Effect of Fixing a Tiny Wearable Display on a Tongue Imaging Analyzing System (TIAS) to Improve Stability of Tongue Presentation

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ABSTRACT

*The tongue is said to express the condition of the entire body. Therefore, tongue diagnosis is an important diagnosis method in **Kampo** Medicine. Changes in the color of different parts of the tongue reflect different health conditions. Digital tongue image capturing systems such as the tongue image analyzing system (TIAS) are aimed at performing diagnosis at a low cost, before the occurrence of illness. In this study, we examined the effect of attaching a small viewer with a guide marker to a TIAS to improve the stability of tongue presentation and the accuracy of color evaluation.*

1. INTRODUCTION

Tongue diagnosis is one of the diagnostic methods used in Japanese traditional Kampo medicine. In Kampo medicine, it is believed that the condition of the tongue reflects that of the whole body. It is possible to diagnose the physical condition of patients from various tongue characteristics, including color, shape, wetness, tongue coating, and texture. In addition, there are cases of tongue diagnosis in which diagnosis is performed by looking at the color of the tongue after dividing it into specific areas rather than looking at the entire tongue.

Multiple studies have reported a correlation between the shape and color of the tongue and an individual's health. However, most people are unaware of how to present their tongues and therefore require practice and guidance for proper tongue indication. We attempted to improve tongue imaging diagnosis for the general population by attaching a tiny monitor with a guide marker to a tongue image analyzing system (TIAS).

2. Method

2.1 Fixing a Tiny Wearable Display

We tried fixing the wearable display to the side of the device and used one eye to view the display, as shown in Figure 1(a). Tongue image on the wearable display (subject person side) and tongue image indicated on the medical practitioner's computer is shown in Figures 1(b) and 1(c) respectively. Since the position of the eyes of the examinee differs from one individual to another, the position could be adjusted by using the universal arm, as shown in Figure 2(a). The subject could see their own real-time tongue image, as shown in Figures 1(b) and 1(c).

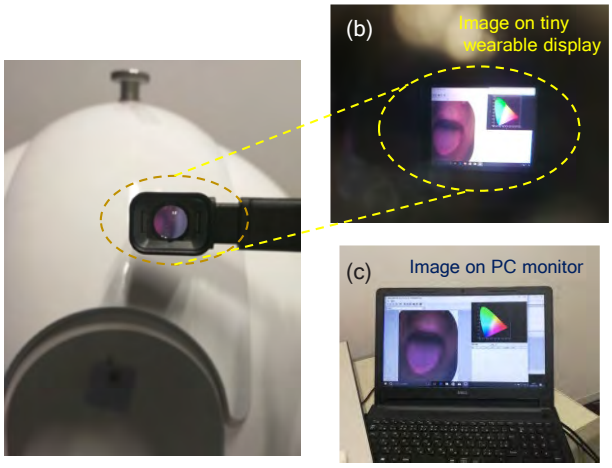

Fig. 1 (a) Photograph of TIAS using one eye of the wearable display, (b) tongue image on the wearable display (subject person side), and (c) tongue image indicated on the medical practitioner's computer.

2.2 Guide Maker Indication

To stabilize the tongue presentation, the guide marker (guide line) was indicated on the monitor, as shown in Figure 2(c). The size of the guide marker is changeable to fit the subject by using the marker image set.

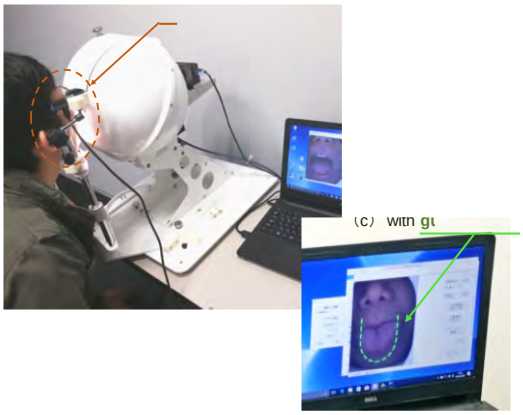

Fig. 2 (a) Image of TIAS for a human participant, (b) tongue image without a guide marker, and (c) tongue image with a guide marker.

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2.3 Setting for Shooting Three Types of Tongue Images

By using the tiny wearable display shown in Figure 1(a), we confirmed the effectiveness of the display. Images of the tongue of eight subjects were obtained with and without the tiny display, and further, with and without the marker as shown in Figures 1(b) and 1(c). These settings and abbreviations are summarized in Table 1.

Table 1. Setting for shooting three types of tongue images.

Setting No.	Tiny monitor	Guide maker indication on monitor	Abbreviation
(i)	without	without	(w/o, w/o)
(ii)	without	with	(w/o, w)
(iii)	with	with	(w, w)

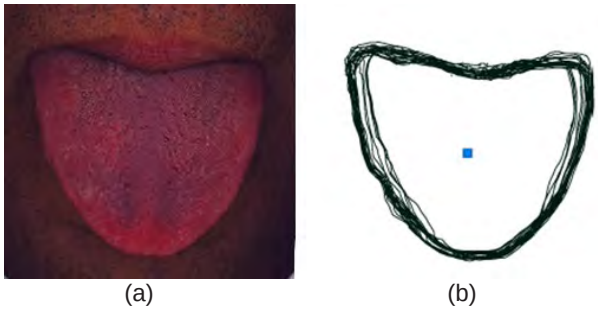
The tongue indication could be influenced by familiarity and experience with the process. Therefore, images were first obtained with glasses for four subjects (subjects A–D), and then images were obtained without glasses for the four remaining subjects (subjects E–H).

2.4 Evaluation for Improving Stability of Tongue Presentation

Tongue shapes were shot every ~10 s over a total of 100 s. By using these data, at first the part of the tongue was selected. After that, we measured each tongue's width, tongue height, and integrated tongue area. All imaging processes were achieved by Photoshop CC.

3. Results and Discussion

Figure 3(a) shows one of the tongue images, and Figure 3(b) shows the changes in tongue shape over 100 s.



(a) (b)

Fig. 3 (a) One of the tongue images and (b) changes in tongue shape over 100 s.

Table 2-1 coefficient of variation of tongue hight (%)

	Participant	A	B	C	D	E	F	G	H	Average of A~H
(i)	(w/o, w/o)	2.9	6.2	2.6	7.6	2.0	4.9	3.8	4.5	4.3
(ii)	(w, w/o)	4.0	8.0	7.6	4.5	1.7	4.1	2.4	1.3	4.2
(iii)	(w,w)	3.8	4.6	5.3	4.8	2.1	3.0	2.6	3.5	3.7

Table 2-2 coefficient of variation of tongue width (%)

	Participant	A	B	C	D	E	F	G	H	Average of A~H
(i)	(w/o, w/o)	6.6	2.6	3.0	4.7	1.2	1.7	2.1	1.3	2.9
(ii)	(w, w/o)	4.0	3.6	4.2	11.2	1.5	1.6	1.2	1.4	3.6
(iii)	(w,w)	2.0	1.4	3.2	2.7	0.8	0.6	1.5	0.8	1.6

To calculate the temporal fluctuation of the size of the tongue, standard deviation / average = coefficient of variation was obtained with size. Table 2-1, 2-2 includes the coefficient of variation (CV) of each with respect to changes in tongue height and width, respectively.

To compare the results of three types of setting (i) ~ (iii), focusing on CV in the height and width of the tongue, it shows clearly that there is little CV in the case of (w, w).

Finally, we examined stability of tongue color at a fixed point. For example, we chose participant F because of appropriate CV improvement with device. Figure 4 (i) (w/o, w/o), (ii) (w, w/o), and (iii) (w, w) indicated tongue color of F at CIE Chromaticity Diagram.

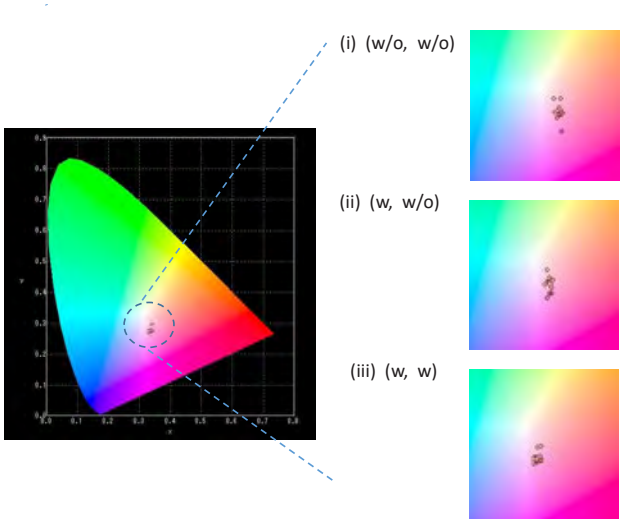


Fig. 4 Tongue color of F at CIE Chromaticity Diagram with each setting (i)~(iii)

In case of (iii) (w, w) in Figure 4, it showed the fluctuation of tongue color to be minimum. Therefore, location stability is effective for measurement of tongue color at fixed point.

4. Conclusion

We confirmed that the tiny wearable display with guide marker indication is a useful device for TIAS. By using the device, the stability of the subject's tongue movement improved. The greatest advantage is that the subject gains a sense of security during imaging of the tongue. These evaluations include many subjective factors, but further studies are planned using objective indicators of the human body.

5. REFERENCES

[1] T. Uchida, K. Yoshihara, S. Ueda, T. Nakaguchi, K. Sakaue, T. Namiki and Y. Miyake, "Effect of Fixing a Tiny Wearable Display on a Tongue Imaging Analyzing System (TIAS) to Improve Stability of Tongue Presentation," Bull. Soc. Photogr. Imag. Japan, pp. 4–8, Vol. 28, No. 1 (2018)