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Integration of Wifi and Mobile Communications in Fire Early Warning Data Sending in Home Based on The Internet of Things

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Abstract

House fires are one of the most frequent disasters in dry climates, with impacts that not only cause material losses but also cause loss of life. This research aims to develop a fire early warning system that integrates WiFi and cellular communication technology to provide a fast and accurate response. The methods used include black-box testing and hardware testing using Arduino Mega2560, ESP32, DHT-22, MQ-2, LDR Array, SIM900, Mini DC Pump, and Mini DC Fan. The test results show that the system can operate both online and offline, where each sensor is able to detect indications of fire, gas, and smoke in real time. Furthermore, this device is designed not only for household applications but also has the potential for use on an industrial scale. This innovation makes an important contribution to disaster risk mitigation efforts by increasing community preparedness, accelerating the evacuation process, and minimizing losses. Thus, the developed system serves as a practical and applicable solution to create a safer and more resilient environment against the threat of fire.

Keywords: Internet of Things; Microcontroller; Blynk; Arduino

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Introduction

The development of technology is now becoming a very important thing and has become a necessity in our daily life, especially in our homes, which should be a safe and comfortable place to live. House fires often occur due to several factors. In the absence of a notification system or notification of disasters such as fires, homeowners will not know that there is a fire, which can cause casualties(Forlizzi et al., 2004). In terms of home security, it naturally makes homeowners feel less at ease, always on alert for a fire. So that homeowners still often check stoves and gas cylinders, which sometimes makes homeowners feel tired because they do it continuously(Jin et al., 2014).

The early warning system, with the integration of Wifi and Cellular communication, will be sent from the microcontroller to the smartphone via the Blynk application over an internet network, and homeowners will still get disaster early warnings when the smartphone is not on the internet network, so that homeowners still get disaster early warning notifications anywhere. and whenever(Asmawati et al., 2019). It is hoped that with this tool, we can increase the safety and comfort of our homes. In terms of convenience, when we are not at home, with this tool, we can find out (notifications) in the event of a fire via a smartphone(Durani et al., 2018).

Method

The research method is needed so that the research carried out can be in accordance with the rules. This research method includes (i) analysis consisting of system weakness analysis, system requirements analysis, and system feasibility analysis, (ii) system design method and process design, (iii) implementation consisting of hardware implementation and software implementation, (iv) testing consisting of hardware testing and software testing(Groce et al., 2007);(Zamli et al., 2011).

1. Analysis

The analytical method used in this research is to look at the needs of the existing system and analyze the weaknesses and needs of the existing system. Hardware analysis is carried out in making a fire early warning tool. We need some

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hardware that is needed as input, process, and output. Software analysis is also carried out in making a fire early warning tool that requires some software to support making a program.

2. System Design

After the problem analysis phase is completed, it will proceed to the next process, namely designing the system and process design. The fire warning system uses smoke or gas parameters, temperature, humidity, and light intensity as a fire marker. mobile. System design is very useful for providing an overview of the system's functions that we will create. The following is a design process for a fire early warning system that researchers will make(Muhammad et al., 2018).

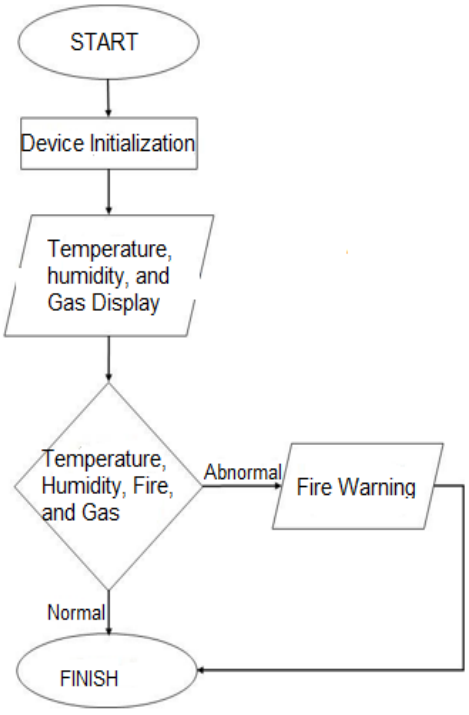

Figure 1. Flowchart of Process Design Stages

3. Implementation or application

The stages of implementation or application consist of 2, namely the application of hardware and the application of software. The hardware application in this research is an electronic circuit in the form of an MQ2 sensor, an LDR Array sensor, and a DHT22 sensor as input(Anik et al., 2022). And the data processing is carried out by the NodeMCU which is connected to the ESP8266 to connect the device to the internet. The outputs used by this tool are the Blynk Application, SIM900A Buzzer Warning, and Relay. While the application of the software in this study which consists of coding or making programs on Arduino UNO using Arduino IDE with C language which contains commands to control reading values from existing sensors as well as controlling and reading drive outputs on relays, buzzers and SIM900A.

4. Testing

At this stage, various tests were carried out which had been implemented in the previous stage, this stage was carried out by (i) Testing Programming on Arduino About Fire early warning. (ii) Testing the MQ2 sensor aims to ensure the sensor works properly, when gas leaks or the sensor detects smoke then the sensor will send data for processing. (iii) Testing the LDR Array sensor aims to detect light, in this study the LDR Array is used to detect light from a fire that causes a fire. (iv) DHT22 sensor testing aims to detect temperature and humidity in a room if the temperature and humidity exceed the specified parameter limits, the sensor will send data for processing and the output will activate the buzzer and turn on the water pump(Koestoer et al., 2019).

Results and Discussion

Result

1. Making Hardware (Hardware).

Assembly begins with making an electronic circuit design from the hardware used. This tool uses an MQ2 sensor, an LDR Array sensor, and a DHT22 sensor as input. And the data processing is carried out by the NodeMCU which is connected to the ESP8266 to connect the device to the internet. The outputs used by this tool are the Blynk Application, SIM900A Buzzer Warning, and Relay(Jumaa et al., 2022);(YADAV et al., 2020).

a. Input Device Creation

The devices used in this study are the MQ2 Sensor as a gas leak detector, the LDR Array sensor as a light detector caused by a fire and DHT22 as a temperature and humidity reader in a room.

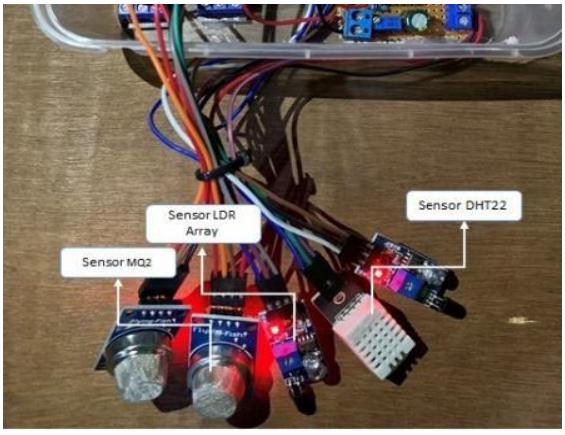

Figure 2. Input Device Circuit

b. Output Device Creation

The output devices used in this tool are SIM900A which functions to send data to users via Short Message Service (SMS), Buzzer warning which functions as a marker when a possible fire is detected and Relay which functions to activate the water pump to flush the fire that causes fire.

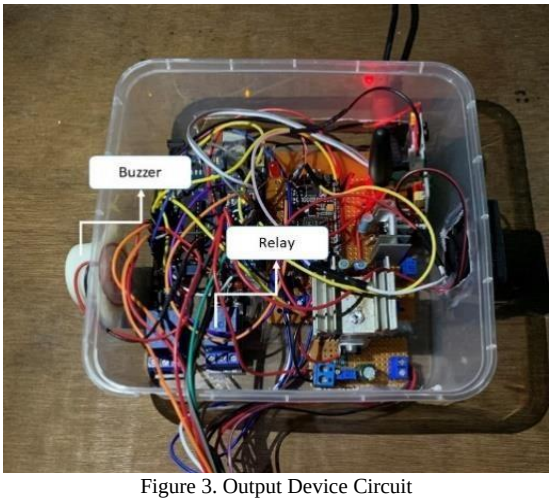

Figure 3. Output Device Circuit

c. Realization of Control Box

The control box used has dimensions of pp xx ll xx tt, there are several holes that are used as lines for the power supply to turn on the device and as a place for other input and output device lines, as well as electronic components that have been assembled into the control box to avoid interference from outside.

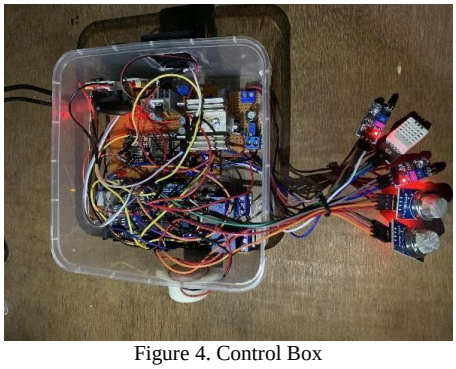

Figure 4. Control Box

2. Software Development

At this stage, coding or programming is carried out on Arduino UNO using Arduino IDE with C language, which contains commands to control reading values from existing sensors as well as controlling and reading drive outputs on relays, buzzers, and SIM900A. NodeMCU 8266 has digital pins that are used for input and output. And the application used, namely the Blynk App, can function as a monitor for the temperature and humidity of a room, and can also set the mode that works on the system. The modes given are Manual and Automatic Modes, where settings with manual mode can control the Relay connected to the pump to activate or deactivate the pump relay, and in automatic mode, the system that works on this tool will adjust to the program that has been planted in the process device(Koehler, 2021).

a. Test Results of Fire Early Warning Tools

This test is carried out to determine whether all tools can function properly. This test aims to determine the performance of the Blynk application system that is used as a relay monitoring and control application when the automatic mode is running. The test is evidenced by the table data as follows:

Table 1. Auto Mode Test Table

No.	Testing	Action	Result	Desc.
1	Info Suhu	✓	30.9°C	Successfully
2	Info Kelembaban	✓	69%	Successfully
3	Mode	✓	Otomatic	Successfully
4	Pump Control	✓	Locked	Successfully
5	Fan Control	✓	Locked	Successfully

In the test table above, the temperature and humidity info is successfully displayed, and when the automatic mode is active, the Relay control activates the pump, and the fan will not function properly because the pump and fan will only turn on when the value for a fire parameter is reached. While the Short Message Service (SMS) feature is a feature that can be used when the device is not connected to the internet, this feature allows users to monitor the temperature and humidity of a room by instructing the system via the SMS feature. The test table for the SMS feature on this system is as follows:

Table 2. SMS Testing Table

No	Testing	SMS Command	Action		Desc.
			Notif SMS	Output	
1	Active Tool	"Automatic"	Fire IoT Ready		Successfully
2	View Info	Send Info	Temperatur, Humidity, dan Mode		Successfully
3	Fire Detection	"Automatic"	Fire Detected		Successfully
4	Gas/Smoke Detection	"Automatic"	Gas/Smoke Detected		Successfully
5	Fire and Gas Detection	"Automatic"	Fire and Gas Detected		Successfully
6	Activate Pump	send Pompa On		On Pump	Successfully
7	Turn off Pump	send Pompa Off		Off Pump	Successfully
8	Activate Fan	Send Fan On		On Fan	Successfully
9	Turn off Fan	send Pompa Off		Off Fan	Successfully

Discussion

The results of tool assembly and testing prove that the implemented system has met the specifications and designs that were previously planned. The results of this test will be used to improve the performance of the system and at the same time can be used for further system development(Tanwar et al., 2020).

Starting from hardware testing conducted to determine the performance of the components used in this study. Hardware testing is carried out to support the system performance of the tool. Then the sensor is tested to ensure it is working properly. When a gas leak occurs or the sensor detects smoke, it will send data for processing. The way to do this is to provide gas stimulation from a mini tube and when the sensor detects gas with a potential for fire, it will send data, and the output will be displayed on the Blynk Application, and send data received by SMS, as well as sound alerts via buzzers and relays, which will automatically activate to turn on the water pump.

In this study, the LDR Array is used to detect light from a fire that causes a fire. If the LDR Array sensor receives excessive fire light stimulation, it will send data to be processed, and the output will be displayed on the Blynk Application, and send data received by SMS, as well as sound alerts via buzzers and relays will automatically activate to turn on the water pump.

Conclusions and Suggestions

Conclusions

An early warning system is very important to reduce the risk of loss of life and material loss. Based on the results of research on "Integration of Wi-Fi and Cellular Communication in Sending Fire Early Warning Data in Homes Based on 'Internet of Things'". With this system, it is expected to reduce the risk of fire, which causes a lot of losses in the form of material or non-material. The conclusions of this study include: (a) with a home fire early warning system by utilizing the internet of things as well as integrating internet and cellular network communication, homeowners can be more comfortable in monitoring when a fire will occur, which will be received via blynk and SMS notifications, (b) with this system, early warning fires in this house can extinguish fires using a mini dc pump and eliminate gas levels using a mini dc fan so that homeowners not only get early warning notifications but also anticipate fires in homes.

Suggestion

Based on the research entitled "Integration of Wi-Fi and Cellular Communication in Sending Fire Early Warning Data in Homes Based on the Internet of Things," the author conveys suggestions to related parties that:

1. Optimizing this early warning system requires the support and cooperation of all parties involved in this research.
2. Every house should have a fire detection system to reduce the risk of fire.
3. However, in addition to the fire early warning system, the public is advised to remain alert to things that have the potential to cause fires.

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