THIAGARAJAR COLLEGE OF ENGINEERING, MADURAI-15
(A Govt. Aided Autonomous Institution affiliated to Anna University)

- where quality and ethics matter

Intelligent Enterprise Assistant: Enhancing Organizational Efficiency through AI-driven Chatbot Integration

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TYPE OF PROJECT:
PRODUCT

Industry/Research area identified

- Type the Research area identified
  - Artificial Intelligence

- Specific Research area
  - Large Language Models
  - Question-Answering

Problem Statement

- Smart Enterprise Assistant: Enhancing Organizational Productivity with Real-Time Query Response
- The solution is used by System Administrators, IT and HR Departments, Employees of the Large Public Sector Organization

Objectives

- To enhance the security and reliability of the chatbot by enabling two-factor authentication (2FA).
- To implement allowing it to analyze and extract relevant information from websites/text input/basic queries uploaded by employees to support organizational needs.

Tools and Technologies used

- Python libraries (Streamlit, sqlite3, hashlib etc.)
- Hugging face token
- SMTP server
- SQLite
- Gemma-2b-it model
- BERT model

Literature survey

Title of the paper	Journal name and year of publication	Q1/ Q2/ Q3/ Q4	Inference of the paper (bulleted points)
Comprehensive framework for implementing blockchain-enabled federated learning and full homomorphic encryption for chatbot security system	Springer Science+ Business Media, LLC, part of Springer Nature 2024	Q1	**Dataset :** SentiWordNet dataset for sentiment analysis, MNIST dataset **Algorithm:**Full homomorphic encryption (FHE) algorithm **Inference :** on encrypted data is mentioned, indicating that the model can perform predictions or analyses on data that has been encrypted, ensuring that sensitive information remains secure during the process

Title of the paper	Journal name and year of publication	Q1/ Q2/ Q3/ Q4	Inference of the paper (bulleted points)
Intelligent chatbot interaction system capable for sentimental analysis using hybrid machine learning algorithms	Information Processing and management (2023)	Q1	**Dataset :** Reddit conversations available on Kaggle. It consists of information from Reddit posts and comments, organized into three columns **Algorithms with sentiment analysis:** Bi-directional Recurrent Neural Network with Long Short-Term Memory (BRNN-LSTM). Naïve Bayes Classifier (NBC). Fuzzy Naïve Bayesian Classifier (FNB).BRNN-FNB (a combination of BRNN and FNB). **Inference :** Bi-directional Recurrent Neural Network with Fuzzy Naïve Bayes classifier (BRNN-FNB) improves the accuracy and effectiveness of digital conversations. The model achieves an accuracy rate of 93% when using the Sequence-to-Sequence (Seq-to-Seq) technique and 92% without it.

Title of the paper	Journal name and year of publication	Q1/ Q2/ Q3/ Q4	Inference of the paper (bulleted points)
How to Make chatbots productive – A user-oriented implementation framework	International Journal of Human - Computer Studies	Q1	**Dataset :**Sample conversations labeled with corresponding entities and intents existing data from company communications and dialogues from the industry sector are utilized. **Algorithms with sentiment analysis:** Convolutional neural networks (CNN) for text classification **Inference :** Emphasizes the importance of understanding user-oriented conditions and the systematic application of design principles in chatbot implementation. The study suggests that future research should explore the practical efficiency of the proposed framework and its impact on user acceptance through larger-scale studies and diverse methodologies.

Title of the paper	Journal name and year of publication	Q1/ Q2/ Q3/ Q4	Inference of the paper (bulleted points)
Co-Design of a Single Session Intervention Chatbot for People on Waitlists for Eating Disorder Treatment: A Qualitative Interview and Workshop Study	Journal of Medical Internet Research (2024)	Q1	**Dataset**: The dataset came from participants recruited through email newsletters, online ads on professional sites, and social media, including individuals 16+ with eating disorder experiences and specialized psychologists . **Solution proposed** :The study's chatbot used a rule-based algorithm via Google Dialogflow, generating responses from expert-defined rules while capturing user inputs and maintaining conversation history for personalized interactions. **Inference:** The paper introduces a co-designed chatbot for delivering a single session intervention to those on eating disorder treatment waitlists, focusing on accessibility. Positive participant feedback indicates preliminary acceptability, highlighting the potential of digital health technologies for early intervention.

Title of the paper	Journal name and year of publication	Q1/ Q2/ Q3/ Q4	Inference of the paper (bulleted points)
An LLM-Driven Chatbot in Higher Education for Databases and Information Systems	IEEE Transactions on Education (2024)	Q1	**Dataset:**Responses on the Technology Acceptance Model (TAM) and educational chatbots, system accessibility (SA) and self-efficacy (SE), while excluding age, gender, and academic degree due to response homogeneity. **Solution proposed:**Retrieval-augmented generation (RAG) approach for the MoodleBot chatbot, enhancing response accuracy while personalizing learning and reducing educators' administrative burdens, assessed through the Technology Acceptance Model (TAM). **Inference:** Concludes that the RAG approach enhances chatbot performance in education, achieving 82% accuracy and 88.04% precision, while emphasizing the need for integrated content and administrative support

Module description for both R&D and industry

1. **User Interface Module:**
   - Provides a user-friendly platform for interaction with the chatbot system.
   - Accepts user inputs such as login credentials, queries, and OTPs.
   - Displays chatbot responses and feedback messages, ensuring smooth communication with the user.

2 . Application Login Module:

   - Handles user authentication processes, including user registration and login.
   - Validates credentials by securely hashing passwords and verifying stored records in the database.

3. 2FA Module:

   - Implements two-factor authentication to add an additional layer of security.
   - Generates One-Time Passwords (OTPs) and sends them to the user via email.
   - Verifies the OTP entered by the user before granting access to the system.

Module description for both R&D and industry

4. Supervised Fine tuning:

- Supervised fine-tuning adapts a pre-trained model (DistilBERT) to a task like question-answering using a labeled SQuAD-like dataset.
- The model learns to predict answer spans in contexts through tokenized inputs. Hugging Face's Trainer API optimizes the model for task-specific performance.

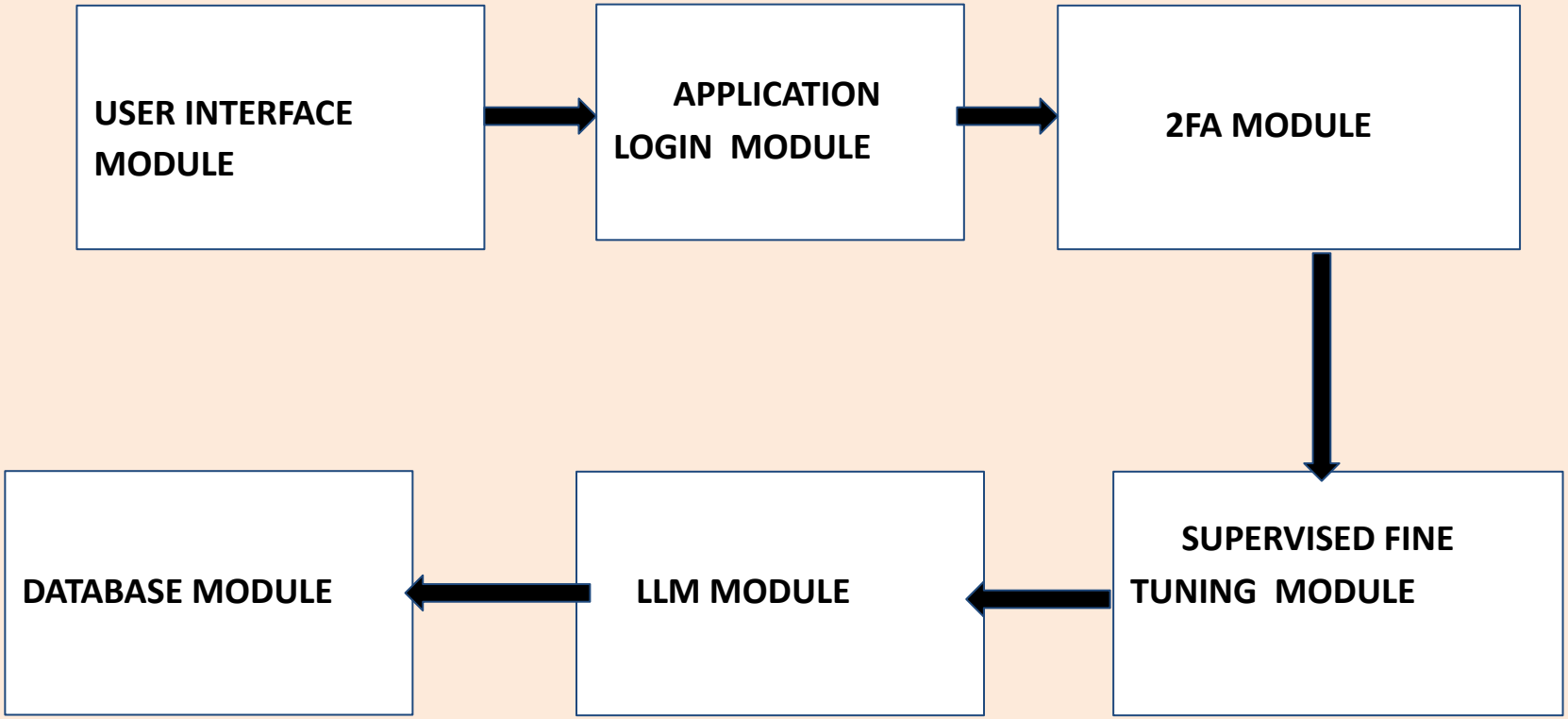
5. LLM Module:

- Integrates a pre-trained Large Language Model (LLM) such as BERT and GEMMA to process and generate intelligent responses.
- Uses the Gradio Client API to communicate with the LLM hosted on Hugging Face.
- Ensures accurate, context-driven responses to user queries.

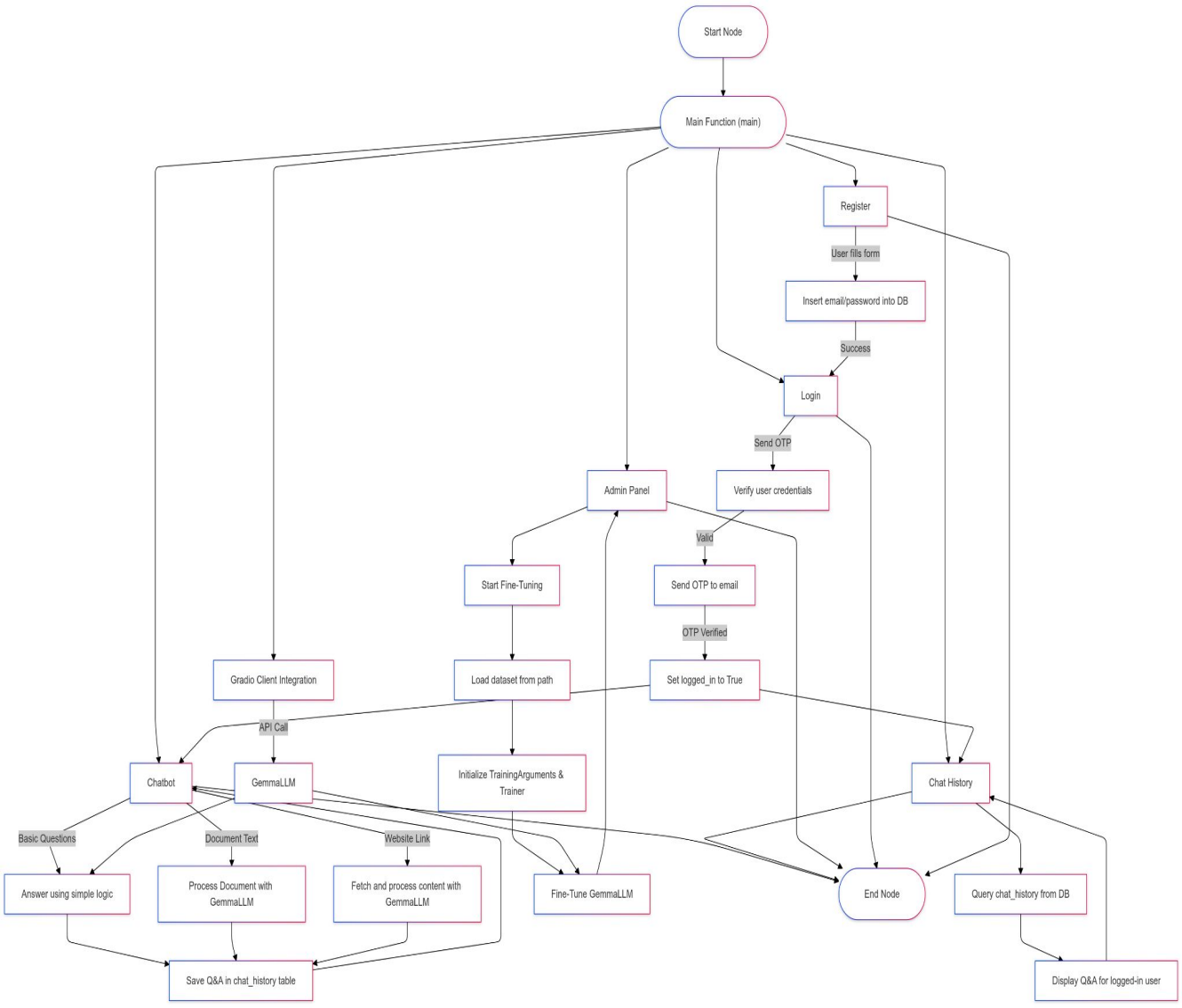
6. Database Module:

- Serves as the backbone for storing critical data such as user accounts, OTPs, and chat histories.
- Enables efficient retrieval and updating of records, ensuring data consistency.

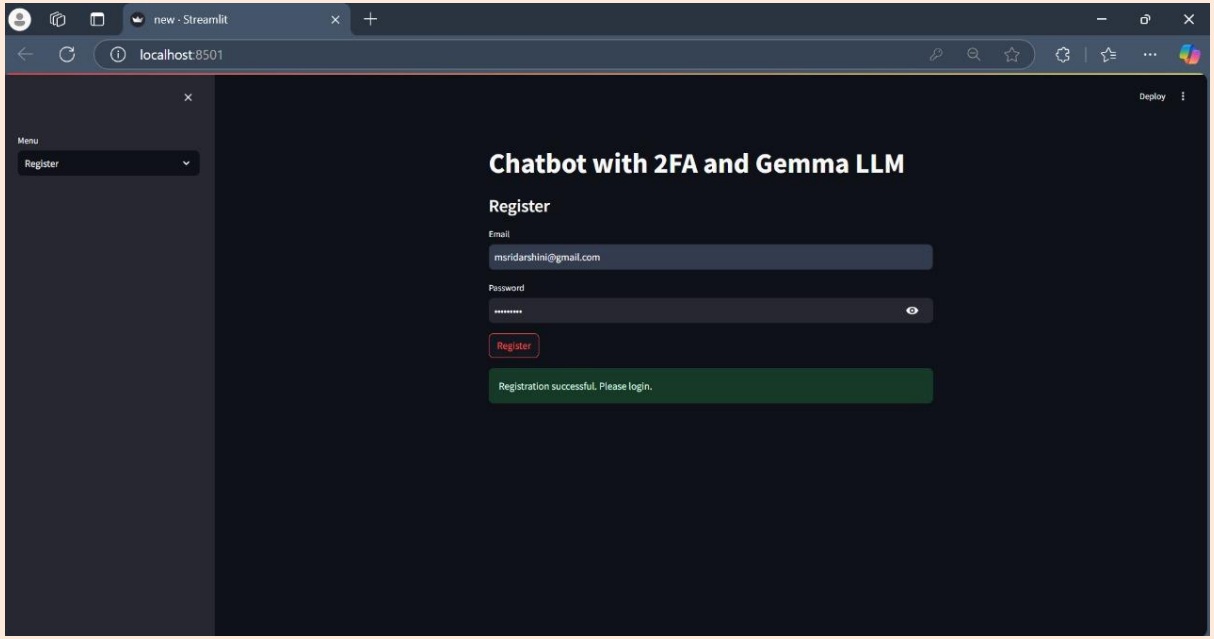
BLOCK DIAGRAM



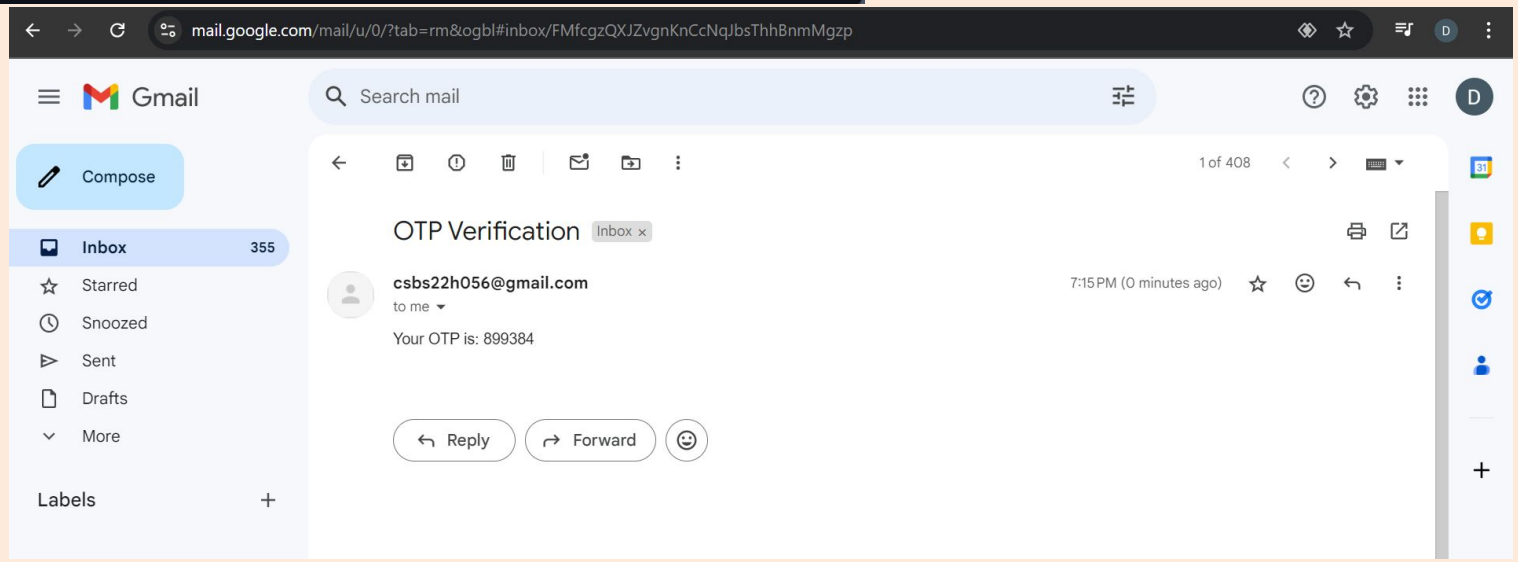
WORKFLOW


Start Node
Main Function (main)
Register
User fills form
Insert email/password into DB
Success
Login
Send OTP
Admin Panel
Verify user credentials
Valid
Start Fine-Tuning
Send OTP to email
OTP Verified
Gradio Client Integration
Load dataset from path
Set logged_in to True
API Call
Chatbot
GemmaLLM
Initialize TrainingArguments & Trainer
Chat History
Basic Questions
Document Text
Website Link
Answer using simple logic
Process Document with GemmaLLM
Fetch and process content with GemmaLLM
Fine-Tune GemmaLLM
End Node
Query chat_history from DB
Save Q&A in chat_history table
Display Q&A for logged-in user

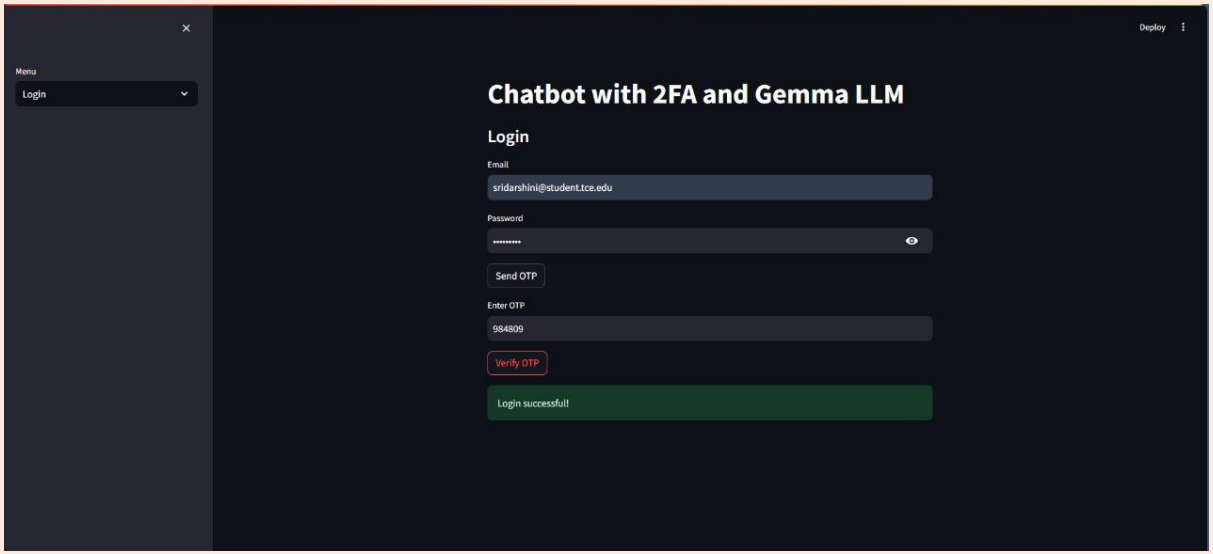
Results and inferences



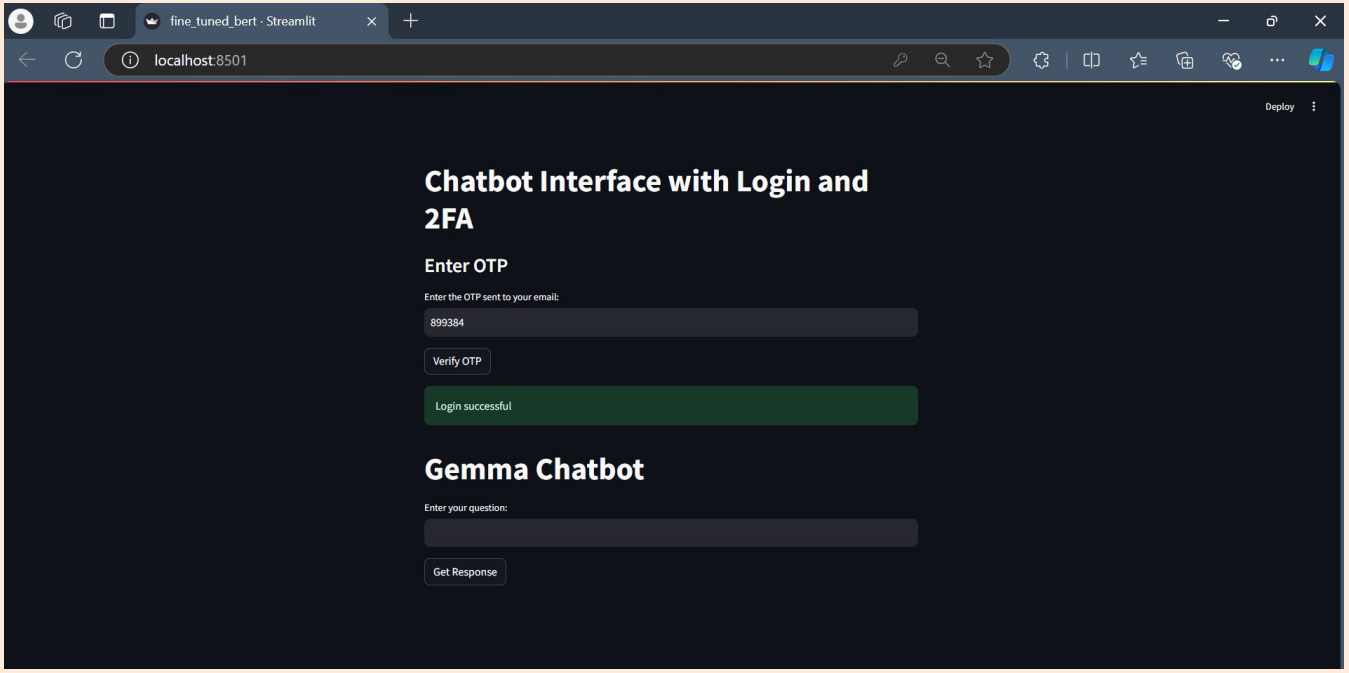
REGISTRATION PAGE



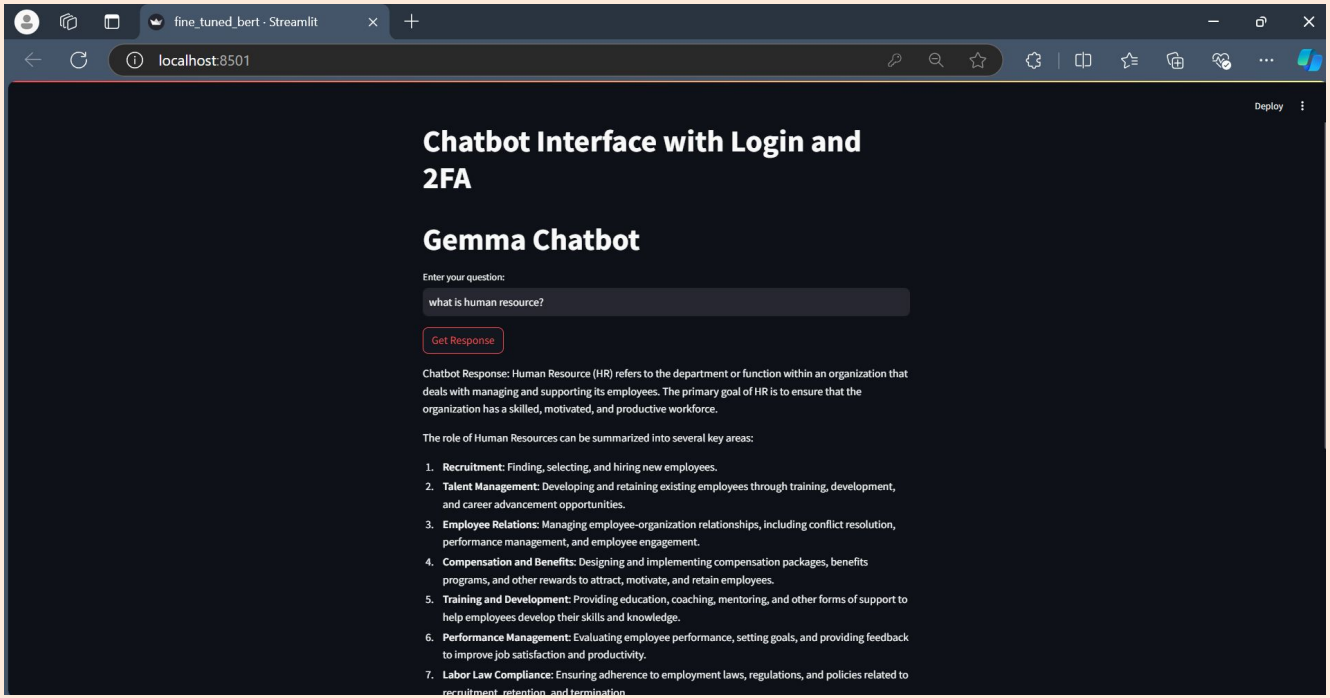
MAIL VERIFICATION(2FA)



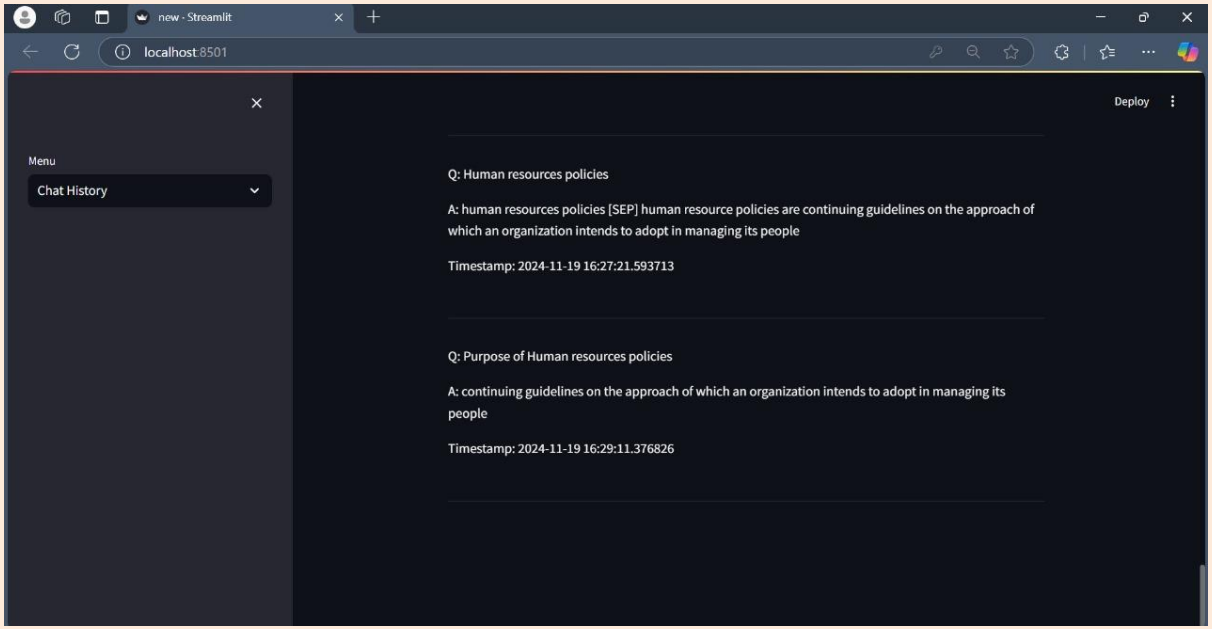
LOGIN PAGE



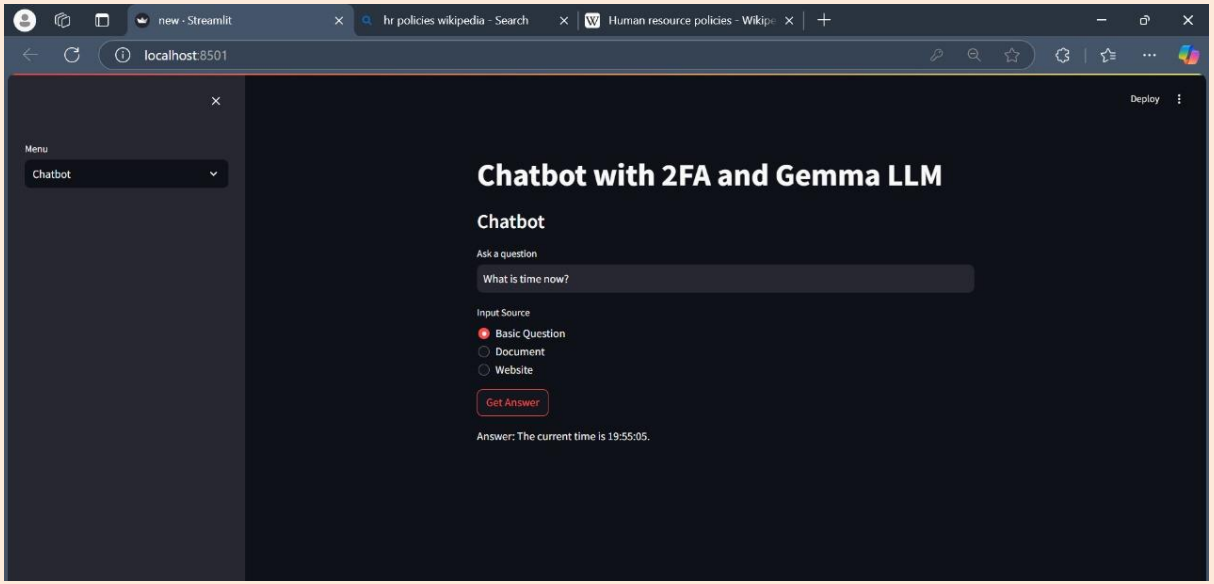
OTP VERIFICATION



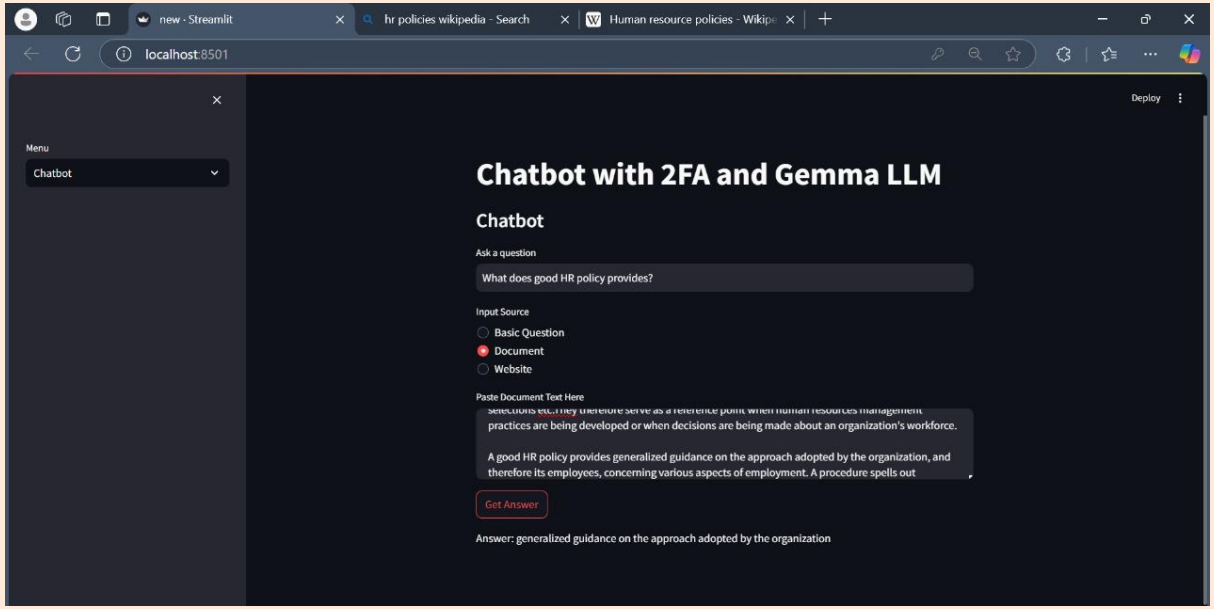
GEMMA INFERENCE API



CHAT HISTORY

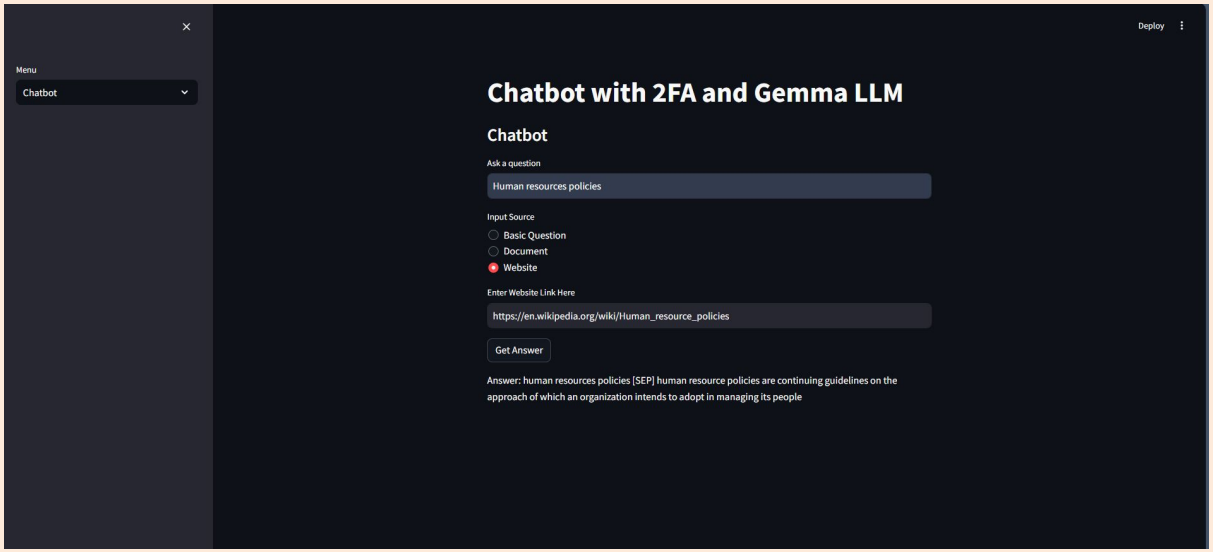


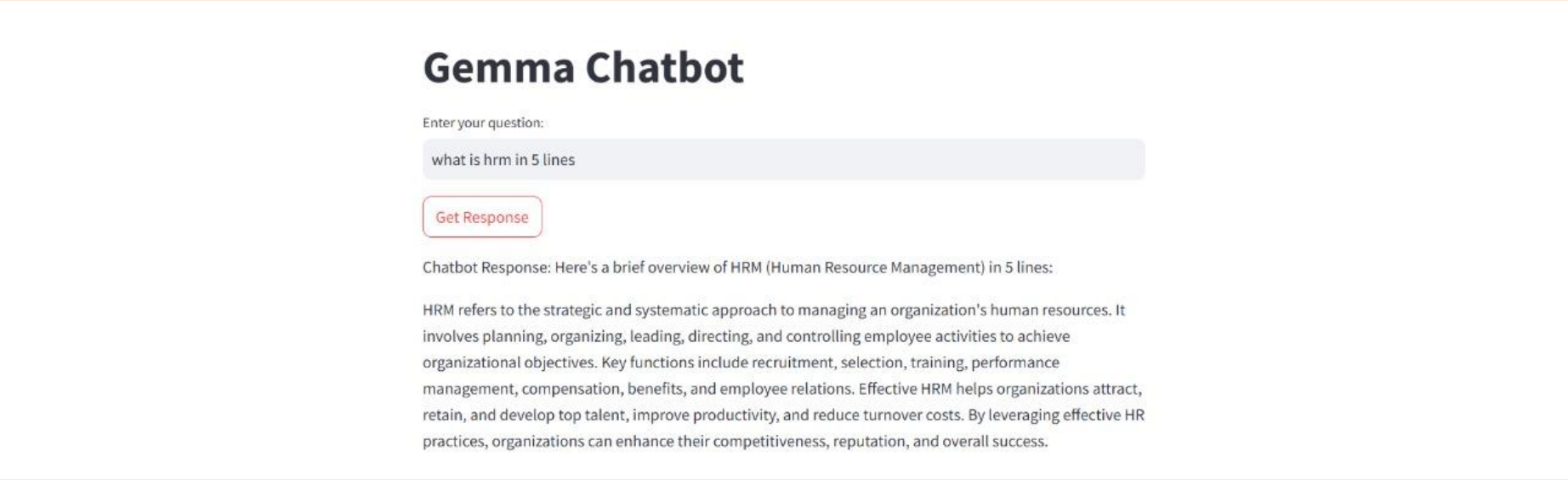
BASIC QUERIES



TEXT BASED QUERIES

WEBSITE BASED QUERIES





GRADIO CLIENT BASED ANSWERS

Challenges faced during the implementation

- Limited error handling in Streamlit for missing inputs or invalid values.
- Managing the high computational demands of the LLM to ensure low latency and quick response times was challenging.
- The system faced constraints on API usage and token limits during interactions with the LLM.
- Ensuring the chatbot provided accurate and contextually relevant responses quickly was challenging.

Conclusion and Future Work

Our project implements a user authentication system with registration, login, and two-factor authentication (2FA) via email OTP. It utilizes SQLite to manage user data and chat history, and integrates a Inference client to enable interaction with a chatbot. Additionally, it provides functionalities to send OTPs via email and save/load chat history in the database.

Future works that are planned to be included:

- Incorporate user input validation to prevent SQL injection and other vulnerabilities.
- Explore using asynchronous email sending to improve performance during OTP delivery.
- Enable user profile management for personalized experiences.
- To ensure the chatbot architecture is scalable to handle at least five concurrent users.

References

- Janssen, A., Cardona, D. R., Passlick, J., & Breitner, M. H. (2022). How to Make chatbots productive–A user-oriented implementation framework. International Journal of Human-Computer Studies, 168, 102921.
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