Predicting the Energy Output of Wind Turbine by using machine learing

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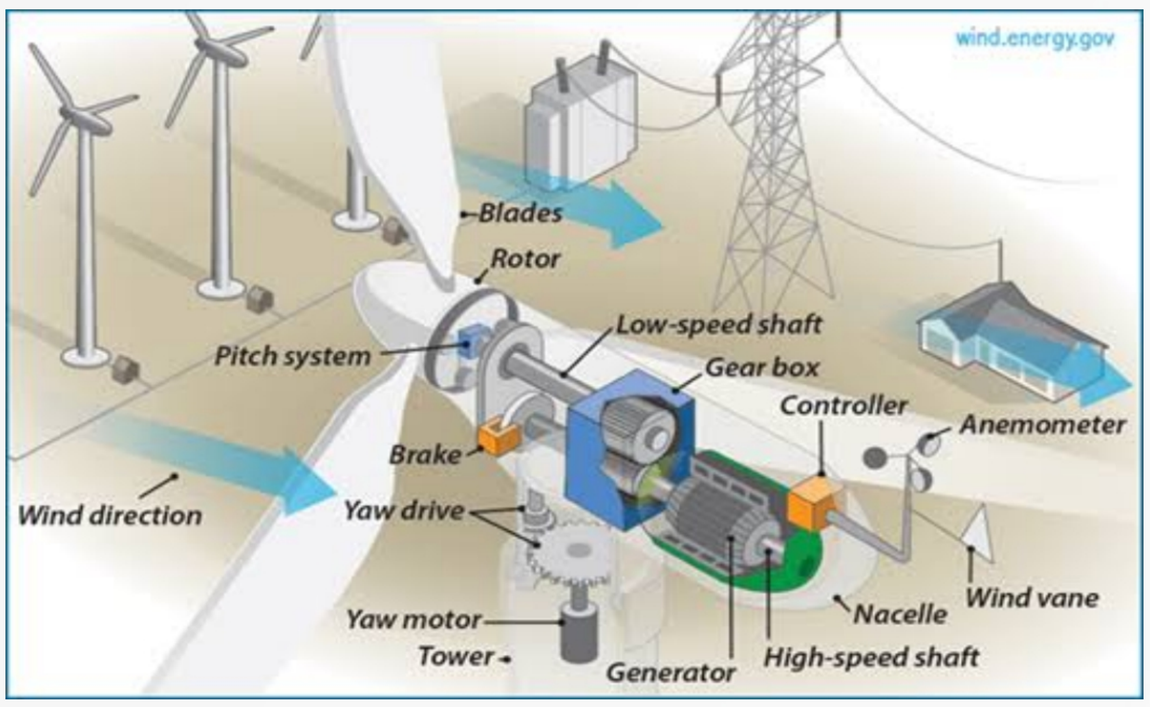
Abstract

Wind turbine power output is known to be a strong function of wind speed, but is also affected by turbulence and shear. In this work, new aerostructural simulations of a generic 1.5 MW turbine are used to rank atmospheric influences on power output. Most significant is the hub height wind speed, followed by hub height turbulence intensity and then wind speed shear across the rotor disk. These simulation data are used to train regression trees that predict the turbine response for any combination of wind speed, turbulence intensity, and wind shear that might be expected at a turbine site. For a randomly selected atmospheric condition, the accuracy of the regression tree power predictions is three times higher than that from the traditional power curve methodology. The regression tree method can also be applied to turbine test data and used to predict turbine performance at a new site. No new data are required in comparison to the data that are usually collected for a wind resource assessment. Implementing the method requires turbine manufacturers to create a turbine regression tree model from test site data. Such an approach could significantly reduce bias in power predictions that arise because of the different turbulence and shear at the new site, compared to the test site.

Introduction

Wind energy plays a major role in providing energy worldwide. Renewable energies are set to conquer the global energy system faster than any other fuel in history. A wind farm's energy output depends heavily on the weather conditions present at its site. A wind performance forecast is an estimation of the production expected of one or more wind turbines.If the output can indeed be predicted more effectively, the energy providers can more effectively organize the joint development of various energy sources to avoid expensive overproduction

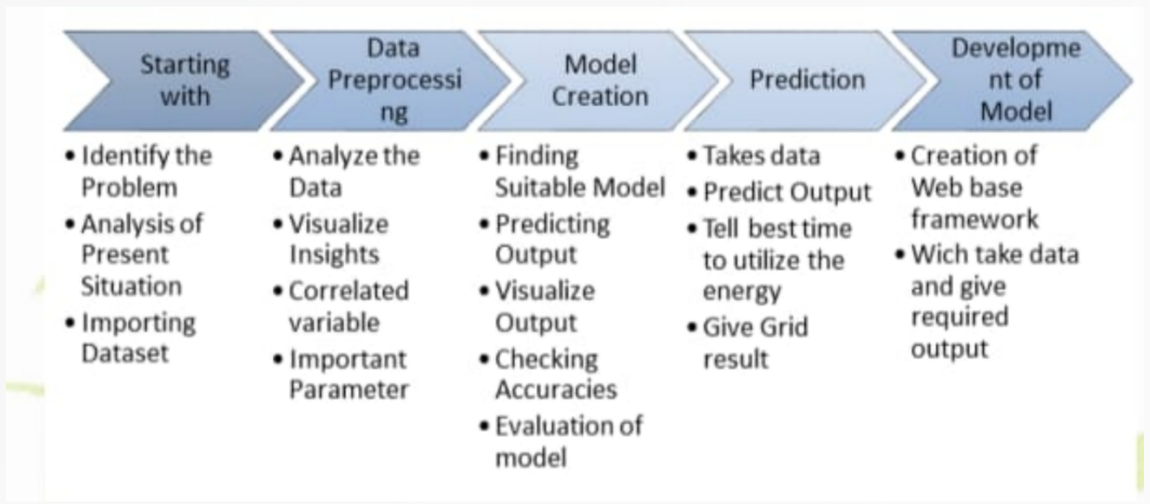


Objective

This project facilitates:

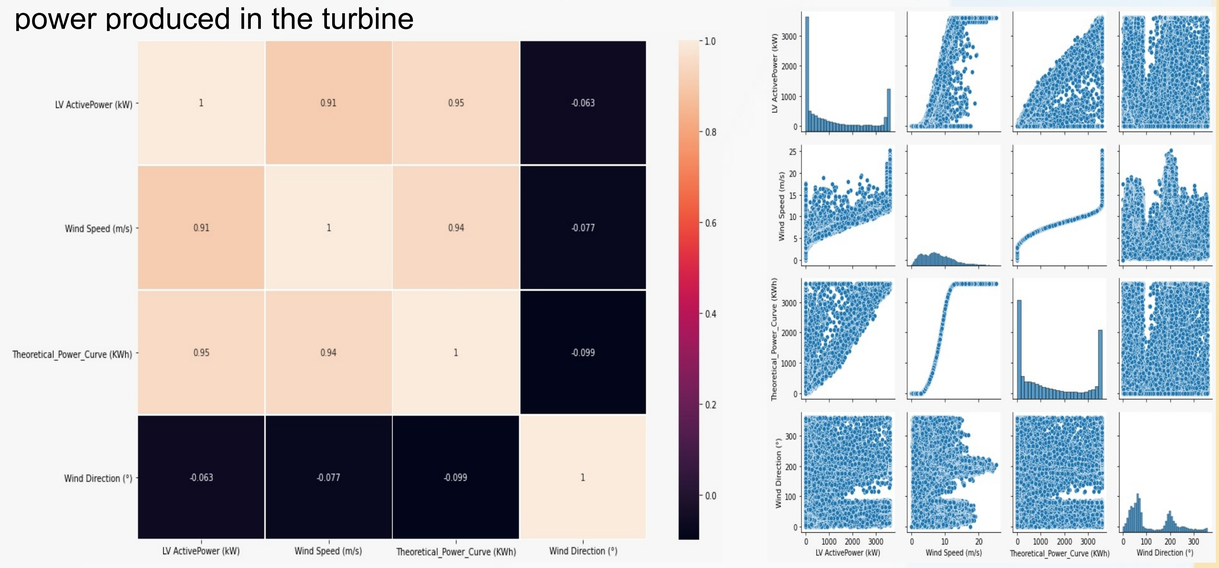
- Identifying most significant features for wind power prediction.
- Continuous learning and model improvement by hybrid ensemble with data and function perturbation.
- Predicting best time for wind farm energy utilization.
- Integrating weather conditions for predicting various time periods like per day, per week, per month, and annual reports for wind energy generation.
- Graphical representations and reports to support various business decisions on
- improving wind energy generation.
- Balancing production and utilization of the wind energy

Block Diagram



Results

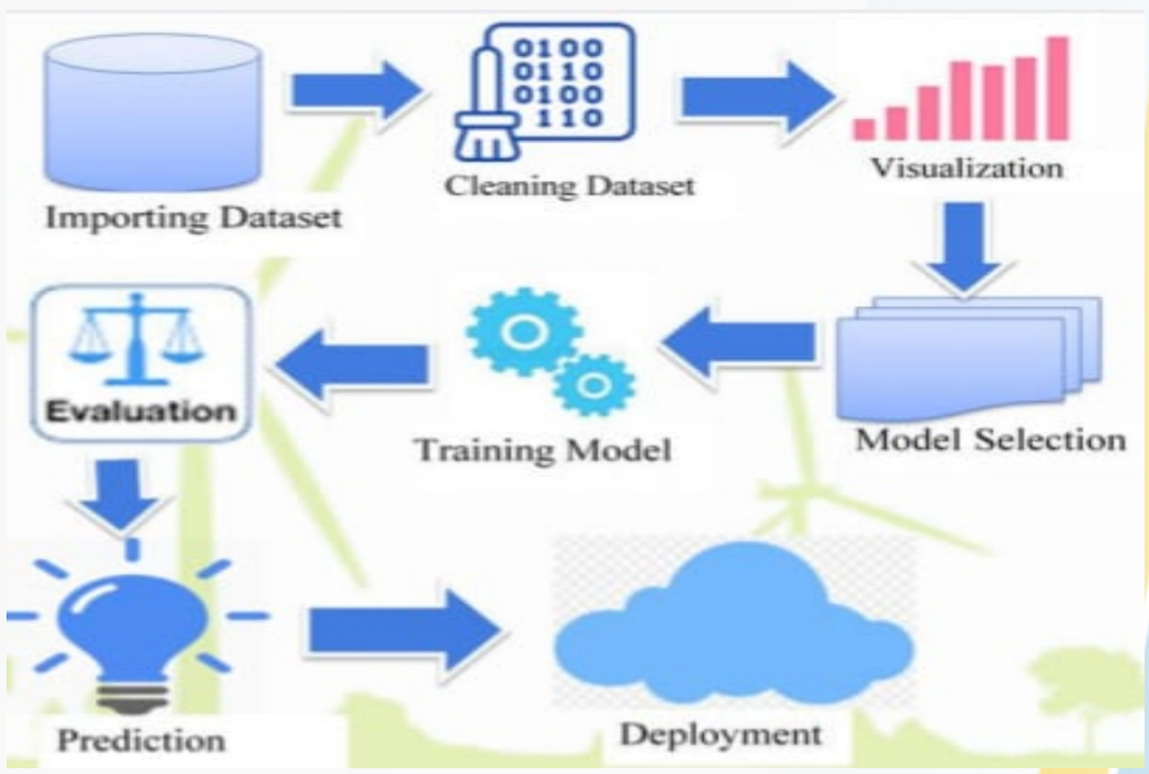
According to the wind speed and wind direction in different months the model give the required power produced in the turbine.Wind speed,wind direction,month is taken as the input in the model.Active power is taken as the output which is the power produced in the turbine



Model Working

FLOWCHART: Project modules and working

- Shows the flow of project modules implementation.
- Represents generalized project steps carried and their synchronization.



Counclusion & Future Scope

As seen from results and discussion, the proposed algorithms give satisfying results for ten-minute measurements. For short term prediction, large number of training data is not required.Predictions are quitesatisfying if model is trained on just one day if one day ahead is being predicted. For long term predictions, larger dataset would have to be used for training which would include data for all four seasons.To identify more environment parameters for testing their impact on wind energy generation.To avail on-demand supply of wind energy. To predict customer usage pattern and try to map with the wind energy generation for better business production.

Bibilography

[1]. Board, J., & Dashboard, C. P. S. A not-for-profit organization, IEEE is the world's largesttechnical professional organization dedicated to advancing technology for the benefit of humanity.

[2]. Ekaterina Vladislavleva, Tobias Friedrich, Frank Neumann, Markus Wagner, Predicting the energy output of wind farms based on weather data: Important variables and their correlation, Renewable Energy, Volume 50, 2013, Pages 236-243

[3]. Chen, N., Qian, Z., Nabney, I. T., & Meng, X. (2013). Wind power forecasts using Gaussian processes and numerical weather prediction. IEEE Transactions on Power Systems, 29(2), 656-665.

[4]. [Online] https://www.energy.gov/eere/wind/2018-wind-market-reports.

[5]. [Online] Dataset-Historical Weather API and Kaggle