

REAL-TIME SMOKE AND AIR QUALITY SENSOR FOR SENSITIVE INDIVIDUALS

A.R. Mithun Jaai, Grade 11,

Contact @ gayathriskiedu@gmail.com

Fathima Central Senior secondary school, Saidapet, Chennai, TN

ABSTRACT

Individuals with respiratory conditions such as asthma are particularly vulnerable to poor air quality and exposure to smoke, which can trigger severe health issues. This project presents the **design and development of a real-time smoke and air quality sensor system** aimed at enhancing the safety and well-being of sensitive individuals. The device is compact, cost-effective, and can be deployed in homes, schools, or workplaces. By providing continuous air quality feedback and early warning in case of smoke or rising pollution levels, the system empowers individuals with respiratory issues to take timely action and avoid health complications. This project emphasizes the importance of affordable, real-time environmental monitoring as a preventive tool

for public health, especially for those most at risk.

Hypothesis Testing:

Null Hypothesis (H₀): The real-time sensor system does significantly detect or respond to changes in smoke and air quality levels relevant to sensitive individuals.

Alternative Hypothesis (H_a): The real-time sensor system **does not** significantly detect and respond to harmful smoke and air quality changes, providing timely alerts that can help protect sensitive individuals.

MATERIALS AND METHOD:

MATERIALS:

1. Air Quality Sensor (MQ-2, MQ-135)
2. Microcontroller (Arduino Uno)
3. Display Unit (LED screen)
4. Detector (Wi-Fi Module (ESP8266))
5. Power Supply (Battery pack or USB adapter)

METHOD:

1. Sensor Calibration
2. Microcontroller Programming
3. Real-Time Monitoring
4. Alert System

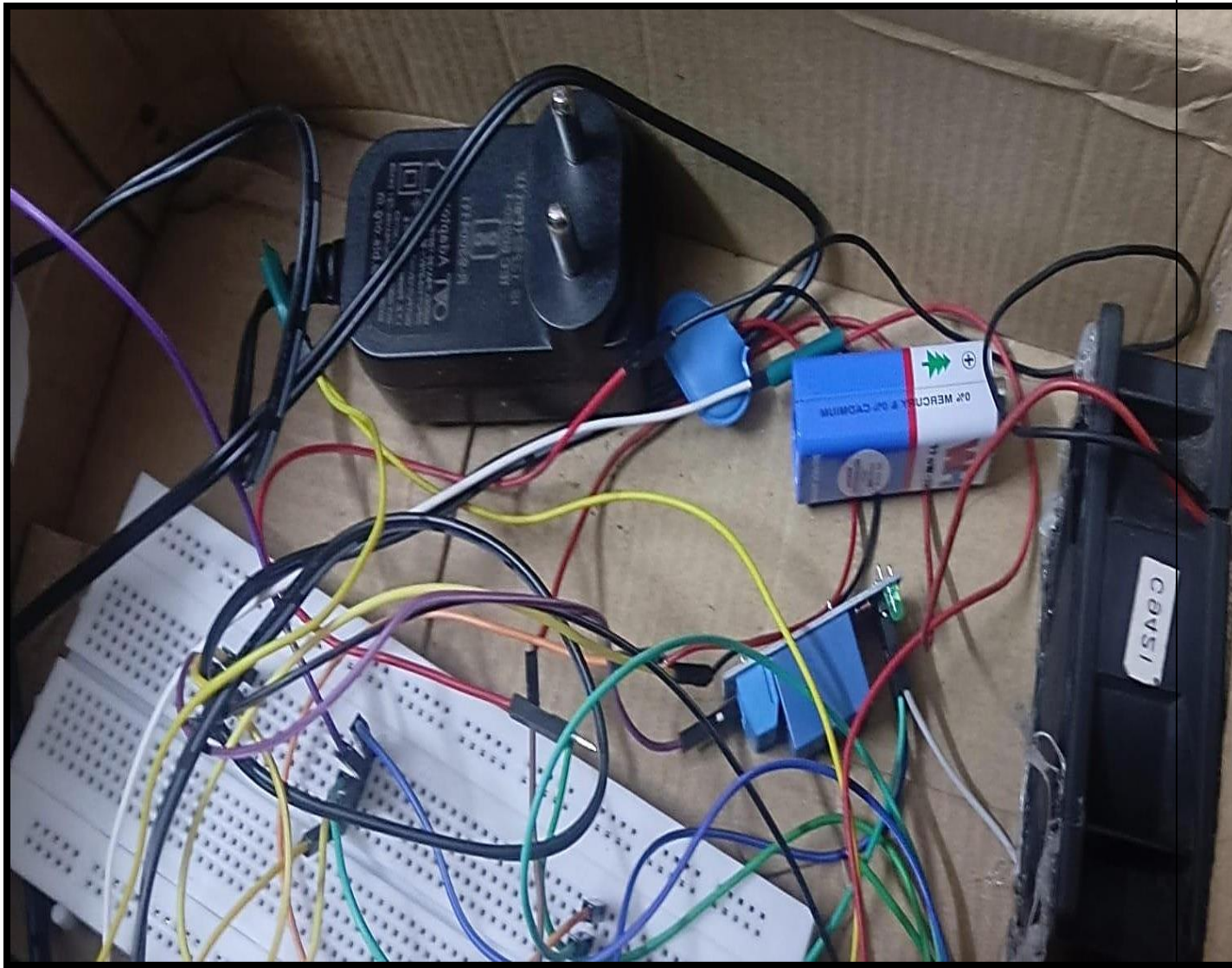


Figure 1. Straight view

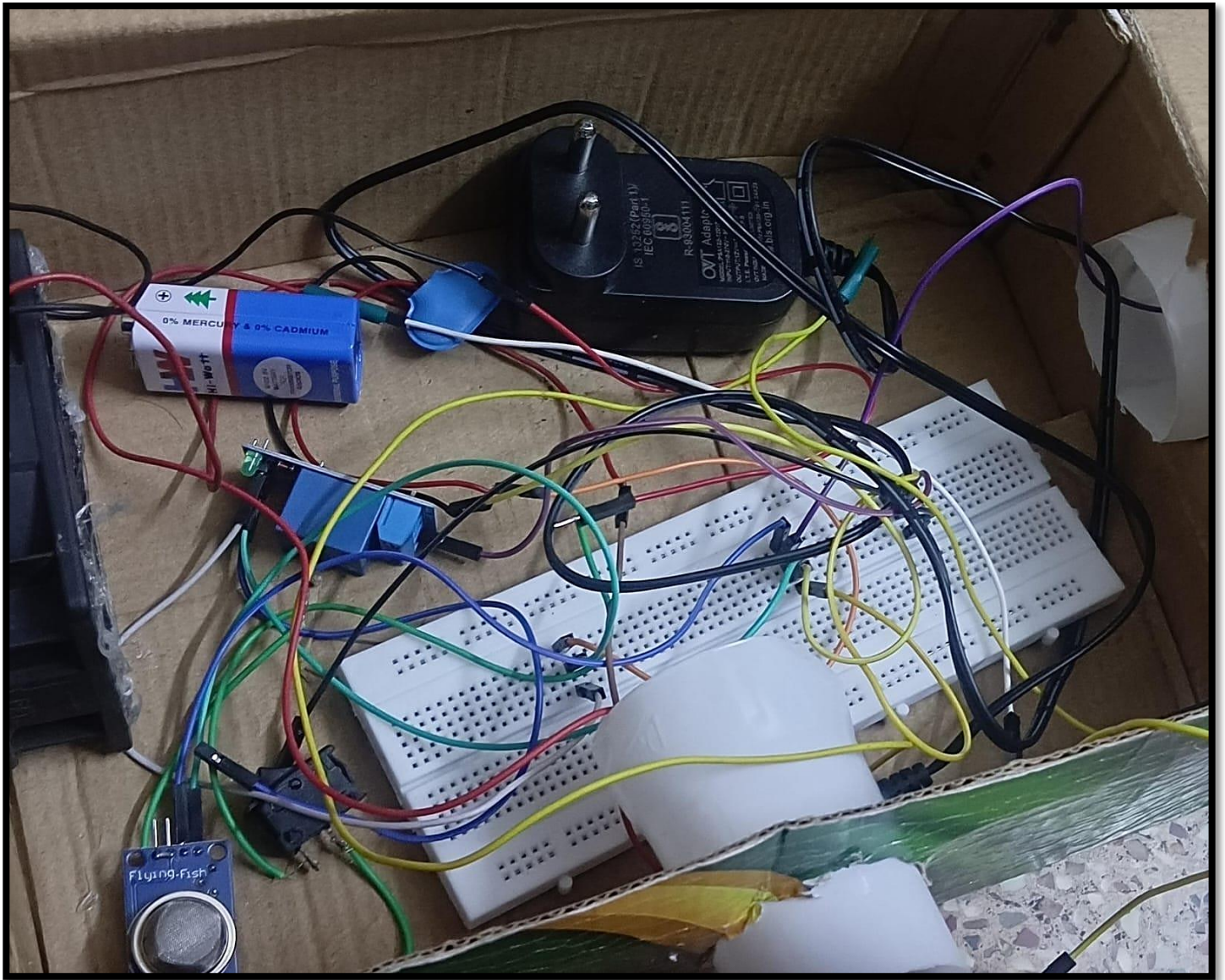


Figure 2. Full View

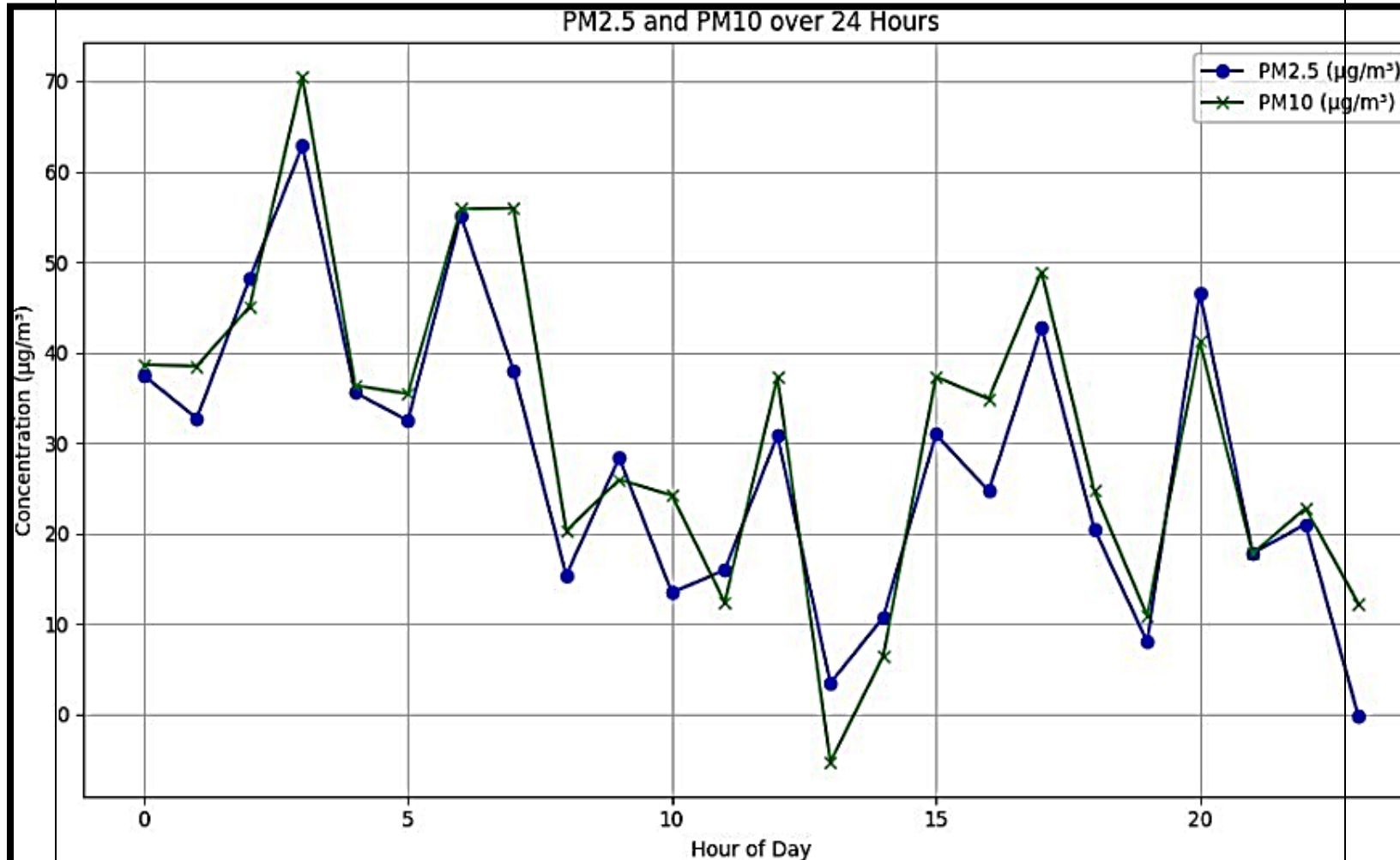
Parameter	Min	Max		AQI Category
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Data Analysis:

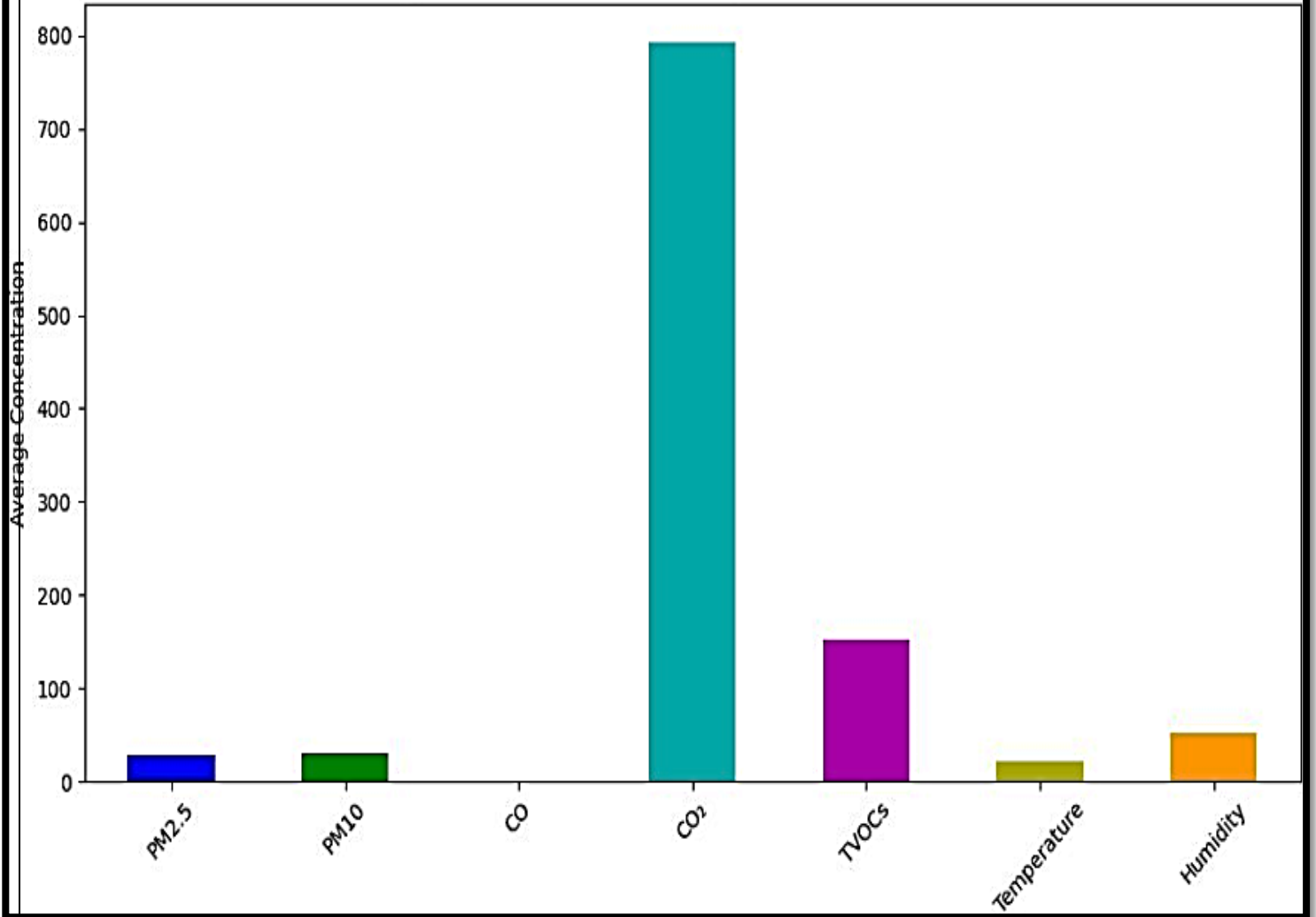
Parameter	Unit	Description
PM2.5	$\mu\text{g}/\text{m}^3$	Fine particulate matter (<math>< 2.5 \mu\text{m}</math> diameter)
PM10	$\mu\text{g}/\text{m}^3$	Coarse particulate matter (<math>< 10 \mu\text{m}</math> diameter)
CO	ppm	Carbon Monoxide level
CO₂	ppm	Carbon Dioxide concentration
TVOCs	ppb	Total Volatile Organic Compounds
Temperature	$^{\circ}\text{C}$	Ambient temperature
Humidity	%	Relative humidity
AQI (Air Quality Index)	—	Overall air quality rating

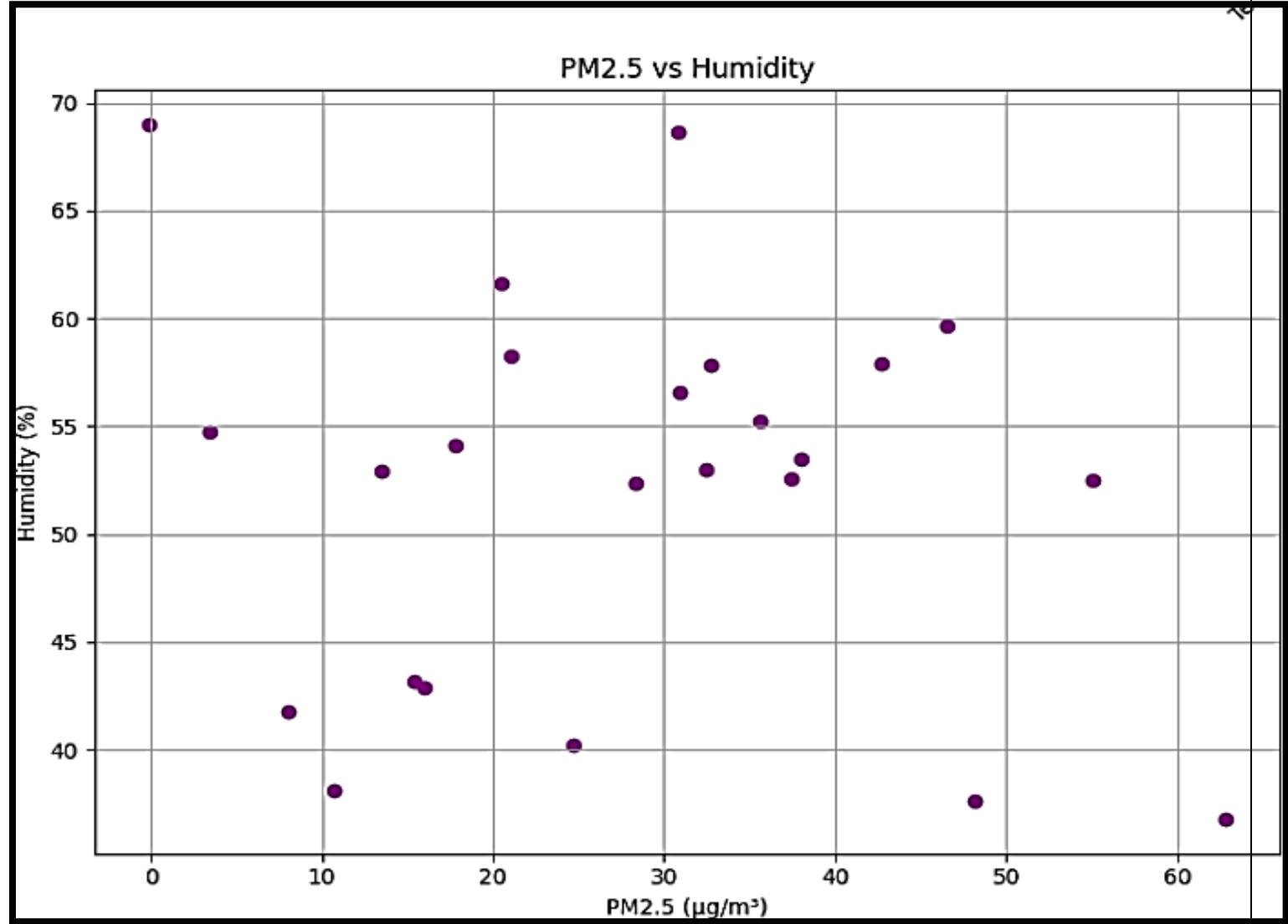
PM2.5	10	180		Unhealthy for Sensitive Groups
PM10	20	210		Unhealthy
CO	0.1	1.3		Good
TVOC	30	600		Moderate
CO ₂	420	1800		Moderate

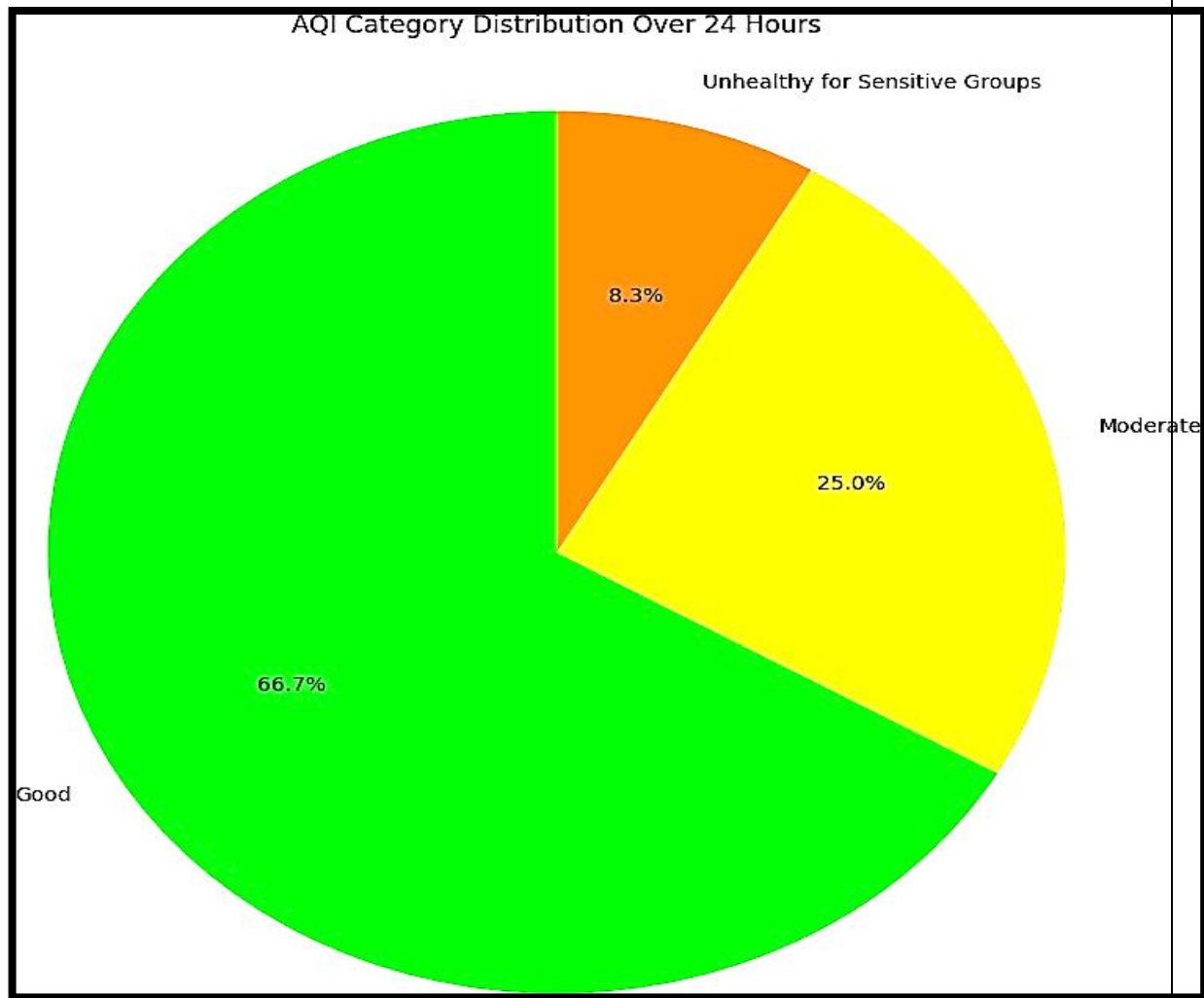
Graphical Representation



Average Concentration of Air Quality Parameters Over 24 Hours







Correlation Analysis

- PM2.5 vs PM10 → Strong positive correlation expected.
- Temperature vs AQI → Inverse relationship

possible (higher temperature → better dispersion).

- Humidity vs PM_{2.5} → Often positive (humid air traps particles).

Discussion

- 1. Sensitive individuals** (asthma patients, elderly) are at risk when PM_{2.5} exceeds **35 µg/m³**.
2. The data suggests avoiding outdoor exposure or activating **air purification systems** during high pollution periods.
- 3. Real-time alerts** can be implemented using thresholds:
 - PM_{2.5} > 100 µg/m³ → Red alert
 - CO₂ > 1000 ppm → Poor ventilation

Result

- Real-time monitoring effectively identifies periods of unsafe air quality.
- Graphical analysis helps visualize pollutant trends and sources.

- System can inform **preventive health measures** and **automatic responses** (e.g., turning on air purifiers, sending app notifications).

Reference

1. Kortoçi, Pranvera, et al. "Air pollution exposure monitoring using portable low- cost air quality sensors." *Smart health* 23 (2022): 100241.
2. Schollaert, Claire, et al. "Wildfire smoke monitoring for agricultural safety and health in rural Washington." *Journal of agromedicine* 28.3 (2023): 595-608.