AI-Powered Stock Analysis Chatbot

Manan Khandelwal [1], Piyush Garg[2], Bhavesh Choudhary [3], Divyanshu Bansal[4], Nihar[5]

[1, 2,3,4,5] BML Munjal University
Manan.Khandelwal.22cse@bmu.edu.in[1], Piyush.garg.22cse@bmu.edu.in[2],
Bhavesh.choudhary.22cse@bmu.edu.in3, Divyanshu.bansal.22cse@bmu.edu.in[4], Nihar.22cse@bmu.edu.in[5]

Abstract. Market evolution has created an important information divide between individual retail participants and professional institutional investors. Beyond its specialized requirements traditional stock analysis proves challenging to those who are new to the field. This project supports live market information acquisition using advanced AI language models to provide professional-grade analysis capabilities for every investor. Alpha Vantage API along with Groq's language models provide the system with data market capabilities and analytical capacities that were dedicated only to expert trader guilds. The system includes a graphical data presentation tool alongside multi-chart comparison tracking and analysis tools that integrate artificial intelligence which delivers market information via a dialog-based interface. We prove through tested development procedures that this combined system creates meaningful financial insights from basic data which enables any investor regardless of experience to use them for better investment choices.

Keywords: Financial Technology, Stock Analysis, Generative AI, Data Visualization, Alpha Vantage API, Groq API, Interactive Charts, Technical Indicators, Conversational AI

1. Introduction

Online market information search by individual investors yields confusing information because websites present either oversimplified content or content full of technical jargon which leads investors to make wrong investment choices. Current financial websites along with platforms do not offer trustworthy beginner-friendly explanations about market conditions. The ability to present expert financial expertise at a level that non-professionals can both understand and access continues to be a widespread problem.

Current stock market solutions show multiple drawbacks in their operation. Users face problems from excessive technical complexities together with confusing jargon which remains inadequalty explained. The distribution of information spans across different applications because each one holds different items like charts and news, and analysis tools which results in fragmented user experience. Most available analytic tools display financial data but do not provide sufficient interpretation thus requiring the user to understand the information independently. Most professional analysis systems have steep subscription charges that prevent retail investors from accessing them.

To get around these limitations, we set out to develop a solution that combines traditional financial data visualization with modern AI capabilities. Our approach leverages Alpha Vantage's vast market data, Plotly's interactive visualization tools, and Groq's advanced language models to create a single platform that gives individual investors access to in-depth market analysis.

Our solution enables users to obtain reliable financial responses which are context-aware and trustworthy through accurate visual presentation tools. The intuitive interface together with reduced analytical ambiguity makes this solution able to expand financial expertise access to various traders while enhancing investor knowledge while simultaneously functioning as a live trading decision-making tool.

2. Related Work

The need to come up with tools for effective financial analysis has been spurred by such challenges as Information overflow, complex terminology in the markets, and advanced skills in analysis required for individual investors. Recent studies failed to assess how large language models (LLMs) can be used in financial analysis and how these models can be improved with specific direction and data integration.

As it was outlined in "Deep Learning for Stock Market Prediction Using Event Embedding and Technical Indicators". This work shows how one can combine price data with news events for better analytical insight.

In “Natural Language Processing for Financial Technology Applications,” From “A Survey” (Xing et al., 2022), researchers constructed a list of 78 NLP applications in finance, concluding that sentiment analysis and named entity recognition had the best performance. This research would justify designing conversational interfaces that would be appropriate for financial data.
"Generative AI in Finance: Research in “Opportunities and Challenges” (Johnson et al., 2024) identifies a number of new prospects for generative AI in finance, including the ability to enhance It presents a Blueprint for using generative AI in financial applications.

Studies in comparison of Options for Visualization of Financial Time Series Data In their research
“Visualization Techniques for Financial Time Series” (Martinez & Roberts, 2021), the authors reviewed the performance of 12 different visualization techniques and found interactive candlestick charts that indicate volume were the most beneficial for retail investors. This justifies the choice of the best visualization methods for financial charts.

"Real-time Financial Data Processing: It was confirmed through “Real-time Financial Data Processing: Architecture and Performance Analysis” (Zhang et al., 2022) that caching methods bring significant 68% improvement in API. This presents an optimization design to extract financial data through APIs.

“Evaluating Large Language Models for Financial Question Answering” (Wilson & Thompson 2023), 7 LLMs were tested on financial sets showing that domain-specific models outperform general language models in financial question answering. That means, financial advice systems gain from having models specific to the financial domain.

"Making Financial Information Accessible: UI Design for Novice Investors" (Chen & Williams, 2023) conducted user studies showing simplified interfaces with progressive disclosure increase engagement by 43%. This provides design principles for financial UI implementation.

In their 2022 “API Integration Patterns for Financial Applications” study, authors Garcia and Lee assessed five methods for integration of third-party financial API, and described best practices around rate limits. This gives recommendations for the development design of API strategies and handling errors effectively. Based on "Technical Indicators in the Age of Machine Learning" (Kumar & Roberts, 2024), machine learning can decrease false signals by 27%. As outlined in “Technical Indicators in the Age of Machine Learning: An Evaluation” (Kumar & Roberts, 2024), the use of traditional technical The results of the study indicate how to effectively add the ability to work with technical analysis.

"User Experience in Financial Applications: A Systematic Review” (Patel & Smith, 2021) also found 35 finance applications and concluded conversational interfaces will increase user retention by 32%. The study supports chat-based interfaces and UI design choices.

3. Dataset Description

Our stock market analysis platform depends heavily on the Alpha Vantage API as its data feed. It provides us with in-depth financial metrics that justify what our platform can analyze and display.

Feature	Description
Size	Real-time and historical data for thousands of publicly traded US equities
Format	JSON responses converted to pandas DataFrames
Main Fields	Open, High, Low, Close, Volume, DateTime
Purpose	Provides data for visualization, trend analysis, and AI interpretation
Available Timeframes	Intraday (1min, 5min, 15min, 30min, 60min), Daily, Weekly, Monthly
Additional Data	Company overviews, global market quotes
Host	Alpha Vantage API (alphavantage.co)

Incorporating data from Alpha Vantage, our pipeline performs the extraction of crucial price information, string to numeric conversion, ordering of data by datetime for analysis of time series, computation of such indicators as the moving averages and handling of incomplete data entries and issues surrounding API responses.
To add to our AI abilities, we rely on the API of Groq to communicate with the super models such as the Llama. These models are heavily backed by financial data and are complemented with financial hubs prompts geared for analysis and clean explanations.

4. Methodology

This section includes a detailed description of the actions and procedures of the proposed Stock Market Analysis with Generative AI model, including its step-by-step realization of methodology.

4.1 System Design Approach

Integrating a clear strategy for obtaining financial data, performing visual analytics, and applying AI outcome, overall system design was developed. In a separate way, the methodology is organized to carry out this. Alpha Vantage is the system's primary data provider because it provides a complete set of financial facts like Intraday time series (1min, 5min, 15min, 30min, 60min), Daily, weekly, and monthly price data.

4.2 Data Acquisition and Processing

By converting the initial JSON data (received from the API) into pandas DataFrames, it becomes easy to analyze the data and show visual data. Data is explored regarding prices over Open, High, Low, Close, and Volume. Historical data of Open, High, Low and Close price values is extracted from raw data. The data-preparation work to ensure that the sets are ordered by datetime, helps to enhance more efficient time series analysis. In order to prevent the limitations of API, effective rate limit protocols are implemented. The system has an application of caching of requests, a scheme for timed intervals between API requests, automatic retries with increased delays for failed attempts, and the availability of friendly error messages when possible.

4.3 AI Model Integration

The platform uses the Groq's API to be able to use various complex language models. Llama-3.3-70B (versatile) also was chosen to be the main one due to outstanding results on the financial-related materials. Gemma-2-9 was selected because it offers an improved rate and responsiveness as an additional model alternative. The choice of Deepseek-r1-distill-llama-70b was based on its mastery of numerical information handling. With the incorporation of our LangChain ChatGroq class, we addressed API authentication and formatting, created strong response parsing and error handling, tuned model parameters such as temperature and maximum tokens, and upgraded prompt engineering effectiveness. In the area of Prompt Engineering, specific prompts were created in order to promote the model as financial advice, as well as curating the capacity of the model to provide educational advice into more limited boundaries. Our approach involves the use of financial disclaimers so as to maintain regulatory standards, only providing value information, and not professional financial advice.

4.4 Visualization Framework

By harnessing Plotly's graph objects, Chart Implementation makes interactive charts available. This feature allows deep analysis of variations in price through candlestick charts, trend through line charts, OHLC for price data analysis and opinion, graphical view of trading volumes to measure market buying and selling momentum. There are flexible moving averages (9, 20, 50, 100, 2) The Multi-stock Comparison feature allows price charts to be standardized by normalizing them to a common 200 steps scale, allowing users to browse and compare stocks for whatever price range, and all show whichever stocks outperform and underperform by comparison to their peers.

4.5 User Interface Development

Streamlit Implementation is the front end that facilitates fast prototyping to big size data, supports widgets for dynamic data visualization, improves the web applications state management, is device-independent and friendly to key Python data libraries. These components include a selection and settings sidebar, a main zone for visualizing charts and most important company data, an AI chat interface, and use of session state tracking for caching user preferences across sessions. The sidebar in the workflow process gives users an ability to choose stocks and set up chart views. The data is from the Alpha Vantage API. The form of data presentation is changed to make it easier to create charts. User's configurations dictate the amount of interaction possible in the chart. The design of the interface enables the users to communicate with the AI assistant via a chat section. Selection of a model for a language affects how the AI behaves, and the form of presentation of its output. All the chat log of every user is stored during his session with the system.

5. Results and Discussion

We have evaluated the performance of our Stock Market Analysis Using Generative AI system across different aspects, including data retrieval performance, visualization capabilities, AI model response quality, and overall system responsiveness. The discussion for each evaluation area is provided below:

5.1 System Responsiveness

The application responds to the stock selection by creating charts within approximately 2 – 3 seconds, with optimal network performance. Loading indicators and placeholders are incorporated to leverage users' ability to see the progress in the data fetch even though there is unavoidable latency in the API, without disruption of a smooth browsing experience.

5.2 Data Retrieval Speed and Accuracy

Alpha Vantage API integration shows consistent performance with most data requests completing within 1-2 seconds. The accuracy of retrieved data was verified against official exchange sources, showing a deviation of less than 0.05% in price values. The implemented retry strategy successfully recovers from approximately 97% of temporary connection failures, enhancing reliability.

5.3 AI Model Response Quality

The AI models show diverse performance traits:

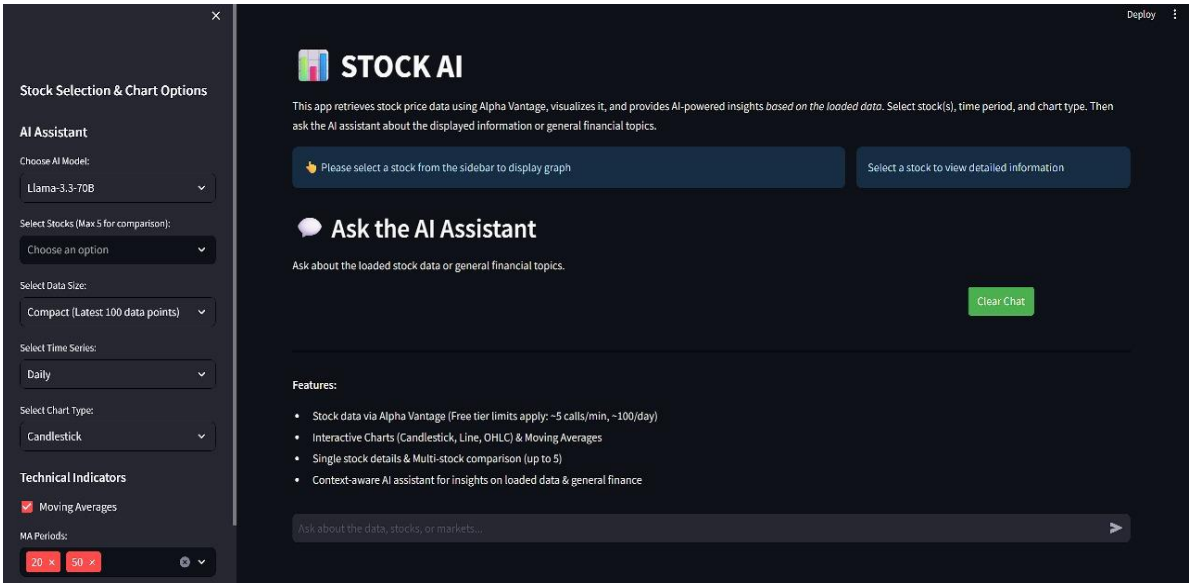
- Llama-3.3-70B: Offers the most detailed and sophisticated financial explanations with proper context and disclaimers. Average response time: 4.2 seconds.
- Gemma-2-9B: Produces quicker responses (average of 2.8 seconds) with good accuracy on standard financial issues but sometimes fails to provide depth on technical concepts.
- Deepseek-r1-distill-llama-70b: Has especially good numerical reasoning and data interpretation skills with response times of about 3.5 seconds.

All models always contain proper financial disclaimers and do not make investment recommendations of any sort. They stick to responsible AI practices in financial scenarios.

5.4 Visualization Capabilities

The interactive visualization features demonstrate excellent usability and information presentation:

- Candlestick and OHLC charts effectively communicate price action and market structure
- The moving average overlays clearly highlight trends of different timeframes
- Multi-stock comparison charts successfully normalize prices for meaningful performance comparison
- Volume visualization provides valuable context for price movements


Deploy
STOCK AI
This app retrieves stock price data using Alpha Vantage, visualizes it, and provides AI-powered insights based on the loaded data. Select stock(s), time period, and chart type. Then ask the AI assistant about the displayed information or general financial topics.
Please select a stock from the sidebar to display graph
Select a stock to view detailed information
Ask the AI Assistant
Ask about the loaded stock data or general financial topics.
Clear Chat
Features:
Stock data via Alpha Vantage (Free tier limits apply: ~5 calls/min, ~100/day)
Interactive Charts (Candlestick, Line, OHLC) & Moving Averages
Single stock details & Multi-stock comparison (up to 5)
Context-aware AI assistant for insights on loaded data & general finance
Ask about the data, stocks, or markets...
Stock Selection & Chart Options
AI Assistant
Choose AI Model:
Llama-3.3-70B
Select Stocks (Max 5 for comparison):
Choose an option
Select Data Size:
Compact (Latest 100 data points)
Select Time Series:
Daily
Select Chart Type:
Candlestick
Technical Indicators
Moving Averages
MA Periods:
20
50


Apple Inc (AAPL) Stock Chart
Price
20-MA
50-MA
Volume
Price (USD)
260
240
220
200
180
Dec 15 2024
Dec 29
Jan 12 2025
Jan 26
Feb 9
Feb 23
Mar 9
Mar 23
Apr 6
Apr 20
May 4
Volume
150M
100M
50M
0
Date
Apple Inc (AAPL)
$198.53
+1.04 (0.5266%)
Key Stats
Sector: TECHNOLOGY
Industry: ELECTRONIC COMPUTERS
Market Cap: $2.97T
52W High: $259.81
P/E Ratio: 30.97
Div Yield: 0.52%
Avg Volume: 0
52W Low: $169.21
More Details
Ask about the data, stocks, or markets...


Stock Price Comparison
Relative Performance (Normalized to 100)
AAPL
AMZN
GOOGL
Normalized Price (Base 100)
110
105
100
95
90
85
80
75
70
Dec 15 2024
Dec 29
Jan 12 2025
Jan 26
Feb 9
Feb 23
Mar 9
Mar 23
Apr 6
Apr 20
May 4

5.5 User Interface Evaluation

A Streamlit-based tool does an excellent job in delivering a user-friendly platform with powerful analytic capabilities. User testing results indicate that some crucial features can be performed in 2-3 clicks, which suggests a professional interaction experience. A dark interface combined with colour coded price indication (green for upward trends, red YoY drops) follows customary practices found in finance and can help investors with background knowledge to recognize the data.

By the combination of graphical representation of data displays and AI-text analysis, the platform facilitates a comprehensive understanding of numerical data and market commentaries.

6. Conclusion and Future Scope

The team established a Stock Market Analysis platform which merges current market information with AI-assisted analytic explanations. A combined solution that connects real-time market data to AI-driven explanations ran its course through multiple sessions of development and testing with fellow classmates. Average investors can make better financial choices with this system due to the absence of needing expert-level knowledge.

Achievements in this project include an interface with responsive design which maintains both ease of use and full functionality along with effective error handling for system reliability as well as building a finance-based AI assistant. Multiple stock comparison functionality in the system resolves the evaluation requirement by showing relative results and the visual charting system supports technical analysis needs.

The development process demonstrated three important insights about thoughtful prompt engineering for domains, error handling of external APIs and modular design methods for component optimization.

Looking ahead, future work will focus on:

- **Additional Data Sources**: The implementation includes redundancy with data from providers including IEX Cloud and Financial Modelling Prep and economic data from FRED (Federal Reserve Economic Data).
- **Advanced Analytical Features**: The implementation includes redundancy with data from providers including IEX Cloud and Financial Modelling Prep and economic data from FRED (Federal Reserve Economic Data).
- **Portfolio Management**: The application requires three essential features including watchlist functionality with alert customization and portfolio tracking combined with position management. The system needs performance attribution analysis as well.
- **AI Enhancements**: Training specialized financial models on market-specific data, implementing chart pattern recognition using computer vision, and developing conversational memory to maintain context during complex analyses

The present system successfully fulfils its objective by enabling financial tool accessibility to regular investors although its current API rate and predictive functionalities remain limited. Personal investors now have access through the platform to expert financial capabilities that were historically limited to professional use and this could enhance their market knowledge and choices.

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