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

Priyanka Shrivastava[1], Dr. Sonal Kanungo[2]

[1]*M.Tech Scholar*

[1,2]*DPG Institute of Technology & Management Gurugram, Haryana*

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. 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 bover 100 leaves out of which some are included in this paper. Results are compared with the graphical technique of leaf area measurement. The advantage of this method is the easiness and the stability of precise estimation of area.

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

I. INTRODUCTION

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. 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. Image segmentation, which is an important aspect for disease detection in plant leaf disease, is done by using genetic algorithm.The agricultural land mass is more than just being a feeding sourcing in today's world. Indian economy is highly dependent of agricultural productivity. Therefore in field of agriculture, detection of disease in plants plays an important role. To detect a plant disease in very initial stage, use of automatic disease detection technique is beneficial. For instance a disease named little leaf disease is a hazardous disease found in pine trees in United States. The affected tree has a stunted growth and dies within 6 years.

1.1 Digital Image Processing - Digital image processing is crucial field of designing and innovation. In current period each field depends on the uses of computerized picture handling, in advanced picture preparing, computerized delineation of pictures generally require a substantial number of bits. In different applications, it is critical to study methodology for implying a picture, or the data contained in the picture, with less bits.

1.2Image 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.

1.3 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.

1.4 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.

1.5 Genetic Algorithm :-Genetic algorithms (GA) are search algorithms based on the principles of natural selection and genetics. It finds an approximate solution to an optimization task. It is based on Darwinian's principle of evolution and survival of fittest. Genetic Algorithms (GAs) and Genetic Programming (GP) has been used for detecting intrusion detection of different kinds in different scenarios. GA used to select required features and to determine the optimal and minimal parameters.

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.

[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.

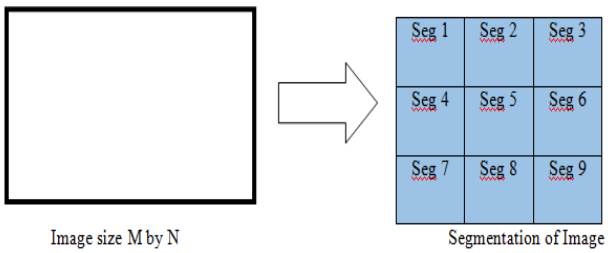
[2] **Image Processing Based Leaf Rot Disease, Detection Of Betel Vine (Piper Betlel.)**Amar Kumar Dey et all in "Image Processing Based Leaf Rot Disease, Detection of Betel Vine (Piper BetleL.)" in International Conference on Computational Modeling and Security 2016 Proposed deals with leaf rot disease detection for betel vine (Piper betel L.) based on image processing algorithm.

[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. Results are compared with the graphical technique of leaf area measurement.

III. THEORY OF IMAGE SEGMENTATION

The widely investigated field of image processing, image analysis and important module of early vision problem is image segmentation. Imagesegmentation is the process of separating an image into some disjoint or distinct regions whose characteristic such as intensity,color, texture etc are similar. No two such regions are similar with respect to these characteristics [1], [2]. In digital image processing, digital image analysis usually involves a 'low-level' and a 'high-level' processing. In low-level analysis, the representation of an image is transformed from a numerical array of pixel intensities to a symbolic set of image primitives: edges and regions. In high-level analysis, object labels (or interpretations) are assigned to these primitives, thereby providing a semantic description of the image. Image analysis techniques can be classified into two major groups: 1) Statistical, which uses probability distribution functions of pixels and regions to characterize the image, and 2) Structural, which analyzes the image in terms of organization and relationship of pixels and regions by the specified relations [3].

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



1. Thresholding Based Methods
2. Edge Based Methods
3. Region Based Segmentation Method

4. Clustering Based Segmentation Method
5. Watershed Based Methods
6. PDE Based Method
7. ANN Based Method

3.2 **Artificial Neural Network Based Segmentation Method** -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. It is used to separate the required image from background. A neural network is made of large number of connected nodes and each connection has a particular weight. This method is independent of PDE. In this the problem is converted to issues which are solved using neural network. This method has basic two steps: extracting features and segmentation by neural network [8].

Segmentation	Description	Advantages	Disadvantages
Thresholding Method	based on the histogram peaks of the image to find particular threshold values	no need of previous information, simplest method	highly dependent on peaks, spatial details are not considered
Edge Based Method	based on discontinuity detection	good for images having better contrast between objects	not suitable for wrong detected or too many edges
Region Based Method	based on partitioning image into homogeneous regions	more immune to noise, useful when it is easy to define similarity criteria	expensive method in terms of time and memory
Clustering Method	based on division into homogeneous clusters	fuzzy uses partial membership therefore more useful for real problems	determining membership function is not easy
Watershed Method	based on topological interpretation	results are more stable, detected boundaries are continuous	complex calculation of gradients
PDE Based Method	based on the working of differential equations	fastest method, best for time critical applications	more computational complexity
ANN Based Method	based on the simulation of learning process for decision making	no need to write complex programs	more wastage of time in training

3.3**Diseases type 1 -Alternaria** - The mold Alternaria is a well recognized allergy causing fungus. Alternaria spores can be detected from spring through late fall in most temperate areas, and can reach levels of thousands of spores per cubic meter of air. Alternaria spores can be at their highest concentrations during dry, windy conditions that are ideal for the spores to become airborne. Alternaria is currently comprised of about 40-50 species.

Figure 3.1 Sample of alternata

3.4 **Diseases type 2 -Anthracnose**- 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.

Figure 3.2 Sample of Anthracnos**e**

3.5 **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.

Figure 3.3 Sample of Bacterial Blight

3.6 **Diseases type 4 Cercospora Leaf Spot** - Cercospora leaf spot can be caused by a wide range of Cercospora contagious pathogen species relying upon the plant compose tainted. For instance, Cercosporabeticola taints sugar beets while Cercosporarosicola contaminates rose plants. This is viewed as a foliar sickness and can be particularly pulverizing to sugar beet edits in North Dakota and Minnesota.

Figure 3.4 Sample of Cercospora Leaf Spot

3.7 **Healthy Leaves** - A new hypothesis explaining the adaptive significance of bright autumn leaf colors argues that these colors signal tree quality to myrmecophilous specialist aphids. In turn, the aphids attract aphid-tending ants during the following spring, which defend the trees from other aphids and herbivores. In this context, other types of plant coloration, such as the color change observed in young and old spring leaves, may function as a signal of plant quality for aphids and other myrmecophiloushemipterans.

Figure 3.7 Sample of Healthy Leaves

IV. PROBOLEM FORMULATION

4.1 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.

$$\mu = \sum \mathbf{x}\,\mathbf{P}(\mathbf{x})$$

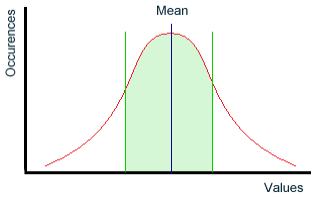


Figure 4.1 Mean Calculation

4.2 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 scores way above (or way below) the average score?. Standard deviation represented by σ.

$$\sigma = \sqrt{\frac{\Sigma\,(X-\bar{X})^2}{n-1}}$$

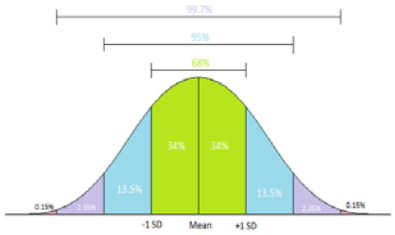


Figure 4.2 Standard Deviation calculation References

4.3 Root Mean Square Calculation - For a set of n numbers or values of a discrete distribution x_i, ..., x_n, the root-mean-square (abbreviated "RMS" and sometimes called the quadratic mean), is the square root of mean of the values x_i^2, namely

$$x_{rms} = \sqrt{\frac{x_1^2 + x_2^2 + \ldots\ldots\ldots + x_n^2}{n}}$$

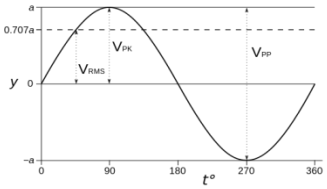


Figure 4.3 Root Mean Square Calculation

4.4 **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.

$$H(x) = \sum_{i=1}^{n} p(x_i) I(x_i)$$

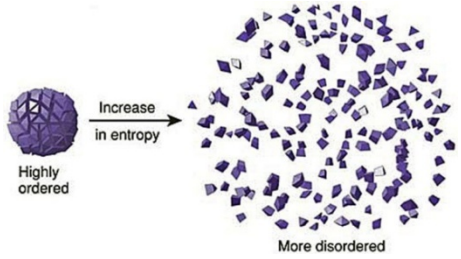


Figure 4.4 Entropy Calculation

4.5 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. Distributions with large kurtosis exhibit tail data exceeding the tails of the normal distribution (e.g., five or more standard deviations from the mean). Distributions with low kurtosis exhibit tail data that is generally less extreme than the tails of the normal distribution.

For univariate data Y_1, Y_2, ..., Y_N, the formula for kurtosis is:

$$kurtosis = \frac{\sum_{i=1}^{N}(Y_i - \bar{Y})^4 / N}{s^4}$$

where $\bar{Y}$ is the mean, s is the standard deviation, and N is the number of data points. Note that in computing the kurtosis, the standard deviation is computed using N in the denominator rather than N - 1.

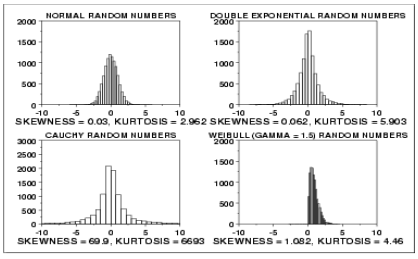


Figure 4.5 Kurtosis Calculation

4.6 **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. A dataset that shows this characteristic differs from a normal bell curve.

For univariate data Y_1, Y_2, ..., Y_N, the formula for skewness is:

$$g_1 = \frac{\sum_{i=1}^{N}(Y_i - \bar{Y})3 / N}{s^3}$$

where $\bar{Y}$ is the mean, s is the standard deviation, and N is the number of data points. Note that in computing the skewness, the s is computed with N in the denominator rather than N - 1.

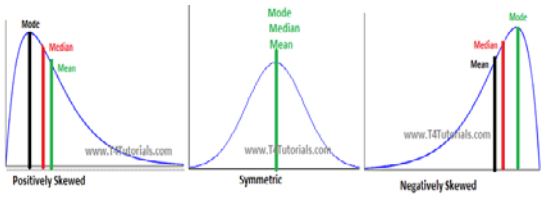


Figure 4.6 Skewness Calculation

V. 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. The GUI typically contains controls such as menus, toolbars, buttons, and sliders. Many MATLAB products, such as Curve Fitting Toolbox™, Signal Processing Toolbox™, and Control System Toolbox™ include apps with custom user interfaces. You can also create your own custom apps, including their corresponding UIs, for others to use.

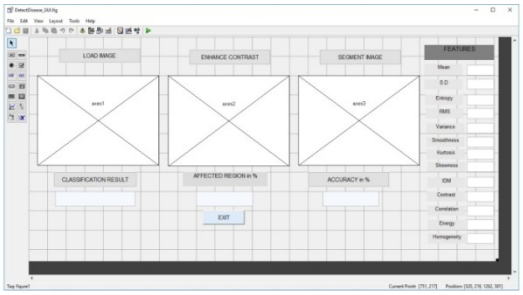


Figure 5.1 Graphical User Interfaces for proposed work

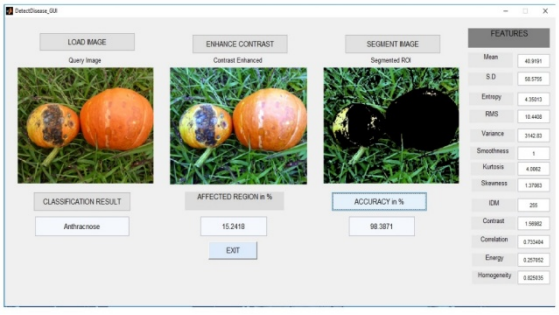


Figure 5.2 Image Graphical User Interfaces for proposed work

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 Cucurbits image (b) Enhance contrast Image

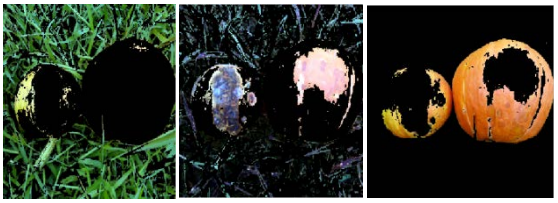


Figure 5.4 (a) Cucurbits c- 1 (b) Cucurbits c- 2 (c) Cucurbits c- 3

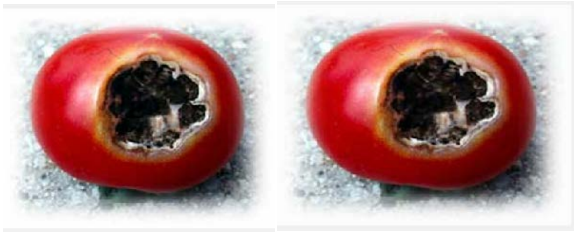


Figure 5.5 (a) Original Cherreyimage (b) Enhance contrast Image

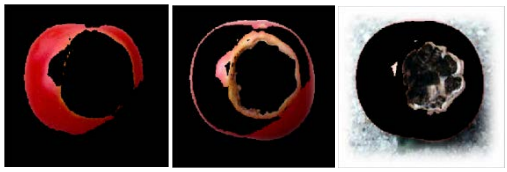


Figure 5.6 (a) Cherry cluster 1 (b) Cherry cluster 2 (c) Cherry cluster 3

5.2.1 Various Parameter Representation of Object One & Two- Object One and Object

Two various result represent in the table.

Parameter	***Cucurbits***			***Cherry***		
	Cluster 1	***Cluster 2***	***Cluster 3***	***Cluster 1***	***Cluster 2***	***Cluster 3***
Mean	40.9	28.8	37.3	14.7	15.9	123.3
Standard Deviation	58.6	66.0	70.4	46.4	46.3	111.5
RMS	10.4	6.3	8.7	4.4	4.9	12.5
Affected Region	15.2	16.4	15.1	16.6	15.7	55.0
Skewness	1.4	2.2	1.9	3.5	3.2	0.0
Entropy	4.4	2.3	3.5	1.8	1.8	5.3
Kutosis	4.0	6.4	5.3	14.3	12.7	1.2
Contrast	1.6	0.6	1.5	0.1	0.3	0.3
Smoothness	1.0	1.0	1.0	1.0	1.0	1.0
Correlation	0.7	0.9	0.8	0.9	0.9	1.0
Energy	0.3	0.6	0.5	0.7	0.7	0.3
Homogeneity	0.8	1.0	0.9	1.0	1.0	1.0
IDM	255.0	255.0	255.0	255.0	255.0	255.0
Variance	3142.8	3749.8	4494.8	1552.1	1927.2	7879.9
Accuracy in %	98.4	96.8	96.8	98.4	98.4	96.8
Classification Result	Anthracnose	AlternariaAlternata	Anthracnose	AlternariaAlternata	AlternariaAlternata	AlternariaAlternata

VI. CONCLUSION AND FUTURE SCOPE

Image Processing Toolbox™ provides a comprehensive set of reference-standard algorithms and graphical tools for image processing, analysis, visualization, and algorithm development. You can perform image enhancement, image deploring, feature detection, noise reduction, image segmentation, geometric transformations, and image registration. Many toolbox functions are multithreaded to take advantage of multi core and multiprocessor computers. Image Processing Toolbox supports a diverse set of image types, including high dynamic range, Gig pixel resolution, embedded ICC profile, and topographic. Graphical tools let you explore an image, examine a region of pixels, adjust the contrast, create contours or histograms, and manipulate regions of interest (ROIs). With toolbox algorithms you can restore degraded images, detect and measure features, analyze shapes and textures, and adjust color balance [19].

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, AkashdeepRana, 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, ShreekantGhorpade, MayurAdawadkar”, 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] NiketAmoda, Bharat Jadhav, SmeetaNaikwadi,”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

[13] GhaiwatSavita N, AroraParul. Detection and classification of plant leaf diseases using image processing techniques: a review. Int J Recent AdvEngTechnol 2014;2(3):2347–812. ISSN (Online).

[14] Dhaygude Sanjay B, KumbharNitin P. Agricultural plant leaf disease detection using image processing. Int J Adv Res Electr Electron InstrumEng 2013;2(1).

[15] Mrunalini R Badnakhe, DeshmukhPrashant R. An application of K-means clustering and artificial intelligence in pattern recognition for crop diseases.IntConfAdvInfTechnol 2011;20. 2011 IPCSIT.

[16] Arivazhagan S, NewlinShebiah R, Ananthi S, Vishnu Varthini S. Detection of unhealthy region of plant leaves and classification of plant leaf diseases using texture features. AgricEngInt CIGR 2013;15(1):211–7.

[17] KulkarniAnand H, AshwinPatil RK. Applying image processing technique to detect plant diseases.Int J Mod Eng Res 2012;2(5):3661–4.

[18] Bashir Sabah, Sharma Navdeep. Remote area plant disease detection using image processing. IOSR J Electron CommunEng 2012;2(6):31–4. ISSN: 2278-2834.

[19] NaikwadiSmita, AmodaNiket. Advances in image processing for detection of plant diseases.Int J ApplInnovEng Manage 2013;2(11).

[20] Patil Sanjay B et al. Leaf disease severity measurement using image processing. Int J EngTechnol 2011;3(5):297–301.

[21] ChaudharyPiyush et al. Color transform based approach fordisease spot detection on plant leaf. IntComputSciTelecommun 2012;3(6).

[22] RathodArti N, TanawalBhavesh, Shah Vatsal. Image processing techniques for detection of leaf disease.Int J Adv Res ComputSciSoftwEng 2013;3(11).

[23] Beucher S, Meyer F. The morphological approach to segmentation: the watershed transforms. In: Dougherty ER,editor. Mathematical morphology image processing, vol. 12. New York: Marcel Dekker; 1993. p. 433–81.

[24] Bhanu B, Lee S, Ming J. Adaptive image segmentation using agenetic algorithm. IEEE Trans Syst Man Cybern Dec 1995;25:1543–67.

[25] Bhanu B, Peng J. Adaptive integrated image segmentation and object recognition. IEEE Trans Syst Man Cybern Part C 2000;30:427–41.