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Stock Price Prediction Using Machine Learning

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Abstract:

The price at which a corporation's shares are trading on the stock market is one way of gauging how successful the company has been. Investors invest their capital funds to earn profits but the unpredictability of the market is such that it is hard to anticipate the direction of the stock prices. Anticipating the worth of a company's stocks is the goal of the economic discipline known as stock price prediction. To predict the stock prices and help the investors to make better decisions regarding investment in the stocks, an approach to predict the prices based on historical data of the company has been presented. For the purpose of forecasting the price of a company's shares, the machine learning algorithm called LSTM was used. LSTM is a deep learning artificial neural network that is a type of RNN. The historical data of the firm is used by the LSTM to predict the stock price. The findings that were obtained are encouraging and give a projection for the share prices of the firm that is fairly accurate.

Keywords — **Stocks, Prediction, RNN, LSTM, Neural Network, Machine Learning.**

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I. INTRODUCTION

A share represents the unit of firm ownership. The shareholder of a corporation earns any profits that the corporation earns as a dividend. They are the bearers of losses as well if that company incurs any losses. So basically, a shareholder is entitled to a percentage of any profit or loss of that corporation in proportion to the share he/she has bought. A shareholder or investor exchanges capital for these shares. Shares are a way for a corporation to generate capital for growth in exchange for sharing the profit and loss in the proportion to the shareholder as a dividend. On the other hand, a stock market is simply the number of venues where shares of any corporation can be sold and bought. These activities can be conducted through formal exchanges in electronic or physical form and via OTC marketplaces and these venues operate by the defined set of regulations that are regulated by some local regulatory bodies.

Investors invest a lot of capital in stocks to earn profits each year, but it is not easy to predict the stock market because of the tendency of the volatility of the stock market. That is why the need for a prediction model has become so important. Machine Learning and Neural networks can be used to predict share prices. The capacity of a computer or other device to acquire new skills or knowledge without being explicitly taught those skills or knowledge by a human instructor is referred to as "machine learning." It is the area of research that focuses on the process of "training" computers to make accurate forecasts by exposing them to vast amounts of data and using various methods. Training in machine learning comprises providing the algorithm with a substantial amount of data and enabling the machine to learn more about the information as it is being processed as the data being provided. Whereas neural networks work like the human brain allowing programs to solve problems in machine learning, artificial intelligence, and deep learning by recognizing the patterns.

To accurately forecast the prices of a stock, the method that we call the Long-Short Term Memory (LSTM) algorithm is used.

A. *General Description of the Recurrent Neural Network*

The neural network called the RNN takes the feedback (previous output) in its memory for a very short time and works on the present input by using the present output. Input Layer, Hidden Layer, and Output Layer are the three layers from which the Recurrent Neural Network is made up of. They give us the equation: - $h_{(t)}=f_c (h_{(t-1)}, x_{(t)})$

where,

$h_{(t)}$ = the new state

f_c =the function with parameter c

$h_{(t-1)}$ = the old state

$x_{(t)}$ = the input vector at the timestep t

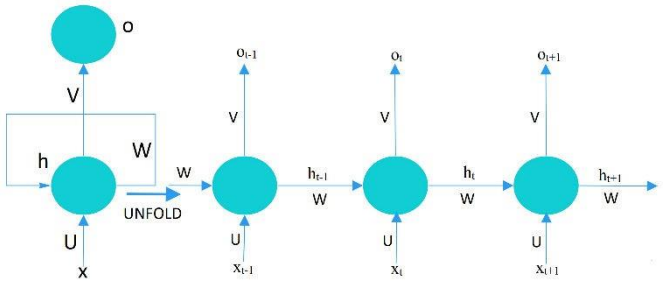

Fig. 1 Simple RNN Architecture

But there are some disadvantages to RNN like it is incapable to store information for a long time. Sometimes, it is necessary to get the context of a piece of certain information that was stored a long time ago to predict the current output. RNN cannot handle these long-term dependencies.

And there is no good control over which part of the information is needed to store and forwarded, and which part of the past needs to be forgotten. Long-Short Term Memory can solve these issues of Recurrent Neural networks.

B. *General Description of Long-Short Term Memory*

LSTM was introduced in 1997 by Juergen Schmidhuber as an improvement of RNN. LSTM solves the problem of long-term dependencies because it makes it easier to remember which past data is to be remembered. LSTM also solves the vanishing gradient of RNN by training the model using backpropagation.

LSTM architecture is made up of: -

(i). Cell State (C_t): The information that was recorded in the memory following the conclusion of the preceding time step is what is kept in Cell State.

(ii). Forget State (f_t): It removes the irrelevant information from previous time steps.

(iii). Input gate (i_t): It adds the new information to the current time step.

(iv). Output gate (o_t): It returns the final information which is needed to predict the stock.

(v). Hidden state (h_t): The output gate vector is multiplied by the cell state to calculate the hidden state.

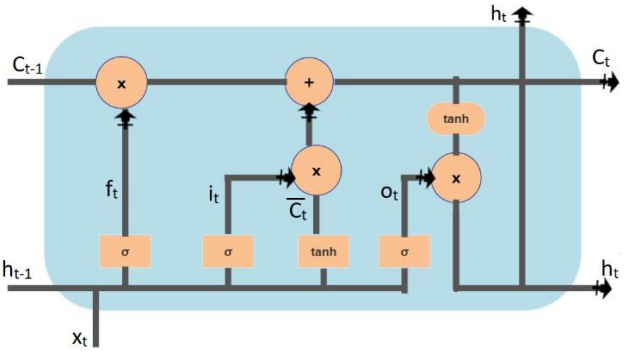

Fig. 2 Structure of Single Cell LSTM

$f_t = \sigma (W^f x_t + U^f h_{t-1} + b^f)$

$i_t = \sigma (W^i x_t + U^i h_{t-1} + b^i)$

$C_t = i_t * U_t + f_t * C_{t-1}$

$o_t = \sigma (W^0 x_t + U^0 h_{t-1} + b^0)$

$h_t = \tanh (Ct) * o_t$

Here, the previous cell state is denoted by c_{t-1}, the input vector is represented using x_t, the previous hidden state is represented using h_{t-1}, the weight matrix for input-to-hidden is denoted using W, the weight matrix for hidden-to-hidden is represented using U, and the logistic sigmoid function is denoted by σ.

II. RELATED WORK

Research into the factors that influence stock returns has grown substantially over the last two decades, making it an important area of study. The discipline of trading known as technical analysis is used to identify trading opportunities and evaluate investments by analyzing statistical trends gathered from activities like the movement of volume and prices. The technical analysis concentrates on studying price and volume rather than fundamental analysis, which seeks to estimate the worth of a security based on company performance such as sales and profits. The foundation of technical

analysis is made up of technical indicators, which are used to forecast how prices will move in the future based on mathematical functions.

In this research, a strategy for predicting stock prices that is based on a neural network was used. In the context of our research and deep learning, models acquire knowledge and model their behaviour based on their previous experiences. However, if a circumstance occurs that is outside of the model's realm of learning, the model, considering the nature of its design, is vulnerable to perform badly or possibly fail completely. The model is "only as good as what it is prepared for".

In recent times, deep learning technologies, like LSTM, have proven to be successful for a variety of time-series problems, and because of its effectiveness, it is becoming more and more popular nowadays along with other deep learning tools. In general, the goal of these kinds of tasks is to determine with a high degree of precision the values that will be associated with time series in the future.

In the case of nonlinear data, LSTM performs more effectively than Gated Recurrent Unit.[3], and stock trading includes a significant quantity of nonlinear data. Istiake Sunny et al. [3] presented an innovative framework for predicting stock prices. Within this framework, he used two well-known RNN models called LSTM and BI-LSTM. Both models are capable of producing high accuracy with low RMSE when applied to a dataset that is freely available from Yahoo Finance. In comparison to LSTM, the BI-LSTM model had a lower RMSE criterion, but it needed a longer amount of time to calculate [3].

The difficulty with predicting the share prices is complicated by the fact that it relies on extremely big quantities [1] and a substantial quantity of data, and that it is mostly reliant on occurrences that took place in the distant past. As a consequence of this, LSTM [1, 3] helps to control error by providing RNNs with the ability to store knowledge for the future. As the stage advances, the prediction becomes a more accurate reflection of the situation [1]. As a result, it is clear that this method is significantly dependable in comparison to other approaches.

Nelson et al. [2] made use of LSTMs in order to estimate future stock price trends by using data pertaining to stock prices as well as technical analysis. In studies, the recommended LSTM model achieved a higher level of accuracy than other machine learning models [2]. Each day's trading session ended with the development of a brand-new neural network from the scratch. This entails the generation of a new set of weights via the usage of the new collection of data and model training. The data from the past 10 months was used to train the model, and the functionality of the model was validated by the data of the previous week. Google's TensorFlow was used to develop the model, and it comprises a sigmoid output layer which was fed by the Long-Short Term Memory's input layer which accepts both stock valuing data and technical pointers as input [2].

After coming to the conclusion that the LSTM neural network would be the most effective tool for making stock predictions, time-series data were gathered from stock firm prices of the stock over a span of 5 years.

III. METHODOLOGY USED

3.1 Algorithm for Stock prediction using Long Short-Term Memory Recurrent Neural Network.

Input: Past data of the company's stock price.

Output: Stock price prediction using historical data.

Step 1: Begin

Step 2: After collecting the past data from the market for a certain share, the next step is to pre-process the data.

Step 3: Input the open price after loading the dataset.

Step 4: Perform a feature scaling operation on the data such that the values of the data will range from 0 to 1.

Step 5: Building together a data structure consisting of 60 timestamps and 1 output.

Step 6: Use the sequential repressor to initialize the Recurrent Neural Network after constructing it for the dataset

Step 7: Get rid of the undesired values by incorporating the Dropout regularization after

inserting the first layer of the Long Short-Term Memory model.
Step 8: The output layer is added after removing the undesired values.
Step 9: Add the mean_squared_error to express the loss and the adam optimizer for optimization to compile the Recurrent Neural Network.
Step 10: Applying plotting tools to visualize the predicted prices after making predictions.

The gathering of information is an essential phase that must be completed before moving on to the processing of the data.

The suggested model's first and most important stage is the collection of information, which is accomplished by importing data from Yahoo Finance. The majority of the information consists of the stock costs from the preceding years.

The data will next need to be pre-processed, which is the next phase in the information mining process. Information Pre-Processing is an important step before forecasting stock prices.

The information that is collected from the source will be inconsistent, and incomplete; moreover, it will comprisefragments. The information will be cleaned up during the pre-processing stage; towards the end, there is a step called highlights scaling that needs to be performed, which will limit the factors. The Dataset is split into two, one for the training model and the other for the test model, and then the model is tuned.

To deliberately adjust the computation training and add information to the computation itself is the goal of the tuning models, which have been developed for this reason. The next step is to visualize the data using data visualization tools like a line chart that will assist to highlight how the output of our algorithm varies depending on the data.

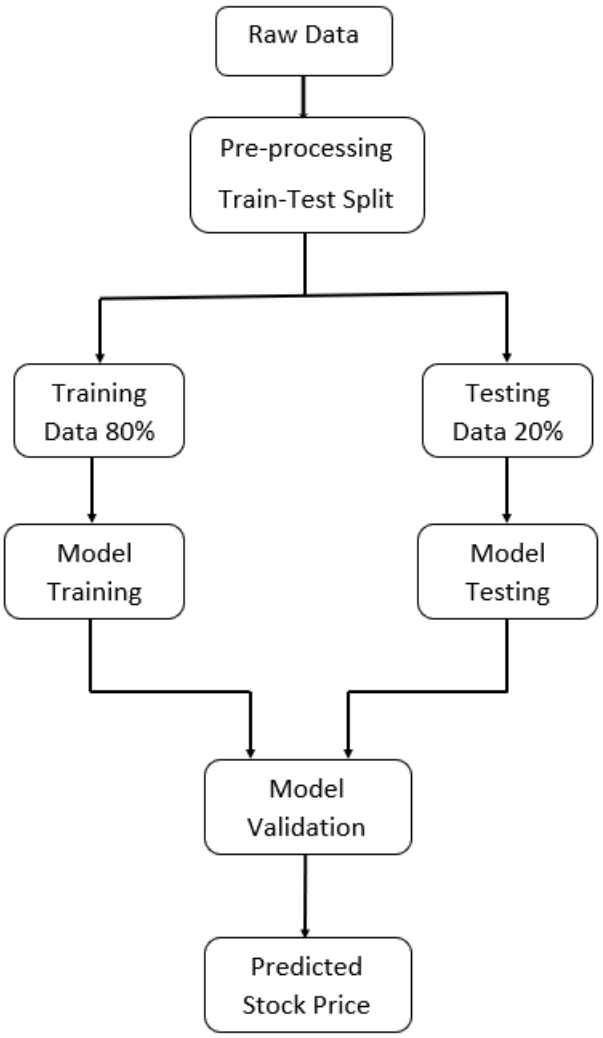

Fig. 3 Stock price prediction system architecture

Within the scope of this study, an analysis of the usefulness of LSTM in terms of forecasting the movements of stock prices has been carried out.

After data was obtained from Yahoo Finance, the raw data was then subjected to some preliminary processing. Following the completion of the pre-processing step, the dataset was subdivided into two parts: eighty percent of the data was designated for the training model, and the remaining twenty percent was used to compare the actual values to the predicted values. After the model has been trained using a Long Short-Term Memory neural network, it is verified with data visualization techniques by comparing the actual price of the share to the values that were predicted. The system

architecture of the suggested model is shown in Figure 3.

The Adam optimizer was used for the purpose of performing the modelling optimization, and the mean_square_error was used to serve as the loss function.

IV. PARAMETERS USED

Table 1 – Parameters that have been used and their meaning.

Parameters Used	Meaning
Date	Date of the particular stock price
Open	The price of the stock when it was opened.
Close	The price of the share when it was closed.
High	The highest share price on that day
Low	The lowest share price on that day
Volume	The number of stocks traded.

V. SIMULATION RESULTS

The LSTM model is implemented by using python which predicts the future stock prices of Reliance shares by using the record of past share prices of the company. Here, in the given figures, line charts compare actual and expected stock prices in which the actual stock price is represented by red colour and the predicted price is represented by blue colour. The LSTM model was trained using three different epochs and batch sizes. Firstly, 25 epochs, 16 batch sizes, 30 timesteps, the second time with 100 epochs, 32 batch sizes, 60 timesteps, and lastly 200 epochs, 32 batch sizes, and 60 timesteps.

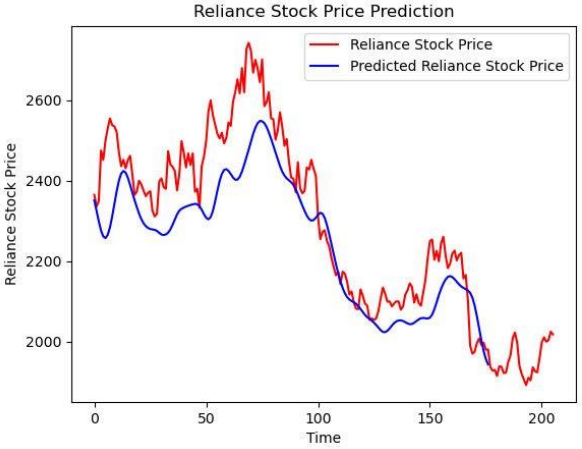

Fig. 4 Predicted Stock Price using Epoch-25

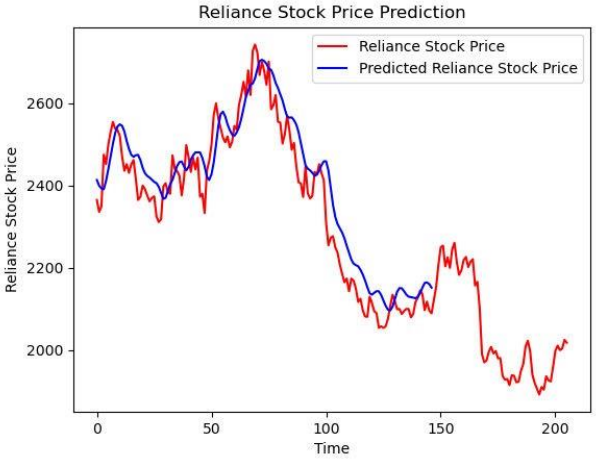

Fig. 5 Predicted Stock Price using Epoch-100

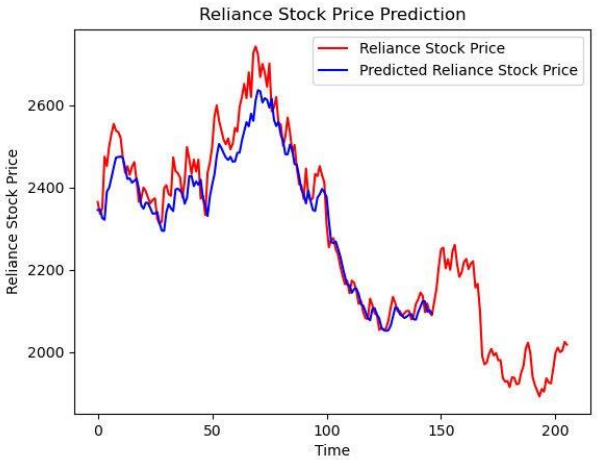

Fig. 6 Predicted Stock Price using Epoch-200

Here, in figure 3 we can clearly see that the prediction is not very accurate but in figure 4, as we increase the epochs the prediction gets better and in figure 5 when we increase the epochs to 200, the prediction gets very close to the actual stock price. Hence, the more epochs, the more the prediction will become accurate.

VI. CONCLUSIONS

The share prices have been studied in this paper using the LSTM algorithm which works on machine learning and can also be used for shares of different companies in the future. We can make this even more reliable if the model will be trained using a bigger data set using higher computing capacities and with more number of layers.

This LSTM model can be improved if the sentiment analysis is included to understand what the people think about that corporation as the perception about a corporation is greatly affected by the market trend posts on social media.

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