A

Mini Project Report on

Investment Banking Chatbot using RAG

Submitted in partial fulfillment of the requirements
for the degree of
BACHELOR OF ENGINEERING
IN
Computer Science & Engineering
Artificial Intelligence & Machine Learning

by

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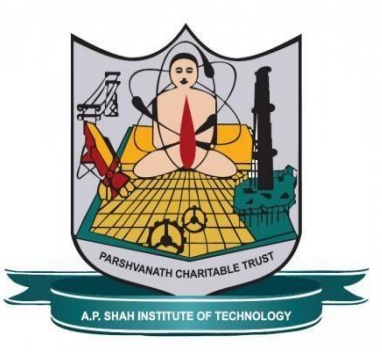

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A. P. SHAH INSTITUTE OF TECHNOLOGY

CERTIFICATE

This is to certify that the project entitled "**Investment Banking Chatbot using RAG"** is a bonafide work of Yash Penkar (22106118), Prarthana Patil (22106035), Rutuja Pawar (22106043), Nikita Patil (22106081) submitted to the University of Mumbai in partial fulfillment of the requirement for the award of **Bachelor of Engineering** in **Computer Science & Engineering (Artificial Intelligence & Machine Learning).**

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Project Report Approval

This Mini project report entitled "**Investment Banking Chatbot using RAG"** by **Yash Penkar, Prarthana Patil, Rutuja Pawar and Nikita Patil** is approved for the degree of ***Bachelor of Engineering*** in ***Computer Science &Engineering***, (AIML) ***2024-25***.

External Examiner: _____

Internal Examiner: _____

Place: APSIT, Thane

Date:

Declaration

We declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission hasnot been taken when needed.

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ABSTRACT

The Investment Banker Chatbot project represents an innovative application of artificial intelligence in the financial sector, aimed at optimizing investment banking operations through advanced conversational agents. Developed with Python and leveraging sophisticated natural language processing (NLP) techniques, this chatbot is designed to assist investment professionals by delivering personalized financial advice, market insights, and portfolio management strategies. The chatbot utilizes state-of-the-art machine learning models trained on extensive financial datasets to understand and address complex queries related to investments, risk assessment, and market analysis. Its features include data retrieval, customized investment recommendations, and interactive dialogue that adapts to user needs. The system is engineered to handle a diverse range of financial topics, providing accurate and relevant information that enhances decision-making processes. By integrating advanced AI algorithms with financial expertise, the Investment Banker Chatbot aims to bridge the gap between traditional investment advisory services and modern technological solutions. Its deployment is expected to streamline financial consultations, improve the efficiency of advisory services, and make high-quality financial advice more accessible to a broader audience.

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CHAPTER 1

INTRODUCTION

1

1.INTRODUCTION

The financial services industry is experiencing a profound transformation driven by advancements in artificial intelligence (AI) and machine learning technologies. One of the most promising innovations in this space is the development of investment banker chatbots—sophisticated AI-driven tools designed to revolutionize the way financial advice and services are delivered. These chatbots embody a blend of cutting-edge technologies, including natural language processing (NLP), machine learning, and data analytics, to create a seamless and interactive user experience. Investment banker chatbots serve as virtual financial advisors, capable of performing a wide range of tasks traditionally handled by human experts. They are designed to engage users in natural, conversational interactions, answering queries about market trends, investment strategies, and portfolio management. By analyzing extensive financial datasets and leveraging advanced algorithms, these chatbots can provide personalized recommendations, assess risks, and track market movements with remarkable accuracy. The rise of investment banker chatbots is driven by the need for more efficient, scalable, and accessible financial advisory services. They offer several advantages over traditional methods, including reduced response times, lower costs, and the ability to provide 24/7 support. As financial markets become increasingly complex, these chatbots help users navigate through vast amounts of information, making informed decisions without the need for continuous human intervention. Moreover, investment banker chatbots democratize access to financial expertise, making high-quality advice available to a wider audience. They cater to both seasoned investors and novices, offering tailored insights that can help individuals and organizations optimize their financial strategies. As the technology continues to evolve, these chatbots are expected to become an integral part of the financial advisory landscape, driving innovation and enhancing the overall client experience.

In summary, investment banker chatbots represent a significant leap forward in financial technology, blending AI and human expertise to offer advanced, efficient, and accessible financial services. Their development marks a pivotal moment in the evolution of financial advisory, with the potential to reshape how investment services are delivered and experienced.

CHAPTER 2

LITERATURE SURVEY

2.LITERATURE SURVEY

2.1-HISTORY

The concept of chatbots in the investment banking sector represents a significant evolution in financial technology, driven by advances in artificial intelligence (AI) and natural language processing (NLP). The origins of chatbot technology can be traced back to the 1960s with the development of ELIZA, an early conversational agent designed by Joseph Weizenbaum at MIT. ELIZA's rudimentary pattern-matching capabilities demonstrated the potential for machines to engage in basic dialogue, setting the stage for future advancements. Throughout the 1990s and early 2000s, the field saw the emergence of more sophisticated systems like ALICE, which employed more complex rule-based algorithms to simulate conversational depth. The adoption of AI-driven chatbots in broader customer service roles began in earnest in the early 2000s. These early chatbots were primarily used to handle routine customer inquiries and transactions, marking the beginning of their integration into business operations. As machine learning algorithms and NLP technologies advanced, chatbots became more capable of understanding and responding to a wider range of queries with greater accuracy.

The introduction of chatbots specifically for investment banking came in the late 2010s, amidst a growing demand for digital transformation in the financial sector. Investment banker chatbots were designed to cater to the specialized needs of financial professionals and clients, providing market insights, personalized investment advice, and portfolio management support. The deployment of these chatbots was facilitated by the availability of vast financial data and advancements in AI technologies, allowing for sophisticated analysis and interaction capabilities. Today, investment banker chatbots have become an integral part of the financial services landscape. They offer both institutional and individual investors enhanced tools for navigating complex financial

environments, delivering timely advice, and improving overall decision-making processes. As technology continues to advance, these chatbots are expected to further evolve, incorporating more advanced AI techniques and delivering even more personalized and efficient financial advisory services. The history of investment banker chatbots illustrates a trajectory from basic conversational agents to advanced, specialized tools that are reshaping the future of financial advisory.

2.2-LITERATURE REVIEW

[1] Smart Banking Chatbot: *International Journal for Research in Applied Science & Engineering Technology (IJRASET) ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538 Volume 10 Issue IV Apr 2022.*

Implementation of the project would make the user experience of a customer on the website, more friendly and seamless. A chatbot can also act as an information-gathering tool that would help the organizations to inspect the needs of customers and then implement them. In the banking domain, contextual assistants need to cover more Indian languages thereby increasing the usability of chatbots.

[2] Banking Chatbot Using NLP And Machine Learning Algorithms: *International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 ,Volume: 10 Issue: 05 ,May 2023.*

The Bank Chatbot using NLP and Machine Learning is a promising solution for the banking industry to improve customer service and automate various banking processes. The performance of the system can be further improved by using advanced machine learning algorithms such as Naive Bayes having 90.6% accuracy.

[3] Smart Chatbot System for Banking using Natural Language Processing Tools: *National Open University of Nigeria,2023*.

The research focused on developing a smart chatbot system for banking using

NLPTK to provide accurate and accessible banking information. The chatbot had a user-friendly web interface. Testing showed 97% response accuracy and spelling error detection. It had a separate back end for administrators. Limitations included occasional incorrect answers, lack of system memory leading to repetitive responses, and no anaphora resolution.

[4] Text-Based Chatbot in Financial Sector: A Systematic Literature Review *Article in Data Science in Finance and Economics· DOI: 10.3934/DSFE.2022011 July 2023.*

The current study highlights the key benefits of implementing chatbots in the financial sector, such as improved decision-making, customer service, productivity, efficiency, resource management and more. Significant influential factors have also been identified when implementing a chatbot. It was also noted that the security and privacy vulnerabilities of chatbots in the financial sector should be considered and analyzed before deployment.

[5] Transforming Finance Through Automation Using AI-Driven Personal Finance Advisors: *4th International Conference on Computation, Automation and Knowledge Management (ICCAKM), IEEE,2024.*

The research covers challenges like budgeting, investment planning, debt management, and retirement preparation. It highlights AI's capabilities in data-driven analysis, predictive modeling, and personalized recommendations, particularly in risk assessment, portfolio optimization, and real-time market monitoring. The paper also addresses ethical and privacy concerns, proposing a transparent deployment framework. User acceptance and trust-building are crucial for widespread adoption. A case study demonstrates enhanced financial literacy, returns, and overall well-being with AI-powered advisors, underscoring their

potential to revolutionize financial wellness.

[6] Exploring the Impact of AI-Powered Chatbots in Banking Services: *Ninth International Conference on Science Technology Engineering and Mathematics (ICONSTEM), IEEE,2024.*

The study aims to examine how using bank chatbots affects customer satisfaction. It also aims to investigate how customer satisfaction impacts trust and bank reputation. In India, 324 clients who have utilized chatbots for financial transactions are participating in a survey. The results offer new perspectives on the channels through which banking services are delivered, which could be helpful to experts, scholars, bank executives, product development teams and design teams.

[7] Conversing with AI chatbots: examining what OpenAI ChatGPT-4, Microsoft Bing Chatbot, and google bard know, think they know, do not know, and would like to know about engineering: *J. Umm Al-Qura Univ. Eng.Archit,2024.*

Brief examination clearly notes that chatbots can provide logical and domain-related information that agrees, for the most part, with that commonly accepted in the engineering domain. The same also alludes to the fact that these chatbots, despite being in their early release days, could serve as virtual assistants to users (i.e., academics, etc.) While some chatbots continue to acknowledge their limitations and AI-based nature in addressing some questions, some do not and deliver their answers in a more confident tone. The answers provided by the chatbots herein can be thought of as well put in terms of generalization.

[8] Study of Chatbot In Customer Service at Banking: *IEEE,2023.*

Chatbots created with AI are one of the most intriguing banking business methods that may lead to the bank winning the contentment vote of their devoted clients. It is projected that chatbots will reduce cost of businesses by about $7.3 billion in the next two years. According to Juniper Research, banks will save 826 million

hours through chatbot interactions in 2023.

[9] Web-based chatbot for basic financial and mortgage services:*2nd International Conference on Vision Towards Emerging Trends in Communication and Networking Technologies (ViTECoN),IEEE,2023.*

The onset of the chatbot system the experience is like getting your queries resolved by a human but there are no common limitations to the same. Many businesses have developed their own chatbots to help their customers with their needs. Their chatbot is a financial services chatbot which specializes in lending and mortgage services.

[10] Using Chatbot Technologies to Help Individuals Make Sound Personalized Financial Decisions: *2021 IEEE International Humanitarian Technology Conference (IHTC),2022.*

Software-based on just-in-time education can make use of nudge theory and gamification to help increase financial literacy while also influencing positive financial behaviour. Using chatbot technology as a conversational interface to this educational software increases convenience and usability, especially among those that struggle with learning to use technology. They present the design for a financial education chatbot that defines core situations for providing suggestions and information to users. Also used a survey to evaluate its usefulness and found that 82 per cent of 68 participants consider the chatbot strongly beneficial to their financial education and behaviour.

CHAPTER 3

Problem Statement

3. PROBLEM STATEMENT

Traditional investment advisory services face high costs, delays, and limited accessibility. Financial advisors struggle with increasing client inquiries, leading to slower, costlier services, especially for individuals and small businesses. An AI-powered investment banker chatbot can solve these issues by offering financial insights, handling multiple queries simultaneously, and providing personalized, affordable recommendations. This technology improves decision-making, streamlines consultations, and makes expert advice more accessible to all.

CHAPTER 4

Experimental Setup

4.EXPERIMENTAL SETUP

4.1 HARDWARE SETUP

To run the Investment Banking Chatbot efficiently, the following hardware configuration is recommended:

- Processor: Intel Core i5 (or equivalent AMD Ryzen 5) and above for optimal performance.
- RAM: Minimum 8 GB of RAM to handle multiple queries and to run model smoothly.
- Storage: At least 256 GB SSD for faster read/write operations, or 500 GB HDD.
- Network: A stable internet connection (preferably 10 Mbps or higher) for handling queries and API interactions.
- Operating System: Linux (Ubuntu 20.04 LTS or above) or Windows 10 (64-bit), as Python environments and Flask frameworks are well-supported on these platforms.
- Python 3.8 or higher: This ensures compatibility with modern Python libraries and frameworks like Flask, FastAPI, and etc.
- Virtual environment setup for managing dependencies.

4.2 SOFTWARE SETUP

To efficiently run the "Investment Banking Chatbot Using RAG" system, the following software tools and modules are required.

4.2.1 Frontend Technologies

1. HTML:

Used for structuring the user interface, including forms, input fields, and the result display section.

2. CSS:

For styling the web interface, including buttons, input fields, and layout responsiveness.

3. JavaScript:

Handles client-side logic, including form submission and sending asynchronous requests to the backend.

4.2.2 Backend Technologies and Python Modules

1. Flask:

Flask is used as the web framework to serve the frontend files and handle requests.

Installation:

```
pip install flask
```

2. PyMuPDF (`fitz`):

This module is used to load and extract text from a PDF file.

Installation:

```
pip install pymupdf
```

3. Sentence Transformers:

Used for embedding sentences and questions for similarity comparison.

Installation:

pip install sentence-transformers

4. Transformers:

The `transformers` library is used to generate text responses using a local GPT-2 model.

Installation:

pip install transformers

5. Torch (PyTorch):

PyTorch is implicitly required as a backend for sentence transformers and the transformers library for similarity calculations and text generation.

Installation:

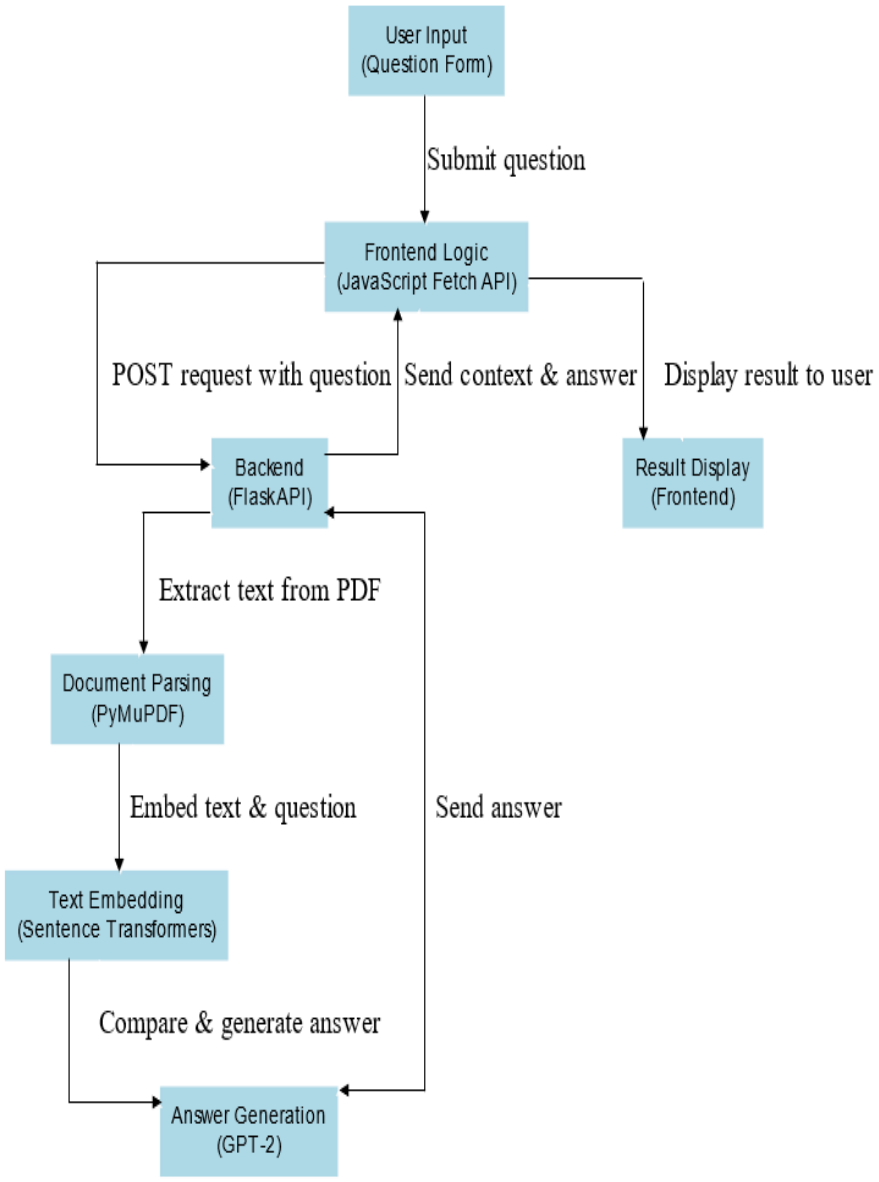
pip install torch

CHAPTER 5

Proposed System & Implementation

5.PROPOSED SYSTEM & IMPLEMENTATION

5.1 BLOCK DIAGRAM OF PROPOSED SYSTEM



5.2 DESCRIPTION OF BLOCK DIAGRAM

The block diagram illustrates the flow of data and processes within a chatbot system designed to handle user queries through a structured pipeline. Each component plays a critical role in transforming user input into a meaningful response.

User Input (Question Form):

This is the initial stage where the user submits their question or query. The input is typically collected through a user interface, allowing for interactive communication.

Frontend Logic (JavaScript):

Once the user submits their question, the frontend logic (implemented in JavaScript) takes over. It uses the Fetch API to send the user's question to the backend server. This component manages the interaction between the user interface and the backend.

Backend:

The backend, built with Flask, receives the user's question through a POST request. It acts as the intermediary between the frontend and the document parsing system. The backend orchestrates the flow of data and ensures that the user's request is processed appropriately.

Document Parsing (PyMuPDF):

In this stage, the system extracts text from PDF documents. PyMuPDF is used to read and parse the content, which will later be compared to the user’s question. This step is crucial for enabling the chatbot to generate contextually relevant answers based on the provided documents.

Text Embedding (Sentence Transformers):

Once the text is extracted, it is transformed into numerical representations (embeddings) using Sentence Transformers. This process allows the system to understand the semantic meaning of the text and the user's question by converting them into vectors in a high-dimensional space.

Answer Generation (GPT-2):

After embedding, the chatbot utilizes GPT-2 to generate an answer. The model compares the user's question with the embedded text to produce a coherent and contextually appropriate response. This stage leverages the power of natural language processing to create meaningful dialogue.

Send Answer to Backend:

The generated answer is sent back to the backend API, which now holds both the answer and the necessary context for it.

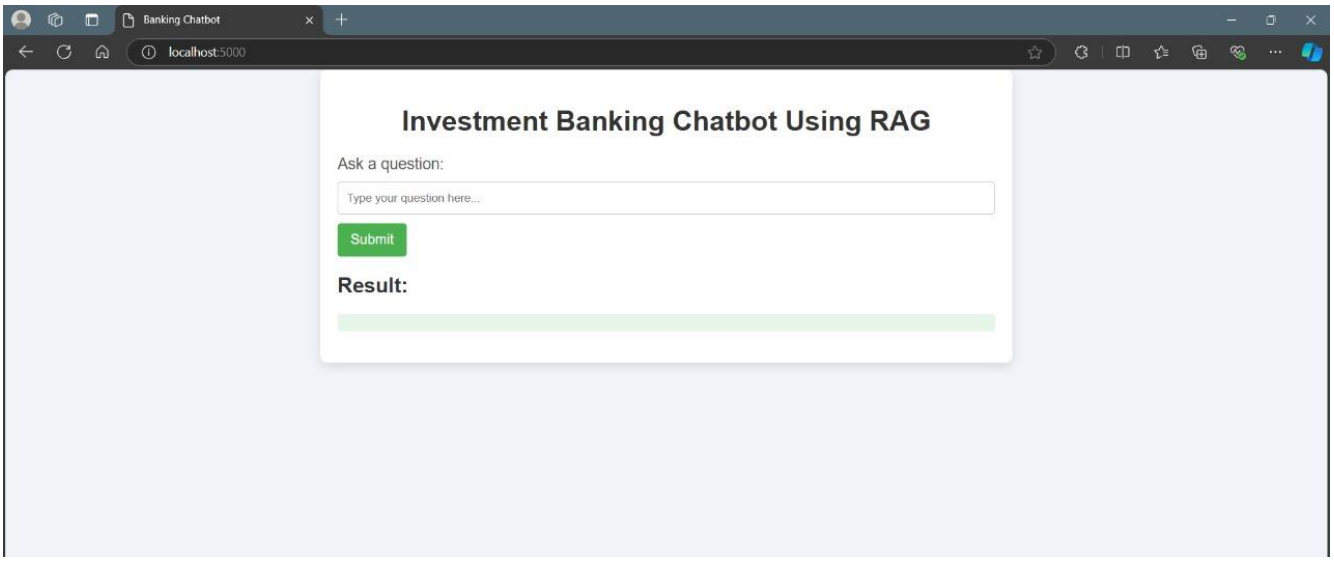
Send Context & Answer to Frontend:

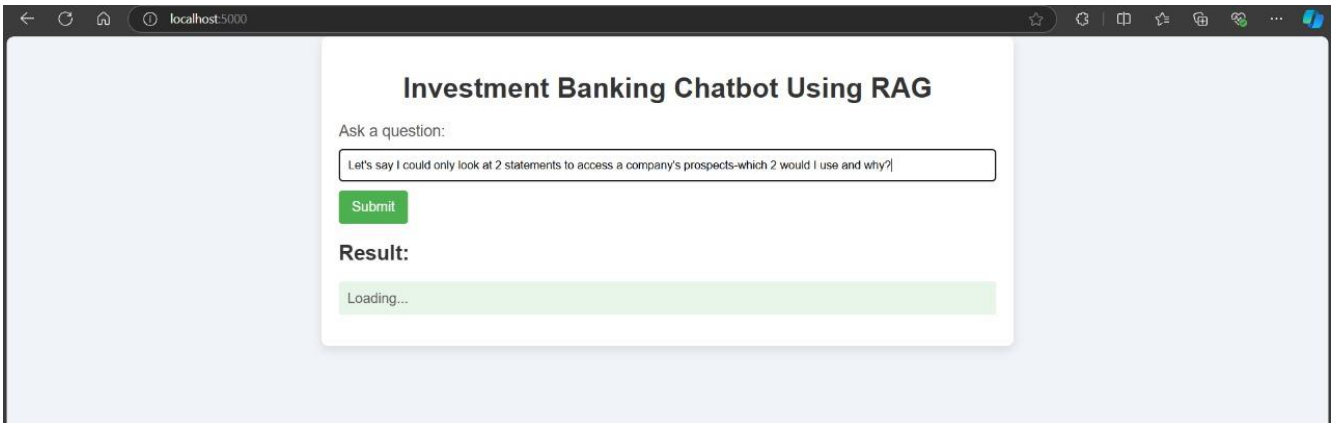
The backend sends the answer and any relevant context back to the frontend logic. This ensures that the user interface is updated with the latest information.

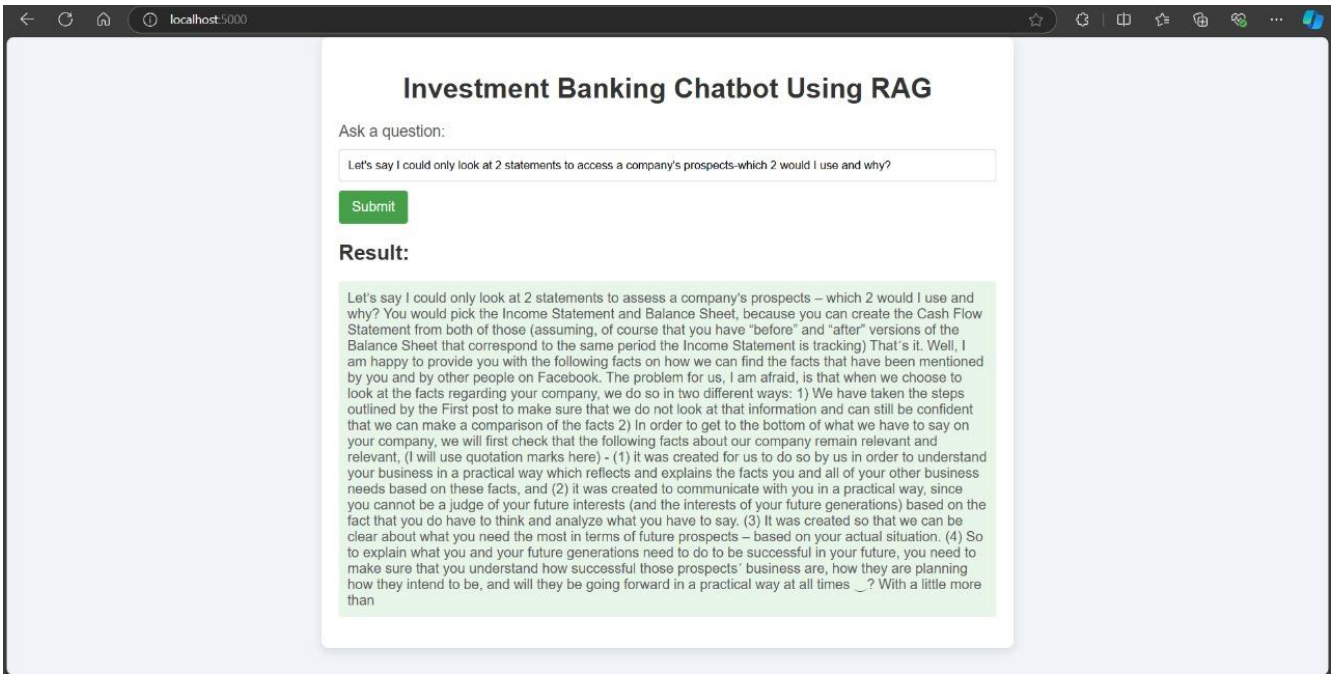
Result Display (Frontend):

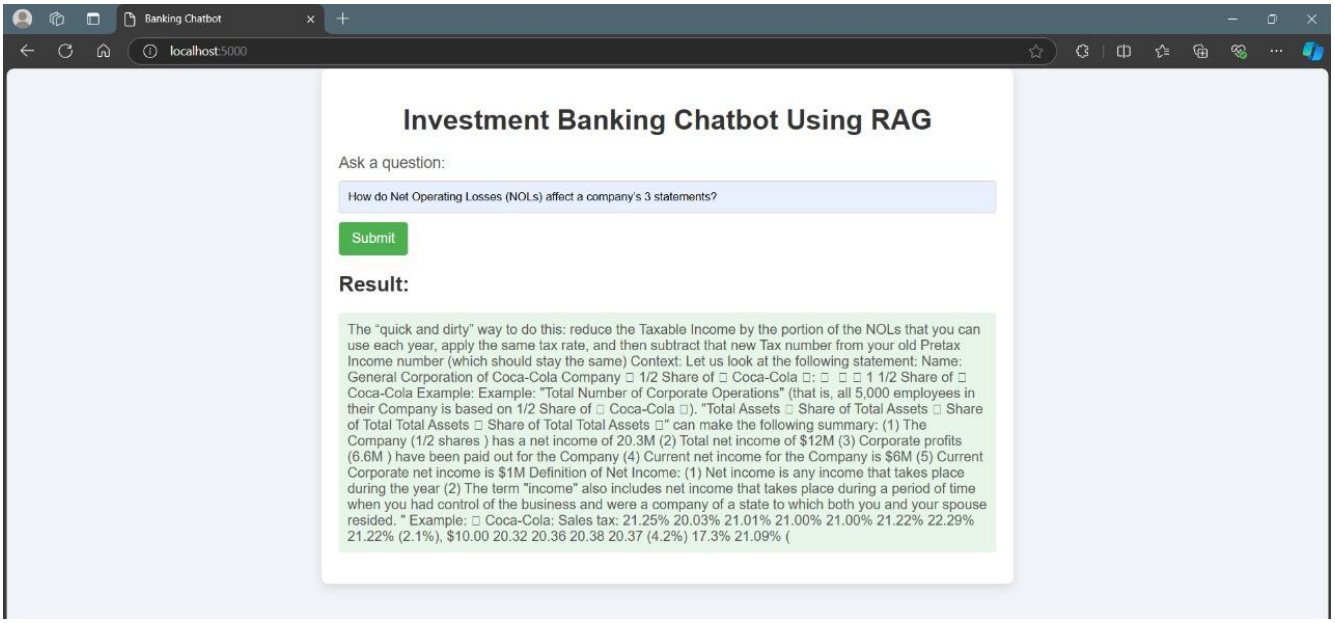
Finally, the frontend presents the answer to the user in a clear and user-friendly format. This is the last step in the interaction, where the user sees the results of their query.

5.3 IMPLEMENTATION






localhost:5000
Investment Banking Chatbot Using RAG
Ask a question:
Let's say I could only look at 2 statements to access a company's prospects-which 2 would I use and why?
Submit
Result:
Let's say I could only look at 2 statements to assess a company's prospects – which 2 would I use and why? You would pick the Income Statement and Balance Sheet, because you can create the Cash Flow Statement from both of those (assuming, of course that you have "before" and "after" versions of the Balance Sheet that correspond to the same period the Income Statement is tracking) That's it. Well, I am happy to provide you with the following facts on how we can find the facts that have been mentioned by you and by other people on Facebook. The problem for us, I am afraid, is that when we choose to look at the facts regarding your company, we do so in two different ways: 1) We have taken the steps outlined by the First post to make sure that we do not look at that information and can still be confident that we can make a comparison of the facts 2) In order to get to the bottom of what we have to say on your company, we will first check that the following facts about our company remain relevant and relevant, (I will use quotation marks here) - (1) it was created for us to do so by us in order to understand your business in a practical way which reflects and explains the facts you and all of your other business needs based on these facts, and (2) it was created to communicate with you in a practical way, since you cannot be a judge of your future interests (and the interests of your future generations) based on the fact that you do have to think and analyze what you have to say. (3) It was created so that we can be clear about what you need the most in terms of future prospects – based on your actual situation. (4) So to explain what you and your future generations need to do to be successful in your future, you need to make sure that you understand how successful those prospects' business are, how they are planning how they intend to be, and will they be going forward in a practical way at all times _? With a little more than


Banking Chatbot
localhost:5000
Investment Banking Chatbot Using RAG
Ask a question:
How do Net Operating Losses (NOLs) affect a company's 3 statements?
Submit
Result:
The "quick and dirty" way to do this: reduce the Taxable Income by the portion of the NOLs that you can use each year, apply the same tax rate, and then subtract that new Tax number from your old Pretax Income number (which should stay the same) Context: Let us look at the following statement: Name: General Corporation of Coca-Cola Company □ 1/2 Share of □ Coca-Cola □: □ □ □ 1 1/2 Share of □ Coca-Cola Example: Example: "Total Number of Corporate Operations" (that is, all 5,000 employees in their Company is based on 1/2 Share of □ Coca-Cola □). "Total Assets □ Share of Total Assets □ Share of Total Total Assets □ Share of Total Total Assets □" can make the following summary: (1) The Company (1/2 shares) has a net income of 20.3M (2) Total net income of $12M (3) Corporate profits (6.6M) have been paid out for the Company (4) Current net income for the Company is $6M (5) Current Corporate net income is $1M Definition of Net Income: (1) Net income is any income that takes place during the year (2) The term "income" also includes net income that takes place during a period of time when you had control of the business and were a company of a state to which both you and your spouse resided. " Example: □ Coca-Cola: Sales tax: 21.25% 20.03% 21.01% 21.00% 21.00% 21.22% 22.29% 21.22% (2.1%), $10.00 20.32 20.36 20.38 20.37 (4.2%) 17.3% 21.09% (

5.4 ADVANTAGES

Advantages of the Investment Banking Chatbot:

- 24/7 Availability:

  The chatbot can provide answers and support at any time, enhancing accessibility for users.

- Cost-Effective:

  Reduces the need for human resources in handling repetitive queries, leading to significant cost savings.

- Quick Response Time:

  Delivers answers instantly, improving user experience compared to traditional methods of obtaining information.

- Scalability:

  Capable of handling multiple queries simultaneously, making it efficient during high-demand periods.

- Consistent Answers:

  Provides uniform responses to questions, ensuring reliability and reducing the potential for human error.

- Reduced Workload for Human Staff:

  Frees up human agents to focus on more complex inquiries and high-value tasks, increasing overall productivity.

- Easy Updates and Maintenance:

  Chatbots can be easily updated with new information and regulations, ensuring that users always have access to the latest data.

CHAPTER 6

Conclusion

6.CONCLUSION

The Investment Banking Chatbot system is a perfect example that stresses how efficiently and effectively artificial intelligence based chatbots can respond to high-end financial related questions. Utilizing technologies such as document filtering and text embedding, this chatbot answers questions effectively and instantly making it an asset to clients and professionals as well.With the development of the financial industry, division that requires automation will be facilitated by this most recent chatbot since it resolves challenges of today and also suggests possibilities for the most wonderful developments in the future.

6.1 FUTURE SCOPE

The journey of the Investment Banking Chatbot is just beginning, and there are countless exciting possibilities ahead.

1.Enhanced Conversation Skills:

Imagine a chatbot that can understand even the most complex questions, allowing for more natural and engaging conversations. By using advanced natural language processing (NLP) techniques, we can make this a reality!

2.Live Market Updates:

Connecting the chatbot to real-time financial market APIs will enable it to provide users with live updates on stock prices and market trends. Users could receive instant alerts, making informed decisions at their fingertips.

3.Predictive Insights:

With the help of machine learning algorithms, the chatbot could analyze historical data and offer predictive insights. This means users could receive tailored recommendations on potential investment opportunities or risks.

4.Personal Financial Advisor:

Picture the chatbot evolving into a personalized financial advisor! It could suggest investment strategies based on individual goals and risk tolerance, guiding users toward achieving their financial dreams.

5. Voice Interaction:

By adding voice capabilities, users could have conversations with the chatbot simply by speaking. This would make the chatbot even more accessible, allowing for a hands-free experience.

6. Multi-Platform Availability:

Expanding the chatbot's reach across various platforms—like mobile apps and social media—would ensure that it's always within reach, making it easier for users to engage.

7. Understanding User Preferences:

Implementing analytics tools would allow us to gather insights about user behavior and preferences. This feedback would help us continuously enhance the chatbot, ensuring it meets users' needs.

8. Robust Security Measures:

In the finance world, protecting sensitive data is crucial. Strengthening security features will ensure that user information remains safe and confidential.

9. Collaboration with Financial Institutions:

Partnering with banks and investment firms could integrate the chatbot into their services, offering enhanced customer support and streamlined processes.

10.Keeping Up with Regulations:

The financial landscape is constantly evolving, and so should our chatbot! Regular updates will ensure compliance with new regulations, keeping users informed and secure.

REFERENCES

[1] Smart Banking Chatbot: International Journal for Research in Applied Science & Engineering Technology (IJRASET) ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538 Volume 10 Issue IV Apr 2022.

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