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# AI Driving Companion

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**A B S T R A C T**

The AI Driving Companion is a voice-based AI solution that provides drivers with instant, relevant information from car manuals. Using Retrieval-Augmented Generation (RAG) and Large Language Models (LLMs), it interprets voice queries and delivers accurate responses. The system supports multilingual input via OpenAI's/Deepseek Whisper and outputs natural speech through ElevenLabs and Pyttsx3. Unlike IoT-based systems, focuses on intelligent document interaction, retrieving data from a vectorized manual database. This AI-powered assistant enhances safety and accessibility by minimizing distractions and simplifying information access while driving. Car manuals are processed into a vector database, enabling the AI to retrieve and summarize precise content in response to user commands.

**Keywords:** Voice-based AI, Retrieval-Augmented Generation, Large Language Models, OpenAI Whisper, ElevenLabs, Pyttsx3, Vector Database.

## 1. INTRODUCTION

AI Driving Companion is an AI-powered assistant designed to enhance driver interaction with vehicle features through natural voice commands. By leveraging Large Language Models (LLMs) and Retrieval-Augmented Generation (RAG), the system provides accurate and context-aware responses by retrieving relevant content directly from vehicle user manuals. The primary objective is to improve road safety and user convenience by reducing the cognitive load associated with manually browsing through extensive documentation while driving.

Traditional vehicle manuals are often lengthy, complex, and not easily accessible in real-time driving scenarios. This limitation can lead to driver distraction, poor decision-making, or incorrect usage of vehicle functionalities. The proposed system addresses these challenges by offering a voice-activated, multilingual, and intelligent query-response interface that interprets user intent and delivers concise, relevant information instantly. Unlike conventional in-car systems that rely heavily on sensor data and static responses, this solution focuses on intelligent document interaction, enabling a more dynamic and scalable driving support system.

## 2. LITERATURE REVIEW

[1] **"**S. Es, J. James, L. Espinosa-Anke, and S. Schockaert, "Ragas: Automated evaluation of retrieval augmented generation," in Proc. 18th Conf. Eur. Chapter Assoc. Comput. Linguistics: Syst. Demonstrations, Mar. 2024."

Proposed an automated evaluation framework (RAGAS) for assessing Retrieval- Augmented Generation (RAG) systems. It measures the quality of generated answers based on relevance, faithfulness, and contextual grounding. While not a driving assistant itself, RAGAS is highly relevant for evaluating systems that rely on RAG to deliver accurate and trustworthy responses.

[2] "R. Yang, X. Zhang, A. Fernandez-Laaksonen, X. Ding, and J. Gong, "Driving style alignment for LLM-powered driver agent," 2024, arXiv:2403.11368."

Introduced a driver agent that adapts its responses to match individual driving styles using large language models. Enhances driver trust and interaction quality, but focuses more on personalization than on task-specific retrieval.

[3] "D. AI, "Evaluating RAG pipelines using langchain and ragas," 2024. Accessed: May 30, 2024. [Online]. Available: https://deci.ai/blog/ evaluating-rag-pipelines- using-langchain-and-ragas/"

Explained how to evaluate RAG pipelines using LangChain and RAGAS, with a focus on practical implementation. Useful for improving the accuracy and reliability of systems that rely on document-based question answering.

[4] ”H. Tanaka, M. Miwata, M. Ikeda, and L. Barolli, “An enhanced AI-based vehicular driver support system considering hyperparameter optimization,” in Proc. Int. Conf. Innov. Mobile Internet Serv. Ubiquitous Comput., 2023”

Proposed an enhanced AI-based driver support system that improves performance through hyperparameter optimization. Focused on system efficiency and responsiveness, though without integrating conversational interfaces.

[5] “S.-J. Hsieh, A. R. Wang, A. Madison, C. Tossell, and E. de Visser, “Adaptive driving assistant model (ADAM) for advising drivers of autonomous vehicles,” ACM Trans. Interactive Intell. Syst., vol. 12, no. 3, 2022.”

Proposed an AI architecture that used sensory fusion and trust modeling to tailor alerts based on how much the driver trusts automation. It integrated predictive AI to make decisions about when to intervene, optimizing both safety and driver comfort.

## 3. METHODOLOGY

The AI Driving Companion was developed using the Evolutionary Prototyping Model**,** enabling iterative improvements based on continuous feedback. The system architecture integrates four core modules: speech recognition (OpenAI Whisper), document retrieval (LangChain with ChromaDB), language understanding (LLMs like GPT-4o, Deepseek), and text-to-speech (ElevenLabs or pyttsx3).

Tools and Technologies:

Programming Language**:** Python.

Libraries**:** LangChain, OpenAI, Deepseek, Whisper, ChromaDB, ElevenLabs, pyttsx3.

APIs Used**:** OpenAI Whisper, GPT/Deepseek models, ElevenLabs TTS.

Interface**:** Tkinter GUI with event-loop based voice interaction.

## 4. MODELING AND ANALYSIS

The development of the **AI Driving Companion** involved systematic modelling and analysis of both functional and non-functional requirements, followed by architectural design to support voice-driven interaction with vehicle manuals.

### *4.1 System Analysis:*

**Functional Requirements**: The system processes voice commands, converts speech to text using Whisper, retrieves relevant information using RAG, and generates responses via LLMs, which are then converted back to speech.

**Non-Functional Requirements**: Key priorities include fast response time, multilingual support, high accuracy, scalability across vehicle models, and an intuitive user experience

### *4.2 Hardware and Software Requirements:*

**Hardware**: A multi-core CPU (Intel i5 or above), 8–16 GB RAM, microphone, speakers, and optional GPU.

**Software**: Python 3.x with libraries and APIs including OpenAI, Deepseek, LangChain, ChromaDB, ElevenLabs, and pyttsx3.

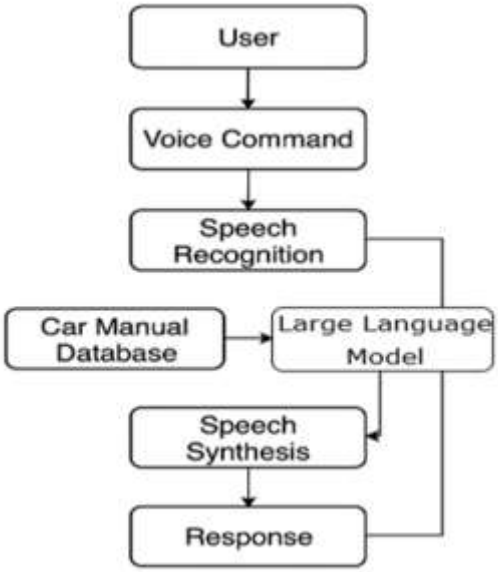
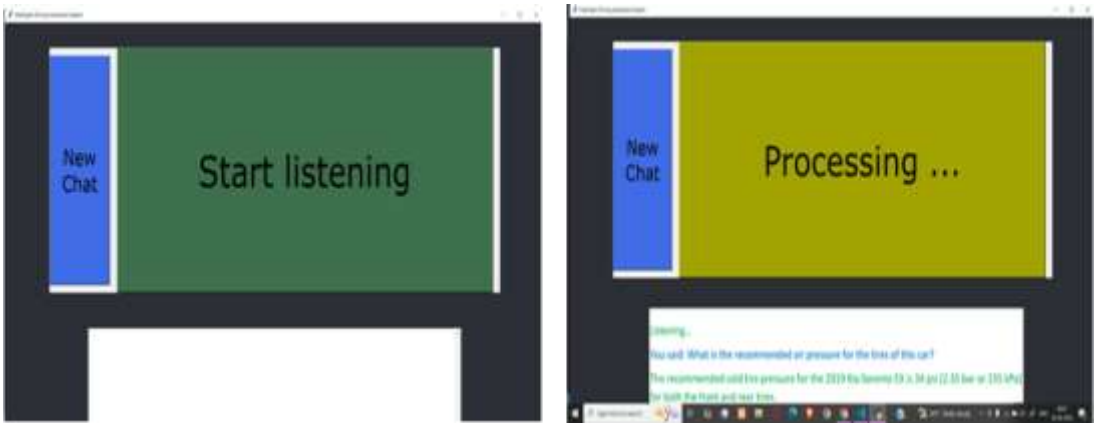



**Fig. 1 - Architecture Diagram**

## 5. RESULTS AND DISCUSSION

The AI Driving Companion was successfully developed and tested as a real-time, voice-activated AI assistant that retrieves context-specific information from vehicle manuals using Retrieval-Augmented Generation (RAG) and Large Language Models (LLMs). The system demonstrated low latency, high accuracy, and robust multilingual support, with Whisper effectively handling speech-to-text conversion and ElevenLabs/pyttsx3 delivering natural-sounding responses. Through unit and integration testing, consistently responded correctly to common user queries, such as checking oil levels or understanding dashboard indicators. These results confirm the system's potential to reduce driver distraction, enhance accessibility, and bridge the gap between static documentation and real-time assistance.




**a)** **(b)**

**Fig 2 – (a) Intial Start, (b) Output**

## 6.Conclusion and Future Works

The development of the AI Driving Companion demonstrates the effective application of Retrieval-Augmented Generation (RAG) and Large Language Models (LLMs) to enhance driver interaction with vehicle documentation through voice-based queries. By eliminating the need for manual searches, the system promotes safer driving and improves accessibility, particularly for multilingual users. The integration of speech recognition, intelligent retrieval, and natural language generation within a modular architecture highlights the potential of AI-driven assistants in modern automotive environments.

## 7. Future works:

1. Support multiple languages to reach a broader user base.

2. Integrate emotion-aware features to adapt responses based on driver mood.
3. Connect with vehicle sensors for smarter, data-driven responses.
4. Develop a mobile or in-dash interface for better user interaction**.**

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**References**

[1] Es, S., James, J., Espinosa-Anke, L., & Schockaert, S. (2024). *RAGAS: Automated evaluation of retrieval-augmented generation*. In *Proceedings of the 18th Conference of the European Chapter of the Association for Computational Linguistics* (pp. 150–158).

[2] Jiang, A. Q., et al. (2024). *Mixtral of experts*. arXiv preprint arXiv:2401.04088.

[3] Meta. (2024). *Introducing Meta LLaMA 3*. Retrieved July 25, 2024, from https://ai.meta.com.

[4] Yang, R., Zhang, X., Fernandez-Laaksonen, A., Ding, X., & Gong, J. (2024). *Driving style alignment for LLM-powered driver agent*. arXiv preprint arXiv:2403.11368.

[5] Radford, A., et al. (2023). *Robust speech recognition via large-scale weak supervision*. In *Proceedings of the International Conference on Machine Learning* (pp. 28492–28518).

[6] Touvron, H., et al. (2023). *LLaMA 2: Open foundation and fine-tuned chat models*. arXiv preprint arXiv:2307.09288.

[7] Ouyang, L., et al. (2022). *Training language models to follow instructions with human feedback*. In *Advances in Neural Information Processing Systems* (Vol. 35, pp. 27730–27744).