Project Report

Development of a Multilingual Virtual Assistant for Farmers

1.Abstract

Keywords: Machine Learning, Convolutional Neural Network (CNN), TensorFlow Lite, Firebase, Disease Diagnosis.

Project Objective: The aim of this project is to develop an Android application for detecting and identifying plant diseases using a deep convolutional neural network. In agricultural countries like India, plant diseases pose a significant threat, leading to considerable annual losses in crop yields. These diseases are often not visible to the naked eye, making it essential to develop an automated method for their identification. This application not only identifies the diseases but also provides actionable solutions tailored to the issues detected. It includes extensive information on various crops, agricultural practices, and weather forecasting. Additionally, it features a community space where users can exchange advice and share issues related to farming. The app also has the capability to recognize different crops through leaf scanning. Designed to be user-friendly, it requires minimal technological know-how from users and supports multiple regional languages, making it accessible to a wide range of farmers.

2.Problem Statement

The agricultural sector is one of the main pillars of the Indian economy, and the sector of late has often faced this danger from plant diseases, which can significantly impact crop yield and quality. Traditional methods of disease diagnosis are almost wholly manual, requiring physical inspection by experts, which is time-consuming and often either inaccurate or simply not achievable in the case of subtle symptoms. In addition, the vast number of smallholder farmers in remote areas do not readily have access to this expertise. Thus, there is a profound necessity for a scalable, reliable, and easy-to-use solution to accomplish early detection of plant diseases, thereby enabling farmers to mitigate losses effectively. Thus, the solution is proposed to use a deep convolutional neural network to analyze images of plant leaves captured via a smartphone app, which provides an immediate diagnosis of potential ailments.

3.Aims & Objectives:

The focus of our research is on the software that uses Deep Learning specifically, CNNs to make plant disease detection easier. Numerous plant diseases, such as those of tomatoes, cherries, oranges, potatoes, corn, apples, and grapes, are detected by the software.

Using the built-in camera in the app, farmers can snap images of their harvests and share them via the app. To identify any diseases on the leaves, the TensorFlow Lite machine learning model examines the photos.

The application's primary goals are:

Enabling farmers to detect and identify agricultural illnesses is known as disease detection quickly and effectively.
User-Friendly Interface: To make technology accessible to all, developers must ensure that farmers can easily identify problems in crop leaves.
Efficiency and accuracy: Improve the efficiency and accuracy of the disease identification procedure over the state-of-the-art, looking beyond what the human eye can see.

4.Features of Application:

• **Admin:** The system is managed by the person who brings the update into the system. He is called the
admin.
• **User login**: Users have to login to enjoy the services of the app. Then they can enjoy the app and start the usage of the apps. Firebase Cloud Fire store is the database of the user information. In addition, the information of the user is stored in Firebase Storage.
• **Three languages are supported in the app**. Telugu, Hindi, and English.
• **Detection**: The TensorFlow lite model integrated in the system can detect disease from the image captured through the camera using the app. Three best outcomes from the deep learning algorithm after the camera image is captured, three best results are drawn out of the model. We have used the priority queue method from the three best results and displayed the highest percentage to the user.
• **Precaution:** After getting the result of the image, we provide the user with a choice of precaution so that he can discover a cure for the disease.
• **Crop Information:** We have provided on a different website information about the plants regarding various crops regarding our work. like the typical environment
of a plant, its scientific name, planning style, and culture.
• **Community:** We have included a function in the application so that users may talk to other users if they have any question. Just type your question with the appropriate image, header, and description.

5.Proposed Work

Our project involves the development of an Android application to apply deep convolutional neural networks in the detection of plant diseases from images of leaves. Training the model with thousands of images for different plant diseases will learn and predict a new image offered by users. It is going to be quite easy to use: the farmer sends a photo of a leaf with the potential of a disease to it through the app, and it returns the diagnosis in a short time.

This is powered by TensorFlow Lite, which enables running of deep learning on mobile devices with minimal computation power demands.
This app is fully functional and adaptable.

7.Scope:

This project is all about developing a capable and efficient tool to detect diseases of the plants' leaves using convolutional neural networks. With the system, farmers, and other interest groups in the agricultural sector can quickly and reliably detect plant diseases that are of paramount importance for the well-managed crops and high yield.

We utilize deep learning in this project to develop a strong and precise model for detecting plant diseases. We use a large collection of plant images and then follow different preprocessing methods to ensure the data is accurate. After training a model using a CNN architecture, the model can detect very important features from the images sent.

We have also developed an Android mobile application that makes it very easy for farmers and agricultural stakeholders to use and access this disease detection model. The app has a simple and user-friendly interface that requires users to take photos of plant leaves and get immediate feedback on the health of the plant.

We made sure our system is reliable and capable of working as expected with the help of several testing methods, such as unit testing, integration testing, and acceptance testing. These tests ensure the system meets all the necessary specifications and works well under various conditions.

9.Algorithms:

1. Convolutional Neural Networks
Convolutional Neural Networks, abbreviated as CNNs, are very important in the app as they operate well on image classifications of complex patterns using various processing layers.

Data Preprocessing: The images are resized and normalized to improve learning efficacy.
Model Architecture: Includes convolutional layers that filter the image to produce feature-rich maps, pooling layers that simplify these features, and fully connected layers that classify the images.
Training: The CNN learns the features of plant leaf images to classify between healthy and diseased states from a vast dataset of plant leaves.

2. Transfer Learning
Transfer learning is the fine-tuning of a pre-trained model, like InceptionV3 from ImageNet, for our application of plant disease identification. This has the benefit of saving time and computing resources if data is limited.
Base Model Selection: Choose a pre-trained model.
Fine-tuning: Fine-tune the final layers for training on our plant disease dataset.

3. Data Augmentation
Data augmentation increases the size and diversity of the training dataset. This increases the size and reduces overfitting. Image transformation is applied during preprocessing to create diverse training samples.
Augmentation Techniques: Images are altered during preprocessing to create varied training samples.

4. TensorFlow Lite
TensorFlow Lite is a lightweight version of TensorFlow designed for low-powered mobile devices.
Model Conversion: TensorFlow model is converted into a TensorFlow Lite model.
mobile Integration: The app can be integrated into the phone to run independently of the internet.

5.System Testing and Validation
Unit Testing: Each component of the app should be tested individually.
Integration Testing: All components of the app should fit together smoothly.
Acceptance Testing: Checks whether the app meets the needs of the farmer under realistic conditions.

10.Algorithm Implementation:

10.1Data Collection:
First, since this is any machine learning project, data collection is the first step in any of them.
For the project, we used a publicly available dataset called Plant Village

10.2 Preprocessing: Normalization of image size and color intensity is undertaken before training, which helps the model learn more efficiently. Common techniques include resizing and normalization of pixel values.
10.3 Model Architecture: The architecture of a CNN normally consists of several layers:

- **Convolutional layers**: Convolutional layers apply several filters to the image to create feature maps capturing essential details of edges and textures.
- **Pooling layers**: Pooling layers after coevolutionary layers reduce the dimensionality of each feature map so that only the most important information is maintained.
- **Fully connected layers**: A few convolutional and pooling layers are followed by one or more fully connected layers to classify the image based on the features extracted.

10.4 Training: The CNN learns to associate features of the images and specific diseases from a large dataset of labeled images of plant leaves, both healthy and diseased.

11.Output:

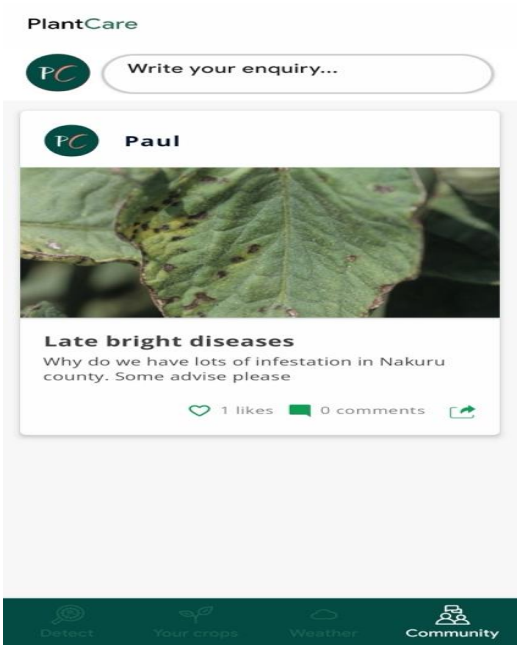

Fig.1

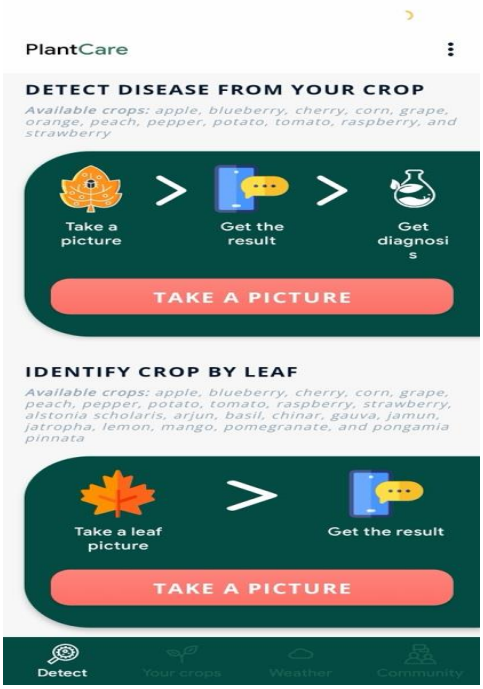

Fig.2

Fig.3

Fig.4

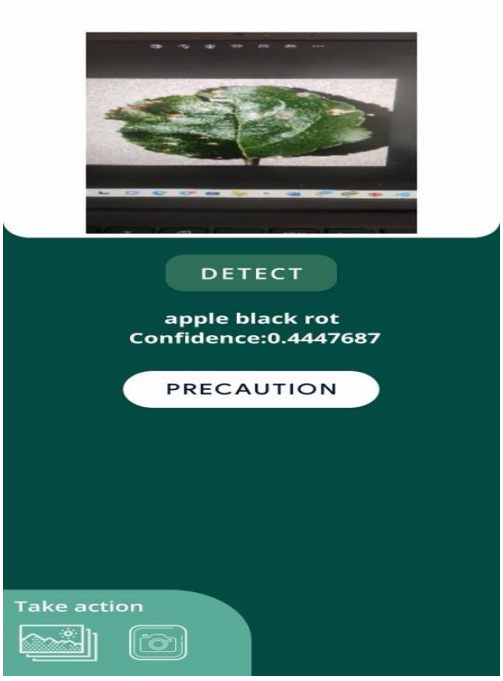

Fig.5

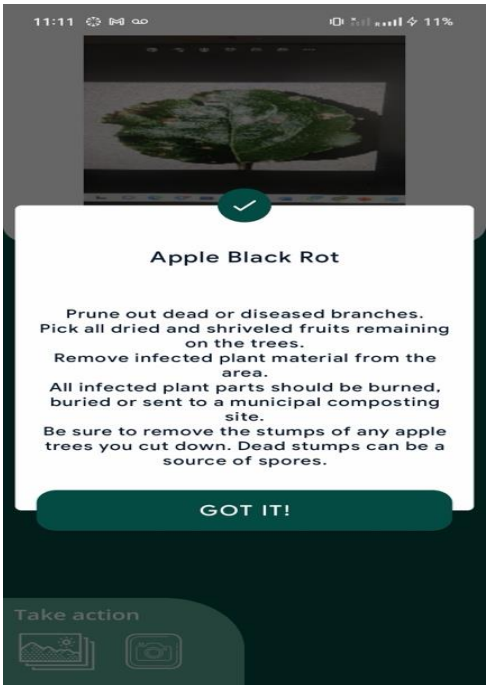

Fig.6

12.Conclusion:

The project is on the development of an Android mobile application that utilizes deep CNN to detect and classify plant diseases. For model training, the large dataset of Plant Village Dataset was used. Model output resulted in an accuracy of close to 98%.
Given a photo of a plant leaf, upon help from the deep CNN model, the model offers both the preventive and therapeutic measure. The application is a useful tool for proper detection of plant diseases and adequate action to boost agricultural yield in rural areas since it is easy to use and cheap, most importantly for farmers.

13.References:

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