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IMAGE CONTRAST ENHANCEMENT USING HISTOGRAM EQUALIZATION TECHNIQUES: REVIEW

[1]Saravanan S , [2]P.Siva kumar
[1]Assistant Professor, Department of IT, PSNA College of Engineering and Technology, Dindigul, India.
[2]Assistant Professor, Department of IT, PSNA College of Engineering and Technology, Dindigul, India.
E-Mail: [1]ssaravananme@gmail.com, [2]sivakumar.paulraj@gmail.com

ABSTRACT: Image contrast enhancement is a fundamental pre-processing step in application requiring image processing operations. Histogram Equalization (HE) method is widely used for contrast enhancement. However, HE is not suitable for consumer electronic products directly. As a result, such image creates side-effects such as washed out appearance and false contouring due to the significant change in brightness. In order to overcome these problems, mean brightness preserving HE based techniques have been proposed. Generally, these methods partition the histogram of the original image into sub histograms and then independently equalize each sub histogram with Histogram Equalization. This paper presents a review of different popular histogram based techniques proposed for gray scale static images. Major difference among the methods is only the criteria used to divide the input histogram. Comparative analysis of different enhancement will be carried out. In order to evaluate, the performance of these techniques are examined on the basis of AIC (Average Information Content), CII (Contrast Improvement Index), AMBE (Absolute Brightness Error). Comparisons with the best available results are given in order to illustrate the best possible technique that can be used as powerful image enhancement.

Keywords— Contrast enhancement, Histogram equalization, Histogram Partition, image enhancement, Brightness preservation, Average Information Content, Contrast Improvement Index, Absolute Brightness Error.

1. INTRODUCTION

Image enhancement plays a significant role in the field of Digital image processing Applications. for both human and computer vision. It is mainly used to enhance the apparent visual quality of information contained in an image and makes it easier for visual interpretation, understanding as well as image features process and analysis by computer vision system [1]. The objective of this method is to make an image clearly recognize for a specific applications. A Visual Image is rich in information, confucious said, "A Picture is worth a Thousand words [2] ".

Original Image Enhanced Image

Fig.1: Image Enhancement

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". Although, the technique of Contrast Enhancement Perform quite well with images having a uniform spatial distribution for grey values, difficulties arises when the background has a non uniform distribution of brightness.

2. CONTRAST ENHANCEMENT TECHNIQUE

The real world applications of automated image contrast enhancement techniques are many and encompass varied fields like medical imaging, geophysical prospecting, seismic exploration, astronomy, camera, video processing, aerial and ocean imaging, sensors and instrumentation, LCD display, optics, surveillance.

There are many image enhancement techniques that have been proposed and developed. One of the most popular image enhancement methods is Histogram Equalization (HE). HE is a technique commonly used for image contrast enhancement, since HE is computationally fast and simple to implement [4]-[6]. HE performs its operation by remapping the gray levels of the image based on the probability distribution of the input gray levels. However, HE is rarely employed in consumer electronic applications such as video surveillance, digital camera, and television since HE tends to introduce some objectionable artifacts and unnatural contrast effects, including intensity saturation effect. One of the reasons to this problem is that HE normally changes the brightness of the image significantly, and thus makes the output image becomes saturated with very bright or dark intensity values. This makes the visual quality of processed images unsatisfactory. Hence, brightness preserving is an important characteristic that needs to be considered in order to enhance the image for consumer electronic products [7] [8]. In order to overcome the above mentioned problems, kim proposed brightness preserving histogram equalization (BBHE) techniques have been proposed in the literature. Generally, these methods separate the histogram of the input image into several sub histograms, and the equalization is carried out independently in each of the sub-histograms [3][10]. His Algorithm preserves the mean brightness of a given image very well, compared to typical and global HE. This method overcomes the brightness preservation problem [9][10]. Similar to BBHE Wang et al, proposed dualistic sub image histogram equalization (DSIHE) methods, which separates an input image into 2 sub images based on the Median of an image, to improve the performance of HE[11]. The Basic idea of the algorithm is to maximize the entropy of an image. DSIHE better than BBHE according to the criteria of mean, AIC (Average Information Content) & Background Gray Level (BGL).

In order to achieve high degree of Brightness preservation with annoying artifacts, Chen & Ramli proposed Minimum Mean Brightness Error Bi-Histogram Equalization (MMBEBHE)[12]. This method uses the minimum Absolute Mean Brightness Error (AMBE)- the absolute difference between input Mean value & output mean value, to compute threshold gray level to separate the input histogram. This algorithm is time consuming and it can perform good contrast enhancement and maximal brightness preservation [13]. Chen & Ramli also proposed another enhancement scheme called Recursive Mean Separate Histogram Equalization (RMSHE)[14]. The mean of each sub histogram is computed as the threshold gray level iteratively. This process is repeated r times and generates 2^r sub histograms. Finally conventional HE is implemented to each sub histograms. It provides scalable brightness preservation. However, it also is not free from side affects.

A similar approach is proposed by sim et al. in 2007 named Recursive Sub Image Histogram Equalization (RSIHE)[15]. However RSIHE is segmented by median of the each histogram instead of the mean of the mean in the RMSHE [14]. A similar problem encountered for the both RMSHE and RSIHE while there are two techniques will lead to insignificant enhancement as the values of r is increased. DHE (Dynamic Histogram Equalization) techniques takes control over the effect of traditional HE, so that it performs the enhancement of an image without making any loss of detail in it. The objective to stretch the contrast and preserve the detail of original image. The DHE partitions the histogram of input image based on local minimal and assigns a new dynamic range for each sub histogram. Before equalizing them separately, these partitions further go through a repartitioning test to ensure the absence of any dominating portions. This method outperforms other present approaches by enhancing the contrast well without introducing severe side effects etc., or undesirable artifacts. Nonetheless, the DHE neglects the Mean brightness preserving and tends to intensity saturation artifacts [16].

To overcome the drawbacks of the DHE, brightness preserving dynamic histogram equalization method (BPDHE) has been introduced as the extension of the DHE. BPDHE segments the histogram of input image using local maximal. By doing this, the algorithm is claimed to be better interms of maintaining the mean brightness than local minimal. Similar to the DHE, the HE is then implemented after assigning a new dynamic range for each sub histogram. In order to maintain the mean brightness, brightness normalization is applied to ensure the enhanced image has the similar mean brightness of the input image. Even though each methods plays a important role for its proposed problem. Some common drawbacks still exist. Brightness preserving is highly demand for consumer electronic products, such as television of monitor. Therefore, numerous brightness preserving methods (as discussed previously) are introduced to enhance the contrast while maintaining the original mean brightness [17].

The rest of this paper is organized as follows. HE for digital input image is reviewed together with their mathematical formulation and BBHE, DSIHE, MMBEBHE and generalization of BBHE, namely-Recursive Mean Separate Histogram Equalization (RMSHE), Dynamic Histogram Equalization (DHE) and Brightness Preserving Dynamic Histogram Equalization (BPDHE) are given in Section II. In Section III, we discuss Performance measures for gray scale images. We present comparison of the experiments results & discussions in section IV. Finally in section V, we conclude this review.

2.1 HISTOGRAM EQUALIZATION

Histogram is defined as the statistical probability distribution of each gray level in a digital image. Histogram Equalization (HE) is a very popular technique for contrast enhancement of images Contrast of images is determined by its dynamic range, which is defined as the ratio between the brightest and the darkest pixel intensities. The histogram provides information for the contrast and overall intensity distribution of an image. Suppose input image f(x, y) composed of discrete gray levels in the dynamic range [0, L-1] then the transformation function $C(r_k)$ is defined as

$$S_k = C(r_k) = \sum_{i=0}^{k} p(r_i) = \sum_{i=0}^{k} \frac{n_i}{n} \qquad (1)$$

where $0 \le s_k \le 1$ and $k = 0, 1, 2, \ldots, L-1$. In equation (1), n_i represents the number of pixels having gray level r_i, n is the total number of pixels in the input image, and $P(r_i)$ represents as the Probability Density Function (PDF) of the input gray level r_i. Based on the PDF, the Cumulative Density Function (CDF) is defined as $C\ (r_k)$. This mapping in (1) is called Histogram Equalization (HE) or Histogram Linearization. Here s_k can easily be mapped to the dynamic range of [0, L-1] multiplying it by (L-1).

2.2 BRIGHTNESS PRESERVING BI-HISTOGRAM

In order to overcome the limitations of HE, several brightness preserving methods have been proposed. One of the popular brightness preserving methods is the mean brightness preserving bi-histogram equalization (BBHE) introduced by Kim (1997). At the beginning, the BBHE divides the original histogram into two sub-histograms based on the mean brightness of the input image as shown in Fig.2.1. One of the sub image is set of samples less than or equal to the mean whereas the other one is the set of samples greater than the mean. In this method, the separation intensity X_T is presented by the input mean brightness value, which is the average intensity of all pixels that construct the input image. After this separation process, these two histograms are independently equalized by HE. Consequently, the mean brightness can be preserved because the original mean brightness is retained.

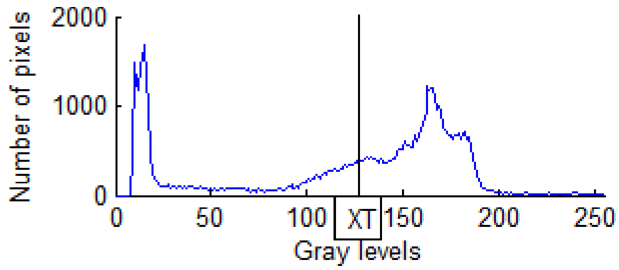


Fig.2: Bi-Histogram equalization.

The histogram with range from 0 to L- 1(255) is divided into two parts, with separating intensity X_T. This separation produces two histograms. The first histogram has the range of 0 to X_T, while the second histogram has the range of X_{T+1} to L-1.

Let f_m be the mean of the image f and assume that $f_m \in \{0, L\text{-}1\}$. Based on input mean f_m, the image is decomposed into two sub-images f_L and f_U as

$$f = f_L \cup f_U \tag{2}$$

$$f_L = \left\{ f(i,j) \mid f(i,j) \leq f_m, \forall f(i,j) \in f \right\} \tag{3}$$

and

$$f_U = \left\{ f(i,j) \mid f(i,j) > f_m, \forall f(i,j) \in f \right\} \tag{4}$$

Note that sub image f_L is composed of $\{f_0, f_1, \ldots, f_m\}$ and the sub-image f_U is composed of $\{f_{m+1}, f_{m+2,\ldots,} f_{L-1}\}$.

Next, define the respective probability density functions of the sub histograms f_L and f_U as

$$P_L(f_k) = \frac{n^k{}_L}{n_L} \tag{5}$$

where k=0, 1, ……….,m, and

$$P_U(f_k) = \frac{n^k{}_U}{n_U} \tag{6}$$

where k=m+1, m+2,…..,L-1, in which $n^k{}_U$ and $n^k{}_L$ represent the respective numbers of f_k in f_L and f_U, and n_L and n_U are the total number of samples in f_L and f_U respectively. Note that $P_L(f_k)$ and $P_U(f_k)$ are associated with the histogram of the input image which represents the number of pixels that have a specific intensity f_k. The respective cumulative density functions for sub-histograms f_L and f_U are then defined as

$$C_L(f_k) = \sum_{j=0}^{m} p_L(f_j) \tag{7}$$

and

$$C_U(f_k) = \sum_{j=m+1}^{L-1} p_U(f_j) \tag{8}$$

Let us define the following transform functions based on cumulative density functions as

$$T_L(f_k) = f_0 + (f_m - f_0)C_L(f_k) \tag{9}$$

and

$$T_U(f_k) = f_{m+1} + (f_{L-1} - f_{m+1})C_U(f_k) \tag{10}$$

Based on these transform functions, the decomposed sub-images are equalized independently and the composition of the resulting equalized sub-images which constitute the output image. The overall mapping function can be obtained by combining (9) and (10).

$$g(i,j) = T_L(f_k) \cup T_U(f_k) = \begin{cases} f_0 + (f_m - f_0)C_L(f_k) & if\ f \leq f_m \\ f_{m+1} + (f_{L-1} - f_{m+1})C_U(f_k) & else \end{cases} \tag{11}$$

If we note that, $0 \leq C_L(f_k), C_U(f_k) \leq 1$, it is easy to see that $T_L(f_k)$ equalizes the sub-image f_L over the range (f_0, f_m) whereas $T_U(f_k)$ equalizes the sub-image f_U over the range (f_{m+1}, f_{L-1}). As a consequence, the input image f is equalized over the entire dynamic range (f_0, f_{L-1}) with the constraint that the samples less than the input mean are mapped to (f_0, f_m) and the samples greater than the mean are mapped to (f_{m+1}, f_{L-1}).

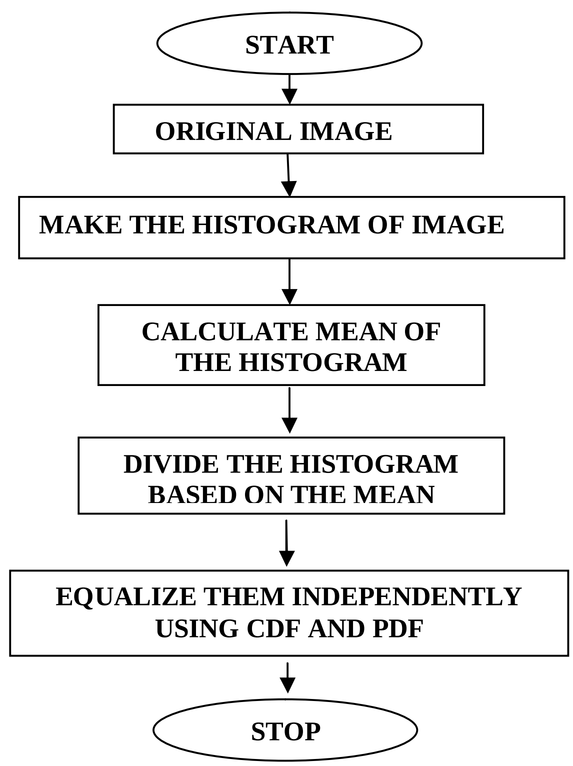


Fig 3: Flow chart for BBHE

2.3 DUALISTIC SUB-IMAGE HISTOGRAM EQUALIZATION

Following the same basic ideas used by the BBHE method of decomposing the original mage into two sub-images and then equalizes the histograms of the sub-images separately; Wang et al (1999) proposed the so called equal area Dualistic Sub-Image HE (DSIHE) method. Instead of decomposing the image based on its mean gray level, the DSIHE method decomposes the images aiming at the maximization of the Shannon's entropy 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).

Wang et al (1999), shown that the brightness of the output image produced by the DSIHE method is the average of the equal area level of the image *I* and the middle gray level of the image, *i.e.*, $L / 2$. Wang et al (1999) claim that the brightness of the output image generated by the DSIHE method does not present a significant shift in relation to the brightness of the input image, especially for the large area of the image with the same gray-levels (represented by small areas in histograms with great concentration of gray-levels), e.g., images with small objects regarding to great darker or brighter backgrounds.

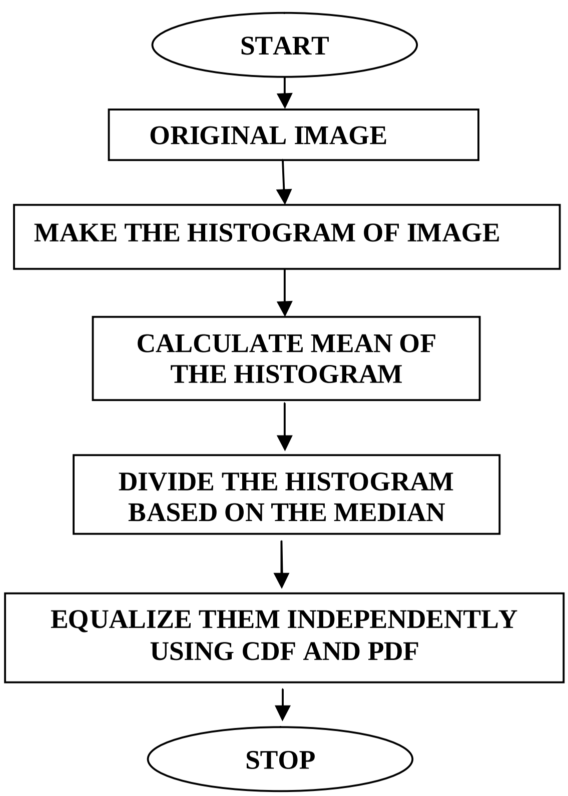


Fig. 4: Flow chart for DSIHE

2.4 MINIMUM MEAN BRIGHTNESS ERROR BI-HISTOGRAM EQUALIZATION

In order to optimize the mean brightness preservation of the input image, an improved version of the BBHE, called Minimum Mean Brightness Error Bi-Histogram Equalization (MMBEBHE), has been introduced by Chen and Ramli (2003). Similar to the BBHE, this method has two sub-histograms, but the separating point is set by finding the minimum mean brightness error between the input and the enhanced images. MMBEBHE is formally defined by the following procedure:

1. Calculate the Absolute Mean Brightness Error *(*AMBE) for each of the threshold level.
2. Find the threshold level, X_T that yield minimum Mean Brightness Error (MBE),
3. Separate the input histogram into two based on the X_T found in step 2 and equalized them independently as in BBHE.

The main difference between BBHE and the MMBEBHE method is that the latter searches for a threshold level X_T that decomposes the image *I* into two sub-images $I\,[0, X_T]$ and $I\,[X_T +1, L-1]$, such that the minimum brightness difference between the input image and the output image is achieved, whereas the former methods consider only the input image to perform the decomposition. Once the input image is decomposed by the threshold level X_T, each of the two sub-images $I\,[0, X_T]$ and $I\,[X_T +1, L-1]$ has its histogram equalized by the HE process, generating the output image [7] [18] [19].

2.5 RECURSIVE MEAN-SEPARATE HISTOGRAM EQUALIZATION

Chen and Ramli (2003) proposed Recursive Mean-Separate Histogram Equalization (RMSHE), which is that recursively separates the histogram into multi sub-histograms instead of two sub-histograms as in the BBHE. Initially, two sub-histograms are formed based on the mean brightness of the original histogram. Subsequently, the mean brightness from the two sub-histograms obtained earlier are used as the second and third separating points in creating more sub-histograms. In a similar fashion, the algorithm is executed recursively until the desired numbers of sub-histograms are met. Then, the HE approach is applied independently on each of the sub-histogram. However, no significant enhancement is performed by the RMSHE when the number of divided sub histograms is large.

The methods discussed above are based on dividing the original histogram into several sub-histograms by using either the median or mean brightness. Even though the mean brightness is well conserved by the above mentioned methods, but fails to expand the region of sub- histogram located near to the minimum or maximum value of the dynamic range.

2.6 RECURSIVE SUB-IMAGE HISTOGRAM EQUALIZATION

Recursive Sub-Image HE (RSIHE) (Sim et al 2007) iteratively divides the histogram based on median rather than mean values. Since the median value is used, each partition shares the same number of pixels. Therefore, both RMSHE and RSIHE divide the histogram into 2^r number of partitions and they preserve the brightness to better extent than previous partitioning method to enhance the visual outlook. However, finding the optimal value of *r* is difficult, and with a large value of *r* there will be no enhancement, despite the fact that the brightness preservation property is fulfilled adequately.

2.7 DYNAMIC HISTOGRAM EQUALIZATION

In this section, we give a detail description of the method Dynamic Histogram Equalization (DHE). Dynamic Histogram Equalization (DHE) method, proposed by Abdullah-Al-Wadud, et al (2007), partitions the global image histogram into multiple segments based on positions of local minima, and then independently equalizes them. In order to eliminate the spikes, a 1×3 smoothing filter is applied across the image. Then, a new dynamic range is assigned to each sub-histogram based on the original dynamic range and the number of pixels in that sub-histogram. Generally, the DHE does not consider the mean brightness preservation. Moreover, the 1×3 smoothing filter is constructed for brightness preserving. Thus, the DHE may cause saturation and it is insufficient to smooth a noisy histogram. As a result, the local minima will be wrongly misclassified and it increases the complexity of the algorithm. However, this method has the limitation of remapping the peaks which leads to perceivable changes in mean image brightness.

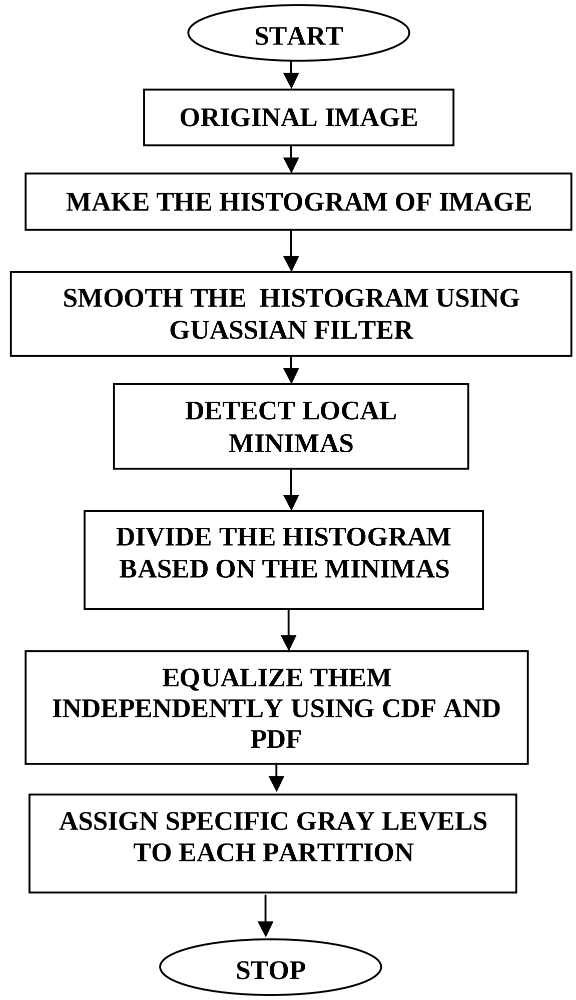


Fig. 5: Flow chart for DHE

2.8 BRIGHTNESS PRESERVING DYNAMIC HISTOGRAM EQUALIZATION

The Brightness Preserving Dynamic Histogram Equalization (BPDHE) introduced by Nicholas sia pik Kong et al (2008) is the enhanced version of the DHE. Similarly, a smoothing filter is applied to histogram before the partitioning process is carried out. On the contrary, the BPDHE uses the local maxima as the separating point rather than the local minima. After the HE is implemented to each sub-histogram, brightness normalization is used to ensure the enhanced mean brightness as a close approximation to the original mean brightness. Although the BPDHE performs well in mean brightness preserving, the ratio for brightness normalization plays an important role. A small ratio value leads to insignificant contrast enhancement. For large ratio (i.e., ratio value more than 1), the final intensity value may exceed the maximum intensity value of the output dynamic range. The exceed pixels will be quantized to the maximum intensity value of gray levels and produce intensity saturation problem (in MATLAB environment).

3. PERFORMANCE MEASURES

The comparison of various image enhancement techniques based on histogram equalization is carried out in objective manner for gray scale images. Quantitative performance measures are very important in com-paring different image enhancement algorithms. Besides the visual results and computational time, our evaluation include Entropy or Average Information Contents (AIC) and Contrast Improvement Index (CII) measure are the two important quantitative measures used here for the performance analysis of various HE based methods.

Absolute Mean Brightness Error(AMBE)

It is the difference between original and enhanced image and is given as

$$\text{AMBE}=\left|E(x)-E(y)\right| \tag{12}$$

Where E(x) is average intensity of input image and E(y) is average intensity of enhanced image.

Average Information Contents (AIC)

The AIC is used to measure the content of an image, where a higher value of Entropy indicates richness of the details in the output image. Higher value of the AIC indicates that more information is brought out from the images. The average information contents or entropy is defined as

$$AIC = -\sum_{k=0}^{L-1} P(k)\log P(k) \tag{13}$$

where P(k) is the probability density function of the k^{th} gray level [20][21].

Contrast improvement index (CII)

In order to evaluate the competitiveness of the different contrast enhancement techniques, the most well-known benchmark image enhancement measure, the Contrast Improvement Index (CII) is used to compare the results of contrast enhancement methods. Contrast improvement can be measured using CII as a ratio [22].

Contrast Improvement Index is defined as:

$$CII = \frac{C_{\Pr oposed}}{C_{Original}} \tag{14}$$

where C is the average value of the local contrast measured with$3_{\times}3$ window as:

$$\frac{\max - \min}{\max + \min} \tag{15}$$

$C_{proposed}$ and $C_{original}$are the average values of the local contrast in the output and original images, respectively.

Tool to be used:

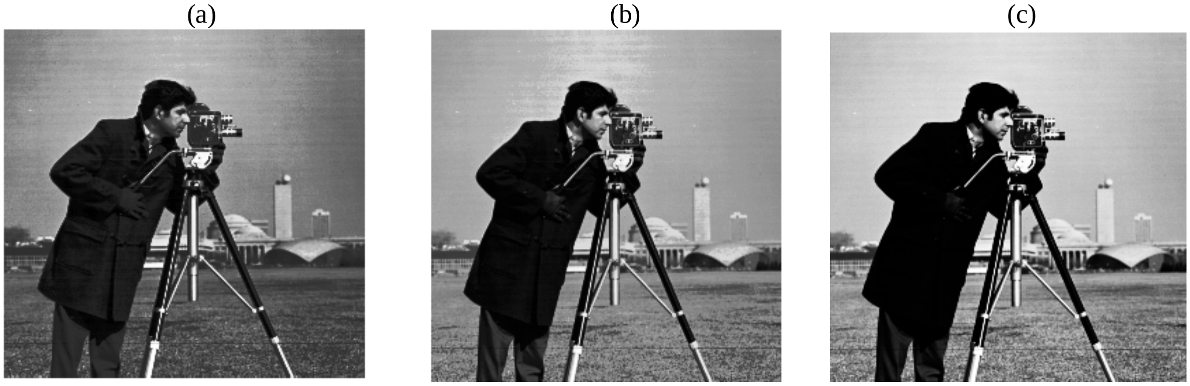
Simulation of various Histogram Equalization techniques, were performed using MATLAB 7.0.2 software version is used. In that image processing toolbox is used. MATLAB® is a high-performance language for technical computing. Enhancement techniques are applied on the images of different sizes and from different application fields like real images, medical images etc.

4. RESULTS AND DISCUSSION

In this section, we reviewed six histogram based techniques for digital image enhancement and performance metrics AMBE, CII and Entropy are calculated. These techniques are HE, BBHE, DSIHE, MMBEBHE, RMSHE and RSIHE. A subjective assessment to compare the visual quality of the images is carried out. AMBE is used to assess the degree of brightness preservation while Entropy and CII are employed to quantitatively assess the degree of contrast enhancement. In addition, for the qualitative assessment of contrast enhancement, we visually inspect the output image.

We have tested number of images with all of methods discussed in this paper. Some of them are presented here. Figure -6 shows original image of “camera man” with processed image by HE, BBHE , DSIHE, MMBEBHE, RMSHE, RSIHE methods. Figure 6(b) shows that HE provides a significant improvement in image contrast. However, it also amplifies the noise level of the images along with some artifacts and undesirable side effects such as washed-out appearance. Figure 6(c) Shows that the BBHE method produces unnatural look and insignificant enhancement to the resultant image. However, it also has unnatural look because of over enhancement in brightness. The result of MMBEBHE and RMSHE(Figure 6(d) and Figure 6(e)) shows good contrast enhancement, and they also cause more annoying side effects depending on the variation of gray level distribution in the histogram. RMSHE, using r=2, is not free from generating unwanted artifacts. On the other hand, the enhancement done by DHE is quite significant enough. It performs much better role with different values of x. The user can change the value depending on his/her requirement.

(a) (b) (c)



(d) (e) (f)

Fig. 6: Simulation results of the Cameraman image. (a) Original image, (b) HE-ed image, (c) BBHE-ed image, (d) MMBEBHE-ed image, (e) RMSHE-ed image, (f) DHE-ed image

Table-1: For Mean Brightness Error (AMBE)

Images	**HE**	**BBHE**	**DSIHE**	**RMSHE**	**RSIHE**	**MMBEBHE**
Couple	96.88	32.07	40.97	10.44	19.74	17.48
Einstein	20.67	17.23	9.98	9.43	9.43	1.35
F16	52.29	0.194	18.10	2.22	4.90	0.46
girl	6.70	22.60	12.89	0.65	1.04	6.10
house	10.13	3.30	14.28	4.35	3.50	3.04
Lady	70.98	21.20	29.21	9.14	13.80	13.74
Plane	37.09	1.463	23.75	9.83	5.86	7.04
Tank	21.76	18.90	9.64	10.4	7.53	2.37
Cameraman	8.6955	24.1245	17.4851	0.777	5.21	0.56
Avg	36.13	15.68	19.59	6.36	7.89	5.79

AMBE chart for Different HE methods

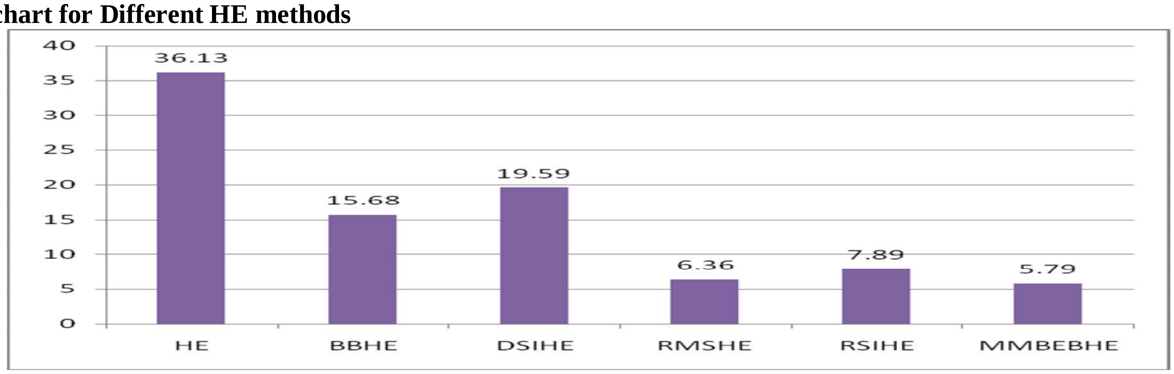


Fig. 7: Shows AMBE chart for Different HE methods

Table-2: For Entropy

Images	Original	HE	BBHE	DSIHE	RMSHE	RSIHE	MMBEBHE
Couple	6.42	6.25	6.19	6.25	6.24	6.24	6.19
Einstein	6.89	6.75	6.75	6.74	6.71	6.71	6.73
F16	6.7	6.44	6.6	6.53	6.56	6.53	6.61
Girl	5.59	5.28	5.28	5.26	5.4	5.13	5.24
House	6.5	6.26	6.25	6.22	6.24	6.23	6.45
Lady	7.05	6.9	6.9	6.91	6.89	6.83	6.82
Plane	4	3.88	3.93	3.89	3.97	3.95	3.92
Tank	5.99	5.88	5.87	5.87	5.94	5.93	5.85
Cameraman	6.86	6.77	6.8	6.6	6.71	6.68	6.75
Avg	6.22	6.05	6.06	6.03	6.07	6.03	6.06

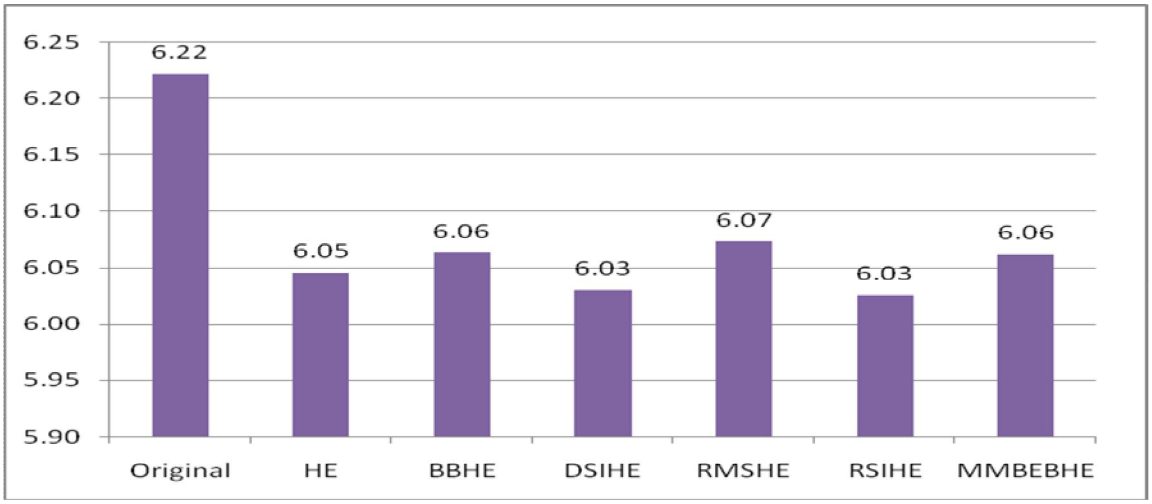


Fig. 8: Shows Entropy chart for Different HE method

Table 3: Comparison of CII values.

Image ID	H.E	BBHE	DSIHE	RMSHE	RSIHE	MMBEBHE
Girl	1.3204	1.3337	1.3267	1.356	1.452	1.2973
Couple	0.8842	0.7973	0.785	0.793	0.851	0.9509
Lena	1.4209	1.4416	1.436	1.434	1.51	1.4264
House	1.3638	1.3443	1.334	1.361	1.462	1.3524
Baboon	1.1884	1.1773	1.165	1.171	1.234	1.2222
Aircraft	1.3776	1.0859	1.28	1.293	1.352	1.2958
Truck	1.1175	1.0865	1.35	1.41	1.465	1.1015
Village	1.1072	1.027	1.251	1.324	1.362	1.22
Einstein	0.9203	0.8446	0.865	0.881	0.911	0.938
Cameraman	1.1773	1.1795	1.176	1.811	1.825	1.2

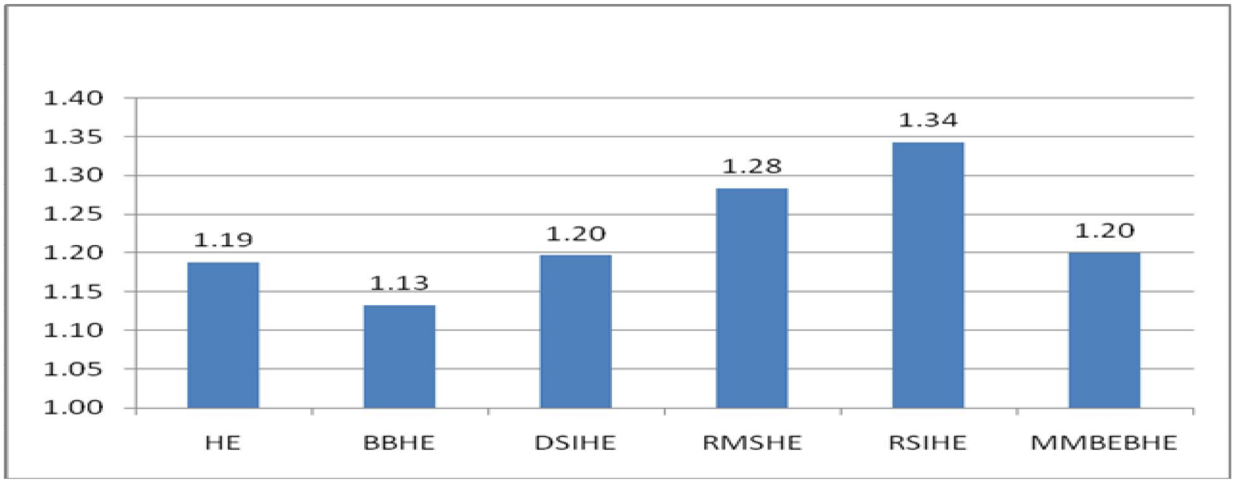


Fig. 9: Shows CII chart for Different HE method

Assessment of Brightness Preservation:

The results shown in the Table-1 presents the performance of brightness preservation of various methods discussed in this paper. Based on the observation of Table-1 we see that MMBEBHE is best in brightness preservation. RMSHE is second best method for brightness preservation

Assessment of Contrast enhancement:

The results shown in the Table-2 presents the AIC(Average Information Content) values for various methods applied to some standard images. AIC or Entropy is used to measure the richness of details in image. RMSHE and MMBEBHE performs better than others in terms of entropy.

Inspection of visual quality:

In addition with brightness preservation and contrast enhancement an image quality is also an important factor in image processing. The processed image should be visually acceptable to human eye and should have natural appearance. The results shown in the Table-3 presents the CII(Contrast Improvement Index) values for various methods applied to some standard images. CII is used to measure visual quality of an image. RMSHE and RSIHE performs better than others in terms of CII.

5. CONCLUSION

In this paper, a framework for Image Enhancement based on prior knowledge on the different histogram Equalization methods has been presented. Many Image enhancement schemes likes HE, BBHE, DSIHE, MMBEBHE, RMSHE, RSIHE, DHE algorithm has been reviewed and compared. Different algorithm was tested on different gray scale images. Qualitative and Subjective measure performance of all these methods has been analyzed and number of practical experiments results, it found that all the six techniques yields different gray scale images for different parameters such as AMBE, Entropy, CII. Observing from the simulation result obtained. Brightness preservation is not handled well by HE, DSIHE, BBHE, but it handled properly by RMSHE and MMBEBHE, has produced the best performance for both qualitative and quantitative evaluation. It is found that MMBEBHE is most suitable technique in terms of AMBE value. In terms of AIC, RMSHE Ensures consistency in preserving image details and free form any severe side effects. RMSHE is the best technique the highest average AIC value. The performance of RSIHE is not satisfactory in terms of Entropy. In terms of CII, RSIHE and RMSHE has improved visual quality as well yielded a higher CII values. Dynamic approach for contrast enhancement of low contrast images. DHE enhances because it has the image without making loss in image details. Moreover, the method is simple and computationally effective that makes it easy to implement and suitable for consumer electronic products.

In future, for the Enhancement purpose more Images can be taken from the different application fields like medical. So that it becomes clearer that for which application which particular technique is better both for gray scale images and color images. New parameter and new color models, soft technique tools can also be choose for Better comparison purpose.

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Mr.S.Saravanan received his B.Tech Degree in Information Technology from RVS College of Engineering & Technology, Dindigul and also completed his M.E. Computer Science & Engineering in P.S.N.A college of Engineering and Technology, Dindigul, Tamilnadu. He is currently working as a Assistant Professor in Department of Information Technology, PSNACET, Dindigul. His research interests include image processing, ad-hoc networks, cloud computing.

Mr.P.SivaKumar received his B.E Degree in Computer Science from KCG College of Technology, Chennai and also completed his M.E. Computer and Communication Engineering in P.S.N.A college of Engineering and Technology, Dindigul, Tamilnadu. He is currently working as a Assistant Professor in Department of Information Technology, PSNACET, Dindigul. His research interests include Vehicular ad-hoc networks, image processing.