**Installation Process**

**1. Set Up Raspberry Pi**

* Install the latest version of Raspberry Pi OS.
* Connect your Raspberry Pi to a monitor, keyboard, and mouse.
* Ensure the device has an active internet connection.

**2. Install Required Libraries and Tools**

Open the terminal and execute the following steps:

1. **Update System Packages**:

* sudo apt-get update && sudo apt-get upgrade -y

1. **Install Python and Pip**:

* sudo apt-get install python3 python3-pip -y

1. **Install Required Python Libraries**:

* pip3 install adafruit-mcp3008 adafruit-circuitpython-dht RPi.GPIO requests\_cache pandas retry-requests flask

1. **Install GPIO Permissions**:
   * sudo groupadd gpio
   * sudo usermod -a -G gpio $USER
   * sudo chown root.gpio /dev/gpiomem
   * sudo chmod g+rw /dev/gpiomem
2. **Enable SPI and GPIO on Raspberry Pi**:
   * Run sudo raspi-config.
   * Go to Interface Options → Enable SPI and GPIO.
   * Reboot the Pi: sudo reboot
3. **Install Flask if not installed**:
   * pip3 install flask

**3. Prepare Project Files**

* Place the provided Python backend script (app.py) and HTML file (index.html) in the project folder.
* Add the image airpollution.jpg to the same directory to use as the background.

**4. Connect Sensors and Buzzer**

* **DHT11**:
  + Connect the **VCC** pin to a 3.3V or 5V power source.
  + Connect the **GND** pin to the ground.
  + Connect the **DATA** pin to GPIO Pin 4 (BCM mode).
* **Gas Sensor**:
  + Connect it via the MCP3008 ADC to the SPI interface (SPI0).
* **Buzzer**:
  + Connect the buzzer’s positive terminal to GPIO Pin 38 (BCM mode) and the negative to GND.

### ****Execution Process****

### ****1. Start the Flask Application****

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* Navigate to the project directory in the terminal: cd /path/to/project/folder
* Run the Flask app: python3 app.py
* The server will start running on http://0.0.0.0:5000.

#### 2. ****Access the Web Interface****

* + Open a browser on your Raspberry Pi or a device connected to the same network.
* Visit http://<raspberry\_pi\_ip\_address>:5000 (Replace <raspberry\_pi\_ip\_address> with your Pi’s IP).

#### 3. ****Interact with the Application****

* Enter a datetime in the format YYYY-MM-DD HH:MM.
* Press **"Check Air Quality"** to fetch and display real-time air quality and sensor readings.
* If pollutant levels exceed safe thresholds, an alert message will appear, and the buzzer will sound.

#### ****4. Trigger the Buzzer Manually****

* Use the /trigger\_buzzer endpoint to manually activate the buzzer:
* curl -X POST -H "Content-Type: application/json" -d '{"message": "Manual alert!"}' http://<raspberry\_pi\_ip\_address>:5000/trigger\_buzzer