

Agriculture Chatbots

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ABSTRACT

AI chatbot is a computer program that uses natural language processing and machine learning to understand and respond to customer queries in a conversational manner. Agriculture chatbots have emerged as innovative solutions to address the evolving needs of farmers in the modern agricultural landscape. They use natural language processing to understand and respond to farmers' inquiries in their native language. The primary functions of these chatbots include crop management guidance, pest and disease identification, weather forecasting, and market analysis. AI chatbots are revolutionizing agriculture by delivering smart, data-driven assistance to farmers worldwide. They offer real-time guidance, data analysis, and decision support—enabling farmers to increase productivity, reduce costs, and improve sustainability. They serve as round-the-clock assistants for farmers. Without the need for professional knowledge, the chatbot can help farmers select crops that are suited for cultivation and evaluate the health of their crops. This paper focuses on the development of chatbots that are customized for the agricultural sector.

KEYWORDS: chatbots, agriculture, agriculture chatbots, automation.

INTRODUCTION

In the evolving world of agriculture, the role of technology cannot be understated. The agriculture industry is a vital sector of the economy, providing food, fuel, and fiber for the world's population. It is undergoing a transformative shift with the deployment of AI-powered chatbots designed to assist farmers with crop management, livestock monitoring, and overall agricultural optimization. With the rise of technology, the industry is turning to AI chatbot to improve efficiency, reduce costs, and provide a better customer experience. These chatbots leverage artificial intelligence, natural language processing, and machine learning algorithms to engage in real-time conversations with farmers, offering tailored information and insights. Farmers benefit from on-demand expertise without needing a technical background, thus democratizing access to predictive analytics. They help farmers monitor crop health by analyzing environmental data, weather forecasts, and pest detection.

In modern agriculture, making informed decisions is essential for successful outcomes. In the world of modern agriculture. Having the right information at

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the right time is crucial. Using chatbot technology alongside knowledge graphs allows for a clear and organized understanding of various agricultural topics [1].

CONCEPT OF CHATBOTS

Chatbots are also known as conversational agents, interactive agents, virtual agents, virtual humans, or virtual assistants. Chatbots, as part of AI devices, are computer programs designed to carry on a dialogue with users using natural languages. Healthcare has become an attractive market for chatbot applications. The main purpose of healthcare chatbots is to help patients in less time and for less money than it would take to visit a medical professional. Healthcare chatbots have great potential, but they still have a long way to go to win over consumers.

The first chatbot (Eliza) was developed in 1966 by Joseph Weizenbaum for psychiatric patients. Since then, Chatbots have gained popularity in all the domains such as banking, e-commerce, healthcare, education, and smart homes [2]. A chatbot describes a

computer system or the situation in which human is chatting with the robot (computer).

Chatbots may be regarded as mimic systems which imitate the conversations between two individuals. They employ different degrees of human-like appearance and behavior, such as facial expressions, compassion, humor, and tone of voice. Thus, chatbots are computer programs with a conversational user interface capable of emulating natural, conversational interpersonal exchange. Fueled by artificial intelligence (AI), chatbots are becoming a viable option for human-machine interaction.

Chatbots can be integrated into various messaging platforms, websites or mobile apps to interact with customers and prospects in real time. For example, healthcare chatbot can diagnose the disease and provide basic details about the disease before consulting a doctor. It is designed to reduce the healthcare costs and improve accessibility to medical knowledge. Healthcare chatbots depend on natural language processing (NLP) that helps users to submit their health problem [3]. Figure 1 illustrates a chatbot based on three key structures in AI [4].

There are essentially two types of chatbots: (1) Fixed chatbots: These are programs with fixed information and hence offer limited help; (2) AI-based: These chatbots thrive on dynamic learning and constantly update themselves using various customer interactions. An AI-based chatbot has three domains: databases, natural language processing (NLP), and machine learning (ML). Mostly chatbots are some kind of computer programs that use natural language processing (NLP) for interpreting the user input and generating the corresponding response. In other words, NLP helps users to submit their problem about the health. The aim of the system is to replicate a person's discussion. Chatbots interact with users using natural languages. Chatbot may ask a review of symptoms and relevant information such as past medical or surgical history. It provides response by use of an efficient Graphical User Interface (GUI). The GUI is an artificial creation invented to enable interactions between human and computers. The chatbot system helps users to freely submit their complaints and queries regarding health by voice since customer satisfaction is the major concern for developing this system [4,5]. Figure 2 shows the evolution of chatbots [6].

One may also regard a chatbot as a software system that allows you to simulate real conversations between devices and users by means of a conversational interface [7]. Chatbots use three types of conversation styles [8]: static, semi-automated, and fully-automated conversation dialogue. The static

conversation style is rule-based and it is easy to build. Automated refers to the generative-based model, which uses deep learning models to build interaction. This is very complex and requires a lot of training data. The semi-automated automates some parts while the rest is handled by a human. Figure 3 shows that a chatbot is designed to answer questions with proper answers [9], while

Figure 4 provides some examples of what chatbots can do [10].

AGRICULTURE CHATBOTS

In recent years, the agricultural sector has witnessed a paradigm shift towards digitalization and automation. In today's fast-paced, tech-driven world, the agriculture sector is not left behind. With the rise of digital farming technologies, one of the most transformative innovations is the agriculture chatbots. AI-powered agriculture chatbots serve as intelligent conversational agents designed to assist farmers in various aspects of their farming activities. Machine learning, data analytics, and natural language processing are creating smart chatbots that can help farmers in real time. Such chatbots have the ability to provide farmers with information that may increase their production and mitigate hazards. Figure 5 shows a representation of agriculture chatbot [11], while Figure 6 shows a farmer using a chatbot [12].

Chatbots represent a pivotal leap forward in agricultural innovation. Once confined to the realms of customer service, chatbots are now breaking new ground in the world of agriculture. They are emerging as transformative allies for farmers. By harnessing the power of artificial intelligence and machine learning, chatbots are transforming the agricultural landscape, streamlining communication, and providing farmers with the insights and support they need to thrive. With the ability to operate 24/7 and handle multiple inquiries simultaneously, these digital assistants reduce the burden on farmers and offer support exactly when it is needed [11].

APPLICATIONS OF AGRICULTURE CHATBOTS

Chatbots for agriculture are changing agricultural methods to become more based on data, sustainable, and farmer-friendly. They are powerful tools that the agriculture industry can leverage to improve efficiency, reduce costs, and provide a better customer experience. Common applications of agriculture chatbots include the following [13-16]:

- *Sustainable Agriculture:* Chatbots are transforming our approach to farming and helping to optimize processes and promote sustainable practices. Agriculture chatbots are not just about

convenience—they are about creating a more sustainable, efficient, and inclusive agricultural sector. Chatbots promote sustainable farming by offering insights into best practices and resource management, benefiting both farmers and the environment. As the world moves toward more sustainable agricultural methods to tackle challenges like climate change, food security, and resource depletion, chatbots are poised to play a critical role in ensuring that farmers are equipped with the tools and information they need to thrive.

- *Livestock Management:* AI chatbot can be integrated into livestock management software to provide instant customer support and help farmers with animal health and nutrition. Chatbots can track livestock health by integrating data from IoT sensors and providing alerts on animal well-being, feeding schedules, and disease risks. This proactive monitoring helps prevent outbreaks and enhances herd productivity.
- *Crop Management:* AI chatbot can be integrated into crop management software to provide instant customer support, such as answering questions about crop growth and disease management. AI chatbots help farmers monitor crop health by analyzing environmental data, weather forecasts, and pest detection. They provide personalized recommendations for irrigation, fertilization, and pest control, improving yield and reducing resource wastage.
- *Virtual Advising:* The implementation of AI-powered agriculture chatbots contributes to knowledge dissemination and skill enhancement among farmers. These chatbots act as virtual agricultural advisors, disseminating best practices, latest research findings, and practical tips. They play a crucial role in bridging information gaps between farmers and relevant agricultural stakeholders, such as government agencies, extension services, and research institutions. By empowering farmers with insights that were once confined to specialized consultants, these virtual advisors democratize cutting-edge knowledge across all scales of operation. These chatbots provide real-time pest and disease advisories, weather updates, and guidance on crop management. Additionally, the chatbots keep farmers informed about government schemes and subsidies.
- *Social Media:* AI chatbot can be integrated into social media platforms such as WhatsApp commerce, WhatsApp business API to provide instant customer support and help farmers with account inquiries and transactions.

- *Market Information:* Chatbots may help with agricultural product trade and offer insights into supply and demand as well as price comparisons. This aids farmers in choosing the best time and location for selling their products.
- *Remote Monitoring:* To ensure that resources are used effectively, farmers may employ AI-powered chatbots to remotely supervise and operate various components of their farms, such as irrigation systems and equipment.

BENEFITS

Chatbots can help farmers with a range of chores. They may respond to inquiries, make weather predictions, give guidance on pest management, and assist in the diagnosis of agricultural diseases. They enable precision farming, give useful support and information, and provide insights based on data that assist farmers address obstacles. Other benefits of agriculture chatbots include the following [14-16]:

- *Accessibility:* What sets chatbots apart from traditional support systems is their ability to provide real-time, 24/7 assistance, regardless of location or time zone. This accessibility makes them especially valuable in rural and remote farming areas, where access to timely agricultural advice and services has historically been limited. Farmers can access information anytime, eliminating the constraints of traditional support hours. Rather than waiting for the next available extension officer or service center to be open, farmers can interact with a chatbot at any time of day or night.
- *Cost-effectiveness:* Utilizing a chatbot for farmers can significantly reduce operational costs by automating routine inquiries and providing timely support. AI chatbot can handle multiple customer queries at the same time, which reduces the need for human customer service agents. This can lead to significant cost savings for businesses in the agriculture industry.
- *Personalized Experience:* AI chatbot can use NLP and ML to understand customer queries and provide personalized responses. This improves the customer experience and helps to build brand loyalty.
- *Improved Efficiency:* AI chatbot can handle repetitive and simple queries, which frees up human customer service agents to handle more complex queries. This improves the efficiency of the customer service team.
- *Decision-making:* From soil analysis to market price tracking, AI chatbots assist farmers with

comprehensive decision-making tools. By analyzing vast amounts of data, chatbots provide farmers with timely and personalized recommendations. This proactive assistance enables farmers to make informed decisions, optimize resource allocation, and enhance overall productivity.

- *Scalability:* The use of chatbots allows agricultural organizations to scale their services without a corresponding increase in manpower. This makes it easier to reach large numbers of farmers with fewer resources, which is especially important in developing countries with large rural populations.

CHALLENGES

Implementing AI-driven chatbots in agricultural settings can be a complex task. In the realm of agriculture, where precision and expertise are paramount, generalized chat assistants like ChatGPT might not always hit the mark. There is the concern of receiving answers that sound accurate, but aren't rooted in verified agricultural practices or research. With the complexity of multilingual chatbots, conducting high-throughput testing and validation processes can be time-consuming and resource-intensive. Other challenges of agriculture chatbots include the following [17,18]:

- *Data Privacy:* Agri-related data often involves sensitive information such as crop yields, farm management practices, and climate change impacts. Ensuring the security and privacy of this data during training, deployment, and maintenance is crucial.
- *Data Quality:* Agricultural data is often scattered across multiple sources, including weather stations, soil sensors, and manual observations. Ensuring data accuracy and consistency is crucial for training accurate chatbot models.
- *Language Issue:* Developing AI chatbots that can effectively communicate with farmers in various languages and cultural contexts is a significant challenge. Multilingual chatbots can be integrated into online platforms, providing support to farmers and agricultural professionals in their preferred language.
- *User Expectations:* Farmers often expect chatbots to offer personalized recommendations based on their specific crop yields, soil types, and weather conditions. Meeting these expectations can be a significant challenge.
- *Integration:* Seamlessly integrating chatbot with existing farm management systems, such as

precision agriculture platforms, is vital for maximizing its benefits. Chatbots must be integrated with existing agricultural systems, including farm management software, GIS mapping tools, and weather monitoring platforms.

- *Scalability:* Ensuring that the chatbot can handle a large volume of user requests while maintaining performance and response times is critical for widespread adoption.

FUTURE OF AGRICULTURE CHATBOTS

As technology continues to evolve, agricultural practices are embracing innovative tools to enhance productivity and sustainability. Chatbots are emerging as a powerful ally for farmers, providing them with instant access to crucial information right at their fingertips.

As we cultivate a future where technology and agriculture intertwine, chatbots stand out as the diligent companions farmers never knew they needed. Agriculture chatbots are much more than a passing trend—they represent the future of agriculture. The future of agriculture is here. Advanced technologies such as chatbots are altering the way farmers connect with their livestock and crops. With these intelligent tools, farmers can now cultivate success with confidence [12].

CONCLUSION

The agriculture sector is undergoing a revolution thanks to such technologies, which would increase productivity and sustainability. By analyzing real-time data and applying machine learning algorithms, chatbots become indispensable partners in the field, empowering every farmer to make informed decisions that enhance productivity and sustainability.

Chatbots have grown into more and more crucial instruments in contemporary agriculture. These AI-powered virtual assistants are revolutionizing how agriorganizations, their field teams, and farmers interact, making it easier, faster, and more efficient to exchange information and deliver valuable services. These chatbots are programmed to assist with a wide range of tasks, from answering simple queries about crop diseases and weather conditions to providing more complex information about farm inputs, irrigation, or even market prices.

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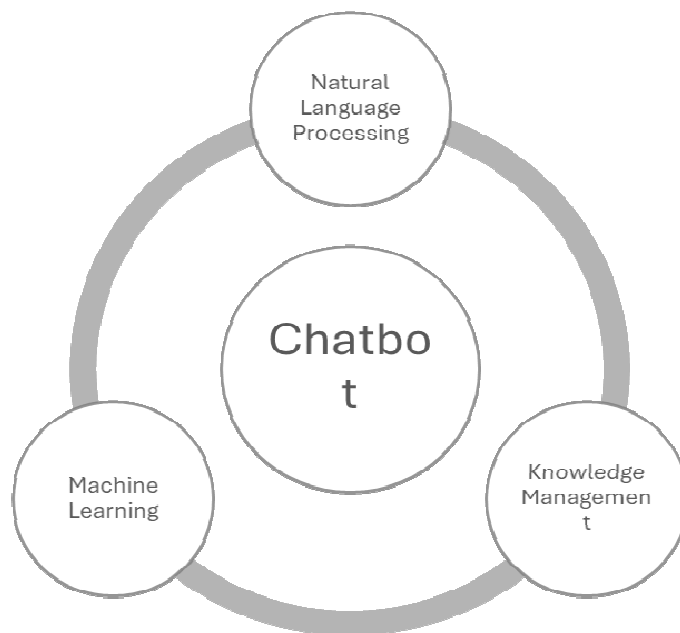


Figure 1 A chatbot based on three key structures in AI [4].

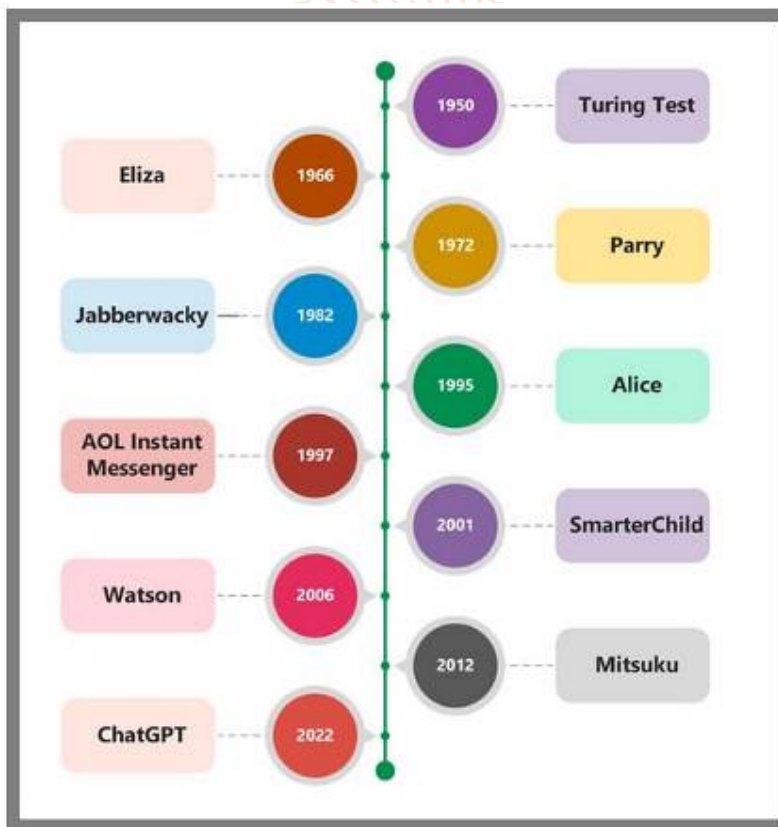


Figure 2 The evolution of chatbots [6].



Figure 3 A chatbot is designed to answers questions with proper answers [9].

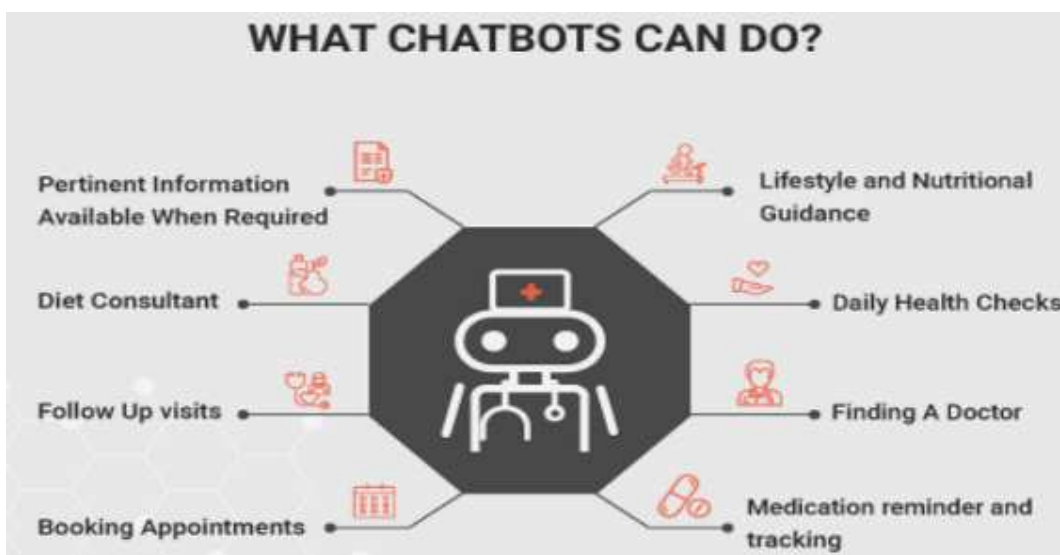


Figure 4 Typical examples of what chatbots can do [10].

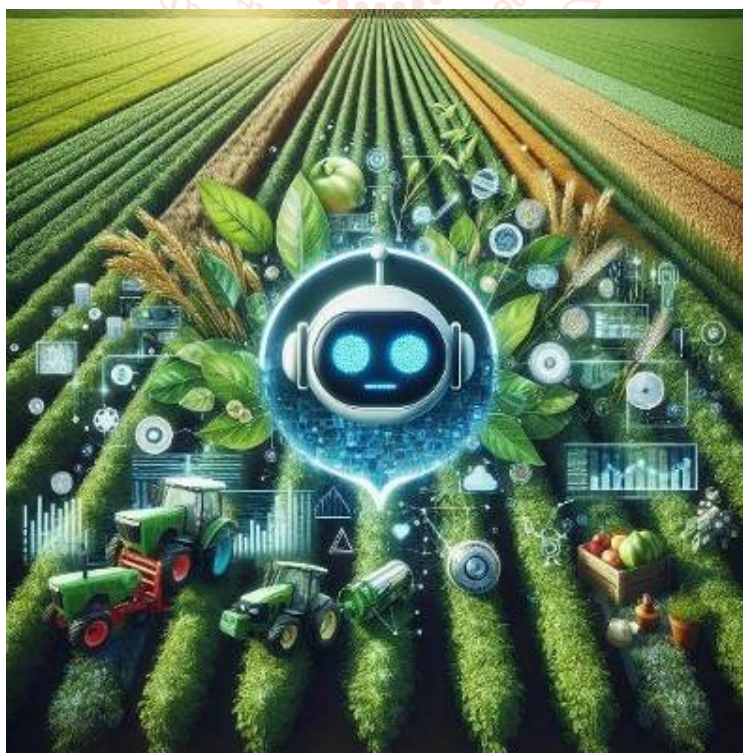


Figure 5 A representation of agriculture chatbot [11].



Figure 6 A farmer using a chatbot [12].

