Exploring Time-Series Forecasting Model for Accurate Dynamic Stock Price Prediction Using Facebook Prophet

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Abstract—The stock market is volatile in nature and accurate prediction of Stock price is a challenge task for the researchers. In literature, current stock forecasting methods rely on a limited set of variables. To enhance forecasting capabilities, factors like open price, close price, high price, low price, Return on Equity (ROE), Return on Capital Equity (ROCE), daily return, and trading volume are integrated in the present forecasting framework. Dynamic data techniques are used to extract real-time data from leading financial websites and forecasting stock prices for next four years using Facebooks Prophet algorithm, which has been implemented in Streamlit. The experimental results show better accuracy and a low error rate.

Keywords—Stock price, dynamic data, Prophet, Streamlit.

INTRODUCTION

Profitable market speculating implies that stock finance is more than simply assumption, and facts were disclosed lately regarding the position of the industry that are instantly assessed in light of the stock price. Changes in financial markets therefore speculate on the release of more information.

There are several factors to consider when predicting future stock prices, including physical, irrational, and rational components. Combining these two points of view yields a share price structure that is dynamic and extremely difficult to predict with remarkable efficiency. In the era of big data, new coevolutionary algorithms like Prophet algorithm is used to anticipate stock advertising valuation and tendency have gained increasing notoriety.

Systematic forecasting of stock market returns is a very challenging task because of the broad and tenacious nature of the commercial stock exchange. In the context of the Time series' enlightenment and improved tendency for ciphering, forecast-related techniques have been proven to be very effective in stock price prediction.

Both traders and investors can make significant profits from accurate stock predictions. It frequently demonstrates that forecasting is more complicated than random expectations, which implies that it can be anticipated by carefully examining the graph of previous stock markets. The Prophet is a useful metaphor for this kind of work. It increases accuracy by predicting a market value that is nearly equal to carrying value. Since the accurate and efficient measurements of Prophet were introduced into the stock market, a great deal of research has been required. A significant component of Prophet is the collected data. Because even minor modifications to the data might have a tremendous influence on the outcomes, databases ought to be as palpable as feasible.

The stock market is a dynamic platform where investors trade shares of publicly listed companies. It reflects economic health, allowing companies to raise funds and investors to profit from price fluctuations. Investors aim to buy low and sell high, contributing to economic growth and wealth creation. This depends upon few factors that effect on stock 1. Opening Price 2. Closing Price 3. High Price 4. Low Price 5. Trade Volume 6. Daily Returns 7. Market Capitalization 8. Dividend Yield 9. Earnings Per Share (EPS) 10. Price-to Earnings Ratio (P/E Ratio) 11. Beta 12. Moving Averages 13. Relative Strength Index (RSI) 14. Book Value 15. Analyst Recommendations 16. ROCE 17. ROE.

Over the past 20 years, the research of determining stock returns has become more and more important. The majority of the scientists' efforts had been focused on creating a clear connection between stock returns and knowledge of macroeconomic variables.

Although a great deal of material has subsequently been published on nonlinear, observable stock display findings, most of them required knowledge of the nonlinear model prior to the estimation procedure. in any case, on the grounds that the financial transaction produces wild, erratic, confusing, and nonlinear results. To forecast the parameters, several functions are used. Add binary, hyperbolic sigmoid, brown, and linear thresholds to the main group.

It has been stated that a machine learning approach was used to investigate stock market prediction. The prediction for the stock exchange has drawn a lot of attention lately. One of them is evaluation, but it is not a reliable way to get specific findings,

thus methods for increasingly accurate gauge must be developed.

Owing to the vast array of options, there exist numerous approaches to determine the optimal plan for estimating stock costs; however, not all methods function in the same manner. Whether or not to apply a comparative educational file affects the yield for each methodology. The stock value gauge in the aforementioned paper was completed using the self- confidence Timberland figure, which is used to indicate the cost of the stock using financial extents structure the upcoming quarter.

Time series analysis is the tool we use to forecast stock values over a given period. We specifically concentrate on data from the National Stock Exchange of India Limited, which is well-known for providing investors throughout India with cutting-edge facilities and services. To improve efficiency, convergence, and transparency in the Indian equities market, this is essential. It is notably used by investors both in India and abroad.

I. LITERATURE REVIEW

First, Numerous variables affecting the state of the stock market and the present market may have an impact on stock price and the two primary characteristics are:

1. The power of stock prices to influence other businesses in the same way is how the acquisition of stocks of A company's stock price is influenced by other firms.
2. Historical output and preferable materials supporting materials for the company's stock price calculations.

There are some techniques that are used to identify the patterns of previous stock markets and predict feature outcomes in line with it. The stock market is categorized as indirect, dynamic, and unseen. Even if a well-run advocacy group maintains that stock market prices cannot be predicted with any degree of accuracy, it has long been acknowledged that mathematics and machine learning-based techniques may be used to analyse stock prediction data series. Each approach has technique listed under the backslide has its own set of ideal circumstances as well as challenges related to its different partners.

An increasingly common application is the prediction of stock prices using AI and human-made awareness frameworks. A growing number of specialists use their work on a daily basis to figuring out how to handle methods that might further enhance the stock speculation model's accuracy. Each approach has its own advantages and disadvantages.

Huang et.al[1] mentions the difficulty of stock value prediction using Multi-Source multiple instance learning techniques to clearly anticipate the protections trade. It is undoubtedly not tough to eliminate any tendencies at this time due to the data's linked course of action. Budgetary trade information can be adequately predicted in an adventurous way. Their strategy included a progressively notable component that involved extracting major happenings from web news and analysing their effect on stock prices.

Mann et.al[2] recommended trading strategies by applying Dynamic Mode Decomposition (DMD) and derive evolutionary patterns from stock price data.

Hua et.al [3] used DMD technique and brand new SVM method to calculate the approximate price of the stock from the data produced from daily stock prices.

Sun et.al [4,5] used ANN algorithm over SVM algorithm and concluded that the performance of ANN resulted in better outcomes. A number of procedures are in place to address the aforementioned issue. While the present mechanisms do assist us in reaching a decision, that is not the end result in this case. The preceding problem's result ought to be precise enough to forecast the choice. Because the decision is so delicate, it must be made with extreme precision.

Hiba Sadia et. al [6] used random forest and SVM on the dataset for forecasting the stock price based on the previous year data. They used the ML model to predict the endurance of stock in a competitive stock field.

To estimate stock price movement and evaluate their effectiveness based on financial index data, Raut Sushrut et al. [7] employed SVM learning classifier. Computer analytical technique was employed in the financial sector and portfolio modelling. There has been a discussion of the statistical AI methodology to apply tactical techniques and SVM methodology for stock price prediction.

According to study of Hegde et al.[8], LSTM networks are a type of RNN's that may tackle volute linear problems. RNNs are also mentioned as a possible instrument for share price forecasting. The LSTM - RNN design is one the frequently used RNN architecture.

According to Roondiwala et al. [9]. The real time distinct inputs can be linked with memory cell through networks which is replacement of conventional artificial neurons in the hidden network layer. This allows data structures to be dynamically captured over time with a high prediction limit. Collecting data is one of the major and crucial components. Subsequently, model need to be trained and tested on many data sets.

Another major problem noted by Kim et al.[10] was a sudden explode of inclination where the vast loaded systems grow humongous or in a too abnormal way and surprisingly reassures to its optimal size. Two common causes of this were loads that are assertively set and loads that gradually slope to transform significantly more at the end of the system than they do at the beginning.

Selvin et.al.[11] says the typical approaches to forecast a stock value. It include a comprehensive review of a company's overall reputation, historical stock information and also recognition and calculation of stock-value. Along with above study the other forms of investigation that is applicable to forecast the stock price.

Loke et al.[12] stress the importance of thorough examination of historical data in light of the stock market's volatile nature. Conventional methods for predicting stock trends rely on historical time series stock data and traditional forecasting techniques. They investigated the development and advancement of stock price prediction using AI and ML methods.

The stock markets are essential to how contemporary civilization does business, claim Xi Zhang1 et. al. [13]. The research also discusses the possibility of analysing data obtained from reliable sources and suggests a methodology that enables us to predict stock prices using a variety of information sources.

Xing et al. [14] used LSTM & RNN techniques that considers a firm's prior equity share price. The proposed approach makes predictions based on a certain property while accounting for the share's known historical data. Shares have the following characteristics: opening price, day high, day low, closing price, day of trading, and price from the previous day. Using time series analysis, the proposed model predicts a share price for a certain length of time.

Using CNN's methodologies and applying them to stock price prediction is one approach to employ sentiment analysis for stock prediction, according to Prosky et al. [15].

X. Shao. et al.[16] noted that, comprehensive LSTMs are safer when compared with other deep learning RNN algorithms or traditional feed forward neural networks as they produce better results in solving RNNs gradient issue. The combination of K-means and LSTM algorithms for short-term stock prediction systems are also covered.

The database used in the present work is taken from Yahoo Finance and web scraping through websites like NSE and Screener. In the literature the researchers concentrated on 5-6 factors for forecasting the stock price using SVM, ML, LSTM etc. In the present work an attempt is made to forecast the dynamic stock price for next 4 years through Facebook prophet using 8 factors like open price, close price, high price, low price, Return on Equity (ROE), Return on Capital Equity (ROCE), daily return, and trading volume ,which has been implemented in streamlit.

II. DATASET

A part of data is taken from web scraping through website like NSE and Screener which will be dynamically updated and the other part of the data is yahoo finance which is a valuable resource for obtaining financial data, including stock quotes, media releases, and financial details. In the present study, datasets are obtained from Yahoo finance.

TABLE I. PARAMETERS

Real Time Data	Historical Data
Symbol	Symbol
Time	Time
Open	Price
High	Volume
Low	
Close	
Volume	

A. Data Collection and Preparation

For better understanding of stock price evolution, datasets are considered from three different sectors like tech companies, banking industry, and food service industries for a decade . The data includes stock-related statistics like High, Low, Open, Close, Adjacent Close prices and Volume.

B. Parameter Selection

Closing price is the most important factor, regardless of the stock fluctuations during that day, because of the market instability. The closing share price is noteworthy for numerous reasons. It serves as a reference point for regulators, traders, investors, financial institutions, and other stakeholders when determining performance across longer time periods like years, months or weeks as well as shorter time periods like minutes or fewer.

As a matter of fact, stakeholders and investors settle on closing stock prices to make judgments about their investment holdings. As a result, the goal attribute to forecast is the closing price. Hence, to train and test the present developed model, closing price of the stock from table II is considered in the study.

TABLE II. DYNAMIC DATA COLLECTEION

Date	Symbol	Open	High	Low	Last_price	Close	Daily_returns	Volume
07-Feb-2024 16:00:00	NIFTY TOTAL MARKET	11350.35	11358.2	11269.05	11322.95	11279.7	0.38	6810740516
07-Feb-2024 15:59:31	EIHOTEL	396	426.5	383.1	426.5	355.45	19.99	15186206
07-Feb-2024 15:59:59	IOB	68.05	81.05	68	81.05	67.55	19.99	379528754
07-Feb-2024 15:59:58	UCOBANK	59.8	70.55	58.9	70.55	58.8	19.98	210883479
07-Feb-2024 16:00:00	YESBANK	26.1	30.45	25.95	30.45	25.4	19.88	1615426506
07-Feb-2024 15:59:52	TRENT	3080	3634.7	2955	3626.3	3035	19.48	5846891
07-Feb-2024 15:59:54	CENTRALBK	66.95	76.9	66.95	76.05	66.55	14.27	154612545
07-Feb-2024 15:59:23	ACE	1035	1170	1025	1120	990.35	13.09	2485849
07-Feb-2024 15:59:46	TRITURBINE	429	498	414.1	480	424.8	12.99	11226518
07-Feb-2024 15:59:52	DELTACORP	137.45	154.55	135.25	151	136.65	10.5	34469221
07-Feb-2024 15:59:57	PAYTM	463	496.25	462	496.25	451.15	10	20273368
07-Feb-2024 15:59:45	MAHABANK	62.35	68.85	62.35	67.9	61.75	9.96	160093709
07-Feb-2024 15:59:48	ADANIGREEN	1749.5	1990	1746	1872	1721.65	8.73	8925796
07-Feb-2024 15:59:00	LTFOODS	184.45	197.65	183.9	196.15	181.7	7.95	2259613
07-Feb-2024 15:59:42	FDC	435.9	471.95	424	466.8	432.9	7.83	2622570
07-Feb-2024 15:59:54	SHILPAMED	363.95	392	360.7	389.5	361.5	7.75	1955488
07-Feb-2024 15:55:11	GOCOLORS	1082.05	1195	1082.05	1159.3	1077	7.64	549109
07-Feb-2024 15:59:59	CANBK	531.1	560.5	530	558.9	521.45	7.18	18728266
07-Feb-2024 15:58:49	ANGELONE	3219	3363.45	3202.8	3356	3132.5	7.13	457752
07-Feb-2024 15:54:51	VIJAYA	667.7	718.8	645.45	671	630.1	6.49	3487727
07-Feb-2024 15:59:42	ITDCEM	329.75	348	328	347.5	327.25	6.19	1413381
07-Feb-2024 15:59:18	INTELLECT	954	1011	953.05	1005.9	947.4	6.17	1891039
07-Feb-2024 15:59:19	ELGIEQUIP	630	682.6	625.6	654	617.95	5.83	1617521
07-Feb-2024 15:59:26	DISHTV	20	21.15	19.95	21	19.85	5.79	71921501
07-Feb-2024 15:59:51	BAJAJHIND	36.25	39.15	35.6	37.6	35.55	5.77	84981693
07-Feb-2024 15:59:55	CDSL	1866.9	1998.85	1848	1954.8	1850.35	5.64	5972762
07-Feb-2024 15:59:32	PGEL	1977.95	2091	1951	2075	1964.2	5.64	118697
07-Feb-2024 15:59:09	DBCORP	297.45	317	288	313.9	297.45	5.53	396898

C. Facebook Prophet

Prophet is a python library used for forecasting time series data with nonlinear trends that match daily, weekly, and monthly outcomes. It performs best with a series of time periods with robust seasonal outcomes and a few seasons of historical data. The prophet frequently treats strangers and has a good sense of lost data and trends. The prophet clarifies how to create a faster, more accurate forecast in comparison to previous time series forecasting techniques. In comparison to other models, it takes very little computation time.

The Core Data Science team at Facebook created an algorithm, which is utilized by several time series forecasting systems. This is frequently employed when there is a potential for seasonal outcomes. The Prophet was first designed to generate accurate sales projections. This is an attempt to make arguments such as: Trend shifts brought on by various companies. Anomalies seasonal outcomes like cycles that occur every week, month, or year.

Facebook Prophet seeks to be comparable to many temporal actions, like objects, that happen successively and subtly. The season is modelled as an add-on using the same technique for exponential smoothness. This library's ability to stand alone amid data and seasonally relevant characteristics is evidence of its relevance.

III. METHODOLOGY

1. Existing System limitations

The current algorithms LSTM and ARIMA perform poorly in prediction with robust or inconsistent data points. They are only appropriate for the short-term forecast and prediction becomes worse as noise fluctuation increases. Traditional and seasonal trends in the data are not properly handled by the mechanisms which are in place.

2. Proposed Methodology

A strong approach is necessary to attain accurate predictions of the stock prices for the next four years in advance. Firstly, gathering and preprocessing the datasets is essential for training the model.

In the initial phase, data is gathered from web scraping through websites like NSE ,Screener and Yahoo Finance are based on the relevant input settings and the features the predictions are decided. Ultimately, the forecasts are generated using Facebook Prophet and plotted on the graph .

The predictions either to buy the stock or sell a stock or to keep the stock on hold is done based on specific threshold values of close price, open price, high, low, daily returns, ROE and ROCE scrapped from websites by utilizing libraries like BeautifulSoup and requests in Python.
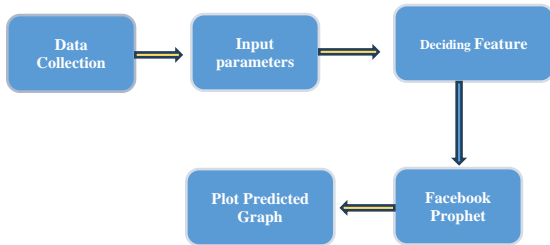

Fig. 1. Proposed System

The following steps are implemented in the present work:

1. Selection of target customers:

- Target Demographics: Our target customers primarily consist of individual investors who engage in daily or weekly trading activities.
- Time and Resource Constraints: Our customers typically lack the time and resources to access commercial forecasting services or hire professional agents for investment advice.
- Investment Behavior: They prefer to manage their investments independently but seek assistance in making informed decisions due to their limited expertise or resources.

2. Selection of information to be tracked:

- Technical Analysis Indicators: Ten key indicators are used to track and analyze the altering averages, Relative Strength Index, Moving Average Convergence Divergence, and Bollinger Bands.
- Additional Services: In addition to predictive analysis, the present model offer various services such as RSS feeds for market news, current stock quotes, price charts displaying historical data, investment recommendations based on analyzed data, and real-time alerts for significant market movements.

3. Data collection:

- Primary Data Source: It consists of daily stock prices over a year in Google Finance, which provides comprehensive and reliable historical data.
- Supplementary Data: Current stock prices are extracted from Yahoo Finance to complement the dataset and ensure the accuracy and timeliness of information.

- To guarantee data quality and dependability, a thorough cleaning procedure is used after data extraction. This includes removing information that isn't useful, dealing with missing numbers, and standardizing the data structure so that it can be analyzed later and used to train models.

4. Charting:

Visualization Tools: The information stored in the
Chart Types: Various charts like line, candlestick, and bar
- visualize the stock price movements over time.
- Chart Types: Various charts like line, candlestick, and bar types are implemented to cater different user preferences and facilitate better understanding of stock trends.

5. Implement Web services:

- Integration with Prediction Models: Web services are designed for prediction of stock price using Facebook Prophet algorithms to analyze stock data and forecast stock price fluctuations.
- Dynamic Querying: Users can query specific stocks of interest, where web services will respond with real-time forecasts and insights based on the latest available data.

6. Design web interface:

- User Interface Elements: The web interface features intuitive navigation, interactive charts, and customizable dashboards to provide users with a seamless browsing experience.

Accessibility: The interface is accessible across various devices, including desktops, laptops, tablets, and smartphones, ensuring users to access valuable information and recommendations anytime, anywhere.

To strengthen the model performance of future stock forecasts, Mean Absolute Percent Error (MAPE), mean absolute error (MAE), Root Mean Squared Error (RMSE), Mean square Error (MSE), and mean percentage error (MPE) parameters are also considered.

MAPE: It is the mean of the amount of the projected and perceived value's outright divergence divided by the perceived value. The performance of the model prediction is good if the inaccuracy is minor.

AME: It is the Absolute Mean Error of the values that are expected and seen. This is used to compare models over three time periods.

RMSE: A lower RMSE indicates a lower error and shows that the model makes more accurate predictions and fits the data well.

Predictive modelling is done using sophisticated Prophet-related algorithms when the dataset is prepared. This could require using time series forecasting models like Prophet, as seen in the code excerpt. Moreover, they demonstrate greater robustness against noise fluctuations, which alleviates some of the constraints faced by current systems.

The objective of the proposed methodology is to improve the accuracy and resilience of predictive modeling for stock price forecasting by including online scraping into the data collecting pipeline.

IV. IMPLEMENTATION AND RESULTS

The results generated in the proposed model are discussed in this section. Yahoo Finance is used to gather data from the past 10 years to anticipate prices for the ensuing five years. In the present work, the Streamlet framework is used as it is incredibly feature-rich, easy to use, and aids in creating interactive applications. The period for prediction is considered as four years.

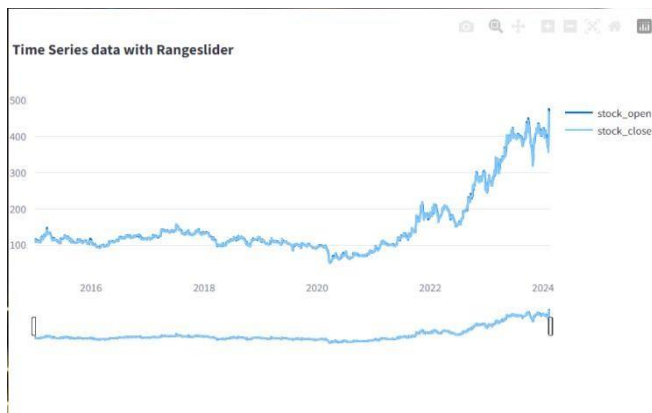Fig. 2. Web Page for Stock Price Prediction

Fig. 3. Time line graph since 2016 to till date

In Fig 3, X-axis represents time in years the closing price of stock is on Y-axis. Graph is plotted for the closing price of required company from 2016 to the current day.
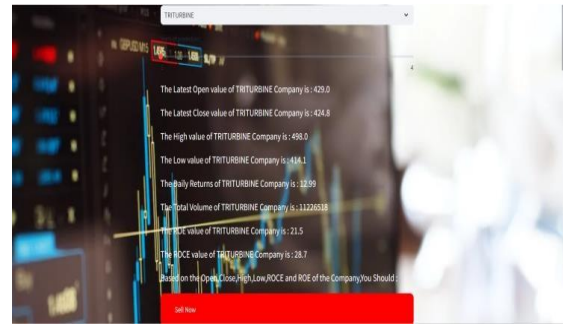

Fig. 4.Parameters for the Selected Company stock

In fig 4, The Parameters of the stock, like Open_price, close_price, high, low, daily_returns, total_volume and the roe, roce values are displayed in the website for the selected company. The prediction can be made either to buy the stock or sell the stock or to keep the stock on hold.
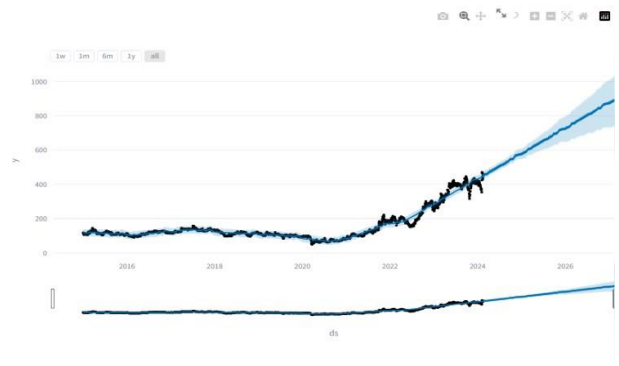

Fig. 5. Graph after Predictions

In Fig 5, Graph is predicting the future values of selected company stock for a period mentioned in code. It will be displayed using plotly module, which takes data from the trained prophet model. X-axis represents time in years the closing price of stock is on Y-axis. The actual data is indicated by black dots, the predicted values are shown by blue, and the confidence interval is shown by light blue. This model has performed admirably in predicting future stock prices.
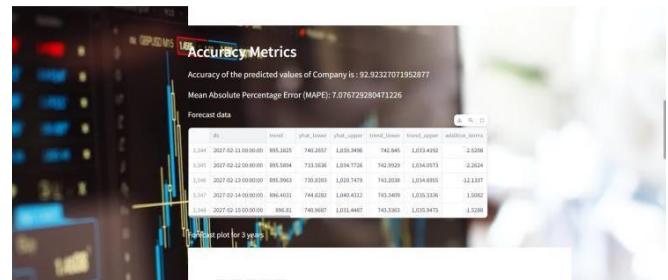

Fig. 6. Predicted stock price and Accuracy

In Fig 6, After training the prophet model with the collected data from the module, the parameters like accuracy and loss updated every day for a selected company. The predicted output of the company can be seen for a selected period of time.
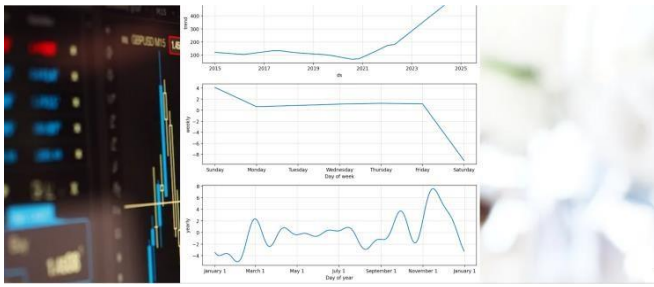
Fig. 7. Predicted Graphs based on Prophet model

The graph shows yearly, monthly day wise trend of predicted stock price.

V. CONCLUSION

A model is successfully developed for the prediction of future stock prices with good accuracy. Facebook prophet algorithm is a more effective technique when considered on massive data sets to identify patterns and forecast outcomes when compared to traditional analysis. This algorithm can predict the stock prices for the next four years in advance, which helps to make better financial decisions.

VI. FUTURE WORK

It is evident from the several findings displayed in the research's tables and graphs that this model can track the development of closing prices. In future, training epochs and massive datasets can be considered to optimize the accuracy in prediction of stock prices and better assert utilization.

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