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Survey on Contrast Enhancement Techniques

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Abstract: Image enhancement is to improve the visual appearance of an image or modify attributes of an image to make it more suitable for a specific application. Mean brightness of the image may loss and computational time is high while enhance an image using local enhancement technique. These limitations can be overcome by contrast enhancement. Contrast enhancement is a part of image enhancement, which brings out hidden feature of an image. This paper analyse performance of various contrast enhancement technique based on the AMBE, computational time. It also suggest the technique to enhance the image without loss of mean brightness of input image and reduced computational time.

Keywords: Contrast Enhancement, Mean Brightness Preservation, Gamma correction, Sub-histogram.

I. INTRODUCTION

Image enhancement used as a pre-processing step in medical image processing, image/video processing application [1]. Contrast enhancement plays an important role in image enhancement. Contrast enhancement automatically brightness images that appear dark or hazy and applies appropriate tone correction to deliver improved quality and clearly. Contrast enhancement will be used to perform adjustment on darkness or lightness of the image. It mainly used to bring out the feature hidden in an image or increase the contrast of low contrast image. This can be done using several contrast enhancement techniques. These techniques applied for various application such as remote sensing images and general images Histogram equalization (HE) is most popular technique in contrast enhancement [13] .It is computationally fast and simple to implement [2].

There are variants of HE techniques are available. Dualistic Sub-Image Histogram Equalization (DSIHE), it produce good image contrast enhancement, output image mean brightness is similar to input image but equalization effect is reduced[10]. Automatic Weighting Mean-separated Histogram Equalization (AWMHE), This method is more suitable for gray scale images. Recursive Sub-Image Histogram Equalization (RSIHE), this method has a good contrast enhancement effect. , Recursively Separated Weighting Histogram Equalization (RSWHE) [7], the Output image produced by this technique have no severe effect also maintain mean brightness of the input image. Automatic Weighting Mean-separated Histogram Equalization (AWMHE), it is suitable for gray scale images.

II. CONTRAST ENHANCEMENT TECHNIQUES

Contrast enhancement will be used to perform adjustment on darkness or lightness of the image. It mainly used to bring out the feature hide in an image or increase the contrast of low contrast image. Several enhancement techniques are available to enhance the image, some of the contrast enhancement techniques are disused in this paper.

A. *Dualistic Sub-Image Histogram equalization*

This technique separates the input image histogram into two subsections. It decompose the image aiming at the maximization of Shannon's entropy of the output image. For that decompose the image into two sub image. one is dark another one is bright, according to the equal area property [15]. This method use entropy value for histogram separation. Output of this technique is obtained after the two sub image are composed into one. .

Fig.1. Input image

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Fig.2. enhanced image

It produce good image contrast enhancement, output image mean brightness is similar to input image but equalization effect is reduced. It cannot solve over-equalization effect problem if the specific image has high density distribution narrow range.

B . Automatic Weighting Mean-Separated Histogram Equalization (AWMHE)

This technique provides a novel histogram equalization to improve the extreme over enhancement. There are two state involved in AWMHE [6].

- Automatic Histogram Separation
- Piecewise Transform Function

In automatic histogram separation input image separated according to the combination of weighting mean function.

In piece wise transform function, equalizing the sub-histogram in small scale details able to achieve contrast enhancement.

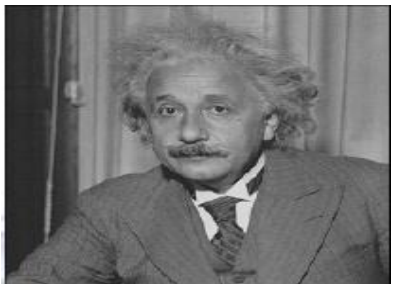

Fig.2. Input image

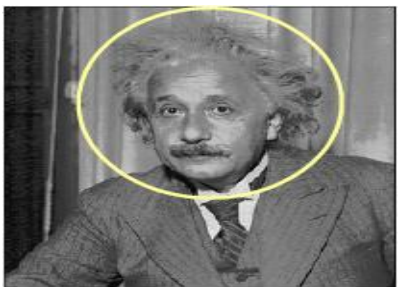

Fig.3. Output of AWMHE

This method is more suitable for gray scale images. But it is not suitable for color images which are produced by consumer electronic product.

C. Contextual and Variational Contrast Enhancement(CVC)

This technique enhances the contrast of image by using inter-pixel contextual information. It increase the image brightness by maintain the high contrast between object region [5]. To improve the overall image quality with clear details, this method increase both contrast and average brightness. Output image of this technique, which have mean brightness of the image value propositional to the original image.

It is not only improving the contrast also preserve the entire content of the image. But needs high computational time.

D. Recursive Sub-image Histogram Equalization(RSIHE)

This technique have multiple local median intensities to overcome the drawback of Dualistic Sub-image Histogram Equalization (DSIHE) [8].Instead of separating image once, it recursively separate the image several time to get multiple sub histograms.

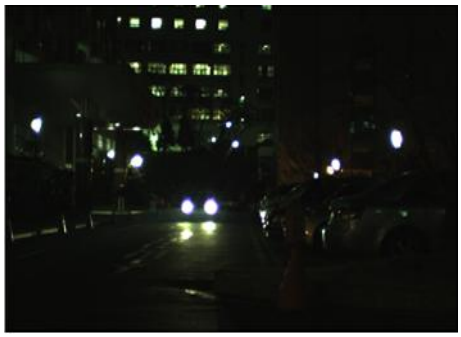

Fig. 4. Input image

Fig.5.output image RSIHE

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Then median based segmentation is performed several time [14].It perform multi-equalization to reduce the generation of unfavourable artifact. This method has a good contrast enhancement effect.

E. *Recursively Separated and Weighting Histogram Equalization(RSWHE)*

The vital idea of this method is to segment the histogram of input image into two or more Sub-histogram[7]. Modify the sub-histogram by using weighting process resting on normalized power law function.

It consist of three modules,

- Histogram Segmentation
- Histogram Weighting
- Histogram Equalization

In histogram segmentation, takes input image and calculate the input histogram. Then recursively divide histogram into two or more sub-histogram [9].

In histogram weighting, modify the sub-histogram using normalized power law function.

In histogram equalization, perform histogram equalization to all modified sub-histogram.

Output image produced by this technique have no severe effect also maintain mean brightness of the input image.

F .Gamma Correction

Gamma correction is a non-linear operation adjusting lightness or darkness of image[6]. Gamma is the term used to describe non-linearity of a display monitor.

According to the gamma value only image brightness can be adjust. Gamma value ranging from 0.0 to 10.0.

0.0 →Darker
1.0 →No change
10.0 →Lighter

Fig.7.Input image

Fig.7.Output image

If gamma value less then 1.0(<1.0), darken an image. Else if gamma value greater than 1.0(>1.0) , lighten an image. Else gamma value equal to 1(=1), produce no effect on image [11]. Gamma is applied only for display image not to the data of image. Monitor of identical gamma are used for any single image and as long as nothing further is done in the image, computationally.

G. Recursive Mean-separated Histogram Equalization(RMSHE)

This method recursively separate the input image histogram into multiple sub-histograms. Based on the mean brightness of the original histogram two sub-histogram are formed [3].

According to the mean brightness of the two sub-histogram used as the separating points for creating more sub-histogram.

This algorithm continuously executed until certain number of sub-histogram met. Then histogram equalization is applied individually to all sub-histogram.

If the sub-histogram is too large then no significant enhancement performed.

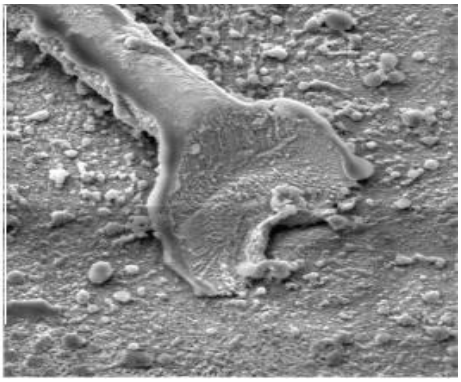

Fig.8. .Input image

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Fig.9. output image of RMSHE

H. *Minimum Mean Brightness Error Bi-Histogram Equalization(MMBEBHE)*

This method decompose the image into two sub-histogram according to the minimum mean brightness between input and output image[4].

Former methods are consider only minimum mean brightness of input image.

Than Perform classical histogram equalization process to equalize two sub images[12].This is extension of BBHE method.

It consist of three steps, which are

- Compute AMBE for each of threshold level.
- Find threshold level, that yield minimum MBE .
- Separate the image into two based on minimum MBE and equalized them independently.

It provides maximum brightness preservation. It provide good contrast enhance.

But they cause frustrating side effects based on variation of gray level distribution in histogram equalization.

It use separating point to produce small absolute mean error.

The output of this technique produces a method suitable for real world application.

III. PERFORMANCE ANALYSIS

This paper collected various contrast enhancement technique. In this section By using MATLAB TOOL, performance of various contrast enhancement technique have been specified below Table 1 based on AMBE and computational time.

TABLE 1

COMPARISON OF CONTRAST ENHANCEMENT TECHNIQUES

Enhancement Techniques	Advantage/Disadvantage	AMBE (Absolute Mean Brightness Error)	CPU time(sec)
DSIHE	Output image mean brightness is similar to input image/ cannot solve over-equalization effect problem.	**3.5019**	**1.5**
AWMHE	More suitable for gray scale images./ But it is not suitable for color images.	**2.0195**	0.22
CVC	Not only improve the contrast also preserve the entire content of the image. /But needs high computational time.	**1.0503**	**2.3**
RSIHE	Method has a good contrast enhancement effect /high time consumption because perform multi-equalization.	**2.8664**	**1.65**
RSWHE	Techniques have no severe effect output image also maintain mean brightness of the input image.	**4.1792**	**0.48**
Gamma correction	Gamma is applied only for display image not to the data of image/ Identical gamma are used for any single image and as long as nothing further is done in the image, computationally.	**1.2217**	**1.25**
RMSHE	Good enhancement if sub histogram is small /If sub histogram is too large than no significant enhancement performed.	**5.8611**	**1.7**
MMBEBHE	More suitable for gray scale images /but not for color images.	**6.1792**	**2.0**

IV. CONCLUSION

This paper discussed about various contrast enhancement techniques. These techniques are evaluated using MATLAB tool and results shown in TABLE I. Each technique gave the better result. The AWMHE technique and RSWHE are produces less computational time. CVC

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and gamma correction provides less Absolute Mean Brightness Error (AMBE). AWMHE and RSWHE techniques are produce the better performance for medical images.

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