Color Assignment via Region Area and Color Harmony

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(a) (b) (c) (d)

Figure 1: *An examaple of different four configurations applied with our method. (a) Configuration with connectivity of regions. (b) Configuration without background region. (c) Configuration with background region (d) Configuration with text*

1 Introduction

Unlike an expert, an ordinary user may find it difficult to assign colors to regions when considering harmony and purpose. Various conditions should be considered, such as the size of the arranged region, the relationship between the arranged colors, and the purpose of the color uses. In this study, with these conditions in mind, we suggest a novel method for assigning a color each region. Recently, a large number of psychologists have proposed a new framework for color harmony as an alternative to the traditional color harmony theory. In these studies, experiments were carried out to examine the degree of preference or harmony between colors by a large number of subjects [Ou and Luo 2006] [Szab et al. 2010]. According to Munsell [Munsell 1921], color combinations are balanced or harmonious when stronger colors occupy less space than weaker colors. Balance is achieved when area $\times$ value (brightness) $\times$ chroma (saturation) is equivalent in two regions. We suggest a new color assignment method based on the theory of Ou and Munsell.

2 Our Approach and User Test

Given regions to be assigned color and some colors, we assign a color to a region respectively and maximize the sum of our energy function when all colors are assigned to all regions. Our energy function has two conditions. The first condition is for harmony between colors. The harmony of all color pairs is computed using [Ou and Luo 2006]'s theory, and we set two normalized weights as the distance and adjacent length between two areas. In other words, a shorter distance between regions and a greater adjacent length between areas has a greater effect on maximizing the total energy value. The second condition is for area between regions. We assign colors in each region based on balance theory by Munsell [Munsell 1921].

To test our proposed method, we conducted a survey by applying the actual variety of color samples and using the configurations of several different regions. We then used the colors provided by Adobe Kuler as the sample data. We used eight color themes and three region configurations, and then conducted a survey of twenty-six participants. Each participant chose the combination they deemed most harmonious and preferable among the four possible combinations with different rankings. We set the scores from 4 to 1 in descending order of rank.

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As a result, the first configuration recorded an average of 2.75; the second, an average of 2.64; and the third, an average of 2.86. An average score of around 4 indicates that the participants chose the best combination among the candidates made using our proposed method. The results of all three configurations came close to an average score of 2.75, which shows the effectiveness of our method. We added a configuration with text additionally.

To test the consistency of the users' color assignment and obtain more information, we performed a second experiment and interview with four of the participants from the first experiment, five days later. The second experiment was carried out using the color samples and configuration of the regions used in the first experiment, and the consistency between the two experiments was approximately 65%. However, the second experiment result of four participants recorded an average of 3.0, whereas the first recorded an average of 2.80. By interviewing four participants, we organized their comments as follows: 1) Both background and wide area have the greatest impact. 2) The distinction between the areas should be sure. 3) Dark or strong colors can be better to assign to the narrow regions than the wide part of. 4) If the connectivity exists between the regions, the colors also have connectivity.

Based on the results of the interview, Comment 1), 2), and 3) can be applied using the proposed method, whereas 4) cannot. Because wide area has great effect, as comment 1), we assigned high weight if two regions have many adjacent lengths. Comments 2) and 3) can be seen as similar to Munsells theory. About comment 4), we would like to proceed with further studies.

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References

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