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Color Distribution Features from Tongue Image for Diagnosing Health Condition Change

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Extended Abstract

Objectives

A tongue provides direct evidence for diagnosing one's health condition based on its visual information, and it has been frequently used in Traditional East Asian Medicine clinics. Since the tongue exhibits different states during the progression of a syndrome, tongue manifestations are advantageous for the assessment of their health conditions with or without apparent disease. The objective of this study is to find meaningful features, which represent a change of the health condition, from tongue images in subjects with no apparent disease.

Scope and Methods

A total of 153 elderly people with no apparent disease were recruited. Tongue images were acquired twice from each subject in a controlled illumination environment at the interval of three to five weeks. Before the image acquisitions, two Korean Oriental Medicine doctors independently interviewed subjects about current digestion, sleep, and perspiration problems to assess their health conditions. Based on agreement between the two Korean Oriental Medicine doctors, digestion disorder (DD), sleep disorder (SD), and perspiration disorder (PD) were determined.

Pixel values in the sRGB color space from the acquired images were converted to the Commission Internationale de l'Éclairage (CIE) L*a*b* color space. Color correction was performed in the CIE L*a*b* color space by using six achromatic color and six chromatic color samples of the color checker in the acquired tongue image. Three linear equations for each L*, a*, and b* coordinate were solved by using a least squares method. A tongue region was automatically segmented by using the combined polar edge method and the gradient vector flow snake technique.

A two-dimensional color histogram counted the number of pixels in each color range based on the L* and a* coordinates. The L* and a* domains of the TDCH were derived from the mean color distribution of the 153 subjects. Intervals of the L* and a* domains were determined as 5 and 6, respectively, which divide each coordinate into 4 ranges. The number of pixels was normalized for each color range by dividing the number of pixels in each color range by the number of pixels in the entire tongue area. Among the 16 histogram variables (HVs), ranges with rarely distributed color in the tongue were excluded from this analysis. A one-sample Student's t-test was used for calculating differences of the HVs between the first and second acquisitions.

Results

Between the first and the second tongue image acquisitions, the health conditions of subjects were changed in the DD (n=36), SD (n=18), and PD (n=16). HV_3 ($32.5 \le L^* < 37.5$, $9 \le a^* < 15$) in the subjects with DD were larger than those without DD ($p=0.021$). HV_2 ($32.5 \le L^* < 37.5$, $a^* < 3$) in the subjects with SD were larger than those without SD ($p=0.019$), whereas HV_7 ($37.5 \le L^* < 42.5$, $21 \le a^*$) in the subjects with SD were smaller than those without SD ($p=0.047$). There was no significant difference in the HV

according to the presence of PD. The results showed that the values of HV_2, HV_3, and HV_7 reflect the changes of the health condition in subjects with no apparent disease.

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