

Hue extraction and Tone match: Generating a Theme Color to Enhance the Emotional Quality of an Image

EunJin KIM, Hyeon-Jeong Suk*
KAIST in Daejeon, Korea

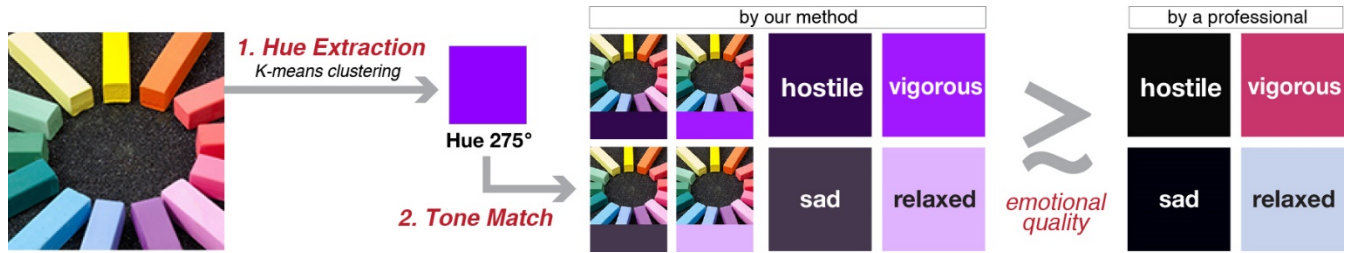


Figure 1: Theme colors generated by hue extraction and tone match, that deliver better emotional quality than professional's

1 Motivation and Concept

In the process of editorial design, a harmonious match between a picture and a solid color is often essential to achieve a high quality of a graphical art work. Color as such is a compelling cue to elicit emotional responses and thus can enhance the emotional quality of an image. Tools and methods have been developed to automatize the color selection process, and a noticeable progress has been achieved to extract perceptually dominant colors of an image. However, little attention has been paid to the emotional characteristics of selected colors, and it has been highly relying on the color designers' manual judgments. In this study, we propose a computational method that creates a color that enhances both aesthetic and affective quality of an image, and call it a theme color.

The method to create a theme color involves two steps: Firstly, we identify the most dominant color of a given image. Based on the HSB values of the image, we perform K-means clustering and then look for the hue angle of the center of the most dominant cluster. Since the hue is derived from the center of the largest cluster, it is naturally inherent to the source image. Secondly, we articulate the emotional characteristics of the hue by matching it with an adequate tone, referring to the existing theories. As revealed by previous studies (Suk and Irtel 2010, Valdez and Mehrabian 1994), emotional responses vary more largely by the color tone than by the color hue. In this way, the method computes a theme color when an image source and a desired emotion are specified.

2 Validation of our Concept

We conveyed a user test in order to examine whether the theme color generated by our method would meet people's expectation as successfully as the color selected by professional designers. We collected 30 neutral pictures and utilized the emotion space as a framework of emotion metrics. The emotion space is profiled with pleasure and arousal dimensions from the PAD theory (Russell 1980), and the pleasure and arousal axes made a right angle to each other, generating four quadrants subsequently. In the emotion space, each quadrant was labelled as, 'vigorous (1st Q.)', 'hostile (2nd Q.)', 'sad (3rd Q.)', and 'relaxed (4th Q.)'.

*e-mail: h.j.suk@kaist.ac.kr

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According to the results of previous studies (Ou et al. 2004, Valdez and Mehrabian 1994), we matched the pleasure and arousal dimension with the brightness and saturation of the color respectively. Then, we specified saturation and brightness value for each quadrant. As a result, the 'vigorous' tone was defined as a combination of 100% brightness and 100% saturation. The 'hostile' tone was (100, 40), 'sad' tone was (40,40), and the 'relaxed' tone was (40,100) of saturation and brightness. In this way, we generated four theme colors for each of 30 neutral images.

For the assessment, we prepared six sets of theme colors; one was computed by our method, the other five were subjectively created by five designers who all possess higher than bachelor degree in graphic or industrial design. A total of 30 college students assessed the affective quality of the combination of an image and a theme color in the aspect of a desired emotion using a 7-point Likert scale. For each emotion, a one-way ANOVA was carried out to compare the affective quality of theme colors generated by designers and the computational method. The results showed that our method produced a significantly better quality of a theme color for vigorous, relaxed and sad emotions ($p < .05$). However, the method performed poorly in generating hostile theme colors.

3 Limitation and Challenge

We were able to confirm that our method is feasible to automatically generate a theme color that enhances emotional qualities of images. However we should address challenges for the further progress. First, K-means clustering, which is the most frequently used method to extract colors of images, has several pitfalls such as ignoring region of interest (ROI) and sorting similar number of items into each cluster that may occur a wrong membership. Second, the tone match algorithm should be investigated further either by elaborating the emotion space or applying affective style classification in order to enhance the practicality of theme colors generated. Currently we are refining our method regarding these issues.

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