

Modification Of Smoke Detector Monitoring Design Using Android Application

Raynold Bintang Ganiezha¹, Nyaris Pambudiyatn², Rifdian Is³

¹Study Program Of Diploma 3 Air Navigation Engineering, Aviation Polytechnic Of Surabaya,
Jemur Andayani Street I/73, Surabaya, Indonesia

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ABSTRACT

This research aims to enhance the effectiveness of smoke detector monitoring by leveraging Android technology. Modifications were made to the existing smoke detector monitoring system by integrating the functionality of an Android application. The Android application was developed to allow users to monitor the status of the smoke detector in real-time through their mobile devices. The tool was created using the Arduino IDE application as its text editing platform, while Flutter was employed as the programming language for the Android application. Sensor integration operates on the mechanism that when smoke is detected, the buzzer emits an audible signal. The temperature sensor on the DHT11 component is also integrated with this application and tool to display information about the room's temperature. Experimental methods and testing were conducted to validate the performance of the modified system. The results of this research indicate that modifying the monitoring design with an Android application can enhance the accessibility and reach of smoke detector monitoring, enabling quick response actions in emergency situations. This study has the potential to make a significant contribution to the development of more advanced and efficient security monitoring technology.



Corresponding Author:

1,2,3 Politeknik Penerbangan Surabaya

Email: reybintang@gmail.com

1. INTRODUCTION

Currently, technological advancements enable internet-based automatic monitoring. This technology can provide real-time information about gas sensor conditions both directly and remotely through the Internet of Things (IoT) concept. Due to the lack of information related to potential fires, a system capable of providing early warnings regarding initial signs of fire is necessary. To detect potential fires, a system capable of recognizing fire symptoms is required[1]. In the field of security, various technologies such as fire alarms, smart doors, smoke detectors, and more are available.

According to Ningrum, smoke detectors operate by detecting the accumulation of smoke particles. Their function is to capture smoke particles, including those invisible to the human eye. These detectors have the ability to detect fires faster than heat detectors. The application of smoke detectors is particularly suitable in buildings where the potential for Class A fires can generate smoke, although they may be less effective in detecting gas or hydrocarbon fires [2]. In a presentation at Proctor and Gamble by Kevin Ashton in 1999, the term Internet of Things was first introduced. The Internet of Things (IoT) is the concept that objects can send and receive data over Wi-Fi networks without requiring human interaction, everything operates automatically through programs[3].

All of this technology is designed to anticipate potential disasters that can happen at any time, including fires. Fires often occur due to a lack of organized safety and prevention systems. This is a dangerous situation that can result in significant losses, both financially and in terms of lives[4]. Therefore, enhancing safety aspects becomes crucial in preventing the possibility of fires. One method to prevent fires is by using smoke detectors. With that in mind, the author aims to make modifications to the design of an Android application that can monitor fire detection.

This smoke detector system utilizes the NodeMCU microcontroller as an Internet of Things (IoT) module with a DHT-11 sensor and an MQ-7 Gas sensor to provide early warnings related to potential fires. This data can be accessed directly through a real-time mobile application[5]. The Internet of Things (IoT) system developed utilizes sensors connected to NodeMCU through Telegram and IoT, allowing sensor owners to receive notifications on their smartphones when potential fires are detected[6].

2. METHOD (10 PT)

The research method used is experimental. The experimental method is an approach that involves experiments, observations, and direct experiences in its process[7]. By using the experimental method, this project is carried out through a series of steps, including identifying the problem, conducting a literature review, designing and collecting materials, designing and creating equipment, and conducting testing. Through this process, the researcher will observe the object, analyze data, and draw conclusions based on the gathered evidence.

a. Data Collection

The first step in this design process is to collect data. The author will collect information by analyzing the existing situation and conditions in the case study location.

b. Studi Pustaka

In this design, desk research was conducted by accessing journals, e-books, websites, and other sources of information. This was done to gain an in-depth understanding of smoke detectors and the Internet of Things.

c. Equipment and Material Collection

In this step, the author selects the devices, including the components and microcontroller to be used, namely the NodeMCU ESP8266. The selection of these devices and materials is a crucial stage in this process.

d. Design Blueprint

The author transforms the collected concepts into the desired design. At this stage, the assembly and integration process between hardware and software components begins, including coding the device according to the design that has been made.

e. Device Construction

This stage is an important stage in the entire process of designing and developing this tool. Design validation aims to test and evaluate the results and ensure the feasibility of the tool design. After the design validation is complete, an evaluation or refinement of the design will be carried out which has been analyzed by experts in their fields. This will result in various suggestions and input to the Smoke Detector design.

f. Device Testing

This design test is a step to check and evaluate how the data from the sensors used is received. The initial stage in the design process is to collect data, analyze it, and set general parameters to achieve the overall design goal. Next, the device will be tested using a series of tests to determine whether the device meets the eligibility criteria.

1. Device Design and Construction

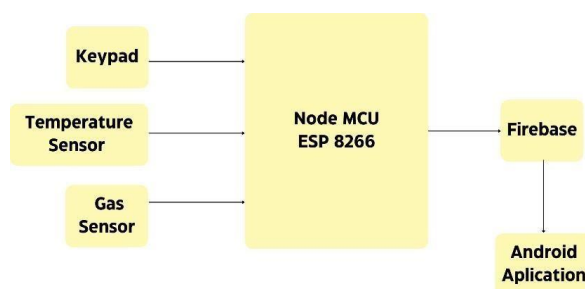


Figure 1. Block Diagram

3. RESULTS AND DISCUSSION (10 PT)

1. The Data Collection

a. Studi Pustaka

Your statement emphasizes the importance of a comprehensive understanding of smoke detector fabrication, requiring a deep knowledge of both IoT and Android components. The tool is created using the Arduino IDE as the text editor, while the Android application is developed using the Flutter programming language. Literature and information for building the device are sourced from relevant journals and books related to smoke detectors, ensuring a well-informed approach to the project.

b. System Design

In this phase, it includes system design by applying analytical techniques and understanding the concept of the tool from available components. This stage is of significant importance as it is the initial step in the device creation process, where the initial design will be formed or planned. In this stage, the system design is also developed based on the existing components. The device is created according to the prepared system design concept.

c. Evaluation

In this step, the current measurement circuit is tested by involving a set of data from various journals, and then the test results are evaluated. Testing each component within the circuit is necessary to ensure the creation of a properly functioning device.

2. Device Design

a. Hardware

The device design and assembly encompass the creation of a shield, assembling and wiring the device, and implementing the device's program. The system design is evident in how the application operates, overseeing the connected database as the destination for the integrated input data from the sensors and microcontroller. This ensures that all input activities or processes up to the output data can be viewed in the database. The sensors utilized are the MQ7 gas sensor and the DHT11 temperature sensor.

1. MQ7 Gas Sensor

The gas sensor used to detect smoke is the MQ7 sensor. The MQ7 sensor is known for its high accuracy in detecting smoke or CO (carbon monoxide)[9]. Thanks to its sensitivity, monitoring the data reading process becomes easier. Additionally, data mapping can be achieved by calculating the value from the analog pin. In the sensor reading process, the recorded data is the Rs/Ro value, which is then processed through logic to obtain the ppm (parts per million) value.



Figure 2. MQ7 Gas Sensor

2. Sensor DHT11

The DHT11 sensor is used to measure the indoor temperature when the device is implemented. This sensor will read analog values of the recorded temperature data[10]. The implementation of the temperature sensor will play a role in the data processing to determine the range of valid data.

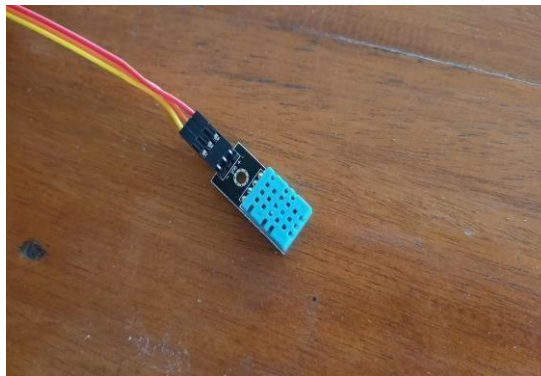


Figure 3. DHT11 Sensor

b. Application (Software)

Application (Software) Design" is the visual representation of the interface that will serve as a control for the device. The application design process aims to facilitate the programming process and the placement of application components, including buttons, labels, tables, and other elements. This application design serves as a model or example of the display that will be implemented.



Figure 4. Application Login Page

Figure 4 displays the login screen of the application, where users need to log in before accessing the application. To log in, users must fill out a form with a username and password. If the entered username and password are correct, the login process will be successful, and the user will be directed to the home page. However, if an error occurs, the application will display a warning and provide information that the entered username or password is incorrect.

In Figure 5, you can see the main page of the application, which provides information about the connected smoke detector. On this page, the application will display detailed information about the device along with data status monitoring. The presented data includes the smoke detector's name, room temperature, room name, time, and status. The status color will change according to the device's condition, with green indicating a safe condition, yellow as a warning, and red indicating danger.

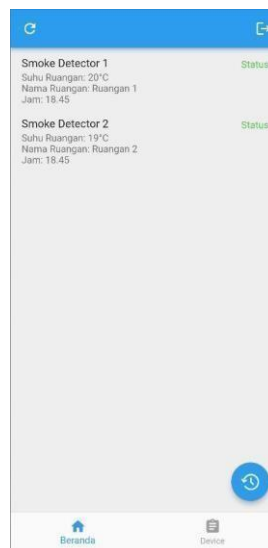


Figure 5. Application Home Page

Figure 5 illustrates a pop-up notification interface that provides options to turn the device on or off. This feature allows users to manually control the buzzer sound or skip such settings. The system is designed to enable users to control the device remotely.

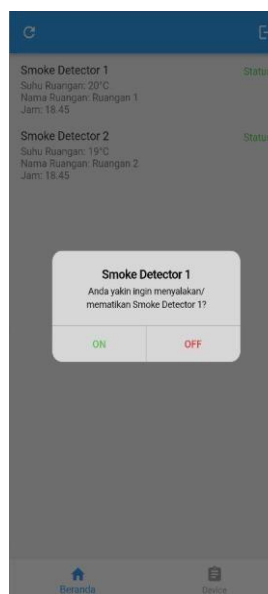


Figure 6. Smoke Detector On/Off Notification Page

In Figure 6, you can see data about devices that have successfully connected to the application. The system will store information about the name of the smoke detector that has established a connection between the device and the application. This means that when the connection is successful, new data will be added to the device page's display

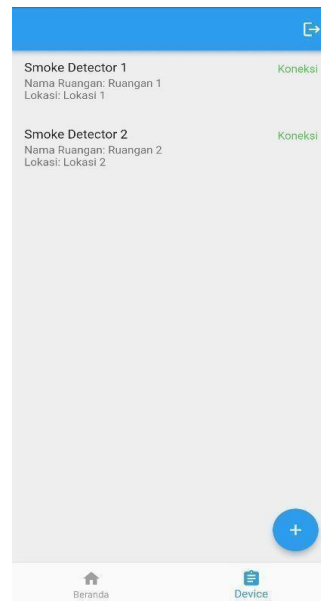


Figure 7. Device Page

Figure 7 shows the data entry form page, where users will input information about the device to be connected. Form completion includes the smoke detector's name, room name, and location. The storage system uses automatic integration. If a user adds a device for the first time, the device that appears as "Smoke Detector 1" will be connected to the device with code 1. If the user fills out the form again with the name "Smoke Detector 2," it will automatically be connected to the device with code 2. Subsequent additions also use a similar system, where each device integration form added will be directly connected to the device with a code corresponding to the number of forms already added.

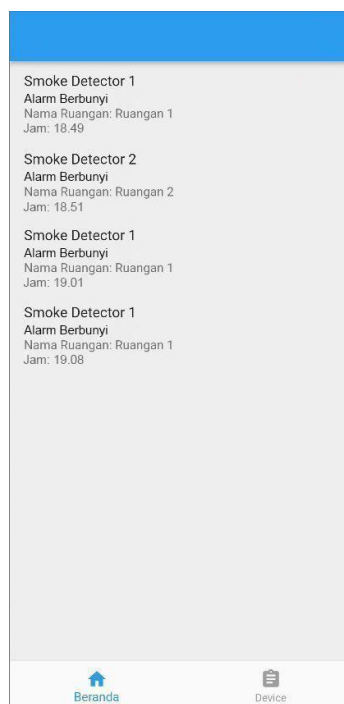


Figure 8. Alarm History Page

Figure 8 displays the alarm history page, which serves as a timestamp record when the alarm goes off. On this page, information about the time the alarm sounded for each device will be displayed. With this page, users can monitor the alarm times more flexibly, which can be used as an indicator of a fire event.

Table 1 Connection to Firebase Configuration

No	Testing Scenario	Results in Firebase	Description
1.	Sending DHT11 Temperature Value	Receiving Room Temperature Value from the Device and Stored Temperature Value	Successful
2.	Sending MQ-7 PPM Value	Receiving Smoke PPM Value from the Device and Stored PPM Value	Successful
3.	Storing Token Data	Generating Token Value and Storing Token Data	Successful
4.	Real-time Sensor Data Storage	Receiving Sensor Values Sent from the Device	Successful
5.	Device Connection with the Application	Integrating the Device with the Application in Real-time	Successful

Table 2. Application Testing

No	The System Being Tested	Testing Scenarios	Description
1.	Login Page	Entering a username and password to access the Dashboard page	Successful
2.	Dashboard Page	Displaying and viewing information from the connected smoke detector devices on the application	Successful
3.	Pop-up Notification On/Off Page	A notification pop-up appears with two buttons, 'On' and 'Off.' You can enable or disable the buzzer by pressing one of them	Successful
4.	Device Page	Displaying the smoke detector devices that have been added to the application	Successful
5.	Add Device Page	Entering data, including the device name, room name, and location, to add a new device	Successful

4. CONCLUSION

Based on the research and analysis conducted, it can be concluded that the smoke detector system has been well designed. This is evident from the testing results performed on each component, as well as the overall testing. The device is capable of integrating with Android devices and can detect ppm levels and temperature, allowing for real-time monitoring. Additionally, the device has been successfully designed to monitor the location of IoT-based smoke detectors through the Android application. The manufacture of this device uses NodeMcu esp8266 which is able to send data to Firebase so that the android application can access real-time data on Firebase

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