AI-Powered Stock Investment Prediction: Buy, Hold, or Sell Based on LLM to Investment Analysis

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Abstract— The stock market is highly influenced by news events and public sentiment, making investment decisions complex and time sensitive. Traditional stock analysis methods often fail to capture the immediate impact of breaking news and market sentiment, leading to missed opportunities or misinformed investments. This study explores the power of AI-driven sentiment analysis in predicting whether a stock should be bought, held, or sold based on financial news and public reactions. Using advances in artificial intelligence, our approach aims to pro- vide investors with timely and data-driven insights, reducing the reliance on subjective decision making. This research sets the foundation for a more intuitive and sentiment-aware investment strategy that aligns with market dynamics and investor confidence.

I. Introduction

Financial markets are inherently complex and volatile, influenced by a wide array of factors including macroeconomic indicators, geopolitical events, investor sentiment, and breaking news. Traditional stock market analysis primarily relies on technical indicators such as Moving Averages, Relative Strength Index (RSI), and MACD to forecast price movements. However, these indicators often lack contextual awareness and require expert interpretation, making them less accessible and sometimes inadequate in capturing real-time market dynamics.

The stock market is also highly sensitive to news sentiment, where financial headlines, social media discussions, and expert reports can significantly influence investor behavior and trigger abrupt price fluctuations. Despite this, conventional investment strategies often overlook the immediate and evolving impact of public sentiment on stock prices.

With recent advancements in Artificial Intelligence (AI) and Natural Language Processing (NLP), particularly the emergence of Large Language Models (LLMs) such as Llama 3.3-70B, there is a promising opportunity to bridge this gap. LLMs can process vast volumes of textual data from news sources and financial platforms, extracting sentiment cues and con- textual insights in real-time. This integration of AI-driven sentiment analysis with traditional technical indicators offers a more holistic and adaptive framework for stock market forecasting. This research aims to develop an AI augmented decision-making system that combines technical indicators with LLM-based sentiment analysis to generate actionable stock insights. By evaluating the tone, polarity, and intensity of financial news, alongside technical trends, the proposed system will provide buy, hold, or sell recommendations. The study seeks to enhance the interpretability and predictive power of traditional methods while aligning with dynamic market sentiment.

II. Area of Interest / Domain

- Data Science
- Natural Language Processing (NLP)
- Artificial Intelligence (AI)
- Large Language Models (LLMs)
- Financial Technology (FinTech)
- Sentiment Analysis
- Generative AI
- Stock Market Forecasting

III. Research Objectives

The primary objectives of this research are as follows:

- Integrate traditional financial technical indicators with Large Language Models (LLMs) for enhanced, context-aware stock

market predictions.

- Develop an AI-driven sentiment analysis model to evaluate the tone, polarity, and intensity of financial news and public sentiment.
- Generate actionable investment insights, such as buy, hold, or sell recommendations, by combining technical and sentiment-based data.
- Provide a real-time, data-driven decision-making framework that reduces reliance on manual interpretation and improves prediction reliability.
- Evaluate the performance and accuracy of the proposed hybrid model against conventional stock forecasting approaches.

IV. Literature Review

The integration of artificial intelligence (AI), particularly Large Language Models (LLMs), into financial forecasting has attracted considerable research interest. Studies show that combining traditional technical indicators with AI-driven sentiment analysis can significantly improve stock market prediction accuracy. NLP techniques enable the extraction of contextual insights from vast textual data sources, such as financial news, analyst reports, and social media, complementing quantitative indicators like Moving Averages and RSI.

a. Existing Studies on AI in Stock Market Prediction

Several researchers have investigated the application of AI and LLMs in the financial domain:

i. Sentiment-Driven Predictions: Bhat and Jain [1] demonstrated how sentiment analysis on news headlines correlates with stock price movement, using NLP to improve market predictions.

ii. Equity Ratings Using LLMs: Papasotiriou et al. [2] used large language models for generating equity stock ratings, showing alignment with expert recommendations.

iii. Earnings Report Analysis: Chen and Kawashima [3] analyzed company earnings re- ports using sentiment models to predict short-term stock fluctuations.

iv. Hybrid AI Models: Vayadande et al. [4] combined sentiment scores with historical price patterns, outperforming traditional techniques in stock forecasting.

v. AI in Indian Stock Markets: Singh et al. [5] reviewed AI-based forecasting models for the Indian stock exchange, suggesting LLMs for future financial analytics.

b. Research Gaps and Challenges

Despite promising developments, critical gaps remain in current literature:

i. Real-Time Applicability: Most models analyze historical data, lacking responsiveness to real-time market sentiment.

ii. Limited Contextual Awareness: Sentiment models often fail to interpret nuanced financial language or indirect cues from news.

iii. Integration with Technical Indicators: Few studies have explored fusing AI-driven sentiment with traditional technical analysis in a unified framework.

iv. Scalability Across Markets: Research typically targets a single stock index, limiting generalizability to broader financial ecosystems.

c. Contribution of This Research

This study contributes by addressing the above gaps through the following innovations:

i. Developing a hybrid model that integrates technical indicators with LLM-powered sentiment analysis.

ii. Leveraging real-time financial news and investor sentiment to generate actionable investment recommendations.

iii. Enhancing financial context understanding in LLMs through domain-specific adaptation.

iv. Expanding predictive analysis across global indices including NASDAQ, Nifty 50, and S&P 500.

v. Validating model performance against traditional techniques to assess interpretability, accuracy, and reliability.

By combining technical and sentiment-based signals, this research proposes a comprehensive AI-driven framework for stock market forecasting, enhancing investor decision-making in volatile environments.

V. Research Methodology

This research follows a data-centric methodology aimed at examining how news sentiment influences investment decisions in the stock market. By leveraging artificial intelligence (AI) and natural language processing (NLP) techniques, the goal is to generate actionable insights—specifically whether to **buy**, **hold**, or **sell** a stock—based on sentiment extracted from financial news and public discourse.

a. Research Design

A mixed-methods approach underpins the study, combining both qualitative and quantitative techniques:

i. Qualitative Component: NLP tools interpret the emotional tone of financial news content and public sentiment from social media.

ii. Quantitative Component: Historical stock price trends and technical indicators are analyzed to discover meaningful patterns that correlate with the sentiment derived from textual data.

b. Data Collection

To ensure a well-rounded and accurate analysis, data is sourced from multiple platforms:

i. Financial News Articles: Headlines and in-depth reports are gathered from platforms like *Yahoo Finance*, *Alpha Vantage*, and others.

ii. Stock Market Data: Historical price data, trading volume, and various technical indicators (such as RSI, MACD, Moving Averages, etc.) are fetched using APIs like *YFinance* and *Alpha Vantage*.

iii. Investor Sentiment: Public opinions and market discussions are scraped from social platforms such as *X (formerly Twitter)* and *StockTwits*, focusing on content that garners high engagement (likes, retweets, comments) to gauge impactful sentiment.

c. System Architecture

The figure below outlines the complete workflow of the system, showcasing how real-time financial data, social sentiment, and AI-driven analysis work together.

The architecture is comprised of the following stages:

i. Data Aggregation:

1. News and market data including stock indicators are collected via APIs.
2. Sentiment-rich social media conversations are retrieved for context-aware analysis.

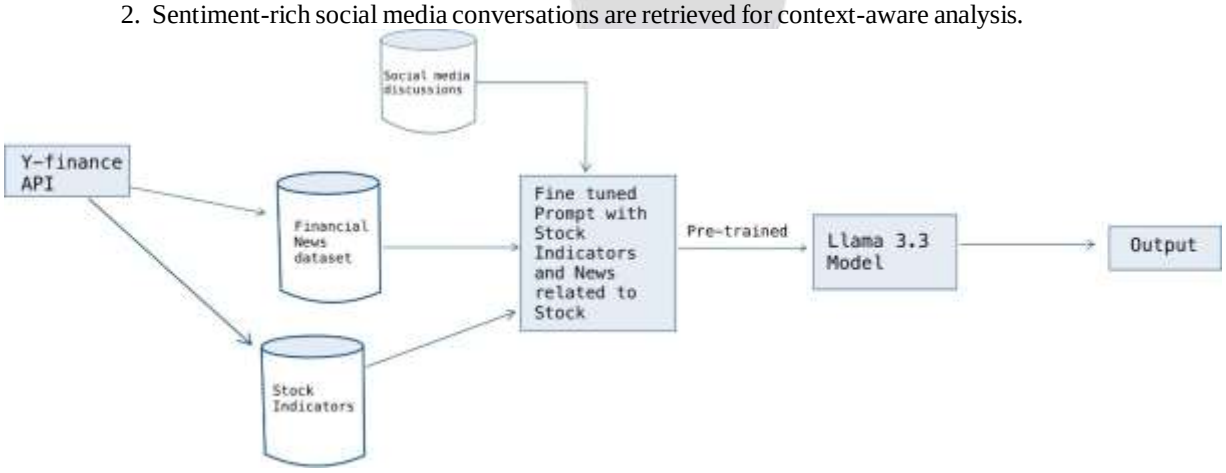

Figure 1: Fine-tuning a Distilled LLM Model for detecting sentiment in financial text.

ii. Data Preprocessing & Prompt Engineering:

1. A combined dataset is formed by merging market news with social sentiment.
2. Carefully designed prompts are curated to include relevant financial metrics and contextual cues for model processing.

iii. AI-Based Processing:

1. A fine-tuned Large Language Model (Llama 3.3), hosted via *Groq Cloud*, is tasked with analyzing the structured prompt.
2. The model outputs investment suggestions (Buy, Hold, or Sell) based on the inferred sentiment and accompanying technical data.

iv. Decision Output:

1. Based on the model's interpretation, actionable investment recommendations are generated and recorded.

d. Sampling Techniques

Sampling is done strategically to ensure high relevance and data quality:

i. Stock Selection: The study targets leading stocks listed on major indices such as the NASDAQ, S&P 500, and Nifty 50.

ii. News Sampling: Articles tied to these stocks are collected over a six-month window to ensure recency and trend analysis.

iii. Sentiment Sampling: Public reactions are filtered using engagement metrics to prioritize opinions likely to influence market behavior.

e. Data Analysis

A blend of statistical tools and AI models drives the analysis phase:

i. Sentiment Classification: NLP models evaluate textual data, categorizing sentiment into positive, neutral, or negative.

ii. Correlation Assessment: Regression and statistical models evaluate how sentiment aligns with both stock price movements and technical indicators.

iii. Predictive Modeling: State-of-the-art models like *Llama 3.3*, powered through *Groq Cloud*, are used to predict outcomes based on multi-modal data inputs.

iv. Model Evaluation: Techniques like precision-recall analysis, financial backtesting, and accuracy metrics help assess the reliability of the system.

f. Tools and Technologies

Various tools and technologies support this research pipeline:

i. Programming Stack: Python with libraries like *Pandas*, *Scikit-learn*, *TensorFlow*, and *JSON* for data handling and ML modeling.

ii. AI/LLM Infrastructure: *Groq Cloud API*, *Llama 3.3* for NLP tasks and recommendation generation.

iii. Data APIs: *YFinance*, *Alpha Vantage* for real-time stock data and indicators.

iv. Social Media Sources: Data from *X (Twitter)* and *LinkedIn* for public sentiment analysis.

v. Visualization Libraries: *Matplotlib*, *Seaborn*, and *Plotly* for creating insightful visuals and trend plots.

By combining sentiment analysis with technical indicators and historical data, this research seeks to build an intelligent system that supports stock trading decisions in real time using the power of AI.

VI. Expected Outcomes & Impact

This research is expected to make meaningful contributions by integrating sentiment analysis from financial news with technical stock indicators to enhance investment decision-making. The following outcomes and impacts are anticipated:

a. Expected Outcomes

i. Enhanced Predictive Accuracy: The system is expected to deliver highly accurate investment recommendations (*Buy, Hold, or Sell*) by analyzing both sentiment and technical indicators (such as RSI, MACD, and Moving Averages).

ii. Granular Market Sentiment Analysis: Deeper insights into the correlation between public sentiment, media tone, and technical price signals over time, helping investors recognize behavioral finance patterns.

iii. AI-Powered Decision Support System: Development of a robust and scalable frame- work that reduces emotional trading decisions by providing objective, real-time AI-based recommendations.

iv. Model Performance Benchmarking: Rigorous comparison of AI-generated investment decisions with actual market trends and traditional technical strategies to validate and fine-tune system accuracy.

b. Impact and Contribution

Academic Contribution:

i. Expands research in the domain of *AI-driven financial analytics*, particularly emphasizing the fusion of large language models (LLMs) with quantitative financial indicators.

ii. Demonstrates a novel framework where sentiment signals from financial news and social media are processed alongside market indicators to create more context-aware predictive systems.

iii. Provides a foundational base for future work in multimodal analysis, model interpretability, and domain-specific prompt engineering within financial AI applications.

Industry Contribution:

iv. Offers a cost-efficient and scalable AI model that complements traditional stock analysis tools used by traders, analysts, and roboadvisors.

v. Equips retail investors, portfolio managers, and algorithmic trading systems with real- time, explainable sentiment-aware trading signals.

vi. Enables integration of the model into financial dashboards, API-based trading platforms, or mobile fintech applications for on-the-go stock evaluation.

Societal Impact:

vii. Democratizes access to investment intelligence by providing retail investors with AI- curated, sentiment-informed market guidance grounded in real data and technical fundamentals.

viii. Acts as a safeguard against disinformation and market manipulation by flagging biased or overly positive/negative news that contradicts technical trends.

ix. Promotes financial literacy by showing how modern AI tools, when combined with fundamental technical knowledge, can improve decision-making and reduce losses.

By unifying sentiment signals from news and social discourse with real-time technical stock indicators, this research bridges the gap between qualitative and quantitative analysis, thereby driving smarter, data-driven investment strategies for both novice and professional investors.

VII. References

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