Journal of Scientific Research and Advances

Enhancement of Infrared Images using Histogram Equalization

H. I. Ashiba[1], H.M. Mansour [1], M.F. El-Kordy [2] and H.M.Ahmed [1]

Cite this article: J. Sci. Res. Adv. Vol. 2, No. 4, 2015, 151-153.

This paper presents a new approach for contrast enhancement of infrared images. This technique combines the benefits of Histogram Equalization image processing of infrared images. The idea behind this algorithm adjusts the contrast of infrared images as these images are dark naturally so result high enhancement by using histogram equalization. This algorithm usually increases the global contrast of many images, especially when the usable data of the image is represented by close contrast values. Through this adjustment, the intensities can be better distributed on the histogram. This allows for areas of lower local contrast to gain a higher contrast. Histogram equalization accomplishes this by effectively spreading out the most frequent intensity values. This approach is performed to get an infrared image with better visual details. Histogram equalization is a specific case of the more general class of histogram remapping methods. These methods seek to adjust the image to make it easier to improve visual quality.

ISSN 2395-0226

9 772395 022004

Introduction

The principal objective of enhancement is to process an image so that the result is more suitable than the original image for a specific application. Image enhancement is one of the most interesting and visually appealing areas of image processing. Image enhancement approaches fall into two broad categories, spatial domain methods and frequency domain methods. The term spatial domain refers to the image plane itself, and approaches in this category are based on direct manipulation of pixels in an image. Frequency domain processing techniques are based on modifying the Fourier transform of an image.

There is no general theory of image enhancement. When an image is processed for visual interpretation, the viewer is the ultimate judge of how well a particular method works. Visual evaluation of image quality is a highly subjective process, thus making the definition of a good image an elusive standard by which we evaluate the compare algorithm performance. When the problem is one of processing images for machine perception, the evaluation task is somewhat easier. The best image processing method would be the one yielding the best machine. In situations when a clear-cut criterion of performance can be imposed on the problem, a certain amount of trials and error usually is required before a particular image enhancement approach is selected**.**

The rest of the paper is organized as follows: section 2 explains Histograms Processing. Section 3 surveys the proposed enhancement algorithm. Section 4 gives the experimental results. Section 5 gives the concluding remarks. Finally, section 6 gives the acknowledgement.

Histograms processing

Histograms are the basis for numerous spatial domain processing techniques. Histogram manipulation can be used effectively for image enhancement [1-5]. Histograms also are quite useful in other image processing applications, such as image compression and segmentation. Histograms are simple to calculate in software and also lend themselves to economic hardware implementations, thus making them a popular tool for real-time image processing. A histogram uses a bar graph to profile the occurrences of each gray level present in an image. We conclude that an image, whose pixels tend to occupy the entire range of possible gray levels and, in addition, tend to be distributed uniformly, will have an appearance of high contrast and will exhibit a large variety of gray tones. The net effect will be an image that shows a great deal of gray-level details and has a large dynamic range.

The proposed approach

Histogram equalization is a common technique for enhancing the appearance of images [2]. Histogram equalization adjusts the contrast in an image by spreading its histogram. This often improves the appearance of an image. Equalization causes a histogram with a mountain grouped closely together to spread out into a flat or equalized histogram. Spreading the histogram makes the dark pixels appear darker and the light pixels appear lighter.

This process is then repeated at all grid points. At each pixel coordinate(j,k), the four histogram modified pixels obtained from the four overlapped mappings are combined by bilinear interpolation. The histogram equalization does not operate on the histogram itself. Rather, it uses the results of the image histogram to transform the original image into an image that will have an equalized histogram. The histogram equalization operation can be represented as follows [3-8].

$$(x, y) = f[c(x, y)] \qquad \textbf{(1)}$$

Where c is an image with a poor histogram, and f is the function that transforms the image c into an image b .The probability density function of a pixel value a is given by:

$$p_1(a) = \frac{1}{Areal} H_1(a) \qquad (2)$$

Where $p_1(a)$ is the probability of finding a pixel with the value a in the image. Area1 is the area or number of pixels in the image and $H_1(a)$ is the histogram of the image.

$$\mathrm{P1(a)} = \frac{1}{\mathrm{Area1}} \sum_{\mathrm{i=0}}^{\mathrm{a}} \mathrm{H1(a)} \qquad (3)$$

Equation 4.3 is the Cumulative-Density Function (CDF) for the pixel value a. The CDF is the sum of all the probability density functions up to the value a. So the desired histogram equalization function $f(a)$ simply takes the probability density function for the values in image b and multiplies this by the cumulative density function of the values in image c.

$$f(a) = \mathrm{Dm} \frac{1}{\mathrm{Area1}} \sum_{\mathrm{i=0}}^{\mathrm{a}} \mathrm{Hc(a)} \qquad (4)$$

Where $f(a)$ is the desired histogram equalization function, $Hc(a)$ is the histogram of the original image c (the image with the poor histogram). Dm is the number of gray levels in the new image b. $Dm = 1/p(a)$ for all pixel values.

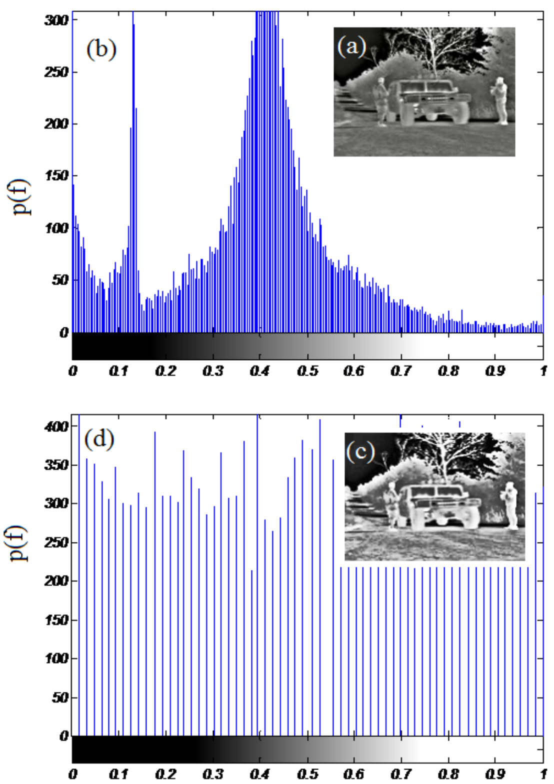

Fig. 1. Results of first experiment, (a) original truck image, (b) histogram of original image, (c) truck image after histogram equalization and histogram of equalized image (d).

Experimental results

In this section, two experiments are performed on two different infrared images to test the performance of the proposed enhancement algorithm.

The steps of the algorithm are performed on these two images. The results of the first experiment are shown in Fig. (1). Part (a) gives the original infrared image. Part (b) gives the histogram of the original infrared image. Part (c) gives the enhanced infrared image using the proposed algorithm (d) gives histogram of the enhanced image.

For the purpose of evaluation we use compare with histogram between both the original infrared image and the enhanced one as an assistance tool with the visual evaluation. It is clear the proposed enhancement algorithm has enhanced the visual quality of the processed image as well as its histogram.

A similar experiment is carried out on another infrared image and the results are given in Fig. (2). From these results, it's clear that the proposed approach has succeeded in the enhancement of the visual quality of that infrared image and more details have been obtained.

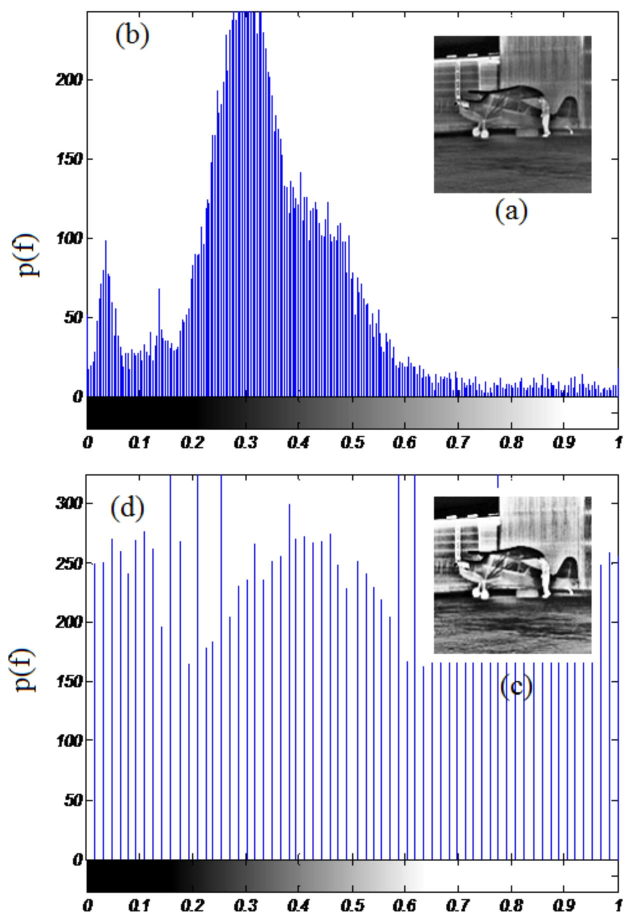

Fig. 2 Results of second experiment, (a) original plane image, (b) histogram of original image, (c) plane image after histogram equalization and histogram of equalized image (d).

Conclusion

The paper presents a new approach for infrared image enhancement .This approach Enhance contrast using histogram equalization by transforming the values in an intensity image. The results obtained using this algorithm reveals its ability to enhance infrared images.

Acknowledgement

ALLAH is the first and foremost, all praises and thanks. I want to thank all those who helped me by their knowledge and experience. I will always appreciate their efforts. I'm extremely grateful to Prof. H. M. Mansour for his valuable suggestions and support. I'm also grateful to Prof. M. F. El-Kordy, for his valuable discussions and support. I would like to thank Dr. H. M. Ahmed, for his supervision, continuous support and helpful discussions throughout this work.

Notes and References

[1]*Department of Electronics and Electrical Communications, Faculty of Shoubra Engineering*
Banha University, Egypt.
[2]*Department of Electronics and Electrical Engineering, Faculty of Electronic Engineering*
Menoufia University, Menouf, 32952, Egypt
Email: eng_h_2006@yahoo.com

[1] Z. H. Long, "Image Fusion Using Wavelet Transform," in Proc. The Symposium on Geospatial Theory, Processing and Applications, 2002.
[2] D. Darian and T. W. Parks, " Adaptively Quadratic (Aqua) Image Interpolation", IEEE Trans. Image Processing, vol. 13, No.5, pp. 690-698, 2004.
[3] J. Vesma, "A Frequency-Domain Approach to Polynomial-Based Interpolation and the Farrow Structure," IEEE Trans. Circuits and Systems--II, vol. 47, No.3, pp. 206-209, 2000.
[4] A. Munoz, T. Blu and M. Unser, " Least-Squares Image Resizing Using Finite Differences," IEEE Trans. Image Processing, vol. 10, No.9, pp. 1365-1378, 2001.
[5] B. Zitova and J. Flusser, "Image Registration Methods: A Survey," Image and Vision Computing, vol. 21, pp. 977-1000, 2003.
[6] R.C. Gonzalez and R.E. Woods. *Digital Image Processing*. Prentice Hall, Upper Saddle River, New Jersey, EUA, 3nd edition, 2008.
[7] K.-Q. Huang , Z.-Y. Wu, and Q. Wang, "Image enhancement based on the statistics of visual representation." Image and Vision Computing, vol. 23, pp. 51–57, 2005.
[8] N. Mikko, R. Halonen, T. Leisti, and P. Oittinen, "Reduced reference quality metrics for measuring the image quality of digitally printed natural images." In *Proc. SPIE*, vol. 7529, p. 75290I. 2010.