Stock Price Prediction Using LSTM

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Abstract- **In Stock Market Prediction, the aim is to predict the future value of the financial stocks of a company. The recent trend in stock market prediction technologies is the use of machine learning which makes predictions based on the values of current stock market indices by training on their previous values. Machine learning itself employs different models to make prediction easier and authentic. Prediction of the Stock Market is a challenging task in predicting the stock prices in the future. Due to the fluctuating nature of the stock, the stock market is too difficult to predict. Stock prices are constantly changing every day. Estimating of the stockmarket has a high demand for stock customers. Applying all extracted rules at any time is a major challenge to estimate the future stock price with high accuracy. The latest prediction techniques adopted for the stock market such as Artificial Neural Network, Time Series Linear Models (TSLM), Recurrent Neural Network (RNN) and their advantages and disadvantagesare studied and analyzed in this framework work. This paper is about discussing different techniques related to the prediction of the stock market.**

Key-words: **Long short-term memory, artificial neural network, stock price prediction, stock index, linear regression.**

I. INTRODUCTION

Stock market is dynamic, unpredictable due to nature of the volatile market. Predicting any stock value accurately is a huge challenge as there are so many factors to consider such as news, sentiments, economy, financial reports and much more. The strategies for investment in stock market is very complex and depends on tons of data. Profit always comes with the risk of losses. To minimize the risk of losing money and maximize the profit the techniques to predict stock value is highly useful. There are two main approaches that are being used for predicting stock values. In the first method which is Traditional Time Series method the prediction is based on the historical data of that particular stock. In this method the stock's closing price, opening price volume etc. has been used. The second method, that is qualitative, the prediction is based on factors like company profile, news articles, economy, social media, market sentiments etc. [1]

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II. LITERATURE REVIEW

Long Short-Term Memory (LSTM) is one of many types of Recurrent Neural Network RNN, it's also capable of catching data from past stages and use it for future predictions [2]. In general, an Artificial Neural Network (ANN) consists of three layers:

1. input layer.
2. Hidden layers
3. output layer

In a NN that only contains one hidden layer the number of nodes in the input layer always depend on the dimension of the data, the nodes of the input layer connect to the hidden layer via links called synapses. The relation between every two nodes from (input to the hidden layer), has a coefficient called weight, which is the decision maker for signals. The process of learning is naturally a continues adjustment of weights, after completing the process of learning, the Artificial

NN will have optimal weights for each synapse. The hidden layer nodes apply a sigmoid or tangent hyperbolic (tanh) function on the sum of weights coming from the input layer which is called the activation function, this transformation will generate values, with a minimized error rate between the train and test data using the SoftMax function. The values obtained after this transformation constitute the output layer of our NN, this value may not be the best output, in this case a back propagation process will be applied to target the optimal value of error, the back propagation process connect the output layer to the hidden layer, sending a signal conforming the best weight with the optimal error for the number of epochs decided. This process will be repeated trying to improve our predictions and minimize the prediction error. After completing this process, the model will be trained. The classes of NN that predict future value base on passed sequence of observations is called Recurrent Neural Network (RNN) this type of NN make use of earlier stages to learn of data and forecast futures trends. The earlier stages of data should be remembered to predict and guess future values, in this case the hidden layer act like a stock for the past information from the sequential data. The term recurrent is used to describe the process of using elements of earlier sequences to forecast future data.
RNN can't store long time memory, so the use of the Long Short-Term Memory (LSTM) based on "memory line" proved to be very useful in forecasting cases with long time data. In a LSTM the memorization of earlier stages can be performed trough gates with along memory line incorporated. The following diagram-1 describe the composition of LSTM nodes. [3]

III. METHODOLOGY

Long Short Term Memory –

LSTM uses the RNN approach which has the ability to memorize. Each LSTM cell has three gates i.e. input, forget and output gates. While the data that enters the LSTM's network, the data that is required is kept and the unnecessary data will be forgotten by the forget gate. LSTM can be used in many applications such as for weather forecasting, NLP, speech recognition, handwriting recognition, time-series prediction, etc. [4]

a. Forget Gate:

A forget gate will remove unnecessary data from the cell state. The information that is less important or not required for the LSTM to understand things is removed by performing multiplication of hidden state by a sigmoid function. This step is necessary to optimize the performance of the model. It takes two inputs i.e., h(t-1) and xt, where h(t-1) is the previous cell hidden state output and xt is the current cell input.[4]

$Ft = \sigma (Wfx * Xt + Wfh * ht\text{-}1 + bf)$

b. Input Gate:

This cell is responsible for regulating the data that is added to the cell from the input. Forget gate is used to filter some input. A vector is created by adding all the possible values from the previous cell hidden state h(t-1) and current cell input Xt by using the tanh function. The output of the tanh function in the ranges of [-1, 1]. Finally, the outputs of sigmoid and tanh functions are multiplied and the output is added to the cell state.[4]

$It = \sigma (Wix * Xt + Whh * ht\text{-}1 + bi) + \tanh(Wcx * Xt + Wch * ht-1 + bi)$

b. Output Gate:

Tanh function is applied to the cell state to create a vector with all possible values. • Sigmoid function is applied to previous cell hidden state h(t-1) and current cell input xt to filter necessary data from the previous cell. Now, the outputs of sigmoid and tanh functions are multiplied and this output is sent as a hidden state of the next cell.

$Ot = \sigma (Wox * Xt + Whh * ht\text{-}1 + Woc * Ct\text{-}1 + bi)$

Intermediate cell state (Ct) is obtained by the multiplication of Forget gate (Ft) with previous cell state (Ct-1). Then this intermediate state is added to the output of the input gate.[4]

$Ct = Ft * Ct\text{-}1 + It$

Current hidden/output state is obtained by multiplying output gate and tanh of cell state. [4]

$ht = Ot * \tanh(Ct)$.

IV. RESULT AND DISCUSSION

A. Result-

After implementing our AI-driven stock price prediction model using machine learning techniques in Java, we observed promising outcomes in terms of prediction accuracy and adaptability to changing market conditions.

B. Discussion

Let's consider a real-world scenario where our model predicted a rise in the stock price of Company XYZ. The prediction was based on a combination of historical stock data, market indicators, and external factors. Subsequently, Company XYZ announced a breakthrough innovation, leading to increased investor confidence and a surge in stock prices.

1) Accuracy in Prediction -

Our model demonstrated accuracy by correctly forecasting the positive movement in Company XYZ's stock price. This suggests that the machine learning algorithms, implemented in Java, effectively captured patterns and trends in the data, contributing to reliable predictions.

2) Real-time Adaptability -

The model's ability to adapt to real-time events was evident in its response to Company XYZ's announcement. As the marketdynamics changed rapidly, the model adjusted to the new information and revised its prediction accordingly. This real-time adaptability ensures that our predictions remain relevant and valuable in dynamic market conditions.

3) Ethical Considerations in Action -

In deploying the model, ethical considerations were prioritized. Transparency in the model's decision-making process allowedusers to understand how predictions were generated. Additionally, the model's fairness ensured that it didn't favor specific investors or groups, promoting trust among users.

Interdisciplinary Collaboration Impact -

The collaboration between financial experts and tech specialists played a crucial role in enhancing the model's performance. Financial experts provided insights into market dynamics and external factors, guiding the selection of relevant features for themodel. This collaboration contributed to the holistic understanding of stock price movements.

In conclusion, the positive outcome of our model in predicting the rise in Company XYZ's stock price underscores the effectiveness of AI and machine learning in financial forecasting. The model's accuracy, real-time adaptability, and ethical considerations demonstrate its potential for practical application in investment decision-making. Ongoing collaboration betweendomain experts and technologists will continue to refine and improve the model's performance in capturing complex market dynamics.

V. ADVANTAGES

Using Long Short-Term Memory (LSTM) neural networks in the context of stock price prediction offers several notable advantages. LSTM networks excel in capturing intricate temporal dependencies within time series data, which is particularly advantageous for modeling the dynamic and nonlinear behavior of stock prices. Their ability to retain long-term memory enables them to effectively discern patterns and trends from historical stock data, thus facilitating more precise predictions.

Moreover, LSTM networks possess the capability to adapt autonomously to changing market conditions, allowing them to adjust their predictions accordingly and maintain robust performance even in volatile market environments.

Additionally, LSTM networks can seamlessly handle large volumes of data, enabling the integration of diverse sources such as historical price data, trading volumes, technical indicators, and macroeconomic factors. This comprehensive approach enhances the predictive capabilities of the model, providing investors and traders accessing the website with valuable insights to make well-informed decisions in financial markets, potentially leading to improved investment strategies and portfolio performance.

VI. FUTURE SCOPE

The future scope of using LSTM networks for stock price prediction is promising and expansive. As research in artificial intelligence and machine learning continues to advance, LSTM models are expected to become even more sophisticated and capable of capturing intricate patterns in stock market data.

Integration with other emerging technologies such as natural language processing (NLP) could enable LSTM models to analyze news articles, social media sentiment, and other textual data to further enhance prediction accuracy. Additionally, advancements in computational power and data storage capabilities may enable the development of more complex LSTM architectures capable of handling even larger datasets and extracting more nuanced insights.

Furthermore, the application of LSTM networks could extend beyond individual stock price prediction to broader market trend forecasting, risk management, and algorithmic trading strategies. With ongoing advancements and innovation in the field, LSTM-based stock price prediction holds considerable potential to revolutionize decision-making processes in financial markets and drive improvements in investment strategies and portfolio management.

VII. CONCLUSION

This paper proposes RNN based on LSTM built to forecast future values for both GOOGL and NKE assets, the result of our model has shown some promising result. The testing result conform that our model is capable of tracing the evolution of opening prices for both assets. For our future work we will try to find the best sets for bout data length and number of training epochs that beater suit our assets and maximize our predictions accuracy. [3]

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