

Using a Mobile Based Web Service to Search for Missing People – A Case Study Of Kenya

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Abstract: Being out of touch with a loved one is concerning and not hearing from someone you care about is terrifying. Several cases of missing people have been reported for many years, where most of the searches turn out unsuccessful. In order to quickly reunite families and friends with their missing loved ones, a solution for effectively searching for the missing people is presented. In evaluation of this solution, an F1 score test was simulated using 20 scenarios, out of which an impressive score of 0.72 was attained. The study concludes that we need to leverage on mobile based technology to devise a more efficient method of finding missing persons more easily and quickly.

Keywords: Mobile Application; Emergency communication system; National Disaster Operation Centre(NDOC); Emergency communication system(ECS); United Nations(UN); Missing Persons Community of Interest(MPCI); International Committee of the Red Cross(ICRC)

1. INTRODUCTION

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 [1]. 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.

More recently, the abductions of children and adults have reawakened public concern about missing people. In most parts of the world, the police and non-governmental organizations working with missing people have recently reviewed their policies and are planning to improve coordination of their work [2]. People end up missing in different scenarios [3]. The circumstances that may lead adults or children to become missing people are often complex and multi-layered. 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 [4].

2. PREVIOUS EFFORTS DONE IN THE SEARCH FOR MISSING PEOPLE

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 we can view the phenomenon under this important study [5].

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[6].

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 victim names [7].

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 [8]. If a disaster occurs, a message is sent to all phones in the area, warning of the danger.

3. METHODOLOGY

The goal was to come up with a prototype of a solution for finding missing persons fast enough to find them safe and sound. The solution is an innovation leveraging on the use of the readily available mobile phone devices and the internet. This kind of approach has shown success in the past [9]. It is also intended to be a solution that takes into consideration privacy and other legally constraining issues that surround missing people [10]. The block diagram in figure 1 below represents the conceptual model of the solution.



Figure 1. The Conceptual model

2.1 Reporting a 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.

2.2 Reporting a 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.

2.3 Sending Email Notification Alerts

In case there is a match between a missing and a found person the system will 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.

2.4 Search for a Missing Person

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

The user is then 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. Figure 2 below is a screen shot that captures the search results.

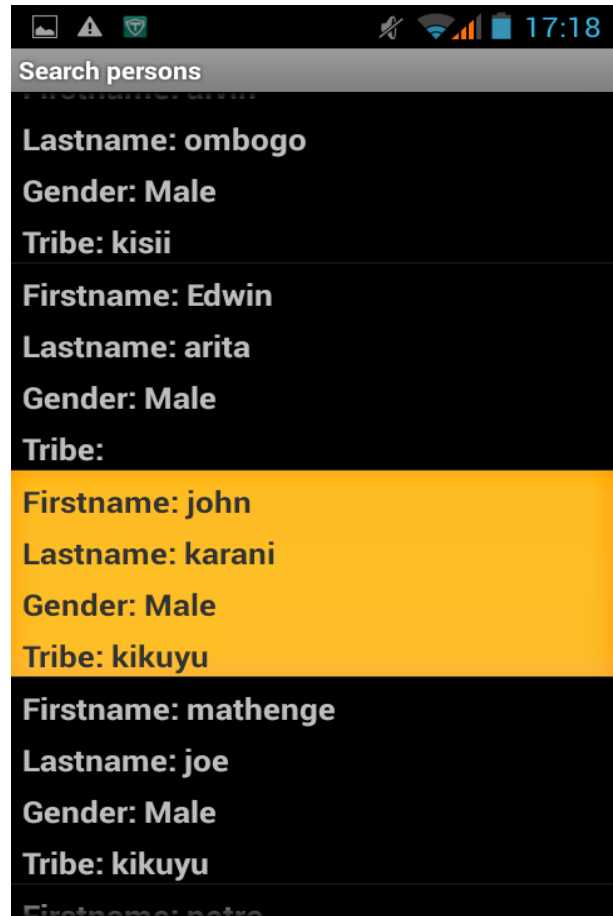


Figure 2. Screen shot showing search results of missing people

3. GENERAL PROCEDURE

The general procedure followed by the system is as illustrated in figure 3 below. A family member or friend reports a missing person case. Anyone with recovery details about the missing person updates the records by providing leading information. The missing case reporter keeps searching for any leading information from the system.

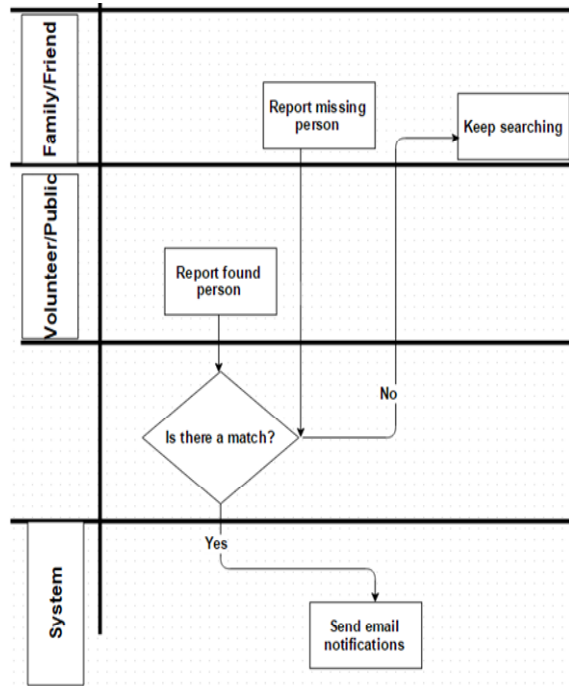


Fig 3. General procedure flow chart

The stakeholders of this emergency communication system include the lost case reporter, found case reporter and missing person. The lost case reporter may be a friend, family member of a person acquainted to the missing person.

4. 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. This information was realized by use of both qualitative and quantitative methods during the collection of data [11].

4.1 Determining the search success rate

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 the victim's current whereabouts. Table 1 below is a summary of the evaluation results.

Table 1. Summary of the evaluation results of finding missing persons

Cases reported	Search success	Search failure
20	16	4

The following pie chart in figure 4 illustrates the portion of success rate versus the failure rate. The success rate is significant enough to qualify the prototype as having satisfied the objectives and expectations of the study.

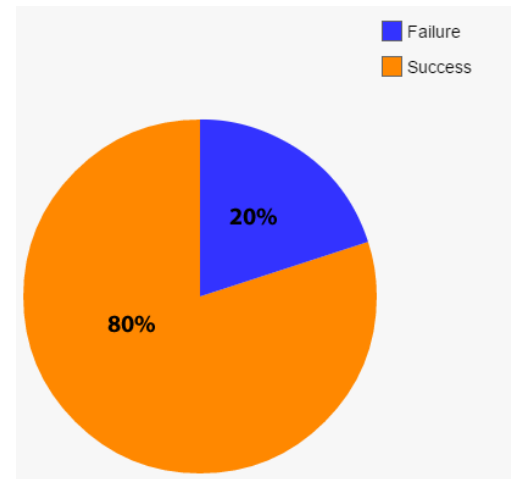


Figure 5. Pie Chart showing the success rate of finding missing people by using the mobile application

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.

The prototype was 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 [12], the **F₁ score** considered both 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
 $F1 = 2(0.528125/1.4626)$

$F1 = 0.72$

4.2 Measuring access of web database

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 6 below is a summary of the client access efficiency data as analyzed.

Table 2. Database client 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

4.3 Measuring rate of success in the identity levels 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.

4.4 Discussion of results

The 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.

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 [13].

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 the 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.

5. CONCLUSION

These findings are consistent with other studies. A significant number of missing people has been traced in developed countries like 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 there is need to do better. These results should be a wakeup call for us to embrace the readily available technology resources in solving our own problems.

The project was indeed a good opportunity to unveil what an innovation using the readily available and widely accepted mobile technology and the internet can achieve. Literature cited alludes that there exists 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 evaluations carried out 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.

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.

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. 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.

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7. REFERENCES

- [1] Paulides, D. (2014). *The missing cases:411 Series*. 1st ed. New York: International Publishers.
- [2] Smith, W. (2000). *Review of national missing persons agencies*.Compass Partnership.
- [3] Nina, A. and Fiona, D. (2011). *Handbook to Practical Disaster Preparedness for the Family*. 2nd ed. London: CreateSpace Independent Publishing Platform
- [4] Skinner, R. (2010). *The missing link to missing people*. 1st ed. New York: HarperCollins Publishers.
- [5] Lundin, C. (2007). *When All Hell Breaks Loose: Stuff You Need To Survive When Disaster Strikes*. 1st ed. London: Gibbs Smith.
- [6] Damon, P. (2006). *Introduction to International Disaster Management*. 1st ed. London: Butterworth-Heinemann.
- [7] Andy, C. (2010). *Using Google's Haiti Missing Persons Widget*, National Public Radio.
- [8] 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].
- [9] Acharya, M. (2005). *Amateur Radio, A potential tool in emergency operations*. 1st ed. New Delhi: A.P.H. Publishing Corporation.
- [10] Levinson, J. and Domb, A. (2013). *Disaster Victim Identification & Privacy*. 1st ed. Jerusalem: -The Hebrew University of Jerusalem.
- [11] Creswell, J.W. (2003). *Research Design: Qualitative, Quantitative and Mixed Methods Approaches*, 2nd Ed, London: Sage Publications.
- [12] David M, (2011). *Evaluation: From Precision, Recall and F-Measure to ROC, Informedness, Markedness & Correlation*. Journal of Machine Learning Technologies. 2 (1), 37–63.
- [13] Bryman, A. (2008). *Social Research Methods*, 3rd Ed, Oxford: Oxford University Press.