Flood Monitoring System (MYFMS)

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Abstract— **This paper presents a design of a flood monitoring system which consists of flood detector, monitoring display and Short Messaging Services (SMS) gateway. Eagle Layout Editor 5.4 software is used to design hardware schematic diagram of the project. Graphical User Interface (GUI) display and Short Messaging Services (SMS) Gateway are developed using Visual Basic 6.0 and Ubuntu Server Edition respectively. Besides, Oracle VM Virtual Machine 4.0.4 is applied to replace hardware into virtual machine. This real time monitoring system is developed to monitor the changes of water level and send an alert to user via a Global System for Mobile Communication (GSM) cellular network immediately whenever a system defined alert condition occurs. This system is targeted to be implemented as a flood warning tool by respective local authorities. This system is cost effective and provides efficient data measurement where the user can easily monitor remotely using virtual private network (VPN) at home.**

Keywords— **Monitoring System, Messaging, Linux, Virtual machine, VPN.**

I. Introduction

Flood is regular natural disasters in Malaysia which happen nearly every year during the monsoon season. Several neighborhoods in the eastern Malaysian state of Sabah, and the states of Johore, Malacca, Negeri Sembilan and Pahang, were flooded after the continuous rain brought by the northeast monsoon winds. Johore is the worst affected country within the five, which number represents more than 30,000 evacuees. During the flood, electricity was disconnected in some districts to avoid electric shock, while some shelters were reportedly to food and water shortages [1].

This disaster is inevitable but with early response and reaction from local authority the destruction can be minimized. Therefore, this flood monitoring system has been designed to help local authority to provide more systematic solution. The overall system can be illustrated in Figure 1.

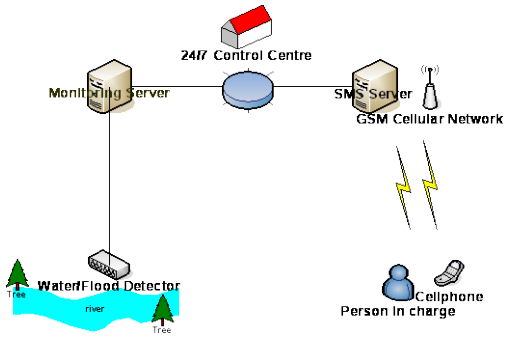

Figure 1: Basic Flood monitoring system

II. Methodology

There are two parts involve in the development of MYFMS which consisting hardware and software design. Hardware part is a process of design the microcontroller and sensor circuit. Meanwhile, in the application part, writing and developing GUI application using Visual Basic 6.0 is carried out. It also involves with developing SMS gateway server using Linux-based operating system in the virtual machine. Both parts should be completed to ensure this system operates properly. This system can be summarized as shown in Figure 2.

Figure 2: Flowchart of MYFMS

The scope of works in this project is described as follows:

a. Design a detector using EAGLE Layout editor 5.4
b. Test the complete design.
c. Fabricate the printed circuit board (PCB) for detector.
d. Assemble all the components on the PCB.
e. Configure microcontroller for detector.
f. Develop graphical user interface (GUI) using Visual Basic 6.0 for result in display.
g. Setup virtual machine using ORACLE VM Virtual Box 4.0.4
h. Setup UBUNTU Server Edition in virtual machine.
i. Setup SMS gateway
j. Setup remote network environment using Teraterm Pro Web Ver.3

A water monitoring system includes detector, monitoring side and warning/Alert side shown in Figure 3.

Figure 3: Simplified block diagram of water monitoring system.

A. Hardware Development

Detector will be installed and placed at the target field such as riverbank and identified low-lying areas. The water level sensor is designed such as in Figure 4.

Figure 4: Water Level Sensor

This system are divided into five levels of changes such as normal zone, level 1, level 2, level 3 and dangerous zone. All analog data collected from detector will be compiled and modulated into digital signal using microcontroller and then will be transmitted to server at monitoring side. In order to complete this process, communication port was used to connect detector and server each other.

The detector is separated into two sections. The first section is a microcontroller and the second section is a water sensor. Figure 5 and Figure 6 shows the schematic diagram for microcontroller and water level sensor respectively.

Figure 5: Microcontroller Schematic Diagram

Figure 6: Sensor schematic diagram.

Water sensors will be located at the selected area determined by user, especially at river and low-lying areas. As requirement, these sensors are used to measure water level either in normal condition or in dangerous zone. This systems identify five difference of water levels which are normal, level 1, Level 2, Level 3 and dangerous. All level will generate electric pulse when it detects presence of water. Microcontroller will compile and modulate into digitize information before transmit it to monitoring server.

In this system, MAX232 was used as an interface between electronic board and monitoring server. The schematic diagram for this interfacing system is shown in Figure 7.

Figure 7: MAX232 Schematic diagram

MAX232 is used as a communication interface between microcontroller to the outside devices such as personal computer or any devices using RS232 protocol. The main function is to convert the RS232 levels down to lower levels, typically 3.3 or 5.0 Volts. Serial RS-232 (V.24) communication works with voltages -15V to +15V for high and low. On the other hand, TTL logic operates between 0V and +5V. Modern low power consumption logic operates in the range of 0V and +3.3V or even lower. The power consumption for this design is shown in Table 1.

RS232	TTL	Logic
-15V … -3V	+2v … +5V	High
+3V … +15V	0V … +0.8V	Low

Table 1: Power Consumption

Thus, the RS-232 signal levels are far too high compared to TTL electronics, and the negative RS-232 voltage for high cannot be handled at all by computer logic. Therefore, in order to receive serial data from an RS-232 interface the voltage has to be reduced. The low and high voltage level also has to be inverted [3].

Computer communication (COM) port is used to communicate between the microcontroller and the computer or server. The digitized information from microcontroller will send the data through the MX232 IC and convert it into RS232 format and received by computer.

B. Application Development

In the monitoring side, raw data from detector will be compiled, analyzed and generated into graphical user interface (GUI) using Visual Basic 6.0 as shown in Figure 8. By using GUI application display, every single variance occurs at water level will be interpreted into graphical interface and appeared in the monitoring server.

Figure 8: Visual Basic 6.0

If water level exceeds dangerous state, this application will communicate to warning/alert side every seconds, minutes or hours depend on how the system is configured. The function of the warning/alert side is to generate a text file and send it to the responsible person in charge e.g. local authorities or police as an alarm for them to take immediate action.

This warning/alert side controlled by one server operated by Linux based operating system. This Linux based machine always in standby mode and ready to receive instruction from monitoring server. This server is developed to generate an alert to user or local authorities by delivering text messaging (SMS). The text message will be activated if water levels reach the dangerous level. The frequency of SMS alert system can be set for every 1 hour or depends on user requirement. This special feature is developed to give user a reminder about current water level when flood occurs.

In this system, Ubuntu is chosen as a SMS server because Linux operating system has managed to stay secure in the realm of widespread viruses, spyware and adware for all these years. It is a computer operating system based on the Debian GNU/Linux distribution and distributed as free and open source software. Ubuntu is designed primarily for desktop use, although netbook and server editions exist as well. Web statistics suggest that Ubuntu's share of Linux desktop usage is about 50% and indicate upward-trending usage as a web server [4].

In line with current technology, virtual machine is used to setup this server. There is a lot of virtual machine software in the market such as VMware, Sun box, Oracle VM VirtualBox and etc. The difference is either it requires license or not. Therefore, Oracle VM VirtualBox as shown in Figure 9 has been chosen as a virtual machine in this system because it is free and no license required. The advantages are it is small, no physical hard drive access and also it almost zero hardware problems [5].

Figure 9: Oracle VM VirtualBox 4.0.4

III. Results and discussion

The set-up for complete Flood Monitoring System (myFMS) is shown in Figure 10. As shown in this figure, the system consists of microcontroller component, water sensor and GUI display component.

Figure 10: Complete Flood Monitoring System

In the monitoring screen, the GUI display shows the date and time, graphical level for each measured water level and also the data for 24 hour as shown in Figure 11.

a) Normal Level

b) Level 1

c) Level 2

d) Level 3

e) Dangerous Level

Figure 11: GUI display for every water level from normal level to dangerous level.

If sensor detects water exceeding dangerous level, the warning alert message will be sent automatically to the authorized user. The template of warning alert message is shown in Figure 12. Thus, with this features, the person on duty can monitor any changes of water level and give immediate response once water level reach at dangerous zone e.g. call local authorities, police and etc.

Figure 12: Example of warning alert message/SMS.

The advantages of using this MYFMS are easy to assemble and dissemble, real time update feature to user or local authorities, easy to update SMS database. In term of computer security, this system is low virus and hacking vulnerability. The use of freeware and no license required make this system cheaper than others in the market. However, this system is limited to monitor and send an alert message only. Local area network (LAN) also is required to link between monitoring side and warning/alert side, without this local area network connection the system cannot be operated properly.

V. Conclusion

The myFMS is successfully designed and suitable to apply as an immediate notification to the respective local authority. This system is designed for ease-of-use and self-guiding so no real training is required. This system also achieved its objective in terms of performance, cost, and flexibility.

There are some recommendations on how to improve the performance of the system in order to make it marketable. This system can be upgraded by adding of GPS module to track the equipment located in the target field such as riverbank or low-lying area. Solar panel equipment also can be used instead of using direct power to reduce electrical power consumption. Hence, at the same time battery will be charged automatically.

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