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Application of Image Enhancement Techniques on Cotton Leaf Diseases

Dr. M. Kalpana[1], Dr. K. Senguttuvan[2] and Dr. P. Latha[3]

Assistant Professor (Computer Science), Department of Social Science, ADAC&RI,
Tamil Nadu Agricultural University, Tiruchirappalli, Tamil Nadu, India[1]
Assistant Professor (Entomology) [2],
Assistant Professor (Pathology) ,
Department of Cotton,
Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India[3]

Abstract: Image Enhancement techniques are widely used to improve the quality of the images. This technique is used to smooth the images or detecting the edges of the images. Image processing is to manipulate the images by using algorithms. In this paper the cotton leaf disease such as Bacterial Blight**,** Anthracnose, Leafhopper damage symptom images are capture. The captured images are processed with images sharpening techniques such as Unsharp Masking, Gaussian Sharpening and images enhancing techniques such as Color Histogram Equalization are used to improve the quality of images. The image dataset are measured with PSNR and MSE values. The results of the three technique are compared with MATLAB Image processing ToolBox, the Unsharp Masking technique results with better PSNR and MSE measurement.

Keywords: Cotton leaf, Bacterial Blight**,** Anthracnose, Leafhopper, PSNR, MSE, Enhancement Techniques.

I. INTRODUCTION

Cotton crop is cultivated for its fibre, which is commonly used as a textile raw material. Cotton crop is an essential commodity in the world economy. So the cotton plant health is very much essential and closely linked with world economy. Cotton leaf and boll are affected by a number of diseases inducing severe reduction in yield by influencing germination, killing the plants, reducing plant productivity and affecting the quality of lint.

Diseases in the plants are observed by the signs and symptoms. Diseases in leaves cause major economic and production losses in the field of agriculture. Monitoring of crops health and detection of diseases in leaf is very important in agriculture. The leaf diseases are identified with machine vision from the colored images.

Digital Image Processing is used to process the images and to mine the knowledge from the images. Digital images are collection of pixel and the pixels are prearranged with systematic rectangular display. The array of rows and columns are specified as height and width of the image. The width and height of the images is determined with the number of columns and number of rows in the array[1]. Prasad *et al.*[2] proposed the image sharpening method by suppressing the noise. Image noise is reduced with noise suppressing methods and image sharpening methods. In the experiment median filter, Homomorphic Filter and Gaussian low pass filter are used. The experimental results the de-noising effect of median filter is much better than low pass filter on Gaussian noise.

Padmavathi, *et al*. [3] proposed genetic algorithm to identify the plant leaf disease and gives the optimal solution. Images are preprocessed using various techniques such as filtering, image resize, segmentation, morphological operations, feature extraction. Genetic algorithms give the potential solutions to the problem. Image Enhancement techniques uses sharpen filter proposed by Singh *et al*.,[4]. A new nonlinear filtering technique is used for enhancement of images, which are highly affected by impulse noise. The proposed filtering technique is used to impulse noise and preserves the image features. The corrupted image is replaced by median values or by its processed neighboring pixel value. Leaf disease recognition method was proposed by Zhang, *et al*. The first step, spot is segmented and feature vector of disease is extracted. The extracted features use K-nearest-neighbor classifier to recognize the plant diseases. The experimental result shows that the proposed approach is effective. The proposed method can recognize and classify the plant disease with highest recognition rate [5].

The cotton leaf disease such as Bacterial Blight, Anthracnose, Leafhopper are capture from the field. The captured images are processed with images sharpening techniques such as Unsharp Masking, Gaussian Sharpening and images enhancing techniques such as Color Histogram Equalization are used to improve the quality of images.

In this paper, Section II describes Methodologies and section III describes experimental results. Conclusion is presented in section IV.

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II METHODOLOGY

Image enhancement technique is the process of adjusting the digital images, so that the results are suitable for displaying or for image analysis [6]. This section describes the image enhancement techniques such as Unsharp Masking Technique, Gaussian Sharpening Technique and Histogram Equalization as shown in Figure 1.

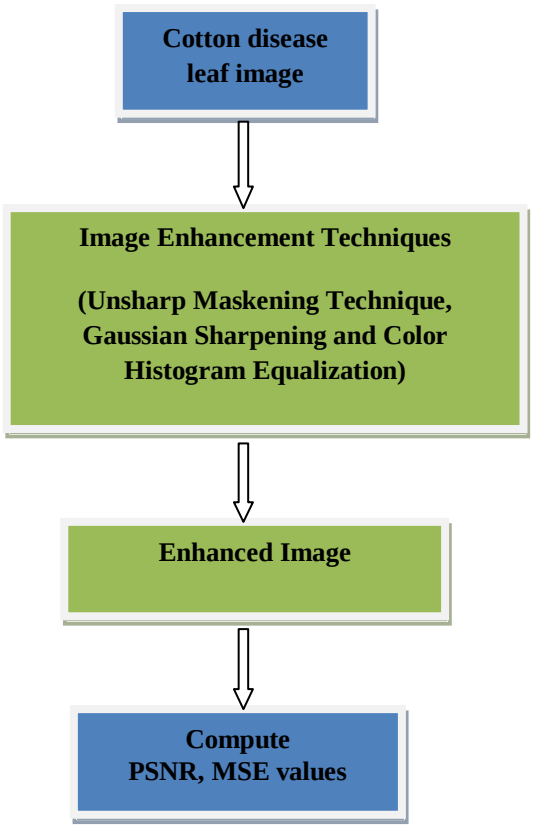

Fig. 1 Diagrammatic representation of Image Enhancement techniques

Algorithm: Cotton leaf disease image enhancement techniques

Step1:	Capture the image from the cotton field.
Step 2:	Use the Image Enhancement Technique: Unsharp Masking Technique, Gaussian Sharpening and Color Histogram Equalization
Step 3:	Compute Peak Signal-to-Noise Ratio (PSNR) and Mean Square Error (MSE)
Step 4:	Unsharp Masking technique results with better PSNR, MSE measurement.

Sharpening is to manipulate the image with the original images [2]. The types are

1. Capture sharpening
2. Creative sharpening
3. Output Sharpening
4. Unsharp Masking
5. Gaussian Sharpening

A. Unsharp Masking

Image processing application is used to improve the quality of the image by using the sharpening technique. Image sharpening process is to sharp the image edges. Unsharp Masking uses blur techniques to the original images. The Unsharp Masking is a linear or nonlinear filter that gives high frequency components [7]. The steps for the Unsharp Masking are

1. Blur the cotton leaf disease image
2. Subtract the blurred image from the cotton leaf image.
3. Add the result mask to the original leaf image

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$$g(x, y) = f(x, y) + k(f(x, y) - f(x, y))$$

k = 1 unsharp masking , k> 1 high boost filtering

where k is a scaling constant. for k vary between 0.2 and 0.7, with the larger values providing increasing amounts of sharpening.

B. Gaussian sharpening

In Gaussian sharpening high pass filters are taken for the cotton leaf disease image processing. Gaussian high pass filter are used to sharp the edges of the cotton leaf disease images. The sharpening helps to identify the cotton diseases in the leaf easily. Gaussian high pass filter minimize the problem that occur to identify the images. The Gaussian High Pass filter allows high frequency image information to pass through and blocks low frequency image information [9]. This effectively sharpens the image. The steps for Gaussian high pass filter are

Step 1: Edit the cotton leaf disease images and remove the low frequency components.
Step 2: Kernel for high pass filter is design to increase the brightness of centre pixel as relative to the neighboring pixels.
Step 3: 3 by 3 kernel are used in high pass filter.
Step 4: Apply filter to the cotton leaf disease images.
Step 5: Add the original cotton images and the filtered image together to know the filter effects the image.

C. Color Histogram Equalization

Color histogram equalization is the technique is used to enhance the image. Color histogram equalization is defined as equalizing the intensity distribution of image and to improve the contrast of the image [8]. The cotton leaf image is used to contrast the image by using color histogram equalization. The images which are lower local contrast are converted to higher contrast. In Color histogram equalization, histogram equalization separates RGB color component to enhance the images.

The steps are

Step 1. Convert RGB cotton leaf image into HSI Image
Step 2. Acquire the 'Intensity Matrix' from the HSI Image matrix
Step 3. Execute Histogram Equalization on the intensity Matrix
Step 4. Update the Intensity Matrix from the HSI Image matrix with the histogram equalized Intensity matrix
Step 5. Convert HSI Image back to RGB cotton disease leaf Image.

III. RESULTS AND DISCCUSSIONS

The Unsharp Masking technique, Gaussian Sharpening, Color Histogram Equalization are applied to the various cotton disease leaf image such as Bacterial Blight**,** Anthracnose, Leafhopper damage symptom. Fig. 2, 3 and 4 displays the result of unsharp Masking , Gaussian Sharpening and Color histogram Equalization for cotton leaf diseases using MATLAB Image Processing ToolBox.

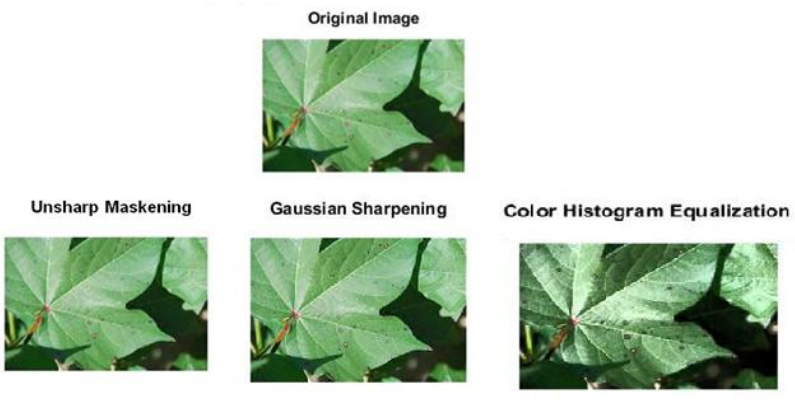

Fig. 2 Image Enhancement techniques - Bacterial Blight

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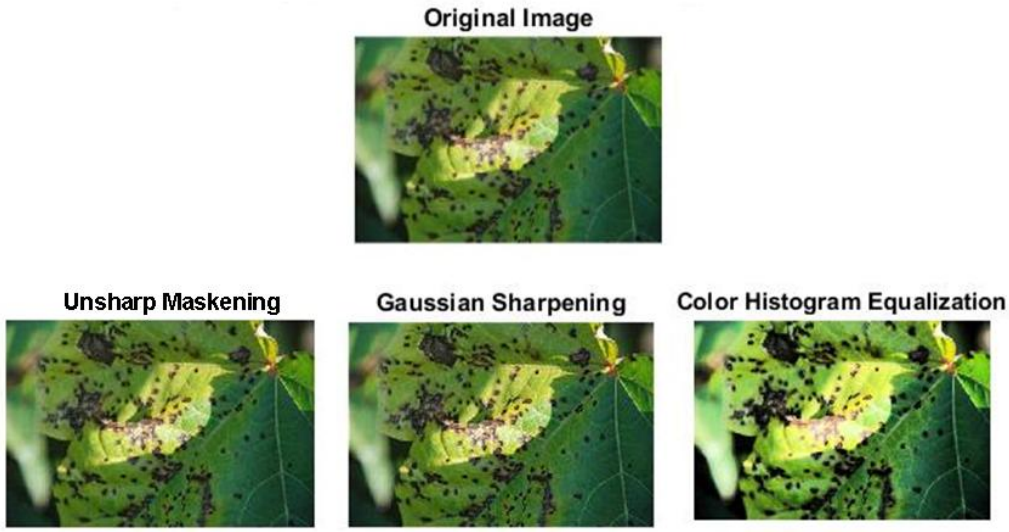

Fig 3 Image Enhancement techniques - Anthracnose

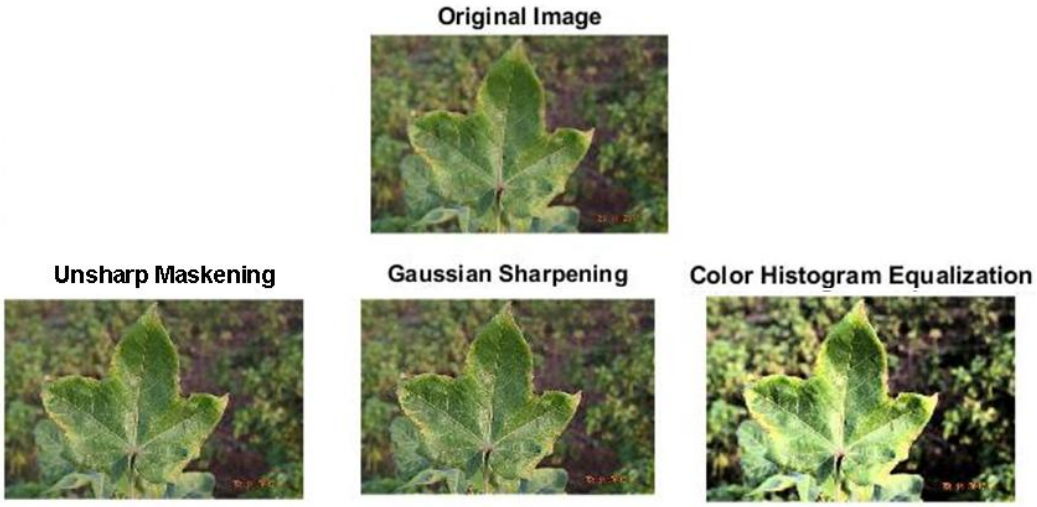

Fig. 4 Image Enhancement techniques - Leafhopper

To evaluate the performance of the image dataset of the three methods, the metric such as Mean Square Error (MSE) and Peak Signal-to-Noise Ratio (PSNR) are calculated for quality assessment. MSE has been calculated to evaluate the performance of the suggested algorithm. PSNR represents the expression for the ratio between the maximum power value of image signal and the power value of distorting noise, which impacts on the image quality. The results of MSE and PSNR value for the cotton leaf disease images are represented in Table 1.

Table 1 Image Enhancement Technique PSNR and MSE values

S.No.	Image	Unsharp Masking Technique		Gaussian Sharpening Technique		Color Histogram Equalization Technique	
		PSNR	MSE	PSNR	MSE	PSNR	MSE
1.	Bacterial Blight	325.035	2.039	325.031	2.0412	324.929	2.089
2.	Anthracnose	324.751	2.177	324.722	2.192	324.061	2.552
3.	Leafhopper	325.886	1.676	325.861	1.686	324.891	2.108

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Table 1 show that of the three image processing technique, Unsharp Masking is better MSE and PSNR enhancement technique for cotton leaf disease. Figure 5 and 6 shows the Image Enhancement Technique PSNR and MSE Value for Cotton leaf diseases

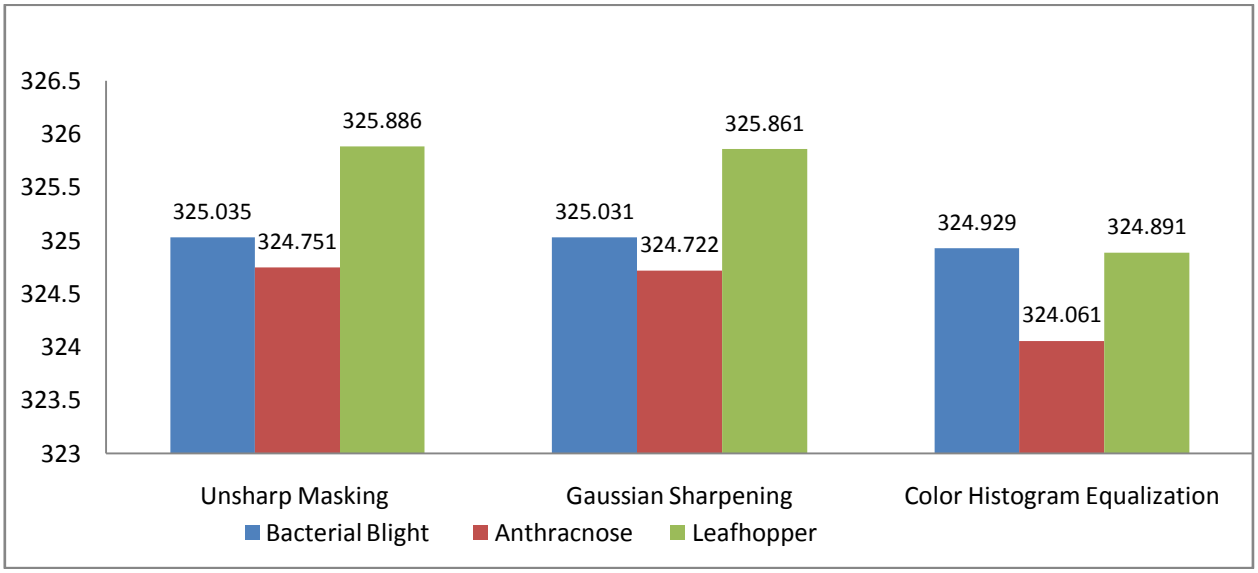

Fig. 5 Image Enhancement Technique PSNR Value for Cotton leaf diseases

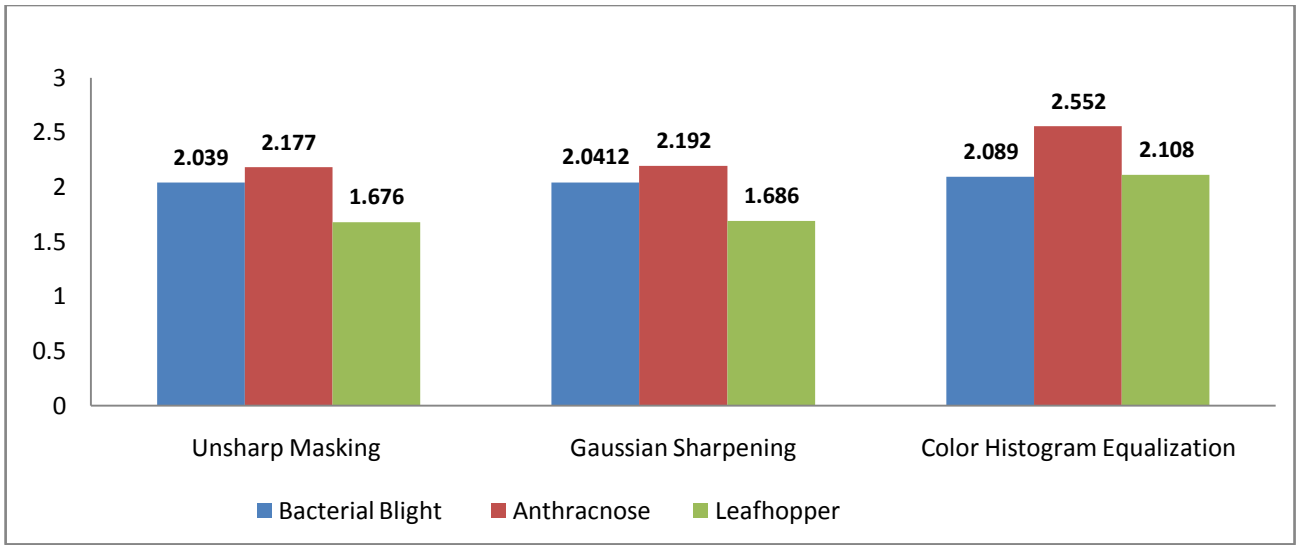

Fig. 6 Image Enhancement Technique MSE Value for Cotton leaf diseases

IV CONCLUSION

Cotton is the important crop grown around the world. Cotton crop is affected by many leaf diseases. It is very much essential to enhance the image to identify the diseases. In this paper, the various image enhancement techniques are taken and analyzed. The enhancement techniques such as Unsharp Masking, Gaussian Sharpening and Color Histogram Equalization processed with MATLAB Image processing Tool Box. To evaluate the performance of the image, the metric such as Mean Square Error and Peak Signal-to-Noise Ratio are calculated for quality assessment. This helps us to give the good quality image to further process such as leaf disease detection. Unsharp Masking has better MSE and PSNR values as that of Gaussian Sharpening and Color Histogram Equalization. The future work is to take the processed image dataset for the construction of decision system using Artificial Intelligence.

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