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Image Contrast Enhancement by Stretch Composite Histogram Equalization

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ABSTRACT: Histogram equalization method provides most easiest and appropriate technique for contrast enhancement. However it does not maintain in its original brightness and grey level enhancement with broadening and equalization of histogram. So here introduce novel approach for grey scale image contrast enhancement by stretch composite histogram equalization method where first stretch the two neighbourhood pixels by grey level and improve dim and brightness of the image then we image enhancement is achieved by assuming that for given image, the modulus of grey level differences between pixels and their neighbouring pixels are equally distributed that are known as histogram equalization algorithm. The simulation results show that for wide range test image the proposed method is enhance contrast and grey level while preserving the natural appearance as brightness

KEYWORDS: Contrast, stretch, histogram equalization.

1. INTRODUCTION

Digital Image processing is a technique to enhance raw image received from camera placed on satellite, space probe and aircraft or pictures have taken and used in daily life applications. Many techniques have been developed in digital image processing during the last decades. Digital cameras capture the picture by automatic focus exposure time and proper brightness in low luminance but many times capture the details of the bright area. When this happen to backlight image, the black lighted region saturate the entire image as pixel intensity in the bright area approaches the high end of the camera range.The histogram equalization (HE) method is an effective and widely used technique for contrast enhancement of images.

II. RELATED WORK

It flattens and stretches the dynamics range of the histogram and achieves overall image contrast enhancement (Gonzales and Woods, 2002)[1]. K.S. Sim et al [2007]as bi-histogram equalization and recursive mean-separate histogram equalization, the proposed RSIHE method yields better image compensation[2]. Chao Wang and Zhongfu Ye [2005] to overcome such drawback as HE. To maximize the entropy is the essential idea of HE to make the histogram as flat as possible. Following that, the essence, named Brightness Preserving Histogram Equalization with Maximum Entropy (BPHEME), tries to find, by the variational approach.

Yu-Ren Chung in year 2012 major theme in contrast enhancement is to partition the input histogram into multiple sub histograms before final equalization of each sub-histogram is performed. Ismail A. Humiedet al [2012] have been presented that the amplitudes of images histogram components are very high at one location on the gray scale and very small in the rest of the grayscale.The method is a combination of Histogram Equalization (HE) and Fast Gray-Level Grouping (FGLG) [12]. The basic procedure of this method is segments the original histogram of a low contrast image into two sub-histograms according to the location of the highest amplitude of the histogram components, and achieving contrast enhancement Fast Gray-Level Grouping (FGLG) technique does not only produce better results than each individual contrast enhancement technique, but it is also fully automated. Moreover, it is applicable to a broad variety of images that satisfy the properties mentioned above and suffer from low contrast.Chao, Qian in year 2013 described range limited Bi-histogram equalization for image contrast enhancementextension of bi-histogram equalization referred to as Range Limited Bi-Histogram Equalization (RLBHE) [13]. calculated to yield minimum absolute mean brightness error between the original image and the equalized one. P. Shanmugavadivu et al in year 2014 Threshold and Optimized Histogram Equalization (TOHE) [14]. Their central idea of this technique is to first segment the input image

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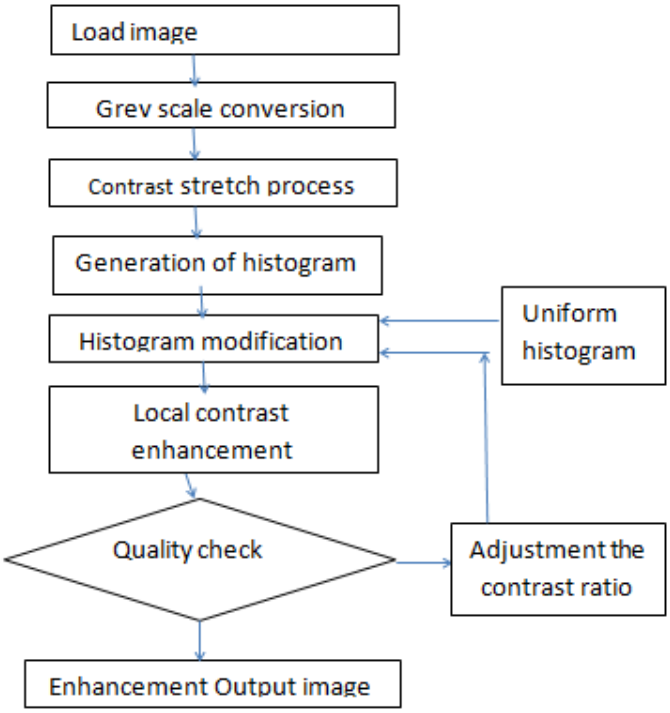
histogram into two using Otsu's threshold, based on which a set of weighing constraints are formulated. A careful study of all above research papers there are many methods that is used to improve the contrast of an image by minimum size of pixel entropy may be improved. For the further enhancement of desired properties in grayscale image which in turn increases the appearance, visual brightness and contrast enhancement. This research paper work deals of grayscale image with the objective of improving its dim image, visual brightness and contrast enhancement without changing the original properties of image.

III. PROPOSED FLOWCHART OF CESCHE



Description of proposed flowchart.

1. Contrast stretch:A high-contrast image spans the full range of gray-level values; therefore, a low contrast image can be transformed into a high-contrast image by remapping or stretching the gray-level values such that the histogram spans the full range [3]. The contrast stretch is often referred to as the dynamic range adjustment (DRA). The simplest contrast stretch is a linear transform that maps the lowest gray level *GLmin*in the image to zero and the highest value *GLmax*in the image to 255 (for an eight-bit image), with all other gray levels remapped linearly between zero and 255, to produce a high-contrast image that spans the full range of gray levels [10]. This linear transform is given by
2.

$$g'(x,y) = INT[\{\frac{255}{GLmax - GLmin}[g(x,y) - GLmin]\}\ldots\ldots \quad .(1.1)$$

$$g'(x,y) = INT\{\frac{GL'max - GL'min}{GLmax - GLmin}[g(x,y) - GL] + GL'min\}\ldots. .(1.2)$$

We can achieve additional contrast enhancement if we replace *GLmin*and *GLmax*in Eq. (1.2) with points that penetrate the gray-level histogram, with *Pmin*>*GLmin*penetrating the low end and *Pmax*<*GLmax*penetrating the high end. The gray-level transform is then given by

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$$g'(x,y) = INT[\{\frac{GL'max - GL'min}{Pmax - Pmin}[g(x,y) - Pmin] + GL'min\}.. \quad (1.3)$$

3. Global histogram equalizationThe histogram of a digital image the pixel values of in the interval [0, L-1]. is a discrete function $g(X_k) = n_k$, where X_k is the k^{th}gray level and n_k is the number of pixels in the image having gray level X_k. It is common practice to normalize a histogram by dividing each of its values by the total number of pixels in the image denoted by n. variable *X* represent the gray levels of the image to be enhanced. In the initial part of our discussion we assume that *r* has been normalized to the interval [0, 1], with X=0 representing black and X=1 representing white.

Transformation S = T(X) $0 \le X \le 1$ $0 \le T(X_k) \le 1$ for $0 \le X \le 1$;

(a) T(r) is single-valued and monotonically increasing in the interval

(b) $0 \le T(X_k) \le 1$ for $0 \le X \le 1$;

The requirement in (a) that T(r) be single valued is needed to guarantee that the inverse transformation will exist, and the monotonicity condition preserves the increasing order from black to white in the output image. A transformation function that is not monotonically increasing could result in at least a section of the intensity range being inverted, thus producing some inverted gray levels in the output image. Finally condition (b) guarantees that the output gray levels will be in the same range as the input levels. The above-normalized values can be scaled between 0 and L - 1 as follows. The inverse transformation from *s* back to *r* is denoted

$X = T^{-1}(s)$ $0 \le S \le 1$ …… (2.1)

The gray levels in an image may be viewed as random variables in the interval [0, 1]

$P(X_k) = n_k/n$ k = 0, 1. . L −1…….(2.2)

Let us suppose that $\mathbf{X} = \{X(i, j)\}$ denotes a digital image, where X (i, j) denotes the gray level of the pixel at (i, j) place. The total number of the image pixels is n, and the image intensity is digitized $\forall X(i, j) \in \{X_0, X_1, X_2 \ldots\ldots X_{L-1}\}$. Suppose n_k denotes the total number of pixels with gray level of X_k in the image, and then the probability density of X_k will be Let pr(r) and ps(s) denote the probability density functions of random variables *X* and *s*, respectively, where the subscripts on *p* are used to denote that P_x and P_s are different functions. Then the probability density function $p_s(s)$ of the transformed variable *s* can be obtained using a rather simple formula:

$$P_s(s) = P_x(X_k)\left|\frac{dX}{ds}\right|. \quad \ldots\ldots\ldots\ldots \quad (2.3)$$

The relationship between $p(X_k)$ and X_k is defined as the probability density function (PDF), and the graphical appearance of PDF is known as the histogram. Based on the image's PDF, its cumulative distribution function is defined as

$$C(X_k) = \sum_{J=0}^{L-1} p(X_J) = \sum_{J=0}^{L-1} \frac{n_k}{n} \quad (2.4)$$

Where k = 0, 1. . . L− 1, and it is obvious that c $(X_{L-1}) = 1$. Let us define a transform function f(x) based on the cumulative density function as. Thus, a processed (output) image is obtained by mapping each pixel with level X_k in the input image into a corresponding pixel with level S_k in the output image via Eq. (.2.4). As indicated earlier, a plot of $P_x(X_k)$ versus X_k is called a histogram. The transformation (mapping) given in Eq. (2-4) is called histogramequalization or histogram linearization. The transformation in Eq. (2-4) satisfies conditions (a) and (b) stated previously use of Eq. (2-4) does have the general tendency of spreading the histogram of the input image so that the levels of the histogram-equalized image will span a fuller range of the gray scale.

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IV. SIMULATION RESULTS AND DISCUSSION

4.1 Image enhancement of pout boy

Image enhancement by histogram equalization:-Pout gray scale image have taken for enhancement see the pout image this image is very blurring and unclear image we cannot recognize pout background image in this image also have very low gray level that means contrast of image is very low so we take this image for enhancement. First method of enhancement have used histogram equalization method by this method enhancement has performed and we get enhanced pout2 image and generate the histogram of HE enhanced pout2 image clearly see that enhanced image2 is seen clearly and this image has visual appearance have better as compare to image 1 in enhanced image almost blurriness has improved but not desired.

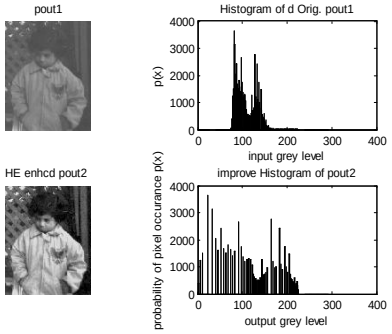

Figure 4.1(a) pout and its enhanced. By HE

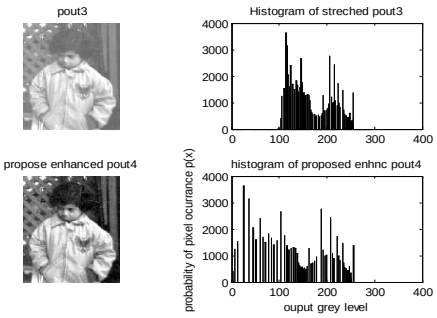

Figure 4.1(b) Enhanced image4 CESCHE

From above result figure 4.1.1(a) it's clear that image enhancement is happened but the highest grey level not reached the GL_{max} it's clear that contrast improvement not good. So we propose novel enhancement method and their result given below figure 4.1.2.

4.2 cameraman image enhancement

Second camraman image have taken for enhancemnet. In this image visual apeareance is showing the darkness. So this type of image can enhance to make image higher contrast and more brightness. So it is pocessed by many method these given below. Firt method of enhancement is histogram equalization in this enhancement image contrast is increased and histogram peaks also increasedFrom the above result Fig 5.2(a) it's clear that contrast enhancement has reached specified gray level but in this process the entropy of image is low because its histogram peaks is low so it can be improves better.So we enhance this image by proposed method in this process we take stretch parameters low gray level and high gray level respectively 10, 40 and their slopes respectively 1, 2, and 1 The result of proposed method contrast enhancement is quit better than other image enhancement methods. The various parameters improved like histogram peaks and entropy, brightness of image. The result of proposed method is given below figure 5.2(b).

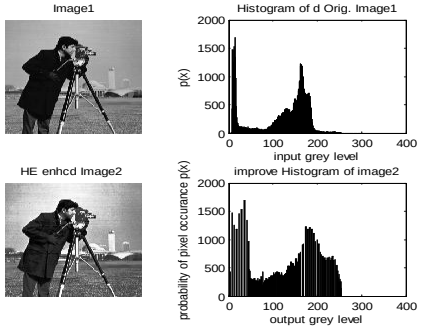

Fig 4.2(a) cameraman image and enhance HE

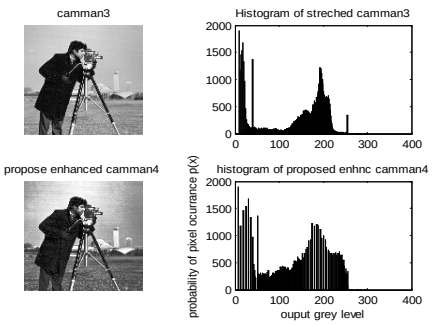

Figure 4.2(b) image1 enhanced by CESCHE

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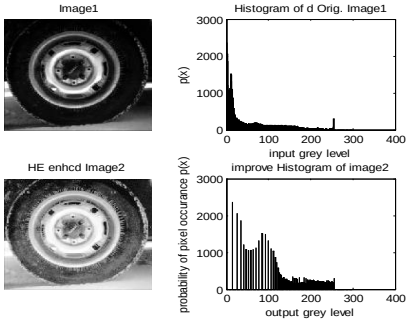
4.3 Tire image enhancement

Third tire image have taken for enhancemnet. In this image visualy is dark imge shows so this type of image can enhance to make image higher contrast and more brightness. So it is pocessed by diffrent methods these given below. First method of enhancement is histogram equalization in this enhancement image contrast is increased and histogram peaks als



4.3(a tire image and Enhanced by HE

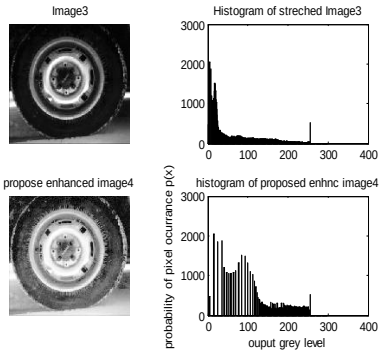


Figure 4.3(b) enhanced tire by proposed CESCHE

4.4 Rice image enhancement

Fourth rice image have taken for enhancemnet. In this image visual apeareance is dark and blurry shows so this type of image can enhance to make image higher contrast and more brightness and remeove the blurrness. First method of enhancement is histogram equalization which are given in figure 5.4(a) in this enhancement image contrast is increased and histogram peaks also increased In proposed method method Figure 5.4(b) of rice image enhancement for contrast stretching parameter respectively 1, 5 and slopes are 1, 2.5, 1. By this process darkness of image is improved and increase the brightness so rice3 is seen more propertyful further this image enhance by histogram equalization get rice4 in this image lower part of image are seen clearly with high contrastand there blurriness is removed. Histogram of this rice4 image also better than the previous results. Histogram is spread over entire range gray level GL_{max} this shows the contrast of image is best as compared to others

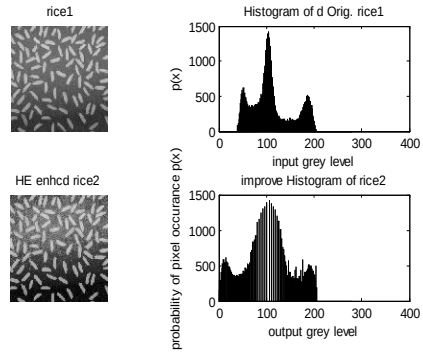


Figure 4.4(a) rise image enhanced by HE

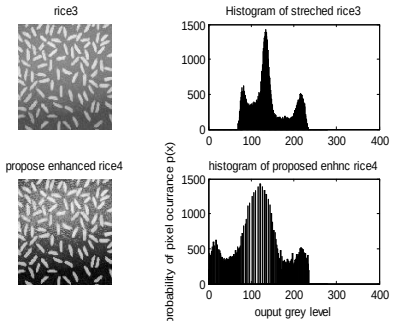


Figure4.4(b) rice image enhanced by CESCHE

4.5Gray level contrast enhancement bar chart

Four images are taken to enhance all these images having distinguished properties like pout image have blurriness low contrast so its original image gray level is very low so it enhance

The gray level and remove the blur and its result are respectively 150, 230, and 255. Cameraman image gray level is more than previous pout image it's have a 200 gray level so its enhancement result are consecutive 240, 250, and 254

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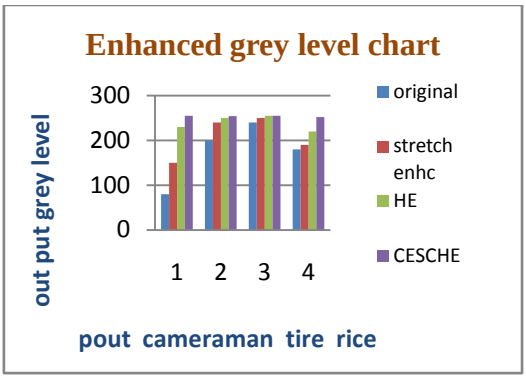

4.5 Bar chart of entire image

Tire image is dark and its gray level is respectively 240, 250, and 255. Rice image have low contrast and its gray level respectively 180, 190, 220, and 252. The height of bar chart is shown higher contrast these entire images gray level bar height shows the enhancement bar chart gives best result is purple color bar height is the best from all these methods. Those are shown in barchart 4.5 Histogram in the high-contrast image cover a broad range of the gray level and, further, that the distribution of pixels uniform, with very few vertical lines being much higher than the others. Intuitively, it is reasonable to conclude that an image, whose pixels tend to occupy the entire range of possible gray levels and, in addition, tend to be distributed uniformly, will have an appearance of high contrast. The net effect will be an image that shows a great deal of gray-level detail and has high dynamic range.

V. CONCLUSION AND FUTURE SCOPE

All the methods using MATLAB programming are implemented to get optimal response. Composite method provides the way to integrate and complementary data to enhance information apparent in the image as well as to increase the reliability of the interpretation. The analysis of enhanced image on original images gives us an idea about the composite enhancement algorithm and their difference on original data and their relevance to extract the structural information. There are some likely extensions to this research, apart from the necessary improvement of the histogram equalization. The grey level of image in histogram approaches was found to influence composite histogram equalization. All this research work carried with gray scale image. For future recommendation coloured and real-time images can take to enhance, and determining the optimum-output technique.

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