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Research Article

Color Matching in Children's Room Based on Computer Interactive Experience

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In order to improve the effect of color matching in children's room, this paper studies the color matching of children's room combined with computer interactive experience technology. Moreover, this paper analyzes the basic knowledge of colorimetry, the principle of color measurement equipment, the basic concepts and mathematical models of color conversion, equipment color characteristic correction, and color gamut matching used in color management research and analyzes the color perception in the process of computer interaction experience. The color design method based on hue harmony is a color harmony design method extracted on the basis of the basic color system and Chevrel's theory of color harmony. The experimental research shows that the indoor color matching system for children's room based on computer interactive experience proposed in this paper has a good color matching effect.

1. Introduction

With the improvement of people's living standards, people's requirements for the indoor environment are also getting higher and higher, and the requirements for the growth environment of the only child in the family are placed in the highest position. Having a healthy environment for children to grow up is a common concern of every parent and child-loving person. The color in the children's room is closely related to the physical and mental health of children. From birth, the color in the room will affect the physical and psychological growth and development of children all the time. Therefore, people must pay enough attention to it.

The children's room is the place where children's dreams begin, and it is also the place that has the deepest impact on their life. It is our responsibility to create a good environment for children to grow up. Moreover, it is our goal to make a beautiful living environment affect and nurture children's beautiful personality. The current family model makes parents pay more and more attention to the growth environment of children, and the design of children's room has become an important part of interior design. As the most important part of interior design, color design is particularly important. At present, modern scientific experiments have proved that color plays an important role in stimulating children's visual development, regulating children's psychological emotions, promoting children's right brain development, and cultivating children's imagination.

People's sense of beauty mainly comes from vision. Only through the visual system can we see rich colors and beautiful things. Thirty one-year-old children are full of curiosity about everything in this world. They like bright and highly saturated colors. During this period, they should consciously cultivate and emphasize their color perception ability and help children establish correct aesthetics, improve their appreciation level of beauty, and gain the enjoyment of beauty, thereby improving children's comprehensive aesthetic quality. However, in the current home improvement market, the color design of children's rooms is often based on the subjective wishes of parents, and it is often a matching case that is taken for granted or an adult version of the children's room. Without scientific theories and mature cases to guide, wrong color matching will seriously affect the physical and mental health of children, and the formation of unsound characters also makes parents and even children experts find no reason.

There are no particularly successful and representative cases in the scientific research and application of indoor colors in children's rooms in China. Therefore, this subject has great research value.

Being in a similar environment for a long time will keep the nerves of children in a state of tension and excitement, which will lead to a lack of security in the long run and even violent intrusion in severe cases. Conversely, blue is a cool color that can make people calm, thoughtful, and peaceful. When children are in such an environment for a short time, it is conducive to thinking about problems and maintaining a quiet and peaceful state of mind. However, too long and too much contact may cause children to suppress their introverted and inarticulate characters. Therefore, color will have various effects on children's growth, both positive and negative. Only through scientific color design to promote strengths and avoid weaknesses, seek advantages and avoid disadvantages, and effectively play the positive aspects of color in children's growth environment can we achieve our ultimate goal.

This paper studies the color matching of children's rooms combined with computer interactive experience technology and builds a computerized intelligent children's room interior color matching system to promote the healthy development of children's physical and mental health.

2. Related Work

Under normal circumstances, the family's understanding of the importance of children's room design can be divided into three situations. The first one is too much emphasis on functionality, and there is no difference in the choice of colors on furniture walls, ignoring the impact of colors on children [1]. The second is to consciously consider the color of the children's room while satisfying the functionality, but lacking understanding of color matching knowledge; the effect is naturally not ideal [2]; the third is to pay attention to the design of the children's room, query, and understand the relevant knowledge, to create a children's room suitable for children to live and grow [3].

Color matching is very important for children in the growth process, and choosing a rich and reasonable color matching will have a great impact on them. First of all, matching according to the personality characteristics of each child is more conducive to the healthy growth of children's body and mind [4]. Light tones, natural and soft color systems, such as beige, light brown, and light khaki, can give people a simple and natural feeling, can relieve anxiety and tension, and feel relaxed; the second is slightly bright, positive, calm, and excitement colors, such as vibrant red and yellow, which are conducive to mobilizing children's enthusiasm and cultivating positive thinking ability; followed by the fresh and natural plant light and color system, giving people a calm and stable atmosphere, based on green colors. It can relieve fatigue [5]; the other is the warm color system, which is too bright in the eyes of adults, but for children, orange and yellow can make them feel energetic and happy, and it is very important for children's cultivation. An open, pure, and lively character is helpful. However, orange and yellow are not suitable for large-scale use, which will cause visual impact and easily affect emotional instability. It can be used as an embellishment on the overall tone [6]. Secondly, children grow and learn in a "bright" space for a long time, which can better promote children's development in a subtle way. If the brightness and purity of the color selected in the children's room are relatively high, it will be more suitable for children's lively psychology and stimulate children's intellectual growth [7]. Through the measurement of children's IQ, the study found that when children were tested in a room with bright colors such as light blue, yellow, yellow-green, and orange, their IQ increased by an average of 12 points, while in white, black, and brown, when tested in a dark room, the average IQ is reduced by 14 points [8], and rich colors can improve children's IQ. Therefore, the children's room is not only a place for children to rest but also a place for children to learn and play [9]. While satisfying the spatial functionality, the collocation and use of colors, from safety to individualization, affects children's personality and mood and plays an important role in their growth [10].

Indoor color is mainly divided into indoor environment color, indoor intermediate color, and indoor environment decorative color, which are mainly manifested in shape, material, and space wall [11]. The environmental color mainly refers to the color of the wall, the ground, and the top surface. The overall tone of the environmental color should be used harmoniously; the intermediate color mainly refers to the color of large furniture such as indoor cabinets, beds, and sofas. The choice of furniture color should echo the space environment. Decorative color mainly refers to the color of indoor furniture, accessories, green plants, and other small decorative objects, which play a harmonious role in the overall color tone of the space [12].

Ambient colors, intermediate colors, and decorative colors should be used harmoniously: first, the ambient color in the indoor color should occupy a larger area of the color tone in the space, followed by the intermediate color; the decorative color is the smallest, and the area occupied by the three indoor colors should be seperated. There is a relationship between the golden ratio; the second is that the three colors cannot be the same; otherwise, it will easily cause the monotony of the space color and even produce a blurred feeling of the surface painting; third, the environment color and the intermediate color should maintain a harmonious relationship; decoration color and ambient color should have both contrast and coordination in color relationship [13].

In the color selection of children's room, proceed from the character of the child. Children's rooms should choose brighter, more relaxed, and cheerful colors, and the beating colors can stimulate children's strong thinking interest and imagination. In many cases, the correct use of color matching can also help to compensate for the defects of children's personality [14]. The combination of bright red and beautiful blue is contrasting which is suitable for introverted children; light blue is an elegant and gentle color suitable for children with more lively personality; the combination of pink and purple gives a romantic feeling. The

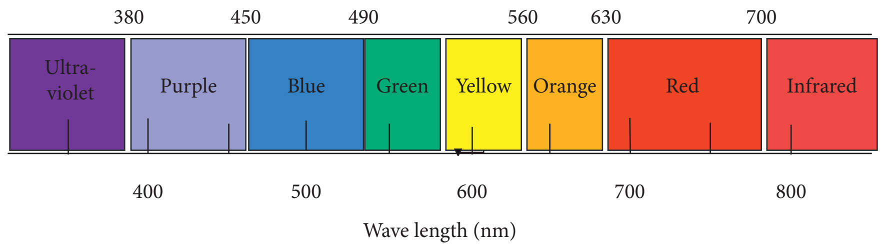


Figure 1: Schematic diagram of colors corresponding to different wavelength spectra.

warm visual experience is suitable for some withdrawn children; the green color is more suitable for children with poor eyesight [15].

When choosing a color combination, some colors should also be avoided and have a negative impact on the child's psychology. For example, the use of a large area of black will make people feel depressed, resulting in unfavorable negative psychology. The combination of very bright yellow and orange indicates danger and is easy to generate tension [16]; a large area of white will make people feel monotonous and lack of vitality and fun, resulting in negative and hopeless emotions; although blue is widely used, it is a lonely tone, and large areas of blue are easy to produce lonely and contemplative emotions; large areas of red and excessive red decorative colors can easily lead to emotional instability and excitement of people [17]. Under normal circumstances, the space color matching should not exceed three. For the matching of colors and materials, the suitability of children should be fully considered, and materials with different materials but with the same color system should not be put together [18]. To maintain the principle of moderation, the overall interior tone is too full or unsuitable for space, white and black cannot be used as the main tone, and gold and silver can be used as a foil color; by fine-tuning the relationship between tone, lightness, and purity, the primary and secondary tones can be achieved. Secondary distribution, reasonable collocation of colors, and unification of primary and secondary colors contribute to harmony [19].

3. Visual Model of Color

Color can be defined as the human eye's perception of light, and it is fundamentally a subjective sensation that exists only in the human brain. The color of any object is the result of the action of the following three basic elements: the light source, the object, and the observer.

When there is no light, there is no color, and the color of a fixed object seen by the observer changes as the lighting changes. The scientific understanding of color originated from Newton, who used a prism to divide white light into sequential colored lights, explaining that white light is composed of a series of colored lights. Modern science interprets visible light as a small part of the electron spectrum, and it is generally believed that radiation in the wavelength range of 380 nm–780 nm can cause a visual response in the human eye, called visible light. The wavelength of visible light is different, which causes the human eye to perceive different colors. The wavelength of monochromatic light is from long to short, corresponding to the perceived color from red to purple, as shown in Figure 1.

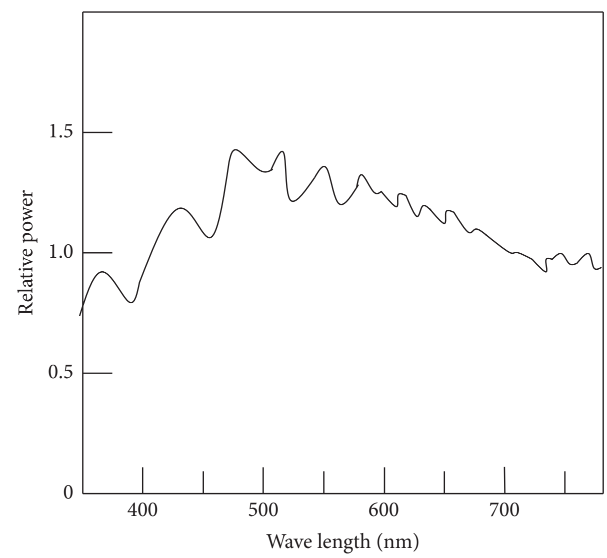


Figure 2: Schematic diagram of solar spectral power distribution.

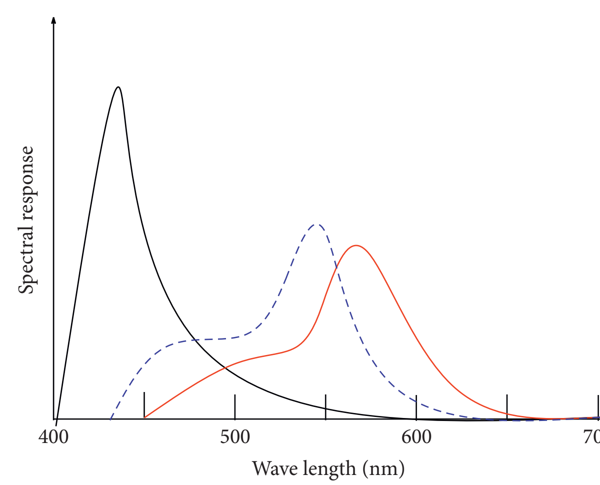


Figure 3: Corresponding graph of the spectrum of pyramidal cells.

According to the above conclusions, any visible light is composed of radiation of a certain wavelength and intensity, and the function of radiation power and corresponding wavelength can quantitatively and accurately describe all light sources, which is called spectral power distribution. The spectral power distribution of perceived white light is approximated as a straight line, and Figure 2 shows a typical daytime daylight spectral power distribution.

The decomposition of incident light into three independent stimuli by pyramidal cells is important for color reproduction (as shown in Figure 3). Another very important phenomenon is that two types of light with different spectral power distributions may produce the same tristimulation signal in pyramidal cells. The significance is that if we want to replicate the visual effect of a color, we do not necessarily have to create the same spectral power distribution, but only need to have three pyramidal cells produce the same stimulus signal as the source color. This phenomenon is called “metamefism.”

When two identical colors are each added and mixed with two other identical colors, the color remains the same. The formula is expressed as

$$\text{if } A = B, C = D, \quad \text{be } A + C = B + C, \tag{1}$$

where “ = ” indicates that the colors match each other.

For two identical colors, each correspondingly subtracts the same color, and the remainder remains the same. The formula is expressed as

$$\text{if } A = B, C = D, \quad \text{be } A - C = B - C. \tag{2}$$

If the color of one unit is the same as the color of another unit, then the two colors are enlarged or reduced by the same multiple at the same time, and the two colors are still the same. The formula is expressed as

$$f\, A = B, \quad \text{be}\, nA = nB. \tag{3}$$

According to the law of substitution, colors that feel the same can be substituted for each other to obtain the same visual effect.

A color matching equation is an algebraic expression for color matching. If (C) represents the unit of the matched color, (R), (G), and (B) represents the unit of the three primary colors of red, green, and blue that produce the mixed color. R, G, B, and C represent the number of red, green, blue, and matched colors, respectively. When the two halves of the field of view are matched in the experiment, this result can be expressed by the following equation:

$$C(C) = R(R) + G(G) + B(B). \tag{4}$$

In the formula, “ = “” means visual equality, that is, color matching; R, G, and B are the number of generations, which can be negative.

In the color matching experiment, the color light to be measured can also be a monochromatic light of a certain wavelength (also known as spectral color). When a series of similar matching experiments are performed for monochromatic light of one wavelength, the tristimulus values corresponding to monochromatic light of various wavelengths can be obtained. If the radiant energy value of each

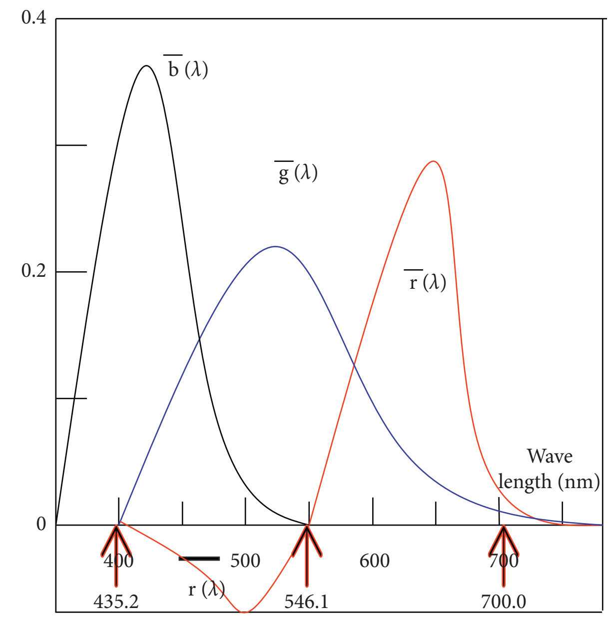


Figure 4: Color matching function of RGB chromaticity system.

monochromatic light is kept the same (such a spectral distribution is called iso-energy spectrum) to carry out the above experiment, the obtained tristimulus value is the spectral tristimulus value, that is, the number of three primary colors that match the spectral color of equal energy. It can be denoted by the symbol $\overline{r}, \overline{g}, \overline{b}$. The spectral tristimulus value is also called the color matching function, and its value only depends on the visual characteristics of the human eye. The matching process is expressed as [20]

$$C_\lambda(C) = \overline{r}(R) + \overline{g}(G) + \overline{b}(B). \tag{5}$$

Any color light is composed of monochromatic light. If the spectral tristimulus value of each monochromatic light is measured in advance, the tristimulus value of the color light can be calculated according to the principle of color mixing. The calculation method is to use the spectral distribution function $\varphi(\lambda)$ of the light to be measured, weight the spectral tristimulus value of each wavelength to obtain the tristimulus value of each wavelength, and then integrate it to obtain the tristimulus value of the light to be measured as follows:

$$\begin{aligned} \dot{R} &= \int_{v=s} k\varphi(\lambda)\overline{r}(\lambda)d\lambda, \\ G &= \int_{vis} k\varphi(\lambda)\overline{g}(\lambda)d\lambda, \\ B &= \int_{vis} k\varphi(\lambda)\overline{b}(\lambda)d\lambda. \end{aligned} \tag{6}$$

The integration range is visible light band, generally from 380 nm to 780 nm.

Figure 4 is a graph of spectral tristimulus values drawn with the tristimulus value as the ordinate and the wavelength as the abscissa.

It can be seen from Figure 4 that a large part of the $\overline{r}, \overline{g}, \overline{b}$-spectral tristimulus values and the chromaticity coordinates of the spectral locus have negative values.

The conversion relationship between the tristimulus values of the XYZ system and the RGB system is as follows [21]:

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = \begin{bmatrix} 2.7689 & 1.7517 & 1.1302 \\ 1.0000 & 4.5907 & 0.0601 \\ 0.0000 & 0.0565 & 5.5943 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix}, \quad (7)$$

$$\begin{bmatrix} R \\ G \\ B \end{bmatrix} = \begin{bmatrix} 0.41844 & -0.15866 & -0.08283 \\ -0.09117 & 0.252422 & 0.01570 \\ 0.00092 & -0.00255 & 0.17858 \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \end{bmatrix}. \quad (8)$$

By formula (7), the tristimulus color matching function of the CIE standard chromaticity system can be calculated according to the CIE-RGB system, as shown in Figure 5. Since it is considered that only the Y value represents both magenta and brightness when XYZ selects the primary color, while X and Z only represent magenta, the $\overline{y}(\lambda)$ function curve is consistent with the photopic spectral luminous efficiency $V(\lambda)$, that is, $\overline{y}(\lambda) = V(\lambda)$.

The CIELab space adopts the following three-dimensional rectangular coordinate color space:

$$\begin{cases} L = 116 f\left(\dfrac{Y}{Y_n}\right) - 16, \\ a = 500\left\{ f\left(\dfrac{X}{X_n}\right) - f\left(\dfrac{Y}{Y_n}\right)\right\}, \\ b = 200\left\{ f\left(\dfrac{Y}{Y_n}\right) - f\left(\dfrac{Z}{Z_n}\right)\right\}. \end{cases} \quad (9)$$

Among them, the function $f(x)$ is expressed as follows [22]:

$$f(x) = \begin{cases} x^{1/3}, & x > 0.008856, \\ 7.787x + 16/116, & x \le 0.008856. \end{cases} \quad (10)$$

Among them, X, Y, and Z are the tristimulus values of the object, X_n, Y_n, and Z_n are the tristimulus values of the completely diffuse reflection surface and are normalized to $Yn = 100$.

The color difference in the CIELab color space and the correlation quantities (lightness, chroma, and hue angle) approximately corresponding to the psychological correlation quantities can be obtained by the following methods:

(1) Color differencethe color difference between two chromaticity values (L_1, a_1, b_1), (L_2, a_2, b_2) in the CIE color space.

ΔE_{ab} is determined by

$$\Delta E_{ab} = \left((\Delta L)^2 + (\Delta a)^2 + (\Delta b)^2\right)^{1/2}, \quad (11)$$

where

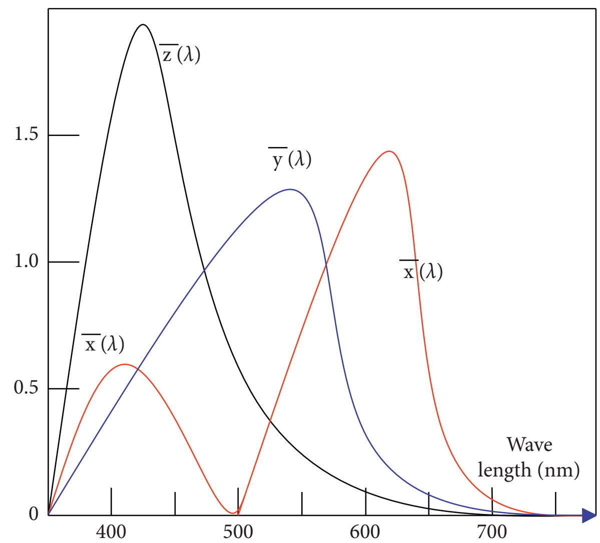


Figure 5: Color matching function of XYZ color system.

$$\begin{aligned} \Delta L &= L_1 - L_2, \\ \Delta a &= a_1 - b_2, \\ \Delta b &= b_1 - b_2. \end{aligned} \quad (12)$$

(2) Brightness:

$$L = 116 f\left(\frac{Y}{Y_n}\right) - 16. \quad (13)$$

(3) Chroma:

$$C_{ab} = \left(a^2 + b^2\right)^{1/2}. \quad (14)$$

(4) Hue angle:

$$H_{ab} = \mathrm{tg}^{-1}\left(\frac{b}{a}\right). \quad (15)$$

The establishment of the CIE standard chromaticity system lays the foundation for people to objectively measure the color of an object, and the color can be determined by measuring the color tristimulus value of the object. The purpose of color management is to achieve consistent color reproduction across devices, which is enough to accurately reproduce CIE chromaticity values on various devices. One of the prerequisites for color management is to obtain the accurate CIE chromaticity value of the color. Through the corresponding relationship between the CIE chromaticity value of the color sample and the device driver value, the output model of the device is established to achieve accurate reproduction of any CIE chromaticity value. We know that the formula for calculating the tristimulus value is

$$\begin{aligned} X &= K\int_{\text{vis}} S(\lambda)\beta(\lambda)\overline{x}(\lambda)d\lambda, \\ Y &= K\int_{\text{vis}} S(\lambda)\beta(\lambda)\overline{y}(\lambda)d\lambda, \\ Z &= K\int_{\text{vis}} S(\lambda)\beta(\lambda)\overline{z}(\lambda)d\lambda, \end{aligned} \quad (16)$$

where $S(\lambda)$ is the spectral distribution of the light source, $\beta(\lambda)$ is the spectral radiance parameter of the object, and $\overline{x}(\lambda), \overline{y}(\lambda)$, and $\overline{z}(\lambda)$ are the color matching functions of the standard observer. The spectral distribution $S(\lambda)$ of the light source, the spectral radiance parameter $\beta(\lambda)$ of the object, and the standard observer spectral tristimulus value $\overline{x}(\lambda), \overline{y}(\lambda)$, and $\overline{z}(\lambda)$ are all necessary to obtain the color tristimulus value. A color measuring instrument is a tool to obtain the color tristimulus value through a certain way. According to the different ways of obtaining the three laser values, color measuring instruments can be mainly divided into two categories: spectrophotometers and colorimeters.

One of the main contents of this study is how to get the mapping relationship $\mathrm{F}_{\text{device}}$ and $\mathrm{F}_{\text{device}}$ between the device-dependent color space and the CIE color space.

The process by which a scanner scans a color image and records its chromaticity values can be expressed as

$$\mathbf{c}_i = H\left(\mathbf{M}^T \mathbf{r}_i\right), \tag{17}$$

where the matrix M represents the three-channel spectral stimulus response parameters including the scanner illumination, $\mathbf{r}_i$ represents the spectral reflection of the ith point in the image space, H represents the nonlinear correction model of the scanner (reversible within the scanner recognition range), and $\mathbf{c}_i$ represents the vector of the color recorded by the scanner, that is, the digital drive value of the scanner, usually a vector in the RGB space, which can be expressed as $\mathbf{c} = [RGB]^T$.

The ideal scanner is colorimetric. That is, colors that look different to a standard observer will be scanned and recorded as different device-dependent color values. For all $\mathbf{r}_k, \mathbf{r}_j \in \Omega_r, k \neq j$, we have

$$\mathbf{A}^{\mathrm{T}}\mathbf{L}_v\mathbf{r}_k \neq \mathbf{A}^{\mathrm{T}}\mathbf{L}_v\mathbf{r}_j \Rightarrow \mathbf{M}^{\mathrm{T}}\mathbf{r}_k \neq \mathbf{M}^{\mathrm{T}}\mathbf{r}_j, \tag{18}$$

where $\dot{\Omega}_r$ represents the set of reflectance spectra of the oscillating medium that can appear, the column vector of matrix A contains the CIE$\overline{\text{XYZ}}$ color matching function, and the diagonal matrix Lv represents the lighting conditions of the observation environment. In other words, a colorimetric scanner scans an image just as a standard observer would observe the image under light $\mathbf{L}_v$. For such scanners, the calibration problem is to determine a continuous mapping $\mathrm{F}_{\text{scanner}}(\cdot)$ to convert the scanned color values into the CIE color space. For all $\mathbf{r} \in \Omega_r$, the chromaticity value t in the device-independent color space can be obtained as

$$\mathbf{t} = \mathbf{A}^{\mathrm{T}}\mathbf{L}_v\mathbf{r} = \mathrm{F}_{\text{semer}}(\mathbf{z}). \tag{19}$$

For the scanner, there is always a set of reflection spectra B_{scan} of the scanned medium, such that the conversion $\mathrm{F}_{\text{scanner}}(\cdot)$ from the scan value to the CIEXYZ chromaticity value exists. The color of the output images, photos, and other media of the decoration simulation platform is always produced by the combination of colorants within a certain range, so the reflection spectrum that can be produced is also limited to a set B_{media}. Generally, in such a set, a transformation is ubiquitous such that (18) is satisfied, for all $r \in B_{\text{scanner}}$.

Therefore, in all calibration methods, the first step is to select a set of calibration samples whose reflectance spectrum belongs to set B_{scanner}, to ensure that the scan value of this set of samples has a one-to-one mapping relationship with the device-independent color space. The reflectance spectrum of this set of M_q samples is $\{\mathbf{q}_k\}, 1 \leq k \leq M_q$. The device-independent color space colorimetric values of these samples are measured by a spectrophotometer or other type of colorimeter according to the following relationship:

$$\left\{\mathbf{t}_k = \mathbf{A}^T\mathbf{L}_v\mathbf{q}_k\right\}, 1 \leq k \leq M_q. \tag{20}$$

In order not to lose generality, $\{\mathbf{t}_k\}$ denotes the chromaticity value of any device-independent color space, such as CIEXYZ. In this case, $\{\mathbf{t}_k = \mathrm{L}(\mathbf{A}^T\mathbf{L}_v\mathbf{q}_k)\}$, where $L(\cdot)$ stands for CIEXYZCIELab and CIELuv.

At the same time, scan these samples with a scanner to obtain the scan value $\mathbf{c}_k = H(\mathbf{M}^T\mathbf{q}_k), 1 \leq k \leq M_q$. Accordingly, the scanner calibration problem can be described as finding a transformation $\mathrm{F}_{\text{scanner}}(\cdot)$ that satisfies

$$\mathrm{F}_{\text{gsmer}} = \arg\left(\min_{\mathrm{F}} \sum_{i=1}^{M_q} \|\mathrm{F}(\mathbf{c}_i) - \mathbf{t}_i\|^2\right), \tag{21}$$

where $\|\cdot\|^2$ is the second norm in the CIE color space, which represents the color difference in the CIE space.

The CMY value output by the decoration simulation platform is c (three-dimensional coordinates), and the measured CIE chromaticity value is t (three-dimensional coordinates), and $\mathrm{F}_{\text{printer}}(\cdot)$ represents the nonlinear mapping relationship from the decoration simulation platform color space (CMY space) to the CIE color space. Then, there are

$$\mathbf{t} = \mathrm{F}_{\text{printer}}(\mathbf{c}), \mathbf{c} \in \Omega_{\text{priner}}, \tag{22}$$

where Ω_{printer} represents the set of all CMY values of the decoration simulation platform. Correspondingly, for each CIE chromaticity value in the color gamut of the decoration simulation platform, the chromaticity value can always be converted into a CMY value output by transforming $F_{primer}^{-1}(\cdot)$, namely,

$$\begin{aligned} \mathbf{c} &= \mathrm{F}_{\text{printer}}^{-1}(\mathbf{t}), \\ \mathbf{t} &\in G_{\text{printere}}. \end{aligned} \tag{23}$$

The color gamut G_{printere} of the decoration simulation platform is defined as

$$G_{\text{printer}} = \{\mathbf{t} \in \Omega_{\text{cie}} | \exists \mathbf{c} \in \Omega_{\text{device}}, \mathrm{r}_{\text{device}}(\mathbf{c}) = \mathbf{t}\}. \tag{24}$$

In essence, the color correction of the decoration simulation platform is to find out the mapping relationship $\mathrm{F}_{\text{printer}}^{-1}(\cdot)$, so as to complete the accurate conversion from the CIE chromaticity value to the CMY value of the decoration simulation platform.

The process of calibrating the decoration simulation platform is as follows. First, the platform selects a set of calibration samples distributed in the color space of the entire decoration simulation platform, namely, the device

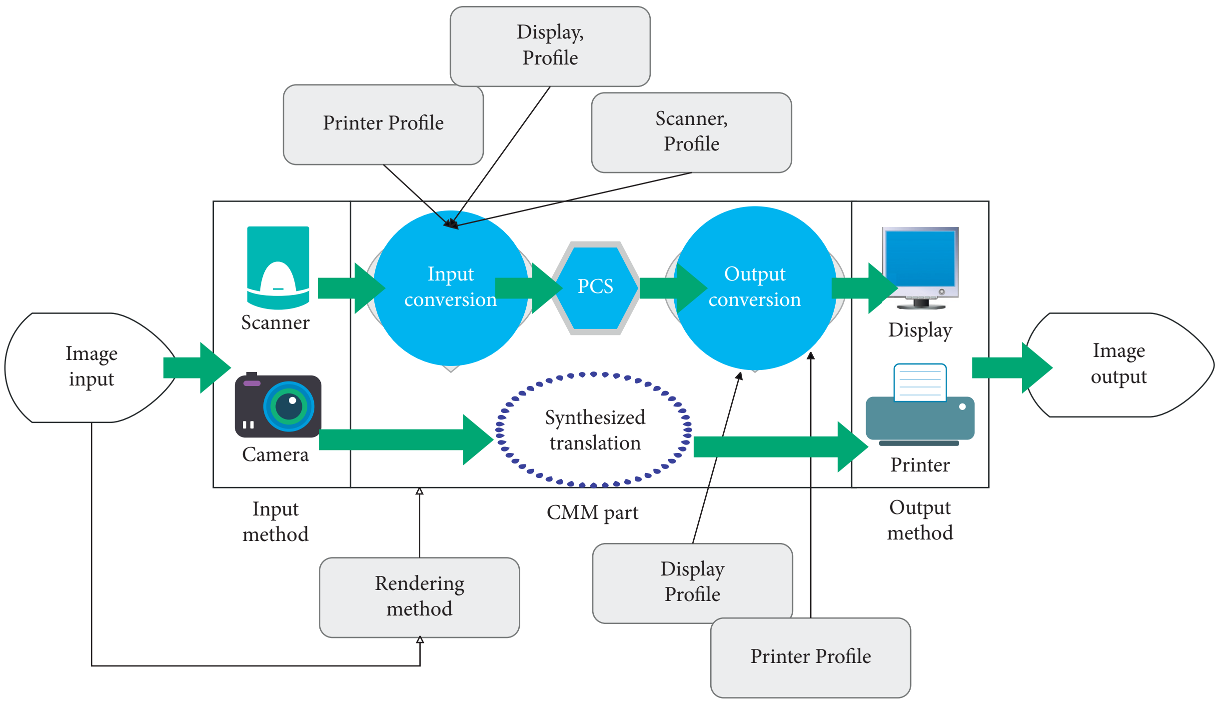


FIGURE 6: CMM color conversion process.

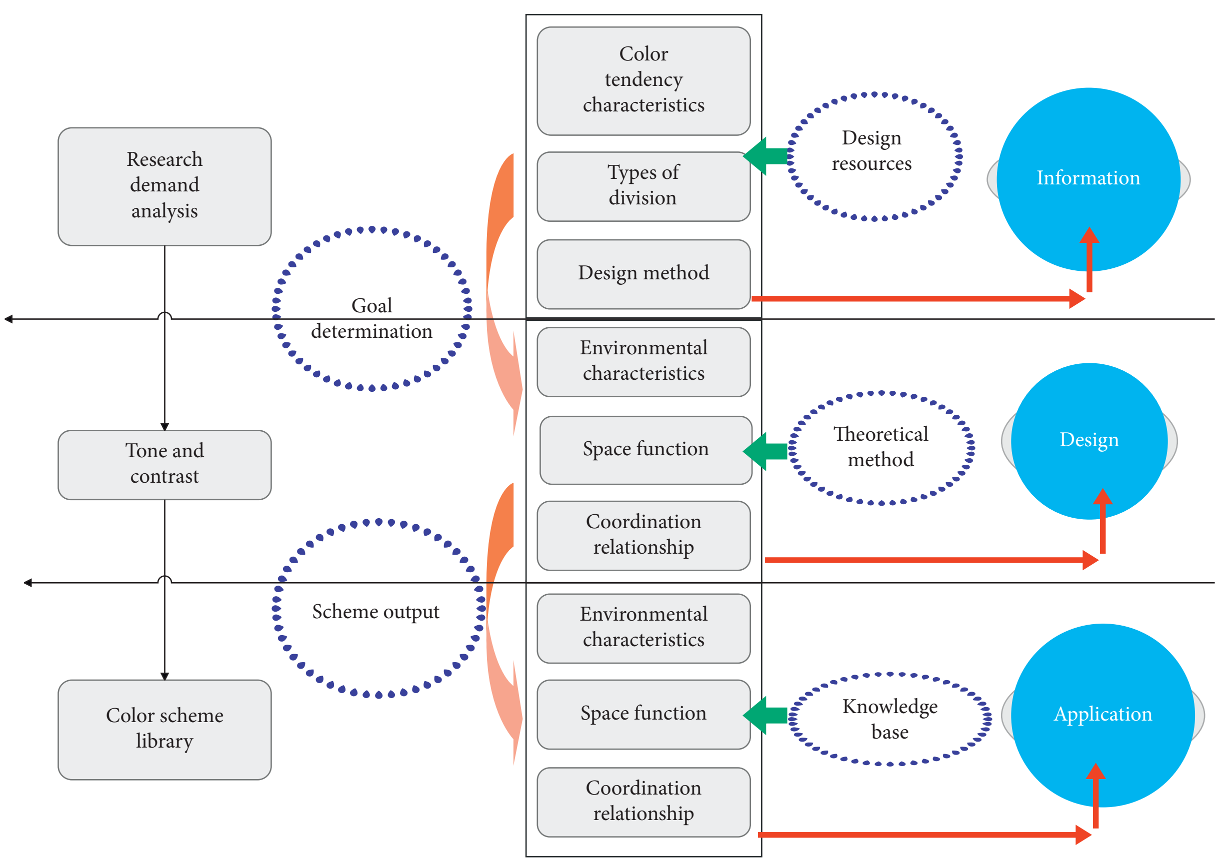
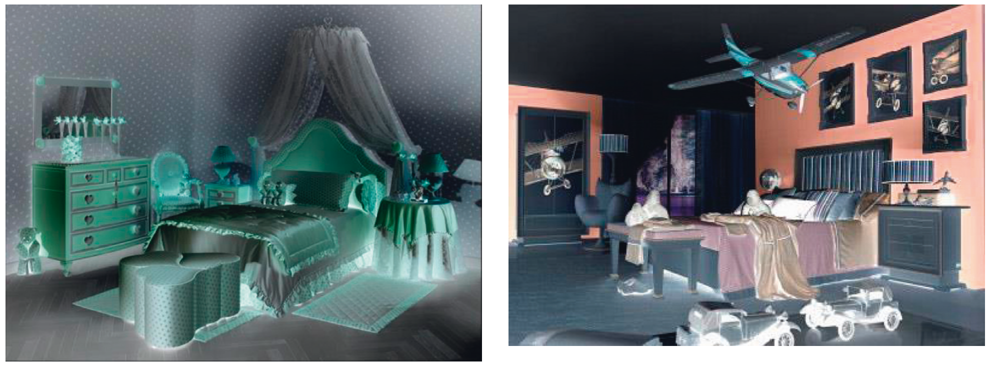


FIGURE 7: Color matching system in children's room based on computer interactive experience.

drive value, which is defined as $\{\mathbf{c}_k\}, 1 \leq k \leq M_q$. After the platform result is output, the spectral reflectance $\{\mathbf{p}_k\}, 1 \leq k \leq M_q$ of the calibrated color target is obtained. Using a colorimeter, the CIE chromaticity value $\{\mathbf{t}_k\}, 1 \leq k \leq M_q$ of the corresponding color sample can be measured and has the following relationship:



(a) (b)

Figure 8: Simulation of female children's room and male children's room. (a) Indoor color matching for girls. (b) Indoor color matching for boys.

$$\left\{\mathbf{t}_k = \mathbf{A}^T \mathbf{L}_v \mathbf{q}_k\right\}, 1 \le k \le M_q, \tag{25}$$

where $\mathbf{t}_k$ represents the CIE chromaticity value, which is generally the Lab value. Therefore, the correction of the decoration simulation platform needs to first find the mapping $\mathrm{F}_{\text{prmer}}(\cdot)$ to meet the following optimization conditions:

$$\mathrm{F}_{\text{printer}} = \arg\left(\min_F \sum_{i=1}^{M_p} \left\| F(\mathbf{c}_i) - \mathbf{t}_i \right\|^2\right). \tag{26}$$

The color correction of the decoration simulation platform is generally carried out with the help of CIELab space. This space is a visually uniform space, that is, the Euclidean distance between two points in the space is proportional to the visual difference. In addition, the Euclidean distance has an isoscopic color space, that is, the Euclidean distance of two points in the space is proportional to the visual difference so that the color gamut matching problem can be solved by an intuitive geometric method.

All output devices, such as decoration simulation platforms and monitors, have their own color reproduction capabilities and can only output colors within a certain range, which is defined as color gamut. Ω_{cie} is the chromaticity value range of the CIE color space and Ω_{printer} is the output device color space, that is, the digital drive value range of the device; then, the device color gamut can be defined as follows:

$$G = \left\{\mathbf{t} \in \Omega_{\text{cie}} | \exists \mathbf{c} \in \Omega_{\text{device}} \text{ where } \mathrm{F}_{\text{device}}(\mathbf{c}) = \mathbf{t}\right\}. \tag{27}$$

Out-of-gamut is defined as

$$G^c = \left\{\mathbf{t} \in \Omega_{\text{cie}} | \exists \mathbf{t} \notin G\right\}. \tag{28}$$

When a color image is transmitted between different devices, ICCCMM will use the information provided by the device profile to convert the color data of the image from the color space of the source device to the color space of the destination device. The conversion process is as follows: first, the color data of the image is converted from the source device color space to the PCS space and then from the PCS space to the destination device space. The algorithm and related information used in the conversion are provided by the device Profile. For example, when the image on the display is output through the decoration simulation platform, the CMM first uses the profile of the display to convert the color data of the image from the ROB space to the Lab space and then converts the color data from the Lab space to the CMYK space according to the Profile of the decoration simulation platform. The decoration simulation platform uses the CMYK data obtained at this time to output the image. Through two conversions, the color of the output image of the decoration simulation platform can be more consistent with the color displayed on the monitor, that is, the color can be accurately transmitted between different image devices. Figure 6 shows the general workflow of the CMM.

4. Color Matching in Children's Room Based on Computer Interactive Experience

The color design method based on hue harmony is a color harmony design method extracted on the basis of the basic color system and Chevrel's theory of color harmony. It uses the color matching relationship between the main environment and the background and the application of color management to generate a user interface for visual circulation operation in the CAD environment and obtains the basic color modeling scheme of the indoor environment. This paper designs an indoor color matching system for children's room based on computer interactive experience, as shown in Figure 7.

Figure 8 shows the simulation diagram of the female children's room and the male children's room designed by the color matching system in the children's room based on the computer interactive experience.

On the basis of the above research, the effect verification of the indoor color matching system in children's room based on computer interactive experience proposed in this paper is carried out. The color matching effect is verified by multiple sets of simulation experiments, and the results are shown in Table 1.

Table 1: Effect verification of color matching system in children's room based on computer interactive experience.

Number	Color matching	Number	Color matching	Number	Color matching
1	84.29	21	79.05	41	86.25
2	80.11	22	90.46	42	88.61
3	89.06	23	80.51	43	91.43
4	86.22	24	86.29	44	87.41
5	81.78	25	88.44	45	91.74
6	81.53	26	89.26	46	85.60
7	81.75	27	87.75	47	82.35
8	89.80	28	84.56	48	83.20
9	80.65	29	87.82	49	82.15
10	87.96	30	88.33	50	85.64
11	79.27	31	85.70	51	88.28
12	90.67	32	85.87	52	86.79
13	89.22	33	81.08	53	91.21
14	80.85	34	81.17	54	82.10
15	85.39	35	81.86	55	88.12
16	83.56	36	86.25	56	86.94
17	91.74	37	86.56	57	88.48
18	91.56	38	83.44	58	88.14
19	84.10	39	86.49	59	80.47
20	86.92	40	79.12	60	89.09

From the above experimental research, it can be seen that the color matching system in children's room based on computer interactive experience proposed in this paper has a good color matching effect.

5. Conclusion

The effect of color on children's psychology and physiology not only is the stimulation effect in the general sense of color psychology but also has the unique group nature of children. High-saturation colors such as big red and bright orange can quickly stimulate children to be in a state of excitement, quickly and effectively improve children's creativity and sensitivity to things, and even improve children's IQ by 8% to 10%. However, it is absolutely impossible to stay in such an environment for a long time. This study uses computer interactive experience technology to study the color matching of children's rooms and builds a computer-intelligent color matching system in children's rooms. The experimental results show that the indoor color matching system in children's room based on computer interactive experience proposed in this study has a good color matching effect.

Data Availability

The labeled dataset used to support the findings of this study are available from the author upon request.

Conflicts of Interest

The author declares no conflicts of interest.

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