Equalization Model for Image Enhancement with Histogram Based Analysis on Gamma Correction

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Abstract: With the growth of technologies and the popularity of imaging devices, billions of digital images are created every day. Because of destructive environment, the quality of the image is affected. To overcome this defect image enhancement technique is needed. This technique is used to enhance the image's quality. Many previous studies proved that contrast enhancement techniques are efficient to clean up the unwanted noises and enhance the image's brightness and control it. In this work, we combine both grey balancing and contrast enrichment to achieve the good tone even as preserving contrast of an image using linearity and non-linearity functions of histogram transform.

INTRODUCTION

Digital images are the major source of knowledge in today's real world, because of their easy acquisition and storage. Digital images are very effective in transmitting the information. Digital images are employed in several applications such as military, biometric signature, medical diagnosis and surveillance video system. Because of some environmental problem, the captured images are not satisfactory. Generally, the real image is stored in RAW format. So tone mapping technique is required. Tone mapping algorithm can be classified into two types:

1. Grey Balancing: due to the physical constraint of inexpensive imaging sensors, the clear color bias has been carried out by the captured image. So there may a chance of color constancy [18], [21].because of this defect, linear transform is required to map the real image into a perfect one.
2. Contrast Enrichment: this algorithm is mostly used for restoring the besmirched media, from that histogram equalization is the best method.

Both contrast and neutral balancing has mutual impact of an image. The image enrichment system separates grey balancing and contrast enrichment as two different phases. Even if the tone adjusted in the grey balancing phase, the contrast enhancement may bias. Achieving contrast enrichment by maximizing the saturation of an image, it may cause tonal distortion. In common, all algorithms of grey balancing and contrast enrichment are based on histogram transformation.

RELATED WORK

In this aspect, P.milanfar [7] has proposed spatial filtering based enrichment methods, which includes non-local mean filter,bi-lateral filter, steering regression etc. J.van de weijer et.al [9] has been proposed an integrated model for color constancy based on low-level visual information.X.Wu [13] has introduced a method called OCTM (optimal Contrast-Tone Mapping) to solve contrast enrichment problem by maximizing the contrast gain. ZhiYu Chen et.al[12] developed a new automatic contrast enhancement technique called GLG(Grey Level Grouping).it is a general and powerful technique, which can be conveniently applied to a broad variety of low-contrast images and generates satisfactory result. Ji-Hee Han et al [14] has compared the performance of color histogram equalization methods based upon the 3-D histogram in RGB color space and analyzed the theoretical basis for the brightening or over equalization effect of the Trahanias algorithm by presenting intensity cdf and pdf.
In this work, we are going to discuss the relation between grey balancing and contrast enrichment of an image using histogram transformation based on linearity and non-linearity function.

A)COMPREHENSIVE EQUALIZATION METHOD

The main aim of generalized equalization model is to achieve both grey balancing and contrast enrichment problems which can be described in the form of histogram transformation. If the transformation is inclines as linear, the output is nearer to grey balancing. In the meantime, if the transform is inclines as non-linear, the output is nearer to contrast enrichment.

Assume that an image I==(I_r,I_g,I_b)T. The dynamic range of I_r is [0,Fc],c=r,g,b. the histogram of image is represented as {h_c,p_c}. here,$h_c \in L^k$ denotes the K intensity levels that corresponds to probability vector $p_c \in L^k$.K is the number of intensity level and its possibility value is non-zero integer. Consider the histogram of real image represented as {h_c,p_c}.

A) HISTOGRAM ANALYSIS BASED ON GREY BALANCING

Grey balancing is one of the important method with color constancy. Here, we used a low-level approach to form a relationship between the histogram and color constancy of an image.

In the lambertian model, the image is represented as

$$I_r=\int r(\lambda)l(\lambda)m_c(\lambda)d\lambda.(1)$$

Therefore, λ is represented as wavelength of light .r(λ) is represented as reflectance of surface, is the light source and is the sensitivity of camera in the channel c. the aim of color constancy is to evaluate the prophecy of light source on the RGB space.

For example, the histogram of grey balancing result is represented as

$$\widehat{h_c} = \frac{1}{e_c(\lambda)\sqrt{3}}\widetilde{h_c}$$

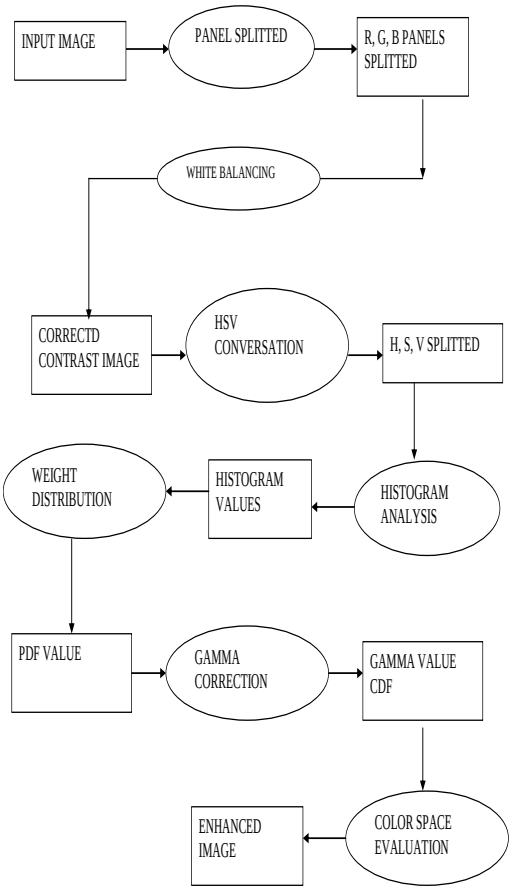
B) HISTOGRAM ANALYSIS BASED ON CONTRAST ENRICHMENT

The context-free contrast of the image is well-defined as,

$$C=P_c^{\,T}S_c(2)$$

Thus, the maximum contrast is I_c, which is achieved by a binary black and white image. If the minimum cost is zero, the image is constant, the contrast enrichment is accomplished by maximizing (2). All enhancement methods are proposed in [1], [5], [7], [13] is in which the histogram transform tends to be non-linear, which is diverse from grey balancing.

C) JOINT GREY BALANCING AND IMAGE ENRICHMENT



The comprehensive model provides a joint strategy for image enrichment. If βvalue is small positive range, then we can combine grey balancing and enhancement into a hybrid algorithm. Tone mapping for HDR image is another application. Most of the tone mapping algorithm based on local adaptive filtering, a primary method called gamma correction.It is the most common choice due to its robustness and lower complexity.It also avoids tone bias and protects the color of the image. By applying gamma correction, the brightness and contrast of the image is enhanced and the outcome image is brighter and more natural.

CONCLUSION

In this work, we discussed the relationship between grey balancing and contrast enrichment through the linearity and non-linearity functions of histogram transform using a comprehensive equalization model. The comprehensive equalization model manages a balance between the contrast enrichment and grey balancing. If the transform is linear, then it is related to grey balancing. If the transform is non-linear, then it is related to contrast enrichment.

In future, we expect more image enhancement methods through image attributes examination.

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