Image Segmentation and Disease Detection of Crops using Discrete Fourier Transformation and Artificial Neural Networks

Mr. Ashfak Ibrahim Shaikh [1], Dr. Amol C. Goje [2]
[1, 2] Vidya Pratishthan's Institute Of Information Technology, Batamati, Pune

Abstract- *In this research image segmentation technique is used for identification of diseases of cotton and sugarcane crops. Four classes of cotton & seven classes of sugarcane crops are used for segmentation. Color images of diseased crops are converted from RGB to *Lab color model for segmentation. Segmented images are converted to grayscale images for feature extraction using Discrete Fourier Transformation (DFT), extracted features are passed to Neural Network Pattern Recognition. It shows 94% and 93% accuracy for recognition of sugarcane and cotton crop classes respectively.*

Keywords- Image Segmentation, K means Clustering, Mean, Grand Mean, cotton and sugarcane Disease, Discrete Fourier Transformation, Neural Networks.

I. INTRODUCTION

The agriculture plays an important role in the Indian economy. Farmers can be in big loss due to unawareness about the diseases of cotton and sugarcane and improper diagnosis of diseases. The steps towards the disease identification with the help of computer could make big revolution to recover from big losses of corps.

Cotton and sugarcane crops play significant contribution in the GDP of Indian economy. The losses due to diseases of these crops can be minimized by diagnosing them on time and treating appropriately.

Automation towards identification of these diseases of cotton and sugarcane can help to minimize the losses and assist the farmers to give proper treatment, ultimately increasing the productivity.

Seven classes of sugarcane and 4 classes of cotton are used in this experiment. The details are as shown in table 1.

Class	Cotton	Class	Sugarcane
1	Healthy leaf	1	Healthy leaf
2	Bacterial blight	2	Healthy sugarcane
3	Powdery mildew	3	Grassy Shoot
4	Red spots	4	Eye Spots
		5	Rust
		6	Red Rot
		7	Scorch

Table1: crop-wise classes considered in the experiment

II. LITERATURE REVIEW

Cios, K.J. and et al. demonstrated the superiority of the fully connected network over the patterned network in neural network. They used the back-propagation network techniques in recognizing the patients with coronary artery disease based on analysis of echocardiographic images [1].H. Fu and Z. Chi proposed the leaf vein recognition system using pattern recognition. The work is done in 2 phase, in first phase image segmentation is performed by using histogram of image, in second phase Artificial neural network is used for pattern recognition [17].A novel procedure has been presented by Souza and et al. for image segmentation based on image similarities. They used Laplacian-of-Gimssian (LOG) operator is used for extracting significant features of the palpebral contour of the human eye[6]. Mammography method plays an important role in early detection of breast cancer disease. A new segmentation method combining dynamic wavelet information with mathematical morphology was developed [2]. [8] Elisa Ricci and Renzo Perfetti proposed the framework for retinal vessel segmentation based on line operators. [4] Wamiq M. et al. used set of 1000 scatter patterns representing ten different bacterial strains. Zernike and Chebyshev moments as well as Haralick texture features were computed from the available light-scatter patterns. The most promising features were first selected using Fisher's discriminant analysis, and subsequently a support-vector-machine classifier with a linear kernel was used.[12] Y-N Sun, and et al. extracted these parameters by using well known feature description methods including the co-occurrence matrix , the statistical feature matrix , the texture spectrum , and the fractal descriptors. They suggested most useful texture feature for classification of liver diseases from these texture descriptors by using forward sequential search approach associated with the multidimensional Bayes' discrimination function. [11]There are three major complications of diabetes which lead to blindness. They are retinopathy, cataracts and glaucoma among which diabetic retinopathy (DR) is considered as the most serious complication affecting the blood vessels in the retina. Nayomi Geethanjali Ranamuka and Ravinda Gayan N. Meegama proposed a technique in which DR retinal images are analyzed by using mathematical morphology and fuzzy sets to detect the hard exudates. [14]Tamalika Chaira proposed the mechanism to segment blood vessels and also the blood cells in pathological images by using fuzzy set theory.

[13] Zhi-Qiang Liu and et al. used k mean clustering and adaptive neighborhood smoothing for bone image segmentation.

III. RESEARCH METHODOLOGY

Data Collection:

The images of cotton and sugarcane are collected from field using Canon HD camera. While capturing images, the camera is fixed on stand and leaves of cotton and sugarcane are kept against white background to minimize the noise.

Separation of objects from background:

K-means clustering is used to extract object from white background.

Image Segmentation:

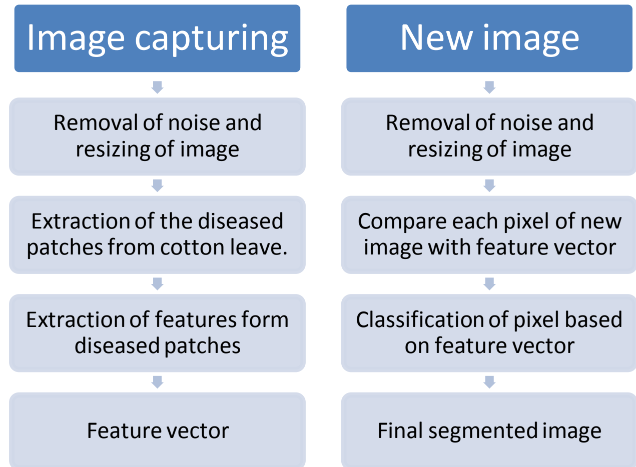
Feature extraction Technique [18] for image segmentation proposed by Mr. Ashfak Shaikh & Dr. Amol C. Goje is used for image segmentation. The results of image segmentation are as shown in figure 2 and figure 3.

Sample Mean	Population Mean
$\bar{x} = \frac{\Sigma x}{n}$	$\mu = \frac{\Sigma x}{N}$

where Σx is sum of all data values

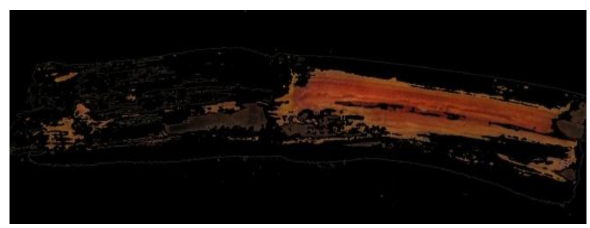
N is number of data items in population

n is number of data items in sample



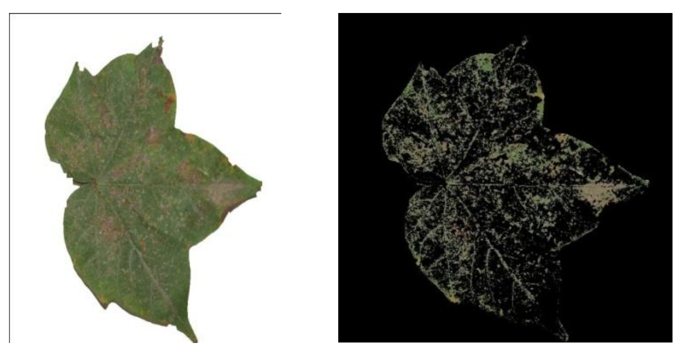
[18]Figure 1: Image segmentation process

a. Sugarcane with red rot disease



b. Segmented image- red rot diseased segment extracted

Figure-2: Segmentation of sugarcane image to identify red rot.



a. Cotton Leaf with powdery mildew

b. Segmented image- diseased segment extracted

Figure-3: Segmentation of cotton leaf image to identify powdery mildew.

Feature extraction Using Discrete Fourier Transformation (DFT)

Segmented images of each class of cotton and sugarcane are converted from colour to grayscale images and resized to [32x32] pixels to reduce the computational complexity. This resized input images are used to find DFT. The absolute component of DFT is used as to train the system. The absolute part of DFT obtained is 2 dimensional matrix of size equal to the size of input image i.e. [32x32] pixels. This 2 dimensional matrix is converted into 1 dimensional matrix by concatenation each row of DFT matrix.

Training and testing by using Neural Networks Pattern Recognition:

The features obtained are passed to neural networks pattern recognition to identify the diseases of cotton and sugarcane.

20 samples per class are passed as input to neural networks. So in case of cotton 80 samples are used. Where as in case of sugarcane 140 samples are used.

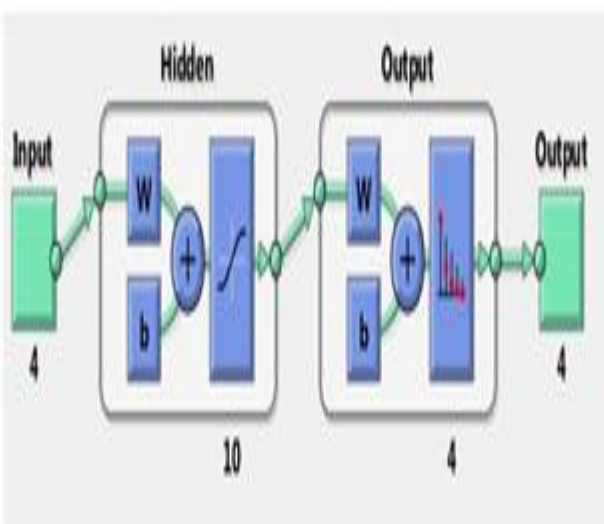


Figure4: Neural Network pattern recognition for cotton crop with 10 hidden layer

IV. EXPERIMENTAL RESULT AND CONCLUSIONS

Four classes of cotton and 7 classes of sugarcane are passes as an input to neural networks pattern recognition tool. It shows 93% of accuracy and 94% accuracy in case of cotton and sugarcane respectively. The results are shown in confusion matrix (table 2 and table 3).

APPENDIX

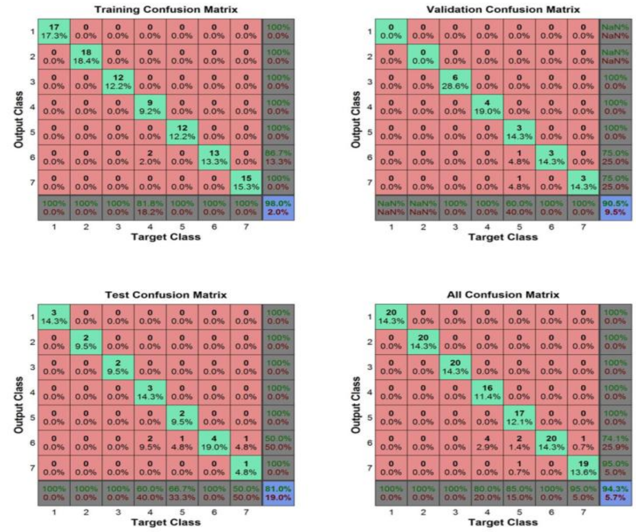


Table-2: 94% accuracy in recognition of sugarcane classes

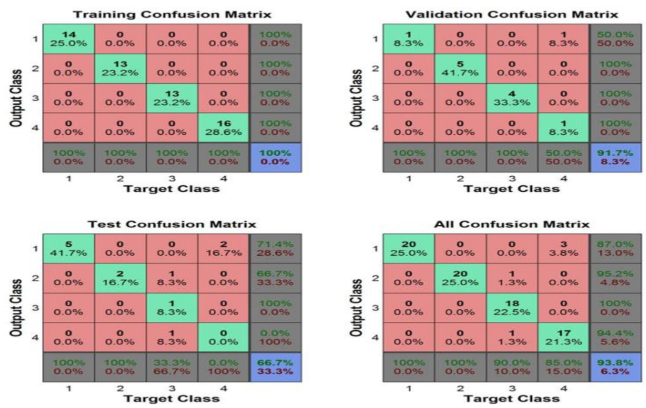


Table-3 : 93% accuracy in recognition of Cotton classes

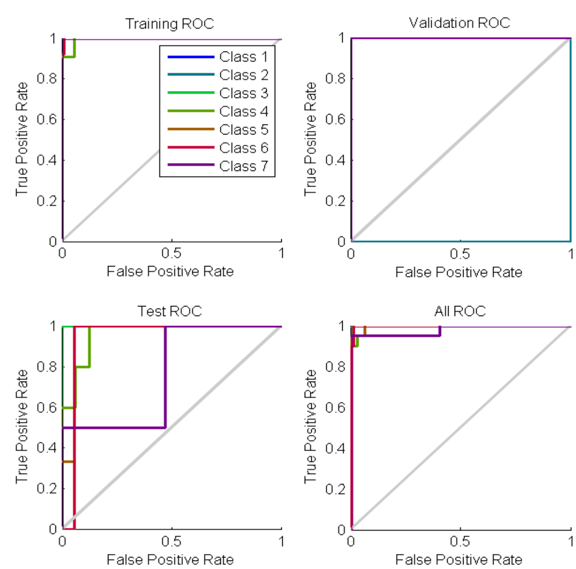


Figure-5: ROC for sugarcane

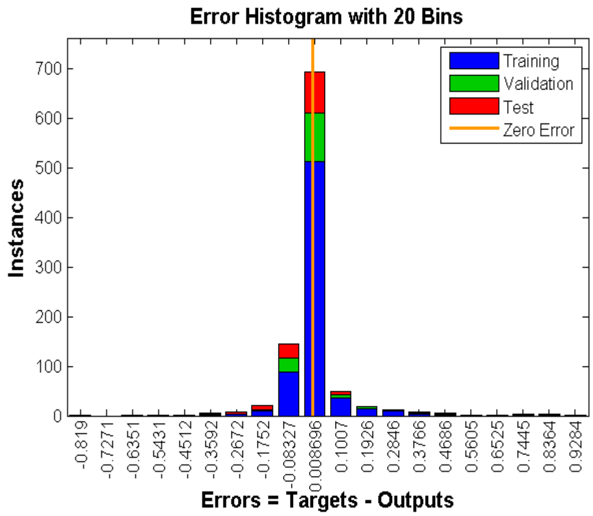


Figure-6: Error histogram for sugarcane

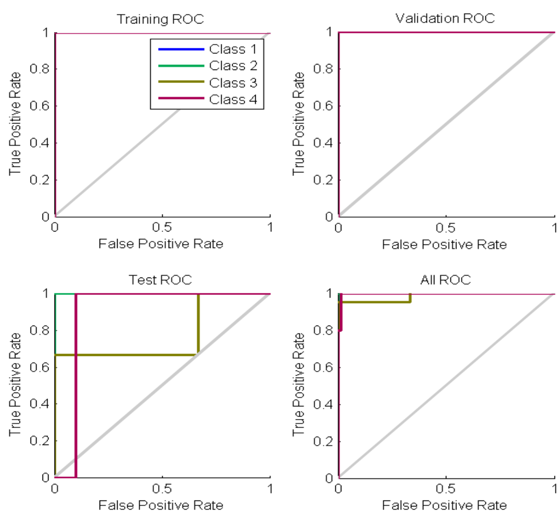


Figure-7: ROC for cotton

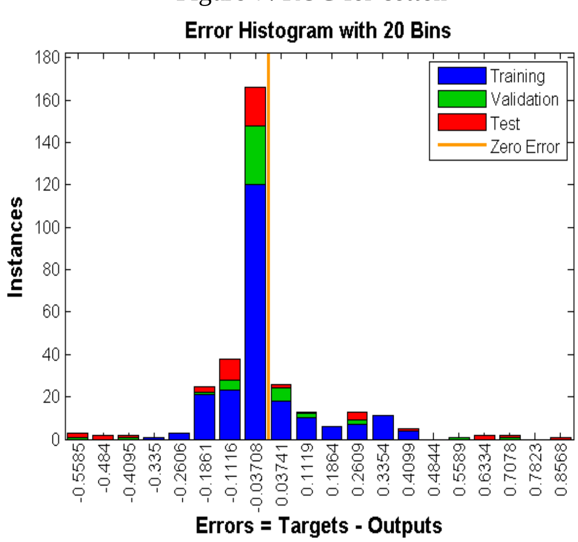


Figure-8: Error histogram for cotton

REFERENCES

[1] Krzysztof J. Cios, Keqing Chen*, Robert A. Langenderfer, "Use of Neural Networks in Detecting Cardiac Diseases From Echochdiographic Images", IEEE JOURNALS & MAGAZINES-2009, Volume: 9 , Issue: 3.

[2] Andre Domingor Araujo Souza and et al., "Palpebral Fissure Morphology Segmentation and Measurement Using Image Processing", Engineering in Medicine and Biology Magazine, IEEE Volume: 19 , Issue: 1

[3] P. Padilla, J.M. Gorriz and et al. ,"Alzheimer's disease detection in functional images using 2D Gabor wavelet analysis",IEEE, Electronics Letters,2010, Volume: 46 , Issue: 8

[4] Wamiq M. Ahmed, Bulent Bayraktar and et al., "Classification of Bacterial Contamination Using Image Processing and Distributed Computing", IEEE JOURNAL OF BIOMEDICAL AND HEALTH INFORMATICS, VOL. 17, NO. 1, JANUARY 2013

[5] Gary L. Hansen, Ephraim M. Sparrow and et al., "Wound Status Evaluation Using Color Image Processing", IEEE TRANSACTIONS ON MEDICAL IMAGING, VOL. 16, NO. 1, FEBRUARY 1997

[6] Arianna Mencattini, Marcello Salmeri and et al. , "Mammographic Images Enhancement and Denoising for Breast Cancer Detection Using Dyadic Wavelet Processing", IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT, VOL. 57, NO. 7, JULY 2008

[7] Nghia Q. Nguyen, Craig K. Abbey, and Michael F. Insana ,"An Adaptive Filter to Approximate the Bayesian Strategy for Sonographic Beamforming", IEEE TRANSACTIONS ON MEDICAL IMAGING, VOL. 30, NO. 1, JANUARY 2011

[8] Elisa Ricci and Renzo Perfetti, "Retinal Blood Vessel Segmentation Using Line Operators and Support Vector Classification" IEEE TRANSACTIONS ON MEDICAL IMAGING, VOL. 26, NO. 10, OCTOBER 2007.

[9] Yeong-Mun Cha and Jae-Ho Han, Member, IEEE, "High-Accuracy Retinal Layer Segmentation for Optical Coherence Tomography Using Tracking

Kernels Based on Gaussian Mixture Model" , IEEE JOURNAL OF SELECTED TOPICS IN QUANTUM ELECTRONICS, VOL. 20, NO. 2, MARCH/APRIL 2014

[10] Ricardo T. Ribeiro, Rui Tato Marinho, and J. Miguel Sanches, Senior Member, IEEE, "Classification and Staging of Chronic Liver Disease From Multimodal Data", IEEE TRANSACTIONS ON BIOMEDICAL ENGINEERING, VOL. 60, NO. 5, MAY 2013

[11] Nayomi Geethanjali Ranamuka, Ravinda Gayan N. Meegama, "Detection of hard exudates from diabetic retinopathy images using fuzzy logic", IET Image Process., 2013, Vol. 7, Iss. 2, pp. 121–130

[12] Y-N Sun, M-H Horng, X-Z Lid, and I-Y Wang, "Ultrasonic Image Analysis for Liver Diagnosis", IEEE ENGINEERING IN MEDICINE AND BIOLOGY,Dec 1996

[13] Zhi-Qiang Liu,* Senior Member, IEEE, Hui Lee Liew and et al. , "Bone Image Segmentation", IEEE TRANSACTIONS ON BIOMEDICAL ENGINEERING, VOL. 46, NO. 5, MAY 1999.

[14] Tamalika Chaira , "Intuitionistic Fuzzy Segmentation of Medical Images", IEEE TRANSACTIONS ON BIOMEDICAL ENGINEERING, VOL. 57, NO. 6, JUNE 2010

[15] B.C. Ko, J.W. Gim and J.Y. Nam , "Cell image classification based on ensemble features and random forest", IEEE, ELECTRONICS LETTERS 26th May 2011 Vol. 47 No. 11

[16] Edmond Chalom, Eran Asa, and Elior Biton , "Measuring Image Similarity: An Overview of Some Useful Applications" , IEEE Instrumentation & Measurement Magazine,February 2013

[17] H. Fu and Z. Chi , "Combined thresholding and neural network approach for vein pattern extraction from leaf images", IEE Proc.-Vis. Image Signal Process., Vol. 153, No. 6, December 2006

[18] Shaikh Ashfak Ibrahim and Dr. Amol C. Goje, "Disease Detection of Cotton leaves Using Image Segmentation" ,International Conference, Management Education, Achieving Global Standard and Recognition, Bharati Vidayapeeth University, Pune and Curtin University, Malaysia.ISBN:978-81-926903-0-8