1. INTRODUCTION

1.1 PROJECT OVERVIEW:

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.

1.2 PURPOSE:

This 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.

2. LITERATURE SURVEY

2.1 EXISTING SYSTEM

1. Xueyan Mei:

Since the crude oil market can make an impact on global economics, it is important to develop some effective approaches to forecast crude oil prices and their volatility. In this paper, the goal is to predict the tendency of crude oil future prices from ten selected features that potentially affect the crude oil price. Currently, the most popular and robust prediction methods are based on machine learning, such as artificial neural networks, support vector machines, and logistic regression, which are classifiers trained from the training data and used to make predictions for the new data. However, the representations of the data are

also crucial to the performance of the classifier training. In this paper, we use non-negative matrix factorization techniques to capture the intrinsic features of the crude oil data, which leads to a part-based dictionary learning problem. Support vector machine (SVM) is trained on the data encoded by the elements from the dictionary in order to predict the tendency of crude oil future price. The experiment shows that the proposed framework is useful for crude oil market prediction.

2. Adnan Khashman:

The price of crude oil is tied to major economic activities in all nations of the world, as a change in the price of crude oil invariably affects the cost of other goods and services. This has made the prediction of crude oil prices a top priority for researchers and scientists alike. In this paper, we present an intelligent system that predicts the price of crude oil. This system is based on Support Vector Machines. Support Vector Machines are supervised learners founded upon the principle of statistical learning theory. Our system utilized as its input key economic indicators which affect the price of crude oil and has as its output the price of crude oil. Data for our system was obtained from the West Texas Intermediate (WTI) dataset spanning 24 years and experimental results obtained were very promising as they proved that support vector machines could be used with a high degree of accuracy in predicting crude oil prices.

3. Chengyuan Zhang]:

The volatility of international crude oil prices is influenced by various external factors on different time scales. User search data (USD) which reflects investor attention has been widely researched and proved to be associated with crude oil price change at different frequency bands. In this paper, a novel hybrid approach that utilizes bivariate empirical mode decomposition (BEMD) with user search data and machine learning is developed for crude oil price forecasting. First, BEMD is adopted to decompose the crude oil price data and USD into a finite set of components. Forecasting results are analysed with various evaluation criteria and verified robustness. Results show that the proposed approach statistically outperforms traditional forecasting machine learning techniques and similar counterparts (with USD or EMD-based methods) in terms of prediction accuracy.

4. Jiayu Yi:

To study the characteristics of crude oil price fluctuations and analyze the impacts of external events, this paper first employs the CEEMD method to decompose the crude oil historical prices into different components and extracts a market fluctuation, a shock from extreme events, and a long-term trend. And we find that when determining the crude oil prices, the shock from extreme events has become the most important factor. we establish the models based on VAR, SVM, and structural breaks to predict the crude oil prices, finding that the CEEMD- VAR-SVM model with structural breaks performs best compared to other models we establish.

5. Lubna A. Gabriella:

Oil is the lifeblood of the global economy. Recently, oil prices have witnessed fluctuations and the prediction of oil prices has become a challenge for researchers. The aim of this research is to design a model that is able to predict the prices of crude oil with good accuracy. We used the daily data from 1999 to 2012 with 14 input factors to predict the price of West Texas Intermediate (WTI), which is a well-known benchmark. We propose an ensemble of Adaptive Neuro-Fuzzy Inference System using a Particle Swarm Optimization algorithm for oil price prediction and the empirical results illustrate high performance and accurate results.

6. Yukun Bao]:

Accurate prediction on crude oil prices over a long time horizon has been appealing both for academia and practitioners. Recursive strategy and direct strategy are two mainstream modelling schemas widely used for multi-step-ahead prediction in the context of time series modelling. In this paper, a comparative study has been conducted to justify these two strategies in multi-step-ahead prediction for crude oil price with Support Vector Regression (SVR). The experimental results show the direct strategy has more consistent performance than the recursive one in the various experimental setting.

7. Lean Yu:

In this study, an Al-agent-based trapezoidal fuzzy ensemble forecasting model is proposed for crude oil price prediction. In the proposed ensemble model, some single AI models are first used as predictors for crude oil price prediction. Then these single prediction results produced by the single Al-based predictors are fuzzified into some fuzzy prediction representations. Subsequently, these fuzzified representations are fused into a fuzzy consensus, i.e., aggregated fuzzy prediction. Finally, the aggregated

prediction is defuzzified into a crisp value as the final prediction results. For testing purposes, two typical crude oil price prediction experiments are presented.

8. Kaijian He:

The prediction of crude oil price remains a challenging issue due to its complicated data-generating process. Aside from the long-perceived nonlinear data feature issue, recent empirical evidence suggests that the mixture of data characteristics in the time scale domain is another important data feature to be incorporated into the modelling process. This paper proposes a novel Morphological Component Analysis based hybrid methodology for modelling the multi-scale heterogeneous data-generating process. The superior performance of the proposed model is attributed to the separation of the underlying distinct data features and the identification of appropriate model specifications for them. Meanwhile, the proposed methodology offers additional insights into the underlying data-generating process and its economic viability.

9. Shangkun Deng:

Crude oil price direction forecasting presents an extremely challenging task that attracts considerable attention from academic scholars, individual investors and institutional investors. In this research, we proposed an integration method by adopting the Multi-Class Support Vector Machine (MCSVM) and the NonDominated Sorting Genetic Algorithm II (NSGA-II) for forecasting and trading simulation in two well-known crude oil markets. Firstly, the proposed approach applied the MCSVM to train a multi-class classification model, and it adopted the NSGA-II to optimize the threshold values of trading rules. Then, the trained MCSVM model was used to forecast the movement direction and magnitude levels. Next, the proposed method forecasted the direction of crude oil price movements one week later and executed trading simulation according to the direction and magnitude level predictions. Finally, after a testing period that lasted for four years, the performances of the proposed approach were gauged in terms of direction prediction correctness and investment yields. Experimental results demonstrated that the proposed approach produced outstanding results not only on the hit ratio and accumulated return but also return-risk ratio. It indicates that the proposed approach can provide beneficial suggestions for individual investors, institutional investors, as well as for government officers engaged in energy investment policy-making.

10. Robert Gunawan:

Commodities are important factors in the Indonesian economy. Being one of the biggest crude palm oil producers, the importance of knowing future crude palm oil prices will bring a significant impact on the Indonesian economy. This paper describes an attempt to predict daily commodity prices, especially crude palm oil by employing a neural network. First of all, this paper will explain how to construct a dataset for learning and testing and how to build a neural network model. There are several experiments to find what configuration of neural network should be selected to make the prediction more accurate, including testing two kinds of network topology named joint network and separated network. The proposed neural network model using joint network topology and regular normalization in the momentum of 0.75 and learning rate of 0.05 is proven to be the best model with a minimum of 50000 iterations. Our proposed model has MAPE of 2.10 per cent and RMSPE of 2.61 per cent when tested using given experimental schemas.

2.2 REFERENCES

[1]. Xueyan Mei; Caiyang Xu; Lei Liu; Yinan Yang 2015 Learning part-based dictionaries by NMF for crude oil market prediction

[2].Adnan Khashman; Nnamdi I. Nwulu 2011 Intelligent prediction of crude oil price using Support Vector Machines

[3]. Chengyuan Zhang; Fuxin Jiang; Shouyang Wang; Wei Shang 2020 A Novel Hybrid Approach with A Decomposition Method and The RVFL Model for Crude Oil Price Prediction

[4]. Jiayu Yi; Yuxiang Cheng 2019 Multi-Scale Volatility and External Event Analysis of Crude Oil Price Prediction

[5]. Lubna A. Gabriella; Talaat M. Wahby; Varun Kumar Ojha; Ajith AbrahamEnsemble of adaptive neuro-fuzzy inference system using particle swarm optimization for prediction of crude oil prices

[6]. Yukun Bao; Yunfei Yang; Tao Xiong; Jinlong Zhang 2011 A Comparative Study of Multi-step-ahead Prediction for Crude Oil Price with Support Vector Regression

[7]. Lean Yu; Shouyang Wang; Bo Wen; Kin Keung Lai; Shouyang Wang; Bo Wen; Kin Keung Lai 2008An AI-Agent-Based Trapezoidal Fuzzy Ensemble Forecasting Model for Crude Oil Price Prediction

[8].Kaija He; Kin Keung Lai; Jerome Yen 2010 Morphological Component Analysis Based Hybrid Approach for Prediction of Crude Oil Price

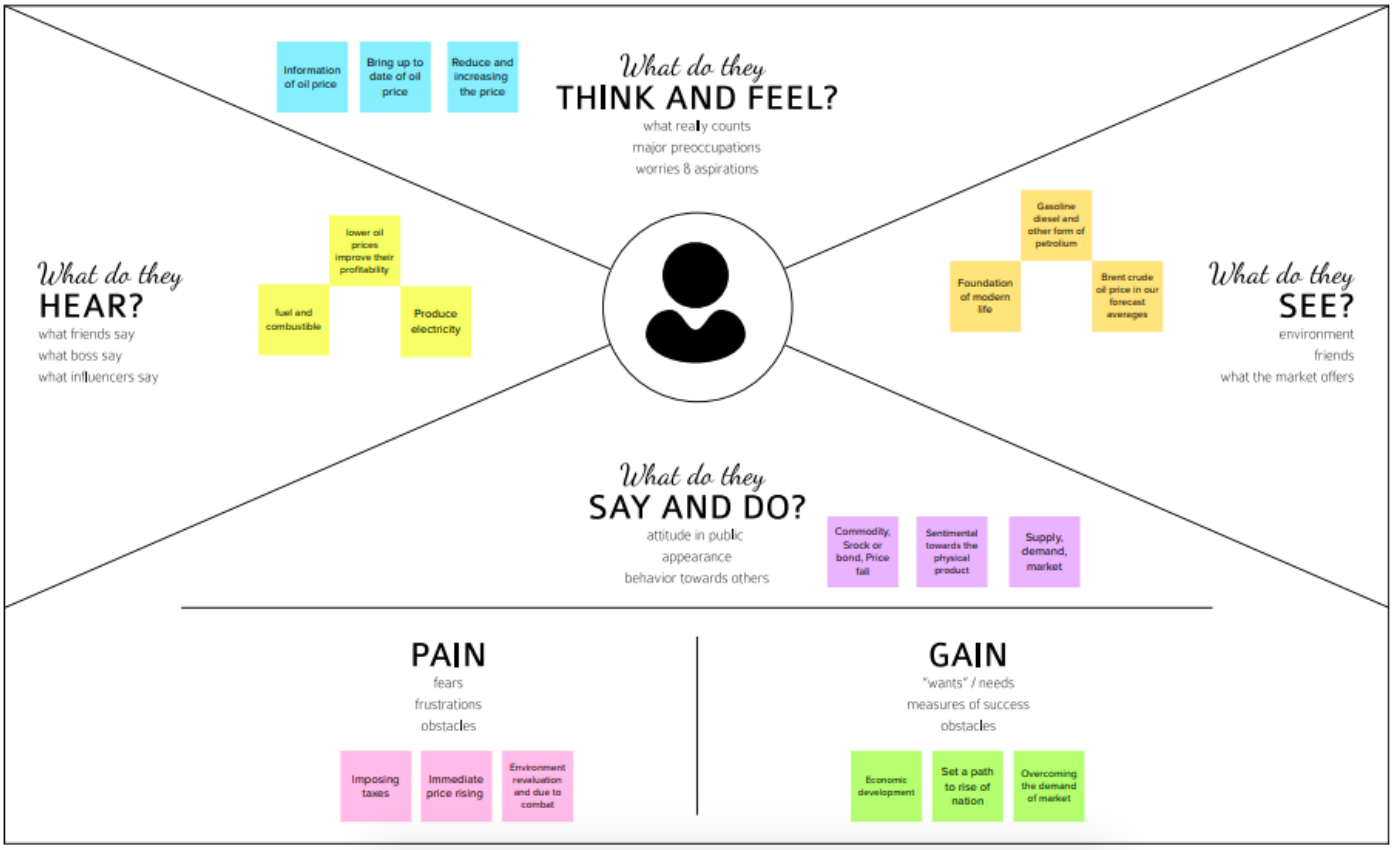
[9]. Shangkun Deng; Xiaoru Huang; Jiashuang Shen; Haoran Yu; Chenguang Wang; Hongyu Tian; Fangjie Ma; Tianxiang Yang 2019 Prediction and Trading in Crude Oil Markets Using Multi-Class Classification and Multiobjective Optimization

[10]. Robert Gunawan; Masayu Leyla Khodra; Harlili 2013 Commodity price prediction using neural network case study: Crude palm oil price

2.3 PROBLEM STATEMENT DEFINITION:

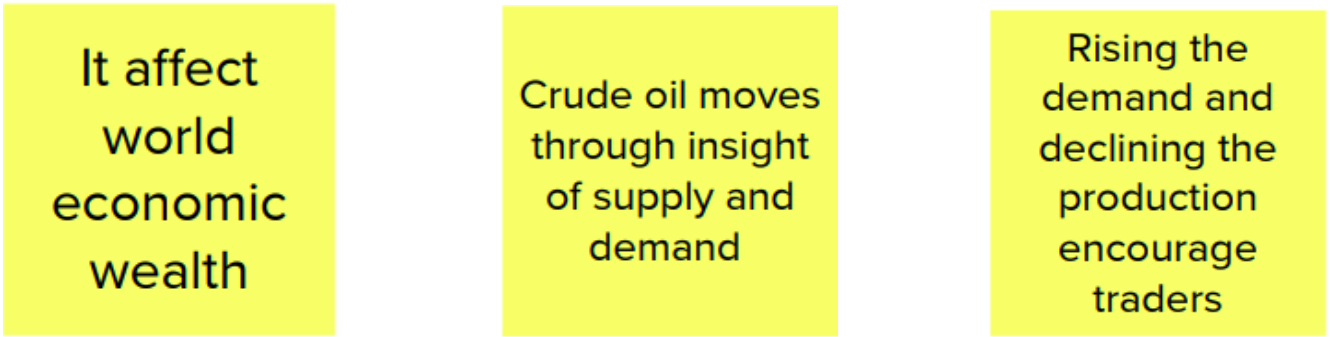
3. IDEATION AND PROPOSED SOLUTION

3.1.EMPATHY MAP CANVAS:



3.2.IDEATION & BRAINSTORMING:

C.ASHISH HAMEED



P.T.ESTHER RANI

Crude oil prices are energetic	Supply and demand is one of the fundamental concepts of economics	challenging companies operate the wells of crude oil

G.S.HARISH VIJAY

The goal is to locate and estimate possible of a resources	Traders can take this as a signal that demand is increasing	Challenging business deal on the oil prices

M.V.MONISHA VALLI

Crude oil demand the major part of economic development	The fall of industries were bidding for supply and demand	Oversupply of crude oil in the challenging session

3.3.PROPOSED SOLUTION:

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

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Oil price increases are generally thought to increase inflation and reduce economic growth. Oil prices directly affect the prices of goods made with petroleum products. As mentioned above oil prices indirectly affect costs such as transportation, manufacturing, and heating.
2.	Idea / Solution description	Crude oil is a raw natural resource that is extracted from the earth and refined into products such as gasoline and petroleum products. Crude oil is a global trade in markets around the world.
3.	Novelty / Uniqueness	Supply, demand, and sentiment towards oil futures contracts, which are traded heavily by speculators play a dominant role in price determination.
4.	Social Impact / Customer Satisfaction	Oil spills can damage the environment and the wildlife and marine life that depends on it they can also cause physical, mental, and financial stress to people as individuals.
5.	Business Model (Revenue Model)	Models general includes information like products or services the business plans to sell, target markets, and any anticipated expenses. There are dozens of types of business models including retailers, manufacturers, fee-for-services, or freemium providers.
6.	Scalability of the Solution	Crude oil prices are determined by global supply and demand. Economic growth is one of the biggest factors affecting retailers. The impact on crude oil prices can name some of them as the US economy, US dollar exchange, supply and demand statistics, and crude oil and petroleum distillates inventory.

3.4.PROBLEM SOLUTION FIT:

1. CUSTOMER SEGMENT(S):

Who is your customer?

Oil accounts for a third of the world's energy consumption. That is the greatest share for any category of government.

2. JOBS-TO-BE-DONE / PROBLEMS:

Economic growth is one of the biggest factors affecting petroleum products and therefore crude oil demand. Growing economics increases the demand for energy in general and especially for transportation.

3. CUSTOMER CONSTRAINTS:

What constraints prevent your customer from taking action or limit their choices of solutions?

Due to the Strong chain effects owned by this crude oil market, any changes in the factors involved will have an exclusive impact on the price.

4. PROBLEM ROOT CAUSE:

There is only one dependent variable, the closing price of crude oil which has been considered, since its a time series.

5. AVAILABLE SOLUTIONS:

Which solutions are available to the customers when they face the problem or need to get the job done? What have they tried in the past? What pros & cons do these solutions have?

There are innumerable ways and approaches which are being used and have been used for predicting the prices of crude oil, one of the common methods is the one based on intuitions where in the experiences.

6. BEHAVIOUR:

What does your customer do to address the problem and get the job done?

The correct information should be given by the individual.

4. REQUIREMENT ANALYSIS

4.1.FUNCTIONAL REQUIREMENT

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 Registration through LinkedIN
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	graph	Showing graph by gaining data from the dataset
FR-4	support	Queries from the users that will be solved by support section
FR-5	News	Oil prices of the information will be updated by the admin
FR-6	Notification	Price message will be send to client
FR-7	Database	All information will be stored by the client

4.2.NON-FUNCTIONAL REQUIREMENTS

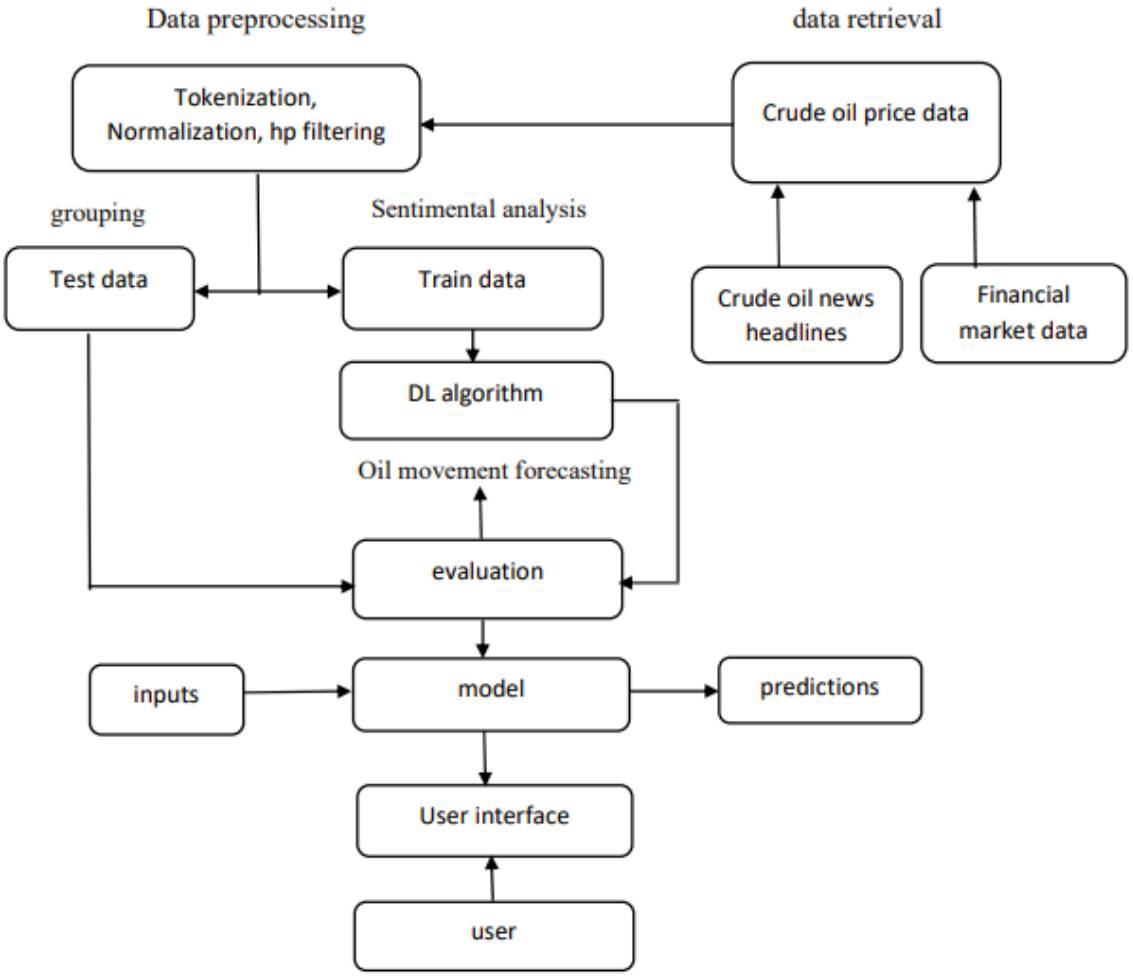
Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	It can use by vast verity of client has it is very easy to learn and not difficult to proceed.
NFR-2	**Security**	We are using login for the user and the information will be confused so that it will be very secure to use.
NFR-3	**Reliability**	It will be reliable that can update with long time period ,so that the accuracy will be fine.
NFR-4	**Performance**	It will be perform fast and secure even at the lower bandwidth.
NFR-5	**Availability**	Prediction will be available for all client but only for additional user news, database and price will be alert by message.
NFR-6	**Scalability**	It is scalable that we are moving to use data in kb. So that the total amount of storage is requested.

5. PROJECT DESIGN

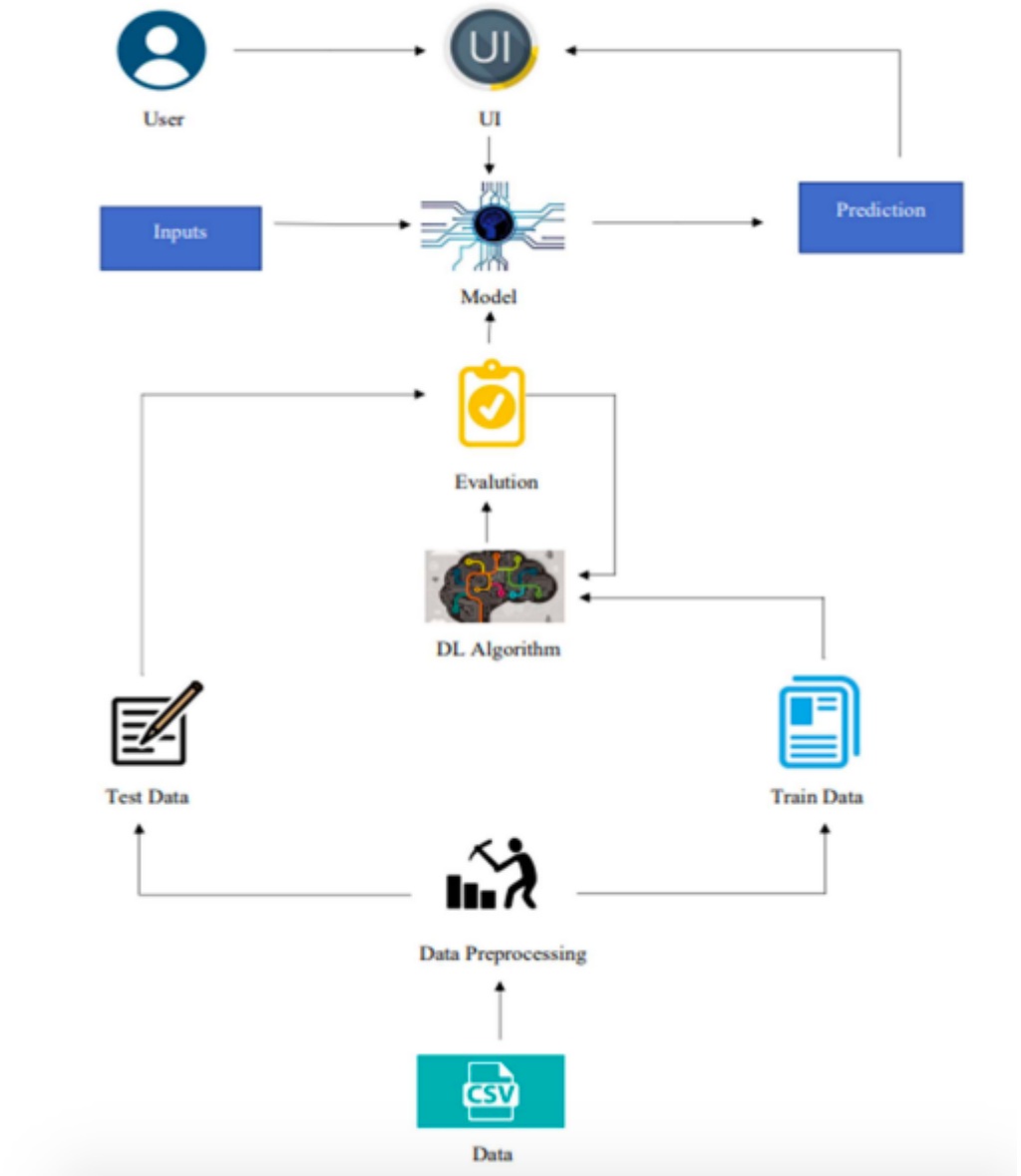
5.1.DATA FLOW DIAGRAMS:

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 of the system requirement graphically.It shows how data enters and leaves the systems, what changes the information, and where data is stored.



5.2.SOLUTION & TECHNICAL ARCHITECTURE:

The Deliveries shall include the architectural diagram as below



5.3.USER STORIES:

SCENARIO

The prices of crude oil various in different part of the world.

EXPECTIONS

considering factors
observing highs and lows
displaying graphically

6. PROJECT PLANNING & SCHEDULING

6.1.SPRINT PLANNING & ESTIMATION:

Sprint	Functional Requirement(Epic)	User Story Number	UserStory/Task	StoryPoints	Priority	TeamMembers
Sprint-1	DataCollection	USN-1	Collecting theDataset	10	High	C.Ashish Hameed P.T.Esther Rani G.S.Harish Vijay M.V.Monisha Valli
Sprint-2	Data Pre-processing	USN-2	DataPre-processing	7	Medium	C.Ashish Hameed P.T.Esther Rani G.S.Harish Vijay M.V.Monisha Valli
Sprint-3	ModelBuilding	USN-3	Prepare the model by importing the necessary libraries, adding the layers, and compiling it.	10	High	C.Ashish Hameed P.T.Esther Rani G.S.Harish Vijay M.V.Monisha Valli
Sprint-3	Model Building	USN-4	The data classification model is trained using RNNs and other systems.	7	Medium	C.Ashish Hameed P.T.Esther Rani G.S.Harish Vijay M.V.Monisha Valli

Sprint-4	Application Building	USN-5	Deploythe modelinthe IBM cloudand build the system	10	High	C.Ashish Hameed P.T.Esther Rani G.S.Harish Vijay M.V.Monisha Valli
Sprint-4	Training and testing	USN-6	Testing the model's performanceand training it	7	Medium	C.Ashish Hameed P.T.Esther Rani G.S.Harish Vijay M.V.Monisha Valli

6.2.SPRINT DELIVERY SCHEDULE:

Sprint	TotalStory Points	Duration	Sprint Start Date	SprintEndDate (Planned)	Story Points Completed (as on PlannedEndDate)	Sprint Release Date (Actual)
Sprint-1	10	6 Days	24 Oct2022	29 Oct2022	8	29Oct2022
Sprint-2	10	6 Days	31 Oct2022	05 Nov 2022	7	05Nov 2022
Sprint-3	10	6 Days	07 Nov 2022	12 Nov 2022	8	12Nov 2022
Sprint-4	10	6 Days	14 Nov 2022	19 Nov 2022	7	19Nov 2022

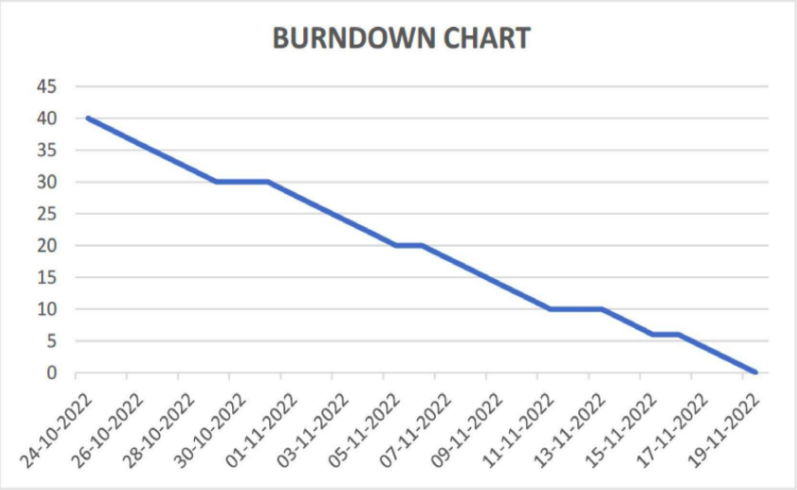
Velocity: Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint).

Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

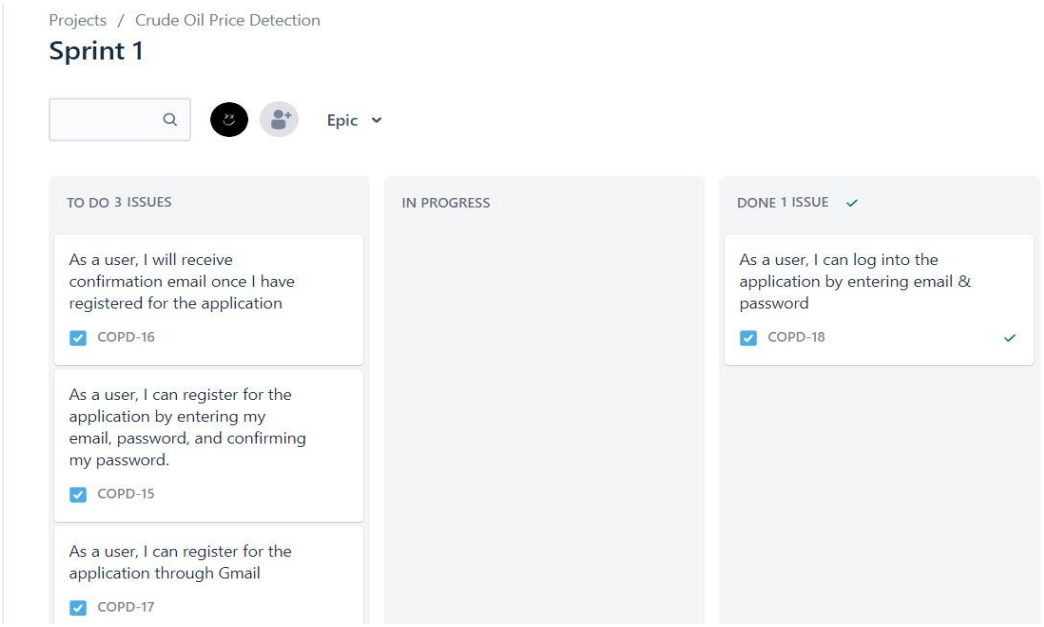
$$AV = \frac{sprint\ duration}{velocity}$$

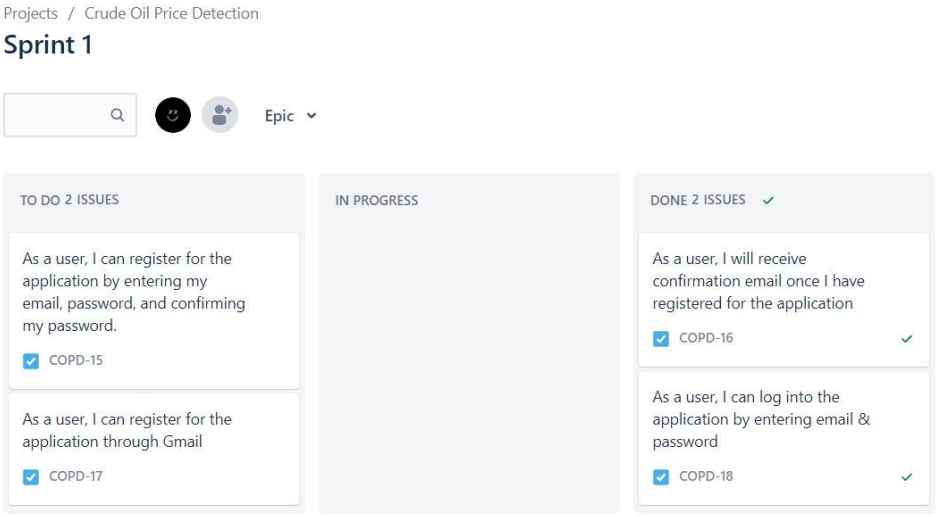
AV = 6/10 = 0.6

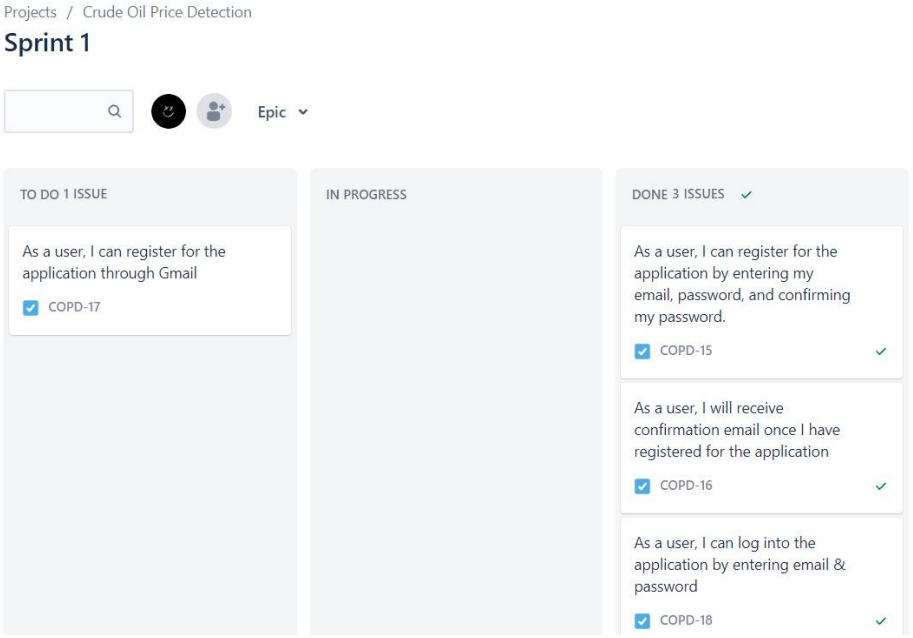
BurndownChart: A burn-down chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies such as scrum. However, burndown charts can be applied to any project containing measurable progress over time

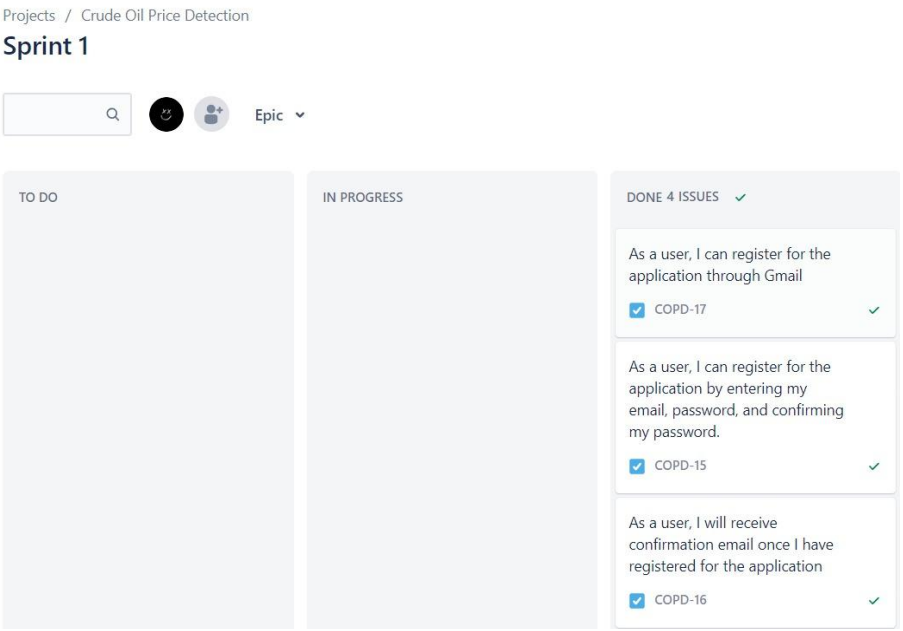


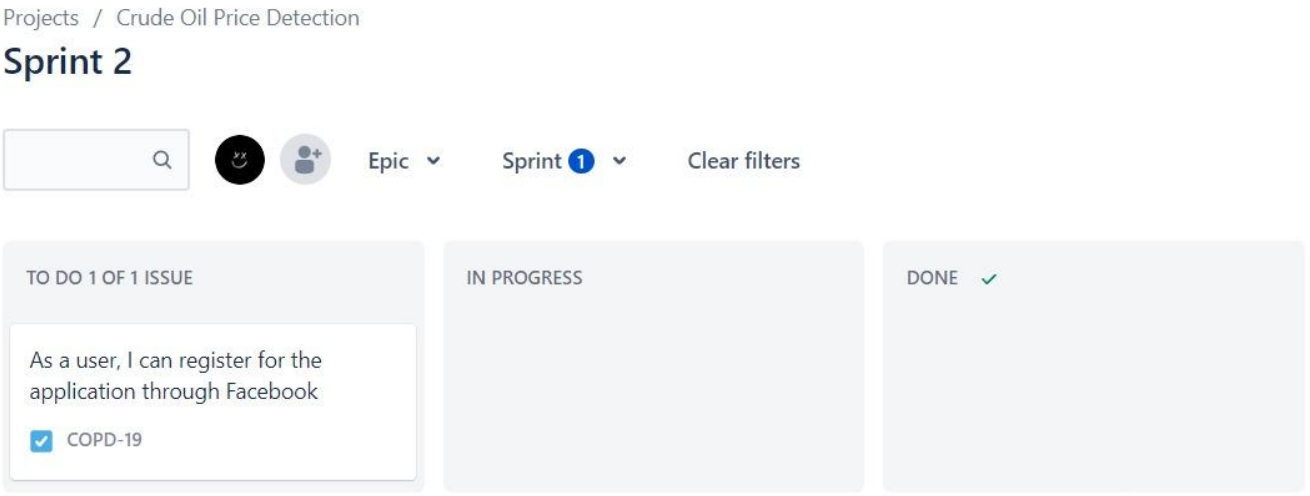
6.3.REPORTS FROM JIRA:

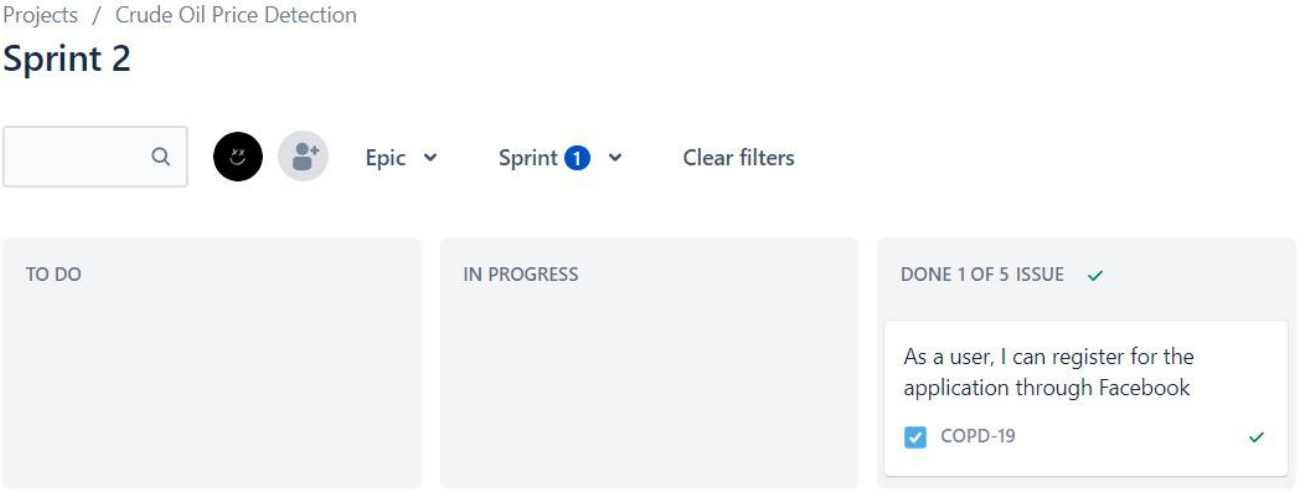







Projects / Crude Oil Price Detection
Sprint 1
Epic
TO DO
IN PROGRESS
DONE 4 ISSUES
As a user, I can register for the application through Gmail
COPD-17
As a user, I can register for the application by entering my email, password, and confirming my password.
COPD-15
As a user, I will receive confirmation email once I have registered for the application
COPD-16


Projects / Crude Oil Price Detection
Sprint 2
Epic
Sprint 1
Clear filters
TO DO 1 OF 1 ISSUE
As a user, I can register for the application through Facebook
COPD-19
IN PROGRESS
DONE


Projects / Crude Oil Price Detection
Sprint 2
Epic
Sprint 1
Clear filters
TO DO
IN PROGRESS
DONE 1 OF 5 ISSUE
As a user, I can register for the application through Facebook
COPD-19

7. CODING & SOLUTIONS

7.1.FEATURE 1:

MinMaxScaler subtracts the minimum value in the feature and then divides it by the range. The range is the difference between the original maximum and the original minimum. MinMaxScaler preserves the shape of the original distribution. It doesn't meaningfully change the information embedded in the original data. This scaling compresses all the inliers in the narrow range.

In [9]:
```
from sklearn.preprocessing import MinMaxScaler
scaler=MinMaxScaler(feature_range=(0,1))
data_oil=scaler.fit_transform(np.array(data_oil).reshape(-1,1))
```

In [10]:
```
data_oil
```

Out[10]:
```
array([[0.11335703],
       [0.11661484],
       [0.12053902],
       ...,
       [0.46497853],
       [0.47038353],
       [0.47149415]])
```

7.2 FEATURE 2:

Removing null values from the dataset is one of the important steps in data wrangling. These null values adversely affect the performance and accuracy of any machine learning algorithm. So, it is very important to remove null values from the dataset before applying any machine learning algorithm to that dataset

In [3]:
```
data=pd.read_excel("/content/Crude Oil Prices Daily.xlsx")
```

In [4]:
```
data.isnull().any()
```

Out[4]:
```
Date             False
Closing Value     True
dtype: bool
```

In [5]:
```
data.isnull().sum()
```

Out[5]:
```
Date             0
Closing Value    7
dtype: int64
```

In [6]:
```
data.dropna(axis=0,inplace=True)
```

In [7]:
```
data.isnull().sum()
```

Out[7]:
```
Date             0
Closing Value    0
dtype: int64
```

In [9]:
```
data_oil=data.reset_index()['Closing Value']
data_oil
```

Out[9]:
```
0       25.56
1       26.00
2       26.53
3       25.85
4       25.87
        ...
8211    73.89
8212    74.19
8213    73.05
8214    73.78
8215    73.93
Name: Closing Value, Length: 8216, dtype: float64
```

8. TESTING

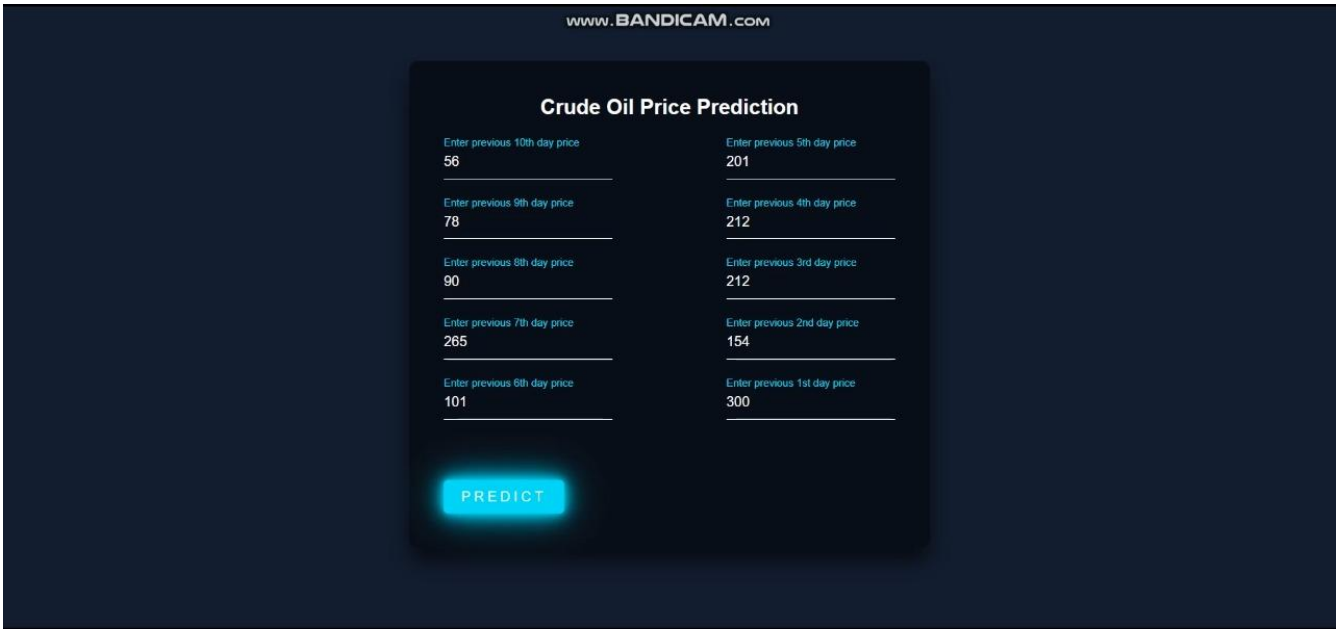
8.1.TEST CASES:

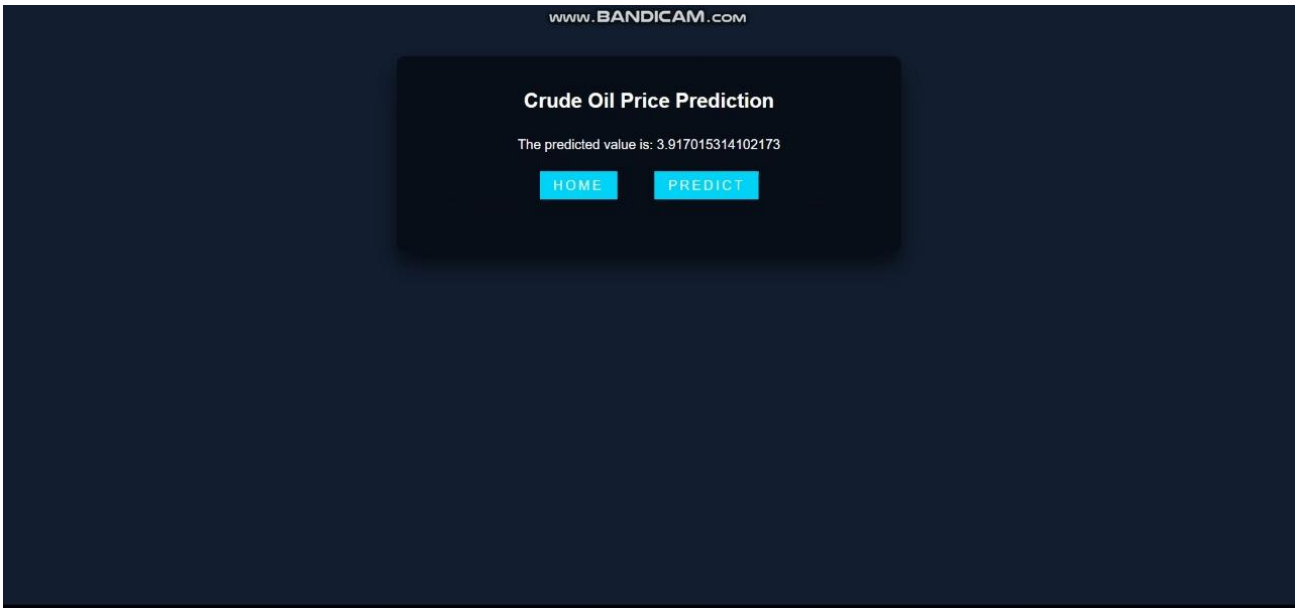
In [35]:

```
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
```

```
[0.46854624]
11
1 day input [0.4811195  0.49726048 0.46794017 0.47297497 0.47119799 0.47341922
 0.46497853 0.47038353 0.47149415 0.46854624]
1 day output [[0.47223023]]
2 day input [0.49726048 0.46794017 0.47297497 0.47119799 0.47341922 0.46497853
 0.47038353 0.47149415 0.46854624 0.47223023]
2 day output [[0.4706972]]
3 day input [0.46794017 0.47297497 0.47119799 0.47341922 0.46497853 0.47038353
 0.47149415 0.46854624 0.47223023 0.47069719]
3 day output [[0.46715337]]
4 day input [0.47297497 0.47119799 0.47341922 0.46497853 0.47038353 0.47149415
 0.46854624 0.47223023 0.47069719 0.46715337]
4 day output [[0.46740875]]
5 day input [0.47119799 0.47341922 0.46497853 0.47038353 0.47149415 0.46854624
 0.47223023 0.47069719 0.46715337 0.46740875]
5 day output [[0.46694806]]
6 day input [0.47341922 0.46497853 0.47038353 0.47149415 0.46854624 0.47223023
 0.47069719 0.46715337 0.46740875 0.46694806]
6 day output [[0.46664917]]
7 day input [0.46497853 0.47038353 0.47149415 0.46854624 0.47223023 0.47069719
 0.46715337 0.46740875 0.46694806 0.46664917]
7 day output [[0.46599752]]
8 day input [0.47038353 0.47149415 0.46854624 0.47223023 0.47069719 0.46715337
 0.46740875 0.46694806 0.46664917 0.46599752]
8 day output [[0.4663454]]
9 day input [0.47149415 0.46854624 0.47223023 0.47069719 0.46715337 0.46740875
 0.46694806 0.46664917 0.46599752 0.4663454 ]
9 day output [[0.46590632]]
```

8.2.USER ACCEPTANCE TESTING





9. RESULTS

9.1.Performance Metrics:

We have used Root Mean Square Error (RMSE) as the standard deviation of the residuals (prediction errors). Residuals are a measure of how far from the regression line data points are; RMSE is a measure of how to spread out these residuals. In other words, it tells you how concentrated the data is around the line of best fit. Root mean square error is commonly used in climatology, forecasting, and regression analysis to verify experimental results.

The formula is

$$RMSE = \sqrt{\overline{(f-o)^2}}$$

Where:

f = forecasts (expected values or unknown results),

o = observed values (known results).

The bar above the squared differences is the mean (similar to $\bar{x}$). The same formula can be written with the following, slightly different, notation (Barnston, 1992):

$$\mathrm{RMSE}_{fo} = [\sum_{i=1}^{N} (z_{f_i} - z_{o_i})^2 / N]^{1/2}$$

Where:

Σ = summation (“add up”)

(zfi – Zoi)2 = differences, squared

N = sample size.

In [27]:
```
train_predict=scaler.inverse_transform(train_data)
test_predict=scaler.inverse_transform(test_data)
### Calculate RMSE performance metrics
import math
from sklearn.metrics import mean_squared_error
math.sqrt(mean_squared_error(train_data,train_predict))
```

Out[27]: 29.347830443269938

10. ADVANTAGES & DISADVANTAGES

ADVANTAGES:

- Crude oil price prediction has become essential, and it benefits many big and small businesses, people, and the government.
- Crude oil price variations have a wide-ranging impact on global economies, and hence price forecasting can help to mitigate the risks connected with crude oil price volatility.
- This project's main benefit is that it captures the shifting pattern of crude oil prices.
- The main advantage of using the Long Short Term Memory (LSTM) technique is that it continuously captures the volatile pattern of crude oil prices that have been incorporated by determining the ideal lag and number of the delay effect that regulates the prices of crude oil.
- The LSTM model is an effective tool for predicting crude oil prices and may be effectively utilised for short-term price forecasting by identifying the best lags.

- When compared to other approaches, this project predicts crude oil prices more accurately.
- This project is effective and highly recommended because investors can use it to assess different investment strategies as well as to initiate trades.

DISADVANTAGES:

- Crude oil price volatility continues to be one of the most difficult forecasting problems.
- Until a significant and abrupt change in the actual data occurs, the prediction is accurate, but it becomes difficult to estimate the precise new price with the change.
- An increase in crude oil prices typically lowers the predicted rate of economic growth and raises inflation expectations over shorter time frames.
- A variety of factors including changes in prices and quantities (demand and supply), the state of the economy, and current affairs, could have an impact on the crude oil price prediction.
- It is difficult to identify which factors have the greatest influence on the crude oil price. If all possible crude oil price factors are included in the current forecast model, over-fitting issues may arise, affecting the forecast results.

11. CONCLUSION

In this project, an LSTM(Long Short Term Memory) model is presented with the task of determining the most favourable lag in the crude oil price data. The prediction is accurate till there is a massive and sudden change in the actual data, where it becomes challenging to predict the exact new price with the change, however, the proposed model has efficiently taken into consideration these patterns. Else ways, this also proves the theory that financial markets are unpredictable and change anytime because of known and unknown factors. This work indicates that the LSTM model is an effective tool for crude oil price prediction and can be efficiently used for long-term price forecasting by determining the optimal lags. The proposed model is powerful and highly suggested because investors can use it not only to initiate trades but also as an effective tool to judge various strategies relating to investments.

12. FUTURE SCOPE

In the coming future, fundamental indicators and market trends have been plan to be incorporated into a model which will help the proposed model perform more efficiently.

13. APPENDIX

SOURCE CODE:

App.py:

App.py

```python
import numpy as np
from flask import Flask,render_template,request
import tensorflow as tf

from tensorflow.keras.models import load_model

tf.get_logger().setLevel('ERROR')
app=Flask(__name__,template_folder='template')
model = load_model('./crude-oil.h5')

@app.route('/')
def home() :
    return render_template("index.html")
@app.route('/about')
def home1() :
    return render_template("index.html")
@app.route('/predict')
def home2() :
    return render_template("web.html")

@app.route('/login',methods = ['POST'])
def login() :
    x_input=str(request.form['year'])
    x_input=x_input.split(',')
    n = len(x_input) + 1

    for i in range(0, len(x_input)):
        x_input[i] = float(x_input[i])
    x_input=np.array(x_input).reshape(1,-1)
    temp_input=list(x_input)
    temp_input=temp_input[0].tolist()
    lst_output=[]
    n_steps=10
    i=0
    while(i<1):
        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:
```

App.py 1

App.py > ...

```
                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


        return render_template("web1.html",showcase = 'The predicted value is:'+" "+str(lst_output[0][0]))


    if __name__ == '__main__' :
        app.run(debug = True,port=5000)

```

Index.html:

index.html

template > index.html > html > style > body

```
<!DOCTYPE html>
<html lang="en">
  <head>
    <meta charset="UTF-8" />
    <meta http-equiv="X-UA-Compatible" content="IE=edge" />
    <meta name="viewport" content="width=device-width, initial-scale=1.0" />
    <title>Crude Oil Price Prediction</title>
  </head>
  <style>
    html {
      height: 100%;
    }
    body {
      margin: 0;
      padding: 0;
      font-family: sans-serif;
      background: linear-gradient(#141e30, #141e30);
    }

    .login-box {
      width: 600px;
      padding: 40px;
      margin: 4% auto;
      background: rgba(0, 0, 0, 0.5);
      box-sizing: border-box;
      box-shadow: 0 15px 25px rgba(0, 0, 0, 0.6);
      border-radius: 10px;
    }

    .login-box h2 {
      margin: 0 0 30px;
      padding: 0;
      color: #fff;
      text-align: center;
    }

    .navbtn {
      padding: 0.5rem 1rem;
      color: white;
      text-decoration: none;
      background-color: #03e9f4;
      font-size: 16px;
      font-weight: 500;
      text-decoration: none;
      transition: 0.5s;
      letter-spacing: 3px;
      text-transform: uppercase;
    }

    .navbtn:hover {
      border: none;
      background: #03e9f4;
      color: #fff;
      border-radius: 5px;
      box-shadow: 0 0 2px #03e9f4, 0 0 10px #03e9f4, 0 0 20px #03e9f4,
        0 0 40px #03e9f4;
    }

    .login-box p {
      margin: 0 0 30px;
      padding: 0;
      color: rgb(215, 215, 215);
      line-height: 140%;
      /* text-align: center; */
    }
```

```
.login-box .user-box {
  position: relative;
}

.login-box .user-box input {
  width: 100%;
  padding: 10px 0;
  font-size: 16px;
  color: #fff;
  margin-bottom: 30px;
  border: none;
  border-bottom: 1px solid #fff;
  outline: none;
  background: transparent;
}
.login-box .user-box label {
  position: absolute;
  top: 0;
  left: 0;
  padding: 10px 0;
  font-size: 14px;
  color: #fff;
  pointer-events: none;
  transition: 0.5s;
}

.login-box .user-box input:focus ~ label,
.login-box .user-box input:valid ~ label {
  top: -20px;
  left: 0;
  color: #03e9f4;
  font-size: 12px;
}

.login-box form .logbtn {
  position: relative;
  display: inline-block;
  padding: 10px 20px;
  color: white;
  background-color: #03e9f4;
  font-size: 16px;
  text-decoration: none;
  text-transform: uppercase;
  overflow: hidden;
  transition: 0.5s;
  margin-top: 40px;
  letter-spacing: 4px;
}

.login-box .logbtn:hover {
  border: none;
  background: #03e9f4;
  color: #fff;
  border-radius: 5px;
  box-shadow: 0 0 2px #03e9f4, 0 0 10px #03e9f4, 0 0 20px #03e9f4,
    0 0 40px #03e9f4;
}
</style>
```

```
        border: none;
        background: #03e9f4;
        color: #fff;
        border-radius: 5px;
        box-shadow: 0 0 2px #03e9f4, 0 0 10px #03e9f4, 0 0 20px #03e9f4,
          0 0 40px #03e9f4;
      }
    </style>
    <body>
      <div class="login-box">
        <h2>Crude Oil Price Prediction</h2>
        <p>
          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.
          <br /><br />
          This 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.
        </p>
        <div
          style="
            display: flex;
            justify-content: space-between;
            width: 50%;
            margin: 0 auto;
          "
        >
          <p><a href="/" class="navbtn">Home</a></p>
          <p>
            <a href="/predict" class="navbtn">Predict</a>
          </p>
        </div>
      </div>
    </body>
  </html>
```

Web.html:

web.html

template > web.html > html > style > .login-box .logbtn:hover

```
<!DOCTYPE html>
<html lang="en">
  <head>
    <meta charset="UTF-8" />
    <meta http-equiv="X-UA-Compatible" content="IE=edge" />
    <meta name="viewport" content="width=device-width, initial-scale=1.0" />
    <title>Crude Oil Price Prediction</title>
  </head>
  <style>
    html {
      height: 100%;
    }
    body {
      margin: 0;
      padding: 0;
      font-family: sans-serif;
      background: linear-gradient(#141e30, #141e30);
    }

    .login-box {
      width: 600px;
      padding: 40px;
      margin: 4% auto;
      background: rgba(0, 0, 0, 0.5);
      box-sizing: border-box;
      box-shadow: 0 15px 25px rgba(0, 0, 0, 0.6);
      border-radius: 10px;
    }

    .login-box h2 {
      margin: 0 0 30px;
      padding: 0;
      color: #fff;
      text-align: center;
    }

    .login-box .user-box {
      position: relative;
    }

    .login-box .user-box input {
      width: 100%;
      padding: 10px 0;
      font-size: 16px;
      color: #fff;
      margin-bottom: 30px;
      border: none;
      border-bottom: 1px solid #fff;
      outline: none;
      background: transparent;
    }
    .login-box .user-box label {
      position: absolute;
      top: 0;
      left: 0;
      padding: 10px 0;
      font-size: 14px;
      color: #fff;
      pointer-events: none;
      transition: 0.5s;
    }
```

```
  .login-box .user-box input:focus ~ label,
  .login-box .user-box input:valid ~ label {
    top: -20px;
    left: 0;
    color: #03e9f4;
    font-size: 12px;
  }

  .login-box form .logbtn {
    position: relative;
    display: inline-block;
    padding: 10px 20px;
    color: white;
    background-color: #03e9f4;
    font-size: 16px;
    text-decoration: none;
    text-transform: uppercase;
    overflow: hidden;
    transition: 0.5s;
    margin-top: 40px;
    letter-spacing: 4px;
  }

  .login-box .logbtn:hover {
    border: none;
    background: #03e9f4;
    color: #fff;
    border-radius: 5px;
    box-shadow: 0 0 2px #03e9f4, 0 0 10px #03e9f4, 0 0 20px #03e9f4,
      0 0 40px #03e9f4;
  }
</style>
<body>
  <div class="login-box">
    <h2>Crude Oil Price Prediction</h2>
    <form
      action="/login"
      method="post"
      style="display: flex; justify-content: space-between"
    >
      <div>
        <div class="user-box">
          <input type="text" name="" required="" />
          <label>Enter previous 10th day price</label>
        </div>
        <div class="user-box">
          <input type="text" name="" required="" />
          <label>Enter previous 9th day price</label>
        </div>
        <div class="user-box">
          <input type="text" name="" required="" />
          <label>Enter previous 8th day price</label>
        </div>
        <div class="user-box">
          <input type="text" name="" required="" />
          <label>Enter previous 7th day price</label>
        </div>
        <div class="user-box">
          <input type="text" name="" required="" />
          <label>Enter previous 6th day price</label>
        </div>

        <input type="submit" class="logbtn" value="Predict" />
      </div>
      <div>
```

web.html

template > web.html > html > style > .login-box .logbtn:hover

```
                <label>Enter previous 8th day price</label>
              </div>
              <div class="user-box">
                <input type="text" name="" required="" />
                <label>Enter previous 7th day price</label>
              </div>
              <div class="user-box">
                <input type="text" name="" required="" />
                <label>Enter previous 6th day price</label>
              </div>

              <input type="submit" class="logbtn" value="Predict" />
            </div>
            <div>
              <div class="user-box">
                <input type="text" name="" required="" />
                <label>Enter previous 5th day price</label>
              </div>
              <div class="user-box">
                <input type="text" name="" required="" />
                <label>Enter previous 4th day price</label>
              </div>
              <div class="user-box">
                <input type="text" name="" required="" />
                <label>Enter previous 3rd day price</label>
              </div>
              <div class="user-box">
                <input type="text" name="" required="" />
                <label>Enter previous 2nd day price</label>
              </div>
              <div class="user-box">
                <input type="text" name="" required="" />
                <label>Enter previous 1st day price</label>
              </div>
            </div>
          </form>
        </div>
      </body>
    </html>
```

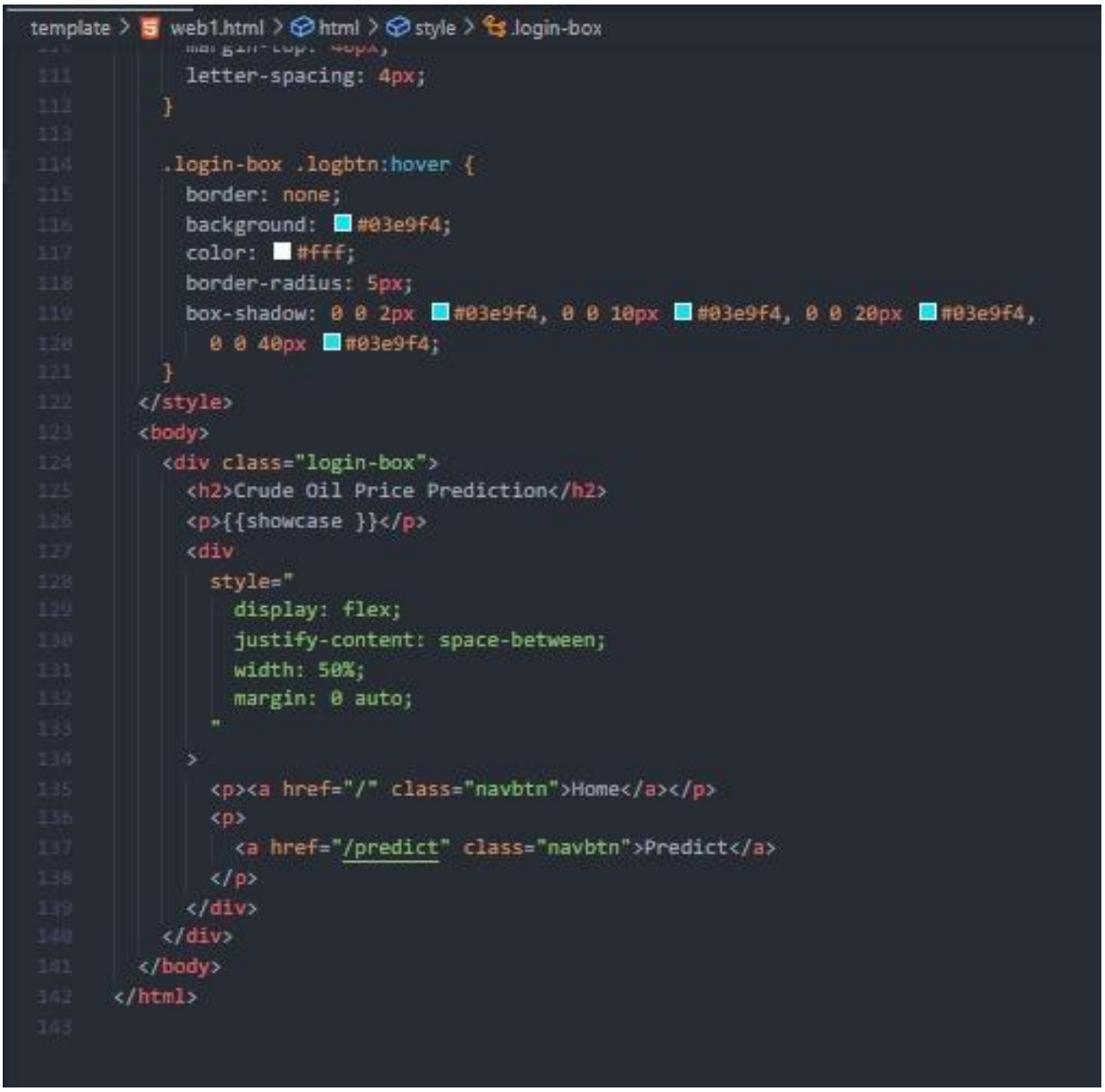
Web1.html:

web1.html

template > web1.html > html > style > .login-box

```
<!DOCTYPE html>
<html lang="en">
  <head>
    <meta charset="UTF-8" />
    <meta http-equiv="X-UA-Compatible" content="IE=edge" />
    <meta name="viewport" content="width=device-width, initial-scale=1.0" />
    <title>IBM Project</title>
  </head>
  <style>
    html {
      height: 100%;
    }
    body {
      margin: 0;
      padding: 0;
      font-family: sans-serif;
      background: linear-gradient(#141e30, #141e30);
    }

    .login-box {
      width: 600px;
      padding: 40px;
      margin: 4% auto;
      background: rgba(0, 0, 0, 0.5);
      box-sizing: border-box;
      box-shadow: 0 15px 25px rgba(0, 0, 0, 0.6);
      border-radius: 10px;
    }
    .navbtn {
      padding: 0.5rem 1rem;
      color: white;
      text-decoration: none;
      background-color: #03e9f4;
      font-size: 16px;
      font-weight: 500;
      text-decoration: none;
      transition: 0.5s;
      letter-spacing: 3px;
      text-transform: uppercase;
    }

    .navbtn:hover {
      border: none;
      background: #03e9f4;
      color: #fff;
      border-radius: 5px;
      box-shadow: 0 0 2px #03e9f4, 0 0 10px #03e9f4, 0 0 20px #03e9f4,
        0 0 40px #03e9f4;
    }

    .login-box h2 {
      margin: 0 0 30px;
      padding: 0;
      color: #fff;
      text-align: center;
    }

    .login-box p {
      margin: 0 0 30px;
      padding: 0;
      color: #fff;
      text-align: center;
    }

    .login-box .user-box {
      position: relative;
    }
```

```
    .login-box .user-box input {
      width: 100%;
      padding: 10px 0;
      font-size: 16px;
      color: #fff;
      margin-bottom: 30px;
      border: none;
      border-bottom: 1px solid #fff;
      outline: none;
      background: transparent;
    }
    .login-box .user-box label {
      position: absolute;
      top: 0;
      left: 0;
      padding: 10px 0;
      font-size: 14px;
      color: #fff;
      pointer-events: none;
      transition: 0.5s;
    }

    .login-box .user-box input:focus ~ label,
    .login-box .user-box input:valid ~ label {
      top: -20px;
      left: 0;
      color: #03e9f4;
      font-size: 12px;
    }

    .login-box form .logbtn {
      position: relative;
      display: inline-block;
      padding: 10px 20px;
      color: white;
      background-color: #03e9f4;
      font-size: 16px;
      text-decoration: none;
      text-transform: uppercase;
      overflow: hidden;
      transition: 0.5s;
      margin-top: 40px;
      letter-spacing: 4px;
    }

    .login-box .logbtn:hover {
      border: none;
      background: #03e9f4;
      color: #fff;
      border-radius: 5px;
      box-shadow: 0 0 2px #03e9f4, 0 0 10px #03e9f4, 0 0 20px #03e9f4,
        0 0 40px #03e9f4;
    }
  </style>
  <body>
    <div class="login-box">
      <h2>Crude Oil Price Prediction</h2>
      <p>{{showcase }}</p>
      <div
        style="
          display: flex;
          justify-content: space-between;
          width: 50%;
          margin: 0 auto;
        "
        >
```



GITHUB & PROJECT DEMO LINK

GitHub Link: https://github.com/IBM-EPBL/IBM-Project-40822-1660636180

Demo Video Link: https://www.youtube.com/watch?v=0Aj4lcSvV0M&feature=youtu.be