Development of a mobile application on disaster emergency alertness targeting communities in Matara district, in Sri Lanka

KA Dinusha[1#], GP Gunasinghe[1], and R P Hapugoda[2]

[1]KDU Southern Campus, Sri Lanka
[2]Remote Sensing Matrix Asia, Colombo, Sri Lanka
[#] <dinushi.25@gmail.com>

Abstract— Sri Lanka experienced different disaster events and millions of people were affected due to these events in the past. It also lacks an efficient emergency management system that will help in times of need. Proper disaster emergency alert system is most essential to save lives and this study was aimed at examining whether a mobile application can contribute to improve emergency response. In this research, a disaster alert system has been developed using android application known as MyEA to provide the Grama Niladhari (GN) map view, safe places, safe routes, emergency contacts and emergency links of the relevant agencies to user within a shortest possible time to make right decisions on their own without a delay.

Keywords— Disaster, emergency management, android

I. INTRODUCTION

Sri Lanka is vulnerable to natural hazards because of its geographic location. It is in the path of two monsoons and is mostly affected by weather related hazards. In Sri Lanka, floods, landslides, cyclones, droughts, wind storms, coastal erosion, tsunami, sea surge, and sea level rise are the main natural hazards that generate disasters (Hemachandra, 2010). So, disaster risk reduction is most important for Sri Lanka and it involves a broad range of intervention including diverse measures as developing early warning systems, ensuring safe building practices, public awareness, and spatial planning etc. There is a need for a system that will help to enhance the efficacy of disaster emergency alertness in disaster-affected areas (Fajardo & Oppus, 2010).

Efficient disaster management is most important to protect people and property in times of calamities and the process of disaster management involves four phases, which are mitigation, preparedness, response, and recovery (Chang et al., 2010).

Right information should be delivered to the right people on right time to make the right decisions at right level when disaster happening. Information sharing and integration is very important at this emergency management stage (Fothergill, 1996). Almost everything in disaster is related to a location and often location is the most important attribute of information. So determination of precise location at which the disaster happened is most important for managers and responder (Ariyabandu, 2007). Also update knowledge about the current condition in the environment of the disaster site is most important for successful and efficient disaster emergency alert system (Bernd et al., 2007).

Public warning is a system and such a system involves identification, detection, and risk assessment of a hazard. Disaster Management Center(DMC), along with other technical agencies and committees is the main institute responsible for disaster early warning and its broadcasting (DMC act, 2005).

In present the trend of using mobile application for decision making is increase and most of time we can get accurate decision efficiently with help of a mobile application (Shih et al., 2008). Smartphones are being used for wide range of activities and new application can be developed of these smart phones for people's day to day task (Fuming et al., 2013). So a well-functioning mobile application for public emergency alerts is important for effective emergency response and protecting lives of vulnerable communities.

II. RESEARCH DESIGN

A. Study Area

Three Grama Niladhari (GN) divisions in Matara district selected as study area for review the existing emergency management process in this research and they are Polhena, Pahala- Athuraliya and Kotapola area.

According to the information which was gathered from director general of district disaster management coordinating unit (DDMCU) in Matara, the Polhena GN division was totally affected due to the tsunami in 2004. The Pahala-Athuraliya GN division is highly vulnerable for flood hazard and in present the human-crocodile conflict is other thread for the community of this area. The Kotapola GN division is highly vulnerable for landslides and the unexpected flood events also effected for this area in past. 30 house-holds in each division were selected as sample to review the gaps and overcome of existing disaster emergency alert system.

B. Methodology
There were two main sections included in the research as reviewing of the existing disaster emergency alert system and developing a mobile application on real-time mapping system.

Primary data were collected through questionnaires survey from vulnerable communities, focus group discussion with committee members in study area and in-depth interview with experts in responsible authorities. The questionnaire survey was done through the selected three GN divisions and 30 house-holders from each division were selected to complete this questioner survey.

The roll of mobile application system in disaster alerts also identified by these surveying methods and gathered essential requirements from these groups which will be included in this mobile application. The flow chart of reviewing existing disaster alert system is shown in figure 1.
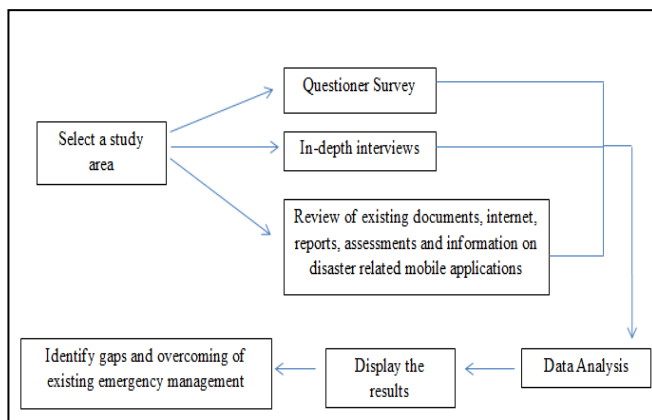

Figure1. Flow chart of Reviewing of the existing disaster emergency alert system

After analysing the collected data, the android-based disaster alert system named MyEA was developed. The activities of this mobile application were defined by considering the requirements of the vulnerable communities in three GN divisions. The MyEA system is shown in figure 2.

FIGURE2. MYEA SYSTEM
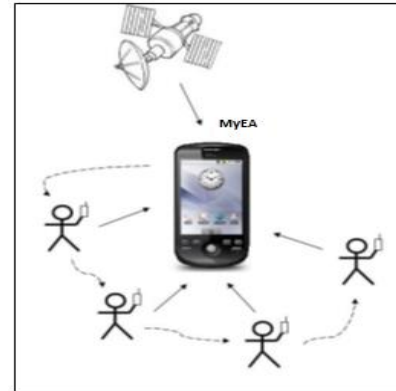
There were four main types of information in the developed mobile application (MyEA) are safe place, GN map, emergency contact number, and links to relevant disaster management intuitions/organizations. The most important activity of MyEA is safe place and it was proved by questioner survey. The details of safe places which are placed in Polhena, Pahala Athuraliya, and Kotapola were obtained from district disaster management unit, Matara. And, locations (Latitude and Longitude) of those places were taken from GPS system at real time. Those locations were then inserted to Android program codes. After that, shortest path from user location to safe place was designed with the help of Google map.

Android specific codes were used for all functions which are output from the mobile application. GN Map activity designed for only visualization of area which is belonging to each GN divisions. The information on each GN division was obtained from district disaster management unit, Matara and respective Grama Niladharies. The activity for emergency contact number is really important to user and that activity designed for making a telephone call to responsible authorities such as Police stations, Hospitals, etc. The emergency links were also inserted into separate activity and it was designed to identify information disaster events.

III. RESULTS/ FINDINGS AND DISCUSSION
The developed mobile application system named MyEA is mainly based on Android operating system and the home

page of the developed software is shown on the figure 3. Mainly MyEA included two views which are map view and list view.
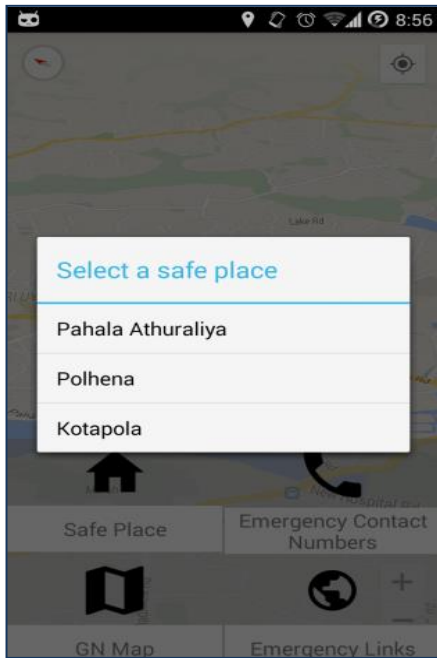

Figure3. Home page screen of MyEA

The home page shows the map view and it is based on the google map. Also it shows the geographical coordinates of user location with the help of the GPS which is integrated with mobile phone. Therefore, user can see his location and road network through this map view.

There are four icons dedicating four main activities displayed in home page and by pressing required icon user can activate them. When pressing the Safe Place icon, list of GN divisions can be displayed (Figure 4) and user can see the relevant safe places by pressing the required GN division. The locations on different safe places were in-cooperated to the program and user has the ability to see these locations through mobile application (Figure 5).

The web sites that are maintained by responsible institutions/agencies give more information specially about disaster events as such present condition of the event, up to date details of the events, some warning massages, etc. The app MyEA has an icon in home page named "Emergency Links" than can open a list of responsible institutes after pressed "Emergency Links" icon (Figure 6). Then, user has an option to select a web link as he/she wish and browse through the web pages.

The icon which is named as Emergency Contact Numbers can be pressed by user to activate telephone calls. The list of telephone number (Figure 7) can be seen by user just after press that icon and then, user can select one of most wanted emergency numbers relevant to the area disaster was occurred. The beauty of this activity is after pressing the required telephone number which is appeared on the list; automatically connect to the destination through activated telecommunication network and then user can communicate his requirements and present condition by voice from the actual location. This is really important to relevant authorities such as Police, Hospitals, and Fire Brigade because they can take immediate actions to reduce loss of lives and properties.
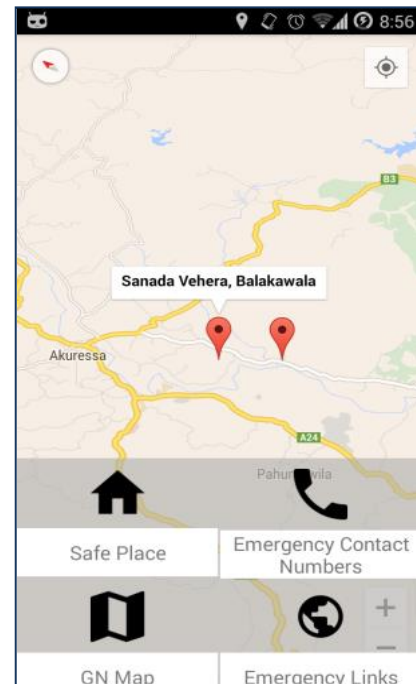

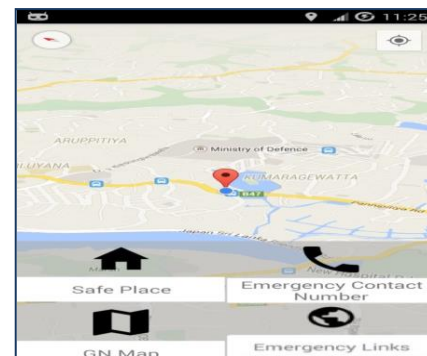Figure4. Index screen of safe place view

Figure5. Safe place view
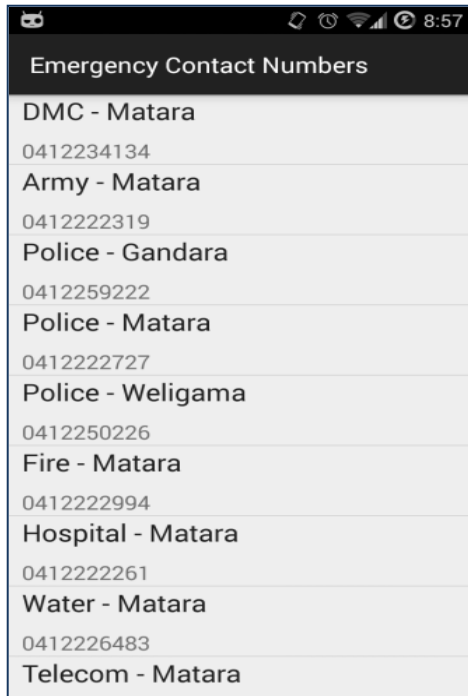
Figure6. MyEA emergency link view

Figure7.

Figure7. MyEA emergency contact numbers

IV. DISCUSSION

The locations on different safe places which were identified by DDMCU were in-cooperated to the program and user has the ability to see these locations through mobile application. Then, software automatically calculates the distances in between the user location and safe places, and shows the optimum route to user with highlighting it. Also, the distance of the selected optimum route is displayed on the screen and according to that distance user can determine the required time to reach to safe location. Within very short time period, if user could do select an optimal route to safe places they have ability to take immediate action to save their lives and properties.

Specially, the emergency organizations which are responsible to provide relief services can be reached to these safe places immediately by using this mobile application, because it provides the optimum route reach to the location. Therefore, vulnerable community has the chance to get services from emergency organizations immediately to satisfy their prioritize requirements.

The GN Map icon which is on the home screen of my app is very important to the user after disaster event than at the disaster event. After pressed GN Map icon, user can select one of three GN divisions and then, the map view is pop up. The GN division map view gives large set of information to the user. The map consists with road network, safe places, location of all government institutes and so on. This information is really important to users who act as a managers and directors of relevant disaster management agencies. Specially, if user is not familiar with the area, GN map view is very important to gather required information about the area.

Also user has the ability to see the all information of GN division as graphical view. It is one of advantages to user; because of reader can extract more information within short time period from graphical represent rather than the text view.

With reference to the study areas such as Polhena, Pahala Athuraliya, and Kotapola, the most common disaster events which were happened few years ago are Floods for Pahala Athuraliya, Tsunami for Polhena, and Landslides for Kotapola. There responsible agencies assigned for above different type of disaster. Then, relevant institutes have major responsibilities such as disaster prediction, management, mitigation, etc. The responsible institute for Flood is Irrigation department. Disaster Management Center (DMC) will disseminate the flood warnings generated by the Irrigation Department and for the other

hazards in Sri Lanka. And, National Aquatic and Research Agency (NARA), Meteorological Department, and Disaster management center are responsible for Tsunami. The responsible institute for generating Landslide alerts is the National building research institute and DMC to disseminate. If there is a way that user can get information from above institutional web sites it will really helpful for making right decisions timely manner saving lives.

V. CONCLUSIONS

Conclusions were made based on the finding as elaborated in the previous chapter under according to relevancy of socio-economic condition, community awareness on responding to early warning, community satisfaction with warning systems and mobile application, availability of mobile devices with the access to Android applications, perceptions on effectiveness of Android Mobile Application and benefits of Android Mobile application.

The main intention of the research was to develop a system for emergency alerting using android-based application. The system could be developed as extreme successfully facilitating users to take necessary actions during disaster situations. Also user can quickly refer the maps and relevant information efficiently and make decisions saving lives. This android mobile application has several advantages as elaborated below. The information in this mobile application can be easily updated unlike printed documents as it is computerized programme. Users can access this mobile application by themselves and not necessary to depend on others. So there is no any labour consuming for this android application and it is most suitable application for vulnerable communities at immediate risk to make right decisions saving their lives.

This sophisticated mobile application directly supports to enhance the disaster emergency alert system among vulnerable community and improve the access to accurate geographic location information using GPS system that is integrated with the mobile phone. Determining the optimum safe routes to safe places in the area, user location, Police, Hospital, etc. is an added advantage of this mobile application. An optimum route along the given geographic locations if the android application highlights more than one route the, individual then has a choice based on the situation.

This android mobile application provides the facility to user to link with web sites of technical agencies which are responsible for relevant disaster. Therefore, user has the ability to refer updated information about the situation through this web links and he/she can take immediate actions without wasting time. As contact numbers are provided in this mobile application, user can make a call to relevant agency (Police, Hospital, Ambulance, etc.) inquiring about anything during disaster situation. If user gets updated information from web links through android application, immediately he/she can transfer this information to his/her relatives/neighbors and responsible authorities making telephone calls through android application.

This mobile application can be customized with other relevant information such as grievance handling, obtaining feedbacks from the communities, etc., as required. And, the new trend of community is using of smart mobile phones with internet facilities available at affordable cost has a high potential to promote use of the android application developed under this study. People in vulnerable areas were willing to install this type of application into their smart phones and it is user friendly and effective accessing the disaster information and early warning in right time saving their lives compared to accessing printed documents. And, this mobile application is most important for person who is not familiar with the vulnerable area and if such a person like a new resident or visitors.

This mobile application was developed and tested only focusing the available information of the study area. However, this developed system can be applied for any GN divisions in Sri Lanka after inserting the relevant information of the area.

References

Ariyabandu, M. M., 2007. Gendering the Hyogo Framework for Action; Training of Trainers on Gendering Disaster Risk Reduction, Colombo: United Nations International Strategy for Disaster Risk Reduction.

Bernd R., Dirk S. and Thomas B. (2007), Enabling Geographic Situational Awareness in Emergency Management. *Proceedings of the 2nd Geospatial Integration for Public Safety Conference. p.* 15-17.

Chang, K.T., Lo, B.C., Teng, M.C. *et al*(2010), Developing An Android-based Emergency Broadcasting System for Natural Hazards, [Online] Available from: http://www. *tgeo.org.tw/ISRS%20Paper/full%20paper_%20Jiang.pdf* [Accessed: 03rd January 2015]

Fajardo, J.T.B. and Oppus, C.M. (2010)   A Mobile Disaster Management System Using the Android Technology. *Wseas Transactions on Communications*. 9(6). p.343–353.

Fothergill, A. (1996) Gender, Risk, and Disaster. International Journal of Mass Emergencies and Disasters. 14. p. 33-56.

Fuming,S., Seneviratne, O., Liccardi, I., Patton, E., Meier, P., & Castillo, C. (2013) *Democratizing mobile app development for disaster management.* Joint Proceedings of the Workshop on AI Problems and Approaches for Intelligent Environments and Workshop on Semantic Cities. p. 39-42.

Hemachandra, M.D. (2010) Final Report for the Visiting Researcher Programe Year 2010, Ministry of Disaster Management, Sri Lanka.

Jo, M. H., Jo, Y. W. and Shin, D. H. (2008) *Advanced real-time disaster information mapping technique By integrating UBGI (ubiquitous geographic information).* The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences. XXXVII(B8).

SRI LANKA. *Disaster Management Act N. 13 of 2005*. (2005) Colombo: Parliament select commetee on Natural Disaster .