Fire Early Warning System of Multi Room Based Internet of Things (IoTs)

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Abstract – Fire disasters are one of the disasters that are often experienced by many residents and apartment rooms. This type of fire disaster often occurs due to the fault of the occupants. Especially for apartment building owners who have security officer offices, a fire early warning system is needed that can be monitored by building security officers remotely using the Internet of Things technology concept (IoTs). This article aims to explain the design of the apartment building room fire warning system using the concept of IoTs. The design was built using a fire sensor, smoke sensor, Arduino Uno as a client and Raspberry Pi as an information system server. This design produces a prototype of a fire early warning client system that detects fires and a prototype server as a web-based information provider and alarm to security officers of apartment buildings.

Keywords – Fire Disaster, Early Warning System, Internet of Things (IoTs), Microcontroller, Information System.

I. INTRODUCTION

The current fire disaster has become one of the national disaster tragedies that has provided many victims both from the human and material sectors [1]. This happens because of many factors including natural factors as part of the effects of global warming. And factors caused by human negligence. Human neglect factors often occur in the housing and building sectors. This often happens because building users are often careless in using electricity and household gas facilities. Carelessness in the use of electricity is often seen during the electrical installation process, where electrical installation officers often do not follow national procedure standards. This can be seen from the installation of electrical wires and other electrical components that are not in accordance with the use of the occupants of the house so that the electricity can not bear the burden of household electricity use, the house or apartment space is susceptible to fire disasters. Therefore, based on the above problem factors, it is necessary to have a fire early warning system that can inform the emergency of a fire disaster through a web-based information system based system to the apartment building security officers to be able to take action to anticipate the impact of a wider fire. From this discussion, the purpose of this article is to present the design and manufacture of a prototype of a multi-room fire early warning system aimed at multi-room apartment-based housing systems using the concept of the Internet of Things (IoTs). System design is limited by a system monitored by the security of apartment buildings through a centralized computer with a web-based interface and alarm.

The prototype was developed using the concept of the Internet of Things (IoTs). The concept of the Internet of Things aims to activate an intelligent environment by gathering all the information that is in one environment that is important for its users. The information is sourced from sensors and actuators accessed through an internet connection or computer network. [2] [3]. In the implementation of objects that have many sensors and actuators, a layered architecture is needed which aims to optimize a system such as application software, communication technology, security and energy efficiency [4][5].

There have been several previous studies that have implemented the concept of the Internet of Things (IoTs) in various fields including remote home monitoring systems that aim to be home security detectors that use web-based information [6]. Furthermore, the use of the internet of things concept (IoTs) on intelligent parking system models uses cloud-based data storage models and uses the concept of wireless sensor networks in the process of sending data to sensors and actuators [7].

While disaster-related research such as flood disasters that have been developed using the concept of Internet of Things (IoTs) are flood monitoring systems built using microcontroller technology and ultrasonic sensors that are integrated with Ethernet as a bridge of communication between information system devices and the internet [8]. And followed by its development in the form of Google Maps based disaster location information [9].

or research on the development of fire disaster mitigation systems, it has been investigated before, the development is Micro Air Vehicle (MAV) which has been used in disaster monitoring systems to determine the location of disaster victims and detect hotspots in fire disasters [10]. While the fire disaster information system that shows the location of the fire has been developed using Arduino Uno Microcontroller integration technology and Google Maps [11], and its development by adopting a wireless sensor network system using Ethernet [12]. While the GSM-based information fire detection system has been able to send preliminary information about indications of gas leakage via SMS messages [13].

In this article the development of the system was continued by creating a new engineering design by building an internet-based building fire early warning system (IoTs) using the main sensors namely fire and smoke sensors. While the processing media uses Arduino microcontroller which is integrated Ethernet as a client in sending data to a Raspberry Pi-based server.

II. SYSTEM DESIGN

The design system of the Internet of Things multi-room fire early warning system prototype (IoTs) is designed with several steps that are taken to build a system architecture analysis in general, then building block diagrams for client systems and server systems. While the last is to build a server system architecture as the center of the information

system.

A. *General System Architecture*

The general system architecture for fire early warning systems that are devoted to multi-room apartments begins with descriptive analysis of the data flow model as shown in Figure 1.
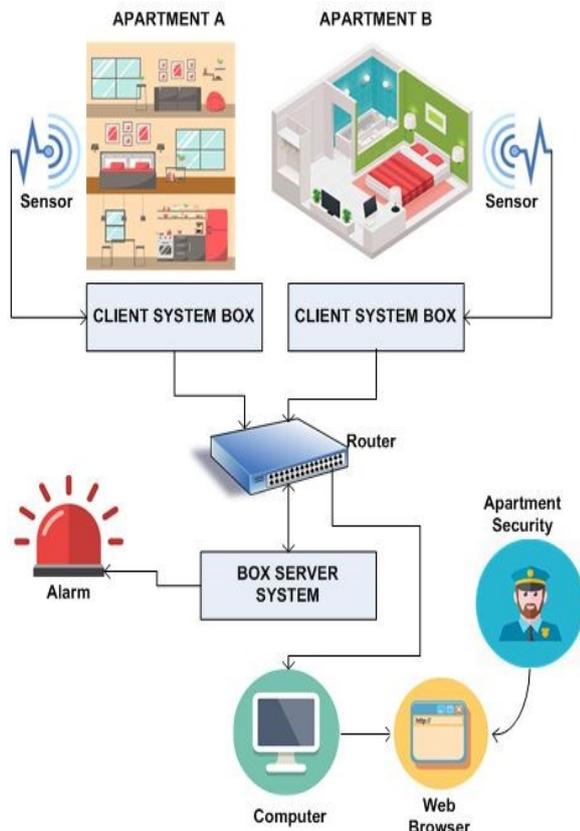

Fig. 1. General System Architecture

The analysis begins with each apartment A and Apartment B having a fire and smoke detection sensor. These sensors send data to the client system box. The client system box collects data and processes it to produce data that is sent to the server system box. The entire stream then data across the system passes through the Router. If there is a result of a fire decision, the system server box sends data to the alarm. Then the server sends data to the security office computer. And officers can access fire data through a web browser.

B. *System Block Diagram*

The system block diagram is a digram that compiles the components or modules contained in a system in general. In the block diagram of the early warning system of apartment room fire consists of two sub systems namely the client system and server system as seen in Figure 2. The client system consists of an input block consisting of a fire detection sensor and a smoke sensor, whereas in the processor block there is a module Arduino Uno microcontroller and on the output block there is an ethernet module. While on server system there is router device which functioned as input block and output block. On the processor block there is a mini raspberry pi computer and ends with a relay module and an alarm as an output block.
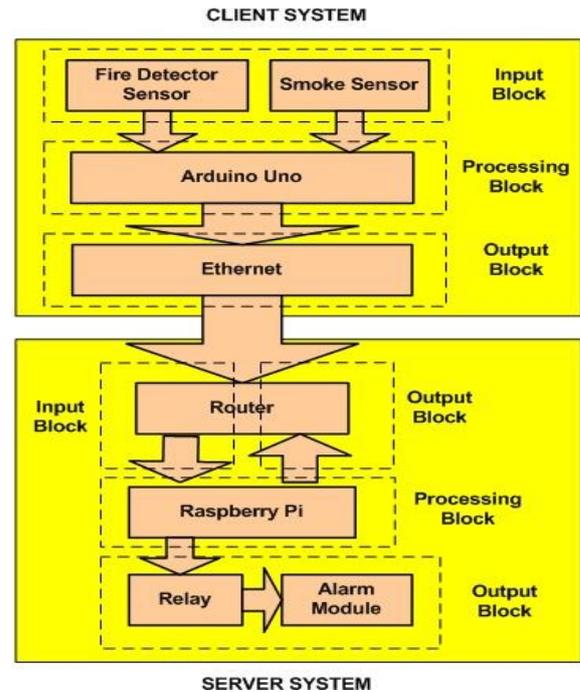

Fig. 2. System Block Diagram

On the server side based on Raspberry Pi there are several components to run a fire early warning information system. The server component can be seen in the form of a server system architecture as shown in Figure 3 and can be explained that the system consists of python interpretatio--ns on the inside which function as input in collecting data from the client system and storing it in the database system using MySQL. Besides that, Python - based commands are used as output in giving commands to alarms. While the Flask Framework application is a web component that consists of the layout and content of information displayed to users through the Nginx web server.
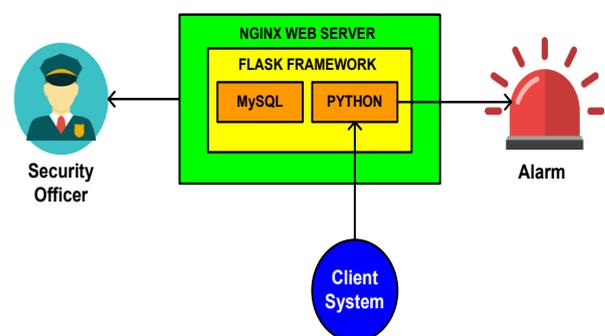

Fig. 3. Server System Architecture

III. RESULT

Based on the design shown in the system design chapter, this study produced a prototype of a fire early warning system for multi-room apartment buildings using the concept of internet of things (IoTs). System products that have been built as seen in the whole system can be seen in Figure 4 that is divided into several systems, namely client system prototype products, server system prototype products.
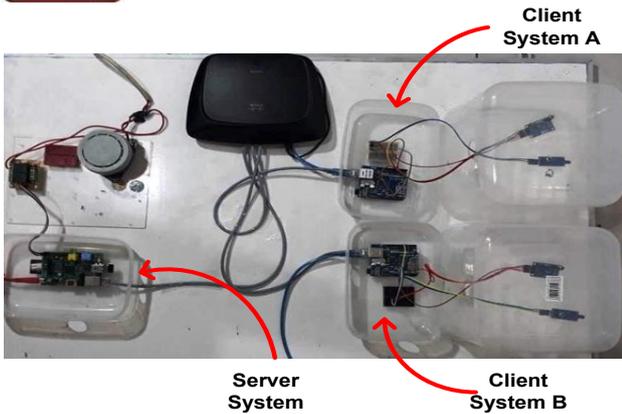
Fig. 4. Client and server system prototypes

Client system prototype products as seen in Figure 5 have been built using several modules including fire detection sensors, smoke sensors, Arduino Uno microcontrollers and Ethernet. In the process of sending data, the Ethernet server is physically connected via a network cable to the router. In this simulation case the client system is built in 2 prototypes. In the testing process, the plastic box is simulated as an apartment room.
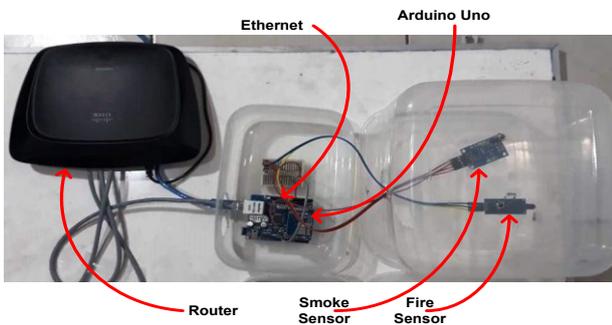

Fig. 5. Client system prototype

Server system prototype products as seen in Figure 6 have been built using Raspberry pi mini computers. The server has successfully distributed information through the web with server supporting applications namely the Rasbian Jessi Lite operating system, Nginx web server, Flask Framework and Python as program interpreters.

Fig. 6. Server system prototype

From the integration of the client system and server system, it produces a building fire early warning information system that is displayed in web form as shown in Figure 7. The web interface describes information on the existence of fire and smoke in an apartment room as a sign of danger of a fire.
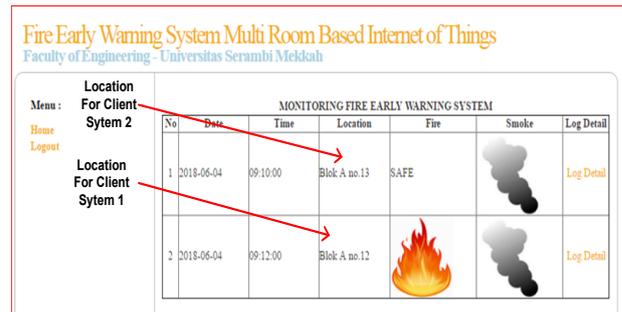

Fig. 7. System interface

IV. CONCLUSION

Based on the design of the system and the results of the multi-room fire early warning system that has been built, it can be concluded that the client system prototype has been able to send data on the presence of fire and smoke in the apartment room to the server system prototype in the form of simulation testing. And the server has been able to distribute fire hazard warning information via the web using the concept of the Internet of Things (IoTs).

ACKNOWLEDGMENT

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