

# Hybrid Strategy for Stock Trading

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**Abstract** - Trading Strategies provide a set of trading rules defining the conditions that must be occurred for a trade entry and exit to occur. Profit Gain is the final aim of a trader competing in financial markets. In order to earn profits, traders find the help of new decision support systems. Nowadays, investors started adopting technical indicators for trading in stock markets. The trading decision prediction is one of the problems faced by many traders. The trading decision prediction is considered as a categorization problem. Integration of technical indicators with trading rules helps traders to decide when to buy, sell and hold stocks. The use of artificial neural networks with the technical indicators conquered the world of stock trading prediction. These are now able to predict the market trend.

In this project, a new decision prediction system which involves the use of Computational efficient functional link artificial neural network learned by back propagation algorithm is studied to understand the behavior of stock trading signal of equity stocks. This strategy is then compared with the Simple Moving Average strategy.

**Keywords:** Trading Strategies, Technical indicators, Computational Efficient Functional link Artificial Neural Network, Back Propagation algorithm, Simple Moving Average Strategy

## I. INTRODUCTION

A Stock Market plays an important role in every economy and it is the most critical aspect of every growing economy. It is a powerful system for every company in the economy for building capital and a best investment method for all classes of people. With the increasing rate of generation of financial data, capability of human to examine them manually became difficult. The crucial problem lies in the prediction of stocks as it depends on variety of market variables. There are a large number of environmental, political, financial and other related factors which can influence price variations on global scale. The political rule of a nation can influence the movement of stock prices directly. However the impact is mainly influenced and occurred due to only those companies which are directly or indirectly related to the concerned variable in one or other way. Due to these challenges, traders have to invent and establish different techniques to predict the stock market accurately and correctly. The financial field is a suitable platform for the implementation of various artificial intelligence technologies. The consistency of the stock exchange has perpetually been questioned in economic studies. Also, Stock market time series data became complicated due to various reasons such as long term trends, cyclical and seasonal variations. For the efficient analysis of financial data, it is essential to develop

better automated approaches. Trading stocks is exciting as it involves high risk and good reward. Trading in stock market can be a process of participating in the stock markets which deals with traditional buy, sell and hold investing. Traders concentrate on short-term stock price moves for getting profit during rising as well as falling markets instead of waiting for higher profits from long term stock price moves. The main duty of trader for successful trading is to develop techniques and strategies to determine entry and exit points. Generally, traders develop a method or style to stick with once they find it helpful. Some people only trade one or two stocks every day while some others trade a basket of favorites. Now, the use of technical analysis in the field of trading became a fashion for experienced traders and beginners. Various types of Technical indicators are also useful in generating signals for entering or exiting a trade. Technical indicators are data points that can be obtained by applying formulae to the stock price data of a security. Price Information data includes open, high, low or close prices over a period of time. Some indicators use only the close prices while others may use volume and open interest into the formulae. The price data is applied to the formula and technical indicators can be produced. Technical Indicators are technical analysis tools which are mathematically derived that are used by traders as well as investors used for analyzing the past and predicting future price trends and patterns. Fundamentalists may use economic reports and annual reports in fundamental analysis, technical traders use indicators to interpret the behavior of the market. The main use of these indicators is to identify trading points such as when to entry and when to exit. Technical indicator such as moving averages are often used for predicting a market trend change. Strategies employ these indicators in an objective manner for determining entry, exit and trade management rules. A strategy involves a set of trading rules that specifies certain conditions under which trades can be established, managed and closed. Strategies contains the detailed use of one indicator or more indicators to establish points where trading activity will take place. These indicators evaluate price movement, volume, momentum, trend direction, trend strength, levels of support and resistance and volatility. Stock trading signals can also be interpreted simply by studying the market. Indicators cannot be trading strategies. An indicator can only help the traders to identify market conditions. A strategy is trader's or investor's rulebook. There are several technical trading tools including trend, volume, volatility and momentum indicators. Generally, traders may use more than one indicator to form a strategy even though different types of indicators are recommended while using more than one. Multi Collinearity should be

necessarily avoided as it produces redundant results thereby making other variables appear less important. Instead of that, traders should select indicators from different categories such as one momentum indicator, one trend indicator, one volume indicator and volatility indicator. In most cases, one of these indicators is used for confirmation while another indicator is producing an accurate signal.

1) *Problem definition:* Trading in Stock Market has now become a challenging issue for the investors and traders to trade in financial market. It involves risk even though it is exciting. It is also an important channel of financial investment. Gaining Profits lies in finding the suitable and best time for trading. But it is always difficult to find the best suitable time to buy, sell and hold stocks. Use of machine learning techniques especially Artificial Neural Network is found more effectively in predicting stock market trend. Only some works related with the usage of Technical indicators with machine learning techniques had seen giving better results in this area. So, in this work, a hybrid model of Computational efficient functional link Artificial neural network learned using Back propagation algorithm and specified rules involving technical analysis has to be developed in order to study the trading signals such as buy and sell of the equity stocks in the market.

2) *Objectives of the work:* The Objectives of the project are to develop a decision prediction system using Computational efficient functional link Artificial Neural Network trained using back propagation algorithm, to determine trading signal for the equity stocks and to compare the hybrid strategy with the Simple moving average strategy.

3) *Research Methodology:* Stock trading requires proper knowledge, planning, careful evaluation and previous trading behavior of the underlying stock. The good knowledge of stock market and its trend is very important for taking proper decision at the right time. The indicators of technical analysis help to know the movement of stock market. Here nine technical indicators are used as input data. Important Steps in this work are collection of data of three equity stocks of a sector listed in NSE, Technical Indicators extraction, Actual Trend Analysis using 15 day Simple Moving Average, Generation of trading signal from trend analysis, Building the model and determine trading signals and compare the model with the Simple Moving Average.

#### A. Literature Review

Several prediction models have been utilized by analysts and researchers to anticipate the stock market trend by using machine learning methods especially Artificial Neural Networks. Stock market trend and Trading signal generation is one such area where several studies have been done. Machine learning techniques especially neural networks is found effective in predicting stock market movement based on the technical analysis. As the problem of finding best time for trading is a serious issue, new method is developed to find the signals[1].

A hybrid neuro fuzzy model had been developed for efficient prediction of stock trend. Decision tree Kernel Principal Component Analysis ANFIS hybrid system had found to be more accurate than all other methods[2].

Kara et al. proposed two models such as Artificial neural network and the Support vector machine models which are used for the anticipation of direction of stock price index movement[3].

Paliyawan P. defined a new approach to forecast direction of forthcoming stock market based on chart patterns with data mining classification. The most favourable model is obtained by Decision Tree over three class order and the model is found highly effective in prediction of market. When it suggests an investor to carry out shorting, there is 51.60% possibility that an investor will earn benefits and 14.10% possibility of loss. From the results, it is found that a historical data set with long span of time can decrease the error rate of forecasting[4].

Fong S., Tai J. and Si Y.W. developed a simulator in which Trend following is implemented as several algorithms. Trend following is basically one type of technical trading method and a rule-based trading strategy that focuses on the movements of long-term stock market trends than on any forecast or external information to predict when to buy and sell a stock[5].

Nayak A, Pai M.M.M. and Pai R.M. suggested two models for prediction in Indian Stock market. Two models of which one model is used for daily prediction and the other one is chosen for monthly prediction[6].

Manojlovic T. and Stajduhar I. suggested two models such as 5-days-ahead predictive model and 10-days-ahead predictive model built by using Random Forests.

Kuo R. J., Chen C. H. and Hwang Y. C. suggested a GA based Fuzzy neural network to design the fuzzy guidelines which can compute the subjective effect on the stock market.

Chang P. C., Fan C.Y., Liu C. H., Lin J. L. and Lai C.M. suggested an ensemble neural network system with Intelligent Piecewise Linear Representation. This linear representation can develop stock trading signals from the historical data and Ensemble Neural Network is used to train and can fetch price patterns from historical data.

Sezer O.B., Ozbayoglu M. and Dogdu E. invented a stock trading system using genetic algorithms integrated with optimized technical analysis parameters for creating buy and sell points.

Shen S., Jiang H. and Zhang T. used two models for study such as a Support Vector Machine and a Multiple Additive Regression Tree.

Ray L. suggests two methods for stock prediction and to know which one is more precise than the other method.

In this work, author have compared the prediction of the stock market using artificial Neural Networks and Support Vector Regression.

Zhao, Lei, et al.(2015) presented a novel data mining approach to forecast long term behavior of stock price trend.

Anbalagan T. and Maheswari S. U. (2015) defined a Fuzzy Metagraph for stock market prediction and decision making. This approach is particularly suggested for traders in Indian market.

Moghaddam A. H., Moghaddam M. H. and Esfandyari M.(2016) studied the efficiency of artificial neural network in forecasting the daily stock rates. The dataset, NASDAQ stock exchange rate was taken for the study.

From the literature reviews, it is understood that the artificial neural network is one of the most commonly used neural network topologies.

Hence, in this project work, a new decision prediction system which involves the use of Computational efficient functional link artificial neural network learned by back propagation algorithm is studied to understand the behavior of stock trading signal of equity stocks. This strategy is then compared with the Simple Moving Average strategy.

#### B. Hybrid Model

1) *Computational efficient functional link Artificial neural network:* Computational efficient functional link Artificial neural network is a type of single layer Artificial Neural Network having two elements. The two elements are Functional expansion and Learning element. For input output mapping purpose, efficient functional expansion block is used in this work. This expansion block is a single layer where a set of non linear trigonometric functions are used. It helps to hold the non linearity that exists in input space and to produce equivalent output space. As a result of the expansion block, it acquires higher convergence rate and less computational cost in which all inputs in the input design is extended through a set of non linear functions.

2) *Back Propagation Algorithm:* Learning Algorithm used to learn the neural network is the Back propagation algorithm. Back propagation algorithm is a learning type of process which can be used in artificial neural networks for computing gradients that are required in the computation of the weights for using in the network. It is ordinary used to train types of deep neural networks which is a phrase implying to artificial neural networks with more number of hidden layer. Back propagation is a particular case of an earlier and more accepted technique named automatic differentiation. In the background of learning, back propagation is ordinarily used by the gradient descent type of optimization to adapt the weights of neurons by computing the gradient of the loss function. This technique is frequently named backward propagation of errors as the errors are computed at the output and referred back over the network

layers. This algorithm has frequently been recovered and is identical to automatic differentiation in the mode of reverse accumulation. Back propagation wants the derivative of the loss function with a view to the output of the network to be known. For this reasoning, it is studied to be a supervised learning method, even though it is used in unsupervised networks such as auto encoders. Back propagation is a rationalization of the delta rule to multi layered feed forward networks which can be made attainable by using the chain rule to repetitively calculate gradients for each layer. It is closely connected to the Gauss Newton algorithm. It is a part of continuing research in neural back propagation. Back propagation can be used with any of the gradient optimizers.

#### C. Experiment Design

1) *Data Collection:* Equity Stock Price data of the selected companies from a sector between 01/01/2013 and 01/01/2018 is collected from NSE. It consists of High, Low, Open and Closing prices of securities and their volume on every trading day. Financial services company, Axis bank listed in NSE NIFTY large cap 50, Canara bank listed in NSE NIFTY mid cap 50 and Allahabad bank listed in NIFTY small cap 50 are taken for study. These variables are considered for calculating various technical indicators. Thus, recent five years data have been collected. All these data have been collected from the NSE website.

2) *Data Pre-processing:* The preprocessing of data was done by removing attributes from data and normalized them in the range of minus one to plus one using min max normalization method. After normalization, this data was then splitted into two sets, the train data and test data. The 80 percentage of the normalized data set is used for training the data and the remaining 20 percentage of the dataset is used for testing.

3) *Tools and Techniques:* The execution of the proposed prediction models is carried out using Windows 8 Professional platform. However, it can also be executed on other platforms. The softwares used are: MS Excel 2010 for Data Preparation and Python 3.5.2 and Java NetBeans for developing code for models. The strategy used for the trend prediction of stock market are Computational efficient functional link artificial neural network.

4) *Methodology for the trend prediction:* There are about seven steps in this strategy for the trend prediction and trading. The steps are technical indicators extraction, Trend analysis using simple moving average, Generation of output trading signal, Normalization of dataset, Neural network structure, Determination of Trend from output and Trading decision prediction. The nine technical indicators includes 3 day MA, 15 day MA, 12 day EMA, 26 day EMA, MACD, %K, %D, RSI and Williams R%. Rules using technical indicator especially 15 day Simple Moving Average are utilized for categorizing the stock price movement as Uptrend or downtrend in this project. If closing price value of stocks

leads its 15 day Simple Moving Average, then trend is Uptrend and trend signal is considered as 1. If close price value of stocks lags its 15 day Moving

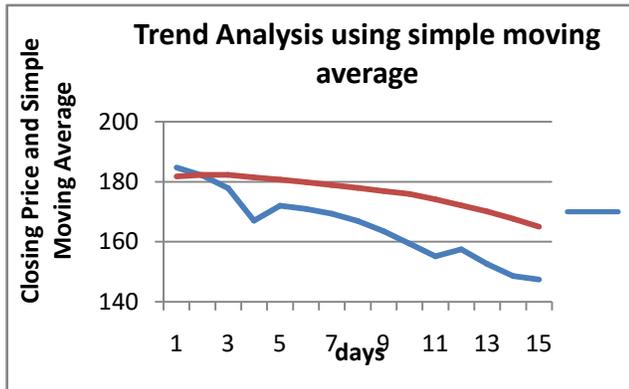


Fig. 1: Trend Analysis

Average, then trend is in Downtrend that is, trend signal is considered as 0. In this project, the nine Technical indicators are used as the input and proposed model generate decision for stock trading such as buy, hold and sell from trend analysis. While the output of artificial neural network are values which is continuous ranging from 0-1, trading signals in range 0-1 are developed using momentum of the stock prices. A new trading signal is generated with reference to paper (Dash R. and Dash P.K. (2016)). The trading signals are created using Trading rules for stock. Trading Signal is used as the output(y variable). The values of nine technical indicator are continuous in different ranges. Therefore, it is necessary to make the input within the range 0-1 using any normalization method. Here the input values are normalized using min max normalization. The network structure is developed using trading rules. The 80% data is trained using network and 20% data is tested. After the training of dataset, testing data is given to trained neural network to generate outputs. The network output is the trading signal which is continuous in the range 0-1. For making trading decision of stocks, it is necessary to identify the trend and to determine when and where to trade or not. The trends are classified from the output signals. The following rule is used as given below. The Mean Trading Signal is taken as 0.5. If Output trading signal is greater than Mean Trading signal, Trend predicted is up. Otherwise Trend predicted is down. Trading decision prediction is the ultimate aim of the study and certain conditions are used for finding trading decision. After observing the stock market direction, stock trading decision points are produced by stock trading rules. If nearest day trend is Up, then the trading decision is Buy. If Buy trading decision exists for the later days, then signal is Hold. If nearest day trend is Down, then the trading decision is Sell. If Sell trading decision exists for the later days, then signal is Hold.

**D. Results and Discussion**

From the study, the number of buy and sell signals using SMA strategy are 6 and 6 while the number of buy and sell

signals using hybrid strategy are 4 and 4 for the axis bank dataset. The number of buy and sell signals using SMA strategy are 8 and 7 while the number of buy and sell signals using hybrid strategy are 4 and 4 for the Canara bank dataset. The number of buy and sell signals using SMA strategy are 6 and 5 while the number of buy and sell signals using hybrid strategy are 4 and 4 for the Allahabad bank dataset.

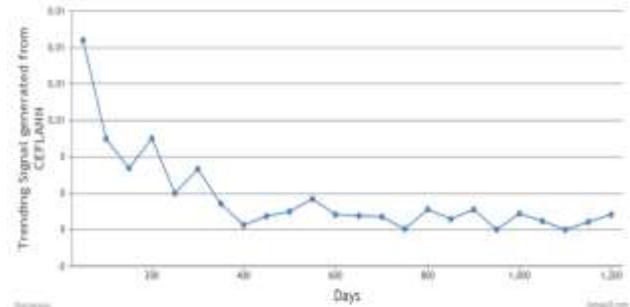


Fig.2: Output signal of Axis bank dataset

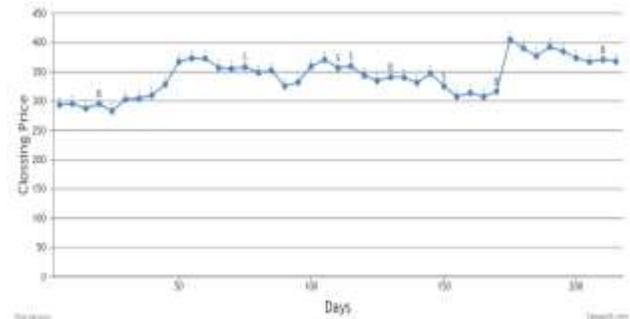


Fig.3: Buy and Sell signal of Axis bank dataset

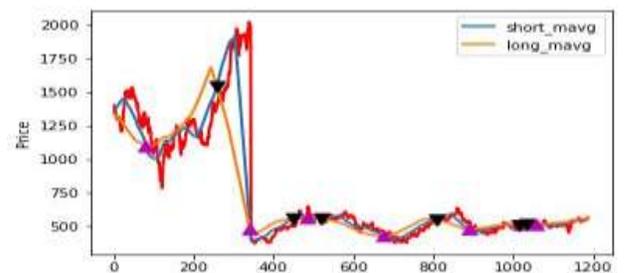


Fig.4: Trading signal of Axis bank dataset using SMA strategy

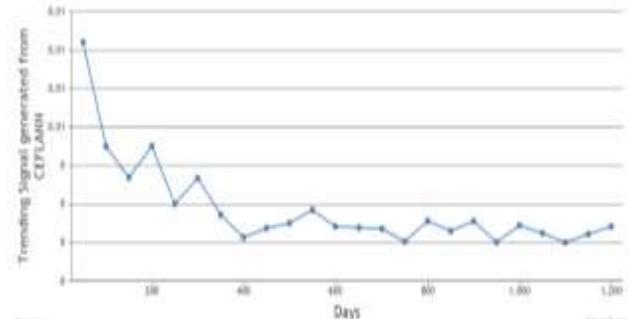


Fig.5: Output signal of Canara bank dataset

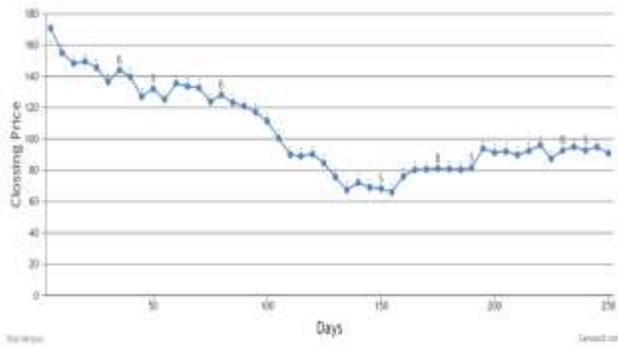


Fig.6: Buy and Sell signal of Canara bank dataset

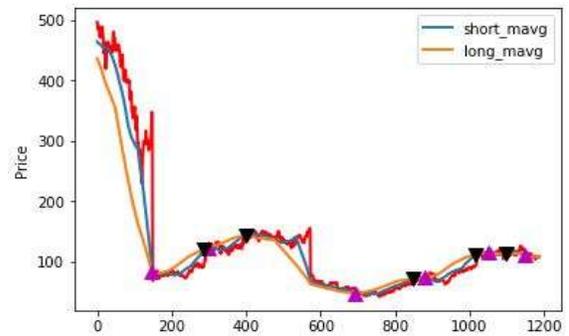


Fig.10: Trading signal of Allahabad bank dataset using SMA strategy

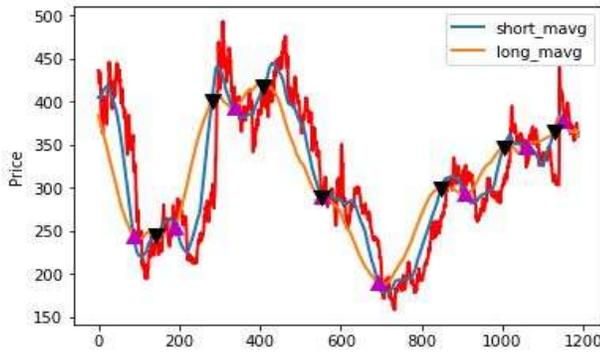


Fig.7: Trading signal of Canara bank dataset using SMA Strategy

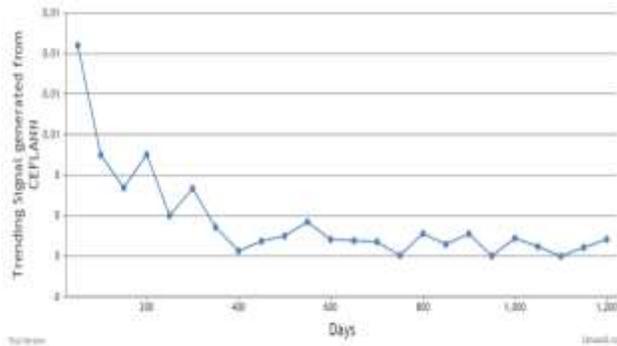


Fig. 8: Output signal of Allahabad bank dataset

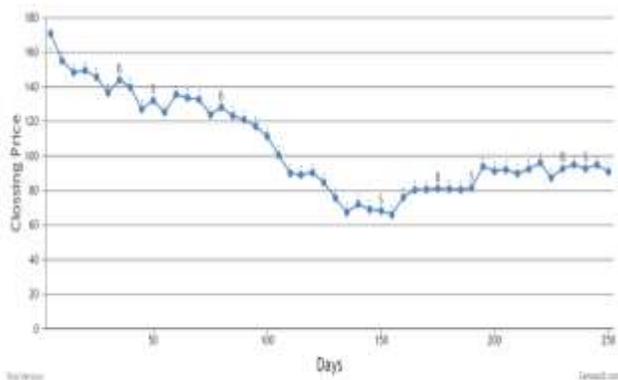


Fig.9: Buy and Sell signal of Allahabad bank dataset

## II. CONCLUSIONS

This project has studied a new decision prediction system for developing suitable stock trading signals such as buy and sell which provide attractive benefits for traders. The buy and sell signals indicate the closing price at which a trader has to enter and to exit a trade. In this project, the stock trading decision prediction problem is considered as a categorization problem with three unknown values such as when to buy, when to sell and when to hold. The dataset used for the study are five years historical data of axis bank listed in NSE NIFTY large cap 50, Canara bank listed in NSE NIFTY mid cap 50 and Allahabad bank listed in NSE NIFTY small cap 50. The strategy used for study is technical analysis. The hybrid strategy of computational efficient functional link artificial neural network learned using back propagation algorithm is developed to study the trading decision prediction. The strategy used for comparing the hybrid strategy is simple moving average. This hybrid strategy has made use of nine technical analysis tools for better generation of trading decisions for the selected three equity stocks. This hybrid strategy gives good profit percentage when compared to simple moving average strategy. The outputs from the hybrid model is then converted into a trading strategy with buy, hold and sell signals using trading rules. From the model results, it is found that this hybrid strategy is useful to generate the trading decisions.

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