Predicting The Energy Output Of Wind Turbine Based On Weather Condition Using Ibm Cloud

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:

Using IBM Watson Studio we train the data set using Random Forest Regression algorithm that help to train the model with the help of machine learning services provided by the IBM. Using the dataset which have the existing sample data of the quality determining experimented values, Machine learn and study the variation according to the values of city , temperature , humidity , pressure, wind speed and theoretical power. So according to these factors wind turbine energy can be predicted machine will learn about it using the algorithm, The 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.

2. LITERATURE SURVEY

2.1 EXISTING PROBLEM

There was a system to predict the energy output of wind turbine. It was highly volatile.Wind energy plays an increasing role in the supply of energy world-wide. 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

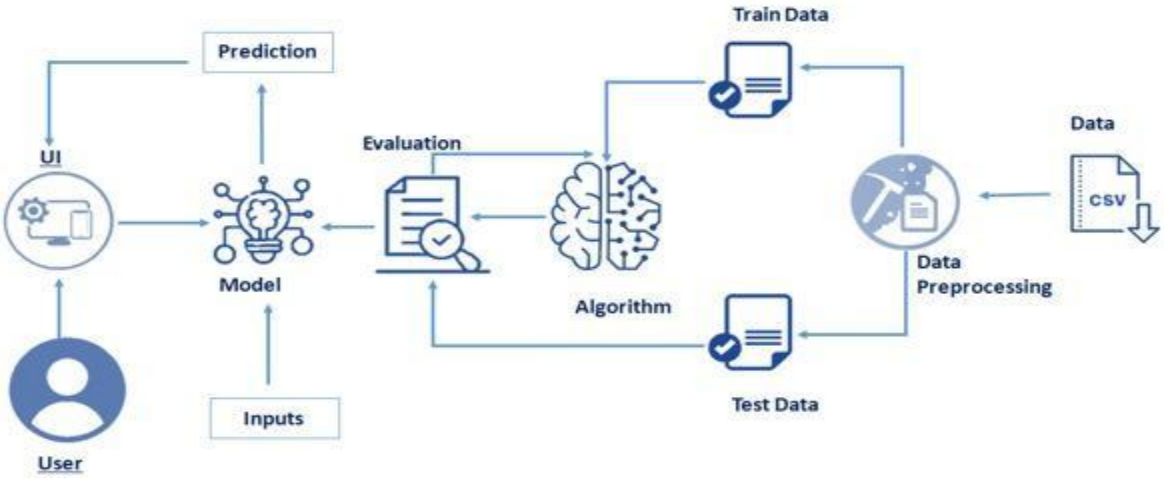
different energy sources more efficiently to avoid costly overproduction. In this paper, we predict energy prediction based on weather data and analyse the important parameters as well as their correlation on the energy output.

2.2 PROPOSED SOLUTION

Our aim is to map weather data to energy production. We wish to show that even data that is publicly available for weather stations close to wind farms can be used to give a good prediction of the energy output. Furthermore, we examine the impact of different weather conditions on the energy output of wind farms. We are building an IBM Watson Machine Learning technique to predict the energy output of wind turbine. The model is deployed on IBM cloud to get scoring end point which can be used as API in mobile app or web app building. We are developing a web application which is built using random forest algorithm. We make use of the scoring end point to give user input values to the deployed model. The model prediction is then showcased on User Interface to predict the energy output of wind turbine

3. THEORETICAL ANALYSIS

3.1 BLOCK DIAGRAM



3.2 HARDWARE/SOFTWARE DESIGNING

Hardware Specification

Processor : Intel i3 Core Processor

Hard Disk : 4 GB Hard Disk

Network : Wi-Fi Internet or Cellular Network

Software specification

Operating System : Windows 10 Home

Web Application : Jupyter Notebook

Front End : HTML, CSS

Back End : Python, Flask

Cloud : IBM Cloud

IBM Watson Studio - IBM Watson Studio helps data scientists and analysts prepare data and build models at scale across any cloud.

IBM Watson Machine Learning - IBM Watson Machine Learning helps data scientists and developers accelerate AI and machine-learning deployment.

IBM Cloud Object Storage - IBM Cloud Object Storage makes it possible to store practically limitless amounts of data, simply and cost effectively.

Machine Learning Services - Machine learning as service is an umbrella term for collection of various cloud-based platforms that use machine learning tools to provide solutions that can help ML teams with: out-of-the box predictive analysis for various use cases, data pre-processing, model training and tuning.

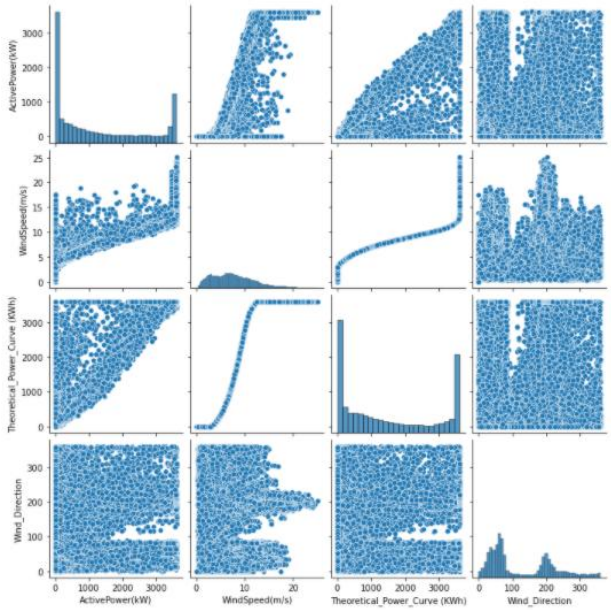
4. EXPERIMENTAL INVESTIGATION

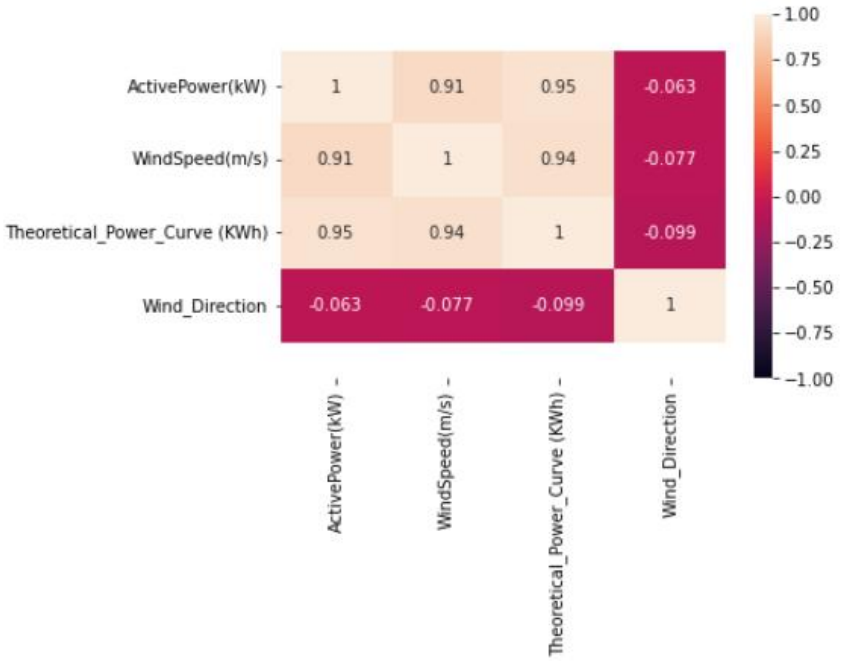
Here we are going to build a machine learning model that predicts the energy output of wind turbine based on the following parameters

- City
- Temperature
- Humidity
- Pressure
- Wind speed
- Theoretical power

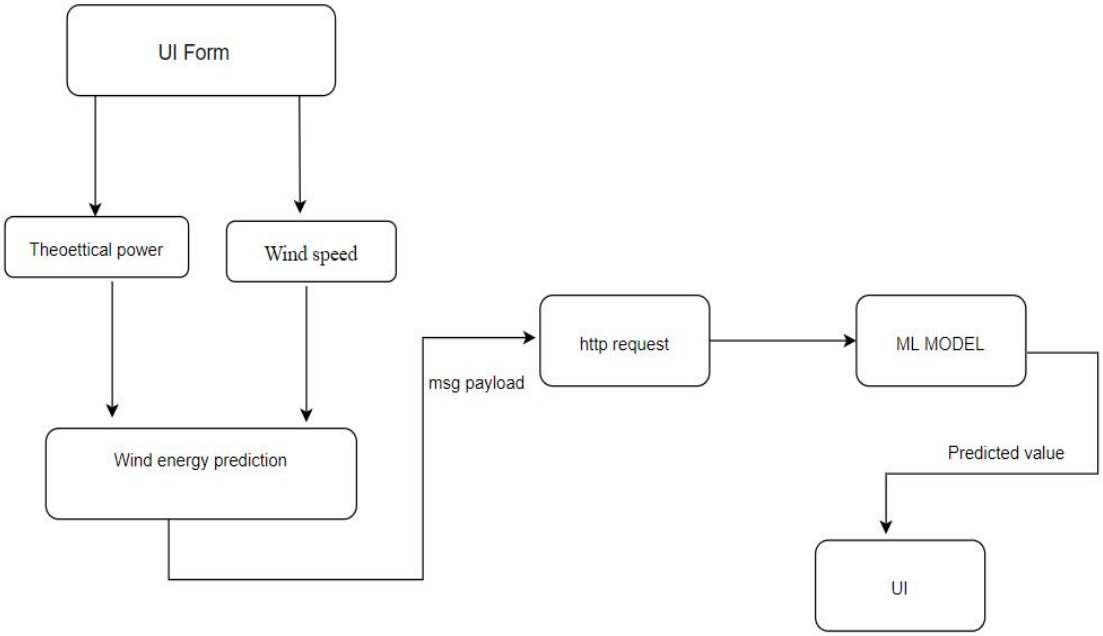
4.1 EXPERIMENTAL ANALYSIS

VISUALIZATION

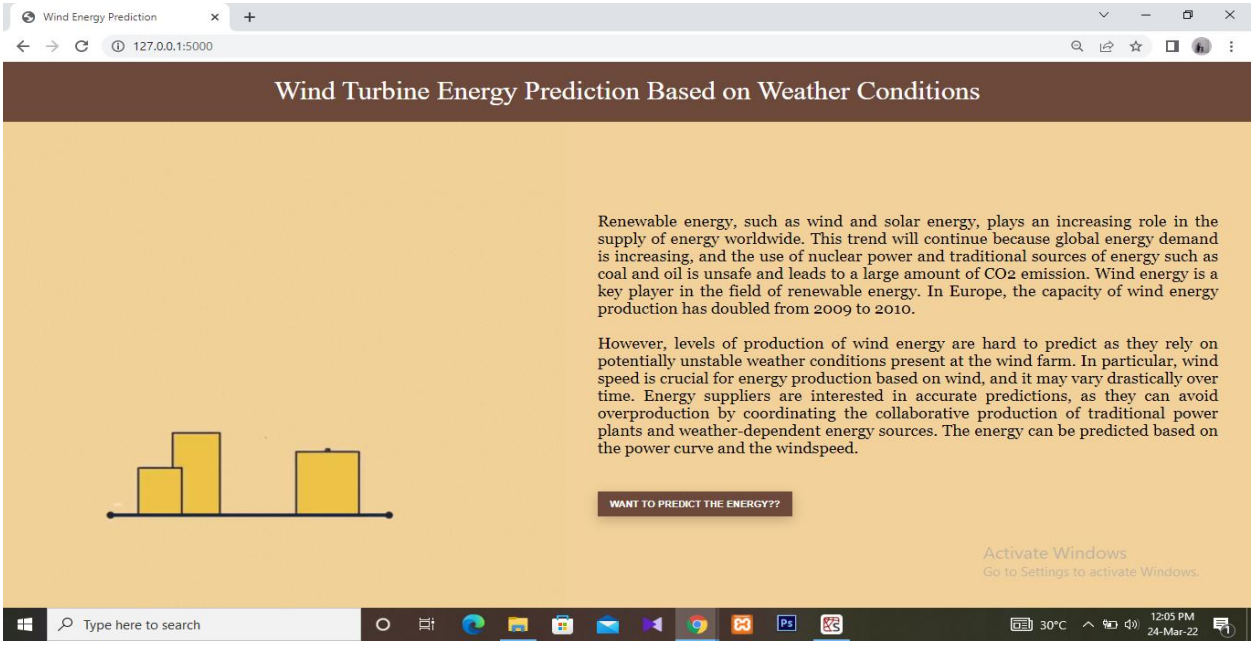


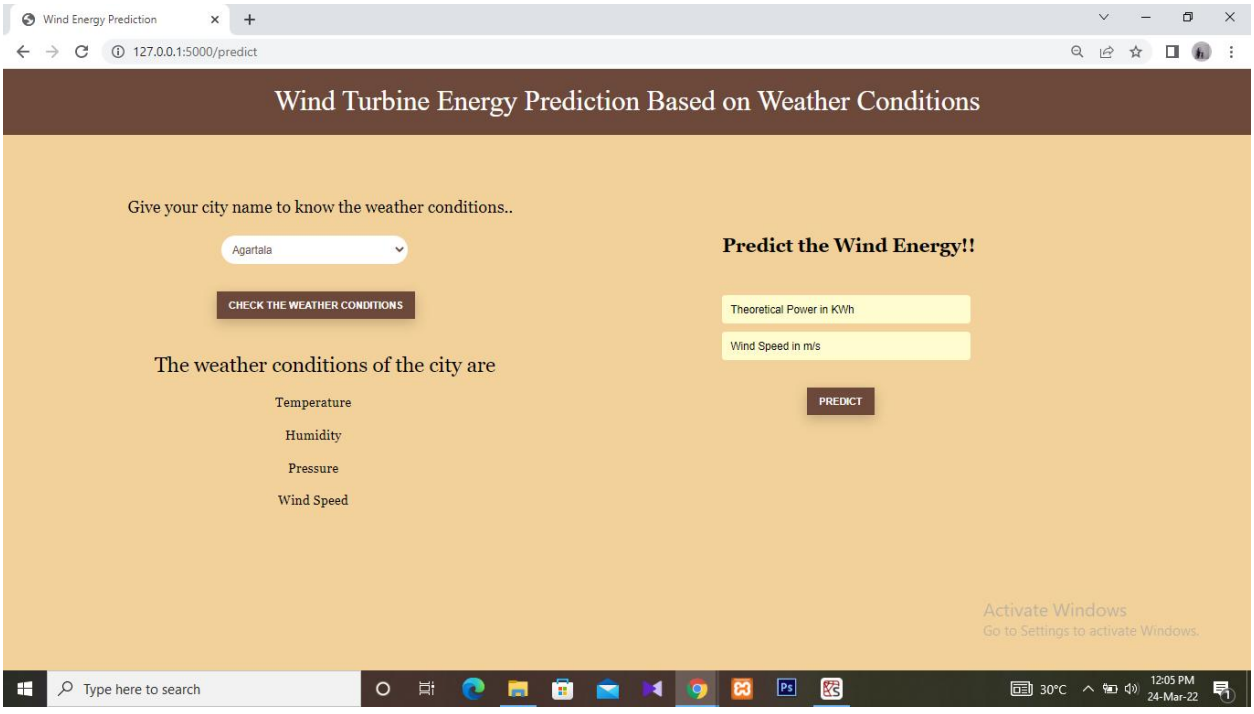


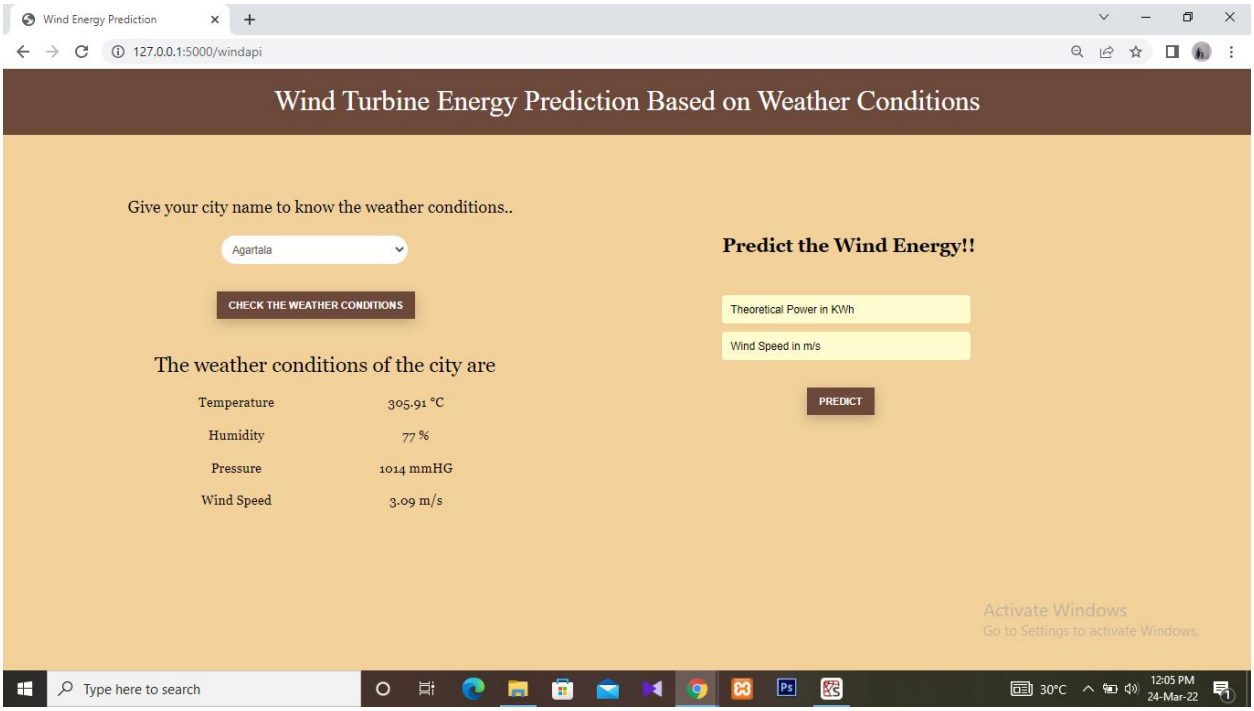
5. FLOWCHART

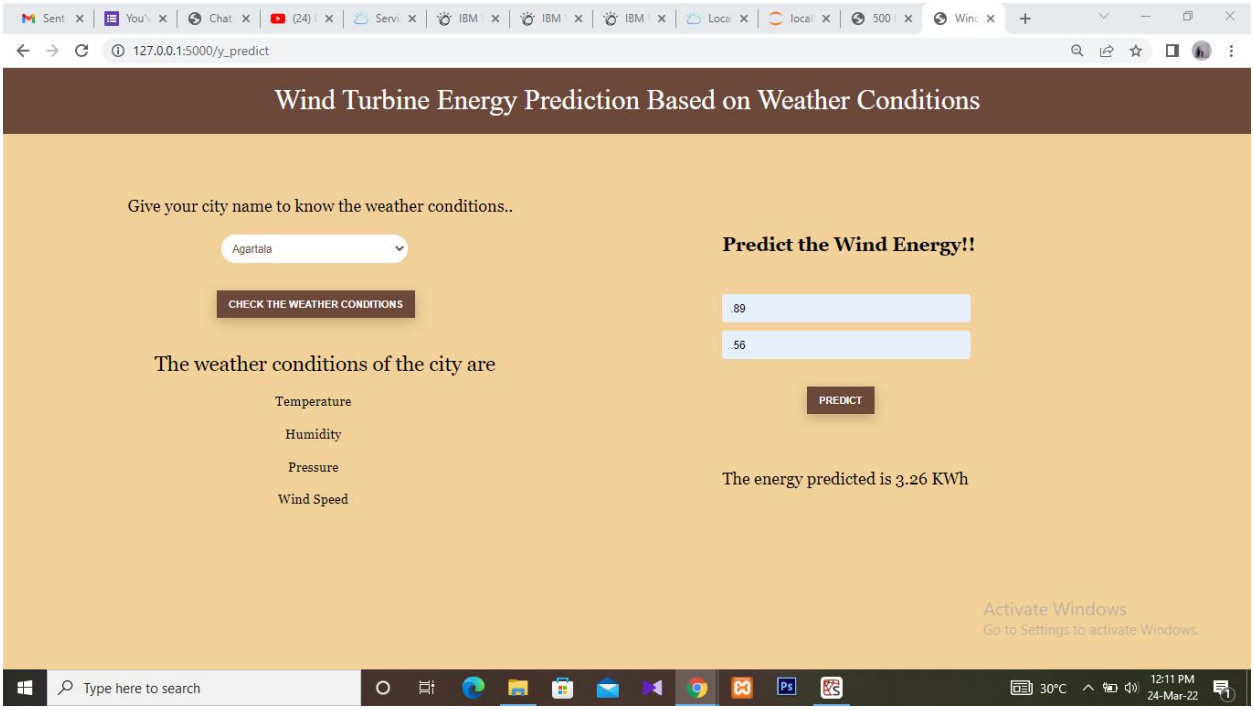

UI Form
Theoettical power
Wind speed
Wind energy prediction
msg payload
http request
ML MODEL
Predicted value
UI

6. RESULT


Wind Energy Prediction
127.0.0.1:5000
Wind Turbine Energy Prediction Based on Weather Conditions
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.
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.
WANT TO PREDICT THE ENERGY??
Activate Windows
Go to Settings to activate Windows.
Type here to search
30°C
12:05 PM
24-Mar-22


Wind Energy Prediction
127.0.0.1:5000/predict
Wind Turbine Energy Prediction Based on Weather Conditions
Give your city name to know the weather conditions..
Agartala
CHECK THE WEATHER CONDITIONS
The weather conditions of the city are
Temperature
Humidity
Pressure
Wind Speed
Predict the Wind Energy!!
Theoretical Power in KWh
Wind Speed in m/s
PREDICT
Activate Windows
Go to Settings to activate Windows.
Type here to search
30°C
12:05 PM
24-Mar-22


Wind Energy Prediction
127.0.0.1:5000/windapi
Wind Turbine Energy Prediction Based on Weather Conditions
Give your city name to know the weather conditions..
Agartala
CHECK THE WEATHER CONDITIONS
The weather conditions of the city are
Temperature 305.91 °C
Humidity 77 %
Pressure 1014 mmHG
Wind Speed 3.09 m/s
Predict the Wind Energy!!
Theoretical Power in KWh
Wind Speed in m/s
PREDICT
Activate Windows
Go to Settings to activate Windows.
Type here to search
30°C
12:05 PM
24-Mar-22


127.0.0.1:5000/y_predict
Wind Turbine Energy Prediction Based on Weather Conditions
Give your city name to know the weather conditions..
Agartala
CHECK THE WEATHER CONDITIONS
The weather conditions of the city are
Temperature
Humidity
Pressure
Wind Speed
Predict the Wind Energy!!
.89
.56
PREDICT
The energy predicted is 3.26 KWh
Activate Windows
Go to Settings to activate Windows.
Type here to search
30°C
12:11 PM
24-Mar-22

7. ADVANTAGES & DISADVANTAGES

ADVANTAGES:

Faster Claim Settlements & Save time:

We can predict the output very fast compared to other system and it save time due to machine learning so we can predict the quality of the water using the machine learning techniques

Cost Efficiency:

Due to automation of everything therefore the cost is reduced compared to the manual process

1. Automation of Everything

Machine Learning is responsible for cutting the workload and time. By automating things we let the algorithm do the hard work for us. Automation is now being done almost everywhere. The reason is that it is very reliable. Also, it helps us to think more creatively.Due to ML, we are now designing more advanced computers. These computers can handle various Machine Learning models and algorithms efficiently. Even though automation is spreading fast, we still don't completely rely on it. ML is slowly transforming the industry with its automation.

2. Wide Range of Applications

ML has a wide variety of applications. This means that we can apply ML on any of the major fields. ML has its role everywhere from medical, business, banking to science and tech. This helps to create more opportunities.

3. Scope of Improvement

Machine Learning is the type of technology that keeps on evolving. There is a lot of scope in ML to become the top technology in the future. The reason is, it has a lot of research areas in it. This helps us to improve both hardware and software.In hardware, we have various laptops and GPUs. These have various ML and Deep Learning networks in them. These help in

the faster processing power of the system. When it comes to software we have various UIs and libraries in use. These help in designing more efficient algorithms.

4. Efficient Handling of Data

Machine Learning has many factors that make it reliable. One of them is data handling. ML plays the biggest role when it comes to data at this time. It can handle any type of data. Machine Learning can be multidimensional or different types of data. It can process and analyze these data that normal systems can't. Data is the most important part of any Machine Learning model. Also, studying and handling of data is a field in itself.

DISADVANTAGES:

1. Possibility of High Error

In ML, we can choose the algorithms based on accurate results. For that, we have to run the results on every algorithm. The main problem occurs in the training and testing of data. The data is huge, so sometimes removing errors becomes nearly impossible. These errors can cause a headache to users. Since the data is huge, the errors take a lot of time to resolve.

2. Algorithm Selection

The selection of an algorithm in Machine Learning is still a manual job. We have to run and test our data in all the algorithms. After that only we can decide what algorithm we want. We choose them on the basis of result accuracy. The process is very much time-consuming.

3. Data Acquisition

In ML, we constantly work on data. We take a huge amount of data for training and testing. This process can sometimes cause data inconsistency. The reason is some data constantly keep on updating. So, we have to wait for the new data to arrive. If not, the old and new data might give different results. That is not a good sign for an algorithm.

4. Time and Space

Many ML algorithms might take more time than you think. Even if it's the best algorithm it might sometimes surprise you. If your data is large and advanced, the system will take time.

This may sometimes cause the consumption of more CPU power. Even with GPUs alongside, it sometimes becomes hectic. Also, the data might use more than the allotted space.

8. APPLICATIONS

Precise forecasts of wind energy generation for power traders, plant and grid operators belong to our core competencies. With our prediction systems we deliver precise forecasts of the wind energy input for any on- and offshore sites worldwide as well as for control zones and grid node levels. By optimally combining weather models, we predict energy output from 5 minutes to 15 days in advance at a high time resolution and with a very short-term adaptation to online measurements.Whether you are an energy provider, power trader or grid operator, system can efficiently integrate the fluctuating input from wind and solar energy into your daily business both technically and economically. In order to calculate a qualified wind energy prediction, system utilize numerical data from all leading weather services, making use of their individual strengths. The complex calculation model applied here obtains a high degree of forecasting accuracy through the optimal combination of various weather models, together with the integration of the surrounding wind farm terrain.

9. CONCLUSION

We started with the aim of improving the predictions of power generated using wind energy and we have achieved that using random forest as machine learning model and performing model optimization on it. We have also observed that if the wind speed is less than 4 m/s the power generated by the system is zero. LSTM is not able to learn this pattern as this is not the part which it can understand in time series analysis. So, if a hybrid new model is created which can work as the combination of Decision Tree/Random Forest and LSTM we can improve upon these results as well.

10. FUTURE SCOPE

While machine learning artificial intelligence may be seen as a data-hungry machine, the crucial aspect of a successful AI system is to accurately predict the energy output of wind turbine. Here we are using the random forest algorithm and only taking city,theoretical power,wind

speed,pressure,humidity and temperature to create the model. In future, we can include those aspects too. To accurately predict the energy output of wind turbine.

11. BIBLIOGRAPHY

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