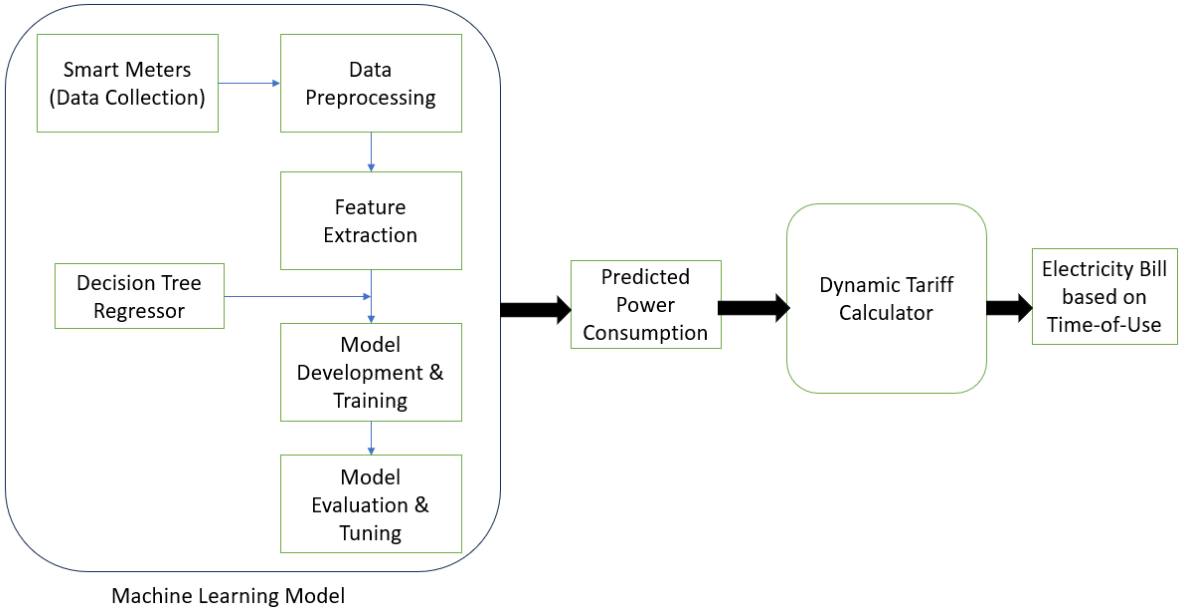
19EEE331 SMART GRID & IoT

RESIDENTIAL SMART METER ANALYSIS

OBJECTIVE:

This project aims to use smart meter data and machine learning techniques to predict residential power consumption accurately. By dynamically calculating electricity bills based on time-of-use tariffs, the project empowers consumers with insights into their energy usage and associated costs. Moreover, this contributes to grid stability, demand response programs, and the integration of renewable energy sources. Through this initiative, we aspire to optimize energy management practices, promote sustainable behaviours among consumers, and enhance the efficiency and reliability of the energy grid.

BLOCK DIAGRAM:



RESULT:

A machine learning model has been successfully constructed using Decision Tree Regressor algorithm to predict the power consumption of houses and the model dynamically calculates electricity bills at any given instance, utilizing Time-of-Use tariff pricing.

OUTPUT:

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Parameters of the Decision Tree Regressor model:
Max depth: 5
Number of leaves: 13

Mean Squared Error (MSE) on the test set: 0.00399999999999999
Mean Absolute Error (MAE): 0.039999999999999945
R-squared (R2) Score: 0.8571428571428574

Enter the place (House 1, House 2, Apartment A, House 3): House 1
Enter the day: 2
Enter the time (hour): 22
Enter the occupancy: 12
Enter the appliance usage (W): 1985
Enter the renewable energy integration factor (0 to 1): 0.7

Predicted Power Usage (kWh): 3.8000000000000003

Peak hours: 8:00, 12:00, 18:00, 22:00

Peak period tariff!

Incentive for renewable integration!
Discount in tariff: ₹ 0.8
Current tariff: ₹ 11.2

Predicted Electricity bill at the instance: ₹ 42.56
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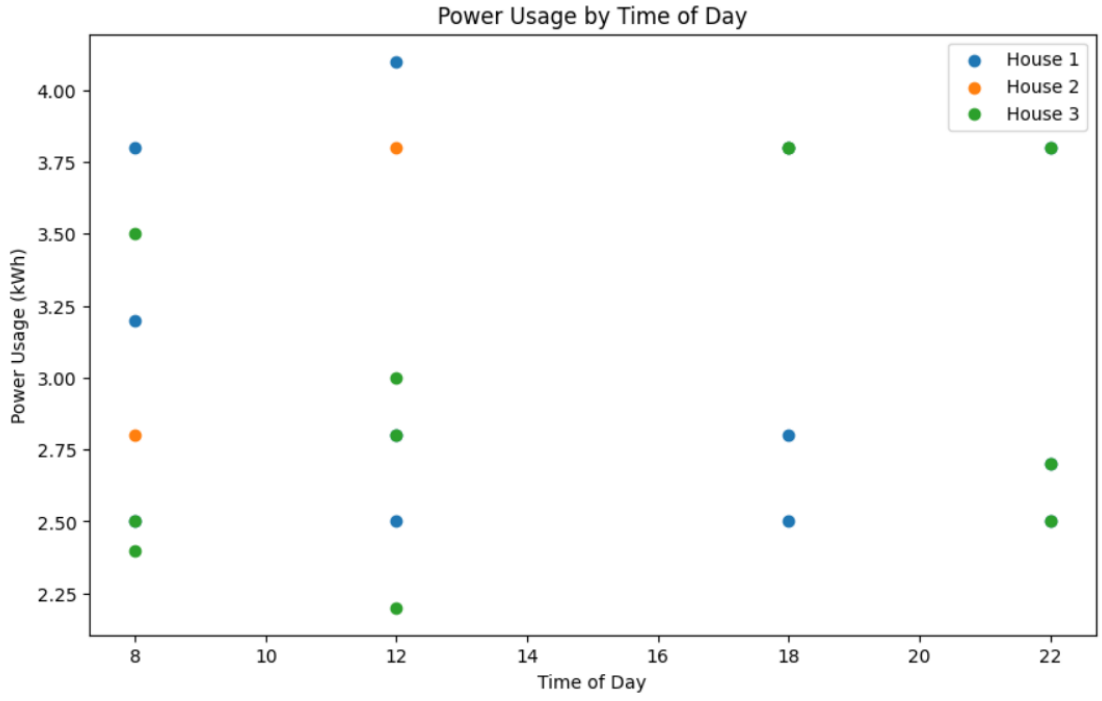

INFERENCE:

- The developed predictive model enables accurate forecasting of power consumption in various residential settlings based on factors such as place, day, time, occupancy, appliance usage, and renewable energy integration.
- This model provides valuable insights into consumption patterns, allowing utilities to better plan and manage their resources, predict future demand, and optimize energy distribution.
- The dynamic tariff system adjusts pricing based on peak and off-peak hours, as well as incentives for renewable energy integration.
- By incentivizing consumers to shift their electricity usage to off-peak hours and integrate renewable energy sources, the tariff system promotes more efficient energy consumption and reduces strain on the grid during peak periods.
- In a smart grid system, the predictive model and dynamic tariff system can be integrated to enable demand response mechanisms.
- Smart meters installed in residential buildings can communicate consumption data to the utility company in real-time, allowing for dynamic pricing adjustments based on current demand and grid conditions.
- The predictive model can anticipate future demand patterns, enabling proactive load management and grid optimization strategies.
- By using renewable energy integration incentives, the smart grid system encourages the adoption of renewable energy sources and reduces reliance on traditional fossil fuels.

Report Submitted by:

- Suneelvijay M (CB.EN.U4ELC21062)
- Sharmista HS (CB.EN.U4ELC21056)

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