Lachesis Chatbot v2

Functional Overview and Improvement Report

Introduction

The Lachesis chatbot v2 is an upgraded conversational assistant integrated into the Lachesis wearable ecosystem. Its primary goal is to support elderly users in understanding their health metrics, accessing wellness tips, and receiving assistance with device usage. This new version builds upon the earlier prototype developed in previous trimesters, which primarily relied on static hardcoded responses and lacked contextual understanding or dynamic document processing.

The revamped chatbot offers a more intelligent, responsive, and accessible experience for elderly users by leveraging advanced AI tools such as semantic search, retrieval-augmented generation (RAG), and text-to-speech output. It is designed as an optional but value-adding feature for the Lachesis wearable device.

Technical Improvements

Several enhancements have been made to transform the chatbot into a production-ready, modular system. The major technical improvements include:

1. Modular Architecture

The codebase has been completely restructured to follow a modular and scalable format. Key modules include:

- **ingest/**: Handles PDF conversion, markdown text splitting, and sentence embedding.
- **db/**: Interfaces with the Qdrant vector database for semantic retrieval.
- **llm/**: Contains the logic for LLM interaction and response generation.
- **app/**: Hosts both the FastAPI backend and the Streamlit frontend with voice capabilities.

This separation of concerns allows for faster debugging, easier maintenance, and future extensibility.

2. Retrieval-Augmented Generation (RAG)

The chatbot uses a RAG pipeline:

- User queries are converted into embeddings using the Sentence Transformers model (all-MiniLM-L6-v2).
- These embeddings are matched against a vector store (Qdrant), retrieving the most relevant document chunks.
- The results are reranked using FlashRank to ensure high relevance.
- A LLaMA 3.1-based language model (served via Groq) then formulates the final answer.

This architecture ensures that responses are grounded in the information available in the uploaded documents, minimizing hallucination and improving factual accuracy.

3. Interactive UI with Voice Output

The user interface has been built using Streamlit, which is intuitive and accessible for elderly users. An additional feature added in this version is **Text-to-Speech (TTS)** using the pyttsx3 library. This ensures that users with visual impairments or limited reading ability can still access the chatbot's responses audibly.

Key Features

The chatbot is now capable of performing a range of useful tasks:

Health Metric Interpretation

It can interpret values for heart rate, blood pressure, hydration, and sleep. Users can input their daily or weekly averages and receive feedback based on standard benchmarks. For instance, if a user asks, "Is 140/90 a high blood pressure reading?" the chatbot responds with context and recommendations.

General Health Education

The chatbot answers queries related to health, wellness, and lifestyle management specifically tailored for the elderly. Topics include heart health tips, hydration guidelines, sleep hygiene, and exercise routines for aging individuals.

Lachesis Device Support

Users can also ask questions like “How do I pair my Lachesis band?” or “What is the hydration estimator?” and the chatbot will provide device-related assistance sourced from the official Lachesis guide and FAQ.

Contextual Search from Documents

Instead of relying on static responses, the chatbot searches its indexed document corpus to answer questions dynamically. It retrieves relevant sections of health guides and user documentation to form contextual and informative answers.

Voice Output (Text-to-Speech)

To enhance accessibility, the chatbot can read responses aloud using a toggle switch in the interface. This is particularly beneficial for users with reduced vision or reading difficulty.

Dataset and Document Sources

To provide intelligent and medically grounded responses, the chatbot was trained and indexed using a curated set of documents, both real and simulated.

Internal Lachesis Documentation

- **Lachesis_User_Guide.pdf**: Contains setup instructions, key features, and usage tips.
- **FAQ_Lachesis.pdf**: Answers to frequently asked questions about the wearable and app.
- **Health_Metrics_Reference_Ranges.pdf**: Benchmark ranges for heart rate, blood pressure, sleep, and hydration.
- **Daily_Weekly_Metric_Averages_Examples.pdf**: Simulated user data to test chatbot feedback accuracy.

Simulated and External Health Resources

- **Elderly_Heart_Health_Tips.pdf**: Compiled using summaries from credible organizations like the Heart Foundation Australia and Mayo Clinic.
- **Sleep_Hygiene_Elderly.pdf**: Based on guidelines from the National Institute on Aging and Better Health Channel (VIC Government).

In addition to these, the chatbot was exposed to **sample health metric datasets** derived from open-source platforms like Kaggle. These include anonymized heart rate and sleep data logs, which were used to establish baseline patterns and simulate realistic user queries. Scholarly articles from PubMed and Open Access Journals were also paraphrased and distilled into FAQ-friendly formats for ingestion. These sources helped ensure that the chatbot's recommendations align with up-to-date medical advice and common geriatric concerns.

Functional Summary

- **Health Q&A**:
  The chatbot responds to questions related to elderly health and wellness. This includes topics like ideal heart rate ranges, hydration needs, sleep quality, and blood pressure norms, tailored specifically for aging individuals.
- **Lachesis Device Support**:
  Users can receive help regarding the Lachesis wearable, including pairing instructions, feature explanations (such as the hydration estimator or sleep monitor), and basic troubleshooting.
- **Semantic Search**:
  Instead of relying on fixed answers, the chatbot uses semantic search to retrieve relevant information from the uploaded PDF documents. It forms its responses based on actual sections of those documents.
- **Metric Evaluation**:
  The chatbot is capable of interpreting health values entered by users. For example, if a user asks, "Is 6 hours of sleep enough for me?", the chatbot compares the input against benchmark data and provides feedback.
- **Voice Output**:
  Using built-in text-to-speech functionality, the chatbot can speak its responses aloud. This is particularly beneficial for users with visual impairments or reading difficulties.
- **UI Simplicity**:
  The chatbot is presented through a Streamlit interface, which is intentionally designed to be simple, clean, and elderly-friendly, minimizing cognitive load and navigation barriers.

Conclusion

The current version of the Lachesis chatbot represents a significant step forward from the earlier static prototype. It is now modular, intelligent, document-aware, and accessible. The enhancements made not only improve the user experience but also align with the long-term goals of the Lachesis project — to support elderly users with proactive health guidance through wearable technology and conversational AI. Future extensions may

include direct integration with real-time sensor data, multilingual support, and more advanced reasoning based on longitudinal health trends.