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Adaptive Color Constancy Using Wavelet Decomposition

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ABSTRACT : *Color constancy algorithms are generally based on the simplifying assumption that the spectral distribution of a light source is uniform across scenes. However, in reality, this assumption is often violated due to the presence of multiple light sources. In this paper, will address more realistic scenarios where the uniform light-source assumption is too restrictive. This methods are too fast and efficient. First, a methodology is proposed to extend existing algorithms by applying color constancy locally to image blocks. which bring unifomality in their information rather than the enter images. It can be done by using fast clustering algorithm model. First algorithm achieves color constancy by combined methods, combination of piece wise linear model and gamma correction. But this methodology fails at the edge of image. In second method uses wavelet decomposition for getting the color constancy. With the use of motion filter reduces the unwanted errors. Both the proposed methods are adaptable to any image with different chromatic intensity value.*

KEYWORDS *- Color constancy, computer vision, illuminant estimation, Piecewise linear model,Gamma correction, Wavelet decomposition*

I. INTRODUCTION

The object color mainly depends on the color of the light sources fall on the image. So the same scene captured under different chromatic light sources may varies its chromatic intensity values. These negatively effects computer vision methods, such as object recognition, tracking and surveillance.The color constancy is the process of removing effect of the illuminant color, either by computing invariant features,e.g., [2] and [3], or by transforming the input image such that the effects of the color of the light that the effects of the color of the light source are removed, e.g.,[1] and [4].

Fig. 1. Scenes with multiple different light sources, taken from the web.

There were a large number of color constancy algorithms are proposed [1],[4] and [5] for review.These color constancy algorithms are mainly exploited to estimates the color of light sources eg: the approaches based on low level features [6],[7] gamut-based algorithms [8], and other methods that use knowledge acquired in a learning phase [9].And there were another method uses derivatives and higher order statistics [10].These all algorithms are based on the assumption that the light sources across the scene is spectrally uniform. For Example the inside scene is effected by both indoor and out door illumination. Both having the different spectral power distribuition. Eg such scenarios are shown in Fig. 1. The another type algorithm, retinex[7] obtained the color constancy based on abrupt change in chromaticity causes the changes in the reluctance property. More over there were a lot of implementation have been proposed. e.g., using very large scale integration for real-time image processing [11], using center/surround for practical image processing applications [12], [13], or using MATLAB to standardize evaluation of the Retinex [14]. More over these another color constancy algorithm have been proposed based on the additional knowledge about scene .Eg:Retinex based method which identifies and uses the surface color that illuminated by two different light sources proposed by Finlayson et al. [15] and Barnard et al. [16].

Xiong and Funt [17] proposed an extension that uses the stereo images to drive 3D information on the surface that are present in image ,by using the stereo method will not available and is not trivial to obtaine.Ebner [18] proposed a method uses local estimation of illumination by convolving the image with kernel function. But this construction uses only in non uniform averaging [19] condition.Another type color constancy algorithm for consider multiple light source. They included physics-based methods [22] that uses [21] is specifically designed for outdoor images and distinguishes between shadow and nonshadow regions. Various other methods that distinguish between shadow and nonshadow regions have been proposed, e.g., [24] and [25], but such methods do not result in output images that have any visual similarity to the original input image. biologically inspired models [22],] is based on retinal mechanisms and adaptation, simulating the properties of opponent and double-opponent cells. And methods requiring manual intervention [22]. It requires spatial locations in the image that are illuminated by different light sources to be manually specified by a user.There another algorithm color constancy for multiple light sources [1] uses the color constancy algorithm for multiple light sources condition but it is not an adaptive method.

In this paper, a new methodology is presented that enables color constancy under multiple light sources adaptable to any type of images carries different chromatic values. The methodology is designed according to the following criteria: 1) it should be able to deal with scenes containing multiple light sources; 2) it should work on a single image; 3) no human intervention is required; and 4) no prior knowledge or restrictions on the spectral distributions of the light sources is required.5) it will be the fast processing method 6) highly efficient and less error producing.7) the technique is adaptable. Although the proposed framework is designed to handle multiple light sources, the focus in this paper is on different chromatic intensity valued scenes captured under *one or two distinct light sources* (including linear mixtures of two light sources), arguably the two most common scenarios in real world images. In this method color constancy achieves by using wavelet decomposition. Furthermore, not only images recorded under multiple light sources but also images that are recorded under only one light source should be properly processed. Hence, the improvement on multiple-light-source scenes should not be obtained at the expense of a decreased performance on single light-source scenes.

In color constancy by combined methods ,To construct color constant images from scenes that are recorded under multiple sources, the proposed methodology makes use of local image blocks, rather than the entire image. These image blocks are assumed to have (local) uniform spectral illumination and can be selected by any sampling method. In this paper k-means clustering, Adaptive clustering of successive approximation evaluated. After sampling of the blocks, illuminant estimation techniques are applied to obtain local illuminant estimates. The first approach is to cluster the illuminant estimates, taking the cluster centers as final illuminant estimate for each of the regions. The second approach is to take spatial relations between local estimates into account by applying segmentation on the back-projected local illuminant estimations. Finally, when the resulting illuminant is estimated, combination of pieces wise linear model and gamma correction is applied to obtain the color-corrected images. But this paper fails at the nonlinear regions such that at the edge portions.

II. COLOR CONSTANCY

In general, the goal of computational color constancy is to estimate the chromaticity of the light source and then to correct the image to a canonical illumination using the diagonal model. Here, we will briefly outline this process.

2.1. Reflection Model

Image color $I=(I_R, I_G, I_B)^T$ for a Lambertian surface at location x can be modeled as

$$I_c(x) = \int_w E(\lambda,x)\, S(\lambda,x)\, \rho_c(\lambda)\, d\lambda \qquad (1)$$

Where $C \varepsilon$ R,G,B and $E(\lambda,x)$,$S(\lambda,x)$, $\rho_c(\lambda)$ are illuminant spectrum, surface reflectance, and camera sensitivity. Furthermore, is the visible spectrum.Then, for a given location x , the color of the light source can be computed as follows:

$$L(x)=\begin{pmatrix} L_R(x) \\ L_G(x) \\ L_B(x) \end{pmatrix} = \int_w E(\lambda,x)\, \rho_c(\lambda)\, d\lambda \qquad (2)$$

where it should be noted that, typically, color constancy is involved with estimating the chromaticity of the light source (i.e., intensity information is not recovered). Estimating this chromaticity from a single image is an under constrained problem as both $E(\lambda,x)$ and $\rho(\lambda)= (\rho_R(\lambda), \rho_G(\lambda), \rho_B(\lambda))^T$ Therefore, assumptions are imposed on the imaging conditions. Typically, assumptions are made about statistical properties of the illuminants or surface reflectance properties. Moreover, most color constancy algorithms are based on the assumption that the illumination is uniform across the scene $E(\lambda,x) = E(\lambda)$ However, for real-world scenes, this assumption is very restrictive and often violated.

2.2. Illuminant Estimation: One Light Source

Most color constancy algorithms proposed are based on the assumption that the color of the light source is uniform across the scene. For instance, the white-patch algorithm [26] is based on the assumption that the maximum response in a scene is white, and gray-world algorithm is based on the assumption that the average color in a scene is achromatic. These assumptions are then used to make a global estimate of the light source and correspondingly correct the images.
The framework proposed in allows for systematically generating color constancy as follows

$$\int |\delta^n I_{C,\sigma}(X)/\delta X|^p dx)^{1/p} = kL_C^{n,p,\sigma} \qquad (3)$$

Where $L_C^{n,p,\sigma}$ is used to denote different instantiations of the frame work .Further more |.| is the Frobenius norm. $C\varepsilon$ (R, G, B), n is the order of the derivative, p is the Minkowski norm, and $I_{C,\sigma} = I_C © G_\sigma$ is the convolution of the image with a Gaussian filter with scale parameter σ. According to the characteristics of the Gaussian filter, the derivative can be further described by

$$\delta^{a+b} I_{C,\sigma}(X)/\delta x^a y^b = I_C * (\delta^{a+b} G_\sigma/\delta x^a \delta y^b) \qquad (4)$$

Where *denotes the convolution and a+b=n

III. WAVELET ANALYSIS

31. Wavelet Decomposition

In practical, we often want to get its multi-stage decomposition for a small wave, so that we can have a more accurate analysis of wavelet. Then we will introduce the multi-level of wavelet decomposition specifically, we will introduce the multistage decomposition diagram and multistage decomposition algorithm, so that we can get more profound understanding from the multistage decomposition of wavelet.[26]

In figure2, 'h' is low-pass filter, 'g' is high-pass filter,' ↓ 2 'is down sampling.

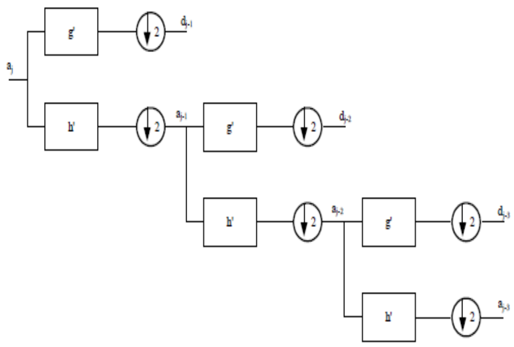

Figure 2: multi level decomposition

3.2. Wavelet Reconstruction

In practical, we often want to get its multi-stage reconstruction for a small wave, so that we can have a more accurate analysis of wavelet. Then we will introduce the multi-level of wavelet [26].Reconstruction specifically, we will introduce the multi stage construction diagram and multistage reconstruction algorithm, so that we can get more profound understanding from the multistage reconstruction of wavelet.In wavelet analysis, when a signal or graphics decomposition, we need restore it and know that if we can get the original signal or graphics, so we need introduce the wavelet multistage reconstruction

In figure 3, 'h' is low-pass filter, 'g' is high-pass filter,' ↑ 2' is up sampling. graphics, so we need introduce the wavelet multistage reconstruction

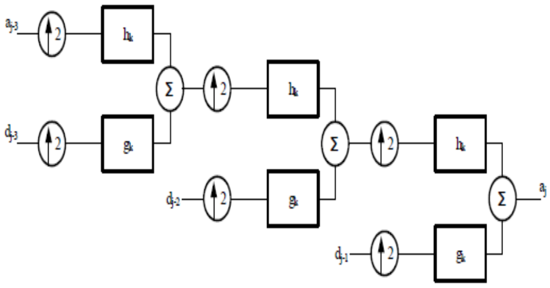

Figure 3. Multi-stage reconstruction.

3.3.Motion filter

It is noise filter removes unwanted frequencies' lies in the smooth sections. In image processing application it works at the Removes isolated pixels (individual 1s that are surrounded by 0s), such as the center pixel in this pattern.

0	0	0
0	1	0
0	0	0

The first paragraph under each heading or subheading should be flush left, and subsequent paragraphs should have a five-space indentation. A colon is inserted before an equation is presented, but there is no punctuation following the equation. All equations are numbered and referred to in the text solely by a number enclosed in a round bracket (i.e., (3) reads as "equation 3"). Ensure that any miscellaneous numbering system you use in your paper cannot be confused with a reference [4] or an equation (3) designation. (10)

IV. PROPOSED METHOD: ADAPTIVE COLOR CONSTANCY USING WAVELET DECOPOSITION

This methodology makes the use of wavelet decomposition for getting the color constancy for multiple lights sources.

The steps are following

Step1: Resizing the image into 256x256 pixels.

Step2: Apply the wavelet decomposition method and get its low value features. The decomposition up to 8x8 pixels. Here use haar wavelet.

Step3: Reconstructed image from its low level image features by using idwt.

Step4: Calculated its estimates and back projected.

Step 5: Color corrected by using the logical estimator and by making the use of motion filter reduces the unwanted error or noise. This logical operator is a morphological operator and it mainly uses the mean value of red and green in image.

V. EXPERIMENT RESULTS

Proposed method provides a good color constancy with the help of wavelet decomposition. The obtained result shows the methodology works at the edge of image.

Fig:4 input

Fig:5 resized into 256x256

Fig:6 average red

Fig:7 average green

Fig:8 average blue

Fig:9 color corrected

VI. CONCLUSION

To conclude, the methodology in this paper has been shown to be able to extend existing methods to more realistic scenarios where the uniform light-source assumption is too restrictive. In this methodology achieves color constancy by making the use of wavelet decomposition and extra uses a motion filter to reduce error or noise. Thus, proposed methodologies are able to increase the performance of existing algorithms considerably. the frame work of this approaches are adaptable to any type of image carries different type of chromatic intensity values. And by considering other color constancy for multiple light source [1] algorithms the proposed method gives highly accurate and efficient. Furthermore, it can able to operates at the edge regions also.

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