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# A Communication Network for Local Community Welfare in the Philippines: An Alternative Approach Using Mobile Phone Technology

#### Dexter L. Duat<sup>1\*</sup> and Consorcio S. Namoco Jr.<sup>2</sup>

<sup>1</sup>College of Industrial and Information Technology, University of Science and Technology of Southern Philippines, Lapasan Highway, Cagayan de Oro City, 9000 Philippines; 1dexterlduat@gmail.com <sup>2</sup>College of Engineering and Architecture, University of Science and Technology of Southern Philippines Lapasan Highway, Cagayan de Oro City, 9000 Philippines; csnamocojr@yahoo.com

#### **Abstract**

**Objectives**: The main objective of this study is to design and develop a communication network facility utilizing the Short Message Service (SMS) of the mobile phone. **Methods/Statistical Analysis**: In disseminating the SMS among the people in the local community, a mobile broadband device, and a computer station is added to the existing network structure of the mobile phone. These devices were used to receive SMS, processed and forward the SMS information to the desired recipients based on the incorporated keyword. To ensure authenticity and network security, some mechanisms such as the registration of the senders and the designated responders and classification of messages based on their sources and content are being implemented. **Findings:**The designed communication facility was deployed and tested in a village. Results of the study showed that the communication facility is reliable and efficient in receiving and processing of SMS and as well as the channeling of SMS information to the desired respondents. Moreover, evaluation of its acceptability and usability yields positive affirmation thereby validating the need and significance of the communication facility. **Application/Improvements:**The study can be extended to other towns or municipality using the same architecture. The system can also be upgraded and improved which can cater not only SMS but also Multimedia Services (MMS).

**Keywords:** Communication Facility, Community Welfare, Local Community, Local Government, SMS Messaging

## 1. Introduction

Mobile phone has become the most ubiquitous communication device in the recent years with higher penetration rates than the internet<sup>1</sup>. Access to information would have allowed individuals and an entire community to make best possible decisions about their well-being within the soonest possible time <sup>2</sup>.

A real-time coordination of efforts by different disaster relief organizations is of great importance during emergencies and urgent situations. In 2008, The Philippine government launched the People's Action Team Responding On-Line (PATROL 117) under Executive order number 226. PATROL 117 is a nationwide hotline

number implemented to promote peace and order and public safety <sup>3</sup>. It also seeks to connect concerned responders, allowing callers to ask for an immediate response in emergency situations. However, prank calls have been flooding the anti-crime hotline since it was established last year <sup>4</sup>. The authorities are having a hard time locating and identifying the prank callers and saboteurs that flooded the hotline more than that of the real recipients. The lack of features such as identifying the source of calls or information and sending or broadcasting certain information to identified responder or group of responders for their awareness and intervention has also defeated the very purpose of its existence. The challenge is to implement inexpensive and secure communication network

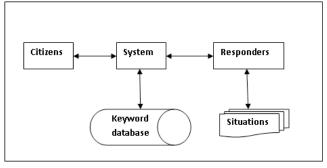
facility which allows sending and receiving of information messages for community awareness and intervention in a responsive manner. Just recently, the Philippine government launched the 911 as the nationwide emergency number which will cater to emergencies such as medical, fire, rescue, police assistance as well as K-9 units <sup>5.6</sup>. Authorities admit that with the new hotline, one of the challenges is the prank calls. In using the said hotline, the citizens will be charge P5 per call.

The rapid penetration of mobile ICTgadgets (Information and Communication Technology) such as mobile phones, smart phones, personal data assistants and other wireless devices has increased the mobility of interaction making mobility the new lifestyle paradigm. This paradigm is marked by mobile technologies and always on citizens who create a burgeoning public interest in mobility<sup>2</sup>. In fact, the rapid growth of information technology has influenced the banking industry throughout the world in a way that these innovations have allowed to create new methods for supply of banking services which is the mobile banking being done through the use of cell phones<sup>8</sup>. In the Philippines, based on the data given by the network provider Globe Telecom, there are almost 119 million subscriptions from a total population of 101 million<sup>2</sup>. Statistically, there is 117 percent penetration rate of which 95 percent are prepaid subscribers<sup>2</sup>. The Philippines is informally considered as the 'texting' capital of the world known for deposing a president using SMS and is ranked as the most SMS-intensive country in the world<sup>10</sup>. SMS more colloquially known as 'text' is a protocol used for sending short messaging over mobile networks<sup>10</sup>. According to a study, SMS is the most effective way to reach the users with 90 percent read rate in minutes<sup>10</sup>. When compared to emails and other applications, SMS maintains a high engagement rate<sup>10</sup>. As long as you have a mobile phone and you are connected to the network, SMS is available and this makes its global reach soar as there are no pre existing connections required 10. The technology for sending and receiving SMS is not reliant on the internet essentially making anyone in the modern society reachable 10. Despite the rise of the smartphone over the top applications like Viber and messenger, SMS remains popular today<sup>10</sup>. By 2010, SMS was the most widely used application, adopted by 80 percent of mobile subscribers11. This study presents a communication network facility that ensures timely dissemination of information to and from the people in the community to

the concerned responders or agency responsible for intervention and awareness. This information may include environmental and socio political issues and emergencies such as natural disasters, accidents, insurgencies, carnapping, kidnapping, health and other local community programs for community awareness and intervention. This facility is a dynamic and a two way communication structure wherein citizens who are registered and even unregistered subject to validation can send or report incidents or information to the locality where they reside by using the SMS capability of their mobile phones.

## 2. Materials and Methods

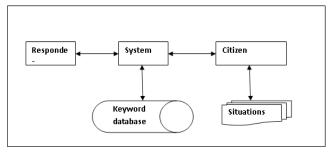
An SMS message containing information which is coming from a citizen is sent to the System via the mobile broadband device connected to the Personal Computer (PC). The System upon receiving the SMS extracts the keyword or keywords incorporated in the SMS. Depending on the keyword, the facility automatically forwards the SMS to the specific designated Responders for their immediate intervention and action. The System or the Communication facility updates the sender citizen that the received message was already forwarded to the designated Responder. In the same way, since the facility is a two way communication system, the designated Responder can also broadcast information via SMS to the specific person or barangay using the pre determined keywords. The study utilized the SMS capacity of mobile phones and its existing network backbone in designing the communication network architecture. The mobile broadband GSM modems were used as the interface to receive the SMS coming from the citizens or from the Responders. Citizens who wish to send or want to receive information must first register to the System.



**Figure 1.** System's facility flow of information (Citizens-Responders).

Likewise for the Responders in order to receive and forward messages, they too must first register to the System. The study used the flow of information when the information was coming from the citizens as illustrated in Figure 1.

In some other scenarios, if the information were coming from the Responders to the citizens of a certain village or barangay, the System can also accommodate. The Responder, using his mobile phone sends SMS to the System, the System analyzed the keyword and based on the extracted keyword, the information were automatically forwarded to the desired recipients, as shown in Figure 2.



**Figure 2.** System's facility flow of information (Responders -Citizens).

If a registered Citizen of a barangay sends SMS about a crime happening in their locality, the SMS format should include either of the keywords for the PNP together with the information he or she wanted to send. The System or Facility extracts the keywords and automatically forward the SMS to the PNP for their immediate intervention and action. Likewise if for example, the Department of Health (DOH) wants to broadcast information about free vaccination to a certain barangay, the DOH should include the Village name or Barangay name in the SMS format or message and the System automatically broadcasts that information to all registered citizen in that barangay. The Citizens and the Responders must be first registered or enrolled to the System either by testing or by manual registration in every barangay. It is assumed that their data are validated and verified. In registering to the System, one should follow the registration format so the System will not reject your message. For any individual in the community, the format for registration is: Reg space barangayname/firstname/middlename/lastname. For the Responders or government agencies in the local government, the format for registering online is: Reg space

*complete name/ name of agency*. Online registrations were subjected to validation and verification.

# 2.1 Categorizing and Grouping of Mobile Contacts

In categorizing and grouping of mobile contacts, it was imperative to identify the common groups of people in the local community and in the big community where they belong. It was also essential to interview some local government officials to determine the roles of each identified groups in the community. The study has included the following local government unit's offices such as the Bureau of Fire Protection (BFP), the Department of Health (DOH), the Philippine Atmospheric Geophysical and Astronomical Service Administration (PAGASA), the different Barangays (comprising of 80 Barangays or Villages) in Cagayan de Oro City, Philippines, Philippine National Police (PNP) and the office of the Mayor, and the City Disaster Risk Reduction and Management Council as the Responders (CDRRMC). Each of these "Responders" has to be registered in the System using their respective mobile numbers. The "Citizens" or the sender has to be registered also in the System.

# 2.2 Identifying the levels of Trust of Information in the Network

Any individual who knows the mobile number of the System can send messages to the Facility. It was important to know which of this information are credible or not. In using the System, it was assumed that all registered users be it Citizens or Responders are assumed credible information sources. All information that was sent to the System was considered trustworthy and plausible. If in the event that somebody who is not registered to the System and send messages, the System can still received it but it has a filtering mechanism not to broadcast it to the specified Responder . However the sender who was not registered gets a notification through the System's auto reply that since he or she was not yet registered, the messages are to be validated first. This is to ensure the System's integrity in sending the information to the intended recipients.

# 2.3 Specific Keywords

In sending SMS information to the Communication facility, it is expected that the user has to incorporate

in the messages a keyword associated to the respective Responder. In the same way also as in the case of Responder if the latter wanted to send SMS information to the user citizens or a barangay. The keyword which is not case sensitive and as long as it is within the SMS messages; it is guaranteed that the SMS will be automatically forwarded to the desired recipients. Table 1 displays a sample of keywords associated with the identified list of Responders.

**Table 1.** Sample table of keywords

Responders	Keywords
PNP	CRIME,KRIMEN,BOMB, GUBOT, SAMOK
DOH	HEALTH, PANGLAWAS, KALUSUGAN
PAGASA	WEATHER, PANAHON
BARANGAYS	BARANGAY NAME OR NUMBER
DSWD	SOCIAL WORK
BFP	FIRE, SUNOG, APOY, KALAYO
CDRRMC	RESCUE, SAKLOLO,HELP

# 2.4 Development and Evaluation of the Designed Facility

The designed Facility was developed using the Visual Basic (VB.net) language and Microsoft (MS) Visual Studio 2008 for the Integrated Development Environment. The system used MYSQL server 2005 as its database. For its hardware implementation, at least the System needed Intel Core 2 Quad processor or higher, at least 2Giga bytes of Random Access Memory (RAM), at least 500Giga bytes of Hard Disk Drive, mobile broadband device for sending and receiving of SMS, regular Subscriber Identity Module (SIM) card preferably 2nd Generation sim card and the computer must have at least a USN port 2.0 port for the broadband connection..

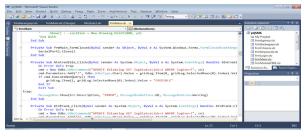


Figure 3. Source code for credible SMS extraction.

Figure 3 and 4 show a set of codes in determining whether the SMS received by the System is either cred-

ible or prank. If the System identifies the number used is not on the list of registered users in the database then it returns a prank code prompting the sender to register first before using the System.



**Figure 4.** Source code for credible SMS extraction.

To evaluate the Communication Facility, the system was deployed and tested in Barangay Patag, Cagayan de Oro City. The criteria considered in the assessment are functionality, usability, reliability, and timeliness. This was conducted to different users including the designated Responders. They were oriented about the System and required to register first using their mobile contacts. The users were also requested to use different keywords associated to different responders. During the testing, it was carefully recorded the time of sending the SMS to the facility and the time the System received the SMS or the mobile originating SMS. The mobile terminating SMS wherein the facility automatically forwards the SMS information to the intended recipients were also carefully noted. After using the System, a survey questionnaire was given to them to answer using a 5 point rating scale, 5 being the highest and 1 being the lowest.

## 3. Results and Discussion

Before starting and finalizing the parts of the whole System, an intensive interview of different local government offices in the locality has been conducted. The features of the designed System were based on the suggestions and interests of the users.

## 3.1 The Develop Communication Facility

The System utilizes the SMS capability of the mobile phone. It is an alternative communication tool designed for information dissemination and awareness and timely intervention of different assigned agencies for the welfare and benefit of the community. Figure 5 shows an SMS message coming from different registered users received and processed through the SMS dashboard.



Figure 5. System's SMS message inbox.

In Figure 6, a sample SMS from unregistered user of the System is shown. The System upon receiving a message from unregistered mobile number automatically sent a reply to the unregistered sender with a notification "since you are not registered, we are still validating your message". The information coming from the unregistered sender will not be broadcasted to the intended recipients.

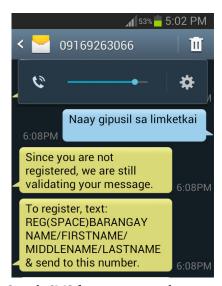
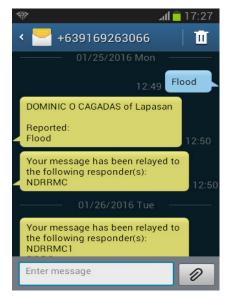


Figure 6. Sample SMS from unregistered user.

As illustrated in Figure 7, an SMS message which is coming from a registered user reporting about flooding that is currently happening in the locality is automatically forwarded to the desired agency for immediate intervention and it also provided an update to the sender informing that the message intended for CDRRMC has already been forwarded to.

# 3.2 Performance Evaluation of the SMS-Based Communication Facility

The designed communication facility was deployed in one of identified village and a series of testing was conducted. The mobile originating SMS is the time elapsed from the time SMS was sent to the System until it was received by the System. The results are outlined in Table 2 showing the average time for sending SMS from the users to the System.



**Figure 7.** SMS from a registered user.

**Table 2.** Mean average time for mobile originating SMS

SMS no.	Time Stamp	Time Stamp	Duration
	Sent	Receive	
1	9:10:11	9:10:18	0:00:07
2	9:14:13	9:14:22	0:00:09
3	9:20:17	9:20:28	0:00:11
4	9:40:16	9:40:25	0:00:09
5	9:55:48	9:55:56	0:00:08
6	10:16:15	10:16:22	0:00:07
7	10:20:13	10:20:21	0:00:08
8	10:26:17	10:26:24	0:00:07
9	10:30:16	10:30:23	0:00:07
10	10:35:17	10:35:23	0:00:06

The shortest duration of mobile originating SMS time during testing is 6 seconds while the longest duration is 11 seconds. The time duration of mobile originating SMS may vary fromtime to time depending on the network congestion. Based on the results, it can be deduced that the average duration is around 8 seconds. This average mean indicated that the System is within the telephone companies average delivery time of mobile SMS which

implies a reliable SMS delivery from the user to the System's mobile number. The mobile terminating SMS is the time elapsed from the time the System forwards the SMS information to the time the SMS was received by the intended recipients. As shown in Table 3, the shortest duration of mobile terminating SMS time is 5 seconds and the longest duration was at 9 seconds. Similarly, the time duration of sending and receiving may vary from time to time depending on the network availability or network congestion when the testing was conducted. Based on the results, the average duration is around 7 second which signifies reliable and consistent delivery of SMS from the System's modem to the appropriate Responder.

**Table 3.** Mean average time for mobile terminating SMS

SMS no.	Time Stamp Sent	Time Stamp Receive	Duration
	1		0.00.00
1	9:10:19	9:10:28	0:00:09
2	9:14:24	9:14:29	0:00:05
3	9:20:29	9:20:35	0:00:06
4	9:40:26	9:40:33	0:00:07
5	9:55:57	9:56:04	0:00:07
6	10:16:23	10:16:31	0:00:08
7	10:20:22	10:20:28	0:00:06
8	10:26:25	10:26:32	0:00:07
9	10:30:24	10:30:30	0:00:06
10	10:35:23	10:35:30	0:00:07

The performance of the designed communication facility was also evaluated by different selected users using different criteria as to its reliability, timeliness, usability and its functionality. Experts from the Information Technology and Telecommunications industry were also invited to help evaluate the Communication Facility. The reliability criterion involves guaranteed message arrival at the destination, ensures SMS delivery within the expected average time, the confirmation receipt is received within the expected time and upon registration to the System, and the automatic reply has been received. The timeliness criterion involves the accurate expected sending time of SMS to the System, confirmation that the SMS is already forwarded to the responders and can be accessed anytime. In the usability criterion, it involves that the keywords that the System used are easy to memorize and recall, the System is easy to use and useful in day to day activities, and the System is easy to be learned and understood by many, even the younger generations. In the functionality criterion, the System is expected to work well even if using different keywords and executed correctly as expected and does not produces error, the incorporated keyword in the SMS information worked well as expected, and most importantly its security to the data. Table 4 presents the results of the evaluation. The average mean for reliability criterion is of 4.15, for timeliness is 4.20, for functionality is 4.02 and for usability is 4.12. The results clearly showed that the designed Communication Facility us indeed reliable, efficient, functional and highly usable to be used.

Table 4. Average mean value of different criteria

Criteria	Mean Value (5-highest; 1-lowest)
Reliability	4.15
Timeliness	4.20
Functionality	4.02
Usability	4.12

### 4. Conclusions

In this study, SMS based communication facility for local government unit application has been developed and deployed. The Communication Facility is capable of sending and receiving SMS from the registered user citizen to the registered user Responders or vice versa using specific keywords. The study utilized the SMS capability of the mobile phone. The messages are received through the mobile broadband device and are automatically downloaded to the system using an open source GSMComm library. Test results revealed that indeed a communication facility utilizing the most ubiquitous device which is the mobile phone for local government application is consistent and reliable. The system has undergone a series of testing and evaluation and results have shown that the developed system is reliable and efficient in delivering the SMS. Based on the findings of the study, it can be deduced that the designed communication facility can be effectively put in place as an additional avenue in information dissemination towards disaster preparedness and prevention. Not only it fosters a culture of prevention but also it encourages the community involvement both in the private and public sector but also in all spheres of government. Furthermore, this study showcases the technological advancement of the society as it utilizes an ICT tool which is cost effective and ever present.

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