E-Palli International Conferences (EIC)
23 & 24 December 2022
Kuala Lumpur, Malaysia

International Conference of Agricultural Science, Engineering (ICASE)

www.conferences.e-palli.com

KRISHOKBOT: AN INTELLECTUAL AGENT FOR FARMERS

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ABSTRACT

Crop disease treatment is vital for improving agricultural production and crop yields. The early prevention and treatment of the disease is very helpful to reduce crop damages. However, traditional crop disease treatment is much costly and time consuming to counsel with an agriculturist. In Bangladesh, most of the farmers are unaware of pest control and disease treatment. In order to overcome this problem, KrishokBot is deployed. It is a smart agent that makes remote interaction with farmers to provide pest and disease related solution using natural language processing. KrishokBot is a Machine Learning based virtual assistant that can respond to simple questions concerning pests and disease that affect rice production via Bengali language. The datasets have been collected from various Bangladeshi agricul ture-based websites to train the KrishokBot, which includes categories, patterns, and responses. A deep neural network has been used to determine which category the user's message belongs to, and then a response is generated. For this, some tools are used such as Natural Language Tool Kit, Keras API, Tensorflow, Android SDK, Android Volley, Heroku, etc. This proposed idea offers great potential for excellent performance with approximately 85 percent accuracy, where user Interface has been developed by android application with both audio and text-based features to provide better interaction. The results prove that the bot is reliable for guiding the treatment of crop disease.

Keywords: KrishokBot, Agriculture, Android, Machine Learning.

INTRODUCTION

Rice is a primary food in Bangladesh. Nearly 160 million people in Bangladesh eat rice as their main food. The people of Bangladesh cultivate 75 percent of their land with paddy (Anon n.d.-e) (Islam et al. 2020). As paddy is the dominant food crop in Bangladesh, it contributes significantly to about 28 percent of the GDP in Bangladesh (Anon n.d.-e). As paddy becomes the staple food for our country it is necessary to produce enough paddy to fulfill the demand of our country. Every year, though, farmers lose an estimated 37 percent of their rice harvest to pests and diseases. Most of the time farmers are unaware of pests and diseases of rice plants and the treatment of these diseases. It is not possible all the time to take agro-experts advice. Agro-experts may be busy or cannot provide so many queries at a specific time or Agro-experts are so low in number in some areas where farmers do not get the proper suggestions of rice crop-related problems. So, there is a keen need for an automating system that will provide necessary queries of farmers all the time. Farmers are unaware of rice crop diseases. Krishokbot for Farmers uses a deep learning algorithm to classify rice plants' disease symptoms and can answer pesticides or prevention steps for the specific disease. As the majority of people of our country speak Bengali, so there is a keen to need to build a system that will take input and deliver output via the Bengali language.

MOTIVATION

Though Bangladesh is considered the fourth largest rice production country (Anon n.d.-e), there are some common major pests and diseases, which hampers significant damages to our rice fields. Few applications provide technological solutions to farmers but most of the time farmers need to specify disease names or need to fill a blank box of choices to forward. In country like Bangladesh where farmers are illiterate or semi-literate it becomes difficult to forward in those applications and often, they don't show enough interest in those applications. Designing user-friendly for low-literate and semi-literate populations like

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our country is a growing area of research. So, it is a good opportunity to make an AI-based Virtual Agent which will provide necessary solutions based on symptoms on the rice crop to the farmers.

LITERATURE REVIEW

FarmChat: A Conversational Agent to Answer Farmer Queries (Jain et al. 2018)

Farmer Questions to be Answered by a Conversational Agent The researchers used the KCC dataset plus information from formative interviews with smallholder farmers and agri-experts to create a knowledge base for potato production. They requested samples of frequent farmer questions from the two agri-experts who took part in the Formative Study, the follow up questions they would ask to further grasp the situation, and the final advise they would give for each of the selected themes. All of these talks were uploaded to the IBM Watson Conversation dialogue flow, and the FarmChat knowledge base was updated with the information. The knowledge base has been transformed into a SQL database with four tables, one for each of the previously mentioned topics.

AgronomoBot: a smart answering Chatbot applied to agricultural sensor networks (Mostaço, Campos, and Cugnasca 2018)

A smart response data about field conditions, such as air and soil temperature, air relative humidity, soil moisture, rainfall, wind speed, and other relevant variables, must be available quickly and easily for use by farm management systems, specialists, or the farmer himself in decision-making processes for agricultural purposes.

METHODOLOGY

A. System Overview

To interact with the KrishokBot mobile app, the user clicks the microphone icon and speaks after hearing a 'beep' (Jain et al. 2018). Once the app detects long silence, it stops listening. Then the user needs to click a 'Send' button to process further. Once the 'Send' has been clicked the response will be delivered with audio as well as the text below. The phone receive input through Google's Speech-to-Text API which takes input as Bengali speech and convert it into Bengali text and then through Google's Translation API, Bengali text is then converted to English text, along with the current context of the conversation is then passed to the Heroku (provides PAAS) mobile app build with Flask API. With a successful hit on Flask API, the query message then goes into a series of the data cleaning process, and after it goes into the deep neural network model. The model returns a response from the knowledge base. Responses are then translated from English to Bengali via Google's Translation API, Bengali text is then converted to Bengali speech through Google's Speech-to-Text API.

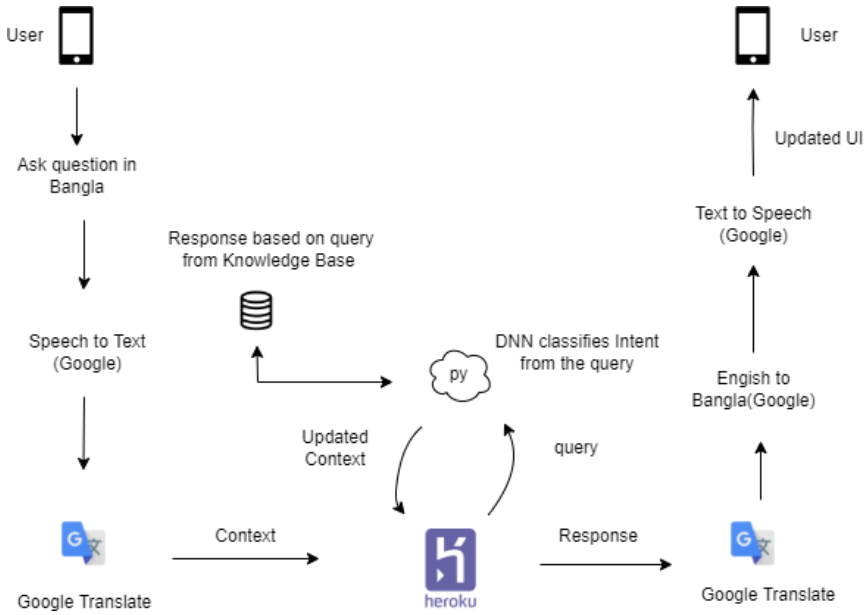

Figure 1: System Architecture of krishokbot

B. Formative Findings

For implementing KrishokBot dataset was restricted to pests and diseases of rice plants. Datasets are collected from Bangladeshi authorized agriculture-related websites such as Bangladesh Rice Knowledge Bank, Agro Knowledge Bank, Krishi Bantayan, Agricultural Information Service, and some other websites, etc. The datasets are converted into JSON format. The datasets contain the following columns (1) Categories, (2) Patterns, and (3) Responses.

C. Heroku Dashboard Interface

Heroku is a platform as a service (PaaS) that enables developers to build, run, and operate applications entirely in the cloud (Anon n.d.-b). Krishokbot application has been deployed in Heroku. As Heroku provides Platform as a Service (PaaS), Necessary libraries are provided with their corresponding version via the requirements.txt file. Files deployment size was

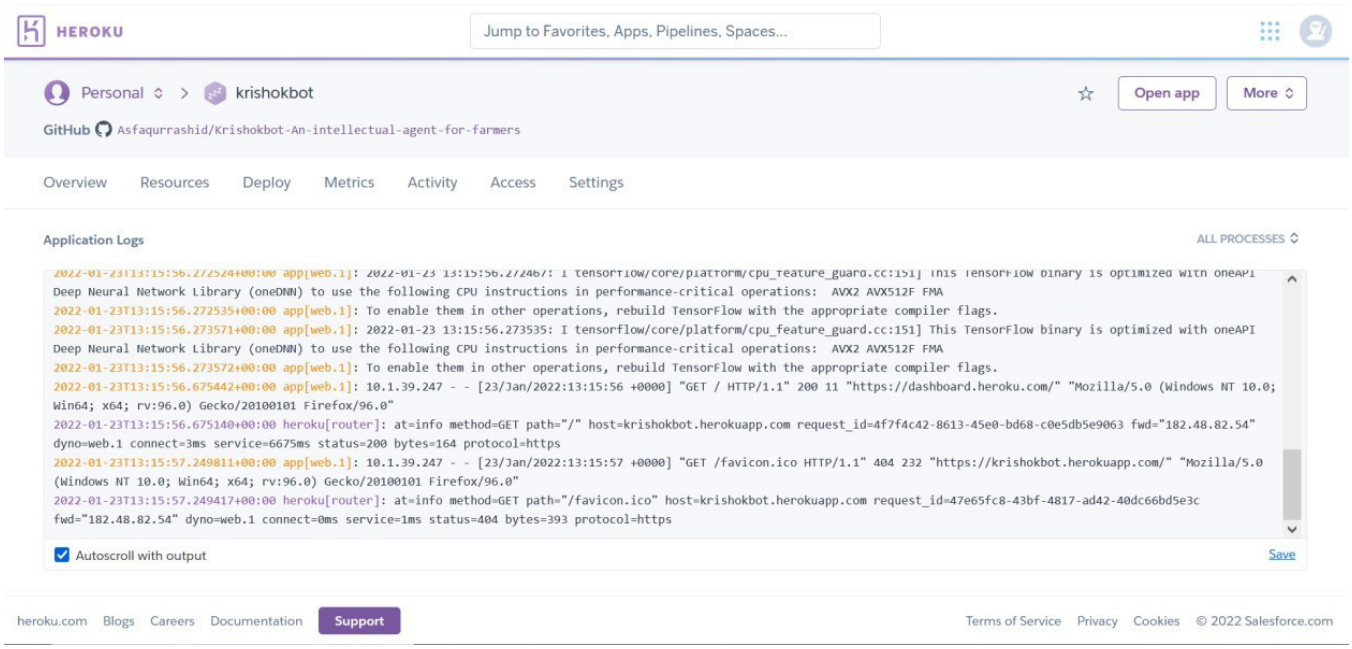

Figure 2: Heroku application log files

350MB which crossed the soft limit specified in Heroku that will affect booting time.

D. Conversational Intelligence: Intent, Entity

Conversational intelligence systems recognize intents and entities from the user's inquiry to understand the user intention and the purpose of the user's inquiry. The intent of a message describes what the message is aiming for. Intent is required to understand the user's purpose. Entity of a message add value to the intention and collects numbers, time, a pattern like an email, phone number, national id, etc. like information from the user's texts. For example, "I want to book a ticket of Saturday 9:00 PM" implies "book-ticket" as intent and "Day: Saturday" and "Time: 9:00 PM" as entities (Anon n.d.-a). A conversational system can be an open domain or closed domain Open-domain refers to when the conversation system can answer anything or is ready to serve not fixed with any specific topic. Whereas, a closed domain conversation system cannot provide a response or service if the message is out of the main context. Closed domain systems are fixed with a topic and can only provide topic-related responses. KrishokBot is restricted to a closed domain system as it can only respond to pests and diseases of rice plants. For example:

Human: Hello

Bot: Hi there, how can I help? Please describe the specific symptoms or disease name of the rice plant Human: tell me how to control brown spots on the leaves? Bot: Keep the seedbed or soil wet with water. Use more organic fertilizers.

Human: thanks Bot: Anytime

Bot detects the user's purpose as 'greet' from the first message sent by the user. with the entity being the 'Hello' word. The bot then tells the user to ask specific symptoms or disease names for the query. From the third message, the bot recognizes that the intent is 'brown spot' which is one kind of rice disease name, and then recommends corresponding steps to apply.

RESULTS AND DISCUSSION

Farmers can ask for direct symptoms of diseases, names of diseases or can greet to see what KrishokBot can offer to the farmers. Initially, KrishokBot asks about the specific disease symptoms of a plant to make the conversation domainspecific. After training the model with 600 epochs, it was able to recognize the farmer queries related to the pests and diseases in rice plants. After providing training data of 800 plus intent data, it was able to get an accuracy of around 85 percent, and by raising the dataset', it is possible to achieve accuracy of 90 percent or higher.

User Interface

Most Bangladeshi Farmers are illiterate or semi-literate. Providing only text-based interaction may impact the majority of farmers in Bangladesh with low literacy levels. Also, to provide a faster and better response text- based interaction may be a good opinion for the semi-literate farmers. A solution has been proposed for both of them. A farmer with a low literacy level

has an option to interact with the system with Audio based. A microphone icon is given to take Bengali speech as a farmer query and response is delivered with Bengali Audio speech as well as Bengali text below the app. User interface with the Bengali language will make it easy to use and Farmers will be able to interact with it conveniently.

Audio Input

An audio-based input system is convenient for low-literate users. KrishokBot now supports Bengali, which is the most generally spoken the Bengali language and responds to questions concerning rice cultivation as a use case for the study. A microphone icon is given for the audio input. By clicking the microphone icon, a Google Speech recognizer will appear. Once get a long silence, it will automatically return "didn't catch it" if there is no message was given. A given speech will be shown in real-time below to check if the message is correctly spoken. After recording the speech, the user must click the 'send' button to continue. Finally, the results will be displayed in the answer area below, both as text and as a speaker.

Text Input

Text-based interaction is necessary for good interaction with the mobile app. For semi-literate users, text can offer faster and unambiguous mode of interaction (Jain et al. 2018). There is a Chat box to write queries in the Bengali language. After writing a necessary query, the user needs to click the 'Send' button to get the response as Audio as well as Text. Sometimes noise or barrier it becomes hard for Google Speech-to-Text API to guess a perfect sentence for the input. So, for accurate user queries and better results, a text-based input system is given for the semi-literate farmers. As farmers can provide the Bengali language as text, it makes a convenient interaction with the Krishokbot app.

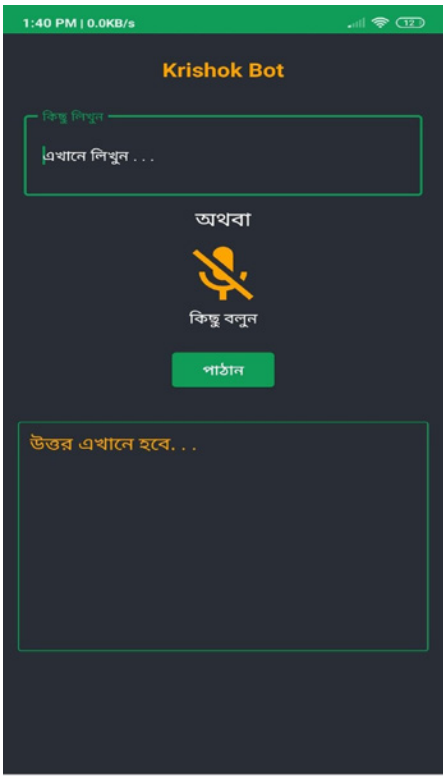

Figure 3: Android interface

LIMITATIONS

A small dataset makes bot hard to guess accurate intent. The system is Retrieval in nature, providing responses based on predefined responses. It does not generate sentences. Miss classifies intents when symptoms are quite similar for different pests or diseases. There is no dialogue management system for back-and-forth conversations to identify a particular intent. As most of the core technologies provide services based on cloud services, it is needed a good internet connection to the rural area where most farmers inhabit.

CONCLUSION

Farmers are the backbone of our agriculture sector. As most of the people of our country are directly or indirectly related to farming, a large number of people's earnings and fate

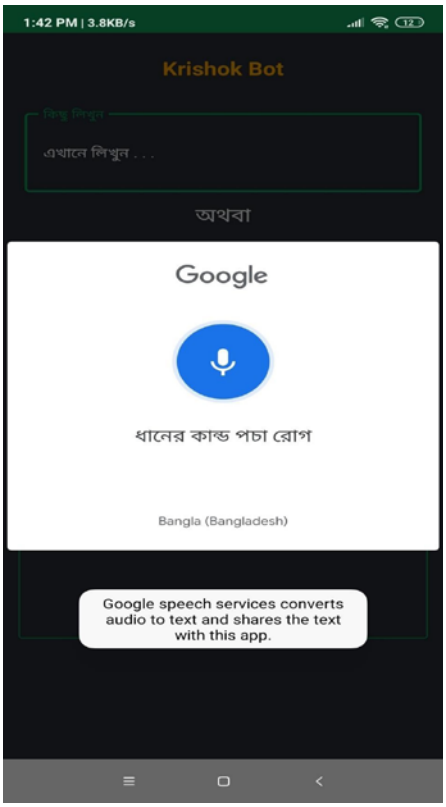

Figure 4: Audio input

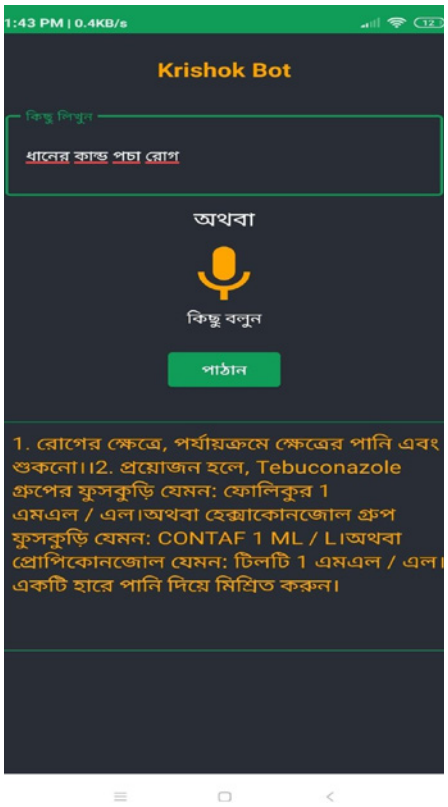

Figure 5: Text Input

are dependent on agriculture sectors. Rice is the most fundamental meal we eat every day of our life and increment of rice production is necessary according to the population increment. Pests and diseases in rice crops are a major problem of lower-yielding. 'Krishokbot: An Intellectual Agent for Farmers' will provide a technological solution to the farmers in answering their farmer- related queries. The conversational intelligence of the virtual assistant was trained with the pest and disease datasets collected from Bangladeshi Agriculture related websites. It can provide basic queries related to pests and diseases in rice plants. In future, 'Krishokbot' can be improved with the aid of latest Machine Learning algorithms such as Forest PA (Adnan & Islam, 2017) and BDF (Adnan et al., 2021).

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