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# AIR QUALITY TEST OF CIGARETTE SMOKE IN COFFEE SHOPS IN SOUTH ACEH

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**ABSTRACT**

This study aims to analyze air quality in coffee shops in South Aceh using the MQ2 sensor to detect cigarette smoke. Cigarette smoke is a significant source of indoor air pollution and can negatively impact health. The MQ2 sensor was installed in various locations within the coffee shops to measure smoke concentration at different times, including peak and off-peak hours. The measurement results showed variations in cigarette smoke concentration, with peak levels occurring during times of increased customer traffic. Coffee shops with better ventilation systems exhibited lower smoke concentrations, indicating the importance of good air circulation in reducing the effects of cigarette smoke. These findings suggest the need for stricter regulations regarding smoking in public places and improvements in ventilation systems to protect the health of customers and staff. This research provides important insights into indoor air quality management and encourages the implementation of smoke-free policies in coffee shops. From the results of tests conducted in several coffee shops, it was found that the average cigarette smoke content increased in rooms with more than four fans, and that the size of the coffee shop had an influence.

## INTRODUCTION

The air quality test of cigarette smoke in coffee shops in South Aceh can be effectively conducted using the MQ-2 sensor, which is designed to detect various gases, including those emitted from cigarette smoke. This sensor can provide real-time monitoring of smoke levels, which is crucial for maintaining a healthy indoor environment, especially in public spaces like coffee shops. MQ-2 Sensor Functionality The MQ-2 sensor detects smoke concentrations and categorizes them into three levels: good, moderate, and unhealthy. It operates by sending data to a microcontroller, which can activate exhaust fans to mitigate smoke levels when thresholds are exceeded, such as 100-400 ppm for moderate and over 400 ppm for unhealthy levels (Paramitha et al., n.d.). The sensor can also transmit data to smartphones or laptops, allowing for remote monitoring and control (Umar et al., 2023). Health Implications Cigarette smoke contains harmful substances like carbon monoxide, nicotine, and tar, which pose health risks to both smokers and non-smokers in enclosed spaces (Kindi & Al-Haidri, 2023). Regular monitoring in coffee shops can help reduce exposure to these pollutants, thereby protecting patrons, especially vulnerable groups like children and pregnant women (Kindi & Al-Haidri, 2023). Implementation Challenges While the MQ-2 sensor is effective, its accuracy can vary based on environmental conditions and the presence of other pollutants, necessitating careful calibration and validation (Wang et al., 2023). Additionally, the integration of such systems into existing coffee shop infrastructures may require investment and training for staff to ensure proper operation (Dari et al., 2023). In contrast, some may argue that the implementation of air quality monitoring systems could lead to increased operational costs for coffee shop owners, potentially affecting their business model. However, the long-term health benefits and customer satisfaction may outweigh these initial challenges.

## LITERATURE REVIEW

The literature on air quality testing of cigarette smoke in coffee shops in South Aceh using the MQ-2 sensor highlights the significant impact of cigarette smoke on indoor air quality and public health. The MQ-2 sensor, integrated with IoT technology, is effective in detecting and managing cigarette smoke levels in indoor environments, such as coffee shops, by activating ventilation systems when smoke levels exceed certain thresholds (Umar et al., 2023). This approach is

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crucial given the high levels of pollutants like CO, PMs, and VOCs found in coffee shops, which pose health risks to both active and passive smokersv(Kindi & Al-Haidri, 2023) (Fidan & Cimrin, 2007). MQ-2 Sensor and IoT Integration The MQ-2 sensor is capable of detecting cigarette smoke and transmitting data via an IoT network, allowing for real-time monitoring and control of indoor air quality. The system activates a fan when smoke levels reach 7 ppm, with further escalation at 32 ppm, ensuring effective smoke management (Umar et al., 2023). Health Implications of Indoor Smoke Coffee shops are significant sources of indoor air pollution due to cigarette and shisha smoke, leading to health issues such as heart disease, lung cancer, and reproductive problems (Kindi & Al-Haidri, 2023). Exhaled CO levels in coffeehouse customers are significantly higher, indicating substantial exposure to harmful pollutants (Fidan & Cimrin, 2007). Environmental Factors Affecting Air Quality Tobacco smoking is a primary contributor to elevated levels of PM, TVOCs, and CO in coffee shops. Other factors include roasting beans and occupant density (Lin et al., 2022). Effective air quality management in coffee shops requires addressing these factors, alongside optimizing ventilation and temperature control (Lin et al., 2022). While the MQ-2 sensor provides a technological solution for monitoring cigarette smoke, broader strategies are necessary to mitigate health risks. These include public awareness campaigns, stricter regulations on indoor smoking, and improved ventilation systems. Such measures can complement sensor-based monitoring to create healthier indoor environments in coffee shops.

## METHOD

This study uses quantitative experimental research methods because its implementation involves system analysis and system design. This study is structured as an experimental study, namely designing circuits and testing the circuits that have been built with the aim of identifying the factors that influence the behavior of each component in the system that has been built.
The research process to be carried out can be seen in the following box diagram in Figure 1: The stages are as follows:

1. Problem Identification : This stage is carried out to identify problems related to the use of microcontrollers.
2. Literature Study : This stage is carried out to find information related to systems that have been built using microcontrollers.

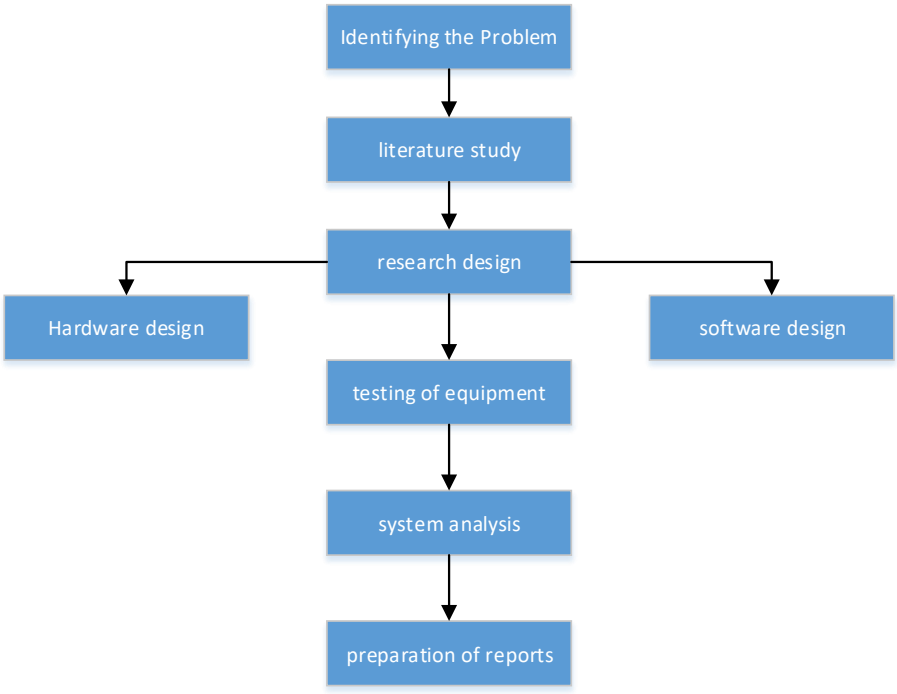


Figure 1. Research Flow

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3. Research Design : There are two parts to the rapid design stage, namely:

a) Hardware Design
Hardware design aims to design supporting equipment/circuits for the system to be created.
b) Software Design
Software design is carried out to facilitate the creation of the software later on.

4. Tool Testing :In this stage, the designed system is tested to see if it runs as planned.
5. System Analysis :In this stage, the system that has been run is analyzed by looking at the aspects to be measured.
6. Report Writing ; In this stage, a research report is written covering the test results and system analysis, ending with a conclusion.

The instruments in this study are the tools and materials used in the research process. This study uses materials consisting of hardware and software. The hardware used in this study includes:

a) A computer with minimum specifications of a Dual Core processor and 2GB RAM, used as the platform to run the Arduino application.
b) The Arduino Uno microcontroller board, which serves as the main board for running the Arduino Uno microcontroller.
c) A 16x2 LCD as a tool for displaying the percentage of CO gas content readings.
d) A buzzer as an output device for emitting sound.
e) A relay as a switch for turning the cooling fan on/off.
f) An MQ2 sensor as a CO gas detector.
g) A 9 V power supply as a power source for the microcontroller and relay

The software requirements for this final project are as follows:

a) Windows 10 Ultimate 64 Bit: The operating system used to run all software on the computer
b) Arduino IDE 1.8.2: Software that facilitates the development of microcontroller applications, from writing source code to compiling, uploading, and testing via the terminal.
c) Fritzing 0.9.3b.pc: Open-source software that can be used to design electronic circuits.
d) Microsoft Visio 2016: A computer application program commonly used to create diagrams, flowcharts, and network diagrams.
e) Proteus 8 Professional: software for designing PCBs that also includes PSpice simulation at the schematic level before and after the PCB is printed.

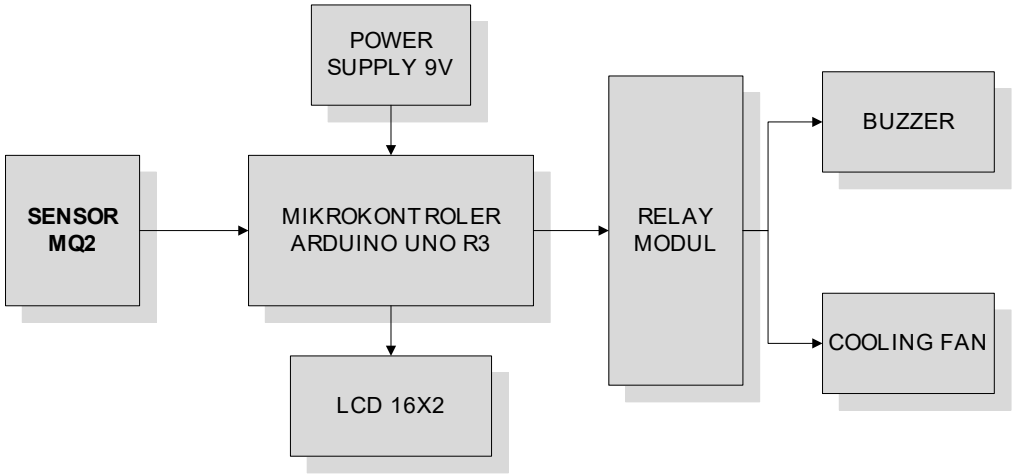


Figure 2. Block Diagram of Main Components

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Detail Diagram :

1. MQ2 Gas Sensor, The MQ2 Gas Sensor module is useful for detecting gas leaks (in homes and industries). It can detect LPG, I-Butane, methane, alcohol, hydrogen, smoke, and so on. Based on its fast response time, measurements can be taken immediately and sensitivity can be adjusted with a potentiometer.
2. 9v Power Supply, The power supply is a rectifier-filter system that converts AC voltage into pure DC voltage. The DC current flowing from the power supply is distributed to modules such as the PIR Sensor, Microcontroller, and Light.
3. Arduino Uno R3 Microcontroller, The microcontroller functions as a control and data processing device for data collected from the PIR sensor module. The processed data is then implemented in the actuator system or ultrasonic detector.
4. Relay Module: A relay is an electrically operated switch and an electromechanical component consisting of two main parts: an electromagnet (coil) and a mechanical component (a set of switch contacts).
5. Buzzer: A buzzer is an electronic component that converts electrical vibrations into sound vibrations.
6. Cooling Fan: A cooling fan functions as an exhaust fan to remove CO smoke gas.
7. LCD, An LCD is used as an output device for sensor results.

The design of the smoke detector in this final project uses Fritzing software, as shown in Figure 3.

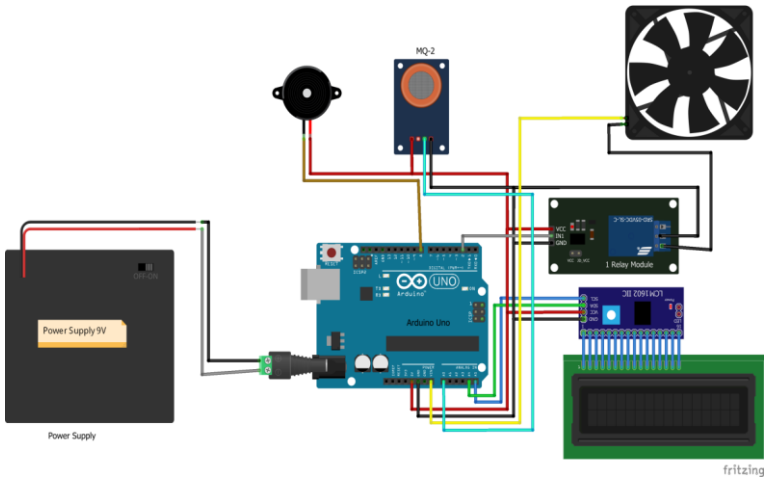


Figure 4. Instrument Design Schematic

Tool Construction and Circuit Explanation The tool design in Figure 4 is as follows:

Table 1. Detail Diagram

| Name | Spesification | Among (unit) |
|---|---|---|
| Power Supply | 9V | 1 |
| Sensor | Mq2 | 1 |
| Buzzer | 5v | 1 |
| Arduino | Uno R3 | 1 |
| Relay Modul | 12V | 1 |
| LCD | LCM 1602 IIc | 1 |
| Cooling Fan | Fan | 1 |
| Jumper cable | Male to female | 12 |

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When the power source is supplied, the power supply is turned on, and the power supply provides 9V to the relay, which has two voltages. To activate the buzzer, 5 volts of power is required, and to activate the cooling fan, 5 volts of power is also required. The MQ2 sensor, connected to the Arduino Uno microcontroller, will activate when it detects smoke, and the LCD will display the detected value as a percentage.

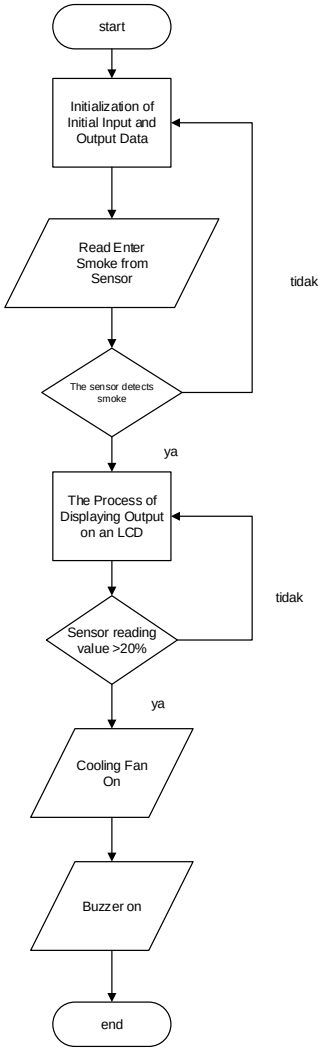


Figure 5. Software Design Flowchart

## RESULT

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Hardware implementation for creating a prototype involves using one MQ-2 sensor, Arduino Uno, and a cooling fan, assembled using a breadboard. A 5V relay is used as a voltage divider, along with a 5V buzzer, while the LCD is connected to the Arduino output to read the smoke content value during the testing process.

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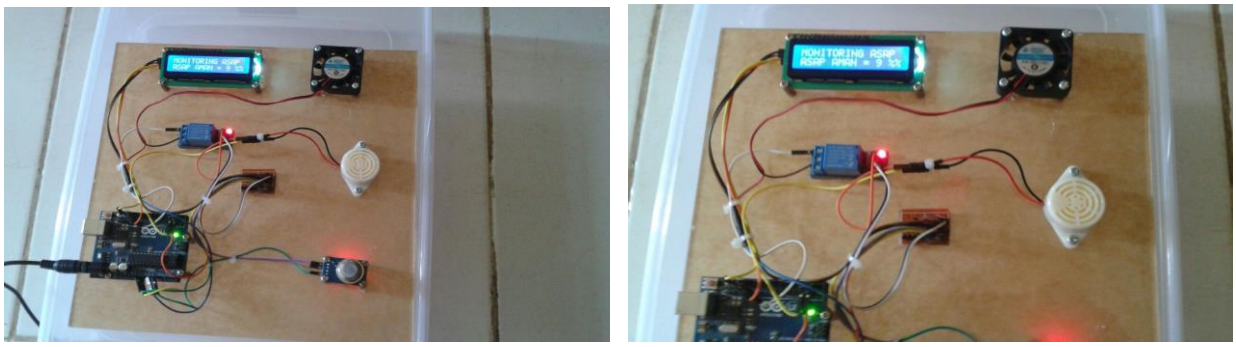

Figure 6. Hardware Implementation

The sensitivity of the MQ-2 smoke sensor series can be adjusted directly by turning the trimpot. This sensor is commonly used to detect gas leaks in homes and gas industries. The following table shows the results of MQ-2 sensor measurements using an analog multimeter:

Table 2. Voltage Measurement with an Analog Multimeter

| No Sensor MQ-2 | Voltage Sensor Non Smoke | MQ-2 Sensor Voltage Smoke |
|---|---|---|
| Sensor MQ-2 room 1 | 4,1 Volt | 4,2 - 4,4 Volt |
| Sensor MQ-2 room 2 | 4,1 Volt | 4,2 - 4,4 Volt |

In this experiment, the author conducted tests at several cafés or coffee shops with enclosed buildings, including Cafe Premier, Kantin Politeknik, Radja Kopi Café, Minion, and Taufik Warkop.

Table 2. Testing Criteria

| Name Café | Room size (m) | Number of Smokers | Smoke level (%) | Room Criteria | Ket |
|---|---|---|---|---|---|
| Radja Kopi | 8 x 8 | 15 | 22, 24, 25, 27 | Semi-closed | 4 Fan |
| Premier Kopi | 8 x 7 | 18 | 21, 22, 22, 26, 27, 30, 32, 33, 35, 36, 39, 42, 46 | Semi-closed | 2 Fan |
| Kantin Poltas | 4x5 m | 17 | 55,50,43,39 28, 27, 26, 25,24, 23, 22, 21, 21, 20, 22, 21, 19, 19, 20 | Open | No |
| Minion | 8 x 10 | 20 | | Semi-closed | 4 fan |

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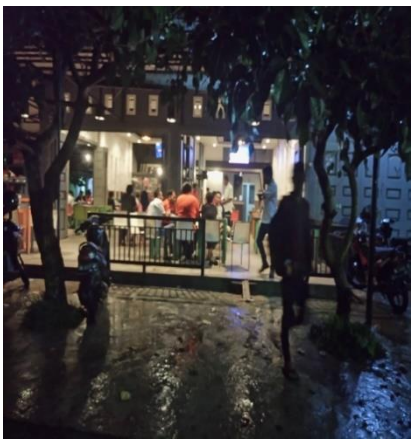
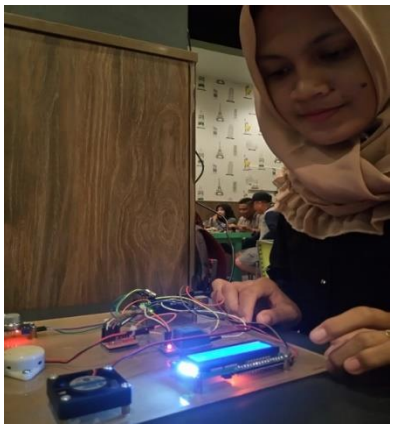
| | | | | | |
|---|---|---|---|---|---|
| Taufik Warkop | 8 x 12 | 22 | 55,50,43,39 28, 27, 26, 25,24, 23, 22, 21, 25, 28, 29, 33, 19, 19, 40<br><br>51,50,43,39 28, 27, 26, 25,24, 23, 22, 21, 25, 28 | Semi-closed | 4 fan |





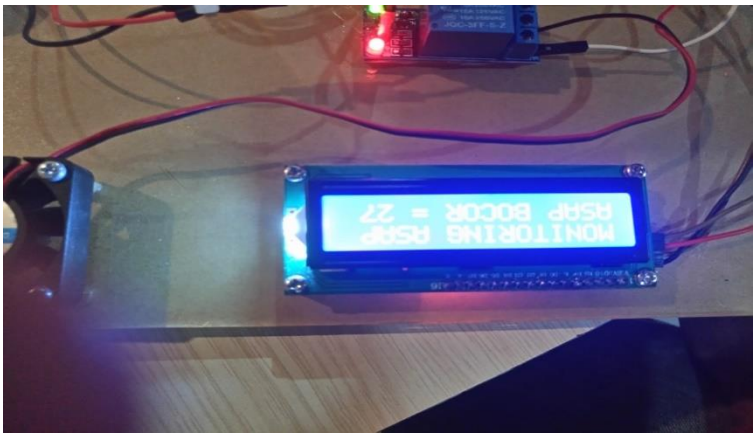



Figure 7. Testing Process on Minion

## DISCUSSION

Concentration Levels: The data collected showed varying levels of cigarette smoke, with peak concentrations observed during busy hours when more customers were present. Comparison Across Locations: Different coffee shops exhibited different smoke levels, likely due to factors such as ventilation, size of the establishment, and smoking policies. Health Implications: Prolonged exposure to cigarette smoke can lead to respiratory issues, cardiovascular diseases, and other health problems. The findings indicate that coffee shops with higher smoke concentrations may pose health risks to both customers and staff. Ventilation Impact: Coffee shops with better ventilation systems showed lower smoke concentrations, suggesting that improving air circulation can mitigate the effects of indoor smoking.
Regulatory Considerations: The results may prompt local authorities to consider stricter regulations on smoking in public places, especially in enclosed environments like coffee shops.

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## CONCLUSION

1. The electronic components required for this cigarette smoke control system are an Arduino UNO microcontroller, an MQ-2 sensor, an LCD, a relay, a cooling fan, and a buzzer. This device is constructed by assembling the electronic components into a system capable of automatically detecting cigarette smoke.
2. Overall, the device functions as intended, making it suitable for use as a smoke control device in enclosed spaces. The Arduino UNO microcontroller, as the main controller, is highly efficient as it requires minimal hardware and a small power supply.
3. The ability of this cigarette smoke detector to detect cigarette smoke in the air depends on the smoke concentration, the distance between the source and the sensor, and the direction of the smoke movement.

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