Portable Water Level Monitoring System via SMS

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Abstract *- Damages and lives taken by the typhoon Ondoy and other super typhoons brought the researchers to think and develop a device that warns people an hour or more than an hour before the devastating phenomena. In this project the researchers have thought of using text messaging in which the country's leading means of communication. The development of the project was guided by the Engineering Design Cycle of Dr. Allan Cheville in his book entitled "Rocket Engineering". The researchers have identified and used the needed materials which are suited in the intended function of the project. The project was already evaluated and had gathered a favorable response from the knowledgeable respondents in the field where the design project is intended to use. The project has a high acceptability level in the respondents' point of view. The researchers are highly recommending the implementation of the project for a better testing in the incoming rainy season and also recommending to be placed in the Pantalan Bridge in Pantalan, Nasugbu, Batangas, Philippines. The researchers are also suggesting another study for a better water proof casing of the project.*

Keywords*: Portable, water level, monitoring, flood*

INTRODUCTION

Technology is evidently booming in the face of the earth. Technology as a whole brought more advantages in the human lives. These may be use in routine information fusion – combining information from several sources could provide a detailed information of the situation, faster information dissemination, deploy several sensors in networks, provide a sensor systems, location awareness through the use of geographical positioning system (GPS), robotics, and alerting systems [1].

One of the well known applications of technology is the mobile technology or the so-called gadgets. One of its features is the text messaging. Through text messaging, information could easily send and retrieve. It could be used for some security measures.

Flash flood that damage the villages and killed some love ones during the typhoon Ondoy last 2009, have been one of those unforgettable calamities that happened in the town of Nasugbu, Batangas. It was so abrupt that if there was some warning in a minute or so, lives and some properties will be saved if only there was a warning. The researchers have thought of the mobile technology to give warning and information about the incoming calamities specially typhoons and floods. The idea was then put into brainstorming and there it goes, the project was come to life.

The main purpose of the project was to warn people of the water level of the river. There are three levels of warning. These are the minor level, moderate level, and the major level. When the water level reaches the minor level sensor, the device will send SMS which has this message. "The water level starts to become higher please stay at home". When the water level reaches the moderate level sensor, the device will send SMS which has this message "Warning! The water level reached the moderate level, please prepare all things that you need, evacuation is possible at anytime!" And when the water level reaches the major level sensor, the device will send SMS which has this message "Alert! The water level reaches the critical level, please evacuate immediately". The device will be supplied by solar power.

LITERATURE REVIEW

Flood Warning System [2] is a system that provides a well-established way to help the communities and the emergency services by giving enough time to prepare for flooding. In this system,

traditional methods were still use like word of mouth, massagers and raising flags and storm cones, to warn the community for the incoming heavy rains, storms or the like.

Wilby [3] stated that the there should have an adaptive management for wider preparedness of society for a systematic monitoring and responding to the evolving flood risks and vulnerabilities.

One of the switches needed for some fluid applications were float switches, it can be used as alarm devices or as control switches, or sending a signal to the actuator or to the system. According to Peng Zhang, in his book entitled "Advanced Industrial Control Technology", one the special switches is the level switches. They have a switched output, and can be either electromechanical or solid state, either normally open or normally closed.

Formulation of Flood Mitigation Measures [4], in the light of the continuing and worsening problem of flooding and devastation, the city government initiated measures spearheaded by the City Mayor Oscar C. Montilla. The City council then passed a Resolution on August 2002 approving the hiring of the services of a consultancy group to conduct a thorough study of the flooding. The hydrographic survey of the Sipalay River and the topographic survey of the flood plain of the city provided a more in-depth analysis of the flood occurrences in the area. Thus, a two-fold set of measures was adopted to be implemented over the short to medium and long terms [4].

The Department of Science and Technology has started groundwork on an ambitious flood monitoring and prevention program that aims to save lives and property by speeding up the delivery of accurate forecast and warning to communities, reports the Inquirer. The National Flood Monitoring Program has been initiated on a directive from President Benigno Aquino III "to step up national efforts toward greater and more intensive disaster risk reduction and management procedures in the wake of Storm Sendong."[5].

Manila - Scientists at the University of the Philippines (UP) - Diliman are pitching in on efforts to improve the country's landslide and flood-warning systems. Dr. Sandra Geronimo-Catane, a respected geo-hazards expert, has clinched funding from the Department of Science and Technology for a 3-year project that seeks to create cheap but effective gadgets for flood and landslide monitoring [6].

PAGASA Administrator Frisco Nilo said that through the high-tech upgrade of the agency's existing Flood Forecasting and Warning System (FFWS), real-time data on actual weather, rainfall and water level of Warning Pampanga river are analyzed on the ground, fed through a computer system that analyzes and outputs final data displayed on computer screens at the PRBFFWS command center for immediate action and information disbursement to concerned communities [7].

The Portable Water Level Monitoring System via SMS has different components that make it work as intended. There is the power source which is a rechargeable battery charge by a solar panel so the project's power source is always on the go. SMS module was used for the SMS messaging wherein the messages depend on the level of the river. There is also a siren that will be activated depending also on the level of the water. Sensors will be placed in line with the water level. Casing was one of the most important components since the project could possible soak and get wet.

OBJECTIVES OF THE STUDY

The project aimed to develop a "portable water level monitoring system". Specifically, it aimed to identify the materials to be used in the development of Portable Water Level Monitoring System via SMS (short messaging system), to come up with a design of the project, to know the techno-economic viability of the project, determine the acceptability level of the portable water level monitoring system in terms of efficiency, accuracy, portability, reliability, and maintenance.

METHODS

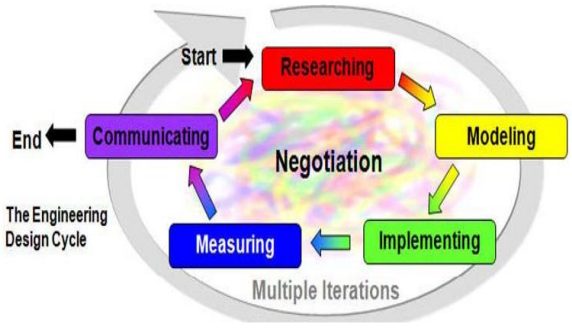

Figure 1. Engineering Design Cycle [8]

Figure 1 shows the Engineering Design Cycle which has five stages. These are researching stages,

modeling stages, implementing stages, measuring stages, and communicating stages. Researching stage is the stage where the facts and conceptual and related literatures were gathered, read, and filtered. Modeling stage is the stage for the application of the literatures and came up with the prototype. Implementing stage is the stage wherein the prototype is subject for some test data if it is working as intended. Measuring stage is the stage for the calibration of the measurements and other needed function to work as needed. Lastly is the communicating stage where the prototype is subject for the evaluation of the intended users or knowledgeable individual for that matter and if there are some required function or added feature to be added, then the cycle will be start again from researching stage.

In the evaluation process, the proponents invited and gave evaluation questionnaires to three (3) Experts from various fields that have extensive knowledge in relation to the System's purpose and design to evaluate the Efficiency, Accuracy, Portability, Reliability and Maintainability of the "Portable Water Level Monitoring System Via SMS" device.

Validation of the questionnaire was done through the series of evaluation of the said questionnaire by the expert in the fields of the questionnaire making as well as having it checked by the respondents as well. Upon several checking, the questionnaires were finalized and proceed to the evaluation.

There were three (3) respondents of the project: the Municipal Environment and Natural Resources Officer (MENRO) of Nasugbu, the Municipal Engineer of Nasugbu and the head of National Disaster Risk Reduction Council (NDRRC) in Nasugbu. The group decided to have those persons to be the respondents of the project since they are the right person to decide and evaluate such kind of project for the municipality of Nasugbu, Batangas.

At the end of the evaluation process, the proponents needed to evaluate the findings regarding the level of accuracy of the developed design project.

The proponents choose the nonprobability sampling to gain knowledge from the respondents who are in the field of their expertise.

Table 1. Guidelines Interval for Evaluation and Interpretation

Scale	Mean Range	Verbal Interpretation
5	4.21-5.00	Excellent
4	3.41-4.20	Very Good
3	2.61-3.40	Good
2	1.81-2.60	Fair
1	1.00-1.80	Poor

Table 1 shows the equal interval of the scale used in the questionnaire given to the evaluators which are more likely knowledgeable in the field.

RESULTS

Final design shows the overall physical appearance of the design project after its development and implementation. It also shows the necessary hardware components that supported the execution and process of the design project.

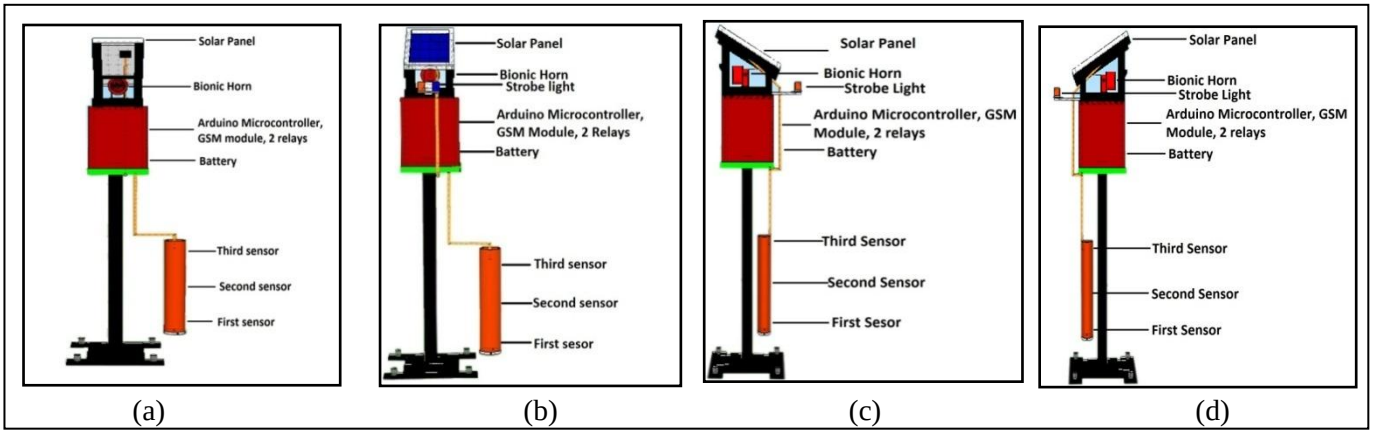

Figure 2. Front, Rear, Left And Right View of The Design Project

The final design of the "Portable Water Level Monitoring System via SMS" shows the different parts and components of the prototype model that helped it to achieve its goal and objective. It also shows the different location of every component in different views of the design project.

The water level monitoring system will start the moment the battery supplies the circuit with the electricity needed. The Solar Panel will be use as the charger of electricity to a rechargeable battery when there is sunlight. Every components of the project is active the moment it is turned on. The three sensors (first, second, and third sensors) in the project will wait for the water level to reach that level and if so, the sensor will send signal to the Arduino Microcontroller. The Arduino Controller will then analyze the signal and it will activate the GSM module to send the necessary message. The GSM module has saved numbers to where the message should be sent. Bionic Horn and Strobe light will be activated by the signal coming from the Arduino microcontroller, it will be dependent on the three warning signals.

Figure 2 shows the (a) front, (b) back, (c) left and (d) right side of the project which also shows the different parts.

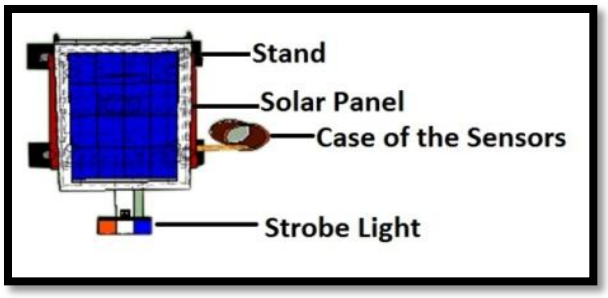

Figure 3. Top View of the Design Project

Figure 3 shows the top project wherein the Solar panel, and the Strobe light as well as the enclosure of the Control System of the Portable Water Level monitoring System Via SMS device are visible.

Table 2 shows the list of hardware requirements and specification. It includes the recommended specification for each hardware requirements. It includes combination of minimum and recommended hardware specification.

The "Portable Water Level Monitoring System via SMS" has the following features:

1. It is a water level monitoring system that alerts the intended user through SMS.
2. It has the capability of measuring the water level.
3. It has a GSM Module that sends the messages.
4. It is powered by solar energy.
5. It has a strobe light and a bionic horn to alert the people living in the area where it is placed.

Table 2. Hardware Requirements and Specification

Hardware Requirements	Recommended Specification
3 Float Sensors	3v – 5v power input
Arduino Microcontroller	Power input: External: 8v – 12v, DC power output: 3.3v
2 GSM Module	Point to point MO and MT, SMS cell broadcast, text and PDU mode
Ride it Motorcycle battery	12 volts, 3Amp
2 Relays	12 volts power output
Solar Panel	21 volts power output
Strobe Light	12 volts power input
Bionic/Siren Horn	12 volts power input
Other Components	No Specification needed

Design Project's Weaknesses and Limitation

The "Portable Water Level Monitoring System via SMS" has the following weaknesses and limitations:

1. The function of the design project is just to alert the people about the level of the water.
2. The message will be sent one by one to the intended users.
3. The maximum numbers of user/receiver that can be entered or saved on the SIM card is up to 200 persons only.
4. The delay of receiving the messages depends on the signal of the used network in the area

Table 3 presents the frequency distribution of the responses about Portable Water Level Monitoring System via SMS Device which are from the actual evaluation of the knowledgeable respondents. It also shows the result of the computation of ratings of the respondents according to the given criteria. The evaluation got a favorable result meaning the project according to the evaluators got a high rating. These will also evidence that the Water Level Monitoring System is functional as intended.

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Table 3. Frequency Distribution of the responses about Portable Water Level Monitoring System Via SMS Device

Criteria	Weighted Mean	Interpretation
1. Efficiency: The water level monitoring system can easily send the information needed.	4.33	Excellent
2. Accuracy: The water level monitoring system sends the exact/real condition of the water level.	4.33	Excellent
3. Portability: The water level monitoring system can be setup and removed from one place to another.	4.33	Excellent
4. Reliability: The water level monitoring system sends the proper message/s for each level.	4.33	Excellent
5. Maintainability: The water level monitoring system is easy to maintain or repair if damaged.	3.66	Very Good

CONCLUSIONS AND RECOMMENDATION

The proponents have identified and used the needed materials which are suited in the intended function of the project. It is also evidently showed in the Table 1 that the chosen materials where economically selected.

The project is conclusively presented that the design of the project been evaluated and gathered a favorable response from the knowledgeable respondents in the field where the design project was intended to use. The project has only one SMS module meaning it could only use one SIM card in which at one moment it could only use only one SIM card.

The project can only send messages; it only has three messages, those warning messages for depending on the water level and it is only a one-way communication. The study focused only on the water level or the flood monitoring, it does not include other calamities. The study used text messaging which in the process the researchers thought of using video in the process.

The project has a high acceptability level in the respondents' point of view which gathered a weighted mean of 4.2 with a verbal interpretation of very good.

The proponents are highly recommending the implementation of the project for a better testing in the incoming rainy season and also recommending to be placed in the Pantalan Bridge in Pantalan, Nasugbu, Batangas, Philippines. Suggesting another study for a better water proof casing of the project.

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