Automatic White Balancing

Basheer Ahammad Ragimanu

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Introduction Automatic White Balancing (AWB) is a process that aims to correct color cast in images caused by varying lighting conditions. We will explore two methods: Gray World and Retinex.

1 Gray World Assumption

The Gray World assumption is based on the idea that the average intensity of the red, green, and blue channels should be equal.

Equations

Given an image $I(x, y)$ of size $M \times N$, where x and y are pixel indices, and $I_r(x, y)$, $I_g(x, y)$, and $I_b(x, y)$ are the red, green, and blue channels respectively, we calculate:

$$R_{\text{avg}} = \frac{1}{MN} \sum_{x=1}^{M} \sum_{y=1}^{N} I_r(x, y)$$

$$G_{\text{avg}} = \frac{1}{MN} \sum_{x=1}^{M} \sum_{y=1}^{N} I_g(x, y)$$

$$B_{\text{avg}} = \frac{1}{MN} \sum_{x=1}^{M} \sum_{y=1}^{N} I_b(x, y)$$

We then define the gain factors for the red and blue channels:

$$\alpha = \frac{G_{\text{avg}}}{R_{\text{avg}}}$$

$$\beta = \frac{G_{\text{avg}}}{B_{\text{avg}}}$$

The red and blue channels are adjusted using the calculated gains:

$$\hat{I}_r(x, y) = \alpha \cdot Ir(x, y)$$

$$\hat{I}_b(x, y) = \beta \cdot Ib(x, y)$$

2 Retinex Theory

The Retinex theory suggests that perceived white is associated with the maximum cone signals of the human visual system.

Equations

Similar to the Gray World approach, we calculate the maximum values for each channel:

$$R_{\text{max}} = \max_{x,y}\{I_r(x, y)\}$$

$$G_{\text{max}} = \max_{x,y}\{I_g(x, y)\}$$

$$B_{\text{max}} = \max_{x,y}\{I_b(x, y)\}$$

We define gain factors for the red and blue channels:

$$\tilde{\alpha} = \frac{G_{\max}}{R_{\max}}$$

$$\tilde{\beta} = \frac{G_{\max}}{B_{\max}}$$

The red and blue channels are then adjusted similarly:

$$\tilde{I_r}(x, y) = \tilde{\alpha} I_r(x, y)$$

$$\tilde{I_b}(x, y) = \tilde{\beta} I_b(x, y)$$

Results

AWB methods, such as Gray World and Retinex, offer techniques to correct color casts in images. Both methods provide different ways of estimating gain factors for channel adjustment, contributing to improved color balance.

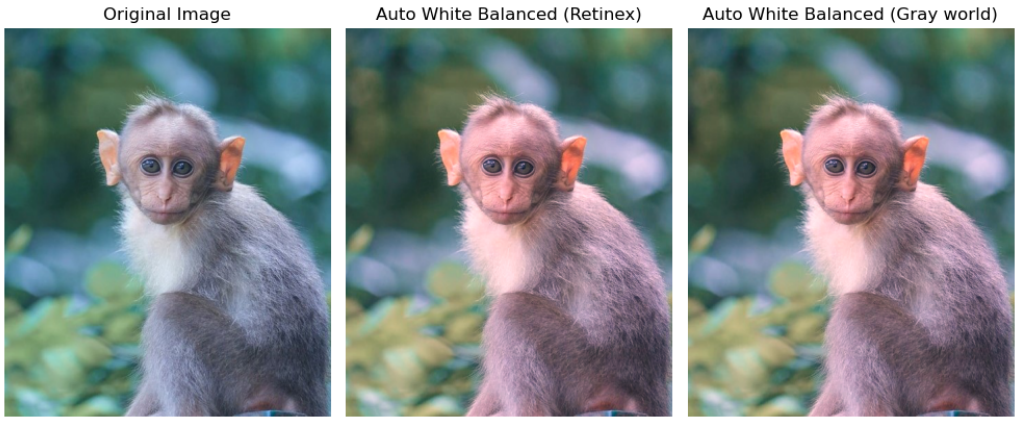

Figure 1: Automatic White Balancing using Gray world and Retinex