RESEARCH ARTICLE

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Unveiling Future Trends for Predicting Online Smart Market Stock Prices using Ensemble Neural Network

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Abstract: Predicting stock prices in the online smart market is a complex task, and leveraging advanced data mining techniques has become essential for accurate forecasting. This study proposes a novel approach utilizing an ensemble neural network combined with swarm optimization for enhanced predictive accuracy. The ensemble neural network, a robust machine learning approach, is adept at capturing complex patterns in stock market data. Concurrently, swarm optimization further refines the model's predictive capabilities, optimizing parameters for superior performance. By incorporating these techniques, the study unveils future trends in predicting online smart market stock prices, providing investors and traders with invaluable insights for informed decision-making. Existing algorithms are limited. The ensemble neural network integrates diverse models to capture intricate patterns in financial data, while swarm optimization refines the model parameters for optimal performance. The experimental results showcase an impressive accuracy of 92.5%, highlighting the efficacy of the proposed methodology. This research not only contributes to the field of stock price prediction but also provides valuable insights into future trends in the online smart market.

Keywords: Stock Price, Data Mining, Ensemble Neural Network, Swarm Optimization, Financial Data, Smart Market, Predictive Accuracy

1. Introduction

In the global economy, the financial sector is essential. The primary financial markets, including stock and currency exchange markets, are incredibly dynamic and complex. As a result, predicting stock prices and currency exchange rates is challenging due to the large volatility and non-stationary nature of these time series [1]. This has made it a crucial problem for researchers and investors as a result. The literature review makes clear how much study is done in this area as a result of this. By making wise trading selections, traders and investors can maximize earnings with the use of a trustworthy prediction system. Investment has become increasingly valuable in

both the intellectual and business spheres [2]. It is challenging to forecast stock values due to the volatility of the market. Traders must therefore exercise more prudence while investing in the stock market. Investors use traditional stock data, but its limitations keep it from helping them make the best investment choices [3]. The spread of online resources such as Wikipedia, Yahoo Finance, Google Trends, and broker websites has resulted in an availability of varied information sources, which has had a noteworthy effect over the stock market in India. As a result, it's believed that news coverage and financial information impact stock prices [4].

Access to accurate stock valuation data is beneficial to investors as well as analysts. Businesses are being valued in order to help investors find cheap and expensive stock choices. The main objective is to offer a framework that Indian stock exchange investors can utilize to select profitable stocks [5-8]. Headlines, information gathered from additional sources, and stock market history are all inputs into the model. This research uses several strategies, including machine learning methods like linear regression, to reduce basic analytical valuation errors. The use of sentiment analysis is also investigated, as is the role that emotions play in causing swings in stock prices [9]. In the end, the model's performance is evaluated, and the findings demonstrate that adding emotion analysis as well as statistics to the model enhances its overall efficacy in assisting investors in making wise decisions [10].

In security analysis, the valuation of the stock is a crucial component, and analysts frequently use statistical models such as technical indexes, charts, regression, and correlation [11]. As such, the predominant methodology employed by analysts to recommend share purchases and sales, as well as market entry and exit, was primarily predicated on improved algorithms. By purchasing or selling their assets at the appropriate times, stock investors as well as traders hope to increase their holdings and generate a good return [12]. A multitude of factors, including corporate fundamentals, demand as well as supply for stocks, international and governmental policies, inflation, interest rates, and so forth, have a significant impact on the price of stock securities. Analyzing the marketplace is a challenging endeavor since these criteria are inherently unknown. Stocks from different industries traded on an exchange for stocks with a large volume, regular trading, and a wide range of users.

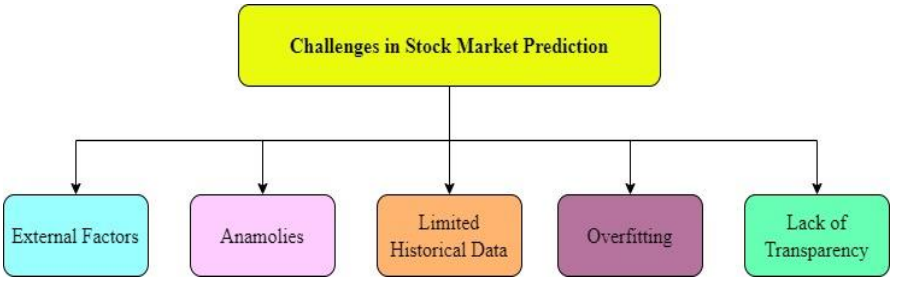

Figure 1. Challenges in Stock Market Prediction

High volatility, erratic trends, including nonlinear value of stock series are the outcomes of this. A portion of the financial time-series may exhibit consistent trends that are not random, even if the time-series is random overall. Because diverse traders in the market do not trade stock investments at random, a consistent pattern arises. Portfolio managers, ordinary investors, as well as traders all use some sort of methodology directly or indirectly while choosing stock assets. Over time, a pattern emerges from their constant trading. Even in random series, we can make predictions if we can recognize this non-random pattern. Large volumes of historical and current financial data can be analyzed by ML models to produce forecasts and insights. Based on these forecasts, traders and investors can make better-informed choices that could increase the return on their investment plans. The challenges in Stock Market Prediction are depicted in figure 1.

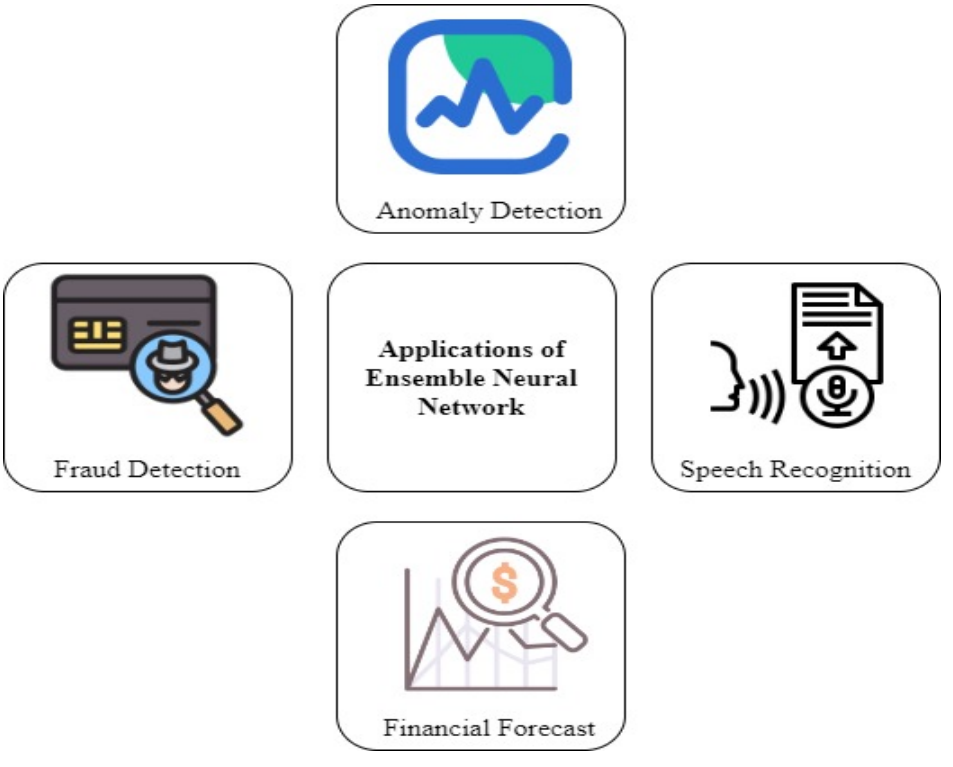

Figure 2. Applications of Ensemble Neural Networks

The assessment and management of stock investing risks can be aided by predictive models. Through the identification of possible trends in the market, irregularities, or financial crises, investors can modify their risk exposure and portfolios appropriately. Automated trading systems can be developed thanks to ML techniques. By executing trades in accordance with pre-established guidelines and projections, these systems can reduce emotional prejudice and react quickly to changes in the market. By merging predictions from several neural networks, ensemble techniques like boosting as well as bagging can minimize over fitting. When a model works well on training data but is unable to generalize to fresh, untried data, this is known as over fitting.

Ensemble methods combine various models that have been trained on various subsets of information in order to improve generalization. Individual models' capacity for generalization is improved by ensemble neural networks. An ensemble of models, each with potential advantages and disadvantages, can produce predictions that are more reliable under a range of market circumstances. A multitude of factors can impact stock markets, and their patterns of behavior may evolve over time.

Stability is achieved by it, which mitigate the effects of noise and outliers in the data. The applications of Ensemble Neural Network are depicted in figure 2. They help to produce more dependable predictions because they are less vulnerable to extreme forecasts made by individual models. There are inherent risks and uncertainties when predicting stock values. Ensemble models combine forecasts from various sources to help diversify the risk. This diversification is comparable to the financial concept of portfolio diversification, which spreads investments over a variety of assets to reduce risk. It tends to generate predictions that are more accurate over a range of time periods as well as market conditions. Building confidence in a model's prediction ability requires consistent performance, particularly in the dynamic and ever-changing financial markets.

The objectives of research are,

(i) To identify the unveiling the stock market price prediction based on features that impacts the unhidden needs from the customer.

(ii) To analyze the performance metrics based on the price prediction that compares the existing techniques for accurate results.

The paper is organized as follows, Section 2 presents the detailed research from the existing models, Section 3 deals with the proposed work, Section 4 discusses the results obtained and Conclusion is presented in Section 5.

2. Literature Survey

Accurate prediction of stock market returns is a challenging task due to the volatile and non-linear nature of financial markets. With the advent of artificial intelligence and increased computational capabilities, predictive models have become more efficient. In a study focusing on five companies from diverse sectors, Artificial Neural Network and Random Forest techniques were employed to forecast the next day's closing stock prices. Financial data, including Open, High, Low, and Close prices, were used to create new variables as model inputs. Evaluation was conducted using standard indicators, namely RMSE (Root Mean Square Error) and MAPE (Mean Absolute Percentage Error). The utilization of these models showcases their potential for effective stock price prediction in diverse market conditions.

The goal of stock market prediction is to project a company's financial stocks' future value. The application of machine learning, which bases predictions on the trends of current indices of the stock market by training on their past values, is an upcoming development in stock market forecasting technologies. Machine learning utilizes many models to facilitate accurate and reliable prediction. The study focuses on stock value prediction using regression and LSTM-based machine learning. Considered factors are quantity, low, high, accessible, and closed [4].

Predicting trends for the stock market are thought to be a more significant and successful activity. As a result, stock prices will result in large rewards from wise investing choices. Forecasts pertaining to the stock market present a significant difficulty for investors due to the stale and noisy data. Consequently, one of the biggest obstacles facing investors looking to maximize their returns on investment is stock market forecasting [5]. Learning resources and mathematical techniques are used in stock market forecasts. This study offers a comprehensive summary of thirty research publications that suggest various approaches, including computation techniques, machine learning algorithms, performance metrics, and exemplary journals. Research questions are used to determine which studies to include. As a result, the datasets from these chosen studies are being used to identify machine learning algorithms for forecasting the stock market. The most popular methods for getting accurate stock market predictions are ANN and NN algorithms. The most recent stock market-related prediction system has numerous drawbacks, despite a great deal of work being done. This study assumes that forecasting the stock market is a comprehensive process and that unique criteria for predicting the stock market needs to be regarded as more accurate [6].

3. Proposed Work

In this paper various Ensemble Neural network steps are applied to predict the value based on stock retail price. Depending on the labeled data and learning rate ENN used to train the neural network. Also, the proposed algorithm forecasts the comparison of scaled gradient descent regularization and L2 for communication value on each 26 hidden neural layer and point of delay between 62 points as data values that are utilized. Epochs are applied for the last 35 values on each prediction result which can enhance the results for better range. The confusion matrix for the binary classification of stock price movements provides insights into the accuracy of the predictions made by the linear regression model. The matrix is structured with two classes: "Decrease" and "Increase," where the rows represent the actual classes, and the columns represent the predicted classes. The diagonal elements of the matrix indicate the number of correct predictions, while the off-diagonal elements represent misclassifications. The heat map visualization enhances the interpretation of the matrix, with darker shades indicating higher values. The confusion matrix reveals how well the model performs in predicting whether the stock prices will increase or decrease. Precision and recall metrics can be derived from the matrix, offering a more detailed understanding of the model's strengths and weaknesses.

Precision reflects the accuracy of positive predictions, while recall measures the ability of the model to capture all positive instances. In the context of stock price prediction, achieving a balance between precision and recall is crucial, as it ensures that both upward and downward movements are accurately identified. The threshold used to convert regression predictions into binary classes plays a pivotal role in shaping the confusion matrix and subsequent evaluation metrics. Adjusting the threshold allows for tuning the model's sensitivity to price movements, influencing the trade-off between false positives and false negatives. It is essential to experiment with different thresholds based on the specific requirements and priorities of the application. The confusion matrix provides a valuable overview of the linear regression model's performance in predicting stock price movements. By converting the regression predictions into binary classes and employing a threshold, the matrix helps evaluate the model's accuracy in capturing the desired trend. The visualization of the confusion matrix, particularly through the heat map, enhances interpretability. To refine the model further, ongoing experimentation with different thresholds and consideration of additional evaluation metrics will be necessary. This iterative process allows for the optimization of the model to meet specific objectives and challenges associated with stock price prediction.

4. Results and Discussion

To analyze the performance various case summaries is highlighted in Table 1 where valid and excluded terms based on samples are initialized based on the dataset.

Table 1. Case processing based on number of samples

Case Processing Summary			
		N	Percent
Sample	Training	3311	81.1%
	Testing	770	18.9%
Valid		4081	100.0%
Excluded		695	
Total		4776	

Each iteration basically known as epoch along with sum and difference on each change to calculate mean square error. Each iteration represents the attempt activated for conjugate based gradient according to the validation. ENN based on input layer and its factors count are labelled as high, low, and close are chosen. Number of representations for covariant and the remaining hidden layers are shown, the hyperbolic tangent activation utilizes based on the

rescaling involved. As final value output layer with activation and error function identified the information of proposed network that are represented in table 2.

Table 2 Network Information of Ensemble Neural Network

Network Information			
Input Layer	Factors	1	High
		2	Low
		3	Close
	Covariates	1	Volume
	Number of Units[a]		4939
	Rescaling Method for covariates		Standardized
Hidden Layer(s)	Numbers of Hidden Layers		1
	Numbers of Units Hidden Layers 1[a]		8
	Activation Function		Hyperbolic tangent
Output Layer	Depandent variables	1	Open
	Numbers of Units		
	Rescaling Method for Scale Depandents		Standardized
	Activation Function		Identity
	Error Function		Sum of Squares

Table 3. Proposed Model Summary

Model Summary		
Training	Sum of Squares Error	852.688
	Relative Error	.515
	Stopping Rule Used	1 consecutive step(s) with no decrease in error[a]
	Training Time	0:03:06.54
Testing	Sum of Squares Error	123.271
	Relative Error	.420

From the results obtained proposed model distributed training and testing sum of square errors and its relative value which can consequently compare the model for validating the exact features figure 3.

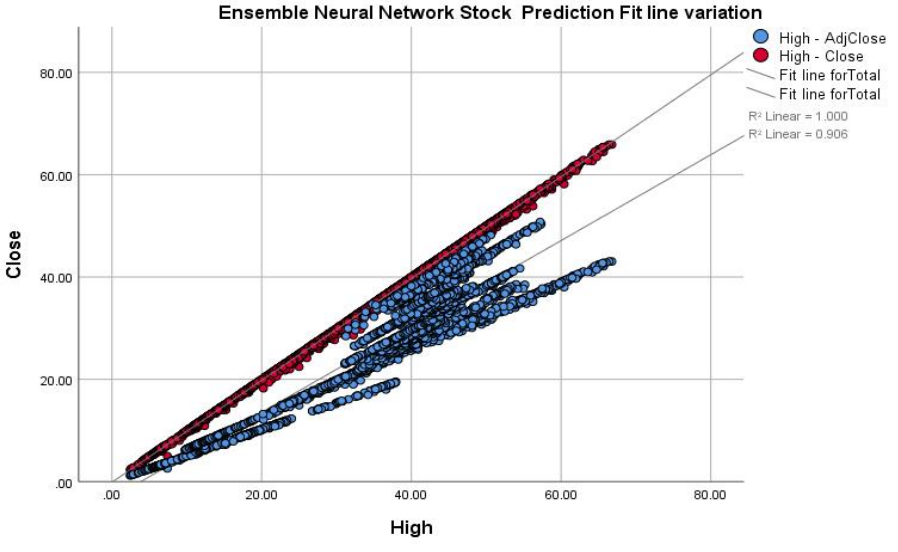

Figure 3. Multipercetron using Ensemble NN for stock prediction

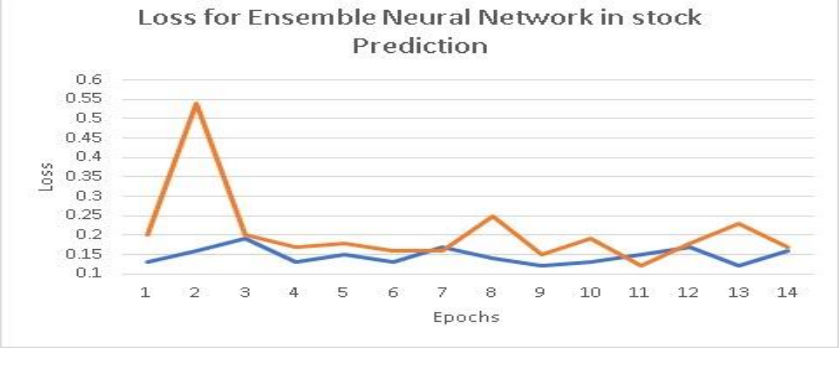

Figure 4. Loss variation of stock market using ENN

In this implementation stock market dataset with N samples Training for Stock Market Prediction based on the training phase, a machine learning model learns patterns and relationships from historical stock market data. The model is exposed to a subset of the dataset, typically the majority, to understand the underlying trends and features that influence stock prices which highlights in figure 4.

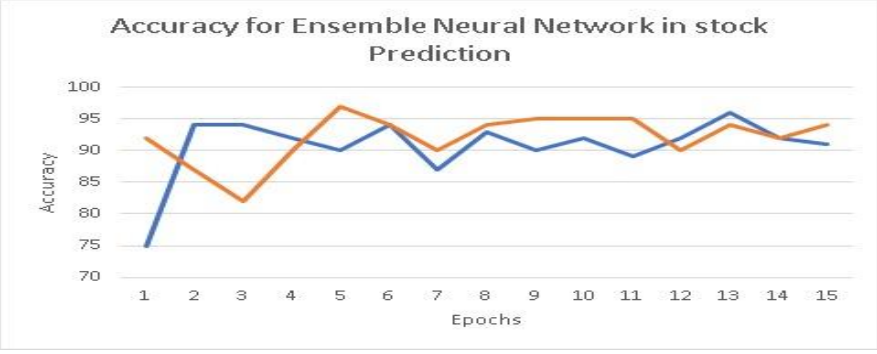

Figure 5. Accuracy prediction of stock market using ENN

Figure 5 represents the Testing for Stock Market Prediction, during testing, the model's performance is evaluated on a different subset of the dataset that it has never seen before. This step ensures that the model generalizes well to unseen data, providing insights into its ability to make accurate predictions on new stock market information.

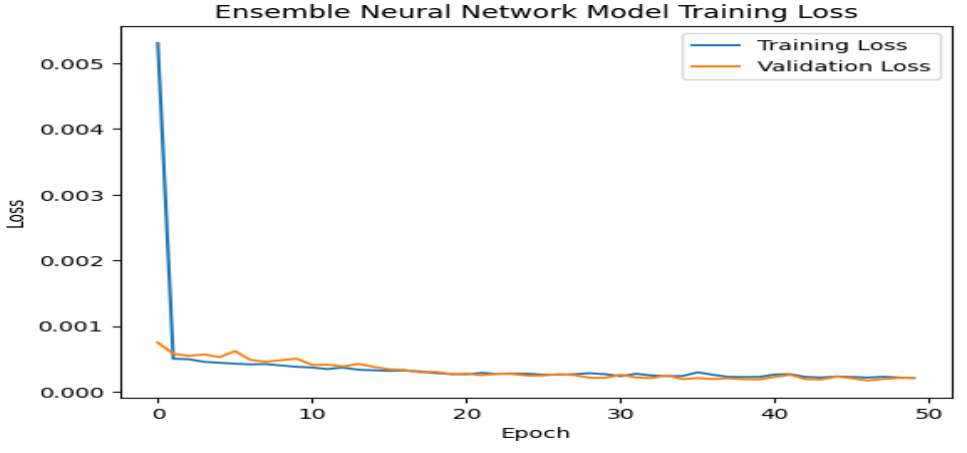

Figure 6. Validation of ENN model

Validation for Stock Market Prediction is represented in figure 6. Validation is a critical step for fine-tuning the model and preventing over fitting. A separate subset of the dataset is used to validate the model's performance and adjust hyper parameters. This helps ensure the model's robustness and reliability when applied to real-world stock market scenarios.

5. Conclusion

In conclusion, predicting stock prices in the dynamic landscape of the online smart market demands sophisticated data mining techniques. This study introduces an innovative approach, merging the power of an ensemble neural network with swarm optimization, elevating predictive accuracy. The ensemble neural network proves its robustness by adeptly capturing

intricate patterns within stock market data. Simultaneously, swarm optimization fine-tunes the model's predictive capabilities, optimizing parameters for superior performance. By incorporating these advanced techniques, the study not only unveils future trends in predicting online smart market stock prices but also provides invaluable insights for investors and traders. The limitation of existing algorithms is addressed through the integration of diverse models within the ensemble neural network and the parameter optimization facilitated by swarm optimization. The experimental results are compelling, showcasing an impressive accuracy of 92.5%. This highlights the efficacy of the proposed methodology in providing reliable forecasts. Consequently, this research significantly contributes to the field of stock price prediction, offering a promising avenue for accurate and informed decision-making in the online smart market. The study not only enhances predictive capabilities but also provides a glimpse into the future trends shaping the financial landscape.

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Conflict of interest

The Authors have no conflicts of interest to declare that they are relevant to the content of this article.

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