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LEAF DISEASE DETECTION USING IMAGE PROCESSING

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Abstract: The "Leaf Disease Detection using Image Processing " project aims to tackle the critical challenge of timely and accurate detection of plant diseases through the integration of advanced image processing techniques and Convolutional Neural Networks (CNNs). Plant diseases can significantly impact agricultural productivity, making early detection a crucial aspect of modern farming practices. This project seeks to develop an efficient and automated system for identifying leaf diseases using the MATLAB environment. The project begins by assembling a comprehensive dataset of leaf images, encompassing both healthy and diseased samples. These images undergo preprocessing to enhance their quality, including noise reduction, resizing, and normalization.

Index Terms - Convolutional Neural Networks, MATLAB, Quality, Noise Reduction, Resizing and Normalization

I. INTRODUCTION

Plants are an integral part of life on Earth. The food we living organisms consume, the nature we live in include plants. Plants are very vital as they prepare their own food from natural resources like sunlight, water and air through a process called photosynthesis. As they are solely responsible for making their own food, they are the bottom level in the food web where they make food and energy available to all the other life on Earth.

In the last few years, due to adverse pollution and other human activities that affect our environment, plants have undergone so many effects. Plants and crops need 13 vital mineral nutrients to grow and survive in a healthy manner. Plants acquire the nutrients they need to grow from the soil. The plant's growth and quality is affected if there is deficiency in any of these vital nutrients. As a result, recognizing nutrient shortage indications in plants is critical in agricultural activities.

Indications of nutrient insufficiency in plant species are usually noticeable in the leaves. Change in colour of leaf, falling of leaves and loss in leaf size are some of the signs. Even though both old and new leaves have the same condition, the nutritional deficiencies can vary.

Digital image processing techniques have enhanced work in this field in recent days. The real objective of this work is to diagnose the nutrient deficiency symptoms in plant leaf image. If the leaf of a plant has an unhealthy part in it, it is categorized as "Infected leaf". If the leaf has no unhealthy part, it is categorized as "Normal leaf". This project uses efficient image processing techniques. Digital image processing is a technique where we use a digital computer to process digital images using an algorithm.

II. RELATED WORKS

The paper proposed by Ahmed S. Abljtaleb [1] has the main goal of extending entropy-based thresholding technique for 2D histogram, also study of individual pixels' grey level value and neighbourhoods' average value is carried out. This proves that the threshold is a vector that has two access points, the first one is pixels' grey level and the second one is its average value. Also, this proposed method works very efficiently when the noise level is small.

The paper proposed by Leon Bottom and Yoshua Bengio [2] gives all details about popular K-Means clustering especially this paper described as gradient descent algorithm and/or this can also be described by improving mathematics of EM algorithm. Also, they proved that quantization error is minimum, the reason for this is due to the usage of a very fast Newton algorithm.

Sachin D. Khirade and A.B. Patil [3] proposed a method in which leaf disease can be detected by providing green leaves, the method is based on K-Means clustering and some auxiliary algorithms the detection steps involves image acquisition after that pre-processing stage takes over and does some basic transforms after that image segmentation takes place which is carried out by K-Means cluster algorithm then classification is carried out by ANN block also this paper gives some mathematics behind mathematical transforms.

Shima Ramesh and Ramachandra Hebbar [4] proposed that Plant infections are a substantial danger to sustenance security, but their rapid distinguishing verification remains problematic in many parts of the globe because of the non-presence of the fundamental foundation. [5] The advancement of accurate algorithms in the area of leaf-based image categorization has demonstrated outstanding results. This article makes use of Random Forest in differentiating between healthy and sick leaves using the data sets provided. Their suggested work comprises multiple stages of implementation like dataset generation, feature extraction, training the classifier, and classification.[6] The produced datasets of infected and healthy leaves are jointly trained under Random Forest to categorize the infected and healthy images. For extracting characteristics of an image, they utilize a Histogram of an oriented Gradient (HOG). Applying machine learning to train the massive data sets accessible publicly offers a clear technique to identify the illness existing in plants at a gigantic scale.

III. EXISTING SYSTEM

Numerous studies have been done that have a focus on detecting nutrient deficiency in plant leaves. They have applied different data mining techniques, image processing techniques and computer vision-based functions for detection and achieved different probabilities for different methods.

The existing system focuses on detecting the nutrient deficiency only for single species plants like for tomato plant or brinjal plant etc . But in our proposed system, we can detect the nutrient deficiency for any species of the plant. For example, consider Betel Leaf Area Measurement using Image Processing, International Journal proposed by Sanjay B. Patil and Shrikant K. Bodhe is used only for the betel leaf whereas our system can process for any leaf using image processing and the computer vision-based detections.

In one of the articles, Method for recognition of grape disease based on support vector machine, in case of feature extraction it considers only the useful extractions from the plant leaf image as the training samples and it would neglect some features due to this the farmer may not get total nutrient deficiency in the plant leaf which may cause disease to a plant . But in case of our proposed system, we consider each pixel value and the whole leaf undergoes the process.

In some articles, they developed a model only to detect the disease in the rice leaf and the model only makes use of the segmentation only for the marked part of the leaf.

IV. PROPOSED SYSTEM

In our project we make use of image processing techniques to detect the healthy regions, unhealthy regions. If we detect unhealthy regions in the leaf, we consider it as nutrient disease or deficiency symptoms and provide the nutrient deficiency percentage based on the total area of the leaf. Our project also detects nutrient deficiency on all kinds of plant leaves.

Our proposed model works as:

Step 1: Initially, the RGB images are captured using a camera and stored in the internal storage.

Step 2: The captured image is uploaded.

Step 3: change the image format to HSI format.

Step 4: The healthy green pixels of the leaf image are masked.

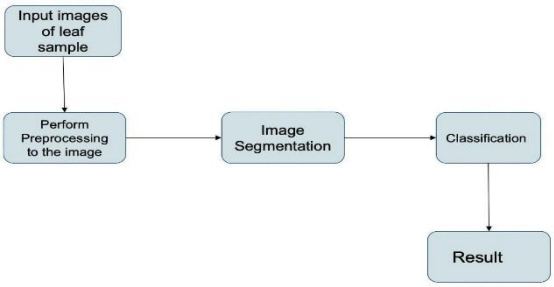
Step 5: Above masked pixels are removed.

Step 6: The necessary components are segmented.

Step 7: Evaluating parameters for classification. The disease caused by is specified

V. BLOCK DIAGRAM

The methodology shows the implementation of the proposed system. The Block Diagram of this project is shown belo



Initially, we upload the RGB Images of the Plant leaf. Then Image undergoes some preprocessing techniques to remove the noise from the image. Convert the RGB image into the HSI image format considering only the hue.

Now mask the green pixels and remove the masked green pixels from the image. Then segment the image into components and get the infected area. If the deficiency percentage of the leaf is greater than zero, then classify it as the ” UNHEALTHY LEAF ” or if the percentage is zero, then it is classified as the ” HEALTHY LEAF ”.

VI. RESULTS

The output progress for **LEAF DISEASE DETECTION USING IMAGE PROCESSING** are shown below

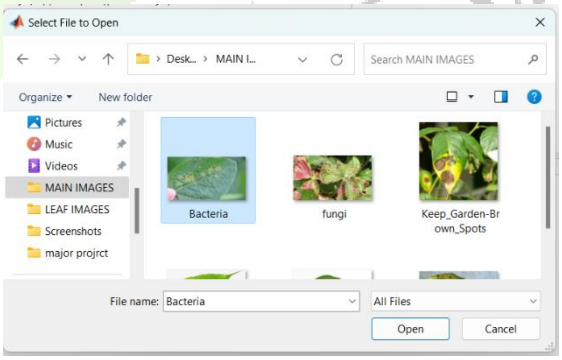


Figure 1

The above figure 1 shows the GUI application for uploading of input image of the leaf .

Figure 2

As we can see in the above figure 2 is the input image of the leaf

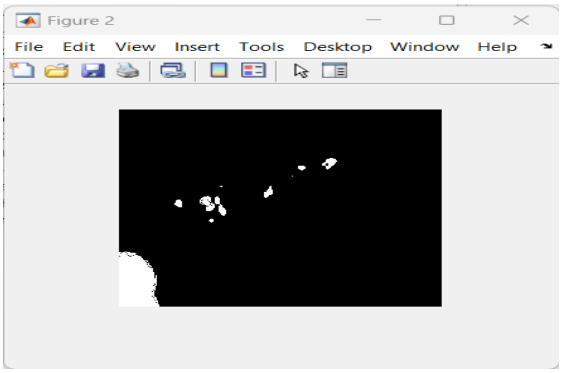


Figure 3

The above diagram shows RGB to gray scale converter image of the leaf by applying threshold to it . The below figure shows the final output of the project.

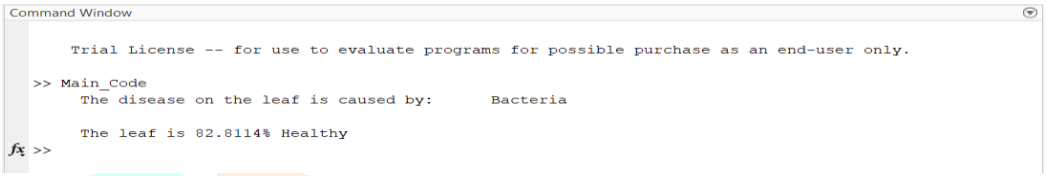


Figure 4

The above figure 4 shows the disease caused on the Leaf and the healthy percentage of the leaf is also calculated and shown on it .

VII. Conclusion

Nutrition deficit occurs whenever a plant does not have enough of one or more critical nutrients. Plants will still not grow effectively if they lack vital nutrients, and they will display a range of disorders to indicate their insufficiency. Our model has detected the diagnosis of nutrient deficiency which is now most commonly seen in plant leaves. We have used digital image processing techniques to process the image. Therefore, by using these techniques we can conclude if a plant is deficient or not in less time which makes farmers get alerted about their plants and take care of them accordingly. Invasive plants could result in significant losses, affecting farming production and food safety. So, it becomes important to detect the plant nutrient deficiencies and take necessary precautions. The identification of the source of the leaf insufficiency would indeed be a potential future improvement. That is to identify due to lack of which nutrient the deficiency is caused. This helps the farmers to give the particular nutrient in required amounts to the plants to prevent the nutrient deficiency.

VIII. Future Scope

To find the nutrient deficiency in advance, we need to consider some features and with the help of these features, we can predict the changes in the leaf and we can notify the farmers or users. A future work can be done on the plant stem, to know the deficiencies in the stem too. Every time capturing an image of the leaf may be a big task to the farmers. So, we can make use of sensors and whenever there is a change in leaf color or growth, then it would make a notification to the farmers.

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