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Towards expert systems for improved customer services using ChatGPT as an inference engine.

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Towards Expert Systems for Improved Customer Services Using ChatGPT as an Inference Engine

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***Abstract*—By harnessing both implicit and explicit customer data, companies can develop a more comprehensive understanding of their consumers, leading to better customer engagement and experience, and improved loyalty. As a result, businesses have embraced many AI technologies, including chatbots, sentiment analysis, voice assistants, predictive analytics, and natural language processing, within customer services and e-commerce. The arrival of ChatGPT, a state-of-the-art deep learning model trained with general knowledge in mind, has brought about a paradigm shift in how companies approach AI applications. However, given that most business problems are bespoke and require specialised domain expertise, ChatGPT needs to be aligned with the requisite task-oriented ability to solve these issues. This paper presents an iterative procedure that incorporates expert system development process models and prompt engineering, in the design of descriptive knowledge and few-shot prompts, as are necessary for ChatGPT-powered expert systems applications within customer services. Furthermore, this paper explores potential application areas for ChatGPT-powered expert systems in customer services, presenting opportunities for their effective utilisation in the business sector.**

***Index Terms*—ChatGPT, customer services, expert systems, business analytics, chatbot, natural language processing**

I. Introduction

The recent development of ChatGPT by OpenAI [1] has the potential to revolutionise how businesses interact with their customers. ChatGPT is a state-of-the-art AI language model trained on vast text data to generate human-like responses to natural language input. Its impressive natural language processing capabilities make it a versatile tool for various applications, including chatbots, customer service, and language translation, making it possible to handle customer queries in different languages on e-commerce platforms [2]. With its ability to understand and respond to a wide range of topics, ChatGPT can provide customers with a more personalised and efficient experience, leading to higher satisfaction levels [3]. ChatGPT's integration with businesses can streamline their operations, allowing them to automate their customer service functions and free up resources to focus on other business areas. Organisations integrating this technology into their operations can expect to gain a competitive advantage and enhanced customer satisfaction [4].

While ChatGPT offers many benefits for businesses looking to improve their customer experience, there are also challenges associated with its application [5], [6]. One of the main challenges is ensuring that ChatGPT's responses are accurate and relevant to the customer's query or concern. While ChatGPT has been trained on a vast amount of text data, there is always a risk of generating irrelevant or incorrect responses, a phenomenon known as artificial hallucination [7], potentially causing frustration to a customer and ultimately resulting in a negative experience. Moreover, there is also the need to ensure that ChatGPT's answers are consistent with the business's model, brand, and values. In scenarios where a company targets a multilingual customer base, ensuring that ChatGPT understands and responds accurately to different languages is challenging [8]. While ChatGPT is capable of direct language translation, it may need help understanding regional idiomatic expressions to avoid confusion on the part of the customer. Although ChatGPT possesses a broad scope of knowledge across various subjects, it often needs help for specific business use cases, requiring domain-specific expertise [6], [9].

Therefore, for businesses to reap the full benefit of ChatGPT, it is crucial to develop effective techniques that can efficiently customise and fine-tune AI language models to suit specific domains, industries, or use cases. This paper proposes integrating ChatGPT with an expert system design framework [10] as a solution to tackle certain of these issues associated with the business application of ChatGPT. Expert system design frameworks typically involve using knowledge engineering techniques to develop a knowledge base that captures domain-specific expertise. The knowledge base can then be used to contextualise the reasoning and decision-making capabilities of the expert system. ChatGPT can provide an inferencing mechanism and a natural language interface to interact with customers, while the knowledge base can give the context required to generate accurate and relevant responses. By developing an expert system that integrates ChatGPT with a knowledge base specific to a particular domain or use case, businesses can leverage the strengths of both approaches. Additionally, expert system design frameworks can also incorporate feedback mechanisms that allow users to provide input and corrections to the system, which can further improve its accuracy and performance over time.

II. Traditional vs ChatGPT-powered Expert Systems

An expert system aims to imitate the thought processes of human experts and to automate problem-solving procedures. These systems belong to five main categories, namely rule-based, frame-based, fuzzy, neural, and neuro-fuzzy strategies, each employing a distinct technique to represent and apply expert knowledge [11]. Each type of expert system has unique strengths and weaknesses, and the choice of which method to use depends on the problem domain and the application's specific requirements. Rule-based systems encode expert knowledge as conditional rules, which specify a particular action to be taken when certain conditions are met. Frame-based systems organise expert knowledge into structured frames representing concepts and relationships in a specific domain. Fuzzy systems utilize fuzzy logic to handle uncertain and imprecise information and can provide more nuanced and flexible recommendations. Neural systems employ artificial neural networks to learn from data and make predictions based on patterns and relationships within the data. Neuro-fuzzy systems combine the strengths of both fuzzy and neural systems to handle complex and dynamic information. From simple symbolic rule-based systems to more advanced neural and fuzzy systems, expert systems employ various methods to deliver reliable and precise recommendations, enhance decision-making processes, and boost operational efficiency across different domains.

Despite successes recorded with the traditional expert systems' applications in various areas, including medical diagnosis, financial analysis and military [12], they are yet to overcome the following limitations:

1) *Limited knowledge representation*: The effectiveness of expert systems is tied to the quality and extent of the expertise encoded into them. As a result, expert systems can be limited by the availability and reliability of expert knowledge. They may require assistance to handle new or complex situations beyond their domain of expertise.
2) *Lack of common sense*: Expert systems can be rigid and inflexible in their reasoning and cannot apply common sense knowledge to solve problems. For example, an expert system designed to diagnose medical conditions may only be able to consider a patient's emotional state or social context in its diagnosis if it is precisely represented in its knowledge base.
3) *Limited learning ability*: Expert systems are typically designed to operate in a static environment, where the knowledge and rules are predefined and fixed. While some expert systems can learn from experience and adapt to changing circumstances, they are limited by the quality and quantity of data available for training.
4) *Difficulty acquiring knowledge*: Developing expert systems can be time-consuming and resource-intensive. Acquiring expert knowledge requires significant effort and expertise, which can be a bottleneck in developing an expert system.
5) *Limited user interaction*: Expert systems often provide recommendations in a rigid and structured format, which may be challenging for users to understand. This can limit users' ability to interact with the system, ask follow-up questions, and provide feedback.

To address these limitations of traditional expert systems, this paper recommends ChatGPT-powered expert systems as a promising solution to transform how we approach problem-solving and decision-making. With the ability to leverage the latest advancements in natural language processing, machine learning, and big data analytics, ChatGPT-powered expert systems have the potential to overcome the limitations of traditional expert systems by providing more flexible, intelligent, and engaging problem-solving solutions. By dynamically updating their knowledge base, learning from user interactions and feedback, and providing more natural and intuitive conversations, these systems can provide more accurate and reliable recommendations, even in complex or uncertain situations. Moreover, ChatGPT-powered expert systems can extract insights and knowledge from large amounts of unstructured data, making knowledge acquisition less resource-intensive and time-consuming. Therefore, ChatGPT-powered expert systems represent a new generation of expert systems that have the potential to revolutionise various industries and domains, including healthcare, finance, legal, and customer service.

ChatGPT-powered expert systems can address certain limitations of traditional expert systems as followings:

1) *Enhanced knowledge representation*: ChatGPT-powered expert systems can leverage large amounts of data and natural language processing to expand their knowledge base and improve their ability to handle new or complex situations in a given domain.
2) *Improved reasoning*: ChatGPT-powered expert systems are designed to reason more flexibly and contextually by using natural language processing to better understand the meaning behind users' questions and provide more human-like responses. To a reasonable extent, they can also apply common sense knowledge to solve problems, which is a limitation of traditional expert systems.
3) *Increased learning ability*: ChatGPT-powered expert systems can learn from users' interactions and feedback, continuously improving their performance and accuracy. They can also adapt to changing circumstances and dynamically update their knowledge base as new information becomes available.
4) *Simplified knowledge acquisition*: ChatGPT-powered expert systems can automatically generate knowledge by extracting information from large amounts of unstructured data. This makes knowledge acquisition less resource-intensive and time-consuming, which is a limitation of traditional expert systems.
5) *Enhanced user interaction*: ChatGPT-powered expert systems can provide more engaging and natural conversations with users, enabling more intuitive interactions. Users can ask follow-up questions and provide feedback

in natural language, making the conversation more fluid and human-like.

III. ChatGPT-powered Expert Systems: The Design Framework and Process Model

ChatGPT-powered expert systems utilise the capabilities of large language models to provide an enhanced user experience. Figure 1 presents a design framework for ChatGPT-powered expert systems, illustrating the critical components and members of the development team. Key differences between the proposed framework and the traditional expert systems' architecture are as follows:

1) ChatGPT-powered expert systems require prompt engineering to define the scope of the expert system and support its reasoning with few-shot prompts. This process can be regarded as an aspect of knowledge engineering, although this has never been a common practice in conventional expert systems development.
2) While traditional expert systems require knowledge encoded in computer-understandable formats, ChatGPT-powered expert systems work well with descriptive knowledge provided in human-level language.
3) ChatGPT-powered expert systems using ChatGPT as the inference engine; this provides flexibility for both forward-chaining and backwards-chaining in how the expert system responds to queries.
4) In some traditional expert systems such as fuzzy, neuro-fuzzy, and neural expert systems, post-processing is provided at the user interface to make output explainable to the user. ChatGPT does not face this difficulty because it produces outputs that are easily understandable by humans.

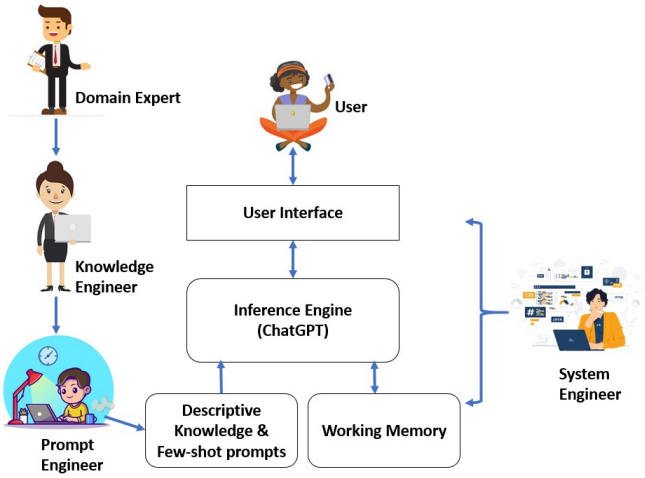

Fig. 1: ChatGPT-powered Expert Systems' Design Framework

In a ChatGPT-powered expert system, the knowledge base can include corpora from various sources. The training process for ChatGPT has involved feeding the model massive amounts of text data from the internet and other sources, allowing it to learn the statistical patterns and structures of language using a variant of the Transformer architecture called the Generative Pre-trained Transformer (GPT) [13]. To ensure the model has learned to understand the nuances and complexities of natural language, it has been trained on a diverse range of texts, including news articles, books, and web pages. The model has also been trained to perform various language tasks, such as translation and question-answering, further enhancing its ability to understand and generate human-like language.

ChatGPT has been developed with general knowledge in mind. As a result, it has acquired a broad base of general knowledge and can answer questions and carry on conversations on a wide range of subjects. However, ChatGPT's ability is limited to what it has learned from the training corpus and may need access to more specialised or niche knowledge outside of that corpus. The goal of knowledge and prompt engineering processes is to make the capability of a ChatGPT-powered expert system as domain-specific as possible while taking advantage of its broad base of general knowledge.

Figure 2 demonstrates iterative procedures for delivering an effective ChatGPT-powered expert system. Knowledge engineering includes all activities required to elicit, understand, and validate domain knowledge from a subject matter or domain expert. Optimal utilisation of ideas obtained from the knowledge engineering process in ChatGPT requires effective prompt engineering, which results in the development of a descriptive knowledge of the domain and examples of how the expert system is expected to respond to users' queries. System engineering is necessary for developing, monitoring and maintaining the system and ensuring that it is up-to-date with the business model and users' expectations.

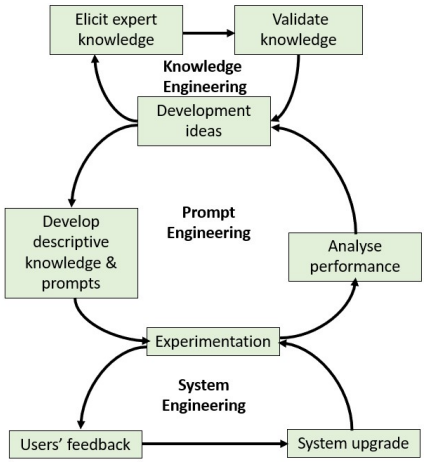

Fig. 2: Iterative process of knowledge acquisition and representation in ChatGPT-powered Expert Systems

IV. ChatGPT API roles

The successful development of a ChatGPT-powered expert system requires understanding the roles needed for the ChatGPT API. The API accesses messages into ChatGPT as System's, User's, or Assistant's message. The System's role is to adapt the general ChatGPT dialogue model to a more

specific task-oriented dialogue model. This is accomplished by providing the system with context-specific information and instructions, allowing it to generate responses tailored to the particular task or domain. This process is fundamental in developing task-specific conversational AI models that address complex business and user needs. The Assistant component in ChatGPT represents the generated response that the model provides to the user's input. Once the system has analysed the user's message and the intent has been identified, the Assistant component generates a response appropriate and relevant to the user's query. The User message is a critical input in ChatGPT's conversational process, serving as the instruction given to the Assistant to generate a relevant response. When a user sends a message to ChatGPT, it is first classified as a User message and then analysed by the Assistant to determine the user's intent and context. Figures 3 and 4 demonstrate how a System role assigned to a ChatGPT-powered chatbot influences its interactions with a customer. As presented in Section III, designing an efficient descriptive knowledge and prompts for a ChatGPT-powered expert system for a complex task can be challenging and requires a systematic engineering process as illustrated in Figure 2.

V. Applications of ChatGPT-powered Expert Systems to Customer Services

ChatGPT has emerged as a valuable tool in customer services, revolutionising how businesses interact with their customers. Its advanced natural language processing capabilities and ability to understand and generate human-like responses make it an ideal solution for automating customer support and enhancing overall customer experience. In what follows, the potential applications of ChatGPT-powered expert systems in customer services will be explored.

A. Automated Customer Support

An expert system powered by ChatGPT can efficiently handle a wide range of customer inquiries, providing instant and accurate responses. It effectively addresses frequently asked questions, offers product information, assists with troubleshooting, and guides customers through various processes. By automating customer support, businesses can simultaneously handle a larger volume of inquiries, reduce wait times, and provide round-the-clock support.

B. Personalised Recommendations

Personalized recommendations drive customer engagement, increase sales, and foster customer loyalty. An expert system powered by ChatGPT can leverage customer preferences and historical data to generate personalised recommendations. By understanding customers' unique needs and preferences, the system can suggest relevant products or services, thereby enhancing the overall consumer experience.

C. Order Tracking and Updates

Customers often seek information about online orders, such as status updates and delivery dates. A ChatGPT-powered

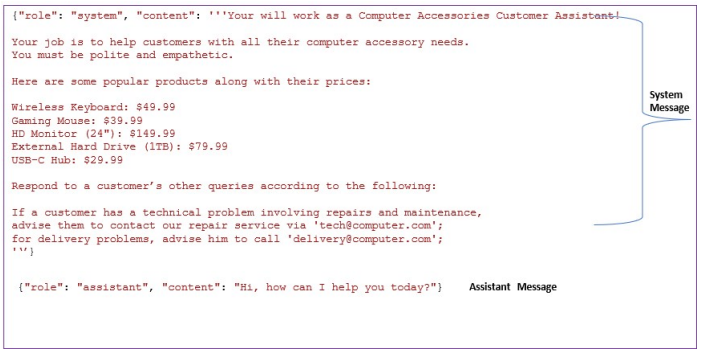

Fig. 3: ChatGPT API system and assistant roles

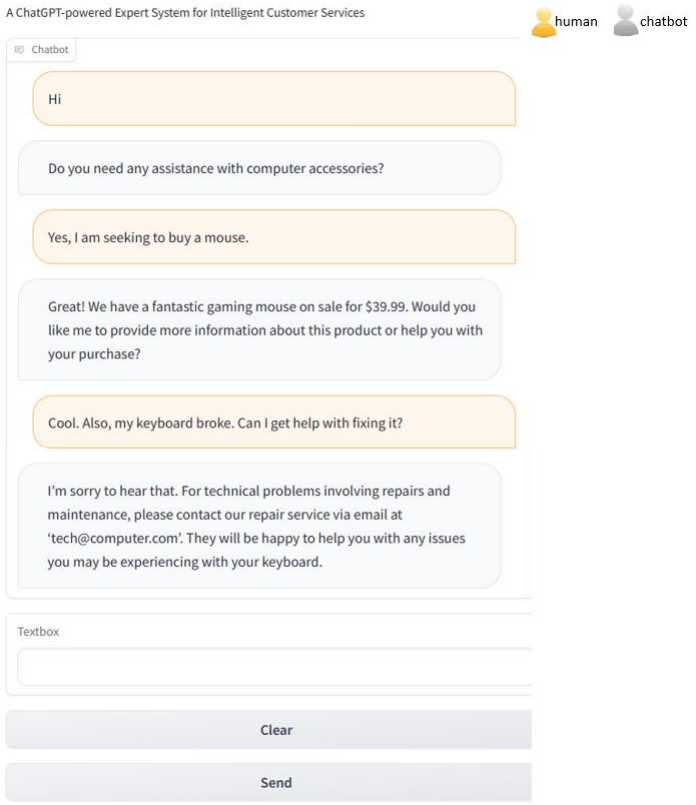

Fig. 4: Chats between a ChatGPT-powered chatbot, acting as a customer attendant, and a customer

expert system can assist customers in tracking their orders by providing real-time updates. Integrating ChatGPT with order management systems can enable the expert system to retrieve accurate and up-to-date information, ensuring customers stay informed throughout the entire order fulfilment process.

D. Complaint Resolution

Handling customer complaints promptly and effectively is crucial for maintaining customer satisfaction. A ChatGPT-powered expert system can play a vital role in addressing customer complaints. It empathises with customers, reflects their concerns, and guides them through the necessary steps to resolve their issues. In cases where problems are more

complex, the system can escalate the matter to human agents, ensuring a seamless transition and maximising customer satisfaction.

E. Multilingual Support

With its language processing capabilities, a ChatGPT-powered expert system can support customers in multiple languages. The system can understand and respond to customer queries in different languages, ensuring effective communication and breaking language barriers. This feature will enable businesses to cater to a global customer base without requiring extensive multilingual support teams.

F. Feedback Collection and Analysis

An expert system powered by ChatGPT can collect customer feedback and opinions. By engaging customers in conversations, it can gather valuable insights, identify areas for improvement, and detect patterns or trends. These insights can help businesses refine their products, services, and customer support strategies, ultimately enhancing customer satisfaction and loyalty.

G. Virtual Assistants

Virtual assistants powered by ChatGPT can significantly enhance customer engagement and overall satisfaction, engaging in natural and dynamic customer conversations. They can provide personalised greetings, guide customers through various processes, assist with account management tasks, and provide general advice or recommendations.

H. Social Media Management

By monitoring and responding to customers' inquiries, comments, feedback, and reviews on social media platforms, a ChatGPT-powered expert system can help to maintain timely engagement and effective social media management. This capability allows businesses to maintain an active social media presence and provide prompt customer support across various channels.

I. Pre-Sales Assistance

A ChatGPT-powered expert system can assist customers in making informed purchasing decisions and supporting customers in understanding the features, benefits, and specifications of products or services by answering product-related queries, providing detailed information, and addressing concerns. It can also cross-sell or upsell relevant products, driving sales and revenue growth.

VI. Conclusions

E-commerce has become an integral part of modern-day shopping, with increasing numbers of consumers opting to shop online for convenience and accessibility. However, the globalisation of e-commerce has resulted in a complex and diverse landscape of consumer needs and behaviours. As geographical boundaries begin to matter less, enterprises must prepare to cater to customers from different cultural backgrounds and with varying preferences regarding expectations, payment methods, and access to relevant product information. Consequently, there is a pressing need for advanced technologies to provide tailored solutions and recommendations to meet each customer's unique needs while respecting their cultural norms and privacy preferences. Looking ahead, the potential application areas of ChatGPT-powered expert systems in customer services are vast. From personalised customer support to proactive assistance and predictive analytics, these systems promise to transform how businesses interact with their customers. By continuously refining the technology and incorporating industry-specific knowledge, ChatGPT-powered expert systems have the potential to become indispensable tools in delivering exceptional customer experiences. This paper has presented an iterative procedure that combines expert system development process models and prompt engineering to design a domain-specific ChatGPT-powered expert system that is applicable to customer services. This approach ensures that the system can effectively address businesses' unique challenges and requirements in various industries. As organisations strive to stay competitive in a rapidly evolving landscape, harnessing the power of AI and leveraging ChatGPT's capabilities can unlock new levels of customer satisfaction and loyalty, ultimately driving growth and success in the digital era.

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