# Algorithmic Trading using Technical Indicators

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***Abstract* - Financial markets are volatile and dynamic. The uncertainties involved in the market and various economic factors affect the asset price. Predicting trends in asset prices and calculating future value of an asset is a very challenging task. This is responsible for increased use of algorithmic trading amongst traders in financial markets. Algorithmic trading is a method of executing orders using pre-programmed automated trading instructions that consider asset variables including price and volume. Algorithmic trading is widely used in financial firms where large orders are executed and where humans take more time to respond. Algorithmic trading is also called black-box trading, automated trading, or Algo-trading. Algorithmic Trading uses the calculating powers of the computer. News or quotes are not sufficient to trade in financial markets. The challenges in trading can be reduced by proper analysis of data. Technical indicators consider the price and volume data of stock. These technical indicators together can be used to build trading strategies with calculated risks. This paper proposes trading strategies based on quantitative analysis of time series data. These strategies were developed for intraday high-profit trading. The strategy with RSI and MACD technical indicator gives the highest returns up to 12%.**

**Keywords— Algorithmic Trading, Technical Indicators, Quantitative Analysis, Stock Market**

## I. INTRODUCTION

Today about three fourth part of the trading in the U.S is done by an automated trading system. The use of machine learning and grid computing in financial markets is increasing day by day. Algorithmic trading gives an edge over speed and accuracy to the trader. Discipline while trading is not maintained due to fear of losses or the desire of making more profit. Algorithmic trading helps traders to maintain discipline in trading.

Algorithmic trading focuses primarily on high-frequency trading which can optimize returns while taking calculated risks. Algorithmic trading is beneficial in both short as well as long positions. Algorithmic trading systems generate orders as soon as criteria required for trade are achieved. These trading algorithms assess market conditions and produce a signal indicating when an order can be executed. Moving into and out of a trade a few seconds faster has a significant impact on the trade's outcome. All other orders, including protective stop losses and benefit goals, are automatically created once a role is entered. In trading news and sentiments play major role in trends, therefore analysis of news while trading also plays an important role, several machine learning algorithms like SVM are used to carry out sentiment analysis[1]. Natural language processing algorithms were also used to carry out sentiment analysis [2]. Some models use reinforcement learning models while developing an automated trading system, allowing it to analyse the situation using its own experience and decide then to decide what the best investment action should be [3]. Several works also suggest the use of algorithms like LTSM and MLP for short-term trading time frames [4]. Some works suggest the use of classification and regression machine learning models to generate trading signals in automated trading systems [5]. Algorithms like stacked denoising autoencoder (SDAE) were also implemented to reduce noise in market trends [6]. Various trading strategies like Fundamental Analysis, Technical Analysis, and Quantitative Analysis can be used for performing algorithmic trading [7]. This work involves developing trading strategies based on the analysis of market data and using inputs from various technical indicators to perform fully automated trading.

The proposed system takes time-series data to form the stock market as input. Web scraping will be used to build the numerical dataset of stocks. Data pre-processing is carried out to avoid glitches in the dataset. Technical indicators such as Moving Average Convergence Divergence (MACD), Renko, ADX, Relative Strength Index (RSI), etc. are useful to measure momentum, trend, and volatility in the market.[8] The technical indicators are formulated with the obtained data. Two or three technical indicators were combined to build trading strategies. The trading strategies were backtested using key performance indicators. The strategy with Renko and Moving Average Convergence Divergence (MACD) was best among five other implemented strategies. After backtesting of trading strategies were incorporated with trading signals to perform automated trading.

## II. WEBSCRAPING

The data displayed on most websites can only be viewed. We can copy or save the data for further computations and personal use. Web scraping avoids manual copying and pasting of data and helps to store data efficiently.

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Scraping is a technique used to fetch a large amount of data from various websites. The data relating to the financial market was extracted from the yahoo finance website using the yfinance library in Python. The data was stored in spreadsheet format and data pre-processing was performed on it.

## III. Technical Indicators

Technical indicators are mathematical calculations based on historic price, volume, or open interest information to predict asset price direction. A fundamental part of technical analysis is based on analyzing chart patterns, price action, etc. [9]. In this paper, we propose to build algorithmic trading strategies based on technical indicators. There are four major types of technical indicators: trend indicators, momentum indicators, volatility indicators, and volume indicators. Trend indicators tell you the direction in which the market is moving. Trend indicators are also known as oscillators because they pass in a wave-like pattern between high and low values [10]. For example, Moving Average Convergence Divergence (MACD) is a momentum indicator . Momentum measures show the power of a pattern and can also predict when it will reverse. Relative Strength Index (RSI) and Average Directional Index (ADI) are two indicators that can be used to identify price ranges (ADX). Volume indicators tell you how volume is changing over time. Volatility indicators tell by how much the value of the stock/currency pair changes in each period e.g., Bollinger Bands. Considering the market's volatility, momentum and trend algorithms are designed to maximize the profit.

### A. *Moving Average Convergence Divergence (MACD)*

MACD is a trend indicator. MACD is calculated as the variance between the fast-moving average (12-period exponential moving average) and the slow-moving average (26-period exponential moving average). Also, a signal line is calculated which is typically a 9-period exponential moving average of the financial instrument. Whenever the MACD line cuts the signal line from below, it indicates a bullish period and the MACD line cutting the signal line from above signifies a bearish period. MACD trails behind the actual price action of the financial asset.

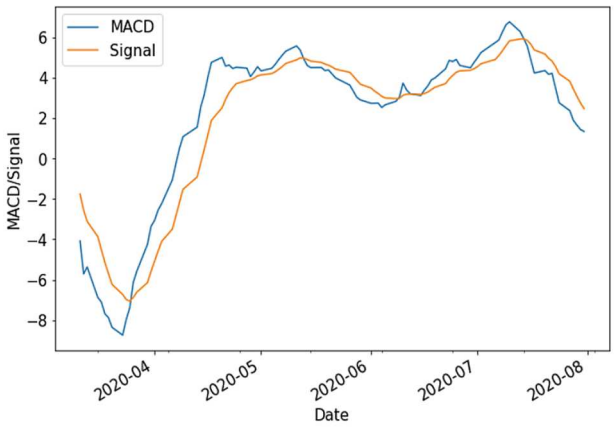


Fig1. MACD signal graph

### B. *Relative Strength Index (RSI)*

RSI is a momentum indicator and measures the speed and change in the price movements. The RSI value lies between 0 to 100. A value above 70 indicates the asset is overbought and a value below 30 indicates the asset is oversold. The formula for calculation of 14 period RSI is as follows:

$$\text{RSI} = 100 - \left[\frac{100}{1+\frac{Previous\ Average\ Gain \times 13 + Current\ Gain}{Previous\ Average\ Loss \times 13 + Current\ Loss}}\right]$$

Here, Gain/Loss = | Current Close Price – Previous Close Price |

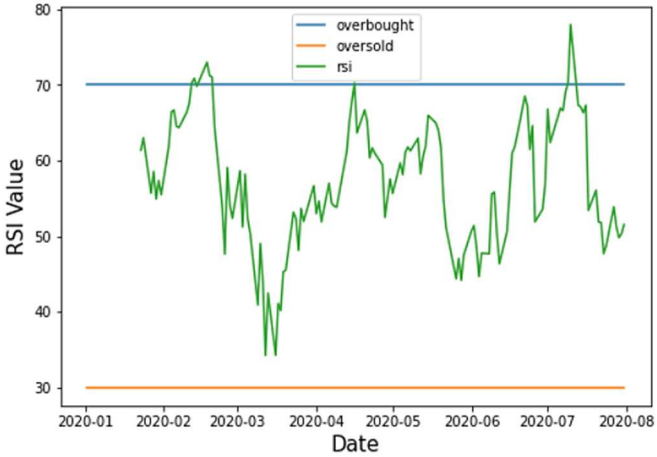


Fig2. RSI graph

### C. *Average Direction Index (ADX)*

Increasing profit potential can be done by trading in the direction of the trend. ADX is used to quantify trends. ADX measures the strength of the trend. The value of ADX is derived using moving averages. The ADX indicator has a value between 0 and 100. It is generally agreed that if the ADX is above 25, it is a sign of a strong trend. The ADX indicator tells us the strength of the trend and not the direction.

Thus, if we take the example of the data from July 2020 to August 2020, the ADX indicator has highlighted the price data signifying that there is a strong trend present.

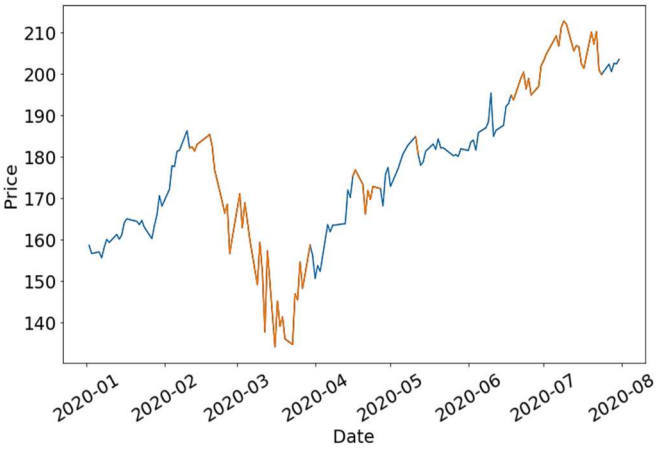


Fig 3. ADX indicating trend in stock.

D. *Renko Charts*

A Renko chart is a type of chart and it is developed by the Japanese. Renko charts are built using price movements instead of against standardized time intervals. In Renko charts price movement is indicated as brick and a new brick is added only when the chart price move by a predetermined value in either direction. Renko charts are composed of bricks that are of the same unit size inclined at 45-degree angles to one another. Consecutive bricks do not occur beside each other.

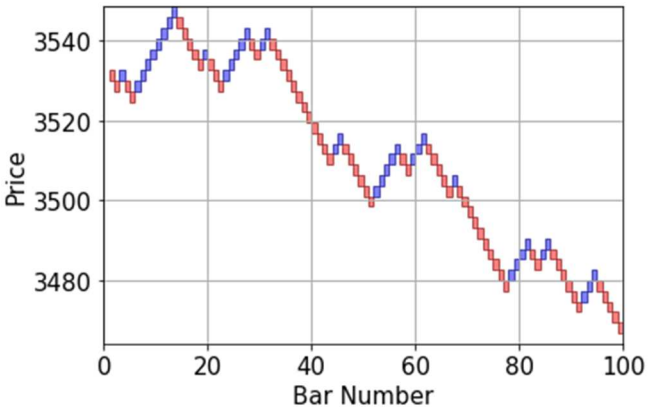


Fig4. Renko Chart

E. *Average True Range (ATR)*

The average true range (ATR) is a technical analysis indicator that decomposes the entire range of an asset price over a given time to determine market volatility. The indicator is mainly used to quantify volatility caused by gaps and restrict up or down movements, rather than to suggest price direction. A stock with a high level of volatility has a higher ATR, whereas one with a low level of volatility has a lower ATR.

F. *On Balance Volume (OBV)*

OBV is a momentum indicator that uses changes in trading volume as an indicator of future asset price movement. OBV formulation is based on the theory that volume precedes price movement. The aim of tracking the OBV is to forecast the likely path of price changes in the near future. The OBV indicator's deviation from the current market trend also indicates an imminent trend shift. A rising OBV reflects positive volume pressure that can lead to higher prices and falling OBV predicts a decline in prices.

## IV. Trading Strategy

There is a well-established trading philosophy that is followed by most traders. But such philosophies are not always profitable. Delay of seconds can lead you to huge losses. But the trading strategies developed using technical indicators and trading signals ensure higher returns from intraday trading. This paper proposes five trading strategies.

A. *MACD and Renko*

This strategy uses a combination of MACD and Renko charts to generate buy and sell signals. A buy signal is generated when three conditions are satisfied which are Renko bar has a value greater than 2, MACD value is greater than MACD signal value and 5 session slopes of MACD line is greater than 5 session slopes of MACD signal line. On the other, an exit signal is generated when the MACD value is less than the MACD signal value and the 5-session slope of the MACD line is less than 5 session slopes of the MACD signal line.

B. *MACD and RSI*

This technique incorporates both a leading (RSI) and a lagging technical indicator (MACD). When three conditions are met, a buy signal is generated: the RSI value is greater than 30, the MACD value is greater than the MACD signal value, and the current session RSI value is greater than the previous session RSI value. The 20-period ATR and the previous close price will be used to produce the exit signal.

C. *OBV and Renko*

This strategy is specifically used for high volume and high activity stocks. Here we use a combination of price movement and momentum indicator. In this strategy, Renko filters out the noise to a greater extent and helps analyze the trend and OBV being the leading indicator precedes an actual change in the market. A buy signal is generated when the Renko bar value is greater than or equal to two and the 5-period OBV slope is greater than 30 degrees. It exits whenever the OBV slope falls below 30$^{o}$.

D. *MACD and OBV*

This technique employs both leading and lagging indicators. OBV is a leading indicator since it changes before the market does. MACD, on the other hand, is a lagging indicator that generates a signal only after the slope line and MACD line intersect. A buy signal is generated 5-period OBV slope is greater than 30 degrees, MACD line is above the signal line and MACD line's slope over last 5 periods is greater than signal line's slope. It exits whenever the MACD line goes below the signal line and the MACD line slope is lower than the signal line's slope.

E. *Resistance Breakout*

When the market is in consolidation or following a sideways trend, it hesitates to cross a certain price limit. The upper limit is resistance, and the lower limit is supported. When price breaches this resistance level of stock it is called a resistance breakout. The breakouts with high volume have a positive effect on the market and can lead to a bullish market. The trading rules are decided using the Average True Range (ATR) technical indicator. The breakout will be defined when the volume notes 1.5 times change, and the resistance level is breached with a 20-period rolling min/max closing price. The exit signal will be generated using 20-period ATR and the previous close price.

## V. API Trading

A real-time market data feed, as well as a company data feed, are needed for an algorithmic trading system. It should either be incorporated into the system or have the potential to be easily implemented from other sources. API means application program interface; it is used to establish a connection between automated bot and broker's interface. API trading is a cheap method to build an algorithmic trading system. The broker usually develops user-friendly API's which allow developers to connect to the interface and perform functions. After establishing the connection between brokers, it will help to obtain real-time pricing, allow us to

obtain account information, and place trade orders. The API of a broker enables a trader to create their trading programs or use a third-party trading platform. Traders who want to run automated models on their trading systems, receive real-time pricing, and execute trades using APIs. Choice of broker's account depends on the choice of market traders want to trade.

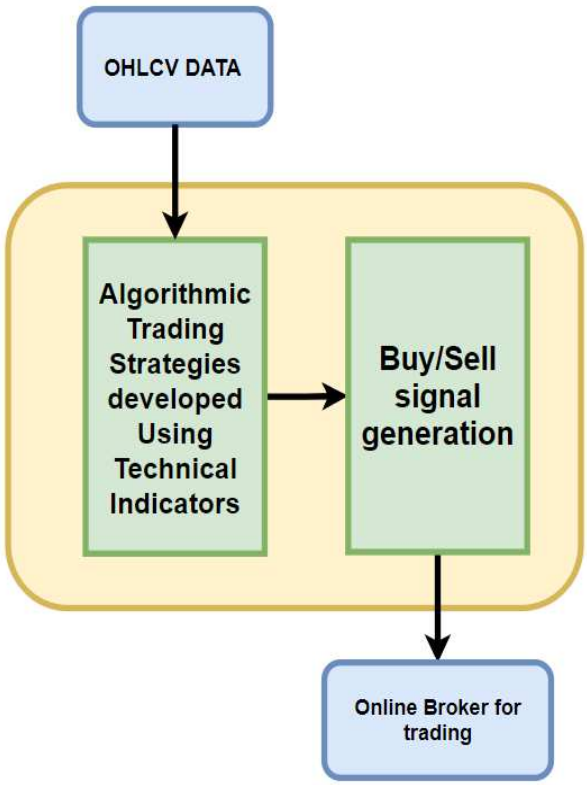


Fig 5. Block diagram of algorithmic trading system

After the connection is made with the broker's terminal, open, high low, close, adjusted close, and volume (OHCLV) data is streamed for trading to take place. This data is used by strategies to generate a signal. Strategies that include a combination of technical indicators are used to analyze extracted data. As soon as a strategy satisfies the particular condition, a signal is generated to open or close a trade. This strategy performs both long and short trades. The application has the requisite connectivity to the broker network for placing trades or to send trade orders directly to the exchange. Thus trading is automated without any human interference. The frequency of opening or closing a trade depends on the broker's API. There are certain limitations upon the data that can be extracted. These limitations vary for different brokers. The library used to develop scrips and connection to broker's account also depend on the broker.

## VI. Experimental Results and Analysis

Backtesting is one of the most important components in the development of an algorithmic trading system. Here the developed strategies are used to see how they work on historical data and trades. The outcome will then assist us in observing the effectiveness of the established strategy. It is done this way because any technique that performs well on historical data is likely to perform well in the future. Backtesting provides us with useful information on the developed strategies, allowing us to compare how different strategies perform on the same historical data and determining the best trading strategy. The net profit or loss is included in these backtesting figures.

The 5 large-cap stocks which were used for strategy backtesting were chosen in such a way that they represent diverse industries of the Indian market. The stocks in the test set included Reliance Industries (energy, petrochemicals, textile, retail, natural resources, and telecommunication), TCS (IT Service Provider), Asian Paint (Chemical Industry), ICICI Bank (Banking), Eicher Motors (Automobile Industry). The testing was carried out between the period of 22-07-2020 to 15-09-2020 by extracting the OHLCV data of the mentioned stocks. The returns provided by all five of our developed strategies were noted for the respective timeframe.

### A. *MACD and Renko*

The MACD, Signal, and Histogram values are plotted as if the chart were a real market activity Renko chart with this indicator. MACD plus Renko also provides a decent return in backtesting. Also, the graph is more stable compared to MACD plus RSI.

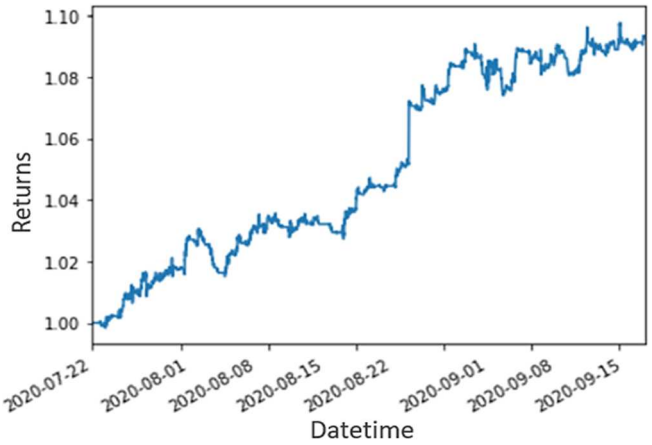


Fig 5. Returns on MACD and Renko strategy

### B. *MACD and RSI*

It is observed that RSI plus MACD strategy provides the highest returns when compared to other trading strategies. The reason behind this is as this strategy uses a combination of leading and lagging technical indicators.

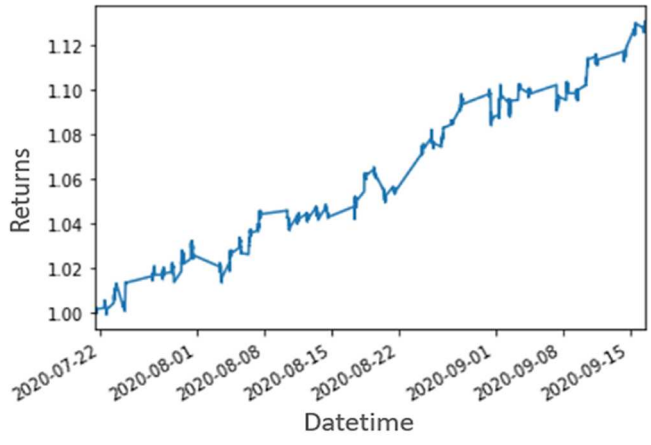


Fig 6. Returns on MACD and RSI strategy

C. *Renko and OBV*

It is a volatile and unstable strategy with many fluctuations. In the figure, a sudden jump was observed in returns from 0.1 to 0.3. Since Renko charts are independent of the time axis and work solely on price movement, it filters out more noise, but it can cause a delay in the signals. Though highly volatile this strategy gives a good return on the value invested and hence can be used to deploy in an automated bot.

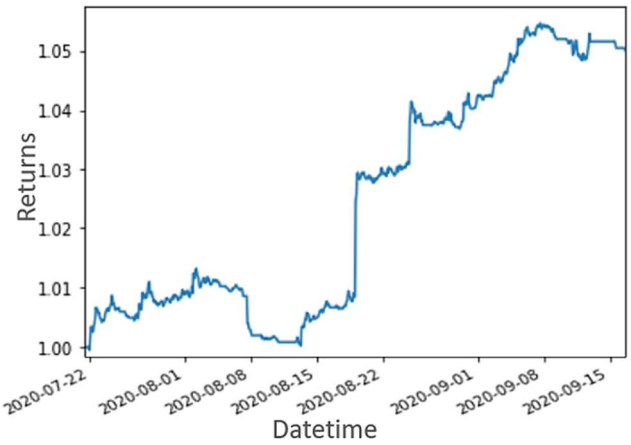


Fig 7. Returns on Renko and OBV strategy

D. *MACD & OBV*

This strategy gave returns up to six percent when it was tested on historical. This strategy used a combination of leading and lagging indicators. This strategy is less volatile as false signals due to MACD in the sideways market were eliminated. OBV signals indicate potential breakout or breakdown when the price moves sideways. It was observed that returns obtained were quite linear with fewer fluctuations and good stability.

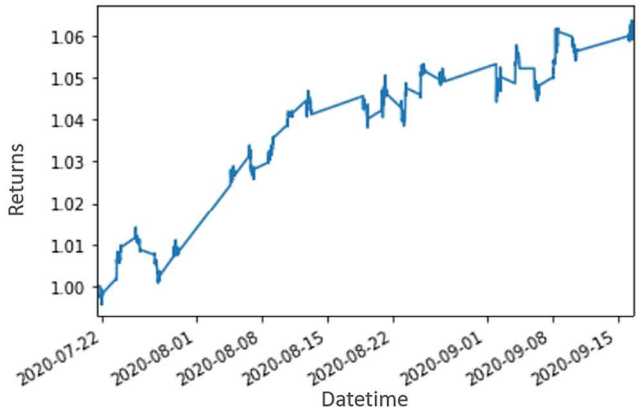


Fig 8. Returns on MACD and OBV strategy

E. *Resistance Breakout*

When the asset breaches the resistance price level the condition is considered as resistance breakout. The resistance breakout is significant when there is a large change in the volume. A triangle pattern is seen with a high change in volume. But many times, the price does not reach the resistance value and follows a sideways trend. The resistance and support levels for an asset are different for different traders which makes resistance breakout a subjective entity. This makes resistance breakout a low-yielding strategy. The returns observed in the backtesting are about 2%.

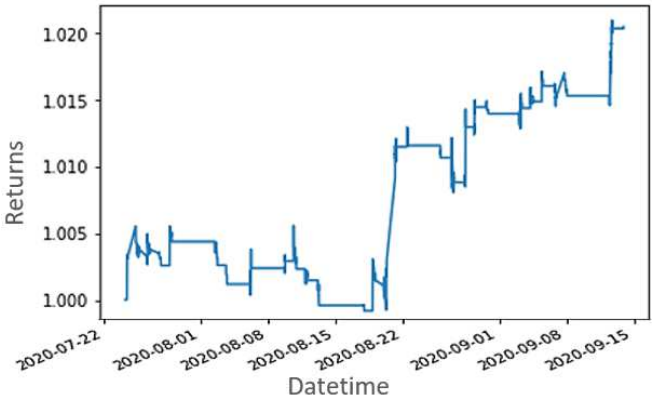


Fig 9. Returns on Resistance Breakout strategy

TABLE I
BACKTESTING STATISTICS

| Strategy | Returns |
|---|---|
| MACD + Renko | 10% |
| MACD + RSI | 12% |
| OBV + Renko | 5% |
| MACD + OBV | 6% |
| Resistance Breakout | 2% |

## VII. CONCLUSIONS

The algorithmic trading system can extract data periodically, perform analysis, execute a trading strategy, and place or close order in an automated fashion. Instead of using a single technical indicator to carry out trade, a combination of two or more technical indicators gives good stability and reduces the risk of losing money up to a certain extent. Thus, in this work combination of different types of technical indicators was used to develop strategies. Two or more technical indicators were combined in such a way that each technical indicator would minimize other's errors. Strategies were tested by applying the rules and trading signal criteria on historical data mimicking actual trading conditions. Backtesting is of utmost importance in assessing the performance of the trading system. Signals were generated to open or close a trade when conditions of technical indicators were satisfied. Using API's, a connection could be made between brokers account and customer. Thus, were able to stream real-time data and intraday trading could be performed. This trading system once build can be run periodically for a specific amount of time and would take care of all orders without any human intervention.

## VIII. REFERENCES

[1] V. Patil, N. Somani, A. Tadvi and V. Attar, "Algorithmic Forex Trading using Combination of Numeric Time Series and News Analysis," 2018 4th International Conference for Convergence in

[2] Technology (I2CT), Mangalore, India, 2018, pp. 1-5, doi: 10.1109/I2CT42659.2018.9058285.

[3] A. Özdemir and S. Bogosyan, "Neural Network based Trading Signal Generation in Cypto-Currency Markets," 2018 International Conference on Artificial Intelligence and Data Processing (IDAP), Malatya, Turkey, 2018, pp. 1-4, doi: 10.1109/IDAP.2018.8620889.

[4] K. Khare, O. Darekar, P. Gupta and V. Z. Attar, "Short term stock price prediction using deep learning," 2017 2nd IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT), Bangalore, 2017, pp. 482-486, doi: 10.1109/RTEICT.2017.8256643.

[5] S. Bouktif, A. Fiaz and M. Awad, "Augmented Textual Features-Based Stock Market Prediction," in IEEE Access, vol. 8, pp. 40269-40282, 2020, doi: 10.1109/ACCESS.2020.2976725.

[6] L. Xucheng and P. Zhihao, "A Novel Algorithmic Trading Approach Based on Reinforcement Learning," 2019 11th International Conference on Measuring Technology and Mechatronics Automation (ICMTMA), Qiqihar, China, 2019, pp. 394-398, doi: 10.1109/ICMTMA.2019.00093.

[7] Y. Li, W. Zheng and Z. Zheng, "Deep Robust Reinforcement Learning for Practical Algorithmic Trading," in IEEE Access, vol. 7, pp. 108014-108022, 2019, doi: 10.1109/ACCESS.2019.2932789.

[8] S. Taneja, D. Garg, M. V. Tarun Kumar and T. Choudhury, "The Machine Predicted Market," 2018 International Conference on Computational Techniques, Electronics and Mechanical Systems (CTEMS), Belgaum, India, 2018, pp. 256-260, doi: 10.1109/CTEMS.2018.87693.

[9] Shah, Dev & Isah, & Zulkernine, Farhana. (2019). Stock Market Analysis: A Review and Taxonomy of Prediction Techniques. International Journal of Financial Studies. 7. 26. 10.3390/ijfs7020026.

[10] H. P. Kumar and B. S. Patil, "Forecasting volatility trend of INR USD currency pair with deep learning LSTM techniques," 2018 3rd International Conference on Computational Systems and Information Technology for Sustainable Solutions (CSITSS), Bengaluru, India, 2018, pp. 91-97, doi: 10.1109/CSITSS.2018.8768767.

[11] Hemanth Kumar P. and S. B. Patil, "Estimation & forecasting of volatility using ARIMA, ARFIMA and Neural Network based techniques," 2015 IEEE International Advance Computing Conference (IACC), Banglore, 2015, pp. 992-997.