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A Critical Review of the Effectiveness of Machine Learning & Deep Learning Approaches in Forecasting Stock Market Trends

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Abstract—For a long time, traders as well as researchers have been actively interested in financial market forecasting. A financial market prediction has an interest for investors & researchers since long time. An existing method for predicting stock prices often rely on technical and fundamental analysis, which have limitations in handling the complexity and volume of financial data. To handle complex data sets for forecasting the value of stock using new emerging learning techniques. The most commonly used approach such as artificial neural networks (ANN), neural network techniques, SVM, decision trees algorithm, and random forests. These techniques can capture complex nonlinear relationships between variables and adjust to changing market conditions. The machine learning & deep learning analyze the trend for the future values of stock prediction and provides observation for making decision. The importance of feature selection and data preprocessing are used for improving the prediction accuracy of stock value. The genetic method feature selection concept can reduce the dimensionality of the data and remove irrelevant features, while data preprocessing techniques such as normalization and scaling can improve the stability and convergence of the algorithms. Sentiment analysis of social media data can capture market sentiment and investor behavior, while news articles can provide insights into company performance and industry trends. The accuracy of predictions tends to decrease as the prediction horizon increases and the prediction accuracy varies across different stock markets. A lot of significant work, the most recent stock market-related prediction system includes multiple limitations. Now the conclusion, the projection of stock markets is a hybrid approach & certain parameters for stock market forecasting should be as accurate as possible.

Keywords-Deep Learning (DL), Machine learning (ML), Stock Prediction, ANN, NN, Support Vector Machine (SVM).

I. INTRODUCTION

Nowadays, the most influential research area for predicting stock prices is the securities market. The two network models that have been widely utilized in predicting stock market prices are using the learning approach such as Artificial Neural Network (ANN) & the Convolutional Neural Network (CNN). Over past three decades, people's interest in the stock market has grown exponentially and more growth is seeing after COVID-19. Because a billions dollars in assets are traded on the exchanges on a regular basis. Investors acting on the market in the hope of profiting over their investment time-frame. If an equity market player such as an Individual or Institutional investor could actually predicted market behaviour. This inspires the utilization of machine learning, computational intelligence technologies to develop better models for predicting the market.

The Bombay Stock Exchange (BSE) & the National Stock Exchange (NSE) represent two majorities of Indian stock exchanges. Both exchanges adopt the similar trading strategy, trading time and settlement the system. Only about 500 of the BSE's listed firms account for more than 90% of its market capitalization and the rest is formed of highly not liquid shares (Somenath Mukherjee et al., 2021). "A hybrid modeling strategy for predicting stock price consists of developing multiple machine learning and deep learning-based frameworks. It depends on the NIFTY 50 index values of India's National Stock Exchange (NSE) from 29th December, 2014 to 31st July, 2020. The results display that the most accurate model is an LSTM-based univariate model that takes one-week prior data as input to predict the coming week's open price of the NIFTY 50 time series data" (Sidra Mehtab et al., 2020). An exclusive strategy for increasing financial market investing returns that combines two Evolutionary Algorithms

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using fundamental and technical investing mechanisms. The technical investigation performed superior in "bear markets," while the basic case study worked very well in "bull markets." For the highest possible financial market investment returns, two Evolutionary Algorithms (EAs) were implemented in conjunction with basic and technical investment methods (Rodrigo Lopes De Almeida, 2022). Across this research, we included the multiple recent articles for inclusive review using the different methodologies.

II. Universal Approaches to Stock Prediction: A broad Analysis of Data and Learning Techniques in the Financial Market

A. *Indicators*

Fundamental indicators are divided into two categories:

(1) Stock information listed on a public exchange.

(2) Income statement and balance sheet, which refer to financial reporting.

Exchange rates, economic performance, commodities and interest rate are the four categories of macroeconomic variables.

Technical indicators are generally useful as input value in forecasting because they employ an important job in long & short signals for trading of stock. They are important in identifying long and short signals of stock. General Indicators and advanced Indicators are two types of indicators. All indicators have specific properties.

Finally, other indicators can be multiple roots with no any classification. For example, several studies predict a particular stock price based on other indicators such as financial news, government policies, institutional data and social media.

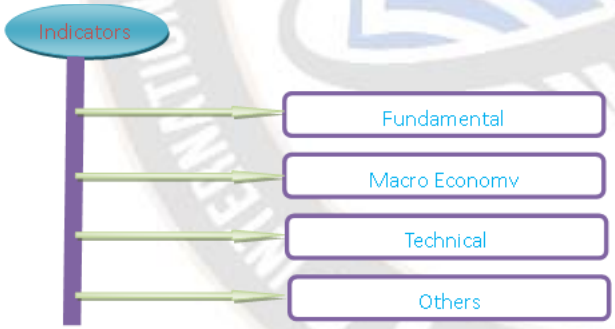

Figure 1: Indicators for stock prediction

B. *Learning Models*

Research articles relating to stock market prediction can be analyzed and reviewed to find predictions. The selected studies were categorized based on the applied prediction methods, performance metrics and software tools used.

Several machine learning, deep learning and statistical techniques were reviewed in this paper. On the basis of existing research, it pointed out some future research directions on data processing methods & data used.

Analyze multiple journals and conference papers to provide a comprehensive picture in stock market forecasting method such as ML methods, deep learning methods, performance calculation and data-set.

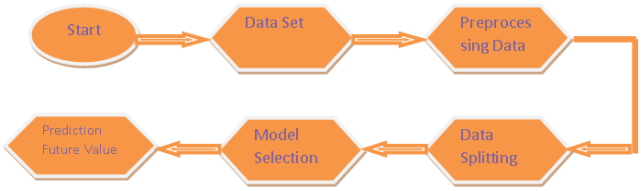

Figure 2: Workflow of stock market prediction

III. STUDY OF WORKS

Indian stock exchange categorized into two types: Bombay Stock Exchange (BSE) & National Stock Exchange (NSE) and another MCX for Commodities. Here, we have studied multiple articles and found the methodology, outcomes of various articles. The outcomes are written in two tables: table1 contains machine learning and statistical techniques based and table2 contains Deep Learning methods for forecast of stock price.

TABLE 1: MACHINE LEARNING FOR STOCK PREDICTION

Authors & Year	***Summary***	***Methodology***	***Key Outcomes***
Chinthakunta Manjunath, Balamurugan Marimuthu, et. All, 2023	The combined PCA approach and machine learning methods that outperform the prediction performance.	Machine learning algorithms to support in accurate prediction trend of index of Nifty 50.	✓ To achieve good accuracy in the Nifty 50 index with support vector classifier (SVC) & radial basis function (RBF). ✓ Achieves a high accuracy and F1-score using the random forest model. Area under the curve (AUC) score is 1.
David Abad, BelÃn Nieto, et. All, 2023	Exchange liquidity threat matter for asset price autonomously of stochastic reduction issue.	a machine learning approach	✓ Volatility of SDF is boosted up by market-wide illiquidity, with trivial effects on high moment of its circulation.
M. Liang, Shaocong Wu, et. All, 2022	Focuses on a candlestick data pattern approach is capable.	candlestick patterns and sequence	✓ The proposed patterns are to validate on actual data in Chinese exchange over 800 stocks and achieves higher accuracy than the SVM and other models used for comparison. ✓ The method is more interpretable, robust, and compatible than other multi-modal data-based approaches.
Salvatore Carta, Sergio Consoli, Alessandro Sebastian Podda et. All, 2022	Explainable AI trading strategies outperform from highly existing comparative strategies.	explainable AI techniques combined into a statistical arbitrage machine learning approach	✓ Remove extraneous features for prediction using given methods in the article. ✓ Explainable AI strategy outperform from existing highly reliable strategies.
Rodrigo Lopes	A sliding window and a	Two Evolutionary	✓ These algorithms were used

Authors & Year	***Summary***	***Methodology***	***Key Outcomes***
De Almeida, Rui Ferreira, 2022	static portfolio of 2 years of train/test performed the best result with self adaptive EA methods.	Algorithms (EAs) combined with technical & fundamental investment	of optimization the weight of fiscal ratio from the F-Score and for defining the importance of preferred technical indicators. ✓ It was also used in the S&P500, with the technical study performing improved in bear market and the fundamental study performing superior in bull market.
Malti Bansal, A. Goyal, Apoorva Choudhary, 2022	Five algorithms (K -Nearest Neighbors, Regression, Linear Regression, Support Vector, Decision Tree Regression and LSTM) are used by the authors but deep learning outperforms in time series prediction	machine learning algorithms	✓ 5 techniques were tested on a dataset of 12 top organization of the Indian exchange market during the last 7 years. ✓ For time series prediction on stock price, the DL algorithm outperformed all other algorithms and provided results with high accuracy.
Arafat Jahan Nova, et. All,2021	Artificial Neural Network (ANN) can predict data after learning & interpreting inputs with their relations.	Artificial Neural Network (ANN) technique	✓ Stock price forecasts can be made using backward propagation algorithm and feed forward network. ✓ An approach can predict the value of stock in any trading day depend on inputs using ANN & back propagation algorithm.
Jingyi Shen, M Omair, 2020	Researchers used the SVM approach on the listed company trends from financial and technical domains.	Support vector machines (SVM) and ANN	✓ Volume based prediction is not very effective the forecasting performance on the data sets used. ✓ Support vector machines outperformed multi-layer perceptrons in most cases.
Sidra Mehtab, Jaydip Sen, S. Dasgupta, 2020	Deep learning with regression model have an extremely better accuracy for predicting stock prices.	Hybrid learning methods	According to implementation time and RMSE values, provided comprehensive results on the predicting accuracy of models.
M. Ananthi, K. Vijayakumar, 2020	Regression and candlestick pattern detection are applied by the algorithm to forecast the stock price of any firm listed for the next days and onwards.	machine learning algorithms	✓ Using computational learning methods, the correctness of stock exchange's prediction was evaluated & improved to 85%. ✓ The system provides candlestick graph signals that user decide whether a stock is a "Buy" or "Sell" and the degree of precision to occur with market movement.

TABLE 2: DEEP LEARNING METHODS FOR PREDICTION OF STOCK PRICE

Authors & Year	***Summary***	***Methodology***	***Key Outcomes***
Azeez Oyedele, A. Ajayi, , et. All, 2023	The CNN model is more accurate for predicting on the daily closing prices for numerous cryptocurrencies with less training data.	Tree-based approaches were boosted and Deep Learning (DL) was improved using a genetic algorithm.	✓ With the Convolutional Neural Network (CNN) had the smallest value of mean average percentage error is 0.08. ✓ The highest average explained variance score of 0.96 across the models. ✓ The models outperformed the boosted tree approach in predicting several cryptocurrencies on closing prices using deep learning.
Ana Lazcano, Pedro Javier Herrera, et. All, 2023	A combination BiLSTM-GCN model offers new opportunities for time series analysis and enhances current results.	BiLSTM-GCN model	✓ The combined BiLSTM-GCN technique increases the accuracy of this model's predictions.
Ana CorberÃ¡n-Vallet, Enriqueta Vercher, et. All, 2023	A novel approach to portfolio selection is proposed on the basis of the analyzing & forecasting the portfolio's worth with the time series method.	A multi-objective genetic algorithm	✓ To analyze the time series and forecast future portfolio values, a damped trend model is applied. ✓ The portfolio chosen difficulty has been resolved with a multi - objective genetic approach.
Zahra Fathali, Z. Aouina Kodia, et. All, 2022	Deep learning networks can be utilized to forecast NIFTY 50 stock price movements in the future.	Deep learning networks	✓ LSTM model has lowest errors compared toward the CNN.
Jaydip Sen,	For accurate stock price	deep learning	✓ In different 9 sectors in Indian

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Authors & Year	*Summary*	*Methodology*	*Key Outcomes*
Abhishek Dutta, et.all, 2021	predictions, there are five deep learning models include long – short term memories and four convolution neural networks (CNN).	methods	exchange, the best possible portfolios were created. Each portfolio's projected the actual returns were found to be high, indicating the high precision of LSTM models. ✓ These models yielded a very good accuracy in future prediction of stock price.
Chinthakunta Manjunath, Christ, et. All, 2021	In comparison to earlier methods, GRU's NIFTY 50 index examines with the technical indicator dataset TA1 was more effective.	deep learning methods	✓ With the technical indicator dataset TA1, the three GRU variations approach produced the lowest MSE=0.023 and RMSE=0.152 results.
S. Mukherjee, Bikash Sadhukhan, et. All, 2021	Network models include the ANN and the CNN has frequently included for forecasting stock market prices.	deep learning algorithms	✓ The precision of the CNN model was 98.92%, in contrast to 97.66% for the Artificial Neural Network (ANN) model. ✓ The CNN model forecasts depend on 2 - D histograms formed from the quantified dataset with a specific time frame.
Sidra Mehtab, et. All, 2020	A hybrid modeling strategy depends on emerging learning models. It was applied on open price of NIFTY 50 index.	deep learning methods	The better model was an LSTM –depend on univariate model. It forecasts the NIFTY 50 time series' open price for coming week with data from previous week as input.
M. Hiransha, et. All, 2018	The current linear model (ARIMA) is underperforming the neural networks.	4 types of deep learning architectures	✓ CNN outperforms the other models in predicting stock prices. ✓ Neural networks are more accurate than the existing linear model (ARIMA).

IV Result & Discussion

These research disciplines involve obtaining the data from a set of selected papers. Several of the selected research was published in publications and conferences. Table 3 tabulated research area of the articles and article published year by the selected studies. Figure 3 shows the article published year and Figure 4 shows the different area of article consider. Most of the Procedia computer science and expert systems & applications are the dominant journals. Most of the articles based on hybrid model but it is not applicable for each sectors. The deep learning model is most suited for multiple sectors for better accuracy. In deep learning, the integrated LSTM model with some other techniques provides better prediction in exchange market.

TABLE 3: NUMBERS OF ARTICLE CONSIDER BASED ON AREA & YEAR

Sr. No.	Article published Year	Nos. of Article	Article consider on area	Nos. of Article
1	2023	5	Machine Learning	10
2	2022	5	Deep Learning	9
3	2021	4		
4	2020	4		
5	2018	1		

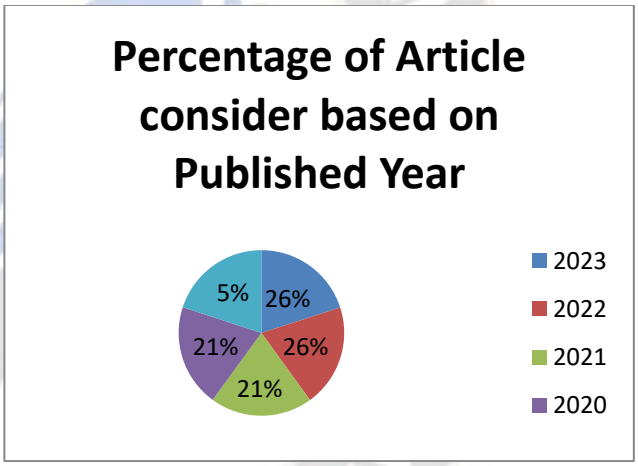

Figure 3: Article consideration based on year

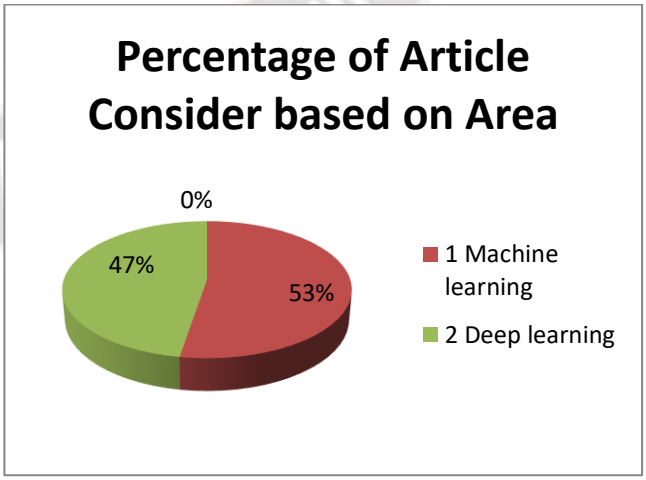

Figure 4: Article distribution based on area

V. CONCLUSION

This manuscript focus research on various mathematical machines learning strategy & also on deep learning strategies selected into various sectors in stock market. This paper goal is to categories current methodologies for using different datasets, performance matrices, and applying techniques. This paper is written using multiple articles from the highly dominant journals. The stock market prediction strategies are categorized using several machine learning algorithms. A number of the chosen studies use hybrid approaches on learning models in the stock market to increase prediction accuracy. It is common practice to use ANN and NN techniques to make accurate stock market predictions. These strategies are used to monitor and keep an eye on the entire stock market. The key problem with stock market forecasting is that a large proportion of modern methods cannot be separated with the assistance of a collection of historical data. Thus, government policy decisions factors and consumer sentiment also have an impact on stock markets. We will continue to work on developing integrated system using various deep learning prediction methods for more accurate stock in financial market.

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