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An Analysis Of Working System Carcinogenic Substance Neutralization Tool (Smoke/Gas) In A Closed Space Using An Arduino Uno-Based MQ3 Sensor

Nuraprilyani Pasaribu[1], Beni Satria[2], Ahmad Dani[3]
Universitas Pembangunan Panca Budi, Medan, North Sumatera, Indonesia

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ABSTRACT
This study aims to analysed the working system of a carcinogenic substance neutralization device for smoke or gas in enclosed spaces, using an MQ3 sensor based on Arduino Uno. Carcinogenic substances in the form of smoke or gas can pose significant health risks, especially in areas with limited air circulation. The device developed in this research utilizes the MQ3 sensor to detect harmful gases, which are then processed through Arduino Uno to automatically activate the neutralization system. The research method involves the design, assembly, and testing of the neutralization system. The MQ3 sensor functions as a detector for hazardous gases at specific concentration levels, sending data to the Arduino Uno, which triggers the activation of a fan and air filter as the neutralization system. Testing was conducted in an enclosed space to evaluate the effectiveness of the system in reducing harmful gas concentrations over a given period. The results indicate that this neutralization device effectively detects and significantly reduces harmful gas concentrations. The MQ3 sensor is highly responsive to changes in gas levels, and the Arduino Uno-based system allows for efficient automated control. With these results, the device is expected to serve as a solution for improving indoor air quality and protecting users from exposure to carcinogenic substances.

Corresponding Author:
Nuraprilyani Pasaribu
Universitas Pembangunan Panca Budi, Medan, North Sumatera, Indonesia
nuraprilyani104@gmail.com

INTRODUCTION

Smoke is a suspension of tiny particles in the air (aerosol) that results from the incomplete combustion of a fuel. It is generally an undesirable by product of fire. One example of smoke is cigarette smoke, which originates from smoking activities. Cigarette smoke has a harmful impact on health, not only for smokers (active smokers) but also for non-smokers who inhale it (passive smokers).

Cigarette smoke contains over four thousand harmful chemicals, including carbon monoxide, which is five times more concentrated in smoke. Additionally, nicotine and tar levels are three times higher, along with other toxic substances found in greater concentrations in second-hand smoke. These chemicals can lead to a range of dangerous diseases that may even be fatal. To reduce the risks associated with cigarette smoke

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exposure—both for active and passive smokers—an effort is needed to minimize indoor carbon monoxide (CO) pollution caused by cigarette smoke. Consequently, a device has been designed to free indoor spaces from the hazards of cigarette smoke. This device activates when smoke is detected by sensors installed within the room, addressing the health risks that indoor smoke poses to humans.

Currently, more than 4,000 chemicals are known to be present in cigarette smoke, including CO. The carbon monoxide produced by cigarette smoke can contribute to indoor pollution, increasing CO levels and potentially impairing lung function. One method to neutralize cigarette smoke and prevent it from disturbing non-smokers, especially in enclosed spaces, is to use a device that can neutralize indoor air from cigarette smoke pollution. This tool is expected to provide a solution to the issue of cigarette smoke pollution within closed rooms (Syaputra, 2018).

The main goal of this device is to eliminate and neutralize smoke and unpleasant odors caused by smoke, especially to benefit both active and passive smokers, while restoring freshness to the room. The device aims to neutralize indoor air from cigarette smoke pollution in closed spaces, enhancing comfort for everyone present.

Literature Review

Power Supply

A power supply is a tool or system that functions to distribute electrical energy or forms of energy, a type that is often used to distribute electrical energy. In principle, the power supply circuit works to reduce AC voltage, rectify AC voltage so that it becomes DC and stabilize DC voltage. Power supply consisting of transformers, diodes and capacitors. Transformers are usually box-shaped and have coils of enamel wire inside. The task of this component is to increase or decrease AC voltage as needed. Its main function is to convert alternating current (AC) electricity available from the electric current into direct current (DC) electricity needed by the components. The power supply is expected to perform the following functions:

1. Rectification: Converting AC electrical input to DC.
2. Voltage transformer: Providing DC voltage output according to what is needed.
3. Filtering: Producing a "cleaner" DC electric current, free from noise or other electrical noise.
4. Regulation (Regulation): Controlling the output voltage to be maintained, depending on the desired level, free of power and changes in working temperature increases as well as tolerance for changes in input power voltage.
5. Isolation (Isolation): Electrically separating the output generated from the input source.
6. Protection (Protection): Preventing electrical voltage surges, so that they do not occur at the output, usually with the availability of fuses on the Melectric current protection in case of interference.

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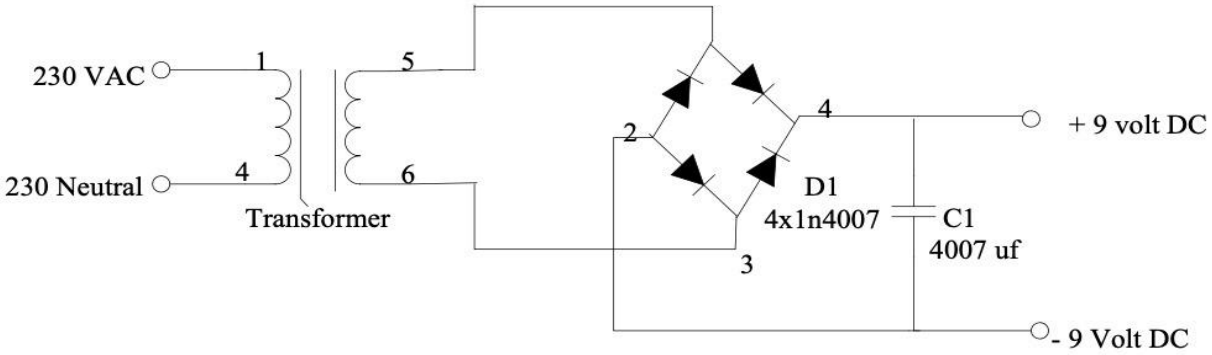

Figure 1. Schematic Wiring

The power supply circuit is one of the simple power supply circuits. Only by using a few core components of the power supply, namely one diode bridge or 4 ordinary diodes and one capacitor. The diode bridge 4 ordinary diodes are used as a rectifier of alternating waves produced by a step-down transformer or voltage reduction transformer and the capacitor used is rectified by the diode bridge. The 220 volt grid voltage from PLN electricity is lowered by a transformer or voltage reduction transformer that applies a turns ratio.

Where the voltage ratio produced by a transformer will affect the voltage ratio produced. The voltage produced by the transformer is still in the form of an AC wave and must be rectified using a rectifier. The rectifier circuit used utilizes 4 diodes that have been designed to be able to pass both AC wave cycles into one direction only.

In the power supply there is a wave direction that has been changed to one direction, the output from the diode bridge still has ripples or still has an uneven voltage amplitude. This is because the diode bridge only eliminates the negative cycle and makes it a positive cycle but does not change the waveform at all where it still has valleys and hills. For that, a capacitor with a large enough capacitance is used to make the wave flat. This is because the length of the charge discharge process by the capacitor makes it seem as if the amplitude of the wave is flat.

Resistor

A resistor is a passive electronic component that functions to inhibit and regulate electric current in an electronic circuit. The unit of resistance value is Ohm (Ω). The resistor value is usually represented by a number or color ring on the resistor body. The resistance of the resistor is often also called resistance. In a resistor, it can be arranged in series and parallel, in a series circuit, the resistor functions as a voltage divider with the characteristic that the resistor value will increase according to the value of the resistor connected in series. Resistors in a parallel resistor configuration function as current dividers and have the characteristic that their resistance value is lower than the number and resistance value of the paralleled resistors.

MQ-2 Smoke Sensor.

The MQ-2 sensor is a monoxide smoke sensor that functions to detect the presence of carbon monoxide gas, where this sensor is used to monitor the presence of cigarette smoke

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in a closed room. This sensor has high sensitivity and fast response time. The output produced by this sensor is an analog signal, MQ2 requires a voltage of 5V DC, the resistance of this sensor will change if there is gas and smoke.

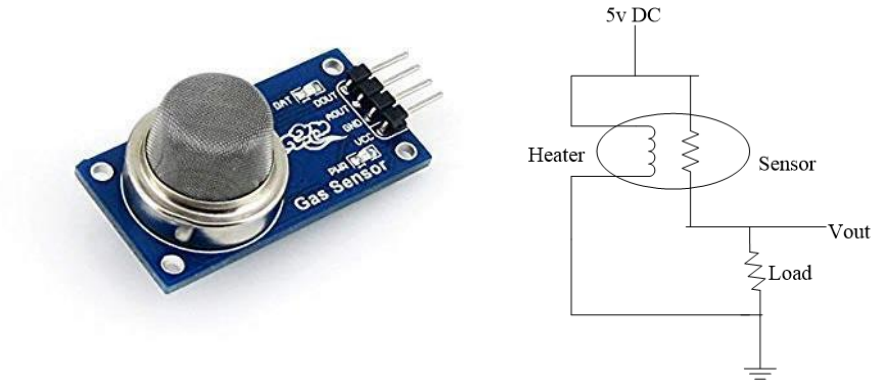

Figure 2. Sensor MQ-2.

The MQ-2 smoke sensor functions to detect the presence of smoke coming from from gas or smoke. Basically this sensor consists of an aluminum tube which surrounded by silicon and in the center there is an electrode made of aurum where There is a heating element. When the heating process occurs, the coil will heated so that the SnO2 ceramic becomes a semiconductor or as a conductor thus releasing electrons and when the smoke is detected by the sensor and reaches aurum electrode then outputThe MQ-2 sensor will produce an analog voltage.

Input and Output

Each of the 14 digital pins on the Arduino Uno functions as an Input. and Output, using the pin mode function, Digital Writing And Real digital. They operates at 5 Volts. Each pin can provide or receive a maximum of 40 mA and have internal pull-up resistors of 20-50 KΩ. In addition, some pins, Some pins have special functions as follows.

1. Serial
   0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) and TTL serial. These pins are connected to the corresponding pins of the ATmega328 USB-to-Serial TTL chip.
2. External interrupts
   2 and 3. These pins can be configured to trigger interruption at a low value, but rising or falling, or changing value.
3. PWM
   3,5,6,9,10 and 11. Provides 8-bit PWM output with write function.
4. SPI
   10 (SS), 11 (MOSI), 12 (MOSI), 13 (SCK). These pins support SPI communication using the SPI library.
5. LED
   There are 13 built-in LEDs connected to digital pin 13. When the pin is HIGH value, LED is on, when the pin is low, it is off. Arduino uno has 6 analog inputs, labeled A0

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through A5, respectively. provides 10 bits of resolution which is 1024 different values. By default The system measures from ground to 5 volts.

6. TWI
   A4 or SDA pin and A5, or SCL pin. Supports TWI communication.
7. Reference voltage for analog input. Used with analog reference.
8. RESET.

Arduino Uno is a facility for communicating with a computer, Arduino Uno or ATmega 328 microcontroller provides UART TTL (5V) serial communication, which is available digital 0 (RX) and (TX) an ATmega328 on The board channel is a serial communication via USB and appears as virtual com port for software on the computer. Firmware arduino uno using standard COM USB driver, and no external drivers are provided. needed. The Arduino Uno software includes a serial monitor that allows simple data to be sent to the Arduino Uno board.

Arduino uno can be programmed with arduino ide software. Select Arduino Uno from the tool then matches the ATmega328 used on Arduino Uno has a bootloader that allows you to upload new program for it without using an external hardware programmer. In this programmer uses this communication protocol from C language.

Neutralization Tool

Ozone is a triatonic compound of the element oxygen. Ozone formed through the ionization of diatomic oxygen gas (O2) into triatomic (O3) Energy ozone formation is about 142.7 kJ/mol. Ozone gas with a high density occupying the stratosphere space, in this layer, natural ozone reactions are produced through the UV radiation process with a wavelength of 220-290 nm.

Along with the development of high voltage based technology(high voltage), Ozone can be produced at dangerous air pressures such as cigarette smoke. through the process of electron discharge(electron discharge)using instrumentation ozone.

Figure 3. Physical Form Neutralization Generator

The Neutralization Generator functions as a tool that is able to neutralize gases. toxic and neutralizes cigarette smoke in closed spaces while eliminating the unpleasant smell that comes from cigarette smoke, Ozone is produced from the process, namely using high voltage electrical radiation or called corona discharge.

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In this design, the ozone generator is made using two electrodes positive and negative which are placed between layers of glass as protection for avoid direct contact which will result in a short circuit, then electrodes will be given high voltage so that it produces an electric jump and The air due to the electric jump will decompose to produce oxygen bonded with 3 atoms or often called ozone (O3).

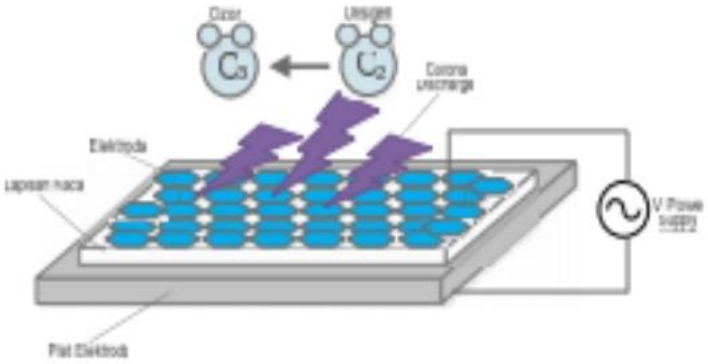

Figure 4. Ozone Generator

The process of ozone formation begins when electrons are released when given high voltage, so that oxygen adds its energy and produces ozone. The working principle of an ozone generator is to neutralize cigarette smoke and other gases. dangerous by attracting dirty air due to smoke and gas, then ionizing it pollutants in the air to produce fresh air.

METHOD

Before designing a system, first create a block diagram. Block A diagram is a simple way to explain how something works system. The system block diagram is shown in Figure 5.

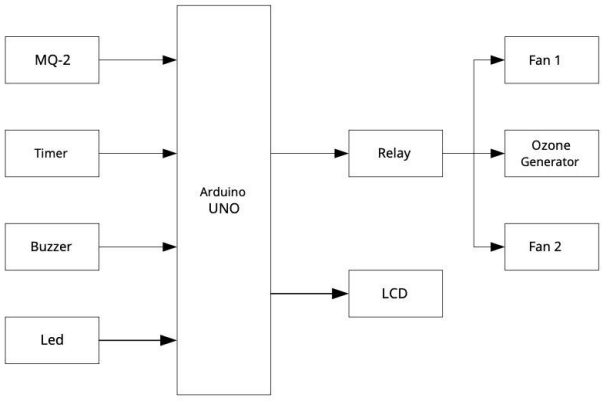

Figure 5. Block Diagram System.

The function of each block is as follows:

1. Smoke Sensor
   Functions to detect smoke in the room whether there is smoke which exceeds the threshold and where it has been previously determined then the tool will send data to Arduino UNO.

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2. Arduino Uno
   Functions as the system control center where all input enters to Arduino UNO will be processed to produce output according to specified program.
3. DC fan
   Functions as a carrier of output signals from Arduino UNO to the DC fan. Ozone Generator
4. Buzzer Driver
   Functions to change electrical vibrations into sound vibrations or alarms.
5. Led
   Functions as a component that can emit light emissions
6. Timer
   As a carrier of output signals from Arduino Uno to the timer.
7. Relay
   As a switch contact or electrical switch.
8. LCD
   As a display of the output voltage produced by the neutralization system on room.
9. Ozone Generator
   Functions as a neutralizer of cigarette smoke and eliminates odors delicious from cigarette smoke.

This circuit functions as the main controller which receives input and process the output of the entire existing system. The main components of This circuit is an ATMega328. On the ATMega328 microcontroller IC which contained in the Arduino Uno, has been filled with programs to run the system effectively the whole tool is designed. Arduino Uno has 14 digital pins and 6 output pins. analog. There are several pins on the Arduino UNO that are used in the circuit. The AO pin is connected to the MQ2 sensor circuit. This circuit functions to detect the presence of cigarette smoke in closed room output generated by Arduino UNO. In this circuit pin A0 is connected to Arduino UNO and VCC pin and GND pin are connected to Arduino UNO. This sensor has high sensitivity and fast response time, when Smoke has been detected by the MQ-2 sensor, the tool will work. Connection image The Arduino UNO pin circuit with the MQ-2 sensor can be seen in Figure 7.

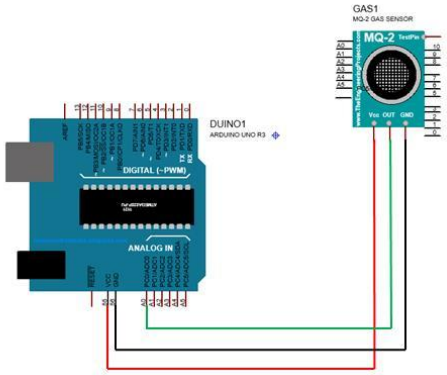

Figure 6. MQ-2 Sensor Circuit with Arduino UNO

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This circuit functions asdisplayoutput voltage produced by MQ2 sensor. As the LCD connector used pinHeaderwhere is the order layout and the pin configuration is shown in figure 3.2, while the 5 V pin of the Arduino UNO connected to VDD on the LCD, GND pin of Arduino UNO is connected to VSS On the LCD, pin A4 of the Arduino UNO is connected to SDA on the LCD, pin A5 of the Arduino UNO is connected to SCL on the LCD.

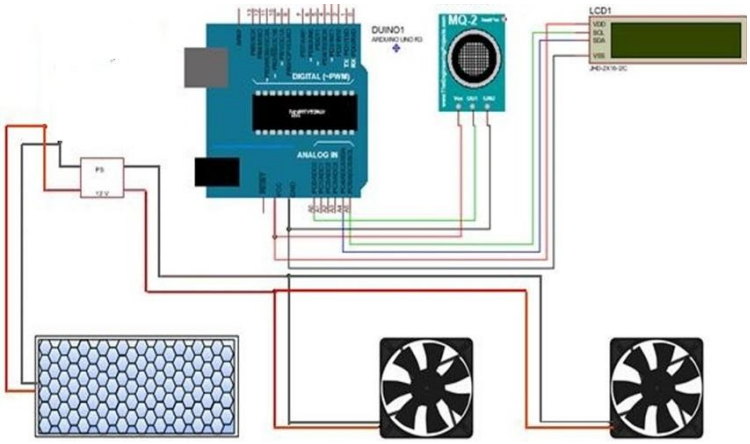

Figure 8. Overall circuit

RESULT

System Testing.

In this chapter we will discuss the measurement of the parts circuit, analysis of the tools that have been made. Testing is carried out after The tool design is completed to find out whether the components are working properly and correctly. After the design and observation of the measurements is carried out, then the analysis results will be obtained which are directly specifications of the tool being made.

Voltage testing power supply aims to find out the voltage output power supply will be used as the working input voltage of the circuit Arduino UNO Atmega328. This test is done to avoid voltage unexpected. Test system power supply can be done with measure the output voltage of the circuit by using a Volt Meter. In this research, testing will be carried out on the series power supply namely by measuring the voltage, the output voltage produced by each voltage source that is supplied to the Arduino UNO circuit Atmega328.

Table 1. Power Supply Output Voltage Stability Test

Test	Measurement Results
1st	12.21 VDC
2nd	12.21 VDC
3rd	12.21 VDC

From the results of measuring the power supply output voltage, the voltage obtained is of 12.21 VDC.

Testing on MQ-2 Smoke Sensor

There is one sensor on this device, namely a smoke sensor using MQ-2 sensor where

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the output value on this sensor is in form of resistance. This sensor is a voltage output, then a voltage divider is provided, testing on Smoke sensors are operated by placing the sensor close to the smoke inside. the container is closed and the sensor detects the presence or absence of smoke.

Then The output voltage is measured by connecting the negative of the Volt Meter into circuit and its positive part is connected to the MQ-2 sensor and calculates how long the device works to neutralize cigarette smoke in the room. Here is is a table of measurement results of the MQ-2 sensor circuit under normal conditions, be careful and dangerous conditions.

Table 2. Sensor Testing

ADC (Analog to Digital Converter)	Vout (V)	LED	Fan 1	Fan 2	Buzzer	Ozone Generator
Normal (0-10)	4.50	Green	Not Alive	Not Alive	Silence	Not Alive
Be Careful (11-50)	4.54	Yellow	Not Alive	Not Alive	Life	Not Alive
Danger (>51)	4.67	Red	Life	Life	Dead	Life

From the table 2, the voltage value from the MQ-2 sensor output is obtained, then from the voltage value, the Rs value can be obtained for the Rs/Ro value. The Ro value has been obtained previously which is the value when the sensor was before given cigarette smoke.

Table 3. MQ-2 Sensor Testing Against Cigarette Smoke

No	PPM (Part Per Million)	Rs/Ro (oh)	Rs (ohms)	Voltage)
1	20	0.89	10000	0.3
2	30	0.75	8428.57	0.35
3	40	0.72	8166.66	0.36
4	50	0.68	7684.21	0.38
5	60	0.66	7461.53	0.39
6	70	0.62	7048.78	0.41
7	80	0.49	5600	0.5
8	90	0.44	5000	0.55
9	100	0.43	4892.85	0.56
10	110	0.38	4322.58	0.62

CONCLUSION

The analysis of the working system for a carcinogenic substance neutralization tool in a closed space, utilizing an Arduino Uno-based MQ3 sensor, provides significant insights into its effectiveness and reliability. The study demonstrated the following key findings: The tool successfully detected the presence of carcinogenic substances (smoke/gas) in a controlled environment. The MQ3 sensor efficiently measured gas concentrations, providing real-time

data to the Arduino Uno microcontroller. The MQ3 sensor showed high sensitivity in detecting smoke and volatile organic compounds (VOCs). The sensor's response time and accuracy ensured timely detection of hazardous substances, a critical feature for indoor safety applications. The integration of the Arduino Uno allowed for automated responses. The system could trigger neutralization mechanisms, such as ventilation or filtration processes, promptly upon detecting harmful gas concentrations exceeding safe thresholds. The system operated with minimal power consumption, making it suitable for continuous operation in closed spaces. The use of Arduino Uno contributed to the tool's energy-efficient design. This tool has potential applications in various indoor environments, such as offices, laboratories, and industrial facilities, where monitoring and mitigating carcinogenic substances is vital for health and safety. While effective, the system's performance may vary with the presence of multiple gas types or in high-humidity environments. Future iterations could include additional sensors for broader substance detection and improved calibration techniques for enhanced accuracy. In conclusion, the Arduino Uno-based carcinogenic substance neutralization tool demonstrates a promising approach to enhancing safety in closed spaces. With further development and optimization, this system could serve as a vital component in environmental monitoring and health protection strategies.

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