Smart Home Energy Automation System
Datasheet

Project Title:

Smart Home Energy Automation System

Abstract:

The Smart Home Energy Automation project is designed to improve energy efficiency and remote appliance control in residential, educational, healthcare, and industrial environments. Utilizing an Arduino Uno, HC-05 Bluetooth module, relays, and a Java-based desktop application, the system allows users to monitor and control appliances remotely. It integrates real-time analytics, including energy consumption graphs, bill calculations, and personalized recommendations. The project contributes to the Smart City Initiative, promoting sustainable urban development and fair energy billing while providing a scalable, adaptable solution for various applications.

1. Project Overview The Smart Home Energy Automation System is designed to enhance energy efficiency and remote appliance control in residential, educational, healthcare, and industrial settings. It integrates Arduino Uno, HC-05 Bluetooth module, relays, sensors, and a Java-based desktop application for real-time energy monitoring and management.

2. Key Features

- **Remote Control**: Users can control appliances via a Java desktop application.
- **Smart Energy Management**: AI-driven recommendations optimize power consumption.
- **Real-Time Monitoring**: Provides energy analytics and billing calculations.
- **User-Friendly Interface**: Java Swing GUI for seamless interaction.
- **Safety Mechanisms**: Insulated connections, fuse protection, and heat management.
- **Simulation & Testing**: System modeled and tested in Proteus simulation software.

3. Hardware Components

- **Arduino Uno**: Main microcontroller for processing data and controlling devices.

- **HC-05 Bluetooth Module**: Facilitates wireless communication with the application.
- **Relays**: Enable switching of high-power appliances.
- **DHT11 Sensor**: Measures temperature for monitoring.
- **Jumper Wires & Breadboard**: Used for circuit connections.
- **Power Supply**: Provides stable 5V power to components.

4. Software Tools

- **Java (Swing GUI)**: For the desktop application.
- **MySQL Database**: Stores user data and energy logs.
- **Proteus**: Used for circuit design and simulation.
- **Arduino IDE**: For microcontroller programming.
- **jSerialComm Library**: Handles serial communication between Arduino and Java application.
- **JFreeChart**: Displays energy consumption trends.

5. System Workflow

1. **User Interaction**: Commands are given through the desktop application.
2. **Communication**: Signals sent via Bluetooth to the Arduino.
3. **Hardware Execution**: Arduino activates relays and collects sensor data.
4. **Data Processing**: Backend server analyzes consumption and generates insights.
5. **User Feedback**: Real-time analytics and recommendations are displayed.

6. Functionality and Performance:

The system offers the following functionalities:

- **Remote Control:** Users can switch appliances on/off using the desktop application.
- **Real-time Monitoring:** Energy consumption is displayed graphically.
- **Smart Energy Management:** AI-driven recommendations optimize power usage.
- **Billing and Cost Estimation:** The system calculates estimated electricity costs.
- **Warnings and Alerts:** Alerts users when power consumption exceeds defined thresholds.
- **Temperature Monitoring:** Reads temperature data from sensors and displays it in real-time.

Simulation Testing: The system was tested in Proteus to verify circuit design before hardware implementation.

7.Conclusion:

The Smart Home Energy Automation System successfully integrates hardware and software to provide a functional, efficient, and scalable energy management solution. Through real-time monitoring, AI-driven recommendations, and remote control capabilities, the system enhances convenience, reduces energy waste, and ensures fair billing. With further development, it can be expanded to include IoT integration, solar energy management, and disaster forecasting, making it a vital component of future smart cities.

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