

# Histogram Equalization-Based Color Image Processing in Different Color Model

Gwanggil Jeon and Young-Sup Lee

Department of Embedded Systems Engineering, Incheon National University,  
12-1 Songdo-dong, Yeonsu-gu, Incheon 406-772, Korea  
{gjeon,ysl}@incheon.ac.kr

**Abstract.** In this paper, we propose an intensity preserving histogram equalization algorithm which enhances contrast of color images. Image enhancement is an important issue which is to meet human visual perception. Fuzzy theory is used for improving histogram equalization. Simulation results show that certain color space gives the best subjective and objective results than the others.

**Keywords:** image enhancement, color image, histogram equalization, color space.

## 1 Introduction

Image enhancement is an important issue which is to meet human visual perception [1]. Currently image enhancement is broadly used for different image processing files [2-5]. The main goal of image enhancement is to improve the edge contrast of image and video.

In this paper, an intensity preserving and contrast enhancing histogram equalization algorithm is proposed for different color space images [6-9]. RGB color space is widely known, and we assume there are four other color spaces, LAB, YIQ, YCbCr, and HSV. Then, we apply our proposed method in the intensity channels.

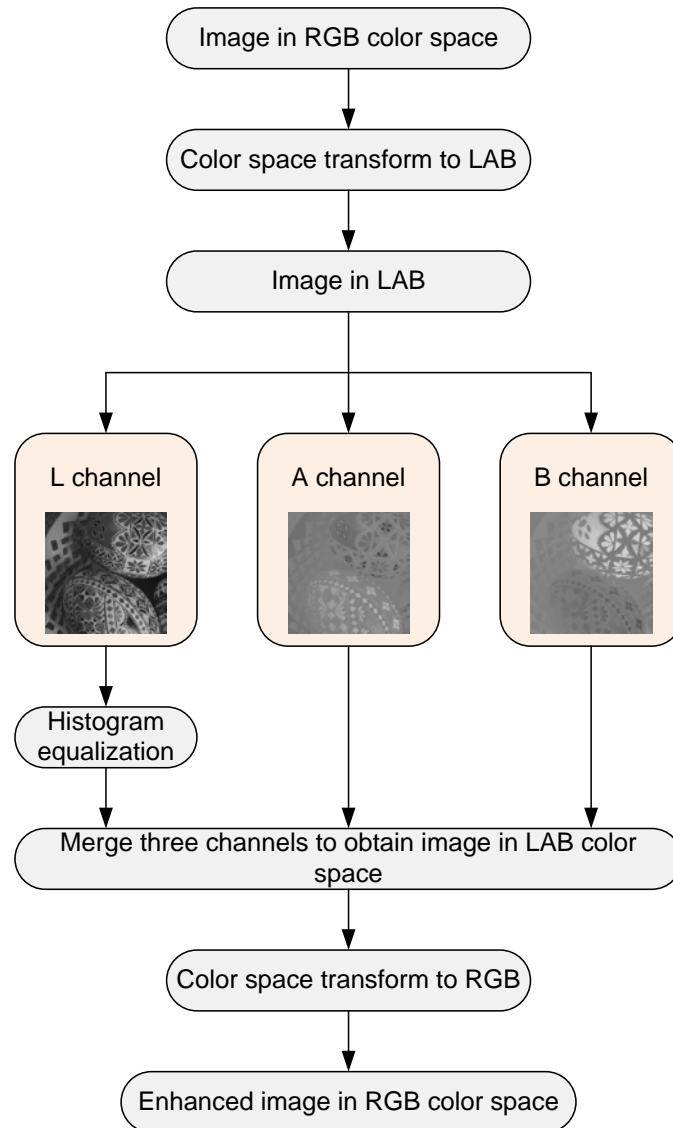
The remainder of the article is organized as follows. Short introduction of color space and the proposed method are introduced in Section 2. Experimental results are shown in Section 3 to compare the performance. Section 5 gives the conclusion and remarks.

## 2 Proposed method

The RGB color space is an additive color model where three color (R (red), G (green), and B (blue)) lights are complemented together in a single way to reconstruct a wide array of possible visible colors. On the other hand, the reverse model is CMYK (cyan, magenta, yellow, and key) color model which is a subtractive color model for

color printing purpose. Although RGB model is widely used, we also use other color spaces such as LAB, YCbCr, YIQ, and HSV [10].

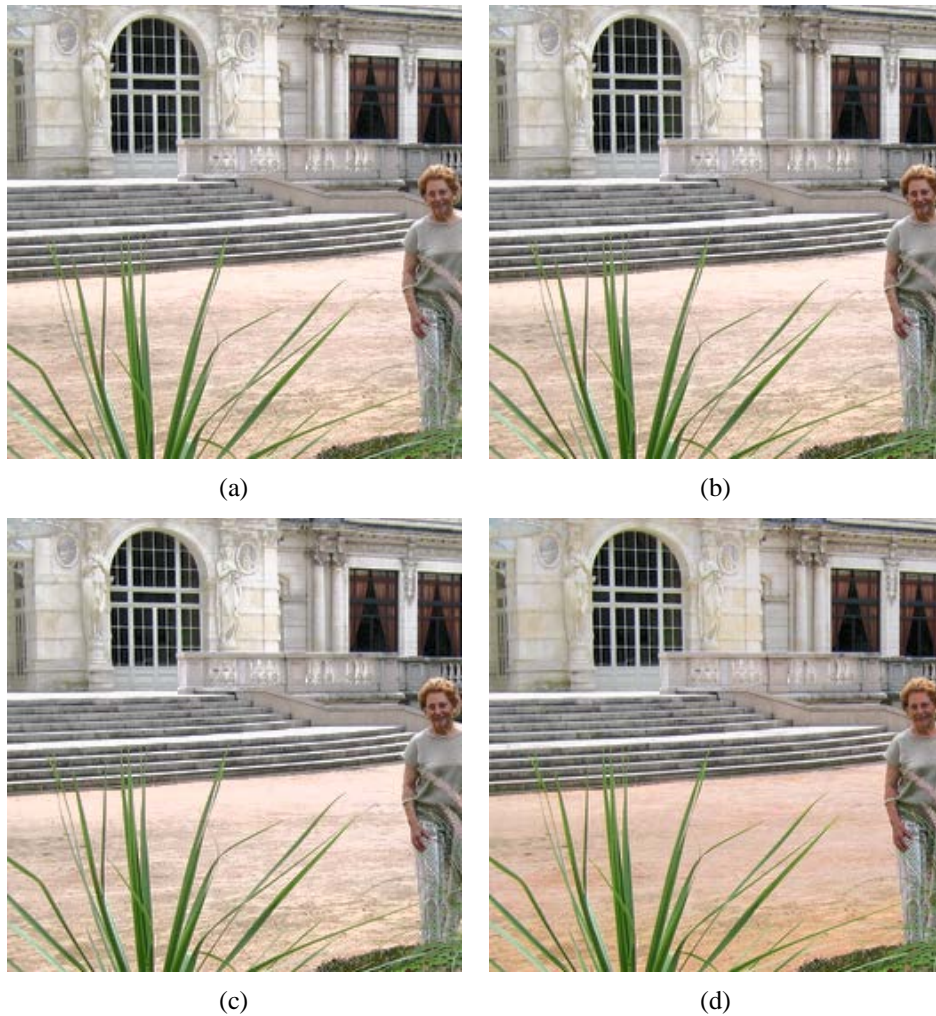
Figure 1 shows the block diagram of the intensity preserving image enhancement process for LAB, YCbCr, and YIQ color spaces.



**Fig. 1.** Block diagram of the intensity preserving image enhancement procedure of LAB color space.

### 3 Experimental Results

This section gives subjective performance comparison. We have four color spaces, i.e., LAB, YCbCr, YIQ, and HSV. We tested color spaces on LC dataset [11]. Figure 2 show visual performance comparison.



**Fig. 2.** Visual performance comparison on four color spaces for LC #113 image. (a) LAB color space, (b) YCbCr color space, (c) YIQ color space, and (d) HSV color space.

## 4 Conclusions

An intensity preserving and image enhancement algorithm was presented in this paper. It is found in visual performance comparison that the HSV color space yields better performance than the other color spaces.

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## References

1. R. C. Gonzalez and R. E. Woods, Digital Image Processing, 2nd ed., Prentice Hall, 2002.
2. C.S. Josephus and S. Remya, "Multilayered contrast limited adaptive histogram equalization using frost filter," in Proc. RAICS2011, 2011, pp. 638-641.
3. V. Vijaya Kumar, N. Gnaneswara Rao, A.L. Narsimha Rao, and V.Venkata Krishna, "IHBM: integrated histogram bin matching for similarity measures of color image retrieval," International Journal of Signal Processing, Image Processing and Pattern Recognition, vol. 2, no. 3, pp. 109-120, September 2009.
4. S.-S. Yoo, Y.-t. Kim, S.-J. Youk, and J.-H. Kim, "Adaptive-binning color histogram for image information retrieval," International Journal of Multimedia and Ubiquitous Engineering, vol. 1, no. 4, pp. 45-53, December 2006.
5. P. Dunne and B.J. Matuszewski, "Histogram-based detection of moving objects for tracker initialization in surveillance video," International Journal of Grid and Distributed Computing, vol. 4, no. 3, pp. 71-78, September 2011.
6. N. Sengee and H. Choi, "Brightness preserving weight clustering histogram equalization," IEEE Trans. Consumer Electronics, vol. 54, no. 3, pp. 1329-1337, Aug. 2008.
7. N. Bassiou and C. Kotropoulos, "Color image histogram equalization by absolute discounting back-off," Computer Vision and Image Understanding, vol. 107, no. 1-2, pp. 108-122, July-August 2007.
8. S.-D. Chen, "A new image quality measure for assessment of histogram equalization-based contrast enhancement techniques," Digital Signal Processing, vol. 22, no. 4, pp. 640-647, July 2012.
9. C. Zuo, Q. Chen, and X. Sui, "Range limited bi-histogram equalization for image contrast enhancement," Optik - International Journal for Light and Electron Optics, vol. 124, no. 5, pp. 425-431, March 2013.
10. Available: <http://www.cs.rit.edu/~ncs/color/>
11. Available: <http://www.gipsa-lab.grenoble-inp.fr/~laurent.condat/imagebase.html>