Exodus: A Mobile-Based Application Tool for Flood Risk Reduction with the Use of Arduino Technology for Macabebe, Pampanga

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Abstract:

    The study aimed to develop a mobile-based application tool to improve the information dissemination between the barangay officials and the residents during the flood season in the Municipality of Macabebe, Pampanga. The proposed study is intended to help the residents to be updated in the daily weather forecast, tips for emergency situations such as flood, route guides, emergency hotlines and real-time information during rainy seasons. The random sampling technique was utilized in the study. The respondents of this research study are from the barangays of Macabebe, Pampanga which includes fifty (50) officials and fifty (50) residents. Out of 25 barangays, the proponents selected ten (10) barangays for random sampling. These barangays are low lying areas and are near to rivers. All of the participants are selected randomly but equally divided to each of the selected barangay. Frequency distribution, weighted mean and the descriptive rating presented the assessment of the respondents on the accuracy, effectiveness, reliability and security of the existing

and proposed system. Results have shown that the mobile application improved the process of measuring the flood level, and finding passable routes during rainy seasons. Through the use of the mobile application, barangay officials and residents experienced an effective way of disseminating flood-related news and reliable method in measuring the water level in their municipality.

INTRODUCTION

The world is a vast pool of knowledge and so are the minds of the human beings. Ideas that innovate the world flow through people's mind and thus technology were created. Technology is one of greatest creation of humans for it helps make life easier and less complicated. It assists people from household chores to transportation, from studies up to businesses. It drastically advanced for the past decade and is still advancing every day. From rich-internet applications, web systems, LAN-based systems and mobile applications, it has been proven that it makes life easier and better.

According to Jiuping Xu, et al. (2016), natural disasters often result in fatalities, injuries, diseases and other negative physical and mental health effects. Indirectly, disasters can result to social grievances and resource scarcities which can trigger social conflicts. Despite the many natural disaster studies, little attention has been devoted to the study of conflicts following a natural disaster.

One of the most common and trending technologies today is the android application. Android application nowadays is a trend not just for adults but as well as for children. It has different categories like games, business based applications,

educational applications as well as emergency alert applications.

Emergency alert applications monitor different scopes. There are ones that monitors earthquake, typhoon, gives first aids, updates the day to day weather and even flood. Flood is the rising and overflowing of a body of water especially onto normally dry land caused by non-stop raining and eventually overflowing of river. Residents that are located in the coastal areas could be affected by this flood and cause them casualties such as damage to property and much worst it could even take lives. This happens due to unpreparedness and the lack of information given to the residents.

The proposed research study titled "EXODUS: A Mobile-based Application Tool for Flood Risk Reduction with the use of Arduino Technology for Macabebe, Pampanga" is intended to help the residents of Macabebe, Pampanga be updated with the daily weather forecast, tips for emergency situations such as flood, route guides, emergency hotlines and real-time information during rainy seasons. The information that they will receive are directly from the microcontrollers that are located from rivers.

The proposed Android application provides three types of user; the administrator, the barangay head and the residents of Macabebe, Pampanga.

With the use of Arduino technology, authorities would be able to measure the water level of the river and this will help them inform their constituents about the current situation of the upcoming flood. Preparedness and proper knowledge is a powerful tool and a must in order to survive such calamities.

The study aimed to develop a mobile-based application tool to improve the information dissemination between the barangay officials and the residents during the flood season in the Municipality of Macabebe, Pampanga.

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Specifically, the study aimed to achieve the following objectives:

1. To provide an accurate source of information about the flood level to be disseminated to the residents of Macabebe, Pampanga.
2. To provide an update about evacuation centers and relief goods effectively.
3. To provide a reliable source of update and method of information dissemination regarding the flood level and to give additional knowledge in performing first aid.
4. To provide a secured way of keeping records and monitoring the distribution of relief goods.

METHOD

This study is a research and development project. The developed system underwent design and development, testing and evaluation for its significance.

According to Creswell (1994), the descriptive method of research is to gather evidence about the present existing condition. Since this study is focused on the measuring of water level of the rivers of Macabebe, Pampanga, the descriptive method is the most appropriate method to use.

The purpose of employing the descriptive method is to describe the nature of a condition, as it takes place during the time of the study and to explore the cause or causes of a particular condition. The researchers chose to use this kind of research considering the desire to acquire first hand data from the respondents so as to formulate rational and sound conclusions and recommendations for the study.

The respondents of this research study are directly from barangays in Macabebe Pampanga which includes fifty (50) officials and fifty (50) residents. Out of 25 barangays, the proponents selected ten (10) barangays for random sampling. These barangays are low lying areas and are near to rivers. All

of the participants are selected randomly but equally divided to each of the selected barangay.

This sampling method is conducted where each member of a population has an equal opportunity to become part of the sample. As all members of the inhabitants have an equal chance of becoming a research participant, this is said to be the most efficient sampling procedure. The proponents chose this method so that the outcome of the data gathering will be credible.

Simple random sampling is the basic sampling technique where the researchers select a group of subjects (a sample) for study from a bigger group (a population). Each individual is chosen entirely by chance and each member of the population has an equal chance of being included in the sample. Every possible sample of a given size has the same chance of selection. (Easton, and McColl, n.d)

The proponents used this type of sampling in implementing the questionnaire. Since the total population of the chosen locale is big and it will take a lot of time to implement it to all its residents.

Various instruments were used by the researchers to come up with accurate conclusions, the data gathered should be reliable and objectively answers the goal of the study. There are numerous techniques to identify the necessities of the locale which is in Macabebe and its residents. The following are the methods used:

1. Questionnaires

A questionnaire is essentially a well-thought-out technique for collecting primary data. It is generally a series of written questions for which the respondents has to provide the answers (Bell 1999).

The questionnaire is one of the most commonly used type of data gathering because it is simple and quick for the respondent to complete and they are relatively easy to analyze. The proponents will use the traditional way of implementing questionnaires by personally administering the printed questions to the sample population of Macabebe Pampanga.

The proponents of the study has employed the questionnaire type of data gathering method thrice. To thoroughly identify problems existing in the locale, the proponents included questions to measure the accuracy, effectiveness, reliability and security of the current system. The proponents asked fifty (50) residents in Macabebe Pampanga to answer the survey questions. Thus, implementing this questionnaires helped the proponents in formulating the features of the proposed study. The second one is when the proponents distributed the questionnaires on ten (10) barangays of Macabebe Pampanga. The proponents have randomly picked five (5) barangay officials and five (5) residents each barangay as respondents of the data gathering. The last implemented questionnaire is to test the proposed application. The same respondents were asked to answer the questionnaires.

2. Interview

Interviews are particularly beneficial for getting the story behind a participant's experiences. The interviewer can pursue in-depth information around the topic. Interviews may be useful as follow-up to certain respondents (McNamara, 1999).

The proponents conducted the interview in the Municipality of Macabebe, Pampanga with MDRRMO / Municipal Administrator. The data gathered was used to make the data flow diagram of the current system.

The proponents have also interviewed an Electronics and Communication Engineering graduate to determine all the needed hardware needed in developing the prototype of the application.

3. Internet Research

One of the most commonly used media nowadays in data gathering is the internet. Internet search are a big part of how people find things online. It is easy to obtain a more diverse sample than in traditional university-based research. Users are able to search for sources in multiple languages and from mobile points of view. The Internet allows for instant access. As compared to using numerous print sources, users save time during a search.

The rapid development of the Internet and the advantages of the medium over traditional communication formats in terms of flexibility, speed and reach make it an obvious route for research dissemination. Given the emphasis on evidence-based decision-making as a way of improving the allocation of scarce resources to improve health, and given the focus on dissemination therein, the potential of the web to get digestible data to the right people at the right time is even more apparent (Duffy, 2000).

The proponents used this method in order to obtain data that is necessary for the study. Some of the studies and literatures gathered by the proponents were accessible through this technique.

4. Library Research

The proponents of the study conducted a library search in able to find related information about the study. Doing the library search takes a lot of time and effort because you have to manually search for the books in the library. But with the help of library staffs who has the knowledge on the library,

searching has been made easier. Depending on the book is much reliable than in the internet, because these materials has already been published.

The proponents of the study gathered information from different university libraries such as, Don Honorio Ventura Technological State University, the University of Assumption, the Pampanga Capitol, and the Bulacan State University school library to find related information that will help on the development on the design project.

Methods Used in Developing the System

The researchers categorized and explained the techniques used in the development of the proposed study. This has allowed the researchers to conduct a successful software and hardware testing.

1. Planning Phase

This phase is where the researchers carefully planned the essential actions that are needed to be conducted to develop the research and the system. The activities is of the following: developing an interview guidelines for the municipal and barangay officials, gathering of information through questionnaires and observation, the outline structure of the user interface and the needed software and hardware to implement the study.

2. Analysis Phase

Studying and analyzing the current system's process to identify the problems and difficulties being encountered by the town during flood seasons will be in this phase so that alteration in the goals and objectives may be made by the proponents. Adjustments may include user inputs and outputs and other requirements that are essential in the development of the proposed study.

Interviews and questionnaires were distributed and conducted by the proponents in order to obtain significant information to justify the proponents study and proposed system.

3. Design Phase

The design and structure of the proposed android application with all the features necessary were produced in this phase. Data flow diagram, entity relationship diagram, the IPO diagram in order to determine the hierarchy of the process and plans, the programming, operational requirements, the stability, security, maintainability and flexibility of the system were determined to guide them throughout the development of the system.

4. Development Phase

In this phase, the functionality of the application will be tested in a systematic way. Necessary adjustments will be applied to satisfy the operational requirements of the application. Appropriate software and hardware technologies had been thoroughly chosen that would best suit the development of the application. The coding and design of the application was accomplished using android studio, Arduino IDE and VB studio for the record management system.

5. Implementation Phase

The fulfilment of the proposed study as well as the system will be in this phase. The satisfaction of the factors that led the development of the study will be completely here. The proponents rechecked every phase to ensure the reliability, maintainability, flexibility, stability and completeness of the system. The system were installed and made functional and operational. This phase was implemented as soon as the users has tested and approved the functionality of the system. The system is user-friendly and reliable according to the users.

6. Operation and Support Phase

With the proposed android application released, the maintenance of it begins. The proponents ensured that the android application is reliable, secured, maintainable and useful to the users that will use the application. In maintaining it, the proponents will instruct the Municipal Administrator, in a day or two to provide him the necessary knowledge in order to maintain the application. The barangay captains and their secretaries will also be instructed in order for them to know the relevant knowledge about the record management system per barangay.

The structural techniques regarded as the more precise and objective method of a research. In collecting statistical data, adequate precautions must be taken to secure complete and accurate information. The weighted mean, also known as the arithmetic mean in mathematics, is a value that helps summarize an entire set of numbers. A set's mean is calculated by adding the numbers in the set together and dividing their sum by the number of members of the set.

The proponents used the following by computing the weighted mean and frequency distribution for questionnaire.

Weighted Mean – a method describe the numeric measures or properties of the item being analyzed.
Where:
WM – weighted mean
WV – weighted value
N – Number of cases
Σ – Summation

In assessing the overall accuracy on information dissemination, the following rating scale with corresponding point values was used:

RATING SCALE	POINT VALUES
Strongly Agree	5 Points
Agree	4 Points
Neutral	3 Points
Disagree	2 Points
Strongly Disagree	1 Point

To get the overall assessment in terms of the accuracy on information dissemination, weighted mean was computed. The following conversion was used and tabulated:

WEIGHTED MEAN	DESCRIPTIVE RATING
4.24 – 5.00	Very Accurate
3.43 – 4.23	Accurate
2.62 – 3.42	Neutral
1.81 – 2.61	Inaccurate
1.00 – 1.80	Very Inaccurate

In assessing the effectiveness of updates, the following rating scale with corresponding point values was used:

RATING SCALE	POINT VALUES
Strongly Agree	5 Points
Agree	4 Points
Neutral	3 Points
Disagree	2 Points
Strongly Disagree	1 Point

To get the overall assessment in terms of the effectiveness on updates, weighted mean was computed. The following conversion was used and tabulated:

WEIGHTED MEAN	DESCRIPTIVE RATING
4.24 – 5.00	Very Effective
3.43 – 4.23	Effective
2.62 – 3.42	Neutral
1.81 – 2.61	Ineffective
1.00 – 1.80	Very Ineffective

In assessing the overall reliability on current status of evacuation centers, the following rating scale with corresponding point values was used:

RATING SCALE	POINT VALUES
Strongly Agree	5 Points
Agree	4 Points
Neutral	3 Points
Disagree	2 Points
Strongly Disagree	1 Point

To get the overall assessment in terms of the overall reliability on the current status of evacuation centers, weighted mean was computed. The following conversion was used and tabulated:

WEIGHTED MEAN	DESCRIPTIVE RATING
4.24 – 5.00	Very Reliable
3.43 – 4.23	Reliable
2.62 – 3.42	Neutral
1.81 – 2.61	Unreliable
1.00 – 1.80	Very Unreliable

In assessing the overall of security of the residents' records, the following rating scale with corresponding point values was used:

RATING SCALE	POINT VALUES
Strongly Agree	5 Points
Agree	4 Points
Neutral	3 Points
Disagree	2 Points
Strongly Disagree	1 Point

To get the overall assessment in terms of security of the residents' records, weighted mean was computed. The following conversion was used and tabulated:

WEIGHTED MEAN	DESCRIPTIVE RATING
4.24 – 5.00	Very Secured
3.43 – 4.23	Secured
2.62 – 3.42	Neutral
1.81 – 2.61	Unsecured
1.00 – 1.80	Very Unsecured

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RESULTS AND DISCUSSIONS

The following tables presented the data analyzed from collecting the results of the questionnaires answered by 100 respondents. The purpose of the analysis and interpretation of data is to transform the data collected into credible evidence about the development of the research study and its performance.

Prior to the initiation of the survey process, the purpose, the significance and objectives of the study were relayed to the respondents. They were also assured that all the information they had provided are solely for the purpose of the study while their identities would remain confidential. All questions asked in the structured questionnaire concern only to the respondent's insights on the existing and proposed system.

Table 4.1 Assessment of the Respondents on the Accuracy of Existing System

ASPECTS	SA (5)	A (4)	U (3)	D (2)	A (1)	WV	WM	DR
The dissemination of information about the flood level is precise.	5 (25)	6 (24)	6 (18)	56 (112)	27 (27)	100 (206)	2.06	Inaccurate
The residents are aware for the passable routes during flood.	22 (110)	54 (216)	7 (21)	9 (18)	8 (8)	100 (373)	3.73	Accurate
Average Weighted Mean							**2.90**	**Neutral**

Table 4.1 shows the frequency distribution, weighted mean and the descriptive rating of the assessment of the respondents on the accuracy of the existing system in terms of information dissemination. With the computed average weighted mean of 2.90, it can be concluded that the respondents found the

accuracy of the existing system for information dissemination as **neutral**.

Table 4.2 Assessment of the Respondents on the Effectiveness of the Existing System

ASPECTS	SA (5)	A (4)	U (3)	D (2)	A (1)	WV	WM	DR
Residents are informed about the possible evacuation centers during emergency situations	18 (90)	23 (92)	34 (102)	14 (28)	11 (11)	100 (323)	3.23	Neutral
The residents are updated with the distribution of relief goods.	17 (85)	26 (104)	32 (96)	17 (34)	8 (8)	100 (327)	3.27	Neutral
Average Weighted Mean							3.25	**Neutral**

Table 4.2 shows the frequency distribution, weighted mean and the descriptive rating of the assessment of the respondents on the effectiveness of the existing system in terms of updates. With the computed average weighted mean of 3.25, it can be concluded that the respondents found the effectiveness of the existing system for the information dissemination as neutral.

Table 4.3 Assessment of the Respondents on the Reliability of the Existing System

ASPECTS	SA (5)	A (4)	U (3)	D (2)	A (1)	WV	WM	DR
The source and method of dissemination of information regarding the news about the water level is trustworthy.	5 (25)	6 (24)	6 (18)	54 (108)	29 (29)	100 (204)	2.04	Unreliable
Residents are prepared for any possible danger during flood and knowledgeable in performing first aid.	6 (30)	9 (36)	8 (24)	48 (96)	29 (29)	100 (215)	2.15	Unreliable
Average Weighted Mean							2.10	**Unreliable**

Table 4.3 shows the frequency distribution, weighted mean and the descriptive rating of the assessment of the respondents on the reliability of the existing system. With the computed average weighted mean of 2.10, it can be concluded that the respondents found the reliability of the existing system as unreliable.

Table 4.4   Assessment of the Respondents on the Security of the Existing System

ASPECTS	SA (5)	A (4)	U (3)	D (2)	A (1)	WV	WM	DR
Records of each resident are properly/securely stored.	8 (40)	13 (52)	56 (168)	14 (28)	9 (9)	100 (297)	2.04	Neutral
The local officials who are in charge for the distribution of the relief goods can easily monitor all beneficiaries.	12 (60)	14 (56)	47 (141)	16 (32)	11 (11)	100 (300)	3.00	Neutral
Average Weighted Mean							2.99	**Neutral**

Table 4.4 shows the frequency distribution, weighted mean and the descriptive rating of the assessment of the respondents on the security of the existing system in terms of records. With the computed average weighted mean of 2.99, it can be concluded that the respondents found the security of the existing system as neutral.

Table 4.5   Assessment of the Respondents on the Accuracy of the Proposed System

ASPECTS	SA (5)	A (4)	U (3)	D (2)	A (1)	WV	WM	DR
The dissemination of information about the flood level is precise.	13 (65)	46 (184)	26 (78)	9 18)	6 (6)	100 (351)	3.51	Accurate
The residents are aware for the passable routes during flood.	9 (45)	12 (48)	39 (117)	23 (46)	17 (17)	100 (273)	2.73	Neutral
Average Weighted Mean							3.12	**Neutral**

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Table 4.5 shows the frequency distribution, weighted mean and the descriptive rating of the assessment of the respondents on the accuracy of the proposed system in terms of information dissemination. With the computed average weighted mean of 3.12, it can be concluded that the respondents found the accuracy of the proposed system for information dissemination as neutral.

Table 4.6 Assessment of the Respondents on the Effectiveness of the Proposed System

ASPECTS	SA (5)	A (4)	U (3)	D (2)	A (1)	WV	WM	DR
Residents are informed about the possible evacuation centers during emergency situations	36 (180)	39 (156)	8 (24)	10 (20)	7 (7)	100 (387)	3.87	Effective
The residents are updated with the distribution of relief goods.	32 (160)	45 (180)	4 (12)	11 (22)	8 (8)	100 (382)	3.82	Effective
Average Weighted Mean							3.85	**Effective**

Table 4.6 shows the frequency distribution, weighted mean and the descriptive rating of the assessment of the respondents on the effectiveness of the proposed system in terms of updates. With the computed average weighted mean of 3.85, it can be concluded that the respondents found the effectiveness of the proposed system for the information dissemination as **effective.**

Table 4.7 Assessment of the Respondents on the Reliability of the Proposed System

ASPECTS	SA (5)	A (4)	U (3)	D (2)	A (1)	WV	WM	DR
The source and method of dissemination of information regarding the news about the water level is trustworthy.	33 (165)	36 (144)	11 (33)	13 (26)	7 (7)	100 (375)	3.75	Reliable
Residents are prepared for any possible danger during flood and knowledgeable in performing first aid.	33 (165)	43 (172)	8 (24)	10 (20)	6 (6)	100 (387)	3.87	Reliable
Average Weighted Mean							3.81	Reliable

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Table 4.7 shows the frequency distribution, weighted mean and the descriptive rating of the assessment of the respondents on the reliability of the proposed system. With the computed average weighted mean of 3.81, it can be concluded that the respondents found the reliability of the proposed system as **reliable**.

Table 4.8   Assessment of the Respondents on the Security of the Proposed System

ASPECTS	SA (5)	A (4)	U (3)	D (2)	A (1)	WV	WM	DR
Records of each resident are properly/securely stored.	20 (100)	23 (92)	26 (78)	23 (46)	8 (8)	100 (324)	3.24	Neutral
The local officials who are in charge for the distribution of the relief goods can easily monitor all beneficiaries.	17 (85)	25 (100)	36 (108)	9 (27)	13 (13)	100 (333)	3.33	Neutral
Average Weighted Mean							**3.29**	**Neutral**

Table 4.8 shows the frequency distribution, weighted mean and the descriptive rating of the assessment of the respondents on the security of the proposed system in terms of records. With the computed average weighted mean of 3.29, it can be concluded that the respondents found the security of the proposed system as neutral.
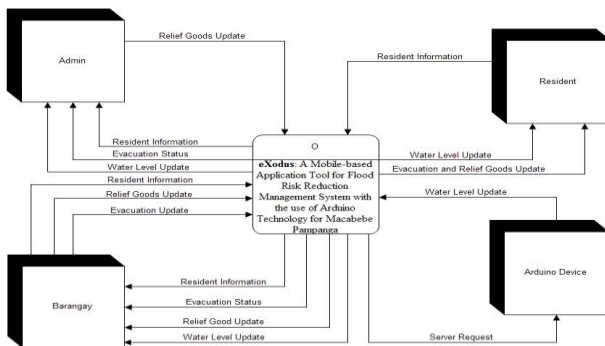
Context Diagram of the Proposed System

Figure 4.1 Context Diagram of the Proposed System

Figure 4.1 shows the Context Diagram of the Proposed System. It consists of four (4) entities namely: the Administrator, Barangay Official/s, Resident/s, and the Arduino Device. The residents will give their survey information to the barangay officials. The barangay officials will then submit all the residents' records to the administrator. The Arduino device will get the water level update and will send the update to the barangay officials. The barangay officials will then inform the administrator about the water level update.

Diagram 0 of the Proposed System
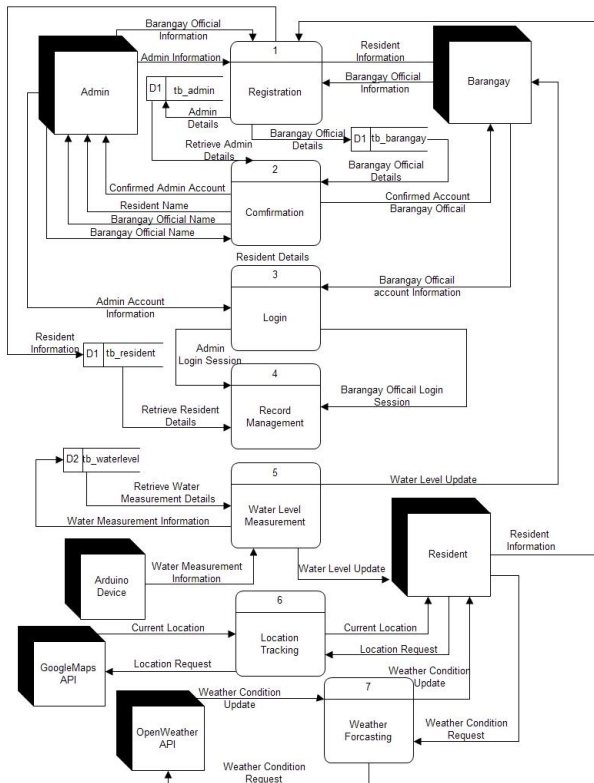
Figure 4.2 Diagram 0 of the Proposed System

Figure 4.2 shows the Diagram 0 of the Proposed System. It composed of seven processes. The first process is Registration. The administrator will register each barangay secretary who will manage the record management system of each respective barangay. The administrator has also the privilege of registering new administrator for future changes. All of the information that are entered by the administrator will be saved to the database. The second process is Confirmation. The administrator will retrieve the required information from the database and will verify them before the administrator and barangay can log in. The third process is Login. After the account of the administrator and the barangay was confirmed, they can now login and access the record management system. The fourth process is Record Management System. In this process, the barangay has the ability to do CRUD (Create, Read, Update, and Delete). The detailed information for this process will be discussed in the Exploded Diagram of the Record Management System. The fifth process is Water Level Measurement. In this process, the water level measurement will come from the Arduino device. The users will request for the information about the water level. The water level will then be sent by the Arduino to the users. The sixth process is Location Tracking. The users will request for the information about their current location. The API will then send the information about the current location back to the users. The seventh process is Weather Forecasting. The users will request for the information about the current weather. The API will then provide the information about the weather back to the users.

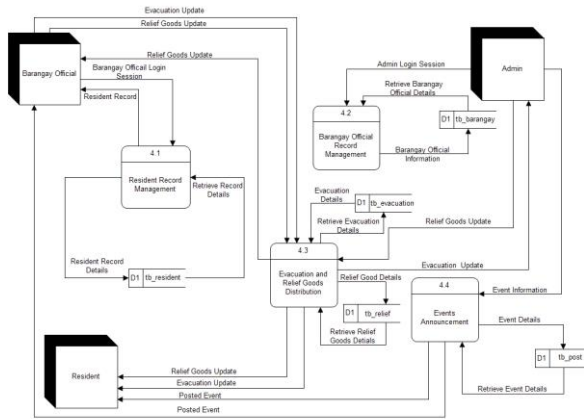## Exploded Diagram of the Record Management System

Figure 4.3 Exploded Diagram of the Record Management System

Figure 4.3 shows the Exploded Diagram of the Record Management System. It composed of four sub processes. The first sub-process is the Resident Record Management. Login session from the barangay official is required. After the barangay has logged in, the resident record can be managed. The second sub-process is the Barangay Official Record Management. The admin can manage the records of the barangay officials. The third sub-process is the Evacuation and Relief Goods Distribution. In this process, the admin updates the source of the relief goods while the barangay officials updates the situations in evacuation centers. The fourth sub-process is Events Announcements. In this process the administrator updates the barangay and residents about additional announcements.

System Architecture

System architecture is the conceptual model that explains the structure, behavior, and more views of a system. An architecture description is a formal description and representation of a system, organized in a way that supports

reasoning about the structures of the system. It can offer a plan from which products can be procured, and systems developed, that will work together to implement the overall system. The purpose of system architecture activities is to define a comprehensive solution based on principles, concepts, and properties logically related and consistent with each other.
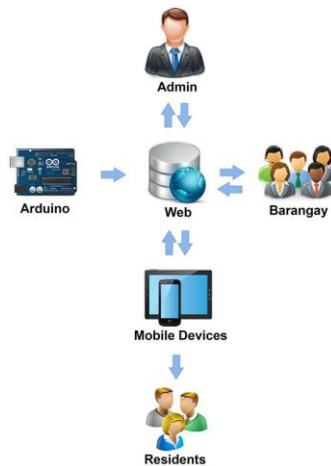

Figure 4.4 System Architecture of the Proposed Mobile Application

The "eXodus: A Mobile-based Application Tool for Flood Risk Reduction Management System with the use of Arduino Technology for Macabebe Pampanga" was uploaded in a hosting server and can be accessed by the users (admin, barangay officials and residents) through tablets or mobile devices with internet connection. The application will be managed by the admin to send information to residents regarding flood.

Prototype Process

Figure 4.5 Main Activity Page of the Exodus Mobile Application

Figure 4.5 shows the main activity page of the mobile application. It includes the water level, navigation, temperature, evacuation/relief, and emergency tips.
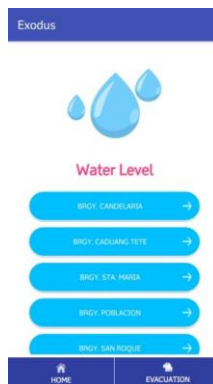

Figure 4.6 Water Level Page

Figure 4.6 shows the page where the flood/water level update in Macabebe, Pampanga will be displayed in the application. The water level will be measured using an Arduino device.
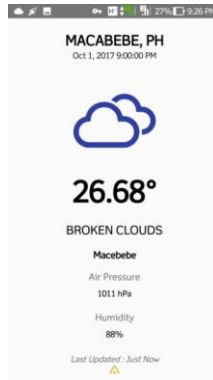
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Figure 4.7 Temperature Page

Figure 4.7 displays real time temperature, air pressure and humidity in Macabebe, Pampanga.

Figure 4.8 Evacuation and Relief Page

Figure 4.8 shows the list of evacuation areas and information about relief distributions in each barangay of Macabebe, Pampanga when there is a calamity due to flood.

Figure 4.9 Emergency Hotlines Page

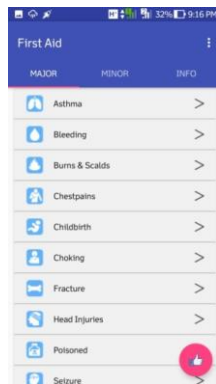Figure 4.9 displays the hotlines associated with emergencies and natural calamities.

Figure 4.10 First-Aid Guide Page

Figure 4.10 shows the guidelines on doing first-aid during emergency situations.

CONCLUSION

The manual process of measuring the flood level as well as locating other passable roads during the flood has become difficult and a huge task, and so realizing the need for an easy management of this process, the mobile and desktop application

were developed especially for the barangay officials and residents.

The implementation of the proposed research study improved the process of measuring the flood level, finding other passable routes, and protecting documents. Through the use of the mobile and desktop application which is done in the Implementation Phase of the study, barangay officials and residents experienced an effective way of updating news, reliable method in measuring the flood level and a secured way of keeping the documents.

REFERENCES

1 Pudasaini, S., Pathak, P., Dhakal S., Paudel, M. (2014), *Automatic Water Level Controller with Short Messaging Service (SMS) Notification*, Retrieved fromhttp://www.ijsrp.org/research-paper-0914/ijsrp-p3391.pdf

2 Kato, A., Sinde, R. and Kaijage, S. (2015), *Design of an Automated River Water Level Monitoring System by using Global System for Mobile Communications*, Retrieved from https://www.academia.edu/19522576/Design_of_an_Automated_River_Water_Level_Monitoring_System_by_using_Global_System_for_Mobile_Communications

3 Trono E.M., Guico, M.L., Libatique, N.J.C, Tangonan, G.L., Baluyot, D.N.B., Cordero, T.K.R., Geronimo, F.A.P. and Parrenas, A.P.F. (2012), *Rainfall Monitoring Using Acoustic Sensors*, Retrieved from http://www.ateneo.edu/sites

4 Ado, R.G., Bautista, J.B, Lleno, K.C.B., Malagday K.H.R, Muya, M.A.D (2013), *Road Flood Sensor With Web And Mobile Application Support*, Retrieved from http://www.slideshare.net/markanthonymuya/road-flood-sensor-with-web-and-mobile-application-support

Maricris R. Manaloto, Vernon Grace M. Mañiago, Cheska T. Manansala, Jerome M. Monsanto, Ervin L. Quiambao, Irish Joy H. Ramos, Heather Lace C. Toledo-**Challenges of Lifelong Learners: A Case of Don Honorio Ventura Technological State University Sto. Tomas Campus Experiences**

5   Illes, C., Popa, G.N and Filip, I. (2013), *Water level control system using PLC and wireless sensors*, Retrieved from http://citeseerx.ist.psu.edu/ viewdoc/download?doi=10.1.1.925.7926&rep=rep1&type=pdf

6   Mohd Annuar, K. A., Ab Hadib, N. A., Saadonc, I. M. and Harund, M. H. (2015), *Design and Construction of Liquid Level Measurement System*, Retrieved fromhttp://www.akademiabaru.com/doc/ARAMV12_N1_P8_15.pdf

7   Deepiga, T. and Sivasankari, A. (2015*), Smart Water Monitoring System Using Wireless Sensor Network at Home/Office*, Retrieved from https://www.irjet.net/archives/V2/i4/Irjet-v2i4218.pdf

8   Caubalejo, R.R.T., Manansala, J.C., Manuel, G.H.F. and Oriño, D.B.M(2013), *Design Of Flood Detection System With Automatic Branch Circuit Cut-Off Capabilities And Sms-Based Warning Transmitter*, Retrieved fromhttp://fs.mapua.edu.ph/MapuaLibrary

9   Ecija, E.B., Medalla, M.M., Morales, R.F.N., Platon, C.A.P. and Rodrigo, J.A (2015), *Automatic Soil Moisture Sensing Water Irrigation System with Water level Indicator*, Retrieved from http://lpulaguna.edu.ph/wp-content/uploads/2016/08/14.AUTOMATIC-SOIL-MOISTURE-SENSING-WATER-IRRIGATION-SYSTEM-WITH-WATER-LEVEL-INDICATOR.pdf

10 Yen, C. (2014), *Low-Cost Wireless High Water Detection System*, Retrieved from https://people.ece.cornell.edu/land/courses/eceprojectsland/STUDENTPROJ/2014to2015/Michael_Yen/cy278_report_201412041151.pdf

11 Azid, S.I. and Sharma B.N (2012), *SMS Based Flood Level Monitoring System*, Retrieved fromhttp://repository.usp.ac.fj/5683/1/SMS_BASED_FLOOD_LEVEL_MONITORING_SYSTEM.pdf

12 Vitales, J.S., Villajin, L.D., Ricafranca, D.V. and Rodriguez, V.M.R. (2015), *Portable Water Level Monitoring System via SMS*, Retrieved from http://www.apjmr.com/wp-content/uploads/2015/10/APJMR-2015-3.4.1.08.pdf