Farmer's Friend: Conversational AI BoT for Smart Agriculture

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ABSTRACT

Farmers are facing lot of issues even in the era of Digital disruptions. 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. All Businesses are adopting latest technology solutions to reduce costs significantly, to increase revenues and to automate time-consuming manual tasks and focus on growth. In this paper we are applying a similar approach for agriculture on which more than 70% of the rural Indian population is dependent. Conversational AI internally uses Natural Language Processing which is a subdivision of Artificial Intelligence (AI) that powers computers to understand, comprehend and process human languages. In addition, Farmers are also affected by climate change, economic issues, environmental issues that affect whether like Soil quality, water quality, climate, and terrain etc. Despite all these issues farmer community is striving hard to supply food to the growing world population. To provide timely help to all the farmers on the various aspects related to farming and market conditions, we have developed Farmers Friend – A Conversational AI BoT for smart agriculture. This bot can also get integrated into Smart Agriculture System based on IoT (SASI) that has been devised by us already.

Keywords: Conversational AI, NLP, Smart Agriculture, IoT**,** Farming

1. INTRODUCTION

Farming involves cultivation in the land, this is one of the factors that determines the development of a country. Many developed countries are adopting modern techniques in farming during cultivation, advanced techniques to control weeds and pests, fertilizers because of the advancements in the technology and increased innovation & research. However, Farmers in our country are a step behind in adopting to latest technology. Spreading awareness of all the technological adavancements is very essential. The stream Conversational AI is related to the creation of speech-based assistants, messaging apps and chatbots to improve communication and to create tailored customer experience by systematizing the communication data flow. It is a collection of technologies that work together to enable computers to to understand and simulate conversations. A chatbot application is a computer program that is intended to simulate human like conversation via input text and audio messages. Operatioanl costs can be reduced only when the related tasks can be performed most efficiently with less time and with little or no manual intervention. Using this automation techniques, the organisations can automate business in many areas like health, travel, news, weather, entertainment and e-commerce. Google and Facebook are focusing on developing Bots which helps organisation to automate tasks. SAP introduced a Bot frame called Recast.ai which helps organisations to develop the Bots for their organizational tasks. Considering the current situation everywhere, it's very difficult for farmers to reach agriculture universities or agriculture offices to get information related to farming as there are many risk factors come along due to COVID pandamic. We are considering agriculture as a domain as there is an IoT system we have set up which will generate lot of data with the help of many sensors used in the system. This data from the database can be explored, in the process, retrieving exact data in conversational style is not possible. Since the data that is generated is of high volume, retrieving appropriate answer for each question is tedious. Many answers will

look similar this makes the process even complex. To obtain exact response to the farmers queries, we are leveraging Natural Language Procesing (NLP) in the form of conversational AI. Our study will help farmers retrieve many details regarding their crops like moisture level, humidity, temparature, raw materials, soil condition and fertilizers.

2. METHODOLOGY

NLP is at the heart of conversational AI. Figure 1 depicts the high-level architecture components of of Conversational AI.

NLP Engine:

Natural Language Processing (NLP) engine makes use of artificial intelligence technology to better understand a sentence or phrase based on the user input query. Chatbots are developed based on a rule-based engine that requires detailed queries to be provided which results in results being large and inefficient. NLP engine extracts data and returns actionable results that comprises of predictable intents, entities (both standard and custom) and user requests from expressions.

Bot Builder:

The Bot builder which is also indicated as the runtime of the dialogue, which is a Graphical User Interface (GUI) where the interaction flow can be created by the user. This is the place where user would indicate the bot how to respond to user's input messages. A bot builder provides a distinctive user experience environment which accelerates the complete bot development process.

Bot Logic:

It is Cloud platform, which is responsible for invoking and consuming OData services or APIs from the back-end database and system and exposing that information to conversational AI, the Bot logic can be written and exposed as a web API in any programming language of the developer's choice.

Bot Connector:

It is an adaptor that enables CAI to connect to many channels of communication, like messenger, webchat, slack, Microsoft teams, etc. Based on customer specifications, the Bot connector may be hosted on on-premises system also.
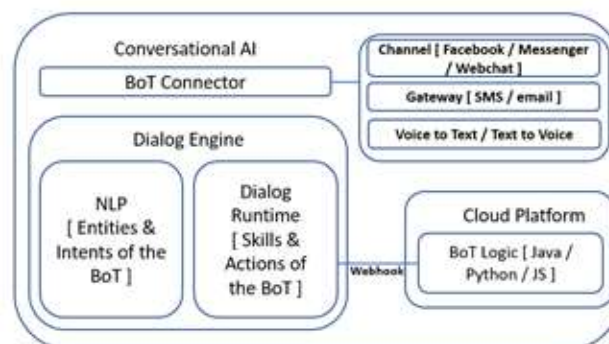

Figure 1. Conversational AI BoT building framework used to build Farmer's Friend chat bot

3. TERMINALOGY USED IN CONVERSATIONAL AI

BoT Training: By leveraging the power of NLP technology to create human-like chatbots in any language, BoT training understands customer needs. It helps to obtain enriched data for smart and effective coding.

Intents: Intent is group of expressions which provide the similar meaning but can be built in multiple ways. It is important for Bots understanding. Each intent represents a specific idea which can be easily understandable by Bot.

Expressions: Intent are user intentions. They are a group of expressions that have the common definition but can be built in many alternative ways. It's crucial for the understanding of Bots.

Each intent represents a particular term that can be easily understood by Bot.

Entities: A set of key terms that are derived from an expression. 28 entities are open for use as part of the Conversational AI framework. Golden entities are called the entities provided by Conversational AI. Users, however, can create personalised entities for their use along with golden entities.

BoT Building: Bot building is used to coordinate and manage skillful communication. By reusing the current Bot Skills, it facilitates human conversation. It allows the customer to get the data for the requests. With the aid of Emotion Analysis, Language Recognition and Emojis, it offers excellent information by fine-tuning the conversations. Existing skills can be used in a simpler and more effective way to make Bot creation. Fork the skills and reuse the skills to accelerate the creation job.

Skills: Skill is a chunk of discussion that has a powerful objective and helps the bot achieve the objective. With only one connection to the consumer, it is not constrained. With multiple connections, it can work.

Skill types: There are two types of skills called business skills and floating skills.

Business: These skills are strictly linked to the core objective of the Bot.

Floating: These skills are ment for small talk, subjects which are not completely related to the main objective of the Bot.

Triggers: Triggers are preset conditions which will control if the Bot should execute the current skill or not. Each skill should map with trigger, if not it will not be executed for the supplied user input.

Skills which are having Fallback skill type will not have triggers as these skills are automatically trigger when no other skill is invoked for execution. A Bot can have only one fallback type of skill.

Requirements: Requirements could be either intents or entities that need to be collected by the skill before performing actions. There are large blocks of data in the discussion. In the Bot building, they can be mandatory or optional. Based on the data supplied to the bot, results will be produced. Once the requirement is met, the relevant information will be processed for full conversation in the bot's memory.

Actions: When all the specified requirements are satisfied, the bot executes the action at a specific time during the execution of a skill.

Fall back: The discussion is diverted to a human agent by this action. Link to a fall-back channel where the message will be redirected by conversational AI.

Connecting the BoT to various Channels: Link the Bot to messaging and fall-back channels like Amzon Alexa, Lync, Messenger, Skype, Microsoft Teams, Slack, CoPilot, Telegram, Twitter etc.

Monitoring the BoT: Bot monitor helps us obtain logs, metrics and analytics. This tab keeps track of all the messages, metadata, log feeds and discovers all sentences analyzed by the Bot. Monitors the usage statistics by giving details on usage of conversations, skills, intents and entities. It provides the summary of conversations, users, messages received, message/conversations, popular entities, popular intents and most used skills. Monitoring training analytics helps us to build a data set for the bot. This is available for Bots with at least 4 intents and at least 30 expressions per intent. Users accessing the Bot system will run a benchmark that will activate multiple processes to evaluate the data set output and provide insights to enhance the classification of purpose and identification of custom entities. For the Bot, the user can run only one benchmark at a time.

4. LITERATURE SURVEY

In [1] and [5] the authors present a voice based intelligent web chat bot which involves the designing and implementation of an intelligent text-based bot based on natural language processing. They showcase the technolgy that can be used to build the bot. They use a service framework, using which the external web services can be consumed and the same set up is used to communicate with all the external clients. This extensibility feature enhances the lifetime of the bot as it uses the needed services in the form of APIs.

The Authors in [4] and [6] present a college Information bot with UI that is text based where

the input commands are sent a text and the response that is received is also text based. The bot that is present here is stateful which maintains the state of the previous commands. In this bot also there is use of web services and the bot works like an artificial person. This bot can run in phones, computers and it can be easily accessed from internet. The conversations that are built using NLP are extreamly intelligent and useful.

In [10], A college enquiry bot is presented by the authors. This bot is having text as well text to speech response. This Bot is also a statful boot which maintains the previous state between subsequent interactions. This bot has a integration to some of the artificial intelligence algorithms which helps users to get appropriate responses. There is also a machanism to handle or monitor the invalid responses in this bot.

In [7],[8],[9] and [12] there is smart responding bot which is depends on optical character recognition and over generating transformation logic and ranking mechanism. Here there is mechanism to convert documents into knowledge. This Knowledge enables the chatbot anser the questions posed by the users. The electronic documents submitted help the bot simulate the responses of the bot. This bot can take the input documents in varied formats like PDF and digital photos. The text from these documents is extracted using OCR technique and later it generates responses using transformation and ranking mechanism.

5. RESULTS AND DISCUSSION

Crop / Monitoring site: It is the farm - An extremely large field or land reserved for agriculture that specialises in produces, usually based on a plantation house. Cotton, coffee, tea,

cocoa, sugar cane, opium, sisal, oil seeds, oil palms, fruits, rubber trees, and forest trees are among the crops grown. It is from here using the sensors the data about the whole agriculture ecosystem is captured using SASI.

SASI: IoT System: SASI- Smart Agriculture System based on IoT[1] is a Smart Agriculture solution which is developed using sensors to carefully monitor the crop field. In the experimental setup multiple sensors are used to monitor soil minerals, light, humidity, temperature, soil moisture, etc. It makes the farmer community or agriculture community reduce the complexity of many events that are achieved manually.

Storege: Cloud Database: A cloud database is a database that normally exists on a network for cloud computing, and access to the database is given as a service. Scalability and high database availability are taken care of by database services. The underlying software-stack is made accessible to the user by database services. The data captured by the sensors in SASI is fed to a cloud-based database. The data is later consumed by the Farmers Friend Bot in real-time via APIs or REST / SOAP based services.

Farmers Friend: It is the Conversational AI Bot that is being developed to share the details to the farmer in a very seamless, flexible and conversational manner. The bot not only gives the details about the crop / field but also what is advised for the crop based on the season or environmental conditions. This BoT will be available to the farmer community through many cannels like telegram, messenger, Microsoft eams, Facebook and telegram etc. which can be accessed from their handheld devices.
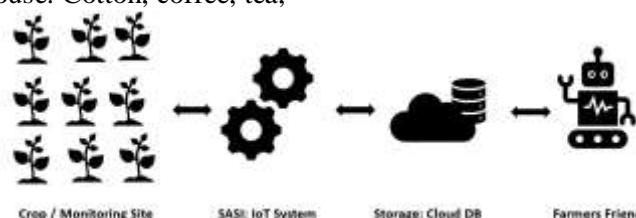

Figure 2. Architeure of Farmer's Friend

5.1 BoT Process flow

As presented in the process flow diagram, the farmer who wants to know more details about

his crop should get connected to the Farmers Friend BoT first. Farmers Friend can be accessed from various channels like Facebook messenger, twitter, telegram, Mcrosoft Skype, Microsoft Teams or using by going to website where this Bot will available in a web channel. After obtaining access, one needs to start the Farmers Friend conversation during which the bot keeps asking multiple questions that are

devised scientifically by reffering to many knowledge repositories on agriculture and websites in consultation with scientists and professors in agriculture universities. For the questions asked by the Farmers Friend Bot, the farmer need to select the options as applicable to him/ her.

Figure. 3: Complete process flow of Farmers Friend chat bot.

Finaly after analyzing the answers given by farmer, the Farmers Friend advices on various aspects related to the crop / field to the farmer. In addition, the Farmers Friend also suggests the appropriate action the farmer need to take based on the field condition i.e if the farmer has to increase or decrease the water level for the crop, the fertilizers that he has to apply based on the soil condition or any action that he has to take in the context of weeds or pests. Alongside helping the farmer assess the crop / field condition basis the data captured by sensors in SASI App the BoT also gives useful information to the farmer on various measures that he / she can take to improve the fertility of the soil which will further improve the yield. Thus, helping farmer obtain higher margin or profits from the yield. Also, based on the requireent or when in doubt about the crop's condition, farmer take up this help from Farmers Friend any number of times.

5.2. Models

Farmers Friend conversational AI BoT uses machine learning and Natural Language Processing for multiple tasks like intent building, expression handling, automated intent

formation and named entity modeling and extraction. Which means, the intent-based model is made to trigger on all the input messages, entities can be used at various places to trigger the skills. In the current section, we provide an overview to the task model we have created, intenets that are built, and entities used.

Our dialog based conversational system makes use of frame-based system that has slot filling mechanism, which is measured by a system based on finite-state automation. In every step, the Farmers Friend app opens up the user to enter the next answer, but enables entering a new response, rewriting a formerly filled value, or entering multiple responses at once. We have used Natural Language Processing for the working of this, extracting the required information from SASI application based on Natural Language Processing engine. Figure 3 represents one of the parts of the finite state machine, executed when a farmer interacts with Farmers Friend. Figure 4 indicates a one of the conversations flows between the famar and the devised bot, represented with the existing state transitions and invocations to the internal ML models.
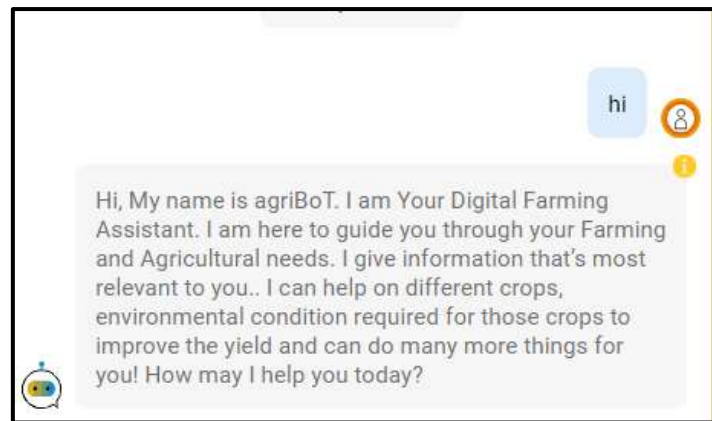
Figure. 4: Diagram representing a state machine part, with the most needed Skills; this section is used when a farmer starts interaction with Farmers's Friend.

Figure. 5: Display of Skills from Converstaional I BoT building framework in graphical view.

Figure. 6: Display of Skills from Converstaional I BoT building framework in list view.

5.3 Results

All the objectives were achieved with the help of Farmer's Friend bot that we have developed.

In this section we are presenting the results that we have achieved. The Bot thus developed can be hosted on messnger, web chat, twitter or telegram to make it visible to farmers.

Figure. 7: Display of initial Farmer's interaction with Farmer's friend with the greetings skill.

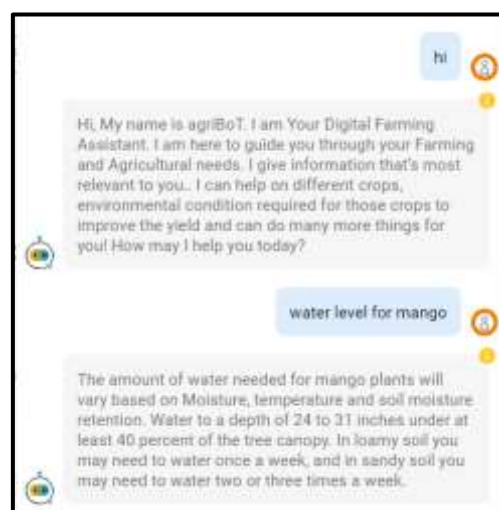Figure. 8: Display of Geo- Climatic condition to be maintained for coconut crop.

Figure. 9: Display of water level to be maintained for mango crop.

6.   CONCLUSION

Bots can help users to improve the efficiency by navigating users to chatbot paltforms. They help to automate all the repetitive, distracting tasks that prevent teams from reaching high performance. By using Conversational AI, user can leverage solutions through easy integrations. User can connect chatbot to the existing SASI and other applications and can keep the data in the cloud ecosystem. This paper provides a detailed explanation of our conversational AI and NLP system for agriculture, we have currently deployed this in the real world. We explain the machine learning model that was have adopted, and the exclusive opportunity of building a chatbot for the agriculture sector. Our success indicates that this chatbot will be a good substitute to farmers looking for help in the context of their crop, health and atmosphere. Infact, we understand that high volume innovations in task-oriented bot or perform actions bot technology will have incredible potential to expand farmer experience and drive revenue growth in new and channels that are not explored in agriculture. In conclusion, Our Farmer's Friend chat bot will reduce dependency on agiculture universities crowd and makes help available at one's fingertips. This saves the time of farmers and agriculture scientists. Easy accessibility of this application to everyone to seek help related to farming or crops makes this application vary unique. The future enhancement to this bot can include speech integration which can extend the usage of the bot to those farmers who cannot read or write.

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