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Color Module Computer Aided Design in Indoor Environment

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Abstract

A comprehensive solution set of strategies is proposed for interior color design in this study. Computer aided design methods are utilized to solve the problems in the color scheme process, the existing circumstances, shortage and trend of current color scheme tools are analyzed based on interior design theory and modern design methodology. The appropriative color space is constructd to redound the process of special color selection, the tone harmonizing tool is built based on architecture exterior design, and the color knowledge database and scheme database are contrived, the rationality of the color scheme method is validated by integrated cases, the effective way of computer aided color design is obtained and this method is applied to the instance of interior design, it provides a key module for the interior design system software. In the design process, the factors are taken such as color space property, color harmonizing effect, color tone classification, material and texture effect, a viable color enactment is provided for modern interior design.

Keywords: Computer Aided Color Design (CACD), Interior Design (ID), color concept of indoor design, tone harmonizing, Color Solutions Database

1. Introduction

Computer-aided design was proposed up for more than 50 years of history from the earliest concept to now [1]. By Industrial Designers Society of America (IDSA) National Conference on Computer Aided Design technology in 1980, it wasl be introduced to the field of industrial design, industrial design was made into the new phase of the computer-aided industrial design (Computer-aided Industrial Design, referred CAID) [2, 3].

The impact of computers on the color design not only is more effectively to complete the work, and its own characteristics but also brings new style and language to color design. Computer programs mimic many features of traditional tools, so that people experience is continuity, their further development make the computer-aided color design with a new tool and with their own unique means of expression. CAID theory and technology is mainly the integrated evolution from the traditional theory of color design, color science and color psychology, which combines advanced computer technology, reflecting the multi-disciplinary, multi-branch features [4, 5].

People has increasingly demanding in survive and consumer environment, better conditions are created for designers to show the unique creativity and individuality of space. Due to Updating concepts, diverse types of decoration materials, and design techniques updates, the colors of the indoor environment are greatly enriched. The pursuit of comfortable, warm, elegant colors environment become common goal to owners and designers. However, there are many environmental problems of color design, such as Color space trivial disorder, lack overall tone, Environment drab, identical, lack change [6].

By studying the knowledge of color science, interior design, psychology and other aspects, more mature theoretical results of interior design are absorbed, so that the computer-aided color module has some applicability [7]. As an application module design, there are also the following advantages [8].

First, the downs and randomness are avoided in the manual design due to the differences in personal feelings and artistic accomplishment, the basic requirements of color design is ensured, while designers are allowed to make the appropriate free play [9].

Second, since the clear purpose of a color design, the system is simple, selecting color and matching color are very intuitive, blindness of color design often is avoid [10].

Third, the system has scalability, a reference solution is can added based on existing design, their own solutions can also be added with software [11].

By a combination of Interior Design, color science, visual psychology, computer-aided color selection is designed for a valuable indoor architectural environment in this study, the correct interior color design objectives, guidelines and principles are developed, the interior design industry is guided to healthy and coordinated development as a whole organism. A reference design is provided for the interior color design staff. An identifiable, distinctive vitality interior color space has been provided for people living in the interior space.

2. Computer-Aided Color Design Architecture

Color design process may relate to the content three aspects, as shown in Figure 1. From the perspective of industrial design study, the content reflects the readability, visibility, memory, associative of the product color.
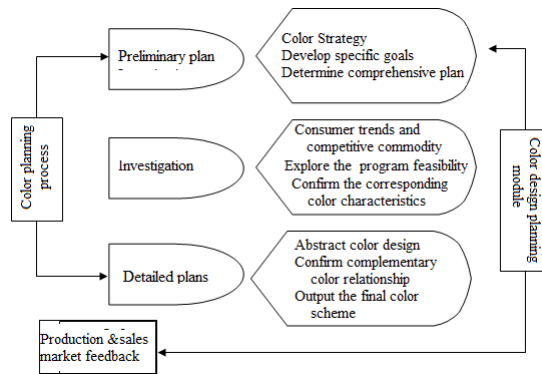

Figure 1. Color Design Process

After color design planning process, "tone" has become the environment overall grasp of color, color coordination depends on tone reconcile configuration design, in order to effectively control the color scheme, so as the visual and psychological needs are to achieved. As shown in Figure 2.
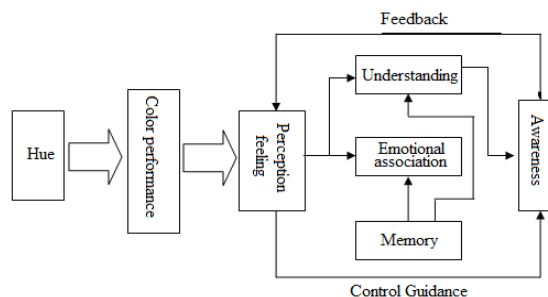

Figure 2. Hue Awareness Relationship Analysis

2.1. Color Quantization Process

For color requirements of multi-regional, multi-population, multi-tend indoor environments, we make rapid and effective auxiliary color design methods.

1) Interior color needs classification management and constraints to form a case base of color values which can be extracted;
2) Color combinations are divided based on the indoor requirement type, color scheme is recordeded at the highest coordinated rate;
3) Standard color card is required to constraint color design process;
4) The new design is needed to update the library of the program.

Category Select color tendencies is in Figure 3. Theoretical framework of color design is summarized above, color category schememay be designed, in computer-aided design process, parameter modifications are guided by the designer or user self coordinate design.
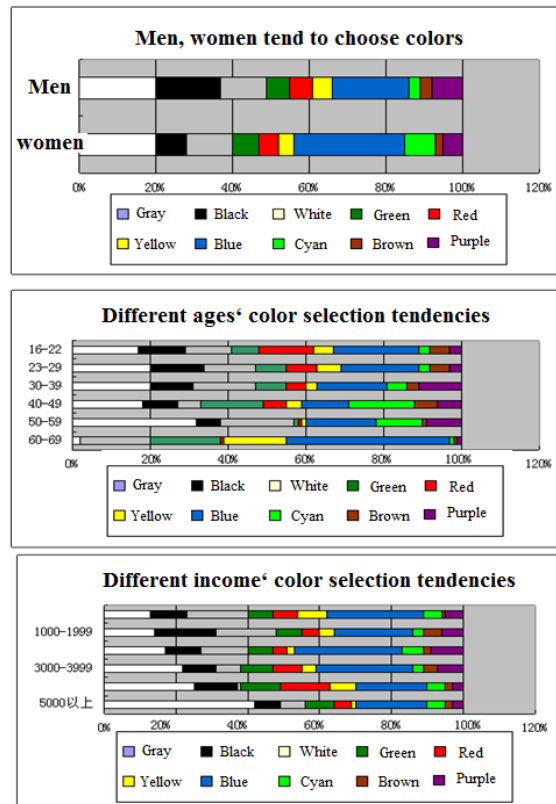

Figure 3. Category Select color tendencies

2.2. Color Space and Vice Versa

Currently, in most use of color system, Munsell color solid is established in accordance with the HVC three attributes. The hue H is divided into 10 zones, R, V, G, B, PS are base color, the five intermediate colors are inserted, they are YR, GY, BG, PB, and RP. Brightness V is divided into n number of levels by gradation rule from black to white. Saturation C is divided with increasing interval, the color system laws are in line with the human eye color perception, the color coordination is proportional in the uniform color space, color model conversion has a certain mapping rules.

2.3. Color Harmony Relationships

In addition to the two-dimensional color relations, but also seven kinds of three-dimensional geometric harmonic relationship are presented in the color space [12].
1) Vertical reconcile: the same hue with purity, order reconcile of the different brightness, the single color three-dimensional non-color axis with hue blending is as parallel lines. Hue presents crisp and refreshing feeling.

2) The inner surface reconcile: the same hue with lightness, order of different purity and complementarity of hue, the same lightness, order reconcile with different purity. No color axis is passed from the color solid horizont. Tone shows a steady and calm sense.
3) Circumference reconcile: the same brightness, hue order reconcile with the purity, no color from the color stereo outer edge arc to the center axis, hue interval choice.
4) Inclined inner surface reconcile: According to the HVC purposes, a fixed orbit of color selection is required with 360-degree rotation through the center, ratio beween frame and color is the complementary color pairs, lightness and purity relative changes are remained.
5) The inner surface reconcile in oblique cross: the same hue, different purity order reconcile. The upper and lower riots are on contact point of the color selection orbit ends, brightness changes, the reconcile of the same hue or a similar hue, tones are composed with a rhythmic.
6) Spiral reconcile: color stereoscopic rely on outside high color purity, spiral track is nearly flat, the brightness contrast changes, the introduction of the desired color combination is introduced in the spiral line in an orderly and interval manner.
7) Oval reconcile: it contains all color harmony of color ring, many complementary color pair reconcile wih the retained purity, color changes regularly and is more abundant.

2.4. Coordinating Color Design Reasoning
Because of the subjective effects of color, the design reasoning is with semantic-driven features. The color selection track and the main theme of the color selection rule are determined. Main color value can be decomposed into HVC Color law qualitative requirements. Based on the ratio, the selected color scheme of three attributes is determined according to the feedback effect.

3. Functional Analysis of Computer-Aided Color Design

3.1. CAID Color Design Methods
Tone reconcile and color scheme design are center in whole color design process, the color scheme is obtained by taking tone, color selection, a tone harmonic filter, color design knowledge base, auxiliary Scheme analogy process of indoor environmental factors, and then color configure is applied to the model. Finally, the integrated case-related evaluation methods are applied to evaluate the color designs. Among them, output or storage are done for coordinating the design, in order to prepare the design again, which is similar to the choice. Otherwise, the re-return to the initial state color design, re-design. Information flow of CAID color design method is in Figure 4.
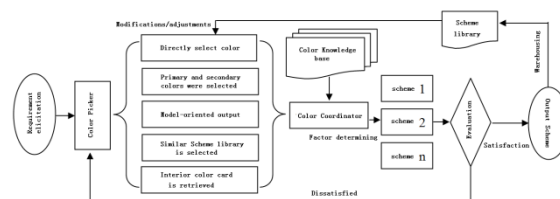

Figure 4. Information flow of CAID color design methods

3.2. Tonal Harmonic Extraction
In various color models, CEIUb has the widest color gamut, including all color with RGB and CMYK color gamut, when they are converting between different color modes, internal color mode is used, but its color space is highly specialized, and is is difficult master; RGB color gamut can be contained on a computer monitor or TV screen, which can display all colors, its models can save memory and improve performance, there is greater device independence, computer-aided architectural color is made, it must use the RGB color space, CMYK color gamut is narrower and contains only colors that can be printed in using a printing ink, it is

suitable for printed output. HSB model is based on human visual perception of color, the judgment is very direct in the color, color shades and color chord , it is better to meet people practice requirements in color design, it is the best platform for building color design. The main use of HSB color space is designed, the RGB, HSB color space is accessed. Relationship between color models and gamut is in Figure 5.
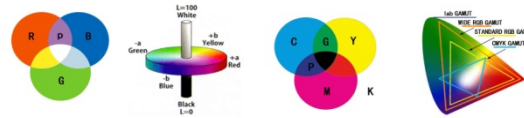

Figure 5. Relationship between color models and gamut

In Hceverul color system, the circumference is divied into the three equal portions, red, yellow and blue is used as a primary color, Between them, the secondary color is matched, such as orange, green, purple, along which is dubbed with the 3-th colors, such as red and orange, orange and yellow, yellow and green, green and blue, blue and violet, violet and purple, totaling has 12 kinds of divided colors. The center of the circle is black, and between the solid, the circumferent is divided concentrically into 20 aliquots, it is extened with the center to the outside, the black component is gradually reduced. Color harmony theory point extraction process is in Figure 6.
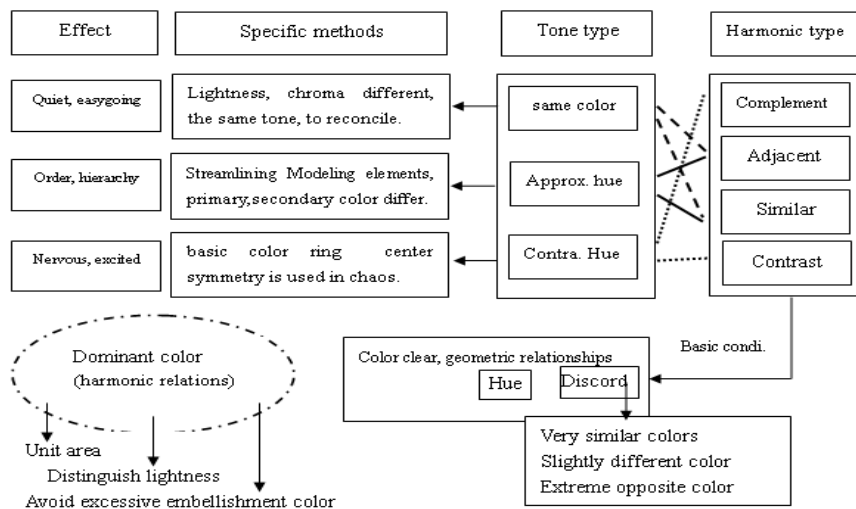

Figure 6. Color harmony theory point extraction process

3.3 Computer Express of Tonal Harmonic Design Method

In computer-aided architectural design, color outside environment is a means of industrial design methods, this method allows the system design has become a multi-objective, multi-perception, multi-factor optimization process. Due to reconcile theory and methods in tone, the information mostly expressed in the more obscure words, it is difficult to reconcile the scope of control, so for architectural color design of computer support, computer-aided color design process is the practical needs, color harmony theory has discussed, it is to build "building factor - Environmental functional division - color coordinated (harmonic tones) - Computer Aided applications", theoretical framework of the process also involves the color module subsystem - design and optimization of tone reconcile tools, the color scheme library is proposed and the color card is recommended, the management is supplemented by evaluation. Hierarchical theoretical framework is in Figure 7.
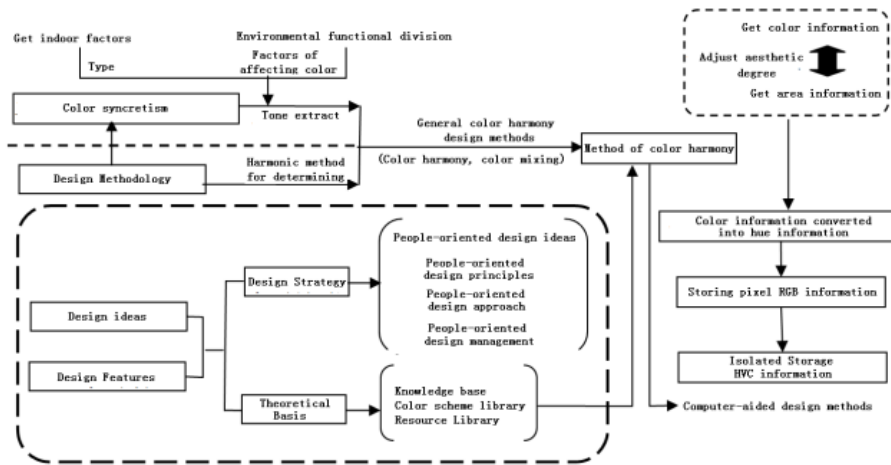
Figure 7. Hierarchical theoretical framework

3.4. Color Design Application Model

Color design method based on tone color is a way to reconcile the basic color system and car Freer color harmony theory, based on the extraction of coordinated design. It uses the built environment and application of the main background color and color management relations, and generates the user interface visualization cycle operation in the CAD environment to obtain basic color indoor environment modeling scheme.

This approach tends to crowd the audience through the investigation of indoor color, get a sample of information, and then put the color scheme through reconcile methods. The color design, with the advance setting words to describe the semantics of design effects, in the CAD environment for storing and color scheme library constantly updated to the new program after generation, you can also draw on a similar design. Indoor Environmental Color Design Structure Model is Figure 8.
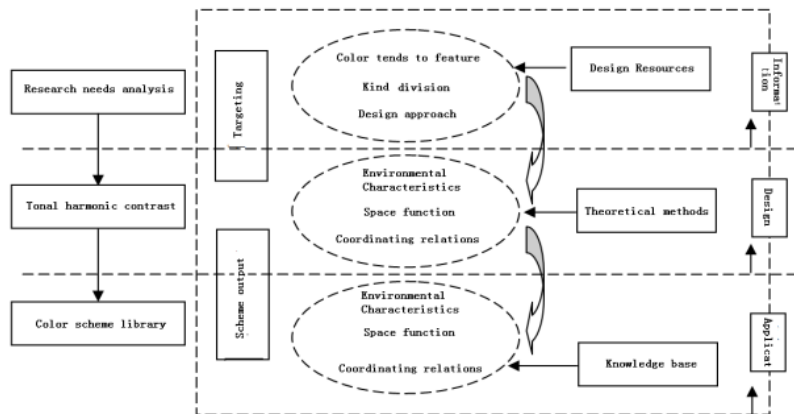

Figure 8. Indoor Environmental Color Design Structure Model

Primary color and a secondary color to approximate to reconcile the relationship, and other auxiliary color contrast to reconcile the relationship between the secondary color for contrast harmonic relationships; both primary color and secondary color contrast to reconcile the relationship between the secondary color for the approximate harmonic relationship.

According to various color cast has its relatively stable color gamut, color can be used to define the scope of the building, and corresponds to the building type. Hue match color process is in Figure 9.
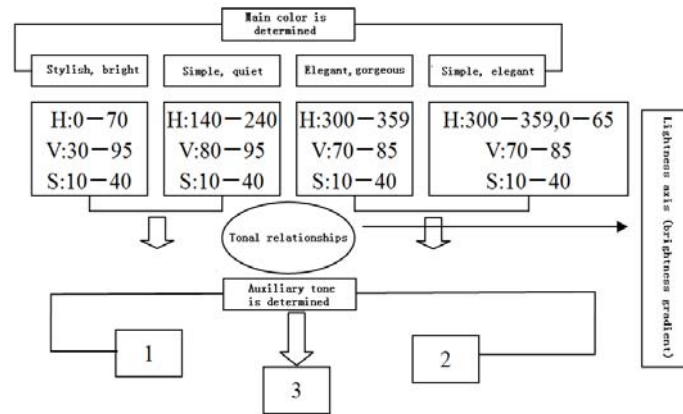
Figure 9 Hue match color process

3.5. Color Harmony Design Process

Semantic tone reconcile: to reconcile the results of real-time display of colors to aid understanding of the vocabulary in the form of tones compared.

Harmonic proportion: sequence can achieve a certain balance effect. According to a certain percentage of 0.618 gamut divided effect there are certain rules to be found [13].

Press the color area to reconcile: With the increase or decrease in the size of the color, the color will also increase or decrease the amount. Color design is usually a large area of multi-choice clear and high, low saturation, contrast weak colors, brings a bright, long-lasting harmony of comfort. Medium-sized multi-color contrast moderate. Such as color, the proximity and brightness of tone color group used more contrast on, both visual interest, and no over-stimulation. Small area of the color used fresh color and strong contrast and bright colors, such as small-scale facilities, small signs, etc. The purpose is noticeable. Tonal harmonic matching method Flowchart is in Figure 10.
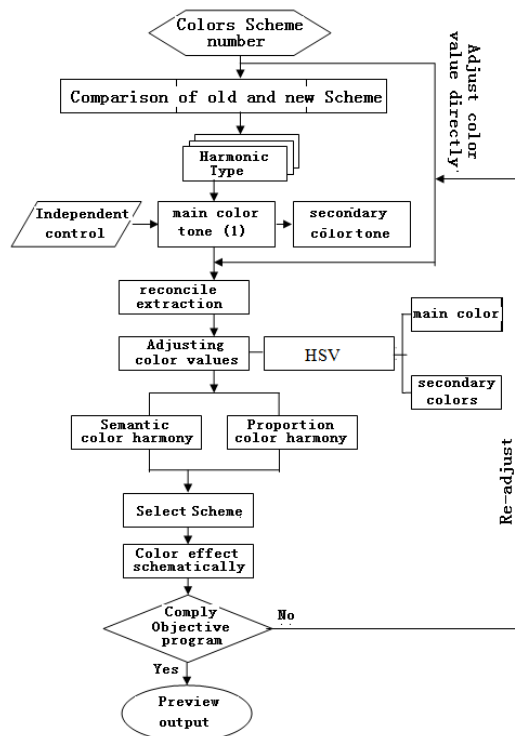

Figure 10. Tonal harmonic matching method Flowchart

4. Conclusion

Interior design color design is a very important part of the focus of the design is how to obtain vivid colors, in order to meet the dual needs of the people of physiological and psychological. Given the importance and difficulty factor color color studies, research on indoor environmental color design approach is always the focus of attention of design theorists. Thesis color design theory, research-based computer-aided design method of color indoor environment.

The concept paper will be introduced to the interior color scheme designs, using computer-aided design process, combined with color harmony theory and methods applied to construct an effective computer-aided design interior color shades reconcile processes.

And on the functions to achieve the color effect of color-imparting real-selection analogy, expanding the use of the library's color scheme to optimize the color design interface, greatly improve the efficiency of design and verify the feasibility of the classic case, to build a good environment and living space provided important ideas. Interior designers can be found so that the desired color design goals, effectively improve the efficiency and accuracy of color applications.

Computer simulation of color, or a new topic, no experience can be called directly. As it relates to quantify color theory, there are many ideas and models are proposed and used for the first time, there needs to be further improvement in theory, some of the better ideas limited to the conditions can not be achieved.

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