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Stock Trade Prediction Using Machine Learning

Asst. Prof. Mrs. Supriya Jawale[1], Rudrani Dhomne[2], Amey Samarth[3]
Artificial Intelligence and Data Science Department, Priyadarshini College of Engineering, Nagpur, India

Abstract: ***The importance of stock market predictions cannot be underestimated because correct predictions ensure good profit and minimize risks for investors. With the expansion of historical data and technological developments in machine learning, the performance of such automatic prediction systems improves significantly. In this paper, the authors consider different prediction techniques with a focus on XGBoostClassifier-based stock market prediction models using technical indicators such as Moving Average, Relative Strength Index, MACD and Volume. Such a model aims to create Buy/Sell signals and calculate the probability of gain to provide investors with additional confidence regarding their investment decisions. There are multiple models and approaches discussed in literature, and the review shows how powerful the classification models are in financial technologies. According to experimental results, the created system can provide trading signals with up to 78% confidence in bulls' probability. Thus, there are high chances for predicting bullish trends with this system. Consequently, the effectiveness of combining XGBoostClassifier with technical indicators is proved by the research.***

Keywords: Stock Market Prediction, XGBoostClassifier, Technical Indicators, Machine Learning, Trading Signals

I. INTRODUCTION

Stock market indices play an important role in representing market performance and also help in guiding investment decisions. Some of the major indices like NIFTY 50 in India, S&P 500 in the United States, and other global benchmarkskeep track of the performance of top companies across different sectors such as banking, information technology, pharmaceuticals, energy, and consumer goods. These indices acts as strong indicators of overall economic health and market direction. Since they offer good liquidity, stability, and high investor participation, market indices are widely used by traders, institutional investors, and fund managers for portfolio construction, market analysis, and derivative trading. And because of their economic significance, predicting stock and index movements accurately is quite valuable for risk management and maximizing profit.

Stock market trading plays a critical role in the global economy by enabling capital flow, wealth creation, and business growth. There are millions of investors, from retail traders to large institutions who participate in financial markets every day with the goal of earning profit through buying and selling stocks. These markets don’t just support individual wealth generation but also help companies to raise capital for expansion, innovation, and job creation. However, generally stock prices are influenced by multiple complex factors such as company performance, economic conditions, investor psychology, geopolitical events, interest rates, and overall market sentiment. These factors interact in ways that are rarely unpredictable and often nonlinear ways, which makes accurate stock price forecasting a incredibly difficult to get right.

Investors used to rely on fundamental analysis and technical analysis to make trading decisions. The fundamental analysis evaluates a company's financial health, earnings, management quality, and growth potential, while technical analysis studies historical price patterns, trading volume, and chart formations to identify future price movements. Although these methods are useful they still largely dependent on human interpretation and experience which results in bias and inconsistency. In modern financial markets, there are thousands of stocks that generate massive amounts of data every second across global exchanges, manual analysis is no longer sufficient to process and interpret all relevant information in a timely and accurate manner.

To overcome these limitations, artificial intelligence and machine learning techniques have become increasingly popular in stock market prediction.These models learn complex patterns from historical data and then use those patterns to predict future outcomes. Unlike traditional statistical methods, they can handle nonlinear relationships, hidden interactions among variables, and changing market conditions. The new data helps with the continuous learning and the machine learning systems can adapt to evolving market behavior and improve their predictive performance over time.

One of the most powerful machine learning algorithms for financial prediction is XGBoostClassifier (Extreme Gradient Boosting). XGBoostClassifier is an advanced ensemble learning algorithm that combines multiple decision trees to create a highly accurate and robust predictive model. This is the reason it is widely used in financial forecasting due to its ability to handle noisy and incomplete data, avoid overfitting through regularization, and process large datasets efficiently. XGBoostClassifier works well for stock market prediction, as the stock market data is very unpredictable and constantly changing.

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TradePredict is designed as an AI-based trading assistance system that uses XGBoostClassifier along with technical indicators such as Moving Average, Relative Strength Index (RSI), Moving Average Convergence Divergence (MACD), and trading Volume. These indicators help capture market trends, momentum, and the strength of price movements in a quantitative manner. Using historical stock data from Yahoo Finance, the system generates Buy or Sell signals and calculates bullish probability with confidence scores, enabling traders and investors to make informed, data-driven decisions rather than relying on intuition or speculation.

II. LITERATURE REVIEW

Stock price forecasting research is of interest to scientists as this task is vital for making rational financial decisions and promoting economic development in general. Due to the availability of large amounts of historical information and new developments in machine learning and deep learning areas, there has been increasing attention toward building intelligent systems capable of forecasting prices with a higher level of accuracy.

Fathali, Kodia, and Ben Said [1] have considered the problem of predicting stock index NIFTY 50 via machine learning techniques. The authors have demonstrated that using historical prices to train supervised machine learning models makes it possible to forecast future trends in stock markets and even to overcome limitations associated with classical statistics tools, especially under volatile conditions.

Aldhyani and Alzahrani [2] suggested deep learning approaches for forecasting and modeling stock prices. A series of various deep architectures was investigated, and it turned out that they were capable of modeling the nonlinearity of time series and providing notably higher forecasting accuracy than classical machine learning methods for large-scale high-frequency data.

Omar et al. [3] have compared two popular machine learning approaches, namely Random Forest and Deep Neural Network, for predicting stock prices under normal conditions and during the COVID-19 pandemic. Ensemble and deep learning models were proved to be stable during market shocks and demonstrated high forecasting accuracy with Deep Neural Networks outperforming other methods in periods of extreme volatility.

Xiao and Su [4] combined deep learning and statistical time series forecasting approach (ARIMA) to forecast stock prices. Hybrid architecture allows leveraging the strength of both approaches and improving forecasting performance, especially in terms of short-term forecasts

Shen and Shafiq [5] suggested a comprehensive approach to stock price short-term trend prediction based on deep learning techniques. A series of experiments showed that a multi-component network capable of capturing temporal dependencies could provide better results in comparison with classic forecasts.

Vijh et al. [6] have considered multiple machine learning algorithms for predicting the closing price of stocks. Both regression and ensemble approaches allowed obtaining better forecasting performance in comparison with classic forecasting methods due to high flexibility and capability of dealing with various kinds of feature selections and historical price patterns.

In Guo's thesis [7], several machine learning approaches have been considered to solve the problem of predicting stock prices. Supervised learning models have been employed, and the author has demonstrated their effectiveness in case of adequate data preprocessing and feature engineering.

III. MATERIALS AND METHODS

Stock market prediction systems mainly depend on historical price data and technical indicators. In most modern systems, data is collected from platforms such as Yahoo Finance, which provides Open, High, Low, Close, and Volume (OHLCV) values for stocks. These values form the foundation of almost all quantitative trading and forecasting models because they capture both price movement and trading activity over time. Historical OHLCV data allows the model to understand how a stock behaves during different market conditions such as bullish trends, bearish phases, and sideways movement.

Before using the data for prediction, it is usually cleaned and preprocessed. This includes handling missing values, removing outliers, and aligning all stock data to a uniform time interval. Financial time-series data often contains noise due to sudden news events, low-liquidity periods, or abnormal trades. Therefore, smoothing techniques and normalization are applied so that the machine learning model can focus on meaningful trends instead of random fluctuations.

Technical indicators are basically derived from raw OHLCV (Open, High, Low, Close, and Volume) data and they help in representing market behavior in a more structured way. Some commonly used indicators include:

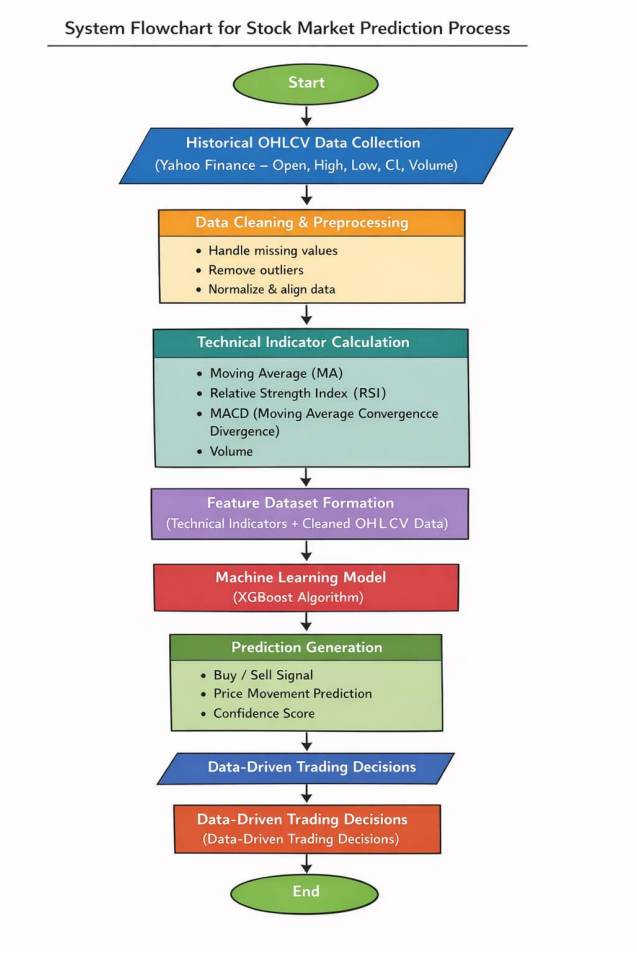
1) Moving Average (MA):it helps in identifying long-term and short-term trends by smoothing out price variations.

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2) Relative Strength Index (RSI):it basically tells whether a stock is overbought or oversold, which helps in detecting potential reversals.
3) MACD (Moving Average Convergence Divergence):it shows the strength, direction, and momentum of price movement.
4) Volume: it tells us the strength behind a price movement and helps confirm trends.

In short these indicators turn raw price data into useful information that describes market psychology and trend strength. This helps the model to find hidden patterns related to price reversals, breakouts, and momentum shifts. And these are then fed into the machine learning model as input.

These features are then used as input to machine learning models. Among different algorithms, XGBoostClassifier is widely preferred because it is an ensemble model based on gradient boosting that combines multiple weak learners to produce a strong predictive model. XGBoostClassifier can handle missing data, prevent overfitting, and capture complex nonlinear relationships between indicators and future price movement. Its ability to work efficiently with large financial datasets makes it highly suitable for stock market prediction systems.



IV. RESULTS

The experimental results demonstrate the effectiveness of the proposed XGBoostClassifier-based stock market prediction system in generating reliable trading signals and estimating bullish probability. The model utilizes historical price data along with technical indicators to identify optimal Buy and Sell points and assess market trend strength. The evaluation was conducted using real market data to ensure the system's practical applicability in live trading scenarios. In this study, the performance metrics were looked at carefully to check the model's accuracy and how reliable it is across different market conditions.

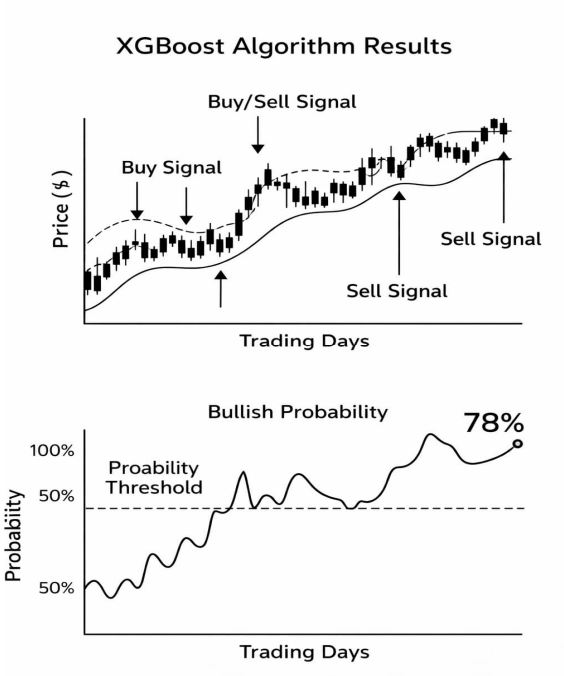


Figure 1: XGBoostClassifier Algorithm Results Showing Buy/Sell Signals and Bullish Probability

Figure 1 basically shows the Buy and Sell signals that were generated by the XGBoostClassifier algorithm over a number of trading days. As we can see the price movement shows an overall upward trend, where Buy signals are generated during periods of price consolidation or early upward momentum, and Sell signals come up when the model detects potential trend reversals or overbought conditions. This shows that the model is able to capture both short-term and medium-term market movements quite well.

Apart from trading signals, the model also computes the bullish probability of the stock price movement. As shown in Figure 1, the bullish probability keeps fluctuating over time based on market behavior and technical indicator values. So when the probability crosses the set threshold, the model gives a signal that there is a higher chance of price going up. In the results that we got, the bullish probability reached around 78%, which shows strong confidence in an upward market trend.

Together the Buy/Sell signals and bullish probability gives investors both a clear trading decision and also a way to measure how confident the model is. All these results show that XGBoostClassifier is able to handle nonlinear relationships in financial time series data and gives stable and data driven predictions that can work well in real world trading situations.

V. DISCUSSION

The results that we got from the XGBoostClassifier based stock market prediction system basically shows that it works well in handling complex financial time series data and gives reliable trading insights. The way technical indicators are combined with ensemble learning helps the model to pick up nonlinear patterns that are usually missed by traditional statistical and rule based approaches.

The Buy and Sell signalsthat the model generated match quite well with the actual price movements, which shows that the system is able to identify good entry and exit points. Buy signals are mostly generated during the early stages of upward momentum or consolidation phases, while Sell signals come up near potential trend reversals or when the upward strength starts reducing. This tells us that the model is actually understanding the market dynamics rather than just reacting to short term noise.

The bullish probability also helps in making better decisions by giving a confidence measure for the predicted price movements. So when the bullish probability goes above the set threshold, it means there is a higher chance of the price going up. In the results we observed, the bullish probability reached around 78%, which reflects strong confidence in the predicted trend. This kind of probability based assessment helps investors to evaluate risk in a better way and not just rely on binary trading decisions.

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When we compare it with traditional machine learning models like linear regression and decision trees, XGBoostClassifier gives better stability and accuracy because of its ensemble structure and regularization. It can also handle missing values and noisy data quite well which makes it a good fit for real world stock market situations where data is often inconsistent. Overall these results confirm that when XGBoostClassifier is combined with technical indicators it gives a strong and reliable framework for stock market prediction and trading assistance.

VI. CONCLUSION

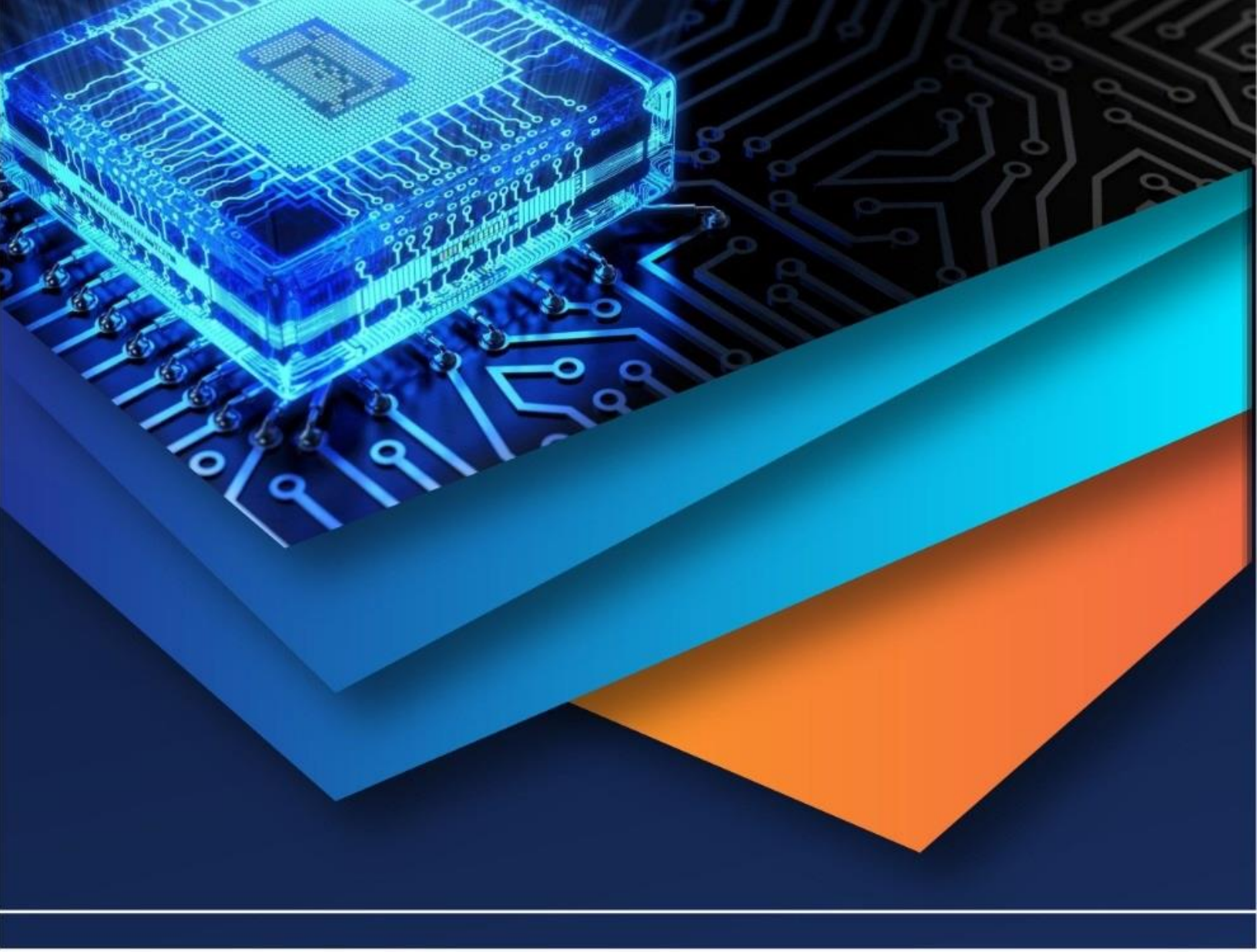
In this research, we have presented a stock market prediction system which is basically based on the XGBoostClassifier algorithm and is combined with technical indicators like Moving Average, RSI, MACD, and Volume.The results we got show that the system is able to generate accurate Buy/Sell trading signals and also calculate bullish probability which helps in making better investment decisions. The 78% bullish probability confidence that we achieved indicates that the system performs quite well in identifying upward market trends.

Basically combining XGBoostClassifier with technical analysis through ensemble learning gives a strong framework for financial forecasting. This also helps in dealing with the limitations of traditional analysis methods as it can handle nonlinear market relationships and can also adapt to changing market conditions quite well. This system is quite useful for traders and investors as it gives data driven insights and also a way to measure confidence for their trading decisions.

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