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Plant Disease Recognition Using Image Processing And Artificial Intelligence

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Abstract - Generally, humans can identify the plants that are affected by certain diseases, but apart from our eyesight, it is tough to detect. Without giving the right treatment and immediate actions, the entire cultivation land can turn into a diseases affected area, else all plants which are a neighbor to one another can get affected through spreading. So to detect plant diseases in advance and to detect the diseases with the help of modern computer technology, we proposed a model for the efficient distinguishing plant diseases

Key Words: plant disease detection, machine learning, Artificial Intelligence, Image processing.

1. INTRODUCTION

The plants are the basic and important element of the food chain. Plants produce food, All the species are directly or indirectly dependent on them for their survival. food is the major factor in living life. According to FAO (Food and Agriculture Organisation of United Nations) plants account for over 80% of the human diet. As such, they are essential for food security, or the ongoing access to sufficient, affordable, safe, and nutritious food for us all to live active and healthy lives. The diseases on the plants are evolving and increasing rapidly which is resulting in poor quality of food. These diseases cause huge losses to the farmer and other communities as well. Nowadays, Identifying and controlling the spreading of the disease is an important challenge. Here we have tried to recognize the disease on infected plant leaf using Transfer learning, which is a machine learning technique. In this technique, the pre-trained CNN models and their weights are used for solving problems in customer use cases. Using this technique, it is possible to reduce the required dataset and the resources required for the model training. As an interface for the proposed system, we have created a mobile application that is developed using the Flutter framework. Flutter framework is an Open-source UI software development kit created by google. It is used to develop cross-platform applications for Android, iOS, Linux, Mac, Windows, Google Fuchsia, and the web from a single codebase.

2. RELATED WORK

To identify the plant disease on the leaf there are various methods, techniques have been proposed.

In this work [1], A CNN architecture Plant Disease Detection Neural Network (PDDNN) is proposed for the effective classification of plant diseases. In this architecture single model is developed for 10 different plant disease classes from the plant village dataset. It achieved an overall accuracy of 86%.

In [2], A Mobile application based on deep AI is proposed. In this proposed system single model for the classification of 10 plants and 27 classes is used from AI Challenger 2018 dataset. The proposed CDCNNv2 model which is based on ResNet50 pre-trained on the ImageNet dataset gives the accuracy of 92%.

In [3], A AI model and a simple deep learning model based on DenseNet121 for plant disease detection are proposed. The model is trained concerning different input sizes of images from the plant village dataset.

In [4], A deep CNN (Convolutional Neural Network) model is proposed capable of classifying the 15 classes of plant disease including healthy and background images. This architecture gives an overall accuracy of 96.3%.

In [5], The performance of Google Net and Alex Net was tested on the plant village dataset on different classification configurations. The analysis is performed on different types of images like grayscale, colored, leaf segmented. And the configuration varies on model training type like training from scratch and using AI. It is found that Google Net performed well as compared to Alex Net and based on the method of training AI always gives better results.

3. METHODOLOGY

We are proposing the methodology of AI for the detection of plant disease and creating models for each plant category separately. We will use the AI technique used in use cases when the size of the dataset and computing resources are limited.

Steps for developing the model:

1. Selection of pre-trained model.

2. Design the classifier i.e., the customer use case classifier in classification problem.

3. Freeze the layers of the base model while training.

4. Combine the base model and classifier.

5. Train the combined model using a custom use case dataset.

VGG16 (Visual Geometry Group) CNN model proposed by K. Simonyan and A. Zisserman from the University of Oxford it is also known as Oxford Net. It is trained on the ImageNet dataset and achieves 92.7% top-5 accuracy. ImageNet dataset is a dataset containing over 15 million labelled high-resolution image datasets belonging to 22000 categories.

4. MOBILE APPLICATION

We are providing a mobile application as an interface to the system which can be used on Android or iOS mobile devices. This is a simple to use application where the user has the feasibility of choosing plant type from 15 different categories for now. For chosen plant category user has to upload or capt,ure the plant leaf image.

After the above process the image and plant type will be sent to the server using base64 encoding as a string, then the image is regenerated using base64 decoding so that the respective trained model can recognize the disease or class of the uploaded image. After recognizing the disease or class of that image it will send back the class name. At the Application end, we have provided the facility to give Symptoms and diagnoses of the predicted disease which will help users to cure the disease

Table -1: DATASET DESCRIPTION

We have used the plant village dataset as well as the gathered dataset from internet. As we are building the models for each category of plant, the organized dataset is as follows:

No.	Plant Species	No of training Images	No of validation Images
1	Apple	2000	200
2	Tomato	6861	1274
3	Grass family (Corn, Jawar)	3599	400
4	Potato	2700	300
5	Grape	2000	200

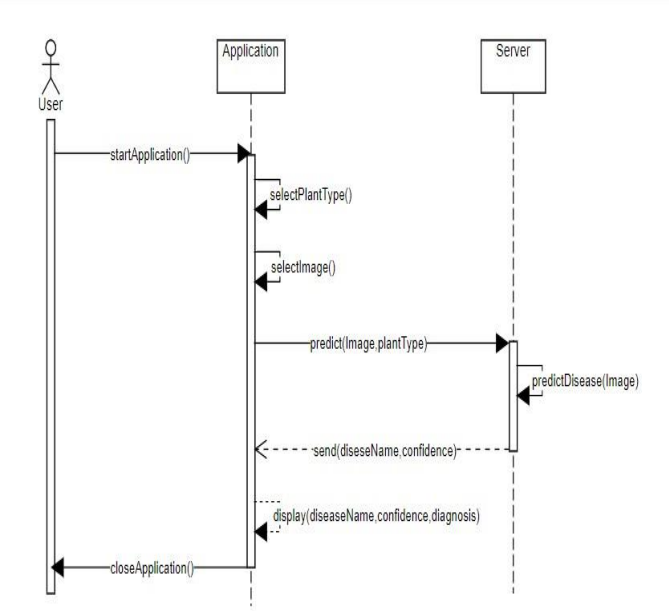

Diagram-1: Sequence Diagram of Plant Disease Detection Application.

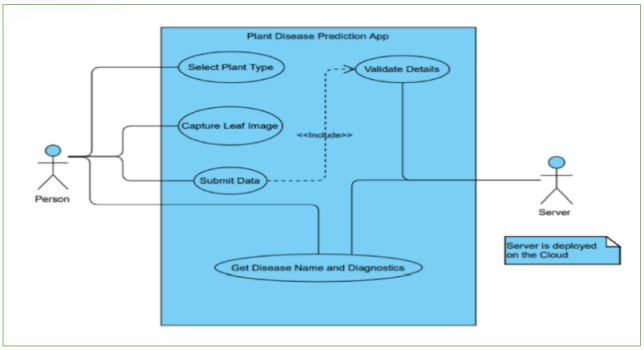

Diagram-2: Use Case Diagram of Plant Disease Detection Application.

5. MATHEMATICAL MODEL

Acquisition

Let S be the Whole system which consists of

S = {IP, Proc, OP}

Where,

IP = is the input to the system.

Proc = is the procedure applied on a given input.

OP = is the Output generated by the system after processing input.

A) Input:

IP = x, I.

Where

x = Name of the plant/type of plant.

I = Image of leaf.

B) Process:

Proc includes,

1. Upload Input to the Server.

2. Process Image file according to the type of plant.

3. Make a prediction of the disease name.

C) Output:

OP = y, D.

Where,

y = predicted disease name.

D = Accuracy Score

6. Background Process Involved

A. Image Acquisition:

In Acquisition Process Diseases images of the plants are captured through the High-Resolution camera. This image is in RGB(Red, Green , and Blue) form.

B. Image Pre-processing:

To remove noise in the image or another object removal, Image clipping i.e. cropping of the leaf image to get the interesting image region.

C. Image Segmentation:

Segmentation means partition of image into different parts of same features means parceling of pictures into different parts of same elements or having some likeness.

D. Feature Extraction:

For the identification of an object feature extraction plays an important role. Feature extraction is used in many applications. To detect plant disease color, texture, edges, and morphology can be used.

E. Classification:

In plant leaf categorization leaf is classified based on its different morphological facial exterior. Some of the classification techniques used Component Analysis, k-Nearest national Classifier. Plant leaf infection classification has wide application in cultivation.

1. This eliminates the subjectivity of traditional methods and human-induced errors it will help farmers to decide the specific quantity for pesticide application which reduces the cost and environmental pollution.

2. We have successfully proposed the mobile application using AI and fine-tuning which to recognize the disease on plants so that we can give diagnosis accordingly.

8. FUTURE WORK

As we are using an individual transfer learning model to detect diseases for each plant, it will become easy to implement a new model for newly discovered datasets.

9. REFERENCES

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