A Community Empowerment Model using ICT for Safety and Security in a Local Village

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Abstract - *Nowadays, criminalities and incidents in any form happen every day. Added to that, are the different natural disasters that threaten the safety of the community. The role of the people in the local community is vital in maintaining safety and security in our country. This study focuses on incorporating ICT in empowering the community by allowing the community to do their part in the local village by reporting incidents, disasters and any events in their respective area. After initial data gathering, it was found out that the most feasible technology that can be used by the community in Barangay Old Sagay, Sagay City is a cell phone with SMS technology. A system was developed that is capable of receiving messages via SMS, analyze the message received, and perform necessary matching for specific action that the system will perform. After which the system provides the necessary information to a specific office for immediate action. Added to that, the system stores all the reported incidents for processing to provide decision support for the local village personnel. After thorough evaluation using the 8 characteristics from ISO 25010 (Software Quality Model) and the 5 characteristics of Quality in Use of ISO 25010, the developed system was found to be useful and of good quality. Further, it was recommended that GIS technology might be used to generate a map of occurring incidents to further enhance decision support capabilities.*

Keywords: *community empowerment, message parsing and analysis, security and safety.*

INTRODUCTION

People in the community play a vital role in maintaining peace and security in our society. According to WHO, cultural, social, economic and political determinants are addressed by community empowerment [1]. The people in the community are the ones who have the first-hand experience of the incidence, and the ones who actually see the event – they are the ones also that are greatly affected for the late response and inefficient action by the responsible agency. The advancement of technology especially in communications brings the community in a wider perspective of "empowerment" by crowd-sourcing information. Crowdsourcing is a method wherein the work is distributed to the crowd to improve decision making and completing a task [2].

There are numerous attempts already to make use the concept of crowdsourcing. One of these is MapLocal, it is a mobile application focused on crowdsourced planning by Jones, Layard, Speed, and Lorne [3]. This application empowers the people to collect spatial data on their neighborhood. Though it is still a pilot project and has so many limitations, it is an effective tool in gathering knowledge about a certain locality.

In terms of ICT (Information and Communications Technology), there are several tools available that the community can use to be part of the said crowdsourcing. In the study of Stanton [4], he said that when the community is given with appropriate education and tools, people are exceptionally well-placed to participate in reporting. This means that all the government needs to do is to provide the people with the right knowledge and tools that they can use in order for them to actively participate in the community-led reporting. This concept was also used by Franco [5] in her study entitled Post Disaster Assessment with Decision Support System. Franco [5] implements a community-based ICT by remotely gathering necessary data for disaster assessment.

Different types of incidents happen every day in a local community. People who gone amok, thieves in the neighborhood, accidents on the streets, electrical post on fire, or sometimes a house is on fire, these are the different events that happen in a community wherein the people in it are the first to witness. Last November 2013 [6] Barangay Old Sagay was in a very strange situation wherein news spreads that pirates will attack the area. This fake news creates panic within the coastal area of the barangay in which

residents abandoned their house and evacuated to the barangay proper and other even evacuated to Sagay City Proper.

All of these issues can easily be managed by the barangay if the barangay has the tool or technology to listen to the community and inform the community. ICT is quite advanced right now. People even in the remote areas have a cell phone. So this study focuses on creating a model which incorporates ICT in empowering the community by allowing the community to do their part in the barangay by reporting incidents, disasters and any events in their respective area. Due to the wide choice of ICT tool that may be used, the researchers have first determined the most appropriate ICT tool or medium the people in the barangay has and may use. This selection of ICT tools narrows from Social Media, Smartphone Application, and the good old yet still very capable SMS (Short Messaging Service). After the initial survey using interviews, it was revealed that most of the residents in Barangay Old Sagay, Sagay City do not have a Smartphone or if they have most of them use it for basic phone purpose only – texting and calling. Thus, the best available technology wherein the people in the community are expected to participate was through SMS.

A system was then developed to collect reported information and perform keyword analysis to match needed or required assistance. The system will then send out the message to the appropriate person or persons. Most importantly this system was designed to log all reported incidents to provide a graphical report to the barangay for better decision making in terms of actions the local government may do to reduce or mitigate such reported incidents. This system requires registration of all community members' cell phone number, their name, and address to avoid or minimize hoax reports.

The researchers used the concept of human-assisted machine learning, which will allow the program to learn on how messages are typed and categorize it properly with the help of humans – in this case, a person working in the barangay. In short, uncategorized messages will then be made available to a verifier with a suggested category and will allow the verifier to verify or set its correct category.

Further, this system will also have the capability to broadcast via SMS to all registered residents important information to facilitate information dissemination in a much efficient way.

OBJECTIVES OF THE STUDY

Generally, the study aimed to create a model wherein the available ICT tool is used to empower the people in the community in maintaining safety and security in the barangay by reporting any incident at their level. Specifically, this study aimed to (1) develop a system with the following features: (a) parse received messages and categorize it intelligently; (b) send message to concerned-person/s regarding the message received; (c) store reported incidents to provide graphs needed for decision support in the local government; (d) analyse uncategorized message and request for assistance to humans for correct categorization to improve learning; (e) allow broadcasting of important information to all registered residents; (2) Evaluate the system based on ISO 25010 Software Quality Model 8 Characteristics: Functional Suitability, Performance efficiency, Compatibility, Usability, Reliability, Security, Maintainability, and Portability; (3) Evaluate the system based on ISO 25010 Quality in Use 5 characteristics: Efficiency, Effectiveness, Satisfaction, Safety, and Usability.

METHODS

This research uses the software engineering method and descriptive method in evaluating the system.

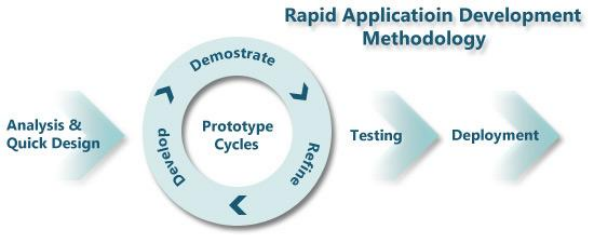

Figure 1. Rapid Application Development Methodology (RAD)

According to Stephens [7], techniques used in RAD model push the developers in generating as much high-quality code in the fastest possible time. RAD methodology combines Analysis and Quick Design followed by the Prototype Cycles – wherein development, demonstration and refinement will continuously cycle until the required specification is met. This is followed after by Testing and Deployment of the System.

To generate a baseline, the researchers conducted the research in Barangay Old Sagay, Sagay City. Data

collection procedure was initiated for the development of the software. A survey was also conducted to further confirm that the majority of the people from the community do not have a smartphone or if they have, they do not have data connectivity (internet connectivity). The initial data gathering confirms that SMS was the best technology for crowdsourcing information in this study.

To simulate this model, a software was developed that will process the SMS reports by the people in the community. This software was developed using PHP as its Scripting Language. HTML, CSS, and JavaScript were used for the front end and MySQL for the database management system. Though these languages are commonly used for web applications, this system can operate locally using an Apache Server with PHP Interpreter and MySQL Database Server. To communicate with the GSM Modem, an SMS Gateway Software was used that is capable of submitting data via HTTP GET. This SMS gateway was used also to route messages to the system. The researchers used a multiband GSM Modem at 155200 baud rate which is capable of AT and AT+GMI command.

The "brain" of the developed system is in the PHP file called "process.php". This file contains the algorithm that performs different levels of matching. The first level is key-phrase matching, followed by keyword matching. Key-phrase and keyword matching use the matching percentage to determine a match in a parsed SMS message. If no significant match is found, the algorithm will then perform a series of keyword re-matching to get the nearest match. This match is then stored temporarily available for verification and modification of human-in-charge. This is also responsible for selecting the proper recipient of information and sending it to the SMS Gateway to be forwarded to the recipient/s. The system itself works even without opening the system's UI since the process happens the moment the SMS Gateway receives an SMS and then routes the message to the system via HTTP GET using the "address" of the system.

The system has a basic UI (User Interface) only. The Primary UI shows the SMS reports in descending order. A menu is also available for the in-charge of the system to view/print generated graph based on SMS reports. Another menu is available to allow the barangay officials/staff to send SMS information to all registered residents in the barangay. It has the option also to categorized messages received without category.

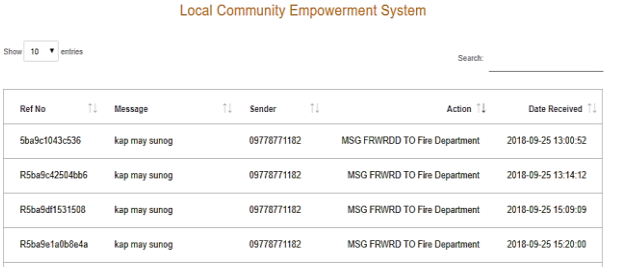

Fig. 2: Main Interface of the Developed System

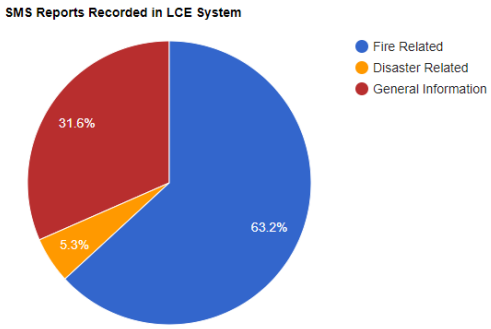

Fig. 3: Sample Graph Produced by the System after Receiving SMS Reports

Figure 3 shows a sample graph produced by the developed system after analyzing SMS received from the respondents. Please do note that the testing that was done is only a simulation, thus, this data/graph is fictitious and for simulation purposes only.

Simulation of the system was done in a controlled environment. Selected people were chosen to participate. The respondents need to register first in the system to perform reporting to avoid erroneous messages and to trace the sender of each message. Registration requires the name of the resident, cell phone number and address. The address is also collected in order to pinpoint the location of the sender if the sender did not include a location in the report.

Figure 4. shows the architecture of the implementation of the local community empowerment model. The community participates in the effort by registering in the barangay. Incidents, reports, information are then sent to the specified SMS gateway number in the barangay for processing. The SMS Gateway software will then route the message to

be processed by parsing the message, analyze the keywords and generate information. Information is then sent to the person from the local government or barangay for action. The response will then be done by the barangay personnel or from the PNP, BFP or LDRRMC (Local Disaster Risk Reduction and Management Council).

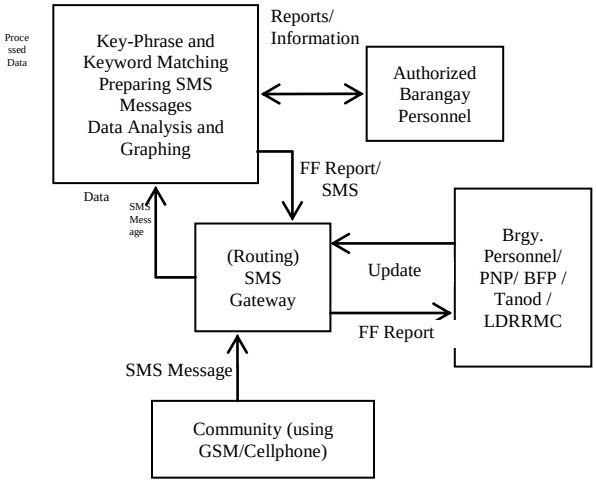

Figure 4: Architecture of the Implementation of the Local Community Empowerment Model

Collected data from reported incidents are grouped together automatically by mimicking the concept of classification tree analysis, though the process of classification is still human-assisted. Each category will have a specific action to be taken like dispatching of Tanod or police or alerting the LDRRMC or even informing the Barangay Captain.

Matching process will use the similar_text() method from PHP. This method follows the concepts from Oliver (1994) in his book Programming Classics: Implementing the World's Best Algorithms. By documentation, this method has a complexity of O(max(n, m)^3).

Instrument

To initially determine the most appropriate tool or technology the community may use before starting the development of the system, the researchers developed a simple interview questionnaire. To determine the quality of the system, the researchers used the 8 characteristics from ISO 25010 Software Quality Model. This includes Functional Suitability, Reliability, Performance Efficiency, Operability (Usability), Security, Compatibility, Maintainability, Portability. Moreover, to determine the outcome of human interaction with the system, the researchers used the 5 characteristics of Quality in Use from ISO 25010. These are Effectiveness, Efficiency, Satisfaction, Safety, and Usability.

Evaluation and Respondents of the Study

During the initial data gathering, the researchers asked 50 random residents from Brgy. Old Sagay. These 50 random residents were selected using convenience sampling technique. Convenience sampling was useful if time and cost is an issue. This allows the researchers to quickly obtain a tentative and/or cursory understanding of the situation [8].

To evaluate the quality of the system using the characteristics described in ISO 25010 Software Quality Model, the researchers asks 3 IT experts to do the evaluation. Two of which came from the academe and 1 was from the Industry.

To evaluate the system based on Quality in Use, the researchers used purposive sampling. Since the developed system is in "Alpha" stage – initial stage of development, the researcher's chooses to limit the number of respondents to create a better control on the performed testing. 50 respondents were purposively chosen from Barangay Old Sagay, Sagay City. These residents are those with Cellphone and can send SMS to the GSM network set by the researchers. The researchers used purposive sampling because purposive sampling is a sampling technique that allows the researchers to pick out the sample in relation to some criterion which is considered important in the conducted study [9].

Ethical Consideration on Human Subject

All respondents of this study were fully informed on the purpose of the study, what they will do, the potential benefit of the study to the community, the protection of their privacy, and the details of the researchers.

RESULTS AND DISCUSSION

Before the development of the system, the researchers conducted a simple survey to determine the most common type of technology the residents of Barangay Old Sagay is using.

Table 1 shows that 88% of 50 respondents use a basic phone (44 out 50) and only 8% uses smartphones (4 out of 50) and there were 2 respondents or 4% of the total respondents that do not have a cell phone.

Table 1. Summary of the Responses of the Respondents on the Initial Interview

Statement	Basic Phone	Smartphone	None
What type of mobile device do you use?	88%	8%	4%

On system development side, required features have been found available in the system. Upon testing the system by sending an SMS to the defined Gateway Number of the GSM Modem, the system can parse the received messages and categorize it intelligently using the algorithm made by the researchers. The system also has sent out messages to concerned-person/s regarding the message received after categorizing it based on key-phrase and keywords analysis. The system has also stored reported incidents to provide graphs needed for decision support. Keyword analysis was also performed by the system on uncategorized message and requested assistance to a human for better categorization. Further, the system is capable of broadcasting important information to all registered residents via SMS by typing a message in the Broadcast SMS panel.

Table 2. FeaturesoftheDevelopedSystem

Statement	Pre-Alpha Testing	Alpha Testing
The system parsed the received messages and categorize it intelligently	100%	100%
The system send message to concerned-person/s regarding the message received	90%	100%
The system stores reported incidents to provide graphs needed for decisión support	80%	100%
The system analysed uncategorized message and request for human-assistance for better categorization	70%	100%
The system can broadcast important information to all registered residents via SMS	100%	100%

After the evaluation of the IT experts, the system was rated with a grand mean of 4.12 which was interpreted as Good. The system was rated Very Good in four out of eight characteristics under ISO 25010 Software Quality Model, while the other four was rated with Good.

Table 3. Summary of Responses on the Evaluation of the Quality of the System Based on ISO 25010

Statement	Mean	Interpretation
FunctionalSuitability	4.13	Good
Performance Efficiency	4.33	Very Good
Compatibility	4.25	Very Good
Usability	4.30	Very Good
Reliability	3.65	Good
Security	3.88	Good
Maintainability	4.36	Very Good
Portability	4.07	Good
Grand Mean	4.12	Good

The result of the evaluation shows that the IT Experts have rated the criteria on Performance Efficiency, Compatibility, Usability and Maintainability with an interpretation of very good. The rating may be attributed to the device and the language used in developing the system. The system has performed efficiently during testing and was found to be usable and can easily be maintained.

Table 4. Summary of Responses on the Evaluation of the Quality in Use of the System Based on ISO 25010

Statement	Mean	Interpretation
Effectiveness	3.80	Good
Efficiency	3.70	Good
Satisfaction	4.18	Good
Safety	4.13	Good
Grand Mean	3.95	Good

In terms of quality in use of the system based on ISO 25010, the system was rated with a grand mean of 3.95 which was interpreted as Good. All five characteristics under ISO 25010 Quality in Use were rated as Good.

Upon post evaluation, the researchers further ask random respondents who rated the system with Good. It was found that the biggest dilemma of the respondents is the cost of sending SMS. Further, the researcher only used one GSM modem with one cellular network, which made some of the respondents hesitate because of the special promos they subscribed from a certain cellular network like “Unlimited Text” specific to their network.

CONCLUSION AND RECOMMENDATION

Based on the results of testing and evaluation of the system after the simulation of the model, the system has provided all necessary functions statedwith

a rating of 100% on all features on the Alpha testing. This is a clear indication that the system is now ready for Beta Testing which will involve actual use of the developed system.

The evaluation result of the IT experts clearly shows that the system is of Good Quality based on the eight (8) characteristics of ISO 25010 Software Quality Model. Further, the system was found useful based on the 5 characteristics of ISO 25010 Quality in Use. Therefore the researchers conclude that the stated objectives of this study were met and were in line with the requirements and needs of the intended users.

The main aim of this study was to create a model wherein the available ICT tool is used to empower the people in the community in maintaining safety and security in the barangay. This was done by developing a system and creating the process wherein people from the barangay may report using their own cellphones to the central computer in the barangay. The major contribution of this study is it provides the barangay an ICT tool that will help for the improvement of the safety and security in a barangay.

The Barangay may consider implementing the system to empower residents by providing them with a way to report incidents or any events that they may experience first-hand. This will also provide the barangay with an efficient way to disseminate information to the community when needed.

This study, being a developmental-descriptive in nature, has opened an opportunity for future research. Firstly, the software development is a continuing process thus development will continually cycle to further improve the system. Secondly, technology changes so fast. The ICT tool commonly used in the intended community may change after a year. Thirdly, there may be different ICT tolos or technology in other local community that may be more appropriate to be used to achieve the objectives. Fourthly, the researcher only used a one-network GSM modem, which may deter other members of the community using other-than the used network.

If availability of technology warrants, a GIS may be incorporated also to further improve decision-support based on geospatial data of reported incidents. Multiple mobile networks may also be used to provide residents with options on mobile networks.

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