IMAGE ENHANCEMENT BASED ON COLOR RESTORATION TECHNIQUE

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ABSTRACT

The paper presents the color image enhancement based on restore techniques. In this work, we propose two color restoration techniques are used. They are multi-scale technique and adaptive filter technique. In multi-scale retinex is to enhance the quality of the image and achieve color constancy. It suffers the color and halo distortion. The adaptive filter finds the importance of color information in color image enhancement and obtains better visibility. It reduces the halo and color distortion. The experimental results shows the adaptive filter is better performance compare to multi-scale retinex.

Index Term: - Adaptive Filter, Color Image Enhancement, Color Space Conversion and Retinex Human Visual System,

I.INTRODUCTION

Standard image enhancement techniques modify the image by using techniques such as histogram equalization, specification etc. [1] so that the enhanced image is more pleasing to the visual system of the user than the original image. Retinex [2-3] is an effective technique for color image enhancement, which can produce a very good enhanced result. But the enhanced image has color distortion and the calculation is complex. Li Tao and Vijayan K. Asari proposed a robust color image enhancement algorithm [4]. The algorithm can enhance color image without distortion, but the edges of the color image could not be handled well. The algorithm use Gaussian filter to estimate background image. Gaussian kernel function is isotropic, which leads to the inaccurate estimation of background image, resulting in the halo phenomenon. Considering the above two algorithms, a new bio-inspired color image enhancement algorithm is proposed by the author [5]. The algorithm is based on bilateral filter and has much better effect than the above mentioned two algorithms. However, the image still exhibits halo phenomenon at the edges in spite of the algorithm improving it. In [5], distance and luminance information of pixels are considered in the bilateral filter instead of only considering distance information in Gaussian filter. But the color information is still not taken into consideration. Another scheme, named Recursive Mean-Separate Histogram Equalization (RMSHE), has been proposed to preserve the brightness [6]. RMSHE uses the BBHE iteratively. First RMSHE separates the input histogram into two pieces, by the mean. Then, to each piece, it uses this operation many times to generate 2n-pieces histograms. Finally, it equalizes each histogram piece independently. It is claimed theoretically that when the iteration level n grows larger, the output mean converges to the input mean, and thus yields good brightness preservation. Actually, when n grows to infinite, the output histogram is exactly the input histogram, and thus the input image will be output without any enhancement at all. In this paper is organized as follows. Modified Multi-scale retinex method in section II. Explain the adaptive filter in section III. Measures are present in section IV. The simulation results are presented in Section V. Concluding remarks are made in section VI.

II. MODIFIED MULTI-SCALE RETINEX (MSR)

Multi-scale retinex technique is a color restoration technique that convolution of surrounding function (F(x,y)) into image distribution and then subtraction the image distribution is given by

$$R_i(x, y) = \log I_i(x, y) - \log[F(x, y) * I_i(x, y)] \quad (1)$$

Where RI(x, y) is the single scale retinex of ith color. Ii is the image distribution. F is the Gaussian surrounds function and is given by

$$F(x, y) = K e^{\frac{-r^2}{c^2}} \quad (2)$$

Where c is the Gaussian surround space constant and K is selected such that

$$\iint F(x, y)dxdy = 1 \quad (3)$$

The multi scale retinex is simply multiply the weighted sum with several R is given by

$$R_{MSR\,I} = \sum_{n=1}^{N} W_n R_{ni} \quad (4)$$

Where N is the number of scales, Rni is the ith color of the nth scale, R_{MSRi} is the ith color component of the MSR output, and wn is the weight associated with the nth scale. The color restoration method for the MSR is given by

$$C_i(x, y) = \log[\alpha I_i(x, y)] - \log[\sum_{i=1}^{S} I_i(x, y)] \quad (5)$$

Where α is a constant parameter of the color restoration function.

The block diagram of MSR is given by

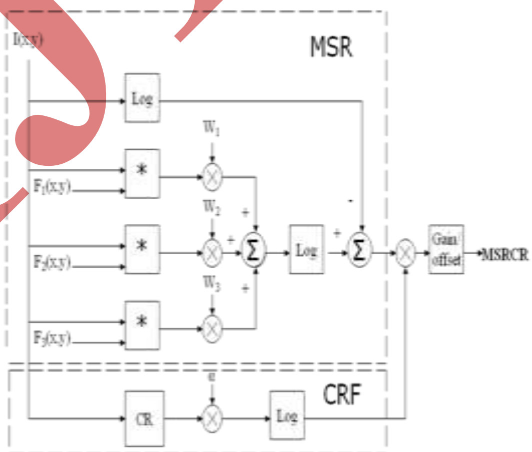

Fig.1. The Block Diagram Of MSR

After performing MSR on that image, the histogram of the Ri image was plotted and find the variance found from that. The clipping point was taken as 'y' times the variance where 'x' can take from 1 to 3 in any image. This y value cannot work for all images. So to avoid that problem using frequency of occurrence of pixels in the histogram as a control measure. The clipping point was chosen as y=0.005, to get the better enhancement in all images. The MSR is a suffers a halo distortion and less contrast enhancement.

III. ADAPTIVE FILTER

This technique is solving the halo distortion and better enhancement compare to MSR. It consists of three major parts. 1) Luminance image and background image 2) adaptive adjustment and 3) color restoration.

The block diagram of adaptive filter is given by

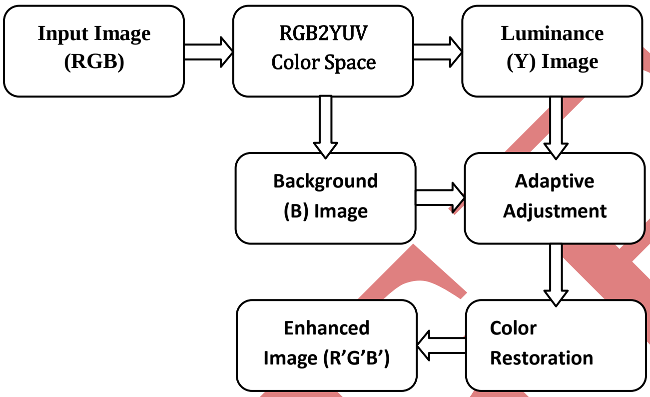

Fig.2. Block Diagram of Adaptive Filter

Firstly, convert the color image to YUV color space. Y stands for the luminance, and U, V are color components, which constitute the color information of RGB image. The luminance is the logarithmic function is expressed as

$$I_L(x,y)=\log(Y(x,y))/\log(range) \quad (6)$$

Where range is the highest pixel value i.e range=255.

Secondly, calculate the background image whose pixels are decided by the distance. The background image I_B of Y,U,V color image is given by

$$I_B(x,y) = \frac{\sum G_R G_N N(x,y)}{\sum G_R G_N} \quad (7)$$

Where

The N(x,y) represents the pixel of (x,y).

G_N is the scale parameter of pixel filtering

G_R is the distance parameter of intensity image. We use the below formula to obtain the distance parameter

$$G_R(x,y,x_i,y_j) = \exp\{-\frac{(x-xi)2+(y-yi)2}{2\sigma_N^2}\} \quad (8)$$

G_I is the distance parameter of U,V image is given by

$$G_I(x,y,x_i,y_j) = \exp\{\frac{(I(x,y)-I(xi,yj)}{2\sigma_i^2} \quad (9)$$

Gc is the scale parameter of U,V is given by

$$G_C(x,y,x_i,y_j) = \exp\{\frac{(U(x,y)-U(xi,yj)2+(V(x,y)-V(xi,yj)2}{2\sigma_C^2}\} \quad (10)$$

HereU(x,y),V(x,y) = chrome images of YUV image

I(x,y)=intensity value at (x,y) $\sigma_R,\sigma_I,\sigma_C$ are the scale parameters, whose values are 20,30 ,60 respectively.

Thirdly, calculate the adaptive adjustment is given by

$$I_E(x,y)=\beta(x,y).I_L(x,y) \quad (11)$$

Where β(x,y) is the pixel coefficients and I_L is the luminance image.

After adaptive adjustment, apply the index transform of IE and restoration to get the color enhancement image. The adaptive filter technique is solving the halo distortion, color distortion compare to multi-scale retinex. It has less complexity and computation time.

IV. ENHANCEMENT MEASURE

In this work, we consider two enhancement measurements. They are entropy and brightness error. The entropy is calculated as

$$\text{Entropy} = -\sum_i P_i \log_2 P_i \quad (12)$$

In the above expression, P_i is the probability that the difference between 2 adjacent pixels is equal to i. If entropy is high to get the better enhancement.

The brightness error (AMBE) is calculated as

$$AMBE(X, R)=|E(X)-E(R)| \quad (13)$$

Where E (.) denotes the expectation (i.e., mean), R is the referenced image, and here R represents the original image.

The mean brightness and entropy are computed and listed in Table I.

image	**entropy**	**AMBE**
person	6.75	0.023
lena	6.23	0.016

Table 1. Entropy and AMBE of Results Image

V. EXPERIMENTAL RESULTS

These work simulated using MATLAB TOOL. In this work, to show the adaptive filter and modified filter technique results.

Fig.3. Person Image

Fig.4. Image Enhancement Based on Modified Multi Scale Retinex

Fig.5. Image Enhancement Based On Adaptive Filter

VI. CONCLUSION

In this work, presents the color image enhancement based on adaptive filter and modified multi scale retinex. The adaptive filter is solving the halo distortion, color distortion compare to multi-scale retinex. It has less complexity and computation time.The result show the better performance of adaptive filter compare to modified multi scale retinex.

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