

SMOKE DETECTION SYSTEM

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering Degree in
Electrical and Electronics Engineering

By

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III year BE-EEE



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SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING

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INSTITUTE OF SCIENCE AND TECHNOLOGY
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April 2023



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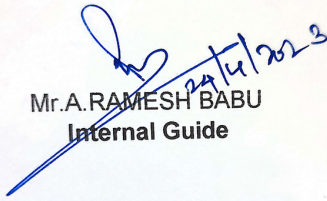
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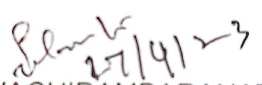
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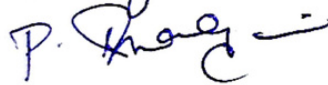
This is to certify that this Project Report is the bonafide work of HAKHILESH N(Reg. No. 40140013) who carried out the project entitled "SMOKE DETECTION SYSTEM" under our supervision from January 2023 to April 2023.


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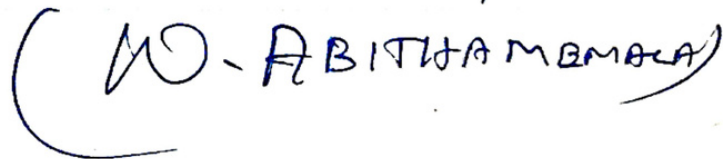
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DECLARATION

HAKHILESH.N (Reg. No. 40140013) who hereby declare that the Project Report entitled
“SMOKE

DETECTION SYSTEM" done by me under the guidance of Mr. A. RAMESH BABU
is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering
degree in Electrical and Electronics Engineering.

DATE: 18.04.2022

PLACE: Chennai

SIGNATURE OF THE CANDIDATE

A handwritten signature in blue ink, appearing to read 'Akhilesh', with a long horizontal flourish extending to the right.

ACKNOWLEDGEMENT

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SMOKE DETECTION SYSTEM

ABSTRACT

A smoke detection system is an essential component of fire safety in buildings and other enclosed spaces. The primary purpose of a smoke detection system is to detect the presence of smoke, which is often the first indication of a fire. Smoke detection systems can be categorized into two types: standalone and integrated systems.

Standalone systems are typically battery-powered and can be installed in individual rooms or areas of a building. They are relatively inexpensive and easy to install, but they are not interconnected and may not provide a comprehensive level of protection for a large building or facility.

Integrated systems, on the other hand, are wired into a building's electrical system and can include smoke detectors, fire alarms, and other safety features. They are more expensive and complex to install, but they provide a higher level of protection and can be monitored by a central control system.

Smoke detection systems work by using sensors to detect smoke particles in the air. The most common type of sensor used in smoke detectors is the ionization chamber, which detects small particles of smoke produced by a fire.

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CHAPTER 1

1.0 INTRODUCTION

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Smoke detection systems work by using sensors to detect smoke particles in the air. The most common type of sensor used in smoke detectors is the ionization chamber, which detects small particles of smoke produced by a fire.

1.1 GLOBAL SCENARIO

Smoke detection systems are widely used around the world to enhance fire safety in buildings and other enclosed spaces. In many countries, smoke detection systems are mandatory by law and are required to be installed in certain types of buildings, such as hotels, hospitals, schools, and offices.

1.2 PROBLEM STATEMENT

One challenge is the issue of false alarms. False alarms can be caused by a variety of factors, such as cooking smoke, dust, and steam. Frequent false alarms can lead to complacency and may result in occupants ignoring alarms when they do go off, which can have serious consequences in the event of a real fire.

Another challenge is the need for regular maintenance and testing. Smoke detectors must be regularly tested and maintained to ensure they are functioning properly, but this can be time-consuming and costly, particularly in large buildings with many detectors.

Furthermore, while smoke detectors are effective in detecting smoke, they may not detect other potential hazards such as carbon monoxide, which can also pose a significant threat to occupant safety.

Lastly, there is a lack of uniformity in regulations and standards across different regions and countries, which can lead to confusion and inconsistencies in the installation and maintenance of smoke detection systems.

1.3 MOTIVATION AND OBJECTIVE

The motivation behind smoke detection systems is to enhance fire safety in buildings and other enclosed spaces by providing early detection of smoke, which is often the first indication of a fire. The objective of smoke detection systems is to alert occupants of a building to the presence of smoke, giving them time to evacuate safely and for emergency services to respond.

The primary motivation for installing smoke detection systems is to save lives and prevent injuries. Early detection of smoke can provide valuable time for occupants to evacuate the building and for emergency services to respond, potentially reducing the number of injuries and fatalities.

Smoke detection systems can also help prevent property damage by alerting occupants to the presence of smoke before a fire has a chance to spread. This early detection can give firefighters a head start in controlling the fire and limiting the damage.

Another motivation for smoke detection systems is to comply with regulatory requirements. In many countries, smoke detection systems are mandatory by law, particularly in commercial and public buildings. Compliance with these regulations is necessary to avoid fines and legal penalties.

The objective of smoke detection systems is to provide reliable and effective detection of smoke to enhance fire safety. This requires selecting the right type of system and ensuring that it is installed and maintained properly. Regular testing and maintenance are necessary to ensure that smoke detection systems are functioning properly and providing the necessary protection.

Overall, the motivation and objective of smoke detection systems are to enhance fire safety, save lives, prevent injuries, and limit property damage.

CHAPTER 2

2.1 LITERATURE SURVEY

Literature survey on smoke detection systems reveals a range of studies and research papers that focus on various aspects of smoke detection systems. Some of the key findings are:

1. **Smoke detection technologies:** Researchers have studied various smoke detection technologies, such as ionization, photoelectric, and multisensor detectors, to evaluate their effectiveness in detecting smoke and reducing false alarms. Studies have shown that each type of detector has its own strengths and weaknesses, and selecting the right type of detector depends on the specific application and environmental conditions.
2. **False alarms:** False alarms are a significant problem with smoke detection systems, and researchers have studied various factors that contribute to false alarms, such as cooking smoke, steam, and dust. Studies have also explored ways to reduce false alarms, such as using advanced signal processing techniques to filter out unwanted signals and improving the sensitivity of detectors.
3. **Maintenance and testing:** Regular maintenance and testing are essential to ensure that smoke detection systems are functioning properly. Researchers have studied various testing methods and maintenance strategies, such as remote testing, self-testing, and automatic maintenance, to reduce the time and cost associated with manual testing and maintenance.
4. **Smart smoke detection systems:** With the increasing popularity of smart home technology, researchers have explored the use of smart smoke detection systems that can be integrated with other home automation devices, such as smart thermostats and security systems. Smart smoke detection systems can provide additional benefits, such as remote monitoring, real-time notifications, and automatic emergency response.
5. **Regulations and standards:** Researchers have also studied the various regulations and standards related to smoke detection systems, such as the NFPA 72 standard in the United States and the EN 54 standard in Europe. Studies have explored the effectiveness of these standards and the challenges associated with implementing them across different regions and countries.

2.2 PROJECT TIMELINE

This project was designed and developed in 3 months starting from 1st week of January to 1st week of April.

2.3 PROJECT COST

The cost of the project workout to be

Servo Motor	-	Rs 268/-
Arduino Uno	-	Rs 1072/-
Battery 9V	-	Rs 295/-
Battery Snap connector	-	Rs 27/-
Smoke Sensor Module	-	Rs 268/-
Passive Buzzer Module	-	Rs 134/-
LM-35 Temperature Sensor	-	Rs 268/-
LED	-	Rs 27/-
Total Cost of this Project	-	Rs 2359/-

CHAPTER-3

3.1 *EXISTING METHODOLOGY*

The existing methodology for smoke detection systems can be broadly categorized into two types: point detection systems and aspirating smoke detection systems.

1. **Point Detection Systems:** Point detection systems, also known as spot-type systems, are the most commonly used smoke detection systems. They consist of individual smoke detectors placed at strategic locations throughout a building. These detectors can be of various types, such as ionization, photoelectric, or multi-sensor detectors. Ionization detectors use a small amount of radioactive material to ionize the air inside the detector. When smoke enters the chamber, it disrupts the ionization process and triggers an alarm. Photoelectric detectors use a beam of light to detect smoke particles, which scatter the light and trigger an alarm. Multi-sensor detectors combine both ionization and photoelectric technologies to provide enhanced detection capabilities.
2. **Aspirating Smoke Detection Systems:** Aspirating smoke detection systems, also known as air-sampling systems, are used in larger buildings or areas where traditional point detection systems may not be practical. These systems use a network of pipes and air sampling points to actively draw air samples from the protected area back to a central control unit. The control unit then analyzes the air samples for the presence of smoke particles.

Aspirating smoke detection systems are highly sensitive and can detect smoke particles at very low concentrations. They are also less prone to false alarms than traditional point detection systems.

In addition to these two types of systems, there are also smart smoke detection systems that use advanced signal processing algorithms and machine learning techniques to detect smoke and reduce false alarms. These systems can also be integrated with other smart home devices, such as thermostats and security systems, to provide additional benefits.

3.2 IDENTIFICATION OF ROOT CAUSE FOR SMOKE

The identification of root causes of smoke is an important aspect of smoke detection system design and implementation. There are several root causes of smoke, such as cooking fires, electrical fires, and smoking.

1. Cooking fires: Cooking fires are one of the most common causes of smoke in residential settings. They can be caused by overheating oil or leaving food unattended on the stove. Cooking fires can produce a lot of smoke, which can trigger smoke detectors.
2. Electrical fires: Electrical fires can be caused by faulty wiring, overloaded circuits, or malfunctioning electrical appliances. These fires can produce a lot of smoke, which can quickly spread throughout a building.
3. Smoking: Smoking is another common cause of smoke in residential and commercial settings. Smoking-related fires can be caused by careless disposal of cigarettes or other smoking materials.

3.3 BLOCK DIAGRAM

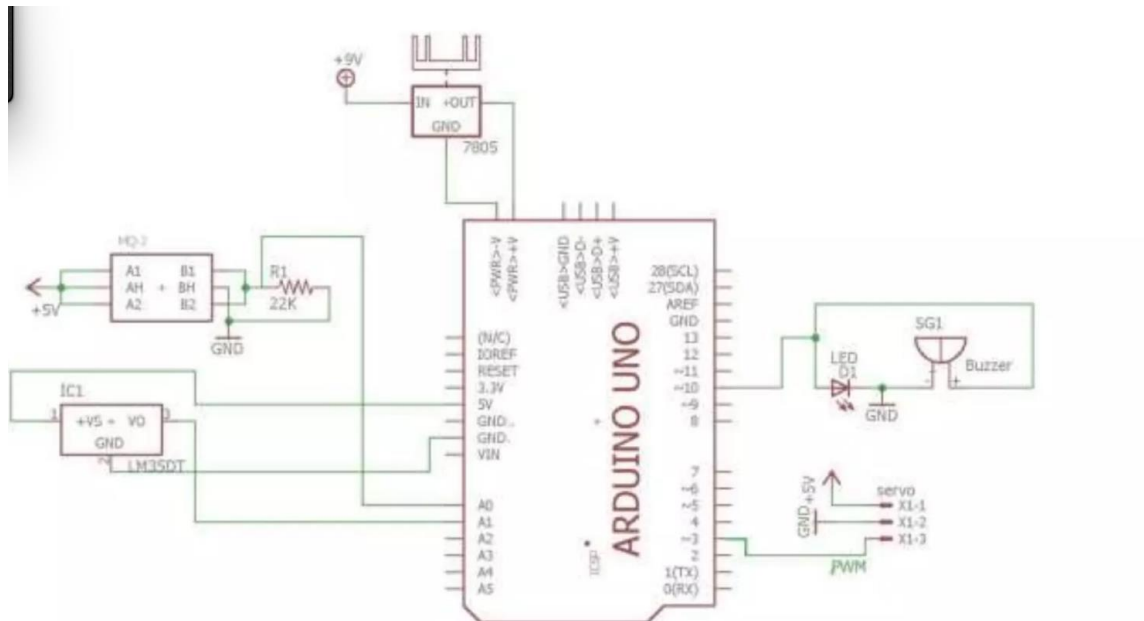


Figure 4 Modified Smoke Detection System Circuit

CHAPTER 4

4.1 HARDWARES OF NEW DESIGN

- ❑ ARDUINO UNO
- ❑ SERVO MOTOR
- ❑ LED
- ❑ GAS SENSOR
- ❑ BUZZER MODULE
- ❑ TEMPERATURE SENSOR

SERVO MOTOR

A Servo Motor is a rotary actuator or linear actuator that allows for precise control of angular or

linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for

position feedback. In our project use of servo motor is quite limited in fact it is optional, we need this for protection purpose.



Figure 3 Servo Motor

ARDUINO UNO

Arduino UNO is a microcontroller board . It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button.

LM-35 TEMPERATURE SENSOR

The LM-35 series are precision integrated-circuit temperature sensors, whose output voltage is

linearly proportional to the Celsius temperature. The LM-35 does not require any external

calibration or trimming to provide typical accuracies at room temperature and over a full -55

to +150°C temperature range. It is suitable for remote applications and low self heating.



Figure 2 LM-35 Temperature Sensor

MQ-2 GAS SENSOR

Among various types of MQ series gas sensors, we select MQ-2 for their wide detecting scope, fast response and High sensitivity. They are suitable for detecting LPG, i-Butane, propane, methane, alcohol, hydrogen, smoke.

The gas sensor is mainly composed of tin dioxide on a ceramic base.

The resistance of the sensor varies depending on the concentration of the reducing gases on the air. We use the module here, where sensor's 6 pins are connected as need internally with resistance. Four pins are outside there, VCC (with 5V dc), GND(with Arduino GND), A0(from where we took output, connected it to Arduino A0) and D0(We didn't use).



Figure 1 MQ-2 Gas Sensor

4.2 PROTOTYPE DESIGN AND CODE

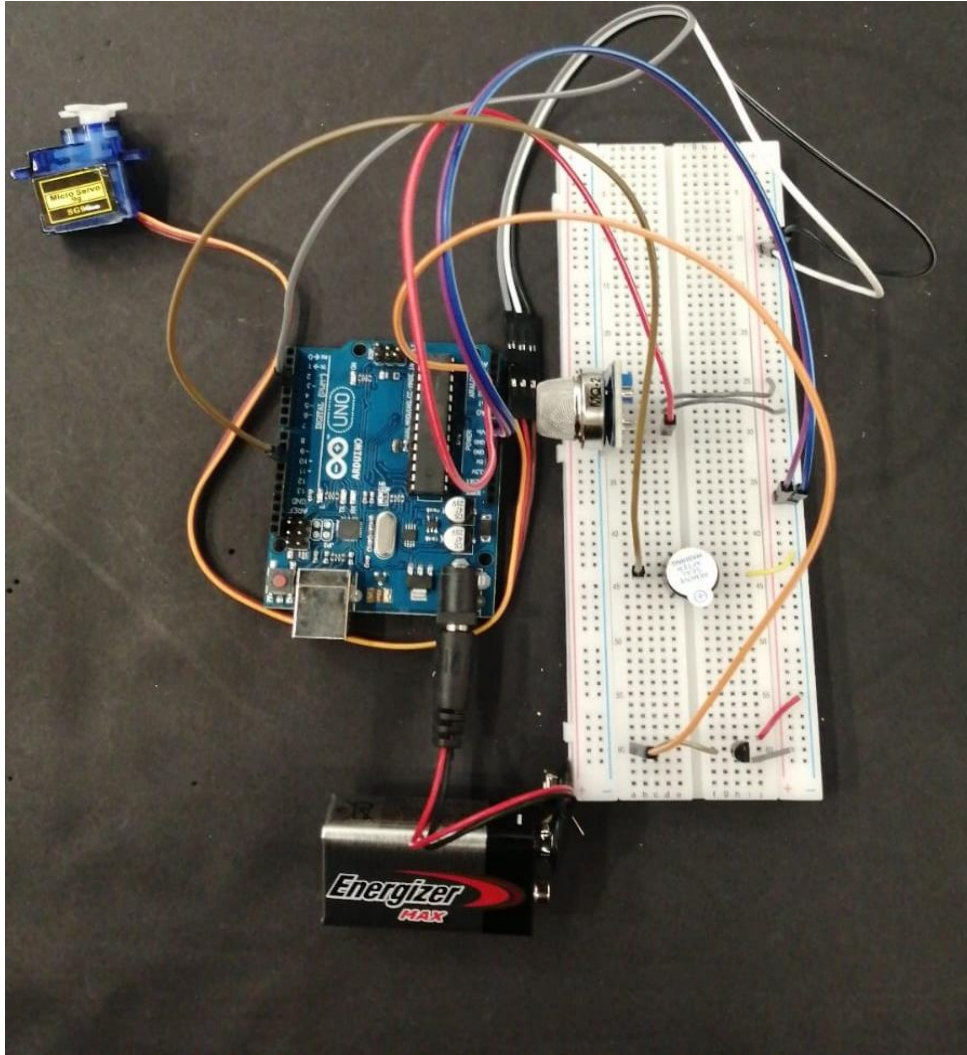


Figure 6 Image View for Smoke Detection System

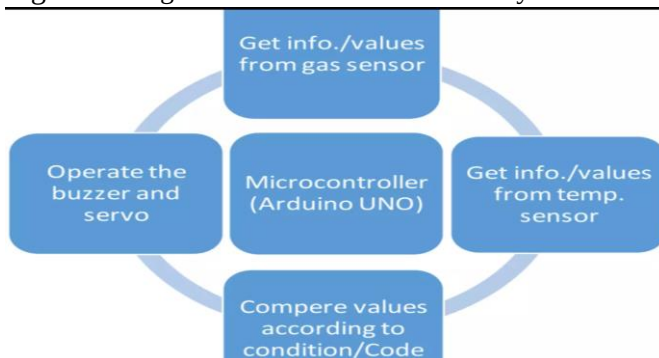


Figure 5 Algorithm for Code

Code

```
#include <Servo.h>

Servo myservo;

int buzz = 10;

int gas = 0;

int smoke = A0;

int temp = 0;

int lm35 = A1;

void setup()
{
    myservo.attach(3);
    pinMode(buzz, OUTPUT);
    pinMode(smoke, INPUT);
    pinMode(lm35, INPUT);
    Serial.begin(9600);
}

void loop()
{
    temp=analogRead(lm35);
    int celsius=temp/2-5;
    Serial.println(celsius);
    gas = analogRead(smoke);
    Serial.println(gas);
    if(celsius>40||gas>190)
    { if (celsius> 45||gas>250)
```

```

{
    digitalWrite(buzz, HIGH);

    delay(200);

    digitalWrite(buzz, LOW);

    delay(200);

    int pos = 180;

    myservo. write(pos);

    delay(5);
}

else

{
    int pos = 0;

    myservo. write(pos);

    delay(5);

    digitalWrite(buzz, HIGH);

    delay(800);

    digitalWrite(buzz, LOW);

    delay(800);
}

}

else

{
    digitalWrite(buzz, LOW);

    delay(1000);
}

}

```

CHAPTER -5

5.1 CONCLUSION

Smoke detection systems are critical components of fire safety systems that help protect people and property from the devastating effects of fire. They work by detecting smoke and alerting building occupants to the presence of a fire, allowing them to evacuate safely and quickly.

There are various types of smoke detection systems available, including point detection systems, aspirating smoke detection systems, and smart smoke detection systems. Point detection systems are the most commonly used and consist of individual smoke detectors placed at strategic locations throughout a building. Aspirating smoke detection systems are used in larger buildings or areas where traditional point detection systems may not be practical. Smart smoke detection systems use advanced signal processing algorithms and machine learning techniques to detect smoke and reduce false alarms.

Identifying the root causes of smoke is essential for designing and implementing effective smoke detection systems. Cooking fires, electrical fires, smoking are some of the common root causes of smoke. Understanding the root causes of smoke is critical for developing a comprehensive fire safety plan that includes smoke detection and suppression systems.

Overall, smoke detection systems play a vital role in fire safety and can significantly reduce the risk of injury, loss of life, and property damage due to fire. It is essential to select the right type of system based on the size and complexity of the building, place detectors at strategic locations, and ensure regular maintenance and testing to ensure proper functioning.

REFERENCES

NFPA 72: National Fire Alarm and Signaling Code, National Fire Protection Association, Quincy, MA, USA.

Bukowski, R. W. (2009). Smoke detectors and alarms. *Handbook of Fire and Explosion Protection Engineering Principles*, 83-118.

Judd, R. P., & Conroy, M. P. (2012). Smoke detection in buildings. *Fire Protection Handbook*, 20-1.

Soltani, M., & Chaikalis, A. (2015). Performance evaluation of smoke detection systems. *Fire Technology*, 51(4), 927-944.

Lazzara, C. P. (2017). Smart smoke detection systems. *Fire Technology*, 53(2), 491-508.

Zhang, J., Sun, Y., Li, Y., & Liu, Q. (2019). A review on smoke detection technology. *Fire Science and Technology*, 38(5), 753-759.

Liu, Y., Tan, Z., Wang, X., & Liao, G. (2020). A novel early fire smoke detection system based on image processing. *IEEE Access*, 8, 218913-218923.

Wan, F., Guo, Y., & Wei, H. (2021). A smoke detection method based on improved K-Means algorithm and support vector machine. *Journal of Ambient Intelligence and Humanized Computing*, 12(7), 7131-7141.