PREDICTING THE ENERGY OUTPUT OF WIND TURBINE BASED ON WEATHER CONDITIONS

SUBMITTED BY

ABHISHEK PRASAD

INDEX

INTRODUCTION

1.1. OVERVIEW

AS OUR TRADITIONAL POWER SOURCES ARE RUNNING OVER NATURAL RESOURCES AND THEY ARE EVEN POLLUTING OUR ENVIRONMENT . MOST OF COUNTRIES ARE STARTED INVESTING IN WIND ENERGY AND IT IS GROWING. BUT WE CAN'T ALONE DEPEND ON WIND ENERGY SINCE IT IS COMPLETE DEPENDS ON NATURE. SO WE CAN MAKE A TIME SERIES MODEL WHICH CAN PREDICT IN FUTURE THAT HOW MUCH ENERGY WILL BE PRODUCED USING SOME INDEPENDENT FACTORS LIKE WIND SPEED AND DIRECTION AND ACCORDING TO THIS OUR TRADITIONAL SYSTEMS DOESN'T OVER PRODUCE.

1.2. PURPOSE

THIS PROJECT'S OBJECTIVE IS TO DEVELOP A TIME SERIES MODEL TO PREDICT THE POWER OUTPUT OF WIND FARM BASED ON THE WEATHER CONDITION IN THE SITE.

LITERATURE SURVEY

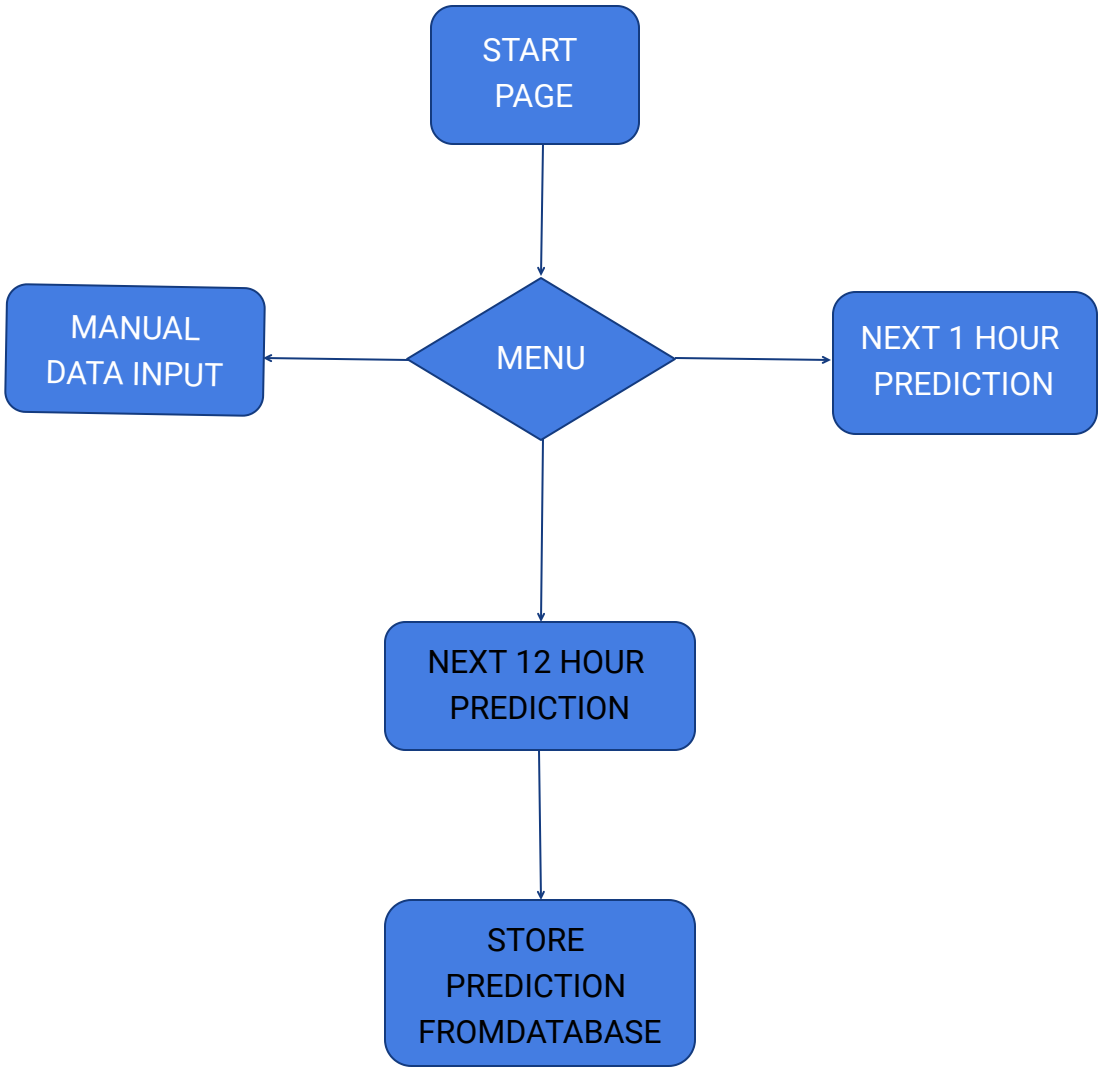
2.1 EXISTING PROBLEM

AS OUR NATURAL RESOURCES LIKE FOSSIL FUELS AS DEPLETING DAY BY AND DEMAND OF CLEANER ENERGY INCREASES DAY BY DAY ONLY SOLUTION IS SUSTAINABLE ENERGY RESOURCES LIKE WIND . BUT ALONE WE CAN'T DEPENDS ON WIND OF ENERGY PRODUCTION . SO WE CAN MAKE A TIME SERIES MODEL WHICH CAN PREDICT IN FUTURE THAT HOW MUCH ENERGY WILL BE PRODUCED USING SOME INDEPENDENT FACTORS LIKE WIND SPEED AND DIRECTION AND ACCORDING TO THIS OUR TRADITIONAL SYSTEMS DOESN'T OVER PRODUCE.

2.2. PROPOSED SOLUTION

THE PROPOSED SOLUTION IS TO USE SARIMAX MODEL AND TRAIN THIS MODEL. THE INPUT FOR THE MODEL 1 HOUR SAMPLED WIND SPEED AND WIND DIRECTION DATA. A USER FRIENDLY INTERFACE CREATED USING HTML THAT SHOWS INTERACTIVE GRAPHS TO SHOW THE PREDICTION OF NEXT 12 HOURS .IT TAKES FUTURE VALUES OF WIND SPEED AND DIRECTION FROM WEATHER API.

BLOCK DIAGRAM



SOFTWARE DESIGN

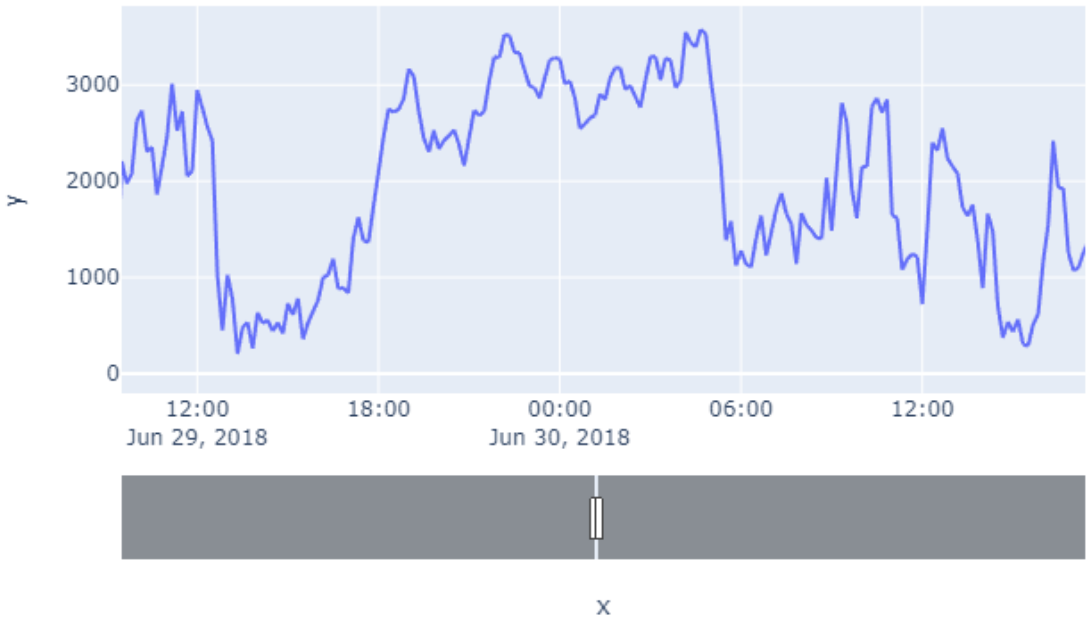
IN THIS WE HAVE USED

1. FLASK
2. BOOTSTRAP
3. HTML
4. PLOTLY
5. IBM CLOUD SEVER
6. IBM DATABASE

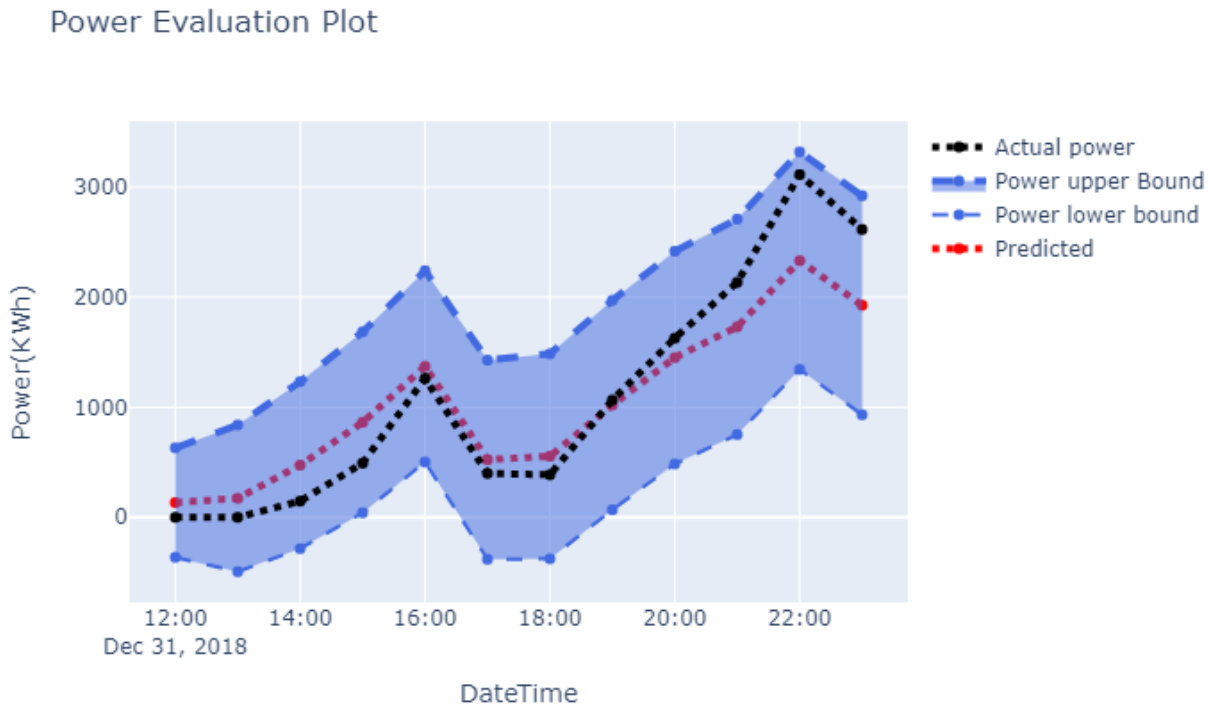
EXPERIMENTAL INVESTIGATION:

IN THIS WE BUILD THE MODEL USING TIME SERIES MODELING. WE HAVE OBSERVERED FROM DATA THAT IT IS STATIONERY AND DON'T HAVE SEASONALITY IN IT AND FROM PREDICTION WE HAVE SEEN IT IS ACCURATE AND INSIDE 95% CONFIDENCE INTERVAL.
ITS RMSE ERROR FOR 12 HRS PREDICTION IS 369 KWH.

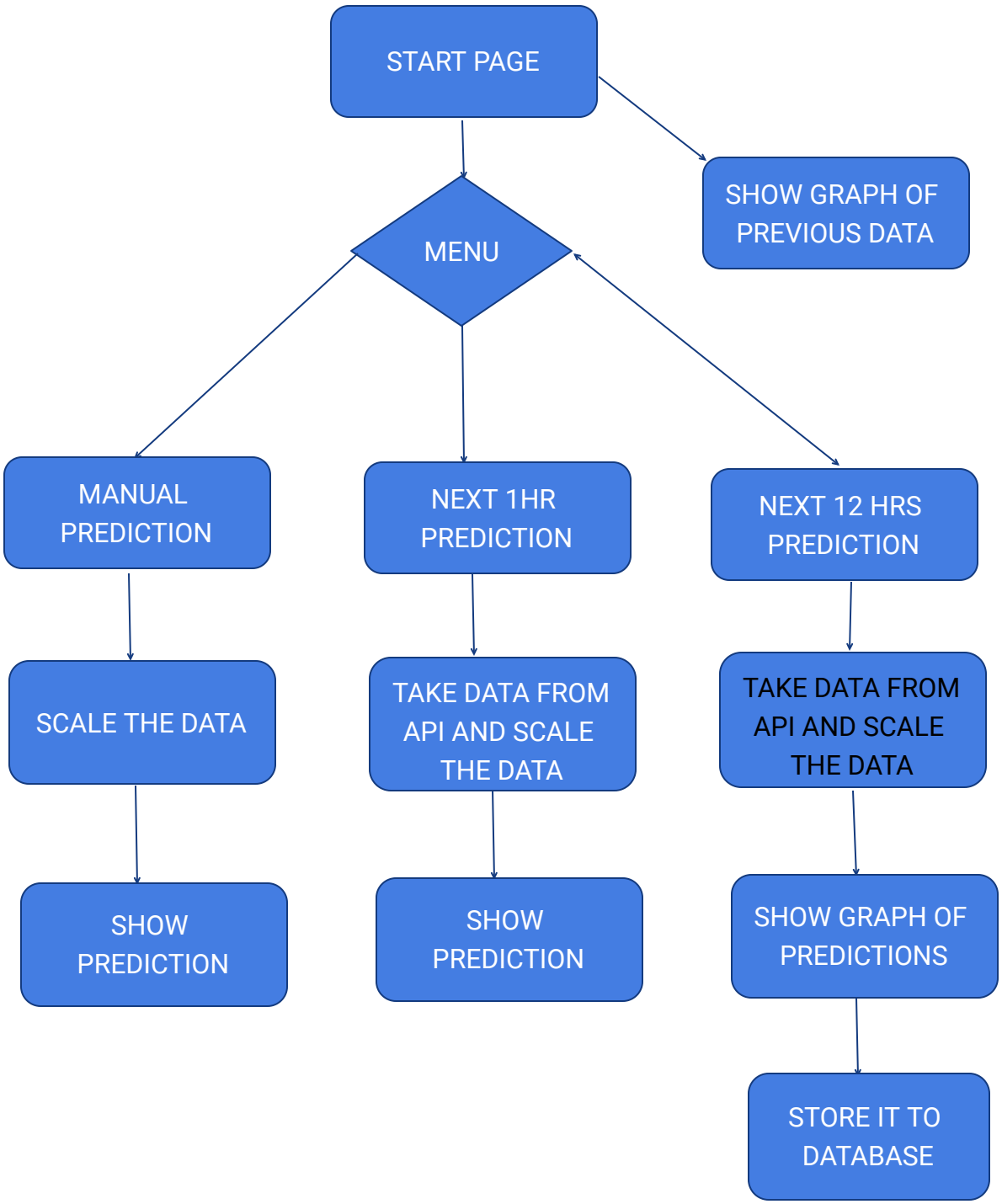
POWER(KWH) VS TIME GRAPH



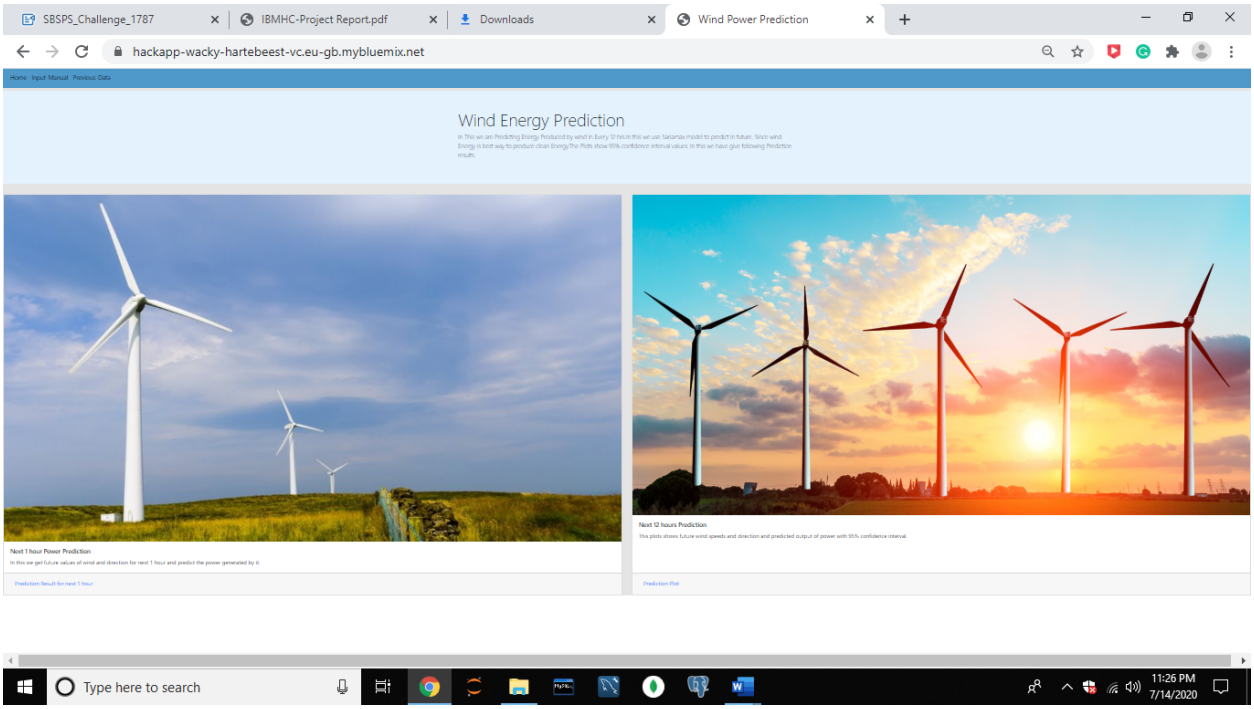
WIND SPEED VS TIME GRAPH



FLOWCHART


START PAGE
SHOW GRAPH OF PREVIOUS DATA
MENU
MANUAL PREDICTION
NEXT 1HR PREDICTION
NEXT 12 HRS PREDICTION
SCALE THE DATA
TAKE DATA FROM API AND SCALE THE DATA
TAKE DATA FROM API AND SCALE THE DATA
SHOW PREDICTION
SHOW PREDICTION
SHOW GRAPH OF PREDICTIONS
STORE IT TO DATABASE

RESULTS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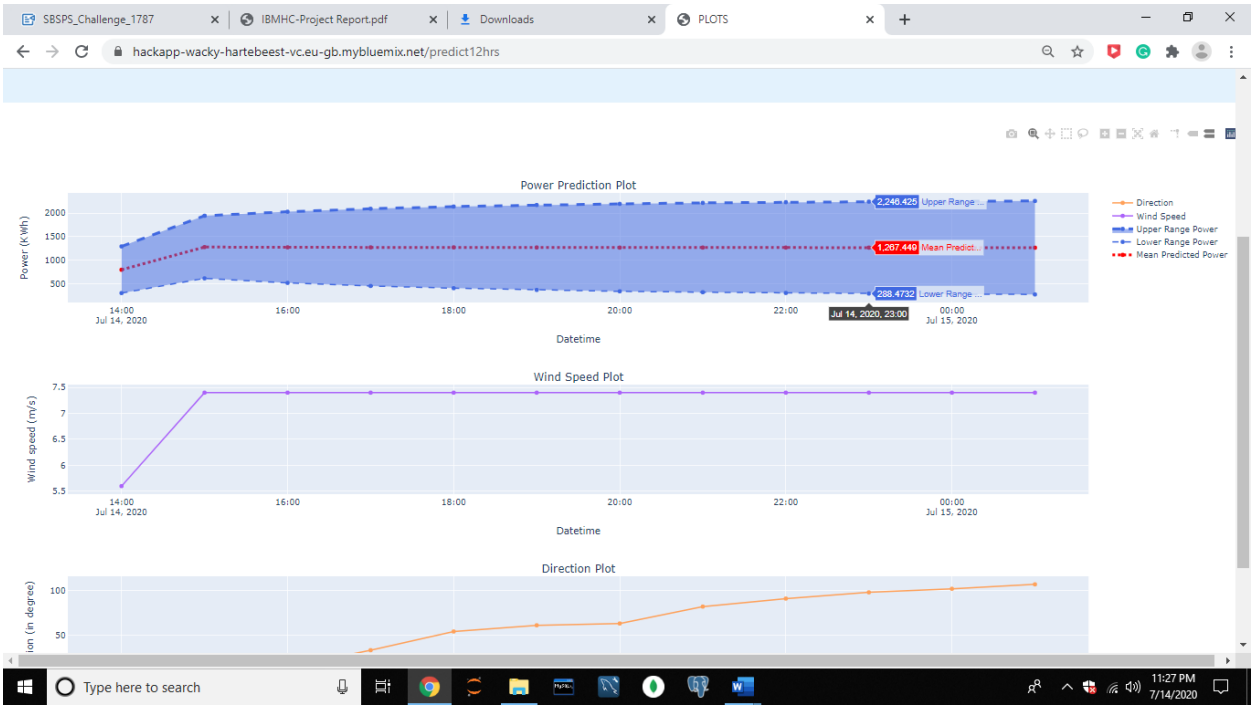
Wind Power Prediction
hackapp-wacky-hartebeest-vc.eu-gb.mybluemix.net
Wind Energy Prediction
Next 1 hour Power Prediction
Next 12 hours Prediction
Type here to search
11:26 PM
7/14/2020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IBMHC-Project Report.pdf
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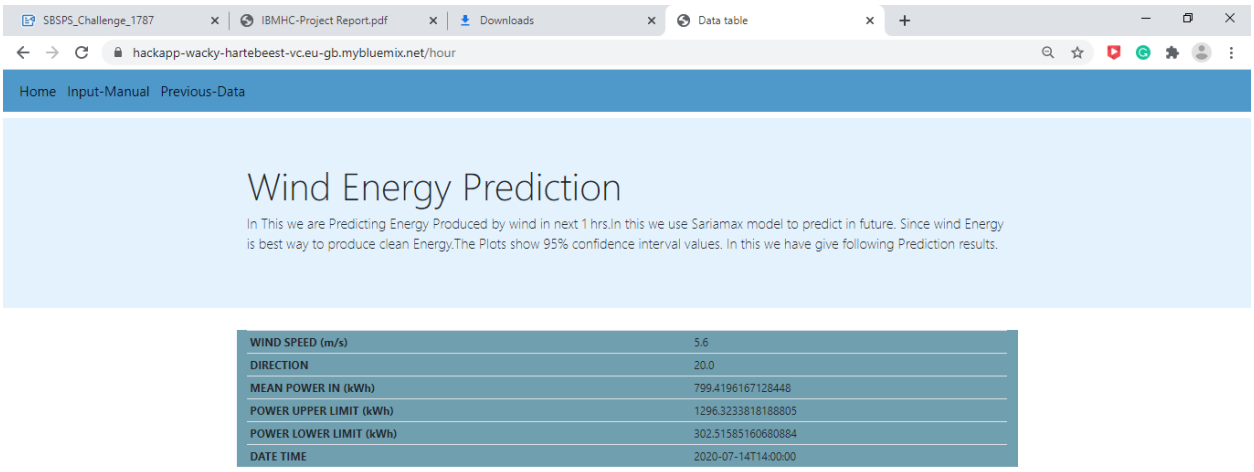
PLOTS
hackapp-wacky-hartebeest-vc.eu-gb.mybluemix.net/predict12hrs
Power Prediction Plot
Power (KWh)
2,246.425 Upper Range ...
1,267.449 Mean Predict...
288.4732 Lower Range ...
Jul 14, 2020, 23:00
Direction
Wind Speed
Upper Range Power
Lower Range Power
Mean Predicted Power
Datetime
Wind Speed Plot
Wind speed (m/s)
Datetime
Direction Plot
Type here to search
11:27 PM
7/14/2020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IBMHC-Project Report.pdf
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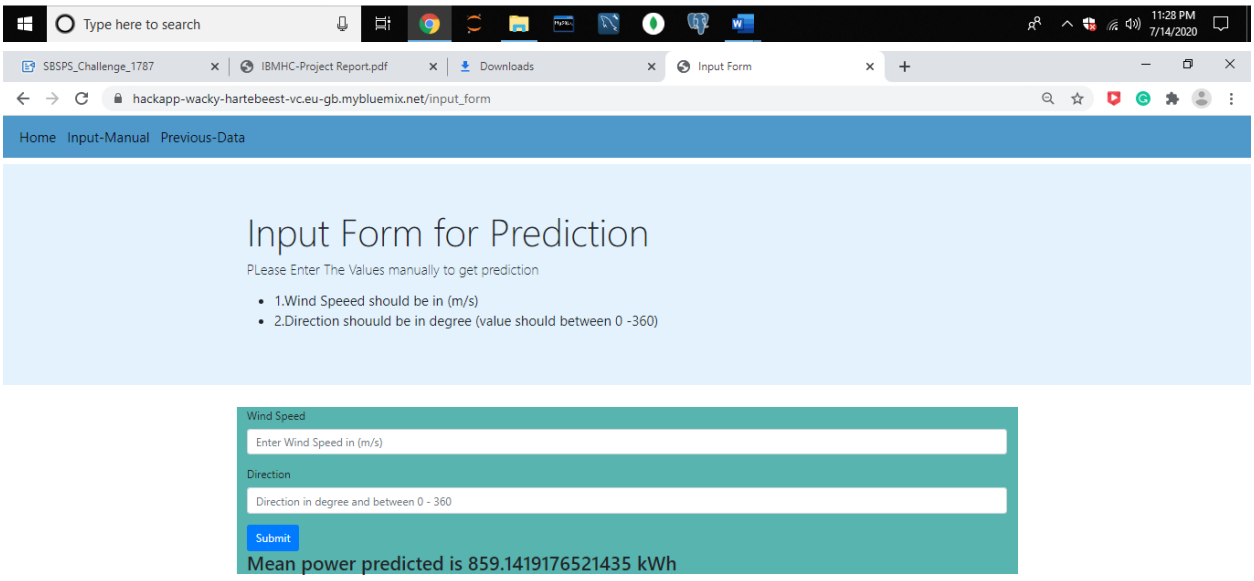
Data table
hackapp-wacky-hartebeest-vc.eu-gb.mybluemix.net/hour
Home Input-Manual Previous-Data
Wind Energy Prediction
In This we are Predicting Energy Produced by wind in next 1 hrs.In this we use Sariamax model to predict in future. Since wind Energy is best way to produce clean Energy.The Plots show 95% confidence interval values. In this we have give following Prediction results.
WIND SPEED (m/s) 5.6
DIRECTION 20.0
MEAN POWER IN (kWh) 799.4196167128448
POWER UPPER LIMIT (kWh) 1296.3233818188805
POWER LOWER LIMIT (kWh) 302.51585160680884
DATE TIME 2020-07-14T14:00:00


Type here to search
11:28 PM
7/14/2020
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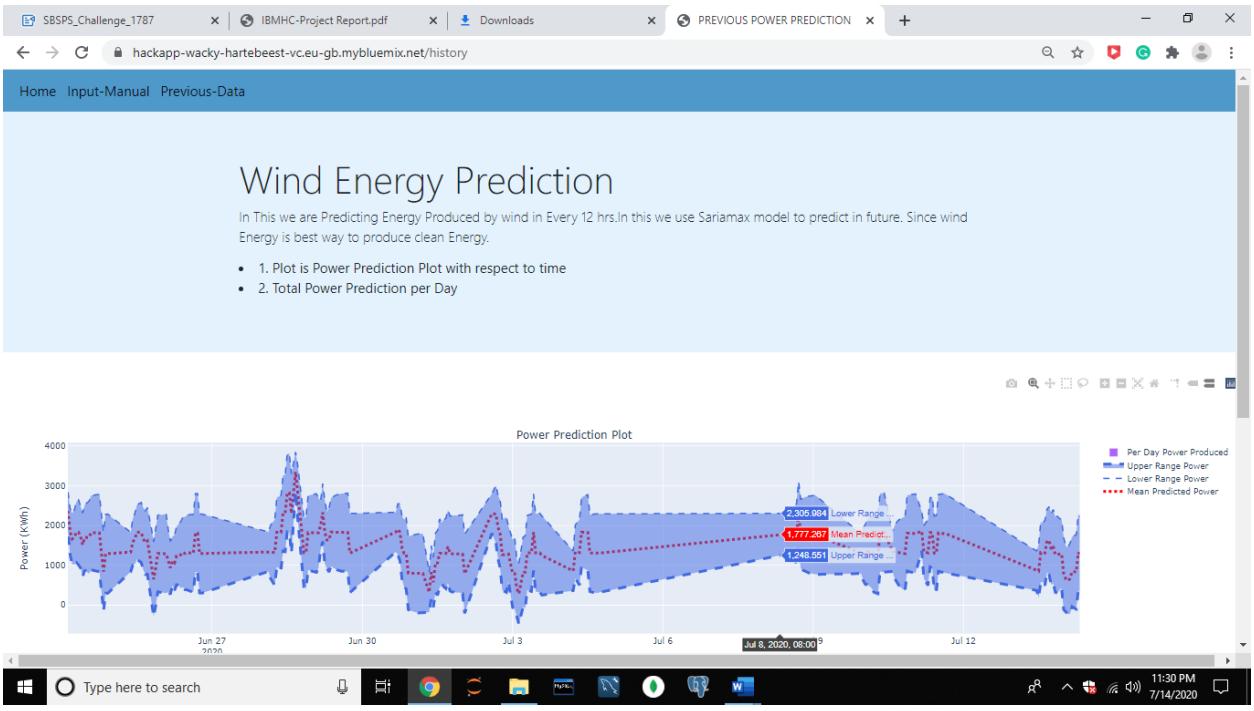
Input Form
hackapp-wacky-hartebeest-vc.eu-gb.mybluemix.net/input_form
Home Input-Manual Previous-Data
Input Form for Prediction
PLease Enter The Values manually to get prediction
1.Wind Speeed should be in (m/s)
2.Direction shouuld be in degree (value should between 0 -360)
Wind Speed
Enter Wind Speed in (m/s)
Direction
Direction in degree and between 0 - 360
Submit
Mean power predicted is 859.1419176521435 kWh
Type here to search
11:29 PM
7/14/2020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PREVIOUS POWER PREDICTION
hackapp-wacky-hartebeest-vc.eu-gb.mybluemix.net/history
Home
Input-Manual
Previous-Data
Wind Energy Prediction
In This we are Predicting Energy Produced by wind in Every 12 hrs.In this we use Sariamax model to predict in future. Since wind Energy is best way to produce clean Energy.
1. Plot is Power Prediction Plot with respect to time
2. Total Power Prediction per Day
Power Prediction Plot
Power (KWh)
Per Day Power Produced
Upper Range Power
Lower Range Power
Mean Predicted Power
Jul 8, 2020, 08:00
Type here to search
11:30 PM
7/14/2020


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PREVIOUS POWER PREDICTION
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Power (KWh)
Upper Range Power
Lower Range Power
Mean Predicted Power
Per Day Power Produced Plot
Jul 12, 2020
REFRESH
Type here to search
11:30 PM
7/14/2020

ADVANTAGES AND DISADVANTAGES

ADVANTAGES:

ONE OF THE BIGGEST ADVANTAGES OF EMBEDDING MACHINE LEARNING ALGORITHMS IS THEIR ABILITY TO IMPROVE OVER TIME. MACHINE LEARNING TECHNOLOGY TYPICALLY IMPROVES EFFICIENCY AND ACCURACY THANKS TO THE EVER-INCREASING AMOUNTS OF DATA THAT ARE PROCESSED.

DISADVANTAGES: AS DATA SET IS QUITE SMALL IT CAN PREDICT FOR PARTICULAR REGION ONLY. MEAN THAT AND IT CAN'T CONSIDER IT FOR SAMPLE AND CAN'T PREDICT FOR WHOLE POPULATION.IT NEED TO BE RETRAINED AFTER COUPLE PEROIDS OF TIME.

APPLICATIONS

THROUGH THIS PROJECT, WIND FARMS CAN GET A GOOD OVERVIEW ON HOW THE WEATHER AFFECTS ENERGY PRODUCTION AND OPTIMIZE THEIR ENERGY PRODUCTION. ALSO, ENERGY SUPPLIERS CAN COORDINATE THE COLLABORATIVE PRODUCTION OF DIFFERENT ENERGY SOURCES MORE EFFICIENTLY TO AVOID COSTLY OVERPRODUCTION.

CONCLUSION

THE END PRODUCT IS A WEBPAGE CREATED AND DEPLOYED ON IBM CLOUD. THE BACKEND OF WEBPAGE IS A SARIMAX MODEL CREATED AND DEPLOYED ON IBM CLOUD SERVICES . THIS MODEL CAN BE USED TO PREDICT THE ENERGY OUTPUT OF WIND TURBINE BASED ON WEATHER CONDITIONS.

FUTURE SCOPE

WE CAN USE DEEP LEARNING MODEL ON HUGE DATASET. TUNE OUR MODEL FOR BETTER RESULT.

BIBLIOGRAPHY

1. Dataset Reference:
https://www.kaggle.com/berkerisen/wind-turbine-scada-dataset
2. IBM Cloud Services:
https://www.youtube.com/watch?v=dbrglahdj48&list=plzpeuwuenmk2pyta scakk4bzjayzhw23l
3. Information On Wind Energy:
https://hpi.de/friedrich/docs/paper/re1.pdf