

ROLE OF CHATBOTS IN THE AGRICULTURE SECTOR

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Abstract—The integration of chatbots in the agriculture sector has revolutionized the way farmers and stakeholders interact with technology. Chatbots, driven by artificial intelligence (AI), are intelligent virtual assistants capable of understanding and responding to human inquiries in real-time. They have emerged as powerful tools, providing valuable insights, guidance, and support to farmers throughout various stages of the agricultural value chain. This paper explores the role of chatbots in agriculture, highlighting their benefits, applications, and potential future developments. By analyzing real-world use cases and success stories, this paper aims to shed light on how chatbots can enhance productivity, efficiency, and sustainability in the agriculture sector. One of the primary benefits of chatbots in agriculture is their ability to deliver timely and accurate information. Farmers can interact with chatbots to obtain real-time weather updates, pest and disease management strategies, market prices, and personalized recommendations for crop cultivation. This instant access to information enables farmers to make informed decisions, optimize their farming practices, and mitigate risks. Chatbots also play a crucial role in providing advisory services. They can offer personalized guidance on crop selection, fertilizers, irrigation practices, and other farming techniques based on specific soil and weather conditions. Moreover, chatbots can assist farmers in diagnosing plant diseases and pests by analyzing images and providing suitable remedies. This not only empowers farmers with expert knowledge but also reduces reliance on physical consultations, making agricultural expertise more accessible to all. Furthermore, chatbots contribute to efficient supply chain management. They can assist in tracking and managing inventories, facilitating seamless communication between farmers, distributors, and retailers. By streamlining logistics and reducing wastage, chatbots help optimize resource allocation and promote sustainability in the agriculture sector. While the potential of chatbots in agriculture is immense, their successful implementation requires addressing challenges such as language barriers, connectivity issues in rural areas, and the need for continuous updates and improvements. Ethical considerations, such as data privacy and security, also need to be addressed to ensure user trust and adoption. Thus, the paper discusses about how chatbots have the potential to revolutionize the agriculture sector by providing timely information, personalized guidance, and efficient supply chain management.

Keywords: Chatbots, Agriculture sector, Artificial Intelligence, Natural Language Processing(NLP), Effective communication.

I. INTRODUCTION

Agriculture is the art and science of soil cultivation, representing a pivotal cornerstone in the socioeconomic development of a nation. However, in the contemporary era of plant breeding, the integration of agrochemicals, including pesticides and fertilizers, coupled with rapid technological advancements, has resulted in the marginalization of our farmers. Consequently, it becomes imperative for them to proactively embrace novel methodologies and stay apprised of cutting-edge agricultural techniques. To address this challenge, a Chat-Bot, an paradigm of human-machine or human-computer interaction, stands as an knowledgeable question-answering system. A chatbot is an Artificial Intelligence system which has grown much further from being a set of pre-loaded answers to be retrieved from a database for a given set of questions.[1] Natural Language Processing (NLP) chatbots are AI-powered virtual assistants that use natural language understanding and generation capabilities to interact with users in a human-like manner. Conversational AI bots powered by natural language processing have the potential to always assist farmers regarding all the intricacies involved in farming which positively impact the economy. Chatbots can be classified into two categories:

- i) Rules based, operating by means of specific commands (or keywords), which generally obey well-defined navigation flows and produce targeted conversations;
- ii) AI-based, making use of more advanced technologies such as machine learning, NLP, among other artifices to increase its capacity for dialogue and interaction[2].

By integrating chatbots into supply chain management in the agriculture sector, stakeholders can benefit from improved efficiency, better decision-making, and enhanced communication throughout the supply chain. Moreover, all the chatbots should have the capability to understand the rural languages and dialects of rural farmers. This research paper proposes an investigation into methods to enhance the multilingual capabilities of agriculture chatbots, with a primary focus on developing more accurate language models to cater to the linguistic diversity of farming communities.

II. ACCESS TO EXPERT ADVICE AND RESOURCES

Among the array of technological advancements, chatbots have gained significant prominence in providing farmers with unprecedented access to expert advice and essential resources. Access to expert counsel regarding the implementation of chatbots in agriculture assumes paramount importance, serving as the compass guiding farmers towards the successful utilization of this transformative technology. The integration of artificial intelligence (AI) and chatbots into education and research has become more prevalent in recent years. Chatbots are automated conversational agents that use natural language processing and machine learning algorithms to interact with users in a human-like manner [3]. Jain et al.,[4] have used a simple Neural network-based model to create an agribot, that can be accessed through any electronic device, to answer queries from farmers. Chatbots rely on an array of advanced technologies, tools, and expertise to ensure their effective development and deployment. The advanced resources empower chatbots to revolutionize industries, such as agriculture, by delivering unparalleled conversational experiences and unlocking boundless possibilities for transformative engagement. Farmers are primed to seize the transformative potential of chatbots, informed by a symphony of expert guidance, empowering them to elevate agricultural productivity and fortify their position on the vanguard of the Agri-tech renaissance.

III. PESTS AND DISEASE MANAGEMENT

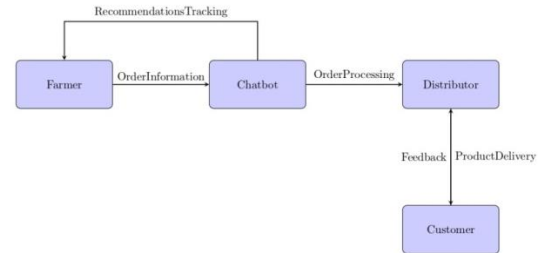
Through image recognition capabilities and real-time monitoring, chatbots aid farmers in identifying pests, diseases, and nutrient deficiencies. Early detection of these issues becomes possible through continuous interactions, enabling farmers to take prompt action and prevent the escalation of problems. Chatbots also excel in recommending integrated pest management (IPM) strategies tailored to the specific crop and geographical location. Chatbots can integrate with pest traps and sensors deployed in the field. This integration allows farmers to receive real-time updates on pest population dynamics, enabling timely responses to changing pest pressures.

IV. VOICE-BASED CHATBOTS

The ability to converse is the thing that distinguishes humans and machines. Answering natural language queries in a semantic manner is a highly challenging task to machines. The existing answering techniques allow the user to query it by typing or by uploading an image or by asking in human voice. For

answering these types of queries, the answering techniques need to focus on Natural Language Processing (NLP), Natural Language Understanding (NLU), image classification, voice recognition, text-to-voice, voice-to-text and so on. Voice-based chatbots have emerged as a transformative tool in the agriculture sector, offering a multitude of benefits and practical applications. With the ability to deliver real-time information at farmers' fingertips, voice-based chatbots enable quick access to critical data on weather conditions, market prices, and agricultural best practices. Most of the farmers prefer using smartphones over computers for searching. It provides a solution by accepting voice queries and responds with voice and text answers. Voice based answering is developed using DialogFlow, a Google-owned developer of Human-Computer interaction technologies based on natural language conversation[5]. Gautam Varma et al[6] demonstrated "A speech-based conversation system in Indian languages for accepting agricultural commodity prices". Voice-based chatbots are particularly beneficial for users with visual impairments or physical disabilities that make typing challenging.

V. SUPPLY CHAIN MANAGEMENT



Supply-chain management (SCM) is 'the management of the entire set of production, distribution, and marketing processes by which a consumer is supplied with a desired product'. The real measure of supply chain success is how well activities are coordinated across the supply chain to create value for consumers, along with increasing the profitability of every link in the supply chain. Supply chain management is the integrated process of producing value for the end user or ultimate consumer. SCM is a philosophy for integrating all the activities in the life of a product or a service from the earliest source of raw materials to the ultimate customer, and beyond to disposal[7]. Integrating supply chain management with a chatbot can enhance efficiency, transparency, and responsiveness, leading to improved customer satisfaction and a competitive edge in the market and enhance the overall agricultural ecosystem, benefiting farmers, suppliers, distributors, and consumers. With

access to various data sources, such as weather forecasts and transportation schedules, chatbots can help optimize the agricultural supply chain. By analyzing this data, the chatbot can suggest the most efficient routes for transportation, reducing costs and improving delivery timelines. The chatbot can be deployed across multiple communication channels, including websites, social media platforms, and messaging apps, making it easier for customers and partners to engage with the supply chain system. They can gather valuable feedback from users and use that data to identify areas of improvement within the supply chain.

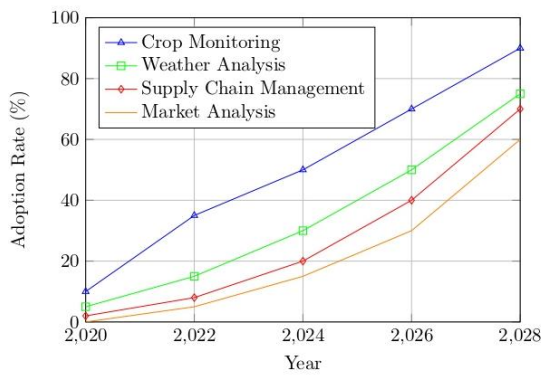


Figure 1: Adoption Rate of Chatbots in Agriculture

VI. WORKING PRINCIPLES

Chatbot also known as “conversational agents” are software applications that are backboned on Artificial Intelligence, Machine Learning and Natural Language Processing. Chatbot will process human speech either in text or voice form, for the purposes of simulating a conversation or interaction with a real person[8]. The functionality of the chatbot is like a virtual assistant for users to help in purchasing and idea generation, resulting in better services and faster response[9]. Chatbot system mainly contains three phases: Question analysis, document processing and answer extraction. Question analysis is the initial step, here the user query in natural language is processed using POS tagging, stemming and removal of key words. Document processing step fetches equivalent documents that contain particular keywords using different algorithms. In the answer extraction phase, it retrieves the answer and tests the answer for the correctness and provides the exact answer to the user[10]. Chatbots are integrated with vast agricultural knowledge databases that contain information on crops, pests, diseases, weather data, best practices and more.



VII. PROPOSED IDEA

Multilingual support is crucial for ensuring the accessibility and effectiveness of chatbots in agriculture, especially in regions with diverse linguistic backgrounds and rural dialects. This research proposal aims to investigate methods to enhance the multilingual capabilities of agriculture chatbots, with a focus on developing more accurate language models to cater to the linguistic diversity of farming communities. Beginning with a comprehensive linguistic diversity evaluation, the proposal will identify the linguistic variations present in target regions. Select a specific region with diverse linguistic backgrounds and rural dialects. Conduct surveys, interviews, and language mapping to identify the languages and dialects spoken by farmers in the region. Analyze existing agriculture chatbot usage and language data, collect linguistic data, including common phrases, terms, and expressions related to agriculture in each language/dialect. Build language models for each identified language/dialect using machine learning and natural language processing techniques. These models will serve as the core of a multilingual chatbot, designed to understand and generate contextually relevant responses in agriculture-related topics across multiple languages. Fine-tune the models to capture the nuances and specific terminology of rural dialects. Further, the research will explore efficient cross-lingual transfer learning and strategies for handling multilingual queries and context. Integrate the developed language models into an agriculture chatbot platform. Scalability and resource efficiency will be integrated into the design, accommodating the addition of languages and optimizing resource usage. Ensure the chatbot can understand and respond in multiple languages and dialects. Implement a user-friendly interface that allows farmers to select their preferred language/dialect. Localize the chatbot's user interface and content to accommodate users with varying literacy levels and technological access. Ensure that the chatbot can function on low-end devices and slow internet connections commonly found in rural areas.

VIII. REAL LIFE EXAMPLES OF CHATBOTS

Plantix, Krushi, and FarmChat are cutting-edge agricultural apps and chatbots. Plantix uses image recognition to identify crop issues, offers localized advice, and works offline. Krushi provides weather updates, market prices, and pest alerts with an easy-to-use interface, accessible even in low-connectivity areas. FarmChat utilizes data analytics to provide evidence-based recommendations for smarter farming decisions, promoting sustainable agriculture and supporting farming communities worldwide. These innovative platforms empower farmers with timely information, expert advice, and collaborative networking, revolutionizing the way agriculture is practiced.

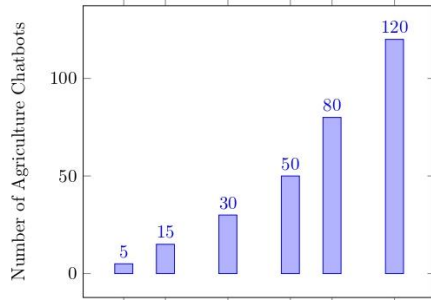


Figure 1: Usage of Chatbots in Agriculture (2010 - 2023)

IX. BENEFITS OF USING CHATBOTS IN AGRICULTURE

- 24/7 service and information are available from chatbots, allowing farmers to access support and insights whenever they need them, regardless of the time of day.
- It provides immediate responses to queries, reducing the need for farmers to wait for human assistance or search for information online.
- Chatbots can deliver real-time weather forecasts and alerts, helping farmers plan their activities according to weather conditions.
- They can provide farmers with current market prices, helping them make informed decisions about selling their produce.
- They assist in managing irrigation schedules, fertilizer application, and crop monitoring, ensuring that resources are utilized efficiently and environmental impact is minimized.

X. CHALLENGES

- It requires a large volume of data for developing model
- Agriculture is a complex domain with many variables that can affect crop growth and yield. It may not be able to take into account all of these variables and may not be able to make accurate predictions
- ChatGPT is a black box model, which means it is difficult to understand how it is making its predictions. This can be a limitation when trying to explain the model's results to farmers or other stakeholders
- It is primarily designed to process and generate text, it may not be able to handle other types of data, such as sensor data, that are commonly used in agriculture
- It is an AI model and it may have bias and errors, so it's important to evaluate the results before applying them to real-world scenarios[11].

CONCLUSION

The integration of chatbots into the agriculture sector marks a significant step towards the digital transformation of farming practices. These intelligent virtual assistants, driven by artificial intelligence and natural language processing, have demonstrated their potential to revolutionize the way farmers interact with technology. The benefits of chatbots in agriculture are multi-faceted, ranging from providing real-time information and personalized advice to efficient supply chain management and enhanced communication. The case studies of Plantix, Krushi, and FarmChat highlight the tangible advantages that chatbots bring to farmers. They offer rapid access to critical data, aid in informed decision-making, and tackle complex challenges like pest and disease control. Moreover, by harnessing the power of data analytics and machine learning, chatbots contribute to precision farming, where resources are utilized optimally, and environmental impact is minimized. As we gaze into the future, the potential of chatbots in agriculture is poised for further expansion with advancing technology. With the advent of voice-based chatbots and more sophisticated AI capabilities, farmers will have even greater access to information and support. As the agriculture sector navigates the complexities of feeding a growing global population while minimizing its environmental footprint, chatbots stand as tools that can empower farmers, increase productivity, and contribute to a more sustainable future. This research proposal outlines a systematic approach to enhancing the multilingual capabilities of agriculture chatbots, ensuring their accessibility and effectiveness in linguistically diverse farming

communities. The outcomes of this research will contribute significantly to improving agricultural extension services and ultimately enhancing livelihoods in these regions.

REFERENCES

- [1] Kiruthika, U. R. (2020). E-Agriculture for Direct Marketing of Food Crops Using Chatbots. 2020 International Conference on Power, Energy, Control and Transmission Systems (ICPECTS).
- [2] Arora, B. C. (2020). Agribot: A Natural Language Generative Neural Networks Engine for Agricultural Applications. 2020 International Conference on Contemporary Computing and Applications (IC3A).
- [3] Kooli, C. (2023). Chatbots in Education and Research: A Critical Examination of Ethical Implications and Solutions.
- [4] Jain, N. J. (June 2019). AgriBot: agriculture-specific question answer system. IndiaRxiv.
- [5] Cynthia. T., & N. (2018). Voice Based Answering Technique for Farmers in Mobile Cloud Computing. International Journal of Scientific Research in Computer Science Applications and Management Studies.
- [6] Gautam Varma et al.G.V.Mantena, S. (2011). "A speech-based conversation system for accessing agriculture commodity prices in Indian languages,". Jt.Work. Hands-free Speech Commun. Microphone Arrays.
- [7] Somashekhar, I. C. (2014). Agriculture supply chain management: a scenario in India. Research Journal of social science and management.
- [8] R. J. Ong, R. A. (2020). A Review of Chatbot development for Dynamic Web-based Knowledge Management System (KMS) in Small Scale Agriculture.
- [9] Makhkamova, O. L.-H. (2020). Deep Learning-Based Multi-Chatbot Broker for Q&A Improvement of Video Tutoring Assistant. 2020 IEEE International Conference on Big Data and Smart Computing.
- [10] Niranjana, P. Y., Rajpurohit, V. S., & Malgi, R. (2019). A Survey on Chat-Bot system for Agriculture Domain.
- [11] Gaddikeri, V. J. (2023). Revolutionizing Agriculture: Unlocking the Potential of ChatGPT in Agriculture Food.