A Contrast Enhancement Method using a Transfer Function of the Local Histograms

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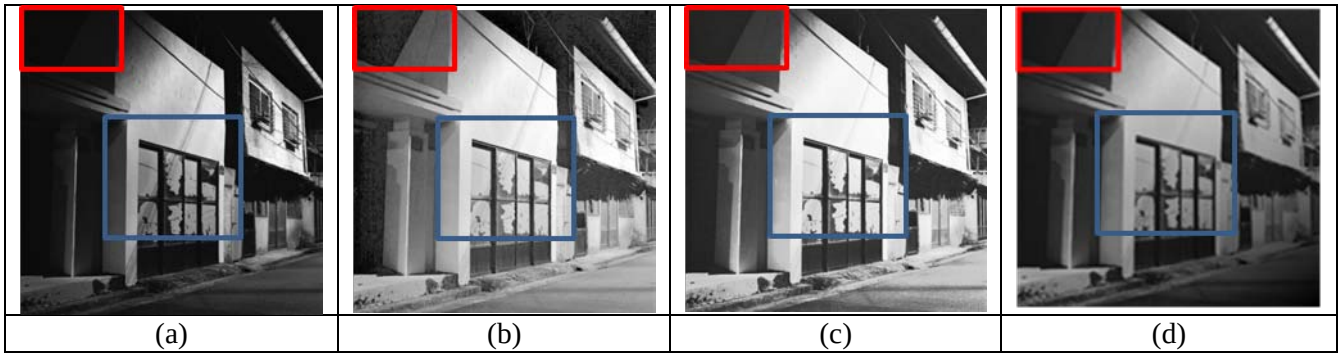
Contrast enhancement is an important step in digital image processing when visual perception of information is limited by small differences in gray levels in the image[1]. Histogram Equalization(HE) method based contrast enhancement is still widely used. This method has side-effects such as washed out apperance and false contouring due to the signigicant change in brightness. To solve these problems, many algorithms have been proposed. Among them, DRSHE(Dynamic Range Separate Histogram Equalization) provides better performance than others due to preventing excessive dynamic range compression[2].

In this paper, a histogram extension for each sub-image based on DRSHE was locally applied. The proposed algorithm generates sub-images, by dividing the width and height of the original image into n pieces. After that, Transfer Function (TF) corresponding to each sub-image is generated using DRSHE. The TF is calculated by the following procedures: Firstly, the dynamic range of the histogram is separated into k level. Secondly, Cumulative Distribution Function, CDF(X_k) of each histogram is used to compute the gain and offset. Finally, TF is calculated with gain and offset data simply. And then, we can achieve enhanced image by applying a weight to the each TF value of the sub-image.



(a) (b) (c) (d)

Fig. 1. Experimental results : (a) Input image (b) HE (c) DRSHE (d) Proposed algorithm

In order to demonstrate the performance of the proposed algorithm, we have simulated several images with HE, DRSHE and the proposed algorithm. Fig. 1(b) shows the side effects including washed-out appearance in overall image. Fig. 1(c) and (d) show that DRSHE and proposed algorihm preserve the naturalness of image and prevent excessive contrast enhancement. But, DRSHE still results in washed-out appearane without electric wire shadow in the blue box. The red boxes of experimental results show that the image of proposed algorithm is most similar to input image without excessive contrast enhancement. Besides, due to improvement of appropriate contrast enhancement, object and background are quite distinct from each other without washed-out appearance. Therefore, the proposed algorithm shows visually natural output image.

References

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