**Predicting Energy of Wind Turbine**

**1.INTRODUCTION:-**

**1.1.Overview:-**

Wind power generation differs from conventional thermal generation due to the stochastic nature of wind. Thus wind power forecasting plays a key role in dealing with the challenges of balancing supply and demand in any electricity system, given the uncertainty associated with the wind farm power output. Accurate wind power forecasting reduces the need for additional balancing energy and reserve power to integrate wind power. For a wind farm that converts wind energy into electricity power, a real-time prediction system of the output power is significant. In this guided project , a prediction system is developed with a method of combining statistical models and physical models. In this system, the inlet condition of the wind farm is forecasted by the auto regressive model.

**1.2.Purpose:-**

Wind energy plays an increasing role in the supply of energy worldwide. The energy output of a wind farm is highly dependent on the weather conditions present at its site. If the output can be predicted more accurately, energy suppliers can coordinate the collaborative production of different energy sources more efficiently to avoid costly overproduction. The main purpose of this project to predict the output related to the energy produced by the wind turbine on the basis of wind speed, wind direction and capacity of LV power used by the turbine.

**2.LITERATURE SURVEY:-**

**2.1. Existing problem:-**

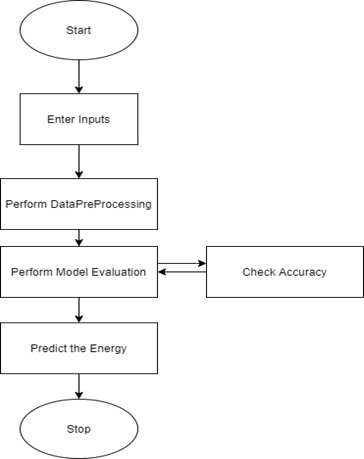
* Design and successful operation of wind energy conversion systems is a very complex task and requires the skills of many interdisciplinary skills.
* Performance of WECs depends upon subsystems like wind turbine whereas the availability of wind resources are governed by the climatic conditions of the region concerned for which wind survey is extremely important to exploit wind energy.
* We have no idea related to the energy generated by the wind turbines at all climatic situations.

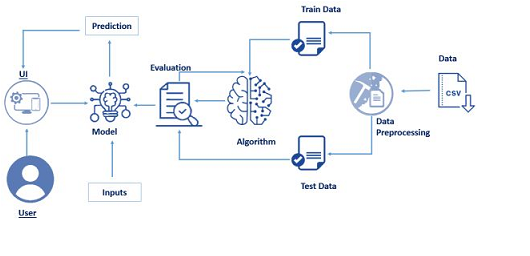
**2.2. Proposed solution:-**

* The proposed solution for the problem is first we need to collect the data related to the energy prediction of wind turbines at certain situations.
* According to the collected data we perform different actions for getting the best energy predicted from the given power and based on weather conditions.
* The use of this method may increase the energy predicted from the windturbines at any any weather conditions and decreases the maintenancecost.

**3.THEORITICAL ANALYSIS:-**

**3.1.Block diagram:-**



**3.2.Technical Architecture:**

**3.3.Hardware/software designing**

**Software Requirements:**

* OS – Windows XP,7,8,10
* Jupyter Software
* Spyder Software
* Anaconda Command Prompt

**Hardware Components:**

* Processor – i3
* Hard Disk Storage – 10 GB
* RAM – 1GB

**4.EXPERIMENTAL INVESTIGATIONS:-**

The main objective of this research is to investigate the effect of attaching nozzle lens with difference diameter and number of blades in non-twisted NACA 4415 on the power output of the Horizontal Axis Wind Turbine . The Artificial of low wind speed were used in this experiment at 2.5 m/s, 3.5 m/s, and 4.5 m/s. The result shows that the lenses increase the power output. The lens diameter is directly proportional to the rotor speed and TSR of the turbine. In the difference number of blades, the three-blades turbine consistently generates the highest power output compared to two-blades and four-blades turbines. The evidence has established that nozzle lenses and three-blades turbine can successfully increase the efficiency of wind turbines in areas where wind speed is low.

**5.Results:-**

This Energy Prediction process constitutes of three steps. These steps are mentioned below:

· There are two inputs to be considered they are Theoretical Power and Wind Speed

\* Theoretical Power is taken from the user.

\* Wind Speed of a place is extracted from Open Weather

website.

· In the next step we use the prediction by train and testing the data which is analyzed during the process of accuracy calculation.

· The output is generated related to the analysis based on the data collected related to the prediction of energy on various conditions.

**6.ADVANTAGES AND DISADVANTAGES:-**

**Advantages:-**

* Wind is a reliable and infinite renewable energy resource.
* Wind energy is cost effective, and prices are dropping still
* Wind energy reduces carbon emissions when used instead of fossil fuels
* Few running costs when the turbines are up and running.
* Offshore wind farms can take advantage of offshore wind flow, without affecting the landscape view.

**Disadvantages:**

* Wind energy can be unpredictable as the amount of electricity generated is dependent on the speed and direction of the wind.
* Wind farms can affect the visual appearance of the landscape.
* Wind turbines can damage the habitats of birds and marine life.
* Wind farms can be expensive to construct.

**7.APPLICATIONS:-**

* **Generation of Electricity**:

Windmills harness wind energy to create electricity. Its a clean & green form of energy.

* **Transportation**:

The power of the wind is used for propulsion in sailing vessels and sail boats

* **Pumping water:**

Similar to windmills the energy from the wind is used to drive a pump.

* **Milling Grains:**

Grain milling is certain locations are done using wind energy.

* **Sports**:

A number of sports use wind energy as their source like Wind Surfing, Land Surfing, Kite boarding.

**8.CONCLUSION :-**

This method proves that the accuracy related to the prediction of energy related to the wind turbines can be calculated related to the LV power and wind related aspects which helps in the increase of production of electricity and manages the issues related to the wind turbines energy prediction and maintenance.

**9.FUTURE SCOPE :-**

The Prediction of Energy from the Wind Turbines has a great advantage related to the data collected from the performance of the wind turbines based on various inputs. This helps to increase the performance related to the energy supply and other weather condition under the basis of wind speed and direction. This makes the production of electricity easy and increase of the supply related to power for consumption.

**10.BIBILOGRAPHY:-**

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2. Butterfield, C.P.; Musial, W.P.; Scott, G.N.; Simms, D.A. (1992). NREL Combined Experiment Final Report-Phase II (draft). NREL!IP-442-4807. Golden, CO: National Renewable Energy Laboratory

3. Eggleston, D.M.; Starcher, KL. (November 1990). "A Comparative Study of the Aerodynamics of Several Wind Turbines Using Flow Visualization." Journal of Solar Energy Engineering. Vol. 112. New York, NY: American Society of Mechanical Engineers

4. Titresher, R.W.; Wright, A.D. (January 1989). Prediction of Stochastic Blade Responses Using Measured Wind-Speed Data as Input to the FLAP Code. SER.I/IP-217-3394. Golden, CO: Solar Energy Research Institute.

**Source Code(Model Building):**

import numpy as np

import pandas as pd

import seaborn as sns

import matplotlib.pyplot as plt

import joblib

path = "T1.csv"

df=pd.read\_csv(path)

df.rename(columns={'Date/Time':'Time','LV ActivePower(kw)':'ActivePower(kw)',"Wind Speed(m/s)":"WindSpeed(m/s)","Wind Direction(°)":"Wind\_Direction"},inplace=True)

corr=df.corr()

plt.figure(figsize=(10,8))

ax=sns.heatmap(corr,vmin=-1,vmax=1,annot=True)

bottom,top=ax.get\_ylim()

ax.set\_ylim(bottom+0.5,top - 0.5)

plt.show()

corr

df.drop(['Wind Direction (°)'],axis=1,inplace=True)

y=df['LV ActivePower (kW)']#'Theoretical\_Power\_Curve(kWh)'

x=df[['Theoretical\_Power\_Curve (KWh)','Wind Speed (m/s)']]#'ActivePower(kW)'

from sklearn.model\_selection import train\_test\_split

train\_x, val\_x, train\_y, val\_y = train\_test\_split(x, y,test\_size=0.2,random\_state = 0)

from sklearn.ensemble import RandomForestRegressor

from sklearn.metrics import mean\_absolute\_error,r2\_score

forest\_model=RandomForestRegressor(max\_leaf\_nodes =500,random\_state=1)

forest\_model.fit(train\_x, train\_y)

power\_preds = forest\_model.predict(val\_x)

print(mean\_absolute\_error(val\_y, power\_preds))

print(r2\_score(val\_y,power\_preds))

joblib.dump(forest\_model, "power\_prediction.sav")

import requests

apikey = "43ce69715e2133b2300e0f8f7289befd"

resp = requests.get("http://api.openweathermap.org/data/2.5/weather?q=London&appid="+apikey)

print (resp.json())

resp=resp.json()

temp = resp["main"]["temp"]

humid= resp["main"]["humidity"]

pressure = resp["main"]["pressure"]

humid = resp["wind"]["speed"]

print (temp, humid, pressure, humid)

**Source Code(Application Building):**

import numpy as np

from flask import Flask, request, jsonify, render\_template

import joblib

import requests

app = Flask(\_\_name\_\_)

model = joblib.load('power\_prediction.sav')

@app.route('/')

def home():

return render\_template('intro.html')

@app.route('/predict')

def predict():

return render\_template('predict.html')

@app.route('/windapi',methods=['POST'])

def windapi():

city=request.form.get('city')

apikey="43ce69715e2133b2300e0f8f7289befd"

url="http://api.openweathermap.org/data/2.5/weather?q="+city+"&appid="+apikey

resp = requests.get(url)

resp=resp.json()

temp = str(resp["main"]["temp"]-273.15)+" °C"

humid = str(resp["main"]["humidity"])+" %"

pressure = str(resp["main"]["pressure"])+" mmHG"

speed = str(resp["wind"]["speed"])+" m/s"

return render\_template('predict.html', temp=temp, humid=humid, pressure=pressure,speed=speed)

@app.route('/y\_predict',methods=['POST'])

def y\_predict():

'''

For rendering results on HTML GUI

'''

x\_test = [[float(x) for x in request.form.values()]]

prediction = model.predict(x\_test)

print(prediction)

output=prediction[0]

return render\_template('predict.html', prediction\_text='The energy predicted is {:.2f} KWh'.format(output))

if \_\_name\_\_ == "\_\_main\_\_":

app.run(debug=True)

**Output:**

