URBAN
SYSTEMS

Final Report
LLM Powered AI Chatbot

Team Members:

Sadia Khan
Jauhar Fathima
Om Patel
Sanket Patel

Submission Date: April 15th, 2025

1. Introduction

Project Overview

The project focuses on developing an advanced LLM-powered AI chatbot to enhance information retrieval within organizations. The chatbot is designed to address employees' challenges when searching for information across multiple systems and folders, which slows collaboration and productivity. The system aims to provide an intuitive and interactive AI-driven solution for efficient information access.

Problem Statement

Employees struggle with locating information due to:

- Fragmented storage across multiple folders and systems.
- Static websites lack interactive and efficient search capabilities.
- Knowledge silos that reduce collaboration efficiency.

To solve this, we propose an AI chatbot and an adding information page to:

- Provide LLM (GPT-4o mini) powered responses for accurate information retrieval
- Seamlessly integrates with internal databases via APIs
- Allow non-technical users to add and edit content easily
- Enhance collaboration and streamline workflow

2. Tech Stack and Justification

Component	Technology Used	Justification
Frontend	React.js	● Provides a fast, scalable, and interactive UI ● All the members have experience with this.
Backend	FastAPI (Python)	● Requested by industry partner ● Helps developers build applications quickly and efficiently
Database	MongoDB	● A flexible NoSQL database suited for chatbot interactions
LLM	OpenAI GPT API	● State-of-the-art language model for accurate responses
Information Retrieval	ChromaDB (Vector Database)	● Open-source & easy to set up ● Works well with LLMs like OpenAI GPT, LangChain, and FastAPI ● Stores text embeddings for semantic search
User Authentication & Security	MultiFactor Authentication (MFA) – Email OTP	● Instantly sends OTP to email for secure, passwordless login ● Simple, smooth experience with stronger protection against unauthorized access

3. Project Timeline

Task	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
UI/UX design, database setup	■	■						
LLM integration, API dev			■	■	■			
Testing & optimization						■	■	
Deployment & finalization								■

4. Deliverables & Task Distribution

Task	Importance	Status	Team Member(s)
UI/UX Design	-	Completed	Sadia Khan, Jauhar Fathima
Database Setup	-	Completed	Om Patel
LLM Integration	Must Have	Completed	Sanket Patel
API Development	Must Have	Completed	Sadia Khan
Frontend Development	Must Have	Completed	Sadia Khan, Jauhar Fathima
Information Retrieval (RAG)	Must Have	Completed	Om Patel, Sanket Patel
User Authentication	Must Have	Completed	Om Patel, Sanket Patel
Chat History	Nice to Have	Completed	Om Patel, Sanket Patel
Customizable Themes (Light vs Dark Mode)	Nice to Have	Completed	Team Collaboration
RAG Enhancement	Must Have	Completed	Team Collaboration

UI/UX Improvements	-	Completed	Team Collaboration
Testing and Debugging	-	Completed	Team Collaboration
Deployment with Docker	Nice to Have	Completed	Team Collaboration

5. Final Pages

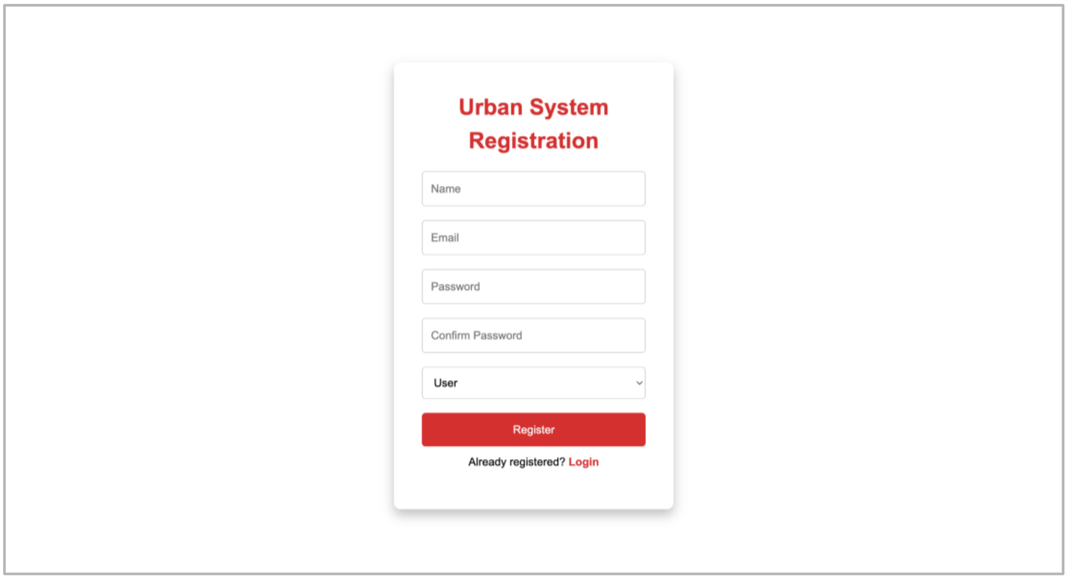
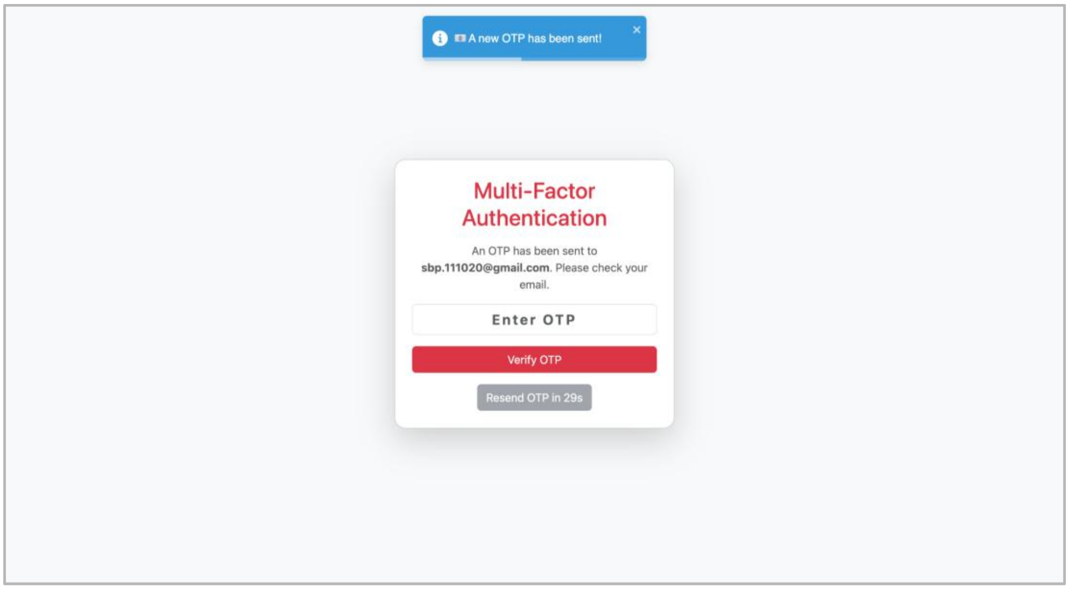

Urban System Registration

Figure 4.1: Registration Page – New User


A new OTP has been sent!

Multi-Factor Authentication

An OTP has been sent to **sbp.111020@gmail.com**. Please check your email.

Figure 4.2: Multi-Factor Authentication Page – Enter OTP

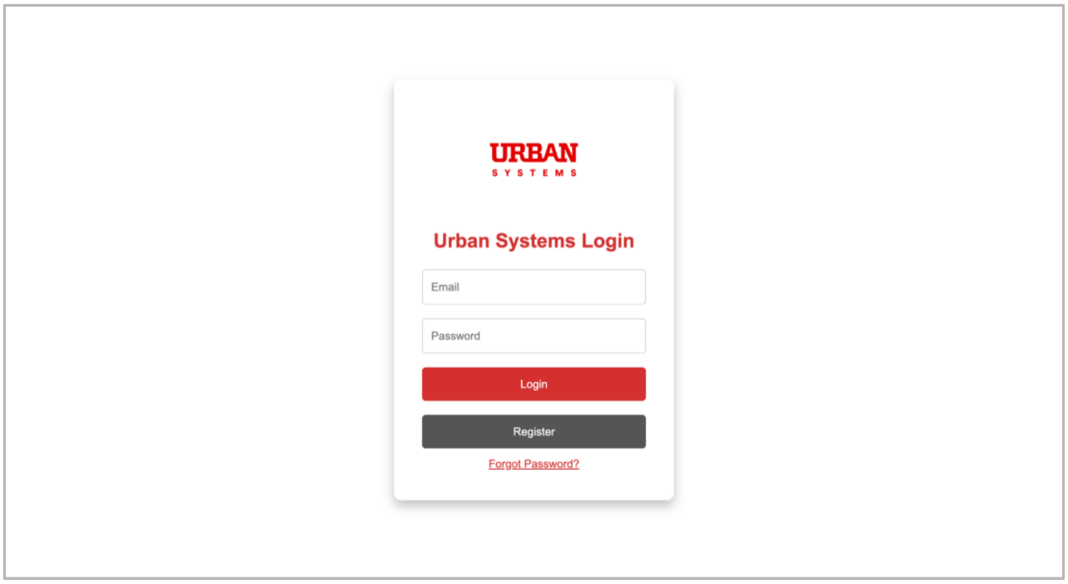
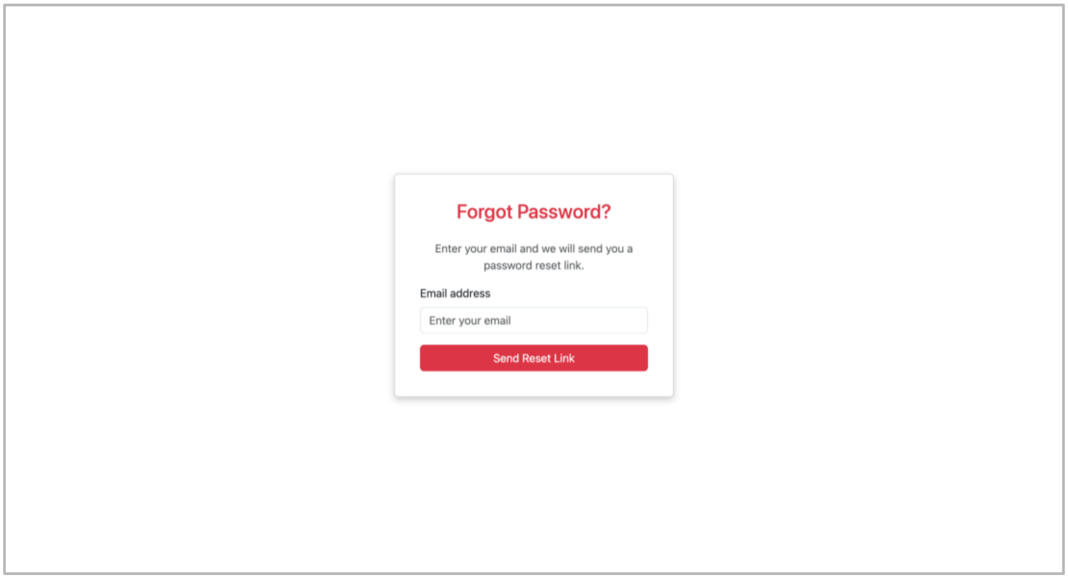
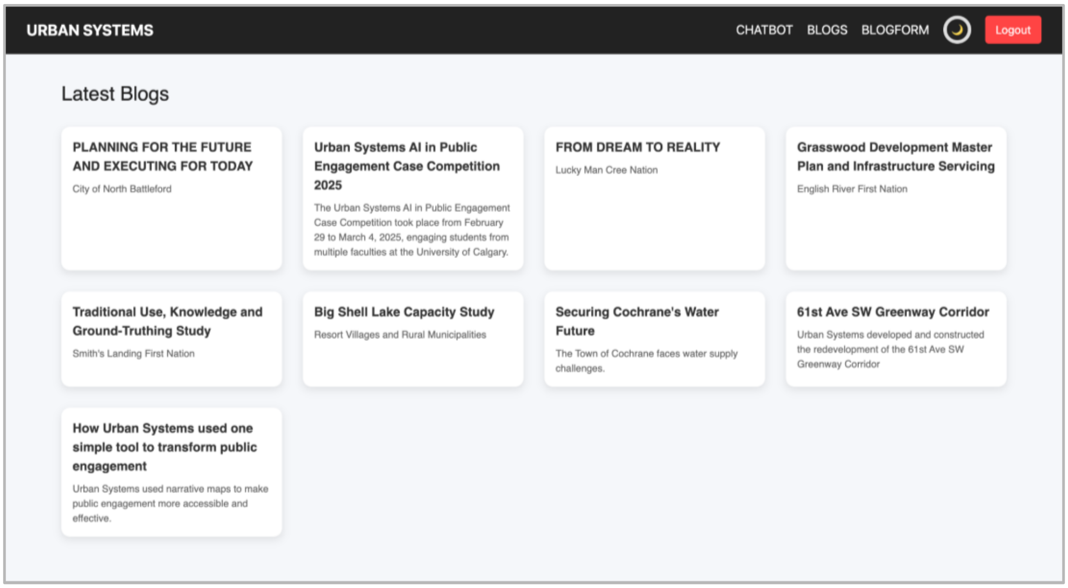


Figure 4.3: Login Page – Existing User


Forgot Password?

Enter your email and we will send you a password reset link.

Figure 4.4: Forgot Password Page



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City of North Battleford

Urban Systems AI in Public Engagement Case Competition 2025
The Urban Systems AI in Public Engagement Case Competition took place from February 29 to March 4, 2025, engaging students from multiple faculties at the University of Calgary.

FROM DREAM TO REALITY
Lucky Man Cree Nation

Grasswood Development Master Plan and Infrastructure Servicing
English River First Nation

Traditional Use, Knowledge and Ground-Truthing Study
Smith's Landing First Nation

Big Shell Lake Capacity Study
Resort Villages and Rural Municipalities

Securing Cochrane's Water Future
The Town of Cochrane faces water supply challenges.

61st Ave SW Greenway Corridor
Urban Systems developed and constructed the redevelopment of the 61st Ave SW Greenway Corridor

How Urban Systems used one simple tool to transform public engagement
Urban Systems used narrative maps to make public engagement more accessible and effective.

Figure 4.5: Latest Blog Page – Light Mode

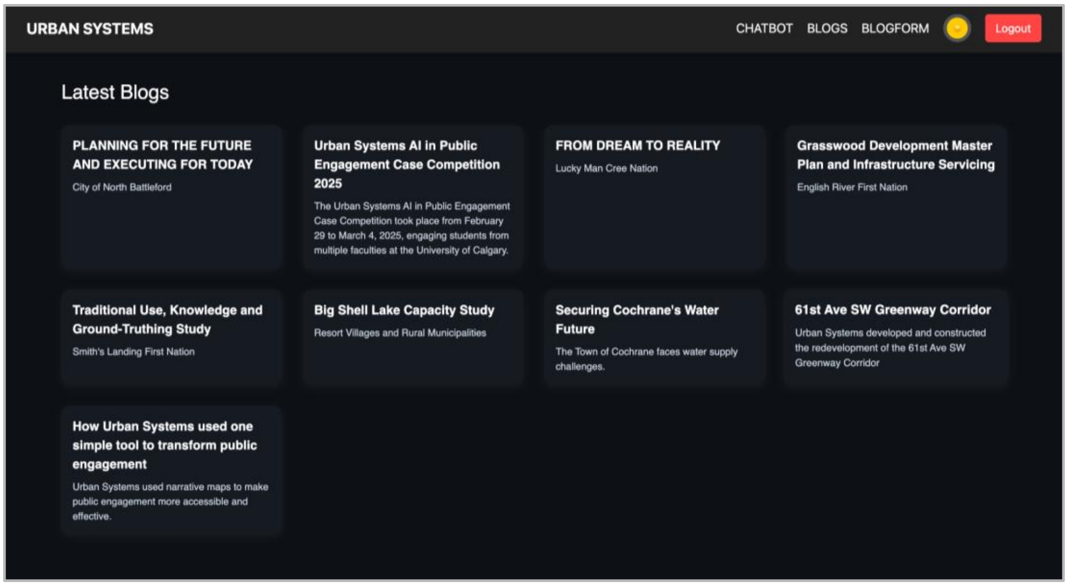

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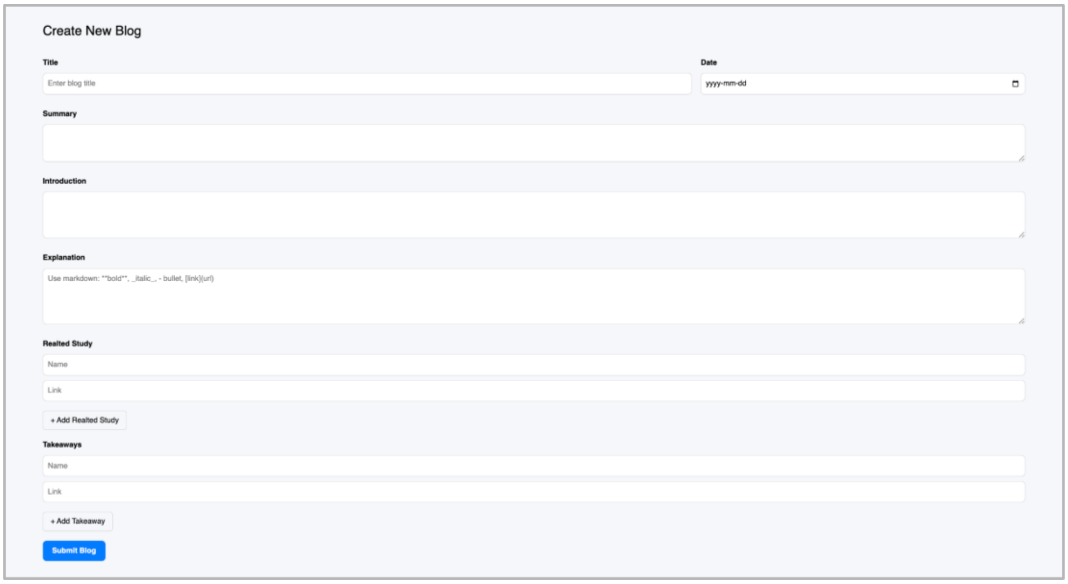
Figure 4.6: Latest Blog Page – Dark Mode



Create New Blog

Title

Enter blog title

Date

yyyy-mm-dd

Summary

Introduction

Explanation

Use markdown: **bold**, _italic_, - bullet, [link](url)

Realted Study

Name

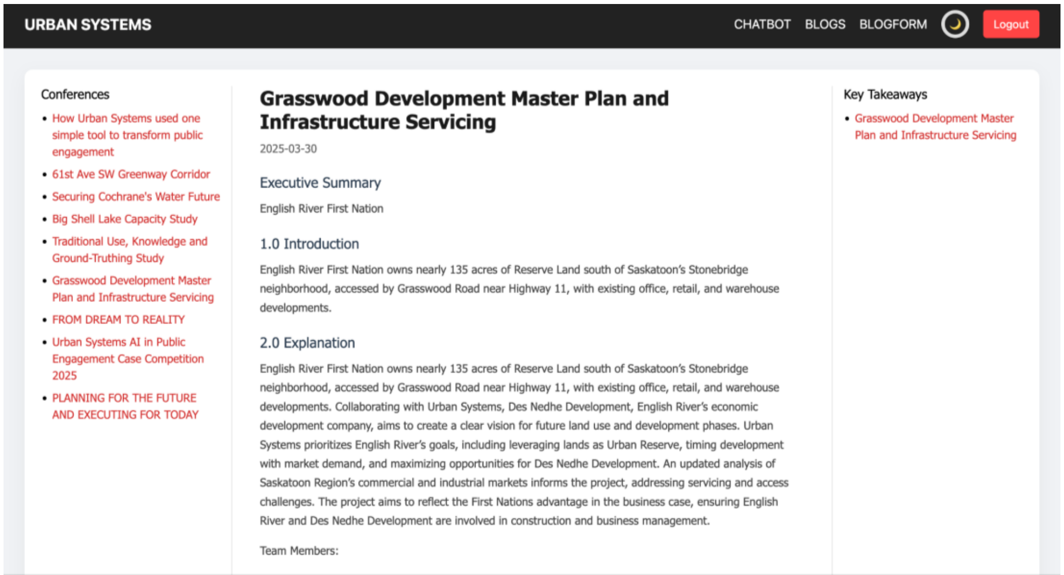
Link

Takeaways

Name

Link

Figure 4.7: Create New Blogpost Page



Conferences

- How Urban Systems used one simple tool to transform public engagement
- 61st Ave SW Greenway Corridor
- Securing Cochrane's Water Future
- Big Shell Lake Capacity Study
- Traditional Use, Knowledge and Ground-Truthing Study
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- PLANNING FOR THE FUTURE AND EXECUTING FOR TODAY

Grasswood Development Master Plan and Infrastructure Servicing

2025-03-30

Executive Summary

English River First Nation

1.0 Introduction

English River First Nation owns nearly 135 acres of Reserve Land south of Saskatoon's Stonebridge neighborhood, accessed by Grasswood Road near Highway 11, with existing office, retail, and warehouse developments.

2.0 Explanation

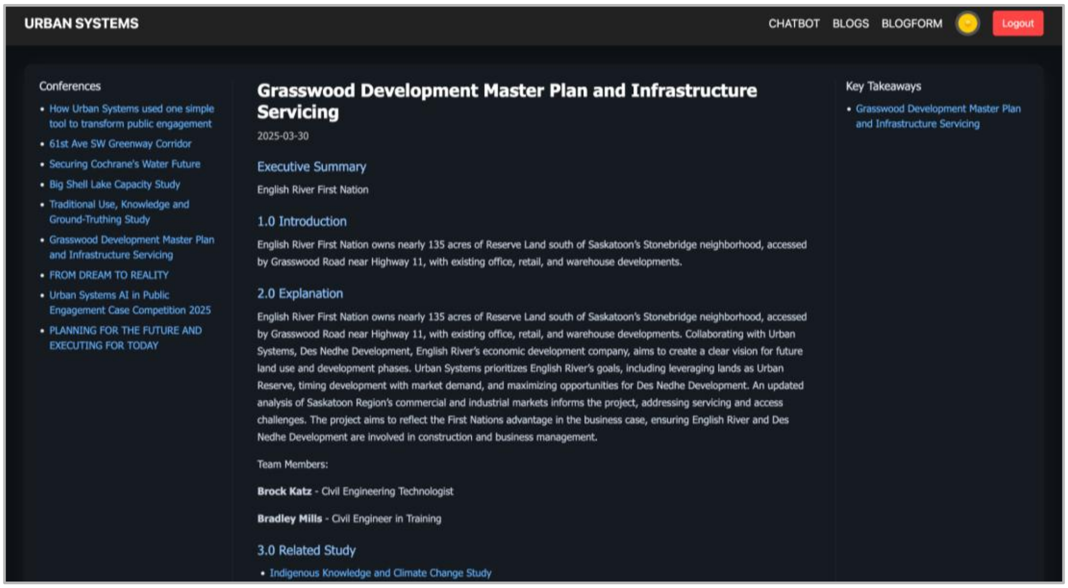
English River First Nation owns nearly 135 acres of Reserve Land south of Saskatoon's Stonebridge neighborhood, accessed by Grasswood Road near Highway 11, with existing office, retail, and warehouse developments. Collaborating with Urban Systems, Des Nedhe Development, English River's economic development company, aims to create a clear vision for future land use and development phases. Urban Systems prioritizes English River's goals, including leveraging lands as Urban Reserve, timing development with market demand, and maximizing opportunities for Des Nedhe Development. An updated analysis of Saskatoon Region's commercial and industrial markets informs the project, addressing servicing and access challenges. The project aims to reflect the First Nations advantage in the business case, ensuring English River and Des Nedhe Development are involved in construction and business management.

Team Members:

Key Takeaways

- Grasswood Development Master Plan and Infrastructure Servicing

Figure 4.8: Blog Post Page – Light Mode



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Team Members:

Brock Katz - Civil Engineering Technologist

Bradley Mills - Civil Engineer in Training

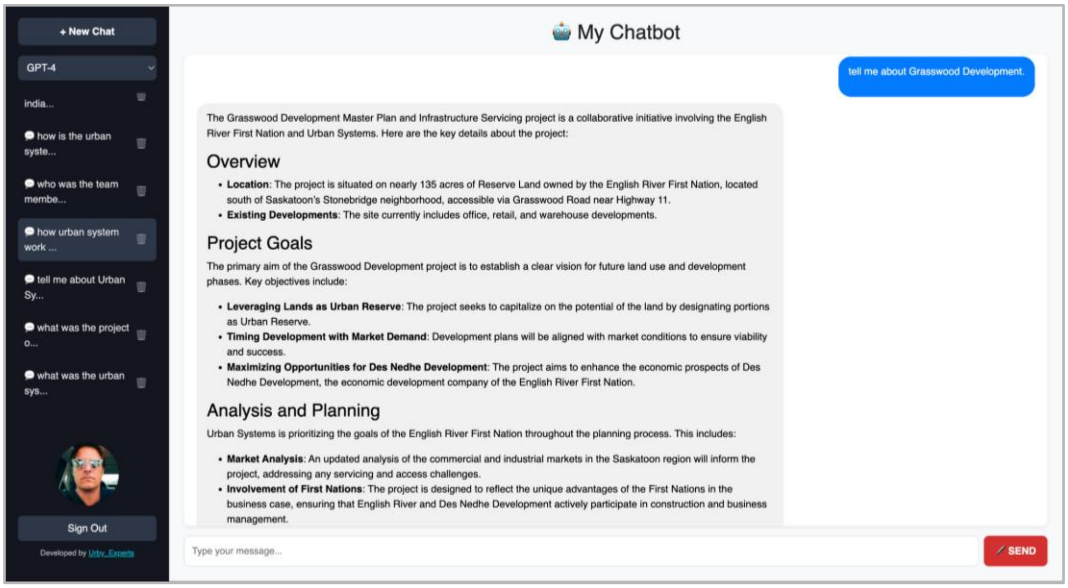
3.0 Related Study

- Indigenous Knowledge and Climate Change Study

Key Takeaways

- Grasswood Development Master Plan and Infrastructure Servicing

Figure 4.9: Blog Post Page – Dark Mode


+ New Chat
GPT-4
india...
how is the urban syste...
who was the team membe...
how urban system work ...
tell me about Urban Sy...
what was the project o...
what was the urban sys...
Sign Out
Developed by Urby_Experts
My Chatbot
Type your message...
SEND

tell me about Grasswood Development.

The Grasswood Development Master Plan and Infrastructure Servicing project is a collaborative initiative involving the English River First Nation and Urban Systems. Here are the key details about the project:

Overview

- **Location**: The project is situated on nearly 135 acres of Reserve Land owned by the English River First Nation, located south of Saskatoon's Stonebridge neighborhood, accessible via Grasswood Road near Highway 11.
- **Existing Developments**: The site currently includes office, retail, and warehouse developments.

Project Goals

The primary aim of the Grasswood Development project is to establish a clear vision for future land use and development phases. Key objectives include:

- **Leveraging Lands as Urban Reserve**: The project seeks to capitalize on the potential of the land by designating portions as Urban Reserve.
- **Timing Development with Market Demand**: Development plans will be aligned with market conditions to ensure viability and success.
- **Maximizing Opportunities for Des Nedhe Development**: The project aims to enhance the economic prospects of Des Nedhe Development, the economic development company of the English River First Nation.

Analysis and Planning

Urban Systems is prioritizing the goals of the English River First Nation throughout the planning process. This includes:

- **Market Analysis**: An updated analysis of the commercial and industrial markets in the Saskatoon region will inform the project, addressing any servicing and access challenges.
- **Involvement of First Nations**: The project is designed to reflect the unique advantages of the First Nations in the business case, ensuring that English River and Des Nedhe Development actively participate in construction and business management.

Figure 4.10: Chatbot Page – Light Mode

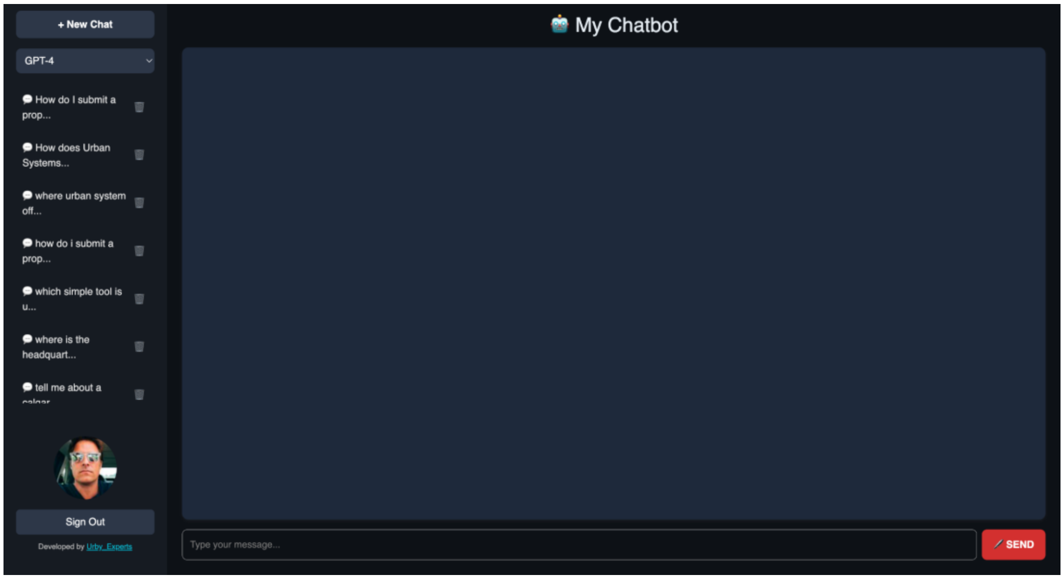

+ New Chat
GPT-4
How do I submit a prop...
How does Urban Systems...
where urban system off...
how do i submit a prop...
which simple tool is u...
where is the headquart...
tell me about a calgar
Sign Out
Developed by Urby_Experts
My Chatbot
Type your message...
SEND

Figure 4.11: Chatbot Page – Dark Mode

6. System Architecture Diagram

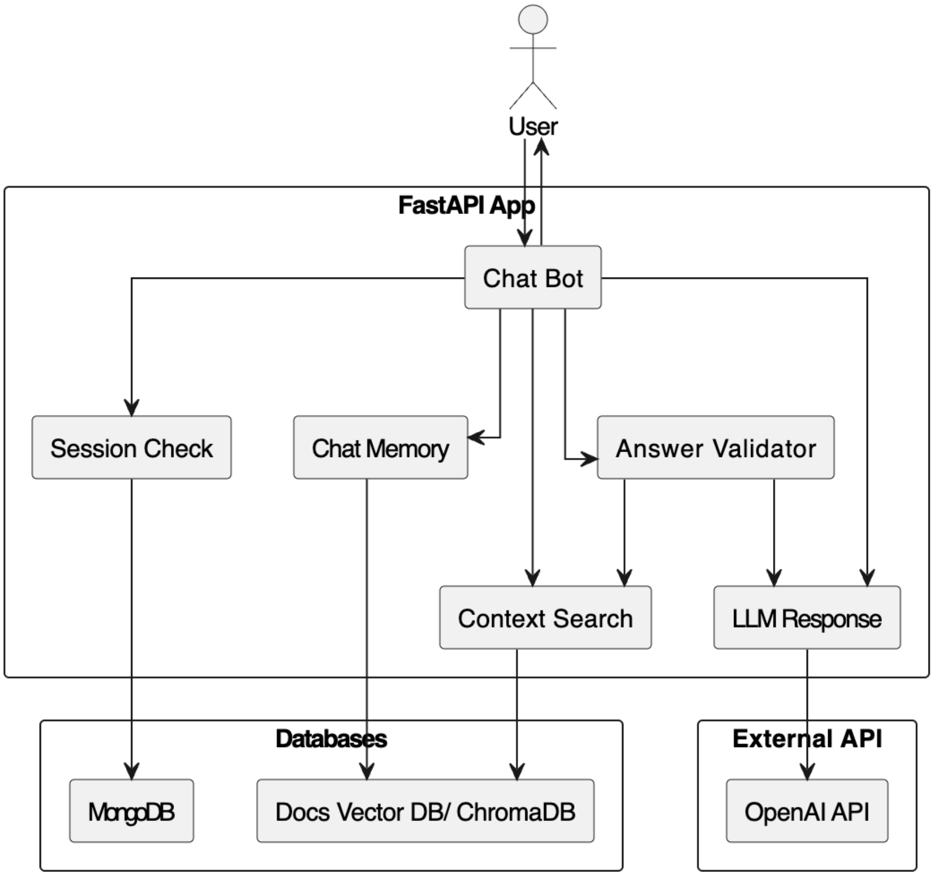


Figure 5.1: Overall Architecture Model

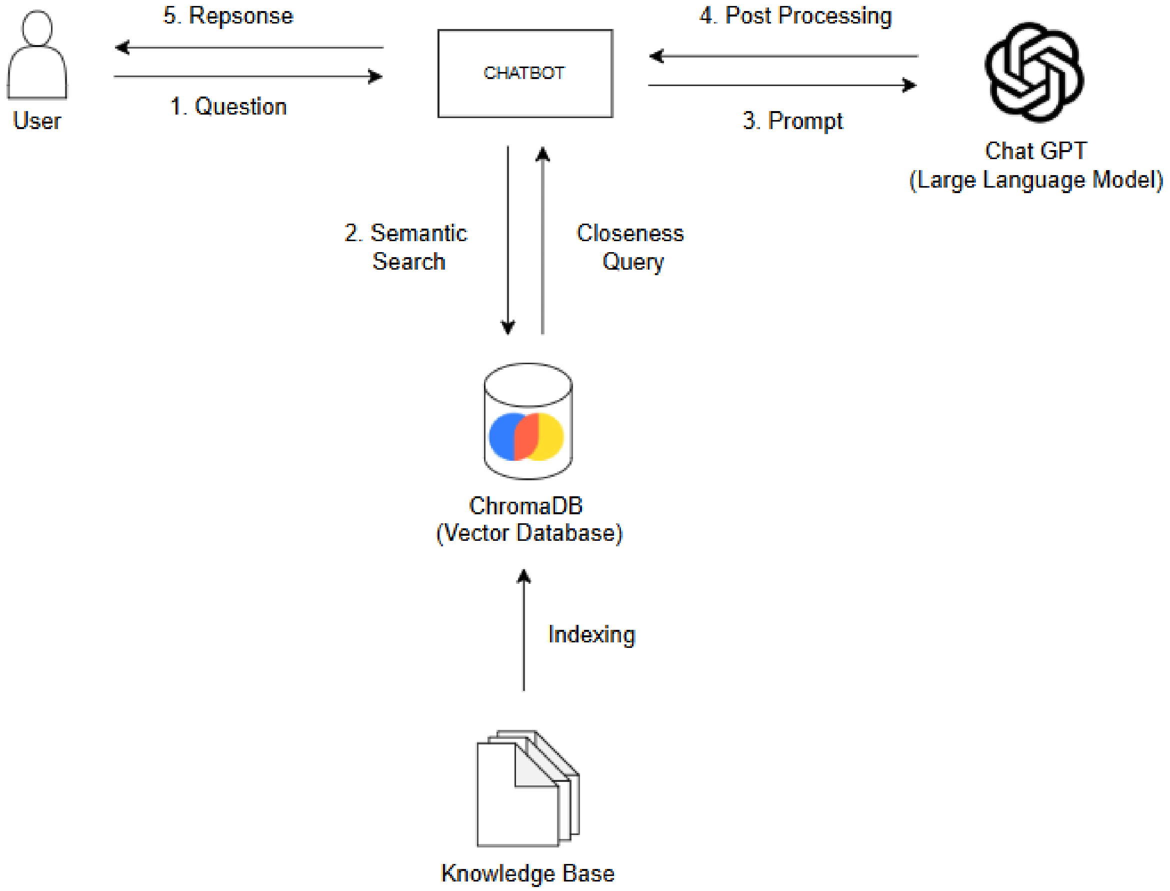


Figure 5.2: Retrieval-Augmented Generation (RAG) Architecture Model

7. System Interaction Diagram

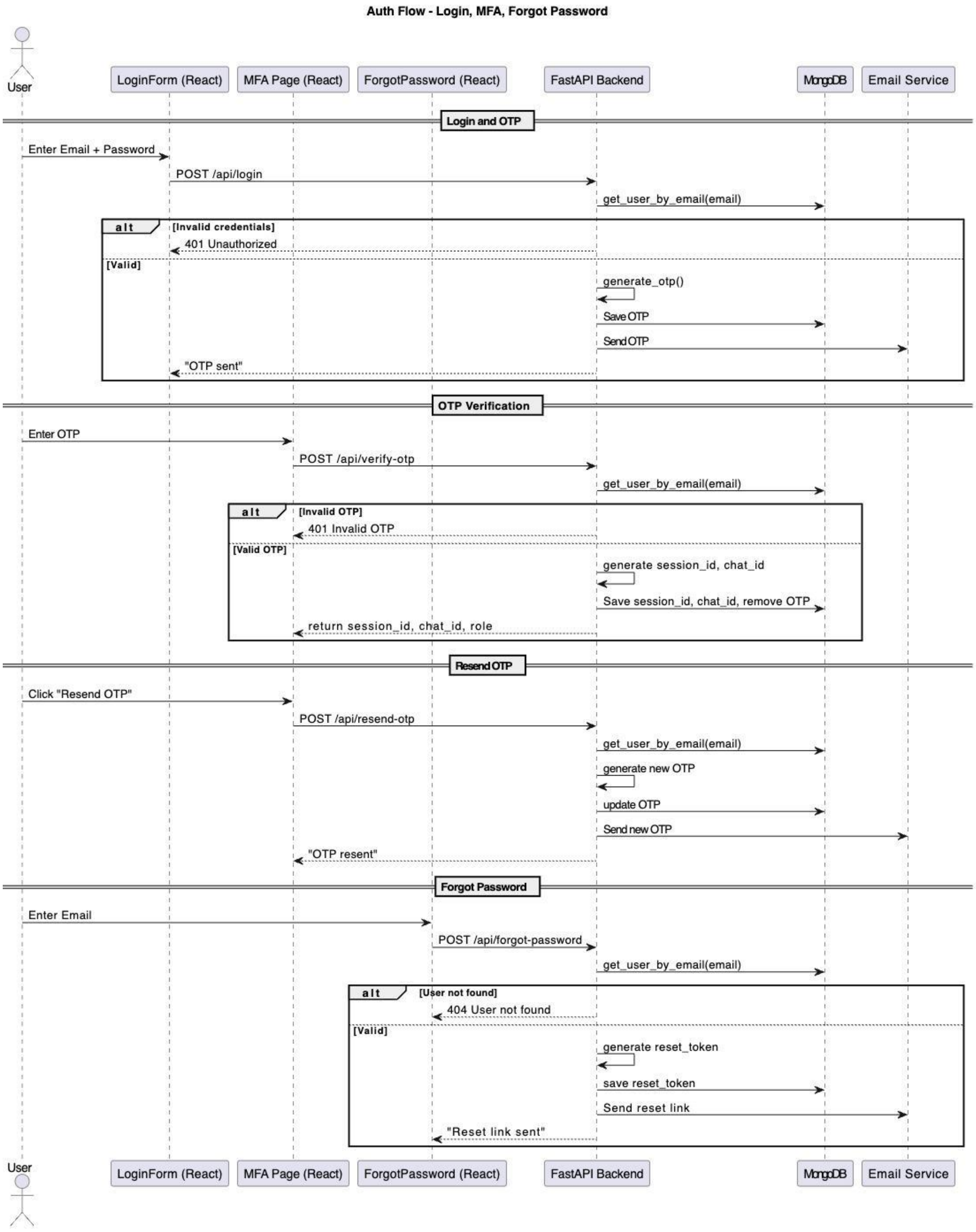


Figure 6.1: Login system interaction diagram

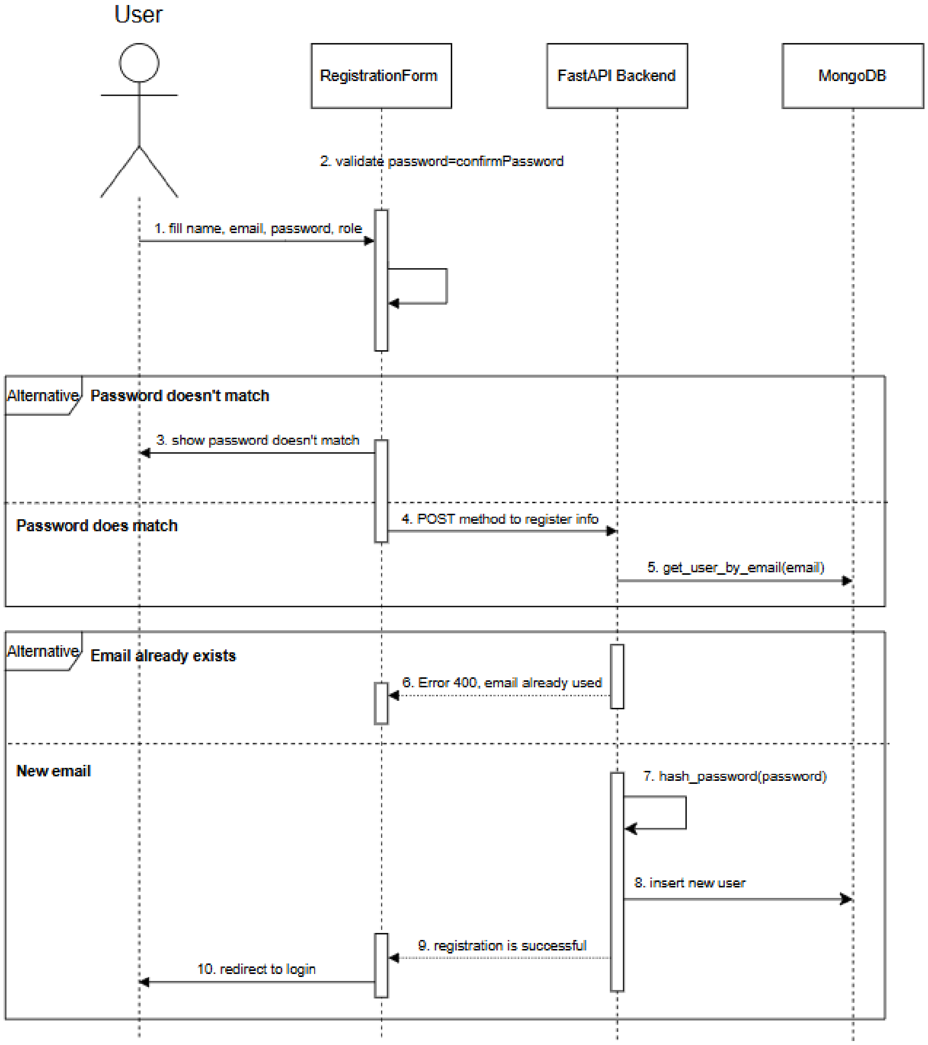

User
RegistrationForm
FastAPI Backend
MongoDB
2. validate password=confirmPassword
1. fill name, email, password, role
Alternative
Password doesn't match
3. show password doesn't match
Password does match
4. POST method to register info
5. get_user_by_email(email)
Alternative
Email already exists
6. Error 400, email already used
New email
7. hash_password(password)
8. insert new user
9. registration is successful
10. redirect to login

Figure 6.2: Registration system interaction diagram

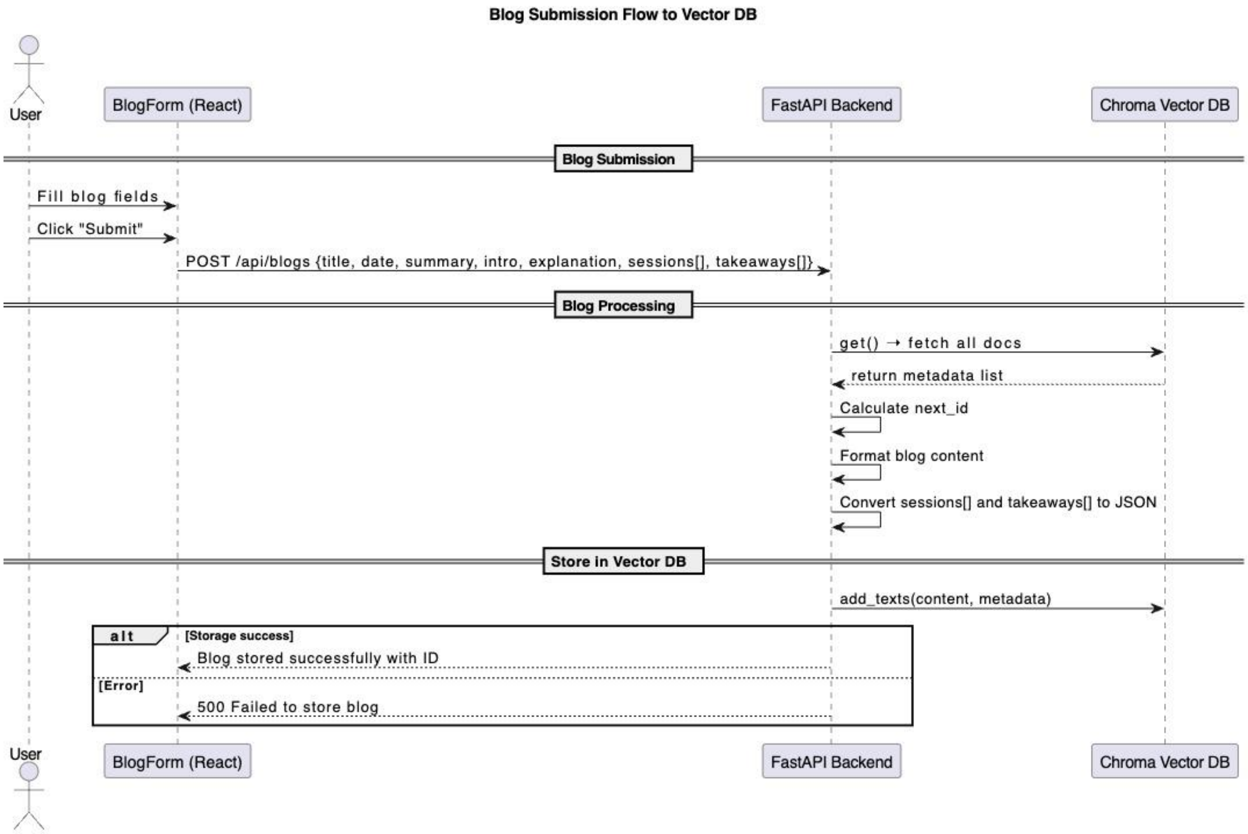


Figure 6.3: Create a new blog post system interaction diagram

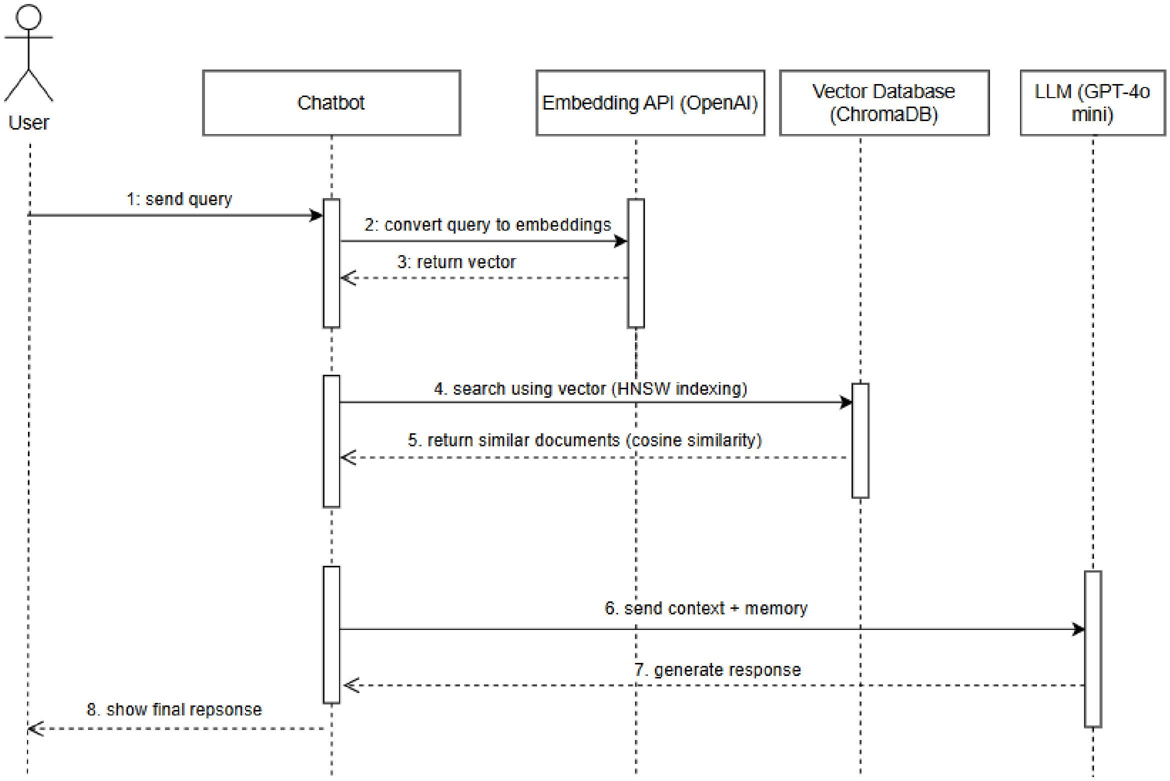


Figure 6.4: Query with chatbot system interaction diagram

8. Problems Encountered and Solutions

1. **Login and Registration Validation:**
    - Challenge: Ensuring that users provide a valid email during registration
    - Solution: Implemented email verification by sending a code to users during registration

2. **Forgot Password Functionality:**
    - Challenge: Users lacked an option to reset their passwords
    - Solution: Implemented a password reset feature using OTP verification

3. **Handling Large API Requests Efficiently:**
    - Challenge: LLM API calls could cause delays under heavy load
    - Solution: Used caching mechanisms and optimized request handling to improve response times

4. **User Role Management:**
    - Challenge: Defining different access for users and admins
    - Solution: Implemented role-based access control (RBAC) to ensure proper authorization

5. **Vector Search Accuracy:**
    - Challenge: Some queries returned irrelevant results or lacked context.
    - Solution: Implemented proper embedding and indexing to improve semantic search. Adjusted generation settings, such as temperature, to ensure responses were more accurate and contextually relevant.

9. Suggestions for Future Work

Feature	Recommendation
Deployment	Deployment with Docker
Multilingual Chat Support	Integrate OpenAI multilingual models or add a translation layer before prompt generation
Voice Command Input	Use Web Speech API for browser voice recognition or Whisper API for transcription
Analytics Dashboard	Track queries, user activity, most-used documents; visualize using Chart.js or Tableau
Document Upload & Extraction	Added file upload and extracted content using LangChain PDF loaders and summarizers

10. References

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