A Method of Classifying Tongue Colors for Traditional Chinese Medicine Diagnosis Based on the CIELAB Color Space

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Abstract. Objective tongue color analysis is an important research point for tongue diagnosis in Traditional Chinese Medicine. In this paper a research based on the clinical process of diagnosing tongue color is reported. The color data in RGB color space were first transformed into the data in CIELAB color space, and the color gamut of the displayed tongue was obtained. Then a numerical method of tongue color classification based on the Traditional Chinese Medicine (for example: light white tongue, light red tongue, red tongue) was developed. The conclusion is that this research can give the description and classification of the tongue color close to those given by human vision and may be carried out in clinical diagnosis.

1 Introduction

The analysis of tongue color is one of the important research points. The objective of it is to describe and classify the color of the tongue with some objective data system or method, and to provide a new way to do the research. In the last 10 years, the development of the technology has provided some new methods for the objective research. In the current researches, the RGB color space is always utilized in the collecting devices (e.g. digital cameras) and displaying devices (e.g. monitors)[1-5].

When RGB color space is used, there is a problem that the color data we got or displayed are closely related to the devices we used. Therefore, the same tongue color data from different digital cameras may be represented with different color. In order to display the tongue color uniquely and truly, we need to characterize the display devices.

Even though, we can only analyze tongue color data in definite display device to make sure of the correctness of the research. Once the data are transmitted to other
devices, the problem of color distortion will also appear. According to this, the conclusion of analysis based on the RGB color space can’t truly describe the tongue color.

In order to conquer this problem, we brought forward a method based on the CIELAB color space. According to it, we studied the distribution of the tongue color in the color gamut to find a more suitable method to classify the tongue color of Traditional Chinese Medicine (i.e. red tongue, light red tongue, light white tongue). Then we analyzed and described tongue colors based on the vision characters, and got the typical color of every kind of tongue colors. All of these are used to work out an exact and simple method which can be widely applied to classifying the tongue color for the clinical tongue diagnosis of Traditional Chinese Medicine.

2 Tongue Color and CIELAB Uniform Color Space

The diagnosis of tongue color is to get the relationship between the visual color stimulations and clinical syndrome-complexes. What is important is to describe the visual stimulation quantificationally (to describe visual stimulation with some data). Then how to choose an appropriate method of tongue description quantificationally is the crux of solution.

For the purpose of quantification description of the visual stimulations and measurement, CIE (The International Commission on Illumination) set up the CIEXYZ and CIE1931RGB system according to the experiments of matching three primitive colors. Later, they also did a great deal of quantity research to make the CIEXYZ system uniform and set up the CIELAB uniform color system. In CIELAB color space, the description of chromatic difference (or the calculation of the chromatic difference) was closer to the difference of human visual perception. So it has become the basis of color criterions in many countries. [6]

When we studied the tongue color diagnosis based on the CIELAB color system, we can get more impersonal and actual tongue color data because the description of color is independent of the color devices. And the distribution and classification of the tongue color in CIELAB color space are more suitable to clinical description and judgment of tongue color in TCM. Accordingly, the CIELAB color system is adopted in this research.

3 Typical Colors of Tongue and Classification

3.1 Three Typical Colors of Tongue

The data of tongue color samples were collected by a tongue analysis instrument in Beijing University of Chinese Medicine and Beijing TongRen Hospital. The tongue analysis instrument had its color performance characterized, i.e. it can transform the data in RGB color space to those in XYZ color space. Then we transformed the data to the CIELAB uniform color space to get the values of $L^*$, $a^*$, $b^*$ at all interested points on the tongue. The classification of tongue colors (i.e. red tongue, light red tongue, light white tongue) is accomplished by experienced doctors.