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HISTOGRAM EQUALIZATION TECHNIQUES AND ITS APPLICATION IN EYE

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Abstract— Histogram equalization (HE) is commonly used for improving contrast in digital images. It has proved to be a simple and effective image contrast enhancement technique. It is a simple and effective image enhancing technique, however, it tends to change the mean brightness of the image to the middle level of the permitted range, and hence is not very suitable for consumer electronic products, where preserving the original brightness is essential to avoid annoying artifacts In this paper we have studied various Histogram equalization and divide the input histogram according to the criteria .In the first part we have discussed Histogram equalization,In the second part we have differentiate various methods of HE. In third part we have filtered an image and applied the program code in the filtered image to get HE. Finally Discussions and conclusions.

Index Terms— Histogram equalization;minimum mean brightness error; Eye Image

1 INTRODUCTION

Histogram equalization (HE) is a popular technique for enhancing image contrast The basic idea is to map the gray levels based on the probability distribution of the image input gray levels. HE flattens and stretches the dynamic range of an image histogram and gives an overall contrast improvement. In fact,
HE has been applied in various areas, such as medical image processing The major difference among
the methods in this family is the criteria used to divide the input histogram. For a given image **X**, the probability density function $p\ (X_k)$ is defined as

$$p\ (X_k)=n^k/n$$

For k = 0, 1… L – 1, where nk represents the number of times that the level (Xk appears in the input image X and n is the total number of samples in the input image. Note that p (Xk) is associated with the histogram of the input image which represents the number of pixels that have a specific intensity . In fact, a plot of nk vs. is known histogram of X. The high performance of the HE in enhancing the contrast of an image as a consequence of the dynamic range expansion, Besides, HE also flattens a histogram. Base on information theory, entropy of message source will get the maximum value when the message has uniform distribution property [1].

2 COMPARITIVE STUDY

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S.No.	Methods of HE	Working Criteria
01	Brightness preserving Bi-Histogram Equalization (BBHE)	BBHE separates the input image histogram into two parts based on input mean. After separation, each part is equalized independently. This method tries to overcome the brightness preservation problem [2].
02	Quantized Bi-Histogram Equalization (QBHE)	QBHE uses the average intensity value as their separating point [2].
03	Dual Sub-Image Histogram Equalization (DSIHE)	DSIHE uses the median intensity value as the separating point. the DSIHE method decomposes the images aiming at the maximization of the Shannon's entropy [5] of the output image. For such aim, the input image is decomposed into two sub-images, being one dark and one bright, respecting the equal area property (i.e., the sub-images has the same amount of pixels) [3].
04	MBPHE	MBPHE methods basically can be divided into two main groups, which are bisections MBPHE, and multi-sections MBPHE. Bisections MBPHE group is the simplest group of MBPHE. Fundamentally, these methods separate the

		input histogram into two sections. These two histogram sections are then equalized independently [4].
05	Minimum Mean Brightness Error Bi-HE (MMBEBHE)	MMBEBHE uses the separating point that produces the smallest Absolute Mean Brightness Error (AMBE) [5].
06	RecursiveMean-Separate Histogram Equalization (RMSHE)	AMBE is another improvement of BBHE. However, it also is not free from side effects [6].
07	Brightness preserving dynamic histogram equalization (BPDHE)	BPDHE method is actually an extension to both MPHEBP and DHE. The brightness preserving dynamic histogram equalization (BPDHE), which is an extension to HE that can produce the output image with the mean intensity almost equal to the mean intensity of the input, thus fulfils the requirement of maintaining the mean brightness of the image [7].
08	Weighting mean-separated sub-histogram equalization (WMSHE)	WMSHE method is to perform the effective contrast enhancement of the digital image. Weighting mean-separated sub-histogram equalization (WMSHE) method is to perform the effective contrast enhancement of the digital image. This method consist the following steps: A. Separation of histogram based on our proposed weighting mean function. B. Achieving contrast enhancement by equalizing subhistogram respectively in small-scale detail [8].
09	MULTILEVEL COMPONENT BASED HISTOGRAM EQUALIZATION (MCBHE)	The MCBHE algorithm starts just like the BPBHE algorithm by decomposing the input image I into two Sub images using the original mean brightness [9].
10	MODIFIED HISTOGRAM EQUALIZATION (MHE)	MHE is an extension of WTHE. Here each original probability density value P(rk) is replaced by a Constrained PDF value Pc(rk) yielding: $H_k = (L-1) \times P_c(r_k)$ [10].

3 Method to Detect Eyes

My approach is broken down into two stages: find the face, and then find the eyes. To find the face, I designed two methods: one utilizing the high symmetry of a human face and the other using average face matching. In the first method I scan the image for the region that has the best symmetry, and then perform some optimization to get better results. Also I apply a skin filter (2 types the user can choose from) to the face detection window to further shrink down the search space.

In the second method I scan the image for the region that has the best correlation with the given average face template. To find eyes I also implemented two ways: rule based one and average eye matching.

a) The rule-based method simply means the program tries to find two clusters of dark pixels (eyes are dark) with some constraints applied to them. It takes too long and is highly error prone.

b) The average eye matching, however, is extremely fast and gives accurate results, but user must supply the approximate ratio of the face size to the image size. This requirement renders this method less practical because ideally, user shouldn't tell the program anything other than the image itself.

4 Hardware Support and Algorithm

IMAGES	Original Image	BBHE	RMSHE
Image1	6.788	5.873	6.3016
Image2	7.33	5.783	6.423

5 Discussion

The comparative study of Histogram Equalization based methods shows that the cases which require higher brightness preservation

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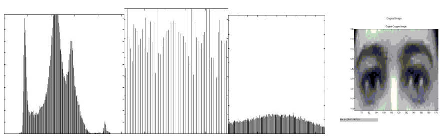
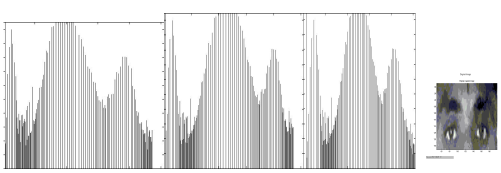
and not handled well by HE, BBHE and DSIHE, have been properly enhanced by RMSHE. MMBEBHE is the extension of BBHE method that provides maximal brightness preservation. DHE ensures consistency in preserving image details and is free from any severe side effects. BPDHE can preserve the mean brightness better than BBHE, DSIHE, MMBEBHE, RMSHE, MBPHE, and DHE. WMSHE achieves the best

(a) Histogram Pattern of Image1



(a)Original Result (b) BBHE (C) RMSHE

(b) Histogram Pattern of Image2



(a) Original Result (b) BBHE (C) RMSHE

quality through qualitative visual inspection and quantitative accuracies of Peak Signal-to- Noise Ratio (PSNR) and

Absolute Mean Brightness Error (AMBE) compared to other state-of-the-art methods. Eye part of image has been filtered and Histogram for original Image,Normalized Image, Equalized Image has been plotted.

CONCLUSIONS

Histogram equalization is a simple and effective image enhancing technique. However, in some cases, it tends to change significantly the brightness of an image.

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