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A Review on Color Constancy Approach

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Abstract— Color constancy has power to displace the particular colors in presented photograph by considering the effectation of color gentle source. Several color constancy practices has been planned so far to improve the color constancy accuracy charge further. In current literature quantity this sort of strategy can be obtained which functions optimistically in most case. Although the color cat suggests successful benefits over available practices, none the less it still is experiencing the problem of unequal illuminate and poor brightness. Ergo to cope with this issue for the reason that report a brand new integrated color cat approach is planned for the reason that dissertation. The newest approach has used color normalization and saturation weighting as article handling of color cat to reduce the effectation of unequal illuminate and poor brightness. The general benefits suggests the effectiveness of the planned technique.
Keywords— Digital Image Processing, Image Enhancement, Color constancy, Adaptive Histogram Equalization, Techniques of Color constancy

I. INTRODUCTION

An image may be defined as a two-dimensional function, f(x,y), where x and y are the coordinates which represents the information present in an image. When x, y coordinates represents a definite or constant value of numbers we can call that image a digital image because intersection of x,y coordinates gives a uniform and definite value of pixel that area [1]. The field of digital image processing basically deals with digital image who is having value in digital form. The digital value gives a definite information which is referred as picture elements, image elements, and pixels. A single dot on the screen is referred as pixel sometimes it is used as a unit to measure the resolution of the information available in the image[3] .More is the resolution of image then overall quality of image is quite high i.e data of image is more clear and consistent in nature. Unlike human eyes, which is limited capacity to the visual band of the electromagnetic (EM) spectrum of light, imaging machines like camera, satellite cover almost the entire electromagnetic (EM) spectrum, ranging from gamma waves to radio waves i.e. from lower to higher frequency [2]. They can evaluate on images generated by sources that humans eves cannot generate or predict. It includes ultra-sound image, electron microscopy and computer-generated images. It can be concluded that, digital image processing deals with large variety of images [2].

Basically there are three levels in with digital image processing deals with: [6]

A. Low level processes
It is also called lowest level and it involve basic evaluations such as image preprocessing to reduce noise, contrast enhancement, color enhancement and image sharpening. A low-level process we give input as an image and output of an image is also a proper digital image.

B. Mid-level processes
This computing on images involves activities such as segmentation(to divide the entire image into smaller segments and perform operations on all the segments of the image to enhance its overall information present in an image) ,object recognition(description of the objects) and Object categorization(classification of individual objects) [8]. A mid-level phenomenon is classified by the factor that its inputs given all basically images, but its outputs are assign distilled from those images (e.g., edges, contours, and the identity of individual objects).

C. Higher-level processing
It imply "making sense" in which we extract the usual part of the image from the whole image and all the operations are performed on that extracted part of the image instead of the whole image [5].

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II. IMAGE ENHANCEMENT

Digital image enhancement techniques present numerous choices for bettering the visible quality associated with diagnostic image. Proper choice of such techniques is greatly influenced by the imaging modality, task at hand and viewing conditions i.e. the problem related to that image. There survive a wide variety of techniques for betterment of image quality. The contrast stretch, density slicing, edge enhancement image segmentation, image compression and spatial filtering are the more commonly used techniques. Image enhancement is attempted after the image is corrected for geometric and radiometric distortions. Image enhancement methods are used separately to each band of a multispectral image. Digital techniques have been found to be more efficient than the photographic technique for image enhancement because of the wide variety of digital processes. Image enhancement techniques can be divided into two broad classes. Spatial domain methods operate on the pixel value of the image .Frequency domain methods, which first takes the Fourier transform of an image and then operate on the pixel values accordingly [9].

A. Image Enhancement in Spatial Domain

The term spatial domain look up the grouping of pixel that forms an image. Spatial domain technique directly operates on the pixel value of an image. The assess of a pixel with coordinate (x, y) in the enhanced image is the result performing some operation on pixels in the neighborhood of (x, y) in the input image. Spatial domain process will be announce by the expression:

$$g(x, y) = T\left[f(x, y)\right] \qquad (1)$$

Where, $f(x, y)$ is the input image, $g(x, y)$ is the processed image, and T is an operator on f, defined over some neighborhood of (x, y). There are various ways to enhance the image. The appraise of a pixel with coordinates (x, y) in the enhanced image $\hat{f}$ is the result of functioning some operation on the pixels in the neighborhood of (x, y) in the input image, f [3].

B. Image Enhancement in Frequency Domain

Image enhancement in the frequency domain is simple in which we take the fourier transform of an image and performs all the operations on the image's pixel whose fourier transform is taken. The image blurring can be decreased by reducing the high frequency components or we can sharpen an image by increasing the magnitude of the high frequency components [9].

III.COLOR CONSTANCY

The human visual system is like a apparatus .It gives us three dimensional perception or view of the objects present in the world. Light is reflected from the objects around us. When the reflected eye enter into our eye it is measured by cells which are present in our eye . According to the reflected light an image is formed which varies in color and the brightness of the object. Color is actually not an attribute which an object inbuild have actually it is the data in processed form which an object reflects when light fall on it. The human visual system is able to determine the color of object irrespective of the illuminant . This ability is called color constancy. Color constancy problem can be solved using two basic approaches [8].

A. Illuminant Estimation under One Light Source

Secern color constancy algorithms usually are produced thus far through research study but they all are depending on evaluation of one homogeneous method to obtain accurate results on digital image. Algorithm alike white patch algorithm, Grey World algorithm and gamut mapping are founded algorithm on the assumption of single uniform source of light.

B. Illuminant Estimation under Multiple Light Sources

The maximal of color constancy algorithm are founded on single light source i.e.they are based on the supposition of spectrally uniform light is falling on the object and a single light source is available around the environment.. However, in real world, an image may be malcontent by multiple sources of light i.e more than one color of light is present around us. The Grey edge algorithm and Physics based algorithms are founded on appraisal of color of multiple sources of light. Hence, better results can be achieved by weighing multiple sources of light as a color constancy action [8].

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IV. COLOR CONSTANCY APPROACH

As discussed higher up, Color constancy is based on undermentioned two accesss which are farther categorized into different color constancy techniques i.e.-

- Pixel Based Approach.

- Edge Based Approach.

A. Pixel Based Color Constancy

Pixel Based color constancy algorithm all operations are performed on various values of pixel present in an image and accordingly output is achieved.

B. Edge Based Color Constancy

Freshly, Pixel based method is prolonged to edge based color constancy algorithms, since most of the detailed information of an object can be recognized from the edges of an image .Various image derivatives (i.e. edges) are accounted for estimation of color of light source .Edge Based algorithm is based on the assumption that the average edge difference in a scene is achromatic [9].

V. COLOR CONSTANCY ALGORITHM

A. Grey World Algorithm

The grey world algorithm [1] is experimental on grey world supposal i.e. the average broody in the arena is not uniform in nature. The light source color can now be appraisal by evaluating the value of all pixels which are present in an image by normalizing the light source from the image. This is actually a very useful algoritm to find the sorce of light present in an image. Long ago, the grey world algorithm is spiritualist to large or broad colored surfaces. Germane to methods may be used to identify the grey color present in an image i.e.method are used to find the amount of grey color present in a particular image. Farther betterment may allow better results in grey world algorithm [3].

B. Grey Edge Algorithm

Most of the methods or algorithm are based on single light source i.e. they consider that only one type of light is present in an image and all the pixel values are calculated according to single uniform light source present in an image,which is not possible in all the case. Since, an image can have multiple sources of light also and the overall information is affected by the amount of light present in an image. Consequently,in this paper a novel method is formed that enables color constancy under multiple sources of light instead of considering single light source. Recently, pixel based methods are extended to incorporate derivative information (i.e. edges) and high order statistics, resulting in grey edge algorithm. This algorithm is developed to have edge based color constancy as most of the detail of an image is present in an image .Since, the grey world algorithm is based on the supposal that the middling reflectance of surfaces as well as average edge difference in an image is achromatic. With the grey edge algorithm assumption the light source color can be computed from the average color derivative in the image [4].

C. Gray Edge 1st Order Derivative

In gray Edge 1st order derivative 4-neighbouring pixel's value are taken which are top ,bottom, left and right neighbour values. The first derivative-based edge detection operator is to observe image edges by computing the image slope values using various operators like Roberts, sobel and prewitt operators.

D. Gray Edge 2nd Order Derivative

In Gray Edge 2nd Order 8 pixels values are considered while performing operations on the image.Eight values include top,down,left,right ad vertical and horizontal neighbor of the given pixels [6].

E. Color cat

It performs well than all the color constancy algorithm by combining the outflank dimensions of two color constancy methods. This paper has introduced a new ,bolted and precise learning based method based on color histogram is proposed and its results are very

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efficient than all other algorithms. The method is called Color Cat (CC) and it surpass most of the other methods in conditions of accuracy and computation cost hence combining the scoop properties of the two main color constancy method groups [2].

1. $I = \text{Get Image}(\ )$
2. $H = I.\text{CalcuteHistogram}(n)$
3. $h' = Mh$
4. $x = c^T h'$
5. $r = x(r_1 - r_0) + r_0$
6. $b = a_1 r + a_0$
7. $g = 1 - r - b$
8. $e = (r, g, b)^T$

Since the chromaticity different parts of the particular ground-truth light valuations use a substantial correlation, one of these might be reconstructed through the different fairly accurately therefore lessening the volume of valuations had to identify the particular light through 2 to 1. In this manner, the especial number of probable chromaticities is delineate by way of single line since revealed. By knowing the two parameters i.e the value of and slope-intercept the value can be reconstructed [2].

The planned approach provides guidelines. Furthermore, it provides two hyper guidelines, resolution with the histogram, as well as, the number of utilized histogram principal elements .Their frozen combinations represent models. Each hyper parameter combination values are used in learning the method's parameters during the cross-validation on the learning. The design of which leads to budget friendly generalization malfunction following cross-validation the idea picked being the very best design. The described procedure is known as model selection. After the model selection procedure, the final parameter studying is performed again overall studying arranged while using the hyper parameters of the best model. The planned approach is frequently a learning-based one particular as well as all of us chose to brand the idea Color Cat (CC). The pseudo code with regard to making use of CC is presented in algorithm. It must be pointed out of which though this uniformity with the chromaticities of different illuminations has already been exploited in numerous published approaches, the color cat approach exploits it in the different as well as novel method [2].

Fig. 1 a) Input image   b) Output image

VI.LITERATURE SURVEY

Nikola Banic et al.[2015] [2]has discussed about color cat (CC), a novel and accurate learning based method for obtaining color constancy .Color cat algorithm has used the values of histograms and values of colors with some amount of light in it.This algorithm is applied on various images and has achieved good result as output.With help of this algorithm we can extract proper information present in an image after eliminating extra amount of light present in it.According to its achieved results it can be concluded that it is very accurate method to achieve color constancy[10].

Kai-Fu Yang et al.[2015] has discussed about new method which is based on the illuminant invariant measure(IIM). This model works efficiently in uniform and non uniform illumination. The value of Grey Pixels is calculated by using only two algorithms i.e. grey world or grey edge assumptions[7] .

Yubing Gong et al.[2015] had thrown a light on Lumiramic phosphor Technology. Its result was 96.0% from the original which was 60.7%. White LED color constancy is not yet achieved in this paper[12].

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S.Bianco et al. [2014] [3] has analyse performance of number of color constancy algorithms was examined and this conclusion was derived that a single algorithm cannot solve the problem of constancy. We have to use combination of more than two algorithm to so that we can have better result of any real time image. This work confirm that best and worst algoritm do not exist at all among the state of the art one and shows that simple combining strategies improve the illuminant estimation[13].

Noha Elfiky et. al.[2014] has examined 3D geometry model for the images. Estimation of multiple illuminations by distinguishing nearby light source from distant illuminations. Existing Algorithms are   based on specific imaging assumptions[8].

Hamid Reza Vaezi Joze and Mark S. Drew [2013] has discussed about nearest neighbor method which works efficiently on multiple light source butill now no appropriate method is used in scene recognition, shape matching image parsing, character recognition etc.

Feng-Ju Chang and Soo-Chang Pei [2013] has demonstrated Soft clustering of pixel in an image. It has improved the results to great extend.This method works efficiently under single as well multiple light source[15].

VII.   CONCLUSIONS

TABLE 1

Author, Journal and year of publication	Title of paper	Issues	Techniques	Benefits
Nikola Banić and Sven Lončarić, IEEE signal processing letters, vol. 22, no. 6, June 2015	Color Cat: Remembering Color Illumination Estimation	Extra amount of light present in the image.	Color cat algorithm	Deals with multiple light source
Kai-Fu Yang et. al ,IEEE,2015	Efficient Illuminant Estimation for Color Constancy Using Grey Pixels.	The value of Grey Pixels is calculated by using only two algorithms i.e. grey world or grey edge assumptions.	New method is based on the illuminant invariant measure(IIM)	This model works efficiently in uniform and non uniform illumination.
Yubing Gong et.al ,IEEE,2015	Impact of the design parameters uncertainty on the PC-white LED color constancy based on the theory of the uncertainty	White LED color constancy	Lumiramic phosphor Technology	Its result was 96.0% from the original which was 60.7%.
N. Banić and S. Lončarić, in 1st IEEE Int. Conf. Image Processing (ICIP), 2014, pp. 605–609, IEEE.	Improving the white patch method by sub sampling	Not even a single algorithm gives best result of color constancy	Introduced new method of sub sampling	Improved result of white patch algorithm
Noha Elfiky et. al. ,IEEE,2014	Color Constancy Using 3D Scene Geometry Derived From a Single Image	Existing Algorithms are based on specific imaging assumptions	3D geometry model	Estimation of multiple illuminations by distinguishing nearby light source from distant illuminations

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Hamid Reza Vaezi Joze and Mark S. Drew.IEEE,2013	Exemplar Based Color Constancy and Multiple Illumination	No appropriate method is used in scene recognition, shape matching image parsing, character recognition etc.	Nearest neighbor method	Works efficiently on multiple light source
Feng-Ju Chang and Soo-Chang Pei, IEEE 2013	Color Constancy via Chromaticity Neutralization:From Single to Multiple Illuminants	Single and multiple light source	Soft clustering of pixel is done	Improved the results to great extend.

VIII.   CONCLUSIONS

The new methods for shade constancy have been regarded for evaluation purpose. The connected techniques to shade constancy show that the the utilization of adaptive histogram adjustment is dismissed in shade cat but its use may decrease the unequal illuminate problem of shade constancy. The colour cat algorithm may introduce minimal energy image, thus saturation weighting based calculations are expected to be incorporated with it. The use of hybrid tone constancy approach can be dismissed in the utter most of existing literature. Thus to deal with this problem in that record a fresh incorporated shade cat method is planned in that dissertation. The new method has applied shade normalization and saturation weighting as post processing of tone cat to lessen the effect of unequal illuminate and poor brightness. The entire advantages shows the potency of the planned technique. That purpose hasn't regarded the aftereffect of numerous kind of looks on the perception image, thus in not as distant future a fresh approach can undoubtedly be planned to boost the outcomes further.

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