Visualization System for Water Levels and Environmental Conditions in the Flood Monitoring Information System

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Abstract*: *Flood disaster is a national disaster that takes a lot of victims and material for now. The government nationally implements short-term programs to anticipate disasters by supporting the various government and private institutions in developing disaster mitigation systems to reduce sustainable casualties. Based on this support, this research aims to develop a flood monitoring information system by implementing a real-time flood visualization system. System development is done by making two systems, namely hardware-based flood detection systems that are used as client systems and software-based flood monitoring information systems as servers. Flood detection systems are built using ultrasonic sensors, temperature sensors, rain sensors, Arduino microcontrollers, and Sim900A GSM modules. On the flood monitoring information system server using the Xampp component as a server application and Gammu as an SMS application. The communication system between the two systems uses the SMS Gateway communication system. The parameter values sent through the flood detection system will be visualized by the server in the form of animation and text. From the research, it was found that the flood detection system as a client has been able to send flood data, temperature, and rain conditions in real-time. And flood monitoring information systems have been able to capture data from client systems and store them in MySQL DBMS.

Keywords*: *Early Warning System, Information System, Flood Disaster, Visualization, SMS Gateway

I. INTRODUCTION

Flood within the scope of a national disaster is a disaster that often occurs in the tropics. The rain that is driven by natural symptoms that are not balanced causes floods to occur. The issue of global warming is a global issue that brings flooding as one of the invoices it affects. The danger of flooding has taken many victims from the material and lives. The problem of the effects of flooding due to global warming is something that has little impact on flood-prone areas. However, forest exploitation is a strong influence of floods. Forests are a gift of nature in saving water. If the forest is damaged, the water storage system will create a disaster for humans.

Currently, to anticipate floods requires the role of government and society in finding solutions. The solution can be in the form of long-term programs and short-term programs. In the long-term program is socialization to the community about the importance of forests for life and reforestation of forests. in the short term is building a flood monitoring system. The flood monitoring system is a system that can directly monitor the condition of the first flood-prone place. Flood-prone places are the first points of water to fill an area determined as an indicator of flooding.

The use of a flood monitoring information system is the first step in mitigating flood disasters [1]. Therefore, based on the importance of disaster mitigation technology, the government supports various sector institutions to develop technology engineering models to build mitigation systems that can quickly detect disasters.

Current disaster mitigation technology is important for the government in reducing disaster victims. Therefore many disaster mitigation systems such as flood information systems have been implemented by various government parties. The current flood information system is still focused on the indicator value of the variables sent by a flood detection system. Display of flood indicator values and several other indicators are still using the value display only. We know that the display in the form of visualization can provide user responses in overseeing an indicator.

Based on the linkages between flood monitoring information systems, a visualization-based interface is needed. An interface which illustrates the visualization of floods in a flood monitoring information system is needed to facilitate the operator in monitoring the flood conditions remotely.

This study aims to build a flood monitoring information system that is integrated with the visualization of flood conditions in the form of animation. Visualizations in the flood monitoring information system can be accessed via the web by the flood supervisor operator. Flood monitoring information system consists of two systems, namely flood detection system as a client and flood monitoring information system as a server. The two systems of communication systems use communication via GSM, the SMS Gateway.

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II. LITERATURE SURVEY

From the experience of researchers before then there is some research work related to flood information systems and the use of GSM as data communication. With the information and experience that has been carried out by the research work, an idea for further system development can be obtained.

Research work involving flood early warning systems and flood information systems has been carried out by many studies. Among them using a flood detection system using ultrasonic sensors as input in detecting flood levels [2][3]. In a flood information system, an ultrasonic sensor is used to measure the distance between the sensor and the surface of the water [4]. To process flood data, some researchers use a microcontroller as a processor that has capabilities such as microprocessors that have low memory usage and mono-tasking [5]. Microcontroller type ATMEGA 238 is often used in many prototype applications. And some of them are built-in Arduino board packaging as a data processing media [6]. Arduino is an open source-based board and is easily applied in various embedded system applications such as industrial applications, disaster mitigation, and environmental management [7]. One of the uses of Arduino and ultrasonic sensors is the measurement of river height and river current speed [8].

Some studies build communication systems between clients and servers using GSM, internet, and Wireless Sensor Network communications. A study using GSM communication is sending flood information using SMS Gateway [9] [10] [11][12], and some GSM applications are used in fire early warning system applications [13]. In addition, the communication system in the flood information system uses the Wireless Sensor Network system as a medium for sending flood data [2], [14], [15].

From several studies conducted the output produced in the form of an SMS-based text interface and is intended for users. Some prototype outputs are in the form of numbers, and text displays of flood indicators received in real-time. From this research, there is no information system based on the real-time visualization of flood indicators built. Therefore this study aims to create a visualization system for flood monitoring in real-time using the web as an interface. System operators are officers who can access the flood visualization system.

III. METHOD

The research work is the development of a monitoring information system that applies a visualization system for flood disasters in real-time using the Software Development Life Cycle (SDLC) methodology. The general stages that he uses are system analysis and system design. In the system analysis is describing the process of using the system in general from client components to server and user components. While the system design stage is describing the need for tools and materials that support the making of the flood monitoring information system.

A. System Analysis

Analysis of the system contained in Fig. 1. can be explained that first, the flood detection system will detect water levels. Furthermore, the flood detection system will send the data of flood height, rain condition and temperature to the flood monitoring information system server using data transfer via SMS. Data entering the flood monitoring information system will process the data in the form of a database and visualization in real-time. Data that is processed into information and visualization is displayed in a browser accessed by the operator user.

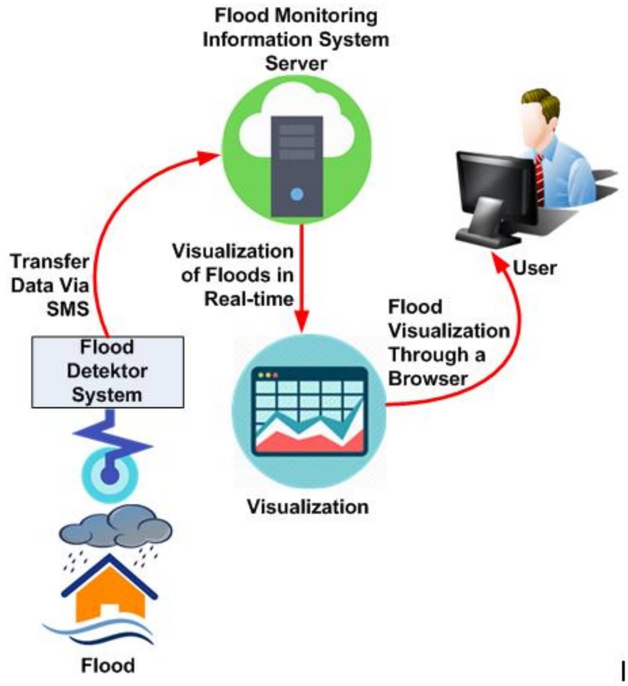

Fig. 1.Analysis of How the System Works

B. System Design

System design is the second stage, which processes the general picture of the system into more detailed stages. The detailed stages here are the stages aimed at providing an overview of the requirements needed to create a flood monitoring information system. as shown in Figure 2, the system design consists of a flood detection system block in the form of hardware components. Second is a block of flood monitoring information system in the form of software components.

In the hardware component, there are input components, namely ultrasonic sensors, rain sensors, and temperature sensors. Ultrasonic sensors function to detect the distance between the surface of the water and the sensor. Rain sensor functions as a component of detecting rain or no rain conditions. While the temperature sensor is a sensor that functions to detect the ambient temperature around the flood detection system. The ultrasonic transducer used in this system is HC-SR04 type. For rain sensors use a standard type sensor. While the temperature sensor uses a DHT22 type sensor. The three sensors are processed by Arduino Uno as a processing microcontroller. The processing results in information that is sent to the SIM900A GSM module.

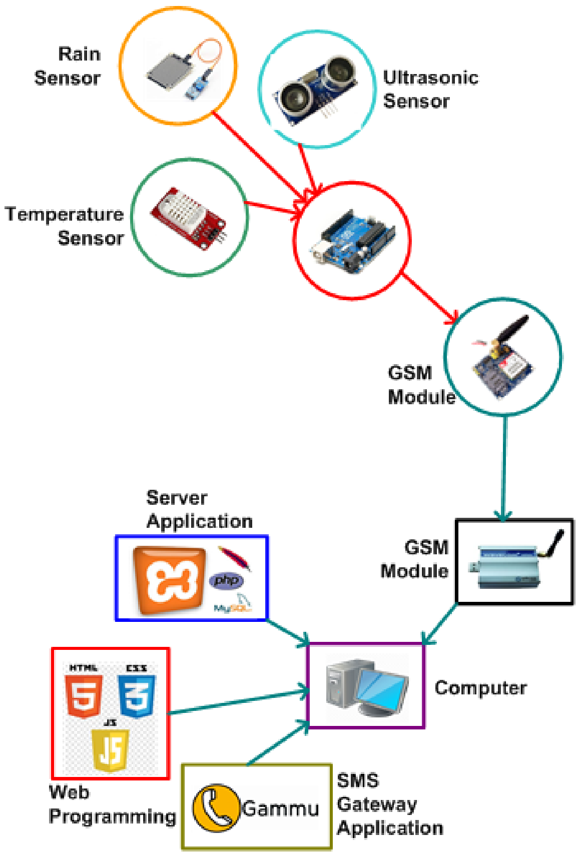

Fig. 2.Monitoring Information System Design

Next, in Fig. 2. There is a block of software systems, namely flood monitoring information systems, there are several supporting software, namely Xampp, Web components, and Gammu. Xampp is a server application consisting of a PHP engine that functions as a PHP programming language processing engine, Apache Web Server as a Web Server application and MySQL is a database management server. In the development of the server component system manages the data received from the flood detection system to be stored in a database and can be accessed by users. While the web programming component is a component of web creation and flood visualization. The web is built using HTML and CSS. Whereas visualization was developed using Javascript.

From both systems, the data communication is handled by the GSM SIM900A module as the sender of information to the flood monitoring information system server. The Wavecom GSM modem is a component receiving data from the server. The system transfers data from the flood detection system and to the server using the SMS Gateway service.

The third stage is the design of the context diagram in Figure 3. The context diagram describes the tasks of each system up to the user. First, the flood detector system takes data on flood height, rain conditions, and temperature. The data is processed by a flood monitoring information system that is integrated with real-time flood visualization whereas the operator accesses flood, rain, and temperature information in the form of visualization of a flood monitoring information system.

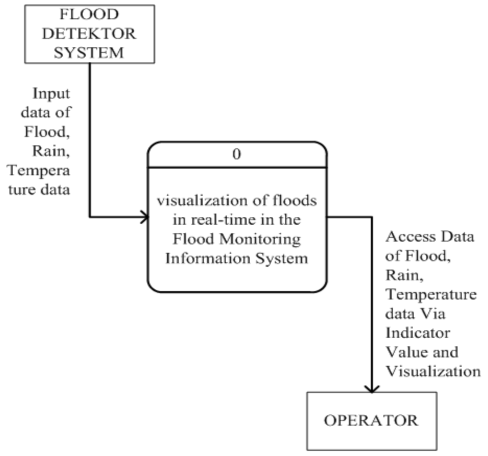

Fig. 3.Context Diagram Design of Flood Information System

IV. RESULT

Based on research work carried out using the system analysis method and system design described in the previous chapter, the research resulted in two systems, namely the SMS gateway based flood detection system as shown in Figure 4. The hardware-based system successfully collected water level data using ultrasonic sensors, rain sensor managed to collect rain data and temperature sensor managed to collect temperature data. From several tests, it was found that from some temperature and rain data collected by the Arduino microcontroller, not all were sent to the server. Temperature and rain data sent to the server is data that has a time equation with the height data that is sent. In the detection system algorithm has a rule that is sending data sent only at a distance of water level with absolute numbers such as 1,2,3 and so on until 30. The rule does not send height data in float size.

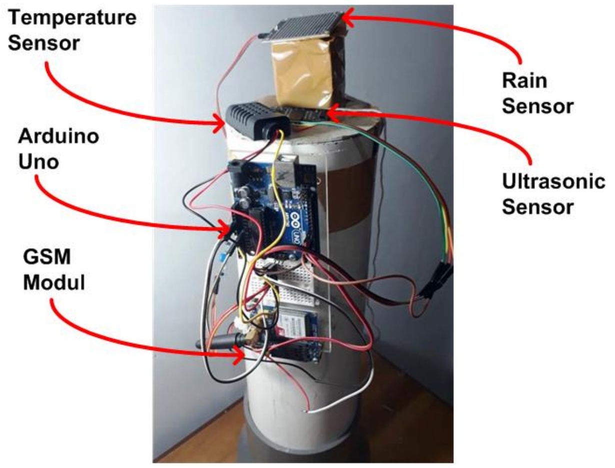

Fig. 4.Flood Detector System

The software system built is a flood monitoring information system. The information system shown in Figure 5 is a visualization page for flood locations in real-time conditions. On the visualization page, it can be seen that there are several visualized variables such as flood height, ambient temperature, rain status, date, time and warning alarm.

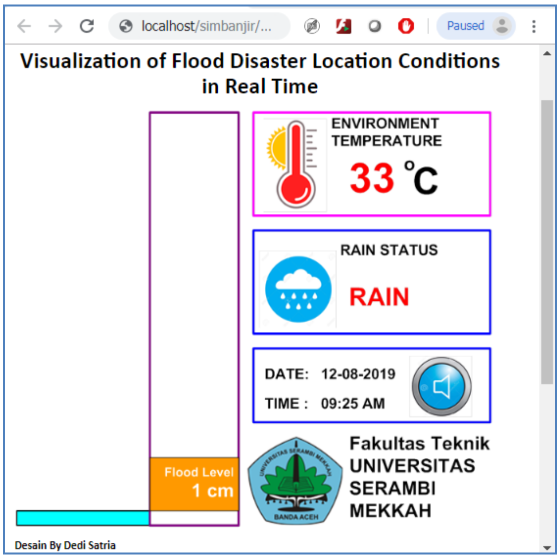

Fig. 5. Flood visualization interface in real-time

In other conditions, there are tests conducted by giving additional flood height from 6 cm to 12 cm. With the addition of the flood height animation shows the change in height, which is aligned with the height value of the flood. Besides that, there is a web-based early warning alarm. The alarm will sound if there is a flood at a size greater than 1 cm. while under the height of 1 cm there is no alarm sound. To stop the alarm sound the user can choose the sound button, as shown in Figure

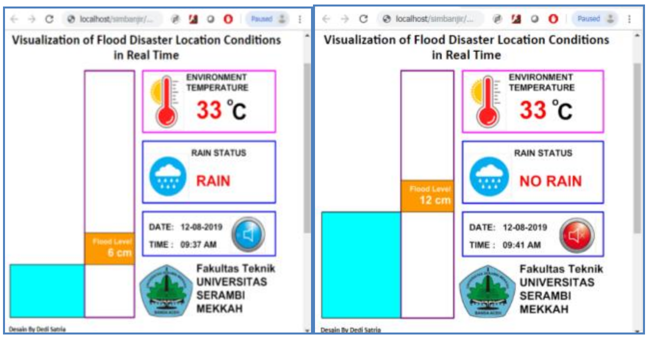

Fig. 6. The Flood Visualization Interface in different altitude conditions.

V. CONCLUSION

Based on the results of the work that has been studied, this study can be concluded that the implementation of visualization of flood conditions in real-time on a flood monitoring information system was built using two systems. The first system is a hardware-based flood detection system. The flood detection system consists of input components, namely ultrasonic sensors, temperature sensors, and rain sensors. Processors in the flood detection system using Arduino Uno and the output component is a GSM module that functions to send data on flood, rain and temperature heights to the server using the SMS gateway service. While the second system is a flood monitoring information system using visualization methods that can be accessed through a web browser. Data received from the flood detection system will be visualized by the system so that the interface display is more dynamic. Also, the visualization system can also provide alarm-based early warning information on a web browser. It is expected that this flood visualization system can add further studies in developing friendly disaster mitigation systems at the interface.

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