 ISSN : 0976-8491 (Online) | ISSN : 2229-4333 (Print)

A Performance Analysis on Iris Image Enhancement Using Histogram Techniques

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Abstract

An iris is unique physiological biometric traitcompared to other biological traits to authenticate a person. In this paper we presented iris contrast enhancement using different histogram equalization (HE) techniques, High-Resolution Fundus (HRF) iris database is considered in the pre-processing. The iris template is enhanced using the Adaptive histogram, Brightness-Bi histogram, CLAHE and HE. The performance of iris image quality is measured such as Peak Signal Noise Ratio (PSNR) and Mean Square Error (MSE).

Keywords

Biometric recognition; Iris Enhancement; HE; PSNR; MSE.

I. Introduction

Image Processing (IP) has worked on many applications [1-3] such as object recognition, video processing and many more in the computer vision area; it traced many problems in this area like image enhancement (IE), biometric recognition and many more. IE implies the quality change in the picture utilizing diverse sorts of procedures. The improved or change should be possible utilizing contrast improvement, IE, edge improvement and so on.

The most well-known method is HE due to its ease and performance in almost all types of images [4]. It is performed by remapping the intensity levels of a picture in light of the probability density function (PDF) of the image intensities. In any case, this technique neglects to upgrade a picture when there is a quantum bounce in the cumulative distribution function (CDF).BBHE partitions the histogram into two sections relying upon the mean of the histogram. After the BBHE technique, a few calculations were proposed in view of apportioning the histogram into at least two sections [5].

II. Literature Review

Hu et al. [6] has presented a new enhancing color iris segmentation (IS) utilizing a model determination procedure. For this enhance the dependability and precision of IS in the color eye pictures, i.e., specifically for the eye pictures caught with the static and cell phones. The technique is mixes for various segmentation methods. In any case an examination of an IS structure. It utilizes three unique models to show that changes can be accomplished by choosing among the results created by three models. At that point, utilization of model

determination technique that diagrams the ideal segmentation in view of a ring-formed area around external division limit distinguished by each model. Creators adjusted the histogram of gradients inclinations (HOG) as the highlights removed from the ring-formed area and after that prepare a support vector machine (SVM) based classifier, which offers the choice.

Tossy et al. [7] has presented an algorithm Random Sample Consensus (RANSAC) for drawing boundaries around non circular area of iris. This boundary traced using Hough transform which is easy to use and accurate method.

Aparna G et al. [8] has proposed IS using hybrid method namely Haar transform, principal component analysis (PCA) and Block sum algorithm which was used for feature extraction process. This work applied this algorithm for finding out the recognition rate and accuracy.

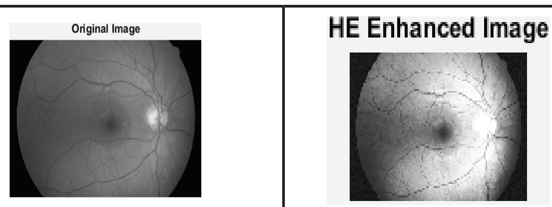
Naglaa F. et al. [9] proposed a quick iris confinement calculation while protecting the precision contrasted with alternate methodologies. Thresholding is utilized as the initial step rather than comprehensive inquiry of a three-dimensional parameter space for countless pixels. This algorithm presented a versatile thresholding framework has been utilized to beat the shifting light conditions. To ensure a satisfactory exactness, this calculation is fine stage utilized the known Daugman's integro differential operator. It has been applied to two segments, and in a specific area according to the database. In this searching a center parameter in a neighborhood of 10x10 pixels around the initial center. The impact of errors in iris boundary is low at the matching stage whereas pupil boundary problem results in FRR. This approach gives high processing speed and acceptable accuracy in comparison to other methodologies.

Kanchan S.et al. [10] has presented a system in which the one is valid through own retina pattern. The texture features was used in this work such as Gray Level Co-occurrence Matrix (GLCM), Gabor and Local Binary Pattern (LBP). SVM was used for iris classification. The experimental outcomes worked on HRF and DRIVE database. Though the GLCM and Gabor feature when considered separately, does not give promising results, the combined results show more accuracy. The system has shown the outstanding performance using LBP features.

III. Enhancement Techniques

A. Histogram Equalization (HE)

The histogram is generally a graphic representation of the distribution of data. The histogram defines how certain times a specific gray level (intensity) appears in an image. HE technique is used for enhancing the contrast and adjustment in IP. The technique of histogram can be used in many application areas such as medical image processing which is providing a better view of the bone structure in x-ray images, improving the foreground and background of photographs in terms of both brightness and darkness [11].

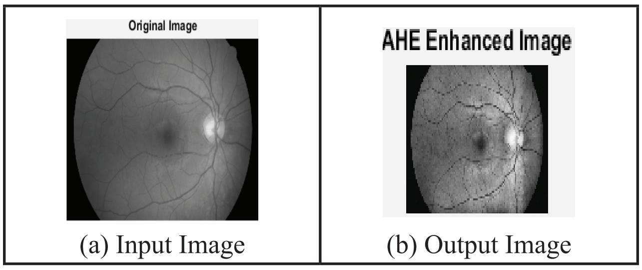


(a) Input Image (b) Output Image

Fig. 1: HE Result

B. Adaptive Histogram Equalization (AHE)

AHE technique is used to improve or enhance the contrast in images. HE only focuses on local contrast place of overall contrast. AHE technique is applicable for all methods. In AHE techniques, those images exhibit with regions that are lighter and darker and contrast in such regions will not enhance are properly enhanced image regions by use [11].

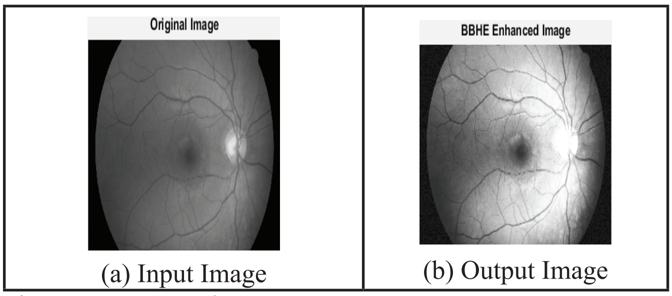


(a) Input Image (b) Output Image

Fig. 2: AHE Result

C. Brightness Preserving BI- Histogram Equalization (BBHE)

This technique separates image histogram into two parts. The intensity of partition is defined by the mean brightness value of input that is average intensity of each pixel that forms an input image. BBHE levels the sub-pictures autonomously on the premise of suitable histograms within the imperative, such samples in the correct settings are mapped into the range from the base gray-level to the info mean and the examples in the last set are mapped into the range from the mean of the most extreme gray-level. Subsequently, the resultant balanced sub-pictures are encompassed by each other around the mean information, which has a result of saving mean brightness [11].

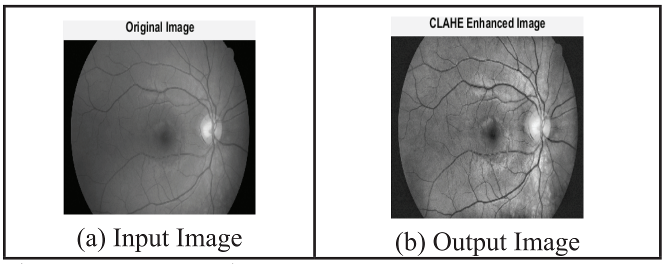


(a) Input Image (b) Output Image

Fig. 3: BBHE Result

D. CLAHE

This method does not need any predicted weather information for the processing of the fogged image. In this method firstly, the image is taken by the camera in the foggy environment and converted from RGB (red, green and blue) color space is converted to HSV (hue, saturation, and value) color space.



(a) Input Image (b) Output Image

Fig. 4: CLAHE Result

The image transform is done because the color sense of humans is similar to HSV colors; CLAHE processed the secondary value component of theimagewithout effecting hue and saturation. The original histogram is cropped and the cropped pixels are redistributed to each gray-level. In CLAHE every pixel value is decreased to maxima of client selectable. Finally, the handled picture in HSV shading space is changed over back to RGB shading space [11].

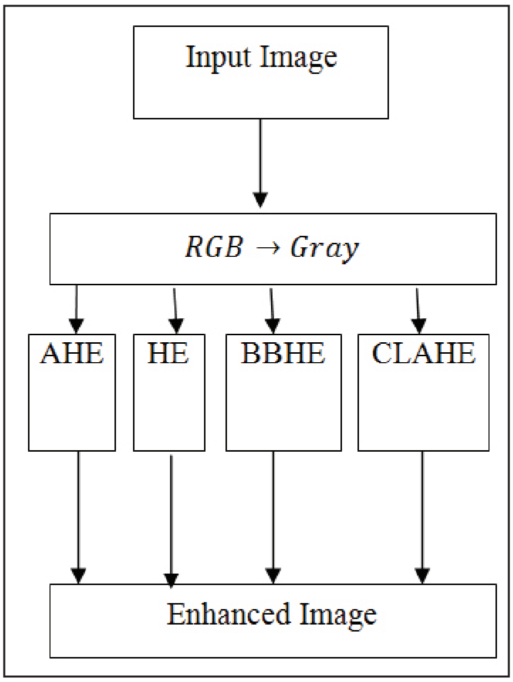


Fig. 5: Flowchart of Enhancement techniques

IV. Performance Measurement

A. Mean Square Error (MSE):

This measure defined as the sum of the squared difference among two images which is input image to improved image. Let N×N is an enhanced HRF image which is denoted as $I_{improve}$, and I_{in} represented as the input HRF image. The below formula is used to calculate the MSE between $I_{improve}$ and I_{in} :

$$MSE = \frac{1}{N}\sum_{i=1}^{N}(I_{in} - I_{improve})^2 \quad (1)$$

Where N is the size of the input image

B. Peak Signal to Noise Ratio (PSNR):

PSNR defined the improved image quality and is the most wanted feature. The higher the value, the processing efficiency is better of the approach. It can be calculated in decibels (dB) and it is given by

$$PSNR = \frac{10\ X\ log_{10}(l_{max}-l_{min})^2}{MSE} \quad (2)$$

Where l_{max} and l_{min} are the maximum and minimum of the image gray values, usually taken 255 and 0.

Table 1: PSNR value is compared using different methods for HRF healthy dataset

Label Name	HE PSNR	AHE PSNR	BBHE PSNR	CLAHEPSNR
(a)	13.0230	22.4593	13.0395	21.3680
(b)	10.9041	20.9548	10.9103	18.9751

Table 2: MSE value is compared using different methods for hrf healthy dataset

Label Name	HE MSE	AHE MSE	BBHE MSE	CLAHE MSE
(a)	3.24	369.10	3.229	474.55
(b)	5.28	521.92	5.272	823.31

Table 3: PSNR value is compared using different methods for HRF Glaucoma Dataset

Label Name	HE PSNR	AHE PSNR	BBHE PSNR	CLAHEPSNR
(c)	10.8946	22.6952	10.9163	20.2590
(d)	11.2802	22.6364	11.3041	20.1664

Table 4: MSE value is compared using different methods for HRF glaucoma dataset

Label Name	HE MSE	AHE MSE	BBHE MSE	CLAHE MSE
(c)	5.292	349.59	5.265	612.60
(d)	4.842	354.35	4.815	625.80

Table 5: PSNR value is compared using different methods for HRF diabetic_retinopathy dataset

Label Name	HE PSNR	AHE PSNR	BBHE PSNR	CLAHEPSNR
(e)	14.2540	23.1883	14.2767	21.4891
(f)	12.5010	25.0467	12.5164	22.8968

Table 6: MSE value is compared using different methods for HRF diabetic_retinopathy dataset

Label Name	HE MSE	AHE MSE	BBHE MSE	CLAHE MSE
(e)	2.4416	312.07	2.428	461.50
(f)	3.65	203.42	3.642	333.73

This section shows the comparison of HE techniques using PSNR and MSE value. This method described in the previous section. In this research, we used different test image format like (.jpg, .png). This evaluation is performed on MATLAB14b version. AHE, BBHE, HE and CLAHE codes are prepared using MATLAB predefined functions. The image quality assessment measures such as MSE and PSNR values are tabulated in Table 1 to Table 6. Table 7 shows the comparative results in the form of an image.

HRF Image Database:

The HRF database has been developed to support the comparative research studies on automatic segmentation algorithms on retinal fundus images. The database contains 15 images of healthy public patients, diabetic retinopathy and glaucomatous patients [8].

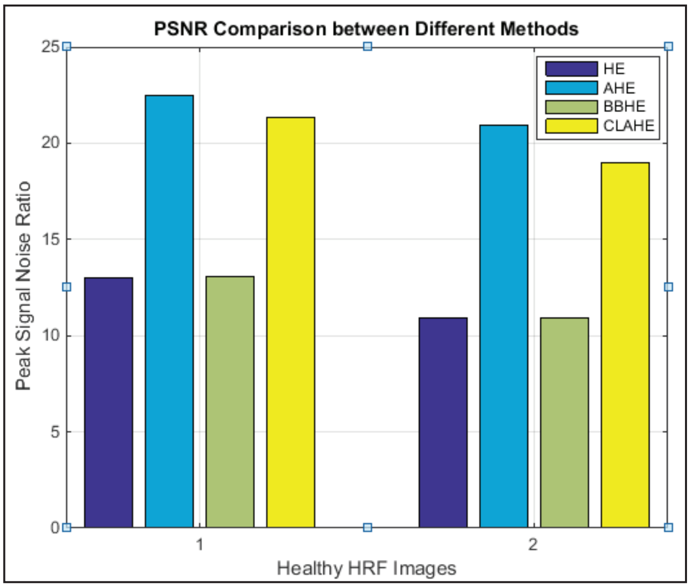


Fig. 6: PSNR Result is compared between different methods for Healthy Images

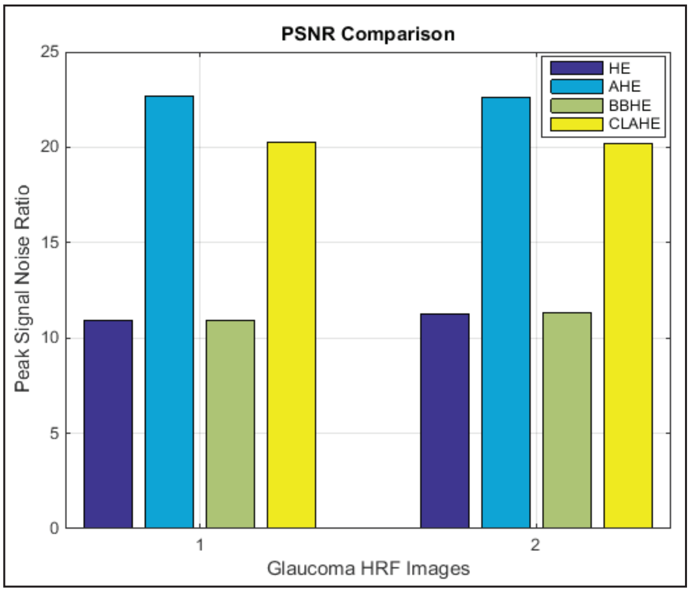


Fig. 7: PSNR Result is compared between different methods for Glaucoma Images

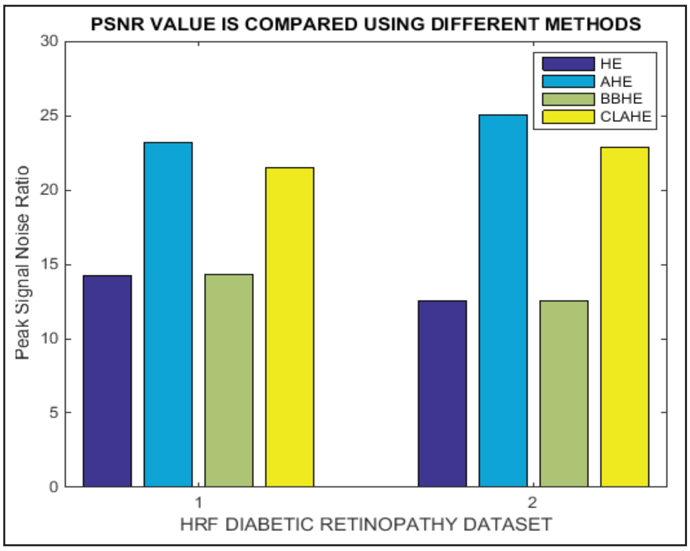


Fig. 8: PSNR Result is compared between different methods for Diabetic Retinopathy Images

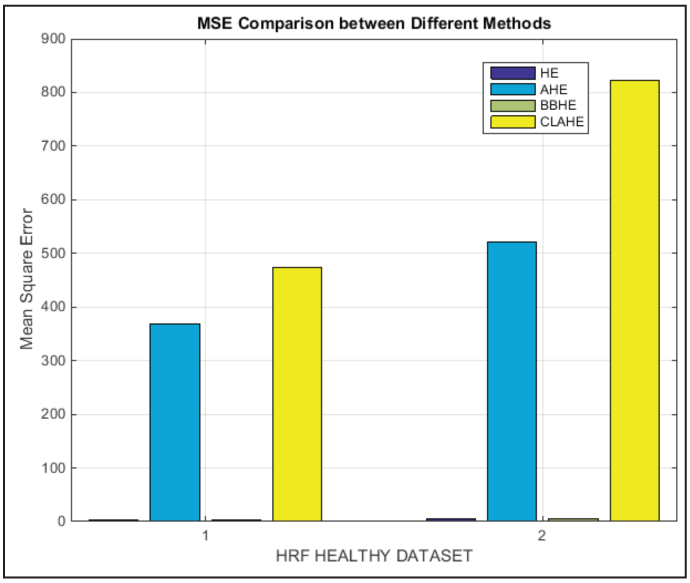


Fig. 9: MSE Result is compared between different methods for Healthy Images

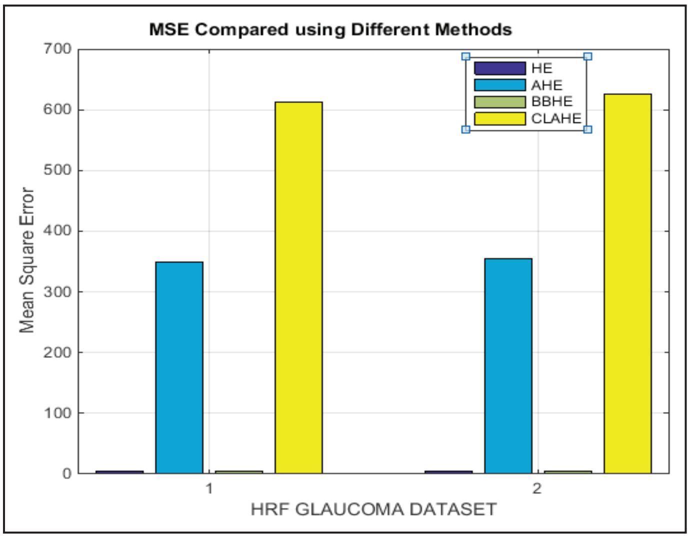


Fig. 10: MSE Result is compared between different methods for Glaucoma Images

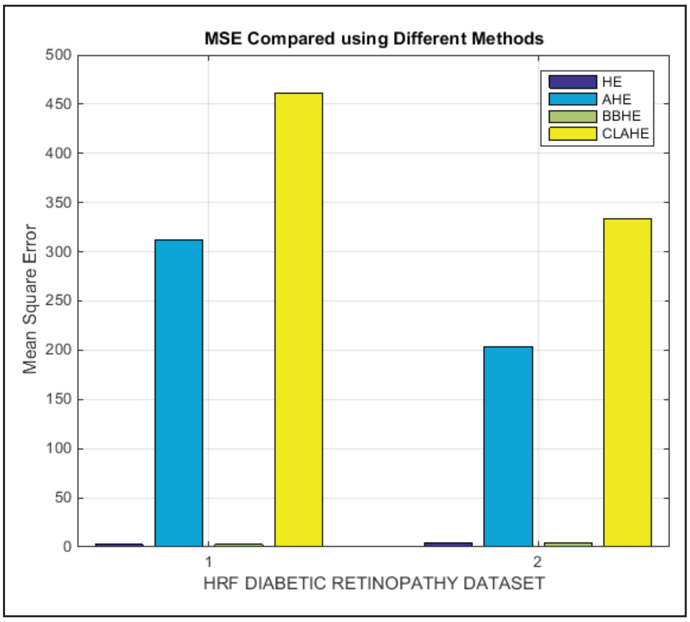


Fig. 11: MSE Result is compared between different methods for Diabetic Retinopathy Images

V. Conclusion

Iris recognition has gained a greater attention due to its uniqueness, stability over the years and difficulty in forging the iris. This paper presents the review of various existing in the literature. The iris template is enhanced using the AHE, BBHE, CLAHE and HE. The performance of iris image quality is measured such as PSNR and MSE.

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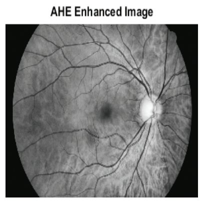
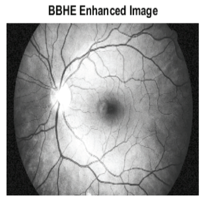
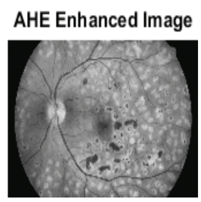
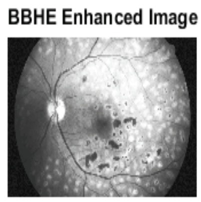
Table 2: The result is compared using different methods for HRF dataset [4]

Label Name	Iris Image	HE	CLAHE	AHE	BBHE
(a)					
(b)					
(c)					
(d)					
(e)					
(f)