Well Bot – Global Wellness Assistant Chatbot:

Project Documentation

Under the Guidance of

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1. Project Overview

Problem Statement

Access to **reliable, non-diagnostic health and wellness information** is often fragmented, language-dependent, or behind paywalls, creating a significant barrier to proactive self-care, especially in underserved global communities. Existing online advice can be misleading or lack authoritative grounding. The core problem WellBot addresses is the need for a **secure, universally accessible, multilingual conversational tool** that delivers evidence-based, public health-aligned guidance (sourced from organizations like WHO and CDC) directly to users through an intuitive, non-medical interface.

1.1. Introduction and Purpose

This report details the design, development, and implementation of **WellBot**, a multilingual, AI-powered conversational agent designed to serve as a global wellness assistant. The primary objective of WellBot is to democratize access to reliable, non-diagnostic health and wellness information by leveraging modern conversational AI technologies. It provides personalized, self-help guidance inspired by authoritative sources, promoting proactive health management for its users.

1.2. Scope and Audience

The system's scope includes secure user management, a robust, multilingual conversational engine, and an intuitive web interface backed by a structured knowledge base.

- **Functional Scope:** Includes user authentication, personalized profile settings, real-time multilingual chat, knowledge retrieval, and administrative control over content and feedback.
- **Non-Functional Scope:** Focuses on security (JWT), scalability (Rasa/Flask microservices), responsiveness (UI/UX), and data persistence (SQLite).

The primary users are the **general public** seeking non-diagnostic wellness advice. Secondary audiences include the project **developers and maintainers**, and the **system administrators** managing the knowledge base.

1.3. Primary Technology Stack

WellBot is built on a modular, open-source technology stack, ensuring flexibility, maintainability, and clear separation of concerns between the web server, database, and conversational AI.

- **Backend & Framework (Flask - Python):** Acts as the RESTful API server, handling authentication and request routing.
- **Authentication (Flask-JWT-Extended):** Manages secure token-based authentication using HTTP-only cookies for persistent sessions.
- **Conversational AI (Rasa - NLU + Core):** Provides Natural Language Understanding (NLU) for intent/entity recognition and Dialogue Management (Core) for conversation flow.
- **Database (SQLite):** A local, file-based database used for persistent storage of user profiles and the central health knowledge base.
- **ORM (SQLAlchemy):** The Object-Relational Mapper facilitating efficient, abstract, and secure Python-based database interactions.
- **Frontend (HTML, CSS, JavaScript):** Handles client-side logic for user interfaces (login, registration, chat) and dynamic interaction with the Flask API.

1.4. Guiding Principles: Public Health Reference

The core content of WellBot's knowledge base is synthesized from guidelines provided by reputable public health organizations, including the **World Health Organization (WHO)** and the **Centers for Disease Control and Prevention (CDC)**. This foundational principle ensures that all guidance provided is non-diagnostic, evidence-based, and aligned with global public health standards.

2. System Architecture

WellBot employs a **Three-Layer Architectural Model** to ensure decoupling and scalability. The system is composed of four main components communicating via HTTP: the **Flask Web Server** (handles user authentication and routing), the **Rasa Server** (processes NLP and dialogue flow), the **Rasa Action Server** (executes custom business logic and database queries), and the **SQLite Database** (persistent data storage). Requests flow securely from the frontend, authenticated by Flask, passed to Rasa for processing, and finally routed to the Action Server to retrieve multilingual knowledge.

2.1. Three-Layer Architectural Model

WellBot operates on a clear, three-layer architecture to maximize decoupling, scalability, and maintainability:

- **Presentation Layer (Frontend):** Handles all user interactions (login, chat, profile updates).
- **Application Layer (Flask/Rasa Core):** Manages business logic, authentication, request routing, and dialogue flow.
- **Data Layer (SQLite/SQLAlchemy/Rasa Action Server):** Responsible for persistent data storage and secure knowledge retrieval.

2.2. Component Breakdown

Each component plays a specialized role and communicates via defined protocols:

- **User Interface:** Renders UI templates, captures user input, and initiates AJAX requests. It communicates using HTTP/S (to Flask).
- **Flask Web Server (Port 5000):** Responsible for user authentication, JWT issuance, session validation, static file serving, and proxying chat requests to Rasa. It communicates via HTTP/S (External) and HTTP (Internal to Rasa).

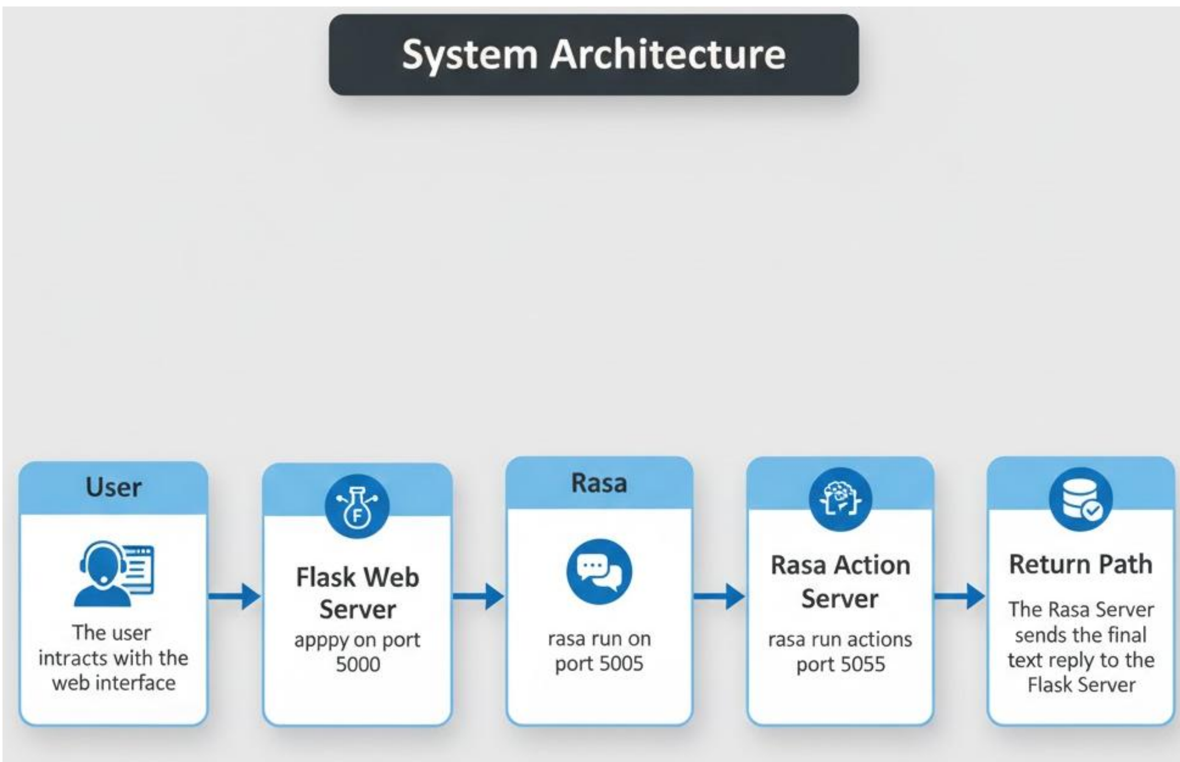
- **Rasa Server (Port 5005):** Processes raw text (NLU), manages dialogue state (Core), and determines the appropriate next action. It communicates via HTTP (Internal to Flask/Action Server).
- **Rasa Action Server (Port 5055):** Executes custom business logic, primarily the database query for the health knowledge base. It communicates via HTTP (Internal to Rasa) and SQLAlchemy ORM (to SQLite).
- **SQLite Database:** Provides persistent storage for User and HealthKnowledge data, accessed through the SQLAlchemy ORM.

2.3. Data and Request Flow Diagram (Conceptual)

The chat interaction workflow follows this critical sequential process:

1. **User Sends Message:** The Frontend captures user input and sends a POST request to Flask's /chat endpoint. The request includes the message and the secured JWT Cookie.
2. **Flask Authentication:** Flask validates the JWT. If valid, it extracts the user_id and the stored preferred_language.
3. **Flask to Rasa:** Flask forwards the user message and the language metadata (as a custom channel or slot update) to the Rasa server.
4. **Rasa NLU Processing:** Rasa NLU detects the conversation's intent (e.g., symptom_inquiry) and extracts relevant entities (e.g., duration, symptom).
5. **Rasa Core Dialogue:** Rasa Core determines the next action. For knowledge queries, it triggers the custom action: action_query_knowledge_base.
6. **Rasa to Action Server:** Rasa sends a request to the Action Server.
7. **Action Server Execution:** The action_query_knowledge_base uses SQLAlchemy to query the SQLite database, utilizing the detected intent and the user's preferred language to retrieve the correct multilingual response.
8. **Response Return:** The structured response (in the correct language) travels back through the Rasa Server, then to the Flask Server.

9. **Flask to Frontend:** Flask relays the final response to the frontend, where JavaScript dynamically updates the chat.html interface.



3. Milestone 1 – Core Foundation: Authentication & User Profiles

This milestone established the **secure foundation** of the application. It focuses on implementing **robust user management** by defining the database schema, creating secure user registration with **password hashing**, and integrating **token-based session management (JWT)** using HTTP-only cookies to protect user sessions and enforce access control across the web application.

3.1. Database Schema: User Management

The persistence layer for user data is managed by SQLAlchemy and stored in SQLite. The primary table, **User**, is defined by the following fields:

- **id:** Integer, Primary Key, Auto-Increment.
- **email:** String, Unique, Not Null.
- **password_hash:** String, Not Null.
- **age_group:** String, Nullable.
- **preferred_language:** String, Not Null.
- **is_admin:** Boolean, Default: False.

3.2. User Registration and Hashing

The /register endpoint (POST) handles new user creation. Passwords are never stored in plaintext.

- **Hashing:** Passwords are processed through a strong hashing library (e.g., Werkzeug's security module) before being stored as password_hash.
- **Default Settings:** Default preferred_language is 'en' and is_admin is set to False.
- **Key Initialization:** The very first registered user is automatically designated as the initial administrator.

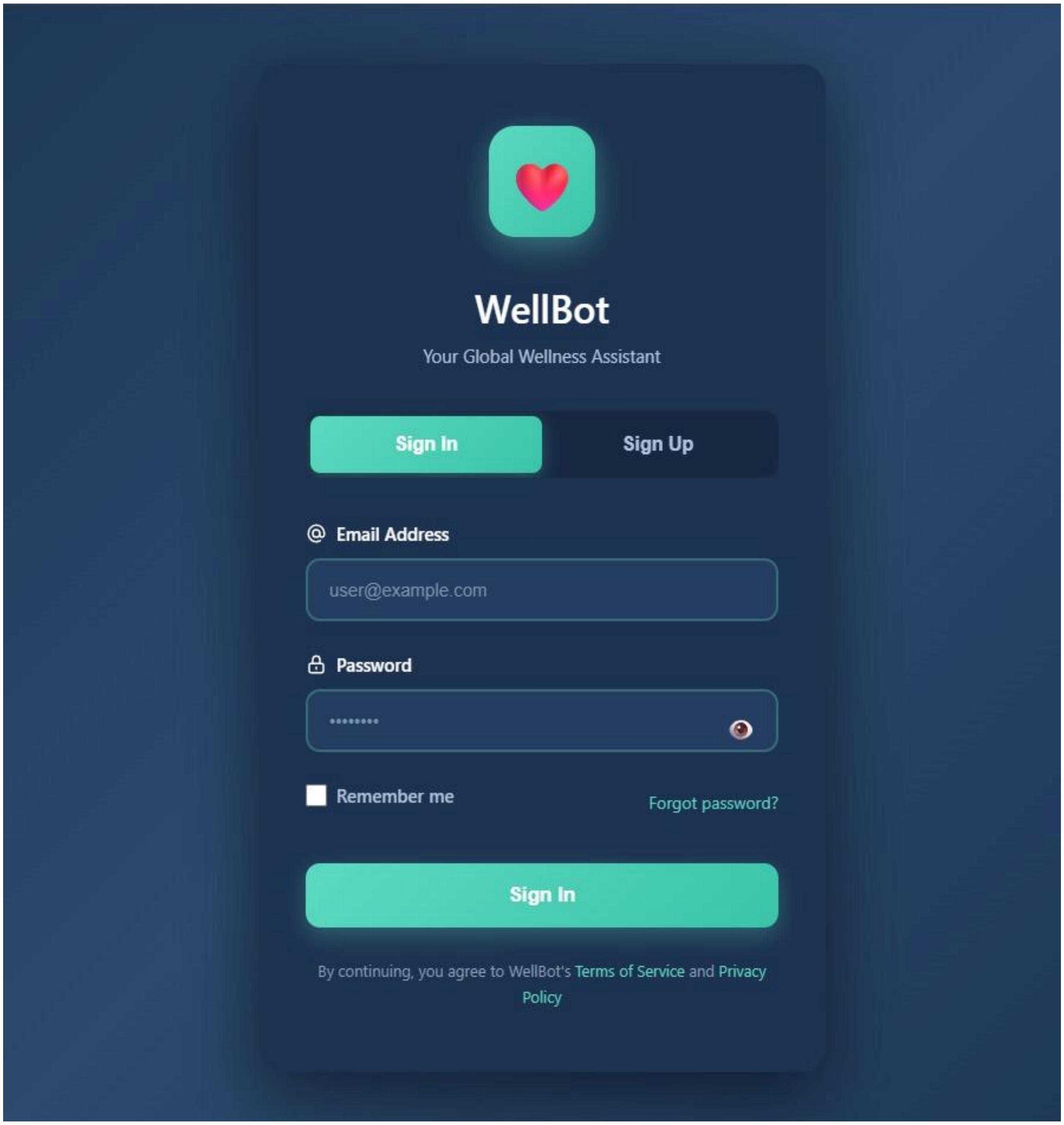
3.3. Secure Session Management (JWT)

Security is paramount, implemented using Flask-JWT-Extended with HTTP-only cookies.

- **Login (/login):** Upon verification, a JWT access token is generated, including user_id, age_group, and preferred_language in its payload.
- **Security:** The token is transmitted via an **HTTP-only cookie**, preventing client-side JavaScript access and mitigating Cross-Site Scripting (XSS) risks.
- **Protected Endpoints:** All critical endpoints are decorated with @jwt_required(locations=["cookies"]).

3.4. Page Access Control

- **Unauthorized Access:** Server-side logic redirects unauthenticated users attempting to access /chat or /profile to the /login page.
- **Frontend Logic:** JavaScript modules handle token expiration and automatically redirect the client upon receiving a 401 Unauthorized response from a protected API call.


WellBot
Your Global Wellness Assistant
Sign In
Sign Up
Email Address
user@example.com
Password
Remember me
Forgot password?
Sign In
By continuing, you agree to WellBot's Terms of Service and Privacy Policy

4. Milestone 2 – Core System: Chatbot Integration & Web UI

This milestone centered on building the **core conversational engine** and linking it to the web interface. It involved implementing the **Rasa NLU model** for intent recognition, designing the **structured HealthKnowledge database**, creating the Python utility for knowledge import, and developing the **Action Server logic** to query the database and retrieve relevant, non-diagnostic guidance. Finally, the basic chat UI was integrated with the Flask API.

4.1. Rasa NLU Model Implementation

The NLU model is trained to identify key intents:

- greet, goodbye, symptom_inquiry, first_aid_request, wellness_advice.

The Configuration (config.yml) utilizes a standard language-specific pipeline optimized for both English and Hindi text processing.

4.2. Structured Health Knowledge Base Design

The **HealthKnowledge** table stores the core intelligence of WellBot:

- id, intent_name, keyword, response_en, response_hi, age_group_filter.

4.3. Data Import Utility (load_knowledge.py)

A dedicated Python script manages the ingestion of knowledge data. It reads from a standardized CSV, uses the **Pandas** library for data cleaning, and leverages **SQLAlchemy** to batch-insert or update entries in the HealthKnowledge table.

4.4. Action Server (actions.py) Logic

The custom action action_query_knowledge_base executes the business logic:

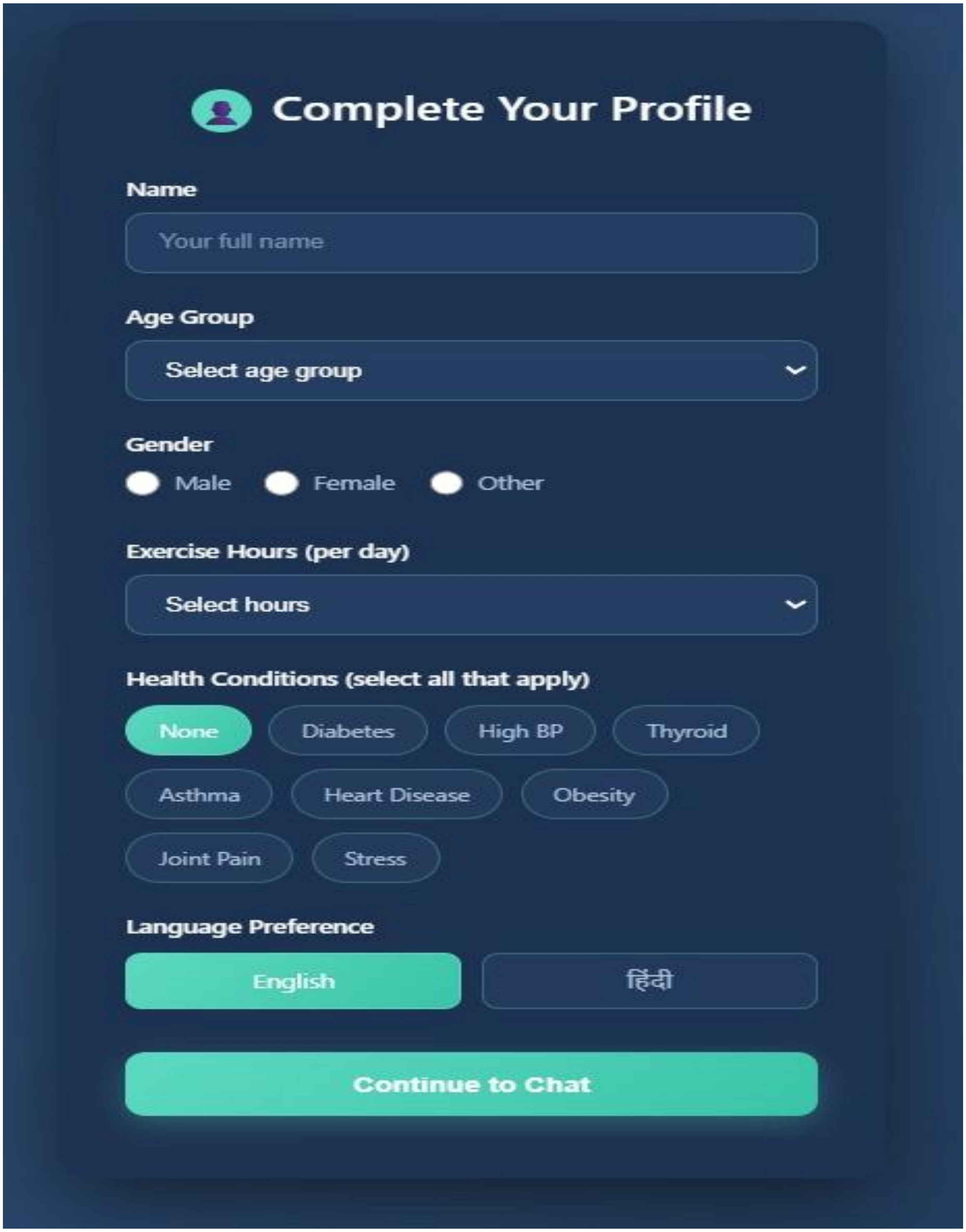
1. **Input:** Receives the intent and user metadata (language, age group).
2. **Query Construction:** Constructs a dynamic SQLAlchemy query.
3. **Filtering:** Filters the query by the user's preferred_language and applies the age_group_filter.

4. **Output:** Returns the retrieved, localized guidance text back to Rasa Core.

4.5. Frontend Structure and Interactivity

The frontend is a lightweight, responsive interface served by Flask.

- **Core Templates:** login.html, register.html, profile.html, and chat.html.
- **JavaScript Interactivity (chat.js):** Manages asynchronous message submission and handles the real-time display of bot responses.


Complete Your Profile
Name
Your full name
Age Group
Select age group
Gender
Male
Female
Other
Exercise Hours (per day)
Select hours
Health Conditions (select all that apply)
None
Diabetes
High BP
Thyroid
Asthma
Heart Disease
Obesity
Joint Pain
Stress
Language Preference
English
हिंदी
Continue to Chat

5. Milestone 3 – Expanded Features: Advanced NLP & Multilingual Capabilities

The focus here was on achieving **global reach and improved intelligence**. This involved expanding the knowledge base content, introducing **multilingual capabilities** (Hindi support) by updating Rasa pipelines and training data, implementing **dynamic language output** based on user profiles, and integrating **advanced Entity Extraction** (duration, severity, location) to enable more nuanced and personalized advice retrieval. Crucially, **safety disclaimers** were also enforced.

5.1. Knowledge Base Expansion Strategy

Content was expanded to over 100 entries, focusing on a preventative and holistic wellness approach.

New Content Categories:

- Common Illnesses and Symptom Management, Preventive Measures, Wellness Recommendations, Chronic Condition Management.

5.2. Safety and Compliance Disclaimers

- **Disclaimer Implementation:** An automated utter_disclaimer action is triggered at the start of every new conversation session via a high-priority rule in rules.yml.
- **Content:** Explicitly states that WellBot provides **non-diagnostic guidance only**.

5.3. Multilingual Rasa Configuration

Hindi language support was introduced.

- **Configuration Update (config.yml):** The Rasa pipeline was updated to include language-agnostic components or separate models.
- **Training Data:** NLU examples were segregated into language-specific files (data/en/nlu.yml and data/hi/nlu.yml).

5.4. Dynamic Language Output Implementation

Response language is now determined by the user's stored profile preference.

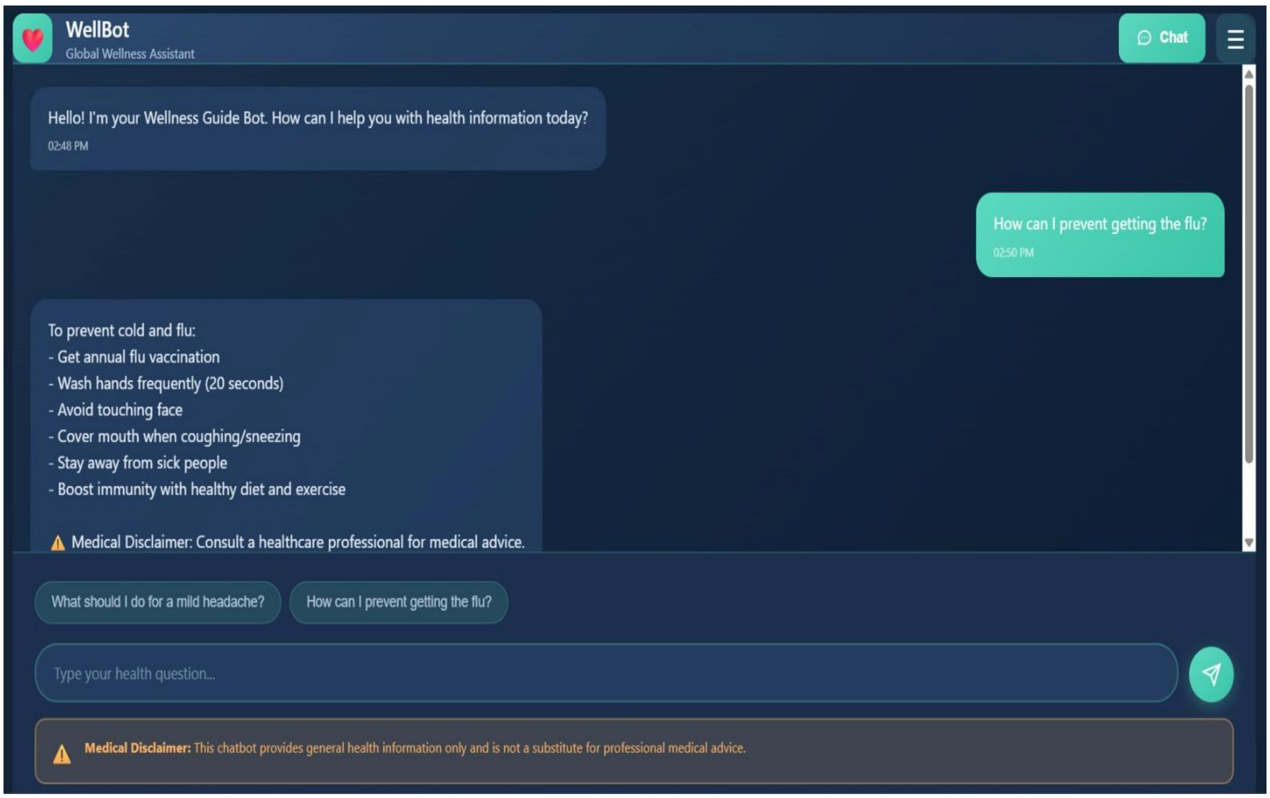
- **Metadata Flow:** The Flask backend injects the user's preferred_language into the Rasa tracker's slot.
- **Action Server Logic:** action_query_knowledge_base uses this parameter to dynamically select the correct bilingual column from the HealthKnowledge table.

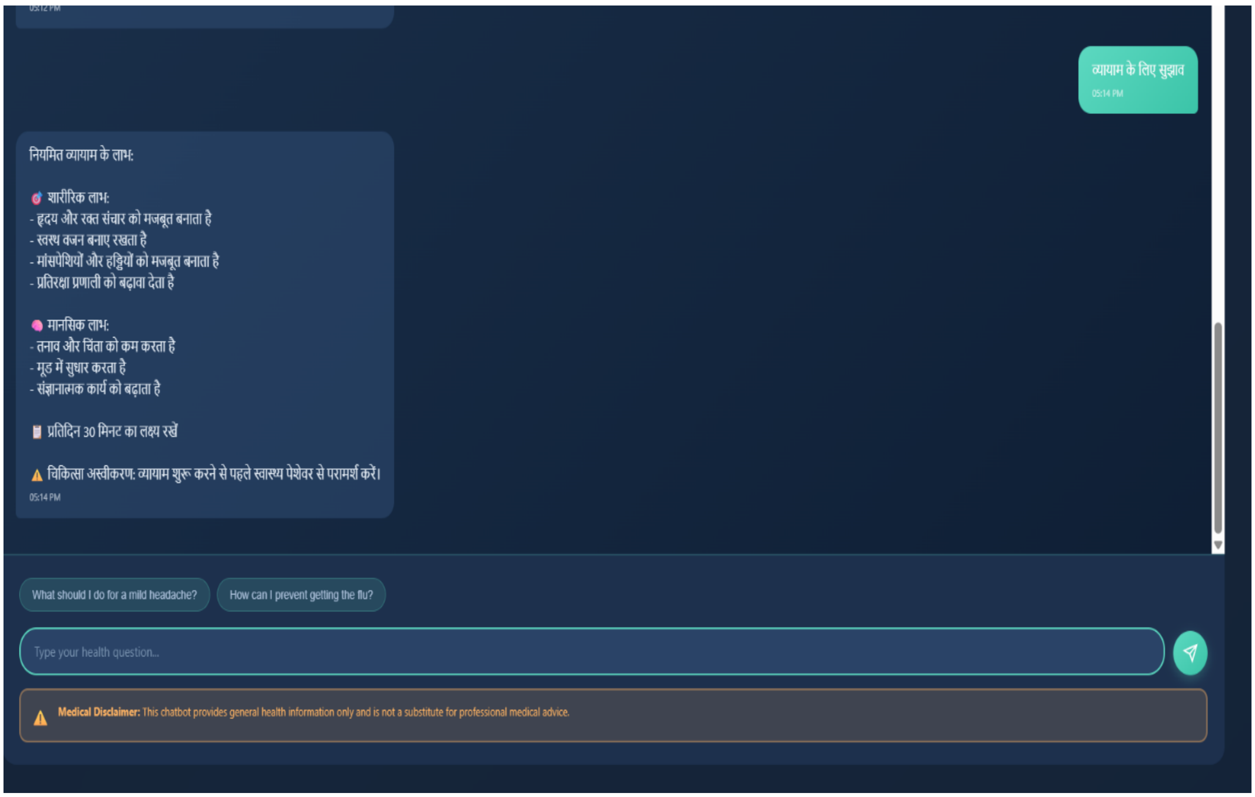
5.5. Advanced Entity Extraction and Slot Filling

Specific entities were introduced to improve personalization:

- duration, severity, location.

Training data was extensively updated in both English and Hindi to accurately recognize and extract these context variables.


WellBot
Global Wellness Assistant
Chat
Hello! I'm your Wellness Guide Bot. How can I help you with health information today?
02:48 PM
How can I prevent getting the flu?
02:50 PM
To prevent cold and flu:
- Get annual flu vaccination
- Wash hands frequently (20 seconds)
- Avoid touching face
- Cover mouth when coughing/sneezing
- Stay away from sick people
- Boost immunity with healthy diet and exercise
Medical Disclaimer: Consult a healthcare professional for medical advice.
What should I do for a mild headache?
How can I prevent getting the flu?
Type your health question...
Medical Disclaimer: This chatbot provides general health information only and is not a substitute for professional medical advice.


05:12 PM
व्यायाम के लिए सुझाव
05:14 PM
नियमित व्यायाम के लाभ:
शारीरिक लाभ:
- हृदय और रक्त संचार को मजबूत बनाता है
- स्वस्थ वजन बनाए रखता है
- मांसपेशियों और हड्डियों को मजबूत बनाता है
- प्रतिरक्षा प्रणाली को बढ़ावा देता है
मानसिक लाभ:
- तनाव और चिंता को कम करता है
- मूड में सुधार करता है
- संज्ञानात्मक कार्य को बढ़ाता है
प्रतिदिन 30 मिनट का लक्ष्य रखें
चिकित्सा अस्वीकरण: व्यायाम शुरू करने से पहले स्वास्थ्य पेशेवर से परामर्श करें।
05:14 PM
What should I do for a mild headache?
How can I prevent getting the flu?
Type your health question...
Medical Disclaimer: This chatbot provides general health information only and is not a substitute for professional medical advice.

6. Milestone 4 – Admin Dashboard & System Optimization

This final milestone focused on **maintenance, quality control, and system hardening**. Key components included building a protected **Admin Dashboard** for administrators, implementing the **Knowledge Base Management Module** (allowing CRUD operations on health content), integrating a **User Feedback System** for continuous improvement, and developing an **Analytics and Reporting** module. System hardening focused on robust **database session management** and improved exception handling for reliability.

6.1. Admin Dashboard Features and Roles

The admin dashboard is a protected Flask Blueprint (/admin) accessible only to users with the is_admin: True flag.

- **Core Role:** Content management, user feedback review, and system monitoring.
- **Access Control:** Requires JWT authentication and an additional server-side check for is_admin status.

6.2. Knowledge Base Management Module

This module allows administrators to maintain the quality and relevance of WellBot's advice.

- **Functionality:** Administrators can **Browse/Search** all entries in the HealthKnowledge table. Web forms enable **Add/Edit** and secure **Delete** operations for bilingual content.

6.3. User Interaction Analytics and Reporting

A dedicated analytics module provides insights into system usage.

Key Metrics Displayed:

- Total User Interactions, Top 10 Most Common Queried Intents, Distribution of Users by Age Group and Preferred Language, Average Feedback Rating.

6.4. User Feedback System Design

A feedback mechanism (Thumbs-up/Thumbs-down) was integrated into the chat interface.

- **Data Model (ChatFeedback Table):** Captures feedback data including user_id, knowledge_id, rating, comment, and timestamp.
- **Endpoint:** The /feedback endpoint handles the submission.

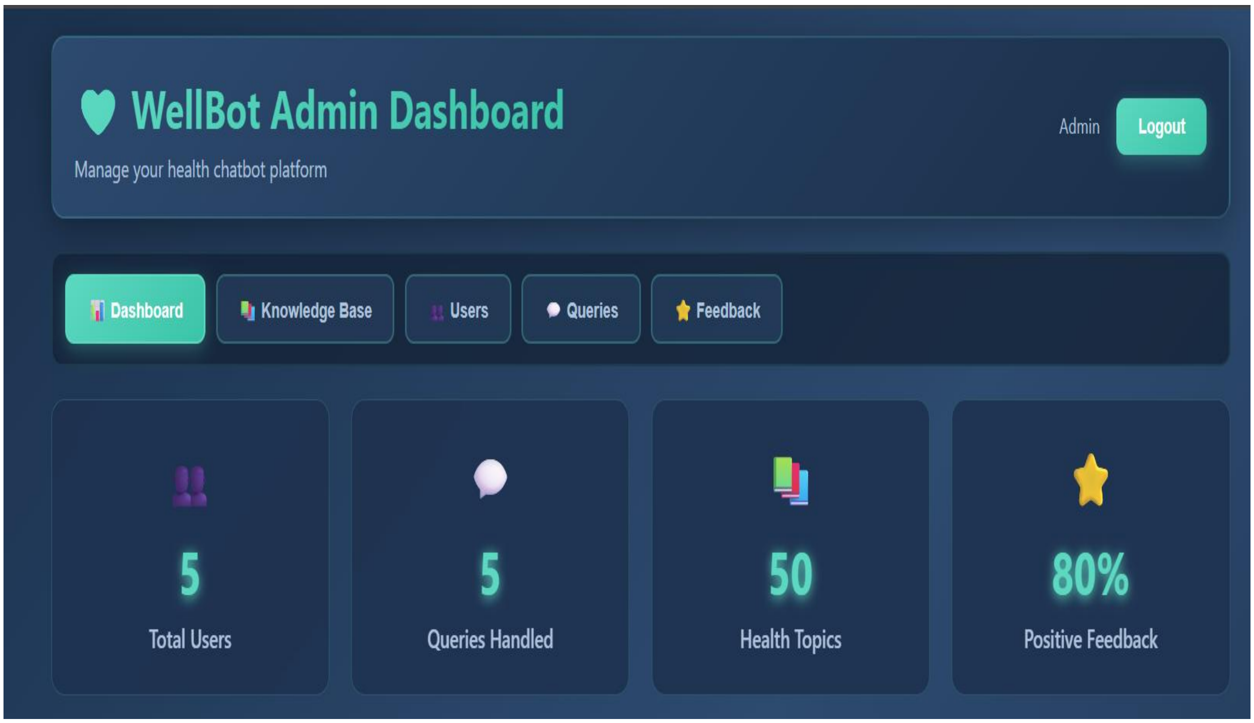
6.5. System Hardening and Database Optimization

- **Database Session Management:** Implemented robust SQLAlchemy session handling with proper rollback and commit logic to prevent concurrent operation errors.
- **Administrative Setup:** The first user created is automatically granted is_admin: True.
- **Exception Handling:** Enhanced error logging and graceful exception handling across Flask API endpoints.

6.6. UI/UX Modernization Summary

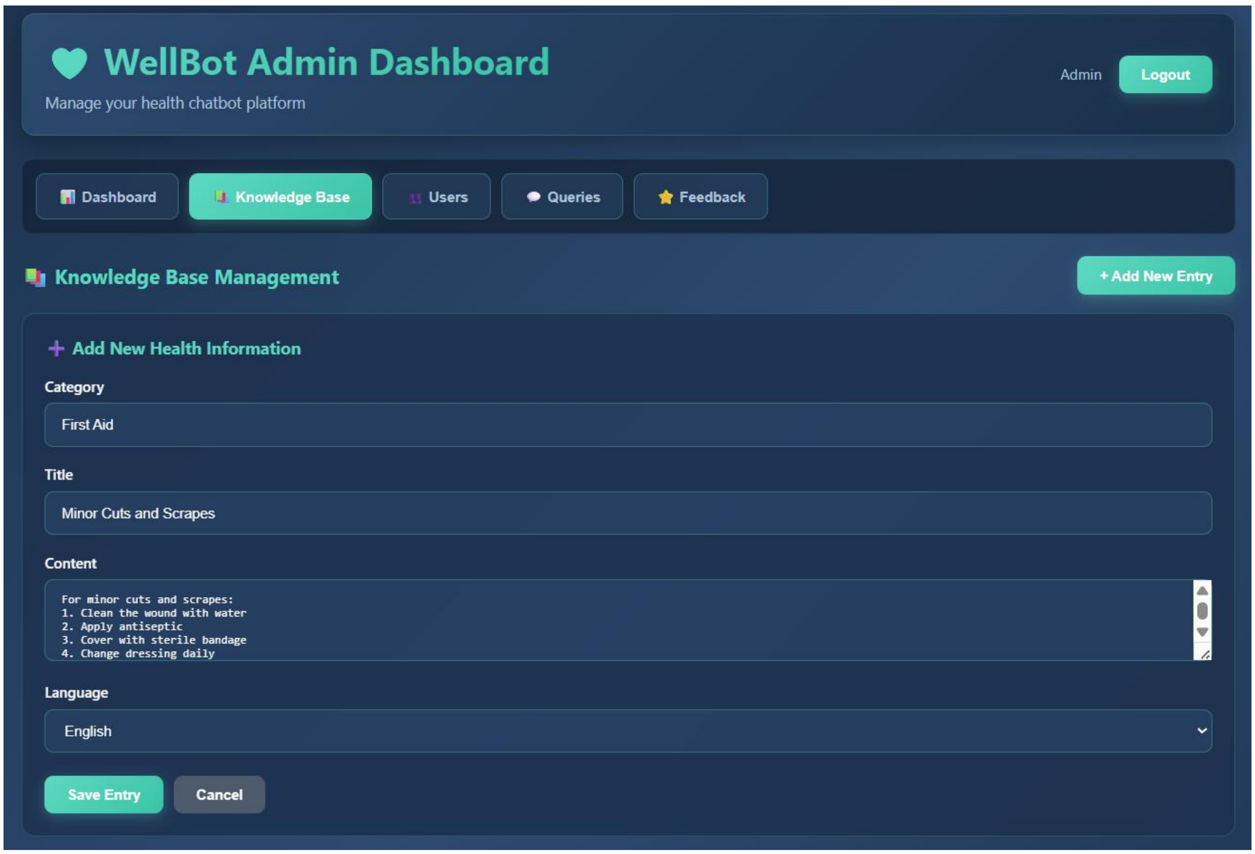
The frontend was refactored for improved aesthetics and usability, adopting a sleek design, responsive layout, and polished authentication flow.

Dashboard

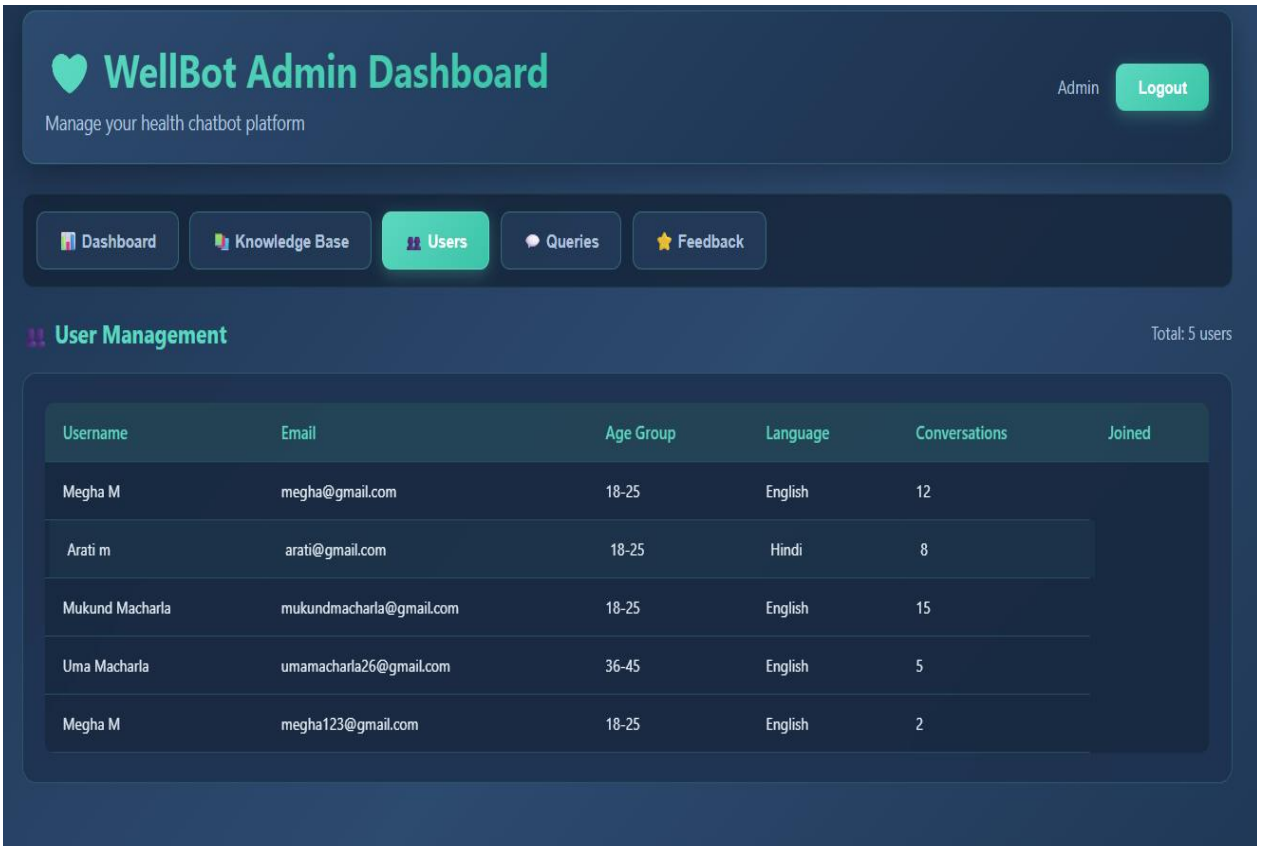

WellBot Admin Dashboard
Manage your health chatbot platform
Admin
Logout
Dashboard
Knowledge Base
Users
Queries
Feedback
5
Total Users
5
Queries Handled
50
Health Topics
80%
Positive Feedback

Query Trends Over Time

Knowledge Base:

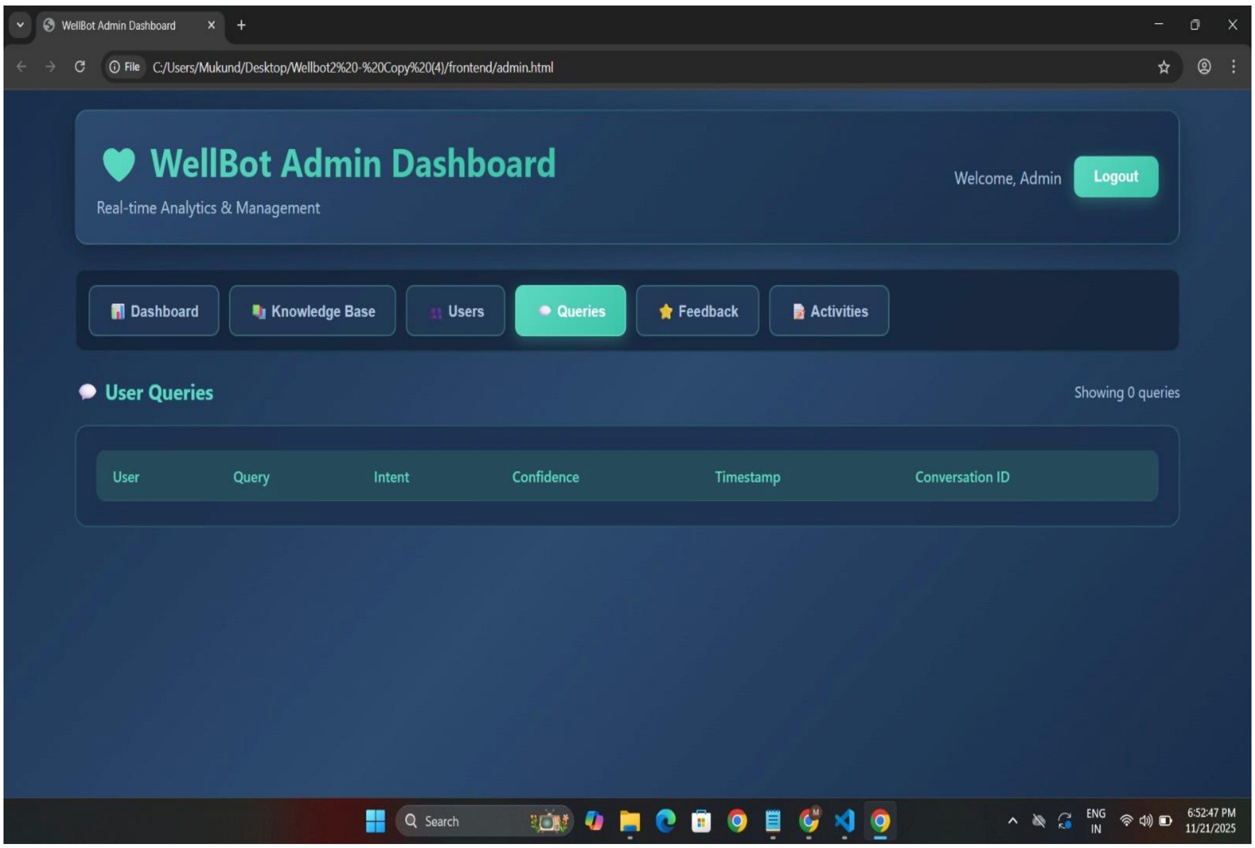


User, user query and Feedbacks:

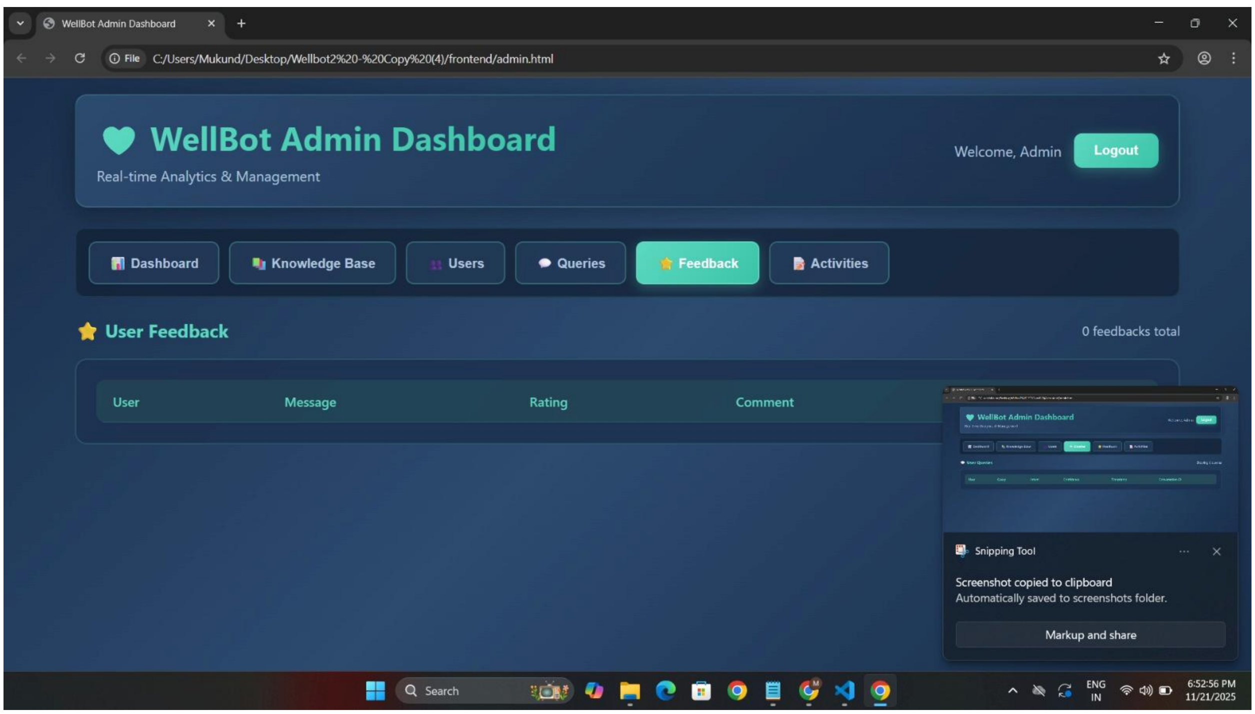


Recent User Queries

r



User Feedback & Ratings



Database schema:

WellBot Database Schema Description

The database schema is organized around a central USERS table, linking out to logs and data specific to each user. The knowledge base is modularized into Q&A and Tips tables.

User and Core Tables

1. USERS (Primary Table)

This is the main authentication and profile table.

- **PK (Primary Key):** id (user)
- session_id
- created_at
- language_preference
- **Relationship:** Has a **1-to-many** relationship with CONVERSATIONS and EXERCISE LOGS.

2. CONVERSATIONS

Logs individual message exchanges for analytics and dialogue history.

- **PK (Primary Key):** conversation_id
- message (text)
- sender (FK from USERS)
- timestamp
- language (for multilingual analysis)
- **Relationship:** Linked back to USERS with a **1-to-many** relationship (one user can have many conversations).

3. EXERCISE LOGS

Tracks user-reported exercise activity.

- **PK (Primary Key):** id (integer)
- **FK (Foreign Key):** user_id (links to USERS table)
- exercise_type
- exercise_date
- sender (integer, FK)
- timestamp
- **Relationship:** Linked back to USERS with a **1-to-many** relationship (one user can have many exercise logs).

Health Data and Knowledge Base Tables

4. USER HEALTH DATA

Stores daily or periodic health metrics logged by the user.

- **PK (Primary Key):** user_h_id (NOT NULL)
- **FK (Foreign Key):** user_b_id (links to USERS table)
- water_intake
- current_mood
- sleep_hours
- date
- **Relationship:** Has a **1-to-many** relationship with HEALTH QA (though the relationship flow on the diagram suggests that HEALTH QA links to USER HEALTH DATA via user_h_id which seems non-standard for Q&A, usually Q&A is static).

5. HEALTH QA (Question & Answer)

The primary knowledge base for specific health inquiries.

- **PK (Primary Key):** HEALTH_QA
- question
- answer
- category
- authority_references
- **Relationship:** Shares a **1-to-many** relationship with WELLNESS TIPS.

6. WELLNESS TIPS

Stores general wellness advice, potentially linked to specific health categories.

- **PK (Primary Key):** TIP

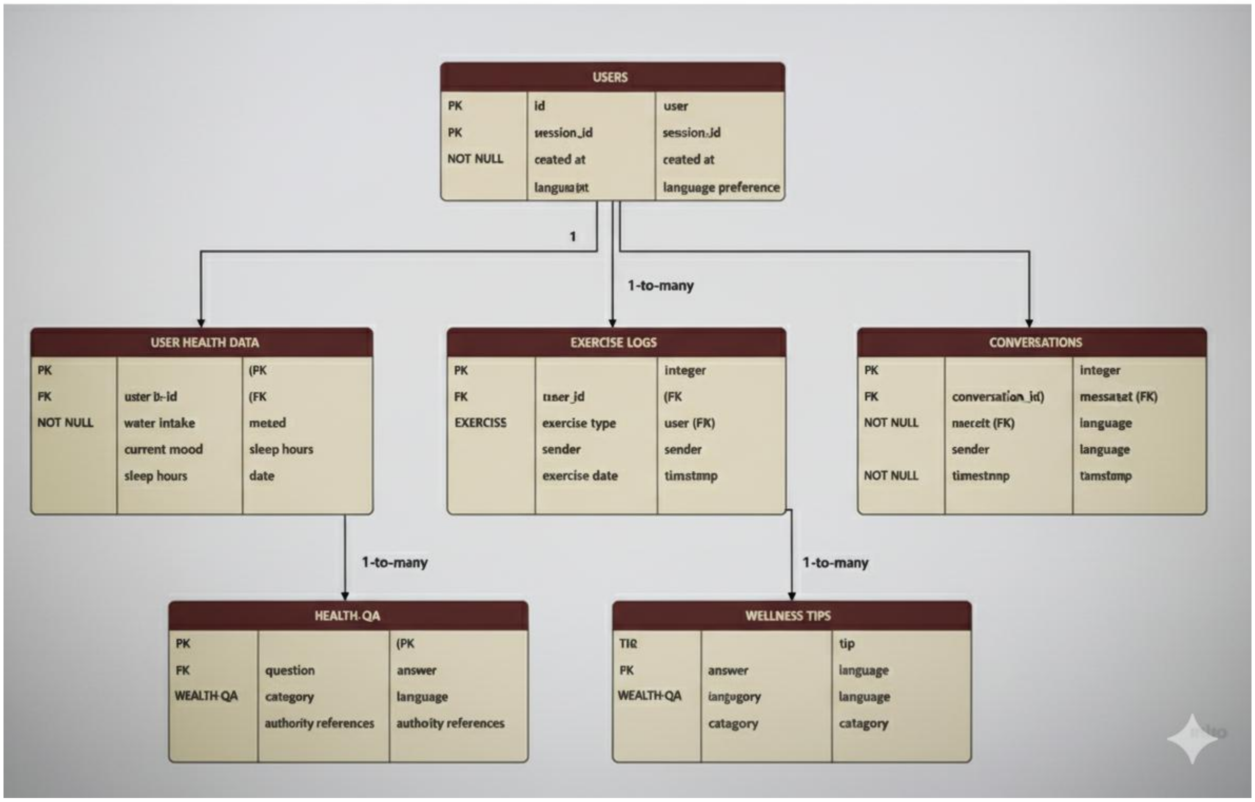
- **FK (Foreign Key):** WEALTH_QA (links to HEALTH QA table)
- tip (the advice text)
- language
- category
- **Relationship:** Linked back to HEALTH QA with a **1-to-many** relationship.

7. CONVERSATIONS (Secondary Entry)

This seems to be a redundant or specialized logging table for message segments.

- **PK (Primary Key):** integer (likely message_id)
- **FK (Foreign Key):** conversation_id (links to the main CONVERSATIONS table)
- message_segment
- language
- timestamp
- **Note:** The structure suggests it might be intended for message fragmentation or slot tracking, though its definition in the diagram is slightly ambiguous compared to the main CONVERSATIONS table.

WellBot Database Schema Diagram



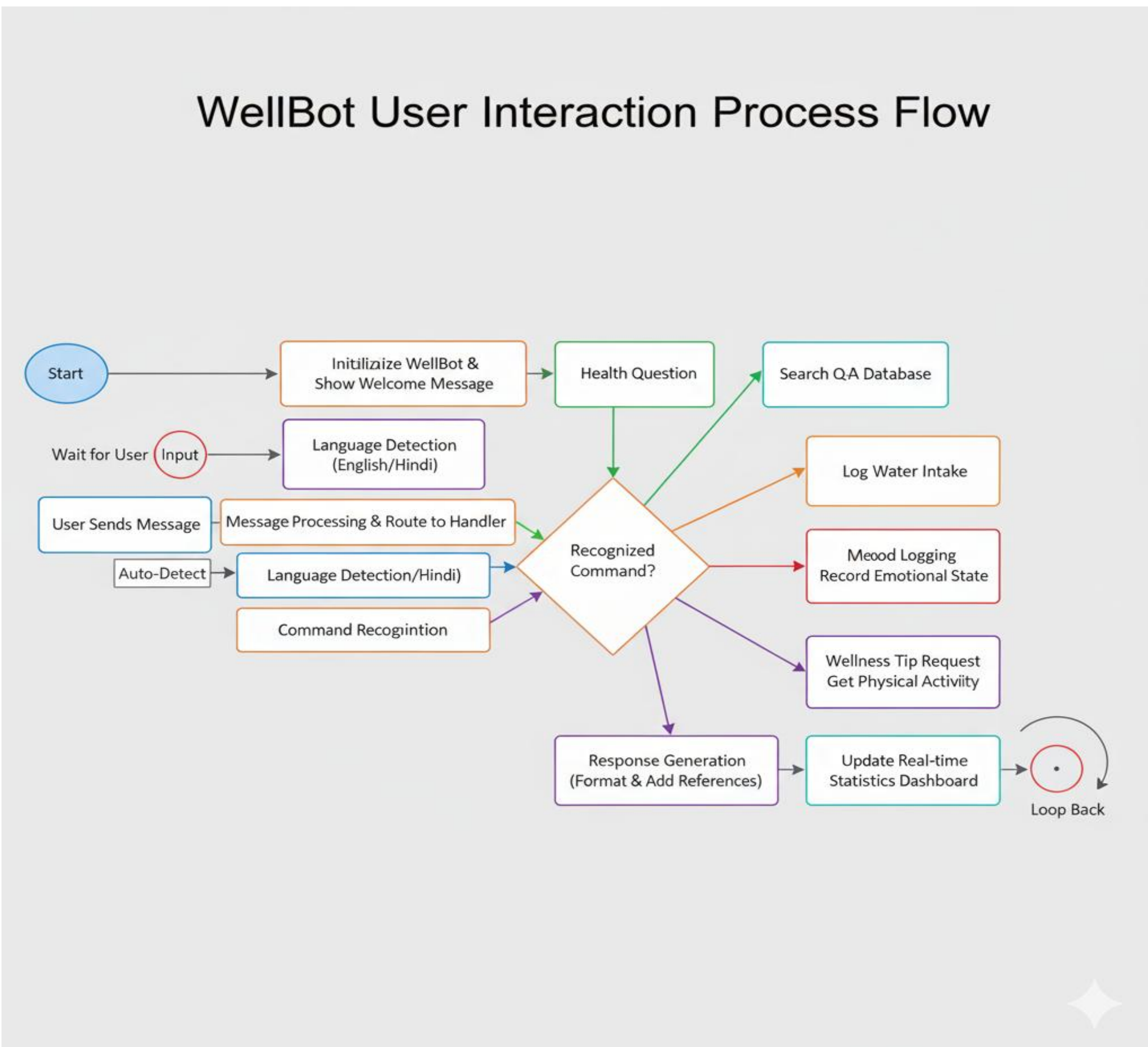
Diagrams:

User Flow diagram:

Purpose: Visualizes the **path a user takes** through a website or application to complete a specific goal. It's focused on the user experience (UX).

What it shows: A series of steps, screens (or pages), and **decision points** (e.g., a diamond shape for "Yes/No") from the entry point to the final desired action (conversion).

Analogy: A road map or flowchart for a customer's journey from finding a product online to completing the purchase checkout.

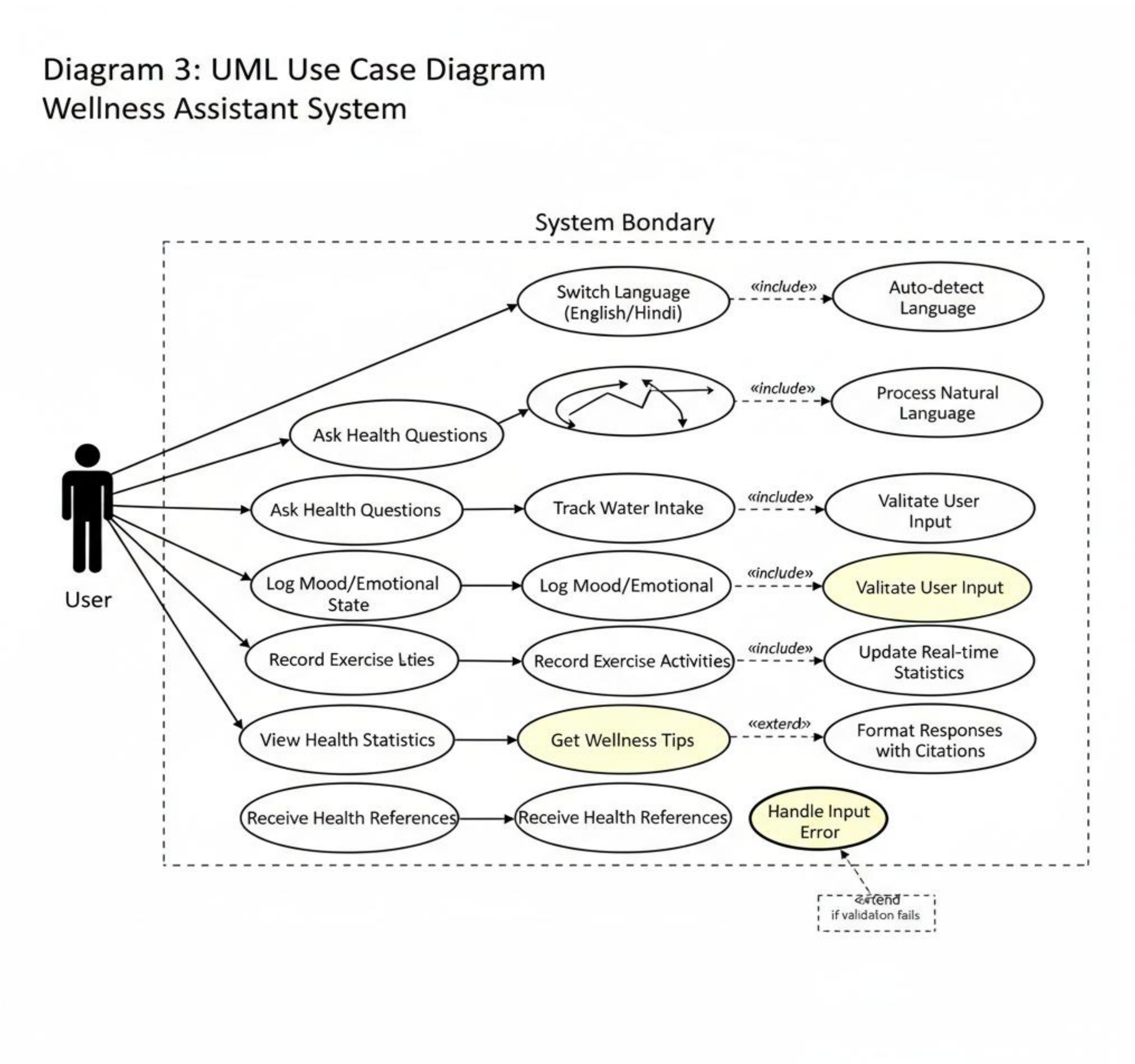


Use case diagram:

Purpose: Captures the **functional requirements** and high-level scope of a system from the **external user's perspective**.

What it shows: The **actors** (external users or other systems) and the primary **use cases** (the discrete functions/goals the system provides, shown as ovals), linked by association lines.

Analogy: A menu for a restaurant, listing everything the customer (actor) can order (use case).

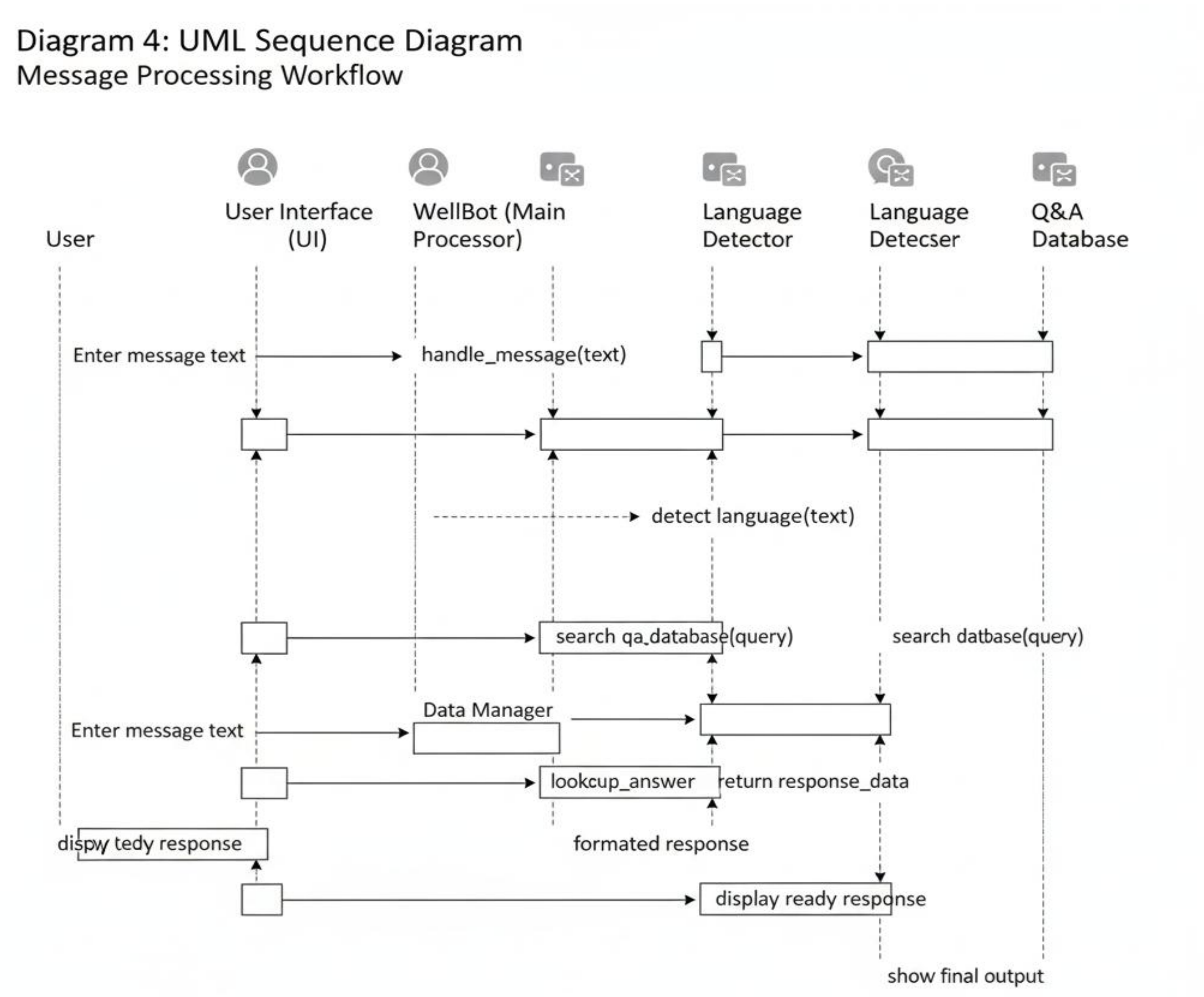


Sequence Diagram:

Purpose: Shows the **order of interactions** between objects or components in a system over time to complete a specific task or scenario.

What it shows: Lifelines (vertical lines representing objects/components) and **messages** (horizontal arrows) exchanged in the exact chronological sequence they occur. It focuses on the time-ordered logic.

Analogy: A script for a play, showing exactly which character (object) speaks (sends a message) to which other character and when.

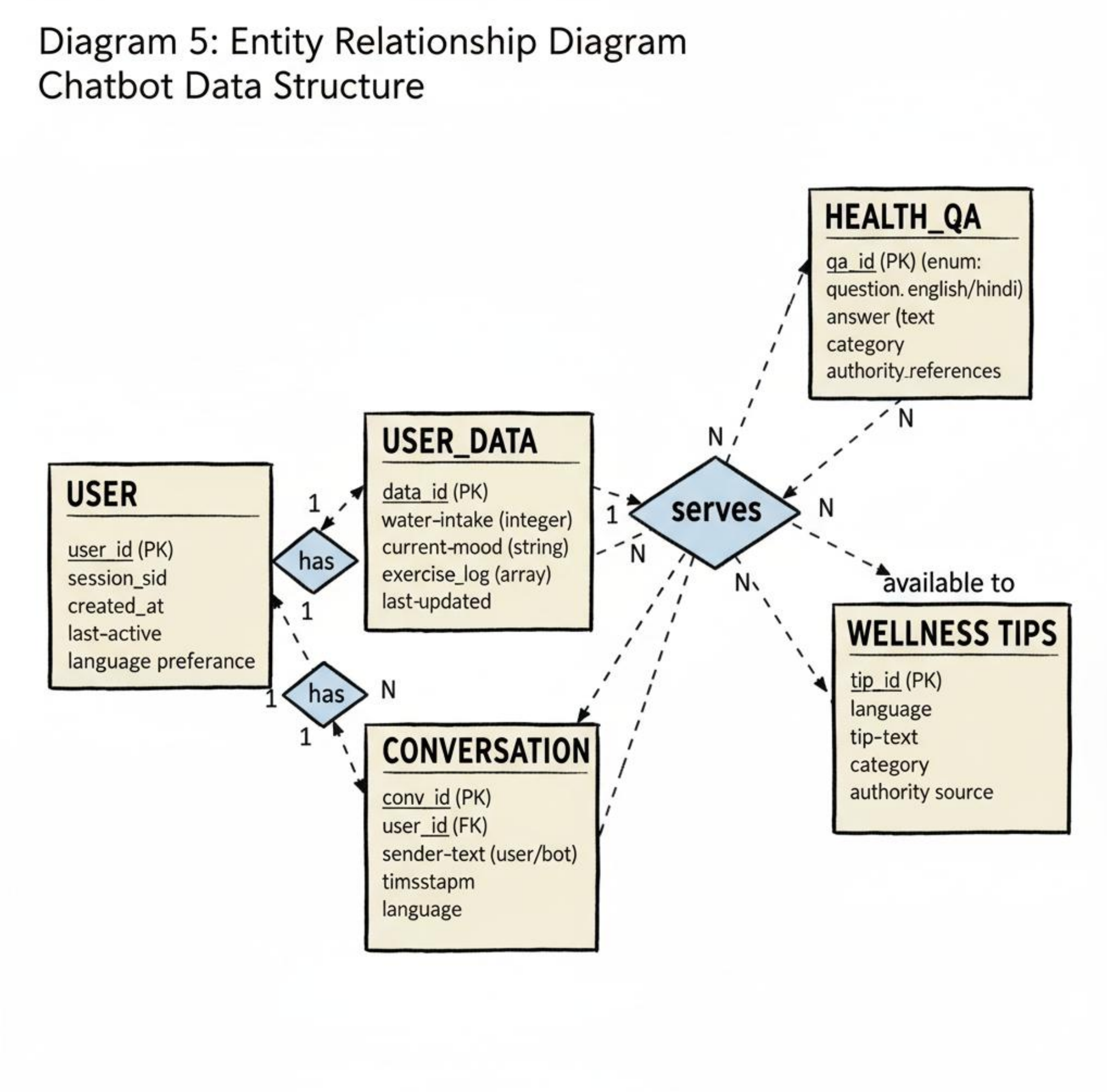


Entity Relation diagram:

Purpose: Models the **structure of a database**.

What it shows: The primary **entities** (tables or concepts) in a system, their **attributes** (columns), and the **relationships** between them, often detailing **cardinality** (one-to-one, one-to-many, etc.).

Analogy: A schematic showing all the key data points in a library (books, members, loans) and how they are linked.

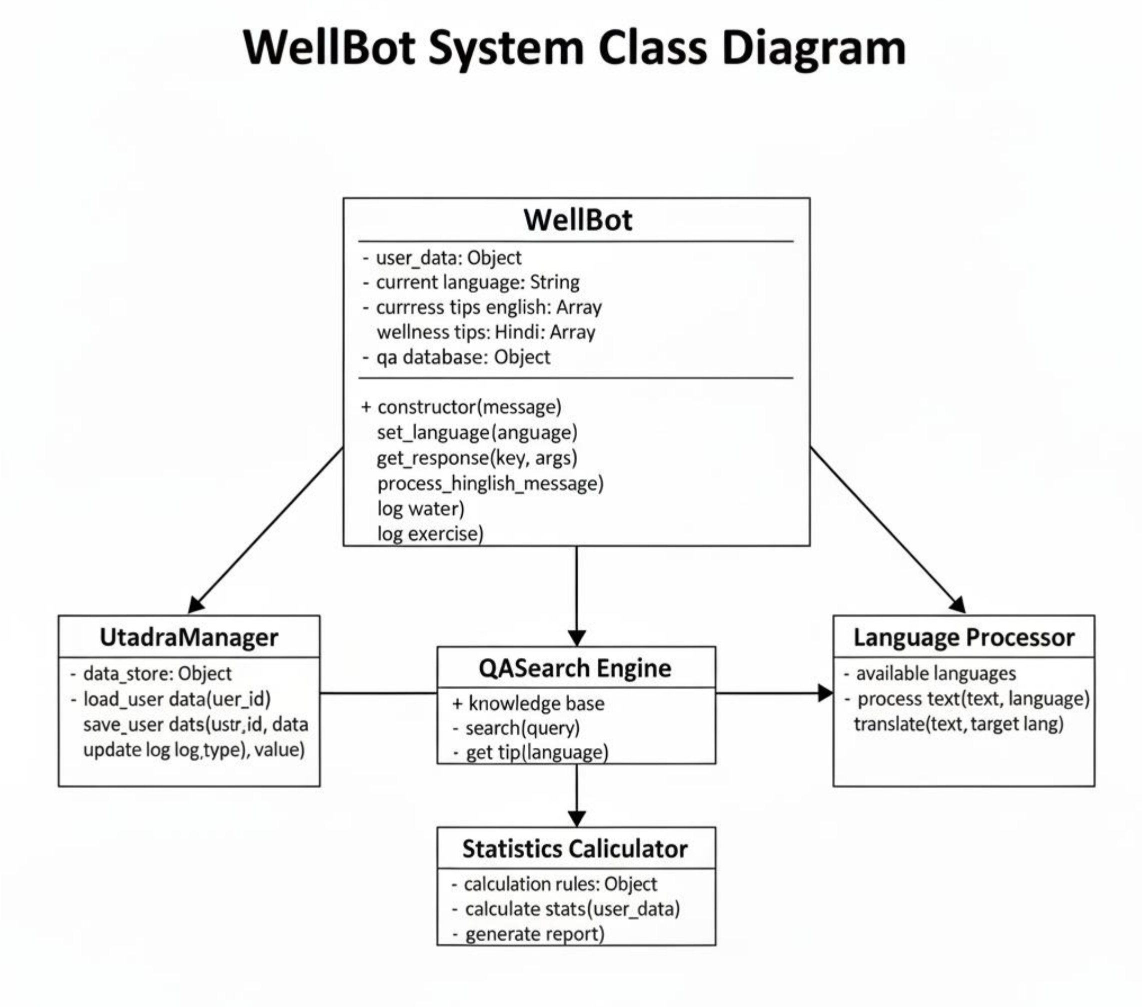


Class Diagram:

Purpose: Describes the **static structure** of an object-oriented system. It's the blueprint for the code.

What it shows: The system's **classes**, their **attributes** (data), **operations/methods** (functions), and the **relationships** (like inheritance, association, or aggregation) between them.

Analogy: The architectural blueprint of a house, detailing every component (room, wall, window) and how they are structurally connected.



7. Conclusion and Future Work

7.1. Project Summary

WellBot successfully delivers a secure, multilingual, and data-driven wellness assistant built on a robust Flask/Rasa architecture. By integrating a customizable knowledge base with advanced NLP capabilities, it fulfills its primary goal of providing accessible, non-diagnostic guidance in both English and Hindi, all within a professional and responsive web application. The implementation of authentication, the Admin Dashboard, and the feedback system ensures the project is not only functional but also secure, maintainable, and iteratively scalable.

7.2. Recommended Future Enhancements

- **Integration:** Migrate from SQLite to a cloud-based database (e.g., **PostgreSQL, Firestore**) for global deployment and improved concurrency/scalability.
- **Conversational Flow:** Implement Forms/Flows for structured information gathering (e.g., asking about symptom duration, pain level) to enhance the conversational depth.
- **Language:** Addition of **Spanish and French** language support.
- **Personalization:** More extensive use of age_group and other profile data to customize advice more precisely.