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Implementation of GSM based Flood Data Communication in the Flood Disaster Location Information System

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Abstract. The frequency of floods that often occur in Indonesia has made floods one of the national disasters designated as national priorities. The flood disaster has caused many casualties and material losses. For the government to anticipate more flood victims, a flood information system is needed that can provide real-time flood information in the form of location information and the level of flood level. Based on these problems, this research article aims to build a flood disaster information system in real-time location-based information using data communication based on Global System for Mobile Communications (GSM). The system design is built in two systems, namely the client system or flood detector consisting of ultrasonic sensor components as input modules, Arduino Uno microcontrollers as processing modules and SIM900 modules as output components. Next is a server system consisting of Wavecom GSM Modem as input component and PHP Engine software, MySQL database, Apache Web Server as data processing. In processing flood information, the client system sends location and water level data using SIM900 in the form of SMS to the server system. The server system processes the data so that it produces information on the location and height of the flood that can be distributed through the website. This study produced a location-based flood disaster information system prototype with data communication between flood detectors and flood information system servers using Global System for Mobile Communications (GSM) media.

Keywords: Information System, Flood Disaster, GSM, Web, Early Warning System.

1. Introduction

Flood Disaster has become a national disaster in Indonesia. Floods have given many victims and property. Floods that occur in general are caused by two factors, namely factors that are caused by illegal logging, resulting in land being unable to hold water in the forest. Water that cannot be detained on the ground will flow as a whole to the river so that the water level rises and flows to the population area. The second factor is due to waste being dumped in the drainage drains of the population resulting in clogging of the waterways and becoming a flood. The cause of these two factors is due to human error. To anticipate the two factors that cause flooding due to human actions a long-term program is needed in the form of making socialization of the importance of public awareness of the environment not to cut trees illegally and littering. Whereas to anticipate flooding in short-term programs is to build an information system that can provide flood hazard warnings and flood monitoring systems.



Based on the short-term program needed for flood disaster management, this paper explains the research aimed at creating a flood location information system that implements a GSM communication system. The information system development program was developed because of government programs that pay attention to government and private agencies to be able to develop research focused on the development of disaster mitigation systems so as to minimize future disaster victims [1].

2. Related Works

Disaster information systems have now been developed from various research centers in various countries. Therefore, a number of studies related to disaster mitigation have been summarized. A study has been conducted to anticipate a house fire disaster that was built using internet communication. In this study, fire information is sent to homeowners through real-time website information using the concept of clients and servers using the internet network [2][3]. Whereas in other studies a similar system has been developed which focuses on web-based flood information using the concept of Internet of Things (IoT) [4][5]. In addition to the web-based disaster information system several studies have developed information systems for victims of mobile-based disasters that are focused on data collection of disaster victims for the needs of regional disaster management agencies [6]. In previous studies the use of internet networks in sending information was the main communication system in the process of distributing disaster information.

In addition to internet communication there is GSM communication that utilizes SMS services in sending information. Information systems using SMS services are also called SMS Gateways. the role of SMS gateway has been applied to the construction project's information progress system [7]. In the information system the interface between the database and modem uses Gammu as its intermediary. Besides that the application of SMS gateways can also be integrated with an RFID-based embedded system for student attendance detection applications [8]. And some of them are used in security monitoring systems [9]. From the application built using the SMS gateway it can send information of an object remotely to the user via GSM communication [8]. For the application of disaster information systems, it has used GSM communication systems such as fire and flood information systems. has provided benefits in the flood disaster information system process using SMS services [10,11,12].

3. Method

The research method of making a flood location information system uses two stages, namely the system analysis stage and the system design stage. At the stage of the system analysis explains the work process of the system as a whole starting data collection to the information that will be displayed to the user. While the second stage is a system design that aims to provide a description of the required components and a description of the integration between each component in the form of a block diagram.

3.1. System Analysis

Analysis of the location information system begins with a sensor that detects the height of the flood through a flood detector system. The data received by the flood detector is processed to produce a data format for the purposes of sending data in the form of SMS to the information system server via a GSM modem. Altitude data received by the flood location information system is stored in the database server. The results of the flood data processing are sent to the flood monitoring officer as seen in figure 1.

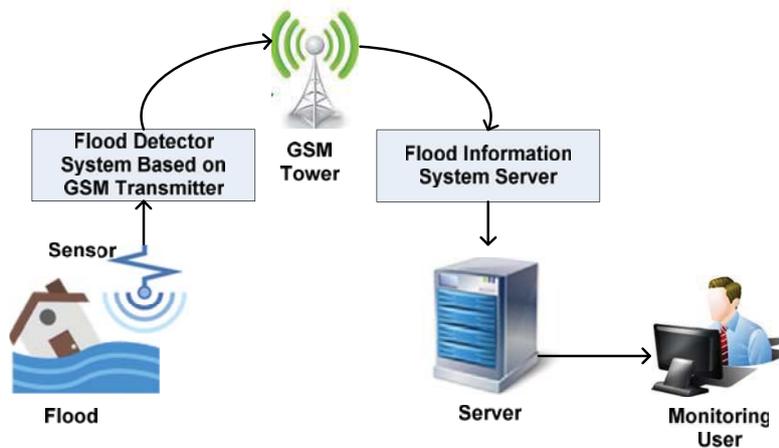


Figure 1. Description of the flood location information system.

3.2. System Design

For the design of the flood detector system and flood location information system, it is made using block diagrams as seen in figure 2. In figure 2, it can be seen that the system is divided into two, namely flood detector systems and flood information systems. In the system detector there is an ultrasonic sensor as an input block that sends data to the Arduino Uno Microcontroller as a processing block. Data that has been processed in the processing block is sent to the GSM modem to send data using the SMS Gateway service to the flood information system. In the flood location information system the data will be received by the GSM mode as the input block. Data from the modem is forwarded to the Gammu application and MySQL database. Flood data on MySQL databases is processed using PHP Engine and displays in the form of information via a web server. In the process on Gammu, MySQL, PHP and Web Server are activities on the exposure block. While the output block is a web browser as the interface between the information system and the user.

In this study the components used by the flood detector system are the GSM SIM900 Module, Arduino Microcontroller, HC-SR04 Ultrasonic Sensor. Whereas the flood location information system uses the GSM modem Wavecom as data receiver, Gammu application, MySQL, PHP and Apache Web Server.

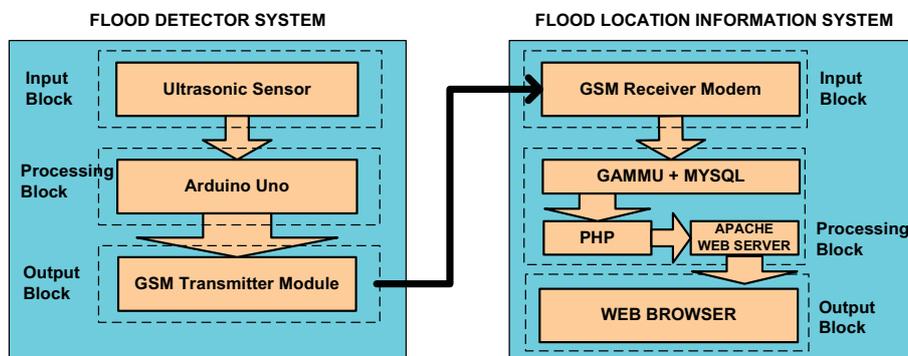


Figure 2. Block diagram of flood location information system.

4. Result

Based on system analysis and system design for flood location information systems that have been created, this study produced a prototype flood location information system consisting of two prototypes namely flood detector system and flood location information system. In the flood detector system shown in figure 3 that the system was built using an ultrasonic sensor, Arduino Uno Microcontroller and GSM SIM900 modem. Whereas in the flood location information system there is a GSM modem Wavecom as the data receiver that is connected to a computer that is used as a server.

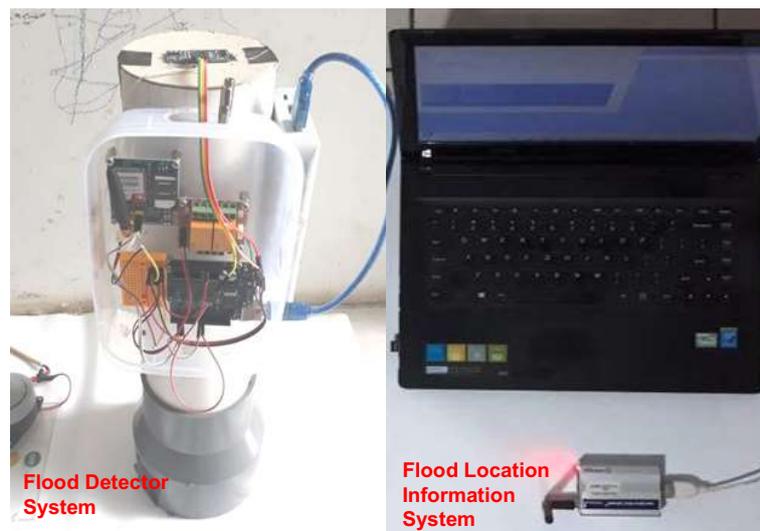


Figure 3. Results of prototype flood detector system and flood alarm.

In testing the flood detector system, an Arduino IDE is used through a serial monitor to see the effect of simulation of increasing flood water. This test is done by giving different heights starting with the height of 0 cm, 2 cm and 7 cm as seen in figure 4. At an altitude of 7 cm, the flood detector system will send altitude and location data using the SMS gateway to the flood information system. In this test the algorithm used is if the height ≥ 5 cm then send an SMS. Furthermore, if the height ≥ 5 cm and the next height data with the previous height data, there will be no sending of SMS.

Testing with a height of 11 cm will send data via SMS at one time and at a fixed height at 11 cm there will be no SMS sending as seen in figure 4. Location detector systems have permanently stored location variables when the flood detector system program is uploaded. And in testing and simulation using two detectors with different location variables.

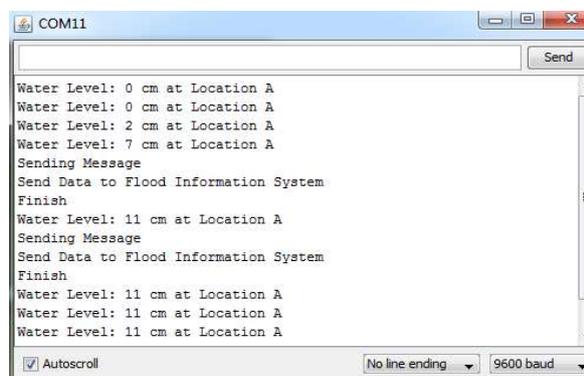


Figure 4. Flood detector system prototype test results.

In the flood location information system prototype generated web-based interface with information in the form of date and time when the flood height change data is stored in the database. Next the system interface displays the location of the flood and the height of the flood in centimeters. In this study testing uses two flood detectors with different locations as shown in figure 5. Information displayed on the flood information system will change if the flood level changes and is followed by the date and time.

Flood Disaster Location Information System
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Monitoring Flood Level Based On Location				
No	Date	Time	Location	Flood Level
1	2018-10-24	11:25:00	Location A	11 cm
2	2018-10-24	11:37:00	Location B	25 cm

Figure 5. Results of flood information system testing.

5. Conclusion

Based on the results, the flood location information system that uses GSM communication has been successfully tested by sending flood height data from the flood detector system to the flood location information system through GSM using SMS services so that users can see changes in flood height based on location through the flood location information system web-based remotely. From the testing of the two prototypes produced this can provide benefits to government agencies that have areas of flood disaster mitigation in anticipating flood victims in flood-prone areas. the system that has been built is limited by the system being able to send data as long as the SMS quota is available, the flood level is no higher than the construction of a flood detection system and at the time of experiment resources use a power bank or battery. As for future research, it is necessary to develop a higher flood detector using internet of things (IoT) technology which is accompanied by resources using solar cells.

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