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Detection and recognition of healthiness of agricultural plants using image processing

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Abstract: *Agriculture is one of the important sectors of the Indian economy. Employment for nearly 50% of the country's labour force is provided by Indian agriculture. Agricultural economic growth depends on the quality of the products they produce, which is based on the growth of the plant and the return that they are entitled to. Consequently, in the area of agriculture, the detection of diseases in plants plays a decisive role. Plant pathology is a science that studies plant diseases and attempts to improve the chances for survival of plants when they are faced with unfavourable environmental conditions and parasitic microorganisms that cause disease. The symptoms of plant illnesses are evident in different parts of a plant, like leaves. Manual detection of plant disease using leaf images is a tedious job. Diseases cannot be avoided because plant farming takes into account numerous variables such as the environment, soil, and amount of sunlight. The latest and most promising technologies, such as image processing, are used to correct such questions by using various types of techniques and algorithms. Plant detection and recognition by machine learning diseases can provide many clues for the identification and treatment of illnesses at their beginnings. This paper uses the convolutional neural network CNN algorithm to recognise and classify the diseases of plants. The main crops focused on in this project are potato, which is the second most important crop in India; tomato, whose season prevails throughout the year in India; and bell pepper, which is mainly cultivated in the southern parts of India. The project also includes a chatbot implemented using Natural Language Processing (NLP). The Linguistic Chatbot is introduced to help farmers of Karnataka get solutions in their regional language. Traditional chatbot technology has the limitation of being able to conduct a conversation only in English. The bot provides a complete solution of a conversational system along with the integration of various predicting modules like crop recognition, crop disease detection, and suggestions about pesticides to be used.*
Keywords: *Deep Learning, CNN, NLTK, Linguistic chatbot.*

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I. INTRODUCTION

Agriculture Farming in India is the oldest activity and has been the major livelihood for farmers. Over the years, farming methods in India have changed thanks to technological inventions making the lives of farmers easier. Increased productivity, regardless of unfavourable environmental factors, is the key problem here**.** There are many instances in which farmers lack complete knowledge of crops and diseases that may adversely affect harvests. Increasing productivity, not withstanding adverse environmental factors, is the main problem here. The proposed idea can be very helpful for farmers by effectively increasing the yield rather than visiting the expert and getting their advice. Most research articles use convolutional neural network architectures (CNNs) for deep learning-based illness screening.

Analysing and monitoring of plants like tomato, potato, and bell pepper diseases are manually done by the farmers and need more time and effort for them to assess certain damage to the plant. Apart from this, it is prone to human error and inaccurate treatment of the plants as the diseases on their leaves are different from each other. Deep learning is a part of machine learning in artificial intelligence that has the ability to learn unstructured or unlabelled information. It can also be stated as Deep Neural Learning or Deep Neural Network. DL is an AI function that acts as a replica of the human brain in data processing and thus plays a major role in creating and making model decisions.

In this proposed work, a chatbot has been implemented using Natural Language Processing, which is a Deep Learning Technology. It is the technology that is used by machines to understand, analyse, manipulate, and interpret human languages. It helps developers to organise knowledge for performing tasks such as translation, automatic summarization, Named Entity Recognition (NER), speech recognition, relationship extraction, and topic segmentation**.** This provides efficient disease detection in the farming crops. The linguistic chatbot provides a complete solution in the regional language (Kannada) that benefits the farmers by increasing their productivity. The trained machine learning model and chatbot are implemented into a single Android

application. The model is imported into Android Studio via Django framework. The app includes features such as image capturing to capture the image of a leaf and upload it in the app; solution and nearby agricultural shop recommendation using a chatbot; and an information section to guide farmers in the process of growing healthy plants.

II. LITERATURE SURVEY

T.Vijaykanth Reddy et al., proposed a paper where they perform automated leaf disease detection using deep learning models[1]. The framework is known as Deep Leaf Disease Prediction Framework (DLDPF). It is designed so that it uses pre-trained models as well as transferring learning to benefit from the accuracy of disease prediction. Rather than directly using core CNN models, the DLDPF has its own mechanism for improving training optimization and test accuracy. It also exploits transfer learning by taking into account two pre-trained models like Alex Net and Google Net. The Alex Net precursor makes it possible to enlarge size convolution kernel in order to support a strong ability to gather information from the leaf image. A total of six convolutional layers are utilized with various core sizes. It uses cascade inception together with convolutional layers and max pooling layers so that you can carry out the prediction of diseases. Once the system is built, it will be updated in every epoch until convergence.

G. Geetha et al., This research presents a representation of leaf disease detection using image processing to identify flaws in tomato plants from photos using colour, binding, and texture to provide farmers with quick and consistent findings[2]. In this project, four consecutive phases are used to find out the kind of leaf disease. The four stages consist of pre-processing, leaf segmentation, feature extraction and classification. To remove the noise, they have done the pre-processing and to part the affected or damaged area of the leaf, image segmentation is being implemented. The k-nearest neighbors (KNN) algorithm, which is a guided, supervised and cutting-edge machine learning algorithm, is applied to trace solutions for both the problems correlated to classification and regression. The treatment for the leaf disease is recommended to the user during the terminal stage. The diseases primarily impact live plants. The project is methodically performed with many variables such as illuminations, the size of performers in an image, and surrounding distinction, etc., and it is held across the neighbouring part of that particular plant. It provides a practical working technique that can be adapted in the domain without relying on expensive, difficult, and compound technology. This technique benefits farmers not only in terms of protecting crops, but also in terms of saving money by only purchasing pesticides that are appropriate for the disease being treated.

Hiba Hussain et al., proposed a disease prediction chatbot and report analyser. Chatbots are the human version of AI-based software that interprets and responds to the user using natural language processing [3]. Using NLP and machine learning techniques, this research suggests a disease prediction chatbot. KNN and Decision tree algorithms are used to make the predictions. KNN and Decision Tree are two of the most commonly used classification algorithms in disease prediction. The chatbot is powered by natural language processing. The NLP principles of wordnet and tokenization are employed. Tokenization is the act of breaking down a piece of text into a list of words, whereas WordNet is a lexical library of dictionaries built for natural language processing. This project also looks forward to provide medical consultation on the predicted disease. The study also looks at how to use the Tesseract Optical Character Recognition tool to extract text from a patient's scanned pathology report. By offering a graphical interpretation of the test result, the generated text aids in the easier translation of the report. Natural Language Processing is being used to create an interactive chatbot that will retrieve symptoms reported by the user.

Ekanayake et al., this research creates a chat room and a Chatbot to discuss current farming concerns with peers and experts [4], and to assist farmers in making timely farming decisions. Through talks and surveys with farmers, experts, and other stakeholders, a standard set of questions was developed. The user interface was created with properties like guidance, user control, consistency, error prevention, feedback, and simplicity in mind. In addition, the interface should provide features for illiterate farmers. The chat room is part of the E - Agro platform server, which runs on a node server. Responder, Classifier, and Graph master are the three main components of the Chat-Bot. The responder receives a response via the user interface. The goals of this project is to connect farmers and provide timely solutions to their problems.

Gore H., Singh et al., this research paper focuses on a python-based web framework known as Django[5]. As Django known for web application framework which is freely available and is extremely demanding in today's market. It consists of MVT design structure (MVT stands for Model View Template). The Django model is capable to work as a database management. Django is completely scalable and it has faster development. Django provides an easy way to generate powerful HTML using its template program. It consists of function and class-based views. Django is a framework that allows us to divide python and HTML, with the python component being contained within views and the HTML part being contained within templates. Django relies on dedicated performance and the Django template language to connect the two.

III. METHODOLOGY

The image dataset for the database will be taken from plants in the village, which may contain more than 500 images of diseases of different plant types. A total of 20,000 images will be collected from the Kaggle website. Deep learning algorithms and image processing will help in training the model in order to predict a specific type of disease in plants which is depicted in figure 3.1. Steps involved in disease classification:

1.Import necessary dependencies and datasets into the TensorFlow dataset.

2. Function to Split the Dataset: The dataset should be bifurcated into 3 subsets, namely:

a) Training: Dataset to be used while training

b) Validation: Dataset to be tested against while training

c) Test: Dataset to be tested against after we trained a model

d) Creating a layer for resizing and normalisation is used before we feed images to the network. We should be resizing them to the desired size. Moreover, to improve model performance, we should normalise the image pixel value. This should happen during training as well as inference. Hence, we can add that as a layer in our sequential model.

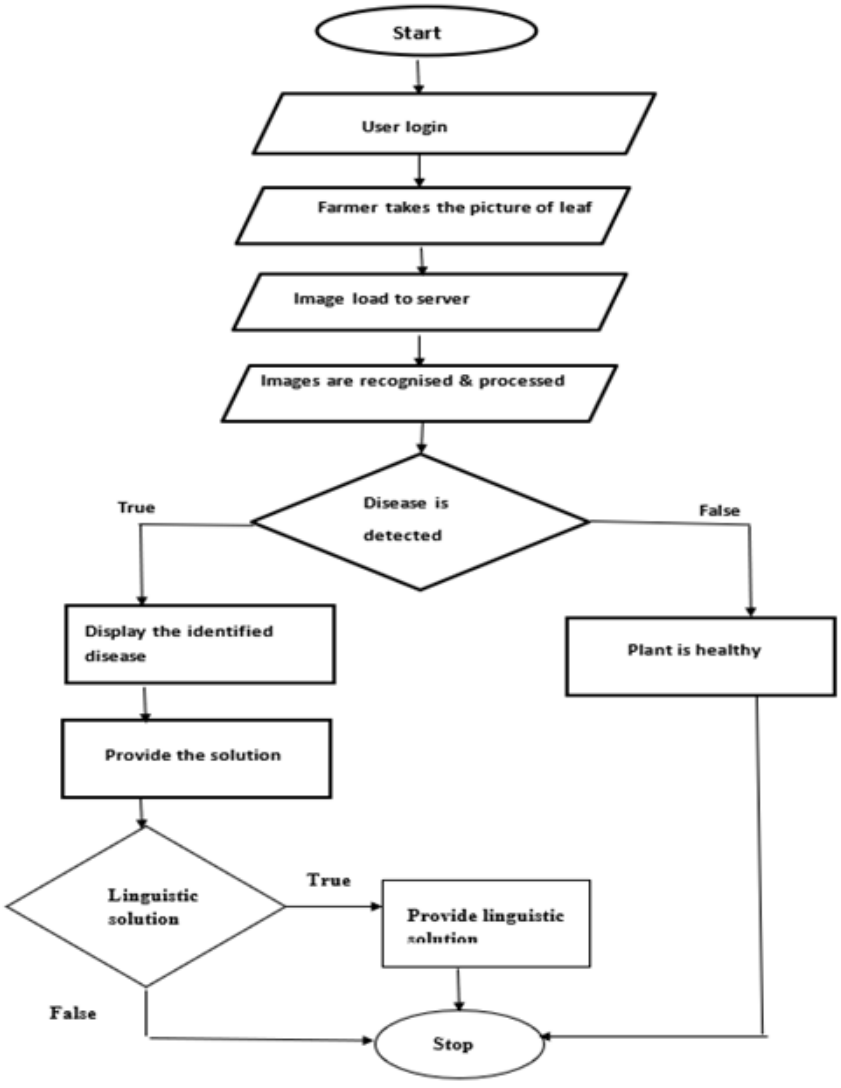


Figure 3.1 General model of detecting agriculture plant disease

Data augmentation is needed when we have less data. This boosts the accuracy of our model by augmenting the data. A model architecture is used to couple CNN with SoftMax activation in the output layer. We also add the initial layers for resizing, normalization, and data augmentation. Compiling the model uses Adam Optimizer, Sparse categorical cross entropy for losses and accuracy as a metric, and writing a function for the interface.

The following steps are used to create a chatbot:

1. The queries entered by users are tokenized and a list of tokens is generated using the bag of words technique. Stop words are thus removed using the NLTK corpus.

2. Training and Testing: The application is streamed with thousands of queries so that the obtained response will be accurate.
3. Multilingualism: The application allows farmers to query both in English and Kannada.

The ML model is connected to the Android application through the Django framework. Django is an open source, high level python web framework that encourages rapid development and clean, pragmatic design, which takes care of much of the hassle of web development, so that we can focus on writing our application. Image uploaded is sent to Django, where image is scanned, processed and plant disease gets predicted. Then, the result is sent to Android application where disease is displayed. A linguistic chatbot is integrated into the Android studio. Apps enhance the ease of use as compared to web applications.

IV. RESULTS

The system helps in predicting whether a plant is having any sickness or not based on the photograph uploaded by the user. Name of the disease is displayed if plant is infected. A person can discover answers for a specific disease from FAQ section of this application. Also, the information section helps the farmers in developing healthy plant life. Some of the screenshots of the application are provided from figure 4.1 through 4.5 below:

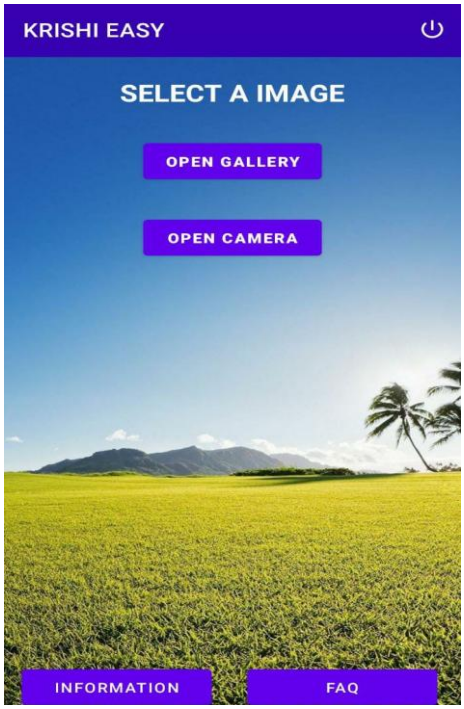
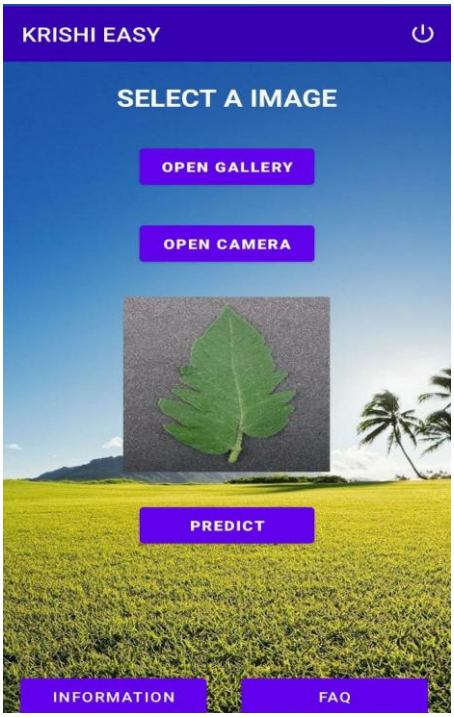


Figure 4.1 Home page



Capture or upload the leaf image

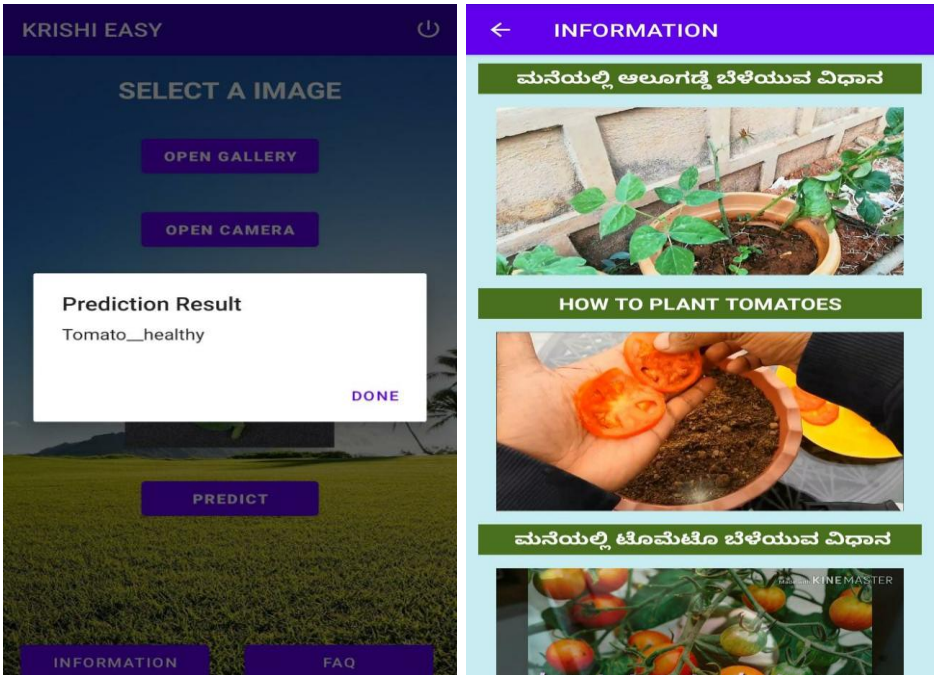


Figure 4.2 Display of result **Information section**

FAQ section Results in regional language for farmers and in English:

Figure 4.3 Selecting the disease type to get solution.

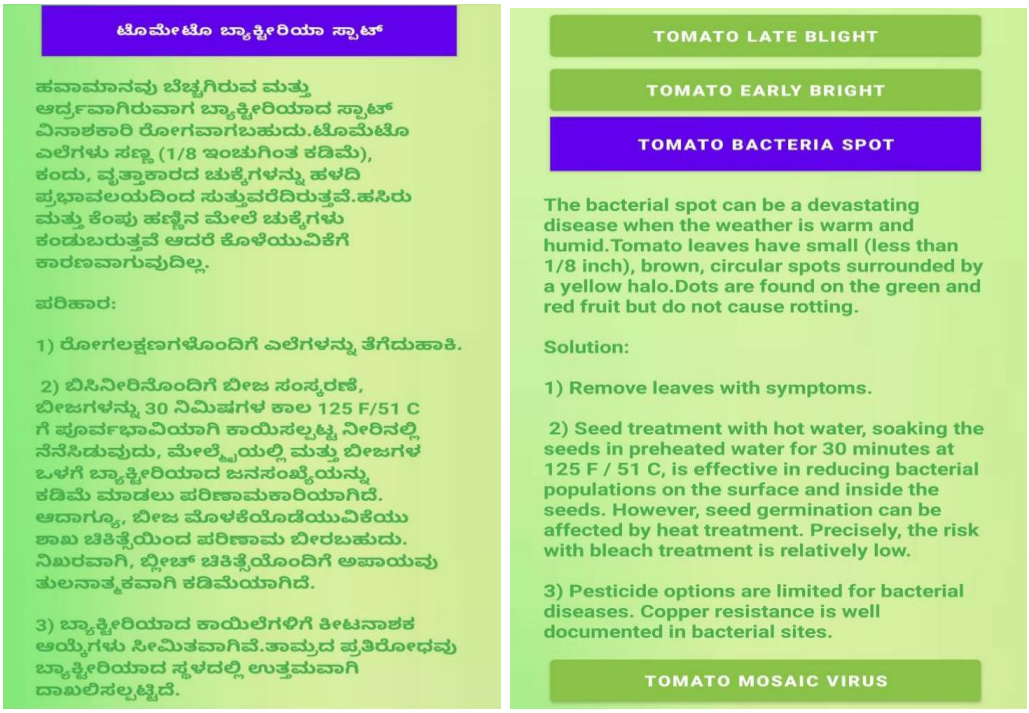


Figure 4.4 Solution is displayed for a particular disease.

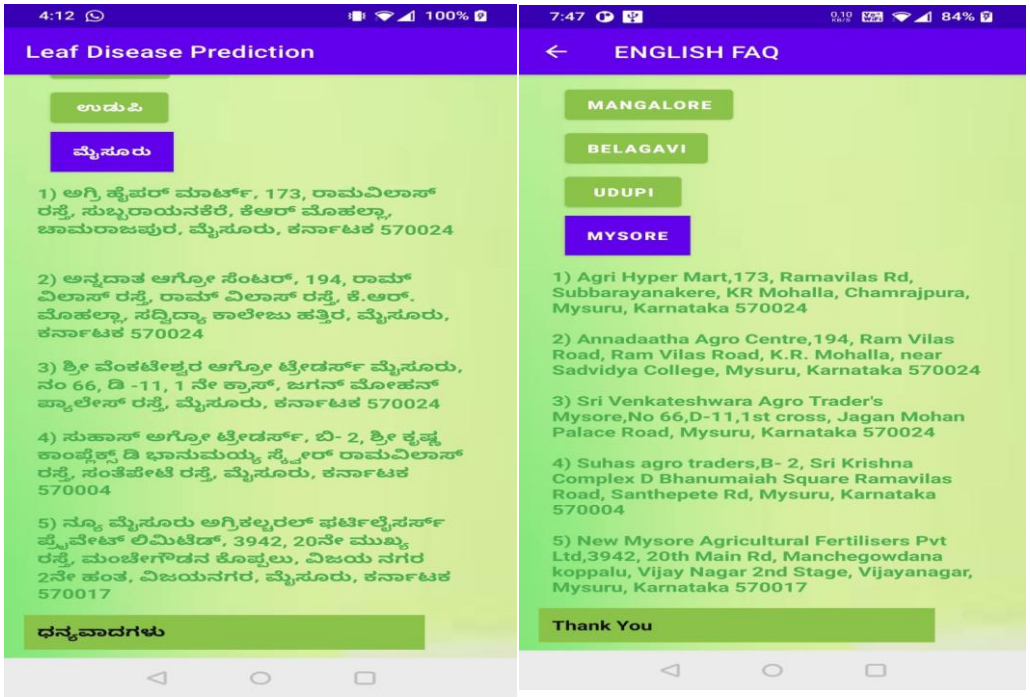


Figure 4.5 Nearby agricultural shop's location are displayed for a respective place.

V. CONCLUSION

The proposed system helps the farmer to recognise the disease at different stages of the plant's life cycle. It can provide help for people who have less knowledge about the disease. The linguistic chatbot present in the system will help to overcome the language barrier by suggesting remedies in their regional languages. The time required for consulting the experts is eliminated as the system provides quick and accurate results just by a single click. The application is cost-effective and time-efficient.

The application can be extended to various kinds of agricultural plants;The entire Android application can be made available in all regional languages and not only limited to chatbots. Additional features such as weather

prediction, soil fertility detection, and predicting the exact quantity of pesticides required for a given area of land

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