

## APPLICATION OF NSF 2025

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TITLE OF THE PROJECT : Real-Time Smoke and Air Quality  
Sensor for Sensitive Individuals

CATEGORY/LEVEL OF THE PROJECT : PHYSICAL SCIENCES / SENIOR  
SECONDARY LEVEL

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# REAL-TIME SMOKE AND AIR QUALITY SENSOR FOR SENSITIVE INDIVIDUALS

## 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.

### **AIM:**

To design and develop a **real-time smoke and air quality sensor system** that continuously monitors indoor air conditions and provides instant alerts when harmful levels of smoke or pollutants are detected, thereby helping **sensitive individuals**—such as those with asthma or respiratory conditions—avoid exposure and stay safe.

### **Hypothesis Testing:**

**Null Hypothesis ( $H_0$ ):** The real-time sensor system does **not** significantly detect or respond to changes in smoke and air quality levels relevant to sensitive individuals.

**Alternative Hypothesis ( $H_1$ ):** The real-time sensor system **does** significantly detect and respond to harmful smoke and air quality changes, providing timely alerts that can help protect sensitive individuals.

### **INTRODUCTION:**

The Smoke Observer is a smart air-monitoring device designed to detect smoke and airborne pollutants that can trigger asthma symptoms. It continuously monitors indoor air quality and provides real-time alerts when harmful smoke particles or other irritants are present. This allows asthma patients to take immediate action—such as improving ventilation, using air purifiers, or avoiding exposure—to prevent respiratory distress. By offering early warnings and detailed air quality data, the Smoke Observer plays a crucial role in helping individuals with asthma maintain a safer and healthier living environment.

### **MATERIALS AND METHOD:**

## **MATERIALS:**

1. Air Quality Sensor (e.g., MQ-2, MQ-135, or PMS5003)
  - Detects smoke, dust, and harmful gases (CO, CO<sub>2</sub>, etc.)
2. Microcontroller (e.g., Arduino Uno, ESP32, or Raspberry Pi)
  - Controls the system and processes sensor data
3. Display Unit (LCD or OLED screen)
  - Shows air quality readings and alerts
4. Buzzer or LED Indicator
  - Alerts the user when smoke or poor air quality is detected
5. Wi-Fi Module (optional, e.g., ESP8266)
  - For real-time updates to a mobile device or cloud system
6. Power Supply (Battery pack or USB adapter)
  - Powers the entire setup
7. Casing or Enclosure
  - Protects the components and gives a clean finish

## **METHOD:**

1. Sensor Calibration
  - The air quality sensor is calibrated to detect a threshold level of smoke or pollutants that could trigger asthma symptoms.
2. Microcontroller Programming
  - A code is written to read sensor values, compare them to safe thresholds, and trigger alerts (e.g., buzzer or message).
3. Real-Time Monitoring
  - The system continuously reads air quality data and displays it on the screen or sends it to a connected app.
4. Alert System
  - When smoke or poor air quality is detected, the buzzer sounds or an LED turns on to warn the user immediately.
5. Data Logging (optional)
  - Air quality data is stored or sent to a cloud service for future analysis or medical reporting.

Analysis for Smoke observer:

1. Nature of Motion
2. Brownian Motion

3. Convection & Buoyancy

4. Diffusion

5. Effect of External Factors

6. Light Interaction

Data Analysis and Graphical Representation

Result

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.