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Candlestick Chart Predictions: Indian Equity Market

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Abstract - Accurate stock market forecasting remains a challenging task due to the unpredictable and volatile nature of financial data. Traditional methods like candlestick chart analysis have helped traders interpret market trends visually, but they often lack predictive capability. In this study, we propose a hybrid model that integrates candlestick pattern recognition with the Prophet algorithm— a time-series forecasting tool developed by Facebook. The model is trained on historical OHLC (Open, High, Low, Close) data from the NIFTY 50 index, with an emphasis on capturing both short-term volatility and long-term seasonality. . By detecting key candlestick patterns (e.g., Doji, Engulfing, Hammer) and combining them with Prophet's seasonality-aware forecasting engine, the system generates actionable buy/sell signals. The results indicate improved prediction accuracy compared to traditional pattern-only methods. This approach bridges the gap between classic technical analysis and modern AI forecasting, offering a more data-driven and adaptable tool for traders and investors operating in the Indian stock market.

***Key Words*:** NIFTY 50, Candlestick Patterns, Prophet Algorithm, Time-Series Analysis, Technical Indicators, OHLC Data.

1.Introduction *(Size 11, Times New roman)*

The financial market is essentially dynamic and volatile, driven by a variety of macroeconomic, geopolitical, and psychological variables. As a result, accurately predicting stock price movements has long been a difficult task in financial data science. Traditional prediction methods, such as statistical regression models and manual chart pattern analysis, frequently fail to capture the non- linear and seasonal structure of market behaviour. Candlestick charts have grown as a key component of technical analysis due to their ability to visually capture price motion within specific time intervals utilising OHLC (Open, High, Low, Close) data. Recognisable forms like as Doji, Hammer, and Engulfing patterns have long been utilised to predict trend reversals or continuations based on trader mood.However, these interpretations are frequently subjective and prone to inconsistency, particularly when conducted manually. To address these constraints, new advances in Artificial Intelligence (AI) and time-series modelling provide more systematic and data-driven solutions. One such method is Facebook's Prophet algorithm, which is built for time-series forecasting with various seasonalities and abrupt trend changes. It decomposes time-series data into trend, seasonality, and holiday impacts, allowing the model to better respond to the cyclical behaviour commonly seen in stock markets. In this study, we present a hybrid model that combines candlestick pattern recognition and the Prophet algorithm to forecast price changes in the NIFTY 50 index, India's stock market benchmark. By automating the detection of significant candlestick patterns and inserting them as external regressors into the Prophet model, we hope to improve forecast accuracy and offer actionable insights like buy/sell recommendations. Our methodology combines classic technical analysis with modern machine-learning-based predictions to provide a scalable and interpretable solution for traders, analysts, and researchers. This study not only exhibits the practical application of AI in stock trend forecasting, but it also adds to the literature by assessing the Prophet model's performance in the Indian stock market context, especially when combined with technical pattern data. The goal is to help investors make more informed decisions by using an adaptive, transparent framework based on previous market behaviour.

2. Related Work & Research Gap

2.1 Related Work

1. Raikwar, R. P., & Parani, A. S. (2021)

Title: Stock Market Prediction Using Candlestick Chart and Technical Indicators

This study explores the application of traditional technical analysis techniques along with candlestick chart patterns to predict stock market trends. The authors employ indicators like MACD, RSI, Bollinger Bands, and CCI to derive useful signals from the past time series data of the NIFTY 50 index for two years (April 2020 – April 2022). The study intends to identify the best points of buying and selling through the use of these various indicators combined. The findings show that such a hybrid method improves the reliability and accuracy of forecasts, presenting a real-life remedy for traders looking for tactical entry and exit points during fluctuating markets.

2. Mehtab, M., & Sen, J. (2020)

Title: Price Trend Prediction of the Stock Market using Deep Learning Models

This research delves into the forecasting potential of deep learning methodologies, with special emphasis on CNNs and LSTM networks. The authors employ a univariate time series method in which historical price data alone is utilized, utilizing a CNN-LSTM encoder-decoder model. The paper proposes a walk-forward validation process to make the model robust across time. The results from the NIFTY 50 index data indicate that employing two weeks of historical price data provides the best forecasts. This accentuates the applicability of deep learning in recognizing both spatial and temporal dependencies within financial data.

3. Kusuma, G. P., & Rahadi, R. A. (2019)

Title: Using Convolutional Neural Networks (CNN) for Predicting Stock Market Trends Based on Candlestick Chart Images

Here in this innovative research, authors convert numerical stock data into graphical candlestick chart images and input them into CNN models for classifying trends. The concept is that visual patterns in candlestick charts tend to contain important predictive cues, which CNNs can learn well. The research, tested on the Taiwan and Indonesia stock markets, achieves accuracy rates above 92%, confirming CNNs' ability to extract useful features from visual information. This method fills the gap between technical charting and contemporary AI-based analysis.

4. Shahbandari, M. M., Mishra, R., & Dubey, A. (2024)

Title: Sentiment-Aware Stock Price Prediction via Deep Learning: Integrating Candlestick Information with Text Sentiment Analysis

This new paper offers a holistic deep learning model that combines technical and textual information for better stock price prediction. Sentiment analysis is applied to financial news and combined with conventional candlestick data to create a multi-input neural network. The integration of qualitative sentiment and quantitative chart features allows the model to grasp not only market trends but also investor mood and perception, leading to higher accuracy and greater ability to adapt to actual market environments.

5. WARSE (2020)

Title: Stock Market Prediction Using Machine Learning Techniques

This research paper gives a review of multiple machine learning methodologies in the task of financial forecasting tasks. Supervised learning algorithms including Support Vector Machines (SVM), Decision Trees, Random Forests, and ensemble models are discussed in detail. Most stress is put on the process of preprocessing like normalization of the data and the choice of relevant features to ensure good model performance. The research is an important guide to comparing the performance of various ML models across different data conditions and practices best model development.

6. Yu, H., & Yan, X. (2021)

Title: Application of Prophet Model in Financial Time Series Forecasting: A Review and Case Study

In this research, the Facebook Prophet model, a model intended to predict time series data with consideration for seasonality, holiday impacts, and long-term trend, is assessed. The authors use the model on financial data, illustrating its interpretability and usability for analysts who are not programming experts. In a case study, they illustrate that Prophet is particularly effective in modeling cyclical behaviors of stock prices and would be a convenient forecasting tool for financial time series with cyclic behaviors.

7. Ho, Trang-Thi, & Huang, Yennun (2021)

Title: Stock Price Movement Prediction through Sentiment Analysis and Candlestick Chart Representation

The current work presents a multimodal deep learning architecture that merges chart image-based representations of candlestick charts with textual sentiment attributes obtained from news headlines. Features from chart images are extracted through the use of CNNs, whereas sequential sentiment information is handled through LSTMs. The model takes advantage of the superiority of both visual and textual sources of information and performs more effective classification of stock price movements. The research supports the power of hybrid methods in finance prediction, where the use of varied data modalities provides a more comprehensive market perspective.

2.2 Research Gap

1. No mix of traditional and modern procedures.Most research employs either chart patterns or machine learning, but not both simultaneously. Prophet can forecast well, although it is rarely utilised with candlestick patterns.

2. Lack of concentration on Indian markets.The majority of models are evaluated using stock data from the United States or around the globe. The behaviour of the Indian stock market, particularly the NIFTY 50, is not extensively examined utilising these new methodologies.

3. Candlestick patterns are not used as input for AI models.

Many models identify candlestick patterns but do not directly apply them to improve predictions. Prophet supports this with custom regressors, but it's not generally used.

3.Methodology

3.1 Data Collection

We gathered historical stock data for the NIFTY 50 index from reliable sources such as Yahoo Finance and NSE India.

- The data provided OHLC (Open, High, Low, Close) values and trade volume for each day.

- Our model was trained and tested using data from the last 2 years.

3.2 Data Preprocessing

We deleted all missing or duplicate values from the dataset.

- We used technical indicators such as RSI (Relative Strength Index) to assess market strength.
- Use MACD (Moving Average Convergence Divergence) to track momentum.
- Use Moving Averages to level out price patterns

The data was normalised to align numbers on the same scale.

3.3Candlestick Pattern Recognition

We designed a Python software to detect typical candlestick patterns, such as:

- Doji, Hammer, and Engulfing, evening star etc.
- The system scanned daily OHLC data and identified trends.

These pattern signals were employed as additional inputs (regressors) to help the Prophet model learn more effectively.

3.4Prophet Model for Prediction

We used Facebook Prophet, a time-series forecasting tool that works well with time-series data.

- The data is divided into three parts:
- Trend: general direction (up or down).
- Repeated seasonal patterns (weekly, monthly)
- Market impact from holidays and special events.

The model was trained on historical NIFTY 50 prices and included candlestick pattern signals as external regressors.

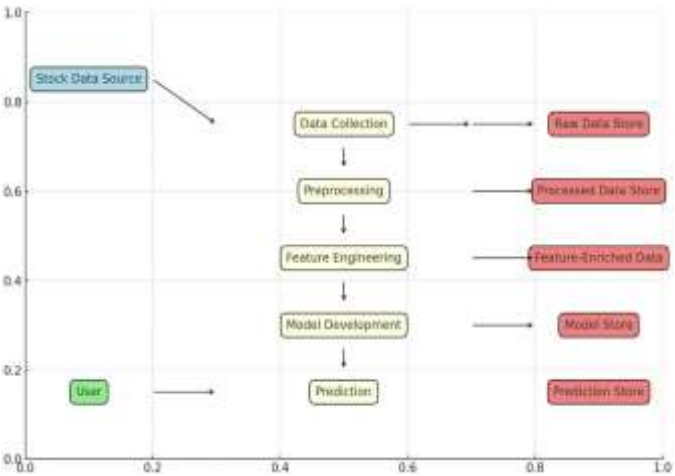


Fig .1 Block diagram

3.5Output and Visualisation

The model generated:

- Future price forecasts
- Confidence intervals showing possible high and low price ranges.
- Buy/sell suggestions based on pattern detection and predicted trend direction Graphs were created using **Plotly** and **Matplotlib** for:
- Candlestick Charts
- Prophet's Trend Prediction
- RSI Indicator Over Time
- Correlation Matrix of NIFTY 50 Stocks

4. Results and Discussions

4.1 Performance metrics

Metric	Prophet	LSTM
MAE	22.635786	31.841192
MSE	820.576859	1439.580904
RMSE	28.645713	37.941809
MAPE	1.723982	2.274503
R-squared	-0.838034	0.813299

1.Accuracy (Error Metrics):

The Prophet model consistently shows lower error across all accuracy metrics:

- MAE, MSE, RMSE, and MAPE are all lower for Prophet, meaning it generally makes smaller prediction errors compared to LSTM.
- Specifically, Prophet's RMSE of 28.64 vs. LSTM's 37.94 suggests better precision in forecasting.

2.Model Fit (R-squared):

- LSTM significantly outperforms Prophet in terms of R-squared (0.813), indicating it explains over 81% of the variance in the data.
- In contrast, Prophet's R-squared is negative (-0.838), which implies that it performs worse than a horizontal mean-line prediction and is not capturing the underlying structure of the data effectively.

4.2 RSI (Relative Strength Index):

Fig .2 RSI Indicator

The chart depicts the Relative Strength Index (RSI), a momentum oscillator that evaluates the rate and change of price movements in HDFC Bank's shares. RSI values range from 0 to 100.

Historically, an RSI greater than 70 indicates that the asset is overbought and may be due for a market correction or retreat, whilst an RSI less than 30 indicates that the asset is oversold and may enjoy a price rebound. The RSI is represented by a purple line on the chart, with red and green dashed lines indicating overbought (70) and oversold (30) criteria, respectively.

Between May 2024 and April 2025, the RSI oscillated regularly, showing both bullish and bearish momentum. The RSI rose above the overbought level multiple times, most notably in July

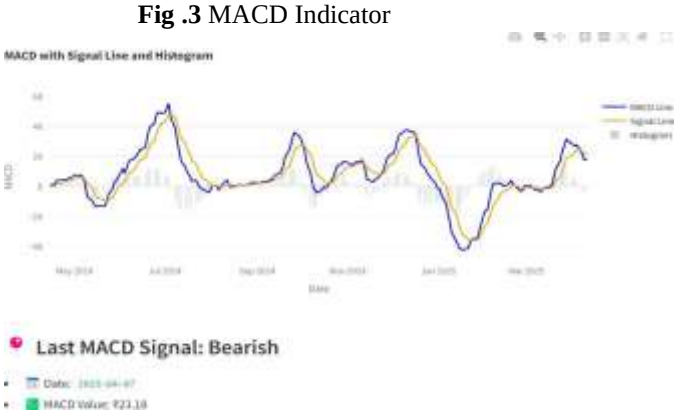
2024 and March 2025, indicating significant bullish momentum during those periods. Conversely, it fell below the 30 level several times, signalling oversold circumstances, particularly around January 2025.

Inference: RSI behaviour indicates a volatile market with frequent adjustments in buying and selling pressure. Traders can use this indicator to detect probable reversal zones. When paired with MACD and candlestick forecasting, RSI improves the dependability of trend predictions and allows for more informed trading decisions.

4.2MACD with Signal Line and Histogram:

This chart shows the MACD indicator applied to HDFC Bank's historical stock data, which provides insight into price momentum and potential trend reversals. The MACD line (blue) is calculated by subtracting the 26-period EMA (Exponential Moving Average) from the 12-period EMA, while the signal line (orange) is the MACD line's 9-period EMA. The grey bars in the backdrop are the histogram, which shows the difference between the MACD and the signal line and helps to visualise the intensity of bullish or bearish momentum.

Fig .3 MACD Indicator



Observation: From May 2024 to April 2025, the MACD cycled upward and downward. When the MACD line crosses above the signal line, it provides a bullish signal (possible price increase), whereas a crossover below the signal line shows negative momentum (potential decrease).On April7, 2025, the MACD line crossed below the signal line, indicating a bearish signal (MACD value: 23.18).

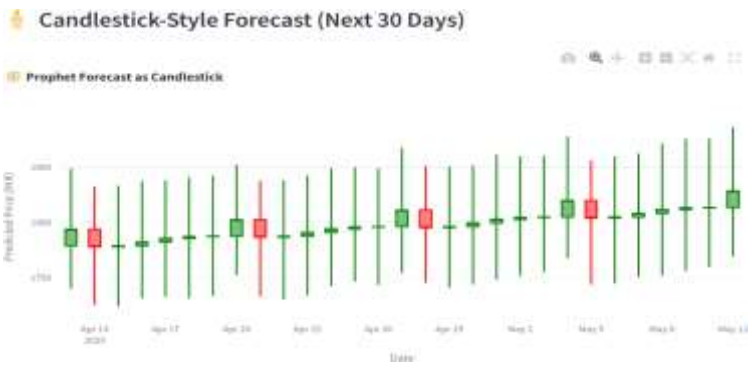
The bearish crossover indicates a potential fall in price momentum, prompting traders to be cautious and explore short positions. When combined with candlestick forecasts and other indicators, this strengthens the prediction model and improves decision-making in equities trading methods.

4.3 Candlestick-Style Forecast using Prophet Model:

Fig .4 Candlestick Forecast

This chart shows a 30-day candlestick-style projection for HDFC Bank stock prices based on the Facebook Prophet model, a time-series forecasting tool. The forecasted data has been visualized in the form of candlesticks, representing the daily:

- Open
- High



- Low
- Close prices.

This format helps to connect machine learning forecasts to traditional financial charting tools. Purpose of the Visualisation:

To make the Prophet model's output more interpretable for financial experts and traders, the forecast was converted to candlestick format. This permitted a visual comparison of expected price ranges over the next few days, similar to real-world trading situations.

Observations:

- The projection shows slight upward momentum throughout the 30-day period.
- Long wicks show price volatility, indicating a broader range of potential high/low levels.

Green candlesticks indicate bullish emotion, with anticipated closes exceeding open prices.

4.4 Forecast Visualization and Uncertainty Analysis:

Fig .5 Forecast Upper & Lower Bound

Fig.5 depicts a 30-day projection for HDFCBANK stock values using the Prophet model. The historical price data exhibits high volatility, which the model accounts for by creating a smooth forecast trend with upper and lower prediction intervals. The prognosis predicts a continuous rise in price, with uncertainty increasing over time, as evidenced by the widening confidence bands. This visualisation enables stakeholders to examine not only the core tendency of stock price movement, but also the accompanying risk margin.

5. Challenges and Limitations

While the proposed hybrid approach, which combines candlestick pattern recognition with the Prophet algorithm, has produced promising results in forecasting the NIFTY 50 index, there are still some problems and restrictions. One of the most pressing concerns is the stock market's volatility, which is significantly influenced by macroeconomic conditions,

geopolitical events, and investor emotion. Although Prophet is well-suited for modelling seasonality and patterns, it is unable to account for unforeseen events such as economic downturns, policy changes, or political instability, all of which can cause sudden and severe market volatility. This constraint decreases the model's reliability at times of extreme volatility.

Another difficulty is the model's reliance on past data. Prophet is a time-series forecasting tool, therefore it expects that future trends will be similar to previous ones. However, financial markets are dynamic, and fundamental breaks or regime changes might make historical data less useful. In certain instances, the model may generate inaccurate or misleading forecasts. Furthermore, the quality of the input data has a significant impact on the system's accuracy. Missing values, abnormalities, or inaccurate entries in the historical dataset might have a severe impact on the training process and the overall accuracy of the predictions. The candlestick pattern identification module, while excellent, has some limitations. Rule-based algorithms used to detect patterns like Doji, Hammer, and Engulfing might produce false positives, recognising patterns that don't exist. Furthermore, similar-looking formations can cause difficulty in classification, and the method does not always take into account the contextual background of a pattern, such as the preceding trend or trading volume, which can be critical in assessing its significance. These simplifications may diminish the efficacy of pattern-based decision-making.

Finally, there is a balance between interpretability and complexity. While Prophet is thought to be more transparent than deep learning models such as LSTM or CNN, the inclusion of several technical indicators and regressors makes it more difficult to explain how each aspect influences the final forecast. This may make the model less accessible to non-technical users or traders seeking a clear explanation for buy/sell recommendations. Furthermore, the current implementation operates in batch mode with historical data and is not designed for real-time forecasting. Developing a real- time system would include additional engineering efforts such as establishing live data streams, lowering latency, and installing effective monitoring systems—challenges that may be impractical in low-resource or academic environments.

6. CONCLUSIONS

In this study, we suggested a hybrid approach that combines candlestick pattern identification with Facebook's Prophet algorithm to forecast stock price fluctuations in the Indian stock market, specifically the NIFTY 50 index. By merging classic technical analysis tools with a modern, seasonality-aware forecasting model, we hoped to close the gap between interpretability and prediction accuracy. The system can identify noteworthy candlestick forms in historical OHLC data, incorporate these signals into the forecasting model, and provide actionable insights like buy/sell indicators and confidence-bound predictions. The findings show that using technical signals as external regressors improves the model's sensitivity to short-term trend shifts, whilst Prophet ensures long-term forecasting stability and clarity.

This methodology provides a systematic and explainable alternative for retail traders, analysts, and academics looking for a mix between traditional chart-based analysis and modern artificial intelligence predictions.

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