"Comparison of Histogram Equalization Techniques for Image Enhancement of Grayscale images of Dawn and Dusk"

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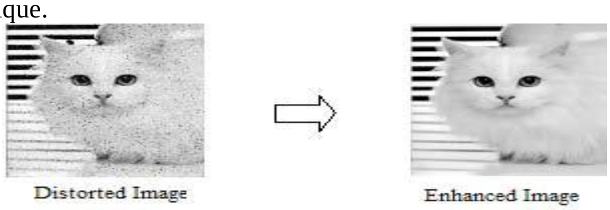
ABSTRACT: *Various enhancement schemes are used for enhancing an image which includes gray scale manipulation, filtering and Histogram Equalization (HE). Histogram equalization is one of the well known image enhancement became a popular technique for contrast enhancement because this method is simple and effective. In the latter case, preserving the input brightness of the image is required to avoid the generation of non-existing artifacts in the output image. Although these methods preserve the input brightness on the output image with a significant contrast enhancement, they may produce images which do not look as natural as the input ones. The basic idea of HE method is to re-map the gray levels of an image. HE tends to introduce some annoying artifacts and unnatural enhancement. To overcome these drawbacks different brightness preserving techniques are used which are covered in the literature survey. There are different images used in different time period and comparison on the basis of subjective and objective parameters. Subjective parameters are visual quality and computation time and objective parameters are Peak signal noise ratio (PSNR), Mean squared error (MSE), Normalized Absolute Error (NAE), Normalized Correlation, Error Color and Composite Peak Signal to Noise Ratio (CPSNR).*

KEYWORD: *Contrast enhancement, Histogram equalization, PSNR, MSE, NAE, CPSNR, Visual Contrast quality.*

I. INTRODUCTION

Contrast enhancement techniques are used widely in image processing. One of the most popular automatic procedures is histogram equalization (HE). Out of the five senses sight, hearing, touch, smell and taste which humans use to perceive their environment, sight is the most powerful. Receiving and analyzing images forms a large part of the routine cerebral activity of human beings throughout their waking lives. In fact, more than 99% of the activity of the human brain is involved in processing images from the visual cortex. This is less effective when the contrast characteristics vary across the image. Adaptive Histogram Equalization (AHE) overcomes this drawback by generating the mapping for each pixel from the histogram in a surrounding window. In future we will take different type of images in different time period and use Adaptive Histogram Equalization (AHE) and compare histogram equalization of images.

A. Image Enhancement: Image enhancement is among the simplest and most appealing areas of digital image processing. Basically, the idea behind enhancement techniques is to bring out detail that is obscured or simply to highlight certain features of interest in an image. A familiar example of enhancement is shown in Fig.1 in which when we increase the contrast of an image and filter it to remove the noise "it looks better." It is important to keep in mind that enhancement is a very subjective area of image processing. Improvement in quality of these degraded images can be achieved by using application of enhancement technique.



B. Adaptive Histogram Equalization method: This is an extension to traditional Histogram Equalization technique. It enhances the contrast of images by transforming the values in the intensity image. The AHE process can be understood in different ways. In one perspective the histogram of grey levels (GL's) in the output is maximally black; if it has the median value in its window the output is 50% gray's window around each pixel is generated first. The cumulative distribution of GL's, that is the cumulative sum over the histogram, is used to map the input pixel GL's to output GL's. If a pixel has a GL lower than all others in the surrounding window

C. Dualistic sub-image histogram equalization method: This is a novel histogram equalization technique in which the original image is decomposed into two equal area sub-images based on its gray level probability density function. Then the two sub-images are equalized respectively. At last, we get the result after the processed sub-images are composed into one image. In fact, the algorithm can not only enhance the image visual information effectively, but also constrain the original image's average luminance from great shift. This makes it possible to be utilized in video system directly.

D.Dynamic histogram equalization for image contrast Enhancement: It employs a partitioning operation over the input histogram to chop it into some sub histograms so that they have no dominating component in them. Then each sub-histogram goes through HE and is allowed to occupy a specified gray level range in the enhanced output image. Thus, a better overall contrast enhancement is gained by DHE with controlled dynamic range of gray levels and eliminating the possibility of the low histogram components being compressed that may cause some part of the image to have washed out appearance.

E.Contrast Limited Adaptive Histogram Equalization Method (1)**Algorithm Steps**:Obtain all the inputs: Image, Number of regions in row and column directions, Number of bins for the histograms used in building image transform function (dynamic range), Clip limit for contrast limiting (normalized from 0 to 1).

Pre-process the inputs: Determine real clip limit from the normalized value if necessary, pad the image before splitting it into regions.

Process each contextual region (tile) thus producing gray level mappings: Extract a single image region, make a histogram for this region using the specified number of bins, clip the histogram using clip limit, and create a mapping (transformation function) for this region

Interpolate gray level mappings in order to assemble final CLAHE image: Extract cluster of four neighboring mapping functions, process image region partly overlapping each of the mapping tiles, extract a single pixel, apply four mappings to that pixel, and interpolate between the results to obtain the output pixel; repeat over the entire image.

II. METRICS FOR GRAY SCALE IMAGES

1. Peak-signal-to-noise-ratio (PSNR): PSNR is the evaluation standard of the reconstructed image quality, and is important measurement feature. PSNR is measured in decibels (dB) and is given by:

$$PSNR = 10\log(255^2/MSE)$$

Where the value 255 is maximum possible value that can be attained by the image signal. Mean square error (MSE) is defined as Where M*N is the size of the original image. Higher the PSNR value is, better the reconstructed image.

2. Contrast: Contrast defines the difference between lowest and highest intensity level. Higher the value of contrast means more difference between lowest and highest intensity level.

Histogram Technique for Equalization: Enhance contrast using histogram equalization

Syntax:

```
J = histeq(I, hgram)
J = histeq(I, n)
[J, T] = histeq(I,...)
newmap = histeq(X, map, hgram)
newmap = histeq(X, map)
[newmap, T] = histeq(X,...)
```

Description: Histeq enhances the contrast of images by transforming the values in an intensity image, or the values in the color map of an indexed image, so that the histogram of the output image approximately matches a specified histogram.

J = Histeq (I, hgram) transforms the intensity image I so that the histogram of the output intensity image J with length (hgram) bins approximately matches hgram. The vector hgram should contain integer counts for equally spaced bins with intensity values in the appropriate range: [0, 1] for images of class double, [0, 255] for images of class uint8, and [0, 65535] for images of class uint16. Histeq automatically scales hgram so that sum (hgram) = prod (size (I)). The histogram of J will better match hgram when length (hgram) is much smaller than the number of discrete levels in me.

J = Histeq (I, n) transforms the intensity image I, returning in J an intensity image with n discrete gray levels. A roughly equal number of pixels is mapped to each of the n levels in J, so that the histogram of J is approximately flat. (The histogram of J is flatter when n is much smaller than the number of discrete levels in I.) The default value for n is 64.

[J, T] = Histeq (I...) returns the grayscale transformation that maps gray levels in the image I to gray levels in J.

New map = Histeq(X, map, hgram) transforms the color map associated with the indexed image X so that the histogram of the gray component of the indexed image (X,newmap) approximately matches hgram. The histeq function returns the transformed color map in new map. Length (hgram) must be the same as size (map,1).

New map = Histeq(X, map) transforms the values in the color map so that the histogram of the gray component of the indexed image X is approximately flat. It returns the transformed color map in new map.

[new map, T] = Histeq(X,...) returns the grayscale transformation T that maps the gray component of map to the gray component of new map.

Class Support: For syntax that includes an intensity image I as input, I can be of class uint8, uint16, int16, single, or double. The output image J has the same class as I.

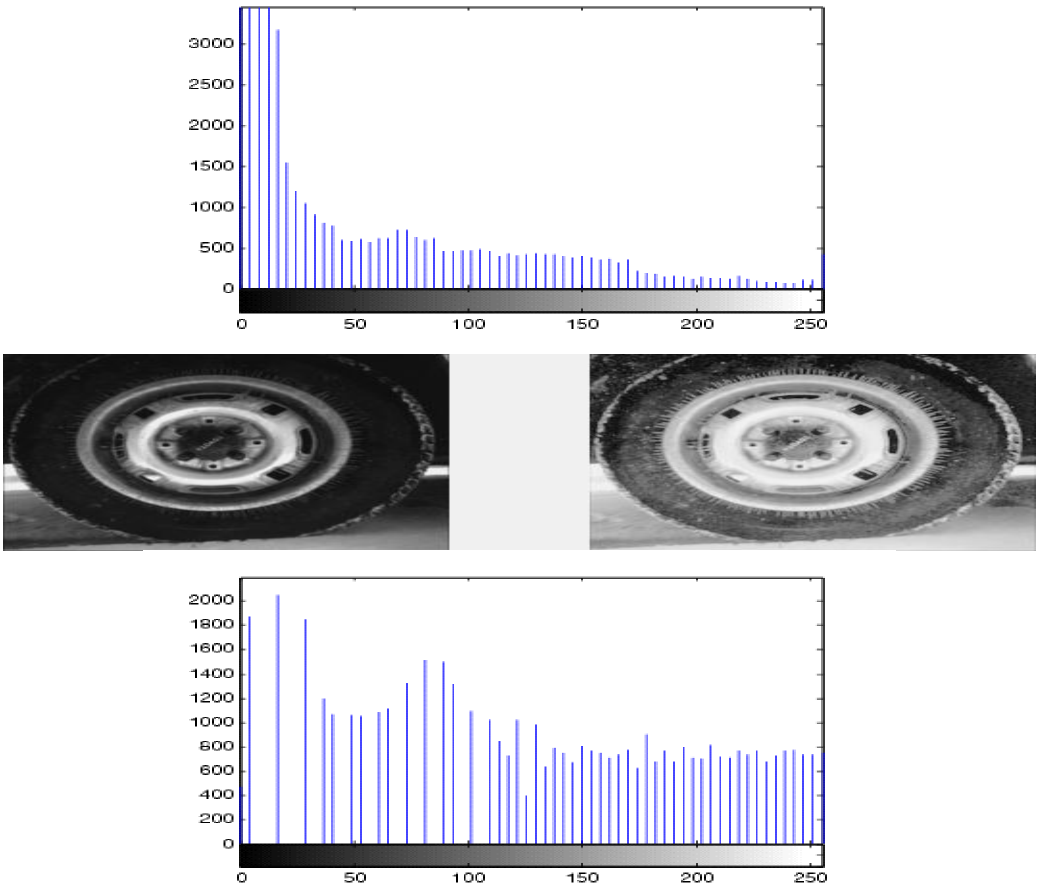
For syntax that includes an indexed image X as input, X can be of class uint8, single, or double; the output color map is always of class double. The optional output T (the gray-level transform) is always of class double.

Examples

Enhance the contrast of an intensity image using histogram equalization.

```
I = imread ('tire.tif');
J = Histeq (I);
imshow (I)
```

Figure, imshow (J)

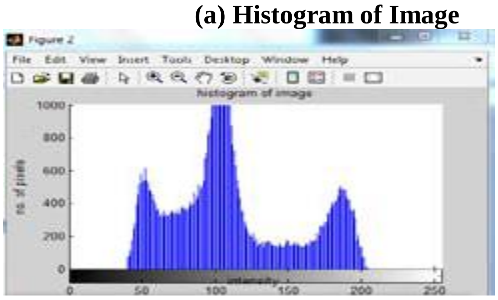


(a).Original image of tire (b) HE image of tire

Results of test image "Rice"

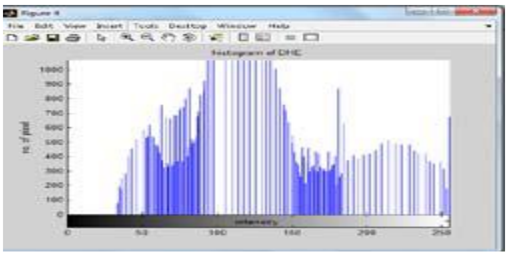
(a) Original image

(a) Histogram of Image



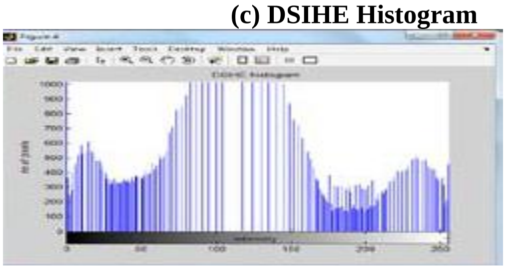
(b) DHE Image

(b) DHE Histogram



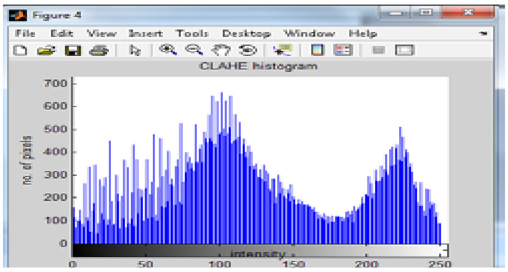
(c)DSIHE Image

(c) DSIHE Histogram



(d) CLAHE Image

(d) CLAHE Histogram



Equalized Histograms for Image "Rice" as shown in Image a, b, c, d as original, CLAHE, DHE, DSIHE Respectively.

Table 1: Comparison of Various Parameters for "Rice" Image:

Parameter Technique	AMBE	Contrast	PSNR
CLAHE	10.576	21.681	0.0266
DSIHE	3.908	31.876	0.0244
DHE	10.476	9.154	0.1021

III. CONCLUSION AND FUTURE ASPECT

IN future we will use different images in different time either are in morning or evening, Natural or Unnatural light and that's images are compare different time duration and take out its equalization. We will be compared images by Histogram Equalization. In this Paper; a frame work for image enhancement based on prior knowledge on the Histogram Equalization has been presented. Many image enhancement schemes like Contrast limited Adaptive Histogram Equalization (CLAHE), Equal area dualistic sub-image histogram equalization (DSIHE), Dynamic Histogram equalization (DHE) Algorithm has been implemented and compared. The Performance of all these Methods has been analyzed and a number of Practical experiments of real time images have been presented. From the experimental results, it is found that all the three techniques yields Different aspects for different parameters. In future, for the enhancement purpose more images can be taken from the different application fields so that it becomes clearer that for which application which particular technique is better both for Gray Scale Images and color Images.

Histogram Equalization images in different Time Period

M1

M2

M3

M4

Morning Period Images (at 06:00 to 10:00 am)

E1

E2

E3

E4

Evening Period Images (at 6:00 to 6:45pm)

REFERENCE

[1]. M. Abdullah-Al-Wadud, Md. Hasanul Kabir, M. Ali Akber Dewan, Oksam Chae, "A dynamic histogram equalization for image contrast enhancement", IEEE Transactions. Consumer Electron. vol. 53, no. 2, pp. 593- 600, May2007.

[2]. Histogram Equalization Techniques For Image Enhancement "Rajesh Garg, Bhawna Mittal, Sheetal Garg, H.I.T., Sonepat, Haryana, India3S.M.Hindu Sr.Sec.School, Sonepat, Haryana, India IJECT Vol. 2, Issue 1, March 2011.

[3]. T. Tom and G. J. Wolfe, "Adaptive histogram equalization and its applications," SPIE Applicat. Dig. Image Process. IV, vol. 359, pp.

[4]. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", 2nd edition, Prentice Hall, 2002.

[5]. K. Jain, "Fundamentals of Digital Image Processing". Englewood Cliffs, NJ: Prentice-Hall, 1991.

[6]. J. M. Gauch, "Investigations of image contrast space defined by variations on histogram equalization," CVGIP: Graph. Models Image Process, vol. 54, pp. 269–280, July 1992.

[7]. Stephen M. Pizer, R. Eugene Johnston, James P. Ericksen, Bonnie C. Yankaskas, Keith E. Muller, "Contrast-Limited Adaptive Histogram Equalization Speed and Effectiveness, IEEE Int. Conf. Neural Networks & Signal Processing, Nanjing, China, December 14-17, 2003.