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RESEARCH ARTICLE

Agri Friendly Conversational AI Chatbot Using Open Source Framework

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Abstract

Objectives: To develop an agriculturally focused conversational AI chatbot using the Rasa Open Source framework and to create a user-friendly interface tailored to the needs of the farming community. The chatbot aims to provide accessible and cost-effective solutions by offering real-time assistance, information, and support to farmers. **Method:** The methodology involves leveraging Rasa's advanced natural language understanding (NLU) capabilities to enable accurate intent recognition and entity extraction. Agricultural data, including FAQs, crop details, pest control methods, and weather information, are collected and used to train machine learning models. The chatbot is refined through iterative testing and feedback from users in the agricultural domain. Deployment is planned on mobile and web platforms to ensure wide accessibility. **Findings:** The findings indicate that Rasa Open Source is a robust framework that allows for the creation of scalable, context-aware, and customizable conversational agents. The integration of advanced NLP techniques enhances the chatbot's ability to comprehend and respond to user inputs effectively. **Novelty:** The novelty of this research lies in its application of open-source conversational AI technology to agriculture, addressing the specific challenges faced by farmers while maintaining cost efficiency. This contributes significantly to the growing use of AI in agriculture, providing a practical tool for decision-making and problem-solving. Unlike traditional tools, this chatbot integrates natural language understanding and dialogue management to deliver real-time assistance on critical topics such as weather updates, crop information, pest control, and market insights.

Keywords: Agriculture Friendly chatbot; AI chatbot; Rule Based chatbot; RASA Transfer Learning

1 Introduction

The essence of this innovative undertaking lies in harnessing the power of conversational artificial intelligence to foster a more seamless and efficient communication channel between farmers and the wealth of information and resources available to them. By leveraging an open-source framework, the intent is to not only deliver a tailor-made

solution for the agricultural community but also to ensure accessibility, adaptability, and affordability. As agriculture continues to be a pivotal force driving global sustenance, the Agri Friendly Conversational AI Chatbot serves as a testament to the potential of open-source technologies in contributing to the advancement of the industry. For the purpose of creating conversational AI chatbots and assistants, Rasa is an open-source framework. It offers libraries and development tools for creating and implementing text-based, AI-driven chatbots that are capable of carrying on natural language discussions with users. With Rasa, developers can build dynamic, interactive chatbot experiences that can comprehend user intents, extract entities, and deliver insightful responses. Rasa is made up of two primary parts- Rasa NLU: This part is concerned with deciphering and interpreting user messages. It carries out functions such as entity recognition—which gathers pertinent data from the user's input—and intent recognition, which determines the user's intent. Rasa Core: This part is responsible for managing the conversation's dialogue. Based on the user's input, the context of the conversation, and predefined actions, it determines how the chatbot should react. In contrast to pre-built platforms, Rasa offers greater customization and control when building AI chatbots in a developer-friendly manner.

2 Related works

The need to use a mobile chatbot to overcome the expertise gap in agriculture. Using an ontology-based strategy, the chatbot seeks to provide farmers with immediate updates on current agricultural methods, hence improving decision-making and total crop yield. The study contributes significantly to the promotion of technology-driven solutions for the region's sustainable agricultural growth[(1)] . Krushi - The Farmer Chatbot" highlights how Artificial Intelligence and machine learning may aid Indian farmers with crop production, weather, and agricultural techniques. This chatbot, which uses data from the Kisan Call Centre, intends to improve processes for making decisions and address difficulties encountered by the farming community, emphasizing the practical use of free platforms for sustainable agricultural growth[(2)]. The Farmer Query Redressal System (FQRS) is a chatbot that uses the Rasa open-source framework to answer farmer questions via natural language processing. FQRS, which was created using machine learning as well as deep learning techniques, exhibits its adaptability in imitating human-like discussions, highlighting the Rasa framework's usefulness in constructing successful Agri Friendly Conversational AI Chatbots. The research emphasizes the model's ability to solve farmers' concerns with adequate training inside the Rasa 3.0 framework[(3)]. The importance of organic agriculture in meeting global food demands refutes assertions that it is environmentally superior to well-managed conventional farming. It investigates issues like as land specifications, biodiversity, water quality, degradation of land, and climate change, arguing that sustainably operated conventional activities, with careful management, may give higher yields and a more sustainable method for fulfilling the needs of expanding populations. The study emphasizes the significance of changing hazardous practices in traditional agriculture to reduce environmental and health risks[(4)]. Plants-associated microbiomes for environmentally friendly agriculture, emphasizing their potential to improve plant resilience, nutrient absorption, and output while reducing environmental impact. It analyses the negative impacts of chemical fertilizers on the ecosystem and investigates the use of microbiological technologies, such as biological fertilizers and bio-pesticides, as environmentally benign substitutes. The findings highlight the importance of understanding collaborative interactions among plants and the roots microbial populations in developing a sustainable and environmentally friendly agricultural method[(5)]. Current advancements and successes in transplastomic plants, with a focus on their potential in the field of genetic engineering for increased agricultural productivity and environmentally friendly agriculture. The study emphasizes the importance of chloroplasts as prokaryotic compartments and highlights the rising popularity of transplastomic plants as a novel and viable approach for agricultural innovation. The chapter also covers issues like commercialization and concerns from the public, while pushing for long-term agricultural growth through the use of transplastomic plants[(6)]. The importance of "planet-friendly agriculture" in tackling the problems of environmental deterioration and resource scarcity connected with traditional farming techniques. It emphasizes the critical need for sustainable agriculture solutions that will treble productivity by 2050 while reducing pollution, emissions of greenhouse gases, biodiversity loss, and water impact. As agriculture is vital to global development, the study emphasizes the importance of adopting an "Agri Friendly Conversational Artificial Intelligence Chatbot" to line with these eco-friendly ideals for promoting food security and meeting the Sustainable Development Goals[(7)].

The abundance of discussion data gathered from social media and fueled by developments in neural network technology. It thoroughly evaluates recent breakthroughs and categorizes existing frameworks, offering useful insights into the changing environment of open-domain conversation systems. Intends to help the NLP community shape the future of open-domain conversation research by providing a platform for constructing an "Agri Friendly Conversational Artificial Intelligence Chatbot" utilizing open-source frameworks[(8)]. Interactive chatbots that link farmers directly with consumers, this innovative approach aims to promote fair pricing in the agricultural sector. The method promotes direct transactions by utilizing an intelligent platform available on social networks such as Facebook Messenger, removing intermediaries and ensuring farmers receive

fair compensation for their goods. The potential of the ”Agri Friendly Conversational Artificial Intelligence Chatbot” as a disruptive solution for improving direct marketing, farmer profitability, and consumer access to agricultural products[9]. The Chatbot system in agriculture recognizes the importance of processing natural language and the necessity for farmers to have access to information on new technology and techniques. The study uses machine learning approaches to handle the difficulty of extracting exact responses in an Agriculture Questions Answering System, delivering significant insights with suggestions and contrast analysis. The project establishes the groundwork for the creation of an ”Agri Friendly Conversational AI Chatbot” that uses open-source frameworks to improve farmers' knowledge and participation[10]. Chatbot applications are a novel solution in the agricultural sector, filling a gap in existing smart systems for agriculture by delivering crop cultivation information to farmers to help them make decisions. The suggested application combines five major functions, including information, surveillance, and control elements to improve user pleasure. Recognizing the existing rule-based nature of the LINE chatbot, the study intends to develop it into an intelligent system further, demonstrating the possibility for ”Agri Friendly Conversational Artificial Intelligence Chatbot” for sophisticated and user-friendly agricultural help[3]. The Farm Query Redressal System (FQRS) is a chatbot built with artificial intelligence and deep neural networks on the Rasa 3.0 framework. The study, which focuses on farmer inquiries, shows that Rasa is more versatile than other platforms in terms of generating successful and human-like conversation chatbots. The findings demonstrate the model's efficacy, highlighting the promise of a friendly Artificial Intelligence Conversational Chatbot for personalized and efficient farmer help inside an open-source framework[11] . The new Question Answer System for Agriculture Domain (QAS-AD) aims to solve the key difficulties encountered by Indian farmers. The suggested QAS-AD improves farmers' agricultural practice decisions by using pattern-matching technologies and an optimized binary-tree technique. The research emphasizes the possibility of implementing an ”Agriculture Friendly Conversational Artificial Intelligence Chatbot” utilizing open-source platforms, resulting in enhanced efficiency and reduced time for computation compared to existing systems[12]. Text classification can help improve chatbot answers by emphasizing their capacity to gather contextual information and increase categorization accuracy. Using multiple libraries for N-Gram creation, the study proposes a way for preprocessing user input messages, extracting N-Grams, and employing algorithms based on machine learning for successful chatbot categorization. The findings reveal that integrating N-Grams considerably improves the capabilities of chatbots, highlighting the promise of the Agri Friendly Conversational Artificial Intelligence Chatbot” for improved and context-aware interaction in agriculture[13].

Design optimization (MDO) is critical for tackling complicated engineering issues, yet current frameworks frequently lack efficiency and innovative techniques. This study proposes OpenMDAO, an open-source MDO framework intended to use Newton-type techniques to solve coupled systems efficiently. Its hierarchical methods and sparsity exploitation improve computing efficiency, making it a potential tool for a variety of applications, including trajectory and structural topology optimization, as shown in the literature. According to the research, OpenMDAO has tremendous potential for expanding engineering design and analysis applications[14]. The Fisheries Library for R (FLR) architecture is intended to improve cooperation and assessment of fisheries management techniques across several disciplines. FLR makes it easier to integrate diverse software packages to examine the resilience of alternative management techniques by supporting open-source principles and object-oriented programming. The study emphasizes the need to be transparent through open source for efficient technology transfer and multidisciplinary collaboration, as well as possible insights for developing a Agri Friendly Conversational Artificial Intelligence Chatbot with open-source frameworks[15]. Chatbot program for the agricultural area, emphasizing the importance of knowledge distribution in improving crop production and assisting farmers in India. Using the Sentence-Transformer technique and API services for real-time market pricing and weather information, the chatbot responds quickly and accurately to a wide range of farm-related questions. The study emphasizes the efficiency and farmer-friendliness of the suggested Agri Friendly Conversational Artificial Intelligence Chatbot, which provides a vital tool for informed decision-making as well as expense savings in the agricultural sector[15].

3 Methodology

The Agri friendly AI chatbot is created in the Rasa open source framework. Rasa has the capability to understand the natural language and give the right response. The working architecture is given in the Figure 1. The Rasa NLU (Interpreter) receives the message from the end user and outputs a structured output that includes the original text. The entity that monitors the status of the conversation is called the Tracker. It is informed that a new message has been received. The Policy received the tracker's output and took action based on the tracker's current state. The policy determines the proper course of action to take next. The tracker keeps track of the selected action log. The user receives the appropriate response. nlu.yml is a crucial file in the Rasa framework. The nlu.md file was present in rasa version 1, but the nlu.yml file was present in rasa version 2. Finding the users' intentions in the query is the function of the nlu.yml. Additionally, the intent classification model uses this file. The user query's intents are automatically classified by the nlu.yml file. Stories.yml is the next import file in the rasa framework. Potential

examples of intent and action in a bot interaction are contained in the stories.yml file. The Stories.yml file aids the chatbot in responding appropriately to messages entered by users. Domain.yml is another crucial file in Rasa. The various bot responses are contained in this file.

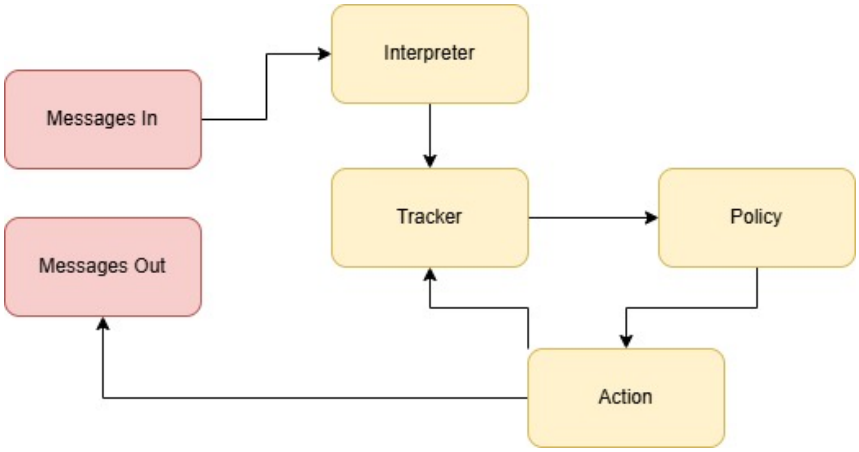

Fig 1. Rasa working architecture

Intent refers to the user's intention or the action they want the chatbot to perform, while entities are specific pieces of information within the user's input that the chatbot needs to extract. In a conversational AI chatbot developed for agriculture using the Rasa open-source framework, the system aims to assist farmers with a range of queries related to crops, weather, pest control, fertilizers, crop diseases, market prices, and general farming tips. The Rasa framework, with its natural language understanding (NLU) and dialogue management capabilities, allows the chatbot to understand user inputs and respond effectively. The sample intent is outlined below. The nlu.yml file consists of intent and entities.

- intent: What's the weather like today
examples: |
- Farmer [weather]{"entity":"weather"}
- story: search weather
steps:
- intent: search_ weather
- action: action_search_ weather

The stories.yml file consists of intent and its corresponding action part as shown in the above yml language. Rasa utilizes Utilize Rasa NLU pipeline components such as tokenizer, intent classifier, and entity extractor for effective natural language understanding. Implement custom actions in the Rasa framework to perform specific tasks, such as fetching weather information, providing crop details, or suggesting pest control measures. Leverage Rasa Core for dynamic dialogue management, ensuring the chatbot maintains context and coherence during interactions. Train the model with diverse and representative training data to enhance the chatbot's ability to handle a variety of user queries. "Agri Friendly Conversational AI Chatbot" using Rasa, the aim is to create a powerful and adaptable tool that empowers farmers with real-time information and support, ultimately contributing to the enhancement of agricultural practices.

4 Results and discussion

The chatbot demonstrates high accuracy in recognizing user intents across diverse queries related to weather, crop information, pest control, fertilizers, crop diseases, market prices, and general farming tips. The entity extraction mechanism successfully identifies and extracts relevant information, such as crop types, locations, weather details, pest types, fertilizer types, disease types, and market crops, with precision. User interactions with the chatbot reveal a high level of coherence and relevance in the responses provided. The dialogue management within the Rasa framework effectively maintains context throughout conversations. Custom actions, responsible for executing specific tasks such as fetching weather information or providing fertilizer recommendations, perform effectively, contributing to the chatbot's utility. A rule-based chatbot is a type of conversational agent that operates on a set of predefined rules and patterns to understand and respond to user inputs. Unlike machine learning-based chatbots that rely on training data and algorithms to learn from interactions, rule-based chatbots follow

explicit instructions encoded by developers. The chatbot's behavior is governed by a set of rules and predefined patterns that dictate how it interprets user inputs and generates responses.

Table 1. Comparison of Google Dialogflow and Rasa

Parameter	Google Dialogflow	Rasa
Customization and Control	Rasa offers a high level of customization and control over the chatbot's behavior. Developers can fine-tune the natural language understanding (NLU) model and dialogue management to suit specific requirements.	While Dialogflow provides a user-friendly interface, it may have limitations in terms of customization compared to Rasa. Users have less control over the underlying algorithms and models.
Natural Language Understanding (NLU)	Rasa allows users to train their own NLU models using their own data, providing more control over domain-specific language and context.	Dialogflow uses pre-trained models by default, leveraging Google's extensive language understanding capabilities. It may be easier for beginners but might not be as tailored to specific industries or use cases.
Integration	Rasa can be integrated into various platforms and systems, offering flexibility in terms of deployment and integration with existing tools.	Dialogflow integrates seamlessly with other Google Cloud services and has pre-built connectors for common platforms, making it easy to integrate with Google's ecosystem.
Development Community	Rasa has a growing open-source community. Users can benefit from community-driven contributions, discussions, and resources.	As part of Google Cloud, Dialogflow users can access Google's extensive resources and support.

The comparison of Rasa is shown in Table 1. Rasa is an open source framework and Dialogflow provides a user-friendly interface. The Recurrent Neural Network, Rule-based chatbot, and Rasa nlu performance are compared in the following Table 2.

Table 2. Comparison of different types of chatbot

Sl. No	Types	Accuracy
1	RASA NLU	0.95
2	Rule based Chatbot	0.80
3	RNN	0.90

Rasa NLU is a component of the Rasa conversational AI framework that focuses on natural language understanding. It is designed to extract intents and entities from user messages, enabling chatbots to comprehend and respond to user inputs effectively. RNN is a type of neural network architecture designed to handle sequential data by maintaining a hidden state that captures information from previous inputs. It is widely used in natural language processing (NLP) tasks such as language modeling, machine translation, and sentiment analysis. This chatbot has innovatively utilized the open-source framework for addressing challenges that the agricultural community has faced differently than the tools normally in use. Due to its integration of natural language understanding and dialogue management, it can provide real-time help regarding information related to critical issues such as weather updates, crop information, pest control, and market insights. Its open-source nature guarantees flexibility to the developers who can tailor its features according to changing agricultural needs. With 95% accuracy and multi-channel access, this chatbot maximizes the dissemination and usability of agricultural information with scalability and friendliness. It marks a radical leap in how AI is utilized to transform the very nature of farming and equip farmers across the globe.

Challenges and Limitations of Chatbot Development

Developing chatbots comes with its set of challenges, ranging from technical complexities to user experience considerations. Extracting the correct intent and entities from user inputs can be challenging, especially when dealing with variations in language, slang, or complex queries. Maintaining context in a conversation is crucial for providing meaningful responses. Understanding user queries in the context of the ongoing conversation can be challenging. Handling multi-turn conversations and maintaining coherence over several interactions can be challenging, especially when user inputs refer to previous messages. Ensuring the chatbot evolves with changing user needs and stays up-to-date with the latest information can be challenging.

5 Conclusion

Agri Friendly Conversational AI Chatbot developed using an open-source framework stands as a promising and innovative solution tailored to address the distinctive needs of the agricultural community. The chatbot, built on a foundation of natural language understanding and dialogue management, showcases the potential of artificial intelligence in revolutionizing agricultural interactions. Its multi-faceted capabilities, ranging from providing weather updates and crop information to assisting with pest control and offering market insights, position it as a versatile tool for farmers seeking real-time assistance and guidance. The open-source nature of the framework not only ensures accessibility but also empowers developers to customize and extend the chatbot's functionality, aligning it closely with the dynamic requirements of the agricultural landscape. The integration of user-friendly interfaces and multi-channel accessibility enhances the chatbot's reach, making valuable agricultural information accessible to a broader audience. The accuracy the Agri friendly chatbot gives 95 percent accuracy. Agri Friendly Conversational AI Chatbot demonstrates significant promise, but there is room for continuous improvement. Future enhancements may focus on expanding the chatbot's knowledge base, refining its natural language understanding capabilities, and incorporating advanced features to address emerging challenges in agriculture.

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