Image Processing Homework 3 Report

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1 Chromatic Adaptation

1.1 Gray World

The gray world Method assumes that the color of each channel approaches a constant gray value. By this assumption, we can calculate the average value of each channel. The ratio of each average value and the constant gray value can be the impact of light.

Assume the gray value equals the half of max value (Gray = 128). First, calculate the average (R, G, B) values ($\bar{R}, \bar{G}, \bar{B}$). Then calculate the ratio (k_r, k_g, k_b) of each channel. Finally, multiply the ratio to each pixel of the image.

$$k_r = \frac{Gray}{\bar{R}}, \qquad k_g = \frac{Gray}{\bar{G}}, \qquad k_b = \frac{Gray}{\bar{B}}$$

1.2 Max-RGB

The max-RGB method assumes that the max value of a image cause by the white surface, and the white surface can completely reflect the light. So, the max value of RGB value can be considered to the light value.

Assume the white surface is the max value (Max = 255). First, calculate the maximum values ($R_{max}, G_{max}, B_{max}$) of each channel. Then calculate the ratio (k_r, k_g, k_b) of each channel. Finally, multiply the ratio to each pixel of the image.

$$k_r = \frac{Max}{R_{max}}, \qquad k_g = \frac{Max}{G_{max}}, \qquad k_b = \frac{Max}{B_{max}}$$

1.3 Result and Discussion

The images processed by the Gray world and the max-RGB method for four different images are as follows. Figure 1.2 shows that the Gray world method may fail when the image has much similar color. Furthermore, Figure 1.3 shows the Gray world method also processes images with an over-brightness. The images in Figure 1.4 are under strong light, and the max value of RGB value may be 255. That causes the coefficients of the max-RGB method equal to 1, so the image looks the same.

After the test, I chose the Gray world method for images 1 and 4; and the max-RGB method for images 2 and 3.

Figure 1.1 (a)Original image (b)Gray world (c)MaxRGB

Figure 1.2 (a)Original image (b)Gray world (c)MaxRGB

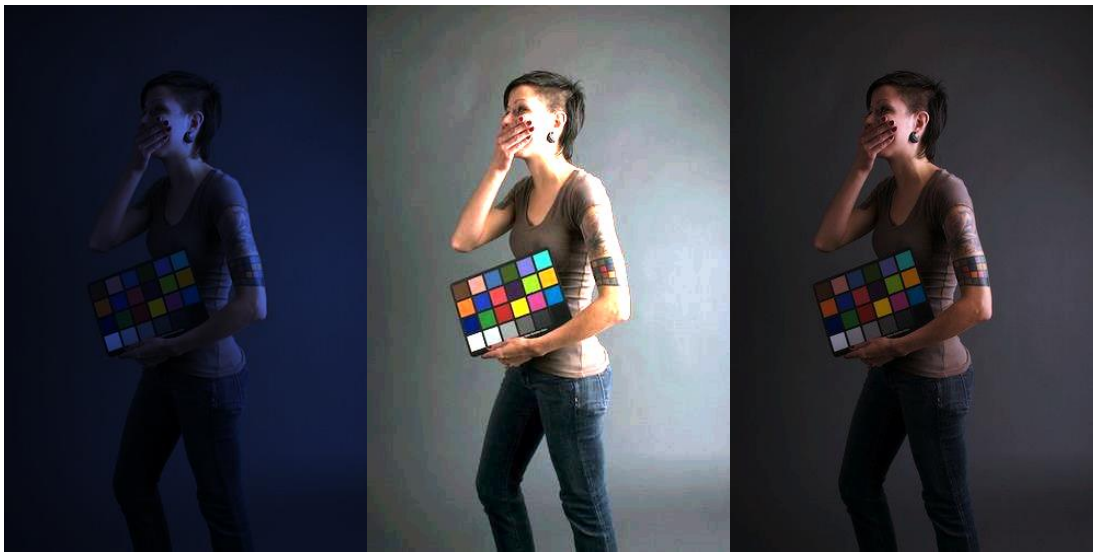

Figure 1.3 (a)Original image (b)Gray world (c)MaxRGB

Figure 1.4 (a)Original image (b)Gray world (c)MaxRGB

2 Image Enhancement

2.1 Histogram equalization

(See homework 2)

2.2 Gamma Correction

(See homework 2)

2.3 Result and Discussion

After the chromatic adaptation of each image, the problem of color constancy is almost solved. But the brightness can also be further enhanced to get a prettier image. I chose the histogram equalization method to enhance the contrast. For the images too bright or too dark the gamma correct can enhance the luminosity.
The condition in image 4 is harder. See Figure 2.1, the bright area is so bright that even a small coefficient of gamma correction can not see the detail in that area.

Figure 4.1 (a)Input image (b)Gamma=0.65 (c)Gamma=0.2