

SURVEY ON STOCK MARKET FORECASTING USING RECURRENT NEURAL NETWORKS AND LSTM

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Abstract -- In a financially volatile environment like the stock market, a very precise prediction of a future trend is critical. Because of the financial crisis and the need for profits, having a reliable stock market prediction is critical. Stock investment strategies are complex and rely on massive volumes of data analysis. Stock investors have persisted to seek out the finest of these two business factors by using forecasting machine learning algorithms to assist in their planning process. However, with so many systems currently in use, it could be asserted that the wide variety of data on upon which they are based is inadequate. They conducted research into the use of long-term short-term recurrent neural networks in stock prediction and intended experiments around the enhancement of the machine learning model's timeliness to ensure its effective implementation into our proposed predictive system. Our goal is to devise an ensemble learning predictive system that will use an array of big data sources.

Keywords: machine learning algorithm, stock market prediction, literature survey, artificial neural network, support vector machine, long short term memory network

I. INTRODUCTION

they now exist solely on data. Predicting future stock market data is a critical financial subject that assumes fundamental information made public in the earlier days has had some predictive relationships to future returns on stocks. Recognizing market dynamics, planning investment options, determining the ideal time to invest in stocks, and determining which stocks to purchase are all part of predicting the stock market. The investment business community, also known as the stock exchange, is a non-direct, non-parametric framework that is difficult to model with any reasonable precision. It is a group of investors who must buy, sell, or hold a particular stock at a specific time. Prediction will continue to be an exciting area of research, with analytic scientists constantly looking for ways to improve existing forecasting models. The goal is to enable businesses

In recent years, the growing importance of machine learning in various sectors has influenced many traders to implement machine learning techniques to the field, and a few of them have generated quite impressive outcomes.

This paper will create a financial data predictor programme with a datasets containing all historical stock prices and data that will be used as training sets for the programme. The prediction's main goal is to reduce the uncertainty associated with investment decisions.

Machine learning algorithms, such as artificial neural networks and support vector machines, had also been utilised to stock market prediction. These algorithms use complex mathematical models and large amounts of data to identify patterns and make predictions. Artificial neural networks, for example, can be used to identify nonlinear relationships between stock prices and other factors, while support vector machines can be used to identify the most important factors affecting stock prices.

More recently, researchers have started to explore the use of alternative data sources, such as social media and news articles, in stock market prediction. These studies have found that incorporating such data can provide additional information and improve the accuracy of predictions. For example, sentiment analysis can be used to determine the overall sentiment of news articles and social media posts related to a particular company, and this sentiment can be used as a predictor of stock prices.

The utilization of ANN with business environments has increased in recent years. An excellent algorithm has been used to forecast the price of a stock or an index. In the last decade, there has been a significant increase in research activities related to neural networks. Artificial neural network models are based on the brain's neural structure. The brain and artificial neural networks both learn from experience. ANN is widely used as a useful analytical tool in analyzing business data stored in databases or data warehouses. Identifying patterns in customer behaviour and predicting stock prices are two

emerging areas of neural network research and application. The majority of businesses have developed new methods for analyzing financial data and making investment decisions. Most businesses use Artificial Neural Networks(ANN) to improve forecasting capabilities in analysis.

Through training, the main objective of neural network forecasting is to discover an approximate solution of mapping among input and output data. After that, the trained recurrent neural network is used to forecast future values. This paper describes how an ANN methodology can be used to forecast stock market prices.

Many investigators often use ANN methods for forecasting stock trends, such as auto-regressive moving average models, two types of back propagation neural networks, and multi-layer perception. The biggest drawback of a feed forward neural network is its inability to handle sequential data since it solely considers the current input and does not remember previous inputs. Recurrent Neural Networks (RNN) have proven to be a popular solution for overcoming this limitation. Given that they are designed to understand time-varying and linear patterns, RNNs had also gained considerable interest in recent stock prediction research. Long Short-Term Memory Networks (LSTM) are a type of RNN that seems to be able to learn long-term dependencies. Gao et al.[8] suggested an approach for forecasting closing stock prices using LSTM, illustrating that LSTM offered a superior prediction performance of 100/200/400 days with the S&P 500 index. As mentioned in numerous studies have been conducted to forecast stock prices using LSTM. Because of the unique attributes of stock data, the precision of forecasts from conventional methods such as Auto-regressive Moving Average (ARIMA), support vector regression (SVR), and random forest is insufficient.

In this paper, they describe and present the research on predictive methods, as they'll as our proposed model to a system that makes use of big data to predict the price of stocks, and how it might be improved more than is typically instated using LSTM. Furthermore, they postulate that our framework use parallelization with the Ray framework [2] to decrease the lag of model training.

II. LITERATURE REVIEW

This paper conducts a systematic review of studies that forecast stock market prediction and analysis using various methods. They extracted and synthesized 15 research papers and discovered various methods for predicting stock market conditions and for investors to easily invest their money in the stock market. Some of these methods include:

- (1) Artificial Neural Network (ANN),
- (2) Support Vector Machine (SVM),
- (3) ARIMA Model,
- (4) Long Short-term Memory (LSTM), and
- (5) Hybrid Methods.

Each category's studies are reviewed to identify common findings, unique findings, limitations, and areas that require further investigation. The final section provides overall conclusions and future research directions.

A. *Studies Based On Artificial Neural Networks (ANN)*

Jahan, Arifat & Mim, Zahada & Rowshan, Sanjida & Riad, Md & Nurullah, Md & Biswas, Milon. (2021). Stock Market Prediction on High-Frequency Data Using ANN. This research presented the Artificial Neural Network (ANN) approach in this research since it can generalise and forecast data following developing and analysing the first set of inputs and connections between them. To forecast the price of stocks, they employed a feed forward network and a backward propagation method. In this research, they presented a technique for predicting the possible future estimation of stock prices utilising certain inputs utilising the ANN backward propagation technique[6].

Pashaei, Zahra & Dehkharghani, Rahim. (2021). Stock Market Modeling Using Artificial Neural Network and Comparison with Classical Linear Models. Signal and Data Processing. In the proposed method, Cognitive Nonlinear Systems such as Artificial Neural Networks (ANNs) and Adaptive Network-based Fuzzy Inference System (ANFIS), they're employed in the suggested technique to estimate the everyday value of the stocks of Tehran's stock market. Finally, the efficiency of the aforementioned models was tested and contrasted to the regular traditional models such as ARIMA and SARIMA. During the evaluation phase, this time series data are fed into non-linear ANN and ANFIS models, and feature selection is used to extract the most influential features using mutual information (MI) and correlation coefficient (CC) criteria[12].

Oloduwo, Ameen & Fashoto, Stephen & Ogeh, Clement & Balogun, Abdullateef & Mashwama, Petros. (2019). Optimization of Artificial Neural Network for Stock Market Price Prediction Using an Enhanced Firefly Algorithm. The Artificial Neural Network (ANN) trained with an Enhanced Firefly Algorithm (EFA) was used in the study. The studies employed a daily historic dataset of the price of stocks for five businesses trading on the New York Stock Exchange (NYSE) from October 13, 2005 to October 14, 2015. The Enhanced Firefly Algorithm (EFA) was implemented to optimise the parameters of the Neural Network with the objective to create

precise projections. To increase the model's forecasting accuracy, a reduction technique was employed to gradually lower the randomly generated parameter for the firefly during the Firefly Algorithm (FA)[11].

Ghashami, Farnaz & Kamyar, Kamyar & Riazi, Ali. (2021). Prediction of Stock Market Index Using a Hybrid Technique of Artificial Neural Networks and Particle Swarm Optimization. In this study, they investigate the potential of Artificial Neural Network (ANN) approaches to forecast the index of stocks. To increase the precision of predictions, they initially do an ANN assessment followed by optimising the ANN model employing the Particle Swarm Optimisation technique (PSO). In the context of statistics, they utilise the NASDAQ index, which happens to be one of the most popular in the United States. Experimental findings demonstrate that by applying PSO to determine the ideal choice of prejudices and the strengths, they may enhance the ANN model's precision on this stock market information set[4].

S. Kumar Chandar. (2022). Convolutional neural network for stock trading using technical indicators. This research develops and implements a stock forecasting model that combines Historical Indicators with Convolutional Neural Networks (TI-CNN). The financial data used in this study were obtained from publicly accessible sources. As feature vectors, ten technical parameters are retrieved from previous data. Following that, vectors with features are transformed into images utilising Gramian Angular Field and supplied onto the CNN[14].

B. Studies Based On Support Vector Machine (SVM)

Mahmoodi, Armin & Hashemi, Leila & Jasemi, Milad & Laliberte, Jeremy. (2022). A developed stock price forecasting model using Support Vector Machine combined with Metaheuristic Algorithms. The goal of this study is to employ an appropriate framework to anticipate stock exchange trading signals at excellent precision. Two methods for analysing technological adaptability were utilised to feed this goal. Support Vector Machine (SVM) is utilised in conjunction with particle swarm optimisation (PSO), where PSO is utilised as a rapid and precise categorization for exploring the problem-solving space, and the outcomes are subsequently contrasted to the effectiveness of a pair of additional meta heuristic algorithms, which includes the neural network as well as the Cuckoo search algorithm (CS)[8].

Gaur, Varun & Bhardwaj, Sharad & Gaur, Utsav & Gupta, Sushant. (2022). Stock Market Prediction & Analysis. The article discusses how they propose an

economical Machine Learning (ML) technique. Algorithms are trained using publicly accessible market data and information, and then apply what they have learnt to create a precise projection. In this context, machine learning is used. Support Vector Machine (SVM) is a method used to anticipate stock prices for major and small size businesses, in addition to three separate marketplaces, utilising up-to-date everyday and they easily pricing Data[3].

Akash, A & Rajaji, Shanthi & Aravindh, R & Vendhan, V & Veerapandi, D. (2019). Stock Market Trend Prediction using Machine Learning. SVM is used in the framework for forecasting the stock market, which is ineffective. As a result, in our project, they suggested the Least Square Support Vector Machine (LS-SVM) and applied the Particle Swarm Optimisation (PSO) technique. To reflect everyday price of stocks, the PSO algorithm is used to optimise LS-SVM. The suggested approach depends on an examination of past stock data and indicators of trading. The PSO method determines the optimal free parameter pairing for LS-SVM in order to prevent biases and local problems with minimization while improving the accuracy of predictions[1].

C. Studies Based On ARIMA Model

Minhaj, Nayab & Ahmed, Roohi & Khalique, Irum & Imran, Mohammad. (2022). A Comparative Research of Stock Price Prediction of Selected Stock Indexes and the Stock Market by Using Arima Model. This article describes how to develop a complete stock price prediction model using the ARIMA model. A prediction model is built using the stock price of Johnson & Johnson (JNJ) and public stock data from the S & P (500). The results show that the ARIMA model can address standard stock price forecasting methodologies and has a lot of short-term forecasting potential for JNJ. Because of its extreme volatility. The ARIMA model, on the other hand, is not well suited to non-stationary or weakly stationary data, such as the S & P 500 index[9].

Bansal, Ankit. (2022). Prediction and Analysis of Stock Market using ARIMA Model and Machine Learning Techniques. They explained in this research that if news sentiment for a certain stock is taken into account, the outcomes are likely to be better. Market psychology, behavioral economics, and quantitative analysis are used to estimate future market behavior. A solid projection of a stock's future price might be extremely beneficial. They usually try to discover the best mix of multiple prediction models-LSTM, Prophet, and ARIMA-so that the forecast is as near to the original as feasible. This will aid in better measuring the market for certain equities and the error gap through the use of technology. It is primarily concerned with evaluating how a present trend will continue and, if not when it will reverse[2].

D. Studies Based On Long Short-term Memory (LSTM)

Venikar, Isha & Joshi, Jaai & Jalnekar, Harsh & Raut, Shital. (2022). Stock Market Prediction Using LSTM. This paper suggests a model for forecasting stock prices that will employ an LSTM model. The stock prices will be projected using historical data. Stacked LSTM will be used for prediction because it uses historical data, making predictions more accurate because it can learn long-term dependencies in data, making LSTM an ideal technique for stock market prediction due to its dynamic and complex nature[15].

Nadif, Mohammad & Samin, Md & Islam, Tohedul. (2022). Stock Market Prediction Using Long Short-Term Memory (LSTM). They propose a non-linear approach based on the architecture of Long Short-Term Memory (LSTM). According to research, LSTM-based models outperform other models in predicting time and sequential models, while RNN is the first algorithm with an internal memory that remembers its input, making it perfect for machine learning issues involving sequential data[10].

Hassan, Mohsen & Youssif, Aliaa & Imam, Osama & Ghoneim, Amr. (2022). On the Impact of News for Reliable Stock Market Predictions: An LSTM-based Ensemble using FinBERT Word-Embeddings. The researcher compares performance and prediction error rates using a range of machine learning and deep learning algorithms. Additionally, the researcher compares the effect of adding the news text as a feature and as a label model, and constructing a Long Short-Term Memory (LSTM) utilising FinBERT word embedding and a specific model for news

sentiment analysis. Our observations show that Deep Learning-based models outperformed their Machine Learning counterparts. The author demonstrates that information taken from news sources is better at forecasting price fluctuation rather than its direction[5].

E. Studies Based On Hybrid methods

Rao, K. & Reddy, B. Venkata. (2023). HM-SMF: An Efficient Strategy Optimization using a Hybrid Machine Learning Model for Stock Market Prediction. In this research, they offer an efficient strategy optimisation for stock market prediction utilising a hybrid ML model (HM-SMP). The suggested HM-SMP model makes the first contribution by introducing the chaos-enhanced firefly bothey rbird optimisation (CEFOBO) technique for optimum feature selection among multiple features, therefore reducing data dimensionality. Second, for stock market prediction, they create a hybrid multi-objective capuchin with a recurrent neural network (HC-RNN), which improves prediction accuracy[13].

Jain, Sakshi & Arya, Neeraj & Singh, Shani. (2020). Stock Market Prediction Using Hybrid Approach. They suggested a hybrid strategy for stock market prediction that incorporates opinion mining and clustering techniques. Among all existing techniques, their suggested model differs from others in that it not only examines broad states of mind and attitudes, but also groups them using clustering algorithms. The model creates two forms of output as an output, one from sentiment analysis and the other from clustering-based by taking popular stock exchange factors into account. The final forecast is based on a comparison of both outcomes[7].

TITLE	AUTHOR	OBJECTIVE	ALGORITHM	INFERENCE
Stock Market Prediction on High-Frequency Data Using ANN	Jahan, Arafat & Mim, Zahada & Rowshan, Sanjida & Riad, Md & Nurullah, Md & Biswas, Milon	Presented the Artificial Neural Network (ANN) approach in this research since it can generalise and forecast data following developing and analysing the first set of inputs and connections between them.	ANN-Artificial Neural Network	Stock prices were predicted using a feed forward network and a backward propagation method. They presented a method for predicting the potential price of the stock market on a given day employing the ANN back propagation algorithm.
Optimization of Artificial Neural Network for Stock Market Price Prediction Using an Enhanced Firefly Algorithm	Oluoduwo, Ameen & Fashoto, Stephen & Ogeh, Clement & Balogun, Abdullateef & Mashwama, Petros.	Employed a daily historic dataset of the price of stocks for five businesses trading on the New York Stock Exchange (NYSE) from October 13, 2005 to October 14, 2015. The Enhanced Firefly Algorithm (EFA) was implemented to optimise the parameters of the Neural Network with the objective to create precise projections	ANN-Artificial Neural Network and EFA-Enhanced Firefly Algorithm	It was found that the suggested model generated 6.40% and 6.80% greater forecasts with lower median errors than Artificial Neural Network (ANN) forecasts taught with the Firefly Algorithm (FA) and Genetic Algorithm (GA). The method, nevertheless, may be

				improved by employing strategies that increase the convergence rate and precision in forecasting
A developed stock price forecasting model using Support Vector Machine combined with Metaheuristic Algorithms	Mahmoodi, Armin & Hashemi, Leila & Jasemi, Milad & Laliberte, Jeremy.	Employ an appropriate framework to anticipate stock exchange trading signals at excellent precision. Two methods for analysing technological adaptability were utilised to feed this goal.	SVM – Support Vector Machine and PSO-Particle Swarm Optimisation	Examining the results, researchers can conclude that all of the novel models were reliable in 6 days, however, and SVM-PSO is superior to basic study. SVM-PSO has a success rate of 77.5%, although neural network (basic research) and SVM-CS have hit rates of 71.2 and 71.4, accordingly. They evaluated the period from 2013 through 2021 in this research, and if additional time frames are employed, it might be able to attain more ideal outcomes.
Stock Market Trend Prediction using Machine Learning	Akash, A & Rajaji, Shanthi & Aravindh, R & Vendhan, V & Veerapandi, D.	To reflect everyday price of stocks, the PSO algorithm is used to optimise LS-SVM. The suggested approach depends on an examination of past stock data and indicators of trading.	LS-SVM - Least Square Support Vector Machine and PSO-Particle Swarm Optimisation	The suggested model was tested and assessed on thirteen reference data sets from finance before being compared to an artificial neural network employing the Levenberg-Marquardt (LM) algorithm. The collected results demonstrated that the suggested model has excellent accuracy in predicting and the potential of the PSO approach for LS-SVM optimisation.
A Comparative Research of Stock Price Prediction of Selected Stock Indexes and the Stock Market by Using Arima Model	Minhaj, Nayab & Ahmed, Roohi & Khalique, Irum & Imran, Mohammad.	Develop a complete stock price prediction model using the ARIMA model. A prediction model is built using the stock price of Johnson & Johnson (JNJ) and public stock data from the S & P (500)	ARIMA –Auto Regressive Integrated Moving Average	The findings indicate that the model developed by ARIMA can deal with standard stock price projection methodologies and offers plenty of short-term projection potential for JNJ. Because of its extreme volatility. The ARIMA model, in contrast, is not well suited to non-stationary or weakly stationary data, like the S & P 500 indexes.

TITLE	AUTHOR	OBJECTIVE	ALGORITHM	INFERENCE
Stock Market Prediction Using LSTM	Venikar, Isha & Joshi, Jaai & Jalnekar, Harsh & Raut, Shital.	To employ an LSTM model using historical data. Stacked LSTM will be used for prediction because it uses historical data, making predictions more accurate because it can learn long-term dependencies in data	LSTM - Long Short-Term Memory	Because of its ability to understand long-term relationships in data, LSTM is a good approach for forecasting stock markets due to its fluid and complicated character. Upon training the model, its precision will be tested using sample data, and the algorithm will then be used to anticipate the price of stocks for the thirty days that follow.
Stock Market Prediction Using Long Short-Term Memory (LSTM)	Nadif, Mohammad & Samin, Md & Islam, Tohedul.	Proposed a non-linear approach based on the architecture of Long Short-Term Memory (LSTM). According to research, LSTM-based models outperform other models in predicting time and sequential models.	LSTM - Long Short-Term Memory	In this experiment, we gathered share market data from a specific firm called Beximco during the previous 11 years. Various test results are utilised to reaffirm the system's performance. Based on LSTM, this study presents a strong strategy for reliably predicting stock price.
HM-SMF: An Efficient Strategy Optimization using a Hybrid Machine Learning Model for Stock Market Prediction	Rao, K. & Reddy, B. Venkata.	Offers an efficient strategy optimisation for stock market prediction utilising a hybrid ML model	HM-SMP, CEFBO-Chaos-Enhanced Firefly Bowerbird Optimisation and RNN-Recurrent Neural Network	To forecast the closing price, employed guided RNN. Lastly, the suggested HM-SMP algorithm's existence can be estimated using benchmark, financial datasets, or its efficiency may be contrasted with existing cutting-edge models in regard to accuracy, precision, recall, and measure.
Stock Market Prediction Using Hybrid Approach	Jain, Sakshi & Arya, Neeraj & Singh, Shani.	Suggested a hybrid strategy for stock market prediction that incorporates opinion mining and clustering techniques. Among all existing techniques, their suggested model differs from others in that it not only examines broad states of mind and attitudes, but also groups them using clustering algorithms.	Hybrid Model	As a consequence, we discovered that the projected values from the suggested technique are the most comparable to the actual values of the stock. When compared to other individual approaches of sentiment evaluation and clustering, the combined method produces more accurate findings.

III. CONCLUSION

In conclusion, the literature on stock market prediction is vast and constantly evolving. Researchers continue to develop new methods and approaches, and new insights and findings are constantly emerging. It is important to take into account the limitations of stock market prediction and to approach prediction results with caution, as accurate predictions are difficult to make in the complex and unpredictable stock market. Nevertheless, the study of stock market prediction remains an important and relevant field, as it has the potential to provide valuable insights into market trends and inform investment decisions. In this paper, they examined various methodologies for stock market prediction that will assist investors in making the right decision to buy or sell stocks. Each method has some limitations and disadvantages. Limitations can be overcome by choosing appropriate prediction techniques for specific domains. In the future, the two methods can be combined to produce the desired results and output. They attempted to evaluate various methods of forecasting stock market trends in order for any investor to find the best method for predicting the stock market much more accurately than previously done methods.

Presently, the test modules are not yet finished and are continuously being worked on. After the experimental tests are completed, the success or failure of the parallelization endeavour will most likely determine our next step in developing the previously anticipated forecasting system. If the experimental experiments are deemed unsuccessful, they will be compelled to take a step back and create another technique of parallel computing to compensate for the time spent training the LSTM RNNs models. Either that, or they'll have to account for such a time-consuming approach of training the models, which seems unlikely to increase when they include more LSTM RNNs models. If the experiments are shown to be beneficial, they would be capable of using this type of parallelization in our future use of LSTM RNNs as they go towards building an entire ensemble prediction system for forecasting stock prices.

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