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Leaf Disease Detection

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Abstract: ***Agriculture is a key source of livelihood. Agriculture provides employment opportunities for village people on a large scale in developing countries like India. India's agriculture consists of the many crops and consistent with survey nearly 70% population is depends on agriculture.***
Most of Indian farmers are adopting manual cultivation thanks to lagging of technical knowledge. Farmers are unaware of what quite crops that grows well on their land. When plants are suffering from heterogeneous diseases through their leaves which will effect on the production of agriculture and profitable loss, also reduction in both quality and quantity of agricultural production.
Leaves are important for fast growing of plant and to extend production of crops. Identifying diseases in plant leaves is challenging for farmers and also for researchers.
Currently farmers are spraying pesticides to the plants but it affects humans directly or indirectly by health or also economically. To detect these plant diseases many fast techniques got to be adopt. In this paper, we have done surveys on different leaf diseases and various advanced techniques to detect these diseases.
As said by Mahatma Gandhi, "Agriculture is the backbone of the Indian Economy". Hence the detection of leaf diseases is an important aspect in increasing the yield of a crop. By detecting the leaf disease farmer can increase the crop yield which leads in growth of country's economy.
Keywords: Image Processing, Convolution Neural Network (CNN), OpenCV, TensorFlow, Django.

I. INTRODUCTION

A. Overview

The primary occupation in India is agriculture due to which India ranks second in the agricultural output worldwide. A great diversity of crops is cultivated by farmers in India. The production of the crops depends on various factors such as climatic conditions, soil conditions, various diseases, etc. The existing method for leaf and plant disease detection is simply naked eye observation which requires more man labour, properly equipped laboratories, expensive devices, etc. and may also lead to inexperienced pesticide usage that can cause development of long-term resistance of the pathogens, reducing the ability of the crop to fight back. The leaf disease detection can be done by observing the spot on the leaves of the affected plant. The method we are adopting to detect plant diseases is image processing using Convolution neural network (CNN) which uses the TensorFlow and OpenCV tools available.

B. Objective

To automate detection of plant diseases is an important research topic as it may prove benefits in monitoring large fields of crops and thus automatically detect the symptoms of diseases as soon as they appear on plant leaves. The image processing and machine learning algorithms can be used in agricultural applications for following purposes:

1) To quantify the area effected by the disease.
2) To enhance the productivity of crop.
3) To help the farmers by identifying the disease present in the plant.
4) To reduce the extra efforts of farmers in terms of time and money.

The major objective of our proposed work is to detect the plants disease with the help of leaf at a very initial stage of the occurrence of the symptoms. As fast as the disease is detected the treatment can be given which will ultimately lead in higher yield of that particular crop.

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This work focuses on the different diseases which are attacked on the crops like corn, tomato, potato, apple, blueberry, grapes, orange, raspberry, soyabean, squash, strawberry, peach and cherry.

II. LITERATURE REVIEW

A. In the paper [1], authors present image processing techniques for detecting the infection in plants. Common infection seen on plant is Bacterial scorch and early detection of infection helps in improvement of plant growth. The image processing starts with image acquisition which involves basic steps like capturing of image and converting it to computer readable format. Then clustering is done to separate the forefront and rear image with the help of K-means clustering method in image segmentation. Clustering basically relies on intensity mapping and leaf area highlighting is completed by subtracting the clustered leaf images from base images. Compared to Fuzzy logic, K-means clustering algorithm is easy and effective in detecting the infected area with reduced manual cluster selection requirement.

B. In the paper [2], the author presents a methodology for early and accurately plant diseases detection, using artificial neural network (ANN) and diverse image processing techniques. As the proposed approach relies on ANN classifier for classification and Gabor filter for feature extraction, it gives better results with a recognition rate of up to 91%. An ANN based classifier classifies different plant diseases and uses the mixture of textures, colour and features to acknowledge those diseases.

C. In the paper [3], authors present image-processing techniques for Leaf & Stem disease detection. The author used a gaggle of leaf images from Jordan's Al-Ghor area. during this technique at starting, image acquisition is obtained then K-Means clustering method is employed for segmentation. Then in the feature extraction process, CCM (Colour Co-occurrence Method) is used for texture analysis of infected leaf and stem. At last paper presents Back propagation algorithm for neural network in classification of leaf diseases.

D. In the paper [4] authors described disease detection, in which image processing is first step for obtaining image in digital form and pre-processing to remove noise and another object from image. Pre-processing also convert RGB images into grey images using equation f(x) = 0.2989*R + 0.5870*G + 0.114*B and makes histogram equalization. Image segmentation is completed using boundary and spot detection algorithms for locating infected a part of leaf. Classifications of objects are done using K-means clustering method. Otsu threshold algorithm is employed for thresholding which creates binary images from grey images.

III. PROPOSED METHODOLOGY

Our proposed work consists of three major parts i.e., the image processing, machine learning techniques and the Django framework.

A. Image Processing Technique

The image processing is done with the help of libraries present in OpenCV python package. The processing has various steps involved for enhancing the image by reducing the background noise and disturbance. The processed image is used as an input to the neural network.

Image Processing is basically done to make the image clear by highlighting the infected and healthy area.

B. Machine Learning Technique

In the past various machine learning algorithm has been used for the work which includes SVM (Support Vector Mechanism), Fuzzy Logic, Artificial Neural Network, Naïve Bayes and K-means Clustering.

For our proposed work we used combination of clustering and CNN. Clustering is used for the image processing work while we used the CNN for the mapping the crop with the disease on the basis of trained model. With the help of CNN, we have been able to attain the accuracy of 96 to 97%.

C. Django Framework

The proposed work uses the Django Framework for creating the web-based application. Django is a high-level web framework for the python programming language.

It takes care of all the hassle of web development, so we can focus on writing our project model. It is a free and open-source framework.

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IV. MODULE DESCRIPTION

The proposed work consists of six modules i.e., Image Acquisition, Image Enhancement, Image Segmentation, Feature Exaction, Classification and Detection. The use and working of each module along with the block diagram are described as following:

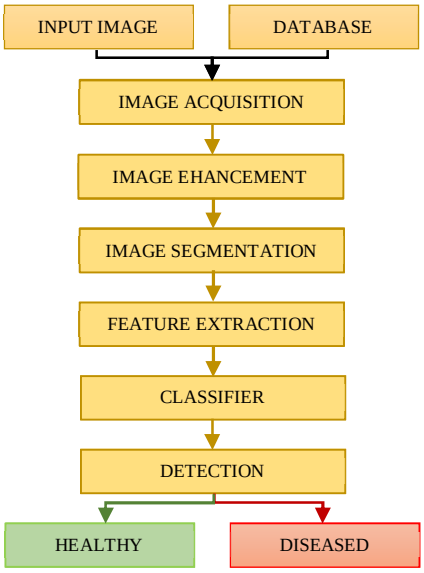


Figure 1: Block Diagram

A. Image Acquisition

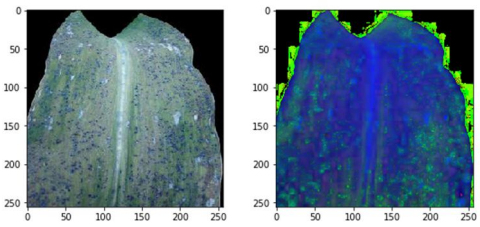
This is the initial step of the entire process in which leaf images are acquired using the camera from a certain uniform distance with sufficient lighting for learning and classification. The sample images of the leaves are collected and are used in training the system. To train and to test the system, both diseased leaf images as well as fewer healthy images are taken. Then, the images will be stored in some standard format. The background of the image should provide a proper contrast to the leaf color.



Figure 2: Image Acquired using the Digital Camera

B. Image Enhancement

Image enhancement is basically done for adjusting digital images in order that the results are more suitable for display and make image suitable further analysis. For instance, one can remove noise, sharpen, or brighten an image, making it easier to notice down its key features. During this stage we enhance the image of the leaf so that it gives more accurate results. One of the foremost important objectives of leaf image enhancement is to reinforce the contrast between regions of interest and therefore the background.



(a) *(b)*

Figure 3: (a) Enhanced Image (b) HSV Image

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C. Image Segmentation

For the segmentation of images there are different image segmentation techniques like threshold based, edge based, cluster based and neural network based. One of the most efficient methods is the clustering method that again has multiple subtypes; k means clustering, Fuzzy C-means clustering, subtractive clustering method etc. One of most used clustering algorithms is k- means clustering. K-means clustering technique is a simple and computationally faster than other clustering techniques and it works for large number of variables.

For this proposed work, k-means is method used to get the clusters of k numbers which matches the specified characters like to segment the leaf.

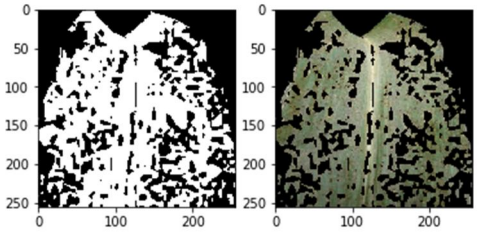


Figure 4: Green Color Part Segmentation

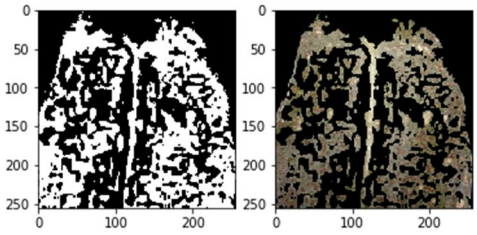


Figure 5: Brown Color Part Segmentation

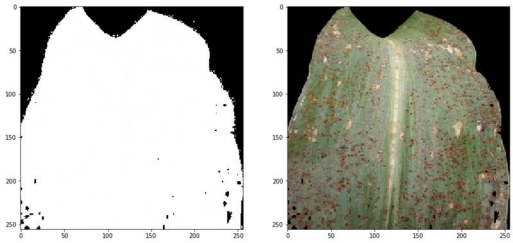


Figure 6: Final Masked Image

D. Feature Extraction

After the segmentation is done, the Region of Interest is selected which is having better image data using, various features are extracted using feature extraction techniques. This precisely describes the infected region based on color, shape and textural features. Various feature extraction methods such as color co-occurrence, skewness, contrast, correlation etc., are used to extract the desired set of features.

The size of feature vector obtained is (345, 128).

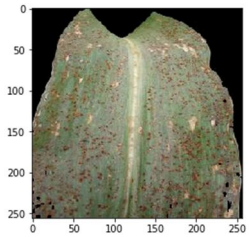


Figure 7: Final Image after all the Pre-processing

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E. Classifier

At this stage, machine learning methodologies are used for classification. This gives us better and more accurate results. The classifier is tested using combination of various features.

F. Detection

This is the final stage; here the detection of disease which is present in the leaf is done after the classification and the result is displayed to the end user via a web application interface implemented using the Django Web Framework.

V. PROJECT SNAPSHOT

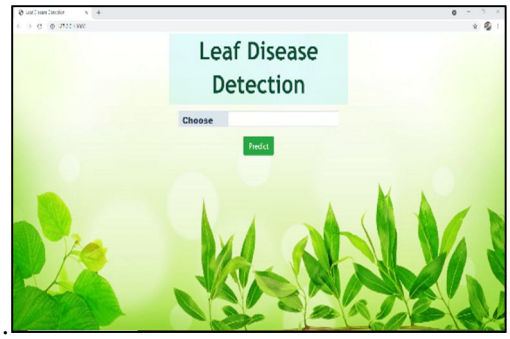


Figure 8: Home Page

Above figure 8 is the home page of the final implemented model. In this first step is to choose the image which has been captured earlier. When we click on the choose button a browser window opens to select the page as show in the figure 9.

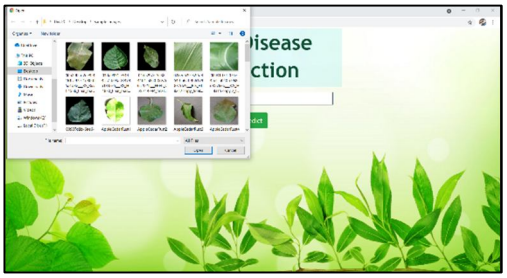


Figure 9: Browser Menu for selecting the image

Once the image is selected. We need to click on the predict button and the result will be displayed as show in the figure 10, and then the proper treatment can be carried out.

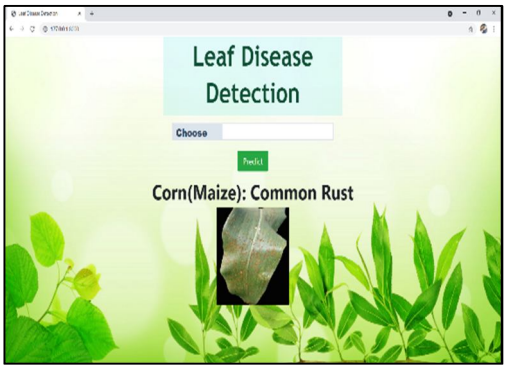


Figure 10: Result Page

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VI. CONCLUSION

The paper proposed a leaf image pattern classification to identify disease in leaf with a combination of texture and color feature extraction. Initially the farmers i.e., the end user send a digital image of the diseased leaf of a plant 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. Firstly, healthy, discolored and diseased images are collected and pre-processed. Then, different features such as shape, color and texture are extracted from these images. After that, these images are classified by classifier. The combination of few features are used to evaluate the appropriate features to find distinctive features for identification of leaf disease. The combination obtained from texture and color feature extraction results a highest classification accuracy. A combination of texture and color feature extraction with polynomial kernel results in good classification accuracy. Based on the classified type of disease a text message is displayed to the end user. And then the end user can do the treatment as need for the crop.

The main key take out from our proposed work is as following:

1) The model detects the leaf diseases in no time and tell the disease name with which the crop is infected.
2) The accuracy of model is approximately 96 to 97%.
3) As the name of disease is known with the help of model proper treatment can be done at very initial stage of occurrence of the disease in the crop.

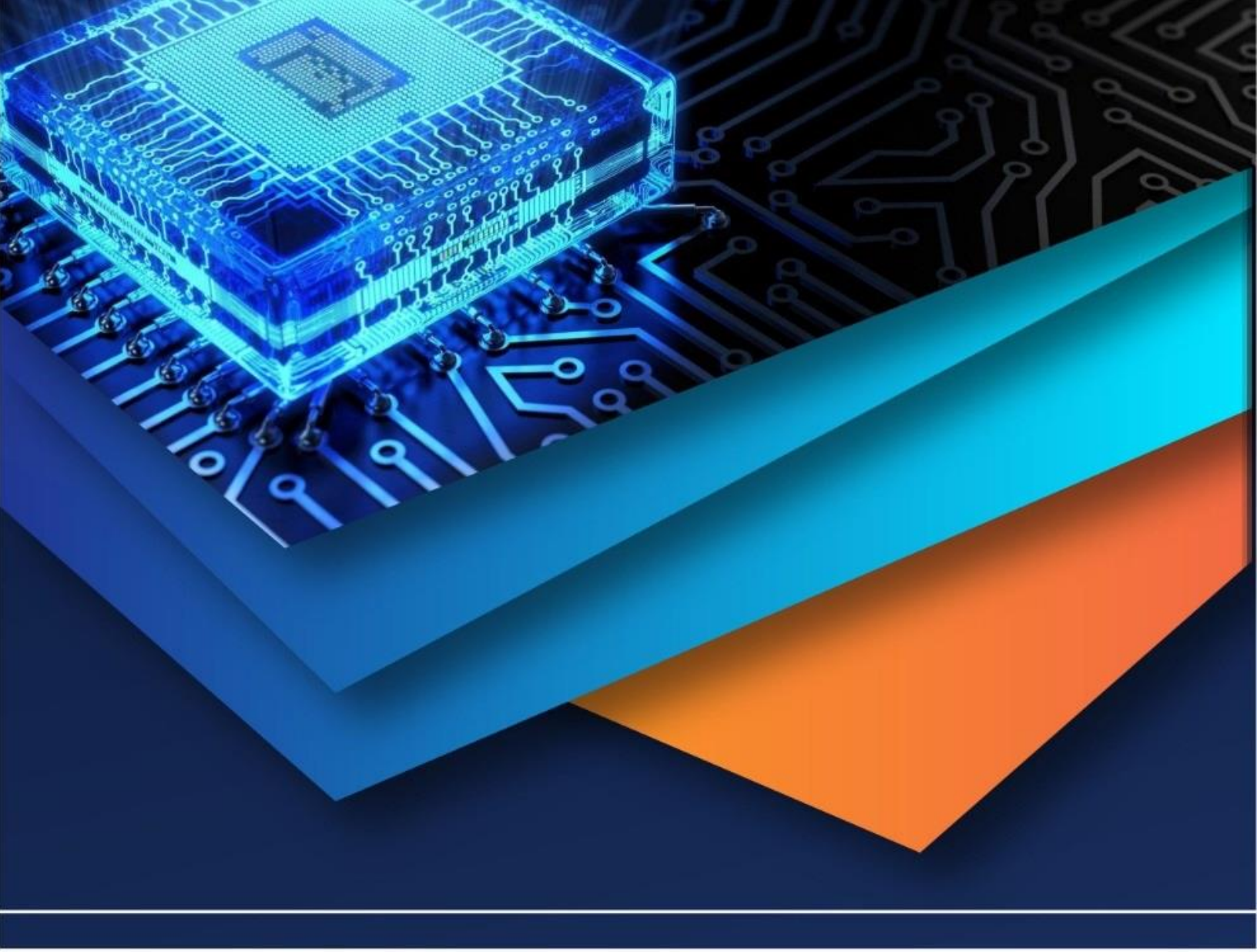
VII. ACKNOWLEDGMENT

This work is an extension to all the past work done regarding this topic. Earlier the work has been carried out using various technologies such as SVM, Fuzzy Logic, ANN and other techniques. We used a CNN based model using the Keras and TensorFlow libraries. This work is performed in collaboration with our project guide and Head of the Department of Computer Science and Engineering, Dr. Atul Kumar of SRMGPC, Lucknow.

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