Predicting the energy output of wind turbine based on weather condition

TEAM ID: PNT2022TMID51318

TEAM MEMBERS:

ABIN RAJ

ASOLIN SAM

SIVA KANNAN

AKILAN

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Introduction

Project Overview

Wind power generation differs from conventional thermal generation due to the stochastic nature of wind. Therefore, we examine the impact of different weather conditions on the energy output of wind farms. Accurate wind power forecasting reduces the need for additional balancing energy and reserve power to integrate wind power. 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.

Purpose

The prediction of wind power plays an indispensable role in maintaining the stability of the entire power grid. Due to its renewable resources and environmental friendliness, wind speed/power has gained increasing interest worldwide. The wind industry is rapidly expanding into a large-scale industry as a result of the fast-rising amount of installed wind generating capacity worldwide. When it comes to scheduling power systems and other practical aspects of wind energy conversion, such as the dynamic management of wind turbines, reliable short-term wind speed forecasts are essential. A precise forecast is required to solve issues with variable energy production brought on by changing weather patterns. The wind speed has a big impact on how much power is produced by the wind. Despite being quite nonlinear, wind speed exhibits a consistent pattern over a specific amount of time. 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.

Literature Survey

Existing Problem

The prediction of wind power plays an indispensable role in maintaining the stability of the entire power grid. Due to its renewable resources and environmental friendliness, wind speed/power has gained increasing interest worldwide. The wind industry is rapidly expanding into a large-scale industry as a result of the fast-rising amount of installed wind generating capacity worldwide. When it comes to scheduling power systems and other practical aspects of wind energy conversion, such as the dynamic management of wind turbines, reliable short-term wind speed forecasts are essential. A precise forecast is required to solve issues with variable energy production brought on by changing weather patterns. The wind speed has a big impact on how much power is produced by the wind. Despite being quite nonlinear, wind speed exhibits a consistent pattern over a specific amount of time. 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.

References

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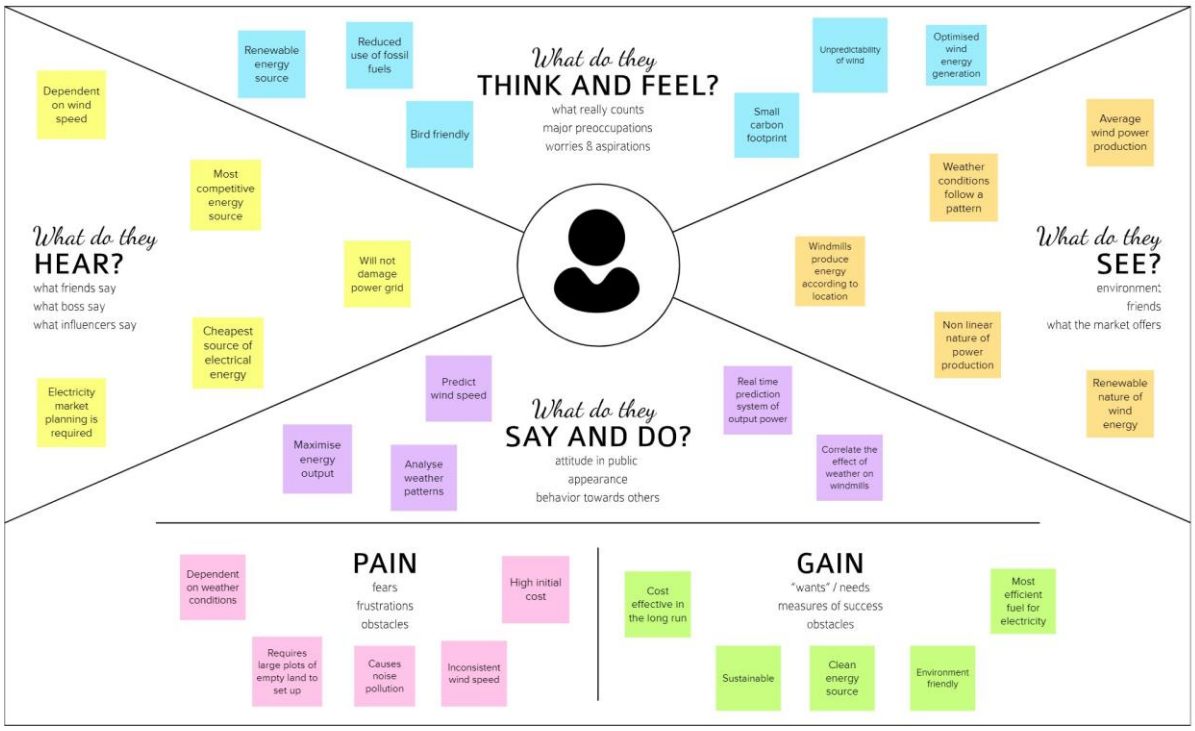
Problem Statement Definition

Wind power generation differs from conventional thermal generation due to the stochastic nature of wind. Therefore, we examine the impact of different weather conditions on the energy output of wind farms. Accurate wind power forecasting reduces the need for additional balancing energy and reserve power to integrate wind power. 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. User interacts with the UI (User Interface) to enter Data.
2. The entered data is analyzed by the model which is integrated.
3. Once model analyses the input the prediction is showcased on the UI

Ideation and Proposed Solution

Empathy Map



Ideation and Brainstorming

Avantika

- Check wind direction and wind speed in different outdoor temperatures
- Analyze model performance on different sites
- Check frequency of wind speed and determine it's likely output energy
- Number of windmills in a wind farm contribute to energy output

Shruthi

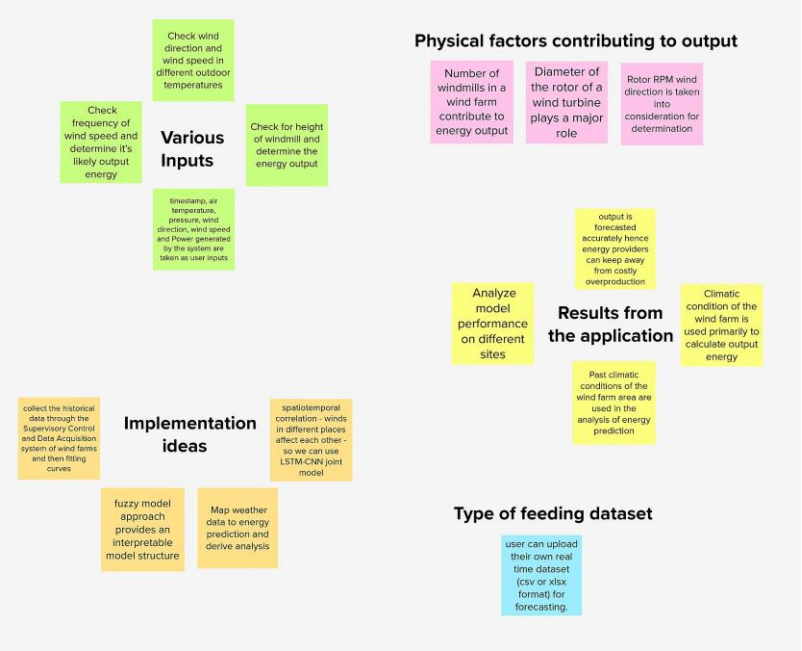
- Check for height of windmill and determine the energy output
- Diameter of the rotor of a wind turbine plays a major role
- Climatic condition of the wind farm is used primarily to calculate output energy
- output is forecasted accurately hence energy providers can keep away from costly overproduction

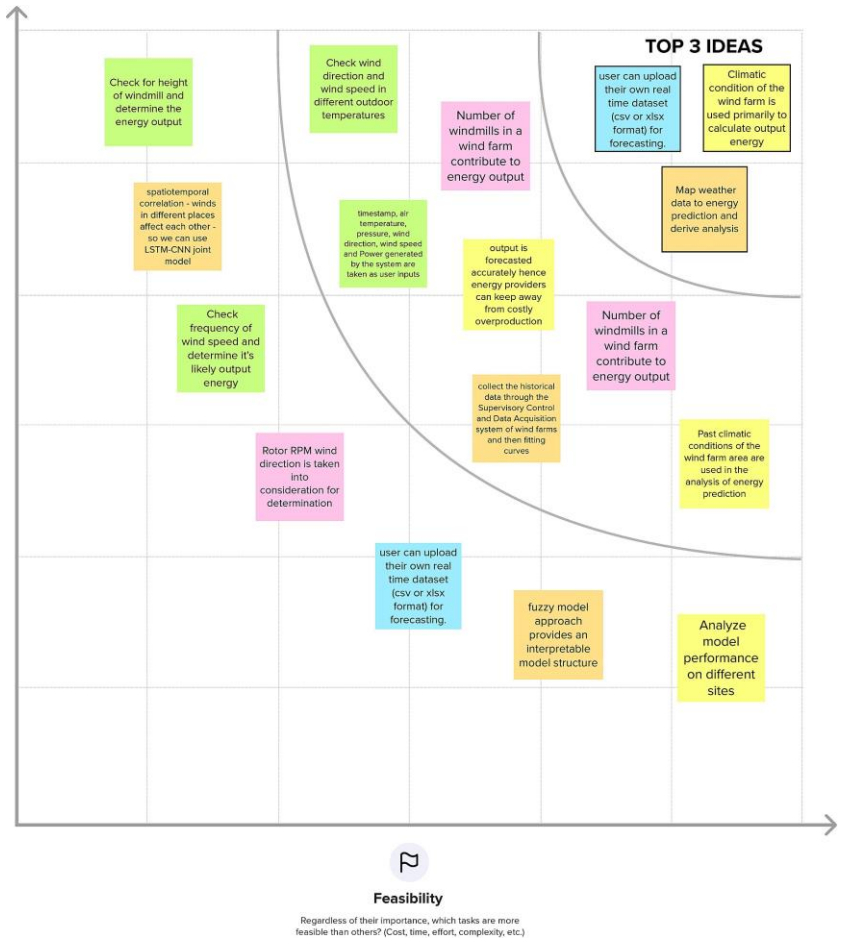
Sweta

- Rotor RPM wind direction is taken into consideration for determination
- collect the historical data through the Supervisory Control and Data Acquisition system of wind farms and then fitting curves
- spatiotemporal correlation - winds in different places affect each other - so we can use LSTM-CNN joint model
- fuzzy model approach provides an interpretable model structure

Subhiksha

- Map weather data to energy prediction and derive analysis
- Past climatic conditions of the wind farm area are used in the analysis of energy prediction
- user can upload their own real time dataset (csv or xlsx format) for forecasting.
- timestamp, air temperature, pressure, wind direction, wind speed and Power generated by the system are taken as user inputs

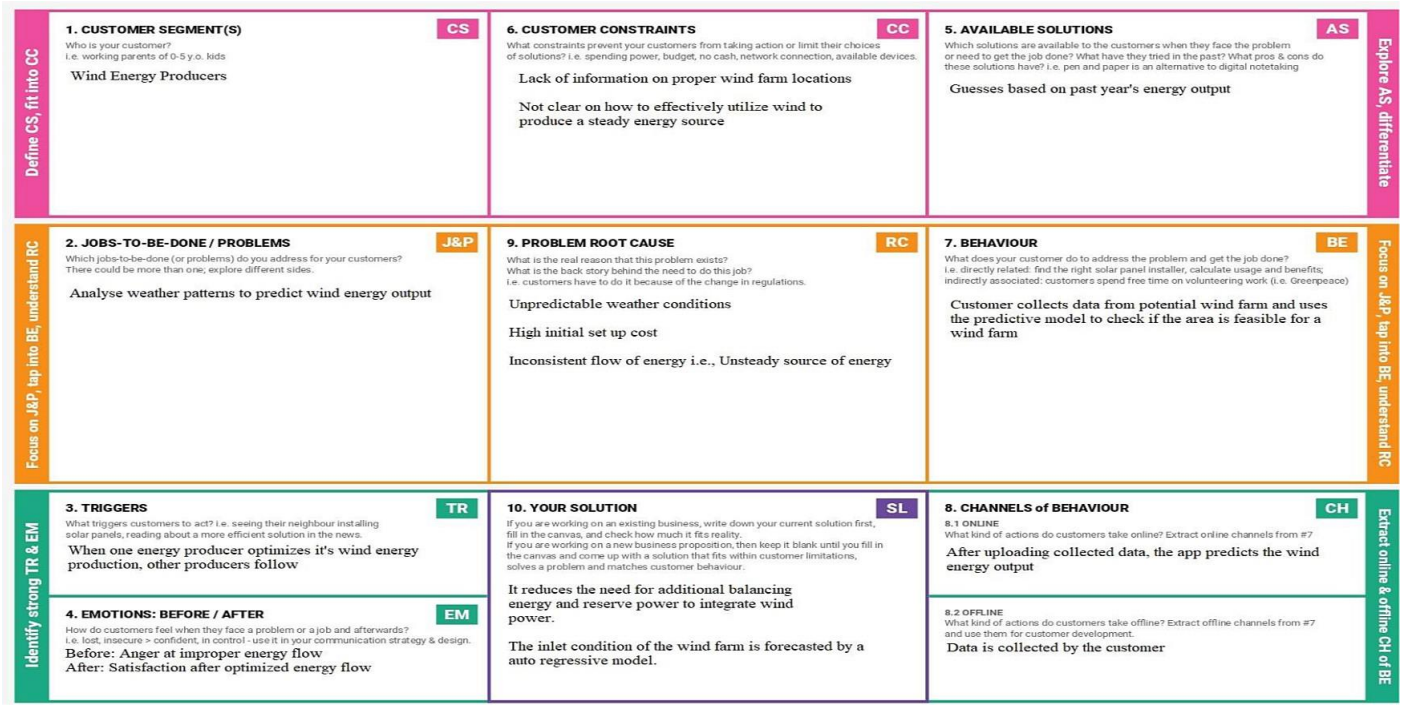




Proposed Solution

Parameter	Descripfion
Problem Statement (Problem to be solved)	The manufacturer needs to find a way to analyse the weather condifions of a region so they can choose regions that produce high quality and quanfifies of wind energy. Overproducfion and cost of producfion needs to be reduced. Wind energy should be ufilised in a way to provide a steady supply of electricity.
Idea / Solufion descripfion	We examine the impact of different weather condifions on the energy output of wind farms. By accurately forecasfing the wind-power, we reduce the need for addifional balancing energy and reserve power to integrate wind power. A predicfion system is developed with a method of combining stafisfical models and physical models. In this model, the inlet condifion of the wind farm is forecasted by the auto regressive model.
Novelty / Uniqueness	Currently, wind energy is not a primary source of electricity. Implemenfing our solufion makes it possible to maximise energy output. This solufion would make renewable energy sources more widely used. The user can upload their own data in real-fime for forecasfing.
Social Impact / Customer Safisfacfion	Local employment, beter health, consumer choice, improvement of life standard, social bonds creafion, income development, demographic impacts, and community development can be achieved by the proper usage of renewable energy system.Renewable energy improves human well-being and overall welfare well beyond GDP.Switching to clean sources of energy, thus helps address not only climate change but also air pollufion and health.
Business Model (Revenue Model)	Wind farm owners need a predicfion model to predict the wind energy so they can provide a steady energy source. A subscripfion model would be efficient here, as the model will improve with fime as it is used for forecasfing using more and more data.
Scalability of the Solufion	This solufion can be applied on a larger scale, to windfarms across the world.

Problem Solution Fit



Requirements Analysis

Functional Requirements

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Gmail
FR-2	User Confirmation	Confirmation via Email
FR-3	User login into website	Login using credentials
FR-4	Home page of the website	Description of the Predictor app
FR-5	Redirection to prediction page	Clicking on a button from home page takes user to next page
FR-6	Enter required parameters	Inputs like city name, area and more
FR-7	Validating all required fields	System checks whether all the required fields are filled and the linked API has the weather condition of the city mentioned
FR-8	Displays weather conditions of of the entered city	Climatic conditions of the entered city will be displayed to the user from the API on the webpage
FR-9	Displays prediction results	Users can view the energy output of the entered weather conditions
FR-10	Download prediction results	Download as jpg/png, download as pdf
FR-11	Logout from the site	User can log out from the site

Non-Functional Requirements

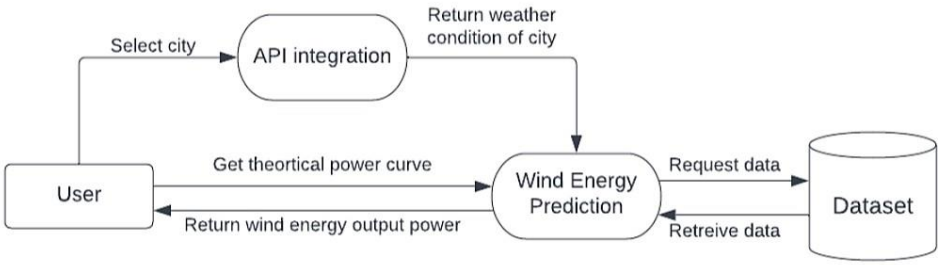
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	The system satisfies the user goals and the application is easy to use
NFR-2	**Security**	Login credentials will be protected from attacks and of single use only. If it doesn't match the existing one, it shows an error message. Number of attempts to login to the site is limited
NFR-3	**Reliability**	The system will provide consistency in output without producing an error. Prediction Model is well trained
NFR-4	**Performance**	Prediction Model will be well trained and accurate with a accuracy above 70 percent to predict correct results
NFR-5	**Availability**	Users can access the site from anywhere, anytime. The resources to the website like the API to get weather conditions will be available at all time
NFR-6	**Scalability**	With sufficient internet access, the system can be used as a web application to handle multiple users.

Project Design

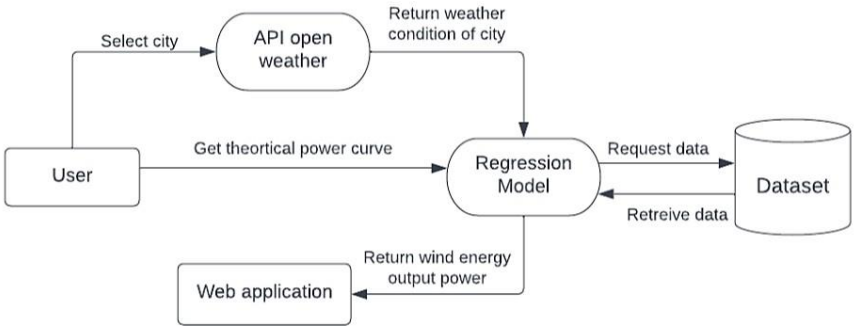
Data Flow Diagrams

LEVEL 0:

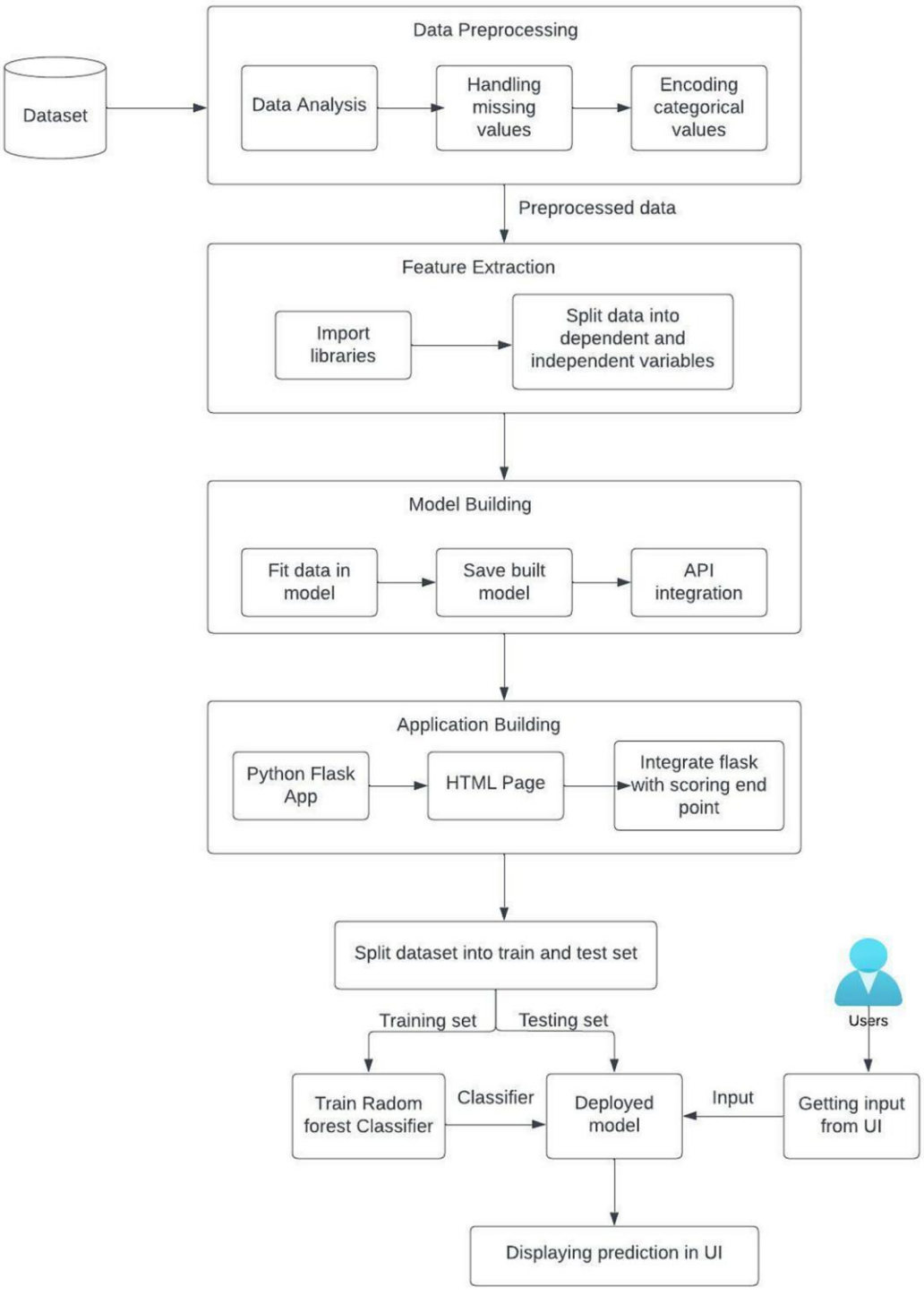
LEVEL 1:



LEVEL 2:



Solution & Technical Architecture



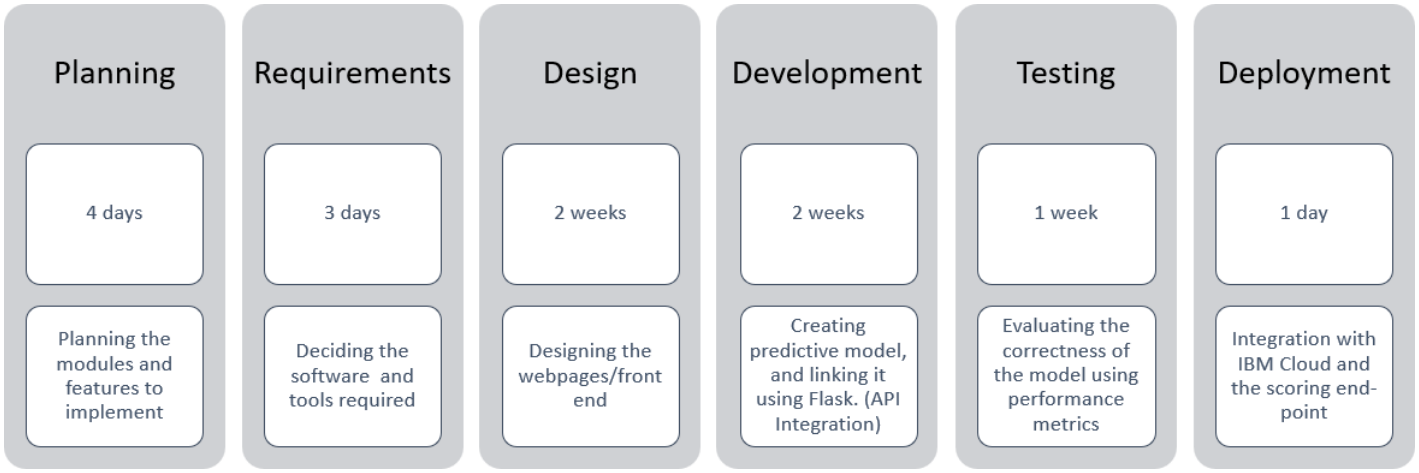
User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer	Home Page	USN-1	As a user, I will be directed to home page of the web app	I can have a overview of the predictor application	Low	Sprint-1
Administrator	Data Collection	USN-2	As an administrator, I have to collect dataset	dataset is available	High	Sprint-1
	Data Preprocessing	USN-3	As an administrator, I have to preprocess data and remove null fields	Cleaned dataset it ready for model building	Medium	Sprint-1
	Model Building	USN-4	As an administrator, I have to build regression model to predict wind energy output	Model is able to predict output	High	Sprint-2
	Training Model	USN-5	As an administrator, after model is built, it has to be trained to improve accuracy	Model is able to predict correct output at all times	High	Sprint-2
	API Integration	USN-6	As an administrator, API integration must be done to automatically input weather condition from the city entered by user	Weather condition is given as output when city is entered	High	Sprint-2
	Interface creation	USN-7	As an administrator, UI interface must be created for the application	Home page and P:redict page is created	Medium	Sprint - 3
	Flask App	USN-8	As an administrator, Flask app has be made to link various UI pages and ensure	Various frontend pages and linked	High	Sprint-3

			smooth functioning of the application			
	API and Model Integration	USN-9	As an administrator, API and deployed Regression model has to integrated with flask app to make correct predictions	The trained model and API is linked to flask app	High	Sprint-4
Customer	Home (Application)	USN-10	As a user ,I am allowed to select the city and can get the weather of the city.	I can select the city ,If the city is correct I can further enter the details.	Medium	Sprint-4
		USN-11	As a user I am allowed to view the weather of the selected city.	If correct city is selected ,then the weather of the particular city will be displayed	Low	Sprint-4
		USN-12	As a User ,I can click on calculate button	If the model is well trained, the energy output will be displayed on the web page	High	Sprint-4

Project Planning & Scheduling

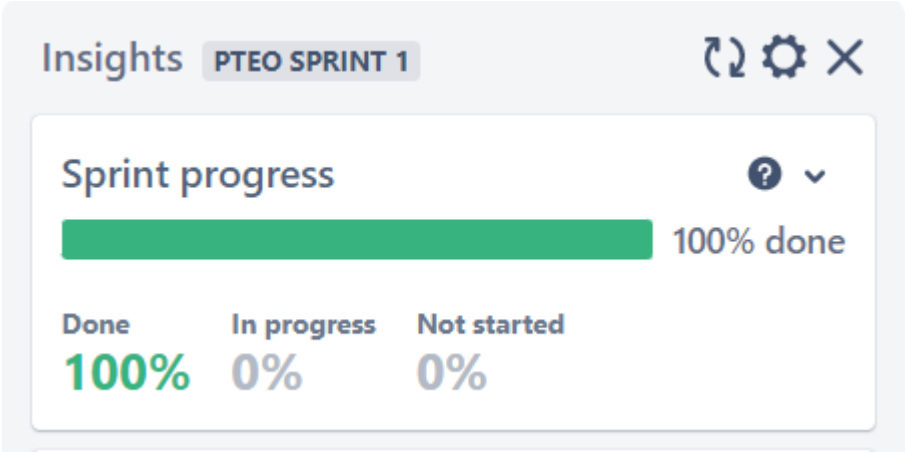
Sprint Planning & Estimation



Sprint Delivery Schedule

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	3	6 Days	24 Oct 2022	29 Oct 2022	3	29 Oct 2022
Sprint-2	3	6 Days	31 Oct 2022	05 Nov 2022	3	05 Nov 2022
Sprint-3	2	6 Days	07 Nov 2022	12 Nov 2022	2	12 Nov 2022
Sprint-4	4	6 Days	14 Nov 2022	19 Nov 2022	4	19 Nov 2022

Reports from JIRA



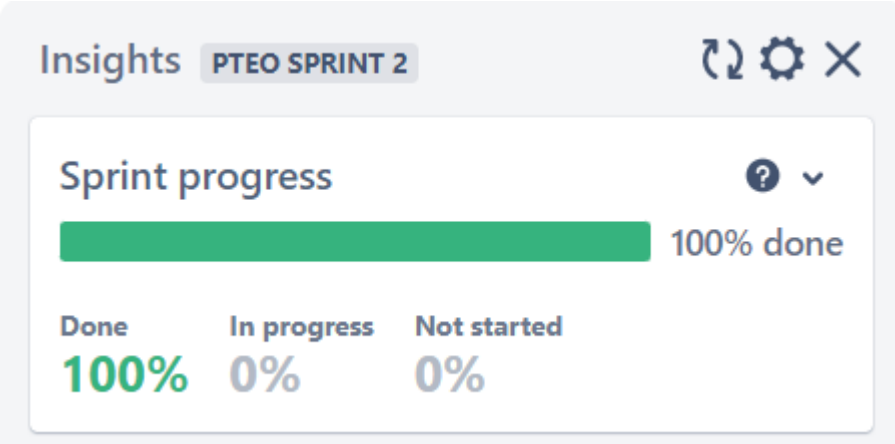
Status Report

* Issue added to sprint after start time

Completed Issues

View in Issue Navigator

Key	Summary	Issue Type	Priority	Status	Story Points (- → 3)
PTEO-1 *	Home Page	Story	Low	DONE	- → 1
PTEO-2 *	Data Collection	Story	High	DONE	- → 1
PTEO-3 *	Data Preprocessing	Story	Medium	DONE	- → 1



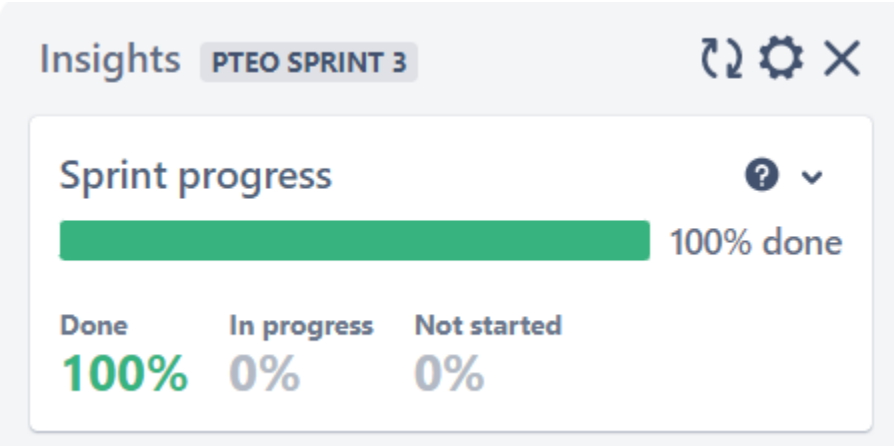
Status Report

* Issue added to sprint after start time

Completed Issues

View in Issue Navigator

Key	Summary	Issue Type	Priority	Status	Story Points (- → 3)
PTEO-4 *	Model Building	Story	High	DONE	- → 1
PTEO-5 *	Training Model	Story	High	DONE	- → 1
PTEO-6 *	API Integration	Story	High	DONE	- → 1



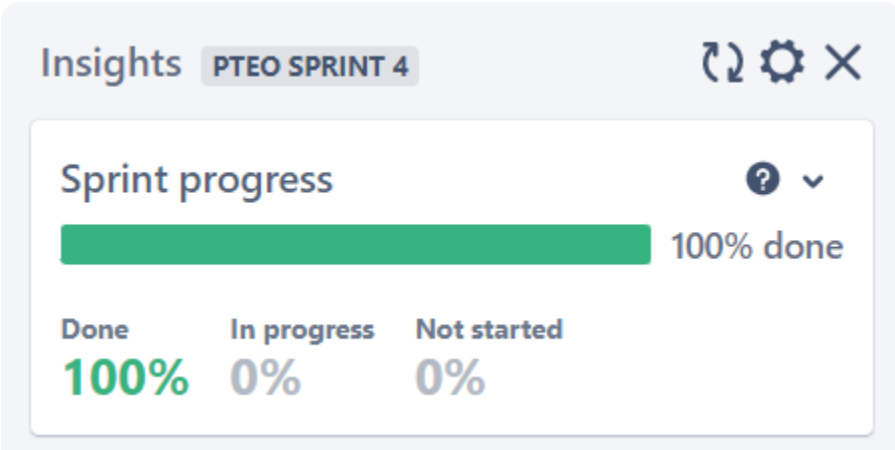
Status Report

* Issue added to sprint after start time

Completed Issues

View in Issue Navigator

Key	Summary	Issue Type	Priority	Status	Story Points (- → 2)
PTEO-7 *	Interface Creation	Story	Medium	DONE	- → 1
PTEO-8 *	Flask App	Story	High	DONE	- → 1



Status Report

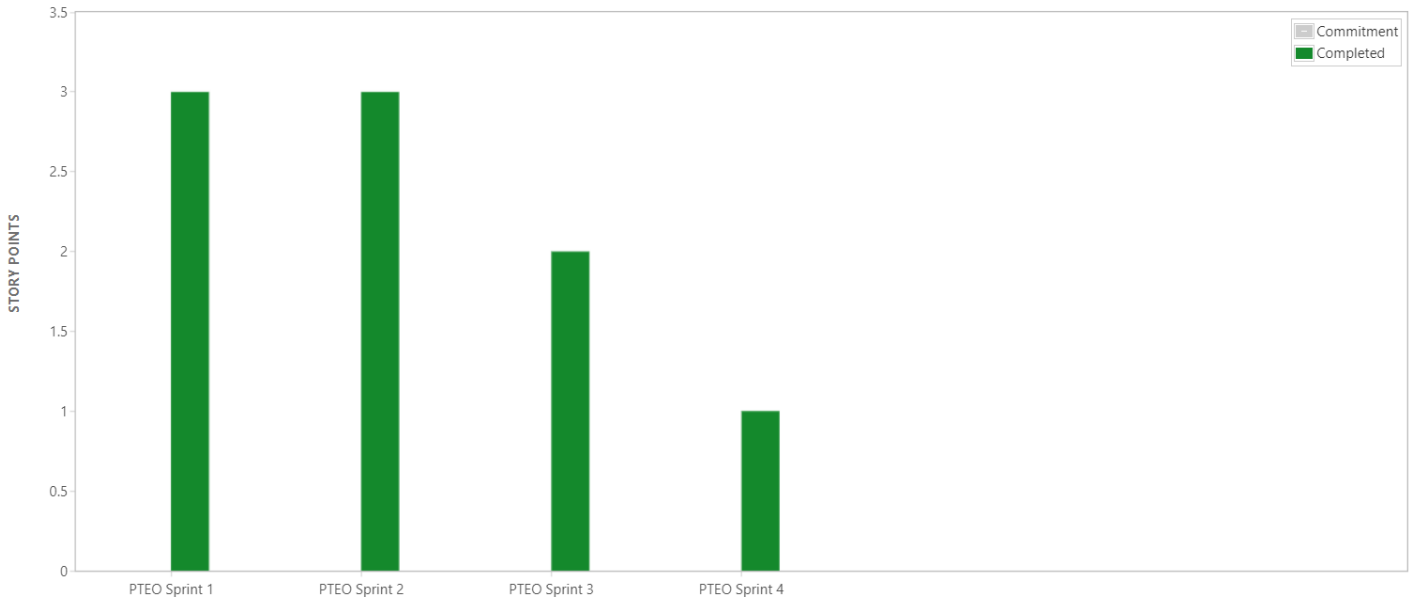
* Issue added to sprint after start time

Completed Issues

View in Issue Navigator

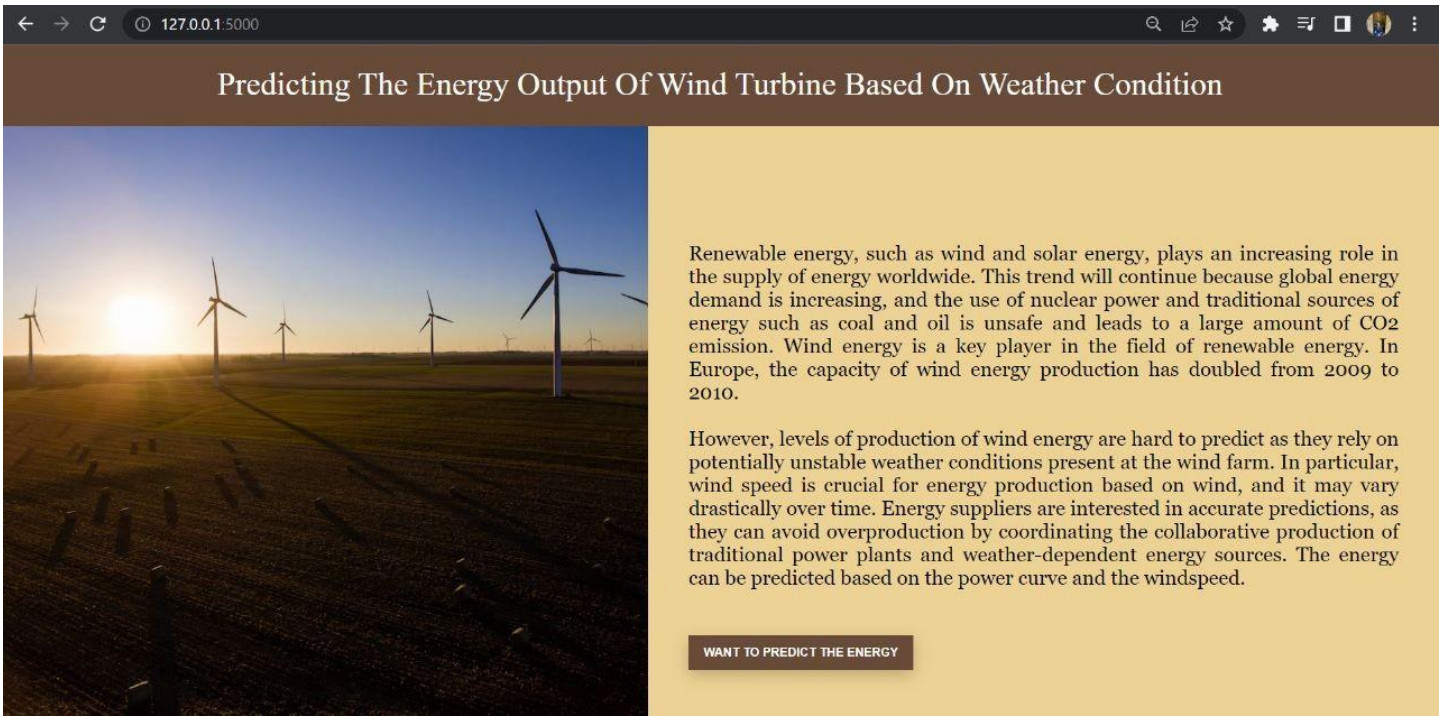
Key	Summary	Issue Type	Priority	Status	Story Points (- → 1)
PTEO-9 *	API and Model Integration	Story	High	DONE	- → 1

Velocity Chart

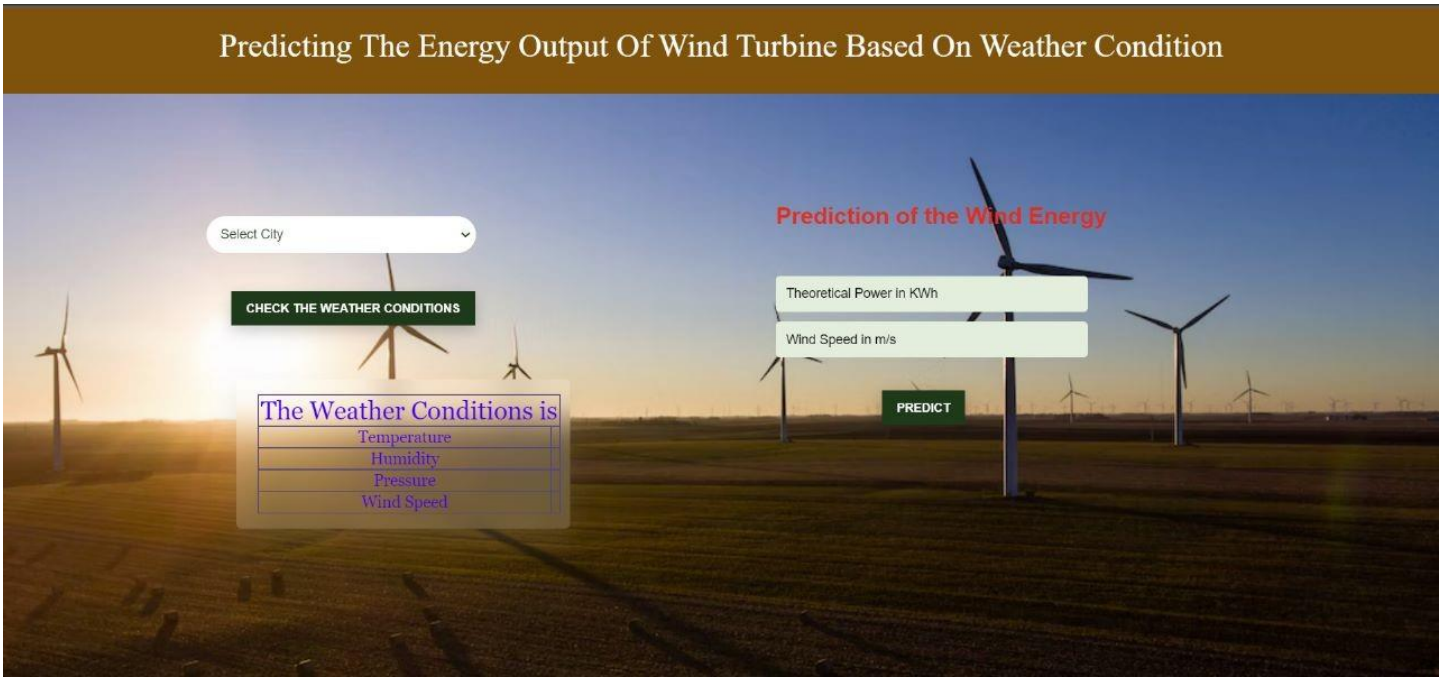


Coding & Solutioning

Home Page:

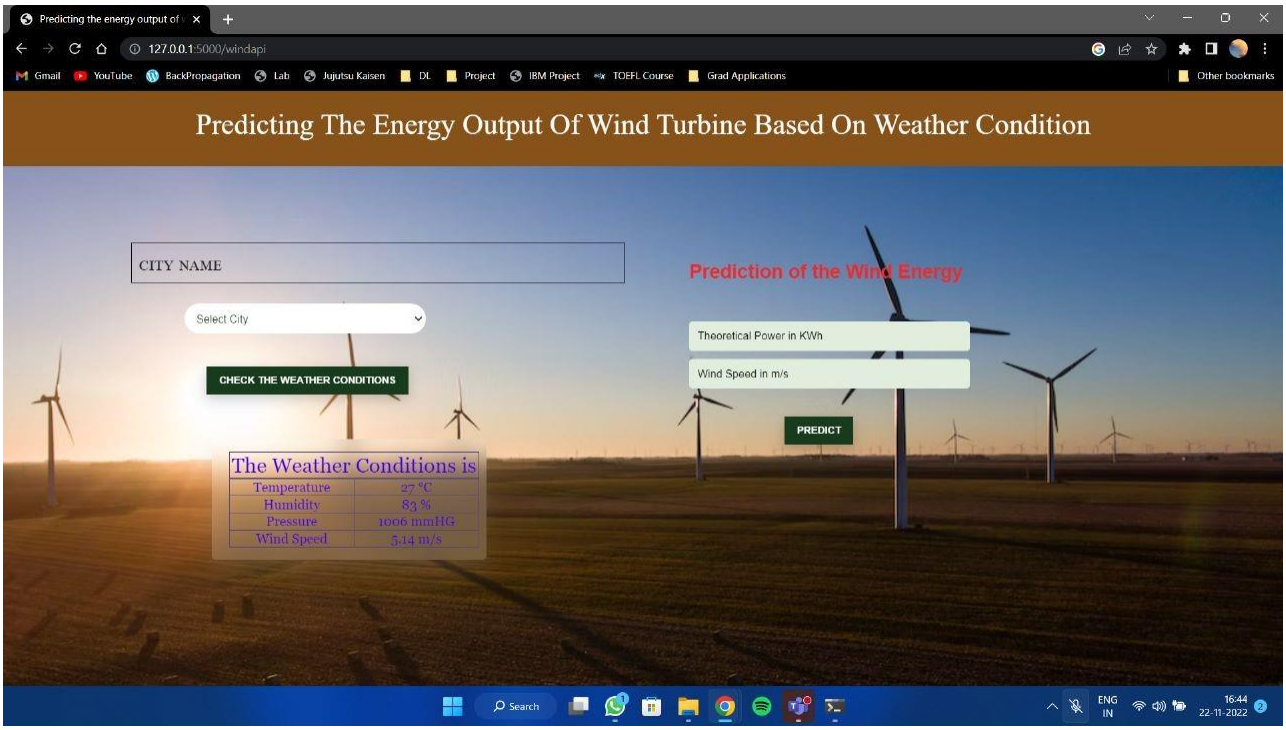


Prediction page:



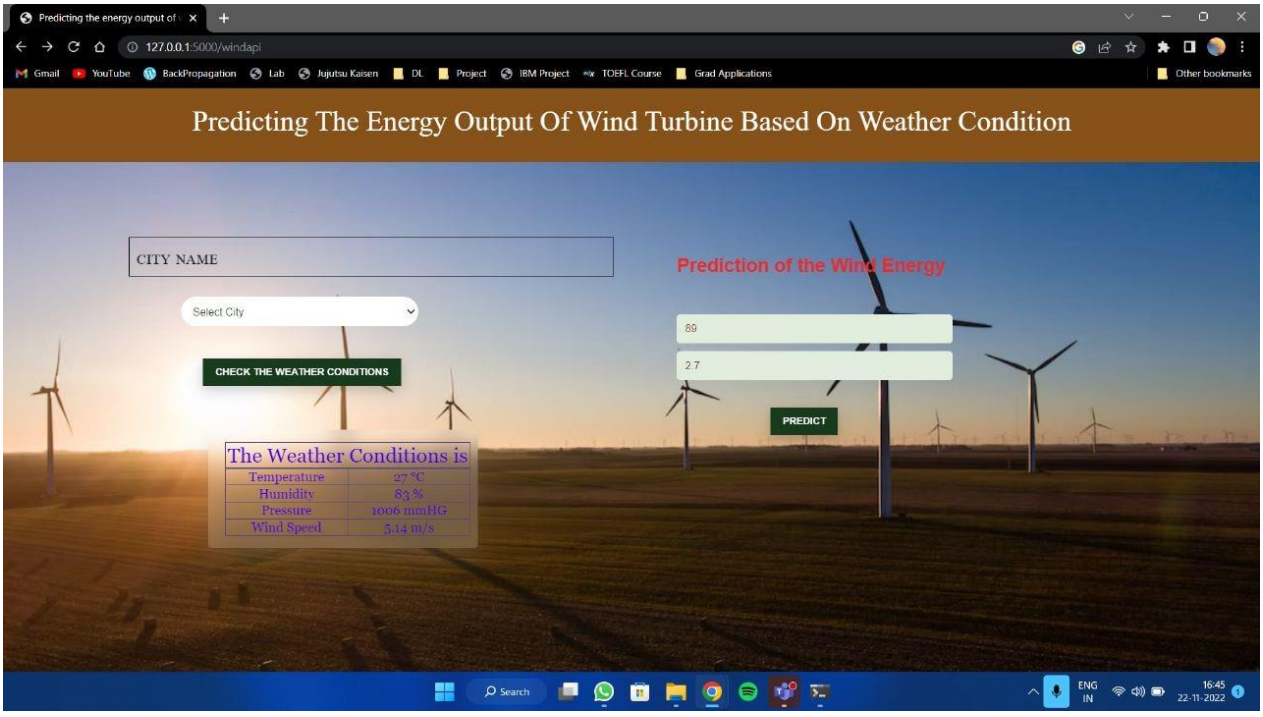
Feature 1

If the user selects a city, using an API, weather conditions are found and used to predict wind energy of that area.
After selecting a city:

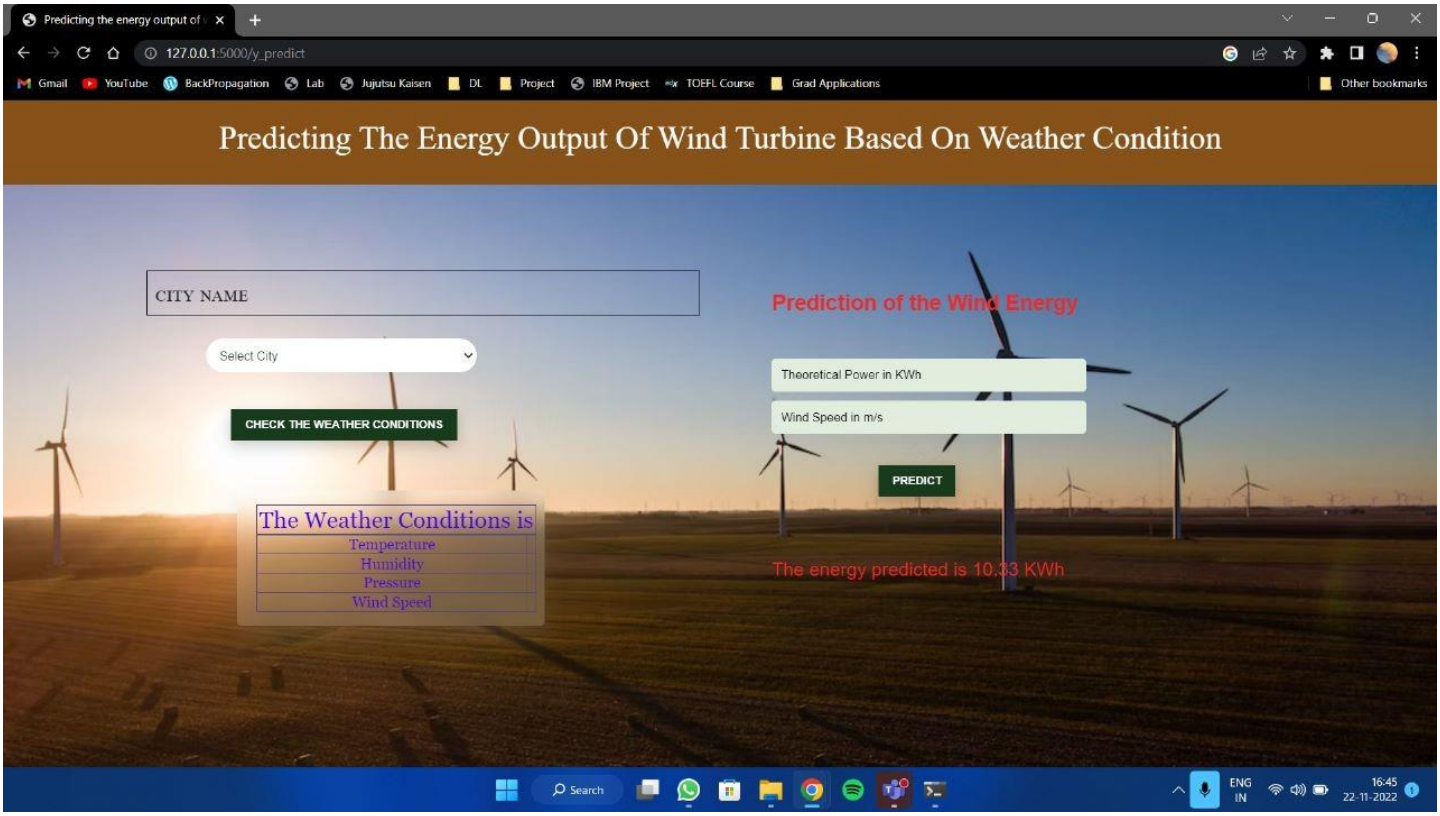


Feature 2

Alternatively, the user can enter the power and speed to calculate the predicted amount of wind energy.



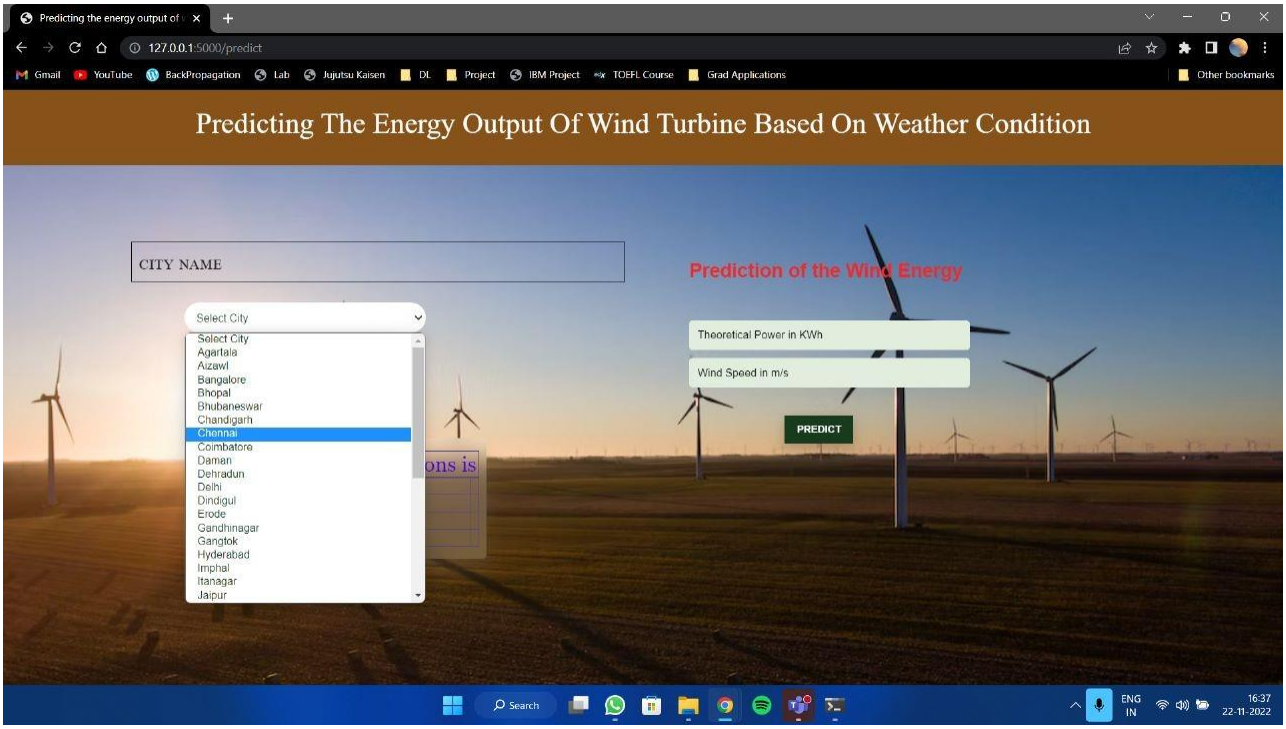
Output:

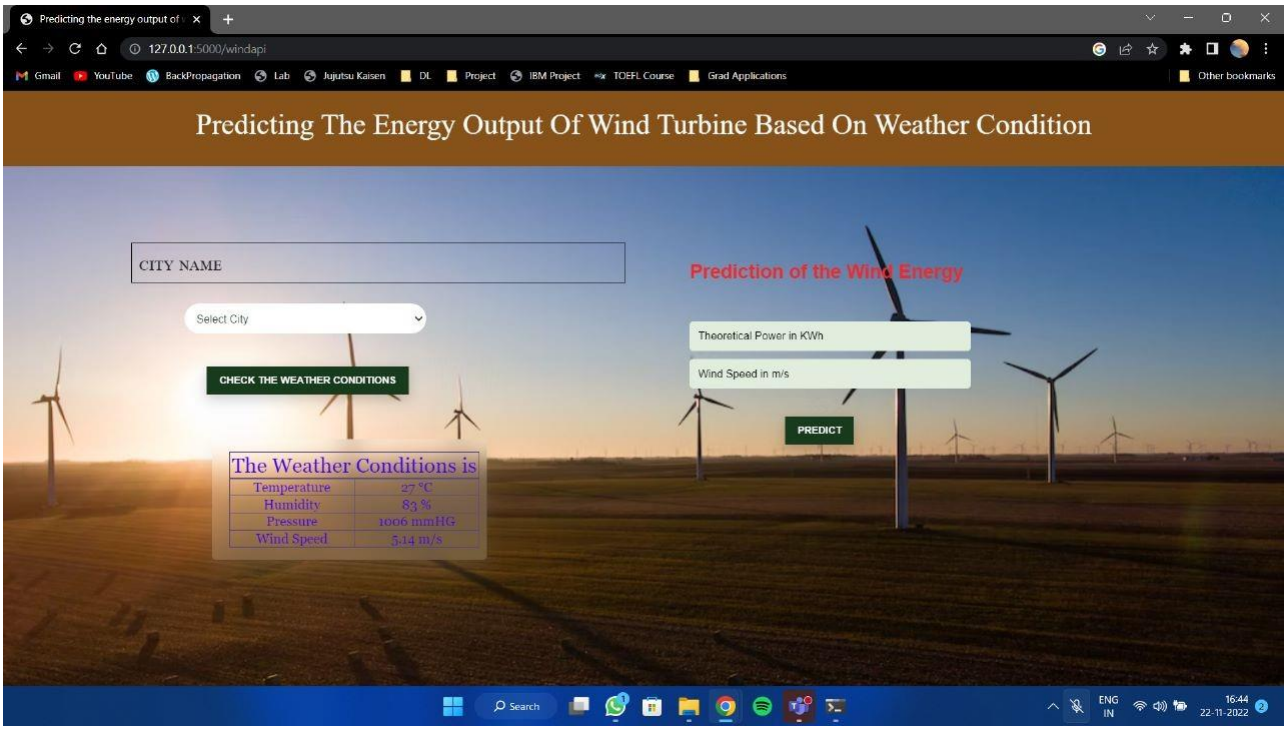

Predicting the energy output of
127.0.0.1:5000/y_predict
Gmail
YouTube
BackPropagation
Lab
Jujutsu Kaisen
DL
Project
IBM Project
TOEFL Course
Grad Applications
Other bookmarks
Predicting The Energy Output Of Wind Turbine Based On Weather Condition
CITY NAME
Select City
CHECK THE WEATHER CONDITIONS
The Weather Conditions is
Temperature
Humidity
Pressure
Wind Speed
Prediction of the Wind Energy
Theoretical Power in KWh
Wind Speed in m/s
PREDICT
The energy predicted is 10.33 KWh
Search
ENG
IN
16:45
22-11-2022

Testing

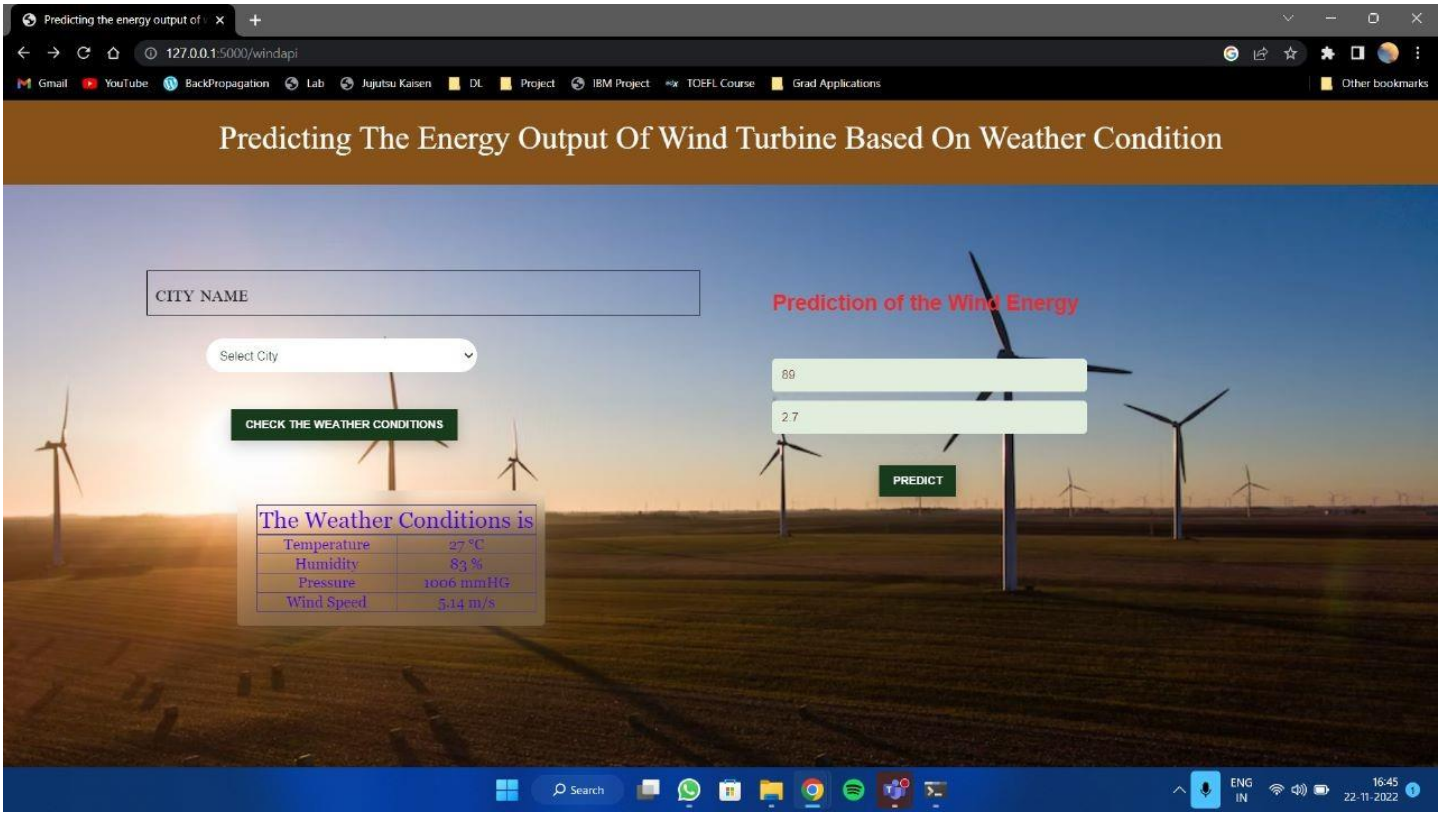
Test Cases

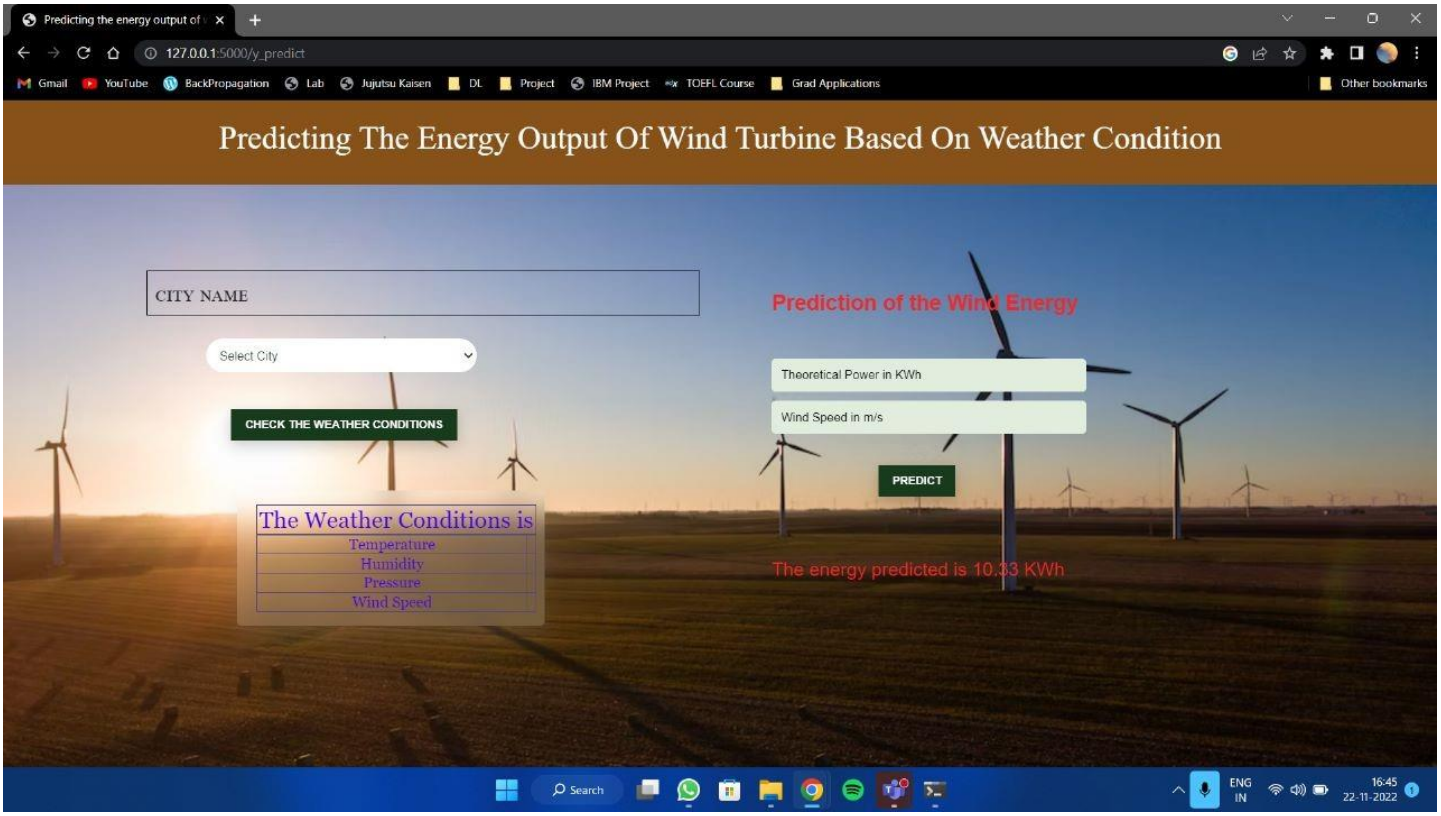
Test Case 1:





Test Case 2:


Predicting the energy output of
127.0.0.1:5000/windapi
Gmail YouTube BackPropagation Lab Jujutsu Kaisen DL Project IBM Project TOEFL Course Grad Applications Other bookmarks
Predicting The Energy Output Of Wind Turbine Based On Weather Condition
CITY NAME
Select City
CHECK THE WEATHER CONDITIONS
The Weather Conditions is
Temperature 27 °C
Humidity 83 %
Pressure 1006 mmHG
Wind Speed 5.14 m/s
Prediction of the Wind Energy
89
2.7
PREDICT
Search
ENG IN
16:45 22-11-2022


Predicting the energy output of
127.0.0.1:5000/y_predict
Gmail YouTube BackPropagation Lab Jujutsu Kaisen DL Project IBM Project TOEFL Course Grad Applications Other bookmarks
Predicting The Energy Output Of Wind Turbine Based On Weather Condition
CITY NAME
Select City
CHECK THE WEATHER CONDITIONS
The Weather Conditions is
Temperature
Humidity
Pressure
Wind Speed
Prediction of the Wind Energy
Theoretical Power in KWh
Wind Speed in m/s
PREDICT
The energy predicted is 10.33 KWh
Search
ENG IN
16:45 22-11-2022

Results

Performance Metrics

```
from sklearn.metrics import mean_absolute_error,mean_squared_error
mae=mean_absolute_error(y_true=val_y,y_pred=power_preds)
mse=mean_squared_error(y_true=val_y,y_pred=power_preds)
rmse=mean_squared_error(y_true=val_y,y_pred=power_preds,squared=False)

print("MAE:",mae)
print("MSE:",mse)
print("RMSE:",rmse)
print("R2 Score:",r2_score(val_y, power_preds))
print("Accuracy:",forest_model.score(val_X,val_y))
```

```
MAE: 164.58015525861344
MSE: 154806.327828882
RMSE: 393.4543529164241
R2 Score: 0.9113496428907649
Accuracy: 0.9113496428907649
```

Advantages and Disadvantages

Advantages	***Disadvantages***
Cost effective in the long run	High initial cost
Sustainable	Inconsistent wind speed
Clean energy source	Causes noise pollution
Environment friendly	Requires large plots of empty land
Most efficient fuel for electricity	Dependent on weather conditions

Conclusion

Using this application, we can analyse the weather conditions of a particular area and predict the energy output, to identify suitable areas to place windmill farms. When it comes to scheduling power systems and other practical aspects of wind energy conversion, such as the dynamic management of wind turbines, reliable short-term wind speed forecasts are essential. A precise forecast is required to solve issues with variable energy production brought on by changing weather patterns.

Future Scope

This solution can be extended to consider other factors to better predict the energy output. The application can be extended to incorporate features allowing windfarm owners to plan and prepare according to the predictions based on their given data.

Appendix

Source Code

App.py:

```
# -*- coding: utf-8 -*-
"""App.ipynb

Automatically generated by Colaboratory.

Original file is located at
   https:/ colab.research.google.com/drive/1D7ryKFXpDT-oT9zRWtVEy_nbSLixhP6r
"""

import numpy as np
from flask import Flask, request, jsonify, render_template
import joblib
import requests

API_KEY = "vRfmC7scgZJ823AuNGkzKb8xo6vG1VW1-QXDcKLaTRX0"

token_response = requests.post('https:/ iam.cloud.ibm.com/identity/token', data={"apikey": API_KEY,
"grant_type": 'urn:ibm:params:oauth:grant-type:apikey'})

mltoken = token_response.json()["access_token"]

header = {'Content-Type': 'application/json', 'Authorization': 'Bearer' +

mltoken} 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 = "21fa8dd805075da43797f6dc3210093a"
    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"]) +" °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():
    payload_scoring = {"input_data": [{"field": [["Wind Speed","Theoretical power "]], "values": [[90, 89]]}]}

    response_scoring = requests.post('https:/ us-south.ml.cloud.ibm.com/ml/v4/deployments/b3036f4f-b8d7-
430c-8584-71e65199dc08/predictions?version=2022-11-20', json=payload_scoring,
    headers={'Authorization': 'Bearer ' + mltoken})
    print("Scoring response")
    print(response_scoring.json())
    probability = response_scoring.json()['predictions'][0]['values'][0][0]
    print(probability)
    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=False)
```

Intro.html:

```
<html>
        <head>
        <title>Predicting the energy output of wind turbine based on weather condition</title>
        <style>

                .header {
                        top:0px;
                        margin:0px;
                        left: 0px;
                        right: 0px;
                        position: fixed;
```

```
                background: #6c493a;
                color: white;
                overflow: hidden;
                padding-bottom: 30px;
                font-size: 2.25vw;
                width: 100%;
                padding-left:0px;
                text-align:  center;
                padding-top:20px;
        }
        .second{
                top:80px;
                bottom:0px;
                margin:0px;
                left: 0px;
                right: 0px;
                position: fixed;
                padding: 0px;
                width: 100%;
                background-image:url(https:/ images.unsplash.com/photo-1511546705877-
f449b6f6dcfd?ixlib=rb-
4.0.3&ixid=MnwxMjA3fDB8MHxwaG90by1wYWdlfHx8fGVufDB8fHx8&auto=format&fit=crop&w=1074&q=80);
                background-repeat:no-
                repeat; background-size:
                contain;
        }
        .inside{
                top:80px;
                bottom:0px;
                margin:0px;
                left: 45%;
                right: 0%;
                position: fixed;
                padding-left: 40px;
                padding-top:8%;
                padding-right:40px;
                background-color:#F2D19A;
                font-family:Georgia, serif;
                color:black;
                font-size:20px;
                text-align:justify;

        }
        .myButton{
```

```
                    border: none;
                    text-align:
                    center; cursor:
                    pointer;
                    text-transform: uppercase;
                    outline: none;
                    overflow: hidden;
                    color: #fff;
                    font-weight: 700;
                    font-size: 12px;
                    background-color: #6c493a;
                    padding: 10px 15px;
                    margin: 0 auto;
                    box-shadow: 0 5px 15px rgba(0,0,0,0.20);
                }
        </style>
        </head>
        <body>

                <div class="header">Predicting The Energy Output Of Wind Turbine Based On Weather Condition</div>
                <div class="second">
                        <div class="inside">Renewable energy, such as wind and solar energy, plays an increasing role in the supply of energy worldwide. This trend will continue because global energy demand is increasing, and the use of nuclear power and traditional sources of energy such as coal and oil is unsafe and leads to a large amount of CO2 emission. Wind energy is a key player in the field of renewable energy. In Europe, the capacity of wind energy production has doubled from 2009 to 2010. <br><br>
However, levels of production of wind energy are hard to predict as they rely on potentially unstable weather conditions present at the wind farm. In particular, wind speed is crucial for energy production based on wind, and it may vary drastically over time. Energy suppliers are interested in accurate predictions, as they can avoid overproduction by coordinating the collaborative production of traditional power plants and weather-dependent energy sources. The energy can be predicted based on the power curve and the windspeed.
                <br><br><br>
                <a href="{{url_for('predict')}}"><button type="button" class="myButton" >Want to predict the energy</button></a>
                </div>


                </div>
        </body>
</html>
```

Predict.html:

```
<html>
        <head>
                <meta charset="UTF-8" />
                <meta name="viewport" content="width=device-width, initial-scale=1.0" />
                <meta http-equiv="X-UA-Compatible" content="ie=edge" />
                <link rel="stylesheet" href="https:/ use.fontawesome.com/releases/v5.7.2/css/all.css"
                        integrity="sha384-
fnmOCqbTlWIlj8LyTjo7mOUStjsKC4pOpQbqyi7RrhN7udi9RwhKkMHpvLbHG9Sr" crossorigin="anonymous" />
                <link href="https:/ fonts.googleapis.com/css?family=Dosis" rel="stylesheet" />
                <link rel="stylesheet" href="static/css/main.css"/>
                <link rel="stylesheet" href="static/css/media.css"/>
                <link rel="stylesheet" href="static/css/items_grid.css"/>



        <title>Predicting the energy output of wind turbine based on weather condition</title>
        <style
> #page {
  max-width:
  80%; margin:
  auto;
}
body {
        background-image: url(https:/ images.unsplash.com/photo-1511546705877-f449b6f6dcfd?ixlib=rb-
4.0.3&ixid=MnwxMjA3fDB8MHxwaG90by1wYWdlfHx8fGVufDB8fHx8&auto=format&fit=crop&w=1074&q=80);
        width: 100%;
        height: 100%;
        background-repeat: no-repeat;
        background-attachment: fixed;
        background-size: cover;
        overflow: hidden;

}
table {
                width: 100%;
                border-collapse: collapse;
}

.card {
       margin-right: auto;
       margin-left: 15%;
       width: 300px;
```

```
    box-shadow: 0 15px 25px rgba(129, 124, 124, 0.2);

    border-radius: 5px;
    backdrop-filter: blur(14px);
    background-color: rgba(255, 255, 255, 0.2);
    padding: 15px;
    text-align: center;
}
            .head {
                    top:0px;
                    margin:0px;
                    left: 0px;
                    right: 0px;
                    position: fixed;
                    background: #86521a;
                    color: white;
                    overflow: hidden;
                    padding-bottom: 30px;
                    font-size: 2.25vw;
                    width: 100%;
                    padding-left:0px;
                    text-align:  center;
                    padding-top:20px;
            }
            .second{
                    top:80px;
                    bottom:0px;
                    margin:0px;
                    left: 0px;
                    right: 0px;
                    position: fixed;
                    padding: 0px;
                    width: 100%;

                    font-family:Georgia, serif;
                    color:black;
                    font-size:20px;
            }
            .inside{
                    top:80px;
                    bottom:0px;
                    margin:0px;
                    left: 51%;
```

```
                right: 0%;
                position: fixed;
                padding-left: 40px;
                padding-top:8%;
                padding-right:40px;

                font-family:Arial, Helvetica, sans-serif;
                color:#f72727;
                font-size:20px;
                text-align:justify;

            }
            .myButton{
                border: none;
                text-align:
                center; cursor:
                pointer;
                text-transform: uppercase;
                outline: none;
                overflow: hidden;
                color: #fff;
                font-weight: 700;
                font-size: 12px;
                background-color: #183a1d;
                padding: 10px 15px;
                margin: 0 auto;
                box-shadow: 0 5px 15px
                rgba(0,0,0,0.20); margin-left:17%;
            }
        input {
        width:50%;
        margin-bottom: 10px;
        background: #e1eedd;
        border: none;
        outline: none;
        padding: 10px;
        font-size: 13px;
        color: #6c493a;
        text-shadow:
        white; border:
        #6c493a; border-
        radius: 4px; box-
        shadow: white;
}
::placeholder {
```

```
  color: black;
  opacity: 1;
}

.left{
                top:80px;
                        bottom:0px;
                        margin:0px;
                        left: 0%;
                        right: 45.5%;
                        position: fixed;
                        padding-left: 10%;
                        padding-top:5%;
                        padding-right:40px;

                        font-family:bold,Georgia, serif;
                        color:rgb(36, 37, 37);;
                        font-size:25px;
                        align:center;

}
        select {
        width:50%
        ;
        margin-bottom: 10px;
        background: white;
        border: none;
        outline: none;
        padding: 10px;
        font-size: 13px;
        color: #183a1d;
        text-shadow: white;
        border: #6c493a;
        border-radius: 40px;
        box-shadow: white;
}

input:focus { box-shadow: inset 0 -5px 45px rgba(100,100,100,0.4), 0 1px 1px rgba(255,255,255,0.2); }



                table, th, td {
  border: 1px solid rgb(86, 72,
  128); border-collapse: collapse;
```

```
  color: #3f00ff;
}

@media screen and (max-width: 500px) {

  .left,
  .second,
  .third {
            width: 70%;
  }
}



        </style>
        </head>
        <body>


                <header id="head">
                <div class="head">Predicting The Energy Output Of Wind Turbine Based On Weather
Condition</div>
                </header>


                <div class="second">
                <div class="left">

                <br>
                <br>

                <div style="margin-left:10%">
                <form action="{{ url_for('windapi')}}"method="post" >
                        <select name="city" required >
                                <option value="" selected>Select City</option>
                                <option value ="Agartala">Agartala</option>
                                <option value ="Aizawl">Aizawl</option>
                                <option value ="Bangalore">Bangalore</option>
                                <option value ="Bhopal">Bhopal</option>
                                <option value ="Bhubaneswar">Bhubaneswar</option>
                                <option value ="Chandigarh">Chandigarh</option>
                                <option value ="Chennai">Chennai</option>
                                <option value ="Coimbatore">Coimbatore</option>
```

```
                                <option value ="Daman">Daman</option>
                                <option value ="Dehradun">Dehradun</option>
                                <option value ="Delhi">Delhi</option>
                                <option value ="Dindigul">Dindigul</option>
                                <option value ="Erode">Erode</option>
                                <option value ="Gandhinagar">Gandhinagar</option>
                                <option value ="Gangtok">Gangtok</option>
                                <option value ="Hyderabad">Hyderabad</option>
                                <option value ="Imphal">Imphal</option>
                                <option value ="Itanagar">Itanagar</option>
                                <option value ="Jaipur">Jaipur</option>
                                <option value ="Kavaratti">Kavaratti</option>
                                <option value ="Kohima">Kohima</option>
                                <option value ="Kolkata">Kolkata</option>
                                <option value ="Lucknow">Lucknow</option>
                                <option value ="Mumbai">Mumbai</option>
                                <option value ="Panaji">Panaji</option>
                                <option value ="Patna">Patna</option>
                                <option value ="Pondicherry">Pondicherry</option>
                                <option value ="Port Blair">Port Blair</option>
                                <option value ="Raipur"       >Raipur</option>
                                <option value ="Ranchi"       >Ranchi</option>
                                <option value ="Shillong">Shillong</option>
                                <option value ="Shimla">Shimla</option>
                                <option value ="Silvassa">Silvassa</option>
                                <option value ="Srinagar">Srinagar</option>
                                <option value ="Thiruvananthapuram">Thiruvananthapuram</option>
                                <option value ="Tirupati">Tirupati</option>

                        </select><br><br>
                        <div style="margin-left:-15%"><button type="submit" class="myButton" >Check
the Weather Conditions</button></div>

                </form>
                </div>
                <br>

                <div class="card">
                <table style="margin-left:2%; text-align:center; border-spacing:20px;">
                        <tr>
                                <td colspan="2" style="font-size:25px;">The Weather Conditions is</td>
                        </tr>
                        <tr>
```

```
                                <td>Temperature</td><td>{{temp}}</td>
                            </tr>
                            <tr>
                                <td>Humidity</td><td>{{humid}}</td>
                            </tr>
                            <tr>
                                <td>Pressure</td><td>{{pressure}}</td>
                            </tr>
                            <tr>
                                <td>Wind Speed</td><td>{{speed}}</td>
                            </tr>
                        </table>
                        </div>
                </div>
                        <div class="inside">
                        <div style="font-size:23px;font-weight:bold;">Prediction of the Wind Energy</div>
                        <br><br>
                        <form action="{{ url_for('y_predict')}}"method="post">
                                <input type="text" name="theo" placeholder="Theoretical Power in KWh"
 required="required"  />
                                <input type="text" name="wind" placeholder="Wind Speed in m/s"
 required="required"  /><br><br>
                                <button type="submit" class="myButton" >Predict</button>

                        </form>

                    <br>
                    <br>
                    {{ prediction_text }}

                </div>
                </div>

            </body>

 </html>
```

GITHUB:

IBM-EPBL/IBM-Project-40630-1660632339: Predicting the energy output of wind turbine based on weather condition (github.com)

PROJECT DEMO LINK:

https://drive.google.com/file/d/1gulZROY0plcupTdmos5VWWzRBSykvb4d/view?usp=drivesdk