Multiclass Classification Method Based on Deep Learning for Leaf Identification for Farmers

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Abstract:- There are estimated to be nearly half a million species of plant in the world. Classification of species has been historically problematic and often results in duplicate identifications. Plant identification based on leaf is becoming one of the most interesting and a popular trend. Each leaf carries unique information that can be used in the identification of plants. In the identification of plants based on leaf, the leaf images need to be pre-processed accordingly to extract the various critical features. As the upcoming ground-breaking performance of neural networks in the field of classification and identification of objects is being carried out where success is being achieved, the new neural network known as Convolutional Neural Network(CNN) has made the identification and classification of objects more reliable with the performance and as well as the computations. Like any other classifier, the Convolutional Neural Network (Model) is trained with images and its specific labels. Having few layered Neural Network; we will get patterns (features) in given object (image). This trained model is used to classify new input images. As supervised deep learning is used it makes it produces accurate results and makes it easier for the user to classify leaf data with much higher accuracy. CNN's are great at images, and have promise for text, simply because they are capable of identifying patterns in huge number of homogeneous features (pixels in 2D or characters in 1D). They are designed to handle large amount of image data. Hence by using Convolutional Neural Network, the accuracy is drastically improved.

I. INTRODUCTION

Plant identification based on leaf is becoming one of the most interesting and a popular trend. Each leaf carries unique information that can be used in the identification of plants. In the identification of plants based on leaf, the leaf images need to be pre-processed accordingly to extract the various critical features.

The proposed approach consists of three phases that are pre-processing, feature extraction, and classification phases. Since most types of plants have unique leaves, so the classification approach presented in this research depends on plants leave. Leaves are different from each other by characteristics such as the shape, colour, texture and the margin. Dataset are used for both training and testing.

Neural networks are used here. Convolutional Neural Networks are very similar to ordinary Neural Networks they are made up of neurons that have learnable weights and biases. Each neuron receives some inputs, performs a dot product and optionally follows it with a non-linearity. The whole network still expresses a single differentiable score function: from the raw image pixels on one end to class scores at the other. And they still have a loss function (e.g. SVM/ Softmax) on the last (fully-connected) layer and all the tips/tricks we developed for learning regular Neural Networks still apply.

II. RELATED WORK

Talking about the existing system there are many traditional machine learning methods like K-nearest neighbour (KNN), Support vector machine (SVM) result in lower accuracy in prediction leading to miss classification of input image. Random forests, KNN, SVM have strengths in other type of problem: mainly in the space where there are relatively few (tens or hundreds) of heterogeneous features. CNN's are great at images, and have promise for text, simply because they are capable of identifying patterns in huge number of homogeneous features (pixels in 2D or characters in 1D). They are designed to handle large amount of image data. Hence by using Convolutional Neural Network, the accuracy is drastically improved. Traditional Image processing uses linear classifier like support vector machine or K Nearest Neighbours (KNN) where it fails to classify new data points into its specific class. If such classifier is used to classify bulk images it could lead to reduction of their quality because of misclassification.

III. METHODOLOGY

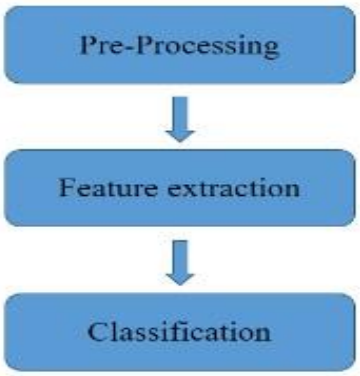


Fig 1:- Flow of process

A. Preprocessing

The input image is first converted into HSV color space model and then using an inrange function which extracts majority of the green pixels present in the image. Further a bounding rect function is used to crop the image where the unwanted region is eliminated. The cropped image that is region of interest (ROI), which is given as input to the next step for identification.

B. Feature Extraction and classification

CNN model is used for feature extraction where the data is analyzed in the following manner where the CNN model automatically extracts thousands of features. The image is passed through a stack of convolutional layers. Response normalization layers follow the first and second convolutional layers. Spatial pooling is carried out by four max-pooling layers. The ReLU non-linearity is applied to the output of every convolutional and fully-connected layer.

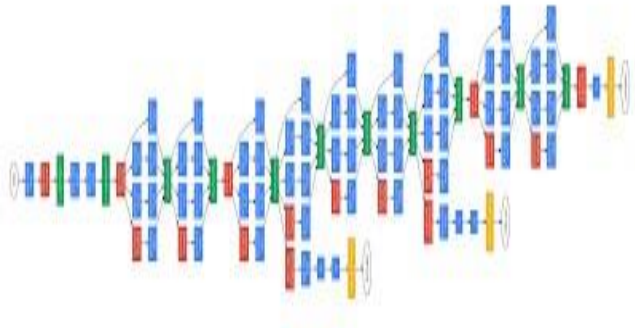


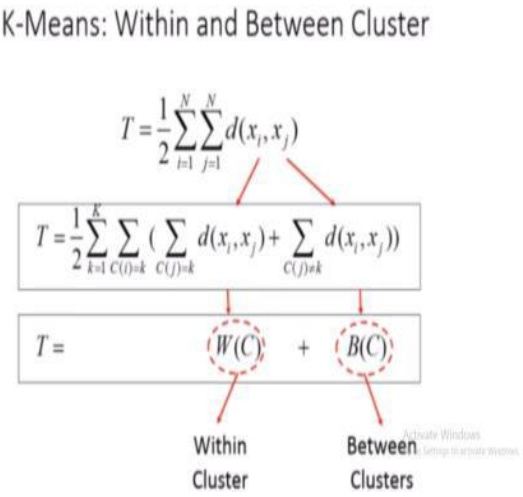
Fig 2:- Inception V3 model

IV. ABBREVIATIONS AND ACRONYMS

HS - Hue Saturation
CNN - Convolutional Neural Network
ReLU - Rectified Linear Unit

A. Equations

k-means Clustering



Equation 1.

Back Propagation

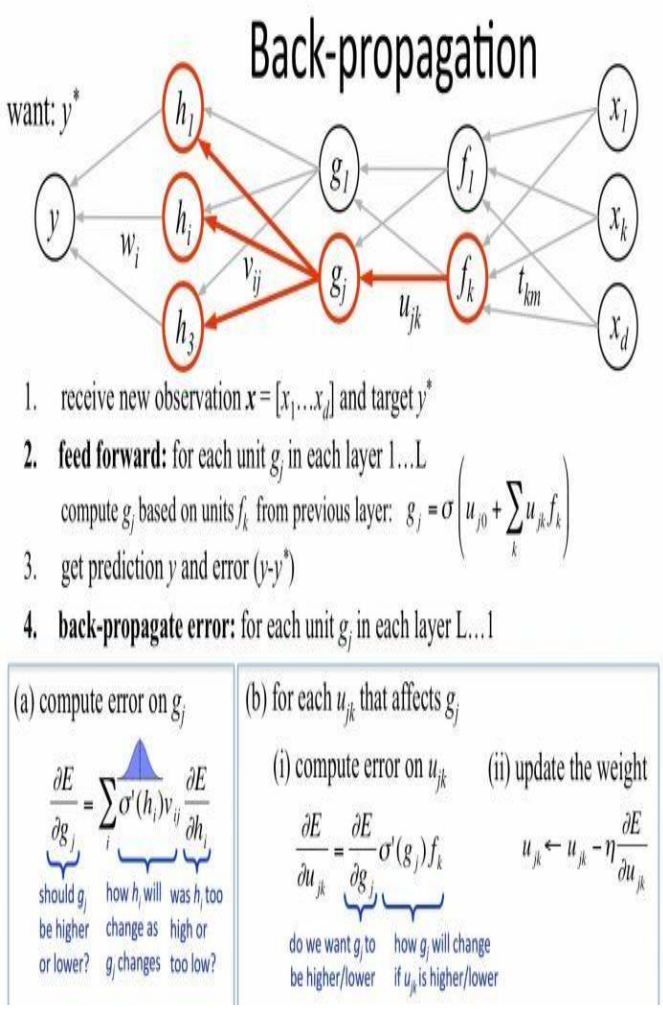


Fig 3:- Back Propagation

V. WORKING

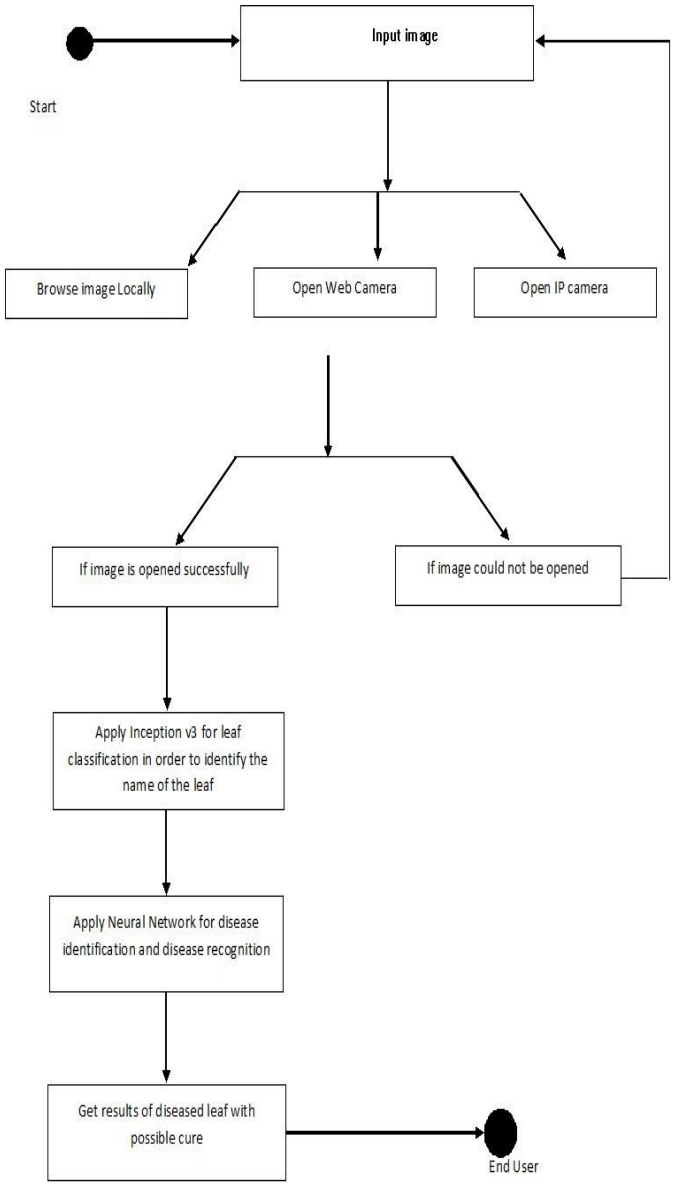


Fig 4:- Working

- *Module 1: Leaf capture using OpenCV*

Leaf is captured using OpenCV. The image of the leaf can be captured by using 3 methods Default camera: The laptop built in camera can be used to capture the image of the individual. IP camera can make use of mobile device and capture HD images of leaf to get better accuracy and results. Web camera can also be accessed to get the image of leaf.

- *Module 2: leaf Recognition using Convolutional Neural Network*

Leaf recognition has always been a challenging task from traditional image processing technique to modern image processing. To obtain higher accuracy and better prediction of the recognized Convolutional neural network is used where Artificial Intelligence Model (CNN) needs to be integrated. This involves the following steps. Collecting the dataset is an important work where we need to collect images of leaves. If we have 2 people, then we need a dataset of at least 20-25 images. More the data better the accuracy in modern AI**.** Training the Model: We need to train the new leaves (20-25 images) and teach our model which the particular leaf is for example, we load 25 images of leaf 1 and train the model and 20 images of leaf 2 and train the model.Leaf Recognition: Finally, we should be able to detect the leaves that we have been trained with good prediction accuracy.Retraining the model: If the model has lower accuracy then we need to retrain the model and start from step1 for better accuracy. We need to make use of Tensor flow (Google's Open Source library) for face recognition where python is used as a base language.

- *Module 3: leaf disease recognition*

The diseased leaf needs to be identified. The disease may be categorized into many forms. We first need to identify the disease of the leaf by giving the image of the leaf. Pre-training the model is necessary as it was done in module 2. The diseased leaf is categorized into its respective category. Creating an UI using C# where an UI is integrated with some buttons, picture boxes, timers as per coding requirement.

- Module 4: Connection leaf recognition code/leaf disease recognition code with that of OpenCV C++ library. The OpenCV C++ code needs to be connected with that of the OpenCV code to make it simpler.
- Module 5: Display the final output on the UI

Final output has to be displayed on the output with no glitch and error free.

VI. ACKNOWLEDGMENT

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