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A Hybrid Forecasting Model for Stock Value Prediction using Soft Computing Skill

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This paper aims to present a hybrid model to forecast stock price by analyzing different trends of stock market. As the stock price are time series but they are not static and highly noise due to the fact that stock market is not stable as it depends on various factors. In this paper we have propose a new approach to forecast stock price using ANFIS model optimized by particle swam optimization (PSO) this model is consisting of an effective algorithm for predicting next day high price of Yahoo stock value and Microsoft stock value. To present this algorithm we have taken real dataset of Yahoo Company and Microsoft Company. This new approach is compared with existing models with real data set and gives more accurate results which give more accuracy result with MAPE of 1%.

Keywords: data Mining, Prediction, Soft computing, Stock market.

I. Introduction

The stock data are most challenging as because they are dynamic, non-liner and no common parameter. So it's very difficult for the inverters to predict stock price without analyzing trends of stock price. The selection and implementation of a proper forecasting methodology has always been an important planning and control issue for most firms and agencies. The organizational and financial stability of an organization depends on the accuracy of the forecast since such information will most likely be used to make key decisions in the areas of human resources, purchasing, marketing, planning and development of any organization and firms [1].

An artificial neural network is defined as an information processing paradigm inspired by the methods by which mammalian brain processes information [2] presented to it. They are an assortment of mathematical models that imitate some of the observed phenomena in a biological nervous system, most importantly adaptive biological learning. One unique and important property of artificial neural network model is the exceptional structure of the information processing system [3-4]. It is made of a number of highly interconnected processing elements that are very similar to neurons and are joined by weighted connections that are very similar.

In this paper we have proposed an efficient hybrid model which works on time series data to predict stock price and result is also optimized using particle swam optimization. Finally the result is compared with existing models and our model seems to be working more accurately in certain conditions.

II. Literature Review

Many researchers have been working on stock market prediction every researches are having different aspect of selecting the models using soft computing. Some of the similar kind of models discussed. A lot of research has been done and models based on a range of intelligent soft computing techniques are developed over the last two decades. This section describes briefly some of the work that has already been done in the field of stock price prediction.

Gitali Rakshak and Amit Pimpalkar (2014) investigated ANN modeling of stock prices of selected stocks under BSE(Bombay Stock Exchange) and they well tried to predict closing prices. Mean Absolute Percentage error Mean Absolute Deviation, Root Mean Square Error are used indicators of performance of network and concluded with the statement that there is a considerable scope to build on the research attempted in all possible ways to predict accurate stock prices [5].

Mayankkumar B Patel ,Sunil R Yalamalle et al.(2014)investigated on data mining techniques and used ANN techniques to forecast the stock listed under LIX15 index NSE(National Stock Exchange),MLP neural network has been used to predict future stock price and end with the conclusion that MLP neural network techniques can give satisfactory output with median normalized error(0.05995), Median correct direction%(51.6),median standard deviation(6.39825) [6].

Amin Hedayati Moghaddam,Moein Hedayati Moghaddam , Morteza Esfandyari et al.(2015) investigated the artificial neural network(ANN) in predicting the daily stock exchange of NASDAQ index prediction for datasets(four prior days and nine prior days)were developed with the validation and the research come to an end with the conclusion that there is no difference between the prediction ability of targeted input datasets[7].

D.Venugopal setty et al.(2010) has investigates the various data mining techniques to check out the performance of the stock markets and concluded that there is a huge rising gap in between more powerful and retrieval systems to mainly focus on specific end-users problem. [8].

Dase R.K reviewed the literature of application of data mining techniques and end up with the conclusion that Artificial Neural Network (ANN) has the ability to extract various data from the larger data sets and can be used in forecasting accurate stock market index [9]

Guresen, kayakatlu and Daim et al.(2011) researched on multi-layer Perceptron (MLP),dynamic ANN as well as hybrid ANN models in predicting stock market values.[6] Qiu,Liu and Wang et al.(2012)reviewed the proposed data mining techniques and worked with fuzzy time series to forecast stock values index of shanghai composite index.

In [10] the technology major Fujitsu and investment company, Nikko Securities joined hands to develop a stock market prediction system for TOPIX, Tokyo based stock index, using modular neural network architecture . Various economic and technical parameters were taken as input to the modular neural network consisting of multiple MLP used in parallel.

In [11] research was done on the effect of change of network parameters of the model using artificial neural network (ANN) with Back propagation on the stock price prediction problem. The paper gives information about the role of the learning rate, momentum, activation function and the number of hidden neurons for prediction of stock market.
In [12] the authors analyzed a number of parametric and nonparametric models for forecasting stock market trends and returns. The observed results suggested that the probabilistic neural network (classification model) outperforms the normal feed forward neural network (level estimation model) in forecasting stock trends.
Interval forecasts of stock prices have the benefit of taking into account inconsistency and uncertainty, reducing the amount of random variation relative to that found in classic single valued stock price time series (e.g., stock closing price). As Hu and He [13] noted the interval predict of stock price are superior to the traditional point prediction in terms of the overall lower mean error.

There are fuzzy logic based application models for the stock market prediction as well. A fuzzy logic forecast support system was used to predict the stock prices using parameters such as inflation, GNP growth, interest rate trends and market valuations [8]. The paper specifies that due to the model-based approach with knowledge management and knowledge accumulation the potential benefits of a fuzzy logic forecast support are better decision making.
In [13] the researchers have proposed a fresh test suites approach which can able to generate variable strength interaction test known as VS Particle Swarm Test Generator (VS-PSTG). The test adopts PSO for ensuring optimal test size reduction. The merit of this proposed study is that it gives competitive results as compared to existing models.
In [14] the researchers have proposed a specific particle swarm optimization technique known as Chaotic Multi Swarm Particle Swarm Optimization (CMS-PSO), where the genetic PSO has been modified using the chaotic sequence for multi-dimension unknown parameter estimation and optimization by forming multiple cooperating swarms. The advantage of this technique is that load balancing can be augmented by allotting the global optimizing task for concurrently operating swarms.
In[15] one model have proposed based on two nonlinear adaptive model FLANN and CFLANN for prediction of three different exchange rates for one, three, six and twelve months ahead. Their performance has been assessed through simulation study and compared with that of LMS model.

III. Proposed Work

The proposed model is hybrid model based on artificial neural network and optimized by Particle swam optimization algorithm.

Particle swarm optimization (PSO)
Particle swarm optimization (PSO) is a meta-heuristic optimization technique, under the category of swarm intelligence [4]. It was first introduced by Kennedy and Eberhart (1995). It was first intended for social behavior (representation of the flocking and schooling of birds and fish. In PSO, each particle flies through the multidimensional search space and adjusts its position in every step until it reaches an optimum solution. In particle

swarm optimization each particle has some fixed distance from the food source and the fitness value of each particle gives the output. From that fitness value which is the best value is considered as particle best (pbest). Then all the particle moves in the direction of Pbest particle by changing their velocity, calculate the Pbest value for each particle. The velocity and the location of the particles at each iteration are updated. From that particle best (pbest) the global best (gbest) value is determined.

Working Process of PSO

Step: 1 Initialize the swarm particle in the search space randomly.

Step: 2 Calculate the fitness value by using objective function and consider it as p_{best}.

Step: 3 update the velocity and the location for each Particle.

Velocity of each particle is updated by using the equation

$$V_t = (w^* v_{t-1}) + (c_1 * r_1 * (gb_{t-1} - p_{t-1})) + (c_2 * r_2 * (pb_{t-1}^k - p_{t-1}^k)) \quad \text{..... (1)}$$

Location of each particle is updated by using the equation

$$P_t = P_{t-1} + V_t \quad \text{..... (2)}$$

Step: 4 update the Pbest and gbest.

Step: 5 stop if max iteration is reached otherwise repeat from step 2.

Adaline Neural Network (ANN)

In computational intelligence Neural networks are the weighted directed graph where the nodes are the neurons and edges are connected in between two neurons in the network. Different types of neural networks are there. Adaline network is simple two-layer neural network with only input and output layer, having a single output neuron. The number of input layer neurons equals the number of inputs.

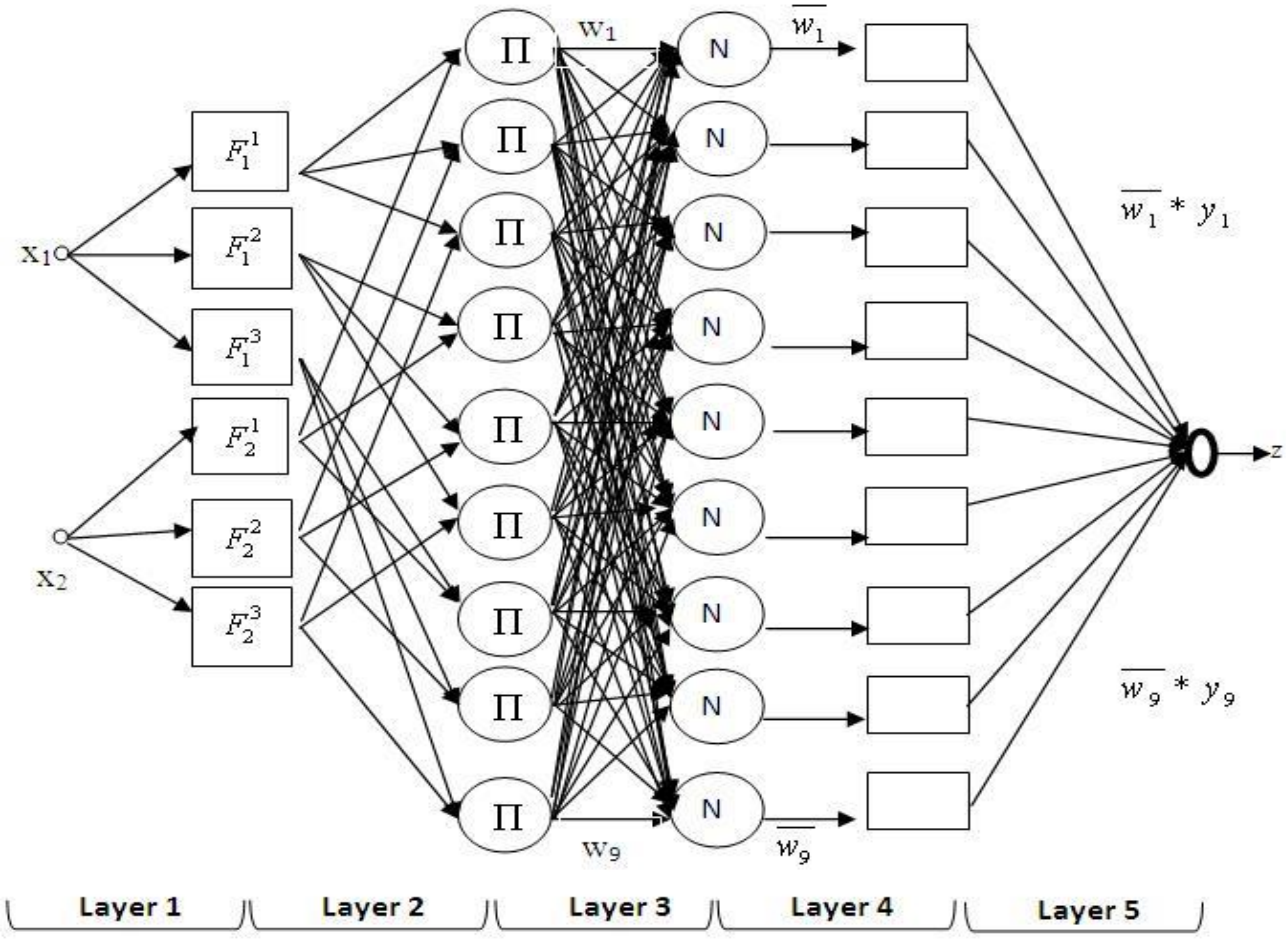


Fig.1: ANFIS architecture of two inputs and nine rules

Data preprocessing, training and testing of the proposed techniques are implemented in Matlab R2013a.

An ANFIS architecture i.e., 06 neurons in input layer, 10 neurons in hidden layer and one neuron in output layer is used to create the required ANFIS model for prediction [32]. For training Firefly algorithm has been used for time series prediction. The parameters considered for training the ANFIS are:

Performance Goal = 0

Learning Rate = 0.01

Training ratio = 0.8

Validation ratio = 0.1

Testing ratio = 0.1

Output of the output neuron is $O = \sum_{i=0}^{n} (Xi * Wi)$ ..... (3)

Error of the Adaline network will be calculated by using the equation

$E = (d - O)^2$ ..... (4)

Mean Absolute percentage error is determined by the equation given below

$$MAPE = \frac{1}{N} \sum_{n=1}^{N} \left| \frac{Odesired - Oobtained}{Oobtained} \right| 100\%$$

..... (5)

Data Set

The real stock market data of stock exchange has been used for the prediction models. The proposed techniques have been experimented with different data sets i.e., Stock data of Microsoft Company and Yahoo Company Table- 1 shows dataset and no of records. Input used to predict high price of stock Value of next day.

Table 1: Details of Data Set Used for prediction

Stock Name	Date From	Up to date	No of Records
Yahoo	May 2006	May 2016	2519
Microsoft	May 2006	May2016	2519

Data Processing

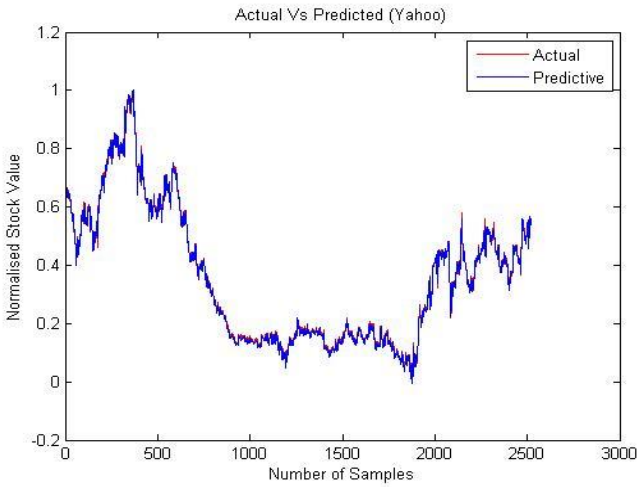
As the range of data values is very large, so data need to be normalized. Normalization transforms measures of magnitude (counts or weights) into measures of intensity. It is the process of creating the shifted and scaled versions of statistics. This is done because the normalized values eliminate the effects of certain gross influences of the data. To normalize a set of data, the original data range is mapped into another scale. Normalization is needed to preprocess data so as to ease the algorithm's job i.e. it helps to bring the data closer to the requirements of the algorithms. Variables can be normalized (to unit zero mean and unit variable, or to the interval [0, 1]), data elements can be normalized (when all their attributes have the same `units') and the target variable can be normalized. In the proposed hybrid method the data set is normalized by using the equation (6).

$$Y' = (Y - Ymin)/(Ymax - Ymin)$$

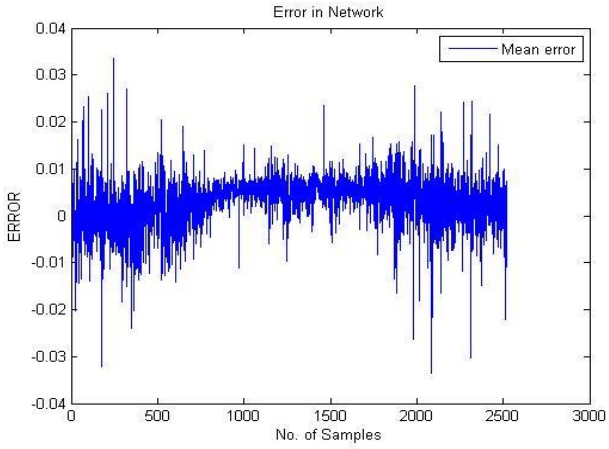
..... (6)

IV. Result and Discursion

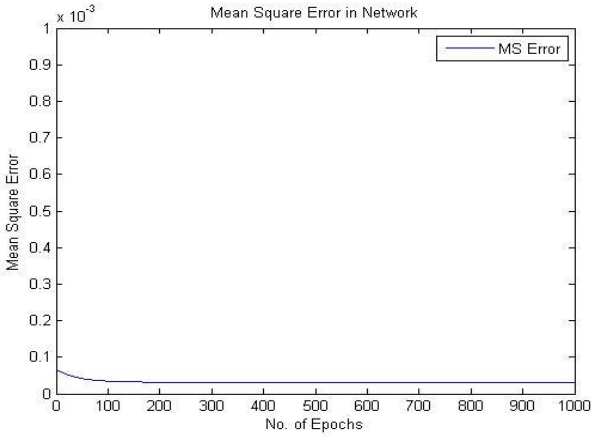
The proposed algorithm is tested under certain conditions to predict stock value of Yahoo and Microsoft stock dataset. The dataset is normalized as stated above then trained in adaline network and optimized using particle swam optimization technique which gives minimum error MAPE 1% as evaluated using equation (5) and shown in figure 4 & 7 for Yahoo dataset and Microsoft Dataset respectively. The figure 2 shows Actual value Vs predicted value of Yahoo stock data set blue line shows predicted value of high stock value in a day which is accurately falls on redline which shows actual high stock value in a day of yahoo stock dataset. The figure 7 shows predicted value and actual value of Microsoft dataset which shows both the lines are very close to each other so error is minimum closed to zero.



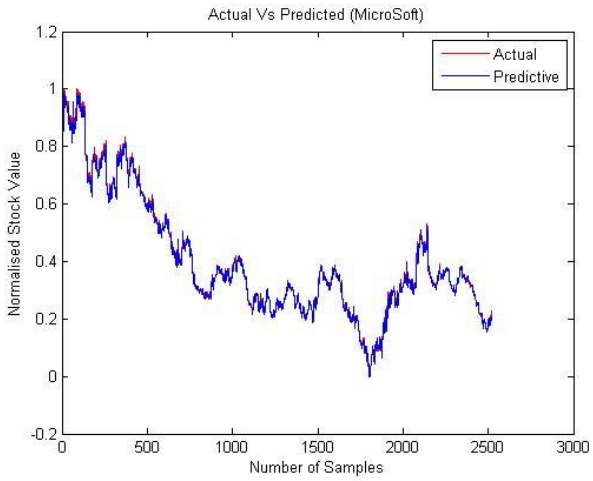
(Fig 2: Actual Vs Predicted Value of Yahoo)



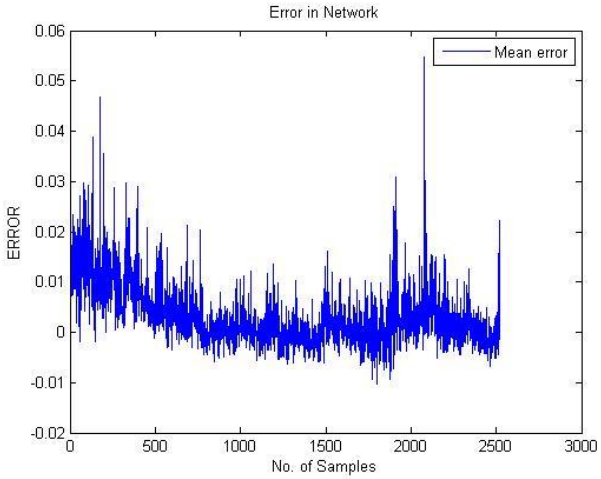
(Fig 3: Error in the network of Yahoo)



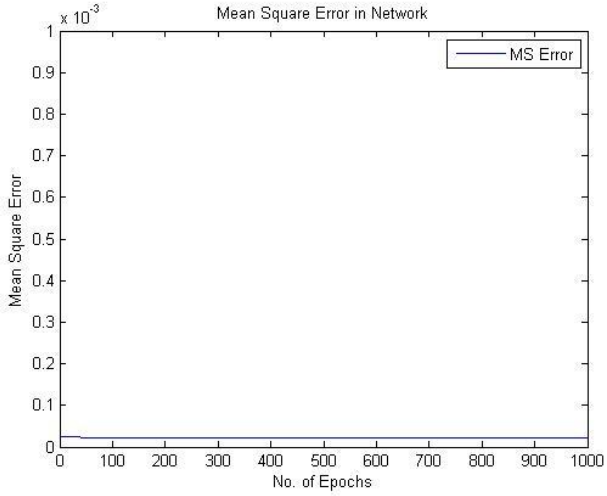
(Fig 4: Mean Squire Error of Yahoo)



(Fig 5: Actual Vs Predicted Value of Microsoft)



(Fig 6: Error in the network of Microsoft)



(Fig 7: Mean Squire Error of Microsoft)

The following table shows comparisons of different model in terms MAPE and our model show minimum error so it's very efficient for forecasting stock value of Yahoo and Microsoft dataset.

Table 2: Comparison of performance in terms of MAPE with different models.

Name of Model	Mean Error	MAPE
HEA [10]	0.0373	3.73%
VSPSEG[1]	0.03513	3.513%
CMS-PSO[2]	0.032	3.2%

ANN-BP[7]	0.0308	3.08%
Proposed Model	**0.010**	**1.0%**

V. Conclusion

In this paper we have proposed an efficient hybrid model for forecasting stock price. The model is working efficiently on Microsoft and yahoo dataset by giving minimum result of MAPE 1%. This model works well for predicting high value of stock price in a day. The experiment result is tested and verified in Mat Lab a2013r in normal system configuration. Therefore we recommend this model will work well for above data set. In future we can implement sudden fall of market and how to predict sudden fall of stock price.

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