INTERNATIONAL TELECOMMUNICATION UNION
TELECOMMUNICATION STANDARDIZATION SECTOR
STUDY PERIOD 2022-2024

FOCUS GROUP ON AI NATIVE NETWORKS

AINN-I-xx

Original: English

Question(s): N/A | Virtual, TBD 2024

INPUT DOCUMENT

Source: *CDAC*

Title: *NatureLover Team - Report on ITU WTSA Hackathon 2024 – AI boosted Interpretable Renewable Energy Forecasting*

Contact: Akash Shinde E-mail: akashshinde1418@gmail.com

Abstract: This document contains the submission of a report for *NatureLovers team* towards ITU WTSA Hackathon 2024 for use case AI boosted Interpretable Renewable Energy Forecasting.

Use case introduction:

"AI boosted Interpretable Renewable Solar Energy Forecasting"

Problem Statement

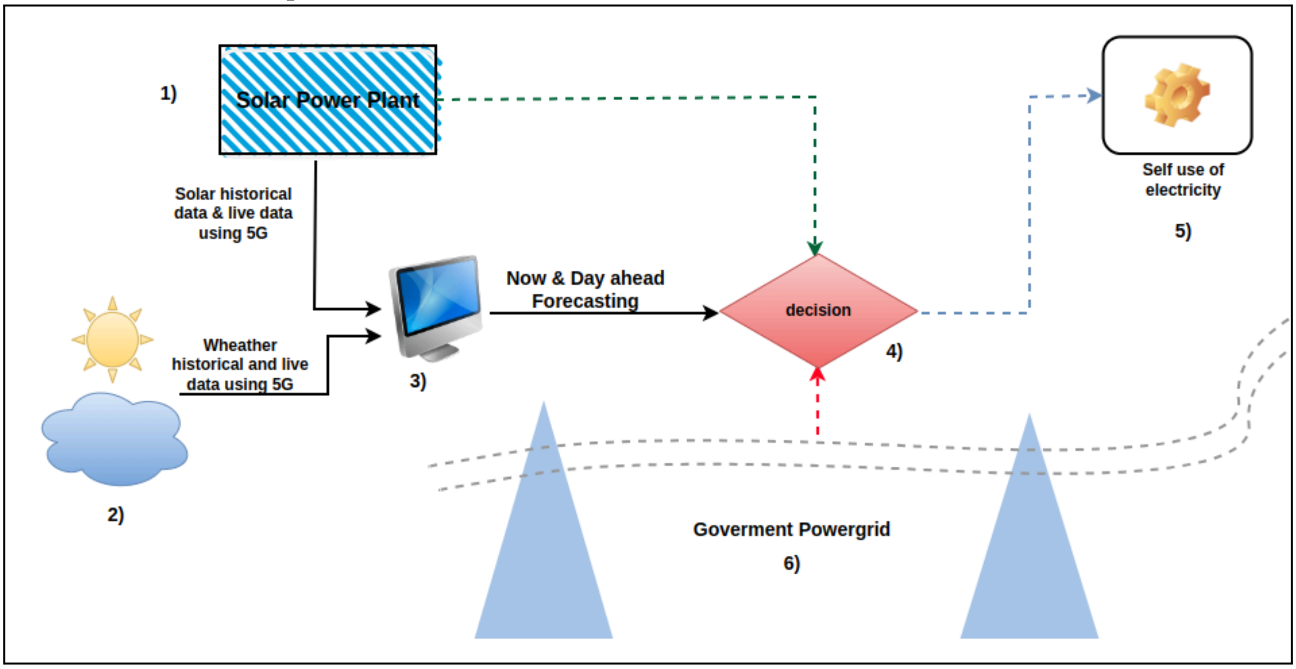
1. **Intermittent Solar Energy Production**: Solar energy production is highly variable due to factors such as weather conditions, cloud cover, and seasonal changes. This variability poses a challenge for private and government electricity producers in managing supply and demand.
2. **Electricity Trading and Grid Management**: Efficient electricity trading and grid stability require accurate forecasts to balance production with consumption, prevent overloading, and plan maintenance activities effectively.
3. **Limitations of Traditional Forecasting**: Traditional models, typically based on simple regression techniques, often suffer from low accuracy and lack interpretability, making it difficult for grid operators to trust and act on the predictions.

Objective

To develop an AI-based solution that provides accurate and interpretable short-term (nowcasting) and long-term (day ahead) forecasting of solar energy production. This solution will assist in:

- **Optimizing Electricity Trading**: Helping private producers decide when to use or sell electricity.
- **Power Grid Management**: Enabling government companies to manage grid stability and schedule maintenance activities efficiently.

Consider the scene map below:



Proposed Solution

1. Data Collection and Preprocessing

- **Data Sources**:
  - Historical solar power generation data from private and government plants.
  - Weather data (temperature, cloud cover, humidity, etc.).
  - Geospatial data (location, altitude, orientation of panels, etc.).
- **Data Preprocessing**:
  - Cleaning and handling missing data.
  - Feature engineering (e.g., creating derived features like solar irradiance).
  - Data normalization and scaling.

2. Modeling Techniques

- **Conventional tree Based AI Models**: For capturing complex interaction between features **and Interpretation.**
  - Decision Tree
  - Random Forest
  - GRadient Boost
- **Nowcasting Approach**:
  - Real-time or near real-time predictions using recent data and rapid adaptation to changing conditions.
- **Long-term Forecasting**:
  - Predictions for a longer horizon, using a combination of historical data and predictive analytics.

3. Interpretability Techniques

- **Visualization**:
  - Heatmaps, feature importance plots, and time-series visualizations to effectively communicate the model's insights to grid operators.

4. Deployment and Integration

- **API Development**: For integrating with existing systems used by electricity producers and grid managers.
- **Real-time Dashboard**: For visualizing predictions, uncertainties, and explanations.
- **Alerts and Notifications**: For proactive decision-making and grid management.

Potential Benefits

- **Improved Accuracy**: AI models can learn complex patterns and interactions, significantly enhancing the accuracy of solar energy forecasts.
- **Enhanced Interpretability**: Model interpretability tools make AI predictions more transparent, increasing trust and usability among grid operators.
- **Operational Efficiency**: Accurate forecasting enables optimized trading and efficient grid management, reducing costs and improving reliability.

Future Directions

- **Incorporating External Data**: Using satellite imagery, real-time weather data, and IoT devices for enhanced prediction accuracy.
- **Collaboration with Energy Stakeholders**: Working closely with energy producers, grid operators, and policymakers to fine-tune models and integrate them into operational workflows.

Use case requirements

1. It’s required to use numerical weather prediction data for day-ahead forecasting.
2. It’s required to use measured power data from renewable power plants, which is always private, for model training.
3. It’s required to use real-time observed weather data for error analysis.

Relation to Standards

1. SDG 7: Affordable and Clean Energy
2. SDG 9: Industry, Innovation, and Infrastructure
3. SDG 11: Sustainable Cities and Communities