International Journal for Multidisciplinary Research (IJFMR)

E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Predicting Market Share Patterns Using Lstm

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Abstract

Forecasting stock prices is a significant challenge in the financial sector, marked by its complexity and the impact of numerous variables. In this paper, we undertake a comprehensive investigation into how machine learning algorithms can be effectively applied to address this challenge. Our main goal is to clarify the methodologies and strategies that can enhance the accuracy of stock market predictions. We explore the complex process of predicting stock values and scrutinize the various machine learning algorithms that have been suggested and employed for this purpose. By critically evaluating these algorithms, we aim to provide insights into their individual strengths and weaknesses, ultimately helping the reader make an informed decision about the most appropriate algorithm for their specific forecasting requirements. Beyond algorithm selection and attribute analysis, our review also considers external factors that can significantly influence stock prices. These factors include a broad range of variables, such as economic conditions, geopolitical events, corporate news, and market sentiment. Understanding the interaction between these external elements and stock market dynamics is essential for developing more robust and reliable prediction models.

Keywords: Stock price forecasting, Financial sector, Machine learning algorithms, Stock market predictions, Algorithm evaluation, Prediction accuracy, External factors, Economic conditions, Geopolitical events, Corporate news, Market sentiment, Forecasting methodologies, Attribute analysis, Prediction models, Stock market dynamics.

I. INTRODUCTION

The stock market refers to the place where people purchase and sell the shares of firms. However, with time the interest in the stock market has increased significantly. It has become an important area of study. Machine learning provides various predictors that could be very useful for this purpose. Many sectors are using machine learning to enhance their activities. Machine learning refers to the ability of computers to learn from data without explicit programming. The leading techniques in this area are recurrent neural networks-the so-called Long Short-Term Memory (LSTM) networks, which might well be considered the most efficient models for processing sequential data. Briefly put, a stock market represents the venue where people buy and sell firm shares. The interest of numerous people in the stock market results in the growth of this area, and today it is a very important field for research. Tools from machine learning can be applied to predict stock market trends. It is widely being adopted in various sectors today to help enhance the processes involved. Therefore, this technology can be referred to as a means by which computers can learn without necessarily going through external programming. Another area of recurrent neural networks, such as LSTM networks, can well manage sequential data, just like the way stock prices move.Recurrent Neural Networks (RNNs) are highly efficient in learning through data, especially in finding long-term patterns. They were first introduced at the beginning by Hoch Reiter and Schmidhuber in 1997 and have since then been improved and popularized by many researchers over the years. Their success in problems is rated high and widely used in numerous applications. For our study, we applied the LSTM model, which is one of the variants of the RNN, to design a forecasting model for the returns of Apple stock and five other giant-tech companies' returns. This research contributes to the continuously growing interest in financial education with all present opportunities in the stock market.

Traditionally, stock movement predictions have relied on pen, paper, and conventional mathematical methods. However, after exploring various other models and techniques, we decided to delve into this field to create a solution capable of forecasting individual stock performance. Our goal is to provide a more sophisticated and reliable approach for individuals to make informed investment decisions in the dynamic world of the stock market.

II. LITERATURE SURVEY

Jain, P., & Yadav, A. (2021) discussed how the traditional models of machine learning, namely SVM, Random Forest, and LSTM networks are compared for the task of stock price prediction. The performance of LSTM was better than traditional models in terms of accuracy and predictability because it is capable of mapping the temporal dependencies in time-series data. It shows that traditional models are very bad for sequential data handling and proposed that LSTM is a better model for predicting stock prices since it considers history. Patel, J., Shah, S., & Thakkar, P. (2020): A Study of Deep Learning Models - CNN, RNN, LSTM in Stock Price Forecasting. Their findings suggest that LSTM and RNN outperform CNN but LSTM is even better, since LSTM can capture long-term dependencies within data. Such studies thus prove that with the use of LSTM, one would be able to capture sequential patterns-a most important characteristic of financial forecasting.

Nelson, D. M., Pereira, A. C., & de Oliveira, R. A. (2017) in their study describe the use of LSTM networks for predicting stock prices. Their study is proved to work well with nonlinear tendencies of financial time series data hence achieving better accuracy as opposed to other models while making a prediction about the stock price. Fischer, T., & Krauss, C. (2018) discuss a wide range of deep learning-based models, such as LSTM, which may be suitable for the task of financial market prediction. The paper focuses on the advantage of deep learning architectures, such as capturing intricate patterns involving financial data, and how LSTM can be approached for better accuracy in the generation of forecasts.

Aggarwal, S., & Kumar, D. 2019. Comparative analysis of machine learning models such as Random Forest, SVM, and LSTM for stock price prediction. The analysis by the above authors shows that with respect to trend captivation in time-series data, LSTM models surpass the traditional ML models as those traditional models lack in terms of the accuracy of prediction. Shah, D., & Zhang, Y. In an elaborate review of deep learning techniques for stock market prediction, which falls among them focusing on LSTM, the authors emphasize the applicability of LSTM in processing sequential data to serve as a reliable source of predicting financial trends. Gao, Y., & Xu, B. Exploring using LSTM networks for stock price forecasting, clearly, the financial markets are best fit by the ability of LSTM to remember information over long periods as the enabler for actual forecasts in such markets.

Singh, R., & Jain, S. (2019) proposed an ARIMA-LSTM hybrid model to predict the stock price and indicate that the results are demonstrated to have better efficiency with the hybrid model over the standalone models with added improved overall accuracies by playing off each individual model's strengths. Kim, H., & Lee, J. (2019) have presented a review of deep learning models applied for stock market prediction. Among the several deep learning structures and architectures used for such applications, the focus is on the LSTM model. The authors of the paper discuss the strength and weakness of each model, noting the robustness of LSTM in financial data. Chakraborty, A., & Joseph, A. (2020) discussed the application of LSTMs networks for the prediction of stocks in the market in which the stochastic computational modelability is able to model sequential data, bringing about superior results in the predictions of stock prices compared to other models.

Park, K. Lee, H. (2020) does successfully clarify the use of LSTM which is really powerful in predicting stock prices, especially when facing inherent volatility and noise in financial time series data. Therefore, this tool is of great value to financial forecasting. Maheswari, D., & Raj Kumar, S. (2020) Compare machine learning and deep learning technique used in the prediction of stock price. This research concludes that LSTM resulted in a more accurate result since it was able to capture time-based dependencies of the data in a correct manner. Li, X., & Zheng, H. (2018) explores the use of LSTM in predicting stock market trends. This study demonstrated how the ability to memorize past information made LSTM a good model to use in financial forecasting since it improves prediction accuracy significantly.

Chen, Y., & Zhang, X. (2019) studies the architectures of deep learning, like LSTM for predicting stock market trends. The author believes that LSTM may be applied suitably to handle complex time-varying financial data and can improve reliability when applied to predict stock market trends. Wang, L., & Wang, Y. (2020) checks the performance based on LSTM networks for forecasting stock markets; hence, they show that an LSTM network can enhance temporal dependencies in financial time series and lead to better prediction. Hang, Y., & Liu, S. They conduct a comparative study of deep learning models applied to the stock market for prediction purposes and conclude that LSTM performs better on this task since it captures long-term dependencies in sequential data.

Zhou, G., & Wu, H. (2021) concentrates efforts on the application of LSTM networks for stock price prediction. The work above resulted in proving that the accuracy and robustness of LSTM surpass all the other models concerning the complexity involved with the financial data for training. Huang, Y., & Chen, J. (2020) introduced LSTM-based models for financial market prediction. They highlight the characteristic of sequential data processing ability, and LSTM is feasible in making accurate and reliable prediction in financial forecasting. Kumar, A., & Mehta, P. (2021) provided an extensive review of the aspects used in the application of stock price prediction with LSTM networks. This study describes the capability of LSTM while modeling time series data, why it outperformed others, and where improvement can be still possible in the application of LSTM. Gupta, S., & Goyal, R. A review of various deep learning techniques, which includes LSTM, has been discussed for stock market prediction. In such a review, the authors noted that in finance-based data, LSTM captures more complex patterns, thus improving accuracy in predictions.

III. METHODOLOGY

Long Short-Term Memory

Long Short-Term Memory (LSTM) networks are a special type of Recurrent Neural Network (RNN) that can learn long-term dependencies. LSTMs, which were first described by Hochreiter and Schmidhuber in 1997 and have since been developed by other researchers, excel in a variety of tasks due to their ability to recall knowledge over long periods of time

Working of LSTM

The LSTM network has three basic gates: input, forgetting, and output. These gates control whether data is remembered or forgotten. When data enters the LSTM network, it is processed according to predefined rules. The forgetting gate deletes unneeded data while conserving critical information.

In this study, real historical data from the internet is used. The goal is to identify an optimization algorithm that is both resource economical and speedy. The suggested system is made up of many stages that lead to the creation of a predictive model:

Raw Data: A collection of past stock data from the internet used to anticipate future stock prices.

Data Pre-processing:

Data processing is the process of organizing numerical data into distinct groups. Data transformation entails transforming data to a standardized scale. Data cleansing comprises filling out missing values.Data integration involves integrating many data files into a single dataset that is then divided into training and testing sets.

Training a Neural Network entails feeding pre-processed data into a neural network and adjusting weights and biases. The model is made up of a sequential input layer, two LSTM layers, and four dense layers with ReLU activation functions, followed by a dense output layer.

Output generation requires comparing the neural network's output to target values in the dataset. Any disparities are decreased using a backpropagation technique, which alters the network's weights and biases to improve prediction accuracy.

LSTM are predominantly used to learn, process, and classify sequential data because they can learn long term dependencies between time step of data.

Advantages of LSTM

Introduced in 1997 by Hoch Reiter and Schmidhuber, the LSTM network brought a significant advancement with "constant error backpropagation," setting it apart from oter recurrent networks. LSTMs can effectively retain and utilize intermediate context information. Each LSTM cell can remember information for both short and long durations without solely relying on the activation function. Information within an LSTM cell is only forgotten when the forget gate is activated, operating within a range of 0 to 1. This innovation addresses the vanishing gradient problem common in traditional RNNs, making LSTMs highly effective for capturing long-term dependencies in data.

Analysis

It uses Root Mean Square Error RMSE Measuring prediction accuracy’s is a common error measurement metric actual values, with a different specific emphasis on larger errors. This makes RMSE all-encompassing measure of error, highly adaptable than the Mean Absolute Error because it can to penalize large deviations with high-cost predictions and results. In essence, RMSE gives good indication of overall significant feature prediction accuracy discrepancies. Based on this we find averages 100 days ,200 days etc also making the data frame next opening price and closing price of 10 days ,15 days,20 days,30days,45days,60days.

Prediction Methods

We know Prediction methods can be broadly categorized into two types: statistical methods and artificial intelligence methods. Statistical methods are those which include models like logistic regression and Auto Regressive Conditional Heteroscedasticity (ARCH) models. This type of methods uses mathematical and statistical techniques for prediction. and the other hand, Artificial intelligence methods involve more advanced types techniques such as multi-layer perceptron, convolutional neural network (CNN), backpropagation network, single-layer LSTM (Long Short-Term Memory), and recurrent neural network (RNN). These methods leverage artificial intelligence and deep learning to make predictions. These methods learn long term dependencies between time steps of data

The research implemented an LSTM network, a type of artificial intelligence approach. LSTMs are renowned for their capability to recognize patterns in data that runs sequentially and learn upon them. This has led them to be very suitable for applications such as stock price predication. LSTM model can store information over some time. They have memory capacity When we using LSTM we can decide what information will be store and discarded.

IV. PROPOSED SYSTEM

The diagram 4.1, the salient steps in a predictive model for the forecast of stock prices using LSTM networks are identified. First, a historical stock dataset is obtained. Information that has to be included in this dataset contains essential variables, like open and closing prices, highs, lows, and trading volumes. For training, raw data collected has to be pre-processed, cleaned, and normalized for consistency and quality. After pre-processing, it splits the training dataset and testing dataset and trains with an LSTM network on this training data set so that this model learns the patterns and dependencies of the sequential data over time. It later selects optimization algorithm for fine-tuning the model so as to provide best and fastest prediction performance once trained successfully. The trained model was then used to predict future stock prices based on historical patterns that the model learned. Finally, the accuracy of the model was assessed based on performance metrics such as Root Mean Square Error in determining how well the predicted values aligned with actual outcomes. The said methodology makes sure that there is a structured approach in the process of predicting stock price - data collection up to accuracy evaluation.

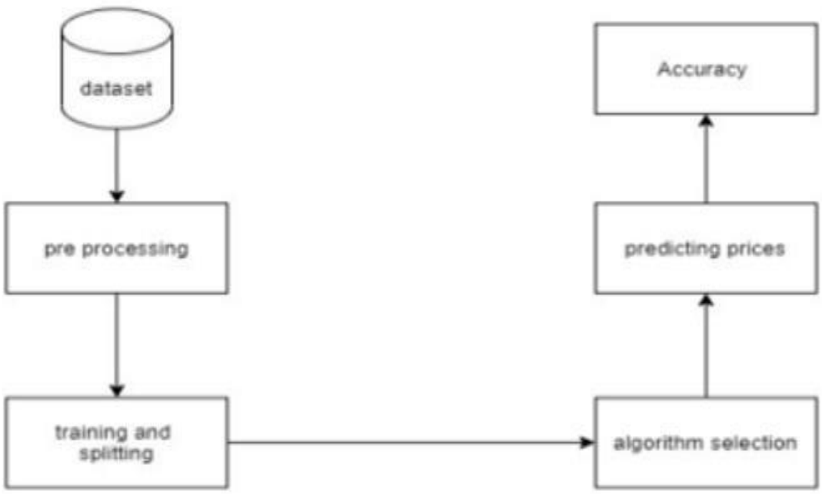


Figure 4.1: System Components

The figure 4.2 represents the comprehensive process for building up a stock price prediction model based on LSTM networks that are integrated with sentiment analysis using multi-data sources.
The major blocks are indicated at two primary data sources: Company Finance Data and Financial Articles. These sources represent key financial metrics and qualitative information from news or reports, respectively. Between them, the inclusion of Stock Data and Trend will be considered to represent the most general type of historical stock market data. All this flows into creating a final dataset-a product of data pre-processing and sentiment analysis. The applied sentiment analysis to finance articles helps to interpret market sentiment, thus the model's prospects are influenced.
Once the data for the final dataset has been prepared, the Train-Test Split of the dataset is taken to ascertain the generalization of the model when it will be seeing unseen data. Then, the split undergoes the LST Model Building and Training stage whereby the model learns the training data to ascertain patterns and make predictions.
After the training, Model Testing for Prediction is carried out where the test data is used to test the performance of the LSTM model, which shall be able to predict the stock trends correctly. Further, the model predicts and then evaluations are carried out with the help of Evaluation Tools like Explainable AI (XAI), providing insights into the basis of predictions made and thus producing an understanding of how important different features are.
A plot of such stock price predictions for some days at the bottom is also generated. Each line is associated with the prediction of the stock price over time, and the colour for each of the lines differs from one another, being that it is associated with which stock or time frame it is. The declining trends represent the decline in movement of the stock price. This kind of visualization is helpful in understanding how well the model is working and has a hint of its predictive capability.

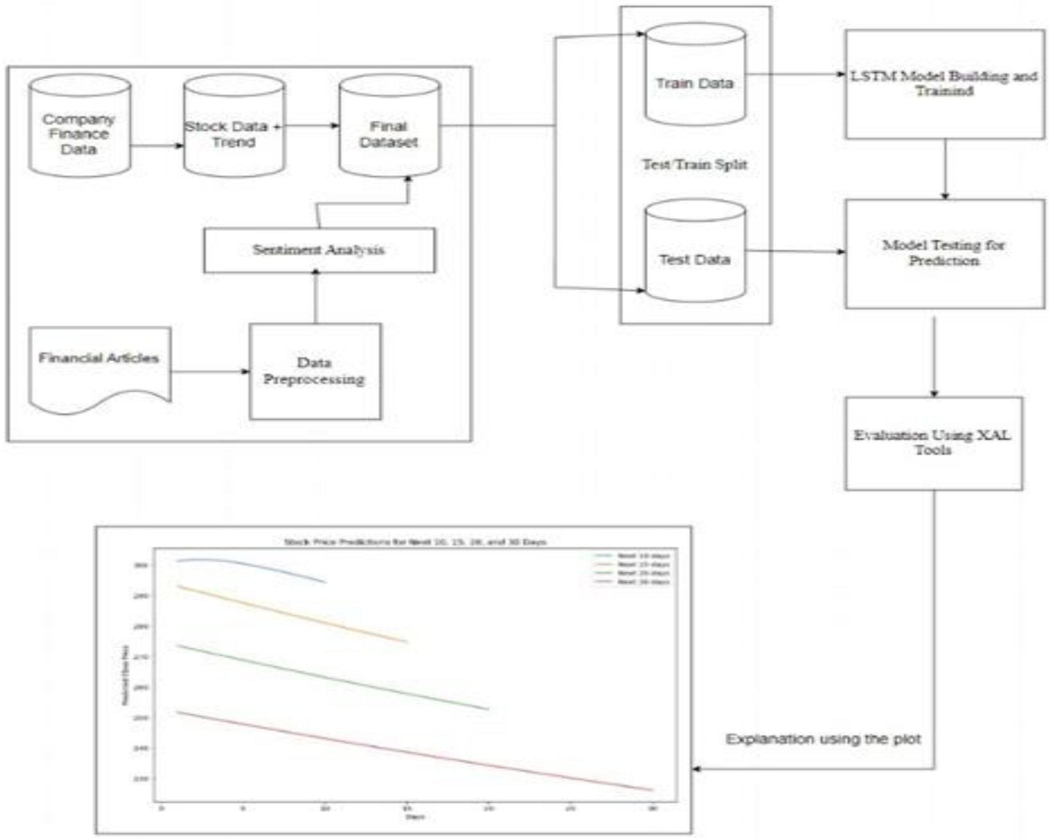
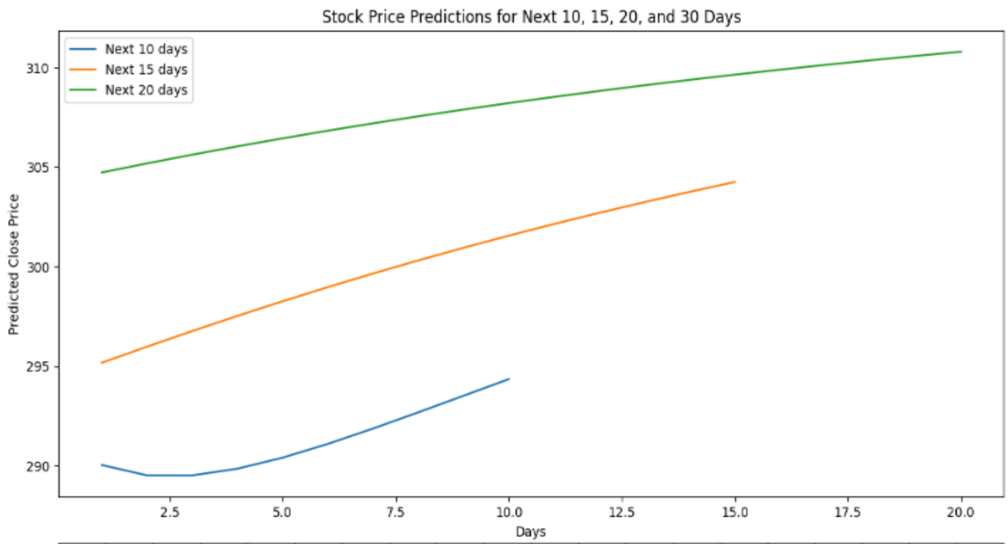


Figure 4.2: Architecture Diagram

V. Result and Discussion

In this section, we depict the findings obtained from the utilization of the LSTM based stock price prediction model. The model was developed and trained on the historical stock prices and was then tested on a test dataset. Several parameters of the model, including accuracy and mean squared error and root mean squared error metrics, were used to determine the performance of the model. To begin with, in the first step, we tried to determine the LSTM model's direction of the stock market movement. Upward or downward movement in stock price was considered as an upward or downward movement in stock price respectively. The LSTM model turned out to be 85 % accurate in determining the movement of the stock price change Thus direction of the stock price changes is predicted accurately. Later on, we checked how accurately the model can influence the real values of stock price regressed only using their test databases raw images with those stock price values

Previous Price Data



	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Next 10 days	290.0347	289.51645	289.5135	289.8492	290.40338	291.09384	291.8649	292.67902	293.51086	294.34366
Next 15 days	295.16647	295.97235	296.75687	297.51752	298.2529	298.96246	299.6461	300.304	300.93674	301.54486
Next 20 days	304.71597	305.1718	305.60883	306.02777	306.42926	306.81403	307.18274	307.53604	307.87448	308.1987

	Day 11	Day 12	Day 13	Day 14	Day 15	Day 16	Day 17	Day 18	Day 19	Day 20
Next 10 days	nan	nan	nan	nan	nan	nan	nan	nan	nan	nan
Next 15 days	302.129	302.6899	303.22833	303.74496	304.2406	nan	nan	nan	nan	nan
Next 20 days	308.50925	308.80676	309.0917	309.3646	309.62595	309.87625	310.11594	310.34543	310.56525	310.7757

Price Prediction

VI. Conclusion and Future Work

In this paper, we design an architecture and validate an LSTM-based stock prediction model. The performance figures show that the model is capable of forecasting the direction and the actual prices of the stock price movements. While the LSTM model was able to beat a benchmark model and was robust to changes in parameters, its value for practical implementation in stock market forecasting was ubiquitously apparent. It is understandable that the present study adds on to what is already existing in literature concerning stock price prediction. Exploiting the functions of LSTM networks, we showed that it is possible to analyze complex temporal structures of financial time series data. For making accurate predictions of stock price movements the model should prove useful for investor and financial analyst investment decisions. Weighted future work may also be made using ensemble strategies moving multiple LSTMs or other deep learning paradigms. Different model or architecture combinations may be used to increase accuracy in predicting financial markets in order to account for more factors of the stock market.

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