

LSTM-RNN Based Predictive Stock Analysis with Real-Time Sentiment Interpretation

Yadhunandan K H¹, Balaji R², Virginia Aslam³

¹Yadhunandan KH, Department of Artificial Intelligence and Machine Learning, Rathinam College Of Arts And Science

²Balaji R Department of Artificial Intelligence and Machine Learning Rathinam College Of Arts And Science

³Virginia Aslam Associate Professor, Department of computer science Rathinam College Of Arts And Science

Abstract - This paper presents a real-time AI-powered dashboard for stock market analysis that integrates advanced deep learning models and sentiment analysis to assist investors with data-driven insights. The system leverages APIs such as Yahoo Finance and Finnhub to fetch live and historical stock data, and NewsAPI to gather current financial news. Sentiment scores are computed using the VADER (Valence Aware Dictionary and Sentiment Reasoner) tool, while Google's Gemini AI enhances interpretation by identifying nuanced market signals. Technical indicators like RSI, MACD, ADX, and Bollinger Bands are used for trend analysis. Machine learning models including Long Short-Term Memory (LSTM), Recurrent Neural Network (RNN), and Gated Recurrent Unit (GRU) are employed to predict future price movements by learning from historical data patterns. Built with the Streamlit framework, the dashboard offers an interactive, secure, and user-friendly interface. This multi-modal approach—combining real-time data, NLP-driven sentiment analysis, and AI-based forecasting—aims to reduce investor uncertainty and improve decision-making in volatile market conditions.

Key Words: Stock Market Prediction, LSTM, RNN, GRU, Sentiment Analysis, VADER, Gemini AI, Streamlit Dashboard, Real-Time Data, Technical Indicators, Financial Forecasting, AI-Powered Analytics.

1.INTRODUCTION (Size 11, Times New roman)

The stock market, a complex and dynamic ecosystem, has long been the subject of intense study and analysis. In recent years, the integration of advanced technologies such as Machine Learning and NLP transformed the methodology employed in stock market analysis and prediction. This paper presents a comprehensive system that employs these cutting-edge technologies to provide enhanced insights and forecasting capabilities with respect to the stock market.

The project, entitled "Predictive Stock Market Analysis through LSTM and RNN Models Combined with Real-Time Sentiment Insights" addresses the multifaceted nature of stock market dynamics by combining real-time

market data, sentiment analysis of financial news, and advanced technical indicators.

The system is designed to provide a comprehensive overview of stock performance and trends, catering to both novice investors and seasoned financial analysts. At the core of our application is a userfriendly dashboard constructed with Streamlit, which ensures secure access and intuitive navigation. The system leverages the capabilities of application programming interfaces (APIs), such as Finnhub and yFinance, to retrieve both live and historical stock data, while integrating NewsAPI to gather current financial news. The real-time data constitutes the basis for the operation of our advanced analytical tools.

A significant advancement in our methodology is the incorporation of sentiment analysis on financial news utilizing the VADER sentiment analyzer, a tool developed by the Natural Language Toolkit (NLTK). This natural language processing (NLP)-driven analysis provides crucial insights into market sentiment, a factor that can significantly influence stock prices but is often overlooked in traditional analysis methods.

Moreover, the system incorporates a comprehensive array of technical indicators, including RSI, MACD, OBV, ADX, and stochastic oscillators. In addition to their visual representation, these indicators are also interpreted by Google's Generative AI (Gemini model), thereby providing AI-powered trend analysis and predictions. The pinnacle of our project's analytical capabilities is the integration of advanced machine learning models for stock price prediction. The project utilise Long Short-Term Memory (LSTM), Recurrent Neural Networks (RNN), and Gated Recurrent Units (GRU) to forecast stock prices. These models are trained on historical price data and technical indicators, thereby enabling them to capture complex temporal dependencies in stock market trends.

By combining these diverse elements—real-time data, sentiment analysis, technical indicators, and machine learning models—our system aims to provide a comprehensive toolkit for market analysis and prediction, potentially transforming the landscape of stock market analysis and decision-making.

2. Body of Paper

2.1 LITERATURE SURVEY

Stock market prediction has improved with the help of AI and machine learning. Many researchers have used different models like LSTM, GRU, and CNN to study past stock prices and find patterns. Some have also added news and social media analysis to make predictions better, especially when the market is unstable. However, there are a few challenges to be addressed. Some models do not give clear reasons for their predictions, making it hard for people to trust them. Also, using different types of data, like financial reports and economic trends, can improve accuracy but makes the models more complex.

2.2 EXISTING SYSTEM

Currently, stock market prediction systems rely on various methods, including traditional statistical models and advanced AI techniques. Investors and analysts use historical data and financial reports to make decisions. Many platforms utilize machine learning models like LSTM, GRU, and CNN to improve prediction accuracy. However, these systems often struggle with market volatility, sudden economic shifts, and the challenge of interpreting AI-generated results. Additionally, most existing tools provide general predictions without personalized insights for individual investors. Though few platforms incorporate sentiment analysis from news and social media, filtering out required information remains a challenge. Overall, while technology has improved stock market forecasting, there is still room for enhancing accuracy, usability, and transparency.

2.3 PROPOSED SYSTEM

The proposed system will use advanced AI models like LSTM, GRU, and CNN to make stock market predictions more accurate. It will not only analyze historical stock data but also consider news and social media trends to improve forecasting. The system will provide users with a simple and easy-to-use dashboard where they can see stock trends, predictions, and insights in real time. It will also include personalized recommendations, helping users find relevant stock opportunities based on their interests. To make the system more accessible, it will support multiple languages and offer a chatbot for assistance, allowing users to ask questions and get instant answers. Unlike existing systems, this platform will provide clear explanations for its predictions, making it more transparent and trustworthy. By combining AI, real-time updates, and user-friendly features, the proposed system will help investors and traders make better financial decisions with ease.

2.4 STEPS INVOLVED IN SYSTEM WORKING

Data Acquisition - The system begins by gathering real-time stock data from external sources using APIs. It uses Yahoo Finance to fetch both live and historical stock prices, Finnhub to retrieve trading volume, stock trends, financial metrics and NewsAPI to collect current financial news headlines and articles. This combination of real-time and historical data forms the foundation for stock trend analysis and future predictions

Sentiment Analysis - The system incorporates NLP-based sentiment analysis to evaluate the market mood from financial news. It uses VADER (Valence Aware Dictionary and Sentiment Reasoner) to assign sentiment scores—categorizing the news as positive, negative, or neutral. Additionally, Google Gemini AI enhances the interpretation by identifying deeper sentiment trends. The sentiment analysis process involves breaking down news articles into individual words, assigning sentiment polarity scores, and visualizing them on the dashboard to reflect the overall market mood.

Data Preprocessing and Feature Engineering - Before training the machine learning models, the data undergoes cleaning and preprocessing. This involves data normalization to ensure that stock price ranges remain consistent. The system also performs feature extraction by calculating key technical indicators such as RSI, MACD, ADX, OBV, and Bollinger Bands. These indicators are then used as input features for the predictive models. The system also merges the sentiment data with stock price data to create a combined dataset, making the predictions more comprehensive.

Technical Analysis - To assess market trends, the system applies technical indicators. It uses RSI (Relative Strength Index) to measure the magnitude of price changes, while MACD (Moving Average Convergence Divergence) helps identify trend directions. The system visualizes these indicators using interactive charts powered by Matplotlib, Altair, and Plotly, making it easier for users to understand market patterns.

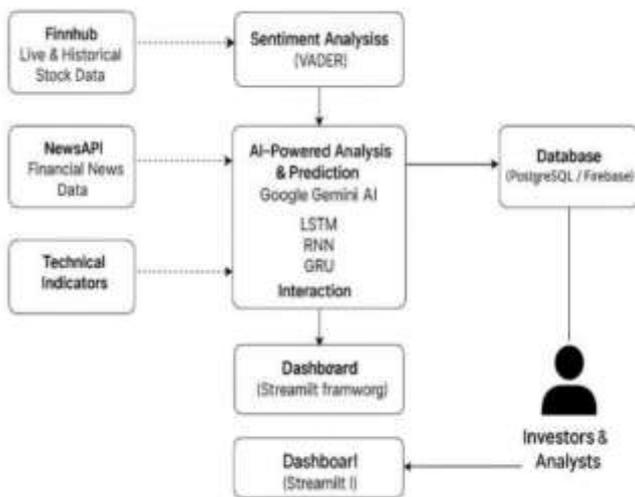
Machine Learning Model Integration - The system employs deep learning models for stock price forecasting. It uses LSTM (Long Short-Term Memory) networks to capture long-term dependencies in stock price patterns, while RNN (Recurrent Neural Networks) captures sequential data trends. To improve the accuracy of predictions and address the vanishing gradient problem, the system also uses GRU (Gated Recurrent Unit). Historical price data and technical indicators are used to train these models, which then generate predictions for future stock prices. Additionally, Google Gemini AI interprets the technical indicators and provides

AI-powered stock recommendations based on predicted patterns and sentiment analysis.

Visualization and Dashboard Display - The analysis results are displayed on a Streamlit-powered dashboard. The dashboard provides real-time stock data through interactive charts showing live price trends, while sentiment scores reflect the current market mood. Users can view technical indicator charts for RSI, MACD, and Bollinger Bands over time. The dashboard also features AI-powered stock recommendations, which offer insights based on both technical analysis and sentiment trends. The visualizations are built using Streamlit, along with Altair, Matplotlib, and Plotly for a dynamic and interactive experience

Deployment and User Interaction - The entire application is deployed on Streamlit Cloud, AWS, or GCP for accessibility. The system offers a userfriendly interface. Users can explore stock insights, view sentiment trends, and access AI-powered recommendations, helping them make smarter financial decisions.

2.5 ARCHITECTURE DIAGRAM



2.6 ALGORITHMS USED

1. Long Short-Term Memory (LSTM) The project uses LSTM, a deep learning model that is great for predicting stock prices over time. LSTM remembers past trends and patterns, making it good at forecasting future stock movements. It analyzes historical price data and technical indicators to make accurate predictions.

2. Recurrent Neural Network (RNN) The system also uses RNN, which processes stock data in sequences. It learns from previous stock prices to predict future ones. Since RNN can sometimes forget older information, it is combined with LSTM and GRU for better performance.

3. Gated Recurrent Unit (GRU) To make predictions even more accurate, the system uses GRU, which is a simpler and faster version of LSTM. It handles long sequences of stock data efficiently and improves the model's accuracy by solving the problem of forgetting older trends.

4.VADER (Valence Aware Dictionary and Sentiment Reasoner) For sentiment analysis, the project uses VADER, an algorithm that reads financial news and assigns a score to it. It labels the news as positive, negative, or neutral, helping the system understand how the market feels, which improves prediction accuracy.

5. Google Gemini AI (Generative AI) The system also uses Google Gemini AI, which is a powerful AI model that interprets financial news and technical indicators. It generates stock recommendations by combining sentiment insights and price trends, helping users make smarter trading decisions.

2.7 Output

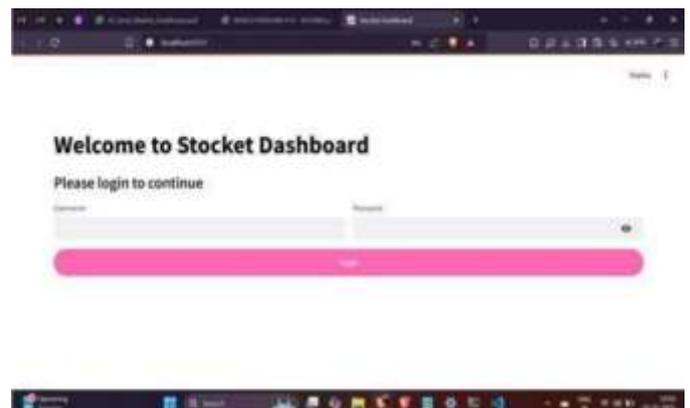


FIG 1.1 Login Page

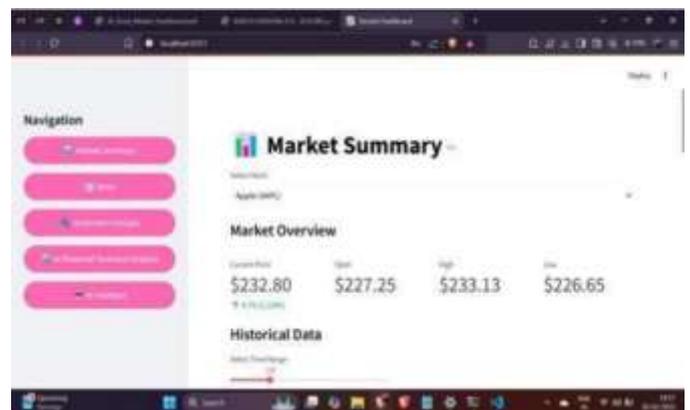


FIG 1.2 Stock Market Summary

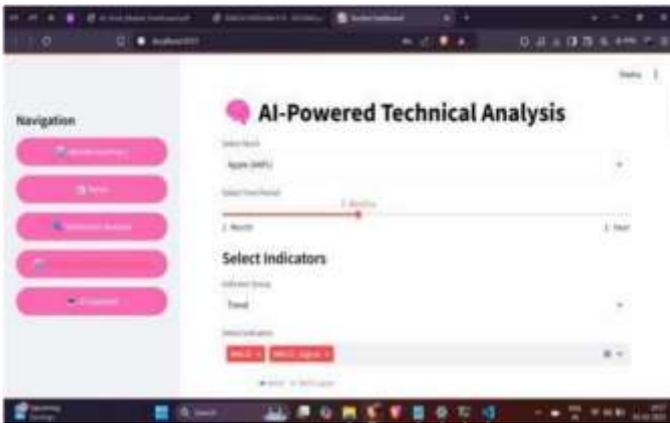


FIG 1.3 AI Powered Technical Analysis

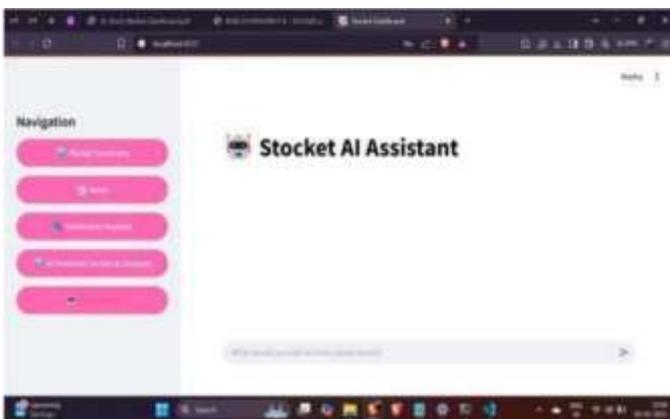


FIG 1.4 AI Assistant

3. CONCLUSIONS

The project successfully created a stock market analysis platform that helps users make smarter trading decisions by combining real-time stock data, news sentiment, and machine learning predictions. The system uses LSTM, RNN, and GRU models to predict future stock prices based on historical trends. It also integrates VADER and Google Gemini AI to analyze financial news and determine whether the market sentiment is positive, negative, or neutral. The Streamlit-powered dashboard displays this information in an easy-to-understand format with interactive charts showing real-time prices, technical indicators, and AI-powered recommendations. By using Yahoo Finance, Finnhub, and NewsAPI, the platform provides live and accurate data. The system's predictions are enhanced by combining technical indicators (RSI, MACD, ADX, and Bollinger Bands) with sentiment scores, making the forecasts more reliable. Overall, the project offers a simple yet powerful tool that allows users to track market trends, understand how news affects prices, and make smarter investment decisions

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