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Research Article

Design and Development of a Fire Monitoring and Alert System Prototype Based on the Internet of Things (IoT)

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Abstract

Bekasi City experienced a significant increase in fire incidents in 2023, reaching 446 cases with material losses amounting to IDR 132.2 billion. Fires are generally only detected when the fire has already spread or the smoke has been extinguished, increasing the risk of losses. To address this, this study designed a prototype Internet of Things (IoT)-based fire monitoring and warning system in the Zedigit program and media team's workspace using a prototype method. The system uses one master module and three child modules equipped with a KY-026 fire sensor, an MQ-2 smoke sensor, and a DHT22 temperature sensor. Sensor data is sent to the master module via the MQTT protocol using a NodeMCU ESP8266. When a fire hazard is detected, the system activates a buzzer and sends a notification via the Telegram app in real time. This system is expected to provide fast and accurate early fire warnings, reducing the risk of asset damage and improving employee safety. This system is an effective solution for improving fire safety management within the Zedigit environment through digital technology.

Keywords: Internet of Things, Fire, MQTT, Telegram Notification, Sensor

INTRODUCTION

The fire data released by the Bekasi City Fire and Rescue Department (Disdamkarmat) indicates that throughout 2023, there were 446 fire incidents. The number of fires in Bekasi City in 2023 showed a significant increase compared to 2022, which only recorded 255 fire incidents.

The material losses due to fires in Bekasi City throughout 2023 amounted to IDR 132.2 billion. The dry season or prolonged hot weather has been a major trigger for the increase in fire incidents in Bekasi City. In addition to the dry season, the most common cause of fires was short-circuiting. Typically, fires are noticed only when the flames have grown larger or when black smoke has started to billow out of the building.

One of the important aspects of buildings, structures, or other management systems is fire safety. A fire is an exothermic oxidation reaction in which a flammable substance ignites, causing a flame or combustion. The three essential elements that cause a fire are heat, oxygen, and fuel. However, fire can have dangerous consequences, affecting individuals and their property, causing material and emotional damage, and in the worst cases, even leading to loss of life (Oktiviani & Ardhiansyah, 2024, pp. 1683–1688).

With the advancement of Internet of Things (IoT) technology, it is now possible to integrate fire sensors with the internet, enabling real-time remote monitoring (Akbar Nuryadin et al., 2024, pp. 877–885).

Erlazet Charity is a professional organization focused on social empowerment and caring for orphans. As part of its efforts to increase income outside of donations, Erlazet Charity established a subsidiary called Zedigit. Zedigit operates in the field of Information Technology and Multimedia, providing services that support the operational activities of various digital projects. In its operations, the workspace for the Zedigit program and media team is equipped with various electronic devices such as computers. Currently, the workspace for the program and media team is not equipped with a fire monitoring and alert system that can detect fire risks early on. This is a significant weakness, given the potential large impact a fire could have on the safety of assets, data, and employees in the program and media team workspace. The need for an automatic fire detection system has become increasingly urgent, especially with the high number of fire incidents in the Bekasi area. Without an early warning system, the risk of damage from fires increases, both in terms of electronic device destruction and potential threats to employee safety.

Due to the high frequency of fires in Bekasi City, the author has designed a fire monitoring and alert system based on the Internet of Things (IoT) using the Prototype method. This system aims to provide early warnings through IoT integration. The system consists of a master module and three child modules. The master module uses NodeMCU ESP8266 and a buzzer, while each child module is equipped with NodeMCU ESP8266, KY-026 fire sensor, MQ-2 smoke sensor, and DHT22 temperature sensor. The child modules collect data from the sensors and send it to the master module via the MQTT protocol. When the master module receives data indicating a fire, the system will trigger the buzzer and send a notification to Telegram. The system also provides real-time information, enabling a quick response and reducing fire risks.

METHOD
Data Collection Techniques

To obtain data regarding the design and development of the fire monitoring and alert system for observing the workspace of the Zedigit program and media team, the following data collection techniques were used:

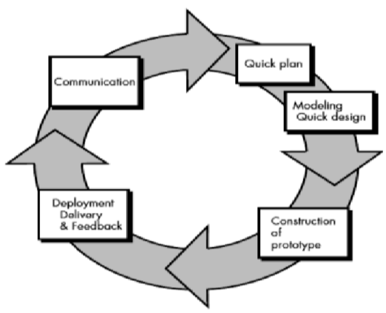
1. **Observation**
   Observation is a data collection technique carried out through direct observation and systematic recording of the objects being studied. The author conducted an observation in the workspace of the Zedigit program and media team in Bekasi on March 20, 2025. This observation was done alongside Mr. Heryadi Mulyana, S.Kom., and focused on the fire monitoring and alert system used, including the condition of the equipment, the detection workflow, and the method of delivering danger alerts.

2. **Interviews**
   Interviews are a data collection technique conducted by directly asking key informants in the field to obtain the necessary information. In this study, an interview was conducted with Mr. Heryadi Mulyana, S.Kom., the Commissioner of Zedigit, to gather information regarding the workspace condition, potential fire risks, and the need for an Internet of Things (IoT)-based early warning and monitoring system.
3. **Literature Study**

   The literature study is a technique for collecting data by reviewing existing findings and objects related to this study, specifically by seeking materials or references from various sources such as journals or scholarly works that relate to the issues in this research.

Development Model

In this study, the author used the prototype method. In addition to collecting field data, this method consists of five (5) steps, namely communication, quick plan, modeling quick design, construction of prototype, and deployment delivery and feedback.



Source: [Dhedy et al., 2021]
Figure 1
Prototype Method

Conceptual Framework

The conceptual framework explains the approach used to solve the problems that have been formulated and serves as the foundation for the entire research process. This framework helps to understand the flow of the research being conducted.

RESULT AND DISCUSSION

System Requirements Analysis

System Requirements Analysis is the process of determining the specifications needed in a system. From the analysis conducted, the researcher identified several system requirements, which include current needs, functional requirements, and non-functional requirements.

Current System Analysis

After collecting data through observation and interviews, it was concluded that the workspace of the program and media team at the Zedigit office is still not equipped with fire detection equipment. The absence of this equipment results in the lack of an early warning system that could provide information in the event of a fire.

Functional Requirements Analysis

The purpose of functional requirements analysis is to determine the features that the system must have in order to function according to the needs and solve the existing problems. Below are the functional requirements for the design and development of the IoT-based Fire Monitoring and Alert System Prototype:

1. The NodeMCU ESP8266 on the master module and three child modules are connected to the internet.
2. The master module and two child modules are connected using MQTT.
3. The master module is connected to Telegram.
4. The KY-026 sensor detects fire, the MQ-2 sensor detects smoke, and the DHT22 sensor detects temperature.
5. Each child module sends its sensor readings to the master module using the MQTT communication protocol.
6. The master module processes all the data received from the three child modules and analyzes whether there are signs of fire based on the temperature, smoke, or presence of fire.
7. If the system detects a danger, two automatic actions will be performed. The first action is that the system will send a real-time notification to the user on their smartphone through the Telegram app, containing the type of danger detected. The second action is that the buzzer will sound as a local alarm to warn those nearby. The buzzer sound will differ according to the type of danger.
8. Users can check the room's condition directly on their smartphone via Telegram Bot. The user just needs to send the command /StatusModul, and the

bot will display real-time information on temperature, humidity, smoke, and fire conditions in each area of the room.

Non-Functional Requirements Analysis

Non-functional requirements analysis is conducted to determine the specifications needed in the system to be developed. These requirements include hardware, software, and user requirements that must be met in order for the system to operate optimally.

1. Hardware Requirements Analysis

Below is the list of hardware required for the design of the system to be developed:

Table 1, Hardware Requirements Analysis

No	Hardware	Amount	Specification	Function
1	Nodemcu	4	Nodemcu ESP8266 Version	Control and connect all components in the system.
2	Fire Sensor	3	KY-026 Sensor	A sensor that detects the presence of fire as a fire indicator.
3	Smoke Sensor	3	MQ-2 Sensor	A sensor that functions to detect smoke.
4	Temperatu re Sensor	3	DHT22 Sensor	A sensor that functions to monitor air temperature and humidity.
5	*Buzzer*	1	5V Passive Speaker *Buzzer*	Issues an alarm sound as a warning of danger.
6	*Breadboard*	4	830 Point *Breadboard*	Board for designing circuits.
7	Jumper Cable	According to the needs	Jumper Cable 20 cm Long	For connecting media between components.
8	Casing	4	X-6 Component Case	Protects and tidies up the circuit to make it safer and more durable.
9	Adapter	4	5V 2A Micro USB Adapter	Provides power to the microcontroller and sensors to keep the system running stably.
10	*Smartphon e*	1	Android and iOS	As a notification receiver and remote sensor condition monitoring tool.

Source: Research Results (2025)

2. Software Requirements Analysis

The following is a list of software required in designing the system to be created:

Table 2 Software Requirements Analysis

No	Software	Specification
1	Arduino IDE	Version 2.3.4
2	Telegram	Version 11.7.4
3	Fritzing	Version 0.9.5

Source: Research Results (2025)

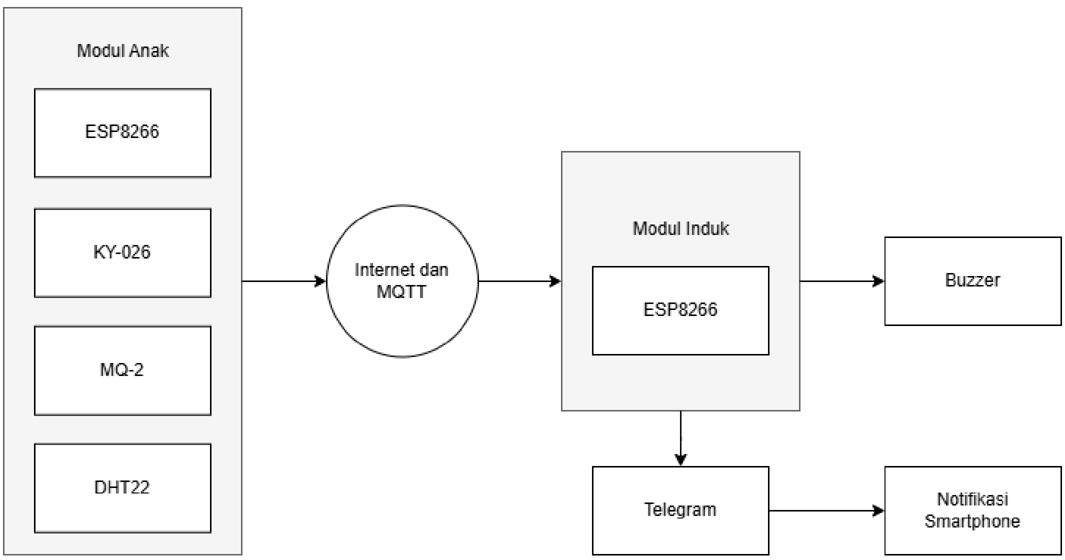
System Design

At this stage, the system design discusses the hardware and software components used to build an Internet of Things -based fire monitoring and warning system . This design aims to ensure the system can function optimally in detecting temperature, smoke, and fire.

The system design consists of three main sections: system description, main components, and system flow. Each section is designed with effectiveness and efficiency in mind in detecting potential fire hazards and sending real-time notifications to users. The system design is explained as follows:

System Description

At this stage, the system is explained in its entirety through a block diagram . This block diagram is created to provide a clear visual representation of the workflow of the system. Design and Construction of a Prototype Fire Monitoring and Warning System Based on the Internet of Things .



Source: Research Results (2025)

Figure 2, Block Diagram

The following is a detailed explanation of the function of each component contained in the block diagram :

1. The child module consists of sensors and a microcontroller that can detect potential fires at the monitoring location :

a. The NodeMCU ESP8266 functions as a sensor controller and signal processor from the sensor before sending data to the parent module
b. The DHT22 sensor measures the temperature and humidity of the air in the workspace, providing environmental data that is important for fire detection.
c. The MQ-2 sensor detects the presence of smoke which can be an early sign of a fire.
d. The KY-026 sensor detects the presence of fire by measuring light at specific wavelengths emitted by the fire.

2. Internet and MQTT , function to send data obtained from the child module to the parent module via the internet network using the MQTT protocol.
3. The parent module uses a NodeMCU ESP8266, which receives and processes data from the child module. This module performs analysis to determine if there is any indication of a fire based on the data received.
4. *The buzzer* functions to provide an alarm warning directly at the location when fire, high temperature, or dangerous smoke is detected, so that people nearby can immediately take action.
5. Telegram is used as a remote notification delivery medium. The system will send *real-time fire alerts* to officers' *smartphones* through this app.
6. *Smartphones* become fire notification receiving devices via Telegram, allowing users to monitor conditions practically and quickly from anywhere.

Main Components

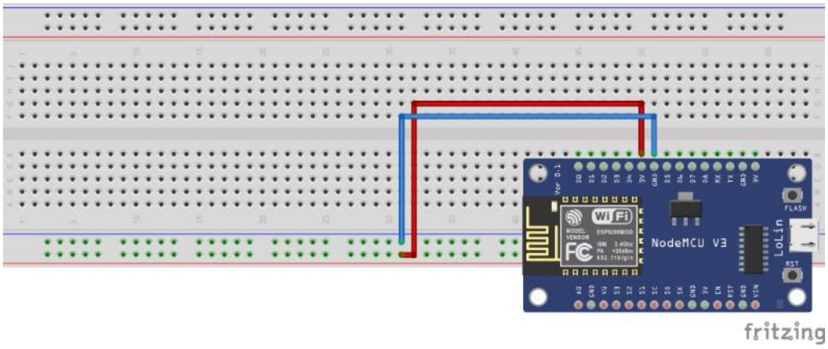
The design of the main components is the initial stage in the development of the hardware system before physical implementation. This system is divided into two main parts, namely the parent module and the child module. The parent module functions as a control center that receives data from the child module, displays information through the user interface, and sends warning notifications via the Telegram application if dangerous conditions such as fire, hazardous smoke, or high temperatures are detected. In addition, the parent module is also equipped with *a buzzer* that functions as an immediate warning alarm when dangerous conditions are detected in the surrounding environment. Meanwhile, the child module functions as an environmental data collection unit by utilizing the DHT22 temperature and humidity sensor, the MQ-2 smoke sensor, and the KY-026 flame sensor. Data collected by the child module is then sent wirelessly using the MQTT protocol to the parent module for analysis and follow-up as needed. The following is the hardware design created in this system:

1. Parent Module Hardware Design

The master module hardware design describes the arrangement and circuitry of the components used in the master module, as well as how each component functions to support the overall fire detection system. This explanation aims to ensure the master module functions effectively as a control center and data receiver for child modules in the system.

a. NodeMCU ESP8266 Design

Figure IV.4 shows the design of the ESP8266 NodeMCU circuit on the parent module. This circuit serves to distribute power from the NodeMCU to all parts *of the breadboard* . The 3V pin of the NodeMCU is connected to the positive line on *the breadboard* to provide a voltage of 3.3 volts, while the GND pin is connected to the negative line as *a ground* or zero volt reference.

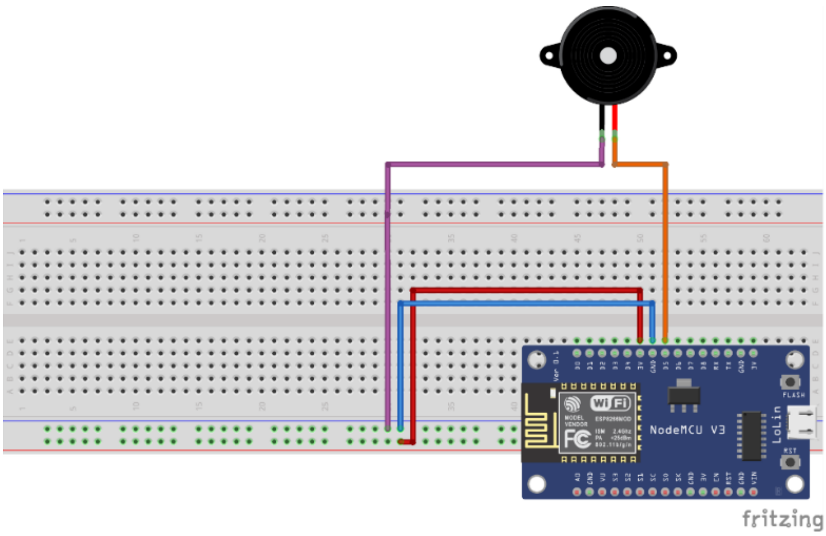


Source: Research Results (2025)

Figure 3, Design of the ESP8266 Nodemcu on the Main Module

b. *Buzzer* Design

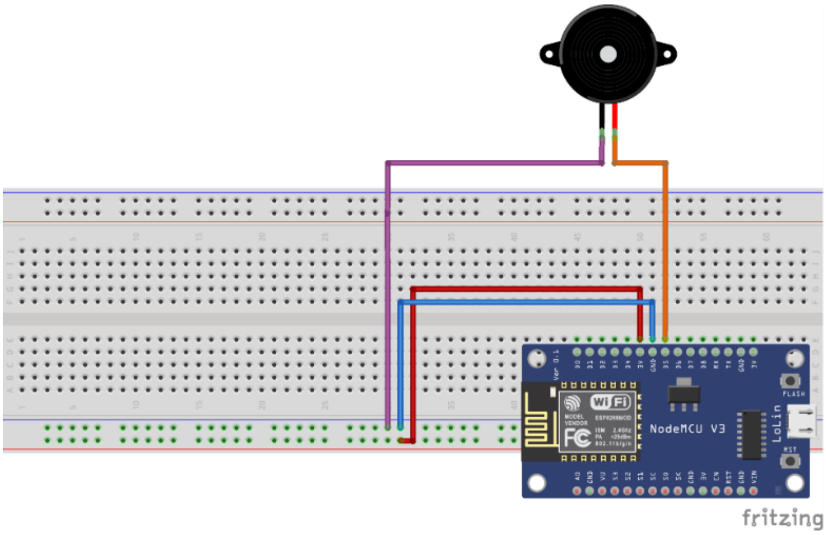
The design in Figure IV. 5 is the *Buzzer design* on the parent module. *The buzzer* is connected to the Nodemcu ESP8266 via pin D5. The orange cable connects pin D5 to the VCC pin on *the buzzer* . Meanwhile, the purple cable from the negative pin of *the buzzer* is connected to the *ground line* on *the breadboard* , which is already connected to the GND pin on the Nodemcu.



Source: Research Results (2025)
Figure 4, *Buzzer* Design on the Main Module

c. Overall System Design

The design shown in Figure IV.6 shows the entire system on the parent module. The 3.3V voltage from the 3V3 pin on the NodeMCU is channeled to the positive line *of the breadboard* using a red cable, while the black cable connects the GND pin to the negative line *of the breadboard* as the system *ground* . The orange cable connects the D5 pin on the NodeMCU to the positive leg *of the buzzer* , allowing *the buzzer* to receive digital signals. The negative leg *of the buzzer* is then connected to *ground* via a purple cable.



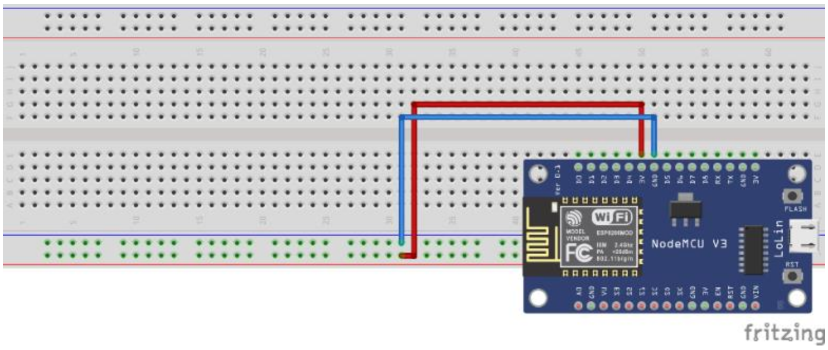
Source: Research Results (2025)
Figure 5, Overall System Design in the Main Module

2. Child Module Hardware Design

This Child Module hardware design explains how the components used in the Child Module are arranged or arranged, as well as how each component works to support the fire detection system.

a. NodeMCU ESP8266 Design

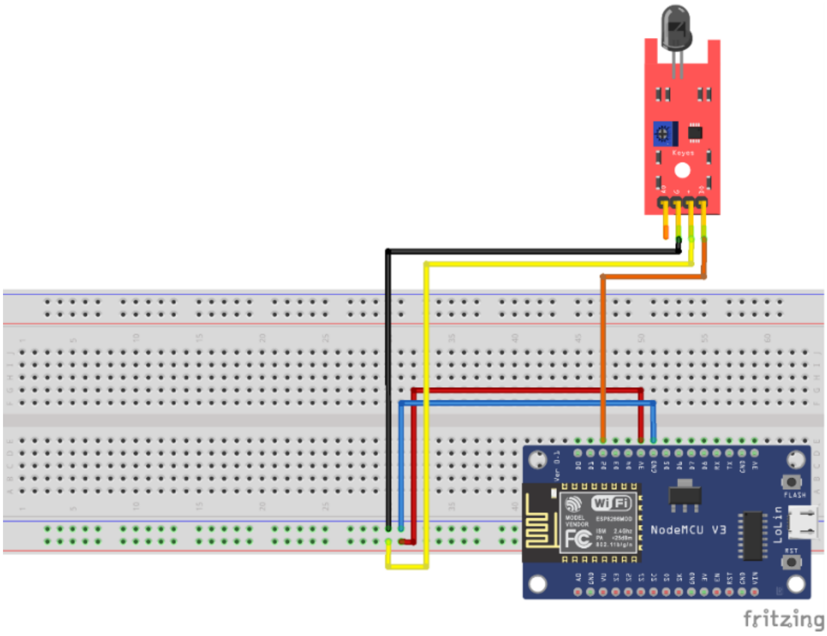
The design in Figure IV.7 represents the design of the NodeMCU ESP8266 on the child module. This circuit serves to distribute power from the NodeMCU to all parts *of the breadboard* . The 3V pin of the NodeMCU is connected to the positive line on *the breadboard* to provide a voltage of 3.3V, and the GND pin is connected to the negative line as *ground* .



Source: Research Results (2025)
Figure 6, Design of Nodemcu EPS8266 in Child Module

b. Design of KY-026 fire sensor

The design shown in Figure IV.8 shows the KY-026 fire sensor installation system on the child module. The VCC pin on the sensor is connected to the positive line *of the breadboard* using a yellow cable, which is then connected to the 3V pin on the NodeMCU as a power source. The GND pin on the sensor is connected to the *ground line of the breadboard* with a black cable, which is connected to the GND pin on the NodeMCU. For the signal path, the Ao pin on the sensor is connected to the D2 pin on the NodeMCU using an orange cable. With this design, the NodeMCU can read the signal from the KY-026 sensor and detect the presence of fire.

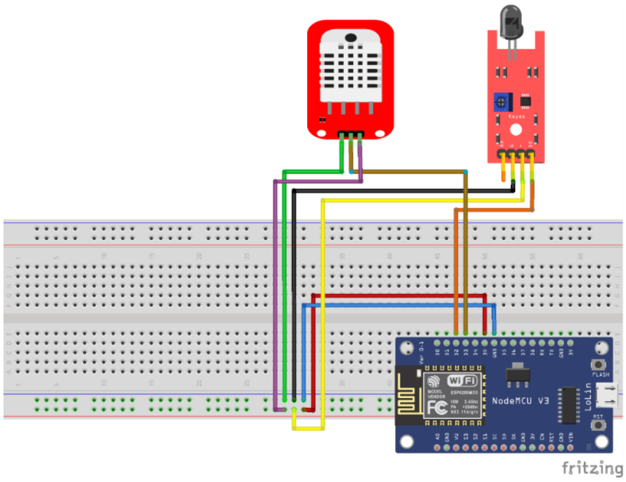


Source: Research Results (2025)

Figure 7, Design of the KY-026 fire sensor in the Child Module

c. DHT22 temperature sensor design

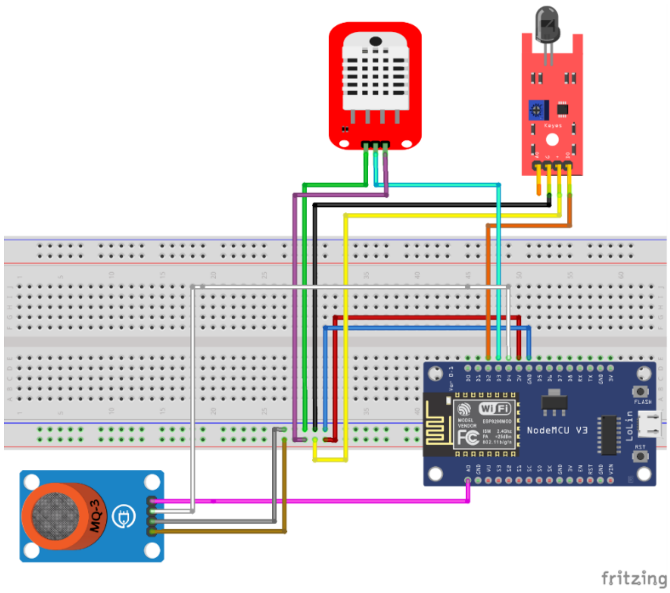
The design shown in Figure IV.9 is the installation of a DHT22 temperature sensor on a child module. The VCC pin on the DHT22 sensor is connected to the 3.3V pin on the NodeMCU using a purple cable, which serves as a power source to operate the sensor. The data pin on the sensor is connected to the D3 pin on the NodeMCU with a cyan cable, which is used for digital transmission of temperature and humidity data from the sensor to the NodeMCU. Meanwhile, the GND pin on the sensor is connected to the GND pin on the NodeMCU using a green cable, which serves as a *ground* or voltage reference in the system.



Source: Research Results (2025)
Figure 8, DHT22 Sensor Design in Child Module

d. MQ-2 smoke sensor design

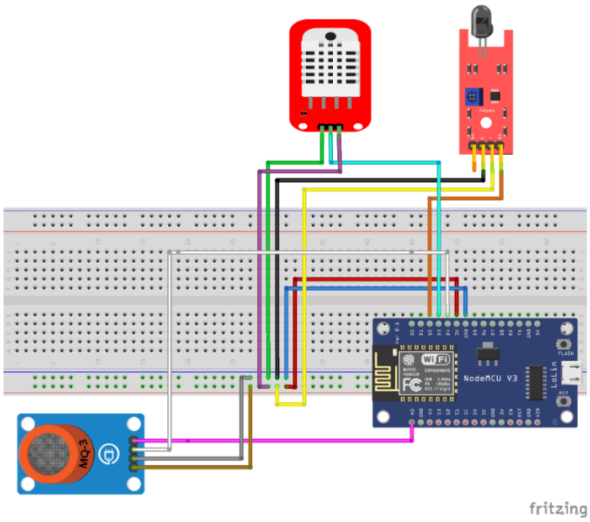
The design shown in Figure IV.10 illustrates the installation of the MQ-2 smoke sensor in a child module. The ochre-colored cable is connected to the 3.3V pin on the NodeMCU, which serves to provide power (VCC) to the MQ-2 sensor for operation. The gray cable is connected to the GND pin on the NodeMCU, which serves as the system voltage *ground* . The white cable is connected to the D4 pin on the NodeMCU, which serves as a digital *output line* that will be activated when the sensor detects smoke or smoke that exceeds a certain threshold. The pink cable is connected to the A0 pin on the NodeMCU, which is used to read the analog *output* from the sensor. This analog value reflects the smoke concentration in more detail and can be used for decision making based on a predetermined threshold in the program code .



Source: Research Results (2025)
Figure 9, Design of the MQ-2 Smoke Sensor in the Child Module

e. Overall system design in child modules

The design shown in Figure IV.11 depicts the entire circuit in the child module connected to three types of sensors, namely the DHT11 temperature and humidity sensor, the KY-026 flame sensor, and the MQ-2 smoke sensor. The DHT11 sensor is connected to pin D3 on the NodeMCU and is used to measure the temperature and humidity of the environment. The KY-026 flame sensor is connected to pin D5 to detect the presence of flames. The MQ-2 smoke sensor is used to detect smoke or hazardous fumes, with a digital *output* connected to pin D4 and an analog *output* connected to pin A0 on the NodeMCU. In the MQ-2 sensor circuit, the pink cable is connected to pin A0, the white cable to pin D4, the gray cable to the GND pin, and the ochre cable to the VCC pin. All components are mounted on *a breadboard* , with the red line as the 3.3V voltage line and the blue line as *the ground* .



Source: Research Results (2025)

Figure 10, Design of the Overall Module in the Child Module

System Flow

At this stage, the system workflow is explained in detail through several steps used to illustrate and understand how the system works. These steps include *a flowchart* . The following is an illustration of the system flow that has been created:

Flow chart

Flow chart This diagram illustrates the workflow of *an Internet of Things* (IoT)-based fire monitoring and warning system. The process begins when all modules are active and connected to a WiFi network and an MQTT broker. Afterward, the parent module connects to the Telegram app, and the child modules begin reading data from three types of sensors: a KY-026 fire sensor, an MQ-2 smoke sensor, and a DHT22 temperature sensor. If any of the sensors detects a dangerous condition, such as fire, smoke levels exceeding 600 ppm, or temperatures exceeding 40°C, the system sends the data to the MQTT broker. The parent module then receives the data, activates *a buzzer* , and sends a fire alert notification to Telegram. Once the process is complete, the system reads the sensor values again.

System Implementation

At this stage, the implementation of the previously designed system begins. The implementation process is divided into two main parts: hardware and software . Hardware implementation involves assembling and arranging the physical components that make up the system, while software implementation involves programming and configuring the system to function as desired.

CONCLUSION

The study focuses on the design and development of an IoT-based fire monitoring and alert system, specifically designed for Zedigit's program and media team's workspace. The increasing frequency of fire incidents in Bekasi City, along with the significant material losses incurred, highlights the urgent need for an early detection system. The system incorporates fire, smoke, and temperature sensors, which send real-time data to a master module. When a fire hazard is detected, the system alerts users via Telegram and triggers a local buzzer alarm. This IoT-based system is designed to improve fire safety management by providing real-time alerts, thereby reducing risks related to asset damage and enhancing employee safety.

Bibliography

Abrar AR, Kaharmen HM, Hakim IN. 2020. Prototype Alat Pendeteksi Kebakaran Berbasis Internet Of Things Dengan Aktifasi Flame Sensor Menggunakan Arduino. Jurnal Keselamatan Transportasi Jalan (Indonesian Journal of Road Safety) 7: 83–93.

Akbar Nuryadin R, Rahman Yusuf A, Reza M, Fadlila Alifian NH, Shagita Dyah PAK. 2024. Prototype Sistem Deteksi Kebakaran Menggunakan Sensor Mq-2 Dan Flame Sensor Berbasis Iot. Jurnal Riset dan Aplikasi Mahasiswa Informatika (JRAMI) 05: 877–885.

Ardiyanto T, Supriadi C, Priyadi. 2024. Rancang Bangun Sistem Monitoring Deteksi Dini Kebakaran Ruang Server Berbasis Iot. JURNAL ILMIAH SISTEM INFORMASI (JUISI) 3: 35–45.

Arif Z, Siswswanto. 2023. Penerapan Deteksi Kebakaran Berbasis IOT dengan Sensor Suhu Dan Gas Pada Toko Kacamata Optik Asia. Seminar Nasional Mahasiswa Fakultas Teknologi (SENAFTI) 2: 2108–2116.

Cahyo PP, Setyowati D, Suraya I. 2020. Implementasi Internet Of Things Pada Sistem Peringatan Keamanan Toko Dari Pencurian Dan Kebakaran Menggunakan SMS Gateway Berbasis Arduino. J Teknol 13: 112–118.

Dhedy M, Putra D, Pramudita R. 2021. Sistem Deteksi Api Berbasis Internet Of Things Pada Rumah. Media Jurnal Informatika 13: 64–69.

Fauzi MA, Sukarno SA. 2025. Pengembangan Sistem Pendeteksi Kebocoran Gas Lpg Berbasis Iot Integrasi Sensor Mq-02 Dan Dht11 Untuk Pemantauan Real-Time. Jurnal Informatika dan Teknik Elektro Terapan 13: 1467–1474.

Kurnianto A, Dedy Irawan J, Ariwibisono FX. 2022. Penerapan IOT (Internet Of Things) Untuk Controlling Lampu Menggunakan Protokol MQTT Berbasis Web. Jurnal Mahasiswa Teknik Informatika (JATI) 6: 1153–1161.

Najib Ainun M, Sulartopo S, Dani S, Danang D, Suasana Saufik I. 2024. Sistem Pendeteksi Bencana Kebakaran MenggunakanESP32Dan Arduino Berbasis WEB

(Studi Kasus Di Toko Citra Berkah Karangawen Demak). Jurnal Ilmu Komputer Dan Teknologi Informasi (Neptunus) 2: 15–24.

Nasichul M, Abidin Zainul R, Arsanto Tri A. 2024. Implementasi Sistem Monitoring Dan Kontrol Gas Lpg Berbasis Internet Of Things (Iot) Menggunakan Sensor Gas Mq-5. Juran Mahasiswa Teknik Informatika (JATI) 8: 10233–10239.

Oktiviani D, Ardhiansyah M. 2024. Rancang Bangun Sistem Pendeteksi Asap Kebakaran Menggunakan Nodemcu Esp8266 Berbasis Internet Of Things (Studi Kasus : Smk Iptek Tangsel). OKTAL : Jurnal Ilmu Komputer dan Science 3: 1683–1688.

Panjaitan M, Gunoto P, Susanti E. 2023. Perancangan Prototype Smart Warehouse Menggunakan Fire Protection System Berbasis IoT (Internet Of Things). Sigma Teknika 6: 368–376.

Raditya CGI, Dharma PAS, Putra IKAA, Sugirianta IBK, Purnama IBI. 2022. Pendeteksi Kebocoran Gas dan Kebakaran Dini Menggunakan NodeMCU Berbasis Telegram. Majalah Ilmiah Teknologi Elektro 21: 13–20.

Rahadiansyah R, Wati PR, Rahayu DP. 2021. Perancangan Sistem Pendeteksi Kebakaran Kebocoran Gas Di PT. BPR Kencana Berbasis IOT. Jurnal PETIK 7: 171–181.

Rahman B, Pernando F, Indriawan N. 2022. Sistem Monitoring Kebocoran Gas Dan Api Menggunakan Sensor MQ-2 Dan Flame Sensor Berbasis Android. Journal Sensi 8: 209–222.

Salindeho GG, Wellem T. 2023. Perancangan Dan Implementasi Sistem Pendeteksi Dan Peringatan kebakaran berbasis Iot Menggunakan Nodemcu Esp8266 dan Sensor Api. Jurnal Penerapan Teknologi Informasi dan Komunikasi 02: 179–191.

Saputra DB, Hidayati R, Suhardi. 2024. Sistem Deteksi Dini dan Pemadaman Kebakaran Otomatis di Rumah Berbasis IoT Menggunakan NodeMCU ESP32. Jurnal Sistem Komputer dan Informatika (JSON) 5: 581–589.

Setyasmara N. 2021. Internet of Things (IoT) Sistem Peringatan Dini Bahaya Kebakaran berbasis Android dan Arduino. Jurnal Multi Median Dan IT (JOMMIT) 5: 009–014.

Shofiyullah RMAH, Bagus Prasetyo I, As'as Prabowo M, Andhani R, Nugroho Pramudhita A. 2024. Pengembangan Aplikasi Mobile dan Alat Pendeteksi Kebakaran Berbasis Sensor untuk Keamanan Elektronik. Komputika : Jurnal Sistem Komputer 13: 121–130.

Siswanto, Laurin MS, Wibowo DW. 2022. Prototype Akses Gedung Perpustakaan Dilengkapi Sistem Peringatan Dini Kebakaran Berbasis Internet Of Things. Jurnal PROSISKO 9: 54–60.

Supriyadi E, Subagja PF. 2020. Rancang Bangun Alarm Pendeteksi Kebakaran Pada Gedung Bertingkat Menggunakan Metode Logika Fuzzy Berbasis Mikrokontroller Serta Terintegrasi Iot. JURNAL PENELITIAN DAN PENGKAJIAN ELEKTRO XXII: 10–20.

Zulkifli, Muhallim M, Hasnahwati. 2024. Pengembangan Sistem Alarm Dan Pemadam Kebakaran Otomatis Menggunakan Internet Of Things. Jurnal Informatika dan Teknik Elektro Terapan (JITET) 12: 2444–2460.