GALGOTIAS UNIVERSITY

BTech CSE 1st year – Sec 16

Project Title: Smart Thermostat with Energy Analytics

1. Introduction

Modern homes and offices need intelligent climate control that balances comfort with energy efficiency. This project simulates a *Smart Thermostat* that dynamically adjusts room temperature and humidity while tracking energy consumption in real time. Designed in Java, it mimics real-world devices like ACs, humidifiers, and smart fans, providing actionable insights to reduce electricity costs.

2. Objective

- Simulate an **adaptive thermostat** that responds to occupancy and environmental changes.

- Integrate **energy analytics** to calculate real-time power consumption and costs.

- Provide a **visual dashboard** for monitoring temperature, humidity, and device usage.

- Ensure scalability using **OOP principles** and modular design.

3. Technologies Used

- **Java (Core Java + Swing)**
- **Object-Oriented Programming** (Modular classes for sensors, devices, and analytics)
- **File Handling** (Logs all data to thermostat_log.txt)
- **GUI** (Live graphs via Java Swing)

4. System Features

a) Dynamic Climate Control

- **Temperature Sensor:** Simulates room temperature fluctuations (±2°C).
- **Humidity Calculator:** Randomizes humidity levels for realism.
- **Occupancy-Based Adjustments:** ACs turn off when the room is empty; fans activate if overcrowded

b) Energy Analytics

- **Real-Time Power Tracking:** Calculates wattage for ACs, humidifiers, and fans.
- **Cost Calculator:** Converts energy usage to monetary cost (₹8/kWh).

- **Per-Person Energy Metrics:** Shows kWh consumed per occupant.

c) Alert System

- **Overheating Alerts:** Triggers if temperature exceeds 35°C.
- **Maintenance Alerts:** Flags excessive AC runtime (>24 hours).

d) Dashboard

- **Live Graphs:** Displays trends for temperature, humidity, and power usage.
- **Auto-Refresh:** Updates every 3 seconds.

5. System Architecture

- **Modular Java Classes:**
  - `TemperatureSensor` / `HumidityCalculator`: Simulate environmental changes.
  - `AirConditioner / Humidifier / SmartFan`: Device logic with power calculations.
  - `ElectricityBill`: Tracks costs and energy usage.
  - `ThermostatDashboard`: Swing-based GUI for visualization.

- **File-Based Logging:** Stores all sensor readings and alerts in thermostat_log.txt.

6. Modules Description

Class	Functionality
TemperatureSensor	Generates random temperature values (±2°C) and adjusts for occupancy.
AirConditioner	Primary/secondary ACs activate based on temperature deviation from 21°C.
SmartFan	Turns on if temperature exceeds 26°C or room is crowded (≥6 people).
ElectricityBill	Aggregates power data and computes costs in real time.
ThermostatDisplay	Orchestrates device control, logs data, and triggers alerts. |
ThermostatDashboard	Swing GUI with live graphs for temperature, humidity, and power consumption.

7. Sample Flow

1. System Boots: Sensors start simulating room conditions.

2. Occupancy Check: Randomly assigns 0–20 people to the room.

3. Device Control:

- ACs activate if occupants are present.
- Humidifier adjusts to maintain 50% humidity.
- Fan turns on if overcrowded or overheating.

4. Dashboard Updates: Graphs refresh every 3 seconds with new data.

5. Alerts: Logs warnings for overheating/maintenance.

8. Team Responsibilities

1.Shreyansh Misra

Role - Project Lead

Designed core architecture, energy analytics, and dashboard.

Admission no. – 24SCSE1010899

2. Virat Bhatt

Role - Device Logic Handler

Implemented AC/humidifier power algorithms.

Admission no. – 24SCSE1011494

3. Tanmay Jaiswal

Role - GUI Developer

Built Swing dashboard and live graphs.

Admission no. – 24SCSE1011312

4. Aryan Tomar

Role - Data Logger

Integrated file handling and alert systems.

Admission no. – 24SCSE1010707