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Analysis and Identification of Macro Nutrients of Leaf

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ABSTRACT: India is an agricultural country. Farmers are experiencing great difficulties in managing the fertilizer usage and disease rectification. Non-destructive nutrient deficiency analysis provides effective tool support for precise farming. According to the plant nutrition mechanism, leaf characteristics displays different changing trends under nitrogen (N) deficiency. Plant diagnosis is an art as well as science which is inherently visual and requires intuitive judgement involves the usage of scientific methods. Nowadays, the fertilizer management is difficult for farmers and also it affects the soil health. Our project approach is to detect the fertilizer deficiency and various disease in the plants automatically. The leaf characteristics were extracted by mean value and region properties functions in MATLAB, and the leaf colour indices identified by comparing the leaves with Leaf Colour chart panel and discriminant analysis were made to identifies Nitrogen(N) deficiency. Leaves were cross matched with Leaf Colour Chart panel. In this study, the dynamic capture of paddy leaf by scanning was used to analyse the changing regulation of leaf characteristics under nutrient deficiency. The samples must be taken under the shadow of farmer. It uses GLCM features and HSV decision tree. The work begins with capturing the images. From the captured images RGB components are extracted by segmentation process using K-Means clustering algorithm. The GLCM features are extracted from the segmented image. These features are used to identify the diseases and Nutrient deficiency.

KEYWORDS:GLCM, K-mean clustering, leaf color chart panel, HSV decision tree.

I. INTRODUCTION

The leaf colour chart has six (06) colours varies from yellowish to dark greenish just like lush green colour of plants. The over use of nitrogen (N) fertilizer has become a common phenomenon in field management, which has also lead to serious environmental pollution and resource waste. Therefore, timely and precisely non-destructive analysis is necessary for precision management of fertilization. Digital image processing analysis is the most widely used technique in non-destructive N deficiency analysis. Digital image processing technology is capable of extracting spectral, morphological, and texture characteristics from digital images, and its effectiveness for nutrition diagnosis has been examined in various studies. It has the advantages of being inexpensive, easy to operate, and portable for practical applications, especially in the field. Given the above, digital image processing technology is more suitable to be generalized and applied in practice. However, the sampling time in nutrition diagnosis has traditionally been arranged at major growth stages, such as the tillering stage, jointing stage and booting stage. Leaf chlorosis, a typical symptom results from N deficiency, is traditionally assessed by leaf colour at certain stages. Moreover, when exposed to nutrition deficiency, the colour changing symptoms are keys to nutrition deficiency analysis. According to the plant growth mechanism, the influence of N deficiency on leaf growth embody colour change in the leaf. These dynamic characteristics, which can be captured at any growth phase and improve the analysing effect. The continuous and complete leaf information, which can be acquired by continuous monitoring, is particularly necessary for the exploration of effective characteristics and improvement of analysing effect. In recent years, continuous monitoring has been applied in many studies.

Studies conducted that the temporal dynamics of leaf morphology and colour differed with nutrition supplies during leaf extension. These results provide evidence for the feasibility of applying incomplete leaves in nutrition

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analysis and further imply that nutrition deficiency can be identified by dynamic features at an early stage. In addition to the incomplete leaf, fully expanded leaves also carry important dynamic characteristics for nutrition analysis. The nutrition deficiency symptoms resulting from N deficiency appear primarily on fully expanded leaves, especially the older leaves. Therefore, the dynamic characteristics of different leaf positions (including the incomplete leaf and fully expanded leaves) represent valuable information for the further study of nutrition analysis.

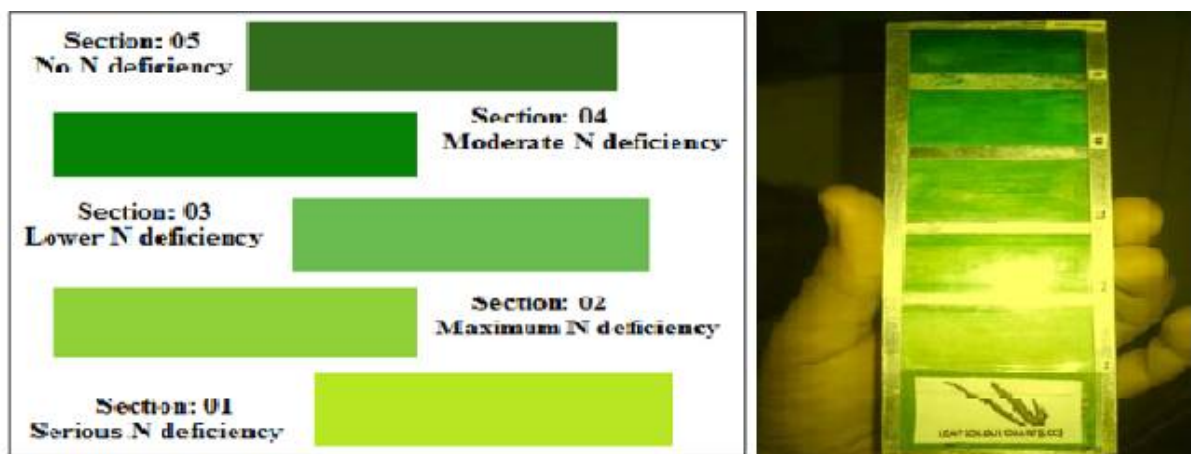


Fig. 1 Model representation of LCC panel

Micro inverters have several advantages over conventional inverters. The main advantage is that small amounts of shading, debris or snow lines on any one solar module, or even a complete module failure, do not disproportionately reduce the output of the entire array. Each micro inverter harvests optimum power by performing maximum power point tracking (MPPT) for its connected module. Simplicity in system design, lower amperage wires, simplified stock management, and added safety are other factors introduced with the micro inverter solution.

The primary disadvantages of a micro inverter include a higher initial equipment cost per peak watt than the equivalent power of a central inverter since each inverter needs to be installed adjacent to a panel (usually on a roof). This also makes them harder to maintain and costlier to remove and replace (O&M). Some manufacturers have addressed these issues with panels with built-in micro inverters. Efficient conversion of DC power to AC requires the inverter to store energy from the panel while the grid's AC voltage is near zero, and then release it again when it rises. This requires considerable amounts of energy storage in a small package. The lowest-cost option for the required amount of storage is the electrolytic capacitor, but these have relatively short lifetimes normally measured in years, and those lifetimes are shorter when operated hot, like on a rooftop solar panel. This has led to considerable development effort on the part of micro inverter developers, who have introduced a variety of conversion topologies with lowered storage requirements, some using the much less capable but far longer lived film capacitors where possible.

II. PROPOSED SYSTEM

This system is used to maintain the balanced nitrogen factor (macro nutrients) in paddy, in addition this system is also used to identify the type of disease. Most commonly faced problems by farmers during cultivation while using a LCC panel are: Human visible errors, leaves absorb the radiation from sun and emit it with excess colour saturation. This leads to mismatch of colour in the LCC panel. It is difficult to measure colours of individual plant over large land areas. An LCC panel consists of hierarchical colour patterns of green arranged in it. This panel has their descriptions with respective colour patterns. The fertilizers are applied to the plants based on these colour patterns. These panels are designed depending on the region in which the system is being deployed. For instance, if this system is implemented in northern part of India this hierarchical pattern consists of six panels. Each panel is of different colour saturations that are

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designed based on the climatic conditions, that varies accordingly with the areas in which they are implemented. Also, these colour patterns vary for different species of plants. For example, Wheat which has higher saturation of green colour when compared with that of paddy's panel. Similarly, for maize, which has a higher colour saturation than that of wheat. The samples must be taken under the shadow of farmer.

In this project, the hue and saturation values are taken for different ranges of green as in the LCC panel. This hue and saturation value are compared with the image under study. Depending on these values the amount of fertilizers applied to the plants are determined. By using weighted median filter, the contrast of the pixels got reduced excluding the pixels green colour of the image. Let consider this case, set of numbers {1;2;3;4;5} with each number having weights {0.15;0.1;0.2;0.3;0.25} respectively. The median is 3 and the weighted median is the element corresponding to the weight 0.3, which is 4. The weights on each side of the pivot add up to 0.45 and 0.25, satisfying the general condition of the image.

One of the metrics that is commonly used to compare results across different values of K is the mean distance between data points and their cluster centroid. Since increasing the number of clusters will always reduce the distance to data points, increasing K will always decrease this metric, to the extreme of reaching zero when K is the same as the number of data points. Thus, this metric cannot be used as the sole target. Instead, mean distance to the centroid as a function of K is plotted and the "elbow point," where the rate of decrease sharply shifts, can be used to roughly determine K. From the captured image, RGB components are extracted by segmentation process using K-Means clustering algorithm. It gives the group of images based on K-Mean value and the value taken from centre point. This algorithm converts partition image into K clusters. In this algorithm each pixel got assigned to the clusters. This process continues till the convergence attains. It minimizes the distance between the pixels. By averaging the pixels in centroid re-compute the clusters. K-mean clustering aims to partition the n observation into $K(≤n)$ set $S = (S_1, S_2, \dots, S_K)$. Clustering gives the required region in the image and enhance the image by reducing the inter pixel distance.

The leaf colour indices are identified by extracting HSV values. For colour indices HSV decision tree algorithm is used. In this algorithm, the saturation and hue values of the hierarchal green colour on panel is derived. Firstly, the image was converted from RGB colour space to HSV colour space to avoid influence of illumination. Secondly, most of the background pixels were removed according to hue value compared with the green plants. Thirdly, the pixels of wheat straw whose hue value is intersected with tender green leaves were eliminated subject to their thresholding was employed to get the green plants. 1. Place the best attribute of the dataset at the root of the tree. Split the training set into subsets. 2. Subsets should be made in such a way that each subset contains data with the same value for an attribute. 3. Repeat step 1 and step 2 on each subset until you find leaf nodes in all the branches of the tree. This result indicates that perfect greenness pixels correctly captured outdoor images. The derived values are compared with Leaf Colour chart panel values and discriminant analysis were made to identify Nitrogen(N) deficiency. It provides respective remedies for N deficiency.

Feed Forward neural network with one hidden layer and enough neurons in the hidden layers, can fit any finite input-output mapping problem. Specialized versions of the feedforward network include fitting and pattern recognition networks. It helps in identifying the type of diseases in leaves. On other hand it enumerates the remedies required for the diseases.

III. PROCESS FLOW

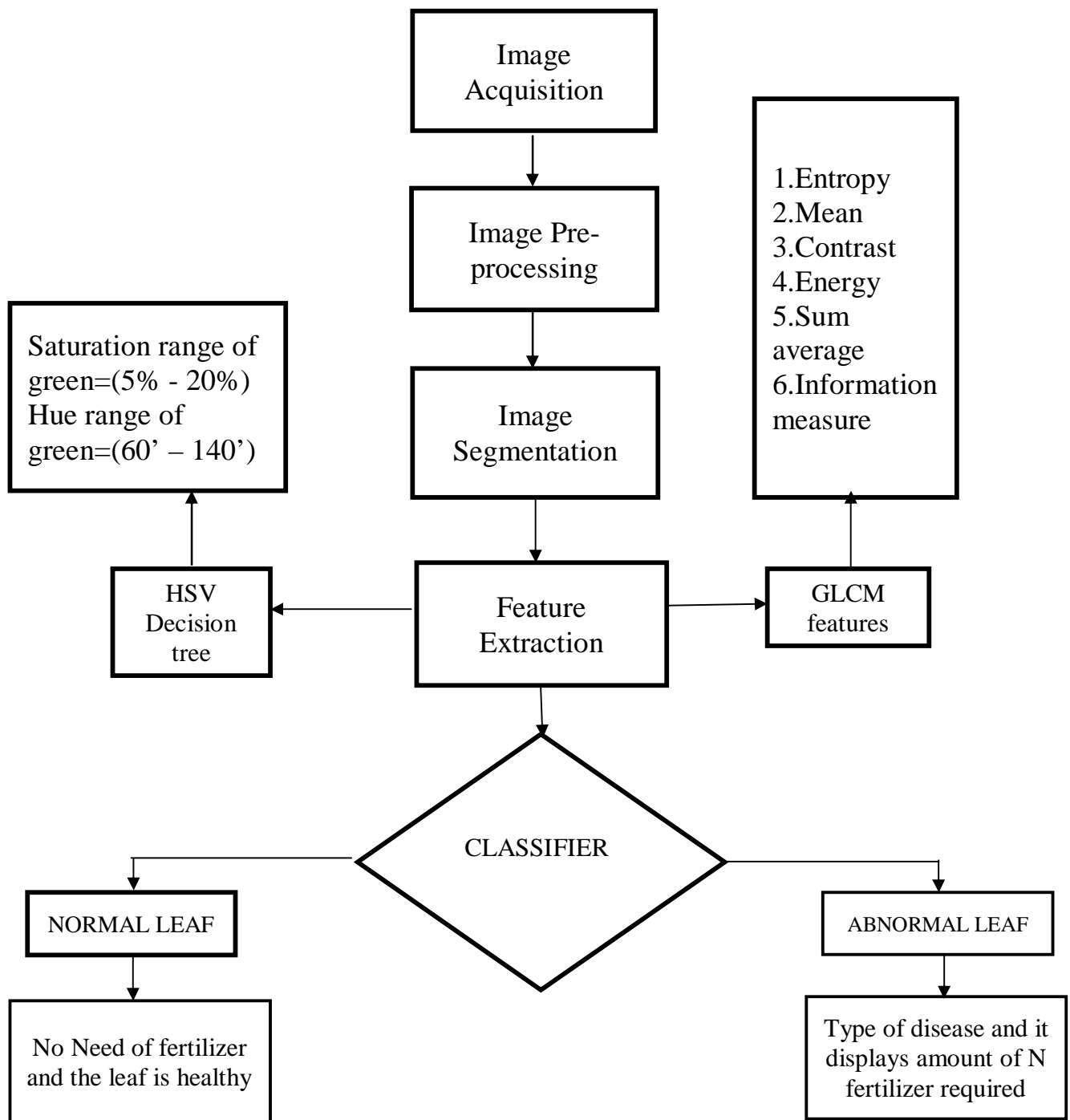
The proposed system working diagram has given below. On the first step images samples are taken. The images should be taken under the shadow of the farmer. The captured images contain different amount of pixels. So it is resized to the base pixel amount. Image pre-processing is followed by image acquisition. The images have noise and it need to be removed. Weighted median filter is used to remove the noise. The median filter considers each pixel in a neighbourhood of a centre pixel and replaces it with the median value of the centre pixel. The median values are calculated by averaging the neighbourhood pixels. The filter reduces various types of noises which include Gaussian noise. The Gaussian noise is blurred using Gaussian function. The level of contrast may vary from images to images. Histogram equalization is the technique used to equalize the pixel values of low contrast image and high contrast image. After equalizing the contrast image is segmented for the discrimination analysis. K-means clustering algorithm is used for segmentation. The algorithm clusters the image pixels into K groups where K is the required threshold. Each cluster centre is recomputed as the average of points in that cluster. The pixels in the cluster got assigned to the closed cluster until it converges. It masks the affected region from the healthy part of the leaf. The affected region is also known as diseased part of the leaf. The leaf characteristics are analysed to classify the disease of the leaf.

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The **GLCM** features are taken from the leaf image for the analysis of classification. The features are

- i. Contrast
- ii. Correlation
- iii. Energy
- iv. Variance
- v. Entropy
- vi. Mean

as major parameters and variance, average, difference entropy as minor parameters. These features are used to analyse the pixel values of the diseased part of the leaf. The features are analysed using the neural network. Feed Forward Neural Network is used for the analysis of the features to classify the disease. This FFDN is an iterative algorithm to train image data to make the analysis close to the accuracy. This neural network fetches the data and analyse it iteratively until it averaging the pixel. This system classifies 16 diseases using the image colour variation and patches. The disease classification is followed by its remedial measures which is important for the farmers to rectify the problem. Disease affects due to the deficiency of the nutrients in the leaf. This system approaches the major macro nutrient Nitrogen deficiency and other liquid chemicals required. The nitrogen deficiency is identified and measured using the HSV decision tree algorithm. Using the hue saturation value of the green colour the nitrogen deficiency is measured. The other colour indices like RGB colour indices cannot classify the greenness of the leaves irrespective of the lightness. As the images are taken in the field the HSV decision tree suits best to the greenness identification. The background and the unwanted straws, soil and ash colour values are made to null to identify the green colour alone. The hue value of unwanted straws, soil and ash ranges $<50^\circ$ and $<150^\circ$. The hue of green ranges from 60° to 140° . Between these range the greenness classified as 4 values. This shows deficiency from low to high. The hue value of leaf compared to the above said green ranges. The pixel value falling under the range shows the deficiency level and the respective remedial measures are given of the nitrogen. This shows the how much nitrogen need to be added for the healthy soil management and leaf. In addition to that liquid chemicals needed to be added are given as for the healthy leaf life.

IV.RESULT

For the analysis paddy, wheat leaves are considered with the total database of 100 samples which includes both normal and diseased leaves. Here as a reference paddy leaf is taken as an input image and the output of each stage is shown then and there. Further 17 GLCM features are extracted from the segmented images as shown in the table. Among the 17 features tabulated 3 features like contrast correlation, skew value does not provide better discrimination results to differentiate normal and abnormal leaves. The remaining features provide better discrimination between normal and diseased leaves homogeneity lies between the range of 9.5128×10^{-1} to 9.7523×10^{-1} for normal leaf and 7.3812×10^{-1} to 9.0099×10^{-1} for abnormal leaves. Entropy shows the range of 8.0481×10^{-1} to 9.3982×10^{-1} for normal. The energy value for normal and abnormal leaf shows 5.045×10^{-1} to 5.700×10^{-1} and 5.288×10^{-1} to 7.733×10^{-1} . Inverse difference moment normalized known as IDNM lies within the range of 9.108×10^{-1} to 9.843×10^{-1} for normal and 9.418×10^{-1} to 9.917×10^{-1} for abnormal among the 17 GLCM features, the features which provides the best efficiency to distinguish between normal and abnormal leaf. Among all the features mean, standard deviation, auto correlation, energy, entropy, homogeneity, sum variance, inverse difference moment normalized, sum average maximum probability, sum entropy, difference entropy, information measure of correlation values is produced major difference between normal and abnormal leaf. These 14 features are used to train the neural network for classification of leaves. In neural network, 60 images are trained which are both affected and non-affected images. The 60 neurons are used in the input layer. In hidden layer it has 6 neurons. It took 700 iterations to produce the results. Finally, it gives the result based on the target.

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NORMAL LEAF

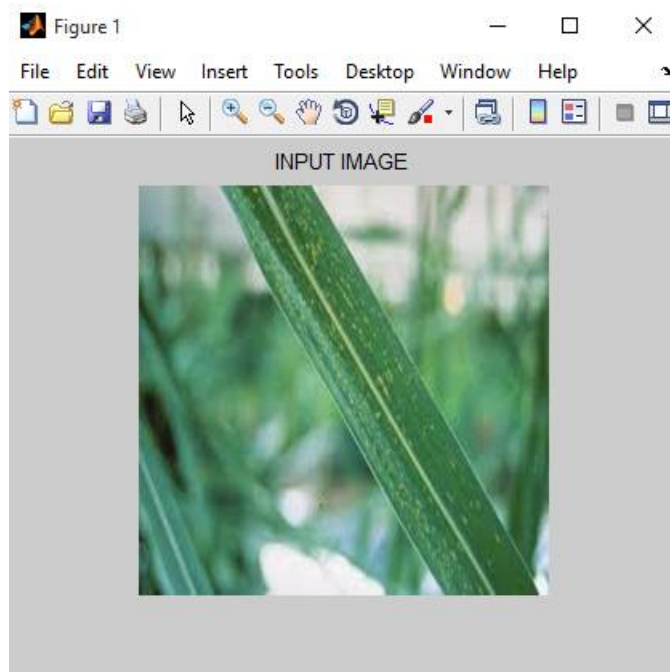


Fig.6.1 Input image of normal leaf

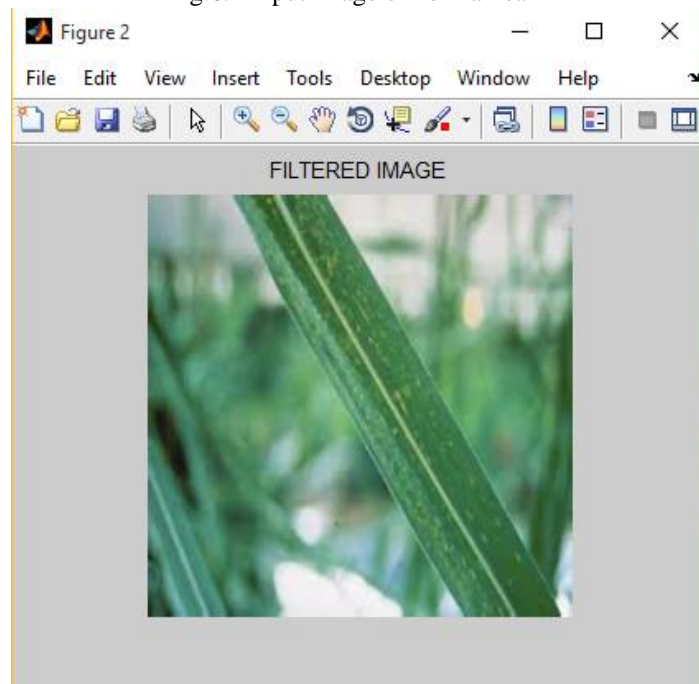


Fig.6.2 Input image of normal leaf

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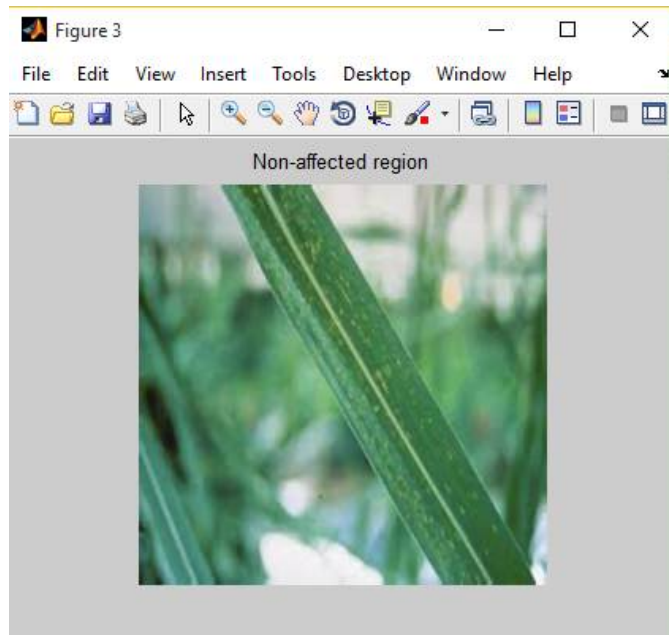


Fig.6.3 Segmented image of normal leaf

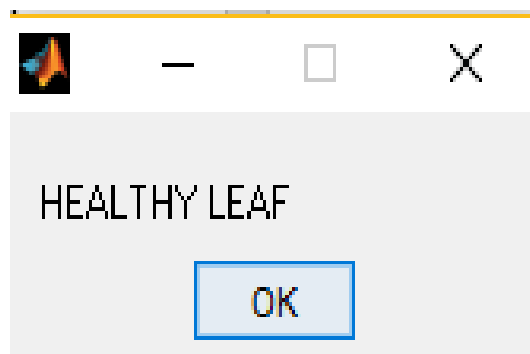


Fig.6.4 Sample output

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ABNORMAL LEAF

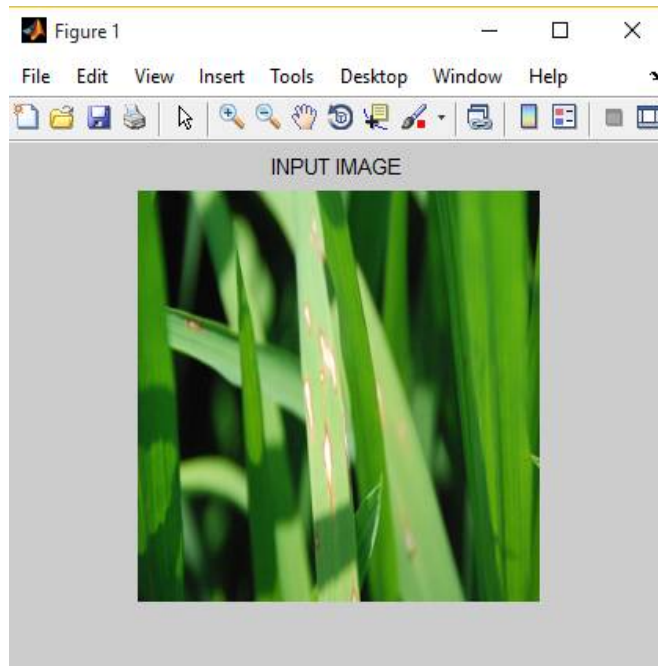


Fig.6.5 Input image of affected leaf

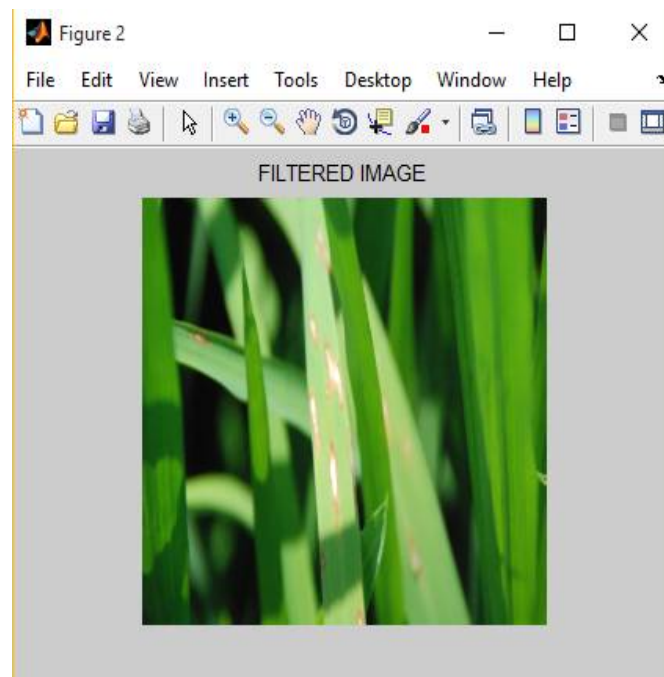


Fig6.6 Filtered image of affected leaf

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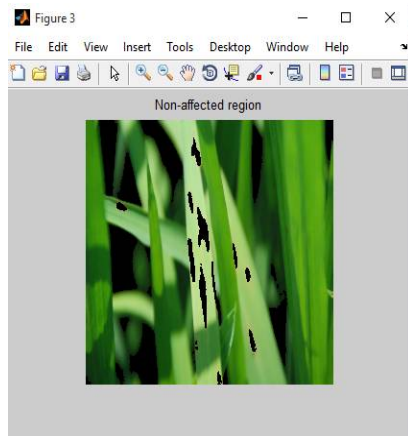


Fig.6.7 Segmented image 1
(Non affected portion)

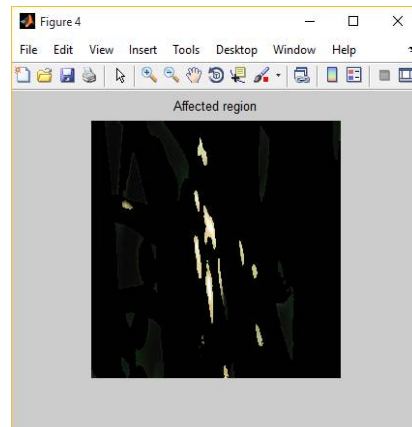


Fig.6.8 Segmented image 2
(Affected portion)

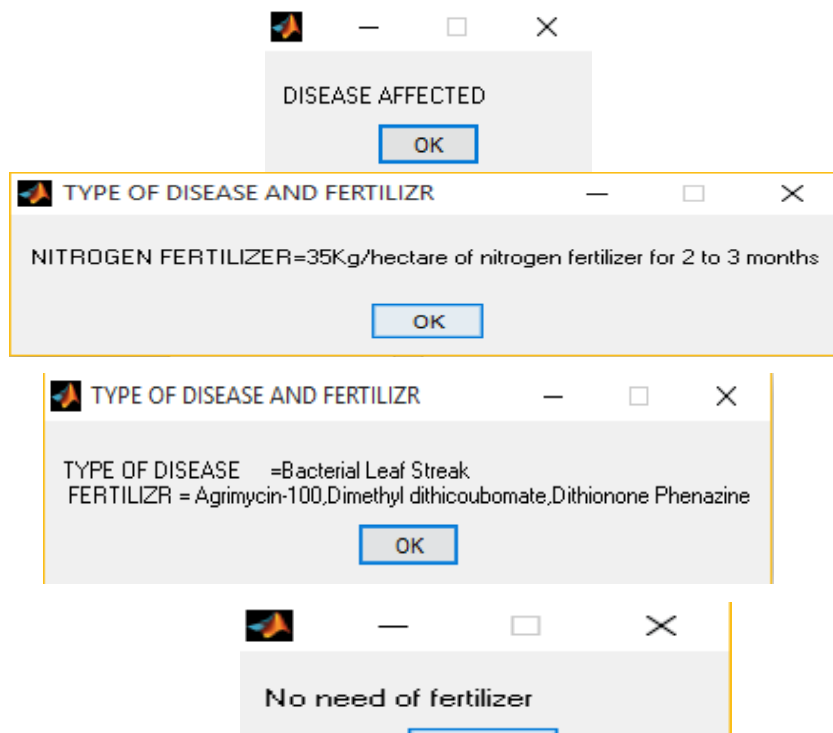


Fig.6.9 Sample output

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V.CONCLUSION

In this work we have considered two types of plants leaf like paddy and wheat. By this experiment the disease get identified at early stage. It helps the farmers to choose the specific quantity of pesticide thereby minimizing the cost and environmental pollution. Here the images are segmented using k-means clustering and features are calculated using GLCM method. The features that showed good variation are selected and the remaining are regulated after feature selection the selected features are given to the classifier. The data set will contain the trained feature values of both normal and abnormal leaves. If the affected leaf is detected feed forward neural network will suggest appropriate fertilizer for the infected leaf. The amount of fertilizer can be suggested using HSV decision tree method. By this method heavy crop loss can be avoided by monitoring the crop field. The main purpose of this work is fast and accurate detection fertilizer deficiency and leaf disease. This project can be enhanced by involving automation system in the agriculture field.

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