Generative AI Microfrontend Chatbot Development

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ABSTRACT
As a software developer intern for General Dynamics Mission Systems (GDMS), I designed a previously nonexistent microfrontend generative artificial intelligence (AI) chatbot for company-wide use to improve productivity and scalability. With the rise of ChatGPT, Copilot, and other large generative AI chatbots, it would be beneficial for GDMS to have access to similar tools. However, as a government contractor, GDMS is unable to utilize the commercial AI tools since the chatbots are continuously being trained on publicly available information. Ultimately, through design and development, my team and I utilized Python for the backend of the tool and used Angular for the frontend. Through multiple meetings with stakeholders, we developed a pilot chatbot for initial testing. For future work, we intend on performing user tests to enhance the user experience, as well as designing additional functions for improved productivity.

1. INTRODUCTION

Artificial intelligence is defined as the field of research in computer science dedicated to the development of algorithms able to simulate human intelligence, with the ability to perform tasks such as visual perception, speech recognition, decision-making, and translation between languages. The term "artificial intelligence" was initially coined in 1955. The idea originated from Alan Turing, who created the Turing Test, a method for determining a computer's ability to think like a human by evaluating how it generates human-like intelligence. In the years since, various projects involving autonomous machines have been developed, including industrial robots (Unimate), chatterbots (ELIZA), autonomous vehicles (The Stanford Cart), and many others. In the years from 1997-2011, more well-known creations were discovered, including inventions such as Deep Blue, Mars rovers named Spirit and Opportunity, and Apple's development of Siri, the virtual assistant available on iOS devices.

As AI continues to improve, the scope of AI applications' capabilities will continue to broaden. For example, the recently commercially available chatbots like ChatGPT and Copilot have transformed the way industries approach productivity and automation. Despite the developments in generative AI, however, there are still concerns involving data privacy and others security risks. As a government contractor dealing with sensitive government information, the work GDMS does is highly confidential. Since ChatGPT and Copilot are models trained from publicly available data, the need to develop a private generative AI tool was vital to advance the company's workplace efficiency and productivity.

2. RELATED WORKS

There have been previous instances observed where workplaces have reported uses of AI applications to increase operational efficiency with tasks such as automating workflows, speeding up data processing, as well as handling customer queries to minimize human intervention (Mikalef and Gupta, 2021). While not directly related to generative AI chatbots, the automation of such features is vital to decreasing the time required to complete certain mundane tasks. Another main company objective is to improve the scalability of the organization. AI can greatly improve the performance and establish the framework for long-term research and development.

GDMS is a company that greatly values work-life balance. Automating tasks can also lead to greater efficiency, since it reduces employee overtime hours (Ansari and Ahmed, 2024). With the implementation of AI tools, employees can spend the time typically used to complete menial, repetitive tasks for accomplishing higher level work that cannot be completed by a chatbot. Automation and other AI tools can ensure that employees are better equipped to handle workloads efficiently. The development of a private generative AI chatbot was thus inevitable.

3. PROJECT DESIGN

The development of the generative AI chatbot followed a structured approach to ensure the needs of a government contractor working with sensitive data. The project was designed with two core goals: creating a secure AI solution that can support a company of that caliber and ensuring that the tool could scale across multiple departments for large-scale use.

3.1 Problem Identification

The initial phase involved identifying key challenges faced by GDMS employees that prompted the need for an AI chatbot. Stakeholder meetings highlighted a need for including different AI models like OpenAI GPT-4, Llama, Claude, Gemini, and others. As a company that emphasizes constant growth, the leadership team also stressed the importance of using an internal AI chatbot tool to improve the productivity levels of employees. Additionally, government contracting regulations require GDMS to maintain a strict data privacy, so we employed strong security features throughout the development process. These requirements laid the groundwork for building an internal, secure generative AI chatbot.

3.2 System Architecture

The system's architecture was designed to prioritize data privacy and performance. The backend was built using Python, preferred due to its extensive AI libraries and compatibility with machine learning models required for the chatbot. The frontend of the project was developed using Angular, a robust framework that allows for the creation of a dynamic, user-friendly interface for GDMS employees. The entire chatbot was hosted on GDMS's secure internal server to ensure that no sensitive information would be released to external networks.

The chatbot's functionality was designed to align with the company's infrastructure. Key components included an AI-driven natural language processing (NLP) engine, capable of understanding and responding to queries. It is also capable of utilizing different AI models depending on their prompt requirements. Certain models may be more precise for technical tasks, while others may provide more creative responses. In addition, the microfrontend design of the chatbot allowed seamless integration into existing applications without disrupting ongoing workflows. The target application for the chatbot is the GDMS

Hub page, which is the landing platform for the whole company.

3.3 Core Functionalities

The primary function of the AI chatbot was to assist employees in basic tasks and improve productivity across the board. For instance, employees could ask the chatbot to generate reports for specific data sets, perform troubleshooting for software related bugs, or even simple tasks such as drafting an email to schedule a meeting or proofreading a report following the completion of a task.

4. RESULTS

Following the development of the generative AI microfrontend chatbot, user testing was conducted within a small, controlled environment consisting of employees from the IT and engineering departments. Early results showed promising improvements in productivity, where employees reported approximately a 50% reduction in time spent on routine tasks. The chatbot's ability to pull and generate information quickly and accurately was highlighted as a key benefit and great success within the company.

Moving forward, my team and I anticipate several areas of improvement based on initial feedback. Enhanced user experience features, such as the ability to save conversations and attach files to the prompt, are planned for future iterations. User testing also revealed the need for more advanced customization options, which would allow employees to tailor the chatbot's functionalities to their specific areas of expertise. Additionally, broader company-wide adoption is expected to result in increased productivity across different departments, with potential time savings predicted to be as high as 60% for certain menial and repetitive tasks.

5. CONCLUSION

The development of the generative AI chatbot microfrontend at General Dynamics Mission Systems demonstrates the impact of custom AI solutions in a government contracting environment where data privacy is of utmost importance. With a system design tailored to meet the specific needs of GDMS employees and strict security protocols, this project addresses a crucial productivity issue by offering a scalable and private tool for generative AI tools. The chatbot has already proven to be effective within the company, initial tests indicating a significant reduction in time spent on routine tasks, enhancing overall productivity for users in the IT and engineering departments.

The benefits of this AI chatbot extend beyond its current abilities since it provides a foundation for future productivity improvements and serves as a model for AI tool integration in secure work improvements. By continuing to refine based on user feedback, this chatbot has the potential to support a broad range of tasks across multiple departments. The knowledge development from this project lays the groundwork for future internal AI innovations at GDMS.

6. FUTURE WORK

Future developments include conducting more extensive user testing to gather data from a wider pool of employees and expanding its functionality to handle a greater variety of tasks. The team also plans to analyze the long-term impact of the chatbot to overall employee efficiency and work-life balance. With the ongoing improvements, the generative AI chatbot has the potential to revolutionize how GDMS employees approach their daily tasks, creating a more streamlined and productive work environment.

REFERENCES

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