A Mobile Application for Fast-Tracking the Investigation of Criminal Activities and Filed Complaints:

A Case Study of National Police Service

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Declaration

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

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Dedication

I am thankful to Almighty God for granting me this opportunity to get this far, in deed He has been faithful. I also want to acknowledge my Husband, my entire family and friends for their undivided attention, concern and indispensable support they have given me during the whole period, lastly to the university's lecturers for the knowledge they have imparted in me that has enabled me put the theory learnt into practice.

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Abstract

Technology is widely recognized as the key to National Development. Notably, the existence and evolution of technology is a necessity to socio-economic growth and productivity as well as high secure quality life. The study investigated the extent to which the system of managing crucial security data in National Security Forces is effective. The effectiveness, in this case, related to criminal investigations and management of vital security data in as far as the police and maintenance of law and order are concerned. In practice, investigation officers mainly depend on the information that is obtained from various sources to aid investigations. Usually, there is an overall delay in the investigation process if no information about a suspect or a scene of illegality is in place. A lot of manual recording and very improper ways of storing and capturing data contributes a lot to loss of information about the same. Therefore, this leads to the existence of several unsolved crimes and complaints. This study sought to find out how to integrate technology into the criminal investigation department of National Police Service to improve their service delivery in terms fast tracking the investigation of criminal activities and filed complaints. The study used both qualitative and quantitative methods to collect data. The proposed system was developed and tested on the Android platform combined with an analytical backend for post manipulation of the mobile application information by an administrator. Usability testing was carried out to ascertain the user friendliness of the system and how a new user interacts with the system; whether they experience ease of use or not. The end result was a mobile application that helps the criminal investigation department fast-track the investigation process of criminal activities and complaints filed eliminating the issue of lack of seamless tracking in the process of investigating a crime.

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Abbreviations

CID Criminal Investigation Department

DCI Directorate of Criminal Investigation

DFD Data Flow Diagram

ERD Entity Relationship Diagram

FIR First Information Report

IPOA Independent Policing Oversight Authority

KPS Kenya Police Service

KPF Kenya Police Force

RF Radio Frequency

MVC Model View Controller

PHP Hypertext Preprocessor

SAD System Analysis and Design

SQL Structured Query Language

UML Unified Modeling Language

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Chapter 1: Introduction

1.1 Background

Criminal investigation is an applied science that involves the study of facts that are then used to inform criminal trials. There is a general belief that technology contributes and makes our life easier, the technologies have changed the way we think, react, perceive things, our attitudes and even the way we engage as a community (Nunn & Quintet, 2002). Technology has changed the whole world into a small village thanks to communication channels all around the globe (Chan, 2001). Unlike traditional way of communication and sharing of information, many companies and organizations have adopted information technologies for faster information transfer and have flexible data management. In the past few years the development and adoption of information technologies has enabled many companies to grasp and improve on information gathering and dissemination. The development of powerful databases with easy access improves speed of retrieval and have searching adjustability, to add on this we have the internet which act as a means for sharing information across cooperating entities and companies (Chen & Hauck, 2002).

There is an increasing and vast widespread investment in information technology by organizations including the police who have high usage rate of Information Systems (Nunn & Quintet, 2002). This has showed that technology has become an important aspect in our lifestyle. According to Gottschalk and Halverson (2006) most police departments in the world and agencies offer information technology as a support for their police officers, this makes their work easier. The matter of fact is that "information is the bloodline of the police", (Colvin & Goh, 2005).

According to Gottschalk (2006), information that is received by the police when they are enforcing law is immense. Information technology system tools are used by police while they patrol, track crime in an ongoing investigation, solve crimes and even in traffic pursuit. Information technology has high effect on police practices (Colvin & Goh, 2005). Increased usage and support of use of information technology by police improves the performance and quality of law enforcement departments (Gottschalk & Holgersson, 2006). Investigators are assigned tasks

that necessitate utmost care to guarantee reliable outcomes. As such, aspects such as completeness, truthfulness and attention to detail are the guidelines for nay investigation. Police obtain information using mechanisms such as interviewing the complainants, witnesses and any other individual with direct knowledge of the facts of a case or crime. Statements are also recorded by complainants including the witnesses in their words. These statements are signed under oath by the complainant failure to which it is noted in the investigating officers' report. A review of all evidence in relation to misconduct or criminal behavior could entail photographs of instances that involve injury (Chen & Hauck, 2002).

Distributed sensing and internet of things (IoT) leverage new technology to enhance the gathering of information around the world. The current IT systems that police use in investigations comprise artificial intelligence (AI), a technique that enables law enforcers to recognize critical places, locate linkages among suspects and explore insights that are usually concealed by suspects. Police also rely on augmented reality, advances in 5G communication and electronics miniaturization that enhance the seeing, acting and hearing in ways that was impossible before. As such, law enforcers can easily use augmented reality glasses to assess unfamiliar situations for relevant information about address calls and crime history.

The shortfalls of these technologies encompass limited budget that restrict police from investing in suitable information technology. Information systems comprise back-up unit, switch, server, printer and router among other things including software such as office programs, and operating systems. The complexity of the IT systems dictate the efficiency and adequate funding is necessary for operating and maintaining the system. Technical and specialized personnel are also required to ensure proper use of information systems. Police agencies should invest in hiring competent personnel, mainly in an era that IT is dynamic following new IT products, new versions of hardware and software. Adequate training is crucial since yesterday's knowledge is not adequate to operate current systems due to the evolution.

Technology is an avenue that can be used to improve security and help in fighting crime. Victims of these crimes require an efficient and effective method of getting assistance when need arises. The country's middle class population is constantly increasing.

This means that criminals are getting motivated by the increasing suitable targets. The most prone criminal area in the city is the eastern area of Nairobi (Gastrow, 2011; Karake, 2014; Mburu, 2014). This is mainly because the region is highly populated making it an easy target of criminal activities and large impact from associated outcomes (Abrahamsen & Williams, 2008). Improved security measures are important for the city because it supports improvement of the resident's livelihood. Enhanced security measures will increase the level of productivity of the workers within the country, consequently translating into improved economic growth (August & Tunca, 2006). This study focuses on the concept of use of mobile application for collection of intelligence by the police in order to make a knowledge base for the police The proposed application will help fast-track a criminal event from the time it is reported till it is completed. It will also review the development of a mobile application and a back-end system for analysis based on collected information.

1.2 Problem Statement

Crime and suspect human activities have always been part of the society. However, there has been acknowledged increase in crime within Nairobi area as documented by Mburu (2014), with most of them not being reported or the reporting done too late. Such cases go unresolved and victims have limited options of following through a case and acquiring justice. With the increase of unresolved criminal activities and complaints, there is need of an application for fast-tracking the investigation process of criminal activities and complaints filed in Kenya. It is essential to have well organized and widely available method for reporting criminal activities to the relevant authorities and track through the reported case. The proposed application will help fast-track a criminal event from the time it is reported till it is completed.

1.3 Research Objectives

i. To investigate factors relating to the investigation of criminal activities and complaints.
ii. To review the existing techniques and applications for tracking the investigation of criminal activities and Complaints Filed.
iii. To develop and test an application for fast tracking the investigation of criminal activities and complaints in Kenya.

iv. To validate that the developed application for fast tracking the investigation of criminal activities and complaints so as to confirm that it meets the requirements.

1.4 Research Questions

The study tries to present answers to the following questions, as arising from the research specific objectives.

i. What are the factors relating to the investigation of criminal activities and complaints?
ii. What are the available techniques and applications for fast-tracking the investigation of criminal activities and complaints filed?
iii. How can an application for fast-tracking the investigation of criminal activities and complaints be developed and test?
iv. How can an application for fast-tracking the investigation status of criminal activities and complaints?

1.5 Scope

This study will be carried out in Nairobi Kenya; focus will be on the Police, investigation officers from the National police service consisting of the Kenya Police, administrative police service and the Criminal investigation department. Sample data used by the police and Investigation officers will be used for this study. The application will be integrated with the test-bed database of criminal Investigation, this at the end will allow the users of the application be able to view the status of criminal activity under investigation.

This dissertation will focus on creating a marketable mobile application which fast-tracks the investigation of a criminal activity and any complaint filed in Kenya. The Mobile Application will be determined successful if the application is able to keep track of investigation of criminal activities and complaints filed in Kenya.

1.6 Limitation of the Study

The two major challenges that were faced included;

i. The limitation of this study was that most of the citizens are not enlightened on mobile applications.

ii. The application requires one to have a smart phone and some of the members do not own a smart phone.

1.7 Basic assumptions of the study

The study was based on the following assumptions:

i. During information gathering, the respondents were knowledgeable and competent enough to provide the required information.

ii. All respondents were honest and provided objective information to the best of their knowledge.

Chapter 2: Literature Review

2.1 Introduction

This chapter reviews what has been done by other researchers on fast tracking criminal activities and complaints. It also presents how the application of mobile technology can be used to facilitate fast-tracking investigation of criminal activities and complaints in Kenya. The chapter also touches on the different proposed models for data collection and management of data. There are several sections that will outline some important work that has been done previously and what is expected of the police by the public.

Mobile technology comprises of applications in social network sites including voice calls, text, emails, tracking devices and other social media platforms. Mobile technology is one form of information communication technology (ICT) that is newly adopted and used by the police organization in all aspects of crime prevention. These may be useful tools in crime prevention if police officers' perception and behavior is intrinsically motivated toward adopting it in crime prevention. The literature is based on police institutions and organization that applied Mobile Technology Acceptance Models (M-TAM) in their adopted technologies and their findings.

2.2 The Use of Mobile Technology in Tracking Crimes

The advent of technological devises improves people's interaction while easing the way they conduct daily activities. In the police sector, the inclusion of technology in core functions eases internal functions. According to Lindsay et al., (2009) usage of mobile technology within the police sector helps in storage of information, and sharing of knowledge. Thus, technology helps in tracking criminal activities and helps in storing the obtained information as evidence. Michael and Michael, (2007) concurs by stating the usage technology eases tracking of criminal activities even across countries due to the existence of global positioning technology. Mobile technology comes into focus as an ideal approach for easing policing due to its convenience.

The rapid penetration of mobile technology and widespread usage in Kenya makes reporting of crime and tracking criminals easy. According to a report on news media DW, Kenya had a mobile penetration rate of 97.8% in 2018 compared to 84.8% rate in the previous year (Nitsche, 2019). Mworia (2016) acknowledges the rise is partly attributed to rise in 3G technology, and better

network coverage. Through this growth, the police department has an opportunity to receive information in a timely manner and respond accordingly since mobile phones allow quicker reporting of crime and sometimes in real time communication of details about crime and criminal. The environment where mobile phones are everywhere, the cost of reporting approaches zero opposing all the problems of delay experienced there before the use of mobile phones (Oduor, Acosta & Makhanu, 2014). Offenders perceived risks of apprehension was seen high when the victim is in possession of a mobile phone. Mobile phones lower the cost victims incur reporting crime. Mobile phone has improved the likelihood of photographic images transmission, apprehension, prosecution and conviction. The victims' phone provides the evidence by various forms which should influence on social behavior. The online interactions seem to influence offline thus the sharing among the police on the online platform is also able to enhance the sharing of knowledge. This is because technology has transformed the way information is being sought though practices and communication routines affects criminal and victim behaviors. Sanders, Weston and Schott (2015) observes mobile technology includes elements on mobile positioning such as location-based features which offer an actual phone coordinate on a mobile user thereby helping in offering exact details on criminal activities. This information could help when planning ways to prevent future crimes and for prompt response. Pell and Soghoiam (2014) concurs by noting mobile computing technology improves officers' access to real time data on crime and other events. It enhances timely deployment in the community, identify persons, vehicles, places and hence improves both reactive and proactive field work and officers' ability to identify potential threats and risk, locate suspects in criminal investigation, problem solving capabilities and quality of information they may provide to the public (Michael & Michael, 2007).

The focus of the study was to assess how mobile phone use by police may reduce crime by identifying the potential offenders and recidivism. Mobile phone use as a tool may be a deterrent effort in identifying and intervening on known criminal offenders and reducing the opportunity to commit crime by improving police visibility and hardening the victim and the target. Research on internet of things in Community Safety and Crime Prevention for South Africa government is one of its major tasks of reducing crime levels on a year-to-year basis. It has used information and communications technologies (ICTs) to facilitate the process of finding solutions to crime. They used ICT subset named internet of things and integrated it with biometric technologies in the fight

against crime. They identified community safety, partnership with the police and internet of things as tools of value in crime prevention (Dlodlo et al., 2015).

Kumbuti (2013) conducted a study on Nairobi city Kenya police level of technology application in detecting crimes. the study found that technology has not been used to improve efficiencies in crime detection. She recommended technology be used as strategic management approach and be used as a tool in crime prevention and management. It never covered in particular the role the police do in utilizing the mobile phone to prevent crime. This study fills this gap by assessing the use of application of mobile applications in crime prevention. Africa countries law enforcement officers' utilization on information communication technology (ICT) in fighting crime. Similarly, Quarshie (2014) assessed the ICT tools available to most African nations and noted that in contrast to developed countries, Africa has not fully taken ICT advantage in crime prevention.

The study showed tools such as CCTV technology, tracking technology, social media and mobile phones are efficient in crime fighting at this time when rate of crime is challenging to the law enforcement officers due to communication and commercial activities taking place in the internet. The mobile phones can alert home owners on potential property crimes and automatically alert the police who may respond as crime is in progress.

2.3 Factors Relating to Crime Investigation

The objective of crime investigation is to recover physical evidence, and to ensure that the location of evidence can be accounted for all the way from the crime scene to the court, in order to secure a conviction. It helps locate potentially relevant and meaningful evidence that could be used to link or clear a suspect or witness to a crime, and to find information and evidence that proves a motive and to identify the crime. Crime investigation enables investigation officers reconstruct the event of the crime, in order to provide answers to what happened and who is responsible (Pepper, 2005; Lee et al., 2013; Ramsland, 2001; Ogle 2014).

The crime investigation process is an organized, methodical, systematic and logical event. Any actions implemented at the scene of the crime must be correct, objective, systematic and thorough, in order to achieve its full potential as a source of information (Ramsland, 2001). There are certain sequences of procedures that need to be followed throughout the crime investigation process Actions

at the crime scene will be determined by the specific facts of the crime - facts such as when and where the crime was committed, who the suspect involved is, and if the victim is able to communicate well. The crime investigation process is characterized by three essential conditions for success: organization, thoroughness and caution. It happens all the time and at nearly every step of crime investigation (Gardner, 2005; Lee et al., 2001; Fisher, 2000; Van der Westhuizen, 1996).

A reactive police investigation typically begins when an offence is brought to the attention of the police. After this, the investigation usually advances sequentially through stages comprising different actions. A case is considered 'detected' if a suspect is charged or summoned for a crime, or is cautioned, receives a penalty notice for disorder or another relevant offence, receives a formal warning for cannabis possession, or asks for the offence to be taken into consideration. However, there are differences between crime types, and within crime types, in terms of the amount of resources allocated to investigations and the actions carried out. Serious crimes such as murders typically receive extensive resources, whereas minor crimes receive much less attention from the police (Feist &Newiss, 2004).

This chapter presents an overview of the processes and actions typically carried out in crime investigations, as described in ACPO's Volume Crime Investigation Manual (ACPO, 2017) and the PIP framework. The steps of crime investigation are summarized as below;

i. Initial contact and initial response

This is the first point of contact between the police and a member of the public reporting a crime. Typically, this happens as a result of a victim or witness calling the police. This stage provides the police with an opportunity to obtain and record relevant details about the crime, advise the caller about what to do (e.g. preserve forensic evidence), and determine whether police attendance at the crime scene is required, and if so, how urgently. If a police response is deemed appropriate, police officers are sent to the scene. Depending on the police force, call takers may also be responsible for determining whether forensic examiners should attend the scene or whether the crime should be filed for no further NFA (ACPO, 2017).

ii. Scene assessment

This stage of the investigation refers to the actions taken by the police when they arrive at the scene of a crime, i.e. the initial police investigation. The officers who first attend the scene will

usually want to speak to the victim and undertake any immediate lines of enquiry that might lead to the suspect being identified (e.g. interviewing witnesses, searching the surrounding area and undertaking house-to-house enquiries). Checking existing intelligence relevant to the enquiry may also be carried out. In some cases, scene assessment may result in the suspect being identified or apprehended, or provide further lines of enquiry to be followed up. However, cases may also be filed after initial enquiries if there are few obvious leads to follow NFA (ACPO, 2017).

iii. Evidence gathering

This part of the investigation includes taking victim and witness statements, locating and collecting CCTV footage, conducting house-to-house enquiries, identifying suspects (if not previously identified), using intelligence systems, recording actions taken and circulating relevant information. In reality, many of these actions are undertaken by officers who first attend the scene, and there is obviously an overlap in terms of what constitutes following 'scene assessment' and 'evidence gathering'.

In some cases the information provided at the scene may be sufficient to identify and arrest the suspect. In others, the information obtained may need to be developed in order to lead to the identification of the suspect. Whether the information is sufficient enough to warrant further investigation or whether the case should be filed is often determined on the basis of the details gathered by first attending officers. If the case is considered to be worthy of further investigation, the actions that are carried out by the first attending officers may in practice be undertaken by follow-up investigators (and sometimes actions will be repeated). If successful, the evidence gathering stage will end in the suspect being identified (and arrested), and if the suspect is not identified, in the case being filed for NFA (ACPO, 2016).

iv. Victim and witness management

Victim and witness management has also been identified as a key part of investigations, due to victims' and witnesses' ability to provide information to help detect the crime as well as provide further intelligence. Victim and witness management cannot be said to dominate any particular phase, but is important throughout the investigative process for NFA (ACPO, 2017).

v. Suspect handling

The suspect handling stage includes the following actions: arresting the suspect; arranging Identification procedures; checking relevant intelligence relating to the suspect; obtaining forensic evidence from the suspect; and interviewing and making a decision on whether to charge. In broad terms, the aims of this stage are to obtain evidence confirming whether the suspect is guilty of the offence and to produce evidence to be used later at court if charged. It is also at this stage in the process that the investigator can encourage a charged offender to admit other offences they may have committed, which could be taken into consideration for NFA (ACPO, 2017).

2.4 State of Security and Intelligence in Kenya

There's a lot that needs to be done in Kenya to improve security and effective counter of criminal activities. The country should put more effort into collecting, disseminating and implementing technology so that it can effectively prevent and make easy availability of data related to the same.

According to a Publication by IPOA, the study found out that 53% of the citizens interviewed described that they were not in any way satisfied with the way the police and the relevant officers handle matters when it comes to criminal offences hence would not recommend the career (IPOA, 2013). Similarly, a report by Transparency International notes 54% of citizens are insecure with the services offered by the police department and 27% of Nairobi residents who reported criminal activities were dissatisfied with the way it was handled (The Transparency International, 2016).

Experience with the police

Majority of the respondents (66%) interacted with the police to report crimes while police-initiated interactions were mainly to seek support on investigations. Nine out of ten respondents contacted the police by physically going to the police stations. It was established that 32% and 23% of respondents that visited police facilities seeking a service in Nairobi and Kisumu counties respectively paid some money for the services (The Transparency International, 2016).

Additionally, 38% of those who paid for the services indicated that the payment was a form of facilitation to the police to cater for airtime and fuel. On the other hand, a third of the respondents reported having been asked to pay bribes for services sought during police-initiated interactions. In terms of compliance with Article 49 of the Constitution on the rights of arrested persons, the survey established that 70% of those who had been arrested were not informed of

their right to remain silent while 82% were not informed of the consequences of not remaining silent (The Transparency International, 2016).

Satisfaction with services rendered by the Police

About half (53%) of the respondents who initiated interaction with the police were dissatisfied with the way their cases were handled. Additionally, 27% of the respondents from Nairobi and 22% from Kisumu reported opting not to involve the police in situations where their intervention was required (The Transparency International, 2016).

Complaints reporting mechanisms within the police

The survey found that 40% and 57% of the citizens in Kisumu and Nairobi were not aware of the existing complaints mechanisms for citizens within the sector. On the other hand, only 46% of the officers interviewed reported existence of an internal complaints reporting mechanism for the police (The Transparency International, 2016).

Performance of the police

Citizens perceived the police to have necessary skills and equipment to perform their duties yet they rated their actual performance of duties as fair. Notably, use of ICT at the police premises was still relatively low as none of the report offices in the police facilities visited used a computer to record complaints. In terms of trainings, responses received from the officers' pointed to gaps in provision of training and knowledge of relevant legislations to enhance delivery of their mandate.

2.5 The Challenges of State Policing in Kenya

According to a study done by Kenneth Omeje & John Mwangi Githigaro, study investigates and analyzes the problems and challenges encountered by the Kenyan Police Force in their function of delivering effective policing services as required by law and expected by the public. The Kenya Police Force has evolved from a pro-imperial colonial police (founded to subjugate the colonized 'native populations') to what it is today. Originally formed as a colonial constabulary, the institution was not created as a people's police, but as a reactionary instrument of conquest and

repression with the aim of achieving the imperial objectives of resource extraction and political domination. (John Kimani Mwangi, 2018).

This peculiar history of pro-imperialist coercion and anti-locals disposition is what preponderantly shaped the institutional character and operations of most African police forces, including the KPF. It is in this historical context that one carn properly understand the role of KPF in the crackdown of the anti-colonial struggle and brutalization of activists in the nationalist movements for independence, such as the famous Mau Mau freedom fighters. One of the greatest but rarely appreciated challenges of independence in Kenya and Africa was the need to transform the inherited colonial police force from an anti-people to a legitimate national police protective of, and owned by the people.

Sadly, the necessary transformative reform of the police force has been mostly elusive in the majority of the post-colonial states of Africa, not least in Kenya. Evidence from the 24 years of President Daniel Arap Moi's regime reveal that the KPF was instrumental to a catalogue of human rights violations, including politically motivated disappearances and targeted killing of many perceived opponents. Many leading pro-democracy activists that campaigned for the expansion of the political space were repeatedly harassed and brutalized by the KPF.

Unlawful and prolonged detention of opponents without trial was rampant. The media houses were not spared as a number of critical private media were banned. Also, owing to the prolonged undemocratic rule by President Moi, the police institution became highly politicized with the result that recruitment and promotion of officers were for the most part based on cronyism and clannism. The police were seemingly dominated by hegemonic ethnic groups. Corruption became widespread even as violent crime soared. The 1990s witnessed an astronomically high crime rate, especially in the Nairobi area. The image and reputation of the police was at its lowest ebb in the post-independence history. Moi presided over a highly regimented one party state largely sustained by an unprofessional police force that many critics likened to the Gestapo (secret state police) of the defunct Nazi Germany.

The return to popular democracy in 2002 following the election of President Mwai Kibaki came with rekindled hope and great expectation in the security sector that KPF would among other things be reformed and professionalized to be able to deliver efficient and productive policing. A number of progressive steps seemed to have been made since 2002 such as the emergence of preventive action through community policing of various neighborhoods. Community policing, which is the main plank of state policing service in Kenya and many modern democracies worldwide, is literally a bottom–up approach that aims at policing in partnership and with the consent of the people.

Community policing adopts various strategies to build trust and partnership with the policed including reaching out to community stakeholders to ascertain their needs, public involvement in intelligence and neighborhood surveillance, the creation of police posts and liaison offices within short intervals in residential neighborhoods, sensitization of the public to the needs, difficulties and challenges of the police with a view to eliciting understanding and sundry supportive actions, etc. Since it was introduced in Nairobi under the Kibaki regime, community policing has been extended to various parts of the country. Ostensibly, there has not been independent impact evaluation of progress made and problems and challenges encountered in community policing in Kenya.

This practical gap in research becomes more compelling against the evidence of growing crime rates, coupled with allegations by many local and international NGOs and human rights watchdogs that KPF perpetrates egregious human rights violations with impunity. Hence, even though the return to multi-partyism in the post-Moi era created a great opportunity for reforms and transformation, this seems to have rapidly slipped away as evidenced during the 2008 post-election violence. The incapacity of the KPF was palpable during the violence as they seemed overwhelmed and unprepared to tackle the situation.

This project is therefore a significant inquiry that investigates the capacity deficits and challenges of the KPF.From a Weberian perspective, the Kenyan state does not have the monopoly of the legitimate use of force required to maintain law and order, as well as to guarantee internal and external sovereignty in a modern state. One of the hallmarks of state sovereignty in the

contemporary international system is the ability to guarantee the security of its citizens and territory.

From available empirical indicators, the Kenyan state ostensibly fits into the mould of states in Africa categorized as weak or fragile, given the fragmented nature of policing and security domains in the country. Apparently, the Kenyan state, like many in Africa and elsewhere in the developing regions, can scarcely guarantee security for it citizenry.

New security governance models seem to be taking shape in Kenya. At the heart of the new security governance architecture is a plethora of self-help efforts and the privatization of state security. This emerging security architecture, which seems to be the trend in many parts of the developing world, has been conceptualized as multi-choice policing, which includes a mixed bag of both functionally responsible public and private security providers on the one hand, and a subterranean network of uncivil and dysfunctional groups that provide alternative but too often menacing security. Some of the alternative security providers that pose threats to state security in Kenya include militia and vigilante groups that have partly emerged in response to the apparent incapacity and failings of the Kenyan state. The re-introduction of multi-partyism in 1991 brought with it the dissolution of the state monopoly of violence by heralding the emergence of ethnic militias. These militias were consequently mobilized as forms of extra-state violence. With time, these militias assumed a life of their own and the Kenyan state could no longer control them.

It has been observed that the Kenyan militia groups are in many instances filling a security vacuum left by the state. But in reality, the diffuse security arrangements constitute a threat to the KPF that has the sole mandate of maintaining law and order as is typical of state policing agencies elsewhere. The KPF officials interviewed for this study claim that the underlying challenges of state policing in Kenya have to do with the growing incapacity of the state to provide the necessary infrastructure for policing, such as operational equipment and facilities. The magnitude and intensity of "structural violence" in the Kenyan society have also aggravated the propensity of criminal and organized violence in the country, and by corollary, the policing challenges.

Our empirical findings suggest that poverty levels have a correlation with increased crime in Kenya. In the study, we came across narratives suggesting that the breakdown of social order predisposes the youth to crime, and this tends to be in line with major sociological discourses of violence, such as the social control theory in criminology. The underlying assumption of social control theory is that individuals are potential law violators, and it is primary social bonds such as family and friends that keep them in control.

Without such supportive social bonds, theorists argue, many vulnerable folks, especially (but not exclusively) those on the margins of society, become prone to criminality and deviant behavior. Hence, from this sociological perspective, criminality in the society is linked to the weakening of ties that bind people to the supportive networks that hold the society together. The correlated links between poverty and crime mentioned above is a trend supported by the apparent shift from conventional security paradigm (national security, national interests and military power) to human security, a shift which in the post-Cold War international order seems to have justifiably taken center-stage in national security strategies, especially among developing countries.

The human security debate was advanced by the 1994 UNDP Human Development Report that defined human security in terms of freedoms. Freedom from fear (of violence and conflict) and freedom from want (hunger and deprivation) is a simplified way of capturing human security.

In Africa, non-military dimensions of security, such as environmental degradation, poverty, resource scarcity, and so forth threaten both societal security and national security. Human security concerns are thus among the contemporary challenges to the provision of state security by KPF (Omeje & Githigaro, 2018).

A Brief Summary of Factors that Account for Insecurity in Kenya

Fieldwork interviews with police officers of various ranks, civil society and grassroots citizens indicate that a multiplicity of factors account for insecurity in the country. The factors mentioned by respondents include unemployment among the youth, poverty, police collusion with criminals, drugs and peer.

Table 2.1 Topology of Crimes

TYPOLOGY OF CRIMES HANDLED BY THE KENYAN POLICE

Typology	Manifestations
1. Economic and Commercial Crimes	Banking fraud, money laundering, among others.
2. Transnational Crimes	Terrorism, cyber crimes, drugs trafficking, human trafficking, arms trafficking, illegal immigrants, money laundering.
3. Gender-based Violence	Rape, defilement, sexual assaults.
4. Traffic Offences	Accidents, breach of traffic rules and regulations.
5. Organized Crimes	Lawless devices and activities of unlawful ethnic militias and vigilante groups (e.g. extortion of public service vehicles and people living in certain residential suburbs compelled to pay protection fees, instigating and prosecuting ethnic clashes, and indulgence in political thuggery at the behest of some local politicians).
6. Resource Conflicts	Cattle rustling, conflicts over land and pastures, among others.
7. Ethnic Violence	Ethnic clashes and related destruction of life and property.
8. Robbery, General Stealing and Kidnappings	Violent robbery, street mugging, car-jacking, etc.

Source: Fieldwork Interviews with Police Officers in Nairobi and Nakuru Fall 2010.

2.6 The goal of Criminal Justice System in Kenya

According to University of Nairobi research Archive, Kenya is one of the rapidly developing countries in the world, together with this development, Kenya is also befallen with high crime rate. It is because of this high crime rate experienced in Kenya to-day that we found it necessary

to open up the door to some research on crime identification and crime reduction (Onyango-Israel,2018).

Due to the limited scope of this dissertation and the time allocated to the same I chose to discuss in detail only the crime of theft. However, for illustration purposes other crimes are touched on. The main aim of this research has been to ascertain whether the present criminal justice system is achieving its goals whether, the criminal, after punishment in this country fits the model aimed at by the punishment which is administered. It is believed that this kind of research coming from a person who is outside the criminal justice system may be less biased and hence acceptable. There is a saying, which most of us might have heard, that if you stand too close to the portrait, you get a great view of the nose but you could not see the face So it is with many who work within the criminal justice system (Chite, 1980).

The head of unit may have a tendency to limit his or her world to the boundaries of that unit There is also a tendency to confine that unit's goals within the unit's boundaries, the heads of different segments of the criminal justice system may have different points of focus. For the police, it may be the number of arrests. For prosecution or prosecutors, it may be the number of prosecutions resulting in conviction.

For, the deference lawyer, it may be the number of acquittals. However, each head shares the same ultimate goal, the reduction of crime. One problem arises. That is, that, by becoming near sighted and losing peripheral vision, each one can fail to see the large goal. Each can therefore, quite unwittingly, contribute to overall failure to reach the goal. In the world, people live in groups. Within these groups there are deviants. That is, persons who cannot or will not conform to the rules. Still, the society in an effort to maintain its integrity attempts to control their behavior through folkway s. mores, and laws, those who violate criminal law are dealt with through the usual government machinery.

Harsh sentences are meted to these people in an attempt to gain conformity. The question is, do these harsh sentences deter, or do they reform the offenders? If retributive, do they take into account the concept of equivalence These are some of the issues which were discussed in this dissertation Looking at the various crimes being committed, it can be stated with certainty that the crime has increased as a result of development process urbanization industrialization, lack of

housing and migration into the city from rural areas, result ins in the growth of slums , wherein, crimes are un limited ,Development has also brought with it an increase in consumer goods and a new outlook, towards life but with unequal opportunity for the acquisition of these goods. Coupled with this are the diminishing clan life and village ties on the one hand and the emergence of a more individualistic style of life characteristic of western countries on the other hand.

For better or for worse, such a change in life outlook has not been accompanied by the other incidents of western countries such as the provisions for old age, for unemployment, and. for the disability to ' dark. It seems therefore, that the rise in crime rate is almost inevitable unless some social-economic steps are taken. In Nairobi City alone, the population is nearing one million people, and with the problem of lack of employment and housing, crime has continued to rise. Added to this problem is the fact that there is already a very high rate of male migrants into Nairobi.

2.7 Cases of Related Techniques and Applications in the Market

There are various applications used by the police and investigation officers in tracking criminal activities and complaints. The following applications are currently used.

2.7.1. Patrolman's Vehicle Guide

Dating back from the year 2000, several vehicles have been introduced in the country's highways and byways. In this app (Weinstein, Drake & Silverman, 2015).it serves as a faster guideline for police officers while patrolling or conducting interrogations on witnesses. At the same time, photographs may also be emailed to fellow police officers.

2.7.2. Shooter

This is known to be most accurate ballistic type of calculator, this device gives an accountability of the atmosphere, the trajectory angle, spin drift and Coriolis Effect (Weinstein, Drake & Silverman, 2015). A police officer may also enter and manage all his or her firearms information direct from his or her PC

2.7.3. Police Field Interview Cards

The design of this application ensures the streamlining of the field of interview process by enabling the police officers in creating a field of contact reports and interview cards from their respective phones (Weinstein, Drake & Silverman, 2015). The app facilitates the organization of personal information, gang affiliation, tattoos, piercings, vehicle information and pictures.

2.7.4. Police Spanish Guide

This application offers a simple and also effective way for police officers in overcoming language variations (Sherman, 2013). Since it is developed into a yes or a no format, this application entails everything starting from routine stops and lost children up to cases of domestic violence and interviews or interrogations.

2.7.5. Crime Scene Tracker

This application assists the police in coming up with digital recordings of hints, reminders and pieces of evidence from crime scenes (Hinduja, 2007). Always, the crime scene is superimposed on a Google Map for the purposes of pinpointing and at the same time may be emailed or printed for use by other police officers.

2.7.6. Police Pad

Police Pad enables the police officers in documenting their shift without the use of pens, pencils, papers or note notebooks (Hinduja, 2007). An officer may create and at the same time share custom events, notes, PDF reports and pictures.

2.7.7. Police One

The Police One application is the best way for Police Officers and other Law Enforcement professionals to keep informed while on-duty or on the move. Stay up to date on breaking police news, videos, expert columnist articles, tactical tips and other relevant information. Whether you need to research something from your squad car or just want to browse the latest news, this

application gives officers free access to mobile resources that have never been available to them before (Hinduja, 2007).

2.8 Conclusion

Crime has led to loss of lives, loss of jobs, loss of revenue as well as hard times to individuals seeking to receive justice. The use of Mobile applications such as Ushahidi and crime watch have significantly played an essential role in the reduction of crimes but sill these applications do not provide a complete solution to the existence of several unsolved cases. With the increase of unresolved criminal activities and complaints, there is need of an application for fast-tracking the investigation process of criminal activities and complaints filed in Kenya. It is essential to have well organized and widely available method for reporting criminal activities to the relevant authorities and track through the reported case. The proposed application will help fast-track a criminal investigation and filed complaints.

Chapter 3: Research Methodology

3.1 Introduction

Research in common term refers to a search for knowledge. One can also define research as a scientific and systematic search for pertinent information on a specific topic. In fact, research is an art of scientific investigation (Kothari, 2004). This Chapter defines the research methodology used by the researcher to attain the research objective. The methods and processes used were presented well to achieve the goal of the proposed solution.

3.2 Research Design

The methodology that was used to develop the system was the unified process. The unified process was originally offered by Rational Software, which is now part of IBM.I t splits the project activities into four categories: -

Inception Phase: - Development of an approximate vision of the system, making the business case why the system is necessary, defining the scope, and producing rough estimates for cost and schedule of the whole project is done.

Elaboration Phase: - The vision is defined, all requirements are identified and described, the scope is finalized, then design and implementation of the critical architecture and functionalities is done.

Construction Phase: - The remaining lower-risk, foreseeable, and easier essentials are developed and the system is prepared for deployment.

Transition Phase: - In this stage, the system is installed and configured to the target user's machines or server to be used in business case. Responses received from previous releases may lead to further modifications which are to be merged over the case of several transition stage iterations. The transition stage also comprises of system revisions and user training.

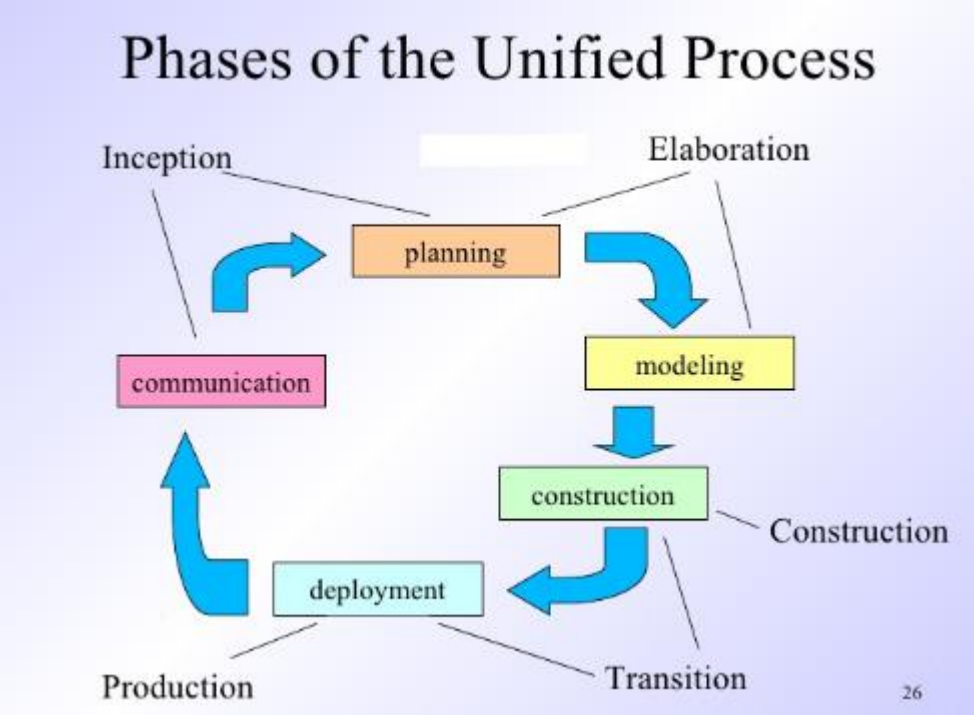

Figure 3.1 Phases of Unified Process

Justification of using the Unified Process Methodology.

The unified process methodology is ideal for new problems which may change a lot over a short period of time depending on the market. Besides, its considerations on ways to improve the software ensures programmers develop high quality software. Additionally, the program milestones or progress is known right from an early stage. The consideration of transition and construction in the development stage ensures programmers build software that adapt to the user environment and based on best practices employed in modern software management.

3.3 Requirements Analysis Phase

This phase involves examining the requirements of the application or what the application is expected to do. Analysis helps in revealing important information like what environment will be needed to develop and test the application, what parameters need to be in place for the successful

development and what exactly does the client want. The knowledge of this information is necessary even before any development starts (Satish, 2014).

Therefore, for the analysis to take place, data has to be collected from all the proposed application stakeholders. Consequentially, this presents a need of determining a sample size from the entire target population from which data was collected. Therefore, the following subsection explains the procedure followed in determining the sample size.

3.3.1 Sampling Strategy

Sampling refers to the selection of a sample number of cases from a wider population so that the results of the sample can be projected back to the entire population (McLeod, 2014). The fundamental idea of sampling is that by choosing some of the elements in population, this helps a researcher draw conclusions about the entire population. In this study, the sample size was determined by using a formula (Creative Research Systems, 2012).

The sample size was determined using the formula developed by (Chow *et al*., 2007). Sample size (n); $n=[Z\propto/2\sigma E]2$ Where: The $Z\propto/2$ is the critical value. The positive z value is the vertical boundary of the area of $\propto/2$ in the right tail of the standard normal distribution, σ is the population standard deviation and n the sample size. Fixing the margin of error as ***1.32*** and the estimated population variance from the sample as ***6.95*** then the sample size is given by;

$$n=(1.96\times6.95\times1.32)2=106.49$$

Approximately 100

This is then approximated to 100 members of the public who were sampled. Four representative subsample per station formed part of the selected population. The target population of interest for the research included the key stakeholders of the police department. That is the management, investigation officers, and staff members of the department. For each category, 100 people were selected randomly for research. 70 people from each category filled questionnaires while the other 30 people took part in interviews. The sample population was chosen from the 100 people who filled the questionnaire. 30 people were selected from the population as the sample.

Data for this research was part of planning and a requirement for the dissertation. Each procedure for data collection was indicated. All the data collected was noted down and transformed from its raw data to workable data. For the research study the data collection tools are summarized as below;

i. **Documents and Records:** These included newspapers, journals and magazines.
ii. **Internet:** To find out the type of cases that exist in the universities of Kenya, records were collected from the Kenya Police. Other sources that provided critical and helpful information that was analyzed and used to develop the system include the Kenyaplex website, and blogs.
iii. **Observations**: A lot of cases and observations from police stations and other several areas where investigations are undertaken about the related cases
iv. **Questionnaires**: questionnaires were issued online using the Google forms to get what the users thought of the current existing system. These questions and more can be found in the appendix. The questionnaire was structured and after sharing them with public, data was gathered which was of great help to develop the system.
v. **Interviews**: I interviewed some of my friends randomly. I got to know what they thought of the current solutions that exist and where they thought could do with some improvements.

3.4 Data Analysis Methods

Pre-formulated questionnaires were done by use of Google forms for data collection, analysis of the data was done using Google analytics tools that provided analysis of the same. For comprehensive analysis and modeling of the user, requirements object-oriented analysis was used. There after concepts of objects were used to make a good understanding of the system design.

For the database, modeling the relational database schema and Entity Relationship Diagrams (ERD) was used which also describes the tables, relationships and the attributes. Data Flow Diagrams (DFD) was appropriate for the implementation the general view of how data will flow, finally the wire frames showed the process flows of the mobile application. Edraw was the tool that was used to come up with all the design diagrams (Lori, 2016). Scientific methods were used

to analyze the data collected from the various sources of data. Various steps were taken to process the data. The steps include.

i. **Editing the data:** The data collected was first scrutinized to ensure that simple errors were corrected based on users' inputs. Also, some of the blanks that were left by the responders in questionnaires were populated with assumed values. This was done to assure that the data are accurate, consistent with other facts gathered, uniformly entered, as completed as possible and have been well arranged to facilitate coding and tabulation.
ii. **Coding:** Here numerals were assigned to answers that were given by respondents so that the responses could be put in limited number of classes or categories which were appropriate to the research problem.
iii. **Classification:** The data was arranged into classes based on those having common characteristics. For qualitative data, it was classified according to attributes and quantitative data way classified according to class intervals.
iv. **Tabulation:** Afterwards the data was then summarized in a compact form by use of statistical tables.

3.5 Designing and Development Phase

After the requirements had been analysed, then design of the solution started. The design included the mobile part, Web part and the database design, in case the solution had a database, use case diagram design to show all the actors and their responsibilities within the application, an entity relation diagram and the system mock up designs. These designs are important because they guide the next phase which is actual building or development phase and are summarized as below;

i. Use Case Diagram

Use case provide sequence of events system users performed as they interact with the system to attain the required system functionality and derive the intended benefit from the system. The use case is as illustrated in Figure 4.2 to Figure 4.5.

ii. Design Class Diagram

The class diagram was used to show objects in the system, their attributes or characteristics and their behavior or functions. It also showed how these objects are related to each other and with what cardinality value. This is as illustrated in Figure 4.6 to 4.9.

iii. Entity Relation Diagram

The entity relation diagram of the application has various entities and their attributes that the system will have and show how they will be related together with their cardinalities. That is, the number of instance one entity has against the other. These are: One to One, One to Many, or Many to Many. This is as illustrated in Figure 4.12.

iv. Wireframes

Balsamiq mockups was used in the design of the wireframes. Balsamiq Mockups is a graphical user interface mockup and website wireframe builder application. It allowed the designer to arrange pre-built widgets using a drag-and-drop as illustrated in Figure 4.13 to Figure 4.17.

3.6 Implementation Phase

This was the actual implementation phase of the designs that were done on the previous phase in section 3.5. The database was created with the guidance from Entity Relation Diagram bringing out all the tables and their relationships and the design mock-ups were transformed to actual interfaces of the application and the functionality of the system is added.

3.6.1 Prototype Development

This involved coming up with a mobile application and web application. Both the mobile and web application were connected to the central database to facilitate post and get request. The application development environments included the below;

i. Mobile Application.

A mobile application that runs on Android Operating System was developed. Java programming language was used to develop the mobile client. Data passed between the mobile application and the database in JavaScript Object Notation (JSON) format The application was tested on Android device. Android devices were chosen due to high number of target users using devices running on Android, it is open source, a large online community exist hence freely available support.

ii. Web Application.

Laravel development framework was used to develop the web application for the back end. PHP is supported in many webservers and databases and can allow security features to be implemented such as cross-site scripting and SQL injections, thus convenient for this research.

In this phase I used the MVC pattern to design the application. The MVC framework is adopted and used by Laravel framework to ensure that application systems build are of high quality.

i. **Model**->The model is the data store and its related components. Any logic relating pieces of raw data, as well as the data store itself, are encapsulated in this module. Any relations between data items are specified in and maintained by the model.
ii. **View**->The view, also referred to as a viewport, presents the model to the client. While both the view and the controller handle requests from the client, the view only handles requests from the client which change the way the model is displayed to it.
iii. **Controller**->The controller interacts with both the view and the model, allowing the client to change the model, if the client has permission via the model. This separation of the three pieces improves maintainability and programmability by allowing each piece to be updated without changing all three--often referred to as "separation of concerns."

Laravel also adds routing on top to direct how data flows into the system. It helps target the needed controller to handle a specific logic required by user from the interface.

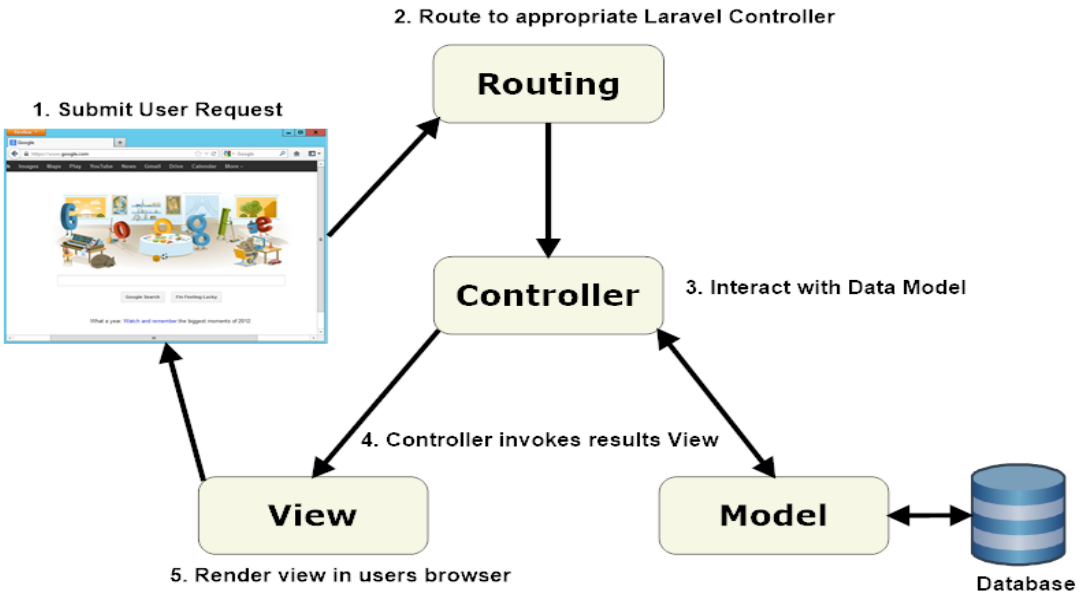

Figure 3.2 Model View Controller

The importance and advantages of using MVC framework to develop web applications include:

1. It enables splitting of roles in a project which is easier. This means that when you encounter a problem with the module you are working on, you can move to another module as you think or consult on how to solve the issue.
2. It enables responsibility isolation in that you can make changes in the views and models separately because the model does not depend on the view.

iii. Database.

MySQL database management system was used to store application data. MySQL was selected because of its high performance, it is open source and there is a lot of support from its open community (Nick, 2017).

3.7 Testing Phase

To test the functionalities and user acceptance the following tests were done;

i. **Functionality Testing**-This test was performed to determine if the system was working as expected. This involved all the modules within the application.

ii. **Usability Testing** - This was performed to facilitate efficiency and ease use of the application. To achieve this a number of respondents were sampled to test the prototype and they gave feedback about the application.

iii. **Integration Testing** - This was conducted to determine if the system will work in the different ranges of mobile phones. To achieve the application was installed in a number of mobile phones.

Chapter 4: System Design and Architecture

4. 1 Introduction

This chapter presents requirement analysis and system design. In requirement analysis, it shows the results of the findings of the research carried whereas system design shows the design structure of the proposed solution. The research questions and objectives were used to guide the discussions in this research. In order to design, develop and test a mobile application for tracking the investigation status of criminal activities and complaints in Kenya. System analysis was performed and various diagrams such as use cases and others were drawn and detailed information for each design was illustrated.

4.2 Requirements Analysis

The first part of this chapter states the requirements which are categorized as functional and non-functional requirements as discussed below;

4.2.1 Functional Requirements

Functional requirement explains the functions that the application will perform. These functions are what will help achieve all the research objectives defined earlier in this research. These functions include:

i. The application shall enable users, that is the general public to search for cases and add ratings and reviews on the cases
ii. The application shall enable new user, investigators and agencies to create accounts and use the system.
iii. The application system shall enable the users to customize their details which they provided.
iv. The application shall allow addition of cases into the system to be seen by the users.
v. The application shall enable verifiers to approve cases added into the system.
vi. The application system shall provide recommendations to the users on which new cases exist.

vii. The application shall provide for mechanisms for admin to approve verifiers who use the system.

viii. The application shall provide a platform where users will air their issues to the admins so that their issues can be dealt with.

ix. The application system shall provide mechanisms by which verifiers can be able to update case progress details as they are not static.

x. The application shall provide mechanism for the admin to respond to each user complaints on the system.

xi. The application shall split the task of case creation this segregation of duties is a control to ensure accuracy and reduce error in the system so that users get quality data.

4.2.2 Nonfunctional requirements

These specify how the application should behave.

i. Performance and Scalability Requirements

The performance of the application shall be appropriate and require a high speed of interaction, thus all tasks will be carried out within a few clicks and seconds.

ii. Security Requirements

The security of the application will be based on the user logon credential which is a requirement to accessing the application data.

iii. Maintainability Requirements

The application is designed such that it can accommodate any changes that arise which only can be implemented by the administrator.

4.2.3 Data Analysis and Survey Results

This research was meant to make an assessment on an application for fast tracking investigation of criminal activities and complaints based on case study at the National Police Service. Questionnaires were administered to 30 respondents from the selected sample population and findings according to the respondents were analyzed using tables, and descriptive statistics.

In addition, distribution and characteristics of the respondents were also highly regarded with the aim of obtaining accurate primary and secondary data that would suit the needs of the research. Factors like gender, occupation and demographics like age were also highly scrutinized in order to obtain accurate results. The findings were based on the research objectives and an appendix of the questionnaire attached to this documentation. Table 4.1 outlines the descriptive statistics based on the response conducted on the respondents;

Table 4.1 Descriptive Statistics

	N	**Minimum**	**Maximum**
Age	30	18	54
Duration	30	5	30
Period	30	0	20
Valid N	30		

N-Sample Size

Duration-Length of Service (Years) within the Department

The youngest respondent was 18 and the eldest was 54 years. The respondents were distributed evenly from age 18 to age 54. In addition, the respondent that has worked Kenya Police for a minimum number of years was 5 years. On the other hand, respondent that has worked for the longest duration was 30 years. Moreover, some respondents have never worked for the police department whereas there are respondents who have worked for the company for a maximum of 30 years. These statistics were taken with the aim of ensuring that the sample population selected was relevant to the research topic, and would provide enough data needed by the study. Table 4.2 outlines frequency table with reference to the distribution of the respondents;

Table 4.2 Frequency Table

Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Female	14	46.7	46.7	46.7
Male	16	53.3	53.3	53.3
Total	30	100.0	100.0	100.0

To show the distribution of respondents in terms of occupation Table 4.3 summarizes all this;

Table 4.3 The Distribution of Respondents in Terms of Occupation

Valid	Carder	Frequency	Percent (%)	Validity (%)	Cumulative (%)
	Administrator	7	23.3	23.3	23.3
	Police	7	23.3	23.3	46.6
	Engineer	1	3.3	3.3	50.0
	Finance Officer	1	3.3	3.3	53.3
	Human Resource	4	13.3	13.3	66.7
	Inspection Officer	1	3.3	3.3	70.0
	Operations Manager	1	3.3	3.3	73.3
	Procurement Officer	2	6.7	6.7	83.3
	Investigation Officers	5	16.7	16.7	100
	Total	30	100.0	100.0	100.0

The distribution of respondents in terms of occupation was 7 administrators, 7 police, 1 engineer, 1 finance officer, 4 human resource managers, 1 inspection officer, 2 operations managers, 2 procurement officers and 5 Investigation Officers. The distribution included customers from

different diversified backgrounds that would provide diversified data to cater for the needs of the research (Bryman, 2015).

4.3 System Architecture

Software architecture encompasses the set of significant decisions about the organization of a software system including the selection of the structural elements and their interfaces by which the system is composed; behavior as specified in collaboration among those elements; composition of these structural and behavioral elements into larger subsystems; and an architectural style that guides this organization. Software architecture also involves functionality, usability, resilience, performance, reuse, comprehensibility, economic and technology constraints, tradeoffs and aesthetic concerns (Shaw and Garlan, 1996). The architecture for this system is as illustrated in Figure 4.1 below;

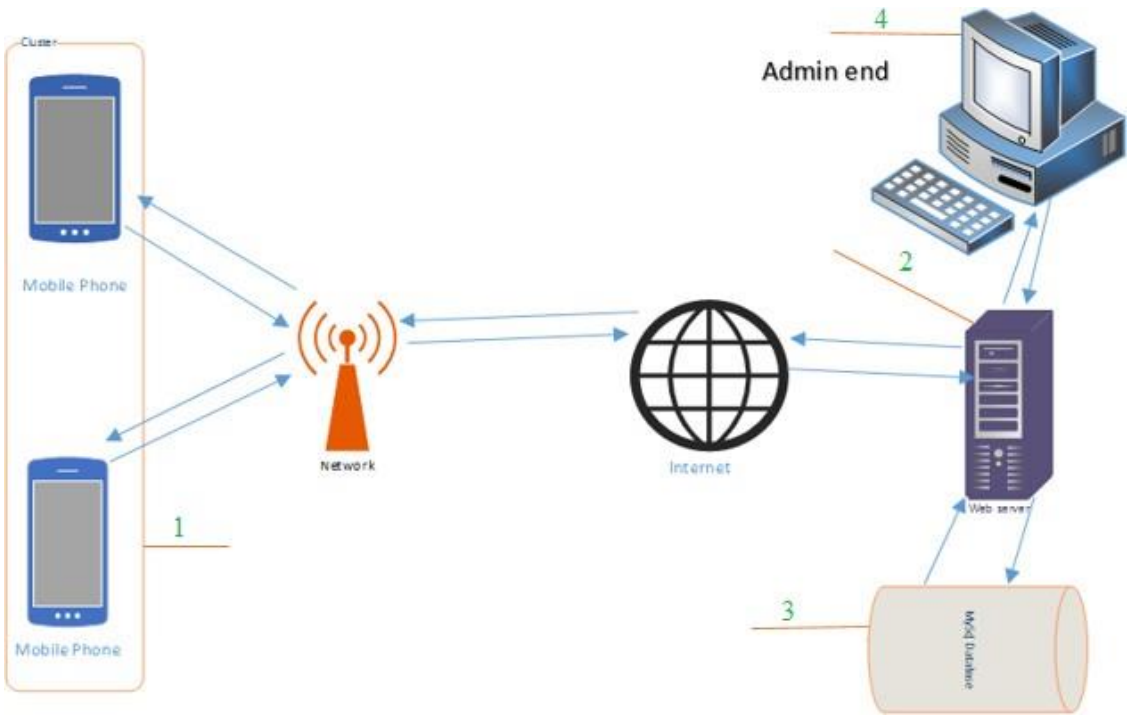

Figure 4.1 Architectural Design

Figure 4.1 above shows the phone were the application will reside after the user installs. The client shall be making request to the server, the backend of the application using the Post and get https

requests and since the application shall be held in firebase it is very secure. The web server as illustrated in Figure 4.1 shall hold the PHP Scripts facilitating front and backend communication. The database shall store the information pertaining the application allowing for data retrieval. The admin part as indicated shall

4.4 Use Case Diagram

Use cases were used to identify and elaborate the system functionality, it enabled the research to separate the system into actors and use cases. The actors are the users that directly interact with the system and cause trigger actions from the system. A use case can be taken as a simple scenario that describes what a user expects from a system (Sommerville, 2011). Each use case represents a discrete task that involves external interaction with a system. In its simplest form, a use case is shown as an ellipse with the actors involved in the use case represented as stick figures.

The users of this application are public citizens, police (Investigating officers), verifier and admin who each have their own interfaces with distinct functionalities. Some of the functionalities of the modules have similarities especially when doing similar tasks though they vary slightly.

Public users (Citizens) use case: the functionalities for this user include registration, login, complete profile, status, register cases, add complaint, view profile, view a case file, and also logout. When a new user accesses the system, on the landing page they choose Public Citizen and register. Here they provide the details that will be used to log them into the system afterwards. Upon successful registration, the user is logged in into his/ her dashboard where they complete the user profile by entering the personal details required by the application. On successful completion of personal details, he/she is taken to the dashboard.

Others already registered into the system login by providing their email and password. If the details match they are successfully logged in and taken to the dashboard. Users who forget their password can recover by using the forgot password where a token is sent to their email. Afterwards they provide the new password and move on to login where they are taken to the dashboard.

From the dashboard the user can choose to register a new case or view his existing case files to see the stage they have advanced to. During a search the user provides the name of the case as per the OB number. All matches from the database are displayed.

Users can launch complaints or suggestions to the admin who views them and responds accordingly. On the profile user sees his/her details that they provide to the system and in case they want to change any details can do so here. The logout destroys users' session and ensures that no one else can see the profile or use the system maliciously when he/she leaves the browser. This user use case is illustrated in Figure 4.2 below;

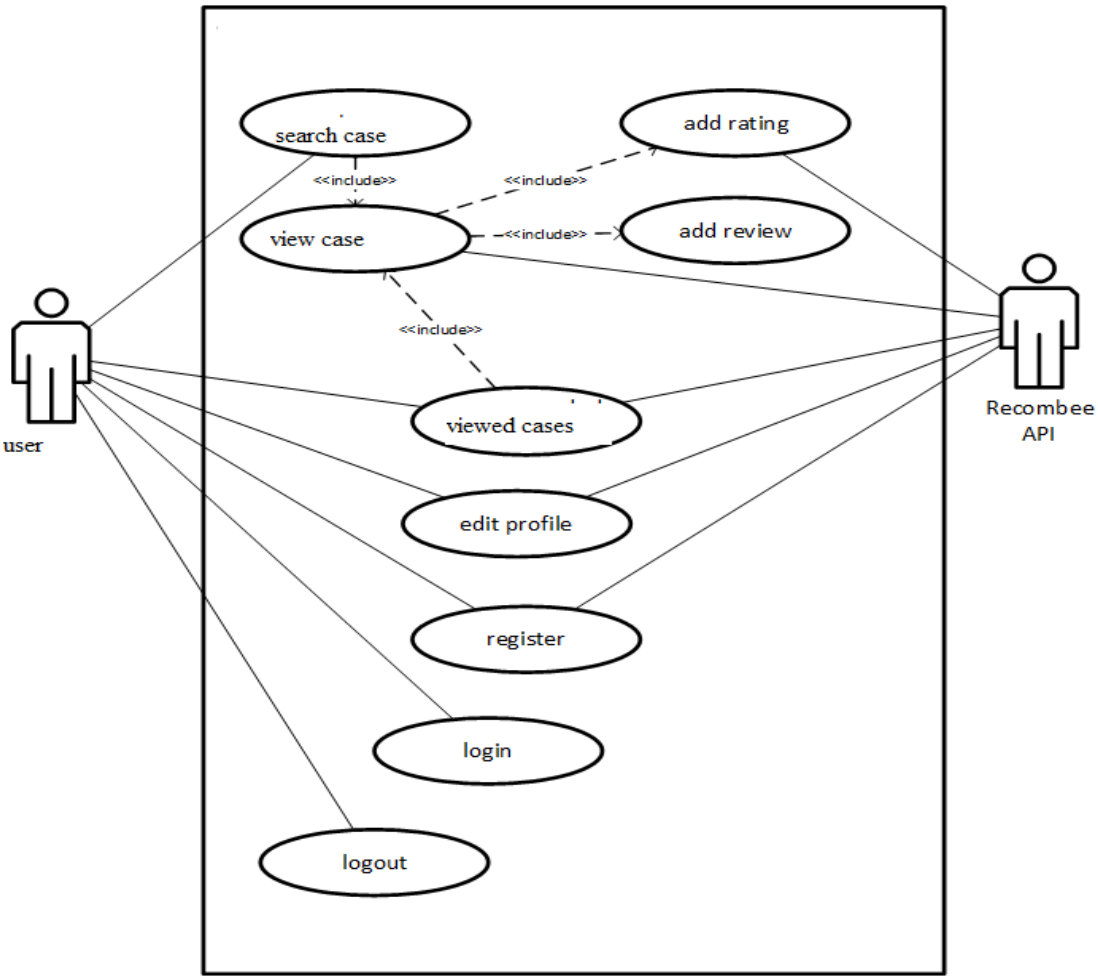

Figure 4.2 user use case diagram

Police Use Case: Some of the functionalities here are similar to those of the normal user and these include the register, complete profile, and login, forgot password, search a case, complaint and logout. This actor can login and search for a case and here similar results like those of a normal user are displayed but instead of being told rate the case, the police can edit the case file and view the case, update history which shows how many times the case was changed and the reason why.

The police officer can also view the rules that have been set by the admin to guide on how the cases should be updated. They are allowed to add new findings from investigations into the system, they can also remove some based on how they collect and conduct their evidences. When the verifier chooses my cases from the menu, two lists are shown, those that have been approved by administrators and the pending ones. The Police use case is as shown in Figure 4.3 below;

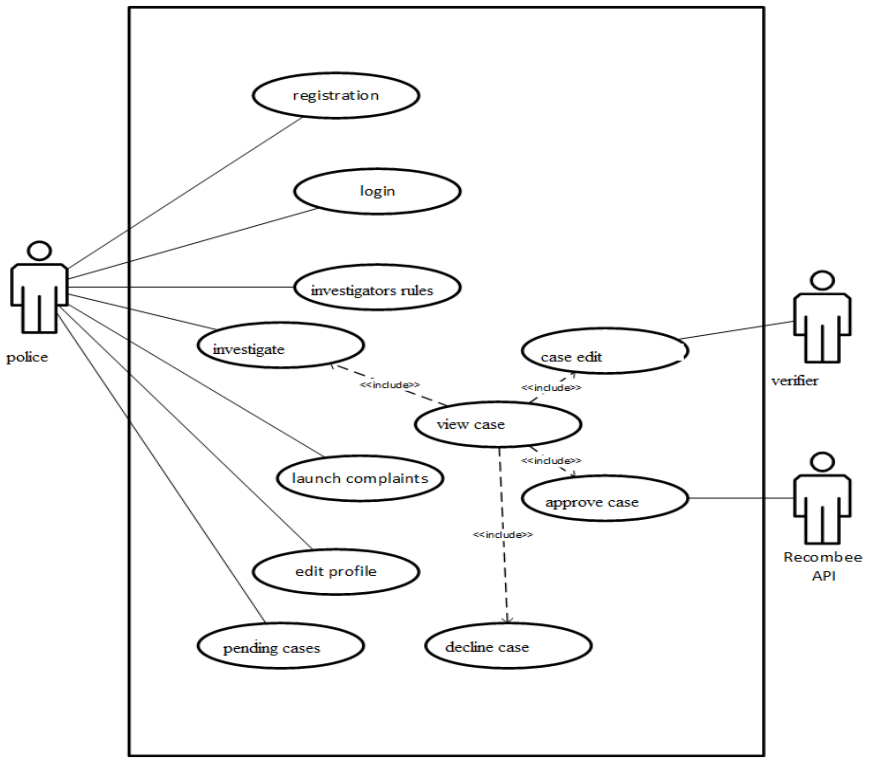

Figure 4.3 Police Use Case Diagram

Verifier Use Case: The verifier functionalities are similar to those of other users include: register, complete profile, login, complaints, profile and logout. Verifiers have to be approved by the admin and once they complete profile they await admin approval. After approval once a verifier logs in he/she is taken to the verifier dashboard.

From the menu, verifier can view verified rules. These are rules set by the admin to help and guide the verifiers in their tasks. Verifiers can also view pending cases. These are all the cases that have been added by police officers or edited and have not yet been assigned a verifier. When the verifier chooses to verify he/she is assigned the case.

The case is removed from the pending category and is now in the verifier's verifying cases. In the verifying cases the verifier is able to see all the materials uploaded by the verifier and can comment on them as need be. Verifier can choose to approve the case if it meets the requirements or he/she can decline to verify the case. Once he/she clicks decline the case is returned to the pending category. Figure 4.4 below is the Verifier use case.

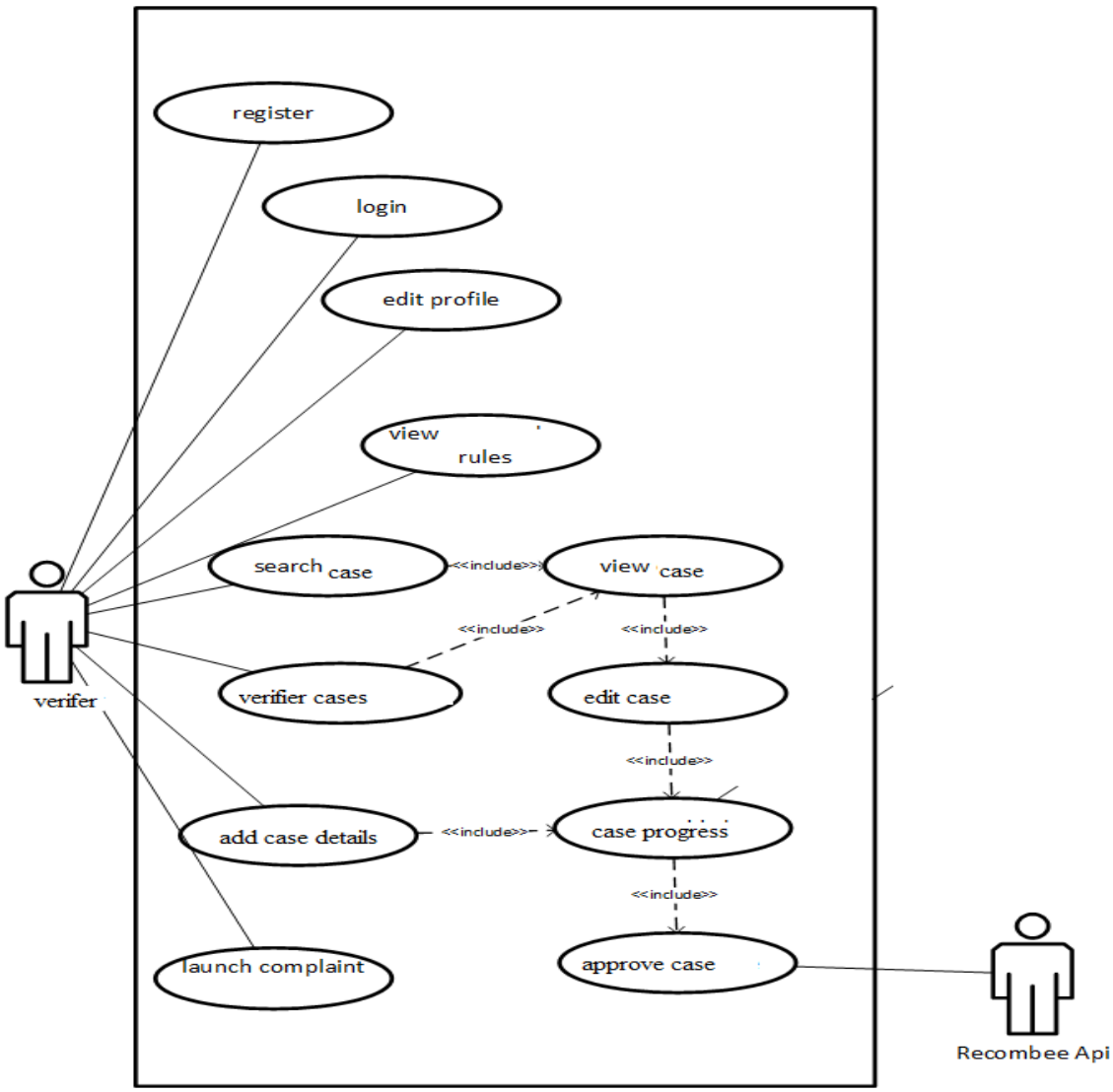

Figure 4.4 Verifier use case diagram

Admin Use Case: An admin is created by another admin and has similar roles to his/her creator. Functionalities that are similar to those of a user are login and profile. Once an admin has logged into the system, he can verify verifiers. He checks for details of verifiers provided and once contented approves the verifier. Once the new admin logs into the system, the can change any attribute they wish to. The complaints raised by different users of the system can be viewed by the admin here and he/she responds accordingly, admin also manages all system users. Rules governing all the other system users are also managed by the admin. The use case is as in Figure 4.5 below;

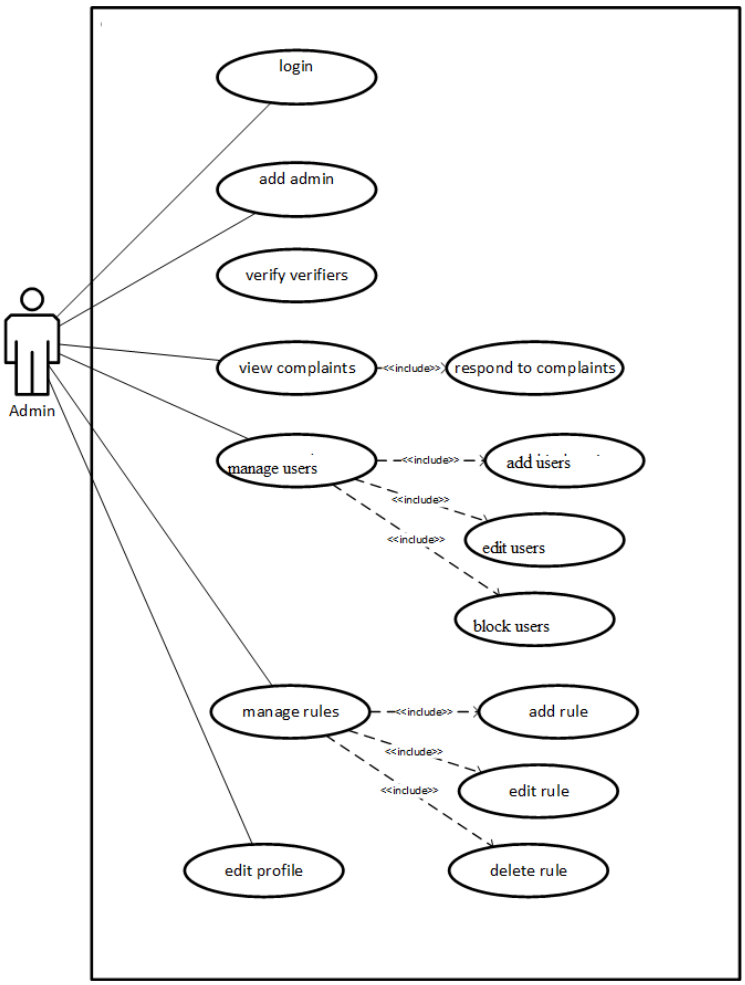

Figure 4.5 Admin Use Case Diagram

Class diagram represents the static view of an application. Class diagram is not only used for visualizing, describing, and documenting different aspects of a system but also for constructing executable code of the software application. It is illustrated as in Figure 4.6

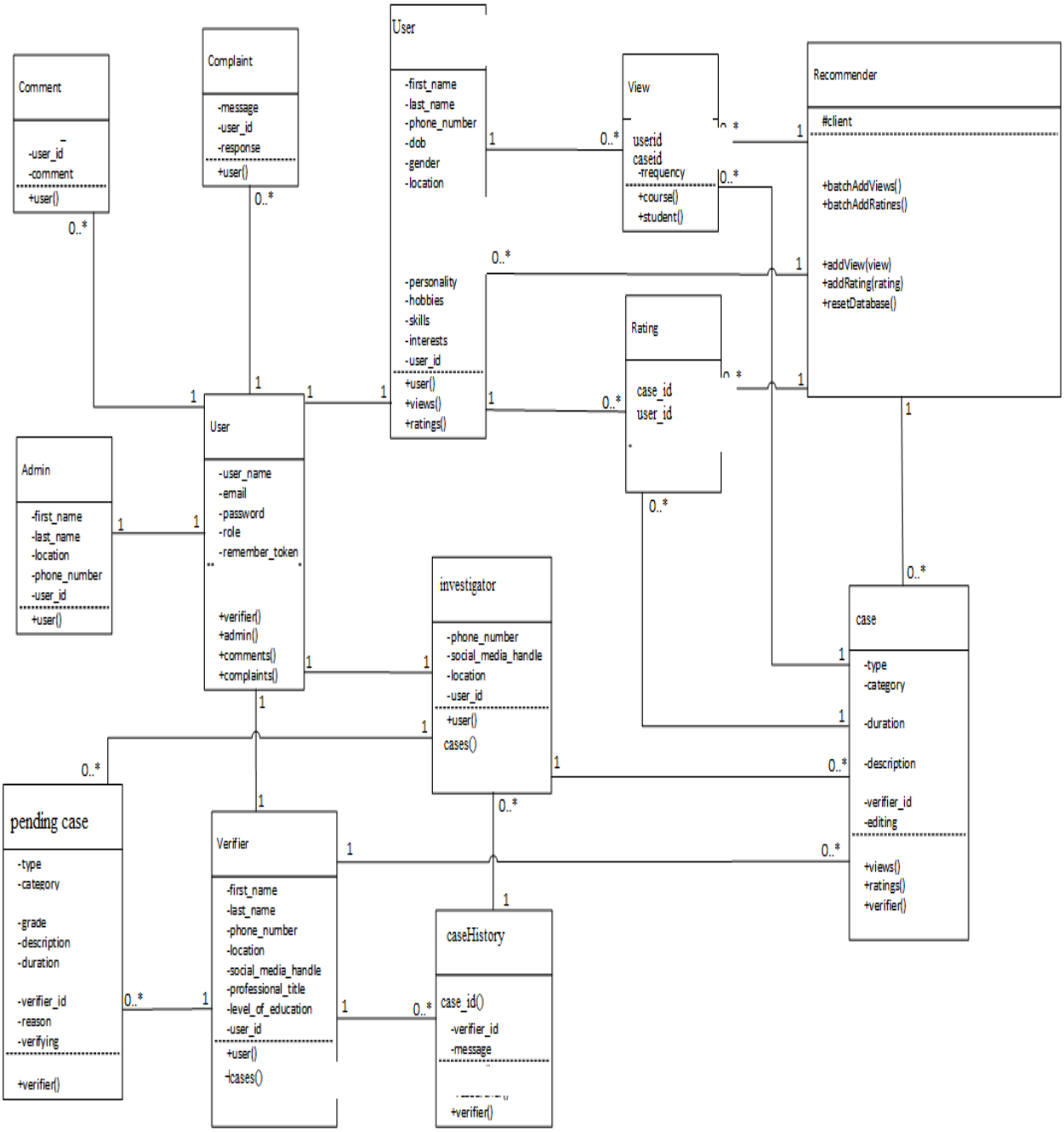

Figure 4.6 Class Diagram

4.5 Data Flow Diagram

Data Flow Diagram (DFD) graphically represents the functions, or processes, which capture, manipulate, store, and distribute data between a system and its environment and between components of a system. The visual representation makes it a good communication tool between User and System designer. Structure of DFD allows starting from a broad overview and expands it to a hierarchy of detailed diagrams. DFD has often been used due to the following reasons:

i. Logical information flow of the system

ii. Determination of physical system construction requirements

iii. Simplicity of notation

iv. Establishment of manual and automated systems requirements

4.5.1 Context Diagram

The Context Diagram shows the system under consideration as a single high-level process and then shows the relationship that the system has with other external entities (systems, organizational groups, external data stores, etc.). It shows your system in context with other systems or objects with which it interacts (Hohmann, 2003). The context diagram is used to clearly show the boundaries of the system and its environment. Figure 4.7 represents the Context Diagram Level 0;

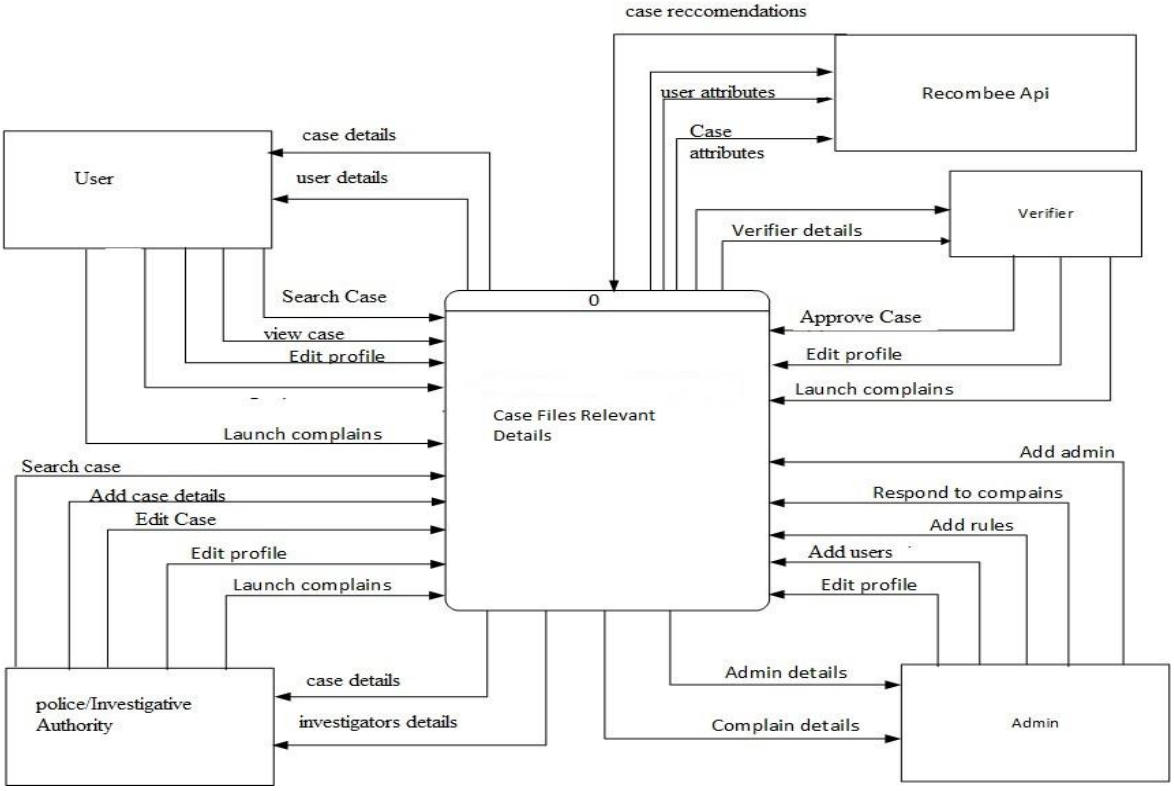

Figure 4.7 Context Level Diagram Level 0

4.5.2 Data Flow Diagram

Data-flow diagrams (DFDs) are system models that show a functional perspective where each transformation represents a single function or process (Sommerville, 2011). DFDs are used to show how data flows through a sequence of processing steps.

The data flow diagram is used to show how the data move through the proposed application. DFD of the application is elaborated in Figure 4.8, Figure 4.9, Figure 4.10 and Figure 4.11. The Figures entails the various processes that constitute to the proposed application among are also the various entities that make up the general flow of information within the application.

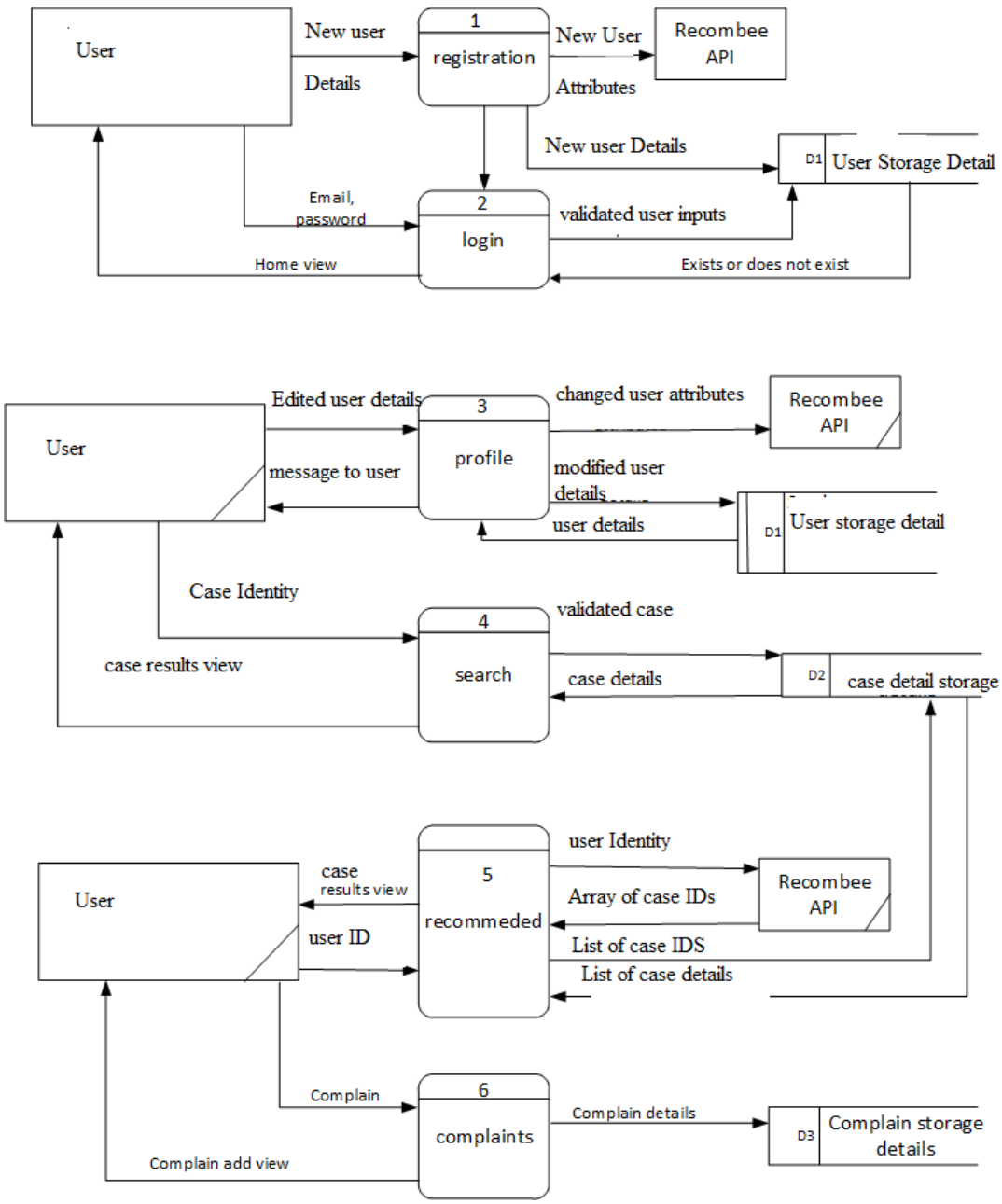

Figure 4.8 User Data Flow Diagram

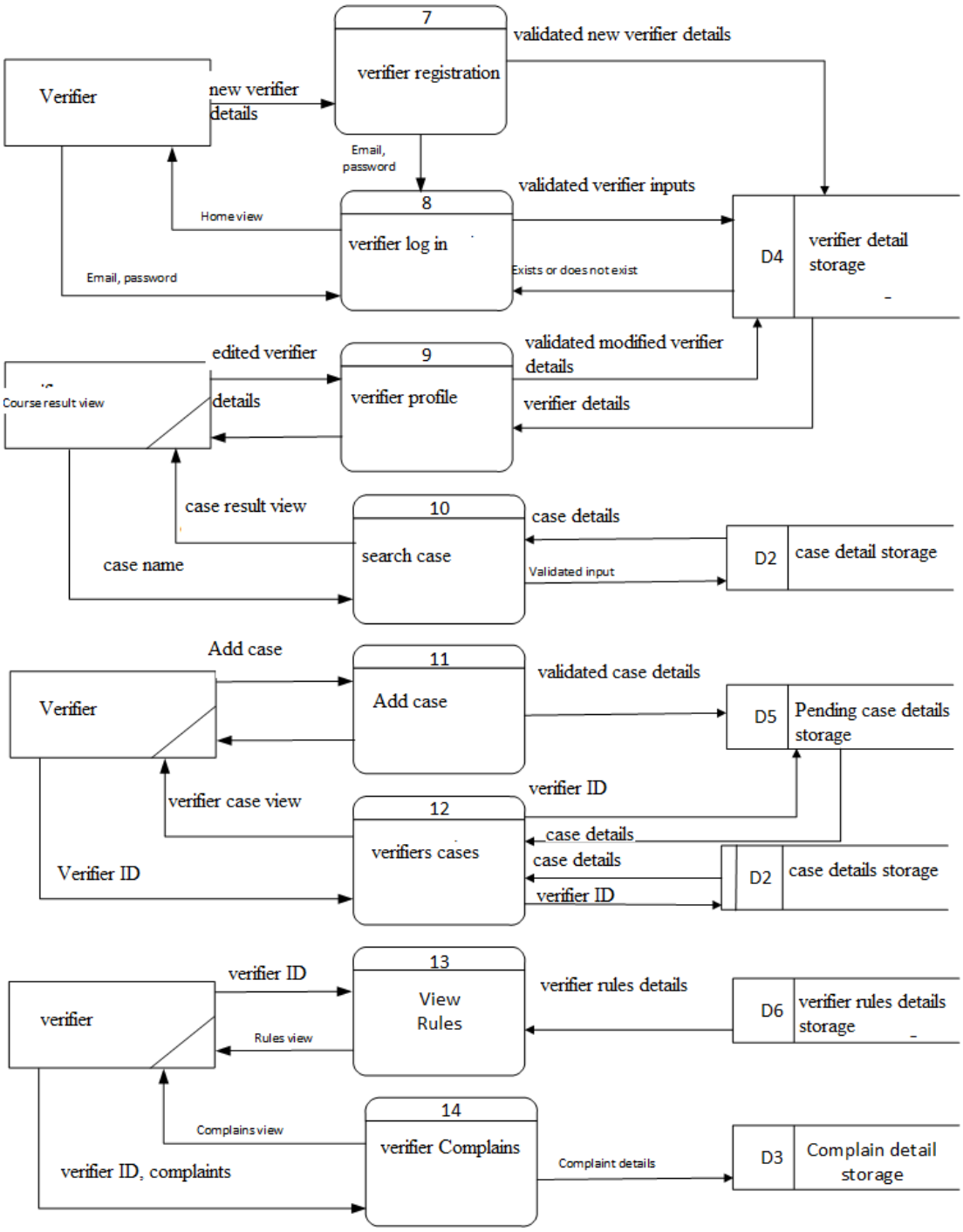

Figure 4.9 Verifier Data Flow Diagram

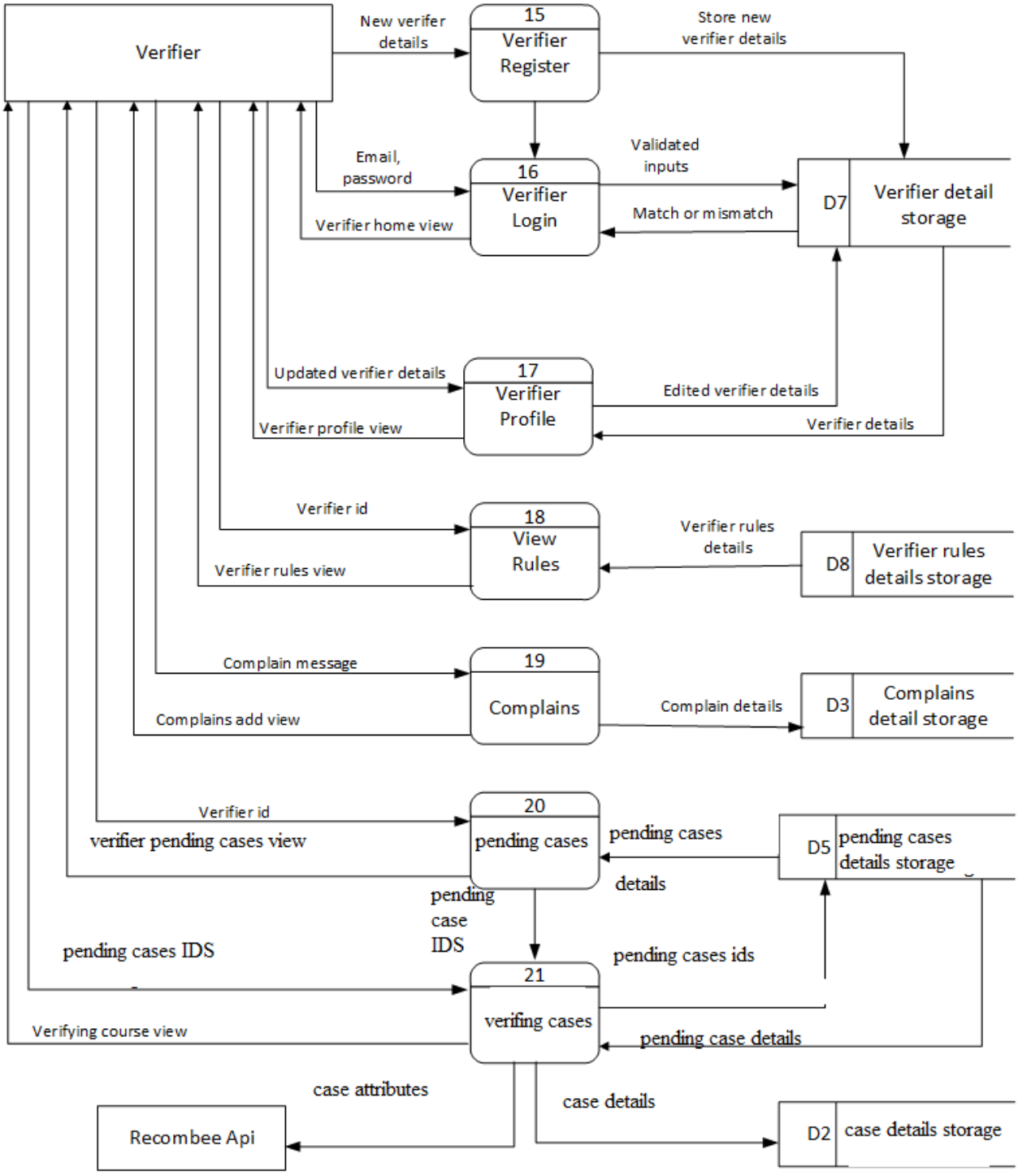

Figure 4.10 Verifier Data Flow Diagram

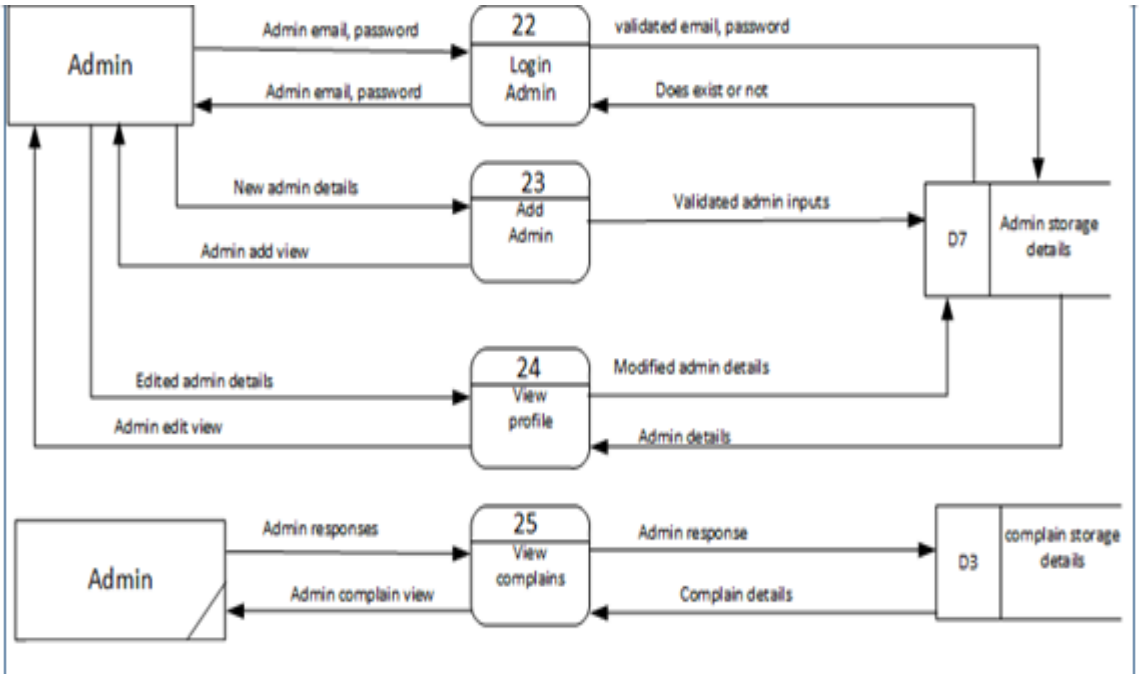

Figure 4.11 admin data flow diagram

4.6 Database Structure

A data model is a theoretical representation of the data structures that are required by a database, it adds by signifying concepts which present the necessary means to accomplish abstraction. The data structures include the data objects, the relations between data objects, and the policies which preside over operations on the objects. Data model focuses on what information is required and how it must be ordered rather than what actions will be performed on the data (Ramez, 2011). The mobile application shall have a database for the storage of all information regarding the application.

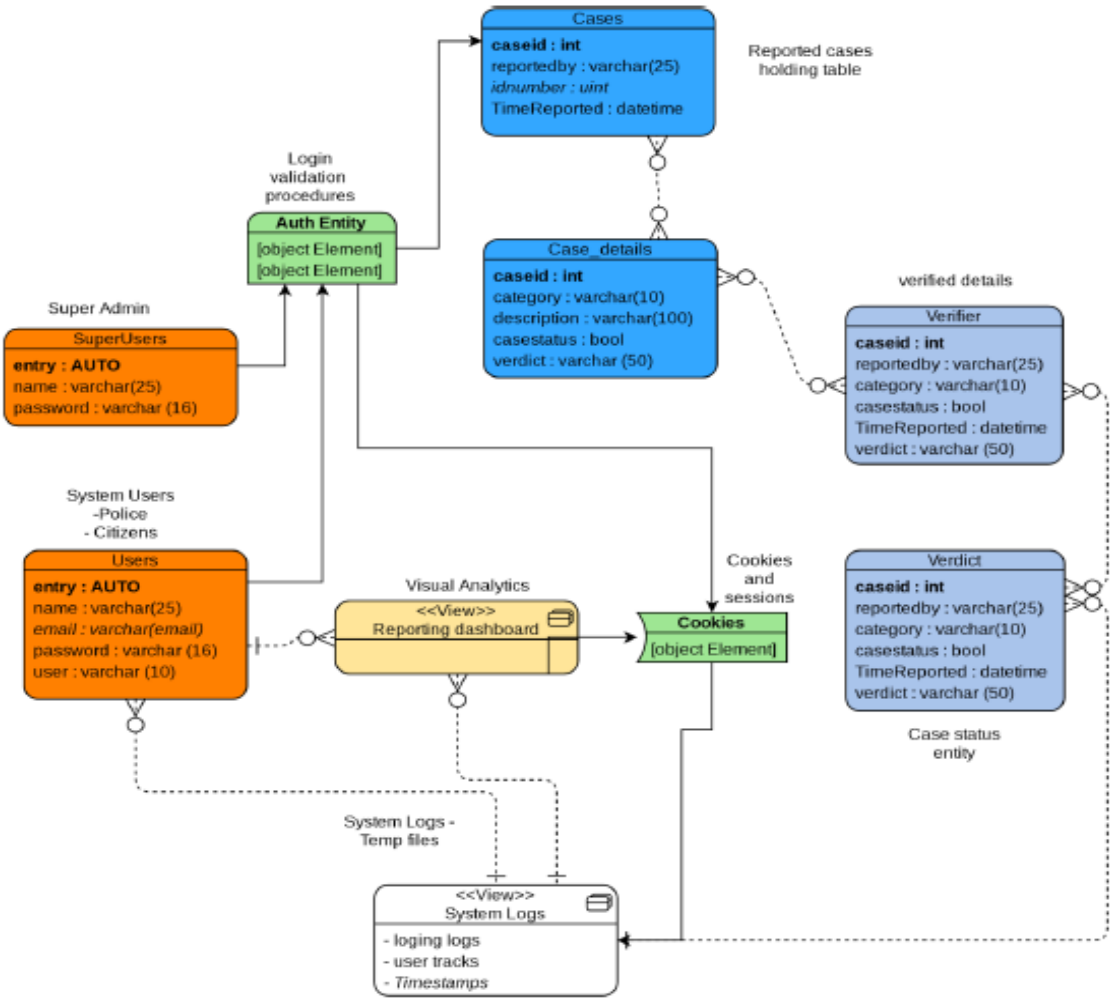

Figure 4.12 Entity Relationship Diagram(ERD)

4.7 Wireframe Design

The proposed Solution should have both the mobile part and the backend part. The users should use the mobile application while the backend can only be accessed by the administrators for all administrative activities regarding the system.

4.7.1 Mobile Application

User Interface (UI) Design focuses on anticipating what users might need to do and ensuring that the interface has elements that are easy to access, understand, and use to facilitate those actions. The proposed solution shall have several interfaces which a few are described in the subsections as follows;

4.7.1.1 Login Screen

This interface is as shown in Figure 4.13 below, it allows the users to register and login into the system, only registered users are able to login else they register to become the users of the system. The Interface also allows users to reset their passwords in case they forgot their Passwords enhancing security .The login screen authenticates anyone trying to access the mobile application thus securing all the information within the mobile application preventing access by unauthorized users. The register page is similar for all users except the admin who is created by another admin. Once registration is done user is taken to complete profile for user role specific details

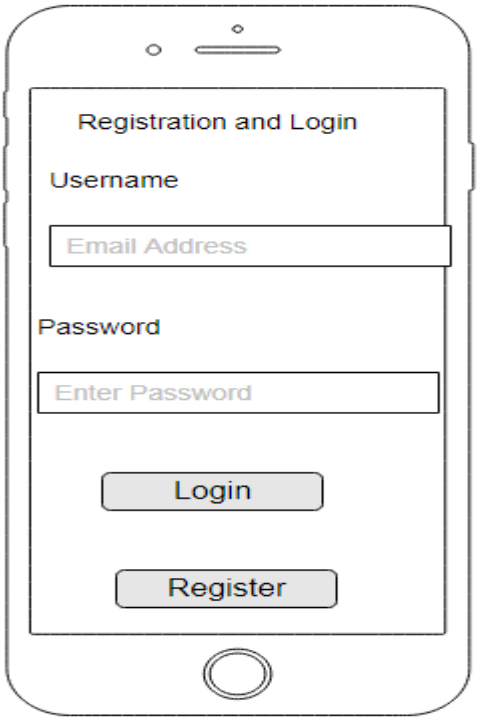

Figure 4.13 Login and Registration Interface

4.7.1.2 Homepage

This is the main interface that allows users perform several operations they include, Register Complaint, View Crime status, give feedback about the application and get to know more about the application. Once a user is logged in he/she is taken to the user dashboard. The police, verifier and also admin also are taken to the dashboard when they log in. The interface is the same but the menu items on the left are different as per the user role. It is shown as in Figure 4.14 which entails Homepage for both the mobile application front end and back end

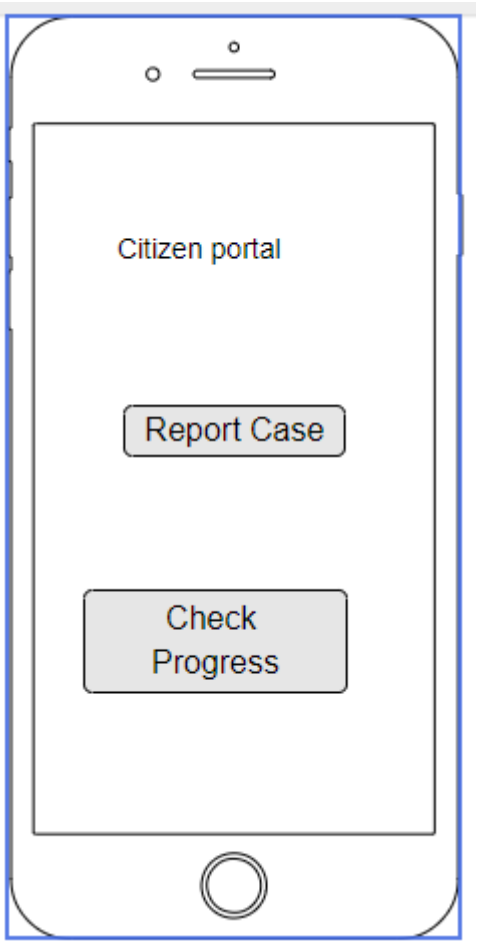

Figure 4.14 Homepage Screen

4.7.1.3 File New Case

The interface is as shown in Figure 4.15, it represents the case page that allows user to register a case and give the first information report regarding a criminal activity.

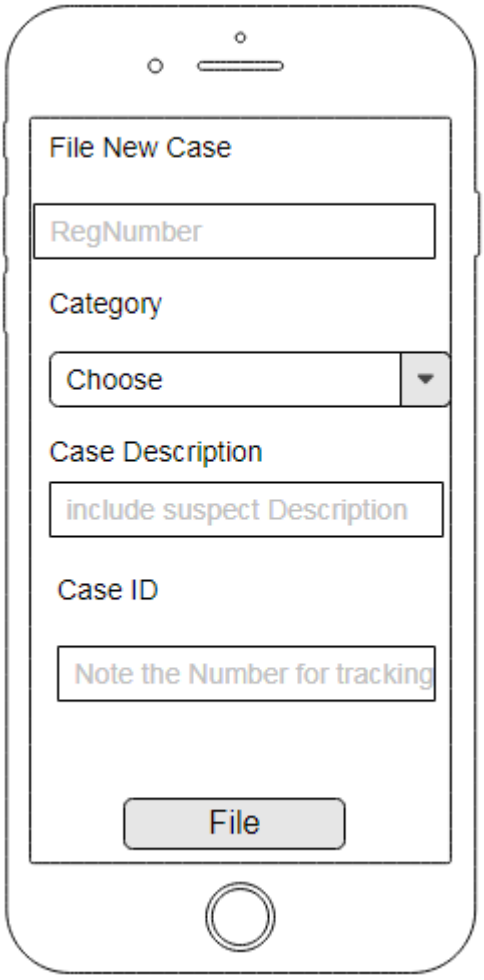

Figure 4.15 File New Case

4.7.1.4 View File Cases Screen

The view case status interface is as shown in Figure 4.16; it allows users view filed cases.

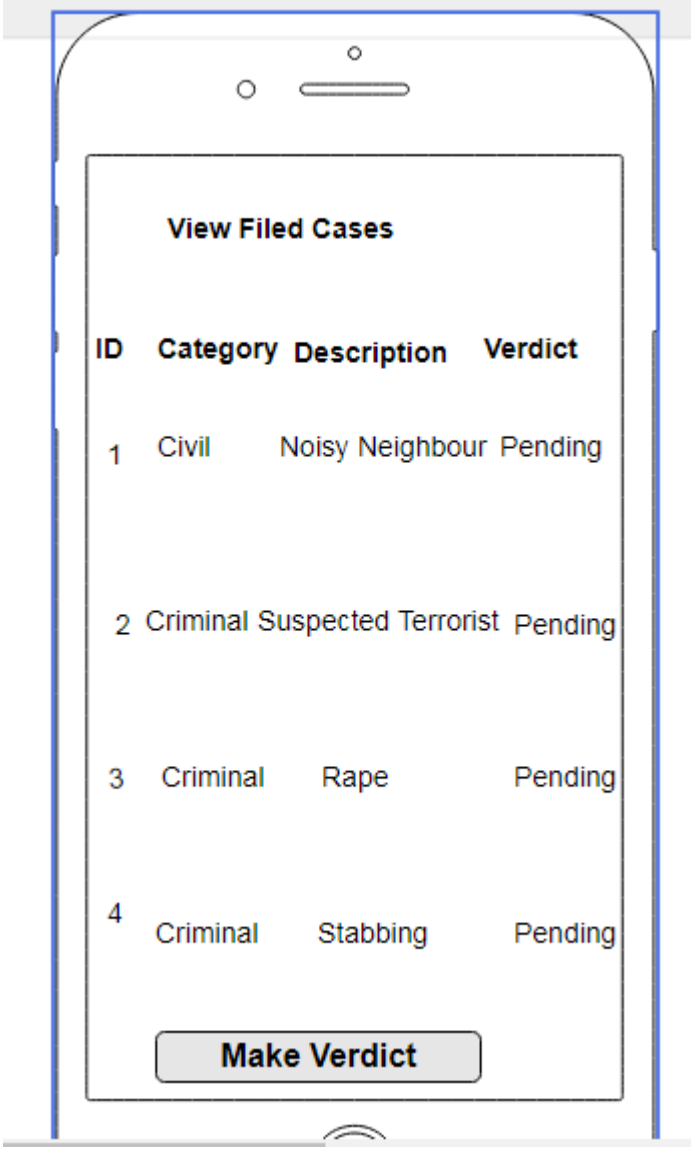

Figure 4.16 View Case

4.7.1.5 Feedback Screen

Feedback interface Screen to the user comes in various forms. The user interface responds to actions. It is also used to engage and explain, and can improve user satisfaction. Feedback

interface can change a confusing experience to a pleasant experience that teaches you how the application works. Figure 4.17 represents the feedback interface which allows users give feedback regarding the system.

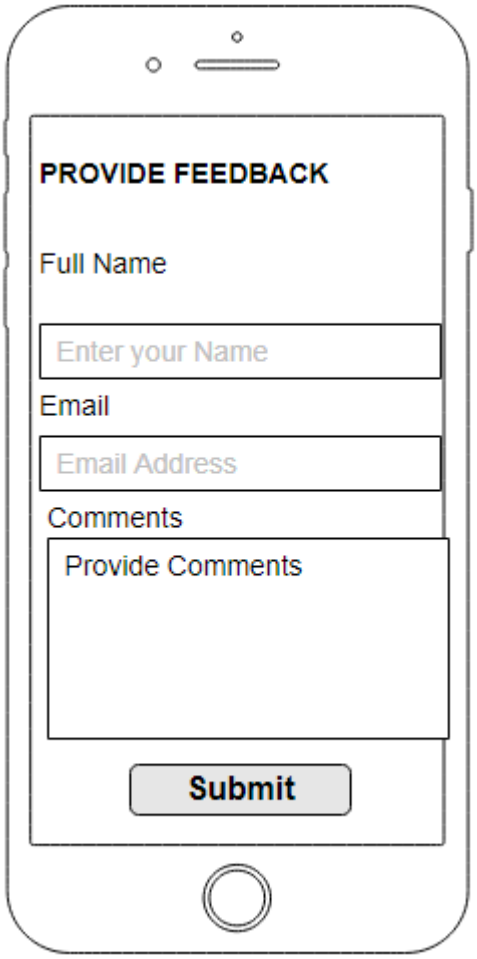

Figure 4.17 Feedback Screen

Chapter 5: System Implementation and Testing

5.1 System Implementation

5.1.1 Mobile Client Side

The Mobile application was developed on a windows 10 pro for the front end was Android, PHP and MYSQL for the database. The server and the database was managed by the XAMPP version 7.0.30. The mobile client features several components namely; Registration, search a cases, View status of a complaint, add a case, view status of a case, verify a case, View rules, view pending cases, Feedback Manager (FM) and many others. The cases, complaints, rules, registration information and rules are stored in the database server, the update status of the complaints and crimes are displayed to the users through the view crimes and view complaints tabs.

The feedback manager captures user feedback on use of the mobile application and posts this to the feedback details database in the database server. This input is used to continually make improvements on the mobile application. For versioning control git version 2.7.1 was used to develop the application. This enables a developer to explore new features of the application without worrying about breaking the code. Once unwanted results are obtained you just revert back to the previous commit and start again. This ensures development is done faster. Also with git it enables developer to push his/ her application directly to GitHub or GitLab or bit bucket. This ensures that the program is safe. If the local machine used to develop the app crashes, on call pull the project online and continue using it as though nothing happened.

5.1.2 Web Server Side

The web server holds the database (back end) for the application which entails user registration details (user, police, investigator, verifier and the administrator), case information, complaints information, verifier rules, administrator module in Laravel and many others

Laravel framework model was used to develop the backend. Some of the reasons for using Laravel framework is it is lightweight and uses and supports object-oriented programming in PHP. Also helps developers build applications that are secure, robust and maintainable in the long run.

Laravel being one of the emerging top frameworks in PHP also gives developers chance to build application as they are in the real world hence helping me connect with thousands of similar developers online who help troubleshoot problems that occur during development

5.2 System Testing

System testing was a fundamental process of the research conducted as it enabled the researcher to evaluate the applications performance based on several metrics; user experience, efficiency, user interface and effectiveness. Through the testing process, the researcher was also able to identify modular improvements that could be made to the application in future versions.

Chrome and Firefox developer edition were used to test the application as it was being developed. The reason these two browsers were used is that they offer additional tools to web developers to debug their apps. As a result, the development process was easier to debug errors.

Test driven development was used while developing this system. Essentially, you develop the code incrementally, along with a test for that increment. You don't move on to the next increment until the code that you have developed passes its test. Testing improves confidence that the application does what it is supposed to do.

The steps involved are ;

1. Identifying the increment of functionality that is required.
2. You write a test for this functionality and implement this as an automated test.
3. You then run the test, along with all other tests that have been implemented. Initially, you have not implemented the functionality so the new test will fail. This is deliberate as it shows that the test adds something to the test set.
4. You then implement the functionality and re-run the test.
5. Once all tests run successfully, you move on to implementing the next chunk of functionality.

5.2.1 Functional Testing

Functional test was performed to determine if the system was working as expected. The results obtained were summarized as in Table 5.1;

Table 5.1 Results from Functional Testing

INTERFACE TESTED	TEST PERFOMED	EXPECTATION	OBSERVATION	RESULTS	PASS/ FAIL
Registration	To test if the application could register users	The application should allow user registration and store data in the database	The application allowed user registration and stored data in the database	OK	Pass
Login	To test if the application could authenticate user login	The application should allow only registered users to log into system	The application validated user login/No access was allowed to unregistered users and blank login	OK	Pass
Report a Case	To test if the application could allow a user report a case	The application should allow a user report a case	The application allows a user report a case then saves the data	OK	Pass
Check case progress	To test if a user can view the progress of a report	The application should allow a user to enter the information	The application allows user to check the progress report	Ok	Pass

File assessed case	To test if the application could allow a user to save assessed case	The application should allow user save assessed case	The application saves a case	Ok	Pass

5.2.2 Usability Testing

Usability testing was performed to facilitate efficiency and ease of use of the application. The results achieved were summarized as shown in Table 5.2;

Table 5.2 Results from Usability Testing

Test Requirement	Application response	Pass/Fail	Comments
Appearance	Theme colors and fonts	Pass	Good
Navigation	User could move to and fro	Pass	Ok
Data Entry	User could enter data easily	Pass	User friendly because data was captured easily

5.2.3 Integration Testing

Integration Testing was conducted to determine if the system will work in the different ranges of mobile phones. For this test 5 phones were used. The results achieved were summarized in Table 5.3;

Table 5.3 Results from Integration Testing

Code Name	Version Number(s)	Compatible
KitKat	Android 4.0	Yes
Lollipop	Android 5.0,5.1.1	Yes
Marshmallow	Android 6.0.1	Yes
Nougat	Android 7.0,7.1.2	Yes

5.3 System Deployment

The application is an android based and would be deployed on mobile phones as an APK file. The application database will be hosted in Firebase as well as used to facilitate the analytics.

Chapter 6: Discussion of Results

6.1 Introduction

The purpose of this research was to identify the challenges facing the investigation officers while performing their daily routines of fast tracking investigation of criminal activities and complaints. The other aim was to analyze the existing techniques and applications for tracking the investigation status of criminal activities and Complaints Filed. This was done in order to identify and develop a suitable technique that will be adopted to address the current challenges faced while tracking investigation of criminal activities and complaints.

The mobile application was developed for the investigation officers/Police who had access to a data enabled phone running an Android operating system. The web application was developed and could be accessed using a computer, laptop, or mobile device. This chapter describes the research findings and achievements of how the research objectives were achieved and it provides a review of the application developed citing the advantages and limitations of the developed mobile application.

6.2 Findings

A review of the literature indicated the techniques and the tools used by the investigation officers in tracking the investigation status of criminal activities and complaints. This process of tracking investigation status of criminal activities by the investigation officers is time consuming and tedious since they go through a complex process to verify the status of a criminal activity. The mobile application platform is the most appropriate technique for tracking the investigation of criminal activities and complaints since it is fast, affordable, and very reliable.

Doing this dissertation was a challenge and a good learning opportunity. It provided a good chance to combine the knowledge learnt from various units studied in computer science and in Mobile telecommunication and innovation like databases, software development life cycles, web development, and artificial intelligence among others.

While developing the mobile application, it sharpened and improved object-oriented programming skills. This was the paradigm that was chosen to develop the application due to its

simplicity when dealing with complex projects. Both web and android development skills also improved as the mobile application was web based.

The dissertation provided a chance to put together the things learnt in class with what exists out in the industry. Using the Laravel framework, which is currently being used in the industries, was a good learning experience. It provided expertise to develop other projects using the same framework.

6.3 Achievements

At the end of development of the mobile application alot of achievements were attained as listed below;

i. The application was able to register new cases, suspects and verifiers
ii. The application provided a mechanism for police to add cases following the set guidelines by the admin.
iii. The application ensured that all cases added by the users were approved by the verifiers following the set guidelines.
iv. The application provides ease of editing the guidelines by authorized persons ensuring that changes in the guidelines were added to the system immediately
v. The application ensured that the verifiers are verified by the admin to continue using the application.
vi. The application provided a centralized place for state to search for cases they want to know about.
vii. The application recommended cases to the investigators based on what they have been looking at and their other attributes.
viii. The application allows users to rate and review services. This help improves the cases investigation officers uploaded as they provide feedback to the public.
ix. The application allowed admin to add the rules which are to guide the verifiers and verifiers.
x. The application allows admin to add or edit the industries which users may select when completing their profile.

xi. The application enables verifiers, users and verifiers to launch complaints and suggestions to the admin.

xii. The application clearly separates the duties of verifiers and verifiers to ensure accuracy of the information added.

6.4 Mobile Application

The feedback from respondents during the testing phase was largely positive and offered more insights to the favored features of the application. Most users found Crime and Complaints status quite useful in offering accurate real time information on the status of the crime.

The users also felt that the information offered by the application was useful and informative and that it would be of benefit to them. The consensus was that the application alone would not fully tackle the current challenges. However, with more support from government and improvement of existing policies and systems, growth of the application would be more apparent.

6.4.1 Overall Application Feedback

While conducting review of the application, some of the questions asked to judge usefulness of the application were;

i) What was the most useful feature?

ii) Did the application experience any system crashes during use?

iii) What was the user experience rating on the user interface, user experience effectiveness, efficiency and navigation?

6.4.2 Results of Testing

Post testing of the application was carried out to measure the effectiveness, efficiency, navigation, user experience and user interface as well as capturing the system functionality in modular form. Figure 6.1 shows the general feel of users about the application from the results collected from respondents. The results show that respondents found the application good in terms of navigation, effectiveness, and user experience.

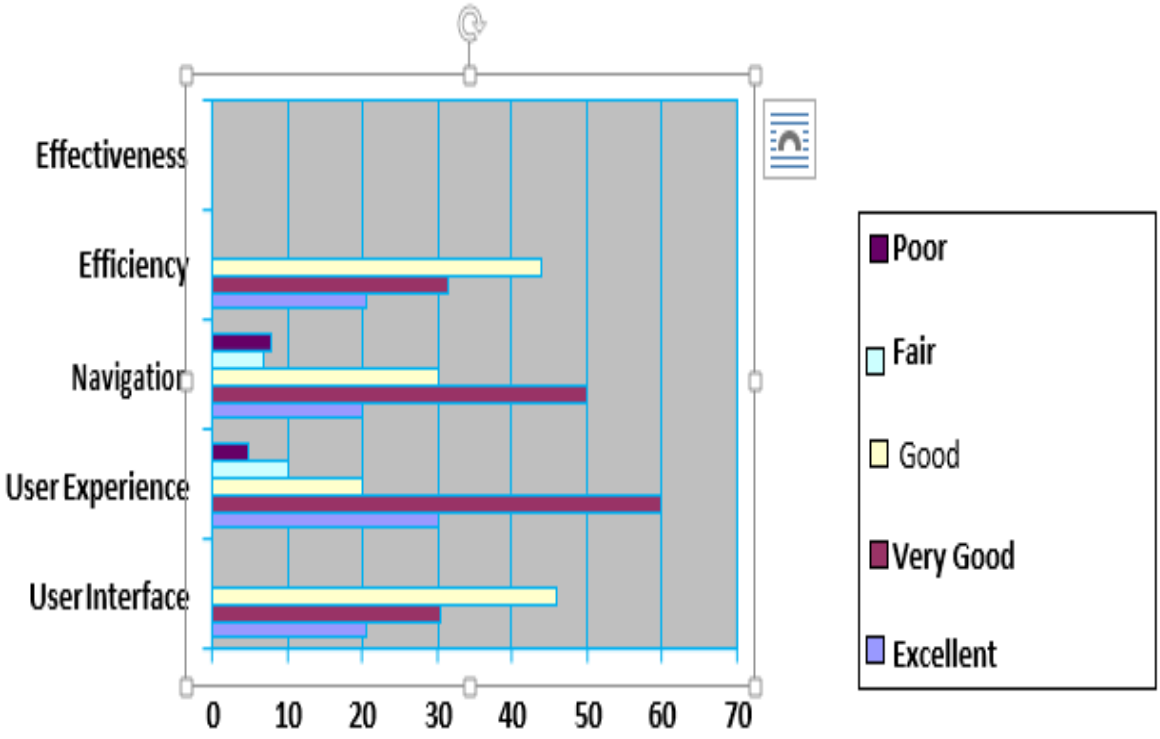

Figure 6.1 Rating of Mobile Application

6.4.3 Assessment of the Individual Modules

In terms of module functionality, the crime reporting functionality, navigation and criminal status updates were the best features for the respondents. Majority found these features easily accessible within the application and easy to use as summarized in figure 6.2. Reporting crimes and navigation, crime and complaints status updates scored 70% from the respondents, which represented 61% and 51% respectively from a total sample size of 100.

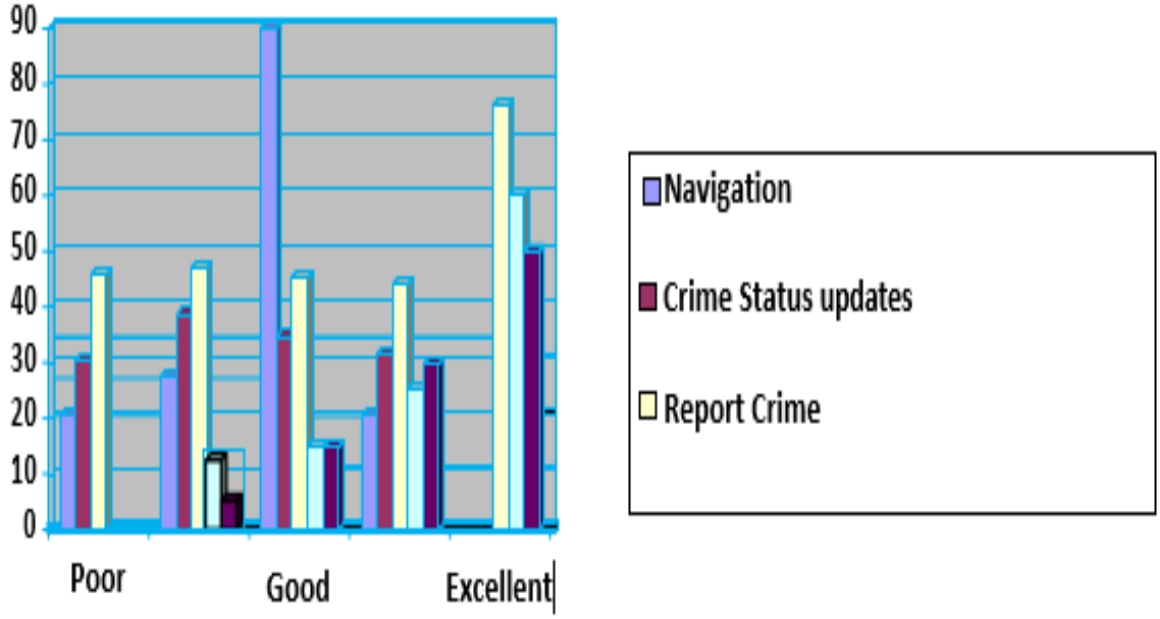

Figure 6.2 Respondents assessment of Application

6.4.4 Assessment in Terms of Speed

As illustrated on (Appendix C), the users were given tasks to complete on each module and respond. These tasks enabled the users to navigate using the various features in the application. The application also allowed them to submit feedback and receive a notification from the application on the status of the crime. Figure 6.3 shows respondents' feedback about the application's speed.

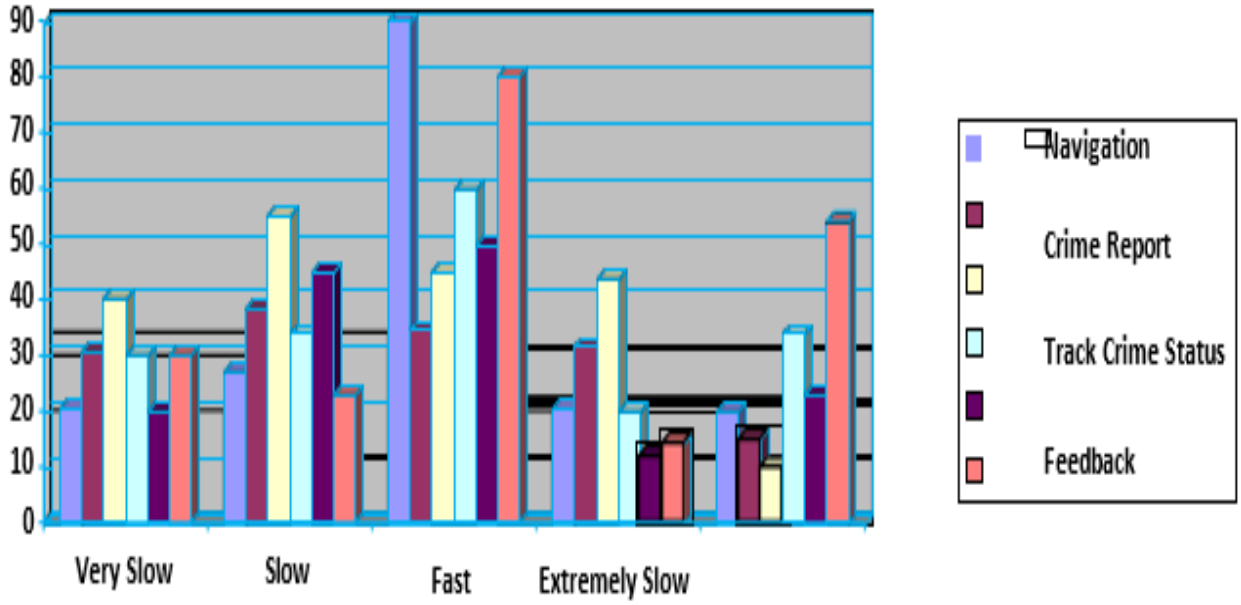

Figure 6.3 Respondent Speed Assessment Feedback

6.4.5 Summary of Results

The feedback of the application was satisfactory and the application managed to meet the set objectives. The users felt that there currently lacks adequate solution in the market that carries out the set features of the mobile solution and that it would address a gap that is a stress point for many unresolved crimes and complaints. Users made recommendations to changes that could be made in terms of user experience in the application as well as efficiency while using the mobile application.

Chapter 7: Conclusion, Recommendations and Future Work

7.1 Conclusion

Developing the mobile application was fun and challenging but the end product is something to be loved. The application though developed under limited resources was able to meet its goals and can be used in the field to better the society.

The application when used will simplify the process of handling cases selections among investigators by providing them with detailed and accurate descriptions they want to do and also recommend those that may be of interest to the public service. It will make the process of data search about criminals less stressing and will create an easy time deciding what to do as they will have detailed and accurate information to make a choice.

7.2 Recommendations

For this application the scope was limited to cases of suspects who are already with the police and are looking forward to be decided upon. This scope can be expanded to ensure the application is used for all type of criminal offences, so as to centralize and put in one place digital database with this vital information. The system also provides a central point for study of how criminal offences are handled.

7.3 Future Work

Despite all the solutions provided in this research, there is room for future improvement. This can be achieved because the technology is constantly changing and more technological tools. The features below can be incorporated into the next version of the application;

i) The use of artificial intelligence that would process the collected data and automatically match a criminal to past crimes

ii) Developing a decision support system that would help the appropriate authorities to make an appropriate decision to support the investigation of criminal activities in the future.

iii) Developing iOS Mobile version of the application to target users using the operating system.

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Appendices A: General Questionnaire

The purpose of this questionnaire is to collect information on an application for fast tracking investigation of criminal activities and complaints Filed in Kenya

1. Gender

   Male □ Female □
2. Age ……
3. Occupation…….
4. Do you believe in the effectiveness of the applications?

   Yes □ no □
5. Have you ever heard about applications for tracking investigation of criminal investigations and complaints?

   …….
6. Which application do you thing is the best?

   …….

   …….
7. How do you see the future of applications for tracking crimes and complaints in the next four years?

   …….

   …….
8. What are the greatest challenges in the implementation of application for tracking crimes and complaints?

   …….

   …….
9. What are your recommendations for improvement of application in future?

   ……..

   ……..

NB/ - The information is for academic purposes only

Appendices B: Police/Investigators Questionnaire

(Please tick □ tick one box)

Section 1: Personal Information

1. Are you a male or a female?

Male □ Female □

2. Which category below includes your age?

□21-29

□30-38

□40-49

□50-59

□60 or older

3. Select your constituency

□Makadara □Embakasi

□Westlands □ Kasarani

□Ruaraka □Kibra

4. Marital status

Married□ Single□ Windowed□

Section 2: Device

5. Do you own any mobile device?

Yes □ No □

6. What operating system does your mobile use?

□Windows □Android □ iPhone (IOS) □Blackberry □ Palm phone □ others

Section 2: Opinion

7. Do you think unresolved crimes and complaints are increasing?

□Strongly Agree

□Agree

□Disagree

□Strongly Disagree

□ Neither Agree nor Disagree

8. Fast tracking crimes is as important as enforcing the law?

□Strongly Agree

□Agree

□Strongly Disagree

□Disagree

□ Neither Agree nor Disagree

9. Would you embrace a mobile app solution for fast tracking criminal activities and complaints launched?

□Strongly Agree

□ Agree

□Strongly Disagree

□Disagree

□Neither Agree nor Disagree

10. What time of the day would you especially favor the usage of a mobile application?

Night □ Day □

NB/ - The information is for academic purposes only

Appendices C: Citizens Questionnaire

(Please tick □ tick one box)

Section 1: Personal Information

1. Are you a male or a female?

Male □ Female □

2. Which category below includes your age?

□18-20

□21-29

□30-38

□40-49

□50-59

□60 or older

3. Select your constituency

□Makadara □ Embakasi

□Westlands □ Kasarani

□Ruaraka □Kibra

4. Marital status

Married□ Single□

Windowed

Section 2: Device

5. Do you own any mobile device?

Yes□ No □

6. How often do you use your mobile phone?

Never □ Rarely □ Sometimes□ Often□ Always□

7. What operating system does your mobile use?

□Windows □Android □iPhone (IOS) □ Blackberry □ others

Section 3: Opinion

8. Have you been a victim of a crime?

Yes □ No □

9. If yes, did you report the crime?

Yes □ No□

10. Was the crime solved quickly?

Yes □ No □

□Do not know

□Cannot remember

11. If yes, to what extent did you find the response helpful?

□Very helpful

□Helpful

□Not much help

□No help

12. Have you ever received a significant update on the progress of your case?

□ Yes

□ No

□Do not know

□Cannot remember

13. If yes, to what extent did you find this further significant development helpful?

□Very satisfied

□Satisfied

□Dissatisfied

□Very Dissatisfied

14. What challenges did you experience during following up a crime or a complaint?

……
……

15. What technology mean do you think would be faster and efficient for fast tracking criminal activities?

…….

16. Would you embrace a mobile app solution for fast tracking crimes and complaints?

□Strongly Agree

□ Agree

□ Disagree

□Strongly Disagree

□Neither Agree nor Disagree

NB/ - The information is for academic purposes only

Appendices D: Mobile Application Screenshots

a) Login and Registration Interface

This is the interface that allows users to register and be able to get access to the mobile application based on their credentials. During the Registration process the Interface allows users to state their functionality i.e. Citizen, Police, Verifier and Admin.

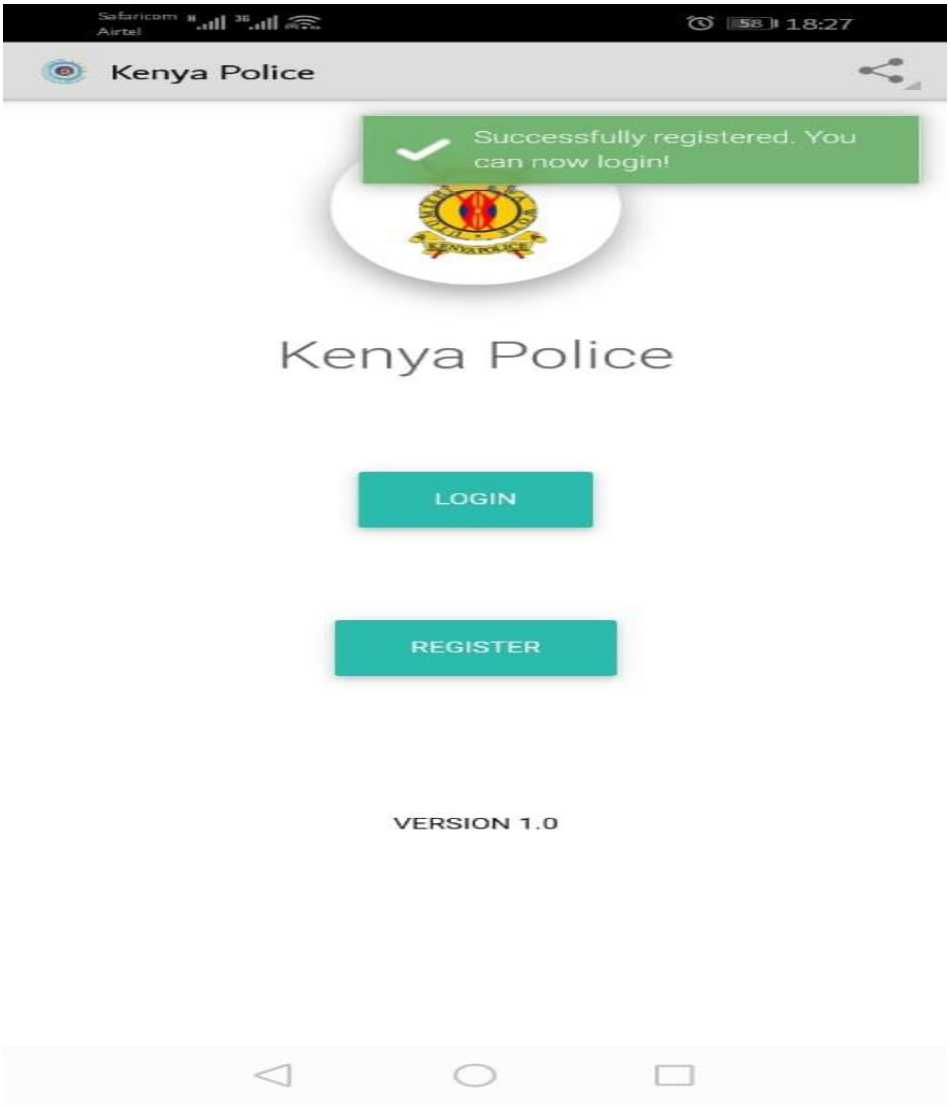

Figure 7.1 Login and Registration Interface

b) Home page Interface

This is the main landing page after a user login. It displays components based on whoever is logged in. For the Citizens it as displayed in Figure7.2 whereas for Verifier and police is different but is based on their roles in the application.

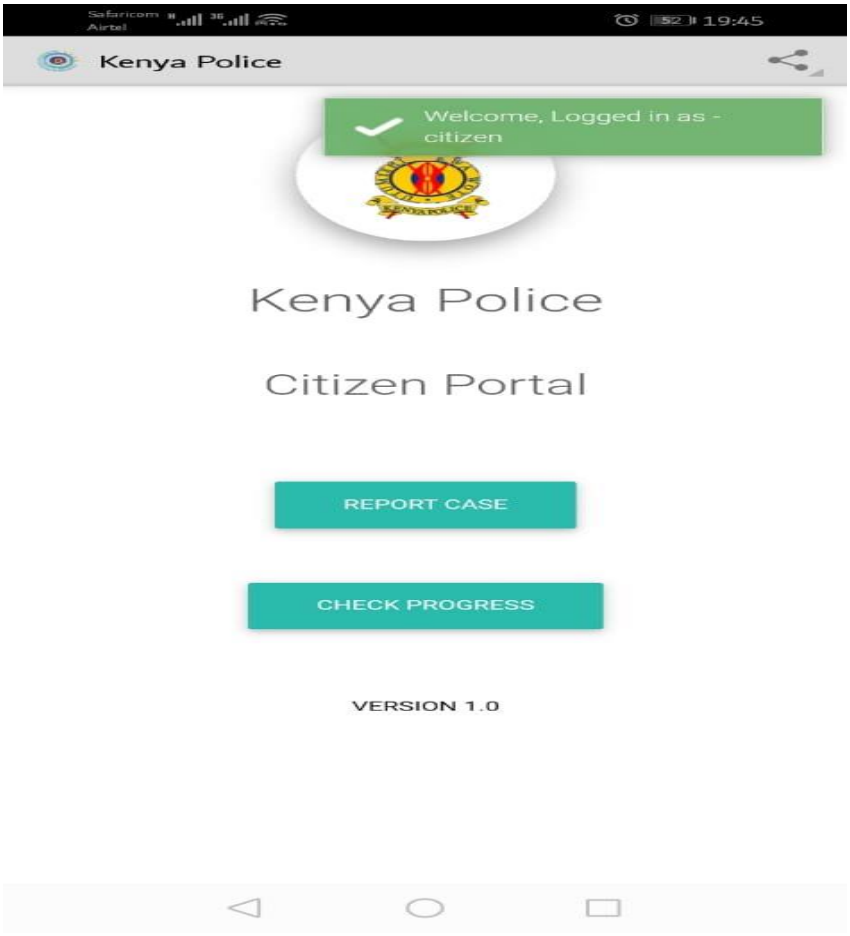

Figure 7.2 Homepage Screen

c) File new case Interface

This is the interface that allows users to register new case and submit the case.

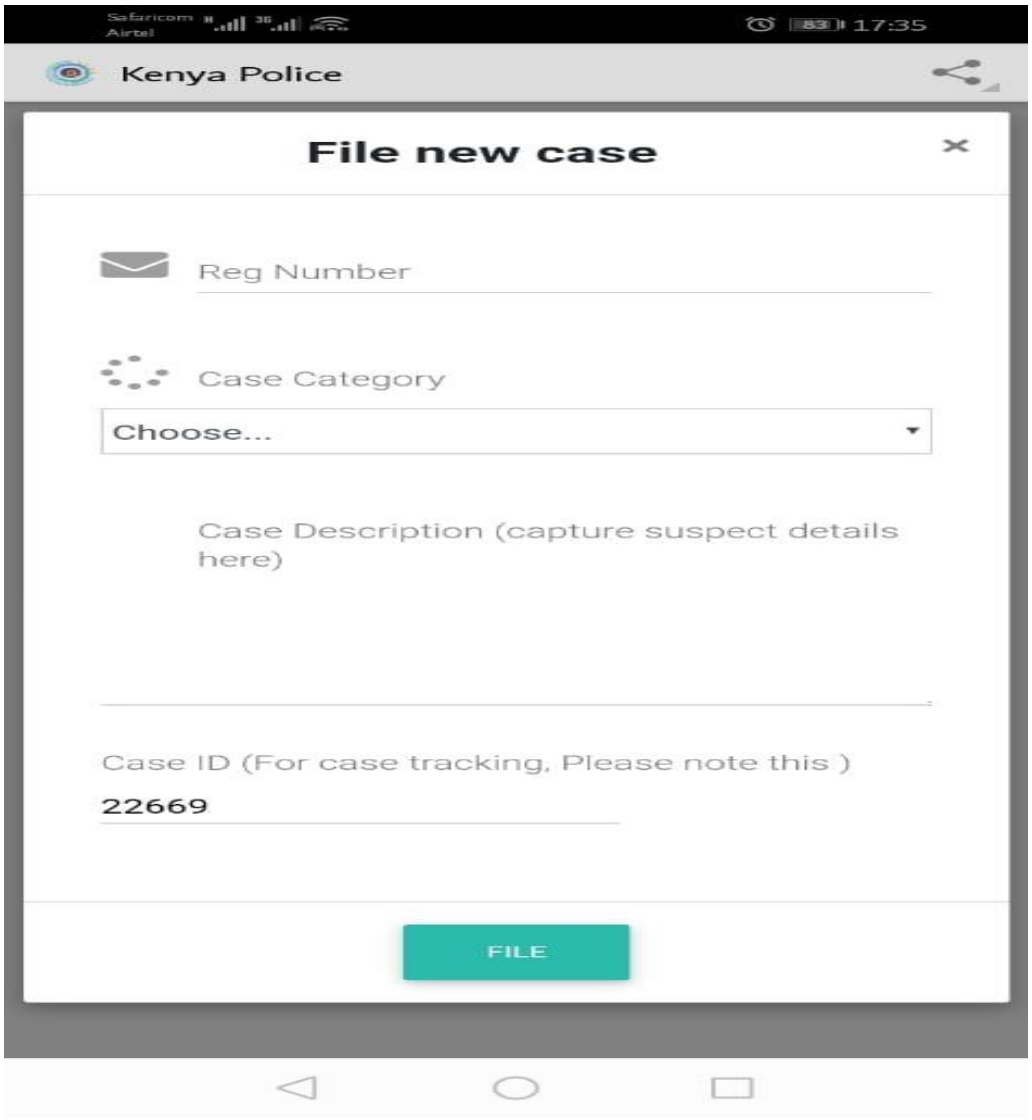

Figure 7.3 Register Case

d) Search Case Interface

This is the interface that allows users to search a case and be able to view the case progress basically by entering the Case ID and be able to get a feedback on the status of the case.

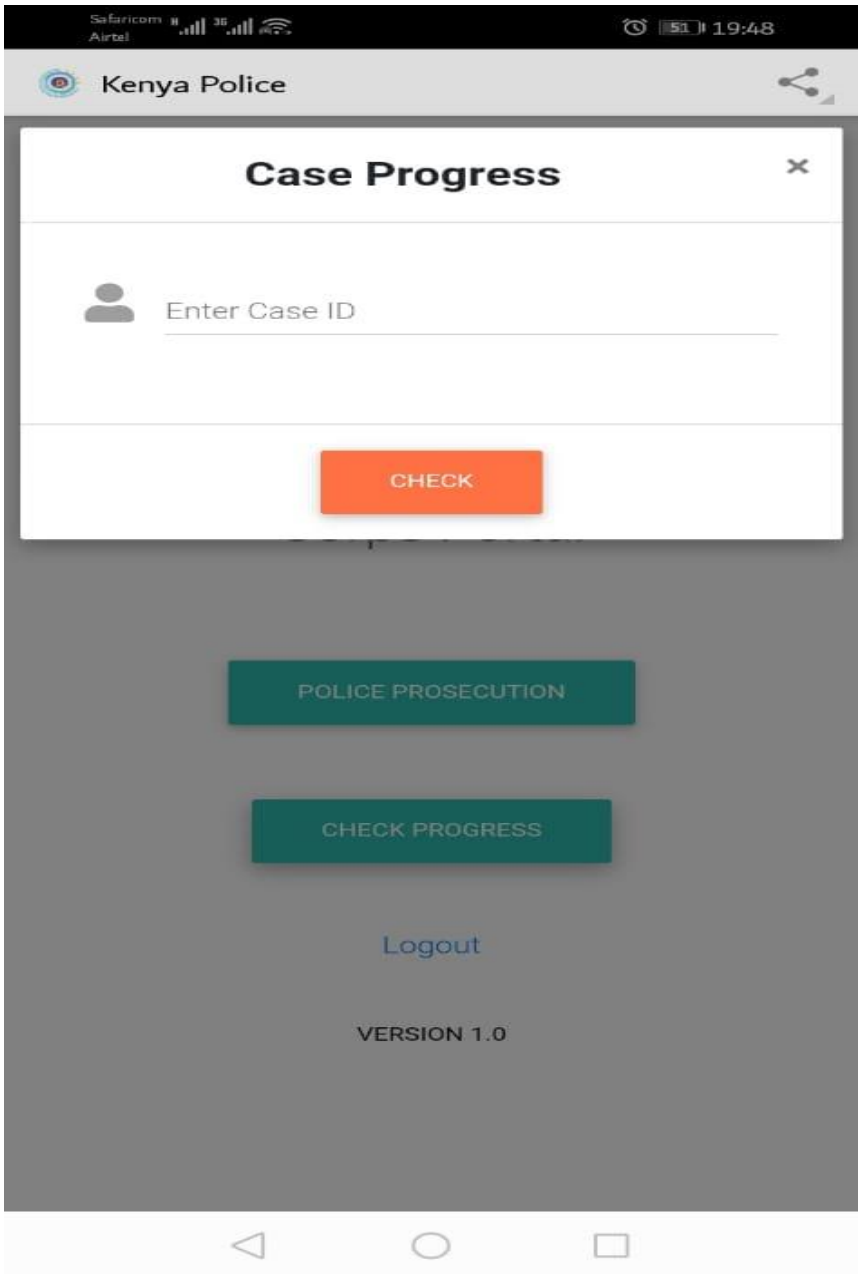

Figure 7.4 Search Case

e) Save Verdict Interface

This is the interface that allows the user to save the verdict based on the outcome

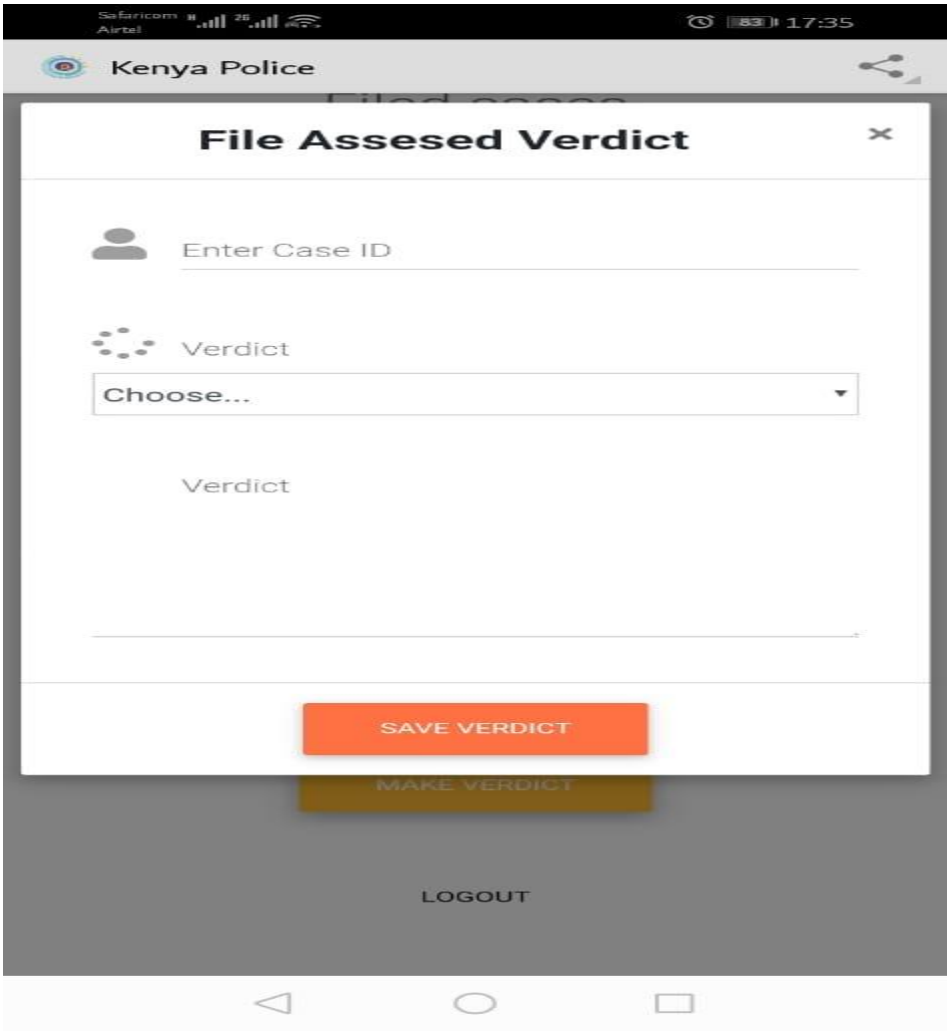

Figure 7.5 save Verdict Screen