M KUMARASAMY COLLEGE OF ENGINEERING

TEAM ID: PNT2022TMID16089

CRUDE OIL PRICE PREDICTION

INDEX

1. INTRODUCTION

1.1 PROJECT OVERVIEW

Crude oil is amongst the most important resources in today's world, it is the chief fuel, and its cost has a direct effect on the global habitat, our economy and oil exploration, exploitation and other activities. Prediction of oil prices has become the need of the hour, it is a boon to many large and small industries, individuals, the government. The evaporative nature of crude oil, its price prediction becomes extremely difficult, and it is hard to be precise with the same. Several different factors that affect crude oil prices. We propose a contemporary and innovative method of predicting crude oil prices using the artificial neural network (ANN). The main advantage of this approach of ANN is that it continuously captures the unstable pattern of the crude oil prices which have been incorporated by finding out the optimal lag and number of the delay effect that controls the prices of crude oil. Variation of lag in a period has been done for the most optimum and close results, we then have validated our results by evaluating the root mean square error and the results obtained using the proposed model have significantly outperformed.

1.2 PURPOSE

Crude oil price fluctuations have a far reaching impact on global economies and thus price forecasting can assist in minimising the risks associated with volatility in oil prices. Price forecasts are very important to various stakeholders: governments, public and private enterprises, policymakers, and investors. Energy has been a crucial production input in the production activities and economic growth and development processes of many countries. In fact, in the face of the global call for sustainable environment through the promotion of green energy sources, the role of fossil fuels, especially crude oil, cannot still be sufficiently relegated particularly in many industrialized and energy-dependent economies.

2.LITERATURE SURVEY

2.1 EXISTING PROBLEM

In recent years, the crude oil market has entered a new period of development and the core influence factors of crude oil have also been a change. Thus, we develop a new research framework for core influence factors selection and forecasting. Firstly, this paper assesses and selects core influence factors with the elastic-net regularized generalized linear Model (GLMNET), spike-slab lasso method, and Bayesian model average (BMA). Secondly, the new machine learning method long short-term Memory Network (LSTM) is developed for crude oil price forecasting. Then six different forecasting techniques, random walk (RW), autoregressive integrated moving average models (ARMA), Elman neural Networks (ENN), ELM Neural Networks (EL), walvet neural networks (WNN) and generalized regression neural network Models (GRNN) were used to forecast the price. Finally, we compare and analyse the different results with root mean squared error (RMSE), mean absolute percentage error (MAPE), directional symmetry (DS). Our empirical results show that the variable selection-LSTM method outperforms the benchmark methods in both level and directional forecasting accuracy.

2.2 REFERENCE

1. A deep learning ensemble approach for crude oil price forecasting: Author: Yang Zhao, Jianping Li, Lean Y (2017)
2. Baumeister C, Kilian L, Zhou X (2013) Are product spreads useful for forecasting? An empirical evaluation of the Verleger hypothesis. Available at SSRN DP9572Castle JL, Qin X, Reed WR (2009)
3. How to pick the best regression equation: a review and comparison of model selection algorithms. Working Papers in Economics 32(5):979–986
4. Chiroma H, Abdulkareem S, Herawan T (2015) Evolutionary neural network model for West Texas intermediate crude oil price prediction. Apply Energy 142:266–273.
5. Cifarelli G, Paladino G (2010) Oil price dynamics and speculation: a multivariate financial approach. Energy Econ 32(2):363–372.

2.3 PROBLEM STATEMENT DEFINITION

Oil demand is inelastic, therefore the rise in price is good news for producers because they will see an increase in their revenue. Oil importers, however, will experience increased costs of purchasing oil. Because oil is the largest traded commodity, the effects are quite significant. A rising oil price can even shift economic/political power from oil importers to oil exporters. The crude oil price movements are subject to diverse influencing factors.

This Guided Project mainly focuses on applying Neural Networks to predict the Crude Oil Price. This decision helps us to buy crude oil at the proper time. Time series analysis is the best option for this kind of prediction because we are using the Previous history of crude oil prices to predict future crude oil. So we would be implementing RNN (Recurrent Neural Network) with LSTM(Long Short Term Memory) to achieve the task.

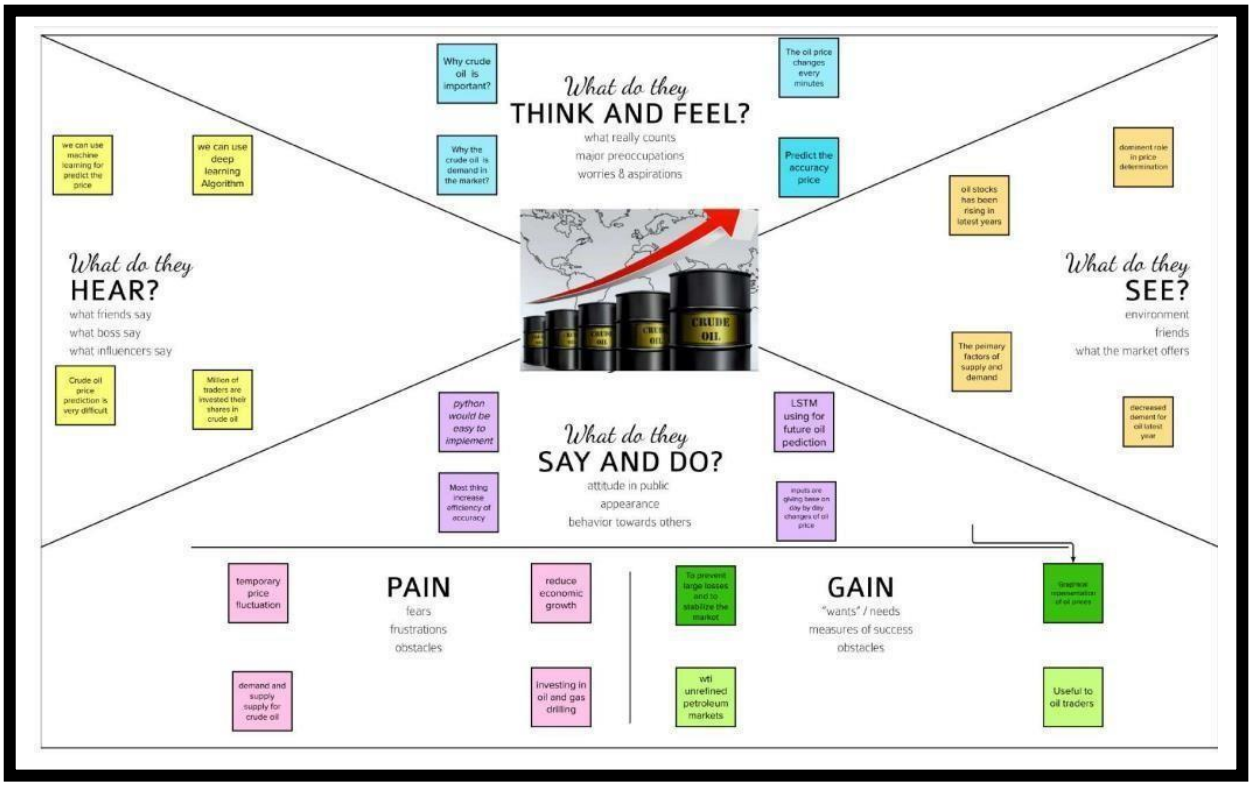
3.IDEATHON AND PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS

An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviours and attitudes.

It is a useful tool to helps teams better understand their users.

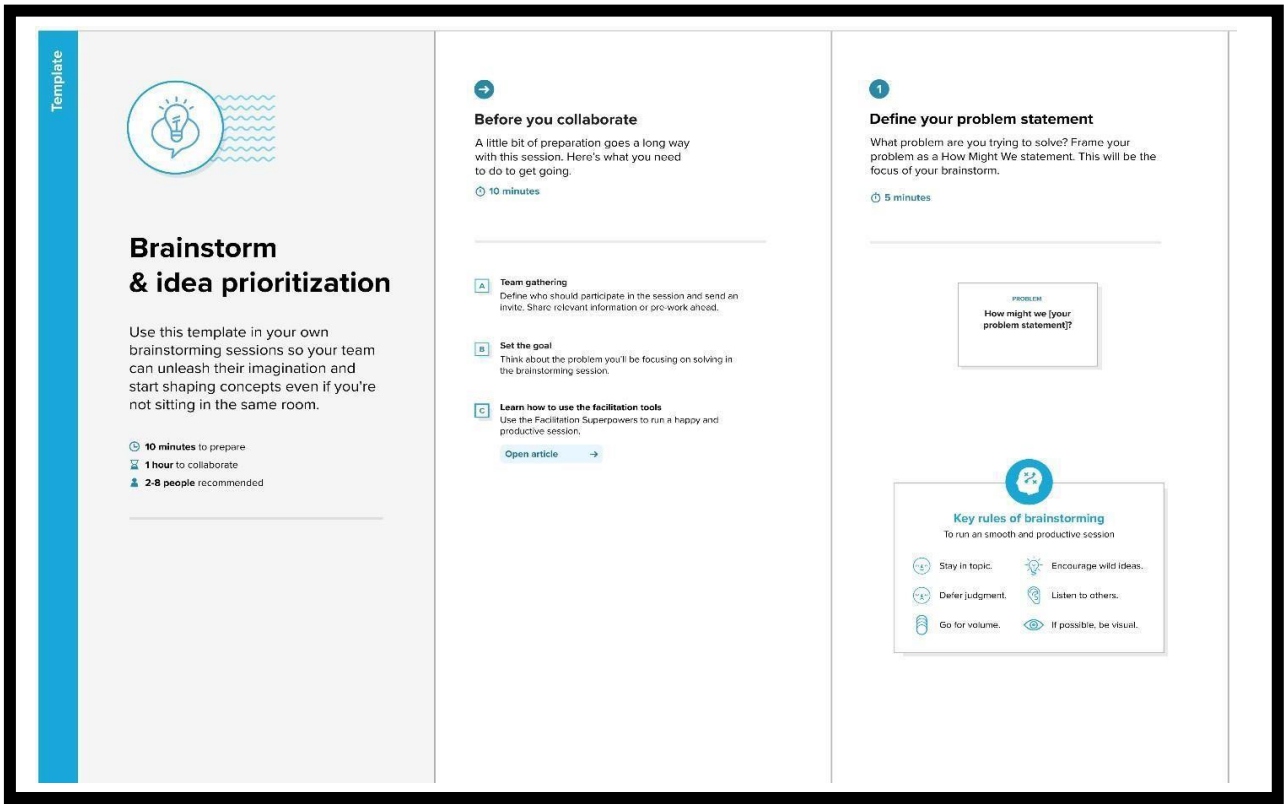
Creating an effective solution requires understanding the true problem and the person who is experiencing it. The exercise of creating the map helps participants consider things from the user's perspective along with his or her goals and challenges.



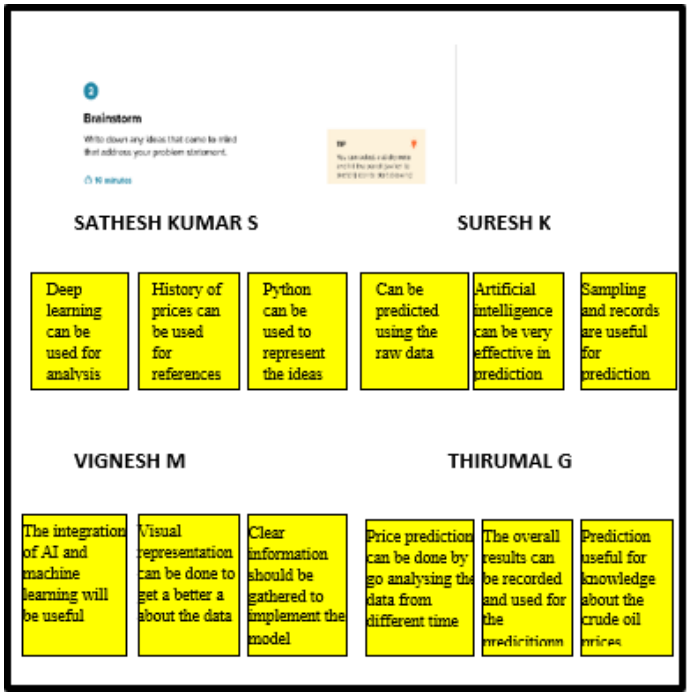
3.2 IDEATHON AND BRAINSTORMING

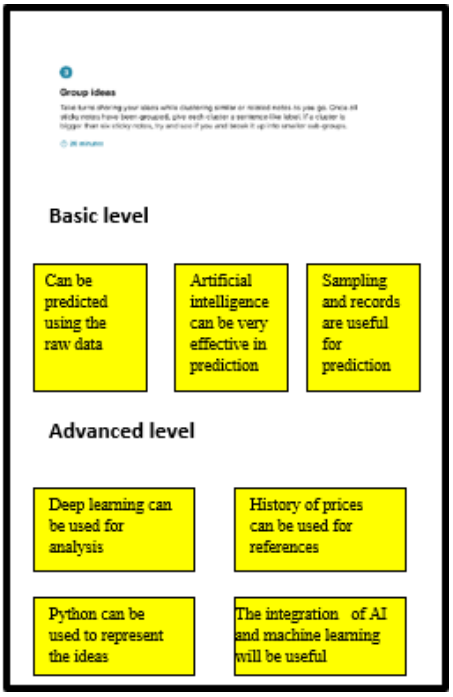
Brainstorm & Idea Prioritization:

Step 1: Team Gathering, Collaboration and Select the Problem Statement



Step 2: Brainstorm, Idea listing and Grouping





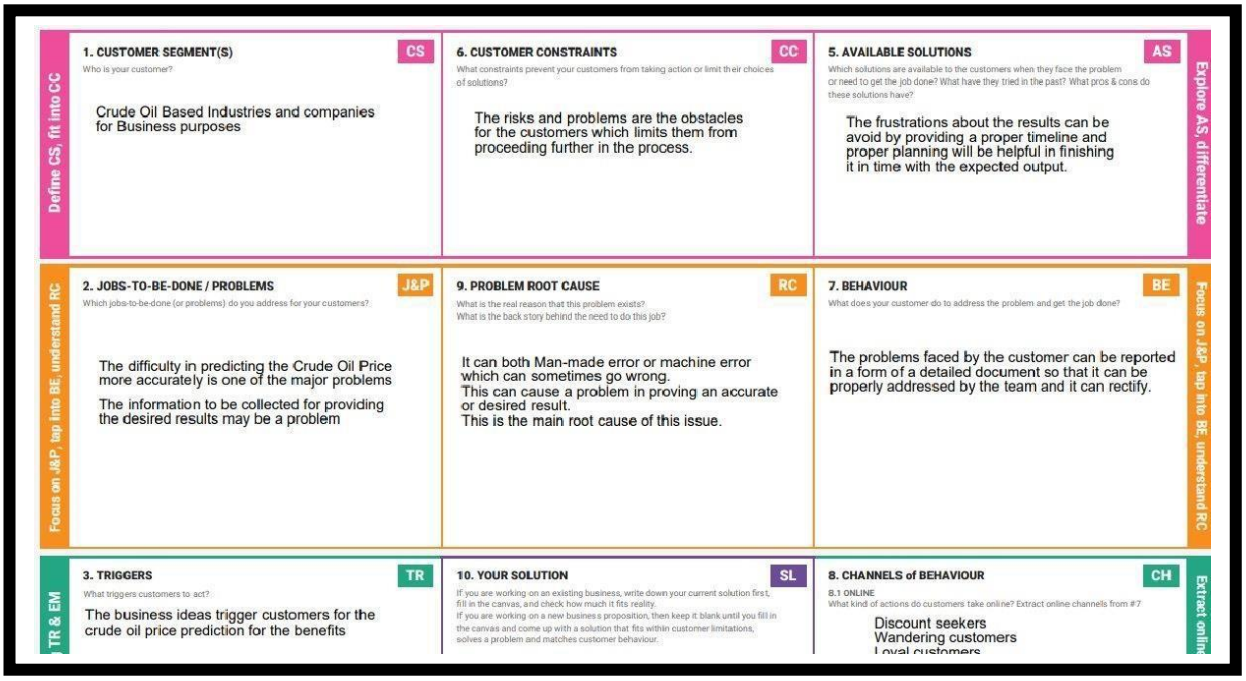
3.3 PROPOSED SOLUTION

Proposed Solution Template:

The project team shall fill in the following information in the proposed solution template.

S.NO	PARAMETER	DESCRIPTION
1.	Problem Statement (Problem to be	The value of crude oil prices on the worldwide market is extremely difficult to anticipate due to the unpredictable variations in supply and demand as well as the impact of geopolitics.
2.	Idea / Solution description	We will gradually compile a dataset of historical oil price data, feed it to the model, train it, compile it, and then implement it in the web application after it has reached the ideal state.
3.	Novelty/uniquness	Despite being an old concept, it will work better if periodic training is used.
4.	Social Impact / Customer Satisfaction	Customers may learn about the price of crude oil and profit financially by utilising the online app.
5.	Business Model (Revenue Model)	Customers may learn about the price of crude oil and profit financially by utilising the online app.
6.	Scalability of the Solution	The concept we put out would use periodic input to alter and train so that it could adapt to a variety of different scenarios.

3.4 PROBLEM SOLUTION FIT



4. REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENTS:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Graph	Showing graph by obtaining the data from the dataset
FR-4	Support	Providing answers for the queries asked by users.
FR-5	News	Information of the oil prices will be updated by admin
FR-6	Notification	Notification will be sent for the users price alert
Fr-7	Database	Information of the User will be stored

4.2 NON-FUNCTIONAL REQUIREMENTS:

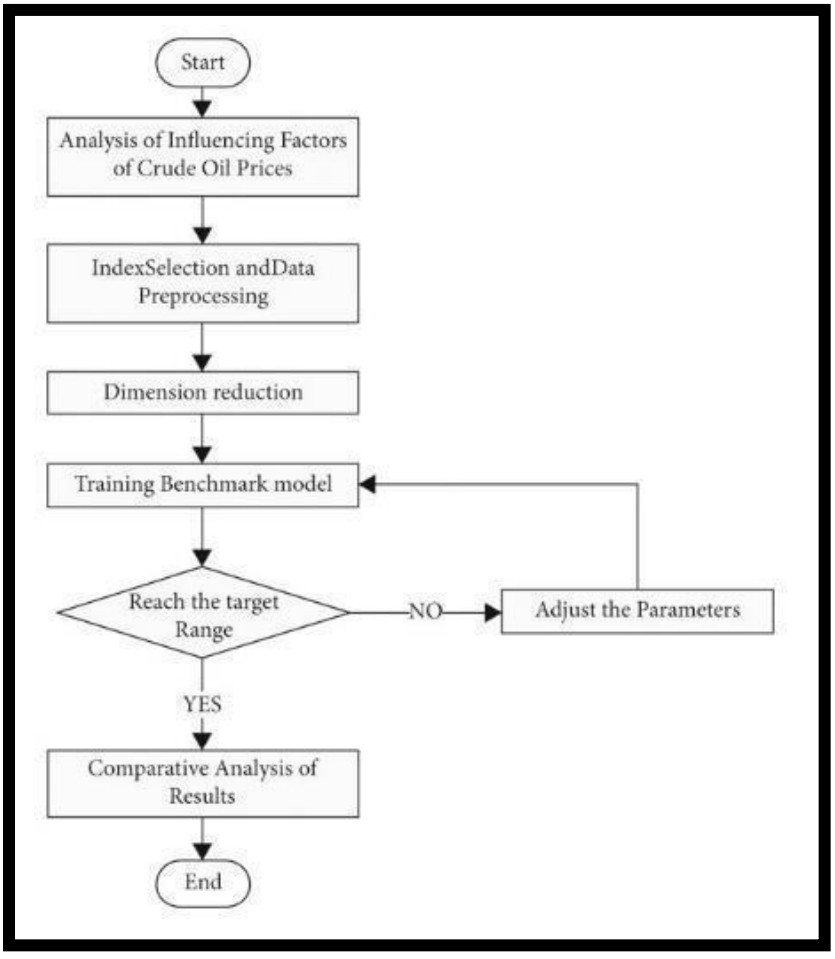
Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	It can use by wide variety of client as it is very simple to learn and not complex to proceed.
NFR-2	**Security**	We are using login for the user and the information will be hashed so that it will be very secure to use.
NFR-3	**Reliability**	It will be reliable that it can update with very time period so that the accuracy will be good.
NFR-4	**Performance**	It will be perform fast and secure even at the lower bandwidth.
NFR-5	**Availability**	Prediction will be available for every user but only for premium user news, database and price alert will be alert.
NFR-6	**Scalability**	It is scalable that we are going to use data in kb so that the quite amount of storage is satisfied.

5. PROJECT DESIGN

5.1 DATA FLOW DIAGRAMES

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount ofthe system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.

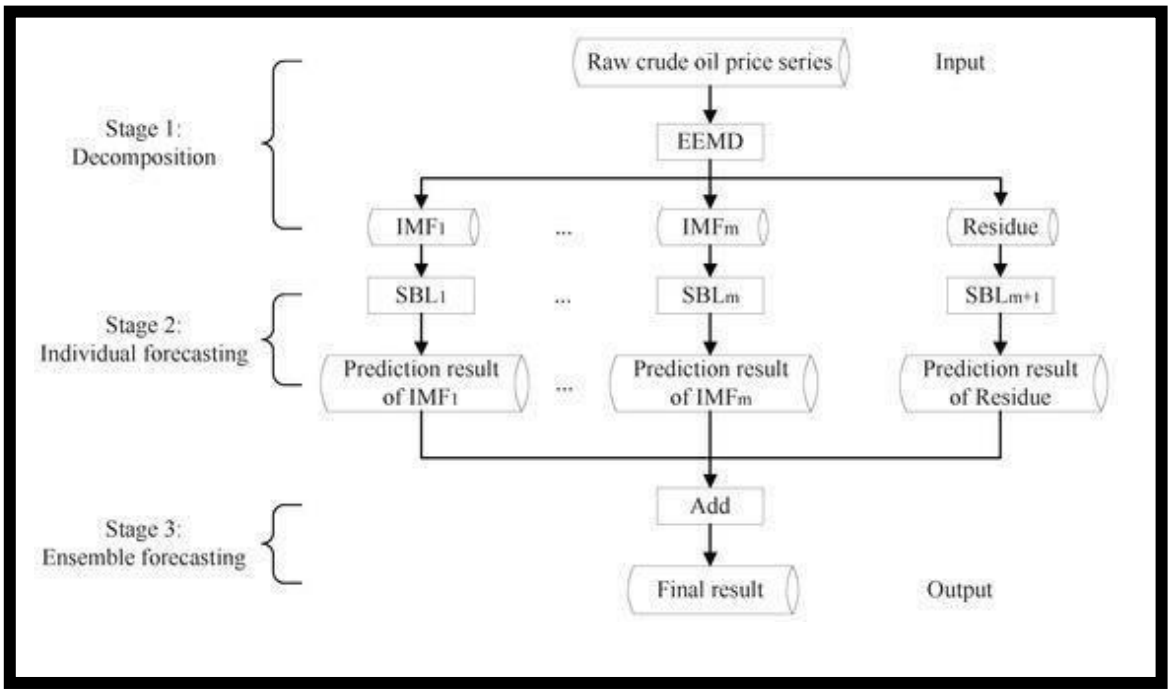


DATA FLOW DIAGRAMES

5.2 SOLUTION & TECHNICAL ARCHITECTURE

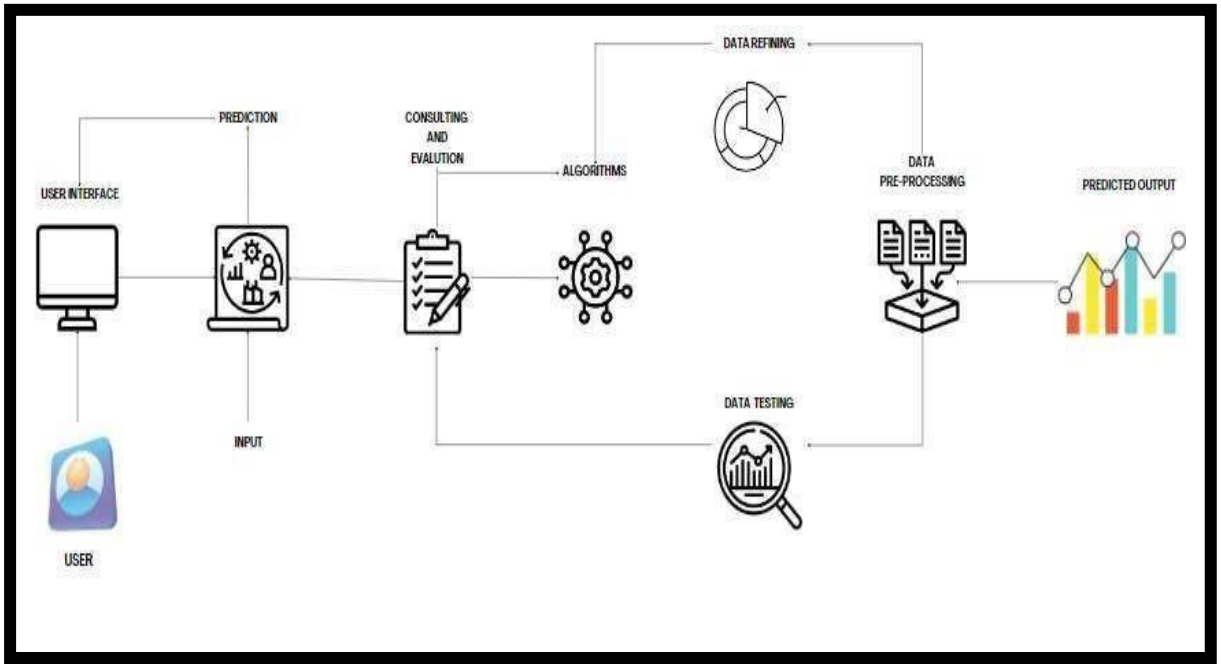
SOLUTION ARCHITECTURE

- A complicated process with several sub-processes, solution architecture connectsbusiness issues with technological solutions. Its objectives are to
- Find the most effective innovative solution for resolving current business difficulties. Understanding to project stakeholders the structure, traits, functionality and other features of the application.
- Define objectives, phases for development and solution requirements.
- Specific guidance for how the solution is established, developed and provided



SOLUTION ARCHITECTURE

TECHNICAL ARCHITECTURE



TECHNICAL ARCHITECTURE

5.3 USER STORIES

Use the below template to list all the user stories for the product.

User Type	Functional Requirement (Epic)	User Story Number	User Story/ Task	Acceptance criteria	Priority	Release
Customer (Mobile User)	Registration	USN-1	I may sign up for the program as a user by providing my email address, a password, and apassword confirmation.	I have access to my account, which shows lineand bar graphs.	High	Sprint-1
		USN-2	If I register for the application as a user, Iwill receive a confirmation email.	I can get a confirmation email and confirm it.	High	Sprint-1
		USN-3	I may sign up for the application as a userthrough Facebook.	I can sign up and access myaccount.	Low	Sprint-2
		USN-4	I may sign up for the application as a userusing gmail.	Through my existing logged-ingmail account, I may signup.	Medium	Sprint-1
	Login	USN-5	I may access the application as a user by providing my email address and password.	After signing up, I can onlylog in using my email and password.	High	Sprint-1
	Line\Bar graph		The model will provide predictions in LineBar Gragh Format when the inputs are entered.	I can obtain the anticipated result in a number of forms.	High	Sprint-3
Customer (Web user)	Login	USN-1	As a user of the internet, I can log in easilyusing my Gmail or Facebook account.	It is possible to log in usinga Gmail account that has already been setup.	Medium	Sprint-2
Customer Care Executive	Support		The customer service department will address any FAQ and also offer ChatBox.	I am able to fix the issuescaused by Support.	Low	Sprint-3
Administrator	News		Admin will provide the most recent oil priceinformation.	Give the current oil pricing.	High	Sprint-4
	Notification		When oil prices change, the administrator will notify.	Gmail-based notification	High	Sprint-4
	Access Control		Admins have access control over user access.	Users' authorization to access.	High	Sprint-4
	Database		Admins have access to user information.	keeps user information.	High	Sprint-4

6. PROJECT PLANNING & SCHEDULING

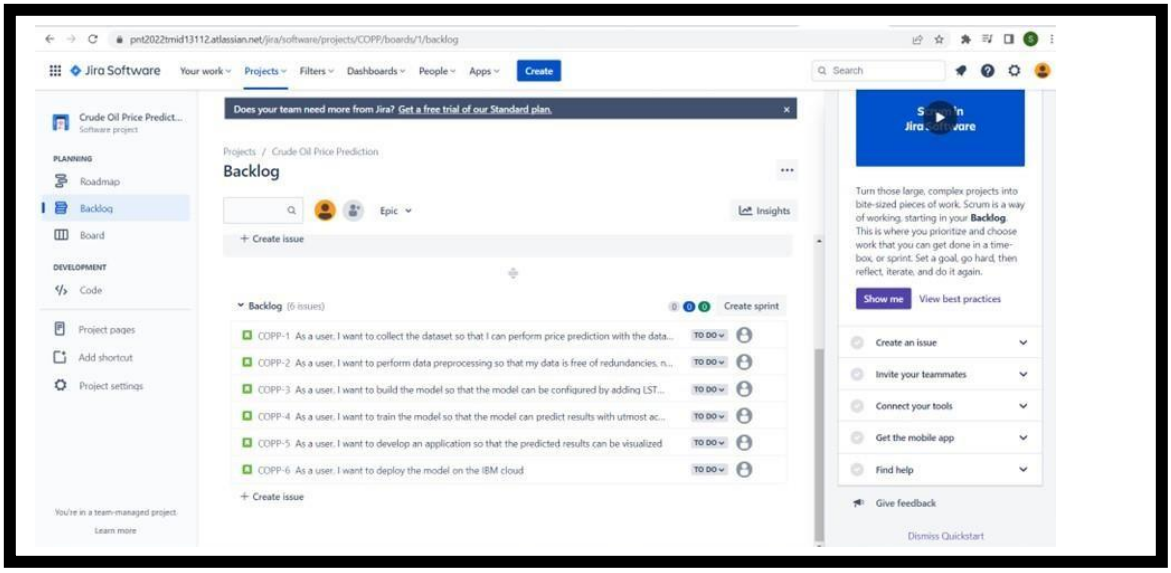
6.1 SPRINT PLANNING & ESTIMATION

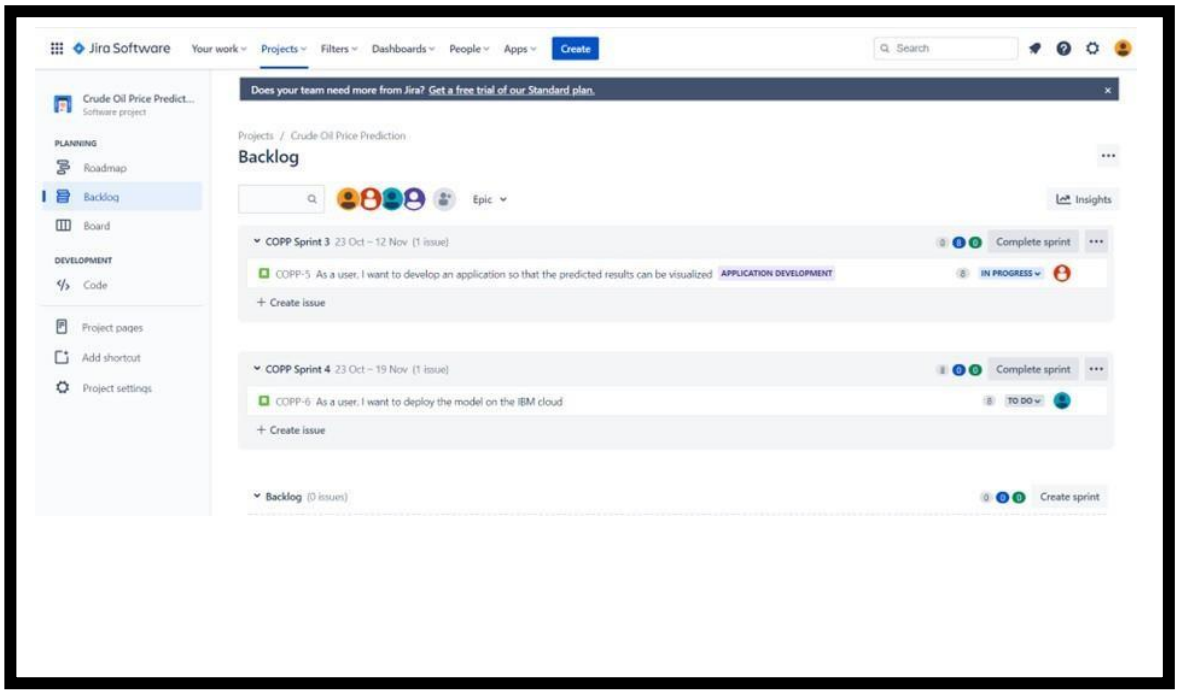
Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration	USN-1	I may sign up for the application as a user by providing my email, password, and passwordconfirmation.	10	High	Suresh K
Sprint-1		USN-2	When I register for the application as a user, I will get a confirmation email.	10	High	Thirumal G
Sprint-1	Login	USN-3	I may access the application as a user by providing my email address and password.	15	High	Vignesh M
Sprint-2	Input Necessary Details	USN-4	I can enter information to predict the probability of crude oil as a user.	15	High	Sathesh Kumar S
Sprint-2	Data Pre-processing	USN-5	Put raw data into a format that will allow for predictio n.	15	High	Suresh K
Sprint-3	Predict ion of Crude Oil Price	USN-6	I can anticipate crude oil as a user using aMachine Learning model.	20	High	Vignesh M
Sprint-3		USN-7	As a buyer, I can predict the price of crude oil with accuracy.	5	Medium	Thirumal G
Sprint-4	Review	USN-8	I may comment on the application as auser.	20	High	Sathesh Kumar S

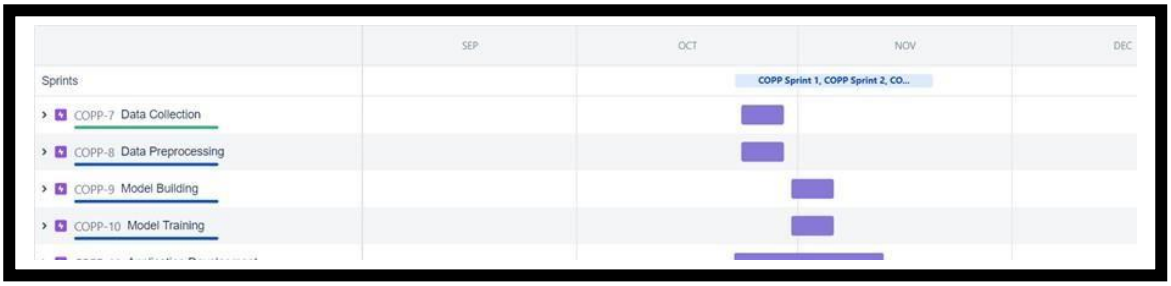
6.2 SPRINT DELIVERY SCHEDULE

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as onPlanned End Date)	Sprint Release Date (Actual)
Sprint-1	8	6 Days	24 Oct 2022	29 Oct 2022	8	29 Oct 2022
Sprint-2	8	6 Days	31 Oct 2022	05 Nov 2022	8	05 Nov 2022
Sprint-3	8	6 Days	07 Nov 2022	12 Nov 2022	8	12 Nov 2022
Sprint-4	8	6 Days	14 Nov 2022	19 Nov 2022	8	19 Nov 2022

6.3 REPORTS FROM JIRA



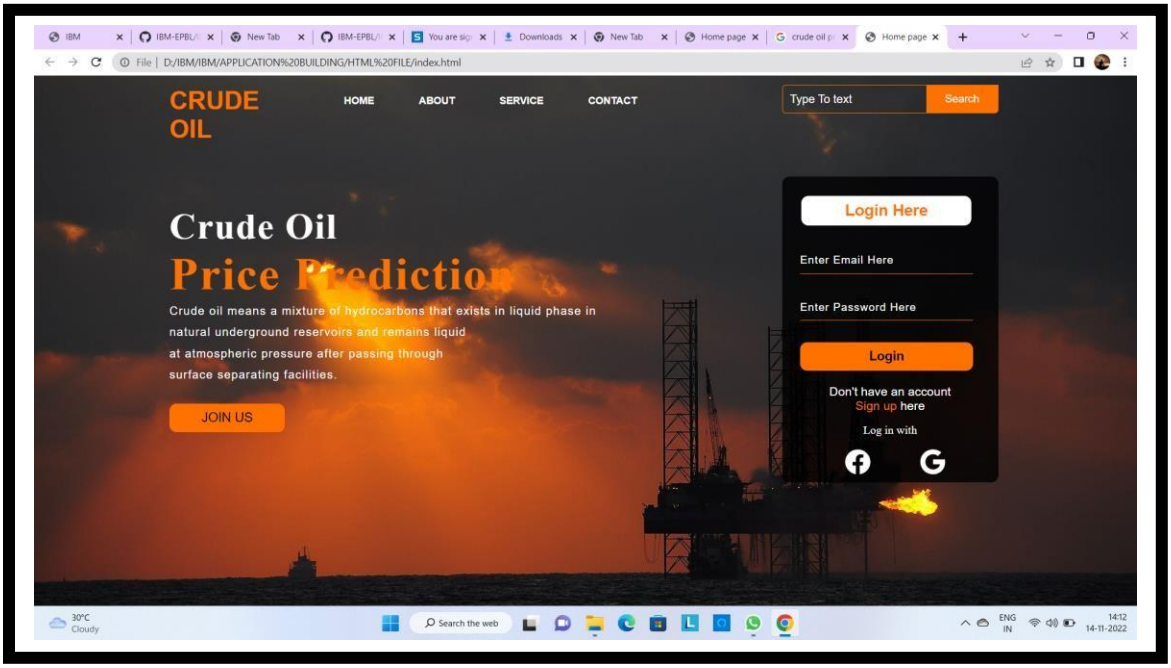




7. CODING & SOLUTIONING

7.1 FEATURE

- The crude oil prediction website provides two options
  - Home
  - predict
- The home allows the user to have an insight on the importance of crude oil priceprediction
- The predict allows the user to give the 10 days input and arrive at the predictionresults.



CODE

Index:

```
        <!DOCTYPE html>
<html lang="en">
<head>
   <meta name="viewport" content="width=device-width, initial-scale=1.0">
   <title>Home page</title>
   <link rel="stylesheet" href="style.css">
</head>
<body>

   <div class="main">
      <div class="navbar">
         <div class="icon">
            <h2 class="logo">CRUDE OIL</h2>
         </div>

         <div class="menu">
            <ul>
               <li><a href="#">HOME</a></li>
               <li><a href="#">ABOUT</a></li>
               <li><a href="#">SERVICE</a></li>
               <li><a href="#">CONTACT</a></li>
            </ul>
         </div>

         <div class="search">
            <input class="srch" type="search" name="" placeholder="Type To text">
            <a href="#"> <button class="btn">Search</button></a>
         </div>

      </div>
      <div class="content">
         <h1>Crude Oil<br><span>Price Prediction</span><br></h1>
         <p class="par"> Crude oil means a mixture of hydrocarbons that exists in liquid phase
in<br>
            natural underground reservoirs and remains liquid <br>at atmospheric pressure
            after passing through <br>surface separating facilities.</p>
```

```
            <button class="cn"><a href="register.html">JOIN US</a></button>

            <div class="form">
               <h2>Login Here</h2>
               <input type="email" name="email" placeholder="Enter Email Here">
               <input type="password" name="" placeholder="Enter Password Here">
               <button class="btnn"><a href="#">Login</a></button>

               <p class="link">Don't have an account<br>
               <a href="#">Sign up </a> here</a></p>
               <p class="liw">Log in with</p>

               <div class="icons">
                  <a href="#"><ion-icon name="logo-facebook"></ion-icon></a>
                  <a href="#"><ion-icon name="logo-google"></ion-icon></a>
               </div>

            </div>
               </div>
            </div>
      </div>
   </div>
   <script src="https://unpkg.com/ionicons@5.4.0/dist/ionicons.js"></script>
</body>
</html>
```

Register:

```
<!DOCTYPE html>
<html>
   <head>
      <title>Registration Form</title>
      <link rel="stylesheet"
      href="register.css" type="text/css">
   </head>
   <body>
      <div class="main">
         <div class="register">
            <h2>Register Here</h2>
            <form id="register" method="post">
               <label>First Name : </label>
```

```
                <br>
                <input type="text" name="fname"
                id="name" placeholder="Enter Your First Name">
                <br><br>
                <label>Last Name : </label>
                <br>
                <input type="text" name="lname"
                id="name" placeholder="Enter Your last Name">
                <br><br>
                <label>Your Age : </label>
                <br>
                <input type="number" name="age"
                id="name" placeholder="How Old Are You">
                <br><br>
                <label>Email : </label>
                <br>
                <input type="email" name="email"
                id="name" placeholder="Enter Your Valid Email">
                <br><br>
                <label>Gender : </label>
                <br>
                     
                <input type="radio" name="gender"
                id="male">
                 
                <span id="male">Male</span>
                     
                <input type="radio" name="gender"
                id="female">
                 
                <span id="female">Female</span>
                <br><br>
                <input type="submit" value="Submit"
                name="submit" id="submit">
            </form>
        </div>
    </div>
  </body>
</
```

8. TESTING

8.1 TEST CASES

Test case analysis
This report shows the number of test cases that have passed, failed, and untested

Section	Total Cases	Not Tested	Fail	Pass
ML Model	4	0	0	4
Flask Application	4	0	0	4
IBM cloud	4	0	0	4
Exception Reporting	2	0	0	2
Final Report output	4	0	0	4

8.1 USER ACCEPTANCE TESTING

The purpose is to briefly explain the test coverage and open issues of the crude oil priceprediction project at the time of the release to user acceptance testing

Defect Analysis:

The report shows the number of resolved and closed bugs at each severity level andhow they were resolved

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	3	0	0	0	3
Duplicate	1	0	1	0	2
External	0	0	0	0	0
Fixed	4	0	1	1	6

Not Reproduced	0	0	0	0	0
Skipped	0	0	0	0	0
Won't fix	0	0	0	1	1
Totals	8	0	2	2	12

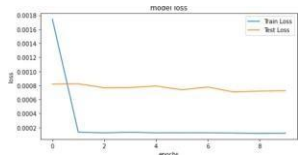
Test case analysis

This report shows the number of test cases that have passed, failed, and untested

Section	Total Cases	Not Tested	Fail	Pass
ML Model	4	0	0	4
Flask Application	4	0	0	4
IBM Cloud	4	0	0	4
Exception Reporting	2	0	0	2
Final Report Output	4	0	0	4

9. RESULTS

9.1 PERFORMANCE METRICS

S.No	Parameters	Values	Screenshot
1.	Model Summary		Model: "sequential_1" Layer (type) Output Shape Param # lstm_3 (LSTM) (None, 10, 50) 10400 lstm_4 (LSTM) (None, 10, 50) 20200 lstm_5 (LSTM) (None, 50) 20200 dense_1 (Dense) (None, 1) 51 Total params: 50,851 Trainable params: 50,851 Non-trainable params: 0
2	Accuracy		Train Mean Absolute Error: 1.0278217422906264 Train Root Mean Squared Error: 1.4285248639934083 Test Mean Absolute Error: 2.780526920817909 Test Root Mean Squared Error: 3.6348234466523737 

10. ADVANTAGES & DISADVANTAGES

ADVANTAGES:

- Prediction of crude oil price can help the importers to choose the right time to buyas they wait for the prices to fall down
- Prediction of crude oil prices can help the exporters to increase the demand
- It can even help in shifting the political powers
- can assist in minimizing the risks associated with volatility in oil prices

DISADVANTAGES

- The prediction results may lack accuracy
- Volatility in prices may be misleading

11. CONCLUSION

LSTM network is better than other traditional neural networks for forecasting prices as it aims in using a back propagation model. Traditional neural networks such as CNN on the other hand predicts the next outgoing but doesn't necessarily save the previous dataor connection which is based on feed-forwarding, in the sense the previous data is not necessary to predict the future data. LSTM focuses on storing the previous data and prediction which is rather encouraging and more approximate. The outcomes derived are relatively encouraging. The results show that large lookups do not necessarily improve the accuracy of the predictions of crude oil prices. Hence it can be concluded, the model with a single LSTM model is definitely the most accurate.

12. FUTURE SCOPE

The project's future potential is enormous. The project can be implemented with the real-time functionalities that are necessary.Because it is quite versatile in terms of expansion, the project can be upgraded in the near future as and when the need arises.The complete prediction value can be increased in a much better, accurate, and error-free manner with the proposed approach. The project can be enhanced with real time data.

13. APPENDIX

Source Code

MODEL:

 # DATA PREPROCESSING

Importing the libraries

```
import pandas as pd import
numpy as np

import matplotlib.pyplot as plt
import tensorflow as tf
data=pd.read_excel(r"Crude Oil Prices Daily.xlsx")
data.head()
```

Handling missing values

```
data.isnull().any()
data.isnull().sum() data.dropna(axis=0,inplace=True)
data_oil=data.reset_index()['Closing Value']data_oil
data.isnull().any()
```

Feature Scaling

```
from sklearn.preprocessing import MinMaxScaler
scalar=MinMaxScaler(feature_range=(0,1))
data_oil=scalar.fit_transform(np.array(data_oil).reshape(-1,1))
```

Data Visualization

```
plt.title('Crude oil price')
plt.plot(data_oil)

## Splitting data into Train and Test Data
```

```
training_size=int(len(data_oil)*0.65)
test_size=len(data_oil)-training_size
train_data,test_data=data_oil[0:training_size,:],data_oil[training_size:len(data_oil),:1]
training_size,test_size
train_data.shape
```

Creating a dataset with sliding windows

```
def create_dataset (dataset, time_step=1):
    dataX, dataY = [], []
    for i in range(len(dataset)-time_step-1):
        a = dataset[i:(i+time_step), 0]
        dataX.append(a) dataY.append(dataset[i +
        time_step, 0])
    return np.array(dataX),np.array(dataY)
time_step = 10
X_train, y_train=create_dataset(train_data,time_step)
X_test, y_test = create_dataset(test_data,time_step)
print(X_train.shape),print(y_train.shape)
print(X_test.shape),print(y_test.shape)
X_train
X_train.shape
X_train=X_train.reshape(X_train.shape[0],X_train.shape[1],1)
X_test=X_test.reshape(X_test.shape[0],X_test.shape[1],1)
```

 # MODEL BUILDING

 # Importing the model building libraries

```
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense
from tensorflow.keras.layers import LSTM# Initializing the model model=Sequential()
```

 # Adding LSTM Layers

```
model.add(LSTM(50,return_sequences=True,input_shape=(10,1)))
model.add(LSTM(50,return_sequences=True)) model.add(LSTM(50))
```

 # Adding Output Layers

```
model.add(Dense(1))
model.summary()
```

 # Configure The Learning Process

```
model.compile(loss='mean_squared_error',optimizer='adam')#
```

Train The Model

```
model.fit(X_train,y_train,validation_data=(X_test,y_test),epochs=10,batch_size=64,verbose=1)
```

 # Model Evaluation

```
train_predict=model.predict(X_train)
test_predict=model.predict(X_test)
train_predict=scalar.inverse_transform(train_predict)
test_predict=scalar.inverse_transform(test_predict) import
math
from sklearn.metrics import mean_squared_error

math.sqrt(mean_squared_error(y_train,train_predict))
```

 # Save The Model

```
from tensorflow.keras.models import load_model
model.save("crudeoilprediction.h5")
```

 # Test The Model

```
look_back= 10
trainPredictPlot = np.empty_like(data_oil)
trainPredictPlot[:, :]= np.nan
trainPredictPlot[look_back:len(train_predict)+look_back, :]= train_predict
testPredictPlot =np.empty_like(data_oil)
testPredictPlot[:, :]= np.nan
testPredictPlot[len(train_predict)+(look_back*2)+1:len(data_oil)-1, :]= test_predict
plt.plot(scalar.inverse_transform(data_oil))
plt.plot(trainPredictPlot)
plt.plot(testPredictPlot)
plt.show() len(test_data)
x_input=test_data[2866:].reshape(1,-1)
x_input.shape
temp_input=list(x_input)
temp_input=temp_input[0].tolist()
temp_input
lst_output=[]
n_steps=10
i=0
while(i<10):
if(len(temp_input)>10):
```

```
#print(temp input)
        x_input=np.array(temp_input[1:]) print("{}
        day input {}".format(i,x_input))
        x_input=x_input.reshape(1,-1)
        x_input=x_input.reshape((1, n_steps, 1))
        #print(x_input)
        yhat = model.predict(x_input, verbose=0)
        print("{} day output {}".format(i, yhat))
        temp_input.extend(yhat[0].tolist())
        temp_input=temp_input[1:]
        #print(temp_input)
        lst_output.extend(yhat.tolist())
        i=i+1

    else:

 x_input = x_input.reshape((1, n_steps,1))yhat =
model.predict(x_input, verbose=0)print(yhat[0])
temp_input.extend(yhat[0].tolist()) print(len(temp_input))
lst_output.extend(yhat.tolist())
        i=i+1
print (lst_output)
day_new=np.arange(1,11)
day_pred=np.arange(11,21)
len(data_oil)
plt.plot(day_new,scalar.inverse_transform(data_oil[8206:]))
plt.title("Review of prediction")
plt.plot(day_pred,scalar.inverse_transform(lst_output)) plt.show()
df3=data_oil.tolist()
df3.extend(lst_output)
plt.title("Past data nad next 10 days output prediction")
plt.plot(df3[8100:])
df3=scalar.inverse_transform(df3).tolist()
plt.title("Past data nad next 10 days output prediction after reversing the scaled values")
plt.plot(df3)
```

Index.html:

```
<!DOCTYPE html>
<html lang="en">
    <head>
        <meta charset="UTF-8">
        <title>Crudeoil price prediction</title>
        <!--<link rel="stylesheet" href="in.css">
        <link
href="https://fonts.googleapis.com/css2?family=Poppins:wght@300;400;500;600;700&d
isplay=swap"rel="stylesheet">
        <link rel="stylesheet" href="https://www.w3schools.com/w3css/4/w3.css">
<link rel="stylesheet"
href="https://cdnjs.cloudflare.com/ajax/libs/font-awesome/4.7.0/css/font-awesome.min.css">-->
      <style>
         ul {
  list-style-type: none;
  margin: 0;
  padding: 0;
  overflow: hidden;
  border: 1px solid #e7e7e7;
  background-color: #057514;
}

li {
  float: left;
}

li a {
  display: inline-block;
  color: rgb(78, 3, 3);
  text-align: center;
  padding: 14px 16px;
  text-decoration: none;
  background-color:rgb(18, 116, 5) ;
}
li a:hover{
```

```
    border:1px solid;
    background-color: lightseagreen;
}
      </style>
    </head>
    <body>
        <nav class="navbar navbar-inverse">
            <div class="container-fluid">
                <ul>
                  <li class="parts"><a href="#">Home</a></li>
                  <li class="parts"><a href="predict.html">predict</a></li>
              </ul>
            </div>
          </nav>

        <h1 >Crudeoil price prediction</h1>

        <style>
            body {
              background-image: url('static/css/image.jpeg');
              background-repeat: no-repeat;
              background-attachment: fixed;
            background-size: 100% 100%;

            }
            </style>

          <h3 style="font-family:system-ui;">
              Demand for oil is inelastic, therefore the rise in
              price is good news for producers because they will see an increase in
              their revenue. Oil importers, however, will experience
              increased costs of purchasing oil. Because oil is the largest traded commodity,the
              effects are quite significant. A rising oil price can even shift
economic/political
            power from oil importers to oil exporters. The crude oil rice movements aresubject to
            diverse influencing factors</h3>
        </body>
        </html>
```

Predict.html:

```
<html>
   <head>
      <link rel="stylesheet" href="static/css/style.css">
      <style>
         body {
           background-image: url('static/css/image3.jpg');
           background-repeat: no-repeat;
           background-attachment: fixed;
         background-size: 100% 100%;

         }
         </style>

   </head>
   <script>
      document.getElementByID("demo").innerHTML =
document.getElementById("ten");
   </script>
<body>
<form action="/method" method="POST" enctype = "multipart/form-data">
<div class="container">
   <!--<div class="brand-logo"></div>-->
   <div class="brand-title">predict the oil price</div>
   <div class="inputs">
     <label>Enter Price</label>
     <input type="text" placeholder="Enter ten days price" id="ten" name="val"/>
     <button type="submit">Predict</button><br><br>
      The next day price is : {{prediction}}
   </div>
  </div>
</form>
</body>
</html>
```

App.py:

```
from flask import Flask, render_template, request, redirect
import numpy as np
# from tensorflow.k
```

```
from keras.saving.save import load_model
app = Flask(___name___,template_folder='template')

@app.route('/', methods=["GET"])
def index():
    return render_template('index.html')

@app.route('/predict.html', methods=["POST", "GET"])
@app.route('/method', methods=["POST", "GET"])
def method():
    if request.method == "POST":
        string = request.form['val']
        string = string.split(',')
        temp_input = [eval(i) for i in string]

        x_input = np.zeros(shape=(1, 10))
        x_input.shape

        lst_output = []
        n_steps = 10
        i = 0
        while (i < 10):
            if (len(temp_input) > 10):
                x_input = np.array(temp_input[1:])
                x_input = x_input.reshape(1, -1)
                x_input = x_input.reshape((1, n_steps, 1))yhat
                = model.predict(x_input, verbose=0)
                temp_input.extend(yhat[0].tolist())
                temp_input = temp_input[1:]
                lst_output.extend(yhat.tolist())
                i = i + 1

            else:
                x_input = x_input.reshape((1, n_steps, 1))yhat
                = model.predict(x_input, verbose=0)
                temp_input.extend(yhat[0].tolist())
                lst_output.extend(yhat.tolist())
                i = i + 1
         val = lst_output[9]
           return render_template('predict.html', prediction=val)
```

```
    if request.method == "GET":
        return render_template('predict.html')

if__name___== "__main__":
    model =
    load_model(r'crudeoilpr
    ediction.h5')
    app.run(debug=True)
```

#cloud deployment code in ml model

```
!pip install ibm_watson_machine_learning

from
ibm_watson_machine_learning
import APIClientwml_credentials
= {
        "url" : "https://us-south.ml.cloud.ibm.com",
        "apikey" : "cRkqykhsnLO1Ogs_xoYjgLkNTtTS1Qxyi0Mn1GSlQ1P5"
}
client = APIClient(wml_credentials)

#for creating a deployment phase
def
    guid_from_space_name(cli
    ent, space_name):
    space=client.spaces.get_de
    tails() #print(space)
return(next(item for item in space['resources'] if
item['entity']['name'] ==
space_name)['metadata']['id'])
space_uid =
guid_from_space_name(client,
'models')print("Space UID =
"+space_uid)
client.set.default_space(space_uid
)
client.software_specifications.list(
) software_spec_uid=
client.software_specifications.get_uid_by_name("tensorfl
ow_rt22.1-py3.9")software_spec_uid
```

GitHub & Project Demo Link

GITHUB: https://github.com/IBM-EPBL/IBM-Project-17780-1659676209

PROJECT DEMO LINK:
https://drive.google.com/file/d/1V6dtLMbN2GLP3WFyazN1W8u7fDaa40_1/view?usp=drivesdk