A study of the influence of video quality on Apparent SpO2

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Abstract— **In this paper, we present subjects 4K high-definition videos with different encoding method and bit rate, at the same time, measured the SpO2 when they were viewing the videos. To show the rate of change, the inclination (regression coefficient) of a single regression line has been obtained by regression analysis. Finally, one-way ANOVA has been examined to find significant channels related to the image quality. In this study, we found that channels 7, 9, 11, 13 satisfied the significance level.**

Keywords— App-SpO2; NIRS; QoE

I. INTRODUCTION

In recent years, with the increase of resolution of displays and enlargement of screens, users have become able to appreciate more delicate images and moving images. However, since the image reduction increases, therefore, the date size is required more. Transportation of huge data. It may cause loss of the image quality. Encoding is effective for reduction, but in some cases it may lead to quality degradation. Therefore, it is important to provide quality "Quality of Experience" (QoE) that satisfies users by evaluation of image quality. Therefore, it is necessary to know the preferences of users born by viewing various displays and contents. In recent years, researches on image quality evaluation using biometric information has been conducted, and researches on the relationship with brain activity are under way. By clarifying the relationship between brain activity and image quality assessment, information on brain activity can be expressed as a numerical index for evaluating QoE, so it is considered to be strength. In previous research, research to investigate changes in cerebral blood flow to contents and changes in Oxy-Hb in the frontal lobe and evaluate QoE has been underway, and different kinds of contents can influence cerebral blood flow. Although it has been reported in previous research [1], research focusing on the change of App-SpO2 obtained from Oxy-Hb and Deoxy-Hb is not advanced and it is unknown whether it can be used to evaluate QoE. Since App-SpO2 is a value output by Spectratech OEG - SpO2 's own calculation, it is different from the value of SpO2 [2]. Therefore, it is necessary to examine that what App-SpO2 will change when viewing the image. Prior research suggests correlation between pleasant, uncomfortable images and App-SpO2, but does not take into consideration the influence of changes in coding of moving images [3]. In this experiment, App-SpO2 was measured using NIRS, a te[1]chnique for measuring cerebral hemodynamics. Our aim to investigate whether code decomposition affects App-SpO2 and to clarify important paths.

II. EXPERIMENTAL METHOD

Measurement equipment uses OEG-16 of Spectratech of all 16 channels. The arrangement of measurement channels is shown in Fig. 1. Presentation pattern presents gray image for 10 seconds, ShakeNDry of evaluation video is presented for 10 seconds, and other evaluation video is presented for 20 seconds. Then show the gray image for 10 seconds. Gray images are presented for brain rest. The subjects were 20 students and the laboratory was in the darkroom. The viewing distance is 1.5 H = 102 cm, the display is 55 inch LCD (3840 * 2160 [pixel]), and the screen resolution is also 3840 * 2160 [pixel]. In the evaluation image, a total of 16 kinds of high-definition images were created by coding four kinds of high-definition images published from Ultravideo with encoding method and bit rate. The encoding high definition image used for the experiment is shown in Fig. 1, the encoding method and details of the bit rate are shown in TABLE I. and the arrangement of the measuring channels is shown in Fig. 2.
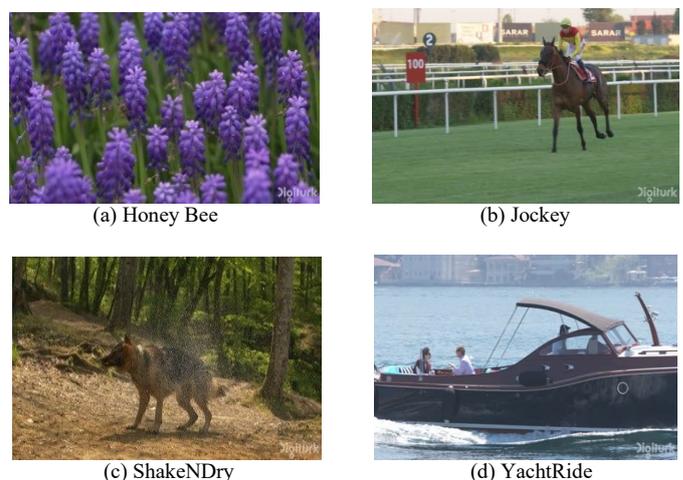

(a) Honey Bee   (b) Jockey

(c) ShakeNDry   (d) YachtRide
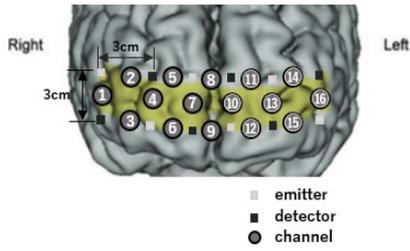
Fig. 1. High definition videos for encoding.

Fig. 2. NIRS channel arrangement (all 16 channels).

TABLE I. ENCODING DETAIL TABLE

Coding scheme	Target bit rate[bps]
H.265/HEVC	15M
H.265/HEVC	8M
H.264/AVC	30M
H.264/AVC	16M

III. ANALYSIS METHOD

In order to investigate the trend of increase / decrease of App-SpO2 due to image coding, we used App-SpO2 data during viewing of high definition videos of 20 subjects. According to previous research, App-SpO2 gently changes and reaches the peak around 5 seconds after the video presentation, and it has been confirmed that the brain activity due to the video presentation lasts until about 5 seconds after the video presentation [2]. Therefore, we picked up the data of 5 seconds to 10 seconds while each video was presenting for each channel for analysis. Regression analysis is performed to found the gradient and the regression coefficient of each change. Then a one-way ANOVA was conducted the check whether there is a significant difference between different video quality, by using the data of regression coefficients.

IV. EXPERIMENTAL RESULT

As a result of setting the significance level to less than 10% (P <0.1) in one-way analysis of variance, channels 7, 9, 11, and 13 satisfied the significance level. The following shows App-SpO2 measured on channel 11 when viewing Jockey's content and change in App-SpO2 measured on channel 9 when viewing the content of ShakeNDry. In the case of Jockey, App-SpO2 showed a decreasing trend for both H.265 / HEVC and H.264 / AVC image presentation for 5 seconds after see the image, but the image of H.265 / HEVC App-SpO2 tends to be increasing after 5 seconds from presentation and App-SpO2 tends to decrease in the case of H.264 / AVC image presentation. In the case of ShakeNDry, App-SpO2 tends to increase in 5 seconds from H.265 / HEVC image presentation after 10 seconds and App-SpO2 tends to decrease in the case of H.264 / AVC image presentation is there.
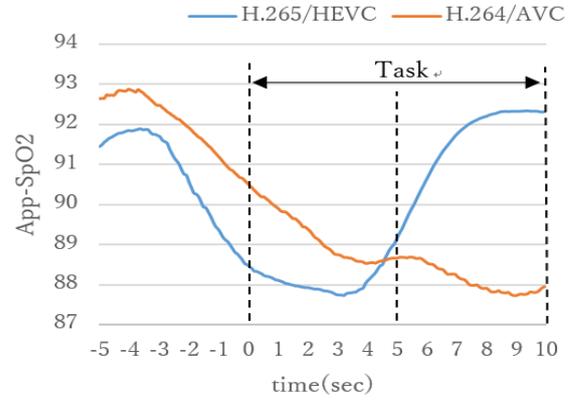

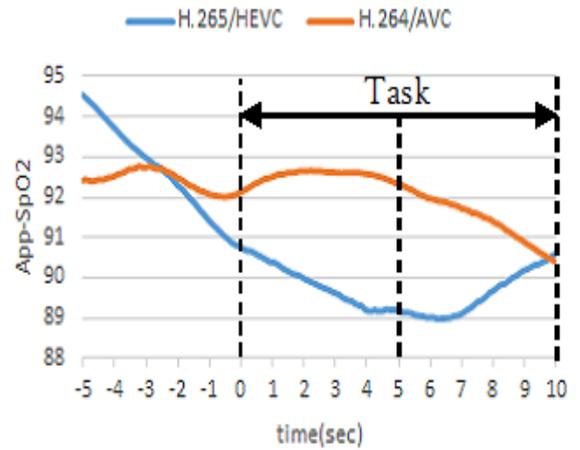Fig. 3. Changes in App-SpO2 when see jockey (ch11).

Fig. 4. Changes in App-SpO2 when see ShakeNDry (ch9).

V. CONSIDERATION

App-SpO2 showed an upward trend when see deteriorated moving pictures with a low bit rate, and App-SpO2 showed a decreasing trend when see moving pictures with a high bit rate. Compared with the previous study [4], since it is known that the amount of oxy-Hb concentration change increases when degraded moving images are observed, App-SpO2 has the same image quality as oxy-Hb concentration change amount. It is thought that there is a correlation. Channel 13 considered to be significant for degradation of image quality is thought to be due to presence feeling influencing the change of brain activity by the previous study [5], and App-SpO2 is also influenced by the presence feeling, and it seems that the decrease tendency was seen when see high quality video with high bit rate.

VI. CONCLUSION

In this study, we focused on the brain wave component of blood flow change that can be measured by NIRS (Near-infrared spectroscopy), and found that when 20 subjects saw 16 kinds of high definition images encoded by encoding method and bit rate. We examined the change of App-SpO2 and the significant channel. Subjects obtained gradient of

change of App-SpO2 from 5 seconds after image observation to 10 seconds by regression analysis, and by one-way analysis of variance, channels 7, 9, 11, and 13 are significant channels for App-SpO2. It could be considered. Therefore, this analysis method suggested that there is a specific channel of NIRS that can measure the change of App-SpO2 greatly when presenting the encoded image. It also suggested that App-SpO2 tends to rise when degraded moving images and App-SpO2 tends to decrease when viewing high-quality moving images. From the above, it suggested that classification of high image quality and low image quality of moving images is possible by using the index called App-SpO2. From now, by conducting experiments using various contents, it is necessary to examine more accurate significant channels.

ACKNOWLEDGMENT

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