VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JNANA SANGAMA", BELGAUM-590014, KARNATAKA

An Internship Project Report

on

"Smart Air Pollution Monitoring System"

Submitted in partial fulfilment of the requirement for the VII semester course of

BACHELOR OF ENGINEERING

In

COMPUTER SCIENCE AND ENGINEERING

Submitted By

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Under the guidance of

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Project Completion Certificate

I, **Chiranth H A** (Roll No: 1AP21CS015), hereby declare that the material presented in the Project Report titled **"Smart Air Pollution Monitoring System"** represents original work carried out by me in the **Department of Computer Science** at the **APS college of Engineering, Bangalore** during the tenure **2 October, 2024 – 12, December, 2024**.

With My signature, I certify that:

- I have not manipulated any of the data or results.
- I have not committed any plagiarism of intellectual property and have clearly indicated and referenced the contributions of others.
- I have explicitly acknowledged all collaborative research and discussions.
- I understand that any false claim will result in severe disciplinary action.
- I understand that the work may be screened for any form of academic misconduct.

Date: **Student Signature**:

In my capacity as the supervisor of the above-mentioned work, I certify that the work presented in this report was carried out under my supervision and is worthy of consideration for the requirements of the B.Tech. Internship Work.

Advisor's Name: Dr Shivamurthaiah **Guide Name:** Sai Charan Teja

Advisor's Signature **Guide Signature**

Project Completion Certificate

I, **Shreyas M** (Roll No: 1AP21CS042), hereby declare that the material presented in the Project Report titled **"Smart Air Pollution Monitoring System"** represents original work carried out by me in the **Department of Computer Science** at the **APS college of Engineering, Bangalore** during the tenure **2 October, 2024 – 12, December, 2024**.

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Advisor's Name: Dr Shivamurthaiah **Guide Name:** Sai Charan Teja

Advisor's Signature **Guide Signature**

Project Completion Certificate

I, **Rakshitha J** (Roll No: 1AP21EC011), hereby declare that the material presented in the Project Report titled **"Smart Air Pollution Monitoring System"** represents original work carried out by me in the **Department of Computer Science** at the **APS college of Engineering, Bangalore** during the tenure **2 October, 2024 – 12, December, 2024**.

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Date: **Student Signature**:

In my capacity as the supervisor of the above-mentioned work, I certify that the work presented in this report was carried out under my supervision and is worthy of consideration for the requirements of the B.Tech. Internship Work.

Advisor's Name: Dr Prakash Jadhav **Guide Name:** Sai Charan Teja

Advisor's Signature **Guide Signature**

Evaluation Sheet

Title of the Project: Smart Air Pollution Monitoring System

Name of the Students: Chiranth H A

Shreyas M

Rakshitha J

External Supervisor:

_____

Internal Supervisor:

_____

_____

Date:

Place:

ABSTRACT

Air pollution is a major global issue, impacting human health and the environment. Traditional air quality monitoring systems are often expensive and complex, limiting widespread use. This report presents a **Smart Air Pollution Monitoring System** using **Raspberry Pi**, **gas sensors**, **temperature sensors**, and **humidity sensors** to measure key air quality parameters in real-time. The system is cost-effective, scalable, and easy to deploy, providing data on pollutants like CO2, VOCs, and environmental conditions such as temperature and humidity. The IoT-based system enables continuous and real-time air quality monitoring, offering an affordable alternative to traditional methods. By leveraging **Raspberry Pi** and cost-effective sensors, the system is easily customizable for various environments. It supports data-driven decision-making and can be expanded to cover larger areas. The system's ability to provide **real-time alerts** helps mitigate health risks associated with air pollution. Overall, this solution fosters awareness, allowing communities to actively manage air quality and improve public health outcomes.

The **Raspberry Pi** collects data from the **MQ-135 gas sensor** (for detecting CO2 and toxic gases) and the **DHT22 sensor** (for temperature and humidity). This data is transmitted to a cloud platform for remote monitoring and analysis. Users can view real-time pollution levels via a web or mobile application, receiving alerts when air quality exceeds safe limits.

The system provides valuable insights into long-term air quality patterns and empowers users to take proactive measures. It offers a solution for monitoring air quality in urban areas, schools, and public spaces, contributing to public health and environmental sustainability. The system is scalable for larger deployments, making it suitable for smart cities and environmental research.

1.INTRODUCTION

1.1 Overview

The Smart Air Pollution Monitoring System uses a Raspberry Pi along with gas sensors, temperature sensors, and humidity sensors to monitor air quality in real-time. This low-cost system detects harmful gases as well as measures temperature and humidity, which influence pollutant behaviour. The Raspberry Pi collects and processes data from these sensors, providing valuable insights into air quality levels. The system can display the data locally or upload it to the cloud for remote monitoring, with alerts triggered when pollutant levels exceed safety thresholds. Applications include monitoring urban air quality, indoor environments, and environmental studies. This system offers an affordable and scalable solution for tracking pollution and ensuring public health, especially in areas where traditional monitoring systems may be inaccessible or expensive.

1.2 Objective

1. To measure and record temperature and humidity levels, providing essential data that influences the dispersion and concentration of pollutants.
2. To develop a low-cost, scalable air quality monitoring system using the Raspberry Pi, making air pollution monitoring more accessible in both urban and rural areas.
3. To present real-time air quality data through local displays or cloud platforms, enabling easy monitoring and access to environmental conditions.
4. To trigger notifications or alerts when pollutant levels exceed predefined safety thresholds, ensuring timely action can be taken to mitigate health risks.
5. To enable long-term tracking of air quality trends, aiding in research and policy-making for improved environmental management and public health.

2. Problem Statement

Air pollution is a significant environmental and health concern, with harmful effects on both people and the planet. Traditional air quality monitoring systems are often expensive, bulky, and difficult to deploy in remote or underdeveloped areas. There is a need for a low-cost, efficient, and scalable solution to monitor air quality in real-time. The Smart Air Pollution Monitoring System using Raspberry Pi, gas sensors, temperature sensors, and humidity sensors aims to address this gap. It offers a cost-effective, portable system for detecting pollutants and tracking environmental conditions, enabling better decision-making to protect public health and the environment.

3. Application

1. **Urban Air Quality Monitoring**: Provides real-time data on pollutants in cities, helping authorities manage air quality and take timely actions to reduce pollution.
2. **Indoor Air Quality Control**: Used in homes, offices, hospitals, and schools to monitor and improve indoor air quality, ensuring a healthier environment.
3. **Environmental Research**: Assists researchers in monitoring air pollution in various ecosystems and studying its impact on flora, fauna, and climate.
4. **Industrial Monitoring**: Used in factories or industrial areas to detect hazardous gases, ensuring worker safety and compliance with environmental regulations.
5. **Smart City Development**: Supports smart city initiatives by integrating air quality monitoring into urban infrastructure for improved city planning and public health.
6. **Agriculture**: Helps farmers monitor air quality in agricultural regions, enabling better management of crops and understanding the effects of air pollution on farming.
7. **Disaster Management**: Used in disaster-prone areas to detect hazardous gases from accidents, industrial leaks, or natural disasters, providing early warnings to authorities.
8. **Public Awareness Campaigns**: Provides accessible air quality data to the public, raising awareness about pollution levels and encouraging environmental responsibility.

4. Components

Hardware :-

Raspberry Pi:

Acts as the central processing unit, collecting and processing data from the sensors.

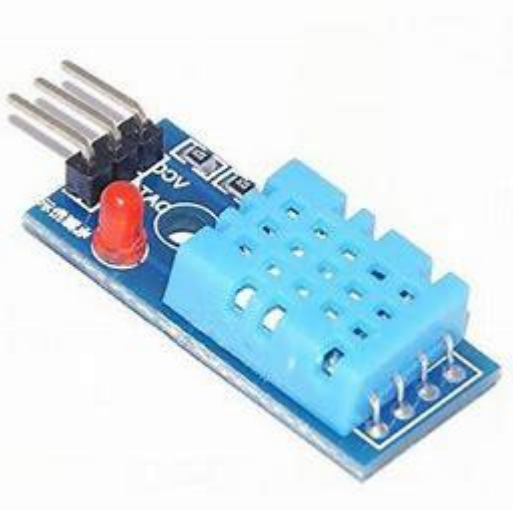
Runs the software for data analysis and communication, such as sending data to the cloud or displaying it locally.

Gas Sensors:

MQ Series Gas Sensors (e.g., MQ-135): Detect harmful gases like carbon monoxide (CO), carbon dioxide (CO_2), and volatile organic compounds (VOCs).

These sensors help assess the level of pollution in the air, critical for health and environmental safety.

Temperature & Humidity Sensor:



Measures ambient temperature. Temperature influences how pollutants disperse and helps assess air quality conditions.

Measures relative humidity. Humidity levels affect the behavior of pollutants, such as particulate matter, in the atmosphere.

Power Supply:

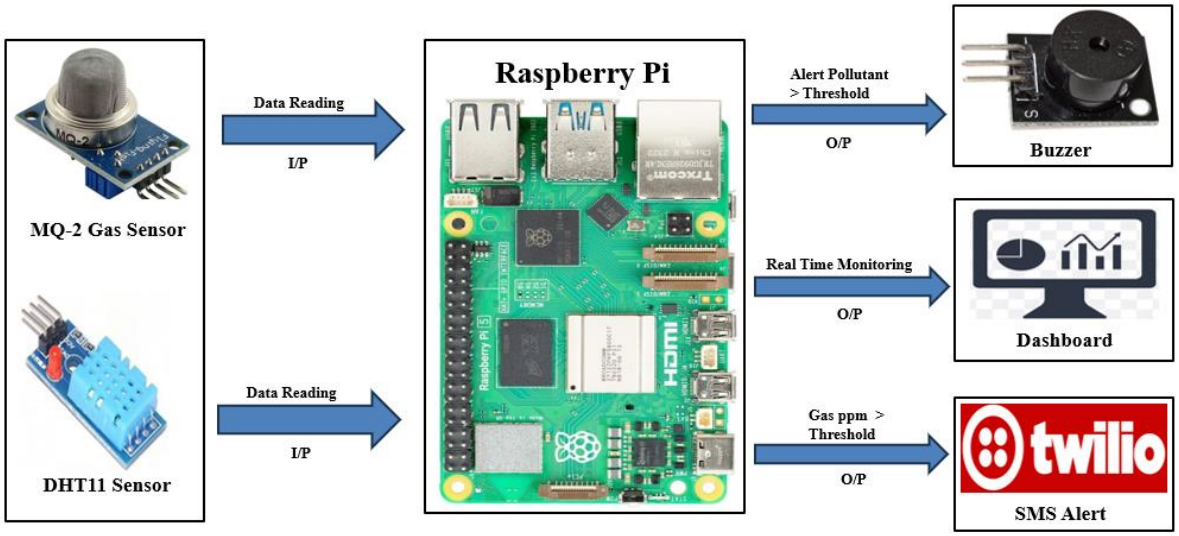
Provides the necessary power for the Raspberry Pi and sensors, which can be a battery, USB adapter, or power bank, depending on portability needs.

Software:-

1. Flask Framework: Backend for data processing and API development.
2. HTML, CSS, JavaScript: Frontend for the web interface.
3. Raspberry Pi OS.
4. Python language.
5. Libraries.
6. Cloud Platform.

5.Flowchart

Flowchart Process:



6.Conclusion

The Smart Air Pollution Monitoring System using Raspberry Pi and various sensors offers an affordable, efficient solution for real-time air quality monitoring. By detecting harmful gases, temperature, and humidity, it provides valuable data for public health, environmental research, and policy-making. This system empowers timely action to combat pollution and promote cleaner, healthier environments.

7. Future work

1. **Integration of Particulate Matter Sensors**: Adding sensors to detect particulate matter (PM2.5, PM10) for a more comprehensive air quality analysis.
2. **Cloud-based Data Analysis**: Implementing advanced cloud platforms to analyze collected data in real-time, offering detailed insights and predictive models for air pollution trends.
3. **Mobile App Development**: Creating a mobile app to provide users with real-time notifications, air quality updates, and trends for better accessibility.
4. **Machine Learning for Predictive Analytics**: Incorporating machine learning algorithms to predict pollution levels based on historical data, weather conditions, and other factors.
5. **Energy Efficiency Improvements**: Optimizing the system for lower energy consumption, making it more sustainable for long-term deployment in remote areas.
6. **Integration with Smart City Infrastructure**: Connecting the monitoring system with other smart city systems, such as traffic management and public health databases, for a more holistic approach to air quality management.
7. **Extended Sensor Range and Accuracy**: Enhancing sensor capabilities to detect a broader range of pollutants with higher accuracy, improving the system's reliability.
8. **Real-time Air Quality Mapping**: Developing geographic information system (GIS)-based maps to visualize air quality across larger regions, supporting better decision-making for urban planning and pollution control.

8. Appendix

A. Required Hardware

1. **Raspberry Pi**: Any model with GPIO pins (e.g., Raspberry Pi 3 or 4).
2. **MQ135 Gas Sensor**: Measures air quality by detecting gases like CO2 and ammonia.
3. **MCP3008 ADC**: Converts analog signals from the MQ135 to digital signals for the Raspberry Pi.
4. **DHT11 Sensor**: Measures temperature and humidity.
5. **Jumper Wires**: For connecting sensors to Raspberry Pi.

B. Wiring Setup

1. **MQ135 Gas Sensor**:
   - VCC -> 5V
   - GND -> GND
   - A0 (Analog Output) -> MCP3008 Channel 0
2. **MCP3008 ADC**:
   - Connect SPI pins (CLK, DOUT, DIN, CS) to Raspberry Pi GPIO pins.
3. **DHT11 Sensor**:
   - VCC -> 3.3V, Data Pin -> GPIO4

C. Code Explanation

- **Flask Web Server**: Serves the HTML page and handles data requests.
- **Sensor Reading**:
  - **MQ135**: Air quality data via MCP3008 ADC.
  - **DHT11**: Temperature and humidity data.
- **JavaScript**: Fetches data from Flask API every 2 seconds and updates the UI.

D. Web Interface

- **Cards**: Displays gas value, temperature, humidity, and air quality.
- **Chart.js**: Visualizes real-time trends for air quality, gas, temperature, and humidity.
- **Alert Section**: Displays an alert if air quality is moderate or bad.

E. Real-Time Data Flow

1. **Backend**: Flask server fetches sensor data, classifies air quality, and serves it as JSON.

2. **Frontend**: JavaScript fetches data every 2 seconds and updates UI components (cards and chart).
3. **Alert**: Triggered if air quality is classified as moderate or bad.

F. Code Installation and Setup

1. **Install Libraries**:

Sudo pip3 install Flask Adafruit-MCP3008 Adafruit-DHT

2. **Run Flask App**:

python3 app.py

3. **Access Web Interface**: Open http://<RaspberryPi_IP>:5000/ in a browser.

G. Troubleshooting

1. **MQ135 Sensor**: Check MCP3008 wiring, and ensure the sensor is heated up.
2. **DHT11 Sensor**: Ensure correct GPIO pin connection and retry readings.

8.1 Pseudo code