Project Design Phase-II
Technology Stack (Architecture & Stack)

Date	15 February 2026
Team ID	LTVIP2026TMIDS62246
Project Name	Weather-Based Prediction of Wind Turbine Energy Output: A Next-Generation Approach to Renewable Energy Management
Maximum Marks	4 Marks

Technical Architecture:

The system architecture for the Wind Turbine Energy Prediction project integrates data preprocessing, machine learning model training, external weather API integration, and a Flask-based web application.
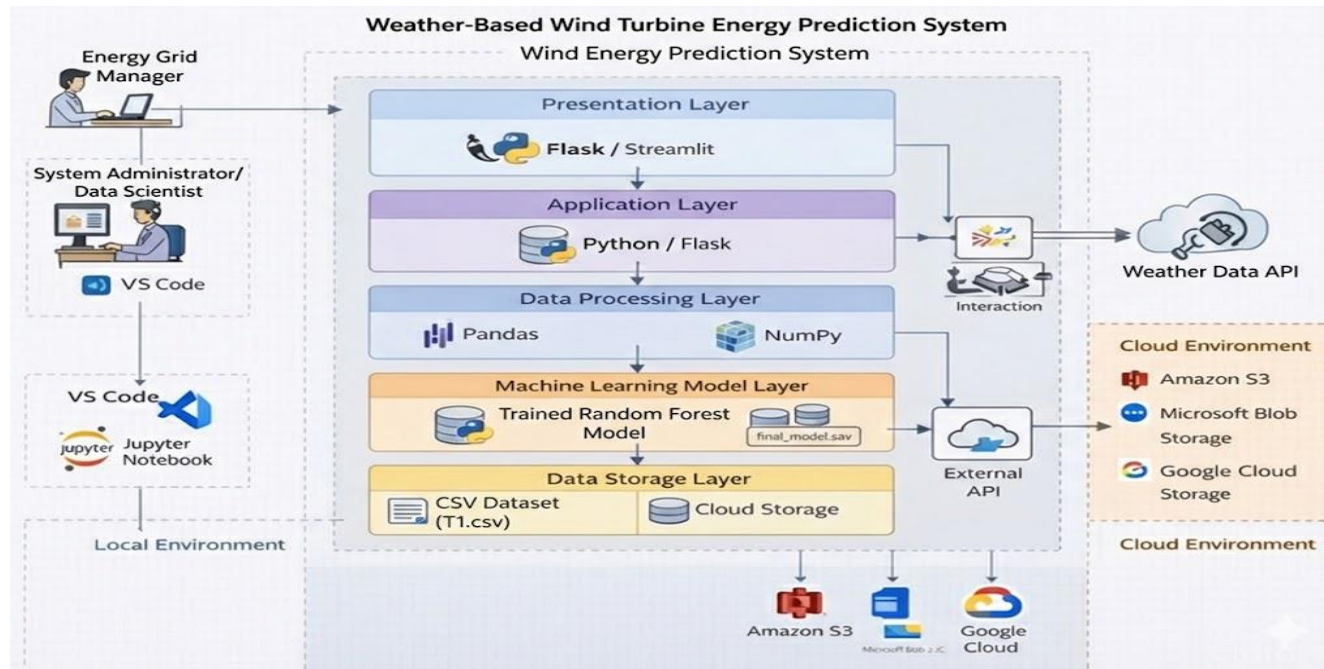
Table-1: Components & Technologies

S. No	Component	Description	Technology
1.	User Interface	Web interface for user interaction including home page and prediction dashboard	HTML, CSS, Flask Templates
2.	Application Logic	Handles user input, validates data, and processes ML prediction requests	Python (Flask, Pandas, Scikit-learn)
3.	Data Preprocessing Module	Cleans dataset, renames columns, handles missing values, performs train-test split	Python (NumPy, Pandas)
4.	Model Training & Evaluation	Trains Random Forest model and evaluates performance using R^2, MAE, MSE, RMSE	Scikit-learn, Matplotlib
5.	Dataset Storage	Stores historical wind turbine dataset	CSV File (Local Storage)
6.	File Storage	Stores trained model file and dataset	Local File System (.sav, .csv)
7.	Machine Learning Model	Predicts wind turbine energy output based on weather parameters	Random Forest Regressor
8.	External API (Optional)	Fetches live weather conditions (if integrated)	OpenWeather API
9.	Infrastructure	Application hosting environment	Local Flask Server

Table-2: Application Characteristics

S. No	Characteristic	Description	Technology
1.	Open-Source Frameworks	Libraries used for machine learning and web development	Flask, Scikit-learn, Pandas, NumPy, Matplotlib
2.	Security	Input validation and safe handling of user data	Flask validation, basic input sanitization
3.	Architecture	3-tier architecture (UI → Backend → ML Model)	Flask-based structure
4.	Availability	System accessible when Flask server is running locally	Local Server
5.	Performance	Optimized model for quick prediction (response < 3 seconds)	Random Forest Model
6.	Scalability (Future Scope)	Can be deployed to cloud platforms for scalability	AWS / GCP / Azure (Future Integration)

This design phase shows your project as a professional architecture document:

- Table-1 captures the components and technologies.

- Table-2 highlights application characteristics