AgriBot: An AI-Powered Farmer's Companion

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SUBMITTED TO:

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1. INTODUCTION

1.1 Overview:

This paper presents a project aimed at assisting farmers through the development of an AI chatbot integrated with a crop disease classification system. The chatbot utilizes a recurrent neural network (RNN) model trained using TensorFlow, and natural language processing techniques. Additionally, the project incorporates a weather API to provide farmers with real-time weather information. The crop disease classification system is implemented using the MobileNetV2 architecture. The combination of these technologies offers a comprehensive solution for farmers to obtain instant answers to their queries, access weather updates, and identify crop diseases accurately.

1.2 Purpose:

The agricultural sector plays a crucial role in ensuring food security and economic stability. However, farmers often face various challenges, including limited access to information and expert guidance. This project aims to address these challenges by leveraging the power of artificial intelligence and machine learning to build an intelligent chatbot and crop disease classification system

2. LITERATURE SURVEY

2.1 Existing problem:

1. Farmer-Bot: An Interactive Bot for Farmers

The Farmer-Bot is designed to seamlessly answer queries of the beneficiaries and is an attempt to provide the mass farmers a communication channel through which they can ask their queries and get resolution at any time without needing to worry about call center timings and network congestion issues. Also since WhatsApp is one of the leading chat mediums in India, with a mass reach we choose to integrate the chat-bot to the WhatsApp platform. The bot will respond to greeting by the user with an appropriate greeting message of introduction about itself, and then the user can proceed with their queries. After answering the query, the bot will check for the satisfaction of the answer, if satisfied, it will welcome user for any further query. If answer is not satisfactory, the bot will provide the details of the call center to the farmer to contact on phone during the working hours.

2. AI Based Farmer's Assistance Chatbot

Lack of information about various crops and climatic conditions are the main issues facing the Indian agricultural sector, Fertilizers, deficiency etc for the farmers. By the lack of knowledge about farming, many problems are being a rised to the farmers like less production of crops, damage of crops by insects, not knowing the season to grow a particular crop and many others. Many farmers does not know how to know about the crops and understand the situations to get more yield and have less problems. As technology is improving day by day, there must be a proper place where all the farming related queries can be solved. When there is a proper guidance and knowledge for the farmers, these problems will be solved. It will enhance and

support the agricultural development in India, thereby improving the quality of life for farmers. In the past, numerous researchers have employed machine learning methods to boost agricultural growth in the country.

3. Krushi Mitra: A Review of Agriculture Bots

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.

4. Agriculture TalkBot Using AI

Automatic talkbot will be created. The Automatic talkbot will be able to answer user questions without any human assistance. The Talkbot provides answer to the query of the farmer. The farmer will have any query; the bot replied the corresponding queries by the way of chat and voice. If the farmer have any query about the agriculture, the bot will send the answers to them through the voice or text. The interface of the Agriculture Talkbot can be displayed as Mobile Application. This system helps farmers to query about the agriculture, get the response in text as well as 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**.**

5. A Literature Review on Detection of Plant Diseases

This paper proposes a CNN based method for plant disease classification using the leaves of diseased plants. Building such a neural network with high efficiency is a complex task. Transfer learning can be employed to achieve greater efficiency. Inception v3 is one of the models available that inherently have the capability to classify images and further can be trained to identify different classes. Thus, use of Inception v3 can play key role in obtaining fast and effective plant disease identifiers. Also by dataset classification using contour method, the training set can be chosen to ensure proper training of model for all features. This provides better feature extraction than randomly classifying the dataset. Optimal results were obtained by employing the methods specified in the paper. Thus, with implementation and use of these methods for plant disease classification losses in agriculture can be reduced.

6. Using Deep Learning for Image-Based Plant Disease Detection

In order to develop accurate image classifiers for the purposes of plant disease diagnosis, we needed a large, verified dataset of images of diseased and healthy plants. Until very recently, such a dataset did not exist, and even smaller datasets were not freely available. To address this problem, the PlantVillage project has begun collecting tens of thousands of images of healthy and diseased crop plants , and has made them openly and freely available. Here, we report on the classification

of 26 diseases in 14 crop species using 54,306 images with a convolutional neural network approach. We measure the performance of our models based on their ability to predict the correct crop-diseases pair, given 38 possible classes. The best performing model achieves a mean F1 score of 0.9934 (overall accuracy of 99.35%), hence demonstrating the technical feasibility of our approach. Our results are a first step toward a smartphone-assisted plant disease diagnosis system.

2.2 Proposed solution

A proposed farmer's assistance system with a chatbot would involve an AI-powered virtual assistant that farmers can interact with to receive recommendations and guidance on managing their crops, fertilizers, medicinal and nutritional values, irrigation, and also deficiency in plants. Here are some of the key features and benefits of a proposed farmer assistance system with a chatbot.

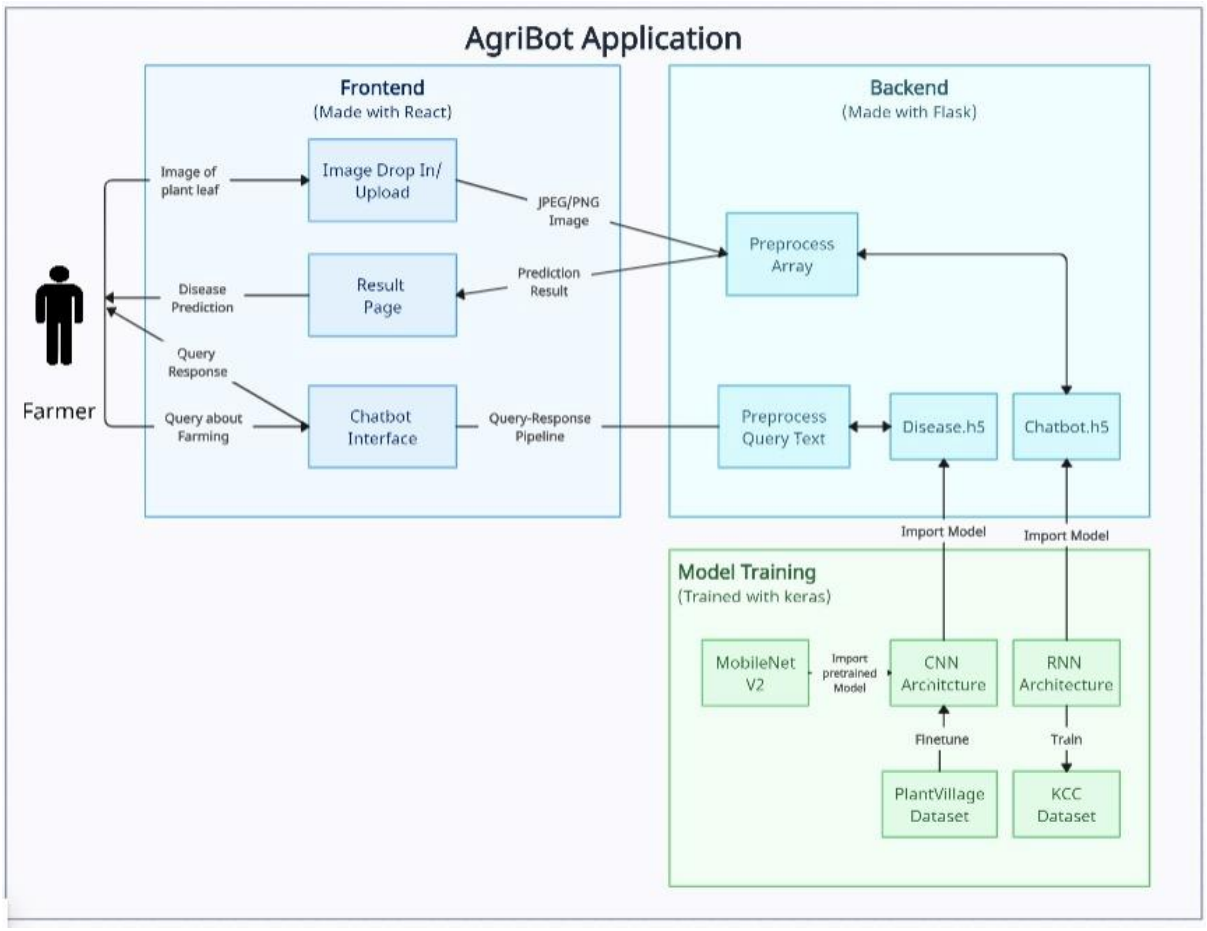
The AI chatbot is developed using React and Flask frameworks, along with TensorFlow for training the RNN model. The model architecture consists of an embedding layer, a SimpleRNN layer, and a dense layer with a softmax activation function. The model is compiled using the Adam optimizer and categorical cross-entropy loss function. The training data for the model is prepared by preprocessing and tokenizing the input sequences. The model is trained on this preprocessed data to understand and generate appropriate responses to farmers' queries.

The crop disease classification system is implemented using the MobileNetV2 architecture. The base model is initialized with pre-trained weights from the ImageNet dataset. The input shape of the model is defined, and the top layers are excluded to facilitate transfer learning. The MobileNetV2 model is then fine-tuned using a dataset of labeled images of crop diseases. The model is trained to accurately classify the type of disease affecting a given crop based on the input image. This classification system assists farmers in identifying and addressing crop diseases promptly.

The AI chatbot and crop disease classification system are integrated into a unified platform to provide a comprehensive set of services to farmers. The platform leverages the weather API key to fetch real-time weather data, which is then presented to farmers through the chatbot interface. Farmers can query the chatbot for various agricultural information, such as crop cultivation techniques, pest control measures, and market prices. Additionally, farmers can upload images of affected crops, and the chatbot employs the crop disease classification system to classify the disease accurately.

3 THEORITICAL ANALYSIS

3.1 Block diagram:



3.2 Hardware / Software designing

Hardware Requirements:

- Computer: A computer system capable of running the necessary software with sufficient processing power and memory.
- Storage: Adequate storage capacity to store the project code, datasets, trained models, and any additional resources.
- Internet Connectivity: A stable internet connection to access external APIs for weather data and any other required services.

Software Requirements:

- Operating System: Compatible operating system such as Windows, macOS, or Linux.
- Text Editor or Integrated Development Environment (IDE): To write and edit code, a popular choice includes Visual Studio Code and PyCharm.
- Web Browser: A modern web browser to test and interact with the React UI during development and deployment.
- Node.js: A JavaScript runtime environment for executing JavaScript code on the server-side. It is required to run the React framework.
- Python: A programming language used for developing the Flask API, training machine learning models, and executing various scripts.
- Flask: A Python web framework used for building the API endpoints and handling requests from the React UI.
- TensorFlow: An open-source machine learning framework used for training and deploying the RNN-based chatbot model and the MobileNetV2 crop disease classification model.
- React: A JavaScript library for building user interfaces. It is used for developing the user interface (UI) of the chatbot application.
- Libraries and Dependencies: Install the necessary libraries and dependencies required by the project, such as NumPy, Pandas, scikit-learn, TensorFlow, Keras, etc.

4. EXPERIMENTAL INVESTIGATIONS

During the development of this project, several experimental investigations and analyses has be conducted to enhance the solution's effectiveness and performance. Here are some potential areas of investigation:

1. Chatbot Accuracy and Response Time:

   Evaluate the accuracy and response time of the AI chatbot by collecting a diverse dataset of farmer queries and corresponding expected responses. Measure the accuracy of the chatbot's generated responses compared to the expected responses. Analyze response time to ensure that the chatbot provides prompt replies to farmers' queries.

2. Chatbot User Satisfaction Survey:

   Conduct a user satisfaction survey or feedback collection mechanism to gather farmers' opinions and feedback on the chatbot's performance. Assess user satisfaction, ease of use, and effectiveness of the chatbot in addressing their queries

and providing relevant information.

3. Chatbot NLP Performance:

   Analyze the chatbot's natural language processing (NLP) capabilities by evaluating its understanding and interpretation of various query types, including questions, statements, and requests for specific information. Assess the chatbot's ability to extract relevant information and generate appropriate responses.

4. Crop Disease Classification Accuracy:

   Measure the accuracy of the crop disease classification model by using a labeled dataset of crop disease images. Compare the predicted disease classifications with the ground truth labels to evaluate the model's accuracy in identifying different types of crop diseases.

5. Weather API Integration:

   Evaluate the performance and reliability of the weather API integration by comparing the fetched weather data with external sources or official weather reports. Ensure that the API consistently provides accurate and up-to-date weather information for the targeted geographical regions.

6. Scalability and Performance Testing:

   Perform scalability and performance tests to assess the system's capability to handle a large number of concurrent users and requests. Measure response times under varying loads and identify any potential bottlenecks or performance issues that need to be addressed.

7. Error Handling and Robustness Testing:

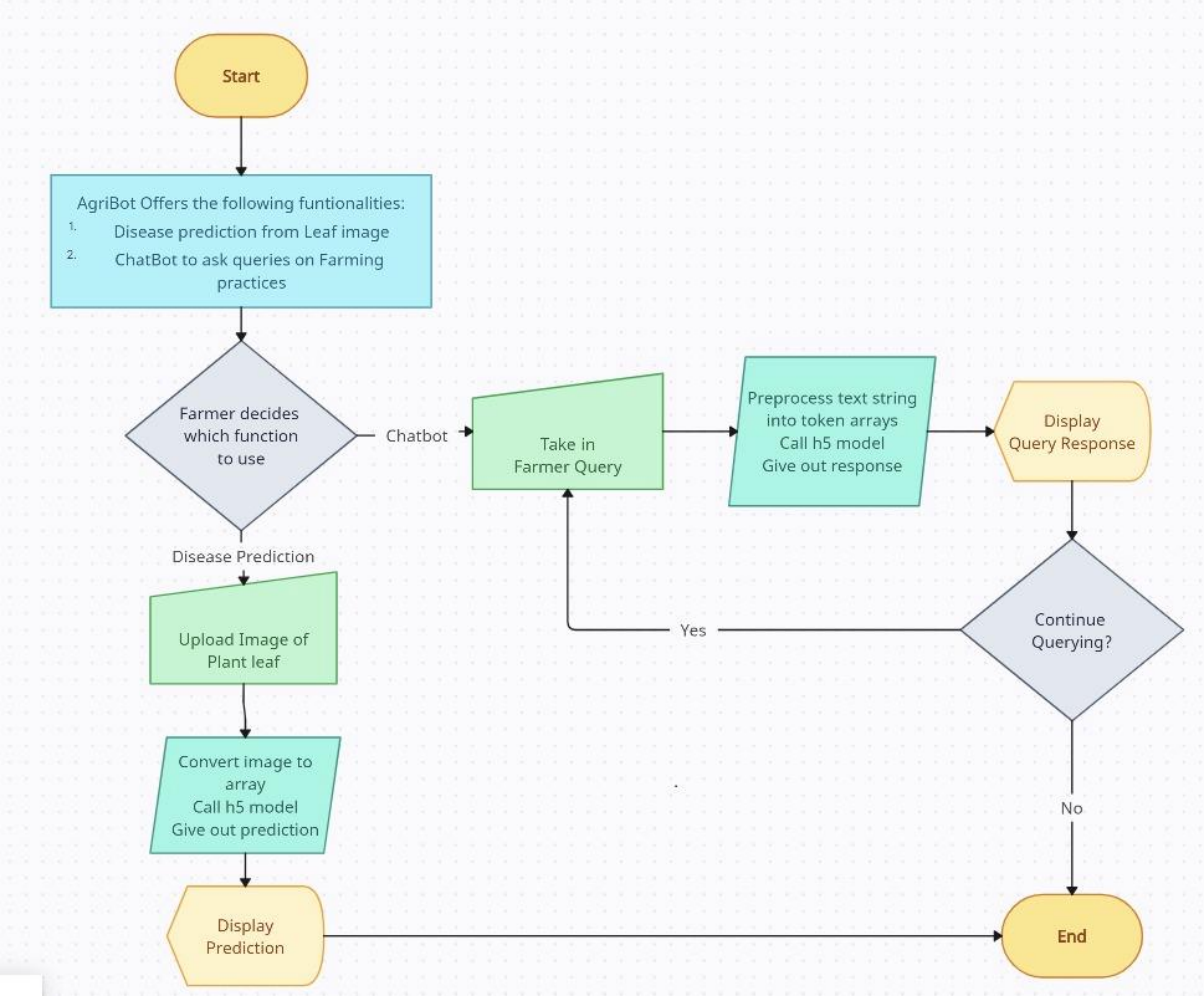
   Test the system's robustness by simulating different error scenarios and edge cases. Investigate how the system handles unexpected inputs, errors, and exceptions. Evaluate the error handling mechanisms to ensure proper error reporting and graceful degradation of the system.

8. Usability Testing:

   Conduct usability testing with a group of farmers or end users to assess the system's overall user experience, interface intuitiveness, and ease of navigation. Gather feedback on the UI/UX design, identify any usability issues, and make necessary improvements based on user suggestions.

By performing these experimental investigations and analyses, valuable insights can be gained to optimize the performance, accuracy, and user satisfaction of the chatbot and crop disease classification system. The findings can guide improvements, fine-tuning of models, and overall enhancements to deliver a more effective solution for farmers.

5. FLOWCHART

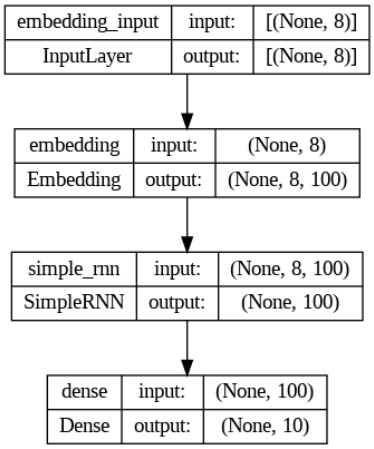


6. RESULT:

AI chatbot

The performance of the AI chatbot and crop disease classification system is evaluated using various metrics. For the chatbot, metrics such as accuracy, response time are measured. A comprehensive dataset of farmer queries and corresponding responses is collected for evaluation purposes.

The model architecture consists of an embedding layer, a SimpleRNN layer, and a dense layer with a softmax activation function. The model is compiled using the Adam optimizer and categorical cross-entropy loss function. The training data for the model is prepared by preprocessing and tokenizing the input sequences. The model is trained on this preprocessed data to understand and generate appropriate responses to farmers' queries

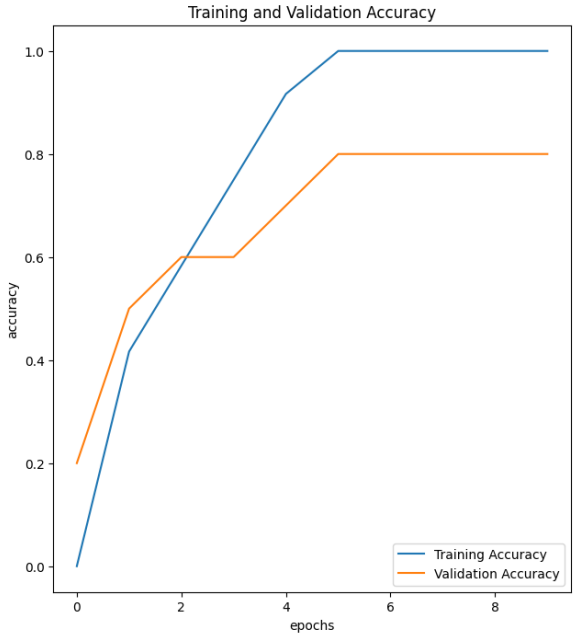


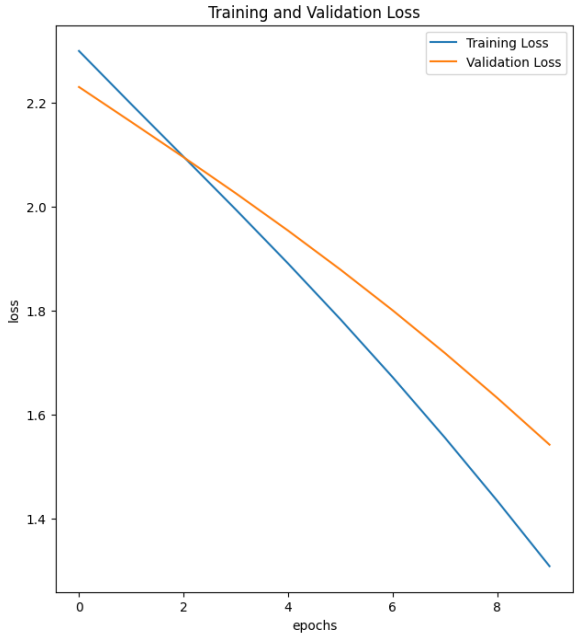

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 embedding (Embedding)       (None, 8, 100)            3000

 simple_rnn (SimpleRNN)      (None, 100)               20100

 dense (Dense)               (None, 10)                1010

=================================================================
Total params: 24,110
Trainable params: 24,110
Non-trainable params: 0
```





Crop disease:

The crop disease classification system's accuracy and precision metrics are evaluated using a separate dataset of labeled images. The results demonstrate the effectiveness and reliability of the developed system in providing accurate responses and identifying crop diseases.

```
model.evaluate(test_data)
```

```
550/550 [==============================] - 517s 940ms/step - loss: 0.2962 - accuracy: 0.9069
[0.2962462306022644, 0.9068973660469055]
```

```
Model: "model"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 input_2 (InputLayer)        [(None, 224, 224, 3)]     0

 mobilenetv2_1.00_224 (Funct  (None, 7, 7, 1280)       2257984
 ional)

 global_average_pooling2d (G  (None, 1280)             0
 lobalAveragePooling2D)

 dropout (Dropout)           (None, 1280)              0

 dense (Dense)               (None, 38)                48678

=================================================================
Total params: 2,306,662
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_________________________________________________________________
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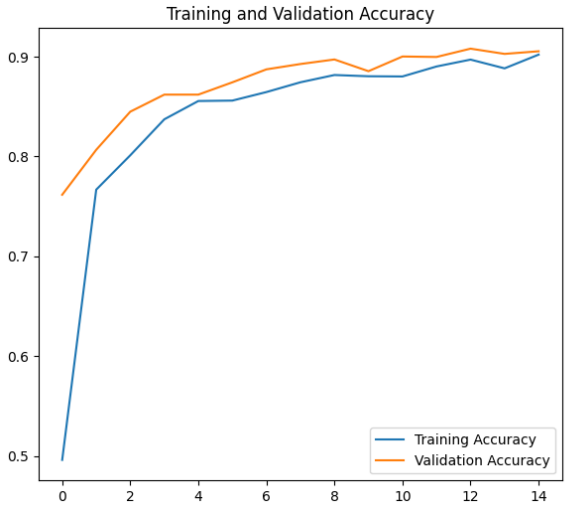

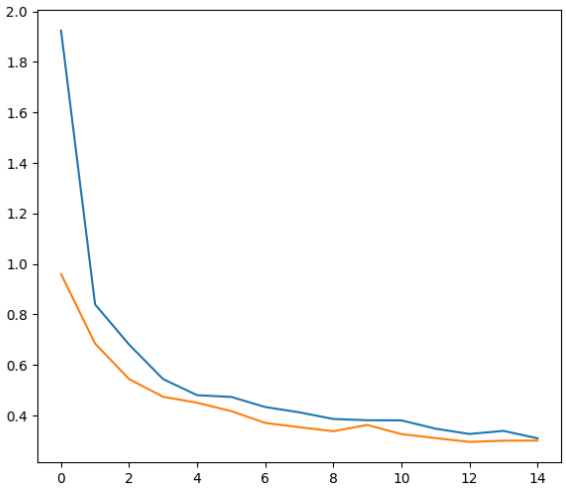

7. ADVANTAGES & DISADVANTAGES

Advantages of the Project:

- Accessible Information for Farmers: The AI chatbot provides farmers with instant access to agricultural information and expert guidance, addressing their queries and concerns promptly.

- Efficient Crop Disease Identification: The crop disease classification system assists farmers in accurately identifying crop diseases based on uploaded images, enabling timely intervention and treatment.

- Real-Time Weather Updates: By integrating the weather API, the project provides farmers with up-to-date weather information, allowing them to make informed decisions regarding crop cultivation and protection.

- Cost-Effective Solution: The project leverages open-source frameworks like React, Flask, TensorFlow, and pre-trained models, making it a cost-effective solution for farmers who can benefit from advanced technologies without significant investment.

- User-Friendly Interface: The React-based user interface offers a visually appealing and intuitive experience, allowing farmers to interact with the chatbot easily and upload images for crop disease classification.

- Automation and Time Savings: The AI chatbot automates the process of answering farmers' queries and providing crop disease information, saving farmers' time and effort in seeking information manually.

Disadvantages of the Project:

- Dependency on Internet Connectivity: The project heavily relies on a stable internet connection to access the weather API, retrieve information, and provide real-time responses. Farmers in remote areas with limited internet connectivity may face challenges in accessing the system.

- Limited Domain Expertise: The AI chatbot's effectiveness depends on the quality of the training data and the expertise of the developers in addressing farmers' queries. It may not possess the depth of knowledge that human experts in the agricultural domain possess.

- Accuracy Limitations: While the crop disease classification system is trained on a reliable dataset, there may still be limitations in accurately identifying rare or new diseases or distinguishing between similar symptoms. Human intervention and expert opinions may still be required for accurate diagnosis in complex cases.

- Language Understanding Challenges: The chatbot's performance in understanding complex or nuanced queries, regional variations, or slang may be limited. The chatbot's responses might not always capture the full context or accurately address farmers' concerns.

- Maintenance and Updates: The project requires regular maintenance and updates to keep the chatbot's knowledge base and crop disease classification model up to date. Failure to update the system may lead to outdated information and reduced accuracy.

- Privacy and Data Security: The project involves collecting user data, including queries and uploaded images. Ensuring the privacy and security of user data is crucial, and appropriate measures need to be implemented to protect sensitive information.

8. APPLICATIONS

The project has several applications that can benefit farmers and the agricultural sector. Some of the key applications include:

- Farmers' Assistance and Guidance: The AI chatbot can serve as a virtual assistant, providing farmers with instant access to agricultural information, best practices, and expert guidance. Farmers can obtain answers to their queries on various topics such as crop cultivation techniques, pest control measures, fertilizer recommendations, and market prices.

- Crop Disease Detection and Management: The crop disease classification system integrated into the project helps farmers identify and manage crop diseases effectively. By uploading images of affected crops, farmers can receive accurate disease classification results, enabling timely intervention and treatment. This can prevent the spread of diseases, minimize crop losses, and optimize yield.

- Weather Monitoring and Planning: The project's integration with a weather API allows farmers to receive real-time weather updates. Farmers can access information about temperature, rainfall, humidity, and other relevant weather parameters. This helps them plan their farming activities, irrigation schedules, and make informed decisions related to crop planting, harvesting, and protection.

9. CONCLUSION

In conclusion, this paper presents a project that integrates an AI chatbot and crop disease classification system for farmers. The chatbot, trained on an RNN model, enables farmers to obtain prompt and accurate answers to their queries. The crop disease classification system, based on the MobileNetV2 architecture, assists farmers in identifying crop diseases efficiently

10. FUTURE SCOPE

The project has several future scopes for further enhancement and expansion. Some of the potential future scopes for the project include:

- Advanced Natural Language Processing (NLP) Techniques: Incorporating more advanced NLP techniques like sentiment analysis, entity recognition, and context understanding can improve the chatbot's ability to comprehend and respond to complex queries more accurately. This can enhance the overall user experience and provide more insightful and personalized responses.

- Integration of Voice-based Interaction: Integrating voice-based interaction capabilities into the chatbot can provide farmers with the convenience of using voice commands or speech recognition for query submission and receiving responses. This can be especially beneficial for farmers who may have limited literacy or prefer voice-based interactions.

- Integration with IoT and Sensor Data: Incorporating data from IoT devices and sensors, such as soil moisture sensors, weather stations, and crop health monitoring systems, can provide real-time data inputs to the project. This integration can enable more accurate decision-making, predictive analytics, and proactive alerts for farmers regarding irrigation, fertilization, and crop health management

11. BIBILOGRAPHY

References:

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- https://www.ijcseonline.org/pub_paper/9-IJCSE-08215.pdf
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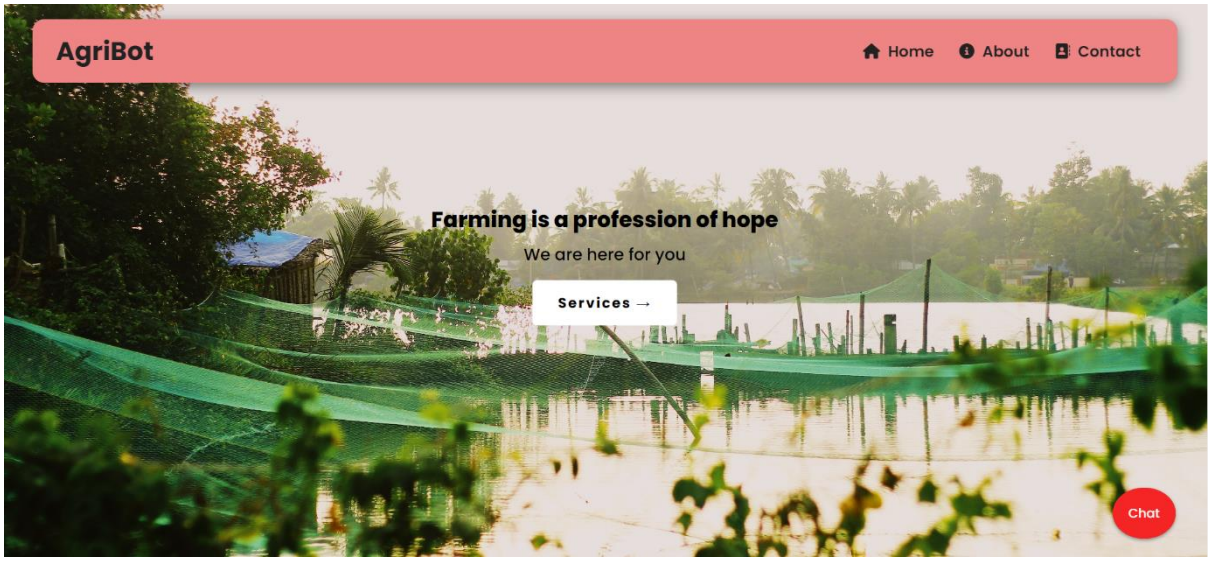
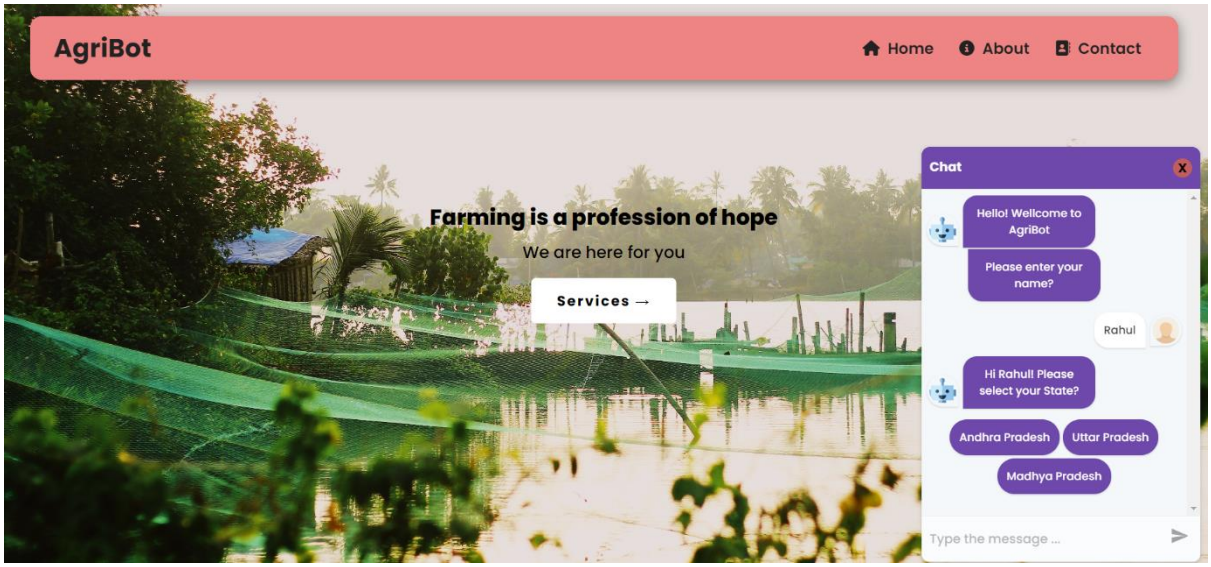
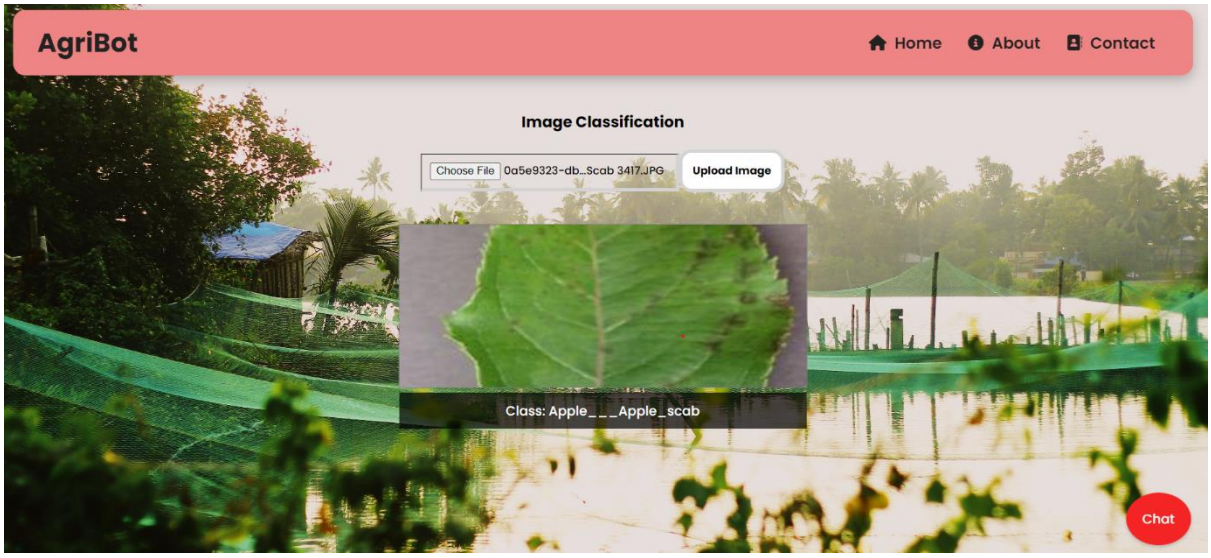
- https://www.ijrte.org/wp-content/uploads/papers/v8i2S5/B10370682S519.pdf

APPENDIX :

Code : Rahulrayudu/farmapp (github.com)






AgriBot
Home
About
Contact
Image Classification
Choose File
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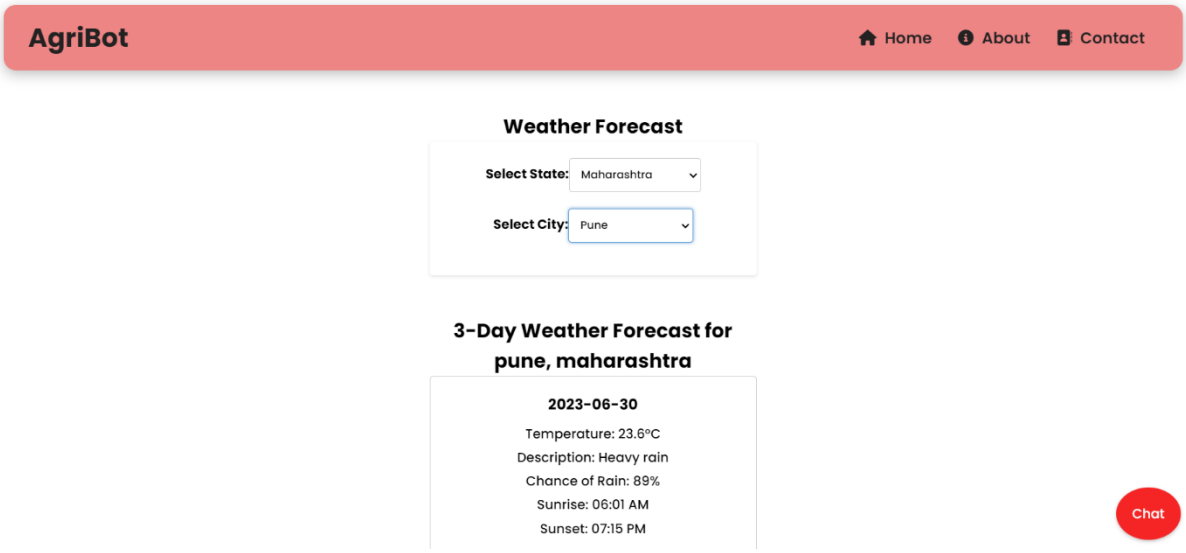
Upload Image
Class: Apple___Apple_scab
Chat


AgriBot
Home
About
Contact
Weather Forecast
Select State:
Maharashtra
Select City:
Pune
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Description: Heavy rain
Chance of Rain: 89%
Sunrise: 06:01 AM
Sunset: 07:15 PM
Chat