**PROJECT SUBMISSION**

**AIR QUALITY MONITORING BASED ON IoT**

**PHASE 5**

**SUBMITTED BY:**

**DHINESH M**

**LAL PRASATH L**

**BALA ARUN R**

**SABARESHWARAN G**

**OBJECTIVES**

When Setting Project Objectives For An Air Quality Monitoring System, It's Essential To Establish Clear And Measurable Goals That Align With The Project's Purpose And Desired Outcomes. Here Are Some Key Objectives For An Air Quality Monitoring Project:

1. Real-Time Monitoring: Develop A System That Provides Continuous, Real-Time Monitoring Of Air Quality In The Target Area.

2. Data Accuracy: Ensure That The Monitoring System Provides Accurate And Reliable Data On Various Air Pollutants, Including Pm2.5, Pm10, Co, Co2, No2, O3, And Others.

3. Data Transparency: Make Air Quality Data Accessible To The Public Through User-Friendly Interfaces Such As Mobile Apps, Websites, Or Public Displays.

4. Location-Based Monitoring: Implement The Capability To Monitor Air Quality At Specific Locations, Allowing Users To Check The Air Quality In Their Immediate Surroundings.

5. Historical Data: Store Historical Air Quality Data To Track Trends And Assess Long-Term Changes In Air Quality.

6. Alerting System: Develop An Alerting System That Notifies The Public And Relevant Authorities When Air Quality Reaches Unhealthy Or Hazardous Levels.

7. Educational Outreach: Collaborate With Educational Institutions And Environmental Organizations To Use The Data For Public Education And Awareness Campaigns About Air Quality And Health Impacts.

8. Community Engagement: Encourage Community Involvement In Monitoring Efforts, Such As Citizen Science Projects Or Crowd-Sourced Data Collection.

9. Compliance Monitoring: Ensure That The Project Helps Enforce Air Quality Regulations And Standards Set By Local Or National Environmental Agencies.

10. Data Integration: Explore The Integration Of Data From Various Sources, Such As Government Monitoring Stations And Satellite Data, To Enhance The Accuracy Of Air Quality Assessments.

11. Environmental Research: Facilitate Research On The Correlation Between Air Quality And Public Health, Climate Change, And Other Environmental Factors.

12. Cost-Effective Solutions: Develop An Efficient And Cost-Effective Monitoring System That Can Be Scaled Or Replicated In Different Regions.

13. Scalability: Plan For The System's Scalability To Accommodate Future Expansions Or Increased Monitoring Demands.

14. Energy Efficiency: Design The System To Be Energy-Efficient And Environmentally Friendly.

15. Data Security: Implement Robust Data Security Measures To Protect Sensitive Information And User Privacy.

16. Stakeholder Collaboration: Collaborate With Local Authorities, Environmental Agencies, And Other Stakeholders To Ensure The Success And Sustainability Of The Project.

17. Public Engagement Metrics: Define Metrics For Measuring The Level Of Public Engagement, Awareness, And Behavior Change Related To Air Quality Issues.

18. Feedback Mechanism: Establish A Mechanism For Users To Provide Feedback, Report Air Quality Anomalies, Or Suggest Improvements To The System.

19. Regulatory Impact: Assess The Project's Impact On Regulatory Decision-Making And Air Quality Policies In The Region.

20. Sustainability: Develop A Plan To Ensure The Project's Sustainability In The Long Term, Including Funding And Maintenance Strategies.

These Objectives Will Help Guide The Planning, Implementation, And Evaluation Of The Air Quality Monitoring Project And Ensure It Aligns With The Project's Overarching Goals And Desired Outcomes.

**IOT SETUP**

Setting Up An Iot Device For Air Quality Monitoring Involves Several Key Components And Steps. Here's A General Guide On How To Set Up Such A System:

Components Needed:

1. Air Quality Sensors: Select Appropriate Air Quality Sensors Based On The Pollutants You Want To Monitor (E.G., Pm2.5, Pm10, Co, Co2, No2, O3). Common Sensors Include The Sds011 For Particulate Matter And Mq Series Sensors For Gas Detection.

2. Microcontroller (E.G., Arduino): Choose A Microcontroller To Interface With The Sensors, Process Data, And Transmit It To A Central Server Or Cloud Platform.

3. Connectivity Module: You'll Need Wi-Fi, Gsm, Lora, Or Other Modules To Enable Data Transmission. The Choice Depends On Your Application And Location.

4. Power Supply: Ensure A Reliable Power Source, Such As A Battery, Solar Panel, Or Mains Power, Depending On The Device's Location And Power Requirements.

5. Enclosure: Protect The Electronics From Environmental Factors Using A Weatherproof Enclosure If The Device Will Be Placed Outdoors.

6. Data-Logging And Processing Software: Develop Or Use Software To Collect, Process, And Transmit Data From The Microcontroller To The Cloud Or A Central Server.

7. Data-Sharing Platform: Set Up A Cloud-Based Platform (E.G., Aws Iot, Azure Iot, Or Custom Server) To Receive, Store, And Process Data.

Setup Steps:

1. Sensor Configuration:

- Connect The Air Quality Sensors To The Microcontroller Following The Sensor's Datasheet.

- Calibrate The Sensors If Necessary.

2.Microcontroller Programming:

- Write Code For The Microcontroller (E.G., Arduino) To Read Data From The Sensors.

- Process And Format The Data As Required For Transmission.

- Implement A Data Transmission Protocol (E.G., Mqtt Or Http) For Sending Data To The Cloud.

3. Connectivity Setup:

- Connect The Microcontroller To The Chosen Connectivity Module (Wi-Fi, Gsm, Lora).

- Configure The Module To Connect To The Internet And Transmit Data Securely.

4. Data Transmission:

- Test The System To Ensure That It Can Reliably Transmit Data To The Cloud Or Central Server.

5. Cloud Platform Setup:

- Create An Account On The Chosen Iot Platform (E.G., Aws Iot, Azure Iot, Or A Custom Server).

- Set Up Devices And Topics For Data Ingestion.

6. Data Storage And Processing:

- Define The Data Structure For Incoming Air Quality Data.

- Implement Data Storage In A Database And Processing Logic For Real-Time Analysis, Alerts, And Visualization.

7. Alerting System (Optional):

- Develop An Alerting System That Can Notify Users Or Authorities When Air Quality Reaches Unsafe Levels.

8. Data Visualization And User Interface:

- Create A User-Friendly Interface (E.G., A Website Or Mobile App) To Display Air Quality Data In A Comprehensible Way.

9. Location Placement:

- Install The Iot Device At The Desired Location, Ensuring It's Properly Secured And Powered.

10.Testing And Calibration:

- Regularly Test And Calibrate The Sensors To Ensure Data Accuracy.

11. Data Sharing And Public Access:

- Share Air Quality Data With The Public Through The Chosen User Interface And Provide Access To Historical And Real-Time Data.

12. Maintenance Plan:

- Develop A Maintenance Plan To Ensure The Long-Term Functionality Of The Monitoring Device.

Remember To Document Each Step Of The Setup Process And Regularly Maintain And Update The System To Ensure The Reliability And Accuracy Of The Air Quality Monitoring Data.

**PLATFORM DEVELOPMENT**

Developing A Data-Sharing Platform For Air Quality Monitoring Involves Creating A Robust And User-Friendly System To Collect, Store, Process, And Present Air Quality Data To Users. Here Are The Key Steps To Develop Such A Platform:

1. Define The Platform's Objectives:

- Clearly Define The Goals And Objectives Of The Platform, Including Who The Target Users Are And What Features It Should Provide.

2. Choose A Technology Stack:

- Select The Appropriate Technologies And Tools For Backend Development, Frontend Development, And Database Management. Common Choices Include Python, Node.Js, React, Sql Or Nosql Databases, And Cloud Services Like Aws Or Azure.

3. Data Ingestion:

- Set Up Mechanisms To Ingest Data From Iot Devices. This May Involve Creating Apis Or Mqtt Brokers For Devices To Send Data To.

4. Data Storage:

- Design A Database Structure To Store Historical And Real-Time Air Quality Data. Choose A Database Technology That Can Efficiently Handle Time-Series Data.

5. Data Processing:

- Implement Data Processing Logic To Analyze And Aggregate Incoming Data. You May Want To Calculate Air Quality Indices (Aqi) And Other Relevant Metrics.

6. User Authentication And Authorization:

- Develop A User Management System, Allowing Users To Register, Log In, And Manage Their Profiles. Implement Appropriate Authorization Controls For Data Access.

7. User Interface Design

- Design A User-Friendly Web Or Mobile Interface For Users To Interact With The Platform. Provide Features Like Data Visualization, Maps, And Historical Data Retrieval.

8. Real-Time Data Updates:

- Implement Mechanisms To Provide Real-Time Updates To Users As New Air Quality Data Is Collected. Use Technologies Like Websockets To Enable Real-Time Data Streaming.

9. Data Visualization:

- Create Visually Appealing And Informative Charts, Graphs, And Maps To Display Air Quality Data. Use Libraries Like D3.Js Or Chart.Js For This Purpose.

10. Alerting System:

- Implement An Alerting System That Can Notify Users And Relevant Authorities When Air Quality Reaches Unhealthy Or Hazardous Levels. This Could Be Through Push Notifications Or Email Alerts.

11. Geographic Data Integration:

- Incorporate Geographic Data To Display Air Quality Information On Maps, Allowing Users To View Data By Location.

12. Mobile Accessibility:

- Develop A Mobile App Or Ensure That The Platform Is Responsive And Accessible From Mobile Devices For On-The-Go Access.

13. Data Export And Sharing:

- Provide Options For Users To Download Data And Share It With Others. Enable Data Export In Common Formats Like Csv Or Json.

14. Public Access And Data Api:

- Make A Portion Of The Data Accessible To The Public Through An Open Api. This Can Encourage Third-Party Developers To Create Applications Using Your Data.

15. Security Measures:

- Implement Security Measures To Protect User Data And Ensure The Platform Is Resistant To Common Security Threats.

16. Data Privacy Compliance:

- Comply With Data Privacy Regulations And Standards, Especially If You Are Handling Personal Or Sensitive Data.

17. Scalability And Performance:

- Ensure The Platform Is Scalable To Handle Increased Data Loads As The Number Of Monitoring Devices Or Users Grows.

18. Documentation:

- Provide Comprehensive Documentation For Users, Developers, And Administrators. This Should Include Api Documentation, User Guides, And Troubleshooting Information.

19. Testing And Quality Assurance:

- Thoroughly Test The Platform For Functionality, Security, And Performance. Use Testing Frameworks And Procedures To Catch And Address Bugs And Issues.

20. Continuous Improvement:

- Regularly Update And Improve The Platform Based On User Feedback And Emerging Technologies.

21. Public Engagement And Outreach:

- Promote The Platform To The Target Audience And Actively Engage With The Community To Gather Feedback And Encourage Usage.

Developing An Air Quality Monitoring Platform Is A Complex Endeavor, And It's Important To Ensure The Platform Is Reliable, User-Friendly, And Aligned With The Needs Of The Users And The Goals Of The Project.

**CODE IMPLEMENTATION**

Required Library

We Need To Add 3 Libraries In Arduino Ide Software. These Are:

Download The Mq135.H Library Here: [Click](https://github.com/GeorgK/MQ135)

Download The Adafruit\_Gfx.H Library Here: [Click](https://github.com/adafruit/Adafruit-GFX-Library)

Download The Adafruit\_Ssd1306.H Library Here: [Click](https://github.com/adafruit/Adafruit_SSD1306)

#include MQ135.h

OLED Display libraries

#include SPI.h

#include Wire.h

#include Adafruit\_GFX.h

#include Adafruit\_SSD1306.h

#define SCREEN\_WIDTH 128 OLED display width, in pixels

#define SCREEN\_HEIGHT 64 OLED display height, in pixels

#define OLED\_RESET 4

Adafruit\_SSD1306 display(SCREEN\_WIDTH, SCREEN\_HEIGHT, &Wire, OLED\_RESET);

In and Out

int RedLed = 9;

int GreenLed = 8;

int Buzzer = 7;

void setup()

{

pinMode(RedLed, OUTPUT); initialize digital pin RedLed as an output.

pinMode(GreenLed, OUTPUT); initialize digital pin GreenLed as an output.

pinMode(Buzzer, OUTPUT); initialize digital pin Buzzer as an output.

Start serial communication between arduino and your computer

Serial.begin(9600);

initialize with the I2C addr 0x3C (128x64)

display.begin(SSD1306\_SWITCHCAPVCC, 0x3C);

display.clearDisplay();

delay(10);

Print text on display

display.clearDisplay();

display.setTextSize(1);

display.setTextColor(WHITE);

display.setCursor(0,0);

display.println(ELECTRODUIN0); Print text

display.display();

display.setTextSize(1);

display.setTextColor(WHITE);

display.setCursor(0,20);

display.println(Air Pollution);

display.display();

display.setTextSize(1);

display.setTextColor(WHITE);

display.setCursor(0,35);

display.println( Monitoring);

display.display();

delay(2000);

}

void loop()

{

Read Senso value

MQ135 gasSensor = MQ135(A0);

float air\_quality = gasSensor.getPPM();

Print Senso value on Serial Monitor Window

Serial.print(Air Quality );

Serial.print(air\_quality);

Serial.println( PPM);

Serial.println();

Print Senso value or Air Quality Index on OLED Display

display.clearDisplay();

display.setCursor(0,0); oled display position

display.setTextSize(1);

display.setTextColor(WHITE);

display.println(Air Quality Index);

display.setCursor(0,20); oled display position

display.setTextSize(2);

display.setTextColor(WHITE);

display.print(air\_quality);

display.setTextSize(1);

display.setTextColor(WHITE);

display.println( PPM);

display.display();

when air quality value less than 1000PPM

if (air\_quality=1000)

{

digitalWrite(GreenLed, HIGH); turn the Green LED on

digitalWrite(RedLed,LOW); turn the Red LED off

noTone(Buzzer); turn the Buzzer off

Print text on OLED Display

display.setTextSize(2);

display.setTextColor(WHITE);

display.setCursor(0,45);

display.println(Fresh Air); Message

display.display();

delay(2000);

}

when air quality value greater than 1000PPM & less than 2000PPM

else if( air\_quality=1000 && air\_quality=2000 )

{

digitalWrite(GreenLed,LOW); turn the Green LED off

digitalWrite(RedLed, HIGH ); turn the Red LED on

noTone(Buzzer); turn the Buzzer off

Print text on OLED Display

display.setTextSize(2);

display.setTextColor(WHITE);

display.setCursor(0,45);

display.println( Poor Air); Message

display.display();

delay(2000);

}

when air quality value greater than 2000PPM

else if (air\_quality=2000 )

{

digitalWrite(GreenLed,LOW); turn the Green LED off

digitalWrite(RedLed,HIGH); turn the Red LED on

tone(Buzzer, 1000, 200); turn the Buzzer on

Print text on OLED Display

display.setTextSize(2);

display.setTextColor(WHITE);

display.setCursor(0,45);

display.println(Danger!!); Message

display.display();

delay(2000);

}

}

**SAMPLE OUTPUT**

Air Quality: 750 PPM

Fresh Air

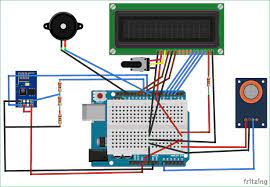
Air Quality: 1200 PPM

Poor Air

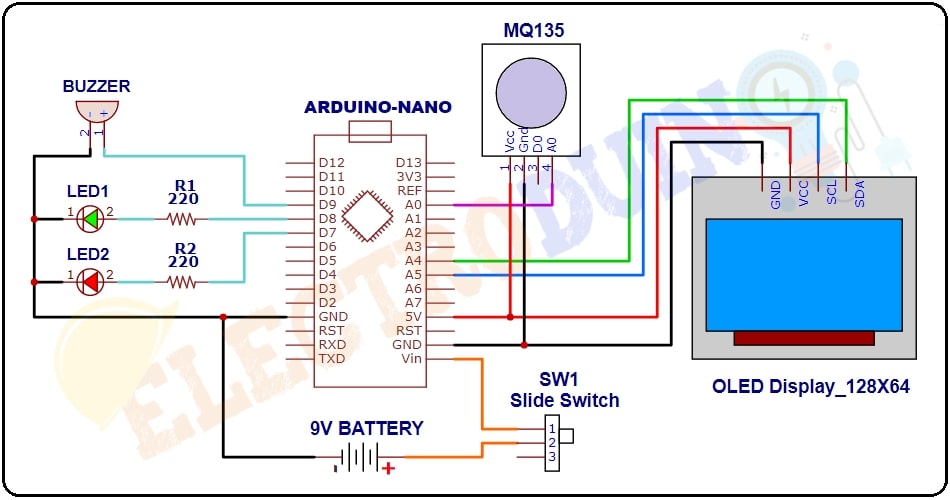
Air Quality: 2100 PPM

Danger!!

**DIAGRAM**



**SCHEMATICS**



**PUBLIC AWARENESS**

A real-time air quality monitoring system can play a significant role in raising public awareness about air quality and its associated health impacts. Here's how:

1. Immediate Data Accessibility: Real-time monitoring provides up-to-the-minute data on air quality. The public can easily access this information through websites, mobile apps, or public displays, giving them immediate insights into current air quality conditions in their area.

2. Visual Representation: Visual representations of air quality data, such as color-coded maps or simple index values, make it easy for the public to understand air quality conditions at a glance. A green "good" reading, for example, provides reassurance, while a red "hazardous" reading indicates the need for caution.

3. Alerts and Notifications: Monitoring systems can send alerts or notifications to the public when air quality deteriorates to unhealthy or hazardous levels. This immediate feedback encourages individuals to take precautionary measures to protect their health.

4. Location-Based Information: Users can access location-specific air quality data, which allows them to make informed decisions based on conditions in their immediate surroundings. For example, individuals can decide whether to go for a run in a park, plan outdoor activities, or adjust their commute based on air quality data from their specific area.

5. Historical Data Analysis: Access to historical air quality data allows the public to understand seasonal variations and long-term trends. This can highlight patterns of air pollution and their impact on health over time, prompting more informed and sustainable behaviors.

6. Public Engagement: Air quality monitoring systems often involve the public in data collection and awareness efforts, fostering community involvement and ownership. Citizen science projects and community monitoring can empower individuals to contribute to and understand the data better.

7. Health Campaigns: Environmental organizations, health agencies, and local governments can use the data to run educational campaigns on air quality and health impacts. These campaigns can inform the public about the risks associated with poor air quality and promote healthier living.

8. Environmental Advocacy: Access to real-time air quality data can encourage individuals and organizations to advocate for cleaner air and stronger environmental regulations. People are more likely to take action when they have firsthand knowledge of air quality issues.

9. Policy Impact: High-quality, real-time data can influence policymakers and encourage them to make decisions aimed at improving air quality and public health. Data-backed policies can lead to the reduction of pollution sources and enhanced regulations.

10. Improved Health Awareness: Public access to air quality data can help individuals with pre-existing health conditions, such as asthma or respiratory problems, take necessary precautions on days when air quality is poor. It can also prompt more people to consult healthcare professionals for advice on managing their health during poor air quality events.

In summary, a real-time air quality monitoring system empowers the public with immediate, accessible, and actionable data on air quality, raising awareness of the associated health impacts. This increased awareness can lead to informed decision-making, lifestyle changes, and advocacy for cleaner air, ultimately improving public health and the environment.