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Image Quality Enhancement by Airlight Estimation Technique

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ABSTRACT*:* Now a day's digital image have enveloped the complete world. The digital cameras which are main source of digital images. Sometimes the image taken from a digital camera is not of quality and it required some enhancement. There exist many techniques that can enhance a digital image without spoiling it. In spatial domain techniques, we directly deal with the image pixels. The pixel values are manipulated to achieve desired enhancement. In frequency domain methods, the image is first transferred in to frequency domain. It means that, the Fourier Transform of the image is computed first. All the enhancement operations are performed on the Fourier transform of the image and then the Inverse Fourier transform is performed to get the resultant image. In foggy weather conditions, images become degraded due to the presence of airlight that is generated by scattering light by fog particles .We propose a new method called the AIRLIGHT ESTIMATION TECHNIQUE to improve the picture quality of the foggy images.

KEYWORDS: Image Quality Enhancement, Spatial Domain Methods, Frequency Domain Methods, Airlight Estimation Technique

I.INTRODUCTION

In digital photography, the coloration of captured images often appears different depending on the illumination under which the image is taken. Different light sources have different spectral characteristics, thus requiring an adjustment of the captured image for the scene illuminant to recover its true coloration. However, cameras cannot judge the captured subject or its color, and cost-effective consumer electronic devices do not have an external sensor for illumination.

Automatic white balancing is one of the key essential image pre-processing components in consumer digital still cameras, and it can highly improve the final image quality of the captured image. In this paper, a novel automatic white balancing algorithm based on the adjacent channels adjustment in RGB domain using both luminance infomation and standard deviation of RGB components of the precaptured image is proposed. A light source model for evaluating different automatic white balancing methods is also described. The simulation results show that the proposed method can improve the final image quality of the captured image.

Different approaches have previously been taken to the problem of imaging in a scattering medium. Temporal-gated sensors and polarization filtering to reduce the amount of scattered light in an image. Other work has been directed towards improving the image quality from conven-tional sensors by digital postprocessing of the image data prior to display.

II. AUTOMATIC WHITE BALANCING OF FRAMES

a. SINGLE FRAME AUTOMATIC WHITE BALANCE BY CCGBMETHOD

Colour Component Gain Based Method (CCGB)Automatic white balancing has the aim of ensuring color consistency of the captured image over a wide range of light sources with different color temperatures. Almost all available automatic white balance techniques contain two main processing steps. Firstly, the illuminant is identified and some gaining coefficients are computed for each color component. After that, the red, green, and blue color components are multiplied with the corresponding gains to obtain the result image. The difference between the majority of the existing solutions rely on the method for gain computation.

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Automatic white balance (AWB) is one of the most important processing step of the image reconstruction chain from any digital camera. The aim of the AWB is to ensure color constancy of the images captured under light sour having different color temperatures. For instance, if a white ect is illuminated with a light source having low color temparature it will appear reddish in the captured image and it will appear bluish in the case of a high color temperature illumine the goal of the AWB is to adjust the color components such as the captured image looks like it was captured under canonical light.

$$Bc = \{C(i,j) | C(i,j) > T1\} \quad (1)$$

$$Maxc = \frac{1}{\#Bc} \sum_{C(i,j) \in Bc} C(i,j) \quad (2)$$

Where C stands for the red, green, and blue color components,C(i,j)represents the pixel at position (i,j) in the color component CT1 is a threshold and #Bc is the number of elements of Bc. Usually, the threshold T1is selected automatically based on the statistics of the processed image.

$$Max = min\{MaxR, MaxG, MaxB\} \quad (3)$$

The gain from of color components are computed such that their dynamic range will fit to the range[0,Max]

$$Gain_C = \frac{Max}{MaxC} \quad (4)$$

After the gains are computed.

$$Cout(i,j) = C(i,j)Gainc \quad (5)$$

Where $C \in \{R, G, B\}$ denotes red, green and blue color component

Figure 1: Input image of CCGB

Figure 2: Processed image of CCGB

Figure 1 shows the input image with pixels greater than threshold value which is selected and maximum value is found. Figure 2 shows the output image after calculating AWB in the input image

b. SINGLE FRAME WHITE BALANCE BY DT METHOD

Dynamic Threshold Automatic white balance is an important function of digital still cameras. The goal of white balance is to adjust the image such that it looks as if it is taken under canonical light. We proposed a novel technique to detect reference white points in an image our algorithm uses dynamic threshold for white point detection and is more flexible than other existing adhoc algorithms.

To maintain the color constancy of an image taken under different light sources, computational color constancy algorithms have been applied to accomplish white balance for digital cameras. There are various computational color

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constancy algorithms proposed in the literature, including grey world, perfect reflector, gamut mapping, and color by correlation. Most of these algorithms make certain assumptions of the color distribution of the image. They differ in the way the illumination is estimated. Illumination estimation is a challenging issue because the sensor response is controlled by many different factors such as object shape, illumination geometry, etc. These factors are difficult to separate in the illumination estimation step.

We use a dynamic threshold (as opposed to predefined threshold in previous approaches) to detect white points in an image. Similar to previous approaches, our method consists of two steps: white point detection and white point adjustment. First, the image is converted from to color space. Based on the color characteristics illustrated a near-white RGB.

The equation satisfying this is given by

$$Db = \sum_{i,j} (Cb(i,j) - Mb)/N \quad (6)$$

$$Dr = \sum_{i,j} (Cr(i,j) - Mb)/N \quad (7)$$

Where, $Cb(i,j)$ and $Cr(i,j)$ are chromaticity values of pixels(i,j), N no of pixels for calculation

The white region is composed of

$$|Cb(i,j) - Mb + Db * sign(Mb))| < 1.5 * Db \quad (8)$$

$$|Cr(i,j) - (1.5 * Mr + Dr * sign(Mb))| < 1.5 * Dr \quad (9)$$

The idea behind these equations is similar to that of the gray world method. That is, the mean values of chromaticity, Mb and Mr , manifest the color deviation of whole image. However, the white color deviate the most in response to different color temperatures.

$$Rgain = \frac{Ymax}{Ravew} \qquad Ggain = \frac{Ymax}{Gavew} \qquad Bgain = \frac{Ymax}{Bavew}$$

Ravew,Gavew,Bavew are mean values of reference white points for three channels.Pixel value of each image is adjusted by

$$R' = R \times Rgain \qquad G' = G \times Ggain \qquad B' = B \times Bgain$$

Where *R*,*G*,*B* are original values of pixels in image and R', G', B' are adjusted pixel value.

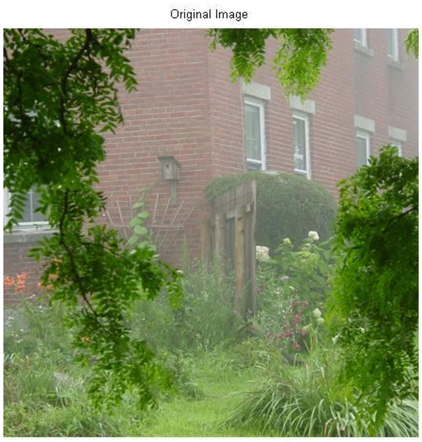

Figure 3: Input Imageof DT

Figure 4: Processed Image of DT

Figure 3 shows the input image of Dynamic Threshold in which Mean is calculated and the white point pixels are selected from the matrix and the gain corresponding to that pixels are calculated. The input image is processed using dynamic threshold method and R,G,B pixels are found out from the matrix and pixels are multiplied with corresponding gain and AWB calculated output is shown in figure 4.

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III. COMPARISON OF CCGB AND DT METHOD

CCGB method is the color component gain based method and DT method is dynamic threshold method and the colour variance of two methods is shown in the figures 2 and 4 respectively.

Table 1: Colour variance of R, G, B in CCGB method

CCGB method	RED	GREEN	BLUE
SUN LIGHT	0.40	0.37	0.44
FLUORESCENT LIGHT	0.16	0.16	0.19

Table 2: Colour variance of R,G,B in DT method

DT method	RED	GREEN	BLUE
SUN LIGHT	0.31	0.32	0.38
FLUORESCENT LIGHT	0.13	0.11	0.15

From the above tables we can conclude that the CCGB method shows better results and so it is selected for Airlight Estimation Technique.

IV. AIRLIGHT ESTIMATION TECHNIQUE FOR DIGITAL IMAGES - REGION SEGMENTATION

In this paper, we suggest estimating the airlight for each region and modeling the airlight for each region and the coordinates within the image to generate the airlight map. In the case of an image with various depth, the contribution of airlight can be varied according to the region. Estimating the airlight for each region can reflect the variation of depth within the image. Regions are segmented uniformly to estimate the regional contribution of airlght.

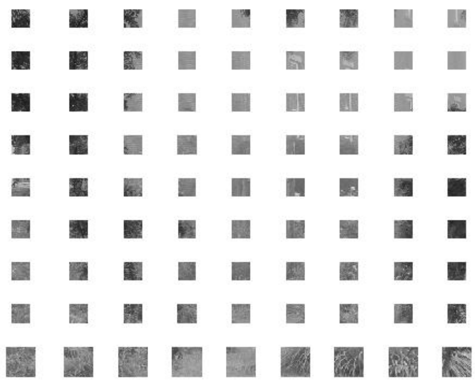

Figure 5: Region Segmentation of input image

V. GENERATION OF AIRLIGHT MAP BY REGRESSION ANALYSIS

Objects in the image are usually located at different distances from the camera. Therefore, the contribution of the airlight in the image also differs with depth. In most cases, the depth varies with the row or column coordinates of the image scene. This paper suggests modeling between the coordinates and the airlight values that are obtained from each region. The airlight map is generated by multiple linear regression using least squares.

So we present an airlight map that models the relationship between the coordinates of the image pixels and the airlight. In this paper, since the amount of scattering of a visible ray by large particles like fog and clouds are almost identical, the luminance component is used alone to estimate the airlight. In order to restore the luminance image, the estimated airlight map is subtracted from the degraded image.

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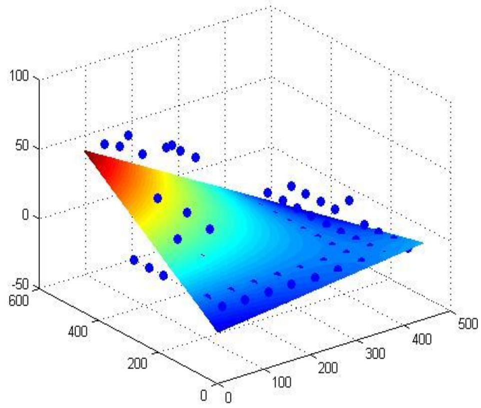

Figure 6: Airlight Map of input image

VI. POST PROCESSING

The fog particles absorb a portion of the light in addition to scattering it. By changing the color space from YCbCr to RGB, can be obtained. Therefore, after the color space conversion, histogram stretching is performed as a post-processing step.

So in this airlight map that models the relationship between the coordinates of the image pixels and the airlight. In this paper, since the amount of scattering of a visible ray by large particles like fog and clouds are almost identical, the luminance component is used alone to estimate the airlightIn order to restore the image blurred by fog, we need to estimate the airlight map and subtract the airlight from the foggy image as follows.

In order to restore the image blurred by fog, we need to estimate the airlight map and subtract the airlight from the foggy image as follows. Before restoration of luminance image the estimated airlight map is subtracted from the degraded image.to correct the blurring due to fog edge enhancement is performed

For this fourier transformed signal that is filtered by a high pass filter is a constant that determines the strength of enhancement is the de-blurred luminance image.

Figure 6: Input Image

Figure 7: Processed Image

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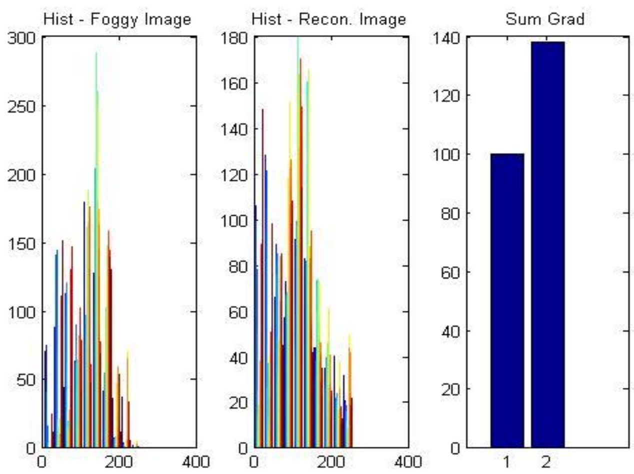
Figure 7 shows the input image in which Airlight Estimation Technique is done. Figure 8 shows the Processed Image by Regression Analysis Technique.

VII. COMPARISON OF ENHANCED AND FOGGY IMAGE

The performance of the enhanced and the foggy image is compared by their contrast, colourfulness and the sum gradient and the result shows a considerable increase in the result of foggy image as compared with the enhanced is shown.

Contrast and colorfulness are improved by 147% and 430% respectively over the foggy image. In addition, the sum of the gradient is also improved 201% compared to the foggy image.



Contrast Colourfulness Gradient

Figure 8: Result of evaluvation

VIII. RESULT AND ANALYSIS

The experiment is performed using MATLAB.The experiment includes the Colour Component Gain Based(CCGB) AWB and Dynamic Threshold(DT) AWB.The CCGB method is selected and is enhanced by REGRESSION ANALYSIS by using Airlight Estimation Technique.

This method includes the region segmentation and the estimation of the airlight map by regression analysis for each region .then the process of edge enhancement and the post processing of image is done and result is compared with contrast, colorfulness and gradient.

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Input Image

Input Image

Enhanced Image

Enhanced Image

Figure 9: Results of image enhancement by Regression Analysis

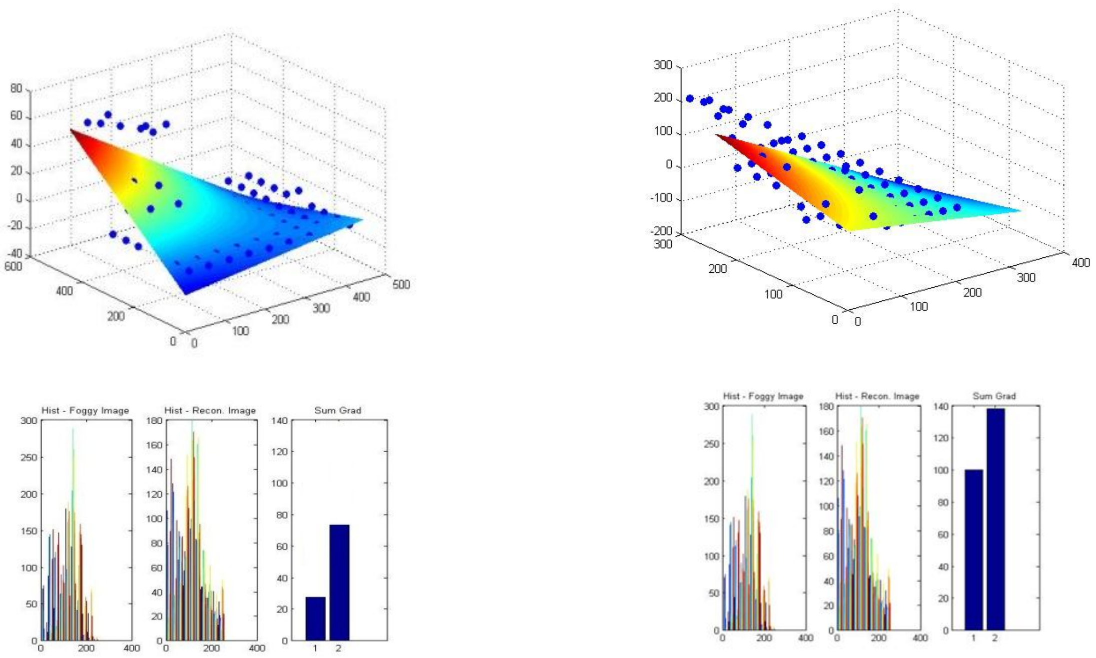

Figure 10: Results of Evaluation

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We propose to estimate the airlight using cost function, which is based on human visual model, and generate airlight map by modeling the relationship between coordinates of image and airlight. Blurred image due to fog is restored by subtracting airlight map from degraded image

In order to evaluate the performance, we calculated contrast, colorfulness and sum of gradient. The results confirm a significant improvement in image enhancement over the degraded image.

IX. CONCLUSION

Some of the most known and recent architectures has been surveyed in order to develop a new method for Automatic White Balance is Multiframe Auto White Balance by CCGB (color component gain based) method. This work is proposed and it improves the colour complexity and quality of the image along with enhanced White Balance.
The future work that is proposed is to apply the Enhanced White Balance to blurred outdoor images using airlight estimation technique.

In foggy weather conditions, images become degraded due to the presence of airlight that is generated by scattering light by fog particles. In this paper, we propose an effective method to correct the degraded image by subtracting the estimated airlight map from the degraded image. The airlight map is generated using multiple linear regression, which models the relationship between regional airlight and the coordinates of the image pixels.
Airlight can then be estimated using a cost function that is based on the human visual model, wherein a human is more insensitive to variations of the luminance in bright regions than in dark regions. For this objective, the luminance image is employed for airlight estimation.

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