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Application of LSTM and Sentiment Analysis in Stock Price Forecasting

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Abstract

Stock price prediction poses challenges but integrating LSTM neural networks and sentiment analysis aims to improve precision. By reviewing historical stock data and incorporating sentiment from news and social media, this model aims to capture temporal dependencies and market sentiment for enhanced stock price forecasting. Combining LSTM techniques and sentiment analysis provides a comprehensive approach to leverage both trends over time and current investor views.

Keyword -- ***Machine Learning models, LSTM, Sentiment analysis, Stock forecasting, Stock trends, Neural networks.***

I. INTRODUCTION

Stock price forecasting is a complex process that involves analyzing various data sources and employing different methodologies to predict future movements in a stock's value. Historical stock prices serve as foundational data set, providing insights into trends and patterns. Trading volume, representing market interest and liquidity, is another critical factor [1]. Technical analysis utilizes past price charts to identify trends and employ indicators including moving average and RSI. Combining these approaches can provide more holistic view of a stock's potential future trajectory. Quantitative models, particularly those leveraging machine learning algorithms, have gained prominence in recent years. Time series analysis treats stock prices as sequential data, considering their temporal dependencies. Algorithmic trading, employing automated strategies based on predefined rules, is another avenue for leveraging quantitative models. Forecasting refers to making predictions about future stock price movements. Analysts analyze historical data to identify patterns and trends to estimate how stock's value may change over time. Forecasting can use technical analysis, fundamental analysis, or quantitative modeling [2]. Time series analysis is a core technique used by analysts to better understand the dynamics of financial markets. It involves reviewing historical stock price data points to discern identifiable patterns, trends and behaviors. Methods like moving averages and regression analysis help uncover trends in the data, providing a more holistic perspective on market influences [3]. Analysts employ methods such as moving averages and regression analysis to discern trends, offering a holistic market perspective. Sentiment analysis also plays an important role in forecasting by helping to gauge investor emotion and opinion. Understanding shifts in sentiment is valuable as it can help anticipate changes in stock price and trends, given investor sentiment has a notable impact on market movements and dynamics. Analysts will evaluate qualitative sources of information such as news reports, social media posts and analyst notes to assess overall market sentiment [4]. Understanding shifts in sentiment is valuable as it can help anticipate changes in stock price and trends, given investor sentiment has a notable impact on market movements and dynamics. Positive sentiment promotes bullish behavior and upward prices while negative sentiment triggers bearish behavior and downward trends. Sentiment analysis seeks to quantify emotional responses to better inform forecasts. It provides valuable perspective on emotional drivers of behavior. Incorporating sentiment insights enhances the capability of forecasting models to predict future stock price movements.

II. RELATED WORK

Long-term Short-term Memory (LSTM) neural networks represent a category of recurrent neural networks that enhance traditional RNNs through improved retention of long-term memory and mitigation of the vanishing gradients phenomenon [5]. LSTM neural networks can dynamically ascertain whether an output should function as the subsequent input based on preserving significant information across time. Researchers have increasingly examined stock price forecasting techniques as stock markets have expanded globally. The goal of this examination is to analyze and attempt to predict fluctuations and variations in stock prices that are influenced by various factors [6]. These influential factors include economic conditions, political environments, governmental policies, natural or human-made disasters, investor behaviors, and other elements. In a recent study, Darapaneni and Agarwal forecasted stock price movements by integrating historical pricing data with sentiment data obtained from sources such as news articles and social media posts [7]. They utilized linear regression and random forest machine learning models to generate projections of future stock prices. Interestingly, they also introduced macroeconomic indicators such as gold and oil prices and currency exchange rates into their models. They used the root mean squared error metric to gauge each model's accuracy. Their study provided stock-specific forecasting results and highlighted the relative predictive performance of each model for different stocks. In separate research, Vijha and Kumar introduced advanced artificial intelligence techniques, specifically artificial neural networks and random forests, to enhance the efficiency of predicting a stock's closing price on the following trading day [8]. This analysis utilized key financial metrics, including opening, highest, lowest, and closing prices for five companies across different industries.

III. PROPOSED SYSTEM

TradingView is an online platform for analyzing financial markets. It provides customizable charts to analyze price movements of stocks, forex, cryptocurrencies, and commodities. The platform offers technical analysis indicators and drawing tools to aid trading decisions. Basic use is free, subscriptions unlock additional features and real-time. Successfully developing a model meeting this challenge could equip traders and investors with a reliable resource for obtaining accurate stock price predictions [9]. Unlike Trading View's delayed or limited access to real-time data for free users, our system ensures continuous updates with the latest market information. By incorporating mechanisms for daily data integration and model retraining, users can access up-to-date predictions, enhancing the timeliness and accuracy of their trading decisions.

IV. METHODOLOGY

In building this stock price prediction system, we leverage a range of tools and APIs to streamline data collection and processing. Historical stock prices are collected from reliable financial data sources including platforms like Yahoo Finance to furnish the necessary source material for modeling purposes.

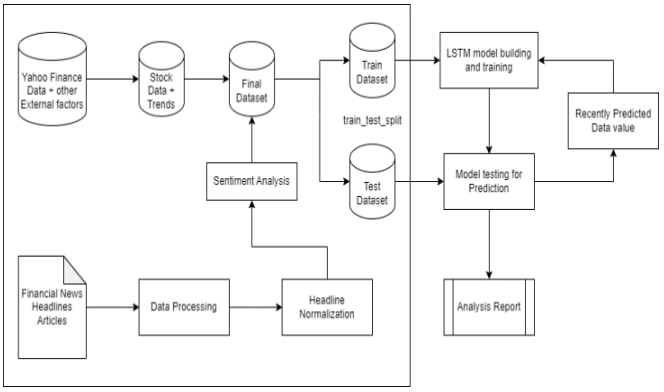

Fig. 1. System Architecture

The collected data may include historical stock prices, economic indicators, financial news. First, preprocess the data by addressing any missing values, outliers, or features requiring normalization. Next, divide the full dataset into separate training and testing subsets. Finally, select an appropriate modeling technique, here we used LSTM, and train the model using historical data [10]. Continuous monitoring and periodic updates are essential for maintaining accuracy in a dynamic financial environment. Several evaluation metrics are used to analyze model performance, including various matrices, and the range between predicted and actual target values within the test set.

Model	MSE	RMSE	MAE	Error %
Linear Regression	119513.9547	345.7079	294.5776	27.9167
Random Forest	3946.30177	62.8196	32.82127	3.11043
KNN	177151.0295	375.7123	254.4853	24.1172
ANN	48075.37253	219.2609	148.3170	14.0558
LSTM	646903.19751	804.3029	697.311	65.898

Table 1. Error Table

The table provides insight into the predictive efficacy of each model using various metrics and Error Percentage. Lower values in these metrics indicate greater predictive accuracy.

V. RESULTS

Upon completion of training, the model's predictive performance is assessed by comparing its predictions against the actual target values contained in the held-out test data. This evaluation involves calculating metrics to assess how well the trained model performs when faced with new, unseen data.

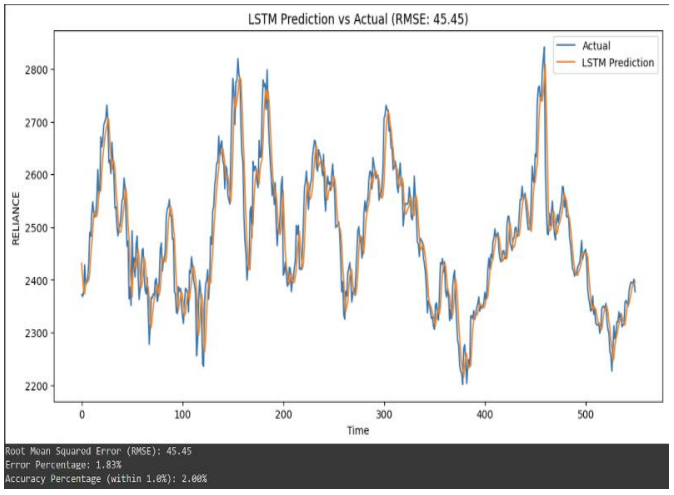

Fig. 2. LSTM Analysis

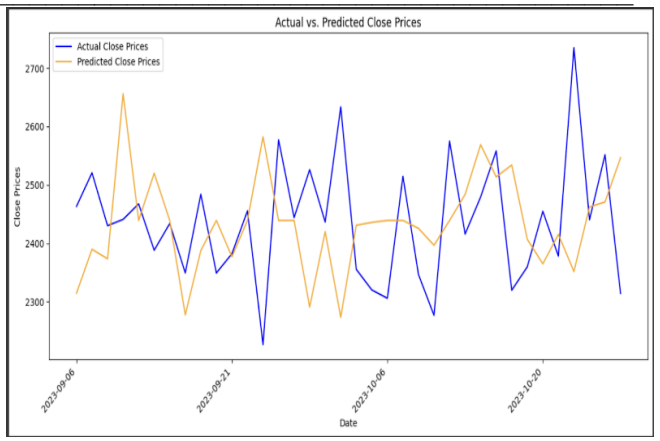

Fig. 3. Sentiment Analysis

After prediction, it was found that LSTM gave closest stock prices when compared to sentiment data on this particular database.

VI. CONCLUSION

Predicting stock prices is a sophisticated task that relies on advanced data analytics, machine learning algorithms, and economic understanding. Developing effective forecasting tools requires careful attention to data quality, thoughtful feature engineering, and the selection of appropriate algorithms. Regular evaluation and updates are necessary to ensure the models accurately capture changing market dynamics. Looking ahead, as technology advances, there's potential for artificial intelligence, deep learning, and data analytics to further refine and improve the precision and agility of stock price forecasting models. This progress can empower market participants with enhanced insights, aiding in more informed and strategic decision-making processes.

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FUTURE WORK

This work presents an opportunity for expansion by incorporating additional data sources beyond news articles, specifically social media feeds, earnings reports, analyst opinions, and macroeconomic indicators. The inclusion of these alternative data points could enhance the results of the sentiment analysis as well as ensure compliance with evolving regulations pertaining to financial projections and automated trading platforms.

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