Project Design Phase-I
Proposed Solution

Date	24 September 2022
Team ID	PNT2022TMID39908
Project Name	Predicting the wind turbine energy output based on weather conditons

Proposed Solution :

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	The number of wind farms is increasing every year because many countries are turning their attention to renewable energy sources. Wind turbines are considered one of the best alternatives to produce clean energy. Most of the wind farms installed supervisory control and data acquisition (SCADA) system in their turbines to monitor wind turbines and logged the information as time-series data. It demands a powerful information extraction process for analysis and prediction. In this research, we present a data analysis framework to visualize the collected data from the SCADA system and recurrent neural network-based variant long short-term memory (LSTM) based prediction. The data analysis is presented in cartesian, polar, and cylindrical coordinates to understand the wind and energy generation relationship. The four features: wind speed, direction, generated active power, and theoretical power are predicted and compared with state-of-the-art methods. The obtained results confirm the applicability of our model in real-life scenarios that can assist the management team to manage the generated energy of wind turbines.
2.	Idea / Solution description	Idea : Integration with grid, Integration with electricity markets. Solution description: Kalman filter is an appropriate solution to various problems such as: complexity in data, over-fitting and outliers of input data generated during learning process . As Unscented Kalman Filter (UKF) achieves higher efficiency in handling random fluctuations, so it is an economical and adequate choice for non-linear estimation of wind speed
3.	Novelty / Uniqueness	Wind energy provides more than 20% of total electricity generation in 11 states, with more than 50% in Iowa and South Dakota, and more

		than 30% in Kansas, Oklahoma, and North Dakota. Overall, wind energy supplied more than 9% of total U.S. electricity generation in 2021. Wind turbines are big. Wind turbine blades average 200 feet long, and turbine towers average over 300 feet tall—about the height of the Statue of Liberty.
4.	Social Impact / Customer Satisfaction	Social Impact: Wind energy projects provide many economic benefits to neighboring communities: jobs, a new source of revenue for farmers and ranchers in the form of land lease payments, and an increased local tax base. Customer satisfaction: Wind turbines do not release emissions that can pollute the air or water (with rare exceptions), and they do not require water for cooling. Windmills provided medieval society with a reliable source of energy that helped initiate a thirteenth-century Industrial Revolution.
5.	Business Model (Revenue Model)	To identify the minimal subset of driving weather features that are significantly related to the wind energy output of the wind farm. To let genetic programming express these relationships in the form of explicit input-output regression models, and To select model ensembles for improved generalization capabilities of energy predictions and to analyze the quality of produced model ensembles using an unseen test set.
6.	Scalability of the Solution	The scalability concept refers to the ability of a system to increase the capacity or dimensions of its design parameters in order to supply or withstand a larger demand. A system is scalable when its design parameters increase the size of the system by keeping its performance and function and retaining all its desired properties without a corresponding increase in its internal complexity.