Optimized Background Preservation for Image Enhancement

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ABSTRACT:

Image processing is a noble field in processing digital images in ample ways to improve quality and decrease redundancy in the image data. In Image Processing contrast enhancement plays an important role in various applications like biomedical , real life photography, satellite etc. Images enhancements mean adjusting the brightness, changing the tone of the color, sharpening the image and reducing noise. The process of editing or modifying the images is, in general, called Image Processing. Image Enhancement (IE) transforms images to provide better representation of the subtle details. The role of contrast enhancement is to improve the quality of image & produce an enhanced image as compare to original image. For improving the contrast various techniques has been developed like Histogram Equalization (HE), Automatic weighting mean separated histogram equalization (AWMHE), Brightness Preserving bi-histogram equalization (BBHE) etc. In order to reduce undesired artifacts & produces the natural image (especially in medical images) one of its solutions is to preserve the mean brightness of input image inside output image. This paper presents the survey of various techniques used for enhancing image & also a proposed technique of Background brightness preserving histogram equalization (BBPHE) with weighted gaussian filter which decomposes the input image into sub-images based on background levels and non-background levels range.

KEYWORDS: Image Processing, Image enhancement, histogram equalization, Brightness Preserving, Gaussian Filtering

INTRODUCTION

Digital image processing often seem to be mathematically complex but central idea behind is quite simple. The main goal of image processing is understand, interpret the given data & give useful information at the output. Image Enhancement is one of the major concern in image processing. It is essential for various applications like medical images, speech recognition, texture synthesis etc. Image enhancement techniques can improve the quality of an image by highlighting certain features of interest in image which can be perceived by human. Noise in digital images has also one of major factor in degrading the quality of the image.

Image Enhancement means adjusting the brightness, changing the tone of the color, sharpening the image and reducing noise. Image Enhancement is an essential pre-processing step for image segmentation. Image enhancement can be divided into two categories: Spatial domain & Transform domain. Spatial domain operate directly to change image pixels & used in sharp & smooth filtering images. Transform domain is based on convolution theorem & change the position of image & compute the image in fourier transform. It is an indirect method which can further divided into histogram modification technique, transform based technique & decompose the image into high & low frequency signal. Histogram equalization is widely used for contrast enhancement in various areas like medical imaging, consumer electronics, speech recognition due to its higher efficiency & simplicity. Histogram equalization remaps the intensity value of the image based on probability distribution but suffers from a drawback by highlighting the edges, borders of the image it degrade the local details within the image & cannot preserve the original brightness of the image. In order to overcome the problem of HE various techniques have been developed such as THE(Traditional Histogram equalization), AWMSHE(Automatic Weighting Mean separated Histogram Equalization),BBHE (Brightness Preserving Bi-histogram Equalization), DSIHE (dualistic sub-image histogram equalization), MMBEBHE (Minimum mean brightness error bi-histogram equalization),RMSHE(Recursive mean separate Histogram Equalization), DHE (Dynamic Histogram Equalization),BPDHE(Brightness preserving dynamic histogram equalization), MCBHE(Multi level component based histogram equalization), WMSHE (Weighting mean-

separated sub-histogram equalization). In this we proposed an optimized technique of BBPHE (Background Brightness preserving histogram Equalization) with gaussian filter which decomposes the input image into sub-images based on background levels and non-background levels range. After that, each sub-image is equalized independently, and then combined into the final output image as an order-statistic filter, which replaces the value of a pixel by the gaussian of the intensity values in the neighborhood of that pixel.

IMAGE ENHANCEMENT TECHNIQUES

Various image enhancement techniques which are widely used in many researches are given below:

1) THE (Traditional Histogram Equalization): It is also called as Adaptive Histogram Equalization (AHE). It cannot enhance the local details of the image. It makes an adaptive selection of channels and thresholds based on the analysis of input image. It also reduces the processing time and noise. The contrast equalized image is generated by transforming the pixels' gray levels in each input interval to the appropriate output gray-level interval according to the dominant Gaussian component and the cumulative distribution function of the input interval.

2) AWMSHE (Automatic Weighting Mean separated Histogram Equalization): Used for gray scale images. In this method an input image is separated into several sub images. It can be determined on the basis of local and global histogram. It involves the stages are as follows.(i) Automatic histogram separation: Separate the input image on the basis of weighted mean function and automatic determine the recursion level.(ii)Piecewise Transform function: By equalizing sub histograms we achieve contrast enhancement.

3) DSIHE (Dualistic sub-image histogram Equalization): It divides the image into sub images on the basis of gaussian value. DSIHE is in term of preserving an image's brightness and entropy. It does not present a significant change in the brightness of the input image, especially for the large area of the image with the same gray-levels.

4) BBHE (Brightness Preserving Bi-histogram Equalization): Divide the image into two sub images on the basis of mean gray level. After separation these two sub images are equalized independently by using histogram equalization & the resultant image which contains the mean brightness between input mean & middle gray level. It cannot preserve the natural appearance of the image.

5) MMBEBHE (Minimum mean brightness error bi-histogram equalization): It divides the image into sub images on the basis of threshold level & equalized by histogram equalization to produce output image. It preserves the mean brightness of the image & suitable for real time applications.

6) RMSHE (Recursive mean separate Histogram Equalization): It decompose the image recursively for generating 2r sub-image. Each sub images is independently enhanced by using HE method. As value of r is large it produces the output image exactly the copy of the input image and there is no enhancement at all. It is good brightness preservation technique.

7) DHE (Dynamic Histogram Equalization): It divides the image histogram based on local minima and a specific gray level is assign before equalization. It can be done on the basis of their dynamic range in input image and cumulative distribution (CDF) on histogram values. It cannot produce any side effects but cannot preserve the mean brightness of the image.

8) BPDHE (Brightness preserving dynamic histogram equalization): In this technique mean intensity of input image is equal output image mean intensity. It is based on the local maxima of the smoothed histogram. It overcomes the brightness preservation problem. In this method the input histogram is smoothed by a Gaussian filter, and then partitions on the basis of local maxima. Now each partition will assign a new dynamic range. Then equalization process is applied independently to these partitions. The changes in dynamic range and equalization process will change the mean brightness of the image. Finally normalize the output image to the input mean brightness.

9) MCBHE (Multi level component based Histogram equalization): In this method it decompose the image into sub images as background & foreground sub images.

PROPOSED WORK

In a proposed work we give a review of a new technique named as BBPHE(Background brightness preserving histogram equalization) with gaussian filter for enhancing the contrast & useful in medical images such as tumor, cancer detection in lungs, brain etc. As medical images are very sensitive to distortion and required good level of enhancement when it got corrupted. With Histogram equalization enhancing the contrast of medical images but over-enhance the image background brightness. In order to

preserve the background brightness for medical images with well-defined background brightness. The proposed scheme will be used which is the combination of Histogram based background preserving scheme with Gaussian Filtering technique.

1. First we decompose the input image into sub-images based on background levels and non-background levels range.
2. After that, each sub-image is equalized independently, and then combined into the final output image. Output image will go through Gaussian filtering process to fine-tune the histogram of an image.
3. In this way, the background levels are only stretched within the original range, hence, the over enhancement can be avoided. Also, although other sub-images contain only comparatively low density grey levels, BBPHE is able to expand them into a wider range due to normalization. Hence, this will provide adequate enhancement on the image & easily detect the tumor, cancer in colored medical images. The flow sequence of the propose work is shown in figure 1.

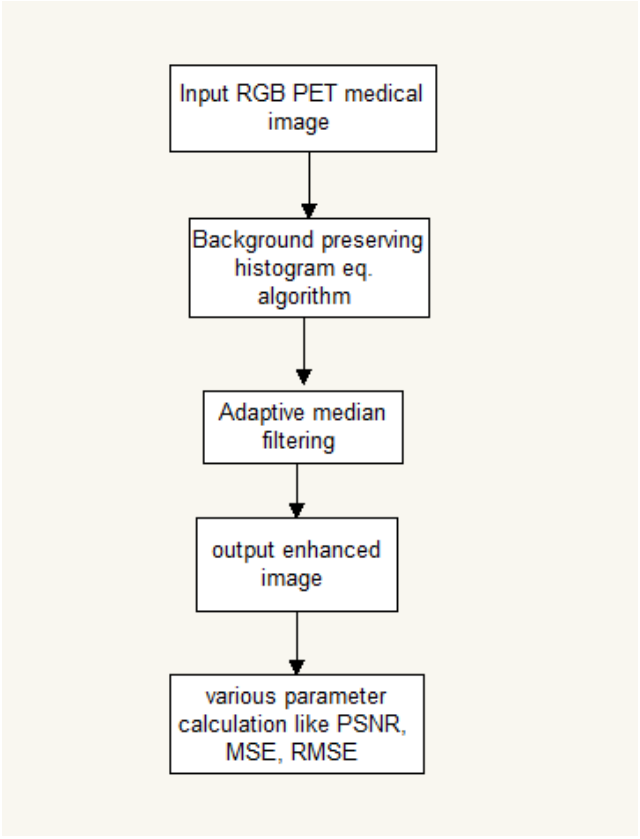

Figure 1: Process flow of the proposed work

Input Image: It is a one kind of smoothing technique for binary representation & has finite set of digital values called pixels. The digital image contains a fixed number of rows and columns of pixels. Various image formats are available such as GIF, JPEG, and PNG.

Background Preserving Histogram Equalization: Medical images are very sensitive to distortion and required good level of enhancement when it got corrupted. With Histogram equalization enhancing the contrast of medical images but over enhancement the image background brightness. In order to preserve the background brightness for medical images with well-defined background brightness without any modification background preserving histogram equalization.

Output Enhanced Image: After passing through filter by removing the noise it produces enhanced image without any modification in the background. Calculation of the following parameters like PSNR, SNR is considered.

EXPERIMENTATION

Background preservation histogram equalization basically brings about enhancement or equalization of the pixels which are involved in construction of foreground where as it doesn't disturb the background pixels. BPHE is having numerous applications in science and engineering, in enhancement of medical images to achieve maximum utilization of resulting images. We have done experimentation on the PET scan medical images of liver cancer. After experimentation we came across improved results with good peak sound to noise ratio value and less mean square error value which shows utility of our enhancement process. Following are the results we get from our proposed scheme.

	PSNR	RMSE
Histogram Equalization	5.16	141.17
BPHE with Adaptive Median Filtering	14.81	46.48

Table 1: Showing PSNR value, RMSE value, correlation and compression ratio

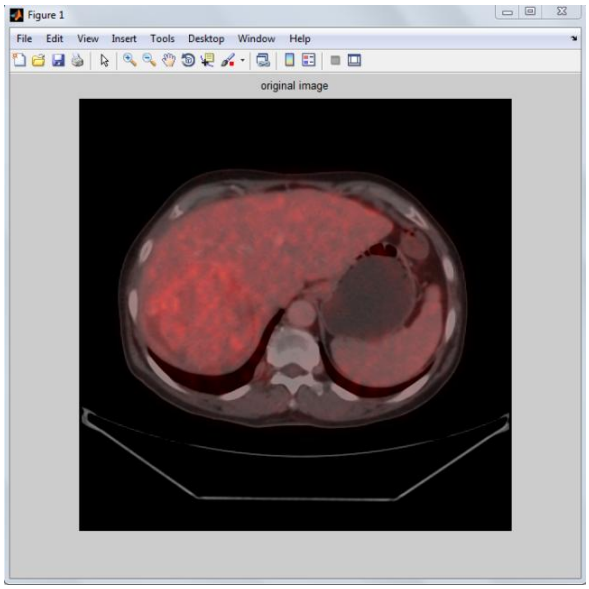

Figure 2: PET medical image taken as input.

For basic experimentation based on the proposed work, image shown in figure2 considered as input image.

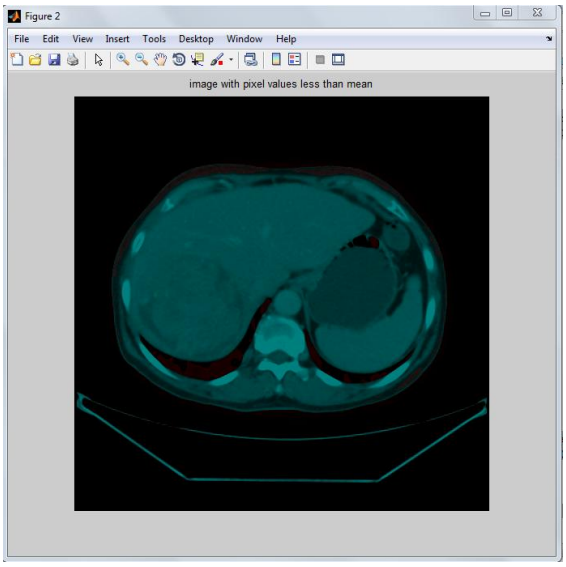

Figure 3: Image with pixel values less than mean

Above figure 3, shows the pixel values for the input image. This process is very essential due to background preservation process. In the process of background preservation, pixels value decides the background intensity to be considered for preservation. Figure 3 shows the pixel value of the image when it is less than value of mean.

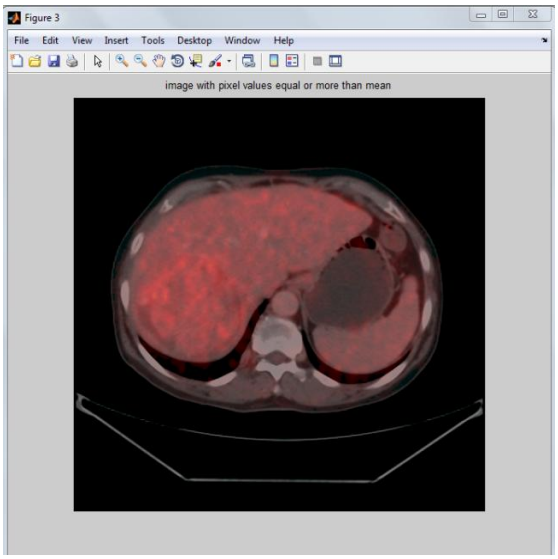

Figure 4: Image with pixel values equal to or more than mean

Above figure 4, shows the pixel values for the input image. This process is very essential due to background preservation process. Figure 4 shows the pixel value of the image when it is more than value of mean so this image will provide suitable results.

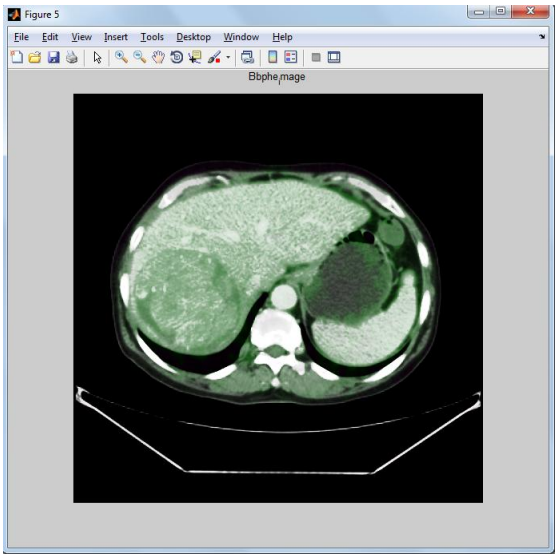

Figure 5: Resulting image after application of BPHE technique

The background preservation process has been applied and above figure 5, shows the output image after applying basic background preservation procedure.

Adaptive Median filtering: in this process the resulted image from the process of BPHE is taken as input and an advanced Adaptive median filtering for RGB images is

applied over it. This is for the removal of additional noise, if any produced during the process. The output image after applying adaptive median filtering is shown in figure 6 below

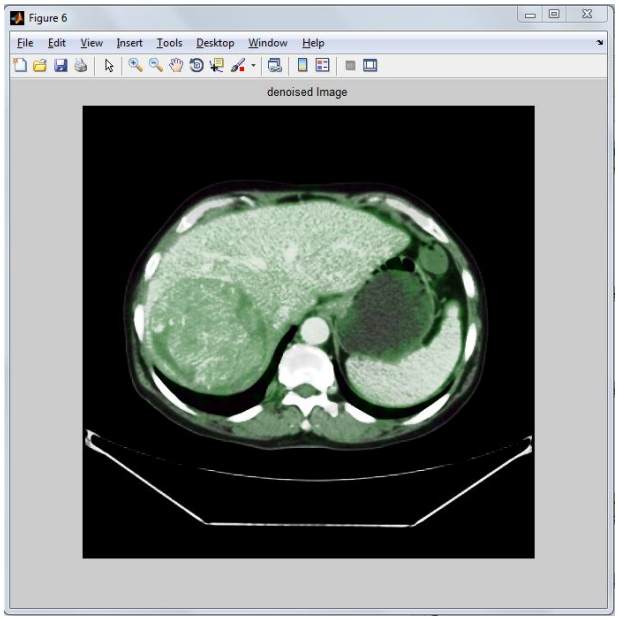

Figure 6: Output image after treatment with Adaptive median filtering process

Final proceedings are based on histogram equalization process.

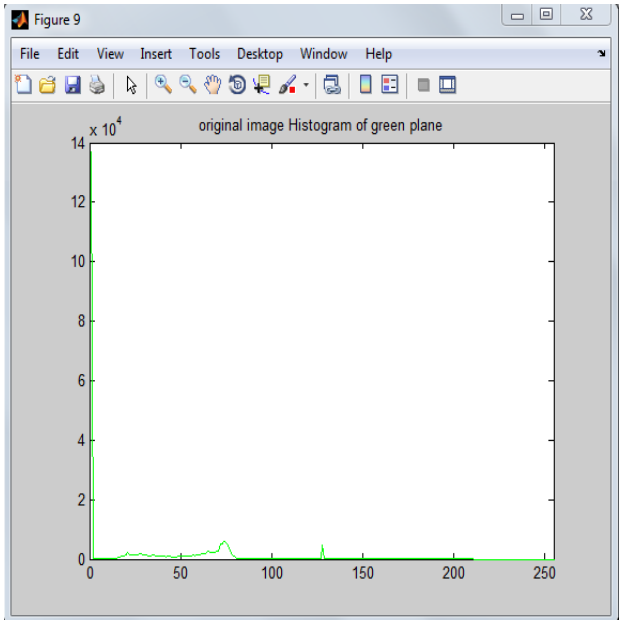

Figure 7: – Histogram of green plane of original image

The green plane structure for histogram equalization is the essential feature of the histogram process.

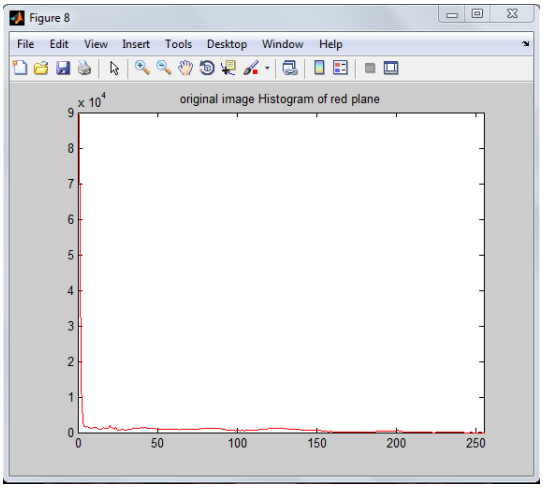

Figure 8: Histogram of red plane of original image

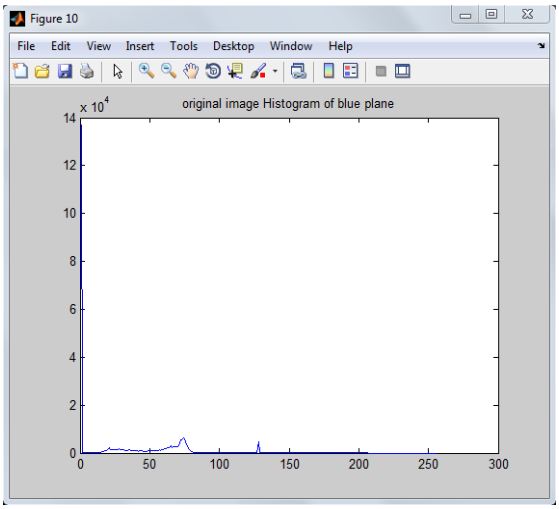

Figure 9: Histogram of blue plane of original image

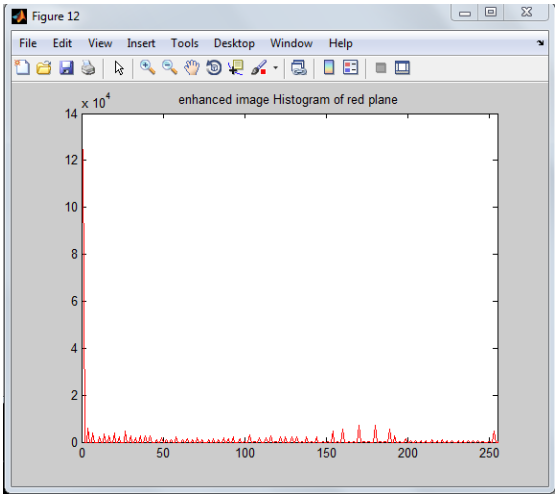

Figure 10: Histogram of red plane of enhanced BBPHE image

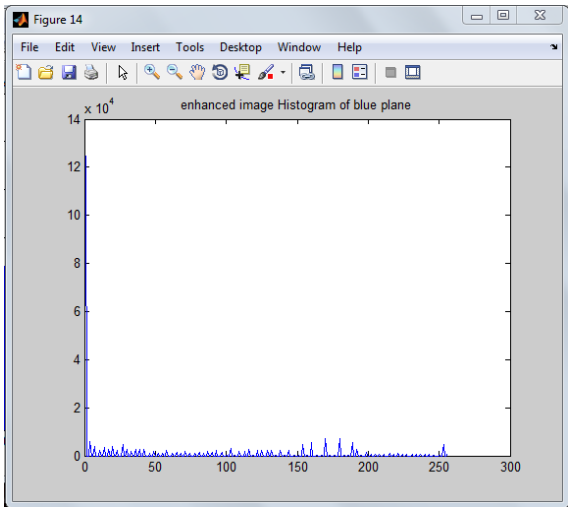

Figure 11: Histogram of blue plane of enhanced BBPHE image

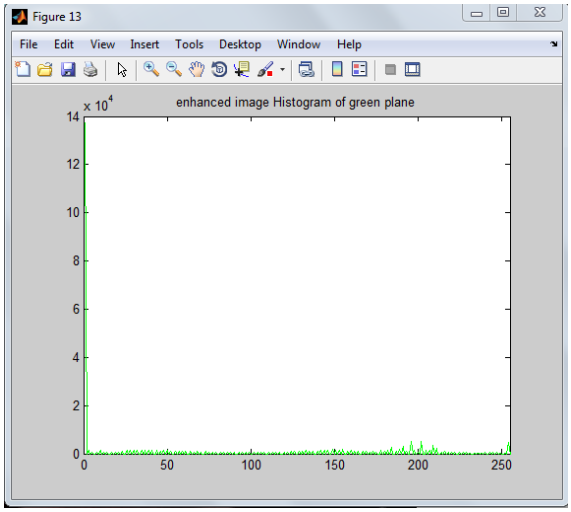

Figure 12: Histogram of green plane of enhanced BBPHE image

CONCLUSION

In this paper, we have discussed contrast enhancement techniques like HE, BPHE, DHE etc. have been studied to enhance the quality of an image & also preserving the brightness of the image. We have proposed an optimized technique BBPHE in which the background brightness has been placed independent of the foreground. Along with it we have used adaptive median filter to further remove unwanted noise from the resulting image. The optimized background preservation method for image enhancement provide better results as compare to histogram equalization method for image enhancement in term of peak signal to noise ratio and mean square error. In our proposed experimentation PSNR is high with value of 14.7346 and MSE are low with value of 46.9365 as compare to the histogram equalization process.

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