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Stock Price Prediction and Alert System

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Abstract: ***In the financial markets, accurate prediction of stock prices is important for investors seeking to optimize returns. This paper presents a project focused on Stock Price Prediction Using LSTM and Alert System. The Long Short-Term Memory (LSTM) models, known for their ability to capture intricate patterns in sequential data, our project aims to forecast stock prices with enhanced accuracy and reliability. Additionally, we introduce an alert system. This supplementary feature enables users to set alerts based on specific stock price, enhancing timely responses to market changes. The methodology involves rigorous data analysis using Yahoo Finance data, preprocessing techniques, and the implementation of LSTM models for predictive modeling. Through comprehensive evaluation and experimentation, we demonstrate the efficacy of LSTM models in generating accurate stock price predictions.***

Keywords: LSTM model, Stock Market, Yahoo Finance

I. INTRODUCTION

The dynamics of the stock market, with its intricate interplay of economic indicators, investor sentiments, and global events, have made predicting stock prices an increasingly challenging yet essential endeavour. Investors seek tools and methodologies that can provide insights into market trends, aiding in informed decision-making to optimize returns on investments. In recent years, the advent of predictive analytics, fueled by the availability of vast datasets, has spurred interest in leveraging artificial neural networks (ANNs) to unlock patterns within this complex financial ecosystem.

Our focus on stock market prediction stems from the recognition that the profitability of investors hinges on their ability to anticipate market movements. Traditional methods have given way to more sophisticated algorithms capable of handling sequential data, and among them, recurrent neural networks (RNNs) have demonstrated notable potential. The application of RNNs, such as Gated Recurrent Units (GRUs), has been explored in recent works. However, inherent challenges, notably the high loss rates associated with GRUs, have prompted us to delve into alternative approaches to enhance the accuracy and performance of stock market predictions. In this pursuit, we turn our attention to Long Short-Term Memory (LSTM), a specialized form of RNN. The unique architecture of LSTMs addresses the persistent challenge of error propagation through time and layers, making them particularly suitable for modeling sequential data.

Additionally, we introduce a supplementary feature, the stock alert system, which signals the likelihood of stock price movements. While not the central focus, this side feature offers an additional layer of utility for investors keen on staying informed and responsive to market changes.

In the subsequent sections, we delve into the nuances of our proposed methodology, the experimental setup using Yahoo Finance data, and the comprehensive evaluation of results.

Through this research, we aim to shed light on the efficacy of LSTM in stock market prediction, providing valuable insights for investors navigating the ever-evolving financial markets.

II. LITERATURE SURVEY

From the literature survey, it was observed that the machine learning techniques are proving much more accurate than the other prediction techniques Accurately predicting future trends is essential for managing crises and making profits in unpredictable financial markets, such as stocks. Radu Iacomin[1] study show that advanced machine learning methods, especially SVM with PCA feature selection, are useful for forecasting nonlinear signals and maximizing profitability. Sumeet Sarode , Harsha G. Tolani , Prateek Kak, Lifna C [2] performed Stock Market Prediction. The literature emphasises how difficult it is to predict the stock market because of its volatile and dynamic environment. The study presents an integrated strategy that uses LSTM for price prediction and real-time news analysis to capture investor sentiments, incorporating insights from behavioural finance and providing thorough recommendations for future investment decisions. Rachna Sable Dr. Shivani Goel , Dr. Pradeep Chatterjee [4] did Empirical Study on Stock Market Prediction Using Machine Learning .This paper aims to study the stock market prediction using multiple Traditional, Machine learning, and Deep learning algorithms.

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Along with the algorithms, the survey has focused on various datasets used for stock market prediction, features of these datasets selected as input parameters and the evaluation metrics used for comparing the results of predictions. Warren Landis and Sangwhan Cha[5] studied High Performance Stock Market Prediction Methods. The literature highlights how timely and efficient transactions are essential for stock markets to generate maximum profits, which encourages investors to investigate predictive machine learning systems. The study acknowledges the difficulties in obtaining sufficient data and suggests an ensemble learning strategy that uses Long Short-Term Recurrent Neural Networks (LSTM) to improve the timeliness of stock predictions by experimenting with a variety of big data sources. Sneh Kalra and Jay Shankar Prasad [6] studied efficacy of News Sentiment for Stock Market Prediction Because stock markets are stochastic, the literature emphasises how difficult it is to predict stock market trends. The research, which makes use of a wealth of data from various sources, suggests a daily prediction model that incorporates historical data and news articles, applies sentiment analysis, and uses machine learning techniques to achieve accuracy ranging from 65.30 to 91.20.Gourav Bathla [3] predicted stock price using LSTM and SVR .The study compares the effectiveness of Support Vector Regression (SVR), a conventional method, and Long Short Term Memory (LSTM), a deep learning technique, in order to address the difficulties in forecasting non-linear and complex stock price movements. Using historical data from multiple stock indices, the analysis evaluates metrics such as Mean Absolute Error to determine how accurate the predictions are. The purpose of the study is to compare how well LSTM captures the complex patterns of stock prices compared to SVR.

III. METHODOLOGY

Stock market prediction poses a multifaceted challenge, requiring developers and researchers to address numerous factors. Leveraging machine learning methods facilitates the establishment of connections between historical and current data, empowering machines to learn and generate accurate predictions.

A. Data Analysis Stage

The foundation of our methodology lies in robust data analysis, recognizing the critical role it plays in the accuracy of predictions. Utilizing machine learning hinges on the seamless correlation of past and present data, enabling the system to discern patterns and trends.

For our study, the Yahoo Finance API serves as the primary tool for extracting both historical and real-time data. The dataset encompasses essential variables such as open, close, low, high, volume, and adjacent close. To ensure the dataset's reliability, we implement the MinMaxScaler to scale the selected features within a specified range, mitigating the impact of minor data fluctuations that could otherwise lead to substantial variations in predictions. This meticulous data preparation stage establishes a solid foundation for subsequent machine learning processes.

B. Flowchart

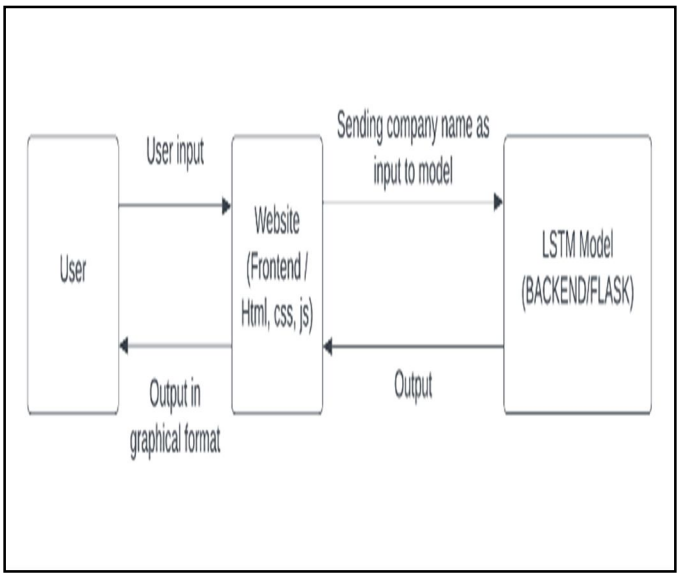


Fig.1. Block Diagram

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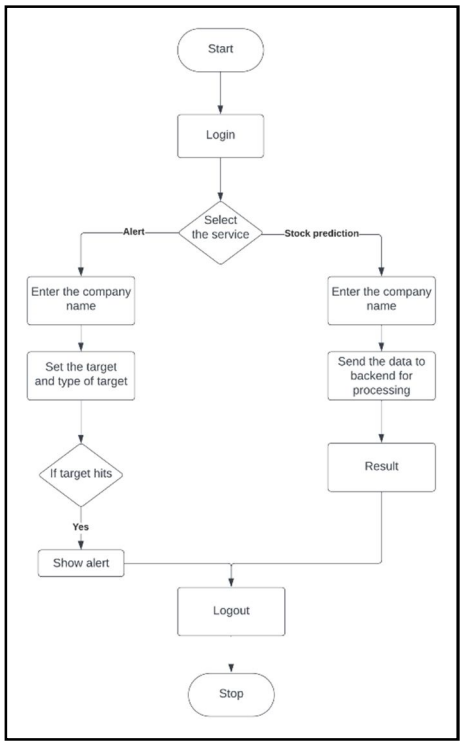


Fig.2. Workflow diagram

C. Long Short-Term Memory Model

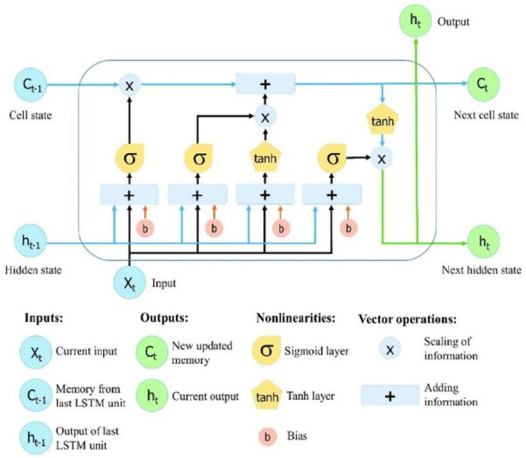


Fig.3.LSTM working diagram[7]

Steps for LSTM model

1) Forget Gate:

The information that is no longer useful in the cell state is removed with the forget gate using Activation function.

f_t = σ(W_f · [h_{t-1}, x_t] + b_f)

C_t = f_t · C_{t-1}

2) Input Gate:

The addition of useful information to the cell state is done by the input gate.

i_t = σ(W_i · [h_{t-1}, x_t] + b_i)

π C_t = tanh(W_c · [h_{t-1}, x_t] + b_c)

3) Cell State Update:

$C_t = C_t + i_t \cdot \pi C_t$

4) Output Gate:

The task of extracting useful information from the current cell state to be presented as output is done by the output gate.

$o_t = \sigma(W_o \cdot [h_{t-1}, x_t] + b_o)$

$h_t = o_t \cdot \tanh(C_t)$

5) Memory Retention:

The forget, input, and output gates control the flow of information into and out of the cell state, allowing the model to selectively store and update information for long-term memory retention.

6) Training Process:

The model undergoes training by minimizing the loss function L with respect to its parameters W_f, b_f, W_i, b_i, W_c, b_c, W_o, b_o through backpropagation.

7) Prediction:

Given a trained LSTM model, the prediction at time t is obtained as $\hat{y}_t = g(W_y \cdot h_t + b_y)$, where g is the activation function, W_y and b_y are the output layer weights and biases, respectively.

D. Forecasting The Data

Long Short-Term Memory (LSTM) stands out among prominent machine learning algorithms due to its exceptional ability to process entire sequences of data, providing a distinct advantage over other neural networks. The objective of this project is to predict share prices over a specific timeframe, constituting a time series forecasting task.

The Yahoo Finance API serves as the primary source for obtaining historical data related to all NSE and BSE stocks. Six attributes are extracted, each holding significance in the data analysis process. The utilization of TensorFlow libraries plays a crucial role in the system, acting as the backend for LSTM. Following necessary installations and initial setup, the project involves setting the start and end dates to retrieve stock data from the API.

Profit-loss calculations are typically based on the Closing Price of a stock for a given day, and due to its favourable fitting effect, it serves as the target variable in this study. The data undergoes preprocessing to ready it for LSTM analysis. Subsequently, the input data is divided into training and test datasets. The MinMaxScaler is applied to the training dataset, reshaping the data within the range of (-1, 1). Once the LSTM model is established, the training dataset is fitted into it, enabling the model to predict the closing price of the stock for the subsequent 10 days. This forecasting process encapsulates the essence of time series analysis, employing LSTM's capability to capture intricate patterns within sequential data for more accurate predictions.

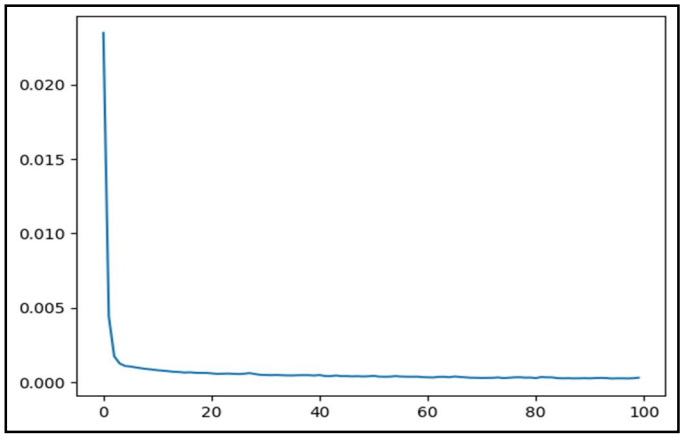


Fig.4. Training Loss plot

Over 100 epochs, the training loss is minimized, showcasing the model's continuous refinement and improved predictive accuracy.

E. Testing And Training Data

Data preprocessing is undertaken to ready it for the LSTM model, employing a 60-40 split for training and testing, respectively. Sixty percent of the dataset is dedicated to training the neural network model, with LSTM layers and dropout adjustments applied to enhance accuracy. The model is compiled using the Adam Optimizer and a mean squared error loss function. During training, epochs can be adjusted, representing the number of times the entire training data is presented to the model in batches. Subsequently, the remaining 40 % of the data is utilized for testing, enabling the evaluation of model performance by comparing predicted values against actual values.

F. Accuracy Of The Model

The performance of LSTM model is evaluated using regression metrics rather than accuracy. In regression metrics such as Mean Absolute Error (MAE) or Root Mean Squared Error (RMSE) are more appropriate . RMSE is a square root of the average squared difference between the predicted and actual value. As observed, smaller the RMSE value, greater the accuracy of the predictions made.

$$RMSE = \sqrt{\frac{\sum_{i=1}^{N} (Predicted_i - Actual_i)^2}{N}}$$

Fig.5.RMSE Mathematical Formula

G. Stock Alert

We have incorporated a feature called "Stock Alert" into the system, enabling users to set multiple alerts for specific stocks. These alerts can be configured to trigger either a notification or a Telegram message. The implementation utilizes Yahoo Finance to monitor real-time stock prices and promptly issue alerts based on user defined conditions.

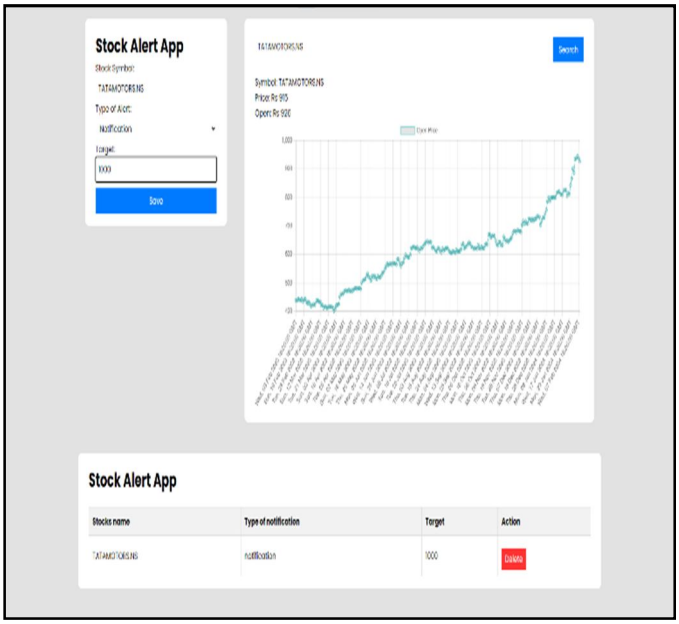


Fig.6. STOCK ALERT

IV. RESULTS

The implemented system utilizes data sourced from Yahoo Finance to forecast stock values for the upcoming 10 days. The visual representation of actual and predicted data of MTNL stock from 23rd february 2024 to 7th march 2024 is illustrated in Fig.7 and Fig.8. These graphs exhibit a side-by-side comparison of the actual closing prices with the predicted closing prices generated by the LSTM model with 87.9993 Accuracy.

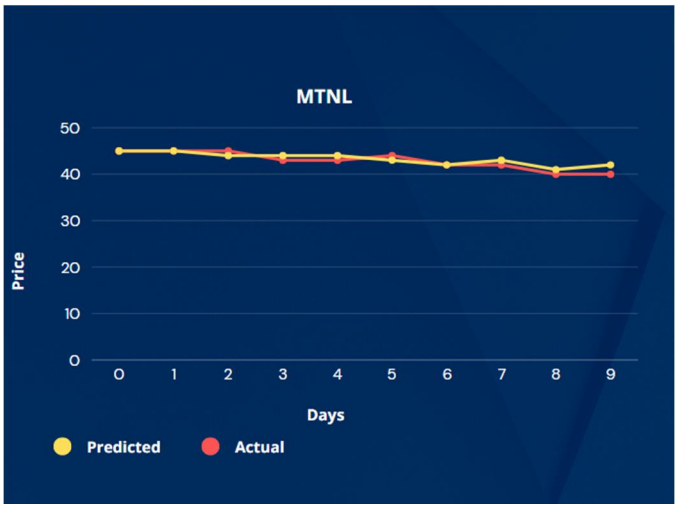


Fig.7. Actual and predicted price

	Actual	Test Predictions	Diff
0	45.049999	45.212742	-0.162743
1	44.750000	44.832394	-0.082394
2	45.150002	44.399143	0.750858
3	43.450001	44.214062	-0.764061
4	42.950001	44.735519	-1.785519
5	43.799999	42.945675	0.854324
6	42.250000	42.481953	-0.231953
7	42.450001	43.538616	-1.088615
8	40.650002	41.919277	-1.269276
9	40.549999	42.040108	-1.490108

Fig.8. Difference in actual and Predicted price

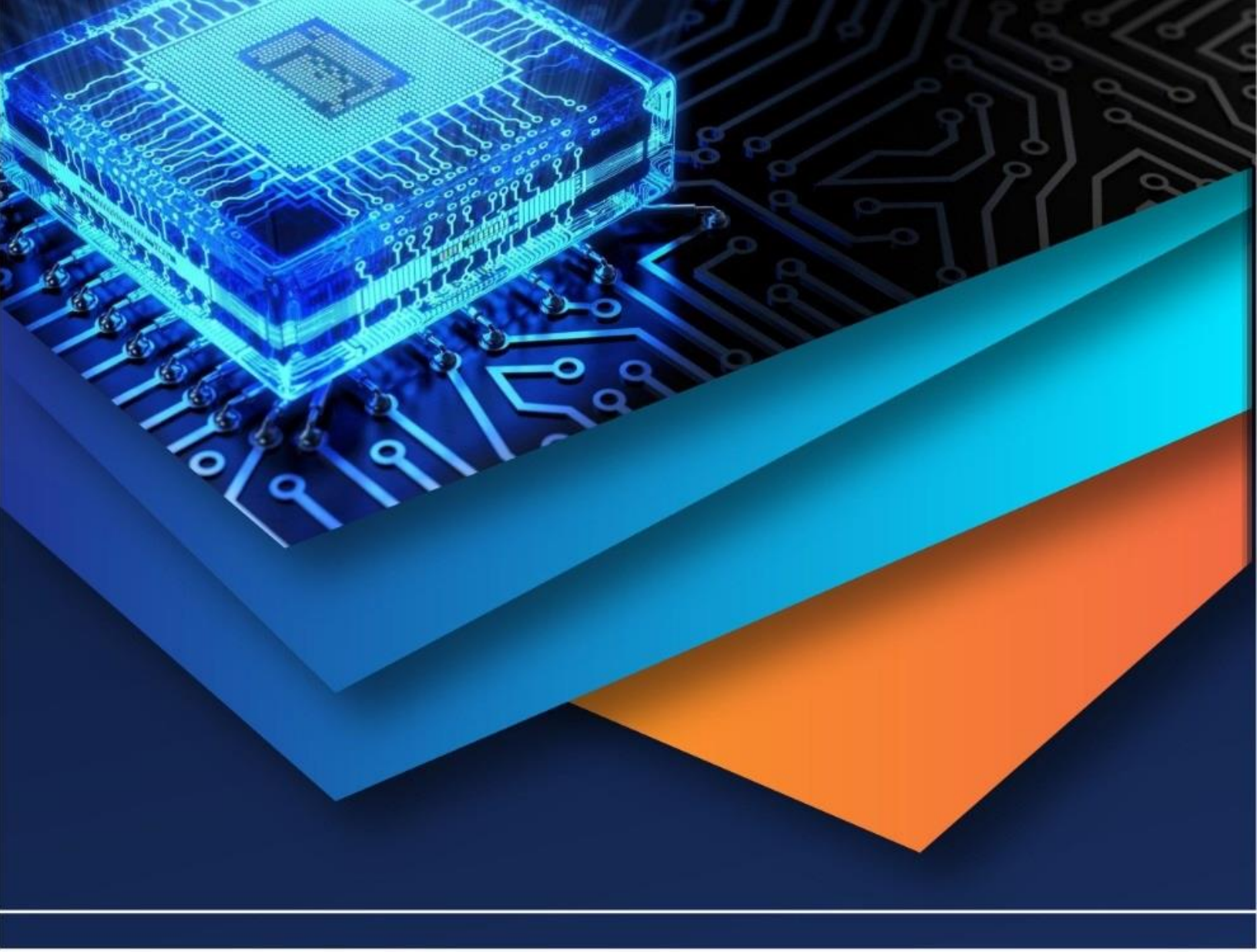
In Fig.7 , the X-axis denotes the days, while the Y-axis represents the stock prices. The actual and predicted stock prices are graphically presented by the red and yellow plots, respectively. Notably, the red line closely aligns with the yellow line, indicating a remarkable proximity between the predicted and actual prices. This visual concurrence underscores the effectiveness of the LSTM model in generating highly accurate stock price predictions.

V. CONCLUSION

The proposed system introduces a robust stock price prediction methodology leveraging LSTM models. Although it is impossible to predict a stock's exact price, a deep learning model can help by predicting the stock value based on past values. This can assist us in assessing the direction or the state of the market. Validated with Yahoo Finance data and includes a practical stock alert system. The results highlight LSTM's superior accuracy, offering a promising tool for precise stock predictions in dynamic financial markets.

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