

THE UNIVERSITY OF NAIROBI



College of Biological and Physical Sciences

School of Computing and Informatics

USING A MOBILE BASED COMMUNICATION SYSTEM TO FIND MISSING PEOPLE

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Project report submitted to the School of Computing and Informatics in partial fulfilment of the requirements for the award of the degree of Masters of Science in
Distributed Computing Technology

Declaration

I hereby declare that this research report is entirely my own work and has not been submitted for assessment at this or any other university

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Signature

Date

This report has been submitted for examination with my approval as University Supervisor

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Signature

Date

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Abstract

Being out of touch with a loved one is concerning in itself, but during times of political dysfunction, violence, and natural disasters, not hearing from someone you care about is terrifying. People go missing from their families and friends for various reasons. One of the prominent reasons is natural disasters of high intensity. Other reasons why one can be missing are abduction, psychological problems and criminal offences.

The aim of this report therefore was to investigate weaknesses in the current system of searching for missing people in Kenya, with the interest to offer a more significant solution. A study was conducted on humanitarian organizations and members of the public on their experience and take on the current manual system. An investigation of the most common methods used for searching missing people was done and the results amazingly prove that in as much as technology keeps improving in Kenya and other parts of the world, more needs to be done in regards to applying this technology to solve our own problems. With the use of technology, the solutions to our problems are within our power and reach.

The results indicate that most of the respondents do not have much confidence in the current method of searching for missing people. From the results, we can see that the current system is not efficient enough, because most of the people reported as missing are either found after a long period of search or not found at all. The report concludes that we need to leverage on technology to devise a more efficient method of finding missing persons more easily and faster. It is recommended that a mobile application for finding missing persons should be developed, since most of the population in the modern world has access to both mobile devices and the internet.

After the development and evaluation of the mobile application for searching for the missing people, it's evident that this method will significantly improve and enhance the process of reuniting missing people with their friends and family. An F1 Score test was conducted on the use of the system and attained a 0.72 mark which is quite impressive in this dynamic domain of application.

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List of Abbreviations

NDOC- National Disaster Operation Centre

ECS - Emergency communication system

UN - United Nations

MPCI - Missing Persons Community of Interest

ICRC - International Committee of the Red Cross

MSC - Master of Science

UVIS - Unified Victim Identification System

SMS - Short Message Service

API - Application Programming Interface

CHAPTER ONE : INTRODUCTION

1.1 Background

Reports of missing persons worldwide have increased significantly in the past recent years, from roughly 450,000 in 1990 to about 10,000,000 this year. The increase was driven in part by the ever growing population. The numbers indicate that more people are becoming victims each day. An astounding 2,300 Americans are reported missing every day, including both adults and children. Kenya on the other hand has at least 20,000 missing people on record every year. Out of the reported number,40% are located after a long period of search while 30% are left untraced. Only 30% of the reported victims are found within a reasonably short period of up to 3 months.

1.2 Problem statement

There has been concern about the alarming number of cases of missing people that end up not being identified. This study undertook to investigate the current process of searching for the missing people, to identify its weaknesses and device a more efficient method of ensuring more recovery of missing people within the shortest time possible. More recently, the abductions of children and adults have reawakened public concern about missing people. In most parts of the world, the police and nongovernmental organisations dealing with missing people have recently reviewed their policies and are planning to improve coordination of their work (Compass Partnership, 2000).

According to Nina and Fiona (2003), people end up missing in different scenarios. The circumstances that may lead adults or children to become missing people are often complex and multilayered. The missing phenomenon is best understood as a continuum in which a break in contact may be either intentional or unintentional. Some people make a conscious decision to leave, albeit often not in circumstances of their own choosing, while others may drift apart from family members over time. Some may never have intended to be missing, and indeed may not conceptualise their experience in these terms, while others may be forced apart through the actions of others. Some of the causes entailed herein are natural disasters, psychological complications, abduction and domestic conflicts.

Authorities and researchers may be overlooking common details that seem to tell a bizarre story about missing persons. When the facts are reviewed over longer periods of time - the results are rather unsettling. David Paulides (2014) presents a running mystery with obvious overlapping clues. The idea is made in a rapid-fire unfolding of details in case-after-case that perhaps authorities are overlooking the common threads tying it all together.

Most missing person cases get a lot of media attention quickly as usually hundreds of volunteers and trained searchers from multiple agencies make the attempt at locating the individual. But after a predictable number of days, based sometimes on their location and age, searchers abandon the case and assume the victim cannot have survived and is dead.

However, some missing people do not wish to be found. These can be people who have committed a crime or someone who owes a lot of money to someone and either cannot pay it back or do not want to pay it back. Men and women who are in an abusive relationship escape the marriage and go into hiding. These people can be helped by the Police and the Police will give a report to their family members to say that they are safe and well but do not wish to be located.

1.3 Research objectives

The following research objectives were core in the process of conducting this research.

- To develop a mobile based emergency communication system which will enhance searching for missing persons.
- To investigate the major reasons that render people missing, with the quest to provide a viable technology based solution to each one of them.
- To measure the effectiveness of the current manual system in comparison with a mobile technology based system

1.4 Research Limitations

As much as it would have been more prudent to collect information from other parts of the world, it was not possible for this research because of a number of constraints. Among the challenges was lack of enough funds to meet the necessary expenses. Visiting another country for research would mean more expenses in travel, food, accommodation and other charges.

Another challenge was jurisdiction conflicts, because different world authorities have different approaches to research. The study of missing persons is particularly a contentious issue because it inevitably touches on human privacy, which most authorities have a keen guard on. Various researchers have raised a number of issues surrounding this matter. Several recent natural disasters have illustrated the need for humanitarian groups, volunteers and policymakers to understand privacy issues when searching for missing persons in the aftermath of these crises.

CHAPTER TWO : LITERATURE REVIEW

2.1 Theoretical review

Research concerning missing persons has been done in the past. A few of the research efforts have been successfully implemented while others did not see the light of the day for a number of reasons. These past researches can enable us to develop a lens through which to view the phenomenon under study.

2.1.1 The International Committee of the Red Cross (ICRC) Central Tracing Agency

Advances in technology have had a major impact on tracing, mainly by speeding up the transmission of information to huge numbers of people, according to the International Committee of the Red Cross (ICRC) Central Tracing Agency. The ICRC started tracing in the late 1800s to alert families to the whereabouts and well-being of detained relatives. It currently relays hundreds of thousands of messages linking families back together and providing the peace of mind and closure so often absent in times of crises. In 2009 alone, more than 253,000 messages were collected and delivered. Tracing assisted the repatriation of Congolese prisoners of war, and enabled nearly 200 video calls between detainees and their families in Afghanistan.

Within two weeks of the earthquake that struck Haiti in January 2010, more than 26,000 missing people were located using the ICRC's Family Links website where people can search for missing people, and submit knowledge on the whereabouts of survivors.

Since 2009, more than 83,000 names of people wishing to contact relatives or people with clues about missing relatives have been entered into the data system. "It enables people to communicate with one another and strives to reunite separated family members to locate missing relatives and to recover and identify human remains," according to the ICRC 2009 Annual Report. The website is currently up and running to find missing people from the tsunami that hit Japan following the 11 March earthquake.

2.1.2 Google person finder

Following Haiti's earthquake in January 2010, Google developed an open source web application Person Finder, which is a registry and message board for survivors, family and friends to post and search for information about one another's whereabouts following a natural disaster. Up until now, following five natural disasters, the registry has collected more than 200,000 names.

2.1.3 San Fransisco 311 Customer Service Centre

In his report entitled 'Post-Disaster Missing Persons Process: San Fransisco 311 Customer Service Centre', Millman (2013) highlighted that in the event of a natural or manmade disaster in San Francisco, the City and County of San Francisco would expect an extraordinarily high call volume from people reporting missing persons. The residents, businesses, and visitors whom 311 serves would contact the Office of the Chief Medical Examiner(OCME) ,the police department, or local hospitals. These calls would detract from the capacity of these crucial organizations to focus their resources on responding to the disaster. The call volume required personnel to divert resources from other primary tasks.

This is clear proof that the development of a robust mobile based emergency communication system that is open to the public would be an ideal way to obtain more capacity for rescue and locating missions by involving the public.

2.1.4 The Dutch Cell Broadcast

The Dutch government has also adopted a mobile phone danger alert system that sends text messages to people who could be affected by natural disasters or terrorist attacks. The system, called Cell Broadcast, uses GSM technology to identify cell phone users in a particular area. If a disaster occurs, a message is sent to all phones in the area, warning of the danger.

CNN's reporter, Clothier (2005) reported that the Cell Broadcast system will be used in addition to the other warning systems which are currently used if disaster strikes, such as sirens and special emergency broadcasts on radio and television. This is a more instantaneous way of informing people about what is going on real time. It's an extra medium to communicate directly with people during a disaster.

2.1.5 Sri Lanka's Early Warning System

The 2004 Indian Ocean tsunami that claimed the lives of one in 500 of Sri Lanka's people and displaced one in twenty has highlighted the critical importance of an effective National Early Warning System for Sri Lanka (NEWS:SL). Meeting this need, which has been discussed (and forgotten) after each of their too frequent disasters such as the cyclones of 1978 and the floods of 2003, can no longer be postponed.

In their concept paper, Rohan and Malathy (2005) emphasize on recognizing that effective warning is just one of the critical parts of a comprehensive risk management system that includes mitigation, preparedness, response and recovery. Their concept paper focuses on the warning component.

They demonstrated the process of risk management and how a timely warning can save lives and property as shown in figure 1 below.

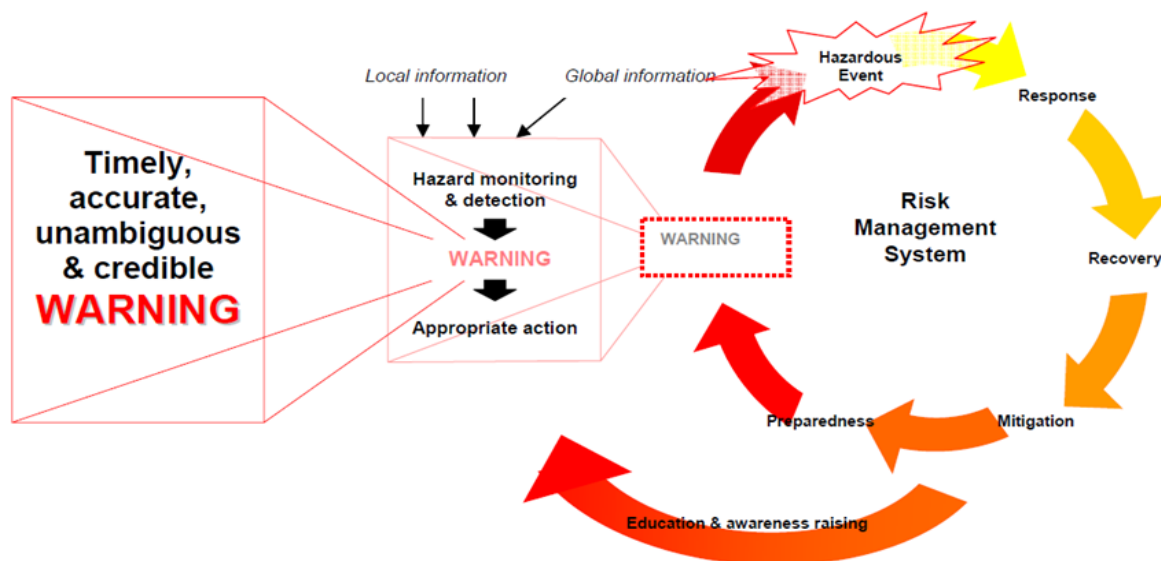


Figure 1 - A warning system providing disaster alerts

2.1.6 The UK Charity Missing People

Similarly, the UK Charity Missing People provides real time information of people reported as missing held in their database via a clickable map of the UK regions. The map allows the public to see who is missing from where, provide information on the number of annual helpline calls received from each region and invites the public to join the search. This provides a useful but partial view, as it only includes those known to the charity and reported via family and kinship networks.

2.1.7 Los Angeles Emergency Preparedness Foundation

In 2005, Hurricane Katrina demonstrated the importance of a coordinated and government-led missing persons protocol. Brent Woodworth, the then President of the Los Angeles Emergency Preparedness Foundation, explained that the ad-hoc creation of several missing persons systems created confusion and compromised public safety. While the systems “meant well,” they “didn’t talk to one another,” they were “highly inaccurate,” they “did not collect the right data” and “there was no privacy.”

2.1.8 The Boston Mayor’s 24 Hour Constituent Service

The recent experience from the 2013 Boston Marathon bombings demonstrates why effectively managing these problems is a vital component of the overall emergency management strategy. The Mayor’s 24 Hour Constituent Service¹⁴ was expecting to receive around 80 calls the day of the marathon. Instead, they received 8,600 calls in 24 hours. This 1,000 percent increase led to the creation of 2,400 records in the makeshift Google Doc they created. Those 8,600 calls led to

only 28 matches of missing people. When calling in to the service, many people experienced delays or busy signals for 10 to 20 minutes before they were able to speak to an operator.

Hastily constituted systems often do not take measures to protect information. Poorly coordinated systems create inefficiencies; families and friends need to report missing persons to several organizations. Worried friends and relatives also make multiple reports for the same missing person, necessitating a system's ability to easily identify duplicate entries.

Most people are sceptical of government systems that collect identifying information. For example, many people living in California are undocumented residents. Some may not feel comfortable sharing their information with a government organization, even in the aftermath of a disaster. Even if the purpose of the information collection seems clear, the public must perceive government's use of their information to be in accordance with its purpose. They must also believe that their privacy will be protected.

2.1.9 The Unified Victim Identification System (UVIS)

The Unified Victim Identification System (UVIS) is a comprehensive disaster management system that manages and coordinates activities related to missing persons reporting and victim identification after a disaster. Following September 11, New York City officials decided that they needed a way to efficiently collect missing persons reports and share information between emergency responders and investigators following a mass casualty incident. In the days after September 11, New York City collected approximately 40,000 missing person reports on paper. It took hundreds of detectives months to track down leads on missing persons and two years to identify the remains of decedents.

In response to the problems encountered after September 11, the New York City OCME secured grant funding from the Department of Homeland Security and contracted with Connecticut-based consulting firm ICRA Sapphire Inc. to develop UVIS. Because the development of UVIS was federally funded, New York City OCME licenses UVIS free of charge to government agencies throughout the country.

In New York City, UVIS enables a centralized communications and data collection system to connect New York City's 311 Call Centre, OCME, New York Police Department, and other agencies throughout the city, in order to develop an accurate manifest of potential victims following a disaster.

By creating a single report for each missing person, UVIS builds a centralized manifest of potential victims, accessible to all agencies involved in the victim identification process. This centralized manifest provides for multiple reports of the same missing person to be consolidated and refined as law enforcement and medical examiner personnel and others gather and analyze data.

When there is no central system where all information can be collected, disseminated and analyzed, it raises some significant concerns. There is no process in place to integrate these various lists. Each database is technologically distinct and it is unclear how or how much information would be shared across organizations. This makes it impossible to quickly know with certainty who is missing, who has been found, or who is deceased.

2.1.10 The Commons Lab and the Fordham Centre on Law and Information Policy (CLIP)

The Commons Lab and the Fordham Centre on Law and Information Policy (CLIP) at Fordham Law School have teamed up on a new report looking at these legal and policy issues. The report, “Privacy and Missing Persons after Natural Disasters,” offers a roadmap to the legal and policy issues surrounding privacy of missing persons in different jurisdictions.

It provides strategies that humanitarian organizations, private sector organizations, volunteers and policymakers can pursue to help those affected by major natural disasters. For example, the report recommends that governments should exercise existing legal authority to support appropriate sharing of personal information about missing persons following natural disasters.

More broadly, the report recommends that those developing technologies to share information about missing persons implement design principles that carefully balance privacy consistent with existing legal obligations. The report also calls on privacy policy makers, legislators, and regulators to take steps to clarify how privacy rules apply to missing persons activities in identified key areas so that missing persons activities can proceed without the threat of legal liability.

2.2 Conceptual framework

However, there is need to record more success in such applications because only a small portion of victims have benefited so far. It can be a highly considered opinion to suggest that an emergency communication system, because of its nature, needs to be easily and readily accessible. Statistics shows that not as many people access internet through computers as they do through mobile phones. More people now own mobile phones and can gain access to such applications on the internet more easily via the mobile phones. Therefore a more viable and useful approach to it would be the development of a mobile application, that gives both the victims and their family members a chance to communicate and reunite. This is likely to tremendously increase usage and subsequently success. The following model as illustrated in figure 2 enables more people to access such a supportive system with ease and convenience, given that mobile and internet access has increased rapidly in the modern world.

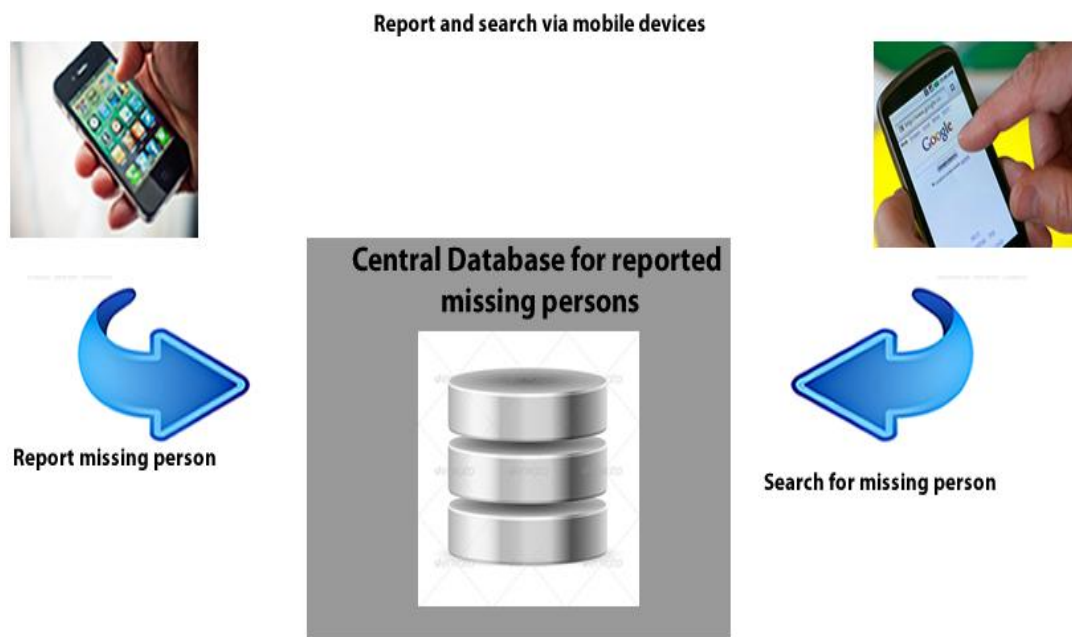


Figure 2 - A conceptual framework of the ideal solution to find missing using a mobile device.

CHAPTER THREE : METHODOLOGY

3.1 Research design

The research study was to a larger extent exploratory. This was influenced by the kind of research questions that needed to be addressed. In an attempt to understand what processes are involved in the search missions, the research explored new constructive ways of solving the problem. There was also an aspect of descriptive research, since the study sought to describe the state of the current processes and their effectiveness.

This was also an applied kind of research, intended to increase understanding of the nature of the problem as well as to enable the stakeholders to control the problem. It pursues potential solutions to disaster desperation, being a human and societal problem in the entire world.

The research also entailed both qualitative and quantitative aspects. This was well determined by the data collection and analysis methods, including interviews and questionnaires. To satisfy the analytical objectives, it required qualitative aspect to describe relationships and variations. The qualitative element complimented the research for its richness in detailed description. This consequently enhanced more understanding of the problem at hand. On the other hand, it took the quantitative aspect to describe population characteristics and quantify variations.

The questionnaire used Google forms and spreadsheets to assess and analyse the responses. This is because the tool has the capability to organize and visualize the responses easily in various ways e.g. plotting the necessary comparative graphs. The questionnaires were filled for a period of 2 months. No personal information was collected, as the survey was voluntary and anonymous.

3.2 Population

The target population on whom the research will be done includes specialised departments such as the National Disaster Operation Centre (NDOC), the Police, the Department of Defence, the National Youth Service (NYS), local Fire Brigades, St John's Ambulance Service, Kenya Red Cross Society, Occupational Health and Safety Services, Kenya Wildlife Services and the National Environment Management Agency (NEMA). This is because they undertake pro-active and responsive disaster-related activities, including Environmental Impact Assessments and Audits, search and rescue, first aid services and evacuation, anti-terrorism surveillance, law enforcement and crowd control, peace building, conflict resolution operations and fire fighting. Therefore they are better placed in providing relevant information as regards to the research.

3.3 Sampling

The research took a non-probabilistic sampling approach. This was to allow mostly the specialized organizations to provide information that is more credible and relevant to the research. A purposive sample worked best for that matter. Some representatives from the aforementioned humanitarian organizations were sampled to serve this purpose.

Trochim (2006) emphasizes that purposive sampling can be very useful for situations where one needs to reach a targeted sample quickly and where sampling for proportionality is not the primary concern. Reliability may not be measured in non-probability sampling. Despite these drawbacks, non-probability sampling methods can be useful when descriptive comments about the sample itself are desired. Secondly, they are quick, inexpensive and convenient. This being an applied social research, it is unfeasible or impractical to conduct probability sampling. Statistics Canada uses probability sampling for almost all of its surveys, but uses non-probability sampling for questionnaire testing and some preliminary studies during the development stage of a survey. A sample size of 45 respondents was used for this study.

3.4 Data collection techniques

3.4.1 Interviews

Face-to-face interviews were preferable for their distinct advantage of enabling us to establish rapport with the respondents and their cooperation. It also enabled us to seek clarity on ambiguous answers. Five respondents were interviewed and they gave a detailed and comprehensive view on the situation surrounding missing people and the outcomes of their search experience.

3.4.2 Questionnaires

In the administration of questionnaires, we were able to obtain more information from respondents we could not be able to reach physically. The respondents were also able to fill the questionnaires at their own convenient time, hence increasing the likelihood of providing accurate information. Most people provide best results when they work at ease.

Online questionnaires were used in this case because of their convenience, affordability and ease of use. A total of 40 respondents received the questionnaires. As a result of the limits of using questionnaires, some respondents may provide limited responses while some questionnaires may not be filled. In order to overcome this challenge, the questions were kept simple and clear. We also kept constant contact with the respondents to increasing chances of filling in the questionnaires in good time.

3.5 Research questions results

There was 75% response rate to the questionnaire. A breakdown of the responses is provided in this report. It can be clearly seen from the results that most people have been involved in searching for a missing person either directly or indirectly. Direct involvement has to do with searching for a person who is closely related or well known to you, while indirect involvement applies when the missing person is transitively related to you.

Various research questions were responded to as stipulated below:

3.5.1 Methods of search

On the issue of the most common search methods used, a larger section of the respondents selected print media, electronic media(TV and radio) as well as the police as the most widely used. The modern digital technologies like mobile and web applications however received relatively fewer responses as indicated in the bar graph as shown in figure 3 below:

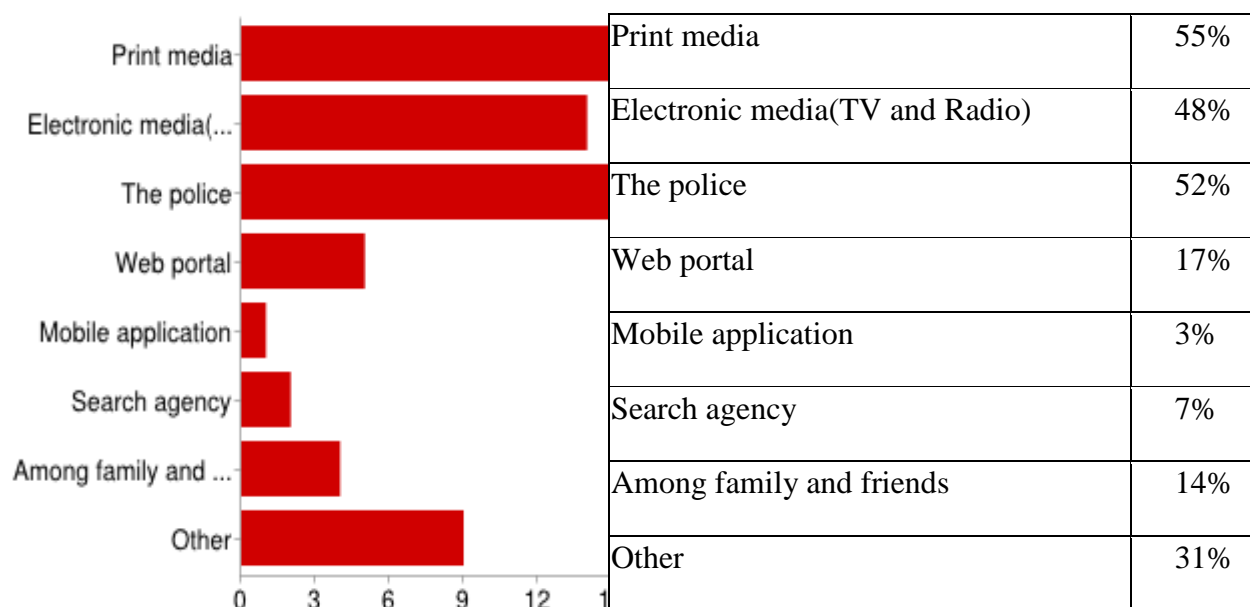


Figure 3 - A bar graph and percentage table representing various methods of searching

3.5.2 Reasons why people go missing

The research undertook to investigate the major reasons why people get missing. Among the provided options, abduction, criminal offenses and natural disasters got the highest responses as being the main reasons. Figure 4 illustrates the causes already mentioned above.

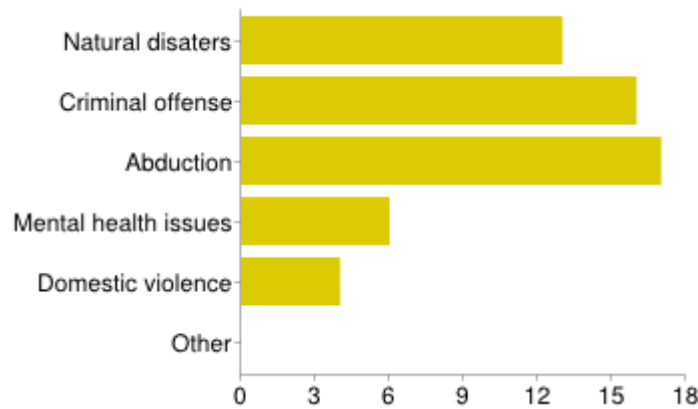


Figure 4 - A bar graph representing various reasons why people end up missing

3.5.3 Period of search

The respondents were provided with a range of periods, within which they think most of the search missions take place. The general analysis portrays that most searches take a long time, some up to 2 years. A significant number of reported cases also remains untraced at all. Figure 5 is a pair of pie chart and table that indicate the periods of time taken by different people to find their missing loved ones.

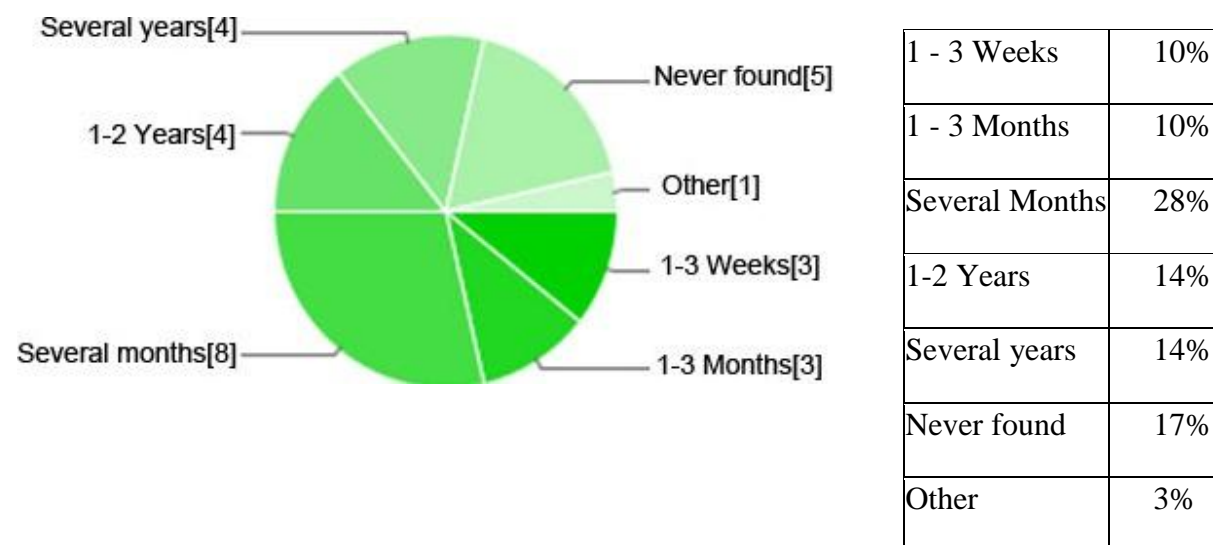


Figure 5 - A pie chart and percentage table representing different periods of search

3.5.4 Missing people statistics

The questionnaire was designed in a flexible manner enough to give the participants a chance to respond based on their actual surrounding or environment. This flexibility drew variations in terms of the actual numbers reported. However, there seems to be a common trend in all the responses regarding statistics of the missing people as reported by participants from various backgrounds. The numbers show that 60% of all the reported missing people were of the female gender while 40% was male. In terms of age, 70% were minors of 18 years and below, 10% were adults of between 19 and 44 years while 20% entails people with 45 years and above. The bar chart in figure 6 below illustrates the statistics by age.

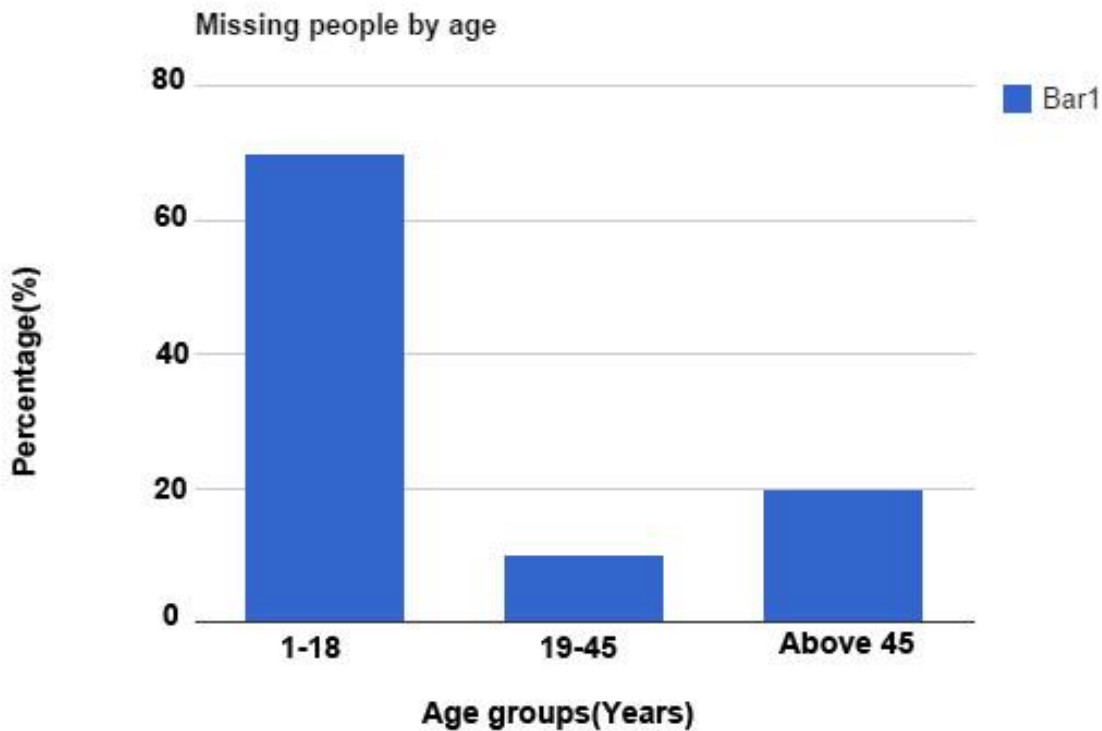


Figure 6 - A bar chart representing statistics of different age groups

The participants also had the chance to recommend the methods they think can work better. From the interviews and questionnaires, the participants were able to express their thoughts about the inefficiency of the current system. Some of them were remarkably informed by their past frustrations, having been involved in the search process, and so this was an opportunity for them to express themselves in a manner that can yield more productive results if well considered.

Although in different forms, the majority of the respondents recommended the use of technology based solutions to deal with the situation. They appreciate the penetration of the mobile phone

and internet technology and as such, they would like to see these resources being leveraged on to solve most societal problems.

3.6 Discussion and interpretation of research question results

It can be seen from the results that most of the participants have been involved in searching for missing persons in one way or another. 80% of the participants said that they know of someone missing and have helped in different ways to find the missing person. The findings therefore imply that missing people scenarios have become a common phenomenon in the contemporary society, hence causing several families unnecessary frustrations.

Under the common methods of search used currently, the traditional tactics were rated highest as compared to the modern digital methods. This means the modern technology, particularly mobile phone applications, has not been adopted enough in this area of application. Despite the fact that this kind of technology has become acceptable in the society for other forms of use, it has not been leveraged upon for purposes of ensuring that families and friends are kept together and in touch as it ought to be.

Technology has become more and more a part of people's lives today. From laptops to cell hat are essentially really small computers, it seems everyone is connected. Take a quick glance around next time you're in a public place – you're sure to see people connected to technology. Whether it's a person with a bluetooth in their ear, a cell phone in their hands, or a laptop on their laps, you'll see at least one person connected to the world of technology.

The statistics and demographics show interesting trends. We can tell that the most affected group are minors under the age of 18. More females were also reported to have gone missing compared to the males. This shows that children and women are more vulnerable to such unfortunate incidences.

CHAPTER FOUR : SYSTEM REQUIREMENTS

4.1 System functional requirements

4.1.1 Report missing person

In case a person goes missing, family members, friends or acquaintances should be able to report the case on the system. They should be able to do so by registering the person's details such as name, age, tribe, place of origin and description. This should give an exhaustive description of the missing person to increase chances of the reader spotting and reporting them.

4.1.2 Report found person

A person having been reported as missing, can be reported as found if spotted anywhere. Anyone with the leading information should be able to post them on the system, about the person in question.

Even the missing people can report themselves in case they are able to access the system and in a condition that may allow them to do so. The current location and contact details of the missing person should be provided, as well as those of the person reporting the case. The reporter may need to be contacted for further details.

4.1.3 Search for missing person

Users should be able to search for their missing loved ones on the system. They should be provided with a search criteria to make their search easier and relevant e.g name of missing person, tribe, age and gender.

They should then be able to see feeds or updates about the missing person they reported. There may be multiple entries about a single missing person, reported by different people at different times. All these updates should appear if they are associated with the missing person, as they may provide quality leading information to finding the missing person.

4.1.4 Send notification alerts

In case there is a match between a missing and a found person the system should be able to send email alerts to those who have reported missing cases and have subscribed to the service. The algorithm used to match involves some major details like names, gender and tribe of the missing person.

4.2 System performance requirements / Non-functional requirements

- Efficiency - The system should be able to perform as expected. Given the necessary input, it should give the expected output.
- Reliability - The system should be available and in good condition whenever it is required. Availability of components and integrity of data must be ensured. The rate of failure should be as low as possible. It should also be consistent.
- Error/Failure Detection and Recovery - Just like any other system, different failure modes and failure consequences are anticipated in this kind of system. To mitigate them in the event that they arise, error logging and reporting will come into play. Manual and automatic recovery procedures will also be applicable at some point.

4.3 System analysis and design

The following diagrammatic representations give an overview of the system analysis.

4.3.1 Flow chart

The flow chart in figure 7 below summarizes the entire system process, from the time a missing case is reported up until the search results and notification alerts.

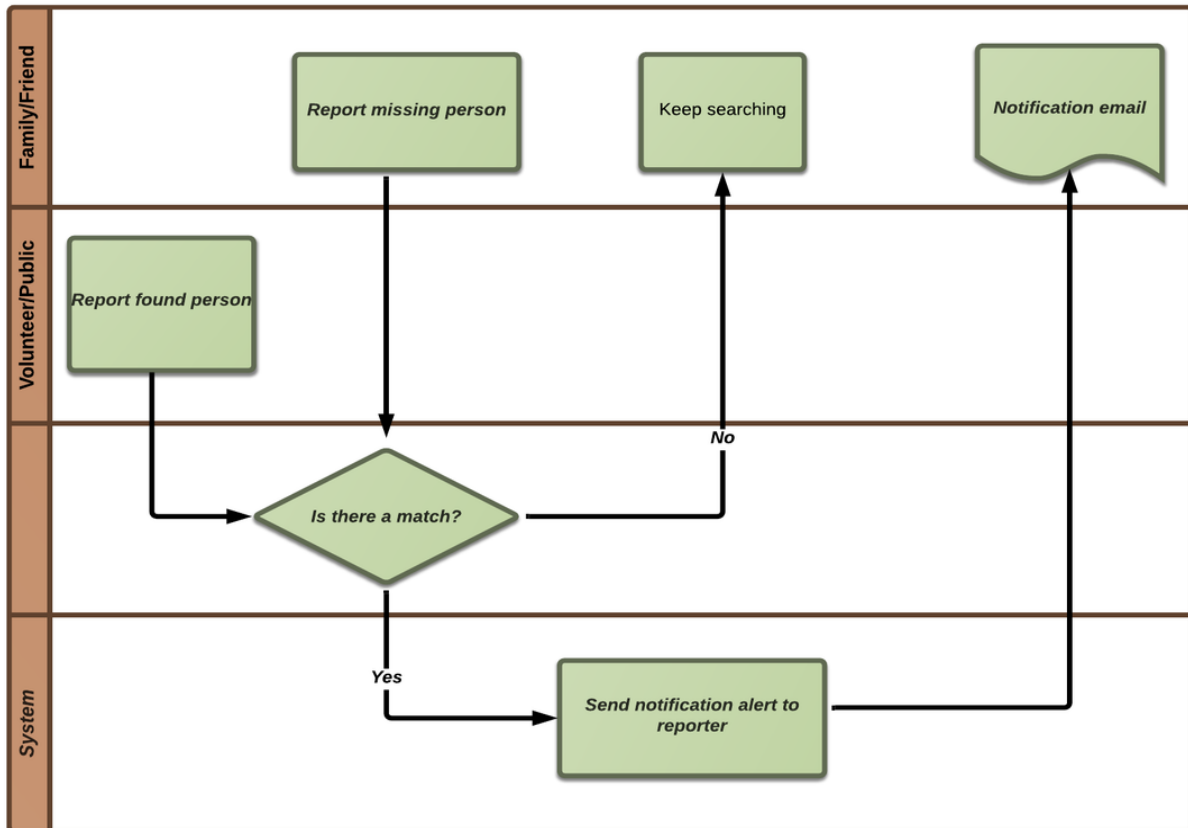


Figure 7 - A flow chart representing the entire process of reporting the missing and found persons

4.3.2 Activity diagram

Figure 8 below shows various activities involved in the system:

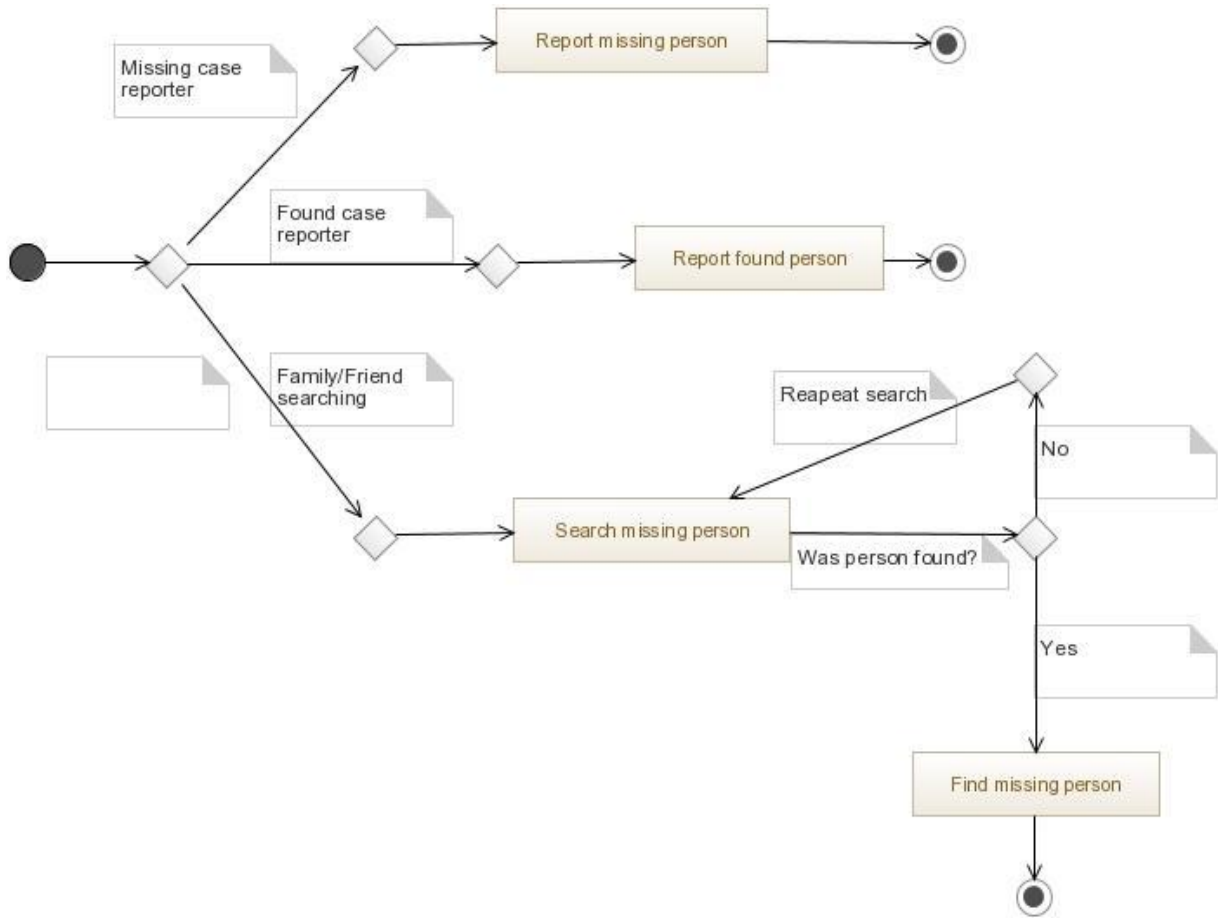


Figure 8 - An activity diagram describing the activity performed by different system entities

4.3.3 Entity Relation Diagram

Figure 9 below is an entity relation diagram that shows all system entities and their interconnection.

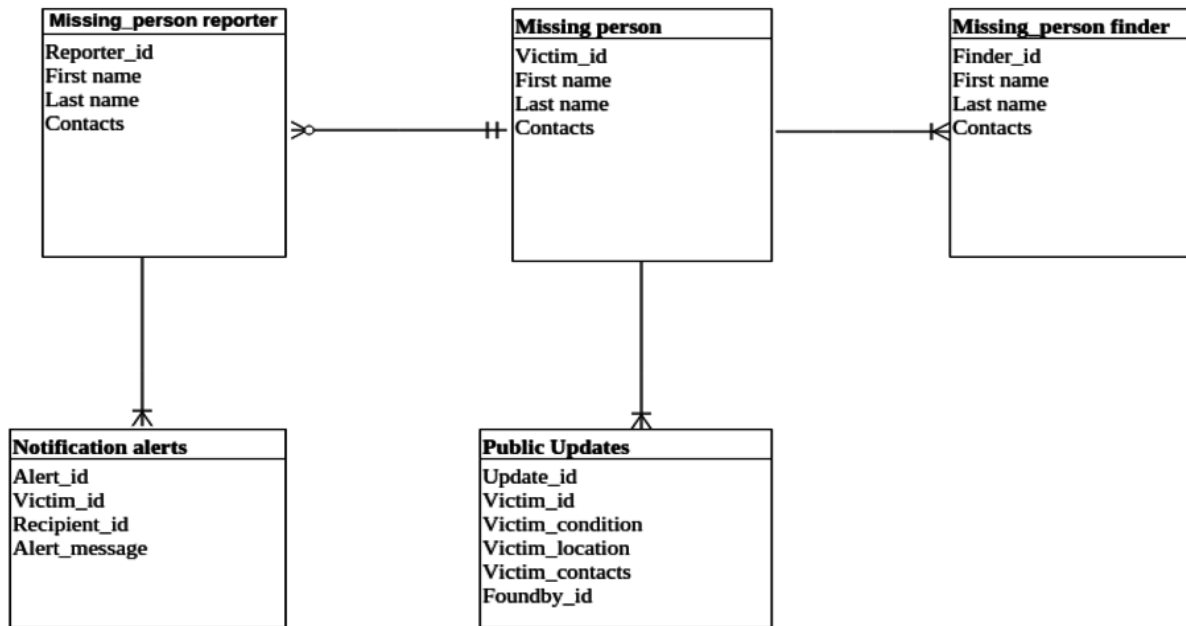


Figure 9 - An Entity Relation Diagram representing the relationship between various system entities

4.3.4 Use case diagram

The system entails a number of use cases which include lost case reporter, found case reporter, lost person, family member, friend and search agency .

The use case diagram in figure 10 below shows the interaction of the system and its stakeholders:

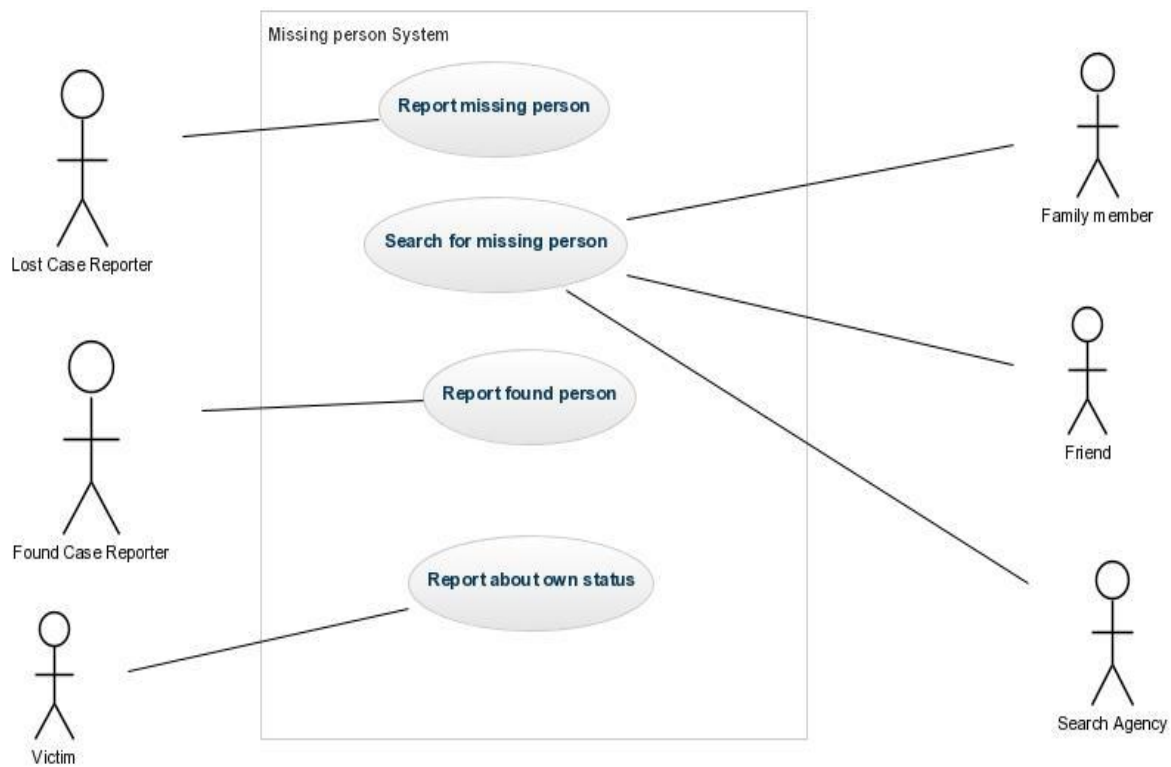


Figure 10 - A use case diagram showing the system use cases and their interactions with the system

4.4 Implementation technology

The system is implemented using the following technologies:

4.4.1 Android Operating System

This is the most popular mobile phone operating system in the world today. Choosing this platform for implementation of the system means more people are likely to have access to it hence making it more useful. The java language is useful at this point.

4.4.2 PHP

Being a server side scripting language, PHP can conveniently be used to process logic of the system and abstract the interaction between the client and the database. These are some of the strengths PHP possesses:

- Open source: It is developed and maintained by a large group of PHP developers, this helps in creating a support community, abundant extension library.
- Speed: It is relatively fast since it uses much system resource.
- It's easy for programmers to pick up and it is very easy to create website scripts.
- Stable: Since it is maintained by many developers, so when bugs are found, it can be quickly fixed.
- Powerful library support: You can easily find functional modules you need such as PDF, Graph etc.
- Built-in database connection modules: You can connect to database easily using PHP, since many websites are data/content driven, so we will use database frequently, this will largely reduce the development time of web applications.
- Can be run on many platforms, including Windows, Linux and Mac, it's easy for users to find hosting service providers.

4.4.3 Mysql Database Management System

MySQL is the most popular Relational Database Management System. The following strengths justify its choice for the system:

- Open Source- It is free and can be used by anyone without any license or permission.
- Easy, Fast and High Performing -This Database is easy to use and it operates very fast. As it is basically a modified version of SQL, a general knowledge of SQL is enough to work efficiently with MySQL
- Cross Platform Supports - It can be installed in all major Operating Systems as UNIX, Solaris, LINUX in addition to Windows without a loss of performance. It also runs without compromise with various development interfaces such as JDBC, ODBC, Pearl, Python, PHP, C++ and many others. This is primarily due to the development APIs that are integrated with it.
- Memory Factor- MySQL prevents memory leaks thus enabling efficient solutions for information storage.
- Data Security -Data security in an utmost necessity. MySQL secures the stored data. This makes this database system safe and reliable as in popular cloud solutions such as Microsoft Azure. An unauthorized access to data is not possible since, it is protected with encrypted database passwords. Special authority and rights are subjected only to authorized entry.

4.4.4 Architecture

The system uses the client-server architecture, the client is an android device and in server side there is a combination of PHP Script and MySQL. In short, PHP Script sits in middle as shown in the figure 11 below:



Figure 11 - A model diagram describing the system architecture in the client and server side ends

4.4.5 JSON(JavaScript Object Notation)

The JSON format is to enhance the communication between android client and the PHP server script. JSON is a lightweight text-based open standard designed for human-readable data interchange.

How JSON will be used in the application.

-When android application executes, it connects to a PHP Script.

-PHP Script will fetch data from the database. It will encode it into json format and send it to the device.

-Now, android application will get these encoded data. It will parse the data and display it on android device.

4.4.6 Input Data

Various data input is required for various functionalities of the system as shown:

To report a missing person, one should be able to enter the following details:

Table 1 - A table of the necessary input fields at the point of reporting a missing person

First name(Required)	Photo	Reporter's name
Last name(Required)	Age	Reporter's email address
Place of origin	Tribe	Reporter's phone number
Place last seen	Gender	
Physical description	Facebook profile	

Reporting a found person:

Table 2 - A table of input data for a found person

First name(Required)	Reporter's email address
Last name(Required)	Reporter's name
Current place spotted	Reporter's phone
Victim current status(eg alive or dead)	
Physical description	

CHAPTER FIVE : SYSTEM TESTING

System testing is necessary to evaluate this system's compliance with the specified requirements. In this regard, this system has been tested under each of the following scenarios:

- **Unit testing** - Each functional module was tested during and after development to ensure that it meets the requirements. Additionally, basic validation has been done to ensure the correct input data on each module.
- **Integration testing** - This testing was done before, during and after integration of all the modules. It therefore checks that the system has the flow required, from the point of reporting lost cases to missing cases and outputting notification alerts.
- **Acceptance testing** - We conducted a beta testing of the system on a sample of users. Some of the users disguised as lost case reporters while others as found case reporters. Wherever there is a match of records, email notifications are sent to the lost case reporters, providing them with the leading information about their missing people. The search function was also included in the test.

Besides, a computation of **F₁ score** test was conducted to measure the system's accuracy. This being a statistical analysis, the **F₁ score** considered both the precision p and the recall r of the test to compute the score. Precision(p) is the number of correct results divided by the number of all returned results while recall(r) is the number of correct results divided by the number of correct results that should have been returned. The F₁ score can be interpreted as a weighted average of the precision and recall, where an F₁ score reaches its best value at 1 and worst score at 0.

After considering 20 search test cases in the system, the following results were yielded:

Total scenarios = 20

Successful searches = 16

Correct searches = 13

Precision = 13/16

Recall = 13/20

$F1 = 2(\text{precision} \times \text{recall} / (\text{precision} + \text{recall}))$

$F1 = 2(0.528125/1.4626)$

$F1 = 0.72$

CHAPTER SIX : SYSTEM EVALUATION RESULTS

After full implementation and testing of the system, evaluation of the prototype was done with the aim to determine if the developed system is delivering the expected results. The following areas were evaluated to provide answers to the research questions set at the feasibility study of the project, which are in line with the project objectives and requirements.

6.1 Determining the success rate in the system search module

To determine this rate, 20 people were reported as missing in the prototype. The success rate was recorded in the database clearly showing matches of people reported as missing and those reported as found. Whenever there is a match, a notification alert is sent to the reporter of the missing person together with the leading information concerning their current whereabouts.

Table 3 - Summary of the evaluation results of finding missing persons

Number of cases reported	Search success	Search failure
20	16	4

The pie chart in figure 12 below also represents the chances of success or failure of the system to capture the correct information and consequently result into a meaningful search.

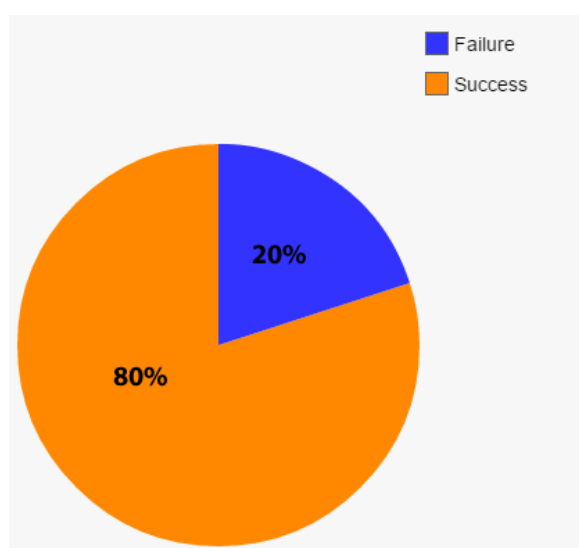


Figure 12 - Chart showing the success rate of finding missing people by using the mobile application

During the tests carried out in evaluation it was determined that reasons why a missing person may not be identified are:-

- The person is not reported as missing in the system.
- The person may be reported with different names and other details from the ones used to search.

6.2 Measuring database access

The measures of efficiency considered were:-

- Successful lost case report
- Successful found case report
- Successful search for reported case
- Success in receiving notification alert emails

Twenty entries were done and data on the above measures was taken and recorded on Mysql server database table. Table 4 below is a summary of the client access efficiency data as analyzed.

Table 4 - Database access success measure

Access Efficiency Measures	Success	Failure
Lost case report	20	0
Found case report	20	0
Search for reported person	16	4
Notification alerts	16	4

6.3 Measuring rate of success in the Identity of missing people

The users suggested that the system should include photos of the missing people to be able to identify them more easily. The use of a photo is significant as some people may recognize the missing person by view of their photo even when they do not have the additional descriptive details like the name.

It was also suggested that the identification details need to be more flexible and exhaustive in order to increase chances of identifying a missing person. For instance, the missing person's age should be a range of numbers rather than an absolute number because sometimes it's not easy to tell the exact age of a person. However, an age bracket consisting of a range of years may work better in this case for instance 25-30 years.

6.4 Discussion of system results

The above results indicate that the system accuracy is high when reporting the lost and found cases. This is simply because all that occurs at this point is to fill in the respective forms and submitting them. As long as the internet connectivity is stable, these functions should be performed with ease. However when it comes to searching for the missing persons, the accuracy goes down by 20 % because this step involves a search algorithm that takes into considerations many parameters. In the event that some parameters used during the search do not match with those used during the reporting of the lost or found case, the intended result returns null even when it should have retrieved the record. This results into a false negative. This is a common phenomenon in social research methods as highlighted by Bryman (2008).

Consequently, the email alerts or notifications are affected by the result of the preceding step. The alerts step is equally affected by 20% and does not send notifications to all the recipients as it should. In the general overview, the system achieves an accuracy level of approximately 80% which is impressive. Even in cases where a false positive or false negative is returned, repeated search with different parameters may increase chances of returning the desired true results.

From the results we can compare the performance of the new system with the pre-existing systems in the same domain. Being a mobile based application, its more convenient and accessible in comparison with the web based solutions like Google's person finder. The new Patanisha application leverages on the readily available and accessible mobile devices and internet technology as opposed to dependency on desktop computers.

Additionally, unlike some of the legacy systems, the new application gives the public and in some cases even the lost person a chance to report themselves in case they are in a position to.

Some legacy systems only allow the administrator to enter the records of missing persons and this level of bureaucracy and limit of accessibility rights becomes a hindrance to the reporting of some missing cases. The new system is also cost effective to develop and maintain as it does not involve much resources. It does not require the rather expensive hardware installation. Since its also based on an emphasis of good will from the public in the reporting and updates of missing cases, it does not require much administrative resources e.g human resources.

CHAPTER SEVEN : CONCLUSION AND RECOMMENDATION

These findings are consistent with other studies. More missing people have been traced in the United States in the last 3 years by using various technology based solutions like social media and personal phone location applications. Kenya is slowly adopting this strategy but quite on a low key note. These results should be a wakeup call for us to embrace the readily available technology resources in solving our own problems.

7.1 Fulfilment of the research objectives

The research ended with remarkable success by accomplishing all the objectives. The rate of success attained for each objective is discussed below.

7.1.1 Development of a new mobile based emergency communication system

The study ended successfully with the development of a mobile based application prototype as was desired in the main objective. The application has the capability to reunite many families and friends in Kenya and beyond. The project was indeed a good opportunity to unveil the potential of an innovation using the readily available and widely accepted mobile technology and the internet. The results attained from evaluation of the prototype indicate that intended users embrace this solution in a positive manner, even giving significant feedback on the improvements that need to be done on it to leverage on it more.

The ultimate objective is to reunite friends and family who have been separated by natural disasters or other reasons. Evaluations carried out to measure the success level of users accessing the database returned positive results. Users could access the mobile application, register missing persons, report found persons and search for their loved ones.

7.1.2 Investigation of the major reasons that render people missing

The study brought into light the most common reasons why people go missing. The missing phenomenon is best understood as a continuum in which a break in contact may be either intentional or unintentional. Some people make a conscious decision to leave, albeit often not in circumstances of their own choosing, while others may drift apart from family members over time. Some may never have intended to be missing, and indeed may not conceptualise their experience in these terms, while others may be forced apart through the actions of others. Some of the causes are natural disasters, psychological complications, abduction and domestic conflicts. Those who go missing intentionally may never wish to be traced, and this hinders the

attempts to locate them because sometimes they go on hide outs. Generally, it becomes more challenging locating them in comparison with those whose reasons are unintentional.

7.1.3 The effectiveness of the current manual system in comparison with a mobile technology based system

Literature cited alludes that there exist a gap in prompt reporting, location and identification of missing people in this country. Indeed this research comes in handy as a technology that will allow for timely reporting and identification of missing people. Results from the evaluation of the new system verify that once a case has been reported, there is 72 % chance that the victim will be found. This is a significant improvement from the 30 % probability experienced by use of the old manual system.

7.2 Recommendations

It is recommended that the mobile phone based application that has been developed as a prototype should be optimized more and be adopted to locate actual missing persons. The application will then give an opportunity to friends and family members to report missing cases, where the public can view and revert with leading information regarding the missing people. In this manner, more families will be reunited with their missing loved ones and never have to worry again.

More resources should be allocated to the project to enable development of the notification module via SMS. An Application Programming Interface(API) should also be provided in future to other platforms to increase visibility and accessibility of the application.

The state humanitarian agencies should embrace and promote this system. This will increase publication of information about unidentified people and remains, enlisting the public to help maximise the chances of identification. This way, families and friends of the missing people will be empowered to play an active part in searching for their loved ones and bring vital closure if they are identified. The application will also feature general information around missing person investigations and is intended to be a valuable resource if well tapped on.

Finally, we should implement warehousing and data mining models on the missing people data obtained from this application and related systems to discover new knowledge and trends of missing people in order to manage such incidences. Such information is paramount as it can be used to either prevent possible missing cases or fasten the search efforts.

REFERENCES

- Acharya, M. (2005). *Amateur Radio, A potential tool in emergency operations*. 1st ed. New Delhi: A.P.H. Publishing Corporation.
- Bradely M.W. (2011). *Handbook to Practical Disaster Preparedness for the Family*. 2nd ed. London: Createspace Independent Publishing Platform.
- Bryman, A. (2008). *Social Research Methods*, 3rd Ed, Oxford; Oxford University Press.
- Clothier, J. (2005). *Dutch trial SMS disaster alert system*. *CNN International*, [Online]. 1, 2. Available at:<http://edition.cnn.com/2005/TECH/11/09/dutch.disaster.warning/index.html>
- Compass, P. (2000). *Review of national missing persons agencies*, Compass Partnership
- Creswell, J.W. (2003). *Research Design: Qualitative, Quantitative and Mixed Methods Approaches*, 2nd Ed, London; Sage Publications.
- Damon, P. (2006). *Introduction to International Disaster Management*. 1st ed. London: Butterworth-Heinemann.
- Goel, S. (2006). *Encyclopaedia of Disaster Management*. Deep & Deep Publications Pvt Ltd.
- Levinson, J. and Domb, A. (2013). *Disaster Victim Identification & Privacy*. 1st ed. Jerusalem: The Hebrew University of Jerusalem
- Lundin, C. (2007). *When All Hell Breaks Loose: Stuff You Need To Survive When Disaster Strikes*. 1st ed. London: Gibbs Smith.
- Nina, B. and Fiona, M. (2003). *Lost From View: Missing Persons in the UK*. 1st ed. London: The Policy Press
- Paulides, D. (2014). *The missing cases:411 Series*. 1st ed. New York: International Publishers.
- Samarajiva, R. (2005). *National Early Warning System*. *LIRNEasia*, [Online]. 2, 2. Available at:<http://lirneasia.net/2005/03/national-early-warning-system/> [Accessed 03 July 2014].
- Skinner, R. (2010). *The missing link to missing people*. 1st ed. New York: HarperCollins Publishers.
- Trochim, M. (2006). *Research Methods Knowledgebase*. 1st ed. New York: International Publishers.

APPENDICES

Tables

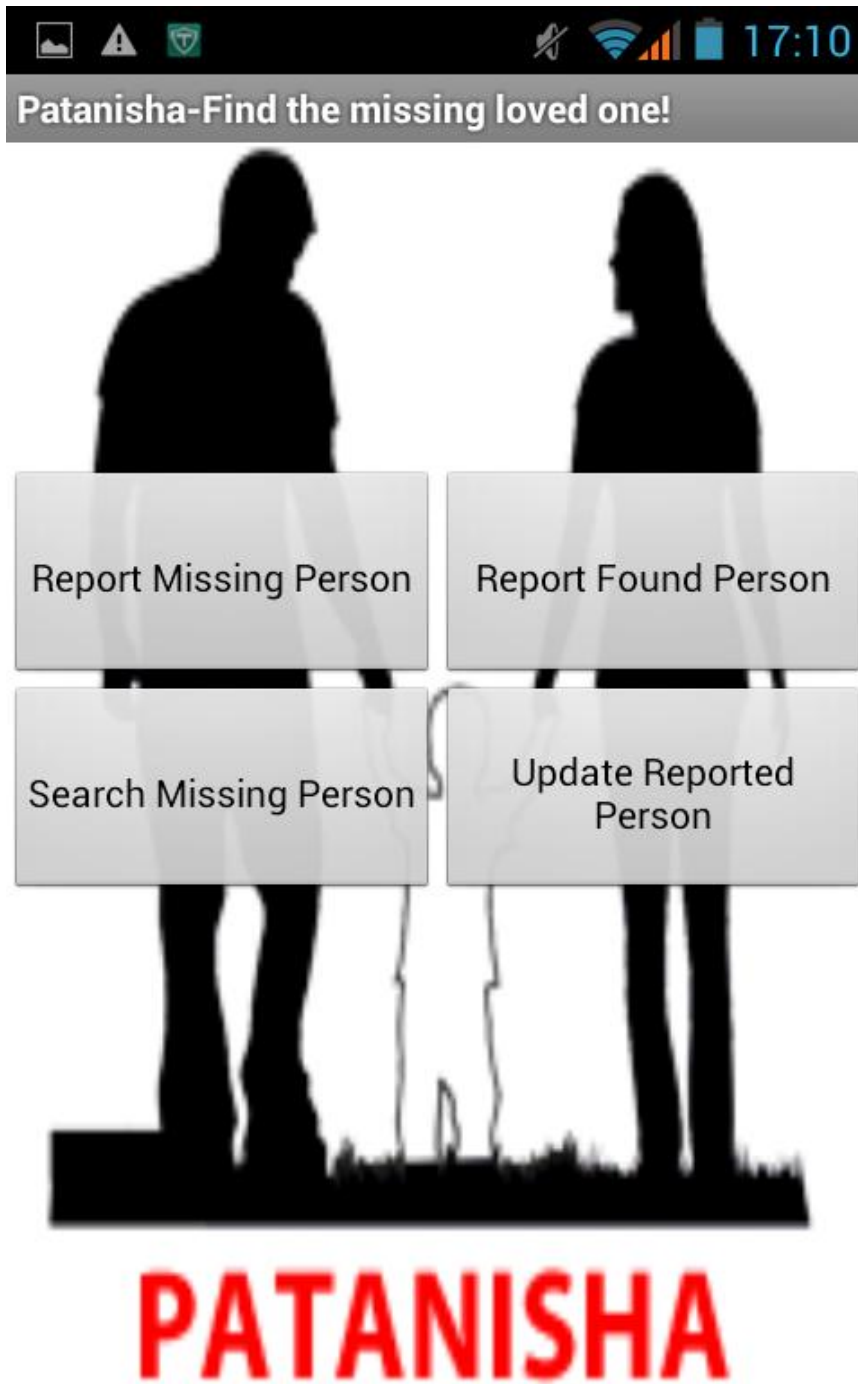
Table 5 - Statistics of people missing in different parts of the world in the recent years

DISASTER	YEAR	DEATH TOLL	DISPLACED&MISSING
Haiti Earthquake	2010	200,000	5,000,000
Cyclone Nargis	2008	84,500	53,800
Pakistan Earthquake	2005	75,000	106,000
Hurricane Katrina	2005		
Indian Ocean Earthquake	2004	310,000	500,000
Rwandan Genocide	1994	800,000	2,000,000
South sudan	2014	10,000	200,000

Table 6 - Statistics of people missing in Kenya from various disasters in the recent years

YEAR	HAZARD	AREAS AFFECTED	CASUALTIES
2007	Post election violence	Major towns	1500 killed 200,000 displaced
2006	Civil conflicts	Molo area - Nakuru	2 killed 5000 displaced
2006	Flash flood	Marsabit, Laisamis area	4 killed 3500 displaced
2005	Conflicts/clashes/insecurity	Turbi village - Marsabit District	7 killed 22 injured 22000 displaced

Figures



By Thomas Omweri(P53/64953/2013)

Figure 13 - Patanisha app Homepage

Report lost case

First Name

Last Name

Age

Tribe

Town of Origin

Figure 14 - Patanisha app report lost case screen

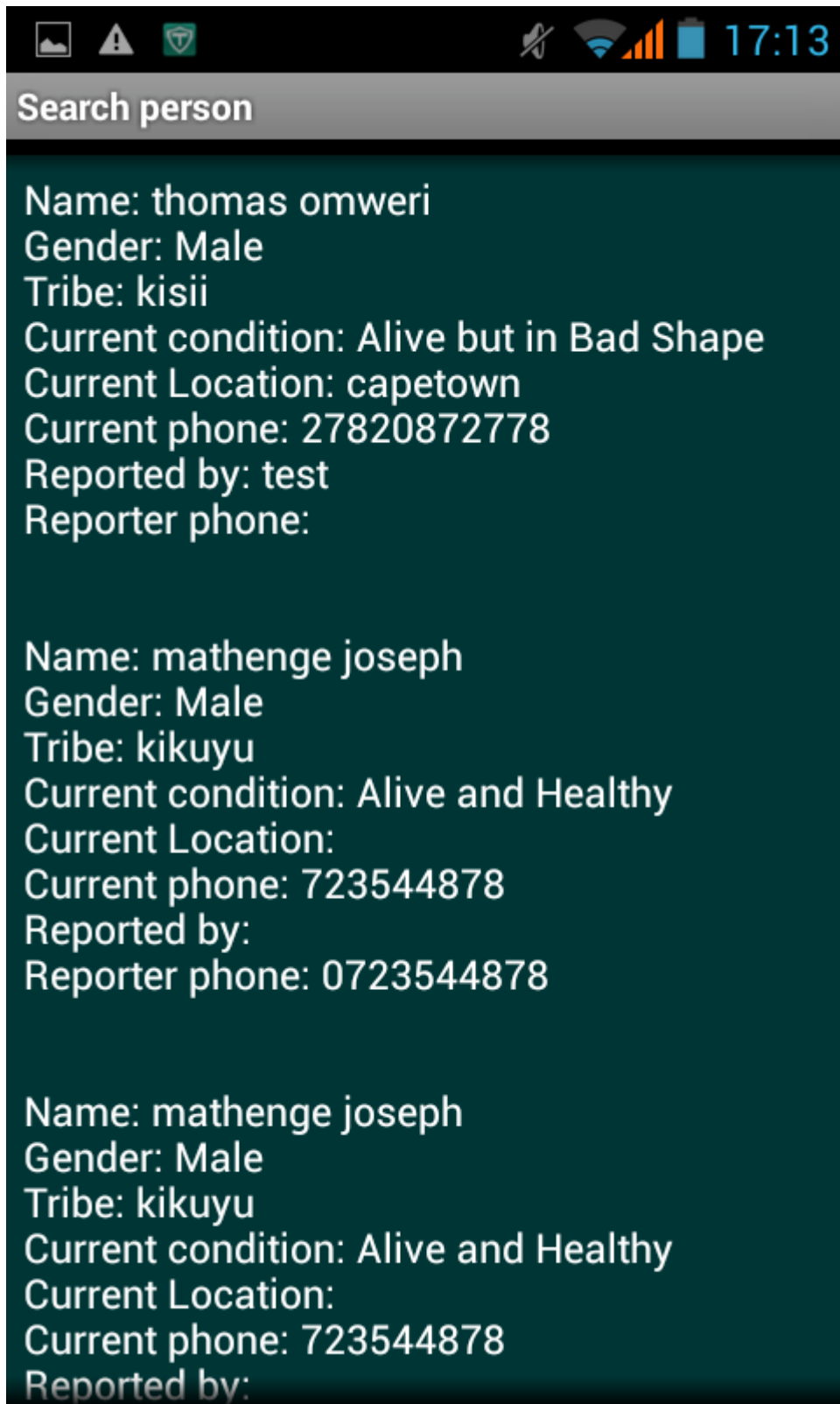


Figure 15 - Patanisha App Search Results Screen

17:17

Edit Found Person

First Name:
Edwin

Last Name:
arita

Victim Condition
Alive and Healthy ▼

Victim Known Location

Victim's Current Phone

Your Name(Reporter)

Figure 16 - Patanisha App Report Found Person

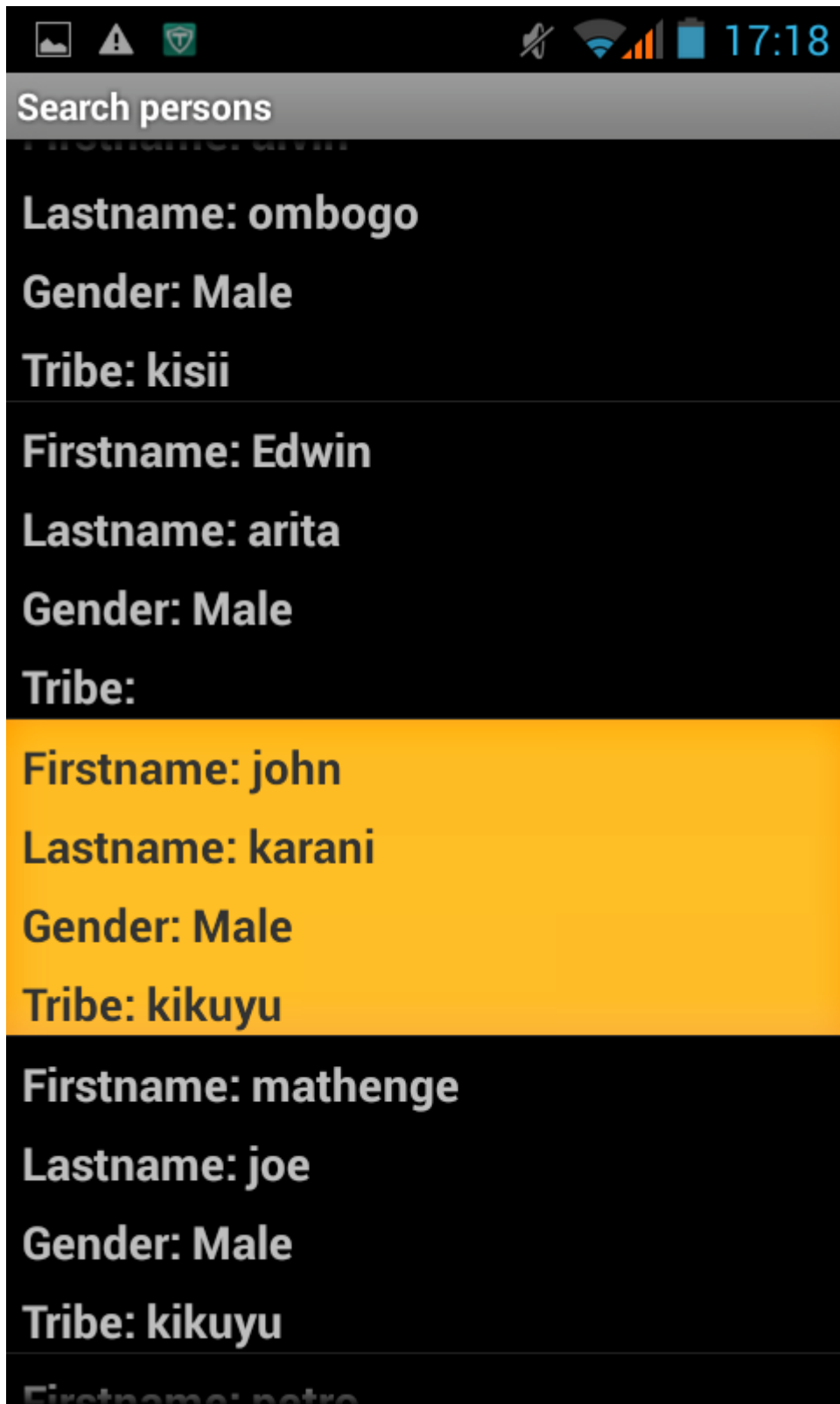


Figure 17 - Patanisha App Search Persons

System sample code

Some code snippets have been attached to highlight the basic system functionalities as shown below:

Client side search:

```
// JSON Node names

    private static final String TAG_SUCCESS = "success";

    private static final String TAG_PRODUCTS = "victims";

    private static final String TAG_PID = "id";

    private static final String TAG_NAME = "firstname";

    private static final String TAG_LNAME = "lastname";

    private static final String TAG_TRIBE = "tribe";

    private static final String TAG_GENDER = "gender";

    // victims JSONArray

    JSONArray victim = null;

    @Override

    public void onCreate(Bundle savedInstanceState) {

        super.onCreate(savedInstanceState);

        setContentView(R.layout.all_products);

        // HashMap for ListView

        victimList = new ArrayList<HashMap<String, String>>();

        // Loading victims in Background Thread

        new LoadAllvictims().execute();

        // Get listview

        ListView lv = getListView();
```

```

// on seleting single victim

// launching Edit victim Screen

lv.setOnItemClickListener(new OnItemClickListener() {

    @Override

    public void onItemClick(AdapterView<?> parent, View view,

        int position, long id) {

        // getting values from selected ListItem

        String pid = ((TextView) view.findViewById(R.id.pid)).getText()

            .toString();

        // Starting new intent

        Intent in = new Intent(getApplicationContext(),

            EditVictimActivity.class);

        // sending pid to next activity

        in.putExtra(TAG_PID, pid);

        // starting new activity and expecting some response back

        startActivityForResult(in, 100);

    }

});

}

// Response from Edit victim Activity

@Override

protected void onActivityResult(int requestCode, int resultCode, Intent data) {

    super.onActivityResult(requestCode, resultCode, data);

    // if result code 100

```



```

if (resultCode == 100) {

    // if result code 100 is received

    // reload this screen again

    Intent intent = getIntent();

    finish();

    startActivity(intent);

}

}

/**
 * Background Async Task to Load all victims by making HTTP Request
 * */

class LoadAllvictims extends AsyncTask<String, String, String> {

    /**
     * Before starting background thread Show Progress Dialog
     * */

    @Override

    protected void onPreExecute() {

        super.onPreExecute();

        progressDialog = new ProgressDialog(SearchMissingPersonActivity.this);

        progressDialog.setMessage("Loading names. Please wait...");

        progressDialog.setIndeterminate(false);

        progressDialog.setCancelable(false);

        progressDialog.show();

    }
}

```

```
$strHeader .= "--".$strSid."\n";  
  
$strHeader .= "Content-type: text/html; charset=windows-874\n";  
  
$strHeader .= "Content-Transfer-Encoding: 7bit\n\n";  
  
$strHeader .= $strMessage."\n\n";  
  
$strHeader .= "--".$strSid."\n";  
  
$flgSend = @mail($reporteremail,$strSubject,'Patanisha',$strHeader);  
  
return true;  
  
}
```

Budget

Table 7 - Research and project implementation budget

Item	Description	Amount(Kshs.)
Project Personnel	Data collection assistants	10,000
Administrative Support	Approval fees for necessary authorization and support to conduct research	5,000
Travel	During data collection	15,000
Tools and equipment	Computers, data collection and analysis tools	50,000
Miscellaneous	For emergency use	10,000
Grand Total		90,000

Project plan

Table 8 - Research and project implementation schedule

TASK	TIME(Weeks)
Project Proposal	4 Weeks
Data Collection	3 Weeks
Data Analysis	3 Weeks
Prototype Design	2 Weeks
Prototype Development	5 Weeks
Final Report	3 Weeks