Phase 3: Development part 1

Air Quality Monitoring

Components Required:

1.Microcontroller(Arduino or Raspberry pi)

2.particulate matter(PM)sensor(SDS011 OR PMS7003)

3. Power Supply(5v)

4. Display(OLED screen or LCD screen)

5. wires and breadboard

6. Data Storage

7. Gas sensors& Temperature and humidity sensors

How does microcontroller work:

Microcontrollers are commonly used in air quality monitoring systems to collect, process, and transmit data from various sensors. Here's how they work in such applications:

1. Sensor Interface: Microcontrollers connect to a range of air quality sensors, such as gas sensors, particulate matter sensors, and humidity sensors. These sensors measure parameters like carbon dioxide (CO2), carbon monoxide (CO), ozone (O3), particulate matter (PM2.5 and PM10), and more.

2. Data Acquisition: The microcontroller continuously reads data from these sensors. It converts analog sensor outputs to digital values for processing.

3. Data Processing: The microcontroller processes the sensor data, performing tasks like data averaging, calibration, and error correction. It can also calculate air quality indices based on sensor readings.

4. Data Storage: Some microcontrollers can store data in onboard memory or external storage devices, such as SD cards. This historical data can be useful for trend analysis and long-term monitoring.

5. Communication: Microcontrollers can transmit data to a central server or display it on local screens. They use various communication methods, including Wi-Fi, Bluetooth, LoRa, or cellular networks.

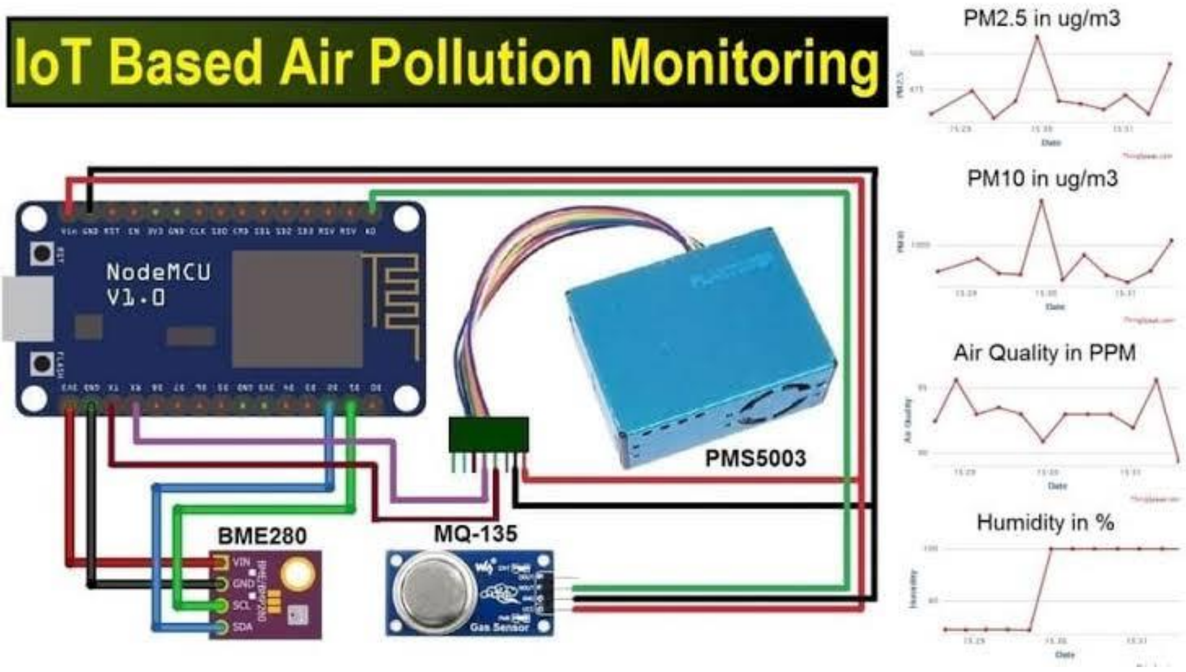
6. Display: In some applications, microcontrollers drive displays to show real-time air quality information. This can be in the form of LED displays, OLED screens, or web interfaces accessible through smartphones or computers.

7. Alerts and Alarms: Microcontrollers can be programmed to trigger alarms or notifications when air quality parameters exceed predefined thresholds. This is crucial for public safety and health monitoring.

8. Power Management: Many air quality monitoring systems operate continuously, so microcontrollers need efficient power management to conserve energy. They may use sleep modes or solar panels for extended battery life.

9. Remote Monitoring: Data collected by microcontrollers can be accessed remotely, making it possible to monitor air quality in real time and identify pollution

Circuit Diagram:



- Connect the PM sensor to the microcontroller via GPIO pins.

- Gas sensors may require an analog-to-digital converter (ADC) if they output analog signals.

- Temperature and humidity sensors usually connect digitally via I2C or similar protocols.

- Connect the power supply to the microcontroller and sensors.

- Connect any displays or user interface components.

- Ensure the microcontroller is properly grounded.

Working of the Air Quality Monitoring System:

1. Sensor Data Acquisition: The sensors continuously monitor the air quality parameters. Each sensor works based on its principles (e.g., light scattering for PM sensors, chemical reactions for gas sensors).

2. Microcontroller: The microcontroller collects data from the sensors. It may process and format the data, making it ready for display or transmission.

3. Display and User Interaction(optional): If included, the system displays air quality data on an LCD or LEDs and allows user interaction via buttons.

4. Data Storage: The microcontroller can store data locally on an SD card or send it to an online database for historical analysis.

5. Data Transmission: The system can transmit real-time data via Wi-Fi, Ethernet, or cellular to a server or the cloud.

6. Alert Mechanism (optional): An alert system can be set up to notify users when air quality reaches dangerous levels, for example, by activating LEDs or sounding alarms.

7. Data Analysis: In more advanced systems, data can be analyzed for trends, and notifications can be sent to users or authorities if pollution levels exceed predefined thresholds.

How Sensors Work:

***Particulate Matter (PM) Sensor:** These sensors typically use light scattering to measure the concentration of particles in the air. A laser or LED emits light into the air, and a photodetector measures the scattered light. The amount of scattered light is proportional to the number of particles, allowing the sensor to estimate PM concentration.

*** Gas Sensors:** Gas sensors work based on chemical reactions between the target gas and a sensing material. The reaction changes the electrical properties of the material, which can be measured. Different gases require specific sensing materials and mechanisms.

*** Temperature and Humidity Sensor:** These sensors usually employ temperature-dependent resistors (thermistors) and capacitive humidity sensors. Changes in resistance or capacitance are used to determine temperature and humidity, respectively.

Python code:

```
import time

import serial

# Define the serial port and baud rate for your sensor

SERIAL_PORT = '/dev/ttyS0'

BAUD_RATE = 9600

def read_sensor_data():

    ser = serial.Serial(SERIAL_PORT, BAUD_RATE)

    data = ser.read(10)  # Read 10 bytes of data from the sensor

    ser.close()

    return data
```

```
def parse_sensor_data(data):
    if data[0] == 66 and data[1] == 77:
        # Data format for PM2.5 sensor (might vary by sensor model)
        pm25 = int.from_bytes(data[2:4], byteorder='little') / 10.0
        pm10 = int.from_bytes(data[4:6], byteorder='little') / 10.0
        return pm25, pm10
    else:
        return None, None


def main():
    while True:
        try:
            sensor_data = read_sensor_data()
            pm25, pm10 = parse_sensor_data(sensor_data)
            if pm25 is not None and pm10 is not None:
                print(f'PM2.5: {pm25} µg/m³, PM10: {pm10} µg/m³')
            else:
                print('Invalid data received from sensor')
            time.sleep(60)  # Read data every minute
        except KeyboardInterrupt:
            print('Monitoring stopped.')
            break


if _name_ == '_main_':
    main()
```