Indian Journal of Science and Technology, Vol 9(32), DOI: 10.17485/ijst/2016/v9i32/80562, August 2016
ISSN (Print) : 0974-6846
ISSN (Online) : 0974-5645

Implementation of Plateau Histogram Equalization Technique on Thermal Images

D. Bhavana[1*], V. Rajesh[1] and K. Kishore Kumar[2]

[1]Department of ECE, KL University, Guntur - 522502, Andhra Pradesh, India;
bhavanaece@kluniversity.in, rajesh71@kluniversity.in
[2]Department of Mechanical Engineering, KL University, Guntur - 522502, Andhra Pradesh, India

Abstract

Background/Objectives: Contrast enhancement is an important stage in uncooled thermal images as uncooled thermal images are low-contrast images. Histogram equalization is the widely used technique for contrast enhancement of images. **Methods/Statistical Analysis:** The proposed method for contrast enhancement is based on plateau histogram equalisation. It preserves all the benefits of classical histogram equalisation but does not extend the contrast of background enormously[24]. Plateau histogram equalization technique is one of the contrast enhancement techniques where the pels count is limited to an inception value defined based on histogram properties. **Findings:** In comparing the results of proposed contrast enhancement system, the image has been significantly enhanced without enhancing the background gray levels and the noise and thereby increasing the brightness preservation and harvested a more natural enhancement. **Applications/ Improvements:** The proposed technique on thermal images provides a good enhancement, which is difficult to achieve with traditional Histogram equalization technique on thermal images. The proposed algorithm is tested on raw images, gain corrected images, and Gain and Offset corrected images and achieved satisfactory results.

Keywords: Contrast Enhancement, Histogram Equalization, Low-contrast images, Plateau Histogram Equalization, Thermal Images

1. Introduction

A digital image is stored in a computer in the pattern of a two dimensional array of pixels or picture elements of an image[1]. Thermal imaging system (thermography) is a non-invasive imaging idea used to report the thermal impression using Infrared (IR) camera[2]. Conventionally infrared imaging system, also called as FLIR, refers to such equipment as thermo optics, which capture two dimensional infrared radiation images with opto- mechanic sweeping and quantum locator. Basically, it was a a non-real time auto-temperature disposing recorder[3]. Thermal imaging is a process of getting infrared radiation from a particular surface above zero degrees centigrade and converts that energy into thermal pattern**.** This Thermal Imaging is a non-influence sampling and these images are unique for each object[4].

1.1 Night vision Equipment

Low light night vision image equipment's show an important aspect for military and civilian application. Night vision images are blurred and clouded because the interval is small, the contrast is subsided and the gray value range is cramped. In this way, it is critical to upgrade picture and enhance its vision quality. Upgrade strategy is an accessibly and efficient technique which can enhance vision quality and recognize focus from complex low-light-level picture.

1.2 Contrast Enhancement

Contrast of an image is dictated by its dynamic range, which is characterized as the degree between the brightest and the darkest pixel intensities. In image processing, contrast enhancement plays a vital role. It is widely used for medical image processing and as a preprocessing

*Author for correspondence

step[6]. The difference in brightness reflectance from two neighboring surfaces is simply called as contrast. In our visual perception, contrast is determined by difference in the color and illumination of an object with otherobjects[7]. If the contrast of a picture is extremely targeting a selected vary, the data could also be lost in those area unit as that are overly and uniformly targeted. the matter is to reinforce the distinction of a picture so as to represent all the data within the input image. Brightness conserving ways area unit in terribly high demand to the buyer electronic product[7].

1.2.1 Histogram Equalization

Histogram Equalisation (HE) is an extremely well known strategy for improving contrast of a picture. Its fundamental thought lies on mapping the dark levels in view of the likelihood circulation of the info dim levels. It smoothens and extends the progression scope of the picture's histogram and bringing about general difference change. The change in this manner changes over the histogram of the first variable into the reference histogram, i.e., it adjusts the histogram[8]. HE has been connected in different fields, for example, medicinal picture handling and radar picture preparing. For the region with low-dark recurrence, complexity will be debilitated in addition. That is to say commotion might be amplified. In this manner, if histogram adjustment is straightforwardly used to improve lowlight level night vision picture, the foundation dim levels and clamor will be reinforced. In actuality, target dim levels will be needed. It might improve foundation and commotion and diminish the objective and points of interest complexity. Likewise the customary HE technique experiences offensive visual antiquities, for example, over upgrade, level immersion (precis) and increment in the commotion level, significantly change in character of a picture. So conventional histogram equalization calculation is not appropriate for night vision picture. In principle, it can be demonstrated that the splendor of the histogram-evened out picture is dependably the center dim level paying little heed to the info mean. This is not an fetching property in a few applications where illumination preservation is significant[10].

2. Algorithm Implementation

Contrast enhancement is fundamental stage in analysed calculation. Contrast improvement is an essential stage in IR pictures as IR pictures are low contrast pictures. Best and most often utilized technique for contrast improvement is histogram equalization. Histogram equalisation is a successful strategy for visual pictures. Be that as it may, when we move to IR pictures, it enhances the complexity of foundation as opposed to the item. The proposed technique for complexity improvement depends on level histogram equalisation. It saves all the benefits of clasical histogram equalization however does not restore the background contrast enormously. In this calculation we characterize level edge, which is gotten in view of histogram properties. This upgrading procedure is appropriate for IR pictures and it requires quit constrained processing power. The initial phase in this calculation is figuring histogram building. Once the histogram building has acquired, the edge worth is resolved .The consequences of complexity upgrade for IR pictures is enormously influenced by the best possible decision of limit quality. Edge worth depends on neighborhood greatest qualities for a given picture histogram. Brief histogram is acquired in light of non-zero estimations of shine capacity as it were. Nearby most extreme qualities are looked from brief histogram information set. The following stride is to compute middle from all the neighborhood most extreme estimations of brief histogram. The computed middle quality is adjusted off to the closest whole number, which is considered as the last edge esteem. Pixel mean each given dim level g (k) is tried by taking after connection:

$H_T(k) = \{g(k)\ g(k) \le T$

$T \quad g(k) > T \quad \rightarrow \quad 1$

Where k is the gray level and assumes the following values: $0 \le k \le 255$.

If the pixel count k is smaller than the threshold value, the gray level remains unchanged. But if the pixel count is greater than the threshold value, the pixel count is limited to threshold value. New gray level values of pixel count are represented by $H_T(k)$. The final contrast enhanced thermal image is described by $I_T(k)$ which includes a set of pixel counts for gray levels.

$$I_T(\mathbf{k}) = \left[\frac{E_T(\mathbf{k})}{E_T}\right] \qquad 2$$

Algorithm:

1. Start.
2. Obtain the image from an object through the optical lens of a thermal imager.
3. Consider the same image in matrix form which is having different pixel values.

4. Arrange all the pixel values of the image in ascending scheme.

5. Then generate histogram building.

6. Calculate the Median for histogram values and round of to the nearest integer value and say it as threshold value.

7. If the pixel mean a given faint level k is more noticeable than edge regard, then the pixel number is limited to the edge regard, for the most part the pixel mean a given faint level k stays unaltered.

8. Perform EXOR operation of corresponding two histogram values and say that values as Cumulative Distribution Function (CDF).

9. Calculate histogram equalization value for every pixel by using the formula:

Histogram equalization= [(CDF value)/ entire number of pixels)]*[(Number of output precise)]. This technique is called Plateau Histogram equalization.

10. End.

3. Results and Discussion

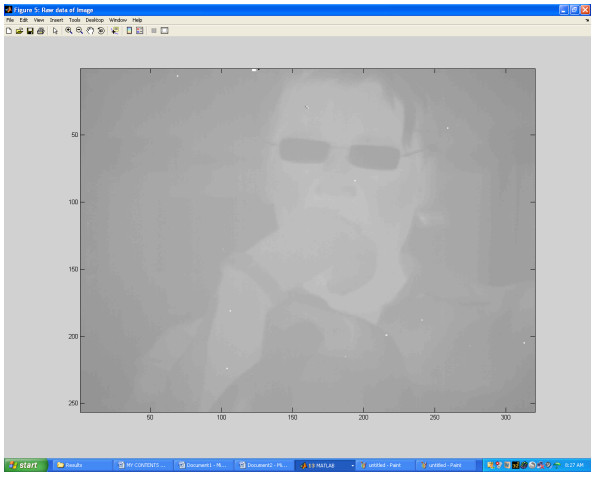

Figure 1. Raw data of an image.

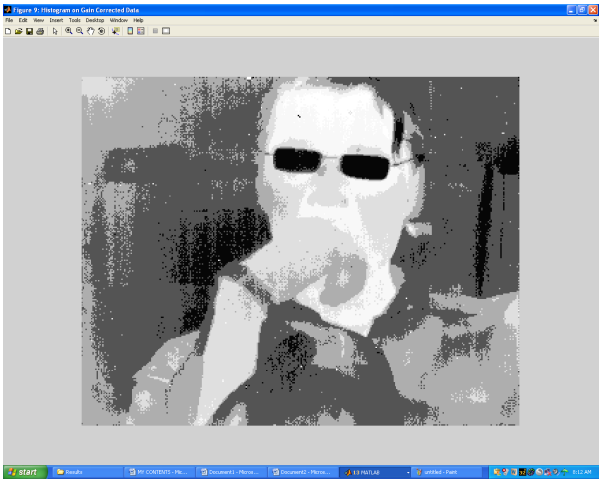

Figure 2. Histogram on gain corrected data.

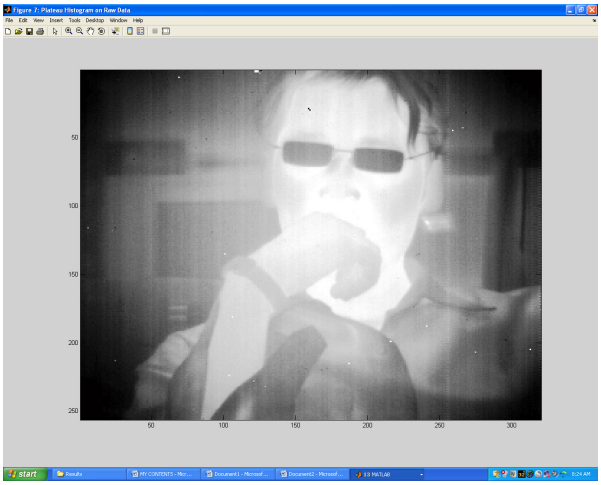

Figure 5. Plateau histogram on raw data.

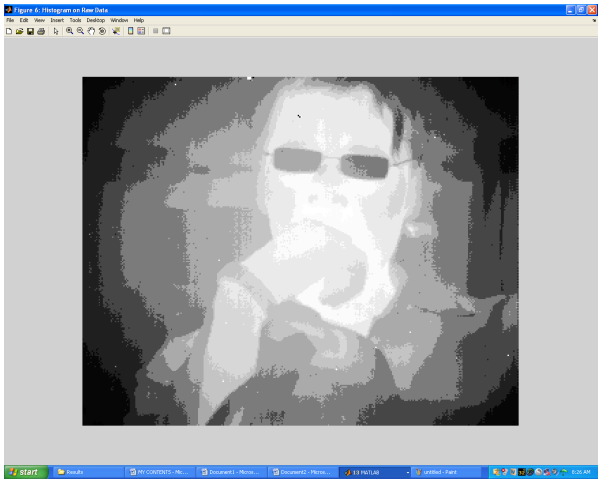

Figure 3. Histogram on raw data.

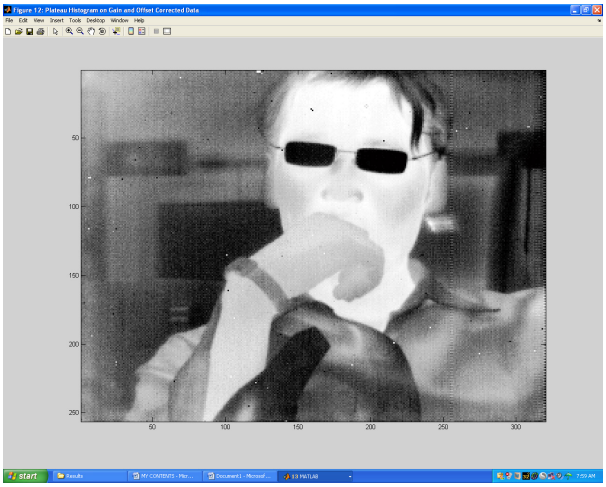

Figure 6. Plateau Histogram on gain and offset corrected data.

In this section we report the performance of Plateau Histogram equalization on raw images, Gain corrected images, Gain and Offset corrected images. Also the performance of Histogram equalization and Plateau Histogram equalization on the same image are compared. In comparing the results of proposed contrast enhancement system, the image has been significantly enhanced without enhancing the background gray levels and the noise and thereby increasing the brightness preservation and yielded a more natural enhancement. We should note that Plateau Histogram equalization on Gain and Offset corrected images is more effective than on raw images. However only non-uniformity correction is not sufficient to say an image is enhanced effectively. So, Plateau Histogram equalization on non-uniformity corrected image is used to enhance the contrast of an image in order to represent all the information in the input image.

4. Conclusion

In this paper a new contrast enhancement algorithm referred to as Plateau Histogram equalization on uncooled Thermal images is proposed. The proposed technique on uncooled thermal images provides a good enhancement, which is difficult to achieve with traditional Histogram equalization technique on thermal images. The proposed algorithm is tested on raw images, gain corrected images, Gain and Offset corrected images and achieved satisfactory results.

5. References

1. SairaBanu J, Babu R, Pandey R. Parallel Implementation of Singular Value Decomposition (SVD) in Image Compression using Open Mp and Sparse Matrix Representation. Indian Journal of Science and Technology. 8(13):1–10.
2. Tan J-H, Ng EYK, Rajendra Acharya U. Chee C. Infrared thermography on ocular surface temperature. Infrared Physics and Technology Articles. 2009; 52(4):97–108.
3. Weili Z, Danyu C. Research and applications of infrared thermal imaging systems suitable for developing countries. International Journal of Infrared and Millimeter Waves. 1986; 7(1):65–70.
4. Bhavana D, Rajesh V, Ravi Tej D, Sankara sarma CV, Swaroopa RVSJ. Scene based two-point non-uniformity correction of thermal images. International Journal Engineering and technology. 2013; 5(2):1748–54.
5. Pizer SM. The medical image display and analysis group at the University of North Carolina: Reminiscences and philosophy. IEEE Transactions on Medical Imaging. 2003; 22(1):2–10.
6. Pei SC, Zeng YC, Chang CH. Virtual restoration of ancient Chinese paintings using color contrast enhancement and lacuna texture synthesis. IEEE Transactions on Image Processing. 2004; 13(3):416–29.
7. Raju A, Dwarakish GS, Venkat Reddy D. Comparative Analysis of Histogram Equalization based Techniques for Contrast Enhancement and Brightness Preserving. International Journal of Signal Processing, Image Processing and Pattern Recognition. 2013; 6(2):353–66.
8. Torre A, Peinado AM, Segura JC, Perez-Cordoba JL, Benitez MC, Rubio AJ. Histogram equalization of speech representation for robust speech recognition. IEEE Transactions on Speech Audio Processing. 2005; 13(3):355–66.
9. Wang Q, Ward RK. Fast Image/Video Contrast Enhancement Based on Weighted Threshold Histogram Equalization. IEEE Transactions on consumer Electronics. 2007; 53(2):757–64.
10. Chen SD, Ramli AR. Contrast Enhancement using Recursive Mean-Separate Histogram Equalization for Scalable Brightness Preservation. IEEE Transactions on consumer Electronics. 2003; 49(4):1301–309.