

A Study on the Method of Image Preprocessing for Recognition of Crop Diseases

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ABSTRACT

Cotton leaf diseases have occurred all over the world including India. They have significant impact on quality and yield of cotton. This paper select bacterial leaf blight, myrothecium and grey mildew as study object. The testing samples of the images are gathered from CICR Nagpur. The image enhancement techniques used include histogram equalization, decorrelation stretching, linear contrast stretch, intensity adjustment and filtering.

Index Terms—histogram equalization, unsharp filtering.

1. INTRODUCTION

Cotton is an important cash crop in India. Cotton plants often suffers from various diseases that can adversely impact quality and quantity of the yield. In Andhra Pradesh state government reported that 20.46 lakh farmers suffered from cotton crop failure in 33.73 lakh acres and lost Rs.3071.6 crores. In Maharashtra the estimated loss is Rs.10000/- in recent years.

The naked eye observation is the main approach used for detection and identification of diseases. However this requires continuous monitoring which is not possible in large farms. At present, the diagnosis of crop diseases mostly depend on manual recognition, but it can mistakenly diagnosed by farmers because they usually judge the symptom by their experiences. The misidentification leads to some incorrect control measurements such as indiscriminate and untimely use of pesticides

Automatic detection of plant diseases is an essential research topic as it may prove benefits in monitoring large field crops and early detection of the symptoms of diseases as soon as they appear on plant leaves. Such systems include image enhancement, image segmentation, feature extraction and training blocks.

2. COTTON LEAF DISEASES

In this paper the leaf diseases considered are Bacterial Leaf Blight, Myrothecium and Grey Mildew. The symptoms of these diseases are as:

<p>Bacterial Blight</p> 	<p>Most important symptoms are appearance of many minute water soaked angular spots scattered on the ventral surface of leaves, these spots turn brown and then are converted</p>
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	<p>into black dead lesions on both sides of the leaf. Very often one or more veins in part or whole becomes water soaked and then turn brown or black, this symptom is called as "Black vein" or "Vein blight". This may appear independently or together with angular leaf spots.</p>
<p>Myrothecium</p> 	<p>The characteristic symptoms are the appearance of circular to semicircular light brown to tan coloured spots with violet to reddish brown margins. Later on shield shaped small fruiting bodies are produced in the central portion of the spot. The center dries and drops off causing big shot holes in leaves.</p>
	<p>A fungus that produces a superficial (usually white) growth on organic matter. The lesions are light green to yellow-green in colour on the upper leaf surface but, on the under surface, profuse sporulation gives them a white mildew like appearance</p>

3. IMAGE ENHANCEMENT

The images required for the experimentation are acquired by using Cannon A460 digital camera and Leica Wild M3C stereo zoom microscope.

The principal objective of enhancement is to process an image so that the result is more suitable than original image for a specific application.

Histogram equalization automatically determines a transformation that produce an image with uniform histogram of intensity values. Consider a discrete grayscale image $\{x\}$ and let n_i be the number of occurrences of gray level i . The probability of an occurrence of a pixel of level i in the image is

$$P_x(i) = p(x=i) = n_i / n, 0 \leq i \leq L$$

Where L being the total number of gray levels in the image, n being the total number of pixels in the image, and $P_x(i)$ is the image's histogram for pixel value i , normalized to $[0,1]$. Let us also define the cumulative distribution function corresponding to p_x as

$$cdf_x(i) = \sum_{j=0}^i p_x(j)$$

which is also the image's accumulated normalized histogram. We would create a transformation of the form $y = T(x)$ to produce a new image $\{y\}$, such that its CDF will be linearized across the value range, i.e.

$$cdf_y(i) = iK$$

for some constant K . The properties of the CDF allow us to perform such a transform; it is defined as

$$y = T(x) = cdf_x(x)$$

The function T maps the levels into the range $[0,1]$. The above describes histogram equalization on a grayscale image. However it can also be used on color images by applying the same method separately to the Red, Green and Blue components of the RGB color values of the image. The image is first converted to another color space, HSL/HSV color space in particular, then the algorithm can be applied to the luminance or value channel without resulting in changes to the hue and saturation of the image. The color intensities are spread uniformly leaving hues and saturation unchanged.

The decorrelation stretching enhances the color separation of an image with significant band-band correlation. The exaggerated colors improve visual interpretation and make feature discrimination easier. The technique consists of applying a Karhunen-Loeve transform to the colors of the image. This diagonalizes the covariance (or optionally the correlation) matrix of the colors. Next the contrast for each color is stretched to equalize the color variances. At this point the colors are uncorrelated and fill the colorspace. Finally the inverse transform is used to map the colors back to an approximation of the original. The decorrelation stretch calculation produces a 3x3 transformation matrix that is then applied to the colors in the image. The image is converted from RGB to the colorspace, the calculation and transformation is performed, and then the colors are converted back to RGB before writing into a digital image. The addition of linear contrast stretch enhances the resulting image by further expanding color range.

Intensity adjustment is an image enhancement technique that maps an image's intensity values to a new range. We can adjust the intensity values in an image

using the `imadjust` function, where you specify the range of intensity values in the output image.

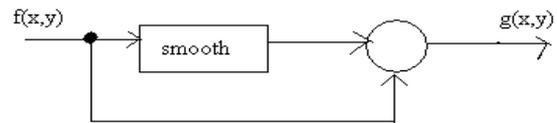
To use `imadjust`, you must typically perform two steps:

1. View the histogram of the image to determine the intensity value limits.
2. Specify these limits as a fraction between 0.0 and 1.0 so that you can pass them to `imadjust` in the `[low_in high_in]` vector.

For a more convenient way to specify these limits, use the `stretchlim` function. (The `imadjust` function uses `stretchlim` for its simplest syntax, `imadjust(I)`.) This function calculates the histogram of the image and determines the adjustment limits automatically. The `stretchlim` function returns these values as fractions in a vector that you can pass as the `[low_in high_in]` argument to `imadjust`;

By default, `stretchlim` uses the intensity values that represent the bottom 1% (0.01) and the top 1% (0.99) of the range as the adjustment limits. By trimming the extremes at both ends of the intensity range, `stretchlim` makes more room in the adjusted dynamic range for the remaining intensities. But you can specify other range limits as an argument to `stretchlim`.

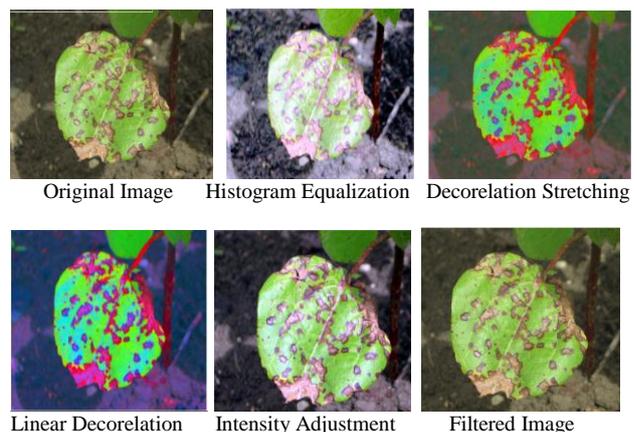
The unsharp filter is a simple sharpening operator which derives its name from the fact that it enhances edges (and other high frequency components in an image) via a procedure which subtracts an unsharp, or smoothed, version of an image from the original image.



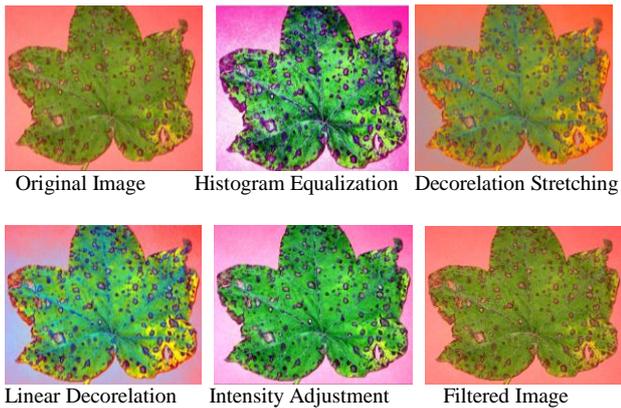
The function '`fspecial`' creates the unsharp filter from the negative of the Laplacian filter with parameter α . α controls the shape of the Laplacian and must be in the range 0.0 to 1.0. The default value for α is 0.2

4. EXPERIMENTAL RESULTS

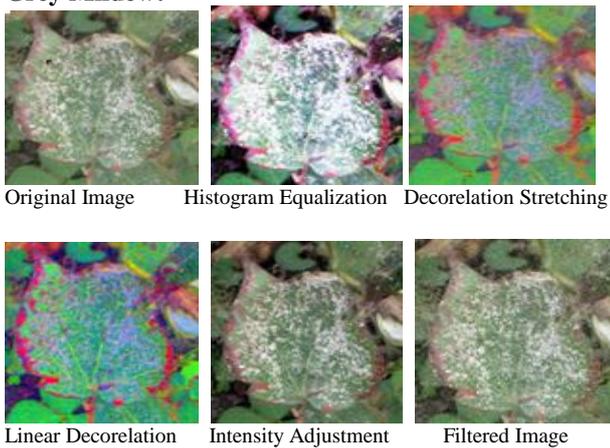
Bacterial Leaf Blight:



Myrothecium:



Grey Mildew:



5. CONCLUSION

Histogram equalization is found to enhance the contrast of images. The decorrelation stretching function performs a decorrelation stretch on images with multiple colors and when two or more bands are significantly correlated. The use of this technique found to enhance the color differences in an image. Adding the linear contrast stretch

enhances the resulting image by further expanding the color range. In this case, the transformed color range is mapped within each band to a normalized interval between 0.01 and 0.99, saturating 2%. Intensity Adjustment maps the intensity values in input image to new values in output image such that 1% of data is saturated at low and high intensities of input image. This increases the contrast of the output image. The use linear filtering is found to remove certain types of noise. The averaging filter is found useful for removing grain noise from a photograph. Because each pixel gets set to the average of the pixels in its neighborhood, local variations caused by grain are reduced.

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