White Balancing with Gamma Correction & Histogram Shifting

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Abstract— **White Balancing is a process that reduces the color cast of an image; sometimes it does not give perfect results and requires high computing process that makes the devices slow. In this paper we propose a WB algorithm that use image enhancement through Gamma Correction, and a modified Histogram Shifting algorithm that reduces color cast on an image.**

KEYWORDS: White balancing, Gamma Correction, Histogram Shifting.

I. INTRODUCTION

On Computational Vision, one of the most common problems is the image recollection in which, some cases, the environmental factors causes unevenness on colors. This makes the image have a colour cast, and requires pre-processing algorithms to fix them; in some cases, those algorithms are not fast enough. This problem not only affects researchers, in common life, people who takes a simple photo with their phone are also affected; because the environment is present in all places, and given the fact that phones have a processor with much less power than the researchers computers, they need a fast algorithm to solve the problem. At the present time, there are many different approaches to solving this problem, but the most used are based on assumptions, as Gray World, White Patch, Shades of Grey & Gray Edge, this approaches are fast, but not completely reliable, as the results are approximations but not the expected result, and more accurate algorithms are too CPU-consuming or slow to be worth. In this paper, we present an algorithm that consists in a gamma correction preserving the colors of every pixel as they should, increasing or decreasing the amount of light, and then perform a histogram shift based on [1].

This paper is organized as follows: Section 2 introduces the WB algorithms used as a reference for the realization of this work. In Section 3, we describe the proposed algorithm in detail. Experimental results are presented in Section 4, and finally, we conclude in Section 5.

II. STATE OF ART

[1] propose a Histogram Shifting Algorithm with a color compensation applied later to perform White Balancing, this algorithm was developed specifically for the AMOLED hardware, starting with a power constraint which calculates a coefficient which lower the color depth in all three color channels in the RGB color space. Then performs the Histogram Shifting with the differentials between the R & G and B & G channels, balancing the colors with each other and then applying a compensation to the pixels that do not belong to a range of values between the differentials previously mentioned and the maximum value of the respective channel.

[2] propound that an image that is affected by a particular color, such as sunrise or sunset photos, are called ”color cast images” and propose a method to apply a correction to these images for local areas that posses a similar brightness value. The local region is determined by the flood-fill algorithm, to then correct the color of the region using histogram equalization. This is done after converting the RGB coordinates to HSV, limiting the local range by a threshold or restriction, because in this color space, the color is driven by the Hue value. Then, it applies histogram equalization for all three color canals previously normalized.

[3] present an algorithm in which the image first pass through a Gray World approximation by which the value of every pixel is balanced and color cast is removed, to then divide every color channel into its Intrinsic Mode Functions (IMF) using Empiric Mode Decomposition (EMD). Every IMF is normalized and added back with a weight value to enhance an underwater image. The enhanced image is built with the lower order IMFs, while the higher order IMFs are discarded in the process.

[4] propose an algorithm that divides the image in blocks, because the computational consumption is lower than a pixel-by-pixel approach, then take the average value of every block and compare it with a threshold, and the blocks which average value is lower than the threshold is excluded from the process to maintain the chromaticity; then extract three different features to find a neutral color, then all three features are compared to standard illuminants to get which one is the more reliable by comparing the euclidean distance between them and the standard illuminant; then, if the distance is bigger than a threshold, that block is ignored, otherwise the colors of the block are compensated by using a coefficient.

[5] propound a histogram stretching algorithm, finding two tonal thresholds for each color channel and stretch the value of the RGB coordinates of every pixel in the image between the two thresholds. These two thresholds are computed by

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getting the value of the pixel that is 99% higher than the others and the pixel that is 99% lower than the others.

[6] present an extension to classic algorithms that applies color constancy locally to image patches rather than applying it directly onto the entire image. After the estimation of local illuminants for the patches, these estimates are combined into more robust estimations and a local color correction is applied based on a modified diagonal model.

III. METHODOLOGY

In the previous section, we explained some of the algorithm proposed to fix the colour cast in an image. Although some of them are good proposals, in a low power processor, they would not have good results, the time execution its too long for the device, or is necessary some environment data who common people don't knows. After studying the algorithm behaviors, we proposed this algorithm based on gamma correction and histogram shifting. **Figure 1** explain the process to fix the colour cast of an image in our purpose.

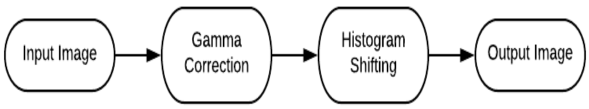

Fig. 1. Algorithm Process.

First, we apply a gamma correction to the input image based on a brightness percentage of the image, there are different ways to find this. In this case we use the average brightness of pixels, which is calculated with the following expression:

$$B = \frac{SumV}{MN} \div MaxV \tag{1}$$

Where *B* is the brightness percentage of the image, *SumV* is the summatory of Value channel of the pixels, *MN* is the image size and *MaxV* is the maximum value of V (*e.g.* the maximum value in OpenCV module is 255).

Then calculate a gamma value that will increase the image brightness if it have a value less than a threshold (this threshold is obtained by experimentation) or decrease the brightness value if it is greater. Therefore calculate a power constraint that will enhance the colour cast if the image was dark, then multiply the color channels by the power constraint. As it is in the expression:

$$C_x = C_x \times k \tag{2}$$

Where C_x is the channel R, G or B and k is the power constraint calculated previously. Finally apply the Histogram Shifting that was proposed by [1] to the result image, which is this expression:

$$diff_1 = R_{avg} - G_{avg} \tag{3}$$

$$diff_2 = B_{avg} - G_{avg} \tag{4}$$

Where $diff_1$ and $diff_2$ are the difference between R & G channels, and B & G channels respectively; R_{avg}, G_{avg} & B_{avg} are the average value of R,G and B channels respectively. Then replace the differences on:

$$R_{ch} = R_{ch} - diff_1 \tag{5}$$

$$B_{ch} = B_{ch} - diff_2 \tag{6}$$

Where R_{ch} & B_{ch} are the pixels value of R and B channel respectively. Finally we get these results:

Fig. 2. Test image.

Fig. 3. Result image.

IV. RESULTS & DISCUSSION

As shown in previous sections we use a low complexity algorithm; the results shown on section III are good at first sight, so we need to evaluate the results, this will be achieve on evaluation of the difference of input image and output image as it did in [2] with a histogram comparison. Which will be shown below:

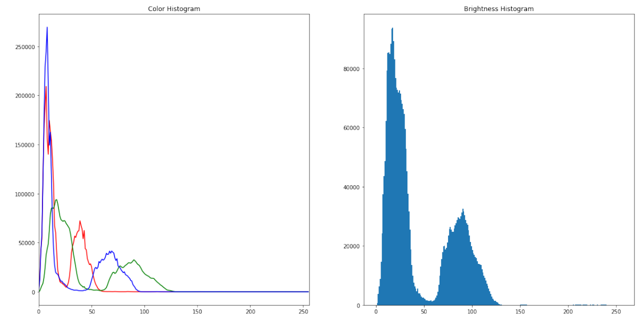

Fig. 4. Test image color and brightness histograms.

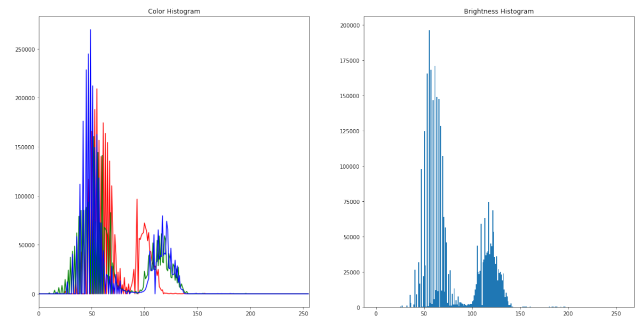

Fig. 5. Result image color and brightness histograms.

As shown on the color histograms, after the application of the algorithm, the colors, in the most parts, are leveled with each other. Which means that the colour cast was greatly reduced.

The brightness histogram shows us that some of the values of V channel were decreased, which means that the image was clarified. Contrary to the algorithm in [1], our propose restores the original colors of the image.

V. CONCLUSIONS

The assumption-based methods are widely used for digital camera applications due to their computational efficiency. However, they are highly dependent on the validity of their assumptions. In this paper, to relieve the dependency, we proposed the gamma correction to increase or decrease the brightness of the image without modifying the color values of the pixels, to then apply a histogram shift for balancing the colors and giving a better enhancement. The experimental results showed that the proposed method arrives at a reasonable color correction even with images dominated by a uniform color or lack of near-white regions.

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