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Plant Disease Detection using Transfer Learning

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ABSTRACT:

Identification and detection of plant Diseases is one of the main points which determines the loss of the yield in crop production and agriculture There is need for system that helps in identification of plant disease and provides remedies that can be used as a defense mechanism against the disease.As we know our country is entitled as 'Krishi Pradhan desh", this system can help our farmers to increase their crop yields.The database obtained from the Internet can be properly segregated and the different plant species are to be identified and renamed to form a proper database then obtain a test-database which consists of various plant diseases that can be used for checking the accuracy of the project.

Keywords: Artificial Intelligence; Convolutional Neural Network; Deep Learning; Machine Learning; Transfer learning

I. Introduction

The problem of efficient plant disease protection is closely related to the problems of sustainable agriculture and climate change. In India, Farmers have a great diversity of crops. Various pathogens are present in the environment which severely affects the crops and various diseases are observed on the plants and crops. The main identification of the affected plant or crop are its leaves. The various colored spots and patterns on the leaf are very useful in detecting the disease.
We will be using leaves as our utility to identify the diseases and overall health of the plant.

II. Problem Formulation

Some of the problems we formulated were :

- Diseases affecting plants cause major damage to agriculture and the economy.
- Identification of such diseases by manual ways is a laborious, tedious and hectic task and is not very accurate.
- Improper diagnosis might lead to excessive and unnecessary use of pesticides.
- To encounter the issue of diagnosis and reduce the manual labour, we need to automate it in a way where a remedy for the problem can be proposed by the system itself.

III.Literature Review

Many plant diseases start from the leaves, and are part of the plant when the symptoms of many diseases first appear. (D.A. Bashish et al.,) used K-method that uses Euclidean squares to split images into segments collections. A combination of color combinations, which combines image color and texture, is used to extract features. Separation is done with the help of neural networks based on retrieval techniques. The accuracy was 93% and a total of 5 diseases were classified. (Al-Hiaryet et al.,) added an additional step to that to hide green pixels after using the K integration algorithm. The threshold value is calculated based on Otsu's method . Red, green, and blue pixel connectors with a green half value below the limit value set to zero. In addition, the elements that are on the border of the sick group and those with zero red, green, and green values are removed. Color the assembly method is used to extract the elements and the separation is done using neural networks. The 5 diseases were classified with 94% accuracy. (Revathi and Hemalatha) has released three aspects which are color variation, shape variation, and texture variations using color histogram, Sobel and canny filters, and Gober filter respectively. Feature selection is done using Particle Swarm Optimization. It divides 270 samples into 6 classes with 95% accuracy. (Deshpande) found Bacterial Blight on pomegranate leaves. A diseased area is extracted by image separation using the K-method of merging and when extracted.

IV.Methodology

Our project is based on strong foundations of Machine learning and Deep Learning. These technologies are revolutionary and impact our daily lives. Many passionate and hardworking people are working with these technologies to make things better, so we observed this and wanted to try something new with these technologies. So we considered using and trying out Transfer Learning in our project. This is basically using the knowledge of well trained models with rich datasets. Also we wanted to make this knowledge easily accessible to the general public so they can also get the exceptional benefits of these technologies so we decided to give this Transfer learning approach a platform with a large number of users. Android OS currently has a humongous user base of around 2.8 billion users, so for this reason we tried to design an Android app on top of this Transfer Learning project approach.

Transfer Learning :

Standard deep learning and machine learning algorithms assume that training and validation data should be of the same domain and have the same space distribution feature, so if there is any change in the data element space the models have to be redesigned and training needs to be repeated from the beginning. In such cases of change in the database, if the transfer of information (features learned in a particular data distribution) can be done from one domain to another, the training time can be reduced, and the problem of data shortages can be eliminated. resolved. . This transfer of knowledge is known as the transmission of knowledge when “the Nerve Network is trained as a model for another task” . The difference between transfer reading and traditional reading is shown in Figure 2. below.

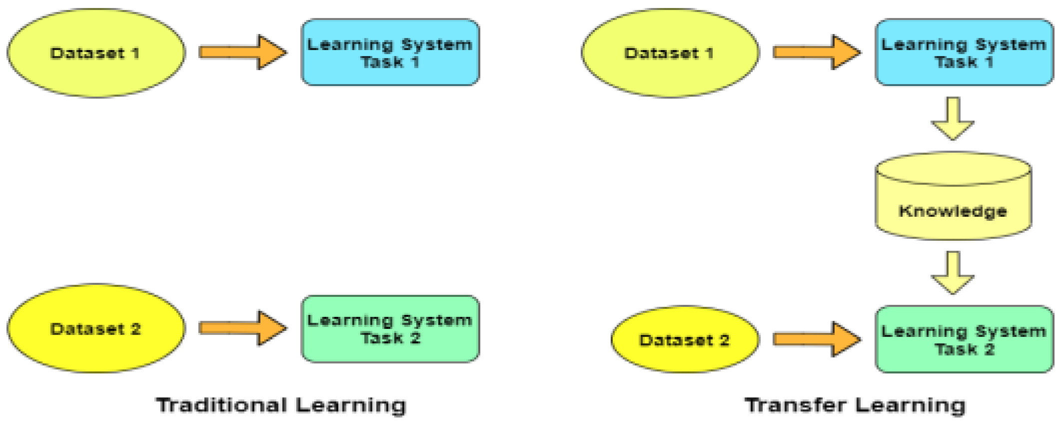

Figure : Traditional Learning v/s Transfer Learning

Dataset : For training and testing purposes, we have used the standard PlantVillage for open access dataset , containing 54,305 numbers of healthy and infected plant leaves. Detailed details, number of classes and photos in each class, their most common and the scientific names, as well as the pathogens shown in Tables 5 and 6. The database contains 38 different classes of 14 different healthy plants- and pictures of leaves affected by the disease. All photos were taken under laboratory conditions. The images cover 14 species of crops, including: apple, blueberry, cherry, grape, orange, peach, pepper, potato, raspberry, soy, squash, strawberry and tomato. It contains images of 17 basic diseases, 4 bacterial diseases, 2 diseases caused by mold (oomycete), 2 viral diseases and 1 disease caused by a mite. 12 crop species also have healthy leaf images that are not visibly affected by disease. All the data from this dataset was then loaded.

Then we did some label mapping from category label to category name. This gave us a dictionary mapping the integer encoded categories to the actual names of the plants and diseases.

Transfer Learning with TensorFlow hub :

For this step we needed to select the Hub/TF2 module to use, we had a choice with inception v3 or Mobilenet. We chose to work with inception v3.

Inception Model :

The Inception model is very well tested in image classification. The model primarily serves as many different filters for convolution, which is a unit of space used for continuous installation, and integration. The output area unit is then integrated. All the buildings before they started, made a convolution on the abstracts and the only intelligent channel background. The launch structure uses a combination of various channels, the use of low adjustment inputs, to avoid space size. We have done a leaf classification using a pre-trained CNN model known as inception-v3. Inceptionv3 is trained with a large amount of databases. The inceptionv3 model takes several days or weeks of computer training with an 8 tesla K40 GPU and apparently costs $ 30,000. Therefore, it is not possible to train models for other quotidian computers. The architecture of the first model is shown below in the figure

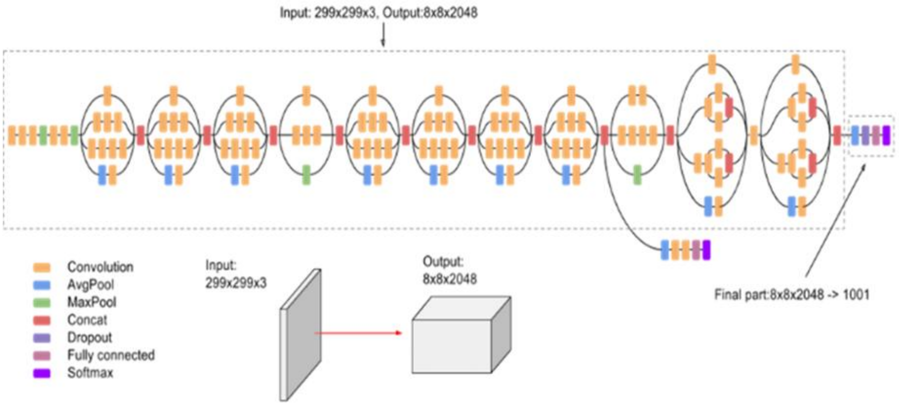

Figure: Inception model architecture

Data Preprocessing :

Then we set up data generators that will read pictures in our source folders, convert them to `float32` tensors, and feed them (with their labels) to our network. Data that goes into neural networks should usually be normalized in some way to make it more amenable to processing by the network. In our case, we will preprocess our images by normalizing the pixel values to be in the `[0, 1]` range (originally all values are in the `[0, 255]` range). we'll need to make sure the input data is resized to 224x224 pixels or 299x299 pixels as required by the networks.

Then to build the model we just needed a linear classifier on top of the feature_extractor with the Hub module. For speed, we started out with a non-trainable feature_extractor. And then we specified loss function and optimizer.

Then we trained the model, and after 10 epochs, we got 94% for accuracy, this has a scope of improvement too with the help of fine tuning. Then we converted this trained model to TensorFlow Lite so as to use this knowledge associated with this model on our Android platform.

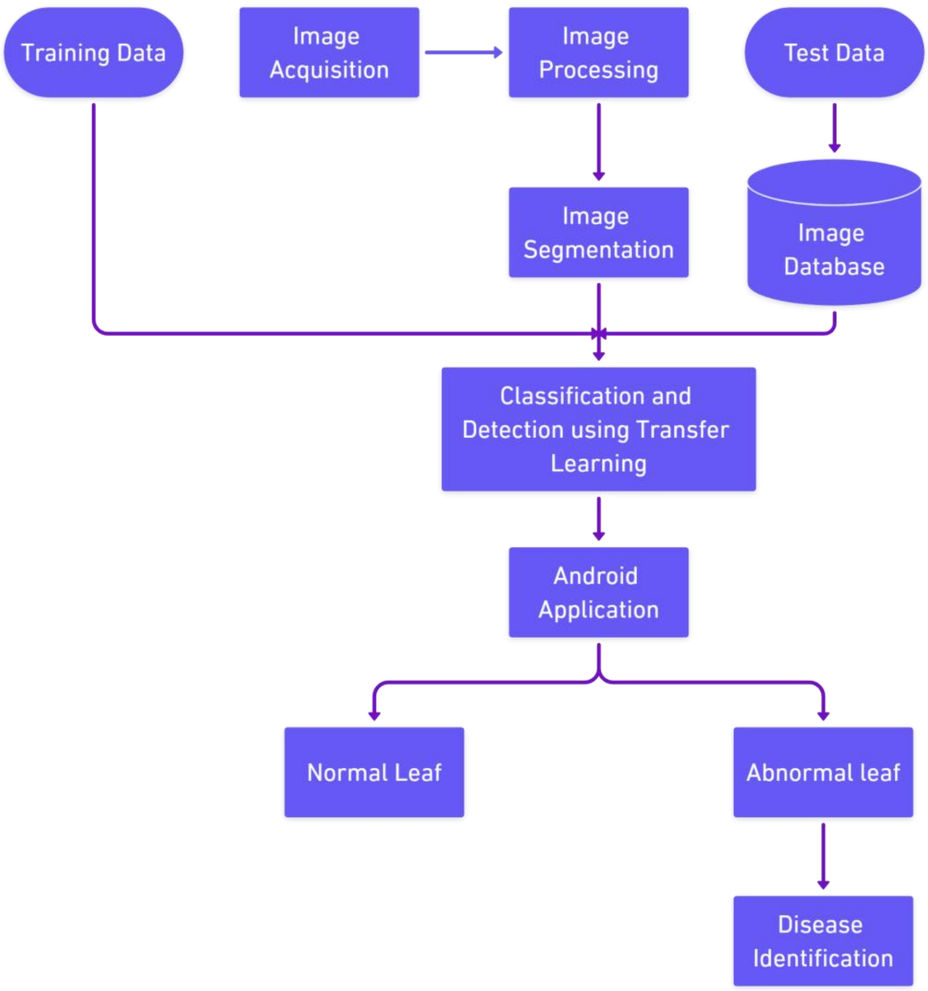

Figure : Transfer Learning based Diagnosis using Inception

V.Result Discussions

The aims of the project are as follows:
1. To detect unhealthy regions of plant leaves particularly Agricultural Plants.
2. Classification of plant leaf diseases using its Physical features.
3. To design such system that can detect crop disease and pest accurately
4. To provide remedy for the disease that is detected.

VI.Conclusion

This project proposed a leaf image pattern classification to identify disease in leaf with a combination of texture and color feature extraction. Initially the farmers send a digital image of the diseased leaf of a plant and these images are read in python and processed automatically based on Transfer Learning and the results were shown. The results of this project are to find appropriate features that can identify leaf disease of certain commonly caused disease to plants.

In this project, we demonstrated only a few types of diseases which were commonly caused, and it can be extended to more diseases in future. Here only diseases are detected but in future a robot can be sent to spray the pesticides to the plants automatically without human interaction.

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