Multi-Axis-Adjusted System for Color Reproduction

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Abstract

In this paper, we propose a system to adjust specific color of image. The HSV of R/Y/G/C/B/M regions can be modified individually. The color reproduction can be preferred color, true color, or stander color for customer requirement.

1. Introduction

As the display industry is growing fast, high image quality is necessary. As the reference [1], the color-mapping algorithm is used to improve the color rendition. The method is the global adjustment, and whole color of image will be influenced. Consider above problems, some specific colors will be dealt with separately. As the reference [2] and [3], the skin and non-skin colors of image are segmented and enhanced individually. In order to satisfy all requirements of digital imaging applications, we propose the "Multi-Axis-Adjusted System" (MAAS) in this paper. Using the proposed system, color will be parted R / G / B / C / M / Y regions from the image, and hue, saturation and brightness can be adjusted independently.

2. Multi-Axis-Adjusted System (MAAS)

In the proposed system, colors of image are transferred to HSV (Hue, Saturation, and Value) color space [4]. According different hue angle, the image color will be separated into 6 axes (R/Y/G/C/B/M) as **Fig.1**.

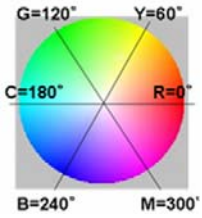

Fig. 1 The defined 6-axes region

The software is designed to adjust 18 set of parameters which are Hr, Hg, Hb, Hc, Hm, Hy, Sr, Sg, Sb, Sc, Sm, Sy, Vr, Vg, Vb, Vc, Vm, and Vy. These parameters are represented the HSV of R/Y/G/C/B/M regions. The parameters are written to T-CON embedded in LCD panel by PC via Inter-Integrated Circuit (I²C) as **Fig. 2**.

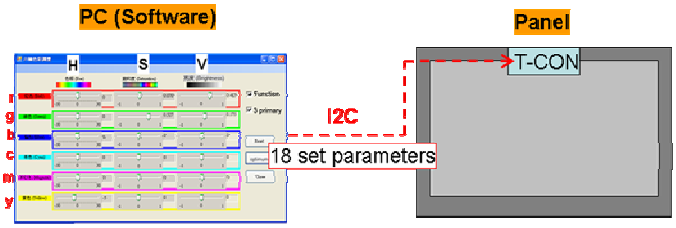

Fig. 2 The 18 set of parameters for T-CON

The procedure of proposed algorithm in T-CON is as **Fig. 3**.

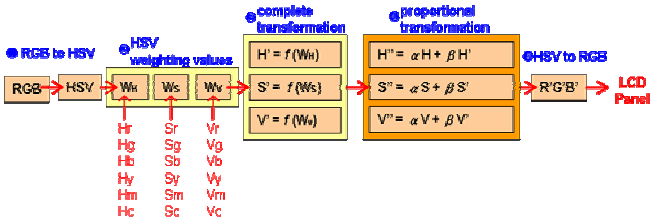

Fig. 3 The procedure of proposed algorithm in T-CON

The "❷ HSV weighting values" are calculated for reducing contour occurred between different axes. The "❸ complete transformation" is used to keep white balance. The "❹ proportional transformation" can control the ratio of original signals and complete transforming signals by the α and β values If the color with very high saturation (ex: 3 primary colors) or very low saturation (ex: white, gray, and black), the α value is minimum, in other word, the ratio of original signals is maximum. If the color is middle saturation, the α and β values are changed gradually.

3. Results and discussion

In this section, some testing patterns and natural images are adjusted by proposed system. The experimental results are as following:

(1) Contour Reducing

The proposed system can adjust color smoothly by using the W_h, W_s, W_v showed in **Fig. 3**. The result is show as the following **Fig. 4**. The contour can be reduced by these weighting values when color is adjusted between different axes.

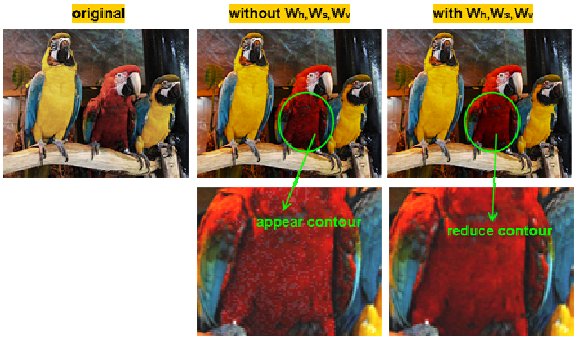

Fig. 4. The proposed system can avoid contour occurred after color enhancement

(2) Detail Remaining and white Balance Keeping

In our system, the color with very high or very low saturation won't be adjusted; other colors will be changed gradually. It can remain detail of high saturation and keep white balance of low saturation. We compare the"❸ complete transformation" with the "❹ proportional transformation" as the **Fig. 5** and **Fig. 6**.

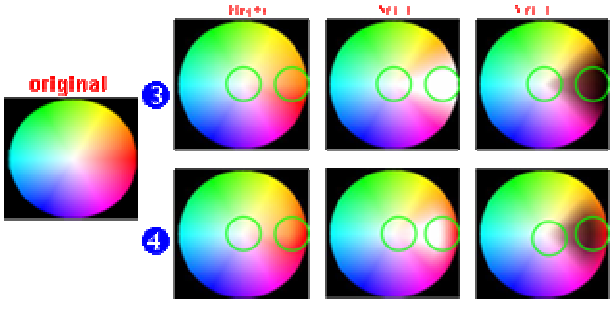

Fig. 5 The white and high saturation color won't be adjust in ❹

Fig. 6 The proposed system can retain detail of image

(3) HSV adjustment in specific axes

The system proposed in our paper can just modify c olor of specific regions without influence other region s as the following **Fig. 7**. The proposed method is imp lemented in CPT 15.6" panel. The 18 sets of paramete rs are optimized for CPT 15.6" panel.

Fig. 7. The system can modify specific color without influence other regions

4. Summary

In this paper, we proposed the multi-axis-adjusted system. In this system, we can adjust the HSV of specific color. The color can be enhanced without contour between different hue axes and detail and white balance of image can be maintained. The proposed system is hence to improve image quality.

5. References

[1] E. H. A. Langendijk, et al., "More Realistic Colors from Small-Gamut Mobile Displays", SID 04 Digest, pp. 1258 – 1261.

[2] H. Pan1, S. Daly, "A Gamut-Mapping Algorithm with Separate Skin and Non-Skin Color Preference Controls for Wide-Color-Gamut TV", SID 08 Digest, pp. 1363 – 1366.

[3] M-C. Kao, “A Vivid Color Management for LCD TV Adjusting Skin Color with RGB Signal Reconstruction”, IDW 07, pp. 1219- 1222.

[4] R. Gonzalez, R. E. Woods, “Digital Image Processing”, 2nd ed. Prentice Hall Press, ISBN 0-201-18075-8, 2002, pp.295.