Application of GSM Communication System on Flood Alarm Systems

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Abstract. Flood disaster has become a category of disaster that is prioritized nationally by the Indonesian government. To reduce the number of flood victims, it was emphasized to all parties to be able to provide disaster mitigation solutions in the form of both long-term and short-term programs. For short-term programs in disaster mitigation in this study aims to build a flood alarm system by utilizing GSM communication between flood detector systems and wireless flood alarm systems. Flood detector system is built using an ultrasonic sensor as a water level detector, Arduino Uno microcontroller as a data processor and a SIM900 sender GSM module as a data communication medium to a flood alarm system consisting of a GSM SIM900 receiver module, Arduino microcontroller and an electric alarm. This study produced a prototype flood alarm system that can ignite when the water level is > 5 cm. It is expected that this prototype can be utilized to contribute to government programs in the field of disaster mitigation.

1. Introduction
Flood disaster has become a category of disaster that is prioritized nationally by the Indonesian government. From flood disasters that often occur in Indonesia today have made many lives and materials for the people. Indeed at this time the category of flooding that occurred due to human error. This can be seen from the effect of garbage disposal that occurs in the city area, which causes clogging of the flow of water in the ditch channel and becomes flooded. Whereas in rural areas are often affected by illegal logging and follow the rules so as to make the village area a flood victim. Anticipating the flood disaster in a long-term program is making socialization to the community to change the mindset of being a society that is aware of the importance of protecting the environment to be free from flooding. However, anticipating floods in short-term programs is also important to deal with victims for now, such as building a flood early warning system that can provide information to the community about flooding around them. Therefore, this article contains the design of a flood alarm system by applying a flood data transmission system to the alarm center. The alarm center is simulated at the center of the residential area. The program to build applications to anticipate flooding is a directive from the government that assigns various parties, both government and the private sector, to make disaster mitigation research that is intended for the general public.[1].
Related Works

Based on research conducted by previous research, the authors have summarized several studies related to natural disasters, including the design of a fire monitoring information system that has been built using the internet to display fire information and use the concept of distributing clients and servers in the form of real-time websites [2] [3]. And so does the flood information system using the web in real-time [4]. The flood information system has client and server concepts. On the client side is a flood detector that uses ultrasonic sensors to measure water level and SIM900 as a medium for sending data to the server via the GSM line. While in other studies there is also a data transmission system to the server using the Internet of Things concept in sending flood data [5]. Client and server-based distribution systems are not only done in the form of web applications, but some mobile-based applications in the application provide mobile-based information for Android-based natural disaster victims data [6]. The use of GSM as a medium of communication between machines to machines has been carried out by many applications such as sending disaster location information based on map coordinates [7] and the implementation of GSM in sending SMS based flood warning data [8] [9] [10] and the average information system is used to send data to the server or hosting to be distributed to the public or certain parties. Apart from the application of flood disaster mitigation using GSM communication, a landslide warning system has used data transmission media via GSM [11], in this study sending text messages in the form of landslides to the disaster information system station. The use of disaster information and communication technology has built several studies using GSM and internet of things (IoTs) [12].

Based on several studies that have been built, there have been many flood information systems that have been built with SMS-based and web-based interfaces. By this, a flood warning system is also needed which is applied in the form of an alarm by using GSM communication in the form of communication from the machine to the engine to ignite alarms remotely.

2. Methodology

The method of building a flood alarm system was built using two systems development, namely a flood detector system and a flood alarm system. Both systems were built separately. And in making these two systems begins with a system analysis that describes how the system is used by the user or how the system should work. Next is the design stage of both systems using block diagrams.

2.1. System analysis

The description of the flood alarm system analyzer begins with a flood detector system that detects water that uses a water level proximity sensor with. The height of the water is the data that is processed by the flood detector system which then decides that there is a flood to be sent through the GSM transmitter module which is sent to the flood alarm system via the receiver's GSM module. From the flood alarm system, lit alarms are placed in the residential center of the residents closest to the location of the flood. Description of flood alarm system analysis can be seen in Figure 1.
2.2. System Design
For the design of flood detector systems and flood alarm systems built using block diagrams as seen in Figure 2 with the explanation that the flood detector system there is an input block with ultrasonic sensor components then on the processing block there is an Arduino Uno microcontroller. Data processed from Arduino is sent to the output block, namely the GSM SIM900 module as the sender of the data. Data is sent via SMS to the flood alarm system via the GSM SIM900 module as the data receiver. The received data is processed by Arduino Uno and sent to the output block consisting of relays to turn on the alarm.

In the flood detector system there is a water detection construction made of paralon pipes which are fitted with an ultrasonic sensor on the top side. While on the inside of the paralon pipe a float is given as a cross section to reflect the trigger signal to determine the water level as shown in Figure 3.
3. Results and Discussion

Based on the design of a prototype flood detector system and a flood alarm system built in accordance with Figure 3 and Figure 2, this study produced a prototype that can send flood hazard information data in the form of alarms as shown in Figure 4. Results in the form of flood detector systems and alarm systems flood based on GSM communication.

In the testing process both systems are tested by giving water to the pipe as a flood detector. When the water is a certain height, namely the water level \( \leq 5 \) cm with the information in a safe condition, the detector system provides information through the Serial Monitor on the Arduino IDE as shown in Figure 5. Whereas when the water level is \( > 5 \) cm the flood detector system shows information be alert by sending a danger signal via GSM as shown in Figure 6. The hazard data sent by the detector is received by a flood alarm system whose information can be shown through the Serial Monitor on the Arduino IDE in the form of alarm information activated as shown in Figure 7. If the water level has been ebb that is the water level \( \leq 5 \) cm then the detector system sends data to deactivate the alarm. The size of the water used in this test is the height used in the simulation test.
4. Conclusion
Based on the results designed the real time flood alarm system based on GSM communication has been successfully tested by sending flood hazard data from the flood detector system to the flood alarm system via GSM so that the alarm system can automatically turn on the electric alarm continuously until the water level decreases. This prototype testing is expected to provide benefits to the field of flood disaster mitigation in anticipating flood victims in flood-prone residential areas.

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References
[1] R. J. M. Mercado, “Design of wireless sensor networks using embedded Programmable System-on-Chip (PSoC) as applied to community-based flood early warning systems (CBFEWS),” in 2016 International Conference on Advances in Electrical, Electronic and Systems Engineering (ICAEES), 2016, pp. 214–223.
[2] S. S. Dewi, D. Satria, E. Yusibani, and D. Sugiyanto, “Design of Web Based Fire Warning System Using Ethernet Wiznet W5500,” in Malikussaleh International Conference on Multidisciplinary Studies (MICoMS 2017), 2018, pp. 437–442.
[3] S. S. Dewi, D. Satria, E. Yusibani, and D. Sugiyanto, “Prototipe Sistem Informasi Monitoring Kebakaran Bangunan Berbasis Google Maps dan Modul GSM,” J. JTIK (Jurnal Teknol. Inf. dan Komunikasi), vol. 1, no. 1, pp. 33–38, 2017.
[4] D. Satria, S. Yana, R. Munadi, and S. Syahreza, “Sistem Peringatan Dini Banjir Secara Real
Time Berbasis Web Menggunakan Arduino dan Ethernet,” J. JTIK (Jurnal Teknol. Inf. dan Komunikasi), vol. 1, no. 1, pp. 1–6, 2017.

[5] D. Satria, S. Yana, R. Munadi, and S. Syahreza, “Design of Information Monitoring System Flood Based Internet of Things (IoT),” in Malikussaleh International Conference on Multidisciplinary Studies (MiCoMS 2017), 2018, pp. 629–639.

[6] Bahagia, D. Satria, and H. Ahmadian, “Perancangan Sistem Informasi Manajemen Data Korban Bencana Berbasis Mobile Android,” J. Manaj. dan Akunt., vol. 3, no. 2, pp. 22–30, 2017.

[7] D. Satria, S. Yana, R. Munadi, and S. Syahreza, “Prototype of Google Maps-Based Flood Monitoring System Using Arduino and GSM Module,” Int. Res. J. Eng. Technol., vol. 4, no. 10, pp. 1044–1047, 2017.

[8] S. Azid, B. Sharma, K. Raghuwaiya, A. Chand, S. Prasad, and A Jacquier, “SMS Based Flood Monitoring and Early Warning Systems,” ARPN J. Eng. Appl. Sci., vol. 10, no. Vol. 10, No.15, pp. 6387–6391, 2015.

[9] E. Kuantama, P. Mardjoko, and M. A. Saraswati, “Design and Construction of Early flood warning system through SMS based on SIM300C GSM modem,” Proc. 2013 3rd Int. Conf. Instrumentation, Commun. Inf. Technol., Biomed. Eng. Sci. Technol. Improv. Heal. Safety, Environ., ICICI-BME 2013, pp. 115–119, 2013.

[10] O. Piller, J. Deuerlein, D. Gilbert, and J.-M. Weber, “Installing Fixed Sensors for Double Calibration and Early-warning Detection Purposes,” Procedia Eng., vol. 119, pp. 564–572, 2015.

[11] C. D. Fernandez, K. J. A. Mendoza, and A. Jude, “Development of Microcontroller-based Landslide Early Warning System,” 2016 IEEE Reg. 10 Conf., pp. 3000–3005, 2016.

[12] S. Poslad, S. E. Middleton, F. Chaves, R. Tao, O. Necmioglu, and U. Bugel, “A Semantic IoT Early Warning System for Natural Environment Crisis Management,” Ieee Trans. Emerg. Top. Comput., vol. 3, no. 2, pp. 246–257, 2015.