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A New Digital Video Quality Enhancement Approach Based On Generalized Histogram Equalization Model

Ramjee.Pinipe [1] K.V.Acharyulu[2]
Department of ECE (ECE) [1] Associate professor M.tech[2]
Chaitanya Institute of Science and Technology, Kakinada, JNTUK

ABSTRACT

In this paper, we have a tendency to propose a generalized leveling model for video improvement. supported our analysis on the relationships between video bar chart and distinction improvement white reconciliation, we have a tendency to initial establish a generalized leveling model desegregation distinction improvement and white reconciliation into a unified framework of protrusive programming of video bar chart. We have a tendency to show that several video improvement tasks may be accomplished by the projected model exploitation totally different configurations of parameters. With 2 shaping properties of bar chart remodel, specifically distinction gain and nonlinearity, the model parameters for various improvement applications may be optimized. We have a tendency to then derive associate degree best video improvement formula that in theory achieves the most effective joint distinction improvement and white reconciliation result with trading-off between distinction improvement and tonal distortion.

Keywords: Contrast Enhancement, White Balancing Contrast Gain, Generalized Equalization, Nonlinearity of Transform, Tone Mapping

1. INTRODUCTION

With the quick advance of technologies and therefore the prevalence of imaging devices, billions of digital pictures square measure being created on a daily basis. Because of undesirable source of illumination, unfavorable weather or failure of the imaging device itself, the contrast and tone of the captured image might not invariably be satisfactory. Therefore, image improvement is usually needed for each the aesthetic and pragmatic functions. In fact, image enhancement algorithms have already been wide applied in imaging devices for tone mapping. As an example, in a typical photographic camera, the CCD or CMOS array receives the photons passing through lens and then the charge levels square measure remodeled to the first image. Usually, the first image is kept in RAW format, with a bit-length too huge for traditional displays. Thus tone mapping techniques, e.g. the wide identified gamma correction, are used to transfer the image into an acceptable dynamic vary. a lot of refined tone mapping algorithms were developed through the years, simply to call a few. Generally, tone mapping algorithms can be classified into two categories by their functionalities throughout the imaging method.

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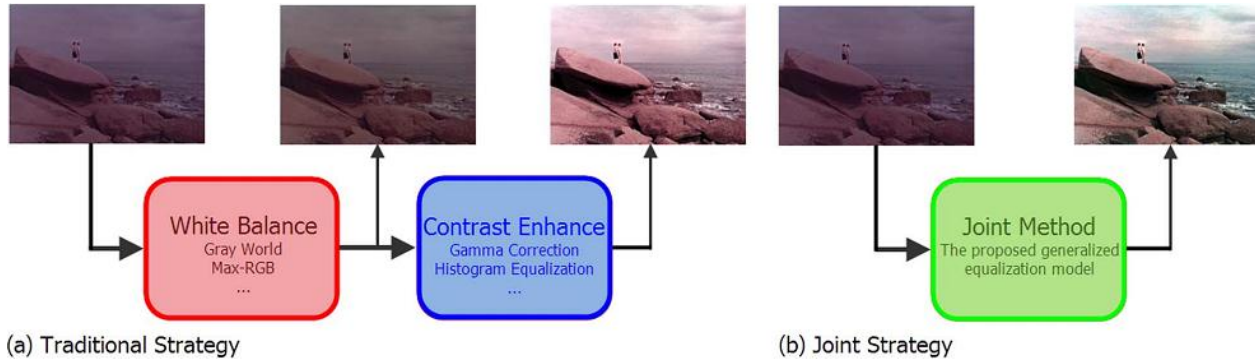

Figure 1: Figure (a) is the illustration of traditional image enhancement strategy. Figure (b) is the illustration of joint image enhancement strategy

A. White Balancing

Because of the undesirable luminance or the physical limitations of cheap imaging sensors, the captured image might carry obvious color bias.1To calibrate the color bias of image, we want to estimate the worth of light source, the matter of that known as constancy. Mistreatment suitable physical imaging model, one will get associate approximated brightness, so a linear trans form are often applied to map the first image into an ideal one.

B. Distinction Enhancement

Distinction improvement algorithms square measure wide used for the restoration of degraded media, among that international bar chart leveling is that the most popular choice. Alternative variants include native bar chart equalization and therefore the abstraction filtering sort of strategies. As an example, in the half filter issued to market the variances of texture thus on enhance the image. In, a texture synthesis primarily based formula is proposed for degraded media, like recent photos or films. On the other hand, remodel primarily based strategies additionally exist, e.g. Curve let based algorithm associate adaptive steering regression kernels planned to combine image sharpening with de-noising. Despite of the plentiful literature on image improvement, including those representatives listed on top of, 2 challenging problems for image improvement square measure still not resolved first, how to reach distinction improvement whereas conserving an honest tone.

2. PROPOSED METHOD

A. Histogram-Based Analysis on White Balancing

White balancing is a popular image enhancement method, with a critical step of color constancy. Being different from the learning based we focus on a low-level approach to color constancy and establish the relationship between color constancy and the histogram of and image.

In the Lambert an surface model, the image is expressed as

$$f_c = \int r(\lambda) l(\lambda) m_c(\lambda) d\lambda \qquad (1)$$

Here λ ,is the wavelength of visible light. $r(\lambda)$ is the surface reflectance, $l(\lambda)$ is the light source, (λ) and is the sensitivity of camera in the channel. The goal of color constancy is to estimate the projection of light source on the RGB space. To achieve this goal, many assumptions have been made. For example, the max-RGB is proposed, which estimates the light source from the maximum responses of the three channels. Another widely used assumption is gray-world hypothesis, which assumes that the average reflectance in the scene is Achromatic. Recently, these assumptions are unified, as follows

$$(\frac{\int |f(X)|^{\alpha} dx}{\int dx})^{\frac{1}{\alpha}} = Ce \quad (2)$$

From the viewpoint of image histogram, the left side of (2) can be rewritten as

$$(\frac{\int |f(X)|^{\alpha} dx}{\int dx})^{\frac{1}{\alpha}} = \begin{pmatrix} (P_r^T)^{\frac{1}{\alpha}} \\ (P)^{\frac{T}{g}} \\ ((P)^{\frac{T}{b}}) \end{pmatrix} \quad (3)$$

Eq. (3) reveals the inter connection among white balancing and histogram. Given an image, is calculated as

$$e_C(\alpha) = \frac{(P_C^T h_C^{\alpha})^{\frac{1}{\alpha}}}{\sqrt{\sum_{c=r,g,b} (P_C^T h_C^{\alpha})^{\frac{2}{\alpha}}}} \quad (4)$$

As a result, the histogram of white balancing result, denoted as, $\grave{h}_C$ is computed as follows

$$\grave{h}_C = \frac{1}{e_C(\alpha)\sqrt{3}} \grave{h}_C \quad (5)$$

It is obvious that this process is linear. The linearity of the trans-form is the most significant feature of histogram-based white balancing algorithm. In the next subsection, we will show that this linearity is also an important difference between white balancing and contrast enhancement

B. Histogram-Based Analysis on Contrast Enhancement

The expected context-free contrast of image is defined by

$$C = P_C^T S_C \quad (6)$$

By the definition, the maximum contrast is, which is achieved by a binary black-and-white image; the minimum contrast is zero when the image is a constant. So, the contrast enhancement is achieved by maximizing (6) in [43], as follows

$$\tilde{S}_C = argmax\ P_C^T S_C$$

$$s.t\ \sum_{i=1}^{K} S_{ci} = L_C\ ,S_{CI} \geq d \quad (7)$$

Where the first constraint makes sure that the output image still has a suitable dynamic range and the second constraint denotes the minimum distance between adjacent gray levels as d.

$$h_{ci} - C \sum_{j=n}^{i} P_{Ci} \quad (8)$$

Here C ,is a constant. Eq. (8) also gives a relationship between histogram and the distance between adjacent intensity levels, as following shows

$$\hat{S}_{ci} = \hat{h}_{ci} - \hat{h}_{c,i-1} = \hat{C}_{pci} \quad (9)$$

According to (8), (9), histogram equalization is equivalent to solving following optimization problem

$$\hat{S_C} = argmax \frac{1}{\|P_C^{-1} S_C\|}, \quad (10)$$

$$S.t. \sum_{i=1}^{K} S_{Ci} = L_C, \quad S_{Ci} \geq d$$

The performance of histogram equalization is not optimal in most situations. The essential reason for its limited performance is the questionable assumption that the histogram of ideal image obeys uniform distribution. To get better equalization result, we need to find a better distribution which is a big challenge. Recently, some adaptive histogram equalization methods are pro-posed but gave neither a clear definition of contrast nor an explicit objective function of contrast enhancement like (7), (10) shows. A common feature of all the enhancement methods mentioned above is that the transform of histogram is non-linear, which is different from white balancing.

C. The Proposed Model

The aims of establishing the generalized equalization model include: 1) giving a unified explanation to white balancing problem and contrast enhancement problem; 2) providing an explicit objective function for these two problems and proposing a joint algorithm for them; 3) controlling the performance of the algorithm by as few parameters as possible. The proposed model is inspired by (7), (10).

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Although (7),(10) seem to be very different, if we regard the order of and

$$\hat{S}_C = argmax \frac{1}{\|P_C^{-\beta} S_C\|n}$$

$S.t. \sum_{i=1}^{K} S_{Ci} = L_C, \quad S_{Ci} \geq d$ (11)

Both (10) and (7) have interesting relationships with (11)

According to the analysis above, (11) provides a reasonable and unified definition with the objective function of contrast enhancement. We will further take white balancing into the model. Based on (4), (11), we formulate the generalized equalization model mathematically as follows

$$\hat{S_C} = argmax \sum_{c=r,g,b} \|P_C^{-1} S_C\|_{n,}$$

$S.t \ \sum_{i=1}^{K} S_{Ci} = \frac{1}{e_c(\alpha)\sqrt{3}} \sum_{i=1}^{K} S_{Ci}, \quad S_{Ci} \geq d$ (12)

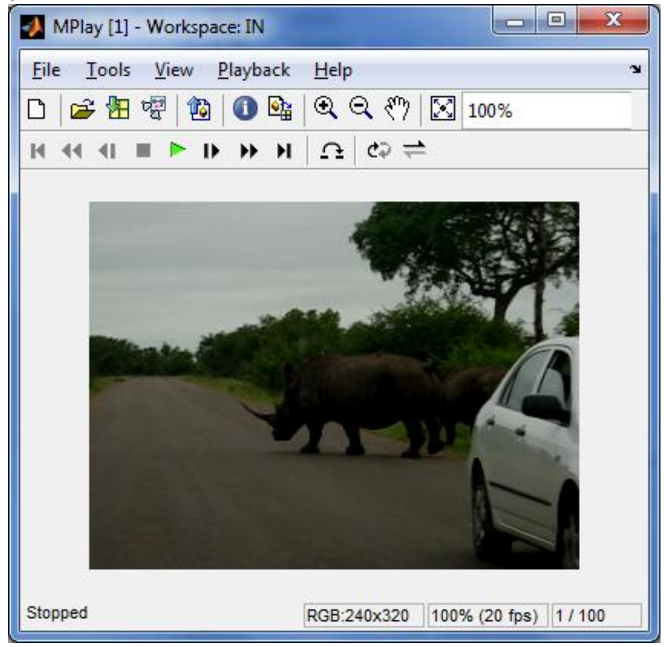
$G = \frac{P_C^T \hat{S}_C}{P_C^T \hat{S}_C}, NL = \|\nabla(\hat{S}_C - \hat{S}_C)\|2$ (13)

However, separate nonlinear transform of histograms of three channels may cause tone distortion. In the next section, we will theoretically prove that the proposed method, with a suitable configuration of parameters, can achieve a best trade-off between contrast enhancement and tone adjustment.

3. SIMULATIONS RESULTS

Below results shows that before and after histogram equalization of a video, figure (a) and (b) respectively

Methods	IMAGE 1 VALUES	IMAGE 2 VALUES
Histogram Evolution	0.6315	0.6654
Adaptive Histogram Equalization	0.6771	0.6896
Proposed Method(Generalized model)	0.6780	0.7270
Extension of the Project(Video)	0.9267	0.9962



Figure(a)

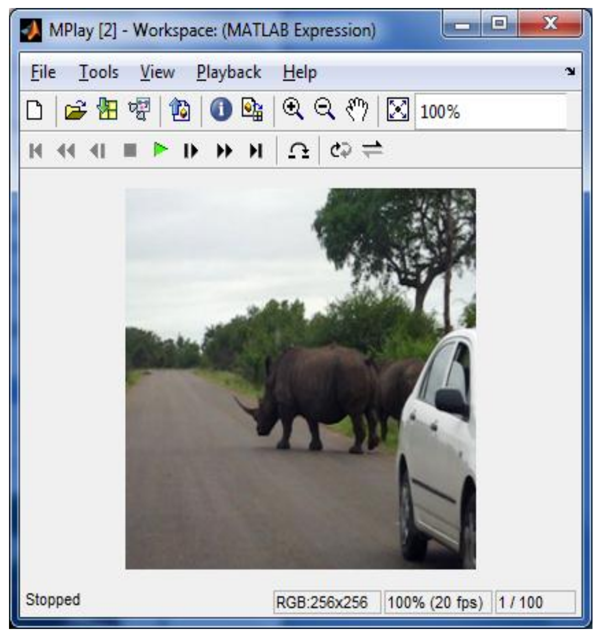


Figure (B)

4. CONCLUSION

In this paper, we have a tendency to analyze the relationships between video bar chart and contrast/tone. We have a tendency to establish a generalized effort model for world video tone mapping. intensive experimental results recommend that the projected technique has sensible performances in several typical applications together with video distinction sweetening, tone correction, white reconciliation and post-processing of de-hazed pictures. Within the future, besides world video sweetening, we have a tendency to expect to unify additional native video sweetening strategies into the model through native video feature analysis.

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