# IoT Project Proposal

# Personalized Climate Control System

**Project Title:** Personalized Climate Control System Using IoT
**Team ID:** 48

**Team Members :** **Shivansh Santoki | Ayush Kanani | Dhyey Thummar**

## Introduction:

### => Problem Statement :

Indoor climate conditions significantly impact both comfort and energy efficiency in residential and commercial spaces. Traditional HVAC (Humidity-Ventilation-AirConditioning) systems operate on fixed schedules or simple thermostat triggers, often leading to:

- Inconsistent comfort levels across different areas of a space
- Inefficient energy usage during periods of low occupancy
- Poor air quality management, particularly for pollutants like $CO_2$, VOCs, and particulate matter
- Lack of personalization based on individual preferences

### => Project Objectives and Deliverables :

This project aims to develop a smart climate control system that monitors and regulates multiple environmental parameters to enhance comfort, improve air quality, and optimize energy consumption. The system will adapt to occupancy patterns and user preferences through IoT integration.

## => Deliverables:

1. A functional prototype demonstrating automated climate control capabilities
2. An interactive web interface for monitoring data and manual control
3. A documented data analysis system to optimize climate settings
4. A comprehensive report on system performance across different conditions

## => Hardware Requirements:

### Sensors :

| Component | Quantity | Series/Model | Purpose | Expected Price per Piece |
|---|---|---|---|---|
| Temperature & Humidity Sensor | 2 | DHT22 (AM2302) | Primary environmental monitoring across different areas of the room | 121 |
| Air Quality Sensor | 2 | MQ-135 (CO2, Smoke) | Detect air pollutants to trigger ventilation | 106 |
| Differential Pressure Sensor | 1 | MPX5010DP | Measure air circulation effectiveness | 1500-2000 |
| Occupancy Sensor | 2 | PIR Motion Sensor (HC-SR501) | Detect presence to adjust climate settings based on occupancy | 58 |

## Controllers and Communication :

| Component | Quantity | Series/Model | Purpose |
| --- | --- | --- | --- |
| Microcontroller | 1 | ESP32 Development Board | Main system controller with built-in WiFi for IoT connectivity |
| WiFi Module | 1 | Built into ESP32 | Enable remote monitoring and control |

## Actuators :

| Component | Quantity | Series/Model | Purpose |
| --- | --- | --- | --- |
| Servo Motors | 2 | SG90 | Control ventilation flaps/dampers |
| DC Fan Motors | 2 | 5V DC Fan | Simulate HVAC airflow control |
| LED Indicators | 2 | RGB LEDs | Visual feedback for system status |
| Buzzer | 1 | Piezo Buzzer | Alerts for critical conditions (high pollution, fire risk) |

## Power and Miscellaneous :

| Component | Quantity | Series/Model | Purpose |
| --- | --- | --- | --- |
| Power Supply | 1 | 5V/3A DC Supply | Provide consistent power to the system |
| Breadboard/Prototype Board | 2 | - | Component mounting and circuit construction |
| Jumper Wires | 20-25 | Male-to-male Male-to-female | Connections between components |
| Housing/Enclosure | 1 | - | Tabletop model housing with ventilation |

| | | | |
|---|---|---|---|
| Female Single Header Strip | 2 | 2.54 mm<br>40 pins in each | To prevent damage to ESP32 while soldering or mounting on PCB |

## => Hardware Features Implementation

1. **Multi-zone Sensing:** The DHT22 sensors will be strategically placed to detect temperature gradients across the model space.
2. **Automated Ventilation Control:** Servo motors will adjust vent positions based on air quality and pressure difference readings.
3. **Simulated HVAC Operation:** DC fans will modulate speeds to represent heating/cooling intensity.
4. **Alert System:** The combination of LEDs and buzzer will provide escalating alerts for deteriorating air quality or extreme conditions.

## => Data Collection Plan:

### Data Collection Methodology

1. **Sampling Frequency:** Environmental parameters will be sampled for 10 days (minimum requirement)
2. **Storage Medium:** Data will be stored both locally and remotely (cloud database)
3. **Parameters Collected:**
    - Temperature and humidity from multiple locations
    - CO2 levels
    - Room occupancy patterns
    - System response actions (fan speed, vent positions)
    - Energy consumption estimates

## => Data Analysis and Expected Outcomes :

1. **Comfort Optimization:**

    - Identify optimal temperature and humidity ranges based on occupancy

- Determine correlation between subjective comfort reports and measured parameters.

2. **Energy Efficiency Analysis:**
   - Calculate potential energy savings compared to conventional systems

3. **Air Quality Improvement:**
   - Measure ventilation effectiveness in reducing CO2.
   - Determine optimal ventilation schedules based on occupancy patterns

4. **System Performance Evaluation:**
   - Evaluate calibration drift in sensors over the testing period
   - Assess failure modes and system resilience

## => Conclusion:

The **Personalized Climate Control System** is more than just a smart gadget—it's a step toward making indoor spaces more comfortable, responsive, and energy-efficient. By seamlessly blending **IoT technology** with environmental sensors, this project shows how automation can **adapt to real-world conditions** and create a more pleasant living or working environment.

The working prototype will showcase the technical feasibility of such a system while providing valuable data on environmental control strategies. The 10-day data collection period will allow for thorough analysis of system performance and effectiveness across varying conditions. The insights gained from this prototype could inform larger-scale implementations in residential or commercial settings, contributing to both energy efficiency goals and enhanced occupant comfort.