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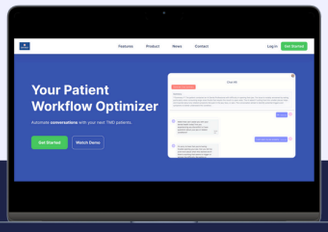
Development of a Large Language Model-Driven Consultation Chatbot for Temporomandibular Joint Disorders (2425DEN1002)

Introduction

- Temporomandibular disorders (TMDs) are a group of conditions affecting the jaw joint and surrounding muscles, often causing pain, discomfort, and restricted movement.
- The diagnosis of these conditions continues to remain time-intensive, requiring long dentist-led interviews and patient self-reports.
- Further imprecision in collating relevant patient histories into diagnostic context means that traditional methods vary in care methodologies.
- This project is aimed to address these issues.

Objective

This research aimed to develop a system powered by LLMs to automate the patient interview process for TMDs. Given the unspecialized knowledge base of existing LLMs, it aimed to integrate a Retrieval-Augmented Generation (RAG)-enhanced Large Language Model (LLM) with patient-specific medical data that would streamline the patient data collection. Furthermore, the project aimed to further provide clinicians with a system to generate structured summaries of the conversations to accelerate clinical decision-making. The proposed approach attempted to enhance both the workflow and the overall quality of care in managing TMDs.



Dentist Dashboard

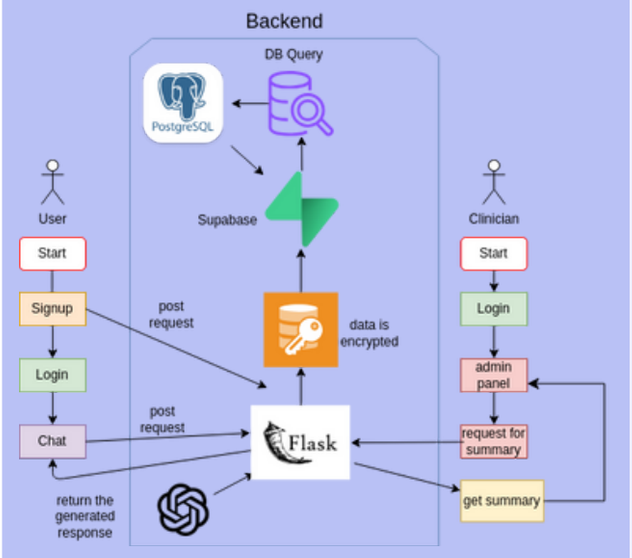
A dedicated dentist-facing web platform was also further implemented using React to allow clinicians to access the full transcript of the patient-AI conversation after completion. The portal, which is supported by the same Flask server and Supabase service, includes a feature to dynamically generate summaries of the interaction, highlighting critical symptoms, patient history, and potential risk factors.

Methodology

The interdisciplinary team began with collaborative discussions to define the problem statement and core logic, selecting an appropriate tech stack aligned with time constraints and team expertise. Concurrently, the dental research team identified key temporomandibular disorder (TMD) questions and topics through literature review.

The data obtained was chunked through the use of LangChain and was eventually supplied to OpenAI's text-embedding-3-small model to create vector embeddings, which were stored in a Chroma database.

A Retrieval-Augmented Generation (RAG) model was created using a relevant prompt containing the conversation scenario, conversation context, and the retrieved relevant chunks of information, which were provided to LLMs. This allowed LLMs to provide context-specific responses with great diagnostic alignment. Multiple LLMs were tested, with some successfully hosted on local servers, eliminating the reliance on third-party APIs and improving overall security and privacy.



Results

The final chatbot was able to demonstrate robust performance, successfully generating contextually relevant responses to patient-specific questions in approximately 5 seconds, achieving strong diagnostic alignment with TMD diagnostic criteria. Additionally, the leverage of the dentist portal reduced overall diagnostic prep time, with the system emphasizing the value of raw transcript access for auditing AI decisions.

Conclusion

This project successfully developed an LLM-driven chatbot application and a dentist portal for streamlining the TMD interview process. By integrating an RAG framework, the chatbot demonstrated strong alignment with diagnostic guidelines. While the system excelled in structured symptom identification, challenges persisted in interpreting subjective patient descriptors (e.g., pain location), underscoring the irreplaceable role of clinician judgment. Overall, this project highlights the potential of AI to augment —not replace—clinical workflows, offering a scalable solution to reduce diagnostic delays for TMD patients. By combining technical innovation with clinician feedback, the system sets a precedent for privacy-conscious, human-AI collaboration in healthcare.

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