

HOW CHATBOTS AND VOICE ASSISTANTS WORK

Kupriyanovich O. A.

Belarusian State University of Informatics and Radioelectronics, Minsk, Republic of Belarus

Likhtarovitch I. I. – Senior Lecturer at the Department of Foreign Languages

Annotation. This article examines how conversational artificial intelligence, including chatbots and voice assistants, is transforming human-machine interaction. It describes the key technologies behind these systems and their applications in finance, healthcare, and education. The paper also discusses the advantages of conversational AI and addresses its limitations, including data-privacy concerns.

Keywords. Artificial intelligence, conversational AI, chatbots, voice assistants.

Introduction. In an era where instant communication and immediate problem-solving have become the norm, conversational artificial intelligence (AI) has emerged as a transformative technology reshaping how humans interact with machines. Chatbots and voice assistants, once simplistic programs capable of only basic responses, have evolved into sophisticated systems that understand context, recognize emotions, and engage in natural, human-like dialogue. From customer service automation to healthcare support and smart home management, these AI-powered tools have become integral to both business operations and daily life. This report examines the fundamental technologies powering chatbots and voice assistants, explores their diverse applications across industries, analyzes their advantages and limitations, and considers future developments that will define the next generation of conversational AI.

Main part. Conversational artificial intelligence refers to technologies such as chatbots and voice assistants that enable machines to understand, process, and respond to human language in natural and meaningful ways. These systems automate communication and enable personalized customer and employee experiences at scale [1].

Chatbots are computer programs integrated into messaging platforms that interact with users via text. They primarily reside in text channels, including web widgets, in-app chat, and social messaging platforms. Early chatbots followed rigid decision trees with preprogrammed, fixed scripted responses, but modern versions have evolved into AI-powered systems driven by large language models that facilitate more human-like conversations. These contemporary chatbots can interpret natural language, access customer relationship management data, share images or links, and hand off to human agents when needed [2].

Voice assistants, also called voicebots, are voice-enabled intelligent chatbots that interact with users and respond to spoken commands primarily through voice. These systems process spoken input and return spoken or visual responses, encompassing smart speaker skills, interactive voice response replacements, or voice-enabled mobile applications. Voice assistants typically handle one request at a time – such as «Play jazz» or «Check my balance» – and rely on speech-to-text and text-to-speech pipelines alongside intent recognition. Latency requirements are stricter for voice assistants than chatbots because long pauses feel unnatural in conversation [3].

The operation of chatbots and voice assistants relies on a sophisticated interplay of multiple AI technologies working in sequence. At its core, a conversational AI follows a three-step process: speech-to-text conversion, language processing, and text-to-speech synthesis [1].

The process begins with the AI interpreting the user's input, which may be in text or speech form. For voice interactions, speech inputs are first converted into text using automatic speech recognition technologies.

Dialogue management orchestrates the conversation with the user, guiding the interaction based on the intent, context, and system capabilities. This component maintains conversation state, tracks context across multiple turns, and determines appropriate next steps. For instance, when a user asks about the weather and follows up with “What about tomorrow?”, the dialogue manager understands that «tomorrow» refers to a weather query for the following day at the previously mentioned location.

The dialogue manager may involve querying databases, accessing knowledge bases, or carrying out specific actions to provide precise and relevant responses [4].

Many conversational AI systems integrate with external knowledge sources to enhance their responses. Knowledge bases serve as structured memory storage, containing domain-specific information such as medical guidelines, legal regulations, etc. When responding to queries requiring specific information, the system retrieves relevant knowledge and incorporates it into the response generation process [5].

Conversational AI is transforming customer interaction and operational processes across virtually every industry sector. The technology automates routine interactions, allowing human agents to focus on complex, high-value conversations [1].

In healthcare, conversational AI enhances patient outcomes and operational efficiency through automated appointment scheduling and by providing easier access to personal health data while maintaining privacy. Voice assistants help with appointment scheduling, medication reminders, and symptom checking, enabling patients to receive voice-guided assistance anytime. AI-powered systems can reference symptoms, medical histories, and drug interactions to aid preliminary assessments. Healthcare providers also use voice assistants to automate tasks such as checking patient eligibility, sending appointment reminders, and logging post-visit summaries, freeing staff to focus on care delivery [1][6].

Educational applications include personalizing tutoring, transcribing lecture notes, and enhancing language learning through real-time conversations. Voicebots serve as interactive tutors, send course reminders, and support language learning, making studying more engaging and effective [1][6].

The main advantages include: 24/7 availability, operational cost reduction (projected \$80+ billion savings by 2026), scalability, personalization, accessibility for users with limited digital literacy, and hands-free operation.

Among the main limitations are difficulty processing sarcasm and idioms, inaccurate responses in complex scenarios, poor conversation flow, data privacy concerns, high implementation costs, emotional intelligence deficit, and multilingual constraints requiring extensive training data.

The market for conversational AI is growing very quickly (see Figure 1). It is expected to increase from \$14.29 billion in 2025 to \$41.39 billion within the following five years. Another report predicts that the market for intelligent virtual assistants will reach \$18.91 billion by 2032, with an annual growth rate of 23.7 percent. This rapid growth is happening because an increasing number of industries – like retail, healthcare, banking, telecom, and travel – are adopting AI-powered tools to handle customer support.

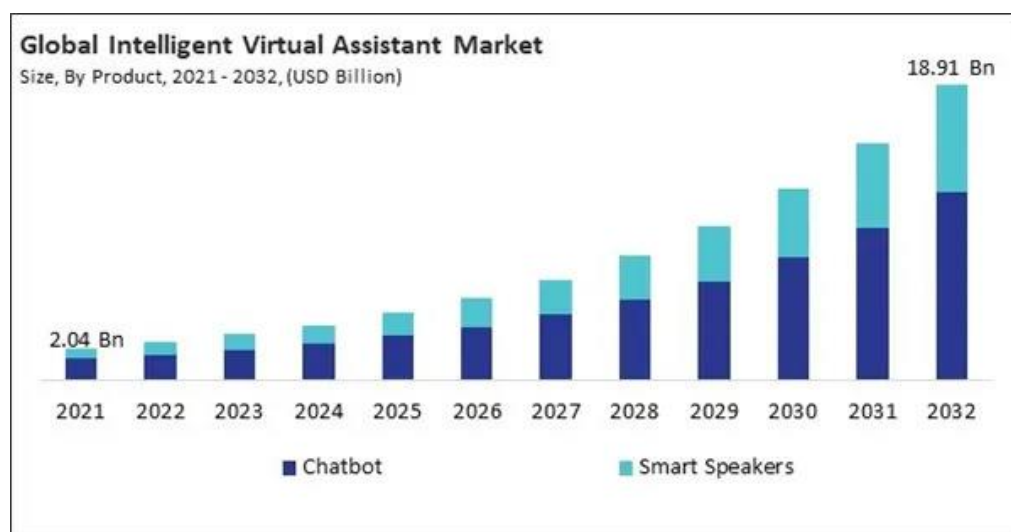


Figure 1 – Global Intelligent Virtual Assistant Market

Soon, AI systems will not only respond to commands; they will also take action autonomously. These assistants will be able to book appointments, process refunds, or send reminders without any

human help. They will also become more emotionally aware, detecting feelings like stress or frustration through voice tone and responding with empathy [7].

AI is also becoming more specialized. Instead of giving generic answers, future systems will be capable of understanding specific industries – helping doctors with diagnoses, lawyers with document reviews, or logistics companies with daily operations.

Security will improve too. Voice biometrics will let systems identify users by their unique voice patterns, making passwords unnecessary and helping to prevent fraud. Finally, as more devices connect to the Internet of Things, voice interaction will become the primary method for controlling connected devices from home appliances to cars, making AI a natural part of everyday life [7].

Conclusion. Chatbots and voice assistants have transformed human-technology interaction through ASR, NLU, and TTS technologies. They deliver measurable benefits across customer service, healthcare, education, and finance: continuous availability, cost reduction, and personalized experiences. However, significant challenges persist – nuance recognition deficits, data privacy concerns, and development costs. Future systems will feature enhanced contextual memory, emotional intelligence, Global and autonomous task execution. The distinction between chatbots and voice assistants will likely diminish, yielding integrated conversational agents combining both modalities for optimal user experiences.

References

1. What is conversational AI: Benefits and applications. [Electronic resource] / SAP., 11.06.2024. – Mode of access : <https://www.sap.com/africa/resources/what-is-conversational-ai/> / Date of access : 20.02.2025.
2. 7 conversational AI use cases for faster, smarter support. [Electronic resource] / Telnyx., 10.02.2026. – Mode of access : <https://telnyx.com/resources/7-conversational-ai-use-cases#7-conversational-ai-use-cases/> / Date of access : 20.02.2025.
3. How to build a conversational agent in less time than Cupid's arrow takes to strike. [Electronic resource] / Speechmatics., 04.04.2025. – Mode of access : https://www.speechmatics.com/company/articles-and-news/how-to-build-a-conversational-agent-in-less-time-than-cupids-arrow-takes-to-strike?utm_campaign=voice-ai-agents-2025 / Date of access : 20.02.2025.
4. Intelligent Virtual Assistant Market Analysis Report 2025. Yahoo Finance. [Electronic resource] / Research and Markets., 24.07.2025. – Mode of access : <https://finance.yahoo.com/news/intelligent-virtual-assistant-market-analysis-092400355.html?guccounter=1> / Date of access : 20.02.2025.
5. Three-Mode Fusion New Paradigm: Chatbox + Knowledge Base + MCP = Machine Learning Personal Voice Assistant. [Electronic resource] Baidu Cloud., 11.10.2025. – Mode of access : <https://cloud.baidu.com/article/3938385i> / Date of access : 20.02.2025.
6. Voicebot vs Chatbot: Which AI Tool Fits Your Business Best? [Electronic resource] / ConvoZen.AI., 28.06.2025. <https://convozen.ai/blog/contact-center/voicebot-vs-chatbot/#respond> – Mode of access / Date of access : 20.02.2025.
7. Future of Conversational AI [Electronic resource] / ConvoZen.AI., 18.07.2025. – Mode of access : https://convozen.ai/blog/ai/future-of-conversational-ai/?utm_source=openai#respond / Date of access : 20.02.2025.