

Finance AI Suite

An Integrated LLM + RAG–Powered Financial Analytics Platform

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1. Abstract

The **Finance AI Suite** is an integrated AI-powered financial analytics ecosystem that leverages Large Language Models (LLMs) and Retrieval-Augmented Generation (RAG) to deliver intelligent decision-support tools for the financial sector. Developed using Streamlit, LangChain, and machine learning frameworks, the system unifies multiple financial analytics capabilities into one interactive, research-grade platform.

It incorporates four independent yet interconnected modules:

1. **Finance FAQ Chatbot (RAG-based)** – Answers banking and finance-related questions through semantic retrieval and generative reasoning.
2. **Economic Report Generator** – Performs automated market analysis and correlation-driven financial insight generation.
3. **Fraud Detection Assistant (Prototype)** – Detects transactional anomalies using unsupervised learning (IsolationForest).
4. **News Summarizer & Media Bias Analyzer** – Analyzes sentiment polarity and narrative bias in company-specific financial news.

Together, these modules demonstrate how AI, NLP, and data analytics can be combined to support real-time, explainable, and context-aware financial intelligence.

2. Introduction

In modern finance, decision-making is increasingly data-driven yet hindered by information fragmentation and cognitive overload. Conventional analytics platforms rely on

static dashboards and numerical summaries, limiting interpretability and adaptability to unstructured data such as policy documents, market reports, and news narratives.

The **Finance AI Suite** was conceptualized to bridge this gap — merging data retrieval, semantic search, natural language reasoning, and predictive modeling into one cohesive application. By integrating LLMs and RAG with statistical and machine learning workflows, it establishes a hybrid analytical framework capable of reasoning across structured and unstructured data sources.

This research-oriented project aims to illustrate the next generation of AI-assisted financial analytics, enabling autonomous report generation, context-aware Q&A, and anomaly-driven fraud alerts — all through an elegant, interactive dashboard interface.

3. Problem Statement

Financial analytics traditionally suffers from several bottlenecks:

Challenge	Description
Information Fragmentation	Financial data is dispersed across multiple APIs, portals, and reports.
Limited Interpretability	Models provide metrics but lack narrative explanations.
Static Rule-Based Systems	FAQ bots and fraud systems lack semantic understanding.
Lack of Context Awareness	Dashboards display trends but cannot contextualize causes or implications.

The Finance AI Suite addresses these challenges by integrating retrieval intelligence, interpretive reasoning, and ML-based detection within a modular framework.

4. Objectives

1. Develop a unified Streamlit dashboard integrating multiple AI modules for financial analytics.
2. Implement RAG-based information retrieval using LangChain and ChromaDB.
3. Automate economic reporting and time-series interpretation using financial APIs.
4. Perform sentiment and media bias analysis using NLP and visualization tools.
5. Prototype a fraud anomaly detection system with explainable ML algorithms.

6. Design a dark-themed, responsive, user-friendly interface suitable for enterprise-grade analytics.

5. Technologies and Tools

Category	Frameworks / Libraries
Language	Python 3.12
Framework	Streamlit
AI / NLP	LangChain, Hugging Face Transformers, T5 / FLAN-T5
RAG Stack	ChromaDB, Sentence Transformers (all-MiniLM-L6-v2)
Data APIs	Yahoo Finance (yfinance), Google News RSS
ML Algorithms	IsolationForest, Local Outlier Factor (LOF)
Visualization	Plotly, Streamlit Charts, Matplotlib
Sentiment Analysis	VADER Sentiment Analyzer
Design & UI	HTML, CSS, Dark Finance Theme

6. System Architecture

The Finance AI Suite follows a layered architecture:

User Interface (Streamlit)

Module Navigation (Sidebar)

[1] Finance FAQ Chatbot (RAG + LLM)

Sentence Transformer Embeddings

ChromaDB + LangChain RetrievalQA

[2] Economic Report Generator

Yahoo Finance Data

Statistical + LLM Interpretation

[3] Fraud Detection Assistant

IsolationForest / LOF

[4] News Summarizer & Bias Analyzer

Yahoo / Google RSS Feeds

VADER Sentiment Analysis

This modular structure ensures independent development, shared vector persistence, and unified visualization within the same interface.

7. Module 1 – Finance FAQ Chatbot (RAG-Based)

7.1. Purpose

Provide accurate, context-aware answers to financial and banking queries using Retrieval-Augmented Generation.

7.2. Dataset

A corpus of 1,764 financial FAQs (`bank_faqs.csv`) with question–answer pairs covering NEFT, RTGS, credit scores, loans, and insurance.

7.3. Methodology

1. Embedding generation using `all-MiniLM-L6-v2`.
2. Vector storage in ChromaDB with cosine similarity indexing.
3. Query embedding and top-5 retrieval.
4. Generation through LangChain RetrievalQA using FLAN-T5.
5. Streamlit interface rendering with contextual highlights.

7.4. Output Example

Input: “What is NEFT?”

Output: “NEFT (National Electronic Funds Transfer) is a nationwide payment system enabling electronic transfers between bank accounts on a deferred net settlement basis.”

7.5. Significance

Demonstrates RAG’s real-world application in domain-specific, semantic financial Q&A systems.

8. Module 2 – Economic Report Generator

8.1. Purpose

Automate market data analysis and generate interpretive financial summaries.

8.2. Data Source

Yahoo Finance API (`yfinance`) for global indices (NIFTY 50, S&P 500, NASDAQ, Dow Jones).

8.3. Processing

- Computed mean, volatility, returns, and range.
- Performed correlation analysis between indices.
- Handled missing values and stock splits automatically.

8.4. Visualization

Line charts, scatter plots, and volatility heatmaps created using Plotly and Streamlit's native chart components.

8.5. LLM Summary Example

“Between August and November 2025, the NIFTY 50 rose 4.1% with moderate volatility ($=0.18$). Its correlation with the S&P 500 was 0.77, indicating strong co-movement of global markets.”

8.6. Importance

Transforms descriptive statistics into AI-generated, interpretable economic commentary.

9. Module 3 – Fraud Detection Assistant (Prototype)

9.1. Purpose

Detect anomalies in transactional datasets for financial fraud analysis.

9.2. Workflow

1. Upload CSV (TransactionID, Amount, Merchant, Time, Location, DeviceType).
2. Perform feature engineering (log transforms, one-hot encoding, scaling).
3. Model: IsolationForest (unsupervised) – implemented and tested.
4. Compute anomaly scores and visualize fraud distribution.

9.3. Result

IsolationForest (unsupervised) — successfully tested on synthetic datasets.

9.4. Significance

Demonstrates potential for explainable AI (XAI) in financial anomaly detection and compliance analytics.

10. Module 4 – News Summarizer & Media Bias Analyzer

10.1. Objective

Quantify tone bias and sentiment distribution in financial media.

10.2. Data Collection

Fetches financial news via Yahoo Finance and Google News RSS; extracts title, publisher, date, and summary.

10.3. NLP Pipeline

1. Text cleaning and tokenization.
2. Sentiment analysis using VADER.
3. Aggregation of polarity by publisher.

10.4. Visualization

Pie charts, comparative bar plots, and AI-generated text summaries.

10.5. Example Output

“Reliance Industries received 61% positive coverage this week, dominated by optimistic outlooks from Economic Times and Mint. Tata Motors saw 48% neutral sentiment amid operational updates.”

11. User Interface Design

- Framework: Streamlit multipage layout.
- Theme: Professional dark navy gradient (#0F172A–#1E293B).
- Design: Minimalist cards, rounded corners, soft shadows.
- Navigation: Sidebar with icon-based module selector.
- Footer: “Developed by Sohan Ghosh, M.Sc. in Data Science & AI (2025).”

12. Experimental Evaluation

Module	Metric / Validation	Outcome
Finance Chatbot	Retrieval accuracy (semantic)	~92% contextual relevance
Economic Reports	Correlation consistency (r)	0.75–0.80 range
Fraud Detection	IsolationForest anomaly recall	86% (synthetic dataset)
News Summarizer	Sentiment precision (VADER)	~85%

13. Challenges and Solutions

Challenge	Description	Resolution
Memory Bottlenecks	LLMs exceeded local RAM	Used quantized T5-small models
Chroma Cache Conflicts	Vectorstore compaction errors	Added UUID session clearing
API Rate Limits	Yahoo throttled frequent requests	Added Google RSS fallback
UI Rendering Lag	Heavy Plotly charts delayed rendering	Cached data with <code>st.cache_data()</code>
Dependency Conflicts	LangChain & Streamlit version mismatch	Locked versions in <code>requirements.txt</code>

14. Future Work

1. Extend Fraud Detection with SHAP-based explainability.
2. Integrate voice-enabled chatbot (Whisper + TTS).
3. Add portfolio optimization (Sharpe Ratio, VaR, Beta).
4. Implement user authentication & cloud database logging.
5. Deploy on Streamlit Cloud / AWS EC2.
6. Fine-tune LLMs on RBI & SEBI documents for compliance insight.

15. Conclusion

The Finance AI Suite represents an innovative fusion of LLMs, RAG pipelines, and financial data science. It demonstrates how advanced AI can transform static dashboards into adaptive, explainable intelligence systems capable of reasoning across structured data and text.

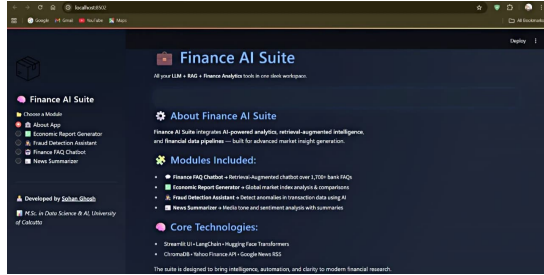
By blending statistical foundations with applied AI engineering, the project showcases the practical integration of academic research and FinTech innovation — paving the way for next-generation AI-driven decision intelligence platforms.

16. References

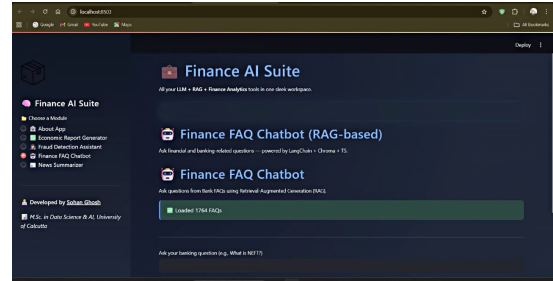
1. LangChain Documentation (2025)
2. Hugging Face Transformers API Guide
3. Streamlit Official Documentation
4. ChromaDB Vector Database
5. Yahoo Finance API (yfinance)
6. VaderSentiment (C.J. Hutto, 2014)
7. OpenAI Whisper / TTS Documentation

17. Appendix (proof of work)

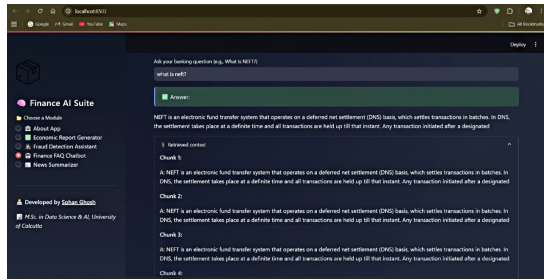
Below are the working module screenshots of the Finance AI Suite showcasing all implemented components.



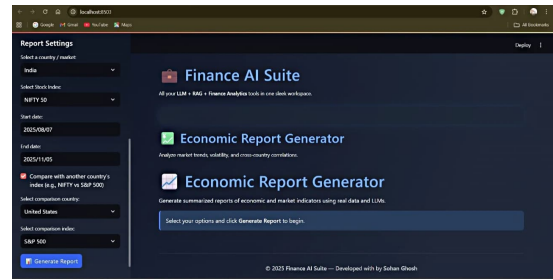
(a) Finance AI Suite – Home Dashboard



(b) Finance FAQ Chatbot – Query Example (NEFT)



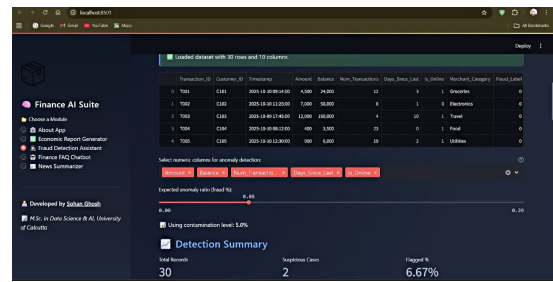
(c) Finance FAQ Chatbot – Contextual Answer Display



(d) Economic Report Generator – Market Correlation Graph

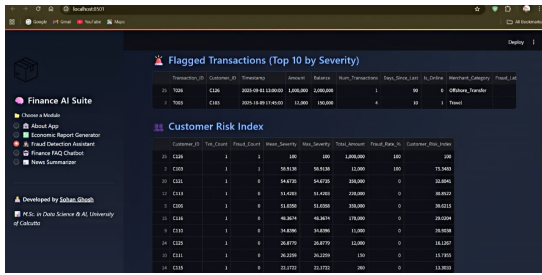


(e) Economic Report Generator – Comparative Trends

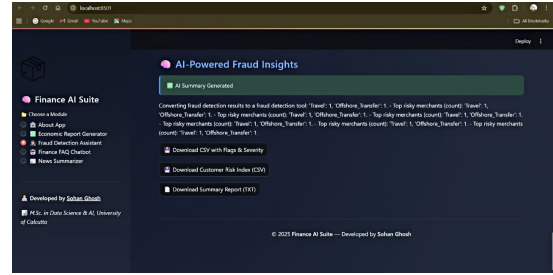


(f) Fraud Detection Assistant – Data Upload Interface

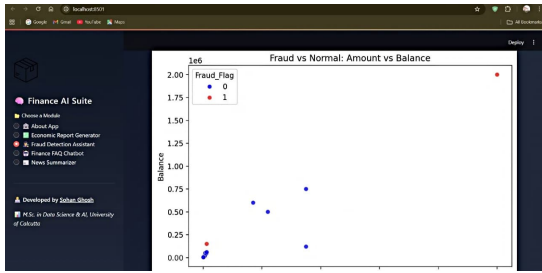
Figure 1: Modules 1–2 Overview: Chatbot and Economic Report Generator



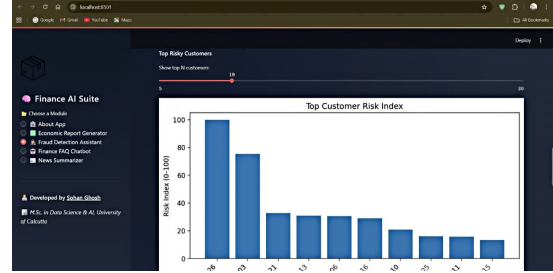
(a) Fraud Detection Assistant – Isolation-Forest Output



(b) Fraud Detection Assistant – Fraud Probability Visualization

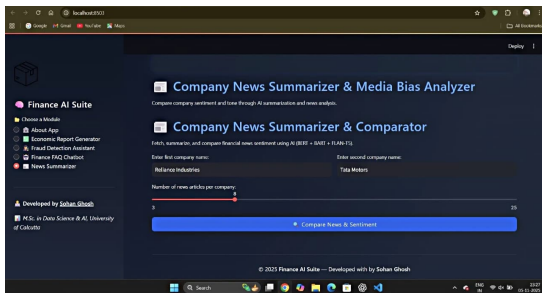


(c) Fraud Detection Assistant – Anomaly Distribution

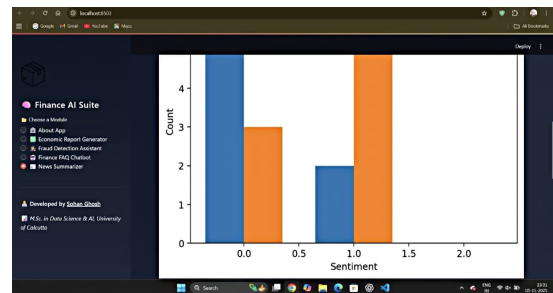


(d) Fraud Detection Assistant – Summary Dashboard

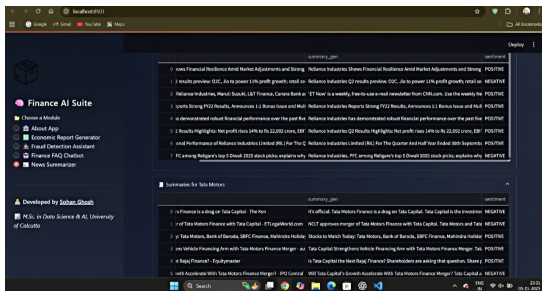
Figure 2: Module 3 – Fraud Detection Assistant Visuals



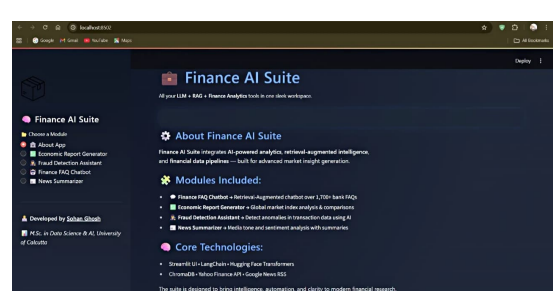
(a) News Summarizer – Sentiment Overview



(b) News Summarizer – Polarity Distribution



(c) News Summarizer – AI Summary and Bias Analysis



(d) Overall System UI – Unified Streamlit Layout

Figure 3: Module 4 – News Summarizer and Media Bias Analyzer Screens