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A Study on Effective Color Production of Outdoor Digital Theme Park

Min-Seo Kwon[1], Sae-Bom Park[2], Du-Beom Kim[3] and Sung-Dae Hong[4*]

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Abstract: This study conducted a study on color production related to cultural contents in a situation where outdoor digital theme parks are activated. With this study, it will be possible to acquire new cultural contents and technologies to which theme park elements combined with digital content are applied by breaking away from existing natural objects and original contents. In addition, by applying more effective color production methods derived from the study to digital theme parks that implement ultra-realistic content, users will be able to use various contents conveniently.

***Keywords**: Media art, outdoor digital theme park, Color perception, Color production*

1. Introduction

Local festivals and events, which have been stagnant due to the spread of the COVID-19 virus, are entering the media art exhibition business to go back to daily life and revitalize the local economy as all measures for social distancing are lifted. However, compared to indoors, outdoor media art exhibitions have great spatial, temporal, and environmental limitations in providing visitors with a sense of immersion. Immersion is emphasized as a major technical consideration factor of media art contents as it provides audience involvement and satisfaction[1].

In order to minimize such problems, visually effective production is required. Color is a phenomenon in which color is perceived through the eyes, a sensory organ, or refers to the same experience effect as such a perceptual phenomenon. It is recognized most intuitively among information delivered to humans and provides useful information that can easily identify the outline and substance of the object[2]. Therefore, specific and detailed instructions are needed on how to effectively create exhibition contents by increasing attention, usability, and visibility with appropriate color coordination. Accordingly, the purpose of this study is to propose effective color production guidelines on outdoor media art exhibitions.

2. Theoretical Background

2.1. Outdoor Digital Theme Park

Media art can be defined as an art applied with mass media technology that aims to convey a lot of information to the public, such as photos, phones, and movies. Since then, high-tech technologies such as computers, robots, and biotechnology have been introduced by the development of science. From a modern point of view, media art introducing the techonologies is referred to as new media art and is commonly used as multimedia art and digital art [3].

Outdoor Digital Theme Park is an outdoor space composed of various programs by actively utilizing technologies such as drones, holograms, projection mapping, lighting, and interactive contents as a theme park composed with media art contents.

Fig. 1: Dpirang

[1, 2]*Student, Department of Design, Seokyeong University*
[3]*Research Professor, Industry Academic Cooperation Foundation, Seokyeong University*
[4*]*Professor, Department of Design, Seokyeong University*
(Corresponding author E-mail address: [4]sungdaehong@gmail.com)*

Fig. 2: Sonata of Light

Fig.1 and Fig.2 are Dipirang and Sonata of Light. Examples include Dpirang located in Tongyeong, Gyeongsangnam-do, and Naora show, a night course at Ganhyeon Tourist Site located in Wonju, Gangwon-do. In this way, sustainable permanent digital theme park projects are expanding around specific topics to attract young people and other residents.

2.2. Color Perception

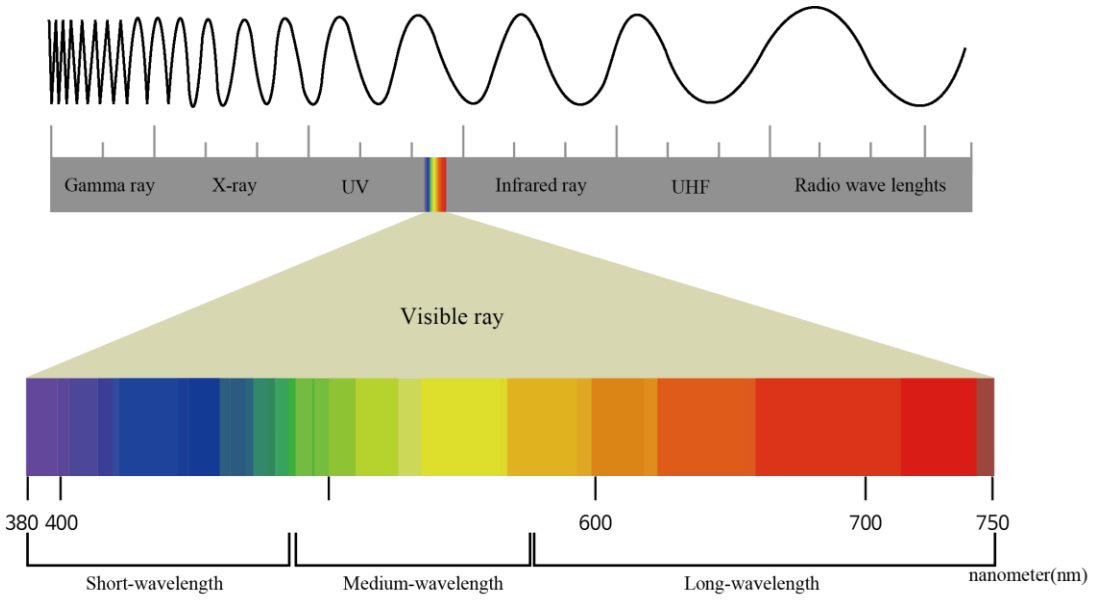

Fig. 3: Visible light and visible light area

Color perception is the result of the interaction of light sources, objects, and observers. They are the three elements of color perception. Light is a kind of electromagnetic wave and is divided into infrared, visible light, and ultraviolet light according to the length of the wavelength. Among them, our visible light ranges from about 380nm to 780nm. The red-colored area of about 560nm to 780nm is called the long wavelength. The green area of about 480nm to 560nm is called the medium wavelength, Last, the blue-colored area of about 360nm to 480nm is called the short wavelength [4].

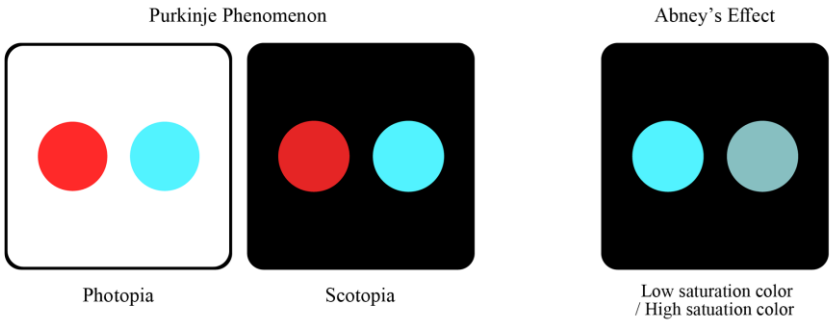

Fig. 4: Purkinje phenomenon and Abney's effect

Fig. 4 is to help explain the following. According to Purkinje Phenomenon, among the color perception phenomena that operate at night, blue appears brighter, and red appears darker when it becomes dark from bright. This is a phenomenon caused by the light of a short wavelength of the rod, and it shows the most sensitive reaction to the light of a short wavelength. There are two types of visual cells in the retina: the Cone Cell, which functions mainly in the light, and the Rod Cell, which functions mainly in the dark. Rods are involved in judging light and dark, and our eyes are most sensitive to lightness among color properties. In particular, it shows the most sensitive response to light at 500nm. According to Abney's Effect, even if the color is the same, the color changes according to the change in saturation [5].

3. Research Content

3.1. Statistical Analysis

Through promotional videos of domestic outdoor digital theme parks and 30 outdoor media art exhibitions, main colors are standardized to red, yellow, green, blue, and purple. And the extracted results were calculated as statistics.

In addition, convenience sampling was conducted for visitors to media art exhibitions and outdoor digital theme parks. As one of the successful cases of the media art business, the Dipirang Theme Park in Tongyeong, Gyeongnam, and the Art Museum in Gangneung, Gangwon, Yeosu in Jeollanam-do, and Jeju were judged to be popular samples, and the survey was conducted focusing on the two exhibitions.

3.2. Analysis and Consideration of Color System

Based on previous studies, the direction of color design in outdoor media art exhibition information was examined in consideration of improvement of attention, usablity, and visibility. By giving meaning and emotion to color, looking at it from a psychological point of view to uderstand on object, the study analyzed an appropriate color system and suggested a consistent use of color schemes.

3.3. Color Perception at Night

This is the result of analyzing the main colors used in 30 outdoor media art exhibitions, such as Deepirang and Baekje Yeonhwa. About 52% of blue, about 23% of green, about 14% of purple, and about 11% of others were mainly short-wavelength colors. It is not known whether a lot of short-wavelength colors were intentionally used, but it is expected that the Purkinje Phenomenon is one of the reasons.

Table. 1: Media art exhibition color perception survey.

Question. 1	Color	Response rate (%)	Question. 2	Color	Response rate (%)
Colors that stood out during the exhibition	Red	13.9%	Memorable colors after visiting the exhibition	Red	10.2%
	Yellow	20.4%		Yellow	19.4%
	Green	24.1%		Green	22.2%
	Blue	89.8%		Blue	86.1%
	Purple	23.1%		Purple	21.3%

Table 1 shows the results of convenient sampling of color perception of outdoor digital theme parks and media art exhibitions for visitors. Also, in response to the question 'Do you think color contributes to providing immersion in content?', 'Yes' showed an overwhelmingly high response rate with 91.7%. As a result of analyzing the response, the correspondence rate between the response of a prominent color, that is, a color with high discrimination, and the response of a memorable color is about 82.4%, showing a correlation with each other. In addition, according to Abney's Effect, high-brightness and high-saturation colors can be used to

increase attention and clarity. In the end, our eyes show the strongest reaction to short-wavelength colors (blue) with high brightness and high saturation in the case of night vision.

Then, to use it more effectively, proper color harmony and color arrangement are necessary. With this, it is possible to further increase the immersion in the contents by increasing the value of the color-related effect.

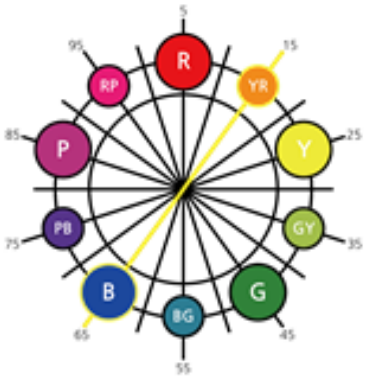

Fig. 5

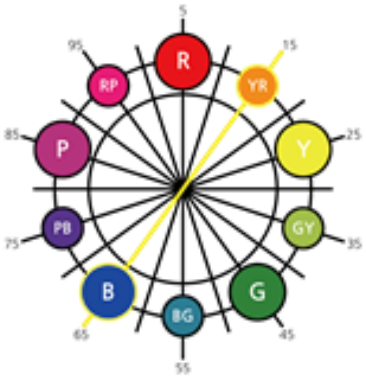

Fig. 6

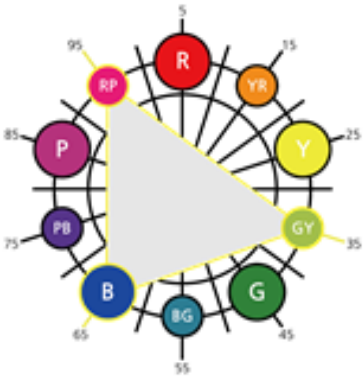

Fig. 7

Fig. 5, fig. 6 and fig. 7 are the results of the study applied to the Munsell color wheel. For example, when using blue and one other color, if the colors are matched using the harmony of complementary colors, the color saturation is higher than the original color due to the influence of each other, and it looks clear and active. The complementary color of blue is Yellow Red, which is the opposite of the color wheel, and the use of adjacent red and yellow gives a more elegant effect with the effect of the adjacent complementary color. Moreover, when using a low-brightness orange or red or yellow along with a high-brightness and high-saturation blue, the contrast effect is more pronounced, effectively emphasizing it and creating a clear harmony. When using the colors of blue, green, yellow, and red purple, the harmony of the three colors can change the color scheme with strong clarity, change rhythm, and give moderate tension. If you use 3 or more high-saturation colors, you can express active and active colors.

4. Conclusion

In the outdoor digital theme park, the appropriate color harmony and coloration with short wavelength colors with high brightness and high chroma will provide visitors with attention and visibility, giving them a sense of immersion and satisfaction in the content. However, this study has its color according to the nature of the content. And there is a limitation in lighting in the color expression of outdoor media art content. To compensate for this, it is expected that users will effectively contribute to the visual production of digital theme parks if they identify the unique colors and colors of diverse contents in the future and approach them in preparation for lighting types.

5. Acknowledgements

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