

Stock Sphere

Dr.M.Sakthivel 

Head, Department of CSE

Sengunthar Engineering College (Autonomous), Tiruchengode, India

csehod@scteng.co.in

<https://orcid.org/0000-0003-4163-6630>

Prince Kumar, Sachin Kumar, Rajnikant Kumar

UG Students, Department of CSE

Sengunthar Engineering College (Autonomous), Tiruchengode, India

patel.prince9934@gmail.com, sachinkumar98@gmail.com, rajnikantkr05@gmail.com



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BibTeX Key Dr.Sakthivel@2026AI **Orcid:** <https://orcid.org/0009-0004-9398-7488>

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Abstract: The stock market generates a vast amount of financial data that investors must continuously monitor to make informed investment decisions. This paper presents Sphere, an intelligent stock market monitoring and alert platform that integrates real-time financial data analytics with modern web technologies to provide timely market insights. The system collects and processes stock market data including stock prices, trading volumes, company information, and market news through financial APIs to generate meaningful insights for users. By analyzing market trends and price movements, the platform enables users to track selected stocks, create personalized watch lists, and receive automated alerts when predefined conditions are met. The modular architecture includes data acquisition, preprocessing, data analysis, alert generation, and interactive visualization dashboards. The platform also provides AI-assisted summaries of financial news to help users quickly understand important market developments. Experimental implementation demonstrates that the system efficiently handles real-time data updates while providing accurate alerts and user-friendly visualization of market trends. This scalable and adaptive solution improves stock market monitoring and supports investors in making faster and more informed financial decisions.

Keywords: Stock Market Monitoring, Real-Time Data, Financial Analytics, Web Application, Stock Alerts, Data Visualization, Investment Insights, Market Trends.

I. INTRODUCTION

The stock market plays a significant role in the global financial system, enabling investors to trade securities and companies to raise capital for business growth [1],[2]. With the rapid expansion of digital trading platforms and financial technologies, investors increasingly rely on real-time data and analytics to monitor market movements and make informed investment decisions. However, tracking multiple stocks, analyzing price fluctuations, and interpreting financial news can be challenging for individual investors, especially when large volumes of market data are generated every seconds [3],[4]. Traditional stock monitoring tools typically provide basic price tracking and simple chart visualizations, but they often lack advanced analytics, automated alerts, and intelligent insights that help investors react quickly to market changes. Many investors must manually analyze charts, monitor financial news, and track market indicators, which can lead to missed opportunities or delayed responses to important market events.[5],[6]. Recent advancements in modern web technologies, financial APIs, and data analytics have enabled the development of intelligent stock monitoring platforms capable of processing large volumes of market data in real time [7],[8]. These platforms provide interactive dashboards, automated notifications, and data visualization tools that help users better understand stock performance and market trends [9],[10]. Financial APIs provide access to live stock prices, company information, trading volumes, and financial news, enabling the creation of scalable and responsive financial applications [11],[12]. Data visualization techniques such as line charts, candlestick charts, and market summaries further enhance the ability of users to analyze market behavior effectively[13],[14]. The proposed system introduces Sphere, an intelligent stock market monitoring and alert platform that integrates real-time financial data analytics with modern web technologies. The system collects live stock market data, processes it efficiently, and presents it through interactive dashboards and visualization tools. Users can create personalized watch lists, track stock performance, and receive automated alerts when predefined price conditions are met. The modular architecture ensures efficient data processing and scalable performance. Experimental implementation demonstrates that the system effectively supports real-time market monitoring and improves the accessibility of financial insights for investors.

II. LITERATURE REVIEW

Modern financial technology platforms increasingly rely on intelligent web-based systems to support stock market monitoring and analysis. Traditional stock tracking tools mainly provide basic price updates and simple charts, but they often lack advanced analytics, automated alerts, and personalized insights for investors [1],[2]. With the growth of financial technologies, modern systems have integrated real-time financial APIs, data analytics, and interactive dashboards to improve accessibility and efficiency in stock market monitoring [3], [4]. Studies have shown that web-based financial platforms significantly enhance user experience by enabling faster access to market data and simplified analysis of stock trends compared to traditional monitoring methods [5],[6]. Advanced visualization tools and real-time data processing technologies further support the development of scalable financial monitoring systems capable of handling large volumes of market data [7],[8]. Several financial platforms have explored the integration of modern web frameworks, data visualization tools, and real-time financial APIs to improve stock market monitoring capabilities. These systems collect financial data such as stock prices, trading volumes, company information, and market trends from financial data providers and process them for analysis and visualization [9], [10]. The collected data is displayed through interactive dashboards that allow users to track stock performance and analyze market movements efficiently [11], [12]. Many platforms provide features such as watch lists, price alerts, and automated notifications that help users stay updated with market changes [13], [14]. Visualization techniques including line charts, candlestick charts, and performance summaries enable users to better understand market behavior and investment trends[15],[16]. Some platforms also provide automated email or application notifications to inform users about important price changes or financial events [17],[18]. However, many existing implementations remain fragmented and do not provide a unified platform that combines real-time monitoring, intelligent insights, and personalized alerts within a single architecture [19],[20]. Despite these advancements, several challenges remain in developing efficient stock monitoring systems. Large volumes of financial data can overwhelm users and make it difficult to identify meaningful market trends in real time [6],[13]. Inconsistent or incomplete financial data may also affect the reliability of analytics and insights provided by financial applications [11],[14]. Processing real-time market data from multiple sources requires efficient system architecture to ensure quick updates and smooth performance in web applications [7],[19]. Additionally, interpreting financial news and market information can be challenging for many investors without simplified summaries or insights [8],[16]. Ensuring secure user authentication and protecting financial data from unauthorized access also remain important considerations in modern financial platforms [18],[20]. The proposed Sphere stock monitoring system addresses these limitations by providing a unified and scalable platform that integrates real-time stock data acquisition, data processing, automated alerts, and interactive visualization dashboards within a single architecture. Sphere stock monitoring system integrates real-time data analysis, automated alert generation, and interactive dashboards within a single architecture. Unlike traditional stock tracking platforms, it combines real-time financial data processing with modular data pipelines and user-friendly dashboards designed for investors. By bridging the gap between fragmented financial tools and comprehensive market monitoring systems, this study provides a unified solution that supports efficient stock analysis and improved investment decision-making.

III. PROPOSED METHODOLOGY ARCHITECTURE

The proposed system architecture for the Sphere stock monitoring platform follows a multi-layer framework consisting of data acquisition, data processing, and visualization dashboards. Real-time stock market data is collected using financial APIs such as Finnhub, which provide information including stock prices, trading volume, company details, and market news. The collected data is transmitted to a centralized processing environment where preprocessing and data organization are performed. Data preprocessing modules filter unnecessary or incomplete records and structure the data for efficient analysis and visualization. The processed data is then used to generate stock insights, price trend analysis, and automated alerts that help users monitor market activities effectively. The system stores processed financial data in a scalable database and performs continuous analysis to track stock price movements and market trends. Interactive dashboards present real-time stock prices, performance charts, and notification alerts to users. This architecture enables efficient monitoring of stock market activities and helps investors make informed financial decisions based on real-time information.

A. System Architecture Design

The proposed methodology implements a multi-layer architecture for the Sphere stock monitoring platform, as shown in Fig.1. The architecture consists of three main components: data acquisition layer, processing layer, and analytics layer. The data acquisition layer collects real-time stock market data from financial APIs such as Finnhub. The processing layer performs data preprocessing, organization, and analysis of stock market information. The analytics layer provides visualization dashboards and alert notifications for users and investors. This architecture ensures continuous monitoring of stock market activities and enables users to track price movements and market trends effectively.

B. Data Monitoring Mechanism

The system continuously monitors stock market data using real-time financial APIs and automated data retrieval mechanisms. The collected data includes important attributes such as stock price, trading volume, company information, and market trends. These parameters help users analyze stock performance and identify important market movements. Alert-based mechanisms generate notifications when stock prices reach predefined thresholds or significant changes occur in market values. Continuous monitoring allows users to track stock movements and respond quickly to important financial events.

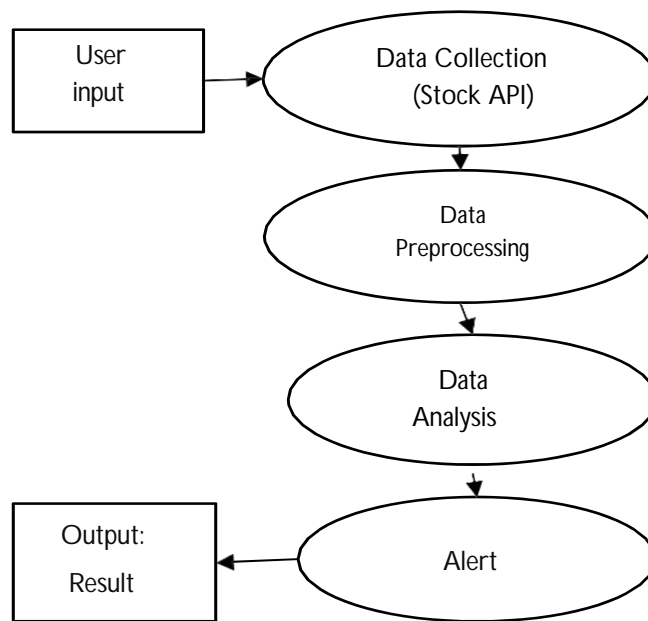


Fig.1.Architecture Diagram

C. Data Processing Framework

The data processing framework includes several stages such as data cleaning, normalization, and organization. Raw financial data collected from APIs may contain incomplete or redundant information that must be filtered before analysis. Data preprocessing techniques structure the information to ensure efficient processing and visualization. Important attributes include stock price history, trading volume, and market trend indicators. The processed data is then stored in a database and used to generate charts, insights, and alerts for users monitoring stock market activities.

D. Market Analysis System

The market analysis module processes stock market data and identifies patterns related to stock price movements and market performance. The system analyzes real-time financial information and provides insights through charts and graphical representations. By examining stock price trends and trading activity, the platform helps users understand market behavior and evaluate potential investment opportunities. When significant price movements are detected, the system automatically generates alerts to inform users about potential market changes.

E. Security Implementation

To ensure system reliability and secure user data, several security mechanisms are implemented in the platform. Data communication between the client interface and the server is protected using secure communication protocols such as HTTPS. User authentication and access control mechanisms restrict unauthorized access to the platform. Secure database storage and regular system monitoring help maintain the integrity and reliability of the financial monitoring platform.

F. Performance Validation

The effectiveness of the proposed system is evaluated based on system responsiveness, real-time data processing capability, and alert accuracy. Experimental results show that the platform efficiently processes real-time stock market data and provides timely alerts to users. The system demonstrates strong capability in visualizing stock market trends and supporting users in monitoring financial market activities effectively.

TECHNOLOGIES USED

A. Data Collection Modules

The system utilizes financial data APIs to collect real-time stock market information from online sources. APIs such as Finnhub are used to retrieve stock prices, trading volumes, company details, and financial news. These APIs provide continuous updates of stock market data, which forms the primary dataset for the stock monitoring platform. The collected data helps users track stock performance and monitor market activities efficiently.

B. Real-Time Data Monitoring

Real-time data monitoring technologies are used to continuously update stock market information within the platform. Instead of manually refreshing market data, the system automatically retrieves updated stock prices and financial information from external APIs. This approach ensures that users receive the most recent stock market updates and can monitor market changes effectively.

C. Web Application Framework

The system is developed using modern web frameworks such as Next.js and TypeScript. Next.js provides a powerful environment for building full-stack web applications with both frontend and backend capabilities. TypeScript improves code reliability and maintainability by providing static type checking and better development support.

D. Data Processing and Visualization

Data processing and visualization are important components of the stock monitoring platform. JavaScript libraries and visualization tools are used to process stock data and present it through interactive charts and dashboards. Visualization techniques such as line charts and stock performance graphs help users easily understand price trends and market behavior.

E. Database Management System

MongoDB is used as the primary database for storing user information, stock watch lists, and alert configurations. The database allows efficient storage and retrieval of large volumes of financial data. It also enables the system to maintain historical records of stock prices for analysis and visualization.

F. Backend Integration Framework

The backend system integrates APIs, database services, and application logic to manage data processing and communication between system components. Server-side APIs handle data requests, store user preferences, and process stock monitoring tasks. This framework enables smooth interaction between the frontend interface and the database.

G. Visualization and Monitoring Dashboard

The system provides an interactive dashboard where users can view real-time stock prices, market trends, and performance charts. Visualization tools display stock price movements and market statistics in graphical form. These dashboards help users quickly understand financial data and monitor their selected stocks effectively.

H. Notification and Alert System

The platform includes an alert mechanism that notifies users when stock prices reach predefined thresholds. Automated notifications can be generated based on user-defined watch lists and preferences. This feature helps users stay informed about important market movements and respond quickly to investment opportunities.

I. Web-Based Monitoring Application

A web-based monitoring interface provides users with real-time visibility into stock market data and alert notifications. The dashboard displays stock prices, market trends, watchlists, and historical performance charts. User authentication and access control mechanisms ensure that only authorized users can access and manage their personalized stock monitoring data.

IMPLEMENTATIONS AND RESULTS

The implementation phase of the Sphere system processes real-time stock market data to generate useful insights and alerts for users. The system collects stock information through financial APIs and analyzes price movements and market trends. Based on predefined conditions and user preferences, the platform generates alerts and notifications for important stock price changes. The results are presented through interactive dashboards and visualizations, enabling users to easily monitor stock performance and market trends as shown in Fig. 2. The Use Case Diagram illustrates the interaction between users and the Sphere Stock Monitoring System. The user accesses the platform to view stock prices, track watch lists, and set personalized stock alerts.

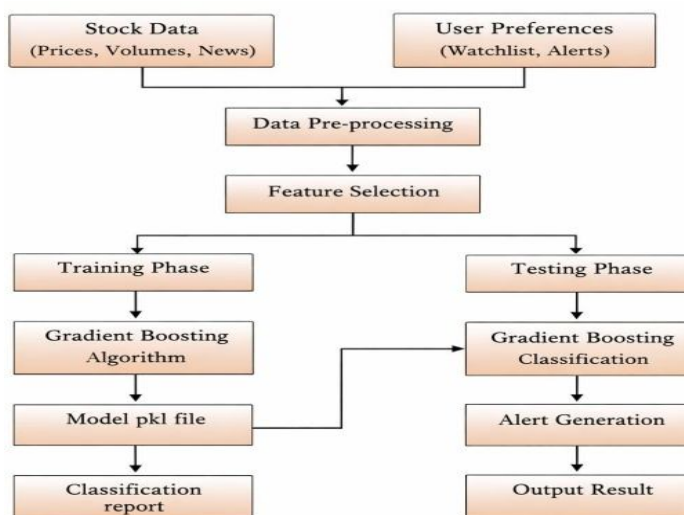


Fig. 2. System Implementation for Sphere Stock Monitoring System.

The performance of the proposed Sphere stock monitoring system was evaluated using a confusion matrix, as shown in Fig. 4. The matrix presents the classification results across different stock alert categories such as no alert, price increase, price decrease, and high volatility. The distribution of stock alert categories across the analyzed market data is shown in Fig. 5, which illustrates the frequency counts for different categories such as no alert, price increase, price decrease, and high volatility. As shown, the no alert category dominates the dataset with the highest frequency, reflecting normal market conditions where most stock prices remain stable without triggering alerts. Other categories represent significant price changes or volatility that require user attention and monitoring.

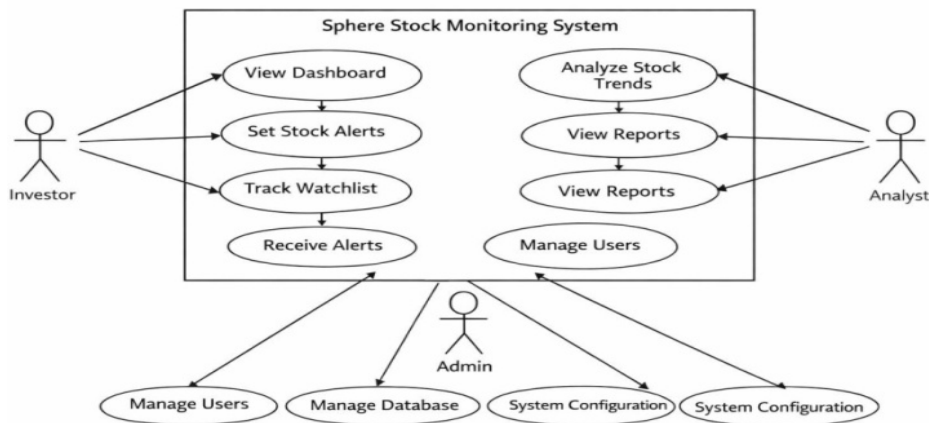


Fig. 3. Use Case Diagram for Sphere Stock Monitoring System.



Fig.4 Stock price alert confusion matrix

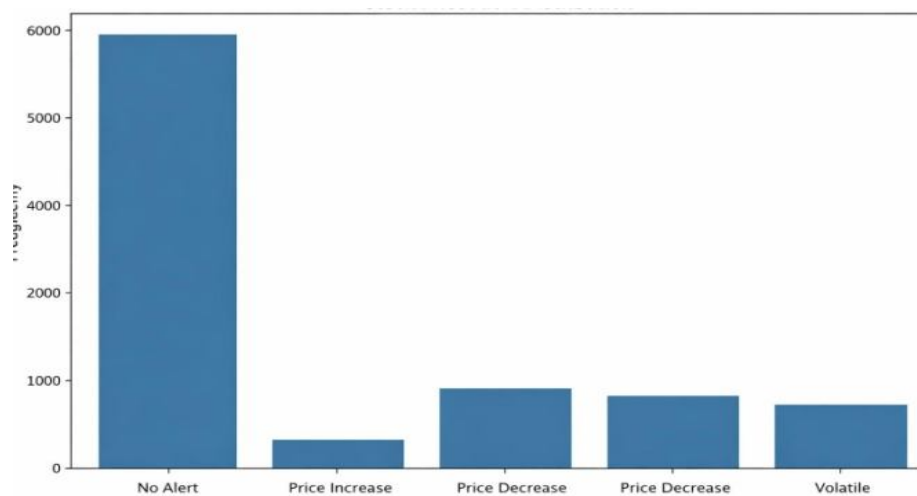


Fig.5 Stock price alert distribution chart

Key Considerations:

Data Quality and Availability: The collected stock market data must be accurate, complete, and regularly updated to ensure reliable monitoring and analysis. Poor quality or outdated financial data may reduce the effectiveness of the stock monitoring platform and lead to incorrect alerts.

Data Selection and Processing: Selecting the most relevant financial attributes is important for improving the effectiveness of the system.

System Accuracy and Performance: The system must efficiently process real-time market data and generate accurate alerts for users. Continuous system monitoring and optimization are required to ensure smooth performance and reliable notification of important stock price changes.

Real-Time Monitoring Capability: Stock prices change frequently throughout trading hours. Therefore, the system must support real-time or near real-time data processing to quickly detect significant price movements and generate alerts for users.

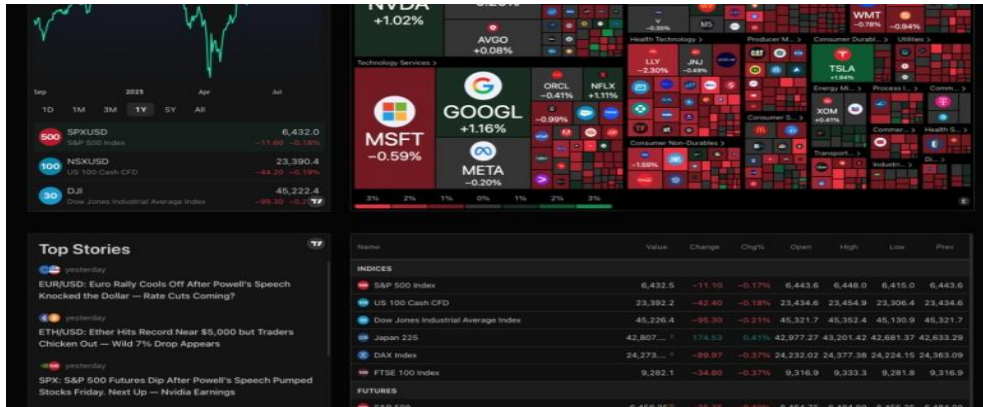


Fig 6: Dashboard Page

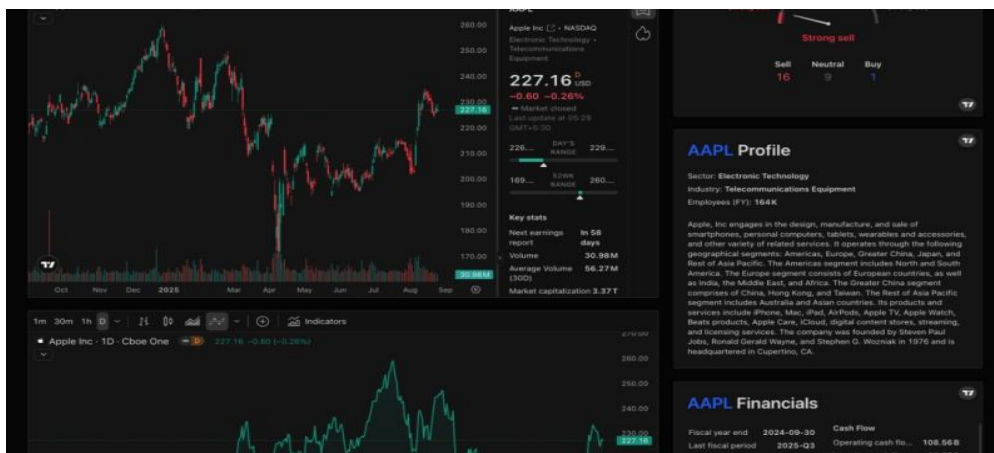


Fig 7: Stock Page
CONCLUSION

The proposed Sphere system presents an effective solution for monitoring stock market activities using real-time financial data and modern web technologies. By collecting and analyzing stock market information such as stock prices, trading volumes, and market trends, the system helps users track stock performance and identify important market changes. The integration of financial APIs, data processing techniques, and interactive dash boards enables users to monitor market behavior and receive timely alerts based on predefined conditions. The implementation results demonstrate that the platform efficiently handles real-time stock data and provides accurate notifications for significant price movements. Overall, the system improves the accessibility of financial insights and provides a scalable and user-friendly solution for stock market monitoring and investment decision support.

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