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Paddy Leaf Disease Detection Using Image Processing and Machine Learning

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Abstract: The spread of plant pests and diseases has increased dramatically in recent years. Globalization, trade and climate change, as well as reduced resilience in production systems due to decades of agricultural intensification, have all played a part. Plant pathogens can be fungal, bacterial, viral or nematodes and can damage plant parts above or below the ground. Identifying symptoms and knowing when and how to effectively control diseases is crucial. In this paper, we propose the idea of leaf detection using leaf images.

Keywords: Leaf disease detection, Image Processing, Image Segmentation, Machine Learning, Feature Extraction

I. INTRODUCTION

A large number of crops are grown in India which often serve as hosts to different kinds of insect pests and pathogens. Most of the Indian regions being subtropical to tropical, the agro-climate is more conducive for the development of insect pests than disease causing pathogens. Prevention and early diagnosis are critical to limiting damage by plant pathogens. The producers need to monitor their crops and detect the first symptoms in order to prevent the spread of a plant disease, with low cost and save the major part of the production. Detection of leaf diseases falls important for these reasons. Identifying diseases through naked eye is often prone to high error rates and faulty classification. This paper proposes a method that solves this issue and helps in identifying and classifying the leaf diseases by applying various image processing and neural network algorithms.

Due to this complexity, even the experienced agronomists and plant pathologists are often unsuccessful to diagnose the plant diseases accurately. The use of an automated system which can detect and diagnose the plant diseases can exponentially help the agronomists keep an eye on the plants and ensure good health of the plants. This simple automated system, can also help the farmers around the world living in remote conditions who lack the appropriate tools to diagnose the plant diseases and improve the health of the plants in order to increase the produce. Paddy or Rice, Oryza sativa, is one of the most important food crops in the world and it is a staple diet of more than 2.7 billion people. Undetected diseases of paddy can lead to major damage to the crop cultivation, and ultimately result in reduced production of crops. There are a number of diseases that can affect the growth of Paddy, but for this paper we will be considering 3 main diseases occurring in Paddy, namely Rice Blast, Brown Spot of Rice, and Sheath Blight of Rice. Blast Disease is caused by the organism Pyricularia oryzae, due to which the Paddy leaves start to develop small water soaked bluish green specks with grey center and dark brown margin. Fig. 1 shows how the Blast Disease affect the paddy leaves. Paddy can be affected by the diseases at different stages of growth and all parts of the plant. Hence, in this paper, in order to detect and diagnose paddy leaf diseases we will be using the Image pre-processing and segmentation technique along with different types of classification features such as SVM.

Fig -1: Blast disease seen in Paddy Leaves

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II. EXISTING WORK

Paddy leaf diseases were identifying by capturing the image of the disease-affected crop.

[1] Manoj Mukherjee made use of image enhancement and image processing in their proposed work. The image is first captured, processed and enhanced and then converted from RGB color image to gray image and then extracted to histogram.
[2] M.N. Abu Bakar used multilevel color image thresholding for the disease diagnosis system of Rice Leaf Blast disease.
[3] Sowmya G M used image acquisition and pre-processing to remove noise and enhance it and then converted to a binary image.

III. PROPOSED WORK

In this system, we propose the use of several image processing techniques for the detection and classification of the paddy leaf diseases.

3.1 Image Pre-Processing and Segmentation

This process is a combination of two techniques. The image is pre-processed to enhance the quality of the input image later followed by disease segmentation step.

VEGETATION SEGMENTATION:
Here , we find the threshold value using two methods -

(A) Otsu's method / thresholding :
In image processing, converting a grayscale image to monochrome is a common task. Otsu's method which was named after Nobuyuki Otsu, is one of the many binarization algorithms. This method involves iterating through all possible threshold values and calculating a measure of spread for the pixels that either fall on the background or on the foreground. The result to be achieved is to find a threshold value where
the sum of foreground and background spreads is minimum.

(B) Setting the threshold to mean pixel intensity :
To discriminate vegetation pixels, a linear combination of RGB planes with coefficients: r =-0.884, g =1.262, b = 0.311 was performed. These coefficients are found using genetic algorithm optimization.

3.2 Feature Extraction Using Texture Analysis

The image analysis focused on the shape feature extraction and color based segmentation.

(A) Shape Feature Extraction :
Shape is an important parameter of an image. People often understand and distinguish an object by its shape. General descriptors such as number of object, width and length of the objects are important characteristics to describe its shape. Those characteristics are used to extract feature the lesion. Blob analysis is used in this research to get number of the object for labeled regions in a noise free binary image. The sum of foreground and background spreads is minimum.

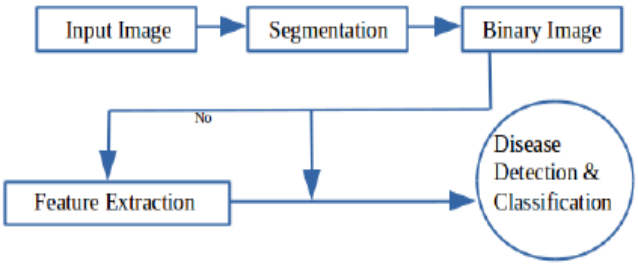

Fig -2: The input image is first applied with image segmentation which converts the image into a binary image. Feature extraction technique is then applied over it for the classification.

(B) Color Feature Extraction :

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Color always plays a most important role in image processing and an important sign in recognizing different classes. Digital image processing produces quantitative color measurements that are very helpful when investigating the lesion for early diagnosis.

3.3 Support Vector Machine (SVM)

The Support Vector Machine is a supervised machine learning algorithm which is mostly used in classification problems. In this algorithm, each data item is plotted as a point in an n-dimensional space (where n is the number of features), where the value of each feature represents the value of a particular coordinate. Classification is then performed by finding the hyper-plane that differentiates the two classes very well. SVM is a binary classifier which uses the decision boundary hyperplane between two classes. Data points falling on either side of the hyper-plane can be attributed to different classes. The dimension of the hyperplane depends upon the number of features. Using the training vectors, the SVM optimizer will find the hyper-plane which will maximize the margin of separation between the two classes as shown in Fig. 3.

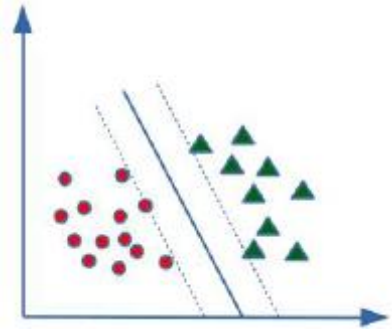

Fig -3: SVM in linearly separable conditions

IV. CONCLUSION

In the agricultural field, loss of yield mainly occurs due to widespread of disease. Mostly the detection and identification of the disease is noticed when the disease advances to severe stage. Therefore, causing the loss in terms of yield, time and money. The proposed system is capable of detecting the disease at an earlier stage as soon as it occurs on the leaf. Hence saving the loss and reducing the dependency on the expert to a certain extent is possible. It can provide the help for a person having less knowledge about the disease. Depending on these goals, we have to extract the features corresponding to the disease. This is one of the reasons that disease detection in plants plays an important role in the agricultural field, as having diseases in plants is quite natural. Detection of plant disease through some automatic technique is beneficial as it reduces a large work of monitoring a big farm of crops, and at a very early stage itself, detects the symptoms of diseases, i.e, when they appear on plant leaves. With this paper, we have attempted to propose a methodology that can detect and diagnose the plant leaf diseases, which we hope will be helpful farmers all around to improve the health of their crops and treat the affected ones at an early stage itself. We hope our proposed system will make a positive contribution to the field of agriculture.

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