# SmartAIR Room Filter: Project Description

## 1. Introduction

The **SmartAIR Room Filter** is an IoT-based indoor air quality monitoring and filtration system. It is designed to automatically assess air quality using a gas sensor and control a fan to improve room conditions. Additionally, it allows manual control through a mobile application powered by the **Blynk IoT platform**. The system offers real-time data on air quality, temperature, and humidity, displayed both on an OLED screen and on the mobile dashboard.

## 2. Objectives

* Monitor **Air Quality Index (AQI)** in real time using the **MQ135 Gas Sensor**.
* Measure **temperature** and **humidity** using the **DHT11 Sensor**.
* Display environmental data on a **0.96-inch OLED Display**.
* Automatically switch a **DC fan** ON or OFF based on AQI thresholds.
* Allow manual control of the fan via the **Blynk IoT mobile app**.
* Provide remote visibility of environmental conditions.

## 3. Components and Justifications

| **Component** | **Purpose** | **Why Used?** |
| --- | --- | --- |
| **ESP32** | Central microcontroller + Wi-Fi connectivity | Low-cost, dual-core MCU with built-in Wi-Fi. |
| **MQ135 Sensor** | Measures air pollutants (CO2, NH3, benzene, etc.) | Provides real-time AQI measurement. |
| **DHT11 Sensor** | Measures temperature and humidity | Inexpensive environmental sensing. |
| **0.96" OLED** | Displays data locally | Allows visual feedback without needing a mobile device. |
| **Relay Module** | Controls high-power DC fan using low-power ESP32 signals | Provides electrical isolation and safe switching. |
| **DC Fan** | Air circulation/filtration | Improves air quality based on system feedback. |
| **Blynk IoT App** | Remote control and monitoring | Enables manual control and real-time data access remotely. |

## 4. Circuit Explanation and Wiring

* **MQ135 Sensor:**
  + AOUT -> GPIO 34 (Analog Read)
  + VCC -> 5V
  + GND -> GND
* **DHT11 Sensor:**
  + DATA -> GPIO 25
  + VCC -> 3.3V
  + GND -> GND
* **OLED Display:**
  + SDA -> GPIO 21
  + SCL -> GPIO 22
  + VCC -> 3.3V
  + GND -> GND
* **Relay Module:**
  + IN1 -> GPIO 15
  + VCC -> 5V
  + GND -> GND
* **DC Fan:** Powered through the relay module using a separate battery supply (6V–9V).

## 5. Fan Control Logic

### Automatic Mode:

* The fan turns **ON automatically** when the AQI exceeds a threshold value of **150** ("Poor" air quality).
* The fan turns **OFF** when air quality is better than this threshold.

### Manual Mode (via Blynk App):

* Users can manually switch the fan ON or OFF regardless of air quality readings using a button (V0) in the Blynk app.

## 6. Blynk Mobile Dashboard Setup

| **Virtual Pin** | **Function** | **Widget Type** |
| --- | --- | --- |
| **V0** | Fan Control Button | Button |
| **V1** | AQI Value | Label/Gauge |
| **V2** | Temperature | Label/Gauge |
| **V3** | Humidity | Label/Gauge |
| **V4** | AQI Category | Label |
| **V5** | Fan Status | Label |

## 7. Why Use a Relay?

* The **ESP32** cannot directly drive high-current devices like a DC fan.
* The **relay** safely isolates the ESP32 from the fan's power supply and allows switching of higher voltages and currents.
* It prevents potential damage to the ESP32 and ensures reliable operation.

## 8. Initial Plan for Variable Speed (Future Expansion)

Originally, the project aimed to include **variable fan speed control** based on AQI levels using:

* An **N-Channel MOSFET** (such as IRF540 or IRLZ44N) to allow **PWM (Pulse Width Modulation)** control from the ESP32.
* A **flyback diode** to protect from voltage spikes generated by the inductive load (the fan).
* This setup would allow the fan speed to increase gradually as AQI worsens instead of simply toggling ON or OFF.

Due to the unavailability of components (MOSFET and diode), this feature is reserved for future versions.

## 9. Power Supply Considerations

* **ESP32, Sensors, OLED:** Powered via 5V from USB or external source.
* **DC Fan:** Powered through relay using a dedicated battery (2x 3.7V lithium cells or equivalent).

## 10. Conclusion

The **SmartAIR Room Filter** offers a smart, efficient, and low-cost solution for real-time air quality monitoring and management. It combines environmental sensing, display, automation, and mobile connectivity in a compact design. Future enhancements such as variable fan speed can further improve its performance and responsiveness.

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