Artificial Neural Network Based On Image Segmentation Technique For Plant Leaf Disease Detection

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Abstract - India is a country where Agronomic production is approximately on which economy extremely depends. This is the one of the reasons that infection identification in flowers, vegetable, corp, leaf plays an important role in agriculture field, as having infection in land & Field are relatively usual. If appropriate action can take to care in this field then it foundations thoughtful properties on plants and due to which particular production quality percentage, quantity or efficiency of production is affected. For the proposed work we try to explain the type of disease detection with the help of Artificial Neural Network approach in this method we have a very huge amount of dataset which either save in the system or save in the server if this work can be implanted over worldwide. For implantation of the work MATLAB software is used with the help of ANN the infected sample is selected or online we can take any sample by on site clicking the photograph of any leaf, flower, corp, vegitalble and call this sample by MTALAB GUI and then enhance the contrast of sample image then we segment the image by clustering approach we can separate the image in different cluster and each cluster can be properly examined by the simulation tools. There are various parameter that can be calculated by the software like Mean, Standard image. This proposed algorithm which help us to Annalise the sample of any of the agricultural product either it can use on site or by the help of any of the communication method to collect the sample real time implementation of the proposed algorithm is also possible.

I. INTRODUCTION

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 [2].

1.2 Digital Image Processing :- Advanced picture handling is essential field of outlining and development. In current period each field relies upon the employments of modernized picture dealing with, in cutting edge picture getting ready, automated depiction of pictures for the most part require a generous number of bits. In various applications, it is basic to examine approach for suggesting a photo, or the information contained in the photo, with less bits. By wiping out dull or unnecessary information, picture weight is the development that tends to this point. Picture getting ready systems have been associated with a couple of scopes of picture and video taking care of, for instance, correspondence, video conferencing et cetera. In the automated picture and video weight it is required to diminish bit rate need and improves speed of transmission.

1.3 Image Compression - Picture pressure is essential term for successful transmission and picture stockpiling. Necessity of picture pressure is in correspondence framework for the information and picture change, it is need of telecom industry, in the field of sight and sound information in the broadcast communications system and ring the mixed media information through Internet. Some other necessity of picture pressure is as in the field of advanced cameras, prerequisites for information stockpiling, control, and exchanges of computerized pictures, has grown violently [22]. These picture records can be huge and can involve expansive memory.

1.4 Feature Extraction - By feature extraction we can diminish the picture into few numbers or gatherings of numbers that depict the material components of the picture [26]. These components fundamental be deliberately chosen such that they create great portrayal of the picture and outline the basic data. Certain cases of elements are mean, standard deviation, angle and edges of picture. More often than not, a gathering of components is utilized to deliver a model for the pictures. By Cross validation on the pictures we can see which highlights speak to the picture well.

1.5 SEGMENTATION OF IMAGE :- Image segmentation is generally the first stage in any attempt to analyze or interpret an image automatically. It can also be regarded as a process of grouping together pixels that have similar attributes (Rafael et al 2002). Segmentation partitions an image into distinct regions that are meant to correlate strongly with objects as features of interest in the image. Segmentation is a critical component of computer vision system because errors in this process will be propagated to higher-level analysis processes and increases the complexity of the subsequent tasks. Ideally the segmented regions within the image should have the following characteristics.

II. LITERATURE REVIEW

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.

[1] Vijai Singh et all in "Detection of plant leaf diseases using image segmentation and soft computing techniques in INFORMATION PROCESSING IN AGRICULTURE 4 (2017) 41–49" in 2017 Proposed Agricultural productivity is something on which economy highly depends. This is the one of the reasons that disease detection in plants plays an important role in agriculture field, as having disease in plants are quite natural. If proper care is not taken in this area then it causes serious effects on plants and due to which respective product quality, quantity or productivity is affected. For instance a disease named little leaf disease is a hazardous disease found in pine trees in United States. 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.

2.4 Image Processing Based Leaf Rot Disease, Detection Of Betel Vine (Piper Betlel.) - [2] Amar Kumar Dey et all in "Image Processing Based Leaf Rot Disease, Detection of Betel Vine (Piper BetleL.)" in International Conference on Computational Modeling and Security 2016 Proposed deals with leaf rot disease detection for betel vine (*Piper betel* L.) based on image processing algorithm. The measurement of plant features is a fundamental element of plant science research and related applications. The information related to plant features is especially useful for its applications in plant growth modeling, agricultural research and on farm production. Few methods have been applied in leaf rot disease detection for betel vine leaf (*Piper Betel* L.).

[3] Amar Prasad Soni et all in "An Image Processing Technique for Estimation of Betel Leaf Area" in Electrical, Electronics, Signals, Communication and Optimization (EESCO), 2015 The green heart shaped betel leaf, in India it is known as Paan. It is useful in number of traditional remedies such as weakness of nerves, stomach disorder, headache, respiratory disorders, constipation, sore throat, inflammation, scanty or obstructed urination and wounds. There are many more traditional uses of the betel leafs. 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.

[4] Pawan P. Warne et all in "Detection of Diseases on Cotton Leaves Using K-Mean Clustering Method" in International Research Journal of Engineering and Technology Volume: 02 Issue: 04 in 2015 proposed an approach for careful detection of diseases, diagnosis and timely handling to prevent the crops from heavy losses. The diseases on the cotton are critical issue which makes the sharp decrease in the production of cotton. So for the study of interest is the leaf rather than whole cotton plant because about 85-95 % of diseases occurred on the cotton leaves like Alternaria, Cercospora and Red Leaf Spot. 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.

[5] Daisy Shergill et all in "EXTRACTION OF RICE DISEASE USING IMAGE PROCESSING" In INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY in 2015 proposed a Crop diseases cause significant damage and economic losses in crops worldwide. It is difficult for farmers as well as experts/doctors to identify the symptoms of diseases correctly and to specify right remedy. It is very difficult task for farmers to monitor the large farms always so farmers are in great need to develop a computerized system that monitors crop when it is infected with diseases. This can be performed by capturing an image of a crop leaf, then extracting a predefined feature from the captured image and finished by determining the disease.

[6] Malvika Ranjan et all in "DETECTION AND CLASSIFICATION OF LEAF DISEASE USING ARTIFICIAL NEURAL NETWORK" in International Journal of Technical Research and Applications in 2015 proposed a Farmers experience great difficulties in changing from one disease control policy to another. Relying on pure naked-eye observation to detect and classify diseases can be expensive. Various plant diseases pose a great threat to the agricultural sector by reducing the life of the plants. The present work is aimed to develop a simple disease detection system for cotton diseases. The symptoms of the attacks are usually distinguished through the leaves, stems or fruit inspection. This proposed system discusses the effective way used in performing detection of plant diseases through leaf feature inspection. Leaf image is captured and proposed to determine the health status of cotton plant. Plant disease diagnosis is an art as well as science. The diagnosis process (i.e. recognition of symptoms and signs), is inherently visual and requires intuitive judgment as well as the use of scientific methods. The work begins with capturing the images.

[7] Prakash M. Mainkar et all in "Plant Leaf Disease Detection and Classification Using Image Processing Techniques" International Journal of Innovative and Emerging Research in Engineering in 2015 proposed Agriculture is the mainstay of the Indian economy. Almost 70% people depend on it & shares major part of the GDP. Diseases in crops mostly on the leaves affects on the reduction of both quality and quantity of agricultural products. Perception of human eye is not so much stronger so as to observe minute variation in the infected part of leaf. In this paper, we are providing software solution to automatically detect and classify plant leaf diseases. In this we are using image processing techniques to classify diseases & quickly diagnosis can be carried out as per disease. This approach will enhance productivity of crops. It includes several steps viz. image acquisition, image pre-processing, segmentation, features extraction and neural network based classification.

III. THEORY OF PROPOSED WORK

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.

Physics and technique based color spaces

RGB color space

CMYK color space

YIQ color space

YUV color space

YC_BC_R color space

Kodak YC_1C_2 color space

$I_1I_2I_3$ color space

1. Uniform Color space

CIELAB color space

CIELUV color space

2. Perception-based color space

HSI color space

HSV Color space

3.2 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.

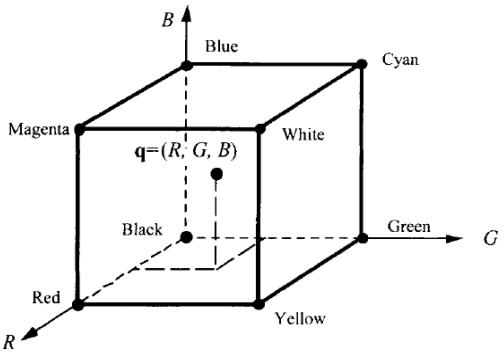


Figure 2.1: RGB color space

3.3 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.

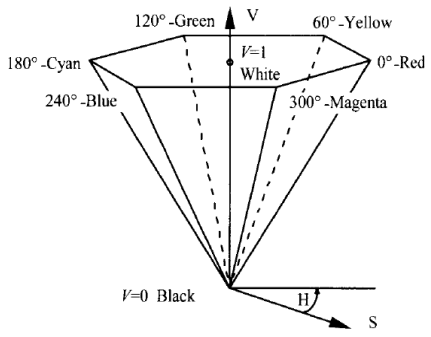


Figure 2.2: Hexagon representation of HSV color space.

3.5 Segmentation Techniques :- In segmentation phase, the image (such as multi-resolution, multispectral) is divided into its constituent parts

- Thresholding Based Methods
- Edge Based Methods
- Region Based Segmentation Method
- Clustering Based Segmentation Method
- Watershed Based Methods
- PDE Based Method
- ANN Based Method

3.5.1 **Thresholding Based Methods** - Thresholding methods are the simplest methods for image segmentation. These methods divide the image pixels with respect to their intensity level. These methods are used over images having lighter objects than background. The selection of these methods can be manual or automatic i.e. can be based on prior knowledge or information of image features. There are basically three types of thresholding.

3.5.2 **Global Thresholding**: This is done by using any appropriate threshold value/T. This value of T will be constant for whole image. On the basis of T the output image ***q (x,y)*** can be obtained from original image ***P (x,y)*** as:

$$q(x,y) = \begin{cases} 1, if\ p(x,y) > T \\ 0, if\ p(x,y) \leq T \end{cases} \qquad (1)$$

3.5.3Variable Thresholding: In this type of thresholding, the value of T can vary over the image. This can further be of two types:

1 .Local Threshold: In this the value of T depends upon the neighbourhood of x and y.

2. Adaptive Threshold: The value of T is a function of x and y.

3.5.4 Multiple Thresholding: In this type of thresholding, there are multiple threshold values like T0 and T1. By using these output image can be computed as:

3.5.5 Edge Based Segmentation Method :- The edge detection techniques are well developed techniques of image processing on their own. The edge based segmentation methods are based on the rapid change of intensity value in an image because a single intensity value does not provide good information about edges.

3.5.6 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].

IV. LIST OF PLANT DISEASES

Diseases type 1 - Alternaria - The shape Alternaria is a very much perceived sensitivity causing organism. Alternaria spores can be recognized from spring through pre-winter in most calm territories, and can achieve levels of thousands of spores for every cubic meter of air. Alternaria spores can be at their most elevated fixations amid dry, breezy conditions that are perfect for the spores to end up airborne. Alternaria is right now contained around 40-50 species. It is ordinarily disengaged from plants, soil, sustenance, and indoor air. One of the animal categories, Alternaria alternate, 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.

Figure 4.1 Sample Image

Diseases type 2 - Bacterial - This fungal sickness disturbs several plants, comprising vegetables, fruits, and trees. It foundations gloomy, dipped lesions on leaves, stems, flowers, and fruits. It also occurrences unindustrialized discharges and intensifying leaves. It canister spread very quickly all through drizzly periods. Anthracnose is a general term for a variety of diseases that affect plants in similar ways. Anthracnose is especially known for the damage that it can cause to trees. Anthracnose is caused by a fungus, and among vegetables, it attacks cucurbits. Anthracnose can survive on infected plant debris and is very easily spread. Like rust, it thrives under moist and warm conditions and is often spread by watering. Anthracnose is a fungal disease that tends to attack plants in the spring when the weather is cool and wet, primarily on leaves and twigs. The fungi overwinter in dead twigs and fallen leaves.

Figure 3.4 Sample of Anthracnos**e**

Diseases type 3 Bacterial Blight - In the vegetable garden, bacterial blight is most often a problem on snap beans and lima beans. (Note that other crops also suffer from bacterial diseases that may be called bacterial blight.) Symptoms of infection are large, water-soaked, pale green spots on leaves that later turn brown. These spots may also appear on pods and can produce a yellowish ooze in wet weather. Leaves infected with halo bacterial blight develop many small dead spots with yellow halos around them; spots on pods produce a cream-colored ooze. Bacterial blight is a widespread soybean disease that is most common during cool, wet weather.

Figure 3.5 Sample of Bacterial Blight

V. PROBOLEM FORMULATION & PARMETER TO BE CALCULATED

5.1 **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.

$$\mu = \sum x\, P(x)$$

5.2 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.

5.3 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.

5.4 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.

5.5 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.

5.6 **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.

5.7 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.

5.8 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.

5.9 Homogeneity Calculation - In physics, a homogeneous material or system has the same properties at every point; it is uniform without irregularities. A uniform electric field (which has the same strength and the same direction at each point) would be compatible with homogeneity (all points experience the same physics). A material constructed with different constituents can be described as effectively homogeneous in the electromagnetic materials domain, when interacting with a directed radiation field (light, microwave frequencies, etc.)

VI. SIMULATION RESULT

6.1 Simulation Result of Object One & Two :- Banana and Tomato object we can take for result simulation we can calculate various parameter**.**

Figure 6.1 (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

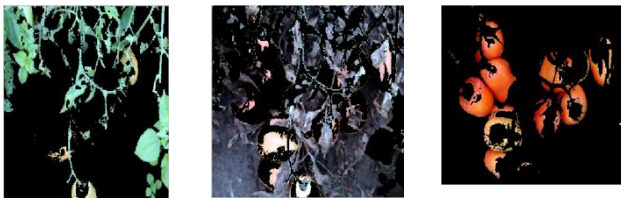


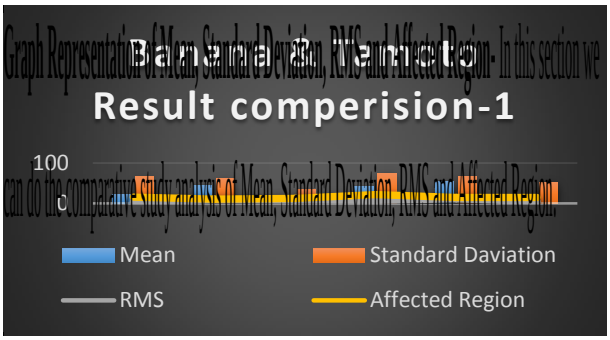
Figure 5.6 (a) Tamoto cluster 1 (b) Tamoto cluster 2 (c) Tamoto cluster 3

6.2 Various Parameter Representation of Object One & Two- Object One and Object Two various result represent in the table 5.1.

6.3 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.

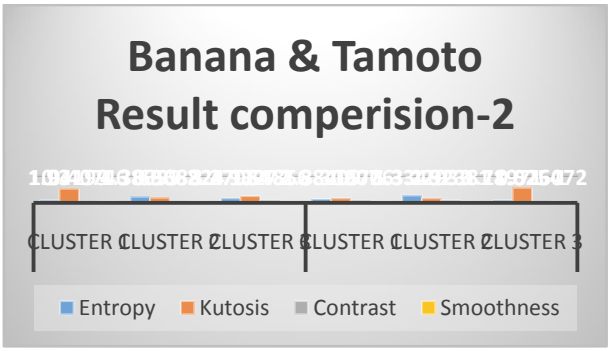
Table 5.1 Result Representation of Banana & Tomato

Parameter	Banana			Tamoto		
	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	1.93	4.38655	3.27084	2.88409	5.33461	1.78971
Entropy	10.4199	3.69662	4.93272	3.30907	3.22933	11.0254
Kutosis	0.40746	0.508824	1.54856	1.6706	1.92381	0.576072
Contrast	3591.88	3213.28	841.182	5286.29	4391.17	2227.97
Smoothness	0.940721	0.919914	0.845914	0.833524	0.732962	0.845276
Correlation	0.718666	0.319507	0.456883	0.489647	0.216789	0.686281
Energy	0.973278	0.935685	0.952956	0.900646	0.817553	0.954567
Homogeneity	1	1	1	1	1	1
Variance	3.01285	1.29476	1.57327	1.38143	1.08424	2.9975
Skewness	255	255	255	255	255	255
IDM	Alternaria Alternata	Healthy Leaf	Healthy Leaf	Cercospora Leaf Spot	Cercospora Leaf Spot	Alternaria Alternata
Accuracy in %	16.4892	None	None	22.3008	15.0046	15.0015
Classification Result	98.3871	96.7742	98.3871	98.3871	98.3871	96.7742



Graph 5.1 Mean, Standard Deviation, RMS and Affected Region

6.4 **Graph Representation of Entropy, Kutosis, Contrast Smoothness Skewness, -** 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)

6.4 Sample Image-3 and 4 object we can take for result simulation we can calculate various parameter**.**

Figure 5.3 (a) Apple Image-3 (b) Enhance Sample Image-3

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

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

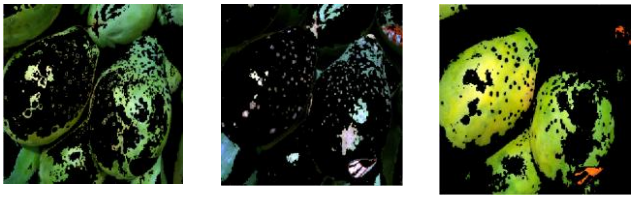


Figure 5.6 (a) Papaya cluster 1 (b) Papaya cluster 2 (c) Papaya cluster 3

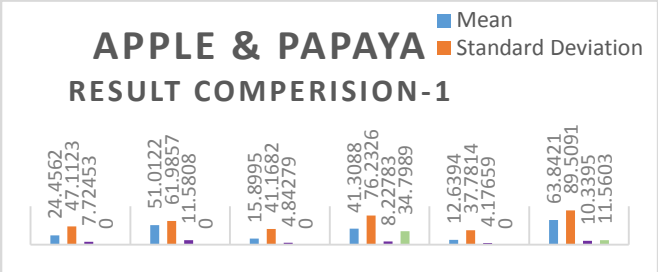
6.5 **Various Parameter Representation of Object Three & Four -** Object Three and Object Four various result represent in the table.

Parameter	Apple			Papaya		
	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

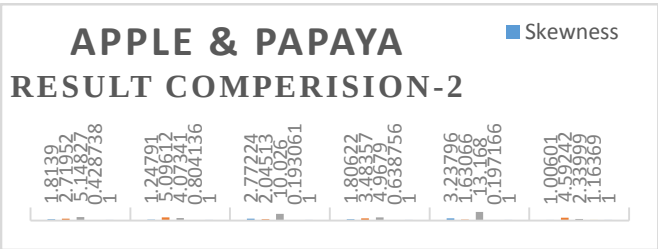
Table 5.2 Result Representation of Apple & Papaya

6.6 **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 (Apple & Papaya)

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



Graph 5.6 Entropy, Kutosis, Contrast and Smoothness (Apple & Papaya)

VII. CONCLUSION AND FUTURE SCOPE

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. The methodology has been implemented successfully and performance tested on a real set of soya leaf data. The result is quite convincing and wide adaptability in developing countries, where such information plays an important role for improvement in yield. The proposed method uses mobile cams for capturing the diseased images and does not require any kind of special training and sophisticated capturing devices. The proposed method is (i) fully automatic for ROI calculation, background separation and parameter.

VIII. REFERENCES

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