

Predictive Maintenance in Solar Power Systems with Enhanced Household Power Management

College Name: Renganayagi Varatharaj College of Engineering

Student Name: SIVA S,Gowtham T,Nanthakumar G,Periyasamy A

The problem

Explain the role of solar power in clean energy and the challenges of maintaining large solar farms. Highlight how equipment breakdown, especially inverters, can reduce power output.

Key Objectives:

Proactive Inverter Failure Prediction:

Develop models to anticipate inverter issues, reducing downtime.

Increase System Lifespan:

Implement predictive maintenance to prevent breakdowns and extend equipment life.

Optimize Household Energy Use:

Use consumption data to distribute solar power efficiently.

Enhance Sustainability:

Reduce waste and environmental impact through smart, data-driven maintenance.

Datasets Overview:

Solar Power Generation Data:

UK Solar Farms (UKPVGeo):

Data on solar panel locations and configurations in the UK.

Solar Power Data:

Provides daily generation metrics, helping model power output trends and detect anomalies.

Electricity Consumption Data:

Indian Household Electricity Consumption:

Detailed household energy usage, aiding in effective solar energy distribution.

Dutch and General Electric Power Consumption:

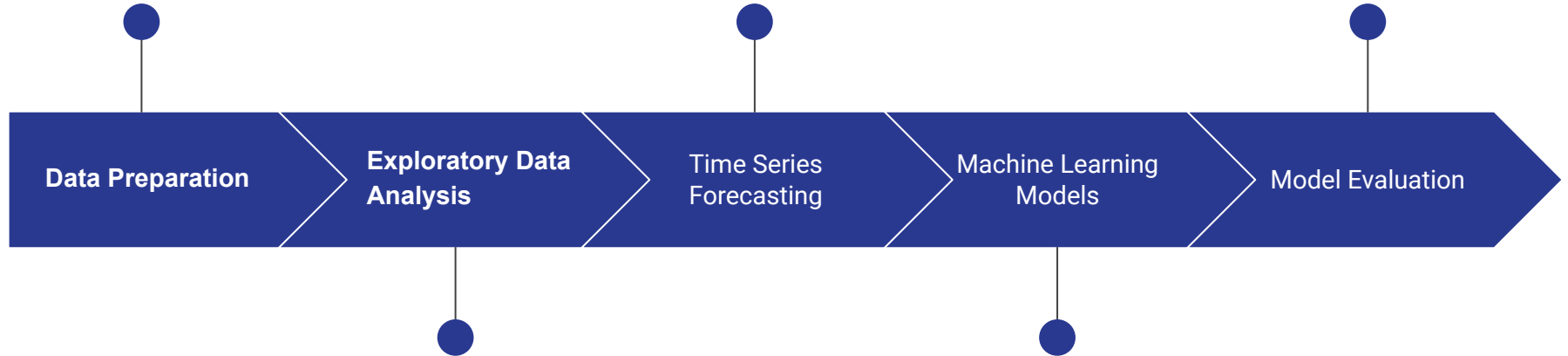
Broader data for comparative analysis and optimization.

Methodology

Loaded and preprocessed generation and weather datasets.

ARIMA/SARIMA: Assessed stationarity and forecasted daily yield.
Facebook Prophet: Forecasted trends and seasonal patterns.

Compared predictions to actual values using error metrics.



Visualized trends in daily yield, AC/DC power, and weather data.

Random Forest & XGBoost: Predicted daily yield and evaluated feature importance.

Enhanced Methodology for Solar Power Management:

Data Preprocessing: Improved handling of time-series data for better accuracy.

Exploratory Data Analysis (EDA): Comprehensive visualizations to understand trends and patterns.

Predictive Modeling:

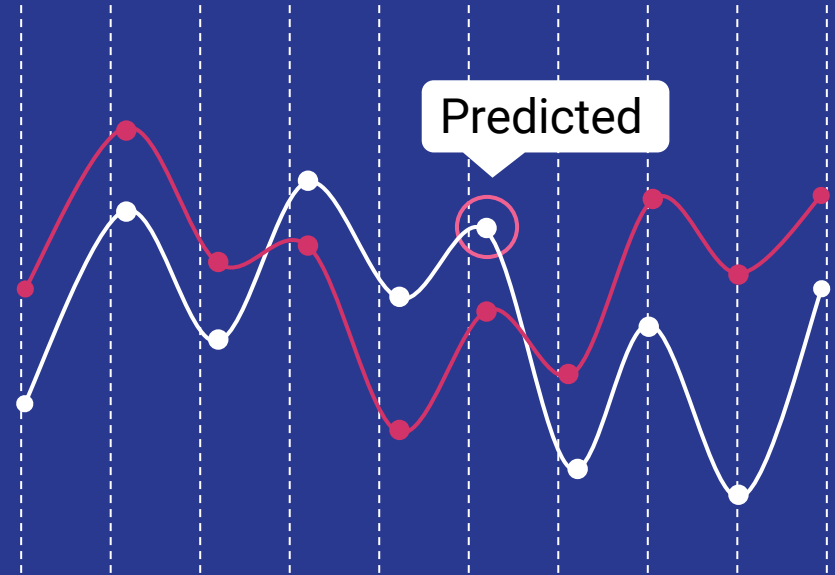
ARIMA/SARIMA: Effective for time series forecasting, capturing seasonality and trends.

Facebook Prophet: Robust handling of missing data and seasonal effects.

Random Forest & XGBoost: Enhanced yield predictions through ensemble learning techniques.

Significant Improvements: Increased accuracy and reliability in solar power generation insights.

Predictive Maintenance: Better identification of inverter failures and efficiency optimization.



Conclusion:

— — —

Summary:

The adoption of predictive maintenance strategies has proven effective in reducing operational downtime and enhancing the reliability of solar power systems. Integrating household energy data has not only optimized energy utilization but also resulted in cost savings.

Future Work:

Plans include enhancing model accuracy by incorporating additional data sources and exploring real-time power distribution adjustments to further improve efficiency.

References

Datasets:

UK Solar Farms: [Link](#)

Solar Power Generation Data (Kaggle):
[Link](#)

Indian Household Electricity
Consumption (Kaggle): [Link](#)

Electric Power Consumption (Kaggle):
[Link](#)

Dutch Energy Consumption: [Link](#)

