Visualization and Electrical Analytics of Kathmandu University using Smart Meters

Sameep Kakshapati Shrestha
Department of Computer Science and Engineering
Kathmandu University

Slok Pradhan
Department of Computer Science and Engineering
Kathmandu University

Bijan Bakabal Thapa
Department of Computer Science and Engineering
Kathmandu University

Manish Bhattarai
Department of Computer Science and Engineering
Kathmandu University

Sadit Rasaili
Department of Computer Science and Engineering
Kathmandu University

Suman Makai Shrestha
Department of Computer Science and Engineering
Kathmandu University

Samundra Gurung
Department of Electrical and Electronics Engineering
Kathmandu University

***Abstract*—This project presents the design and implementation of a Real-Time Smart Meter Analytics System developed for Kathmandu University to enhance campus energy monitoring, reliability, and data-driven decision-making. Unlike traditional analog meters that provide only cumulative readings, the proposed system processes high-resolution smart meter data in real time, enabling detailed analysis of energy consumption, voltage stability, load fluctuations, and outage events.**

The system integrates directly with the Iammeter Smart Meter API using secure JWT-based authentication to ensure continuous and reliable IoT data acquisition. Key electrical parameters including active energy, voltage, current, power factor, and load behavior are collected and stored for real-time and historical analysis. The backend is built using FastAPI to deliver scalable, low-latency RESTful services, while PostgreSQL ensures structured and reliable storage of large time-series datasets. Docker-based containerization supports modular deployment and future scalability.

A web-based dashboard developed with React provides interactive visualizations, including real-time monitoring graphs, historical trends, voltage stability indicators, outage tracking, and block-level consumption comparisons. These features transform raw meter data into actionable insights, enabling administrators to detect anomalies and optimize energy distribution.

To support proactive energy management, a Random Forest–based forecasting module predicts short-term energy demand and potential peak loads using historical trends. Additionally, an automated billing module calculates energy costs based on consumption and tariff structures, ensuring transparent and accurate cost assessment.

Overall, the system delivers a comprehensive, scalable solution for modern smart campus energy monitoring and decision support.

***Index Terms*—Automated Billing System, Energy Forecasting, Real-Time Energy Monitoring, Smart Meter Analytics**