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High dynamic range image tone mapping based bilateral histogram equalization for biomedical images

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ABSTRACT:
This paper introduces a novel tone mapping operator, designed to offer a good rendering of the local structures. The new operator fusions the multiple versions of a single HDR input obtained by clipping and normalizing its intensity based on a complete set of disjoint intervals. Defining the weight map associated to each version to be its clipping interval indicator function promotes contrast enhancement, but induces artifacts when neighboring pixels belong to distinct intervals. We thus propose to smooth out the indicators across neighboring pixels with similar intensity, using a standard cross bilateral filter. With such weight maps, the fusion operator becomes equivalent to applying histogram equalization on the image regions on which the cross-bilateral filter diffuses the indicators, and is therefore referred to as Bilateral Histogram Equalization (BHE) operator. It compares favorably to previous tone mapping algorithms.

1.INTRODUCTION

X-ray test is a very common, non-invasive radiology test that produces an image of the chest and the internal organs. To produce a chest X-ray test, the chest is briefly exposed to radiation from an X-ray machine and an image is produced on a film or into a digital computer. Chest X-ray is also referred to as a chest radiograph, chest roentgenogram, or CXR. Traditional digital images are stored by using formats such as TIFF, JPEG etc., which allow to represent only a limited range of luminance and color gamut. However, in real scenes, light intensity has a greater range that is about eight orders of magnitude. The human eye is capable of adapting to lighting conditions that vary by nearly 10 orders of magnitude [1] and within a scene it can perceive a range of about five orders of magnitude simultaneously. In the last years, the development of High Dynamic Range Imaging has introduced a new class of images, which are able to represent a visual scene without any range restriction. However, the maximum intensity radiation of nowadays commercial monitors is limited, therefore HDR images can not be properly displayed without adapting the HDR signal. The transformation of the HDR image into its Low Dynamic Range (LDR) version requires the application of a Tone Mapping operator that, in principle, realizes a dynamic range compression. During this process it is important to preserve the information provided by the HDR content in order to create an image that perceptually matches the original real scene.

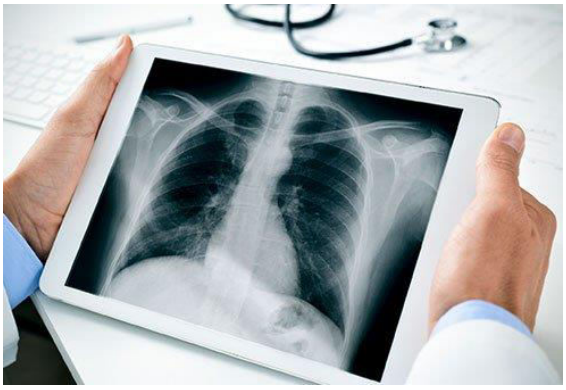

Fig1 Chest X-rays can diagnose pneumonia, lung masses, and broken ribs.

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Many times it is needed to process the image in order to remove noises which are in advertently introduced in the image it may be caused by the sensor and circuitry of digital camera. Image enhancement can be carried out in two domains they are spatial domain and frequency domain. Histogram and its equalization is a spatial domain or pixel domain processing. Histogram that shows only a fraction of the total range of gray levels in the image then the image has low contrast. Histogram equalization is one of the well known image enhancement technique. It became a popular technique for contrast enhancement. The significance of histogram processing of an image particularly the histogram equalization (HE). It is one of the widely used image enhancement technique. It has become a popular technique for contrast enhancement because the method is simple and effective. The basic idea of HE is to re-map the grey levels of an image. Here we propose two different techniques of Histogram Equalization namely, the global HE and local HE. The Histogram Equalization has been performed in the MATLAB environment.

2. LITURE SURVEY

2.1 Topic: Local and global contrast enhancement techniques for a digital image

Image enhancement is one of the challenging issues in low level image processing. The main aim of image enhancement is to enhance quality of the image so that visual appearance can be improved. Contrast enhancement is an important factor for image enhancement. Histogram based techniques are one of the most important image processing techniques that are used for enhancement tasks. Histogram equalization is a very effective approach to contrast enhancement. However, histogram equalization tends to change the brightness of the image. The present paper describes a review of different local and global contrast enhancement techniques for a digital image.

2.2 Topic: A New Methodology for Improvement of Contrast to Show Fractures in X-ray images

Imaging is one of the most important application areas of digital image processing. Processing of various medical images is very much helpful to visualize and extract more details from the image. Many techniques are available for enhancing the quality of medical image. For enhancement of medical images, contrast enhancement is one of the most acceptable methods. Different contrast enhancement techniques i.e. Linear Stretch, Histogram Equalization, Convolution mask enhancement, Region based enhancement, Adaptive enhancement are already available. Choice of Method depends on characteristics of image. This research work deals with contrast enhancement of X-Ray images and presents here a new approach for adjustment of contrast so that minor fracture in bones will be visible. Adaptive histogram equalization (AHE)is a good contrast enhancement method for medical images. In medical imaging, its automatic operation and effective presentation of all contrast available in the data make it a competitor to the standard contrast enhancement method. Bilateral Histogram Equalization (BHE) is the contrast limiting procedure has to be applied for each neighborhood from which a transformation function is derived. Bilateral filtering that smooth images while preserving edges, by means of a nonlinear combination of nearby image values. The method is noniterative, local, and simple. It combines grey levels or colour based on both their geometric closeness.

3.EXISTING SYSTEM

3.1 HISTOGRAM EQUALIZATION

3.1.1. Basic Steps of Image Enhancement

The basic steps of image enhancement, if we are taking the any input image, the image is then

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specify application pre-processing method will be performed on those image after this method the image quality is increased.

Input Image: In this first an image will be taken as an input. These images can be medical images, blur images, remote sensing images machine vision, the military applications etc.

Perform Pre-processing on the Image: Images that will be taken as input can be blur image or noisy image so the various pre-processing methods will be performed on those images before applying enhancement technique.

Applying Domain Techniques: After applying pre-processing method on input images then image quality will be enhanced by using Image enhancement domain techniques such as spatial or transformation.

Output Enhanced Image: In this the output image will be get which is an enhanced image.

3.2 Histogram Based Methods

Histogram-based methods are very efficient when compared to other image segmentation methods because they typically require only one pass through the pixels. In this technique, a histogram is computed from all of the pixels in the image, and the peaks and valleys in the histogram are used to locate the clusters in the image. Color or intensity can be used as the measure.

A refinement of this technique is to recursively apply the histogram-seeking method to clusters in the image in order to divide them into smaller clusters. This is repeated with smaller and smaller clusters until no more clusters are formed.

One disadvantage of the histogram-seeking method is that it may be difficult to identify significant peaks and valleys in the image. In this technique of image classification distance metric and integrated region matching are familiar.

3.3 Image Histogram

An image histogram is a type of histogram that acts as a graphical representation of tonal distribution describes the distribution of various bright and dark tones with in an image. During the scanning or image editing stage tones can be redistributed lightening a dark image (or) darkening a bright image. This histogram plots the no. of pixels for each tonal value. by looking at the histogram for a specific image a person will be able to judge the entire tonal distribution.

Image histograms are present on many modern digital cameras. The horizontal axis of the graph represents the tonal variations and the vertical axis represents the no. of pixels in that particular tone. For this histogram we are assuming a discrete function

3.4 Histogram Equalization

The most well-known use of equalization is in sound recording and reproduction but there are many other applications in electronics and telecommunications. The circuit or equipment used to achieve equalization is called an equalizer. These devices strengthen (boost) or weaken (cut) the energy of specific frequency bands. The probability of occurance of intensity level rk in a digital image is approximated written in equation 4.2

$$p(r_k) = \frac{n_k}{MN} \qquad (4.2)$$

Where

K=0,1,2.....L-1

MN=Total number of pixels in the image

n_k= number of pixels that have intensityof rk

Histogram equalization is a technique for adjusting image intensities to enhance contrast.

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Histogram equalization is used to enhance contrast. It is not necessary that contrast will always be increase.

4.PROPOSED METHOD

4.1 Bilateral Histogram Equalization (BHE)

In this section the proposed tone mapping algorithm, which has been derived from the Bilateral Histogram Equalization (BHE) method, is explained. The original BHE algorithm, has not been designed for tone mapping operations [11]-[12], and to apply it directly on an HDR image gives unsuccessful results. The hereafter proposed enhancements and modifications ensure that the obtained LDR image is well suited to the human visual system, and very detailed.

4.2 BHE Algorithm

The BHE algorithm was originally developed for medical imaging and has proven to be successful for the enhancement of low-contrast images. The method itself is an extension of histogram equalization [13], a well known technique based on the assumption that in a good contrast grayscale image, pixels values are uniformly distributed. Since human eyes can adapt to the local image content, the Adaptive Histogram Equalization (AHE, [11]) divides the input image in a grid of rectangular contextual regions, in which histogram equalization is performed independently. In order to avoid region boundary effects, a bilinear interpolation is used to blend the local mapping functions. The problem of region based histogram equalization, is that in nearly flat areas perhaps all pixels will be remapped to the maximum output value, producing a very noisy adapted image.

4.3 Wavelets Method

The Wavelet change is a change of this sort. It gives the time-recurrence portrayal. (There are different changes which give this data as well, for example, brief time Fourier change, Wigner dispersions, and so on.) As a rule a specific ghostly segment happening at any moment can be specifically compelling. In these cases it might be helpful to know the time interims these specific otherworldly segments happen. For instance, in EEGs, the idleness of an occasion related potential is specifically compelling (Event-related potential is the reaction of the cerebrum to a particular improvement like blaze light, the inactivity of this reaction is the measure of time passed between the beginning of the upgrade and the reaction).

Wavelet change is equipped for giving the time and recurrence data at the same time, consequently giving a period recurrence portrayal of the picture. DWT utilizes two arrangements of capacities, called scaling capacities and wavelet capacities, which are related with low pass and high pass channels, separately. The disintegration of the picture into various recurrence groups is essentially gotten by progressive high pass and low pass sifting of the time space picture. The first picture x[n] is first gone through a half band high pass channel g[n] and a low pass channel h[n]. After the sifting, half of the examples can be dispensed with as per the Nyquist's standard, since the picture currently has a most noteworthy recurrence of □/2 radians rather than □ . The picture can consequently be sub sampled by 2, basically by disposing of each other example. This comprises one degree of decay and can numerically be communicated as pursues:

$$y_{high}[k] = \sum_n x[n] \cdot g[2k - n]$$

$$y_{low}[k] = \sum_n x[n] \cdot h[2k - n]$$

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where y high[k] and y low[k] are the yields of the high pass and low pass channels, individually, in the wake of sub sampling by 2.

The recreation for this situation is extremely simple since half band channels structure orthonormal bases. The above method is followed backward request for the remaking. The pictures at each level are up sampled by two, went through the combination channels g'[n], and h'[n] (high pass and low pass, individually), and after that additional.

5.SIMULATION RESULT

If we are taking the one image, for example the input image in this image is not clear to visual appearance of eye. To increase the image quality we use the different enhancement techniques i.e. histogram equalization and wavelets by using image enhancement. We use this techniques .to remove the noise and increase the image quality. It use the histequalent process image quality is observe very simple ,because histogram is a graphical representation, then the pixels are divided to equal number of values.

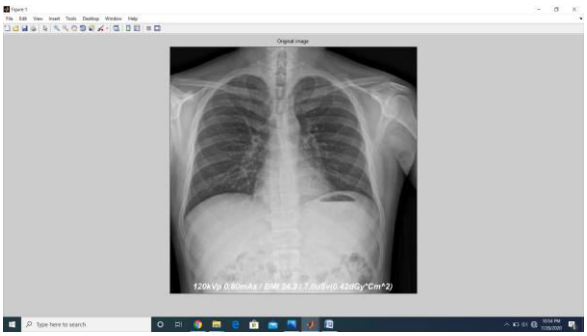

FIG 2: INPUT IMAGE

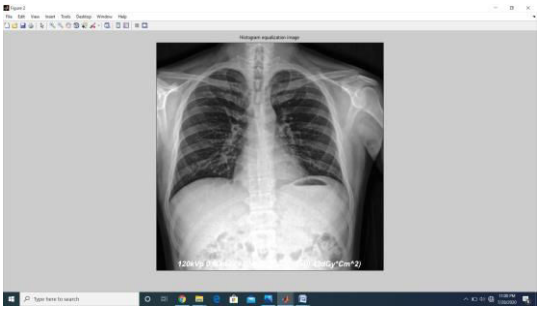

FIG 3: HISTOGRAM EQUALIZATION OUTPUT

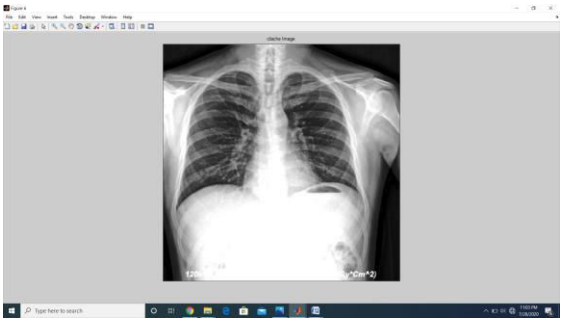

Fig4: BHE OUTPUT

6. CONCLUSION

This paper has introduced an original fusion-based strategy to implement a locally adaptive tone mapping that approximates histogram equalization on a support that is implicitly defined by the diffusion capabilities of a cross-bilateral filter. The method is shown to be competitive with common tone mapping approaches.

7.FUTURE SCOPE

We have already seen in generalized equalization model for image enhancement, In the future, besides global image enhancement, we expect to unify more local image enhancement methods into the model through local image feature analysis and also implement morphological and dilation and erosion process.

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