Weather-Based Prediction of Wind Turbine Energy Output: A Next-Generation Approach to Renewable Energy

Date	1 oct 2025
Team ID	LTVIP2025TMIDS40838
Project Name	Weather-Based Prediction of Wind Turbine Energy Output: A Next-Generation Approach to Renewable Energy
Maximum Marks	3 Marks

Phase 1: Project Initialization and Planning

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1. Proposed Solution Overview

The proposed solution is a machine learning-based predictive system that estimates wind turbine energy generation using real-time and historical weather data. By analyzing key meteorological parameters such as wind speed, air pressure, temperature, and humidity, the system predicts the potential energy output, helping wind farm operators optimize energy production and reduce wastage.

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2. System Architecture / Approach

1. Data Collection: Weather data will be collected from reliable APIs and historical datasets.
2. Data Preprocessing: Cleaning, normalization, and feature engineering to prepare data for model training.
3. Model Development: Multiple machine learning models (e.g., Linear Regression, Random Forest, Gradient Boosting) will be trained.
4. Model Evaluation: Models will be evaluated using metrics like RMSE, MAE, and R^2 score.
5. Optimization and Tuning: Hyperparameter tuning and feature selection to improve accuracy.
6. Deployment: Best-performing model will be deployed via a Flask web application for user-friendly prediction.

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3. Technologies Used

- **Python –** For data analysis, preprocessing, and model development.
- Pandas, NumPy, Scikit-learn, Matplotlib/Seaborn – For data handling, visualization, and machine learning.
- Flask – To create a simple web interface for predictions**.**

- **Jupyter Notebook –** For model development, testing, and documentation.

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4. Expected Results

- Accurate prediction of wind energy output based on weather conditions.
- Reduced energy wastage and optimized turbine utilization.
- A deployable system accessible via a web interface for operators and planners.

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5. Timeline / Milestones

Milestone	Duration
Data Collection & Preprocessing	1 week
Model Development	2 weeks
Model Evaluation & Selection	1 week
Optimization & Tuning	1 week
Deployment via Flask	1 week
Documentation & Submission	1 week