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EVALUATING THE SHORT COMINGS OF COLOR CONSTANCY ALGORITHMS

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Abstract: This paper is a review on existing color constancy algorithms. The color constancy is a procedure that measures the influence of different light sources on a digital image. The image traced by a camera depends on three issue: the physical content of the view, the illumination incident on the scene, and the characteristics of the camera. The aim of the computational color constancy is to account for the effect of the illuminate .Many traditional methods as Grey-world method, Max RGB and learning-based method were used to evaluate the color constancy of digital images influenced by light source. All these process 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 overall objective of this paper is to find the short comings of earlier work on color constancy.

INDEX TERMS: COLOR CONSTANCY, ILLUMINATES, LIGHT SOURCE, GRAY WORLD AND NON LOCAL MEANS.

1. INTRODUCTION

An image [1] of a three-dimensional view depends on a number of factors. First, it depends on the physical properties of the imaged things, that is on their reflectance properties. But, it also depends on the form and direction of these objects and on the position, intensity, and color of the light sources. Finally, it depends on the spectral sampling properties of the imaging tool.

It is [2] renowned that color is a dominant cue in the distinction and identification of objects. Segmentation based on color, rather than just intensity, provides a broader set of bias between material margins. Modelling the physical procedure of color image formation provides a sign to the object-specific parameters. To decrease some of the difficulty intrinsic to color images, parameters with recognized invariance are of prime importance. Existing methods for the measurement of color invariance need a fully sampled spectrum as input data usually derived by a spectrometer.

The perceived color [3] of a surface depends on its spectral reflectance properties the amount of incident illumination reflected at each wavelength of the spectrum mediated by the long, medium, and short wavelength sensitive cone receptors of the eye. But, if a surface is regular and presented in isolation in a shady field, it is not possible to tell whether its perceived color is due to its own reflecting properties or to the spectrum of the illuminating illumination: a red piece of paper in white light can look the same as a white piece of paper in red illumination

The straightest approach [3] for measuring the, perceived surface color experiment; whether color names are used properly or not? Although the terminology is normally constrained to certain basic color terms or categories, the principle is common. For example, subjects given a free selection of names might label a surface with a strong light blue color under on e illuminants as copen blue. The level to which color constancy holds can then be determined by measuring how correctly they use the label copen blue for the similar surface under a dissimilar illuminant. The second major approach to measuring perceived surface color tests how well subjects can make matches between colored surfaces beneath different lights.

Color constancy [4] is the capability to identify colors of objects invariant of the color of the illumination source. It commonly consists of two steps. Firstly, the illumination source color is estimated from the image statistics. Secondly, illuminant invariant descriptors are computed, which is usually completed by adjusting the image for the color of the light source such that the object colors look like the colors of the objects under a known light source. A straightforward color constancy technique, called max-RGB, estimates the light source color from the maximum response of the different color channels.

One more renowned color constancy technique is based on the Grey-World hypothesis, which assumes that the average reflectance in the scene is achromatic. Although more detailed algorithms exist, methods like Grey-World and max RGB are still generally used because of their low computational costs. They have pursued color constancy by the Grey Edge hypothesis, which assumes the average edge difference in the scene to be achromatic. The technique is based on the surveillance that the division of color derivatives exhibits the biggest variation in the light source path. The average of these derivatives is used to estimate this path.

$$\left(\int \quad \frac{d^n f^{\sigma}(x)}{dx^n}\right) |^p dx)^{\,1/p} = \mathrm{k}e^{n,p,\sigma}$$

i. The order n of the image structure is the parameter determining if the method is a gray-world or a gray edge algorithm.

ii. The Minkowski norm p which determines the relative weights of the multiple measurements from which the final illuminant color is estimated. A high Minkowski norm emphasizes larger measurements whereas a low Minkowski norm equally distributes weights among the measurements.

iii. The scale of the local measurements as denoted by sigma . For first- or higher order estimation, this local scale is combined with the differentiation operation computed with the Gaussian derivative. For zero-order gray-world methods, this local scale is imposed by a Gaussian smoothing operation.

Color Constancy [7] is a phenomenon that defines the human ability to estimate the actual color of a scene irrespective of the color of illumination of that scene. Since an image is a product of the illumination that falls on the scene and the reflectance properties of the scene, attaining color constancy is an ill posed problem and various techniques have been planned to address it. Our method is based on the observation that an image of a scene, taken under colored illumination, has one color channel that has significantly different standard deviation from at least one other color channel.

The standard deviations of the color channels of an image with no color cast are very alike to each other. We discover the ratio of the maximum and minimum standard deviation of color channels of local patches of an image and usage as a prior to estimate the color of illumination and achieve color constancy.

In order to purify [10] the acquired image as close as possible to what a human observer would have observed if placed in the original scene, the first stage of the color correction pipeline aims to emulate the color constancy feature of the human visual system (HVS), the ability to perceive relatively constant colors when objects are lit by different illuminants. The dedicated module is usually referred to as automatic white balance (AWB), which should be able to determine from the image content the chromaticity of the ambient light and compensate for its effects. The only information available are the camera responses across the image, color constancy in as under determined problem ; and thus further assumptions and/or knowledge are needed to resolve it. Typically, some information about the camera being used is exploited, and/or assumptions about the statistical properties of the expected illuminants and surface reflectance.

Color correction methods [12] are used to compensate for illumination conditions. In human perception such correction is called color constancy the capability to perceive a relatively constant color for an object even under changing illumination. Most computer methods are pixel based, correcting an image so that its statistics fulfil assumptions such as the average intensity of the scene under neutral light is achromatic, or that for a given illuminant, there is an inadequate number of expected colors in a real world scene. Various schemes have been proposed to use features instead of pixels including higher order derivatives or homogeneous color regions.

These features [12] are selected based on their probability to best characterize the illuminant color and ignore the specific color of the objects in the scene. For example, higher order derivatives are used based on the assumption that the average of reflectance differences in a scene is achromatic. However, to the best of knowledge, none of the existing methods account for the fact that even at the level of the distinct pixels, the reliability of the color information varies. Introduce the notion of color strength, a measure of color information accuracy.

Color [13] is an important cue for computer vision and image processing related topics, like feature extraction, human computer interaction, and color appearance models. Colors observed in images are determined by the intrinsic

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assets of objects and surfaces, as well as the color of the illuminant. For a robust color-based system, the effects of the illumination should be filtered out. Color Constancy is the ability to identify the correct colors, independently of the illuminant present in the scene. Human vision has a natural capability to correct the color effects of the light source. However, the mechanism that is involved in this capability is not yet fully understood. The same process is not trivial to machine vision systems in an unconstrained scene.

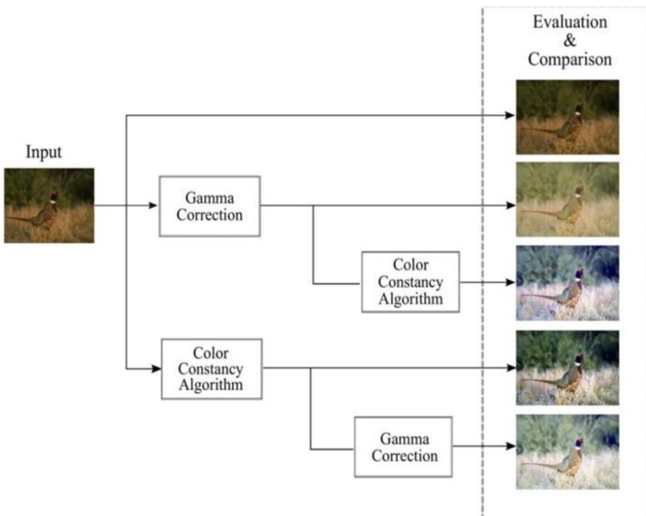

Fig1. Experimental Evaluation of four approaches combining Color Constancy and Gamma Correction Algorithm [13]

There [14] are generally two branches in color constancy: One is to characterize an image by the illuminant invariant features the other, called color correction , is to fix the deviated image color, aiming to create a color corrected image that looks as if it were pictured beneath the canonical (i.e. white) light. This paper focuses on the second division. Based on our surveillance that the chromaticity division of an image with no color deviations (the deviations are led by the non-canonical illuminants) is almost neutral, an iterative algorithm named the chromaticity neutralization process is projected, which goes throughout each integer percentage, determines the equivalent representative pixels, calculates the illuminant, and creates the color-corrected image through the Von Kries model.

A sight is a set of illuminated things. In common the illumination has a multifaceted spatial distribution, so that the illuminant falling on one object in the scene may vary from that falling on another. None-the less ,a of use point of departure is to judge the case where the illumination is consistent across the scene, so that it may be differentiated by its spectral power distribution, E(λ).This functions specifies how much control the illuminant contains at each wavelength. The illuminant reflects off things to the eye, where it is gathered and centered to figure the retinal image. It is the image that is openly available for determining the work of art of the scene.

Fig 2.Image under different illuminations

However human eye has capability to exhibit color constancy to huge extent. Consider an instance concerning only lightness, get a page of black print on white paper seen initially under an indoor light and then beneath straight sunlight i.e. achromatic illumination. The intensity of the light accomplishment the eye from the white region of the page in indoor illumination is approximately equal to the intensity of the illumination reaching the eye from the black print in daylight. In spite of this irregular fairness, the page looks white under the indoor light and the print looks black beneath daylight.

A. Gray World

Gray-World [2] – [7] is most well-known method of color correction which considers the regular reflection from surfaces of an image is white light. This supposition is said to be very well: in a real world image, it is usually true that there are a group of different color differences. The variations in color are chance and self-governing; the regular would join to the mean value, gray, by given a sufficient quantity of samples. Color balancing algorithms can be appropriate this supposition by forcing its images to have a frequent standard gray value for it's R, G, and B mechanisms. In the case an image is engaged by a digital

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camera below a exacting lighting environment, the outcome of the particular illlumination cast can be removed by enforcing the gray world supposition on the image. As a result of estimation, the color of the image is much nearer to the original scene.

(a) Original Image

(b) Result of Gray World

B. White Patch

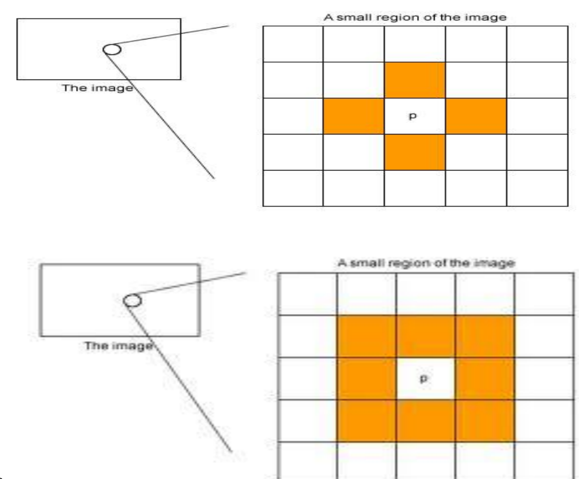
White Patch method try to locate the things that are really white, within the scene; by presumptuous the whites pixels are also the brightest (I = R+G+B). White Patch move towards is typical of the Color Constancy adaptation, searching for the lightest scrap to use as a white reference alike to how the human visual system does. In White Patch maximum value in the image is white. White Patch algorithm is finest suited for forest class.

(a) Original image

(b) Result of white patch

C. Gray Edge Hypothesis

In gray Edge 1st order derivative 4-neighbouring pixels are considered. The first derivative-based edge detection operator to notice image edges by calculating the image gradient standards, such as Roberts operator, Sobel operator, Prewitt operator.



(a)

(b)

Figure 5 (a) 4-neighbouring pixels (b) 8-neighbouring pixels

The 8-neighbouring pixels are considered. Nothing like 4-connected, in 8-connected more information for image correction is presented. Gray Edge using 1st order derivative does not evidence to be well-organized because each pixel considers its 4-neighbouring pixels. So, in this technique not all information is obtainable for color correction.

(a)Input image (b) Gray world 2nd order

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E. Gamut Mapping

The gamut mapping is most broadly used color constancy process to attain effective results. On standard pixel values are used to approximate the reflectance on surface of an image. Gamut mapping is extensive to put together the numerical environment of images. It has been sensibly shown that the projected gamut mapping structure is capable to take in any linear filter output.

(a) Original image (b) result of gamut mapping

2. ADAPTIVE HISTOGRAM EQUALIZATION

Ordinary histogram equalization uses the similar transformation derived from the image histogram to convert all pixels. This works fine when the division of pixel values is similar all through the image. However, when the image have regions that are considerably lighter or darker than most of the image, the contrast in those areas will not be sufficiently enhanced. Adaptive histogram equalization (AHE) improves on this by transforming each pixel with a conversion function derived from a neighbourhood area.

When the image section containing a pixel's neighbourhood is fairly uniform, its histogram will be strongly peaked, and the transformation function will plot a narrow range of pixel values to the whole range of the result image. This causes AHE to over amplify small amounts of noise in largely uniform regions of the image. This method used to get better contrast of the images. It varies from histogram equalization with respect that the adaptive method make the computation of the several histograms, every corresponding to a different segment of the image, and use to reallocate the lightness values of the image. It is therefore suitable for to increase the local contrast of an image and put across more detail.

With histogram equalization [26] the mapping function m(i) is proportional to the cumulative histogram

$$m(i) = (display\ range) * (cumulative\ histogram(i) / range\ size)$$

Since the derivative of cumulative histogram is the histogram, the slope of mapping function at any input intensity i.e. the contrast enhancement, is proportional to the height of the histogram at that intensity :

$$\frac{d_m}{d_i} = \left(\frac{display\ range}{region\ size}\right) * histogram$$

Therefore, limiting the slope of the mapping function is equivalent to clipping the height of the histogram.

3. RELATED WORK

The problem of illuminant estimation [1] for given image of a sight is recorded under an unidentified light; they can recover an estimate of that light. Obtaining such an estimate is a vital part of solving the color constancy problem that is of recovering an illuminant self-governing demonstration of the reflectance in a scene. They start by determining which image colors can take place under each of a set of probable lights.

The color constancy problem; that is how can discover an estimate of the unknown illuminant in a captured scene. They have shown a correlation framework to solve color constancy. The straightforwardness, flexibility, and sturdiness of this framework make solving for color constancy easy. A number of other formerly proposed algorithms were also positioned within the correlation framework, and others which, while they cannot be exactly formulated within the framework, were shown to be closely interrelated to it.

For a constant visual world, the colors [3] of objects should appear the similar under different lights. This property of color constancy has been assumed to be elementary to vision, and lots of experimental attempts have been made to enumerate it .So, does color constancy exist? Advancement has been made in quantifying the level, to which it might hold, but present measurement techniques remain unfinished, and their restrictions need to be made clearer.

The straightest method, color naming, might be enhanced by training subjects to use a superior vocabulary, but, without additional scales or ratings, it is improbable to attain the precision of similar procedures. Individually, the other two major methods, of asymmetric color matching and achromatic alteration, are not sufficiently specific to detecting changes in surface reflectance, but they might be when taken jointly. Is there a way, therefore, to merge them

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naturally into a single measure? This represents an interesting problem although the illuminant can only be predictable reliably in scenes with many surfaces; it is not understandable that surface color perception is different in scenes with just a small number of surfaces. Until that problem is determined or other specific measurement methods are devised, then whether color constancy exists, other than in nominal terms, will remain unverified.

A well known color constancy method [4] is based on the Grey World assumption i.e. the average reflectance of surfaces in the world is achromatic. The Grey Edge hypothesis assuming that the average edge difference in a scene is achromatic. Based on this hypothesis, they projected an algorithm for color constancy.

Color constancy [5] is the capability to compute colors of things independent of the color of the light source. A renowned color constancy method is based on the gray world assumption which assumes that the average reflectance of surfaces in the world is achromatic. A new theory for color constancy namely the gray edge hypothesis, which assumes that the standard edge difference in a scene is achromatic. Color constancy algorithms obtain equivalent results as the state of the art color constancy methods with the merit of being computationally more efficient.

In comparison to existing methods, which are based on zero order configuration of the image, their method is based on the higher order configuration of images. Furthermore, the outcomes show that color constancy based on the gray edge hypothesis obtains better outcome than those obtained with the gray world technique for real-world images.

Light, which is reflected from an object, varies with the kind of illuminant used. Nevertheless, the color of an object appears to be something like constant to a human observer. The ability to calculate color constant descriptors from reflected light is called color constancy. In order to solve the problem of color constancy, some assumptions have to be prepared.

Natural scenes regularly have multiple illuminants. A room may be illuminated by artificial light as well as reflected sunlight. Even if there is only a single illuminant, the intensity of the illuminant usually varies across the image. In order to calculate color constant descriptors from the calculated data, one has to estimate the illuminant locally for each image pixel. A simple yet very efficient method is the use of local space average color.

Images with color cast [7] have standard deviation of one color channel significantly different from that of other color channels. This observation is also valid to local patches of images and ratio of the maximum and minimum standard deviation of color channels of local patches is used as a prior to select a pixel color as illumination color.

A new technique use to achieve color constancy that is based on the statistics of images with color cast. The illumination estimation may not always be correct if noise is present as it may cause abnormal modification in the ratio of standard deviations. Pre-processing with Denoising algorithms will solve this problem.

A color gradient [8]is presented with good color constancy preservation properties. The method does not need a priori information or variations in color space. It is naturally invariant to intensity magnitude, indicating high robustness against bright spots produced be specular reflections and dark regions of low intensity. It does not imply or need color segmentation, on the contrary can provide good color region split-up with little assumptions. It works on the RGB space, which the most common color processing space.

Computational color constancy purposes to estimate the actual color in an acquired scene disregarding its illuminant. Many illuminant estimation solutions have been suggested in the last few years, although it is known that the problem addressed is actually ill-posed as its solution lacks uniqueness and stability. To handle with this problem, different solutions usually exploit some assumptions about the statistical properties of the estimated illuminants and/or of the object reflectance in the scene.

Until now, most methods have been [11] based on physical constraints or statistical assumptions derived from the scene, whereas very little attention has been paid to the effects that selected illuminants have on the final color image representation. They describe the category hypothesis, which weights the set of possible illuminants according to their capacity to map the corrected image onto specific colors.

These color categories encode natural color statistics, and their relevance across different cultures is specified by the fact that they have received a common color name. From

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this category hypothesis, they suggest a fast implementation that allows the sampling of a large set of illuminants.

A fast implementation is simply defined by working in log space. Method is a purely bottom up method providing a framework for further combination with complementary visual information. Results have been attained without the need for a training step, as required in many other approaches. The suggested method can be enclosed within the family of statistical methods that estimates the illuminant by voting.

Color information [12] is a significant feature for many vision algorithms including color correction, image retrieval and tracking. The limitations of color measurement accuracy and explore how this information can be used to improve the performance of color correction .The notion of color strength, which is a combination of saturation and intensity information to define when hue information in a scene is reliable.

The principle advantage of the color strength model is that it can be used to estimate the reliability of the color information contained in a pixel. The color strength model can be used to expand the performance of many other algorithms which rely on hue information such as image retrieval by color, object tracking, and person re-identification.

Image enhancement [13] issues are addressed by analyzing the effect of two well-known color constancy algorithms in combination with gamma correction. Those effects are studied applying the algorithms separately and in combination. The performance of the approaches is evaluated comparing the Average Power Spectrum Value of the test images and their corresponding outcomes, as a quality measure. According to the experimental results, it is observed that the application of the gamma correction after a color constancy algorithm results in an improved image quality.

Gamma correction [13] illuminates dark areas in the image, allowing a more clearly distinction of colors. Gamma correction is mainly used in practical applications requiring a dynamic range correction, an effect that also color constancy produces. Image enhancement produced by a single algorithm, the combined application of a color constancy algorithm and afterwards the gamma correction, yields a better result. The use of gamma correction after a color constancy algorithm for dark image enhancement. Such improvement can be useful in a number of computer vision and image processing tasks.

An improved color constancy approach [14] is obtainable by considering the drawback of the well-known max- RGB algorithm: Only the unreliable maximum intensities are taken for illuminant estimation.
In addition, to get better the color correction results on images lighten by multiple illuminants, soft clustering is performed to first divide the image pixels into a number of groups; the predictable illuminants of these groups are then joint for each image pixel specifically based on its membership values. The experiments on both the widely-used datasets and numerous web images show the efficiency of their approach.

3. GAPS IN LITERATURE

i. Edge based Color Constancy [13] will reduce the impact of the light thus may results in low brightness.

ii. The use of Non Local Mean [22] has been neglected by many researchers for Color Constancy algorithm

iii. Edge based Color Constancy [26] also may introduce Gaussian/random noise.

4. CONCLUSION

Color constancy is the capability to determine colors of objects independent of the color of the light source. These Edge-based color constancy methods make use of image derivatives to estimate the illuminants. However, different edge types exist in real-world images, such as material, shadow, and highlight edges. These different edge types may have a distinctive influence on the performance of the illuminate estimation. The survey has shown that existing researchers has neglected the use of (a) Edge based Color Constancy will reduce the impact of the light thus may results in low brightness. (b) The use of Non Local Mean has been neglected by many researchers for Color Constancy algorithm. And (c) Edge based Color Constancy also may introduce Gaussian/random noise.
In near future we will modify Edge Based Color constancy using NLM and to check various standard images under multiple light sources. In order to validate the performance of the future work; design and implementation of the future work will be done in MATLAB using image processing toolbox.

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