# An Overview of AI in Customer Support Systems

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## ABSTRACT

Artificial Intelligence (AI) is rapidly transforming industries, with customer service among the most impacted sectors. This literature review explores AI-driven technologies in customer support systems, such as chatbots and virtual assistants, and examines the benefits they provide to businesses that utilize them. It also examines the challenges of AI adoption in customer support, ranging from technical limitations to system biases. Emerging trends and innovations such as hyper-personalization and emotionally intelligent AI tools are discussed, emphasizing the need for ethical considerations and customer trust in an AI-augmented customer service field. The findings suggest that while AI offers transformative potential, its successful integration requires careful management of risks and responsibilities.

**Keywords:** artificial intelligence, customer service, chatbots, AI adoption, emotionally intelligent

## INTRODUCTION

Global corporate investment in AI has increased 13-fold over the last decade, reflecting the rapid expansion and transformative impact of AI technologies (AI Index Report, 2024). Often referred to as the “next big thing” in society, AI refers to the systems and machines designed and constructed to perform tasks that conventionally require human intelligence. Over the last decade, artificial intelligence has become increasingly common in everyday life, changing home, education, and most significantly, the workplace. Various fields such as medicine, law, education, and business have been transformed by the incorporation of AI into industry. These sectors have witnessed AI-driven innovations in task automation, efficiency optimization, and personalized insights. This literature review will conduct a thorough examination of the customer service field, as it represents a crucial area of AI development.

Among the sectors affected by AI, customer service has been particularly targeted because of the numerous possibilities in revolutionizing customer-business interaction, allowing for better resource usage and the ability to stay competitive in the market. **Figure 1** illustrates the prioritization of AI implementation in customer service systems across various industries.

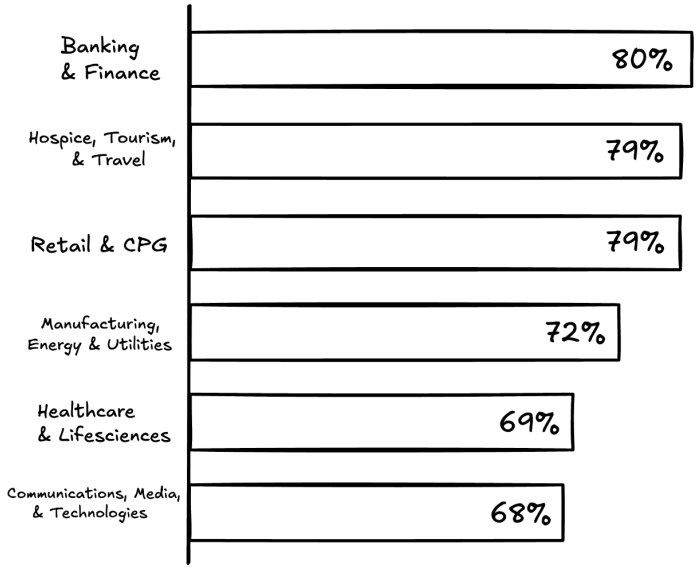


**Figure 1. Industry-Wide AI Prioritization in Customer Service. Adapted from AI in Customer Service Statistics (2024), Sourced from LTIMindtree.**

At least 65% of businesses prioritize integrating artificial intelligence into customer support, with the financial sector leading in priority rates. Meanwhile, industries such as communications and healthcare exhibit relatively lower levels of AI implementation focus in customer service systems, reflecting variations in importance by industry. Looking further into the customer service field, the effects of artificial intelligence are more evident within areas such as telecommunications, self-service, and digital/in-person support. The aims of integrating AI within these areas include, but are not limited to, quicker response times, personalized solutions, and improved resource management. Overall, development in these factors can significantly grow the business itself, which is why customer service is so heavily prioritized in AI modernization.

With these seemingly endless possibilities, AI brings numerous limitations and concerns. In customer service, these issues consist of but are not limited to ethical considerations (such as bias), privacy and security risks, lack of emotional intelligence, and holistic technical restrictions. As a result, there is widespread controversy regarding merging artificial intelligence into both this sector and society as a whole. Determining whether the benefits of AI outweigh these downsides is pivotal for the future of this field and will affect the involvement of AI in the workforce as a whole. This topic will be further explored and expanded upon later in this paper.

The structure of this literature review follows four main objectives:

- AI-Enabled Innovations in Customer Service
- Impact, Effectiveness, and Benefits of AI-Integration
- Challenges, Concerns, and Limitations of Utilizing AI Systems
- Future Trends and Possibilities Regarding AI and Customer Experience

This literature review will touch on several key themes and concepts within these areas, ranging from essential AI tools and technologies, such as chatbots and virtual assistants, to the future of

emotional intelligence and the role of humans in an AI-powered industry. These ideas will compose definitions of fundamental principles and frameworks, followed by examples, statistical evidence, graphs, or research. While this review will not delve deeply into one specific subcategory, it hopes to help the reader establish connections, identify patterns, and gain a comprehensive understanding of the overarching subject.

## AI-ENABLED INNOVATIONS IN CUSTOMER SERVICE

1980 marks the start of the “AI Boom”, a nearly decade-long period of increased interest, investment, and development in artificial intelligence, particularly in the market. Since then, AI has seen greater purpose in business and customer service, through chatbots, virtual assistants, and backend automation systems. According to Tom Eggemeier, the CEO of Zendesk, a company that creates customer service enhancement software, “We advance toward a world where 100 percent of customer interactions involve AI in some form, and 80 percent of all inquiries will be resolved without the help of a human agent.” (Eggemeier, 2024). Businesses are rapidly incorporating AI tools into their operations, and those who fall behind risk being outperformed by competitors.

AI chatbots are arguably the most well-known technology in modern customer service, as they are meant to directly engage with customers. They are designed to assist with customer queries by providing FAQs or helpful web pages using human-like conversation. The key components of AI chatbots include Natural Language Processing (NLP), which allows them to process and interpret human language, and Machine Learning (ML), which concerns the creation of algorithms that allow models to learn from data by recognizing patterns and making predictions. **Figure 2**, shown below, illustrates the customer support process with the integration of AI chatbots, outlining the stages from user query to resolution.

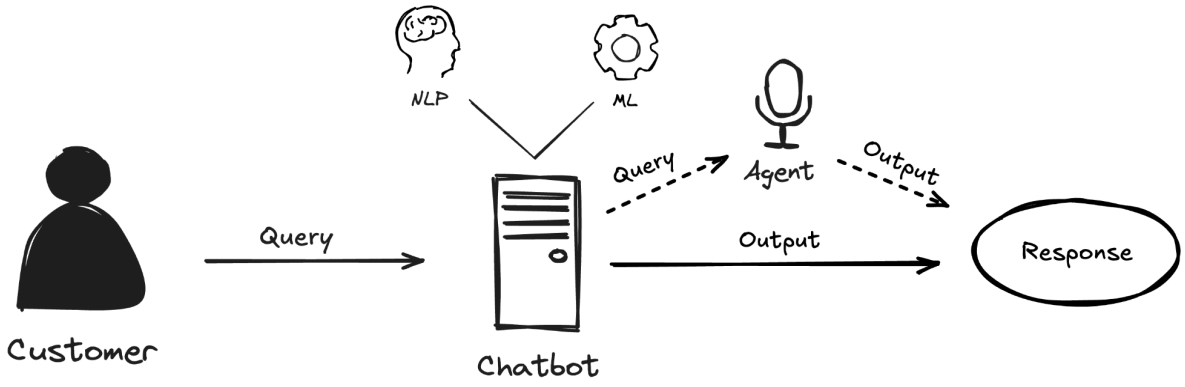


**Figure 2: Diagram of Customer Support Process with AI Chatbot**

The customer provides queries to the AI chatbot, which uses NLP and ML to provide adequate responses. Alternatively, if the chatbot cannot resolve the query, it can be escalated to a human agent to provide manual responses.

A systematic literature review of 40 studies by Nicolescu and Tudorache (2022) explains several elements through which chatbots influence the customer experience: attributes of the chatbot, user-related factors, and the situational context. The paper emphasizes the role of chatbots’ functional features in shaping customer interaction, such as the effectiveness of their NLP capabilities. Overall, chatbot performance is highly dependent on how well they are constructed, therefore requiring considerable investment in the technology by businesses. AI chatbots excel

at handling standard and straightforward tasks, but virtual assistants can be a better alternative to face more complex challenges.

Virtual assistants are AI-driven programs intended to assist users with tasks and access information through speech or text-based interactions. They utilize similar technologies as chatbots, including NLP and ML, aiding them in understanding user commands and offering services like setting reminders, answering questions, and scheduling appointments. Virtual assistants often flow in a conversational, human-like manner, similar to chatbots but with broader functionality. While AI Chatbots are often programmed with narrow, task-specific knowledge, making them efficient at the intended purpose but lacking when it comes to more sophisticated queries, virtual assistants tend to have a more generalized nature, allowing them to solve more in-depth, individual problems but struggle with handling simple tasks and repetitive queries more efficiently (in comparison to the speed and costs of chatbots). As a whole, virtual assistants can offer more personalized and tailored customer experiences, making customer service interactions smoother and more efficient.

Aside from chatbots and virtual assistants, AI has a significant role in the automated processes behind customer service systems. AI-driven systems boost operational efficiency by optimizing data processing, streamlining workflows, and improving resource allocation. In 2017, KFC, a powerhouse in the fast-food industry, introduced AI facial recognition technology to some of its Chinese locations to personalize the shopping experience. The system can, using facial recognition, “suggest different menu items based on the person’s estimated age and mood”, such as a “crispy chicken sandwich” for a 20-year-old male or “porridge and soybean milk” for a 50-year-old female (Rubkiewicz, 2024). Processes like this facilitate increased response speeds and more personalized interactions, benefiting businesses’ customer service capabilities and fostering deeper connections with their customers.

## IMPACT, EFFECTIVENESS, AND BENEFITS

Through the application of these various AI tools and technologies, customer service sectors can expect significant benefits that will ultimately drive overall business growth and competitiveness. For example, utilizing AI chatbots to handle common queries frees human agents to focus on more complex issues, maximizing productivity and support quality. The possibility of revolutionary advantages provides incentives for businesses to remain updated on the latest AI technologies, as these innovations empower companies to develop more personalized solutions for their clients, enhance operational efficiency, and elevate customer satisfaction.

One of the primary objectives of customer support systems is to provide customer-tailored responses. Ensuring that clients are delivered solutions that effectively solve or assist with their issues is essential for evaluating the overall system's effectiveness; a customer service system that cannot provide adequate solutions cannot truly be considered a support system. The combination of two technological approaches, LLMs (Large Language Models) and RAG (Retrieval-Augmented Generation), can facilitate the personalized customer experience that is essential in modern business.

LLMs are trained to generate solutions on immense amounts of data from the internet or other large databases to understand and generate human language. They are utilized in a variety of applications, including chatbots and virtual assistants. Common examples of LLMs are ChatGPT, Claude, and Gemini, created by OpenAI, Anthropic, and Google, respectively. They can also be privatized; many large businesses tend to create or buy private LLMs, as they allow for further customization, increased security, and greater long-term gains (such as lesser storage costs), compared to pre-trained public LLMs (McGeough, 2024). However, LLMs have many restrictions, including hallucinations (inaccurate generated responses), outdated information, and context limitations (within a specific domain). To combat these issues, the RAG process was created.

RAG can be defined as “a natural language processing (NLP) technique that combines the strengths of both retrieval- and generative-based artificial intelligence (AI) models” (Exploring the Benefits of Secure, AI-Ready Data, 2023). Retrieval models extract relevant information from data sources, such as a database, whereas generative models create new information or solutions. RAG, a technique that leverages both approaches, can be generalized through the process in **Figure 3** below.

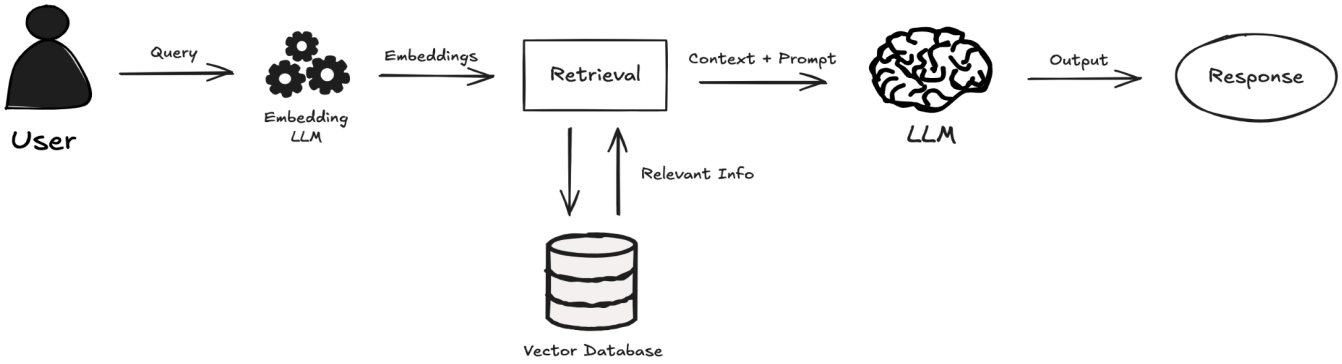


**Figure 3: Diagram of RAG Process**

The user query is converted into embeddings (using a different LLM designed for that purpose), which are then plotted onto the vector database. Nearby (relevant information) is then returned, which is given as “context”, along with the prompt/query to the LLM, which can then generate a response.

Using RAG with LLMs enables AI tools in customer service to be more contextually informed, leveraging additional data rather than relying on information coming directly from the query. Additionally, they can be confined by restricting responses to specific, verified sources, optimizing efficiency, and enforcing response accuracy (including up-to-date information).
As a whole, boosting operational efficiency is possibly the most significant improvement, at least quantitatively, in AI–driven customer service systems. As mentioned, AI implementation is often undertaken to drastically decrease the capital and effort required to perform simplistic, repetitive tasks. Though there are significant costs to using artificial intelligence (e.g. maintenance, initial hardware costs), which will be further discussed later on in this review, when utilized properly, AI tools can compensate for them by reducing time-intensive burdens and handling large volumes of queries with ease, while maintaining or increasing the quality of responses provided.

While these business-side improvements are indispensable to companies, improving customer satisfaction is often regarded as the topmost priority on the front end, as it closely ties into customer loyalty, brand image, and thus, overall sales. Efficient AI usage reduces customer wait times and allows for 24/7 accessibility. These and other benefits, such as increased personalization, have been statistically proven to improve the customer experience. One specific questionnaire/interview-based study investigates how artificial intelligence quantitatively affects customer experience using the “Voice of Customer”, which essentially captures deeper customer feedback and insights. (Ullah, 2023). Findings delve deeply into a statistical correlation found between AI and the customer experience, which highlights the significant impact of AI improvements on customer satisfaction.

## Challenges, Concerns, & Limitations

The various benefits outlined throughout the previous section can make AI integration seem highly advantageous, but there are significant challenges that can deter businesses from pursuing this process, at least for now. The following section will explore key concerns enterprises must consider regarding AI adoption in customer service systems, particularly focusing on technological restrictions, security issues, costs, the necessity of oversight, and bias.

The most standard of these issues are technical limitations, particularly the current gaps in technological expertise, which are often overcome with time. At present, AI's most notable shortcomings include creativity, ethical decision-making, and common sense (Levis, 2024). For example, customers often complain about receiving unhelpful or misleading solutions to their questions. As artificial intelligence research develops, innovation will help narrow critical gaps in these areas, reducing their frequency and impact. Technical weaknesses act as foundational obstacles in AI integration, limiting systems' abilities to function optimally and, in turn, amplifying other AI concerns such as privacy and security issues.

When it comes to new technology, people tend to be hesitant, especially when sharing confidential or personal information, out of fear of potential data leakages. AI-driven technologies are no exception, as they frequently handle large volumes of highly sensitive customer data, intensifying the risks and potential consequences of data breaches. There are three primary areas of concern regarding data security and artificial intelligence: informational privacy, group privacy, and predictive harm (Sullivan, 2023). Informational privacy, as the name suggests, refers to the protection of stored data and is a concern in any information-storing system. The other two issues are often overlooked and more AI-specific: group privacy involves stereotyping as a result of analytical pattern creation, and predictive harm concerns the prediction of sensitive information. The failure of a business to protect its customers' data from these troubles induces customer distrust and has a detrimental effect on brand reputation.
On the topic of companies' reputability, one critical issue regarding artificial intelligence is the possibility of bias. Model bias, defined as systematic errors leading to incorrect predictions, often originates during the training phases of AI models (What is Model Bias in ML?). A common example is selection bias, which occurs when training data does not accurately represent the target audience. This can result in the generation of responses that disadvantage or differentiate between specific groups of people, ultimately damaging a brand's image and trustworthiness in the eyes of its customers. Significant bias reduction can require extensive resource usage, as data, measurements, and algorithms must be carefully assessed and examined regularly, contributing greatly to the broader costs of artificial intelligence.

As briefly mentioned earlier in this review, there are several significant costs to AI implementation and maintenance. The most common hardware expenses include data storage and high-performance computing, often requiring expensive and high-end GPUs. Meanwhile, software costs are typically not as expensive as the former but are still significant factors in the financial decision to adopt AI. They are not only comprised of access licenses and cloud services, which can easily cost thousands per server, but also the finances required to clean, organize, and process data (Reilly, 2024). A third notable expenditure that is often overlooked is

labor expenses, particularly for specialists responsible for creating, developing, and maintaining AI systems. High-demand professions, such as data scientists, machine learning engineers, and software developers, command salaries ranging from $120k to $160k annually on average. As a result of such high-demanding expenses, companies, especially smaller ones, must weigh the trade-offs of utilizing AI tools in their customer service systems. While long-term efficient AI usage can prove financially rewarding, such immediate and enormous capital outlay losses can harm a business's health, hindering its ability to remain operational in the long run.

## FUTURE TRENDS AND POSSIBILITIES

The Intercom Customer Service Trends Report highlights that nearly half (45%) of customer support systems have already integrated artificial intelligence into their operations (2024). This rapidly growing adoption is fueled by significant investment in artificial intelligence research and innovation, opening the doors to countless new possibilities. Emerging AI technologies frequently aim to enhance efficiency, convenience, or personalization in specific improvable areas. For example, the Apple Intelligence system optimizes Apple's devices to prioritize information through message summarization, allows for easier reformability of text or data, and generates custom images and graphics tailored to the customer's preferences. (Apple Intelligence, 2024).

One AI-based innovation within the customer service sector is Interactive Voice Response (IVR), which utilizes voicebots, chatbots designed to communicate through speech, in support systems for better convenience and natural interaction with customers. Additionally, IVR enhances emotional understanding by analyzing voice tone and sentiment, which is possible with more advanced voicebot systems. Improved emotional intelligence allows for a more personalized customer experience, which is especially important for users dealing with sensitive or complex issues, ultimately leading to higher levels of customer satisfaction.
Hyper-personalization is another emerging technological advancement that utilizes predictive AI to analyze vast amounts of real-time customer data, optimizing the customer experience (Hyper-Personalization, 2024). By offering tailored recommendations, messaging, and support, the technique allows businesses to more effectively meet the needs of clients. One key feature is the adjustment to customer context using historical analytics–for instance, predictive AI can anticipate customer needs without detailed explanations or explicit input, which creates a more streamlined and efficient experience.

While the development of technologies like hyper-personalization can be revolutionary, they also pose great risks to consumer security. Businesses must be able to take responsibility to protect their customers by maintaining transparency in their customer service systems and preventing the misuse of consumer data. This becomes even more crucial for clients who struggle to grasp the complexities of artificial intelligence. Efforts should be made to bridge the digital divide that results from AI integration and ensure that such disparities do not compromise the welfare or trust of customers.

## CONCLUSION

This literature review provided an overview of the current and future role played by artificial intelligence in customer service systems. Key AI tools like chatbots and virtual assistants were examined for their functionality and applications. The benefits of utilizing such technologies were then discussed, primarily focusing on improved efficiency, personalization, and customer satisfaction. This was followed by an analysis of major issues and challenges faced by businesses regarding AI integration. Lastly, the review presented emerging AI technology and the responsibility of businesses to continue protecting their customers in an AI-augmented customer service field.

Given the direction society is heading, it seems almost inevitable that artificial intelligence will become a significant part of customer service and other business operations. The impact of AI has already begun to reshape human lifestyle, affecting nearly every individual and industry. Yet the true extent of its influence remains uncertain, ultimately depending on how people choose to use it.

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