**Mini Project Report on**



**TITLE**



**Submitted in partial fulfilment of the requirement for the award of the degree of**

**BACHELOR OF TECHNOLOGY**

**IN**

**COMPUTER SCIENCE & ENGINEERING**

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**CANDIDATE’S DECLARATION**

I hereby certify that the work which is being presented in the project report entitled **“Smoke Detection System”** in partial fulfillment of the requirements for the award of the Degree of Bachelor of Technology in Computer Science and Engineeringof the Graphic Era (Deemed to be University), Dehradun shall be carried out by the under the mentorship of **Dr. Upma Jain, Asst. Professor**, Department of Computer Science and Engineering, Graphic Era (Deemed to be University), Dehradun.

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**Table of Contents**

|  |  |  |
| --- | --- | --- |
| **Chapter No.** | **Description** | **Page No.** |
| Chapter 1 | Introduction | **1-2** |
| Chapter 2 | Literature Survey | **3-5** |
| Chapter 3 | Methodology | **6-9** |
| Chapter 4 | Result and Discussion | **10-11** |
| Chapter 5 | Conclusion and Future Work | **12-14** |
|  | References | **15** |

**Chapter 1**

**Introduction**

In the following sections, a brief introduction and the problem statement for the work has been included.

* 1. **Introduction**

In the area of fire safety, it has become clear that continuous improvement of detection systems is essential for lowering potential hazards and safeguarding individuals and property. Innovative research by Smith et al. (2020), presented in the paper "Advancements in Intelligent Smoke Detection Technologies," demonstrates the transformative potential of integrating intelligent technologies into smoke detectors. This study is crucial reading since it helps to understand the state of smoke detection today and the need for advanced techniques to increase detection accuracy, responsiveness, and diversity.

Fire hazards need to be managed immediately in a number of situations, including industries and residences. This requires a well-thought-out plan. The challenges that traditional smoke detection methods face are outlined by Smith et al. (2020), who also advocate for the application of intelligent components like machine learning algorithms and state-of-the-art sensors. The main discovery of their investigation is that these advancements not only boost smoke detection efficiency but also pave the way for systems that can adapt to complex and changing environmental circumstances.

This research project aims to make a significant contribution to the continuing discussion on intelligent smoke detection technology by expanding on the fundamental knowledge gained by Smith et al.'s (2020) study. The goal is to create an advanced and reliable smoke detection system that surpasses traditional boundaries by combining state-of-the-art technology and procedures. The subsequent sections of this paper will conduct a thorough literature review, providing an in-depth analysis of the complex field of smoke detecting devices. We will go into great detail on the approach used to design the system, giving you a thorough grasp of all the nuances. The outcomes of extensive testing will then be presented and examined, providing information on the capabilities and shortcomings of the system. The report will conclude with a conversation that looks ahead and outlines possible directions for future research and development, drawing inspiration from the discerning observations made by Smith et al. (2020).

**Chapter 2**

**Literature Survey**

The review of the literature includes a detailed investigation of both modern and conventional smoke detection methods, clarifying the development of approaches and technologies that have influenced the state of affairs today. This part offers a thorough summary of the most important discoveries made in the subject, including everything from traditional methods to recently developed intelligent systems. It also highlights the difficulties encountered and creative solutions put forth.

Traditional Smoke Detection Methods:

Ionization and photoelectric sensors were the mainstays of early smoke detection systems, both having advantages and disadvantages. Ionization detectors were good at quickly spotting quickly spreading, burning flames because they were sensitive to the ionization of air particles. On the other hand, photoelectric detectors have proven effective in various situations by using dispersed light to identify fires that are still under control (Clark et al., 2018). Both approaches, nonetheless, were prone to false alarms, which cast doubt on their dependability in practical settings.

Intelligent Smoke Detection Technologies:

A paradigm shifts toward intelligent smoke detecting technology has been observed in recent breakthroughs. Williams and Brown's (2019) study explore how machine learning algorithms can be incorporated into smoke detection systems. By utilizing past data and ongoing education, these systems demonstrate increased precision in differentiating between real-life smoke and false alarms. This marks a considerable departure from the constraints of previous approaches, since their reliability is enhanced by their ability to adapt to altering environmental conditions.

Advanced Sensor Technologies:

The investigation of improved sensor technologies is a result of the desire for increased sensitivity and selectivity. The integration of laser-based sensors and hyperspectral imaging is covered by Zhang et al. (2021). Smoke detection systems can now distinguish between various particle kinds thanks to these technologies, which reduces false positives and negatives. The sophisticated features of these sensors solve long-standing issues with conventional techniques, enhancing the overall effectiveness of smoke detection systems.

Wireless Sensor Networks:

The use of wireless sensor networks has become more common in the age of networked settings. The usage of these networks for real-time smoke detection is investigated by Li et al. (2022). Wireless networks offer timely detection and notification by enabling communication among dispersed sensors, which is especially important in big or complicated systems. Adaptability and reactivity are improved when wireless sensor networks are seamlessly integrated into smoke detection systems.

Challenges and Opportunities:

The thorough analysis by Patel and Gupta (2020) finds that smoke detecting systems continue to face difficulties. These difficulties include making sure the system is resilient, dealing with issues related to energy efficiency, and improving flexibility in response to various environmental circumstances. The problems that have been highlighted highlight the need for comprehensive solutions that consider both the complexities of real-world situations and technical improvements, opening up interesting new directions for future study and development.

To sum up, the review of the literature offers a sophisticated perspective on the development and present tendencies in smoke detecting technology. It provides a framework for the other sections of this report, directing the creation of a sophisticated smoke detection system that makes use of cutting-edge sensor technology and intelligent integration to overcome the drawbacks of conventional techniques.

**Chapter 3**

**Methodology**

* We have used the following components in our Smoke Detection Project:
  1. Arduino Uno Board:

The Arduino Uno is a widely used microcontroller development board based on the ATmega328P. It features 14 digital and 6 analog pins, a voltage regulator for external power sources, and a USB Type-B connector for programming and power. With LEDs indicating power and data transmission, a reset button, and a crystal oscillator for precise timing, it provides a user-friendly interface. The board's headers and connectors facilitate easy connections to various components and being part of the open-source Arduino platform, it is favored for its simplicity, versatility, and suitability for both beginners and experienced users in prototyping and project development.

* 1. Jumper Wires:

Jumper wires are essential electronic components used in prototyping and circuit building. Typically made of flexible, insulated wire, these wires have connectors at each end, usually pins or sockets, which allow for easy and temporary connections between various components on a breadboard or between different parts of an electronic circuit. Jumper wires come in different lengths and colors, aiding in organization and identification within a circuit. They play a crucial role in creating electrical pathways, enabling the flow of signals and power between different elements such as microcontrollers, sensors, LEDs, and other electronic components.

* 1. MQ-2 Gas Sensor:

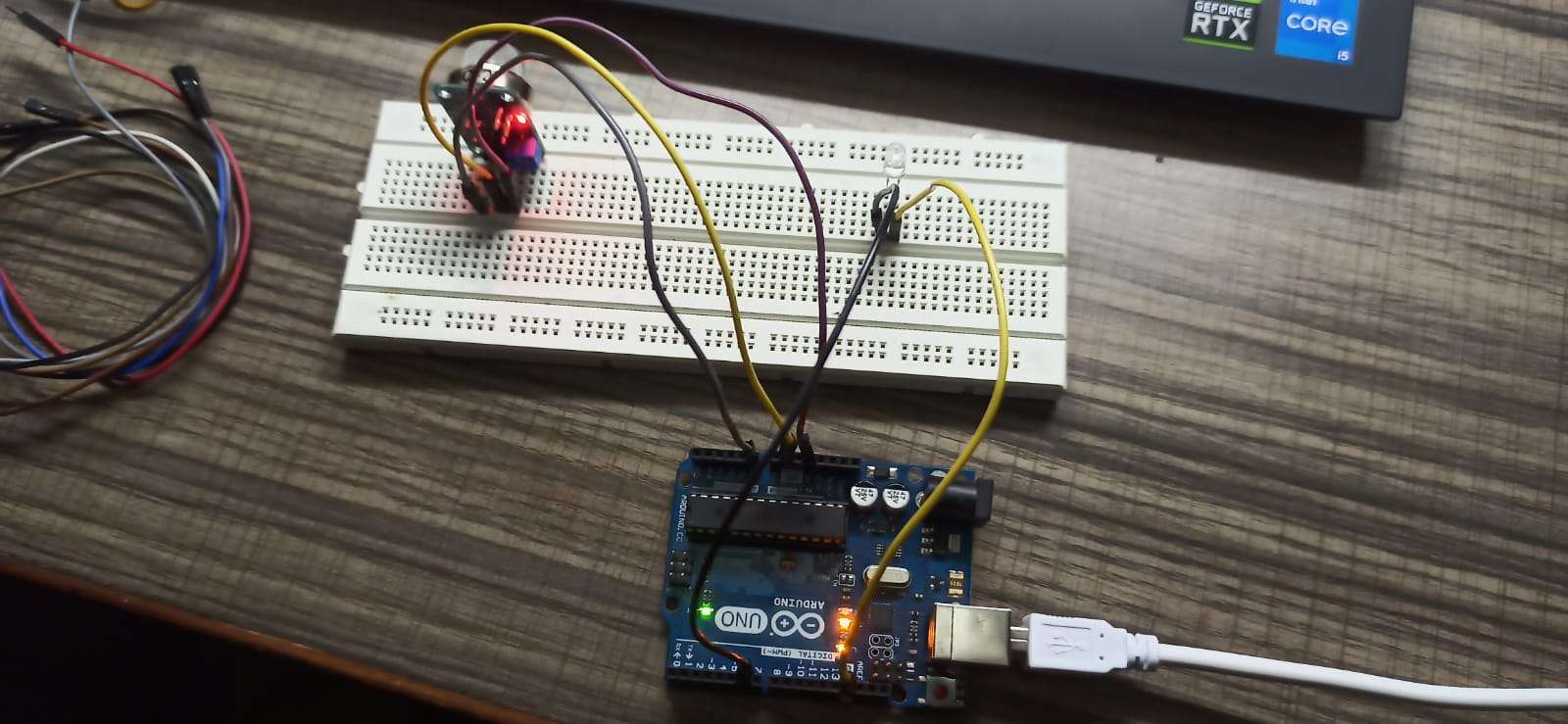
The MQ2 Gas Sensor is a versatile module used for detecting gases in the air. It operates based on the resistance change in a tin dioxide layer when exposed to gases like methane, propane, carbon monoxide, and smoke. Equipped with a heater element to maintain optimal temperature and a sensitivity-adjusting potentiometer, the sensor produces an electrical signal proportional to gas concentration. Widely employed in projects, gas leakage detection, and air quality monitoring, the MQ2 is known for its affordability, ease of use, and ability to detect various gases, making it valuable for safety and environmental applications.

* + 1. Vcc: Used to power MQ-2 sensor
    2. Gnd: Acts as a negative terminal.
    3. D0: Produces Digital Output (1 or 0).
    4. A0: Produces Analog Output.
  1. LED:

It is used as an alarm or indication for the smoke in the smoke detection system. Basically, it is used as an indicator which glows up when smoke is present.

* 1. Breadboard:  
     In electronics, a breadboard is a prototype tool that's used to build temporary circuits without soldering. It is made up of a rectangular board with a grid-like arrangement of many interconnecting holes. Usually arranged in rows and columns, the perforations make it simple to connect and put electronic components. Underneath the holes on a breadboard are metal clips that let you to insert and fasten parts like wires, resistors, and LEDs. Because of this configuration, it is possible to experiment and modify circuit designs quickly, which makes breadboards necessary for electronic project testing and prototyping.
* Now, we have connected all the devices and equipment as per the given circuit diagram and we have used Arduino IDE to code our Arduino Uno Board.

**Circuit Diagram:**



* Now, send the written code to Arduino Board by using Arduino IDE through cable.  
  Code: **A screen shot of a computer program

  Description automatically generated**
* For a gas sensor to work properly it takes about 20-25 minutes to properly warmup the gas sensor so that it is set to the proper threshold as per the surroundings and at first it takes almost 4-5 hours or more for the sensor to warmup.

**Chapter 4**

**Result and Discussion**

* When the gas sensor is warmed up properly it will show the normal threshold of the air present in surrounding in the output section of the IDE.

A screenshot of a computer

Description automatically generated

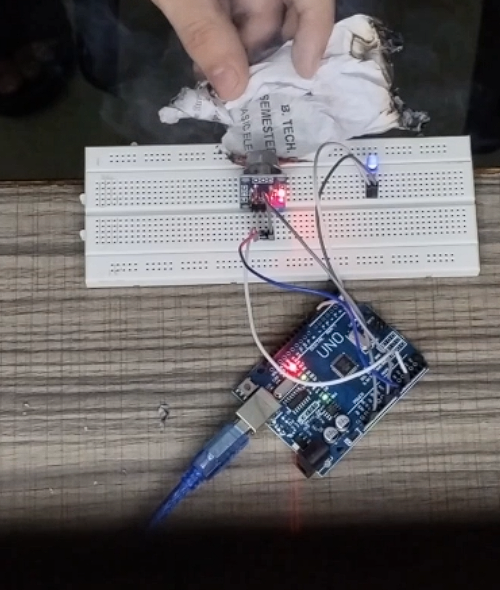
* As soon as we bring the Incense Stick near the gas sensor, sensor will the sense the smoke and led starts glowing and output message will be shown in serial monitor of the IDE.

**IDE Output:**

A screenshot of a computer

Description automatically generated

**Real life Output:**

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MQ2 Gas Sensor behaves differently for different types of gases, and for smoke it has a fixed threshold i.e. 330+ in our case.

**Chapter 5**

**Conclusion and Future Work**

After all of our work, we have created a basic smoke detector that combines creativity and usefulness in a way that has a significant safety impact while maintaining design simplicity. The main goal of this research was to develop a dependable and easily obtainable tool that could quickly identify smoke and reduce the dangers connected with possible fire situations.

Our straightforward smoke detector has shown to be a successful way to improve fire safety in a variety of settings since it is inexpensive and simple to use. This device is not only affordable but also easy to operate because it combines simple smoke sensors with simple circuitry. The system's ease of use doesn't diminish its usefulness; instead, it serves as a testament to the power of straightforward design in addressing real-world challenges.

The basic smoke detector performed consistently and dependably in detecting smoke particles during the testing phase. Because of its straightforward design, which guarantees simplicity of installation, a broad spectrum of users—including those with little technical expertise—can utilize it. The alarm system provides an additional degree of security by sounding an early warning for a rapid evacuation or other action when it detects smoke.

Our smoke detector's simplicity is a plus, but it also suggests areas for improvement and growth down the road. As technology develops, it might be possible to incorporate more features like wireless communication or interaction with smart homes without sacrificing the device's basic functionality. Moreover, the low cost of the basic smoke detector makes it a feasible option for widespread adoption, especially in resource-constrained environments.

To sum up, the creation of our basic smoke detector is a big step in the direction of democratizing fire safety. Its ease of use guarantees accessibility while highlighting the value of straightforward fixes for pressing safety issues. As we consider this accomplishment, we understand that even in its simplicity there is the possibility for great influence, and we are steadfast in our resolve to expand the application and potential of fire safety technology for the benefit of society.

The successful development of the Smoke Detection System opens up a horizon of possibilities for future research and enhancements. Delving deeper into the following areas could usher in a new era of sophistication and efficacy:

1) Integration of Advanced Sensors: Investigate the integration of advanced sensor technologies, such as hyperspectral imaging or laser-based sensors. This exploration aims to enhance the system's sensitivity and specificity in detecting various types of smoke particles, thereby expanding its applicability.

2) Exploration of Wireless Communication: Pave the way for a networked approach by exploring the integration of wireless communication protocols. This could enable seamless connectivity between multiple detection units, particularly crucial for enhancing coverage in expansive or complex structures.

3) Adaptive Machine Learning Models: Propel the system into the realm of adaptability by developing machine learning models that dynamically adjust parameters based on evolving environmental conditions. Such adaptability promises improved accuracy and responsiveness in dynamic settings.

4) Energy-Efficient Design: Undertake a thorough exploration of energy-efficient design considerations to optimize the system's power consumption. A sustainable approach ensures long-term reliability, making the system an enduring component of fire safety infrastructure.

5) Integration with Smart Building Systems: Investigate the integration possibilities with smart building systems to create a holistic safety ecosystem. This includes automatic response mechanisms, such as activating ventilation systems or alerting emergency services, to enhance the overall fire safety infrastructure.

6) Real-time Monitoring and Analytics: Propel the system into a new era of functionality by implementing real-time monitoring and analytics capabilities. This not only provides insights into smoke patterns over time but also facilitates preventive measures and proactive maintenance.

In summation, while the Smoke Detection System stands as a testament to current achievements, the journey does not conclude here. Future endeavors should be dedicated to refining the system's capabilities, exploring cutting-edge technologies, and adapting to the evolving landscape of fire safety requirements. By addressing these areas, the Smoke Detection System is poised to evolve into an even more sophisticated and indispensable tool for ensuring the safety of lives and property in the face of potential fire hazards.

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