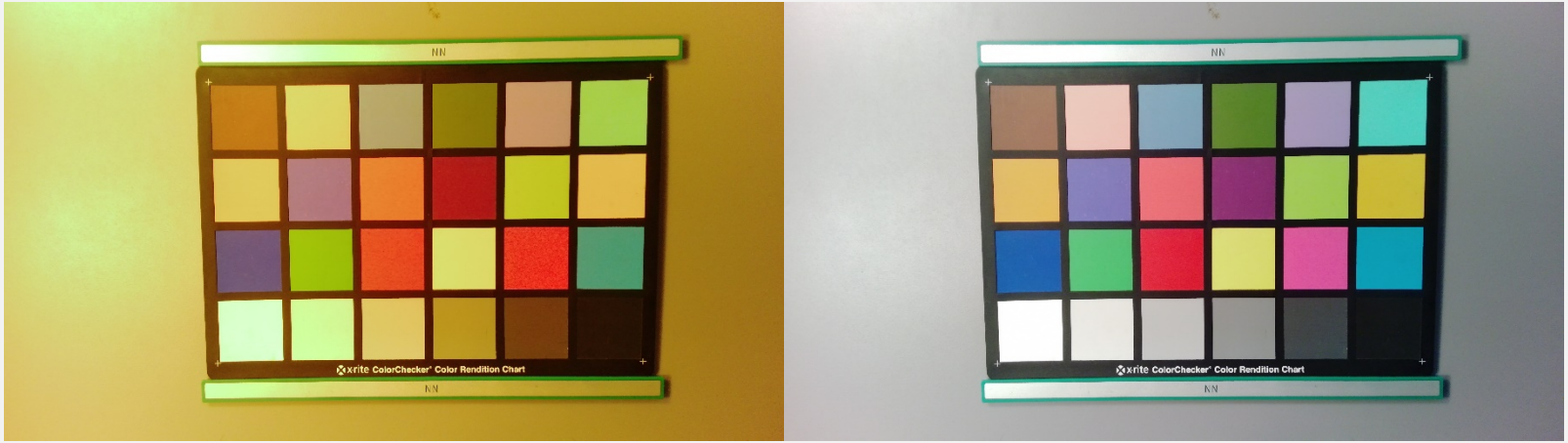
AWB-Auto White Balance

食鱼者

202108

AWB-Auto White Balance



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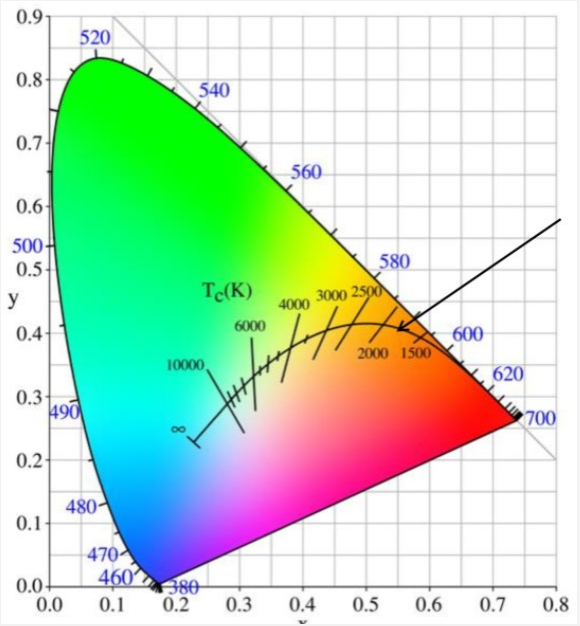
01 产生原因

产生原因

色温的定义：色温描述的是具有一定表面温度的“黑体”（blackbody）的辐射光的光谱特性

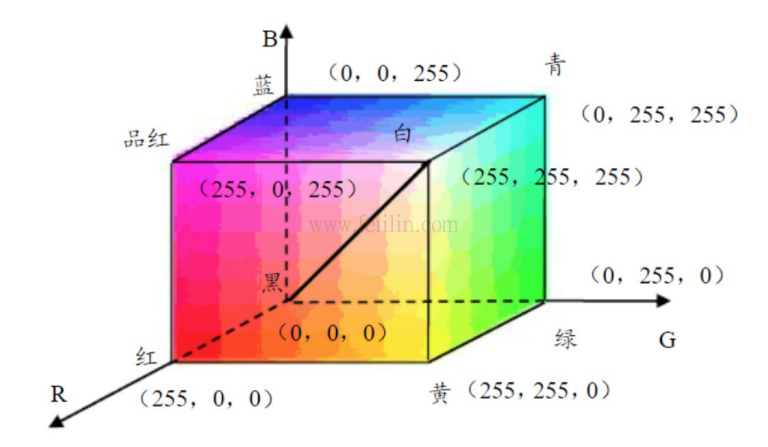
颜色恒常性：颜色恒常是指在照度发生变化的条件下人们对物体表面颜色的知觉趋于稳定的心理倾向

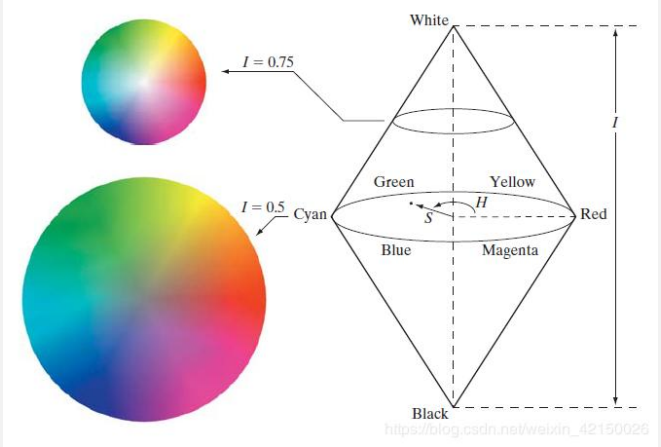
白平衡原理：传感器不具有人眼的不同光照色温下的色彩恒定性，白平衡模块就需要将人眼看来白色的物体进行色彩的还原，使其在照片上也呈现为白色



02 校正方法

校正法——YCbCr颜色空间





$$\begin{bmatrix} Y \\ U \\ V \end{bmatrix} = \begin{bmatrix} 0.3 & 0.59 & 0.11 \\ -0.15 & -0.29 & 0.44 \\ 0.51 & -0.52 & -0.095 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

校正法——Gray World Assumption

灰度世界理论：

任一幅图像，当它有足够的色彩变化，则它的RGB分量的均值会趋于相等。这是一个在自动白平衡方面应用极为广泛的理论。

校正法—Perfect Reflector Assumption

完美反射法

基于这样一种假设，一幅图像中最亮的像素相当于物体有光泽或镜面上的点，它传达了很多关于场景照明条件的信息。如果景物中有纯白的部分，那么就可以直接从这些像素中提取出光源信息。因为镜面或有光泽的平面本身不吸收光线，所以其反射的颜色即为光源的真实颜色，这是因为镜面或有光泽的平面的反射比函数在很长的一段波长范围内是保持不变的。完美反射法就是利用用这种特性来对图像进行调整。算法执行时，检测图像中亮度最高的像素并且将它作为参考白点。基于这种思想的方法都被称为是完美反射法，也称镜面法。

1．图像相关信息统计：

$$\begin{cases} R_{\max} = \max(R_{ij})(i=1\cdots N, j=1\cdots M) \\ G_{\max} = \max(G_{ij})(i=1\cdots N, j=1\cdots M) \\ B_{\max} = \max(B_{ij})(i=1\cdots N, j=1\cdots M) \end{cases} \quad \text{式（3-6）}$$

2．RGB 通道增益计算：

$$\begin{cases} Gain_{R\max} = \max(R_{\max}, G_{\max}, B_{\max}) / R_{\max} \\ Gain_{G\max} = \max(R_{\max}, G_{\max}, B_{\max}) / G_{\max} \\ Gain_{B\max} = \max(R_{\max}, G_{\max}, B_{\max}) / B_{\max} \end{cases} \quad \text{式（3-7）}$$

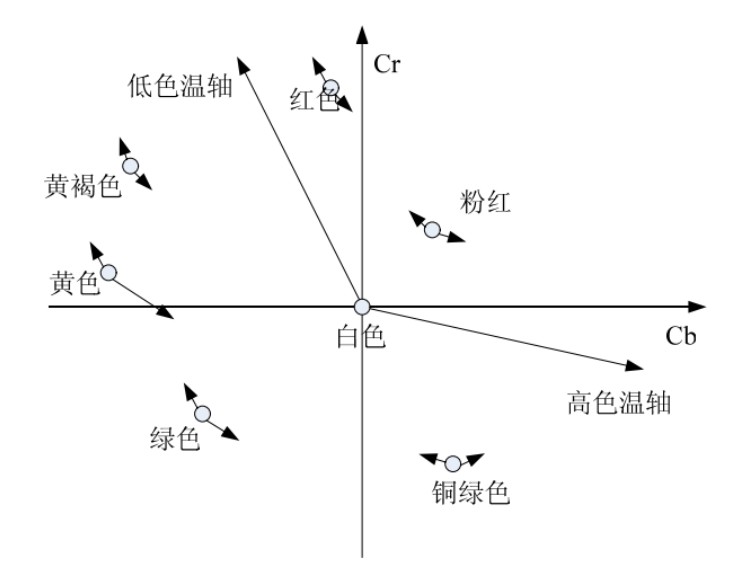
3．校正：

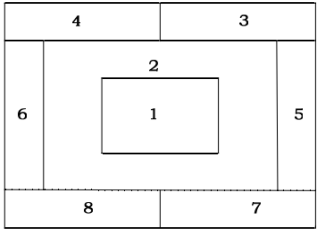
$$R'_{\max} = \begin{cases} R * Gain_{R\max} \longrightarrow R * Gain_{R\max} < 255 \\ 255 \longrightarrow R * Gain_{R\max} > 255 \end{cases} \quad \text{式（3-8）}$$

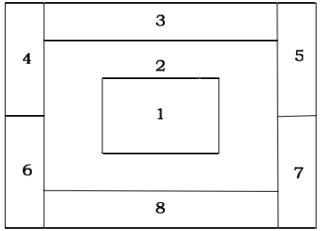
校正法—QCGP

将灰度世界和完全反射以正交的方式结合

校正法—模糊逻辑算法







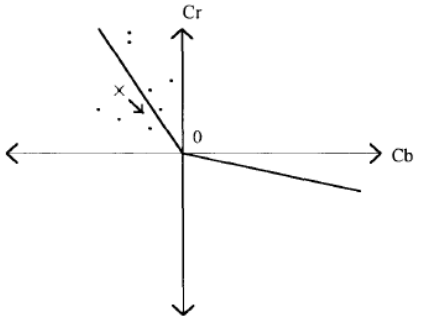


Fig.10a

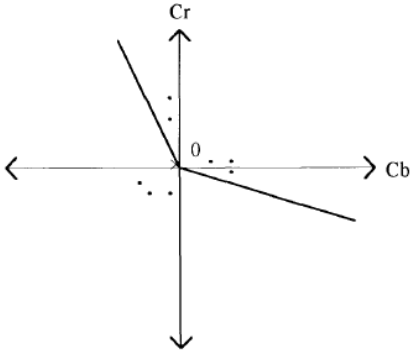


Fig.10b

校正法—基于白点或者基于色温的方法

The local AWB algorithms pay their attentions to extracting a number of pixels using some prior knowledge, such as white area [3], [4], human face [5], and so on. Pixels satisfying (1) given by Nakano's algorithm [3] are considered as white color points.

$$\begin{cases} Y > \chi \\ -\alpha < U < \alpha \\ -\beta < V < \beta \end{cases} \quad (1)$$

Reference [4] exploits the relations between U, V, and Y component, furthermore, a modified condition of the white area is given by (2).

$$Y - |U| - |V| > \phi \quad (2)$$

Where ϕ is a fixed value, which is set to 180. Fig.2 shows the white area defined by (2).

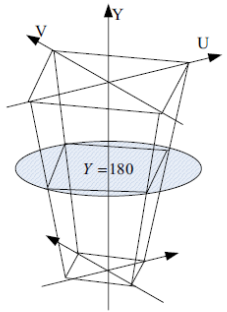


Fig.2. The modified white area in YUV domain, Y is larger than 180.

$$xD = \begin{cases} \frac{0.27475e^9}{T^3} - \frac{0.98598e^6}{T^2} + \frac{1.17444e^3}{T} + 0.145986 & 2000 \le T \le 4000 \\ \frac{-4.6070e^9}{T^3} - \frac{2.9678e^6}{T^2} + \frac{0.09911e^3}{T} + 0.244063 & 4000 < T \le 7000 \\ \frac{-2.0064e^9}{T^3} - \frac{1.9018e^6}{T^2} + \frac{0.24748e^3}{T} + 0.23704 & 7000 < T \le 15000 \end{cases} \quad (2a)$$

$$yD = -3 \times xD^2 + 2.87 \times xD - 0.275 \quad (2b)$$

$$X = \frac{xD}{yD} \quad (2c)$$

$$Y = 1 \quad (2d)$$

$$Z = \frac{1 - xD - yD}{yD} \quad (2e)$$

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$$\begin{bmatrix} R \\ G \\ B \end{bmatrix} = \begin{bmatrix} 3.24071 & -0.969258 & 0.0556352 \\ -1.53726 & 1.87599 & -0.203996 \\ -0.498571 & 0.0415557 & 1.05707 \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \end{bmatrix} \quad (2f)$$

校正法—基于边缘的方法

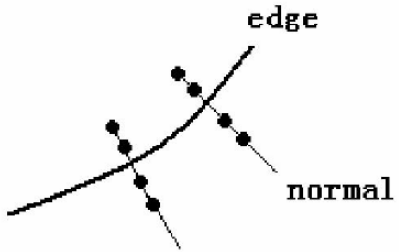
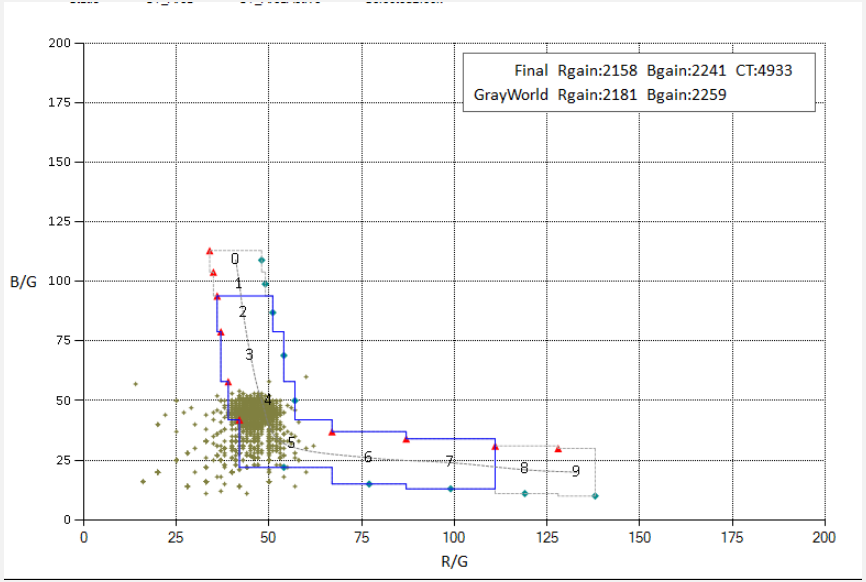


Fig.3. The way of marking reference pixels

校正法—多种方法融合


Final Rgain:2158 Bgain:2241 CT:4933
GrayWorld Rgain:2181 Bgain:2259
B/G
R/G
0
25
50
75
100
125
150
175
200
0
1
2
3
4
5
6
7
8
9

03 AWB的实现

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See You!