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Machine Learning Based Segmentation Technique of Detection of Fungal Diseases in Plants

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Abstract: **Agricultural productivity is something on which economy exceptionally depends. This is the one reason that disease detection in plants plays an important part in agriculture field, as having disease in plants are very natural. If proper care isn't taken here then it causes genuine consequences for plants and because of which respective product quality, quantity or productivity is affected. Detection of plant disease through some automated system is valuable as it reduces an extensive work of monitoring in huge farms of crops, and at beginning period itself it detects the symptoms of diseases i.e. when they show up on plant leaves.In this paper, we propose a novel frameworkto recognize plant leaf disease in combination of K-means clustering and Neural Network Algorithm. The proposed technique successfully identify and classify the infected plant leaves.**

Keywords: **Feature Extraction, Dicot Plant Disease, Monocot Plant Disease, Pre-Processing, Segmentation, Classifier.**

I. INTRODUCTION

In Agriculture sector, plants or crop cultivation have seen quick development in both the quality and quantity of food production, nonetheless, the existence of pests and diseases on crops particularly on leaves has blocked the quality of agricultural products. In the event that the existence of pests on crops and leaves isn't checked accurately and the timely solution isn't given at that point the quality and quantity of food production will be decreased, which brings about upsurge in poverty, food insecurity also, the mortality rate [1]. This serious impact can disturb any country's economy particularly of those where 70% of the inhabitants depend on the products from the agricultural sector for their job and endurance. One of the significant issues for agriculturists is to diminish or destroy the development of pests influencing crop yields. A pest is an organism that spreads disease, causes harm or is a nuisance. The most frequent pests that influence plants are aphids, fungus, gnats, flies, thrips, slugs, snails, mites and caterpillars. Pests prompt sporadic outbreaks of diseases, which prompt famine and food lack [2].

The farmers are utilized to detect pests manually through their perception of naked eyes, which requires consistent monitoring of the crop stems and leaves, which is a troublesome, labor intensive, inaccurate and costly errand for extensive homesteads [3].

Encourage the early detection of diseases on plants is really required as few diseased leaves can spread the infection to the entire batch of fruits and vegetables and in this manner influences promote storage and offers of agriculture products. This impact of plant diseases are extremely destructive as a great deal of farmers were discouraged to the point where some decided to give up the work of crop cultivation.There is a need to distinguish these diseases at an early or superior stage and propose solution with the goal that maximum harms can be avoided to enhance crop yields.

Digital image processing procedures has discovered various applications in different fields, for example, medical imaging, remote sensing, industrial inspection and agricultural processing and so forth [4]. In the field of agriculture digital image processing systems have been built up as a successful means for analyzing purposes in different agricultural applications like plant recognition, crop yield estimation, soil quality estimation and so forth [4].

With the presence of massive volume of plant species and their utilization in different fields, the quality of agricultural products has turned into a noteworthy issue in agriculture sector. Image processing method, for example, machine vision system has been ended up being a viable automated procedure. Image processing based artificially intelligent computer vision strategies can decrease the computational time and thus, the automated leaf disease detection can be made considerably quicker.

All together for better comprehension of the further investigations of the issue zone, it is crucial to have a thought regarding some essential ideas like precision agriculture, computer vision innovation, soft computing strategies and the requirement for an automated system for leaf disease detection and so on.

A. *Precision Agriculture*

Agricultural production system is a result of a dense interaction of seed, soil, water and agro-chemicals which incorporates fertilizers and so on [2][5]. Thus an appropriate management of each of these inputs is fundamental for such a complex system. The primary point of any agricultural firm is to diminish the input costs, minimization of working time, to get improved crop yield, to enhance the quality of crop, to support up profit margin and to complete in domestic and global markets.

Precision agriculture is an overseeing reasoning for recognizing, analyzing and managing inconsistency inside fields for the most ideal productivity, sustainability and fortification of the agricultural landscapes and its resources [2].

B. *Computer Vision Innovation*

It is a field that incorporates techniques for acquisition, processing, analyses, and then understanding images with a specific end goal to deliver different sorts of data from those images, e.g., as decision and conclusions [4]. Essentially it is the creation of specific and significant clarifications and depiction of physical items from images [6].

C. *Need of Automated Innovation in Agriculture*

In the present situation, plant pathologists generally depend on manual eye prediction systems for detecting, recognizing what's more, grading of diseases on plants. This kind of system for grading is extremely time taking yet in addition not practical sometimes [7].Moreover, there are issues with the efficiency and precision of manual grading system since the outcomes are most certainly not accurate and exact and furthermore a few times this master guidance of pathologist isn't sensibly estimated and isn't timely accessible to farmer[8].

Digital Image processing based artificial computer vision strategies alongside available communication system can modify the circumstance of receiving an expert guidance well inside time and at a sensible cost. Along these lines, having a hearty automated disease detection strategy encourages a quick, predictable and convenient method for detecting leaf diseases on plants [8].

II. VARIOUS TYPES OF PLANT LEAF DISEASE

There are different types of plant leaf disease:

1) Fungal
2) Bacterial
3) Viral

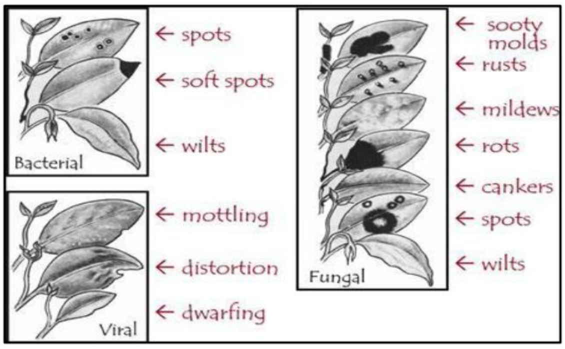

Fig. 1. Different types of plant leaf diseases

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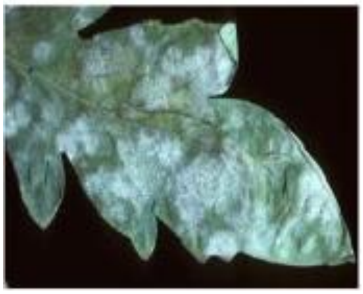
The majority of the leaf diseases are caused by viruses, fungi, and bacteria. Viruses are extremely small particles comprising of protein and genetic material with no related protein [9]. Fungi are distinguished mainly from their morphology, with emphasis set on their reproductive structures and Bacteria are considered primitive than fungi what's more, for the most part have more straightforward life cycles with the distinction that bacteria exist as single cells and increment in numbers by partitioning into two cells amid a procedure called binary fission. The majority of the image processing and pattern recognition strategies in agricultural applications for detection of weeds in a field, arranging of fruits and vegetables, recognizing diseases and so on. Automatic Detection of plant leaf disease is a basic research point as it might demonstrate advantage in monitoring substantial fields of crops, and distinguish the side effects of disease when they show up on plant leaves[10]. Image Samples of Plant leaf disease is shown.

(a)



(b)

(c)

(d)

Fig. 2: Image Samples of Plant Disease (a) Black Spot, (b) White Powder, (c) Ring Spot and (d) Brown Spots

III. BASIC TYPES OF PLANT FAMILY

D. Monocot Family Plant

Plant leaf disease detection can be detected on the basis of their type of plant family. There are commonly of two types of plant Monocot family plant and Dicot family plant. The Monocot family plant has different characteristics such as one seed leaf, leaf veins, seed leaf are straight and parallel, which are in absence of wood [11].

E. Dicot Family Plant:

Dic*ot family plant has mainly* two seed leaf, nested leaf veins and complex structured, woody as well as woodless. The examples of Dicot family plants are cotton, coffee, potatoes, tomatoes, beans, honeysuckle, roses, peppers, str*awberry, etc. Cotton is used* to make textile products and y*arn products in India. Various* precautions and pesticides are available to control *the cotton d*iseases.

IV. LITERATURE SURVEY

Many research has been carried out in the field of plant leaf disease identification. This section presents various existing mechanism and techniques for plant leaf disease classification.

P. Revathiet al. [12], proposed work depends on Image RGB feature ranging strategies used to recognize the diseases (utilizing Ranging values) in which, the captured images are processed for improvement first. At that point color image segmentation is done to get target regions (disease spots). Next Homogenize strategies like Sobel and Canny channel are utilized to identify the edges, these removed edge features are utilized as a part of classification to distinguish the disease spots.

P. Revathiet al. [13], proposed work depends on Image Edge detection Segmentation systems in which, the captured images are processed for improvement first. At that point R, G, B color Feature image segmentation is completed to get target regions (disease spots). Afterward, image features, for example, boundary, shape, color and texture are separated for the disease spots to perceive diseases and control the pest recommendation.

S. S. Sannakkiet al. [14], proposed framework, grape leaf image with complex background is taken as info. Thresholding is sent to mask green pixels and image is processed to expel clamor utilizing anisotropic diffusion. At that point grape leaf disease segmentation is finished utilizing K-means clustering. The diseased segment from divided images is distinguished.

R. Gavhaleet al. [15], Proposed framework is demonstrate into four sections image preprocessing including RGB to various color space conversion, image improvement; portion the region of enthusiasm utilizing K-mean clustering for factual utilization to decide the imperfection and seriousness territories of plant leaves, feature extraction and classification. Texture feature extraction utilizing statistical GLCM and color feature by means of mean values. At long last classification accomplished utilizing SVM.

V. METHODOOGY

This section discusses the proposed work process in detail. The fig. 3. Describe the proposed system architecture.

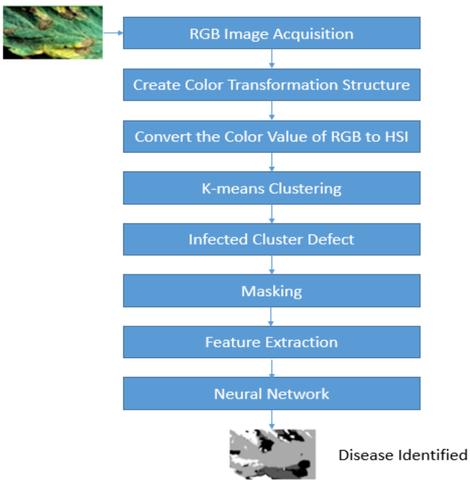


Fig. 3. Proposed System Architecture

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F. RGB Image Acquisition

The image is taken as input. The image of various plant diseases is considered.

G. Trasnformation

The leaves image are transformed into HIS color value. The transformation ought to be conceivable with no loss in the quality of the image. It is transformed to HIS since it relies upon human observation and the system can suitably read each one of the pixels in HSI value.

H. Masking

In this part, the green pixels are expelled to detect diseases. If the green segment is less in the leaves than the RGB segment reset the pixels value to zero.

I. K-Means Clustering

The leaves are divided into 4 particular clusters. It is useful when the quantity of classes is known before. The k-means extracted and puts the pixel data in the clusters. One of the clusters incorporates the infected leaf.

Algorithm: K-Means Clustering

Input: Leaf Images

Output: 4 cluster, with one as infected cluster.

- Features of images denoted as

$$X = \{x_1, x_2, \dots x_n\}$$

- Initialize the cluster, k = 4.
- Select ‘c’ centers, randomly.
- Calculate Euclidean distance for each data point

$\{x_1, x_2, \dots.\}$and so on.

$$Euclidean\ Distance = \sqrt{((x_1 - y_1)^2 + (x_2 - y_2)^2)^2}$$

- Select those data points which are closer.
- New center calculation by below formula.

$$Center(x, y) = \frac{x_1, y_1}{2}, \frac{x_2, y_2}{2}$$

- Repeat steps, until no centroid changes its position.

J. Neural Network Recognization

The neural network is used to find the contaminated leave and its compose. ANN model can feasibly process in light of input parameters and deliver output.

K. Mathematical Equaltion Involved

a. Calculation of Euclidean distance

$$ED = \sqrt{((x_1 - y_1)^2 + (x_2 - y_2)^2)^2}$$

b. Center calculation

$$Center(x, y) = \frac{x_1, y_1}{2}, \frac{x_2, y_2}{2}$$

c. HSI Conversion

$$I = \frac{1}{3}(R + G + B)$$

$$S = 1 - \frac{3}{R + G + B}(\min(R, G, B))$$

$$if\ B \leq G$$

$$H = \cos^{-1}\left[\frac{\frac{1}{2}(R - G) + (R - B)}{\sqrt{(R - G)^2 + (R - B)(G - B)}}\right]$$

Else

$$H = 360 - H$$

VI. RESULTS

We have the database of different leaf plants named SSGI-PL of 67 leaves. We tested our approach onto all of the plant's leaves and sample of a few plants leaves are appeared in fig.4. In this segment, we present the results got from executing all the algorithm. To evaluate and simulate proposed component MATLAB is used. We have simulated our model in MATLAB 2009 version.

Step 01: Input Dataset

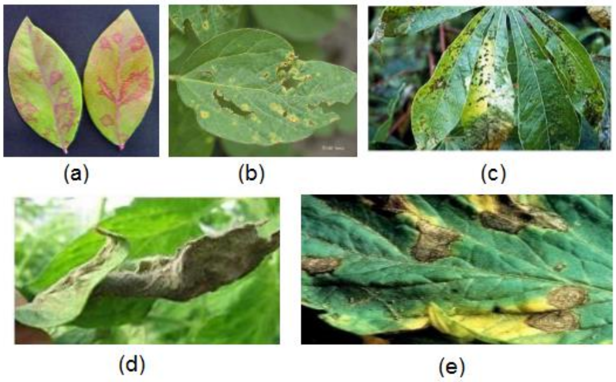


Fig. 4. Input Dataset, (a) SSGI-PL-1, (b) SSGI-PL-2, (c) SSGI-PL-3, (d) SSGI-PL-4, (e) SSGI-PL-5

The fig. 4 is the input image. The input image is changed to remove the RGB component data.

Step 02: Color Transformation

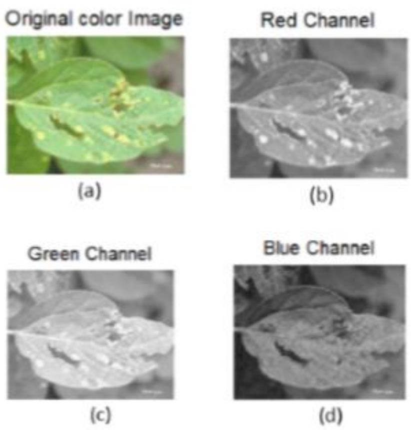
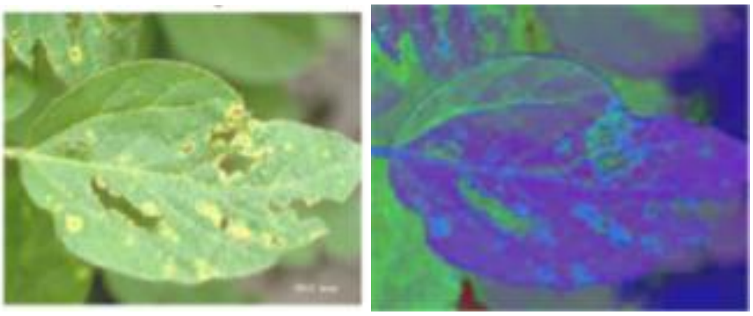


Fig. 5. RGB Color Image of SSGI-PL-2

The fig. 5 shows distinctive components of RGB space.

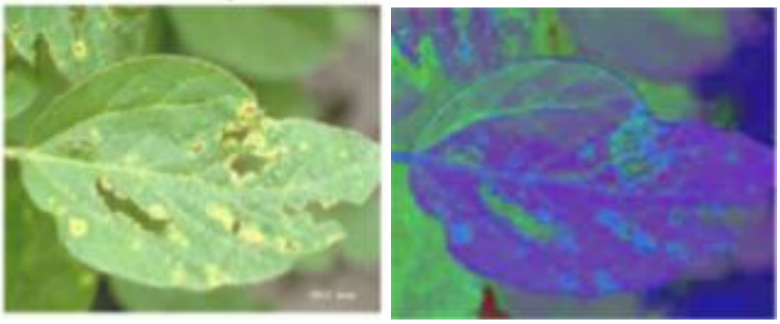
Fig. 6. Demonstrates the transformation of RGB space to HIS space. Fig. 6 d, e, and f demonstrates the Hue, Saturation and Intensities of Leaf.



(a) **(b)**

(c)

Fig. 6. RGB and HSI color space of SSGI-PL-2 (a) RGB Image (b) HSI Image (c) HSI Equalized Image



(a) **(b)**

(c)

Fig. 7. HSI color space of SSGI-PL-2 (a) Hue (b) Saturation(c) Intensity

Step 03: K-Means Clustering

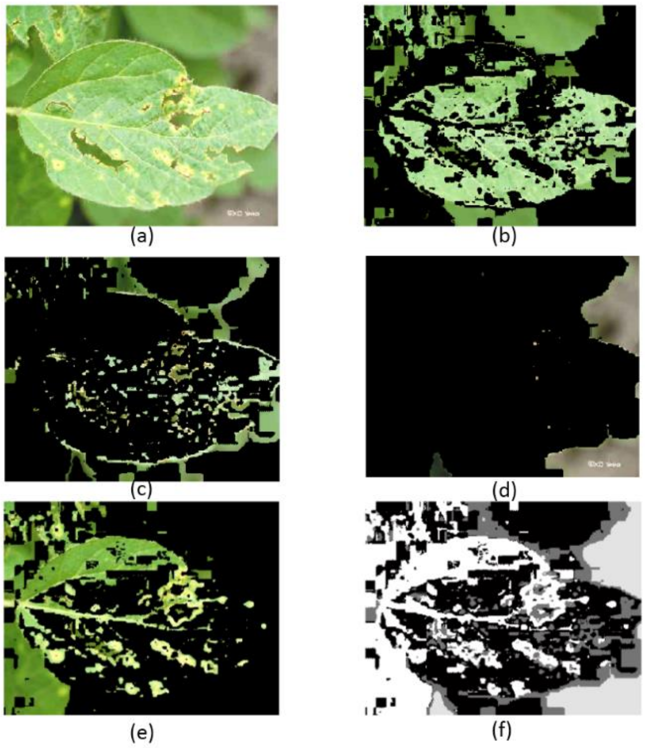


Fig. 8. K-Means Clustering Results of SSGI-PL-2Input Image (b) cluster 1 (c) cluster 2 (d) cluster 3 (e) cluster 4 (f) cluster 5

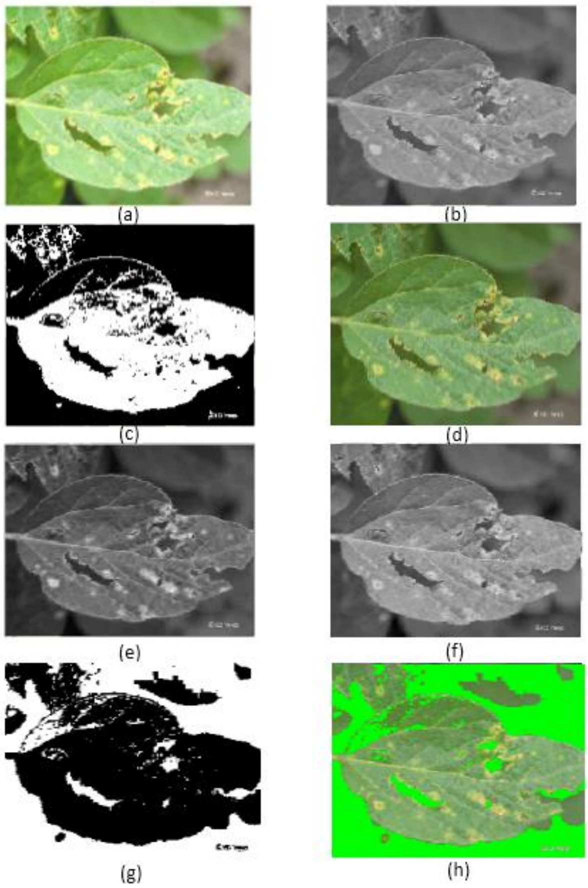


Fig. 9. Green Pixel Masking ofSSGI-PL-2

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Step 04: Detection of Infected Leaf

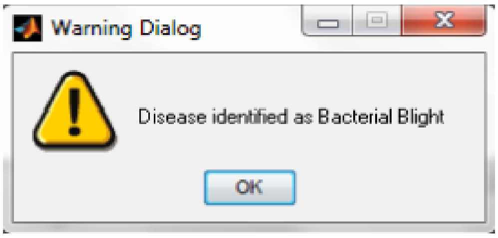

Fig. 10. Shows Detected Infected Leaf for SSGI-PL-2

We have tested most basic plant diseases and results are demonstrated as follows. The dieases are as follows:

a. Anthracnose Infections

b. Ashen Mold

c. Bacterial Blight

d. Bacterial Blight Cassava

e. Blueberry Leaves Disease

f. Early Scorch

Comparison of existing and proposed approach is shown in Fig. 10.

For calculation of accuracy, is done by using the accuracy formula with the help of neural network algorithm.

$$accuracy = \frac{\alpha}{total}$$

Where,

$$\alpha \rightarrow number\ of\ leaf\ identified\ as\ correct\ disease$$

$$total = total\ number\ of\ leaf\ in\ the\ dataset$$

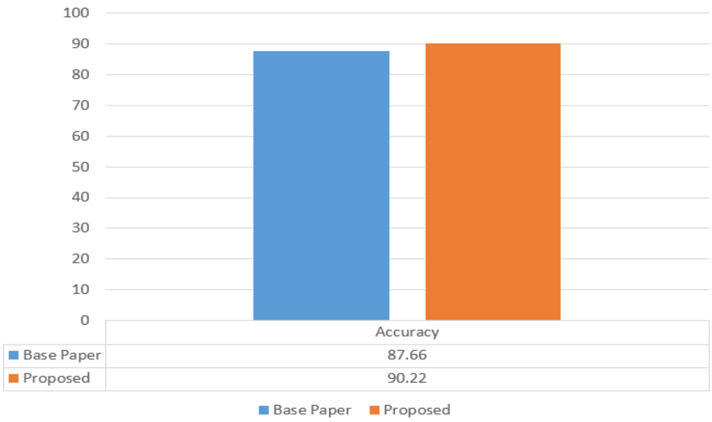

Fig. 11. Comparison betwene proposed and existing approach

Arivazhagan [11] proposes plant leaf disease detection method using SVM. The overall SVM accuracy is 87.66% while our proposed architecture achieves 90.22% of accuracy while classifying the plant disease.

VII. CONCLUSION

The technique which is fundamentally used for the detection and classification of leaf contamination in plants which are K means clustering for segmentation, artificial neural network, Probabilistic Neural network and GLCM and SGLDM for texture analysis. There is few of the challenges appear in these strategies are, it requires tremendous dataset for classification and diseased indications are differs.

The proposed method can easily classify the diseased plant with higher accuracy. The proposed technique uses k-means clustering, Segmentation and Neural network algorithm. The proposed algorithm achieves 2.56% accuracy than the previous classification algorithm.

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