

# A Technique for Enhancement of Gray Image using Local Gamma Correction

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## ABSTRACT

Image enhancement is used to improve the visual effects and the clarity of image or to make the original image more beneficial for computer to process. Uneven illumination always affects image quality serious in practice. To weaken illumination effect on image quality, local gamma correction with adaptive threshold is used to improve the visual appearance of the image or to provide better transform representation for future automated image processing. In proposed method, whole image has been divided into two levels having low and high contrast values and low contrast regions are enhanced by large gamma values and high contrast regions are enhanced by low gamma value. Therefore gamma correction has been applied locally on separate regions. Results are measured by finding mean, standard deviation, average gradient and entropy values and are compared with existed techniques.

## Keywords

uneven illumination, image enhancement, local Gamma correction, adaptive thresholding

## 1. INTRODUCTION

The uneven luminance is one of the factor which directly reducing the appearance of an image on many computer vision system which often leads to diminish structures or in all the same intensities of the image due to different touch of the object surface, lack of experience and shadows cast from different light source directions[1].

### 1.1 Need of Contrast Enhancement

During poor illumination conditions, the image appears darker. Uneven contrast always affects visual quality in the image which results in poor understanding about the content of the image. Image enhancement is the process of making images more useful. Removing noise from images and smooth the image[4].

There are the various image enhancement algorithm is used to obtain the useful information of digital image. It can be a unclear process in order to improve the visual effects of the given image. The processing is for a specific purpose and is different for different applications. So that the processed image may be very different with the original image in the visual effects, but it also may be similar to the original image [20]. It will be a developing trend to integrate the advantages of various algorithms to practical application to image enhancements [21]. In this process provide brief description of the existed image enhancement algorithms such as median filtering, average smoothing, homo-morphed filtering, histogram equalization and gamma correction by using three-

level thresholding and then propose a new method which use pyramid blending of gamma correction method and global mean and global variance calculation[1]. The homomorphic filtering technique is widely used in illumination compensation, contrast enhancement, image restoration, gray-level correction and many other image processing systems. The median filtering, average smoothing and histogram equalization are also frequently used in image processing field [2,3].

Uneven illumination is common problem therefore to attack this problem various techniques have been proposed by different research scholars such as histogram equalization, homomorphic filtering, color constancy method, median filtering color space transformation, and image gamma correction etc. Due to technical limitation, many imaging devices may not display the actual appearance of objects [5]. Although nearly all image enhancement methods can effectively improve the perception of information for human viewer, however, these proposed methods have their own limit in weakening the effect of uneven illumination. They still have some deficiencies to give perfect image to viewer such as loss of local contrast and the loss of details. For color constancy set up, a reasonable illumination model is always unworkable in many cases. For color space transformation, the absolute separation between chrominance components and luminance components is not achievable due to the correlation of color channels [19].

These enhancement operations are performed in order to alter the image brightness, contrast or the distribution of the grey levels. The result pixel intensities of the output image will be modified according to the transformation function applied on the input values. Image enhancement is applied in every field where images are ought to be understood and analysed. For example, medical image analysis, analysis of images from satellites etc [21].

### 1.2 Gamma Correction

The Gamma correction is based on a non-linear multiplication-based conversion and it overcomes the effect of light. It define the relationship between a pixel's numerical value and its actual luminance. That has been used to gray-value image analysis. For alternating the pixel value to enhance the image, the projection relationship between pixel value and Gamma value is established according to the internal map.

The principle is, Suppose the data value of the original image is  $L_{org}$ , before send  $L_{org}$  to the CRT display, substitute  $L_{org}$  in Equation.

$$L_{in} = L_{org}^{1/\Gamma} \dots \dots \dots (1)$$

And then send the pre-compensation image data  $L_{in}$  to the CRT display with distortion. After arrangement, the relationship between output  $L_{out}$  and input value  $L_{org}$  of the distortion CRT is:

$$L_{out} = L_{in}^{\gamma} = ((L_{org}^{1/\gamma})^{\gamma}) = L_{org} \dots \dots \dots (2)$$

As Equation (2) shows, the input of CRT generates Gamma reverse distortion contrasting the original image before hand, which counteracts the Gamma hardware of display device. Therefore, a linear relationship is established between the output of display device and the original data of the image to achieving the Gamma correction on the CRT.

## 2. EXISTING TECHNIQUES

There is a number of technique which are available in it. Histogram equalization can improve the contrast of the image but the area appeared too bright enhancement and used for contrast enhancement in a variety of application due to its simple function and effectiveness [9]. Histogram indicates that most of the pixels are too dark only the minority of pixel are light. This technique work by flattening the histogram and stretching the dynamic range of the grey level by using the cumulative density function of the image. There is a still one problem of the histogram equalization is that brightness of an image is changed after the histogram equalization, hence not suitable for consumer electronic products, where preserving the original brightness and enhancing contrast are essential to avoid annoying artefacts' [4,15].

Homomorphic filtering is a techniques is a frequency domain operation applied on low contrast images .the homomorphic filtering used high pass filter .high pass filter is remove the low frequency components. After that the image becomes enhanced.which are mostly used improve the image uneven illumination and the details of the department where can't be reflected [3].

Average smoothing can be used to reduce the image noise and suppress the noise. This technique used to deal with transitions in the image pixel value of the images. This is the basic form of image smoothing. In this technique the neighborhood pixel is equal, the general subjective model make point (x, y) as the center, the  $3 \times 3$  neighborhood of the point are involved to determine the new image (x, y) points pixel value, and the coefficient is 1. Apart from this such as to process Gaussian smoothing template can be used[20,21].

A great deal of work has been devoted to diminish the effect of uneven illumination on images, such as colour constancy method [1-2], colour space transformation [3], homomorphic filtering [4], histogram equalization (HE) [5-6] and image Gamma correction. Compared to the above methods, Gamma correction method has some advantages to overcome the effects of light.

Gamma correction is luminance based non-linearity introduced by imaging device can often describes with simple point-wise operation called gamma correction. Luminance is the area of light. They measure the luminance intensities per unit area of light traveling in a given direction .It describes the amount of light that passes through or it emitted from particular area[6,8]. Gamma correction method has a number of advantages to overcome the effect of light. Gamma correction controls the over all brightness of an image [11]. The Gamma correction is based on a non-linear multiplication-based conversion and has been used to gray-value image analysis. A proper estimation of gamma value enhances the contrast of the image.

For neighbourhood pixel value to enhance the image, the ridge correlation between pixel value and Gamma value is recognized according to the internal map [15].After applying technique to overcome the problem of bleaching of the images. For this purpose use the thresholds for each colour spectrum of the image [17]. So that bleaching in images is avoided and information is retained in the enhanced images as same as parts of the image in the original which does not require any enhancement [22].

## 3. PRESENT ALGORITHMS

A presented method which used local gamma correction having two gamma values in which low value gamma correction is applied to high contrast regions and high gamma value applied to low contrast regions. It is different from three level thresholds as three level threshold divide the entire image into three different levels such as light, dark, brighter according to gray scale levels and then applied the gamma correction on that region differently. The present algorithm separates the two regions using luminance based quantization method. The algorithm works well in low contrast regions captured in natural light and also on indoor images where there is problem of bad lightening conditions. Following are the main steps involved in the present algorithm.

1. Find unique colors in the image by making 3 column matrix containing RGB values.
2. Sort the matrix according to column one containing red component in descending order.
3. Use a threshold value and crop the sorted matrix according to given threshold value.
4. Approximate the whole image according to the colors chosen.
5. The whole image has been approximated to all colors.
6. Separate low contrast and high contrast pixels.
7. Apply gamma correction to low contrast pixels using high gamma and high contrast pixel using low gamma value.
8. Show resulted output image and low and high contrast regions separately.
9. Calculate Mean, standard deviation, Average gradient and entropy for the resulted image and compare with basic gamma correction.

## 4. EXPERIMENT RESULTS AND DISCUSSION

To verify the efficiency of the method, in the present paper uses color image and gray level image to demonstrate the effect of the method. Figure 1 shows gray image enhancement results.(a) shows original image,(b) shows traditional Gamma correction,(c) shows the proposed approach. The images acquired under uneven illumination conditions generally have different tones, so the image can be divided into different contrast regions and that parts should be enhanced respectively with different value. The algorithm tested on number of images but here we explain the results for one image only taken inside of a house.



Figure 1 (a) Original image from inside a house.

As we have seen in figure 1, the image has very low contrast in most of the region. Below are the results for the image use threshold value.



Figure 1(b) Output image after traditional gamma correction.

In the traditional Gamma correction algorithm improve the low contrast images. First, the three-level thresholding is used to segment the image based on maximum fuzzy entropy. The two thresholds name  $t_1$  and  $t_2$ . They make it possible to segment the image into three gray levels (dark, medium tone, and bright). Then, to reduce the illumination, local Gamma correction is applied to the three levels respectively.



Figure 1 (c) Proposed approach

The proposed approach shows the result where low contrast regions increase and high contrast regions decreases. So that the algorithm works, where low contrast regions with high gamma value and high contrast regions with low gamma value with fixed thresholds to improve the visual quality of digital images that captured under insufficient lighting conditions.

Table 1. Showing mean, standard deviation, average gradient and entropy for image 1 (T=10)

Technique	Mean	Std	Av. Grad.	Entropy
Gamma Correction	1.0294	51.792	0.0003	0.0483
Presented Algorithm	34.578	27.583	0.0063	0.0562

The table 1 shows the result of the proposed method will be compared with the traditional method on the basis of performance metrics. An mean is function can be used to evaluate the image contrast. Over the region what is the contrast value after the reconstruction of image. Average gradient can express the ability of small details. Can be used to evaluate the clarity of the image, the greater its value, the more clear that the image. An entropy is function can be used to measure how much information is contained in data set, its value greater means that richer of the information contained and better the image quality.

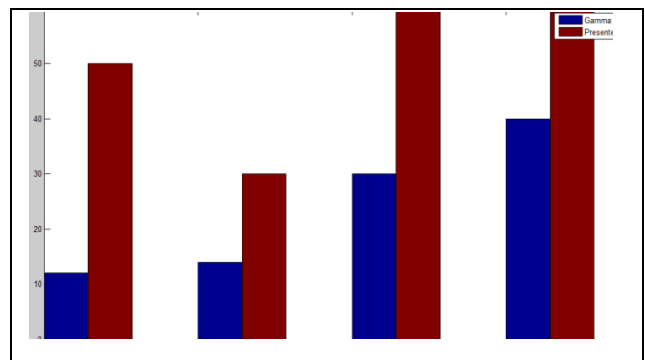


Figure 2. Bar graph of image 1

## 5. CONCLUSION

In the present method can decrease the loss of local contrast in local regions by applying high value gamma correction to that portion. The ultimate goal behind the proposed method is to allow higher level of brightness preservation to avoid un pleasant artifacts and unnatural enhancement due to excessive equalization while enhancing the contrast of a given image as much as possible.

## 6. FUTURE SCOPE

The present method uses RGB image as input and resulted output comes in gray scale. In future algorithm can develop in order to use it as color image output.

## 7. REFERENCES

- [1] Stark J L, Murtagh F, Candies J, et. al, Present a method “Gray and colour image contrast enhancement by the curve let transform”, in Image Processing, with IEEE Transactions on, vol.12,No.6, 2003, pp. 706-717
- [2] Perona P, Malik J, Present a “Scale-space and edge detection using an isotropic diffusion” in Image Processing, with IEEE Transaction in 1990, 12(7):629-639.

- [3] Vijay A. Kotkar Sanjay.S Gharde, Proposed a “Review of various image contrast enhancement techniques” in Image Processing, International Journal of Innovative Research in Science, Engineering and Technology Vol. 2, Issue 7, July 2013.
- [4] V.Vanathe, Boopathy,Manikandan, Present a method “MR Image Demising and Enhancing using Multi-solution Image Decomposition Technique”, in Image Processing and Pattern Recognition, International Conference on Signal Processing [ICSIPRI] in 2013.
- [5] Zheng Zhang Yanping Wang, Present a method “Digital image processing and machine vision: implement of Visual c++ and Mat lab” The People's Posts and Telecommunications Press, 2010
- [6] Zia-Urrahman,Daniel.J Jobson and Glenn A.Woodell, Present algorithm "Retinex processing for automatic image enhancement", in J. Electron. Imaging 13,100 (2004); doi:10.1117/1.1636183
- [7] Znhal O.Munhanda V .K,S.Shandilya”, Image Enhancement using a Combined Approach of Spatial and Transformation Domain Techniques” in International Journal of Emerging Research in Management &Technology in 2012.
- [8] Menotti D, Najman L, Facon J, et al., present approach “Multi-histogram equalization methods for contrast enhancement and brightness preserving”, in Consumer Electronics, IEEE Transactions on, vol. 53(3), 2007, pp. 1186-1194.
- [9] Kong N S P, Ibrahim H, Present a method “Color image enhancement using brightness preserving dynamic histogram equalization”, Consumer Electronics, in IEEE Transactions on, vol. 54, No.4, 2008, pp. 1962-1968.
- [10] H.Farid,Blin,,. Present a method “Inverse Gamma Correction”, in IEEE Transaction on Image Processing, vol. 10, No.2, 2001, pp.1428-1433.
- [11] Guan X,Jian S Hongda P, et. al, Proposes a approach “An Image Enhancement Method Based on Gamma Correction”,Proc. IEEE Second International Symposium on Computational Intelligence and Design 2009, pp.60-63,doi:10.1109/ISCID.2009.22.
- [12] Mansuo Zhao Alan M.N .and Hong Yan, Present a method “A Technique of Three-Level Thresholding Based on Probability Partition and Fuzzy 3-Partition”,in IEEE Transactions on Fuzzy System, vol. 9, No. 3, JUNE 2001,pp. 469-479
- [13] Tao W B,Tian J W, Liu J, Present a method “Image segmentation by three-level thresholding based on maximum fuzzy entropy and genetic algorithm”, in Pattern Recognition Letters, vol.24, No.16,2003,pp. 3069-3078.
- [14] Xu Guan Su Jian et.al, Present a method “An Image Enhancement Method Based on Gamma Correction”, in 2009 Second International Symposium on Computational Intelligence and Design.
- [15] Garg,Rajesh Bhawan Mittal Sheetal Garg, Present a method “Histogram Equalization Techniques For Image Enhancement”, IJECT Vol. 2, Issue 1, March, 2011.
- [16] Salem Saleh Al-Amri et.al .,Proposes a “Linear and Non- Linear Contrast Enhancement Image” ,in IJCSNS International Journal of Computer Science and Network Security, VOL.10 No.2, February 2010.
- [17] Wang, Xin; Wong Brian Stephen;Chen, “Spotting Defects More Clearly: Radiographic Image Enhancement”, in Industrial Heating; Jan 2006.
- [18] Soong Der Chen and Rahmanrml, Present a method “Minimum Mean Brightness Error Bi-Histogram Equalization in Contrast Enhancement”, in IEEE Transactions on Consumer Electronics, Vol. 49, No. 4, pp.1310-1319, 2003.
- [19] Chen.D and Ramli R., Present a method “Contrast Enhancement Using Recursive Mean-Separate Histogram Equalization for Scalable Brightness Preservation”, in IEEE Transactions on Consumer Electronics, Vol. 49, No. 4, pp.1301-1309, 2003.
- [20] Menotti D, Najman L,Facon J and Araujo, Present a “Multi-Histogram Equalization Methods for Contrast Enhancement and Brightness Preserving”, in IEEE Transactions on Consumer Electronics, Vol. 53, No. 3, pp.1186-1194, 2007.
- [21] Nichlolas Slapik Kong and Haidi Ibrahim, Proposed a techniques,” Color Image Enhancement using Brightness Preserving Dynamic Histogram Equalization”, IEEE Transactions on Consumer Electronics, Vol. 54, No. 4, pp.1962-1968, 2008.