ARTIFICIAL IINTELLIGENCE POWERED LEAF DISEASE IDENTIFIER

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ABSTRACT

Plant disease is major problem to food security, but their rapid prediction remains difficult in many parts of the world due to the lack of the necessary infrastructure. Recent advances in computer vision made possible by deep learning has paved the way for AI assisted disease diagnosis. Connects plant professionals with a portable database of photographs of diseased leaves to help determine plant disease severity. Estimate relies on Standard Area Diagrams (SADs), a series of photographs of diseased leaves, with each photo containing a leaf incrementally more diseased than the previous one. Each SAD shows disease severity in terms of the percent of the leaf that is diseased. Users then examine a leaf in the field. For example, compare and match it with SADs to estimate the disease severity. "This app is useful for crop consultants and research scientists looking to cut costs and improve the time and accuracy for assessing disease severity in plants,"

Keywords: Plant disease, Standard Area Diagrams, Deep Learning, AI, MobileNet, TensorFlow Lite.

INTRODUCTION

The agriculturist in provincial regions may think that it's hard to differentiate the malady which may be available in their harvests. It's not moderate for them to go to agribusiness office and discover what the infection may be. Our principle objective is to distinguish the illness introduce in a plant by watching its morphology by picture handling and machine learning. Pests and Diseases results in the destruction of crops or part of the plant resulting in decreased food production leading to food insecurity. Also, knowledge about the pest management or control and diseases are less in various less developed countries. Toxic pathogens, poor disease control, drastic climate changes are one of the key factors which arises in dwindled food production. Various modern technologies have emerged to minimize postharvest processing, to fortify agricultural sustainability and to maximize the productivity. Various laboratory based approaches such as polymerase chain reaction, gas chromatography, mass spectrometry, thermography and hyper spectral techniques have been employed for disease identification. However, these techniques are not cost effective and are high time consuming. In recent times, server based and mobile based approach for disease identification has been employed for disease identification. Several factors of these technologies being high resolution camera, high performance processing and extensive built in accessories are the added advantages resulting in automatic disease recognition.

The paper is proceeded as follow, II Section describes the related works; III Section present the proposed system; Section IV covers the experimentation results and analysis; Section V describes the conclusion.

I. RELATED WORKS

In 2016, Bhumika S.Prajapati et.al.,proposed a system for detection and classification of cotton leaf disease using image processing and machine learning techniques . Also the survey on background removal and segmentation techniques was discussed. Various image processing concepts such as image filtering, segmentation, image feature extraction have emerged to detect the leaf diseases. There are various image segmentation methods available such as k-means clustering, Canny and Sobel segmentation, and Otsu thresholding. Techniques such as Support Vector Machine (SVM), Neural Network (NN), and Homogeneous Pixel Counting technique for Cotton Diseases Detection (HPCCDD) can be used for classification. Features play an important role in the classification process. This paper presents a survey on detection and classification of cotton leaf diseases. It is difficult for human eyes to identify the exact type of leaf disease which occurs on the leaf of plant. Thus, in order to identify the cotton leaf diseases accurately, the use of image processing and machine learning techniques can be helpful. The images used for this work were acquired from the cotton field using digital camera. In pre-processing step, background removal technique is applied on the image in order to remove background from the image. Then, the background removed images are further processed for image segmentation using otsu thresholding technique. Different segmented images will be used for extracting the features such as color, shape and texture from the images. At last, these extracted features will be used as inputs of classifier.

In 2015, Sachin D. Khirade et.al., proposed a system for identification of the plant diseases to prevent the losses in the yield and quantity of the agricultural product. It requires tremendous amount of work, expertise in the plant diseases, and also require the excessive processing time. Hence, image processing is used for the detection of plant diseases. This paper discussed the methods used for the detection of plant diseases using their leaves images. In most of the cases disease symptoms are seen on the leaves, stem and fruit. The plant leaf for the detection of disease is considered which shows the disease symptoms. This paper gives the introduction to image processing technique used for plant disease detection. This paper also discussed some classification techniques to extract the features of infected leaf and the classification of plant diseases. The accurately detection and classification of the plant disease is very important for the successful cultivation of crop and this can be done using image processing. This paper discussed various techniques to segment the disease part of the plant. This paper also discussed some feature extraction and classification techniques to extract the features of infected leaf and the classification of plant diseases. The use of ANN methods for classification of disease in plants such as self- organizing feature map, back propagation algorithm, SVMs etc. can be efficiently used. From these methods, we can accurately identify and classify various plant diseases using image processing technique.

In 2015, M.Malathi et.al., proposed a system which provides survey on plant leaf disease detection using image processing techniques. Disease in crops causes significant reduction in quantity and quality of the agricultural product. Identification of symptoms of disease by naked eye is difficult for farmer. Crop

protection especially in large farms is done by using computerized image processing technique that can detect diseased leaf using color information of leaves.

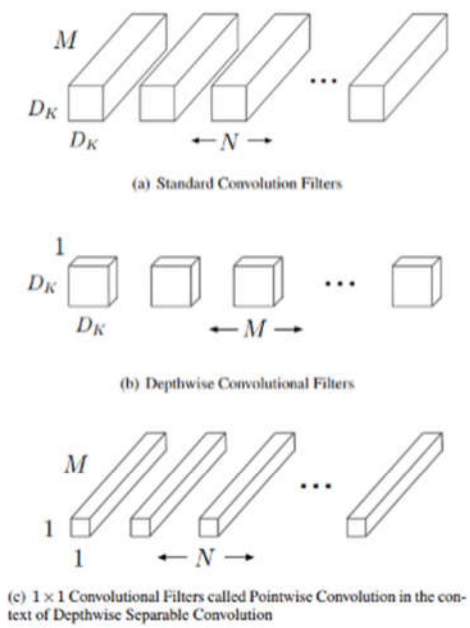
In 2013, Prof. Sanjay B. Dhaygude et.al., proposed a system for detecting the plant leaf disease firstly by using color transformation structure. Here RGB is converted into HSV space because HSV is a good color descriptor. Most plant diseases are caused by fungi, bacteria, and viruses. Fungi are identified primarily from their morphology, with emphasis placed on their reproductive structures. The term disease is usually used only for the destruction of live plants. The developed processing scheme consists of four main steps, first a color transformation structure for the input RGB image is created, this RGB is converted to HSI because RGB is for color generation and his for color descriptor. Then green pixels are masked and removed using specific threshold value, then the image is segmented and the useful segments are extracted, finally the texture statistics is computed from SGDM matrices. Finally the presence of diseases on the plant leaf is evaluated. Keyword: HSI, Segmentation, Color Co-occurrence Matrix, Texture, Plant Leaf Masking and removing of green pixels with pre-computed threshold level. In this paper application of texture statistics for detecting the plant leaf disease has been explained Firstly by color transformation structure RGB is converted into HSV space because HSV is a good color descriptor. Masking and removing of green pixels with pre-computed threshold level. Then in next step segmentation is performed using 32X32 patch size and obtained useful segments. These segments are used for texture analysis by color co-occurrence matrix. Finally, if texture parameters are compared to texture parameters of normal leaf. The extension of this work will focus on developing algorithms and NN’s in order to increase the recognition rate of classification process.

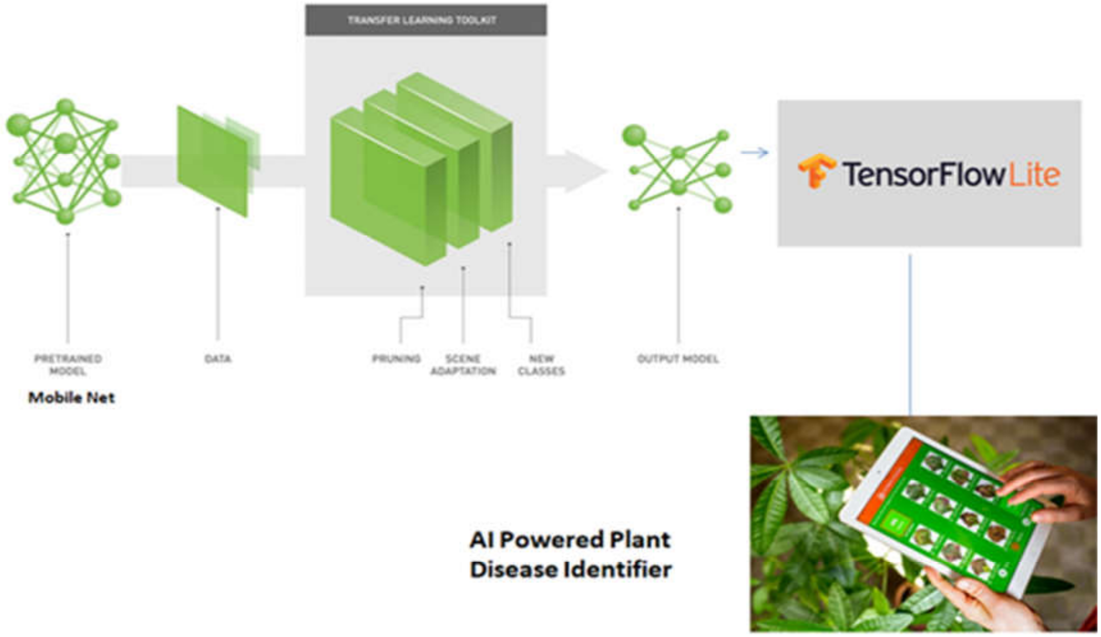
II. PROPOSED METHOD

The proposed system use the Power of AI to Help Farmers by Building a Light weight Deep Neural Network to Identify the Plant Disease. In that, transfer learning i.e. MobileNet model is used. MobileNet is an architecture which is more suitable for mobile and embedded based vision applications. This architecture was proposed by Google. TensorFlow Lite is a set of tools to help run TensorFlow model on mobile, embedded, and IoT devices. It enables on-device machine learning inference with low latency and a small binary size.

A. MobileNet

MobileNets are a class of convolutional neural network designed by researchers at Google. They are coined "mobile-first" in that they're architected from the ground up to be resource-friendly and run quickly, right on our phone. The main difference between the MobileNet architecture and a "traditional" CNN's is instead of a single 3x3 convolution layer followed by batch norm and ReLU, MobileNets split the convolution into a 3x3 depthwise conv and a 1x1 pointwise conv.





Mobilenet as it is lightweight in its architecture. It uses depthwise separable convolutions which basically means it performs a single convolution on each color channel rather than combining all three and flattening it. This has the effect of filtering the input channels. For MobileNets the depthwise convolution applies a single filter to each input channel. The pointwise convolution then applies a 1×1 convolution to combine the outputs the depthwise convolution. A standard convolution both filters and combines inputs into a new set of outputs in one step. The depthwise separable convolution splits this into two layers, a separate layer for filtering and a separate layer for combining. This factorization has the effect of drastically reducing computation and model size. ”

The overall architecture of the Mobilenet is as follows, having 30 layers with

1. convolutional layer with stride 2
2. depthwise layer
3. pointwise layer that doubles the number of channels
4. depthwise layer with stride 2

5. pointwise layer that doubles the number of channels, etc.

Type / Stride	Filter Shape	Input Size
Conv / s2	3 × 3 × 3 × 32	224 × 224 × 3
Conv dw / s1	3 × 3 × 32 dw	112 × 112 × 32
Conv / s1	1 × 1 × 32 × 64	112 × 112 × 32
Conv dw / s2	3 × 3 × 64 dw	112 × 112 × 64
Conv / s1	1 × 1 × 64 × 128	56 × 56 × 64
Conv dw / s1	3 × 3 × 128 dw	56 × 56 × 128
Conv / s1	1 × 1 × 128 × 128	56 × 56 × 128
Conv dw / s2	3 × 3 × 128 dw	56 × 56 × 128
Conv / s1	1 × 1 × 128 × 256	28 × 28 × 128
Conv dw / s1	3 × 3 × 256 dw	28 × 28 × 256
Conv / s1	1 × 1 × 256 × 256	28 × 28 × 256
Conv dw / s2	3 × 3 × 256 dw	28 × 28 × 256
Conv / s1	1 × 1 × 256 × 512	14 × 14 × 256
5× Conv dw / s1	3 × 3 × 512 dw	14 × 14 × 512
5× Conv / s1	1 × 1 × 512 × 512	14 × 14 × 512
Conv dw / s2	3 × 3 × 512 dw	14 × 14 × 512
Conv / s1	1 × 1 × 512 × 1024	7 × 7 × 512
Conv dw / s2	3 × 3 × 1024 dw	7 × 7 × 1024
Conv / s1	1 × 1 × 1024 × 1024	7 × 7 × 1024
Avg Pool / s1	Pool 7 × 7	7 × 7 × 1024
FC / s1	1024 × 1000	1 × 1 × 1024
Softmax / s1	Classifier	1 × 1 × 1000

Mobilenet Full Architecture

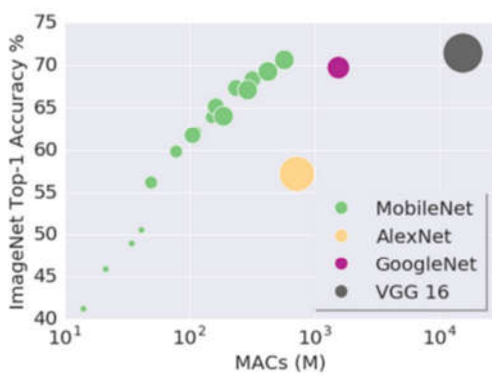


Fig.3. Accuracy Analysis

B. TensorFlow LiteFig.3. Accuracy Analysis

TensorFlow Lite provides all the tools we need to convert and run TensorFlow models on mobile, embedded, and IoT devices. A TensorFlow model is a data structure that contains the logic and knowledge of a machine learning network trained to solve a particular problem. There are many ways to obtain a TensorFlow model, from using pre-trained models to training our own. TensorFlow Lite comprises of two primary segments:

The TensorFlow Lite translator, which runs uncommonly improved models on various equipment types, including cell phones, inserted Linux gadgets, and microcontrollers.

The TensorFlow Lite converter, which changes over TensorFlow models into an effective structure for use by the translator, and can acquaint optimization with improve binary size and execution.

AI at the edge

TensorFlow Lite is intended to make it simple to perform AI on devices, "at the edge" of the system, rather than sending information to and fro from a server. For designers, performing AI on-device can help improve:

Idleness: there's no full circle to a server

Security: no information needs to leave the device

Availability: an Internet association isn't required

Power utilization: arrange associations are power hungry

TensorFlow Lite works with an enormous scope of devices, from modest microcontrollers to powerful cell phones.

III. EXPERIMENTAL RESULTS

In this part, we identify/analyze the different plant leaf disease and their severity based on our AI model.

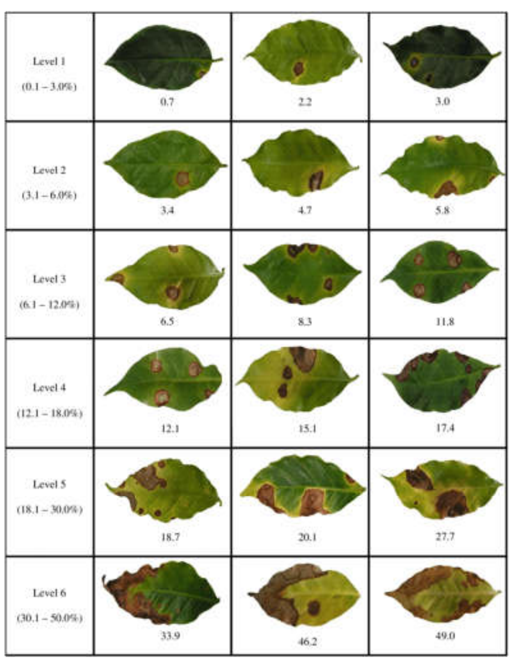
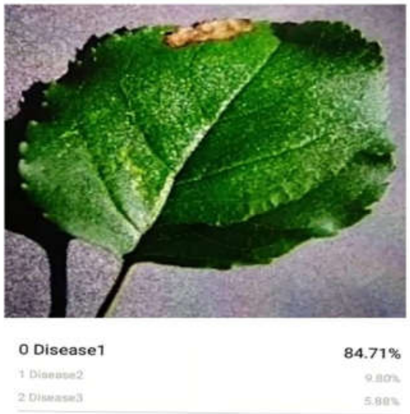


Fig.4. Disease Severity Identification Result by our Model

IV. SAMPLE OUTPUT



V. CONCLUSION

This paper presented a novel model to plant leaf disease detection and classification. The model is transfer learning i.e. MobileNet used here. Our model is a lightweight deep neural network; it helps to former for easily identification of leaf disease. From study of above model we come up with following conclusion. The portable application (SAD) is helpful for crop experts and research researchers hoping to reduce expenses and improve the time and precision for evaluating disease severity in plants.

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