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Edge Based Color Constancy by Using Improved Saturation Weighting Algorithm

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Abstract— Several different techniques for color constancy are recommended if you want to generate ale vision program which identifies the natural colors of physical objects under various illuminants. The technique based on the low-level statistics is generally used because of their lower computational complexity and also adequate outcomes with acceptable parameters. In this paper, several color constancy algorithms are discussed. An improved saturation weighting algorithm is proposed which performs better than previous algorithms. Experiments are performed and the outcomes show that suggested technique enhances the color constancy with uncomplicated and efficient manner.

Keywords- Color Constancy, Illumination, Gray Edge, Computer Vision, Histogram.

I. INTRODUCTION

COLOR is borrowed as of three mechanisms, i.e., the reflectance of the object, the affectability of cones, and the illuminant spectra. Of these mechanisms, the illuminant spectrum is the least constant. The dissimilar aspects depend on the illumination changes, for example daytime (daylight, noon, and evening) or inside/outside situations. Therefore, the color of an object depends on the illumination under which we seeing it, that is the main difficulty for computer vision. Color constancy is the capability to identify colors of objects autonomous of the color of the light source. Obtaining color constancy is of significance for various computer vision applications, like image retrieval, image categorization, color object identification and object tracking. Color Constancy is an observable fact that describes the human capability to approximate the real color of a view irrespective of the color of illumination of that scene. As an image is creation of the light that falls on the scene and the reflectance properties of the scene, achieving color constancy is an ill-posed problem and various techniques have been proposed to address it.

Color constancy is the ability to perceive a comparatively stable color for an object even under changing illumination. Most computer methods are pixel-based, correcting an image so that its statistics satisfy assumptions such as the average intensity of the scene under neutral light is world scene.

Fig 1.Image under different illuminations

II. SATURATION WEIGHTING ALGORITHM

The capability based on the intensity values and saturation values were observed, there was a similar method using this type of characteristic. The gray method gives high weights to the high values of each RGB channel according to the Minkowski norm *p*. Even if the method does not use the intensity channel but uses each RGB channel, since the values of each RGB channel can be thought as the independent intensity values of each channel, similar effects are expected. Therefore, the shades of gray method gives much better results than the gray world method. This method is based on the strong tendency of the performance changes according to the saturation values. Differently weighted pixels based on their saturation values will surely improve the performance of the color constancy. So a saturation weighting function added into the gray world method, which is called the gray world with saturation weighting (GWSW) given by

$$\int w^s(f(x))\, f_i(x)dx = ke_i.$$

Where *s* denotes the saturation strength factor, $w(.)$ is the saturation weighting function, where $w(f(x)) = (1- S(f(x)))$, $S(\cdot)$ is the saturation value of the pixel.

The saturation weighting function is designed according to the observations. Since the pixels which have low saturation values tend to contain more information related to the light source than the pixels which have high saturation values. The value of the saturation weighting function decrease as the saturation value of a pixel increases. The saturation strength factor S added to the weighting function so as to adjust the strength of the weights.

For $s = 0$, method becomes the gray world method because all values of the saturation weighting function have equal weights.

For $s = \infty$, our method becomes the "do nothing" approach. Only when the saturation value is equal to zero, the weight becomes one but otherwise the weight becomes zero. Since the pixels whose saturation values are equal to zero are achromatic, they do not have color information, which results in estimating the light source as the canonical light source, i.e., the "do nothing" approach.

Finally this method was improved as general gray world with saturation weighting (GGWSW) presented as

$$\left(\int w^s(f(x))\left(f_{i,\sigma}(x)\right)^p dx\right)^{1/p} = ke_i.$$

The scale of smoothing operation σ handles local correlation between pixels. The smoothing operation reduces the influence of noise in an image and it was proven to be beneficial for improving the color constancy. In this way, we get better results than gray world method.

III. GAPS IN LITERATURE

The survey has shown that still much improvement is required in the color constancy algorithms. It has been found that the most of the existing research has following limitations:-

Color normalization has been neglected to balance the color artefacts which will be presented in the image produced by the color constancy algorithms; as the modification is done in the image according to measured light source.

Effect of the Human visual system is also ignored. Because the modification done by the color constancy is based upon the measured light source; which can be efficient some time or may produce poor results in certain cases. So histogram stretching is required to overcome this problem.

Most of the existing research has taken the results on the available data sets; not much work is done by taking real time color source affected images.

IV. PROBLEM DEFINITION

The color constancy is a procedure that measures the influence of different light sources on a digital image. The image recorded by a camera depends on three factors: the physical content of the scene, the illumination incident on the scene, and the characteristics of the camera. The goal of the computational color constancy is to account for the effect of the illuminate. Many traditional methods such as Grey-world method, Max RGB and learning-based method were used to measure the color constancy of digital images affected by light source. All these methods have an obvious disadvantage that the light source across the scene is spectrally uniform. This assumption is often violated as there might be more than one light source illuminating the scene. For instance, indoor scenes could be affected by both indoor and outdoor illumination, each having distinct spectral power distributions.

The main objective of this dissertation is to implement Improved Edge Based Color Constancy using histogram stretching and gradient based smoothing. The problem is seem to be justifiable and will have great impact on vision application because as edge based color constancy will reduce the impact of the light but it also reduces the sharpness of the image and also may result in some noise so to remove this problem we will use an integrated effort of the edge based color constancy along with the histogram stretching and gradient based smoothing. In order to validate the performance of the proposed algorithm design and implementation will be done in MATLAB using image processing toolbox. The comparison among state of art techniques will also be drawn by considering the well-known image processing performance metrics.

V. PROPOSED ALGORITHM

This section contains the various steps to achieve the objectives of this research work: Figure has shown various steps required to get the final image using the proposed algorithm. Subsequent are the various steps with brief detail:-

Step 1: First of all given image will be acquire and converted into a digital image to apply vision processing operations.

Step 2: Apply integrated edge based color constancy which comes up with integration of the edge based color constancy and the histogram stretching.

Step 3: Apply gradient based smoothing to preserve edges.

Step 4: Evaluate performance parameters.

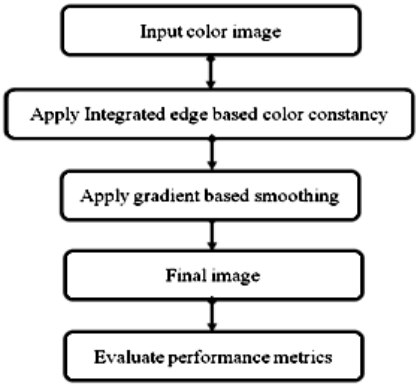

Fig. 2 Flow chart of proposed algorithm

VI. EXPERIMENTAL SETUP

In this research work, different kind of images have taken .Proposed algorithm can be implemented in MATLAB software using Image processing toolbox.

TABLE 1: EXPERIMENTAL IMAGES

Sr. no.	Name	Format
1	Image 1	JPEG
2	Image 2	JPEG
3	Image 3	JPEG
4	Image 4	JPEG
5	Image 5	JPEG
6	Image 6	JPEG
7	Image 7	JPEG
8	Image 8	JPEG
9	Image 9	JPEG
10	Image 10	JPEG
11	Image 11	JPEG
12	Image 12	JPEG
13	Image 13	JPEG
14	Image 14	JPEG
15	Image 15	JPEG

VII. EXPERIMENTAL RESULTS

We have taken 15 different kinds of images. And then passed to the first order derivative, 2nd order derivative, saturation weighting algorithm and then to proposed algorithm. This section contains result one of the 15 images which shows the improvisation of the proposed algorithm over the other technique.

Fig.3 shows the input image. This image has less brightness, low intensity and effect of red color is much. The main aim is to improve the brightness of the image and produce the actual color of the source.

Fig. 3 Input Image

Fig.4 shows the result produced by 1st order derivative which has more brightness but effect of red color is more

Fig. 4 Grey Edge 1st Order Result

Fig.5 shows the result produced by 2nd order derivative. It produced the image with more intensity but there is no effect of green channel.

Fig.5 Gray Edge 2nd Order Result

Fig.6 shows the result produced by saturation weighting algorithm. It produced the better image than previous technique but it darks the image slightly.

Fig. 6 Saturation Weighting Result

Fig. 7 shows the result produced by proposed algorithm. It produced image with much brightness and effect of red channel is also reduced. Color normalization factor is also taken into account.

Fig.7 Improved Saturation Weighting

VIII. PERFORMANCE ANALYSIS

This section contains the calculation of different parameter of the images under different algorithms. These parameters show the comparison between these different algorithms and also show the better results of proposed algorithm than previous algorithm.

PSNR: Peak signal to noise ratio should be high .So our goal is to increase PSNR. PSNR has highest value in our proposed algorithm then previous algorithm.

Table 2 Shows the relative examination of peak signal to noise ratio (PSNR).

TABLE 2: PSNR

Image Name	Edge 1st order	Edge 2nd order	Saturations Weighting	Improved Saturation Weighting
Image1	65.0522	68.4004	69.6580	69.9939
Image2	62.7470	66.2300	67.6381	71.1370
Image3	60.9938	64.4619	65.7765	66.2314
Image4	62.8431	66.1652	68.0592	74.7758
Image5	63.6863	66.7874	69.0772	78.1215
Image6	61.5823	64.9540	66.6662	66.9136
Image7	62.1723	65.6158	67.1661	69.0437

Image8	60.5302	63.5880	65.8386	66.3931
Image9	61.6746	65.0129	66.6768	69.8753
Image10	59.2215	62.3578	64.5302	69.3731
Image11	59.6991	63.2235	64.5451	70.1054
Image12	62.4170	65.6343	67.6645	70.9679
Image13	60.9528	63.6303	69.1699	72.2632
Image14	63.9098	67.5118	68.7375	69.9436
Image15	61.1336	64.4445	66.2765	69.3720

Table 3: Shows the relative examination of Mean Square Error (MSE).

MSE: As mean square error MSE needs to be abridged therefore proposed algorithm produced better results than previous algorithm.

TABLE 3: MSE

Image Name	**Edge 1st order**	**Edge 2nd order**	**Saturation Weighting**	**Improved Saturation Weighting**
Image1	0.0203	0.0094	0.0070	0.0065
Image2	0.0345	0.0155	0.0112	0.0050
Image3	0.0517	0.0233	0.0172	0.0155
Image4	0.0338	0.0157	0.0102	0.0022
Image5	0.0278	0.0136	0.0080	0.0010
Image6	0.0452	0.0208	0.0140	0.0132
Image7	0.0394	0.0178	0.0125	0.0081
Image8	0.0576	0.0285	0.0170	0.0149
Image9	0.0442	0.0205	0.0140	0.0067
Image10	0.0778	0.0378	0.0229	0.0075
Image11	0.0697	0.0310	0.0228	0.0063
Image12	0.0373	0.0178	0.0111	0.0052
Image13	0.0131	0.0282	0.0079	0.0039
Image14	0.0264	0.0115	0.0087	0.0066
Image15	0.0501	0.0234	0.0153	0.0075

As MSE shown in proposed algorithm produce better results than previous algorithms.

IX. CONCLUSION AND FUTURE SCOPE

This research work has proposed improved saturation weighting color constancy based algorithms by using histogram stretching and smoothening. As known in prior that color constancy reduce the illuminate from the given image. Therefore lead to the darker image. So the use of histogram stretching has removed the problem of darker output of saturation weighting based color constancy. In near future we will modify the proposed algorithm further modifying the edge based hypothesis with fuzzy set theory.

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