

Research Paper

ADVANCED AI CHATBOTS USING LLMS

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Abstract— The rapid development of large language models (LLMs) has radically changed the nature of human-computer communication, with intelligent computers being able to comprehend and generate natural language with stunning accuracy. Multimodal LLM integration improves the understanding of text, visual, and structured data, therefore expanding the opportunities of automatic reasoning and information retrieval. In this paper, the author presents an elaborate design of a sophisticated AI chatbot system based on the state-of-the-art large language models (Llama 3.3 70B) and vision processing (Llama 3.2 90B). The system makes use of optimized prompts and response temperature modifications to generate contextually accurate and relevant results. Document processing capabilities help to extract and read PDF, Word, picture files, and base64 encoding ensures the management of data. The back-end is a FastAPI server which supports real-time communications, session persistence, and multi-format interactions, supplemented by a reactive front-end with modern UI components, animation effects, and mobile optimization. Additional functionalities include coding syntax highlighting, markdown rendering, and image analysis, which make it easy to interact with the user. The issues related to deployment include security, performance improvement, and scalability, which exemplify the feasibility of the practical implementation of multimodal LLMs into intelligent conversational systems. The results highlight significant improvements in precision of response, user engagement and document comprehension.

“Keywords— large language models, multimodal AI, real-time chatbots, document processing, system prompt optimization, FastAPI backend, code rendering, image analysis”.

I. INTRODUCTION

The breakthrough of AI has transformed human-computer interaction. Large language models with capabilities of understanding and generating natural language have had a

significant influence on the development of intelligent conversational systems. The models enable the intelligent conversational agents to imitate human speech. Large language model AI chatbots are fast, automated, and more engaging. They augment efficiency as well as availability of internet communication [1]. Big language models are able to see context, meaning, and purpose in the context of language processing. Dialogue systems are better than automatic replies. These models process big data within the health care, education, consumer services, and research. The multimodal conversational language models use text, graphics, and documents as well as structured data. Commercial digital assistants have changed because of chatbots. Research shows that conversational bots as a result of AI can aid learning, solve problems, and improve online services. Chat system expounds, answers questions and directs users in complex processes. Many websites use AI chatbots to enhance the customer experience and support [3].

The conversational AI can advance education, technology, information sharing, and support services. Chatbots can explain complex issues, answer technical questions and give guided information. Digital knowledge systems are improved with the help of contextual responses [4]. It must have a clear and trustworthy conversational AI. It has been shown that successful use of AI chatbots is achieved when the clients trust automated answers. The consideration of these issues will contribute to improved trust in AI-based communication systems and will lead to the establishment of digital services [5]. Chatbots deliver and distribute medical data. The examples of huge language models on such applications demonstrate how AI-based communication systems can help to retain complex information and promote engaging communication [6]. The AI chatbots can be used to achieve culture and education. Natural language processing and

customized responses are available through technologies. Online learning technologies increase the engagement to a great extent [7].

Conversational AI produces interdisciplinary chatbots. These systems have intelligent conversational interfaces that support complex conversations about diverse topics, which proves that big language models can improve knowledge discovery and transdisciplinary learning [8]. Specific businesses that need precise information have analyzed the credibility of AI chatbots. Chatbots response to technical and educated chatbots is an example of the shortcomings of AI-based communication systems. Such studies found out that context and accuracy of answers improve user confidence in automated conversational systems [9]. The studies of AI chatbot accuracy prove the presence of complex issues like retrieving medical data. Proper and culturally sensitive language models thrive in the presence of veracity among users [10]. Companies and online platforms are creating conversational bots which are powered by massive language models to improve communication and user interaction. Chat systems that operate on AI machine responses automate responses, provide digital services, and enable natural language discussions. The current project aims to create a smart conversational platform with large language models (LLMs) as a tool to engage with customers via natural interaction, manage users, and communicate automatically [11].

II. RELATED WORK

The large language models and artificial intelligence have undergone significant progress that has greatly improved conversational systems. These systems have been using more and more natural language communication and intelligent response generation to help users in various fields. Studies have shown that AI-powered chatbots have the ability to combine human knowledge with computer-based conversation support to solve mental health issues. These plans are to deliver sympathetic and safe communication networks through which people can communicate without losing privacy and dependability in online communication platforms [12]. There have been studies which have extensively investigated large language models regarding their ability to modernize the outdated information systems and enhance the digital infrastructure. Studies have shown that language model can help transform institutional systems, improve information access and promote more than just conversational processing. These results show that large language models (LLMs) can be used to improve knowledge management, communication, and intelligent interaction with complicated digital systems [13].

The generative AI technology has been designed to produce specialized chatbots that can analyze and understand text based on different sources. The combination of natural language interaction with news article analysis chatbots allows the user to process large amounts of data through content summarization and answering of questions. The area of conversational AI is gaining importance in terms of knowledge acquisition and information analysis [14]. It is also significant to research the interactions between users and conversational AI systems. Interaction and prompting guidelines can be used to increase the relevance of answers and the quality of communication when the learner communicates with a chatbot based on language models. This study shows that the degree of user interaction and timely

design determine the effectiveness of conversational AI systems in learning and educational contexts [15].

Generative AI-based modular conversational platforms, especially those based on creating the question-answering chatbots, have elicited significant attention. They provide flexible models of building conversational robots of responding to user queries and delivering useful information. Such technologies show that scalable platforms can combine generative models to provide automated knowledge assistance in applications [16]. Privacy and security should be taken into consideration in the creation of conversational AI. Studies have also studied privacy chatbots which help people to take care of health issues via interactive communications without exposing their personal data. The technologies illustrate how AI chatbots can support consumers and protect their data [17].

ML as a means of categorizing human-chatbot interactions is an important field of study. This paper examines how conversational patterns and user inputs can be used to improve the performance and accuracy of chatbots. Such technologies allow conversational systems to understand the intention of the user and alter the response. The impact of conversational AI on the educational performance was widely studied. Studies have discussed the application of AI chatbots in learning regarding student interactions and achievement. The conversational systems may support learning through interactive guidance, elucidations and information provision on the basis of natural language communication interfaces [19].

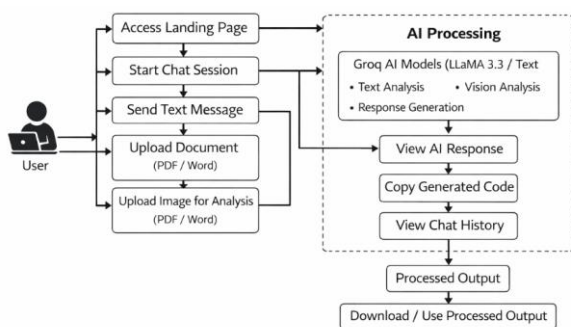
The systematic reviews have shown how the AI chatbots have evolved into big language model systems despite their rule-based frameworks. Such studies include the application of language modeling to enhance the contextual understanding, coherent response, and the complex conversational interaction of chatbots in a variety of applications [20]. In addition, responses of chatbots in the area of expertise have been evaluated in terms of accuracy and efficiency. Reactions of chatbots to expert questions suggest that the conversational AI systems may also help the users learn and comprehend complicated issues, as well as, in an interactive manner, but the accuracy should be improved [21].

Critical assessments of AI chatbots and language models include the latest technologies of conversational systems and approaches. These researches demonstrate how traditional natural language processing has evolved to more sophisticated language models that facilitate intelligent communication, assistance in knowledge and automatic interaction over digital platforms [22].

III. MATERIALS AND METHODS

An advanced conversational AI system based on massive language models and multimodal intelligence is proposed to improve the human-computer interaction. The method enhances user-AI chat interaction (conversation) with the use of natural language. Modern research shows that giant language model-based chatbots are increasingly being viewed as intelligent digital assistants with the ability to provide contextually aware responses and offer engaging interaction in the style of human communication. Such features improve conversational systems and make them sound more natural, informative and user-friendly [23]. The proposed system leverages a standardized conversational interface that is skillfully used to handle various user inputs. The technology

can understand visual and document data and speak in a written language. Sophisticated AI algorithms are used to analyze user queries so as to provide contextually relevant answers. The conversational systems may help users in knowledge discovery, question answering and information retrieval by making the system more accessible and usable through interactive conversation [24]. The system uses multimodal big language models to handle the different types of data within the same conversational system, which increases flexibility of interaction. Such models allow the platform to understand images and text, retain user conversation. Multimodal intelligence makes the AI systems respond to complex input to produce correct answers, therefore enhancing conversational platforms. We are interested in creating intelligent conversational experience that will combine the high knowledge of language, multimodal processing of input, and interactive communication to facilitate access to information and automated help on the digital platforms [25].



“Fig. 1. Workflow of the AI-based document and image analysis chat system”

Figure 1 illustrates a process that is user-centric to an AI-enhanced platform. The process starts by a user browsing into the landing page to start a chat session. Groq AI Models analyze and react to inputs in the form of text messages, documents, or photographs (LLaMA 3.3). The processed result can now be downloaded or replicated by the user or accessed to get the history.

A) System Environment and Development Framework:

The development of the conversational AI platform is based on a modern web-based application framework, which will allow communicating with users on a large scale and effectively and efficiently with intelligent computing units. The backend is built on the basis of high-performance web framework that handles asynchronous requests and enables effective API connection. This architecture ensures timely and reliable handling of user requests that come in such as text messages, photos, file uploads.

The application environment includes document processing and image data library. These tools are useful in enabling the extraction of textual information out of files by the system and the preparation of image information to be analyzed by the vision-based model. The resources which are not dynamic, such as interface elements, style sheets and interactive scripts are managed within the environment to ensure a responsive and user friendly web interface.

The system environment is configured to support the communication between the frontend interface and the units

of backend processing through well defined API routes. These paths help the program to receive user inputs, manipulate them using complicated models, and provide the answer in real-time. The environment is also available with the session management capabilities that support continuity of user interaction during the long chats.

The environment has security mechanisms and performance optimization strategies to ensure reliable operation in case of simultaneous user interaction. This development environment provides a strong platform to develop an intelligent conversational platform capable of managing the different user interactions and give meaningful responses through an interactive web interface.

B) Conversational AI Processing using Large Language Models:

The conversational intelligence of the system is driving on massive language models that understand natural language queries and generate appropriate answers. These are the models that are designed to research the linguistic construct and contextual meaning of user inputs to produce specific and logical responses. Textual questions are processed by the system and sent to the language model which processes the text and comes up with a response that is contextually relevant.

Some of the conversational activities that language model can carry out include answering questions, providing explanations, summarizing content and assisting the users with technical questions. The ability of the chatbot to understand contextual connections allows the continuity of the interactions in multiple discussions. This feature refines the quality of dialogue and enables the system to give answers that are similar to the past user-feedbacks.

The system incorporates a vision-based language model that examines visual data that is posted by its users on photos. This model will analyze the material of pictures sent and will provide meaningful conclusions to come up with informative responses. The chat system combines textual and visual understanding capabilities and is consequently able to understand multimodal input and provide more comprehensive explanations.

The language model conduct is guided with care by using rapid design and parameter tuning processes to ensure that the responses of the model are relevant and structured. These algorithms enable a trade off between accuracy and flexibility in responses generated enabling the chatbot to work effectively in numerous conversations.

C) Multimodal Input Handling and Data Processing:

The system is designed in such a way that it can accommodate different types of user inputs such as a text, pictures, and document files. This feature helps the chatbot to aid the user in the analysis of papers, interpreting images, or deriving information out of written content. All types of inputs experience different operations that prepare the data to be interpreted by the AI models.

The system can accept document based inputs in such formats as PDF and Word documents. When a file is uploaded, the system scans the internal structure of the

document and finds textual information. The content obtained is then filtered and organized before it is passed on to the language model to analyze. The chatbot is then able to answer questions related to the content or summarize the content on the file.

Image inputs are processed by using image handling protocols which converts the file supplied into a format that can be analysed. The system uses encoding schemes to encode image information in a transportable format that can be processed by the language model that is vision enabled. The model then analyzes visual elements in the image and forms responses of the information that has been identified.

The technology also increases the number of activities that can be obtained by the use of conversational interaction by supporting the different types of input. This multimodal processing feature enhances the flexibility of the chatbot and makes it be able to support different user needs in a unified communication system.

D) Interactive Chat Interface and User Interaction Management:

The user interaction arm of the system is implemented through a web-based chat interface which is used to support real time interaction between the users and the conversational AI platform. The interface provides a user-friendly interface where one can post queries, upload documents, and receive AI-generated responses. The methodologies of responsive design ensure that the interface will be effective on different gadgets and screen sizes.

Chat interface supports the real time communications which allows users to talk with the AI system in a conversational manner. When a message is sent, it is immediately transmitted to the backend processing part through API requests. The request is handled by the backend and the response is generated which is displayed on the chat window.

The interface also has the features which enhance usability and readability of response. Formatting allows the orderly delivery of information by the chatbot with the help of lists, explanations, or prepared text. Code syntax highlighting ensures that the responses related to programming are displayed in a different manner which eases understanding and reuse of the generated code by the user.

In addition to this, uploading of files allows users to transfer documents and pictures instantly in the chat. These files are processed by the system and even the AI models analyze them so that the chatbot can create answers through the uploaded material. This interactive interface is critical in supporting easy connection of users with the smart conversational platform.

E) Conversation Context Management and Response Delivery:

One of the most important aspects of the advanced dialogue systems is the preservation of conversational context. The system has systems that store and control chat sessions and the conversational AI can use previous messages to make their responses. It is a process that will ensure conversations are always the same and that the chatbot is able

to provide contextually aware replies in the case of extended conversations.

Session management techniques are used in order to save continuity of user activities. When a chat session is launched, the system creates a session instance that keeps track of the history of the conversation. Each incoming message will be associated with the session, and the chatbot will be able to contextualise questions in relation to the previous discussion. The approach helps the system to provide more meaningful and relevant responses.

The responses generated are presented to the chat interface in a structured manner, which can easily be discussed. The answers can be in the form of elucidations, synopses or technical information depending on the nature of the query. Additional features such as the ability to copy code will allow the users to easily reuse the outputs they have created in their development or research purposes.

The performance optimization methods ensure the speed in terms of delivering responses even when more than one user is interacting. Good data handling and scalable communication protocols lead to increased reliability of the systems and the conversational platform is able to provide a user with continuous support through intelligent interaction.

IV. EXPERIMENTAL RESULTS

The developed AI chatbot platform is characterized by the demonstrated skills of conversational abilities, as it is able to process the types of inputs and give context-related responses. The site is also highly efficient in terms of text search, document submission and image submissions within an integrated chat system enabling the user to obtain relevant information through interactive communication. The ability to process documents helps extract and interpret the textual information on uploaded files and picture analysis improves the understanding of the visual information. The system maintains context of discussion through session management, which improves continuity of the dialogue and relevancy of responses. The solution illustrates strong real-time interaction between the UI and AI models, which enable the effective knowledge searching, automatic help, and flexible interaction with different queries of the user.

TABLE I
FUNCTIONAL EVALUATION OF AI CHATBOT SYSTEM
FEATURES

Feature / Function	Input Type	System Operation	Output Generated	Observation
Text Query Processing	User text message	Query sent to language model for interpretation	Context-aware AI response	System generates relevant conversational replies
PDF Document Analysis	Uploaded PDF file	Text extracted and analyzed	Summary or answer based on document content	Document information successfully interpreted
Word Document Processing	DOC/DOC X file	Document parsed and	Explanation or extracted	Structured text

		text processed	information	correctly processed
Image Understanding	Uploaded image	Image encoded and analyzed by vision model	Description or response related to image	Visual content correctly interpreted
Chat Session Management	Continuous user queries	Session context maintained	Contextual responses across conversation	Conversation flow maintained
Code Generation Support	Programming query	Model generates technical content	Formatted code snippet	Code displayed with syntax formatting

Table I outlines the functional analysis of the designed AI chatbot system by presenting the salient system attributes, type of inputs, process of processing, output generated and the behaviour exhibited by the system when interacting with the users.

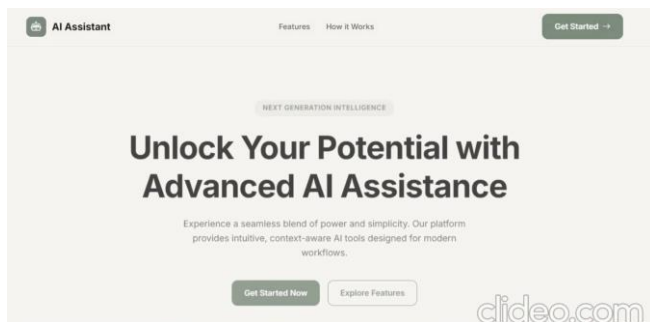


Fig. 2 AI Assistant Landing Page Interface

Figure 2 demonstrates the home page of the AI Assistant with a smooth and modern design that focuses on improving the user experience by introducing intelligence to their capabilities.



Fig. 3 AI Assistant Chat and Code Generation Interface

The chat interface of the AI Assistant (Fig. 3) has a sidebar to view discussion history and a Flask code sample of a response.

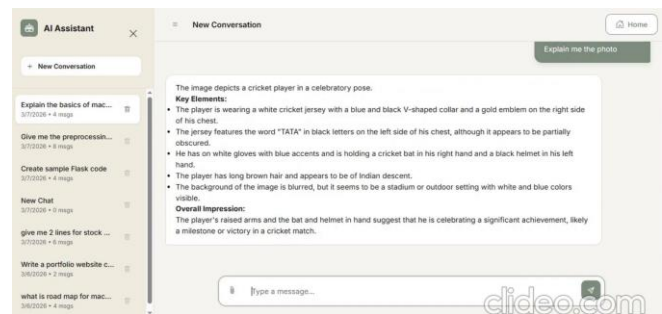


Fig. 4 AI Vision Analysis and Image Description Interface

Figure 4 demonstrates the visual abilities of the AI, which provides a detailed descriptive study of an uploaded image of a cricket player.

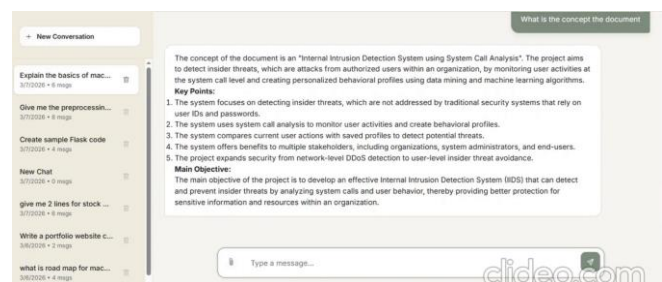


Fig. 5 AI Document Analysis and Summarization Interface - Internal Intrusion Detection System (IIDS)

In Figure 5, one can see how the AI can summarize uploaded documents, especially the concept of an Internal Intrusion Detection System.

V. CONCLUSION

Multimodal large language models employed by advanced AI chatbots have significant interactive and intelligent user contact. The system is able to read and respond to various user questions with a great degree of contextual accuracy by combining Llama 3.3 70B in text understanding of the query and Llama 3.2 90B in sight-based query. The continuity of conversations is made possible by real-time messaging, session preservation, and multi-format support, whereas document processing is also provided with an opportunity to extract and interpret PDFs, Word documents, and picture files accurately. System prompt optimization and response temperature adjustment allows making the outputs generated more relevant and accurate. The user interface, which includes flexible layouts, modern UI design, and animation effects, and mobile responsiveness, improves the experience of users with different devices. This is due to the sophisticated capabilities of the system such as code syntax highlighting, markdown rendering and picture analysis making it more useful to technical and data-intensive applications. The FastAPI-based backend ensures the effective handling of the requests, security, and scalability, which makes it possible to deploy it in the production environment without a decrease in the performance. The integration of multimodal LLMs into intelligent chat systems is associated with user engagement and faster information discovery as well as better interpretations of structured and unstructured input. The paper highlights the real-world practicability and transformational ability of AI-based conversational agents in the fields of research and practice.

Future developments can focus on the further expansion of the capabilities of multimodal conversational AI by introducing the elements of real-time video understanding and emotion recognition to make the interactions more contextually conscious and more personalized. The incorporation of federated learning or on-device inference could be used to improve privacy and make adaptive learning based on user interactions. This is through integration of enhanced reasoning modules and knowledge graph that allow the system to provide more accurate, verified answers and handle complex multi-turn queries. Accessibility can be improved by means of cross-lingual and multilingual support to international users. Additionally, the quality of the discussion can be improved with the help of reinforcement learning based on human feedback (RLHF) that helps to reduce bias. Scalable cloud implementation combined with edge computing can enhance the performance of applications with high demand. These principles will support the creation of smarter, more contextual and safer AI-based conversation systems.

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