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RESEARCH PAPER

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LANGKIWA RIVER WATER DETECTION SYSTEM IMPLEMENTING INTERNET OF EVERYTHING

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Abstract: The goal of this study is to establish a structure and test model that will provide communities with information and early flood warning and notification system and information dissemination for the municipalities of Biñan City, Laguna particularly in Command Control and Communication Centre (City Disaster Risk Reduction and Management Office). Since the study focuses on the design, development and evaluation of instructional research methods, The study focuses on the design, production and evaluation of teaching systems, procedures and products. With the introduction of the IOE, the Langkiwa river water level detection system is a significant aid to the disaster rescue team of the Biñan City local government. It could be a replacement for the municipality's existing manual control scheme. It uses ultrasonic sensor to detect the current situation of the river, and by the power of Arduino microcontroller that serves as the brain of the system that initiates to produce reliable and accurate information, and delivering of messages through GSM modem in a most convenient and fastest way of communication. The proposed project can also be a useful tool for monitoring the impact of global warning, the sudden increase and heavy rain water per year. It keeps the data gathered by the system from the river in database for future study and reference.

Keywords: Disaster Risk Reduction; SMS Notification; GSM modem; Flood Monitoring; Flood Warning System.

I. INTRODUCTION

The recent flood demonstrated the importance of alerting the public to the risks of natural disasters. Given the reality that mobile phone is a handheld device that we almost always keep close to us, it has become a perfect tool for all sorts of warning systems and provides the public with a form of rapid alert delivery. Ultimately, this technology has such enormous potential, which is implemented quite quickly. The researcher's target client is Biñan Command Control and Communication Center (City Disaster Risk Reduction and Management Office). Biñan City has revealed its new modern command center that will support its capacity to fight crime and provide a more effective response to emergencies. Constructed in a 400-square-meter area in front of Biñan City Hall, the command center's two-story building is fitted with top-of - the-line network administration and communications facilities, front-line camera recognition frame and a synchronized system.

II. BACKGROUND

The project entitled Langkiwa River Water Detection System with Implementing IOE, is a combination of both hardware and software components which can monitor the water level and Global System for Mobile Communications (GSM) modem for sending alert to end-user. This project will be deploying in the strategic location which is the Langkiwa river. It will be powered through solar energy so it can stand by its own in case of disaster and power interruption. Solar energy is pollution-free and does not emit greenhouse gases, it also reduces dependence on foreign oil and fossil fuels. Rechargeable batteries will be used for storing of electricity from the solar panel to enable devices to be placed in the Langkiwa river.

IoE is an extension of IoT, it is an entire ecosystem where everything is interconnected. Thus, IoE is a wider concept that includes not only machine-to-machine communication (M2M) but also people to machine (P2M) and people to people (P2P) communication through technology. While the M2M connection is always important, IoE places emphasis on the other two types of communication. The proposed project is a perfect tool that can be used for early detection of water level in the river and a big factor to shorten the process of dissemination of information. Accuracy and reliability of data is guaranteed thru the implementation of IOE.

A. OBJECTIVE OF THE STUDY

The objective of this project is to design a system and create prototype model that will provide information and early warning to the responsible official of Biñan Command Control and Communication Center (City Disaster Risk

Reduction and Management Office) thru SMS Electronic Notification. The study aims the following:

- To create a system that will monitor the water level of Langkiwa River.
- To give a warning when the water level reached the critical level to the Biñan Command Control and Coordination Center (City Disaster Risk Mitigation and Management Office) thru electronic notification.

- To create a webpage monitoring for data trend for the local residence of Biñan City.
- To create a recoverability of the system when the internet connection disrupted.
- To generate an accurate database that will record all the data that will gathered by the system for development of the project and online data viewing.

III. DESIGN OF THE STUDY

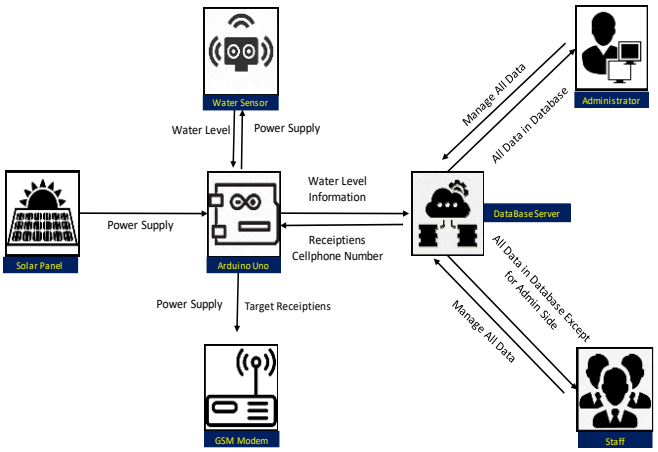

Figure 1: System Architecture

Figure 1 illustrates the relationship with other external entities that the system has. The Arduino R3 Microcontroller and Water Sensor will be powered by solar power that produces electrical energy. The Water Level Sensor will be responsible for collecting input data to the system, the Arduino R3 Module will receive the data to be analyzed by the system from the water sensor and sent directly to the data repository database server. If the critical level detected by the system, it will have triggered and automatically sent SMS to the end user through GSM module. The admin can manage and access all information of the system, and the staff have an access for a certain record or information of the system. The Arduino UNO will be powered by 9V DC from a solar energy battery. Arduino's are directly controlled by the GSM module and ultrasonic sensor with 5V and 3V respectively.

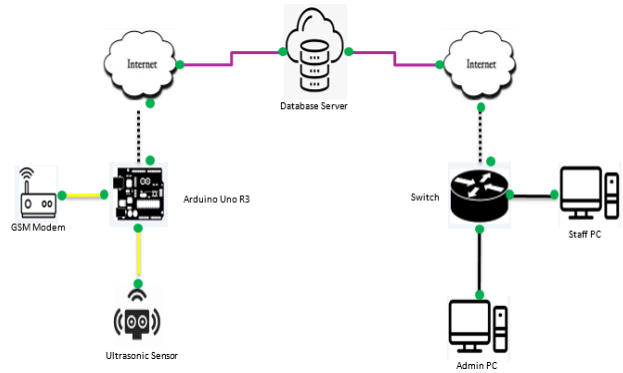

Figure 2: Hardware Interface

Figure 2 above shows the network connectivity of each device. Ultrasonic sensor and GSM modem are connected to Arduino Uno R3 thru modified IOT connection i.e., USB cable and wires. Researchers used a cloud database server for fast and convenient accessibility of data and storing purposes. Internet connection are crucial part of the system to transmit the data back and forth to the devices installed at the Langkiwa River. Admin & Staff PC are connected to a switch; it is also required an internet connection to access the information that stored at database since it is a cloud type of server.

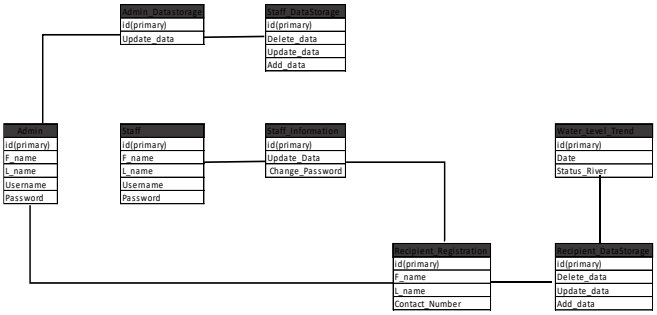

Figure 3: Database Schema

Figure 3 shows the database schema of the system. The admin can update his/her information anytime or as needed. The admin has the full control of the database; he/she can penetrate all the information found in database. The staff has a certain data or limited access to the database.

A. FLOWCHART

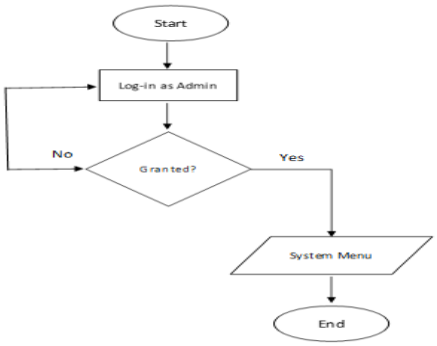

Figure 4: Administration Module

Figure 4 the administrator uses his/her account to log into the web page and, if permission is allowed, the device menu will be shown if refused, returning to the first procedure. The administrator will handle all documents, including recipient information updates, personnel, patterns in water data and password changes. The administrator may also access and query all the records in the database that can be found.

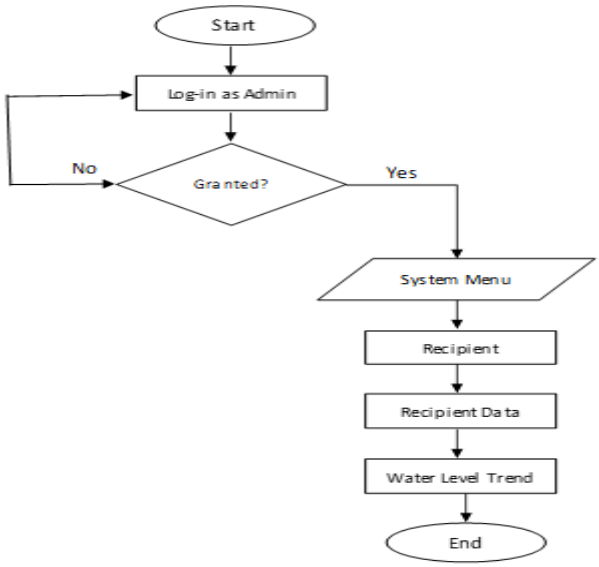

Figure 5: Staff Module

Figure 5 shows The employees can login to the web page using their account, and if access is allowed, the device menu will be shown if refused, returning to the first process. The staff will record the recipients' data, display and query the recipient's data storage data, and view the pattern of the water level. Other data is limited

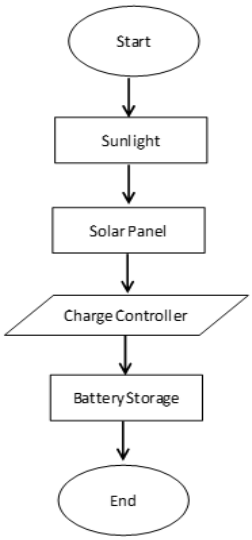

Figure 6: Solar Panel Module

Figure 6 shows the solar panel should be mounted in an environment where free-acquired photons are exposed to sunlight and produce electricity. The electricity generated by the solar panel will be stored in the battery to be used during the operation of the equipment. The functionality of the solar panel, as well as the current state of the battery storage, can be controlled via the charge controller. Charge controllers are also responsible for avoiding overcharging and early discharging of the battery.

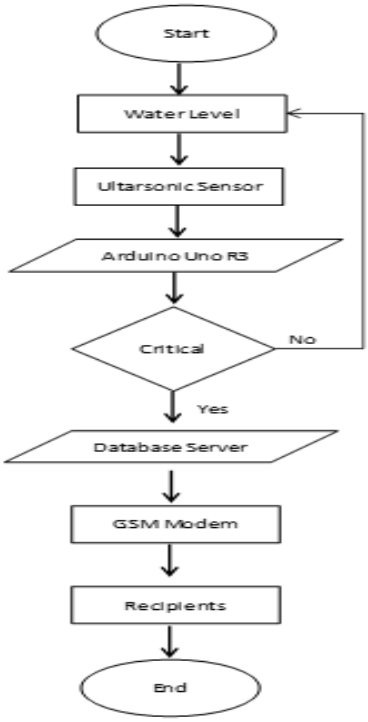

Figure 7: Adruino Uno R3 & GSM Module

Figure 7 shows to make sure that the machines are turned on and connected to the storage battery. The ultrasonic sensor will detect the water level of the river, which is the adruino uno R3 operation. The adruino uno will submit the status of the river to the database server if the water level is important, and the server will process the details of the target recipients who receive the warning message from the system.

IV. RESULTS AND DISCUSSION

Figure 8: Prototype of the System

Figure 8 shows the first goal is to build a system to track the water level of the Langkiwa river, the physical components of which are the reflection of the actual project to be deployed at the river. The Arduino R3 serves as the system's brain, a programmable device that tells the GSM module or gives the command to send SMS if appropriate. The components of solar power are the source of life in the system. It is the duty of the charging controller to protect the battery from overcharging to make it last longer. The battery serves as repository of energy that gathered from the solar panel, and can be use at night-time operation of the system. The aquarium will be use as simulation of the Langkiwa river.

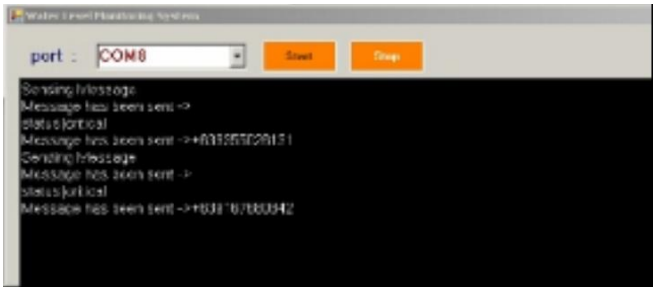

Figure 9: SMS Monitoring Server of the System

Figure 9 shows this SMS monitoring server shows information or descriptions of transactions that have occurred on the river Langkiwa. It shows the number of messages received and the status of the messages sent.

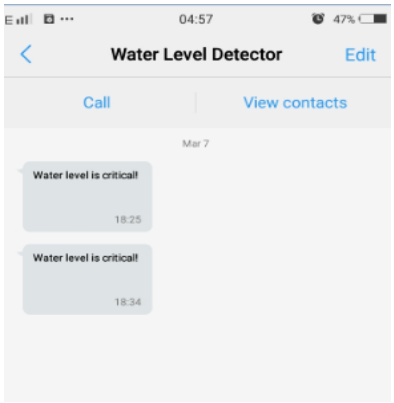

Figure 10: SMS Alert from the System

Figure 10 shows when the water level reach the critical level the system will automatically sent alert thru SMS to the recipient with the above details.

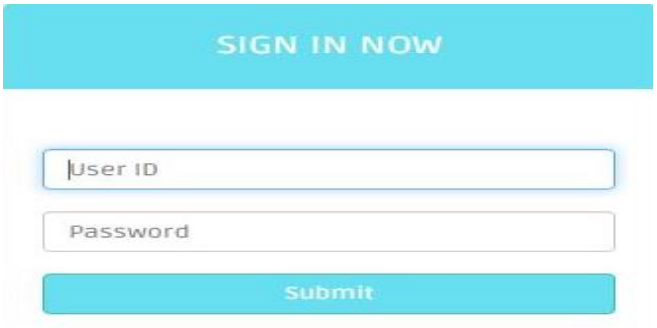

Figure 11: Log in Interface

Figure 11 shows the Log in interface of the system for Admin and User/Admin Staff.

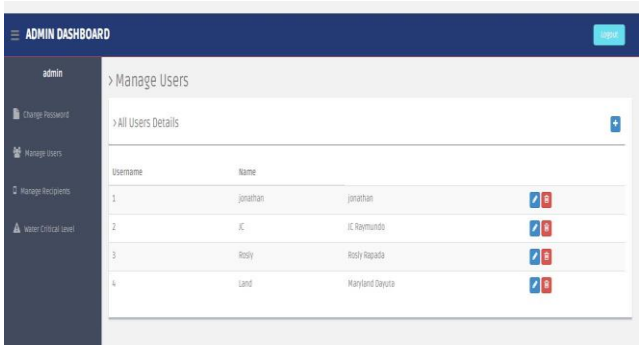

Figure 12: Admin Side System Interface

Figure 12 shows all the information that can be found on the website. Admin can control all the data that stored on the website, from adding, editing and updating of user's/admin staff and the recipient's information.

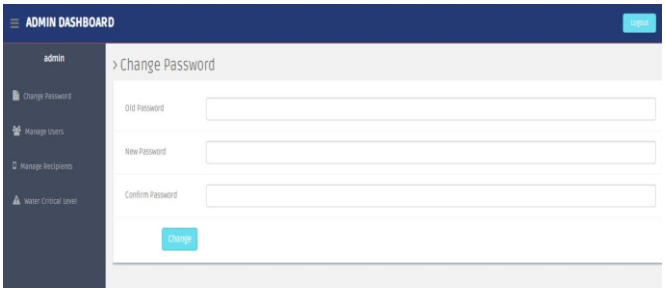

Figure 13: Change Password System Interface

Figure 13 shows the admin side of the system. The admin can change password anytime for the security purposes.

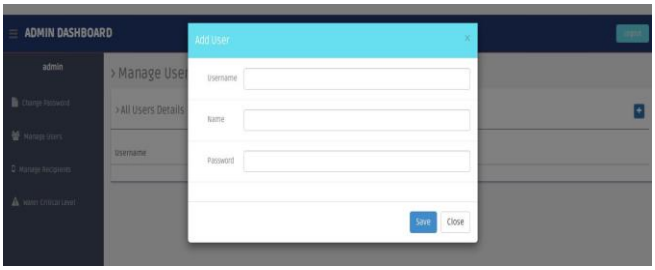

Figure 14: Add User System Interface

Figure 14 shows the system interface for adding user/admin staff.

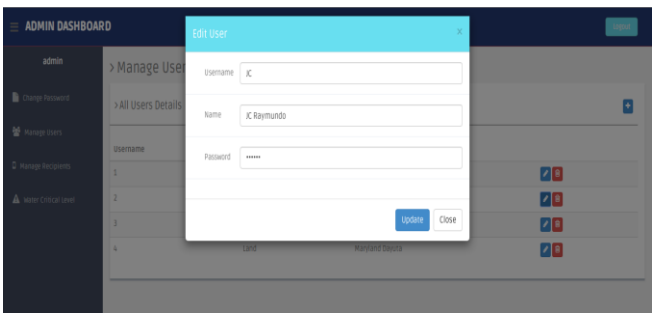

Figure 15: Edit and Delete User System Interface

Figure 15 shows that Admin can edit, update and delete the information of the user.

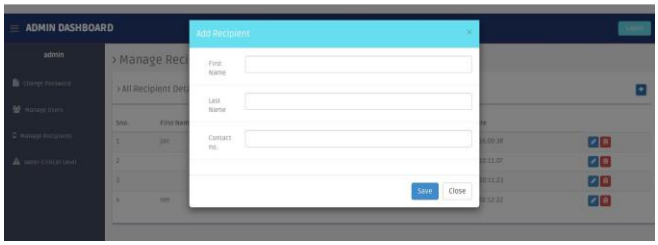

Figure 16: Add Recipient for Admin Side System Interface

Figure 16 shows that admin can add recipients or the receiver of the alert message when the river reached the critical condition.

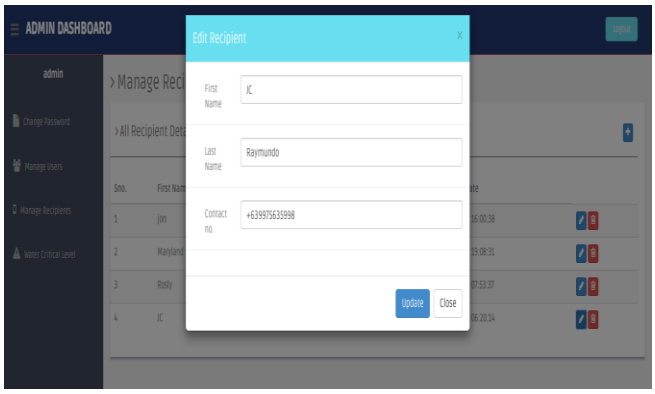

Figure 17: Edit and Delete Recipient System Interface

Figure 17 shows that Admin can edit, update and delete the information of the recipients.

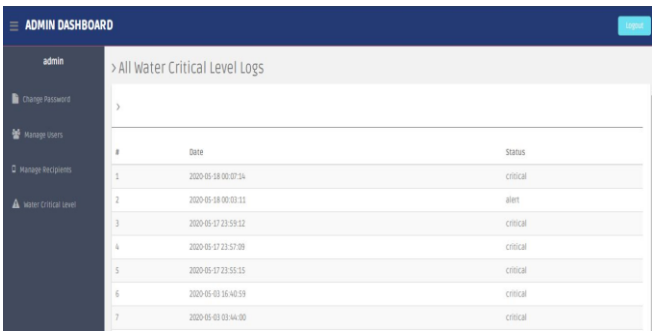

Figure 18: Water Level Critical and Alert Logs for Admin Side System Interface

Figure 18 shows that the last objectives. This is the all Critical and Alert logs data gathered of the system from Langkiwa river. The system displays details of date, time and status of the river. The system record logs only when the status of the river is critical or alert. The information stored will be used for future study and reference.

Figure 19: Log out System Interface

Figure 19 shows the Log-out system interface of either Admin or User/Admin Staff.

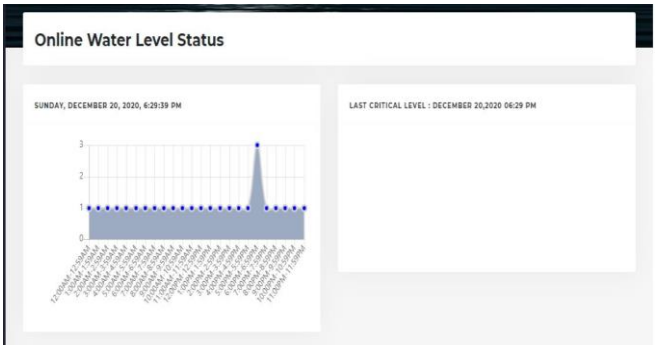

Figure 20: Online Water Data Trend System Interface

Figure 20 shows the online water data trend. This webpage is designed to give an update to the local residence of Biñan, it is presented in a graph chart to easily understood by the end user.

A. SUMMARY OF SOFTWARE EVALUATION OVERALL MEAN SCORE

Table 1- Summary of Software Evaluation Overall Mean Score

Criterion	Mean	Interpretation
A. Functionality	4.63	Highly Acceptable
B. Reliability	4.62	Highly Acceptable
C. Usability	4.61	Highly Acceptable
D. Efficiency	4.62	Highly Acceptable
OVERALL MEAN	**4.62**	**Highly Acceptable**

Table 1 In general, the software yielded a total weighted mean of 4.62 from the 25 respondents which fall on the HIGHLY ACCEPTABLE in the Likert scale. The system received the excellent remark for each criterion, connoting that the system has passed the evaluation and proven its capabilities.

V. CONCLUSIONS

Based on the aims of the study and the results of the evaluation the following conclusions were drawn;

1. The Langkiwa water detection system with implementing IOE, the monitoring of water level of the river will be more easily and precisely, Ultrasonic sensor detect the water level accurately. The implementation of GSM Technology and Arduino

could save time and operation cost of the municipality.

2. The Arduino and GSM Technology, the dissemination of information or alerting the local official will be faster in case of sudden increase of the water level of the river, for preparedness at prevention of possible life lost.
3. The internet technology, the local residents of Biñan City can easily monitor the status of the river in case of disaster or sudden increase of the water level of the river thru the webpage that can be access via browser.
4. The system created by the researcher is internet based system any disruption or failure of internet connection can terminate the system. But being creative and critically thinker of the proponent's the creation of data recoverability is a great help to the local official for monitoring of the river specially during disaster where internet connection is volatile.
5. Data gathering will be easily conducted when needed for the future study, availability of history data can be accessed with the help of internet browser.

VI. ACKNOWLEDGMENT

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