IOSR Journal of Computer Engineering (IOSR-JCE)
e-ISSN: 2278-0661,p-ISSN: 2278-8727, Volume 21, Issue 3, Ser. III (May - June 2019), PP 58-63
www.iosrjournals.org

A Histogram Based Technique For Contrast Enhancement Of Medical Images

Richa Bansal[1], Amandeep Kaur[2], Kapil Kumar[3], G. N. Verma[3]
[1]*Research Scholar, SSIET, PTURC, Dera Bassi, Punjab, India*
[2]*Assistant Professor, SSIET, PTURC, Dera Bassi, Punjab, India*
[3]*Assistant Professor, SSIET, PTURC, Dera Bassi, Punjab, India*
[4]*Professor, SSIET, PTURC, Dera Bassi, Punjab, India*
Corresponding Author: Richa Bansal

Abstract: *There are various and different types of software tools available for the solution of different medical image methods. There are different types of medical images like computed tomography, magnetic resonance imaging, x-ray and ultrasound and many more. So image contrast enhancement should be a step that increases the clarity and information present in the medical images. Also the contrast is the significant value of a medical image because if there is less contrast then it is not possible for the investigator to diagnose the problem. The main purpose of this research work is to enhance contrast of medical image based on the histogram based method so that maximum information can be retrieved from the medical image. There are different techniques based on histogram equalization like Dynamic histogram equalization (DHE), bi-histogram equalization (BBHE), brightness preserving dynamic histogram equalization (BPDHE), Novel technique which all is extensions to HE techniques. There is a cumulative distribution of values or intensities of pixels of image over the complete range of histogram. Problem in these techniques is that image in some cases can lead to a significant decrease of contrast or to the disappearance of small-size objects on the current image. In this present research work hybrid histogram technique is used to enhance the medical images. There are different parameters are taken to evaluate the performance of proposed automated algorithm like correlation, ,mean square error, peak signal to noise ratio and normalized absolute error of the images. This work is implemented on the software MatLab 2016.*

Keywords: *Medical image processing, histogram equalization, contrast enhancement, error, bilateral*

Date of Submission: 20-05-2019 Date of acceptance: 05-06-2019

I. Introduction

Image processing is a significant part of current era technologies because human relied very much on the perceptible and visible data and information. Nearly 98.9 percent knowledge we recognize regarding the world is procured with our senses that is by eyes. So images are one of the best ways available to get knowledge. A digital image is obtained by performing digitization of a continuous signal. This process includes sampling and quantization of the input signal. Here the main aim is overlying a regular grid on input signal and to allocate a distinct number to each and every other square of the grid. Mathematically, a digital image is a two-dimensional function, I(x; y), where x and y are spatial coordinates. Here each and every pair of coordinates (x; y) is called a pixel, for picture element, and its cost, I, represents for a certain attribute of the image. For example, in a gray scale image for a single band (0 to 255) it is stated as intensity. While it is termed as a vector field of two components and also known as a color vector of three bands: red, green, and blue. One of the other significant attribute of an image is its size which is also knows as resolution. Resolution is defined as the number of rows and columns in the image. The more the value of resolution closer is the digital image to the real time physical world.

A digital image system is known as processor which can be further assumed of as an input-output model, where the input I_0 is an acquired image by a device and the output is $F = T[I_0]$ which can be basically defined number of permutation and combinations of attributes that have visible significant. In this modern era medical theories fall into scope of a critical area that makes considerable utilization of image processing. Medical images can be gathered utilizing different modalities like classical X-ray imaging. Other modern computer aided CT, Magnetic Resonance Imaging, and Positron-emission tomography (PET) imaging which are further depend on a open spectrum extending from gamma rays, X-rays, to ultrasound waves. Image processing functions in the above described fields are operated self sufficiently by a machine, which further is based on the implementation of artificial intelligence algorithms or medical image processing is usually a shake hand between human and the machine.

The aim of this research work is to implement and compare various image enhancement techniques based on histogram equalization such as bi-histogram equalization (BBHE), brightness preserving dynamic histogram equalization (BPDHE) which all is extensions to HE techniques for Contrast Enhancement. There is a cumulative distribution of values or intensities of pixels of image over the complete range of histogram. Problem in these techniques is that image in some cases can lead to a significant decrease of contrast or to the disappearance of small-size objects on the current image. In this present research work histogram technique is used to enhance the medical images. There are different parameters are taken to evaluate the performance of proposed automated algorithm like contrast, peak signal to noise ratio (PSNR) and entropy of the images. This work is implemented on the software MatLab 2016. Finally determine the best one in terms of the performance parameters both in subjective and objective manner.

II. Literature Survey

E. S. Yelmanova et al. [1] proposed a histogram dependent technique for automatic contrast improvement of specific dim contrast digital images with very small size entities or objects on the foundation of the evaluation of contrast scattered at peripheries of objects and background. The assumed technique is supposed to do preprocessing of very complex medical digital images with compact magnitude small contrast objects along with the enclosed details in the digital image. Contrast enhancement was managed utilizing the conventional no-reference contrast criterions. The outcomes of the proposed experiments show that the methods of digital image processing on the groundwork of technology of the different histogram equalization techniques like HE, BBHE and DSIHE which further confirm the supreme hike of established contrast of input digital image. At this the maximum values of the estimation established contrast for every examine contrast metrics are accomplished for techniques of HE, BBHE and DSIHE. Here in some instances lead to a major decline of contrast or to the dissipating of compact magnitude entities on the modern digital image.

The advantage of contrast enhancement utilizing various techniques of gamma-correction typically relies on the variables of brightness allocation of digital image and to a huge scope evaluated by the solution of estimates of the known gamma parameter denoted by symbol γ. It intimates the option of the different values of γ in interactive mode. The stated algorithm gives the rise of efficiency of contrast enhancement of very complex dim contrast digital images by an mean of 11 percent to 24 percent for complete reference digital images without lowering the contrast of tiny size entities in digital image. The proposed algorithm could be recommended for real time application of dim contrast medical digital images with very complex structure in automatic mode.

Z. Yao et al. [2] presented a modern digital image enhancement technique utilizing histogram equalization called Bi-Histogram Equalization with Non-parametric Modified Technology (BHENMT). This supposed technique involves of three steps. In the first step the histogram of the input original image is quartered into two regions utilizing the Otsu technique. In the second step histogram modification method is utilized to control the over enhancement and further to increase the entropy. In the third step two sub digital images are improved by the old histogram equalization technique utilizing the corresponding upgraded histogram respectively. Then at the last step it is merged into one output improved digital image. The experimental outcomes display that BHENMT technique is far better than various contrast enhancement techniques according to subjective determination and other digital image objective evaluation parameters like entropy, Absolute mean brightness error and peak signal to noise ratio.

According to performance outcome of experiments authors reached on different conclusions which are stated here. First is that proposed method is behaves gently than other image enhancement techniques for preserving brightness. Second one is that proposed method is the best technique amid other image enhancement techniques in terms of three digital image objective evaluation parameters. Third one is that proposed method generates enhanced digital images that have real time appearance and a very good contrast in the daynamic range. Proposed technique have maximize entropy or preserve original brightness and control the over enhancement.

III. Propsed Techniques And Research Methodology

1. Brightness Preserving Bi-Histogram Equalization (BBHE)

This technique segments the image histogram into two different sections. Here the separation intensity having value XT is denoted by the input mean brightness cost which is the mean intensity of whole pixels that design the input image. Now both histograms are independently equalized. With effect of this the average brightness of the final digital image will lie amid the input mean and the middle gray level of the range. The nucleus of the stated algorithm is to employ self sufficient histogram equalizations unrelated over two other images derived by degrading the input digital image rely on its average value with a limitation that the final equalized sub digital images are joined by each other around the input average value.

2. Brightness Preserving Dynamic Histogram Equalization (BPDHE)

It 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 fulfills the requirement of maintaining the mean brightness of the image.

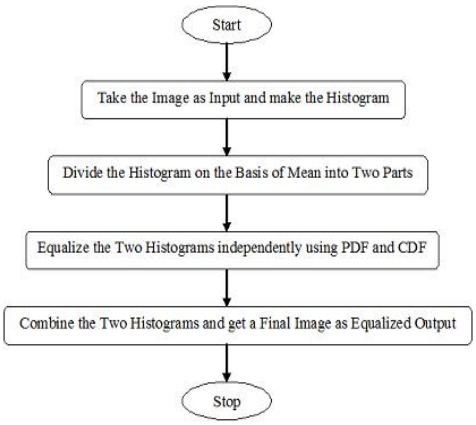


Fig. 1: BBHE

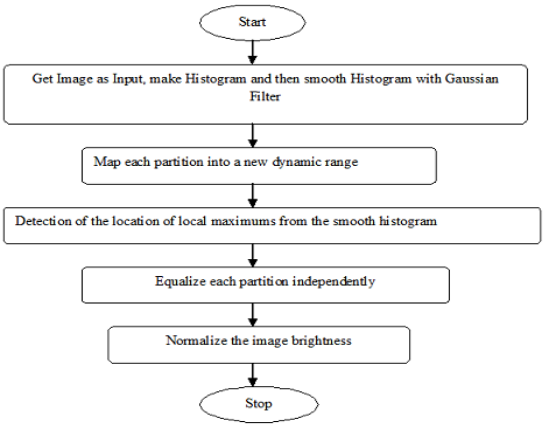


Fig. 2: BPDHE

3. Proposed Technique

The proposed technique utilizes the concept of seed point and performs separately on low pass and high pass filter. It uses contrast adjustment and bilateral filter effect to adjust the contrast.

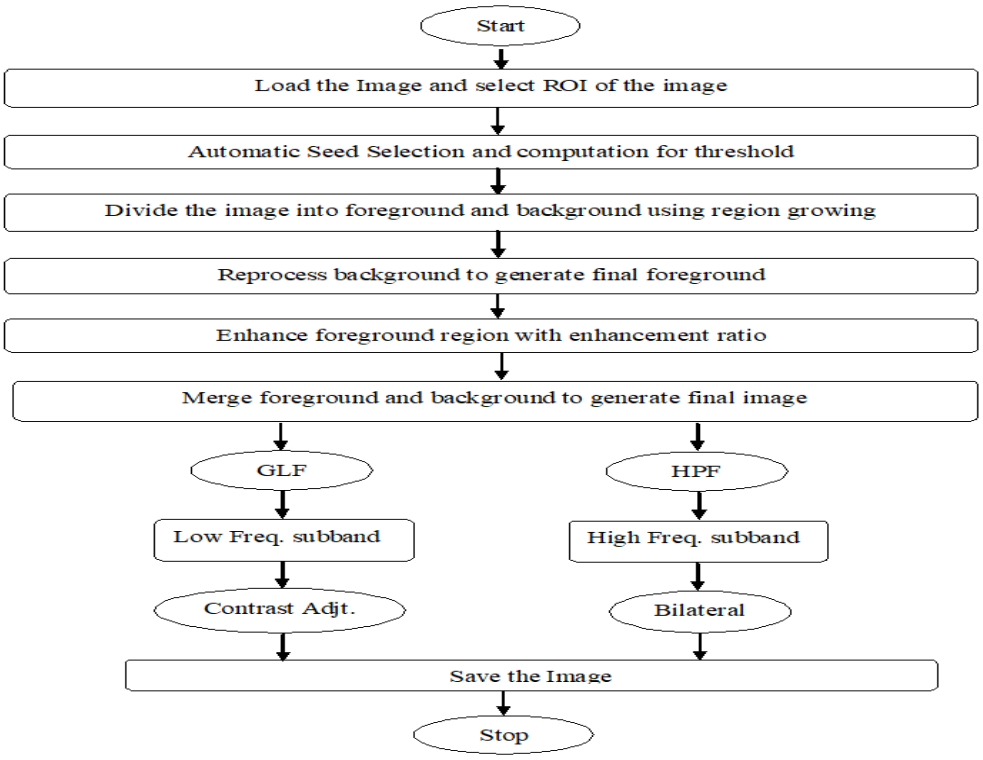


Fig. 3: Proposed Technique

4. Research Methodology

1. Implement existing techniques in matlab 2016.
2. Implement the proposed technique so that to improve contrast only in desired regions especially low in fined content regions and high in coarse content regions.
3. This technique automatically will detect the seed point and will perform bilateral filtering.
4. Comparative study with existing techniques.
5. The parameters for evaluation are PSNR, MSE, Correlation and NAE.

5. Parameters for Performance Evaluation

A. Peak Signal to Noise Ratio (PSNR)

$$\text{PSNR} = 10 \log_{10} \frac{255^2}{MSE}$$

Peak Signal to Noise Ratio should be as large as possible which means that the content of signal in the output is large and the noise is less. As it is maximum value of signal to noise ratio so the cost of the input signal is assumed as maximum which is equal to 255 as for gray digital images the gray values ranges from 0 – 255.

B. Mean Square Error (MSE)

$$\text{MSE} = \frac{1}{MN} \sum_{j=1}^{M} \sum_{k=1}^{N} \left(x_{j,k} - x'_{j,k} \right)^2$$

Where, *M* and *N* are rows and columns, respectively of the image. $x_{j,k}$ is the original image and $x'_{j,k}$ is the corresponding output image. The MSE should be less, which means that the pixel intensity of the input and output image should be as close as possible.

C. Correlation

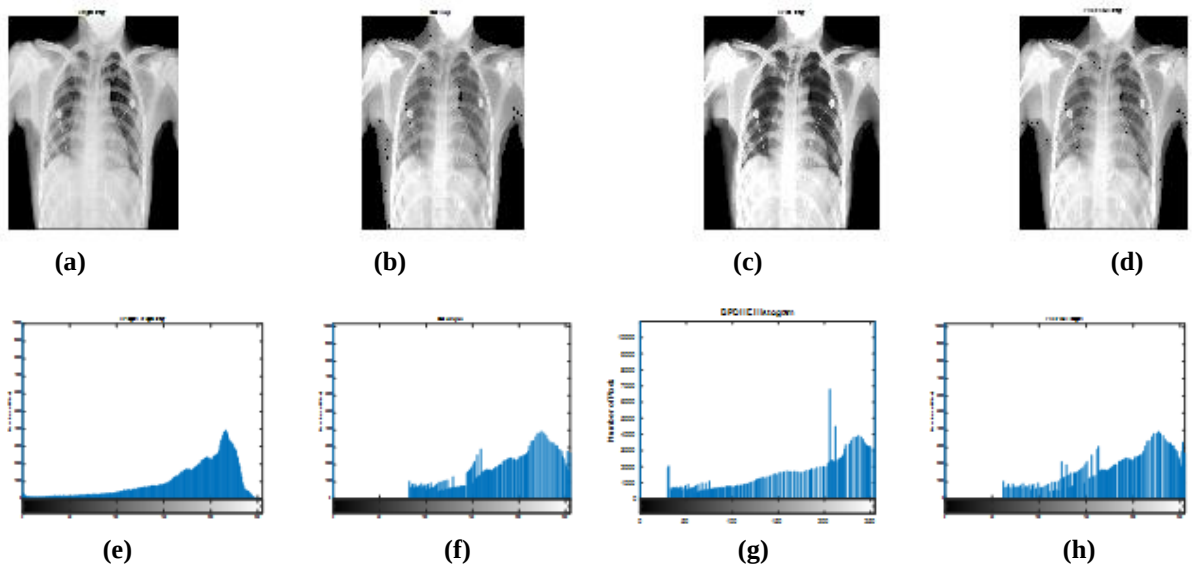
The value of each pixel in a correlation image is a measure of how well the target image matches the searched image at that point.

D. Normalized Absolute Error (NAE)

$$\text{NAE} = \frac{\sum_{j=1}^{M} \sum_{k=1}^{N} | x_{j,k} - x'_{j,k} |}{\sum_{j=1}^{M} \sum_{k=1}^{N} | x_{j,k} |}$$

where, $x_{j,k}$ is the input original image and $x'_{j,k}$ is the corresponding output digital image Normalized Absolute Error is the normalized absolute error, so it should be minimum showing that the difference amid the input digital image and the output digital image is very less.

IV. Results



(a) **(b)** **(c)** **(d)**

(e) **(f)** **(g)** **(h)**

Fig. 4(a, b, c, d, e, f, g, h): Original chest image, it's histogram, BBHE image, it's histogram, BPDHE image, it's histogram, Proposed image, it's histogram

Table 1: shows the objective evaluation parameter values of different techniques on chest input image

Technique Name	MSE	PSNR	CORRELATION	NAE
BBHE	242.9372	24.2759	0.0089	0.0606
BPDHE	504.8711	21.0990	0.0185	0.1244
PROPOSED	15.4226	36.2492	5.4395e-04	0.0157

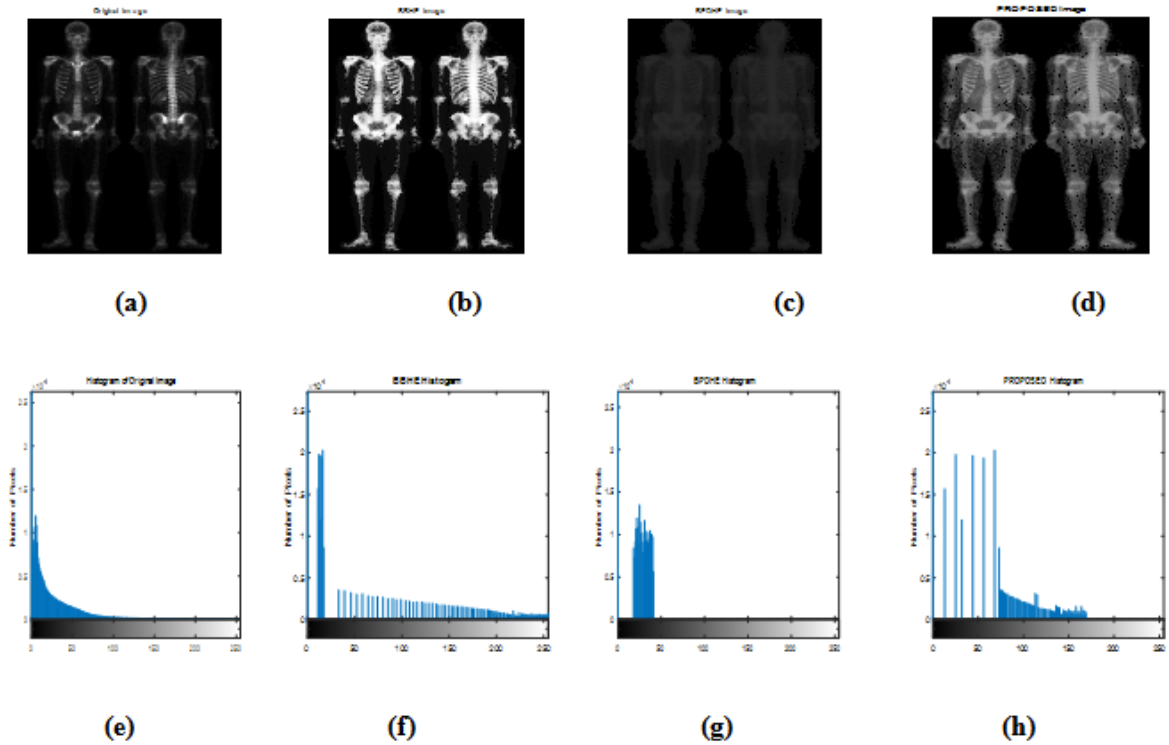


Fig. 5 (a, b, c, d, e, f, g, h): Original bone image, it's histogram, BBHE image, it's histogram, BPDHE image, it's histogram, Proposed image, it's histogram

Table 2: shows the objective evaluation parameter values of different techniques on bone input image

Technique Name	MSE	PSNR	CORRELATION	NAE
BBHE	2.8686e+03	13.5541	2.4787	1.6488
BPDHE	460.5976	21.4976	0.3980	0.6395
PROPOSED	1.0526e+03	17.9080	0.1466	0.4590

V. Conclusion

From the result it is cleared that proposed technique perform better than Bi-histogram equalization (BBHE) and brightness preserving dynamic histogram equalization (BPDHE). Mean square error (MSE) of the proposed method in all cases is very less. Also peak signal to noise ratio is always more in comparison to all scenarios. Also the correlation is always less compared with other methods. Normalized absolute error is also the minimum in comparison to other methods.

Hence the proposed technique performs much better than other two techniques and can be easily used for contrast enhancement of x-ray medical images.

In the future work more number of techniques can be compared with the proposed technique. Also the other objective evaluation parameters can be taken for consideration. Even on the basis of theory of proposed algorithm new technique can also be proposed.

References

Journal Papers:

[1]. E. S. Yelmanova and Y. M. Romanyshyn, Medical Image Contrast Enhancement Based on Histogram, IEEE 37th International Conference on Electronics and Nanotechnology (ELNANO), 2017, pp. 273-278.

[2]. Z. Yao, Q. Zhou, Z. Lai, Z. Ren and L. Liu, Image Enhancement Based on Bi-Histogram Equalization with Non-Parametric Modified Technology, IEEE 22nd International Conference on Parallel and Distributed Systems (ICPADS), 2016, pp. 1211-1215.

[3]. J. Yang, W. Zhong and Z. Miao, On the Image Enhancement Histogram Processing, 3rd International Conference on Informative and Cybernetics for Computational Social Systems (ICCSS), 2016, pp. 252-255.

[4]. H. N. Manh and C. Y. Tseng and C. C. Huang, X-RayImage Contrast Enhancement Based on Tissue Attenuation, in International Conference on Acoustic, Speech and Signal Processing, 2014, pp. 6602-6606.
[5]. H. Ibrahim and N. S. P. Kong, Brightness Preserving Dynamic Histogram Equalization for Image Contrast Enhancement, in IEEE Transactions on Consumer Electronics, 53(4), 2007, pp. 1752-1758.
[6]. C. Tomasi and R. Manduchi, Bilateral Filtering for Gray and Color Images, Proc. of Int'l Conf. on Computer Vision, Bombay, 1998.
[7]. Y. T. Kim, "Contrast Enhancement Using Brightness Preserving Bi-Histogram Equalization," in IEEE Transactions on Consumer Electronics, 43(1), 1997, pp. 1-8.

IOSR Journal of Computer Engineering (IOSR-JCE) is UGC approved Journal with Sl. No. 5019, Journal no. 49102.

Richa Bansa "A Histogram Based Technique For Contrast Enhancement Of Medical Images" IOSR Journal of Computer Engineering (IOSR-JCE) 21.3 (2019): 58-63.