Consideration of the Effect of Preference for Image Contents using Apparent SpO2

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***Abstract*— From our previous research, we confirmed that "preference" and "quality evaluation" of video content are related to brain function measurement using NIRS (Near InfraRed Spectroscopy) respectively. In this experiment, we show the different image contents for subjects and obtain the data for evaluating as "likes / dislikes". In addition, cerebral blood flow is measured by NIRS and Apparent SpO2 is calculated. Single regression analysis was performed on data from 5 seconds after the start of image observation to 10 seconds after image observation, and a slope (regression coefficient) *Slope_img* from a single regression line was obtained. Furthermore, with reference to the value of happiness and disgust of NAPS, we extracted pleasant images and unpleasant images one by one and compared the change of App-SpO2 when observing images and *Slope_img*.**

Keywords—NIRS; QoE; Apparent SpO2

I. INTRODUCTION

In recent years, smartphone screens and 4KTV are moving toward higher resolution, higher definition, multi-functionalization and multi-viewpoint. For such services, "QoE" (Quality of Experiment), which is the quality of service actually experienced by users, has been drawing attention. In the past, "QoS" (Quality of Service) was often used as the quality of communication services, but various studies on QoE have been conducted recently. Therefore, we focused on biological information that can directly sense the human brain and read the activity of the brain by numerical value. By inputting neurophysiological data obtained by such physiological measurement directly to the QoE analysis and evaluation system, we believe that the dilemma of the psychological approach can be solved and the accuracy and practicality of the system can be improved.

Therefore, we focus on NIRS (Near Infra-Red Spectroscopy), which is a technique for measuring cerebral hemodynamics, from among physiological measurement methods. As an advantage of using NIRS, there is a thing that it can be worn without putting a heavy burden on the subject side and operation is easy. In NIRS, blood hemodynamic response (Oxy-Hb and deOxy-Hb) in the brain is measured from detected light data obtained by a plurality of optodes (a pair of light irradiation parts and light detection parts) arranged on the scalp, and visualize the brain activation area [1].

Furthermore, fNIRS devices is adopted the CDMA (Code Division Multiple Access) scheme as the latest optical modulation technology realize high signal-to-noise ratio (SNR) in addition to high-speed sampling [2], and The apparent arterial blood oxygen saturation (App-SpO2) was defined from the beat components of the Oxy-Hb and deOxy-Hb, indicating the possibility of reflecting the oxygen state in the brain without being affected by the skin [3].

Our previous work, we have shown that cerebral blood flow fluctuations at specific positions on the left and right of the frontal lobe revealed that there is relevance for "preference" and "quality evaluation" of the video content. Besides, it is reported that there was a change in cerebral hemodynamics when subjects saw a still image and felt comfortable / uncomfortable [4].

In this research, brain activities when subjects observe image contents were measured, and the relevance between image content and "preference" was analyzed using App-SpO2.

II. ABOUT APP-SPO2

App-SpO2 is called apparent oxygen saturation, and it calculates by the following principle. First, the pulse wave component of blood flow change is measured, and Oxy-Hb and deOxy-Hb of the pulsatile component can be obtained. The power spectrum of the obtained hemoglobin change signal is obtained, the frequency of the pulse wave is confirmed, and the hemoglobin change signal is processed by a band pass filter which passes the confirmed frequency band. Calculate the maximum amplitude within one pulse wave of the obtained hemoglobin change (ΔCoxy·L, ΔCdeoxy·L) signal and perform the following calculation [5].

$$\mathrm{AppSpO2} = \Delta\mathrm{Coxy} \cdot L^{p-p} / (\Delta Coxy \cdot L^{p-p} + \Delta Cdeoxy \cdot L^{p-p})$$

However, since the value obtained by this method at this time is not a calibrated value like a pulse oximeter, it becomes an interpretation range that it is increasing or decreasing at the corresponding time.

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Therefore, in this paper, the subject focus on increasing / decreasing App-SpO2 when observing "comfortable / uncomfortable" images.

III. Experiment

In this experiment, the subject was asked to show the content of the image and evaluate "like" and "dislike". At the same time, we measured cerebral blood flow with NIRS and calculate Apparent SpO2. We used OEG-SpO2 (by Spectratech) to measure brain activity. Subjects were 9 adults with no problem of visual acuity, who agreed to participate in the experiment. Images used for the experiment were selected from Nencki Affective Picture System (NAPS) [6], we choose picture from emotion of “happiness” and “disgust” with high subjective evaluation values and low standard deviations. As shown in the presentation pattern in Fig. 1, the evaluation image was presented for 15 seconds, and the gray image was presented for 5 seconds. Then a questionnaire with 5 grade scale (1 “dislike” ~ 5 “liking”) was conducted for 5 seconds. Before the next image was presented, a gray image was shown for 15 seconds in order to rest the brain. In addition, the experiment was divided into the first half and the second half, after seeing 15 images, we took a break and then saw the remaining 15 images. Images were played at random, so that not influenced by the order of images. An example of the image used in the experiment is shown in Fig. 2.

IV. Analysis

First of all, data was sorted with reference to the reliability of experimental data. Data less than 80% reliability in each channel was removed and analyzed. As shown in the Fig. 3, App-SpO2 gently changes around 5 seconds after the start of task and then reaches its peak. It is understood that the brain activity due to the stimulation of the task lasts about 5 seconds after the task is over.

First, in order to investigate the change rate of App-SpO2, a single regression analysis was performed using data from 5 seconds after the start of image to 10 seconds after the start of image to obtain the slope (*Slope_img*) of a single regression line.

Next, one-way ANOVA was performed on *Slope_img* for each channel, and the p-value of each channel was obtained to obtain the superiority of the channel.

Finally, with reference to the evaluation of NAPS, a pleasant image with the highest value of happiness and an unpleasant image with the highest value of disgust are extracted one by one, respectively, and the variation of App-SpO2 when observing the image is compared with *Slope_img*.

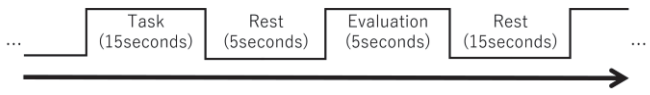

Fig. 1. Presentation Pattern.

(a) happiness (b) disgust

Fig. 2. Sample image.

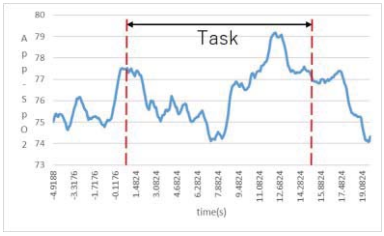

Fig. 3. Changes in App-SpO2 during image observation.

V. Result

Table. 1 shows the average of the subjective evaluation values of "likes / dislikes" for 9 subjects in Fig. 2 and the average value of happiness and disgust of NAPS. Significant differences for each channel when the significance level is 10% are ch. 3 ($p = 0.0729$, $F = 2.76$), ch. 7 ($p = 0.0995$, $F = 2.73$), ch. 9 ($p = 0.0148$, $F = 2.79$). At this time, the number of data exceeding the reliability of 80% in each channel is three in ch. 3, six in ch. 7, and two in ch. 9. Changes in SpO2 in ch. 3, 7, and 9 when viewing the evaluation image in Fig. 2 are shown in the Fig. 4, 5, 6. The horizontal axis was the time of time presentation, and the vertical axis was the value of App-SpO2.

VI. Discussion

The reason why the p-value of the channel is low and it can satisfy the significance level may be due to a significant difference in the reaction difference between when viewing liked images and when viewing disliked images.

In ch. 3, it was observed that App-SpO2 tends to decrease when viewing the image of disgust. In the image of happiness, App-SpO2 value tended to rise from the latter part of the task. In ch. 7, there was not much regularity in the change of App-SpO2 when seeing the image of disgust. However, in the image of happiness it was seen that the value of App-SpO2 tends to rise. In ch. 9, there was not see much change of App-SpO2 when seeing at the image.

From the above, ch. 3 and ch. 7 are thought to relate to the change in App-SpO2 when the evaluation image is viewed.

			disgust (NAPS)
happiness	4	5.56	1.03
disgust	2	1.03	4.71

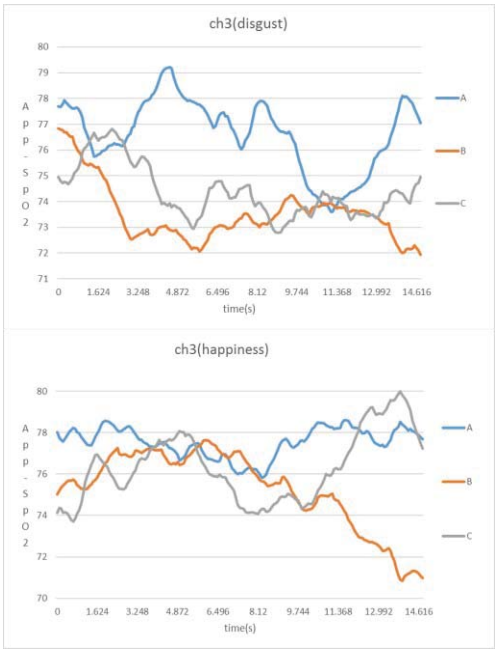

Fig. 4. Result of ch. 3.

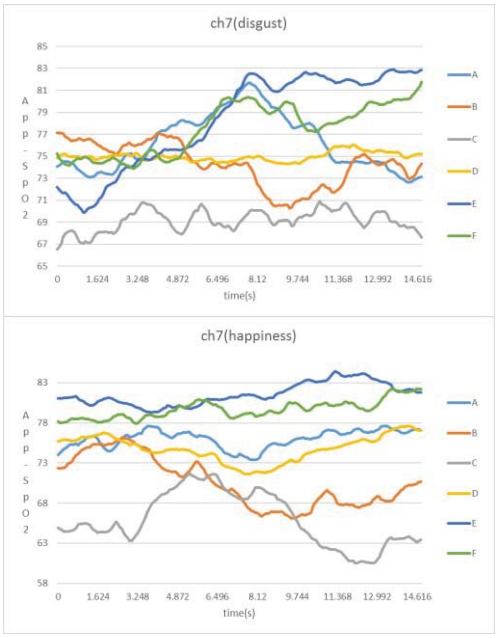

Fig. 5. Result of ch. 7.

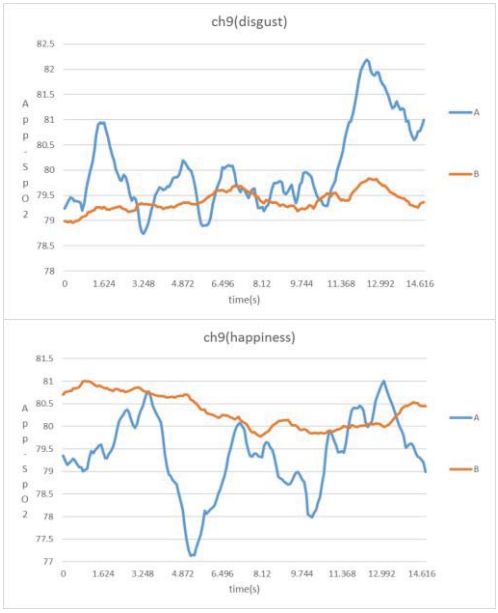

Fig. 6. Result of ch. 9.

VII. Conclusion

In this paper, we focused on NIRS (Near-infrared spectroscopy) which is one of brain function measurements, Apparent SpO2 (apparent arterial blood oxygen saturation) when 9 subjects observe a liked / disliked still image was measured. The influence of the preference when viewing the evaluation image in ch. 3 and ch. 7 is thought to be related to the change of App-SpO2, suggesting that it is possible to classify likes and dislikes.

Acknowledgment

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