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Self Organizing Map Neural Network and Fuzzy based Method to Identify Profit Making Stocks in Stock Market

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Abstract

Selections of stocks that are suitable for investment are always a complex task. While making investment, main aim of every investor is to identify stocks that have potential to go up so that the investor can make good profit on investment capital. After identification of stock the second important point of decision making is the time to make entry in that particular stock so that investor earn more profit on the invested money in short period of time. There are many conventional techniques being used and these include technical and fundamental indicator based analysis. The main issue with any approach is the proper weighting of criteria to obtain a list of stocks that are good to investment in. This paper proposes an improved method for stock selection and finding strong stocks for investment using a hybrid method consist of self-organizing maps and fuzzy-logic on selected technical indicators. The set of stocks identified by our proposed technique has given 9.53% better returns in a period of one month in comparison to NSE index.

Keywords: Fuzzy-Logic, Neural Network, Stocks Classification, Technical Analysis, Fundamental Analysis, Self-Organizing Map (SOM).

1. INTRODUCTION

Finding stocks that are appropriate for investment is a challenging task. Technical Analysis [1] provides a framework for studying investor behavior, they focuses on price and volume data. Technical Analysis based approach is suitable for short-term

investment horizons, and access to price and exchange data. Fundamental analysis checks company's performance and profitability to determine its share price. If we stud the economic conditions and the company's competition, it is possible to determine excellent returns and the intrinsic value of shares. This type of analysis assumes that a share's future as well as current price depends on its intrinsic value and anticipated return on investment. As new information is released pertaining to the company's status, the awaited return on the company's shares will change, which affects the stock price. So the advantages of fundamental analysis are its ability to predict changes before they show up on the charts. Growth potentials are related to the current economic environment. Stocks have been selected by us on the basis of fundamental analysis criteria. These criteria are evaluated for each stock and compared in order to receive a list of stocks that are suitable for investment. Stocks are selected by applying one common criteria on the stocks listed on Bombay Stock Exchange (BSE). The purpose of this paper is to evolve a method of classification of selected stocks in to fixed number of classes by Self Organizing map. Each of the class is having its own properties; stocks having properties closer to a specific class get assigned to it. After getting best class stocks we then select stock for investment using technical analysis.

2. STOCKS CLASSIFICATION

Stocks are much classified based on the type of company it is, the company's worth, or in some cases the plane of return that is expected from the company. Some companies grow up faster than others, while some have compassed what they perceive as their extremum and don't think they can handle more growth. In some cases, management just might be contented with the level of business that they've attained, thus stalling to make moves to gain further business. Before investing in a specific company, it is very important to get to know the company on a individual level and find out what the company's goals and objectives are for the short and long time period. In order to expand in the world of stock investing, a person must have a clear statement of what they are doing, or they shouldn't be doing it at all. Stocks can be a very dangerous investment, depending on the level of cognition held by the person(s) making the investment decisions. Below is a list of classifications which are mostly known to us- Growth Stocks, Value Stocks, Large Cap Stocks, Mid Cap Stocks, and Small Cap Stocks. Stocks are usually classified according to their peculiar. Some are classified according to their growth expected in the long run and the others as per their current prices. Similarly, stocks can also be classified according to their market capitalization. The classifications are not strict and no rules are laid down anywhere for their classification. We classified stocks by taking in account the Shareholding Pattern, P/E Ratio, Dividend Yield, Price/Book Value Ratio, Return on Net worth (RONW), Annual growth in Sales, Annual growth in Reported Profit After Tax, Return on Capital Employed (ROCE) and Adjusted Profit After Tax Margin (APATM) with Self-Organizing Map.

3. STOCK MARKET INDEX

A stock market index is a means of measuring a entire stock market as a whole. Stock market indexes may be graded in many ways. A broad-base index corresponds the performance of a whole stock market — and by proxy, indicates investor opinion on the state of the economy. The most regularly quoted market indexes are broad-base indexes consisted of the stocks of large companies listed on a nation's biggest stock exchanges, such as the American Dow Jones Industrial Average and S&P 500 Index, the British FTSE 100, the French CAC 40, the German DAX, the Japanese Nikkei 225, the Indian Sensex and the Hong Kong Hang Seng Index. Movements of the index should correspond the returns obtained by particular portfolios in the country. Ups and downs in the index indicate the changing feelings of the stock market about future profits of country's corporal sector. When the index goes up, it is because the stock market considers that the prospective dividends in the future will be better than previously expected. When prospects of dividends in the future become hopeless, the index drops.

4. COMPOSITION OF STOCK MARKET INDEX

The most important type of market index is the broad-index, consisting of the large, liquefied stocks of the country. In most countries, a single major index influences benchmarking, index funds, index derivatives and research applications. In addition, more specialized indies often find interesting postulations. In India, we have seen situations where a devoted industry fund uses an industry index as a standard. In India, where clear categories of ownership groups exist, it becomes fascinating to examine the performance of classes of companies sorted by ownership group. We compared NSE Index with the stock chosen using SOM and Fuzzy Inference system. We choose NSE index for compare because it is regarded to be the pulse of the Indian stock market. The computation of NSE Index involves market capitalization of 50 companies in the NSE Index. The Divisor is the only link to the original base period value of the SENSEX.

Table 1: List of companies of NSE Index

NSE	VEDL, SUNPHARMA, GRASIM, ZEEL, CAIRN, BANKBARODA, BPCL, LT, RELIANCE, CIPLA, HDFCBANK, BHEL, ULTRACEMCO, YESBANK, ICICIBANK, DRREDDY, SBIN, TATAMOTORS, KOTAKBANK, PNB, BOSCHLTD, POWERGRID, WIPRO, HCLTECH, COALINDIA, AXISBANK, HINDALCO, NMDC, TATASTEEL, ITC, INDUSINDBK, MARUTI, TECHM, INFY, HDFC, AMBUJACEM, ASIANPAINT, LUPIN, NTPC, ACC, HEROMOTOCO, M&M, GAIL, ONGC, TATAPOWER, BAJAJ-AUTO, TCS, HINDUNILVR, IDEA, BHARTIARTL

It keeps the Index comparable over time and is the accommodation point for all Index adjustments arising out of corporate actions, replacement of scrips etc. During market hours, prices of the index scrips, at which latest trades are executed, are used by the trading system to compute NSE Index in every 15 seconds and propagated in real time.

5. APPLICATION OF NEURAL NETWORKS IN STOCKS

Overview

The ability of neural networks to detect nonlinear relationships [3] in input data makes them perfect for modeling nonlinear dynamic systems such as the stock market. Neural networks, with their significant ability to derive meaning from complex or imprecise data, can be used to extract patterns and discover trends that are too complex to be detected by either humans or other computer techniques. A neural network method can intensify an investor's prediction ability [4]. Neural networks are also gaining popularity in prediction market variables [5]. A trained neural network can be well thought out as an expert in the category of information it has been given to study. This expert can then be used to provide predictions given new situations of interest and answer what if questions. Conventionally forecasting research and practice had been controlled by statistical methods but results were inadequate in prediction accuracy [6]. Monica et al's work [7] supported the potential of NNs for forecasting and prediction. Asif Ullah Khan, Bhupesh Gour [8] used the back propagation neural networks with various number of hidden layers to study the prediction of the buy/sell. Neural networks using back propagation algorithms having one hidden layer give more faithful results in comparison to two, three, four and five hidden layers.

Kohonen self-organizing map

Self-organizing maps (SOM) consist of a general class of neural network methods, which are nonlinear regression techniques that can be applied to find relationships between inputs and outputs or form data so as to identifying so far unknown patterns or structures. It is an excellent tool in exploratory phase of data mining [9]. It is widely used in application to the analysis of finance related information [10]. The results of the work signal that self-organizing maps can be workable tools for classification of large amounts of financial data [11]. The Self-Organizing Map, SOM, has made its position as a widely applied tool in data-analysis and visualization of high-dimensional data. Within other statistical methods the SOM has no close duplicate, so it provides a compartmental view to the data. The SOM is, still, the most widely used method in this category, because it provides some worthy advantages over the alternates. These include, easiness of use, particularly for inexperienced users, and very intuitive display of the data projected on to a regular two-dimensional block, as on a sheet of a paper. The main prospective of the SOM is in exploratory data investigation, which differs from regular statistical data analysis in that there are

no presumed set of possibilities that are valid in the analysis. Instead, the hypotheses are created from the data in the data-driven explorative stage and validated in the confirmatory stage. There are some problems where the explorative phase may be sufficient alone, such as visualization of data without more quantitative statistical reasoning upon it. In practical data analysis problems the most common task is to search for dependencies between variables. In such a problem, SOM can be used for exploit insight the data and for the initial search of potential dependencies. In general the findings need to be validated with more classical methods, in order to assess the sureness of the judgement and to reject those that are not statistically significant. In this endeavour we discuss the use of the SOM in finding for dependencies in the data. First we normalize the selected parameters and then we initialize the SOM network. We then train SOM to give the maximum likeliness estimate, so that we can match a particular stock with a particular node in the classification layer. The self-organizing networks assume a topological structure among the cluster units [2]. There are m clustering layer units, arranged in a form of one or two dimensional array: the input signals are n-dimensional. Fig. 1 shows architecture of self-organizing network (SOM), which consists of input layer, and Kohonen or clustering layer.

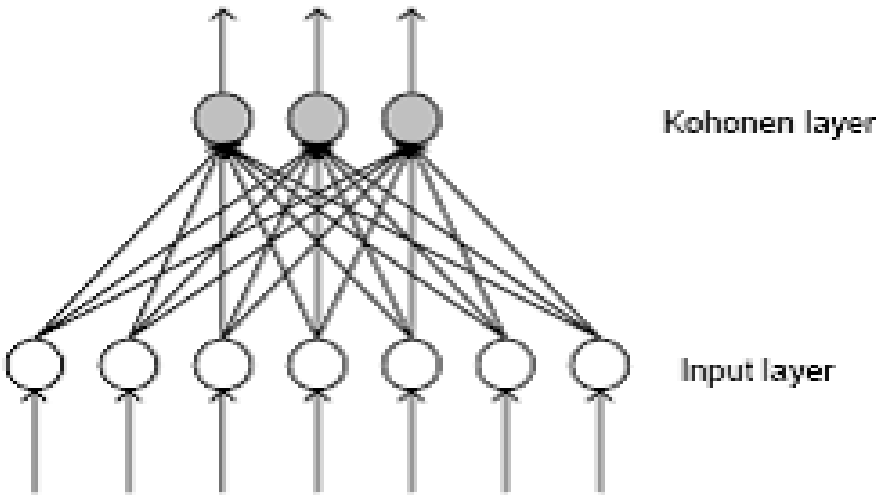

Fig 1: Architecture of Kohonen self-organizing map

The gray units in the Fig. 1 are processing units. SOM network cluster the data into N number of classes. When a self-organizing network is used, an input vector is presented for each pattern. These vectors make the environment of the network. Each new input pattern produces an adaptation of the parameters. If such modifications are correctly controlled, the network can form a kind of internal representation of the environment.

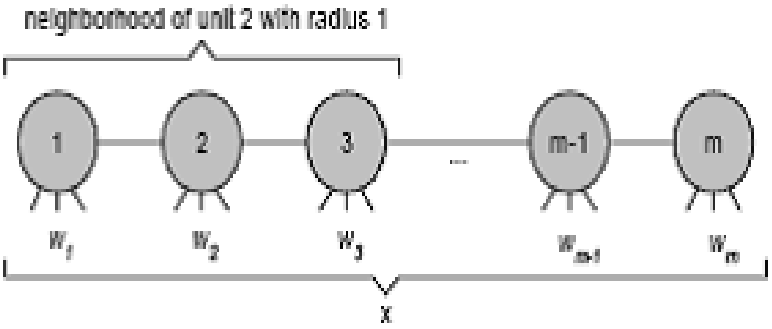

Fig. 2: A one-dimensional matrix of computing units

The n-dimensional weight vectors w_1, w_2… w_m are used for the computation. The ultimate aim of the clustering for each node is to learn the specialized pattern present on different regions of input space as shown in Fig. 2. When an input from such a region is fed into the network, the corresponding clustering unit should compute the maximum excitation. SOM distinctly reduce mis-classification errors [12]. Kohonen's learning algorithm is used to guarantee that this effect is achieved. A clustering layer nodes computes the Euclidian distance between an input x and its weight vector w. The complete description of Kohonen learning algorithm can be found in [2] and [3].

Technical Analysis

Technical analysis is a type of analysis method that evaluate securities by analyzing the statistics generated by market activity, such as past prices and volume. Technical analysts do not attempt to measure a stock's intrinsic value, instead it use charts and other tools to identify patterns that can suggest future activity. Just as there are many investment styles on the fundamental side, there are variety of technical traders. Some rely on technical chart patterns; others use technical indicators and oscillators, and most use some combination of the two. In any case, technical analysts' methods use historical price and volume data. It is separates them from their fundamental counterparts. Unlike fundamental analysts, technical analysts do not care whether a stock is undervalued or over valued the only thing that matters is a security's trading data of [past period and what information this data can provide about where the security might move in the future. The technical analysis is based on three assumptions:

1. The stock market discounts everything.
2. Price moves in trends.
3. History tends to repeat itself.

Despite all the kind of exotic tools it employs, technical analysis really just on studies of supply and demand in a market in an attempt to determine what direction, or trend,

will continue in the future. So we can say that, technical analysis attempts to read the emotions in the market by studying the market itself, as opposed to its components. Moving Average, MACD, ROC and RSI are mostly used technical indicators.

5.1. RSI

The full name is "Relative Strength Index" but the RSI does not compare the relative strength of two securities, but rather the internal strength of a single security. A more appropriate name must be "Internal Strength Index". The RSI usually tops above 70 and bottoms below 30. It usually forms these tops and bottoms before the underlying price chart.9-day RSI is used for calculation.

5.2. Williams %

Williams %R is called momentum indicator that is the inverse of the Fast Stochastic Oscillator. Also referred to as %R, Williams %R reflects the level of the close relative to the top of highest for the look-back period. In comparison, the Stochastic Oscillator reflects the level of the close relative to the lowest low. %R corrects for the inversion by multiplying the raw value with 100. As a final result, the Fast Stochastic Oscillator and Williams %R produce the exact same lines, only the scaling is different. Williams %R oscillates from 0 to -100. If readings in between 0 to -20 it will be considered overbought. If readings from -80 to -100 are considered oversold. Unsurprisingly, signals derived from the Stochastic Oscillator are also relevant to Williams %R.

5.3 Ultimate Oscillator

Ultimate Oscillator is a momentum oscillator which is designed to capture momentum across three different time frames. The multiple time frame objective seeks to avoid the drawbacks of other oscillators. There are many momentum oscillators surge at the beginning of a strong advance and then form bearish divergence as the advancement are going on continues. This is because they are stuck with one time frame. The Ultimate Oscillator attempts to correct this fault by integrating longer time-frames into the basic formula. Williams indicator identify a buy signal based on a bullish divergence and a sell signal based on a bearish divergence.

5.4. MACD

It is based on three exponential moving averages (EMA). These averages can be of any period, though the most common combination, and the exponential moving averages we have focused on, are 12-26-9 days MACD. If the MACD is above the 9-days EMA gives buy signal is generated and only if MACD is pointing below the 9-days EMA sell signal is generated.

5.5. Stochastic Oscillator

The Stochastic Oscillator is a momentum signal that shows the location of the close comparative to the high-low range over a set number of periods. The Stochastic Oscillator does not follow price, it does not follow volume or anything other like that. It follows the speed / the momentum of price. As a rule, the momentum changes direction before price. The bullish and the bearish divergences in the Stochastic Oscillator can be used to foreshadow reversals. This the most important, signal that Lane identified. Lane also used this oscillator to identify bull and bear set-ups to anticipate a future reversal. Since the Stochastic Oscillator is range bound one, is also useful for identifying overbought and oversold levels.

5.6. On Balance Volume (OBV)

On Balance Volume (OBV) measures the pressure - buying pressure and selling pressure as a cumulative signal that adds volume on up days and subtracts volume on down days. OBV was developed by Joe Granville. It was one of the first indicators to measure positive as well as negative flow of volume. Chartists can look for divergences between OBV and price to predict price movements or use OBV to confirm price trends.

Fuzzy Logic-Based Stock Prediction System

There are three modules: the technical analysis module, the convergence module and the fuzzy inference module. The technical analysis module takes in the historical stock prices and calculates for each series the six technical indicators. The SOM module transforms the stock data in to four clusters, then best cluster stock data are used as inputs for the fuzzy inference system. In this work, we have divide stocks into four clusters to keep the model simple and fast. The output of this module serves as the input variable for the fuzzy inference system on the bases of that FIS module generates a trading signal based on the rules defined in the rule base as shown in fig.3.

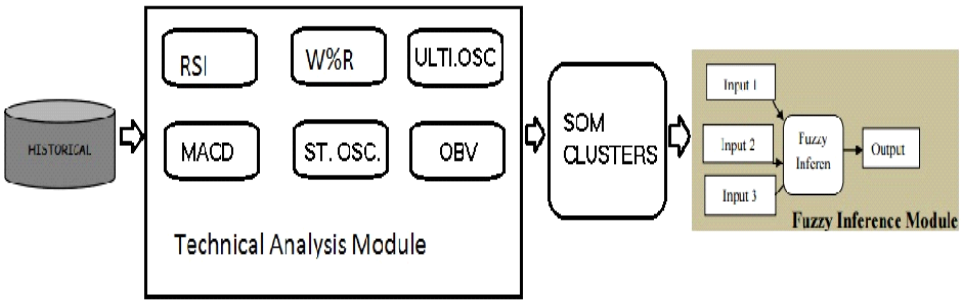

Fig. 3: Technical Indicator, SOM and Fuzzy Based Stock Prediction System

7. EXPERIMENTAL RESULTS

The system has been developed and tested on Windows XP operating system .We have used Visual Basic and Microsoft Access Historical data was taken from National Stock Exchange (NSE).We have selected technical indicators RSI, Williams %R, Ultimate Oscillator, MACD, Stochastic Oscillator, On Balance Volume (OBV). With these inputs SOM divides them into different clusters. SOM is more relevant to the problem where stocks of different companies are to be compared on some common parameters and arranges in the form of different classes. Out of these clusters stocks belonging to the best class have been compared by the fuzzy inference module. Input attributes should be carefully selected to keep the dimensionality of input vectors comparatively small [16].

Table 2: Buy and Sell Rates of Selected Stocks and Sensex

S. No.	Stock	BUY		SELL	
		Date	Rate	Date	Rate
1	SCI	30-04-15	47.00	01-06-15	51.50
2	BEML	30-04-15	980.50	01-06-15	1059.05
3	Voltas	30-04-15	281.10	01-06-15	337.95
Total					

As we know close rates are primary quantifiable factors for individual equities and from quantitative factors the key qualitative factor of the market sentiment can be identified. Closing rate of stock has been used as input in the technical indicators. Stocks classified using SOM and then best category stocks are used by Fuzzy system. We have used NSE index Stocks for the period 30/04/2015 to 01/06/2015 for experiments. We have found that our selected stock gives 9.53% more returns in comparison to NSE Index as shown in fig. 4.

During the period from 30-04-15 to 01-06-15 NSE gain only 3.07% against which our selected stocks has given 12.60% returns on investment.

Table 2: Gain in Return on Investment

Gain in Return on Investment
Our Portfolio
12.60%

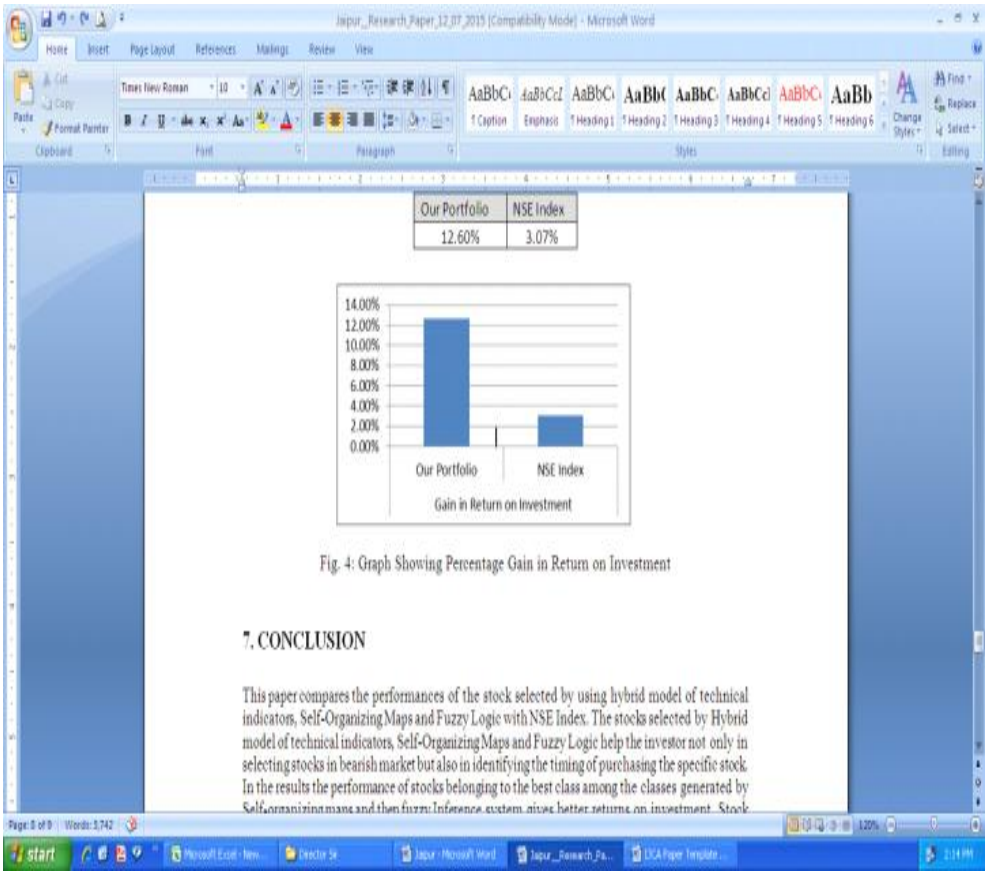

Fig. 4: Graph Showing Percentage Gain in Return on Investment

7. CONCLUSION

This paper compares the performances of the stock selected by using hybrid model of technical indicators, Self-Organizing Maps and Fuzzy Logic with NSE Index. The stocks selected by Hybrid model of technical indicators, Self-Organizing Maps and Fuzzy Logic help the investor not only in selecting stocks in bearish market but also in identifying the timing of purchasing the specific stock. In the results the performance of stocks belonging to the best class among the classes generated by Self-organizing maps and then fuzzy Inference system gives better returns on investment. Stock selected using Self-organizing maps and then fuzzy Inference system gives 9.53% more returns in comparison to NSE Index.

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