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NPK Deficiency Detection in Paddy Leaf Images

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***Abstract*—** Majority of people in India has got their source of income by means of rice cultivation (approximately 70%). But if they easily prone to deficiencies the entire crop field will be wasted. So, in order to get the paddy field high we need to predict the diseases or deficiencies caused to that paddy fields. Paddy leaves will be deficient with multiple nutrient components at a same time. The deviation from being healthy can be identified based on the color and pattern because the healthy leaves are dominant in green color rather than any other color, whereas unhealthy leaves are not dominant in green. The proposed work is to identify individual N, P, K and combination of nitrogen phosphorous (NP), nitrogen-potassium (NK), phosphorous-potassium (PK) and nitrogen-phosphorous-potassium (NPK) deficiencies in a leaf at a same time. Here pattern analysis and RGB color options are extracted to spot defected paddy leaves. Multiple color and multiple pattern comparison is done against the healthy leaves thereby we can easily identify the exact deficiency of nutrient (like N, P, K, NP, NK, PK, NPK) of that unhealthy leaf.

Keywords- *Paddy leaves, N, P, K, NP, PK, NK, NPK Deficiency and pattern recognition*

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I. INTRODUCTION

India is associate agricultural country and concerning seventy proportion of the population depends on agriculture. Where plant leaf diseases wide have an impression on the assembly of the country here this survey provides a fast description on varied identification techniques. Illness identification could also be a tedious task and for the most part diseases are seen on the leaves or stems of the plant.

The Image RGB characteristic constituent listing strategies is loosely connected to farming science, and its extraordinary purpose of browse considerably among the plant insurance field, that ultimately prompts crop administration.

The purposes for applying image analysis in plants are as follows:

1. To sight the boundaries of the affected house.
2. To identify the item properly
3. To go looking out pathological leaf, stem, fruit.
4. To quantify affected house by illness.
5. To examine the color and have of the affected house.

Numerous analysis works creates the event registering framework to inform apart the maladies utilizing contaminated photos of assorted plant leaf spots. Photos are captured by advanced cam transferrable and handled utilizing image turning into, that the contaminated piece of the leaf spot has been used for the grouping reason for the train and check. The most 2 common diseases within the North East India area unit named as Leaf Blast and Brown Spot. The samples of the infected rice leaves are collected from totally different components victimization Nikon COOLPIX P4 photographic camera. No heritable pictures reworked to Hue Intensity Saturation (HIS) model for segmentation. Entropy based mostly bi-level thresholding methodology has been invoked for segmenting the photographs to facilitate distinctive the infected components of the leaves. The RGB color pictures of paddy leaf area unit captured employing a Canon Power Shot G2 photographic camera. The image segmentation supported gray-level threshold segmentation is tailored and also the binary image is gained. The most objective of segmentation method is to get the binary image with less noise or noise free. The RGB image is born-again into a binary image victimization threshold methodology. Native entropy threshold methodology of Eliza and river and Otsu methodology is employed for the segmentation. An occasion matrix is generating from the input image in accordance with chance distribution required for entropy measures. 5 characteristics of lesion i.e., percentage, lesion kind, boundary color, spot color, and broken paddy leaf color were tested for the classification task Color is a very important sign on recognizing totally different categories. Four characteristics of lesion kind, boundary color, spot color, and broken paddy leaf color were tested for wont to establish the system. The magnitude relation of height and breadth of the lesion spot provided a singular form characteristic for decisive the sort of the lesion. Generally, the color distinction is evaluated victimization the {space the gap} between 2 color points in an exceedingly color space. The foremost common distance is geometer distance. Our planned technique is predicated on the CIELAB color area that may be a uniform hue color area to induce boundary color, spot color and broken leaf color. it's better-known that geometer distance of 2 colors is proportional to the distinction that human sensory system perceived within the CIELAB color area.

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II. LITERATURE SURVEY

Aakanksha Rastogi *et al*, (2015) have proposed leaf disease identification in two phases. In first phase leaf is recognized based on preprocessing on stages of image processing and artificial neural network is used as a classifier. During second phase k-means based segmentation is used to identify defected area. Douglas Baquero *et al*. (2014) proposed a novel strategy for image retrieval of tomato leaves which helps to diagnose diseases. Strategy is based on color structure descriptors and nearest neighbor. Ratih Kartika Dewi *et al*, (2014) proposes an image pattern classification using combination of color and texture features to identify rust disease in sugarcane leaf with classification accuracy of 97.5%. E Sandeep kumar and Vishwanath Talasila (2014) focuses on automatic identification of medicinal plants using Gaussian distribution method. Jayamala K Patil and Raj Kumar (2011) propose an advanced method used to study plant disease using image processing. The method ensures increased throughput. Song Kai *et al* proposes an image recognition method of corn leaf diseases. It uses YCbCr color space and co-occurrence matrix to extract disease spot texture feature. BP neural network is used as a classifier with an accuracy of 98%. Lili Ma *et al*, (2010) proposed a method to analyze nitrogen content in soybean plant. Author uses leaf images of six stages of soybean growth with different percentage of fertilizer applied. The leaf images are analyzed using RGB and HSI model. Mohammad Zare *et al*, (2011) propose pseudo coloring technique to analyze and identify color surfaces of sample images. The method uses different values of R, G B layers of a color image and histogram characterization. Nithin S *et al*, (2014) has surveyed several research papers on detection of diseases in cotton plant. The survey is based on detection of disease by extracting color feature, shape feature and by texture features. Noor A Ibrahim *et al*, (2012) proposes a review on most popular color models. Author discusses application areas, usage and classification of color models, advantages and disadvantages of different color models. P R Rothe *et al*, (2015) proposed an active contour model which uses neuro fuzzy inference system to classify three cotton leaf diseases. i.e. bacterial blight, myrothecium and alternaria with classification accuracy of 85%. Parag Bhandarkar *et al*, (2014) proposed a method of structural decomposition of edges and the features extracted are independent of leaf size and orientation. The proposed method gives an accuracy rate of 67.5%. Jagadeesh D Pujari *et al*, (2014) presents a study on the image processing techniques for early detection and classify fungal disease symptoms on different agricultural crops. Shitala Prasad *et al*, (2014) proposed an android based application for detecting spotting of disease patch in plant leaves using k means clustering. The method ensures reduced transmission cost. Wang Li Shu *et al*, (2013) uses computer visual and image information collected through preprocessing based on pattern recognition of soybean for nitrogen element detection. The work focuses on using HSV color model and rules defined to compare trained database against tested database to find NPK deficiency in paddy leaves. The remaining part of the paper is organized into four sections. Section two discusses literature Survey. Section three deals with methodology which further explain input image, feature extraction and classification in two stages. Section four gives with results and discussion and finally section five deals with conclusion.

III. DISEASES OF PADDY LEAVES

Rice plant is distress from several diseases the most diseases area unit caused by microorganism and flora. The RGB traditional rice leaf is shown in Fig 1(a). The diseases that area unit thought of during this work area unit listed below.

A. Brown spot

it's caused by the virus named as Cochliobolusmiyabeanus & Helminthosporium. Brown spot unhealthy leaf is shown in Fig 1(b). The most symptoms area unit
1 .At the start seems as dark-brown spots on leaves.
2 .Later, it becomes Oval formed foliar spots with yellow halo.
3. The spots area unit brown, with gray centers once totally developed.
4. Seem in blade & sheath

B. Narrow brown spot

It's caused by the virus named as Cochliobolusmiyabeanus& Helminthosporium. Slender Brown spot unhealthy leaf is shown in Fig 1(c). The symptoms area unit almost like the brown spot however these area unit long and narrower in comparison to brown spot unhealthy half.

C. Bacterial leaf blight

It's caused by the microorganism named as Xanthomonasoryzae_andpv. Oryzae. : Microorganism blight pathologic leaf is shown in Fig 1(d). The most symptoms are
1. Water soaked lesions move from tip downwardly on the sides of leaves.
2. Bit by bit symptoms grow to be yellow and straw colored stripes with wavy margins.
3. In early morning in wet areas yellow, opaque, cloudy drops of microorganism ooze could also be seen.

D. Rice Blast

It's caused by the plant life named as Pyriculariagrisea. Rice blast morbid leaf is shown in Fig 1(e). The most symptoms square measure
1. Begin as tiny water soaked dark-blue inexperienced specks.
2.Leaf spots square measure usually elliptical (football shaped), with gray-white centers and brown to red-brown margins. Absolutely developed leaf lesions square measure roughly zero.4 to 0.7 in. long and zero.1 to 0.2 in. wide.

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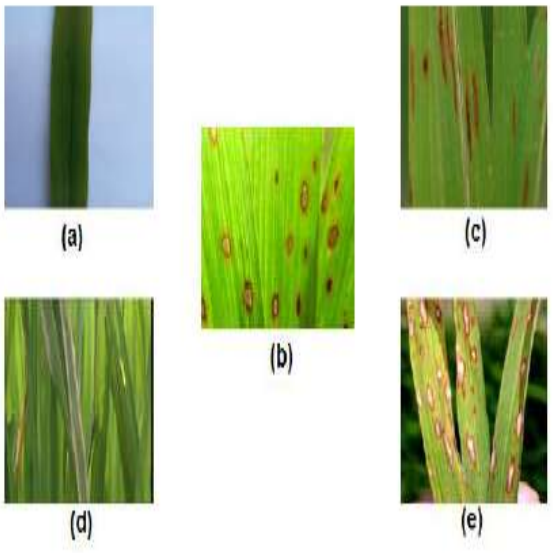

Fig.1: RGB image of normal leaf (a), (b)-(e) diseased leaves of brown spot, narrow brown spot, bacterial leaf blight, rice blast respectively

IV. METHODOLOGY

The planned methodology uses HSV color options for 2 approach classification of paddy leaf pictures. 1st classification is predicated on healthy and unhealthy options. Unhealthy leaves area unit any classified as N, phosphorus and metallic element deficient paddy leaf pictures. Leaf image classification of paddy is split into 3 steps, namely, Input image, Feature extraction and Classification as shown in fig.2.

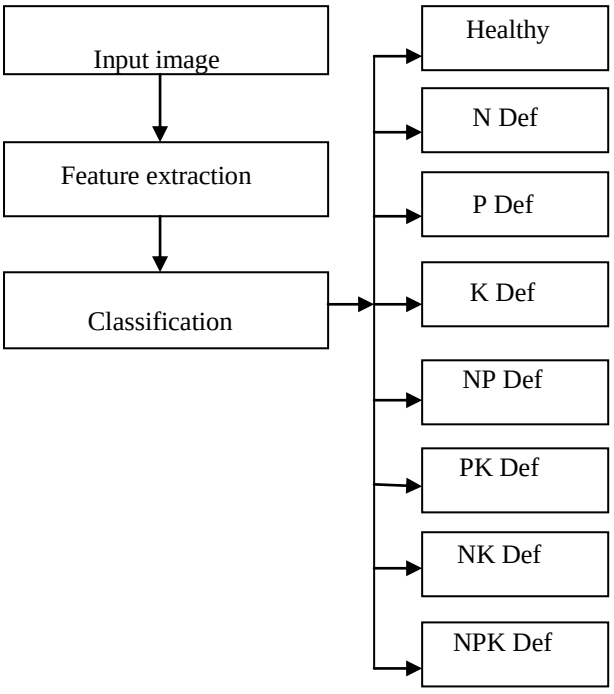

Fig.2: Block Diagram of the Proposed Work

Fig.3: Disease affected leaf

A. *Feature Extraction*

Various color models square measure won't to extract color options from pictures like RGB, HSV, and CMY etc. HSV color model is chosen as a best approach compared to RGB color model because it isn't distracted from natural lightweight. Color properties like hue, saturation and price square measure extracted for every leaves of healthy, nitrogen, phosphorus and metal defected image dataset. HSV Color has the most important importance in content based mostly image retrieval system. Our initial study was essentially done mistreatment HSV color area then extra options were thought of so as to extend the identification rate of deficiency in paddy leaf pictures. Tricks often use HSV color area. It's to a small degree from human perception. The 3 colors square measure Hue, Saturation and Intensity additionally referred to as brightness. Hue is that the Wavelength inside the visible radiation spectrum at that the energy output from a supply is greatest. Expression for the relative information measure of the visible output from a lightweight supply is termed saturation. And relative expression of the intensity of the energy output of a clear source of illumination is termed brightness. It may also be expressed because the amplitude at the wavelength wherever the intensity is greatest. For the projected work sixty leaf pictures were thought of in every class like healthy, chemical element defective, phosphorus defective and metal defective and over one hundred fifty pictures were used as take a look at pictures. HSV color options square measure extracted from these four classes in conjunction with take a look at pictures. supported Hue, Saturation and Intensity (HSV) color model, mean, minimum, maximum, deviation values square measure computed {for every for every} image in each dataset. Then minimum of minimum price, most of most price are computed. Since hue price resulted in correct results compared to saturation and price, average hue, minimum hue and most hue and deviation price of all four classes square measure extracted.

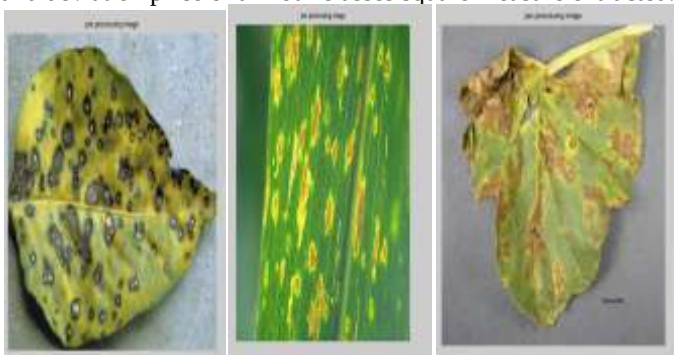

Fig.4: Pre Processing Image

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B. Classification

Classification is attempted in two stages. First level is to classify healthy and non-healthy paddy leaves and second level is to classify unhealthy paddy leaves as nitrogen, phosphorus and potassium defective, NP,PK,NK,NPK paddy leaf images.

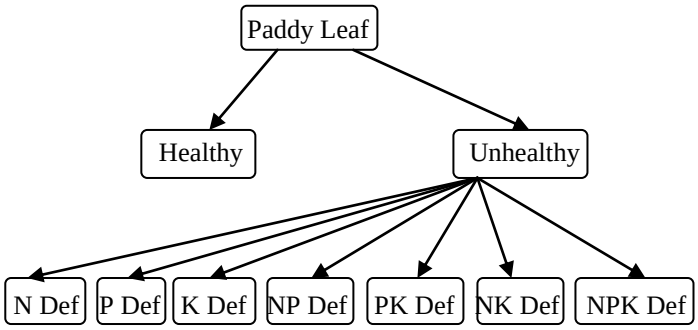

Fig.5: Classification diagram

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i. First Level

The first level of classification is to identify the given image as healthy or unhealthy.

1. Identify number of pixels which are non-healthy in the test image to compute percentage of deviation from being healthy.
2. If the percentage of failure samples in test image is less than the percentage of failure samples in nitrogen, phosphorus or potassium defected paddy leaf then image shall be considered as healthy otherwise the image is unhealthy paddy leaf image.

ii. Second Level

The second level further classifies an unhealthy image as nitrogen defective, phosphorus defective or potassium defective image.

1. Identify number of pixels which are non-healthy in the test image to compute percent of deviation from being healthy.
2. If the percentage of failure samples in test leaf is more than or equal to the percentage of failure samples in trained nitrogen, phosphorus or potassium defected leaf then image shall be considered as defective leaf.
3. Extract the computed hue properties for failure portion in the test image.
4. Calculate the mean hue, minimum hue and maximum hue and deviation value of failure portion.
5. Compare with database properties and identify the defective type of leaf.

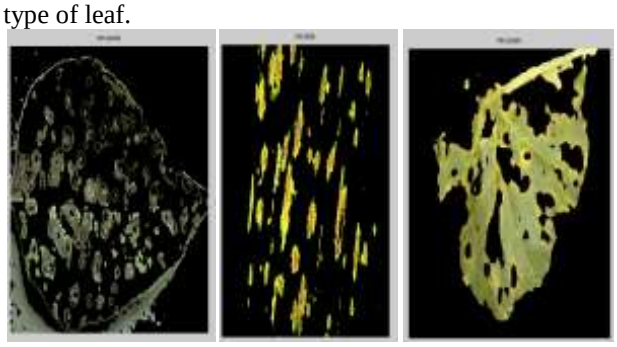

Fig.6: Min Pixel of Image

C. Color Feature and pattern analysis

In image processing color features plays very important role and an important sign in recognizing different classes. These color features are very helpful when investigating the lesion for early diagnosis. Here, "Grid based color moments" are used as a feature vector. Compute the color features for a given image using following steps

1. RGB image converted into HSV color spaces
2. An image is uniformly subdivided into 3X3 blocks
3. Compute mean color (H/S/V) for each of the nine blocks

The algorithm computes red, green and blue color values for all paddy leaf images. The pixel value of each color varies from 0 to 255. From RGB values average red, green and blue values computed along with average color band ratios of G/R and G/B. Since the identification is with respect to healthy leaf properties mainly considered band ratios are G/R and G/B as healthy leaves are predominant with green color. Next G/R mean, G/R median, G/B mean, G/B median along with ratios of Gavg/Ravg and Gavg/Bavg are computed to identify specific nutrient deficiency accurately. These color features are repeated for all images in all four categories which are considered for the study. Along with color features patterns like circles are identified. If the circle is identified its area, diameter and then color in the circle is extracted.

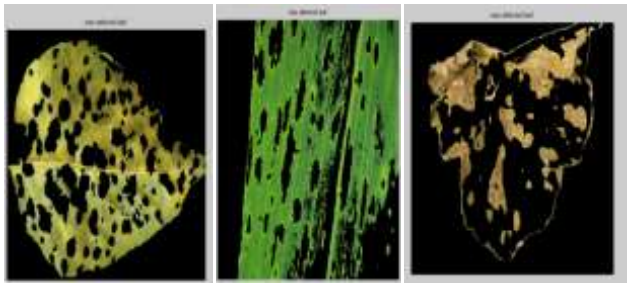

Fig.7: Max Defected leaf

D. Experimental Results

Color properties such as red, green and blue are computed for 50 healthy leaves, then min, max, mean values are computed. Along with this color ratios such as G/R and G/B are also computed. Fig. 3 shows the computed properties with reference to healthy leaves. To detect leaf defected by both phosphorus and nitrogen, test image is feed as input and its color properties extracted. Combined nutrient defective leaf shows G/R median value is less than 1 which indicates that leaf is phosphorus defective and shows yellow spots which can be identified by finding circles with yellow color using pattern recognition and pixel properties at the centre. If centre color properties (G/R) lies as per range given below, it is concluded that test image is nitrogen defective.

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Fig.8: Output Phosphorus Detected leaf

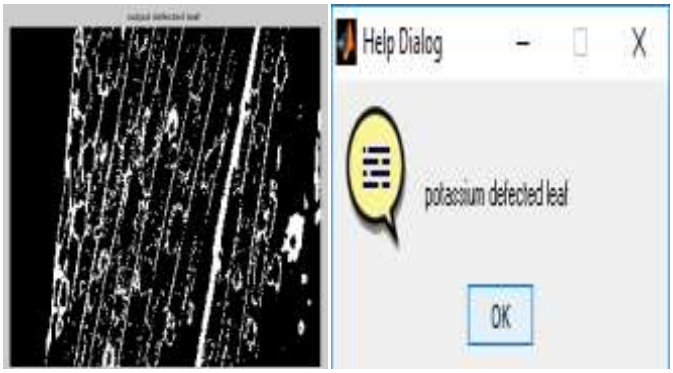

Fig.9: Output Potassium Detected leaf

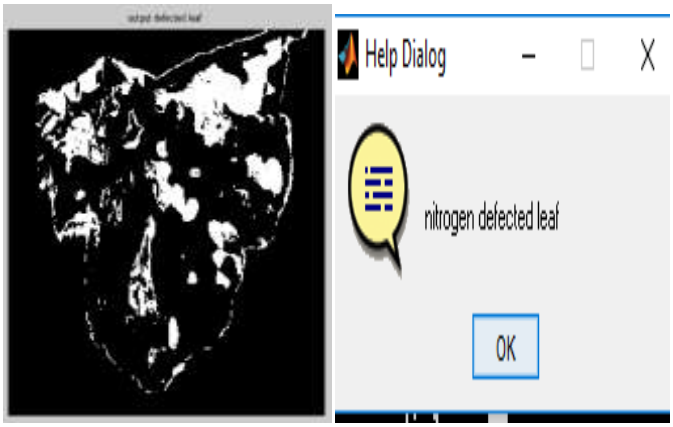

Fig.10: Output Nitrogen Detected leaf

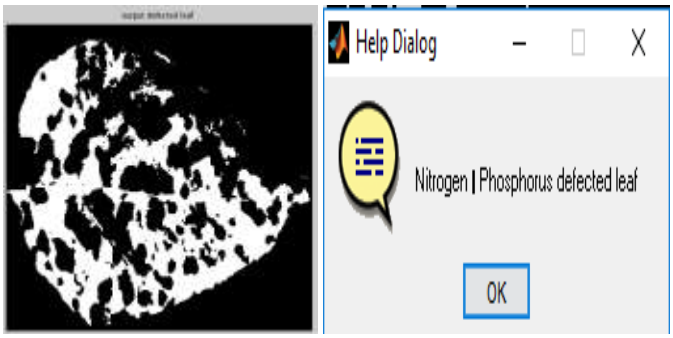

Fig.11: Output Nitrogen Phosphorous Detected leaf

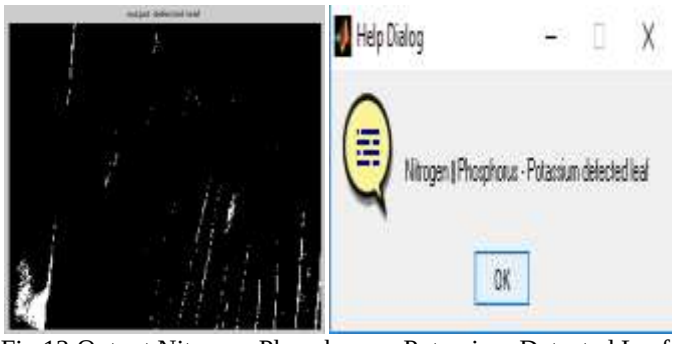

Fig.12:Output Nitrogen Phosphorous Potassium Detected Leaf

V. CONCLUSION

A total of 165 test images were used for identifying healthy and specific nutrient element deficiency in paddy leaves. Results show healthy leaf classification accuracy up to 100%, rate of nitrogen, phosphorus and potassium, nitrogen phosphorus, phosphorous potassium, nitrogen potassium and nitrogen phosphorous potassium deficiency identification was 90.32%, 97.22%, 94%, 91%, 93%, 91.11% and 92% respectively with an overall identification accuracy of 95.39%. The proposed work finds its application in timely recognition of nutrient deficiency in paddy crop. The work concentrates on paddy leaves and NPK deficiency only which can be further extended for other nutrient deficiencies like boron, manganese etc. and also be applied on entire paddy field images.

Identification of the symptoms of plant diseases by means of image processing techniques is of prime concern in the area of research. An introduction to the research in agriculture field and different types of diseases in rice leaf is given. The literature survey done in preprocessing techniques and segmentation of leaf disease detection and classification has been discussed. After applying the suitable preprocessing technique classification of normal and diseased leaf using histogram plot is presented. Shape features are extracted using PCA method and the color features are extracted by using color based grid moments. These features are combined and fed to the SVM classifier. 85% accuracy is achieved for four different diseases.

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