

Wind Turbine SCADA Performance Analysis

Assignment: 5

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Domain: AI / Machine Learning

Abstract

This project analyzes wind turbine SCADA data using Machine Learning and Deep Learning techniques to evaluate turbine performance, forecast power generation, detect anomalies, and generate AI-based insights.

1. Exploratory Data Analysis

EDA was performed to understand turbine behavior using time-series plots, scatter plots, and missing value analysis.

2. Time-Series Forecasting

Supervised learning models were trained to forecast wind speed, power output, theoretical power, and wind direction using windowed sequences.

3. Anomaly Detection

Isolation Forest was used to detect under-performance anomalies by comparing actual and theoretical power output.

4. AI Turbine Performance Score

An AI-based performance score between 0 and 100 was generated to classify turbine health and suggest maintenance actions.

5. Deep Learning - CNN

A Convolutional Neural Network (CNN) was built for image classification, including confusion matrix, predictions, and Grad-CAM visualization.

Conclusion

The project successfully demonstrates the integration of Machine Learning, Deep Learning, and Explainable AI for wind turbine performance monitoring.