타겟 피부색에 따른 이미지 감성

Affective Effect of Target Skin Color

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Skin color is a crucial feature for portraits. It has been widely used to enhance portrait quality, but the standard or reference for skin color are quite vague. In this paper, we explore the affective effect of target skin color for image quality. Target skin color are obtained from literature review of three aspacts of skin researches, measured real skin color, memory skin color and preferred digital skin color. According to the evaluation results, we could conclude that different target skin color setting could lead to different emotional image qualities.

주제어: 피부색, 색채 인지, 감성 화질
Keywords: Skin Color, Color Perception, Emotional Image Quality

1. Introduction

1.1. Background

Portrait photos have a relatively profound meaning compared with landscape or object photos. They not only appear as attractive media, but can be used to intuitively convey certain information or emotion. Therefore, instead of computing methods, appear of portrait photos in professional level relies more on designer's adjustment in software slide by slide. Many efforts have still been paid to generate automatic approaches to enhance portrait photos though. Skin color, one of typical memory colors, is widely used to tackle the enhancement.

Bianco and Schettini (2014) developed algorithm that exploits skin color to estimate and correct the scene illuminant. Portrait data set filmed with color checker was used as the reference. Similarly, Kim, Kim, Kyung, and Ha (2011) also using preferred skin color as a standard for calibration. Therefore, a 'good' skin color standard or reference is crucial for the image quality of portrait photos.

1.2. Aim

In this research, we aim to explore the affective effect of target skin color for emotional image quality. Target skin color setting is obtained from literature review of three aspacts of skin researches, real skin color, memory skin color and preferred digital skin color. Matlab is used to realized the color change based on target skin color

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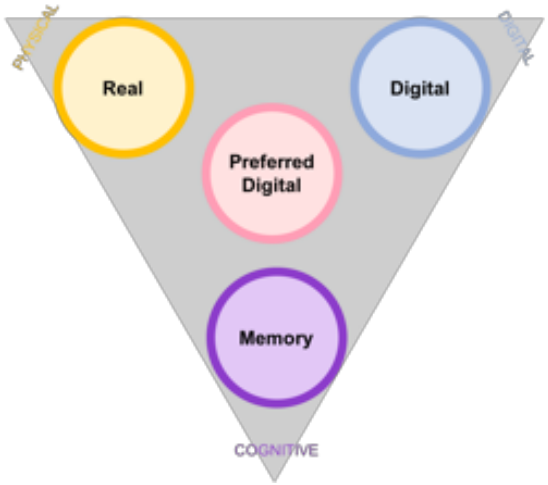
setting. 24 participants evaluated the stimuli based on five affective image quality criteria.

2. Three Skin Color Research Extremes

2.1. Real, memory and preferred digital skin color

Skin color has long been an interest for researches from biology, anthropology, sociology and computer vision. We could category skin color from three levels, real skin color, memory skin color and reproduced skin color.



<Figure 1> Preferred skin color model

Measured skin color is the real color we have on our skin. It could be measured with spectrophotometer. Many researches have been conducted to see the ethnicity or country difference in skin color (Choi & Suk, 2017) (Han, Choi & Son, 2006). In general, we could summarize that the difference in hue is quite minor. The difference is mainly resulted in lightness for different races. In terms of memory color of skin, you can clearly see a wider range and a difference in saturation and hue (Bodrogi & Tarczali, 2001). Relatively higher saturation and increased hue value could be spotted in those researches. This reveals a slightly vivid face color is recognized and remembered by people. Finally, when it refers to the preferred skin color in digital display (Kuang, Jiang, Quan & Chiu, 2005) (Zeng & Luo, 2013) (Yamamoto, Lim, Wei, Inui & Kobayashi, 2003), two trends are discovered, one is both increased a* b* value with higher L* and the other is reduced saturation when L* increases. From this we could conclude that preferred digital skin color is generally brighter, for some people, vivid skin color is more preferred but for the others a little pale skin color makes character beautiful.

2.2. Selected target skin color

Based on these findings, we propose two basic standard skin colors and two advanced skin colors under certain pursuing of image quality and detailed data is listed in Error! Reference source not found.. We think the first two colors are closer to real skin color and memory skin color. Lightness value is maintained due to the pursuing of reality. Two skin color settings obtained from preferred digital skin colors are also selected. These two settings both increase lightness value to a certain level but one is with relatively high saturation and the other is paler. We think whether vivid or pale skin color is preferred might be affected by the character and image usage.

<Table 1> Target skin color

No.	L	a	b	Reference skin color research
1	-	12	17	Measured skin color
2	-	11	22	Memory skin color
3	65+	14	14	Preferred digital skin color
4	70+	10	9	Preferred digital skin color

3. User Study

3.1. Stimuli

In order to apply the target skin color to portraits, we used Matlab to realize this. The key concept of our approach is to first

extract skin color from the portrait that we want to process and then conduct color correction based on the difference between current and target skin color. Two technical problems are considered for skin balancing. First is to correctly detect the skin color of the current image. Face or faces in a portrait is detected with existing object detection algorithm. Pixels in certain color ranges a marked as skin and the skin color is extracted with clustering. Secondly, a robust color shifting algorithm was developed for color adjustment based on current skin color and target skin color. CIELab color space was selected due to its perceptual uniformity that the same amount of color value changes produce the same amount of visual difference. Color adjustments are achieved with one gain factor and two offset factors:

(a) Lightness adjustment by a gain factor K_L

$K_L = L_{target} / L_{original}$

(b) a adjustment by an offset factor t_1

$t_1 = a_{target} - a_{original}$

(c) b adjustment by an offset factor t_2

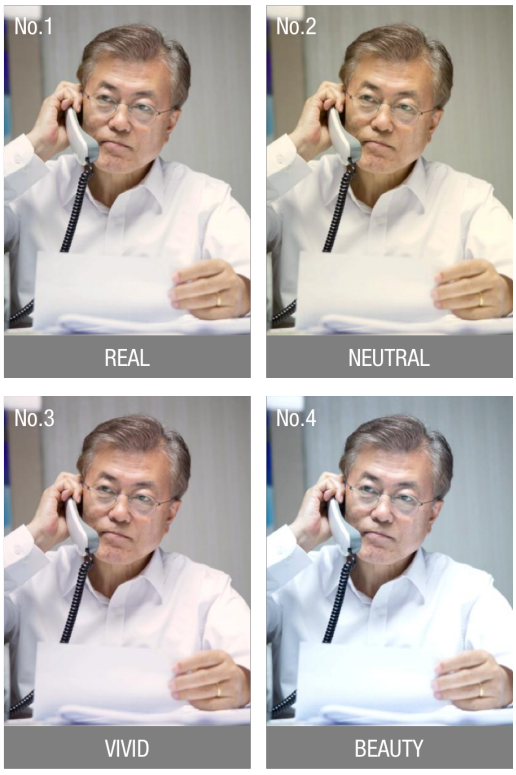
$t_2 = b_{target} - b_{original}$

3.2. Evaluation

We conducted a user test with 24 participants in order to examine whether generated portraits would convey certain emotional image quality. Participants have to select one (at least two) most suitable portraits according to evaluation criteria. Five criteria were considered and designed. They are reality (Yendrikhovskij, 1999), naturalness (Yendrikhovskij, 1999), preference (Sheikh, Bovik, & Cormack, 2005), emotion (Fedorovskaya & De Ridder, 2013) and appropriateness (Yendrikhovskij, 1999), generated from previous researches.

4. Results and analysis

A Chi-square test was carried out to analyze whether portrait reproduced with certain target skin color could represent certain emotional image quality pursuit. The results showed that there is a statistically significance in portrait type selection considering 5 criteria (Pearson Chi-square = 243.06, $p < 0.05$). A post-hoc analysis was further carried out to investigate whether certain portrait performs different from others for each criterion. We could conclude that portraits reproduced based on measured skin color (No.1) present a more real and natural feeling. No.4 is most preferred by participants, which increases the lightness and reduced the saturation, creating the feeling of beautified images. No.3 and No.4 are selected to be most appropriate considering the image usage. For example, artist portrait for magazine and politician portrait for government official website. Both these two settings increase lightness to a certain range. No.3 is more vivid and No.4 is more pale. Therefore, we named these settings according to their color feature.



<Figure 2> Four target skin color and emotions

5. Conclusion

In this research, we explored how people perceive the same portraits concerning different target skin color. Researches related to measured skin color, memory skin color and preferred digital skin color are referenced and four target skin colors are summarized as standards for color adjustment. Through the evalaution, we could conclude that different target skin color does convey different image quality affectively, even though the color difference is quite tiny. However, we should also consider and address to following problems for future research. First, when generate and design these standards, we only considered Asian people as a target. When using our method for people of other ethnicities, the effect might not be this impressive. Second, skin color detecting algorithm should be investigated further either by utilizing other face features for skin detection or better clustering method for a more accurate skin color value.

Reference

1. Bodrogi, P., & Tarczali, T. (2001). Colour memory for various sky, skin, and plant colours: effect of the image context. Color Research & Application: Endorsed by Inter-Society Color Council, The Colour Group (Great Britain), Canadian Society for Color, Color Science Association of Japan, Dutch Society for the Study of Color, The Swedish Colour Centre Foundation, Colour Society of Australia, Centre Français de la Couleur, 26(4), 278-289.
2. Bianco, S., & Schettini, R. (2014). Adaptive color constancy using faces. IEEE transactions on pattern analysis and machine intelligence, 36(8), 1505-1518.
3. Choi, K., & Suk, H. J. (2017). Facial Skin Color Variability in Korean Women. In 50th Congress of International Association of Color, AIC2017. International Association of Color.
4. Han, K., Choi, T., & Son, D. (2006). Skin color of Koreans: statistical evaluation of affecting factors. Skin Research and Technology, 12(3), 170-177.
5. Kim, D. C., Kim, K. M., Kyung, W. J., & Ha, Y. H. (2011, September). Skin tone reproduction based on multiple preferred skin colors. In Consumer Electronics-Berlin (ICCE-Berlin), 2011 IEEE International Conference on (pp. 108-111). IEEE.
6. Kuang, J., Jiang, X., Quan, S., & Chiu, A. (2005, January). A psychophysical study on the influence factors of color preference in photographic color reproduction. In Image Quality and System Performance II (Vol. 5668, pp. 12-20). International Society for Optics and Photonics.
7. Yamamoto, M., Lim, Y. H., Wei, X., Inui, M., & Kobayashi, H. (2003). On the preferred flesh colour in Japan, China and South Korea. The Imaging Science Journal, 51(3), 163-174.
8. Zeng, H., & Luo, R. (2013). Colour and tolerance of preferred skin colours on digital photographic images. Color Research & Application, 38(1), 30-45.