Image Quality Enhancement for Wheat rust Diseased Leaf Image using Histogram Equalization & CLAHE

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Abstract. In the domain of agriculture, few crops play an important role as wheat is one of them. It is one of the most important one's across the globe. Nearly providing 15% food production across the world, it is also a winter cereal crop and a most essential food. The real challenge is to enhance the images of wheat crop in the agricultural area. because some of these are captured in real space environments may not be that clear to predict the type of disease of the crop that it is suffering from. So, we enhance the captured images using few existing techniques using the image histograms and the further details are extracted from these enhanced images, which make the disease judgement easy. We try to enhance the pixel intensity of the image using histogram equalization technique and by exploring various other models which deal with CLAHE which stands for Contrast Limited Adaptive Histogram Equalization then we finally conclude with results of the enhanced image by comparing with the originally clicked images which has fine detailed information about the rust in the crop.

1.INTRODUCTION

Any kind of an Image is represented basically in a format of its dimensions, like the height and the span of the image which are indirectly based upon the pixel count of an image. The Pixel can be referred to as a smallest part which contains the information of the image. Each individual pixel in a image is known to be a sample of its own, where the samples indicate the accurate representations of the image. We use images in order to highlight the features that we require to bring out. Hence Image Enhancement is a process of highlighting the certain features of an image, which can be done by changing a few characteristics of the image like brightness, Contrast, etc. We employ a few Image Enhancement methods like as of CLAHE which stands for Contrast Limited Adaptive Histogram Equalization to obtain the enhanced image. For obtaining an enhanced image we follow a basic root system of few steps to eliminate the unwanted noise or unwanted information featured to with the image that we process with.

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1.1.NOISE & NOISE REMOVAL

Noise is generally defined as unwanted information or the random variation that is carried by an image which disturbs the actual nature and the characteristics like color, brightness, contrast of the image. Noise is broadly classified as that of photoelectronic, structural and impulse noise. The various types of noise in an image can be Gaussian Noise, Salt and Pepper Noise, Speckle noise etc. Basically, Noise in an image is detected using few filters called Noise Detection Filters. The Images that are captured with digital cameras will always pick up the disturbances from the surroundings which create noise in the captured image. These unwanted disturbances are further filtered by few filters. The Filter is said to be effective only when the noise is completely removed from the image while preserving the actual details of the image. There are many kinds of filters, and we use Mean Filter, Gaussian Filter etc. The Noise Removal Techniques are those which reduce the effect of noise on the image characteristics without disturbing the nature of the image. There are various kinds of noise removal techniques in an image. It can be achieved by using Linear Smoothing filters, Non-Linear Filters etc

1.1.1.Mean Filter

The mean filter is described as an averaging linear filter, where it computes the average value of the corrupted image in a particular area. The pixel values are replaced by the average values and the same process is repeated for all the pixel values in the image.

1.1.2.Gaussian Filter

The Gaussian Filter is somewhat like that of the mean filter where it involves the surrounding pixel's weighted average and sigma as a parameter. Gaussian Distribution is approximated discretely which is represented as a Kernel. This gaussian filter blurs image boundaries or edges and preserves them when compared to the other filters.

1.2.HISTOGRAM ANALYSIS

Histogram is defined as the graphical representation of the data of an image. The plot of a Histogram is between the ratios of grey level intensities to the number of pixels at a particular location in the image. It shows the distribution of colour tones or intensity per pixel value in the image. The peaks and depths in the histogram depict their multiple places in the image where the grey level intensities are different. So, the image can be hiding few details in the dark spots or in the very light spots.

1.3.HISTOGRAM EQUALIZATION

The Image Histogram equalization technique is used to adjust the contrast, brightness or the other features of the image, which are the grey level intensities of the image at the particular pixels of the image. The Histogram Equalization concept doesn't involve the loss of image data or details in it. The narrowly arranged values are distributed in the graph after histogram equalization to broaden and feature more characteristics.

1.4.CLAHE

CLAHE is a method employed to improve low contrast images. It limits only contrast enhancement in the image. To reduce the effect of noise amplification in the image, a clipping limit is implemented in the CLAHE. The image is divided into a grid type system where the contextual regions are non-overlapping. The amplification is limited by using a cumulative distribution function (CDF). The 2 defining parameters of CLAHE are Block Size('m') and the Clip Limit('l'). They prioritize the quality of the image. Both the 'm' and 'l' are always directly proportional to the image contrast and make the histogram of the image flat enough.

2.PROPOSED METHOD

2.1.Noise Filtering

The Proposed method deals with the captured images so as to remove the absolute noise in the captured image. The filters remove the noise in the image in a significant way using the Mean and the Gaussian Filter, we can compare the images with the filtered ones.

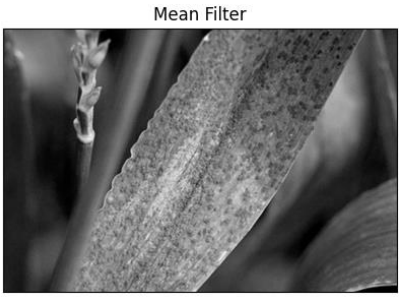


Fig. 1. Image after using Mean Filter

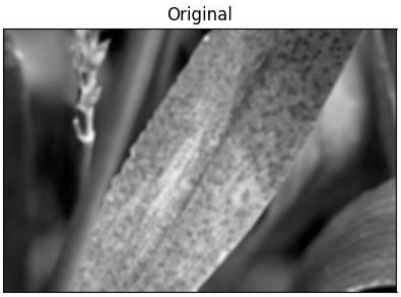


Fig. 2. Image without Mean Filter

Fig. 3. Image after using Gaussian Filter

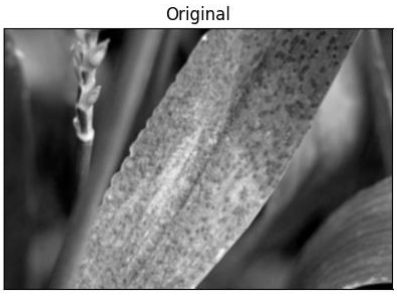


Fig. 4. Image without Gaussian Filter

2.2.Histogram Equalization

The Filtered Images are then processed to the Histogram Equalization,` where the technique is used to adjust the contrast, brightness, or the other features which are the grey level intensities of the pixels in the image. This process does not involve in the loss of any information of the image. We flatten the original Histogram of the image to obtain the hidden featured which cannot be seen in the image because the Histogram stores only the information of the grey level intensities but not the pixel location in the image.

Fig. 5. Original Captured Image

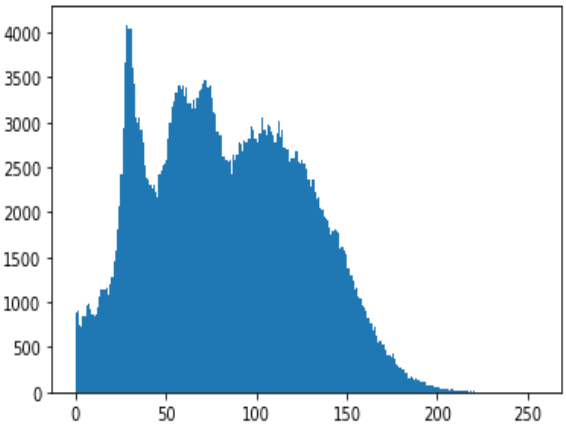


Fig. 6. Original Histogram of the Image

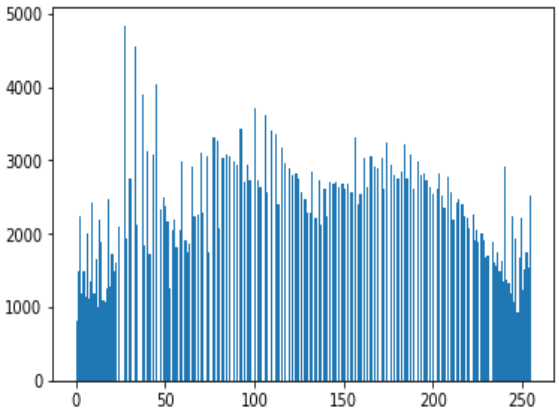
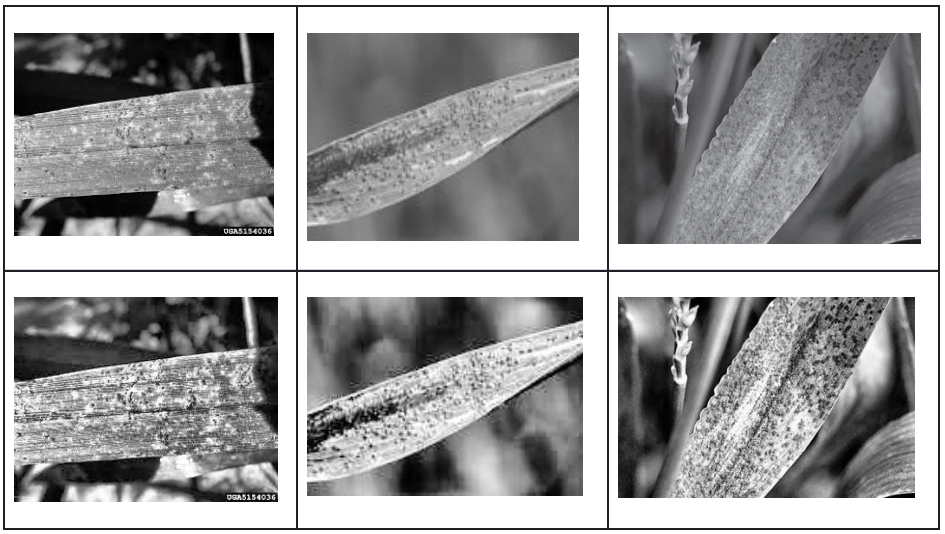


Fig. 7. Equalized Histogram Of the Original Image

2.3 CLAHE Illustrations

The step after we equalize the histogram of the image we further move to the method of CLAHE where we can obtain the contrast enhanced image and can compare with the originally captured image so as to identify that the leaf or crop is suffering from the rust. The below table is the data set comparison of the images captured and enhanced finally using the CLAHE method as to identify the rust on the crop.

Table 1. Representation of the Originally clicked images to the Enhanced Images



3.Equations and mathematics

We calculate the PSNR ratios of the image so as to compare the enhanced images with the originally captured images and we tabulate the PSNR values of the captured images to the Enhanced images. The equations for calculating the PSNR ratio is followed by,

$$PSNR = 20*log(a/sqrt(C)) \quad (1)$$

$$C = mean\ ((img1 - img2)\ ^2) \quad (2)$$

Where ‘a’ Is the maximum pixel count that is equal to 255.0
And c is represented as the MSE ratio of the compared images.

Table 2. Representation of the PSNR ratios of the Captured to the Enhanced Images

Size of the Image	Noise Size	PSNR of Captured Image	PSNR of Enhanced Image
(198,255,3)	(182,208,4)	32.341	66.994
(114, 203,3)	(182,281,4)	32.473	67.457
(514,770,3)	(182,238,4)	37.185	92.595

4.Conclusion

In this study, we find ourselves dealing with different types of image quality enhancement techniques. The current study involves about the Noise filtering, Histogram analysis and its Equalization, Color space models and Contrast Enhancement Technique. These methods are further helpful with even more efficient programming and can be extended to detect the area of disease in the wheat leaf and texture based features in the crop.

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