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Agronomic Spot Detection with Image Segmentation & Clustering by Artificial Neural Network

Pritam Singh [1], Shivraj Singh[2,]

[1]*M. Tech Scholar*, [2]*Assistant Professor*

[1,2]*TIT, Bhopal, INDIA*

Abstract - The agriculture sector is the main contributor in Indian economy and doing well in white, green and blue revolution. According to APEDA by 2014 export of Indian agriculture will reach to 5% of total production of the world and rank 10th in the ranking [1]. Agriculture plays very important role in the provision of food surplus to expanding population, contribution to capital formation, provides raw material to industries, market for industrial products and major contribution in international trade. With increasing population, even though the contribution is continuously falling since independence from 55.1% in 1950 to 14% in 2012, it remained the major employment sector with a marginal difference. So there is a need to accelerate the pace for competitive, productive, diversified and sustainable agriculture. Raising agricultural productivity per unit of land, reducing rural poverty through a socially inclusive strategy and ensuring that agricultural growth responds to food security needs are three major challenges for Indian agriculture

Keyword:- Segmentation, Detection, Agricultural.

I. INTRODUCTION

The agricultural land mass is something other than being a nourishing sourcing in this day and age. Indian economy is profoundly reliant of horticultural efficiency. Consequently, in field of agribusiness, location of infection in plants assumes an imperative part. To identify a plant ailment in extremely introductory stage, utilization of programmed malady recognition system is gainful. For example, an illness named little leaf infection is an unsafe malady found in pine trees in United States. The influenced tree has a hindered development and kicks the bucket inside 6 years. Its effect is found in Alabama, Georgia parts of Southern US. In such situations early location could have been productive. The current strategy for plant sickness recognition is essentially bare eye perception by specialists through which recognizable proof and identification of plant infections is finished. For doing as such, an expansive group of specialists and in addition consistent checking of plant is required, which costs high when we do with extensive ranches. In the meantime, in a few nations, ranchers don't have legitimate offices or even thought that they can contact to specialists. Because of which counseling specialists even cost high and also tedious as well. In such conditions, the proposed method turns out to be gainful in observing substantial fields of yields. Programmed location of the ailments by simply observing the indications on the plant leaves makes it simpler and in addition less expensive.

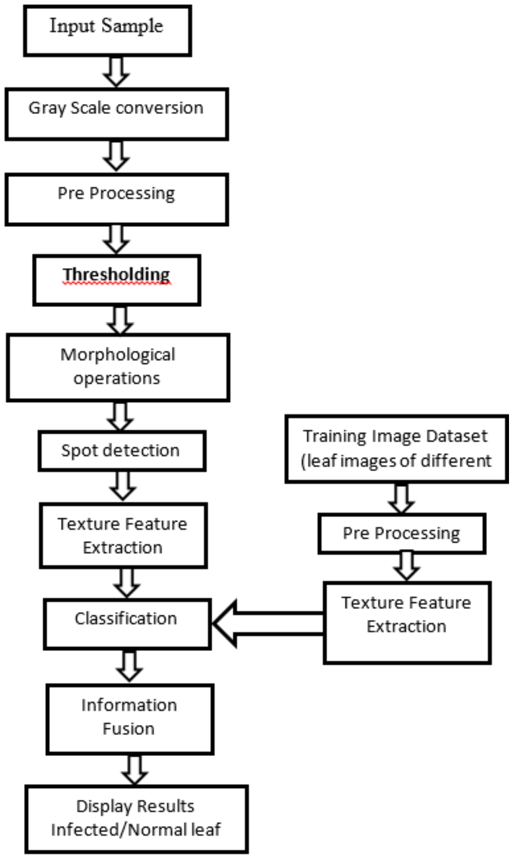


Figure 1.1 ASM chart Procedure

II. LITERATURE SURVEY

Neural network procedures have been effectively pertinent to the conclusion of a few restorative issues. In this study we dissect the diverse neural system strategies for the determination of diabetes. The different information pre-preparing strategies are assessing to enhance the speculating exactness of the neural system calculations. Plant nutrients are essential for the healthy growth of any plant. The plant takes up different nutrients from various sources. It shows visible symptoms on leaves in deficiency as well as toxicity.

2.1 Plant Nutrition: Plant growth and metabolism depends on 17 elements or nutrients even though 60 elements are found in the chemical analysis of plant tissues. Nutrients keep plants healthy which leads to less susceptibility to pests. Nutrients are broadly classified into two: Macro and micro nutrients. Macronutrients are those elements which are required in larger quantity whereas micronutrients are required in lesser quantity [5,6].

2.2 Detection Diseases Computing Techniques- Detection of plant disease through some automatic technique is beneficial as it reduces a large work of monitoring in big farms of crops, and at very early stage itself it detects the symptoms of diseases i.e., when they appear on plant leaves. This paper presents an algorithm for image segmentation technique which is used for automatic detection and classification of plant leaf diseases. It also covers survey on different diseases classification techniques that can be used for plant leaf disease detection.

2.3 Image Processing Based Leaf Disease, Detection- This paper describes the steps to achieve an efficient and inexpensive system acceptable to the farmers and agricultural researchers as well for studying leaf rot disease in betel vine leaf. In this paper, we have implemented Otsu thresholding-based image processing algorithm for segmentation of leaf rot diseases in betel vine leaf. The proposed method was successfully applied to twelve leaf images with very high precision. The proposed scheme will be helpful in the diagnosis of leaf disease. A leaf disease severity11 scale can be prepared by calculating the total leaf area12, 13and finding the percentage diseased area.

2.4 Image Processing Technique of Betel Leaf- This paper includes the easy, accurate, and less expensive method of leaf area measurement. Leaf area of plants is a useful tool in physiological and agronomic studies. Investigation of betel leaf area is done over 100 leaves out of which some are included in this paper. Results are compared with the graphical technique of leaf area measurement.

2.5 Cotton Leaves Using Clustering Method- In this proposal initially preprocessing the input image using histogram equalization is applied to increase the contrast in low contrast image, K-means clustering algorithm is used for segmentation which classifies objects based on a set of features into K number of classes and finally classification is performed using Neural-network. Thus image processing technique is used for detecting diseases on cotton leaves early and accurately. It is used to analyze the cotton diseases which will be useful to farmers. Study of diseases on the cotton leaf can robustly studied by using the image processing toolbox and also the diagnosis by using MATLAB helps us to suggest necessary remedy for that disease arises on the leaf of cotton plant.

2.6 Rice Disease Using Image- The proposed method is useful in crop protection especially large area farms, which is based on computerized image processing techniques that can detect diseased leaves using color information of leaves. It can be summarized by capturing an image of a certain plant leaf followed by extracting feature from the captured image then convert rgb to gray image & resize it, create stem, stirs, canny edge detection, apply various comparison techniques, which would decide the disease and would also detect the type of plants diseases at early stages and enables early control and protection measures. This is an accurate and efficient technique for automatically detection of plant diseased. Rice leaf diseased is detected by using stem, stairs, canny edge detection, surf, entropy, warp, images techniques of image processing.

3.1 Color Image Processing (CIP): -

Color is a powerful descriptor of an object and has an advantage over gray scale. Color information is an important feature like shape, texture which has been successfully used for many image processing applications like object recognition, image matching, CBIR, color image compression. The object in the scene as perceived by human eyes or the camera system is characterized by its radiance R (λ, x, y, t) where λ is the wavelength of the electromagnetic radiation at position (x, y) and at time t for a particular color.

The fundamental difference between color image and gray image is the values assigned. For color images in color space a color vector is assigned to a pixel where as in gray image a gray value is assigned. Thus, in Color Image Processing vector valued functions are used. Depending on the principles of processing CIP can be broadly classified into two classes [8].

1.Monochromatic- based techniques: Planes are treated separately and the results are combined.

2. Vector- valued techniques: Image is considered as a vector value.

3.1.1 **RGB Color Space:** RGB color space is the most commonly used color space for computer application which uses the mixing of three primary colors viz. Red, Green and Blue with wavelength 700, 546.1 and 435.8 respectively. The model is based on the Cartesian coordinate system. Visible colors and wavelengths are not equivalent. In the RGB color space the color image is treated as the vector for three components R, G and B. Digital color image

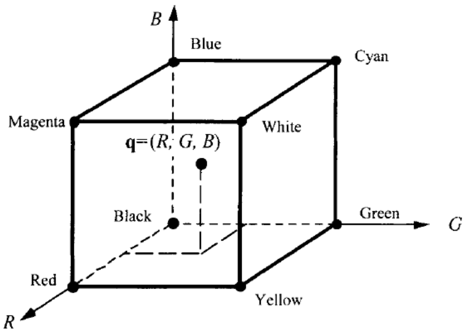


Figure 2.1: RGB color space

3.1.2 CMYK color space - Cyan, Magenta and Yellow are the secondary colors of light or primary colors of pigment. Pure Cyan, Magenta and yellow do not reflect red, green and blue colors respectively. Addition of black color leads to CMYK model which forms base for printing process.

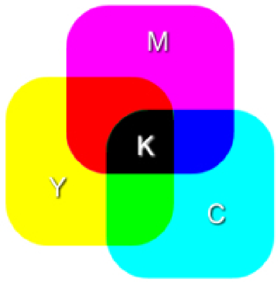


Figure 2.2: CMYK color space

3.1.3 HSI color space: HSI model decouples the intensity from color carrying information (hue and saturation). Hue represents the dominant color, Saturation represents the purity (amount of white added) and I represents the relative brightness. Saturation depends upon the wavelengths of color. Wider the wavelength range the purity is lower and vice versa. HSI color space separates the chromatic and achromatic information in color images. Existence of singularities is the disadvantage of HSI model.

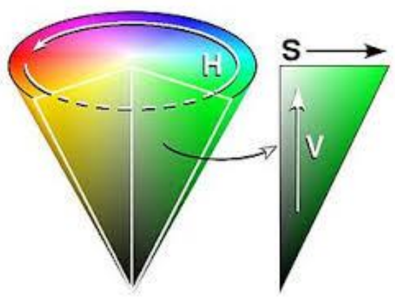


Figure 2.3: RGB color space

3.1.4 HSV color space: Fields of computer vision and computer graphics are always interested in color spaces which intuitively represents human color perception. Colors can be easily described in this color space compared to RGB or CMYK color space. HSV color space is also known as HSB color space with hue, saturation and brightness coordinates.

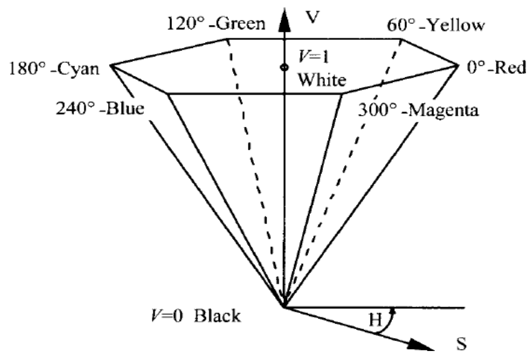


Figure 2.3: RGB color space

3.2 Segmentation Techniques In segmentation phase, the image (such as multi-resolution, multispectral) is divided into its constituent parts as shown in figure (3.1).

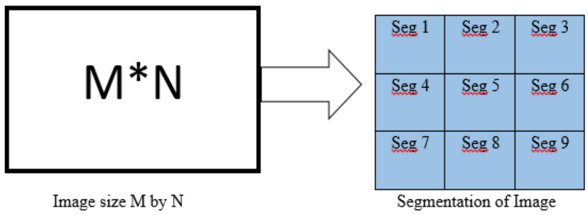


Figure 3.1: Typical Image Segmentation

3.2.1**3 Region Based Segmentation Method** The region-based segmentation methods are the methods that segments the image into various regions having similar characteristics. There are two basic techniques based on this method [3] [8] [26].

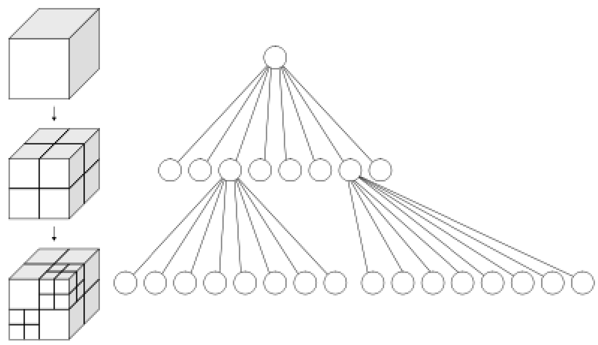


Figure. 3.2 Division of regions based on quad tree

3.3 Clustering Based Segmentation Method - The clustering-based techniques are the techniques, which segment the image into clusters having pixels with similar characteristics. Data clustering is the method that divides the data elements into clusters such that elements in same cluster are more similar to each other than others. There are two basic categories of clustering methods: Hierarchical method and Partition based method. The hierarchical methods are based on the concept of trees. In this the root of the tree represents the whole database and the internal nodes represent the clusters.

3.4 List of plant diseases

Infectious plant diseases are caused by bacteria, fungi, or viruses and can range in severity from mild leaf or fruit damage to death. The following is a list of some of the major plant diseases, grouped by type of causative agent and ordered alphabetically.

3.2.1 Bacterial

- *Aster yellows*
- *Bacterial wilt*
- *Blight*
    - *Fire blight*
    - *Rice bacterial blight*
- *Canker*
- *Crown gall*
- *Rot*
    - *Basal rot*
- *Scab*

3.2.2 Fungal

- *Anthracnose*
- *Black knot*
- *Blight*
    - *Chestnut blight*
    - *Late blight*
- *Canker*
- *Clubroot*
- *Damping-off*
- *Dutch elm disease*
- *Ergot*
- *Fusarium wilt*
    - *Panama disease*
- *Leaf blister*
- *Mildew*
    - *Downy mildew*
    - *Powdery mildew*
- *Oak wilt*
- *Rot*
    - *Basal rot*
    - *Gray mold rot*
    - *Heart rot*
- *Rust*
    - *blister rust*
    - *cedar-apple rust*
    - *Coffee rust*
- *Scab*
    - *Apple scab*
- *Smut*
    - *Bunt*
    - *Corn smut*
- *Snow mold*
- *Sooty mold*
- *Verticillium wilt*

3.2.3 Viral

- *Curly top*
- *Mosaic*
- *Psorosis*
- *Spotted wilt*

3.4.1 Diseases type 1 –Alternaria: - Alternaria alternata, has been confined from various sorts of natural materials in soggy circumstances, including materials, put away sustenance, canvas, cardboard and paper, electric links, polyurethane, fly fuel, sewage and effluents. Alternaria alternata causes dark spot in numerous foods grown from the ground far and wide. It is an inactive organism that creates amid the cool stockpiling of natural products, getting to be obvious amid the promoting time frame along these lines causing extensive postharvest misfortunes.

Figure 4.1 Sample Image

3.4.2 Diseases type 2 - Bacterial: - The problem can be cyclic but is rarely fatal. Anthracnose fungus infects many deciduous and evergreen trees and shrubs, as well as fruits, vegetables and grass. Anthracnose is noticeable along the leaves and the veins as small lesions. These dark, sunken lesions may also be found on stems, flowers and fruits. In order to distinguish between anthracnose and other leaf spot diseases, you should carefully examine the undersides of leaves for a number of small tan to brown dots, about the size of a pin head. If you are unsure about diagnosing anthracnose, consult your local Cooperative Extension office for assistance and additional anthracnose disease info.

Figure 4.2 Sample of Anthracnose

4.1 Parameter to Be Calculated: - By this experimental various parameter is to be calculated according to requirement the no of parameter is to be increased.

4.1.1 Mean Calculation: - The mean is the average of all numbers and is sometimes called the arithmetic mean. To calculate mean, add together all of the numbers in a set and then divide the sum by the total count of numbers.

4.1.2 **Standard Deviation calculation -** Standard deviation is a measure of dispersement in statistics. “Dispersement” tells you how much your data is spread out. Specifically, it shows you how much your data is spread out around the mean or average. For example, are all your scores close to the average? Or are lots of score’s way above (or way below) the average score? Standard deviation represented by σ.

4.1.3 Root Mean Square Calculation - For a set of numbers or values of a discrete distribution, the root-mean-square (abbreviated "RMS" and sometimes called the quadratic mean), is the square root of mean of the values.

4.1.4 Entropy Calculation - In this situation, **entropy** is defined as the number of ways a system can be arranged. The higher the entropy (meaning the more ways the system can be arranged), the more the system is disordered.

4.1.5 Kurtosis Calculation - kurtosis is a statistical measure that is used to describe the distribution. Whereas skewness differentiates extreme values in one versus the other tail, kurtosis measures extreme values in either tail.

4.1.6 Skewness Calculation - Skewness is a term in statistics used to describes asymmetry from the normal distribution in a set of statistical data. Skewness can come in the form of negative skewness or positive skewness, depending on whether data points are skewed to the left and negative, or to the right and positive of the data average.

4.1.7 Correlation Calculation: - Related. For example, height and weight are related; taller people tend to be heavier than shorter people. The relationship isn't perfect. People of the same height vary in weight, and you can easily think of two people you know where the shorter one is heavier than the taller one. Nonetheless, the average weight of people 5'5" is less than the average weight of people 5'6", and their average weight is less than that of people 5'7", etc. Correlation can tell you just how much of the variation in peoples' weights is related to their heights.

4.1.8 Energy calculation - Leaf is a renewable energy and sustainable technology investment firm providing venture and growth capital across the renewable energy industry to support innovative, well-managed, rapidly-growing companies. Leaf is backed by some of the world's leading institutional investors.

4.1.9 Homogeneity Calculation - In physics, a homogeneous material or system has the same properties at every point; it is uniform without irregularities.

4.1.10 Variance Calculation- In probability theory and statistics, variance is the expectation of the squared deviation of a random variable from its mean. Informally, it measures how far a set of (random) numbers are spread out from their average value. Variance has a central role in statistics, where some ideas that use it include descriptive statistics, statistical inference, hypothesis testing, goodness of fit, and Monte Carlo sampling.

III. SIMULATION RESULT

5.1 GUI Representation - GUIs (also known as graphical user interfaces or UIs) provide point-and-click control of software applications, eliminating the need to learn a language or type commands in order to run the application. MATLAB apps are self-contained MATLAB programs with GUI front ends that automate a task or calculation.

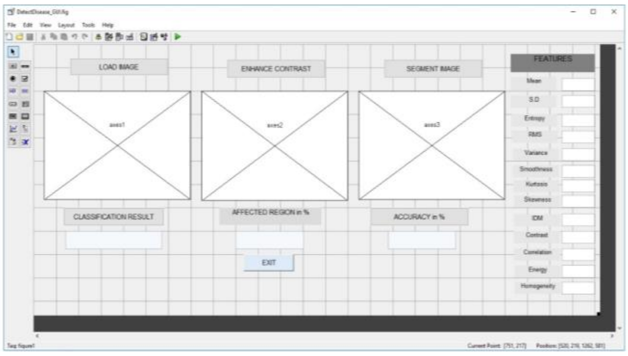


Figure 5.1 Graphical User Interfaces for proposed work

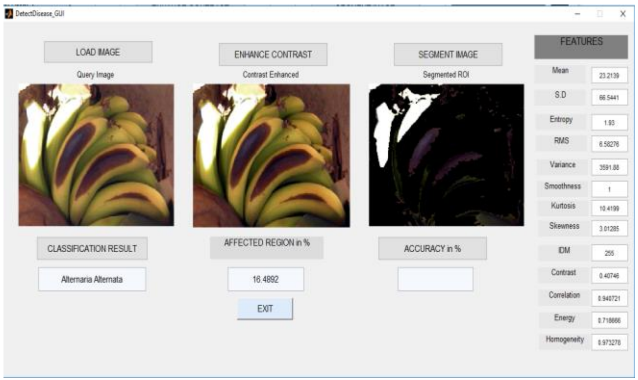


Figure 5.2 Image Graphical User Interfaces for proposed work

5.2 Simulation Result of Object One & Two:- Cucurbits and Cherrey object we can take for result simulation we can calculate various parameter.

Figure 5.3 (a) Original Banana image (b) Enhance contrast Image

Figure 5.4 (a) Banana cluster 1 (b) Banana cluster 2 (c) Banana cluster 3

Figure 5.5 (a) Original Tamoto image (b) Enhance contrast Image

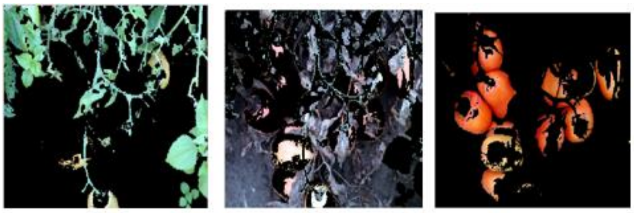


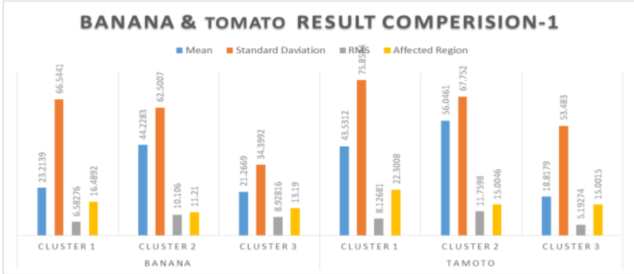
Figure 5.6 (a) Tamoto cluster 1 (b) Tamoto cluster 2 (c) Tamoto cluster 3

5.2.1 Various Parameter Representation of Object One & Two- Object One and Object Two various result represent in the table.

Parameter	Banana			Tomato		
	Cluster 1	Cluster 2	Cluster 3	Cluster 1	Cluster 2	Cluster 3
Mean	23.2139	44.2283	21.2669	43.5312	56.0461	18.8179
Standard Daviation	66.5441	62.5007	34.3992	75.8584	67.752	53.483
RMS	6.58276	10.106	8.92816	8.12681	11.7598	5.19274
Affected Region	16.4892	11.21	13.19	22.3008	15.0046	15.0015
Entropy	1.93	4.38655	3.27084	2.88409	5.33461	1.78971
Kutosis	10.4199	3.69662	4.93272	3.30907	3.22933	11.0254
Contrast	0.40746	0.508824	1.54856	1.6706	1.92381	0.576072
Smoothness	1	1	1	1	1	1
Correlation	0.940721	0.919914	0.845914	0.833524	0.732962	0.845276
Energy	0.718666	0.319507	0.456883	0.489647	0.216789	0.686281
Homogeneity	0.973278	0.935685	0.952956	0.900646	0.817553	0.954567
Variance	3591.88	3213.28	841.182	5286.29	4391.17	2227.97
Skewness	3.01285	1.29476	1.57327	1.38143	1.08424	2.9975
IDM	255	255	255	255	255	255
Accuracy in %	98.3871	96.7742	98.3871	98.3871	98.3871	96.7742
Classification Result	Alternaria Alternata	Healthy Leaf	Healthy Leaf	Cercospora Leaf Spot	Cercospora Leaf Spot	Alternaria Alternata

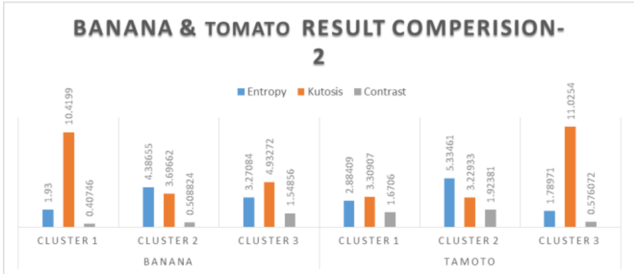
Table 5.1 Result Representation of Cucurbits & Cherry

5.2.2 Graph Representation of Mean, Standard Deviation, RMS and Affected Region- In this section we can do the comparative study analysis of Mean, Standard Deviation, RMS and Affected Region.



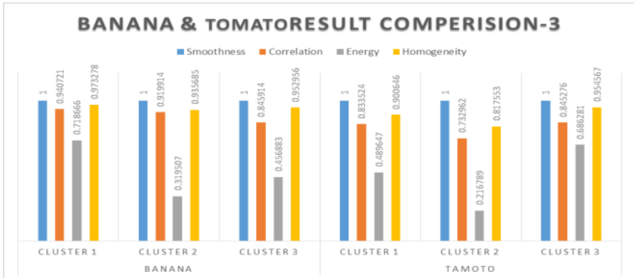
Graph 5.1 Mean, Standard Deviation, RMS and Affected Region (Banana &Tomato)

5.2.3 Graph Representation of Skewness, Entropy, Kutosis, Contrast and Smoothness- In this section we can do the comparative study analysis of Entropy, Kutosis, Contrast and Smoothness.



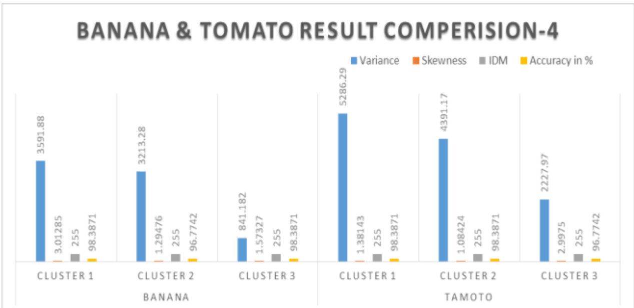
Graph 5.2 Entropy, Kutosis, Contrast and Smoothness (Banana & Tomato)

5.2.4 Graph Representation of Correlation, Energy & Homogeneity- In this section we can do the comparative study analysis of Correlation, Energy & Homogeneity.



Graph 5.3 Correlation, Energy & Homogeneity (Banana & Tomato)

5.2.5 Graph Representation of IDM, Variance, Accuracy - In this section we can do the comparative study analysis of IDM, Variance, Accuracy.



Graph 5.4 IDM, Variance, Accuracy. (Banana &Tomato)

5.3 Simulation Result of Object Three & Four: - Sample Image-3 and 4object we can take for result simulation we can calculate various parameter**.**

Figure 5.7 (a) Sample Image-3 (b) Enhance Sample Image-3

Figure 5.8 (a) Sample-III cluster 1 (b) Sample-III cluster 2 (c) Sample-III cluster 3

Figure 5.9 (a) Original Tomato image (b) Enhance contrast Image

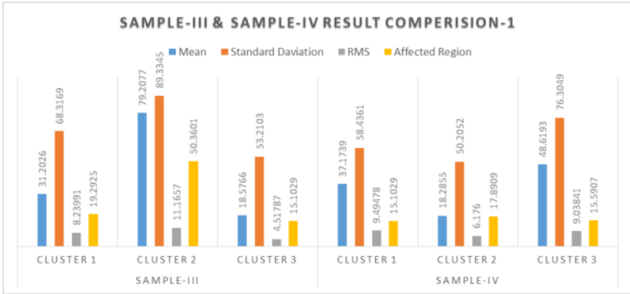
Figure 5.10 (a) Tomato cluster 1 (b) Tomato cluster 2 (c) Tomato cluster 3

5.3.1 Various Parameter Representation of Object Three & Four - Object Three and Object Four various result represent in the table.

Parameter	Sample-III			Sample-IV		
	Cluster 1	Cluster 2	Cluster 3	Cluster 1	Cluster 2	Cluster 3
Mean	31.2026	79.2077	18.5766	37.1739	18.2855	48.6193
Standard Daviation	68.3169	89.3345	53.2103	58.4361	50.2052	76.3049
RMS	8.23991	11.1657	4.51787	9.49478	6.176	9.03841
Affected Region	19.2925	50.3601	15.1029	15.1029	17.8909	15.5907
Entropy	3.36339	4.88679	1.57573	3.88398	2.38192	3.76916
Kutosis	6.28899	1.51576	9.8206	4.14353	11.121	2.97509
Contrast	1.1627	2.08658	2.55255	1.60432	0.811351	1.06837
Smoothness	1	1	1	1	1	1
Correlation	0.8544	0.851963	0.838476	0.741051	0.79567	0.90113
Energy	0.665498	0.253792	0.723652	0.33425	0.710206	0.387145
Homogeneity	0.958314	0.89423	0.951409	0.889226	0.938088	0.930789
Variance	4364.23	7120.32	2401.28	2890.79	2329.11	4453.53
Skewness	2.19764	0.469221	2.84279	1.47105	2.98181	1.24382
IDM	255	255	255	255	255	255
Accuracy in %	98.3871	98.3871	96.7742	96.7742	98.3871	98.3871
Classification Result	Alternaria Alternata	Cercospora Leaf Spot	Alternaria Alternata	Alternaria Alternata	Alternaria Alternata	Cercospora Leaf Spot

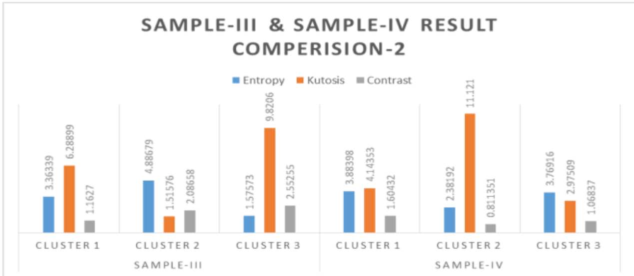
Table 5.2 Result Representation of Sample-III& Sample-IV

5.3.2 Graph Representation of Mean, Standard Deviation, RMS and Affected Region- In this section we can do the comparative study analysis of Mean, Standard Deviation, RMS and Affected Region



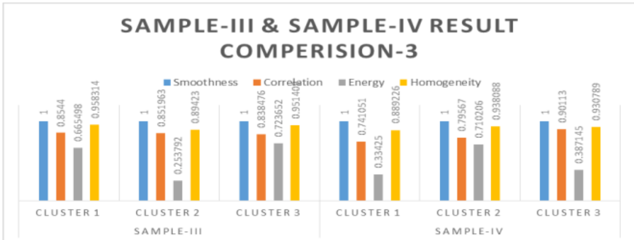
Graph 5.5 Mean, Standard Deviation, RMS and Affected Region (Sample-III & Sample-IV)

5.3.3 Graph Representation of Skewness, Entropy, Kutosis, Contrast and Smoothness- In this section we can do the comparative study analysis of Entropy, Kutosis, Contrast and Smoothness



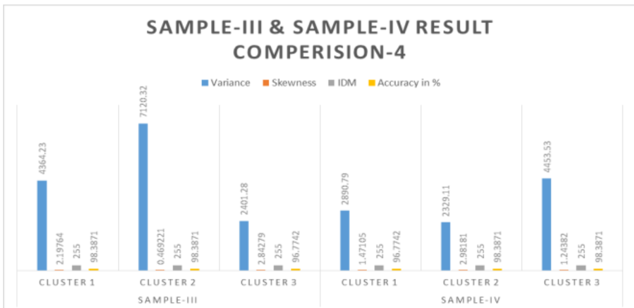
Graph 5.6 Entropy, Kutosis, Contrast and Smoothness (Sample-III & Sample-IV)

5.3.4 Graph Representation of Correlation, Energy & Homogeneity- In this section we can do the comparative study analysis of Correlation, Energy & Homogeneity.



Graph 5.7 Correlation, Energy & Homogeneity (Sample-III & Sample-IV)

5.3.5 Graph Representation of IDM, Variance, Accuracy - In this section we can do the comparative study analysis of IDM, Variance, Accuracy.



Graph 5.8 IDM, Variance, Accuracy (Sample-III & Sample-IV)

IV. CONCLUSIONS

The method reported in the thesis can be used to design a soya bean expert system for farmers for the early detection of plant foliar infection, infection grading and getting the appropriate cure remotely. Through the thesis work, we have tried to highlight the problems associated with the cultivation of soybean and causes of low yield loss in the developing countries like India. It has been taken-up six soya plant foliar diseases, namely; Rust, Bacterial Blight, Sudden Death Syndrome, Brown Spot, Downy Mildew, and Frog Eye, which are mainly responsible for significant yield loss; it has been proposed a fully automatic method for identification and classification by different digital image processing techniques and also to classify the disease severity level using five classes. It has been derived and development various new parameters and indices like DSI, IPR, DLP, which are subsequently used for disease level prediction.

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