

PowerPulse: Household Energy Usage Forecast

In the modern world, energy management is a critical issue for both households and energy providers. Predicting energy consumption accurately enables better planning, cost reduction, and optimization of resources. The goal of this project is to develop a machine learning model that can predict household energy consumption based on historical data. Using this model, consumers can gain insights into their usage patterns, while energy providers can forecast demand more effectively.

This project provide actionable insights into energy usage trends and deliver a predictive model that can help optimize energy consumption for households or serve as a baseline for further research into energy management systems.

Business Use Cases:

1. **Energy Management for Households:** Monitor energy usage, reduce bills, and promote energy-efficient habits.
2. **Demand Forecasting for Energy Providers:** Predict demand for better load management and pricing strategies.
3. **Anomaly Detection:** Identify irregular patterns indicating faults or unauthorized usage.
4. **Smart Grid Integration:** Enable predictive analytics for real-time energy optimization.
5. **Environmental Impact:** Reduce carbon footprints and support conservation initiatives.

Approach:

1. Data Understanding and Exploration:

- Load and explore the dataset to understand its structure, variables, and quality.
- Perform exploratory data analysis (EDA) to identify patterns, correlations, and outliers.

2. Data Pre-processing:

- Handle missing or inconsistent data points.
- Parse date and time into separate features.
- Create additional features such as daily averages, peak hours, or rolling averages.
- Normalize or scale the data for better model performance.

3. Feature Engineering:

- Identify relevant features for predicting global active power consumption.
- Incorporate external data (e.g., weather conditions) if available.

4. Model Selection and Training:

- Split the dataset into training and testing sets.
- Train regression models such as Linear Regression, Random Forest, Gradient Boosting, and Neural Networks.
- Perform hyperparameter tuning to optimize model performance.

5. Model Evaluation:

- Evaluate models using appropriate metrics (e.g., RMSE, MAE, R-squared).
- Compare model performance and select the best-performing model.

Dataset:

<https://archive.ics.uci.edu/dataset/235/individual+household+electric+power+consumption>

Results:

- An accurate prediction model for household power consumption.
- Clear insights into key factors influencing energy usage.
- Visualization of energy trends and predictive performance.