International Journal of Engineering &Technology, 7 (4) (2018) 6069-6071

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET
doi: 10.14419/ijet.v7i4.23127
Research paper

Implementation of Wireless Sensor Network on Fire Early Warning System Using GSM Communication

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Abstract

Wireless Sensor Network (WSN) is a concept in which the information delivery system from a sensor from a workstation or node to the center of the information system through a wireless network either in the form of a computer network or GSM network. The use of Wireless Sensor Network (WSN) has been widely applied in various fields of military, health and disaster. Therefore, this article discusses how to implement the Wireless Sensor Network (WSN) by using GSM as a communication medium for fire early warning systems. The flood early warning system is built into 2 separate systems namely a client system consisting of fire sensors, smoke sensors, microcontrollers and GSM modules. Then the server system is built using Apache Web Server, PHP Engine, mySQL and Gammu. This study produced a prototype of a fire early warning system that has successfully sent fire data in the form of web and SMS based information display.

Keywords: *Early Warning System; Fire; Wireless Sensor Network; GSM; Information System.*

1. Introduction

Fire disasters are currently the main topic of national and international hatred in the past few years. This can be seen in many fires that are associated with environmental influences or due to human error. In terms of environmental influences can be seen from forest fires caused by high regional temperatures or high droughts. To anticipate fires caused by environmental influences is very difficult due to naturally occurring by nature. However, it is different from the fire disaster that occurs by human error, which is a disaster caused due to human neglect of the home environment and the surrounding environment. One example is the installation of electrical installations in buildings and houses that are not in accordance with national standards, resulting in fire-prone electrical installations. Besides that, there are also errors caused by leaky kitchen gas causing a fire. These are some of the sources that often occur in community housing today. Therefore, with the above problems, a solution is needed that can provide anticipation to the community to reduce the impact of house and apartment fire so that it does not spread in a wider direction. Based on the above background, this article discusses the implementation of wireless sensor network (WSN) as a communication medium for fire early warning in a residential or apartment building that has a lot of space by utilizing GSM-based wireless media.

Along with the rapid development of sensors to date has led to the latest devices that allow the transmission of data from a detector wirelessly through a computer network. The technology is a collection of sensors that are integrated with a series of computer networks known as the Wireless Sensor Network (WSN) (W. Dargie, 2010) [1]. Wireless Sensor Network (WSN) in its use has several nodes that send data to the center of the information system by using an encryption coding system (K. Sohraby, 2017) [2]. Currently the application of the use of the concept of Wireless Sensor Network (WSN) has been adopted in various fields such as military, industry, education and disaster (I.F Akyildiz, 2010) [3]. Based on applications that are used in various fields, it can be said that the purpose of the Wireless Sensor Network (WSN) is to build a system of sending information from a sensor from a workstation or node to the center of the information system over a wireless network in the form of a computer network or GSM network (W. Dargie, 2010) [1]. Global System for Mobile Communication (GSM) is one component that can be used in the Wireless Sensor Network application. One of the data transmission systems in GSM technology is SMS (Short Message Service).

Some previous studies that have used the concept of sending data via SMS are flood information systems using water level detection integrated with a GSM modem (D. Satria, 2017) [4]. While others use the integration of sensor modules with the media of sending data via Ethernet Wiznet wirelessly (S.S Dewi, 2018) [5], Other applications use SMS Gateway to provide information on a gas leak (S.S Dewi, 2017) [6]. And a flood early warning system that sends flood location data via GSM (D. Satria, 2017) [4] (D. Satria, 2018) [7].

In the fire disaster information system research that has been carried out prior research related to it such as the Drone system blocking that can explore in monitoring the location of the fire disaster (A. Motaparthi, 2014) [8]. And a study has been carried out by giving the location of the fire using Google Maps (S.S. Dewi, 2017) [9].

This article aims to develop previous research by designing a fire information system by implementing the Wireless Sensor Network concept by using a GSM module as a remote data sender to a remote fire warning system.

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2. Methods

The method used in building a fire early warning system based on Wireless Sensor Network is built using several stages, namely system analysis and system design. In the analysis phase the system is built to show how the system description when used is starting from the fire detector to the early warning information system and at the design stage shows the block diagram of the entire module or client component up to the integrated server.

2.1. Analisa sistem

The analysis stage of the early warning information system system based on the Wireless Sensor Network (WSN) can be explained through Figure 1, which begins with the location of the house or apartment space that has experienced a fire will be detected by sensors from the client system. The client system will provide local hazard information in the form of alarms around the house or apparatus. Furthermore, the client system provides information via SMS communication to the fire early warning information system server that is monitored by the local housing or apartment official. After the data is processed by the information system, the server also sends SMS-based information to firefighters.

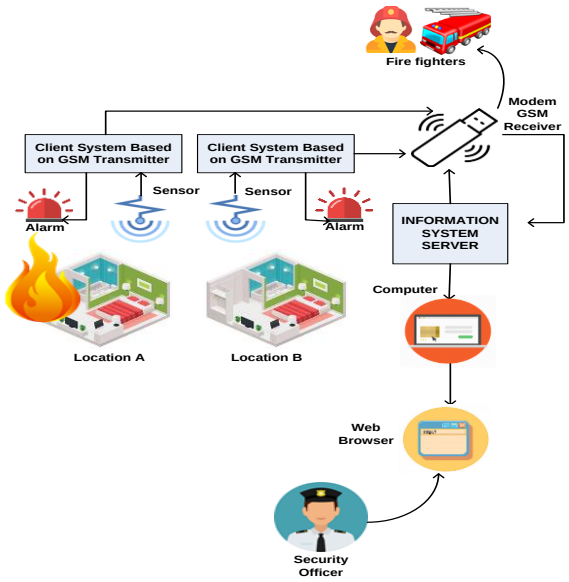


Fig. 1: Description of System Analysis.

2.2. Desain sistem

To implement the design of the system analysis that has been built, the design of a fire early warning system based on Wireless Sensor Network is built as shown in Figure 2, the overall system block diagram. At this system design stage, the whole system consists of 2 systems, namely the client system and the server system. On the client system there is an input block consisting of a fire sensor and smoke sensor, while in the processing block there is an Arduino Uno microcontroller. And to block output there is a relay that is connected to the local alarm and a GSM modem module that sends fire data via the SMS gateway. The SMS information on the fire is received by the receiving modem on the server system side and processed in the system and returns the fire data to the Fire Department.

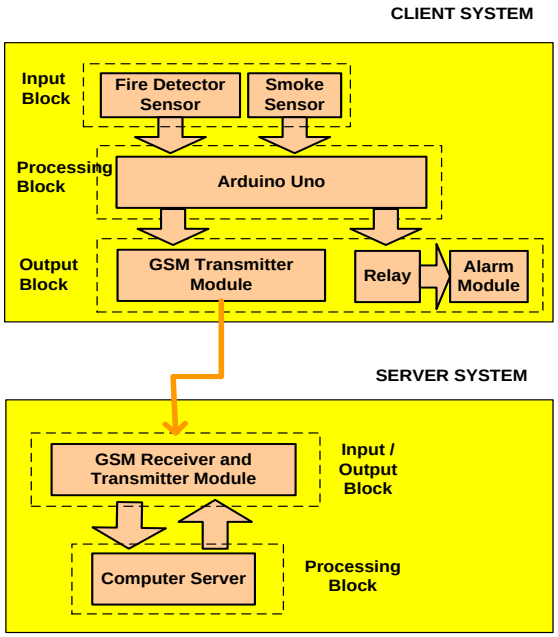


Fig. 2: System Design.

Based on the design of fire early warning systems, it can be explained that on the server computer side has an information system with architecture as shown in Figure 3. The fire early warning system architecture consists of PHP engine, mySQL database and Gammu as intermediaries between databases and modem devices. The client system sends fire data received by Gammu and vice versa Gammu who sends the information back to the fire department.

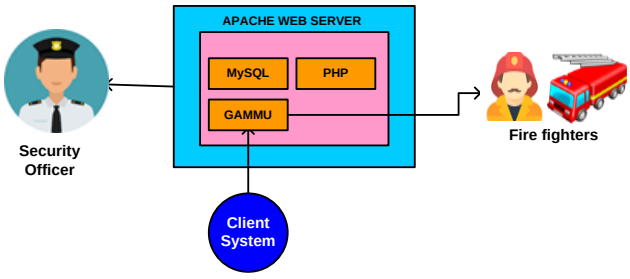


Fig. 3: System Architecture.

3. Result and discussions

In accordance with the system analysis and design that has been done, this research produces a prototype of a fire early warning system based on Wireless Sensor Network (WSN) with GSM communication media as shown in Figure 4. The system works by sending sensor data from the client or node to the information system server fire early warning.

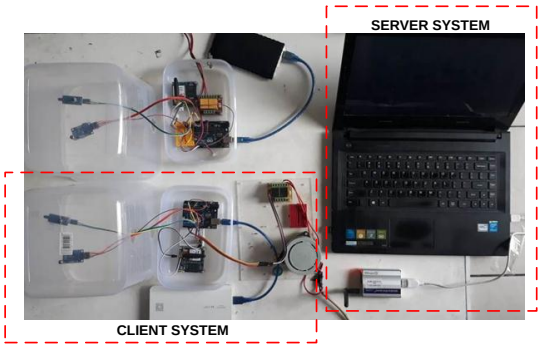


Fig. 4: Prototype of Fire Early Warning System Based on Wireless Sensor Network (WSN).

The information system built consists of a client system as shown in Figure 5. The client system is seen using a fire sensor and smoke sensor as input and Arduino Uno microcontroller as a process that produces data that will be sent to the GSM modem module as an output and so does the process send data to relay to turn on alarms locally.

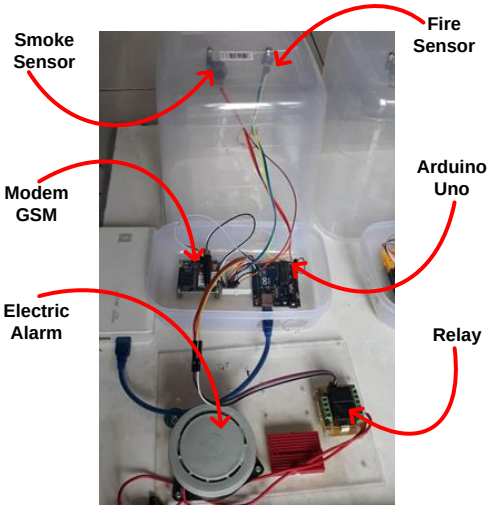


Fig. 5: Client System.

The prototype simulation is powered by power banks and fire simulations use a box instead of a house equipped with fire sensors and smoke sensors.
While on the server side can be seen a web-based interface that can be accessed by apartment security officers. In the data column there is a table that displays information including the date, time, location of the fire or the address of the house or apartment block, the detection of fire and smoke detection as shown in Figure 6. The test results show that there is fire and smoke seen in the table second line fire early warning monitoring that occurs at Block A no.12 location. whereas in the first line that occurred at Block A no13 there was no fire and only smoke was detected.

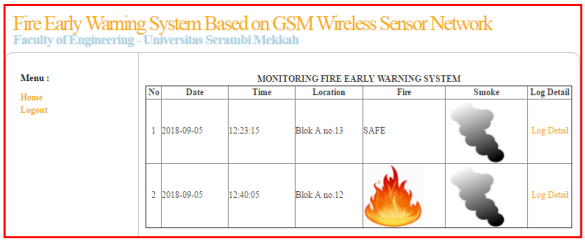


Fig. 6: The Results of the Early Warning System Interface are Wireless Sensor Network Based.

While the information sent to the fire department through a fire early warning system based on wireless sensor network with editors such as "Dear Firefighters, informed that there had been a fire in the housing location of Block A no.12 with indications of smoke and fire at 12:40 : 05 Date 201-09-09 (by Fire EWS) ". The results of the SMS reception can be seen in Figure 7.

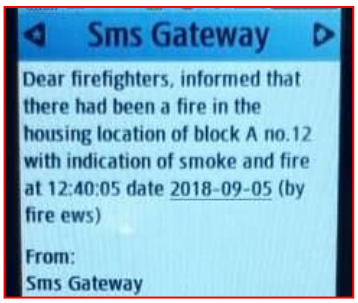


Fig. 7: SMS Fire Information to Firefighters.

4. Conclusion

Based on the analysis and design of the system that has been carried out, this research has succeeded in producing a prototype of the fire early warning system by implementing the GSM-based Wireless Sensor Network (WSN) concept. The system prototype consists of a client system consisting of fire sensors, smoke sensors, electrical alarms and GSM modules. While the server system consists of an early warning information system built using Apache Web Server, mySQL, PHP and Gammu. This research has succeeded in sending data in the form of simulations resulting in data display in web-based applications and SMS sent through the fire early warning system.

Acknowledgement

This research is supported by the Ministry of Research and Higher Education as grant funds of research scheme from University Co-operation Research (PKPT). We are very grateful to the Research Team from Universitas Syiah Kuala who has supported laboratory facilities and technical consultation.

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