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Stock Market Price Prediction Using LSTM

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Abstract

Predicting stock prices is a challenging task because of the volatility and indeterminacy of financial markets. Machine learning algorithms are capable of efficiently processing historical data, extracting patterns, and predicting future stock prices. This paper presents the implementation of the Long Short-Term Memory (LSTM) model for forecasting stock prices, after a detailed comparison with Recurrent Neural Networks (RNN) and Convolutional Neural Networks (CNN). The research demonstrated that LSTM outperformed RNN and CNN with minimal loss and maximum accuracy. It is the capability of LSTM to grasp long-term dependencies and sequential patterns in time series data, which facilitated the improved results. The dataset is taken from Yahoo Finance. The study would be valuable for investors and analysts.

Introduction

Stock market is intricate and kinetic system that semi-dependent upon several facts; such as economic indicators, market sentiment, and global events. A correct forecast of stock price is a key point for investors, financial institutions, and analysts who want to make a sound decision. With the establishment of the machine learning, predictive models can show a great potential in capturing the market trends and minimizing the financial risks. My research is dedicated to investigation of LSTM technology for stock price prediction and its successful application. The technology has shown its dominance over CNN and RNN models in terms of accuracy and loss percentage in various experiments. Due to its unique memory and sequential data processing capabilities, LSTM model has a significant advantage in identifying the market trends. The research results have identified LSTM technology as the most promising for stock price prediction and it can be widely used for reliable assistance in financial decision-making.

Literature Review

Payal Soni, Tewari, and Krishnan analyze various machine learning techniques applied to stock price prediction, encompassing traditional methods, deep learning models, neural networks, and graph-based approaches.[1]

In their study, Usmani et al. developed a model to predict the Karachi Stock Exchange's daily closing performance using machine learning techniques. The research compared algorithms including Single Layer Perceptron, Multi-Layer Perceptron, Radial Basis Function, and Support Vector Machine, demonstrating the efficacy of these approaches in forecasting market trends.[2]

In his study, V Kranthi Sai Reddy employs Support Vector Machines (SVM) to predict stock prices across various market capitalizations, utilizing both daily and intraday data frequencies. The research emphasizes the

application of machine learning techniques, particularly SVM, in forecasting stock market trends.[3]

Malti Bansal et al. present a comprehensive analysis of machine learning techniques for stock market prediction, emphasizing the integration of deep learning models and sentiment analysis to enhance forecasting accuracy. Their study evaluates five machine learning algorithms for stock price prediction of twelve Indian companies, concluding that the LSTM algorithm outperforms others with the lowest error rates and highest accuracy.[4]

Ghosh et al. investigate the application of Long Short-Term Memory (LSTM) networks for predicting stock prices in the Indian share market, aiming to enhance forecast accuracy. Their study demonstrates that LSTM models effectively capture temporal dependencies in stock price data, leading to improved predictive performance compared to traditional methods.[5]

SreelekshmySelvin et al. compare the effectiveness of deep learning architectures—Recurrent Neural Networks (RNN), Long Short-Term Memory networks (LSTM), and Convolutional Neural Networks with a sliding window approach (CNN-SWM)—for stock price prediction. Their study concludes that the CNN-SWM outperforms RNN and LSTM models in capturing complex patterns and trends in stock market data.[6]

Hoseinzade and Haratizadeh introduce CNNpred, a convolutional neural network framework designed to predict stock market movements by analyzing a diverse set of variables from multiple financial markets. Their study demonstrates that CNNpred effectively captures complex inter-market correlations, leading to improved predictive accuracy over traditional models.[7]

Najem et al. provide a comprehensive analysis of advancements in artificial intelligence and machine learning techniques applied to stock market prediction, highlighting various methodologies and presenting relevant case studies. Their study offers insights into the effectiveness of these approaches in forecasting stock market trends and informs future research directions in this domain.[8]

Malti Bansal et al. present a comprehensive analysis of machine learning techniques for stock market prediction, emphasizing the integration of deep learning models and sentiment analysis to enhance forecasting accuracy. Concluding that the LSTM algorithm outperforms others with the lowest error rates and highest accuracy. Support Vector Regression was identified as the second-best model, while K-Nearest Neighbours demonstrated the weakest performance due to its classification nature.[9]

Janky Patel et al. developed stock price prediction models using Recurrent Neural Networks (RNN) and Long Short-Term Memory (LSTM) networks, applying them to BSElisted companies. Their comparative analysis revealed that RNN achieved an accuracy of 89%, slightly outperforming LSTM's 87%.

Methodology

During this research, I followed several steps to successfully implement the LSTM model, including data collection, preprocessing, training and testing, and finally, model implementation.

Dataset:

The dataset that is utilized in the study is the last 10 years historical stock market data of GOOGLE(GOOG) consist of 7 columns. It is downloaded from the yfinance (Yahoo Finance) library.

Data Preprocessing:

The data preprocessing involves resetting the index to ensure the date column is accessible as a feature rather than an index. Next, two moving averages are calculated: a 100-day moving average and a 200-day moving average, which helps in capturing long-term and short-term trends in stock prices. Finally, any missing values generated during the moving average calculation are removed to ensure a clean dataset.

Data Training and Testing:

The data set is divided into two parts. The first is the training data. It is 80% of the total data. It is 2208 records. This training data is the data with which the model is trained. It looks at it to learn the patterns, the trends and the relationships in the stock market data.

Second is Testing Data which contains remaining 20 % of data consists of 553 records. This data is used to evaluate the model performance.

Model Architectures:

CNN Model: It's been built to extract the local features from time series data. It's provided tenths of convolutional layers and pooling layers in order to reduce the dimensionality. It's been followed by fully connected layers in order to make the prediction.

RNN Model: It processes sequential data by maintaining a hidden state that captures information from previous time steps, the RNN model comprised recurrent layers followed by dense layers for output.

LSTM Model: It is designed to capture long-term dependencies in sequential data. The model consisted of multiple LSTM layers followed by

dense layers to output predictions. This is the best model for predicting the stock prices.
Here's the comparison graph showing the accuracy and loss percentages of LSTM, CNN, and RNN for stock market price prediction. From the above graph, LSTM has the highest Accuracy (95%) and lowest loss percentage (1.59%) compared to CNN and RNN, indicating its superior performance in this project.

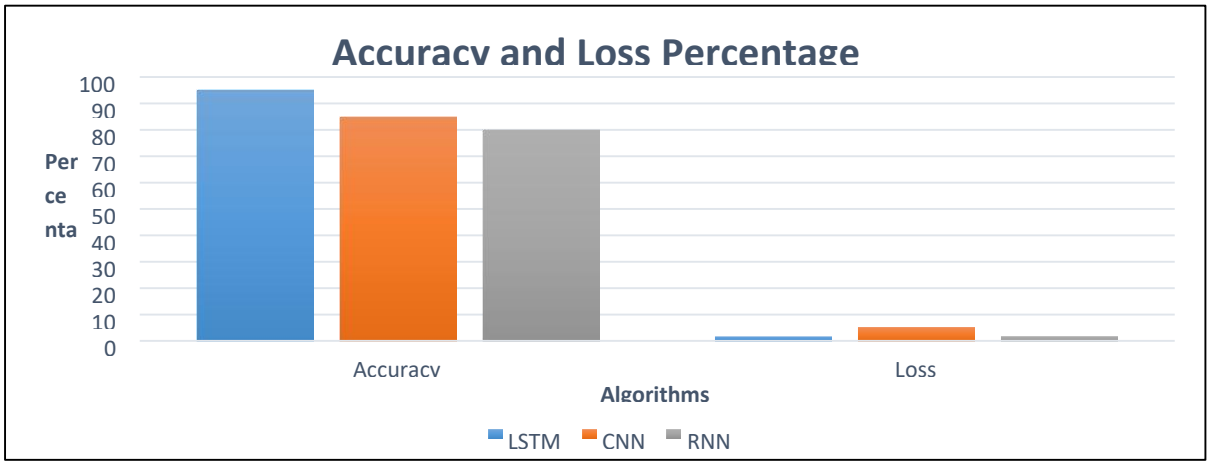

Fig 1. Comparison of Accuracy and Loss percentage in stock price.

Output

Fig 2. Original Stock Price VS Predicted Stock Price Using LSTM.

Conclusion

The investigation has successfully realized a LSTM model for predicting stock prices. A study has provided a detailed comparison of Long Short-Term Memory (LSTM), Recurrent Neural Networks (RNN) and Convolutional Neural Networks (CNN) for stock price prediction. The LSTM model showed high results according to the thorough examination through historical stock market information, providing the lowest loss level (1.59 %), as well as highest precision (95%.) The LSTM demonstrated better results than RNN and CNN models because of its ability to capture intricate models and long-term dependencies in time series information, which is why the LSTM's prediction is more precise. The results of the study provide new insights for investors and financial consultants, recommending the use of LSTM networks in stock price prediction to help in making informed decisions.

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