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Research Article

Design of a Fire Warning Prototype System at PT. Sevta Nusa Energi Using N Sensor Modules

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Abstract

Fire is an unexpected disaster and can occur at any time, often due to human negligence. Data from the Bogor Regency Fire Department shows an increase in the number of fires, especially in industrial and commercial areas, with a total of 280 cases in 2023, including 170 cases in Bogor City, which increased significantly from 172 cases in 2022. PT Sevta Nusa Energi, which is engaged in convection, merchandising, and Event Organizer, stores various materials and equipment that have the potential to catch fire. To reduce the risk of fire, an advanced fire detection system can be a solution, using technologies such as fire sensors, automatic alarms, and Internet of Things (IoT) connectivity to provide early warning to warehouse management and emergency response teams. The use of KY-026 sensors to detect fire, as well as DHT22 sensors to measure temperature and humidity, allows for accurate and fast data collection, so that preventive measures can be taken immediately. Based on this explanation, a title was made, Designing a Fire Early Warning System at PT Sevta Nusa Energi Using N Sensor Modules.

Keywords: Internet Of Things, Fire, KY-026, Nodemcu

INTRODUCTION

Fire is one of the disasters that is unpredictable and can occur at any time. Fires can be caused by several factors, including human error. According to data from the

Bogor District Fire Department, fires in this area have shown a concerning increase, especially in industrial and commercial areas. In 2023, there were a total of 280 fire incidents, including 15 cases in South Bogor, 18 in East Bogor, 31 in North Bogor, 22 in Central Bogor, 24 in West Bogor, and the largest number of incidents occurred in Bogor City, with 170 fire cases. This number shows a significant increase in fire incidents in Bogor City compared to 2022, where only 172 cases were reported.

PT. Sevta Nusa Energi is a company operating in the fields of convection, merchandising, and event organizing under the brand Huggy Boo. The company stores various materials and equipment that have a high potential for fire. Currently, PT. Sevta Nusa Energi does not have an autonomous fire warning system but still relies on incidental visual detection by employees present at the location. This poses a high risk, as if a fire occurs when there are no employees near the source of the fire, early preventive actions become impossible, leading to significant losses both in terms of assets and worker safety.

Smart sensors connected through a network allow for better detection and faster response capabilities. By utilizing advanced IoT technology, a more sophisticated fire detection system can be developed, which can be directly connected to an automatic fire suppression system (Anggarani et al., 2024, pp. 97–111).

The use of the KY-026 sensor to detect fire and the DHT22 sensor to measure temperature and humidity allows for the accurate and rapid collection of data to prevent fires from occurring. This system can provide early warnings to users through alarms or notifications, enabling immediate preventive actions.

METHOD

Data Collection Techniques

The data collection techniques used are intended to gather the necessary information that can support the research. The following methods were used to collect information:

Observation

At this stage, the author conducted an observation of the warehouse space at PT. Sevta Nusa Energi on March 24, 2025. This observation was carried out together with Mrs. Novita Hapsari. The researcher observed directly at PT. Sevta Nusa Energi to identify issues, such as the development of a fire detection system prototype.

Interviews

To gather data for the research, the interview method was used with respondents or informants. As a result of an interview with Mrs. Novita Hapsari, the owner of PT. Sevta Nusa Energi, on March 24, 2025, it was found that the warehouse of PT. Sevta Nusa Energi currently lacks a prototype that can detect fires and a system that can send notifications when a fire occurs in the warehouse. If a fire happens in the warehouse during non-working hours or when it is not in use, the overall loss will be significant.

Literature Study

To gain a comprehensive understanding of the research process from start to finish, a literature study is necessary. The literature study includes various activities for searching data and information, such as theories found in journals, e-books, books, and access to various literature that is relevant to the research being discussed.

RESULT AND DISCUSSION

Company Overview

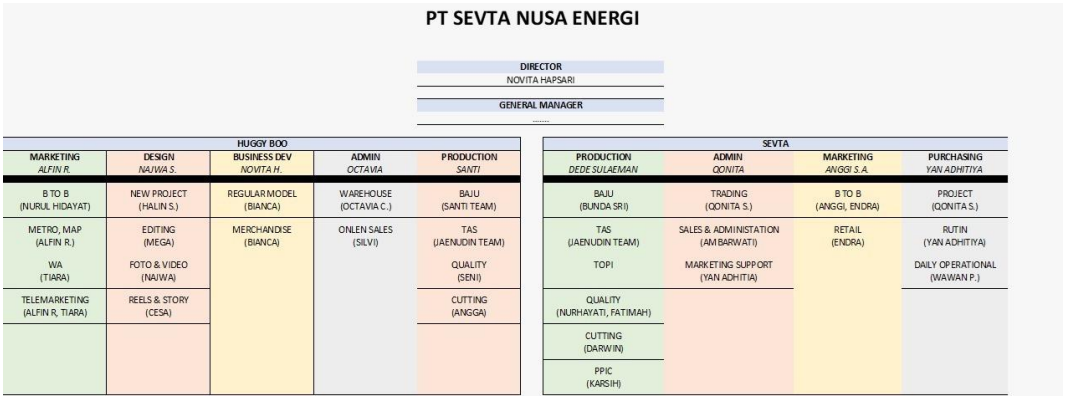
PT Sevta Nusa Energi is a company established in 2011, specializing in the fields of convection, merchandising, and event organizing. The core value of PT Sevta Nusa Energi is prioritizing customer satisfaction by maintaining high quality, providing the best services, and ensuring fast delivery.

Company Profile

PT Sevta Nusa Energi, founded in 2011, operates in the areas of convection, merchandising, and event organizing. With over a decade of experience, we are committed to providing high-quality products and services, prioritizing customer satisfaction, and ensuring timely delivery. In the field of convection, we manufacture various types of clothing such as t-shirts, jackets, uniforms, and custom apparel with the highest quality standards. For merchandising needs, we offer a range of promotional products, such as mugs, tumblers, bags, and caps, which can be customized for branding purposes. Additionally, as an event organizer, we handle a variety of events, from seminars and gatherings to corporate events, with professionalism and high creativity. With core values including top-quality products, customer satisfaction, punctuality, and continuous innovation, PT Sevta Nusa Energi continues to grow and is ready to become a trusted partner for various business and event needs. Our office is located at Gg. Tumaritis, Gandoang, Kec. Cileungsi, Kabupaten Bogor, West Java 16820.

Company Structure

Below is the organizational structure of PT Sevta Nusa Energi:



Source: Research Results (2025)
Figure 1. Company Organizational Structure

System Requirements Analysis

System requirements analysis is a crucial process to determine the specifications needed for the system. Based on the analysis conducted, several system requirements were identified, including current needs, functional requirements, and non-functional requirements.

Current System Analysis

The current system analysis at PT Sevta Nusa Energi shows that there is no existing system in place for early detection and notification of fire incidents. In the event of a fire, there is no detection or notification system to alert the owner of PT Sevta Nusa Energi when they are outside the house or far away, which could result in significant losses.

Functional Requirements Analysis

Functional requirements analysis provides an overview of the processes in the system that will be developed and outlines the requirements needed for the system to function effectively. Below are the functional requirements for the system to be created:

1. The system must be able to detect fires early through sensors located in the designated room.
2. The system must provide alerts or notifications of a fire through a buzzer and Telegram notifications.
3. The Telegram app on Android devices and other operating systems should be used to monitor detected data in real-time.

Non-Functional Requirements Analysis

Non-functional requirements analysis is conducted to determine the specifications for the system, including hardware, software, and user analysis. Below are the non-functional requirements used in the design of the early fire detection system:

1. **Hardware Requirements Analysis**
   This analysis will describe the hardware used in the design of the system, detailing the specific hardware components involved. Below is the hardware used in the system design:

Table 1
Hardware Requirements Table

No	Device Hard	Amount	Specification	Function
1	Nodemcu	3	Nodemcu ESP8266 version	As a controller of electronic circuits or other

No	Device Hard	Amount	Specification	Function
				components.
2	*Breadboard*	2	400P mini *breadboard*	A place to design circuits from electronic components.
3	Fire Sensor	2	KY-026 Module	A sensor that functions to detect flames.
4	Temperature Sensor	2	DHT22 Sensor	Detects room temperature.
5	*Buzzer*	1	*Active Buzzer Speaker* 3V-24V	Provides notification in the form of sound
7	Jumper Cable	30	Length 20 cm	As a connecting medium between components
8	Electronic Box	3	Size X6: 10.5cm x 17.5cm x 5.8cm	As a place to put all the components so that the components can be better arranged.
9	Adapter	3	5V adapter	Charging electronic devices

Source: Research Results (2025)

2. **Software Requirements Analysis**

Software requirements analysis is conducted to explain which software is used to

support the use of the system that has been created. Below is the software requirements analysis:

Table 2, Software Requirements Table

No	Software	Specification
1	Arduino IDE	Version 2.3.4
2	Fritzing	Version
3	Telegram	Version 11.8.2

Source: Research Results (2025)

System Design

This stage describes the hardware and software components used to build an *Internet of Things -based fire monitoring and early warning system* . The design aims to ensure the system performs optimally in detecting temperature and fire.

This 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 overall system design is explained using *a Block Diagram* . *The Block Diagram* is created to facilitate understanding of the workflow of the Fire Early Warning System at PT. Sevta Nusa Energi Using N Sensor Modules.

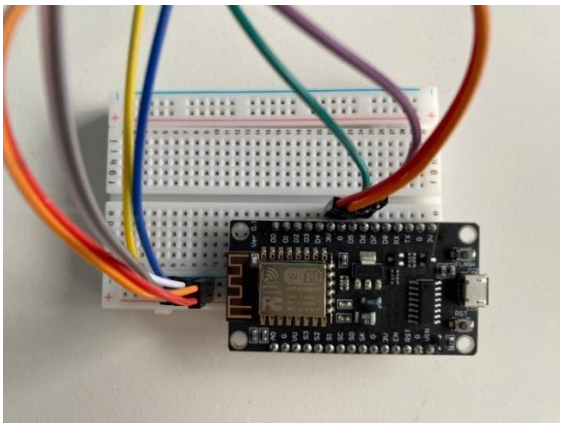
System Implementation

System implementation is the application or design stage of hardware and software. The system implementation stage is divided into two parts: hardware implementation and software implementation, which are described as follows:

Hardware Implementation

Hardware implementation is the design of the hardware components used to create a fire detection system using *the Internet of Things* -based *prototype method* using the NodeMCU ESP8266, namely as follows:

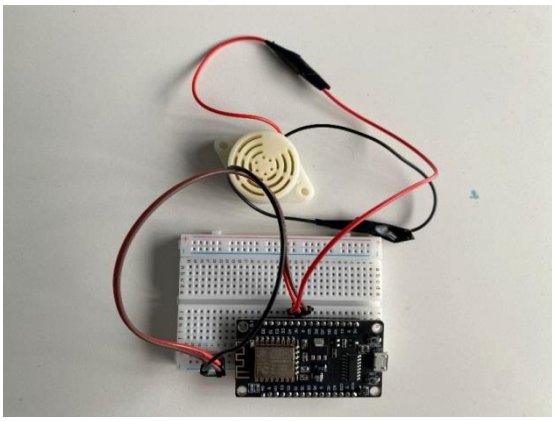
1. **Parent Module Hardware Implementation**
   NodeMCU ESP8266 Implementation
   The NodeMCU ESP8266 implementation is connected by connecting the NodeMCU ESP8266 pins to *the Breadboard*



Source: Research Results (2025)
Figure IV. 1NodeMCU ESP8266 Parent Module Implementation

A. *Buzzer* Implementation

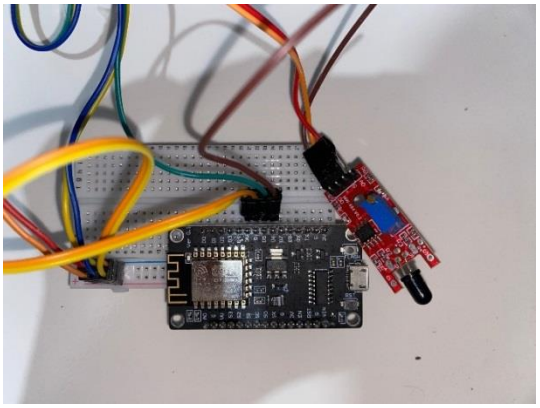
buzzer implementation is connected to the NodeMCU ESP8266 which is already connected to *the breadboard* . *The buzzer* functions to emit a sound as a sign of fire. The implementation is done by connecting *the buzzer* to one of the digital pins on the NodeMCU ESP8266 via *the breadboard* . The positive pin (VCC) on *the buzzer* is connected to the NodeMCU's digital *output pin* , while the negative pin (GND) is connected to *ground.*



Source: Research Results (2025)
Figure IV. 2Implementation of the Main Module *Buzzer*

2. Child Module Hardware Implementation 1
Implementation of KY-026 Fire Sensor Child Module 1

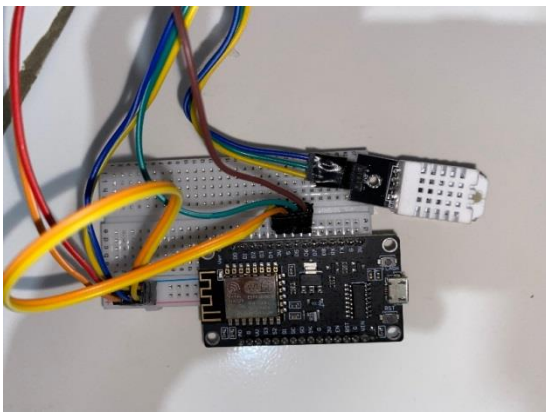
The fire sensor implementation is connected to the NodeMCU ESP8266 and *the breadboard* using jumper cables. The fire sensor has a black section at the end that detects fire.



Source: Research Results (2025)
Figure IV. 3Implementation of the KY-026 Flame Sensor Child Module 1

B. Implementation of DHT22 Sensor Child Module 1

The DHT22 sensor is implemented by connecting the sensor to the NodeMCU ESP8266 microcontroller via a *breadboard* using jumper cables. The DHT22 sensor has two main measurement parameters, namely temperature and humidity. The wiring process is carried out by connecting the sensor data pin to one of the digital pins on the NodeMCU, while the VCC and GND pins are connected to the 3.3V power supply and *ground* . Once connected, the system will periodically read temperature and humidity data and display it via the serial monitor or forward it to the notification system if needed.

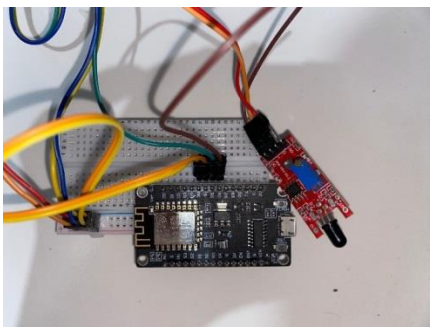


Source: Research Results (2025)
Figure IV. 18. Implementation of the DHT22 Sensor in Child Module 1

3. Child Module 2 Hardware Implementation

A. Implementation of the KY-026 Fire Sensor Child Module 2

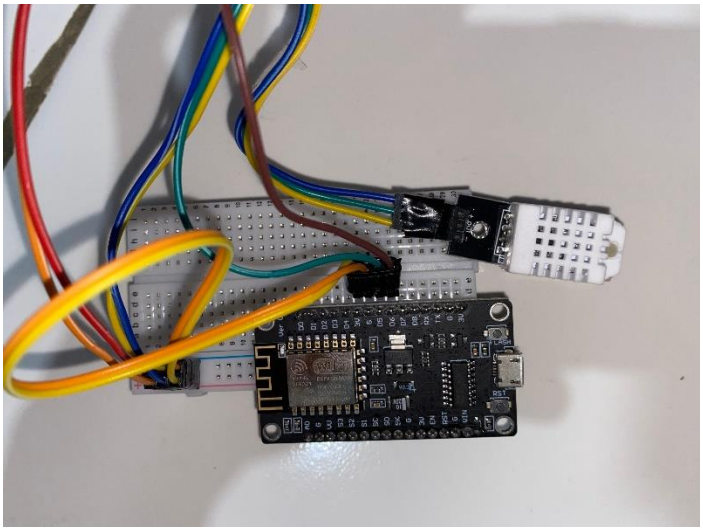
The fire sensor implementation is connected to the NodeMCU ESP8266 and the breadboard using jumper cables. The fire sensor has a black section at the end that detects fire.



Source: Research Results (2025)
Figure IV. 19. Implementation of the KY-026 Flame Sensor Child Module 2

A. Implementation of DHT22 Sensor Child Module 2

The DHT22 sensor is implemented by connecting the sensor to the NodeMCU ESP8266 microcontroller via a *breadboard* using jumper cables. The DHT22 sensor has two main measurement parameters, namely temperature and humidity. The wiring process is carried out by connecting the sensor data pin to one of the digital pins on the NodeMCU, while the VCC and GND pins are connected to the 3.3V power supply and *ground* . Once connected, the system will periodically read temperature and humidity data and display it via the serial monitor or forward it to the notification system if needed.



Source: Research Results (2025)
Figure IV. 4Implementation of the DHT22 Sensor in Child Module 2

B. Overall Circuit Implementation

The implementation of the entire circuit on the tool uses *a black box* that has been designed to be more neatly arranged and easy to place.

1. Implementation of the Overall Parent Module Series

The circuit is implemented in the main module by placing all components within a specially designed casing. This ensures neat arrangement of the components and simplifies system installation and maintenance.

Source: Research Results (2025)
Figure IV. 5Overall Implementation of the Parent Module

2. Implementation of the Whole Series of Child Modules 1

The implementation of the overall circuit in child module 1 is done by placing all components in a previously designed casing.

Source: Research Results (2025)
Figure IV. 6Implementation of the Overall Series of Child Module 1

3. Implementation of the Whole Series of Child Module 2

The implementation of the overall circuit in child module 1 is done by placing all components in a previously designed casing.

Source: Research Results (2025)
Figure IV. 7Implementation of the Overall Series of Child Module 2

CONCLUSION

The study focuses on the design and development of a fire warning prototype system at PT. Sevta Nusa Energi using N sensor modules. Fire incidents in the Bogor area, especially in industrial and commercial sectors, have increased significantly, highlighting the need for improved fire detection systems. PT. Sevta Nusa Energi, which stores materials with high fire risk, currently lacks an autonomous fire warning system, relying instead on incidental visual detection. The system designed in this study utilizes sensors such as KY-026 for fire detection and DHT22 for measuring temperature and humidity, ensuring early detection and rapid response. This IoT-based system provides real-time alerts via Telegram and a buzzer, enabling prompt preventive actions, reducing risks to assets and employee safety.

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