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A Robust Stock Price Prediction Based on LSTM with Regression Improved Features Selection Process

Sonali Lovanshi[1], *Prof. Arpita Dash*[2],
M.Tech Scholar of CSE[1], *Assistant Professor* [2],
[1,2]**Department of Computer Science Engineering**
[1, 2] **Vaishnavi Group Of Institutions, Bhopal, (M.P), India**
[1]*sonalo1c612@gmail.com*

***Abstract*— Today, analysing and predicting the stock market is the biggest obstacle. There has been recent investigation on the potential use of AI in stock forecasting. The current value of the stock is affected by a number of variables, both independent and dependent, such as market volatility. Several methods for predicting stock prices based on machine learning and deep learning have been proposed by researchers in the last ten years. Strong Stock Price Prediction using an Enhanced Regression Model and a Long Short-Term Memory (LSTM) Feature Selection Method is the subject of the suggested study. Make advantage of the Google Colab-based Python platform to put the suggested approach into action. In comparison to earlier approaches, the new technique demonstrates superior accuracy. The accuracy rates for training, validation, and final testing are 100%, 99%, and 96%, respectively. With a mean absolute percentage error (MAPE) of 1.45, a mean square error (MSE) of 1.48, a root mean square error (RMSE) of 1.22, and a mean absolute error (MAE) of 0.76, the suggested approach demonstrates lesser mistakes compared to other prior methods.**

Keywords*— *Machine Learning (ML), Long Short Time Memory (LSTM), Mean Square Error (MSE), Root Mean Square Error (RMSE), Artificial Neural Network (ANN), Stock Price Prediction etc...

I. INTRODUCTION

Two of the hardest industries to work in are stock market analysis and prediction. This is influenced by a number of factors, including market volatility and other factors that have an independent impact on a stock's price on the market [10]. These factors make it difficult for even the most seasoned stock market expert to anticipate with precision when the market will rise or fall [28]. Experts in machine learning and data science must examine historical stock data and develop various

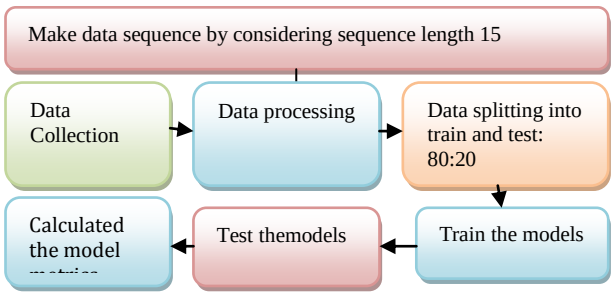

Fig 1 Stock Market Prediction Using Machine Learning

Algorithms that enable the identification of patterns within the data. This is made feasible by the availability of additional data, such as the total number of stocks trading on the market

To put it simply, stock market forecasting is nothing new. Buyers investigate a stock either technically or fundamentally before investing in it [29]. A basic study looks at the company's basic importance together with the expansion of the government, the economy, and friendship [18]. A growing number of brokers have been inspired in recent years to use machine learning strategies into their businesses as a result of the growing popularity of machine learning across numerous industries. In this study, we will develop a financial data prediction system and provide a training dataset comprising all stock prices ever recorded [17]. The primary goal of the prediction is to lessen anxiety during financial decision-making. Investor morale is being unsettled by the significant fluctuations in stock market indices. Because of the underlying nature of the financial sector, stock prices are believed to be extremely volatile and vulnerable to quick fluctuations based on a mix of known factors (the previous day's closing price, the P/E ratio, etc.) and unknown ones. Numerous academics have

attempted to forecast stock values using artificial intelligence [25].

- The price target change may be short-term (starting tomorrow and lasting up to a few days), long-term (starting months from now), or near-term (less than a minute).icy material.
- The sets of stocks can be in limited to less than 10 particular stocks, to stocks in particular industry, to generally all stocks.
- A worldwide news and economic trend, specific firm features, time series data on the stock price, and other factors can all be employed as predictors.

Machine learning is distinct from other conventional prediction models in this regard [26]. It involves complicated mathematical procedures, cross-validation methods, optimization algorithms, and typically needs a lot of processing power to produce the output. With the result being highly accurate (but low in interpretability). Potential of machine learning model to predict stock market [16].

Another crucial skill for making accurate stock market projections is knowing the many types of artificial intelligence algorithms and which ones could work [11]. Machine learning methods applied in supervised training situations perform better because stock price forecasting requires tagged data [30]. Now that we know the basic model for machine learning categories that might be used, let's also grasp the kind of data we need to build the model. When selecting a time series-based approach, the model accounts for time series data; that is, the data needs to be indexed. through extended periods of time such that trend and seasonality [19].

II. METHODS FOR STOCK MARKET RESEARCH

The two most fundamental research methods are Fundamental research and technical research of the stock you are trying to predict [9][23].

A. Fundamental Research

Let us first start with Fundamental research. By conducting such research, one may learn the fundamental facts about the firm whose stock is being traded [13], which have a significant impact on how the market will behave [24]. To put it simply, if there is negative news about Reliance, a blue-chip company, then its prices will not fall as dramatically as, say, of a small-sized company from a tier-2 city whose reserves will run out in 3 days [20]. Thus, fundamental research is critical as it can tell the machine learning model the magnitude of the movement when an input appears [12].

Fundamental research frequently involves examining and documenting the following:

- Market Capital: A business's market worth. (Share price * Outstanding Shares)
- P/E (Price/Earnings) Ratio: You've probably heard a few economists claim that Tesla's current stock price explosion is sustainable because the business is being overvalued. Such a calculation is done by calculating the P/E ratio which is the ratio of a company's share price to the company's earnings per share. To put it simply, it explains if the stocks of the company are overbought or oversold [15].
- Dividend: When you buy a share, you literally have a share in the company i.e. you own the company. And when the company makes a profit, they distribute the profit among its shareholder. This is what is called a dividend.
- Deliverables: Simply put, this refers to how long stockholders hold onto it. If they hold it for a long time, it means that the shares are steady and that buyers are interested in making long-term investments.
- Net Profit/Loss: This represents the company's whole revenue or loss for the fiscal year.
- Net Sales: It is a company's overall revenues for a certain fiscal year.
- Total Debt: It refers to the total amount of debt listed on the company's statement of affairs. A company's stock price may decline dramatically if there is bad news about it, especially if it has high debt levels and few assets to cover such debts.
- Total Asset: It is the total value of the asses the company owns. As mentioned above, this can impact the stock price.
- Profit before Tax / Profit after Tax: This is the total profit company has made before and after paying tax in a financial year.

B. Technical Research

While foundational research is crucial, there is a different school of thought that claims that technical research may actually provide more accurate predictions, especially for short-term traders [22]. As a data scientist, you must be familiar with a wide range of these approaches, understand why they work and where they don't, and combine them with other outside variables [14]. Fundamental research suggests that one should only pay attention to the short- to medium-term (and occasionally long-term) stock performance, seek for recurring patterns, and then predict when these patterns will occur in the future. Some of these trends are so prevalent that they eventually start to come true for themselves [27].

III. LITERATURE SURVEY

Liege Cheung et.al (2023) - In this research work presented, Statistics were used to forecast changes in the supply, demand, and cost of food in a number of studies. The researchers used statistical inference to unearth data correlations for use in developing a forecasting model. Ecosystems, genetics, molecular biology, precision agriculture, the study of animal genes, and technology are all important, but environmental change and economic considerations also affect crop yield and the trend of agricultural prices. Moreover, the trend in agricultural prices follows a non-stationary pattern and is impacted by several dimensional variables, meaning that conventional time series forecasting methods like autoregressive integrated moving average (ARIMA) do not work effectively. Adjusting the parameters of a CNN model allows it to learn non-linearity and handle non-stationary data, allowing it to outperform more standard statistical

techniques of prediction. In light of this, this study seeks to (1) perform a literature analysis to find more comprehensive elements that may impact crop production as well as price changes, and (2) present a unique Clustered 3D-CNN model for forecasting crop future price changes [01].

Latrisha N. Mintarya et.al. (2023) - In this research work presented, for decades, analysts have used fundamental and technical analysis to make stock market predictions. Machine learning makes it easier and more reliable to make stock market forecasts. Stock market forecasting using machine learning techniques has evolved over the years. The purpose of this research is to summaries existing literature on machine learning techniques for predicting the stock market. We conducted a comprehensive literature search to help us get there. This meta-analysis looks at 30 previous researches that have used machine learning methods or models to forecast the stock market. The support vector machine and neural networks had been among the methods used. According to the findings of this research, neural networks are now the most popular model for stock market forecasting. Nonetheless, this does not exclude the employment of other stock market prediction models [02].

Thanh Trung Huynh et.al. (2023) - In this research work presented, stock market prediction problem: (i) internal dynamics, where each stock keeps its own specialised behaviour, and (ii) multi-order dynamics, which indicates high non-pair wise correlations between the price movement of multiple stocks. We provide ESTIMATE, a stock recommendations methodology that allows for the learning of node embeddings obtained from hyper graph representations and multi-role correlations between stocks (i) and their individual temporal patterns (ii). Two new mechanisms are made available by the framework: To begin, a memory-based sharing parameter LSTM network is implemented to aid in the learning of temporal patterns for each stock via the use of temporal generative filters. Second, we introduced wavelet basis attention hyper graphs layers of convolution, i.e. a convolution paradigm that uses the polynomial wavelet basis to streamline information transfer and put more emphasis on regional homogeneity [03].

Payal Son et.al. (2022) - In this research work presented, Forecasting the fluctuations of the price of stocks and the market becomes necessary in order to avert big losses and make appropriate choices due to the stock market's close relationship with economic development, the market's ability to attract substantial investment from investors, and the public interest in issuing shares. In this research, we put up the idea of a comprehensive investigation of the accuracy of several stock-price-forecasting algorithms. The research was broadened to include Deep Learning and Neural Network models such Convolution Neural Networks, Artificial Neural Networks, Long Short Term Memory, etc., in addition to the more conventional ML methods like RF, KNN, SVM, Naive Bayes, etc.The research also contains and contrasts the outcomes of other methods used to anticipate stock values, such as sentiment evaluation, time series analysis, and graph-based techniques [04].

IV. PROPOSED METHODOLOGY

In the above section discuss the different methods which are presented in the last decade by different researchers. Now discuss the proposed method which is based on the linear regression model and LSTM model. Now let's talk about the LSTM-based stock price prediction technique. The long short-term memory (LSTM) and how it functions are discussed in this section [21]. A sort of recurrent neural network is the LSTM. The result from one phase is passed to the next in this deep learning approach, and so on. The LSTM attempts to address the recurrent neural network's long-term reliance issue. Formula of Long Short-Term Memory.

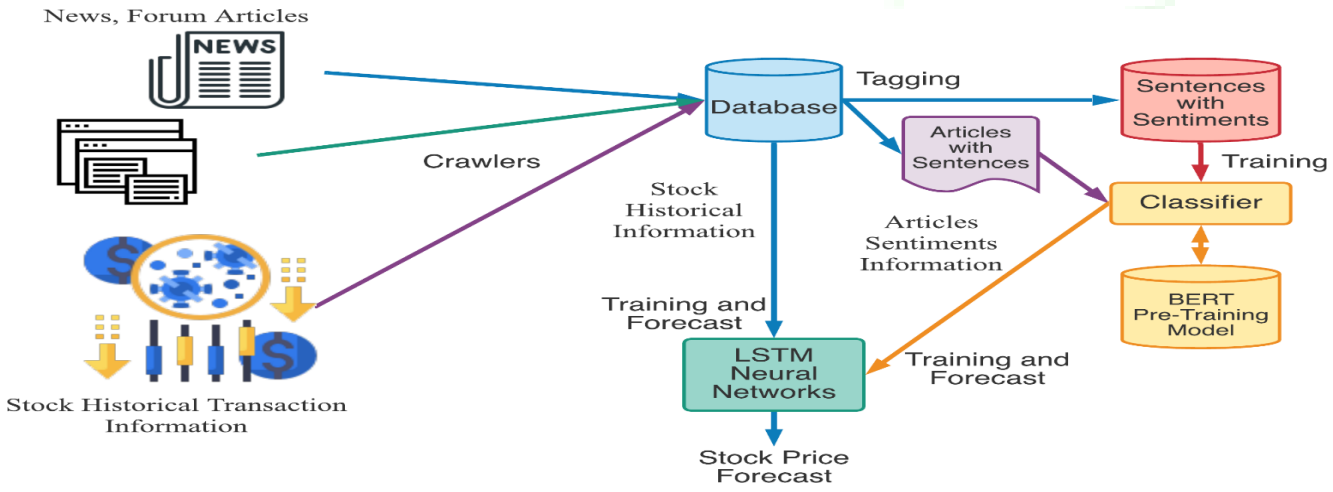

Fig 2 Flow Chart for Regression Based LSTM Model

The proposed method is based upon the use of linear regression algorithm for predicting correct values by minimizing the error function as given in Figure 2.

- Work was carried out on CSV format of data through panda library and calculated the parameter which is

to be predicted, the price of the stocks with respect to time.
- The data is divided into different train sets for cross validation to avoid over fitting.
- The test set is generally kept 20% of the whole dataset.
- Linear regression as given by the above equation is performed on the data and then predictions are made, which are plotted to show the results of the stock market prices Vs time.
- Long Short-Term Memory (LSTM) Network Based Model
- LSTM is the advanced version of Recurrent-Neural-Networks (RNN) where the information belonging to previous state persists.
- These are different from RNNs as they involve long term dependencies and RNNs works on finding the relationship between the recent and the current information.
- This suggests that the data interval is generally less than the LSTM interval.
- The primary motivation for utilizing this model in predicting the stock market is the fact that forecasts rely heavily on data and, in most cases, on the long-term performance of the market.
- So, LSTM regulates error by giving an aid to the RNNs through retaining information for older stages making the prediction more accurate.

B. Features Selection Approach

The suggested method's identification of characteristics is a crucial phase in the stock's price prediction process. Use the features indicated below in the suggested technique. -

- Spatial Distance: Spatial distance in the stock market refers to the physical or geographic separation between the headquarters or primary location of a company and the location of its investors or traders.
- Mean: A statistical metric called the mean may be used to assess performance across time.
- Standard Deviation: The statistical indicator for market volatility, a standard deviation quantifies how much prices deviate from the median price.
- Variance: Variance is a way to gauge how risky a purchase is.
- Correlation Coefficient: A statistical indicator of the strength of a linear link among the two variables is their correlation coefficient. Its values may be between -1 and 1.
- Incremental variance: When it comes to the stock market, supplementary variance is the extra risk or uncertainty that one stock, or a portfolio of stocks, contributes to the investor's entire risk assessment.
- Spatial correlation: Spatial correlations in the shares market refers to the connection between the returns of various securities in various geographical regions. It gauges how closely stock returns in a particular area are connected to stock returns in another location.
- Seasonal Distribution Error: The seasonal distribution error feature for environment monitoring applications. But it may not be meaningful to healthcare monitoring applications. Thus, other methods for feature extraction and selection have been studied.
- Linear Prediction Error: Differences among the actual values of the variable that is dependent and the expected values for that variable produced using a specific regression equation and the reported values of the variable that is independent are referred to as errors of prediction.

C. Linear Regression

A variable that is dependent and one or more distinct variables are modelled in a linear manner using linear regression [7]. In organize to employ linear regression in this situation; we will first fit a model to the previous N values in order to predict the value for the current day.

A common statistical method for simulating the connection between a dependent factor and one or more uncorrelated variables is a linear regression. There are a number of indicators that may be used to assess the effectiveness of linear regression models, including:

- Mean squared error (MSE): The MSE computes the average of the squares difference between the predicted principles and the actual values. A lower MSE indicates more effectiveness.
- R-squared (R2): R2 estimates the percentage of the variation in the dependent variable that can be accounted for by the variables that are independent. Improved efficiency is indicated by higher R2.
- Root mean squared error (RMSE): The mean variation between what was anticipated and the real values, expressed in the same measurements as the dependent variable, is careful by the RMSE, which is the square root of the MSE.
- Mean absolute error (MAE): The average relative variance between the expected and actual values is measured by MAE.
- Adjusted R-squared: Adjusted R2 the R2 is adjusted to reflect the number of variables that are independent utilised in the model.

In general, a good linear regression model should have a low MSE, low RMSE, and low MAE, and a high R2 and adjusted R2. However, the performance metrics depend on the specific application and data set, and it is important to consider both the statistical significance and practical significance of the results.

V. SIMULATION AND RESULT

For the simulation of proposed method use Google co lab. Google co lab provide user friendly environment to implement the proposed research work with power full graphic card and required hardware. There are different result parameters are calculated to optimized the result.

A. Mean Squared Error (MSE): It is possible to define empirical danger (the mean loss on an observation

information set) as an assessment of the actual MSE (the genuine risk:

MSE= 1/(n) ∑_(i=1)^n(Y_1-〖Y^^〗_1)^2
MSE = mean squared error
N = number of data points
Yi = observed values
Y^i = predicted values

B. Root Mean Square Error (RMSE): One of the methods most commonly used to assess the quality of forecasts is the root mean squared error, also known as the average of the root mean square deviance.

RMSE=√((∑_(i=1)^N 〖‖ (i)-Y^Λ (i) ‖ ^2 〗)/N)

C. Accuracy- One parameter for assessing systems of classification is efficiency. The percentage of predictions that our model correctly predicted is known as accuracy. The following is the official definition of accuracy:

Accuracy=(Number of correct predictions)/(Total number of predictions)

For binary classification, accuracy can also be calculated in terms of positives and negatives as follows:

Accuracy= (TP+TN)/(TP+TN+FP+FN)

Where TP = True Positives,
TN = True Negatives,
FP = False Positives
FN = False Negatives.

D. Stock Price: The task of stock price prediction involves estimating future stock values based on historical data and a range of market variables. This approach makes use of statistical models and learning technologies to evaluate financial data and project a stock's future profitability [8]. Stock price prediction provides a perspective for future stock prices in an effort to help investors make informed investment decisions.

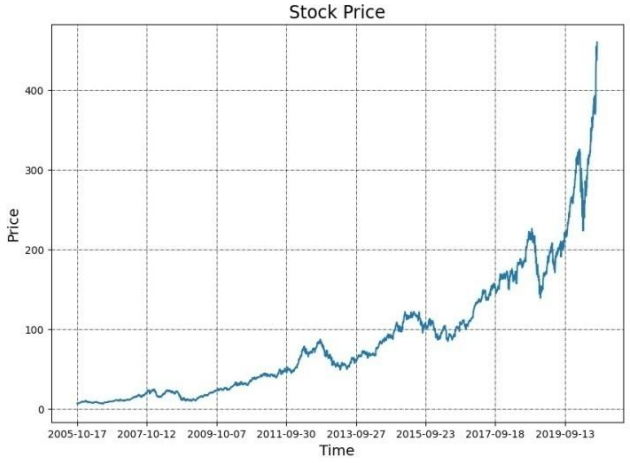

Fig 3 Stock Price

The above figure 3 shows the training data set based stock price prediction. This data use for training and validation of proposed method.

Table I Stock Price

Proposed method	Result Parameters				
	Accuracy	MAPE	MSE	RMSE	MAE
Training	1.0	1.45	1.48	1.22	0.76
Validation	0.99	1.68	1.48	5.91	3.75
Testing	0.96	1.77	79.21	8.9	6.5

In the Table I shows the different result parameters of proposed method such as accuracy, MAPE, MSE, RMSE and MAE. The proposed shows 100% accuracy in training, 99% in training and 96% in testing. In the below figure 4 shows the graphical representation of proposed method error (MAE, RMSE, MAPE) and accuracy comparison of proposed method at different stage.

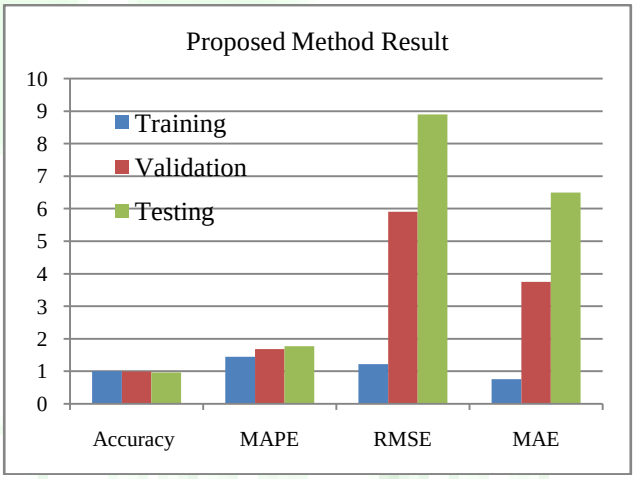

Fig. 4 Error and accuracy comparison of proposed method at different stage

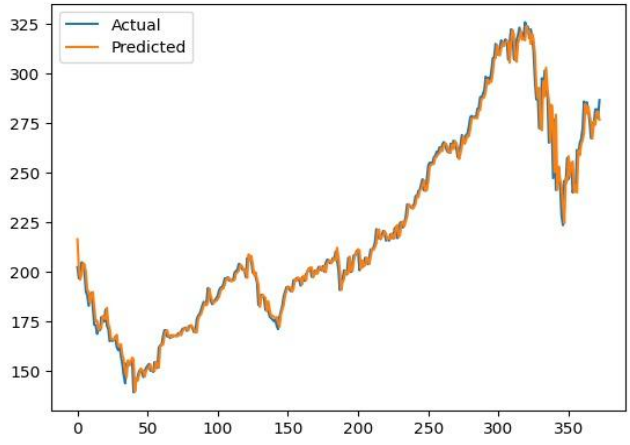

Fig 5 Actual Predicted

In the above figure 5 shows the proposed method testing result of proposed method. For testing of proposed method use different time frame. The above figure 5 clearly shows that the proposed method shows robust result for stock price prediction. for better visualization shows this graph in the tabular form. In the below table II shows the actual

value and predicated value. The proposed shows good accuracy for the prediction of stock price in testing section up to 97%.

Table II. Actual Predicted

S.NO.	Actual	Predicted
0	202.30	216.289778
1	196.56	201.470182
2	198.68	195.948933
3	204.71	199.043601
4	204.00	204.193666
...	...	...
368	273.79	275.751755
369	281.70	274.020243
370	281.90	280.710045
371	277.33	280.543603
372	286.44	276.562125

Now discuss the comparison of proposed method with different previous method presented in the recent year on the basis of machine learning and deep learning.

Table III. Comparison of proposed method different Previous Method

Year/Ref.	Method	Avg. Result
2024/ proposed	Proposed Linear Regression based model	MAPE- 1.77 RMSE 8.9 MAE 6.5 Accuracy 0.96
2023/ [1]	Clustered 3D-CNN model	MAPE- 0.083 RMSE 40.39 MAE 32.31
2023/ [3]	LSTM network	Accuracy approximately 75%
2021/ [9]	LSTM based hybrid Network based on Doc-W-LSTM And LSTM	LSTM MAE-0.385 RMSE0.240 Accuracy 0.906 Doc-W-LSTM MAE-0.019 RMSE 0.110 Accuracy 0.957

VI. CONCLUSION

This research presents a study on the use of an improved regression model with Long Short Time Memory (LSTM) using an enhanced features selection process for robust stock price prediction. The approach proposed in this study demonstrates superior accuracy compared to earlier methodologies. The training accuracy achieved is 100%, the validation accuracy, which stands at 99%, and the final testing accuracy, which is 96%. The approach under consideration demonstrates reduced mistakes in comparison to prior methodologies, with a mean absolute percentage error (MAPE) of 1.45, a mean square error (MSE) of 1.48, a root mean square error (RMSE) of 1.22, and a mean absolute error (MAE) of 0.76. The current approach demonstrates superior performance compared to earlier methods in terms of accuracy, RMSE, MAE, and MAPE. This study compares the results of the proposed technique with three other contemporary methods: a 3D CNN model, a pre- and deep neural network, and an LSTM-based hybrid network based on Doc-W-LSTM. The approach developed in this study demonstrates superior performance in terms of MAPE (1.77), RMSE (8.9), MAE (6.5), and Accuracy (0.96). In the subsequent part, an examination of the suggested method's conclusion and future prospects will be undertaken.

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