UNIVERSITY OF NAIROBI

SCHOOL OF COMPUTING AND INFORMATICS

BEYOND ZERO CAMPAIGN MOBILE CLINIC LOCATOR

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Submitted in partial fulfillment of the requirements for the award of the Degree of Master of Science in Applied Computing

DECLARATION

This research is my original work and has not been presented for a degree or any other award in any other university or learning institution.

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DEDICATION

To my family,

Mr and Mrs Job Muriuki, Elias, Caroline and Christine Muriuki

God Bless

ACKNOWLEDGEMENT

I thank God for the gift of life and the opportunity to study further with whom, this research was possible. I also thank my family for the support they gave me. I would like to thank most sincerely my supervisor, Dr. Christopher Chepken who gave support and guidance right from the start of this research to the end. His academic and professional input made it possible for this study to be done, Dr Mwangi Kikuyu Sub-County, Kerwa Child and Family Programme fraternity especially Mr. Benson Njoroge the program officer who gave insightful information on health out reaches targeting communities within Kikuyu Sub-county of Kiambu County.

ABSTRACT

The Beyond Zero campaign initiated by the First Lady, Margaret Kenyatta, intends to complement existing initiatives to improve access and quality of health services to a zero state of maternal and child mortality, and zero new HIV infections, these mobile clinics provide free services on prenatal, antenatal and postnatal care. Limited resourceful information of where a mobile clinic is inconveniences most patients. This research paper studies the existing mobile clinics and as an outcome develops a web based application based on Location Based Services technology to locate the beyond zero campaign mobile clinic, quick access options, scheduled activities and supplementary information as an outreach program on health for beyond zero campaign patients. A web based prototype application was developed using several web technologies (HTML, Javascript, XML, PHP & MySQL). Using a simple SMS query "location" a patient or enrolled patient at the clinic can get the location of the mobile clinic and scheduled activities. Questionnaire survey was done with 12 participants that were used to represent the population on test and evaluation. All the components of the model were implemented and tested. The results obtained from the testing phase showed that 75% of the participants were satisfied with the application ease of use from its simple Short Message inquiry of the location using any kind of phone, regardless of whether the phone is a smart phone or a feature phone, timely message reply, and real time location with street name and route. 83.3% of the participants were satisfied with the structuring, the location inquiry and patient enrolment with Short message reminders of scheduled clinic appointments. It is recommended that a pilot application of the prototype should first be developed tested with a given sample participants especially in counties where low turnout of patients was recorded at beyond zero campaign mobile clinics. Afterwards a viable production application should be implemented to test its viability in locating the mobile clinic.

ABBREVIATIONS / ACRONYMS

APHRC	Africa Population Health Research Center
GPS	Global Positioning System
LBS	Location Based Services
MDG	Millennium Development Goals
RFID	Radio-frequency identification
OAFLA	Organization of Africa First Ladies against AIDS
EMTCT	Elimination of Mother to Child Transmission
OFL	Office of the First Lady
MHU	Mobile Health Units
CDMA	Code Division Multiple Access
CSS	Cascade Style Sheets
XHTML	Extensible Hypertext Markup Language
PHP	Hypertext Preprocessor
APIs	Application Program Interface
GPS	Global Positioning System
OpenLS	Open Location Services Platform
WHO	World Health Organization

DEFINITION OF TERMS

Beyond Zero Campaign	An initiative formed to partner with the government in reducing maternal and child mortality. Spearheaded by the First Lady of the Republic of Kenya, Her Excellency Margaret Kenyatta
Location-based service	Service that can be found easily on the basis of its described location with the aid of different kinds of indexing and guidance services
JavaScript	An object-oriented computer programming language commonly used to create interactive effects within web browsers.
GeoMobility	Web Service-enabled middleware piece that operates common/core LBS functionality, these services include directory service, gateway service, location utility service, presentation service, routing service and tracking service.
Open Geospatial Consortium	Standards developed in a unique consensus process supported by the industry members; government and academic to enable geo-processing technologies to interoperate.

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CHAPTER ONE

This chapter discusses the background of maternal health in urban and rural Kenya, the growing trends in location based services, the objectives this research intends to accomplish and the questions it intends to answer. Last but not least, the significance of the research study, scope, limitations and the assumptions made.

1.1 Background of the problem

Kenyan women, many of who deliver at home face various challenges. A research conducted by Africa Population Health Research Center (APHRC) estimated that, approximately 68% of surveyed women said it was not necessary to go to a health facility. Poor road infrastructure and insecurity often prevented women from delivering in a health facility. Women who went into labor at night often felt it was unsafe to leave their homes for a facility and risked their lives, giving birth at home away from the support of skilled medical personnel and health facilities.

From Kenya Demographic and Health Survey 2012-2013, about 92% of women giving birth have received antenatal care in 2010, approximately only 47% had received more than four antenatal cares, while 56% of Kenyan women deliver at home, with home births being more common in rural areas with about 44% of births being assisted by a health care professional.

To improve the maternal and child health in Kenya, the First lady Margaret Kenyatta launched the Beyond Zero Campaign in January of 2014. The initiative aims to fast-track the nations plan towards the United Nations millennium development goal (MDG) number four (Reduce Child Mortality), five (Improve Maternal Health) and number six (combating HIV/AIDS, malaria, and other diseases), and goal number three in line with the sustainable development goals adopted in September 2015. The beyond zero mobile clinics will be used to deliver essential health services. The beyond zero campaign mobile clinics will also be used to deliver important health supplies such as mosquito nets to serve Kenyans who have limited access to static health facilities, and also to strengthen existing hospitals, referral and emergency services.

1.2 Location Based Services

According to Berkowitz and Lopez, location based services refers to applications or services that make use of location information provided by suitable devices or software (location need not be the primary purpose of the application or service), while location sensitivity refers to location-enabled mobile devices that can be used by location aware applications and services such as mobile phones, personal digital assistants and pagers. Such devices rely on GPS (Global Positioning System) or mobile phone related technologies.

As smart phones, Google Application Programming Interface and Android-based devices have become progressively more popular, and so will the use and omnipresence of Location Based Services. Frost and Sullivan in 2009 forecasted a 20% increase in users of Location Based Services by the year 2012 (Vaughan- Nichols, 2009). While, (Juniper Research, 2010) had forecasted that the size of the mobile Location Based Services market will exceed 12 billion dollars by 2014 from application sales revenue, with mobile advertising set to drive growth progressively over the following years. These figures show a large and growing consumer market. Location Based Services can provide considerable benefit for enterprise operations such as asset tracking and locating, to realize the LBS potential, many organizations are using specialized software and hardware.

A report by (Berg Insight, 2012), mobile Location Based Services are already achieving mainstream market acceptance in Europe and North America. Nearly one third of all mobile subscribers use LBS applications regularly in North America, while 20 percent of users do so in Europe.

1.3 Problem statement

The Beyond Zero campaign initiative intends to complement existing initiatives to improve access and quality of health services to a zero state of maternal and child mortality, and zero new HIV infections, these mobile clinics provide free services on prenatal, antenatal and postnatal care. However, there is limited resourceful information source on where the beyond campaign mobile clinics are located at any given time, particularly to the underprivileged in the rural and urban areas.

The clinic offers low cost and quality health care is, misguided information inconveniences the patients, hence the patients end up in a health facility or hospital, where they were not expecting to, or cannot afford, resulting in the patients changing from one health facility to another during the course of the treatment, others are detained in the health facility or hospital due to failure of clearing their hospital bills in time, hence increasing the cost of treatment.

Inadequate access to primary care is a key contributing factor to overcrowding and long waits in in public hospitals and higher overall costs in health care. Private clinics provide nearly half of primary health care to the underprivileged population. A significant number of the most affordable private clinics are run by non-qualified health care workers, often posing as certified doctors or nurses (David et al, 2004). Besides, the medical charges are higher, especially for the underprivileged.

1.4 Objectives

The main objective of this research is to develop an application/system based on Location Based Services technology that can provide the location of the beyond zero campaign mobile clinic, quick access and supplementary information for beyond zero campaign patients.

1.4.1 Specific Objectives

i. Review other existing mobile clinics and their methodologies
ii. Design and develop a beyond zero campaign clinic prototype
iii. Test the beyond zero clinic locator prototype
iv. Evaluate and report results

1.4.2 Research questions

i. What is the Beyond zero campaign services offered and fees charged for the services if any?
ii. How would one design the Beyond zero campaign clinic locator system?
iii. How would the Beyond zero campaign clinic locator system be implemented?
iv. What would be the best way to test the beyond zero campaign clinic locator system?

1.5 Justification of the problem

This research suggests a solution for the Beyond Zero Campaign Mobile clinics to identify the location and the services offered by the Beyond Zero Campaign Mobile Clinics using an SMS query. The clinic does not need to use a lot of funds in advertising to raise awareness of its existence, location and the services offered. The clinic by use of an onboard fitted GPS and the clinic administrator updating the clinic details in the system and their patients will be notified, and where necessary a broadcast SMS to enrolled patients. While the patients for ease of use have a centralized location to inquire the location and services offered at the mobile clinics. Most people have access to mobile phones, either a simple feature phone or a smart phone. The mobile phone access and use is increasing and there are investments in mobile technology infrastructure. (Republic of Kenya, Vision 2030)

The solution makes use of readily available technological tools to the public to provide a solution.

1.6 Scope of the study

The researcher intends to focus his research in Nairobi and Kiambu County; this is due to the availability of the mobile clinics within. The two counties are convenient for the researcher to conduct his research with the resources that are available to him. In addition, Kiambu, Homabay and Elgeyo Marakwet counties recorded the lowest turnout of patients to have been served at the beyond zero campaign clinics, compared to other counties by recording 299, 195 and 413 patients respectively, Ministry of Health, Kenya report on beyond zero campaign impact, December 2015.

1.7 Limitations

The limitations of this study include the sample size of the involved population, time constraints, limited access to the beyond zero campaign mobile clinics, there being an ongoing partnership between the beyond zero campaign initiative and the University of Nairobi project for Central Province Response Integration Strengthening and Sustainability Project (CRISSP) in Kiambu County, which offers services and expertise in the elimination of mother to child HIV transmission. And other institutions, namely; Centre for Disease Control and Prevention (CDC), University of Maryland - Institute of Human Virology (UOMSOM-IHV), Futures Group International and the Ministry of Health – Kenya, therefore the prototype was not implemented at the clinic's physical location.

1.8 Outcomes

At the end of the research duration, the deliverables are;

i. A beyond the zero campaign mobile clinic locator prototype.
ii. Research report

CHAPTER TWO

LITERATURE REVIEW

In this chapter, literature related to the objectives of the project, is systematically reviewed. Relevant literature on the characteristics relating to the factors of beyond zero campaign clinics or mobile health clinic projects in Kenya and other countries is discussed, as well as technologies in mobile computing.

2.1 The beyond zero campaign

Maternal morbidity and mortality rate in Kenya is as a result of the interplay of social, cultural, economic and logistical barriers, coupled with a high fertility rate and inadequate and under-funded health services. Strengthening the health system and improving the quality of healthcare delivery is pivotal to reversing the trend of high maternal morbidity and mortality.

The rates observed in the Kenya demographic and health survey 2014 show a reduced rate in levels of childhood deaths compared with the rates observed in the 2008-09, 2003, and 1998 KDHS surveys. The infant mortality rate decreased to 39 deaths per 1,000 live births in 2014 from 52 in 2008-09, also the under-five mortality rate decreased to 52 deaths per 1,000 live births in 2014 from 74 in 2008-09. These improvements in child survival can be attributed to increase in treated mosquito net use among children and improvements in maternal health, including an increase in the proportion of births assisted by a skilled provider and delivered in a health facility and increase in postnatal care. The downward trend in childhood mortality mirrors trends seen in other countries, for example: Ethiopia, Rwanda, and Uganda (UNICEF, 2013).

At the 2013 Organization of Africa First Ladies against AIDS (OAFLA, 2013) meeting held in Addis Ababa, Ethiopia, African First Ladies committed to elimination of Mother to Child Transmission of HIV (EMTCT) and Keeping Mothers Alive (KMA). Her Excellency the First Lady of Kenya, Margaret Kenyatta, made a commitment to champion this worthy cause. On December 2013, at the World AIDS Day event, held in Mombasa, Her Excellency the First Lady of the Republic of Kenya launched a Strategy for HIV Control and Promotion of Maternal, Newborn and Child Health in Kenya (2013 to 2017). The National Steering Committee (NSC) for EMTCT and the Technical Advisory Team (TAT) in conjunction with the Beyond Zero

secretariat has been set up to support the Office of the First Lady (OFL) in the implementation of her strategy. To operationalize the strategy, Office of the First Lady has had various stakeholder engagements for advocacy and resource mobilization. These include private sector and development partners' meetings to launch Beyond Zero campaigns and a multi-stakeholder national steering committee for the elimination of mother to child transmission of HIV (NSC), and hosting of Governors to be county champions for the Beyond Zero campaign. Additionally, H.E ran in two marathons: one in Nairobi and another in London to save the lives of mothers and children.

As a result of the Beyond Zero campaign and resource mobilization efforts, Her Excellency committed to provide at least one mobile clinic to all the 47 counties. The mobile clinics are intended to complement existing initiatives to improve access and quality of health services. The aim of the Beyond Zero campaign and other government interventions is to ensure that the country reaches a zero state of maternal and child mortality, and zero new HIV infections and among children and beyond.

2.2 Overview of the beyond zero clinic

The mobile is designed to provide health care to all clients, especially women and children.
It will offer basic HIV, maternal, newborn and child health care.

There are 4 partitions in the clinic, namely:

i. The common area at the entrance.
ii. The maternal-cum-general consultation/procedure room
iii. The pediatric consultation/procedure room.
iv. The laboratory/pharmacy area.

Additionally, there is an external canopy, which acts as a reception and triage area.

2.3 Roles and responsibilities

i. The beyond zero campaign will provide a fully - kitted mobile clinic to the county governments for the purposes of HIV control and improvement of maternal and child

health. However, this does not exclude services that may benefit men and the general population at large.

ii. In conjunction with MOH, enter into a memorandum of understanding with the county government on the mobile clinic's operationalization.

iii. Facilitate a national accountability forum to share reports on the utility and performance of the mobile clinics.

iv. The community is expected to, own, use and advocate for mobile clinics and services that it renders, participate in accountability mechanisms and consultation with county teams and structures.

2.4 Beyond zero campaign impact

The initiative, which is spearheaded by First Lady Margaret Kenyatta, has already seen all the 47 counties receive the mobile clinics. The Beyond Zero campaign was aimed at accelerating the implementation of the national plan towards the elimination of new HIV infections among children and promoting maternal, newborn and child health in Kenya. In the past maternal health care has not been given much consideration and with the new system of devolved government, there was hope that those particularly in the rural areas would access such services, but with the challenges faced by county governments this is yet to happen.

But besides giving counties the mobile clinics, the Beyond Zero campaign has helped create awareness on the importance of seeking medical care through pregnancy, delivering in hospital or under the care of a trained midwife and also ensuring baby's growth rate is monitored to reduce maternal and child mortality.

2.5 Reviews of some of the existing mobile clinics

2.5.1 Community Heath Africa Trust Laikipia, Kenya

A few organizations in Kenya are using more than one means of delivering health services. CHAT (Community Heath Africa Trust) /NCT, works with scattered, nomadic populations in the Laikipia region of Kenya, it uses an integrated model, including trucks, bicycles or foot travel to nearby communities; and also camel convoys in areas without a road network. (African

Impact, 2011) The Most of the identified Mobile Health Units operating in low income or developing countries provide services and treatment free of charge.

Of the MHUs that did request payment, patients were charged nominal rates for certain medications, but none of the non-profit MHUs claimed to be sustained through patient revenue. CHAT charges a token rate of 20 Kenyan shillings to cover medical treatment and other services, but individuals or groups that have no money can pay with milk or other food items.

2.5.2 Mozambique Mobile Clinic Project

The Mobile Clinic trucks/Mobile Health Units are custom built as mid-sized trucks and provides a multipurpose and flexible platform to provide primary health care services, education and counseling. Since its inception in 2008, the Mobile Clinics have been hugely successful and remains the only mobile clinic in all of Mozambique (Lindgren, et al, 2011). Collaboration between RMF, Vanderbilt University's Friends in Global Health and Medical Mission International, the clinics are currently deployed in one of the most populous provinces of Mozambique, Zambézia Province, located in the central coastal region with a population of almost 4 million.

The main aim of the clinic is to improve the quality of life and provide access to health services, particularly access to maternal-child health care and anti-retroviral therapy (ART) for people living with HIV and AIDS, Tuberculosis and other diseases. The clinics provide access to healthcare in remote areas of Zambézia Province, Mozambique. The mobile clinic works to reinforce the expansion of HIV care and treatment services initiated by the Zambézia Provincial Health Directorate, by providing temporary reinforcement in terms of staff, training, and space for peripheral health units initiating implementation of ART until the DPS can organize the infrastructure and resources necessary for these sites to function independently.

The Mobile clinics are most commonly used on a temporary basis, such as before the opening of a more permanent health facility, in settings where health services are absent or dysfunctional, or in emergency relief settings. The International Committee of the Red Cross (ICRC) which presented guidelines for the deployment of MHUs in emergency relief settings emphasizes that

MHUs is a strategy, which is sometimes effective but rarely has lasting effects to be used as a last resort to reach population groups cut off from health services. (Du Mortier S, Coninx R, 2006) Yet the use of MHUs extends well beyond emergency relief; there is a diversity of services being provided, including promotive, preventative, curative, even palliative care depending on population need and access to services.

MHU programs most commonly target specific groups such as homeless, displaced, marginalized or indigenous sub-populations, inner-city youth, migrant farm workers, nomadic herders, or industry employees. Some target specific age or gender categories such as the elderly, pregnant women and children, female sex workers, or male truck drivers. MHUs may also provide services to the general population, particularly when the main service offered is primary health care. (Laura, 2012)

Most of the MHUs in Mozambique are scheduled to operate within a defined region or number of districts. Others are more flexible and operate in certain areas based on requests from sponsoring organizations of from regional Community Based Organizations, NGOs, government ministries or community leaders that identify communities lacking essential services.

2.5.3 Mobile health clinics and mobile phone technology to promote safe motherhood initiative in Tanzania

VSO Tanzania initiated a project in two district hospitals in Pemba Island, Wete and Micheweni to increase the coverage on maternal, newborn and child health services through the following activities: community maternal health promotion; mobile health clinic services delivered by trained health workers and a gynecologist in villages providing pre and post natal care; an innovative referral system using mobile phones enabling women to access health services and training in maternal, newborn and child health for community health workers; and traditional birth attendants.

The data collected shows there was an increased number of deliveries, as per percentages below, for both districts. In Wete district, the number of deliveries increased from 103 deliveries in the six months prior to the project to 128 in the six months after the project started, an increase of 24% in the number of deliveries taking place at a health center or other health facility. In

Micheweni district, the number of deliveries over the same period increased from 160 to 211, an increase of 31% in the number of deliveries taking place at health facilities. Overall, for both districts combined, the number of births taking place at health facilities increased by 29%. (VSO, 2013)

2.6 Mobile Technology in Health

Mobile technology is a collective term used to describe the various types of cellular communication technology (ITU Telecommunication Development Bureau). Mobile CDMA technology has evolved rapidly over the past few years. Over the past few years, a standard mobile device has gone from being no more than a simple two-way pager to being a cell phone, GPS navigation system, an embedded web browser, and Instant Messenger client, and a handheld video gaming system. Many experts argue that the future of computer technology rests in mobile/wireless computing.

There is capacity to support mobile technology due to better telecommunications infrastructure provided by mobile network operators and availability and high penetration of cheaper advanced mobile devices such as smart phones (Hersman, et al, 2011). Globally 3.2 billion people were estimated to be using the internet by the end of 2015; of 2 billion are from developing countries. For every internet user in the developed countries there are 2 in the developing countries. However 4 billion people from developing countries remain offline, representing two thirds of the population residing in developing countries. Of the 940 million people living in the least developed countries, only 89 million use the internet corresponding to a

9.5 % penetration rate (ITU, 2015)

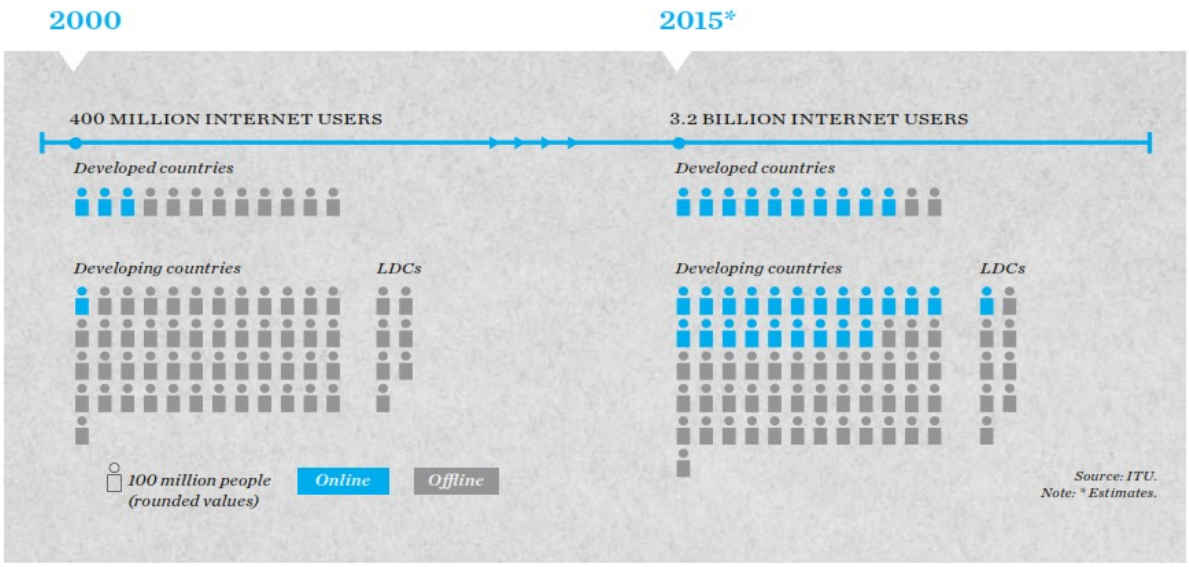

Table 1: MDGs 2000-2015: ICT revolution and remaining gap (ITU, 2015)

The potential of mobile communication to transform healthcare and clinical intervention in the community is remarkable. This can be proved by previous studies that have evaluated the use of mobile phones in support of healthcare and public health interventions, especially in the collection and collation of data for healthcare research (Blaya, Fraser and Holt, 2010) as well as in healthcare education and clinical practice in the community (Johansson, et al, 2008). Some studies also, have highlighted the successful use of mobile phones in support of telemedicine and remote healthcare in developing nations, with examples including the use of off-site medical diagnosis and as information support in the treatment of HIV care in rural areas.

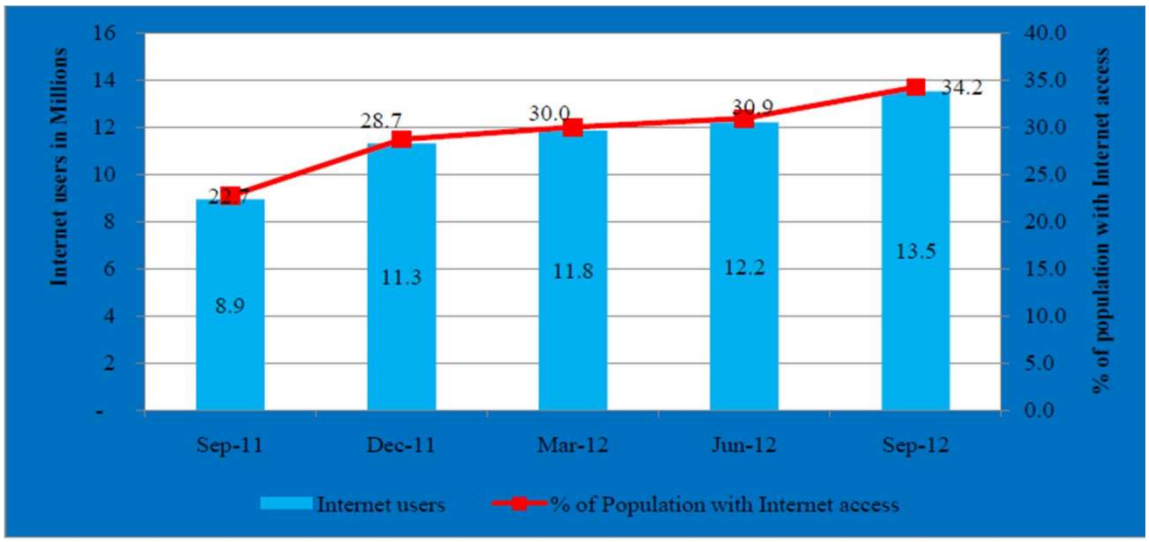

Table 2: Estimated number of internet users and internet penetration (CCK, 2012, p. 23)

The Millennium Development Goals (MDGs) acknowledge the importance of health in reducing poverty and increasing human development (UNICEF, 2013) The role of mobile phones, as with other information and communication technologies (ICT), is increasing in health, for there are potential gains from technology development (Sheila and Katrin, 2008)

Studies that have assessed specific functionalities of smartphones have featured in symptom research, the use of short message service (SMS) text on the management of behavior change (Fjeldsoe, Marshall and Miller, 2009) in sexual health education (Lim MS, et al, 2008), and to improve patients' adherence to antiretroviral treatment. In one of the studies they compared the use of mobile phone records against traditional paper based records in controlled drug trials (Horvath, et al 2016)

Mobile technology has been piloted in a range of health-related areas, including improving dissemination of public health information (e.g. Disease outbreak and prevention messages); facilitating remote consultation, diagnosis, and treatment; disseminating health information to doctors and nurses; managing patients; monitoring public health; and increasing the efficiency of administrative systems. In all these areas, (Chetley, et al, 2006) evidence supports that mobile phones can play a significant role in health.

2.7 Location Based Services

(Moein, Ehsan, and Ali, 2011) detail the components of the Location Based Services design that are crucial for the location based services; these components are the foundation for the LBS and they include; mobile device, communication network, service provider, positioning component and content provider.

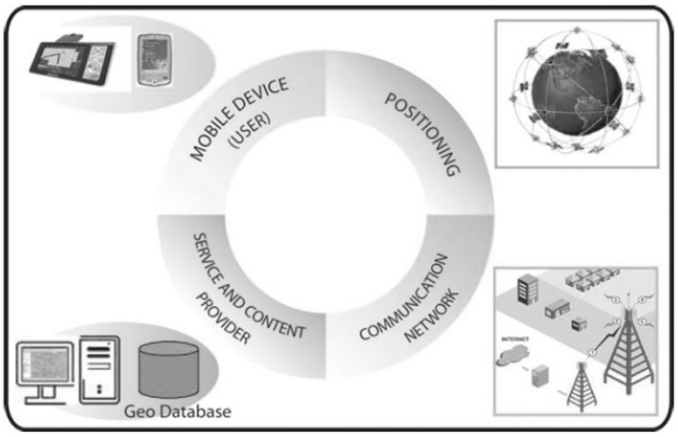

Figure 1: The basic components of LBS: user, communication network, positioning, service provider and content provider. (Moein, Ehsan, and Ali, 2011)

2.7.1 The Components of Location Based Services

2.7.2 Mobile tools

A Location Based Service component that is used to request for information; it is both an output and input entity. The mobile device can have a positioning component for the position of the user to be determined so that he or she can be provided with context aware information of which is dependent on the user's geographical location.

2.7.3 Communication link

Mobile link which communicates between the user and the service provider of the system, activities are such as data, user requests and content delivery. (Ficco, Pietrantuono, & Russo, 2010) further restate that the communication network component is composed of the wireless communication networks and is classified into network range and network topology.

2.7.4 Positioning

The system often provides positioning information of the user. Positioning of user could be done by methods such as wireless link or by using GPS. (Dao, Rizos and Wang, 2002) in their paper suggested that there are three ways or methods of determining positions, namely, non-GPS positioning methods, GPS and Assisted GPS. Cell of Origin, Time of Arrival, Angle of Arrival and Enhanced Observed Time Difference are all non-GPS positioning techniques.

2.7.5 Service provider

LBS providers usually provide different services to use in the result of processing her/his request. This service includes positioning, user's address, lining/routing a way to distinction point, returning interested information of users.

2.7.6 Data and content provider

This provides storage for geographic base data and location information, which includes the Geographical Information System server that provides access to the location data source. The data can be stored in different formats.

2.8 SMS gateway

The SMS gateway application will enable the application to send/receive SMS messages to mobile devices from the computer. The application will use a GSM technology on the GPS component with IP SMS technology to transmit and receive the messages.

2.9 Mechanism of Location Based Services Architecture Components

(Dao, Rizos, & Wang, 2002) demonstrated in detail how mechanisms on a Location Based System work together through a diagram in Figure 2 below. The Location Based Services components are grouped into three categories; the mobile positioning system, the telephony network and the location-based service application.

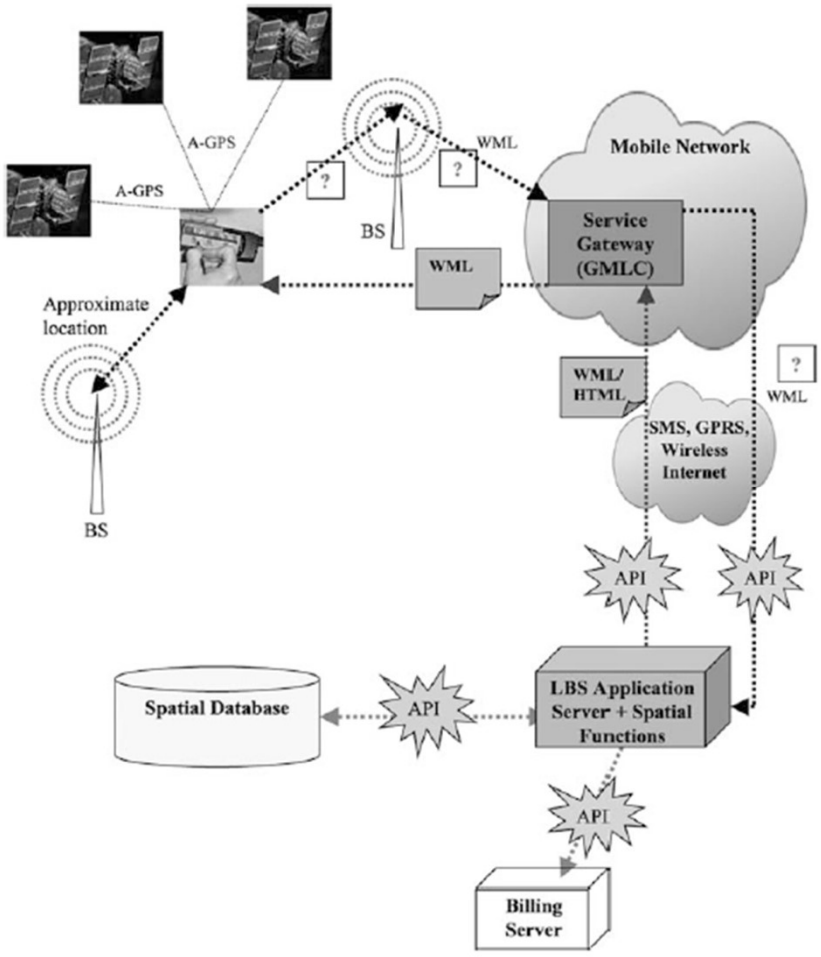

Figure 2: Location Based Services components mechanism (Dao, Rizos & Wang, 2002)

The mobile network delivers the services to mobile device users through service gateways that connect the positioning systems to the wireless network of the mobile user and the Location Based Services application. The Location Based Services application consists of an application server and a spatial database. The application server controls the user interface functions and communicates with the spatial database via Application Programming Interfaces. This Component therefore integrates location-based services with the mobile telephony networks.

Dao, Rizos and Wang suggests the use of the Open Location Services Platform as a standard architectural design that can be used by develop Location Based Services software, these offers interoperability of which highlights the adoption of Location Based Services. This is further restated by Reichardt as cited by (Dao, Rizos, & Wang, 2002) suggesting that, in

achieving the full value of location based services, it will depend on consistent communication across different regions including terrains, technology platforms, networks, application domains, and classes of products.

Open Location Services Platform initiative is an invention of the Open Geographical Information System Consortium (OGC), the worlds' authoritative industrial organization for information processing mainly on spatial and location information (Dao, Rizos, & Wang, 2002).

The Geographical Mobility server is a Web Service-enabled middleware piece that operates common/core Location Based Services functionality. It has six services and Google Maps API provides most of these services; these services include directory service, gateway service, location utility service, presentation service, routing service and tracking service. (Dao, Rizos, & Wang, 2002).

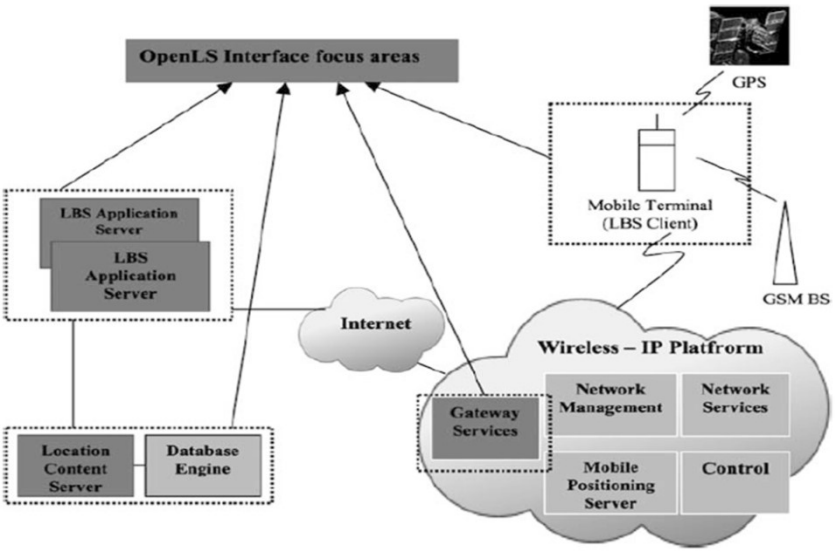

Figure 3: OpenLS focus areas. (Dao, Rizos & Wang, 2002)

With the above architecture model design in figure 3 above, (Shek, 2010), offers a modern and simple approach towards Location Based Services architecture given the rapid progressive change and transformation that technology has undergone in the past years.

The architecture design in figure 3 above, also lays emphasis on Open Location Services standards, but also in addition, the Extensible Markup Language (XML) from which two

other technologies are derived from it, that is, Geography Markup Language (GML) and Keyhole Markup Language (KML)

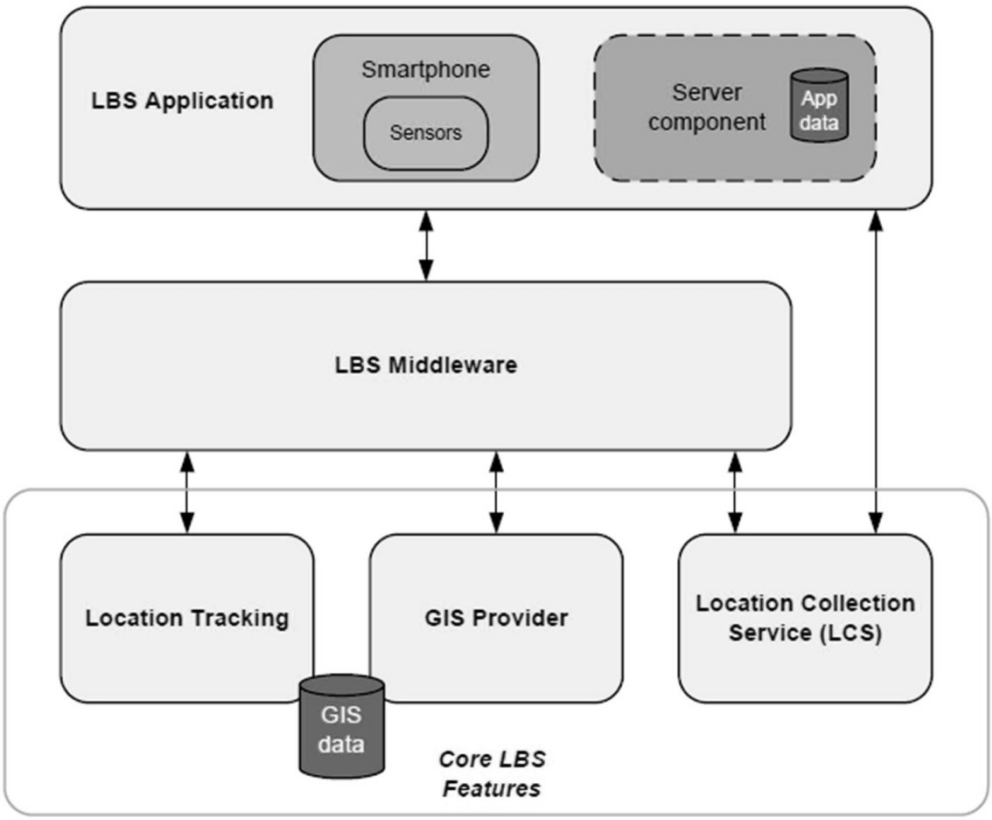

Figure 4: Components of a modern LBS architecture (Shek, 2010)

Geography Markup Language represents geographical data as referrals while Keyhole Markup Language gives clarification information and markings on maps; Keyhole Markup Language a Google initiative used in the Google Maps Application Programming Interface. (Shek, 2010) cites that the above LBS architecture standards can be used in integrating with Geographical Information Systems and as a starting point for data models of Location Based Services applications where detailed geography data is required to be stored or transferred.

This can be appreciated as a good and recommended advice given by the author to integrate the standards into the proposed LBS model since the mapping systems are already in place and are rich in mapping data.

Component	Description
Location Based Services	It is composed of a smartphone component, which has a number of sensors, and potentially a server component that includes application-specific data.
Location Based Services Middleware	Acts as a bridge between Core LBS Features (Location Tracking, GIS Provider and Location Collection Services) LBS applications to provide a consistent interface.
Location Tracking	It stores the location trace of individual users. It contains the data that allow a user's route to be determined and potentially predicted. It functions by keeping records on the user's current and past locations, notifying other components when a specific user has moved, or when they move in or out of an area, determines which users are within a defined location and it requests queries of location trace to generate user movement models.
GIS Provider	It provides geospatial functionality for many LBSs such as map information, map visualization and directory services. A good example is Google Map with its API.
The Location Collection Service (LCS) / Positioning	It obtains the latitude and longitude for a specific user. This component may be accessed via the LBS Middleware (e.g., Mobile network triangulation via a service provider) or directly (e.g., via GPS receiver in the smartphone) depending on the technology.

Table 3: Description of components for modern LBS architecture (Shek, 2010)

CHAPTER 3

RESEARCH METHODOLOGY

This chapter discusses the methods and tools that were used in developing the system/application prototype.

3.1 Research Design

In this study, the researchers carry out a comprehensive literature review on the concepts of Location based services and Prototyping: A prototype is a model of a product or a system in part or in whole used to demonstrate various aspects of a product and as a proof of concept. The rapid prototyping approach involving requirements gathering, quick design, development, refining of requirements and testing, was used in the translation of the geo-location to location.

3.2 Data Collection

3.2.1 Interviews

Semi-structured interviews to understand the interviewee's knowledge and perspective on the beyond zero clinics. The interviews were to understand an individual's experience.

3.2.2 Observations

Was used to obtain more reliable information which provided a basis to verify or nullify information provided in face to face interviews/encounters

3.2.3 Literature Review

Researcher reviewed comprehensive literature on the concepts of Location based services, prototyping, journal articles; as well as reports on Location Based Services technology improvement and developments in the health sector, mobile telephony statistics reports in Kenya, reports on the ICT industry and the Kenya vision 2030 document.

3.3 Data Analysis

3.3.1 Thematic analysis

The procedure for the categorization of verbal or behavioral data for the purpose of classification, summarization and tabulation, either descriptive or interpretative (Hsiu-Fang and Sarah E. Shannon, 2006)

3.4 Beyond zero campaign clinic locator prototype system

The beyond zero campaign clinic locator prototype will support in improving service delivery for the beyond zero campaign initiative. The system prototype enables users to search for the clinic location, services offered and complimentary information such as visiting health specialist, health outreaches scheduled, at any mobile clinic.

The application has been developed using web technologies, languages such as HTML, XHTML, CSS, JavaScript, and PHP, allowing the administrator and users to interact with the system through a standard web browser. The server-side component has been developed on an experimental setup consisting of a web server, a MySQL database server and the PHP scripting language.

The positioning is done by a GPS gadget, mobile telephony networks and android based SMS gateway. Location data is provided by Google Maps API for the Location Based Services, application will connect to the Google Maps API using Android SMS gateway which relays the SMS to the application domain. The Open Geospatial Consortium encourages developers to focus on creating applications rather than concentrating on the Location Based Services core components which have been taken care of by the creation of common standards that are managed by the OGC (Open Geospatial Consortium), (Shek, 2010). Google is a member of the OGC and it has rich geospatial data since it has been around for many years, unlike other online map providers such as Microsoft Bing Maps or Apple Maps (Dobson, 2012; Tejani, 2011).

3.5 Architecture Overview

The mobile telephony network delivers the services to mobile device users through service gateways that connect the positioning systems to the wireless network of the mobile operator and the Location Base Services application. Reichardt (as cited in Dao, Rizos, & Wang, 2002). The Location Based Service application, the third component consists of an application server and a spatial database. The application server operates the user interface functions and communicates with the spatial database via APIs. This component, therefore integrates location based services with the mobile telephony networks.

Open Location Services platform as a standard architectural design can be used to develop Location Based Services software because for it offers interoperability of which emphasizes the widespread adoption of Location Based Services, Reichardt (as cited in Dao, Rizos, & Wang, 2002) cites that achieving the full value of location services will depend on consistent communication across different regions, technology platforms, networks, application domains, and classes of products.

The proposed system will have a three level distributed architecture.

i. The end user level.
ii. The middle layer will comprise of components to be used example the GPS system.
iii. The third level will consist of data repositories that allocate and implement the service requests.

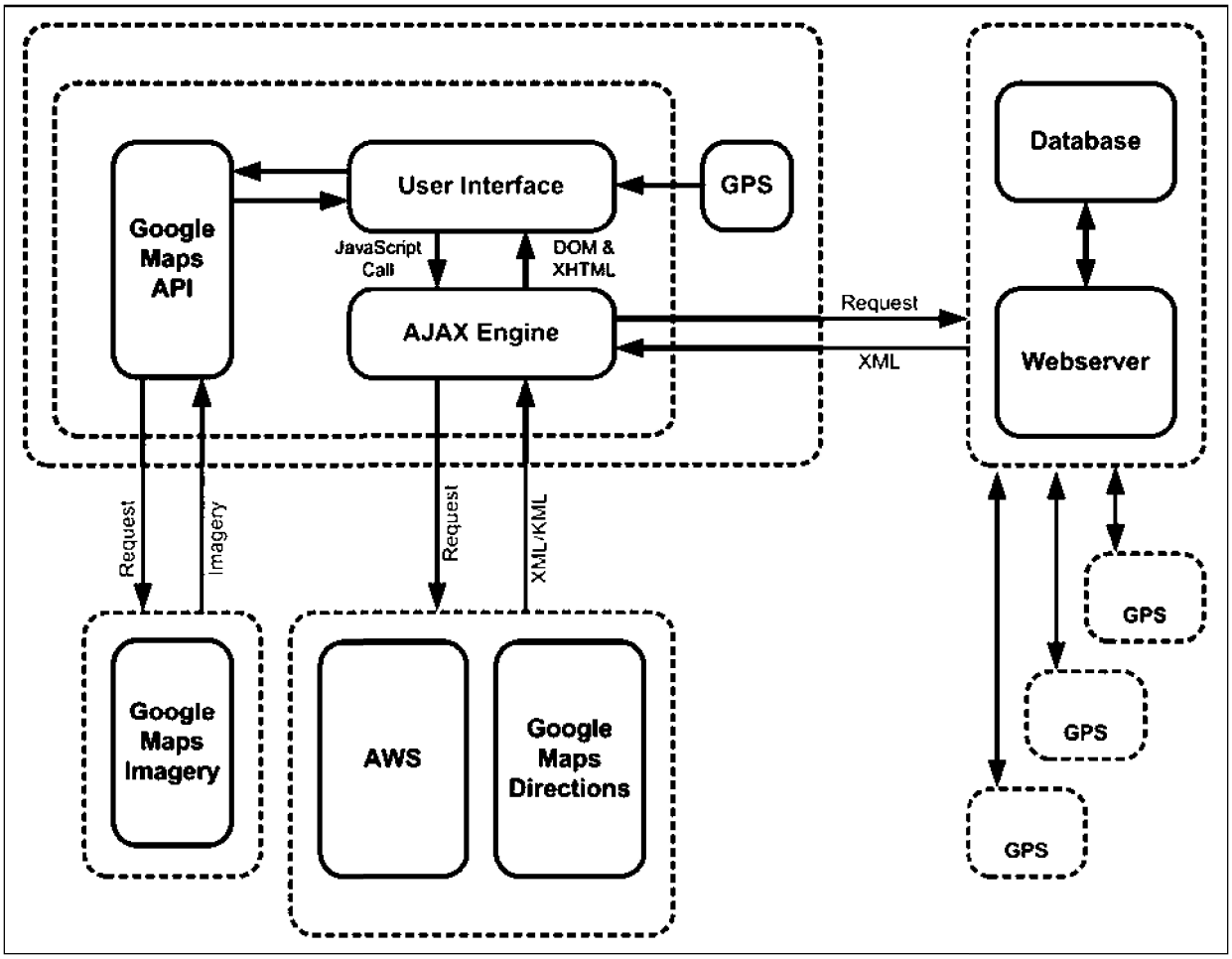

Figure 5: System architecture of the proposed beyond zero campaign LBS Model

3.6 Use Case Model

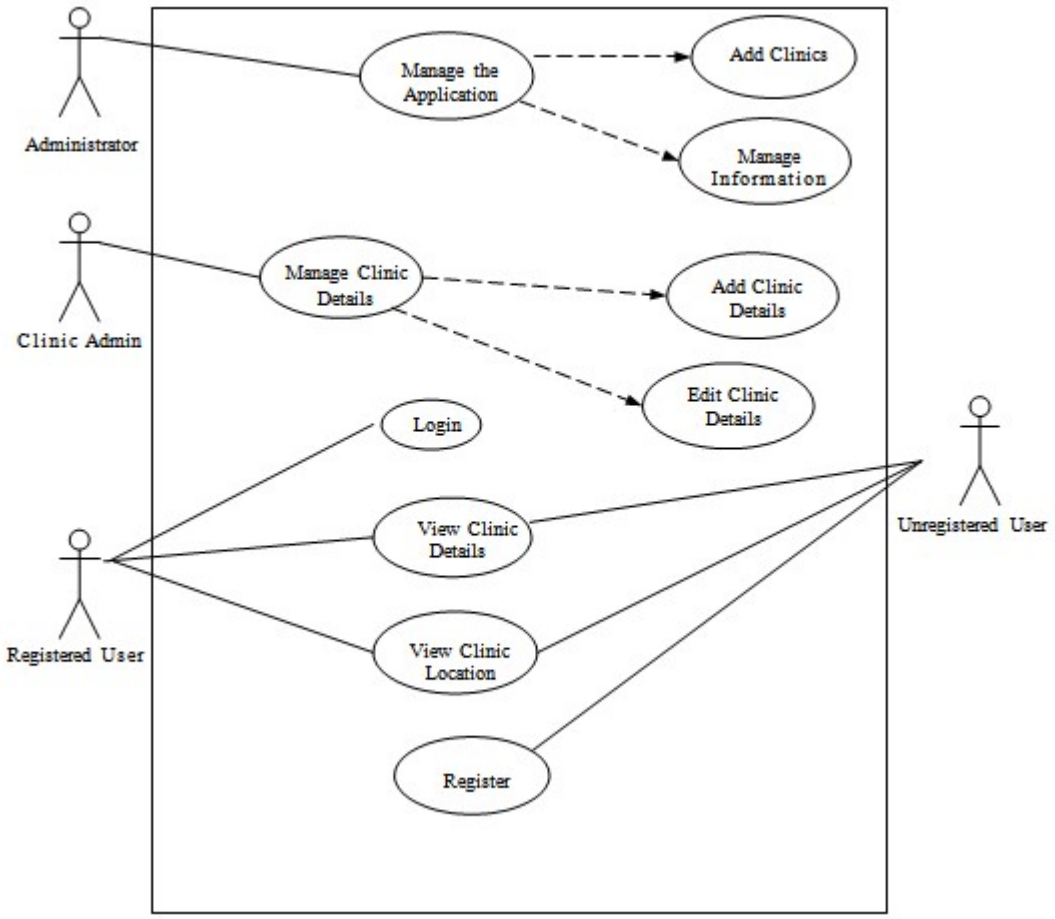

Figure 6: Use Case Diagram

3.7 Ethical Issues

Ethics and governance mechanisms for virtual health technology are still unclear, especially for application on hand- held devices, in September 2013 (FDA, 2013), when the FDA released guidance for the development of mobile medical applications and defined mobile medical applications as those which are intended to be used as an accessory to a regulated medical device or to transform a mobile platform into a regulated

medical device and this was last updated on Februray 2015 (U.S. Food and Drug Administration, 2015)

In Kenya, there is limited information on ethical guidelines regarding the mobile health, therefore the government through the ministry of health should consider enacting legislation that would not only enable law enforcement agencies to access mobile phone information to fight crime, but also limit the ability of these agencies to access or share personal health information. For the purpose of this study, interventions used will be subjected to the same level of privacy requirements as other forms of electronic technology for health that will involve data encryption and consent agreements from the involved parties.

CHAPTER 4
ANALYSIS AND DESIGN

4.1 System requirements

User requirement gathering was carried out using qualitative research methods so as to understand the operations of the beyond zero campaign within Kiambu County and requirement needs which were used to develop the beyond zero campaign clinic locator.

To achieve the above, focus was on a User Centered Design and ethnographic research activities to identify the scope of the project, gather literature materials for review, identification of data collection methods, means of obtaining and understanding the ethics required in the run of the project. These ask involved doing semi-structured interviews and observations to gather user requirements.

4.2 Beyond zero campaign analysis

The Beyond zero campaign initiative offers has launched 47 mobile clinics spread across the counties nationwide that complements the existing health systems at the county and national level on by providing health services to the less privileged women and children in Kenya;

i. maternal and child health,
ii. curative services,
iii. de-worming of the children,
iv. administration of Vitamin A,
v. HIV Counseling and Testing/ Elimination of HIV among children while keeping their mothers alive,
vi. Cervical cancer screening.

By the end of December 2015, 37,807 Kenyans from 15 counties had benefited from the Beyond Zero mobile clinics across the country. The Ministry of Health statistics on beyond zero campaign, 2015 estimate 11,401 women, 9,193 children between 0-5 years, 5,984 children

between 5-14 years old, 1,255 adolescents between 15-24 years and 1,577 pregnant women had been treated at the facilities. The data was collected from Kwale, Kilifi, Taita-Taveta, Marsabit, Isiolo, Tharaka Nithi, Kiambu, Turkana, Samburu, Uasin Gishu, Elgeyo Marakwet, Baringo, Bomet, Narok and Homa-bay counties.

Children 0 – 5 yrs	Children 5 – 14 yrs	Adolescents 15-24 yrs	Women	Pregnant Women	Men	Total
9,193	5,984	1,255	11,401	1,577	8,397	37807

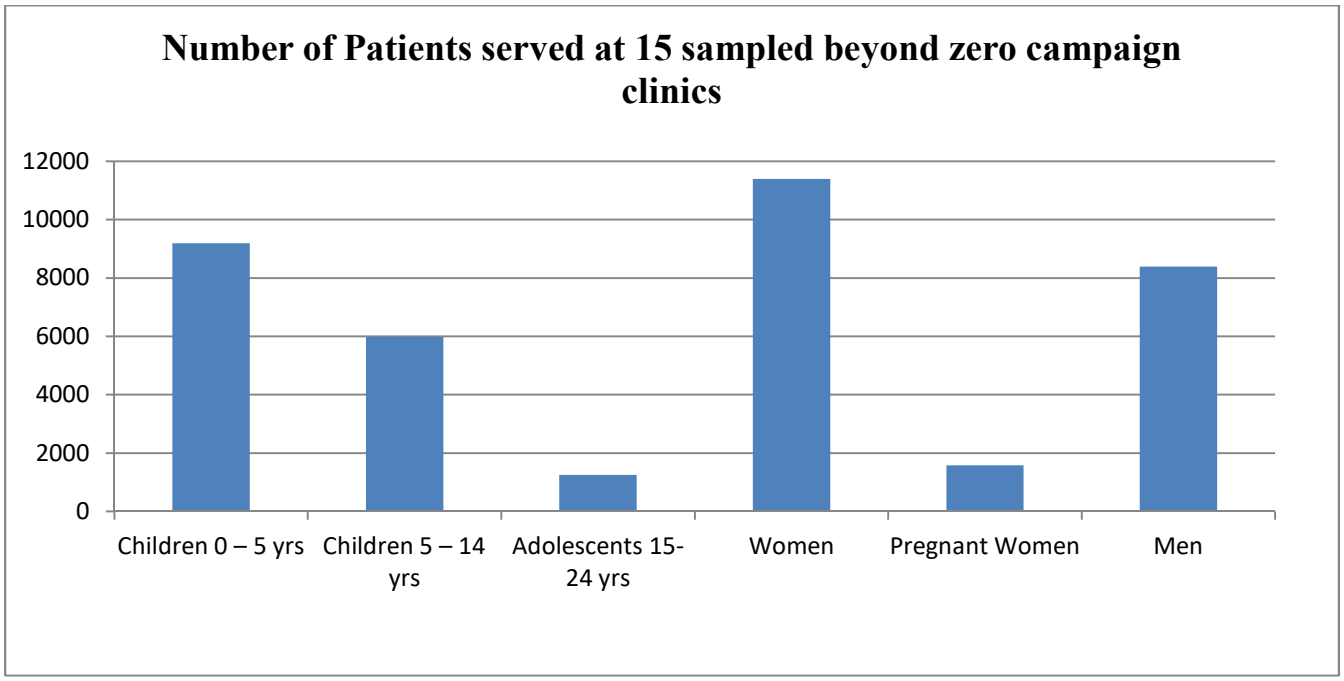

Table 4: Statistics on beyond zero campaign, source: Ministry of Health, Kenya

In Kiambu, Homabay and Elgeyo Marakwet counties recorded the lowest turnout of patients was recorded compared to other counties by recording 299, 195 and 413 patients respectively.

4.3 System Development

For this research, the prototype is implemented on a benchmark experiment. The prototype system uses a client/server structure, the client end interface to operate the web application prototype is a standard web browser, and database used is MySQL and administration done on phpMyAdmin.

SMS gateway	Android Application: SMS Number: 0738388834
Bulk SMS Service	Africa is Talking
GPS (TK110 Model)	Gadget fitted with a GSM SIM card
Development Environment	PHP (Lavarel framework), Java, MysQL and phpMyAdmin
Url	bzcl.jirani-link.co.ke

Table 5: Description of prototype development tool

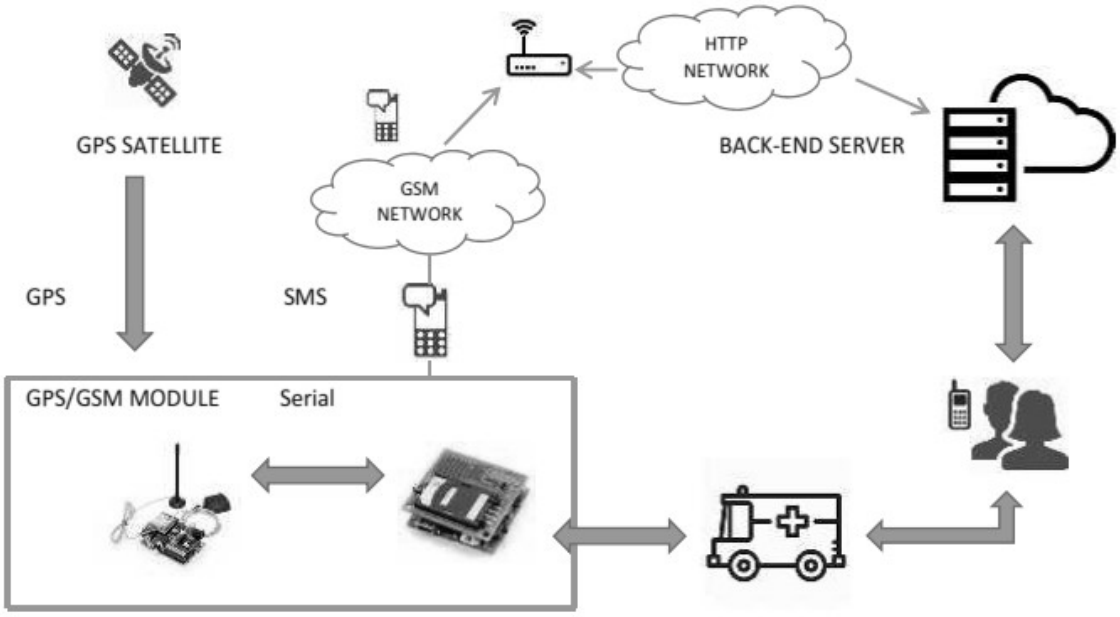

Figure 7: Prototype system structure

4.4 System Overview

The prototype has several modules

i. Van Details, capture the van plate number and physical description,
ii. Physician details to capture the clinic administrator or a visiting specialist and area of specialty,
iii. Van's schedule of where the clinic will be and its activities,
iv. Clinic map location on Google maps,
v. Patient profiles module to capture details of enrolled patients a particular clinic,
vi. A summary of location queries,
    a. To get the location of the clinic a patient sends a text message "location" to 073838884; the message is relayed through an SMS gateway to an http server which relays the location of the clinic to the patient.
    b. A summary of location queries and an SMS outreach messaging to patients.

4.5 System Testing

To detect the system defects', testing was introduced to uncover the errors starting from unit testing; module integration testing and final system testing was carried with documentation at every step. An acceptance test was done by the system users with real-life data. Test report and error report were generated from this task documenting the test cases done and the results and action that was undertaken to resolve the error reports.

4.5.1 Functional Testing

The application was split up into the required modules; data recording, data processing, and data sharing, each performing a very specific function and each module was tested against a set of specific inputs and outputs.

4.5.2 Usability Testing

Once the prototype was ready, it was availed to the users to gain feedback about the following issues.

i. Error Handling - The prototype was able to notify the user if they made errors and direct those, those errors are like, network error among others.

ii. Efficiency- The time taken to input, process data and issue information was found to be acceptable. This was compared with the manual location inquiries, that patient use in parallel with the application.

iii. User interface design- The user interface design analysis was involved in testing on the visibility of instruction and input of data and how they will be visualized to the users. This helped to capture user interference during the use of the system and how they could cope with the situation.

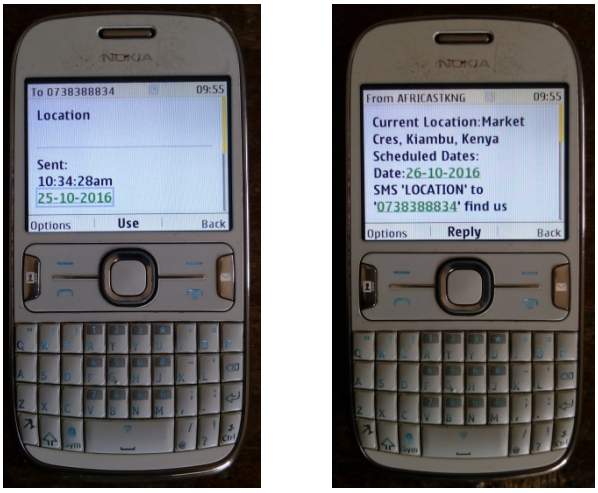

Figure 8: SMS Location inquiry and reply SMS respectively screenshots

CHAPTER FIVE

RESULTS AND DISCUSSION

This chapter consists of results and discussions obtained from data analysis procedures. Methods used for data collection included interviews and questionnaires.

5.1 Test Case

After the application development, various application users were used to undertake the application test during which the following processes were undertaken in the test cases as described in the table below.

TEST CASE: 1 - *Description:* Integration testing of the Input, Output and Alerts.			
Instructions	**Expected Results**	**Actual Results**	**Comments**
i. Launch the application ii. Input data	Correct fill up on input fields results to positive user alert while error gave warning alerts	Input fields that were for data entry were filled-up and gave to give respective feedbacks.	The test was successful and moderation done.
TEST CASE: 2 - *Description*: Location query response time			
Location Query	The duration used to get the response was adequate with no delays (Response under 1 minute)	Time taken by the system to respond was deemed acceptable.	The system's response time was acceptable.
TEST CASE: 3 - *Description*: Data synchronization			
i. Launch the system ii. View clinic location	On location, movement, data is available to all users having the privilege to view it by querying for the location	Time taken to refresh data and to display different mobile clinics was acceptable.	Data synchronization was successful with every movement.
TEST CASE: 4 - *Description*: Usability and navigation			

1. Launch the system. 2. Navigate to handle different tasks. 3. Close task and open other tasks.	The entire task should be able to run independently.	All tasks were easily navigable to and launched.	Navigation was easy with simple guidance by clicking on the menu items (web application).
TEST CASE: 5 *Description*: Error Handling			
i. Start the application ii. Add records	Errors made in choices supposed to be handled before the user navigates out of the activity	The System responded rightfully to the errors	The system handles errors correctly

Table 6: Test case scenarios

5.2 Respondents

Subjects included those who were willing to use beyond zero campaign mobile clinic locator System prototype application and willing to give consent to participate in the research study. A final analysis was performed on data from 11 participants who completed the questionnaire after interaction with the prototype.

5.3 Participants

Subjects included those who were willing to use beyond zero campaign mobile clinic locator System prototype application and willing to give consent to participate in the research study. A final analysis was performed on data from 12 participants who completed the questionnaire after interaction with the prototype.

5.4 Ethics statement

This study was carried out with respondents who agreed to participate in the research and who were ready to test the beyond zero campaign mobile clinic locator application. The study subjects were recruited via interviews and the willing participants given access to, and instruction on how to use the application. The participants would fill the questionnaire forms at

the end. The anonymity of the user information was upheld since the data collected was private and confidential.

5.5 Methods of data collection

A questionnaire on the satisfaction with the beyond zero campaign mobile clinic locator application was used in this study consisted of general information of the subjects and their knowledge of beyond zero campaign mobile clinics. Subjects who agreed to participate in the survey took part in query for the location via SMS using their own personal device.

5.7 Results

Selection of participants was on a rolling basis between August to October 2016. 12 participants were interviewed for the study. During the inclusion period; all the participants met the inclusion criteria; each participant owned a mobile phone regardless of type (smartphone or a feature phone. The participants filled consent forms and were given instructions on how to use the application. In cases where participants did not have a mobile phone they were deemed ineligible to undertake the study.

5.8 Subject Characteristics

Participant	Gender	Age	Location of Residence	Education	Services sort at the mobile clinic
P1	M	32	Juja	Tertiary education	Once
P2	M	26	Kikuyu	Secondary	Never
P3	M	30	Westlands, Nairobi	Tertiary education	Never
P4	F	29	Kangemi	Tertiary education	Never
P5	M	28	Kiambu	Secondary	Never
P6	M	23	Kiambu	Tertiary education	Never
P7	F	31	Kahawa Wendani	Tertiary education	Never
P8	M	25	Muguga	Tertiary education	Never
P9	M	32	Kikuyu	Tertiary education	Never
P10	F	35	Nairobi	Tertiary education	Never
P11	F	27	Kenol, Thika	Secondary	Never

Table 7: Subject Characteristics

From the table above,

Male participants: 7

Female participants: 4

Mean Age of Participants: 29yrs;

5.9 User Satisfaction

The results showed 75% of the participants were satisfied with the application ease of use from its simple Short Message inquiry of the location using any kind of phone, regardless of whether the phone is a smart phone or a feature phone, timely message reply, and real time location with street name and route instead of coordinate (longitude and latitudes), which may take time to translate to location.

The majority of those interviewed at 83.8% agreed that the application can be referenced if more improvements were made for future work. 83.3% of the participants showed were satisfied with the structuring (location inquiry and patient enrolment with Short message reminders of scheduled clinic appointments). From the use of the application, 83.3% agreed that the solution would have a positive effect on locating the mobile clinic, especially for the underprivileged patients.

	Strongly Agree	**Agree**	**Disagre**	**Strongly Disagree**
Are you satisfied with the structure and completeness of the application?	1(8.3%)	10(83.3%)	1(8.3%)	0
Is the application easy to use?	2(16.7%)	9(75%)	1(8.1%)	0
Do you think there will be a positive change if the application is used at by the mobile clinic?	2(16.6%)	10(84.3%)	0	0

Table 8: User Satisfaction

5.10 Discussion

The prototype SMS query results, the application has a satisfying near accuracy with an estimation of 2 to 3 Km to the location of the clinic translated to street name and route based on GPS coordinates. SMS outreach to patients at once as a broadcast message, this can be used to reach out to a large number of patients at once. A patient enrollment module allows a clinic administrator to remind enrolled patients of a scheduled clinic appointment.

The system can reduce the time by which patients search for clinic location in a rural and urban context. The SMS Location Based Service prototype can be implemented to save time and offer patient convenience. Users can easily access the application over the web browser or my SMS query. The model that Polyzos & Ververidis (2012) had suggested required users to register and log in to search for information.

5.10.1 Geo-location

The geographical location factor is the primary key component of the LBS prototype that helps it differ from the reviewed mobile clinics in this research report. The resolve of the clinic's current and exact location is done using HTML5 geo-location API that makes use of a mobile phone's GSM capability.

5.10.2 Limitations of the Study

The limitations of this study include the sample size of the involved population, time constraints, limited access to the beyond zero campaign mobile clinics, there being an ongoing partnership between the beyond zero campaign initiative and the University of Nairobi project for Central Province Response Integration Strengthening and Sustainability Project (CRISSP) in Kiambu County, which offers services and expertise in the elimination of mother to child HIV transmission. And other institutions, namely; Centre for Disease Control and Prevention (CDC), University of Maryland - Institute of Human Virology (UOMSOM-IHV), Futures Group International and the Ministry of Health – Kenya, therefore the prototype was not implemented at the clinic's physical location.

During the testing phase, an encounter was documented where the geo-location functionality was not synchronized with the current GPS position. This could be attributed to GPS service provider

fourth generation coverage. For instance, the application was tested while on location at the college of physical and biological sciences at Chiromo Campus, Nairobi; however, the SMS reply showing the current position was in Ondiri – Kikuyu road at Muguga, Kikuyu.

The geographical location functionality requires high internet data speeds, such as the 3G network for it to function optimally while on 2G network it performed dismally; yet 3G network coverage and data speeds within Nairobi is poor (COFEK, 2012).

CHAPTER SIX
CONCLUSION

The prototype was put through a simulated test experiment with a sample of 11 participants. However, a few variations and issues were identified and therefore would be used as a basis for future research.

6.1 Recommendations

Due to delayed GPS location tracking a more advanced GPS model than the TK110 can be used, Micro Real-Time GPS Tracking Device by BlackOps synchronizes with google APIs.

The application can be hosted in a custom Unix server to allow direct shell run of Cron job utility for automatic patient notification of scheduled clinic appointments, instead of sending a text reminding a patient to attend clinic appointment.

6.2 Future works

A sequential and scalable implementation of the prototype should be carried out to test its scalability and user acceptance by the general public within Nairobi or an identified County where low numbers of patient turn out has been recorded, such as, Kiambu, Homabay and Elgeyo Marakwet. A pilot application of the prototype should first be developed to be tested with a given sample participants. Afterwards a viable production application should be implemented to test its viability in locating the mobile clinic.

This study was affected by time constraints, it is recommended implementing a pilot project in one of the 47 counties especially in where low patient turnout was recorded. This will enable realization of how different constraints will differ quantitatively after being subjected to the intervention tool.

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APPENDIX A: SAMPLE CODE

Location Inquiry sample code

```
  protected function sendLocationMessage(Request $request, $phone) {

    $address = self::getLocationName("-1.169153,36.8271424");
    $van_schedules = self::vanSchedules();
    if (is_string($van_schedules)) {
      $message = "Current Location:" . $address . "\n" . $van_schedules;
    } else {
      $message = "Current Location:" . $address;
    }
    $sms = new AfricasTalkingGateway(Config::get('settings.sms')['username'], Config::get('settings.sms')['key']);

    $result = $sms->sendMessage($phone, $message);
    if (strtolower($result[0]->status) == 'success') {
      return $message;
    }
    logger($result);
    return FALSE;
  }
```

Patient outreach sample code

```
public function sendOutreachMessage(Request $request) {
    $validate = Validator::make($request->all(), [
            'message' => 'required',
            'phone_numbers' => 'required'
    ]);
    if ($validate->fails()) {
      return redirect()->back()->withErrors($validate->errors())->withError('Please check errors on page');
    }
    $ids = $request->get('phone_numbers');
    $contacts = PatientOutreach::whereIn('id', $ids)->get(['phone_number']);
    foreach ($contacts as $contact) {
      $sms = new AfricasTalkingGateway(Config::get('settings.sms')['username'], Config::get('settings.sms')['key']);
      $result = $sms->sendMessage($contact->phone_number, $request->get('message'));
      if (strtolower($result[0]->status) == 'success') {

      }
    }
    return redirect()->route('patient.outreach')->withSuccess('Message Sent to All selected contacts');
  }

}
```

APPENDIX B: QUESTIONNAIRE

INTRODUCTION AND DEFINITIONS

Please read this to have your consent!

Am conducting a survey on a location based service application that uses a SMS query service and a web application, to locate Beyond Zero Campaign mobile clinic. The survey will take at most 5 minutes to complete, additional time to learn and use the application will be added. Any information that you provide will be kept strictly confidential and will not be shown to other people. This is voluntary and you can choose not to answer any or all of the questions if you want; however, I hope that you will participate since your views are important.

1. DEMOGRAPHICS

1.1	What is your gender?			[ ]	Male	[ ]	Female
1.2	What is your age bracket? (*Tick your age group*)	<17 yrs.	18-5yrs.	26-34 Yrs.	35-45Yrs.	46-60Yrs	>60Yr s.
1.3	Where is your location of residence?						
1.4	Duration of residency from 1.3 above?						
1.5	What is the highest level of education you have completed or currently enrolled?			[ ] No schooling completed [ ] Nursery school Primary		[ ] Some high school, no diploma [ ] Tertiary education (Diploma >)	

2. BEYOND ZERO CAMPAIGN APPLICATION

2.1	Have you ever sort out services at a Beyond Zero Campaign Mobile Clinic?	[ ] Yes	[ ] No
2.2	If yes, Specify (e.g, maternal, curative, deworming)		
2.3	How many times have you used beyond zero campaign services?	[ ] 0 – 5 [ ] 6 – 10 [ ] Never	[ ] 10 – 15 [ ] 16 – 20
2.4	How did you know where the mobile clinic would be located?	[ ] Friend [ ] Chief's public baraza [ ] Church announcements [ ] other (specify)_____	[ ] Advertisement
2.5	Do you have a mobile phone, and use it for location based services (e.g finding a location of school hospital)	[ ] Yes	[ ] No
2.6	If yes, state the application used.		
2.6.1	After using the Beyond Zero Mobile Clinic Locator application provided, please fill up below		
2.7	Do you always feel like you Know what to do and where to click?		[ ] Yes [ ] No
2.8	Have you done something and got an unexpected result?		[ ] Yes [ ] No

2.9	How quickly could you get what you wanted with this application?	
2.10	Did the application act and feel like other, more familiar applications?	
2.11	Did you find the application efficient to use?	

3. APP NAVIGATION						
	Tick the one that fits your rating.	strongly disagree	disagree	undecided	agree	Strongly Agree
3.1	Is the interfaces of the application pleasant?	[ ]	[ ]	[ ]	[ ]	[ ]
3.2	Is the main navigation easily accessible?	[ ]	[ ]	[ ]	[ ]	[ ]
3.3	Are the navigation labels clear and concise?	[ ]	[ ]	[ ]	[ ]	[ ]
3.4	Are the links consistent and easy to clicks?	[ ]	[ ]	[ ]	[ ]	[ ]
3.5	Are the number of entry fields reasonable?	[ ]	[ ]	[ ]	[ ]	[ ]
3.6	Which field/content can be added?					

4. USER SATISFACTION						
	Tick the one that fits your rating.	strongly disagree	disagree	undecided	agree	Strongly Agree
4.1	Are you satisfied with the structure and completeness of the application?	[ ]	[ ]	[ ]	[ ]	[ ]
4.2	Is the application easy to use?	[ ]	[ ]	[ ]	[ ]	[ ]
4.3	Do you think there will be positive changes after the use of the application?	[ ]	[ ]	[ ]	[ ]	[ ]

5. APPLICATION INTERACTION AND INFORMATION						
	Tick the one that fits	strongly disagree	disagree	undecided	agree	Strongly Agree
5.1	Does the application give error messages that clearly show you how to resolve them?	[ ]	[ ]	[ ]	[ ]	[ ]
5.2	Does the application recovery easily and quickly with every mistake made?	[ ]	[ ]	[ ]	[ ]	[ ]
5.3	Is it always easy to find the information you need each and every time?	[ ]	[ ]	[ ]	[ ]	[ ]

5.4	In such situation, was the information effective in helping you complete task?	[ ]	[ ]	[ ]	[ ]	[ ]
5.5	Was the organization of such information on the website clear?	[ ]	[ ]	[ ]	[ ]	[ ]

6. APPLICATION EXPERIENCE		
	Tick the one that fits	
6.1	How professional is this application?	[ ] Extremely professional [ ] Very professional [ ] Slightly professional [ ] Not at all professional
6.2	How convenient is the application to use?	[ ] Extremely convenient [ ] Very convenient [ ] Slightly convenient [ ] Not at all convenient
6.3	How well do you feel that the application understands and assists on providing location services?	[ ] Extremely well [ ] Quite well [ ] Moderately well [ ] Slightly well [ ] Not at all well
6.4	In your own words, what are the things that you like most about the application?	
6.5	In your own words, what are the things that you would like to be improved on the application?	

Declaration	
Name (Optional):	Date: _ _ / _ _ / 2016
Sign: …….	

Thank You for your Time