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Computer-Aided Design AND APPLICATIONS

Computer-Aided Design of Visual Communication Expression with Creativity as the Core

Kunkun Yang[1*] and Fugen Liu[1,2]

[1]Jiangxi University of Applied Science, Academy of Art Design, Nanchang 330100, China, 18970027555@139.com
[2]Sangmyung University, Department of Plastic Arts, Seoul 03016, Korea, liu1981.fugen@gmail.com

Corresponding author: Kunkun Yang, 18970027555@139.com

Abstract. In the color coordination design system, based on the RGB model and the Munsell color model, the particle swarm algorithm is used to optimize and adjust the color design plan, and the fitness function is set with the classic color harmony theory as a constraint to obtain the optimized color design. The realization of the product color scheme optimization function module in the computer-aided design system proves that this method can quickly and effectively generate reasonable and innovative color schemes. The color configuration scheme in the design example often represents a certain type of design style, convention or trend, which has important reference value and guiding significance for new designs. The clustering analysis method and the particle swarm optimization algorithm are combined and applied to computer-aided color design, and the color configuration scheme extracted from reference design examples is proposed and applied to the new design example-based color design method. The extraction and reuse of color design schemes are conducive to further enhancing the function of computer-aided color design and improving design efficiency.

Keywords: Computer-aided design; visual communication; color coordination design; creativity
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1 INTRODUCTION

The rapid development of computer hardware equipment and software technology has made a series of related industries that use computers, software and other auxiliary equipment for visual design and production gradually formed and matured. The visual communication design industry has reached the basic popularization of computer-aided design. The charm of the design makes the design show amazing effects, but also attracts all people who love design performance

diligently pursue and make unremitting efforts [1, 2]. As visual communication, computer-aided design in visual communication creation rules, formal rules and aesthetic methods are the same as traditional visual communication design. Facing the widespread application of computer-aided design in the environmental visual communication design profession, we must not only recognize the instrumental nature of computer drawing software, but also realize that it is not just a tool in the ordinary sense [3, 4]. Its emergence will change people's perceptions of the performance and cognition of environmental visual communication design on more levels of environmental visual communication design.

The development of technology and the advancement of aesthetics have prompted people to have higher and higher visual tastes for seeking new and different ideas. Only by continuously improving the imagination and creativity of visual designers Power and performance ability can meet people's increasing requirements for visual communication. Many people blindly learn all kinds of drawing software, leading to the emergence of a large number of machine-like "drawers" in the society, ignoring the visual communication that the computer-aided environment visual communication design works as visual communication should have. In the color coordination design system, based on the RGB model and Munsell color model, this paper uses the particle swarm algorithm to optimize and adjust the color design plan, and set the fitness function with the classic color harmony theory as the constraint, so as to obtain the optimized color design scheme. The color configuration scheme in the design example often represents a certain type of design style, convention or trend, which has important reference value and guiding significance for new designs. The computer-aided color coordinated design system is designed and implemented for specific functions, and the method of computer-aided product color coordinated design is preliminarily verified through product design examples.

2 RELATED RESEARCH

Modern society is also an era of design, and visual communication design is flooding all areas of people's lives. From outdoor advertisements to paper advertisements, from small cards to huge buildings or public environments, there are graphics. They are all inseparable from the expression of graphics. Colorful graphics not only beautify and decorate human life, and meet people's visual aesthetic needs, but they are also an information medium. Chang et al. [5] pointed out that people use the information conveyed by these graphics to understand what is happening around them. Graphics have become the main language form for information transmission and mass communication by humans today. Graphic design has therefore become an important subject in the field of modern design.

Visual communication design carries out information transmission activities in various forms and various expression methods, and graphics, as one of the important components of visual communication design. As long as you want to develop in this major, you must master this compulsory form of visual communication design for information exchange between people. Just as a person wants to live well in a foreign country, he needs to be fluent in the language of that country. The dissemination of information in the visual language form of graphics is the expression of the creativity we want to carry out. Gulati et al. [6] believe that the form of graphics is rich and enlightening, and it is the most humanistic and visual communication value in the creation of human visual communication design. In a broader sense, graphics are also the basis of various visual forms including text. Therefore, the creation of graphics is an important part of the creation of human civilization.

The visual communicators of the whole society and the famous computer visual communication design master George Capson founded a special scientific research institution dedicated to designing computer graphics research of visual communication. Gale [7] pointed out that computer vision communication graphic design and creation has quickly become a novel technique

and new tool for visual communicators and designers to create paintings. Jin et al. [8] believe that computer graphics-aided design will play a key role in the future society and industry.

Zeng et al. [9] pointed out that visual communication design is a comprehensive design work that conveys valuable information through visual elements and symbols. Through the integration and analysis of requirements, the key information is sorted out, and through the integration and reorganization of the designer, the valuable information is transmitted to potential audiences as much as possible, so as to achieve the information transmission goal and realize the value of the information. This activity is more about using visual elements and symbols to express information, building a platform for the sender of the information to inform the recipient of the information, so as to achieve the purpose of information transmission.

Sung et al. believe that visual communication design integrates the specific content of multiple disciplines including semiotics, visual psychology, visual physiology, marketing, and communication [10]. It has made important contributions to the progress of business society and the increase of business value. At the same time, visual communication plays an increasingly important role in the emotional communication between people under the vision-based transmission method. Through vision as the basis of transmission, human deep-level emotions are more easily transmitted and accepted.

3 THE TECHNOLOGY OF VISUAL COMMUNICATION DESIGN AND THE INTEGRATION OF VISUAL COMMUNICATION IN A COMPUTER-AIDED ENVIRONMENT

3.1 Computer Graphics Technology Provides Designers with A New Form of Visual Communication Expression

You can get a perspective view that is calculated by the computer in the perspective view. You can also change the viewing angle, material, etc. at will according to customer requirements. Observing, examining, and modifying works from different perspectives greatly improves the authenticity and predictability of the design. It provides designers with a new form of visual communication and performance space, thereby opening up the potential of the designer's creativity and improving the designer's design expression and work efficiency. The logical structure of visual creative links is shown in Figure 1.

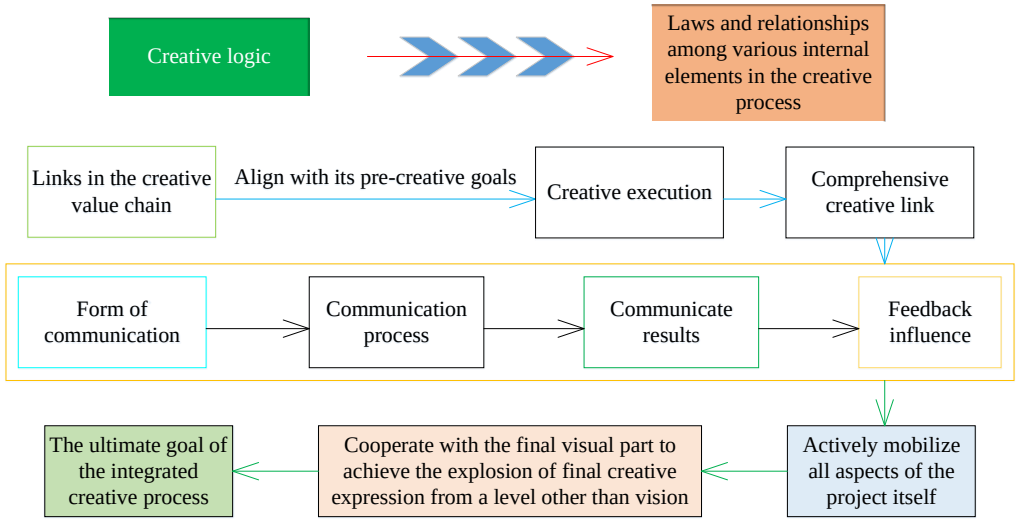

Figure 1: The logical structure of visual creative links.

3.2 Computer Graphics Technology Brings Profound Changes in Visual Communication Design Aesthetics and Visual Communication Design Thinking

The appearance of the camera marks the advent of a new era of visual communication. The painter Corot has absorbed photography techniques into his traditional paintings, and is a typical painter who "rediscovers" the subject matter in photography. His early works showed interest in capturing momentary effects, which was most thoroughly demonstrated in his subsequent impressionist works. The exposure time of photography had shrunk to just a few seconds, and even an exposure time of 1 second was not a small problem for landscapes. For example, leaves swaying in the wind will affect the light of the photo. This breakthrough in science and technology has allowed the painter to develop a deeper understanding and expression of the world, thus affecting the aesthetic development of the entire society.

For example, the computer architecture roaming animation in the computer-aided environment visual communication design can more realistically simulate the real scene, and the viewer can watch the space effect from different angles, giving people an immersive feeling. This kind of virtual space expression method that is so close to the real space effect is difficult to achieve by other expression methods. Through the use of computer three-dimensional software technology, a non-existent virtual world is created, enabling the designer's creative imagination to be truly realized. In the works, lighting, sound and other effects can also be used to enhance the atmosphere of the scene, which improves the vividness and authenticity of the works. The application of computer graphics software technology makes the environment visual communication performance space wider and more abundant.

3.3 Computer-Aided Environmental Visual Communication Design Perfectly Integrates the Connotation of Science and Technology and Visual Communication

This new form can be said to be a technical form of visual communication, or it can be said to be a form of technical visual communication. To be precise, it is a form in which science and technology and the connotation of visual communication are perfectly integrated. Computers have gradually become the main tool of design expression. Through the continuous upgrading and renewal of various three-dimensional drawing software, the performance of indoor and outdoor architectural effects becomes more and more vivid and lifelike. All the creation of expressions is a kind of technology, so the general process and practical skills of the development of visual communication-architecture, pottery, weaving, sculpture, and usually civilized people can ' t understand its importance. The witchcraft activities of China are closely related. Technology is a means of creating forms of expression and a means of creating sensory symbols. The technological process is a certain application of human skills to achieve the above goals. From this passage, we can see that Susan. Lange discovered the important value of technology in visual communication.

However, it is not enough to focus on technology in the design of computer-aided environmental visual communication. As a form of visual communication, it should have the connotation of visual communication. As an important factor, the aesthetic factor of visual communication is stored in a certain aesthetic form, that is, the form of visual communication.

3.4 Color Three-Dimensional Structure and Color Sequence System

Color stereo is composed of hue, lightness, and purity coordinates. It is a three-dimensional representation of a sphere-like color stereo model. Each color is located in a specific space coordinate value area based on its color attribute value. In the color stereo, the vertical axis represents the achromatic brightness change of the white and black series. The top of the axis is white, the bottom is black, and the middle is a variety of gray transitions. Hue is represented by a horizontal circle, and each point on the circle represents a variety of different hues. The transition

from the circumference to the center of the circle indicates that the purity of the color gradually decreases. When the color changes on the same plane of the color solid, the lightness of the color will not change, only the hue and lightness are changed. Color stereo is a three-dimensional color spectrum, and it is also an idealized schematic model, but it well represents the spatial relationship between the three attributes of colors and is the basis of many commonly used color systems. The basic structure of color three-dimensional is the same, but different color systems have their own characteristics, forms are different, and cross-sections also have certain differences.

Munsell color system is a three-dimensional space model that uses cylindrical coordinates to represent color attributes. Its vertical center axis coordinate corresponds to lightness (V), the circumferential angle coordinate corresponds to the hue (H) of the object color, and the radial coordinate corresponds to the chroma (C) of the object color. The hue circle of the Munsell color system is based on the five basic colors red (R), yellow (Y), green (G), blue (B), and purple (P). Yellow is inserted between the adjacent two colors. Red (YR), yellow-green (YG), blue-green (BG), blue-purple (BP), red-purple (RP) form a hue ring with 10 main hues. Each of the 10 main hues is divided into 10 equal divisions, a total of 100 scales. Each main hue has a sign from 1 to 10, and 5 is the representative sign of the hue. The central axis in the Munsell color stereo indicates that there is no black, white, gray, and achromatic series, and the brightness scale is obtained by dividing it into ten equal parts. It extends from the ideal black at the bottom (0) to the ideal white at the top (10). The center of the ruler (5) means medium gray or neutral gray. The Munsell color representation method is HV/C—hue, brightness/purity. For example, a color labeled 5R5/8 has a hue H of 5R, a lightness level V of 5, and a saturation level C of 8.

The International Commission on Illumination Standard Chromaticity System (CIE Chromaticity System) is based on 2 sets of basic visual experiment data, using the quantities of the three primary colors of R, G, and B-the tristimulus value to represent the color, and its chromaticity coordinate refers to the relative proportion of each of the three primary colors in the total amount of R+G+B. Suppose the chromaticity coordinates of a certain color C are r, g, and b respectively, then:

$$\begin{cases} r = R/(R+G+B) \\ g = G/(R+G+B) \\ b = B/(R+G+B) \\ C = 0.2 \bullet r(R) + 0.3 \bullet g(G) + 0.5 \bullet b(B) \end{cases} \tag{1}$$

As long as you know the two values of r and g, you can calculate the value of b, so the two values of r and g can represent 1 color. The three primary colors can be matched to standard white light, and the tristimulus values of standard white light are equal:

$$W = 0.25R + 0.30G + 0.45B \tag{2}$$

3.5 Computer-Aided Color Design Method Based on Particle Swarm Algorithm

If the hue of the color contained in the design scheme does not fall into the two mixed areas of Moon & Spencer (otherwise the hue will be changed), you use the particle swarm algorithm to adjust the brightness and purity of each color.

According to Munsell's color harmony theory, the mixed colors of n kinds of harmony should be gray. Set the RGB values of R1, G1, B1, then R1=G1=B1, so there are:

$$R_1 = \sum_{i=0}^{n-1} R_i = \sum_{i=0}^{n-1} l_i \bullet r_{i+1} \tag{3}$$

$$G_1 = \prod_{i=0}^{n-1} G_i = \prod_{i=0}^{n-1} l_i \bullet g_{i+1} \tag{4}$$

$$B_1 = \prod_{i=0}^{n-1} B_i = \prod_{i=0}^{n-1} l_i \bullet b_{i+1} \tag{5}$$

This is a system of inhomogeneous linear equations. The necessary and sufficient condition for a solution is that the rank R(A) of the coefficient matrix A is equal to the rank R(B) of the augmented matrix B. From R1=G1=B1, we get R(A)=R(B). Therefore, this non-homogeneous linear equation system must have a solution, but it cannot be obtained by solving this equation. This paper uses the particle swarm algorithm to search for its optimal solution.

4 THE STRUCTURE AND EXPERIMENT OF COMPUTER-AIDED COLOR COORDINATED DESIGN SYSTEM

4.1 Computer-Aided Color Coordination Design System Structure

Through the integration of this system with the "visual collaborative design system supporting product innovation", the color design module for visual communication in appearance design and intelligent assembly of works has been applied and verified. The system is developed by Visual C++.NET and SQL Sever2010.

This article provides two color design approaches: PSO-based color scheme design and color scheme design based on image examples. Among them, the former uses PSO for intelligent optimization of color schemes, and the latter provides knowledge assistance for color scheme design based on color clustering. The specific design method is based on the Munsell color model, combined with Munsell Harmony Theory and the color harmony principles and methods in the Monsell-Spencer Color Harmony Theory, and provides a way of color harmony that follows the relationship of different color orders.

The determination of the product design plan includes three major modules: the selection of product components, the layout of the components, and the determination of the product color scheme. Among them, the design of the product color scheme should be carried out on the basis of the determined product assembly layout scheme. The main production process of the product design plan is shown in Figure 2.

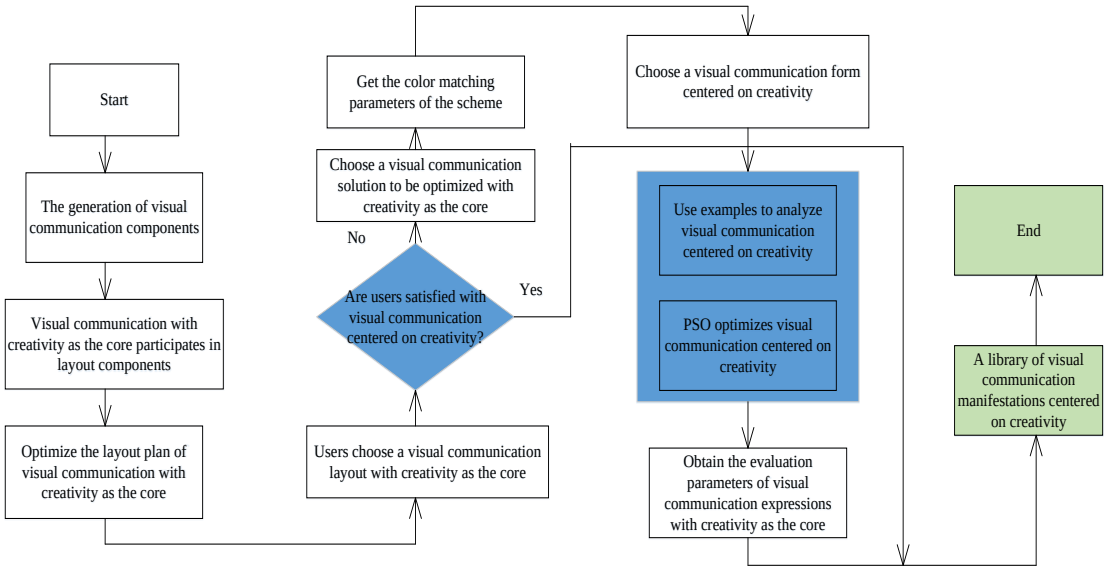

Figure 2: The main generation process of the product design plan.

4.2 Design of Coordinated Color Scheme Based on Particle Swarm Algorithm

The user selects the visual communication performance work to be assembled from the database, and reads its initial parameters: shell_width, shell_length, etc. Each component can be displayed separately according to the parameters, and a preliminary intelligent design can be performed on it, as shown in Figure 3. The user can select a satisfactory assembly scheme for color setting and further optimize its color scheme.

Figure 3: Preliminary intelligent image enhancement and segmentation effect diagram.

According to the user's preliminary color settings for each component of the appearance, the search space for the optimal solution is determined, that is, the color with the same hue as the set color scheme. It is expressed as n C-V planes in the color space (n is the maximum number of colors), and the ratios between the RGB values of the colors in the same plane are the same. Since the user sets the color in the RGB color space, you convert the RGB value of the selected color and the coordinates in the HVC color space to obtain the color parameters (h, v, c).

According to the HVC value of each color in the color scheme, first you judge whether it falls into the mixed area, if it is, remind the user to reselect the color; otherwise, calculate the harmony aesthetic degree, and record the RGB value of the scheme into the database if it is greater than 0.5. You convert the optimization results into RGB values and record them into the database. The optimization result is displayed according to the RGB value, as shown in Figure 4 and Figure 5.

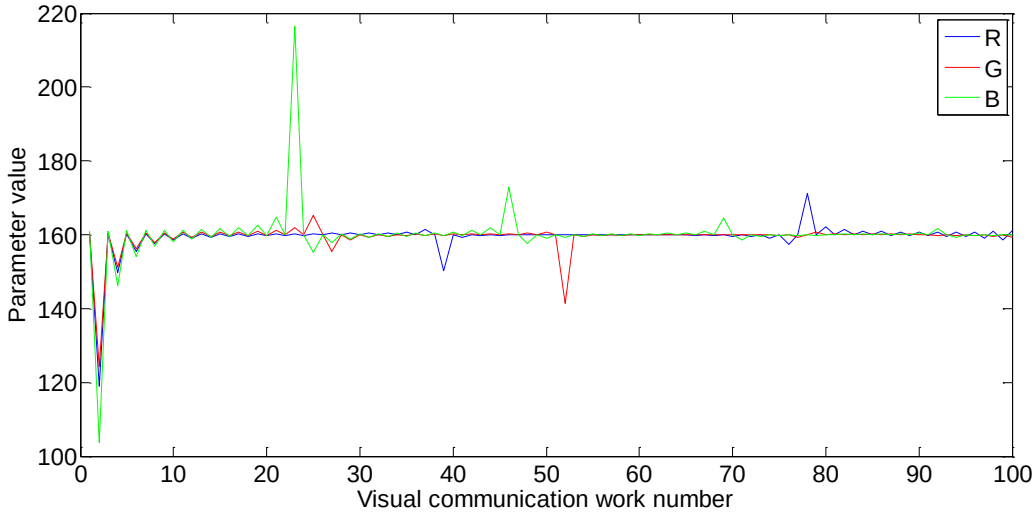

Figure 4: Original color scheme and its parameters.

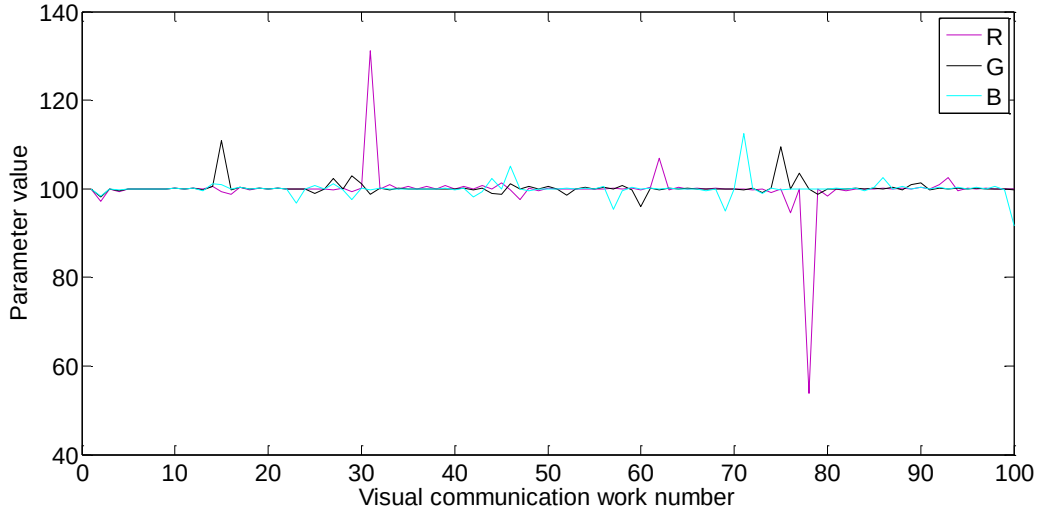

Figure 5: Optimized color scheme and its parameters.

Through the above steps, the module can optimize the color design scheme of the product according to certain rules according to the initial color set by the user and specific product components, so as to obtain a more innovative color matching scheme for users to choose and use, which improves effectiveness and innovation of the system.

4.3 Coordinated Color Scheme Design Based on Image Examples

You save the example color scheme to the scheme library. Since the number of colors in each instance is different, if the largest array is used uniformly, it will be a great waste of database space in the storage process. Therefore, converting it into an XML format file for storage and management is beneficial. The unification of the format is conducive to the optimization of the database and the transmission of data. The user can select the color scheme of a more satisfactory design example through the database preview, and obtain its parameters, as shown in Figure 6.

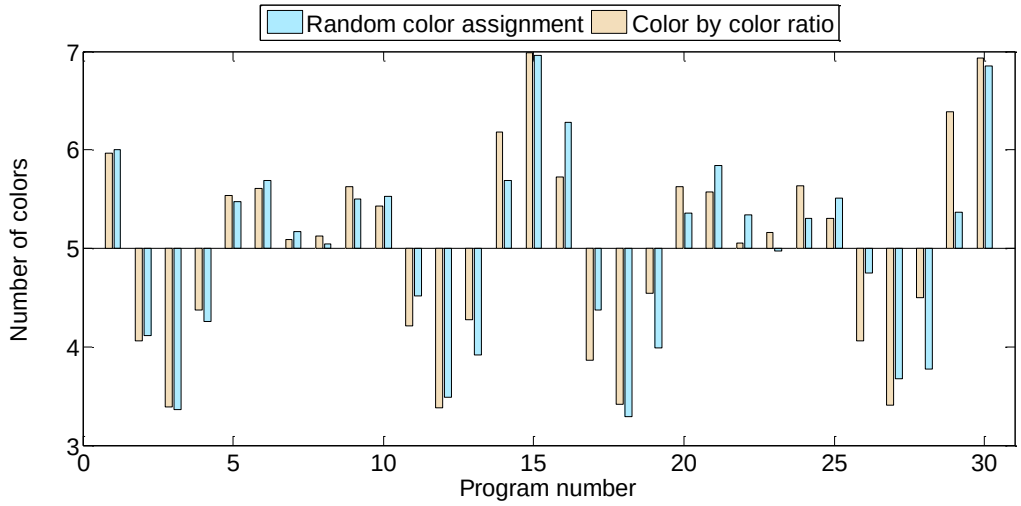

Figure 6: Color schemes of different examples.

You choose a coloring strategy to initially color the product. Under normal circumstances, the color matching parameters (number of colors, color proportions) of the design example and the product to be designed will not directly match. The system provides two coloring strategies: random coloring of color blocks and coloring based on color proportions. The random coloring strategy is randomly selected from the colors of the example schemes to assign colors to different color patch areas of the product. The user can randomly change the coloring results multiple times; according to the specific gravity, the color is assigned according to the order of the proportions of the colors in the example scheme. It is sorted, and the corresponding specific gravity color block of the corresponding product scheme is colored.

You evaluate the coloring results and calculate that the aesthetic degree of harmony is greater than 0.5, then convert the scheme into RGB values and record them in the database. Otherwise, you use PSO to optimize it. The specific layout plan and color scheme of the product need to be stored in the plan library, as shown in Figure 7.

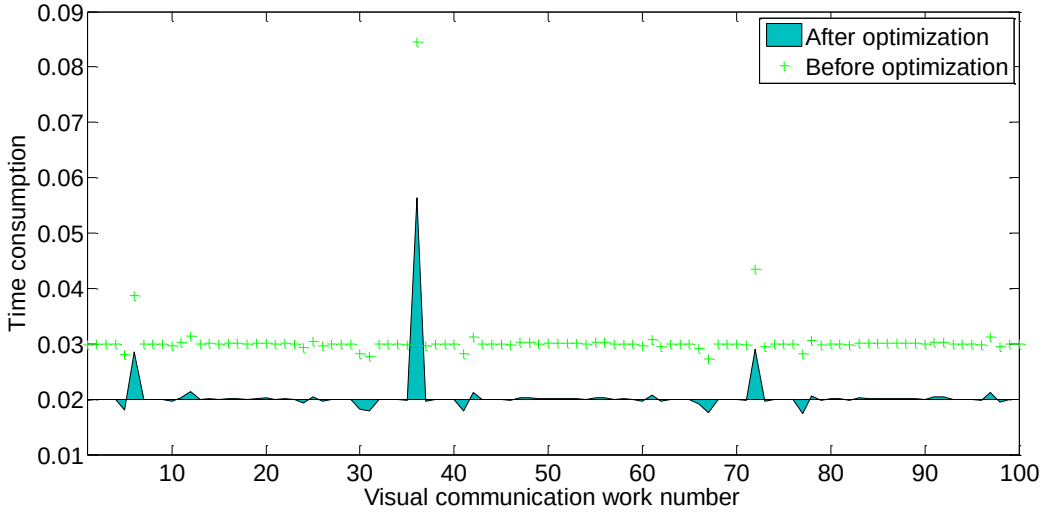

Figure 7: The time required for the layout scheme and color scheme to be stored in the scheme library.

5 CONCLUSION

The development and advancement of computer-aided environmental visual communication design not only requires proficiency in computer software technology, but also makes the work appealing for visual communication. First of all, it can combine the applicable places of various performance techniques to make its style unique; secondly, it can cultivate and stimulate the creativity of designers, and make designers' design concepts. There have been certain improvements in visual communication accomplishment; finally, there must be appropriate reform measures in the teaching of visual communication design in computer-assisted environment, so as to cultivate more people with strong professional quality and visual communication accomplishment. On the basis of basic research on color theory, this paper extracts applicable color design principles and methods, and proposes a method for intelligently optimizing color design schemes using particle swarm algorithm. This method provides a certain degree of color theory knowledge assistance for computer-aided color design, which helps to improve the efficiency of color design and provide color design creativity. Combining the clustering analysis method and the particle swarm

optimization algorithm in computer-aided color design, an example-based color design method is proposed, which is conducive to further enhancing the computer-aided color design.

Kunkun Yang, https://orcid.org/0000-0002-2686-6342
Fugen Liu, https://orcid.org/0000-0001-8523-2107

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