AIR QUALITY MONITORING-PHASE 5

INTRODUCTION

As we progress into Phase 5 of our comprehensive air quality monitoring project, we find ourselves at a pivotal juncture in our efforts to better understand, assess, and address air quality in our region. This phase represents the culmination of significant research, data collection, and action taken to enhance the quality of the air we breathe.

Throughout the preceding phases, our primary objectives have been to assess the current state of air quality, identify pollution sources, evaluate public health risks, and propose strategies for improving air quality. We have strived to adhere to stringent regulatory standards, engage with the local community, and promote transparency in our findings.

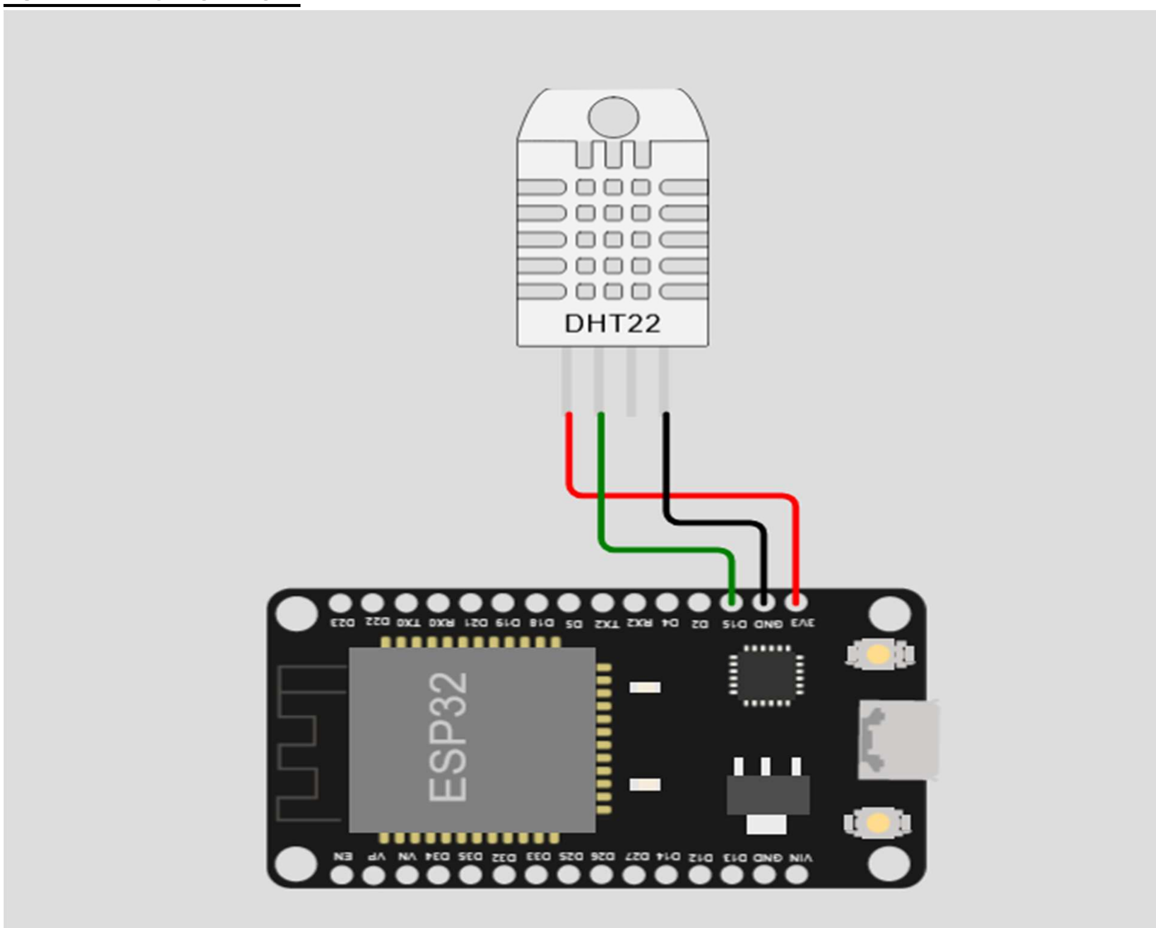
PROJECT OBJECTIVES

1. **Assessment of Air Quality:** The primary objective of an air quality monitoring project is to assess the current state of air quality in a specific region. This includes measuring the concentration of various air pollutants, such as particulate matter (PM), nitrogen dioxide (NO2), sulfur dioxide (SO2), carbon monoxide (CO), ozone (O3), volatile organic compounds (VOCs), and others.
2. **Identify Pollution Sources:** Determine the sources of air pollution in the area, such as industrial emissions, vehicular traffic, construction activities, and natural sources like wildfires. Understanding the sources is crucial for developing effective pollution control measures.
3. **Public Health Assessment:** Assess the potential health risks associated with poor air quality, such as respiratory illnesses, cardiovascular diseases, and other health issues. This helps in raising awareness among the public and policymakers.

4. **Compliance with Regulations:** Ensure that air quality complies with local, national, or international air quality standards and regulations. Non-compliance may necessitate regulatory or policy actions to address pollution.
5. **Trend Analysis:** Monitor air quality over time to identify trends and changes. This can help in understanding the effectiveness of pollution control measures and predicting future air quality scenarios.
6. **Early Warning Systems:** Develop systems to provide early warnings to the public and authorities when air quality reaches dangerous levels. This is crucial during events like wildfires, smog episodes, or industrial accidents.
7. **Emission Reduction Strategies:** Identify and recommend strategies to reduce pollution, such as promoting cleaner transportation, improving industrial processes, and enforcing emissions standards.
8. **Data Sharing and Transparency:** Make air quality data accessible to the public, researchers, and policymakers to promote transparency and informed decision-making.
9. **Environmental Education:** Raise awareness and educate the public about the importance of clean air, the health risks associated with pollution, and how individuals can contribute to air quality improvement.
10. **Research and Innovation:** Support research initiatives aimed at understanding the specific challenges and sources of air pollution in the area. Encourage innovation in air quality monitoring technologies and pollution control methods.
11. **Community Engagement:** Engage with local communities and stakeholders to gather their input, concerns, and suggestions for improving air quality. Community involvement can be crucial in developing effective solutions.
12. **Data Collection and Analysis:** Establish a robust system for continuous data collection, analysis, and reporting. This includes setting up monitoring stations, ensuring data quality, and using analytical tools to process the information.

13. **Policy Recommendations:** Provide recommendations to local and national governments for policy changes and regulations to improve air quality.
14. **Mitigation and Adaptation Strategies:** Develop strategies to mitigate the impacts of air pollution and adapt to changing conditions, especially in the face of climate change.

IOT DEVICE SETUP



PLATFORM DEVELOPMENT

1. *Define Your Project Goals:*

   - Begin by clearly defining the objectives of your air quality monitoring system. Determine the specific parameters you want to measure, such as PM2.5, PM10, CO, NO2, SO2, or other air pollutants.

2. *Select Sensors and Components:*

- Choose the appropriate sensors and components for your project. Depending on your chosen parameters, you may need sensors like PM sensors, gas sensors, and microcontrollers to interface with these sensors.

3. *Create a Wokwi Account:*

- If you haven't already, sign up for a Wokwi account. This will give you access to the platform and its simulation tools.

4. *Design Your Circuit:*

- Use Wokwi's virtual breadboard and components library to design the electronic circuit for your air quality monitoring system. Connect sensors to a microcontroller and any other components you need for data processing and visualization.

5. *Program the Microcontroller:*

- Write the code for the microcontroller (e.g., Arduino, ESP8266) to gather data from the sensors, process it, and potentially display or transmit the data. Use the Wokwi code editor to develop your firmware.

6. *Simulate Your Project:*

- Use Wokwi's simulation tools to test and simulate your air quality monitoring system. Observe how the sensors behave, how data is processed by the microcontroller, and how your code functions in a virtual environment.

7. *Analyze Results:*

- Review the simulation results to ensure that your system works as intended. Check for any anomalies, unexpected behavior, or errors in your code.

8. *Iterate and Optimize:*

- Make improvements and optimizations based on the simulation results. This may involve adjusting sensor placement, fine-tuning your code, or adding additional features to enhance your system.

9. *Data Visualization:*

- Implement data visualization tools within your code to display air quality data in a user-friendly way. This could include generating graphs, charts, or creating a graphical user interface (GUI) to present the data.

10. *Connect to the Real World:*

- Once you are satisfied with the simulation results, you can proceed to build the physical system using real hardware components and microcontrollers. Transfer your code and circuit design to actual hardware.

11. *Data Logging and Reporting:*

- Set up data logging and reporting mechanisms in your real-world deployment to collect and store air quality data over time. This data can be used for analysis and reporting.

12. *Remote Monitoring (Optional):*

- If needed, implement remote monitoring and control features in your system. This may involve connecting the system to the internet for real-time data access and remote management.

13. *Deployment and Maintenance:*

- Deploy your air quality monitoring system in the desired location, such as an urban area or industrial site. Ensure regular maintenance to guarantee data accuracy and the reliability of your system.

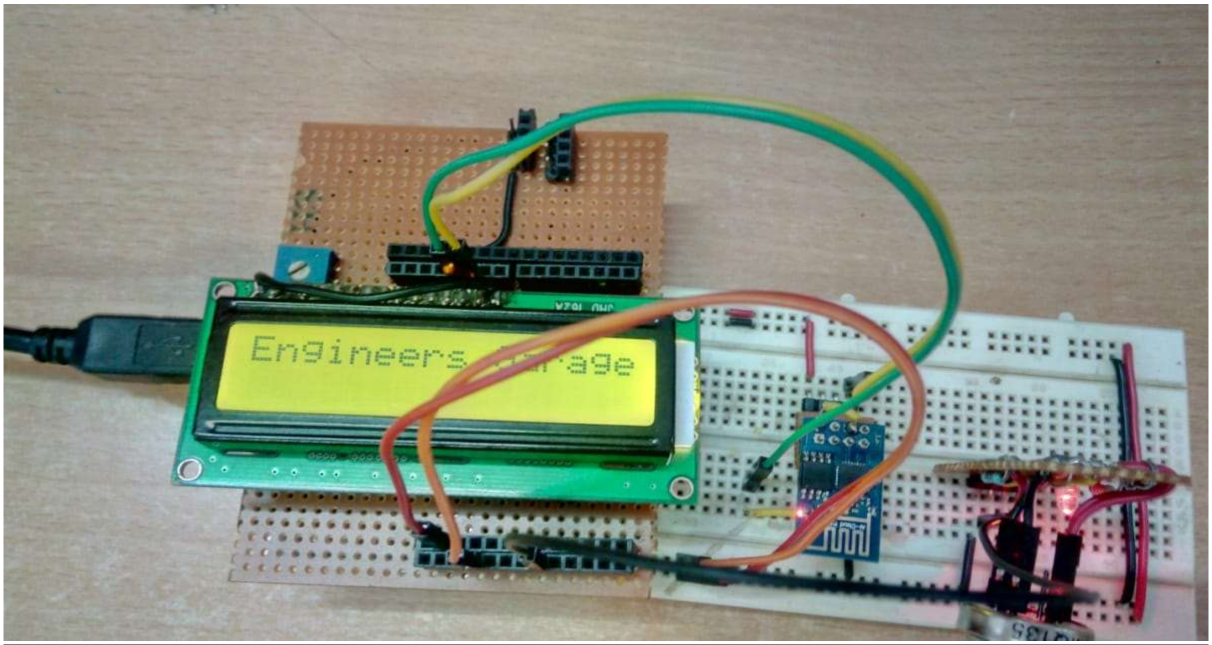
CODE IMPLEMENTATION:

```
from machine import Pin, ADC
from time import sleep
import dht
import network
import urequests
import random

# Initialize Wi-Fi
sta_if = network.WLAN(network.STA_IF)
if not sta_if.isconnected():
    print('connecting to network...')
    sta_if.active(True)
    sta_if.connect('Wokwi-GUEST', '')
    while not sta_if.isconnected():
        pass
    print('network config:', sta_if.ifconfig())

# Initialize DHT22 sensor
sensor = dht.DHT22(Pin(15))

# Initialize ADC pins for gas sensors
# Replace the pin numbers and attenuation settings as needed
# Replace these values with your specific pin and attenuation settings
YOUR_CO_PIN = 34  # Replace with the actual pin number
YOUR_CO_ATTENUATION = ADC.ATTN_11DB  # Replace with the actual attenuation
setting

YOUR_SO2_PIN = 35  # Replace with the actual pin number
YOUR_SO2_ATTENUATION = ADC.ATTN_11DB  # Replace with the actual attenuation
setting

YOUR_NO2_PIN = 36  # Replace with the actual pin number
YOUR_NO2_ATTENUATION = ADC.ATTN_11DB  # Replace with the actual attenuation
setting

firebase_url = 'https://air-quality-monitoring-b1ac7-default-
rtdb.firebaseio.com/'  # Replace with your Firebase URL
firebase_secret = '933awzAPGFzKWjkqSldUBhnFB6IK2zJW6SZZi3g4'

def send_data_to_firebase(CO_level,NO2_level_level,SO2_level):
    data = {
        "CO": CO_level,
        "NO2": NO2_level,
        "SO2":SO2_level
    }
    url = f'{firebase_url}/Air_data.json?auth={firebase_secret}'
```

```
    try:
        response = urequests.patch(url, json=data)  # Use 'patch' instead of
'put'
        if response.status_code == 200:
            print("Data sent to Firebase")
        else:
            print(f"Failed to send data to Firebase. Status code:
{response.status_code}")
    except Exception as e:
        print(f"Error sending data to Firebase: {str(e)}")


while True:
    try:
        sleep(2)
        sensor.measure()
        temp = sensor.temperature()
        hum = sensor.humidity()
        temp_f = temp * (9/5) + 32.0
        print('Temperature: %3.1f C' % temp)
        print('Temperature: %3.1f F' % temp_f)
        print('Humidity: %3.1f %%' % hum)

        # Read gas sensor values (simulated random values)
        CO_level = random.uniform(0, 50)  # Simulated CO level in ppm
        SO2_level = random.uniform(0, 10)  # Simulated SO2 level in ppm
        NO2_level = random.uniform(0, 20)  # Simulated NO2 level in ppm

        print('CO Level: %3.1f ppm' % CO_level)
        print('SO2 Level: %3.1f ppm' % SO2_level)
        print('NO2 Level: %3.1f ppm' % NO2_level)

        # Check if gas levels are in danger as per norms
        if CO_level > 50:
            print('Danger! High CO level detected.')
        if SO2_level > 50:
            print('Danger! High SO2 level detected.')
        if NO2_level > 50:
            print('Danger! High NO2 level detected.')
        else:
            print('you are in good environment')

       # Send data to Firebase
        send_data_to_firebase(CO_level,NO2_level,SO2_level)

       # time.sleep(1)  # Adjust the sleep duration as needed
```

```
    except OSError as e:
        print('Failed to read sensor.')
```

SCREENSHOT OF IOT DEVICE



SCHEMATICS

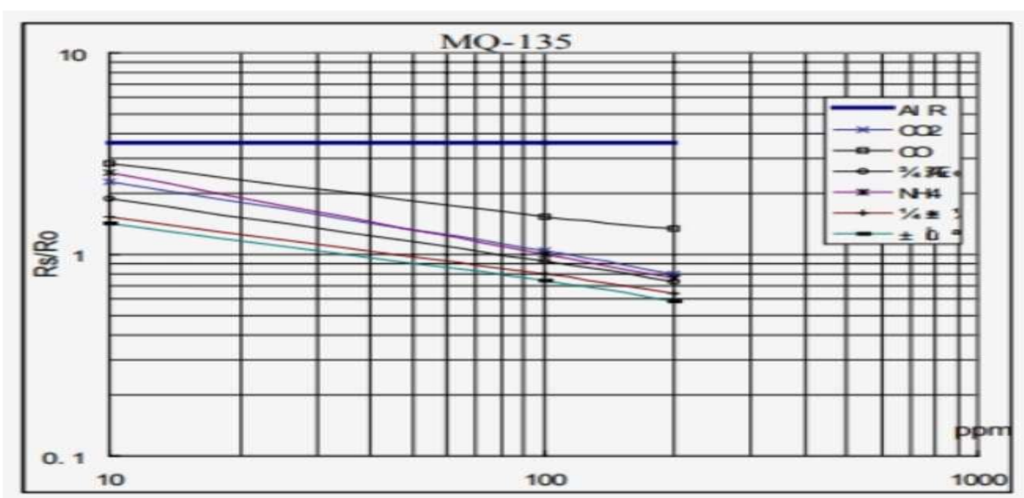
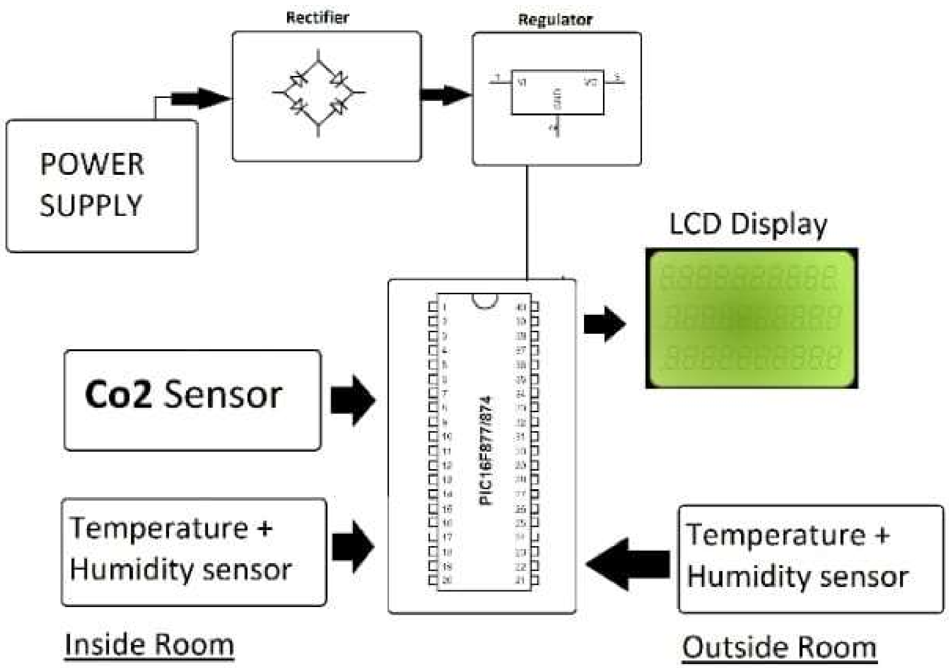
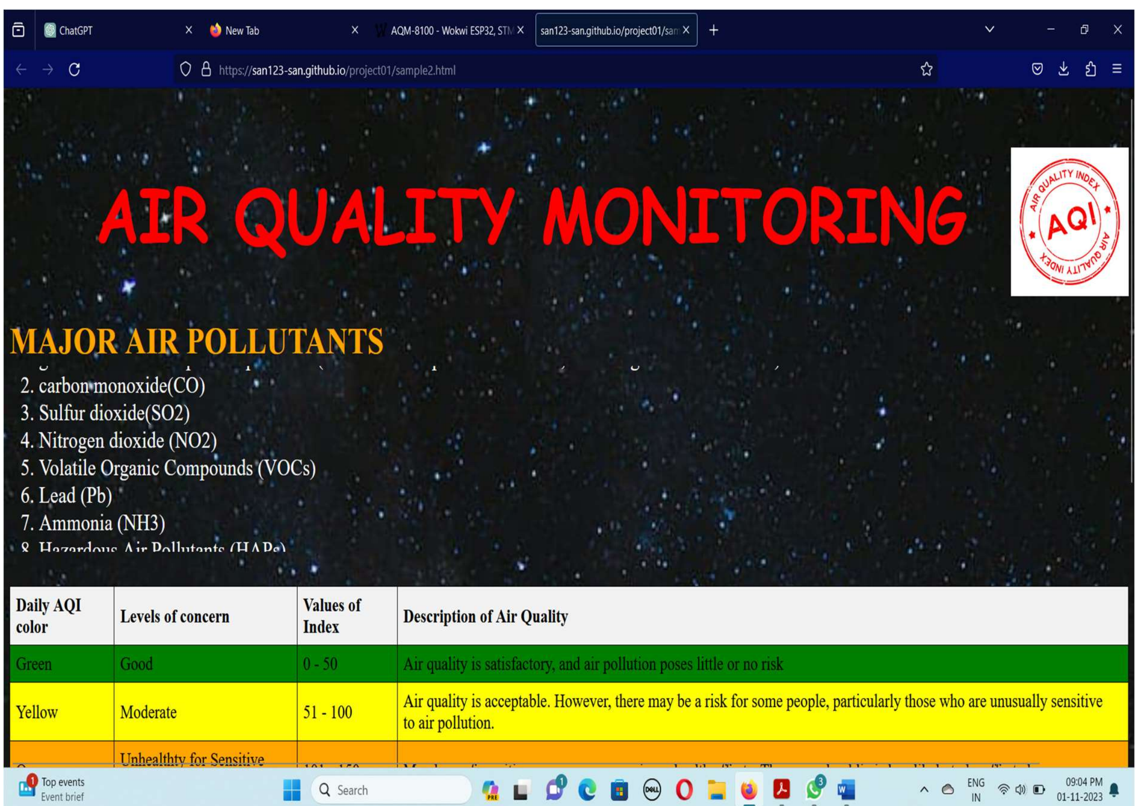


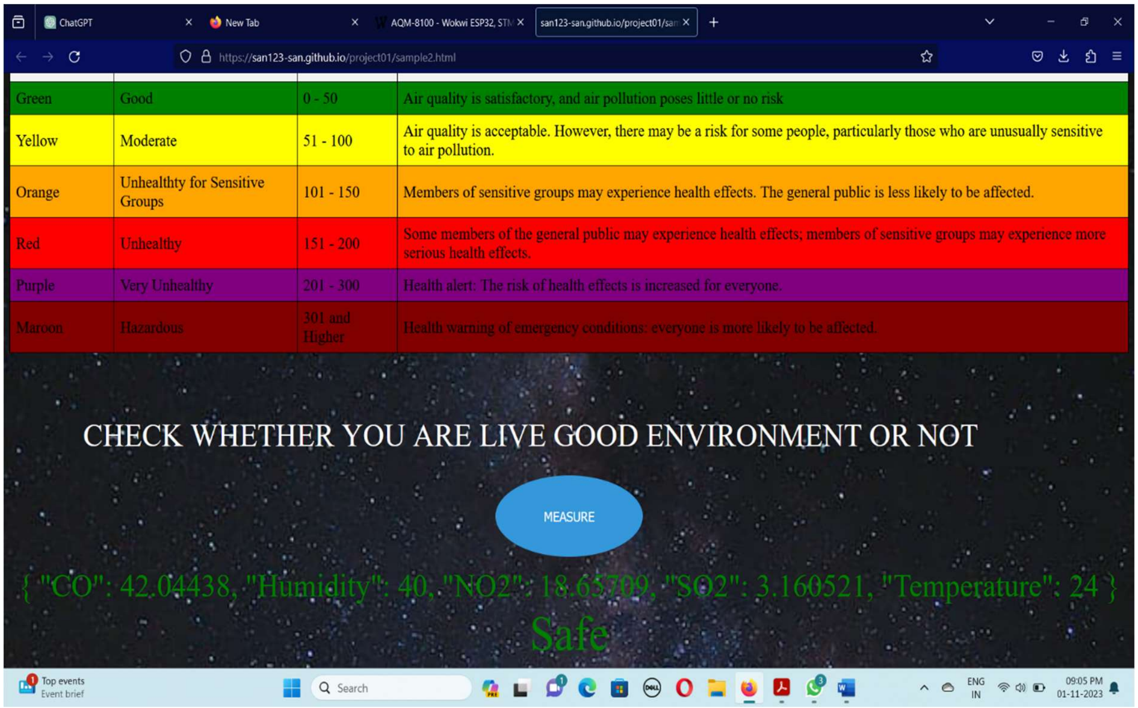
Fig. 7: Graph showing Sensitivity Curve of MQ-135 Sensor

DIAGRAM



DATA SHARING PLATFORM





Green	Good	0 - 50	Air quality is satisfactory, and air pollution poses little or no risk
Yellow	Moderate	51 - 100	Air quality is acceptable. However, there may be a risk for some people, particularly those who are unusually sensitive to air pollution.
Orange	Unhealthty for Sensitive Groups	101 - 150	Members of sensitive groups may experience health effects. The general public is less likely to be affected.
Red	Unhealthy	151 - 200	Some members of the general public may experience health effects; members of sensitive groups may experience more serious health effects.
Purple	Very Unhealthy	201 - 300	Health alert: The risk of health effects is increased for everyone.
Maroon	Hazardous	301 and Higher	Health warning of emergency conditions: everyone is more likely to be affected.

PUBLIC AWARENESS ABOUT AIR QUALITY

1. *Instant Data Access:*

   - Real-time monitoring provides the public with instant access to up-to-date air quality data.

   - People can check the current air quality index and pollutant levels at any time, fostering awareness.

2. *Visibility of Trends:*

   - Historical data is available for tracking air quality trends over time.

   - Users can see patterns and variations, helping them understand seasonal and daily fluctuations in air quality.

3. *Location-Specific Information:*

   - Users can access air quality data for their specific location, such as their city or neighborhood.

   - This personalized information makes the issue of air quality more relevant and relatable to individuals.

4. *Health Impact Information:*

- Real-time monitoring systems often provide health impact assessments along with air quality data.

- Users can learn about the potential health risks associated with the current air quality conditions.

5. *Alerts and Notifications:*

- Monitoring systems can send alerts and notifications to the public when air quality reaches unhealthy levels.

- This immediate feedback raises awareness of urgent air quality concerns.

6. *Educational Resources:*

- Real-time monitoring platforms can offer educational materials and resources about air quality and its effects on health.

- Users can access information about how to protect themselves during poor air quality periods.

7. *Community Engagement:*

- The availability of real-time data encourages community discussions and engagement.

- People can share information, experiences, and best practices for dealing with air quality issues.

8. *Policy Advocacy:*

- Public access to air quality data empowers individuals and organizations to advocate for air quality improvements.

- Informed citizens can pressure policymakers to implement more effective regulations.

9. *Behavioral Changes:*

- Real-time monitoring can lead to behavioral changes, such as using public transportation on poor air quality days or reducing outdoor activities during smoggy conditions.

10. *Environmental Awareness:*

- Monitoring systems may include data on the environmental impact of poor air quality.

- This information can foster environmental awareness and encourage efforts to reduce pollution.

11. *Research and Education:*

- Real-time air quality data can be valuable for research and educational institutions.

- It supports studies on the effects of air pollution and can be used as a teaching tool.

12. *Data for Vulnerable Groups:*

- Monitoring systems can provide data specifically relevant to vulnerable groups, such as children, the elderly, and individuals with respiratory conditions.

- This ensures that those most at risk have access to essential information.

SUBMISSION

INSTRUCTIONS TO REPLICATE THE PROJECT

- **Sign up for Wokwi and Create a New Project:**
    - Go to the Wokwi website (https://wokwi.com/) and sign up for an account.
    - Create a new project.
- **Select an IoT Device:**
    - In the Wokwi platform, select an IoT device that you want to simulate. Common options include ESP8266, ESP32, or NodeMCU.
- **Create the IoT Device Circuit:**
    - Use the Wokwi Circuit Editor to design your IoT device circuit. Add components like LEDs, sensors, and GPIO pins as needed.
- **Connect to Firebase:**
    - To send data to Firebase, you'll need to integrate Firebase into your IoT device code. You can use Firebase libraries for Arduino or the specific platform you're using.
- **Write the IoT Device Code:**
    - In the Wokwi platform, write the code for your IoT device. This code should collect data from sensors or other sources, format it, and send it to Firebase. Here's a simplified example using the Arduino IDE
- **Create a Firebase Project:**
    - If you haven't already, create a Firebase project on the Firebase Console (https://console.firebase.google.com/).
- **Get Firebase Credentials:**

- In your Firebase project settings, get your Firebase project URL and authentication token. Replace `"your-firebase-project.firebaseio.com"` and `"your-firebase-auth-token"` in the code above with your actual Firebase credentials.

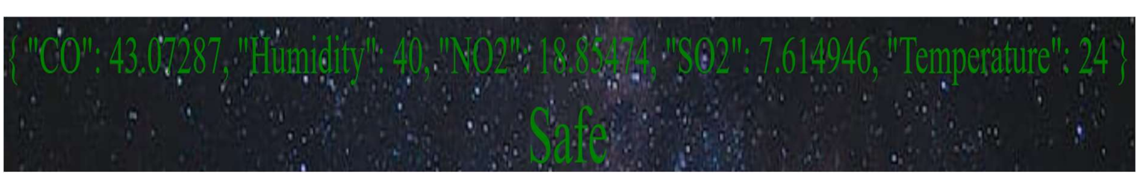
- **Simulate the IoT Device:**
  - In the Wokwi platform, simulate your IoT device. Ensure that the data is being sent to Firebase as expected.

- **Create a Webpage:**
  - Set up a simple webpage that will display the data retrieved from Firebase. You can use HTML, JavaScript, and the Firebase Web SDK for this. Host this webpage on a web server.

- **Fetch Data in the Webpage:**
  - In your webpage's JavaScript code, use the Firebase Web SDK to fetch data from Firebase and update the webpage with the predicted output.

- **Run the Webpage:**
  - Open your webpage in a web browser to view the real-time data from Firebase and any predictions or visualizations you've implemented.

EXAMPLE OUTPUT



CONCLUSION

In conclusion, air quality monitoring is an essential endeavor, pivotal in safeguarding public health, preserving the environment, and guiding policy decisions. By providing real-time data on pollutant levels, it empowers individuals to take protective measures during poor air quality episodes, aids in identifying pollution sources, and supports regulatory compliance. Accessible data fosters awareness and research, while long-term monitoring enables the understanding of air quality trends and the development of predictive models. Additionally, monitoring systems serve as early warning tools during air quality emergencies, prompting timely responses to protect public health. Continual improvements in monitoring methods and equipment are crucial for maintaining data accuracy and staying responsive to evolving air quality challenges.