



FEATURE

Conversational AI

Five vectors of progress

Sherry Comes, David Schatsky, and Rameeta Chauhan

Technology and human interaction strategists take note: Innovators are tackling current limitations to conversational AI through their work in five areas. We expect them to lead to much broader adoption of conversational bots in the near future.

CURRENT VERSIONS OF chatbots can be inefficient and frustrating to use, besides being confined to answering simple queries that follow a set pattern. But what if a chatbot could help you perform more complex, multistep tasks such as checking your schedule, clearing your calendar, and calling a cab to the airport in 30 minutes?

Our analysis of patents in the area of conversational AI reveals that this might be possible soon.

Rapid adoption of conversational AI will likely be underpinned by innovations in the various steps of chatbot development that have the potential to hasten the creation and training of chatbots and enable them to efficiently handle complex requests—with a personal touch.

Signals

- The global conversational AI market, including chatbots and intelligent virtual assistants, is expected to grow at a CAGR of 22% during 2020–25, reaching almost US\$14 billion by 2025.¹
- Chatbots currently represent the top use of AI in enterprises, and their adoption rates are expected to almost double over the next two to five years.²
- Conversational AI is one of the AI domains that filed the highest number of patents in the past year.³

- Setup challenges, including training data and maintenance, were among the top reasons for not implementing chatbots in enterprises, according to a recent Deloitte survey.⁴
- By 2022, 70% of white-collar workers will interact regularly with conversational platforms, according to Gartner.⁵

Conversational agents are among the leading applications of AI

Conversational AI solutions—including chatbots, virtual agents, and voice assistants—have become extraordinarily popular over the last few years, especially in the previous year, with accelerated adoption due to COVID-19. Data from various conversational AI vendors showed that the volume of interactions handled by conversational agents increased by as much as 250% in multiple industries.⁶ These solutions are already delivering significant value for many organizations. Around

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90% of companies mentioned faster complaint resolution and over 80% reported increased call volume processing using conversational AI solutions, according to a recent survey.⁷ However,

the technology still suffers from a number of limitations that make it difficult to use and limit its value. Fortunately, innovators are tackling these challenges. We expect this to lead to much broader adoption of conversational bots in the coming years. Technology and human interaction strategists should take note.

Five vectors of progress in conversational AI

To understand how innovators are working to enhance conversational AI technology, we analyzed conversational AI-related patents filed in the United States over the last couple of years.⁸ Our analysis, along with Deloitte’s own experience of implementing conversational AI solutions for many clients, suggests we can look forward to progress in at least five areas (figure 1). These developments are likely to increase the value of conversational agents and help to expand their use across industries.

TRAINING CONVERSATIONAL AGENTS

Conversational agents need to be trained on the content pertaining to the domain they are used in. For instance, a contact center chatbot would require training data such as live agent logs and transcripts from previous conversations and FAQs. But training conversational agents with traditional rule-based or manual approaches is tedious and time consuming. The process can take as much as six to nine months.⁹ And it tends to result in inadequate understanding and unsatisfying—even biased—behavior.¹⁰

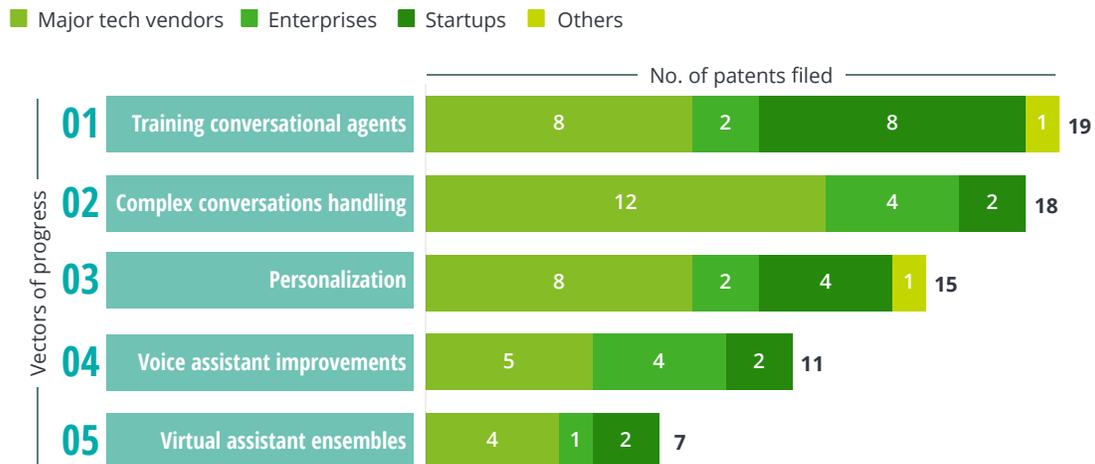
One of the most common areas of innovation in conversational AI is improving the training process. Around 20% of patents in our survey related to this—the top category.¹¹ Innovations focus on automating and accelerating the training process to better understand users’ inputs and improve the quality of responses.

One patent covers techniques to automatically generate questions and responses to train customer service agents, deriving new data from past customer interactions with similar virtual

FIGURE 1

Top patent topics for conversational AI

September 2019–December 2020



Sources: Free Patents Online, Deloitte analysis.

assistants or entity-specific data sources such as websites.¹² Another patent describes a health care chatbot trained using deep learning-based unsupervised learning techniques. The chatbot can answer patients' queries about suitable health care providers based on symptoms and insurance coverage. It learns from previous interactions to provide responses in future ones in as few iterations as possible.¹³ A third describes a method of detecting and mitigating bias in training data that could lead, for instance, to labeling customers as upset when they are not.¹⁴ Collectively, these training innovations could get conversational agents up and running faster, producing more satisfying and effective interactions.

HANDLING COMPLEX CONVERSATIONS

Wouldn't it be great if you could simply instruct your personal assistant to clear your calendar for the afternoon and call a cab in 30 minutes to take you to the airport? Most conversational bots cannot fulfill such a request because they are designed to handle only short, simple queries. They operate in a "tic-tac flow" format where the user asks, and the machine responds synchronously. Therefore, they fail to understand multiple intents in a single user command, making the experience inefficient, and even frustrating for the user.

Around 18% of the patents in our analysis address handling of complex conversation scenarios such as this, involving multiple commands in a single utterance or multitopic conversations.¹⁵ For example, a patent describes a scenario where on being asked to set up a business meeting with a client, the virtual assistant can handle a series of tasks in the background, such as calendar conflict resolution and restaurant table reservations.¹⁶ Another patent involves the use of a "concept lattice" technique to build topic-independent agents that can automatically build a dialogue

structure to guide the discussion. For instance, a product recommendation agent using concept lattices can interact with the user autonomously about any product category mentioned in the catalogue. Concept lattices are graphical representations of any object of interest (e.g., camera, vehicle, vacation package, daycare provider) and its attributes as nodes connected with edges representing different possible combinations of the object's attributes.¹⁷ Overall, with these advancements, autonomous agents could asynchronously manage a wide range of conversations effectively.

PERSONALIZATION FOR BETTER PERFORMANCE

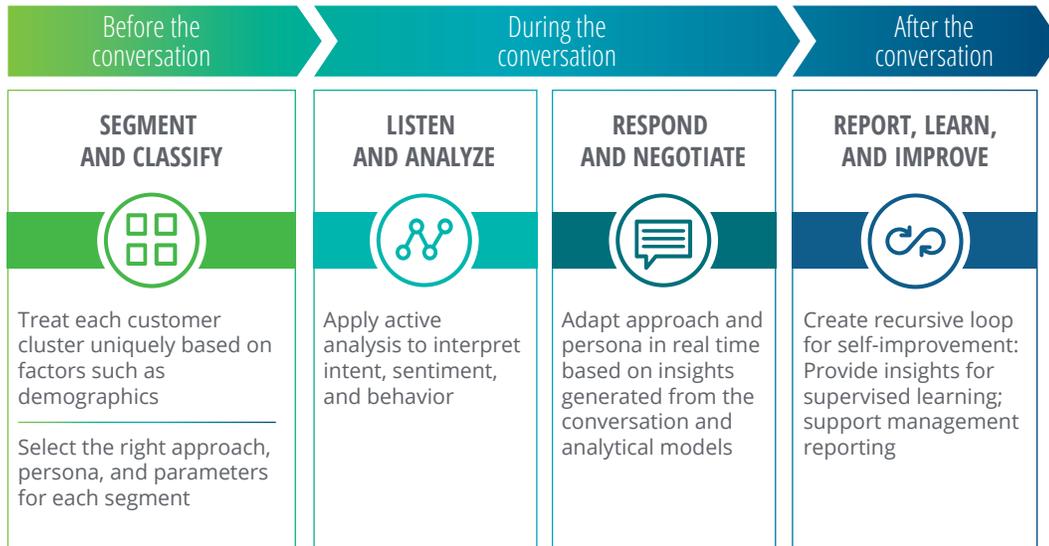
When chatbots personalize conversations, customers are more likely to take the desired action. In our work implementing chatbots to support high-volume business processes for a range of clients, we have seen that personalization can significantly improve the performance of a chatbot in terms of user experience, cost of operations, and business outcomes. (For a perspective on end-to-end personalization of conversational agents, see figure 2.)

Personalization is a major area of innovation, comprising some 16% of patents in our survey.¹⁸ For instance, one patent we examined describes customer service agents that tailor their communication style in real time based on customers' characteristics. If the customer is impatient, the agent will increase the rate of speech; if the customer seems highly dissatisfied, the digital agent will involve a human agent in the conversation.¹⁹

Another patent describes a home assistant that can automatically adapt to the age of the user, switching to "kids mode" if appropriate, based on the user's communication style.²⁰

FIGURE 2

End-to-end personalization of conversational agents



Source: Deloitte analysis.

CAN YOU HEAR ME NOW?

Digital voice assistants have gone mainstream. More than half of US adults use them on smartphones.²¹ But voice assistants have their weaknesses. They can fail in noisy environments, for instance. And their intensive processing requirements can rapidly drain batteries on portable devices.

Technology vendors and electronic device manufacturers, among other innovators, have devised approaches to improve the performance of voice assistants; 11% of patents in our survey are focused on this area.²² They include techniques to automatically filter out background noise to improve speech recognition by virtual assistants.²³ Innovations are also targeting efficient and precise methods for activating voice assistants. One patent describes a method for reducing the likelihood of a virtual assistant being erroneously triggered by background noise. Systems will be able to ignore wake words used in a TV commercial running in the background, for instance.²⁴ Based on these developments, we can expect greater use of voice assistants in busy environments, including offices.

VIRTUAL ASSISTANT ENSEMBLES

Conversational bots are typically designed for a narrow purpose such as handling a particular set of queries related to a business function such as IT, HR, or finance. Attempts to build general-purpose bots have generally produced poor results. Another area of innovation aims to sidestep this challenge by describing efficient methods for composing multiple specialized chatbots into an ensemble. These virtual assistant ensembles can handle a range of tasks for a user by automatically inferring intent and routing the request to the appropriate specialist agent. Around 7% of patents are targeting multibot architecture, according to our analysis.²⁵

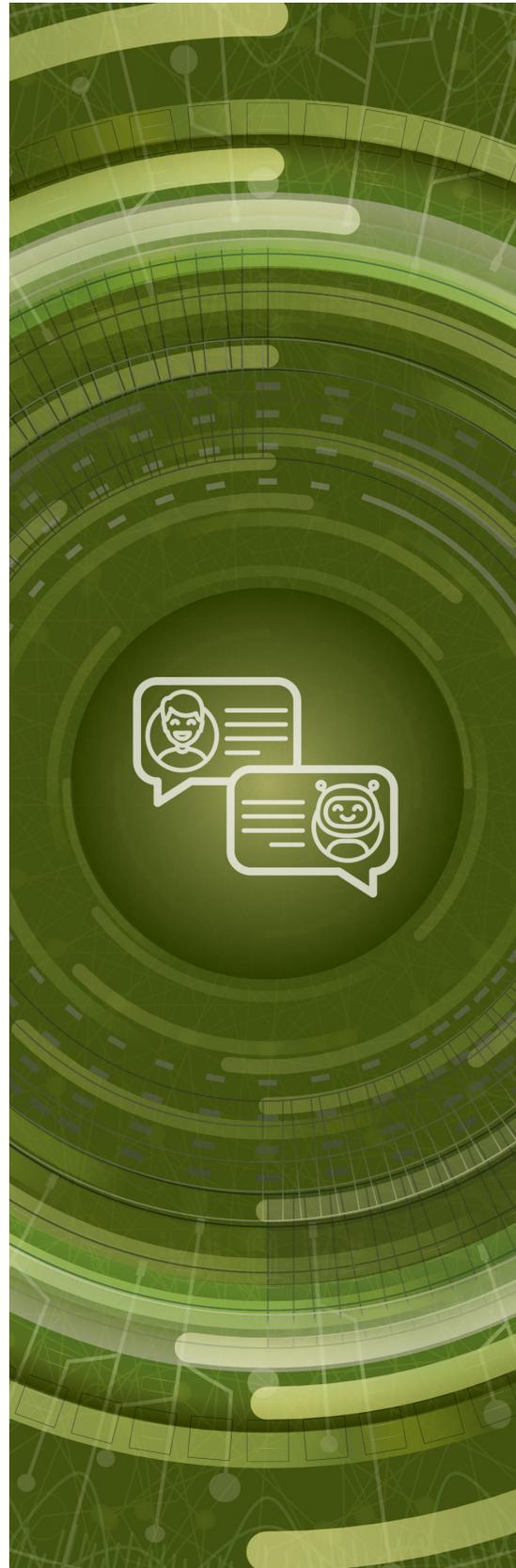
One of these patents describes an enterprise assistant with a single master interface that can route users to virtual assistant specialists for CRM, ERP, and human capital management (HCM).²⁶ Another describes an approach to build personal or home assistants that may suggest an alternate service provider when one fails to respond to a user query. For instance, the assistant may say, “Alexa does not know how to answer that question. Do you want Google to try and answer that?”²⁷

Technology to orchestrate multiple bots and their interactions with internal systems and users will make it easier to maintain and scale conversational bots. Developers can focus on obtaining high performance from chatbots for specific tasks and add new chatbots rather than expanding existing ones—with coordination provided by the routing mechanism or middleware.²⁸

From converse to engage

Conversational agents have their limits, but many have already proven their worth. And the technology is getting better. With technological improvements on the way, it's important to keep in mind that success with conversational AI depends on more than technology; good experience design, informed by behavioral science, is crucial.

Collectively, these vectors of progress point toward a future in which engaging and effective conversational agents will be increasingly common. These agents will likely be able to manage complex conversation scenarios with personalized responses. Voice-based assistants will become usable even in busy environments such as offices and public transport. Modular ensembles of agents will be able to handle diverse sets of tasks. The training of conversational agents will get easier, with some agents up and running in weeks, not months. Judging from these vectors of progress, conversational AI is likely to have a long life span. A flawless experience with a conversational agent can feel like magic. Conversational AI isn't magic. But it's getting closer all the time.



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About the authors

Sherry Comes | scomes@deloitte.com

Sherry Comes is a managing director with Deloitte Consulting LLP's Applied AI group. She specializes in the areas of voice solutions, AI, NLP, sentiment analysis, analytics, data science, and machine learning. A recipient of multiple awards and patents, Comes has led many ground-breaking advancements, such as being the first person to bring AI solutions to Africa. She has also worked extensively on creating voice virtual assistants in financial services. Starting her career as a researcher at the National Center for Atmospheric Research, she has held management and executive positions at companies such as Genpact, Century Link Telecommunications, Advanced Micro Devices, and IBM.

David Schatsky | dschatsky@deloitte.com

David Schatsky is a managing director at Deloitte LLP. He analyzes emerging technology and business trends for Deloitte's leaders and clients. Before joining Deloitte, Schatsky led two research and advisory firms.

Rameeta Chauhan | ramchauhan@deloitte.com

Rameeta Chauhan is a manager at Deloitte Services India Pvt. Ltd. She tracks and analyzes emerging technology and business trends, with a primary focus on AI, for Deloitte's leaders and its clients.

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Sherry Comes

Applied AI practice—Conversational AI & Virtual Assistants leader
Managing director | Deloitte Consulting LLP
+1 720 325 3757 | scomes@deloitte.com

Sherry Comes is a managing director with Deloitte Consulting LLP's Applied AI group. She specializes in the areas of voice solutions, AI, NLP, sentiment analysis, analytics, data science, and ML.

David Schatsky

Technology Strategy
Managing director | Deloitte LLP
+1 646 582 5209 | dschatsky@deloitte.com

David Schatsky is a managing director at Deloitte LLP. He analyzes emerging technology and business trends for Deloitte's leaders and clients.

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