Battery Health Prediction System

Leveraging Data Science and Machine Learning to Predict Battery Maintenance

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Project Overview

1

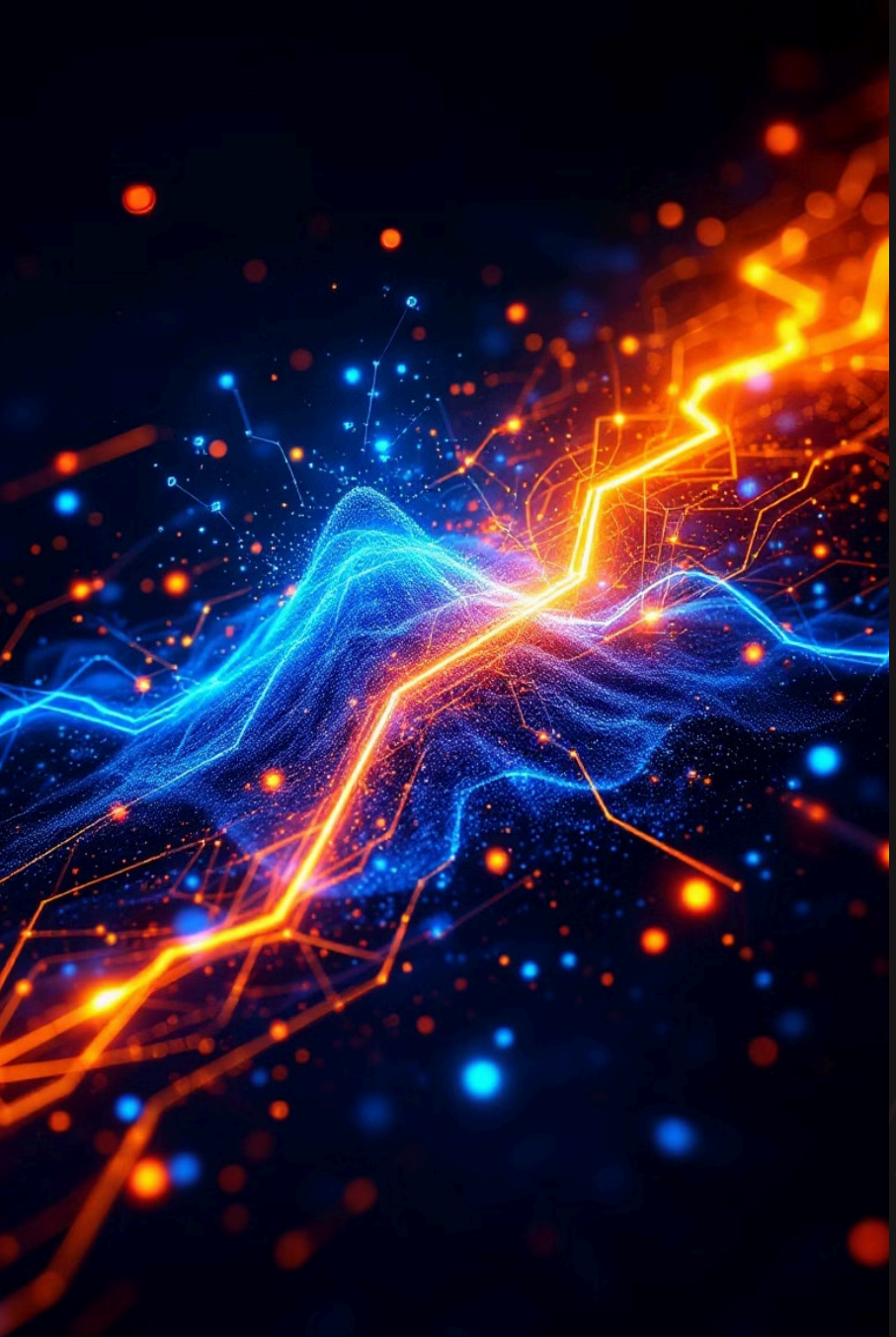
Objectives

- Provide recommendations to increase battery cycle life.
- Provide recommendations to the battery maintenance team to improve service quality.

2

Key Components

Data preparation and EDA. Feature engineering and model training. Predictive maintenance dashboard.



Data Story Overview

1

Data Collection

Gather raw battery data from IoT sensors.

2

Analysis & Modeling

Clean data and build predictive models.

3

Actionable Insights

Estimate cycle life and identify maintenance needs.

System Architecture

Data Collection

IoT sensors

Data Processing

Pandas, NumPy, Scikit-learn

Visualization

Dash dashboard for real-time monitoring

Modeling

CatBoostRegressor for cycle life prediction

Data Exploration

Dataset Overview

Source: InfluxDB (90-day retention).

Key features(Factors): Temperature, voltage, SOC Patterns, current, cycle count, Environmental Factors, Alarms and Faults.

Data Challenges

Sparse data, categorical features, and missing values.

Data Cleaning

Handle missing values. Encode categorical features. Aggregate sparse data.

Feature Engineering

Key Features

Temperature (internal, surface, BMS PCB). Voltage (cell, total). SOC, current, cycle count.

Derived Features

Time Analysis. Voltage standard deviation. Voltage range. Temperature differences.

Categorical Features

Location type. Battery status. FET states, AlarmDesc.

Model Development

1

Model Selection

CatBoostRegressor handles categorical features and missing data.

2

Training Process

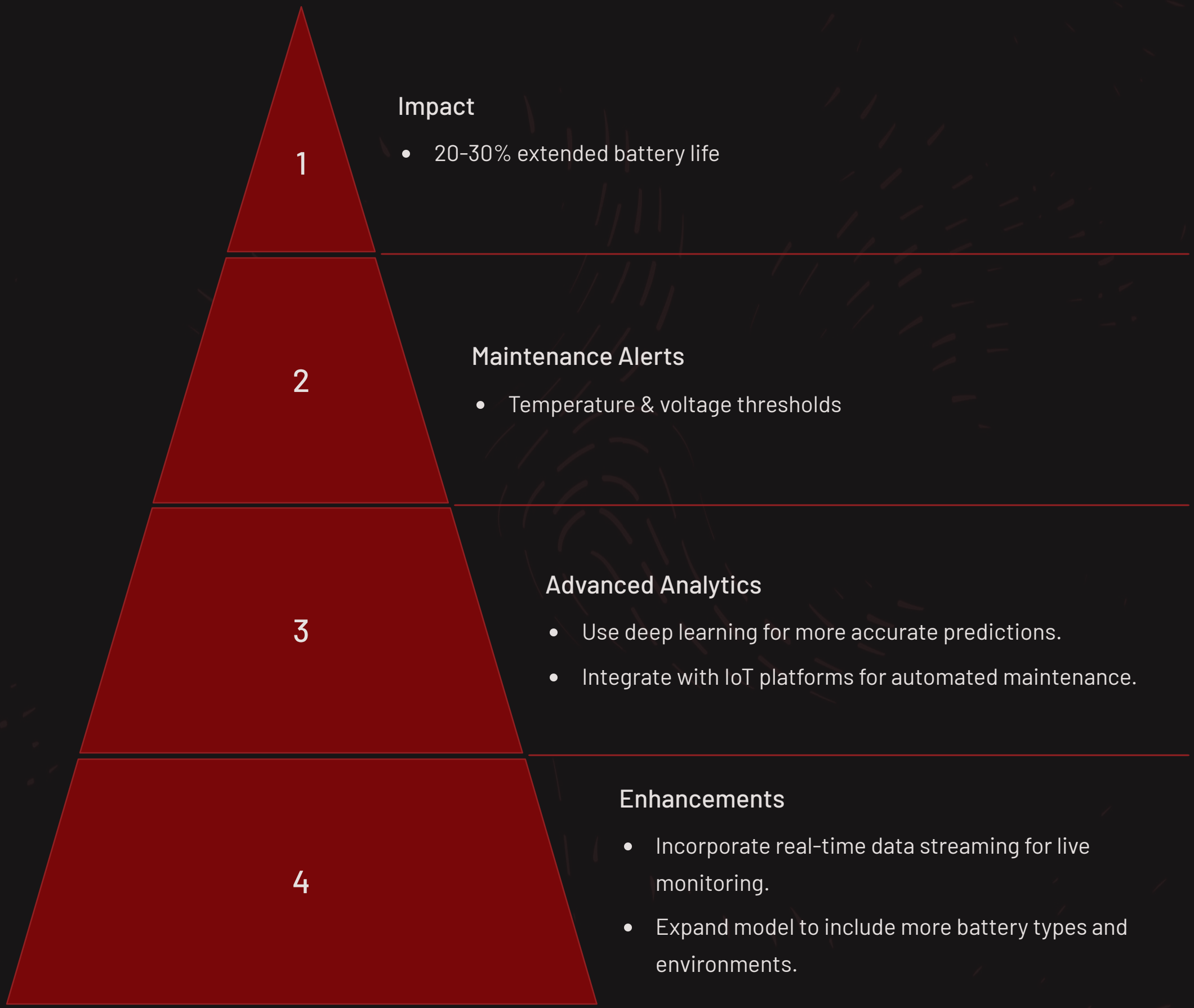
Split data into training and testing sets. Train on key features. Where Number_of_Cycles was considered as the target variable.

3

Performance

MSE: 0.0066, R^2: 0.9989 (excellent performance).

Predictive Insights & Future Work



Impact

- 20-30% extended battery life

Maintenance Alerts

- Temperature & voltage thresholds

Advanced Analytics

- Use deep learning for more accurate predictions.
- Integrate with IoT platforms for automated maintenance.

Enhancements

- Incorporate real-time data streaming for live monitoring.
- Expand model to include more battery types and environments.