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Paddy Leaf Disease Detection and Recognition using Image Processing

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Abstract: Rice crops have been recognized as one of the most powerful energy sources for resource production over the last few decades. Rice plant diseases are regarded as a major cause of crop failure, economic and communal loss in the agricultural field's future development. Since the last ten years, researchers have been keenly interested in the diagnosis of plant disease approaches to image processing techniques. The primary goal of this research is to create an image processing system capable of identifying and classifying bacterial blight disease. A set of infected rice plant images from a rice field are captured using a digital camera and empirically evaluated using background removal and segmentation techniques. Image segmentation, feature extraction, feature selection, and classification are used to compare them. This paper also makes recommendations for future research on the diagnosis of bacterial blight disease.
Index Terms: Pre-processing, Disease detection, Disease recognition, K- means clustering, SVM (support vector machine)

I. INTRODUCTION

Rice is a deliberate major source of food among the rural population and also it is considered, and the second most cereal crop cultivated over the world. Rice belongs to the family of Poaceae and correspond to two main subspecies i.e., Japonica and Indica. Rice is the most widely recognized low cost and effective nutrient food available in Asia. Rice demand expected to grow faster than the production in most countries. In this situation, damage of rice crop by any cause is unacceptable. Detection of rice plant disease and its severity has always been challenging. Earlier naked eye observation (visual analysis) was the only available techniqueto diagnosis the rice disease. This technique requires continuous monitoring of the crop field for the correct estimation of disease by expert of this field. As the visual analysis requires constant human observations, the process (visual analysis) tends to be very costly, cumbersome and time-consuming for large areas of plants. The exponential increasing population changes the demand of supply of food produce scenario rapidly. Such situation forces the society, as a whole, to think for, use of advanced technology so that early and accurate estimation of disease for the implementation of remedial measure can applied at the right time. Image processing techniques are proven one of the accurate andeconomic practices for measuring the parameters related to various plant diseases. The Growing period of rice crop comprises: (1) Germination, (2) Vegetative Phase, (3) Reproductive phase, (4) Ripening phase. In germination, at first root and shoot crop up from the seed. The vegetative phase is from uprooting of plant to initiation of panicle. The reproductive phase includes the emergence of panicle from tiller to complete growth of panicle. Then in ripening phase, the panicle is mature enough so that the kernel inside the grain is completely grown. The disease can affect any part or any growing stage of rice crop.

The paddy diseases are due to many constraints such as pathogens, insect pest, deficiency of nutrients and unusual environmental condition. Plant pathogens can be parasitic, bacterial, viral or nematodes and can harm plant parts above or underneath the ground.

1) Because of the exponential tendency of population, the climatic conditions additionally cause the plant sickness. The significant difficulties of maintainable improvement is to lessen the utilization of pesticides, cost to spare the earth and to build the quality. Exact, precise and early conclusion may diminish the utilization of pesticides. Rice is one of the significant crops developed in India. These days, innovation generally utilized for plant disease expectation. The idea of image processing with information mining advances helps us in following purposes:
2) Recognizing infected leaf and stem
3) Measure the influenced region
4) Finding the shape of the infected area
5) Disease detection and recognition is a demanding task. Generally, diseases are detected manually which is very difficult and time-consuming. The naked eye observation of experts is the main approach adopted in practice which is expensive on large farms [1].

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The manual classification and recognizable proof strategies which are being utilized to recognize diverse sorts of leaf disease that are concerned with the human resource. Thereby it exposed to some sort of mistakes since these systems engaged by human contribution. Therefore, advance automated technique like image processing and machine learning is needful to implement for diagnosis of paddy.

II. PROPOSED METHODOLOGY

The block diagram for proposed system is shown in the Fig 1. It is an image recognition system for identifying the paddy plant diseases for decreasing the sufferings of people in agricultural fields.
The proposal that involves is preprocessing the input image followed by detection and feature extraction of individual leaf and finally the recognition of the disease portion of paddy leaf.

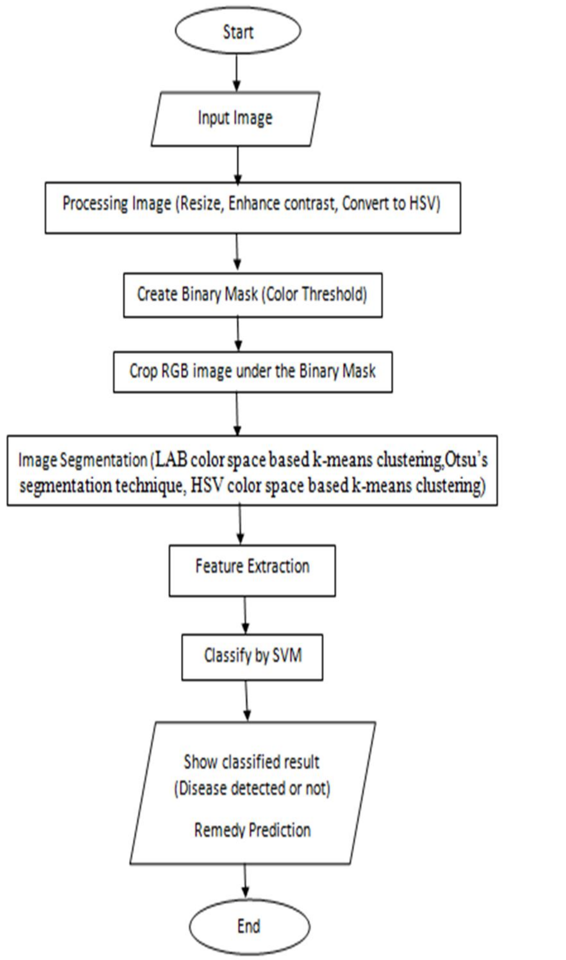

Fig 1. Block diagram of the proposed system

III. METHODOLOGY USED

1) *Image Acquisition:* The images of rice plant leaves are captured from the farm field, which is needed when a dataset is not available. Approximately 20 images of bacterial blight disease image database will be prepared. The format of all images will be in jpeg.
2) *Image Preprocessing:* During processing in our system, the images are resized and cropped into a dimension of 1000x260x3 pixels to reduce the memory requirement and computational power. Furthermore, an essential task is to remove the background from the image.
3) *Disease Segmentation:* K-means clustering for image segmentation is used. Three clusters are expected from a leaf image: (A) background, (B) diseased portion, and (C) green portion. Application of three image segmentation techniques to extract diseased portion from the leaf image takes place in following steps:

a) *Lab Color Space-Based K-Means Clustering:* In LAB color space, we have one channel is for Luminance (Lightness) and other two color channels are a and b known as chromaticity layers. The a* layer indicates where the color falls along the red, green axis, and b* layer indicates where the color falls along the blue-yellow axis.
b) *Otsu's Segmentation Technique:* This algorithm takes the maximum inter class variance between the background and the target image as the threshold selection rule.
c) *HSV Color Space based K-means Clustering:* HSV separates color information (Chroma) and image intensity or brightness level (Luma) which is very useful during image segmentation.
d) *Feature Extraction:* Features have a crucial role in differentiating one disease from another. Usage of various features under three categories: color, texture, and shape are considered.

A. Training And Testing Using Svm Classifier

For paddy plant disease detection, totally 10 disease affected sample images are taken. Each image undergoes training and testing using SVM classifier algorithm. Based on number of iterations, thus the training stages and False alarm rate is getting varied for every input image given to the classifier. The SVM classifier is mainly used to convert the weak classifier to strong classifier. The images on bacterial blight disease is taken. Among the 10 disease images taken 9 are detected accurately.

Fig 2 Screen shots of bacterial blight disease

Fig 3 Cropped view of bacterial blight disease

Feature extraction of a query image is performed in the same way as training phase. After creating the feature vector of a query image, the feature vector is sent to the classifier and SVM classifies the paddy leaf diseases using training dataset. [2]

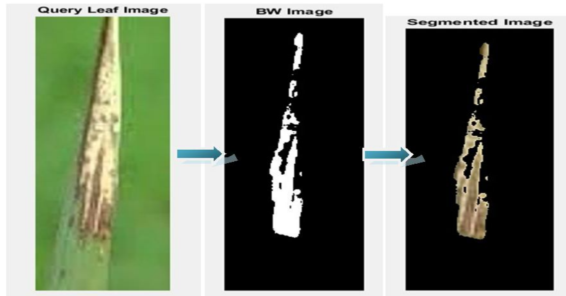

Fig.4.1 Result after feature extraction in diseased leaf

1) *SVM Classifier:* Support vector machine (SVM) depends on the Structural Risk Minimization (SRM). Like RBFNN, Support vector machines can be utilized for pattern classification and nonlinear regression. SVM maps the input image into a higher dimensional element space through some nonlinear mapping picked from the earlier. A direct choice surface isthen developed in this high dimensional component space. Along these lines, SVM is a straight classifier in the parameter space, however it turns into a nonlinear classifier as an after effect of the nonlinear mapping of the space of the data designs into the high dimensional element space.
2) *SVM principle:* Support vector machine (SVM) boycott be utilized for ordering the got information (Burges, 1998). SVM are an arrangement of related directed learning strategies utilized for classification and regression. They fit in with a group of summed up straight classifiers. Give us a chance to denote a input vector (termed as example) by x=(x1, x2, .., xn) and its class label by y such that y = {+1, −1}. In this manner, consider the issue of isolating the arrangement of n-training patterns having a place with two classes.

IV. EXPERIMENTAL RESULTS

The experiment is performed in two phases: Training phase and testing phase, where we train a set of 20 images, 10 healthy and 10 unhealthy leaf images, which are resized to a dimension of 1000x260x3 and saved in jpeg format. The result of image segmentation is shown using K-means clustering. From the three segmented images, the disease affected segment is chosen to extract the feature. After extracting the features, the feature vector is created and
classifies the paddy leaf diseases using training dataset. [2]

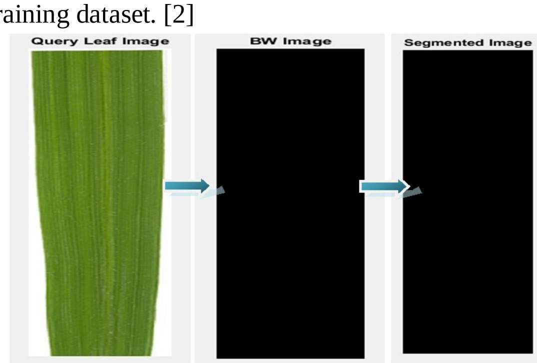

Fig.4.2 Result after feature extraction in healthy leaf

By simulating, extracted features of paddy leaf are:

1) *Contrast:* A measure of intensity contrast between a pixel and its neighbor over the entire image. The range of values is 0 to (K − 1)2.

$$Con = \sum_{i=1}^{K}\sum_{j=1}^{K}(i-j)^2 p_{ij}$$

[3]

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2) *Energy:* It is also called uniformity. A measure of uniformity in the range [0, 1]. Uniformity is 1 for a constant image.

$$E = \sum_{i=1}^{K}\sum_{j=1}^{K} p_{ij}^2$$ [4]

3) *Mean:* The mean takes the average level of intensity of the image. In other words, this can be described as the sum of the pixel values divided by the total number of pixels.

$$m = \sum_{i=1}^{L-1} r_i p(r_i)$$ [5]

4) *Variance:* The variance is denoted by σ 2 or μ2 whereas the mean is a measure of average intensity, the variance is a measure of contrast of an image.

$$\mu_2(r) = \sum_{i=1}^{L-1} (r_i - m)^2 p(r_i)$$ [6]

5) *Standard Deviation:* Standard deviation is the square root of variance.
6) *Entropy:* It is a statistical measure of randomness to characterize the texture of an image. The entropy is 0 when all the pixel values are 0 and is maximum when all the pixel values are equal. The maximum value is *2log2k*.

$$H = -\sum_{i=1}^{K}\sum_{j=1}^{K} p_{ij} log_2 p_{ij}$$ [7]

7) *Root-Mean-Square (RMS):* It is the square root of the mean of the squares of the value.

$$RMS = \sqrt{\frac{1}{MN}\sum_{i=1}^{K}\sum_{j=1}^{K}(I_{ij} - \bar{I})}$$ [8]

Where, intensity *Iij* is *ith* and *jth* element of the two-dimensional image of size M by N. I am the average intensity of all pixel values in the image.

Total number of diseases affected images (1 class) = 10images
Total number of healthy images (1 class) = 10 images
Total number of training samples = 20 images
Total number of testing samples = 1 image

<table>
<tr><th>Unhealthy image</th><th>Histogram Plots</th><th>Results</th></tr>
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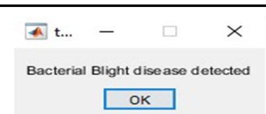
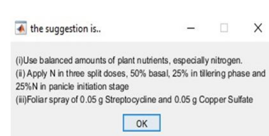
<td>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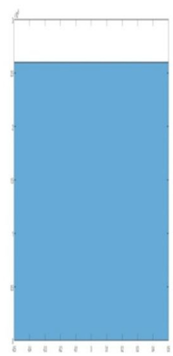
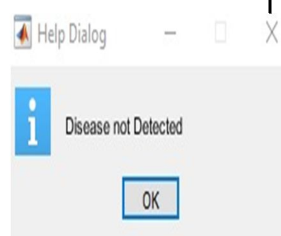
4.3.1 Experimental Results for unhealthy leaf image

Leaf Type	Number of Images	Resolution	Pixel value	Image Type
Healthy	10	1000x260x3	uint8	jpeg
Disease	10	1000x260x3	uint8	jpeg

Table 1.SVM Learning database

Healthy image	Histogram Plots	Result
		

4.3.2 Experimental Results for healthy leaf image

V. CONCLUSION AND FUTURE SCOPE

The image processing techniques were used to deploy the disease detection system. Overall idea behind this project is to detect and recognize paddy leaf disease. It can be useful to farmers and agriculture related research. This will further be detected to improve the complexity and accuracy so that in the field of agriculture the leaf detection and classification can be of a useful application.

Dataset used in the proposed method can be extended to all paddy diseases. This work is focused currently on front view of Paddy leaf but can be extended to side view and back view also. Fusion of some other advance features will improve the output. Real Time Detection of Diseases will further help the farmers to protect crops from diseases in more fast way.

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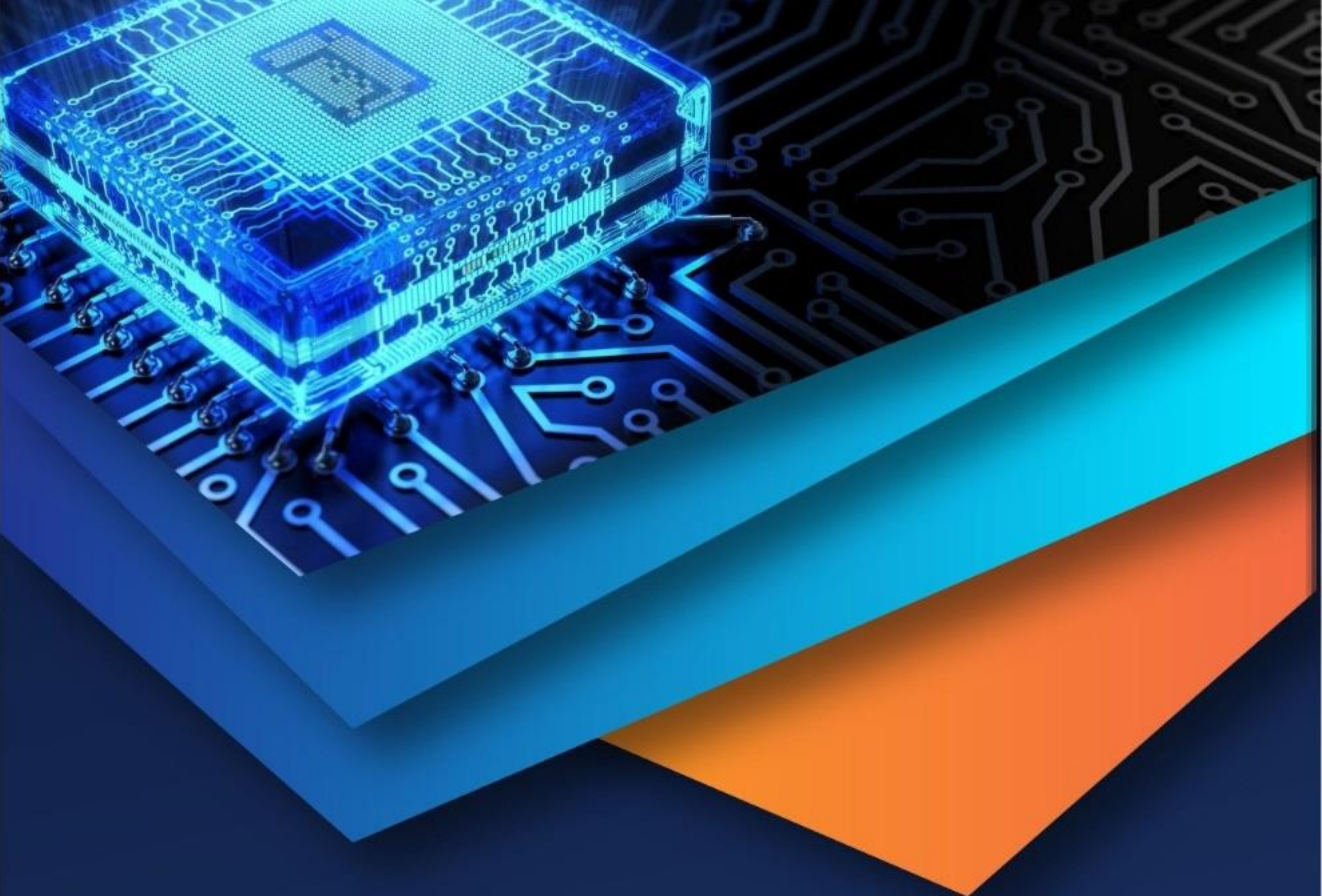

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