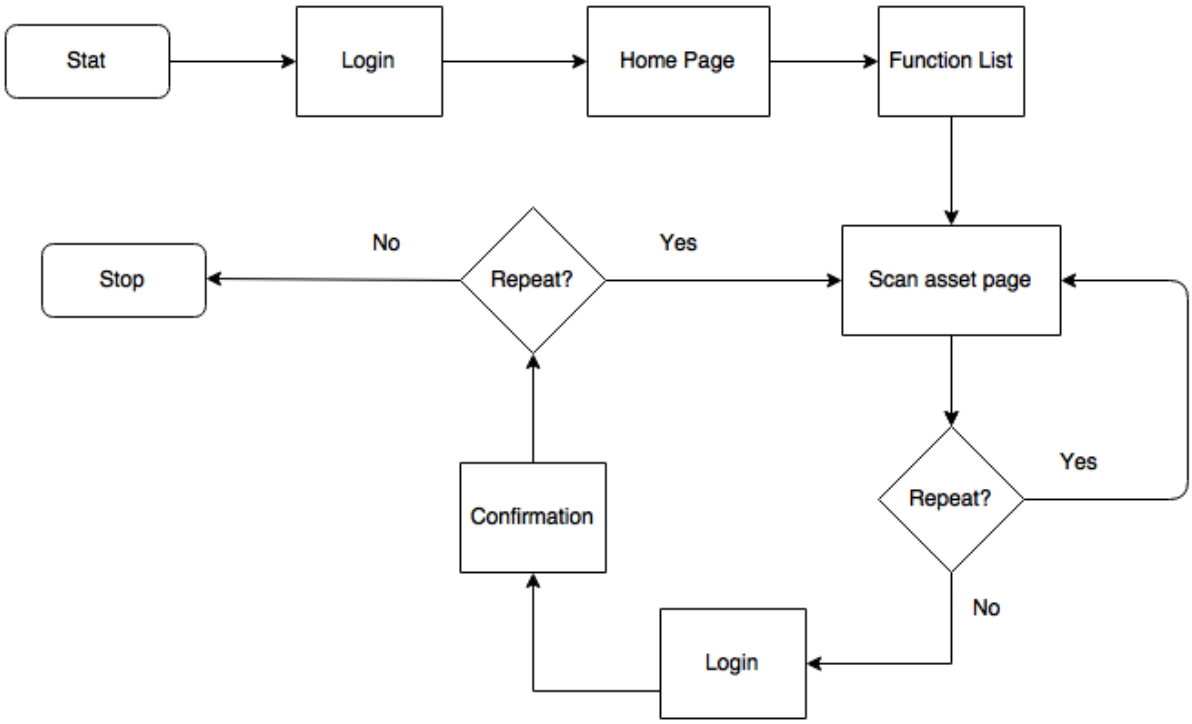


Figure 6-4: Identify item using NFC

6.6.2 Online payment

Diagram - Mobile Sales Process – High Level Diagram

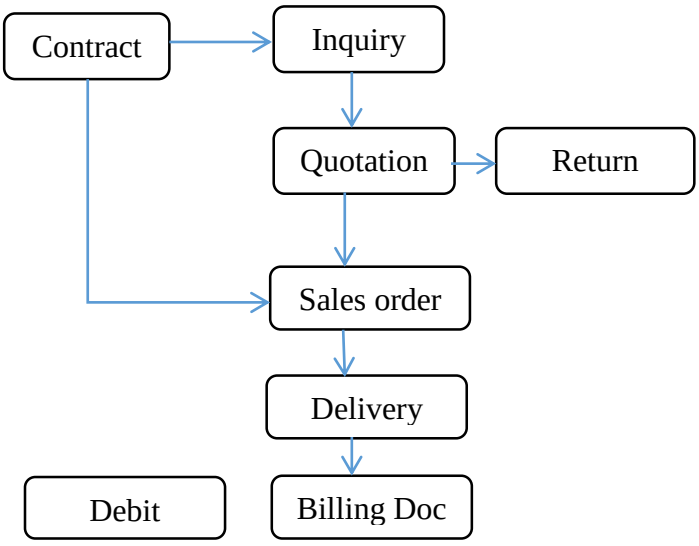


Figure 6-5: Sales process when using nfc card and other technology– high level diagram

UML Diagram - online payment

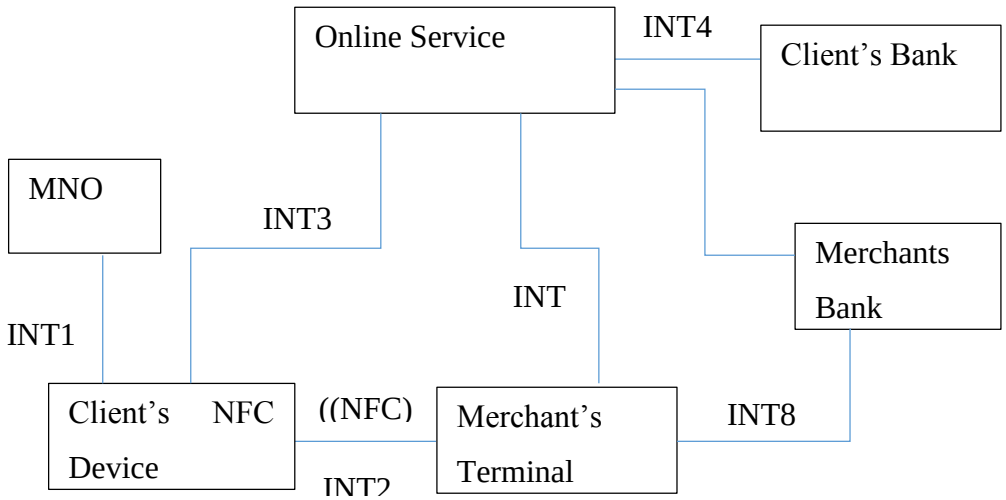


Figure 6-6: Payment - Online

Credit Card payment – Use case diagram

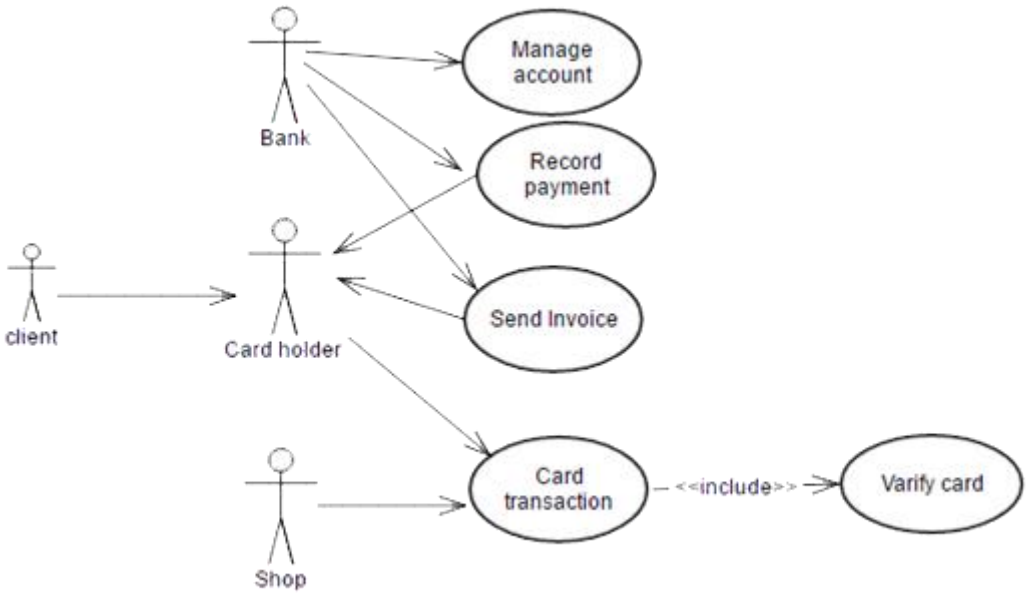


Figure 6-7: Use case diagram for credit card payment

6.6.3 NFC Checking balance of the Card – Sequence Diagram

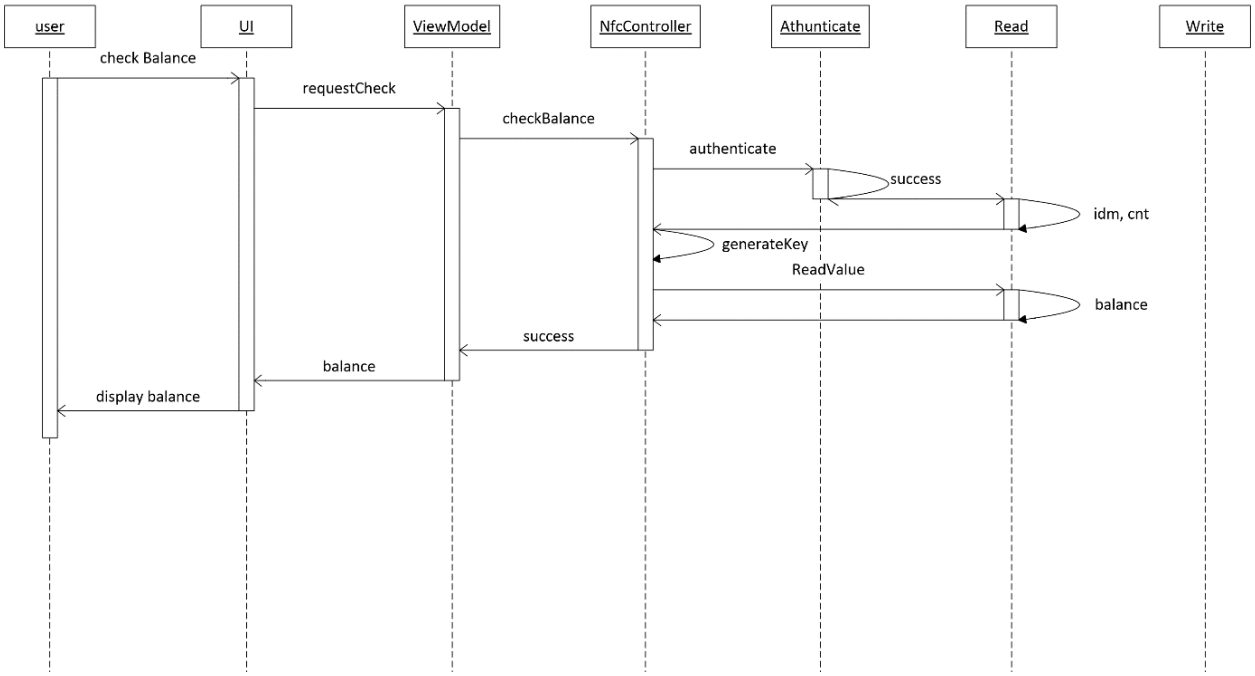


Figure 6-8: NFC Checking balance of the Card – Sequence Diagram

6.6.4 PayPal – Sequence Diagram

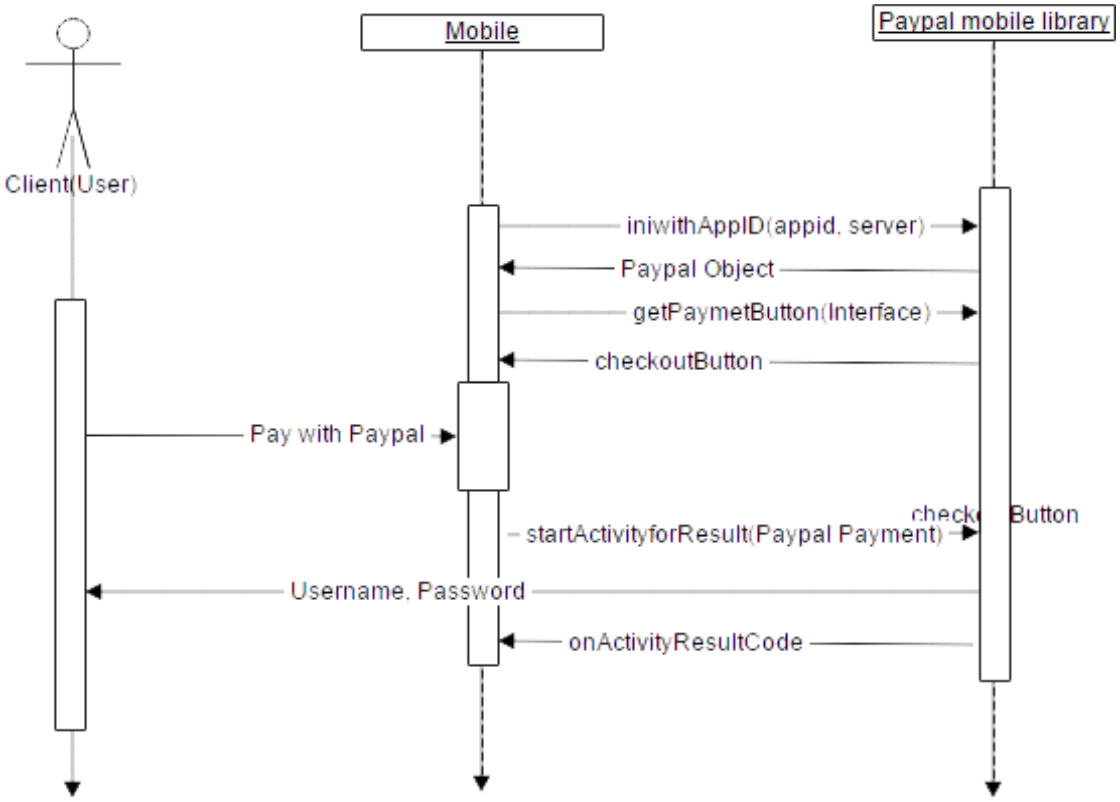


Figure 6-9: PayPal – Sequence Diagram

6.6.5 Facebook Integrtion – Login – Sequence diagram

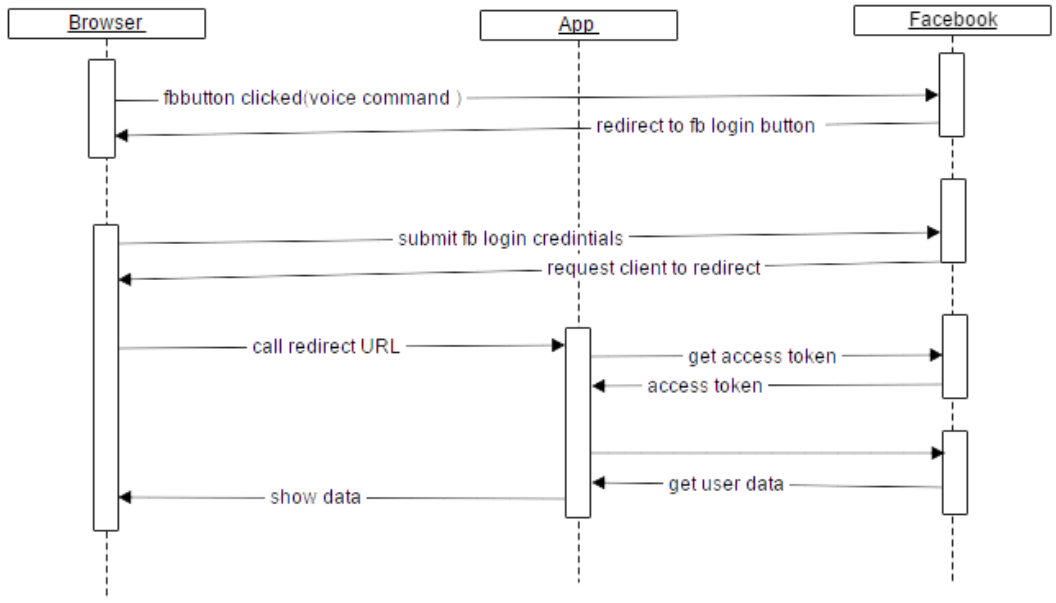


Figure 6-10: PayPal – Sequence Diagram

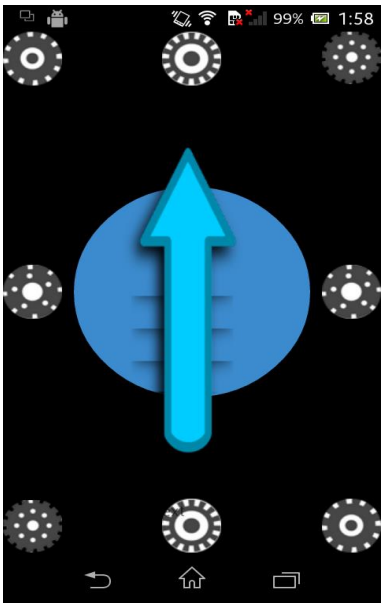
7. Implementation

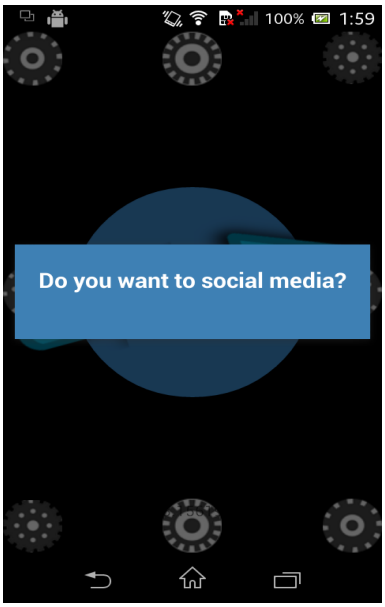
The implementation of the framework shall be done using a prototype project, addressing the visually impaired people's problem reviewed in second chapter. The prototype shall be complex enough to show the essential functionalities of the algorithm and its functions. The system shall consist of a server, and a mobile client. The management component shall be implemented in server side as a prototype website and/or mobile interface. Touch optimized multi app supporting mobile applications shall be implemented under client side.

Following sub chapters will explain the core functionalities implemented followed by this prototype application later on.

7.1 Menu selection

This one is created to select menu by touching on screen (middle – this can be done by visually impaired people easily) and rotating (there one image is rotating) and it will ask when the one corner of the image points to the each option (image) those are aligned in each corner. Each time it passes it will read the menu name, if user wants to use that option, user has to stop rotating and double tap to navigate to that particular page or he/she should do single tap to exit from that menu selection.
Motion will be used in the ontouch overridden method, degree of the object will be found. (Source 1.0)





7.2 Implementation of item recognition

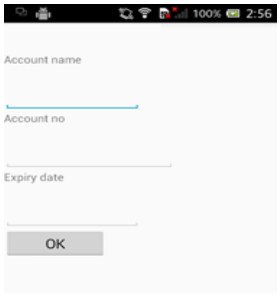
Barcode scanner – When user moves the image (Arrow) to point to the menu option and voice command will ask whether user wants to move to that site or not, if he/she double tap on it, then it will navigate to that page

ZBar – third party library is downloaded and add into the libs folder then refered through build.gradle file,

7.3 Read/Write NFC

Read nfc: NFC data will be read and this class is defined as implicit intent and when swipes the NFC card automatically data will be read. (Source 1.1)

Write nfc: This is for the admin option (after implementing localisation voice input also will be recorded in NFC card.(Source 1.2)



7.4 Augmented Reality – Item Detection

Install NDK(can download externally also) and in the **project structure** add the ndk location path. Download OpenCv and in the project string under the module

select dependencies tab, select ‘Module dependencies’ and then select path to opencv location.(Source 1.3)

7.5 Speaker Class

Used in all the class to convert text to voice (Source 1.4)

7.6 Facebook Integration

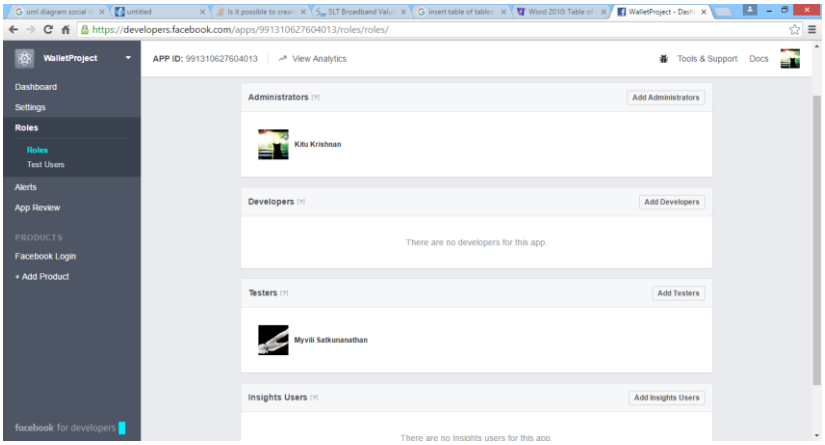


Figure 7-1: Facebook user roles

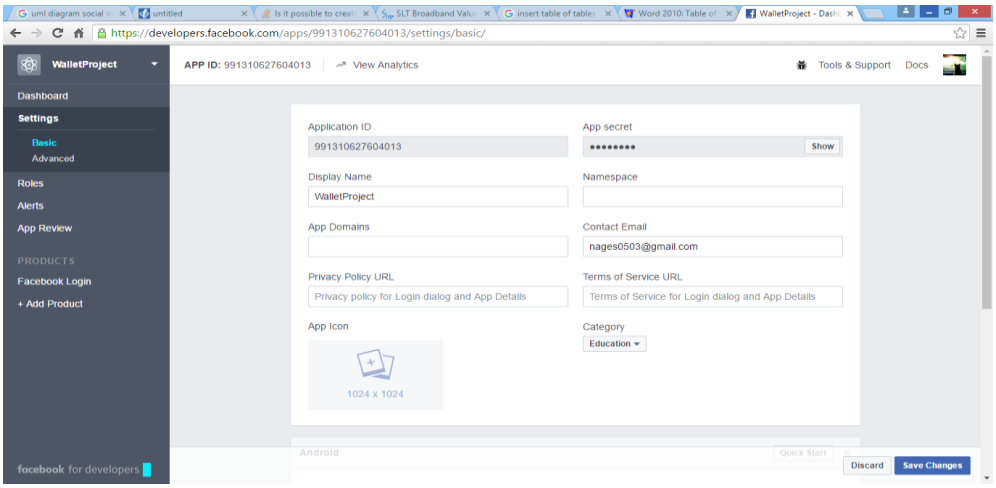


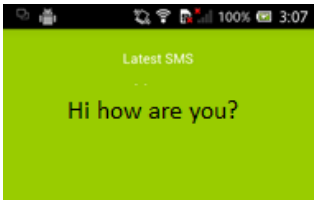
Figure 7-2: Facebook settings page for Application ID

Above images shows how register new user to give access to the app, and how and where to get the app id. Speaker class is used here to read friends list

Login activity, (Source 1.5).

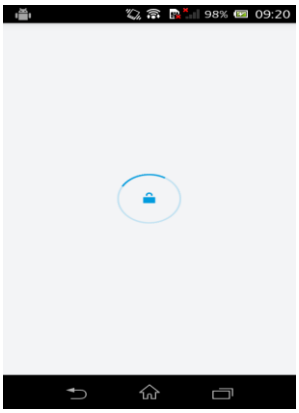
7.7 Read received SMS

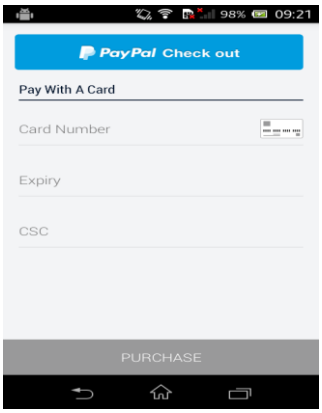
SMS will be received while that interface is opened, (Source 1.6, 1.7).



7.8 Payment using NFC (Source 1.8)

While swiping NFC payment detaisl will be passed in the Braintree Payment Interface (Source 1.9)





Web portal – WSDL generation in php

Token generation (Source 2.0)

7.8 Dial number

Soap service - to retrieve item details(Source 2.1)

7.9 Morse Code

Example declaration for numbers and texts are show in below

```
private static final long[][] LETTERS = new long[][] {
    /* A */ new long[] { DOT, GAP, DASH },
    /* B */ new long[] { DASH, GAP, DOT, GAP, DOT, GAP, DOT },
    /* C */ new long[] { DASH, GAP, DOT, GAP, DASH, GAP, DOT },
    /* D */ new long[] { DASH, GAP, DOT, GAP, DOT },
}
private static final long[][] NUMBERS = new long[][] {
    /* 0 */ new long[] { DASH, GAP, DASH, GAP, DASH, GAP, DASH, GAP, DASH },
    /* 1 */ new long[] { DOT, GAP, DASH, GAP, DASH, GAP, DASH, GAP, DASH },
    /* 2 */ new long[] { DOT, GAP, DOT, GAP, DASH, GAP, DASH, GAP, DASH },
```

Generating the pattern (Source 2.2)

8. Evaluation

In this research done, the user evaluation was done with visually impaired and blind people in all age groups, around 60 members were selected, few were omitted due to inappropriate results, and the evaluation is done via questionnaires and user comments received from them. Each user is requested to rate each question from 1 to 5, with 5 being the highest value.

Results is stored in excel and then evaluated with the help of SPSS software.

8.1 Methodology

Since the prototype consist of several components, each functionality of a component was given a weighted value by discussing with the developer evaluation team. Apart from functionalities implemented, users were also requested to evaluate the system against usability, portability, accuracy, reliability and finally against the system response speed. Users have split into two categories and evaluation is done by given certain areas to each type of the users.

Based on the feedback received and the weight, the weighted score values for each component was obtained. Score of first user is given in Table 8.*1* and Table 8.*2*.

Wallet Mobile Application	User 1		
Functionality	Weight (w)	Score (s)(1-5)	ws
Menu selection	13	5	65
Navigation	15	4	60
Payment	12	5	60
SMS services (reading)	10	3	30
Voice-Morsecode output	10	2	20
Social media	10	2	20
Low Cost	10	4	40
Usability	15	5	75
Portability	5	3	15
Accuracy	8	5	40
Reliability	5	4	20
System Speed	7	3	21
Total			**466**

Table 8.1: Wallet application evaluation

Wallet Mobile Application(non-VIP-Admin) – Web portal	User 1		
Functionality	Weight (W)	Score (s)(1-5)	ws
Customer details entry	15	4	60
Item entry	13	4	52
NFC writing	12	5	60
Low Cost	10	3	30
Usability	15	4	60
Portability	5	3	15
Accuracy	8	3	24
Reliability	5	4	20
System Speed	7	5	35
			406

Table 8.2: weighted value table for other users

8.2 Android, iOS and other technologies

There are many software programming tools available to build innovative creative applications for the mobile users, and iOS is more powerful and easy to create interfaces than Android, but according to the sources 90% Android users and 10% of iOS users found.

Also people who are disables are mostly not very much rich in money but they effort to get Android phones than iOS, and also there are many open source(free) tools available to build android applications than iOS applications and Blackberry and other tools.

There many advantages have been found (Wikitude, 2013), on Android Apps rather iOS phones, main point is mostly there are many Android users found and it's affordable also.

According to the Literature review there are many apps found free for visually impact people, but unfortunately all of them are not combined together, and there it's difficult for them for to open each app for different purpose, also not easy to operate them as well

And the Tool kit compared in the above for the augmented reality, as mentioned in literature review

And in the above latest android sdk version will be used, but make sure all the features would be support to Android 2.1, as it has most of the good features, also this will support to the most of the latest technology

Since the prototype consists of several components, each functions of a component were given a weighted value by discussing with the developer evaluation point of view. Apart from functionalities implemented, users will be also requested to evaluate the system against usability, portability, accuracy, reliability and finally against the system response speed.

One of the most common problems that many blind and visually impaired people experience is their day-to-day challenge in coping with their impairment. Equipment such as Braille, reading glasses, or a walking stick are just some of the few things that help visually impaired people get along with their lives.

With the advancement of technology, a common Android smartphone equipped with specific applications can aid visually impaired and blind people in functioning. Here are some of the best applications that are tailor-made for visually impaired persons.

Overall the project concluded with a significant achievement of the objectives regarding key generation framework and demonstrating the functions with the prototype tourist application and provides the first step towards making a comprehensive application using the framework, designed for NFC based secure application developments.

Augmented reality is a broad and that fall into many aspects of Android development and many APIs.

For Voice to Text technology Google's Voice Search and Google API have found and used in many apps, also its easy to implement and open source can be found.

Each AR SDK, like all SDK's, are not created equally. They all have their advantages and disadvantages. So here Wikitude will be used based on the features referred and analysed in the above chapters. Its free and have many attractive features.

8.3 Read SMS

Reading SMS will read, when SMS receives while that interface is opened and received SMS will be read. This is not very good feature because that interface should be opened always.

8.4 NFC Architecture

For this thesis, the proposed architecture would be based on the 2nd approach considered in previous chapter. When designing the windows based prototype, it was decided not to hard code or keep any keys on non-volatile storage space of client devices, but to retrieve them from server on runtime and keep them in volatile memory. This was considered as evidence found for where keys can be extracted from byte codes by use of disassemblers like Hopper [15] and IDA [16] reverse engineering tools.

While the application keys and encryption keys are retrieved from server, the card access keys are generated at run time and discard afterward. This figure **Error! Reference source not found.** shows the overall architecture for the proposed system and how the keys and data exchanged among clients and server.

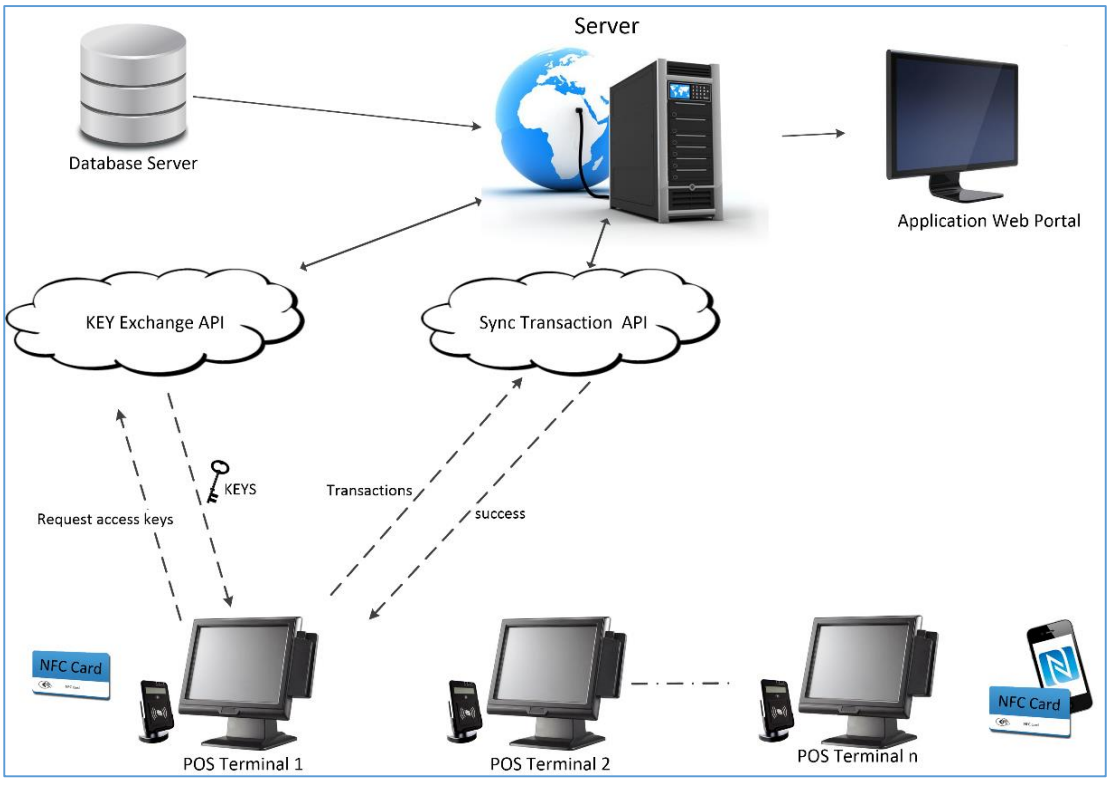


Figure 9-1: Overall Architecture

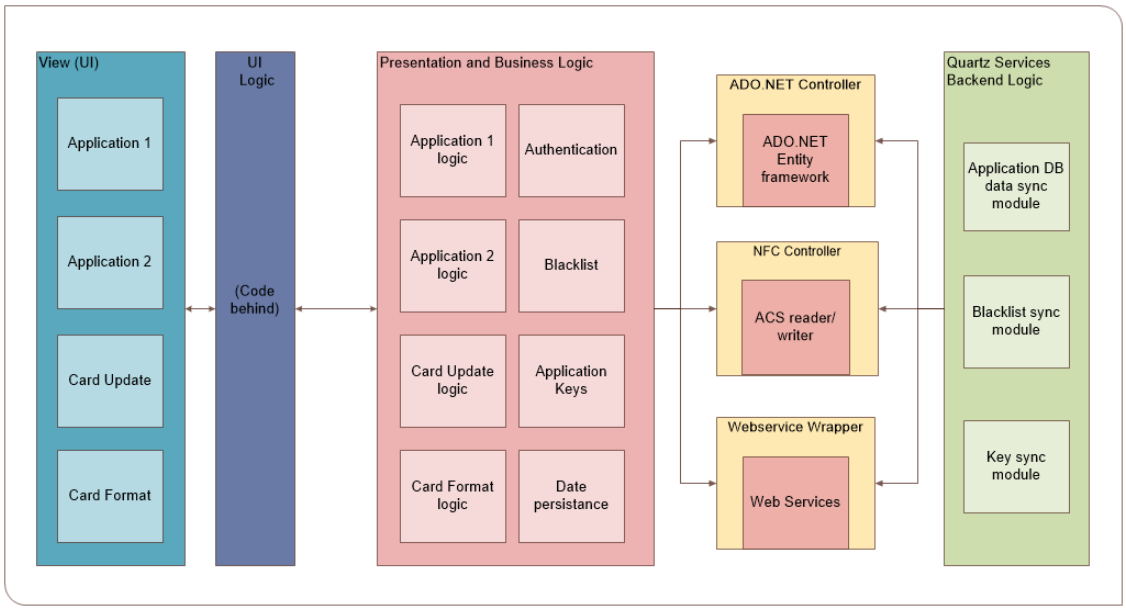


Figure 9-2: Client Architecture

Ease of navigation of the application

One of the key components of this research project is how it helps VIP to navigate this app from interface to interface.

Feel comfortable with the app

This application each and every option is able to convert from text to voice also voice to text and not directing to unwanted place by mistakenly

8.5 Card Read/Write Algorithm

When designing an ordinary NFC based application, the card access keys are stored in application layer. If the keys are known or extracted by decompiling the byte code, one can have access to read write the card content making it vulnerable. Considering MIFARE classic card, the encryption algorithm Crypto-1 is possible to break in lab conditions with the right tools and computer power. This is where it was decided to introduce an algorithm not only to generate keys but update access keys dynamically for each sector per transaction basis making the extracted keys from above mentioned methods meaningless or not worth the effort.

Please note the card is required to be reformatted from transport configuration as explained in previous chapter to cater proposed algorithm.

8.5.1 How it works

One of the key advantages of this read write algorithm is, for each NFC card, each sector; the access keys will be unique and valid only for one card access.

8.6 ZBar - Bar Code & QR-Code scanner

Uses a deprecated feature camera (ZBar – API 21) still working without any error, and also working both Bar Code reading and QR Code reading. QR code returns the URL of the item and it reads to the user and will wait for the user to say “Yes” to navigate to that particular page (but there won’t much need for navigating to that page).

This option also uses deprecated features on camera preview, there may be possible for that feature could be stop working in future.

8.7 Social media integration

This feature will use the logged in (registers Facebook user of that phone). And to access certain features that user should also add in the settings (https://developers.facebook.com/apps/991310627604013/roles/) of the Facebook developer’s site role page as a tester or other role.

And this could be implementing in a better way

9. Conclusion and Future developments

The designed features have been implemented in the desired way. Though most of it feature satisfies the users according to the evaluation, it's not highly possible for the visually impaired in our country as the price of the latest phone is with wifi connection is bit more expensive. But this will be automatically solved near future.

This app mostly design not only visuall impaired but also blind (complete) people also, this would convert 100% into voice output.

Also according to Dr. Prasad, some visually impaired people also effects by hearing aid problem, so here just testing for converting text to morse code is done, but in future this will be implemented in all the areas.

Localisation on Speech recognition has some issues while implementing the algorithm, and in future it could be corrected. Other features like social media integration with another app, item recognition, shopping features, location findings are cannot be seen any other application.

Augmented reality could be used in many areas such as face detection (Intorobotics, 2013), and the item detection and face recognition and many more options could be done using this option. Login option also will be implemented in a secure way (fingerprint)

This app developed in prototype level, sales part of payment, item recognition is shown here, in future complete sales process will be implemented

Using Google API – Map could be very in a very creative way to use find the direction (route) to the place which could be highly recommended feature by user.

In future all Facebook functionalities can be done in this way using voice command also converting text to voice command.

This app considered the less hearing issue which more visually impaired people have. Morse code technique has implemented in this app, that will enhance more in the future development.

Unlike usual application this application has many integrated technologies which is being used in the appropriate way, but still it’s implemented in prototype level. Interfaces will be design in more innovative way also above mentioned technologies will be integrated in very useful and innovative way.

Overall the project concluded with a significant achievement of the objectives regarding implemented collective useful features for visually impaired people in an innovative way.

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Appendix A - Quality Assurance (Test Cases)

Test Case for Item Recognition & web URL (QR Code)

Test Case:	Item Recognition		
Description:	Scan barcode and get item details as voice and scan QR code to navigate to url.		
Actors:	User, Admin		
Preconditions:	Camera enabled android with minimum api 16		
Feature	Procedure	Expected Result	Status
Scan barcode	Scanning of the item's barcode	Display barcode number(for other reference)	PASS
Item description	Web returns item description and voice over tech convert it to voice	Description including price and its details coming in voice form	PASS
Navigation to the web pages	Scan QR Code	After scanning URL if you want to go that url just say "OK" and then it will take you to that page	PASS

Table A.1: Test Case for Travel Card windows application

Test Case for location tracking

Test Case:	GPS wallet		
Description:	Listen place description		
Actors:	User		
Preconditions:	Users should have an android based phone with minimum API – 16, GPS enabled		
Feature	Procedure	Expected Result	Status
Add address	Voice command is given	Display address	PASS
Find location	Google API is used	Direction is shown	PASS
Converted to voice command	Text to voice command is used	Voice command	PASS

Table A.2: Test Case for Travel Card mobile application

Test Case for Facebook integration

Test Case:	Facebook integration		
Description:	User access fb in his/her mobile application		
Actors:	User, Admin		
Preconditions:	User should be authenticated		
Feature	Procedure	Expected Result	Status

Login	Click login button(voice command)	Successfully logged in move to next page	PASS
Select particular friend to chat	Voice over command – friend name	Provide chat option	In-Process

Table A.3: Test Case for Tourist Ticket Book application

Test Case for Web Portal and Braintree Payment

Test Case:	Web Portal		
Description:	Manage retrieve and save details		
Actors:	User, Admin		
Preconditions:	Internet enabled		
Feature	Procedure	Expected Result	Status
Update item details	Add item details via interface	Record added successfully	PASS
Customer details (Admin)	Enter customer details with card details	Record added successfully	PASS
Return item details for particular barcode	Scan and send , webservice (php) search and return	Voice command will describe the feature	PASS
Braintree nonce return	Send appid and get nonce	On the result of the callback method in front end nonce returns	PASS
Credit card payment via pay-pal	With setting nonce and creadit card details and amount send request	Payment successfully completes	PASS

Table A.4: Test Case for Web portal

Test Case for Item detection - augmented

Test Case:	Item Detection		
Description:	Camera will scan the item (eg: faces or items) and read the no of item near by		
Actors:	User, Admin		
Preconditions:	Camera enabled android with minimum api 21		
Feature	Procedure	Expected Result	Status
Scanning item	Camera will be focused on surrounding around the user	Detect the item and give message by voice	

Appendix B - Questionnaire Used For User Evaluation

Basic Information

Name of the Person: …….	
Place: ……..	If working years of experience: ……
Working/Studying/Other…….. Gender:…….	Age: ……..

Questionnaire - Set A

Basic information of about yourself, your project, team (Tick on your selection please)

1	Have you ever used similar application before? i) Yes ☐ ii) No ☐
2	If yes how many different kind of apps? i) < 3 ii) 3 – 5 iii) 6 – 10 iv) > 10
3	The biggest problem area which you think you have is i) Communication ii) Shopping (Item recognition) iii) Travelling (Recognizing places) iv) Reading/Writing Messages v) All above
4	The most required feature? i) Reading ii) Writing iii) Guiding iv) Identifying item

Questionnaire - Set B

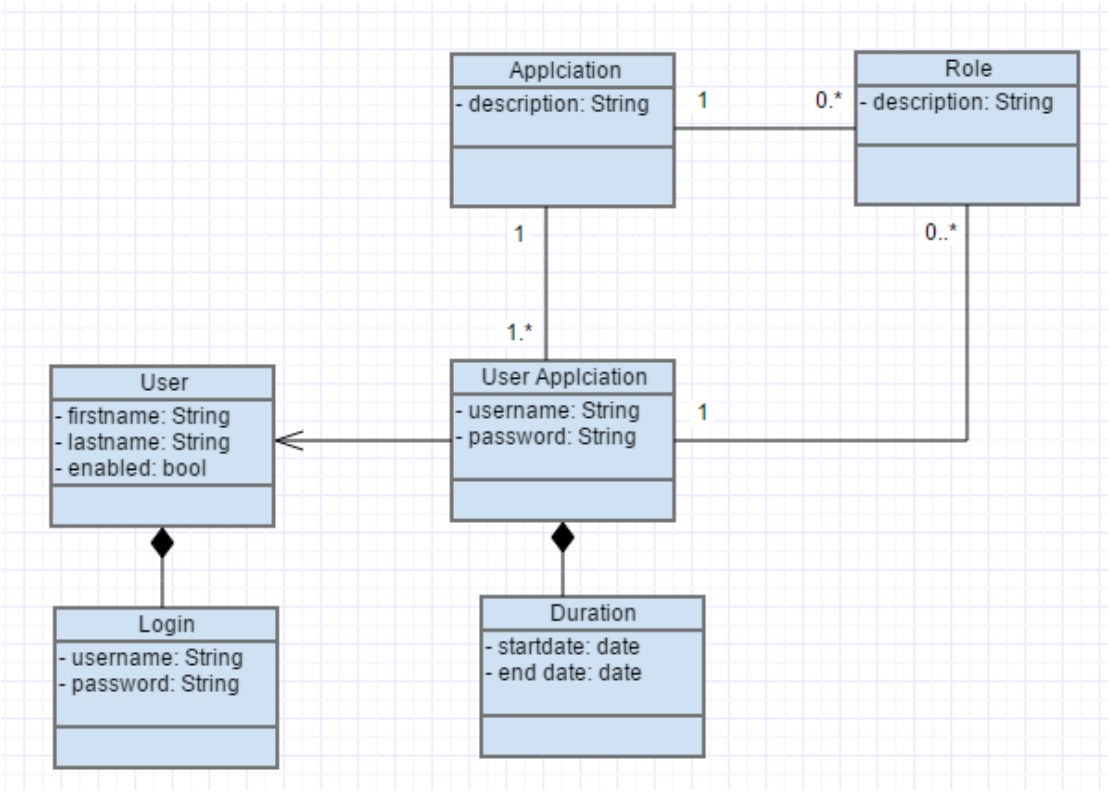
Please tick your answer

Strongly Disagree (SD)	1
Disagree(D)	2
Neither Agree or Disagree (NAD)	3
Agree(A)	4
Strongly Agree(SA)	5

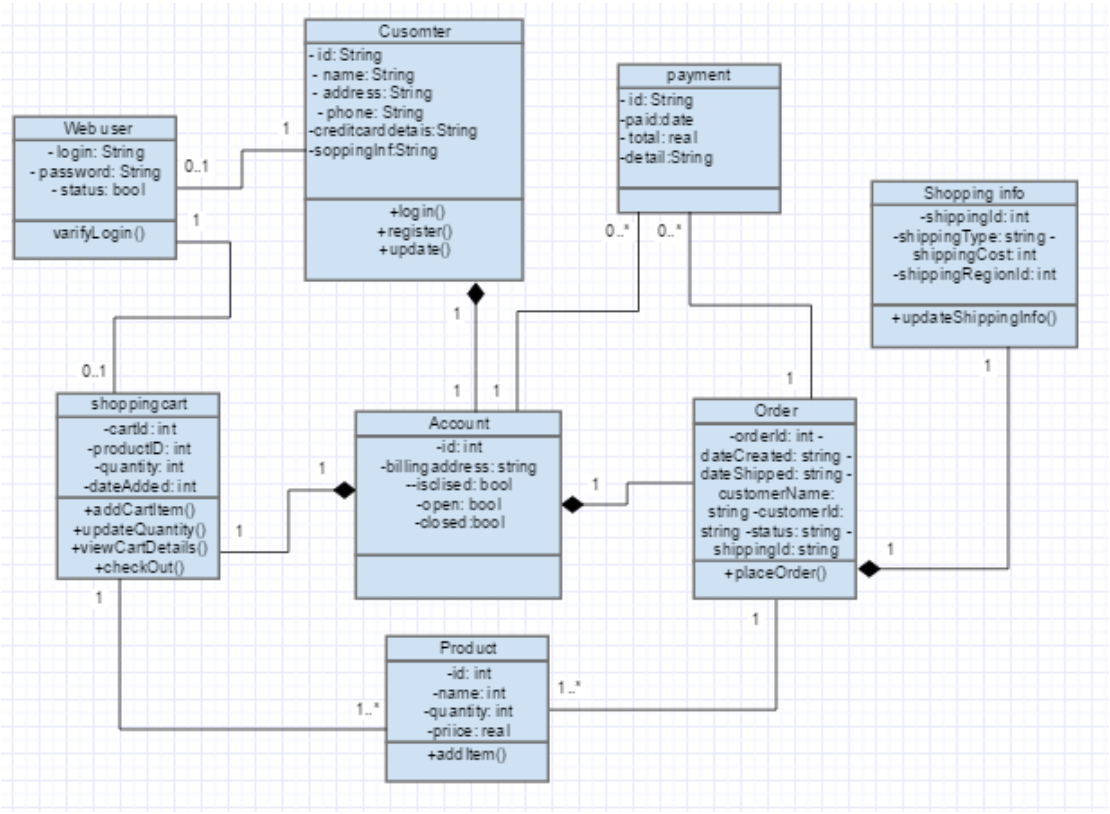
No		SD 1	D 2	M 3	A 4	SA 5
	Familiarity of the Application					
6	I can understand the flow of the app	☐	☐	☐	☐	☐
7	I'm satisfied with navigation	☐	☐	☐	☐	☐
8	Operations for the functions are easy	☐	☐	☐	☐	☐
9	Myself alone I can operate this function	☐	☐	☐	☐	☐
10	Tap, long press, double tap events are obvious	☐	☐	☐	☐	☐
	Satisfaction					
11	I'm satisfied with the functionalities available	☐	☐	☐	☐	☐
12	The options provided by this app is enough for the basic needs	☐	☐	☐	☐	☐
13	Voice commands and Morse code are helpful?	☐	☐	☐	☐	☐
No		**VL 1**	**L 2**	**N 3**	**M 4**	**VM 5**
	Ease of use					
14	Easy to move one item to another	☐	☐	☐	☐	☐
15	User friendly	☐	☐	☐	☐	☐
16	Many menu items are in the only app but easy to operate each functions	☐	☐	☐	☐	☐
	Communication					
17	Localization option is a useful option	☐	☐	☐	☐	☐
18	Can use morse code in case if I don't hear	☐	☐	☐	☐	☐
19	Text – to – Speech and Speech to Text option is useful and used in appropriate place.	☐	☐	☐	☐	☐
	Meeting planned goal					
20	Does project meet all Operational/functional requirements?	☐	☐	☐	☐	☐
21	Does the product delivered at the end of the project match the original requirements and scope?	☐	☐	☐	☐	☐
22	Does project efficiency being very high?	☐	☐	☐	☐	☐

Appendix C - Class diagrams

Login



Item purchasing



Appendix D - Crucial part in implementation..

```
@Override
public boolean onTouch(View v, MotionEvent event) {
    final float xc = mCircle.getWidth() / 2;
    final float yc = mCircle.getHeight() / 2;

    final float x = event.getX();
    final float y = event.getY();

    mPrevAngle = mCurrAngle;
    mCurrAngle = Math.toDegrees(Math.atan2(x - xc, yc - y));
    animate(mPrevAngle, mCurrAngle, 0);
    int rotateAngle = (int) mCurrAngle;

    switch (rotateAngle){
        case 30:
            tv.setText("30");
            builder.setText("Do you want to go to Guide Tour page?",
speaker, context, "G");
            builder.show();
            break;
```

Source 1.0

“Speaker object” is initialised to enable text to voice conversion.

```
speaker = new Speaker(this);
speaker.allow(true);
```

```
Parcelable[] data =
intent.getParcelableArrayExtra(NfcAdapter.EXTRA_NDEF_MESSAGES);
if (data != null) {
    try {
        for (int i = 0; i < data.length; i++) {
            NdefRecord[] recs = ((NdefMessage)data[i]).getRecords();
            for (int j = 0; j < recs.length; j++) {
                if (recs[j].getTnf() == NdefRecord.TNF_WELL_KNOWN &&
                    Arrays.equals(recs[j].getType(), NdefRecord.RTD_TEXT)) {
       String textEncoding = ((payload[0] & 0200) == 0) ? "UTF-8" : "UTF-16";
        int langCodeLen = payload[0] & 0077;
         s+= new String(payload, langCodeLen + 1, payload.length -
langCodeLen - 1,
```

Source 1.1

```
Parcelable[] data =
intent.getParcelableArrayExtra(NfcAdapter.EXTRA_NDEF_MESSAGES);
if (data != null) {
    try {
        for (int i = 0; i < data.length; i++) {
            NdefRecord[] recs = ((NdefMessage)data[i]).getRecords();
            for (int j = 0; j < recs.length; j++) {
                if (recs[j].getTnf() == NdefRecord.TNF_WELL_KNOWN &&
                    Arrays.equals(recs[j].getType(), NdefRecord.RTD_TEXT)) {
       String textEncoding = ((payload[0] & 0200) == 0) ? "UTF-8" : "UTF-16";
        int langCodeLen = payload[0] & 0077;
         s+= new String(payload, langCodeLen + 1, payload.length -
langCodeLen - 1,
```

Source 1.2

```
public void surfaceChanged(SurfaceHolder _holder, int format, int width, int height)
{
    Log.d(TAG, "surfaceChanged");
    if (mCamera != null) {
        Camera.Parameters params = mCamera.getParameters();
        List<Camera.Size> sizes = params.getSupportedPreviewSizes();

        mFrameWidth = width / 2;
        mFrameHeight = height / 2;

        // selecting optimal camera preview size
        {
            double minDiff = Double.MAX_VALUE;
            for (Camera.Size size : sizes) {
                Log.d(TAG, "size : " + size.width + ", " + size.height);
                if (Math.abs(size.height - height) < minDiff) {
                    mFrameWidth = size.width;
                    mFrameHeight = size.height;
                    minDiff = Math.abs(size.height - height);
                }
            }
        }
```

Source 1.3

```
public void speak(String text){
    // Speak only if the TTS is ready
    // and the user has allowed speech
    if(ready && allowed) {
        HashMap<String, String> hash = new HashMap<String,String>();
        hash.put(TextToSpeech.Engine.KEY_PARAM_STREAM,
                String.valueOf(AudioManager.STREAM_NOTIFICATION));
        tts.speak(text, TextToSpeech.QUEUE_ADD, hash);
    }
}
```

Source 1.4

```
    mname = object.getString("name").toString();
    ttshowstatus.setText(mname+" Please wait...");

     new GraphRequest(
             tokenToken.getAccessToken(),
            "/me/taggable_friends",
            null,
            HttpMethod.GET,
            new GraphRequest.Callback() {
                public void onCompleted(GraphResponse response) {
                    Intent intent = new Intent(LoginActivity.this,GetFriends.class);
                    try {
                        JSONArray rawName =
response.getJSONObject().getJSONArray("data");

                        intent.putExtra("jsondata", rawName.toString());
                        startActivity(intent);
                        ttshowstatus.setText("");
                    } catch (JSONException e) {
                        e.printStackTrace();
                    }
```

Source 1.5

```
for (int l=0; l < friendslist.length(); l++) {
    final JSONObject obj = friendslist.getJSONObject(l);
    handler1.postDelayed(new Runnable() {
        @Override
        public void run() {
            try{
                User us=new User();
                us.setID(obj.getString("id"));
                us.setName(obj.getString("name"));
                us.setPictureURL(obj.getString("picture"));
                speaker.allow(true);
                speaker.speak(obj.getString("name"));
                speaker.allow(false);
                friends.add(us);
            } catch (JSONException e) {
                e.printStackTrace();}
```

Source 1.6

```
if (cur.getCount() > 0) {
    while (cur.moveToNext()) {
        String id = cur.getString(cur.getColumnIndex(ContactsContract.Contacts._ID));
        String name =
cur.getString(cur.getColumnIndex(ContactsContract.Contacts.DISPLAY_NAME));
        if
(Integer.parseInt(cur.getString(cur.getColumnIndex(ContactsContract.Contacts.HAS_PHONE_NUMB
ER))) > 0) {
            System.out.println("name : " + name + ", ID : " + id);
            // get the phone number
            Cursor pCur = cr.query(ContactsContract.CommonDataKinds.Phone.CONTENT_URI,
null,
                    ContactsContract.CommonDataKinds.Phone.CONTACT_ID + " = ?",
                    new String[]{id}, null);
            while (pCur.moveToNext()) {
                String phone = pCur.getString(

pCur.getColumnIndex(ContactsContract.CommonDataKinds.Phone.NUMBER));
                System.out.println("phone" + phone);
            }
            pCur.close();
```

Source 1.7

```
void testEntity() {
    AsyncHttpClient client = new AsyncHttpClient();
    StringEntity entity = null;
    try {
        entity = new StringEntity("{aa:sss}");
    } catch (UnsupportedEncodingException e) {
        e.printStackTrace();}
    client.post(this, "http://wallet.tigrimigri.com/serconfig.php", entity,
null,
            new TextHttpResponseHandler() {
                @Override
                public void onSuccess(int statusCode, Header[] headers,
                                      String responseString) {
                    try {
                        JSONObject obj = new JSONObject(responseString);

                        String success = obj.getString("result");
                        String customerid = obj.getString("cust_id");
                        String token = obj.getString("token_name");
                       // tv_result.setText(success);
                        clientToken = token;
                            mBraintreeFragment =
BraintreeFragment.newInstance(PaypalActivity.this, clientToken);
```

Source 1.8

```
@Override
public void onNewIntent(Intent intent) {
    String action = intent.getAction();
    Tag tag = intent.getParcelableExtra(NfcAdapter.EXTRA_TAG);
```

Source 1.9

```
require_once("lib/Braintree.php");
Braintree_Configuration::environment('sandbox');
Braintree_Configuration::merchantId('n7z5dzhpmwgc92kr');
Braintree_Configuration::publicKey('dqyq6kpp8vrc436t');
Braintree_Configuration::privateKey('6e2c5906103b87f87e2547c7b088ca25');
$clientToken = Braintree_ClientToken::generate();
$array = array("result" => $result->success,
        "cust_id" => $result->customer->id,
                "token_name" => $clientToken);
echo json_encode($array);
```

Source 2.0

```
        $conection = new Connection();
        $link = $conection->getConnection();
        $query = "SELECT * FROM item  where itemcode = '$itemid' ";
        $result = mysql_query($query, $link) or die('Errant query:  '.$query);
        if(mysql_num_rows($result)) {
                while($post = mysql_fetch_assoc($result)) {
                        //$posts[] = array('post'=>$post);
            $posts[] = $post; }
        }
        if($format == 'json') {
        header('Content-type: application/json');
        $ret_value = json_encode(array('posts'=>$posts+"<br>"));
        }
    else {          $ret_value = $posts;        }
```

Source 2.1

```
long[] result = new long[len+1];
result[0] = 0;
int pos = 1;
lastWasWhitespace = true;
for (int i=0; i<strlen; i++) {
    char c = str.charAt(i);
    if (Character.isWhitespace(c)) {
        if (!lastWasWhitespace) {
            result[pos] = WORD_GAP;
            pos++;
            lastWasWhitespace = true;
        }
    } else {
        if (!lastWasWhitespace) {
            result[pos] = LETTER_GAP;
            pos++; }
        lastWasWhitespace = false;
        long[] letter = pattern(c);
        System.arraycopy(letter, 0, result, pos, letter.length);
        pos += letter.length;
```

Source 2.2

Appendix E - Significance of the coding

Ignificat coding in this prtype app is mentioned in the below

Reading NFC

```
Parcelable[] data =
intent.getParcelableArrayExtra(NfcAdapter.EXTRA_NDEF_MESSAGES);
if (data != null) {
    try {
        for (int i = 0; i < data.length; i++) {
            NdefRecord[] recs = ((NdefMessage)data[i]).getRecords();
            for (int j = 0; j < recs.length; j++) {
                if (recs[j].getTnf() == NdefRecord.TNF_WELL_KNOWN &&
                        Arrays.equals(recs[j].getType(),
NdefRecord.RTD_TEXT)) {
                    byte[] payload = recs[j].getPayload();
                    String textEncoding = ((payload[0] & 0200) == 0) ? "UTF-
8" : "UTF-16";
                    int langCodeLen = payload[0] & 0077;

                    s  += new String(payload, langCodeLen + 1,
payload.length - langCodeLen - 1,
                            textEncoding);
                }
            }
        }
    } catch (Exception e) {
        Log.e("TagDispatch", e.toString());
    }
}
```

Recognise an item

```
private void retriveItemdata(){

    try {
        // SoapEnvelop.VER11 is SOAP Version 1.1 constant
        SoapSerializationEnvelope envelope = new
SoapSerializationEnvelope(SoapEnvelope.VER11);
        SoapObject request = new SoapObject(NAMESPACE_ITEM, METHOD_ITEM);
        request.addProperty("itemid", itemcode);
        envelope.bodyOut = request;
        HttpTransportSE transport = new HttpTransportSE(URL_ITEM);
        try {
            transport.call(NAMESPACE_ITEM + SOAP_ACTION_PREFIX_ITEM +
METHOD_ITEM, envelope);
        } catch (IOException e) {
            e.printStackTrace();
        } catch (XmlPullParserException e) {
            e.printStackTrace();
        }
        //bodyIn is the body object received with this envelope
        if (envelope.bodyIn != null) {


            SoapObject vectorOfSoapObject = (SoapObject) envelope.bodyIn;
```

```
System.out.println(vectorOfSoapObject.getProperty(0).toString());
            String output = vectorOfSoapObject.getProperty(0).toString();
            resp = "";
            Vector<Object> mjson = (Vector<Object>)
vectorOfSoapObject.getProperty(0);
            //mjson.
            for (int i = 0; i < mjson.size(); i++) {
                SoapObject obj = (SoapObject) mjson.get(i);
                resp = resp +
obj.getPropertyAsString(0)/*+"\n"+obj.getPropertyAsString(1)*/+"
"+obj.getPropertyAsString(2)
                        +" "+obj.getPropertyAsString(3)+"
"+obj.getPropertyAsString(4);

            }
        }
    } catch (Exception e) {

        e.printStackTrace();
        resp = e.getMessage();
    }
}
/**
 * @see AsyncTask#onPostExecute(Object)
 */
@Override
protected void onPostExecute(String result) {
    // execution of result of Long time consuming operation
    // In this example it is the return value from the web service
    //Toast.makeText(this,result, Toast.LENGTH_LONG).show();
    //mtextview.setText(""+result);

    speaker.allow(true);
    speaker.speak(result);
    speaker.allow(false);
}
```

Facebook login and display taggable friends

/*In this method login (before that register with Facebook developer site and get appid and set in the manifest), then request for taggable friends using Facebook API, and display then using GetFriends class */.

```
protected void getLoginDetails(LoginButton login_button){
    // Callback registration
     login_button.registerCallback(callbackManager, new
FacebookCallback<LoginResult>() {

        LoginResult tokenToken = null;
        String mname;

        @Override
        public void onSuccess(LoginResult login_result) {


            tokenToken = login_result;
            ttshowstatus.setText("Please wait...");

            GraphRequest request = GraphRequest.newMeRequest(
                    tokenToken.getAccessToken(),
                    new GraphRequest.GraphJSONObjectCallback() {
```

```
                        @Override
                        public void onCompleted(
                                JSONObject object,
                                GraphResponse response) {
                            try {
                                mname = object.getString("name").toString();
                                ttshowstatus.setText(mname+" Please
wait...");

                                 new GraphRequest(
                                         tokenToken.getAccessToken(),
                                        "/me/taggable_friends",
                                        null,
                                        HttpMethod.GET,
                                        new GraphRequest.Callback() {
                                            public void
onCompleted(GraphResponse response) {
                                                Intent intent = new
Intent(LoginActivity.this,GetFriends.class);
                                                try {
                                                    JSONArray rawName =
response.getJSONObject().getJSONArray("data");


intent.putExtra("jsondata", rawName.toString());
                                                    startActivity(intent);

ttshowstatus.setText("");
                                                } catch (JSONException e) {
                                                    e.printStackTrace();
                                                }
                                            }
                                        }
                                ).executeAsync();

                            }catch (Exception ex){}
                        }
                    });
            Bundle parameters = new Bundle();
            parameters.putString("fields", "id,name,email,gender,
birthday");
            request.setParameters(parameters);
            request.executeAsync();
        }

        @Override
        public void onCancel() {
            // code for cancellation
        }

        @Override
        public void onError(FacebookException exception) {
            //  code to handle error
        }
    });
}
```

Appendix F - Evaluation results

Sample evaluation reports