IBM Recommendation Model To Utilize Energy From Wind Farm

- **BY HOROSCOPER"S**

SCOPE :

- Our **Ultimate Aim** Is To **Competitive Real Time** , **Reduce Energy Wastage** And **Losses In Power Grid**.
- By Using Our Model, we Can Predict The **Valuable Time** Of Power Production.
- **Rest Of Plant** Can Be Provided **Frequently** By **Predicting** The **Unworthy Time** By Forecasting Energy, so We Can **control Machine** Break Down's.
- We Can Solve The **Future Energy Needs**.
- As Well **Availability Of Energy** Can Be Determined.

LITERATUER REVIEW :

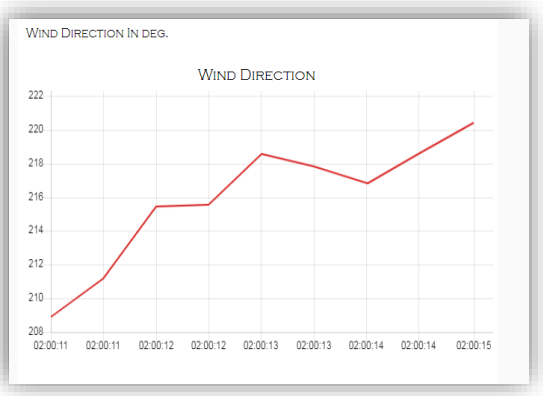
- We get into this great paper to gather information about this domain.
- Below mention's are our aspects from this paper.

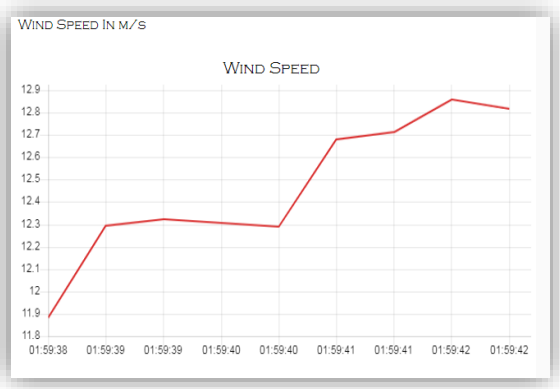
Article A New Hybrid Approach to Forecast Wind Power for Large Scale Wind Turbine Data Using Deep Learning with TensorFlow Framework and Principal Component Analysis

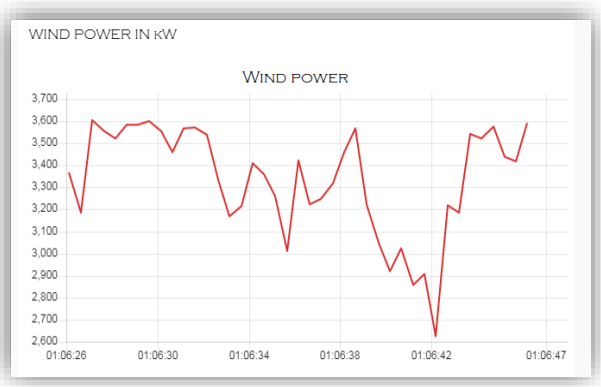
-Mansoor Khan , Tianqi Liu ,* and Farhan Ullah

- The principal components are then used as input data to **deep learning** based on the TensorFlow framework. **PCA provides feature extraction and selection.**
- Here, **acc, val_loss, val_acc represents accuracy**, validation loss and validation accuracy, respectively. The loss, accuracy and loss, and **validation loss** are **calculated** for **wind power forecasting**.
- The proposed deep learning algorithm is applied to PCs **to forecast wind power**. The Keras API is used with **TensorFlow to configure** a more reliable **neural network**.

Forecasted Output Of Our Model :

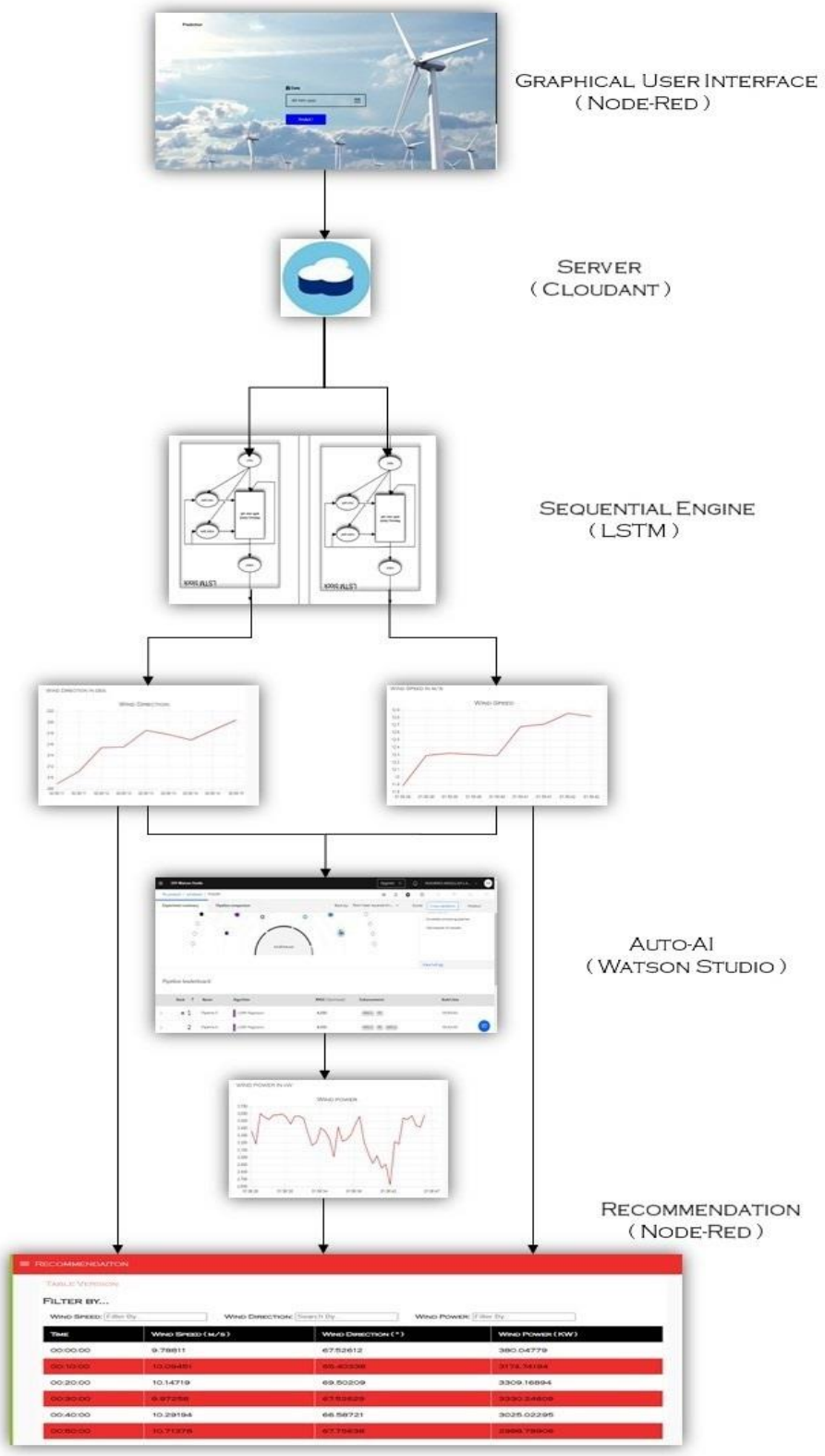






The Above Forecasting Done For 24 Hrs On Date 28-10-2021

Architectural Flow

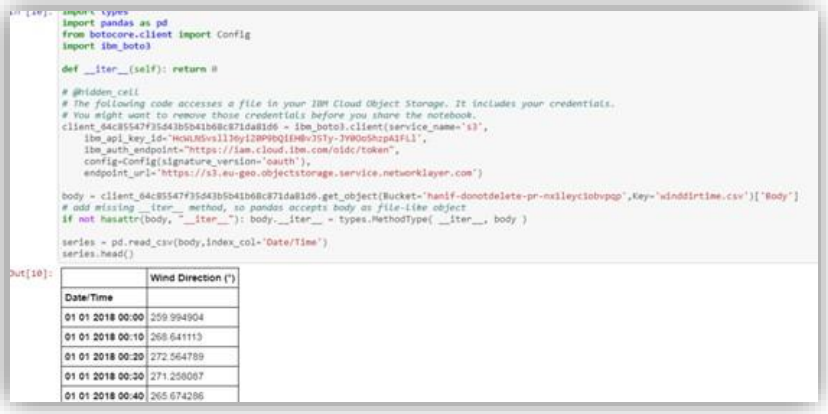


Work Process :

- IBM Account Creation.
  - Smart Internz assigning template.
  - Assigning team.
- Fetching Input.
- Selection of algorithm.
- Date preparation.
- Deploying Model.
- GUI creation.

Fetching Input :

- Collecting of data from various website.
  - Kaggle- https://www.kaggle.com/berkerisen/wind-turbine-scada-dataset
  - Github-https://github.com/ShashwatArghode/Wind-Energy-Prediction-using-LSTM/blob/master/AL_WIND_07_12.xlsx
- Importing data in **IBM Watson Studio** in a click.



```
import pandas as pd
from botocore.client import Config
import ibm_boto3

def __iter__(self): return 0

# @hidden_cell
# The following code accesses a file in your IBM Cloud Object Storage. It includes your credentials.
# You might want to remove those credentials before you share the notebook.
client_64c85547f35d43b5b41b68c871da81d6 = ibm_boto3.client(service_name='s3',
    ibm_api_key_id='HcWLN5vsll36y12RP9bQiEHBvJSTy-JY8OoShzp41FLl',
    ibm_auth_endpoint="https://iam.cloud.ibm.com/oidc/token",
    config=Config(signature_version='oauth'),
    endpoint_url='https://s3.eu-geo.objectstorage.service.networklayer.com')

body = client_64c85547f35d43b5b41b68c871da81d6.get_object(Bucket='hanif-donotdelete-pr-nxileyc1obvpqp',Key='winddirtime.csv')['Body']
# add missing __iter__ method, so pandas accepts body as file-like object
if not hasattr(body, "__iter__"): body.__iter__ = types.MethodType( __iter__, body )

series = pd.read_csv(body,index_col='Date/Time')
series.head()
```

Out[10]:

	Wind Direction (°)
Date/Time	
01 01 2018 00:00	259.994904
01 01 2018 00:10	268.641113
01 01 2018 00:20	272.564789
01 01 2018 00:30	271.258087
01 01 2018 00:40	265.674286

Selection Of Algorithm :

- Choosing **Best algo**. is the **main** process ever in **forecasting**.
- Normally algo. Like **SVM, Arima, Auto Arima** are **used** for **time series** prediction.
- But in this recommendation model **we tried LSTM** algo, which is one of library of **keras.**
- We have done this **forecasting** in **three segment**, Wind Speed, Direction, Power.
- **Wind Speed** and **Wind Direction** using **lstm model.**
- **Power Forecasting** using **Auto Ai**, the facility provided by our **IBM Watson studio**.

Feature Engineering :

- FOR WIND SPEED AND DIRECTION :
  - To fit our model we done some **preprocessing**,
  - Split up data into **train** and **test**.
  - Converting the data into **scalar form**, then take **difference of past data**.
  - Setting the **epoch**, finding **study rate**, fix the **batch size**, selection of **neurons** and **validate**.
- FOR POWER :
  - We done it in **auto AI.**
  - For **power** prediction we give the **input** from the **output** of **former prediction**.

SPLITTING OF DATA

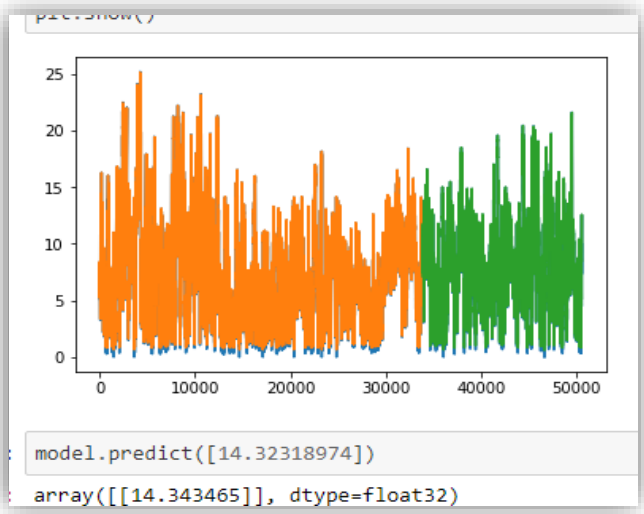
```
[8]: X = df[['WindSpeed','WindDirection']].values
     print(X)
     y = df['ActivePower'].values
     print(y)
     from sklearn.model_selection import train_test_split

     x_train,x_test,y_train,y_test = train_test_split(X,y, test_size = 0.2)
```

```
[[  5.31133604 259.99490356]
 [  5.67216682 268.64111328]
 [  5.2160368  272.56478882]
 ...
 [  8.43535805  84.74250031]
 [  9.42136574  84.2979126 ]
 [  9.97933197  82.27462006]]
[ 380.04779053  453.76919556  306.37658691 ... 2201.10693359 2515.6940918
 2820.46606445]
```

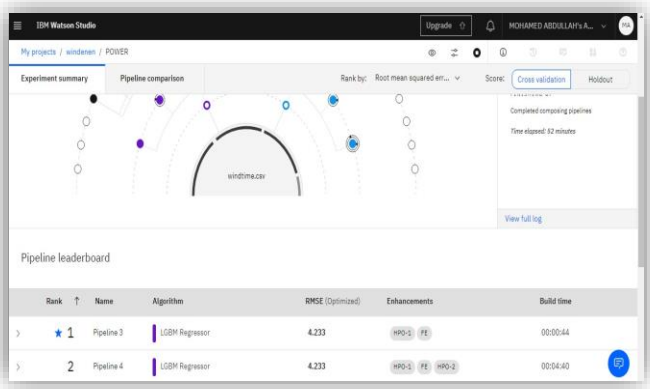
Validation of our Prediction :

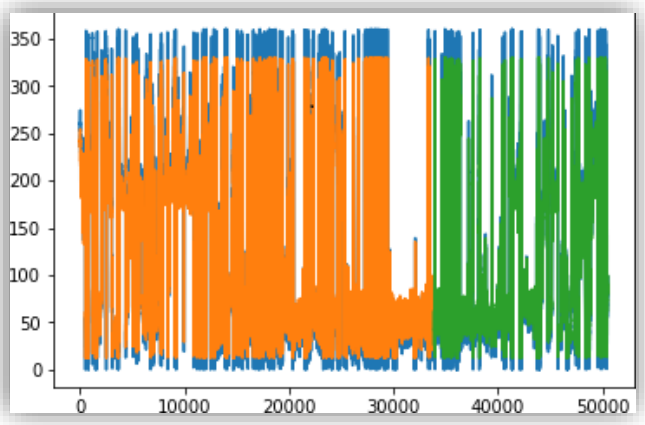
- The plot shows the **test and train data set fitted with our model.**
- The RMSE value showing below are **model fitted by power** data which is especially done by **Auto Ai Service** provided by Our **IBM Watson Studio.**




```
import math
# Estimate model performance
trainScore = model.evaluate(trainX, trainY, verbose=0
print('Train Score: %.2f MSE (%.2f RMSE)' % (trainSco
testScore = model.evaluate(testX, testY, verbose=0)
print('Test Score: %.2f MSE (%.2f RMSE)' % (testScore
```

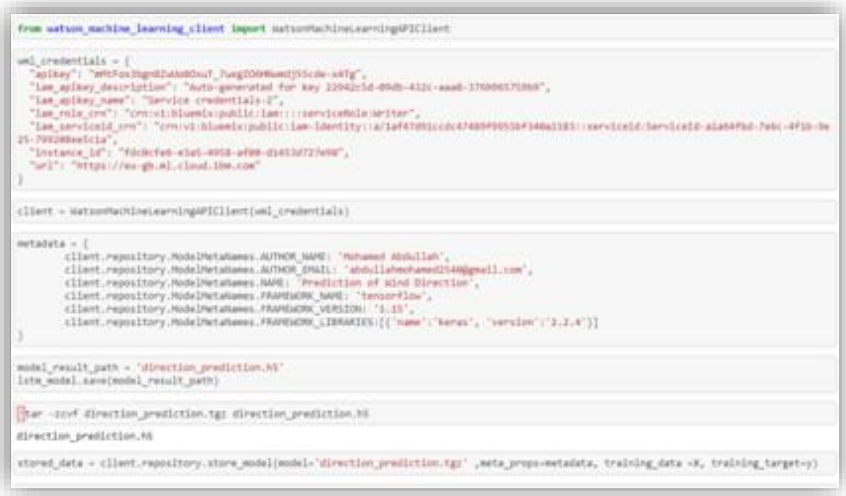
```
Train Score: 0.58 MSE (0.76 RMSE)
Test Score: 0.54 MSE (0.74 RMSE)
```





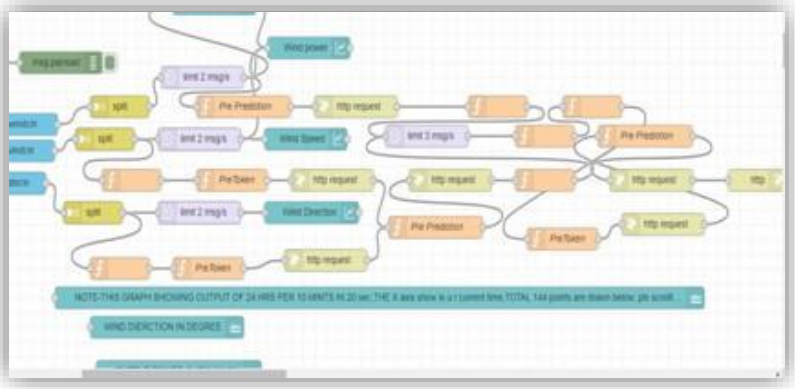
Deployment :

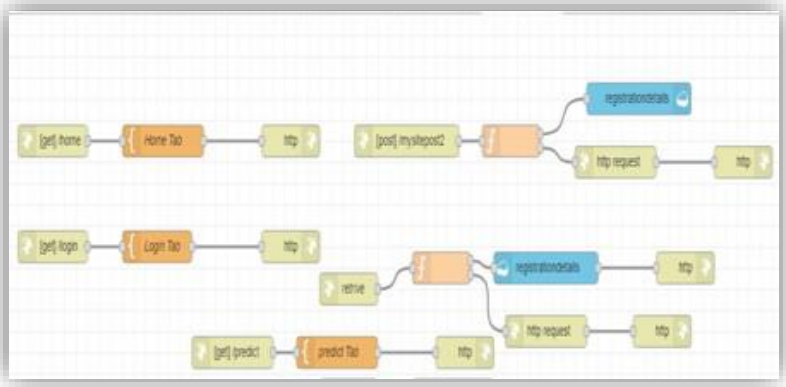
- **IBM Watson Studio** made **Deployment easy** in few steps.
- For deployment purpose, we created a service credentials in **Watson machine learning service**.
- After creating credentials **load the model in service** Provider ,We **get the guid**
- that's all its done



GUI Creation :

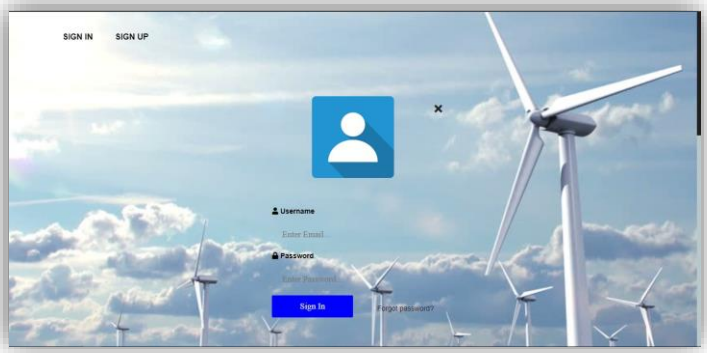
- We Done Our GUI With **Node-red**, it Is One Of **Service** Provide By **Our IBM**
- Below Shown Node Are Our **Prediction Node** And Our **GUI Tab Nodes**





Our GUI with IBM

☞ below shown image' s are our different tabs in our GUI.



HIGHLIGHT' S :

- We Predicting **Wind Speed, Wind Direction** In **separate algo**., and giving the **output of this prediction** to predict **power**, however real time scenario happens like this, so our model should be best to **competitive with real time.**
- It can also **recommend** the time to **Utilize Power from grid**.
- So that we can give **rest period** to grid and **Save Energy**.
- **24 hours** forecast with **10 minutes interval**, just in **20 seconds.**
- For easy understanding of users " **Recommended Table Version** " are provided.
- To view forecast in better way, **Search** and **Filter** options are added.

REPORT ON -SBSPS_Challenge_2238-**IBM Recommendation Model To Utilize Energy From Wind**

≡ RECOMMENDAITON

TABLE VERSION

FILTER BY...

WIND SPEED: Filter By... WIND DIRECTION: Search By... WIND POWER: Filter By...

TIME	WIND SPEED (M/S)	WIND DIRECTION (°)	WIND POWER (KW)
00:00:00	9.78811	67.52612	380.04779
00:10:00	10.09451	65.40338	3174.74194
00:20:00	10.14719	69.50209	3309.16894
00:30:00	9.97258	67.52629	3330.24609
00:40:00	10.29194	66.58721	3025.02295
00:50:00	10.71378	67.75638	2988.78906

≡ RECOMMENDAITON

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00:00:00	9.78811	67.52612	380.04779
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00:40:00	10.29194	66.58721	3025.02295
00:50:00	10.71378	67.75638	2988.78906
01:00:00	10.51755	65.80247	1261.66296
01:10:00	10.3856	66.7978	1307.474
01:20:00	10.22741	64.7504	1483.552

Future Plans :

- To give **chart bots** to **help more** for the service users.
- **Prediction** of **weather** also help to maintain **more stability** in prediction.
- All **screen compatibility** will be launched soon.

To Access our GUI :

- https://node-red-itpxr.eu-gb.mybluemix.net/home

To Appreciate Our Work :

- https://node-red-itpxr.eu-gb.mybluemix.net/home#contact

SPECIAL THANKS TO:

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