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# A Mobile application for locating the available handyman services within a locality

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A Mobile Application for Locating the Available Handyman Services Within a Locality

Denis Gikundi

Submitted in partial fulfillment of the requirements of the Degree of Masters of Science in  
Mobile Telecommunication and Innovation

Faculty of Information Technology

Strathmore University

June, 2017

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Denis Gikundi

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.....

### Approval

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## **DEDICATION**

I dedicate this dissertation first to my God for seeing me through to completion and second to my classmates, friends and family for all the love and support that they have shown me throughout the master's program and finally to my supervisor Dr. Bernard Shibwabo for the guidance and advice that he gave me through the dissertation process.

## **ACKNOWLEDGEMENTS**

I would like to acknowledge my supervisor Dr. Bernard Shibwabo for all the support and guidance he offered me through the dissertation period and masters' period as my Lecturer. I would like to thank @iLabAfrica, Safaricom Academy in conjunction with Strathmore university for giving the opportunity to undertake my master's program in Mobile Telecommunication and innovations. Finally, I would also like to acknowledge the efforts and support of my lecturers in molding me and equipping me with knowledge to prepare me professionally in my career.

## **ABSTRACT**

There has been a growing need of handyman services in Kenya and other regions as well which is attributed to several contributing factors which include, local demand, market influence, having second homes, income/rental units and commercial property maintenance and people's lives becoming busier and more hectic with more people now looking for help with odd-jobs around their home, like changing light fittings, or putting up shelves. However, immediate access of such services has proven to be a challenging task especially when one is travelling or settling in a new area. This is because, the service providers are situated across different areas and differ in costs, quality and type of service that they provide.

The existing handyman services solutions striving to solve this problem are defragmented offering contacts scattered in the web and favor's high-end users with knowledge about the web. There is also no structured method of determining the quality of service provided by these handymen. The main aim of this research was to develop a mobile application for locating handyman services within a locality to help in streamlining the process of acquiring handymen.

This study applied Agile methodology as the software methodology for developing the application. Data was collected using questionnaires and interviews. The data analysis was done using Google analysis tools and the results from the system requirements. Handyman mobile application was then built to locate the available handyman services within a locality. A web based application was also developed for managing and monitoring the mobile application. Testing of the final application was done successfully by the potential users and developer of the application. From the results of the test, the respondents agreed that the developed application would be effective in addressing the shortcomings of the already existing systems by effectively locating handyman services within a specific area and providing a more structured approach for determining the quality of services to be provided. Users will benefit by using the handyman application to locate handyman services easily and more specific to their location. The application will also serve to meet the growing need for on demand handyman services.

**Keywords:** Handyman Services, Android, Location Based Services.

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## **LIST OF ABBREVIATIONS/ACRONYMS**

- GPS** – Global Positioning System
- GNSS** – Global Navigation satellite system
- HLR** – Home Location Register
- LBMS** - Location based mobile services
- LBS** – Location Based Services
- MSC** – Mobile Switching Centre
- MTD** – Mobile Terminal Device
- NFC** - Near Field Communication
- SMS** – Short messaging service
- SMPP** - Simple Messaging Peer- Peer
- SCS** – Shopping City System
- USSD** - Unstructured Supplementary Service Data
- UML** - Unified Modelling Language
- VLR** – Visitor locator register
- WAP** – Wireless Access Protocol

## DEFINITION OF TERMS

**Location Based Services** – refers to the usage of mobile devices in provision of location sensitive information to users (EGNOS, n.d.).

**Near Field Communication** – It is a method of wireless data transfer that detects and enables technology in close proximity to communicate without the need for an internet connection (Faulkner, 2015)

**GPS** - The Global Positioning System is a constellation made up to 32 satellites that orbit above the earth at a height of 26,600km. They are owned by the US Department and allows anyone to use the signals provided they have a receiver (Dempster, 2013).

**Bluetooth** – It is the global wireless standard that enables exchange of data over short distances using radio transmissions (SIG, 2015).

**Wi-Fi** - Local area wireless computer networking technology that aids networking of electronic devices (Wood, 2014).

**SMS** – short messaging service for sending messages of up to 160 characters (Rouse, 2007).

**SMS Short code** – These are special telephone numbers significantly shorter and more memorable than full telephone numbers that are used to facilitate communication on mobile phones (Symbiotic, n.d.).

**Android** This is an OS created by Google for mobile devices; smart phones and tablets (Verizon Wireless, 2016)

# CHAPTER 1: INTRODUCTION

## 1.1 Background

Handyman services fall under the category of informal sector in Kenya. Several studies (Amenya, 2007 ; Irungu, 2015) suggest that there are high levels of the informal sector as a result of increased rural to urban migration and the inability of the formal sector to be able to absorb the huge numbers of job seekers in the country which leads to creation of new job opportunities in the informal sector such as handyman service jobs

The demand for handyman services in Kenya and the rest of the world has been because of several influencing factors. According to The Startups Team (2015), demand for handyman service jobs is attributed to the increasingly busy and hectic lives that people lead. Finding enough time to juggle work with family and other commitments can be troublesome, and consequently more and more people are looking for help with odd-jobs around their home, whether it is changing light fittings, putting up shelves or repairing dripping taps.

Several studies (Balasundar, 2013; Goldberg, 2015; Kenya Business Ideas, 2015) suggest several factors contributing to the growing need for handyman services as having second homes, income/rental units and commercial property maintenance. Secondly, Kenya as well as other African countries, have experienced a decline in cost and increase of new phone models which has seen rise in phone handyman services. There is a also a rise in local demand for handyman services in countries such india.

Handyman services are odd jobs that people cannot do without but find it difficult to locate these services when they relocate or travel to new areas since these service providers are situated across different areas and differ in costs, quality and type of service that they provide. In case of emergencies like tap leakages, car breakdown among others, it becomes difficult for one to access these services immediately. In cases where the emergency is serious such as an electric fault from electronic equipment's, this can lead to calamities like fire which have profound consequences (Residential Tenancies Authority, n.d ; South Liverpool Homes, n.d).

Another great challenge faced by clients is determining the quality of services to be provided by these handymen. According to Soft Kenya (2015) in an article about investment and business

opportunities in Kenya, potential clients perceive small businesses as lacking the ability to be able to provide quality services. The existing solutions are defragmented offering just contacts scattered in the web. This makes the process of finding and locating these services difficult and tedious.

This research aims to leverage on this existing technology to develop a platform inform of a mobile solution that will facilitate the location of handyman services within a certain specific location by making the process fast, easy and ensure quality delivery of services by the handymen.

## **1.2 Problem Statement**

Locating handyman service providers is a challenging task especially when one travels and moves to a new place because service providers are situated across different areas and differ in costs, quality and type of service that they provide. The existing solutions striving to solve this problem are defragmented offering contacts scattered in the web which in some cases are not genuine but end up being fraudsters posing as handyman providers (Balasundar, 2013; Goldberg, 2015 ; Kenya Business Ideas, 2015 ; Soft Kenya, 2015).

Another problem that exists is determining quality services provided by these handymen who fall under the category of small businesses. Potential clients often perceive small businesses as lacking the ability to be able to provide quality services. This makes these services to be more expensive and risky in cases where poor services are provided and one must seek for other handymen to do the same job (Balasundar, 2013; Goldberg, 2015 ; Kenya Business Ideas, 2015 ; Soft Kenya, 2015).

### **1.3 Research Objectives**

- i. To investigate the factors that affect the acquisition of handyman services
- ii. To analyse the deficiencies in the technologies currently used to locate handyman services
- iii. To develop a mobile application that determines the location of handyman services within a specific location.
- iv. To validate the effectiveness of a mobile application for locating handyman services within a specific location.

### **1.4 Research Questions**

- i. What factors affect the acquisition of handyman services?
- ii. What are the deficiencies in the technologies currently used to locate handyman services?
- iii. How can a mobile application for determining handyman services within a specific location be developed?
- iv. Does the application locate handyman services within a specific location effectively?

### **1.5 Justification of the Research**

With the rise of handyman service providers because of the inability of the formal sector to be able to absorb the vast numbers of job seekers mainly from the informal sector in the country, this study is very relevant as it seeks to streamline the process of acquiring these handymen. It serves to build the public trust in handyman's quality of service by providing them with a rating feature and repair person work history to determine the quality of service. It also serves to meet the growing need for on demand handyman services by easing and fastening the process of acquiring handymen.

## **1.6 Scope and Limitation**

This study was conducted within Nairobi county and its environs. Various handyman services within various locations were targeted. They were incorporated in the application and the entire process of searching and accessing these services was tested. The application was then developed. It used LBS to be able to provide information based on one's locality.

## CHAPTER 2: LITERATURE REVIEW

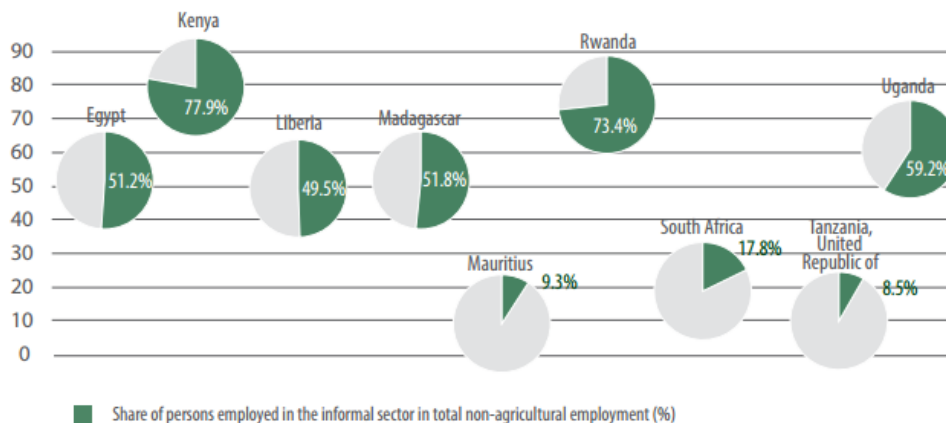
### 2.1 Overview

This chapter investigates the factors affecting the acquisition of handyman services. It discusses the extent of the existing systems to automate the process of finding and acquiring handyman services. It outlines the technologies that have been used and their deficiencies. It also focusses on the modern technology and how it will be used to create a model that would help improve the process of acquiring handyman services within a certain locality.

### 2.2 Factors Affecting the Acquisition of Handyman Services

#### 2.2.1 Handyman services

According to Greengrass (2006), handyman services are often perceived as small maintenance jobs, including tasks associated with repairing furniture, installing shelving and curtains, hanging artwork, changing lighting fixtures, and many other tasks also referred to as handyman services. In Kenya, handyman services fall under the category of informal sector. According to United Nations Economic Commission for Africa (2015) report, Kenya has one of the highest informal sector employment as shown in Figure 2.1.



**Figure 2.1: Informal Sector Employment (Adapted from United Nations Economic Commission for Africa, 2015)**

The elevated levels of the informal sector are because of increased rural to urban migration and the inability of the formal sector to be able to absorb the vast numbers of job seekers in the country which leads to creation of new job opportunities in the informal sector such as handyman service jobs (Amenya, 2007; Irungu, 2015).

### **2.2.2 Factors that Influence the Demand for Handyman Service Jobs**

There has been a growing demand for handyman services in Kenya and the rest of the world because of several influencing factors. According to The Startups Team (2015), demand for handyman service jobs is attributed to the increasingly busy and hectic lives that people lead. Finding enough time to juggle work with family and other commitments can be troublesome, and consequently more and more people are looking for help with odd-jobs around their home, whether it is changing light fittings, putting up shelves or repairing dripping taps.

According to Goldberg (2015), factors contributing to the growing need for repair and improvement include having second homes, income /rental units and commercial property maintenance. Kenya Business Ideas (2015) points out that Kenya and other African countries have experienced a decline in cost and increase of new phone models that has seen rise in phone handyman services while Balasundar (2013) highlights a rise in local for handyman services in countries like India.

### **2.2.3 Challenges Currently Faced in the Acquisition of Handyman services**

Locating the handyman servicepersons is a challenging task especially when one travels and moves to a new place because these service providers are situated across different areas and differ in costs, quality and type of service that they provide. The existing solutions striving to solve this problem are defragmented offering just contacts scattered in the web and favor's high end users who use high end devices such as smartphone and with knowledge on technology such as web but little being done for most users who are mainly none tech and use low end devices. In cases of emergencies like a car breakdown in the middle of nowhere, tap or gas leakages, electricity faults,

the lives of individuals are endangered if they are not able to access this service immediately (Balasundar, 2013; Goldberg, 2015; Kenya Business Ideas, 2015 ; Soft Kenya, 2015).

Another problem that exists is determining quality services provided by this handyman who fall under the category of small businesses. Potential clients often perceive small businesses as lacking the ability to be able to provide quality services. This makes this service to be more expensive and risky in cases where poor services are provided and one has to seek for other handyman to do the same job (Balasundar, 2013; Goldberg, 2015; Kenya Business Ideas, 2015 ; Soft Kenya, 2015).

## **2.3 The Role of Location Based Mobile Services in Providing Information**

### **2.3.1 Location Based Mobile Services**

Location based mobile services is the use of mobile devices to be able to provide users with location sensitive information such that a user can access information based on a suitable or preferred location. Mobile location based services make use of the Geographic location of personal phone or navigational device and use embedded satellite navigation receivers or network-based technologies like triangulation from the location of the base station transmission cells to be able to determine the position of the device (EGNOS, n.d.).

According to Thiga (2013), context specific information may be delivered to the user by first establishing the users' location by using existing technologies and services such as Radio Frequency identification, Bluetooth, Near Field Communication (NFC), wireless networks and location-based systems using Global Positioning Services (GPS) technologies. The information is then used to identify relevant information that is related to the user using short messaging service (SMS), Mobile applications and WAP (Wireless Application Protocol). All these technologies are suitable and applicable in high end devices that support WAP or are JAVA enabled, but are not readily available or accessible universally to all types of mobile devices (Azene, 2014 ; TechTarget, 2009).

### **2.3.2 Growth of Location Based Mobile Services**

Location based services have been around since 2000 with their use mainly being in commerce with a subscription based business model. Developers are now able to introduce millions of consumers to LBMS with the release of Apple's 3G iPhone and Google's LBS enabled Android operating system. Location Based Mobile services have topped the global league. According to survey conducted by TNS Global, three quarter of all Kenyans with access to mobile phones are willing to share their location details with close friends, family members and business associates which means big opportunities for businesses (Omondi, 2012; TechTarget, 2009).

Study further reveals that almost one fifth (19 per cent) of the world's six billion mobile users are already using LBMS, with more than three times this number (62 per cent) of people globally are aspiring to use LBMS. "In Kenya, only 8 per cent of mobile users currently use LBMS but a huge 74 per cent would like to. LBMS users are increasingly using services to enrich their social lives, with one in five (26 per cent) using it to find their friends nearby and 12% 'checking in' through platforms like Foursquare or Facebook places," states the report (Omondi, 2012; TechTarget, 2009).

LBMS are services that are provided through mobile applications by utilizing the network connectivity and ability to detect the user's location so as to be able to adapt the service to a particular geographic location. An LBMS requires five basic modules: the service provider's software application, a mobile network to transmit data and requests for service, a content provider to supply the end user with geo-specific information, a positioning component and the end user's mobile device. By law, location-based services must be permission-based. That means that the end user must opt-in to the service in order to use it. In most cases, this means installing the LBMS application and accepting a request to allow the service to know the device's location (TechTarget, 2009)

## 2.3.3 Technologies Currently Used to Provide LBMS

### 2.3.3.1 GPS

Global Positioning System (GPS) is a satellite based navigation system that is made up of 24 Satellites that are placed into orbit by the U.S. Department of Defense as shown in the Figure 2.2.



**Figure 2.2 Satellite Based Navigation System (Adapted from Garmin, n.d.)**

It circles the earth twice a day in a very precise orbit while transmitting signal information to earth. This information is taken up by the GPS receivers which make use of triangulation to calculate and determine the user's exact location. The GPS receiver also compares the time a signal was transmitted by a satellite with the time it was received to be able to determine the location distance. The time difference can tell the GPS receiver the distance of the satellite from its current location. With distance measurements from a few more satellites, the receiver can now determine the user's position and display it on the unit's electronic map (Garmin, n.d.).

### 2.3.3.2 Bluetooth

According to (SIG, 2015; Thiga, 2013), it is the global wireless standard that enables convenient, secure connectivity for an expanding range of devices and services. Exchanges data over short distances using radio transmissions. Enables devices to form networks and exchange information

based on master-slave connection model. It has been used to obtain information in a number of location based mobile marketing applications such as beacons, Bluetooth Mobile Advertising and Bluetooth mobile context aware system.

### **2.3.3.3 Wi-Fi**

According to Wood (2014), it is a local area wireless computer networking technology that aids networking of electronic devices. It is a product based on the institute of Electronic Engineers (IEEE) 802.11 standards. Wi-Fi enabled devices emit regular 'probes' when trying to connect to Wi-Fi. Wi-Fi access points can be placed in a certain way inside a venue, so that the position of a given device in the space can then be calculated, using the strength of the phone's probes and timing to estimate the distance from each APC for customers, it can be used to provide people with relevant information to approximately where they are standing Common use of Wi-Fi LBS is restaurant, stadia and even healthcare (Thiga, 2013).

### **2.3.3.4 NFC**

According to NFC (2016), Near Field Communication, or NFC, refers to an offshoot of radio-frequency identification (RFID) with the exception that it is designed for use by devices within proximity to each other. This technology enables you to interact securely with the world around you just with by a simple touch. NFC is likely to transform location -based services with their flexibility to embed on wristbands or payment cards, which makes it so easy to use for mobile device owners if the device is within range, it works without any manual intervention unlike other technologies. One of the application of NFC is checking mobile users into a room as they walk in and being able to offer location-sensitive information. It is also used as supplement to GPS to be able to offer more accurate information about the location or position of a device or object (Griffiths, 2012).

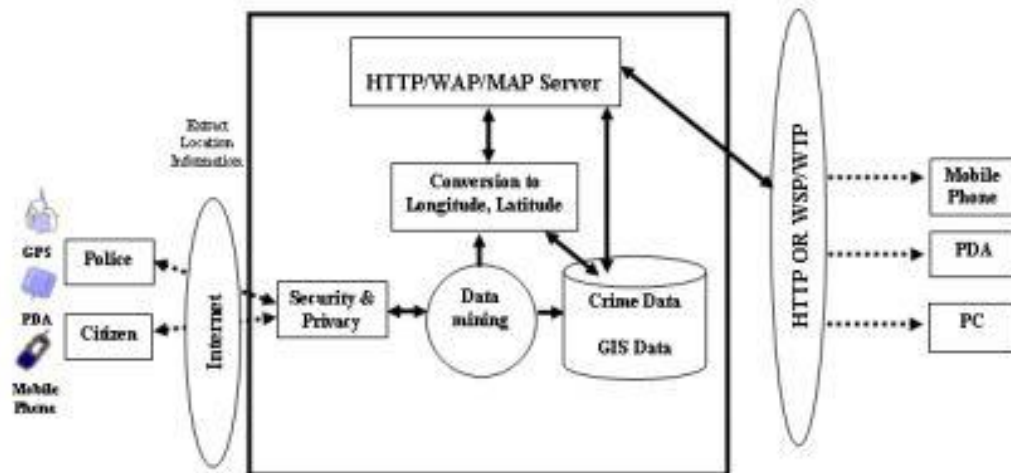
## **2.3.4 LBMS Architecture Models**

Several Models have been developed using LBMS technology. This section reviews these models which include, location based services for Crime Control in section 2.3.4.1, Location-Based Service Mobile Marketing Model for Small Businesses in section 2.3.4.2 and Model of system for marketing promotion based on user location in section 2.3.4.2.

### **2.3.4.1 A Model of Location Based Services for Crime Control**

This is a crime control system built by integrating Map Server, Internet server and crime database into a Web based client/server environment as shown in Figure 2.3. There are two sets of data that have been incorporated namely, the background data sets and data that relate to crime. The background data sets include police station districts, police station, road and small lane layers. Data that relate to crime include a location of crime such as murder, robbery and gang robbery layers. Crime control applications in the project include crime monitoring and crime analysis (Boondao, Esichaikul & Tripathi , 2003).

The users of the system are police and citizens, who connect to it via PDA, mobile phone and PC. The system then proceeds to identify the source of a message through authentication and authorization then based on the systems security policy. The users can be allowed or denied access to the system through the authentication process. The purpose of the authorization process is to control access to resources once identity has been verified. Data analysis is used to obtain the data which is then converted to longitude and latitude and sent to the database. The database constitutes of the crime data and GIS data which is integrated before being sent to the server. The HTTP server/Map server/WAP server then does the computation. The Web browser/WAP browser is used for viewing the results (Boondao, Esichaikul & Tripathi , 2003).



**Figure 3.3 Location Based Services Model for Crime Control (Adapted from Boondao, Esichaikul , & Tripathi , 2003)**

### **2.3.4.2 A Location-Based Service Mobile Marketing Model for Small Businesses**

This is a LBS model proposed by Polyzos and Ververidis. The model has three main building blocks which include the web server, location server and LDAP system as shown in Figure 2.4. During the design of the system, the authors emphasized on the following key features which are scalability, distribution and interoperability as important factors to be considered in the system. The system initialization is a process that involves access to the system via mobile phone for the essence of accessing location based information by the user. This occurs through communication with the Web Server over the WAP protocol through the a WAP Gateway (Ververidis and Polyzos, 2002).

The sent information includes the user's ID, password and telephone number. The Web Server sends the users information to the Location server to be able to grant user access. The user's credentials on whether he/ she is in the access list of the Location Server is confirmed by the Location server through recording the current user's location and sending back the confirmation message to the Web Server. The user is then informed of a 27-successful sign in by the Web Server and is provided with the necessary categories of products or services of supermarket. When the user selects a category, a list of all supermarkets with the selected items appears with information

that includes the credentials, addresses of the supermarket. Furthermore, the user can get available promotions for products chosen offered by that particular supermarket (Ververidis and Polyzos, 2002).

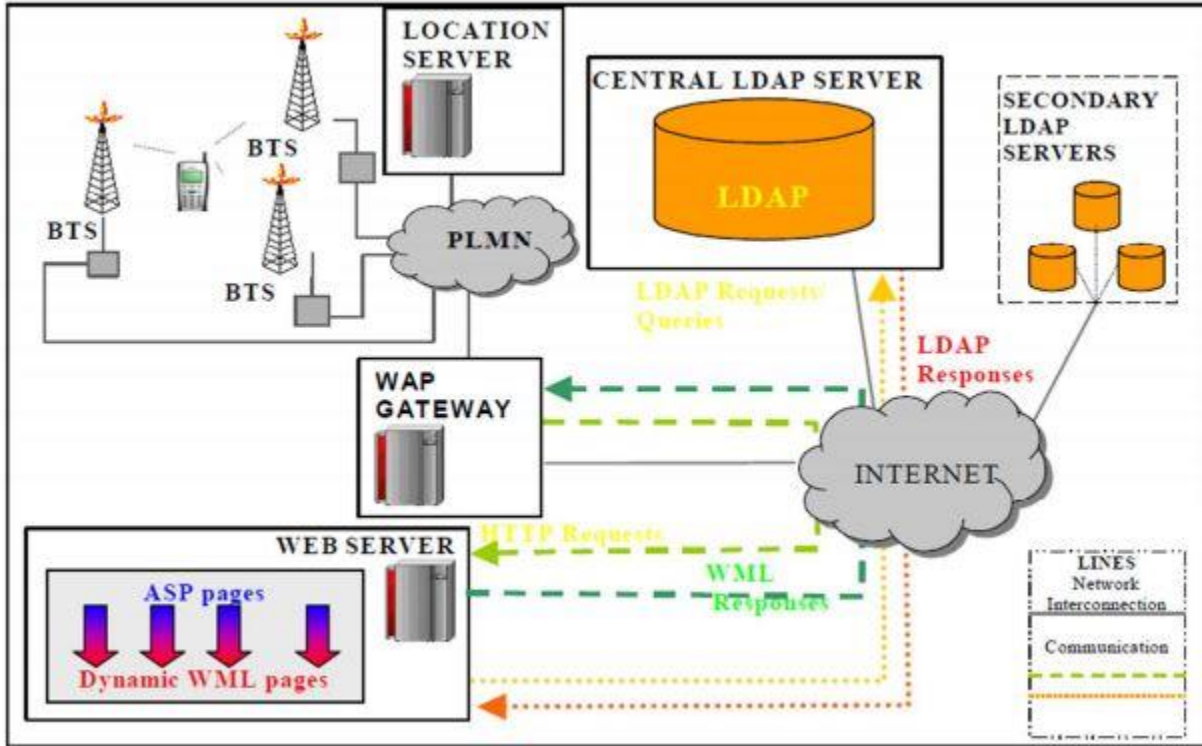


Figure 4.4 System architecture for LBS model (Adapted from Ververidis & Polyzos, 2002)

### 2.3.4.3 Model of system for marketing promotion based on user location

Shopping City is a location based system that allows a movable buyer the ability to select the desired information and transparent delivery and display of the content to the terminal and to the suppliers of the product or services direct advertising upon request of the customer or consumer. The system can connect supply and demand easily in a particular area on only the required and needed products and services at a particular specific time by a buyer. This hence shortens the search time of a selected product or service and allows the supplier to target customers with direct marketing. The system works on the client-server principle where problems such as the problems related to limitations of the possibilities of MTD as well as the problem of traffic over a wireless connection are avoided. The client performs only basic tasks, specific to the client and his location. Demanding data processing and supplying of the content is performed by fixed computer - server.

This essentially unloads the client device, which was the original goal (Perakovic, Jovovic, and obota, 2015). The topological architecture of the system as shown on Figure 2.5 consists of:

a. The client

The client in this case represents a user who has, over MTD with a preinstalled MSc application which is a part of a SCS. He must have a smartphone that is equipped with a GNSS receiver as well as a reliable connection to the Internet. The GNSS technology is used because it is the most accurate technology in determining the user's location which stores corresponding data to the requested query

b. Server

The Server in this case refers to a computer which is responsible for performing all the necessary actions. It processes the data, adapts it and sends it back to the user for display on a MTD.

c. Web application Shopping City

This aims to register all the nearby stores, which wishes to advertise through the Shopping City System.

d. Database model of Shopping City system

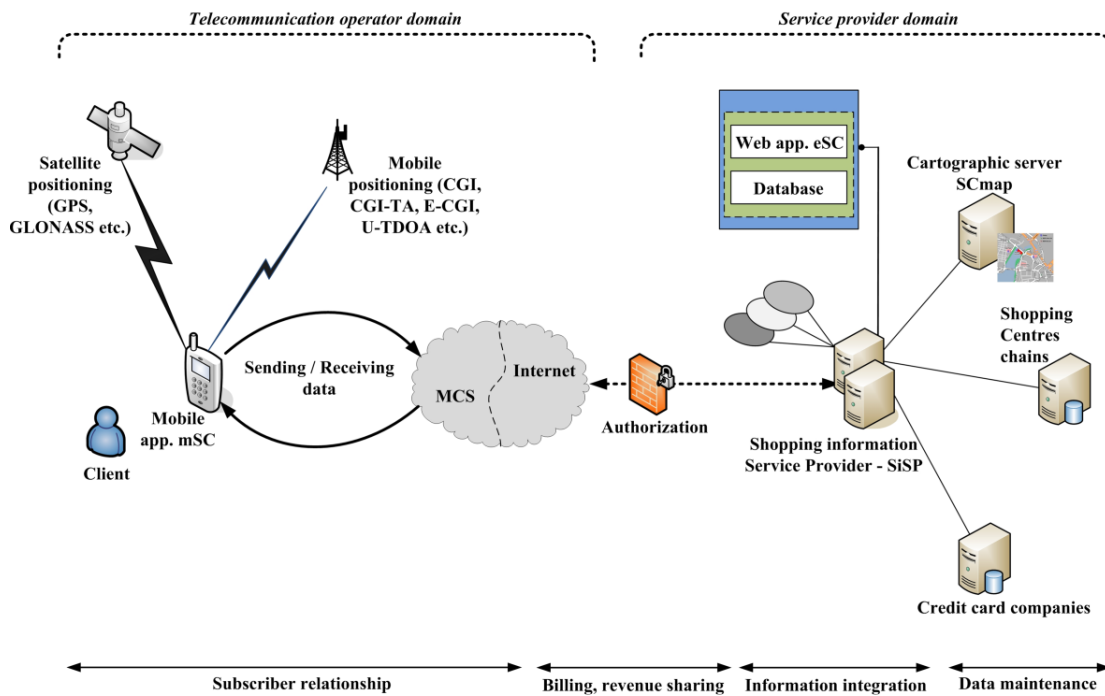
The type of information that is related to the stores is mostly correlated with the location. It is necessary to have a good database model that is dynamic, flexible and scalable and is regularly updated either via a Web form on eSC or by the administrator, because of the efficient search database records

e. Cartography

The MSc application for MTD uses raster maps that are sent from the server to the MTD. They are rectangular and are part of a much larger mapping system, but due to limited performance and memory resources MTD segments it into smaller parts.

f. Mobile Application Shopping City

The work of MSc application is based on a simple and intuitive use. The goal is to enable the user in fewer steps to reach the desired results. Immediately after starting the application and registration to SCS, the user is lead to the main menu where the user selects the desired category of products or services.



**Figure 5.5 Topological architecture of the Shopping City system and LBS Value Chain (Adapted from Perakovic, Jovovic, and Sobota, 2015)**

### **2.3.5 Limitations of Location Based Mobile Services**

Location based mobile services are limited where there is use of low end devices that lack built-in sensor techniques and are unable to transfer their location information over the network known as the low-end mobile phones (LEMPS). This limitation can be overcome using carrier billing records. These are used to identify the geolocation of the base station transceiver (BTS) with which the mobile phone is communicating because the BTS for each cell is in fixed location, this can be buffered with maximum distance of the BTS antenna coverage. This can be translated later into a location of the mobile user and then the better approximate location can be achieved through interactive communications (Azene, 2014).

## **2.4 Existing Handyman services Locator Applications**

### **2.4.1 Yellow pages Kenya**

This is an online directory that lists businesses and residential contacts in Kenya. Enables you to search and find phone numbers, addresses and even map directions of business premises. It has a web, android and iOS version of the application (numberway, n.d.).

### **2.4.2 Whodoyou (International)**

This is an online platform that relies on social recommendations to find local businesses recommended by friends and neighbors. Enables one to search and find various local businesses like dentist, plumbers etc. and find results based on advice and recommendations that is shared between friends on social media (WHODOYOU, n.d.). This solution gives results based on social media advice and recommendations from friends and neighbors while the new system is more superior because it will give priority by ranking results according to ratings from former employers or clients who have used those services before. Whodoyou platform also is a web based platform but the proposed system is a mobile platform which will target more users who use mobile phones.

### **2.4.3 OLX (Kenya)**

Marketplace for used goods including furniture, musical instruments, sporting goods, cars, youngster and baby items, motorcycles, cameras, mobile phones, and property but recently introduced a jobs and services feature that allows users to post and find various jobs such as repair jobs. The search results are usually contacts and location details of these service providers. The search results of this platform are based purely on type of service and location (OLX, n.d.).The new system will be superior because the search results will be based on the nearest location, best price and highest ranking.

### **2.4.4 Lynk (Kenya)**

This a web and mobile application platform that helps one to find and book reliable blue-collar jobs. Its focus is on high end users who have smartphones and knowledge on how to use the web and mostly focusses on scheduled appointments. One must apply for a job first and book an appointment. The appointment is then scheduled to a specific day and time according to the availability of the service provider (Mulligan, 2015). The new system is superior because it is suitable for services required immediately like emergencies situation since it links directly to these service providers unlike in Lynk where the application process must go through an approval process by the team before being responded back to the user which slows down the process.

### **2.4.5 Mocality (International)**

Online business directory available both on mobile and web. Enables individuals to get the exact location of a given premises by searching for the location on the site and once the location is found the details including the map are then displayed (Corporate News, 2013). This platform favor's businesses with an actual physical location which can be mapped out but the new system is more suitable as it allows both physical and mobile businesses to be found on the platform hence favor's all types of handyman service businesses. It also has much better result type where the results are ranked based on the location amount and ratings.

#### **2.4.6 Facebook Page (International)**

Social media is another avenue that has been used for marketing various handyman services where user's profiles and contacts can be obtained online. For one to find a reliable service provider, the process is lengthier and tedious as one must go through a variety of pages (Sponser, 2015). This process is also not very reliable and accurate as Facebook is open to all user s hence it is common for one to get unreliable handyman service provider or even an imposter or fraudster posing to be a service provider. Handyman services in Nairobi, Kenya is a good example of a Facebook page used by handyman service providers in Kenya to market their services.

#### **2.4.7 MrFixit (International)**

It is an online website that contains information about the various handyman services offered by the handyman service providers who are members of the website. It also contains their contact details and information on where they are located (MrFixit, n.d.). This platform is web based and only accessible online but the new system is more suitable because it is available on mobile version hence its able to reach more people. It is also much flexible as one can search and obtain more desired information about the handyman service providers. This website is not usable in the Kenyan Market.

### **2.5 Proposed System Technologies**

The proposed system is a location based mobile application built on Android and SMS based technologies which serves to ensure the availability and accessibility by most users.

#### **2.5.1 Short Messaging Services (SMS)**

According to Rouse (2007), short messaging services (SMS) is commonly referred to as text messaging and it is a service for sending short messages of up to 160 characters. It transmits the messages between mobile phones that and allows the message to be stored briefly in-case of the recipient's absence. Thiga (2013) describes it as a basic service that is offered on the Global

System for Mobile Communications (GSM), General Packet Radio Service (GPRS) and Code Division Multiple Access (CDMA) networks and allows exchange of messages with a short amount of text limited to 160 characters between mobile devices. According to the WebWise Team (2012), any type of mobile phone has the ability to send SMS messages with the more advanced phones being able to do much more including pictures, videos and messaging. SMS can also be sent and received from any network and it is also possible to be sent to different countries as well.

### 2.5.2 Android

Android is the name of a mobile operating system that is owned by American company; Google. Android mostly comes preinstalled on a variety of smartphones and tablets from a host of manufacturers that offers users access to Google’s own services like Search, YouTube, Maps, Gmail and more. According to TEAM AA (2016), Android has evolved a lot over the years and has quickly become the dominant mobile platform across the globe.

According to an article by tutorialspoint ( n.d.) which is an authoritative programming guide, website, android operating system is a stack of software components which is roughly divided into five sections and four main layers as shown in the architecture diagram Figure 2.6.

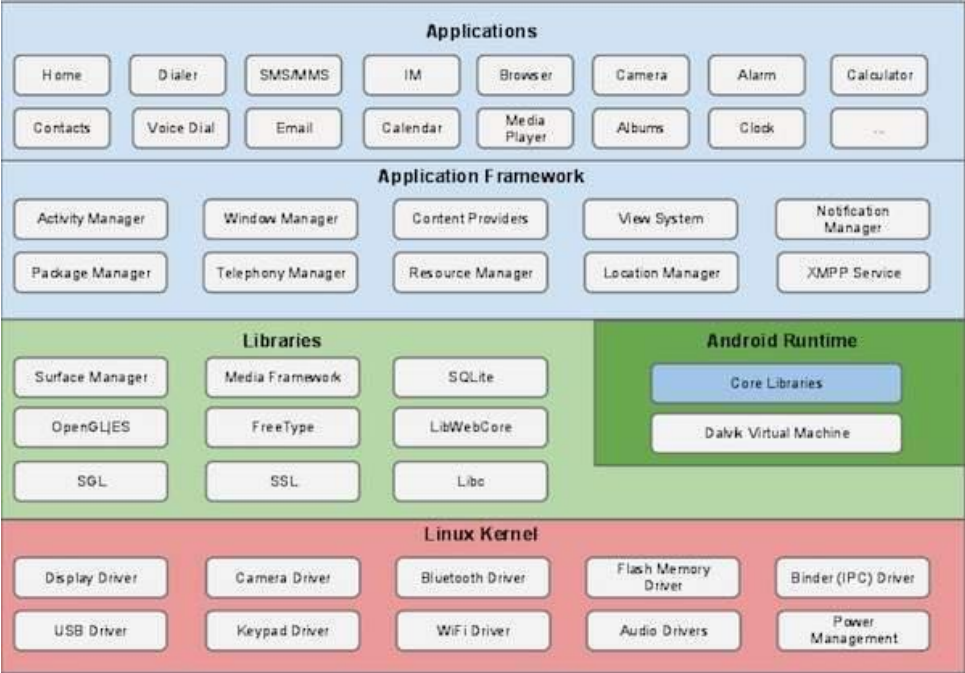


Figure 6.6 Android Architecture (Adapted from tutorialspoint, n.d.)

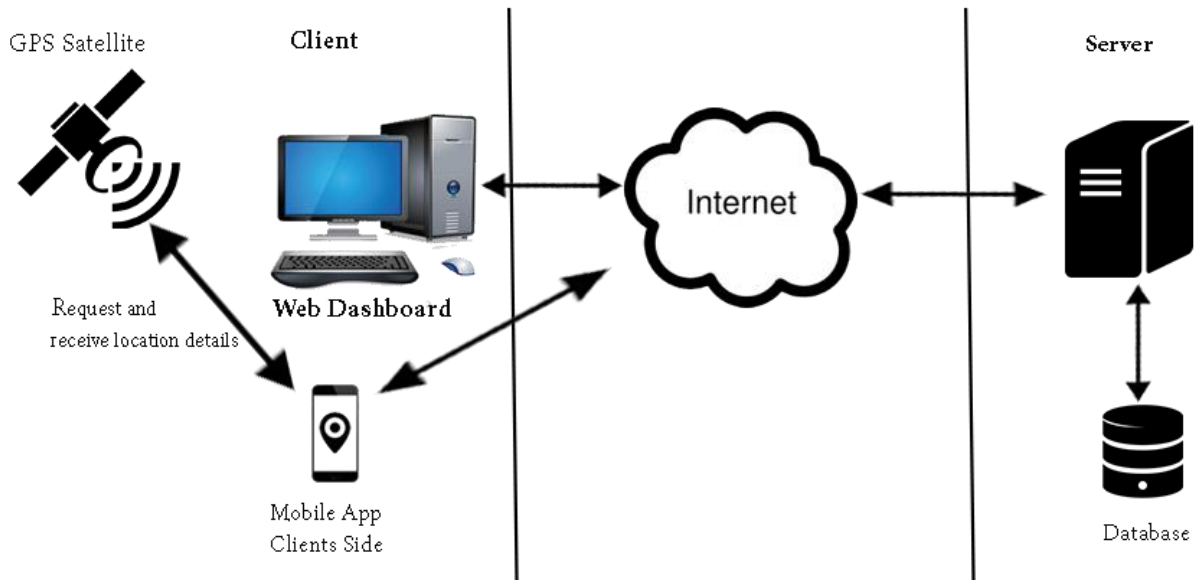
## **2.6 Gaps and Limitations**

Review of existing handyman services locator applications has shown that the applications currently used to locate handyman services are mostly web based and their approach is mostly in providing Contacts and addresses of these handyman service providers. This has to some extent been useful in providing contact information but lacks out majorly in providing guarantee in the trust and quality of services to be provided by these handymen. The current existing systems are also not suitable for on demand and location based services. Most users also use mobile as opposed to web.

There is therefore a need in for a mobile application system that strives to streamline the process of acquiring handyman services to meet the current need and demand. This will ensure that handyman services are provided based on the user's location and on demand.

## **2.7 Conceptual Model**

The proposed model will use GPS to provide location based information to the mobile app clients. The Figure 2.7 shows the conceptual Model of the proposed system which includes a front-end which is an Android application, a back-end web application and a database. The client will request for location details from the GPS. These Location details will be used to determine the location of the client to be able to provide information based on his location. The web dashboard will be used for reporting and monitoring the data submitted by the client mobile app to the database. The database will be used to store data from both the client mobile application and the web dashboard. The server will be used to process request between the clients and the database.



**Figure 2.7 Conceptual Model**

## 2.8 Conclusion

The proposal to come up with a mobile application that will be used for on demand location based services was justified given that the current existing solutions do not meet these needs. The application will be suitable where the handyman services will be needed immediately because the entire process is automated requiring little or no human intervention making the process fast and efficient. The application has a rating feature that will be used to determine quality delivery of services. The results are ranked on considerations of nearest location making it more suitable and efficient as compared to the existing systems.

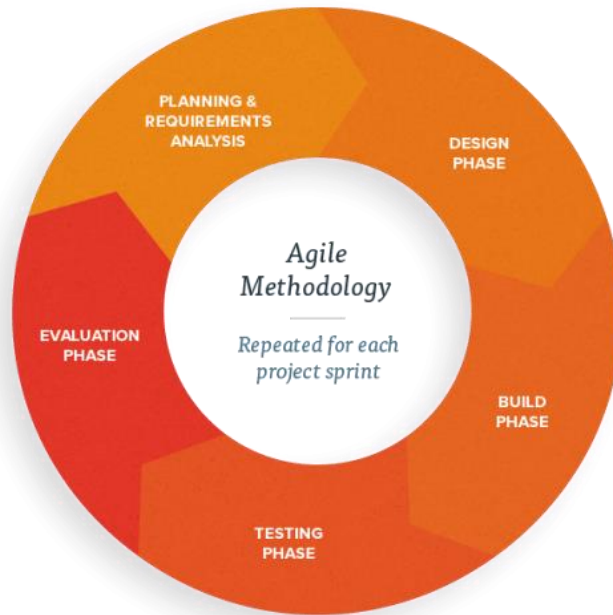
## **CHAPTER 3: METHODOLOGY**

### **3.1 Introduction**

This chapter discusses about the software methodology that was used in the development process of the system. This study used the Agile Development Methodology as the main framework to plan, design, develop and evaluate the proposed system.

### **3.2. Agile Development Methodology**

This research used Agile methodology which was founded by a group of practitioners and consultants (Beck et al., 2001). Agile methods refer to a subset of iterative and evolutionary methods which are based on iterative enhancement and opportunistic development processes. Each iteration is a self-contained, mini-project with activities that range from requirement analysis, design, implementation and test and each of the iterations leads to an iteration that integrates all software across the team and is growing and evolving subset of the final system as shown on Figure 3.1. The purpose of having short iterations is so that the feedback from iterations N and earlier, and any other new information can lead to refinement and requirements adaptations for iteration N + 1 (Boehm, 2007).



**Figure 3.1 Agile Methodology (Adapted from Agile Methodology, 2016)**

### **3.2.1 Planning Phase**

The first stage is planning which involves developing a strategy on how the set goals are going to be established. The time required to perform each activity and develop each functionality is estimated, a schedule formulated and milestones are also set. This helped in identifying the resources for developing the system and in allocating time.

### **3.2.2 Requirements Analysis Phase**

This phase involves analyzing a list of functional, nonfunctional and technical system requirements as gathered from the users to assist in determining the feasibility of the system to be developed. This research used a survey that was administered by means of questionnaires as shown on appendix A to a sample of handyman services persons and random ordinary people out of a target population. The questionnaires structure employed both closed and open-ended questions. A staged approach was used to produce a valid questionnaire. Cross-checks were also used to

ensure validity of the questionnaire. The findings of this research lead to the design, implementation and testing of a mobile application as shown in appendix B, that would help in finding handyman services within a locality.

### **i. Location of the Study**

This research was carried out within Nairobi County. The area of research was in south B due to the type of population settlement who form the client base of the application and the variety of handymen found within the area. Most people there also own smartphones therefore the location was well suitable.

### **ii. Target Population**

The target population comprised of 83 people. This research focused on handymen offering different services such as plumbing, electrical appliances repair, car repairs among others and ordinary people mostly tenants living around Nairobi who need these handyman services.

### **iii. Sample Size**

To arrive at the sample size, the study used a mathematical formula as shown in Equation 3.1. which means every person got a chance to be part of the sample population. The desired sample size obtained was 96 however based on availability, the respondents that were involved in the study were 83 in number. This sample size was selected using simple random sampling method. The sample size was grouped into two groups namely 20 handymen and 63 clients who were all based within Nairobi.

$$n = \frac{NZ^2 * 0.25}{[d^2 * (N - 1)] + (Z^2 * 0.25)}$$

n = Sample size

d = Precision level (mostly 0.10 or 0.5)

N = Total population

Z = Statistic for a level of confidence (for example 1.96 for 95% confidence level)

Equation 3.1 Random Sampling (Frerichs, 2013)

#### **iv. Sampling Strategies**

The research used simple random sampling method where respondents were selected randomly from the target population. This technique was used to ensure that all the respondents in the target population had an equal chance of being chosen.

### **3.2.3 Data Analysis and Functional Modelling**

According to Nasimoya (2006), the reason for data analysis is to acquire usable and useful information. Descriptive analysis was used for comprehensive analysis. The process of carrying out data collection through the pre-formulated questionnaires was done by use of Google forms. Google analytics was used to analyse the respondent's data and the qualitative data was represented as charts and graphs.

Object oriented analysis was used for comprehensive analysis and modelling of the user requirements. This process involved identification of all objects within the system and their relationships. The functionality of the system was then modelled using use case diagrams and description. The flow of the system was modelled using sequence diagrams. The database was the final thing where the entity relationship diagram displaying all the tables within the database with their attributes and relationships was shown.

### **3.2.4 Design Phase**

A feasibility study was made for the project through the reviews of literature. Unified Modelling Language (UML) notion was used for modelling and designing diagrams to present both structural and behavioral aspect of the system (Object Management Group, 2015). The study employed four different UML diagrams for its design which included a use case diagram, database schema, sequence diagram and entity relationship diagram.

### **i. Use Case Diagram**

The Use Case diagram was used to model the system functionality. The system functionalities were identified which lead to identification and separation of the system into actors and use cases. The actors of this system were handymen, clients and the administrator. The use cases or actions to be performed were represented as text (Object Management Group, 2015).

### **ii. Sequence Diagram**

The system sequence diagram was used to show how the information was passed between the main entities of the system and used to model the system flow (Object Management Group, 2015).

### **iii. Entity relationship Diagram**

This was used to show the tables, their attributes and relationships and was used to model the database (Object Management Group, 2015).

### **iv. Database Design**

The entity relationship diagrams enabled us to come up with the database design that showed the relationship between different entities and their attributes.

### **v. Wireframes**

The system Wireframes were designed using a desktop tool known as Balsamic (<https://balsamiq.com>) to help the developer visualize how the final interfaces would look like.

## **3.2.5 Building Phase**

This stage involves the actual development of the system regarding the designs discussed above. This involved the creation of a mobile application and a web application both linked to a database. Below is the approach that was used in the application development.

### **i. Mobile Application**

The mobile application was developed in Android platform using java for android and PHP5 programming language together with JavaScript Object Notation (JSON) which was used for building the communication logic for communicating with the data base. Android was preferably chosen as the main platform for developing the mobile application due to its ease of learning and use, and availability for free use with a large community support.

### **ii. Web Application**

The web system was developed using Laravel (<https://laravel.com>) which is a PHP5 development framework and web scripting languages which included HTML5, CSS, JavaScript and jQuery. The main development environment was the NetBeans IDE (<https://netbeans.org/>) running on Linux operating system. Apache web server was used to host and test the system locally. Laravel was chosen as the main development framework due to its stability, security features and high performance.

### **iii. Database**

The database that was used for the storage and retrieval of data was MySQL since it is free, open source, light, easy to use and to customize (Oracle, n.d.).

## **3.2.6 System Testing**

System testing process involved testing the application after development using the following techniques;

### **i. Usability testing**

This was done to determine the usability of the application. To carry out this exercise, a total number of 10 respondents were sampled to test and give their feedback with regards to the application. This feedback was useful as it was used to refine the application and in validating the system.

## **ii. Functional Testing**

This was done to test the systems' functional and non-functional requirements.

## **iii. Compatibility Testing**

This involved testing the web application on different web browsers and the mobile application on different android mobile to ensure compatibility.

## **iv. Performance Testing**

This was done for checking the amount of time the application would take to process a request or perform a certain functionality by performing queries and observing how long it took to execute and accomplish them.

## **v. Validation**

To validate if the Mobile application streamlines the process of acquiring handymen, a sample 20 respondents composed of handymen and clients was selected from the target population and put through the process of testing. The entire process of searching and requesting services from handymen was tested and the analysis of the feedback collected led to this validation. Validation was also done by analysis of the feedback received from data collection process.

## **3.3 Conclusions**

This Chapter discussed on the methodology that was used to develop the mobile application and discussed in detail the different phases on each methodology from planning to Testing. In the planning phase resources for developing the system were identified, in requirement analysis phase Location of study, sampling strategies, target population and Sample Size were discussed in detail. The process of data collection was discussed in data analysis phase while in design phase the UML diagrams to be used for design were discussed. The final phase was testing where the different techniques to be used for testing were discussed.

## **CHAPTER 4: SYSTEM DESIGN AND ARCHITECTURE**

### **4.1. Overview**

This chapter discusses three sections in detail namely data analysis, system analysis, and system design. Data Analysis will focus on the collected data while system analysis and design will discuss on how the collected data was converted to the actual designs of system.

### **4.2 Data Analysis**

The data was collected using mainly interviews and Questionnaires that were printed out and taken to the respondents and others sent online via mail and Google forms. Other information was obtained through observation of the entire working process.

#### **4.2.1 Degree of Response**

The target population included the ordinary people mostly tenants who are often in need of handyman services who would be the clients of the system. It was of essence to know how they usually go about the process of finding handymen for their handyman service needs. It was especially of significant importance to determine how they go about this process when in an emergency like an electric shock or a tap leakage. The other targeted population were the handymen to be able to understand the methods that they use when marketing their services to the public, how they acquire new clients, challenges that they face, what they feel should be done, and to get their views on the proposed solution.

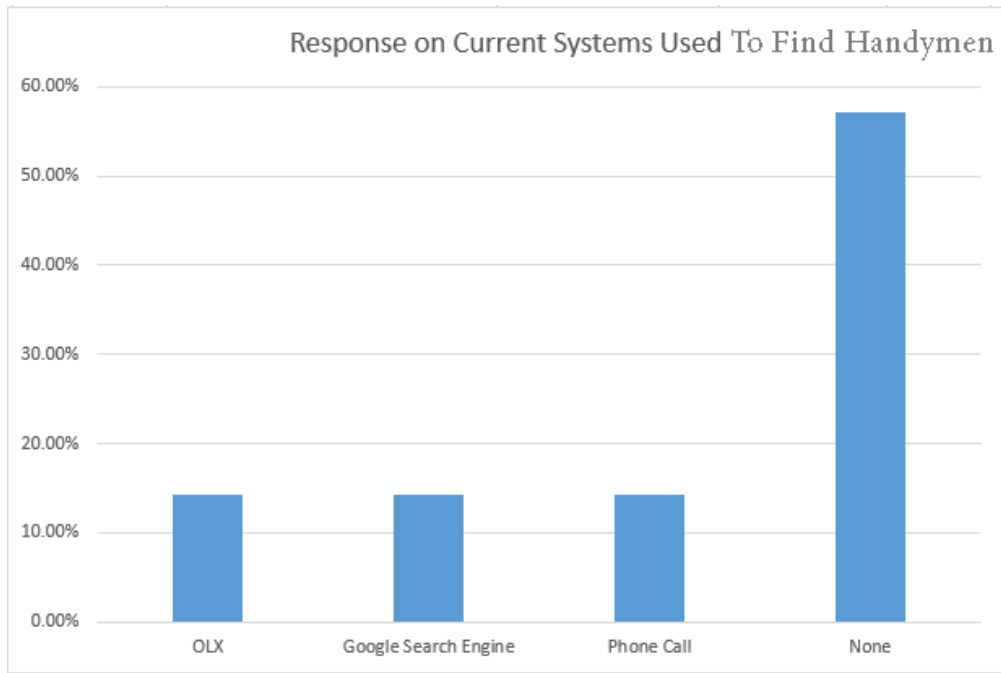
#### **4.2.2 Demographic**

The target population was spread in this way, the ordinary people who are the expected clients of the system population had a response rate of 55.5% which was a good response rate and, the

handymen had 45% response rate which was sufficient. The sample population was well covered with this data.

### 4.2.3 Users' Response on Current Systems Used to Find Handymen

The response that was obtained from the respondents was that 25 people who were 42.87% of the respondents had used some other technical means to obtain a handyman like using Google search engine for the information but the rest 32 who were 57.14% of the respondents had not due to various reasons most being technical challenges, others use of unreliable manual means like walking around to search for these handymen and asking around new people as shown in Figure 4.1.



**Figure 4.1: Current Systems Used to Find Handymen**

### 4.2.4 Challenges Faced by Users in Finding Handyman services in New Areas

The question was posed to the public individuals to establish whether they faced any difficulties or challenges in finding handyman services when they migrated or moved to new areas. It was discovered that out of the number that responded to the question 50 people who were 83.3% of the respondents do have challenges in finding handyman services in New areas. The challenges given are shown in Figure 4.2.

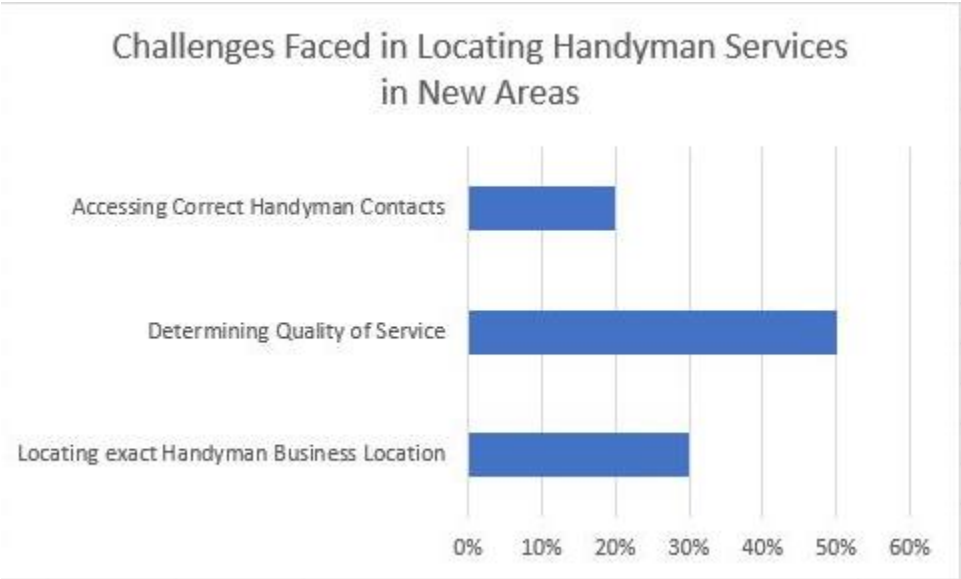
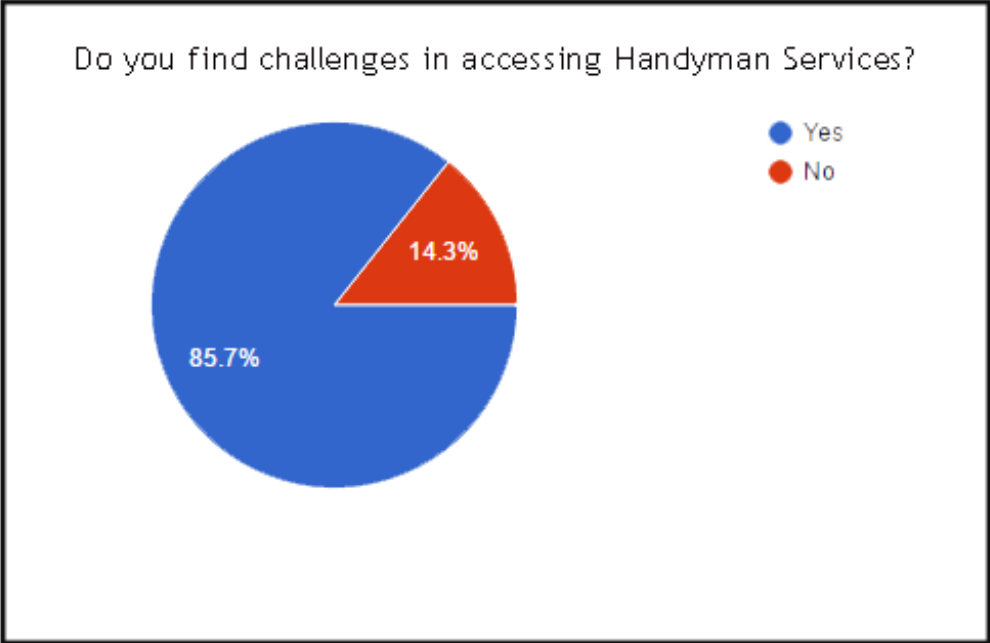


Figure 4.2: Challenges Faced in Finding Handyman Services in New Areas

### 4.2.5 Challenges Faced by users in Finding Handyman services

Figure 4.3 shows the no of people that face challenges of finding handyman services such as electrician, plumber, phone repair, computer repair, shoe repair etc. within their current area. Among the number sampled 53 people who were 85.7% of the population sample are faced by this

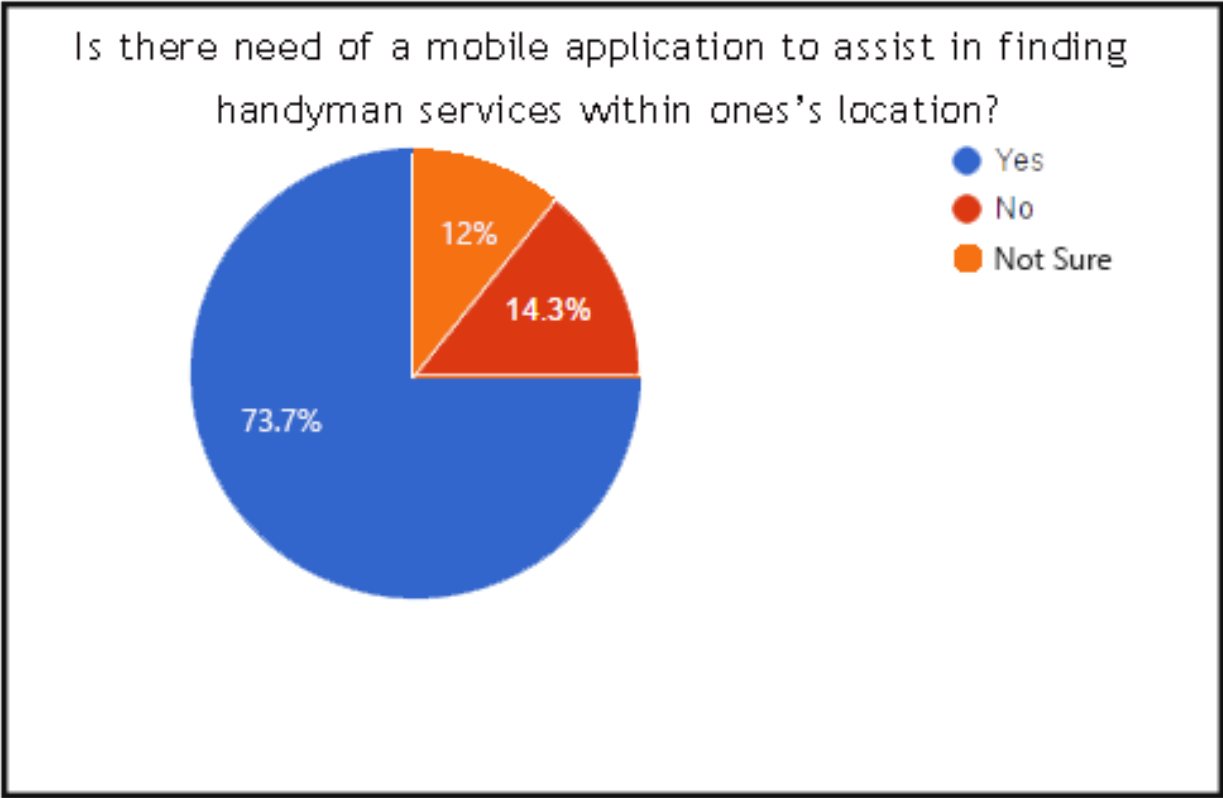
challenge while 10 people who are 14.3% of the population use manual means of finding these handymen such as walking around and inquiring from friends to locate the handyman service which is time consuming and not very efficient.



**Figure 4.3: Challenges in Finding Handyman Services**

### 4.2.6 Viability of a Mobile Application

This was set to find out the essence and importance of a mobile application in helping the users to locate handyman services near them. The idea was highly welcomed with several suggestions made. The rating feature was deemed to be viable as it would help them a lot in determining the quality of service which was a major concern. The users also wanted a system that would provide them with the details of a handymen near their location or current place of settlement. From the data collected, it was clear that the users needed such a system and that the new system would be very relevant and helpful to them as shown in Figure 4.4.



**Figure 4.4: Viability of a Mobile Application**

Figure 4.4 shows the users response on the need of a mobile application to help users to locate handyman services within ones' location. Out of the sampled population 46 people who were 73.7% of the sample population agreed that there was indeed a need of such of an application out of the experience they had gone through before and the benefits that it had to offer. Nine people who about 14.3% of the sample population were mostly users who had not experienced any challenges before feeling that there was no need while the rest 7 who were about 12 % of the sample population were not sure.

## 4.2.7 Data Analysis Conclusions

The response that was received from the respondents was highly valuable and very informative when it came to making the decision of whether to proceed in building the mobile application. The features of the system were refined majorly basing on the feedback that was collected by the researcher. The findings that were made from the responses were; most users preferred systems that would run across mobile devices. They also welcomed the idea of rating capability that would be very effective in determining quality of services offered by the handymen. There was a genuine concern of the accuracy and precise details about a handyman as provided by the system due to the bad and negative experience with the current systems. The users also had a high preference of location specific information.

## 4.3 Requirement Analysis

The requirements for the mobile application for Locating Handyman services within a Locality be divided into functional and non-functional requirements.

### i. Functional Requirements

Functional requirements are the capabilities, functions and basic processes that the implemented application must be able to perform. These include:

- a) Create account - where clients and handymen should be able to set a username and password to access the system.
- b) Activate account – handymen are supposed to activate their accounts for them to login to the application
- c) Login and Logout – for users to Login to the application they must provide their correct username and password credentials and they need to logout to exit the system.
- d) Update handymen details – handymen should update their details which include area of operation, type of service they offer, cost they charge per hour and area of operation for them to be visible to their clients.
- e) Search for a handymen services - This involves login to the application, selecting the handyman service category i.e. plumber, electrician, mechanic etc. The system searches for a

handyman near the user's current location and within the selected category and displays a list of handyman's details

- f) View handyman profile - after the search results the client can select different handymen on the map to view their profile details which include number of jobs completed and rating score given.
- g) Requesting for handyman services – after viewing the profile for different handymen the client proceeds to make a request on the preferred handyman.
- h) Accepting and rejecting client job request – the handyman is notified by the system every time there is a new request and he can choose to accept or reject the request.
- i) Rate a Handyman Services- For this to happen, the client must have made a request and the handyman must have accepted it. The details of the handyman are hence available on the ongoing tasks menu option and the client can click on the rate handymen' option on his dashboard and proceeds to rate the handyman. Once this is done the system registers this as work done which appears in the handymen' profile. The rating feature allows the client to input a comment and uses a five-star rating widget which the client can select from one to five star which is calculated as 1 -5 rating score by the application.

## **ii. Non-Functional Requirements**

These are requirements that any system can perform without but are desirable qualities that make the system interactive and user friendly. They include:

Security - the back-end web application has an administrator who has authority over the usernames and passwords. Error reporting by keeping error logs for purposes of resolving issues.

Performance – the system should have a reasonable response time when performing its functions

Availability - the system should be available all the time.

Scalability – the system should easily allow for future improvements and upgrades.

Integrity – the system should make sure that stored data is not altered or corrupted.

Reliability – the system should be reliable to perform user tasks.

### iii. **Technical Requirements**

To be able to run the application, one only needs to have an android phone whose android operating system version is not lower than 15 which is API level 8 and above. The phone memory must be more than 525MB and above which most android phones. The web version will run on any computer with internet connection since it is available online and is also accessible via phone.

## **4.4 Data and Process Modelling**

### i. **Use Cases Modelling**

Use cases are used to model the various processes in the system and how external entities interact with them. The actors here include client, Handyman, review committee and Administrator.

a) Use Case Diagram

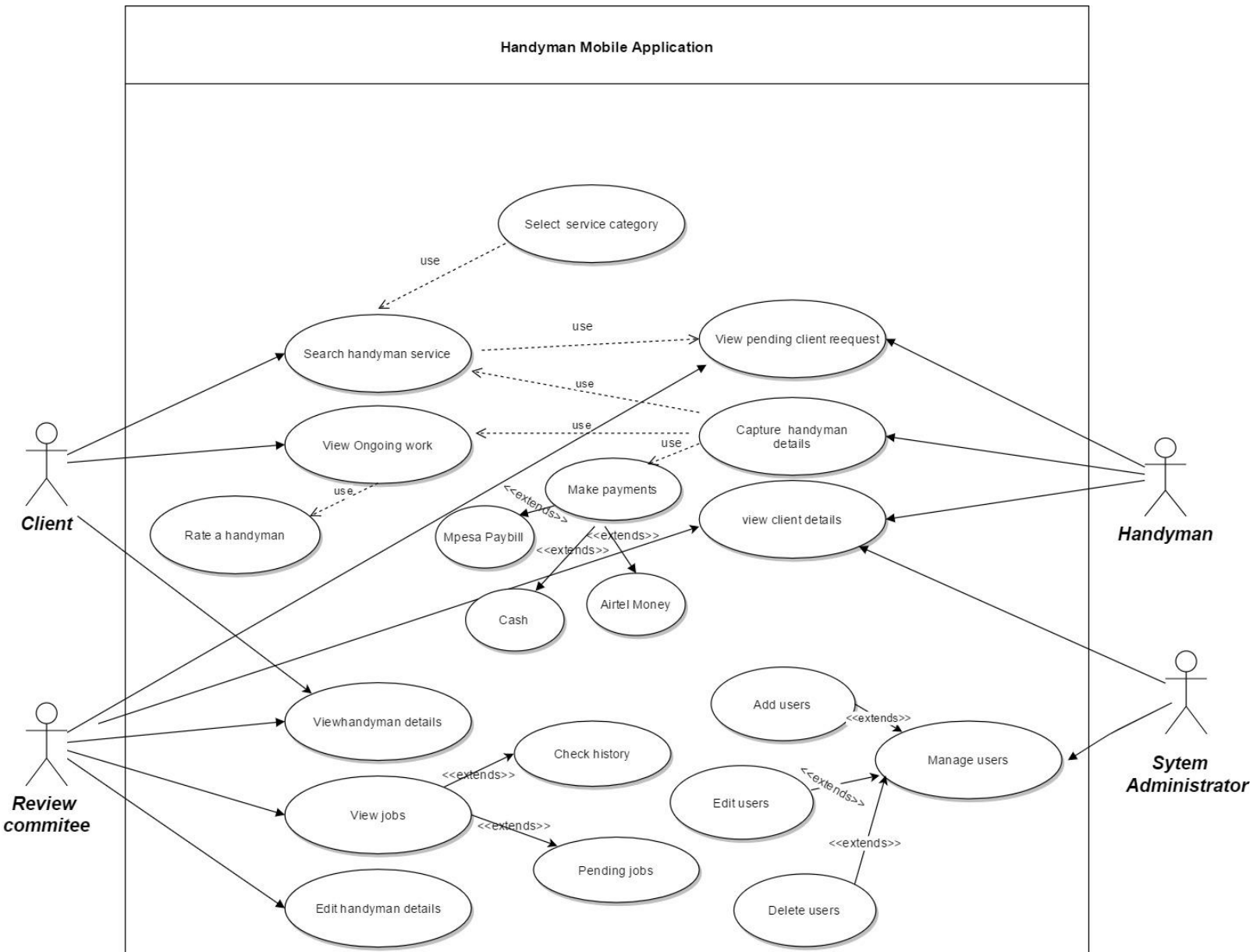


Figure 4.5: Handyman Mobile Application Use Case Diagram

**b) Use Case Description**

This Section gives a description of the various use cases in the system, their triggers and the information that is sent by the various uses case as steps occur.

**Table 4.1 Search Handyman services Case**

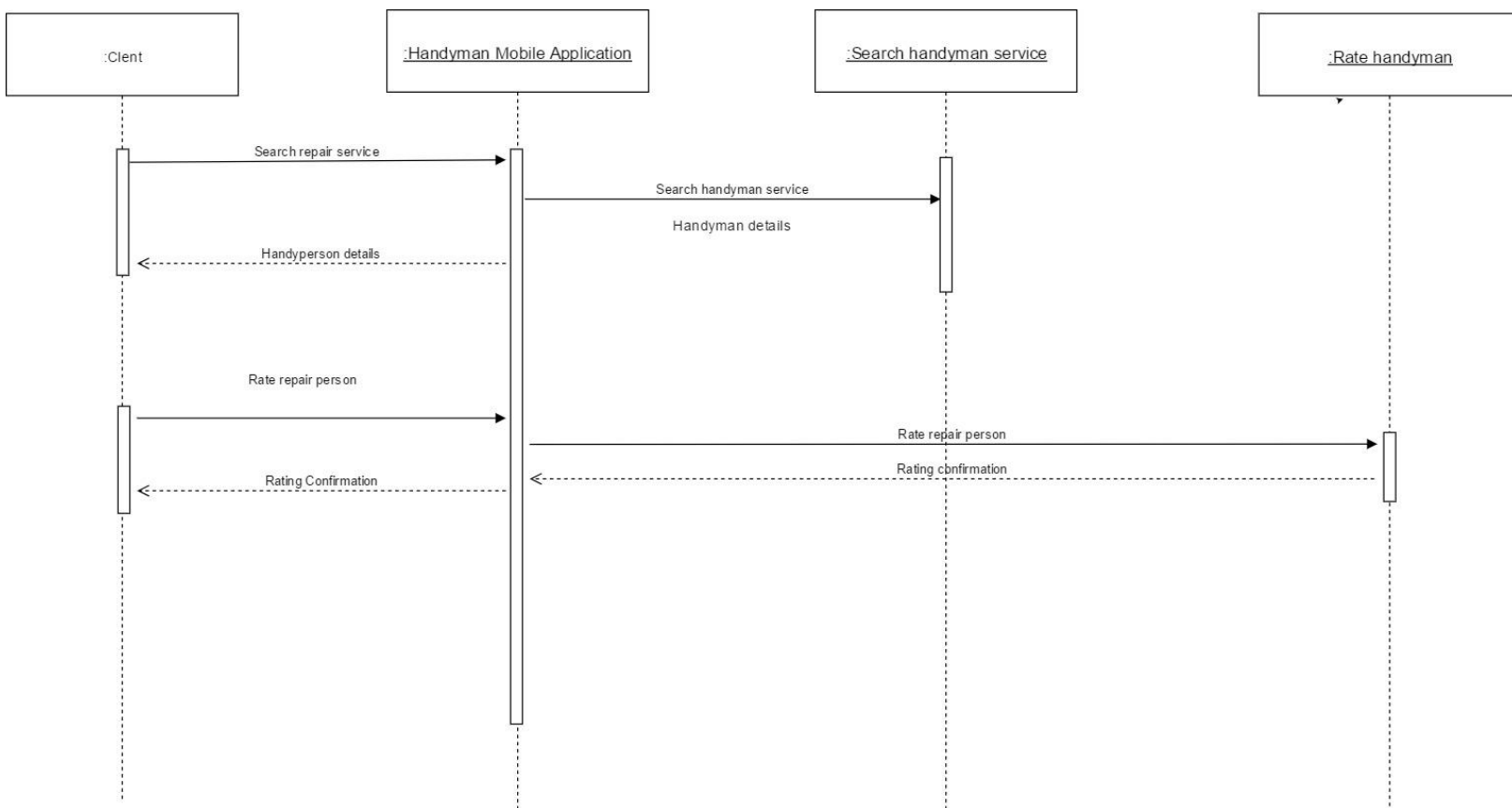
<b>Use case Name</b>		Search Handyman Service	
<b>Description</b>		Describes how clients search for handyman services	
<b>Trigger</b>		Clients launches the application logs in and then proceeds to search for the repair service	
<b>Type</b>		External	
<b>Major inputs</b>			
<b>Description</b>	<b>Source</b>	<b>Description</b>	<b>Destination</b>
Client launches the application and logs in	Client	Main menu access	Client
Search handyman service	Client	Handymen' profile details	Client
<b>Major steps Performed</b>			
<b>Major steps Performed</b>		<b>Steps</b>	
i Launch the application and Login		Android Mobile Application	
ii. Search for repair service		Type of service and current location	
iii.Check whether there is a handyman offering that type of service within the current Location		Handyman offering type of service within current location	
iv.If the handyman is found place the job request		Job request	
v. If they are available notify clients		Availability Notification	

Table 4.1 describes the search handyman service process and the major steps that happen as that process is being executed. It also shows the triggers for this. This process is the core

business of the application and the data that's being sent as the various steps are executed are given as well.

## ii. Sequence Diagram

Figure 4.6 shows the major sequence of events of the client user from searching of the handyman service to rating the handyman.



**Figure 4.6: Sequence Diagram**

### iii. Entity Relationship Diagram

The application handles private and confidential data about the client and handymen that is transmitted across the mobile application. Device of the various users to the system’s database. Figure 4.9 show the ERD Diagram for the database used in the application which was normalized to help improve the integrity of the data in the application. The main table in the diagram is the handymen’ table that has relations to all the other tables.

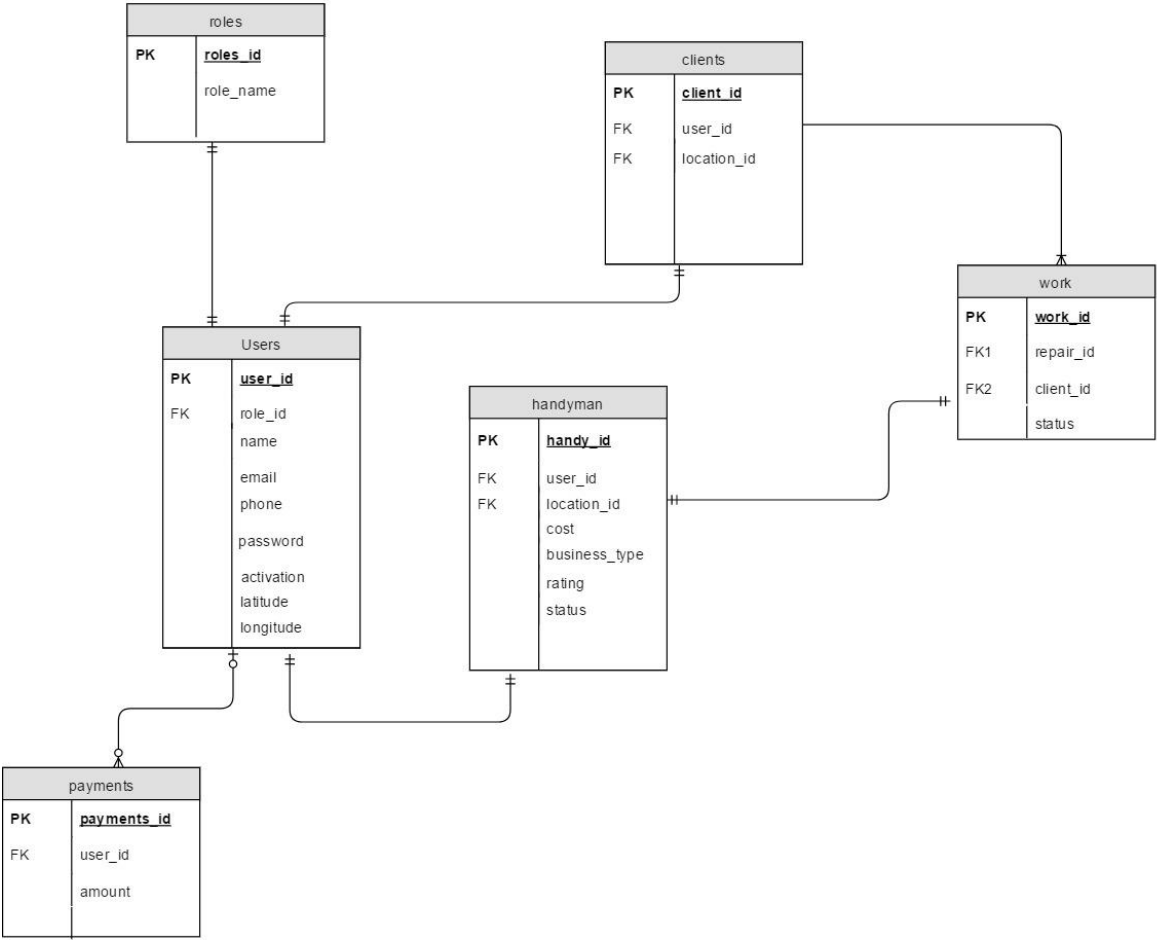


Figure 4.7: ERD Diagram

## Database Tables

### a) Roles Table

This table contains the roles of users within the system, these details are used during log in. Whenever a user enters their details the system checks against the details in the database and directs the user to a certain page depending on their role. The role table is shown in Table 4.2.

**Table 4.2 Roles Table**

Column Name	Data Type	Index
role_Id	Integer(10)	Primary key
role_name	Varchar(30)	

### b) Users Table

This table contains the user details, these details are used during log in. Whenever a user enters their details the system checks against the details in the database if the details match the user is logged in otherwise they are prompted to enter the correct details. Table 4.3 shows the Users table.

**Table 4.3 Users Table**

Column Name	Data Type	Index
user_Id	Integer(10)	Primary key
role_Id	Integer(10)	Foreign key
name	Varchar(30)	
email	Varchar(100)	
password	Varchar(100)	
activation	Integer(10)	
latitude	Float(10,6)	
longitude	Float (10,6)	

### c) Payments table

This table contains payment details made by handymen to activate their account. The handymen can only login into the application after activating their account. Table 4.4 shows the payments table.

**Table 4.4 Payment Table**

<b>Column Name</b>	<b>Data Type</b>	<b>Index</b>
payments_id	Integer(10)	Primary key
user_id	Integer(10)	Foreign key
amount	Decimal(6,2)	

### d) Handymen Table

This table contains handymen details about their business. These details include their business location, type of business and cost charged per hour. Table 4.5 shows the handymen table.

**Table 4.5 Handymen Table**

<b>Column Name</b>	<b>Data Type</b>	<b>Index</b>
handyman_id	Integer(10)	Primary key
user_id	Integer(10)	Foreign key
cost	Integer(10)	
business_type	Varchar(20)	
rating	Integer(10)	
status	Integer(10)	

**e) Clients Table**

This table contains client personal details. The clients are users who desire handyman services.

Table 4.6 shows the clients table.

**Table 4.6 Clients Table**

<b>Column Name</b>	<b>Data Type</b>	<b>Index</b>
clients_id	Integer(10)	Primary key
user_id	Integer(10)	Foreign key

**f) Work Table**

This table contains details about ongoing, pending and done work. It shows details of both the handyman and client with a work request. Table 4.7 shows the work table.

**Table 4.7 Work Table**

<b>Column Name</b>	<b>Data Type</b>	<b>Index</b>
work_id	Integer(10)	Primary key
repair_id	Integer(10)	Foreign key
client_id	Integer(10)	Foreign Key
status	Integer(10)	

#### iv. Design Class Diagram

Figure 4.8 is a design class diagram that shows all interactions between classes their corresponding methods and attributes.

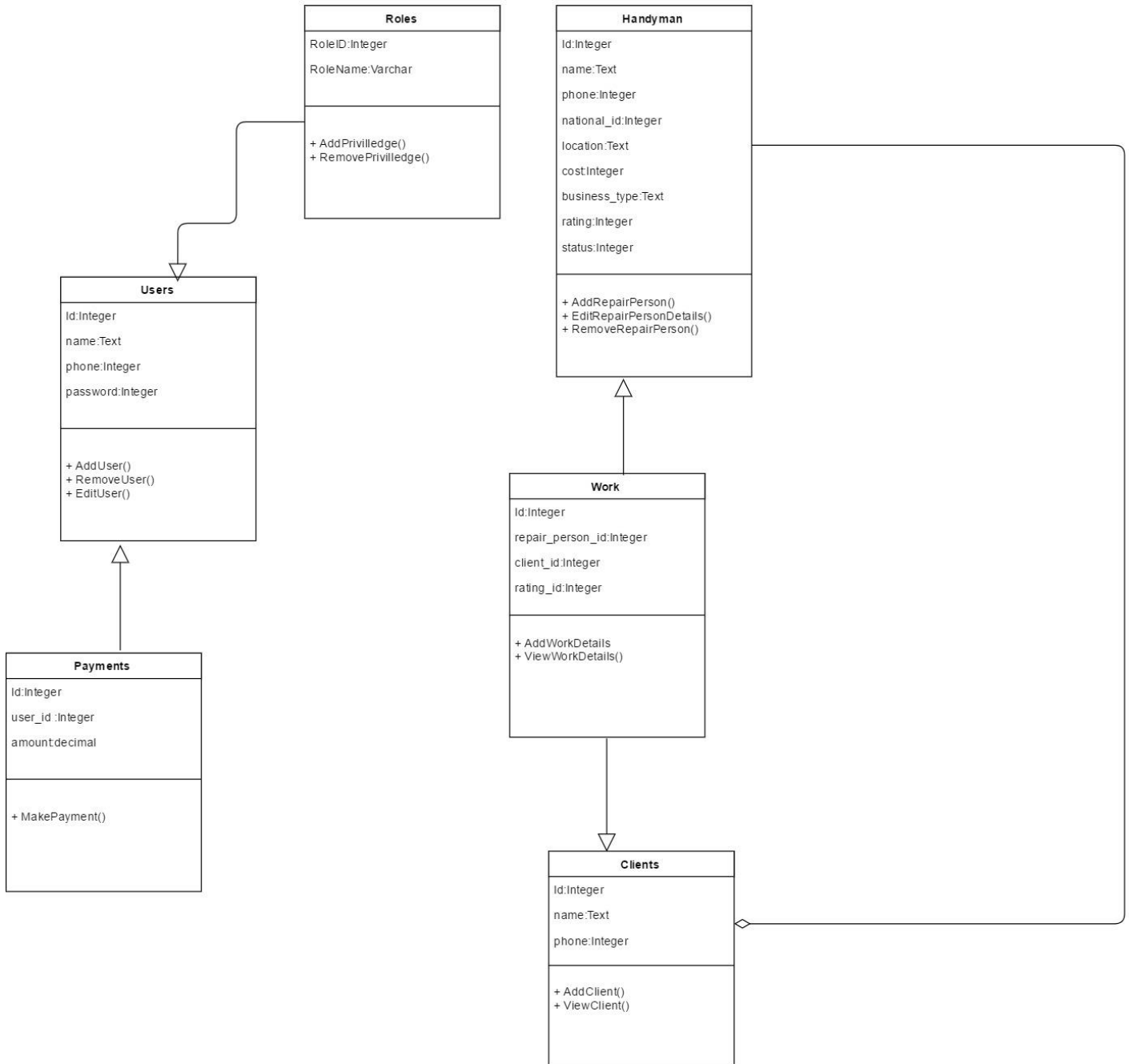


Figure 4.8: Class Diagram

## 4.5 System Architecture

The client-server architecture was adopted for the development of the system. This acts as a distributed model that divides tasks between resource providers known as servers and service requestors known as clients. Figure 4.9 shows the architecture of the system and how its various components interact.

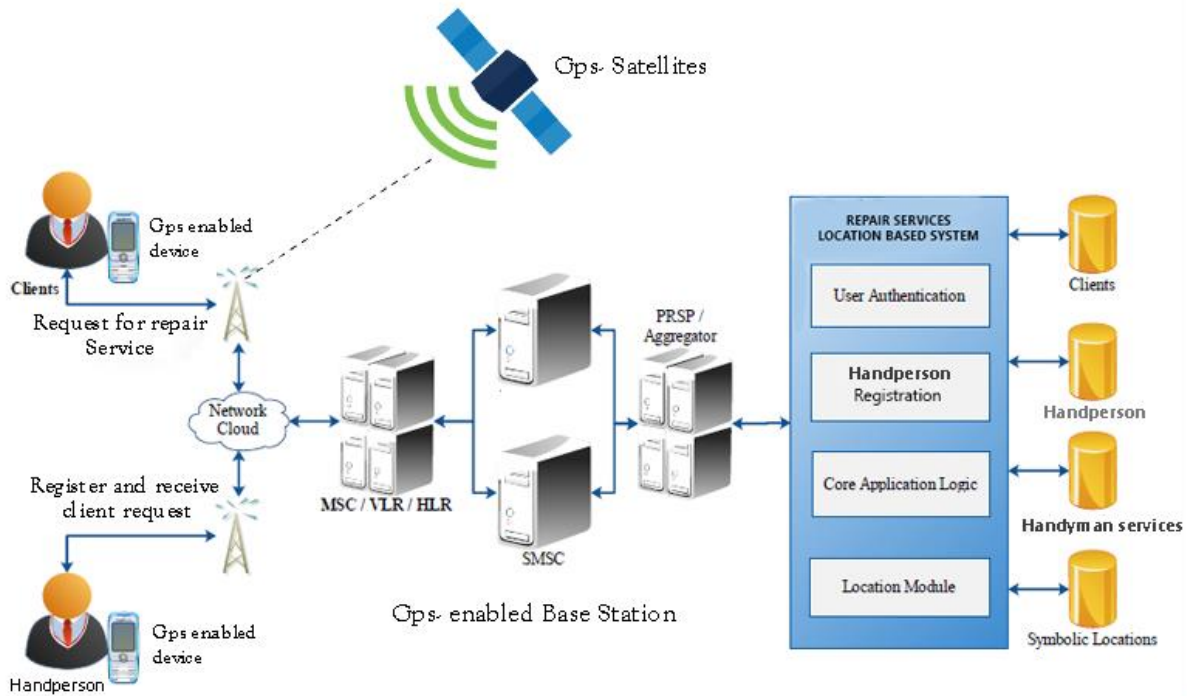


Figure 4.9: System Architecture

## 4.6 User Interface Flow Diagram

This section shows the user interface flow diagrams which include mobile application wireframes and web application wireframes

### 4.6.1 Application Wireframes

Figure 4.10 shows the application Registration where one is supposed to select the registration type in the dropdown either as client or as a handyman. And it also shows the client dashboard after login.

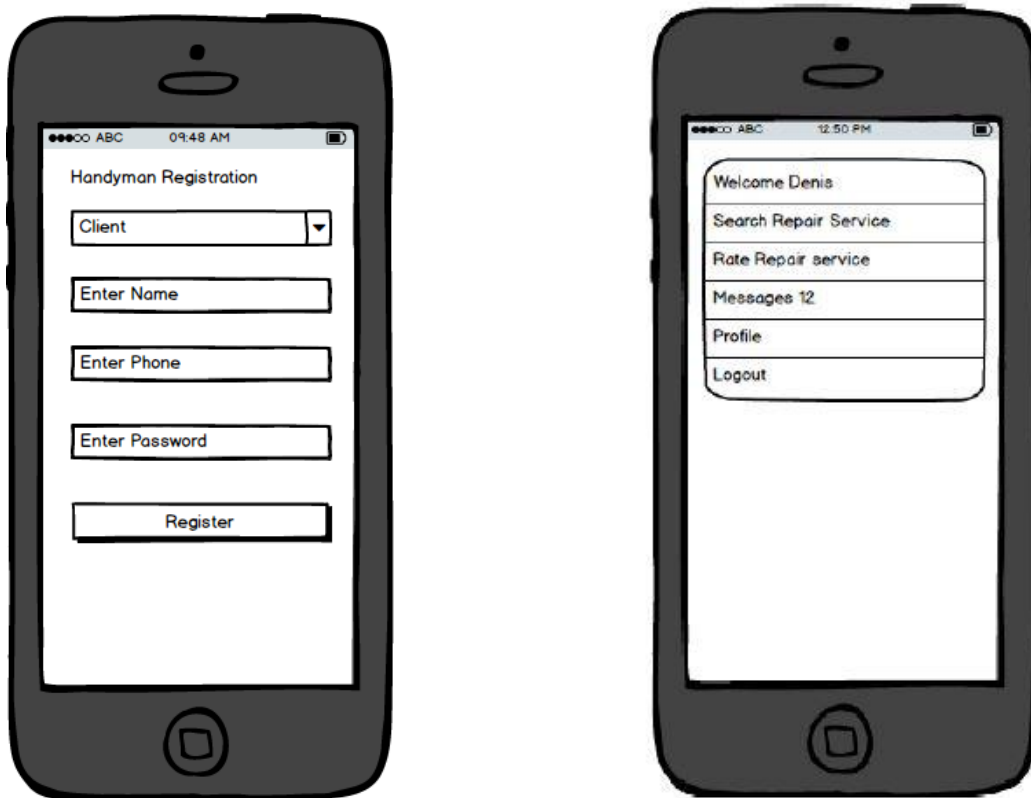


Figure 4.10 User Registration Screen and Client Dashboard

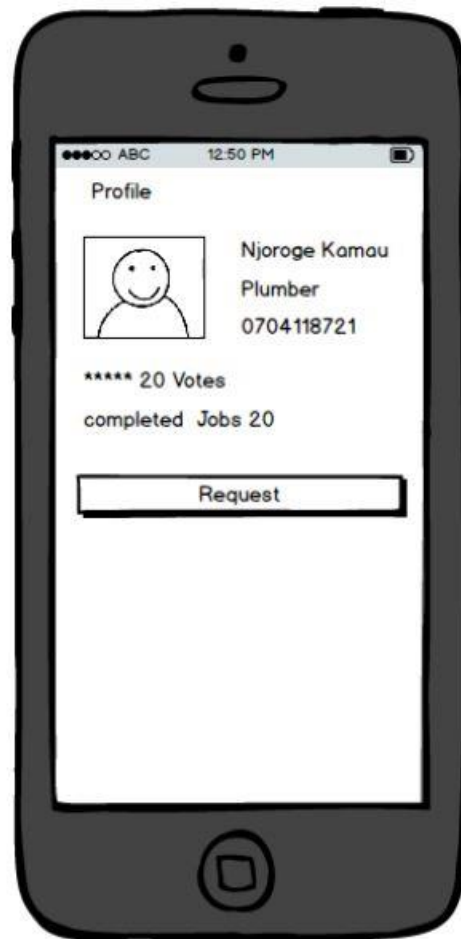
Figure 4.11 shows the search repair process where a client is supposed to select the category of handyman services populated from the database. When one selects the category of handyman service the system checks the client’s current geolocation and compares it with existing handyman services registered in the system. It then populates a list of 3 nearest handymen to where the client currently is.



Figure 4.11 Search Repair Process Screen

Figure 4.12 shows the handymen’ profile after clicking the search results in Figure 4.11 which shows extra details about the client such as names, type of service, phone, ratings and jobs done.

The client can then proceed to request the job after viewing the handyman details. This is sent as an SMS notification to the handyman.



**Figure 4.12 Handyman Profile Screen**

**Figure 4.13** Shows clients rating process where after the handyman successfully finishes the work for the client, he requests the client to rate his services for the system to register the work as finished.

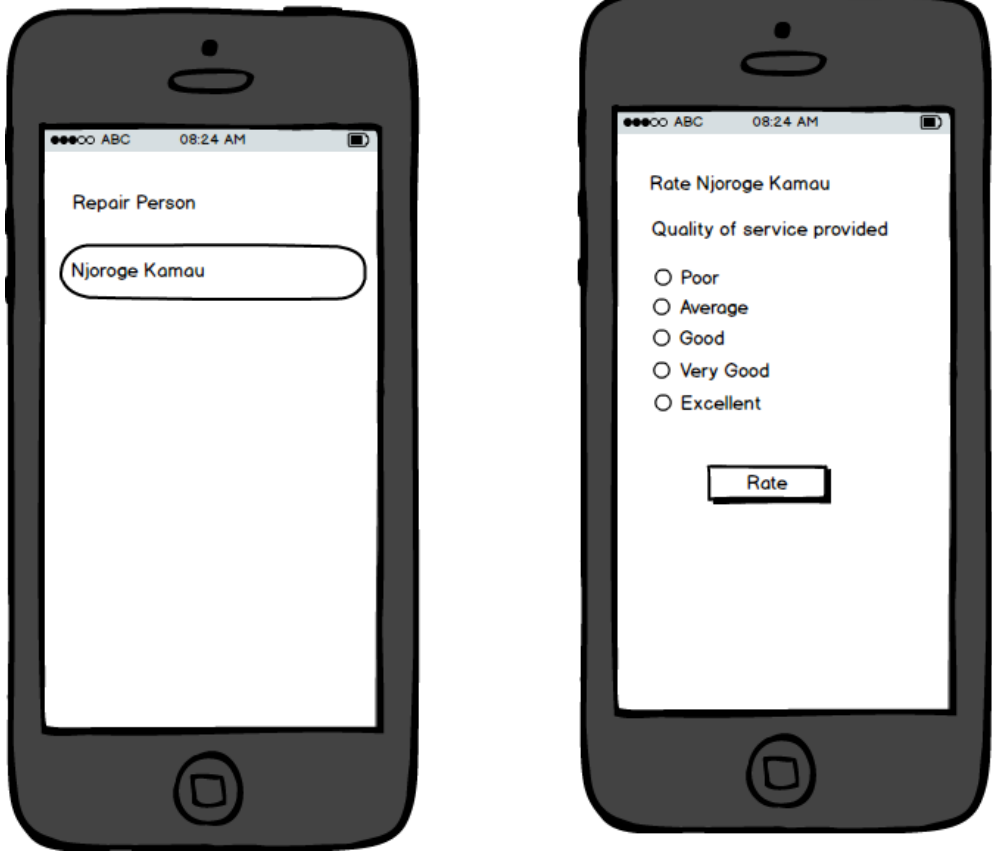
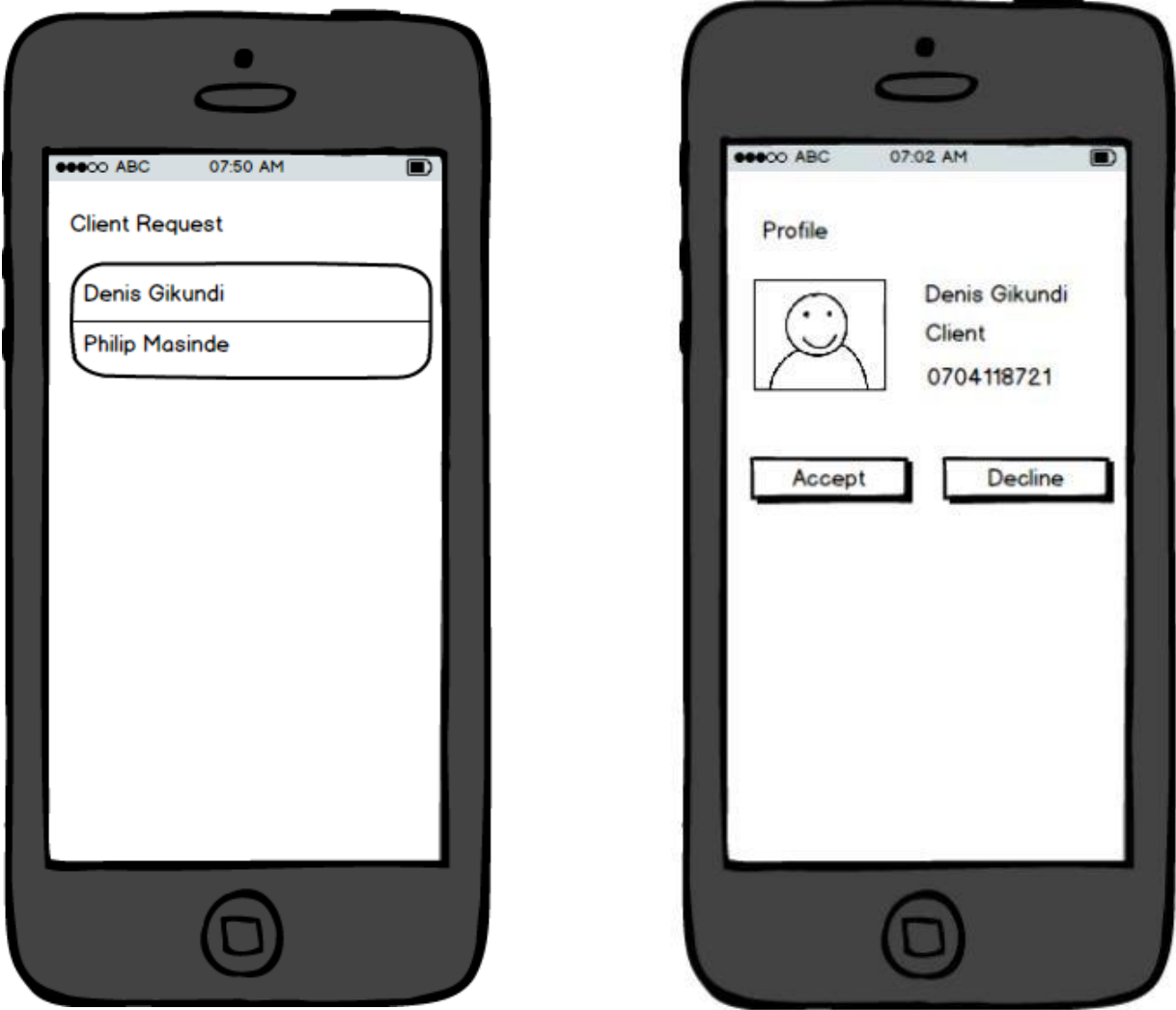


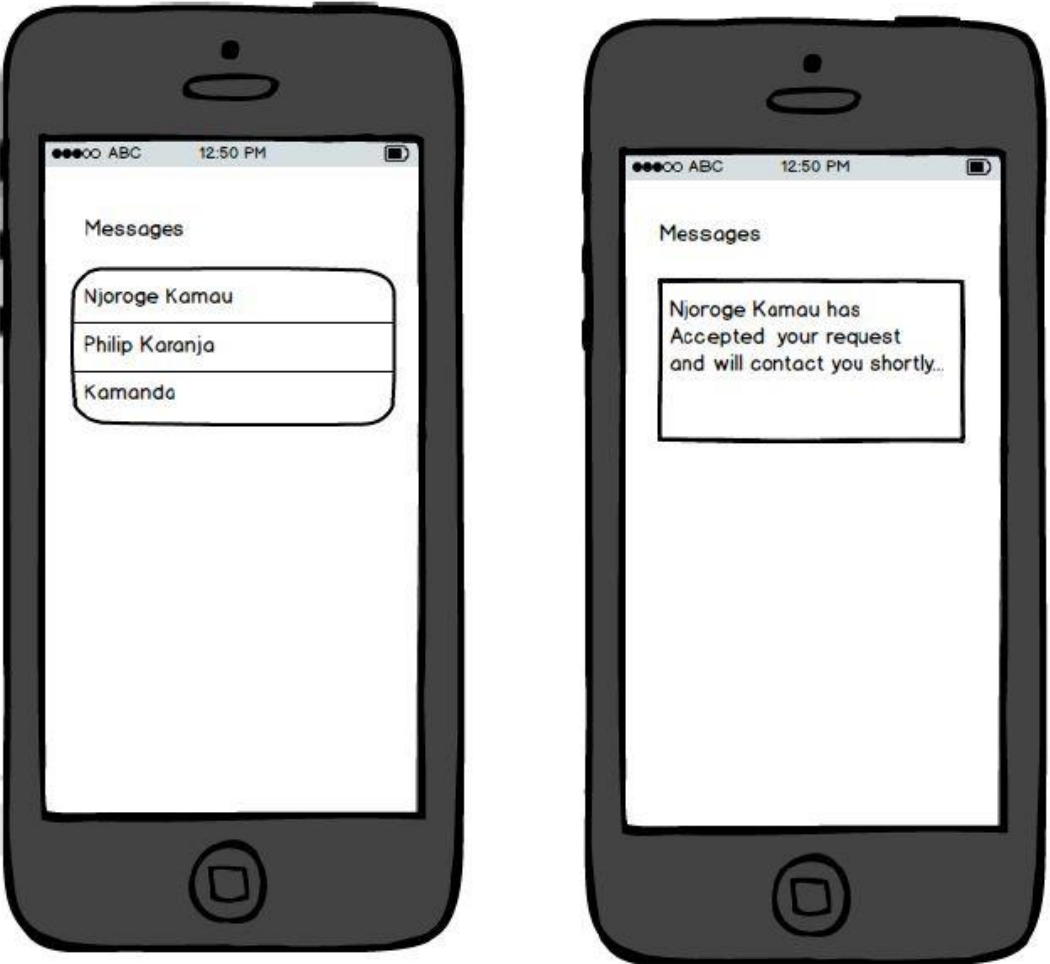
Figure 4.13 Rating Process

**Figure 4.14** Shows the clients with request which when the handyman clicks on shows the clients Full Details where he is expected to accept or decline based on his availability which notifies the client either to wait and be contacted or to choose another handyman.



**Figure 4.14 Client Request**

**Figure 4.15** Shows the clients messages that he receives from the handyman. He can view a message about the status of his pending job, i.e. whether the handyman accepted the work or not as shown in the figure below.



**Figure 4.15 Client Request**

### 4.6.2 Web Application Wireframes

The other design of the Handyman application is the backend system that is used to manage the mobile application. The overall management is the system administrator who has the rights to edit and update the details of users who in this case are the review committee and other administrators. He can modify their details, add them into the system and has the rights to remove them if they are

no longer needed in the system. They use the same login as the review committee but, their credentials allow them to view a different page as compared to what the review committee will see. Figure 4.16 how the Administrators dashboard and the functions that they can perform. That is, they can add a new user to the system and manage them.

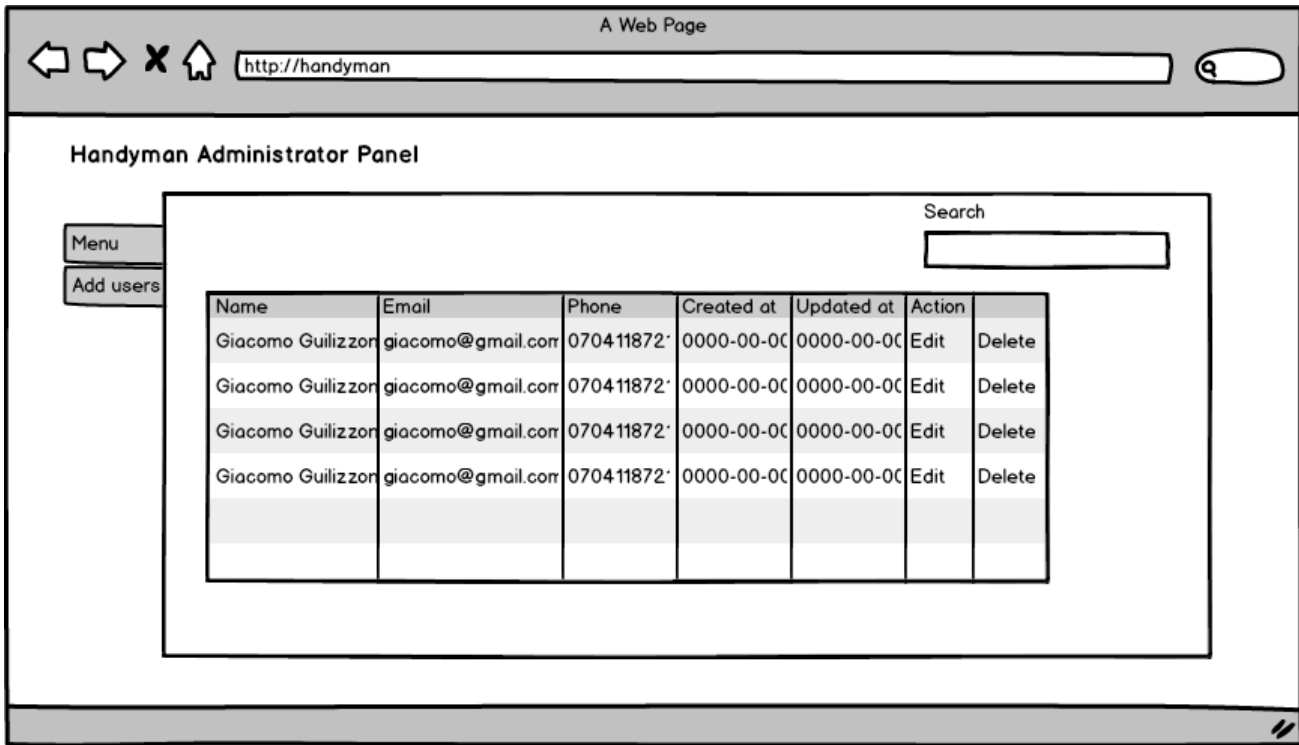
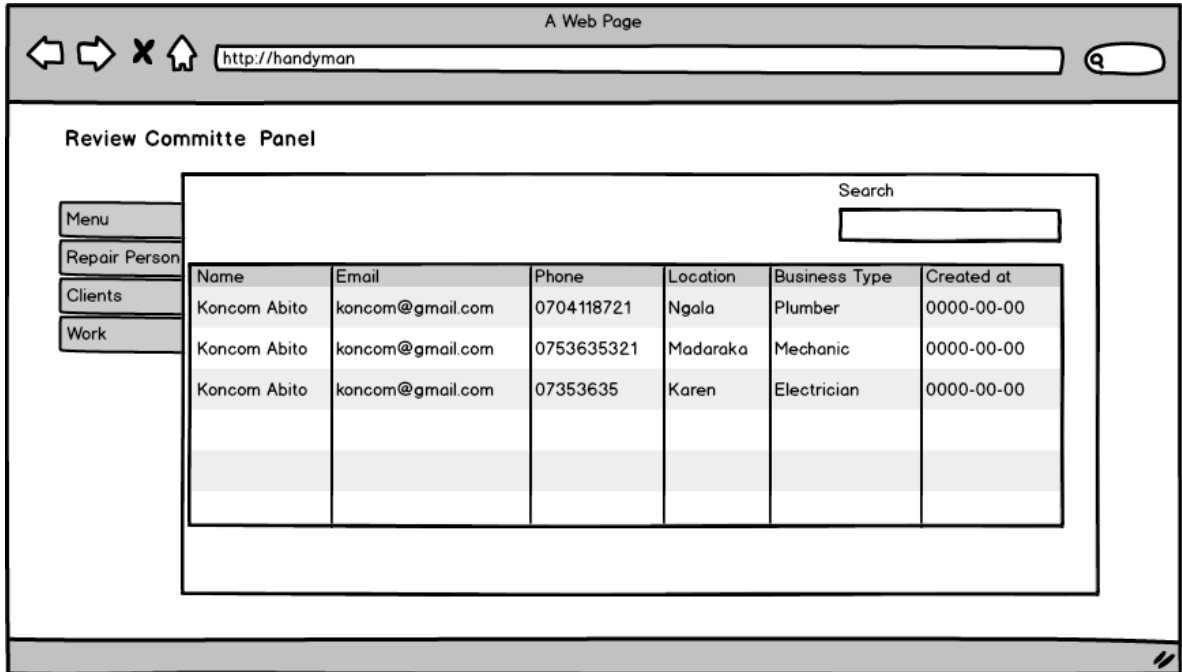


Figure 4.16 Administrator Dashboard Screen

The Review committee represent a group of users who are responsible for reviewing handymen's registrations and verifying their incoming applications. They can add and edit handyman details. They are also in charge of monitoring the overall work progress and have access to client's details. Their functions are described in the Figure 4.17.



**Figure 4.17 Review Committee Dashboard Screen**

## **CHAPTER 5: SYSTEM IMPLEMENTATION AND TESTING**

### **5.1. Introduction**

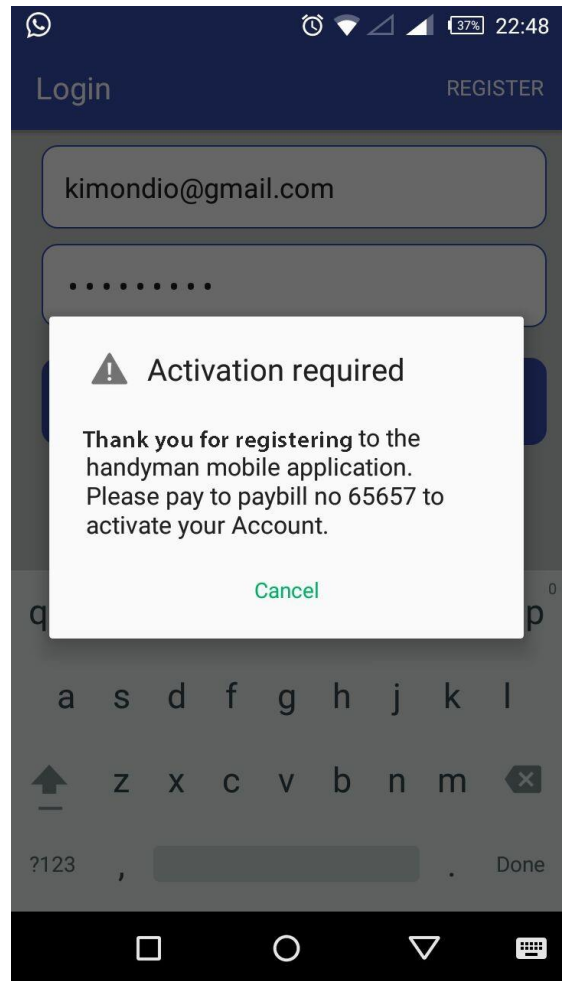
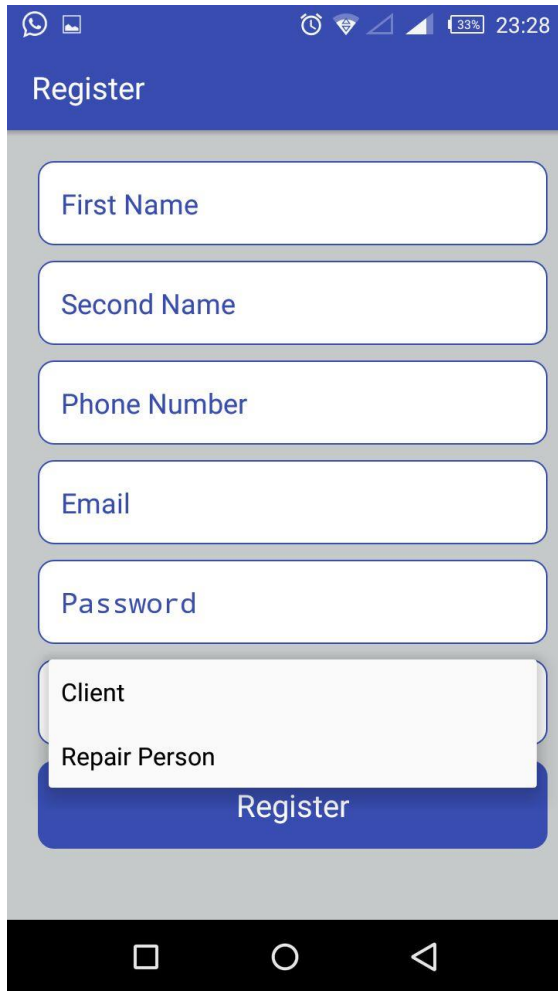
After the system design discussed in chapter 4, the designs were converted into the actual system and put on a series of tests to test the workability and whether they meet the requirements as outlined in the actual designs. This section presents the implementation and testing results also shown in appendix B.

### **5.2 Mobile Application Target Environment and Description**

The mobile application was built to run on Android enabled phones and platforms. Below are screen shots of the mobile application and their functionalities. Appendix D contains more implementation screens.

#### **5.2.1 User Registration**

**Figure 5.1** shows user's registration where a user is supposed to register either as a client or handyman. When one registers as a handyman, when he logs in for the first time he must pay to activate his account.



**Figure 5.1 User Registration Screen**

### 5.2.2 Dashboard Screen

Figure 5.2 shows the client and handyman’s dashboard screens. The client can search and request for a handyman service while the handyman can see and accept the client request. The client also can view ongoing services and rate the services of a handyman.

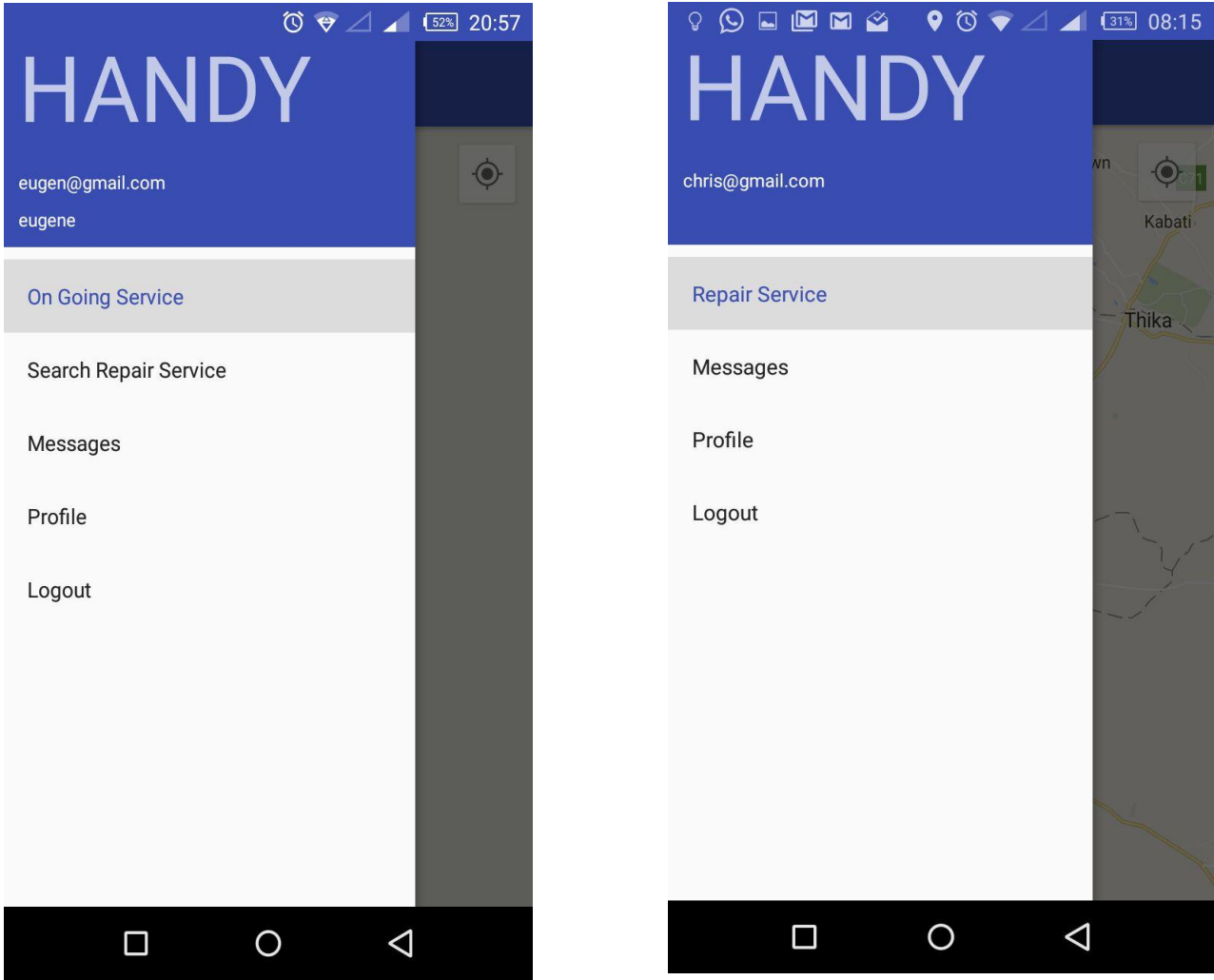
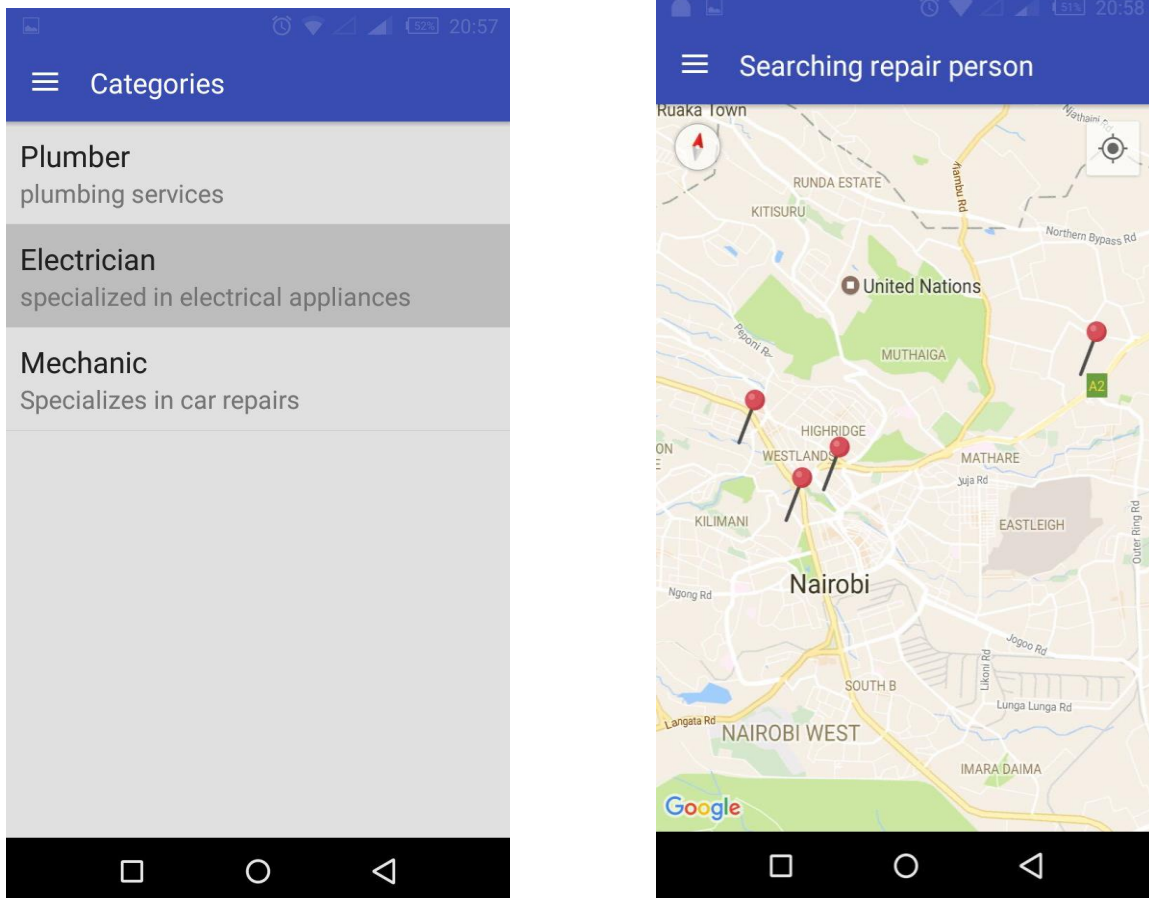


Figure 5.2 Client and Handyman Screen

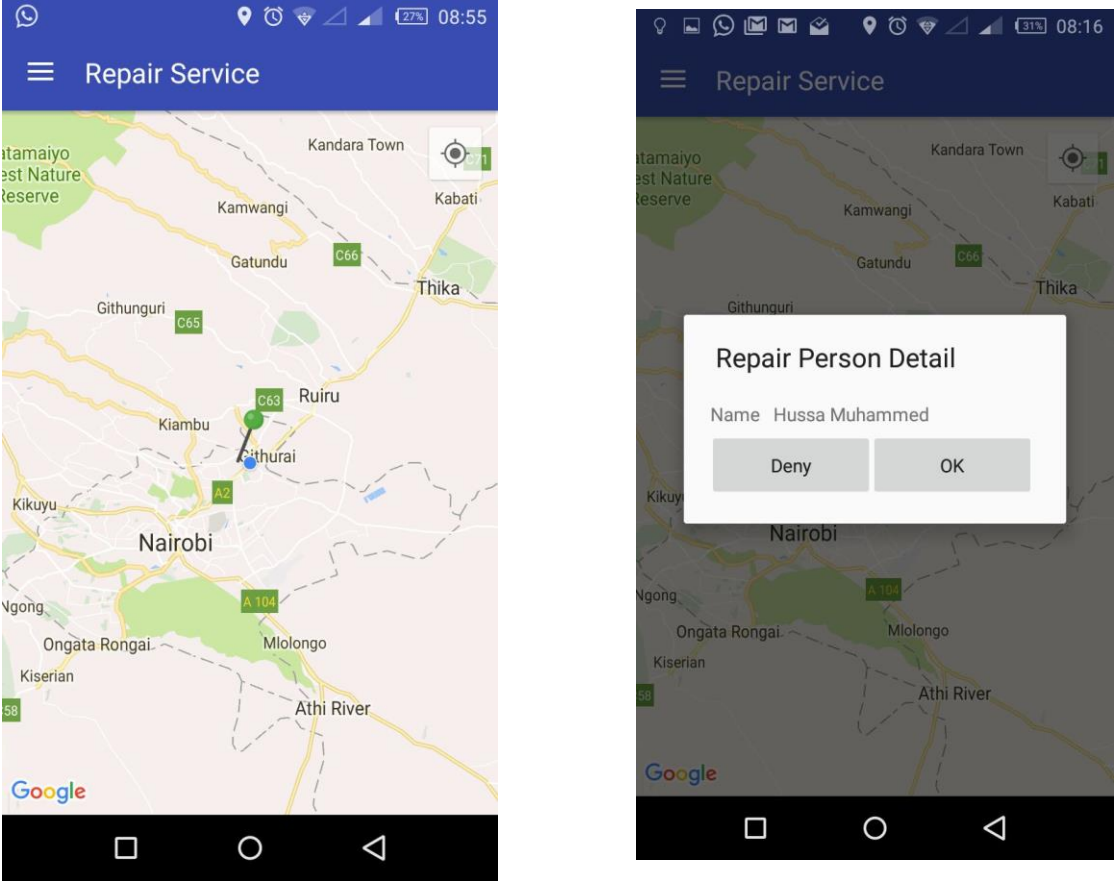
### 5.2.3 Search Handyman Process

**Figure 5.3** shows the process of searching for a handyman. The client selects the category of service then the system searches for a handyman in that category near the user's current location and displays the request on a map. The algorithm used for implementing the search works by first fetching the users coordinates i.e. longitude and latitude from the database and fetching the desired service from the search request. It then compares this against the locations and services of different handy persons registered in the application and relays the results of the handymen providing the desired service 5km away from the client on the map. The client can then choose to request any handyman of his choice by clicking the handymen displayed on the map and viewing their profile details. The handyman then receives a notification of this request.



**Figure 5.3 Search Handyman Screen**

**Figure 5.4** shows the client request as seen by the handyman. When he clicks on it, he can choose either to accept it or reject it based on his availability which the client receives inform of a notification as shown.



**Figure 5.4 Client Request on Handyman Screen**

## 5.2.4 Rating Handyman Process

Figure 5.5 shows the client rating process. When the handyman finishes his work, he requests the client to rate his services. The client selects the ongoing services option and clicks on the handyman. The application allows the client to rate the handyman via a comment and five-star rating feature. When he finishes rating, the handyman gets a notification about this and the system registers this as finished work. The rating algorithm works by checking whether the client initiating the rating request has an ongoing work request with the handyman to be rated. If so the client is allowed to rate the handyman and this rating score is updated on the handymen details. If the client does not have a pending ongoing work request, then the rating ability is disabled. The algorithm computes the total score by adding the score value from the five-star rating widget with the current handyman score in the database.

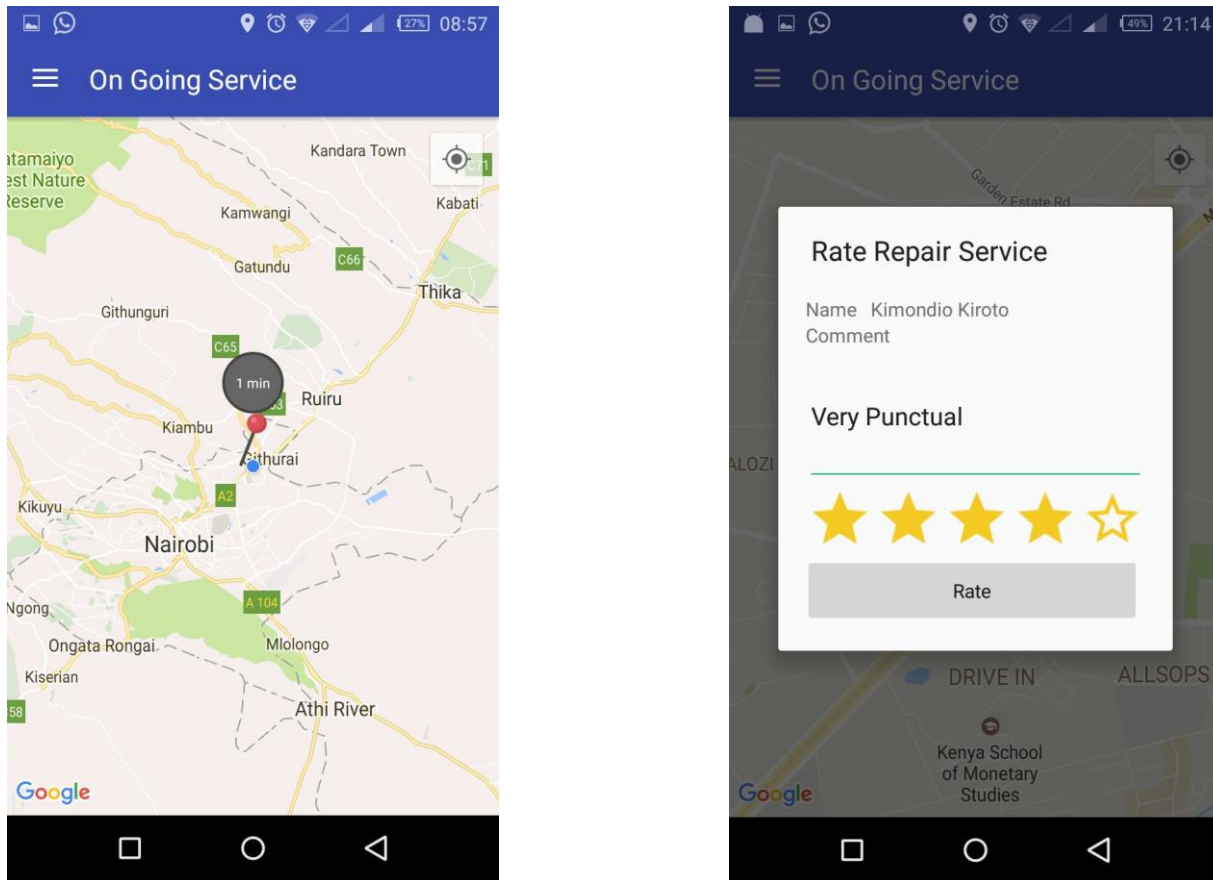


Figure 5.5 Rate Handyman Screen

## **5.3 Handyman Application Administration Management Portal**

This is a web portal that was built for the management and monitoring of the mobile application. It has two types of users, the overall administrator who has super administrative rights and the review committee who will oversee receiving and reviewing the applications requests by the handymen and monitor the progress of new clients' request.

### **5.3.1 Handyman Administrator**

He is the main system administrator who has super administrative rights over the system and can access all the features of the system. He can edit the details of both the review committee and the handyman, add them into the system and remove them if they are no longer needed in the system. They use the same login as the review committee but, their role allows them to view all the features as compared to what the review committee will see. Figure 5.6 shows the Administrators dashboard and the functions that they can perform. That is, they can add a new user to the system and manage them.

Figure 5.7 shows a list of the handymen as a result of the review committee clicking on the view options of the handymen' menu. He can View Add or Delete the Handymen details.

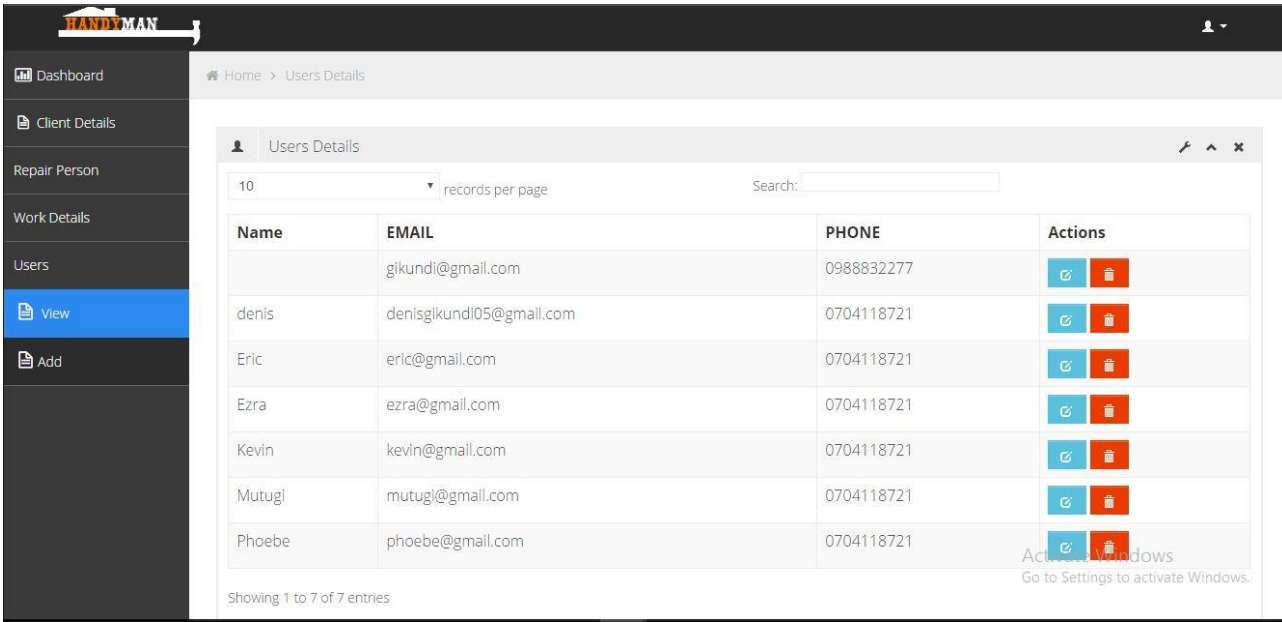


Figure 5.6 Administrators Dashboard Screen

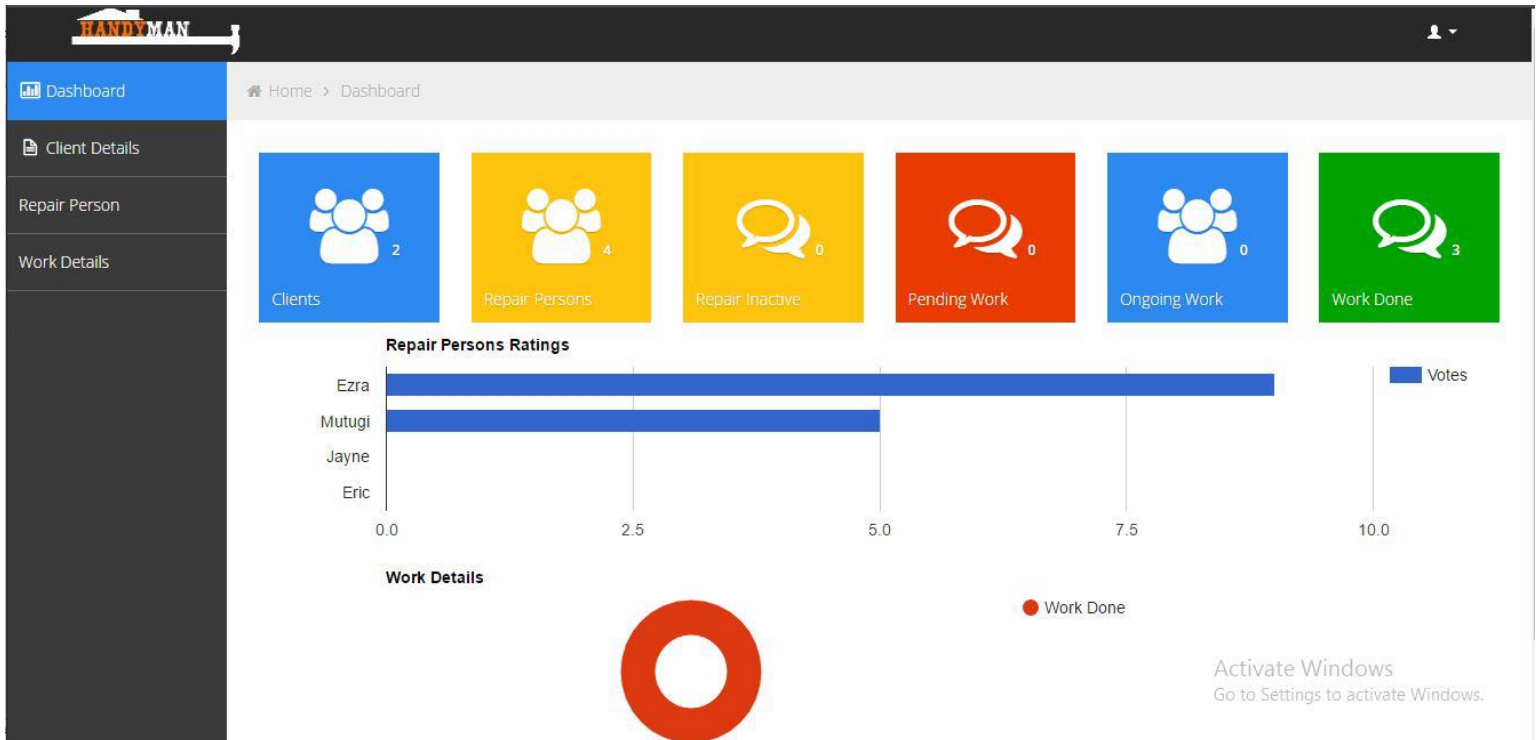


Figure 5.7 Review Committee Dashboard Screen

## 5.4 Developer Testing

This Section covers testing of the mobile application to ensure that it works well, the testing was divided into two sections, developer testing and user testing. The first tests done by the developer were to ensure that the various functionalities were working well, the tests included:

### 5.4.1 Compatibility Testing

Additionally, Compatibility testing was done to ensure that the application runs on major device versions. This would ensure users running different Android versions would be able to use the application with ease and without any problems. Table 5.1 show the results of the testing:

**Table 5.1: Compatibility Testing**

Test Case Name: <b>Compatibility Testing</b>				
Date Tested: 15 December 2016				
Tested By: Denis Gikundi				
Test Description:				
Pre-Condition:				
Post-Condition:				
Test Steps				
steps	Action	Expected Response	Pass/Fail	Comments
i	Download and install the application	Application installs without any problems	Pass	None
ii	Check if the application is running well	Application runs well	Pass	None
iii	Repeat steps 1 and 2 on multiple phones running different android versions	Installs and runs well	Pass	Works well on different versions of android

## 5.4.2 Search for a Handyman Functionality

This was tested to make sure that when the user selects the desired category of service, the system searches for a handyman in that category near the user's current location and displays the request on a map and the user can request the service of any handyman on the map results without any problems as shown on Table 5.2.

**Table 5.2: Search Handyman Testing**

Test Case Name: <b>Search Handyman Testing</b>				
Date Tested: 15 December 2016				
Tested By: Denis Gikundi				
Test Description:				
Pre-Condition:				
Post-Condition:				
Test Steps				
steps	Action	Expected Response	Pass/Fail	Comments
i	Launch the application and Login as a Client	The Client Application Home page with Clients Menu	Pass	Requires correct Client credentials to Login
ii	Select desired category to search	Results of different handymen near the user's current location are displayed on the map	Pass	Gives the desired results

iii	Click on any handymen result as shown on the map	Handyman profile details including contact and work information	pass	desired results
iv	Click on request feature	Sends a new client request to the handyman	pass	

### 5.4.3 Register as a Handyman Functionality

This functionality enables the handyman to register himself in the application by submitting his personal details as shown on Table 5.3.

**Table 5.3: Register Handyman Testing**

Test Case Name: <b>Register Handyman Testing</b>				
Date Tested: 15 December 2016				
Tested By: Denis Gikundi				
Test Description:				
Pre-Condition:				
Post-Condition:				
Test Steps				
Steps	Action	Expected Response	Pass/Fail	Comments
i	Launch the Application and Click on Register Menu Option	Registration Screen with fields for registering	Pass	None

ii	The handyman submits his personal details and clicks on register	The handyman receives a success message upon successful registration and is taken back to the Login screen	Pass	Gives the desired results
iii	Submit credentials to Login	For first time Login, the handyman receives an alert for payment to activate his account	Pass	
iv	Pay to the account number to activate account	On successful payment, the handyman can Login normally to the system	Pass	

**5.4.4 Rate a Handyman Functionality**

This functionality was tested to make sure that when a handyman finishes his work, the client can rate his services for the system to register this work as done as shown on Table 5.4.

**Table 5.4: Rate Handyman Testing**

Test Case Name: <b>Rate Handyman Testing</b>  Date Tested: 15 December 2016  Tested By: Denis Gikundi  Test Description:				
Pre-Condition:				
Post-Condition:				
Test Steps				
steps	Action	Expected Response	Pass/Fail	Comments
i	Launch the application and Login	The Client Application Home page with Clients Menu	Pass	None
ii	Click on the ongoing services menu option	The handyman details are shown on the map	Pass	Behaves as expected
iii	Click on the handyman icon on the map	Rating feature which has a comment section and five-star rating feature pops out	Pass	Behaves as expected
iv	Type comment and choose five-star rating then click on rate	The application rates the handyman with the rating scores and notifies the handyman and registers the work as done	Pass	Behaves as expected

## 5.5 User Testing

After the developer testing was over, the study sought to obtain the users feedback on the application. This was done through supplying of post questionnaires as shown in Appendix B to 20 respondents to get their feedback on the mobile application. Users were given instructions on how to download and interact with the application by being supplied with the name of the application on the Google Play Store. This is covered in the sections that follow below.

### 5.5.1 Accessing the Application

The application was hosted on Google play store for testing. A bulk SMS account was also obtained for use in sending the messages to the users during the testing process. The users could be able to interact with the application by downloading, launching the application and creating dummy client and handymen' account for testing. The Figures 5.8, 5.9 and 5.10 show the results of the tests.

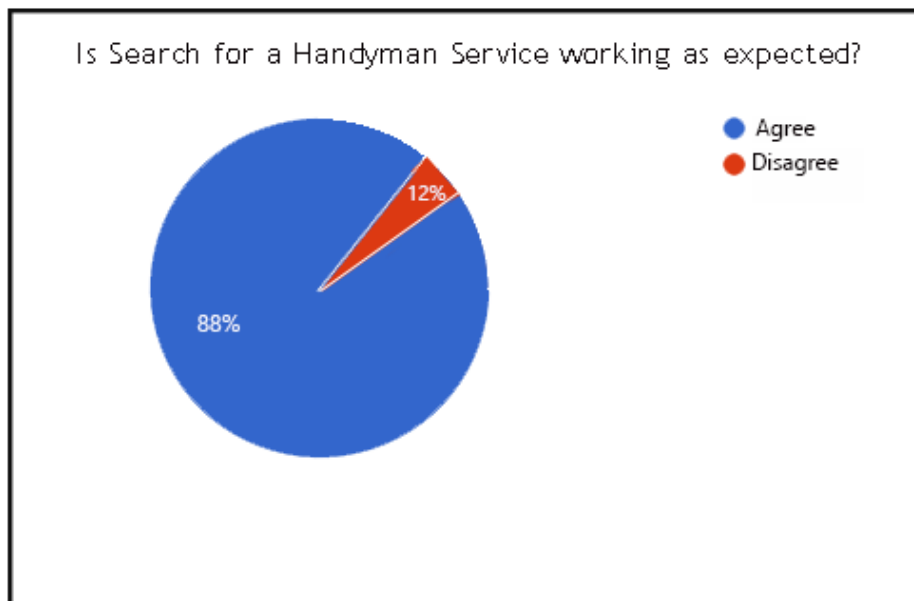
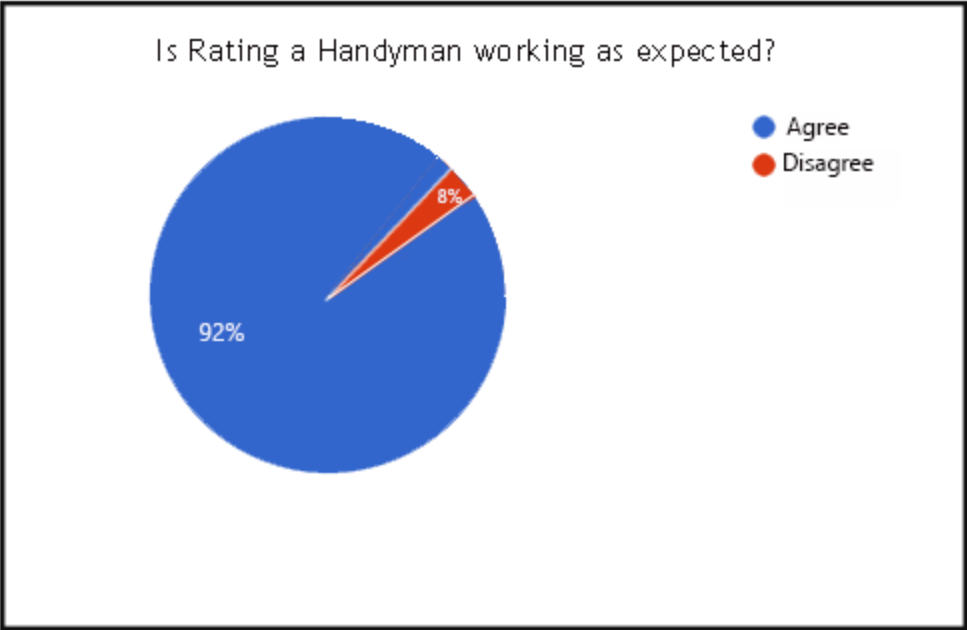
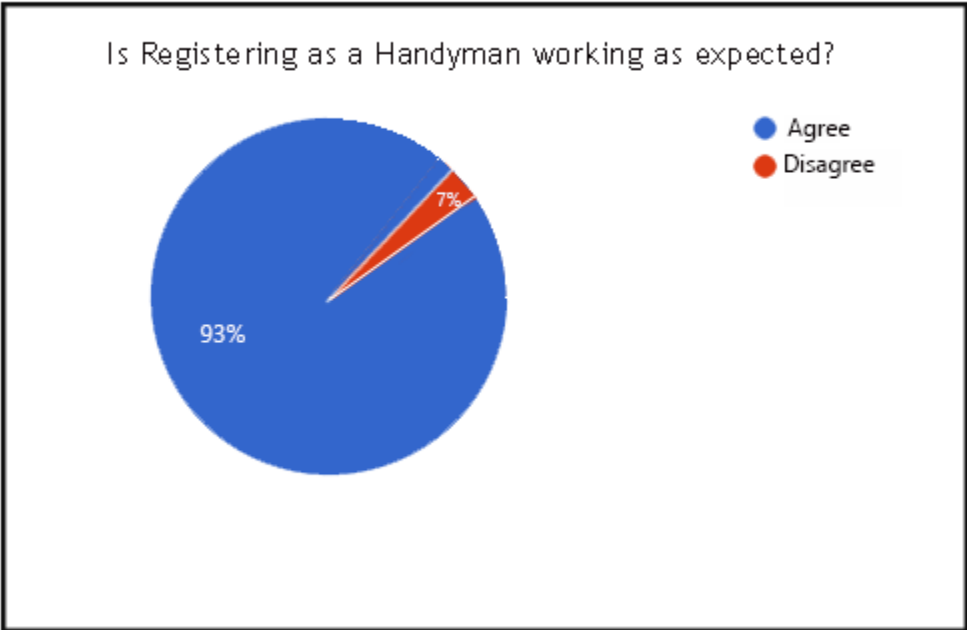


Figure 5.8 Search for a Handyman Service



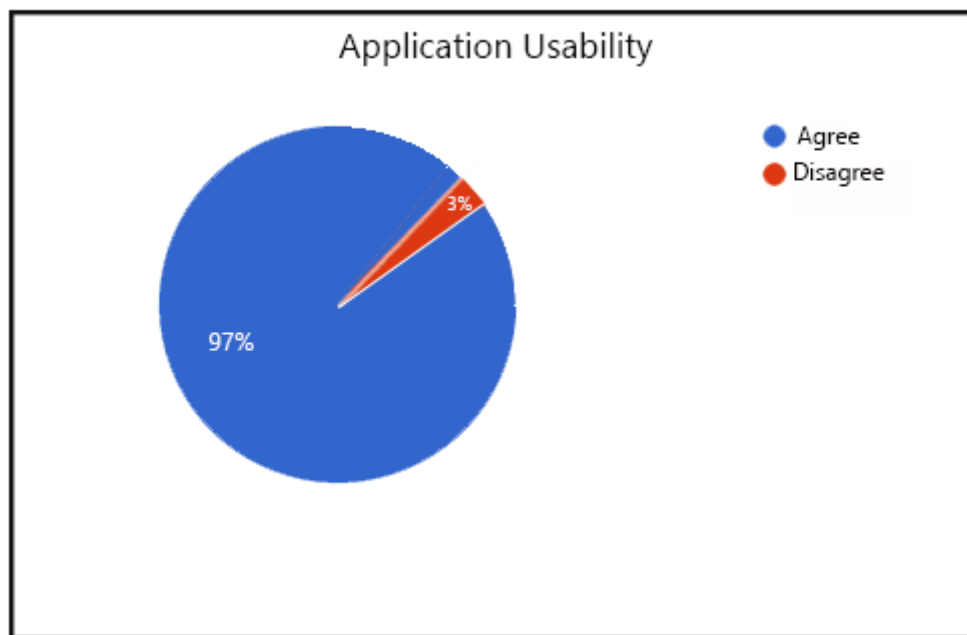
**Figure 5.9 Rate a Handyman**



**Figure 5.10 Register a Handyman**

## 5.5.2 Usability

The study sort to see if the application was easily understood and the users could interact with it with it without any issues or need for any human intervention need to explain to them on how to use it. Figure 5.11 shows the response from users with regards to their interaction with the application.



**Figure 5.11 Application Usability**

### 5.5.3 Downloading and Installing the Mobile Application

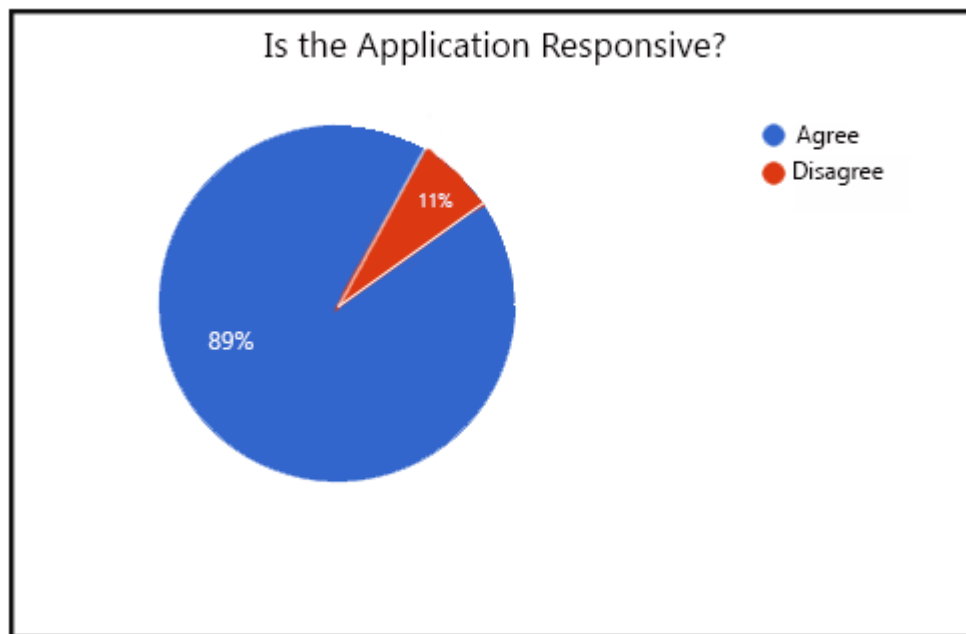
The user goes to Google play store and searches the application by name. He is then able to download, install and launch the application Table 5.5 shows this.

Test Case Name: <b>Downloading and installing the application</b>				
Date Tested: 19 December 2016				
Tested By: Denis Gikundi				
Test Description:				
Pre-Condition:				
Post-Condition:				
Test Steps				
steps	Action	Expected Response	Pass/Fail	Comments
i	Go to play store search for the application and click on download	The application begins downloading on phone	Pass	None
ii	Launch the application and check if the application is running well	The application runs well and the user can interact with it.	Pass	None
iii	Repeat steps 1 and 2 on different phones of different android API Levels.	The user can install and run the application without any compatibility issues	Pass	Works well on android phones with different versions

**Table 5.5: Downloading and installing the mobile application**

### 5.5.4 Application Responsiveness

When an application is engaging the users, and giving responses to them, it is more appealing to them as compared to ones without responses to them, when an action is being performed in the background the user should be notified to be patient with the application, these responses are what make the application rate more in stores, Figure 5.12 shows the response from the users with regards to this.



**Figure 5.12 Application Responsiveness**

## **5.6 Conclusions**

The methodology chosen for design and development of the application allowed for changes to be made until the right product was achieved. Agile development allowed for the developer to be able to involve the users of the product to give in their inputs at various times in the production and for them to be considered, it also allowed the researcher to be able to make changes to the application that were deemed needed. After the design was done the study could implement the various concepts considered, the users were given questionnaires to give feedback on the application and the functionalities which have been covered in the chapter.

## **CHAPTER 6: DISCUSSIONS**

### **6.1 Introduction**

When the application testing was completed and all the functionalities proved to be working the study sought to seek if the set objectives were achieved and to see how the developed application was superior against the current system, its advantages and benefits and the improvement that it has brought that make it unique. It also shows how the set objectives have been met and accomplished.

### **6.2 Findings and Achievements**

The developed system features were compared to the existing solutions and the results analyzed in section 2.4.1 - 2.4.7. First, the new system is a mobile application running on android platform hence usable by many users because as the research shows android is the most popular OS while the existing system majority are web based usable by fewer users with knowledge about the web. The ease of use also makes the system more usable than the existing systems.

The new system requires little or no human intervention to complete the process of searching and requesting for handyman service as the whole process is automated as compared to most existing systems which cannot work without human intervention at some level. The system makes the process of searching for handyman services very fast and efficient hence making it suitable for on demand services as compared to the existing system which encourage booking of services and scheduled appointments. The new system uses live Google map to track location of handymen and their clients making it more interactive, efficient and superior as compared to existing systems that just contain contact and location information on the handymen.

There is a great challenge with the existing systems on determining the quality of services provided by the handymen but the new system addresses this by having a rating feature that enables clients to rate the quality of service provided to them and availing this information on successful search of handymen to help users to make an informed decision when selecting a handyman

## 6.3 Discussions

The study was able to meet its research objectives through the following ways; The first objective in Section 1.4 was to investigate the factors affecting the acquisition of handyman services, the study shows that clients were faced by several challenges while seeking for handyman services. In section 2.2 the research captures in detail the various challenges. It is due to these challenges that a need for the new developed application was justified.

The second objective was to analyze the deficiencies in the technologies currently used to locate handyman services. The study shows that there are a number of web based systems that strive to locate handymen services. Section 2.4 discussed these existing systems. Their weakness and limitations are then discussed and compared to the new system.

The third objective was to develop a system that facilitates the location of handyman services within a locality. In Section 2.9-2.10 the study showed the various ways through which such a system can be designed. In Section 4.3 the study shows how the application was designed with regards to the requirements generated from the data collection stage in Section 4.3.3. The application was then developed and the post questionnaires given to the sample population that tested the application as discussed in Section 5.5.

The application was tested to determine whether the various functionalities worked as required. The developer did a lot of testing while doing development for the application and the results are discussed in Section 5.5, then the users were also given the application to test and their results are highlighted in Section 5.51,5.52.5.53 and 5.54. It was concluded that the application's functionalities worked as required and the results indicate support this hypothesis, any corrections or errors that were found were rectified.

The final objective was to validate the effectiveness of a mobile application for locating handyman services within a specific location. This objective was addressed by a comprehensive literature review in the study of existing systems that strive to determine and locate handymen services within a locality as shown in Section 2.4 where their shortcoming as compared to the proposed system were discussed. It was seconded by questionnaires feedback where respondents found the

features in the application helpful in streamlining the process of locating handyman services within a locality (Appendix B).

#### **6.4 Advantages of the Proposed Mobile Application**

Compared to the existing systems used to locate handyman services within a locality, the proposed solution offers a more streamlined approach for locating handyman services within a locality. First, the application has been developed to target android mobile users who form the majority of users as compared to web users currently targeted by the existing systems. Secondly, the rating score and completed work statistics for each handyman serves to provide guarantee in the trust and quality of services to be provided by these handymen. The application is more interactive as it uses live Google maps to show the location of handymen and clients and makes the process of accessing handymen fast and very efficient.

#### **6.5 Limitations of the Application**

This mobile application only targets handyman services which are majorly home-based repairs and maintenance. Secondly, its only useful to smartphone users running android operating system. Finally, the application is dependent on the availability of internet connectivity for users to be able to send and retrieve data, hence Internet connectivity is required for one to use the application.

# **CHAPTER 7: CONCLUSIONS AND RECOMMENDATIONS**

## **7.1 Conclusions**

This research established the factors that lead to acquisition of handyman services as increased busy and hectic lives led by people today, work, family time and other commitments which leads to demand for odd jobs. A number of existing technologies are already currently being used to determine and locate handymen services within an area. In the research conducted, it was discovered that 25% of the respondents had used some other technical means in an attempt to obtain a handyman like using Google search engine, Facebook, yellow pages, handyman sites among many others. From the data collected, it was clear that the users were in need of a new system that would strive to address the shortcomings of the already existing systems.

First, the users wanted a system that would provide them with the details of a handymen near their location or current place of settlement which is not the case with the already existing systems. The research discovered that the existing systems currently used to locate handyman services lack in providing trust in the quality of service being provided by handymen as desired by the clients. The results led to the development of a Handyman application with both a web and mobile interface to streamline the process of locating Handyman services within a locality.

The new system serves to build the public trust in handyman's quality of service by providing them with a rating feature and work history information to determine the quality of service. It is very interactive, easy to use and suitable for on demand services which greatly increases its relevance and the chances of it being adopted and is a distinguishing factor from the current existing systems. It provides users with details of handyman's in consideration to the nearest location, best price offered and highest rating score making it more suitable and efficient as compared to the existing systems. The new system is also of relevance and of great importance to the informal sector as it seeks to streamline the process of acquiring these handymen with the current rise and demand of handymen in this sector.

## **7.2 Recommendations**

The new system is very important to the informal sector as it provides a platform for the job seekers mainly handymen to connect easily and efficiently with their clients by streamlining this process. It serves to build the public trust in handyman's quality of service by providing them with a rating feature and work history information to determine the quality of service. It also serves to meet the growing need for on demand handyman services by easing and fastening the process of acquiring handymen.

## **7.3 Suggestions for Future Study**

The researcher has seen that the proposed solution can be expanded in the future. The following can be used to further enhance the system:

- i. Implement the application for different mobile platforms such as Windows, iPhone and blackberry to cater for users who do not have Android mobile phones
- ii. Integrate other payment gateways to aid in the activation of handymen.
- iii. Have premium features on the application that require clients to pay to be able to use as an alternative revenue model for the application
- iv. Support other common languages such as Kiswahili to increase its usability and target more users.

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# APPENDICES

## Appendix A: Questionnaires

### i. Client Questionnaire

The aim of this questionnaire is to collect data about your experience in finding handyman services and the quality of service offered to you by handymen. Your feedback on this will be of great benefit to the researcher in the accomplishment of the academic goal. Kindly attempt all the questions to the best of your abilities, there is no right or wrong question, your response will be highly appreciated. This research is anonymous hence there is no need to give your name anywhere on the form as the information collected will be used for academic purposes only.

## QUESTIONS

\*Required

1. How many times have you shifted from your current settlement in the last 5 years? \*

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2. Do you find challenges of finding handyman services such as electrician, plumber, phone repair, computer repair, shoe repair etc. when you move to a new area? \*

*Mark only one oval.*

Yes

No

3. What methods do you use to find handyman services when in a new area? \*

Be as elaborate as possible

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4. What criteria do you often use to determine the effectiveness of the services of a repair person even before the services are provided to you? \*

Be as elaborate as possible

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5. Are there any existing technologies that you have used before to find handyman services and if yes please name them?

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6. If there any existing technologies that you have used before to find handyman services how user friendly and effective were they?

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7. What is it that you did not like about them? Be as elaborate as possible

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8. Is there need of a Mobile Application for finding Handyman services within ones' location? \*

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9. What suggestions, expectations and recommendations would you make of a new system to help you in locating handyman services near you? \*

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10. What is your current age?

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11. What is your gender?

*Mark only one oval.*

Male

Yes

## **Appendix B: Post Questionnaire**

The aim of this questionnaire is to get your response on the developed mobile application to help refine it further. Please follow the steps below to access the mobile application. This is just a prototype with dummy data that has been used to facilitate this.

### **i. Downloading and Launching the Application**

The users should be able to interact with the application by first downloading the application from Google play store and launching it.

#### **Steps**

1. Go to play store search for the application and click on download
2. Launch the application and check if the application is running well.
3. Repeat steps 1 and 2 on different phones of different android API Levels.

### **ii Main Functionalities**

After Launching the application, the following are the main menu functionalities that you should try out;

#### **a) Search for a Repair Service**

This feature should allow a client to select the handyman service category i.e. plumber, electrician, mechanic etc. The system then searches for a handyman near the user's current location and within the selected category and displays the results on a map. The client should be able to click on each of them to view their profile which contains their details which include ratings, work done, experience etc. If the client likes a handyman's profile he then proceeds to request them for the

service which sends a notification to the handyman inform of an SMS and as a request which he can see in his dashboard when he logs in.

## **b) Register as a Handyman**

This feature should allow a handyman to register himself through the application. He is expected to provide several details prompted by the system including his name, age, gender ID, business details, charges per hour, services offered, and location among many others. He is also expected to pay a small fee to activate his account.

## **c.) Rate a Handyman Services**

The rating feature should allow the client to input a comment and use a five-star rating widget which the client can select from one to five star which is calculated as 1 -5 rating score by the application. The handyman is expected to get a notification that his services have been rated by the client.

## **iii Test Questions**

1. Were there any issues while downloading the application and installing it?

Yes

No

2. If you had issues please list them

3. Were the major menu options working correctly?

Yes

No

4. If not please give your reasons

5. Would you consider the application effective as compared to the current system?

## **Appendix C: Interviews**

### **i. Handyman Interviews**

1. Do you face any challenge while trying to market your services? \*
2. How do you acquire and retain new customers?
3. What can be used to determine the viability of your business?
4. What technology platform have used to Market your handyman services.
5. What type of phone do you use mostly?
6. Would pay a small fee to be connected to customers in need of your services?

## Appendix D: Implementation Screenshots

### i. Home Screen

This contains the main menu options as shown in the Figure D.1. Gives the user three options to choose from which include, search for a repair service, register as a handyman service provider and to rate the services of the handymen.

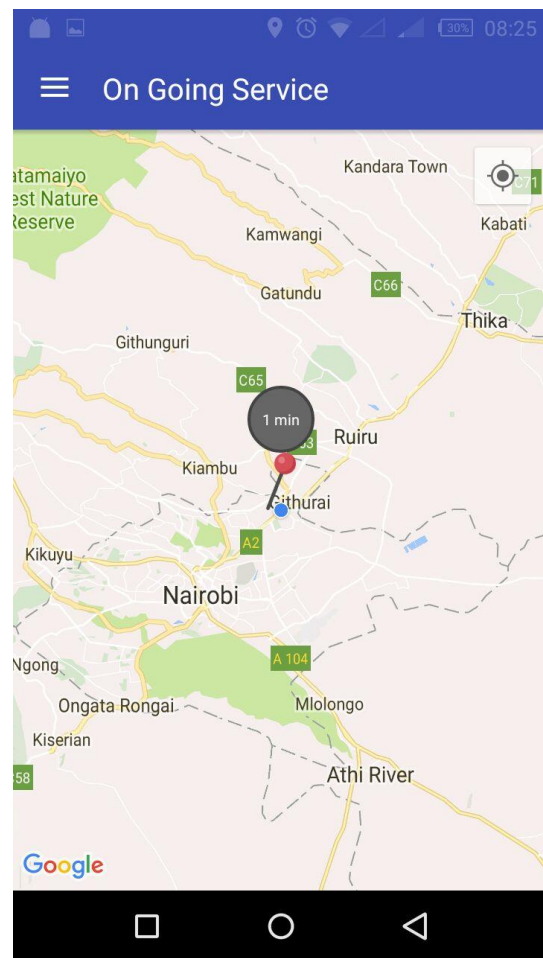
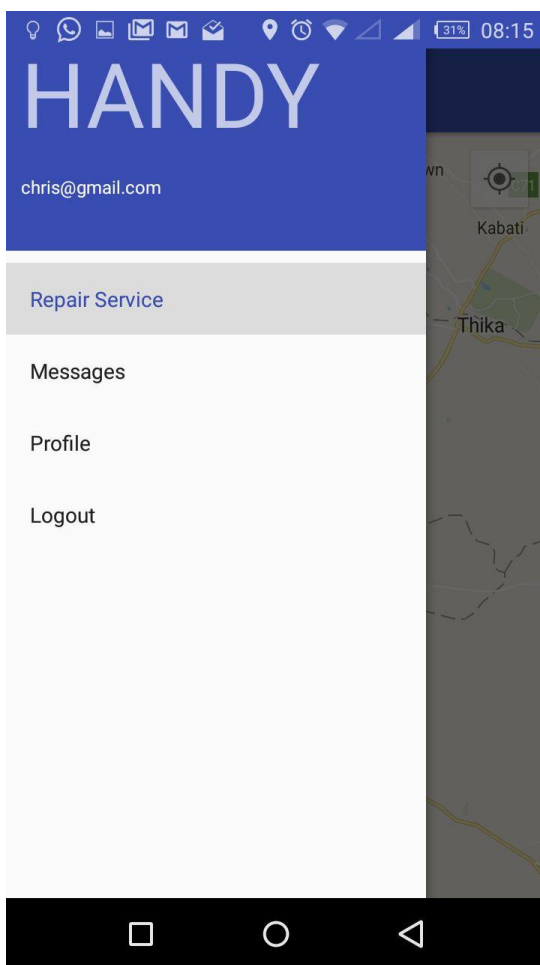


Figure D.1 Main Menu Screen

## ii. Response Messages

The Figure D.2 shows example of the system response messages that are displayed to the user at different stages in the mobile application. The first screen shows system response to the client after successful review, the second screen shows the user message after searching for a handyman service and the third screen shows a response message screen to the handyman after registering as a handyman service provider.

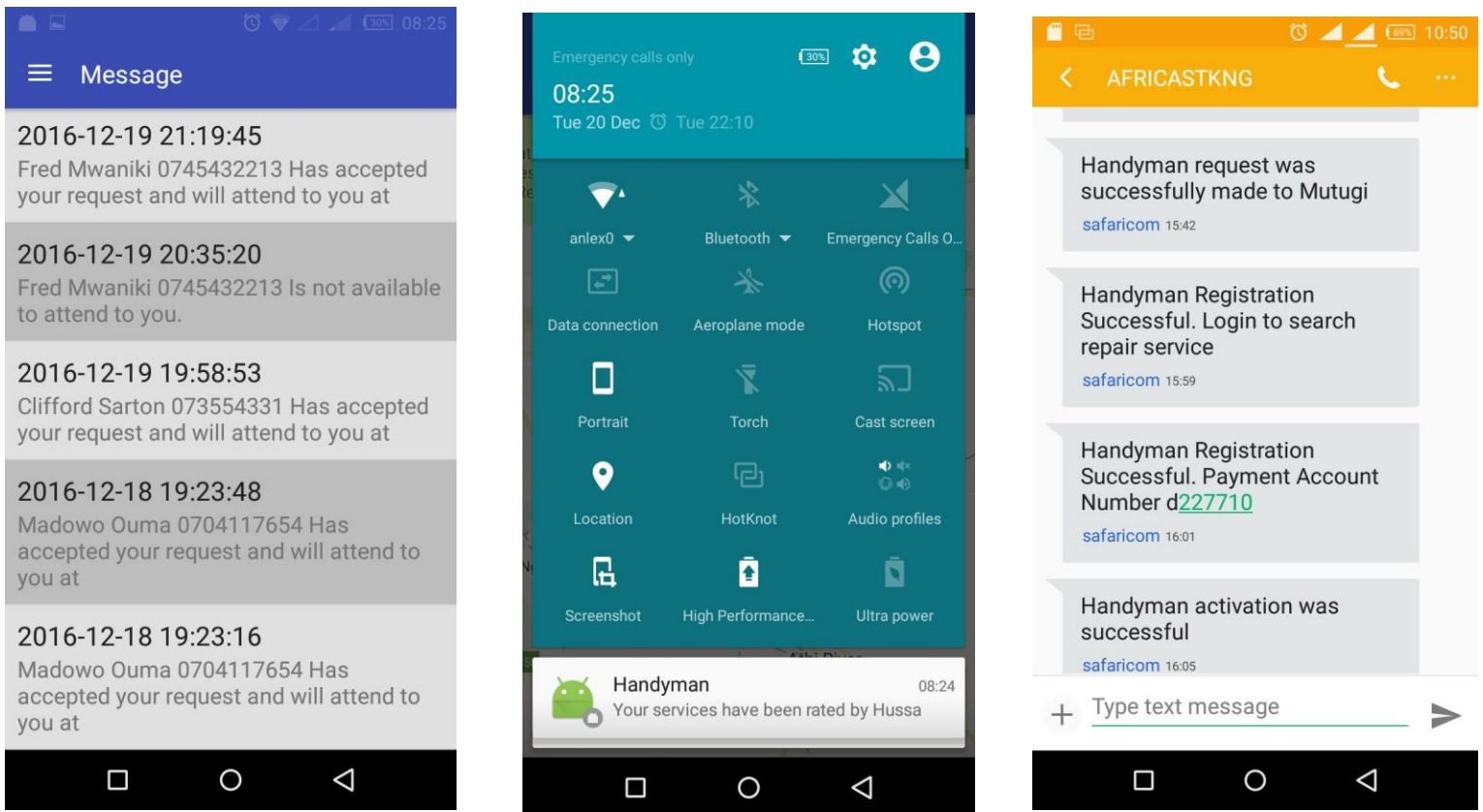
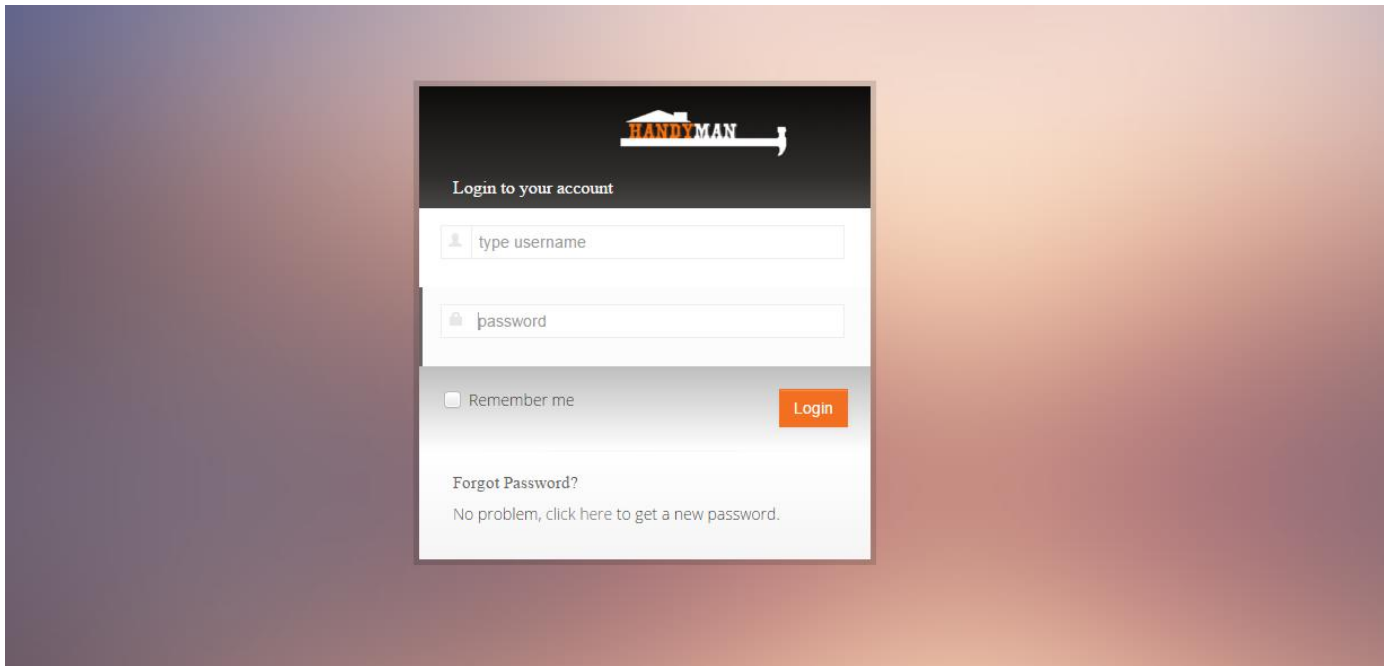


Figure D.2 Message Response Screens

### iii. Web Application Login

This is the login screen where the different review committee members and system administrator login to the web application. They are differentiated by the role id to view various dashboard options.



**Figure D.3 Login Screen**

## i. Add Handymen Screen

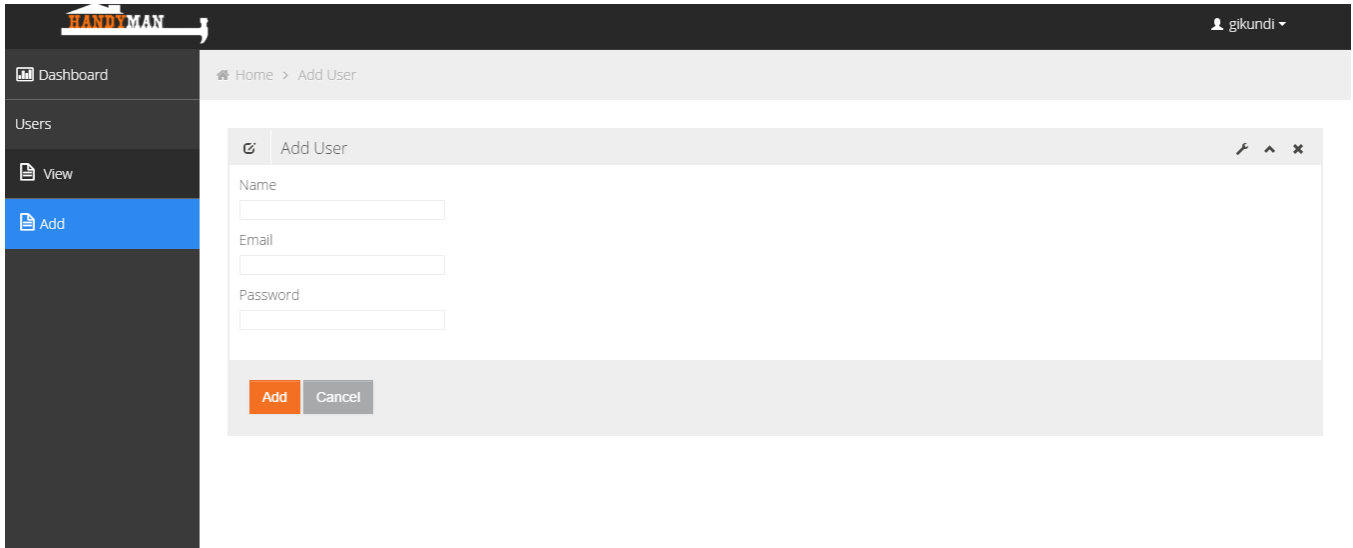
The Figure D.4 shows the add handyman screen which is an option available to the review committee which allows him to register a handyman to the system.

The screenshot displays a web application interface for adding a handyman. The top navigation bar includes the 'HANDYMAN' logo and a user profile for 'denis'. The left sidebar contains menu items: 'Dashboard', 'Repair Person', 'View', 'Add' (highlighted in blue), 'Client Details', and 'Work Details'. The main content area is titled 'Add Repair Persons' and features a form with the following fields: Name, Phone, National ID, Location, Cost, Business Type, and Business Reg. At the bottom of the form, there are two buttons: 'Add' (orange) and 'Cancel' (grey).

**Figure D.4 Add Handyman Screen**

## v. Add User Screen

The Figure D.5 shows the add user screen which allows the Administrator to add a new user to the system.



**Figure D.5 Add User Screen**

## vi. Done Work Screen

The Figure D.6 shows the done work screen that shows the details of the handyman who has fully completed a job and the details of the client attended to. It falls under the category of work details which also allows a user to view pending work details.

Handyman

denis

Home > Work Done

10 records per page

Search:

Export to Excel

Repair Person Name	Phone	Client Name	Phone	DATE	Actions
Philip Karanja	0704118721	Emanuel	071221122	2016-03-17 08:01:48	

Showing 1 to 1 of 1 entries

← Previous 1 Next →

**Figure D.6 Done Work Screen**

## Appendix E: Use Case Description

Table 4.2 shows how a handyman can register himself to the application by submitting his details which include personal and details about his services. The handyman existence is checked and if he is not found, then he is allowed to proceed with the registration process. He then gets a registration confirmation.

**Table E.1: Handyman Registration**

<b>Use case Name</b>		Register Handyman	
<b>Description</b>		Describes how handymen are able to register their services in the application.	
<b>Trigger</b>		Handyman launches the application and then proceeds to register his Services.	
<b>Type</b>		External	
<b>Major inputs</b>			
<b>Description</b>	<b>Source</b>	<b>Description</b>	<b>Destination</b>
Handyman launches the application	Handyman	Main menu access	Handyman
Handyman details	Handyman	Registration confirmation details	Registration
<b>Major Steps Performed</b>			
<b>Steps</b>			
i Launch the application and Log in		Android Mobile Application	
ii Register as a handyman		Handyman details	
iii Check whether handyman exists and if not proceed with registration		Handyman registration confirmation.	

**Table E.2: Rate Handyman Service**

<b>Use case Name</b>		Rate Handyman	
<b>Description</b>		Describes how clients are able to rate the services of the handyman who has attended to them.	
<b>Trigger</b>		Client launch the application and logs in	
<b>Type</b>		External	
<b>Major inputs</b>			
<b>Description</b>	<b>Source</b>	<b>Description</b>	<b>Destination</b>
Client launch the application and logs in	Client	Main menu access	Client
Rate handyman service	Client	Rating confirmation	Repair service
<b>Major steps Performed</b>		<b>Steps</b>	
1 Launch the application and Log in		Android Mobile Application	
2. Rate handyman services		Ratings details from a scale of 1 – 5 star	
3. Check whether the client has ongoing tasks		Handyman	
4. If the client has ongoing tasks he is able to rate		Rating confirmation	
5. If not, he is not able to rate		Rating rejection	

From table 4.3 it describes the process of rating a handyman and involves rating details from a scale of 1 – 5-star rating. The system checks whether the client has any ongoing tasks. If he has, he is able to rate the handyman and also allows him to add comments on the same. If this is not the case, then he is not able to proceed with rating.

## Appendix F: Turnitin Report

The image shows a screenshot of a Turnitin report viewer in a Google Chrome browser. The browser's address bar shows the URL: [https://www.turnitin.com/dv?o=657588128&u=1050899608&s=&student\\_user=1&lang=en\\_us](https://www.turnitin.com/dv?o=657588128&u=1050899608&s=&student_user=1&lang=en_us). The page title is "Turnitin Document Viewer - Google Chrome". The browser tabs include "Library Services Plagiarism Check..." and "2016 Plagiarism Check (UG) - DUE 31-D...".

The main interface features a header with the document title "THESIS DISSERTATION DOCUMENT" and the author "BY DENIS NYAGA". On the right, the Turnitin logo is displayed next to a similarity score of "15% SIMILAR" and "-- OUT OF 0". Below the header, there are three tabs: "Originality", "GradeMark", and "PeerMark".

The document content is displayed in a white box on the left, containing the following text:

**A MOBILE APPLICATION FOR DETERMINING THE AVAILABLE REPAIR SERVICES WITHIN A LOCALITY**

By  
Denis Gikundi  
084943

A Dissertation Submitted to the Faculty of Information Technology in partial fulfilment of the requirements for the award of a Degree of Masters of Science in Mobile Telecommunication and Innovation (MSc. MTI) at Strathmore University

The right side of the interface is a greyed-out area with the text "No Service Currently Active".

Figure F.1 Turnitin Report