

# Mobile Based Crime Mapping and Event Geography Analysis for CARAGA

Mark Phil B. Pacot

Caraga State University, Ampayon Butuan City

---

## ARTICLE INFORMATION

### Article History:

Received: 31 January 2017

Received in revised form: 1 December 2017

Accepted: 11 December 2017

---

### Keywords:

emergency reporting, mobile user, Geographical Information System, mobile technology, forecasting

---

\*Corresponding author: Mark Phil B. Pacot

(markphilpacot@gmail.com)

---

---

## ABSTRACT

*Mobile Based Crime Mapping and Event Geography Analysis for Caraga Region play a significant role in ensuring peace as well as security of lives and properties of its citizenry. To address this goal, the researcher designed an innovative way through web and mobile technology to predict would-be incident and crime commission for analysis and preventive actions. It also has a participatory community in terms of crime reporting using mobile application for the immediate response of local government authorities. And a real-time monitoring of different crime incidents that are vital in an effective crime rate analysis and forecasting within the region.*

---

## Introduction

With the advent of new technologies, people nowadays have a greater access to information and other necessary resources needed for their daily routine, as a way to improve the quality of life. One aspect is a peaceful and safe community. This study provides a greater impact in achieving the said quality of life by devising a new technology integrating different frameworks, such as mobile computing, geographic information system, decision support system and web applications. But broadcasting the different warning signals of emergency situations towards concerned officials was a great challenge among developing countries due to insufficient usage of information technologies (Rahman, 2007). With this situation, the researchers formulated an idea on creating mobile application that focuses on emergency reporting that has

the capability to capture an emergency situation such as crime, flood, fire and accident (Therese, Fajardo, & Oppus, 2009). In terms of data transmission, unobtrusively it uses two mobile transmission medium such as internet or plain SMS. To ensure reliable information sent to the web server as key source of emergency response team, resident personal profile information will be saved first in an emergency response database server.

Furthermore, this technology will predict would-be incident/crime commission for analysis and possible preventive actions. Mobile users can report any type of incidents and crime within the area, thus providing information to the local government authorities. The system also provides geographical distribution of crime rate through graphical representation and a great help in our local society.

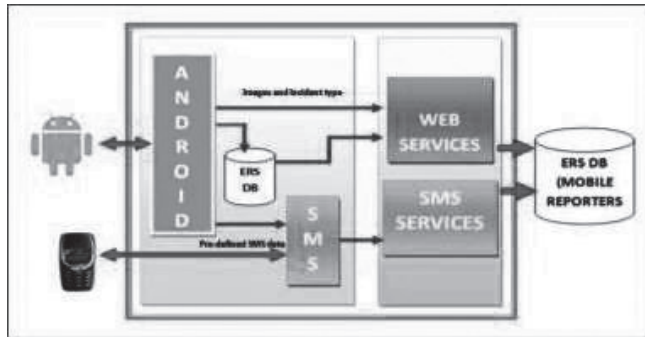


Figure 1 Conceptual Framework of Seamless Emergency Broadcasting System using Mobile Application.



Figure 2. Event Geography Analysis Conceptual Framework.

### Framework of the Study

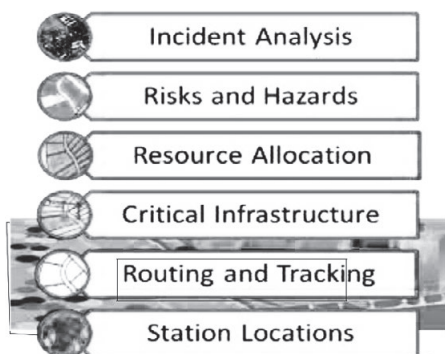
A reporter is an entity who will inform the populace of any emergency situations using an android-based and non-android based mobile phone. For an android phone user with no mobile data/internet connection, a built-in camera will be used to capture a photo of any incident that happened. For non-android phone users, a pre-formatted text message in three languages used by Filipinos (English, Cebuano and Tagalog) will be utilized as a form of report. Both users will use a text message containing the type of incident and its exact location using GSM Short Messaging System. The GSM modem with its capability to send and receive SMS messages provided that it has a valid Subscriber Identity Module

(SIM) card, receives the incoming message. The SMS Gateway acts as a middleware between the GSM modem and the web server. It translates the packet of data from the GSM modem into useful business information and vice versa. It is also responsible for uploading and downloading data to the web server that houses the database. On the other part, a web server (web-based application) is the interface that handles the location-based mapping using Google Map application. Finally, the Emergency Reporting database is the main storage of any kinds of reported incidents and the reporter's basic information from android and non-android mobile devices.

The emerging technology such as Geographical Information System (GIS)

has a prodigious aid in crime [7] analysis by way of identifying apprehensive incidents and events in any geographic area, thus participatory report generation amongst the community using mobile-based infrastructure makes the public aware crime concerns and enhance the policing methodologies' decision making. Significantly, this system provides enormous importance for stakeholders to carry on their specific anti-crime related activities for peaceful citizenry. Peacekeepers, who are the administrator/rescue head officer has now an aid on identifying the different lists of untoward incidents happened with his/her area of responsibility. This system will become an important factor for an effective crime monitoring and analysis in the region. The community also benefits from the design. Apparently, concerned citizens or a person involved in actual incident has now an opportunity to seek help from any concerned government agencies. Seamless transmission of any crimes observed by any individual will be done using mobile application. This will be a timely solution to enhance the process of our traditional way of crime reporting. With its capability known as application layer, that serves as the backbone of the entire system. It caters the different mechanisms such as mobile reporting, crime forecasting, crime distribution and decision-making. It also has the three layers such as database server, web server and map server to achieve the aforementioned seamless transaction.

#### *Applying GIS Technology to Crime Analysis*



*Figure 3. Crime Mapping Architecture.*

Crime Mapping using Open Layer GIS answers the following:

- Detection of incident types for immediate response and validation.
- Identifying of usual incidents happened in every place for analysis.
- Improvement of various policing techniques for better and safety community.
- Community participation in terms of identifying crimes and reporting emergency situations.
- A mechanism to support crime analysis and forecasting using spatial crime database.

#### **Purposes of the Research**

The study aims to devise a new technology that would strengthen the monitoring of crime and provision of assessment within the vicinity of the region, thus improving the quality of life towards a peaceful and safety community.

Specifically, it intends to:

- Develop a graphical interface integrating geographic information system for crime distribution in the vicinity.
- Design a mobile application for participatory reporting of incidents and crimes within the locality.
- Devise a system that predicts incidents/crimes to provide preventive actions and crime rate analysis.

## Literature Review

This chapter concentrates mainly on related literature and studies. It involves the systematic identification, location, and analysis of documents containing information in Mobile technology innovation such as Global Positioning System, Short Message Services, and Global System for Mobile Communication, and Android Operating System used in Disaster and Emergency Management System. It also includes researches that examine the capability and effectiveness on the said technology.

The Philippines usage of wireless mobile technology becomes a prevalent that one out of two Filipino subscribes to mobile service. It is noted that there are two billion mobile users worldwide. The widespread acceptance of this technology becomes prevalent due to its mobility and convenience. The increasing subscription of mobile technology implies a greater viability for reporting and notification. This will be a good communication avenue for disaster and emergency management system. Study of (Tomas, Filip, & Antonin, 2008) stipulated that mobile technology can be used as a key source in disaster information in finding shortest path towards different cities to be visited using Travelling Salesman Problem (TSP).

Bringing the same context in Philippines, being noted as the SMS capital in Asia and recently strike by natural disaster and man-made calamities, this mobile technology through SMS could facilitate emergency reporting especially during emergency situation. Moreover, mobile technology integrates global positioning system (GPS) as an inherent functionality for location-based services. The latitude and longitude information along with other attributes can be captured using your mobile phone. Also (Chapman, 1996) used a portable device with satellite global positioning system to determine individual or an object specific location.

The ubiquity of handheld computing technology marks the recent development of Android mobile operating system by Google Company that is specialized for mobile applications. According to *Oppus, et.al* (2009) [3] on their study entitled "A Mobile Disaster Management System Using the Android Technology" determined that mobile application using android platform serves as a key source for disaster and emergency management system.

And according to (Palmer, Kemp, Kielmann, & Bal, 2012) where they describe their work in progress on RAVEN, a framework, which makes it possible to build applications for collaborative editing of structured data on Android. RAVEN offers developers compile time tools, which use only the schema to generate all database handling components, edit and list user interfaces, as well as those needed for data synchronization, significantly reducing development effort.

On the other hand, Short Message Service (SMS) is a text messaging service component of phone, web, or mobile communication systems. It uses standardized communications protocols to allow fixed line or mobile phone devices to exchange short text messages (Palmer, Kemp, Kielmann, & Bal, 2012).

SMS was the most widely used data application with an estimated 3.5 million active users, or about 80% of all mobile phone subscribers at the end of 2010. Texting is popular around the globe because of its convenience, simple and concise and light of use.

In the Philippine setting, it has been consistently referred to as the texting capital of the world, with an estimated 200 million text messages sent a day in the country.

## Methodology

This phase is based on identifying the different modules needed for system development following the Mobile Application Development model, which includes:

### *System Requirements*

*Security Check.* This module contains the security countermeasure of the system. It serves as validation of different types of reporters to ensure correctness of data. Lastly, this security measure was executed only once, after successful installation.

*Camera Intent.* Implementing the camera feature in a mobile device runs through an android operating system. This is the source in creating emergency reports such as crime, flood, fire and accidents by just capturing an image.

*Mobile Data/Internet Transmission.* The transmission of data into the web server has been done through mobile data or internet connection. This mobile application checked the availability of this communication medium upon transmission. After successful transmission, the web server will then receive an image, type of incident and reporter's number.

*SMS Transmission.* SMS gateway served as a transmission medium for android and non-android mobile reporters.

The unavailability of mobile data connection has been replaced through this communication medium. After successful transmission, the web server will then receive a pre-formatted SMS message shown below.

### *Development and Testing*

This module is the testing phase of the system execution to identify its usability and reliability. The researcher selected the programming environment and standards used in building the system. The Android Development Toolkit powered by JAVA language is used in developing the Mobile Application because it fits the requirements needed in developing the said application. In developing the web-based interface, an open source programming language Hypertext Pre-processor (PHP) was used. Another language used is the SQL, which is a query language that serves as storage of the system on the different kinds of reported incidents. The programming languages were chosen because they have met the requirements for the development of this study.

Validation, verification, and testing are done in this phase. They are conducted according to the plan and conclusively demonstrated that both the user and system requirements have been met. The first testing done was desk checking the program in which the researcher reviewed the entire system process to check for logical and physical errors. Next, the researcher conducted series of unit testing to identify and solve different system errors that causes the program to end abnormally.

## Unit Testing

This section deals with the various tests that have been made to developed software so as to detect the failures it may have.

**Table 1**

*Unit Testing Result*

SIN	Modules	Possible Output	Rendered Result	Status
1	Install QuickHelp.apk on Android phone	Installation Successful	Installation Successful	Success
2	Check whether UI is Displaying On screen	Display UI	Display UI	Success
3	Capture Image using Android phone	Captured Image	Captured Image	Success
4	Send SMS from Application	SMS sent	SMS sent	Success
5	Send Report using Mobile data connection	Report sent	Report sent	Success

## Results and Discussion

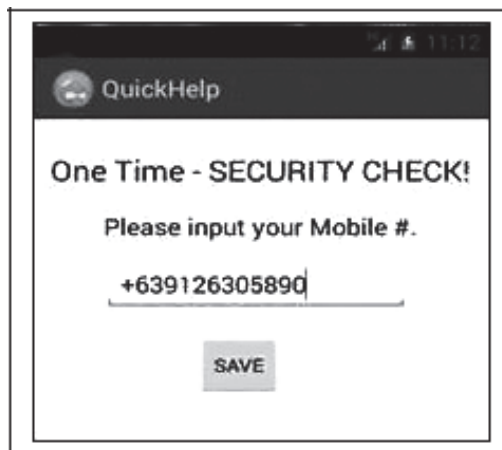
This section presents the findings and discussions regarding the study. The data presented in this chapter are data based.

Tables and figures are used to add to the clarity of the presentations of the findings.

### *Android Mobile Application Graphical User Interface*

A user interface shows the different features of the system. In this study, it maintains the simplicity of its design to enhance users familiarity and software production. The following figures are screenshots of the user interface of the study.

Figure 4 shows the security check screen wherein a reporter will input a valid mobile number used in validation of an emergency reports.



*Figure 4. Security Screenshot.*



*Figure 5. Home Screenshot.*

Figure 5 shows the home screen which contains command buttons on different types of incident such as crime, flood, fire and accidents. Each command buttons has link towards the phone built-in camera in capturing emergency situations.

### *Web-based Application Graphical User Interface*

Figure 6 shows the lists of reporters using android and non-android mobile devices. The mapping of reporters uses the Google Map technology in identifying name of location and Mobile Global Positioning System (GPS) for accurate location.

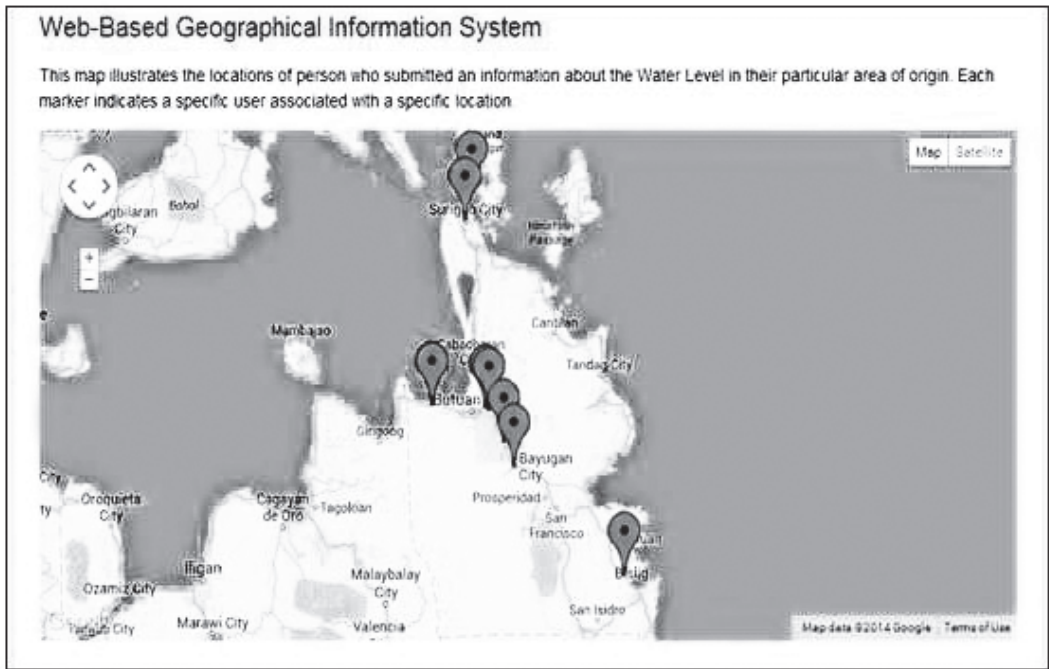


Figure 6. Location-based Map.



Figure 7. Event Geography Based-Map.

Figure 7 shows the geographical information on different types of crime happened within a specific location.

This will aid the local officers for their crime rate analysis and in decision making.

Home	E-Report	MOBILE and WEB e-Reporters	Images	Admin	Q		
HOME							
Sender	Latitude	Longitude	Country	Type of Incident	Message	Type of User	Time/Date Sent
Jim hanarose Anapayon, Bataan City	8° 57' 14.5804° N	126° 06' 87.8728° E	Philippines	CRIME	CRIME	Web-Android	2014-03-24 06:59
Vicente Pitogo San Vicente, Bulacan City	8° 14' 81.2852° N	126° 17' 87.6072° E	Philippines	ACCIDENT	ACCIDENT	Web-Android	2014-03-24 06:55
Mark Merygale Alaga Sibagani	8° 49' 8.8142° N	125° 42' 87.700° E	Philippines	FLOOD	FLOOD	Web-Android	2014-03-24 06:55
Juan Tamad Boybay, Sangaay City	8° 52' 8.1126° N	125° 32' 87.8788° E	Philippines	FIRE	FIRE	Web-Android	2014-03-24 06:55
Anonymous Casay	8° 41' 17.6928° N	125° 42' 1.44° E	Philippines	Fire	Wag mang ipasa sa casay bayugan	Mobile-SMS	2014-03-24 06:55
Anonymous	8° 45' 25.6716° N	125° 30' 89.5612° E	Philippines	Crime	Wag muna pahaba kaya sa mga sundang sa gi ambash sa mga nabito	Mobile-SMS	2014-03-24 06:55
Mark Phil B. Pacot Talsay, Nasipit	8° 08' 17.363° N	125° 21' 85.6992° E	Philippines	Flood	FLOOD	Android Mobile-SMS	2014-03-24 06:55
Mark Phil B. Pacot Talsay, Nasipit	8° 08' 17.3634° N	125° 21' 85.6992° E	Philippines	FLOOD	FLOOD	Web-Android	2014-03-24 06:55
Mario Mario Alaga Sibagani	8° 07' 8.5032° N	125° 37' 85.8868° E	Philippines	FLOOD	FLOOD	Web-Android	2014-03-24 06:55

Figure 8 Monitoring of Emergency Reports Webpage.

Android Web Reporters		
Web Reporter	Captured Image	Type of Incident
Vicente Pitogo		ACCIDENT
Jim hanarose		CRIME
Juan Tamad		FIRE
Mark Phil B. Pacot		FLOOD
Mario Mario		FLOOD
Mario Mario		FLOOD

Total no. of Incidents Reported:  
 Accident = 1  
 Crime = 2  
 Fire = 2  
 Flood = 4

Figure 9. Reporters using android phone with mobile data connection.

Figure 8 shows the list of three different types of reporters with their reported incident and specific location. The Web Android reporters use their android mobile phone to capture an image and then send a report using mobile data or internet connection. On the other hand, Mobile SMS reporter uses sms gateway with their non-android mobile device in sending emergency reports via text message. The composition of the text message includes the type of

report, description and identified place where it happened. With this, the web-based application will perform automated generation of reports and crime mapping.

Figure 9 shows the list of captured emergency situation from reporters using android phone with mobile internet connection as way of transmitting reports. It displays the information of the reporter, the type of incident and the captured image from



the phone built-in camera. This webpage also contains the identification of total number of reports on each type of incident.

## Conclusion and Recommendation

The functionality introduced by this project demonstrated the Crime Mapping using Geographical Information System to determine the crime distribution within the region. The result showed that smart phone and ordinary mobile phone sent to the emergency reporting portal captured most of the report classified by incident set by the administrator. Standard geo-code for latitude and longitude along with incident images are captured and rendered in a map-based interface to locate the exact location of the incident.



## References

- Chainey, S., & Ratcliffe, J. (2013). *GIS and crime mapping*. John Wiley & Sons.
- Chapman, R. W. (1996, April 2). Global status and position reporting system. Retrieved from <https://www.google.com/patents/US5504491>.
- Murphy, M. L. (2010). The Big Picture. In *Beginning Android 2* (pp. 1-4). Apress. Retrieved from <http://goo.gl/EZZ9kp>.
- Palmer, N., Kemp, R., Kielmann, T., & Bal, H. (2012). Raven: Using smartphones for collaborative disaster data collection. *Proceedings of ISCRAM*.
- Rahman, T. (2007). *GSM technology & its application in Bangladesh* (Doctoral dissertation, BRAC University).
- Therese, J., Fajardo B., & Oppus, C.M. (2009). A Mobile Disaster Management System Using the Android Technology". Retrieved from <http://goo.gl/Jhgklo>.
- Tomas, K., Filip, M., & Antonin, S. (2008, April). Mobile approach, trends, and technologies in modern information systems. In *7th WSEAS International Conference on Applied Computer and Applied Computational Science*, 6-8.