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LSTM and CNN based Stock Price Prediction APP

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***Abstract*—The Stock Market is one of the most important parts of today's economy. The prices of the stock market represent the growth of the economy of that country. For many years researchers from various parts around the world have been studying various methods for predicting the next trends in the stock market. One such method for predicting stock prices is machine learning. Machine learning is quite effectively implemented in forecasting the prices of various Stocks. Stock market prediction is a difficult problem in machine learning. It can be extremely complex. In this project I will attempt to implement an LSTM model to analyze the stock market data accurately predictions about whether the stock prices are going to go up or if they are going down. LSTMs are extremely efficient in predicting the trends in stock prices because they're able to store previous information. This is crucial because, the previous price of a stock is required in order to make the predictions on what the future price of that stock will be. The main purpose of this is to be able to make well educated and informed decisions about the investments in the stock market and ensure that a profit margin is maintained through trading various stocks.**

1. INTRODUCTION

The stock market is a simple and powerful tool for investment. Having the shares of a company allows you to own a part of that company. The owners and directors of the company sell the shares in order to get funding for the companies to grow. This is called an Initial Public Offering (IPO) where the where the shares of the company are then sold to the investors. A private company becomes a public company by selling the shares of the company. However, lack of knowledge, preparation and patience can make the stock market a dangerous game for most people. Entire fortunes have been lost in the stock market. Thus, people have been trying to figure out tools and methods that would maximize their profits while minimizing their risks and losses.

Two stock exchanges in which most of the Indian stock market trading happens are the National Stock Exchange (NSE) and the Bombay Stock Exchange (BSE).

Being able to accurately predict the trends of the stock market has been the main goal of the investors. However, the stock market is extremely volatile and is affected by many different factors such as Government Policies, Politics, Inflation, Foreign investors, Exchange rates, and even natural disasters. This makes predicting the stock market extremely difficult. Millions of dollars' worth of trading happens every day on the stock market. It is impossible for investors to go through all this information and then make analysis and predictions.

This is where Automated Trading Systems (ATS) come into play. Automated Trading Systems use a computer program to buy and sell stocks according to a set of predefined rules and strategies made by the user. They can perform better and more efficiently than any human can perform. These rules and strategies and based on equations, algorithms technical analysis of the market and machine learning algorithms for predicting the future price. This will allow the investor to focus on other things as the computer will do the bulk of the work. The system will constantly monitor the financial market and will instantly makes trades if the conditions that are set have been met. This also allows you to simultaneously execute multiple trades. The main aim is to be able to execute faster trades before anyone and be more efficient in order to maximize our profits and reduce the risk as much as possible. Though automated trading systems are capable of performing extremely well one of the main disadvantages of them is that an internet connection loss could lead to the failure of the whole system. Also, they still need to be monitored because technology can sometimes fail and there could be some errors which could cause the system to behave erratically.

Time series prediction is a technique that is widely used

in the prediction of the trends in the financial market. It involves making accurate scientific predictions based upon historical data and analysis. It involves making a time series model and training it based on historical data and then using it to make strategies and future predictions. Most of the common Time series prediction algorithms these days are based on Recurrent Neural Networks and LSTM (Long Short-Term memory). In this project I will be using LSTM to create a stock price prediction app that will be able to accurately predict the trends in the market up to 100 days in the future.

A. MOTIVATION FOR WORK

The Stock Market gives people the change to be happy in their life and prosperous by investing small amounts of money with low risk initially. This has quite low risk compared to starting a new business or getting a high paying job. The stock market gives people the chance to live better lives. Thus, stock price prediction is an extremely important problem. With a successful time series prediction model for the stock market, we learn more about the market behavior and the trends in the market. Also, this will enable people to make investments with much less risks of losing their money and a much higher chance for success.

2. LITERATURE SURVEY

Stock market investment strategies are varied and complex and are often dependent on an evaluation of vast amounts of data every single day. In the past few years, machine learning techniques have increasingly been examined to assess whether they can improve market predictions and trends when compared with the more traditional approaches.

In "An innovative neural network approach for stock market prediction" by Xiongwen Pang, Yanqiang Zhou, Pan Wang and Weiwei Lin in The Journal of Supercomputing
proposes the deep long short-term memory neural network (LSTM) with embedded layer and the long short-term memory neural network with automatic encoder to predict the stock market.

We can find an extreme comparison analysis performed on the decade long history of stock market prediction by Nusrat Rouf, Majid Bashir Malik, Tasleem Arif, Sparsh Sharma, Saurabh Singh, Satyabrata Aich and Hee-Cheol Kim in the published paper "Stock Market Prediction Using Machine Learning Techniques: A Decade Survey on Methodologies, Recent Developments, and Future Directions" in IRJET in 2021 and they thus concluded that SVM (Support Vector Machine) is the most popular technique used for SMP. However, techniques like ANN (Artificial Neural Networks) and DNN (Deep Neural Networks) are mostly used, as they provide more accurate and faster predictions. Furthermore, the inclusion of both market data and textual data from online sources improve the prediction accuracies.

In the paper "Stock Price Correlation Coefficient Prediction with ARIMA-LSTM Hybrid Model" published in Springer International Publishing by Hyeong Kyu Choi in 2019 we can clearly see that they apply LSTM Recurrent Neural Networks (RNN) for prediction of the stock price correlation coefficient of two individual stocks. RNN's are already quite competent in understanding and handling the temporal dependencies. The use of LSTM then further enhances the long-term predictive properties. To encompass both linearity and nonlinearity in the model as well, we can get the ARIMA (Autoregressive Integrated Moving Average) model as well. The ARIMA model filters linear tendencies in the data and passes on the residual value to the LSTM model. The ARIMA-LSTM hybrid model is tested against other traditional predictive financial models such as the full historical model, constant correlation model, single-index model and the multi-group model.

It is proposed by Abidatul Izzah; Yuita Arum Sari; Ratna Widyastuti; Toga Aldila Cinderatama in the paper "Mobile app for stock prediction using Improved Multiple Linear Regression"
that Improved Multiple Linear Regression (IMLR) be built into a mobile application. This was on the Android Platform and was for the purpose of Stock Price prediction. IMLR can be defined as a hybrid Multiple Linear Regression with Moving Average technique. In this app, users not only could see daily purchase stock history and trends but they could also observe the price predictions happening in real time.

3 PROPOSED WORK

This project implements Machine Learning approach to predict stock prices. Machine learning is effectively implemented in forecasting stock prices. The objective is to predict the stock prices in order to make more informed and accurate investment decisions.

We will be using stacked LSTM to do this. LSTMs are very powerful in sequence prediction problems and are also perfectly suited for predictions in the financial market for investments because they're able to store past information.

3.1 RNN (Recurrent Neural Network)

They are a type of neural network which is used in the time series prediction. The various connections between the nodes of a Recurrent Neural Network form a directed graph or an undirected graph. In this type of

network, the output from the previous step will be given as the input of the step which is ongoing. Recurrent Neural Networks use the sequences, characteristics and patterns in the data in order to predict what will happen next. They are commonly used in speech recognition and natural language processing (NLP). They have also been used in several different popular apps such as Google Translate, Siri and Cortana. Thought they are extremely useful one of their main disadvantages is that training a RNN is an extremely complicated and difficult task.

3.2 LSTM (Long Short-Term Memory)

LSTM can be defined as one of the types of the Recurrent Neural Network (RNN). It is mostly used for Deep Learning. These networks were created for the specific purpose of overcoming the problem of the long-term dependency that challenges the RNNs. LSTM retains the knowledge for a long time. It is also used to solve the vanishing gradient problem. This is a common problem faced by RNAs. LSTM also has a special property that it can process single data points, which are images as well as process entire long sequences of data such as video files.

LSTM has a special structure with three gates. These gates are:

- The input gate
- The forget gate
- The output gate

The input gate is responsible for getting the date into the cell. Only the information that is in accordance with the algorithm will be kept. The rest of the information that is left will be discarded by the forget gate. Thus, the forget gate decides which information is useful. The output gate passes the updated information as the output.

Some of the common applications of LSTM are as follows:

- Time series prediction
- Speech recognition
- Gesture recognition
- Handwriting recognition
- Drug designing
- Intrusion detection systems.

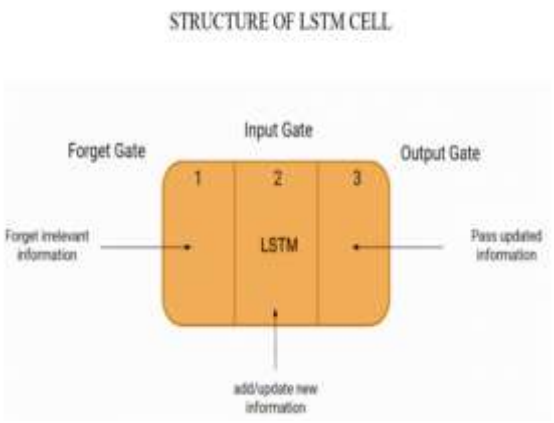


Figure 3.1: Structure of LSTM cell

4 EXPERIMENTAL ANALYSIS

4.1 WORKFLOW

The basic workflow of the system has been described as follows:

1. Taking input as dataset
2. Pre-processing
3. Data splitting
4. Creating the LSTM model
5. Predict the test data and plot the output

4.2 STRUCTURE CHART

This is a chart which shows the absolute breakdown of the system into the smallest possible manageable levels. It represents the hierarchical structure of the models. Each model is represented by a box which contains the name of that particular module.

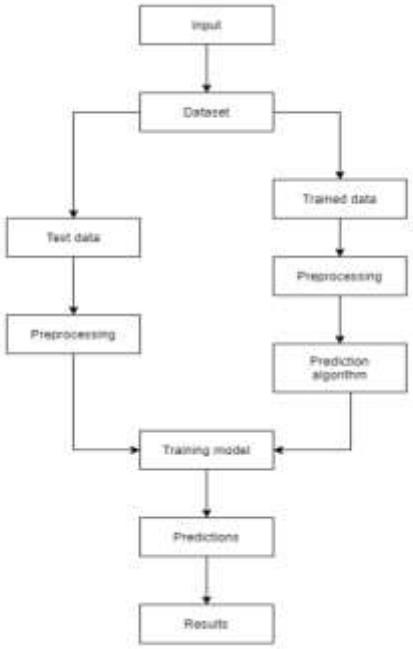


Figure 4.1: Structure Chart

4.3 TOOLS and TECHNOLOGIES USED:

4.3.1 Python

The language that was chosen for this particular project was python. Python is a very popular programming language and can be used to create web applications, software, etc. Python also has a huge community, and you can find the solution to most of the problems you may face in this community. It is also better for beginners because of its simple and easy to read and understand syntax. Python is the leading language for Machine Learning, Deep Learning and Data Analysis. Python also has a lot of powerful tools and packages. Many of the most important packages such as NumPy and Pandas are freely available and can be easily downloaded.

4.3.2 Jupyter Notebook

Jupyter Notebook is an open-source web application. It allows you to edit and run notebook documents using a web browser. It is used in the creation and sharing of various documents that contain code, text, equation and visualizations. It is a very good tool for machine learning and data visualization.

4.3.3 Visual Studio Code

Also referred to as VS Code, Visual Studio Code is a source code editor created by Microsoft for use in Windows, Linux and MacOS. You can start coding in any programming language you want without switching the editor. It is extremely refined and optimized. It is freely available and easy to download. It also fully supports Python. Thus, it was the ideal choice to use in building our web application.

4.3.4 NumPy

NumPy is a library for the python programming language. It is a huge library with support for multi-dimensional and large arrays and matrices. It also provides you with a large number of complex mathematical equations to work on those arrays. It also has functions for the working of the linear algebra and Fourier Transforms.

4.3.5 Pandas

While NumPy is most used for the working of numerical data, Pandas is used for working with data in the form of tables and columns. It also provides you with a set of powerful tools such as Series and DataFrame for analysing and working on the tabular data.

4.4 SYSTEM ARCHITECTURE

An Architecture diagram is a type of diagram which will be the visual representation of all the components and elements that make up the software or system. It helps in visualizing the high-level structure of your application and also helps you figure out how to tend to the needs of the users.

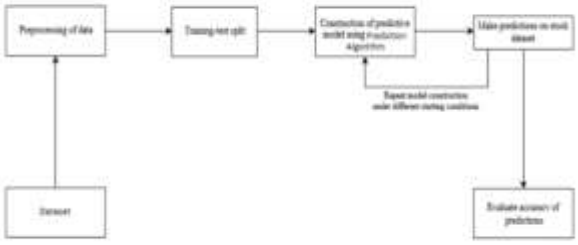


Figure 4.2: Overall System Architecture

4.5 DATASET ANALYSIS

We need to get the datasets for the stock of the company which we are going to analyze. We can do this with Yahoo Finance or we can do this with Tiingo, which is a stock market tool. Both of these websites provide the data about stocks, financial trends, news, financial reports and commentary.

4.5.1 Dataset from Yahoo Finance

In Yahoo Finance you can choose the specific dates for which you want to get the stock prices data. This makes it a lot more efficient than Tiingo. Going forward we will only be using and implementing Yahoo Finance because of this reason

```
import pandas as pd
import pandas_datareader as dat
import numpy as np
import matplotlib.pyplot as pt


startdate = '2012-01-01'
enddate = '2022-04-24'
df=dat.DataReader('AAPL','yahoo',startdate,enddate)
df.head()
```

Figure 4.3 Yahoo Finance Apple Stock Data

4.6 DATA SPLITTING

For training and testing, we'll break the data into two sets. 70% of the data will be used for training, the leftover data will be used for testing and ensuring the model's accuracy. We'll check the precision by comparing the expected and actual results.

```
df.shape
```

```
(2594, 5)
```

```
train=pd.DataFrame(df['Close'][0:int(len(df)*0.7)])
test=pd.DataFrame(df['Close'][int(len(df)*0.7): int (len(df))])

print(train.shape)
print(test.shape)
```

```
(1815, 1)
(779, 1)
```

Figure 4.4 Splitting data into testing and training

4.7 DATA PREPROCESSING

After dividing the date into training and testing parts I will now do preprocessing on the dataset. Min-Max Scaler is used to preprocess the data. It removes the noise present in the data and converts it to 0-1 form.

4.8 LSTM MODEL

After generating and processing the datasets we need to create the LSTM Model and train it to predict the financial trends. The code used to create this LSTM Model is as follows:

```
from keras.layers import Dense, Dropout, LSTM
from keras.models import Sequential

lstxyz = Sequential()
lstxyz.add (LSTM (units=50, activation = 'relu',
return_sequences=True,
            input shape=(x_tr.shape[1],1)) )
lstxyz.add(Dropout(0.2))
lstxyz.add(LSTM(units=60,  activation = 'relu',
return_sequences=True,))
lstxyz.add(Dropout(0.3))
lstxyz.add(LSTM(units=80,  activation = 'relu',
return_sequences=True,))
lstxyz.add(Dropout(0.4))
lstxyz.add(LSTM(units=80,  activation = 'relu', ))
lstxyz.add(Dropout(0.5))
lstxyz.add(Dense (units=1))
lstxyz.summary()
```

```
Model: "sequential_1"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 lstm (LSTM)                 (None, 100, 50)           10400

 dropout (Dropout)           (None, 100, 50)           0

 lstm_1 (LSTM)               (None, 100, 60)           26640

 dropout_1 (Dropout)         (None, 100, 60)           0

 lstm_2 (LSTM)               (None, 100, 80)           45120

 dropout_2 (Dropout)         (None, 100, 80)           0

 lstm_3 (LSTM)               (None, 80)                51520

 dropout_3 (Dropout)         (None, 80)                0

 dense (Dense)               (None, 1)                 81

=================================================================
Total params: 133,761
Trainable params: 133,761
Non-trainable params: 0
_________________________________________________________________
```

Figure 4.5 LSTM Model Summary

5. RESULT

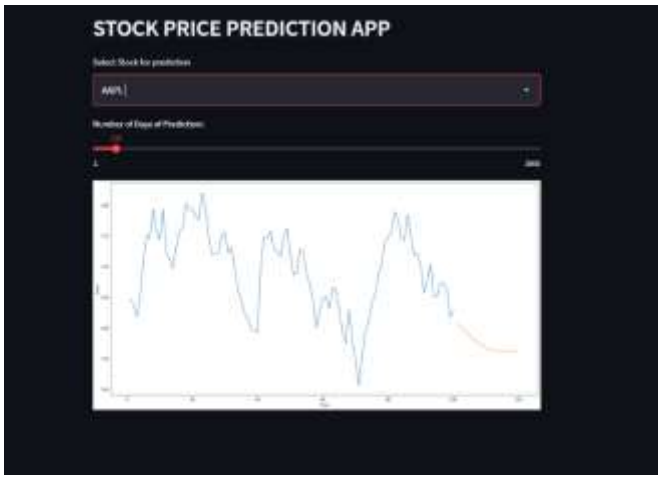
Thus, the code has been successfully run, all functions have been performed step by step and the results and observations have been included. The project folder contains the Python code for the project and the LSTM Model that we created and used in the project.
Thus, we have successfully completed and implemented a stock price prediction project code in python.

5.1 FINAL GRAPH

Figure 4.4
Thus, here we can see the graph of the Predictions made by our LSTM model plotted against the Original Price of the Stock present in the testing data. As we can see the graph is extremely accurate and there are very little deviations from the Original Price and it follows the same trends.

5.2 PREDICTING FUTURE PRICE TRENDS

We will use our LSTM model to predict the stock prices of Apple 20 days into the future.



Thus we have successfully completed and implemented a stock price prediction project code in python.

6. CONCLUSION

This project predicts the closing stock prices of any company that is given for prediction. We compared the closing prices with their 100 day and 200 day Moving Averages. The datasets were divided into 2 parts for training and testing. 70 percent of the data was to be used for training the model, while the rest of the 30 percent of the data will be then used for testing and comparing with the original prices of the stocks. We have created and trained a stacked LSTM Model for our predictions. We also used this model to predict the closing stock prices from the datasets of various companies such as Google, Tesla, Apple, GameStop, Coca-Cola, etc. We have achieved an extremely high level of accuracy for all of our predictions. Then we used our model to predict the stock price 'n' days into the future. The farther into the future we go the chances for errors will then increase. The stock market can be broadly defined as the place where the buying and selling of the shares of public companies will take place. Investing in the stock market can be dangerous for individuals without the proper knowledge, research and preparation. They can have huge losses in their first few ventures. If a company that you have selected doesn't do well in the market or if loses its standing with the investors, its stock can fall in price, and people who have invented in the company could lose huge amounts of money. First time investors all make a lot of the same mistakes in the beginning. But with the proper preparation and knowledge the stock market can be an extremely powerful tool to build your fortune and live happy and prosperous lives. You should always deal with the proper absolute facts when investing in the stock market rather relying on any rumors you may have heard. Thus, this makes tools such as this are extremely important. Automated trading systems (ATS) also play a huge role in the stock market. Due to the extremely accurate predictions of share prices of companies by these applications investors will be able to make a lot more profit in the market with a lot less risk.

6.1 FUTURE WORK

In the future for better accuracy and results I will try to train the model with a lot more varied data. I will also try to use other algorithms along with LSTM in order to create a better hybrid model. In fact, research shows that a hybrid model of LSTM and CNN will be extremely efficient, accurate and will be able to identify the minute changes in the stock market. I will also try to extend the application for trading cryptocurrencies.

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