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Krushi Mitra: A Review of Agriculture Bots

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***Abstract*—** India is an agro-based economy and proper information about agricultural practices is an essential key to optimal agricultural growth and output. Artificial Intelligence and Machine Learning are driving the IT industry to a new landscape. In order to answer the queries of the farmer, agricultural Chatbot can be designed. The system "Krushi Mitra" overcomes the problem and provides farmers the better opportunity to obtain the desired information and to scale up with upcoming market trends and technologies in a user friendly manner. Krushi Mitra is actually a chat bot, which is a virtual conversational assistant, through which the users can communicate with the bot as if they are conversing with humans. The focus is on developing the bot in a more intellectual way, that it can even recognize not so well grammatically defined sentences, misspelled words, incomplete phrases, etc. This can help people to converse easily with the bot, since this system uses the Natural Language Processing technique to parse the user queries, identify the keywords, match them with Knowledge Base and respond with the accurate results.

***Keywords*—**Chatbot, Natural Language Processing (NLP), Agriculture, Prediction Algorithm, Machine Learning

I. INTRODUCTION

In India, agriculture plays an important role in economic development by contributing about 16% to the overall GDP and accounting for employment of approximately 52% of the Indian population. According to the Farmers portal, rapid growth in agriculture is essential not only for self-reliance but also to earn valuable foreign exchange.

Agriculture is the major provider of employment to people in many parts of the world. Many people depend on agriculture for their livelihood. Most countries depend on agriculture for their GDP growth. The technology in the field of agriculture is developing day-by-day. Also, a large number of software is being simultaneously developed, to educate the farmers with this technological information. Most of them provide static information about farming, they require a large number of searching steps to get the accurate information and they don't provide an interactive way of querying and responding. Also the lack of information and various benefits (like. Govt. Schemes, Loans, etc) for them are not informed to them or not known to them. (So the objective is).Language also acts as a barrier, as majority of farmers in India are illiterate and are technologically backward. They require a proper medium where they can achieve every information through a safe and interactive system which will solve their problems ,provide them required solutions in easy and user friendly manner.
Chatbots can overcome the above mentioned drawbacks by providing a user interface, where farmers or any other users can interact effectively to get the desired responses with less number of steps. This system "Krushi Mitra " is a Chatbot, which is a virtual assistant that enables users to get their queries clarified in a user friendly manner. The input is obtained from the user, the textual query will undergo pre-processing steps in order to find the category of the query it belongs to, and provide the corresponding response. The main attractive feature of the bot is that this system will actually get the input from the user like land area, soil type, rainfall condition etc., and uses the prediction algorithm to predict the crops that can be sown by them to get the better yield and also deal with anything other than the crop suggestion, for example if the user wants to get information about the future price of any crop and also any farming equipments they require will also be able to choose from. The focus is on developing the bot in a more intellectual way, that it can even recognize not so well grammatically defined sentences, misspelled words, incomplete phrases, etc.

This can help the farmer to converse easily with the bot, since this system uses the Natural Language Processing technique to parse the user queries, identify the key words, match them with Knowledge Base and respond with the accurate results. To make the responses more understandable, the responses are generated using classification algorithms and produce non textual responses so that it can be easily perceived by the users.

Krushi Mitra is mainly based with the use of NLP and the main features used are: Tokenization, Noise Removal, Lexicon Normalization, Bag of Words or Vector Space model.Hence, this system will help farmers to query about the agriculture, get the response in text and also helps in predicting the future data of price, so that they can plan their

activities. The future enhancement can be done by giving the response in their regional language itself and prediction can be extended to rainfall, productivity, etc.

II. LITERATURE SURVEY

Literature survey of development in field of agriculture bots are as follows:

A. Virtual Conversational Assistant

This paper presents a query about agriculture, gets the response in text as well a**s** speech and also helps in predicting the future data of price, so that they can plan their activities. The future enhancement can be done by giving the response in their regional language itself and prediction can be extended to rainfall and productivity [1].

The usage of cognitive technologies predicts exciting times ahead for agriculture on its road towards efficiency, sustainability and meeting the world's food needs. This conversational assistant uses Natural Language Processing techniques to understand the user queries in their natural language. This will make the system understand even the grammatically not well defined sentences as input queries. The user queries undergo the pre-processing stage where the query is first tokenized into words, then the stop words like, a, is, the, etc., are removed so that it would not contribute to the probability of classifying the queries based on their respective classes and then the stemming process is carried out where the words are converted to their root words. The words are converted to a bag of words and then converted to a vector form so that they can be processed efficiently by the classification algorithm. The bot is then trained with the training dataset. Based on the training set data, a neural network is constructed and error is optimized using the gradient descent algorithm. The test data set undergoes the same pre-processing stages, classification and neural network construction. The class with the highest probability is iterated to get the accurate results. The system uses the speech synthesis [6].

B. Smart Chatbot for Agriculture

This paper presents the system that helps farmers in remote places where no connectivity is present to better understand the crop to be grown based on atmospheric conditions and also answer their basic questions on farming.

They utilized the Lowenstein distance to measure the difference between a submitted question with that of a predefined question-answer corpora Once a closest instance is selected the intelligent agent forwards the answer to the communication agent which then sends the answer back to the sender through Telegram chat service. There is huge change foreseen in the way the farmers are going to access information. These developments support the growth of Auto-chat bot. The focus of this project is to develop a chat-bot which will provide assistance and guidance to farmers using NLP. This bot will answer all their questions related to agriculture practice and technology. This chatbot should understand all the farmers' requirements and should be stable, scalable and flexible along with a high level of intention in human language. The knowledge of chatbot is stored in the database. A Chatbot is implemented using pattern comparison, in which the order of the sentence is recognized and a saved response pattern is acclimatized to the exclusive variables of the sentence. The Chatbot must be simple, user friendly, must be easily understood and the knowledge base must be compact [2].

C. FarmChat

This paper presents FarmChat which combined conversational and language technologies to naturally converse with farmers in answering their farming-related queries. The conversational intelligence of the chatbot was informed by analysis of large corpus of farmer call center logs and guided by agric-experts who work closely with farmers. The study with farmers in rural area indicated that it's possible to provide satisfying information support to the farmers through Chatbot .We also compared the effectiveness of two interface modalities: Audio-only and Audio Text .Our study indicated that although text-based output allows for repeated consumption of the same information, participants expressed different preferences due to literacy, digital-literacy, and other environmental and physical factors. The feedback of the farmers indicates that conversational intelligence as a technology delivered through the ever present smartphone is often an efficient tool to enhance information access to the people of rural areas with limited literacy and technology experience [3].

In this paper, they propose the use of a conversational agent, implemented during cloud-based scalable services, as a way to help address the information needs of rural farmers. From the user study, we found positive evidence for introducing chatbot technology as a usable solution for serving the information needs of Indian farmers. With Farm Chat, it was possible to provide satisfying answers for common questions that farmers encounter in their farming activities .With the help of local NGOs to edit and endorse content,farmers showed trust in the information given by FarmChat .As expected, speech-based conversational interface cater to the low-literate and digitally-illiterate users, as the resemblance with human-human interactions made it easy to use [4][5] .

III. LIMITATION OF EXISTING SYSTEM

Farmers are the backbone of our society. Even though there is technical development in other aspects of life, farmers condition is still miserable because even in today's time rural farmers are not aware of various schemes launched by Government for their betterment .Farmers in Marathwada faces scarcity of water and might not know the optimal ways of farming and irrigation ,similarly the knowledge of crops that have demand in world are not known to them and hence they face losses.

In recent years, agriculture has seen a growth in usage of Information & Communication Technology (ICT). There are

around 14 crore farmers in India. The circumstance might be changing silently right under our nose The Internet and Mobile Association of India (IAMAI), report states there are about 11 crore people in rural India who are accessing the internet via their mobiles. There is huge change foreseen in the way the farmers are going to access information. These developments support the growth of Auto-chat bot [5] .

The problem with existing Auto-chatbots is they provide only limited features like crop suggestion, price estimation, and speech synthesis. But the system does not deal with anything other than the crop suggestion, for example if the user wants to get more details related to various schemes launched by the government, this system is not useful. The existing system provides only one feature per bot so farmers have to traverse between various bots to get their problem solved which is too much of hectic work. There is no chat bot available to suggest relevant loan for farmers which may be provided by government or private organisation, for such type of information these bots are irrelevant.

IV. PROPOSED SYSTEM

We propose a chatbot specialized only for farmers and their rights. This conversational bot communicates with farmers and solves their problems by giving out the preferred solution. Also, all the government given subsidies, facilities and rights will be informed to them through this bot. The main attractive feature of the bot is that this system will actually get the input from the user like land area, soil type, rainfall condition etc., and uses the prediction algorithm to predict the crops that can be sown by them to get the better yield and also deal with anything other than the crop suggestion, for example if the user wants to get information about the future price of any crop and also any farming equipments they require will also be able to choose from.

The focus is on developing the bot in a more intellectual way, that it can even acknowledge not so well grammatically defined sentences, misspelled or incorrect words, and incomplete phrases. This can help the farmer to communicate easily with the bot, since this system uses the Natural Language Processing (NLP) technique to parse the user queries, identify the key words, match them with Knowledge Base and respond with the accurate results. To make the responses more comprehensible, the responses are generated using classification algorithms and produce non textual responses so that it can be easily perceived by the users.

The user inputs the query in the user interface in the form of text. The user interface receives the user queries and then forwards it to Krushi Mitra bot. In this chat bot, the textual query undergoes a pre-processing stage. Pre-processing Steps include Tokenization where the query sentence is tokenized into words, then the stop words are removed, and then the words are stemmed to their root words. If the query is classification based, it would undergo classification using the neural network classifier, which uses the knowledge base to retrieve the relevant responses. Krushi Mitra is mainly based with the use of NLP and the main features used are: Tokenization, Noise Removal, Lexicon Normalization, Bag of Words or Vector Space model.

Hence, this system will help farmers to query about the agriculture, get the response in text and also helps in predicting the future data of price, so that they can plan their activities. The future enhancement can be done by giving the response in their regional language itself and prediction can be extended to rainfall, productivity, etc.

V. METHODOLOGY

The methodologies followed to build a conversational chatbot are as follows:

NATURAL LANGUAGE PROCESSING

Natural Language Processing (NLP),is broadly defined as the automatic manipulation of natural language, like speech and text, by software. Natural Language Processing facilitates human-to-machine communication without humans needing to “speak” Java or any other programming language.NPL helps us to understand the user inputs even if it is not completed. NLP represents the automated handling of natural human language like speech or text. NLP can help you with many tasks and therefore fields of application just seem to extend on a daily basis.

Tokenization is one of the pre-processing steps in NLP. Tokenization is the process of splitting the input sentences into a list of words, called tokens. In a common term, it is just to split apart the text into individual units, and each individual unit should have a value associated with it. There are six types of tokenizations like word tokenization, sentence tokenization, etc. Word tokenization is breaking down the sentences into words. Sentence tokenization means breaking down the paragraph into sentences [6].

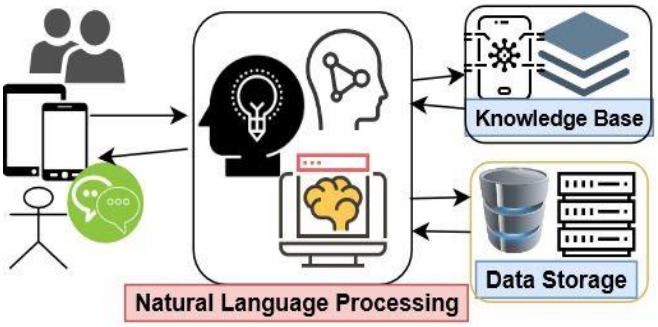

Figure 1. Natural Language Processing

QUERY PREPROCESSING

Query pre-processing prepares the query for optimization. Query Processing is a translation of high-level queries into low-level expression. It is a step wise process that can be used at the physical level of the file system, query optimization and actual execution of the query to urge the result. The query processing steps taken when Component

Integration Services is enabled are almost like the steps taken by Adaptive Server. The user queries are tokenized into words using the bag of words technique, and then the stop words (like is, the) are removed using the NLTK Corpus. The stemming process is performed to convert the words to their root words. For example cultivation, cultivated, cultivate all stem into cultivate which is the root word [7].

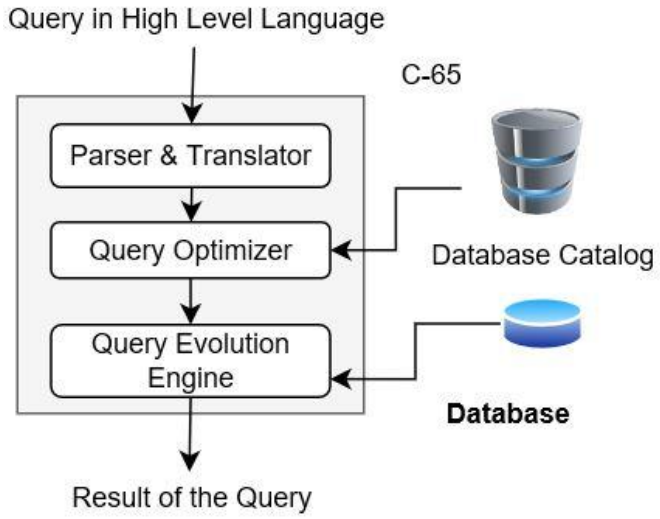

Figure 2. Query Processing

CHATBOT DEVELOPMENT AND TRAINING

The chatbot is a computer program used to communicate by text in a humanly manner and which provides services to human users in order to accomplish a well-defined goal. There are existing frameworks that allow developers to develop a chatbot once and release it to multiple platforms at a similar time with none adjustments to individual platforms [7].

The development process ,first of all a suited application needs to be chosen and specified in its requirements. Before starting with the implementation, possible usage scenarios have to be defined and matching user stories need to be created. When all requirements are set, appropriate platforms, tooling and solutions are often selected. After all preparations are done the technical implementation can happen. The Bot is trained, by building a neural network and the error values are optimized. The trained data is saved in a data structure for future usage.

NEURAL NETWORK

Neural network is a computation model which has input output and hidden layers. These hidden layers are used to transform input to the form required for output. Chat bots mainly make use of deep learning, Recurrent Neural Network, Convolutional Neural Network.

Convolutional network (CNN) is a neural network that's specialized for processing a grid of values such as a picture or an image. And a recurrent neural network (RNN) is a neural network that's specialized for processing a sequence of values. Deep Neural Network is used for classification [1] [8].

RESPONSE RETRIEVAL USING MACHINE LEARNING

The neural network classification is used to construct a model using the training dataset. Using the model constructed probabilities is generated for the test dataset. The least probabilities are filtered out using the threshold value and sorted in descending order [8][9].

Using this repository with predefined responses and some kind of heuristic to pick an appropriate response based on the input and context. The heuristic might be as simple as a rule-based expression match, or as complex as an ensemble of Machine Learning classifiers. These systems don't generate any new text, they only pick a response from a hard and fast set[9].

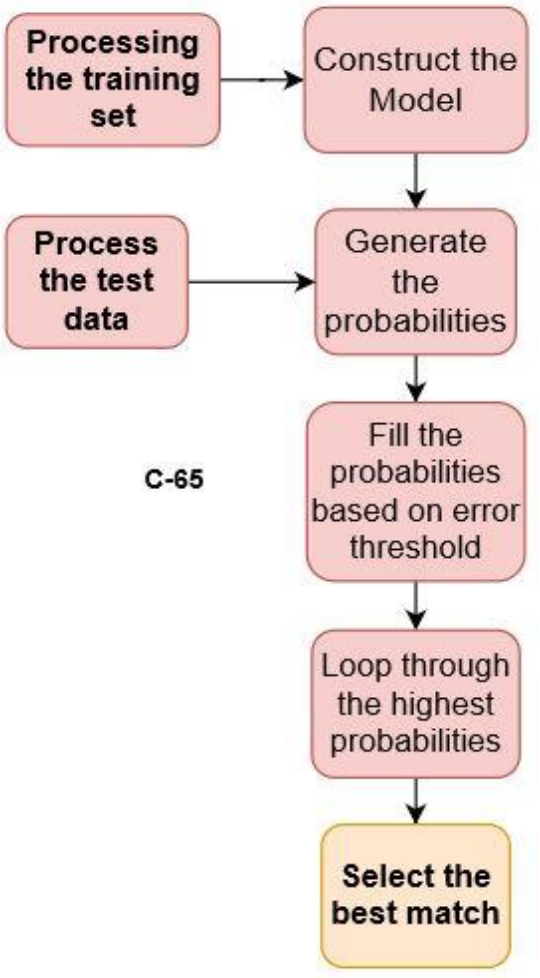

Figure 3. Response retrieval using Machine Learning

SPEECH SYNTHESIS AND RECOGNITION

Verbal communication is the favoured form of communication for most people and while creating a Chatbot especially for farmers the communication may be a great barrier. So, for that conversing for them via speech rather than text is feasible and saves time as some farmers may be illiterate, so it makes sense to have your chatbot communicate in the same way and at same predicted language. The role that speech recognition plays in making your bot understand speech and how speech synthesis can

help you build out your bot's voice, sentiments, and language [10].

Speech recognition and synthesis technology takes an audio note of a farmer's request and breaks it down into minor parts, based on voice regularity and pitch, before feeding it into a neural network. The neural network then finds patterns in the audio sampling.

Recurrent neural networks can remember previous audio patterns and can use that data to help build out future responses. This training data also makes it easier for your chatbot to comprehend what a user wants—without being distracted or muddled by background noise, dialects, or accents—because it has a larger pool of data to filter through to find similar requests and comebacks.

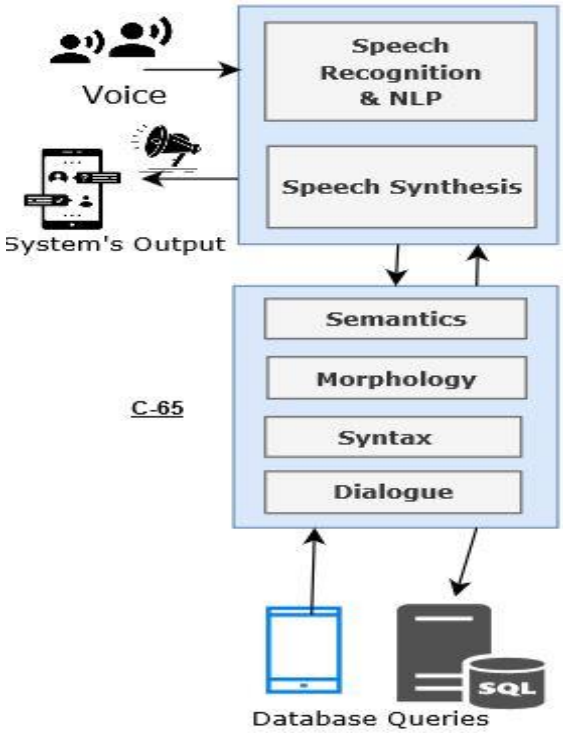

Figure 4. Speech Synthesis and Recognition

MULTILINGUAL

A **Multilingual Chatbot** allows enterprises to converse with users speaking numerous languages enhancing engagement and conversions. Single language Chatbot technology holds a restriction of conducting a conversation only in one particular language. Some chat bots are capable of conversing in multiple languages [10]. A multilingual bot can offer users the same content in multiple languages. As the farmers may not know English and can only converse in his/her regional language so for that the bot should be able to understand the given language and translate it into machine required form and again deliver the relevant information to the farmer in his/her preferred language. This technology is very useful to the farmers as he/she can access the information and gain knowledge in his/her favoured language and make proper use of the technology.

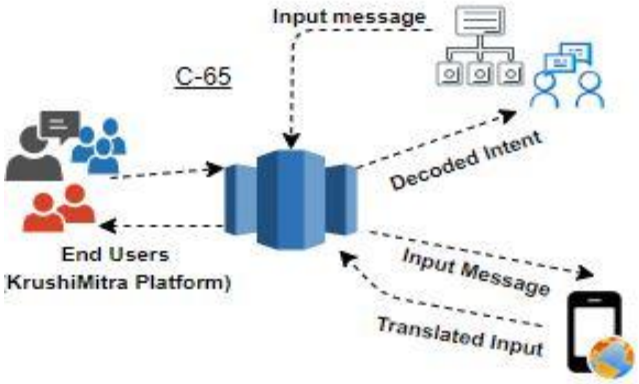

Figure 5. Multilingual

PREDICTION ON FUTURE COST OF AGRICULTURAL PRODUCTS

Agriculture products have seasonal rates; these rates are spread over the whole year. If these rates are known or informed to the farmers in advance, then it will be promising on ROI (Return on Investments). The work carried out here for predicting prices of agricultural commodities (i.e. crops and equipment) is useful for the farmers because of which they can sow appropriate crops depending on its future price. The change in price should be known by the farmers [11]. From the time of crop sown to the time of harvest, they have a threat of price uncertainty; hence in the agricultural market the prediction of future price of agricultural products can help the production and the pricing of the crops correctly. This prediction of crop price and equipment would also help to make agricultural policies and improve configuration of agricultural resources, resulting in development of the economy of our country.

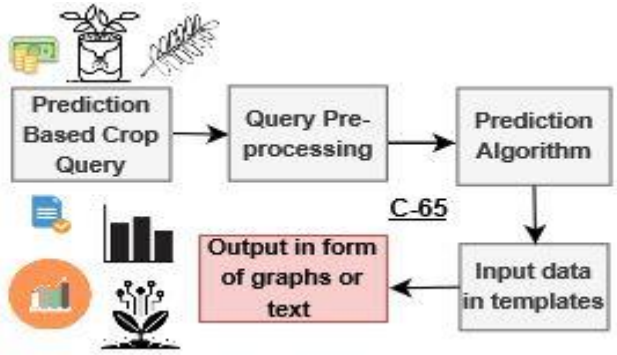

Figure 6. Prediction on Future cost of agricultural product

VI. CONCLUSION

To address the problem of farmers, we have proposed a conversational assistant Krushi Mitra. The proposed chatbot can positively impact underserved communities by solving queries related to agriculture using natural language processing technology. The farmer will be able to receive agricultural information as well as localized information such as the current market prices of various crops in his/her district every useful detail in one place in easy fashion. A farmer can directly message the AI, define their concern, and

get an answer. This system would enable the farmer to ask any number of questions, anytime, which will in turn help in spreading the modern farming technology faster and to a higher number of farmers. Also they will be able to get the information in Marathi and English for the State of Maharashtra to the farmers who don't know English. Further the Chatbot can be enhanced to provide customised services for farmers.

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