Indian Institute of Information Technology Vadodara
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Design Project Report-2024
On
Stock Market Prediction Using LSTM and Chart Pattern Recognition for Intraday Forecasting

Submitted by

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***Abstract*—This paper explores independent approaches for stock market prediction using chart pattern recognition and Long Short-Term Memory (LSTM) networks. Technical chart patterns, such as Head and Shoulders and Double Top, are identified using Convolutional Neural Networks (CNNs). Separately, LSTM models are employed to forecast future price movements using time-series analysis. Intraday stock data from Yahoo Finance is preprocessed and scaled, with sliding windows created for the LSTM-based prediction tasks. The independent evaluation of these models demonstrates their individual potential to enhance stock prediction accuracy, offering distinct insights that can assist traders in making data-driven decisions.**

I. INTRODUCTION

The stock market is a dynamic and volatile environment, where accurate predictions can significantly enhance trading strategies. Traditional technical analysis often relies on chart patterns and historical data, which, while effective, can benefit from automation and advanced predictive models. This research explores the integration of chart pattern recognition and deep learning models for intraday stock market prediction, aiming to combine the strengths of human expertise and machine learning.

We focus on two key approaches: chart pattern recognition using Convolutional Neural Networks (CNNs) and stock price forecasting with Long Short-Term Memory (LSTM) networks. CNNs are utilized to identify classical chart patterns like Double Top, Head and Shoulders, and others from stock price data. Meanwhile, LSTMs, a type of Recurrent Neural Network (RNN), excel in processing time series data, making them ideal for predicting future stock prices based on past movements.

By leveraging these two methodologies, we propose a robust framework capable of providing both pattern recognition insights and accurate price forecasts. The research aims to advance stock market prediction by integrating AI-driven techniques, improving accuracy and providing actionable predictions for traders. This combination of technical analysis and deep learning has the potential to significantly improve trading decisions and market forecasting.

II. LITERATURE REVIEW

Stock market prediction has been extensively studied, with traditional methods relying on statistical models like ARIMA and technical analysis. These approaches, while effective for trend analysis, often struggle with the non-linear and complex nature of financial data. Recent studies have demonstrated that deep learning models, such as Convolutional Neural Networks (CNNs) and Long Short-Term Memory (LSTM) networks, achieve high accuracy in stock price prediction, with certain architectures excelling in precision and others in speed [1]. LSTMs, a type of Recurrent Neural Network, are particularly effective for time series forecasting due to their ability to capture long-term dependencies [2]. While prior research has explored chart pattern recognition and price forecasting individually, limited attention has been given to their independent evaluation in stock market prediction. This paper builds on existing work by developing separate CNN-based and LSTM-based models, each addressing distinct aspects of stock market analysis, to provide more accurate and reliable insights for traders.

III. Problem Statement

Stock market prediction is a complex task due to the non-linear and dynamic nature of financial data. Traditional methods, such as manual technical analysis, are not only time-consuming but also prone to human error, while forecasting intraday prices demands recognizing recurring trends in historical data. Many machine learning models struggle to effectively identify chart patterns, limiting their predictive capabilities. This research aims to address these challenges by developing independent deep learning models: a Convolutional Neural Network (CNN) for automated chart pattern recognition and a Long Short-Term Memory (LSTM) network for time series forecasting. By leveraging these advanced techniques separately, the study seeks to enhance the accuracy and reliability of stock market predictions, providing traders with actionable insights and supporting data-driven decision-making.

IV. Project Scope

This research aims to explore independent approaches for stock market analysis by employing deep learning models for chart pattern recognition and intraday price forecasting. The scope of the project includes the following:

1) **Chart Pattern Recognition**: Implementing Convolutional Neural Networks (CNNs) to identify and classify common stock chart patterns (e.g., Head and Shoulders, Double Top/Bottom) from historical candlestick data.
2) **Intraday Stock Price Forecasting**: Using Long Short-Term Memory (LSTM) networks to predict future stock prices based on past price movements and technical indicators.
3) **Data Sources**: Utilizing historical stock data from Yahoo Finance, focusing on intraday time series with varying intervals (e.g., 60 minutes).
4) **Evaluation**: Assessing the model's performance through accuracy, error metrics, and real-world applicability for traders.
5) **Scope Limitation**: The project will not cover broader market dynamics such as macroeconomic factors, which may also influence stock prices but are outside the scope of this work.

V. Objective

The primary objectives of this research are:

1) To develop a model for automated chart pattern recognition using Convolutional Neural Networks (CNNs) to identify key patterns in historical stock price data.
2) To implement an intraday stock price prediction system using Long Short-Term Memory (LSTM) networks, leveraging past price movements for future forecasting.
3) To ensure the CNN-based pattern recognition model and the LSTM-based time series forecasting model, addressing different aspects of stock market analysis.
4) To evaluate the performance model, comparing their accuracy and effectiveness with traditional methods.

VI. Methodology

The proposed methodology focuses on independently addressing chart pattern recognition and intraday stock price forecasting to provide insights into stock market behavior. The research is divided into the following phases:

1) **Data Collection** Historical stock market data, including open, high, low, close prices, and timestamps, are collected using the Yahoo Finance API. The data spans intraday intervals (e.g., 60 minutes) for various tickers and includes multiple months of trading history.
2) **Chart Pattern Recognition**
   - **Preprocessing**: Stock price data is visualized as candlestick charts to represent daily trading movements. Patterns such as Double Top, Double Bottom, Head and Shoulders, and Reverse Head and Shoulders are annotated in the dataset.
   - **Feature Extraction**: Candlestick charts are cropped, resized, and converted to grayscale images to reduce noise and improve computational efficiency.
   - **Model Training**: A Convolutional Neural Network (CNN) using the VGG16 architecture with transfer learning is trained to classify chart patterns. This model automates the detection of significant patterns critical for technical analysis.
3) **Intraday Stock Price Forecasting**
   - **Preprocessing**: Numerical data is scaled using MinMaxScaler for better model convergence. Time series data is segmented into sliding windows to create input features and target labels for prediction.
   - **Model Design**: A Long Short-Term Memory (LSTM) network is implemented to predict future stock prices. The network includes stacked LSTM layers with varying units to capture temporal dependencies in the data.
   - **Training and Testing**: The data is split into training and testing sets (e.g., 80:20), and the model is trained over multiple epochs using the Adam optimizer.
4) **Evaluation** Model performance is evaluated using metrics such as mean squared error (MSE) for price prediction and accuracy for pattern classification. Results are analyzed to assess the practical applicability of the system.

VII. Future Scope

This research can be extended in several directions:

1) **Incorporating Macroeconomic Factors**: Integrating data like market indices, interest rates, and news sentiment for holistic predictions.
2) **Real-Time Forecasting**: Adapting the system for live stock market data to provide real-time insights.
3) **Expanding Chart Patterns**: Training models to recognize additional complex patterns for broader applicability.

4) **Cross-Market Analysis**: Extending the methodology to predict trends in other financial markets, such as forex or cryptocurrency.
5) **Reinforcement Learning**: Using advanced AI techniques to improve decision-making based on predicted trends.

VIII. Testing and Results

To evaluate the performance of the proposed framework, we conducted tests on historical stock market data, analyzing the ability of the model to identify chart patterns and predict future trends. The table below (Table I) highlights the detected patterns for specific dates, showcasing patterns such as "Head and Shoulders," "Double Top," and "Reverse Head and Shoulders," alongside periods with no identifiable pattern.

The Long Short-Term Memory (LSTM) model's prediction capabilities were assessed using a comparison between the actual stock trends and the model's predicted trends. Figure 2 illustrates the current trend and the predicted trend as derived from the LSTM model. The results demonstrate the model's ability to capture key price movements and align with real-world patterns.

The analysis shows that independently employing chart pattern recognition and time-series forecasting provides valuable insights into stock market trends. Each approach proves effective in its respective domain, with chart pattern recognition aiding in trend identification and time-series forecasting offering reliable future price predictions. These standalone models assist in making informed decisions for stock market investments.

IX. Conclusion

This research successfully develops independent frameworks for **chart pattern recognition** using CNNs and **intraday stock price forecasting** with LSTM networks, addressing distinct aspects of stock market analysis. By automating pattern detection and utilizing time series forecasting, each model provides actionable insights for traders, reducing reliance on manual methods and traditional approaches. The results demonstrate the effectiveness of advanced deep learning models in enhancing accuracy and reliability in their respective domains. While the findings are promising, future work can explore incorporating real-time data and macroeconomic factors to further improve each model. This study highlights the potential of AI-driven tools to independently revolutionize stock market prediction and decision-making.

Date	Pattern
2020-01-02	No Pattern
2020-01-03	No Pattern
2020-01-06	Head and Shoulders
2020-01-07	No Pattern
2020-01-08	Head and Shoulders
⋮	⋮
2021-02-18	No Pattern
2021-02-19	Double Top
2021-02-22	No Pattern
2021-02-23	Reverse Head and Shoulders
2021-02-24	No Pattern

TABLE I
Detected Chart Patterns Over Time

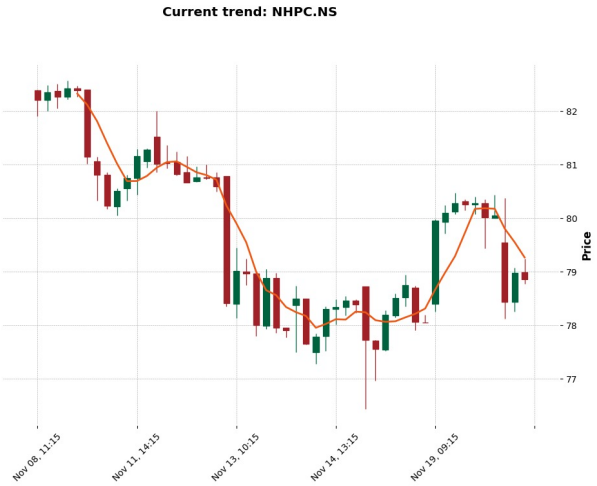

Fig. 1. Current Trend using LSTM Model

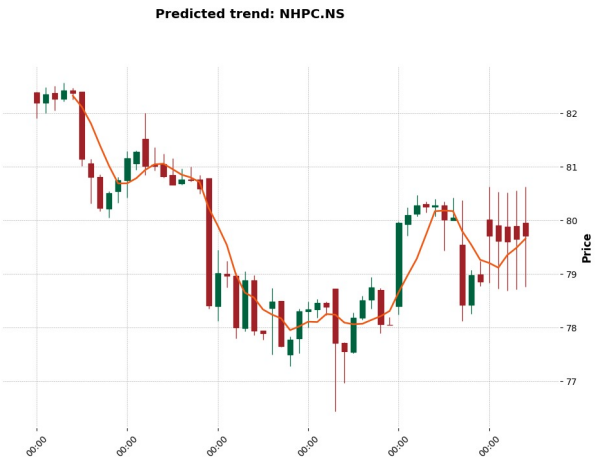

Fig. 2. Predicted Trend using LSTM Model

References

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[2] Z. Li, H. Yu, J. Xu, J. Liu, and Y. Mo, "Stock market analysis and prediction using lstm: A case study on technology stocks," *Innovations in Applied Engineering and Technology*, vol. 2, no. 1, 2023. [Online]. Available: https://doi.org/10.62836/iaet.v2i1.162