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# A Mobile application to track pension payments: a case for pensions department in Kenya

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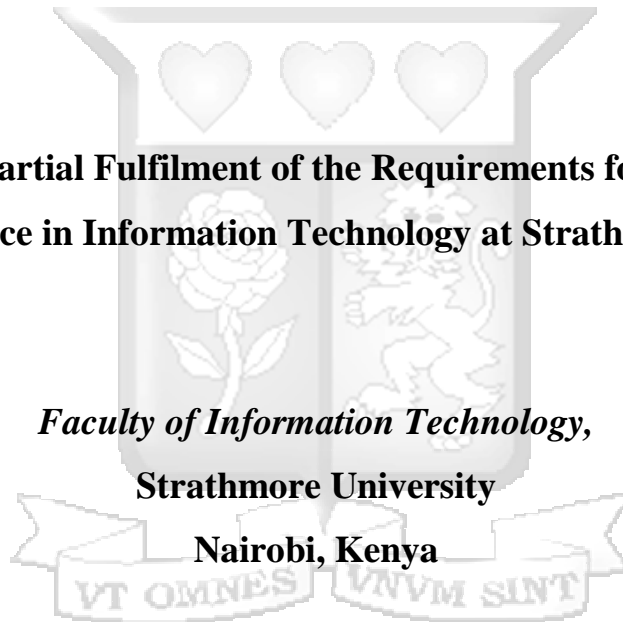
**A MOBILE APPLICATION TO TRACK PENSION PAYMENTS:  
A CASE FOR PENSIONS DEPARTMENT IN KENYA**

**Arthur Odongo**

**Submitted in Partial Fulfilment of the Requirements for the Degree of  
Master of Science in Information Technology at Strathmore University**

*Faculty of Information Technology,*  
**Strathmore University**

**Nairobi, Kenya**



**June, 2019**

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Arthur Odongo

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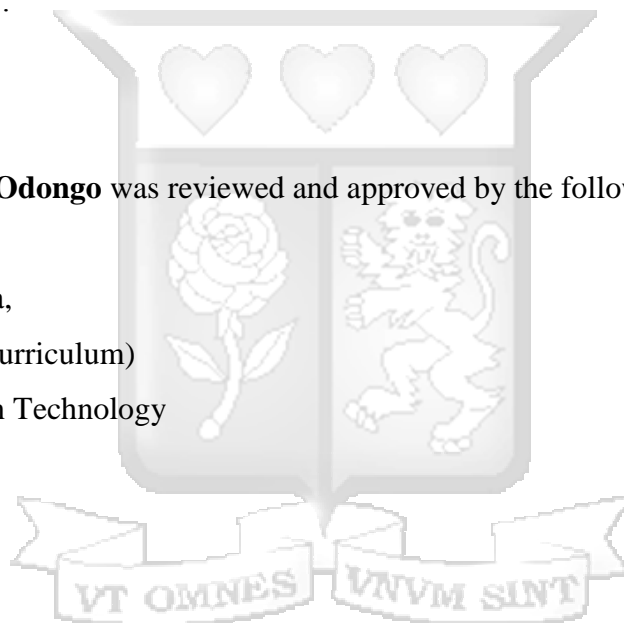
## Approval

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## **Abstract**

According to the existing terms and conditions of service especially for the permanent and pensionable officers in public service in Kenya, officers expect terminal benefits as an incentive for the services they rendered to the country for a number of years of their working life. These terminal benefits are referred to as pension in this study, which is simply the amount set aside either by employer, employee or both to ensure that at retirement there is something for employees to fall back on as an income so that they are not stranded financially. All public service retirees or pensioners are aware that they are entitled to some pension benefits. However, most pensioners do not know what their benefits are as well as not knowing how to access the benefits due to lack of reliable, effective and efficient methods of interaction between them and the Pensions Department. This leads to suffering and hardship of pensioners and their dependents and beneficiaries of deceased public servants associated with delay in the processing and payment of pension. Current methods used for interacting with pensioners are through the media, sending letters or pensioners visiting the Pensions Department in Nairobi. These methods are costly, inefficient and unreliable.

These challenges and weaknesses necessitated the development of a mobile application exclusively for the civil service pensioners whose pension is disbursed through the Pensions Department. The application helps pensioners interact directly with the Pensions Department by tracking their pension payments through an interactive menu-based Unstructured Supplementary Service Data application that provides feedback and notifications through a Short Message Service. The study used a V-shaped software development model to design, develop and test the application. The application was tested to show that pensioners can interact directly with the Department and access pension services using a mobile phone. Findings from usability testing illustrated that pensioners appreciated that the application was simple to use, provided clear feedback and instructions as well as being easy to learn, even for the first time. Overall, they were satisfied using the application and agreed to recommend it to other pensioners. Feedback from the respondents testing the application showed they liked the idea that such a digital tool could be accessed using any mobile phone without Internet connectivity or the need to download it. The application helped them familiarise themselves with the pensions processes by providing them with feedback or alerts as they tracked their payments till the payment stage. The study concluded by recommending the

adoption of the application by the Pensions Department in Kenya and in other African countries with such public pension schemes.

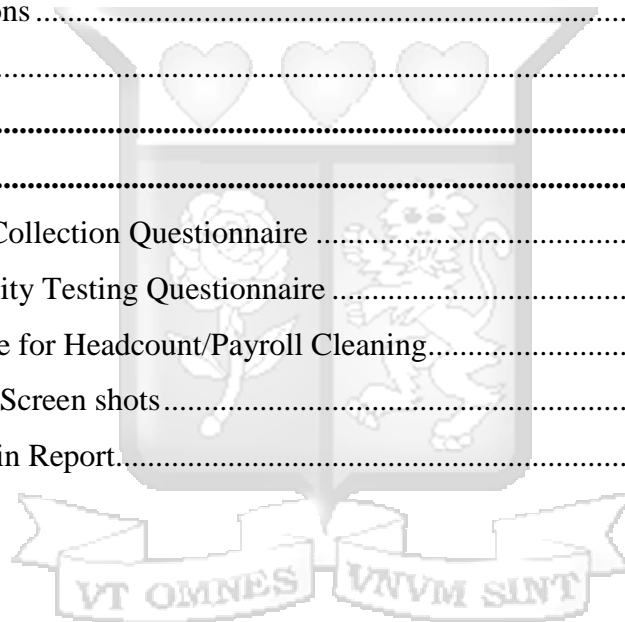
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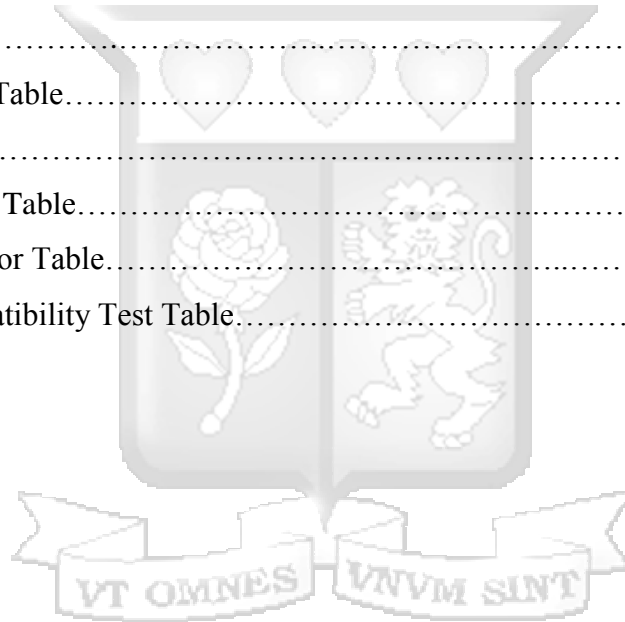
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## Acronyms

CAJ	-	Commission on Administrative Justice
CSPS	-	Civil Servants Pensions Scheme
DWH	-	Data Warehouse
EACC	-	Ethics and Anti-Corruption Commission
ERD	-	Entity Relationship Diagram
GSM	-	Global System for Mobile Communications
HLR	-	Home Location Register
HTML	-	Hypertext Markup Language
IRS	-	Individual Retirement Schemes
ITU	-	International Telecommunication Union
KACC	-	Kenya Anti-Corruption Commission
MAP	-	Mobile Application Part
MMS	-	Multimedia Messaging Service
MSC	-	Mobile Switching Center
NSSF	-	National Social Security Fund
OECD	-	Organisation for Economic Co-operation and Development
PF Number	-	Personal File Number
PIN	-	Personal Identification Number
PMIS	-	Pensions Management Information system
SMPP	-	Simple Messaging Peer-Peer
SMS	-	Short message service
SMSC	-	Short Message Service Center
TSC Number	-	Teachers Services Commission Number
USSD	-	Unstructured Supplementary Service Data
VLR	-	Visitor Location Register
WAP	-	Wireless Application Protocol

## Acknowledgment

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Special thanks go to Strathmore University's Faculty of Information Technology for the greatest opportunity they have given me to study this course and also work on my thesis.

I also thank the Pensions Department at the National Treasury for allowing me collect and use their data for this research. Finally to my dedicated supervisor Dr. Vincent Omwenga for his guidance towards the preparation and completion of the research I say God Bless you.



## Dedication

I dedicate this research to God Almighty for His grace, mercy and blessings that have seen me through this program.

To my parents, wife Irine and our children Ivy, Iva, Alvira and Baby Ivanna I pray that the time I have taken does not discourage any of you in your academic journeys since you have encourage me as I struggled.



## Chapter One: Introduction

### 1.1 Background

According to Raichura (2008) the Kenyan Retirement Benefits Plan fund system has four types of schemes: Individual Retirement Schemes (IRS), The National Social Security Fund (NSSF), Occupational Retirement Schemes (ORS) and Civil Servants Pension Scheme (CSPS).

IRS is usually operated by financial and insurance firms that offer a savings plan for employers who do not have their own individual plans, and for employees who anticipate making extra deliberate contributions. IRS is regulated by the Retirement Benefits Authority (RBA) in accordance with the Retirement Benefits Act No. 3 of 1997 (Raichura, 2008).

Kibet and Simiyu (2016) explained that NSSF was established in 1965 through an Act of Parliament Cap 258 of the Laws of Kenya. The Fund initially operated as a Department of the Ministry of Labour until 1987 when the NSSF Act was amended transforming the Fund into a State Corporation under the Management of a Board of Trustees. The Act was established as a mandatory national scheme whose main objective was to provide basic financial security benefits to Kenyan upon retirement. The Fund was set up as a Provident Fund providing benefits in the form of a lump sum.

Further, in 2013 NSSF Act, No.45 transformed NSSF from a Provident Fund to a Pension Scheme through which every Kenyan with an income shall contribute a percentage of their gross earnings so as to be guaranteed basic compensation in case of permanent disability, basic assistance to needy dependants in case of death and a monthly life pension upon retirement. The Act establishes two funds namely, the Pension Fund and the Provident Fund, to provide for contributions and payment of benefits out of the Funds (Kibet & Simiyu, 2016).

Chitembwe (2007) illustrates ORSs are employer sponsored arrangements, set up under irrevocable trust. Upon being set up, the scheme is a separate legal entity. The principle objective of setting up an Occupational Retirement Benefits Scheme is to provide for employees upon their retirement or for their dependants on the unfortunate demise of an employee. ORS can either be a defined contribution scheme, or defined benefit scheme. With the defined contribution scheme, which has proven to be very popular in Kenya, the amount or rate of contribution is determined at the start of the scheme. At the time of

retirement, the overall benefit is determined by the total amount of contributions and the accrued interest earned on the contributions.

Finally, the CSPA is a scheme for public employees, judiciary workforce, military workforce, Kenya armed forces, parliamentarians and teachers. CSPA offers benefits counting old age, pension, compensation and injury, benefits of continued existence, and dependents pension for 5 years immediately after a pensioner's death, pension on disability in accordance with the Pensions Act CAP 189 of Kenya.

The Pensions Department, that operates under the National Treasury, administers the CSPA in Kenya; its mandate is founded by the Pensions Act and several other statutes, it does the processing and settlement of pensions, death gratuities and other benefits for retired, deceased or terminated officers from public service, it is also mandated to implement and periodically review Pensions Acts and other relevant Acts and Regulations related to pensions and, advise the government on the pensions policy of the public service.

## **1.2 Problem Statement**

Retirement from the Civil Service in Kenya is usually welcomed with a sense of uncertainty since the retirees are always not in a position to tell when and how to access their benefits and entitlements from the Pensions Department. Even after presenting all the required documents and records upon leaving the service, they might not be informed sufficiently about how long the processing of their payments will take. This is due to lack of reliable interaction between the pensioners and the Pensions Department.

The traditional interaction methods being used by the Department are newspapers, radio, television, the Internet and outreach events have many shortcomings. When using radio communication, there is need to make topic fit the format of the radio station. For newspapers the items needs to be newsworthy, televisions sets may not be available in some locales and access to the Internet may not be available in some areas (Gitonga, 2017).

Research by Christopher et al. (2006) on mood maintain theory suggests that when positive emotions are present, people – including retirees, are motivated to engage in activities that will allow them to maintain a positive mood and to avoid activities that would make positive emotions disappear. Meaning, the creation of positive vibes by the employer departments makes it possible for an individual to face retirement with a positive attitude; this positive mood can only be maintained by public service pensioners in Kenya through reliable interactions with the Pensions Department that updates them on their pension payments.



Based on the above shortcomings and recommendations, this study developed an Unstructured Supplementary Service Data (USSD) mobile application that allows direct interaction between the pensioners and the Pensions Department. This application enables them track their pension payments and receive regular notifications from the Pensions Department through a Short Message Service (SMS). Continuous interaction between the pensioners and the Pensions Department is necessary and helpful because the processing of pensions and gratuity involves other entities which make most payments face a lot of procedural tailbacks.

### **1.3 Aim of Research**

The aim of this research was to develop a USSD mobile application that enables pensioners track payments of their pension at the Pensions Department.

### **1.4 Research Objectives**

- i. To evaluate the challenges civil service pensioners face in seeking information from the Pensions Department.
- ii. To investigate how the Pensions Department interacts with Civil Service pensioners in Kenya.
- iii. To analyse the existing technology options to support interaction between the Pensions Department and the Civil Service pensioners.
- iv. To develop a USSD mobile application that enables interaction between the Civil Service pensioners and the Pensions Department in Kenya.
- v. To test the USSD mobile application with Civil Service pensioners in Kenya.

### **1.5 Research Questions**

- i. What are the challenges faced by civil service pensioners in seeking information from the Pensions Department?
- ii. How does the Pensions Department interact with civil service pensioners in Kenya?
- iii. What are the existing technology options to support interaction between the civil service pensioners the Pensions Department?
- iv. How can a USSD mobile application used to enable interaction between the civil service pensioners and the Pensions Department in Kenya be developed?
- v. How can the USSD mobile application be tested?

## **1.6 Justification of the Research**

This study explored the use of a USSD mobile application to track pension payments for the retired public servants at the Pensions Department, and enable direct interaction between the pensioners and the Pensions Department. The impact caused by challenges of the existing methods of interaction is huge and severe on the welfare pensioners and their dependants. The application minimises the risk of leakage of confidential information (KACC, 2008) at times third parties get information before the Department informs the pensioner or the dependent of the payments.

Further this application provides solutions for (KACC, 2008) and (CAJ, 2016) that operations of the Pensions Department are centralised at the head office in Nairobi, implying that majority of pensioners, dependents and guardians travel to Nairobi for any form of enquires with this application no charges are applicable for the transactions and no Internet connection is required to access the service.

The application serves as one stop information and communication source for pensioners of government in Kenya (especially central government civil service pensioners) across the country. With this application in place the Pensions Department has put in place a strategy to interact with, and provide feedback and inform the pensioners until finalization of their pension's payment process.

## **1.7 The Scope of Study**

The USSD mobile application developed in this study only enables interaction between the Civil Service pensioners and the Pensions Department in Kenya, USSD applications can work without the Internet and on any mobile phone. The system offered pensioners a mobile application that allowed them to track their pension benefits.

## **1.8 Limitation of the Research**

The first limitation of this study was access to data and information since pension records and documents are confidential, the Pensions Department allowed limited access to the Pension Management Information System (PMIS), physical forms and records used in the processing of payments. Another limitation was the lack of reliable data on the exact number of pensioners, dependants and guardians that necessitated a countrywide headcount from 11<sup>th</sup> February 2019 to 3<sup>rd</sup> May 2019 at Huduma Centers, as shown by the notice in appendix C.

## Chapter 2: Literature Review

### 2.1 Introduction


This chapter reviewed existing literature relevant to the study. The chapter provided basic knowledge about the issues or problems that pensioners seek information about from the Pensions Department, challenges faced by pensioners when seeking information; interaction methods used by the Pensions Department in Kenya and Further, the existing technology options to support interaction between the Pensions Department and pensioners were introduced. Likewise, the necessary literature on the technology, elements and the USSD architecture and how it relates to the proposed system were discussed in this chapter.

### 2.2 Issues or Problems that Pensioners Seek Information about from the Pensions Department

There was limited literature available on the issues or problems that pensioners seek information about from the Pensions Departments for purposes of comparative analysis.

(a) Pensions Department (2018) customized a list of the issues on a hard-copy and named it an attendance slip as illustrated in Figure 2.1. The slip is filled by pensioners who select the kind of issue or problem that they are seeking information regarding the different pensions services offered the Pensions Department for them to be served by the relevant officer in the Department.

THE NATIONAL TREASURY



REPUBLIC OF KENYA  
PENSIONS DEPARTMENT  
P.O. Box 20191 – 00200 NAIROBI  
Tel: 020 2252299, 0728 338 111, 0733 660 606  
Email: pensions@treasury.go.ke

**ATTENDANCE SLIP**

Date: October, 2018	Serial Number:
<b>PART I (To be completed by customer/visitor)</b>	
Name of customer/ visitor: _____	
Personal contact (Mobile No.): _____	
<b>Issue/ problem: (Tick box as appropriate)</b> i. Pension Status <input type="checkbox"/> ii. Pension File Number <input type="checkbox"/> iii. Return of forms <input type="checkbox"/>	
iv. Stoppage of Pension <input type="checkbox"/> v. Death Notification <input type="checkbox"/> vi. Adjustment of records <input type="checkbox"/> vii. Request for forms <input type="checkbox"/>	
viii. Enrollment of Dependants <input type="checkbox"/> ix. Change of Account/ pay point <input type="checkbox"/> x. Application <input type="checkbox"/> xi. General complaint <input type="checkbox"/>	
xii. Any other problem (specify here) _____	
Reference Number (APN/PC or PF/No. or TSC No.): _____	
Name of Pensioner or Dependand: _____	

**Figure 2.1 Attendance Slip (Adapted from Pensions Department, 2018)**

The issues or problems from above figure are listed below;

- i). Pension status
- ii). Pension file number

- iii). Return of forms
- iv). Stoppage of pension
- v). Death notification adjust records
- vi). Register forms
- vii). Enrollment of dependents
- viii). Change of Account/pay point
- ix). Application
- x). General complaints and any other problem

(b) The Public Pension Agency (PPA) of Saudi Arabia. PPA is public agency in the Kingdom of Saudi Arabia that provides many services to retired persons; it disburses pensions to pensioners for civil and military personnel who have referred to retirement and pays monthly pensions to beneficiaries of deceased pensioner's family.

The PPA digitised issues that Saudi Arabian pensioners seek information about from the agency and automated some of the services on its interactive web portal where pensioners interact with the PPA online through <http://www.pension.gov.sa> an address of the PPA web portal that displays the issues and services as listed below;

**i). Pension Value**

This service enables pensioners know the actual value of their monthly retirement pension.

**ii). Statement of Service Terms**

This service provides pensioners with a statement of their service terms including the entity they worked for, service commencement date, service termination date and the calculated term for the purpose of retirement.

**iii). Update my Information**

This service allows pensioners to electronically update their personal information registered with the PPA (e.g. residence, mobile number and email) without the need for reference to the PPA headquarters to update the same.

**iv). Military Retirement**

Through this service the military personnel can get their provisional retirement periods spent during military service without paying the subscription. Pensioners are provided by a list containing the provisional retirement period (from / to) and the value required for each period.

**v). Adding a Beneficiary**

Through this service pensioners can input all information and data of their family members to register the same accurately on the PPA databases to facilitate communication with them easily when required.

**vi). Account Statement**

This service provides pensioners with a detailed account statement of the swift transfers, transfer value and the date thereof.

**vii). Cash Status**

This service displays the amount to be deposited in the pensioners account, Account Number and the deposit date.

**viii). Name Modification**

Pensioners can modify their name in PPA database using this service, and uploading the required documents that proofing this modification such as (A copy of your ID). A message will be displayed as soon as the service accomplished.

**ix). Pension Status**

This service displays the value of pensioner's monthly pension and the pension status (activated or deactivated) and the deactivation reason if deactivated.

**x). Beneficiaries' Data**

This service provides a detailed list of the names of all beneficiaries and the relationship of each beneficiary to the original retiree and the share of each beneficiary and the status of its monthly pension (activated or deactivated) in addition to the name of the disburser.

**xi). Beneficiaries' Names**

By entering the deceased retiree's civil registration number, users can get to know all names of the beneficiaries represented by such retiree.

**xii). Account Statement**

This service provides pensioners with a detailed account statement of the swift transfers, transfer value and the date thereof.

**xiii). Cash Status**

This service displays the amount to be deposited in pensioners account, account number and the deposit date.

**(c) Pensions Department Services**

Table 2.1 lists the one or more benefits that eligible civil servants or their dependants are paid by the Pensions Department in accordance with the Pensions Act (Cap.189), processing of

pension claims is done through a workflow process that is followed after the pensioners files have been submitted by ministries, the work flow has the these steps and processes; Claims, Registry, Assessment, External Audit, Approval, Accounts, Cash office and Dispatch.

**Table 2.1 Services offered by the Pensions Department**

	<b>Type of Service</b>
1	Service pension plus commuted pension
2	Service gratuity
3	Marriage gratuity
4	Injury pension
5	Death gratuity
6	Dependants pension
7	Compassionate gratuity
8	Annual allowance

### **2.3 Challenges Faced by Pensioners When Seeking Information from the Pension Department**

Investigations by CAJ (2016) revealed the main challenges faced in the processing and payment of pensions to retirees included poor records management, centralisation of services, long distances, corruption, bureaucratic processes, inaccessibility of pension officers and offices at the Pensions Department and the fact that some employers or ministries and agencies did not maintain up-to-date employees records, including provision of proper and updated information on next of keen or beneficiaries when needed by Pensions Department for processing pension payments. Table 2.2 shows the summary of the finding on systematic issues faced in payment of retirement benefits in Kenya.

**Table 2.2 Systematic Issues Faced in Payment of Retirement Benefits (Adapted from CAJ, 2016)**

<b>Systematic Issues</b>	<b>No. of Respondents</b>	<b>Percentage</b>
Centralization of services	27	19.9
Bureaucratic processes	20	14.7
Lack of Communication	12	8.8
Misunderstanding when identifying beneficiaries	7	5.1
Corruption in the system	19	14.0
Chief withholding information when identifying beneficiaries	6	4.4
Lack of cooperation between concerned offices	10	7.4
Technological problems and poor policies	6	4.4
Delay	5	3.7
Incomplete forms	4	2.9
Shortage of staff	5	3.7

Don't know	10	0.7
No response	14	10.3
<b>Total</b>	<b>136</b>	<b>100</b>

Centralisation of pension services in Nairobi presented a challenge to majority of respondents since they must travel long distances to Nairobi for very basic services, however, with a mobile application these services are accessed using a phone and therefore eliminated unnecessary travel, this application also solves the lack of communication, and technological problems and reduces corruption since there is minimum human interaction.

#### **2.4 Interaction Methods used by Pensions Departments in Africa**

In order to provide services or goods, organizations interact with their clients or other organizations using various methods be they operational (manual), electronic and or mobile, that provide significant opportunities to enhance service delivery in both private and public sector. This section gives examples of how Pensions Departments in Africa interacts with pensioners and how the in order to improve service delivery.

Governments in the majority of developing countries have poor reputations with respect to service delivery which, in many cases, involves repetitive and manual operations in government offices. Low throughput coupled with traditional communication channels are expensive and require intensive human processing (Bassara et al. 2005).

Research by (Maduga, 2015) on how social security institutions communicate to the public in Tanzania concluded that the nature and spread of social security beneficiaries among the community members convinced service providers to go for mass communication.

Tools such as newspapers, national radio and television channels are the first choice in day to day information. Leaflets, newspaper adverts and seminars are regular features addressing members and the general public in Tanzania. Almost all social security organisations in the country have launched and are maintaining their own websites. They participate in regional and national exhibitions, demonstrating and displaying their works (Maduga, 2015).

#### **2.5 Interaction Methods used by the Pensions Department in Kenya**

The following are some of the methods used by the Pensions Department when delivering services and interacting with the pensioners as illustrated by (OECD, 2013) survey on improving pensions information and communication, further Peelen (2005) defines the

various types of interaction points used by organizations namely, the Media which includes television and radio, Websites, E-mails, Telephones Personal Sales and Service Employees.

### 2.5.1 The Media

OECD (1996) opined that to reach large numbers of the population, governments everywhere rely heavily the media. This includes a diverse range of channels, for example television, radio, newspapers / journals (independent articles, placed articles and advertorials), and press releases. The media plays an intermediary role by filtering and analyzing information from the government to the citizens as the media seeks to communicate with the population.

Figure 2.2 by Gitonga (2017) illustrates the advantages and limitations of each type of media channel and how it can be used by an organization; further Appendix C shows a newspaper notice for a countrywide headcount of all pensioners, dependants and guardians from 11<sup>th</sup> February 2019 to 3<sup>rd</sup> May 2019 at Huduma centers.

Channel of communication	Method of communication	Advantages	Limitations
Interpersonal communication	Seminars and workshops	Viewed as credible  Allows for 2-way discussion	Can be expensive Requires time Audience limited
Outreach events	Parades, runs, walks  Town hall meetings  Workplace campaigns	May be familiar, trusted, and influential  Can be motivational  Can reach a large audience in one place	Requires a fair amount of coordination from several partners  Requires time
Newspaper	Feature articles  Advertisements  Letters to the editor	Can reach a broad audience rapidly  Can convey information more thoroughly than radio or TV  Faster than magazine outreach	Item needs to be newsworthy  Exposure is limited to one day  Article placement may vary
Radio	News Advertisements (public service announcements) Talk shows	May be the main form of media in some locales  Range of formats Opportunity to direct messages toward target audience	Need to make topic fit the format of the radio station  Difficult for intended audience to retain or pass on information
Television	News Advertisements	Can reach a wide range of audiences, Visual and audio	May not be available in some locales  Message can get lost in other commercial messages
Internet	Web sites  Social networking sites  Newsgroups	Can reach a large number of people rapidly  Can be tailored for the intended audience  Can be updated quickly and provide information in a graphically appealing way	May not be available in some areas  Requires that target audience is connected and looking for the information

**Figure 2.2 Advantages and Limitations of Different Media Channels (Adapted from Gitonga, 2017)**



Press releases are a very specific and narrow proxy for government communication activities, but previous studies have found that they provide essential policy information, as desired by the government, and have a more consistent impact on public perceptions than any other form of government communication (Sounman, 2016)

### **2.5.2 Website, E-mail and the Internet**

According to the World Bank (2010) the use by government agencies of information technologies, such as Wide Area Networks, the Internet, and mobile computing, that have the ability to transform relations with citizens, businesses and other arms of government is referred to as e-government.

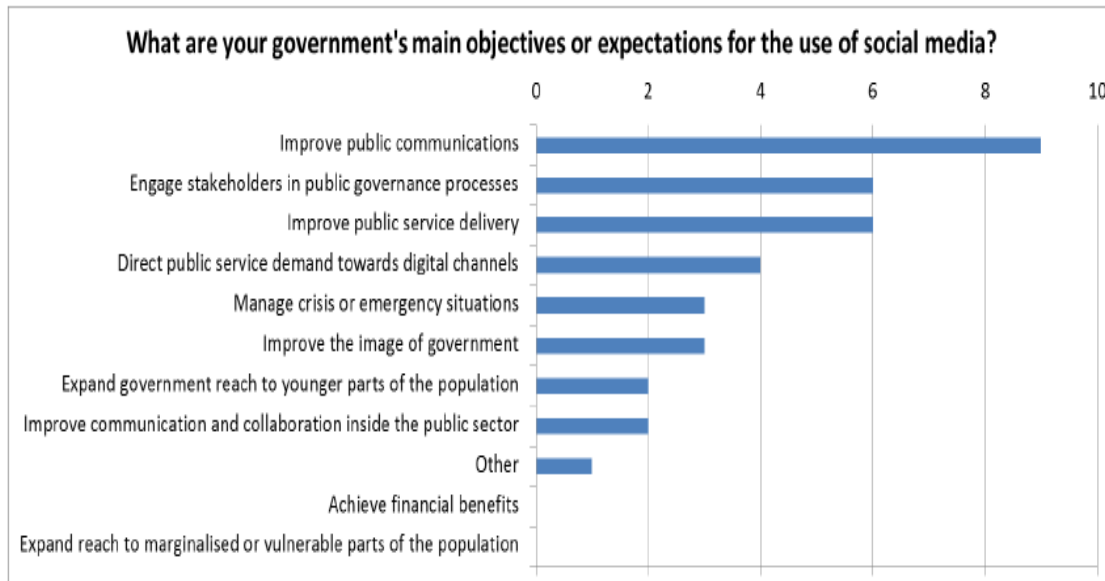
E-Government has come to decrease the use of the main means of traditional contact, such as phones, face-to-face and postal mail, with public agencies, there is no doubt that the adoption of e-Government makes life easy for both citizens and the government (World Bank, 2010).

OECD (2013) illustrates that a website is a central distribution channel for information for the target audience, which typically is the working population but might also include schools and colleges, and retirees. The site might be a section on the supervisor's website or there might be a dedicated website for the new system. In some cases the website will be the result of collaboration between the supervisor and private providers.

The site communicates information and might also encourage member engagement through the provision of a pension calculator, among other features, using e-mail in both private and public sector is one of ways to improve customer service by more quickly responding to certain needs or help request (OECD 2013).

### **2.5.3 Social Media**

A survey on governments use of social media by OECD (2013) got responses from 12 member countries indicating that the primary objective for governments is to improve communications, followed by stakeholder engagement and service delivery improvements as illustrated in Figure 2.3, In a sense this illustrates that social media are as of today still mainly regarded as means to diffuse information and secondly to improve consultation or even active participation as part of better government-citizen relations (Mickoleit, 2014).



**Figure 2.3 Main Objectives or Expectations for the use of Social Media (Adapted from OECD, 2013)**

According to internet world statistics (2018) there were 7 Million Facebook users in Kenya in December 2017 with a market share of 67.49%, Twitter had a market share of 9.74% and Instagram 1.33%.

#### 2.5.4 Mobile Phones

Mobile phones subscriptions have outnumbered Internet connections in both developed and developing countries, and mobile cellular is becoming the most rapidly adopted technology in history and the most popular and widespread personal technology in the world. Access to mobile networks is available to 90% of the world population, and to 80 % of the population living in rural areas (OECD ITU, 2011).

Given this unparalleled advancement of mobile communication technologies, governments are turning to m-government to realize the value of mobile technologies for responsive governance and measurable improvements to social and economic development, service delivery, operational efficiencies and active citizen engagement. The interoperability of mobile applications, which support quick access to integrated data and location-based services, paves indeed the way for innovative public sector governance models - also called mobile governance or m-governance - based on the use of mobile technology in support of public services and information delivery (OECD ITU, 2011).

### **2.5.5 Letters**

The formal and traditional way of communication with individual pensioners is through letters for example, however with communication technology advancing postal letters have become less important as a routine form of communication.

## **2.6 Existing Technology Options to Support Interaction between the Pensions Department and Pensioners**

### **2.6.1 Web-site Access to the Pensions Department**

An interactive website or web portal would allow pensioners to access more services offered by the Department such as change of address details and banking details and also access to e-mail services or enquiries, pension calculations, check pension status, inquire for pension entitlements and provide feedback to the pensioners, a web site is important since some pensioners might have access to the Internet and also websites can accommodate and allow access to many services.

### **2.6.2 Customer Relationship Management**

This study adopted Bose's definition Customer Relationship Management (CRM), as an integration of technologies and business processes used to satisfy the needs of a customer during any given interaction. More specifically, CRM involves acquisitions, analysis and use of knowledge about customers in order to sell more goods or services more efficiently (Bose, 2002). In public sector domain the term Citizen Relationship Management (CiRM) is also used to refer to Customer Relationship Management, CiRM in public sector is aimed at improving the relationship with its constituents which is normally the goal of the government (Bose, 2002). Schellong (2005) defined CiRM as a strategy enabled by technology with a broad citizen focus, to maintain and optimise relationships and encourage citizenship.

#### **i). The CiRM Framework**

Schellong (2005) explains the basic principles of CRM as personalization (products, information, services), integration (planning processes, business process re-engineering, product development) interaction (channel, long term communication, surveys and selection (identify the top 20% of customers and make 80% of the profit) and eventually change management and strategy promotion customer orientated culture is vital to any CRM concept

or project, Figure 2.4 illustrates the summary of the principles and visualises the importance of the holistic approach of CRM/CiRM.

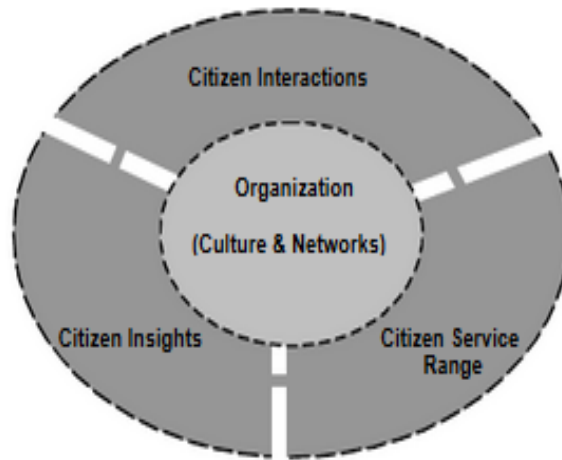


Figure 2.4 CRM/CiRM Framework (Adapted from Schellong, 2005)

ii). CRM Architecture

The system architecture for CRM application is illustrated in Figure 2.4 as adapted from (Zigner, 2001).

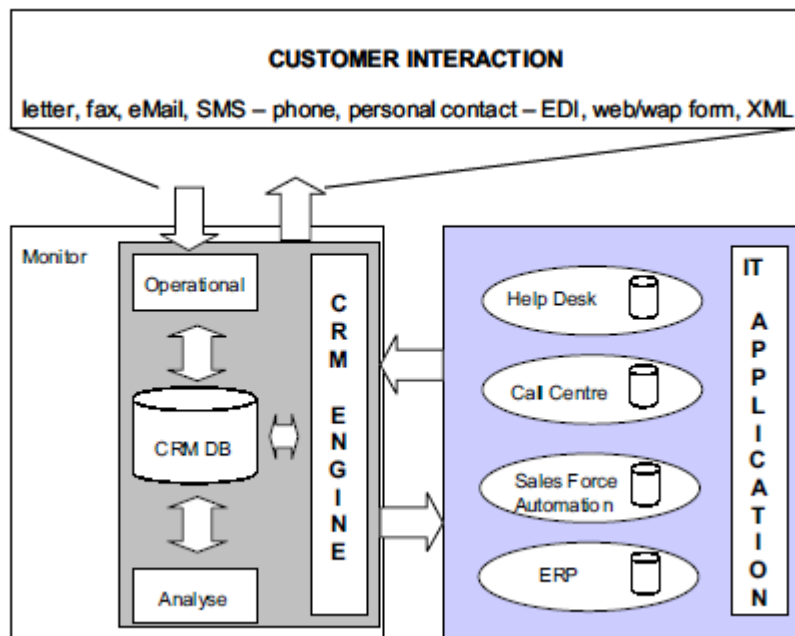


Figure 2.4 CRM System Architecture (Adapted from Zigner, 2001)

### **iii). Customer Interaction**

The customer interactions with the CRM are tracked by the system independent of the incoming channel, each interaction produces data that are stored as interaction documents in the engine. The CRM engine collects all the interaction documents and takes the responsibility for handling them either automatically or manually.

### **iv). CRM Engine**

The CRM engine is a central CRM database that stores information that results from the users, if data is stored in other systems; the system provides transparency in order to maintain a unique view of the data. Using a robust realtime analysis engine, the data stored in the CRM database is being explored very close to its collection. Using state-of-the-art techniques of real time Data Mining and Data Morphing, the system is able to detect failures, successes, trends, statistics and any other noticeable event. The reports produced by the analysis engine should serve for top management and marketing purposes, as well as assisting the self-learning process of the system.

### **v). IT Application**

This is the existing IT application of the company that includes help desk, call centre, sales force automation or ERP that may be linked with the CRM engine through an ZML- based interface, Which allows for integration of dispersed data of stand-alone software. By doing so the function-spanning customer interaction processes are seamlessly linked for the first time. This is particularly a benefit for companies that do not want an entire CRM solution but only needs to integrate their existing heterogeneous IT applications.

### **vi). CRM Lessons for the Public Sector**

Schellong (2005) explains the major differences between CRM in the public sector and the private sector that leads to challenges in implement CRM in public sector, he sites organizational challenges inherent in any CRM initiative and the diversity of the people involved as a threat to CRM in public sector, he opines that many projects fail because of lack of coordination between strategy and processes, he suggest that public administration have to understand all processes in great detail which might not be possible due to human resource constraints and the issue of costs due to budget constraints and the long time it takes to implement CRM system in the political sphere. Figure 2.5 illustrates differences in the

private and the public sector and the constraints on the use of CRM as adapted from (Schellong, 2005).

Private Sector	Public Sector
Competition (some)	Monopoly
Market orientation	Jurisdiction
Million relationships	Millions / Billion relationships
Homogeneous product range / controllable quantity	Huge number of heterogeneous products (services) / uncontrollable due to political decision making
Personalization	“One size fits all” approach
Segmentation (Pareto rule 20-80)	Segmentation possible / no termination of unprofitable customers
Budget / sunk costs	Budget / sunk costs
Legacy systems (IT)	Legacy systems (IT)
	Poor service image
Organization culture	Organization culture
	Human resources (lack of knowledge, salaries not competing with private sector)
Laws	Laws
	Accountability/ Federalism
	Political influence (planning cycle)
Profit orientation / maximising the shareholder value	Democratic understanding / philosophy

**Figure 2.5 Major Differences in the Private and the Public Sector and the Constraints on the Use of CRM, (Adapted from Schellong, 2005)**

### 2.6.3 Mobile Voice Channel

OECD ITU (2011) explains that although there is much focus on texting, mobile applications and the mobile web, voice remains an important function for mobile communications for many reasons namely;

- i). voice works on all telephony networks and all phones;
- ii). it has greater capacity for information exchange;
- iii). voice systems do not require literacy;
- iv). voice is a familiar and trusted communication channel; and
- v). voice systems can be developed easily in multiple or local languages not supported on all handsets.

Voice XML (VXML) – According to Reusch et al. (2005) VoiceXML is a language of the World Wide Web Consortium (W3C) to create voice-user interfaces, particularly for the telephone. It uses speech recognition and touchtone (DTMF keypad) for input, and pre-recorded audio and Text to Speech Synthesis (TTS) for output.

Voice applications can be developed and deployed in the same way that HTML is for visual applications through VXML, the W3C's standard format for interactive voice dialogues between a human and a computer.

VXML documents are interpreted by a voice browser, which allow people to access the Web using speech synthesis, pre-recorded audio, and speech recognition and can be supplemented by keypads and small displays.

Commercial VXML applications process millions of telephone calls per day to check orders, get driving directions, use voice access for email, refill prescriptions and many other everyday activities. Infrastructure costs can be high for voice channels and open source solutions for additional modules, such as text-to-speech and speech recognition are limited (OECD/ITU, 2011).

#### 2.6.4 Short Messaging Service

Short message service (SMS), elsewhere known as text messaging is a technology that enables the sending and receiving of messages between mobile phones, one major advantage of SMS is that it is supported by all GSM mobile phones. The mobile messaging market is growing rapidly and is a very profitable business for mobile operators.

SMS enables the transmission of up to 1 -120 bit alphanumeric messages between mobile phones and external systems. It uses an SMS centre (SMSC) for its routing operation in a network and can be transmitted into another network through the SMS gateway (Brown et al. 2007).

SMS uses the popular text message to enable mobile application based service. User can send information through an SMS gateway (Lease, 2010). The Services provider responds with a reply through pre specified number. Figure 2.6 illustrates the SMS architecture.

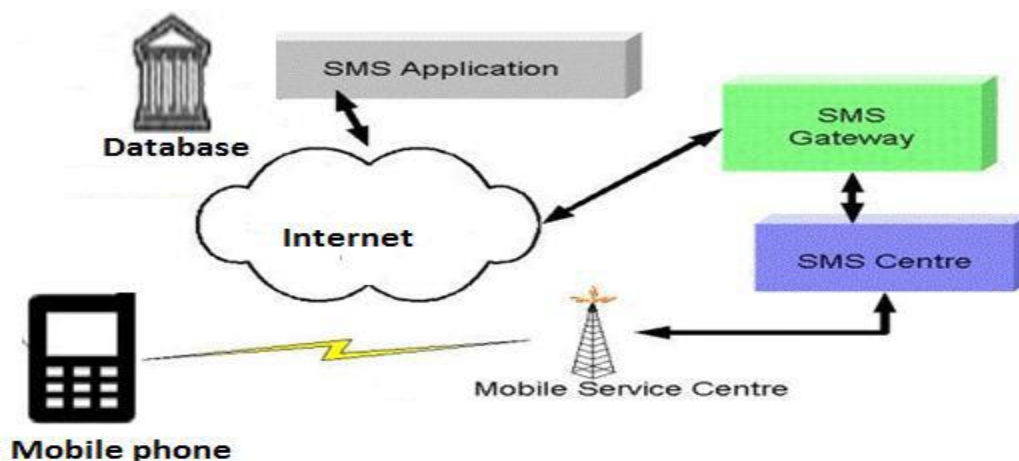


Figure 2.6: SMS Architecture (Adapted from Lease, 2010)

### 2.6.5 Mobile Applications

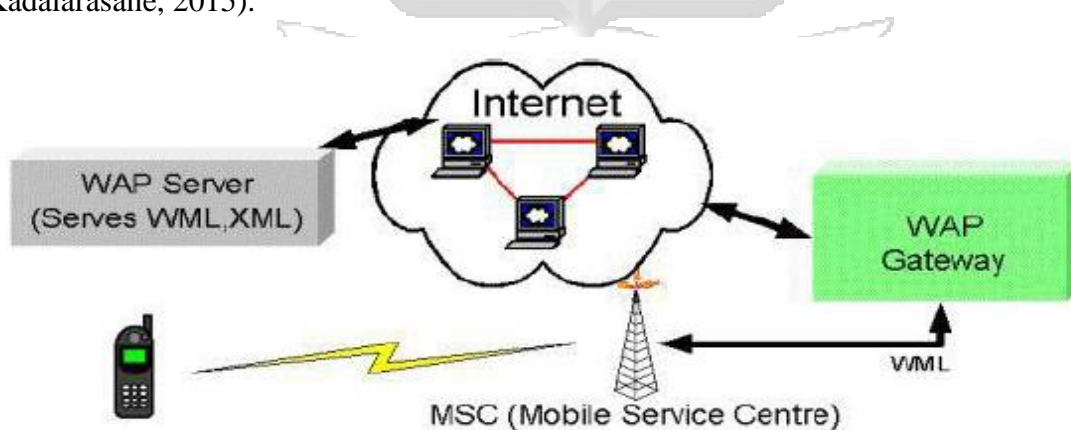
Mobile applications are also referred to as mobile app are executable programmers that run digital hand held devices namely tables and smartphones, today mobile application are functionality wise compatible with personal computer applications. However unlike application for PCs, mobile apps are typically obtained from a respective application stores and for some platforms third party sites (Ottka, S. 2015), mobile applications can be divided into three groups namely native, web based and hybrid applications (Zlatka & Babic, 2014).

### 2.6.6 Wireless Access Point

Wireless application protocol (WAP) is an open, global specification that empowers mobile users with wireless devices to easily and instantly access information and services, and they can interact with government. Small mobile devices commonly use a WAP browser, which accesses websites written in or converted to Wireless Markup Language (WML).

Devices that use WAP include mobile phones, pagers, two-way radios, smartphones and communicators, from low-end to high-end. WAP provides service interoperability even between different device families (OECD ITU, 2011).

Figure 2.7 illustrates the framework for enabling mobile applications over WAP. The actual forms that go into a mobile application are stored on a WAP server, and served on demand. The WAP Gateway forms an access point to the Internet from the mobile network (Kadalarasane, 2015).



**Figure 2.7 WAP Network architecture for mobile applications (Adapted from Kadalarasane, 2015)**



### **2.6.7 Multimedia Messaging Service**

Multimedia Messaging Service (MMS) is mobile messaging similar to SMS for data transfer, but with additional functionality for rich text, video and audio attachments using WAP to access and display the content.

MMS allows for easy bulk-messaging and, combined with mobile Internet connectivity, can be used to drive an audience to social media or a website. However, MMS is not compatible with basic phones, costs more than SMS, and content is not always well adapted. This messaging platform has had issues with transferring malicious software and has lower read and response rates than SMS.

MMS continues to make headway in the consumer peer to peer market, but is finding more significant success as an enabler of mobile advertising and thus, ad-funded messaging tariffs, Morgan (2009) from the perspective of public service delivery, MMS may open a whole range of possibilities, for instance in the medical field.

### **2.6.8 Unstructured Supplementary Service Data**

USSD was created specifically for standard GSM devices, USSD messages are transferred directly over network signaling channels. This is unlike MMS messaging, which is transferred via a wireless data connection. USSD is free, simple, logical, inexpensive and accessible, with great potential for mobile banking, accessing news services, submission services, feedback, voting, and directories. With interactive navigation, USSD is fast and allows for mass usage. However, messages cannot be saved or forwarded, the codes may be difficult to remember, and usage is not always reliable due to session-based timeouts, a summary of the strengths and weaknesses of mobile channels or technologies is provided in Figure 2.8 as illustrated by (OECD/ITU, 2011).

CHANNEL	STRENGTHS	WEAKNESSES
<b>Voice XML</b>	<ul style="list-style-type: none"> <li>• Portable voice-activated services</li> <li>• Voice- and phone-enabled Internet access</li> <li>• Fast time-to-market</li> <li>• Open standard</li> <li>• Supports natural language</li> <li>• Less expensive than traditional IVR</li> <li>• Ease of integration</li> </ul>	<ul style="list-style-type: none"> <li>• Limited capability and development tools</li> <li>• Web browsing must be specific</li> <li>• Inability to pause, resume, forward and rewind</li> </ul>
<b>SMS</b>	<ul style="list-style-type: none"> <li>• Simple, easy and convenient</li> <li>• Cost effective</li> <li>• Private communications</li> <li>• Fast communications</li> </ul>	<ul style="list-style-type: none"> <li>• Some security vulnerabilities</li> <li>• Fake SMS (spoofing)</li> </ul>
<b>USSD</b>	<ul style="list-style-type: none"> <li>• Simple and logical</li> <li>• Real-time, fast and responsive</li> <li>• Inexpensive</li> <li>• Harmonious with other technologies</li> <li>• Interactive navigation</li> <li>• Can be used for payments, mass usage</li> </ul>	<ul style="list-style-type: none"> <li>• Session-based timeouts</li> <li>• Codes more difficult to remember than Common Short Codes</li> </ul>
<b>WAP</b>	<ul style="list-style-type: none"> <li>• Minimal risk and investment</li> <li>• Independence from carriers</li> <li>• Based on Internet standards</li> <li>• Easier to maintain and iterate user interface/ design</li> <li>• Streamlined reporting</li> <li>• Good for pushing content</li> <li>• One version across platforms, except iPhone</li> </ul>	<ul style="list-style-type: none"> <li>• Small size of mobile screen</li> <li>• Not as popular as SMS or USSD</li> <li>• WML scripts not embedded in WML pages</li> <li>• Cannot update for offline consumption</li> <li>• Must leave WAP site for video or audio</li> <li>• Slow to update</li> <li>• Not great for user-generated content</li> </ul>
<b>MMS</b>	<ul style="list-style-type: none"> <li>• Direct and personal</li> <li>• Messages can be stored and forwarded</li> <li>• WAP push potential</li> <li>• Segmentation</li> <li>• Interactivity through multi-media</li> <li>• Easy bulk messaging</li> </ul>	<ul style="list-style-type: none"> <li>• Not compatible with basic phones</li> <li>• More expensive than SMS</li> <li>• Content adaptation limited by screen size and resolution variations</li> <li>• Read and response rates lower than SMS</li> </ul>
<b>Data Applications</b>	<ul style="list-style-type: none"> <li>• Self-contained experience</li> <li>• Graphics and user-generated content</li> <li>• Automatic updates and read content offline</li> <li>• Leverages device-native capabilities (camera, GPS)</li> <li>• Strong paid model</li> </ul>	<ul style="list-style-type: none"> <li>• Fragmentation, need to build for multiple platforms, with time and costs</li> <li>• Managing multiple releases</li> <li>• Client side changes</li> <li>• Need to submit app to some stores for approval</li> </ul>
<b>Mobile Web</b>	<ul style="list-style-type: none"> <li>• More economical than mobile apps</li> <li>• Mobile phones and smartphones supported</li> <li>• Mobility for content and services</li> <li>• Mobblogging, with videos and photos</li> </ul>	<ul style="list-style-type: none"> <li>• Less functionality, unable to use advanced phone features such as camera, GPS</li> <li>• Small display size</li> <li>• Low text input and low bandwidth</li> </ul>

**Figure 2.8 Strengths and Weaknesses of Mobile Channels or Technologies (Adapted from OECD/ITU, 2011)**

## 2.7 The USSD Technology and Mobile Phones

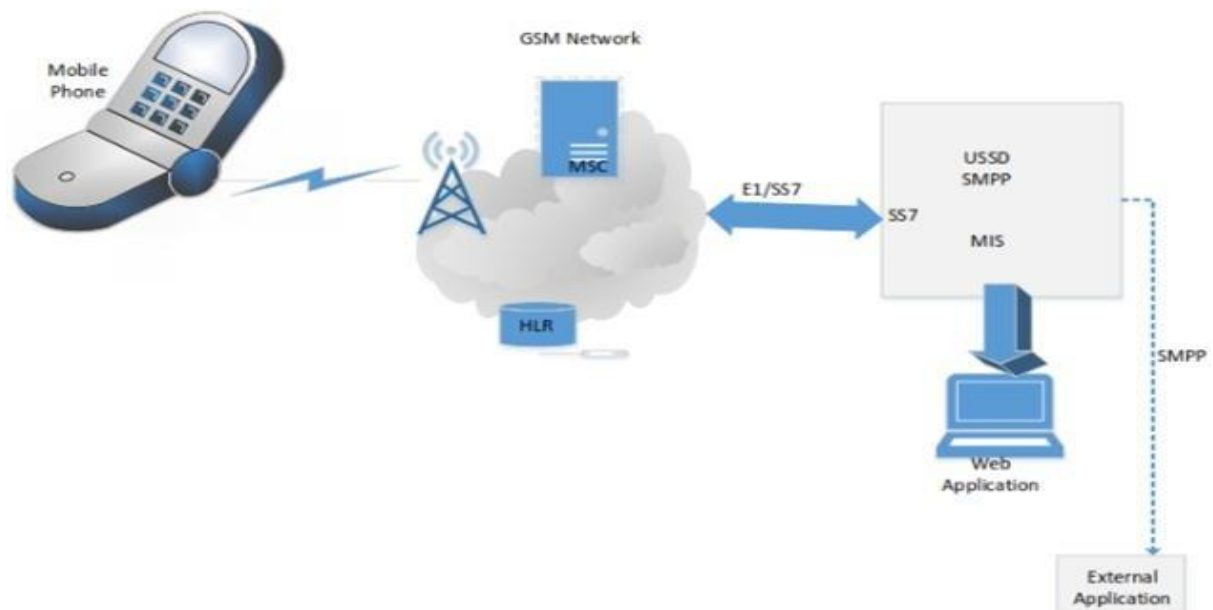
USSD is a GSM communication technology similar to SMS that is used to send messages between a mobile phone and an application server in the network (Punnet, 2010); GSM is an open technology for transmitting mobile voice and data services. For this project, USSD was selected instead of SMS because of the following reasons

- (a) Unlike SMS which is a store-and-forward, transaction-oriented technology (Aniket & Chetna, 2009) USSD is session-based and interactive, and is real-time, therefore offering faster response. USSD service is almost seven times faster than SMS, and there is minimal delay between sending a query and receiving a response (Suddul et al., 2011). This concept of a real-time data session is particularly useful if opting to build an interactive menu-driven application, such as a mobile-initiated “Balance Enquiry and Top Up” application.

- (b) Being a session-based protocol it allows for a real-time “session” to be initiated between a mobile user and an application platform to send data back and forth.
- (c) USSD sessions can be initiated by the user (pull) or the application (push). Being interactive means menu-based applications can be supported (Aniket& Chetna, 2009).
- (d) USSD includes the ability to work when users are roaming (virtual home environment concept) as USSD commands are routed back to the home mobile network’s Home Location Register (HLR), the ability to work on all existing GSM mobile phones and support by both SIM Application Toolkit and the WAP (Aniket & Chetna, 2009) when roaming in another place or country there are no charges on roaming partners like for SMS (Sanganagouda, 2011).
- (e) It is also much cheaper than SMS and uses simple operations, also the user does not need to remember anything and does not need either an Internet connection or to install any applications (Sanganagouda, 2011) and (Suddul et al.,2011).

### **2.7.1 USSD Architecture and Operation**

The USSD architecture is illustrated in Figure 2.9, when the service is invoked; a real-time, interactive session is established between a client and an application server on the network. This allows data to be exchanged between the customer and the provider until the service is completed. A session needs to be allocated to every transaction request; the response for this request and the following series of requests and responses in the session all share the same session ID until the session is closed or times out (Gupta, 2010). The communication can be established through different communication channels (Taskin, 2012) USSD services use signaling channel while call services use traffic channels.



**Figure 2.9 USSD Architecture (Adapted from Sanganagouda, 2011)**

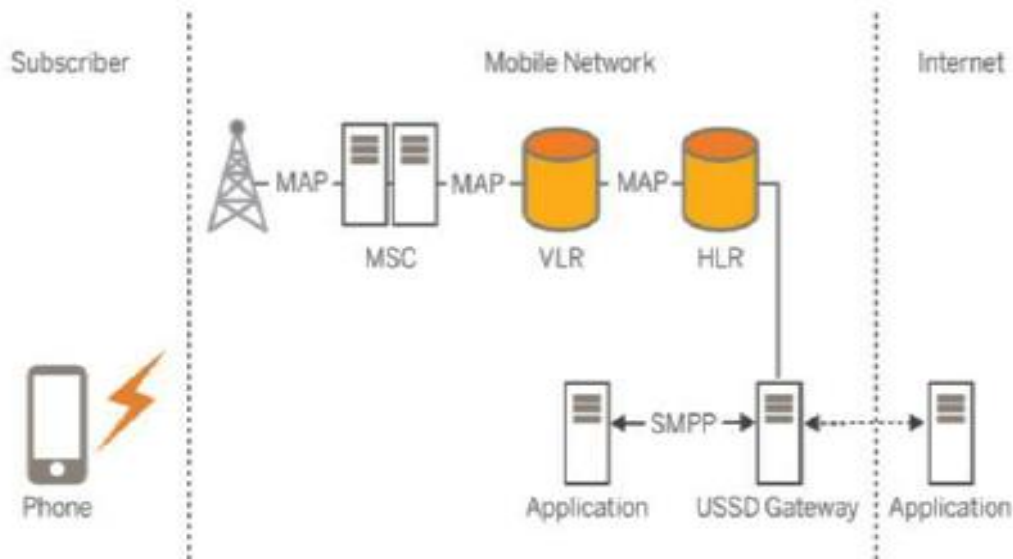
The Mobile Switching Center (MSC) connects to the HLR via the Signaling System 7 (SS7) in the home network. SS7 link also connects the GSM network with its components Visitor Location Register (VLR), HLR and MSC to the USSD Gateway. Simple Messaging Peer-to-Peer (SMPP) is used for communications between the external applications and the gateway. The USSD Gateway is open for integration with other telecom systems as well as the Internet, USSD services are housed as applications in the network, they can reside in the MSC, VLR, HLR or an independent server that is connected using SMPP through a USSD Gateway (Sanganagouda, 2011).

Applications that are housed in the network are typically those which are under control of the mobile operator and the third-party applications are located in other telecom system including the Internet, when a message is not destined for an application in the VLR, MSC or HLR, it is routed to the USSD Gateway by a USSD handler in these nodes using the protocol.

The USSD code is interpreted by the gateway and routed to the corresponding USSD application server that contains the information requested by the customer. The relevant information is sent back by the application to the gateway which then formats the message into Mobile Application Part (MAP) and formats it back to the user. USSD modes of operations can be categorised into two groups; the mobile – initiated operation and the network operation (Taskin, 2012).

### 2.7.2 Elements of the USSD Mobile Network

While USSD seems to be a complex architecture, the focus of this study is not in analyzing USSD architecture but rather to make use of it as a black box. Our only concern is on the Internet and Subscriber sides. Figure 2.10 illustrates the elements of USSD mobile network.



**Figure 2.10 Elements of the USSD Mobile Network (adapted from Sanganagouda, 2011)**

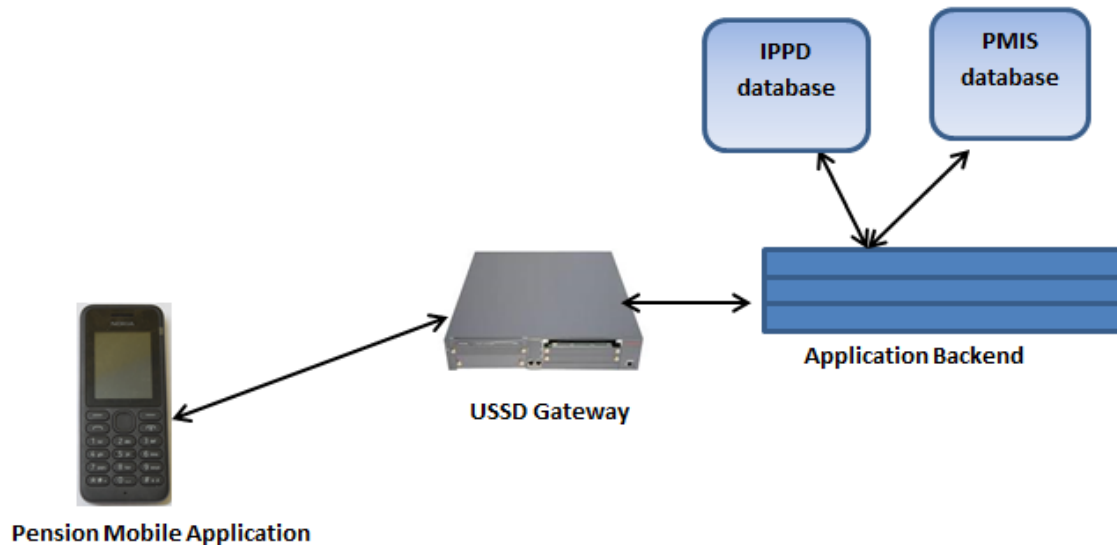
Additional elements of the USSD architecture comprise: Data Records (CDRs), a rating platform /billing system to rate the post-paid Call, Management Information Systems (MIS), for pre-paid billing, Data Warehouse (DWH) systems for reporting and reconciliation. CDRs generated at USSD Gateway can also be used for these purposes. They may be interconnected with SMSC that can be used to send notification or special SMS to users.

### 2.7.3 USSD code Generation and Format

USSD is the GSM technology used for sending messages between GSM phone and hosted server. USSD code is composed of digits \*, #, keys and user services from the mobile operator, a user can directly use the code without cost (Misra, 2004). USSD messages are simple to form and easy to send. User can directly enter the USSD string and press call to send the message. A typical USSD message starts with a \* followed by digits which indicate an action to be performed or are parameters. Each group of numbers is separated by a \*, and the message is terminated with a #. The USSD gateway in turn can interact with external applications based on the USSD command. This allows access to number of value added services via USSD.

## 2.8 Proposed System Flow

Figure 2.11 illustrates the system flow diagram of the proposed USSD application composed databases at the ministries and PMIS at Bima House, of a front end the USSD application interface and back end for the analysis, when a pensioner dials the USSD short code on their phone the request directed to the USSD gateway that will create a session or connect to the USSD application hosting server for the menu based service back and forth session based communication.



**Figure 2.11 Proposed System Flow Diagram**

### 2.8.1 IPPD and PMIS Databases

Integrated Payroll and Personnel Database (IPPD) is a payroll system for civil servants in Kenya, IPPD contain all staff records and documents necessary for processing pension benefits and the Government Human Recourse Information System (GHRIS) a portal that is interfaced with IPPD and is used for accessing salary payslips online.

The Pensions Management Information System (PMIS) is the system and database that has a workflow process that pension documents go through after being received from ministries and departments in government. PMIS generates pension numbers after capturing pensioners' details from hard copy files that includes staff number, date of birth, date of retirement, and full names, type of claim or benefits, dependants, and pensioners work history among others.

### 2.8.2 Application Back-end.

The system had a USSD application and a web application back end for development and administration. The USSD application was developed using Php and HTML codes while the

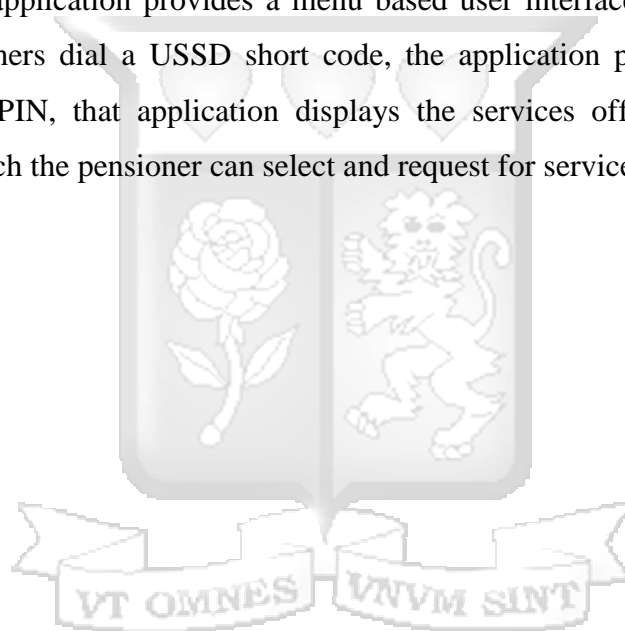
web application admin back end was developed using HTML codes, the relational database was created using MySQL database.

### **2.8.3 USSD Gateway**

The USSD gateway allows connection between the mobile application and the signalling network through the Short Message Peer to Peer (SMPP) protocol that send text data over the Internet. The gateway in this study was provided by Africa's Talking USSD gateway that allowed pensioners to send USSD messages and receive responses on their mobile phones.

### **2.8.4 Pensions Mobile Application**

The pension mobile application provides a menu based user interface, the front end of the system, when pensioners dial a USSD short code, the application prompts for a PIN, on entering the correct PIN, that application displays the services offered by the Pensions Department from which the pensioner can select and request for services.



## Chapter 3: Research Methodology

### 3.1 Introduction

This chapter focuses on how the research was conducted by elaborating on the research design, the population and sampling, the preferred data collection and analysis, validation and finally the approaches that were applied in system analysis, system architecture, system design, system development methodology, system implementation and testing, the application was developed using Object Oriented Analysis and Design (OOAD) and therefore highlights how this methodology was applied is also explained.

### 3.2 Software Development Methodology

A software development methodology is a way of managing a software development project (Young, 2013), this study adopted the V-Shaped Model, Project management, quality assurance, software development and configuration management are the main focuses of the V-Shaped Model (Boggs, 2004), the model executes its processes in sequential steps like the old waterfall model, it has different phases and one phase must be finished before a new phase is started (Ragunath et al. 2010).

The main reason for selecting this methodology is because testing is considered very important in this model, a test plan is developed before the start of development, and the focus of the test plan is to meet the functional specifications mentioned in the requirements gathering as illustrated in Figure 3.1.

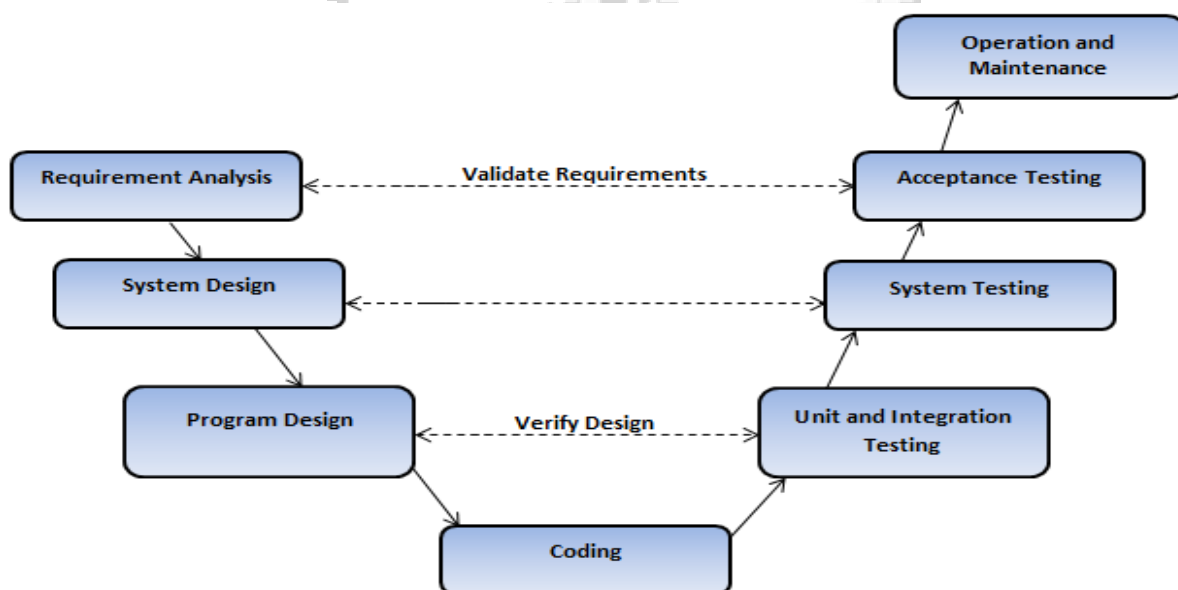


Figure 3.1 V-Shaped Software Development Model (Adapted from Boggs, 2004)



In a typical V-Model development process, the left hand side shows development activities and the right hand side shows the testing activities. In the development phase both verification and validation are performed along with actual development activities.

### 3.3 Research Design

This study used a mixed research approach, qualitative approach helped the researcher know the current methods of interaction used by the Pensions Department and what challenges are faced by the pensioners in view of those methods and which technology options to support interaction between the Pensions Department and the pensioners, the researcher used questionnaires in gathering this information. The quantitative research was used to get the number of pensioners who believe that by adopting the USSD application the Pensions Department has enhanced its service delivery and is reliably, efficiently and effectively interacting with the pensioners.

#### 3.3.1 System Analysis

This study used the Object Oriented Analysis approach (OOA) which combines both processes and data into a single entity called objects or components. User requirements were modeled into system requirements using a use case diagram and a sequence diagram that helped in identifying, modeling and documenting the data requirements, based on the requirements that were outlined a road map to develop the system was conceptualized and thereby a mobile application was developed to assist public service pensioners in Kenya interact with the Pensions Department and track their pension payments.

The target population of this study was all the public service pensioners retiring or retired from the Kenya's public service, whose pension benefits are disbursed by the Pensions Department in Nairobi. The Department maintained a payroll of 330,000 pensioners, dependants and injured officers while on duty as per its census of pensioners' files and the PMIS payroll system (Pensions Department, 2017)

Therefore, in a bid to derive the sample size for the study Fisher et al. (1998) formula was used.

This is

$$n = \frac{z^2 pq}{d^2}$$

Where

n= the desired sample size when the population is more the 10,000

z = the normal standard deviation, usually set at 1.96 which corresponds to 95% confidence level;

p= the proportion of the target population that has similar characteristics; if there is no reasonable estimate, then use 50 percent (the study will use 85)

q= 1-P (1-0.85) and

d= degree of freedom = 5 % (0.05)

If the z – statistic is equal to 1.96 degree of freedom (d) equals 0.05 and proportion of the target population with similar characteristic (p) equals 85%, the (n) would be;

$$n = \frac{(1.96)^2 (0.85)(0.15)}{0.05^2}$$
$$= 192$$

The sample size for the research was 192 pensioners. The researcher managed to administered hard-copy questionnaires for data collection to 183 respondents for three working days at Bima House first floor at the inquiries section of the Pensions Department in Nairobi.

According to Denscombe (2007) a questionnaire is a very useful tool for data collection especially when a large number of respondents in many locations are to be used and when the information required is straightforward, questionnaires were economical and provided standardised answers from respondents in this study.

Findings from the 183 respondents who had come to seek various services from the Department helped in the design of the mobile application for the pensioners. The main focus of the questionnaire shown in Appendix A was to collect data from respondents on the challenges they face while interacting with the Pensions Department and the data on how the Pensions Department interacts with the pensioners, Appendix B shows usability testing questionnaire for the mobile application, Questionnaires are one of the most used tools for measuring usability in terms of the user's subjective satisfaction.

### **Data Analysis Procedure**

This research used context analysis study objectives, user and system requirements these included use case model, sequence and an entity relationship diagrams. For the descriptive statistical presentations which included percentages, pie chart, bar charts and tables were used to display usability test results and challenges faced by pensioners when interacting with the Pensions Department for services.

### **3.3.2 System Design**

The researcher formulated a conceptual model for the application with the required features. This was achieved through coming up with an architectural design, use case diagram, system sequence diagram, Entity Relationship Diagram and website wireframes by use of online tools lucidchart.com and SmartDraw 2019.

### **3.3.3 System Implementation**

Korson & McGregor (1990) identified three traditional activities of object oriented software lifecycle being Analysis, Design and Implementation. Hypertext Pre-processor (PHP) language was used to develop the USSD application, the web-backend dashboard comprised of PHP and HTML Version 5 codes. MySQL a Relational Database Management System (RDBMS) was used to provide the multiuser access to the database; Both PHP and MySQL are most popular open source software tools and platform independent (Wan-hin Luk, 2017), (Andersson & Berggren, 2017) and therefore reason for being used in this work.

### **3.3.4 System Testing**

V-shaped software development model was used in this study in which testing was done in each phase and corresponded to a test case, the system testing was done to determine if the system corresponds with specifications developed during the design of the application (Mechelle et al. 2002), functional and usability testing procedures were also done. Functional testing was done to ascertain whether the system operates to achieve its intended objectives while usability testing entailed testing validation flow, ease of navigation, responsiveness and user friendliness.

### **3.5 Research Quality**

Validity and reliability objectivity are two major components to measure the quality or trustworthiness in this study. Validity and reliability of results in this study have been described below.

#### **3.5.1 Validity**

In order to ascertain the validity of the study in relation to the answering of questionnaire, a pilot test was conducted on a few individuals (non-pensioners) to test, comment and point out any problems with test instructions, as well as instances where there was lack of clarity. This helped in fine-tuning usability study and provides reliable results. Using the refined questionnaire, responses to questions by respondents were analysed to check whether the new application adds value to the pensioners and also establish the notch to which the content domain associated with the construct, content validity was chosen matches the test content.

#### **3.5.2 Reliability**

The stability and consistence of the results from the questionnaire helped the researches collect quality data for this study.

### **3.6 Ethical Consideration**

Prior to conducting this study the research instruments were submitted to the supervisor for review before being administered consequently confidentiality, anonymity and privacy of all respondents were respected and no personal information of the participants was shared.

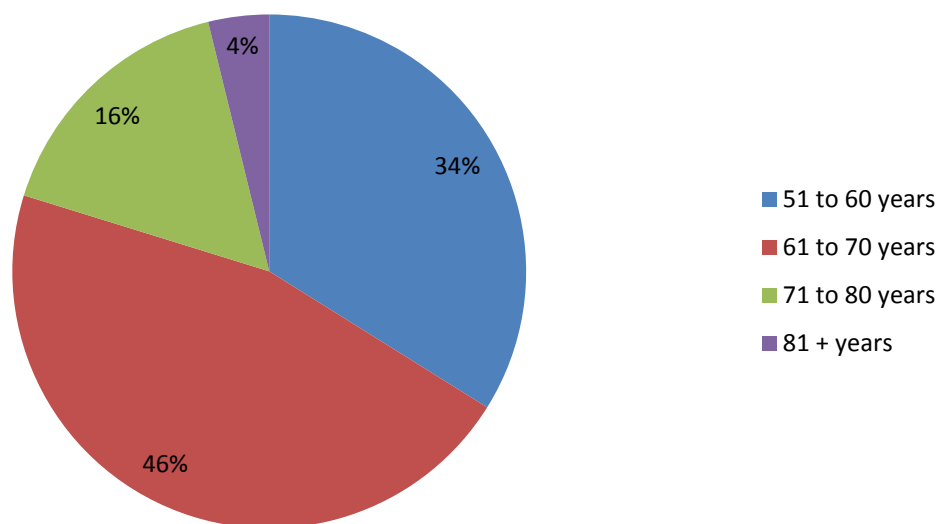
## Chapter Four: System Architecture and Design

### 4.1 Introduction

The objective of this research was to develop a mobile application that helps the pensioners track their pension payments at the Pensions Department in Nairobi, objective oriented analysis and design was used in this research. Data analysis, system analysis and system design are discussed in detail in this chapter, in data analysis the focus was on collection from the sample population, while system analysis was based on the collected data, finally the design or architecture of the system was developed according to the user requirements.

### 4.2 Requirements Analysis

#### 4.2.1 Age Groups of Respondents



**Figure 4.1 Age Groupings of the Respondents.**

Results from the questionnaire shows that 46% of the respondents belonged to the age group of between 61 years and 70 years, which is closely followed by those aged between 51 years and 60 year, representing 34%, the least represented category was those who were aged 81 years and above representing 4% these results are summarised in Figure 4.1.

### 4.2.2 Experience in the Usage of Mobile Phones

Results with respect to experience in the usage of mobile phones as illustrated in Figure 4.2, it emerged that 62% of respondents believed that they have the highest experience and rated ‘5’ (5 being the highest and 1 the lowest) 25 % rated 4 while 2% rated ‘1’ .

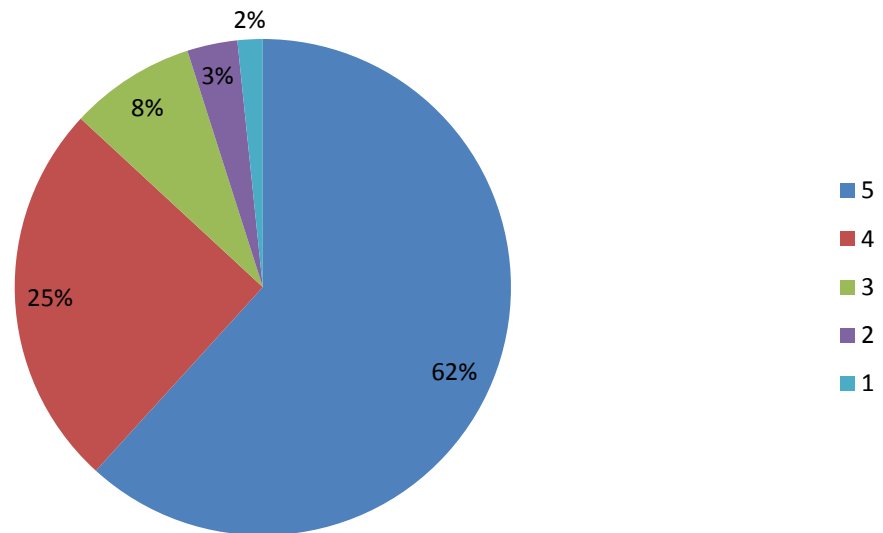


Figure 4.2 Experiences in the Usage of Mobile Phones

### 4.2.3 Mobile Devices Owned by Respondents

Table 4.1: Mobile Devices owned by Respondents

Mobile Phone Usage	Respondents	Percentage
Feature phone	173	95
Smart phone	150	82
Tablet	23	13
Multimedia phone	21	11
Others	4	2

Table 4.1 shows that most respondents which was 95% owned feature phones followed by 82% of the respondents who said they owned smart phones, and a significant percentage of

the respondents 13% owned tablets and 11% owned multimedia phone and very few who owned other phones like black berry were represented by 2%.

#### 4.2.4 Issues Pensioners seek Information about from the Pensions Department

From Table 4.2, it could be concluded that all of the 183 respondents who participated in this study seek information about their pension status from the Pensions Department this was represented by 100%, while 90% of the respondents had general complaints issues that they wanted addressed by the pensions Department, 55% of the respondents were seeking to return or get various forms from the Department, 53% were seeking to know their pension numbers, and 50% were seeking to update their pension records in their files, 40% of the respondents selected other services and finally those seeking for notifications for death, stoppage of pension and change of account and pay point had the least percentage of 25%.

**Table 4.2 Issues Pensioners seek Information about from the Pensions Department**

<b>Issues pensioners seek information about from the Pensions Department</b>	<b>Respondents</b>	<b>Percentage</b>
Getting Pension Number	97	53
Inquire about Pension Status	183	100
Notifications for death, stoppage of pension and change of account and pay point	46	25
Pension File update	92	50
Return or receive Pension Forms	100	55
General Complaints	165	90
Other Services	74	40

#### 4.2.5 Interaction Methods used by the Pensions Department

Table 4.3 shows that majority of respondents above 95% affirmed that the Pensions Department interacts with them through the media and also direct interaction by travelling to the Pensions Department which was 89%, while more than 69% interacts with the Department manually through letters, interaction through technology received the least choices with the website, the Internet and e-mail being selected by only 23% of the respondents, social media and other methods had 2% of the respondents.

**Table 4.3 Interaction Methods used by the Pensions Department**

<b>Interaction Method</b>	<b>Respondents</b>	<b>Percentage</b>
The media namely – Newspapers, Radio, Television and Press releases	173	95
Websites, Internet and E-mail	42	23
Social media	4	2
Letters through the parent or originating ministry and the post office	126	69
Direct communication when your travel to the Department	163	89
Others	2	1

#### **4.2.6 Challenges with the Current Interaction Methods**

Following an assessment of the current interaction methods used by the Pensions Department and in view of the efficiency and effectiveness, it was imperative to consider the challenges respondents face when interacting with the Pensions Department. From Table 4.4 it could be observed that majority of the respondents represented 98% indicated that it was costly for them to travel to the Pensions Department, another 94% said they did not have Internet connectivity to enable them access government websites, social media and also read E-mails, 94% of the respondents indicated that the media provides ambiguous or unclear information, 78% of the respondents had challenges with the use of letters since they delay to reach the destination and 60% observed that media provide unreliable information that may be outdated at the time the information reaches them. A marginal number represented by 1% of the respondents indicated other challenges like language barrier.

**Table 4.4 Challenges with the Current Interaction Methods used by the Pensions Department**

<b>Challenges with the Current Methods of Interaction</b>	<b>Respondents</b>	<b>Percentage</b>
Letters take long to reach the intended destination hence delaying other processes	142	78
Newspaper report are not completely reliable and may be outdated	109	60
I do not have constant Internet connectivity to access information from websites, the Internet, e-mail and Social media	172	94
The media provides ambiguous or unclear information	168	92
It is costly travelling to the Pensions Department in Nairobi	179	98
Others	2	1



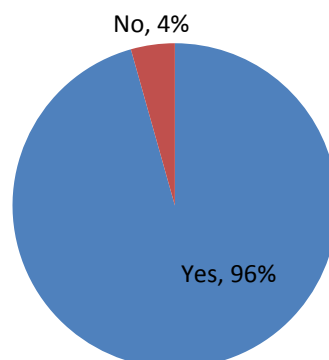
#### 4.2.7 Technology Options to Support Interaction between the Pensions Department and Pensioners.

Table 4.5 shows the different existing technology option to support interaction between the Pensions Department and the pensioners, majority of respondents represented by 99% were familiar with USSD/SMS applications, 55% of the respondents were familiar with Downloadable Mobile applications for smartphones, 23% were aware of Customer Relationship Management Systems (CRM), a marginal 4% and 1% were familiar with Multimedia Messaging Service and Wireless Access Point (WAP) respectively and none of the respondents 0% selected others.

**Table 4.5 Technology Options to Support Interaction between the Pensions Department and Pensioners**

Technology options	Frequency	Percentage
Downloadable Mobile applications on smartphones	100	55
USSD/SMS applications	181	99
Customer Relationship Management Systems (CRM)	42	23
Multimedia Messaging Service	7	4
Wireless Access Point	3	2
Others	0	0

#### 4.2.8 Respondents who think a USSD/SMS is necessary for the Pensions Department



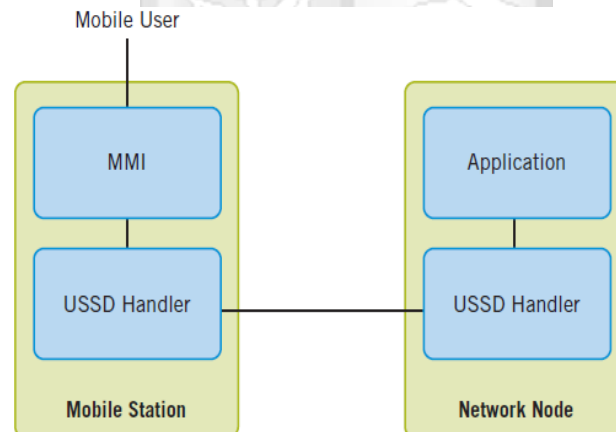
**Figure 4.3 Respondents who think a USSD/SMS is necessary for the Pensions Department**

An overwhelming majority of respondents represented by 96% agreed that a USSD/SMS application was necessary to help the Pensions Department interact with the pensioners this as illustrated by Figure 4.3.

### 4.3 General USSD Architecture

USSD services use the existing architecture of GSM networks, USSD information is sent directly from a sender’s mobile handset to an application platform handling the USSD service. The USSD service can be located either in the sender’s mobile network or in a visited mobile network.

According to Sanganagouda (2011) a real-time “session” is initiated between the mobile user and the USSD application platform when the service is invoked, allowing data to be sent back and forth between the mobile user and the USSD application platform until the USSD service is completed. Figure 4.4 illustrates a block diagram of a USSD architecture implementation. The proposed USSD system flow for a mobile application to track pension payment has been illustrated in figure 4.5. The mobile application service resides in an independent application server that was connected through a USSD Gateway using SMPP protocol.

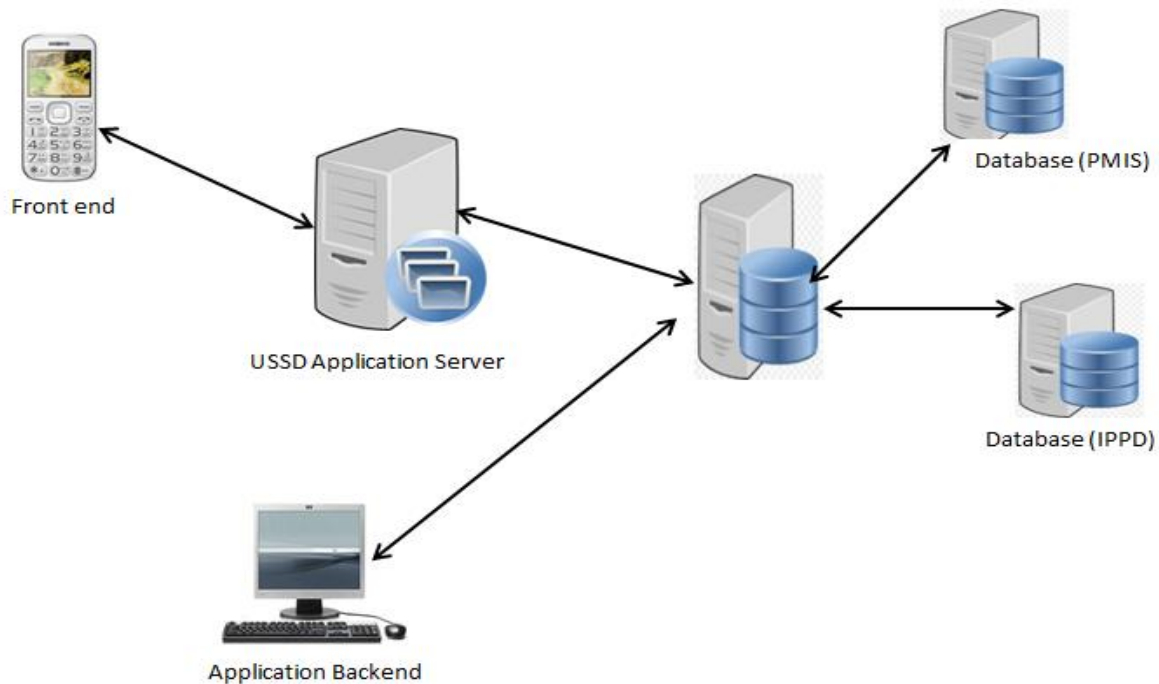


**Figure 4.4 Block Diagram for USSD Architecture (Adopted from European Telecommunications Standard Institute -ETSI)**

### 4.4 Proposed System Architecture

The proposed architecture of the system consists of the pensioners’ mobile phone and USSD client for sending and receiving SMS, a web application and database server for proceedings and storage of pension payments respectively. Figure 4.5 shows the overview of how the application works, pensioners dial a USSD code and enter the system generated PIN, after the

system successfully authenticates the pensioner, they can access the first menu items of the mobile application.



**Figure 4.5 Architecture for a Mobile Application to Track Pensions Payments**

#### **4.4 System Requirements and Analysis**

System analysis of the Pensions Department processes and user requirements clearly indicated the need for a mobile application to be designed and developed due to shortcomings of the current methods of interaction; the pensioners required a reliable, efficient and faster interaction process with the Pensions Department. The application was designed to track pension payments and provide feedback to the pensioners on the various pensions services and transactions they query about their claims. This led the researcher to define functional and non-functional user requirements of the new application.

During this initial phase of requirements analysis, system requirements and analysis was performed to determine or derive and validate the functional and non-functional requirements that users will expect when using the system, in V-shaped software development model user requirements documentation occurs only once hence necessary to dedicate enough time. However, during each design stage, the corresponding tests are also designed to be implemented later during the testing stages, thus during the requirements phase, acceptance tests are designed.

#### **4.4.1 Functional Requirements**

Functional requirements of the mobile application to track pension payments are as listed below

- i). Authenticate pensioners using their PIN
- ii). View and generate system analytics
- iii). Administrator to securely login into the system using credible credentials
- iv). Send alerts, notifications and feedback to the pensioners
- v). Administrator to search, edit and maintain the system
- vi). Query the system for pension services, records transaction and claims by the pensioners.

#### **4.4.2 Non- Functional Requirements**

This refers to attributes that affected user experience when interacting with the system, these characteristics included:

- i). Security – the administrator who has access to the web backend uses authorised usernames and passwords to view and access the system, while the pensioners have a mandatory four digit Personal Identification Number (PIN) to aid in authentication when accessing the application.
- ii). System availability – the application must be available all the time and on all mobile devices.
- iii). Reliability – the system must be dependable.
- iv). Usability – the system must have easy to navigate user interface, user friendly and menu items since most user were of an advanced age group.

#### **4.5 System Design**

System design comprises of creating a layout of the system or application design that was developed, object oriented techniques was used to transform the conceptual framework or model in object oriented analysis taking into account the constraints imposed by the chosen architecture and any non-functional. The concept from the analysis was mapped onto implementation classes and interfaces. The result is a model of the solution domain, a detailed description of how the system was built.

#### **4.6 Diagrammatic Representation of the System**

This study used a use case diagram, a sequence diagram; design class diagram and entity relationship diagram for diagrammatic representation.

### 4.6.1 Use Case Diagrams

Njeru & Kasamani (2018) noted that in a use case diagram, users or devices are external to the system and are represented as actors that interact with the system whereas user requirements are represented as ellipses/use case. The actors in a mobile application to track pension payments are the pensioner and the administrator as demonstrated in Figure 4.6.

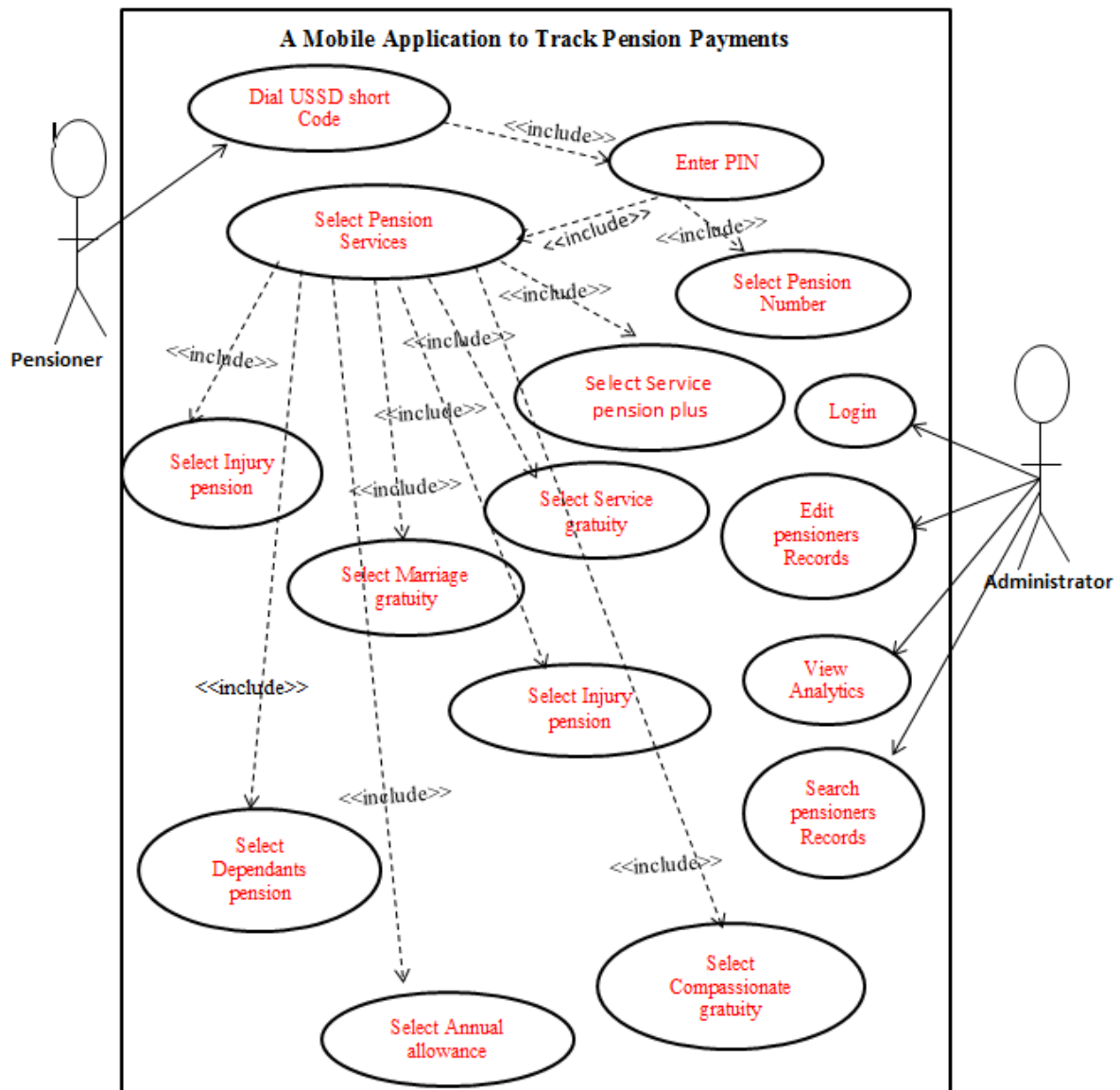


Figure 4.6 Use Case diagram

#### 1. Use Case: Dial USSD Code

This use-case indicates how the pensioners views the USSD menu

#### Preconditions:

Pensioner must be issued with a USSD short code.

**Post conditions:**

The pensioner must dial the USSD to view the welcome message that prompts for PIN

The pensioner enters the correct PIN and views the application menu

**Main Action Scenario:**

- i). Pensioner views the USSD Menu
- ii). The pensioner selects Pension Number
- iii). The pensioner selects Pensions Services
- iv). The pensioner selects Notifications
- v). The pensioner selects Update File
- vi). The pensioner selects Other Services
- vii). The system bring a new sub- menu for the USSD menu items

**Alternative Flow: Menu Selection**

At step 2, the user selects any menu item to get the sub menu

- The customer selects the sub menu and wait for feedback from the system

**2. Use Case: Pension Number**

This use case reports how pensioner queries for a pension file number

**Preconditions:**

The pensioner is allocated pension number by the Pensions Department

**Postconditions:**

Pensioner must key in a Personal File Number, TSC Number, Service Number, and Other staff Numbers or ID Number

**Main Action Scenario:**

- i). Pensioner views the Pension Number Menu
- ii). Pensioner selects PF Number
- iii). Pensioner selects TSC Number
- iv). Pensioner Selects Service Number
- v). Pensioner Selects Other Numbers
- vi). Pensioner keys in the Number
- vii). System sends SMS to the user indicating the Pension Number

**Alternative Flow: Pension Number**

At step 2, user selects one file number

- Pensioner receives an SMS from the system detailing the Pension Number

### 3. Use Case: Select Pensions Services

This use case reports how the pensioner views the pensions services menu

#### **Preconditions:**

Pensioner has to view the USSD application menu

#### **Postconditions:**

Pensioner select pensions services menu

#### **Main Action Scenario:**

- i). The pensioner views pensions services menu
- ii). The pensioner selects type of benefit
- iii). The Mobile application sends SMS to the pensioner indicating the process or step at which the claim has reached in the workflow.

#### **Alternative Flow: Benefit selection**

At step 2, user selects one specific benefit

- Pensioner receives the pension service information

### 4. Use Case: Notifications

This use case reports how pensioner notifies the Pensions Department about changes that directly affects the payment of benefits including updating of bank account details.

#### **Preconditions:**

The pensioner is already getting pension benefits

#### **Postconditions:**

Pensioner selects sends a notice to the Pensions Department

#### **Main Action Scenario:**

- i). Pensioner views the Notifications menu
- ii). Pensioner selects Pension Stoppage
- iii). Pensioner selects Change Account/Pay point
- iv). The mobile application sends an SMS to the pensioner directing them to download specific forms from the National Treasury's website, fill them, attach relevant documents and drop them at nearest Huduma Center within a specified time.
- v). The application sends an SMS to the pensioner stating that the notification has been received by the Department and has been acted upon.

### **Alternative Flow: Notifications**

At step 2, user selects one notifications menu item

- i). The mobile application sends an SMS to the pensioner directing them to download specific forms from the National Treasury's website, fill them, attach relevant documents and drop them at nearest Huduma Center within a specified time
- ii). The application sends an SMS to the pensioner stating that the notification has been received by the Department and has been acted upon.

### **5. Use Case: Update File**

This use case reports how pensioner views personal details available with the Pensions Department including contact address and how to adjust personal records and enroll dependants or update next of kin details

#### **Preconditions:**

The pensioner is already getting pension benefits

#### **Postconditions:**

Pensioner selects sends a notice to the Department

#### **Main Action Scenario:**

- i). Pensioner views the Update File menu
- ii). Pensioner selects View My Records
- iii). Pensioner selects Adjust my records
- iv). Pensioner selects Enroll dependants
- v). On selecting view my records the application sends an SMS to the user displaying key personal details available with the Pensions Department including contact address.
- vi). On selecting Adjust records or Enroll dependants the application sends an SMS requesting the pensioner to download specific forms from the National Treasury's website, fill them and drop them at nearest Huduma center.
- vii). System sends an SMS to the user stating that the forms have been received and record updated.

#### **Alternative Flow: Update File**

At step 2, user selects one Update File menu item

- i). The application displays the Update File menu items where an option is selected
- ii). The application sends an SMS to the pensioner requesting them to download specific forms from the National Treasury's website, fill them and drop them at nearest Huduma center.



- iii). The application sends an SMS to the user stating that the notification has been received and effected.

## **6. Use Case: Other Services**

This use case reports how pensioner accesses other services offered by the Pensions Department through the mobile application.

### **Preconditions:**

Pensioner views the Other Services Menu

### **Postconditions:**

Pensioner selects the other services Menu

### **Main Action Scenario:**

- i). Pensioner views the Other Services Menu
- ii). Pensioner selects PIN change
- iii). Pensioner selects Contact Centre
- iv). The system prompts user the current PIN, the next prompt requests for a new PIN, followed by a prompt of confirmation of the new PIN, for the Contact Centre menu item the application sent an SMS to the pensioners list customer service hot line numbers, e-mails address, website, social media handles, postal and physical address

### **Alternative Flow: Other Services**

At step 2, user selects one Other Service Menu item

- The system prompts user the current PIN, the next prompt requests for a new PIN, followed by a prompt of confirmation of the new PIN, for the Contact Centre menu item the application sent an SMS to the pensioners list customer service hot line numbers, e-mails address, website, social media handles, postal and physical address

## **7. Use Case: Login**

This use case reports how the system administrator logs into the system

### **Preconditions:**

The administrator must enter the correct username and password

### **Postconditions:**

The administrator views the dashboard of the system and must logout after use

### **Main Action Scenario:**

- i). The administrator enter the correct address of the on the browser
- ii). The administrator enters the correct username and password

- iii). The administrator clicks login or enter
- iv). The application opens the dashboard of the system where the administrator can register and manage the system

#### **Alternative Flow: Login**

At step 2, the administrator directly enters the correct password and logs into the system

### **8. Use Case: Search Pensioner Details**

This use case reports how the system administrator search pensioners details from the system

#### **Preconditions:**

The pensioner's record can be searched using a unique pension number, Name, phone number, staff number

#### **Postconditions:**

The pensioners' details queries by the administrator from the system are displayed by the system.

#### **Main Action Scenario:**

- i). The administrator clicks in the search text box icon on the dashboard
- ii). The administrator enters pensioner name, ID number, mobile number, pension number or staff number as the system filters and displays the generated results according to the search criteria.
- iii). The administrator selects and views the required search results.

#### **Alternative Flow: Register New Pensioner**

At step 2, the administrator directly item to be searched from the database into the search text box and views the search results.

### **9. Use Case: View Analytics**

This use case reports how the system administrator views the backend analytics

#### **Predictions:**

Users must query the system for services

#### **Postconditions:**

System Administrator views the charts

#### **Main Action Scenario:**

- i). The administrator clicks on pensions services
- ii). Views the number of pensioners who queried for pensions services

### 4.6.2 Sequence Diagrams

Kruchten (2012) states that sequence diagrams are used to display the sequential flow of information and interaction between an actor, objects and components within a system as they execute a single case. Figure 4.7 shows a system sequence diagram for viewing an SMS based on the service requested from mobile application scenario by users.

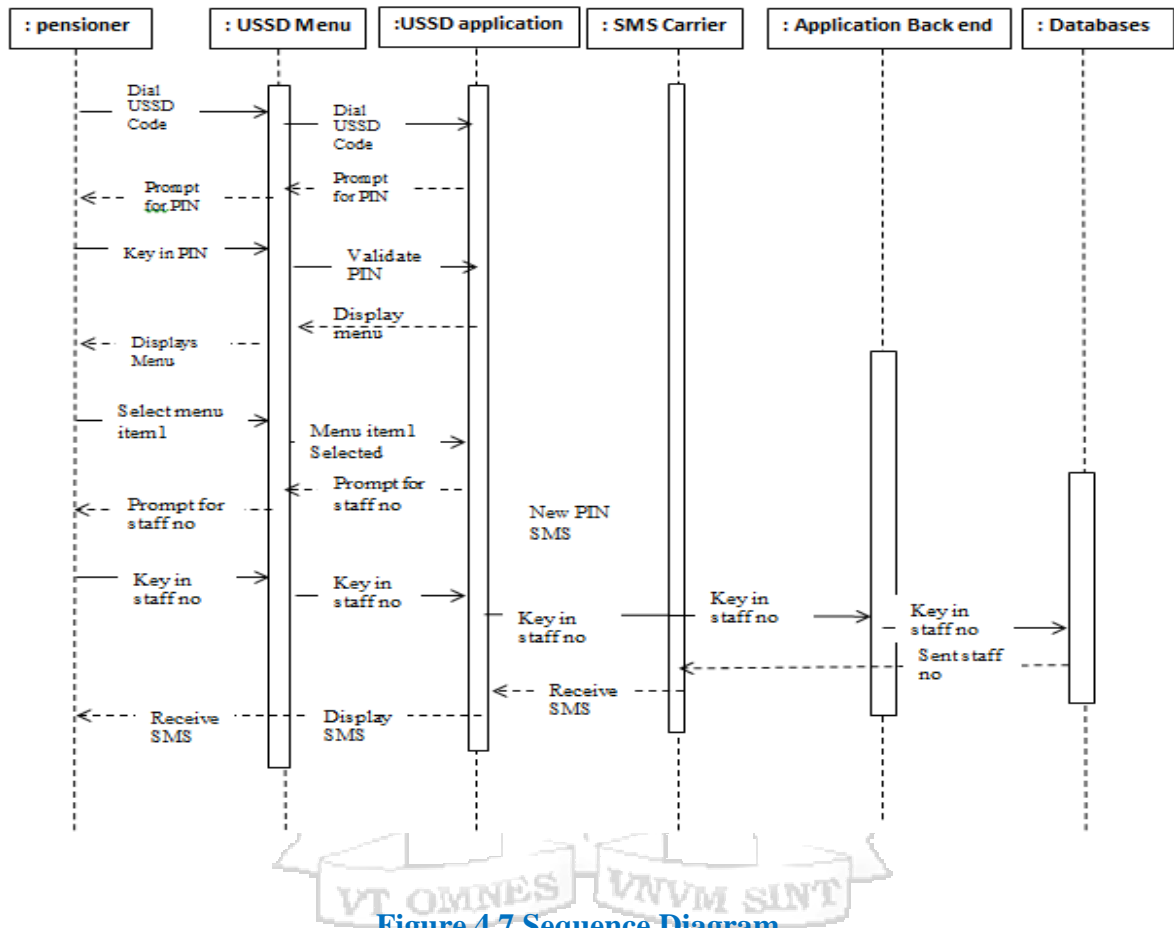
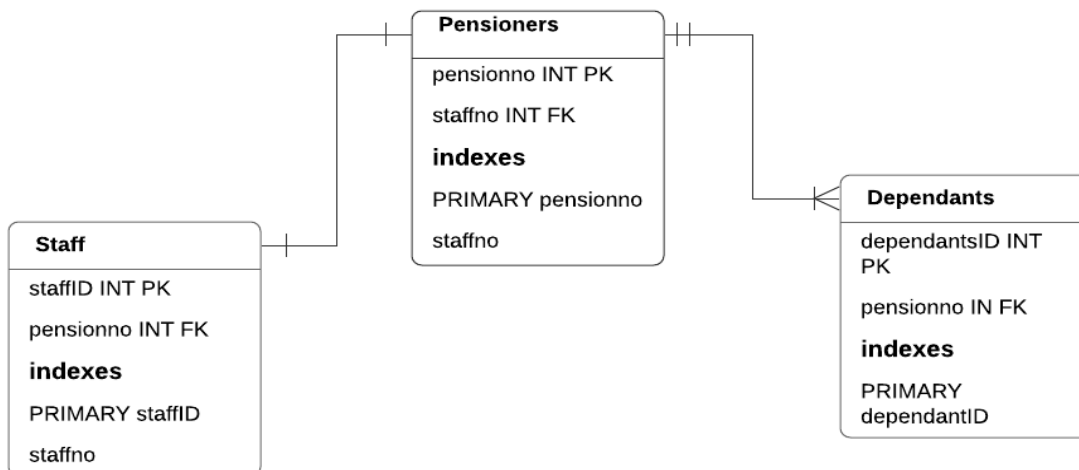


Figure 4.7 Sequence Diagram

### 4.6.3 Entity Relationship Diagram (ERD)

According to Kendall and Kendall (2014) the ERD is a data modeling technique that is widely used to produce data designs, Figure 4.8 illustrates the database design of the USSD application for the tracking pension payments.



**Figure 4.8 Entity Relationship Diagram of the Database**

The following tables represent the relations contained in the database of the system as illustrated by the ERD diagram.

### Pensioners

This is the key table for system that holds pensioners details as represented on Table 4.6.

**Table 4.6 Pensioners Table**

Columns			
Column	Type	Default Value	Extra
pensionID	Int(11)	None	AUTO_INCREMENT
surname	Varchar(25)	None	
middlename	Varchar(25)	None	
lastname	Varchar(25)	None	
gender	Varchar(6)	None	
age	Int(3)	None	
IDNO	Int(11)	None	
phoneno	Int(15)	None	
pensionno	Int(11)	None	
pensiontype	Varchar(255)	None	
approvalstep	Varchar(255)	None	
staffno	Int(10)	None	
staffID	Int(11)	None	

<b>Indexes</b>			
<b>Key</b>	<b>Type</b>	<b>Unique</b>	<b>Column</b>
PRIMARY	Varchar(10)	Yes	pensionID
<b>Foreign Keys</b>			
<b>Name</b>	<b>Table</b>	<b>Column</b>	<b>Table Referenced</b>
staffno	staff	staffno	staff

### Staff Table

This table contains all on the staff who are retiring from the public service. The tabular representation is shown on Table 4.7.

**Table 4.7 Staff Table**

<b>Columns</b>			
<b>Column</b>	<b>Type</b>	<b>Default Value</b>	<b>Extra</b>
staffID	Int(11)	None	<b>AUTO_INCREMENT</b>
surname	Varchar(25)	None	
middlename	Varchar(25)	None	
lastname	Varchar(25)	None	
gender	Varchar(6)	None	
age	Int(3)	None	
staffIDNO	Int(11)	None	
phoneno	Int(15)	None	
staffno	Int(10)	None	
areaofservice	Varchar(255)	None	
<b>Indexes</b>			
PRIMARY	Int(11)	Yes	staffID
<b>Name</b>	<b>Table</b>	<b>Column</b>	<b>Table Referenced</b>
<b>Foreign Keys</b>			
pensionno	pensioners	pensionno	pensioners

### Dependants Table

This table contains all information about the next of kin of the pensioners. This is represented in a tabular form in Table 4.8.

**Table 4.8 Dependants Table**

<b>Columns</b>			
<b>Column</b>	<b>Type</b>	<b>Default Value</b>	<b>Extra</b>
dependantID	Int(11)	None	AUTO_INCREMENT
surname	Varchar(25)	None	
middlename	Varchar(25)	None	
lastname	Varchar(25)	None	
relation	Varchar(25)	None	
dependantIDNO	Int(11)	None	
dependantphoneno	Int(15)	None	
dependantage	Int(15)	None	
gender	Varchar(6)	None	
pensionID	Int(11)	None	
pensionno	Int(11)	None	
<b>Indexes</b>			
PRIMARY	Int(11)	Yes	staffID
<b>Name</b>	<b>Table</b>	<b>Column</b>	<b>Table Referenced</b>
<b>Foreign Keys</b>			
pensionno	pensioners	pensionno	pensioners

**Administrators Table**

This table contains details of the system administrator as shown on table 4.9.

**Table 4.9 Administrator Table**

<b>Columns</b>			
<b>Column</b>	<b>Type</b>	<b>Default Value</b>	<b>Extra</b>
name	Varchar(25)	None	
username	Varchar(40)	None	
password	Varchar(45)	None	
<b>Indexes</b>			
<b>Key</b>	<b>Type</b>	<b>Unique</b>	<b>Column</b>
PRIMARY	INT	YES	adminID

#### 4.6.5 Security Design

Security design considerations are based on a systems approach and data approach, system approach for security design is achieved by the use of PIN that is used to authenticate all users by the backend application before the welcome screen for the application is displayed

#### 4.6.6 Applications Wireframes

In mobile applications developed well designed wireframes are used to graphically display the visual layout and the functions of the mobile application by showing the navigation inside the application and also determine the way the application will look like in terms of the structure and functionality of the application (Robles, 2017).Figure 4.9 illustrates the USSD short code that the user dials to display welcome screen and applications main menu where the users select one option and a sub menu of the selected option is also displayed.

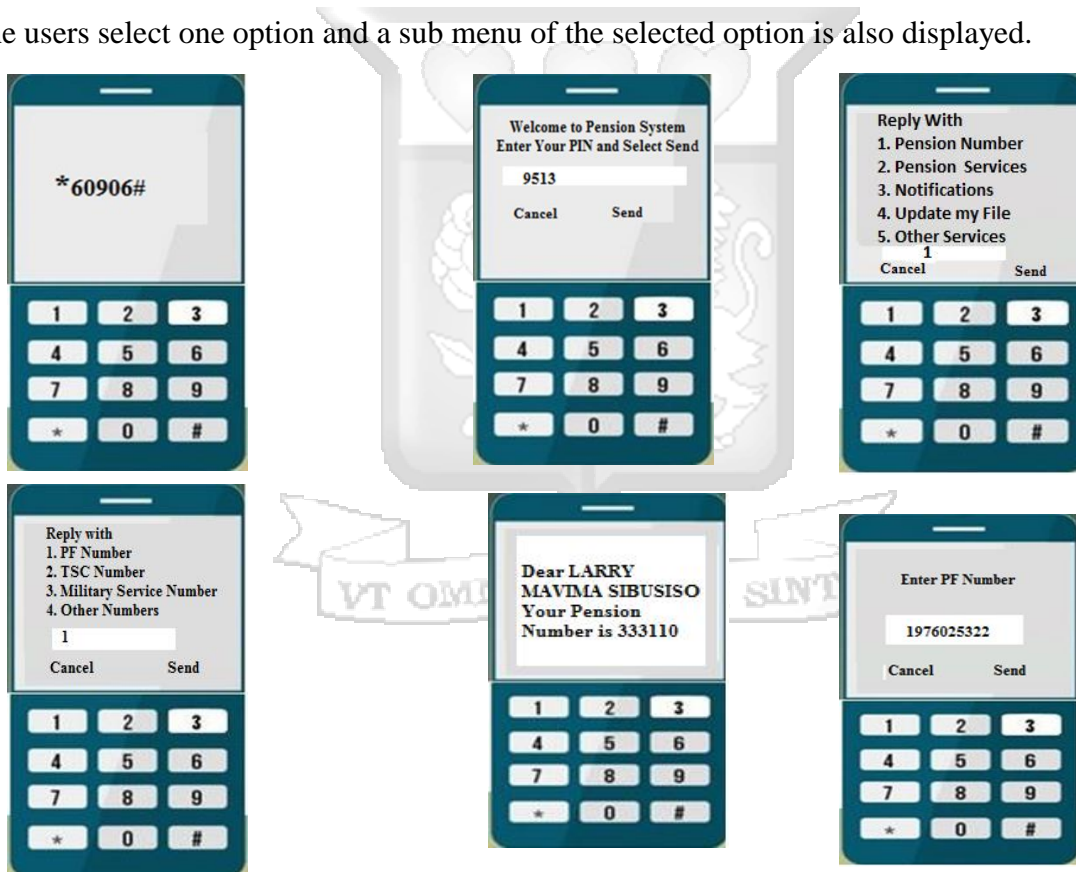
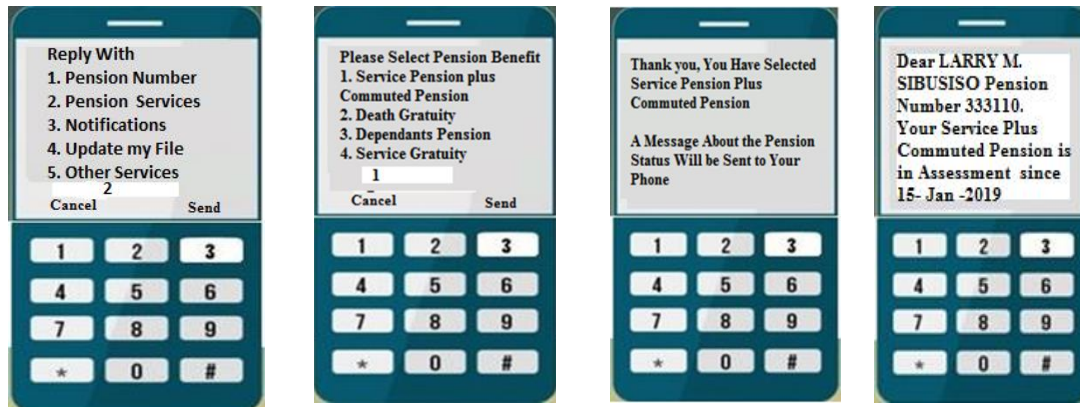


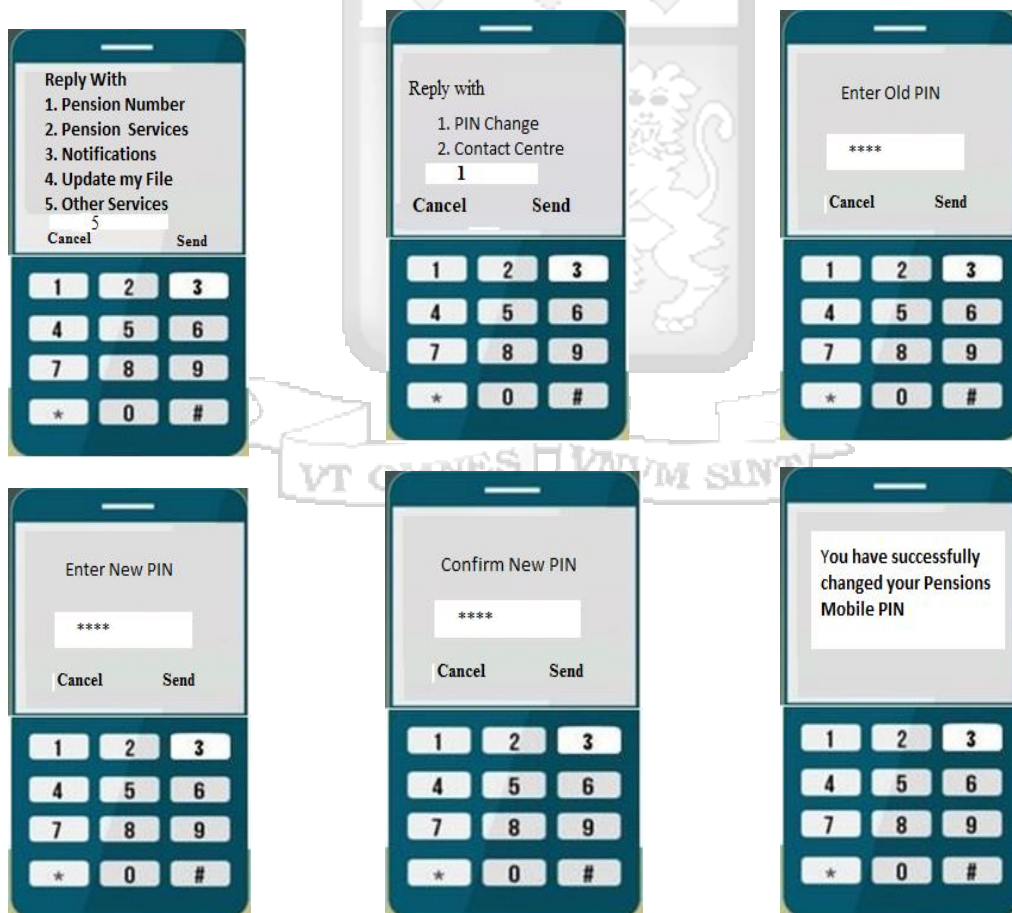
Figure 4.9: USSD short Code, Welcome Screen and First Menu Wireframe

The next wireframes Figure 4.10 illustrates how the pensioner selects a pension service and receives and SMS notification about the status of the service.



**Figure 4.10: Pensions Services and SMS Wireframe**

Figure 4.11 shows the steps for changing the PIN that is used to authenticate the pensioners before they access the application using their mobile phones.



**Figure 4.11: PIN Change Wireframe**



Figure 4.12 shows the data analytics for the pension status breaking down the analysis of all the benefits queried by the pensioners.

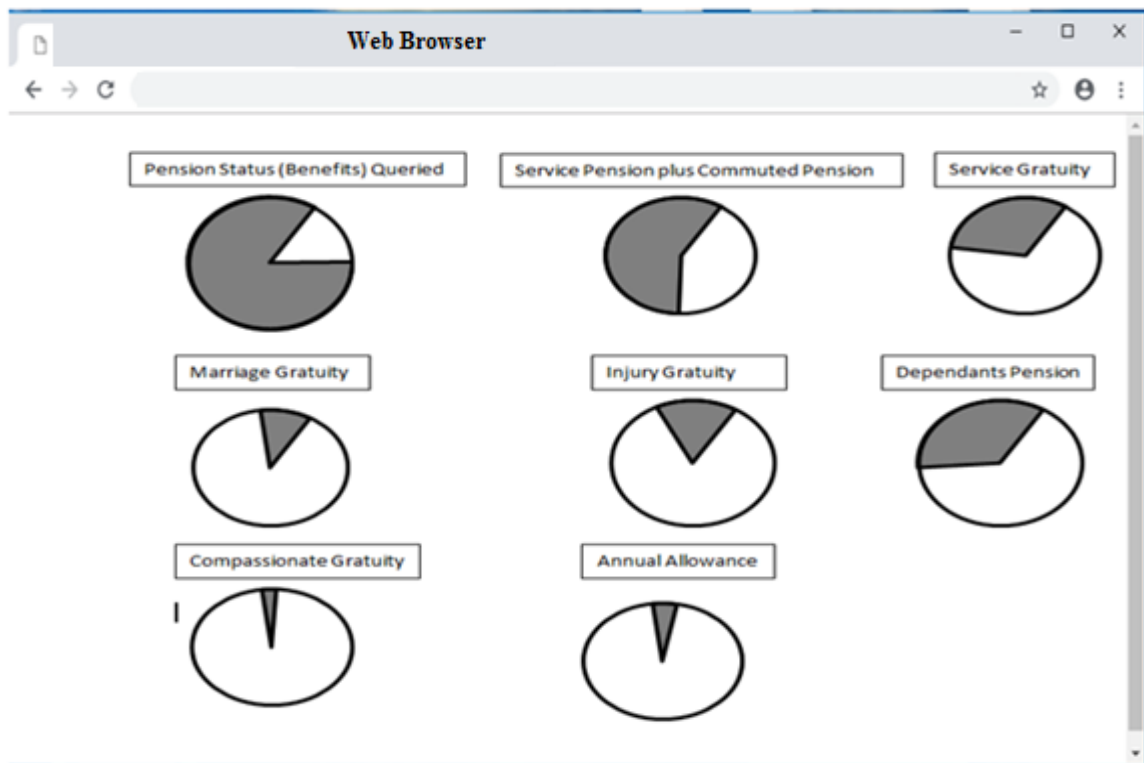
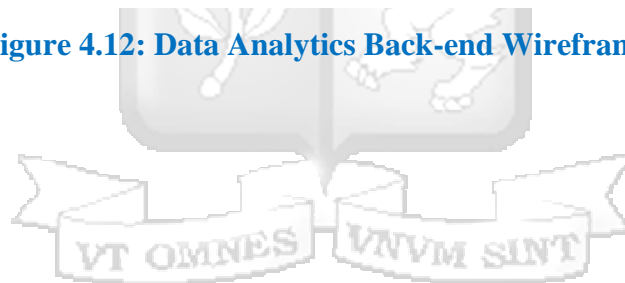


Figure 4.12: Data Analytics Back-end Wireframe



## Chapter Five: System Implementation and Testing

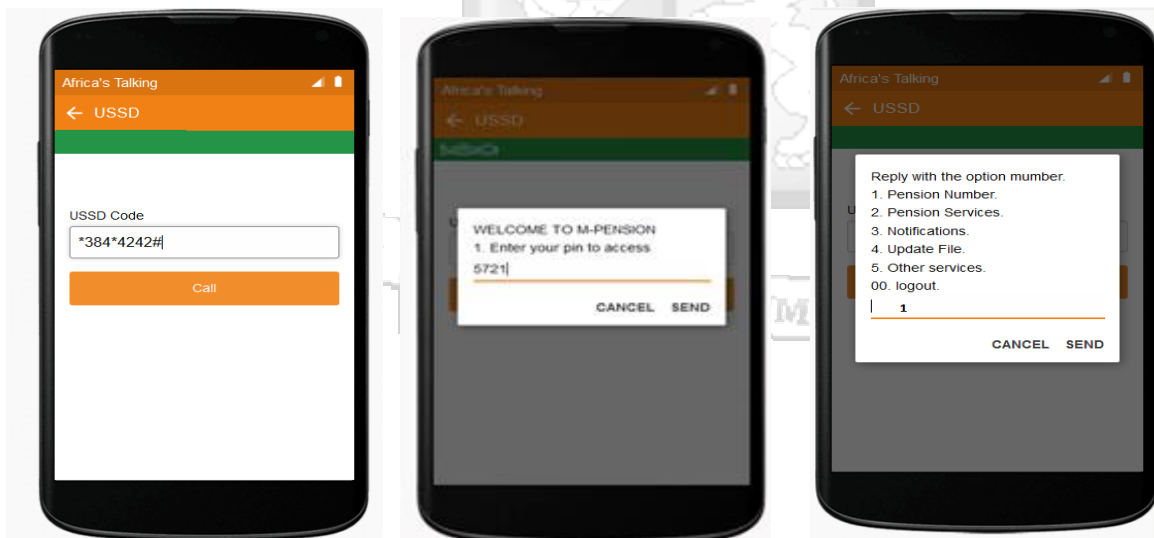
### 5.1 Introduction

This chapter highlights the development and testing of the mobile applications. The back end of the system was developed using PHP 7 language and MySQL database. The user interface or system front end was developed using PHP and HTML. Testing, which includes unit, integration, system or functional testing and usability testing, were done to make sure that the system design was taken care of in the developed mobile application.

### 5.2 System Implementation

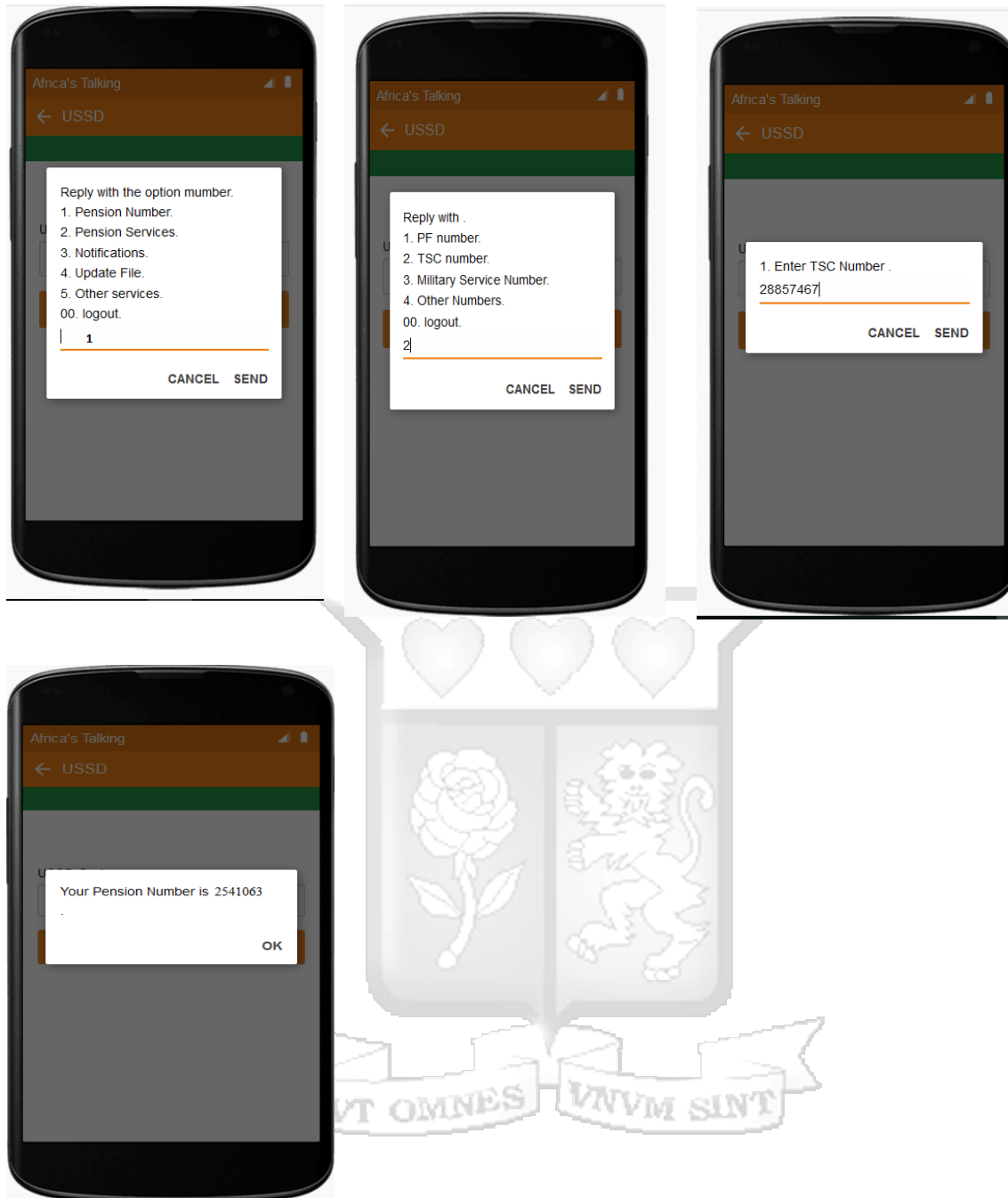
The PHP programming language was used to develop the USSD application back end while the front end of the web application made use of PHP and HTML 5. Figure 5.1 shows how the USSD application works.

#### USSD Application



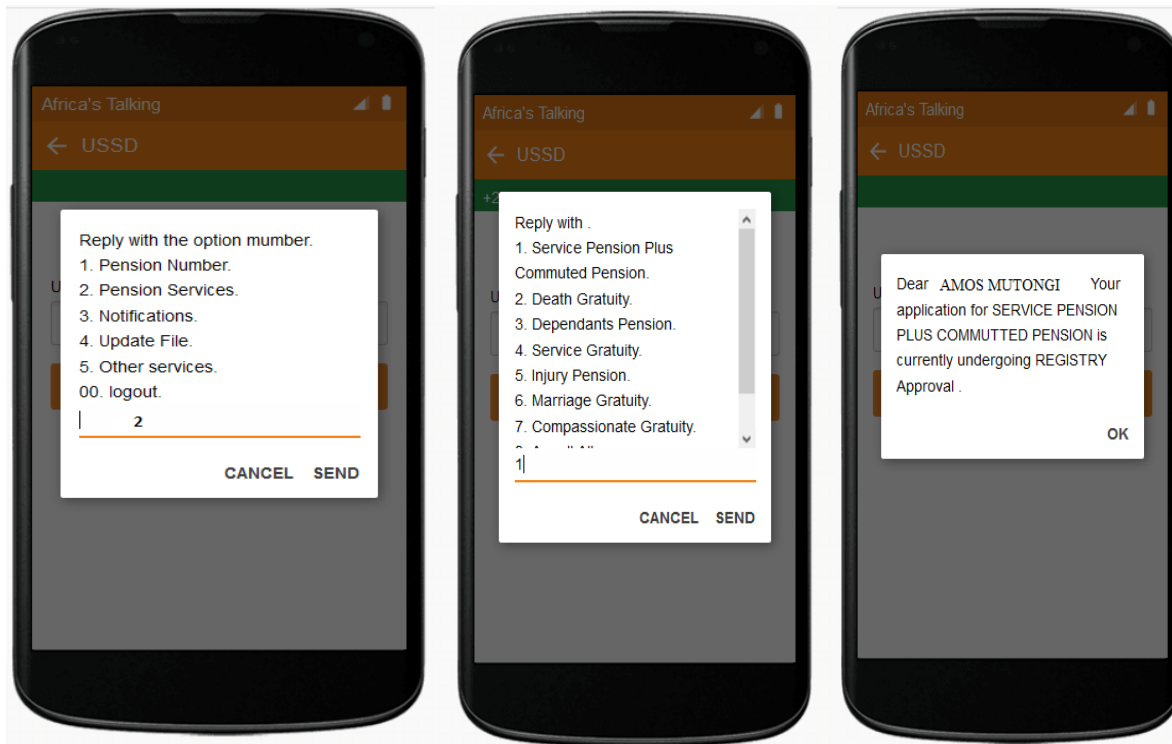
**Figure 5.1 USSD Short Code and Menu Screenshot**

Figure 5.1 shows a USSD short code and menu screenshot. When a user dials the short code in the first screen, the menu in the second screen appears. The menu has three selection options, which the pensioners can select.



**Figure 5.2 Pension Number request, and Pension Number SMS Confirmation Screenshots**

Figure 5.2 shows number request screenshot and pension number SMS confirmation screenshot. The pension number screenshot shows a sub menu of menu 1 shown in figure 5.1. The second screen shows notification SMS of the pension number confirmation screenshot.

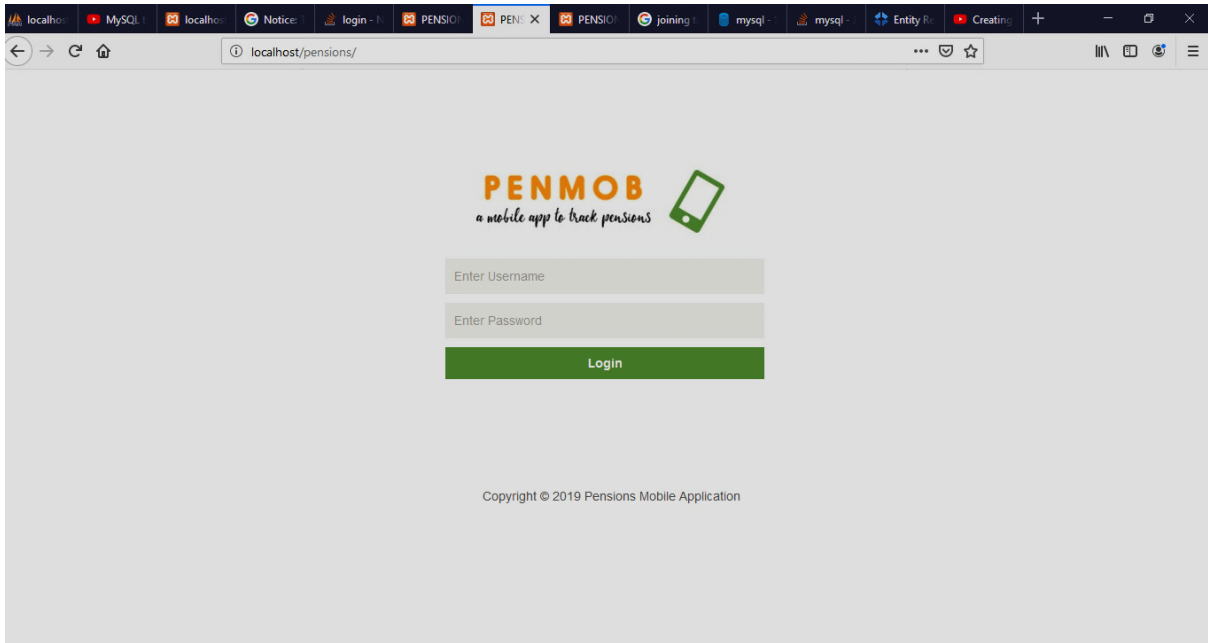


**Figure 5.3 Pension Status Confirmation and SMS Screenshot**

Figure 5.3 shows pension status confirmation and SMS screenshot. The pension status screenshot shows a sub menu of menu 2 shown in figure 5.1. The second screen shows the notification SMS of the pension status confirmation screenshot.

### **5.3 Application Back End**

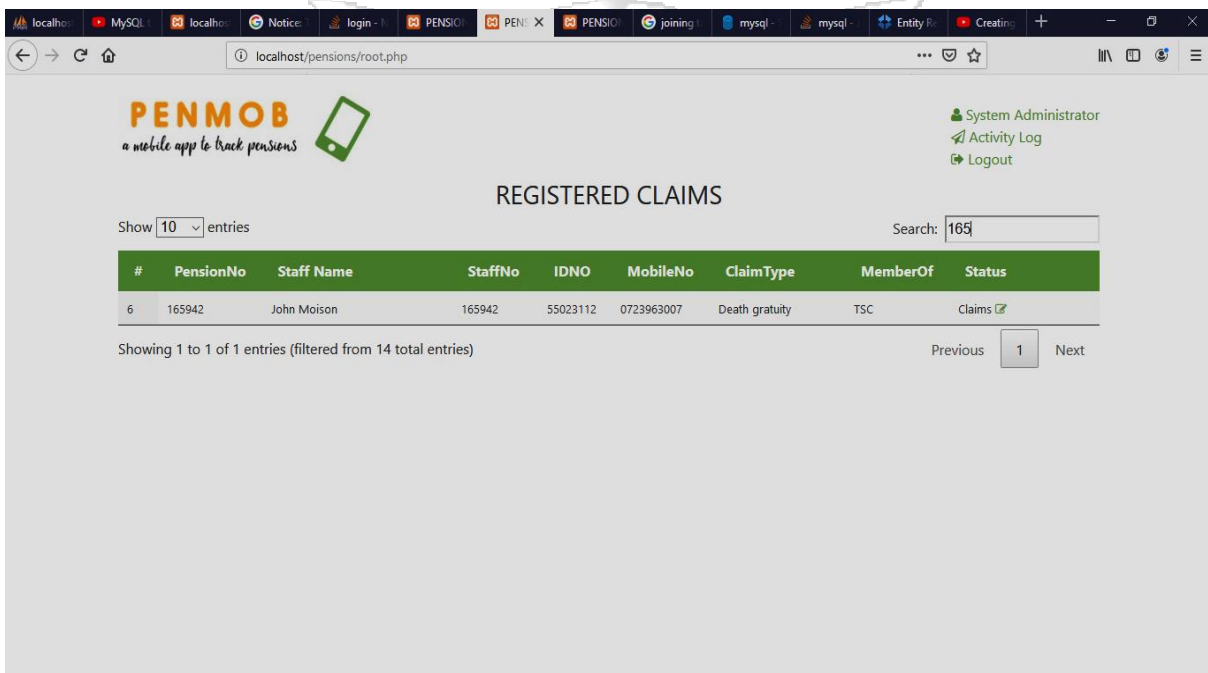
The functional parts of the system was accessed and tested through the back end of the application by the system administrator who logged into the system using the correct login credentials, searched for records using the search facility and edited some specific pensioner details, pensioners received SMS notifications concerning their specific pension claims.



**Figure 5.4 Administrator Login Screenshot**

Figure 5.4 shows the administrator login screenshot for the backend of the system, the administrator must key in a username and a strong password for them to view and search pensioners records.

For the administrator to search Figure 5.5 illustrates the search facility that was used to search records using any unique field displayed including the pension number, ID number, Staff number and Mobile Number.



**Figure 5.5 Search for Records Screenshot**

Figure 5.6 and Figure 5.7 illustrates the admin management page screenshot or the dashboard, where the administrator can view or update or edit pension records of pensioners respectively.

#	PensionNo	Staff Name	StaffNo	IDNO	MobileNo	ClaimType	MemberOf	Status
1	419835	Amos Munyaradzi Mutongi Ombima	41983	28857467	0704739391	Compassionate gratuity	Military	Registry
2	2018941	Louise Njeri Muthoni	07134151222	28857467	0704739380	Service gratuity	TSC	Cash office and Dispatch
3	214748	Christopher Khavusi	122222	26512024	0724764531	Injury pension	PSC	Accounts
4	567584	Musa Hassan	546722	356678695	0705378002	Service gratuity	Military	Accounts
5	456780	Grace Akoth	0755456783	041983	0704739380	Service gratuity	TSC	Approval
6	165942	John Moison	165942	55023112	0723963007	Death gratuity	TSC	Claims
7	125486	Francis Ruto	0725946162	748536	359140	Compassionate gratuity	TSC	Assessment
8	432147	Elizabeth Muindi	4321111	55023112	0723963011	Marriage gratuity	PSC	Accounts
9	631833	Musa Kassim Mohamed	4034541	28857467	0704739380	Service gratuity	Military	Assessment
10	39652	ARTHUR ODONGO SENIOR	333301	28857467		Marriage gratuity	PSC	Registry Approval

Figure 5.6 Admin Management Page Screenshot

RECORD SUCCESSFULLY UPDATED

OK

Save Changes

Figure 5.7 Admin Records Update Screenshot

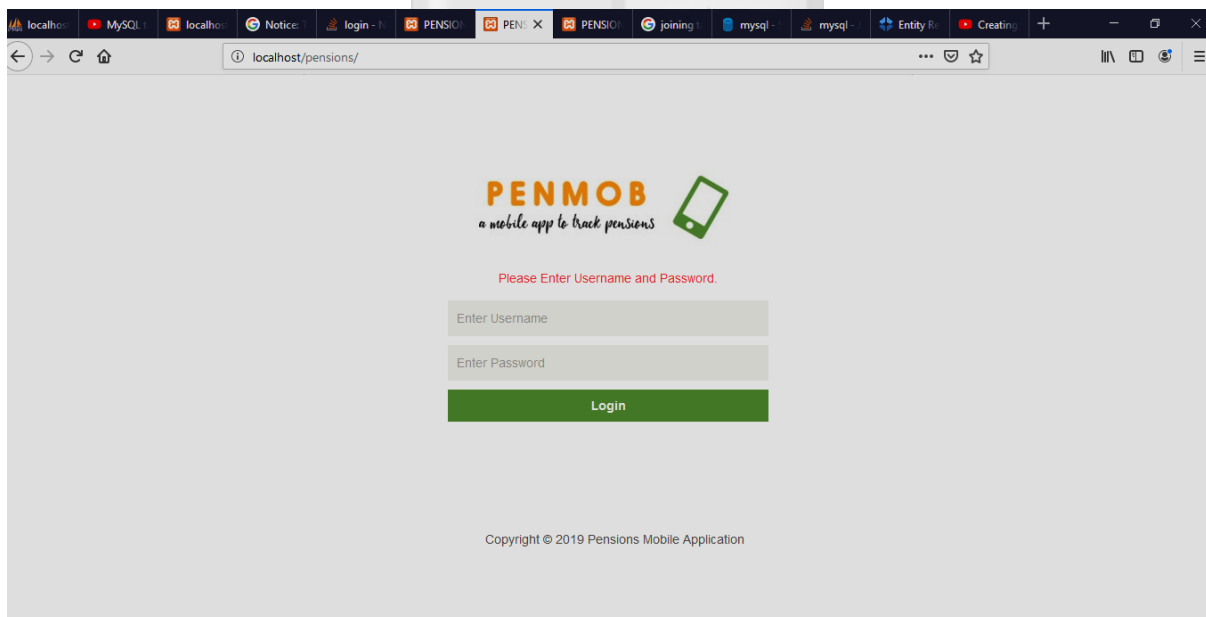
## 5.4 System Testing

This section discusses the various tests undertaken by the researcher and the users of the mobile application and the web application in order to fulfil the functional and non-functional

requirements of the system, Further the V shaped model that was used in system development has the following testing phases, unit, integration, system testing or functional testing and user acceptance testing (UAT), unit testing was done on the various units like the backend, and web application, USSD codes of the system to eliminated bugs while integration testing performed on the architectural design like the front end, back end and the USSD gateway to ensure that the modules were integrated and that the entire system can be tested for functionality.

#### 5.4.1 Functional Testing

Functional testing of the system was carried out to determine how effective the system was in terms of implementation design and logical user requirements, Figure 5.8 shows tests for user login by the system administrator, for successful login the administrator must enter both the correct username and the password, neither does the system allow blank username and passwords.



**Figure 5.8 Testing System Administrator login Credentials**

#### 5.4.2 Compatibility Testing

The compatibility testing was done to ensure that the web application is compatible with the different browsers; it was tested against the common browsers and their various versions as shown in Table 5.1 on web compatibility test.

**Table 5.1 Web Compatibility Test Table**

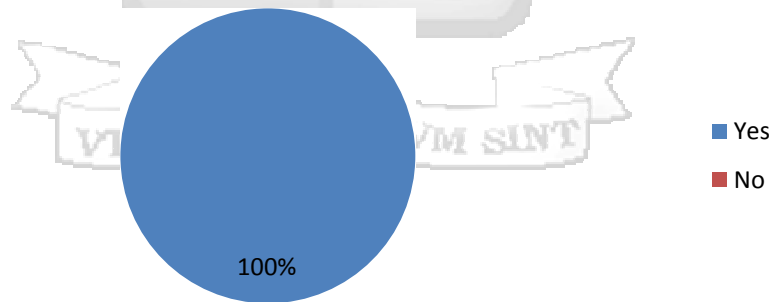
Web Browser	Compatibility Test Results
Microsoft Internet Explorer (versions 4 and above)	Yes
Mozilla Firefox (version 8.0 and above)	Yes
Google Chrome (All versions)	Yes

### 5.4.3 Usability Testing

The mobile application was developed for pensioners who are the key end users of the system, therefore usability testing involved end users testing the system with the aim of making sure that it can be used by people of advanced age groups in Kenya, the usability questionnaire in appendix B summarises the five key dimensions of usability attributes (Ryan et al. 2016). In this study usability tests were undertaken by nine respondents. Section 5.5 summarises the usability test results.

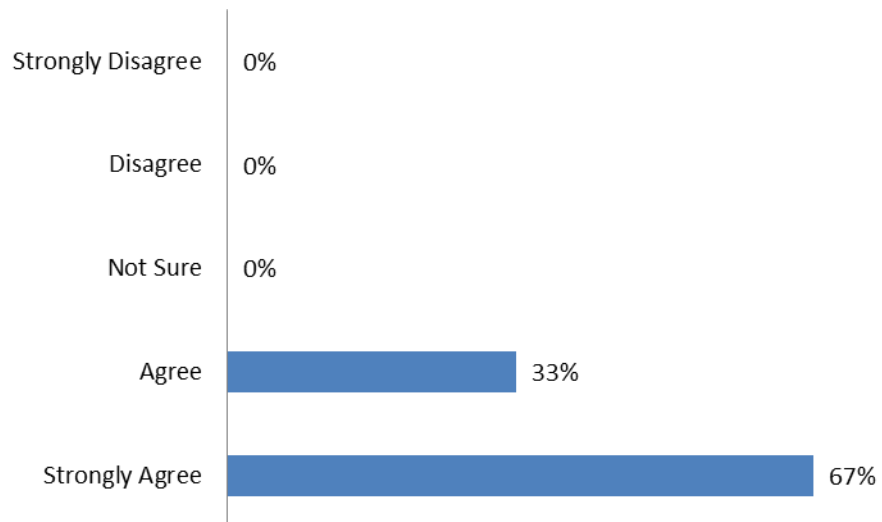
### 5.5 Usability Test Results

- a) All the nine pensioners who participated in the usability testing correctly dialled and used the USSD short code.

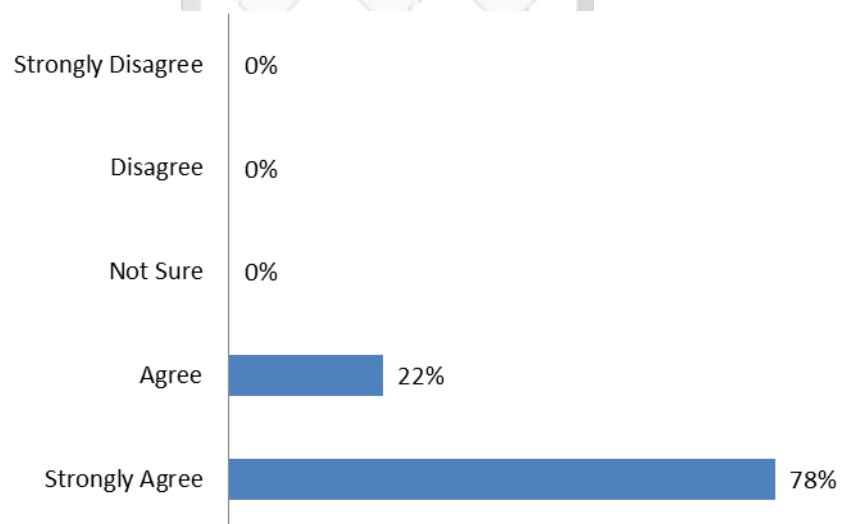


- b) The respondents who participated in the mobile application usability testing 67% strongly agree and 33% agree that “It was simple to use the mobile application”

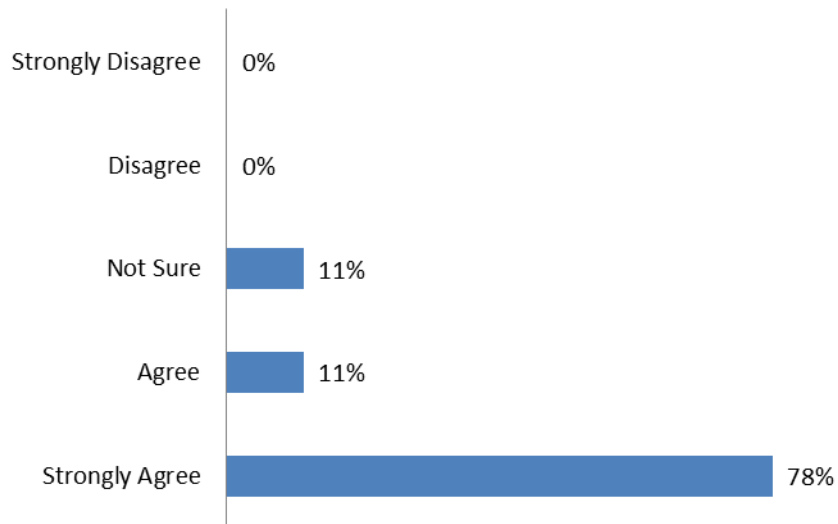




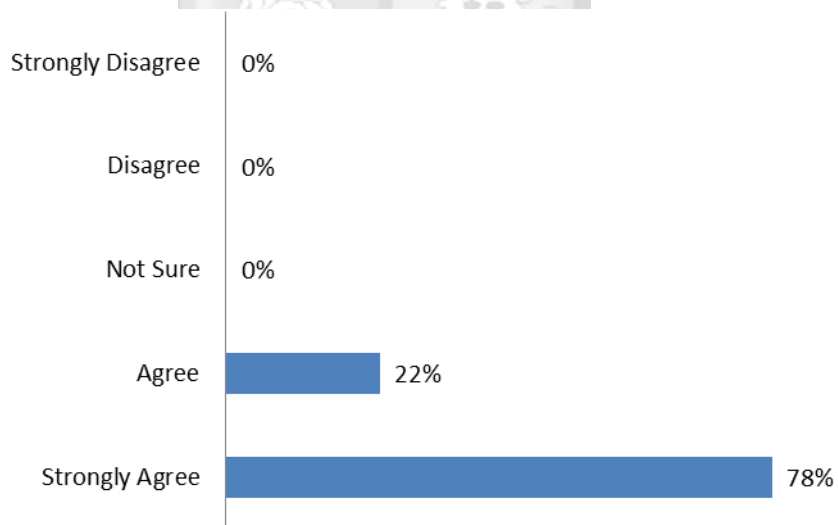
c) On “feedback and instructions provided by the application are clear” 78% rated Strongly Agree and 22% rated Agree.



d) On the suitability test attribute “the application was ease to learn even for the first time” 78% strongly agreed, 11% agreed while 11% were not sure that the application was ease to learn.



e) Regarding the suitability test attribute “Am generally satisfied with the how it is easy to use the mobile application” 78% indicated that they strongly agreed and 22% agreed that they were satisfied with the application.



f) Finally on “I can recommend the application to other pensioners” 89% strongly agree while 11% of the pensioners agreed that they will recommend the application to other pensioners.

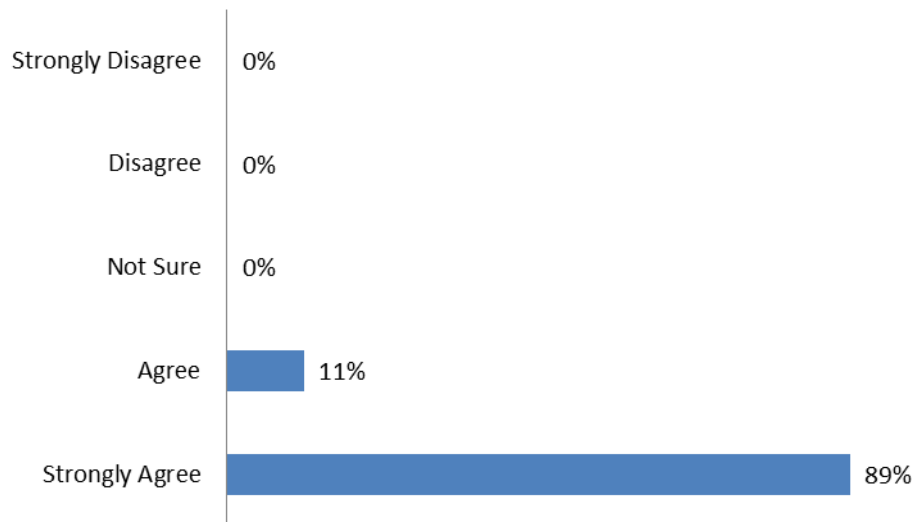
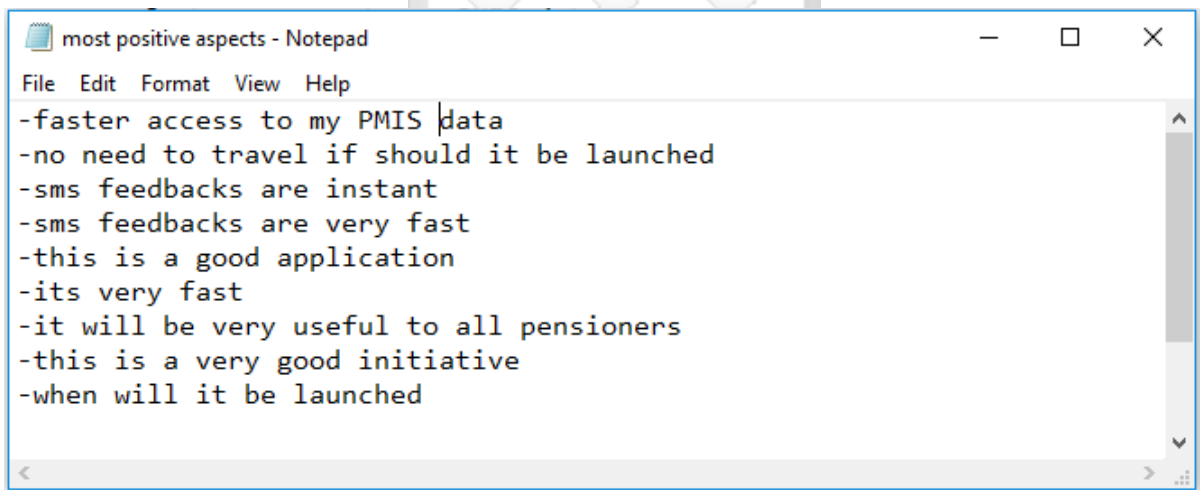
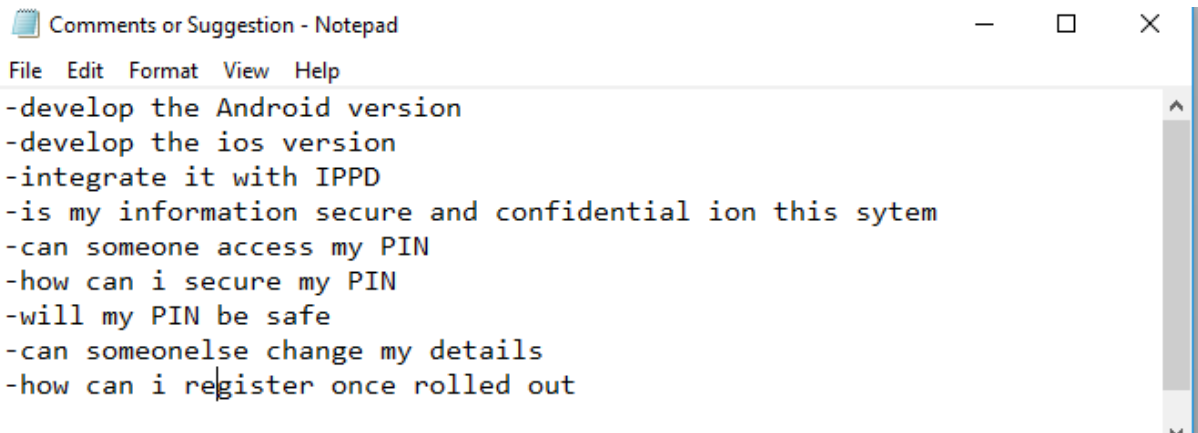


Figure 5.9 shows lists the most positive aspects about the mobile application according to the pensioners.



**Figure 5.9 Most Positive Aspects in the Mobile Application**

Figure 5.10 shows the comments and suggestions about the mobile application from the nine respondents.



**Figure 5.10 Comments or Suggestion about the Mobile Application**



## **Chapter Six: Discussion**

### **6.1 Introduction**

The findings obtained during the research informed the reasons as to why a mobile application to track pension payments was developed. The following sections of this chapter discussed the research findings based on research objectives and literature review including the advantages and disadvantages of the developed mobile application mobile.

### **6.2 Issues or Problems that Pensioners Seek Information about from the Pensions Department**

The first objective in Section 1.3 was to determine which issues or problems that pensioners seek information about from the Pensions Department. From the study, it was found that all the respondents inquired about their pension status which referred to the of stage at which their claims for pension payment had reached in the PMIS work flow, this was followed by general complaints about the various pension services, more than half of the respondents were seeking to know their pension numbers, half of respondents were seeking information on how to update their files, the least number respondents were seeking to notify the Pensions Department on about deaths, stoppage of pension and change of account and pay point. These findings reflect the information in the literature which illustrates the issues that pensioners seek information about from the Pensions Department.

### **6.3 How the Pensions Department Interacts or Communicates with the Pensioners**

Objective number two for this study was to find out how the Pensions Department communicates or interacts with the pensioners. From the study findings, it was found that most respondents prefer or use direct communication to the Department where they have to travel to Nairobi for them to receive reliable information from the Department; this is followed by communication through the media namely Newspapers, Radio, Television and Press releases from the Department.

Further, finding on communication methods used by the Department also show that the pensioners face a number of challenges with different methods used such as being costly to travel to the Pensions Department in Nairobi from other regions of the country and lack of daily access to newspaper that leads to receiving out-dated information. The literature review illustrated the challenges of various communication channels which were reflected in the

study findings, this finding show the need for direct interaction between the Department and the pensioners which informed the need for developing a mobile application to track pension payments and also enable direct interaction between the pensioners and the Pensions Department.

#### **6.4 Existing Technology Options to Support Interaction between the Pensions Department and the Pensioners**

The third objective was to get to understand the technology options that can be used to support interaction between the Pensions Department and the pensioners; most pensioners were familiar with the use of USSD/SMS applications.

#### **6.5 A Mobile Application to Track Pension Payments**

This study developed a mobile application to track pension payments for the public service pensioners which is currently being centrally administrated by the Pensions Department in Nairobi as its fourth objective. The application allows the pensioners interact with the Department directly without travelling to Nairobi they can get to know the various pension services and track their own pension transactions.

Research findings shows that the pensioners preferred the development of a USSD/SMS mobile application to track their pension payments and interact and communicate with the Pensions Department reliably from anywhere and at any time in the county. The USSD application is of great convince to the pensioners because it can be accessed using feature phones, low end phone and high end phones and does not require Internet connectivity neither does it require downloading as illustrated in chapter two.

#### **6.6 Testing of the Mobile Application that Tracks Pensions Payments**

The last and critical objective of the study was testing to ensure that the mobile application worked as required and that it had the necessary functionality, both functional and non-functional. In the literature review the test were done in every stage of the software developed as per the V shaped software development methodology with usability testing being the main approach of testing the application. Appendix B shows the usability testing questionnaire that was used to test the developed application. All the respondents who participated in the usability testing were able to correctly dial and use the USSD short code, meaning that it was reliable. Most respondents between 67% and 89% who took part in the application usability testing, ‘strongly agreed’ on the five key attributes of usability testing.

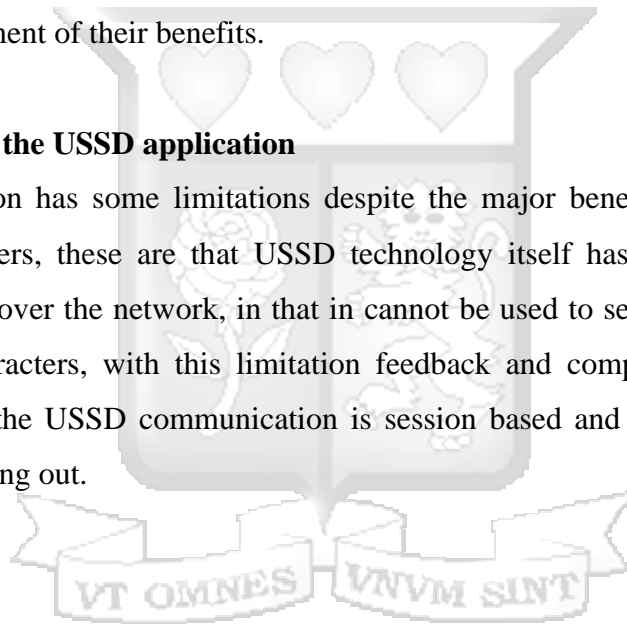
### **6.7 Advantages of the Application to the Pensioners**

Research findings show that pensioners prefer direct communication and interaction with the Pensions Department hence the reason for travelling long distance in Nairobi which is costly and time consuming.

The proposed application allows direct and faster access to the pensioner's information and details in the PMIS system, the USSD application works on any phone, without the need for Internet; therefore pensioners will interact with the Department at no cost and only travel to the Pensions Department in Nairobi when it is absolutely necessary, further with this application the Pensions Department has put in place a strategy to interact with, provide feedback and inform pensioners until finalisation of the pensions payment process and during the monthly disbursement of their benefits.

### **6.8 Disadvantages of the USSD application**

This USSD application has some limitations despite the major benefits and advantages it offers to the pensioners, these are that USSD technology itself has a limited number of characters it can sent over the network, in that in cannot be used to send a message of more than 160 to 182 characters, with this limitation feedback and complaints must be short, another limitation is the USSD communication is session based and the sessions are short lived and ends up timing out.



## **Chapter Seven: Conclusion, Recommendations and Future Work**

### **7.1 Conclusion**

This study revealed challenges faced by pensioners as they seek information and services from the Pensions Department in Kenya. The key challenges included use of old interaction methods and the lack of adoption of technology by the Department. Using the available technology options discussed in chapter two, the development of a USSD mobile application to track pension payments for public pensioners in Kenya was conceived as a solution, which helps pensioner interact directly with the Department using any mobile phone.

The application was developed using the V-shaped model with tests being done in every phase namely unit, integration, system and then usability testing was performed in which the most pensioners strongly agreed with the five key attributes of usability. The application helps pensioners track their pension payments while receiving alerts or SMS notifications from the Pensions Department therefore reducing reduce the stress, time and cost associated with the current interaction methods.

### **7.2 Recommendations**

The mobile application to track pension payments is of a great convenience to the pensioners, dependants and guardians, while for the Pensions Department the applications helps in producing a summary of management reports for quicker decisions making.

However, the researcher notes that the mobile application does not solve the delay in the payment of benefits which is at times occasioned by the delay in the release of funds from the consolidated fund service to pay new pension claims; the National Treasury has to ensure that the Pensions Department receives adequate funds to settle the ever increasing claims.

Finally, researcher recommends that other public pension agencies running state or federal public pension schemes in African countries like those in Tanzania, Nigeria and Zimbabwe can adopt this application.

### **7.3 Future work**

It should be noted that the Pensions Department runs a pension scheme in Kenya that benefits thousands of retired Public Servants including those who might have access to the Internet. Therefore, development of a mobile application for tracking of pension payment on other mobile platforms like Android, iPhone and Windows will be necessary.



Secondly, there is need to develop a web portal where most of the forms and information can be accessed by the pensioners should they require more information and services they can download or even upload forms, the portal can also give definitions of all the pension benefits, what benefits are the pensioners or dependants entitled to and for how long and a calculator with formulas on how different benefits are computed or calculated.



## References

- Aniket, D., & Chetna, D. (2009). Implementation of Real Time Tracking using Unstructured Supplementary Service Data, *World Academy of Science, Engineering and Technology* June 2009, Vol. 54, p241.
- Bassara, A., Wiśniewski, M. & Zebrowski, P. (2005). USE-ME.GOV – A Requirements driven Approach for M-GOV Services Provisioning. *Business Information Systems. Poznan*, Poland. Accessed February 10 2019.<http://kie.ue.poznan.pl/en/content/use-megov-requirements-driven-approach-m-gov-services-provisioning-0>
- Bose R., (2002). Customer Relationship Management: Key Components for IT Success *Industrial Management & Data Systems*, Vol. 102 Issue: 2, pp.89-97, retrieved on 15<sup>th</sup> February 2019 at <https://doi.org/10.1108/02635570210419636>.
- Brown, J., Shipman., & Vetter, R. (2007). SMS: The short message service. *IEEE Computer Society*. Retrieved February 15 2019. doi: 10.1109/MC.2007.440
- Christopher, D., Catherine, H.A., Charles, R., & Wood, R., M. (2006). Making the Transition to Retirement: Appraisals, Post Transition Lifestyle, and Changes in Consumption patterns, *Journal of Consumer Marketing*, Vol. 23 Issue 2 pp. 87 – 99.
- Commission on Administrative Justice (2016). *Sentenced to Poverty at Sunset, An Investigation Report on systemic Issues Inherent in the Payment of Pensions, Gratuity and other Benefits-* Commission on Administrative Justice January 2016.
- Denscombe, M. (2007). *Questionnaires in the Good Research Guide for Small-Scale Social Research Projects*. 4<sup>th</sup> ed. England: Open University Press.
- Ottka, S. (2015). *Comparison of mobile application development tools for multi-platform Industrial applications*. Master's Thesis. Aalto University. Retrieved December 21, 2018, [https://aaltodoc.aalto.fi/bitstream/handle/.../master\\_Ottka\\_Sanna\\_2015.pdf?](https://aaltodoc.aalto.fi/bitstream/handle/.../master_Ottka_Sanna_2015.pdf?)
- Gitonga, C., M. (2017). *Analysis of communication channels used in the educational book publishing industry in Kenya*. Master's Thesis. University of Nairobi. Retrieved October 21, 2018, [https://journalism.uonbi.ac.ke/.../GITONGA%20CAROLINE%](https://journalism.uonbi.ac.ke/.../GITONGA%20CAROLINE%20)
- Gupta, P. (2010). End to End USSD System, *Tata Teleservices Ltd*; India.
- Internet World Statistics (2018). [www.internetworldstats.com](http://www.internetworldstats.com) Accessed October 25, 2018.
- Kadalarasane, T. (2015). *Acceptance of Mobile Banking Services: Antecedents and Consequences*.
- Kendall, J. E., & Kendall, K. (2014). *E-Systems Analysis and Design*, 9th Edition, Rutgers University ©2014 Pearson.

- Kenya Anti-Corruption Commission (2008). *Report of the Examination into Systems, Policies Procedures and practices of the Pensions Department Ministry of Finance*. Kenya Anti-Corruption Commission Directorate of Preventive Services.
- Korson, T., & McGregor, J. D., (1990). Understanding Object-Oriented: A Unifying Paradigm, *Communications of the ACM* 33.n9 (Sept 1990): pp40 (21)
- Kibet, A., K. & Simiyu, R., S. (2016). The Role of Pension Schemes in Economic Development: Comparing Kenya and Singapore, *Research Journal of Finance and Accounting* www.iiste.org ISSN 2222-1697 (Paper) ISSN 2222-2847 (Online), Vol.7, No.16, 2016. Retrieved in October 2018
- Maduga, F., C. (2015). *Public Communication and Social Security Delivery in Tanzania*. PhD Thesis. University of West London. Retrieved December 21, 2018, [https://repository.uwl.ac.uk/id/.../Frank\\_Maduga\\_Final\\_Thesis\\_](https://repository.uwl.ac.uk/id/.../Frank_Maduga_Final_Thesis_)
- Mechelle, H., Michael, David, G., Yong, W., K. & Pramod, G. (2002). *An empirical Evaluation of system and regression testing*. In CASCON 02. Proceedings of the 2002 conference of the Centre for Advanced Studies on Collaborative research Page 3. Toronto, Ontario, Canada — September 30 - October 03, 2002. Accessed April 2019.
- Mickoleit, A. (2014). Social Media Use by Governments: A Policy Primer to Discuss Trends Identify Policy Opportunities and Guide Decision Makers, *OECD Working Papers on Public Governance, No. 26*, OECD Publishing, Paris.
- Misra, S. K., & Wickamasinghe, N. (2004). Security of Mobile Transaction: A Trust Model. *Electronic Commerce Research*, Vol. 4, No. 4, pp 359-372. Accessed January 12 2019 doi=10.1023/B:ELEC.0000037082.39182.3a
- Kenedy, N., & Kasamani, B. (2018). A Mobile-based Tea Farming Information System. *International Journal of Computer Applications*. 179. 37-44. 10.5120/ijca2018916334.
- OECD (1996). *Effective Communications between the Public Service and the Media, SIGMA Papers, No. 9*, OECD Publishing, Paris.
- OECD (2013). *Survey and lesson learnt; Improving pension information and communication* [https://www.oecd.org/.../TrustFund2013OECD%20Improving\\_Pension\\_Information](https://www.oecd.org/.../TrustFund2013OECD%20Improving_Pension_Information) Accessed December 15, 2018.
- OECD, ITU (2011) *M-Government: Mobile Technologies for Responsive Governments and Connected Societies*. Accessed December 15, 2018. <http://handle.itu.int/11.1002/pub/804db8ac-en>
- Peelen, E. (2005). *Customer Relationship Management*, Prentice Hall, UK.

- Pensions Act Chapter 189 Revised Edition (2018) 1986 Government of Kenya Published by the *National Council for Law Reporting with the Authority of the Attorney-General* [www.kenyalaw.org](http://www.kenyalaw.org).
- Pensions Department (2017). *Payroll and Registry file Census Report of August 2017*.
- Pensions Department (2018). *Attendance slip*.
- Public Pension Agency (PPA) (2019). <http://www.pension.gov.sa/sites/en/PortalServices/e-serviceguide/Pages/pensioner-services.aspx>. Accessed May 29- 2019.
- Ragunath P.K., Velmourougan, S., Davachelvan, P., Kayalvizhi, S., & Ravimohan, R. (2010). Evolving a New Model (SDLC Model-2010) for Software Development Life Cycle (SDLC), *IJCSNS*, vol. 10, 2010, p. 112. Retrieved in February 12 2019.
- Raichura, S., K, (2008). *Analytical Review of the Pension System in Kenya*. Retrieved February 12 2019. <https://www.oecd.org/finance/private-pensions/41564693.pdf>
- Reusch, J. A., Bastian, S., Studnik D., Jürg S. (2005). VoiceXML-Applications for E-Commerce and E-Learning Computing, *International Scientific Journal of Computing* Vol. 4, Issue 3, 131-137.
- Robles, J. (2017). *The Role of Wireframing in Mobile App Design*, <https://chaione.com/blog/the-role-of-wireframing-in-mobile-app-design/> Accessed January 25, 2018.
- Ryan, S., Armando, P., Kevin, G., & Ashish, A. (2016). *Usability of a Smartphone Application to Support the Prevention and Early Intervention of Anxiety in Youth*, <https://doi.org/10.1016/j.cbpra.2016.11.002>. Retrieved February 11 2019.
- Sanganagouda, J. (2011). USSD – A potential Communication Technology that can Ouster SMS Dependency, *International Journal of Research and Reviews in Computer Science (IJRRCS)*, Vol 2. No. April 2, 2011.
- Sounman, H. (2016). Government Press Releases and Citizen Perceptions of Government Performance: Evidence from Google Trends Data, *Public Performance & Management Review*, 39:4, 885-904, DOI: 10.1080/15309576.2015.1137776. Retrieved March 25, 2019.
- Suddul, G., Soobul, A., Bahadoor, U., Ramdoyal, A., Doolhur, N., & Richomme, M. (2011). An Open USSD Enabler to Simplify Access to Mobile Services in Emerging Countries, *Emerging Trends in Engineering and Technology (ICETET)*, 4th International Conference on , pp.323,326, Retrieved January 10, 2019, Doi= 10.1109/ICETET.2011.53.
- Schellong, A. (2005). CRM in the Public Sector: Towards a Conceptual Research

Framework. *Kennedy School of Government, Harvard University* DOI: 10.1145/1065226.1065342 Retrieved October 4 2018.

Taskin, E. (2012). GSM MSC/VLR Unstructured Supplementary Service Data (USSD) Service, *Uppsala University*.

Wan-hinLuk, P. (2017). *An Empirical Analysis of PHP in Open Source Applications*. Masters Thesis. Queen's University Kingston, Canada. Retrieved January 21, 2019, [https://qspace.library.queensu.ca/bitstream/.../Luk\\_Patrick\\_W\\_201711\\_MSC.pdf?..](https://qspace.library.queensu.ca/bitstream/.../Luk_Patrick_W_201711_MSC.pdf?..)

World Bank (2010). <http://go.worldbank.org/M1JHE0Z280>. Accessed on October 9 2018.

Zigner, B. (2001). *Concepts and Infrastructure*. Magic Software Enterprises Ltd.



## Appendices

### Appendix A: Data Collection Questionnaire

#### A Mobile Application to Track Pension Payments Questionnaire

Dear Respondent

I am a Masters student in the Faculty of Information Technology at Strathmore University, am conducting a research on **A Mobile Application to Track Pension Payments: A Case for Pensions Department in Kenya**. As client for the Pensions Department you have been selected to form part of the study, kindly take a few minutes and fill out this questionnaire, the information will be used for academic purposes only; it will be treated in strict confidence and maximum caution.

Kind Regards

**Arthur S. Odongo**

#### Section A: General Information

\* Not optional

1. Select your Age group – (Choose only one that apply)\*
  - 51 to 60 years
  - 61 to 70 years
  - 71 to 80 years
  - 81 + years
2. Kindly rate your experience in the use of mobile phones (Choose only one that apply)\*

	1	2	3	4	5	
Not Experienced	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Highly Experienced

3. What mobile devices do you own? (Choose all that applies)\*
  - Feature phone
  - Smart phone

- Tablet
- Multimedia phone
- Other: \_\_\_\_\_

**Section B: Issues Pensioners seek Information about From the Pensions Department**

4. Which issues do you normally seek information about from the Pensions Department?

(Choose all that applies)\*

- Getting Pension Number
- Inquire about Pension Status
- Notifications for death, stoppage of pension and change of account and pay point
- Pensions File update
- Return or receive Pension Forms
- General Complaints
- Other Services.....

**Section C: Methods Used by the Pensions Department when Interacting with Pensioners**

5. Which methods of interaction does the Pensions Department use when delivering services to you as a pensioner? (Choose all that applies)\*

- The media namely – Newspapers, Radio, Television and Press releases
- Websites, Internet and E-mail
- Social media
- Letters through the parent or originating ministry and the post office
- Direct interaction by travelling to the Pensions Department
- Others.....

6. What challenges are you currently facing while interacting with the Pensions Department (Choose all that applies)\*

- Letters take long to reach the intended destination hence delaying other processes
- Newspaper report are not completely reliable and may be out-dated
- I do not have constant Internet connectivity to access information from websites, The Internet, e-mail and Social media
- The media provides ambiguous or unclear information
- It is costly travelling to the Pensions Department in Nairobi
- Others .....

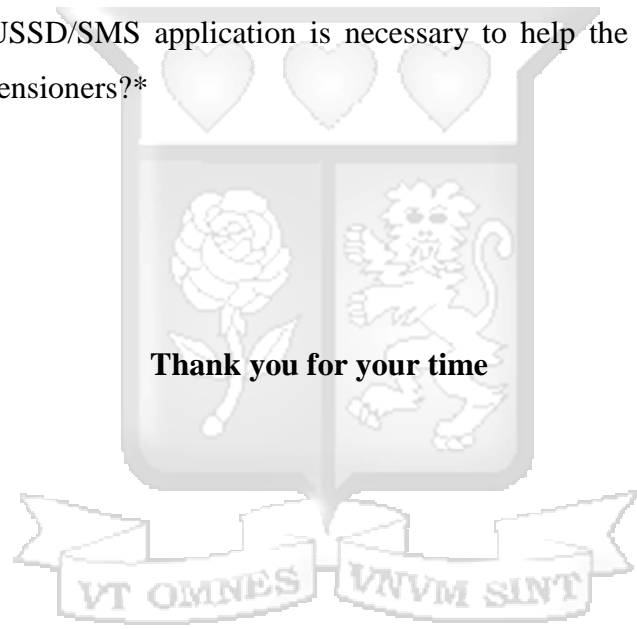
**Section D: Technology Options to Support Interaction between the Pensions Department and Pensioners**

7. Which technology options to support interaction between the Pensions Department and the pensioners are you familiar with? (Choose all that applies)\*

- Downloadable Mobile applications for smartphones
- USSD/SMS applications
- Customer Relationship Management Systems (CRM)
- Multimedia Messaging Service
- Wireless Access Point
- Others.....

8. Do you think a USSD/SMS application is necessary to help the Pensions Department interact with the pensioners?\*

- Yes
- No





## Appendix B: Usability Testing Questionnaire

### A Mobile Application to Track Pension Payments Usability Testing

The USSD short code is \*384\*4242#, using one or more mobile network operators

1. a) Were you able to use the USSD application by using the prescribed short code? Please Choose only one option\*

- Yes
- No

a) If your answer for number 1a) above is No, kindly list the problem(s) you encountered.

---

2. How would you rate the usability of the whole application? Please Choose only one option\*

a) It was simple using and navigating the mobile application

- Strongly Agree
- Agree
- Not Sure
- Disagree
- Strongly Disagree

b) The feedback and instructions provided by the application are clear

- Strongly Agree
- Agree
- Not Sure
- Disagree
- Strongly Disagree

c) The application was ease to learn even for the first time

- Strongly Agree
- Agree
- Not Sure
- Disagree
- Strongly Disagree

d) Am generally satisfied with the how it is easy to use the mobile application

- Strongly Agree
  - Agree
  - Not Sure
  - Disagree
  - Strongly Disagree
- e) I can recommend the application to other pensioners
- Strongly Agree
  - Agree
  - Not Sure
  - Disagree
  - Strongly Disagree

3. Please list the most positive aspect(s) in the application\*

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4. Any comments or suggestion about the application\*

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**Thank you for your support**



## Appendix C: Notice for Headcount/Payroll Cleaning

REPUBLIC OF KENYA



**THE NATIONAL TREASURY AND PLANNING  
PENSIONS DEPARTMENT**

**NOTICE TO ALL PENSIONERS, DEPENDANTS AND GUARDIANS  
SUBJECT: PENSIONERS AND DEPENDANTS HEADCOUNT/PAYROLL  
CLEANSING**

The Pensions Department under the National Treasury and Planning will conduct a headcount for **ALL** pensioners and dependants countrywide to update their personal data with the objective of cleansing the pension payroll.

The mandatory exercise will commence on 11<sup>th</sup> February 2019 to 3<sup>rd</sup> May 2019 at Huduma Centres countrywide. The exercise will cover beneficiaries of the Public Pensions Schemes administered by the Pensions Department. The schemes cover retired Parliamentarians, Military Personnel, Judicial Officers, Civil Servants, Government Teachers and the Disciplined Services. The objective of the exercise is to cleanse the database to ascertain its accuracy and integrity for improved service delivery.

Consequently, all pensioners, dependants and guardians are required to avail themselves in person at any Huduma Centre closest to them with the original and copies of the following documents for verification.

**Pensioners**

1. National ID Card/Passport
2. Bank Plate/ATM Card

**Dependants and Guardians**

1. National ID Card/Passport
2. Birth Certificates of Deceased Pensioner's Children
3. Death Certificates of Deceased Pensioners

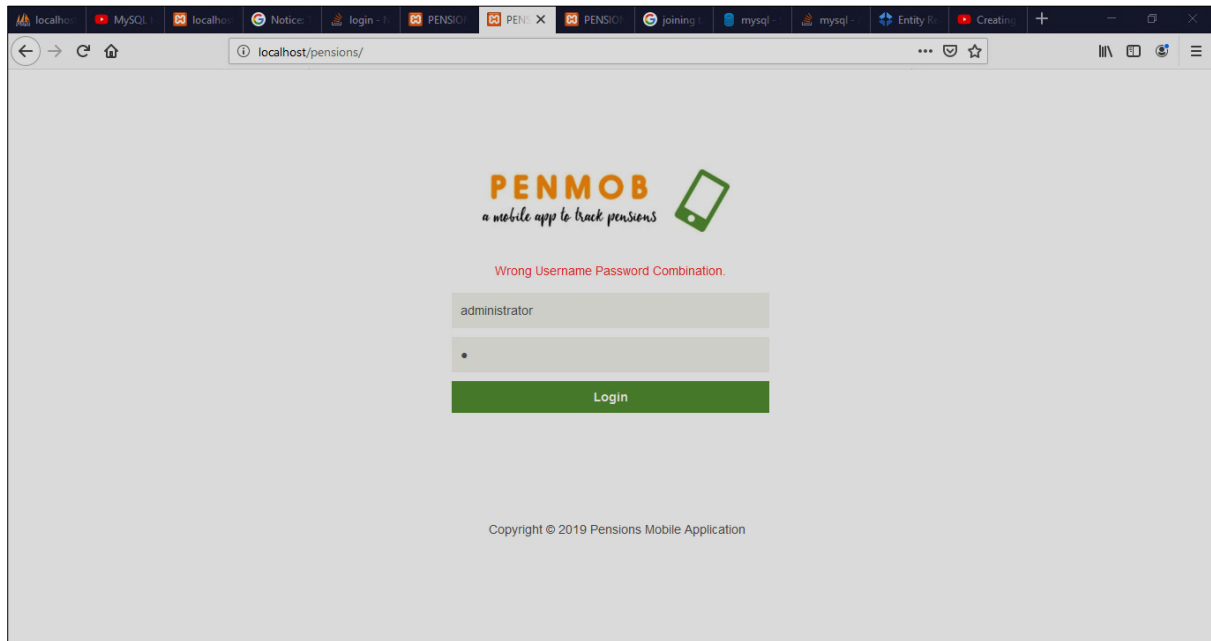
**SCHEDULE OF DATES TO VISIT HUDUMA CENTRES IN YOUR REGION**

REGION	DATES
COAST	11 <sup>TH</sup> FEBRUARY TO 22 <sup>ND</sup> FEBRUARY 2019
RIFT VALLEY	11 <sup>TH</sup> MARCH TO 22 <sup>ND</sup> MARCH 2019
CENTRAL	25 <sup>TH</sup> FEBRUARY TO 8 <sup>TH</sup> MARCH 2019
EASTERN	25 <sup>TH</sup> MARCH TO 5 <sup>TH</sup> APRIL 2019
NORTH EASTERN	8 <sup>TH</sup> APRIL TO 19 <sup>TH</sup> APRIL 2019
WESTERN	22 <sup>ND</sup> APRIL TO 3 <sup>RD</sup> MAY 2019
NYANZA	22 <sup>ND</sup> APRIL TO 3 <sup>RD</sup> MAY 2019
NAIROBI	11 <sup>TH</sup> FEBRUARY TO 3 <sup>RD</sup> MAY 2019

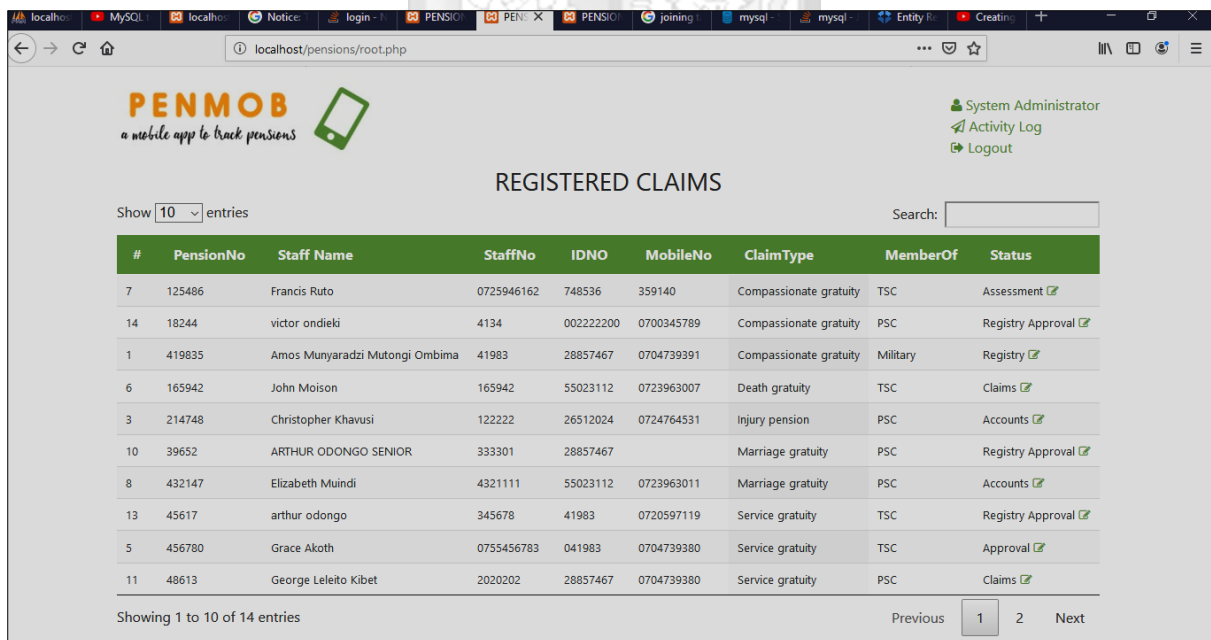
**SHEM NYAKUTU  
SECRETARY/DIRECTOR OF PENSIONS**

## Appendix D: Other Screen shots

### 1. Functional testing wrong username or password



### 2. Customised arrangement of records by claim or benefit type



# Appendix E: Turnitin Report

Arthur Odongo Shida | A mobile application to track pension payments, a case for pensions Department in Kenya

**A MOBILE APPLICATION TO TRACK PENSION PAYMENTS:  
A CASE FOR PENSIONS DEPARTMENT IN KENYA**

Arthur Odongo  
060906

A Thesis Submitted in Partial Fulfilment of the Requirements for the Degree  
of Master of Science in Information Technology

Faculty of Information Technology,  
Strathmore University  
Nairobi, Kenya

May, 2019

**Match Overview**

**29%**

Rank	Source	Percentage
1	ogcio.gov.vu Internet Source	3%
2	Submitted to Strathmor... Student Paper	2%
3	Submitted to University... Student Paper	2%
4	www.actapress.com Internet Source	2%
5	www.nssf.or.ke Internet Source	1%
6	is2.lee.ac.uk Internet Source	1%
7	www.i-policy.org Internet Source	1%
8	www.escc.go.ke Internet Source	1%
9	www.digitalgovermen... Internet Source	1%
10	www.jubileeinsurance... Internet Source	1%
11	Submitted to Kwame N... Student Paper	1%
12	www.tandfonline.com Internet Source	1%

46 | Text-only Report | High Resolution | On | 5:33 PM

