Jashore University of Science and Technology

Department of Computer Science and Engineering

THESIS

Report on

Predictive Modeling of Battery Powered Vehicles (BPVs) Charging Load on the Power Grid: A Machine Learning Approach

Supervised By	**Submitted by**
Monishanker Halder Assistant Professor Dept. of Computer Science and Engineering Jashore University of Science and Technology	Rakesh Biswas Id: 200112 4th year, 1st semester Session: 2020-21 Dept. of Computer Science and Engineering Jashore University of Science and Technology

Submission Date: 26 April, 2025

Thesis Title:

Predictive Modeling of Battery Powered Vehicles (BPVs) Charging Load on the Power Grid: A Machine Learning Approach

Main Objectives:

1. Design a machine learning model to forecast BPV charging load in Bangladeshi cities (especially Khulna, Jashore).
2. Use a combination of synthetic and real-world datasets (traffic, temperature, trip patterns).
3. Compare the performance of multiple models including Linear Regression, Random Forest, XGBoost, LSTM, and Quantile LSTM.
4. Simulate different demand scenarios (e.g., rush hours, weekends, seasonal variations).
5. (Optional) Visualize the predictions and usage patterns using dashboards.

Motivation:

- With the increasing adoption of BPVs in urban areas of Bangladesh, the demand for electricity is rising rapidly.
- Without accurate forecasting models, utility providers may:
    - Misjudge electricity supply needs
    - Cause overloading or underutilization of the grid
    - Increase operational costs and stress the grid
- A predictive model can ensure:
    - Grid stability
    - Efficient energy planning
    - Better decision-making in smart grid management

Research Gaps Identified:

- Existing studies often focus on electricity generation or component-level modeling.
- There's a lack of models specifically targeting BPV charging behaviors.
- Limited integration of temporal, spatial, and behavioral variations in current models.

Technologies and Tools:

- **Programming & Platforms**: Python, Jupyter Notebook, Google Colab
- **Visualization**: Matplotlib, Seaborn, OpenStreetMap (OSM)
- **Traffic Simulation**: SUMO, TraCI Framework
- **Communication Modeling**: OMNeT++
- **Big Data Workflow**: KNIME (optional)

Timeline (Over 12 Months):

Phase	Duration	Activities
Literature Review & Tool Setup	Month 1–3	Review papers, set up tools
Data Collection & Preprocessing	Month 4–6	Collect and clean traffic, weather, and EV data
Model Development & Optimization	Month 7–9	Baseline + advanced ML models
Scenario Simulation & Visualization	Month 10–12	Simulate demand and visualize results

Key References (Q1/Q2 Journals):

1. **Klausmann et al. (2023)** – Adaptive control for battery storage with peak load limitation *(Energies, Q1)*
2. **Yaprakdal (2023)** – Ensemble deep learning with feature selection *(Energies, Q1)*
3. **Vulfovich et al. (2021)** – Inductive power transfer modeling *(Simulation Modelling Practice and Theory, Q1)*
4. **Schreiber & Ulbig (2023)** – Transfer learning for renewable forecasting *(Energy and AI, Q1)*
5. **Crespo & Aliberti (2024)** – ML comparison and uncertainty analysis *(Engineering Applications of AI, Q1)*

Summary:

This thesis aims to build an ML-based forecasting model for BPV charging loads, addressing the need for smarter grid management in Bangladesh. By combining modern prediction techniques with real-world data, the research seeks to improve load prediction accuracy, prevent grid stress, and guide energy distribution strategies.