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# Automatic gamma correction based on average of brightness

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**Abstract**

Preprocessing is essential stage in image processing because of limitation of imaging device or inappropriate environmental light. This paper presents a preprocessing technique for estimating the amount of gamma correction in the absence of any information or knowledge about environmental light and imaging device. The basic approach exploits the amount of gamma correction based on average brightness. The amount of gamma correction is then estimated by a power which transports average of brightness to center of histogram .

***Keywords***: *average of brightness, pre processing, histogram, gamma Correction, execution time*

## 1. Introduction

Luminance is an important factor in image processing that leads to perception of details. Technical limitation of imaging devices result non-linear effects on image. Gamma correction is non-linear operation which enhances brightness of image. Gamma correction is defined by the following power law expression:

$$S = T(R) = R^{\gamma}$$

S is the value of brightness in output image and R is value of brightness in original image that are mapped to [0 1].

If the value of gamma is known then inverting this process is obvious:

$$S = T(r) = r^{\frac{1}{\gamma}}$$

Gamma correction would be advantageous to remove non-linear effects in preprocessing stage For many applications in digital photography, image processing, and computer vision. In this paper a technique is presented for estimating the amount of gamma correction in the absence of any information or knowledge about environmental light or imaging device. The basic approach exploits the fact that amount of gamma correction is determined by transposing average of brightness to center of histogram.

## 2. Proposed method

Average of brightness is simple element that can be computed in the least amount of time. Basic approach in this article present a technique to estimate appropriate gamma based on average brightness. Although average of brightness doesn't present all information about image, it is the best choice to choose a sample between amounts of brightness in histogram. This method presents a technique which is different method and low order to estimate gamma. This paper proposes a method which estimates a power that transport average amount of brightness to center of histogram. This method extends the estimated power for gamma correction. This power can be chosen as global gamma for gamma correction. We suppose a gamma which changes average of brightness to $\frac{1}{2}$ , then gamma is estimated based on following equations:

$$X^{\gamma} = \frac{1}{2}$$

$$\gamma = \log_X \frac{1}{2}$$

$$\gamma = \frac{\log_{10} \frac{1}{2}}{\log_{10} X}$$

$$\gamma = \frac{-0.3}{\log_{10} X}$$

X is average brightness and X ∈ [0 1]. In the equations, $\frac{1}{2}$ is center of histogram brighness which is global for any format and it is'nt limmited to Unint8 and int8 etc.

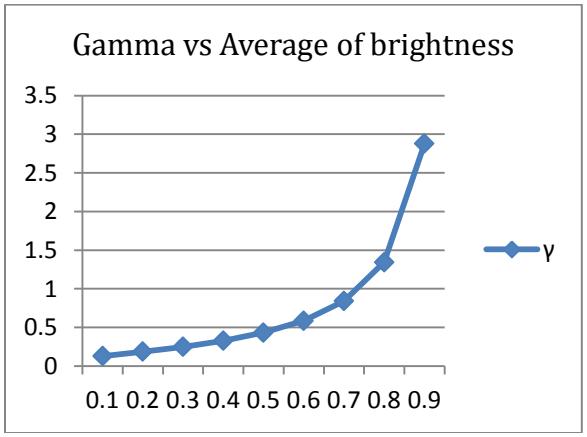


Fig. 1 Graph of Gamma Vs. Average of brightness

Finally, average of brightness in output image is not $\frac{1}{2}$ because this method just chooses the average of brightness in original image as a sample to estimate gamma. All pixels in output image will be enhanced with estimated gamma. After all input image will be enhanced with this method. Graph 1 demonstrates that proposed method estimates a logical and appropriate value for gamma correction.

## 3. Experimental results

In this paper we present a new preprocessing technique for estimating the gamma values without any information or knowledge of the imaging device or environmental luminance. We consider subjective and objective image quality assessment to demonstrate the performance of the proposed method. These figures are benchmark images with a high contrast and low contrast. The enhanced images bring out much more details of the original images. Quality of enhanced images indicates that the enhancement results using the proposed method have an appropriate performance compared to the other methods. In fact, our proposed method estimates gamma in least amount of time between existing approaches. Minimum execution time of proposed method is noticeable feature against other methods and algorithms.

Fig. 2 original image

Fig. 3 enhanced image

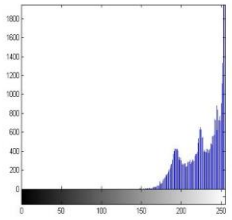

Fig. 4 original histogram

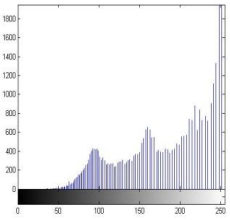

Fig. 5 enhanced histogram

Average of brightness in Figure 2 is 0.92 and estimated gamma is 3.5. more quality and more details (face and hat) in output image demonstrates that proposed method leads to enhancement.

Fig. 6 original image

Fig. 7 enhanced image

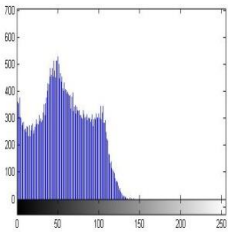

Fig. 8 original histogram

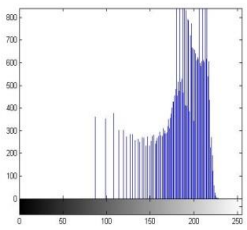

Fig. 9 enhanced histogram

Average of brightness in Figure 6 is 0.21 and estimated gamma is 0.2. more quality and more details (hair hand nose of baboon) proves that proposed method performs well.


Fig. 10 original image


Fig. 11 enhanced image

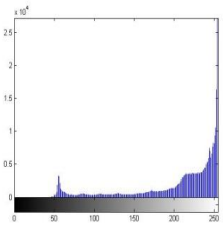
Fig. 12 original image

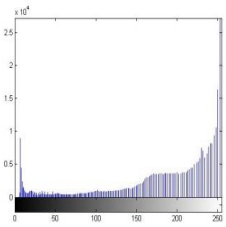
Fig. 13 enhanced image

Average of brightness in Figure 10 is 0.87 and estimated gamma is 2.33. more quality and more perceiving of details (reflection of object on mirror and details in shelf) shows that proposed method enhances original image.


Fig. 14 original image


Fig. 15 enhanced image

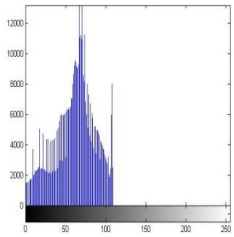
Fig. 16 original histogram

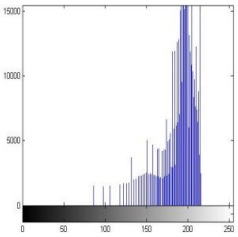
Fig. 17 enhanced histogram

Average of brightness in Figure 14 is 0.2.17 and estimated gamma is 0.19. more perceiving of details (houses and road) demonstrates that proposed method enhances image.
Histogram of all images became equalized and include more amount of brightness which leads to more contrast.

## 4. Comparison of results

Execution time is very important parameter in improvement of a method. Simulations demonstrate that Other methods such as local gamma correction and blind inverse gamma correction perform in more time than proposed method. All execution times are existed in Table 1.

Table 1 Execution times in different methods

| *Method* | ***Blind inverse gamma correction*** | ***Local gamma correction*** | ***Proposed method*** |
|---|---|---|---|
| Execution time on 512X512 | 0.72 Sec | 0.63 Sec | 0.22 Sec |
| Execution time on 256X256 | 0.63 Sec | 0.56 Sec | 0.19 Sec |
| Execution time on 128X128 | 0.58 Sec | 0.52 Sec | 0.17 Sec |
| Execution time on 64X64 | 0.56 Sec | 0.50 Sec | 0.16 Sec |
| average | 0.6225 Sec | 0.5525 Sec | 0.185 Sec |

Execution time in proposed method is the least amount of time. Difference between proposed method and other methods is noticeable. Comparison between three mentioned methods are existed is Graph 1 and 2.

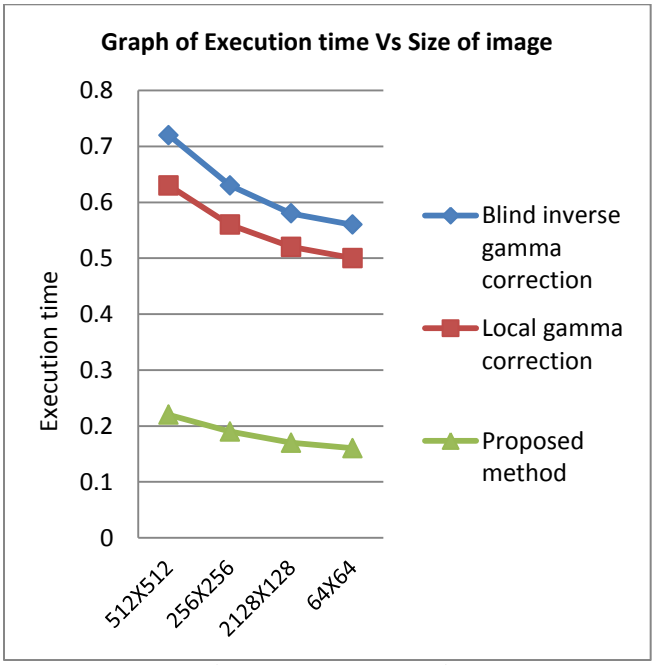

Fig. 18 Graph of Execution time Vs Size of image

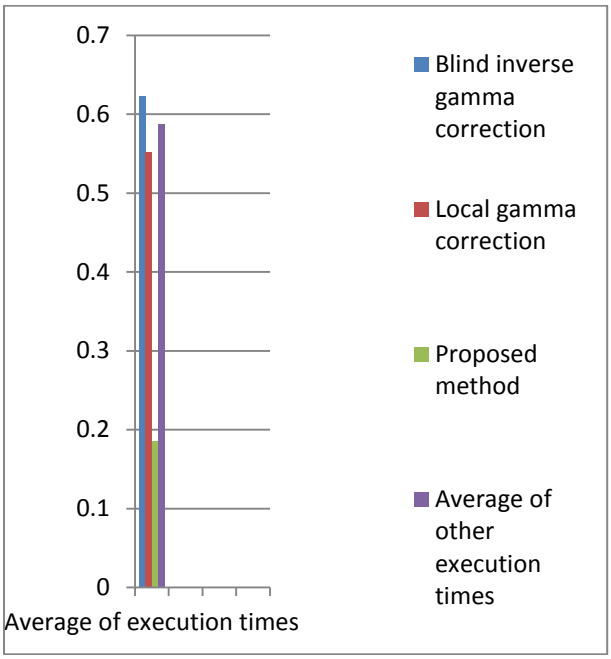


Fig. 19 Graph Average execution time Vs. Methods

Execution time is reduced from average 0.5875 second to 0.185 second (68.6 %) by proposed method. In sum up, proposed method performs at least time against other methods.

## 5. Conclusion

We have introduced a new image enhancement method based on gamma correction that estimates image gamma values without any calibration information or knowledge of the imaging device. The proposed method is a necessary preprocessing stage for most image analysis. Experimental results in this research indicate that the proposed method improves image quality, enhances the dynamic range and details of the image in least amount of time. On the other hand, proposed method performs in less time than other methods. This method can be implemented as a ASIC in the photography or printing devices.

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