Journal of Engineering and Applied Sciences 13 (18): 7578-7582, 2018
ISSN: 1816-949X

Contrast Enhancement Using Adaptive Gamma Correction with Histogram

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Abstract: There are many reasons cause bad contrast of image which demand many different ways to treatment, therefore, we classify the images into different categories based on the statistical information of specific images. The Adaptive Gamma Correction (AGC) is an active tool for contrast enhancement butfails to enhance the global bright images and the images with local bright regions. In this research, we suggested using (AGC) to enhance the contrast of the image byrelating the parameters of AGC with image histogram where pick point depending on the natural of image. This suggested method has been applied with many different images, the results of proposal method has been performed with high efficiency.

Key words: AGC, contrast, histogram, pick point, images, Iraq

INTRODUCTION

The digital image devices had been improved and digital images became one of the fundamental important ways to acquits information. Digital image uses in many applications where there is needed for contacting the working system. To realize the benefits available from the imaging technology applicationsis indispensable of computer image depending on image processing techniques (Jiang *et al*., 2015; Gonzalez and Woods, 2006). The principle aim from using the enhancement is to process the image and produce image better from the origin depending on the aim of which the image process for it (Saleh, 2010). The enhancement of image contrast is very important to improve the quality and digital image processing (Chiu *et al*., 2011).

In dimmed images, the enhancement techniques can be divided into 2 kinds: indirect enhancement methods and direct enhancement methods. The image contrast can be defined by a specific contrast term for direct methods. Some of these contrast measures cannot gauge contrast together in each simple style and complex images (Cheng and Xu, 2000; Tang *et al*., 2009). But in indirect enhancement methods the enhancement of image contrast by redistributing the probability density. In other words, redistributing of the image intensities into the dynamic range without a limited contrast term. The histogram adjustments are the most popular indirect techniques with dimmed image enhancement due to their easy and fast application (Wang *et al*., 2009).

Contrast: There are many possible ways for the contrast enhancement of images which are aimed at a specific application or designed for some purpose (Huang *et al*., 2013). Enhancement contents different objects of image correction such as sharpness, saturation, denoising, tonal balance, tonal adjustment and contrast correction enhancement. The techniques of contrast enhancement can be classified into three categories: global, local and hybrid techniques (Rahman *et al*., 2016). Histogram modification for framework of contrast enhancement reduces a cost function which includes the deviation of histogram from primary to uniform histograms, smoothness of histogram and white and black stretching. Its results of enhancement are rather sensitive to set the parameters. Also, the model of Gaussian mixture is proposed to the image intensity distribution model which is divided into several intervals (Celik and Tjahjadi, 2012).

The enhancement of image contrast is the basic condition in the many applications of image-based. The most choice of enhancement technique of imageis the histogram equalization method which is designed to change pixel intensity levels towards a specific distribution such that maximum view information can berestored. In general linear histogram is one of the most available methods it hasbeen the most popular method for its simple implementation and good performance (Jiang *et al*., 2015).

Gamma correction: Gamma correction is non-linear approaches, also, it is attractive methodfor better working that imposes a non-linear change of the image in tensity while histogram equalization has an ability to orientation the mean brightness of the image which has been processed to a some value (Gonzalez and Woods, 2006).

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In gamma correction for enhance the image can be determined from the image when the value of gamma is <1, the result image becomes lighter than the natural image and when the value of gamma is >1, the transformed image will be darker than the natural image. Can be describe the image contents with a number of properties in terms of frequency energy distribution, luminance and spatial orientation (Hassanpour and Asadi, 2011; Kaur and Singh, 2004).

MATERIALS AND METHODS

Proposal method: Many methods for modification image contrast have been developed for image enhancement in the image processing. There are two classes to distinguish contrast corrections: local and global corrections. With global contrast corrections it is difficult to adjust both highlight and lowlight detail. Instead, the advantage of the local contrast corrections is that it offers a method to determine one input value to different output values.

When the gamma value approaches from unity, we notice difference in the output and input intensity values. As gamma approaches infinity, the output pixels in image become darker while as gamma approaches zero, the pixels become brighter. Gamma correction carries out the inverse function of the exponential operation caused by defect in the display device. In this research applying equations of Adaptive Gamma Correction (AGC) as following:

$$I^{out} = \left(I^{new}\right)^{\gamma} \quad (1)$$

Where:

I^{out} = The out image

I^{new} = The image after shifting and scaling

$$I^{new} = \left(I^{in} - shift\right) * scale \quad (2)$$

$$Shift = I^{in}_{min} - 1 \text{ and } Scale = \frac{1}{I^{in}_{max} - I^{in}_{min}}$$

I^{in}_{min} and I^{in}_{min} is the minimum and maximum value for input image, respectively. Then, we can calculate gamma value from two equations as:

$$\gamma = \frac{k}{\overline{I_{in}}} \quad (3)$$

$$\gamma = 0.5 - \frac{k}{\overline{I_{in}}} \text{ or } \gamma = 1 - \frac{1}{\overline{I_{in}}} \quad (4)$$

where $\overline{I_{in}}$ is the mean of input image (Umbaugh, 1998; Hana'H *et al*., 2016):

$$Mean = \frac{1}{N^2}\sum_{i=1}^{N}\sum_{j=1}^{N} I_{in}(i,j)$$

$$Std = \frac{1}{N^2}\sum_{i=1}^{N}\sum_{j=1}^{N} I_{in}(i,j) - \left(Mean\right)^2$$

Algorithm 1:

1. Read input image I^{in}
2. Give the histogram of input image and choice arbitrary point (k)
3. Determine k from point in beginning of histogram
4. Calculate gamma value from Eq. 3
5. Read output image from Eq. 1
6. Repeat Determine k from point in the middle or last of histogram.
7. Read again output image from Eq. 1

Algorithm 2:

1. Read input image I^{in}
2. Remapping of image intensity
3. Calculate gamma value from Eq. 4
4. Read output image from Eq. 1

RESULTS AND DISCUSSION

In this research, many different images has been used applying adaptive gamma correction on them with two algorithms as above. From Fig. 1, Algorithm 1 was been applied depending on the histogram with taking k value from beginning, middle and the end of the histogram. The second algorithm was been applied on the same images depending on Eq. 4 and the results clear in Fig. 2. The comparison between the two algorithm exist in Table 1 and 2 according to contrast measurement.

Table 1: Contrast measurement C = Std/Mean for many different images

	Contrast measurement C = Std./Mean			
Images	Bad contrast	Gamma = k/mean (x)	Gamma = 1-1/mean (x)	Histogram equalization
Family	0.06870	0.0755	0.0910	0.0710
Couple	0.05120	0.0914	0.0921	0.0589
Race	0.04809	0.2221	0.4170	0.0745
X-ray	0.10960	0.1429	0.1075	0.1087
Satellite	0.04500	0.0598	0.0853	0.0532
Harbor	0.01650	0.0688	0.0403	0.0500
Lena	0.03270	0.1921	0.1312	0.1569

Table 2: Contrast measurement Std for many different images

	Contrast measurement Std.			
Images	Bad contrast	Gamma = k/mean (x)	Gamma = 0.5-1/mean (x)	Histogram equalization
Family	3.47	7.33	8.01	9.06
Couple	8.34	10.07	11.70	7.51
Race	10.17	11.56	12.61	9.52
X-ray	11.42	14.41	12.37	13.95
Satellite	1.07	6.16	7.27	6.76
Harbor	2.33	5.44	4.88	6.36
Lena	4.08	18.31	16.71	20.00

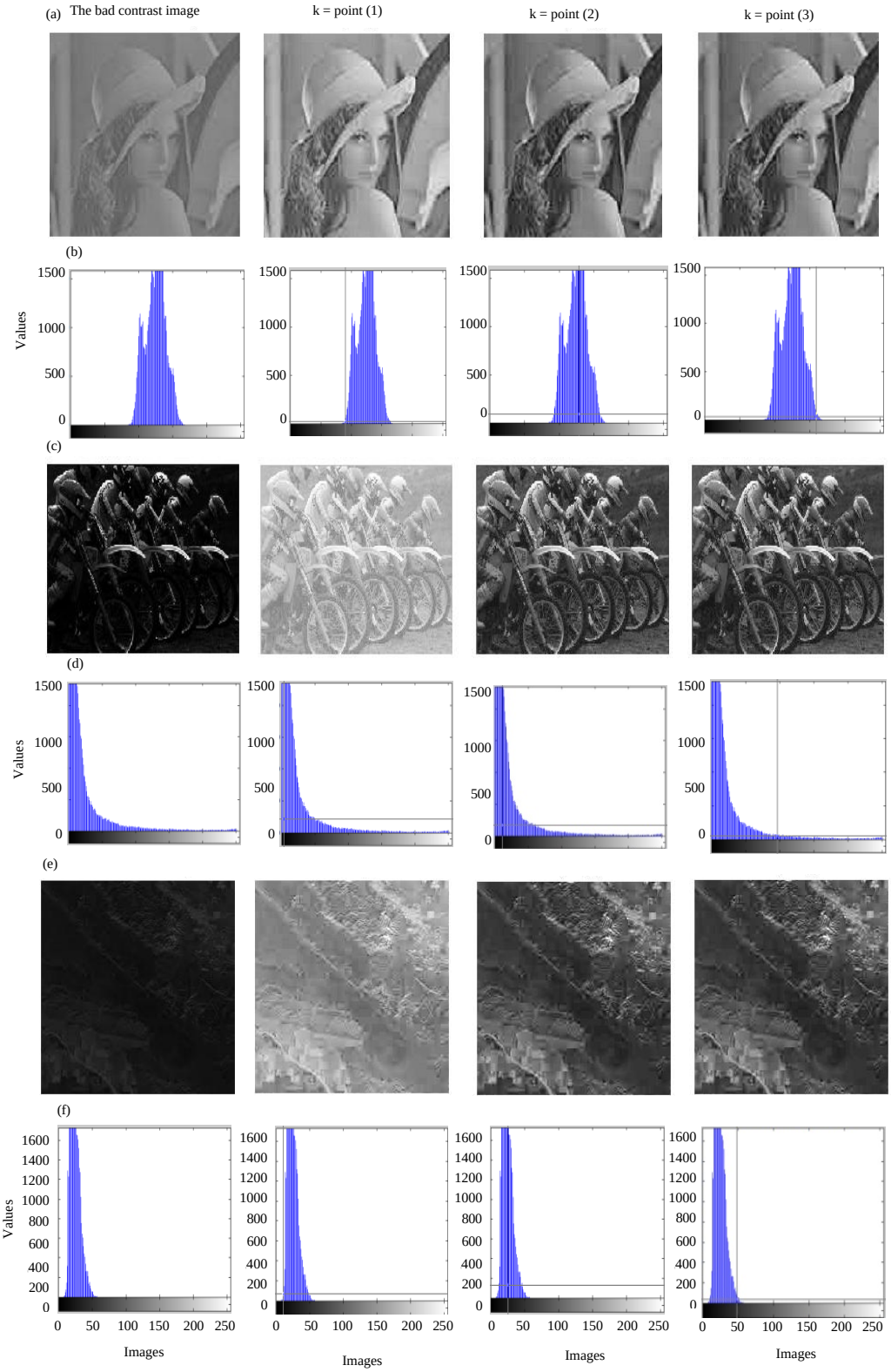

Fig. 1a-f): Applying proposed method (Adaptive Gamma Correction AGC) with different histogram picked point (k = point 1-3) (start, mid and end point, respectively) on different images (Lena, Race and satellite images)

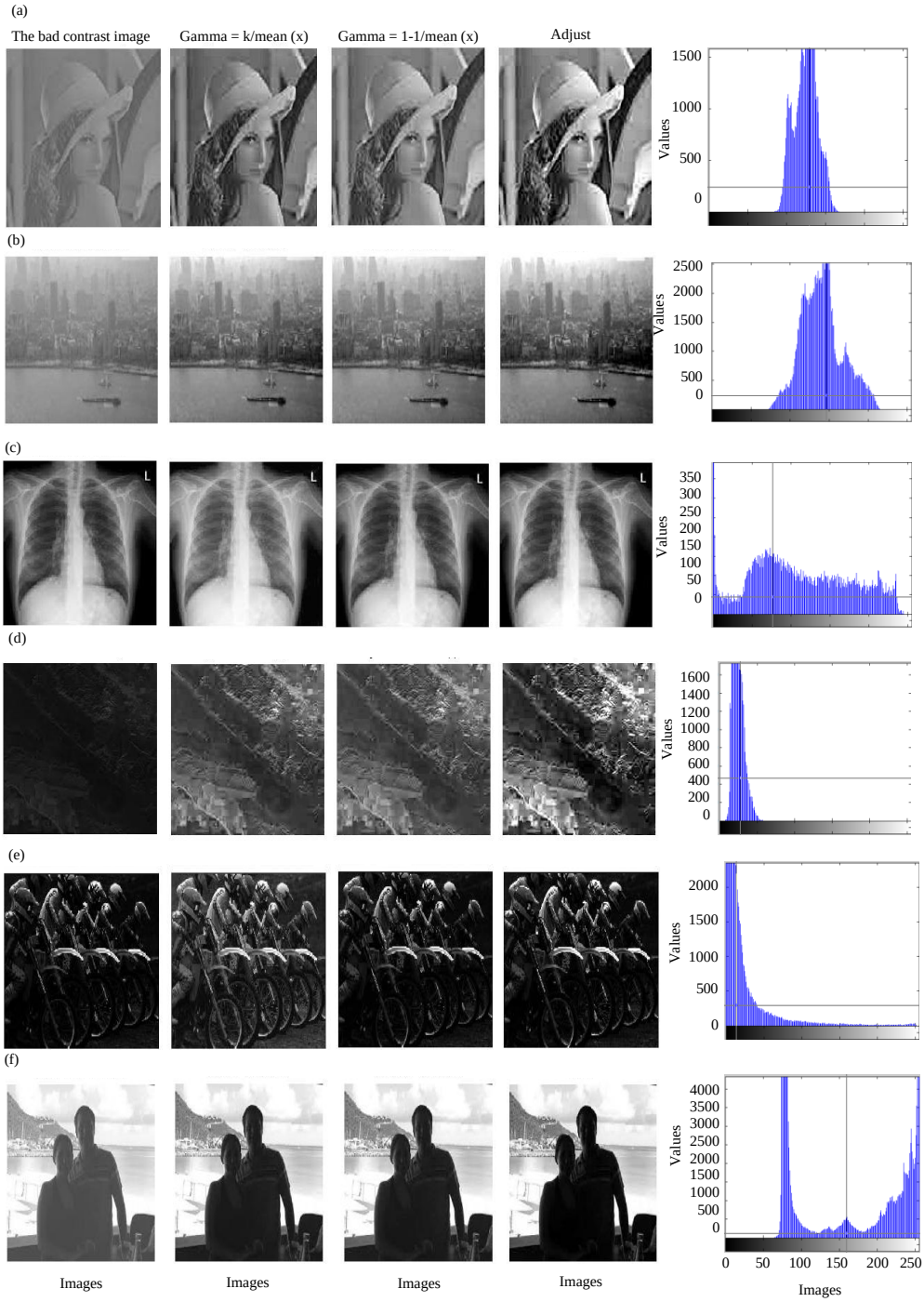

Fig. 2a-f): Performing proposed method (Adaptive Gamma Correction AGC) with two schemes {(gamma = k/mean (x)) and (gamma = 1-1/mean (x))} on different images and compare with other method (adjust method)

CONCLUSION

The adaptive method has proved to be effective in improving the bright, cloudy or light-colored images by using statistical variables for the image. This method has succeeded for various types of images including medical, space and ordinary images. The results showed that the best value at the middle of the histogram or corresponds to the greatest recurrence.

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