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Implementation of GSM Communication on Flood Monitoring Systems Based on Multiple Locations Visualization

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Abstract: ***Flooding is one of the national disaster tragedies that currently often occurs in various countries. Therefore the government encourages various government, private and community institutions to develop disaster mitigation systems. Disaster mitigation systems are short-term programs aimed at reducing disaster victims. Therefore, this paper aims to describe the results of research in building flood monitoring information systems by developing flood data visualization systems in many locations. The system as a whole consists of two systems namely a flood detection system as a client and a flood monitoring information system as a server. the two systems communicate in sending flood data using GSM services, namely SMS. Flood detection systems are designed using ultrasonic sensors, temperature sensors, rain sensors, Arduino Uno microcontrollers and GSM modules. While the flood monitoring information system server was designed using a GSM modem, web server application, mySQL database, PHP engine and Gammu. The results showed that the flood detection system can send flood data consisting of flood locations, water levels, temperatures and rain conditions to the flood monitoring information system using SMS. SMS data received can already be converted by a flood monitoring information system server to a flood visualization-based interface for many locations in real time.***

Keywords : Early Warning System, Visualization, SMS Gateway, GSM, Information System, Flooding.

I. INTRODUCTION

Indonesia as a tropical country is a country that has a tendency to be a disaster-prone country. Disaster-prone can be seen from the many natural disasters that have occurred in recent years. The location of the country on the transcontinental fracture path makes it very prone to disasters so that it is not uncommon for earthquakes or volcanic disasters.

arthquake and volcanic disasters are disasters that are often associated with natural influences. In contrast to floods, floods are disasters caused by two causes, namely natural influences and human influences. Natural factors are often experienced due to the effects of global warming, tsunamis and other natural influences. While the influence of humans can be seen in the over-exploitation of forests, resulting in forests unable to store water. The forest cannot store water resulting in flooding.

Based on many current disasters, especially floods that hit Indonesia or other countries, the role of government and society is needed in overcoming various solutions to anticipate more human and material casualties. To anticipate it, there are several programs that the government often does with the community, namely the long-term program. The long-term program in dealing with floods is to make socialization about the community's concern for the environment in general such as not over-exploiting forests and throwing trash in its place.

While the short-term program carried out by the government is to encourage the private sector and research institutions in building disaster mitigation systems to reduce victims of natural disasters.

Based on the short-term program, this paper aims to describe the design of flood disaster monitoring information systems in real time. The flood disaster monitoring system developed is an information system that applies a flood visualization system in several flood locations simultaneously. In general, the system is divided into two systems, namely flood detection workstation systems as clients and monitoring information systems as server applications.

II. LITERATURE SURVEY

The presentation of the development of a flood information system that applies a real-time flood data visualization system is based on the development of systems that have been built by previous researchers.

From a number of surveys collected, there are several jobs related to the flood information system developed further. Some of the initial research that was discovered was an early warning system that used a proximity sensor in determining the water level. The sensor used in this study is an ultrasonic sensor. Ultrasonic sensors work using a trigger and echo system to determine the distance from the center of the signal transmitter to the object being measured [1][2][3].

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To process sensor data from a flood detection system requires a microcontroller such as an ATMEGA238 microcontroller. The microcontroller works mono-tasking and has a small memory so that data processing is faster [4]. Arduino has many libraries to develop various embedded system applications such as prototypes in the field of disaster mitigation. The libraries were developed by many developers who volunteered to develop various types of sensor libraries and other algorithms [5]. The integration of Arduino with ultrasonic sensors in disaster applications is the measurement of river water levels and velocity [6]. While the data delivery system between client and server information systems can be done in a variety of communication media services such as the internet, radio frequency and GSM. Disaster information systems have used these three data communication systems.

This paper discusses the use of data communication media using GSM. SMS Gateway is one of the services provided by GSM in many of the communication services it provides. Some research on disaster information systems has used SMS Gateway including the use of SMS Gateway services in flood warning systems for villages and community information [7]. Next is an SMS-based flood early warning system [8][9]. And followed by a location-based flood early warning system using GSM communication [10]. Besides its use in flood disaster information systems, GSM services are also used in fire early warning systems [11]. In addition, the communication system in the flood information system using the Wireless Sensor Network system using GSM services has been implemented as a data transmission medium [1], [12], [13].

The studies conducted above can be concluded that the final result of the study is a prototype that displays data values in real time with the user interface using text and mobile-based display on its users. In contrast to other studies that are displaying visualization of floods in real-time to find information on the state of water levels in flood conditions [14]. In this study the data communication system still uses the SMS Gateway. However, the visualization carried out on the research is still done for one workstation. Therefore, this paper aims to build a flood visualization system in the conditions of many workstations. Besides that, the system developed in this paper works in real-time using an SMS-based data delivery system. In this study the data transmission is carried out by flood detector worstation to the flood monitoring information system server continuously. And the visualization-based information system can be accessed by users through an internet browser interface from a flood monitoring information system web server.

III. METHOD

The method of making a flood disaster visualization system for multiple locations is done in two stages, namely the system analysis stage. At the stage of system analysis will describe the system work system in general. And the second stage is system design. The design phase will explain the material requirements for the design of flood detection systems and the design of multi-location flood visualization systems.

A. System Analysis

The system analysis stage can be described as Figure 1. In general, the work system has several flood locations, namely flood 1, flood 2 and N. flood locations. Each of these locations has a flood detection system. Each flood detection system sends data to the flood monitoring system server using GSM communication media. The GSM communication service used is the SMS Gateway. The flood monitoring system server processes the data to produce a flood visualization that can be accessed by the user. Users access the flood visualization system through a browser.

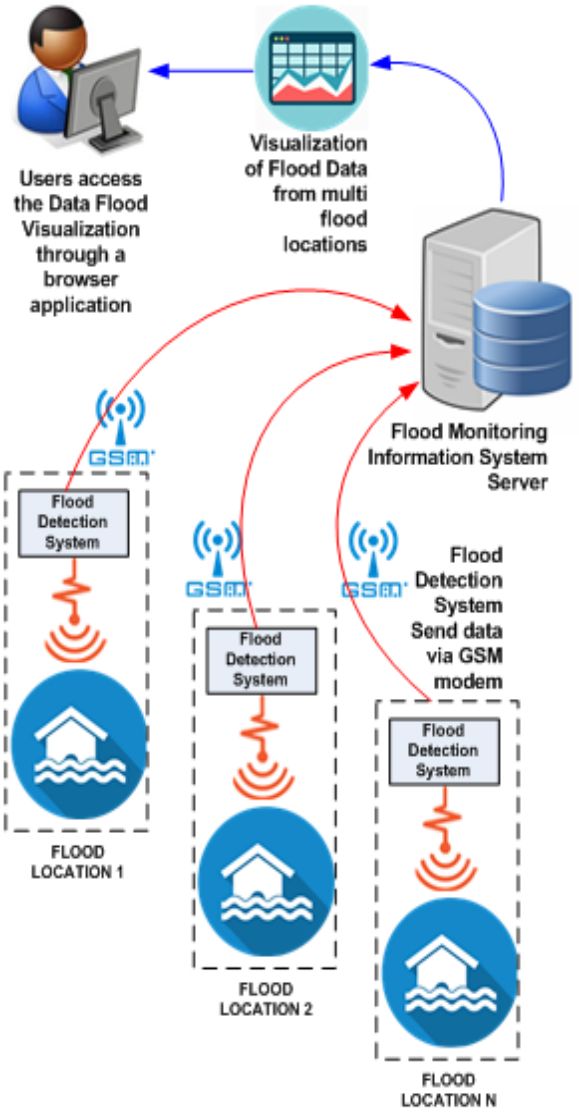

Fig. 1.System Analiysis

B. System Design

The second stage is system design. The system design in this paper explains the material requirements as shown in Figure 2. The prototype designed consists of two parts, namely the design of a flood detection system and the design of a flood monitoring information system. In the flood detection system is built using several sensors as input including ultrasonic sensors to measure water levels, rain sensors to determine the rain conditions and temperature sensors. The sensors are connected to the microcontroller as a processor. The results of the processing of sensor data will be sent to the flood monitoring information system server using SMS through the GSM transmitter module.

While the design of a flood monitoring information system that will display flood visualization was built using GSM receiver modules, server applications, web programming and SMS gateway applications. All requirements of a flood monitoring information system are installed on the server computer.

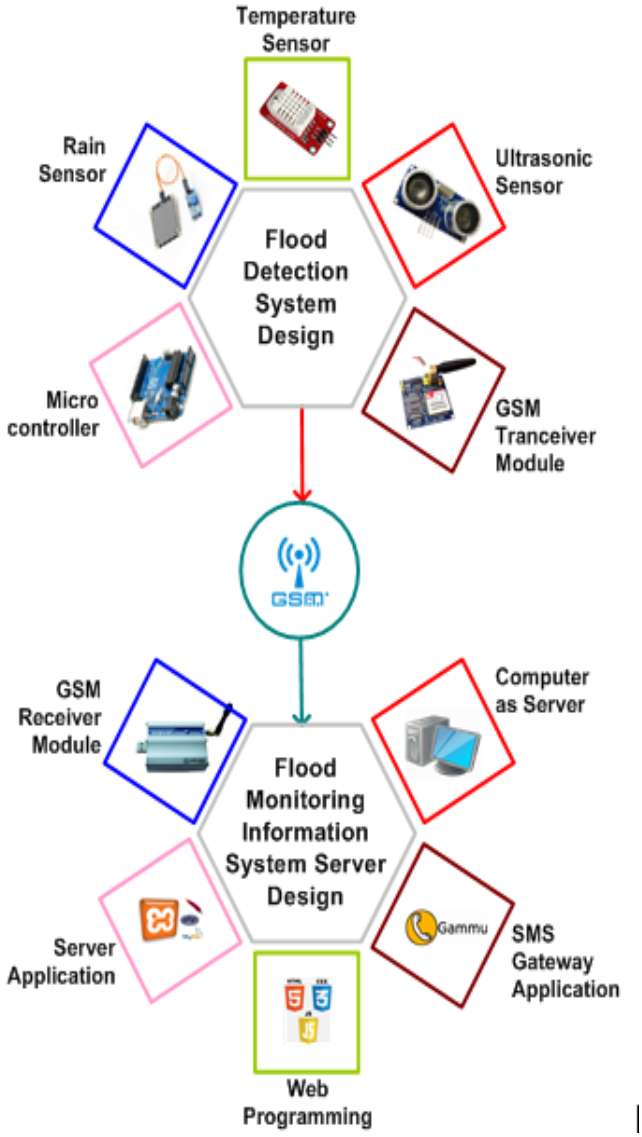

Fig. 2.System Design

The data communication system between the banijr detection system and the flood monitoring information system uses the SMS format as shown in Figure 3. The SMS text format sent by the flood detection system is no_location # value_sensor1 # value_sensor2 # value_sensor3. With this format the modem sends an SMS to the information system server. The flood monitoring information system server will change the format of the data into several variables, namely no_location to location, value_sensor1 to sensor_us, value_sensor2 to sensor_temp and value_sensor3 to sensor_rain.

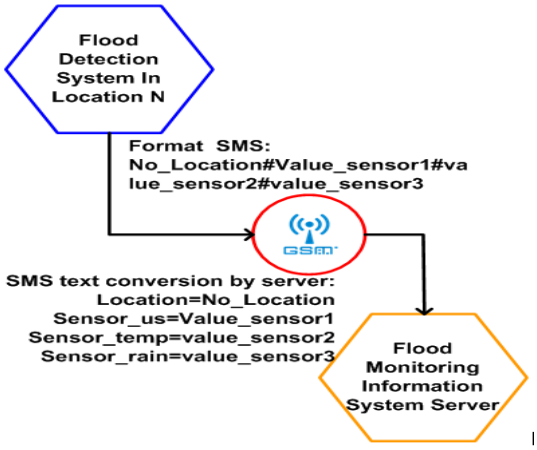

Fig. 3.Flood Data Format through the flood detection system to the flood monitoring information system server

IV. RESULT

Based on the design of a flood visualization system on a flood monitoring information system, the results that have been built are the flood detection system as shown in Figure 4. The flood detection system that was built uses a paralon pipe as a container for measuring water levels. The pipe used has a height of 60 cm. On the inside of the pipe there are buoys as height markers and as height objects detected by ultrasonic sensors. Next, the prototype system is placed in a system box consisting of an Arduino microcontroller equipped with input components, namely ultrasonic sensors, rain sensors and temperature sensors. And the output component is the GSM transmitter module. All input, processing and output components are placed in the side position of the flood detection pipe.

Flood detection system work system is every increase of water by 1 cm, the system will send data via SMS with the data format for the North location is "NORTH # 15 # 32 # NO RAIN". When the height value and other sensor values are the same the next time there is no SMS sending. Data transmission is sent if there is a difference in value from the sensor. In testing the flood detection system, GSM operator data quota is ignored.

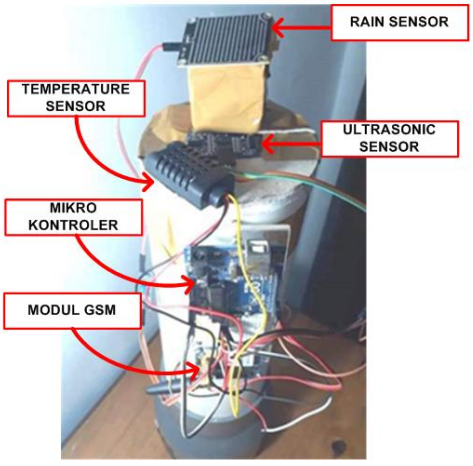

Fig. 4.Flood Detector System

Furthermore, the data sent by the flood detection system will be received by the information system modem as shown in Figure 5. The modem will send data to the mySQL database using Gammu application.

Fig. 5.The server is integrated with a GSM Modem

The flood monitoring information system application will make data conversion from the flood detection system to location = NORTH, sensor_us = 15, sensor_temp = 32 and sensor_rain = no rain. With the converted value, the flood monitoring information system will display the visualization of flood in real time as shown in Figure 6. In the visualization that is displayed there are several components displayed, namely the height of the flood with animated water level that moves according to the height value in the flood detection system. Next, name the location, temperature, rain status and hazard warning status. While the loudspeaker icon is a menu to stop the sound of the hazard warning generated by one of the visualizations of the flood detection system station that has a hazard status.

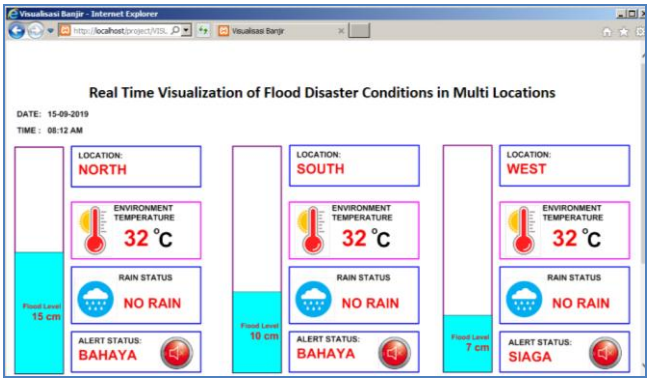

Fig. 6.Multi-location flood visualization interface

From the two systems that were built to give results in accordance with analysis and design. In the simulation for testing carried out by using three detection systems

flood. At the testing stage there are obstacles, namely the time of receiving SMS. The time of receiving SMS data on the server has a varying time in the span of a few seconds from each incoming SMS. Therefore, in the simulation the test conducted has given satisfactory results, namely the flood detection system as a client has succeeded in sending data using SMS and the flood information system server has been able to receive and display data in the form of visualization of floods in real time.

V. CONCLUSION

Based on the literature review conducted, this paper describes the development of a new system of flood information systems, namely visualization of floods in many locations in real-time. So therefore the conclusion of the presentation of the results of this study is based on a system analysis as a whole, namely from several flood detection systems sending data to the flood monitoring information system server using SMS gateway. And based on the design of the system produces a prototype of a flood detection system with material requirements namely ultrasonic sensors, rain sensors and temperature sensors as input components, Arduino Uno microcontrollers as processing components and GSM sending modules as output components can send data on water level, temperature and rain status through SMS to the flood monitoring information system server. And the flood monitoring information system server consisting of a GSM modem receiver, web server application, mySQL database, PHP engine and Gammu successfully received SMS data. Besides that the server also corrects the SMS data sent from the flood detection system to data in the form of visualization of flood data at many locations in real time.

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