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Testing E-Water Level Alert System to Monitor Flooding in Rivers

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Abstract: The increase of heavy rain has contributed to numerous thunder flood occurrences especially in the area near a river and main drainage. This paper present a water level alert system that has been developed to provide a mean to monitor the water level and send out email alert when the monitoring system sense that the water level has reached a dangerous level. This was done by implementing a e-water level sensor in a flood prone area. A monitoring system will store the water level reading in a database to generate an informative water level graph. This water level graph will then be displayed at the Aqua website, the official website for this research. Public users can browse into this website to get the current water level information for free from any internet enabled devices. Should the monitoring system sense that the water level has reached to a dangerous level, the system will notify user via email.

Keywords: Flood, Water Level Sensor, Monitoring System, Web Based, Email Notification

1. INTRODUCTION

The flood arising in the low ground areas due to rivers overfull each year. This is caused by the river are unable to provide the additional amount of water accumulated during heavy rain and the water overflow to other regions. Flood is one of natural disaster that cause damage to property as well as life's of human being. Flooding in a city is worse adding to the closure of roads, which contributes to heavy traffic congestion in Klang valley and its surrounding area. This paper presents a water level system that able to observe the river's water level for initial flood detection.

This paper proposed to implement a sensor to size the water level in flood area as well as publishing the information through a web-based system. This research emphasize on obtaining the data from sensor and displaying it in real time. This is to offer updated information on the current water level of the river to the community. The monitoring system will analyse the recorded data and generate the pattern of water level that be recorded in the database. Apart from providing up-to-date information to the public, the monitoring system will provide alert mechanism to related personnel via e-mail.

This paper is organised as follows: Section 2 presents the related works of this research. Section 3 describes the methodology used in developing the prototype. Section 4 presents the testing and result. While, Section 5 presents to summarise the paper and recommendation for future work.

2. RELATED WORKS

One technique has been used to monitor river sites and detect flooding by using the microwave radiation using The Global Flood Detection System (GFDS). The modified methodology uses the 36GHz- H-polarization band of the descending (nightly) orbit of AMSR-E with a footprint size of approximately 8 x 12km, available in the level 2A product. The clarity temperature for the observed site over the selected river is extract in order to monitor floods events that occur.

Therefore, based on Malaysian-invented Remote Sensing and Transmission Unit (RSTU), EWARNS™ rainfalls observe the flash flood prediction utilization. They are using the rainfall impact as denoted by the variance in rainfall amplitudes. The web-server is use as 'remote panel' to view data from World Wide Web. The user was able to monitor any changes of rainfall. Hence, the General Packet Radio Service (GPRS) can be used since the high gain antenna capabilities, non, non-coverage areas due to blind spots EWARNS-(2005).

Table-1 Comparison between systems

System / Characteristics	EWARNS VT SOIL TECH SDN BHD	i-FIS Fairuz Azrin Bin Zolkafle and Norlidia Binti Sanip	Public InfoBanjir Department of Irrigation and Drainage (DID) Malaysia	E-Water Level Alert System Norazizul b. Muhamad and Khairul Anwar b. Zainual Rashid
Platform	Web-based	Stand alone	Web-based	Web-based
Alert mechanism	SMS (free trial and paid)	SMS	On site alert at homepage	Email and end system alert
Location	Peninsula Malaysia	Potential flood area	All over Malaysia	Potential flood area

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In Malaysia, Department of Irrigation and Drainage (DID) develop the Online Flood Information System in order to display the location, state, update time, current water level, critical river level and road flooding depth. The system collects information and generate graph for public to view the current water level InfoBanjir (2006), Thus, there have another method that is the public able to receive the Short Messaging System (SMS) regarding to the flood information. I-FIS able to define the water level in any controlled area. The user needs to register to the database in order to receive the information via SMS (Zolkafle, 2011).

(Table-1) shows the comparison between system. A E – Water Level Alert System attempt to take the best of both i-FIS and Public InfoBanjir feature into a better low cost water level monitoring system plus email notification. E – Water Level Alert System aimed to answer the suggestion from i-FIS system that is to develop a back end water level monitoring system with a web-based information centre based on these aspects; "the Web's unbound space/time characteristic implies a global, 24-hour-a-day audience **(**John. 2011), "Scaling a web application is all about allowing more people to use your application. (Royans 2012), a true "real time" application can only be achieved by putting the computation of the requested data and information be performed at the client. (Samsung *et al.,* 2008)

3. METHODOLOGY

Rational Unified Process development cycle have four phases. The phase is Inception phase, Elaboration phase, Construction phase and Transition phase that is to measure the milestones for each phases. It is used to define achievement of the research. The inception phase is to create the product feasibility.

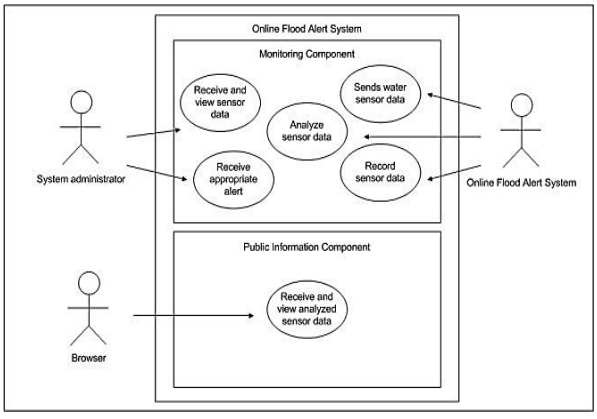

Fig. 1 Use Case

(Fig. 1) shows the core functionalities of the Online Flood Alert System where it depicts the main role of the Online Flood Alert System and what the system administrator and the browser of the website can do. During the construction phase, all components are developed and integrated into the prototype;

i. System coding using Visual Basic 6.0.
ii. Aqua web development through HTML and JavaScript.
iii. Amassing the hardware and device to run the system consisting of the liquid level sensor.

The transition phase is when the software product is ready for testing in real life conditions; Testing to certify the new system against real life potentials; water level recording test, email alert timing test, web browser performance test. Analysing test results to determine whether the system is able to operate to meet the research objectives. Continuous system testing for monitoring system fault and reliability. The Web Based Water Level Monitoring System consists of three parts. First is the water level sensor, second is the administrator's computer that housed the database and the web server for the system and finally the mobile phone representing the public user as shown in **(Fig. 2).**

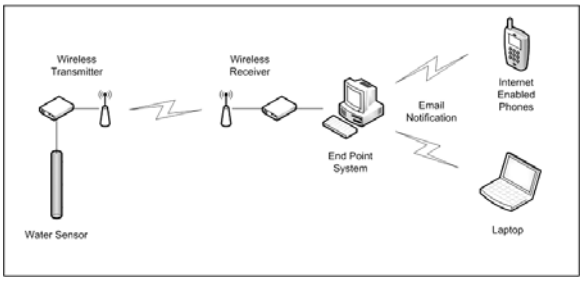

Fig. 2 System Architecture

(Fig. 3) shows the flowchart for the water level monitoring system. The flowchart represents the most basic process flow and core system functionality for the monitoring system.

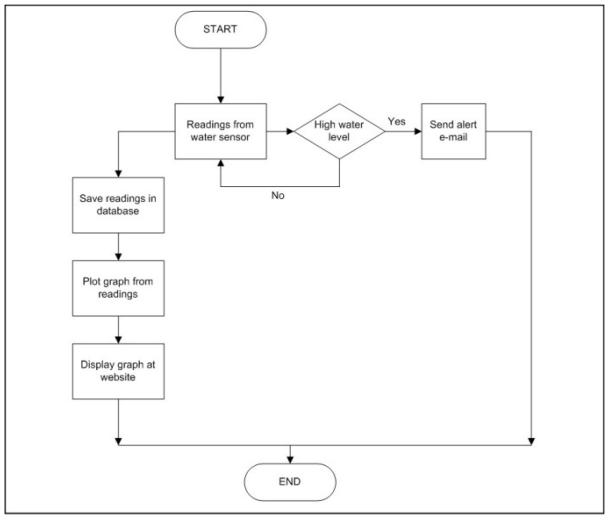

Fig. 3 System Flowchart

In the system development phase, all the critical monitoring system designs and hardware were produced to be used to develop the monitoring system. We used one eTape Liquid Level Sensor eTape 8 inches, Xbee Modules (Transmitter/Receiver) and 40-pin Programmable Interface Circuit (PIC) startup kit Combo 1. Details are below:

eTape Liquid Level Sensor 8 inch (**Fig. 4)** shows the schematic diagram of the Liquid Level Sensor eTape. The tape is connected using alligator clips or by soldering leads to the crimp connectors with low temperature solder. We choose this sensor tape because it is suitable to test and measure the height of water level in the container. The sensor is working very well during the testing. There is no replacement of the sensor while we experiment the prototype.

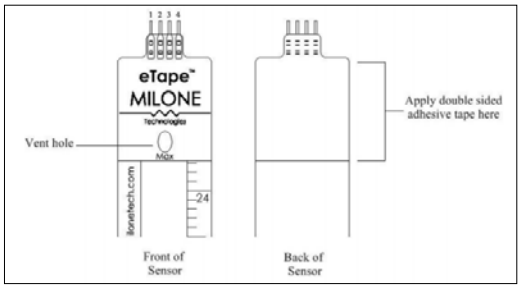

Fig. 4 Schematic Diagram of Liquid Level Sensor 8 inches

The eTape sensor provide a resistive output that is inversely proportional to the level of the liquid: the lower the liquid level, the higher the output resistance while the higher the liquid level, the lower output resistance Mileone Technologies, (2016)

A. Xbee Modules

To develop this prototype, we used Xbee/Xbee Pro RF Network to transmit and receive the data.

B. 40-pin PIC startup kit Combo 1

We choose 40-pin PIC startup kit combo 1 board as the processing board which directly connected plugging in the I/O component

4. TESTING AND RESULT

The completed system has gone through a series of tests to ensure the critical system functions are working as intended to achieve the research objectives. Three tests have been constructed to test each of the system critical function as well as the hardware;

i. Water level reading data recording test.
ii. Email alert timing test.
iii. Internet browser performance test.
iv. Transmitting range and water density tests

4.1 Water level reading test

This test deals with the ability of the monitoring system to store the water level reading received from the sensor into the database. The readings will be compared with the value stored in the database.

As shown in (**Fig. 5)** the values that have been stored I the database are identical with the values represented in the Data List. This test has proved that the system ability to successfully stored water level reading that being received from the water level sensor into the Microsoft Access database.

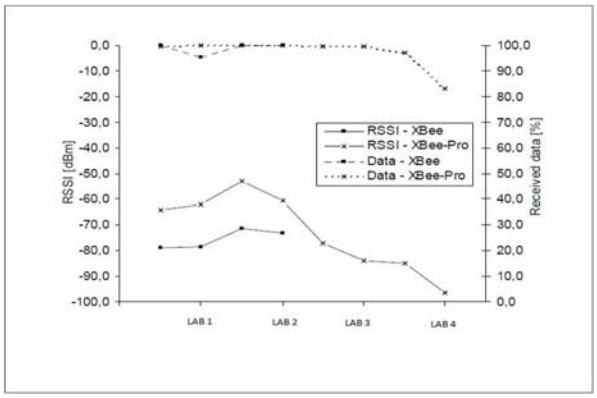

Fig. 5 Water Level Reading in Data List

4.2 Email alert timing test

The average time of all three tests shown in **(Fig. 6)** is 10.15 seconds. Therefore, it is safe to conclude that the monitoring system is able to send out email alert within the recommended time, ensuring the alert reach the recipient as soon as the alert is being detected by the monitoring system.

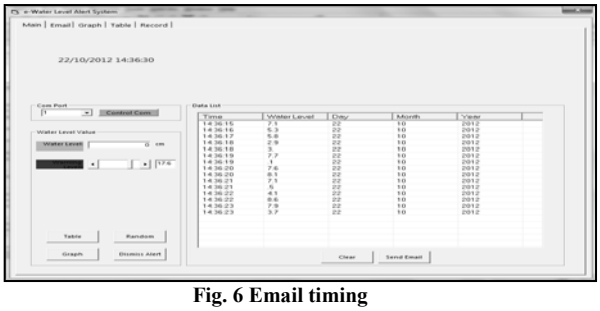

Fig. 6 Email timing

4.3 Internet browser performing test

(Fig. 7) shows result that have been recorded, it is clear that the Google Chrome browser is the internet browser that performed the best in both pages with average loading time of 0.45 seconds for the Water Level Table page and average time of 2.95 seconds for the Water Level Graph page. Mozilla Firefox browser is the second best internet browser to perform in this test, with Opera browser in third and Internet Explorer is the least performer.

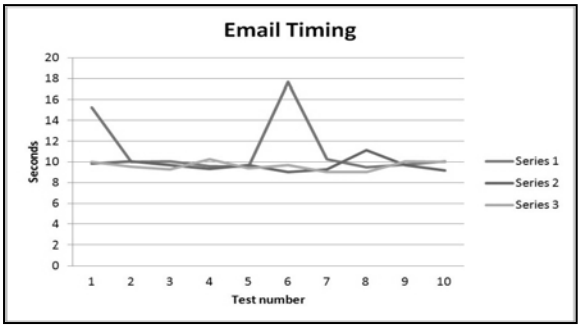

Fig. 7 Water Level Table Page Loading Test

4.4 Transmitting water and density test

The result on (**Table-2)** shows that the liquid level sensor is in effect when calculating the seawater as it is salty and heavier compared to any other liquid. For another result, the sensor is not effective as expected when measuring oil because it is much lighter that the others.

Table-2 Water Density Testing Table

Types of Water	Results
Sea Water (Salty)	Detected and precise
River Water	Detected and moderately precise
Chlorine Water	Detected and not very precise
Oil	Detected but not precise

(Fig. 8) shows the link quality or signal strength status. It depends on the material of the various obstacles and indoor environment for example the wall. For the indoor environment, it depends on how reflections interfere.

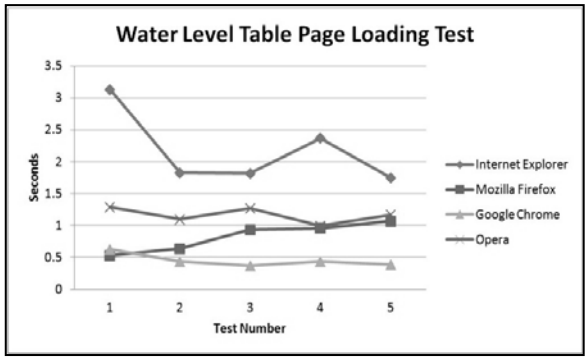

Fig. 8 Measured Packet Received Ratio and RSSI

5. CONCLUSION

As conclusion, this paper proposed the prototyped of E – Water Level Alert System that able to implement a sensor that can be used to measure water level in a flood area and utilizing a website for the public. The status of the water level can be view via website and use electronic mail as the alert notification for the system administrator and from that, they can inform the authorities themselves about any possible flood that are going to occur.

In future, this research able to improve by using solar power as the power supply for the sensor instead of the battery power that is being used currently. An addition of IP camera will give a visual input of the river besides the water level reading. This would add an extra mean of monitoring the water level.

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