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Nexus-Sentinel: AI-Powered Virtual Portfolio Analyzer with RAG

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ABSTRACT
Nexus-Sentinel: AI-Powered Virtual Portfolio Analyzer with RAG is designed to help investors understand and evaluate their stock portfolios using Artificial Intelligence. The system analyzes portfolio performance, investment risks, asset allocation, and stock correlations to provide meaningful financial insights. It also uses Retrieval-Augmented Generation (RAG) to retrieve relevant information from company annual reports, making financial information easier to access and understand. By combining portfolio analytics with AI-driven document retrieval, the proposed system aims to support more informed and transparent investment decisions.

Keywords: Artificial Intelligence, Virtual Portfolio Analyzer, Retrieval-Augmented Generation, Financial Document Analysis, Stock Market, FAISS, LangChain, Portfolio Management.

INTRODUCTION
Stock market investment has become a popular way for individuals to manage their finances, but tracking multiple investments and understanding company financial information can still be challenging. Investors need to monitor purchase prices, current stock values, portfolio performance, and company-related financial details, which are often scattered across different sources. Annual reports contain valuable information but can be lengthy and time-consuming to review manually. To address these difficulties, we developed **Nexus-Sentinel**, a web-based Virtual Portfolio Analyzer that brings portfolio management and financial document retrieval into a single application. Built using Python and Streamlit, it uses yfinance for stock market data, PostgreSQL for storing user and portfolio information, and a Retrieval-Augmented Generation (RAG) system using LangChain and FAISS to make company annual reports searchable. This allows users to ask questions about financial documents and retrieve relevant information more easily, helping them understand their investments and make informed decisions.

IMPORTANCE
Nexus-Sentinel is developed to simplify virtual portfolio management and financial information retrieval by bringing both features into a single application. It allows users to maintain their stock holdings, monitor investment values, and calculate profit or loss using market data obtained through yfinance. The RAG-based document search feature helps users find relevant information from lengthy company annual reports without manually going through the entire document. Individual user authentication also ensures that users

can access their own portfolio information, making the application more convenient for understanding and monitoring investments.

SCOPE

Nexus-Sentinel is a web-based application developed using Python 3.10.11 and Streamlit, with PostgreSQL for storing user and portfolio data. It provides user registration and login using JWT and bcrypt, virtual stock portfolio management, and performance calculations using yfinance. The system also supports retrieving annual reports of NSE-listed companies using the NSE package and processing them through LangChain and FAISS for RAG-based question answering. The application focuses on virtual investment tracking and financial document retrieval; it does not perform actual stock transactions or guarantee investment results.

LITERATURE SURVEY

Several researchers have explored the use of artificial intelligence, machine learning and natural language processing in stock market analysis, portfolio management and financial document processing. Ramamurthy et al. [1], in their study on *Automatic Indexing of Financial Documents via Information Extraction*, discussed techniques for extracting and organizing information from financial documents to make retrieval easier. Similarly, Gondhalekar et al. [2] introduced *MultiFinRAG: An Optimized Multimodal Retrieval-Augmented Generation Framework for Financial Question Answering*, which focuses on retrieving relevant financial information to generate answers to user queries. These studies provide useful approaches for financial document processing and question answering. However, the accuracy of retrieved information depends on document quality, extraction methods and the complexity of the data.

Research has also been carried out on predicting stock market movements using machine learning techniques. Mallam et al. [4] explored stock price prediction using historical market data, while Nelson et al. [6] proposed an approach based on Long Short-Term Memory (LSTM) neural networks to identify patterns in stock price movements. These studies demonstrate how historical data and deep learning techniques can support stock market analysis. However, changing market conditions and unpredictable price fluctuations can affect the reliability of prediction models.

Another important area of research focuses on portfolio management and investment optimization. Thalapathy et al. [8] studied the application of machine learning techniques for portfolio optimization and investment distribution. Similarly, Singh et al. [10], in *Harnessing a Hybrid CNN-LSTM Model for Portfolio Performance: A Case Study on Stock Selection and Optimization*, explored the combination of CNN and LSTM techniques for stock selection and portfolio optimization. Although these approaches support investment analysis, their effectiveness depends on data quality, model assumptions and changing market conditions.

The reviewed studies show that stock market prediction, portfolio optimization and financial document retrieval have been explored through different approaches. However, these areas are often addressed separately. This creates a need for an integrated platform that combines virtual portfolio monitoring, stock price visualization and financial document analysis. The proposed Nexus-Sentinel system addresses this need by bringing portfolio tracking and RAG-based financial question answering together in a single web application.

Comparative Analysis Table

Sl. No	Paper	Methodology	Key Features	Limitations
1	Automatic Indexing of Financial Documents via Information Extraction	Information extraction and document indexing	Financial information extraction; searchable document indexing	Depends on document structure and extraction quality
2	MultiFinRAG: An Optimized Multimodal Retrieval-Augmented Generation Framework for Financial Question Answering	Multimodal RAG	Financial question answering; retrieval across multimodal content	Multimodal processing and indexing can be complex
3	Structured Financial QA with LLMs: Fine-Tuning vs. Code-Augmented Retrieval	LLM fine-tuning and code-augmented retrieval	Compares approaches for structured financial question answering	Results depend on evaluation data and task setup
4	Stock Market Price Prediction Using Machine Learning	LSTM neural networks	Predicts stock-price movement from historical data	Changing market patterns can reduce prediction accuracy
5	Stock Price Prediction using Random Forest Classifier and Backtesting	Random Forest classification and backtesting	Stock prediction with historical strategy evaluation	Backtesting may not represent future market conditions
6	Stock Market's Price Movement Prediction with LSTM Neural Networks	LSTM neural networks	Predicts stock-price movement from historical data	Changing market patterns can reduce prediction accuracy
7	Forecasting in Stock Market with Machine Learning: A State of Art	Literature review of machine-learning forecasting	Reviews stock-market forecasting methods and applications	Studies may use different datasets and evaluation metrics

8	Portfolio Optimization Using Machine Learning Techniques	Machine learning for portfolio optimization	Asset allocation and portfolio decision support	Results depend on assumptions, data quality, and market conditions
9	Sentiment Analysis of Financial Texts Based on Attention Mechanism of FinBERT and BiLSTM	FinBERT, BiLSTM, and attention mechanism	Classifies sentiment in financial text	Financial language can be ambiguous and context-dependent
10	Harnessing a Hybrid CNN-LSTM Model for Portfolio Performance: A Case Study on Stock Selection and Optimization	Hybrid CNN-LSTM model	Stock selection and portfolio performance/optimization	Performance depends on historical data and market conditions

PROPOSED MODEL

The proposed system, Nexus-Sentinel, is a web-based virtual portfolio analyzer that combines stock market monitoring, portfolio management and financial document analysis using Retrieval-Augmented Generation (RAG). The main objective of the system is to provide users with a single platform where they can monitor their virtual investments, understand stock price movements and access financial information from company annual reports.

The system begins with user login, after which the user is directed to the portfolio dashboard. Users can enter stock details such as the stock ticker, investment amount and purchase price. The application retrieves the latest available stock information using the yfinance library and calculates the number of shares, current portfolio value, profit or loss and percentage return. These details are displayed on the dashboard along with graphical representations of stock price movements, helping users understand the performance of their selected stocks.

The system also provides a separate facility for processing financial documents. Annual reports of supported NSE-listed companies are collected and processed as PDF documents. LangChain is used to extract the text and divide it into smaller chunks. The extracted content is converted into embeddings and stored in a FAISS vector index. When a user asks a financial question, the system retrieves relevant information from the stored documents and uses it as context for the language model to generate an answer.

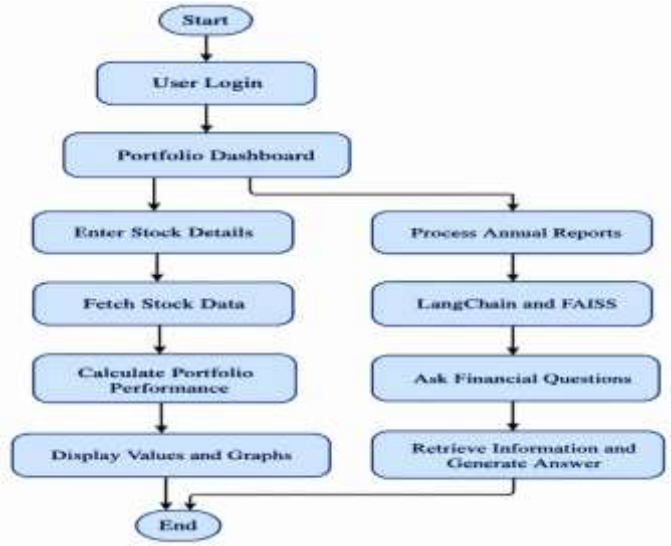


Figure 1: Flowchart of the Proposed Model

As shown in Figure 1, the proposed workflow consists of two major operations: virtual portfolio analysis and financial document retrieval. Both operations begin from the portfolio dashboard and provide their respective results to the user. Through this approach, Nexus-Sentinel brings stock monitoring, graphical portfolio analysis and annual report-based question answering together in one web application.

RESULTS AND DISCUSSION

The developed Nexus-Sentinel application successfully integrates virtual portfolio management, stock market visualization and financial document analysis into a single web-based platform. After logging in, users can create and manage their individual virtual portfolios by entering stock tickers, investment amounts and purchase prices. The dashboard displays important information such as total investment, current portfolio value, profit or loss and percentage return. Current stock prices are retrieved using yfinance, and the application uses these values to calculate the updated performance of each holding. This allows users to monitor their virtual investments without performing manual calculations.

One of the important features of the application is the graphical representation of stock price movements. The stock price graph displays changes in the market price of a selected stock over a particular period. The horizontal axis represents time, while the vertical axis represents the stock price. The plotted line connects the available price values and provides a clear view of upward and downward movements. An upward movement indicates an increase in stock price, whereas a downward movement indicates a decrease. This graphical representation helps users observe historical price fluctuations and understand stock performance more easily than by viewing numerical data alone.

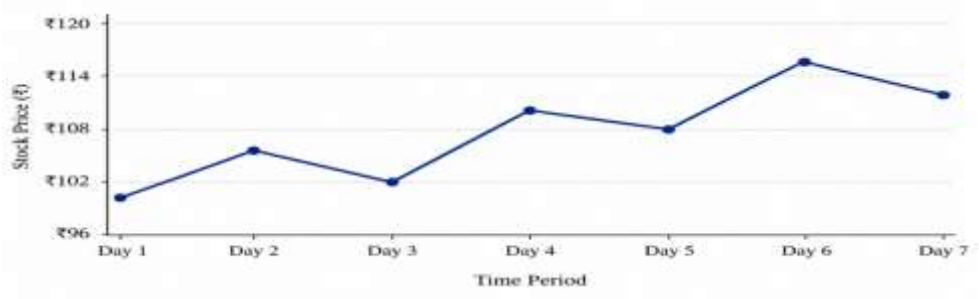


Figure 2: Graphical representation of historical stock price movement

The portfolio analysis feature helps users understand how their investments are performing by displaying the number of shares, current value, profit or loss and percentage return. These values are calculated using the investment amount, purchase price and latest available stock price, making it easier to track individual holdings.

The RAG-based document retrieval feature allows users to ask questions about company annual reports. The system processes the reports, stores their information in FAISS and retrieves relevant content to generate answers. This saves users the effort of manually searching through lengthy documents.

Overall, Nexus-Sentinel brings virtual portfolio tracking, stock graphs and financial document analysis together in one platform. It helps users understand their investments and access company information more easily. The system is designed for virtual analysis and does not carry out actual stock transactions.

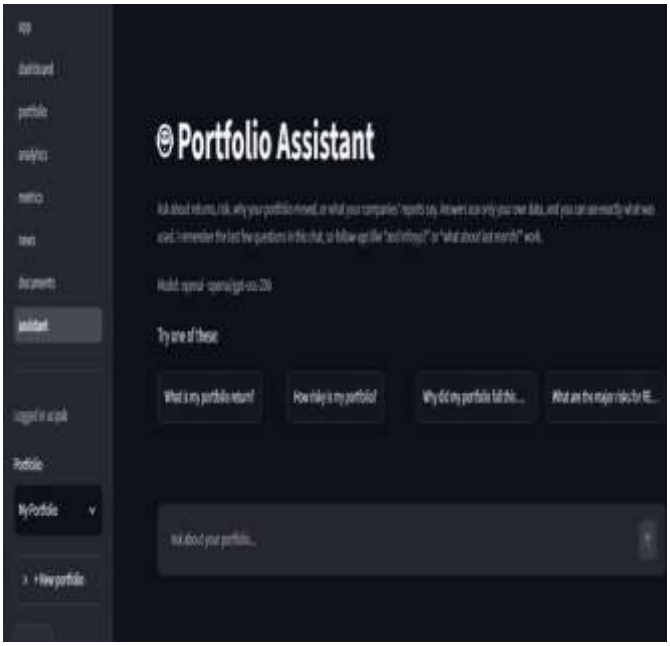


Figure 3: AI-Powered Portfolio Assistant

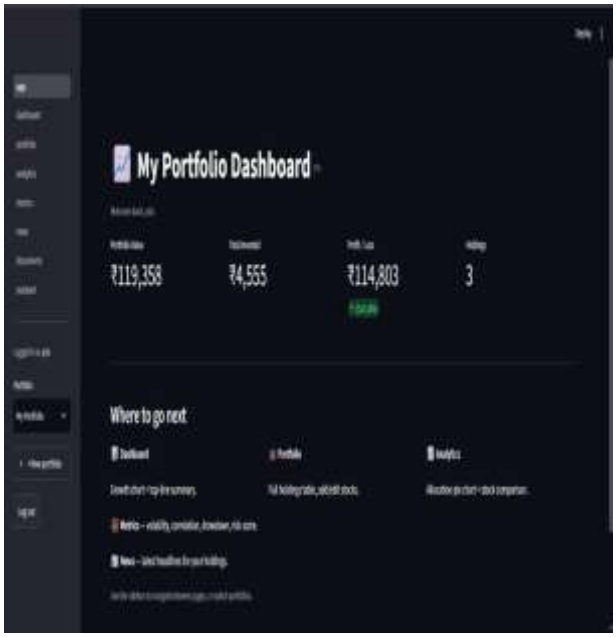


Figure 4: Portfolio Dashboard



Figure 5: News and Sentiment Analysis

The application also includes an AI-powered Portfolio Assistant, as shown in Figure 3, which allows users

to ask questions about their investments and receive responses based on their portfolio information. Figure 4 presents the main portfolio dashboard, where users can view their portfolio summary and easily navigate between features such as analytics, metrics, news, documents and the assistant. In addition, the News and Sentiment Analysis feature, shown in Figure 5, displays financial news classified into positive, neutral and negative categories. In the displayed result, out of 30 news items, 8 are positive, 19 are neutral and 3 are negative, helping users understand the overall sentiment of the collected financial news.

Summary Table

Research Area	**Techniques**	**Main Contribution**	**Relevance** to Nexus-Sentine
Financial Document Processing	Information extraction and indexing	Organizes financial documents for retrieval	Annual report processing
Financial Question Answering	RAG and language models	Retrieves relevant financial information	RAG-based document search
Stock Market Prediction	Machine learning and Random Forest	Studies stock price movements	Stock market information
Historical Data Analysis	LSTM neural networks	Identifies patterns in historical stock data	Understanding stock behaviour
Portfolio Optimization	Machine learning techniques	Supports investment distribution	Portfolio management
Financial Sentiment Analysis	FinBERT and BiLSTM	Analyses financial text	Financial information processing
Portfolio Performance	CNN-LSTM	Supports stock selection and optimization	Portfolio-related analysis

Conclusion

Nexus-Sentinel demonstrates the integration of virtual portfolio management and AI-based financial document retrieval within a single web application. The system allows users to maintain individual stock portfolios, monitor investment values and calculate profit or loss using market information obtained through yfinance. It also provides a RAG-based approach for searching company annual reports using LangChain and FAISS. PostgreSQL manages user and portfolio information, while Streamlit provides the application interface. The completed application brings portfolio tracking and financial document retrieval

together, making company-related financial information more accessible to users. Further improvements can focus on expanding supported financial data sources, evaluating retrieval performance and introducing additional portfolio analysis features.

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