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Enhancing emergency services access through a mobile based directory

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ENHANCING EMERGENCY SERVICES ACCESS THROUGH A MOBILE BASED DIRECTORY

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Declaration

I declare that this work has not been previously submitted and approved for the award of a degree by this or any other University. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made in the thesis itself.

Wachira Patrick Weru

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June 22, 2016

Approval

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Abstract

An emergency is any situation that poses an immediate risk to property, life, environment or health. The emergency situations demand urgent intervention to avoid more damage. Worse still, it is usually difficult to predict the occurrence of a given emergency and therefore impacting negatively on response. In most cases, the victims or the people around a given victim lack a reliable and professional contact during emergency periods and might end up increasing the magnitude of the damage.

With the advent of mobile technology in Kenya, the previously used printed directories are less popular. It should be noted that emergency contacts in the directories are at times location dependent and do not operate in the victim's current location hence delaying any response. In addition, some of the currently available contact-directories are web based and in the event of an emergency, the panic stricken victims may lack the emotional strength and composure to conduct the web searches for a given emergency facility.

Based on the aforementioned challenges, this dissertation presents a geo-location based mobile emergency directory that allows the user to get the nearby emergency centres from any location. The system leverages on the phone's geo-locating features, such as Global Positioning System (GPS) to identify the user's location. This is then used to search from a database of available emergency centres for the centre(s) that are closest to the user and responds with the centres' contact information, which can then be used to reach them. Professional response from the emergency centres can then be enhanced. The development of the solution followed the Waterfall Software Development Methodology. The developed solution comprises of two main components: a mobile application which serves as the client side and a backend. The proposed solution has been tested and recorded positive feedback in terms of accuracy, performance and reliability.

Keywords: Emergency, geolocation, location based service, directory, and emergency response.

Table of Contents

List of Tables

List of Figures

List of Equations

Abbreviations and Acronyms

CSS - Cascading Style Sheets

GSM - Global System for Mobile communications

GPS - Global Positioning System

HTML - HyperText Markup Language

HTTPS - Hypertext Transfer Protocol over SSL

IMEI - International Mobile Equipment Identity

KNBS - Kenya National Bureau of Statistics

KWS - Kenya Wildlife Service

NDOC - National Disaster and Operations Centre

PHP - Hypertext Preprocessor

SIM - Subscriber Identity Module

SMS - Short Message Service

SMSC - Short Message Service Centre

SSL - Secure Socket Layer

UAV - Unmanned Aerial Vehicles

UML - Unified Modelling Language

UNDP - United Nations Development Program

Chapter 1: Introduction

1.1 Background

An emergency is any situation that poses an immediate risk to property, life, the environment or health. According to Oxford Dictionary (2010), an emergency is "a serious, unexpected and often dangerous situation requiring immediate action". Whereas an incident may pose only one of the above risks, most emergencies results to multiple risks on their occurrence. To help address emergencies, emergency centres or facilities are set up and which are equipped with the capacity to handle their corresponding emergency service needs. The Kenyan government and the private sector have invested hugely in disaster management operations, both in the prevention and response to emergencies (Government of Kenya, 2009).

Kenya is described as a country with a track record of public-private partnership for humanitarian actions, this includes emergency response (Jim & Nicholas, 2014). This partnership between the different stakeholders has facilitated combined operations in the event of emergencies where with proper coordination, the available resources, human or material, are contributed to serve the emergency needs which could have been impossible to meet with one emergency centre or facility. An example of such coordination of the different stakeholders was witnessed during the Westgate attack in Kenya (Hamilton, 2013). The public joined forces with the professional response teams to attend to the victims as well as provide palliative care to the more serious cases.

According to International Rescue Committee, the best way to reduce the impact of a given crisis is by having adequate preparation to respond to one in advance (IRC, 2016). In the event of an emergency, the victim or any other person around the victim will try to administer first aid or other countermeasures such as palliative care for the aftermath. When this is encouraged, as it helps in pain alleviation, professional help is always advised. The professional teams are able to provide proper handling and rapid transportation of the victims to the reliable facilities such emergency trauma sections of hospital thus avoiding a problem commonly referred to as 'disaster transfer from site of emergency' (Leopold, 2004). Professional teams are trained to assess a situation prior to attending to the victims thus settling on the most effective approach.

There exist a number emergency service providers depending on the nature of the emergency incident. These include: ambulance services, emergency medical services, police, fire fighters, humanitarian organisations, road recovery, lifeguards and lifeboats, mine rescue, blood and organ transplant suppliers, air rescue, forest and wildlife services, among others (Venton et al., 2012). In this dissertation, emergency centres considered include hospitals, ambulances, fire stations, police stations and other security bodies.

A crucial factor in any emergency service is the response time. This is the amount of time taken for emergency responders to arrive at the scene of an incident. The magnitude of an emergency's effect is directly proportional to the time taken for response to happen, in this case professional response. Emergency service systems thus demand the ability to facilitate fast response. Emergency centres are usually stationed at strategic locations and any request for their service is promptly addressed through their control centres. These centres have professional emergency response personnel who are dispatched to handle such requests (IRC, 2016).

From the above aspects of emergencies, fast response demands for efficient communication between emergency service providers and people in need or victims. In the context of an emergency, most victims or witnessing persons prefer making a call to an emergency service provider as compared to other options such visiting the centres or sending a message. Communication has been enhanced through mobile technology with the ability to reach a person from any location irrespective of his mobility. The per-second billing also makes the use of mobile voice a cheaper means of communication. Most countries have emergency numbers where any person can call from any location at any time to get emergency help, in Kenya, this 999 number had been inoperative for 15 years but was recently reintroduced with the Kenya Police committing to seeing 80 percent of emergency requests handled in reliable time (Karobia, 2013). With the concept of community policing, the interaction between the law enforcers and the public has been boosted with a number of police hotlines being released to the public. Also, it is possible for a victim to call a given centre through their publicly availed numbers. Majority of these centres have control rooms where the calls are handled and deployment coordinated.

Mobile technology has dominated over previous communication technologies such as fixed telephone line. This has seen termination of some of the previously available services such as provision of printed directories. Consequently, investment in digital platforms has replaced these

previously offered services. The current versions of directories exist mostly in digital platform such as websites (Holdeman, 2014).

From the above discussion this dissertation aims at developing a mobile based solution to the problem of lack of reliable emergency directory. The solution is geared at enhancing the visibility of emergency response service providers to the victims or people in need of these services. Based on the aforementioned challenges, this dissertation aims at developing a geolocation based mobile directory to provide the necessary emergency contacts to victims or any other persons in need. The solution will also provide the feature of getting the directions to a given centre and increased convenience of finding a given centre from a number of service providers nearest to him/her.

1.2 Problem Statement

Kenya has in the recent years experienced cases of increased emergencies contributed by different factors such as floods, terrorism, road accidents, diseases/epidemics, collapsing of buildings, among others (Willis & Rebecca, 2011). The current statistics indicate that Kenya recorded an average yearly occurrence of 5,672 accidents, 69,376 reported crimes, and a morbidity of 47,038,650 in 2014 (KNBS, 2015). This data reflects just a small portion of incidents that may demand emergency attention. All these incidents demand for fast response to minimise loss of lives and damage to property.

Responding to the increased risk of emergency incidents, the country has invested hugely in emergency response facilities and in the training of response teams (Government of Kenya, 2009). The private sector has also partnered with the government in availing emergency services to the public. However, there exist a number of challenges hindering the utilisation of these resources. Victims who are supposed to benefit from these centres are faced with challenges of getting professional emergency services and therefore are exposed to more risks. Firstly, a communication gap exist between victims and emergency service providers (Mbugua, 2015). Victims and people witnessing a given incident do not know where to seek professional emergency services. Secondly, a problem exists with the unreliability of available sources of contacts. Most of the existing directories and sources of emergency contacts such as websites contain outdated information. Lastly, a problem exist with the tracking of a given victim. According to Faridah, St. Johns Ambulance Kenya, for cases where a victim is able to reach an emergency service provider, there

exist a challenge for the service provider to locate the location of the reported incident (personal communication, August 7, 2015).

1.3 Objectives

This dissertation is based on the following objectives:

1. To identify emergency services offered in Kenya.
2. To review the existing solutions for emergency response in Kenya.
3. To develop a geo-location based mobile directory for emergency centres.
4. To test the effectiveness, performance and reliability of the geo-location based mobile directory.

1.4 Research Questions.

This dissertation is based on the following research questions:

1. Which emergency services are offered in Kenya?
2. What are the existing technological solutions applied in emergency response in Kenya?
3. How can a geo-location based mobile directory for emergency centres be developed?
4. How can the geo-location based mobile directory be tested on its effectiveness, performance and reliability?

1.5 Justification

During emergency incidents, people tend to run to safety as well as assist any victims. The majority of these, save for the trained emergency professionals, will not be adequately composed to search for emergency contacts from available sources such as searching from one web page to another. This also factors the fact that most stickers displaying emergency numbers are in such moments damaged from the incident's effect. For instance, in a fire incident, computers or large devices, as advised by the fire department, are usually left behind. The only option one is left with is to use the phone to search for emergency contacts. Despite the advent of the mobile web, the widely scattered information from the many available websites may not be time-reliable. This is especially when one is not sure of what facility to search for, a common problem when one is travelling and out of their home area. This study is aimed at developing a mobile solution that will help enhance this process of emergency response in Kenya. The solution should allow offline usage for areas where connectivity is poor.

1.6 Scope of Study

This dissertation aims at enhancing access to emergency services by developing a mobile based directory that facilitates increased visibility of the emergency centres to their target victims. Whereas the Kenyan context of emergencies may demand more than only increased visibility to better facilitate efficient response, this research aims at enhancing communication between the users and the centres. Enhancement of this visibility will target the use of mobile technology. Implementation of the mobile application was based on the Android platform. The context of study will be the Nairobi County and the dissertation will limit the scope to four emergency response categories, namely: ambulance services, firefighting, police and medical service providers.

1.7 Limitations of study

The study had a few limitations. First, the study was conducted on a limited budget thus data collection was focused on Nairobi county only. The scope was Nairobi county but the application can be used everywhere, however information sourced from centres' headquarters sheds light on the situation in many regions of their operations. Also, the solution could only be first implemented on android platform thus limiting availability only to android device users. Secondly, unstandardized communication systems used by different service providers limited the integration of the solution to the systems. The developed system does not address the problem of different standards used in communication by the emergency service providers. Lastly, the emergency sector needs more than improving on communication channels, for instance, commitment by the emergency service providers to respond to distress calls can add to the effectiveness of the communication channels.

Chapter 2: Literature Review

2.1 Introduction

An emergency is any situation that occurs in an untimely and unexpected manner thus demanding redirection of resources or deviation from the normal operations. A much severe incident can lead to a situation being declared a disaster (Venton et al., 2012). This chapter discusses the concept of emergencies in Kenya in terms of: types of emergencies experienced, the response process, stakeholders, the challenges experienced in the process, applied technologies and the existing frameworks aimed at enhancing the whole process. A detailed discussion of the existing solutions is concluded with the identification of their limitations.

2.2 Types of Emergencies in Kenya

Kenya profile of major incidents is dominated by: road accidents, internal conflicts, terrorism, fires, floods, collapsed buildings, disease and epidemics, poisoning, human-wildlife conflicts and droughts. Some of these incidents start as minor incidents but escalate to become major. This phenomenon can be linked to the country lacking an integrated emergency services, inadequate resources, poor coordination and lack of standard operational procedures and emergency response plan (Benjamin & Wayne, 2013).

Statistical records in the country indicate the occurrence of the following incidents in the past. Table 2.1 below shows the statistical record of the above cases categorized in three major groups, namely: road accidents, occurrence of diseases and crimes reported to the police. The table only shows cases were reported to the respective body (KNBS, 2015).

Table 2.1Reported Incidents for the Period 2010-2014 *(KNBS, 2015)*

Incident	**No. in 2010**	**No. in 2011**	**No. in 2012**	**No. in 2013**	**No. in 2014**
Reported road accidents (cases)	9,771	8,193	6,917	6,205	5,672
Morbidity (incidences)	38,262,097	38,332,477	39,390,685	43,636,517	47,038,650
Crimes reported to police	70,779	75,733	77,852	71,832	69,376

2.2.1 Other Incidents

Some incidents have been left out of the table for detailed statistical information could not be obtained.

2.2.1.1 Human-wildlife Conflict

Cases of human-wildlife conflict cannot be overlooked. Some of the cases have involved the Kenya Wildlife Service (KWS) but a huge number is reported of residents killing or injuring the animals during the conflicts, for instance, according to African Wildlife Foundation, 141 of the 437 elephant deaths reported between 1974 and 1990 in the Amboseli ecosystem were caused by people (Muruthi, 2005). Recently, there have been cases of wildlife, specifically lions believed to have strayed from Nairobi National park, being spotted on Nairobi highways (Kushner, 2016).

2.2.1.2 Terrorism

In the years between 2013 and 2015, terror related incidents had risen in the country. Mass shootings and suicidal bombings had risen claiming a large number of lives and destruction of property. The terror attack on Westgate Shopping Mall on 21st September 2013 presented the biggest terror since the 1998 embassy bombing and where at least 67 fatalities were recorded. More than 175 people were injured in the incident (Wachira & Smith, 2013).

2.2.1.3 Stampedes

Cases of stampedes have been reported in the past during mass gatherings. In October 2010, an incident of stampede occurred at Nyayo National Stadium during a football match resulting to at least 7 fatalities. In the recent past, such cases have occurred in different institutions owing to panic associated with terror attack fear (Wachira & Smith, 2013).

2.3 Emergency Services in Kenya

The nature of an incident is one of the factors that determine the teams involved. Most emergency situations overlap in the services required to mitigate or alleviate their effects, for instance, a road accident may involve the police –always a police case, ambulance service, insurance agency, NTSA, medical facility to accommodate the casualties and probably the fire brigade in situation threatening fire cases (Hamilton, 2013). Also, whereas most medical cases are addressed by the victim visiting the health facilities, the more urgent ones may demand the services of an ambulance

to get the victim or casualty to the hospital or the health facility. Situations that may involve legal action must also be reported to the police.

Escalation of an incident may demand the working together of the different agencies, both private and public, to provide a remedy. Such cases demand for a fast and effective manner of coordination and communication. An emergency situation in Kenya may involve a few or all of the following agencies and bodies: security forces, ambulance services, fire brigade and medical facilities where the specific subgroups may handle instances demanding specialized cases. For instance, the Recce Company, a unit within the General Service Unit will provide support to other companies of the GSU but is highly trained to perform security operations that demand highest level of attention (Sayia, 2010). Cases involving wildlife are assigned to the Kenya Wildlife Service while Kenya Forest Service is charged with the responsibility of conserving, developing and managing the Kenyan forest resources. While the public can directly reach the relevant body in event of an emergency or for any communication purpose, request of services for some of the specialised units follows the set response protocols owing to their sensitivity.

2.4 Emergency Response in Kenya

The Kenyan scene of emergency response is characterized by different approaches of reporting an incident. The structure of reporting any emergency case vary depending on the nature of the incident, however, reporting an incident to the police comes as a sure bet for anyone seeking further intervention since the officers, from their broad experience, can determine the urgency and the right emergency service provider to contact. The reintroduction of the emergency number 999 comes as a relief to many Kenyans as compared to the past experience where one had to have their local police station's or officer's number to reach the service (Karobia, 2013). Despite this, the adoption of technology and community policing in the country has encouraged a healthy relation between the police body and the local communities with the police publicizing the numbers to call in case of an incident. This saves time and also makes it easier for the officers to better address the situation since it is in their familiar geographical and social context. The Kenyan context of communication between emergency service providers and those in need is mostly through direct calls and social media (Coyle & Meier, 2009).

A majority of the public are comfortable reaching their intended recipient through social media, especially twitter and Facebook. This has led to the major emergency response centres and

organizations setting up accounts on these platforms and from which they can interact with the public and track incidents as they happen. These platforms have served as the main sources of most breaking news which attract high visitors' traffic and comments. According to Philip Ogola, the person in charge of the Kenya Red Cross social media command centre, social media has made it possible to coordinate response to hundreds of emergencies as they are able to comprehend the situation on the ground much easier and even call for more resources (Hamilton, 2013).

An alternative to the social media and one that accommodates any type of phone is the direct call. In the past, victims in different incidents have been reported to communicate with relatives and rescue teams from their mobile phones. The use of mobile devices has made it possible to link different parties in an incident as compared to visiting a given centre to report. The latter is time consuming in a process where time is of essence (Hollow et al., 2012). It thus shows that use of technology had the bigger share in facilitating reporting of incidents.

The preference of the above methods can be linked to the increasing number of mobile subscribers and use of smartphones. The International Telecommunications Union (ITU) report says Kenya has the third highest number of subscribers in Africa, after Nigeria and South Africa that respectively account for 26% and 19% of mobile cellular subscriptions in sub-Saharan Africa. Projections for mobile connection indicated that over a third of mobile connections in South Africa would be via smartphones by the end of 2016, and in excess of 15% in Egypt, Kenya and Nigeria (Jotischky & Nye, 2011).

From the above, availing emergency contacts to the public would boost timely interaction between the service providers and those in need. Currently, getting an emergency contact is through a number of options with both private and public stakeholders offering avenues of getting the numbers to the public. Of the many avenues available are: social media, websites, mass media, strategically positioned banners and billboards, security officers and emergency information stickers. Some of these avenues will be discussed in broad later in the chapter.

2.5 Challenges Facing Emergency Response in Kenya

According to a report by the Government of Kenya Ministry of State for Special Programmes (Government of Kenya, 2009), Kenya lacks a well-established disaster management and emergency response system. The report proposes the implementation of such. The recovery from

most past incidents have been majorly through contingency measures. This has however added to the cost of response as compared to when a properly documented response system was in place. The increased cost can be attributed to factors that include: increased magnitude of the incidents' effects such as loss of lives, damage to property and huge costs incurred in ending the relatively more intense emergency incident (Morgan, 2015).

For instance, Centre for Disease Control and Prevention (CDC) – Kenya cites the need for an established coordination and communication systems among the governmental and non-governmental stakeholders in improving emergency medical response and risk communication to the public. It emphasizes the need for the community to timely report any incident of disease outbreak to allow early control if possible. Early reporting allow mobilisation of resources to monitor these incidents and which would demand fewer resources to control at this early stage (Snyder, 2015).

2.5.1 Poor Administration of Remedy

Emergency response organizations and centres in partnership with the public regularly organize forums and training to enlighten the public on the expected steps to follows in event of an emergency. Emergency drills are also conducted to rate the public preparedness in such cases. Despite this, an actual incident may find the public short of reliably handling the situation thus administering improper remedies. This can partly be attributed to the lack of proper specialised equipment to address the situation as would be with the emergency teams (24hrs Ambulance Services, 2016).

2.5.2 Tampering of Evidence

The Kenyan police is charged with maintenance of law and order and apprehension of offenders against other functions. In event of an incident, the police should collect evidence that aid in the investigation so as to identify the causes and proper course to take in averting such incidents in future. Such evidence is also used to bring to book any offenders in the incident. When the relevant profession response team fails to reach an incident in good time, the people on the ground may tamper with the scene and thus hinder collection of any reliable evidence.

2.5.3 Communication

Whereas most emergency response agencies have an effective manner of communicating amongst themselves (Ombati, 2015), the party that ought to report the incident lacks a means of contacting them resulting to untimely reporting. Owing to this, the public try different avenue available such as social media or seek referral from friends and families on the best approach to communicate with the service providers hence importing the avenues' limitations.

2.5.4 Validation of Information

Authenticity of information is a crucial element of any usable emergency information. The reliance on social networks as a source have introduced the problem of validation and authentication of information. It is thus necessary for emergency service providers to confirm the details of a given incident before deploying their team. Incidents of hijacking and redirection of response resources have been reported when service providers have responded to false incidents (Coyle & Meier, 2009).

2.5.5 Response

A major problem lies in the reliability of the service provider. The public is not certain on the response from most service providers. Contacting a given centre could be possible but them addressing your incident is not assured. Instances of service providers not responding or responding late to incidents have been reported in the past. For instance, there are many cases of the public claiming late arrival to a scene of an incident by police despite proper notification having been made. There also have been cases where ambulance service providers have been denied access to hospital emergency access. This has led to the government enacting policies to govern emergency service accessibility for the public (Wachira & Smith, 2013).

2.6 Technologies in Emergency Service

Technology, especially in information and communication, have been used to improve crisis preparedness, response and preparedness. The advent of newer technologies such as the Internet and mobile phones has enhanced the communication operations in the periods before, during and after an incident. Early warning systems have also found an important place in emergency preparedness with information on possible occurrence of an incident being captured and shared with the relevant parties (HHI, 2011).

2.6.1 Information Gathering Technologies

2.6.1.1 Satellite Imagery

Based on satellite technology, satellite imagery has been used to provide overhead assessment of emergency situations especially in inaccessible areas or where a quick assessment of remote areas is required. These images and assessment enhance the speed of informed warning and response. In this technology, it is possible to transmit information over long distances and inaccessible regions where other media such as copper, microwave or fibre would be cost prohibitive or impossible to setup. Satellite imagery also has the benefits of ubiquitous coverage, consistent quality of service, scalability, and establishment of temporary networks (Intelsat, 2013). Application of satellite technology has been adopted for a long time with the United Nation's Operational Satellite Applications Program (UNOSAT) being an example of satellite based solution established in 2000. The program has since been adopted in different incidents with positive outcomes. Such incidents include: averting an imminent attack on a village in Democratic Republic of Congo in 2012, monitoring and assessing movement of people along Chad-Cameroon border in 2008.

2.6.1.2 Unmanned Aerial Vehicles

Unmanned Aerial Vehicles, commonly known as 'drones', provide overhead imagery same as satellites but possess the ability to produce much higher resolution imagery at a cheaper cost. The UAV also possess the advantage of operating in cloudy environment as compared to satellites. The vehicles are remotely controlled to areas of interest or can have a flight plan preloaded. The vehicles are relatively small in size and simple to use. Their use however is met by the challenge of jurisdiction restrictions and have a level of distrust (Coyle & Meier, 2009).

2.6.1.3 Global System for Mobile Communication (GSM)

Figure 2.1 illustrates the GSM architecture.

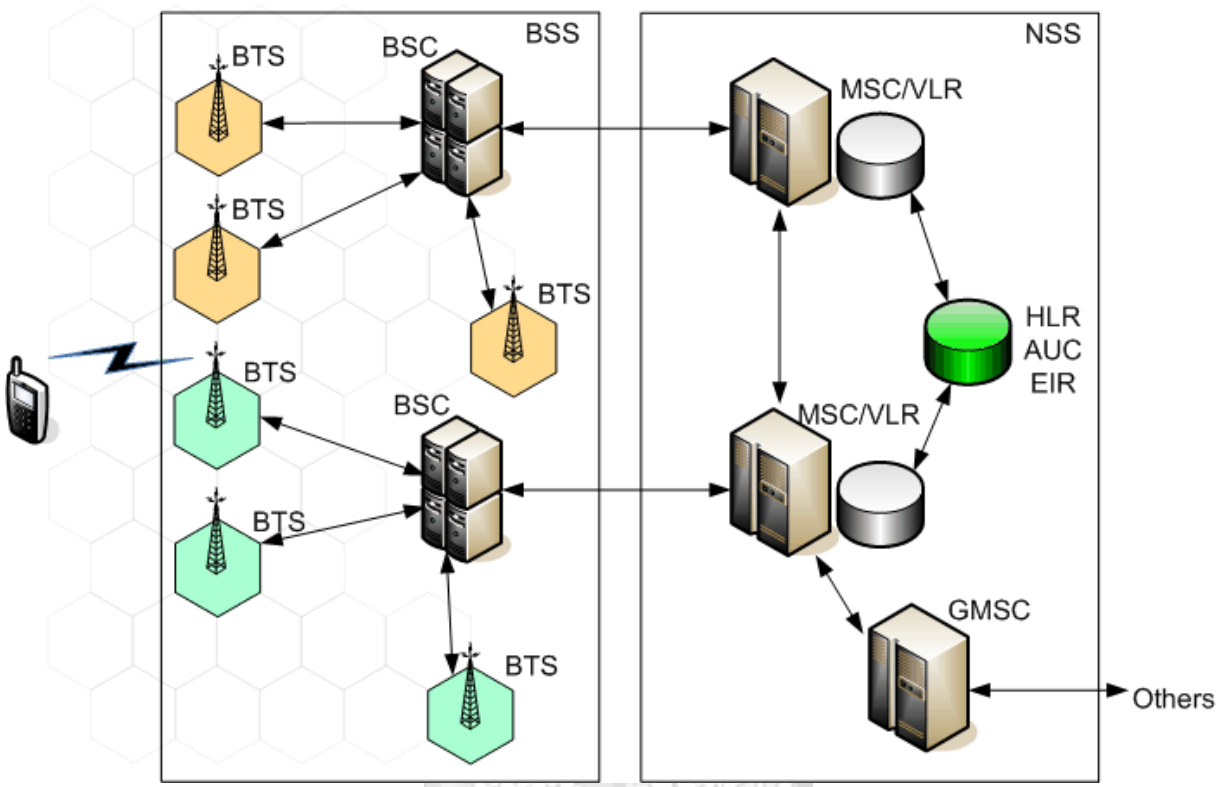

Figure 2.1 GSM Architecture (Mutuku, 2013)

The system is comprised of (Mutuku, 2003):

1. Mobile services Switching Centre (MSC). MSC routes and set up calls to and from the Mobile Station (MS).
2. Visitor Location Register (VLR). This is a database that holds a file for the mobile stations present in the area controlled by the connected MSC. The file is erased in a given specific VLR when the MS leaves that area. The feature allows mobility of users.
3. Gateway MSC (GMSC). All mobile terminated calls are routed to the GMSC which finds the MS and route the call to the MSC/VLR controlling that area.
4. Home Location Register (HLR). This is the main database that holds files for all the MSs in an operator's network.
5. Authentication Centre (AUC) and Equipment Identity Register (EIR): GSM security aspects can be divided into mainly two levels: identification and verification of a correct MS so that unauthorised, barred or stolen equipment cannot be used and privacy on the radio channel. AUC and EIR allows for these security features. The AUC generates

parameters and triplets for authentication of the subscriber and ciphering while the EIR is a database for the identification of the mobile equipment.

6. Inter Working Functions (IWF) allows the GSM network to handle data. It holds the modems needed to allow different bit rates.
7. Short Message Services Centre (SMS-C) handles short messages point-to-point. SMS can be sent to and from the MS.

2.6.1.4 Global Positioning System (GPS)

The Global Positioning System (GPS) is a U. S. owned utility that offers positioning, navigation, and timing (PNT) services to users. This system is segmented in three: the space segment, the control segment, and the user segment.

The space segment consists of a constellation of satellites transmitting radio signals to users. The satellites are arranged into six equally-spaced orbital planes surrounding the Earth where ach plane contains four "slots" occupied by baseline satellites. This 24-slot arrangement ensures users can view at least four satellites from virtually any point on the planet. However, the U.S. Air Force ensures more than 24 operational satellites to avoid any downtime (The Global Positioning System, 2016).

The control segment consists of a global network of ground facilities that track the GPS satellites, monitor their transmissions, perform analyses, and send commands and data to the constellation.

The user segment consists of a wide range of devices and applications at user level. With a track of reliability, GPS being free and open has led to the development of a wide range of applications. The technology is currently integrated in many devices and equipment such as cell phones, wristwatches, shipping containers and vehicles (The Global Positioning System, 2016).

2.6.2 Information Distribution Technologies

This section covers the technologies in use based on their format of communication.

2.6.2.1 One-to-many Technologies

Technologies in these categories include: broadcast media such as television, radio, web, mobile applications and short message broadcasts.

i. Television

Television has been used to reach out to the masses since its advent. The invention of television technology was followed by its wide adoption by the mass thanks to its ability to relay both audio and visual information. The evolution to colour television in the late 1950s was a major enhancement to this technology. Television technology was for a long time limited by its analogue nature but the adoption of the digital television system standards recommended by Advanced Television System Committee (ATSC) in 1996 gave it much more capabilities and more refined video quality. Such improvements included sharper images, lesser video flicker, greater image detail and widescreen image qualities (Briere & Hurley, 2005).

During emergencies, television has been used to broadcast helpful information to the masses where real-time communication is reached. Despite the challenge of this method passing information in one way, a professional emergency expert can guide the viewers on the situation. The technology brings the benefit of ease of use, wireless transmission that can survive damage to cable infrastructure, cheap cost and the ability to reach a large number of viewers in a very short time. This technology is also resistant to channel jamming (Coyle & Meier, 2009).

ii. Radio

Used hand-in-hand with television, this technology has survived ages despite the growth of other media of communication. The evolution to digital technology has also been adopted in radio through refined transmission and addition of value addition complementary services such as broadcast of station IDs, playlist and program titles (Hoeg & Lauterbach, 2001). A huge step has been the ability to produce smaller to produce smaller radio receivers which can be integrated in other devices such as mobile phones. This introduces the convenience of portability and mobility.

Radio technology is unparalleled in its ability to disseminate information during crises since its available almost everywhere and any time. Listeners can get radio broadcasted information as they go about their activities. The power in this media is illustrated by the many programs developed by emergency agencies for radio broadcast.

iii. Web Systems

Web systems rely on the Internet technologies to interact with other systems, application and information users. Data transfer is facilitated through hypertext based approaches with the web browser being used as the front-end to the system and from which the web application are run. The

benefits of web applications include: ubiquity, ease of use- no installation by user needed, and their cross platform compatibility. Web systems support a wide range of applications, from office tools, design applications, analytics to ecommerce system.

During emergencies, web application such as search engines are utilised by information seekers to find any reporting on the incidents. News broadcasting agencies also use web applications to reach online listeners and viewers. For instance, people will tend to visit news websites when an incident occurs or use the key terms in the search engines. Based on traffic analysis on its bbc.com website, British Broadcasting Corporation (BBC), an internationally recognised news agency, reports high number of daily visitors when major incidents occur (Holdeman, 2014).

iv. Mobile Applications

The evolution of mobile technology from voice only device have seen a number of additional capabilities being integrated to provide solutions to growing user needs. Proliferation of mobile applications available to users have been one of the improvements giving the user the control over their devices and the ability to manage the few device available resources such as memory. New devices come with inbuilt applications but the user can select the application of interest from available application market. The user is able to install or uninstall any application. Sim Tool Kit (STK) applications are availed by the service provider (Hollow, Mitchell, & Gladwell, 2012).

Application market have enabled the interaction of phone users and developers where developers can introduce solutions informed by specific challenges experienced by users. Mobile applications leverages on the device capabilities to deliver the intended output. Informational applications fall under this category of one-to-many communication technology. However, the need to user interaction have most mobile applications facilitating two-way communication.

v. Short Message Broadcast

This service relies on the SMS capability of the GSM but incorporates the ability to send SMS to a large number of recipient. The ability to send large number of messages can be enhanced through integration of SMS gateway which allow transformation of messages to mobile network traffic from other media. Many informational systems are thus able to send SMS messages to mobile phone subscribers.

Emergency systems, especially early warning systems, are built to send SMS notifications to the relevant authorities when an impending incident is detected. Authorities are also able to share the information to people in the affected areas much easier. Such systems have been used to avoid loss of lives and damage to property. UNDP have leveraged on this technology to develop instant disaster alerts in Bangladesh. The benefits of message broadcast include: security of information since it is hard for outsiders to generate the message, periodical message broadcast and ability to tailor message to a given incident (Coyle & Meier, 2009).

2.6.2.2 Many-to-many Technologies.

These technologies is comprised mainly of social networks including crowdsourcing, mapping of incidents, information sharing, among others.

i. Social Networks

Internet connection has made the growth of social networks where people interact irrespective of their geographical location and time. Social media has made possible sharing of information in different formats ranging from video, audio, images to text. There exist many social media applications and websites, the most popular being Facebook and Twitter. Social media is leveraged on by other technologies as a source of information from the public. A given instance was the use of Twitter and Facebook in Iran on 13th June 2009 where these networks were used as tools of communication where other media were restricted (HHI, 2011).

Through analytics, data related to a given incident can be filtered and help emergency response teams get a visualisation of the situation on the ground. Through Facebook and Twitter social networks, many incidents have attracted response rates that hugely exceed the expectation of the response teams. For instance, use of social media in Kenya during major incidents have attracted generous participation from the public in the past (Hamilton, 2013). This was witnessed with the Sinai fire on 12th September 2011, Westgate attack on 21st September 2013 and Garrissa attack on 2nd April 2015, where the public was hugely involved in the mitigation process. The use of social media information during emergencies is however faced by the issue of authentication and possible abuse of the powerful tool through insensitive dissemination.

ii. Crowdsourcing

Crowdsourcing is the ability to tap the ability of the masses into a given task. Within the context of communication, information is collected from the crowds through information shared through mobile phones, web, or emails. The system can thus be categorised as open systems since everyone can share information. Mapping of incidents is then done using the collected information. Based on the perishability of information, any information available carries with it a significant development in the response process.

These platforms provide a source of awareness on the development of an emergency situation. Crowdsourcing platforms have been used in different incidents in the past, such include the Ushahidi platform which was used in the Kenyan context in 2008 during the post-election violence. Ushahidi relies on SMS, twitter and Google maps to gather crisis information. Crowdsourcing brings the benefit of public participation thus the ability to gather data on the ground. The approach is however met by the challenge of confidentiality and reliability of the shared information which are two crucial aspects of any usable information (Coyle & Meier, 2009).

iii. Incident Mapping

With information collected through other technologies such as crowdsourcing, geographic information systems and satellite imagery, incident mapping help to identify incidents patterns. This informs decision making especially where the spread of the incident needs to be monitored. Incident mapping is used alongside other spatial data to aid in coordination of emergency response (Coyle & Meier, 2009).

2.6.2.3 One-to-one Technologies

Technologies under this category include mobile voice and Short Message Services (SMS) sharing.

i. Mobile Voice

The evolution of mobile phone technology have seen the integration of more capabilities in addition to its fundamental function, voice call. Through a voice call, one party is able to communicate with another over the duplex channel. This means of communication has the benefits of: real time communication, ability to ascertain on deliver of message, cheap in cost and ease in usage (Anttalainen, Introduction to Telecommunications Network Engineering, 2003).

ii. Short Message Service (SMS)

Short Message Service (SMS) allows a GSM mobile subscriber to send a short message of 160 characters. SMS delivery is handled by the Short Message Service Centre (SMSC). The process of SMS delivery follows the following steps: SMS sent from a mobile phone reaches the SMSC which then forwards it to the intended recipient. The SMSC issues the message status report. In cases where the recipient in is not available, the SMSC stores the message for the time equal to the set maximum validity period, usually 24 hours. SMS introduces the benefits of low cost for concise information, notification of message status, ability for the involved parties to screen the message for the right feedback, and provides reference (Anttalainen, Introduction to Telecommunications Network Engineering, 2003).

2.6.3 Problems with Emergency Technology

From the above, modern technology have boosted the ability to effectively communicate and in flow of information. Information access is as crucial as other needs during a crisis with any sort of information being consumed by the eager parties. Despite the milestones, the use of modern technology in emergency crisis is met by these challenges:

2.6.3.1 Accuracy

Information will only be helpful and reliable if it is accurate. The use of modern technologies is being met by the challenges in authentication. This is especially the case with information spread through social media where false information can appear true based on the number of users sharing it (HHI, 2011).

2.6.3.2 Information Flow

Information will be of greater benefits if the flow is two way; from the victims to the response teams and from the response teams to the victims. This helps in tracking of the situation and rate any progress in solving the crisis. The communication technology employed should allow the participation of both parties (HHI, 2011).

2.6.3.3 Standardisation

Standards in technology allow for interaction and communication of different systems. In an environment with inadequate standards, systems developed may independently operate efficiently but lack the ability to interface with other systems thus hampering sharing of information. Further

global standardization of communication technology in emergency situation is thus necessary (Holdeman, 2014).

2.6.3.4 Overwhelming of Systems

During crises, a burst in information traffic is experienced in the major communication channels. This is as a result of sharing the news, families reaching out for each other, seeking for help, and possible destruction of some communication infrastructure thus overreliance on the functional ones. An instance of this problem was jamming of mobile networks in Sri Lanka on 19th September 2007 during a tsunami warning by the state's Disaster Management Centre. This problem was attributed to a high volume of voice calls where a remedy to this was the directive by Sri Lankan telecommunication authority advising people to use SMS messaging only during emergencies (Coyle & Meier, 2009).

2.6.3.5 Priority

Emergency incidents demand fast response. Priorities should thus be established for emergency communication needs when communication channels are limited (IRC, 2016).

2.6.3.6 Coordination of Information

The process of collecting and sharing information demand proper coordination to filter the information based on the sources, accuracy, confidentiality issues, protection and timeliness. The systems in use should aim for these functions as information flows through them (Meier, 2016).

2.6.3.7 Trust

Any information to be used must be trusted. Mutual trust must exist between the victims and the response bodies for the information to be used. When confidence lacks in either of the party, information obtained from them will be disregarded. The tools of communication used should thus ensure that the confidentiality of the information is met.

2.7 Existing Systems

While a number of factors are cited as cause of failure or untimely reporting of an incident or failure to seek professional help in an incident, lack of contacts or address to an emergency centre adds to this. A number of systems have since been developed to meet this gap.

Some of the existing systems and architecture aimed at aiding in locating a centre for professional service are discussed below.

2.7.1 Yellow Pages

Build around the concept of providing business addresses and telephone contacts, this business has grown to incorporate mobile technology in complementing their services, the yellow pages mobile application. The Kenya Yellow Pages application provides an updated list of business and residential contacts in the country. It provides an option of viewing in a georeferenced format of the place of interest or as a simple list. The application also gives some more details of a given place of interest and also has a search feature. The application has the advantages of providing a wide range of business. The application however lacks the offline mode (Yellow Pages Kenya, 2016).

2.7.2 Sonko Rescue Team Application

The Sonko Rescue Team application is developed to supplement the operations of the Sonko Rescue Team which was an initiative by the Nairobi Senator Hon. Mike Sonko to enhance service delivery to the residents of the Nairobi County. The team operations has since been transferred to the county government. Services that were provided by the team include: emergency response, hearse, breakdown, wedding transport, water, ambulances and security. The main strength of the application is that the users are assured of reliable response as the team manages its own fleet of service vehicles and skills as compared to other applications where the application just connects the user to the service provider and cant assure of the reliability. The weakness include lack of geo-referencing feature, limited service providers and location of use (SoftKenya, 2016).

2.7.3 Emergency Numbers Kenya

This application provides contacts for service providers in four main categories, namely: ambulance, fire rescue, hospitals and police. The application allows the user to call the centre of interest by clicking on it. The main strength of the application lies in the ease of use. The application however lacks additional features to supplement on its usage. Such could include map views and providing directions.

2.7.4 Mobile Life Kenya

Mobile Life Kenya is an application tailored to provide emergency hotlines. The application provides Ambulance, Police, fire fighting, tow trucks, Kenya Wildlife Services and County Disaster Management emergency contacts. The major strengths of the application is the ability to

provide a wide range of service providers and a mobile community to help users interact (MobileLife, 2016).

2.7.5 Ujirani Application

Ujirani is a mobile application developed after the Kenyan government initiative of Nyumba Kumi, an initiative where the community is encouraged to take part in ensuring security in their corresponding neighbourhood. The application allows the user to have a list of emergency response teams to reach in case of an emergency. This can be through a direct call or through the use of a panic button. The distress call reaches the provider one is subscribed to. Ujirani is aimed at having a cohesive community where services are integrated and any issue in the community discussed in the community forum. Emergency services are thus localized to one's permanent residence. Some of the application features have their reliability limited to the user's geographical home area (Ujirani, 2016).

2.8 Chapter Summary

The risk of emergency incidents is high in the Kenya contributed by both man-made and natural causes. These include: road accidents, diseases and epidemics, crime, fires, attacks, human-wildlife conflicts, and stampedes. The country is also faced by a number disasters such as drought and flooding that affects a large number of people. These incidents have attracted different emergency service providers and humanitarian organisation to help in the prevention, response and mitigation processes. The response process involves different agencies based on the nature and magnitude of incident. The process is however faced by the problems of: lack of reliability in response, communication barrier, validation of information and consequently poor administration of emergency remedy.

As aforementioned, adoption of technology have helped enhance the processes of emergency preparedness, response and mitigation. However, the right framework must be present for the technology to be effective. Different technology have been applied to help in the gathering and transmission of information. Leveraging on technology, a number of solutions have been developed to help seal the gap between the society and the centres providing professional help. Some features of the developed products overlap in some instances but there are some weaknesses that still exist within them.

The researcher observed the following limitations in the usage of the applications. Most of the above application leverages on having the user search for a centre he/she is familiar with, thus a victim new to a given locality experiences difficulty in finding the nearby service provider. The victim will not be sure of where to begin the search and what to search for. Another problem lies with the principle of operation of the solutions where a majority of them are reliable when in online mode. In cases where there is no Internet connectivity, the victim is limited to the features to use. A major problem in the solutions lies in the reliability of the information. From the reviews, cases of misinformation are observed where some of the available information is not up to date. Authenticity of the information is cited as major issue with the information where the process of source validation is overlooked in the solutions.

Chapter 3: Research Methodology

3.1 Introduction

This chapter explains the methodology and approaches used to develop the system, research design and collect data. Methods used in collecting data used to ascertain the viability of the dissertation are analysed to support the research design type settled on. This will also help in answering the research questions. In software development methodology, a detailed structure on how the system was developed is analysed and the reason on settling on the methodology explained.

The development of the system demanded that accurate and actual data be collected to help in design of the system in relation to features the intended users would want the system to have. Also, a sample of the users were involved in the testing of the final system.

3.2 Research Design

The process of developing the project of study demanded an informed design. This required that proper descriptive research be done to evaluate the current systems aiding in the emergency communication, the interaction between stakeholders and the ways used by emergency centres to enhance their visibility as well as their predisposition towards dissemination of any information on their services. The study used the descriptive survey design to evaluate the above. Descriptive design was utilised as it allowed a multifaceted data collection approaches, both quantitative and qualitative (Jonassen, 2004). The research process included brief interviews and administration of questionnaires to the relevant staff in the emergency sector, as well as phone users who might be in need to reach these centres. This was aimed at collecting adequate data to address any special requirement that the designer could have overlooked and any data that would have led to a more efficient service delivery within the sector. Document review was also employed to gather more data in the history of emergency response. Information collected was organized, analysed and interpreted to produce applicable data.

The collected data was based on two categories: state of operations before and after the implementation of the project. The latter was aimed at collecting information on the reaction of the sector towards the proposed system.

3.3 Location of Study

The research was carried out within the Nairobi County. The main reason for this location is the fact that most professional service providers have branches in the county, if not their headquarters. This allowed ease and convenience of acquiring necessary permissions and interacting with the centres' staff. Information obtained from these headquarters would also reflect the respective centres all over the country. Also, the county has a large population comprised of people of diverse cultures, occupation and socioeconomic status. Nairobi County also boasts of a large number of tourists. This high population creates a higher demand for these services due to the high population related contributing factors such as crime, accidents, among others.

3.4 System Development Methodology

The proposed solution comprises of both a mobile application and a backend system that interact to give the output the users need and request for. The Software Development Life Cycle (SDLC) followed the Waterfall Development Methodology. Figure 3.1 illustrates the phases in waterfall development methodology. The main phases in the development of the system included: planning of why and how the system will be developed; analysis of the system's use, its users, where and when it can or will be used; the design of the system to detail its working principle; and finally the implementation of the proposed solution was done. Despite the constraint of time, the early design and planning helped to identify the major system requirements and its feasibility before the programming began where relatively fewer changes were required (TutorialsPoint, 2016).

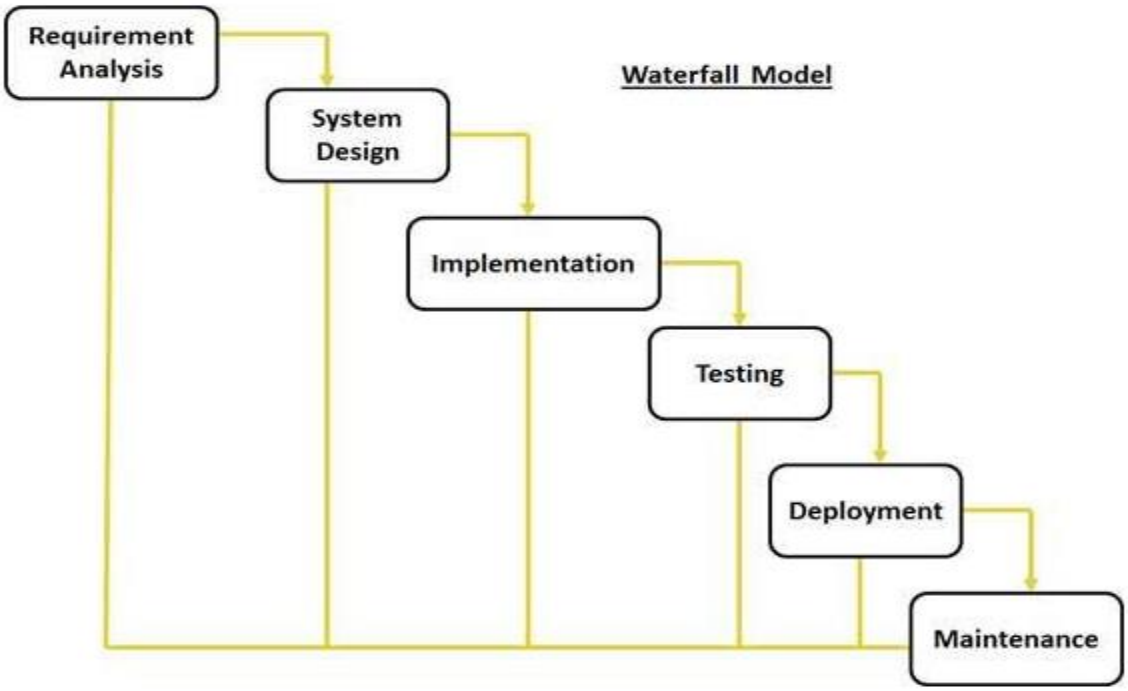

Figure 3.1 Waterfall Methodology *(TutorialsPoint, 2016)*

3.4.1 Planning

The planning phase comes first in the methodology with an aim of studying the feasibility of the project and developing a work plan of the process. It helps identify what resources would be needed to help achieve the intended system.

The researcher intended to develop a geo-location based mobile directory to run on a platform that would reach the most users. From the literature review, existing solutions had been reviewed and the identified challenges were used to inform development of this solution. The researcher intended to have the working solution over a period of four months. The research process was projected to take one and a half months.

3.4.2 Analysis

This phase helps define the requirements of the system and how the development process will be carried out so as to provide the expected value. The phase thus requires the proper gathering of the requirements of the expected system so as to add value. Process and data modelling are carried out in this phase. Process modelling is done to identify how the system processes will interact and

work while data modelling helps to identify how the data needed will be collected, stored and accessed. A workable system proposal should be achieved at the end of the analysis phase.

In this dissertation, requirement analysis was through conducting a research as discussed in the sections below.

3.4.2.1 Target Population

According to Kenya National Bureau of Statistics (2015), Nairobi County is the county with the highest population in Kenya, 3,134,265 according to the 2009 national housing and population census and which is projected to rise to 4,247,770 by year 2017, in the country. The county also handles a large number of arriving tourists per annum, for instance, Jomo Kenyatta International Airport (JKIA) recorded 743,600 tourist arrival in 2014. The county also boasts a large number of people who own a smartphone. These reasons made it possible to have an enhanced data collection due to reduced costs and presence of diverse consumer groups. The solution is targeted for use by anyone but the sample size was obtained from the population of Nairobi County above 15 years of age which translates to 35.4 percent of the total population (KNBS, 2015). The reason for this was to have a population that has the ability to own a phone and to make a rational decisions.

Data available from the Kenya National Bureau of Statistics (KNBS, 2015) indicates the relatively higher numbers of infrastructure and facilities to provide professional help in event of an emergency which exist within the county. The data indicates existence of 950 health facilities, 37 police stations, 8 firefighting service provider and 4 public ambulance service providers within Nairobi. It is however worth noting that in major incidents both private and public emergency organisations deploy their teams for joint operations. The research considered the above numbers of service providers to gather information on the response process.

3.4.2.2 Sampling

Sampling is the process of systematically selecting elements to represent a population. Whereas this application can be used by any person in need, the study demanded a workable number of participants to conveniently involve in the research. Different sampling techniques were applied to settle on a number of participants in each of the available two categories of research subjects. The researcher wanted a fair representation of people in all demographic groups. To settle on the sample for the consumers of the different services available random sampling was applied. The

size of the population based on this criteria was still large and to get a sample to work with, equation 3.1 was applied:

$$\text{sample size, } s = \frac{z^2 * p * (1 - p)}{c^2}$$

Where:

s=sample size

z=z value based on the confidence level (95% confidence, z=1.96)

p=sample proportion of success in decimal form

q=1-p

c=interval confidence in decimal form

Equation 3.1 Equation Applied to Calculate Sample Size (Naing, Winn, & Rusli, 2006)

This formula in equation 3.1 was applied with the following parameters in consideration: a population of 1,109,530 service consumers, 95% confidence level and confidence interval of 8. The resulting sample size was: 150 participants.

Judgmental sampling was used to settle on the individual service providers to involve in the study and within the four main categories of centres, namely: health centres, police stations, ambulance service providers and fire stations. In the categories of health centres, ambulance service providers, and fire stations, the researcher picked one public and one private centre in each category, while only the police represented the security bodies. This gave a total of seven emergency service centres. The researcher targeted the headquarters of these service providers to get a detailed and broad information on their operations in different regions. An interview session for staff in these centres was requested in advance.

3.4.2.3 Data Collection

To achieve a reliable reflection of the viability of the system development, data collection was of extreme importance. Accurate data helped to reflect the needs of the users in the system. Three

methods of data collection were used to get data from the subjects, namely: questionnaires, interviews and document investigation.

i. Questionnaires

The study employed the use of questionnaires in the collection of information from the participants. The use of questionnaires is preferred as it provides a fast, specific and concise way of collecting related information from different participants. It also provides adequate time for the participants to think over the set questions and also the questions can be set in a logical manner that encourages the participants to provide his/her feedback.

Two different types of questionnaires were developed to provide specific and familiar questions to the participants: one for the service consumers and one for centres' staff. The questions were comprised of both open and close ended questions developed in the different categories of questions. Questionnaires used in this dissertation are attached as appendices A and B. Online questionnaires were preferred due to ease of distribution and data submission.

ii. Interviews

The study also included one-to-one interviews to help expound on some of the areas of the research study. This method was particularly effective with the centres' staff and also helped to introduce new concepts the staff might have encountered but the researcher had possibly overlooked. The researcher however had to have the intended questions being sought for answers prepared in advance and their time allocation adjusted to fit in the interviewee's available time. This method involved visits to the different centres once an interview request was made and granted.

iii. Investigating Documents

Review of the reports and journals from accredited government bodies and agencies as well as private organisations was carried out so as to shed light on the situation of the emergency sector, its evolution to the current state and the proposed changes. Both online and hard documents were reviewed and the gathered information recorded, however, more online documents were considered due to their ease of availability. This method was specifically resourceful in gathering data on the regulations of the sector and the interactions between the different bodies.

3.4.2.4 Data Analysis Procedure

The collected information was analysed using used tools such as SPSS statistics and Microsoft Excel to analyse the collected information. This helped obtain interpretable data applied in the design of the application project. Use of charts and graphs was employed to enhance the representation of the collected information and help observe any trends and patterns. The findings were integrated into the project implementation or recommended for future developments.

3.4.3 Design

This phase is intended to provide designs that guide the actual implementation of the system. The design is informed by the requirements obtained from analysis phase. The design covers: architectural, interface, data storage and program designs. The design phase should deliver the complete system specifications. Unified Modelling Language (UML) diagrams were used in the design of the proposed system to aid in its visualization, documentation and construction. The UML diagrams used to represent the system are: Use Case, Data Flow and Design Class diagrams. The system's database is represented using Entity Relationship Diagram that shows the relationships in the data tables.

3.4.3.1 Use Case Diagram

Use Case Diagrams shows the relationship between actors and use cases. Use cases were used to describe the reaction of the system to an event that triggers it as a result of the actors' interaction. Any set of activities that produced an output were classified as use cases.

In this solution, the actors include the system admin, centre admin, and the phone user or victim. The main use cases identified for the victim include: searching for a given centre, viewing centre details and contacting a centre while the use cases for the system admin include: tracking and analysing user interaction with the application, managing centres accounts and reviewing centres' information. The centres admin interacted with the system mainly to review and update centre information.

3.4.3.2 Data Flow Diagram

Data Flow Diagramming were used to show the flow of data in the system based on the input and outputs and also to illustrate the activities performed on the data.

3.4.3.3 Design Class Diagram

Class diagram were useful in visualizing the relationship between software classes, interfaces and collaborations. These classes are mapped into code during the system development process.

3.4.4 Implementation

The implementation phase of the methodology involved the actual construction and installation of the system following the obtained designs. The installation of the system was followed by the testing process, training and any maintenance if needed.

Implementation of the proposed system involved:

- A mobile application developed using Android programming language
- A backend system built using JavaScript, PHP, HTML5 and CSS languages.
- A database developed on MySQL.

3.4.5 Testing

The developed system, all modules, was tested to ensure it met the intended objectives. The following tests were carried out: usability, load, integration and functional tests.

3.5 Reliability

The research study aimed at producing reliable data which can inform the system development. The expected application should be able to meet the functional requirements in enhance the process of emergency response. A thorough pre-test in every stage was conducted to ensure that no ambiguous situation was left unaddressed. The questionnaires were thoroughly checked for any incorrect phrasing, grammatical errors and semantic errors and the right corrections made to enhance their use as research instruments.

3.6 Piloting

A pilot of the data collection tools was conducted on 10 people selected randomly who helped provide useful feedback that served as the basis of improving the questionnaires. The same participants were invited to progressively test the system.

3.7 Ethical Measures

The study was conducted in accordance with the expected ethical measures. The subjects in the research were approached and requested for participation in the study in a manner that did not

infringe into their privacy, rights and handling of their responsibilities. Confidentiality of subjects was also ensured. Also, anonymity was maintained where requested.

3.8 Conclusion

The research design methodology used was descriptive research. Its application was aimed at facilitating the collection of usable and reliable data targeted at enhancing the development and implementation of this study project. The research also aimed at establishing a mutual relationship with all the subjects for any future research works and development as well as treating with value all the information that is gathered. Involving the participants in defining the user requirements help to deliver a user centred and friendly system, one that could be scaled and modified easily in future if needed. The Waterfall Development Methodology approach of software development introduced the benefits of early identification of the intended requirements, timely management of the process and lesser time consumption to the survey participants. However, a little prototyping was employed in the implementation process before the product was released. The methodologies also allowed development of the system and data collection to be accomplished in a timely manner.

Chapter 4: System Analysis

4.1 Introduction

This chapter present the analysis of the system requirements. The researcher analyses and interprets the information obtained using the research instruments discussed in chapter three to obtain data showing the relevance to the targeted users. Both qualitative and quantitative methods of data analysis will be employed to allow flexible representation of the findings and easy drawing of conclusions. Data illustration tools such as graphs and pie charts were employed to show the feedback from the participants. The study involved 150 participants, who had been provided with the rationale and the purpose of study before commencing on filling the questionnaire. Out of the 150 people who were issued with the questionnaire, 125 questionnaires were successfully filled and returned. Response rate for the service providers was 100 percent with all of the 7 pre-identified centres participating in the research.

4.2 Data Analysis

Respondents were grouped in terms of age, place of residence, occupation and travelling patterns.

4.2.1 Age

The respondents were categorised in terms of the age of age brackets as shown in figure 4.1 below.

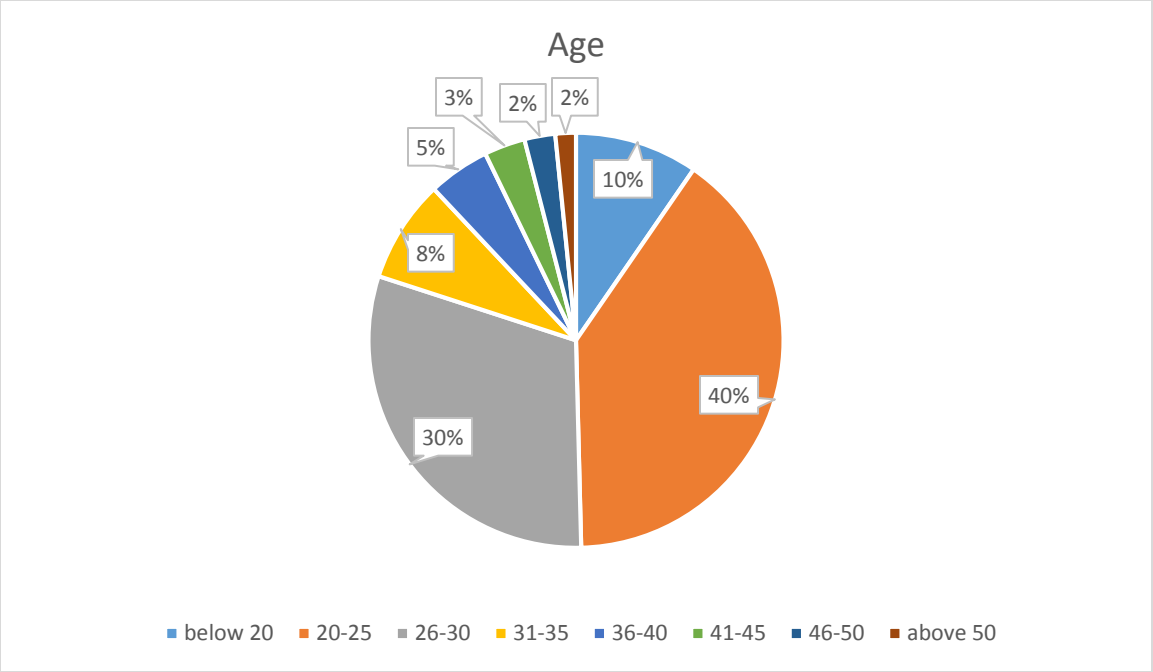

Figure 4.1 Age Distribution of the Respondents

The major group of respondents were between 20 and 30 years of age. This can be presumed as the people with the ability and willingness to invest in technological solutions and who have interacted with technology in the past. 10% of the respondents were below 20 years, and who were in the final years of their secondary school or had just enrolled in tertiary education institutions. 8% of the respondents were 30-35 years old and could be presumed to be members of young families while 5% were 36-40 years old. The number of respondents gradually reduced as the age increased, with 3% being 41-45 years old, 2% being 46-50 years old and 2% were above 50 years of age. The younger population is active in adoption of technological solutions and exploring the capability of their devices. Having a wide range of participants based on age helped obtain diverse requirements and expectations for the proposed solution.

4.2.2 Place of Residence

This research was conducted with an aim of reaching people from all areas of the Nairobi County, the respondents were asked to indicate their current place of residence and the researcher then mapped the answers to fall under the four categories below. Those who indicated their places of residence outside Nairobi County were put in the Touring category and comprised of 10%. Figure

4.2 below illustrates the different areas of residence of the respondents: 33% resides in upscale areas, 39% were middle class and 18% resided in informal settlement. This response would thus reflect the situation in the whole county.

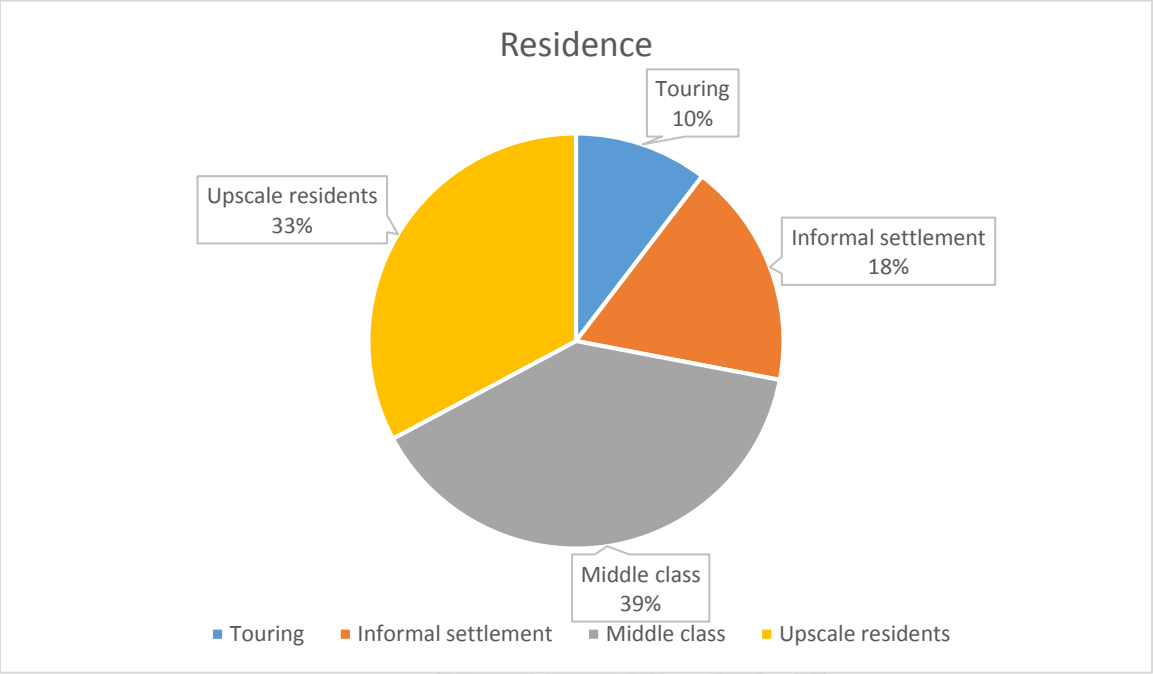

Figure 4.2 Respondents Distribution by Area of Residence

4.2.3 Travelling

The researcher intended to understand how often the respondents travel so as to rate the effectiveness of the mobility factor of the application relative to their familiar centres. This indicated how often the respondents were in new environments, different from their home town. The respondents travelling pattern was matched against a scale where 4% indicated to avoiding travelling, 18% engage in minimum travelling only when necessary and 13% travels a lot. A majority of the respondents, 65%, appeared to be average travellers. A great percentage attributed their travelling to business reasons followed by leisure or tourism. Figure 4.3 illustrates this information.

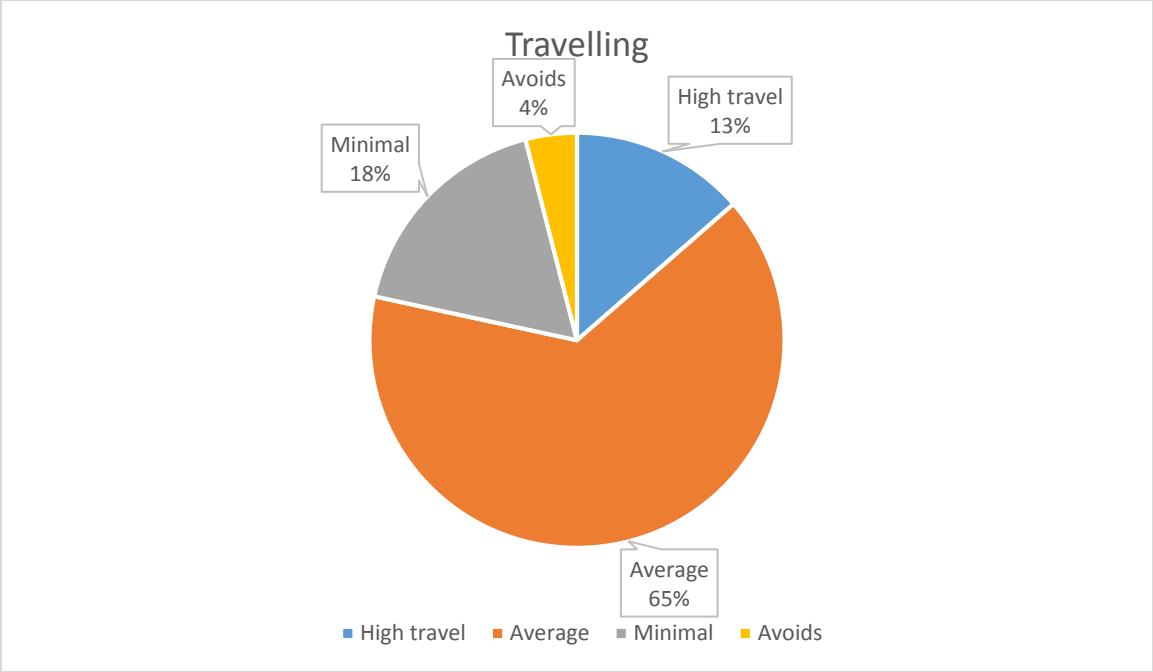

Figure 4.3 Travelling Pattern for the Respondents

4.2.4 Device of Use

The development of the application required the researcher to identify the best mobile operating system to start on. The respondents were thus requested to indicate their devices. Data collected from the respondents is illustrated in figure 4.4 below. The device operating system that was in use by most respondents was Android at 61% followed by feature phones at 18%. Windows mobile, BlackBerry and IOS followed at 10%, 7% and 4% respectively. It was however noted that a number of people had more than one phone.

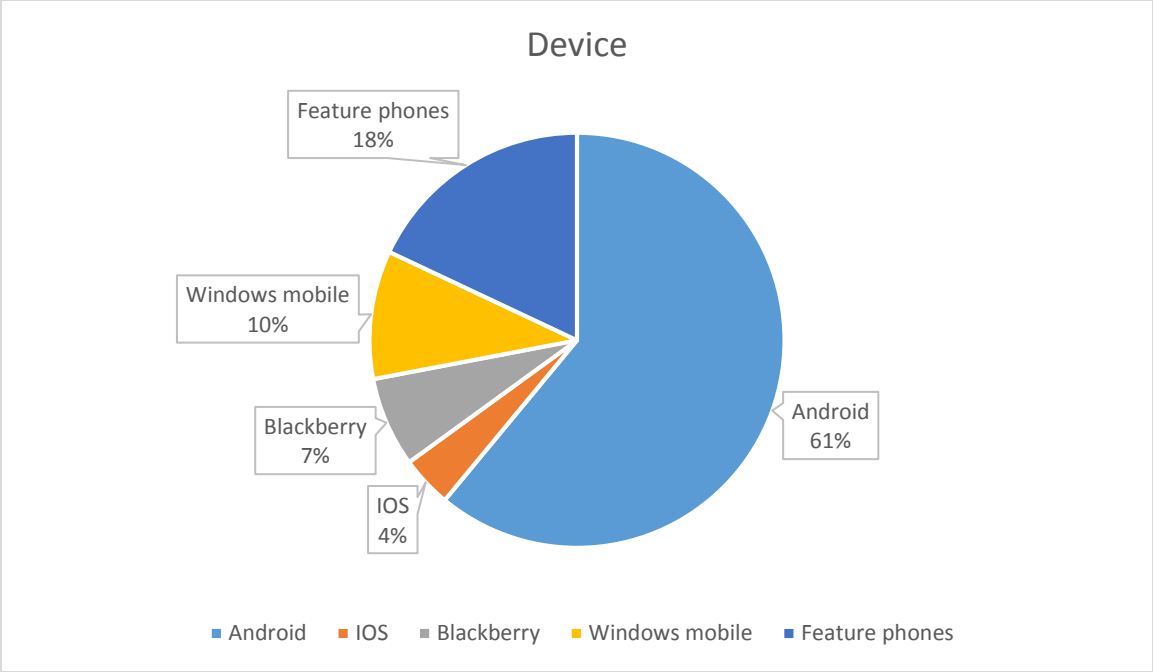

Figure 4.4 Device Distribution among Respondents

4.2.5 Emergency Experience

Respondents were asked to indicate their experience with emergency situations and the prevalence of emergencies analysed. Figure 4.5 illustrates the feedback on emergency feedback. 43% of the respondents indicated not to have experienced an emergency situation in the past while 57% of the respondents indicated they had. The experience was either directly as a victim or being present in such a situation.

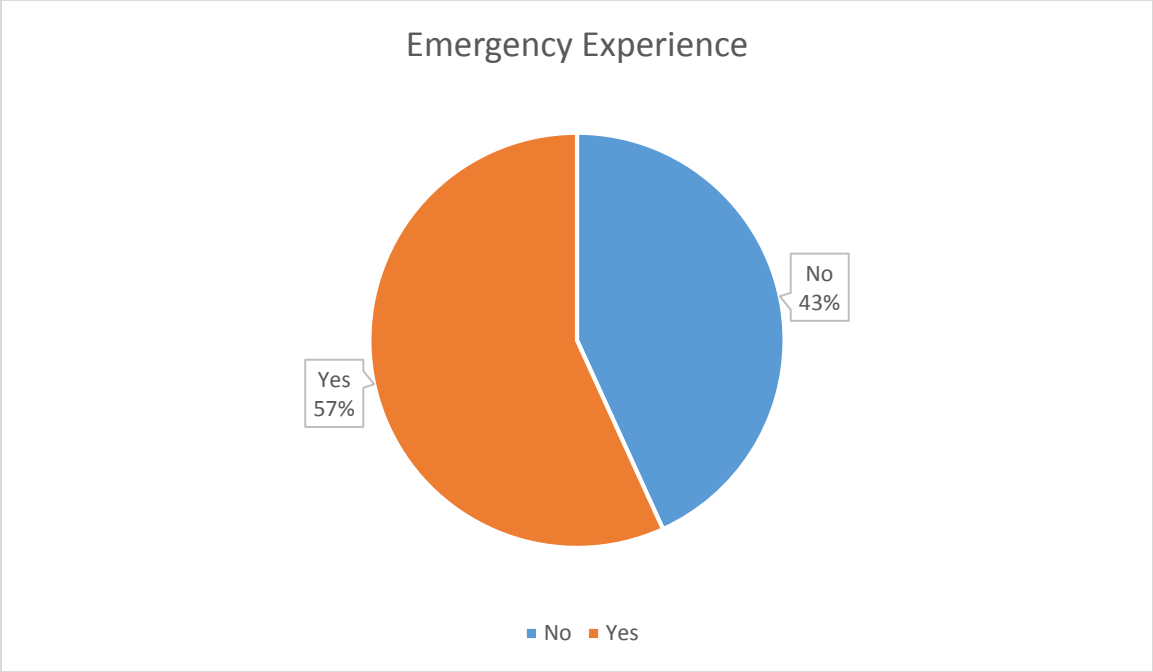

Figure 4.5 Emergency Experience among the Respondents

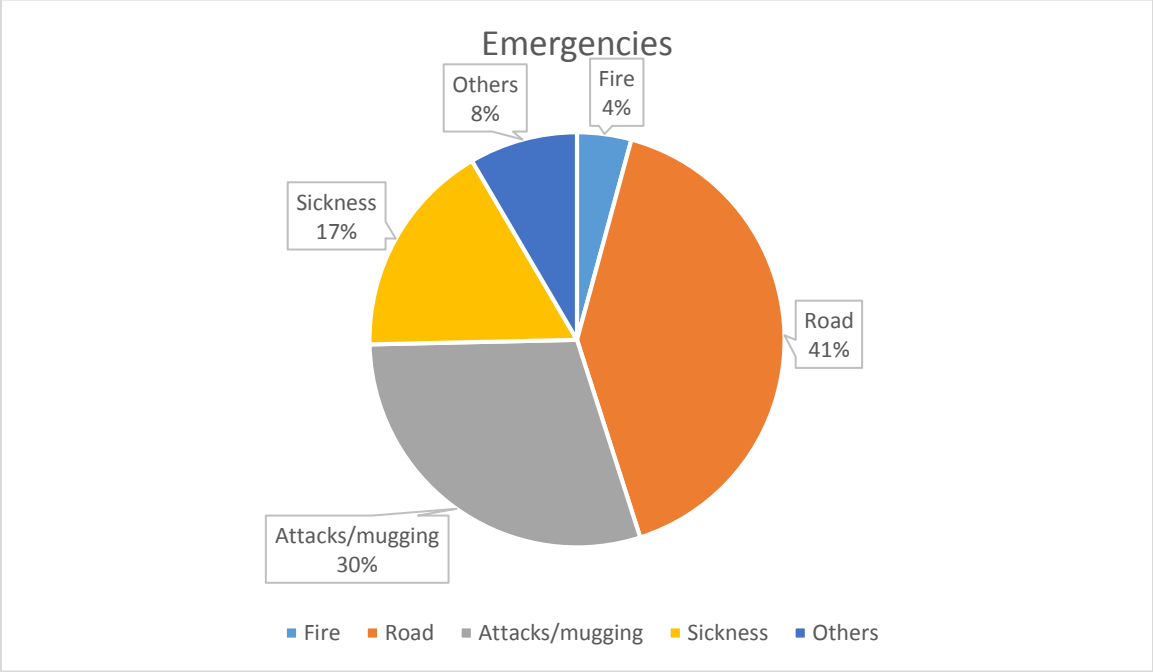

Figure 4.6 Prevalence of Emergency Incidents

The respondents who indicated an experience with emergency incidents were requested to identify the nature of the emergencies. As illustrated in figure 4.6, road related emergencies were the highest at 41%, followed by attacks and mugging at 30% while cases requiring urgent medical

attention followed at 17%. Fire related incidents were noted to have been experience by 4% of the respondents. 8% of the respondents indicated to have experienced other varying incidents such as vandalism, wildlife conflict, among others.

4.2.6 Response to the Emergency Incident

Respondents indicated different reactions to the emergency incidents as shown in the figure 4.7 below. Calling for help appeared to be employed by most of the respondents at 39% while 30% respondents indicated addressing the emergency situation using their own know-how. 11% percent of the respondents indicated to have used the available resources to improve the situation.

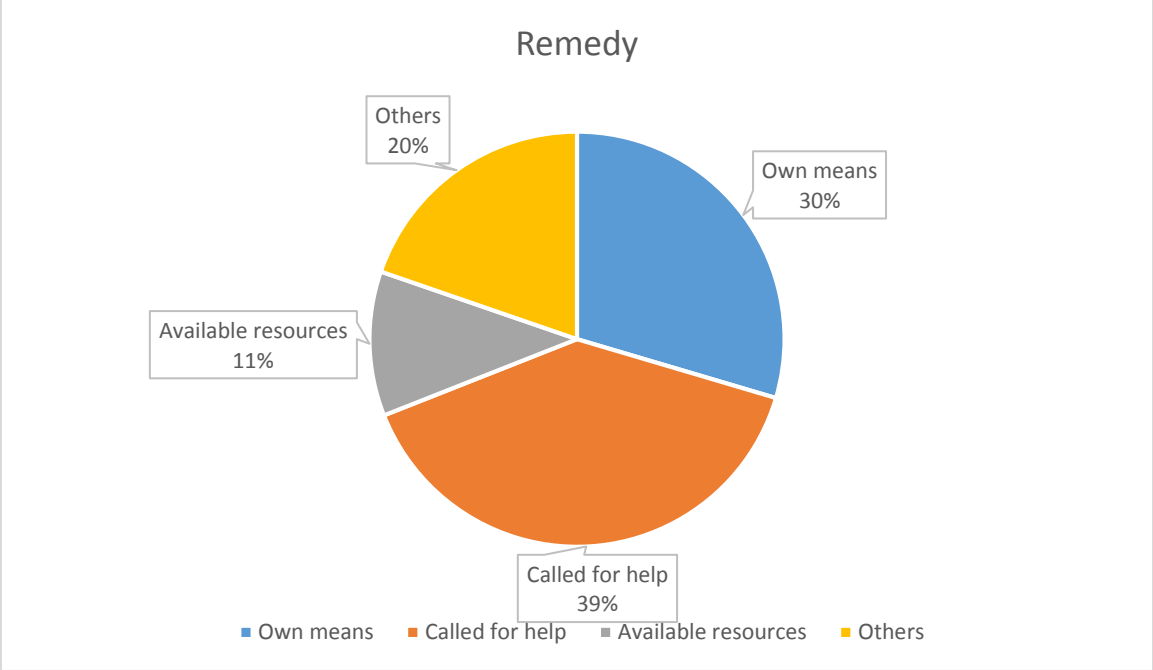

Figure 4.7 Respondents Reaction in the Event of an Emergency

4.2.7 Means Used to Reach the Service Provider

Figure 4.8 below illustrates the means used by the respondents to call for help. Majority of respondents, at 60%, indicated making a phone call to request for help. Word of mouth was also preferred by a large percentage of respondents at 30%. Text messages are also used with 9% of the respondents indicating their application.

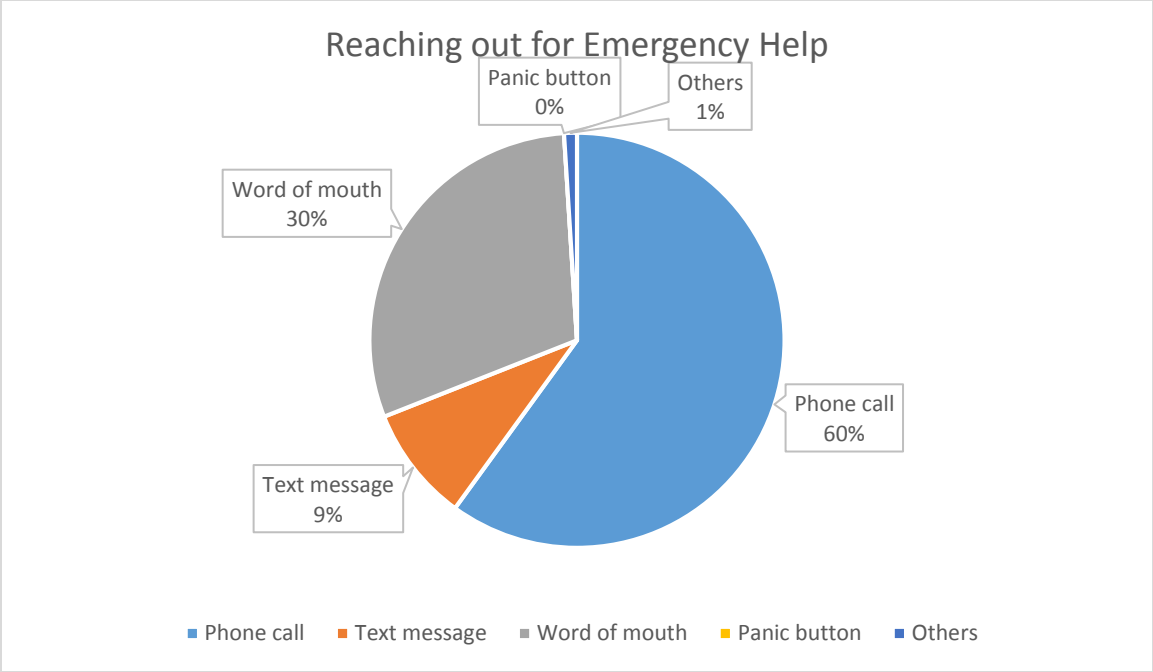

Figure 4.8 Current Preferred Means of Contacting an Emergency Centre

4.2.8 Response Time

Respondents were requested to rate their experience on emergency response. Figure 4.9 below indicates the feeling of the respondents with 9% expressing the disappointment with the response as unbearable, 13% felt the response is usually slow, 42% felt the process was fair and factored the surrounding factors. 25% and 11% of the respondents indicated their contentment with this process describing the process fast and impressive respectively.

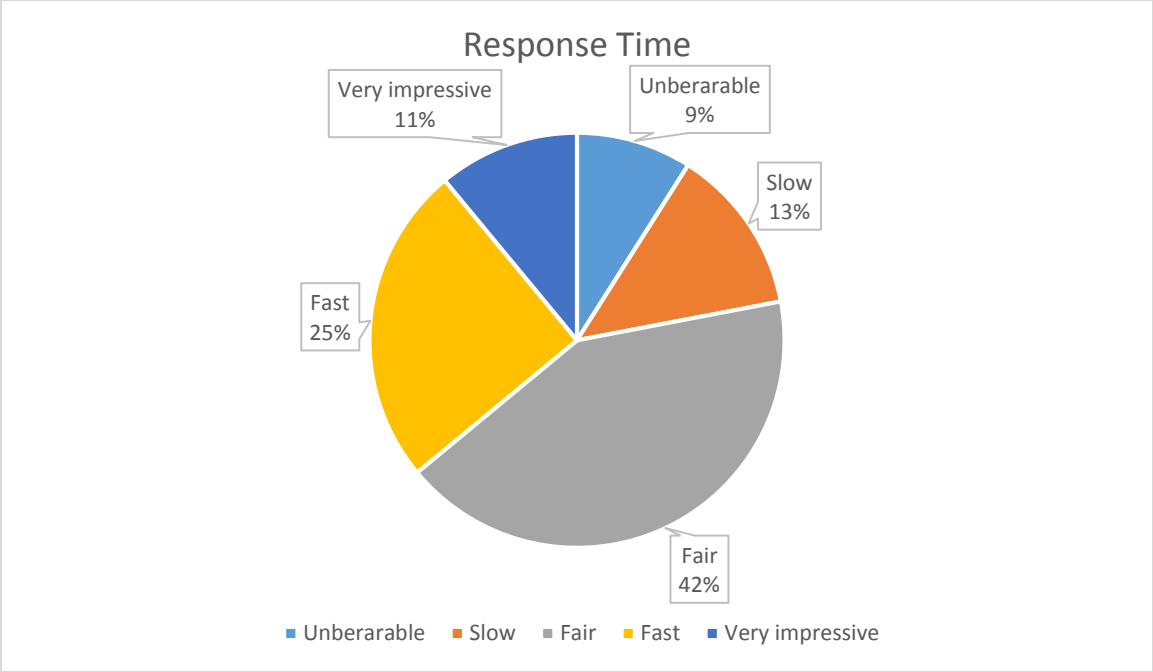

Figure 4.9 Respondents Feeling on the Process of Emergency Response

4.2.9 Reasons for Poor Response

Respondents were requested to indicate what they felt was the main reason contributing to poor response to emergency cases or no response at all. 36% of the respondents cited communication barriers between the emergency centres and the victims. 39% felt that emergency facilities were inadequate in meeting the needs at the time of the incidents. Poor accessibility to scene of the incidents were also cited by 17% of the respondents. A part of the respondents, 6%, felt that the response teams had ignored the call for help from the victims. Other reasons such as religious factors were also indicated to have affected the interaction between the response teams and the victims. Figure 4.10 illustrates this information.

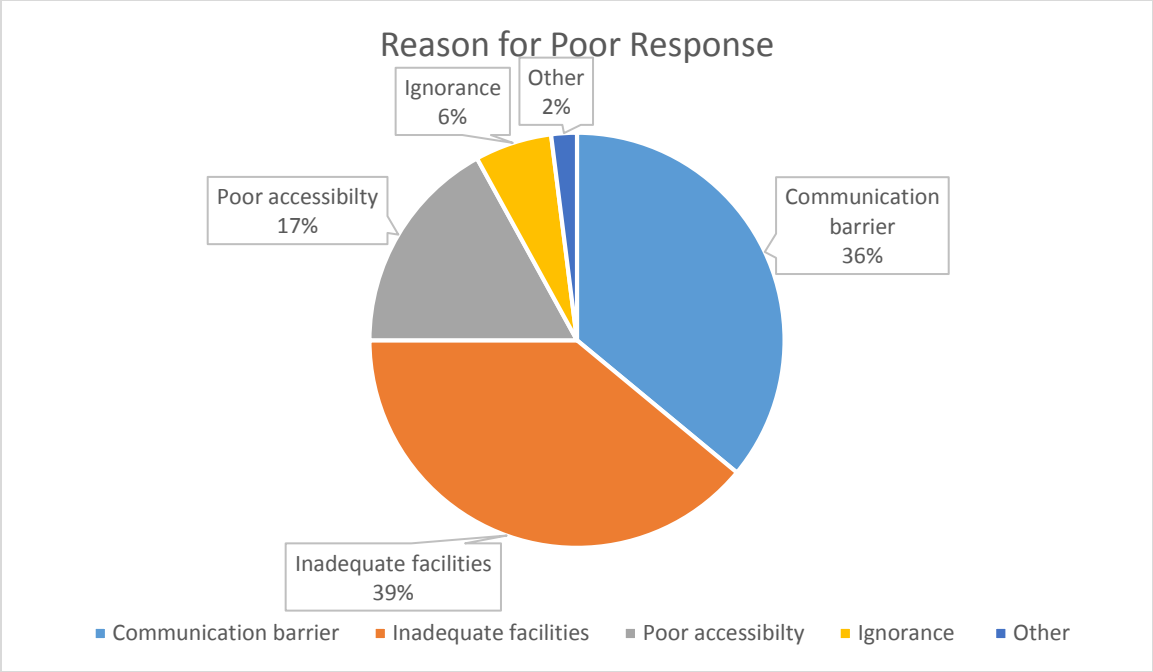

Figure 4.10 Reasons Attributed to Poor Emergency Response

4.2.10 Contact Source

The respondents were asked what they would do in event of an emergency and where they needed to contact an emergency response team. Figure 4.11 below illustrates the feedback obtained from the respondents. 20% of the respondents indicated having emergency contact in their phones or on cards while 33% indicated they would call the default emergency numbers such as 999 in case of an emergency. A majority of the respondents however indicated they would possibly try get contacts and directions to a centre in event of an emergency.

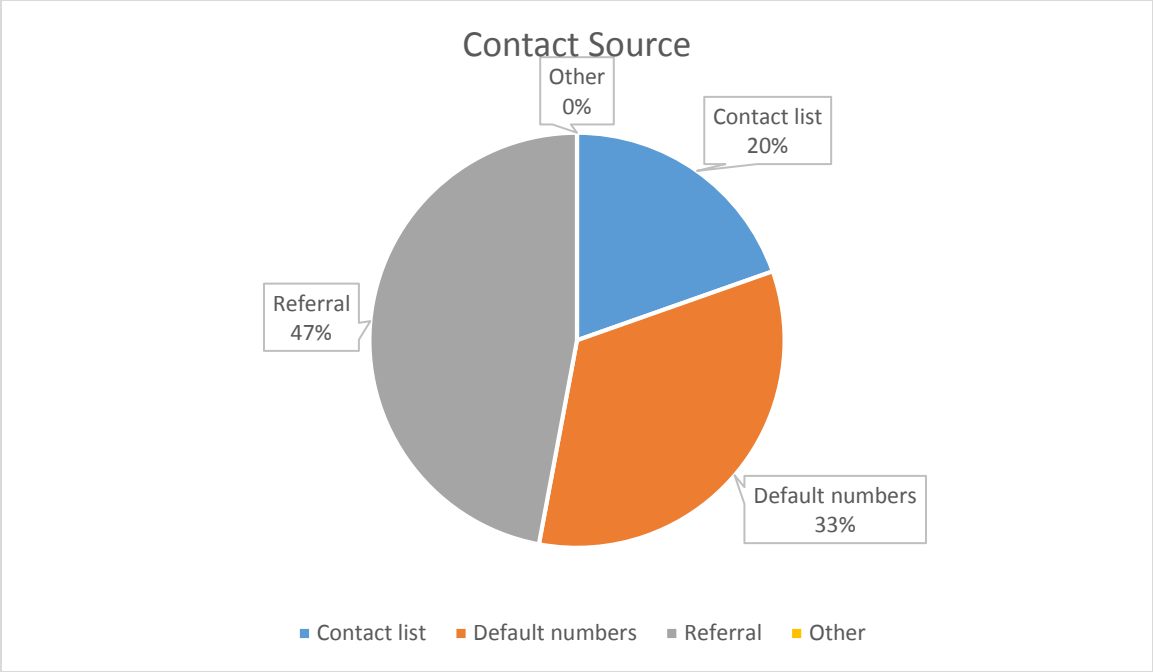

Figure 4.11 Projected Source of Contacts in the Event of an Incident

4.2.11 Current Status

The researcher was interested in knowing how the respondents would respond to emergency incidents. A majority of the respondents replied in affirmative in their willingness to address an emergency incident. The researcher however noted that 19% of the respondents had acquired first aid skills and would attend to the situation as they await help to arrive, of these, majority were those in formal employment where employers had possibly facilitated the training. A number of students were also trained in first aid. 48% of the respondents were not trained in first aid but indicated their willingness in addressing an emergency situation. 33% of the respondents indicated they would directly call for help.

4.2.11.1 Percentage that would need an Application to Help on this

A majority of respondents, 76% would appreciate having an application providing contacts to emergency centres. Some of the main comments made on the choice included the appreciation of the fact that emergency cases are unpredictable and can happen anywhere anytime. The rest of the respondents expressed different reasons for their decision. Some felt that the contacts they currently have and service packages they are subscribed to would meet their emergency needs. Other cases can only be linked to pessimistic reasons.

4.3 Requirement Analysis

The proposed solution requirements are as analysed in this section. The analysis was done while factoring in the data obtained from the survey. The feedback was applied in identification of use cases for the proposed solution.

4.3.1 System Requirements

The survey considered fair distribution of the population in terms of age, area of residence, education level and experience on emergencies. Data obtained from the analysis indicates a majority of participants are average in their travelling thus the necessity to have a mobile solution. Also, based on the results, a number of challenges hinder efficient response to emergency cases. Communication barrier was cited as one of the challenges. A majority of the respondents, 76%, indicated a need to having an application that facilitates access to emergency contacts. Android was also noted to be the device platform that had the highest number of users.

From the above observation, a location based solution was identified to better serve the needs. Being a mobile application, the application should run on the limited system requirements available in smart phones. Android operating system was settled on as the preferable to develop the solution on. The application should take the minimum possible portion of the device's primary memory. The application should support offline usage, however, an Internet connection when available is required to have the application load data from the servers wherever the user starts the application. This ensures that the users have the most recently updated information from the centres. The device should also possess the location settings enabled for the georeferenced results to work. The system backend was built to run on any browser.

4.3.2 Functional Requirements

Functional requirement defines a function of the system or one of its components. The mobile application should display the information the user requests to get in a clear concise way as well allow the navigation from screen to screen in a friendly manner. These details include: location of the centres relative to the user, main functions of a given centre and contact information. Also, the application should allow the user to contact the corresponding centre requesting for a certain service provided its contact details are available. The system should allow the user to narrow down on his area of interest by picking one of the many options presented to him/her at every stage of navigation.

The system backend should allow the system admin and the administrators from different centres to interact, update information and analyse data on various incidents as reported by the victims. A mapping option should be present to illustrate incident distribution.

4.3.3 Non-functional Requirements

Also referred to as quality requirements, these are the requirements that impose design and implementation constraints so as to enhance the reliability and usability of the whole system. They set a benchmark against which the operations of the system can be evaluated against.

The user should be able to launch and exit the application as expected. The application shall be expected to provide the most recent information on emergency centres.

The application should also allow the users to contact the centre without the user having to exit the application. It should only provide the information that is usable and avoid navigation to screens that are null or cannot be used, for example the contact icon should not be displayed if the contacts for that corresponding centre are not availed. The application should also communicate to the user in case there is an error with the system such as lack of Internet connectivity; this should allow the user to decide on the right corrective remedy for it. The application's user experience should always be ensured to be of high quality.

4.4 Conclusion

Data collected from the participants helped better identify the setting on ground in the event of an emergency. This, combined with the information obtained in the literature review, helped in the identification of the requirements and in the design of the application as discussed in chapter 5.

Chapter 5: System Design and Architecture

5.1 Introduction

This chapter builds on the work in the preceding chapters. The design of the application was guided by the system requirements obtained from the analysis phase. The researcher was able to identify the needs in an emergency setting and the best platform to use in the implementation of the solution.

5.2 System Architecture

The interaction of the different hardware and software components in the proposed solution is as shown in the figure 5.1 below.

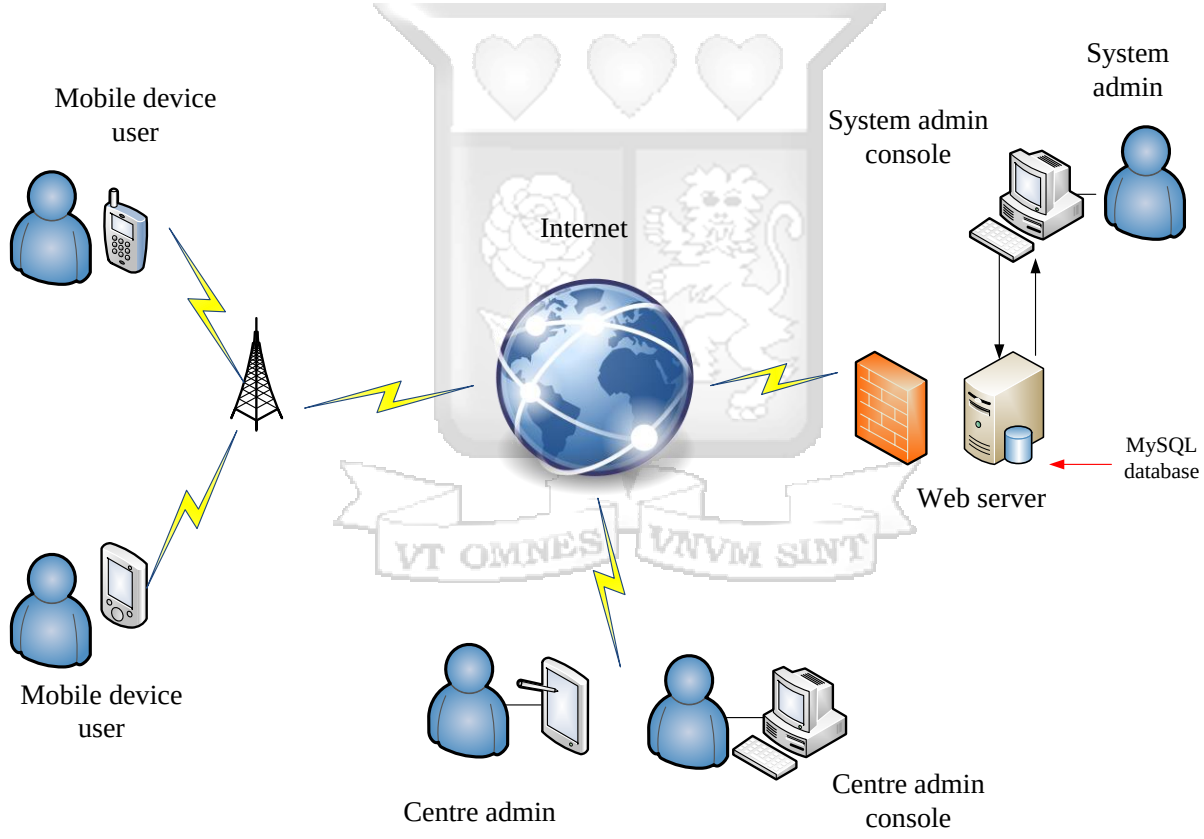

Figure 5.1 System Architecture

5.2.1 System Components

The system architecture can be subdivided into five sections: client, server, database, and network. These are discussed in this section.

5.2.1.1 Client side

The client represents the mobile device where the application will run. The client makes https requests to the server using the POST method. The centre administrators section is also a client that helps the admin to interact with the system to monitor and perform data operations. This client in this case are devices running latest browser either desktop, laptop or any handheld device.

i. Mobile Device

Victims and general users interacts with the system through the mobile phone. The mobile phone consists of the software and hardware components that allow its communication with a mobile network, in this case GSM. For the proposed system, the Subscriber Identity Module (SIM) and the IMEI number are used to track the mobile device. The mobile phone must support the proposed Android application and should have adequate memory to support the system requirements.

The application feature of voice calling and data access is through the GSM architecture but data access is possible through other options such as WiFi networks. For the geo location feature to work, the device must be connected to the Internet or GPS be activated. GPS make the offline working mode of the application possible. This is because, GPS helps in acquiring user location details which aid in geolocation based search. It is however worth noting that accuracy of the location of the user is improved when both data access and GPS are enabled.

Users are linked to the service providers through the call feature. The system is not interfaced with the different technologies used in the service providers' call centres.

ii. Centre Administrator Console

This client allow the centre administrator to interact with the system. System accounts are created on request for the centres. These accounts allow the administrators to manage information related to their respective centres.

5.2.1.2 Internet

To enable the interaction between the clients and the server, the system requires network connectivity, in this case the Internet to facilitate mobility of the clients. Firewall are created to enhance security of communication and regulate access.

The mobile device client operate through the GSM infrastructure to connect to the Internet and also to facilitate the voice calling feature of the application.

The centre administrators' clients connect to the server through the Internet.

5.2.1.3 System Admin Console

The system administrator also interact with the system to manage and monitor system operations, reliability of information, and also to generate and view system reports. The admin can access the server through a local networked console or a client connected through the Internet.

5.2.1.4 Web Server

The server hosts the PHP scripts that allow the processing of the clients requests and issuing response. The scripts are also responsible for interacting with the database.

5.2.1.5 Database

The database is the section where the application data is held and from where all data for all requests is retrieved or stored. The implementation of this section uses the MySQL database management system.

5.2.2 Process Modelling and Data Flow

This section explains the interaction of the system components to perform the targeted functions and the corresponding data flows.

5.2.2.1 Mobile Application

The mobile application is launched when the icon is tapped. The application checks for system settings and recommends any changes to enhance its operation. Where Internet connection is established, updates are made to the offline directory to match the servers' version.

User can select on any category from the home page. The application picks the category details which together with device location details are used to search for the centres in the category and within a radius of 2 kilometres from the user. The system repeats the search with a bigger radius where the first search return is empty. This process is abstracted from the user. The application displays a list of centres with their corresponding details on: services, contact and location. The user selects on any of the centre and is presented with an option of: calling, viewing location on map or adding details.

Where the user choose to view map, the application loads the map facilitated by Google Map Android API. The application marks the point of the user and the centre on the map based on their coordinates. Where the user chooses to call, the applications picks the user location details to enlighten the user of his or her whereabouts. The 'dialer' application of the phone is the initialised with the centres phone number displayed. Making the voice call relies on the GSM architecture.

The application generates a report on the user interaction which is submitted once an Internet connectivity is established. The application prompts the user to create an account in order to access some of the features, however, being an emergency application the feature of calling and map location do not require an account. Creating an accounting is completed when the user account details are captured in the backend. This process relies on the Internet.

5.2.2.2 Backend

The backend allows the proposed system admin and centre admins to interact with different aspects of data. Analytic tools, for example Tableau, are used to filter and illustrate relationships in the information and distribution of incidents. Tracking of user interaction with the system is also possible based on submitted reports. The backend also support illustration of the spatial distribution of the incidents.

5.3 Actors

The proposed solution was developed to meet the needs of three different parties in an emergency setting, specifically on the communication aspect. These include: emergency service providers, victims or people in need of emergency services, and the system admin. The interaction between the people in need of emergency services and the organisations or bodies providing the service was a major factor in the design. The emergency service providers interact with the system to ensure reliable visibility to the public while emergency victims or people in need use this information to access these services. The system admin monitors and manages the system.

5.4 System Design

The design of the proposed system involved both process and data modelling. Process model represents the operation of a system, how the activities are performed and the movement of data among them. Data modelling on the other hand, illustrates how data flows in the system, the inputs and outputs. The UML representation of the design is highlighted below.

5.4.1 Use Case Diagram

Figure 5.2 below represents the use cases in the proposed solution. The system has three main actors, namely: victim or phone user, the admin for the service provider and the system admin. The system admin interacts with the system to: monitor activities of both the centres and users, validate centre information, manage centre subscriptions, track user actions and ensuring the information available is up to date and reliable. The service provider' admin interact with the system to: add centre, edit and update centre details, and pay for subscriptions. The victim or phone user interacts with the system to: search for a centre of need, view centre details, call a centre, view centres location on map, get his current location details, and add a new centre.

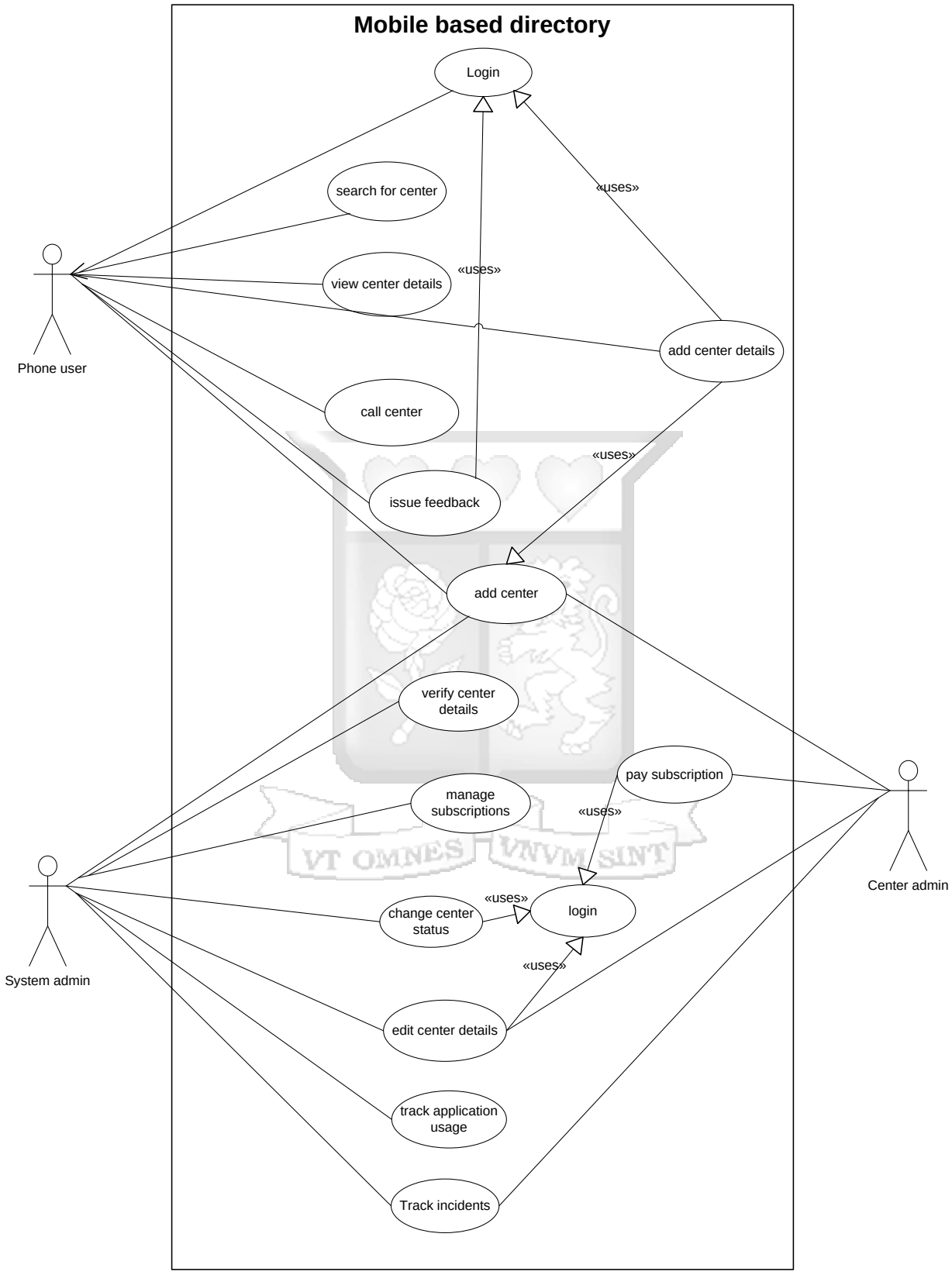

Figure 5.2 Use Case Diagram

5.4.1.1 Use Case Description

This section fully describes some of the use cases mentioned above.

i. Use Case 1:

Table 5.1 Add a Centre Use Case Description

Use Case Full Description	
System: Geo-location based mobile directory	
Use Case Name: Add a centre	**Group ID:**
Primary Actor: Phone user	**UC ID:**
Stakeholders: System admin, centre admin	**Priority (H, M, L):** H
Brief description: Addition of a new centre to the system	
Trigger: Tapping on 'Add centre' button	
Relationships: • **Association:** • **Includes:** Login • **Extends:** • **Generalization:** • **Extension points:**	
Inputs: point on the map, centre details: name, category, phone number, email, services	
Preconditions: User already logged in	

Basic Flow:

Steps:

Actor	System
1. Tap on the 'Add centre' button 3. Tap on the point of interest on the map. 5. Taps the 'Ok' button on the alert 7. Fills the expected details and taps on the submit button 9. Confirms the centre details by taping on 'Ok'	2. Map with user's location displayed 4. Displays an alert of user's surety in picking the point. 6. Displays an input page with the expected fields of centre details 8. Displays a toast with the entered centre details and prompts user to confirm 10. Application submits data to await verification by system admin

Alternate Flow:

5.1 User taps on the 'No' button

a. System display the map

9.1 User want to change displayed centre details thus taps 'No' on the toast displaying the entered centre details

a. System displays the input page with the previously entered details

Post conditions on Success: New centre details added to the database
Post conditions on Failure
Output: Centre added notification

ii. Use Case 2:

Table 5.2 Call a Centre Use Case Description

Use Case Full Description	
System: Geo-location based mobile directory	
Use Case Name: Call centre details	**Group ID:**
Primary Actor: Phone user	**UC ID:**
Stakeholders: System admin, centre admin	**Priority (H, M, L):** H
Brief description: Calling a given centre.	
Trigger: Tapping on 'Call' icon	
Relationships: • **Association:** • **Includes:** Login • **Extends:** • **Generalization:** • **Extension points:**	

Inputs: point on the map, centre details: name, category, phone number, email, services

Preconditions: User already logged in, centre of interest already selected on the list

Basic Flow:

Steps:

Actor	System
1. Tap on the 'Call' icon	2. System displays the user's location details
3. Tap on call 'Ok' button.	4. Displays a toast with the centre numbers to call
5. Taps the 'Call' icon corresponding to a given number on the displayed toast.	6. Launches the dialer application of the phone with the number displayed.
7. Confirms call on dialer application	8. System generates a report on the user interaction.

Alternate Flow:

5.1 User taps on the 'Cancel' button

a. System returns to the selected centre's details page

Post conditions on Success: Communication with a centre respondent initialised

Post conditions on Failure

Output: User interaction report

5.4.2 Context Diagram

Figure 5.3 below represents the context diagram for the proposed solution. The diagram shows the system as one main process, the external entities that receive or contribute information to the system and the information shared by the two.

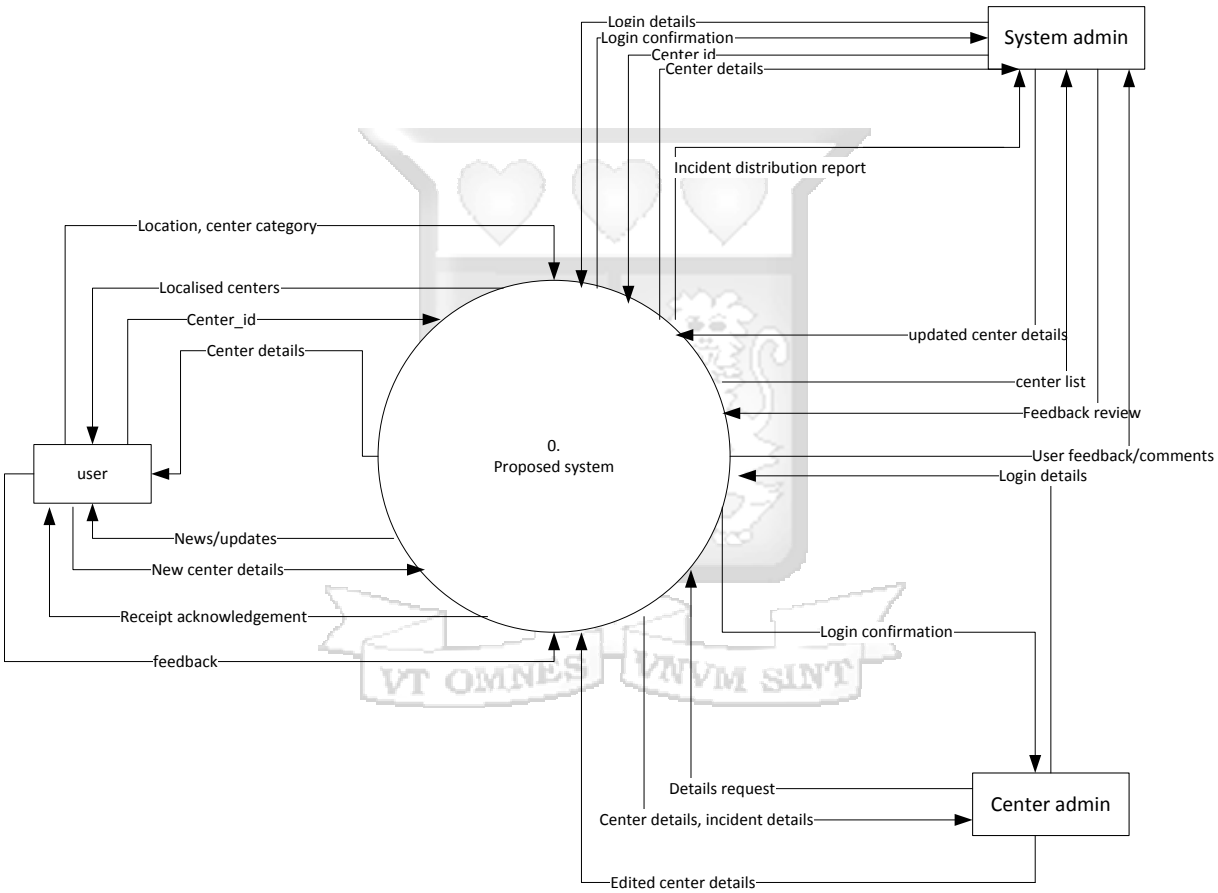

Figure 5.3 Context Diagram

5.4.3 Data Flow Diagram

Figure 5.4 shows the level 0 data flow diagram for the system. The figure indicates the major processes comprising the system, the external entities, the data flows, and the data stores.

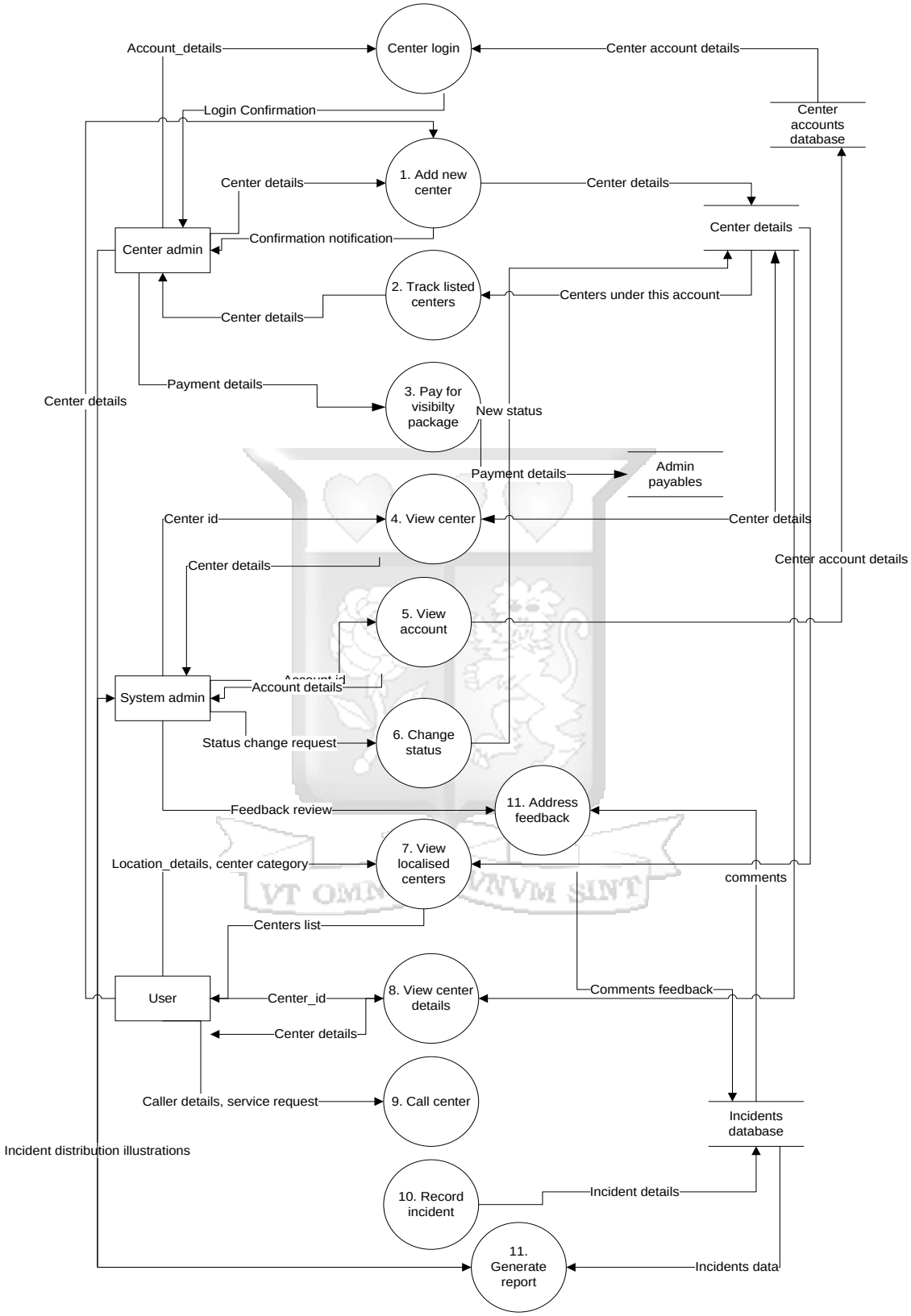

Figure 5.4 Data Flow Diagram

5.4.4 Design Class Diagram

The specification of software classes in the system are as shown in the figure 5.5 below. It gives the class name, class attributes, the methods within the class, and the association between classes.

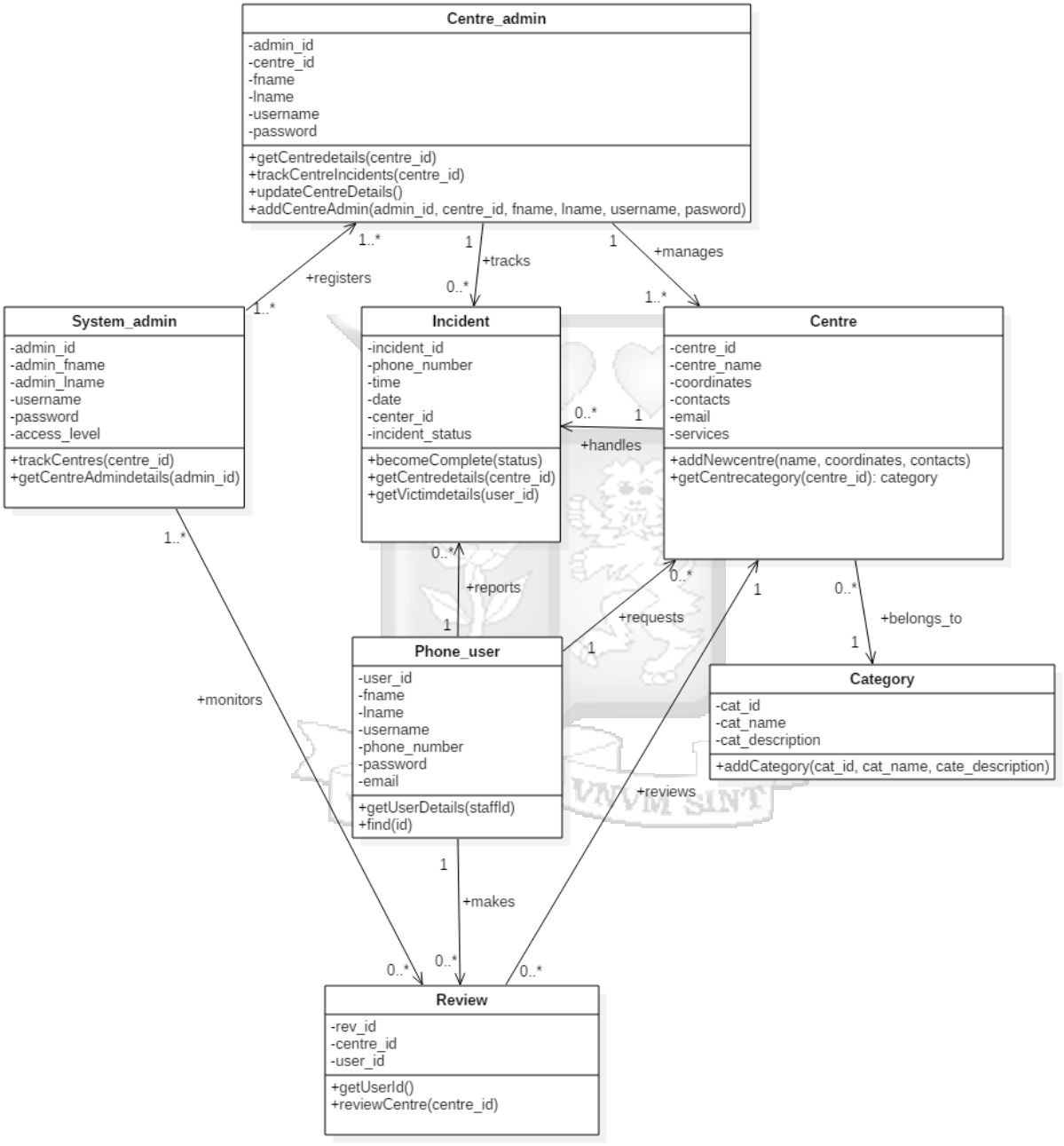

Figure 5.5 Design Class Diagram

The classes contained in the Design Class Diagram include: System Admin, Centre, Category, User, Incidents, Centre Admin, and Review.

System admin is the class that is used to register the proposed system administrators. Its attributes include: admin_id, first name, last name, username, password and level of access.

Centre is the class that handles registration of centres. Its attributes include: centre name, id, coordinates, contacts, email, and services.

Category is the class that handles registration of different categories a centre can belong to. Its attributes include: cat_id, name, and description.

Centre admin is the class used to register admins to their respective centres. The class attributes include: admin_id, first name, last name, username, password and the respective centre id.

Incident class is used to pass the details of the reported incidents with the system. The class attributes include: incident_id, centre_id, status, date, time, and phone_number.

User class handle registration of users in the application. Attributes in this class include: user id, user location, first and last name, username, password and phone number.

Review class is used to handle the centre reviews obtained from different users. Its attributes include: review id, centre_id and user_id.

5.5 Database Design

5.5.1 Entity Relationship Diagram

Figure 5.6 below shows the entity relationship diagram. The relationships are as described below:

The relationship between Category and Centre is one to many since a centre can belong to only one category but a category can have many centres.

The relationship between Centre and Centre_admin is one to many since a Centre_admin must belong to a given Centre but a centre can have more than one admin.

The relationship between Centre and Incident_record is one (optional) to many since a centre can address zero to many incidents while a given incident is addressed by a given centre.

The relationship between User and Feedback is one (optional) to many since the user can make a number of comments or choose not to while every comment is traceable to a given user.

The relationship between User and Centre_review is one (optional) to many because a victim can make a number of reviews or choose not to while every review is made by a given user.

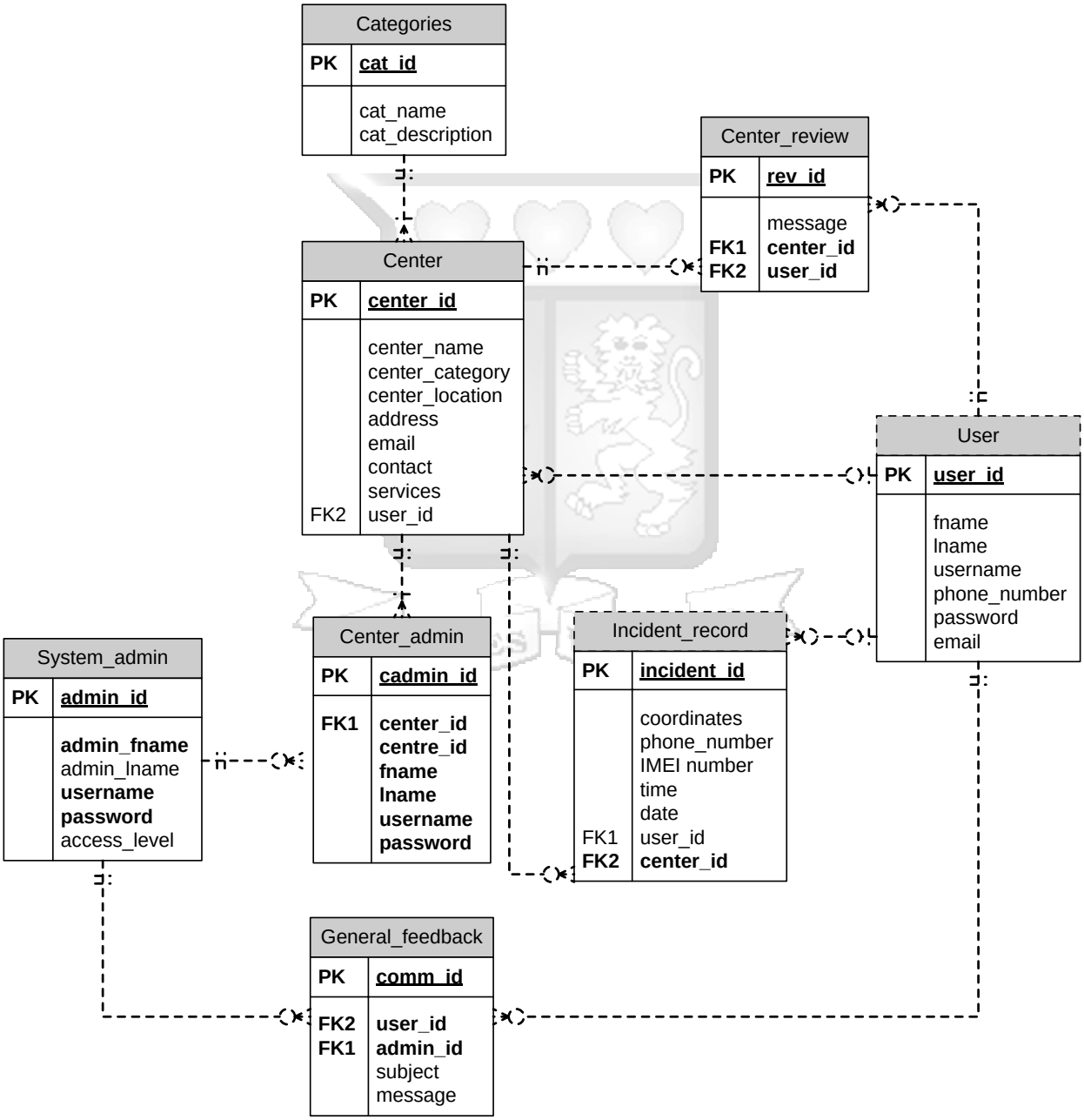

Figure 5.6 Entity Relationship Diagram

5.5.2 Database Schema

Table 5.3 Centre Table

Column Name	**Data type**	**index**
centre_id	Varchar(255)	Primary key
centre_name	Varchar(255)	
centre_location	Varchar(100)	
address	Varchar(255)	
email	Varchar(255)	
contact	Varchar(100)	
services	text	
cat_id	int	Foreign key

Table 5.4 Centre Admin Table

Column Name	**Data type**	**index**
admin_id	int	Primary key
centre_id	Varchar(255)	Foreign key
fname	text	
lname	text	
username	Varchar(100)	
password	Varchar(100)	

Table 5.5 Category Table

Column Name	**Data type**	**index**
cat_id	int	Primary key
cat_name	text	
cat_description	text	

Table 5.6 User Table

Column Name	**Data type**	**index**
user_id	bigint	Primary key
fname	text	
lname	text	
username	Varchar(100)	
phone_number	Varchar(100)	
password	Varchar(100)	
email	Varchar(255)	

Table 5.7 Incident Record Table

Column Name	**Data type**	**index**
incident_id	bigint	Primary key
coordinates	Varchar(100)	
phone_number	Varchar(100)	
time	Datetime	
date	Datetime	
centre_id	Varchar(255)	Foreign key

Table 5.8 System Admin Table

Column Name	**Data type**	**index**
admin_id	int	Primary key
admin_fname	text	
admin_lname	text	
username	Varchar(100)	
password	Varchar(100)	
access_level	int	

Table 5.9 Reviews Table

Column Name	**Data type**	**index**

rev_id	bigint	Primary key
message	text	
centre_id	Varchar(255)	Foreign key
user_id	bigint	Foreign key

Table 5.10 Feedback Table

Column Name	**Data type**	**index**
comment_id	bigint	Primary key
user_id	bigint	Foreign key
subject	Varchar(255)	
message	text	

5.6 User Interface Design

Design for user interface for both the mobile application and backend was aimed for the system user to communicate with the system in a friendly way. From the collected data in the research, the designer was able to list the functional requirements of the system and the possible interaction the users would have with the system. The mobile application home page has minimal information to allow the user to search for a centre without having to learn the system. The design settled on a choice of icons and words which are concise and easily comprehensible. Graphics were used since the target device display offer graphic capabilities and they highly complement used words. The application draws very minimal attention to itself but lets the user concentrate on the intended task. The main pages are designed with the need for minimal or no scrolling.

5.7 Security Design

Security was an important consideration in this application, both in the back end and in the mobile application. Users need to send and receive data from the server. For instance, users need to send

centre data when adding a centre. Data sent from the application to the server is secured through the application of Hypertext Transfer Protocol over SSL (HTTPS) thus ensuring its integrity and privacy being ensured. HTTPS provides authentication and bidirectional encryption of the data exchange to avoid man-in-the-middle attack.

User accounts for were also created with the requirement to provide both the username and password to access some features of the application. These passwords are not stored in their raw form but are secured through the use of bcrypt hashing function which is a one way hashing that can keep up with Moore's law in withstanding attacks. It is thus difficult for an attacker to obtain the password from the hash value.

Chapter 6: System Implementation and Testing

6.1 Introduction

This chapter is about the actual working system and the test procedure undertaken to ensure its proper functioning. It details the different sections of the developed system where both the working of the mobile application and the backend are discussed. The procedure of performing individual tests on the system is also described and the test results outlined. The system was tested by 20 participants sourced from the public through convenience sampling.

6.2 Requirements

The implementation of the solution involved the following software and hardware requirements.

6.2.1 Hardware Requirements

Hardware requirements for the system can be categorised into mobile and backend components. For optimal application functioning, the mobile device should have available memory space above 25 megabytes, GPS capability and data access capability – Wi-Fi or over GSM. The memory space should support the application needs in all stages: installation, online and offline operations, back-ups and updates. GPS feature allows the identification of the device's location in addition to the network supported location identification feature. Data access allows the application to interact with the server side.

The backend component of the system is comprised of a client where the centre admin and the system admin interact with the system. The client can be any device with a browser. A reliable internet connectivity is required to facilitate the communication between the server and the clients.

6.2.2 Software Requirements

The preferred mobile platform to implement the solution was Android while the backend was aimed to run on any browser. To develop the mobile application, Android programming language was used. The minimum platform version was set to Android 3.0 at an API level of 11. This was chosen to facilitate some of the features identified in the requirement analysis phase such as use of maps. This map feature was made possible by the use of Google Maps Android API.

The system backend is built to run on any browser, but for the best performance, latest desktop browsers are recommended. The system's functionality is mainly based on the power of scripting languages, PHP5, HTML5 and CSS3. The database management system used was MySQL.

6.3 System Implementation

The application was developed to have two interfaces, a native mobile application interface and a web interface which allows access to the backend. The mobile application allows the users to enjoy the main benefits of this application as a geographical location based service. The web based interface allows ease of following up on the population of the centres, the validation of any service provided by a centre and its existence and tracking of subscription fee payment where applicable. It is mainly an add-on for the centres' administration and also the proposed system admin. The mobile application is developed to run on android based smartphone while the system backend is built to run on any browser, but for the best performance, latest desktop browsers are recommended. This is because of their support capability to system components such as Bootstrap framework used. The back end's functionality is mainly based on the power of scripting languages, HTML and CSS.

6.3.1 Native Mobile Application

Based on the rate at which Kenyans are embracing smart mobile devices and appreciating their application in different sectors, this application project was implemented first for the Android smart phones where android is main platform running in most smartphones in Kenya. The application development is adapted to run on devices with intermittent Internet connectivity, a characteristic of the mobile devices. It is tailored to collect data from the servers at intervals when the user wants to use it, a feature based on this is the ability to use downloadable material which is automatically updated every time a connection to the Internet is established. It is also designed to handle minimum phone resources in term of memory and processing capacity. Designed to utilize only the current network infrastructure and available services, the application requires that the users can embrace its use without the pain and cost of adapting or integrating into it. It thus poses as an added utility for the mobile device users.

The application can be used by any person, having an account or not. However, the features available for use will be regulated. Being an emergency application, it allows the user to access the essential actions without creating an account. All actions performed by such user shall be

tracked using the phone details: IMEI number and phone number. These actions will include: viewing location details, map, contacting the centres and accessing the basic information of the application.

On creating an account, the user shall access more features of the application in addition to the essential actions. These features will include the ability to review a centre, add a new centre, and edit centre details. Tracking user actions in this category will be done through the user account details.

The main pages of the mobile application are:

6.3.1.1 Home Page

Figure 6.1 shows the mobile application home page. This is the first page once the application is launched. To achieve the application's objective of quick search, the main categories of professional help centres are listed and where tapping of any of them will navigate to the page listing nearby centres of the category. A link to adding a new centre is also available.

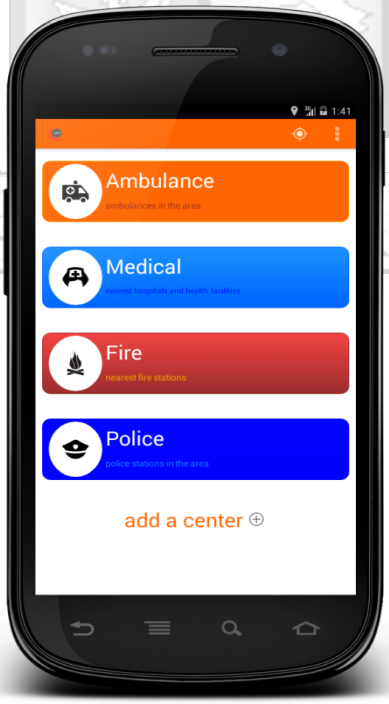

Figure 6.1 The Proposed Solution Mobile Application Home Page

6.3.1.2 View Centre Details Page

This page displays all the details related to the selected centre. A number of actions can be initiated from this page, such include: the calling action if the centre's contacts are available, viewing the centre's relative position on the map and adding or modifying centre's details. Figure 6.2 illustrates two possible actions available, the calling feature and view centre's location on map. The centre's location is shown relative to user's location.

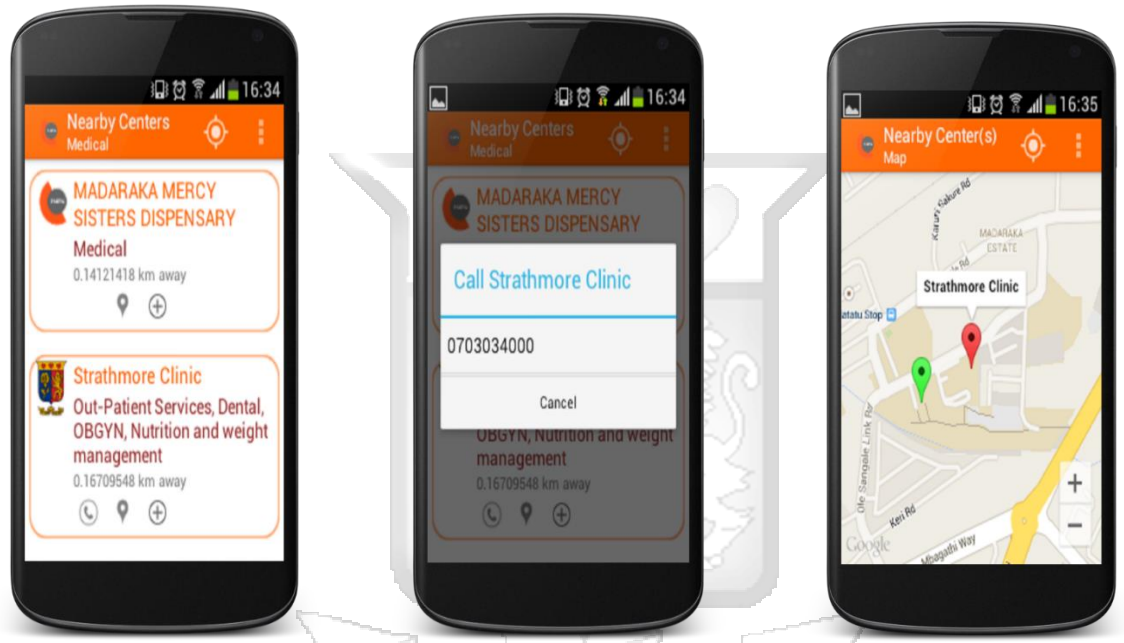

Figure 6.2 Centre Details Page with some of the Possible Actions

6.3.1.3 View Map Page

The application has two views of the map; one that shows the centres point on the map relative to the user's location and the other that show all the centres available within the user's vicinity as shown in figure 6.3. This former page can be navigated from clicking the map icon on the centre details page while the latter is navigated from the map icon on the action bar.

Figure 6.3 General Map View Showing all Centres within the User's Locality

6.3.1.4 Add Centre Pages

A feature of the application is to have end users add centres they feel are not in the system. Clicking the 'add centre' button leads the user through a number of pages that allow the user to enter the details of the centre of interest. The first step is to capture the centres location on the map, followed by adding the centre's namely: name, category, contact and address. This information is later validated from the backend. Figure 6.4 illustrates these steps.

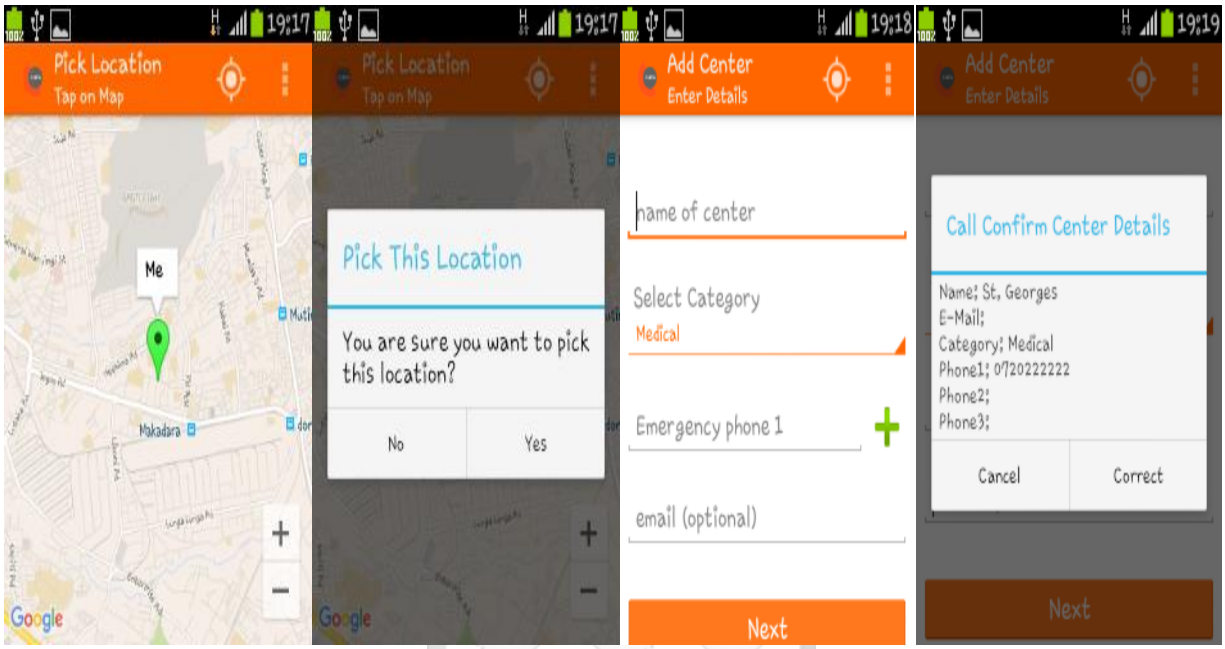

Figure 6.4 Process of Adding a New Centre

6.3.1.5 Centre Information

Most emergency response centres advise that a call made for emergency response should follow a certain standard for ease of tracking, the common requirements being that the call should contain this information: where, what and when the incident occurred, the type of casualty and the nature of assistance being requested for. This application aims at making this process easier by providing the user with the required detailed for reference. These include: location details, directions and category of emergency response required.

6.3.1.6 Review Centre

The user shall be able to review a given centre on their interaction. This information once submitted will be reviewed by the system admin before being availed to other users.

6.3.2 Back End System

The back end system is implemented to supplement the functionality of the mobile application. The system admin and the centres' administrators can interact with the back end to ensure that the information available to the end users is validated and reliable. The visibility of the information available to the users is also monitored and managed through the back end.

The system admin performs these operations from the backend: track user actions and analyse their category and level of interest in the application, analyse collected user data and group related incidents, review user comments, manage subscriptions, validate updated information, track and analyse usage and incidents data and monitoring the general working of the system.

The web interface is also used by the centres' administration to regulate and manage the information they want the users see as well as request any service from the admin. This is done through the accounts assigned to them by the system admin.

The main pages of the back end include:

6.3.2.1 Home Page

Figure 6.5 shows the back end's home page. This page gives an overview of the services and features available from the application and its background information. The page is available to viewing to anyone irrespective of them having an account or not. It also acts as the launch page to other services available from the backend where one can log in.

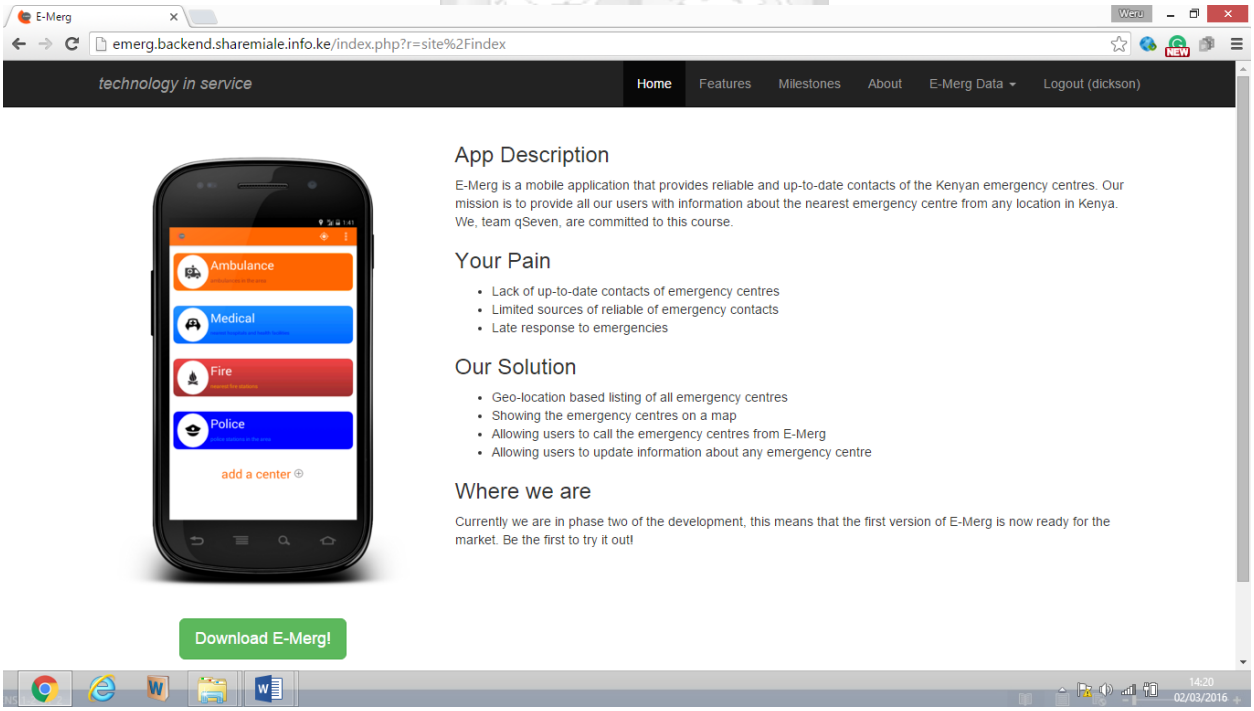

Figure 6.5 Backend Main Page

6.3.2.2 Centres Page

To help manage all centres available to the users, this page allows one to view, edit, delete or add the main information specific to a given centre. Figure 6.6 shows the centre management page.

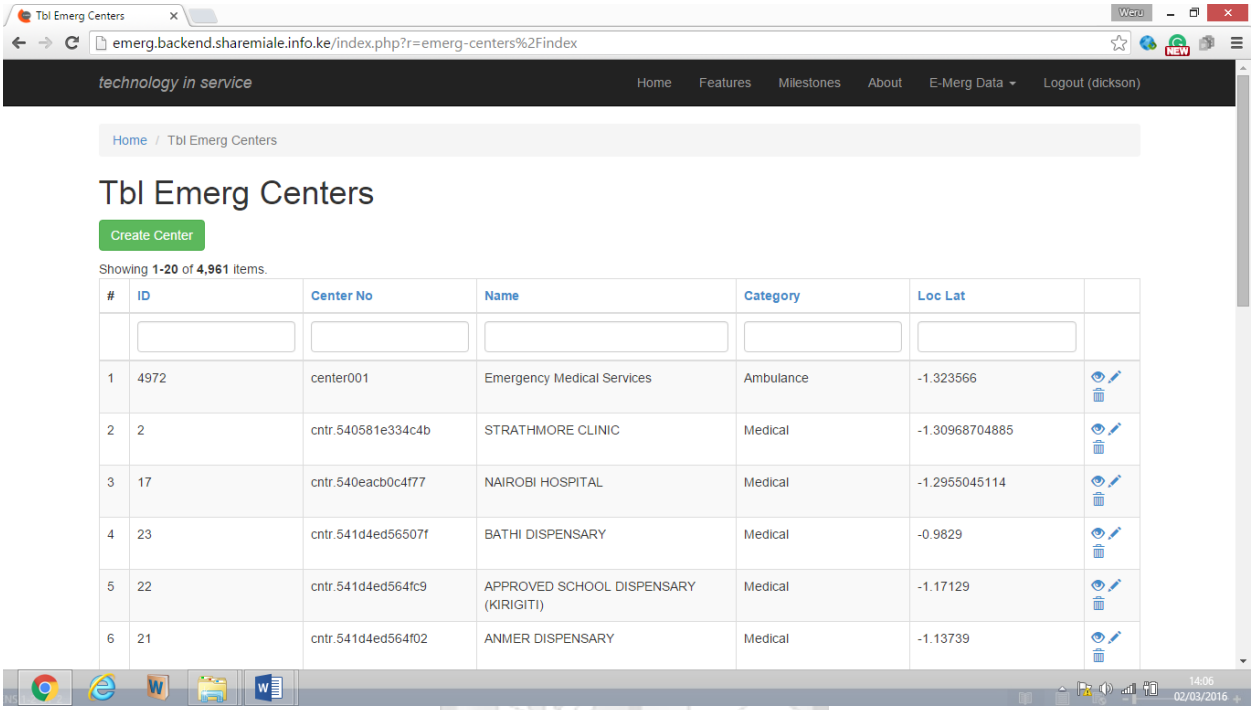

Figure 6.6 Centre Management Main Page

6.3.2.3 Centre Contacts

Shown in figure 6.7 below, this page helps manage the contacts of a given centre to keep a reliable updated list of contacts.

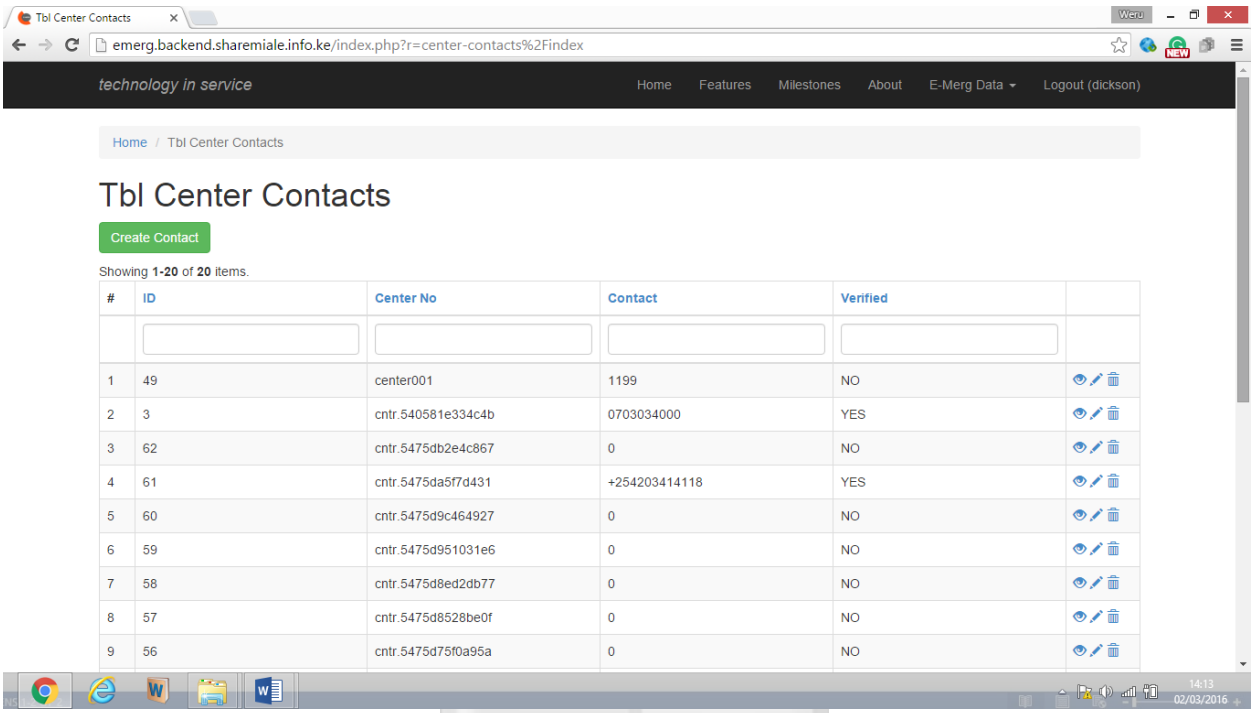

Figure 6.7 Centre Contact Management Page

6.3.2.4 Centre Services

One of the features available from the proposed solution is the ability to show the service a specific centre is known for or wishes the public to see. From the centre service page, shown in figure 6.8, the admin can add, view, edit or delete information on the services available from a given centre.

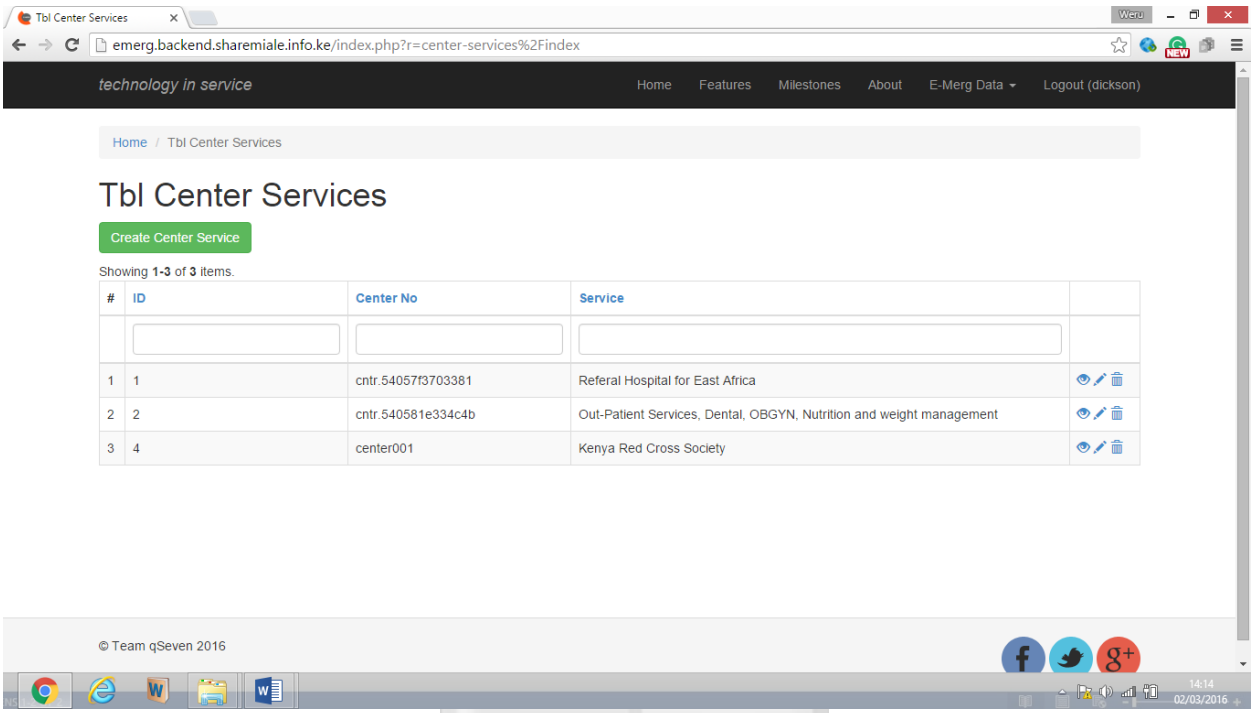

Figure 6.8 Centre Service Management Page

6.3.2.5 Subscription Page

This page, shown in figure 6.9 below, was created to help track and manage subscriptions.

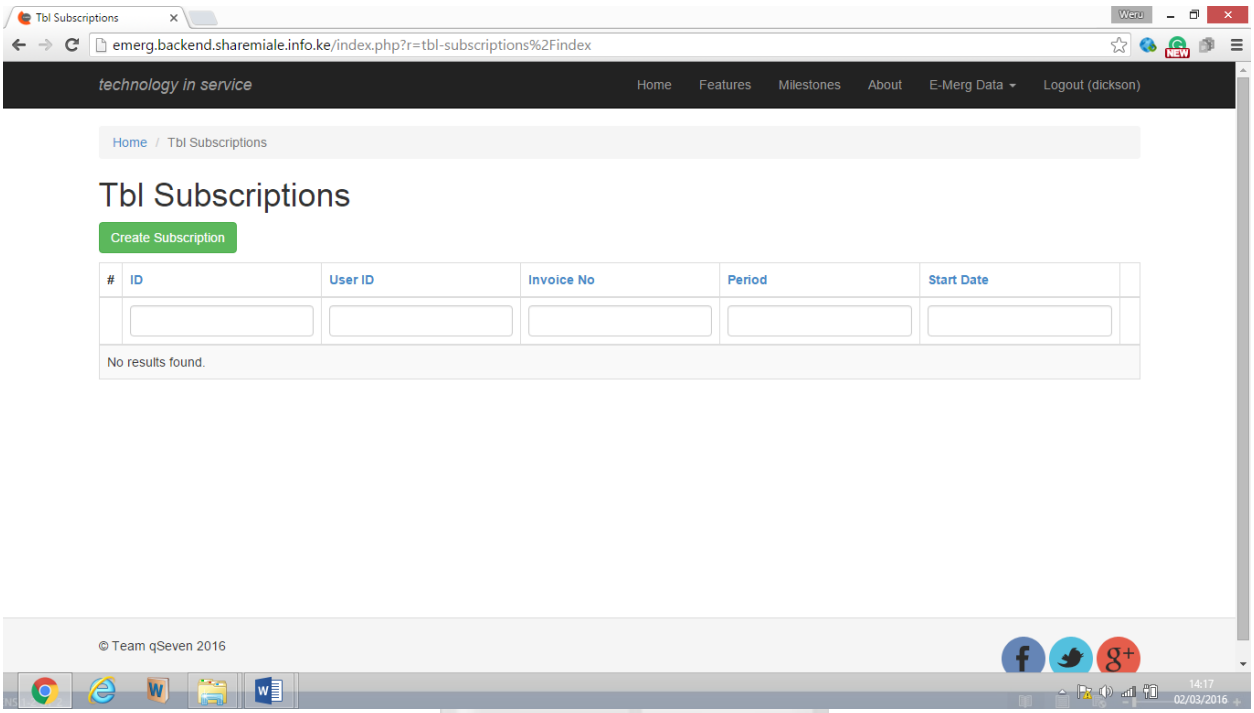

Figure 6.9 Centres Subscription Management Page

6.3.2.6 Data Reports

The backend facilitates the system admin to track different aspects of application data. These are explained in the following subsections:

i. User Actions

The system baked allows the admin to track the actions of the application users. Data collected from the interaction of the user with the application is sent as the usage report once Internet connectivity is established. The different aspects of the data processed include data on: category views, centre views with details on the specific centre of interest to the user, the action performed by different users and the location details of different incidents needs. The report on this help the admin to rate the features the users are interested in or not and also in making follow up on the possible reasons why. Also the admin is able to rate the resourcefulness of the application from the number of features users access.

ii. Incident Distribution

Incident data with common characteristics is analysed to test whether fit to be grouped as one incident. The admin is thus able to view the report of incidents prevalence in their respective

location and category. These reports can be used by service providers in decision making. Prevalence of a given incident may inform the type of response resources a service provider will need to provide a solution.

iii. Subscriptions Report

The admin is able to view a report on the subscription of service provider to given visibility features available from the system. Comparing the data with the report on the users' actions, the admin is able to rate the effectiveness of a given package to the service providers.

6.4 System Testing

The system was subjected to a number of testing as detailed in this section. These tests were guided by test case template attached, appendix D.

To conduct the tests, the researcher requested the participation of the would-be users. The participants were selected from people having an android smartphone through purposive sampling where a total of 20 respondents were identified. Table 7.1 below indicates the demographic distribution of the participants where the researcher wanted to have the experience of different categories of people encountered in the pre survey questionnaire.

Table 6.1 Distribution of Participants in the Application Test Survey

Group	Description	Number
Gender	Male	10
	Female	10
Age in years	Below 20	4
	21-30	4
	31-40	4
	41-50	4
	Above 50	4

Residence	Upscale residence	5
	Middle class	5
	Informal settlement	5
	Touring	5

6.4.1 Test Results

Both unit and system testing were conducted. Unit testing was done on the main modules before integrating them into the overall system. These included unit testing on the backend application and on the mobile application to test their ability to deliver the expected functionality. Once integrated, the system was subjected to the following tests:

6.4.1.1 Usability Testing

This was conducted to test the ease of use of the system and its ability to work without errors. The user-friendliness of the application was rated against: ease of learning, system navigation from across pages and the interaction modes between the user and the system such the choice of words and icons.

The feedback on this test was given on a scale of: very hard, hard, fair, easy, very easy. Figure 6.10 illustrates the feedback on usability testing for the application. A majority of the respondents found the system very easy or easy to use. General usability of the application was found very easy by 10 respondents, 8 respondents found it easy while 2 respondents found it generally fair to use. Respondents could easily find their way around the application as illustrated by the ease of learning bars. The interface feature of the application received an evenly distributed feedback based on the users' preferences. However, no respondents found the application hard to use.

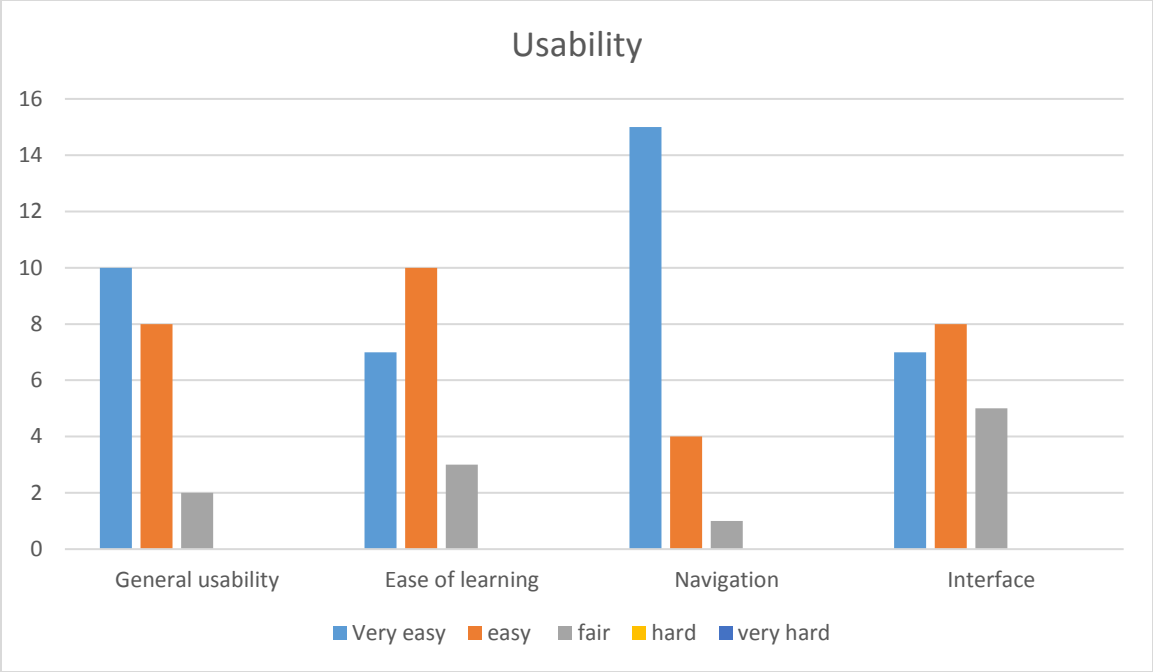

Figure 6.10 Respondents Feedback on Usability Testing

6.4.1.2 Functional Testing

This test was conducted to rate the working or the functions of the system against the required system specification. This testing was done on the main functions of the application. These include: searching for a centres, viewing centre details, performing the intended action such as calling the centre, adding a new centre, offline capability of the application, and the ability to manage the centres from the backend. Feedback on functionality testing was as illustrated on figure 6.11. The respondents found the application to meet what they could have expected from such an application with 13 respondents finding the application one that could meet their needs effective and 7 respondents found the application effective but made some few recommendations.

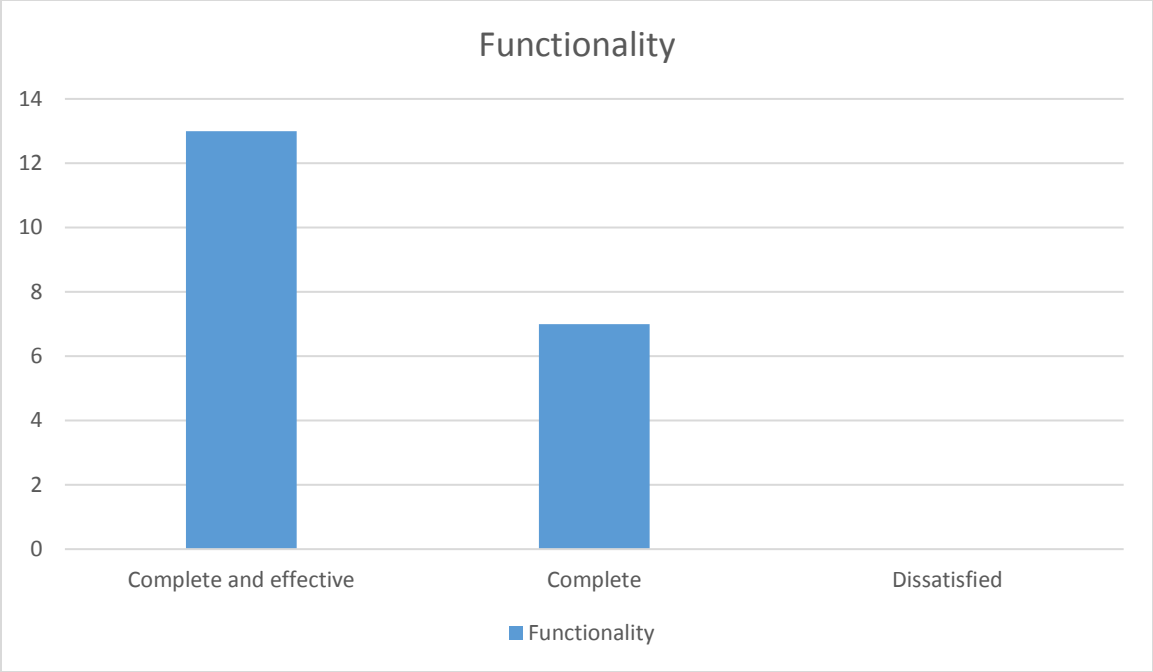

Figure 6.11 Respondents Feedback on Functionality Testing

6.4.1.3 Performance Testing

Performance testing to check the system's ability to be error-free when subjected to high intensity activity. This was tested on the backend application. Subjecting the system to increased load was met by normal performance. The system could handle many users at the same time without experiencing errors.

6.4.1.4 Integration Tests

Under the integration testing, use-scenario testing was done to check for proper working of the system in different scenarios. Such scenarios included when device data access is turned off, turned on and when GPS is enabled or not. The respondents' feedback on the use-scenario testing was expressed in numerical form where a "Pass" mark was represented by 1 while the "Fail" mark represented by 0. The feedback was then rated on a scale where a test was considered a fail if the total points fell below half. The overall feedback collected indicated the system was working as expected. The only difference arose from the respondents' individual device setting and was thus negligible.

Data flow testing was also done on the processes of: adding a new centre to verify the accurate collection and storage of data, retrieval of the data and editing of the centre details.

6.5 Summary of Findings

The final system developed had captured all the functionality expected of it so as meet the gaps that were identified in the literature review. The above pages indicates the smooth interaction of mobile application and the backend. Different testing conducted on the system to allow the users experience the working of the system and rate against their expected requirements. Different categories of testing received a positive feedback from the 20 respondents who took part in the process. The developed application provided different modes of operation, offline and online and leverages on the device capabilities to provide the user with the nearest centre in his category of choice at all time in any geographical location.

The process helped answer the research questions formulated by the researcher since it was possible to develop a geolocation based mobile directory that passed the conducted tests and which can enhance emergency response by reducing the communication barrier between the two parties.

Chapter 7: Discussions

7.1 Summary of the Previous Chapters

Chapter one introduced the concept of this dissertation and sought to explain the problem that exist and its possible solution: which is built around cases of emergencies in Kenya. In this chapter, background on emergency incidents and response was covered where the researcher expounded on the evolution of this sector to the present, the milestones achieved, the challenges and the pains in the event of an emergency. The researcher discussed the importance of minimising loss of property and life as well helping alleviate the effect of an emergency. The researcher aimed at enhancing emergency response through an increased visibility of the emergency centres and the response teams. The researcher set to answer the following by the end of the study:

1. Which emergency services are offered in Kenya?
2. What are the existing technological solutions applied in emergency response in Kenya?
3. How can a geo-location based mobile directory for emergency centres be developed?
4. How can the geo-location based mobile directory be tested on its effectiveness, performance and reliability?

The development of this dissertation was based on information on the Nairobi County.

In chapter two, the existing literature is reviewed using the research objectives as the guide to appreciating the steps made in filling the gap of communication between centres providing professional response and the users or general public. The researcher observed that despite there being a number of systems geared at sealing the communication gap between victims and emergency centres, there still existed some challenges with usability, efficiency, reliability of the available data and the effectiveness of these solutions. The researcher noted that developing a system that would allow usage in offline mode, provide a wide coverage of centres in the country, have the georeferenced viewing allowed, one with an enhanced quick search and built on mobility feature, would help reduce the challenges with the current systems.

In chapter three, the methodology used in software development and the research design are discussed. A sample of 150 end user participants and 8 centres were involved in the research. The development of the system followed the Waterfall Development Methodology in interlinking the

four phases namely: planning, analysis, design and implementation phases. UML notation was used in visualizing the designs.

In chapter four, data analysis and interpretation was done so as to help identify the specific user and system requirement and ascertain the viability of developing the system. Graphical illustrations were used to compare the information obtained through the data collection tools settled for in this research, namely: questionnaires, interviews and document reviews.

In chapter five, the system architecture and design of the proposed system are discussed in details. This helped in the implementation of the system as the software development process was now informed by the available designs.

In chapter six, the implementation of the system is documented and the final product tested relative to the expected functioning of the system. In the chapter, the main functions in the application are discussed. All the functional and performance tests were carried and the system rated on a percentage scale. The functionality of the system was indicated to be a success based on the information obtained from the post tests. The system also exhibited user friendliness, robustness and effective performance.

7.2 Matching to Research Objectives

The preceding chapters of this dissertation have been developed on the set research objectives. The dissertation considered a situation of general response to any incident that demands professional response. Services within the scope of this work, these include: medical centres, police or security bodies, fire brigade and ambulance services. While the urgency of the response varies, this study indicated that cases requiring medical attention are normally addressed in the earliest time possible once detected by the victim visiting the nearest or preferred health facility, only the life threatening cases are referred to an ambulance and mostly this decision is left at the discretion of the people around a victim. The police are involved in most incidents with reason ranging from legal issues, investigation, settling disputes to safety reason. Police cases varied in urgency of action and the participating agencies. The police can mark a case late for reporting where evidence might have been lost but it was found advisable to always notify the police of any incident. Fire services were found to demonstrate the best partnership between the public and private firms in responding to incidents. It was however noted that proper coordination was of essence in incidents of fire. With

the proliferation of mobile phones in the country, the most used means of reaching these service providers was through a voice call.

The review of the existing systems and from the research findings indicated the crucial role technology can and plays in enhancing emergency response. The most used ways of reaching the centres for professional help are: voice call, social media and actual visit to the centre. This was found to be largely contributed to by the increase in the number of mobile phones in the country as well as the urgency to acknowledge reception of the message. Technology can be applied in different aspects; from advanced call centres, tracking systems, mobile application, phone calls, visibility enhancing media and informational websites. This work was developed to majorly rely on mobile technology where the following main features were implemented: geographical location based listing of centres of the category of interest, map view with estimated distance from the user, calling feature where contacts are available, core services available in a centre. The proposed system was tested on functionality, performance, usability and reliability. Respondents' feedback indicated a match with the parameters set in the objectives.

Chapter 8: Conclusions and Recommendations

8.1 Conclusions

The study was conducted in Kenya and the subject of interest was the application of technology in enhancing the interaction between centres providing professional emergency service response and victims. The study emphasized on mobile technology, specifically a mobile application, to enhance the visibility of the centres. The study made the following conclusions:

The researcher noted that the number of emergencies in Kenya have increased with the statistics indicating the following incidents for the year 2014: 5,672 road accidents, 69,376 reported crimes, and a morbidity of 47,038,650. This adds to incidents of burglary, reported cases of assaults, rape cases, fire, and terrorism among others that have been reported in the past. These cases indicated the need of the existence of centres providing professional emergency services.

The study observed that most centres are using technologically advanced systems in their operation. Despite this, a means to reaching their consumers has been left to the discretion of those who are in need of their services. A number of people have subscriptions to services from security firms, insurance covered medical centres and ambulance services. This however may not be the case with a majority of citizens with most relying on referral means of reaching a centre in the event of a need. Even the one who are privileged to have the subscription service are faced with the problem of reaching the centres when travelling or out of their home towns. A number of websites and application do exist that try to avail the contacts of such centres to the public, however, this application is aimed at providing geographical location based service with the option of offline use for places where connectivity is poor. This warranted the researcher to develop the proposed system that was aimed at reducing the gap left by the shortcoming of the existing systems. The system utilises mobile technology to provide geolocation based services of emergency contact provision, localised map view and the ability to track incidents based on the user reports. The application utilises location acquisition features of a mobile device, specifically, GPS or through data access to identify the user's location. This is then used to pool the details of the nearby emergency service providers. The user can the select to report an incident to any of the centres. The system facilitates analysis of user data and incidents.

The developed system that was subjected to various tests and the participants agreed to it having met the expected performance and functionalities. The feedback from the participants in the test indicated that the application had satisfied the expected user requirements and expectations.

8.2 Challenges

The study was faced by a few challenges that include: securing an interview with some of the service providers, limited resources in terms of cost and time, and implementation of some concepts in the solution was relatively difficult based on device capability and development environment. Also, integration with communication systems used by the service providers was hampered by differences in the systems used.

8.3 Recommendations

Whereas this application plays a role in sealing the gap in communication between the emergency centres and the public, there still exists room for enhancing the interaction between the two. From the research findings, the following recommendations were made:

The application should be developed in other platforms like mobile web, Windows Mobile, BlackBerry and IOS to reach more people in the country who have access to smartphones. An USSD application was also recommended to complement the native application and to help reach majority of people who use feature phones.

The system can be adapted to cover a wider range of services such as banks, support centres, among others.

Partnership with the service providers was highly recommended to overcome the bottleneck caused when the service required involves huge financial costs. A scenario is where a victim may be unconscious and no family member can be reached to give consent on the emergency operation. The partnership would also help with commitment of the service providers to respond to user's calls.

8.4 Future Work

A means to track calls made from the application on the service provider's side should be developed. The possibility of interfacing this application to the technology used in various call

centre to allow direct tracking of the caller location would help reduce the time spent on call and allow flagging of incidents already being addressed to.

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Appendices

Appendix A: Questionnaire for Consumers of the Emergency Services

1. Please indicate your age.
   - □ Below 20 years
   - □ 20-25
   - □ 26-30
   - □ 31-35
   - □ 36-40
   - □ 41-45
   - □ 46-50
   - □ over 50
2. Where do you live?
   - □ County: ……
   - □ Town: ……
   - □ Estate/Village: ……
3. Please indicate your highest level of education?
   - □ Primary
   - □ Secondary
   - □ Tertiary
   - □ Other

     ……

     ……
4. How often do you travel?
   - □ Travels a lot
   - □ Average travelling
   - □ Minimal travelling
   - □ Avoids travelling

   4.1. Please indicate the highest factor that contributes to your travelling?
   - □ Business
   - □ Educational

- Tourism
- Other

……

……

5. Have you ever experienced or witnessed an emergency?
   - Yes
   - No

   5.1. If yes, what kind of an emergency was it?
   - Fire
   - Road accident
   - Attack
   - Sickness
   - Other

   ……..

   5.2. What did you do or what was done?
   - You managed to solve it on your own
   - Called for help
   - Used the available resources to help solve e.g. used your own car than the ambulance
   - Walked away
   - Other

   ……..

6. How can you handle an emergency incident?
   - Trained in first aid thus can deal with wait as you wait for help
   - Not trained in first aid but bold enough to handle the incident as you wait for help
   - Call for help
   - Other

   ……

   ……

   6.1. If you were to call for help, what means could you use?

- Make a phone call
- Send a text message
- Word of mouth
- Panic button
- Other

……..

6.2. If you were to call or send a text message for help, where could you get your contacts from?

- Phone contact list
- Default emergency number e.g. 999
- Referral by another person
- Other

7. Do you have an emergency contact in your phone?
   - Yes
   - No

   7.1. What category is the emergency number?
   - Ambulance
   - Local police
   - Personal or family physician
   - Fire station
   - Security firm
   - Other

   ……...

   7.2. Where did you get the contact from?
   - Broadcast
   - From the facility
   - Issued on subscription of service
   - Other

   ……..…..

8. In your opinion, how can you rate the response time by emergency service providers?

- Unbearable
- Slow
- Fair
- Fast
- Very impressive

9. What could you possibly indicate as the cause of poor response to emergency situations?
   - Communication barrier
   - Inadequate facilities
   - Poor accessibility
   - Ignorance by response teams
   - Other

     ……..

10. Which type of phone do you have?
    - Feature phone
      - Samsung
      - Nokia
      - Techno
      - Other

        ……
    - Smart phone
      - Android based
      - Windows mobile
      - BlackBerry
      - IOS
      - Other

        ……

11. Would you download an application to use in times of emergencies?
    - Yes
    - No

12. Why? Please comment.

…….

…….

13. What features would you like to be present in the application?

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14. Would you prefer a native application on your phone or a USSD application?

- Native
- USSD
- Other

……..

15. Please add any comment you would wish to.

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Thanks for your time in answering this questionnaire, your contribution will go a long way in helping us develop a product that meets your needs better.

Appendix B: Questionnaire for Service Providers

1. Are you a public or private facility/organization?

   - Public
   - Private

2. Which category of emergencies do you address?

   - Fire fight
   - Ambulance
   - Security
   - Law and order

3. What main services do you offer?

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   ……
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   ……
……

4. Of your services, do you address emergencies?

   - Yes
   - No

5. How do you get requests from your clients?

   - Phone call
   - Referral
   - Email
   - Social media
   - Panic button

6. How is the customers' requests communicated to the emergency service personnel on the ground?

   - Direct line from customer to waiting service personnel

- Command from call centre to waiting service personnel
- Others

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7. Do you have other branches over the country?
   - Yes
   - No
8. Have you ever been notified of an emergency and did not manage to address it?
   - Yes
   - No
9. What could you give as the main cause for this?
   - Geographical inaccessibility
   - Poor communication
   - Was beyond your capacity
   - Other

   ……
   ……..
10. How can rate your feeling on the capacity of your operations?
    - Optimal capacity
    - Below capacity
    - Above capacity

    10.1 If operating below capacity, what do you think could be the reason?

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    ……

    ……
    ……

    10.2 How do you think this can be improved?

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11. What do you think could be the effect of increasing your visibility i.e. having more people know of your existence and only a phone call away from you?

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12. Could you appreciate such a system that would enhance your visibility to the public?

- Yes
- No

13. What features or functionalities would you recommend the system to have?

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Thank you for taking time to fill this questionnaire.

Appendix C: Post Application Questionnaire

1. During your interaction with the application, was there anything unexpected?

   - Yes
   - No

   If yes, please explain

   ……

   ……

2. In the application which feature(s) did you like the most, why?

   ……

   ……

   ……

3. From your experience, how would you rate the general application?

   - Excellent
   - Very good
   - Good,
   - Fair
   - Poor

4. On the following scale, how would you rate these aspects of the application?

Application aspect	Very easy	Easy	Fair	Hard	Very hard
General usability					
Ease of learning					
Navigation					
User Interface					

5. How effective is the system in following tasks?

	Task	Complete and effective	Complete	Dissatisfied
1	Searching for a centre			
2	Viewing centre details			
3	Calling the centre			
4	Adding a new centre			
5	Offline capability			
6	Map feature			

6. Any additional comment?

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Appendix D: Test Case Template

Test Case for 'view centre details' process

Test Case #: 1 Test Case Name: View centre details

System: Geo-location based mobile directory Subsystem: Mobile application

Designed by: Patrick Design Date: 24/02/2015

Executed by: Execution Date:

Short Description: Test the ability to use the application to obtain details of a given centre

Pre-conditions
The user has an android smartphone with the mobile application installed
The phone has Internet connectivity and GPS capability.

Step	Action	Expected System Response	Pass/ Fail	Comment
1	Tap on the application icon	The application launches and displays the home page that lists the available four categories: ambulance, medical, fire and police station respectively.		
2	Select any of the category by tapping on it	If the phone location settings are not abled, user is prompted to turn them on. If there is not Internet connectivity and an offline version is not available, the application displays the message 'Oops, Sorry No Centres Near you have been found. You can add one'. The 'add a centre' option is given. If phone location settings are enabled and Internet connectivity available, the application displays a list of centres in the user's locality with their estimated distance from the user.		
3	Tap on any centre to view details	The system displays the available details on the centre. Clicking on any of the displayed icon triggers the		

		respective action, for instance, tapping on the map pointer displays a map showing the centres location relative to the user while tapping on the call icon initiates the dialer function of the device with the specific number on.		

Post-conditions

1. The page displays the details of the specific centre selected by the user.

Test Case for 'add a centre' process

Page: 1 of 1

Test Case #: 2 Test Case Name: Add centre

System: Geo-location based mobile directory Subsystem: Mobile application

Designed by: Patrick Design Date: 24/02/2015

Executed by: Execution Date:

Short Description: Test the add centre process

Pre-conditions The user has an android smartphone running the application The user is at the home page with the 'add centre' button active

Step	Action	Expected System Response	Pass/ Fail	Comment
1	Tap the 'add centre' button	The system displays a map with a pointer showing the user's location. The page has the instruction 'Tap on the map' on the title.		

2	User taps the position of interest on the map. (Zooming in and out enabled)	The system displays a notification message asking the user to confirm he/she wants to pick the location. User can choose 'Yes' or 'No'.		
3	User taps on 'Yes'.	The system may displays a loading bar. The system displays a page where the user can enter the centre details, namely: name, category, emergency phone number(s) and email. A 'Next' button is shown at the bottom of the page.		
4	User fills in the details and taps the 'Next' button.	The system displays a toast box showing the centre details the user entered and prompts him/her to confirm as correct or cancel the process.		
5	User taps on 'Correct'.	Data submitted.		

Post-conditions

1. The new centre's details are saved in the database but the status is yet to be changed to active.