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PLANT LEAF DISEASE DETECTION USING IMAGE SEGMENTATION BASED ON CLUSTERING WITH ARTIFICIAL NEURAL NETWORK TECHNIQUE

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***Abstract* - This research work present survey on plant leaf disease detection using Image Segmentation based on clustering with Artificial Neural Network technique. Disease in crops causes significant reduction in quantity and quality of the agricultural product. Identification of indications of disease by stripped discernment is problematic for farmer. Crop fortification exclusively in huge farm house is done by using computer image processing technique that can detect diseased leaf using color information of leaves.**

***Keywords* - leaf disease, k-means clustering, Image segmentation, Neural network.**

1. INTRODUCTION

Creating nations like India the economy is significantly depend upon farming. Developing countries like India the economy is greatly depend on agriculture. The quantity and quality of agricultural merchandise is concentrated due to plant disease. Plant disease is caused by micro-organism like fungi and bacteria .the lifecycle of micro-organism is unable to predict .some disease do not have visibility during early stage it only appear that final stage. The prediction of plant disease by naked eye is used in practice but results are subjective and disease extent is not precisely measured. Nowadays automatic detection of plant disease is an important research topic and thus automatically detects the diseases from the symptoms that appear on the plant leaves.

Depending on the applications, many image processing technique has been introduced to solve the problems by pattern recognition and some automatic classification tools. In the next section this papers present a survey of those proposed systems in meaningful way.Some following Points are:

2. LITERATURE SURVEY

The various approaches for detecting the disease in plant leaf using image processing technique is described in this section

Vijai Singh et all [1] describe the 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.

Amar Kumar Deya et all [2] discuss 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.).

A.P Soni et all [3] Proposed a 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.

Pawanp.warne& et.al., [4] describes the approach to prevent the crops from heavy loss by careful detection of disease. In cotton, diseases in leaf are critical issue because it reduces the production of cotton. The region of interest is leaf because most of diseases occur in leaf only. The diseases that occur in cotton leaf are Alternaria, Cercospora and

Red Leaf Spot. Histogram equalization is used to s the input image to increase the contrast in low contrast image, K-means clustering algorithm which classifies objects.

Daisy shergill& et.al.,[5] describes a approach is useful in crop protection especially in large area farms, which is based on automated techniques that can detect diseased leaves using color information of leaves. The disease can be detected by capturing an image of a certain plant leaf followed by extracting feature from the captured image.

MalvikaRanjan& et.al.,[6] describes a diagnosis process that is mostly visual and requires precise judgment and also scientific methods. Image of diseased leaf is captured . performance is 80% better in accuracy.

RenukaRajendraKajale [7] describes the approach for detection and computation of texture information for plant leaf diseases. The processing system consists of four main steps, color image is converted to HSI, then the green pixels are masked and removed using specific threshold value.

Prakash M. Mainkar& et.al.,[8] provides a software solution to automatically detect and classify plant leaf disease. This approach will increase productivity of crops.

Mr. Sachin B. Jagtap& et.al., [9] describes a system consists of four stages; the first stage is the image enhancement, which includes, histogram analysis, HSI enhancement and intensity adjustment. Fuzzy c-means algorithm is used for segmentation of captured image.

Niket Amoda& et.al., [10] provide image processing based solutions that are automatic, cheap, and accurate. Solution is composed of four main steps; in the first step the RGB leaf image is transformed to other color model. Next, in the second step, the transformed images are segmented to obtain better information .the K-means clustering techniques used for segmenting the input image.

SmitaNaikwadi&et.al.,[11]describes the approach that has different steps. In first step, mostly green colored pixels are identified. Next, based on specific threshold values green pixels are masked. Otsu's method computes threshold value to mask the green pixels.

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Anand.H.Kulkarni et.al., [12] describes the approach begins with capture of leaf the images from agricultural field. Gabor filter is used segment the input image before feature extraction.

3. IMAGE SEGMENTATION

The Image segmentation is referred to as one of the most important processes of image processing. Image segmentation is the technique of dividing or partitioning an image into parts, called segments. It is mostly useful for applications like image compression or object recognition, because for these types of applications, it is inefficient to process the whole image. So, image segmentation is used to segment the parts from image for further processing.

A. DISCONTINUITY DETECTION BASED APPROACH:

Discontinuity detection is an approach which is based on discontinuity region for segmentation of an image. In this technique, partition of an image is based on change in the intensity.

B. SIMILARITY DETECTION BASED APPROACH:

Similarity detection is an approach which is based on finding the similar region of an image. The following are the techniques that come under this are: region growing, thresholding techniques and region merging and splitting.

So image segmentation has mainly three perspective approaches. These are:

1. Region Approach: This falls under similarity detection approach.
2. Edge detection and Data Clustering Approach: Edge detection approach comes under discontinuity detection approach but data clustering comes similarity detection based approach

4. CLASSIFICATION OF IMAGE SEGMENTATION TECHNIQUES

Image Segmentation has several techniques for dividing the images into segments. Each technique has its own features. All these techniques follow

mainly two basic approaches for image segmentation. The two approaches are: region based approach and edge based approach. All techniques of image segmentation is broadly divided into three parts.

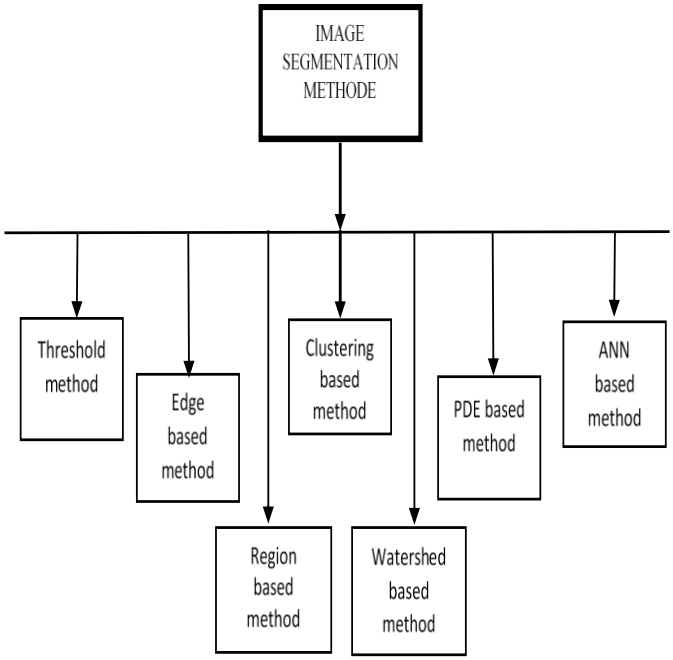


Figure 1

A. STRUCTURAL SEGMENTATION TECHNIQUES:

This technique is based upon having knowledge about the structure of the image which is going to be segmented. In other words, this technique works by having the information about the structure of an image.

B. STOCHASTIC SEGMENTATION TECHNIQUES:

This technique is based on pixel values of an image for segmentation of an image. In other words, it takes help of discrete pixels for segmenting an image.

C. HYBRID TECHNIQUES

The word hybrid means mixture of things. The hybrid technique is a technique which uses the features of both structural segmentation technique and stochastic segmentation technique.

5 .IMAGE SEGMENTATION TECHNIQUES

A. THRESHOLDING METHOD –

The most popular and commonly used method for image segmentation is Thresholding methods. In this method, image pixels are divided with the help of intensity level of an image.

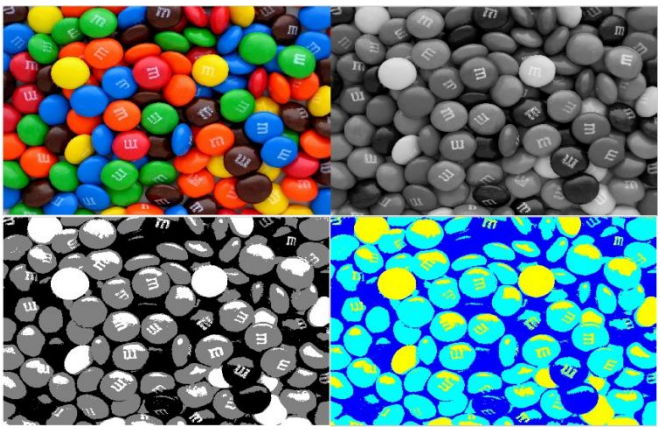


Figure 2- Thresholding of Image

B. EDGE BASED SEGMENTATION METHOD

A connected pixel that is found on the boundary of the region is called an edge. So these pixels on an edge are known as edge points [3]. Edge can be calculated by finding the derivative of an image function. Some edges are very easy to find. These are: Ramp edge, Step edge, Roof edge, Spike edge.Step edge is an abrupt change in intensity level.

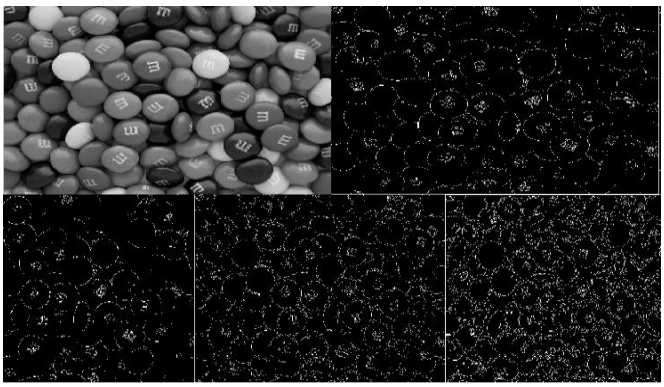


Figure 3- Edge Based Segmentation

C. REGION BASED IMAGE SEGMENTATION

This method is based on segmented an image on the basis of similar characteristics of the pixels. Region

Based segmentation method is further divided into two categories:

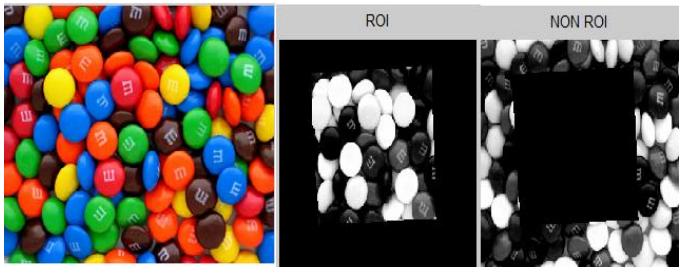


Figure 4- Region based Image Segmentation

D. 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. On the other side the partition based methods use optimization methods iteratively to minimize an objective function. In between these two methods there are various algorithms to find clusters.

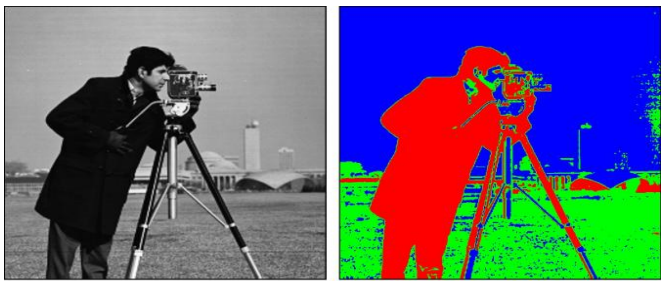


Figure 5- Clustering Based Segmentation

E. MARKER-CONTROLLED WATERSHED SEGMENTATION

In the study of image processing, a watershed is a transformation defined on a grayscale image. The name refers metaphorically to a geological *watershed*, or drainage divide, which separates adjacent drainage basins. The watershed transformation treats the image it operates upon like a topographic map, with the brightness of each point representing its height, and finds the lines that run along the tops of ridges.

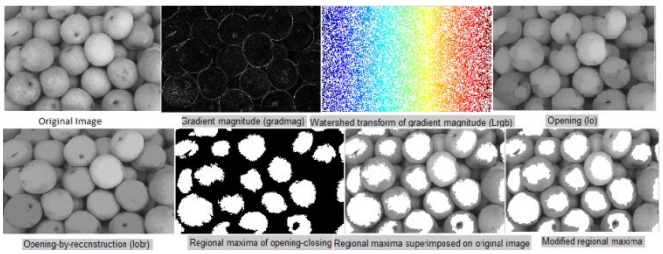


Figure 6- Watershed Segmentation

F. PARTIAL DIFFERENTIAL EQUATION BASED SEGMENTATION METHOD -

The partial differential equation based methods are the fast methods of segmentation. These are appropriate for time critical applications. There are basic two PDE methods: nonlinear isotropic diffusion filter (used to enhance the edges) and sconvex non-quadratic variation restoration (used to remove noise).

Figure 7- Partial Differential Equation Based Segmentation

G. Artificial Neural Network Based Segmentation Method:

Based Segmentation Method: A neural network is an artificial representation of human brain that tries to simulate its learning process. An artificial neural network [9] [10] is often called a neural network or simply neural net. The artificial neural network based segmentation methods simulate the learning strategies of human brain for the purpose of decision making. Now days this method is mostly used for the segmentation of medical images.

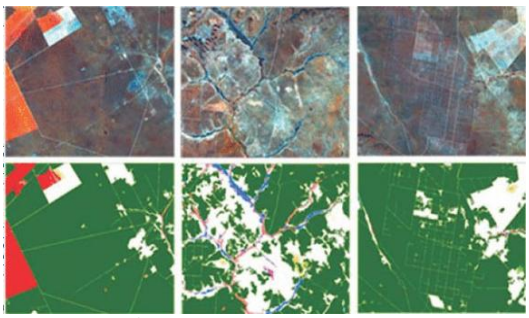


Figure 8- Artificial Neural Network Based Segmentation

6. PARAMETER CALCULATION

A. MEAN –

Mean In mathematics, mean has several different definitions depending on the context. In probability and statistics, population mean and expected value are used synonymously to refer to one measure of the central tendency either of a probability distribution or of the random variable characterized by that distribution.

$$\mu = \sum xP(x)$$

B. STANDARD DEVIATION –

Definition: Standard deviation is the measure of dispersion of a set of data from its mean. It measures the absolute variability of a distribution; the higher the dispersion or variability, the greater is the standard deviation and greater will be the magnitude of the deviation of the value from their mean.

C. ENTROPY -

Derived from the Greek word for “transformation,” entropy is the part of energy not converted to work but is instead dissipated to its surroundings. The concept of entropy stems from the second law of thermodynamics that states isolated systems tend toward disorder and entropy is a measure of that disorder.

D. RMS VALUE –

In statistics and its applications, the root mean square (abbreviated RMS or rms) is defined as the square root of mean square. The rms is also known as the quadratic mean and is a particular case of the generalized mean with exponent

E. VARIANCE –

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.

F. KURTOSIS –

Measure of the tails of a frequency distibution when compared with a normal distribution. Similar to skew ness, kurtosis measures the tailed ness of the probability distribution as opposed to the peaked ness in the center. Kurtosis is defined as the measure of thickness or heaviness of the given distribution for the random variable along its tail.

G. SKEWNESS –

Skewness is asymmetry in a statistical distribution, in which the curve appears distorted or skewed either to the left or to the right. Skewness can be quantified to define the extent to which a distribution differs from a normal distribution. In a normal distribution, the graph appears as a classical, symmetrical "bell-shaped curve." The mean, or average, and the mode, or maximum point on the curve, are equal.

H. CONTRAST –

Contrast resolution is the ability to distinguish between differences in intensity in an image.[1] The measure is used in medical imaging to quantify the quality of acquired images. It is a difficult quantity to define, because it depends on the human observer as much as the quality of the actual image.

I. ENERGY -

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.

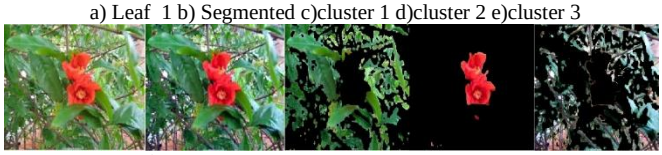
J. HOMOGENEITY -

In statistics, homogeneity and its opposite, heterogeneity, arise in describing the properties of a dataset, or several datasets. They relate to the validity of the often convenient assumption that the statistical properties of any one part of an overall dataset are the same as any other part. In meta-analysis, which combines the data from several studies, homogeneity measures the differences or similarities between the several studies

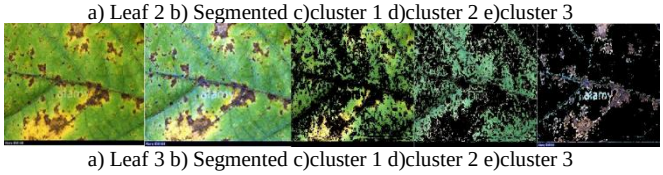
7. SIMULATION RESULT & GRAPH

This paper presents a survey on different method for plant leaf disease detection using image processing technique There are many methods in automated or computer vision for disease detection and classification but still there is lack in this research topic. All the disease cannot be identified using single method .The future work is to develop a method for processing an image that acquired with different background.

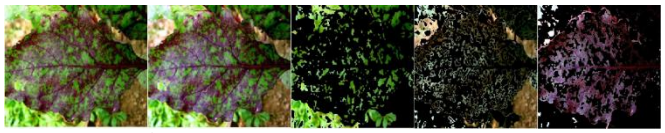
a) Leaf 1 b) Segmented c)cluster 1 d)cluster 2 e)cluster 3



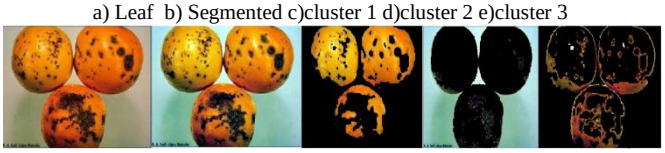
a) Leaf 2 b) Segmented c)cluster 1 d)cluster 2 e)cluster 3



a) Leaf 3 b) Segmented c)cluster 1 d)cluster 2 e)cluster 3



a) Leaf b) Segmented c)cluster 1 d)cluster 2 e)cluster 3

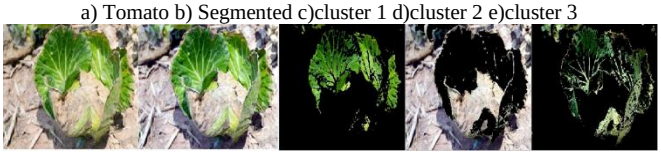


a) Orange b) Segmented c)cluster 1 d)cluster 2 e)cluster 3

a) Papaya b) Segmented c)cluster 1 d)cluster 2 e)cluster 3

a) Pomegranate b) Segmented c)cluster 1 d)cluster 2 e)cluster 3

a) Tomato b) Segmented c)cluster 1 d)cluster 2 e)cluster 3



a) cabbage b) Segmented c)cluster 1 d)cluster 2 e)cluster 3

a) Cucurbits b) Segmented c) cluster 1 d)cluster 2 e)cluster 3

Object	Leaf sample1			Leaf sample 2		
Cluster No.	C-1	c-2	C-3	C-1	c-2	C-3
Mean	*39.11*	*39.2*	*37.1*	*47.9*	*7.82*	*49.7*
S.D	*59.84*	*59.9*	*60.9*	*58.6*	*36.6*	*71.4*
RMS	*9.492*	*9.5*	*8.93*	*11.2*	*2.13*	*10*
Entropy	*3.765*	*3.77*	*3.41*	*4.85*	*0.88*	*4.14*
Kurtosis	*3.446*	*3.44*	*3.83*	*2.85*	*33*	*3.16*
Skrewness	*1.297*	*1.29*	*1.44*	*0.96*	*5.44*	*1.19*
Contrast	*1.593*	*1.6*	*0.93*	*1.14*	*0.07*	*1.39*
Correlation	*0.746*	*0.75*	*0.87*	*0.8*	*0.93*	*0.83*
Energy	*0.339*	*0.34*	*0.42*	*0.23*	*0.85*	*0.33*
Homogenity	*0.843*	*0.84*	*0.91*	*0.87*	*0.99*	*0.85*
Affected Region	*15.01*	*15*	*None*	*None*	*15*	*15.4*
Accuracy	*96.77*	*98.4*	*96.8*	*95.2*	*96.8*	*96.8*
Leaf Type	*Anthracnose*	*Anthracnose*	*Healthy Leaf*	*Healthy Leaf*	*Alternaria Alternata*	*Anthracnose*

Table 1 Compression of sample 1 & 2

Object	Orange			Papaya		
Cluster No.	C-1	c-2	C-3	C-1	c-2	C-3
Mean	*44.7*	*73.6*	*14.5*	*48.6*	*37.2*	*18.3*
S.D	*79.8*	*90.6*	*37.9*	*76.3*	*58.4*	*50.2*
RMS	*7.97*	*9.98*	*6.01*	*9.04*	*9.49*	*6.18*
Entropy	*3.43*	*4.41*	*2.01*	*3.77*	*3.88*	*2.38*
Kurtosis	*3.63*	*1.64*	*11.8*	*2.98*	*4.14*	*11.1*
Skrewness	*1.5*	*0.61*	*2.98*	*1.24*	*1.47*	*2.98*
Contrast	*0.45*	*0.42*	*0.59*	*1.07*	*1.6*	*0.81*
Correlation	*0.95*	*0.97*	*0.7*	*0.9*	*0.74*	*0.8*
Energy	*0.43*	*0.36*	*0.64*	*0.39*	*0.33*	*0.71*
Homogenity	*0.94*	*0.96*	*0.93*	*0.93*	*0.89*	*0.94*
Affected Region	*13.4*	*20.3*	*15.5*	*15.6*	*None*	*17.9*
Accuracy	*98.4*	*96.8*	*96.8*	*96.8*	*96.8*	*96.8*
Leaf Type	*Alternaria Alternata*	*Cercospora Leaf Spot*	*Anthracnose*	*Cercospora Leaf Spot*	*Healthy Leaf*	*Alternaria Alternata*

Table 1 Compression of sample 3 & 4

Object	Pomegranate			Tomato		
Cluster No.	C-1	c-2	C-3	C-1	c-2	C-3
Mean	51	15.9	24.5	43.5	56	18.8
S.D	62	41.2	47.1	75.9	67.8	53.5
RMS	11.6	4.84	7.72	8.13	11.8	5.19
Entropy	5.1	2.05	2.72	2.88	5.33	1.79
Kurtosis	4.07	10	5.15	3.31	3.23	11
Skrewness	1.25	2.77	1.81	1.38	1.08	3
Contrast	0.8	0.19	0.43	1.67	1.92	0.58
Correlation	0.87	0.89	0.89	0.83	0.73	0.85
Energy	0.24	0.67	0.53	0.49	0.22	0.69
Homogenity	0.88	0.97	0.94	0.9	0.82	0.95
Affected Region	15.5	None	None	22.3	15	15
Accuracy	96.8	96.8	98.4	98.4	96.8	98.4
Leaf Type	Anthracnose	Healthy Leaf	Healthy Leaf	Cercospora Leaf Spot	Cercospora Leaf Spot	Alternaria Alternata

Table 1 Compression of sample 5 & 6

Object	cabbage			Cucurbits		
Cluster No.	C-1	c-2	C-3	C-1	c-2	C-3
Mean	17.2	106	20.4	37.3	28.8	40.9
S.D	44.7	94.9	51.8	70.4	66	58.6
RMS	5.49	12.5	5.88	8.69	6.32	10.4
Entropy	2.05	5.82	2.03	3.45	2.28	4.35
Kurtosis	9.63	1.32	8.59	5.29	6.38	4.01
Skrewness	2.73	0.06	2.58	1.89	2.18	1.37
Contrast	0.96	1.39	1.83	1.55	0.61	1.57
Correlation	0.75	0.91	0.63	0.81	0.91	0.73
Energy	0.62	0.16	0.6	0.45	0.61	0.26
Homogenity	0.92	0.83	0.9	0.87	0.96	0.83
Affected Region	15	62.9	15	15.1	16.4	15.2
Accuracy	98.4	96.8	96.8	98.4	96.8	98.4
Leaf Type	Anthracnose	Alternaria Alternata	Bacterial Blight	Anthracnose	Alternaria Alternata	Anthracnose

Table 1 Compression of sample 7 & 8

Object	Leaf sample 3			Leaf sample 4		
Cluster No.	C-1	c-2	C-3	C-1	c-2	C-3
Mean	53.7	51.4	22.3	26.2	34.2	30
S.D	71.7	71.1	56.8	55.7	57.7	52.6
RMS	10.3	10.1	6.15	7.57	9.26	8.73
Entropy	4.16	4.02	1.95	2.79	3.75	3.56
Kurtosis	2.6	2.76	8.36	6.85	5.36	6.61
Skrewness	0.97	1.05	2.54	2.18	1.75	1.93
Contrast	3.48	3.46	2.12	1.05	1.86	0.94
Correlation	0.63	0.63	0.58	0.82	0.67	0.75
Energy	0.24	0.25	0.65	0.49	0.33	0.44
Homogenity	0.78	0.79	0.9	0.91	0.84	0.89
Affected Region	None	None	15	None	18.4	15.4
Accuracy	96.8	98.4	98.4	98.4	96.8	98.4
Leaf Type	Healthy Leaf	Healthy Leaf	Bacterial Blight	Healthy Leaf	Anthracnose	Anthracnose

Table 1 Compression of sample 9 & 10

8. CONCLUSION

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 image 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. Based on the disease severity levels amount and frequency of specific quantities of pesticide application can be regulated, which reduces the cost pesticide used for treatment. Also helpful in reducing environmental pollution due to regulated and controlled application of pesticides. This is an innovative approach ever done for extracting disease features of the leaf. The methodology uses a blend of machine vision and machine intelligence for precision agriculture. In machine vision part, image processing is used where the leaf detail, the disease infected area will be extracted. This is a small contribution towards agriculture and growing this medicinally valued precious plant species, to boost up the national economy as well as the national employment generation through proper exploitation of betel vine crop.

REFERENCES

[1] Singh, Vijai, and A. K. Misra. "Detection of plant leaf diseases using image segmentation and soft computing techniques." *Information Processing in Agriculture 4, no. 1 (2017)*: 41-49.

[2] Dey, Amar Kumar, Manisha Sharma, and M. R. Meshram. "Image processing based leaf rot disease, detection of betel vine (Piper BetleL.)." *Procedia Computer Science* 85 (2016): 748-754.

[3] Soni, Amar Prasad, Amar Kumar Dey, and Manisha Sharma. "An image processing technique for estimation of betel leaf area." In *Electrical, Electronics, Signals, Communication and Optimization (EESCO), 2015 International Conference on*, pp. 1-5. IEEE, 2015.

[4] PawanP.Warne, Dr.S.R. Ganorkar" Detection of Diseases on Cotton Leaves Using K-Mean Clustering Method", *International Research Journal of Engineering and Technology(IRJET)* Volume: 02 Issue: 04 | July-2015, 425-431.

[5] Daisy Shergill, Akashdeep Rana, Harsimran Singh "Extraction of rice disease using image processing",*International Journal Of Engineering Sciences & Research technology*,June, 2015,135- 143.

[6] Malvika Ranjan1, Manasi Rajiv Weginwar,NehaJoshi, Prof.A.B. Ingole, detection and classification of leaf disease using artificial neural network, *International Journal of Technical Research and Applications e-ISSN: 2320-8163*, Volume 3, Issue 3 (May-June 2015), PP. 331-333

[7] RenukaRajendraKajale. Detection & recognition of plant leaf diseases using image processing and android o.s "*International Journal of Engineering Research and General Science* Volume 3, Issue 2, Part 2, March-April, 2015.,ISSN 2091-2730
[8] Prakash M. Mainkar, Shreekant Ghorpade, Mayur Adawadkar", Plant Leaf Disease Detection and Classification Using Image Processing Techniques", *International Journal of Innovative and Emerging Research in Engineering* Volume 2, Issue 4, 2015,139-144
[9] Mr. Sachin B. Jagtap, Mr. Shailesh M. Hambarde," Agricultural Plant Leaf Disease Detection and Diagnosis Using Image Processing Based on Morphological Feature Extraction", *IOSR Journal of VLSI and Signal Processing (IOSR-JVSP)* Volume 4, Issue 5, Ver. I (Sep-Oct. 2014), PP 24-30.
[10] Niket Amoda, Bharat Jadhav, Smeeta Naikwadi,"Detection And Classification Of Plant Diseases By Image Processing",*International Journal of Innovative Science, Engineering & Technology*, Vol. 1 Issue 2, April 2014.
[11] SmitaNaikwadi, NiketAmoda," Advances In Image Processing For Detection Of Plant Diseases,"*International Journal of Application or Innovation in Engineering & Management (IJAIEM)* Volume 2, Issue 11, November 2013.,168-175
[12] Anand.H.Kulkarni, AshwinPatil R. K., applying image processing technique to detect plant disease. *International Journal of Modern Engineering Research (IJMER)* Vol.2, Issue.5, SepOct. 2012 pp-3661-3664 ISSN: 2249-6645

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