VIT
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

Submitted by

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Bachelor of Technology

Computer Science and Engineering

Under the guidance of

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1. INTRODUCTION:

OBJECTIVE:

The foremost objective of our air quality monitoring system is to safeguard public health and safety by providing real-time data on air pollution levels. High concentrations of pollutants such as particulate matter (PM2.5 and PM10), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO), and ozone (O_3) can have detrimental effects on respiratory health and overall well-being. By continuously monitoring these pollutants and alerting authorities and the public to potential risks, our system aims to mitigate the adverse health effects associated with poor air quality.

Another key objective of our system is to empower policymakers, urban planners, and environmental agencies with accurate and comprehensive data to support informed decision-making. By collecting data from strategically placed monitoring stations and leveraging advanced analytics, our system will provide insights into pollution hotspots, trends over time, and the effectiveness of pollution control measures. This information can inform the development of targeted policies and interventions aimed at reducing pollution levels and improving air quality in urban and industrial areas.

APPROACH:

The first step in developing an air quality monitoring system is to clearly define the scope and requirements of the project. This involves identifying the pollutants to be monitored, such as particulate matter (PM), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), ozone (O_3), carbon monoxide (CO), and volatile organic compounds (VOCs). Additionally, it's essential to determine the geographical area to be covered and the desired level of monitoring granularity, whether it's at a city-wide scale or localized to specific neighborhoods or industrial zones.

Choosing appropriate sensors and data acquisition methods is critical to the accuracy and reliability of the monitoring system. Factors to consider include sensor sensitivity, response time, operating range, and compatibility with existing infrastructure. Various sensor technologies, such as optical, electrochemical, and semiconductor-based sensors, offer different trade-offs in terms of cost, accuracy, and maintenance requirements. Additionally, data acquisition methods, including wireless networks, IoT platforms, and cloud-based data storage, must be selected to ensure seamless data collection, transmission, and analysis.

Once data is collected from the sensors, it needs to be analyzed and visualized to provide actionable insights for stakeholders. Advanced data analysis techniques, such as machine learning algorithms and statistical modeling, can be employed to identify trends, patterns, and correlations in the data.

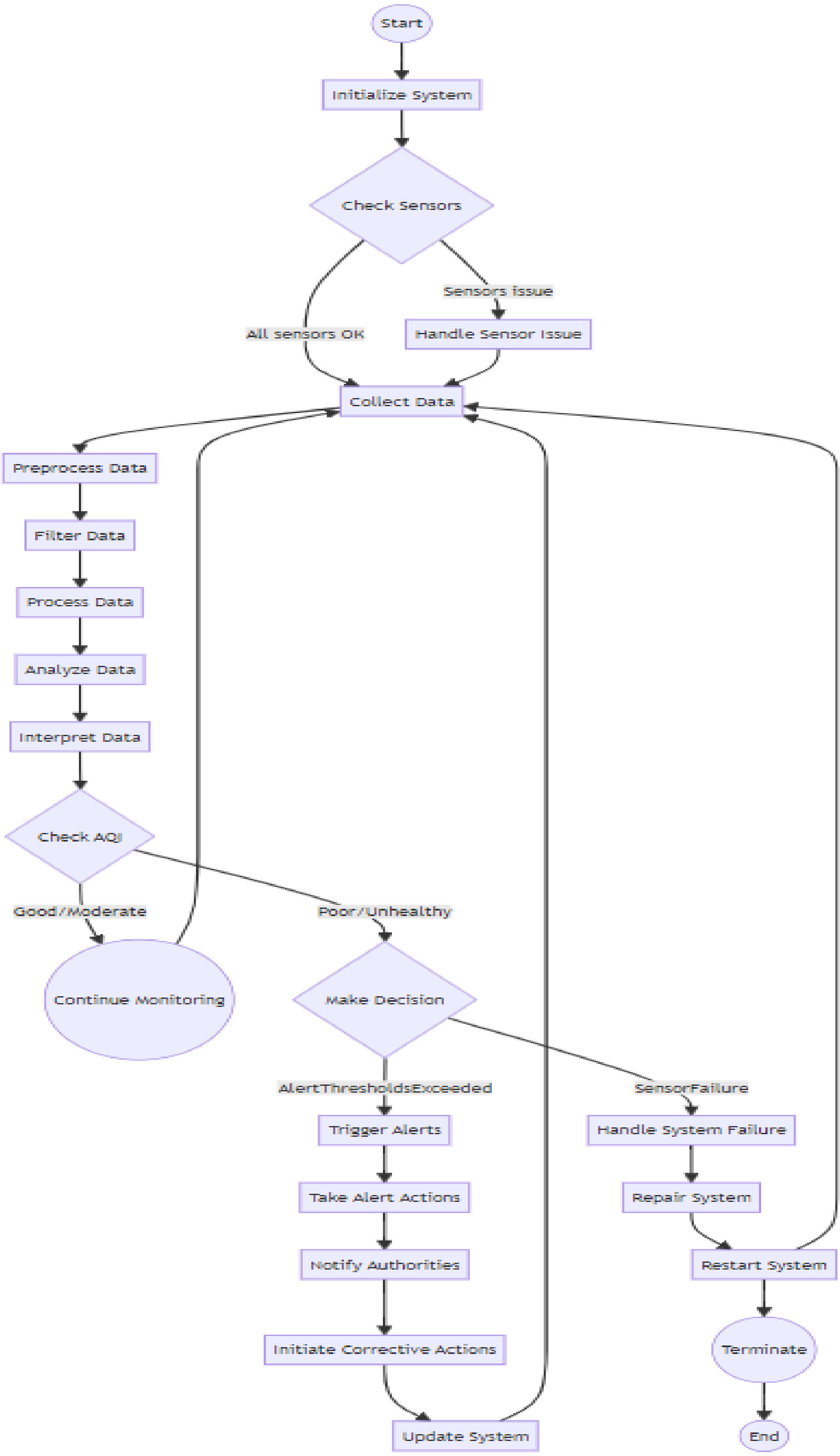
2. RELATED WORKS:

SURVEY OF ANALYSIS:

SL	JOURNELS	OUTCOME	PROS	CONS
1	Air Quality Monitoring System	Develops a real-time system to measure pollutants, aiding informed decisions for pollution mitigation.	1. Real-time data for timely actions. 2. Raises public awareness for informed choices.	1. Initial cost may be prohibitive for some users. 2. Maintenance and calibration requirements can add to ongoing expenses.
2	A comprehensive review on indoor air quality monitoring systems for enhanced public health	Analyzes existing systems to enhance public health outcomes through indoor air quality monitoring.	1. Highlights latest indoor monitoring tech. 2. Emphasizes health benefits for policy actions.	1. Implementation may require significant time and resources. 2. Limited accessibility to advanced technologies in certain regions.
3	Air Quality Monitoring System	Utilizes IoT for real-time monitoring, enabling data-driven environmental management.	1. Enables remote monitoring. 2. Easily scalable for wider coverage.	1. Vulnerable to cybersecurity threats. 2. Reliability may be affected by network connectivity issues.
4	Air Quality Monitoring System Based on IoT	Evaluates IoT's role in monitoring air pollution, guiding future research and innovation.	1. Integrates with smart systems. 2. Provides accessible data for analysis.	1. Dependence on internet connectivity for data transmission. 2. Privacy concerns regarding data collection and sharing practices.
5	Air Quality Monitoring Systems using IoT: A Review	Collects real-time data on various pollutants for proactive pollution control measures.	1. Holistic monitoring with multiple sensors. 2. Enables prompt interventions for better health outcomes.	1. Complexity in integrating multiple sensors may lead to technical challenges. 2. Power consumption for continuous monitoring can be high, impacting energy efficiency.
6	Development of Multi-Item Air Quality Monitoring System Based on Real-Time Data	Integrates air quality monitoring into Android devices for on-the-go access to real-time data.	1. Utilizes widely available smartphones. 2. Offers user-friendly interface for easy understanding.	1. Compatibility issues with older smartphone models. 2. Limited accuracy compared to specialized monitoring equipment.
7	Android Based Air Quality Monitoring System	Conducts comprehensive testing to identify and mitigate indoor air pollutants, promoting occupant health.	1. Identifies indoor pollutants accurately. 2. Gives personalized recommendations for improvement.	1. Requires specialized equipment and expertise for accurate testing. 2. Costs associated with professional testing services may be prohibitive for some users

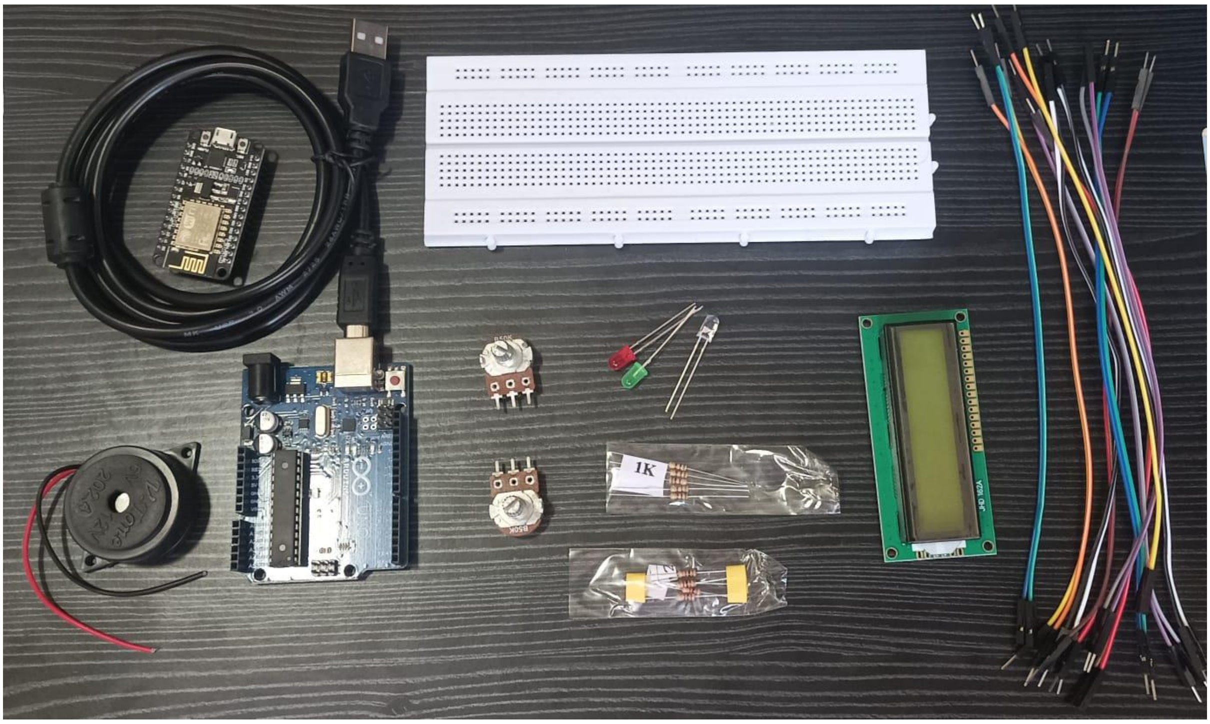
8	Indoor Air Quality Testing	Deploys IoT devices for real-time air quality monitoring, aiding policy decisions for pollution control.	1. Utilizes existing IoT infrastructure. 2. Drives data-driven decision-making for interventions.	1. Dependence on IoT infrastructure may limit deployment in rural or remote areas. 2. Lack of standardized protocols may hinder interoperability with other systems.
9	Air-MIT: Air Quality Monitoring Using Internet of Things †	Assesses IoT's effectiveness in monitoring air pollution, offering insights for future research.	1. Cost-effective solutions for monitoring. 2. Enables continuous monitoring for early detection.	1. Reliability of IoT devices may be affected by environmental conditions. 2. Limited coverage in areas with poor internet connectivity.
10	Air pollution monitoring system using IoT devices: Review	Provides an overview of IoT-based air pollution monitoring systems, guiding future developments.	1. Seamless integration with IoT ecosystem. 2. Provides real-time alerts for immediate actions.	1. Potential for data inaccuracies due to sensor drift or malfunction. 2. Privacy concerns related to the collection and storage of personal data.
11	Air Quality Monitoring System	Provides real-time monitoring of air pollutants to inform public health decisions and interventions.	1. Provides real-time data for immediate action. 2. Raises public awareness for proactive environmental stewardship.	1. Initial setup costs can be prohibitive. 2. Maintenance requirements may lead to ongoing expenses.
12	Air and water quality monitoring system	Monitors both air and water pollutants to ensure environmental safety and public health protection.	1. Comprehensive monitoring for multiple environmental parameters. 2. Enables early detection of pollution for effective mitigation measures.	1. Integration complexities between air and water monitoring components. 2. Increased resource and infrastructure demand for dual monitoring systems.
13	Research Review Inquisitive on Indoor Air Quality Monitoring System Facilitate with Internet of Things	Monitors both air and water pollutants to ensure environmental safety and public health protection.	1. Integrates IoT for remote monitoring and control. 2. Enhances data accessibility and analysis for informed decision-making.	1. Vulnerability to cyber threats due to interconnected IoT devices. 2. Limited interoperability between different IoT platforms and protocols.
14	Ambient (outdoor) air pollution	Examines the sources, impacts, and mitigation strategies of outdoor air pollution on human health and the environment.	1. Helps identify pollution sources and patterns for targeted interventions. 2. Supports policy development for air quality improvement initiatives.	1. Limited control over external pollution sources. 2. Difficulty in accurately assessing individual exposure levels in dynamic outdoor environments.

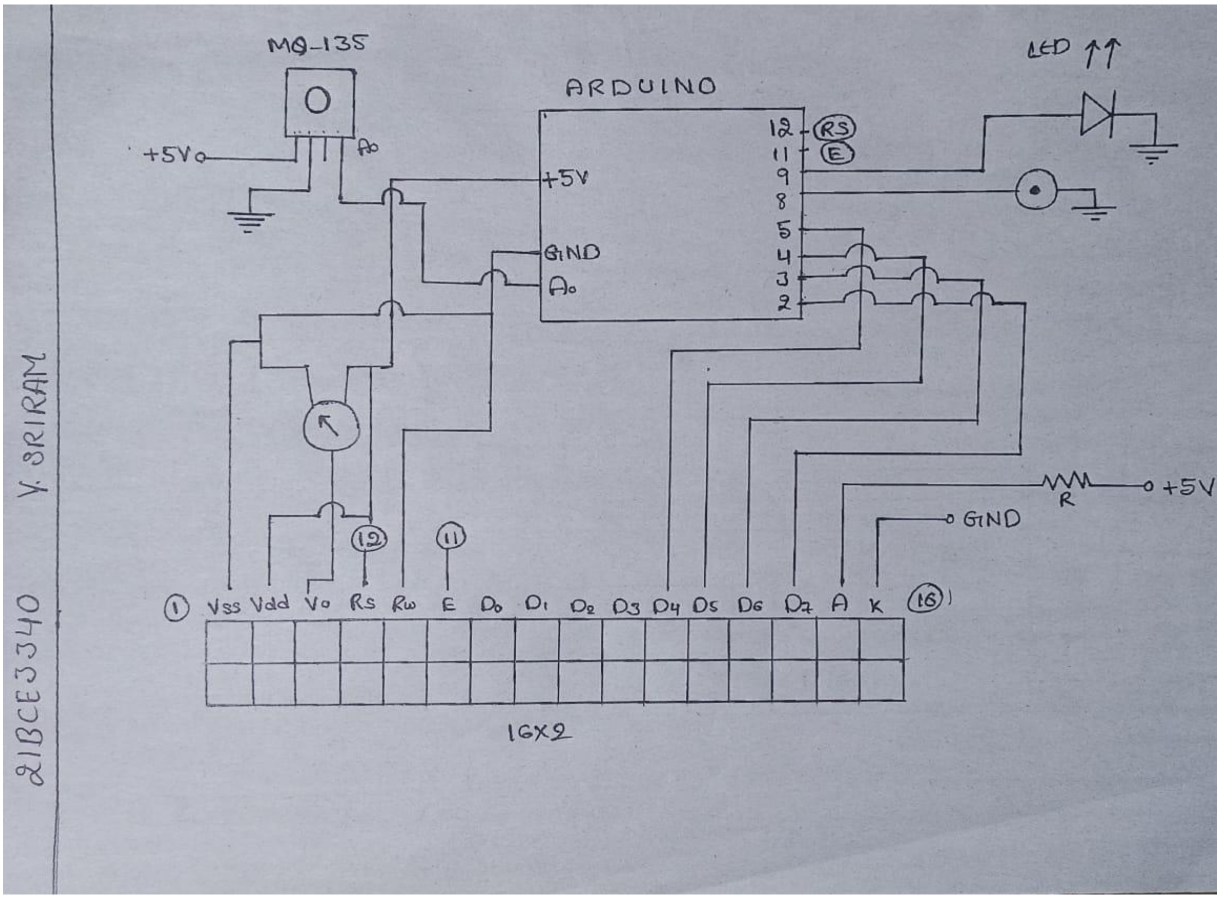
3. FLOW CHART

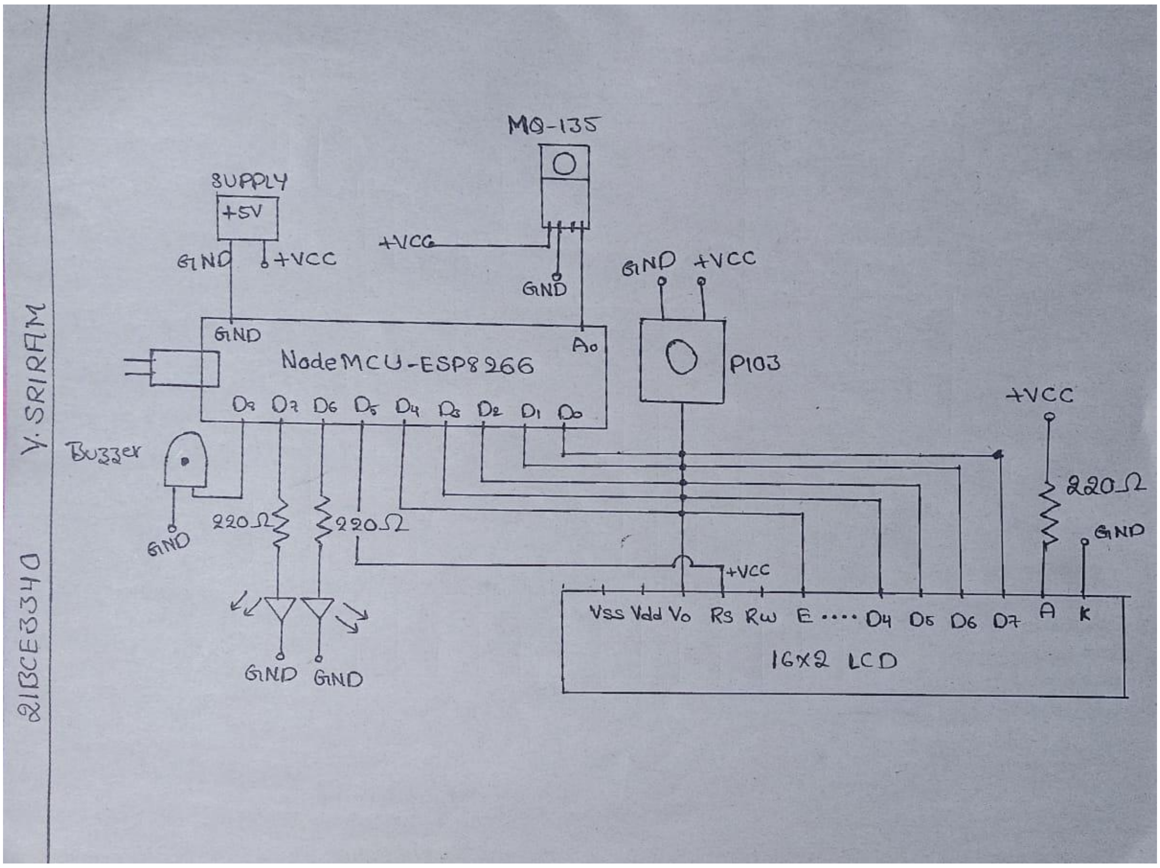

Start
Initialize System
Check Sensors
Sensors issue
All sensors OK
Handle Sensor Issue
Collect Data
Preprocess Data
Filter Data
Process Data
Analyze Data
Interpret Data
Check AQI
Good/Moderate
Poor/Unhealthy
Continue Monitoring
Make Decision
AlertThresholdsExceeded
SensorFailure
Trigger Alerts
Handle System Failure
Take Alert Actions
Repair System
Notify Authorities
Restart System
Initiate Corrective Actions
Terminate
Update System
End

4. SENSORS, MICROCONTROLLER CIRCUIT DIAGRAM

Components Required:

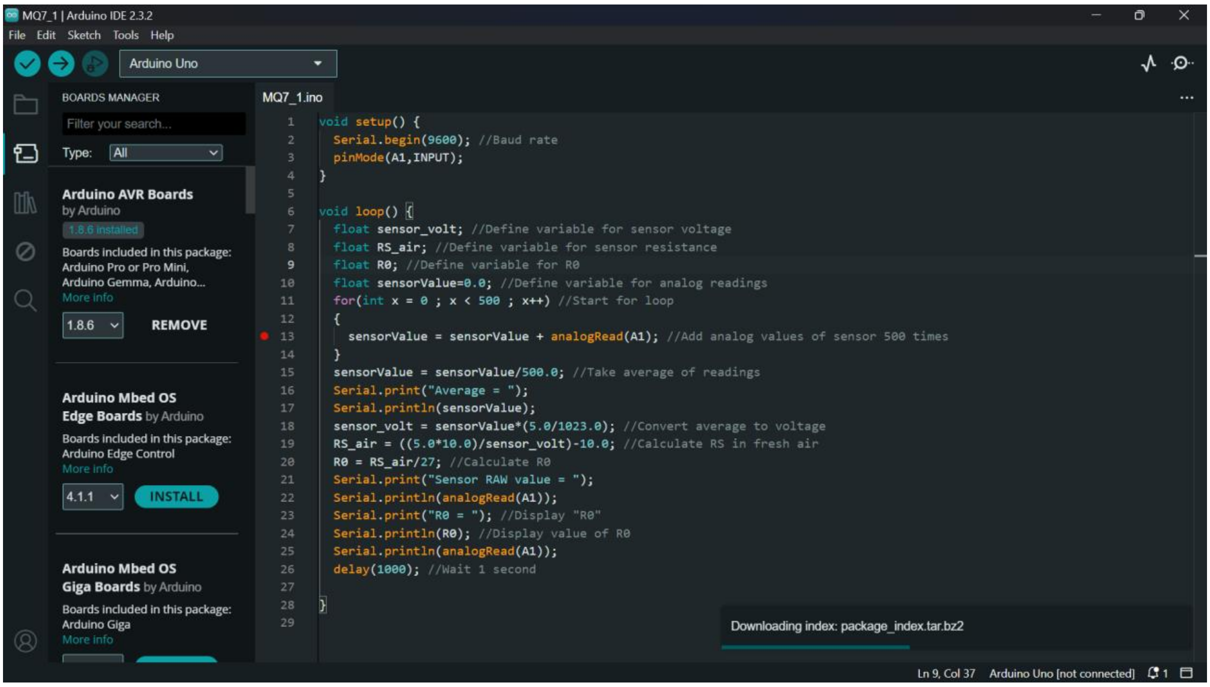


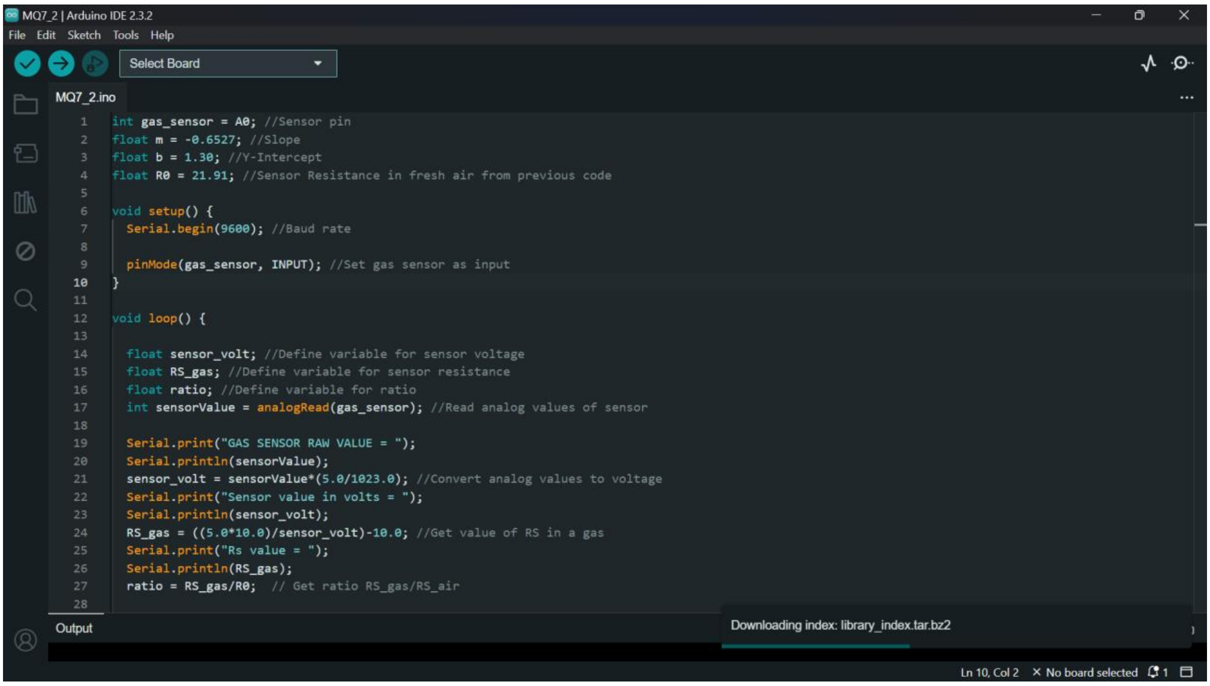


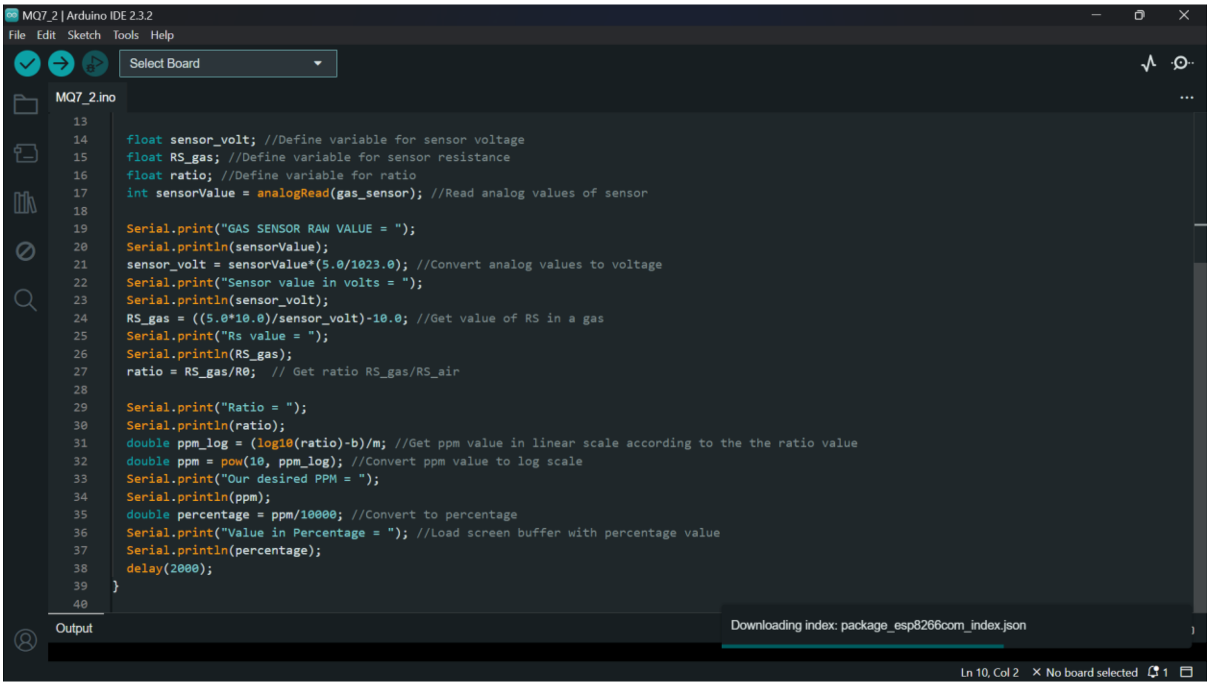


5. RUNNING THE EXPERIMENT

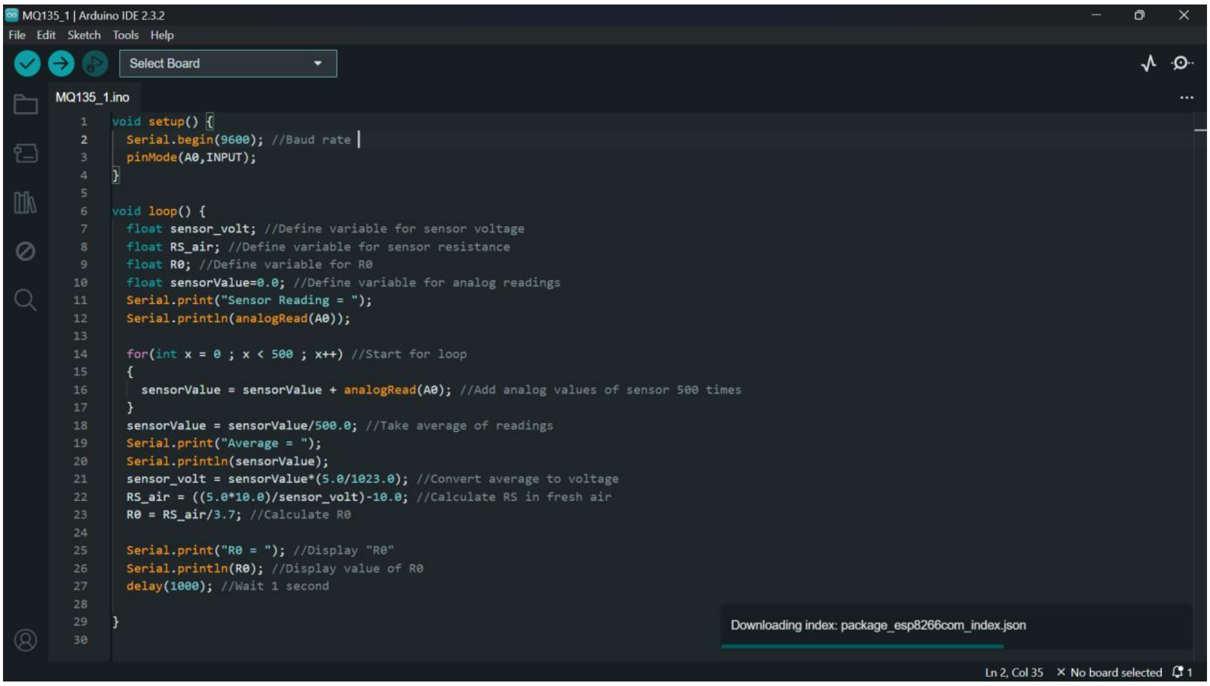
MQ-7:

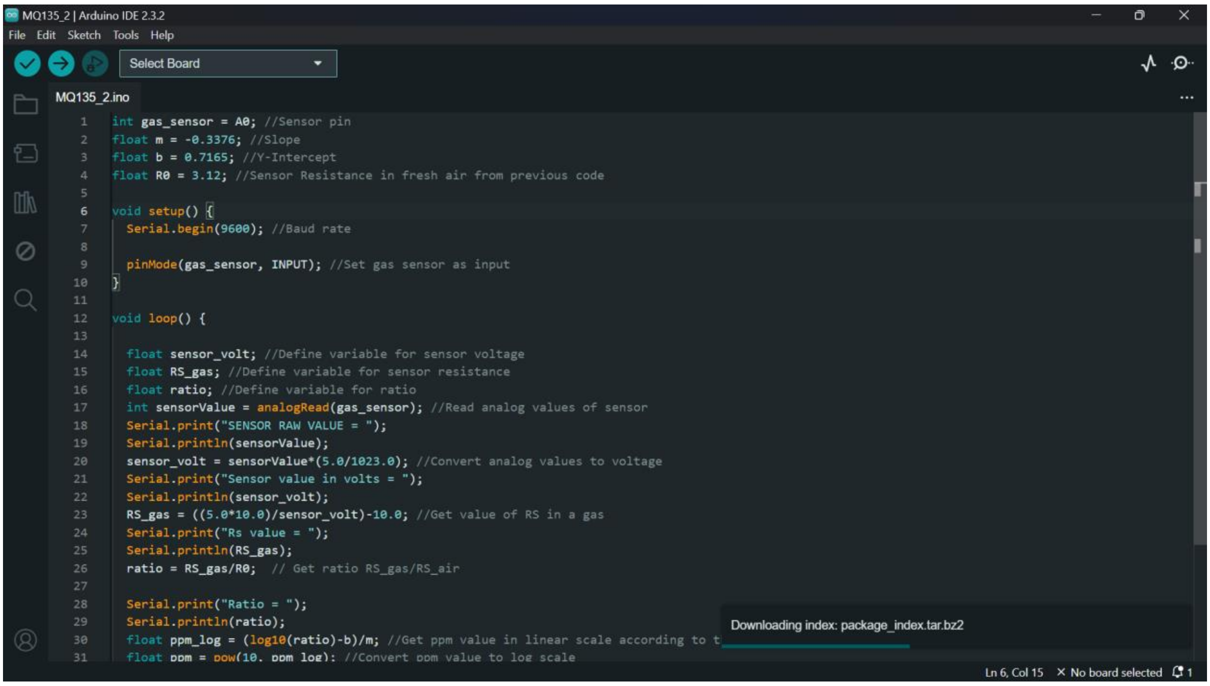


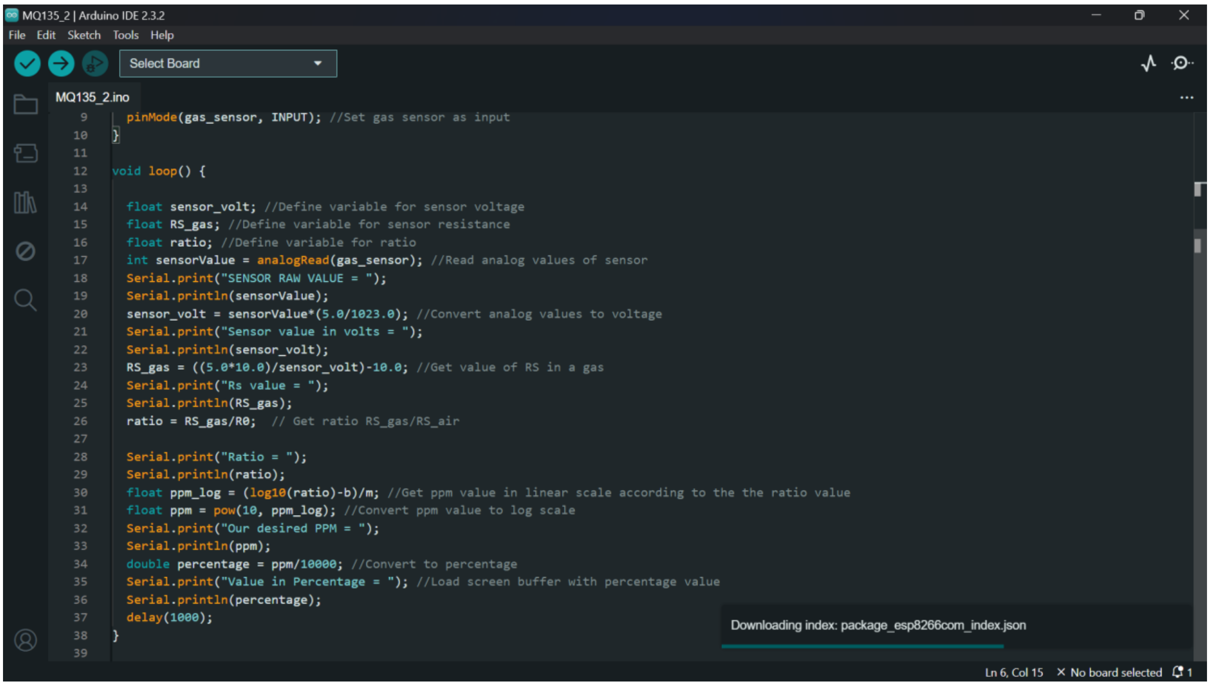

MQ7_2 | Arduino IDE 2.3.2
File Edit Sketch Tools Help
Select Board
MQ7_2.ino
int gas_sensor = A0; //Sensor pin
float m = -0.6527; //Slope
float b = 1.30; //Y-Intercept
float R0 = 21.91; //Sensor Resistance in fresh air from previous code
void setup() {
Serial.begin(9600); //Baud rate
pinMode(gas_sensor, INPUT); //Set gas sensor as input
}
void loop() {
float sensor_volt; //Define variable for sensor voltage
float RS_gas; //Define variable for sensor resistance
float ratio; //Define variable for ratio
int sensorValue = analogRead(gas_sensor); //Read analog values of sensor
Serial.print("GAS SENSOR RAW VALUE = ");
Serial.println(sensorValue);
sensor_volt = sensorValue*(5.0/1023.0); //Convert analog values to voltage
Serial.print("Sensor value in volts = ");
Serial.println(sensor_volt);
RS_gas = ((5.0*10.0)/sensor_volt)-10.0; //Get value of RS in a gas
Serial.print("Rs value = ");
Serial.println(RS_gas);
ratio = RS_gas/R0; // Get ratio RS_gas/RS_air
Output
Downloading index: library_index.tar.bz2
Ln 10, Col 2 No board selected 1


MQ7_2 | Arduino IDE 2.3.2
File Edit Sketch Tools Help
Select Board
MQ7_2.ino
float sensor_volt; //Define variable for sensor voltage
float RS_gas; //Define variable for sensor resistance
float ratio; //Define variable for ratio
int sensorValue = analogRead(gas_sensor); //Read analog values of sensor
Serial.print("GAS SENSOR RAW VALUE = ");
Serial.println(sensorValue);
sensor_volt = sensorValue*(5.0/1023.0); //Convert analog values to voltage
Serial.print("Sensor value in volts = ");
Serial.println(sensor_volt);
RS_gas = ((5.0*10.0)/sensor_volt)-10.0; //Get value of RS in a gas
Serial.print("Rs value = ");
Serial.println(RS_gas);
ratio = RS_gas/R0; // Get ratio RS_gas/RS_air
Serial.print("Ratio = ");
Serial.println(ratio);
double ppm_log = (log10(ratio)-b)/m; //Get ppm value in linear scale according to the the ratio value
double ppm = pow(10, ppm_log); //Convert ppm value to log scale
Serial.print("Our desired PPM = ");
Serial.println(ppm);
double percentage = ppm/10000; //Convert to percentage
Serial.print("Value in Percentage = "); //Load screen buffer with percentage value
Serial.println(percentage);
delay(2000);
}
Output
Downloading index: package_esp8266com_index.json
Ln 10, Col 2 No board selected 1

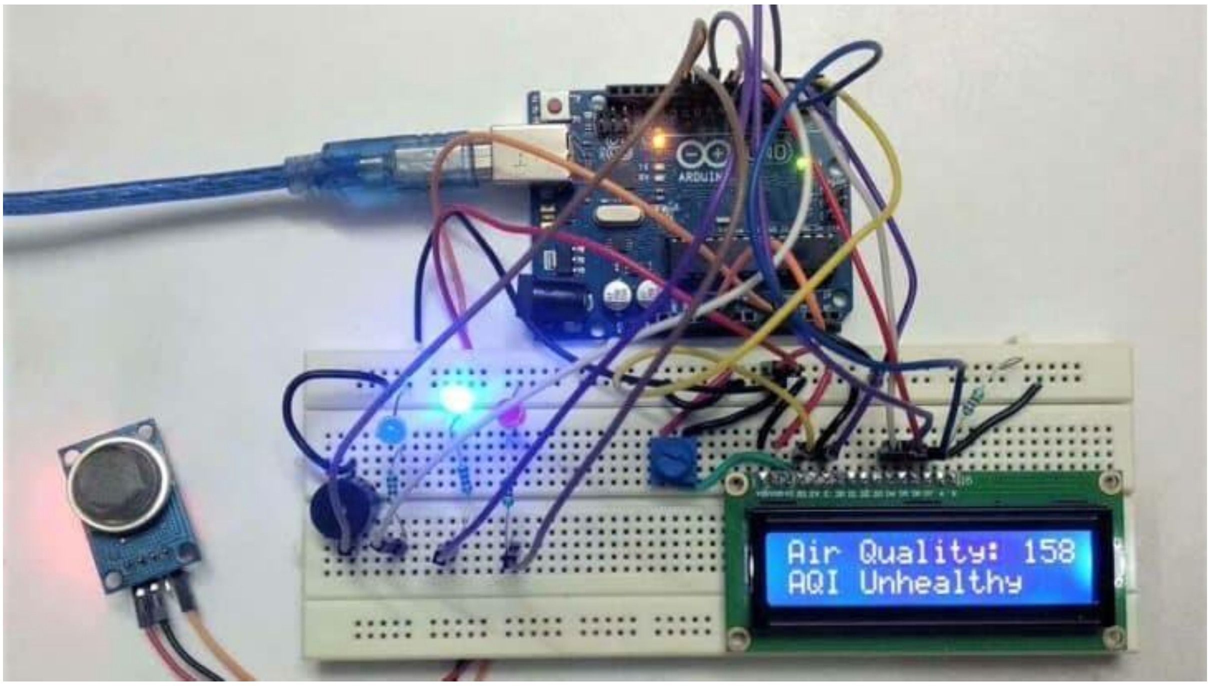
MQ-135:


MQ135_1 | Arduino IDE 2.3.2
File Edit Sketch Tools Help
Select Board
MQ135_1.ino
void setup() {
Serial.begin(9600); //Baud rate
pinMode(A0,INPUT);
}
void loop() {
float sensor_volt; //Define variable for sensor voltage
float RS_air; //Define variable for sensor resistance
float R0; //Define variable for R0
float sensorValue=0.0; //Define variable for analog readings
Serial.print("Sensor Reading = ");
Serial.println(analogRead(A0));
for(int x = 0 ; x < 500 ; x++) //Start for loop
{
sensorValue = sensorValue + analogRead(A0); //Add analog values of sensor 500 times
}
sensorValue = sensorValue/500.0; //Take average of readings
Serial.print("Average = ");
Serial.println(sensorValue);
sensor_volt = sensorValue*(5.0/1023.0); //Convert average to voltage
RS_air = ((5.0*10.0)/sensor_volt)-10.0; //Calculate RS in fresh air
R0 = RS_air/3.7; //Calculate R0
Serial.print("R0 = "); //Display "R0"
Serial.println(R0); //Display value of R0
delay(1000); //Wait 1 second
}
Downloading index: package_esp8266com_index.json
Ln 2, Col 35
No board selected
1


MQ135_2 | Arduino IDE 2.3.2
File Edit Sketch Tools Help
Select Board
MQ135_2.ino
int gas_sensor = A0; //Sensor pin
float m = -0.3376; //Slope
float b = 0.7165; //Y-Intercept
float R0 = 3.12; //Sensor Resistance in fresh air from previous code
void setup() {
Serial.begin(9600); //Baud rate
pinMode(gas_sensor, INPUT); //Set gas sensor as input
}
void loop() {
float sensor_volt; //Define variable for sensor voltage
float RS_gas; //Define variable for sensor resistance
float ratio; //Define variable for ratio
int sensorValue = analogRead(gas_sensor); //Read analog values of sensor
Serial.print("SENSOR RAW VALUE = ");
Serial.println(sensorValue);
sensor_volt = sensorValue*(5.0/1023.0); //Convert analog values to voltage
Serial.print("Sensor value in volts = ");
Serial.println(sensor_volt);
RS_gas = ((5.0*10.0)/sensor_volt)-10.0; //Get value of RS in a gas
Serial.print("Rs value = ");
Serial.println(RS_gas);
ratio = RS_gas/R0; // Get ratio RS_gas/RS_air
Serial.print("Ratio = ");
Serial.println(ratio);
float ppm_log = (log10(ratio)-b)/m; //Get ppm value in linear scale according to t
float ppm = pow(10, ppm_log); //Convert ppm value to log scale
Downloading index: package_index.tar.bz2
Ln 6, Col 15
No board selected
1



6. RESULTS AND OUTCOME



7. REFERENCE

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