Final Project Report

Title: Combined CNN-RNN architecture for stock market analysis

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ABSTRACT

The research of the stock market was done at first to get a proper understanding of the basics and functionality. After that, various research papers with different neural networks consisting of convolutional neural network (CNN) and Recurrent neural network (RNN) were studied and analyzed. To get a deeper understanding of both the neural networks, research was conducted, including the basics of both the neural networks and their application. The uses and advancements in both the fields were taken into account along with various publications done on the stock market analysis and prediction.

Further research LSTM (Long Short Term Memory) model belonging to the Recurrent Neural Network was discovered. A similar deep learning approach to the LSTM was done as CNN and RNN to discover its advancement and uses. Various publications, along with research articles, were studied to develop a grasp of the accuracy and precision of the proper use of the appropriate neural network. Upon further analysis, an implementation scenario was developed along with the ongoing research for the development of the LSTM model for the stock market analysis and prediction. The implementation was done with a target of getting accurate results which were researched before for the current stocks in real-time analysis. The price analysis and prediction of the top 5 mega-cap companies, according to the US stock market, were selected for the implementation. Using the Python language for deep learning, the implementation was completed resulting in analysis and prediction values in comparison to the actual real-time values. The predicted values have inaccuracy ranging inbetween 5-10% from the actual closing values of the selected stocks. The results were adequately noted and accurately plotted on the graphs.

INDEX TERMS: CNN, RNN, LSTM, Stock analysis, Stock Prediction, Stock market, Architecture, Neural Network.

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1.INTRODUCTION

1.1 Motivation

Due to the various advancement made in the field of artificial intelligence in the last decade, the overall interest in the specific areas of machine learning and especially deep learning has grown exponentially. As a computer engineer, I have a growing interest in learning the various aspects of the field. As a result of this, I am keenly learning Python language along with multiple libraries that help in machine learning. The main selection reason for this project is to be able to enhance my capabilities in the field of architecture, along with machine learning as a prospect. Financial analysis is one of its applications that can be done with the help of deep learning. Hence, all of the above reasons are the motivation behind the selection of this project.

1.2 Objectives and Challenges

- The main objective of the project is to analyze and predict the stock market using machine learning. The LSTM method, which is proposed, must be implemented using real-time data of selected stock, and from the input data at first, we will train the model to recognize data and gather information from it.

- Most of the data will be used for the training portion. After completing the training, we will proceed with the next phase, which will be validation. In this phase, we will already have the data from the stock prices, but we will let our trained model determine its price and then compare both to determine the accuracy.

- After that, we can either modify or enhance efficiency by further changes to our model and additional test this for the results and measure its accuracy.

- The final phase would be a prediction, which will be used to determine the future prices of the stock and determine whether it will go up or down.

- Hence these are the main objectives of the project and the implementation. The challenges will be to gather as much data as possible for the model to have higher accuracy as possible. Also, multiple tests will have to be done while testing phase to validate the prices correctly. The prediction of the price would be the hardest of all the challenges.

1.3 Structure

The report is divided into six sections. All the main sections are divided into separate subsections as well. Initially, the report starts with different types of neural network architectures and lists the necessarily researched architectures studied for this project along with their essential summary, features, and uses. At the end of this section, a comparison study between architectures is made along with the selection and target. In the next section, the stock market analysis is done. An introduction, history, and market types are discussed along with various methods of analysis and prediction. The following section is the implementation section where the subsections include specification and design, program code, and the obtained results from the implementation. In the last section, the conclusion, and discussion, along with a listing of the future aspects of the project. A list of all the references is listed at the end of the report.

2. TYPES OF NEURAL NETWORK ARCHITECTURES

2.1 CNN Architecture

The CNN (Convolutional Neural Network) architecture is a class of artificial neural networks that can extract the spatial data of a network. It implies that this neural network applies a mathematical operation of convolution, which is a specialized kind of linear operation. This type of neural network use convolution in place of general matrix multiplication in at least one of its layers. Hence, they are also known as shift invariant or space invariant artificial neural networks (SIANN). [1]

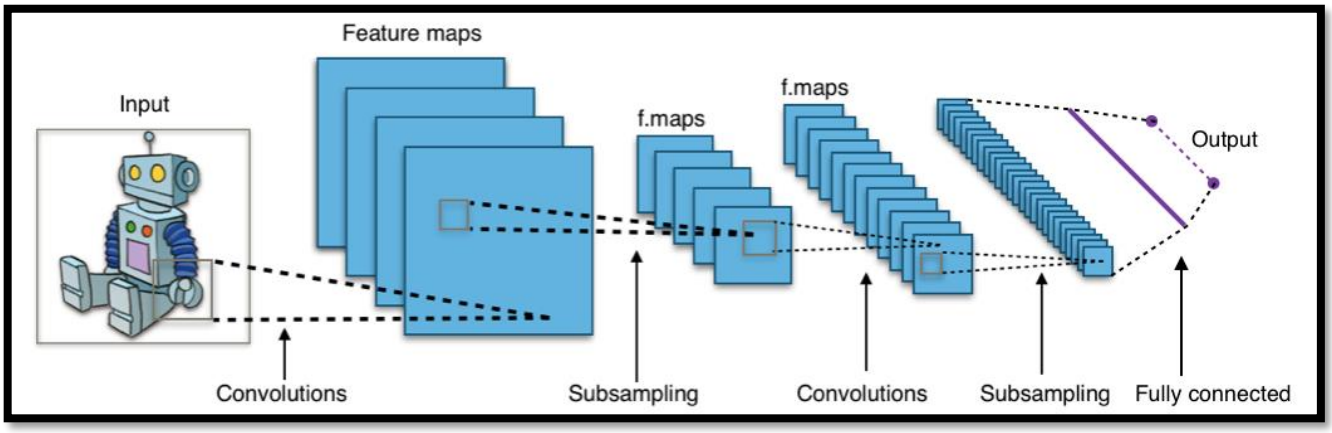

Figure 1 – Convolutional Neural Network [1]

There are mainly input and the output layer along with multiple hidden layers in between which perform the operations such as convolution, pooling, subsampling, etc. The sharing of weights of the local field of view allows reducing the number of parameters significantly because of which the training can speed up. There are various applications of CNN, such as financial time series [2][3], image and video recognition, recommender systems, image classification [4], natural language processing (NLP), medical image analysis, etc.

2.2 RNN Architecture

The neural network in which the connection between nodes form a directed graph along a temporal sequence is known as RNN (recurrent neural network). It is a form of artificial neural network and derived from a feed-forward neural network. It has three layers in the structure, i.e., input layer, hidden layer/s, and

output layer. The connection between neurons makes directed cycle due to which the output not only depends on input but also on the previous step

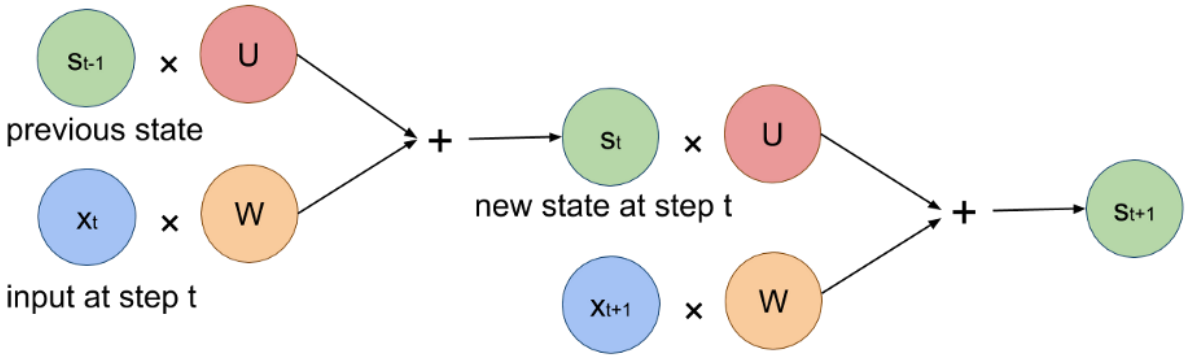

Figure 2 – Recurrent Neural Network [5]

neurons [6]. Due to these types of structure, RNN has various applications such as handwriting recognition, Speech recognition, Financial Analysis [7], etc.

2.3 LSTM Architecture

LSTM is an abbreviation used for Long Short Term Memory. It is a type of RNN architecture that was developed to model temporal sequences along with their long-range dependencies more accurately using its feedback connections. It can

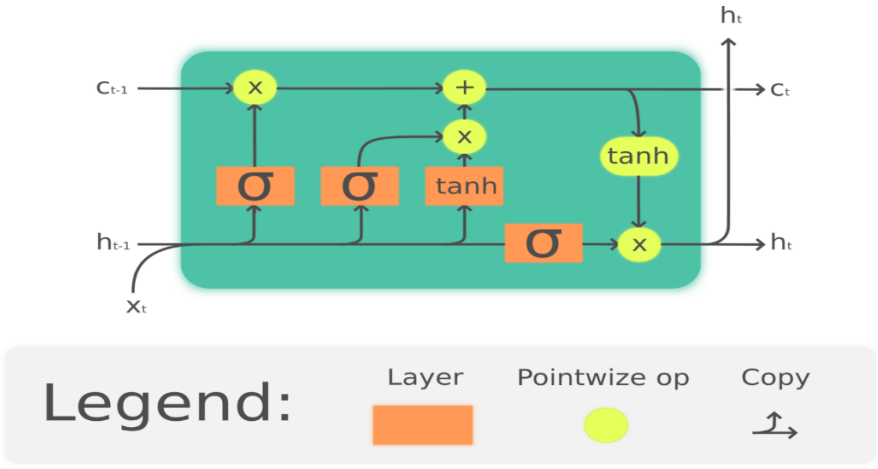

Figure 3 – Long-Short term memory [8]

process single data points as well as entire data sequences. An LSTM unit generally comprises a cell, input gate, output gate, and forget gate. The cell recollects values over self-assertive time interims and the three entryways direct the stream of data into and out of the cell [8].

The use of LSTM is in classification, processing, and making predictions based on time series data and addressing the lags that can occur between essential events in the time series [9][10][11]. Various applications of LSTM include handwriting and speech recognition, traffic anomaly detection, instruction detection, etc.

2.4 Comparison, Selection, and Target

The analysis of the stock market for the price prediction can be considered as a series of events that affect each other since the beginning of a stock's IPO (Initial Price offering). A stock's price is determined with its previous daily ending prices along with the emotions of the people invested in that stock. The main target to be achieved is the market analysis and prediction of any stock. The above-given information allows us to have a grasp of knowledge that every neural network provides and their capabilities of operation. The final selection for implementation of the project after studying various research [9][10][11][12] for stock market analysis would be made through LSTM architecture.

The main reason for the selection of this option is to consider every individual daily market close as a time-series event; we need to accurately analyze every day as a time-series event and determine its correlation to any previous such event. In this way, we would be able to train the neural network to look for a specific pattern that would help in determining the analysis of the stock and its price prediction as well. The overall training would occur first over a long period than using that trained network. We can validate or authenticate the stock price for a small period, which would be able to determine whether our model is working as it should or not. Finally, after both these steps are complete, our last target would be to determine the future price of the stock by testing.

3. STOCK MARKET ANALYSIS

3.1 Introduction, History, and Market Types

A stock represents all shares in which ownership of a corporation, which may be public or private, is divided. The market in which such types of different securities are traded is known as the stock market. There are also other names for by which it is known, such as equity market, share market, etc. Every country has its stock market in which people can trade stocks based on their own estimated value of the business or the company. A stock exchange is an exchange where various types of people trade their stocks, bonds, securities, etc. The various types of people that trade the stocks include individual retail investors, institutional investors, investor groups, banks, publicly traded corporations, etc. which take part.[13] There are mainly two different types of stock – (1) Common stock and (2) Preferred Stock. The main difference between these two is that the common stocks are for people who want to invest and, along with that, receive dividends upon liquidation as well as have shareholder rights, whereas preferred stocks give higher dividend returns and do not have any voting rights in the company. [14][15]. Hence, the share prices are set by the current orders placed through buyers and sellers, which invest in the stocks. In the current pace where many huge companies have grown so much in the last decade, most of them need capital from people to develop and grow at such a rapid pace. Such a big capital is gathered from various investors and institutions through the stock sold by that company. Through the law of supply and demand, the basic need for stock prices depend on how many people are buying and selling at the current time through exchanges. As per the demand for the stock reaches higher, the prices also increase along with that. If there are some negative sentiment, then obviously the supply would increase, which is cause a lot of people to sell their stock and because of which the prices would decrease. With increasing greed, people try to think about how the company is going to perform in the future and perform analysis based on the history of performance and its prices. This procedure is known as stock market analysis. With the help of the LSTM (long short-term

memory), we will be doing the same thing by determining whether the prices will go up or down based on the past.

The earliest modern stock market is known to have started around the early 16th century. The earliest known exchanges of trade happened were recorded from around 12th, 13th, and 14th centuries where people traded goods and services for other forms of payment. In the 14th century, people also traded government securities, which could be the earliest period of the initialization of the stock market. The modern stock market started around the 16th century when an Italian company issued stocks for buying and selling, which was followed by England and the low countries during the colonization of the 'Europe' and so-called new world.[15]

They are three types of markets [16] for the stocks, which are as follows:

TABLE 1 – Types of markets

1) Primary Market: The primary market is where the companies sell their shares directly to the investors during its IPO (initial public offering). The phenomenon mentioned above can also take place when a company decides to re-raise more money by making more shares available at a given price in the new round of funding. This is usually done because companies need a quick flow of cash in massive amounts. Hence, at first, they raise capital directly from huge investors, hedge funds, mutual funds, etc. because they can purchase large quantities and trade swiftly.
2) Secondary Market: The secondary market is usually between the investors and does not involve companies. Some institutional investors and hedge funds do participate in this as well for the trading of stocks. But mostly this market is for people who don't want to accumulate a lot of company's share and are looking for trading stocks mostly.

3) Over the counter Market: The companies who want to raise the capital sometimes do not want to get publicly listed, and in such a case, OTC trading is an option where the company sells its stock at a fixed price to an investor. This is quite risky as the prices are not transparent.

An index is a place that tracks a list of companies within that added index. Such type of index may be favoring companies based on their performance and growth. Some of the examples of enormous stock market indexes are S&P500, Dow30, FTSE, Euronext, etc.

Hence, the main features of a stock market are fair dealings in transactions, efficient price discovery, liquidity maintenance, secure and valid transactions, Eligible participant's support, investor protection, balanced regulation, etc. [17]

3.2 Methods for analysis and prediction

There are a lot of different methods [18] which are available for the stock market analysis, which comprises of techniques such as:

TABLE 2 - Methods for Stock Analysis table

1. Technical Analysis: In this analysis method, a lot of focus in done on the current trends, charts, and patterns along with stock's historical performance, which is used for indication of its future price. The company's value and market cap are taken less into consideration during this analysis.
2. P/E Ratio: In this analysis, the P/E ratio stands for the price to earnings ratio. It is calculated by dividing the stock's market value per share to the earnings per share. The stock is a favorable investment if the P/E ratio is lower.
3. Earnings Per Share: This form of analysis is done based on earnings acquired from the per-share price. EPS is a short form for earnings per share. The higher the EPS value, the more investors will be indulged to invest in that stock. Hence, increasing EPS is considered

as a good indicator for investors.
4. PEG Ratio: The PEG ratio stands for the price to earnings growth ratio. It is a step advanced after the P/E ratio, which also includes the growth of the company yearly. To calculate the PEG ratio, the P/E ratio is divided by the 12-month growth of the company. A stock is considered reasonable by the PEG ratio if its value derived by the ratio is typically less than 1.
5. Book Value: The book value is calculated by the price to book ratio. To calculate this, the count of the company's market price divided by its total equity value. The equity value is derived by subtracting the liabilities from the assets. The lower the price to book ration would derive that the company's stocks are undervalued.
6. Return on Equity: The return on equity is calculated by dividing net income by average shareholder's equity. The ROE analysis is used to determine companies that generate profit are suitable investments. The continuous increase in ROE is a good sign for investors.
7. Analyst Recommendation: Many investors use analysts who perform fundamental and technical research and provide a trade recommendation based on their analysis. It saves time and effort of review on the investor's end, which is provided by the analysis giving guidance who later is compensated through money obviously for their work.

The analysis performed by the above methods [19] is used for prediction of the stock prices in the future. The various ways of analysis are as follows:

TABLE 3 - Methods for Stock prediction table

1. Fundamental Analysis: The analysis performed based on the current price of the stock, i.e., either it is undervalued or overvalued, is fundamental analysis. It is an analysis performed as a long term strategy. Built on the basis that human society needs capital to make progress, and much like that, a company progresses its growth based on how it operates. Some of the methods used for fundamental analysis are the top-down approach, Bottom-up approach, etc.
2. Technical Analysis: The analysis performed based on the historical prices of the stock is done with the help of technical analysis. This analysis is performed using various patterns and techniques are used. The ideology used behind this analysis is that everything significant about the company is already priced into the stock, and the history of prices and trends tends to repeat itself due to market psychology. Patterns for analysis include head & shoulders, Cup & saucer, etc. Techniques along with patterns such as exponential moving average, oscillators, support & resistance level, etc. are employed. The use of various indicators, such as candlesticks, is also done for technical analysis as well.
3. Machine Learning: The advancement of various machine learning field has made it a suitable option for the stock market prediction. With so much data available for processing, it is always better to use machine learning for stock market analysis and prediction in this modern century. Use of ANN (artificial neural networks) along with GA (genetic algorithms). Most commonly in ANN's the feed-forward neural network is used for prediction with the backward propagation of error algorithm. Other forms of ANN's are time recurrent neural network (RNN) and time delay neural network. The LSTM method, which we are applying for the project, is part of RNN in deep learning, which is a subset of machine learning.

4. PYTHON PROGRAM FOR TESTING

4.1 Specification and Design

- At first [20], we will start importing all the necessary libraries which will be needed for the creation of the program, which is math, NumPy, pandas, scikit learn preprocessing, Keras, matplotlib, DateTime, etc. With the help of the imported libraries, we would be able to use it for implementing different functions of those libraries.

- After that, we would import the company's data we want to process. This would be done by importing the web data reader from yahoo finance [21]. Alternatively, google finance can also be used to gather the data as an optional method. The top 5 mega capital companies will be collected data from and imported. As of 2020, July, ending these are Apple (AAPL), Microsoft (MSFT), Amazon (AMZN), Google (GOOGL), and Facebook (FB). We would be gathering the High, Low, Open, Close, Volume, and Adjusted Close in columns, whereas the rows, would show the date [22].

- Once we verify that the data frame has imported the data and what size it is stored in, then we can create a graph to visualize the data from that frame. Plotting the graph can be done along with naming the title as well as setting up the x and y-axis with variables and names and specifications. The X-axis would be showing the timeline of the company's stock in terms of years, and Y-axis would show the prices in US dollars $. Once the graph is created according to desired specifications, we can verify its look by showing it. If changes are needed, then the same procedure is done until the graph is set correctly.

- After that, we would create a new data frame with a closing price and convert it to a NumPy array. To train the dataset, we would first train it with data ranging from 60 to 90 percent. This will be stored in a variable,

and this is how we will train our model.

- After that, we would scale the data between 0 and 1 by using the minmaxscaler function. By doing this, we would scale the data before sending it to the neural network.

- Using the company's stock for the last 120 days, we would be able to implement two new training datasets. These datasets would contain a total of 120 values, with each incrementing from the last by one index. Both newly trained datasets would be converted to NumPy arrays so that we can use it for training the LSTM model.

- The three-dimensional form of the LSTM model will be restructured, and we can set the number of neurons we want to add along with specifying the number of LSTM layers. The model would be sequential and compiled using the mean squared error function.

- Using the training data sets, we would proceed to train the model along with the defined batch size and epochs. This will use the number of training data set cases in a batch and pass it forward and backward through a neural network. This is the end of the training part of the model, and now we will commence with the testing.

- Two testing variables will be created at first. Both variables will be set up with dataset values, and after that, one of them will be converted to NumPy array so it can be used for testing the LSTM model.

- The variable used for the testing of the LSTM model is reshaped according to the three-dimensional specifications, which would require samples, time steps, and features as its input.

- Using the values from the testing, we would proceed to obtain the prediction values from the model. Also, at this point, we would undo the

scaling. We would then proceed with calculating the root mean squared error. This would give us an idea of the model's accuracy. The model will have performed better if the value is as low as possible.

- At this point, we would plot all the data on to the graph of trained, tested, and predicted values and visualize it. We can now perform validation on the obtained predicted price. This would give an idea about the performance of the model and the accuracy of predicted prices from the model.

- If we want to predict the prices further, then we can extend the data frame to the last available date of the validation phase and again predict the price of the stock on the next day. Hence, in this way, we would achieve the training, testing, validation, and prediction of the created model.

4.2 Program Code

The following is the designed code for the stock market analysis and prediction through python using the LSTM model. The code has been implemented in google collaborator and using python notebook.

```
# -*- coding: utf-8 -*-

"""ENGI_9861_LSTM_stock_analysis_and_prediction.ipynb


Automatically generated by Collaboratory.


The original file is located at


https://colab.research.google.com/drive/1F1BZPW4oP6pOKBsZp4055brhnUh3neoz
```

```
"""

# Name: Utkarsh Trivedi - ENGI 9861 HPCA Python Program

# Email: ubtrivedi@mun.ca

# Using LSTM to predict stock prices of a company

# For analysis I would be targeting the top 5 mega-cap companies which are Apple (AAPL), Microsoft(MSFT), Amazon(AMZN), Google(GOOGL) and Facebook(FB) as of 31/07/2020

# Version: 5.2 (Last modified 31//07/2020)


#Importing all Python libraries

import datetime

import pandas_datareader as pdr

import pandas as pd

import numpy as np

import math

from sklearn.preprocessing import MinMaxScaler

from tensorflow.python.keras.layers import Dense, LSTM

from tensorflow.python.keras import Sequential

import matplotlib.pyplot as mplt


#Getting stock price from yahoo

stock = input("Enter the stock symbol: ")
```

```
dataframe = pdr.DataReader(stock, data_source='yahoo', start='2010-01-01',
end='2020-07-29')
dataframe

# Getting the shape of our data frame
dataframe.shape

#Creating a graph to visualize the closing price history
mplt.style.use('seaborn-pastel')
mplt.figure(figsize=(18,9))
mplt.title('Closing Price History')
mplt.xlabel('Timeline',fontsize=15)
mplt.ylabel('USD $',fontsize=15)
mplt.plot(dataframe['Close'])
mplt.show()

#Creating a new dataframe with only the 'Close' column from the available data
data = dataframe.filter(['Close'])

#Converting the dataframe to a numpy array
dataset = data.values

#Creating a variable to store the length of the training dataset
```

```
#We could ideally take 60 to 90 % of data from the set for training
#In our case, we are taking 85 % of the dataset for training
training_data_length = math.ceil( len(dataset) *.85)

#Scaling all the values of data inbetween 0 and 1
#Scaling is done inorder to feed data better to a neural network
scaler = MinMaxScaler(feature_range=(0, 1))
scaled_data = scaler.fit_transform(dataset)

#Create the scaled training data set
train_data = scaled_data[0:training_data_length  , : ]

#Split the data into x_train and y_train data sets
x_train = []
y_train = []

for i in range(120,len(train_data)):
   x_train.append(train_data[i-120:i, 0])
   y_train.append(train_data[i, 0])
   if i<= 120:
     print(x_train)
     print(y_train)
     print()
```

```
#Convert x_train (independant train dataset) and y_train (dependant train dataset) to numpy arrays

# Conversion is done inorder to use them in LSTM network model

x_train, y_train = np.array(x_train), np.array(y_train)


#Coverting the data to three dimension form (samples , timesteps, features) which can be used in LSTM

x_train = np.reshape(x_train, (x_train.shape[0],x_train.shape[1],1))


#Constructing the LSTM network model

#Two LSTM layers with 200 neurons each and two dense layers in which one is 100 neurons and other is 1 neuron respectively

model = Sequential()

model.add(LSTM(units=200,
return_sequences=True,input_shape=(x_train.shape[1],1)))

model.add(LSTM(units=200, return_sequences=False))

model.add(Dense(units=75))

model.add(Dense(units=1))


#Compiling the LSTM model using Adam and  Nadam optimizer and mean squared error method

model.compile(optimizer='Nadam', loss='mean_squared_error')


#Model Training
```

```
#Batch size contains the total number of training samples in one batch
#Epoch is the number of iterations when an entire dataset is passed forward or backward
model.fit(x_train, y_train, batch_size=8, epochs=2)

#Creating a test data set
test_data = scaled_data[training_data_length - 120: , : ]

#Create the x_test and y_test data sets
x_test = []
y_test =  dataset[training_data_length : , : ]
for i in range(120,len(test_data)):
   x_test.append(test_data[i-120:i,0])

#Convert independant x_test array to a numpy array to use it in LSTM model
x_test = np.array(x_test)

#Reshaping in to the three dimensional data (samples , timesteps, features) accepted by the LSTM
x_test = np.reshape(x_test, (x_test.shape[0],x_test.shape[1],1))

#Using the test data getting the models predicted price values
predictions = model.predict(x_test)
```

```
#Reversing back by undoing the scaling
predictions = scaler.inverse_transform(predictions)

#Calculating the root mean square value and getting its value as output
rmse=np.sqrt(np.mean(np.power((np.array(y_test)-np.array(predictions)),2)))
rmse

#Plotting and visualizing the data for the graph
train = data[:training_data_length]
valid = data[training_data_length:]
valid['Predictions'] = predictions

#Visualize the data
mplt.figure(figsize=(18,9))
mplt.title('LSTM Trained Model')
mplt.xlabel('Timeline', fontsize=15)
mplt.ylabel('USD $', fontsize=15)
mplt.plot(train['Close'])
mplt.plot(valid[['Close', 'Predictions']])
mplt.legend(['Trained Data', 'Valid Data', 'Predictions Data'], loc='upper left')
mplt.show()

# Comparing the actual price with the prediction price
```

Valid

4.3 Optimizer, Epoch's, Batch Size, and RMSE values

RMSE = Root mean squared error value [23]
Values of RMSE with 85% training data, Nadam optimizer [24] with batch size 8 and epoch = 1

TABLE 4 - RMSE value with one epoch table

# AMAZON ANALYSIS	epoch = 1	RMSE = 121.5790
#APPLE ANALYSIS	epoch = 1	RMSE = 8.5157
# MICROSOFT ANALYSIS	epoch = 1	RMSE = 5.1023
# GOOGLE ANALYSIS	epoch = 1	RMSE = 52.3937
# FACEBOOK ANALYSIS	epoch = 1	RMSE = 9.6287

Values of RMSE with 85 % training data, Nadam Optimizer with batch size 8 and epoch = 2

Table 5 - RMSE value with two epoch table

# AMAZON ANALYSIS	epoch = 2	RMSE = 142.3315
# APPLE ANALYSIS	epoch = 2	RMSE = 11.1749
# MICROSOFT ANALYSIS	epoch = 2	RMSE = 6.7777
# GOOGLE ANALYSIS	epoch = 2	RMSE = 51.9522
# FACEBOOK ANALYSIS	epoch = 2	RMSE = 7.6239

5. RESULTS

5.1 Conclusion and Discussion

The achieved resulting plots of the LSTM model for the five companies, which are Amazon, Apple, Google, Facebook, and Microsoft provide the following conclusion:

- The graph obtained values of the prediction are close to the actual closing values with 5 to 10 % inaccuracy
- The blue line shows the trained data, the green line shows the validation data, and the red line shows the predicted data from the model.
- The lower or higher number of epochs is not suitable for the model to achieve accuracy. The model's epoch's and batch size both need to be set according to the amount of size of the dataset and the resulting requirement.
- Both Adam and Nadam optimizers can be used for the model. Still, considering the values obtained from all the analysis and the RMSE values from both, I have chosen to use the Nadam optimizer over Adam.

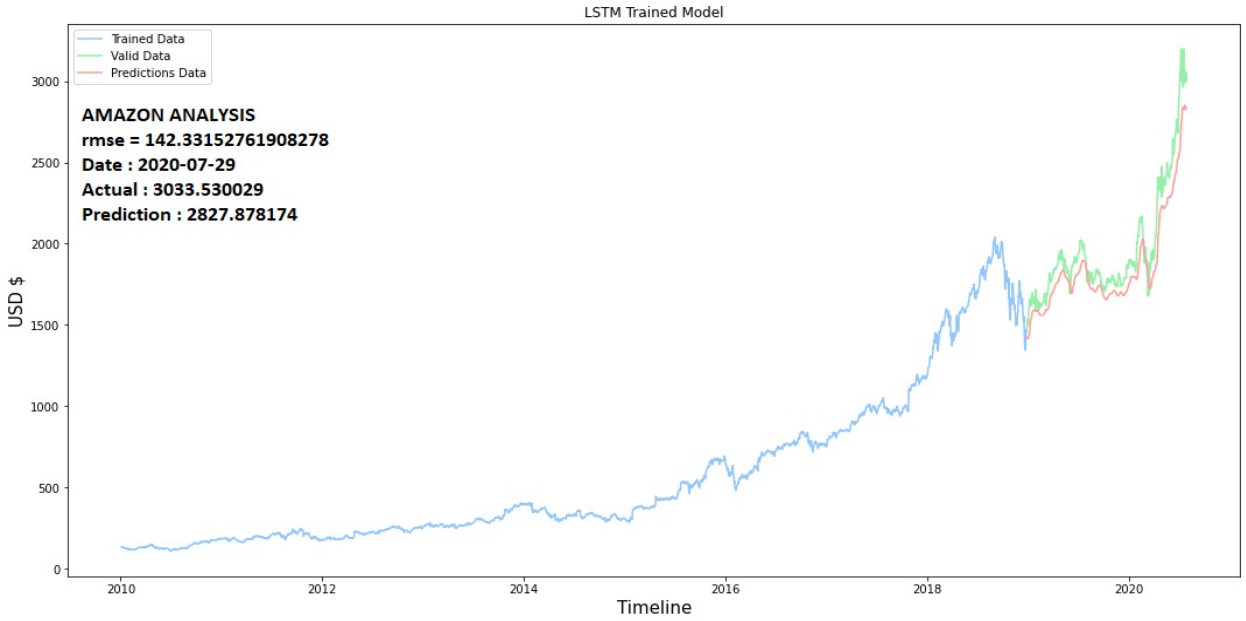

FIGURE 4 - Prediction Graph of Amazon Stock Analysis

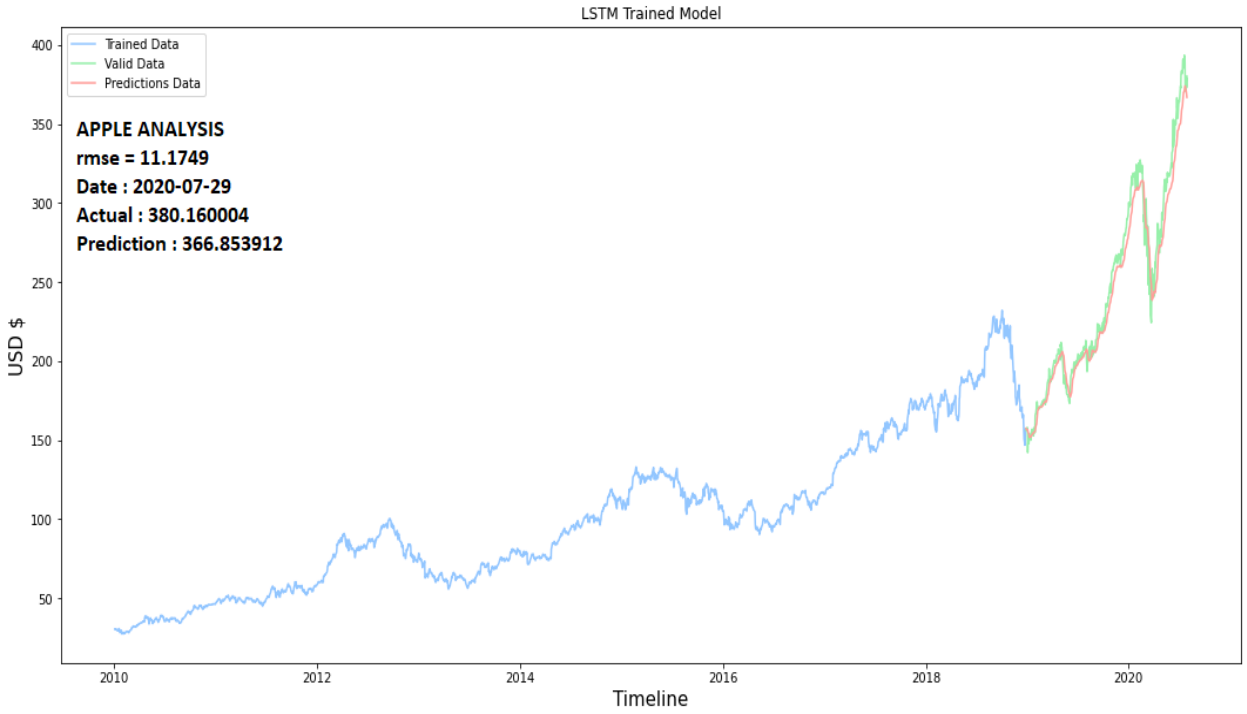

FIGURE 5 - Prediction Graph of Apple Stock Analysis

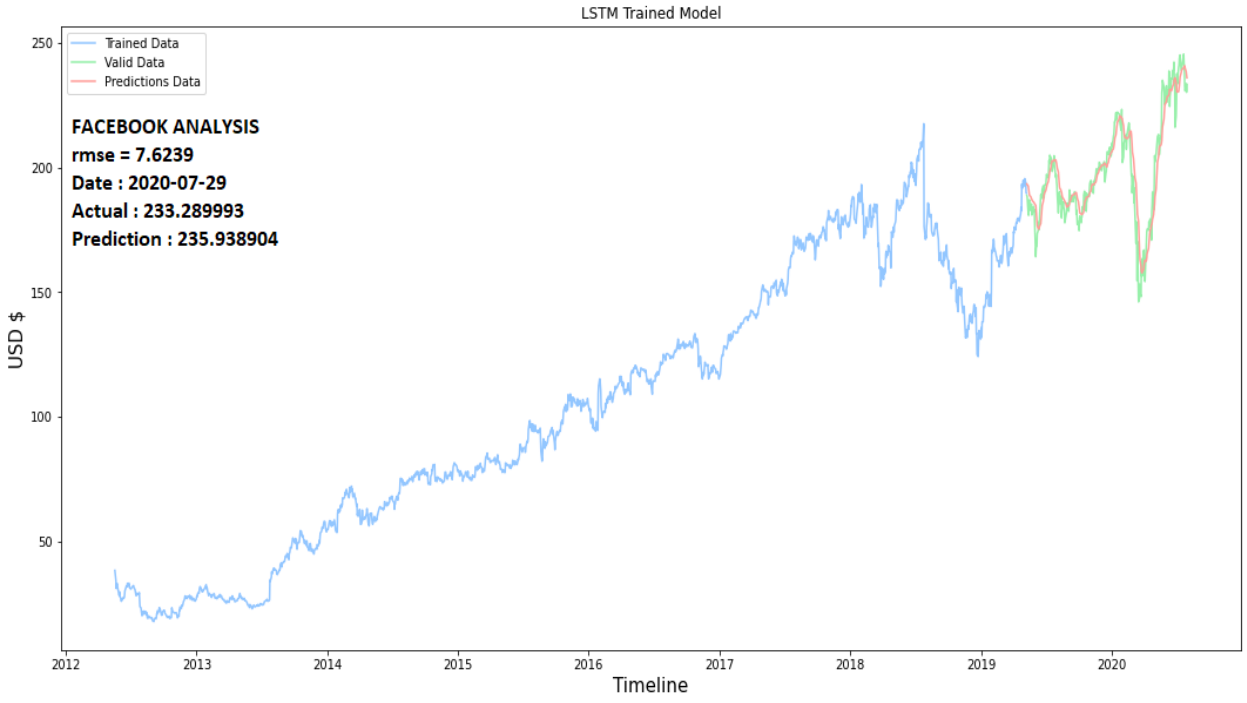

FIGURE 6 - Prediction Graph of Facebook Stock Analysis

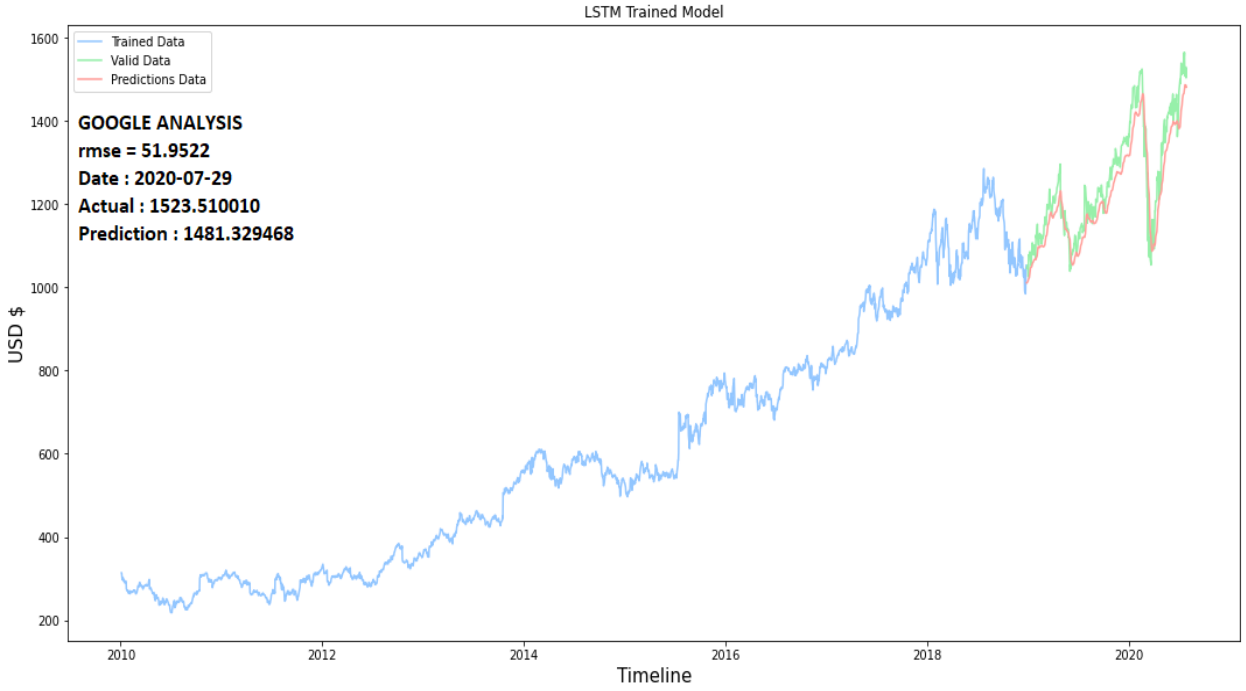

FIGURE 7 - Prediction Graph of Google Stock Analysis

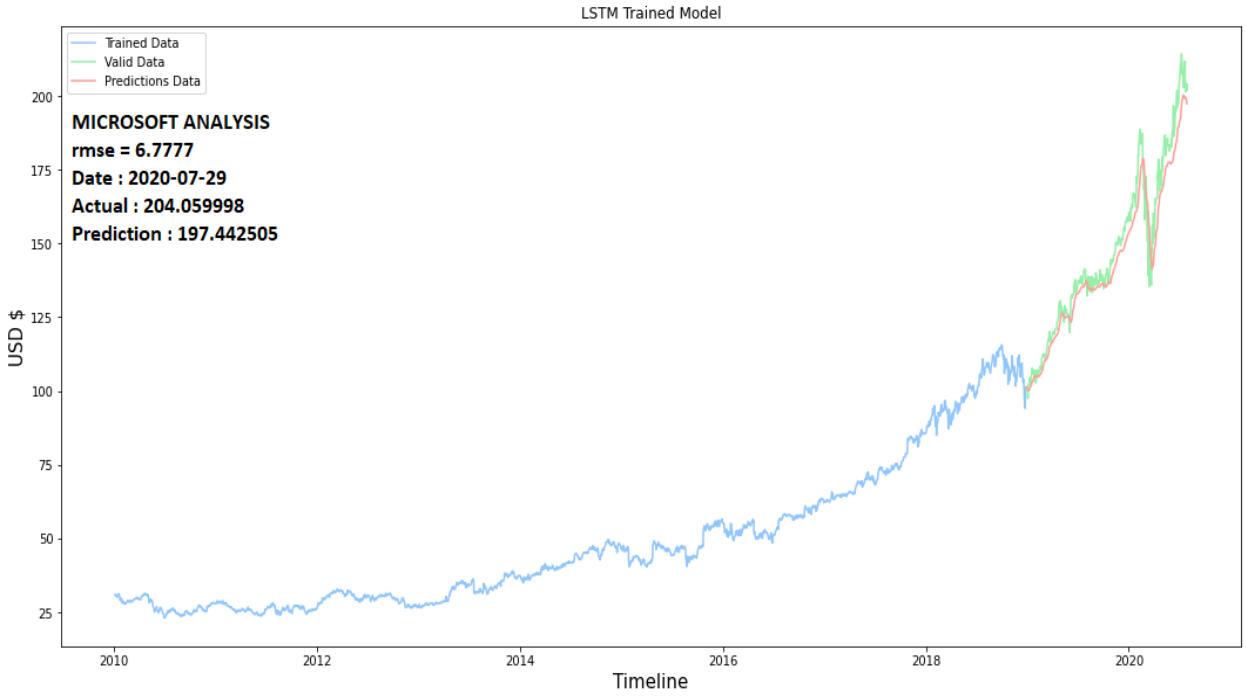

FIGURE 8 - Prediction Graph of Microsoft Stock Analysis

5.2 Future Aspects

The following are the future aspects of the project, which can be worked upon and tried to be implemented:

1. The accuracy of the model can be improved more using more epoch, longer dataset than ten years, and having a very high-end system for computation, which would be able to perform the calculations faster.

2. The implementation of the LSTM model, along with various other models, to achieve higher accuracy. One of the examples of such a model is the sentimental analysis model, which would show the trending and the declining interest and act on it for the selection of the stock. [25]

   E.g. (1) Due to the delayed 7 nm chips news by Intel, its stock went down about 15 %, and AMD's Stock went up by 16 %. This type of news creates sentiment and allows us to use such stocks for analysis.[26]

   E.g. (2) Apple company announced its 4:1 stock split resulting in its stock growing over 10 % within a single day trading, which can be included in the sentimental analysis along with the existing LSTM model.[27]

3. Efficient trading bots can be made using the analysis that would automatically buy and sell stock and generate a profit from the analysis of our model.

Hence, as stated from all the above observations and analysis, we can agree that the future aspects of the projects are immense, and a lot of work can be done in various selected approaches to get mind-blowing results.

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