



**National Conference on Computer, Electrical,  
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# KU Smart Meter Monitoring and Analytics System

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# Presentation Outlines

1. Introduction
2. Problem Statement
3. Methodology
4. Results and Discussions
5. Conclusion and Future Works
6. References



# 1. Introduction

- Modern energy systems require real-time monitoring for efficiency and reliability.
- Traditional analog meters only provide cumulative readings.
- Smart meters provide high-resolution data including

*Energy consumption*

*Voltage levels*

*Load variations*

*Outage events*

- This project develops a real-time smart meter analytics platform for Kathmandu University.



# 1. Introduction

- *Objectives*

*Develop a scalable web-based smart meter monitoring platform.*

*Integrate secure API-based real-time data acquisition.*

*Provide interactive dashboards for visualization and analysis.*

*Implement AI-based forecasting for energy prediction.*

*Design a modular and scalable system architecture..*

## 2. Problem Statement

- Kathmandu University operates multiple facilities with significant energy demand.
- Challenges:
  - No centralized real-time monitoring
  - Limited visibility into voltage instability and outages
  - No predictive insights for peak load management
  - Difficulty in data-driven energy planning
- Research Gap:
  - Existing IoT platforms are generic and not tailored for smart meter analytics in academic environments.
- Need:
  - A domain-specific, customizable, and scalable smart meter monitoring and analytics system.

# 3. Methodology

- System Architecture

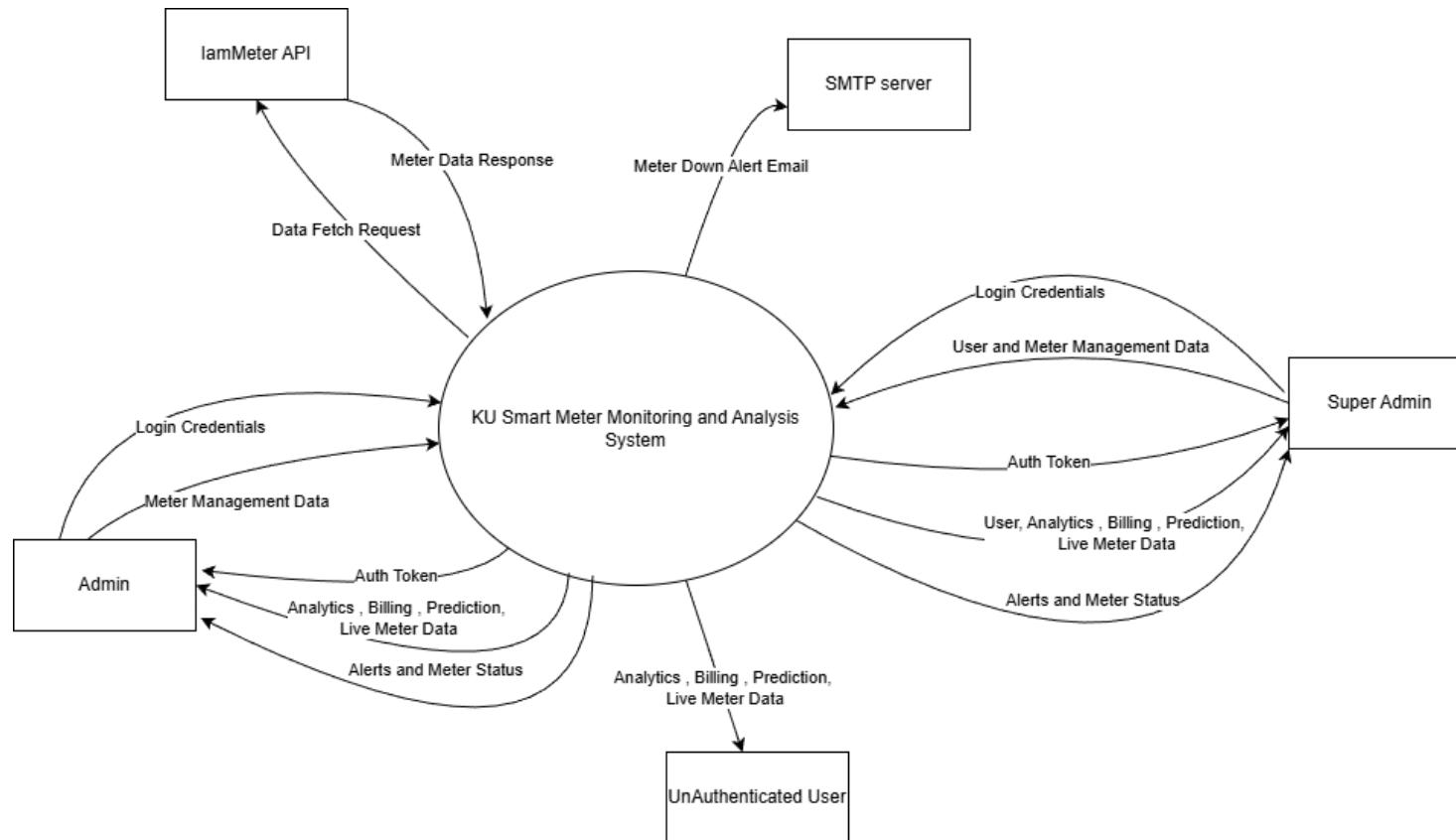


Figure 1- Context Diagram



# 3. Methodology

- *Development Approach*

*Agile development methodology adopted.*

*Phases:*

*Planning and requirement analysis*

*Research on smart meter APIs and forecasting models*

*Frontend development using React*

*Backend development using FastAPI*

*Database design using PostgreSQL*

*Model training using Random Forest regression*

*System testing and validation*



# 3. Methodology

- *Machine Learning Model*

*Model Used: Random Forest Regression*

*Features:*

*Hour of day*

*Day of week*

*Month*

*Historical lag values*

*Total Dataset Size: 8355 samples*

*Training Samples: 6684*

*Testing Samples: 167*

*Evaluation Metrics:*

*Mean Absolute Error (MAE): 13.26 kW*

*Root Mean Squared Error (RMSE): 19.65 kW*

*Coefficient of Determination (R2 Score): 0.6777*

# 4. Results and Discussions

- *System Features and Implementation*

- Real-time smart meter data acquisition*

- Interactive dashboard with graphs and trends*

- Voltage and current analysis*

- Billing and cost analysis*

- Geographical meter mapping*

- Role-based access control*

- ML-based 24-hour forecasting*

*System successfully integrates IoT, web technologies, database systems, and ML models.*

# 4. Results and Discussions

Smart Meter | Dashboard



Figure 2- Main Dashboard

# 4. Results and Discussions

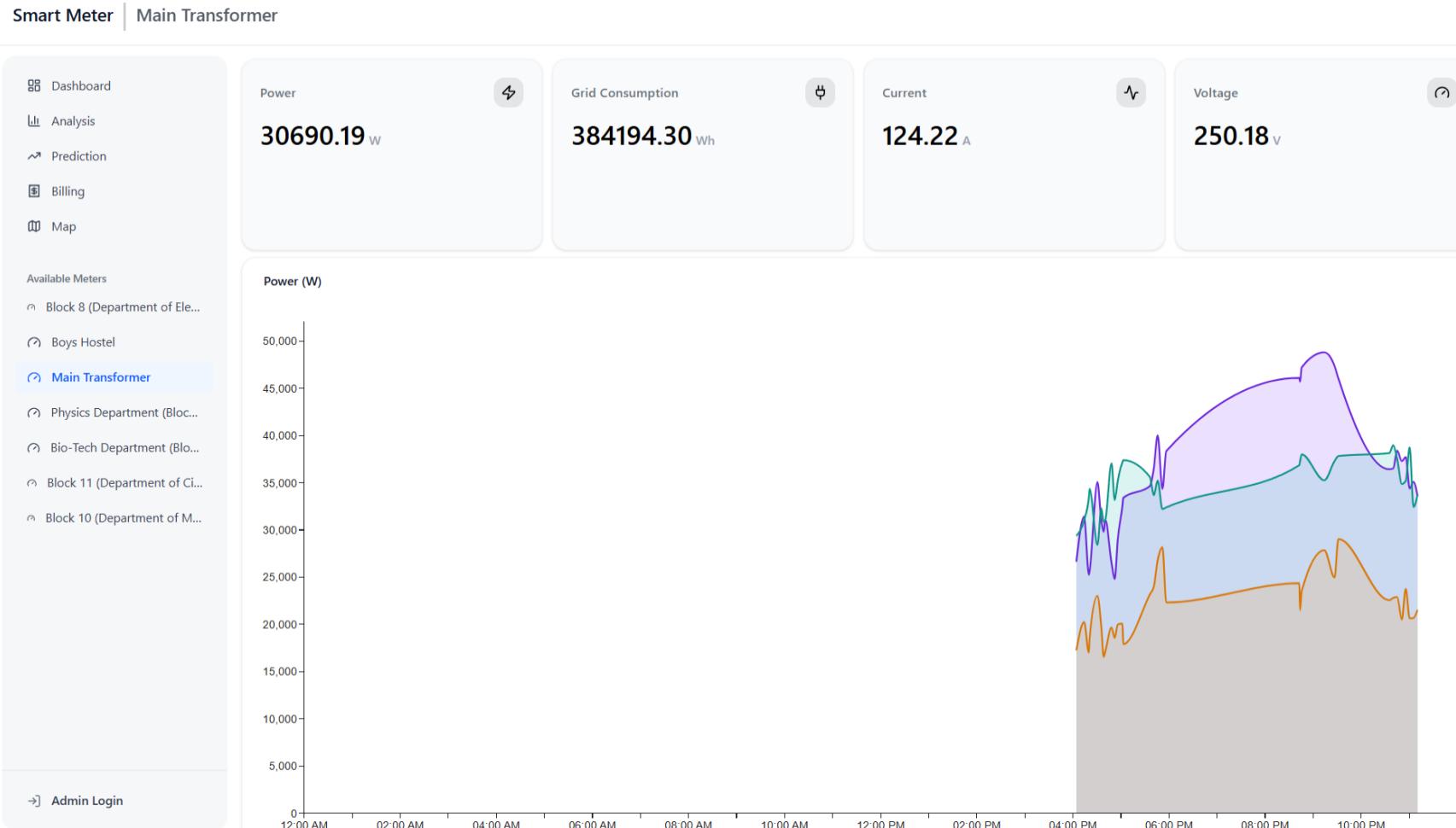


Figure 3.1.- Individual Meter Page

# 4. Results and Discussions

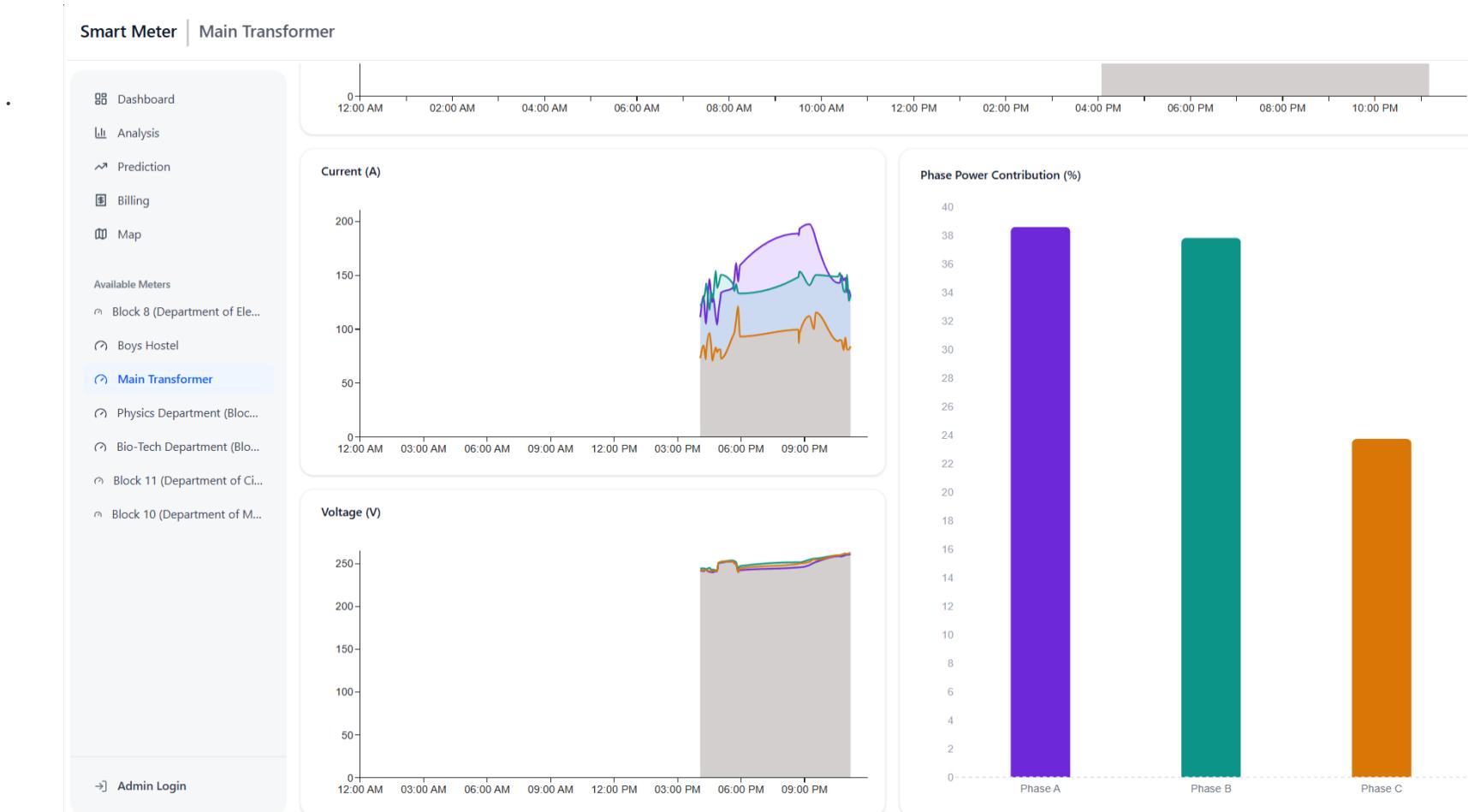


Figure 3.2. – Individual Meter Page



# 4. Results and Discussions

Smart Meter | Analysis

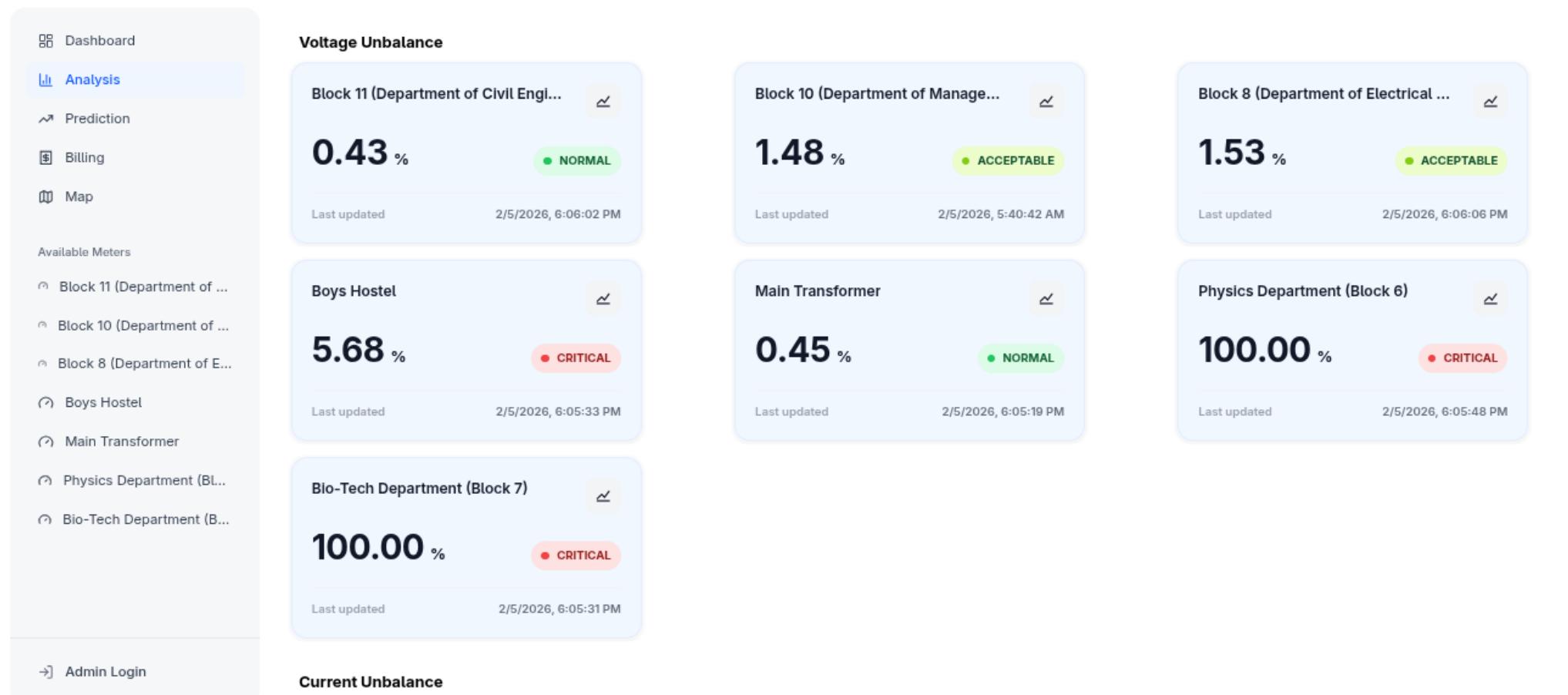


Figure 4- Analysis Page

# 4. Results and Discussions

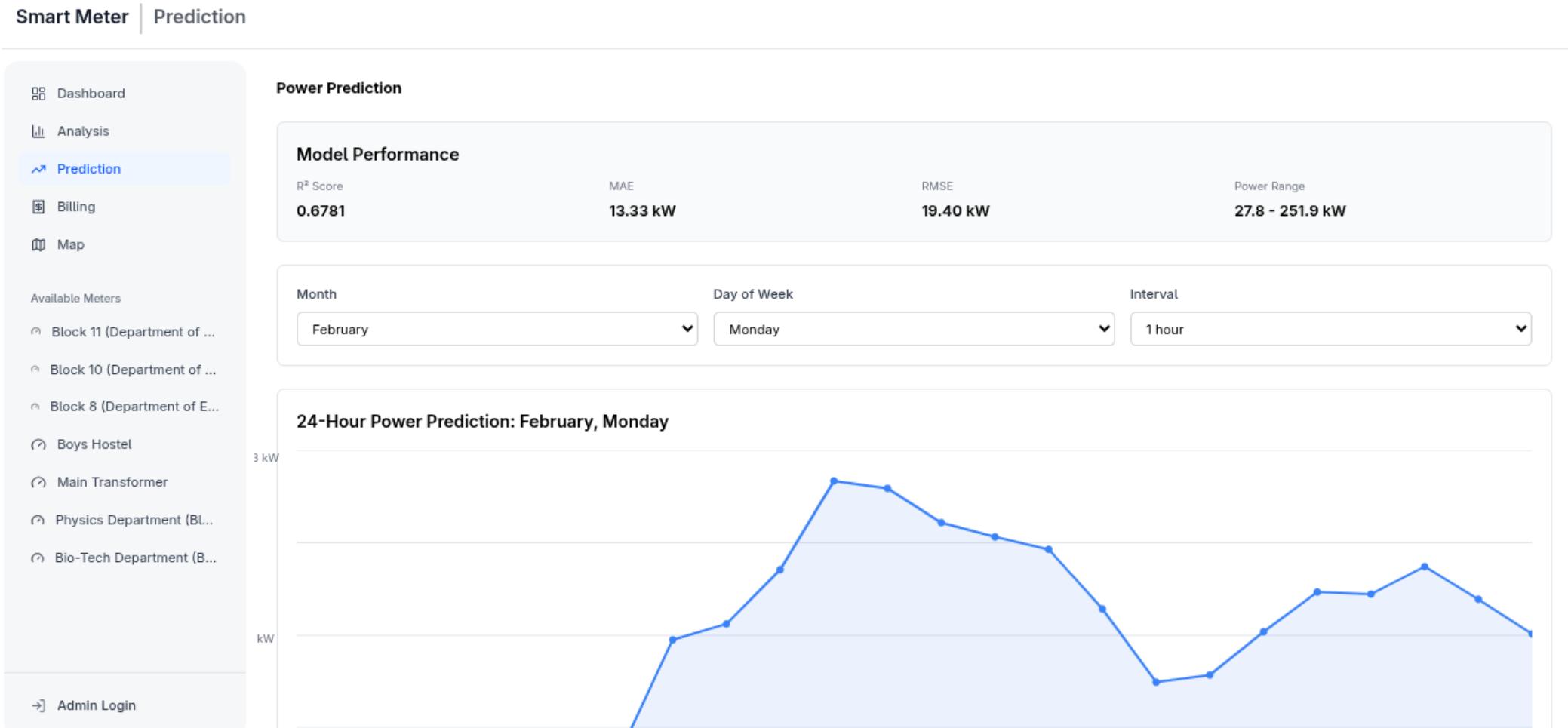


Figure 5- Prediction Page

# 4. Results and Discussions

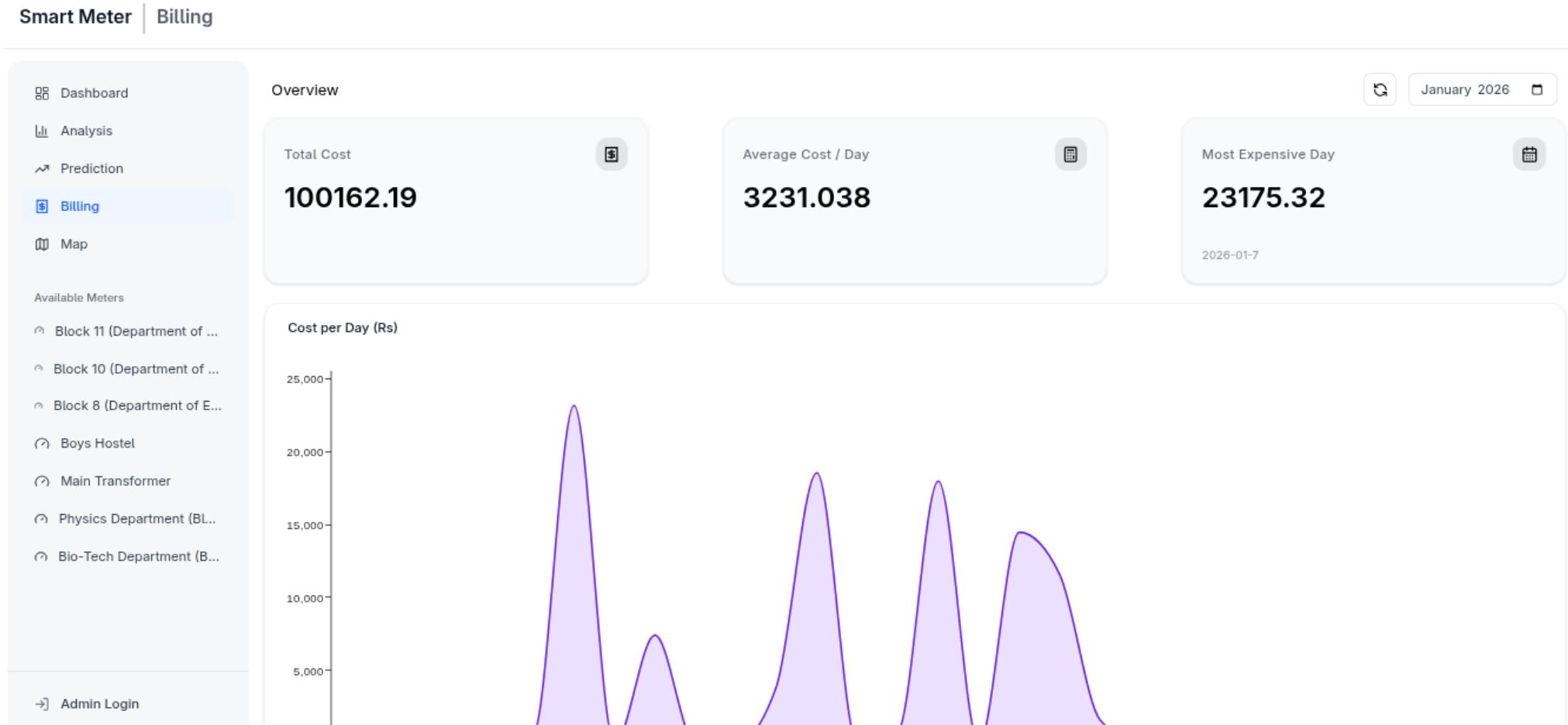


Figure 6 – Billing Page

# 4. Results and Discussions

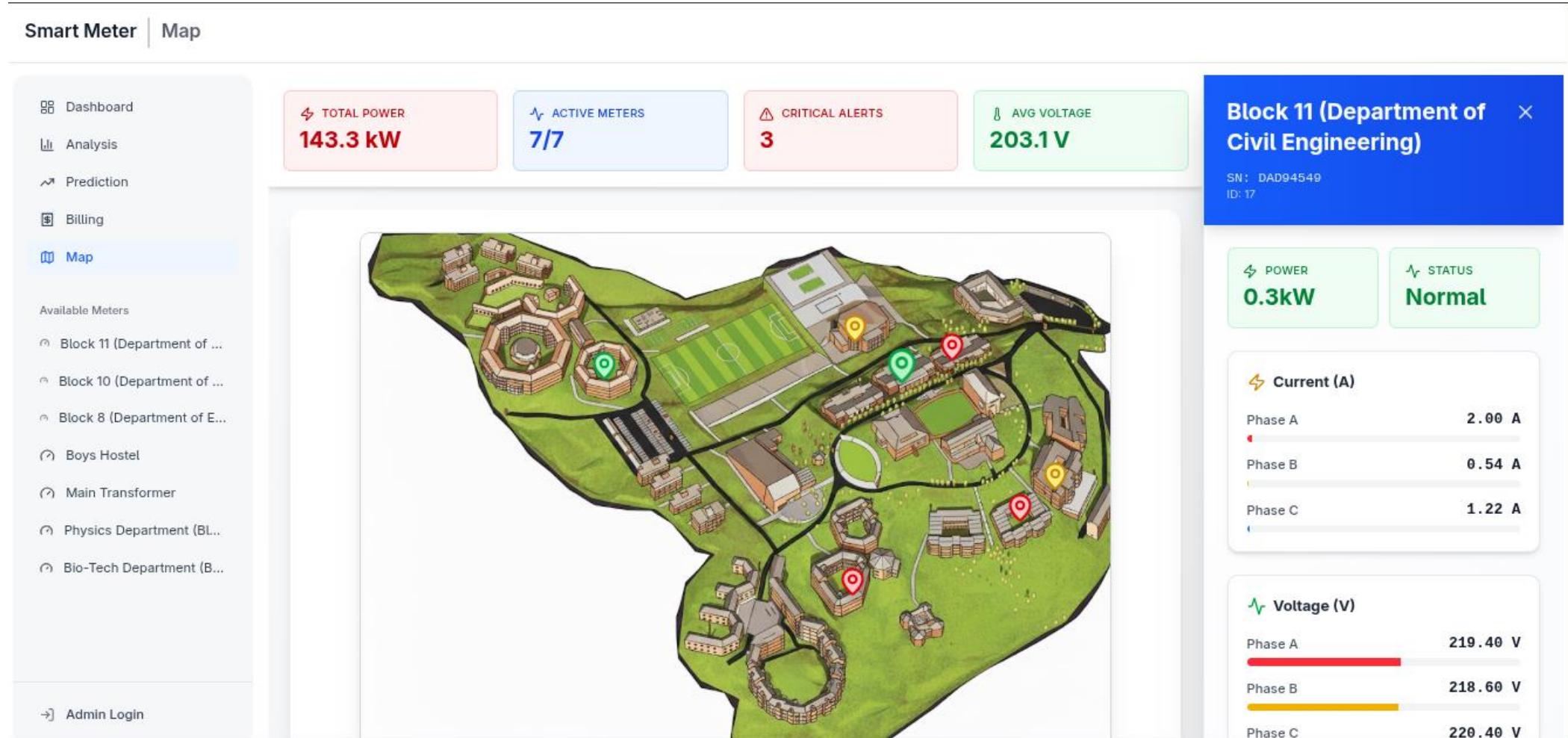


Figure 7- Maps Page



# 4. Results and Discussions

Smart Meter | Super Admin Dashboard

**Super Admin Dashboard**  
Full system control and management

Refresh  Super Administrator

Total Users	Active	Inactive	Super Admins	Admins
2	2	0	1	1

**User Management**

Search users...

Add User

User	Email	Created	Status	Type	Action
Super Administrator	admin@kusm.edu.np	Feb 4, 2026	Active	Super Admin	<input type="button"/> <input type="button"/> <input type="button"/>
hello	hello@gmail.com	Feb 5, 2026	Active	Admin	<input type="button"/> <input type="button"/>

Logout

Figure 8- Super-Admin Dashboard



# 4. Results and Discussions

Smart Meter | Admin Dashboard

The screenshot shows the Admin Dashboard interface for a smart meter system. The top navigation bar includes links for Smart Meter, Admin Dashboard, Dashboard, Analysis, Prediction, Billing, and Map. On the left, a sidebar lists Available Meters: Block 8 (Department of Ele...), Boys Hostel, Main Transformer, Physics Department (Bloc...), Bio-Tech Department (Blo...), Block 11 (Department of Ci...), and Block 10 (Department of M...). The main content area is titled "Admin Dashboard" and "Manage data collection and meters". It features tabs for "Data Collection" (selected) and "Meters". A header section displays "Nepal Time (NPT)" (Asia/Kathmandu (UTC+5:45)), the current time "19:01" (Current time), and three status cards: Status (Stopped), Schedule (No schedule), and Interval (Not set). Below this is the "Collection Timeline" section, which indicates "Last Collection" (No collections yet) and "Next Collection" (Collection stopped). The "Controls" section contains "Start Collection" and "Run Now" buttons. At the bottom, a "Collection Info" box states: "Data is automatically collected from all configured meters during the scheduled time window (Nepal Time). Use 'Run Now' to trigger an immediate collection". The footer of the dashboard includes a "Logout" link and the user information "Sudit Rasalli" (sudit-admin@gmail.com) and "Admin".

Figure 9.1. - Admin Dashboard



# 4. Results and Discussions

Smart Meter | Admin Dashboard

The Admin Dashboard interface includes a sidebar with navigation links like Dashboard, Analysis, Prediction, Billing, and Map. It also shows a list of available meters under 'Available Meters'. The main area features a 'Meter Management' section with a 'List View' tab selected, showing 7 meters configured. Below this is an 'Add New Meter' button. A scrollable list displays five meter entries: 'Block 8 (Department of Electrical and Electronics)' (SN: C249361B), 'Boys Hostel' (SN: D4C3566B), 'Main Transformer' (SN: F51C3384), 'Physics Department (Block 6)' (SN: CD0FF6AB), and 'Bio-Tech Department (Block 7)'. Each entry has a 'Delete' button next to it. The bottom of the sidebar shows user information (Sudit Rasali, sadit-admin@gmail.com) and an 'Admin' button.

**Admin Dashboard**  
Manage data collection and meters

Data Collection **Meters**

**Meter Management**  
7 meters configured

**Add New Meter** + Add Meter

**Block 8 (Department of Electrical and Electronics)**  
SN: C249361B

**Boys Hostel**  
SN: D4C3566B

**Main Transformer**  
SN: F51C3384

**Physics Department (Block 6)**  
SN: CD0FF6AB

**Bio-Tech Department (Block 7)**

**Admin Dashboard**

Sudit Rasali  
sadit-admin@gmail.com

**Admin**

**Logout**

Figure 9.2. – Admin Dashboard

# 4. Results and Discussions

- *Results :*

- Clear visualization of consumption trends*

- Voltage stability monitoring*

- Peak load identification*

- Monthly and daily billing summaries*

- Improved transparency in energy usage*

*System enables data-driven decision-making for energy planning.*

# 4. Results and Discussions

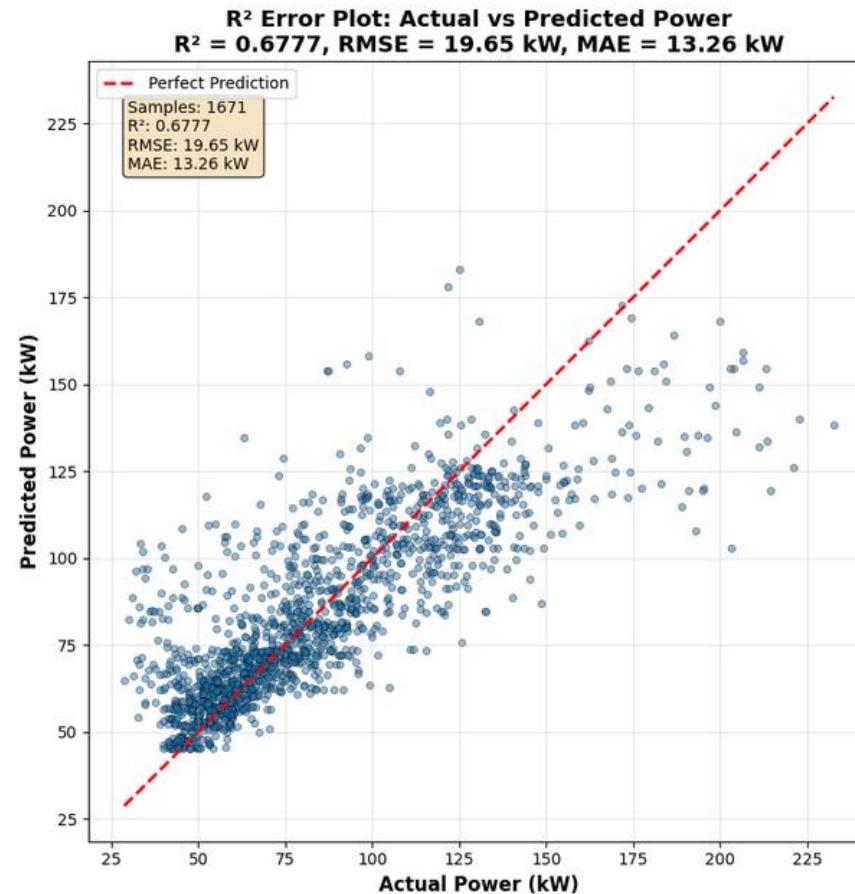


Figure 10 - R<sup>2</sup> Error Plot : Actual vs Predicted Power

# 4. Results and Discussions

- *Results :*

- Predictions closely follow actual values*

- Model captures non-linear consumption patterns*

- Useful for anticipating peak demand*

- Supports proactive energy management.*

# 5. Conclusion and Future Works

- Developed a scalable real-time smart meter monitoring system.
- Integrated IoT APIs with a web-based analytics dashboard.
- Implemented AI-based forecasting for predictive insights.
- Enabled role-based secure access control.
- Provides a foundation for smart grid research and campus-wide energy optimization.

# 5. Conclusion and Future Works

- *Limitations:*
  - Dependence on external API availability*
  - Forecast accuracy depends on historical data quality*
  - Web-based access only*
- *Future Enhancements*
  - Real-time anomaly detection and automated alerts*
  - Mobile application support*
  - Advanced deep learning forecasting models*
  - Energy optimization and sustainability recommendations*



# 6. References

- [1] ThingsBoard. Open-source IoT platform. <https://thingsboard.io/>
- [2] Kaa IoT. Smart metering solutions. <https://www.kaaiot.com/>
- [3] Oakter. OakMeter energy monitoring system. <https://oakter.com/>
- [4] IAMMETER API Documentation. <https://www.iammeter.com/docs/system-api>

# THANK YOU!