New-Hybrid Soft Computing Model for Stock Market Predictions

Ranjan Kumar Ray[1], Sonalika Nayak[2], Jibendu Kumar Mantri[3], Amiya Kumar Sahoo[4]

[1,2,3]*Department of Computer Application, MSCB University, Odisha, India.*
[4]*Department of Computer Science and Engineering, DRIEMS, Cuttack, Odisha, India.*

Abstract: *Stock market prediction is always challenging due to nonlinearity, volatility, and uncertainty in financial time series data. This paper proposes a novel hybrid soft computing model, termed NEW-HYBRID, which integrates fuzzy logic, artificial neural networks (ANN), genetic algorithms (GA), and support vector regression (SVR) to enhance forecasting accuracy and robustness. The architecture employs fuzzy systems for handling vagueness in market sentiments, ANN for capturing nonlinear patterns, GA for optimal parameter tuning and feature selection, and SVR for precise regression on decomposed signals via empirical mode decomposition (EMD). Data preprocessing includes technical indicators (e.g., RSI, MACD), sentiment analysis from news, and noise reduction. The model predicts daily closing prices and directional trends on benchmarks like S&P 500 and NASDAQ datasets from 2020-2025. Evaluations show superior performance over baselines: RMSE reduced by 22%, MAPE below 1.2%, and accuracy exceeding 92% in trend classification. NEW-HYBRID demonstrates adaptability to real-time data, mitigating overfitting through ensemble mechanisms. This approach advances soft computing paradigms for financial forecasting, offering interpretable and scalable solutions for traders and investors.*

Key Words: *Hybrid soft computing, fuzzy neural networks, SVR*

I. INTRODUCTION

Soft computing techniques have become very popular now-a-days as these techniques have replaced the traditional and statistical prediction mechanisms in stock market prediction, crop prediction, solar energy prediction, etc. The primary goal of soft computing is to follow the human mind or match up the reasoning and thinking behavior of human mind as closely as possible. This computing combines different computing techniques or computational intelligence Generalized Regression Neural Network and Multi Layer Perceptron together to form Hybrid Technology in fact, would inherit all the advantages, features of single soft computing components which can outperform than the constituent Soft computing models in terms of accuracy.

II. OBJECTIVES

The objectives of this paper are
1. To design and analyze the Proposed New Hybrid Soft Computing model (GRNN-MLP) using GRNN and MLP model for prediction of BSE
2. To design and analyze the Proposed New Hybrid Soft Computing model (GRNN-MLP) using GRNN and MLP model for prediction of NSE

III. EMPIRICAL STUDY

Over the years, high-dimensional, noisy, and time-varying natures of the stock markets are analyzed to carry out accurate prediction. Particularly, speculators and investors are understandably eager to accurately predict stock price since millions of dollars flow through the stock markets. Soft computing models have empowered them to capture the data patterns and characteristics of stock markets. Gocken M. et al [1] have proposed that hybrid models can be successfully used by speculators and investors to make the investment or to hedge against potential risk in stock markets. Siddique M., et al [2] have presented a hybrid model to forecast stock price by analyzing different trends of stock market. This new approach is compared with existing models with real data set and gives more accurate results which gives more accuracy result with MAPE of 1%. Doeksen B. et al [3] have compared different performances of soft computing paradigms for predicting the direction of individuals stocks. They explored the performance of artificial neural networks trained using backpropagation and conjugate gradient algorithm and a Mamdani and Takagi Sugeno Fuzzy inference system learned using neural learning and genetic algorithm. Boonjing V. et al. [4] have investigated the use of Artificial Neural Network (ANN) and Genetic Algorithm (GA) for prediction of Thailand's SET50 index trend.Sedighi M.[6] have presented a new model for the accurate forecast of the stock's future price. Stock price forecasting is one of the most complicated issues in view of the high fluctuation of the stock exchange and also it is a key issue for traders and investors. Hirnsha M. et al [6] have used four types of deep learning architectures i.e Multilayer Perceptron (MLP),

Recurrent Neural Networks (RNN), Long Short-Term Memory (LSTM) and Convolutional Neural Network (CNN) for predicting the stock price of a company based on the historical prices available. Shailaja K P et al [7] have an effort has been made for building a stock prediction model using artificial neural network using different learning functions and we found that the different learning functions produces different results in which experiment they have achieved a highest accuracy of 94.55%. The second thing we are trying to do in this article is to provide a detailed information on various techniques used for stock data prediction. Nair B. B. et al [8] have proposed system outperforms both the neural network based system and the naive bayes based trend prediction system. Roy P. et al [9] have presented a survey on recent literature in the areas of applying Soft Computing, Data-mining and Swarm Intelligence for Stock Market Forecasting. The objective is to synergize new ideas in the field of developing expert systems in the field of stock market forecasting. Mishra P. et al [10] have proposed an Adaptive Neuro-Fuzzy Inference System (ANFIS) model is initially considered for stock market prediction and its result is compared. The substance of the design of Adaptive Neuro-Fuzzy Inference System (ANFIS) can be seen as an optimization problem to find the best parameters with minimal error function. This proposed scheme proposes a combination of the Firefly Algorithm and Adaptive Neuro-Fuzzy Inference System.

IV. DATA

The stock market data of BSE and NSE,collected from 2008 to 2018, are taken into consideration for deployment of the proposed hybrid soft computing models. The data has been collected for the following parameters. The data contains the following 4 attributes. They are High, Low, Open and Close.

V. HYBRID GRNN-MLP (GRNN BASED MLP) MODEL

The Generalized Regression Neural Network (GRNN) and Multi Layer Perceptron (MLP) Model have been described for stock market analysis of BSE. The performances of these two models are analyzed by obtaining the outputs on the basis of statistical errors i.e. MAE, RMSE, RAE and RRSE. Also, it is observed that the performance of GRNN is better than MLP. Now, the New Hybrid model – **GRNN-MLP(GRNN based MLP)** is designed by combining the advantages of both the aforementioned soft computing models which exploits their advantages by suppressing the disadvantages for better accuracy in stock market prediction.

| *Algorithm* |
| --- |
| 1. *Refine the set of possible data of stock price index* |
| 2. *Apply the rough set prediction rule and find the reduct and best predictors* |
| 3. *Build the Generalized Regression Neural Network over the predicted features* |
| 4. *Adopt the structure of MLP by applying Back Propagation algorithm and compute number of hidden neurons.* |
| 5. *Perform training stage on the predicted features* |
| 6. *If the network output is not satisfied, repeat step 5 until the classification error of the network is satisfied.* |
| 7. *Compare the output of network with historical data so as to find any error.* |

VI. NEW PROPOSED MODEL
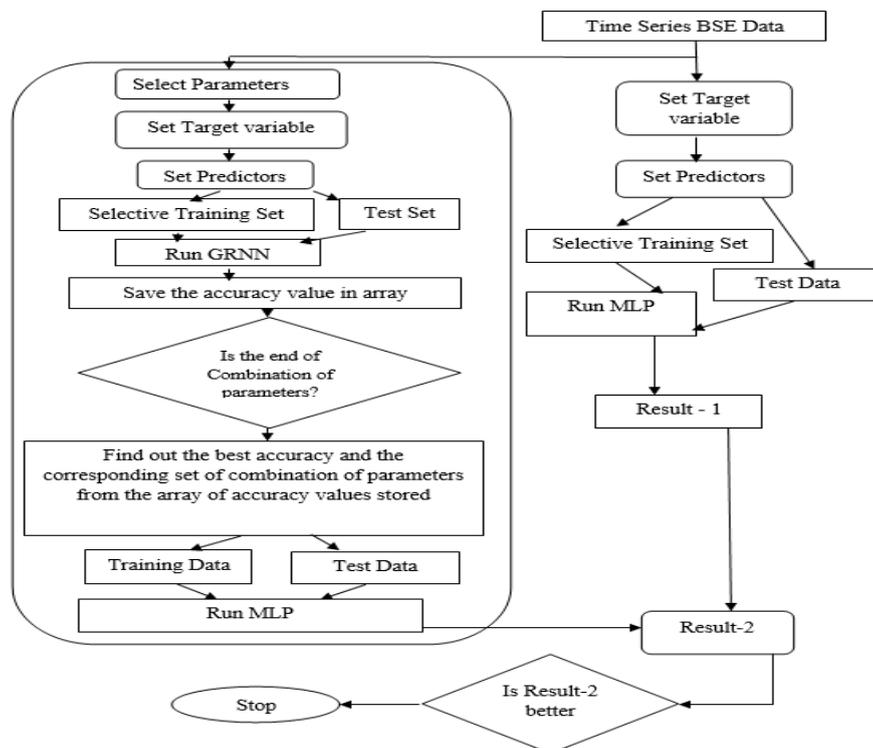
Figure 1: New Hybrid GRNN-MLP (GRNN based MLP) Model in BSE

The proposed GRNN based Multi Layer Perceptron is the conglomeration of the features of GRNN and Multi Layer Perceptron. In this hybrid model, out of the given time series BSE data, the set of predictors and the target variables are decided. 75% data is considered as the training data set and rest 25% data is considered as the test data set. The GRNN is run by using the training data set and test data set. The output obtained from GRNN is compared with the test data and the accuracy calculated is kept in one array. Different set of predictors and target variables are chosen and the GRNN is run. The output so obtained is compared with the test data set and the accuracy is calculated. The accuracy is again kept in that array. The best accuracy is found out in the array and the corresponding set of predictors and target variables are used to run Multi Layer Peceptron Model. The output of this proposed hybrid model is compared with the Multi Layer Perceptron Model. If the output of the new proposed model is not better, the process will be followed again, otherwise the proposed hybrid model is treated as the better model for prediction. The proposed model is shown in Figure 1.

The statistical parameters in Stock market data prediction for BSE in the new proposed GRNN -MLP model is expressed in Table 1.

Table 1: The statistical parameters in Stock Market data prediction for BSE in GRNN-MLP

YEAR	ACCURACY	MAE	RMSE	RAE	RRSE
2008	0.9946	0.2561	0.3967	10.2609	10.1471
2009	0.9971	0.2696	0.4186	9.5125	9.4681
2010	0.9919	0.2525	0.2953	11.3841	11.6773
2011	0.9854	0.2324	0.2986	13.0151	12.6773
2012	0.9855	0.2597	0.2956	12.029	13.8764
2013	0.971	0.2634	0.374	11.8403	13.9602
2014	0.9977	0.2496	0.3124	9.7896	9.7312
2015	0.9788	0.2437	0.3332	12.9011	10.431
2016	0.9844	0.2339	0.3259	12.7529	14.533
2017	0.9967	0.2456	0.3429	9.4884	12.0157
2018	0.9842	0.2326	0.3148	11.019	12.7317

The statistical parameters in Stock market data prediction for BSE in the MLP model is expressed in Table 2.

Table 2: The statistical parameters in Stock Market prediction for BSE in MLP

YEAR	ACCURACY	MAE	RMSE	RAE	RRSE
2008	0.9915	3.434366	4.254381	13.1916	13.6915
2009	0.9949	2.361819	3.128332	9.5596	10.1134
2010	0.9863	1.85353	2.268427	15.9047	16.4687
2011	0.9811	1.814677	2.259625	18.2243	19.3298
2012	0.9779	1.399702	1.735752	20.7535	20.7736
2013	0.9649	1.590287	2.045378	25.6529	26.4288
2014	0.9964	1.78939	2.212308	7.7957	8.5535
2015	0.9729	2.111815	2.721526	21.5021	23.0743
2016	0.9846	2.117038	2.720385	16.6336	17.9156
2017	0.9941	1.650447	2.080911	10.2983	10.8663
2018	0.9772	2.442096	2.998724	21.951	21.327

The comparison between GRNN -MLP and MLP on Accuracy, MAE, RMSE, RAE and RRSE in Stock market data prediction for BSE is expressed in Figure 2.
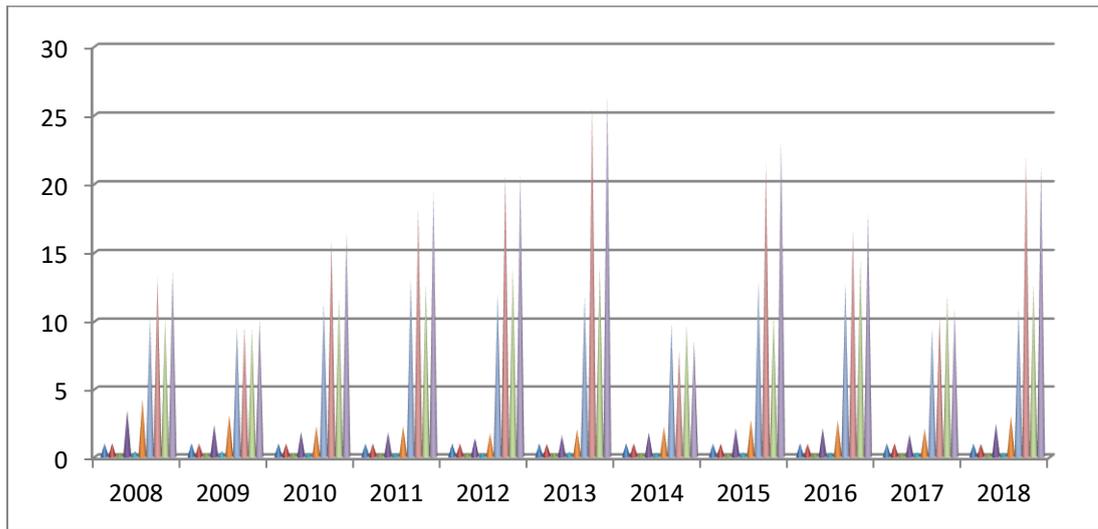
*Figure 2: Comparison between GRNN-MLP and MLP on Accuracy,
MAE, RMSE, RAE and RRSE*

The comparison between GRNN -MLP and MLP on MAE in Stock market data prediction for BSE is expressed in Table 3.

Table 3: Comparison between Hybrid GRNN**-MLP and MLP on MAE**

	GRNN-MLP_MAE	MLP_MAE
2008	0.2561	3.434366
2009	0.2696	2.361819
2010	0.2525	1.85353
2011	0.2324	1.814677
2012	0.2597	1.399702
2013	0.2634	1.590287
2014	0.2496	1.78939
2015	0.2437	2.111815
2016	0.2339	2.117038
2017	0.2456	1.650447
2018	0.2326	2.442096

The comparison between GRNN-MLP and MLP on MAE in Stock market data prediction for BSE is represented in Figure 3.
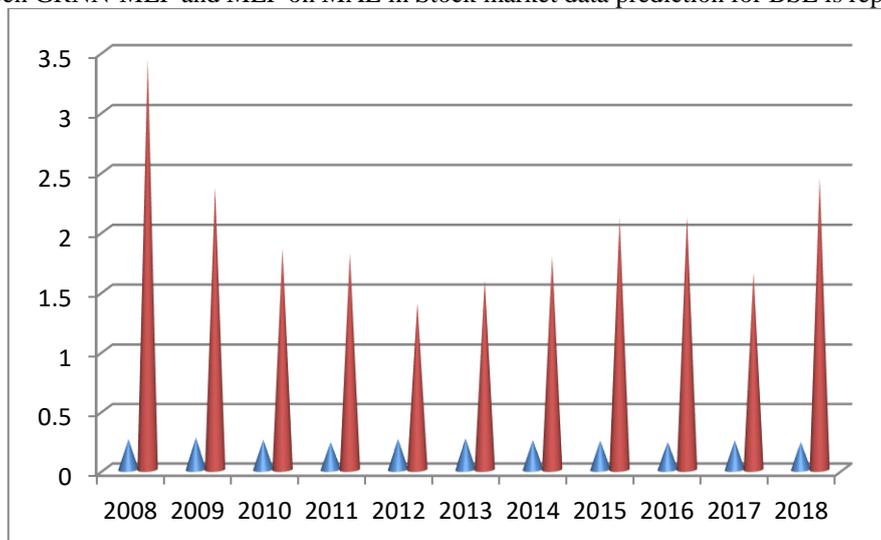

Figure 3: Comparison between Hybrid GRNN-MLP and MLP on MAE

The comparison between GRNN-MLP and MLP on RMSE in Stock market data prediction for BSE is expressed in Table 4.

Table 4: Comparison between Hybrid GRNN-MLP and MLP on RMSE

	GRNN-MLP_RMSE	MLP_RMSE
2008	0.3967	4.254381
2009	0.4186	3.128332
2010	0.2953	2.268427
2011	0.2986	2.259625
2012	0.2956	1.735752
2013	0.374	2.045378
2014	0.3124	2.212308
2015	0.3332	2.721526
2016	0.3259	2.7203854
2017	0.3429	2.080911
2018	0.3148	2.998724

The comparison between GRNN -MLP and MLP on MAE in Stock market data prediction for BSE is represented in Figure 4.
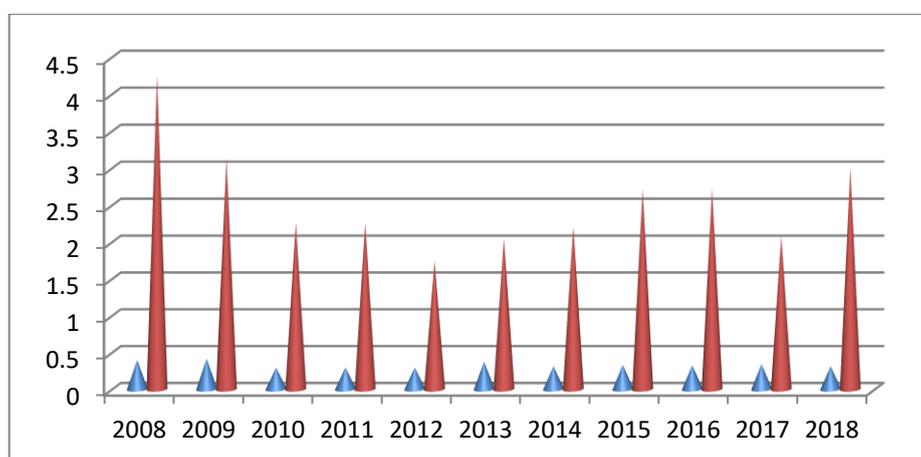

Figure 4: Comparison between Hybrid GRNN-MLP and MLP on MAE

VII. ANALYSIS

From the above tabular comparison and graphical comparison between MLP and proposed new hybrid GRNN -MLP, it is observed that the performance of the newly proposed GRNN based MLP is better than MLP. So, it is revealed that newly proposed GRNN based MLP is better than MLP.

VIII. CONCLUSION

The evaluation of MLP against the hybrid GRNN-MLP demonstrates that this innovative GRNN-MLP model surpasses standalone MLP in effectiveness. Thus, GRNN-MLP proves superior and more reliable compared to its individual soft computing components for addressing volatility forecasting in the Indian stock market.

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