Date	01 November 2022
Team ID	**PNT2022TMID05596**
Project Name	**PREDICTING THE ENERGY OUTPUT OF WIND TURBINE BASED ON WEATHER CONDITION**
Maximum Marks	4 Marks

SYSTEM ARCHITECTURE – METRICS

The models operating on the production server would work with the real-life data and provide predictions to the users. The below mentioned framework represents the most basic way data scientists handle deep learning.

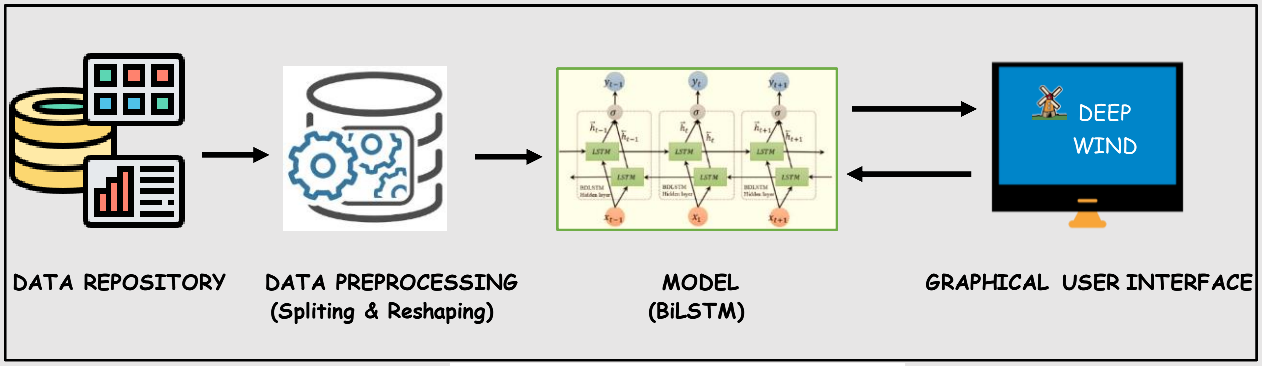

Figure: System Architecture

1. Data Collection:

Collecting the required data is the beginning of the whole process. Data repository has the repository of all the data related to weather conditions and power generated. The data which is used to train the model is obtained from National Renewable Energy Laboratory (NREL) to do this analysis. The dataset contains the details about timestamp, air temperature (°C), pressure (atm), wind direction (deg), wind speed (m/s) and Power generated by the system (kW). We have hourly data for about 6 years (i.e) almost 52000 entries.

Input Parameters:

- **Wind Speed (m/s):**

  Higher wind speeds generate more power because stronger winds allow the blades to rotate faster. Faster rotation translates to more mechanical power and more electrical power from the generator.

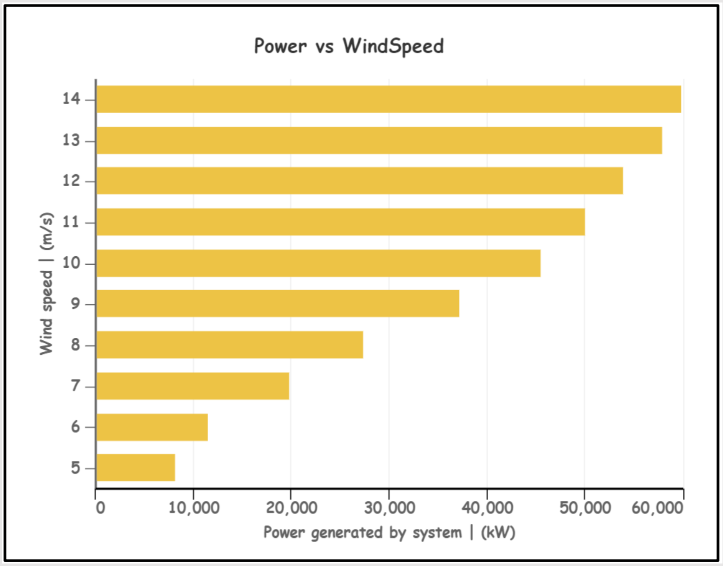

Figure: Graph of Power versus Wind Speed

- **Air Temperature (°C):**

Wind speeds increase with a greater temperature difference. If the temperature is too high, the air density will be low, which will lessen the energy output. If the temperature is too low, the blades and other parts might be frozen, and the wind turbine will stop working. Fig.4.3 shows the variation of power output with respect to air temperature.

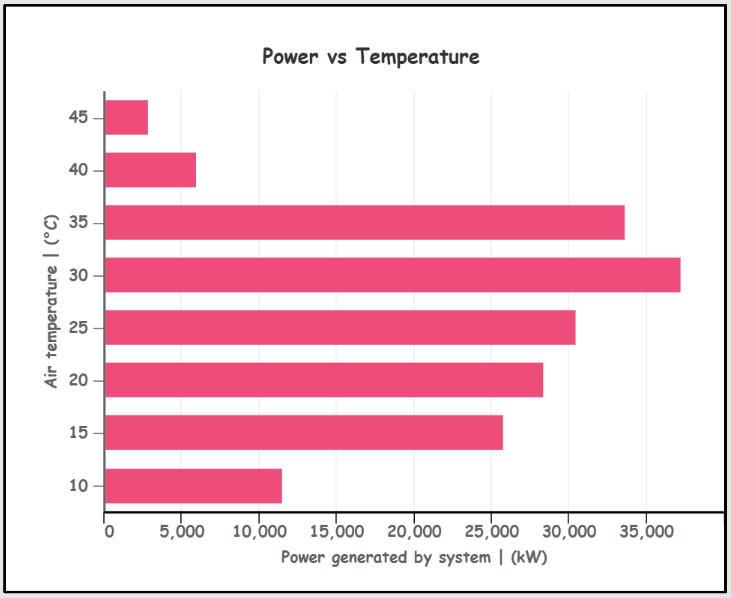

Figure: Graph of Power versus Air Temperature

- **Air Pressure (atm):**

When air slows down, its pressure increases. This means that higher wind speeds will show lower air pressure readings. Fig.4.4 shows the variation of power output with respect to air pressure. We can conclude that wind power increases with decrease in air pressure.

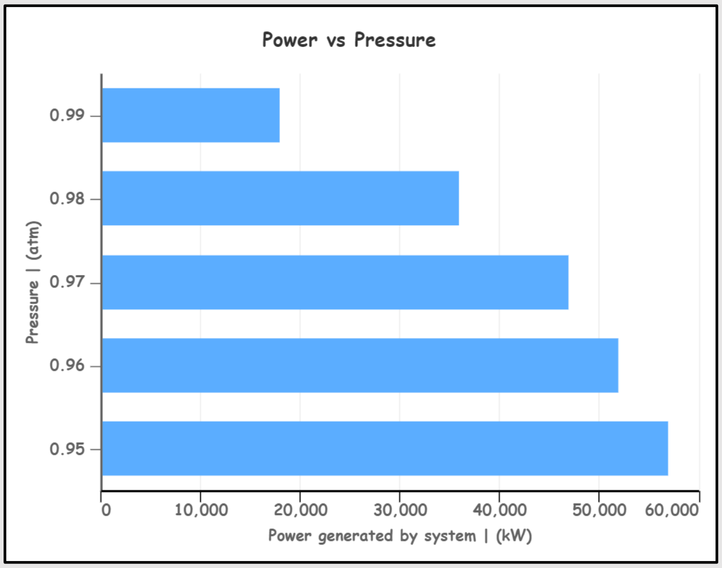

Figure: Graph of Power versus Air Pressure

- **Wind Direction (deg):**

Wind flow direction affects the turbines, reducing the wind speed and increasing turbulence for the wind turbines. A weather vane is a instrument which shows the direction the wind is blowing. Getting more nearer to 360° (north), wind speed increases, so severe winds blow from north generating more power. Fig.4.5 shows the variation of power output with respect to wind direction.

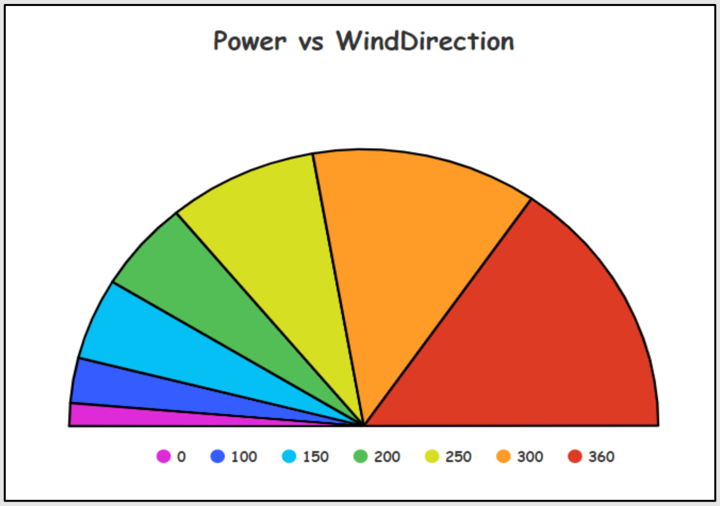

Figure: Graph of Power versus Wind Direction

From all the above graphs we can able to learn the pattern in the data very well. Wind speed available at the wind farm is a crucial parameter. Other parameters that influence the energy output are for example temperature, pressure, wind direction. Our goal is to make use of the correlation of these parameters with respect to the energy output.

$$\textbf{Power (kW)} = \frac{\textbf{(wind speed)}^3 * \textbf{wind direction} * 10}{\textbf{pressure} * \textbf{temperature (in °F)}}$$