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Performance Analysis of HE Methods for Low Contrast Images

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Abstract

The image enhancement is one of the important issues in image processing. The main purpose is to highlight certain characteristic of image such as: contrast, sharpening. Histogram equalization is the well-known method for image enhancement. Histogram equalization became a popular technique because it is simple and effective. However Histogram equalization cause excessive contrast enhancement which cause visual artifacts of processed image. In this paper new forms of histogram equalization are overviewed to overcome this drawback. The major difference among the methods is the way to divide the input histogram. Recursive exposure based sub-image histogram equalization (R_ESIHE) use average intensity value as the separating point. Median-mean based sub-image clipped histogram equalization (MMSICHE) and Quadrants dynamic histogram equalization for contrast enhancement (QDHE) use median intensity value as separating point. Here objective parameters are Peak signal to noise ratio (PSNR) and Absolute Mean Brightness Error (AMBE)used to compare the quality of enhancement.

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1. Introduction

Now a days use of mobile phones and digital cameras has been tremendously increased as it is very easy to take pictures & light for portability. But sometimes pictures taken by mobile cameras are of low quality due to low light environment or because of any unnatural light sources & surrounding condition. Sometimes by our unconsciousness also mobile phones being shaked and gives blurred image. So many details of the image can't be perceived by normal human eyes. So post processing of the images is necessary. So contrast enhancement and preservation of brightness of the original images plays a very vital role to overcome such problems giving natural enhancement of the image. Thus small details of the image can easily be perceived by human eyes. Histogram equalization (HE) is a very popular method of contrast enhancement technique because of its ease of implementation. HE flattens the probability distribution and stretches the dynamic range of gray level. Hence HE improves the overall contrast of the image and preserves the mean brightness value [1]-[2]. It has application over vast areas such as medical imaging system (X-ray), texture synthesis, video enhancement and speech recognition etc. HE is not suitable for consumer electronics systems as it tends to change the mean brightness of the image to the middle level of the gray level range which produces annoying artifacts such as over enhancement, noise amplification, saturation effect.

Various methods have been proposed by researchers to overcome the drawbacks of traditional histogram equalization method. In 1997 Kim [2] proposed a method namely brightness preserving bi-histogram equalization (BBHE) for brightness preservation and contrast enhancement. This method bisects the histogram into two sub-histograms based on the mean brightness value of the input image and finally equalizes each sub- histogram. In 1999 Wan et al. [3] introduced a method named dualistic sub-image histogram equalization (DSIHE) .This method separates the histogram based on the median value thus containing approximately equal number of pixel. Wan et al. claimed that DSIHE method is better than BBHE brightness preservation and entropy of the image. Chen and Ramli proposed a method named minimum mean brightness error bi- histogram equalization (MMBEBHE). This method can preserve the mean brightness optimally [4]. MMBEBHE iteratively calculate absolute mean brightness error (AMBE) and bisect the histogram into two sub- histogram with minimum AMBE. Chen and Ramli has also proposed another method named recursive mean separate histogram equalization (RMSHE) [5] which is another version of BBHE. RMSHE iteratively performs BBHE. This method recursively separates the histogram into two sub-histogram based on the average brightness value of the input image and after sub division BBHE is performed to each sub-histogram. The algorithm is performed recursively until the desired number of sub-histogram is found. A similar technique is proposed by Sim et al.[6] named recursive sub-image histogram equalization(RSIHE). In this method sub-division is based on median value of brightness value of the input image. But no significant enhancement result is found for iteration to find the optimal value.
Kim and Chung [7] has introduced a method named recursively separated and weighted histogram equalization (RSWHE). This method divides the histogram iteratively and modifies the histogram by means of a weighting process using normalized power law function. But these techniques do not provide the mechanism for enhancement rate. In [8-10] Singh and Kapoor have proposed Exposure based Sub Image Histogram Equalization (ESIHE) method for enhancement of low exposure images where the exposure threshold value is being used for decomposition of histogram. The histogram equalization technique is the most popular technique and is applied in many ways by number of researchers.
This paper is organized as follows: section 2 describes different contrast enhancement methods, section 3 provides experimental results and section 4 concludes the paper.

2. Proposed Method

There are different types of contrast enhancement techniques applied by many authorsas described in literature. But in this work, authors tried on histogram based approach and compared among the proposed techniques. Though it is a common technique, still its variants work different way and made it attractive. Some of them are discussed in this section.

Histogram equalization (HE)
The traditional histogram equalization method can be described as follow:

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