Design of The Smoke Level Measuring Device and Cigarette Smoke Control Device in The Smoking Area on Campus

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A R T I C L E I N F O

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A B S T R A K

A cigarette smoke controller is intended to control the level of cigarette smoke in a room. Smoking areas are usually located in small, confined spaces. If the smoking area is located inside a building, the air quality in the smoking area will be very worrying, especially if there are several people in the room. The design of this cigarette smoke controller is intended to be able to control the air quality in the room. Cigarette smoke in the smoking area is controlled by a fan or blower that can be turned on automatically. All of these can be controlled by a microcontroller based on the Arduino Uno microcontroller. The MQ-2 sensor is used to measure the smoke level in the air, and the DS18B20 temperature sensor is used to measure the room temperature. To display the measurement values from the sensors used, a 16x2 character display is chosen. This design is intended to control the AC fan used to neutralize cigarette smoke levels in the air, whether it should be on or off, whether to increase the fan rotation speed, or keep it at a low speed. All of these functions must be implemented to obtain good research results.

INTRODUCTION

Healthy and clean air is everyone's right, so anything that can cause air pollution, including cigarette smoke, must be prevented. Cigarettes are an addictive substance that, when used or inhaled, can pose health risks to individuals and communities, both active and passive smokers.[1]

The office is a workplace that must be kept comfortable for effective work. If the office is uncomfortable, working there will not be happiness or enjoyable. Therefore, maintaining office comfort is crucial. Even in air conditioner rooms, the air

surrounding the room does not circulate properly due to cigarette smoke. Cigarette smoke in the air is inhaled back into the lungs. The impact is even more severe if smoking in an air-conditioned room.[2]

Generally, everyone is aware of the dangers of smoking because those who actively smoke read the warnings on every cigarette package about the health risks of smoking every day. However, despite this, many people around the world smoke. It's not just active smokers who are exposed to the dangers of smoking; those around them, also known as passive smokers, are also affected. From a health perspective, the dangers of smoking significantly impact the body. Cigarette smoke contains dangerous chemical toxins. [3]

Many people die from excessive smoking. Initially, it may not be painful, but the longer a person smokes, the more diseases they develop. Most of the diseases suffered by smokers are generally incurable. Therefore, based on this reality, the author wants to design a device to detect and measure smoke levels in smoking areas to simply remind employees working in the room or office that the air in those areas is no longer healthy for smokers. [4]

LITERATURE REVIEW

Understanding Cigarette Smoke

Cigarette smoke contains thousands of chemicals that are toxic to humans and substances that can cause cancer (carcinogens). The dangerous substances and toxins in cigarettes not only cause health problems in people who smoke (active smokers), but also in people around them who do not smoke (passive smokers). Cigarette smoke contains toxic chemicals such as carbon monoxide (CO), nicotine, and tar.[5]

Smoke Sensor MQ-2

The MQ-2 smoke sensor is a sensor typically used to detect airbone contaminants. The MQ-2 sensor is made from a gas-sensitive material, specifically CO. If the sensor detects the presence of this gas in the air at a certain level, it will assume is smoke from a fire. When the sensor detects the presence of these gases, the sensor's electrical resistance will decrease. By utilizing the working principle of the MQ-2 sensor, the gas content can be measured.[6]

DS18B20 Temperature Sensor

The DS18B20 sensor is a sensor that the functionally to detect and measure temperature digitally and has a 12-bit internal ADC (Analog to Digital Converter) data if supplied with 5V voltage. The DS18B20 temperature sensor has precision at the smallest data change level of up to ±0.5ºC with a temperature range of -10 to +85ºC. The DS18B20 temperature sensor has 1-wire data communication. Each sensor produced has a unique code of 64-bit data embedded in the chip in each sensor, allowing for the use of a large number of sensors through only 1 data path (single wire data bus/1 wire

protocol). This sensor can be applied to a microcontroller by adding a pull-up resistor.[7]

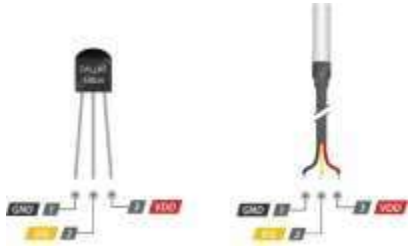


Figure 1. DS18B20 Sensor

DS18B20 Temperature Sensor

The Arduino Uno is a microcontroller that is equipped with features ready for immediate use. It has 14 digital pins that can be used as inputs and outputs (6 of which can be used as high-frequency or PWM output pins), 6 analog input pins, and has a 16 MHz ceramic resonator. It has a USB connection, a power supply jack, an ICSP connector that can be used for parallel data programming, and a reset button. It contains everything needed for a microcontroller to work and be programmed directly.[8]



Figure 2. Arduino Uno Microcontroller

Relay

A relay functions as a switch that can be activated using an electric current. This property is used to handle the voltage gap generated by the microcontroller when controlling other electronic components that operate at a higher voltage than the microcontroller.

A relay has an electromagnet in the form of a coil that acts as a magnet and can move a small metal panel, called the CO terminal, between two different positions: the NC terminal and the NO terminal. To determine the position of the connected COM terminal, turn the electromagnet on/off, and connect a low-power signal to the electromagnet's control terminal.

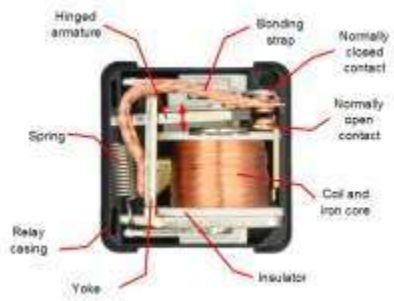


Figure 3. Relay

When the power is disconnected, the spring returns the contacts to their original position and returns the second circuit to the disconnected position (off state). This is the state or condition of the relay called the "normally open" (NO) condition, where the contacts of the second circuit are in the normal state of being in the disconnected (default) position and the switch only changes when the magnet is activated, pulling or pushing the contacts and in general the NC conditional relay is most often used.[9]

METODOLOGI

The circuit essentially measures the air pollution caused by cigarette smoke using an MQ-2 sensor. The MQ-2 sensor is paired with a DS18B20 temperature sensor to measure the temperature inside the smoking area. A hot and smoky room will undoubtedly make people feel uncomfortable.[10]

The MQ-2 sensor provides an air pollution reading in parts per million (PPM). Under normal conditions, the reading is below 50 PPM[11]. If the reading is above 50 PPM, the green LED will illuminate and the buzzer will sound is slow, indicating that the air in the room has been contaminated by cigarette smoke. If the reading is above 100 PPM, the blue LED will illuminate and the buzzer will sound moderately, indicating that the air pollution in the room is becoming serious. If the reading is above 200 PPM, the red LED will illuminate, the buzzer will play high, and the fan will turn on, indicating that the air pollution is very serious and requires action by turning on the fan in the room. The fan that is on will turn off automatically if the air pollution content value is below 30 PPM.[4]

RESEARCH RESULT

Application Block Diagram

Block diagram design is intended to make it easier to design a system, both software and hardware. Block diagram design is intended for hardware design. The image below is the block diagram design for this design.

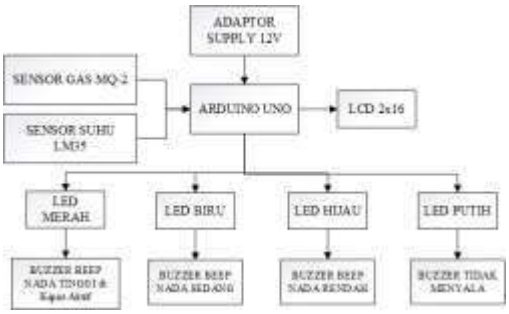


Figure 4. Application Block Diagram

Software Design

A flowchart shows the programming flow that forms a program in the designed application system.

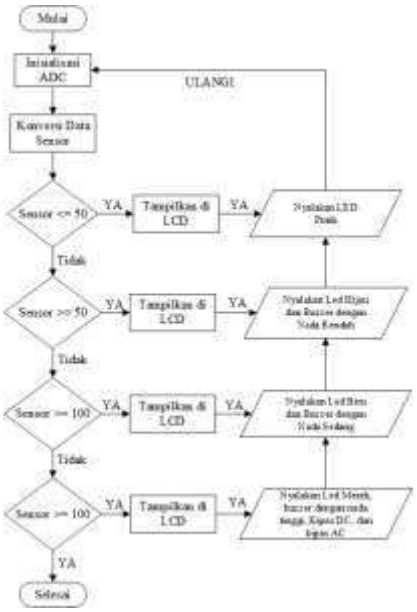


Figure 5. Flowchart Programming

In the programming flowchart above, programming begins by initializing the ADC (Analog to Digital Converter) because the sensor used is an MQ-2 sensor, which has analog output data. The analog data obtained will first be converted into a 10-bit decimal number (2^{10}= 1024, data from 0 to 1023). Then, the unit of smoke content in the air can be taken in PPM units. Next, the display will display all sensor readings and show them in numeric units. [12]

DISCUSSION

Hardware testing aims to determine whether the devices connected to the microcontroller are functioning properly. This testing requires a multitester to measure the voltage requirements and to measure the data entered into the microcontroller. The steps are as follows:

1. Measuring the voltage on the power supply.
2. Measuring the circuit (supporting components).
3. Testing the microcontroller.

Power Supply Testing

The design application uses two voltages : 12 volts and 5 volts. The 12-volt voltage will be used for the relay circuit. The 5-volt voltage is used for the microcontroller, LCD display, and sensor components. The 12-volt circuit it use an adapter circuit to step down the voltage from 220 volts to 12 volts. The 5-volts circuit uses a schematic as shown below:

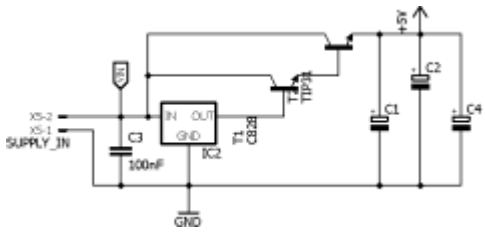


Figure 6. 5 Volt Circuit Schematic

The 12 volt and 5 volt voltage measurements are shown int the following image:

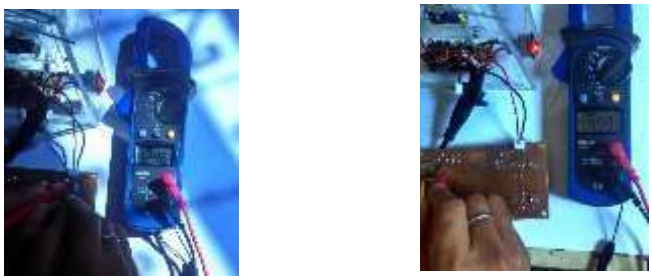


Figure 7. Measuring 12 volt and 5 volt Voltage

Circuit Testing

Circuit testing focuses on the VCC and Ground pins. This testing is crucial for the circuit to function properly. The first test is performed on the LCD pins. Pin 2 on the LCD must be connected to VCC, 5 volts, and pin 1 must be connected to ground. Then, pins 15 and 15 are used for the LCD backlight. The measurement results are as follows:



Figure 8. Voltage Testing on the VCC Pin and LCD Backlight

After checking the voltage, the results on the LCD display will be as shown in the following image:



Figure 9. LCD Display When Powered On Without Programming

Microcontroller Testing

To ensure the microcontroller works like a regular Arduino board, testing must be performed. Typically, Arduino boards contain a small, pre-installed program called a bootloader. This program allows the ATMega 328P microcontroller to be programmed directly through a computer.[13]

To test whether the microcontroller is working, a test program is inserted into the microcontroller. If the LCD displays "Hello World", the microcontroller is confirmed to be working and can proceed with further testing. The test is as follows:



Figure 10. LCD Display After Program Given

The microcontroller pins are connected to the LCD can be seen in the following table:

Table 1. LCD Pins Connected to Microcontroller

LCD Pins	**Microcontroller Pins**
RS	D7
RW	Ground
E	D6
D4	D5
D5	D4
D6	D3
D7	D2

After the entire circuit has been tested, the overall results are obtained. The results are as follows:



Figure 11. Overall Design Results

The results obtained are shown in the following table:

Table 2. Overall Results

Input DC Sensor	ADC Value	PPM Value	LED Condition	Fan Condition	Buzzer Condition	Room Condition
0.25 V	54	24	OFF	OFF	OFF	Normal
0.33 V	68	66	Green ON	OFF	LOW	Normal
0.65 V	134	130	Blue ON	OFF	MID	Alert
1.00 V	205	199	Red ON	ON	HIGH	Danger

The test table above shows each sample used to measure smoke levels in the air and its hazard points. After the DC or AC fan is turned on, it will continue running until smoke levels in the air return to normal.

CONCLUSIONS AND RECOMMENDATIONS

From this research, several important conclusions can be drawn, as follows:

1. The Arduino Uno, based on the ATMega 328P microcontroller, can be used for indoor smoke measurement applications.
2. The Arduino board can be modified and customized to meet user needs.
3. The ADC (Analog to Digital Converter) programming is quite easy to use to read data from the MQ-2 sensor and digital sensors such as the DS18B20 temperature sensor.
4. The MQ-2 sensor uses a heater to detect and measure smoke levels in the air. Therefore, the sensor must be sufficiently warmed up to ensure accurate measurements.
5. This design is expected to be an alternative to reduce or raise awareness among smokers about smoking indoors.

ADVANCED RESEARCH

My suggestions for this application are as follows:

1. The sensor used could be an industrial-grade smoke sensor with higher sensitivity to measure smoke levels outdoors, so the application can applied to outdoor smoking areas.
2. For smoke measurements and the results obtained, it would be better to use artificial intelligence or soft computing methods such as fuzzy logic to create a smarter application for maintaining air quality in smoking areas.
3. This application should be optimally maintained to ensure smooth performance.

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