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## A Comparative Analysis of Proposed and Existing Technical Indicators for Indian Stock Market

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### Abstract

This paper is aimed at comparison of various technical indicators on NSE indexed sectors with a five-year dataset i.e., Apr'16 to Mar'21. The data used is scraped via NSE's official website. Popular technical analytical indicators such as Moving averages, may it Simple or Exponential, Moving Average Convergence and Divergence, Bollinger Bands, Williams %R, Stochastic Oscillator, Commodity Channel Index, Rate of Change, Directional Movement Index, Relative Strength Index along with the proposed indicator GIST(Global Indicator of Strength and Trends) are applied to make investments & efficient markets judgments, in addition, to evaluate, how much every undertaken technique is sensitive, reliable. This paper does a comparative study of all the listed indicators and will be beneficial for everyone who wants to make good investment decisions, as this study will help them choose the best indicators for investment judgments. Results show that the proposed indicator is giving better results in terms of profits over other technical indicators, that are used in this paper.

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## 1. Introduction

The nation's stock market provides excellent possibilities for investors to profit from long-term gains or trading on the stock by purchasing a stock and turning into a stockholder. The stock marketplace is active and unpredictable.

Making good investment decisions in the stock market is formed on the understanding of not only technical analysis (TA) but also based on how efficiently and accurately one can shortlist the foreboding sectors and then find the best companies with-in those spheres. [1] Gaining ample knowledge about the functioning of the financial market is of utmost importance for getting good returns. It is a term that refers to the correlation between experience and understanding of stock prices. Efficient markets (EM) influence shareholders' investment options since there are no incorrectly valued stocks in an EM. Hence, there will be a certain level of earnings, beyond which there is a very low possibility of bigger returns. On contrary, markets that have inefficiency can lead to greater profits, when stocks are chosen wisely. Technical Analysis helps in the identification of the right sectors, considering previous stock values and trading volume. Understanding and making the right decisions based on previous stock patterns is the main motive of trading. There are [2] various points that are kept to be in mind while making predictions such as policies of Government, Economic state of the country, sentiments of stake-holders, and seasonality. Statistical Calculations revolve around some important assumptions i.e., price movements & momentum, and trends. In this study authors have shown one hybrid implementation of machine learning techniques along with news headlines data [3], results were quite close to the market result.

The basic idea of this research paper is to probe the NSE indices trends and try to generate timely Buy and sell signals. This paper will help the investors to find out the best indicator(s) to find out the trends and strength of those trends for an identified sector. A total of 16 indices' data is used for this study. Detailed Comparison is done to find the best possible solution.

The study can prove helpful for all the stakeholders who are willing to make in-vestments in terms of the identification of best-performing sectors using TA. This research stresses the selection of the most suitable indicator(s) to make predictions about future trends. Investors can make a clever decision by identifying the market efficiency to know which sector performed well in the past and present and to predict future performance using TA to invest in the best sector in the future.

Multiple TI ranging from the simplest of all i.e., MA to the DMI and proposed custom-tailored indicator GIST are implemented and compared for their reliability and dependency

## 2. Literature Review

Study of Boobalan C. [4] is based on thorough technical analysis of a few carefully chosen companies, which aids in understanding the price behavioral patterns of the stock, the signals they send, and the key market turning points. The purpose of this paper is to perform technical analysis on the stocks of the chosen companies and to support investment choices on the Indian Market, based on the predictions of five companies. Technical analysis is crucial to forecast the trend of short- and medium-term price movement and aid investors in choosing the best strategy and decisions when investing in profitable stocks. The different patterns of stock prices of these firms provide an idea of the future pattern of these firms that could be analysed with the appropriate technical analysis tools.

Ameya Sunil Pawar's [5] 2019 research focuses on understanding the types of analyses conducted by the traders and investors who belong to the Facebook group "Day Trading Stocks and Options" as well as the motivations behind each analysis. This is done in an effort to determine why it is so uncommon for people to combine fundamental and technical evaluations, despite their complementary nature.

The goal of the study of Dubey R. et. al [6] is to decriminalization of algorithmic trading and give AT the credit it deserves for improving market quality. This study uses the Order-to-Trade Ratio (OTR) as a metric of AT efficiency and uses direct identification of AT from NSE. It also paves the way for regulators and traders to acknowledge the beneficial effects of AT on market quality.

Asadi et. al [7] have created a hybrid intelligent model for forecasting stock ex-change indexes is proposed. The proposed model combines genetic algorithms, Levenberg-Marquardt (LM) algorithm, and data preprocessing techniques for learning feed-forward neural networks.

Research study of Sharma K. et al [8] shows that the fb-prophet is the latest tool to show improved efficacy in terms of forecast precision. In comparison to standard models, Facebook's Prophet model, which was built expressly for time series prediction, has lately proven effective in accurately fitting data patterns and seasons. To account for both seasonal and non-linear components of stock price data, this study uses the Facebook Prophet model to anticipate the resulting closing cost of the top-ranked bank's shares on the NSE. This study demonstrates that fb-prophet outperforms the ARIMA model in terms of error rate and prediction accuracy.

The crossovers, volume-weighted average, sentimental analysis, and arbitrage statistical algorithms are used by Luyao Zhang et al. [9] to illustrate how the data science pipeline functions with respect to these four common algorithms. Their re-search provides a methodical way to plan, assess, and contrast various trading strategies. Additionally, we use Python 3's object-oriented programming for building our algorithms, making it available as open-source software for upcoming academic studies and practical uses.

Sharma K. et. al [10] have made use of both historical data along with financial news data and then integrated both followed with the application of different regression techniques and have come up with an ensembled technique to predict the stock market. This Ensembled technique, when supplied with five crucial inputs i.e. open, high, low, close, volume and polarity score (derived from news dataset) gave promising results.

### **3. Methodology**

#### *3.1. Data Collection*

Data set for a quinquennium i.e. fiscal years from 2016 to 2021 is scraped from NSE's [11] site based on selected sectors. Data is then pre-processed to deal with missing values for weekends and national holidays, as stock exchange is closed on such days.

#### *3.2. Data Analysis*

The Sectors that were undertaken in this study are listed in Table 2. All the listed indices are from the Nifty index for the period of 5 fiscal years of India (2016 to 2021). The total technical indicators are eleven which were implied on the selected indices dataset. Thus, retrieving the BUY and SELL calls for the next trading days.

#### *3.3. Application of Technical Indicators*

A total of eleven TIs is implemented over the dataset, as shown in Table1 [1]. Descriptions of the same are given below:

**Simple Moving Average.** Simply calculating the average cost of stock data, for a specific period. Whenever new data becomes available, it starts considering the latest data and eliminates the older one. [12] SMA can help in identifying support and resistance.

$$SMA = \frac{s_1 + s_2 + \dots + s_n}{n} \quad (1)$$

where,

$s_n$  = Stock price at a specific period n

n = total number of periods

**Exponential Moving Average.** Similar to SMA, it computes the average only but gives more importance to the latest data[13], which leads to better accuracy in results.

$$EMA = Price(c) \times i + EMA(p) \times [1 - i] \quad (2)$$

where,

c = current day price

p = previous day price,

N = Number of Days

$i = 2 \div (N + 1)$

Table 1. List of technical indicators used

S.No.	Technical Indicator	Acronym
1	Simple Moving Average	SMA
2	Exponential Moving Average	EMA
3	Moving Average Convergence and Divergence	MACD
4	Bollinger Bands	BB
5	Williams %R	W%R
6	Stochastic Oscillator	SO
7	Commodity Channel Index	CCI
8	Rate of Change	ROC
9	Directional Movement Index	DMI
10	Relative Strength Index	RSI
11	Global Indicator of Strength and Trends	GIST

**Moving Average Convergence and Divergence.** MACD works with two averages, one to show convergence & divergence and the other for giving a signal. [14] To calculate MACD formula is given as[15] :

$$\text{MACD Line} = EMA(12 \text{ Days}) - EMA(26 \text{ Days}) \quad (3)$$

$$\text{Signal Line} = EMA(9 \text{ days})$$

**Bollinger Bands.** It is calculated based on SMA (20 days). It is depicted in the form of two lines, positive and negative standard deviations at a distance from SMA.

$$BB_u = MA(P, n) + \alpha \times \sigma(P, n) \quad (4)$$

$$BB_l = MA(P, n) - \alpha \times \sigma(P, n)$$

where,

BBu = Bollinger Band Upper

BBl = Bollinger Band Lower

P = (high price + low price +close price)/3

n = number of smoothening days (generally 20)

$\alpha$  = number of Standard Deviation (generally 2)

$\sigma$  = Standard Deviation over n of P

**Williams % R.** It's a momentum indicator that ranges from zero to negative hundred, and indicates overbought or oversold[16].

$$W\%R = \frac{H_h - C}{H_h - L_l} \quad (5)$$

where,

H<sub>h</sub> = Highest price in a given time (generally 14 days)

C = Latest close price

L<sub>l</sub> = Lowest price in a given time (generally 14 days)

**Stochastic Oscillator.** Comparison of the latest stock prices with high and low prices of a given period, thereby generating values in the range 0-100 to give momentum-indications[17] is the main idea behind Stochastic Oscillator(SO).

$$\%k = \left( \frac{C - L_l}{H_h - L_l} \right) \times 100 \quad (6)$$

where,

%K = Latest value of SO

H<sub>h</sub> = Highest price in a given time (generally 14 days)

C = Latest close price

L<sub>l</sub> = Lowest price in a given time (generally 14 days)

**Commodity Channel Index.** CCI finds strengths and trends of stock and helps investors to assess the market for purchasing, holding, or selling decisions. Values greater than 0 tells stock is currently lower than the historic mean whereas values lower than 0 are the indication of its opposite.

$$CCI = \frac{\sum_{i=1}^P ((H + L + C) / 3) - MA}{0.015 \times MD} \quad (7)$$

where,

H = High Price, L = Low Price, C = Close Price

MA = Moving Average

MD = Mean Deviation

**Rate of Change.** It is depicted in form of a line slope. It refers to the rate at which an item transforms over time. Thus, it is the increase or slowdown of variations rather than the intensity of specific changes. ROC is used in finance to comprehend rates of return and recognize trend momentum.

$$ROC = \frac{(D_{t+1} - D_t)}{T} \quad (8)$$

where,

D = Distance at time t

T = Time taken for occurred change

**Directional Movement Index.** DMI [18] identifies the direction of the movement of stock prices. Two lines are drawn to indicate positive and negative price movements respectively, called +DI & -DI. Here one more line named ADX can also be utilized to determine the strength of the trend line to show up or downtrend.

$$ADX = MA \left[ \frac{(+DI) - (-DI)}{(+DI) + (-DI)} \right] \times 100 \quad (9)$$

where,

+DI = latest high – previous high

-DI = latest low – previous low

**Relative Strength Index.** It helps in identifying bull or bear trends in the market. When its value is above seventy it indicates overbought whereas lower than 30 shows an oversold indication.

$$RSI = 100 - \left\{ \frac{100}{(1+RS)} \right\} \quad (10)$$

RS = Average Up close price/Average Down close price, for a given period

**Global Indicator of Strength and Trends.** This paper makes use of a newly proposed technique named GIST for making the prediction. The feature that makes this indicator special and efficient is the type of signals this indicator generates. It gives the trader a clear indication of the right time to invest based on five different signals. Signals are based on the strength of the trend and thus give promising results.

The complete architecture of the proposed system Gist is portrayed in Fig 1. GIST architecture has majorly 6 steps, which when completed generate trade signals. The process starts with the ticker of the company for which trade is to be done, then data for the past year is scraped using a script written in python from NSE's official website. Then pre-processing on the dataset is performed which includes the normalization of the dataset between 0-100, and then a weight is assigned to each of the final features. Final threshold values are calculated based on the past patterns of the input ticker. Finally, the GIST algorithm with a set of Buy\_rules and Sell\_rules is then applied to the processed dataset, which gives the final output in form of five trade signals: BUY, STRONG\_BUY, SELL, STRONG\_SELL, HOLD.

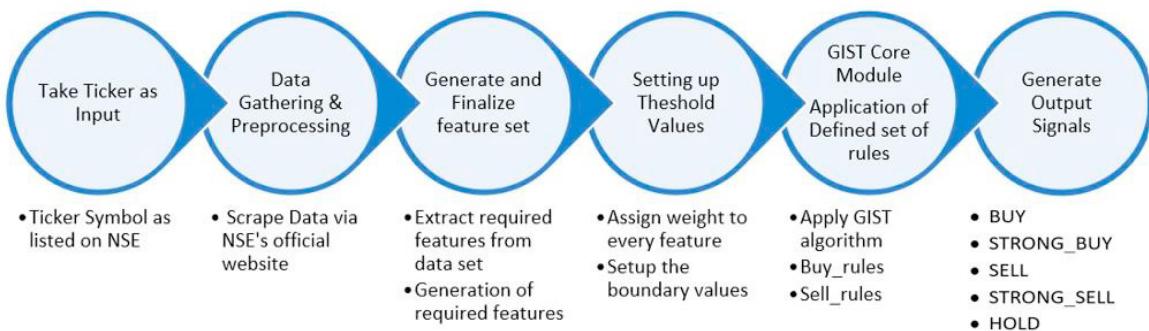


Fig. 1.GIST TI Proposed Architecture

These five signals generated by GIST depend on the strength of the current trend of the market. When it comes to buying, there are two buy signals: BUY and STRONG\_BUY. BUY signal indicates that little or some amount can be invested at this particular time, whereas STRONG\_BUY is the indication of big investment advice. Similarly SELL calls for a small/little selling signal and STRONG\_SELL tells the time to exit from the trade. The HOLD signal is also there, which is the indication to stay with the current investment until the next signal is generated. This indication gives a sense of security to the investor in terms of constant returns from their investment decisions. GIST does not guarantee the highest return, instead, it guarantees a stable/consistent return on the investments. Moreover, it is that simple, that even a naïve person can apply and can gain profits.

**Buy-rules and Sell\_rules.** GIST is built around on the basis of values derived from RSI, MACD and, DMI. Derived feature set is used to figure out the cross-over & cross-down values. Values are the used to find out the range values, which in turn is used to do comparison with cross-over and cross-down points. These values keep on changing depending on the entered ticker symbols, as every ticker symbol has its own high and low points in its past dataset. A set of five threshold values are finalized, each of the threshold value is compared against these ranges with RSI value.

If RSI values is lower than the first threshold then STRONG\_BUY signal is generated. RSI is further compared with other threshold values and cross-over value to either give BUY or STRONG\_BUY. Current market price is considered while making the buy or sell calls. Opposite to this for giving sell signals a hit counter is maintained with initial value as 0. RSI value is check against range values, then DMI signals are checked for their Boolean values, in case it is true, STRONG\_SELL otherwise SELL signal is generated. If threshold value does not lie within the second range, hit counter is incremented by one, and HOLD signal is generated. When hit counter reaches two or higher value, STRONG\_SELL is generated.

### 3.4. Back Testing

Back testing was done to cross-check the authenticity and is correlated. The number of signals produced formed the basis of how much it is sensitive whereas the success rate is counted as a level of reliability. Finally, reliability and sensitivity are correlated to find out their relativity.

### 3.5. Runs Test of correlation

This model is useful when assessing if a trial outcome is purely random, particularly when the difference between random and incremental data has repercussions for consecutive theories & assessments. It may be an extremely useful tool for buyers who use TA to make investment choices. Buyers look for viable investment options by analyzing trends and patterns. This test can assist these buyers in knowing the fundamental factors that may be influencing stock prices.

Table 2. Sector-wise results of RUNS tests

Sector	Ticker Symbol	Indices	Z score	SIG
Auto	NIFTY_AUTO	Nifty Auto	-2.187	0.029
Commodities	NIFTY_COMMODITIES	Nifty Commodities	-2.23	0.026
Energy	NIFTY_ENERGY	Nifty Energy	-2.327	0.02
Pharma	NIFTY_PHARMA	Nifty Pharma	-1.991	0.046
Realty	NIFTY_REALTY	Nifty Realty	-2.618	0.009
Bank	NIFTY_BANK	Nifty Bank	-1.433	0.152
Finance Services	NIFTY_FIN_SERVICE	Nifty Financial Service	-1.537	0.124
FMCG	NIFTY_FMCG	Nifty FMCG	1.096	0.273
India Consumption	NIFTY_CONSUMPTION	Nifty India Consumption	-1.365	0.172
Infrastructure	NIFTY_INFRA	Nifty Infrastructure	-0.964	0.335
IT	NIFTY_IT	Nifty IT	1.315	0.188
Metal	NIFTY_METAL	Nifty Metal	-0.999	0.318
Media	NIFTY_MEDIA	Nifty Media	-1.022	0.307
MNC	NIFTY_MNC	Nifty MNC	-1.275	0.202
PSU Banks	NIFTY_PSU_BANK	Nifty PSU Banks	0.606	0.545
Service Sector	NIFTY_SERV_SECTOR	Nifty Service Sector	-1.365	0.172

As depicted in Table 2, it is visible that Eleven indices have lower z-score, where-as five sectors have got the higher z-scores, with the highest value of -2.618 (Nifty Realty). These results can be of great help to traders in taking investment decisions.

#### 4. Results and Discussions

Table 3 lists the technical indicators along with their rank and success rate in per-centge, sector-wise. The ranking is calculated and validation is done based on the total number of generated signals. A signal is valid or not, is calculated based on the following procedure:

Repeat for all generated Signals

**Step1:**

```
If (close_price_SellSignal > close_price_BuySignal)
    valid_signal_count =valid_signal_count+1;
else
    goto Step 1;
```

**Step2:**

```
if(end_of_signals)
    generate success_rate;
```

After getting the total count of valid signals final success rate percentage is calculated, and the same is mentioned in Table 3.

Table 3. Sector-wise reliability rate and ranking of technical indicators

	TI Name	Success Rate (%)	Rank
[1]	SMA	49.5	4
	EMA	49.4	5
	MACD	44.4	6
	ROC	55.2	3
	W-R	40.2	9
	BB	70.2	2
	RSI	40.7	8
	STOCH	38.6	10
	ADX	38.5	11
	CCI	41.9	7
Proposed Indicator	GIST	82.5	1

With the highest accuracy of 82.5% (Fig. 2), GIST indicator proved to be the best amongst the list of all undertaken indicators. This indicator has generated the maximum number of signals. Moreover, usage of this indicator assists the traders all the time, so that trader never misses a buying opportunity, or sell his/her holdings. GIST, as its name suggests not only generates signals but also tells the strength of that signal by Analysing past patterns. Maximum profits can be earned by investing [1] in Nifty's Auto, Commodities, Energy, Pharma, and Realty. Bollinger Bands are also giving good accuracy of 70.2 in terms of signal generation. Investors have to take their investment decisions very carefully. One either can create his/her trading strategy based on the usage of multiple indicators or can rely on the indicators like GIST, which has a built-in successful trading strategy.

#### 5. Conclusion and Future Work

This study emphasizes the NSE's indices trading prediction. Mostly the signals generated by the chosen indicators were accurate. The difference lies in the percentage of profit that one can earn with the help of the said indicator. Timings and strength of the indicators play a major role. The success rate of every TI formed the basis of TI's rankings. Whereas choosing the correct set of indicators for predicting future prices is the key element to success. GIST indicator is proven to do the same.

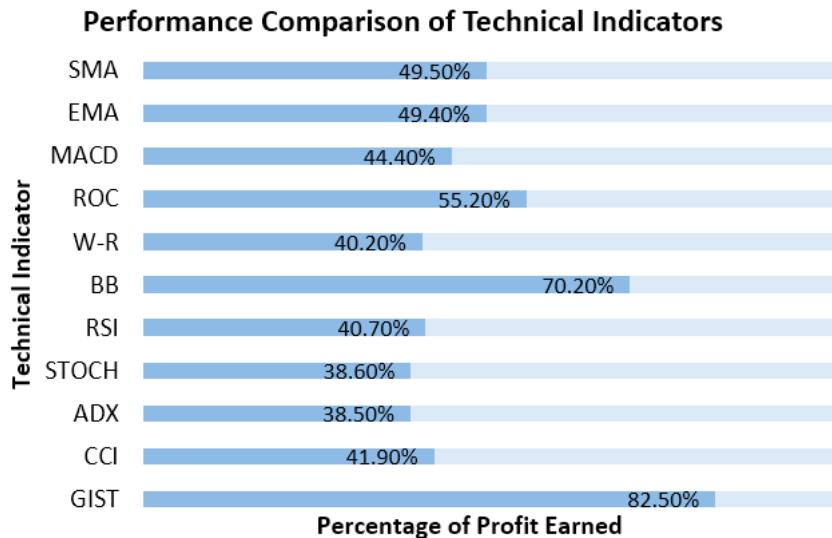


Fig. 2: Percentage of profit earned by each indicator

The GIST indicator is meant to help each individual who finds trading difficult. As it gives five signals to help the trader in taking decisions regarding their investments. It not only signals the best time to buy and sell but also understands the strength of the given trend, resulting in different signals. The best opportunity to buy a little number of stocks or to buy a big quantity of stocks can be determined by BUY or STRONG\_BUY signals respectively. Similarly, it gives clear signals of accurate time to sell the investments either in small quantity or in big numbers, depending on SELL and STRONG\_SELL signals. Moreover, it is also indicated, when it is not a good time to trade and is the time to stick to the investment until the next buy or sell signal, this is done by the HOLD signal. In the future GIST, the indicator can further be enhanced to incorporate the sentiments of the stakeholders through news, social networking data, etc.

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