Electric Vehicle Charging Demand Forecasting

Abstract

This project focuses on forecasting the demand at Electric Vehicle (EV) charging stations using historical charging data, traffic conditions, and weather information. With the increasing adoption of EVs, predicting charging demand is crucial for efficient energy management and infrastructure planning. Time-series forecasting techniques were applied to predict future charging loads, and interactive dashboards were developed using Power BI to visualize demand trends and forecast results.

Introduction

The rapid growth of electric vehicles has significantly increased the demand for charging infrastructure. Efficient utilization of EV charging stations requires accurate demand forecasting to avoid congestion, reduce waiting times, and optimize energy consumption. This project aims to analyze historical EV charging data and predict future charging demand based on temporal patterns, traffic density, and weather conditions.

Tools Used

Python was used for data preprocessing, exploratory data analysis, and time-series forecasting. Key Python libraries included Pandas, NumPy, Matplotlib, and Statsmodels. Power BI was used to create interactive dashboards for visualizing charging demand trends, peak hours, weather impact, and forecasted versus actual demand.

Steps Involved in Building the Project

The project began with data collection and cleaning, including handling missing values and converting time fields. The data was then aggregated at an hourly level for each charging station. Exploratory data analysis was performed to understand demand patterns. A SARIMAX time-series model was built to forecast charging demand using weather and traffic as external variables.

Finally, the processed data and forecast results were visualized in Power BI using line charts, heatmaps, and scatter plots.

Conclusion

The EV Charging Demand Forecasting project successfully demonstrated how data analytics and time-series modeling can support smarter energy and infrastructure planning. The results highlight clear demand patterns influenced by time, traffic, and weather conditions. The forecasting model provides valuable insights for optimizing charging station operations, enabling better resource allocation and improved user experience.