CRUDEOIL PRICEPREDICTION

Bonafiderecordofworkdoneby

NANDHINI D (1902125)
PRATHIKSHA R **(**1902143)
KARTHIKEYAN R **(**1902105)
HARISH KUMAR H.H (1901050)

ProfessionalReadinessforInnovation,Employability,andEn trepreneurship

GUIDE:Mr.SELVAGANESH,Mr.VIMAL

BACHELOROFENGINEERING

BRANCH:ELECTRONICS AND COMMUNICATIONENGINEERING

NOVEMBER2022

DEPARTMENTOFELECTRONICS AND COMMUNICATIONENGINEERING

SRI RAMAKRISHNA ENGINEERING COLLEGE
(AutonomousInstitution)C

OIMBATORE –641022

TableofContents

ProfessionalReadinessforInnovation,Employability, andEntrepreneurship.....0

PSGCOLLEGEOFTECHNOLOGY.....0

INTRODUCTION.....2

1.1 ProjectOverview.....2

1.2 Purpose.....2

This project helps the People working in the investment of crude oil needs earlier crude oilprice prediction system, which can help them to find the right time to buy crude oil so that theycanincreaseprofitfromthe purchaseandreduceanysubstantialloss.....2

LITERATURESURVEY.....3

2.1 ExistingProblem.....3

2.2 ProblemDefinition.....3

2.3 References.....3

IDEATIONANDPROPOSEDSOLUTION.....4

3.1 EmpathyMap.....4

3.2 IdeationandBrainstorming.....5

3.3 ProposedSolution.....6

3.4 ProblemSolutionFit.....7

REQUIREMENTANALYSIS.....8

4.1 FunctionalRequirements.....8

4.2 Non-FunctionalRequirements.....8

PROJECTDESIGN.....9

5.1 DataflowDiagram.....9

5.2 TechnicalArchitecture.....9

5.2.1 ComponentandTechnologies.....10

5.2.2 ApplicationCharacteristics.....10

5.3 UserStories.....11

PROJECTPLANNINGANDSCHEDULING.....13

6.1 SprintPlanning &Estimation.....13

6.2 SprintDeliverySchedule.....14

6.3 ReportsforJIRA.....14

CODINGANDSOLUTION.....15

7.1 Feature.....15

TESTING.....17

8.1TestCases 17

RESULTS 18

9.1 PerformanceMetrics 18

PROSAND CONS 19

10.1 Pros 19

10.2 Cons 19

CONCLUSION 20

FUTUREWORKS 21

APPENDIX 21

13.1 SourceCode 21

13.2 GitHub& ProjectDemo Link 23

CHAPTER1

INTRODUCTION

1.1 ProjectOverview

Oil demand is inelastic, therefore the rise in price is good news for producers because theywill see an increase in their revenue. Oil importers, however, will experience increased costs ofpurchasing oil. Because oil is the largest traded commodity, the effects are quite significant. Arising oil price can even shift economic/political power from oil importers to oil exporters. Thecrudeoil price movements are subjecttodiverse influencing factors.

This Guided Project mainly focuses on applying Neural Networks to predict the Crude OilPrice. This decision helps us to buy crude oil at the proper time. Time series analysis is the bestoption for this kind of prediction because we are using the previous history of crude oil prices topredict future crude oil. So, we would be implementing RNN (Recurrent Neural Network) withLSTM(Long Short-TermMemory)toachievethetask.

1.2 Purpose

This project helps the People working in the investment of crude oil needs earliercrudeoilpricepredictionsystem,whichcanhelpthem tofindtherighttimetobuycrudeoilso thattheycanincreaseprofit fromthepurchaseandreduceanysubstantialloss

CHAPTER2

LITERATURESURVEY

2.1 ExistingProblem

Crudeoilisoneofthemostsignificantsourcesofenergyavailabletoday.Withoverathirdof all energy consumed worldwide, it continues to be the most popular fuel. In the currentenvironment, when technology is taking over our lives and efforts are being made to reduce theneed for human labor, the Artificial Neural Network Technique has emerged as one of the mostvaluable techniques for data prediction. This paper offers a method for predicting oil prices thatuses an artificial neural network (Sigmoid Function with the Learning Algorithm). Complex andnon-linearinteractionsbetweeninputandoutputcanbemodeledusingANNs.TheabilityofANNto generalize allows it to infer relationships even in the absence of data or input after learningfrom the inputs. A trustworthy method for creating predictions, ANN also learns from hiddenrelationships in the data without imposing any fixed relationships on the data. Many economistsand analysts forecast the price of crude oil using data transformation and regression techniqueslike autoregressive moving average (ARMA) models and vector autoregressive (VAR) models,eachtimeusingadifferentinputvalue.Theythenplotthegraphwiththeirforecastedpriceswhilec onsideringthemaineconomicfactors.

2.2 ProblemDefinition

The business people who invest or works in the crude oil field and petrol bunk ownersrequires a way to predict the crude oil price for the next day so that they can take some majorinvestmentdecisionswhich can leadtobusinessprofitorreduceloss.

Persons working in the investment of crude oil needs a earlier crude oil price predictionsystem,whichcanhelpthemtofindtherighttimetobuycrudeoilsothattheycanincreaseprofitfr omthe purchaseandreduce anysubstantialloss.

To develop a system that predicts the crude oil prices using LSTM (Long Short-TermMemory)andGRU(GatedRecurrentUnit) andtodisplaytheresults using python-flaskapp.

2.3 References

1. “AcomparisonbetweenAdaBoost-LSTMandAdaBoost-GRUforimprovingforecastprediction”.Ganiyu AdewaleBusari,DongHoonLim.(2021)
2. “CrudeOilPricePredictionUsingLSTMNetworks”.VarunGupta,AnkitPandey.(2018)
3. “CrudeOilPricePredictionusingArtificialNeuralNetwork”.NaliniGupta,ShobhitNigam
4. “Crude Oil Price Forecasting based on Support Vector Machines”. Wen Xie, Lean Yu,ShanyingXu,andShouyang Wang.
5. LSTM.https://blog.mlreview.com/understanding-lstm-and-its-diagrams-37e2f46f1714 6.GRU.https://medium.com/geekculture/understanding-basic-architecture-of-lstm-gru-diagrammatically-6365befc64d

CHAPTER3

IDEATIONANDPROPOSEDSOLUTION

3.1 EmpathyMap

Theprimarypurposeoftheempathymapistobridgetheunderstandingoftheuseranddeveloper.Figure3.1represe ntstheempathymap fortheCrudeoilPricePredictionSystem.

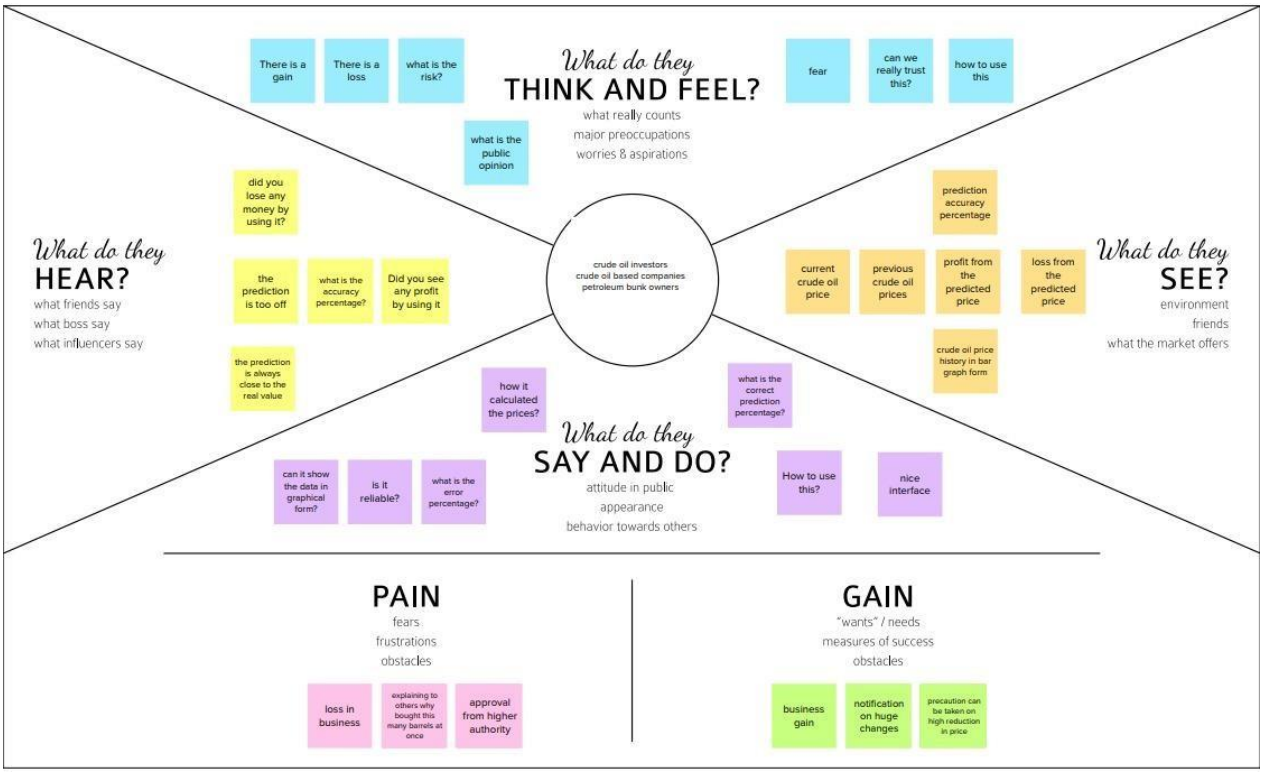
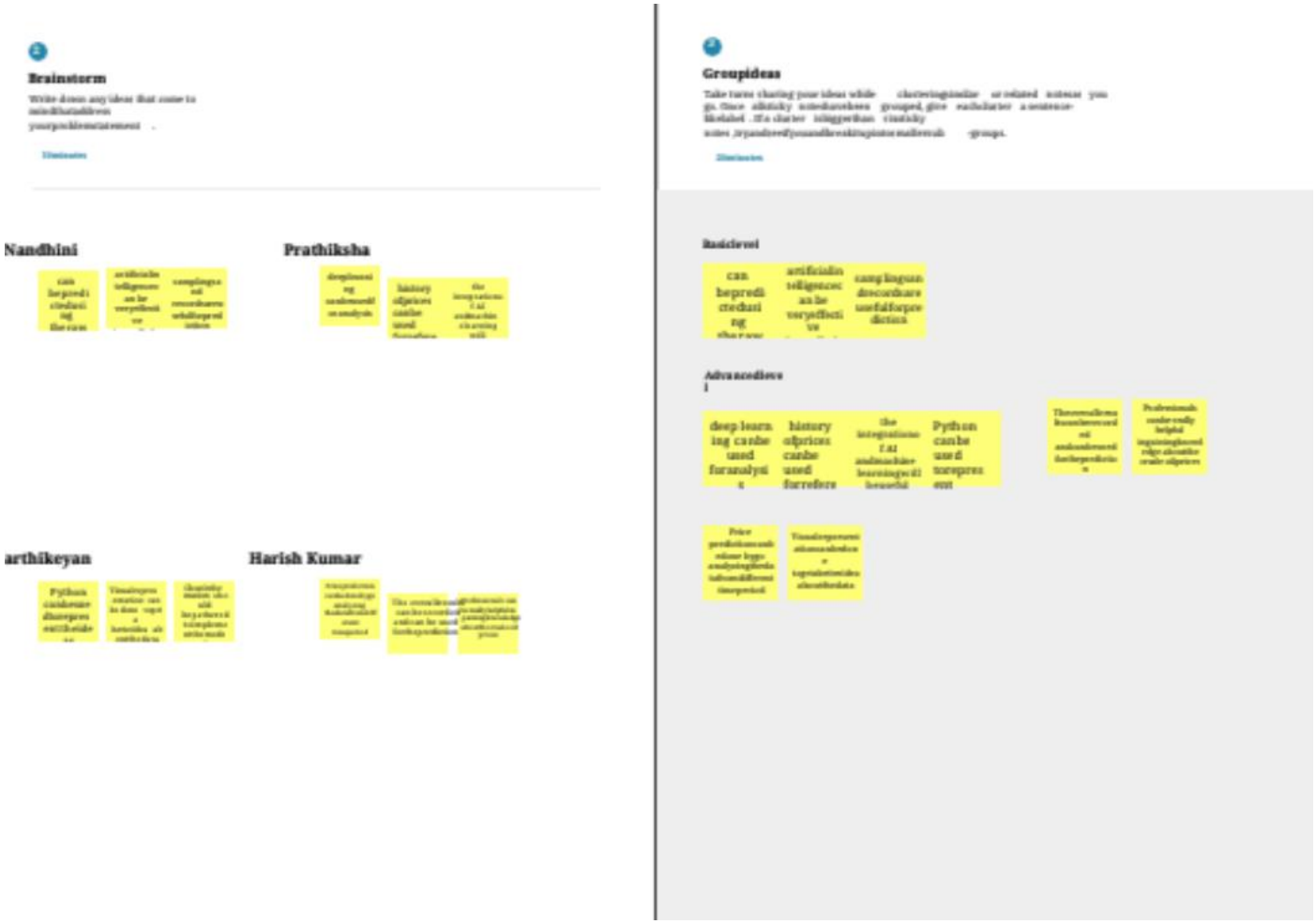


Figure 3.1–EmpathyMap

3.2 IdeationandBrainstorming

This is often the most exciting stage in a project, because during Ideation and brainstorming, theaim is to generate a large quantity of ideas that the team can then filter and cut down into thebest, most practical, or most innovative ones to inspire new and better design solutions andproducts. Figure 3.2 shows the stages of ideation and brainstorming for the Crude oil PricePredictionSystem.



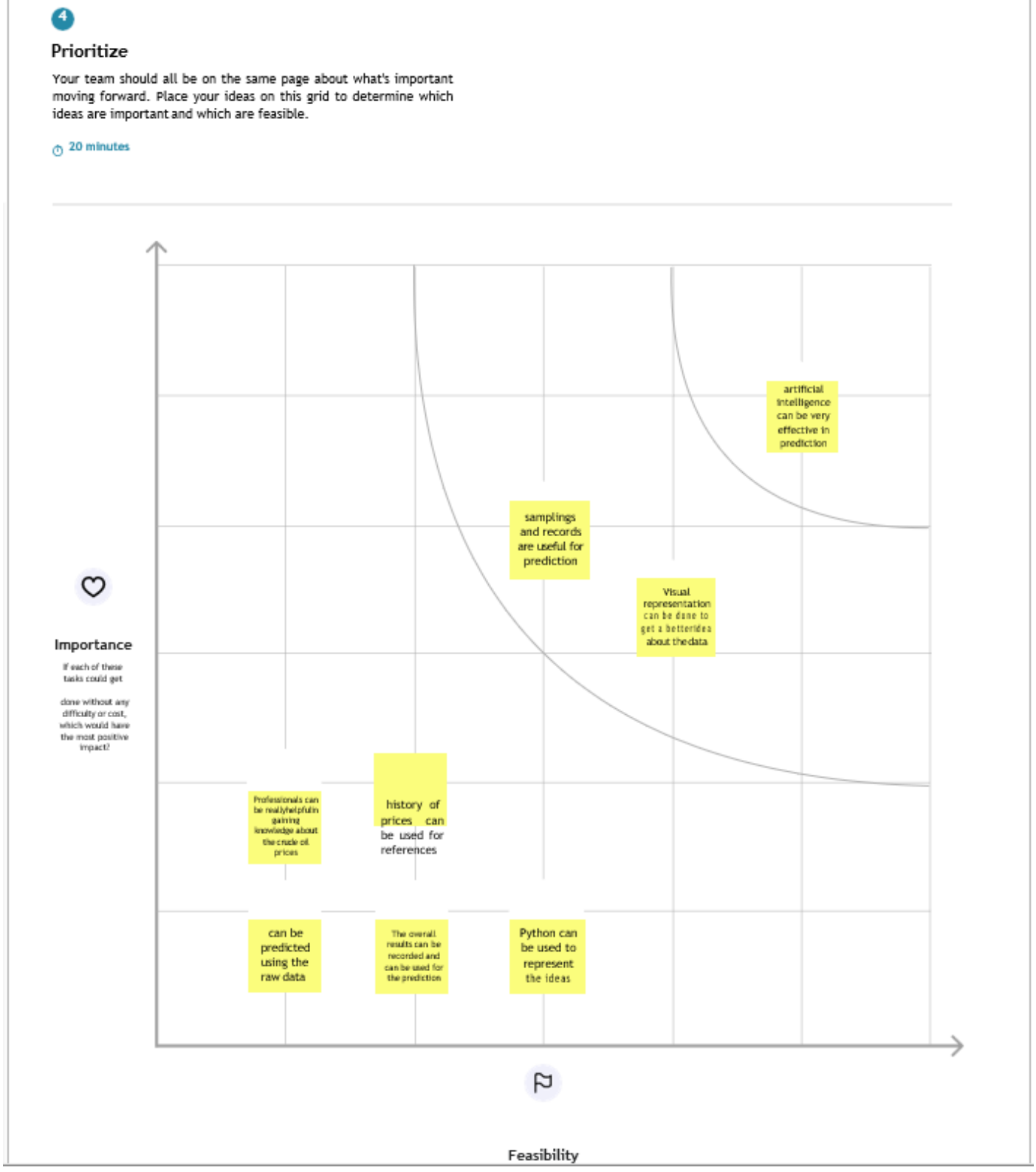


Figure 3.2–Ideation &Brainstorming

3.3 ProposedSolution

S.No.	Parameter	Description
1	**ProblemStatement(Problem to besolved)**	People working in the investment of crude oil needs anearlier crude oil price prediction system, which can helpthemtofindtherighttimetobuycrudeoilsothattheycan increaseprofitfromthepurchaseandreduceanysubstantialloss.
2	**Idea / Solutiondescription**	This solution uses, deep learning models for the predictionof crude oil price. The deep learning models that are usedfortimeseriespredictionareusedinthissolution.Twosuch models are LSTM (Long Short-Term Memory) and GRU(Gated Recurrent Units). They can be used in combinationtomaketheprediction.
3	**Novelty /Uniqueness**	Thesolutiontriestocombinethetwobesttimeseriespredictionmodelsandpredicttheoilpricewithleast error.
4	**Social Impact /CustomerSatisfaction**	This application will help people working in the area ofinvestment to take better decision regarding investing onthe crude oil. This will help them to predict days to buy andsellcrudeoil,asthepricesareoftenvariable.Thecustomers atisfaction depends on the accuracy of the solution. Thebettertheclosenessofthepredictedpricesofthecrudeoil totheoriginalprices,moreusefulthissolutionbecomes.
5	**Business Model(Revenue Model)**	Therevenuemodelcanbeimplementedaspay permonth usemodel.Theusercanpayfortheserviceforamonth.Oritcan alsobe provided by a yearly subscription
6	**Scalability of theSolution**	Thesolutionfrontendpagesarebuiltmodularly.Morepages can be added as we require. In backend flask canorchestratethedifferentfunctions,sointhefuturenew functionsandrelated pagescan beaddedtothesolution.

3.4 ProblemSolutionFit

Theproblemsolutionfitisthesolutiononehasfoundtoaddresstheproblemofthecustomer.Figure3.4depictsthesolution fitfortheCrude oilPrice PredictionSystem.

Define CS, and fit into CC	**1. CUSTOMER SEGMENT (CS)** • governments, public and private enterprises, policymakers, and investors • Other businesses which are indirectly depends on crude oil	**6. CUSTOMER CONSTRAINTS (CC)** Cash, high volatility, latency in acquiring related news	**5. AVAILABLE SOLUTION (AS)** Prediction by humans based on the news on crude oil. Prediction systems existed in the past, but they weren't very reliable.	Explore AS and differenti ate
Focus on J&P, tap into BE, understa nd RC	**2. JOBS-TO-BE-DONE (J&P)** As crude oil prices fluctuate daily, Inorder to make better decisions in business which are based on crude oil, it is important to somehow predict the price of crude oil for upcoming days	**9. PROBLEM ROOT CAUSE (RC)** The root cause of the problem is the fluctuating price of the crude. The price of crude oil varies everyday. Thus creating an uncertainty in the investment decisions of the investors and other members related to the crude oil trade.	**7. BEHAVIOUR (BE)** The final price at which a stock trades during a standard trading session is known as the closing price. Open the app to learn more about the current market trends.	Focus on J&P, tap into BE, understa nd RC
Identify strong TR & EM	**3. TRIGGERS (TR)** seeing companies that are able to predict the crude oil prices yields more than those who are not **4. EMOTIONS: BEFORE / AFTER (EM)** Before: A sense of doubt in the price leads to fear of losing money. Sudden dip in price may cause frustration. After: Assurance in future prices, security, and joy in case the price increase is predicted.	**10. YOUR SOLUTION (SL)** Prediction of the crude oil price prediction using deep learning related models	**8. CHANNELS of BEHAVIOUR (CH)** 8.1 ONLINE Looking up the most recent crude oil prices online. 8.2 OFFLINE Technical analysis,Risk Management	Identify strong TR & EM

Figure3.4–ProblemSolutionFit

CHAPTER4

REQUIREMENTANALYSIS

4.1 FunctionalRequirements

Table4.1arethefunctionalrequirementsoftheproposedsolution.

FR No.	FunctionalRequirement(Epic)	SubRequirement(Story/ Sub-Task)
FR-1	**Graph**	ShowingGraphbyobtainingthedatafromtheExcelsheet.
FR-2	**News**	Informationofalloilprices willbeupdatedbytheadmin
FR-3	**Database**	Information of the crude oil price will be updated stored inexcel sheet

Table4.1 –FunctionalRequirements

4.2 Non-FunctionalRequirements

FRNo.	Non-FunctionalRequirement	Description
NFR-1	**Usability**	Itcanuse bywidevariety ofclientasitis verysimpletolearnandnotcomplexto proceed.
NFR-2	**Security**	Theinformationwillbehashedsothatitwillbevery securetouse.
NFR-3	**Reliability**	It will be reliable that it can update with very time period so thattheaccuracywill be good.
NFR-4	**Performance**	Itwill beperformedfastandsecureevenatthelower bandwidth.
NFR-5	**Availability**	Predictionwillbeavailableforeveryuser.
NFR-6	**Scalability**	wearegoingtousedatainexcel soitwillbeeasily scalable.

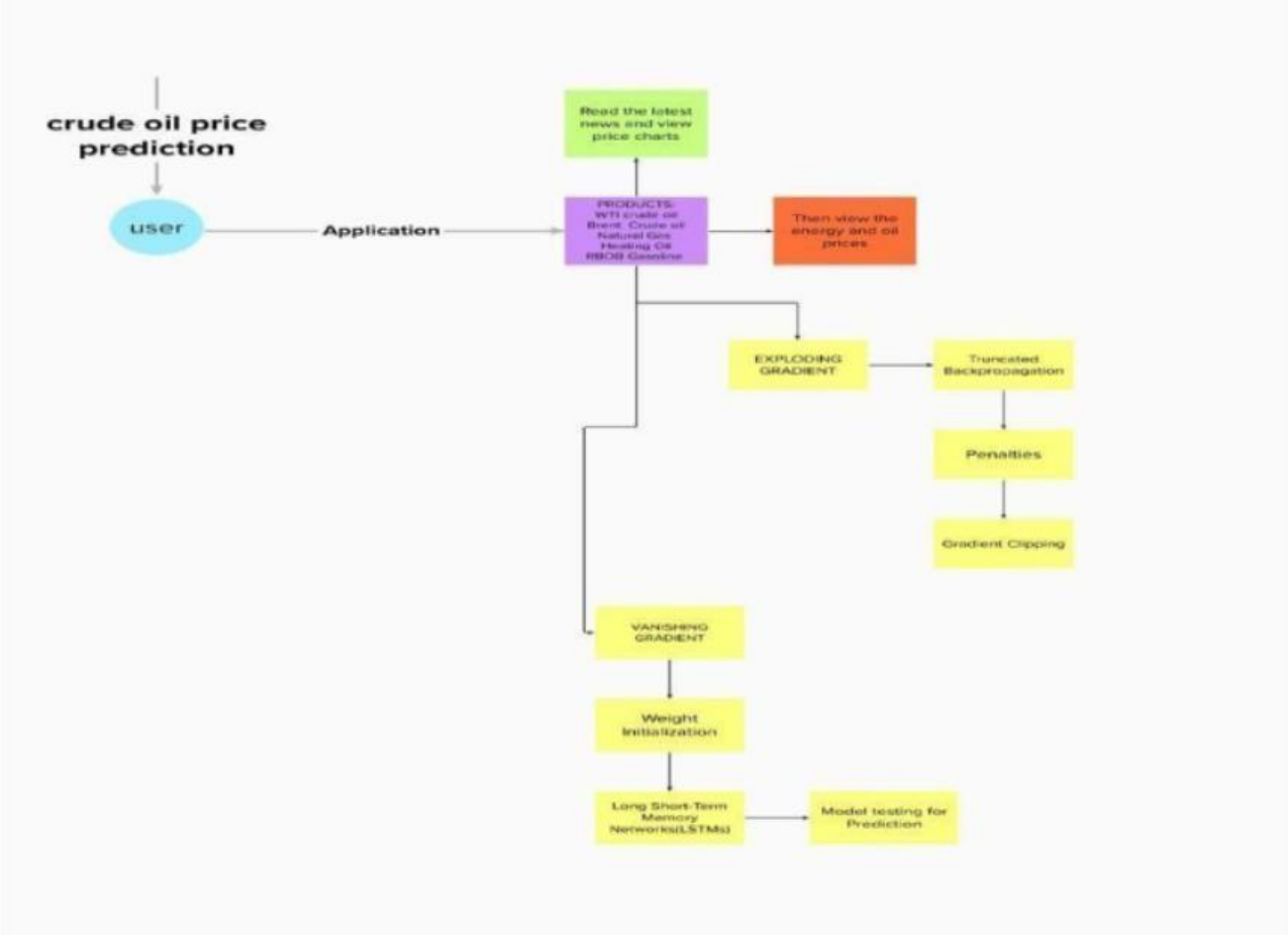
Table4.2–Non-FunctionalRequirements

CHAPTER5

PROJECTDESIGN

5.1 DataflowDiagram

A Data Flow Diagram (DFD) is a traditional visual representation of how information flows withina system. A neat and clear DFD can thus depict the right amount of the system requirementsgraphically.Itnotonlyshowshowdataentersandleavesthesystem,butalso whatchangestheinformationandwherethe datais stored.Figure5.1representstheDFDforthegiven



project.

Figure5.1–DataflowDiagram

5.2 TechnicalArchitecture

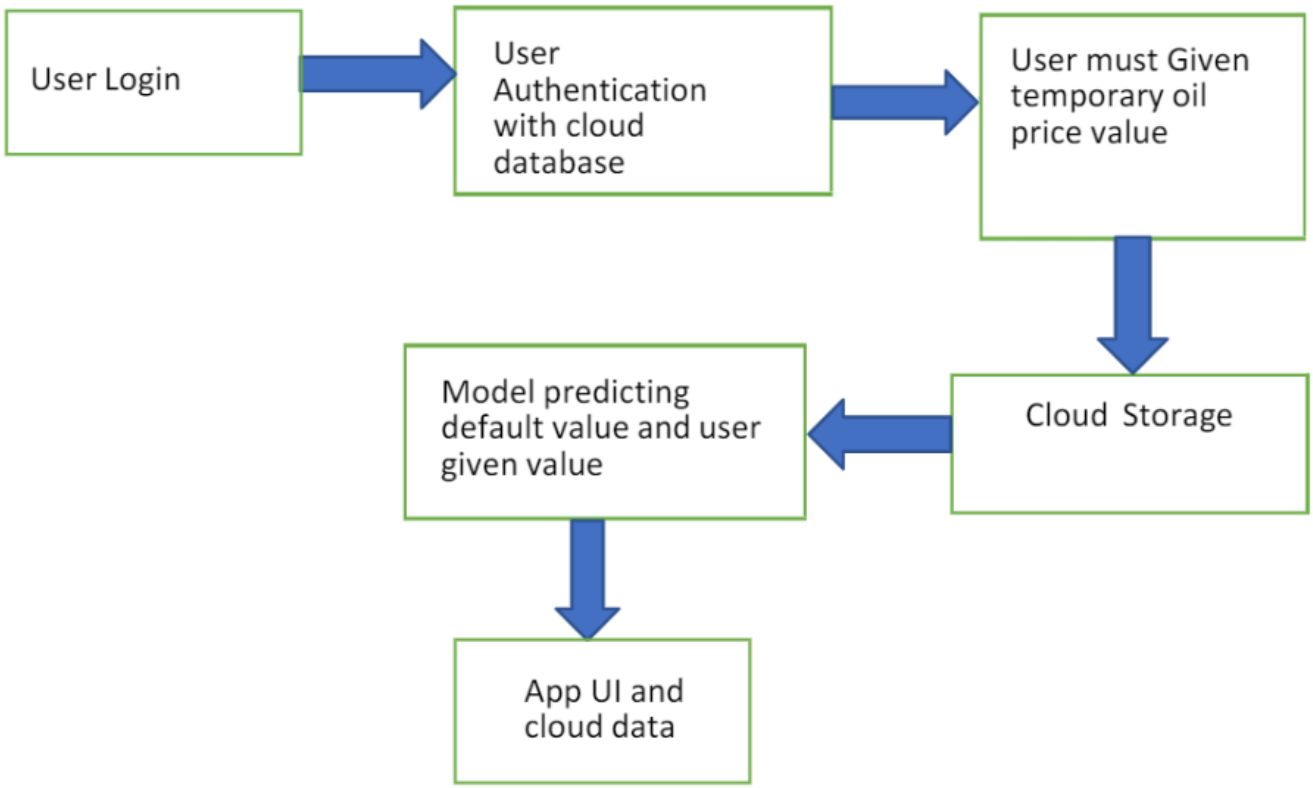


Figure5.2TechnicalArchitecture

5.2.1 ComponentandTechnologies

S.No	Component	Description	Technology
1.	UserInterface	Howuserinteractswithapplicationе.g.Web UI,MobileApp,Chatbotetc.	HTML,CSS,JavaScript /Flask
2.	Loadingdata	Convertingthecsvfiletopythonobject	Python
3.	Pre-Processing ofdata	Pre-Processingandnormalizingthedata to get accurateresults	Python
4.	CloudDatabase	DatabaseServiceonCloud	IBMDB2,IBMCloudant etc.
5.	FileStorage	Filestoragerequirements	IBMBlockStorageorOth erStorage ServiceorLocalFilesyst em
6.	MachineLearni ngModel	Long short-term memory (LSTM) is anartificialneuralnetwork.Unlikestandar d feedforward neural networks,LSTMhasfeedbackconnectio ns GRU Gated recurrent units is like a longshort-term memory (LSTM) with a forgetgate,buthasfewerparametersthan LSTM,asitlacksanoutputgate.	Object Recognition Model,etc
7.	Infrastructure(S erver/Cloud)	ApplicationDeploymentonLocalSystem/ CloudLocalServerConfiguration:2.5Ghz processor,8GBRAM CloudServerConfiguration:4GBGPU	Local,CloudFoundry,Ku bernetes,etc.

Table 5.2.1–Components andTechnologies

5.2.2 ApplicationCharacteristics

S.No	Characteristics	Description	Technology
1.	Open-SourceFram eworks	Listtheopen-sourceframeworksu sed	Flask
2.	ScalableArc hitecture	Justify thescalability ofarchitecture(3 –	CloudFoundry,IBMCloud ant

		tier, Micro-services)	

3.	Availability	Justify the availability ofapplication (e.g., use ofloadbalancers,distributed serversetc.)	CloudFoundry
4.	Performance	Designconsiderationfor the performance ofthe application (numberofrequestspersec,useofCache,useof CDN's)etc.	CloudFoundry

Table5.2.2–ApplicationCharacteristics

5.3 UserStories

UserType	FunctionalRequirement(Epic)	User StoryNumber	UserStory/Task	Acceptancecriteria	Priority	Release
Customer(Mobileuser)	Application	USN-1	You can download the crude oil price byopeningtheGooglePlayStoreappdirectlyasauser.	I can access owndecisions.	High	Sprint-1
	AvailableProducts	USN-2	Users of the application may instantly updatetheenergyandoilpriceswhileusingit becausetherearesomanydifferentproductsinthecrudeoilpriceapp.	I can receive the dataonceclickthen confirm	High	Sprint-1
	AdditionalFeatures	USN-3	Userscanreadthemostrecentnewsandseeoil pricecharts. MajorEnergyQuotesUserView Theusermayusemanycolourschemes.	Ican view then read thepriceprediction.	High	Sprint-2
	Expectations	USN-4	User Can Convert Currency AndExchangeRates	Icanexpect	Medium	Sprint-1
	Login	USN-5	Log in as a user without usingyouremailaddress,username,orpassword.		High	Sprint-1
Customer(Webuser)			Icanseethepriceofcrudeoilasaconsumer.	Icanviewthepricedirectly	High	Sprint-1
Customer CareExecutive			Iamthe userandIexecutivethe pricing history.	Icanacceptttheterms	medium	Sprint-1
Administrator			Asamanager,itanticipatestheresults.	Showtheresult	High	Sprint-1

Table5.3–UserStories

CHAPTER6

PROJECTPLANNINGANDSCHEDULING

6.1 SprintPlanning&Estimation

Sprint	Functional Requirement(Epic)	User StoryNumber	UserStory/Task	StoryPoints	Priority	TeamMembers
Sprint-1	Registration	USN-1	Asauser,Icanregisterfortheapplicationbyenteringmyemail,password,andconfirmingmypassword.	10	High	RITHICK ROSHAN
Sprint-1		USN-2	Asauser, Iwillreceiveconfirmationemailonce Ihave registeredfortheapplication	10	High	RITHIKA
Sprint-1	Login	USN-3	Asauser,Icanlogintotheapplicationbyenteringemail&password.	15	High	KEERTANA
Sprint-2	Input NecessaryDetails	USN-4	As a user, I can give Input Details toPredictLikelinessofcrudeoil	15	High	NITHIN SOUNDAR
Sprint-2	DataPre-processing	USN-5	Transform raw data into suitableformatforprediction.	15	High	NITHIN SOUNDAR
Sprint-3	Prediction ofCrudeOil Price	USN-6	Asauser,IcanpredictCrudeoilusingmachinelearningmodel.	20	High	KEERTANA
Sprint-3		USN-7	Asauser,Icangetaccuratepredictionofcrudeoil	5	Medium	RITHICK ROSHAN
Sprint-4	Review	USN-8	Asauser,Icangivefeedbackoftheapplication.	20	High	RITHIKA

Table6.1–SprintPlanning

6.2 SprintDeliverySchedule

Sprint	Total StoryPoints	Duration	SprintStartDate	SprintEndDate(Planned)	Story PointsCompleted (as onPlannedEndDate)	SprintReleaseDate(Actual)
Sprint-1	20	6Days	24Oct2022	29Oct2022	20	29Oct2022
Sprint-2	20	6Days	31Oct2022	05Nov2022	20	05Nov2022
Sprint-3	20	6Days	07Nov2022	12Nov2022	20	12Nov2022

Sprint-4	20	6Days	14Nov2022	19Nov2022	20	19Nov2022

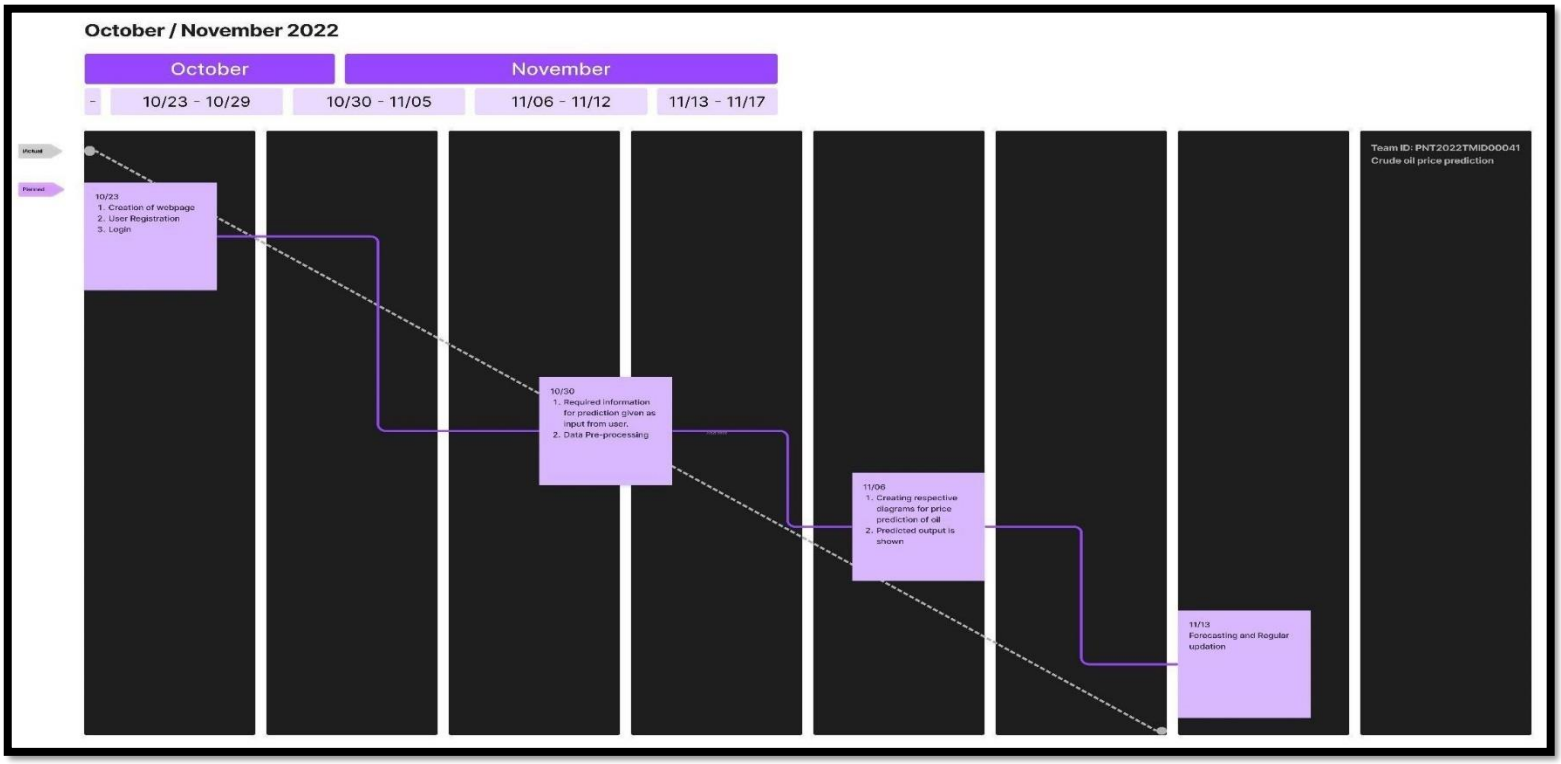
Table6.2 –Sprint DeliverySchedule

6.3 ReportsforJIRA

Velocity:
Imaginewehavea10-daysprintduration,andthevelocityoftheteamis20(pointspersprint).Let'scalculatetheteam'saveragevelocity(AV) periterationunit(storypointsperday)

$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

Burndown Chart: A burndown chart is a graphical representation of work left to do versus time.Itisoftenusedinagilesoftwaredevelopmentmethodologiessuchas Scrum.However,burndownc hartscanbe appliedtoanyprojectcontaining measurable progressovertime.



CHAPTER

7CODINGANDSOLUTION

7.1Feature

FR No.	Feature	Description
FR-1	CrudeoilPriceGraph	Showing the price of crude oil for respective dates in agraphwithdatesin xaxisand crudeoil pricesony axis
FR-2	CurrentPricePrediction	Showingthelastpredicted priceofthecrudeoil
FR-3	Prediction based on userprovided values	When user provided with the three days prices of the crudeoilthe applicationwill givepredictedpriceforthenextday

Table 7.1 –DescriptionforFeature

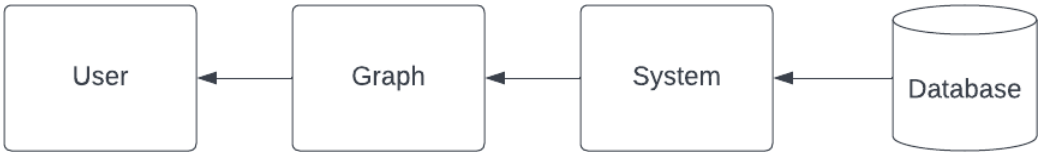


Figure7.1–DataflowDiagramfor Feature1

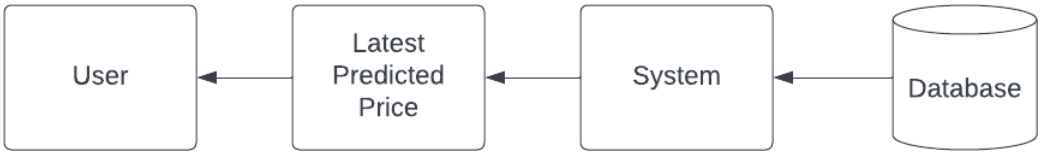


Figure7.1–DataflowDiagramforFeature2

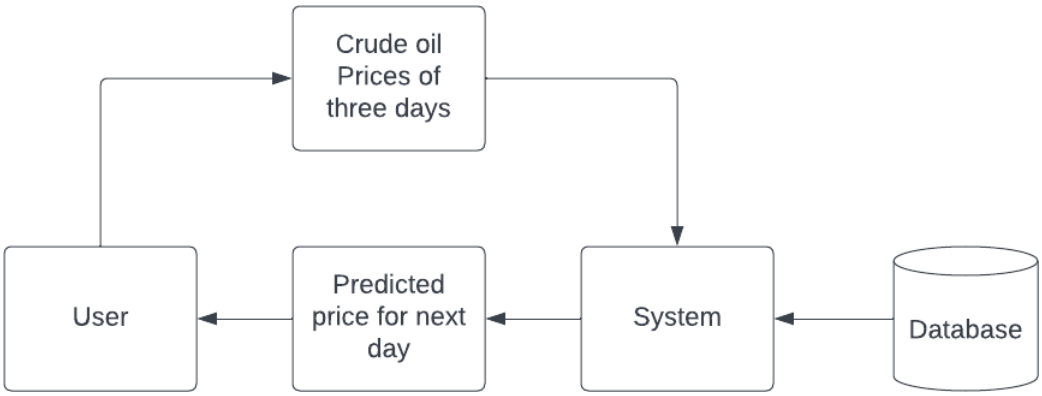


Figure7.1–DataflowDiagramfor Feature3

CHAPTER1

TESTING

8.1 TestCases

The test cases are window of closing prices, where the window size is 3. The test casesare sent to the model and the prediction is compared with the original closing price. The lossmetric is used to analyze the performance of the model. Figure 8.1 shows the result after thetesting. The blue line in the bottom shows the true closing prices. The orange lines denote thepredictionusingthetrainingdata.Thegreenlinedenotesthepredictionbased ontestingdata.

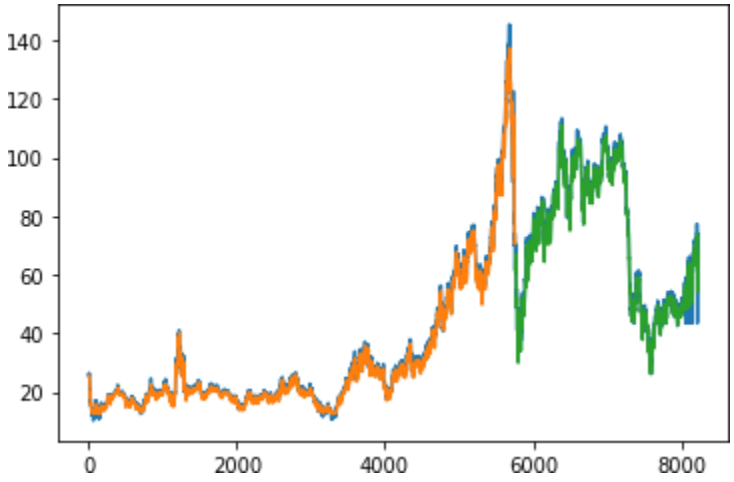


Figure8.1–TestCases Run

CHAPTER2

RESULTS

9.1PerformanceMetrics

The performance metric used to measure the model is RMSE (Root Mean SquareError). RMSE is measured on both the prediction on training data and the testing data. Lowerthe RMSE score, better is the accuracy of the model. The results of the RMSE are given in thefigure 9.1. From the figure 9.1 it can be observed that the RMSE are quite low. This indicatesthemodelisworking better andthepredictionsarequite accurate.

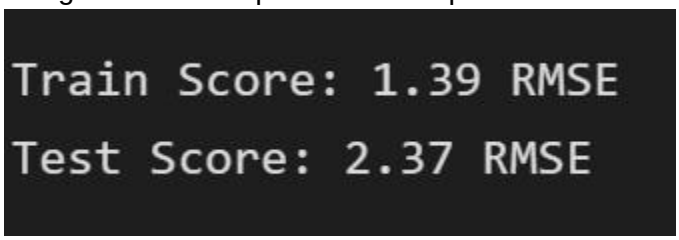


Figure9.1–PerformanceMetrics

CHAPTER21

PROS ANDCONS

10.1 Pros

- Theapplicationwe havecreatedis userfriendly
- This application is flexible as user can choose the way they need to predict theprice
- User can either give crude oil prices of any three continues dates or can get thelatestpredictedpriceofcrude oil

10.2 Cons

As thedataused inthisprojectisnotupto datethe pricesthemodelpredicted will notbeapplicable forusing inreal worldcrudeoil priceprediction

CHAPTER11

CONCLUSION

The prediction system works using the model that is built by combination of LSTM andGRU. The RMSE score for both the training and testing data is quite low. This shows that theaccuracy of the model is good. A website is served using flask framework, which helps toenable the users to interact with the model. It helps the user to see the current predicted pricethecrudeoil.Andithelps todopredictionformanuallyenteredcrudeoilclosingpricevalues.

CHAPTER12

FUTUREWORKS

The model currently cannot update the prices to the current data automatically. Web automationcan be enables to let the system update its database to current prices. And the model can beretrainedonthe updateddata.

CHAPTER13

APPENDIX

13.1 SourceCode

App.py

```
from flask import Flask,render_template,request,redirect
import joblib
from keras.models import load_model


app = Flask(__name__)


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


@app.route('/predict',methods=["POST","GET"])
def predict():
    if request.method == "POST":
        string = request.form['val']
        if(string ==""):
            return render_template('predict.html')
        string = string.split(',')
        x_input = [eval(i) for i in string]
        sc = joblib.load("scaler.save")
        x_input = sc.fit_transform(np.array(x_input).reshape(-1,1))
        x_input = np.array(x_input).reshape(1,-1)
```

```
        x_input = x_input.reshape(1,-1)
        x_input = x_input.reshape((1,10,1))
        model = load_model('model.h5')
        output = model.predict(x_input)
        val = sc.inverse_transform(output)
        return render_template('predict.html' , prediction = round(val[0][0],2))
    if request.method == "GET":
        return render_template('predict.html')


if __name__=="__main__":
    model = load_model('model.h5')
    app.run(debug=True)
```

13.2 GitHub&ProjectDemoLink

GitHublink:https://github.com/IBM-EPBL/IBM-Project-22149-1659805918
Project Demo
Link:https://drive.google.com/drive/folders/1nHufpbcAsPpI1zr5xqFod9Qf2brMkKq4?usp=share_link