Hindawi
Journal of Function Spaces
Volume 2023, Article ID 9848736, 1 page
https://doi.org/10.1155/2023/9848736

*Retraction*

# Retracted: Data Analysis of Ceramic Material Color Matching Collection Points in Furniture Design Based on the Image Difference Prediction Model

**Journal of Function Spaces**

Received 12 December 2023; Accepted 12 December 2023; Published 13 December 2023

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This article has been retracted by Hindawi, as publisher, following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of systematic manipulation of the publication and peer-review process. We cannot, therefore, vouch for the reliability or integrity of this article.

Please note that this notice is intended solely to alert readers that the peer-review process of this article has been compromised.

Wiley and Hindawi regret that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

## References

[1] C. Zhou and Y. Li, "Data Analysis of Ceramic Material Color Matching Collection Points in Furniture Design Based on the Image Difference Prediction Model," *Journal of Function Spaces*, vol. 2023, Article ID 4684904, 10 pages, 2023.

Hindawi
Journal of Function Spaces
Volume 2023, Article ID 4684904, 10 pages
https://doi.org/10.1155/2023/4684904

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*Research Article*

# Data Analysis of Ceramic Material Color Matching Collection Points in Furniture Design Based on the Image Difference Prediction Model

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Received 12 August 2022; Revised 28 September 2022; Accepted 12 October 2022; Published 28 March 2023

Academic Editor: Miaochao Chen

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The manufacturing process of ceramic materials and exquisite patterns is not simply artistic acts. At the same time, it condensed the excellent traditional culture of ancient China. The application of ceramic materials in modern furniture can not only enhance the taste of living room culture but also show the charm of China's ceramic culture. *Objective*. To optimize the scientific data model required by traditional ceramic materials. On the basis of image difference prediction calculation, the data of ceramic material color matching collection points were analyzed and processed, and the image difference prediction model was established. This paper introduces the application and development of ceramic materials in furniture industry. On the basis of the traditional image difference prediction algorithm, the consideration of image difference and difference prediction expansion is added, and the image difference prediction calculation model of ceramic material color matching is established. The survey results show that 83% of customers are very satisfied with the color matching of new ceramic materials calculated by image difference prediction. This experiment uses image difference prediction model to remove the redundant pixels of ceramic material color and make multiple judgments on color display. According to the initial color data of the collection points, this experiment finally obtained a new combination color matching of ceramic wardrobe, which is more suitable for the "minimalist" and "quiet" styles.

## 1. Introduction

Thousands of years of human history is essentially the history of human use and invention of materials. Materials are the most basic material needs for human survival and the cornerstone of human civilization [1]. Cohen, a British material scientist, wrote in the preface of fundamentals of material science and engineering that "we are surrounded by materials. They not only exist in our real life in the physical form of entities, but also have been deeply rooted in our culture and ideological field." This further shows the importance of materials to human beings. Every scientific and technological leap of mankind is inseparable from the understanding and application of materials [2]. At the same time, with the development of science and technology, mankind has developed a variety of new materials, indicating that the application of materials has entered a higher stage from the backward era [3]. The application of these new materials in various fields has fundamentally changed the traditional way of material selection and product design and has had an incredible impact in the fields of industry and art [4]. Because of this, new materials are not limited to the field of industrial manufacturing but are more and more closely related to product modeling and design. Every material that can be mass produced will greatly change and promote the change of product structure, thus affecting the product modeling design, and may eventually develop a new design style [5]. However, the application of new materials is a new challenge for product designers. Designers need to fully understand the physical and chemical parameters of materials, meet the design requirements and the emotional needs of users, and truly reflect the humanistic care required by products. Through the collected literature on the application of ceramic furniture, we found the following shortcomings in the theoretical research on the application of ceramic furniture. The development speed of the combination of ceramic materials and modern home decoration is relatively slow. This is due to the lack of relevant theoretical research and theoretical works. Relevant scholars should pave the way for the latecomers and do more theoretical research with practical significance. To lay a certain foundation, because of the educational background and aesthetic perspective, different consumer groups have different attitudes towards ceramic furniture, and the deviation between them is large, which is difficult to balance.

In a broad sense, materials are defined as all substances except human ideological activities. The research object materials of this experiment refer to the collection of substances of articles owned and used by human beings in a narrow sense [6]. In the scope of industrial production and design, materials are usually divided into traditional materials and new materials. Traditional materials usually refer to substances that have been used for a long time and have been used in most fields of human activities, mainly including metal, wood, ceramics, glass, and plastics [7]. There are two kinds of new materials. The first one refers to special materials that are emerging and in the early stage of development and have one or more physical and chemical properties better than traditional materials [8]. The other refers to materials that greatly improve traditional materials or have some excellent properties through new technologies or preparation processes [9]. From the definition, we can know that new materials are the inevitable product of human scientific and technological development, so they have the characteristics of timeliness, adaptability, and excellence. The timeliness refers to that with the preparation and application of new materials; they are finally extended to all aspects of human life and finally gradually become traditional materials. Today's plastics have evolved from new materials to traditional materials through this path [10].

In the context of people's life, furniture is conventionally defined as an appliance used in human daily life and social activities, which has the functions of sitting, lying, chair, storage, spacing, and so on. It is generally assembled by several parts and components according to a certain joint mode [11]. With the application of new materials, this definition is also changing dynamically. The definition of furniture is becoming larger and larger, including more and more types. For example, with the invention of cars, aircraft, and ships, the seats and other supporting facilities of these vehicles also belong to the field of furniture [12]. With the improvement of urban infrastructure and the rise of the concept of outdoor furniture, such as park seats, cement stone platforms and decorative ornaments have been included in the category of furniture [13]. Only by embracing and storing, constantly updating ideas and adapting to the emergence and use of new materials, can it be possible to design furniture products that do not fall behind the times.

Modern furniture materials are not limited to the use of wood, metal, and plastic. In addition to the use of new materials, the addition of traditional materials and ceramics has also evolved the furniture design style [14]. Moreover, with the aid of image difference prediction, ceramic materials have also got rid of people's impression of its inherent white and cyan. More colorful ceramics have been added and applied to furniture design. This new visual design will deeply affect people's aesthetics of furniture.

## 2. Introduction and Application of Ceramic Materials

*2.1. Overview of Ceramic Materials.* Ceramic material is a kind of inorganic nonmetallic material made by forming and sintering [15, 16]. As an artificial synthetic material first manufactured and used by primitive humans, it has also made two major scientific and technological leaps along with human development [17]. With the control of fire and full understanding of combustion, ceramic materials have evolved from pottery with lower sintering temperature to porcelain with higher sintering temperature and denser structure, realizing the first leap in the development history of ceramic materials. The second leap took place in modern times. The breakthroughs in human physics and chemistry have made great breakthroughs in ceramic materials in light, sound, electricity, magnetism, and heat. Therefore, the evolution from porcelain to special ceramics is the second leap in the development of ceramic materials. With the two leaps, ceramic materials have developed from the original utensils containing water or food to the fields of decoration, daily necessities, and even military industry. Stronger hardness, richer color glaze, and unique warm temperament of ceramic materials make it also favored by furniture designers [18].

*2.2. Application of Ceramic Materials in Furniture.* Furniture is not only an object with use value but also a historical and cultural carrier of various countries and nationalities. The application of ceramic materials in furniture adds a unique artistic beauty and endows this cultural carrier with richer connotation. When ceramics no longer only appear in people's daily life as tableware, decorative vases, and other objects as furniture, this transformation reflects and conforms to the pursuit of diversified lifestyles of modern mankind. Moreover, as a pollution-free and completely degradable material, ceramic materials are also suitable for the current human concept of environmental protection. They are a favorable tool for the furniture industry to achieve the goal of sustainable development. As the origin and manufacturing country of porcelain, in the long historical development, ceramic craftsmen and scholars have endowed ceramic materials with profound cultural heritage. For the Chinese people, every piece of porcelain is the embodiment of the breadth and depth of Chinese civilization. Ceramic furniture also appeared in the life of ancient Chinese people [19]. The four-animal foot three-color glazed

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pottery cabinet unearthed in the Tang tomb in Xi'an has a beautiful and generous shape. It is not only a daily furniture but also a rare art.

Ceramic itself has the characteristics of high hardness, wear resistance, and high chemical stability, so that it can participate in the manufacture of furniture. However, the problems of fragility, difficult processing after forming, and low yield also limit its application in the field of furniture. Except for a few all porcelain furniture, porcelain in the Ming and Qing Dynasties mostly appeared in the form of patches in furniture design. However, with the progress of modern technology, high-strength ceramics have emerged. This ceramic has the performance of preventing falling and scratching, greatly expanding the application of ceramic materials in furniture [20]. The technical breakthrough of ceramic glaze makes the ceramic get rid of the white and cyan in the traditional impression. The bolder and bright colors combined with the texture of ceramic as warm as jade have brought new use elements to the furniture design industry [21]. At the 2019 Milan International Furniture Exhibition, a complete set of furniture with ceramics as the main body appeared. A large number of colored dots of different sizes are hand painted on the white ceramic background as decoration, which makes the whole set of furniture stable and reveal a different vitality. In recent years, nanotechnology has overcome the shortcomings that ceramic materials have always been difficult to change the shape after firing. New nanoceramics have achieved a great breakthrough in plasticity and greatly strengthened the machinability and flexibility of ceramic materials. If it reaches the standard of industrialized mass production and enters the furniture industry, it will inevitably bring broader space for the development of ceramic furniture.

*2.3. Reasons for Ceramic Materials Entering Furniture Industry.* This paper analyzes the development process of furniture materials and obtains three reasons for entering the ceramic industry. Firstly, it is because of the continuous progress of materials and furniture manufacturing technology. As mentioned above, the progress of ceramic materials enables them to enter the field of furniture, but this is not enough. Only with the common progress of different materials and the innovation of furniture manufacturing technology can ceramic materials be better and more organically integrated into furniture design. Nowadays, ceramics can not only be used as the main structure of furniture but also beautify and decorate the human indoor and outdoor environment together with other materials. The second reason is the human demand for individuality. With the progress of human science and technology, the vast majority of human demand rises from the low end of Maslow's demand pyramid to the high. The demand for beauty and personality different from most people can give birth to the emergence and development of ceramic furniture. The application of ceramic materials in the hands of different designers has produced wonderful chemical reactions and produced a wealth of furniture categories. Finally, earth shaking changes have taken place in human life style, and the functionality of furniture has been gradually weakened, which is more the embodiment and display of the taste of the owner of the house. As a scarce and precious material, it is natural for ceramics to be used in the furniture industry. With its changeable texture and pattern of glaze, ceramics exudes unique charm in beautifying residents' life and cultivating cultural spirit.

## 3. Prediction and Calculation of Image Difference

The technology of prediction and calculation based on image difference is a research hotspot in image processing in recent years. The predictable algorithm based on difference expansion proposed by some scholars has attracted extensive attention. This algorithm can provide a large amount of embedded values and has good plasticity. The algorithm can be adjusted by using integer wavelet coefficients and image prediction error to meet different needs. Based on the traditional image difference prediction method, this study makes full use of the correlation between color components, improves the traditional method, reduces the amount of calculation of the algorithm, and significantly improves the accuracy of prediction calculation, so as to select the color of ceramic materials. This article compares the two images with Python using the Structural Similarity Index (SSIM). Using this method, we can easily determine whether the two images are the same or judge the difference due to the intentional tampering of slight image processing compression. The SSIM method will be extended so that we can use OpenCV and Python to visualize the differences between images. Specifically, we will draw bounding boxes around areas in two different input images.

*3.1. Traditional Image Difference Prediction Method.* The traditional image difference method can predict the adjacent color pixels. The mean and difference of two color pixels can be expressed by the following formula:

$$\begin{aligned} l &= \left\lfloor \frac{x+y}{2} \right\rfloor, \\ h &= x - y. \end{aligned} \tag{1}$$

$x$ and $y$ in the formula are the gray values of two adjacent color pixels, respectively, and their value range is 0 to 255. $l$ represents the mean value, and $h$ represents the difference value. The integer wavelet inverse transform of formula (1) can be obtained as

$$\begin{cases} x = l + \left\lfloor \dfrac{h+1}{2} \right\rfloor, y = l - \left\lfloor \dfrac{h}{2} \right\rfloor | h \geq 0, \\ x = l + \left\lfloor \dfrac{h}{2} \right\rfloor, y = l - \left\lfloor \dfrac{h-1}{2} \right\rfloor | h < 0, \end{cases} \tag{2}$$

where $\lfloor \ \rfloor$ is rounding down symbol.

Then, the predicted difference $h_w$ of the embed 1 pixel between two adjacent pixels is obtained by

$$h_w = 2h + w, \tag{3}$$

where $w \in [0, 1]$ and it is the information to be embedded between two adjacent pixels. And $h_w$ is the difference after expansion with $h.h_w$ would be substituted into formula (2) to obtain the new embedded 1 pixel's value, which is the predicted pixel value. In order to ensure that the new predicted pixel value does not overflow, the formula (4) should be satisfied.

$$|h_w| \in [0, \min \{510 - 2l, 2l + 1\}. \quad (4)$$

*3.2. Single Component Image Prediction Error.* There is a strong correlation between the color pixels of ceramic materials, which is the basis of color prediction and linear compression. With the increase of the distance between pixels, this correlation is negatively correlated and gradually weakened. Therefore, it can be predicted by adjacent pixels, and its accuracy is higher than that of distant pixels. Therefore, this experiment takes any designated pixel on the color of ceramic materials, determines the surrounding pixels, and then calculates the prediction error.

$$p_w = 2p + w. \quad (5)$$

Suppose $a$ is the value of one pixel in an image and $\bar{a}$ is the average value of the adjacent pixels surrounding $a$. $\bar{a}$ can be used as the predicted value of $a$. In formula (5), $p$ is the difference between the pixel value $a$ and the predicted value $\bar{a}$. It is also called prediction error. Combine the embedded information $w$ and the original prediction error $p$ into formula (5) to obtain the prediction error $p_w$.

Then, the predicted pixel value could be calculated by

$$a_w = \bar{a} + p_w, \quad (6)$$

where $a_w$ is the new embedded pixel value.

According to the principle that the components of RGB in the hue triangle are independent, the pixels on the color of ceramic materials also have their own independent components. In order to improve the accuracy of image prediction and make use of the strong correlation of adjacent pixels, take the upper, lower, left, and right pixels adjacent to the pixel to be predicted as the reference points, and their average value can be calculated by the temple as

$$\bar{S} = \frac{1}{4} \times \begin{vmatrix} & 1 & \\ 1 & \cdot & 1 \\ & 1 & \end{vmatrix}, \quad (7)$$

where the black dot in the center of the prediction template in the above formula represents the pixel to be predicted. According to equation (7), $\bar{a} = \lfloor a_{\text{upper}} + a_{\text{lower}} + a_{\text{left}} + a_{\text{right}} \rfloor$ can be obtained as the prediction value of the embedded point pixel.

*3.3. Single Component Image Prediction Difference Expansion.* When predicting the color components of any two pixels in the color of ceramic materials, the mean and difference of errors are as follows:

$$l = \left\lfloor \frac{p_1 + p_2}{2} \right\rfloor, \quad h = p_1 - p_2. \quad (8)$$

Referring to the traditional image difference prediction method, the integer wavelet inverse transform of the above formula can be obtained:

$$\begin{cases} p_1 = l + \left\lfloor \frac{h+1}{2} \right\rfloor, p_2 = l - \left\lfloor \frac{h}{2} \right\rfloor \Big| l \geq 0, h \geq 0, \\ p_1 = l + \left\lfloor \frac{h}{2} \right\rfloor, p_2 = l - \left\lfloor \frac{h-1}{2} \right\rfloor \Big| l \geq 0, h < 0, \\ p_1 = l + \left\lfloor \frac{h}{2} \right\rfloor, p_2 = l - \left\lfloor \frac{h+1}{2} \right\rfloor \Big| l < 0, h \geq 0, \\ p_1 = l + \left\lfloor \frac{h-1}{2} \right\rfloor, p_2 = l - \left\lfloor \frac{h}{2} \right\rfloor \Big| l < 0, h < 0. \end{cases} \quad (9)$$

Then, utilize the original difference $h$ of two adjacent pixels, the embed information $w$, and the adjacent pixel values $p_1$ and $p_2$ to compute the expansion difference $h_w$ of the prediction pixel by

$$h_w = (p_1 + p_2)\sqrt{2h + w}. \quad (10)$$

In order to suppress errors caused by rounding down, the $l$ and $h$ are updated by formula (11) and marked as $l'$ and $h'$.

$$l' = \left\lfloor \frac{(p_1 + p_2)^2 + (p_1 - p_2)^2}{2} \right\rfloor, \quad h' = 2\sqrt{(p_1 + p_2)^2 + (p_1 - p_2)^2}. \quad (11)$$

The corresponding integer wavelet inverse transform is transformed into two equations:

$$\begin{cases} p_1 = l' \pm \left\lfloor \frac{h'+1}{2} \right\rfloor, p_2 = p_2 \pm \left\lfloor \frac{h'}{2} \right\rfloor \Big| l' \geq 0, h' \geq 0, \\ p_1 = l' \pm \left\lfloor \frac{h'}{2} \right\rfloor, p_2 = p_2 \pm \left\lfloor \frac{h'-1}{2} \right\rfloor \Big| l' \geq 0, h' < 0, \end{cases} \quad (12)$$

$$\begin{cases} p_1 = l' \pm \left\lfloor \frac{h'}{2} \right\rfloor, p_2 = p_2 \pm \left\lfloor \frac{h'+1}{2} \right\rfloor \Big| l' < 0, h' \geq 0, \\ p_1 = l' \pm \left\lfloor \frac{h'-1}{2} \right\rfloor, p_2 = p_2 \pm \left\lfloor \frac{h'}{2} \right\rfloor \Big| l' < 0, h' < 0. \end{cases} \quad (13)$$

The least effective pixel function can be further obtained by calculating

$$w = LSB(a_w). \quad (14)$$

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Figure 1: Schematic diagram of the closing and opening of the Keramos cabinet door with ceramic furniture wardrobe combination.

According to (6), the combined pixel gray value should be between 0 and 255; the gray value range of pixels to be predicted is also limited:

$$p_w \in [-\bar{a}, -255 - \bar{a}]. \tag{15}$$

In this range, considering the error obtained above, the color component of any pixel to be predicted is calculated, and finally, the ceramic material color image difference prediction model is obtained.

$$\begin{cases} |p_{nw}| = |p_n| - 1 | p_n > T_n, \\ p_{nw} = p_n + 1 | \bar{a} < 128, p_n < T_n, \\ p_{nw} = p_n - 1 | \bar{a} \geq 128, p_n < T_n. \end{cases} \tag{16}$$

## 4. Case Analysis of Ceramic Furniture

*4.1. Color Ceramic Wardrobe Combination Keramos.* The limited ceramic wardrobe combination designed and launched by two Italian designers in 2016 is named after Keramos in Greek, which means "pottery." With its lively and flexible color and flawless luster of ceramic glaze, it was very popular once launched and later won several design awards one after another.

Figure 1 is the schematic diagram of the closing and opening of the Keramos cabinet door of the ceramic furniture wardrobe combination. When you see this group of ceramic wardrobe, three bright colors of red, yellow, and blue first come into sight, leaving an unforgettable impression. After careful observation, it will be found that solid wood is used for the cabinet door, interior, and cabinet legs, and the log color is retained, which is perfectly and harmoniously combined with ceramics without dominating. However, the bright color of ceramic materials usually carries a young and lively label in the design field, and at present, a large number of customers prefer the aesthetic style of "minimalism" and "silence." Therefore, in order to meet the aesthetic preferences of these customers, this study uses the image difference prediction model established earlier to predict the color of ceramic materials and get the required results.

*4.2. Prediction Using Image Difference Model.* This paper uses Python as the programming language, calls OpenCV and other libraries, and builds and designs the program system. The difference image sequence is filtered to remove the noise interference in the image and get more accurate moving targets. After the moving object is extracted and segmented, the Camshift algorithm is used to calculate the candidate window, and the gray histogram distribution feature and area feature of the moving area are extracted for target tracking. Firstly, the ceramic material surface is photographed and sampled, and the image processing model is used to analyze the effective ceramic color pixels and redundant ceramic color pixels. The results are shown in Figure 2.

In Figure 2, the white part is the effective pixel area, which is the pixel block that can be used by the image difference model, while the green part is the redundant pixel area, which needs to be removed during prediction calculation. Redundant pixels include pixels overlapping with effective pixel information and pixels containing useless information. Both pixels will interfere with the calculation of the model and slow down the calculation speed, which must be eliminated.

The space and memory occupied by the extracted ceramic material color matching original pixels and the predicted pixels also need to be calculated and considered. The spatial complexity of the original pixels increases smoothly and approaches a straight line, which shows that the original pixel data extracted in this experiment is stable. As the abscissa pixel value increases, the spatial complexity of the ordinate increases gradually. The pixel data of the color to be predicted shows exponential growth, which shows that the predicted data contains large information, and the higher the spatial complexity, the more accurate the prediction result is. The detailed and intuitive data structure is shown in Figure 3.

Select a circular area with radius $r$ on the surface of ceramic material. If $n$ sampling points are included, $2n$ modes will be generated by using the image difference prediction model. Therefore, with the increase of sampling points, the generated patterns will also double. Too many binary patterns are not conducive to the extraction, recognition, classification, and prediction of color information. Traditional statistical methods usually use histogram to express the information of image pixels, but too many patterns will cause the sparsity of histogram and weaken its expression function. In order to solve this problem and improve the efficiency of statistics, it is necessary to reduce the dimension of data in order to reduce the amount of data and complete the image expression information. In this study, dynamic uniform pattern is used to reduce the dimension of too many binary patterns generated by the image difference

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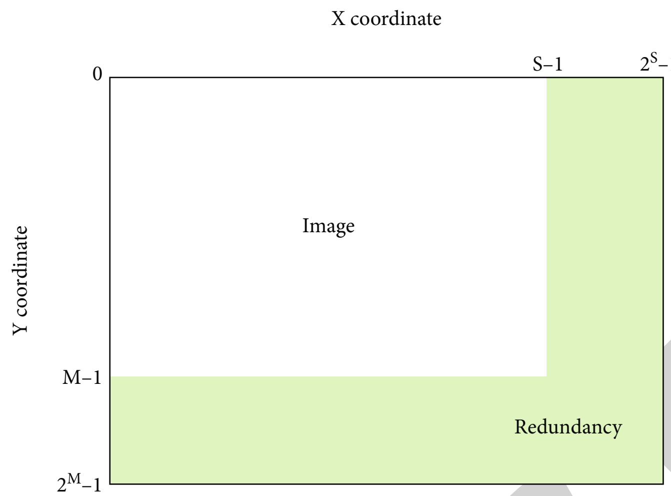


Figure 2: Effective ceramic color pixel and redundant ceramic color pixel map obtained by model processing.

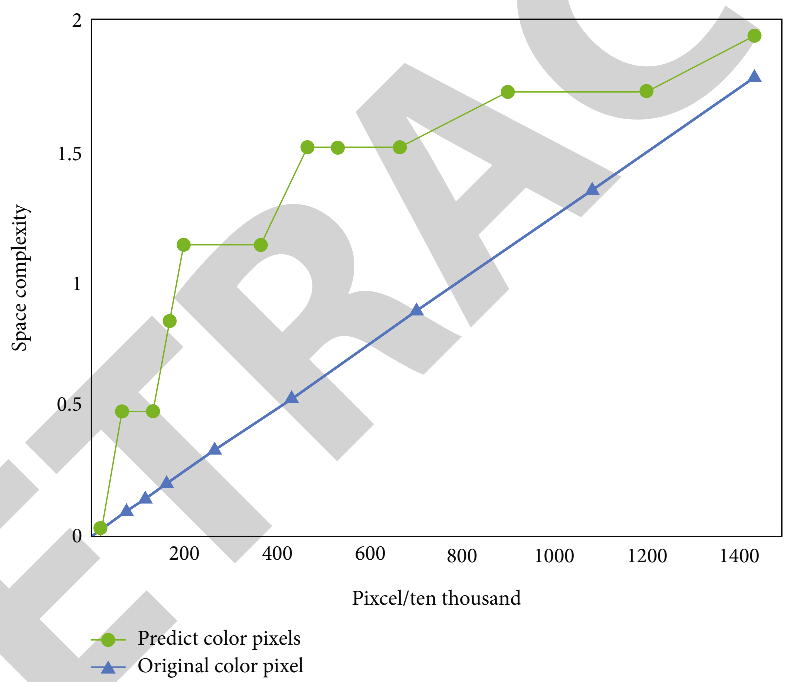


Figure 3: The spatial complexity of the original color matching pixels of ceramic materials and the pixels obtained after prediction.

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prediction model. The dynamic equivalence pattern holds that when a cyclic binary number jumps from 0 to 1 or from 1 to 0 at most twice, its corresponding binary is an equivalence pattern class. For example, 000000 (0 jumps) and 110011 (2 jumps) are dynamic equivalent mode classes. Through this improvement, the types of binary modes are greatly reduced. Therefore, in this study, 8 sampling points are taken from a 3 by 3 circular area, as shown in Figure 4. The dimension reduction of binary mode can reduce the final eigenvectors greatly by using dynamic equivalent mode. Noise is an important cause of image interference. An image may have a variety of noises in practical applications. These noises may be generated in transmission, or in quantization and other processing. Although these model-based methods have strong mathematical derivation, the performance of texture structure restoration under heavy noise will be significantly reduced. In addition, because of the high complexity of iterative optimization, they are usually time-consuming. After removing the interference of high-frequency noise, the accuracy of experimental results will be improved.

This HSV model is widely used to predict the color matching required by human vision. It represents the color through the brightness, hue, and saturation of the color. Its structural model is shown in Figure 5.

It can be clearly seen from the figure that the HSV color space structure is an equilateral hexagonal pyramid; black is located at the vertex of the equilateral hexagonal pyramid,

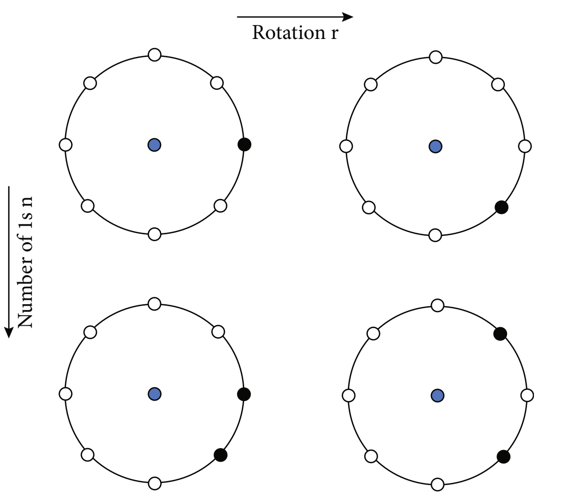


FIGURE 4: Four modes of color pixel collection points of ceramic materials after dimensionality reduction using dynamic equivalent mode.

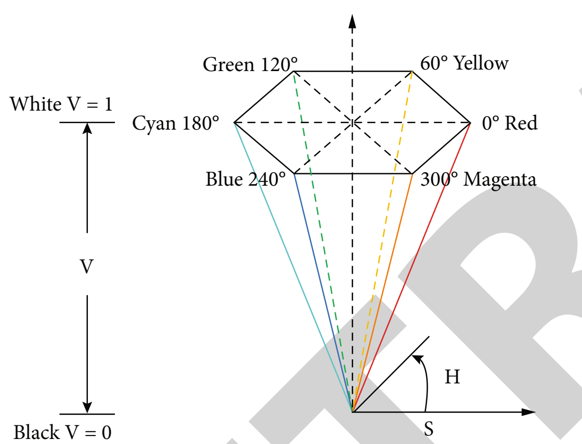


FIGURE 5: Hue, saturation, and value color space model structure diagram.

because the brightness of this point is 0, and white is located at the center of the bottom surface of the equilateral hexagonal pyramid, because the brightness of this point is 1, which is the point with the highest brightness. As indicated by the central axis in Figure 6(a), $V$ represents the brightness of the color, and the color on the central axis represents all the colors of this gradient from black to gray to white. $H$ is the hue of the color. The six edges of the equilateral hexagonal pyramid represent the six main colors of the model, respectively, of which 0° is red, 60° is yellow, 120° is green, 180° is cyan, 240° is blue, and 300° is magenta. These edges are arranged equidistantly around the central axis and contain all colors visible to human vision from 0° to 360°. $S$ refers to the saturation of color. This parameter is used to characterize the purity of color. The point in the figure represents the color. The closer the point is to the central axis, the lower the saturation of the color $H$. The brightness, hue, and saturation represented by $S$ and $V$ are three independent color parameters. One of them can be adjusted arbitrarily without affecting the other two. Therefore, the color prediction of ceramic materials can be selected in a larger range without considering the interaction between various color parameters, which effectively improves the efficiency of model calculation.

The color display of ceramic materials follows the general rules of color. The lower the saturation of the color, the lower the purity of the color. When the saturation is low, it is more gray in human visual perception. When the brightness is close to 0 in Figure 6, it is also shown when the brightness is near 0 in Figure 6. When the saturation is still 0 and the hue is close to 0, the color near the horizontal axis will be perceived from black to gray and then to white with the increase of brightness. For furniture made of ceramics, white glaze and colored glaze are mostly applied on the surface as the base color, and large decorative patterns are decorated with blue and white, multicolored and pastel glaze on the base color. Placed in other wooden furniture, it is eye-catching and bright, playing a very bright decorative effect. It is an important ornament of high-end home environment in the bright and cool period. If the saturation of a color is low, the hue information will become unstable and unreliable. This is because the three components of red, green, and blue are almost equal in low saturation colors. This makes it difficult to determine the exact color; "achromatic" refers to scaling the edge color channel (or subtracting the partially scaled edge channel). From Figure 6(b), we can know to design the $S$ value of the color and take the overlapped part, not the values on both sides, so that the human eye can see the real color. Only when the three are in an appropriate range can human beings perceive the original appearance of this color in the traditional sense. Therefore, in the image difference prediction model, the fuzzy method is used to truncate the saturation. And Figure 6(b) will be obtained. Because of the subjectivity of correction in the perception of color and noncolor by the human eyes, the two areas in the picture overlap.

As shown in Figure 7(a), when the saturation and color values are 0, the reduction interval of brightness is 0 to 1, showing a gradual process from black to gray and then from gray to white. From this display, it can be inferred that the most intuitive difference of noncolor for human perception is the difference of brightness. Therefore, use the fuzzy method to blur the noncolor trapezoid again to get Figure 7(b). Similar to the trapezoidal blur result in Figure 6, there are overlapping areas of black and gray and gray and white due to the human eye itself.

By removing the pixels of the color of ceramic materials, making a number of decisions on the color display, and according to the data collected from the initial color, the experiment finally predicts a new combined color matching of ceramic wardrobe that is more suitable for the "minimalist" and "quiet" style. The results are shown in Figure 8.

It can be seen from Figure 8 that the color saturation of the changed ceramic combined wardrobe is greatly reduced after image difference prediction. Compared with the bright red, yellow, and blue of the original color, the color value orientation of the new color is lower, but the predicted color of ceramic materials still retains flexibility and elegance because of the permeability of ceramic glaze. The predicted

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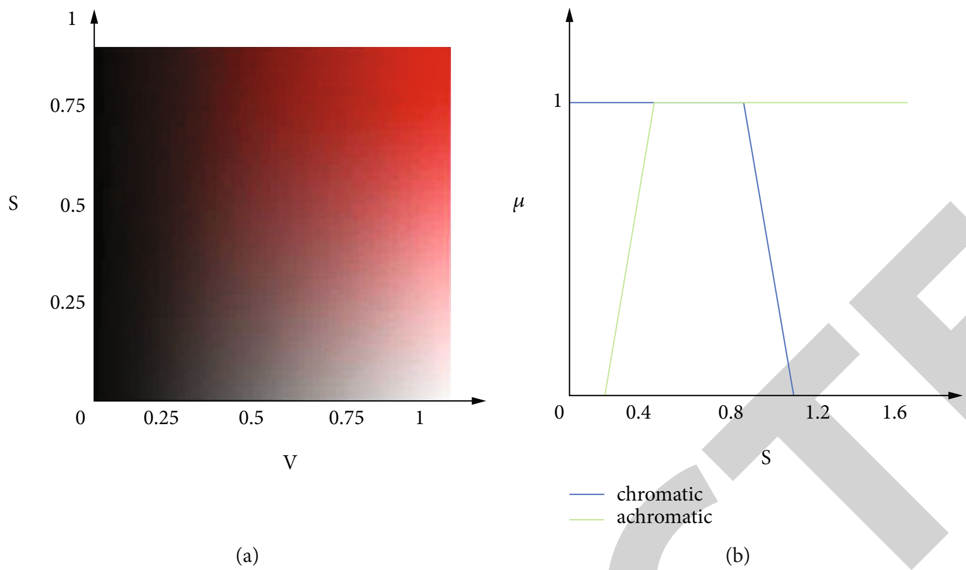


Figure 6: Variation of color with $S$ and $V$ at $H = 0$ (a) and $S$-component fuzzy set partition (b).

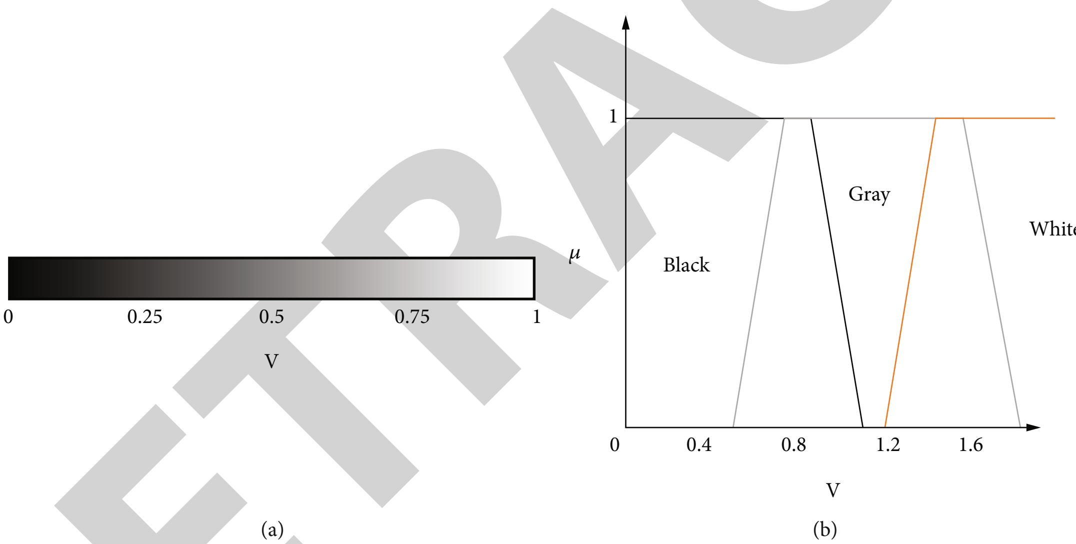


Figure 7: Plot of ceramic material color as a function of $V$ (a) and $V$-component fuzzy set partition (b).

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colors are dark green and black cyan with low brightness and ivory white with high brightness. The first two are in line with the popular Morandi color style, and the latter is a classic color, which can be matched with any interior decoration style. The predicted color finally needs the market and customers to test the popularity. Therefore, this study sent a questionnaire on the sales website. The final statistical results are shown in Figure 9.

The survey results show that 83% of furniture customers are very satisfied with the color matching of new ceramic materials calculated by image difference prediction, 16% are basically satisfied with this color, and about 1% of customers express their dislike. From the results, the color matching of new ceramic materials calculated by image difference prediction has achieved the expected effect. Based on the original bright color matching and young customer groups, the color matching of ceramic wardrobe more suitable for the current popular style is predicted, which greatly expands the market.

Figure 8: Keramos schematic diagram of ceramic furniture wardrobe combination after image difference prediction.

The change and evolution of traditional furniture production are of epochal significance. The application of modern furniture design to ceramic decorative materials is not only a continuous line of traditional Chinese culture but also

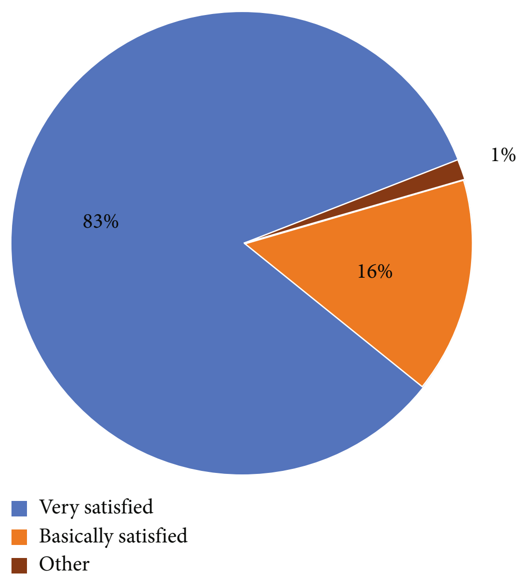


Figure 9: The result of the Keramos customer satisfaction questionnaire survey of ceramic furniture wardrobe combination after image difference prediction.

an important driving force for expanding the industry with new elements. From this point of view, we should adjust the artistic style of contemporary furniture design according to the development of national spirit connotation. While summarizing the experience of applying ancient and modern ceramic decoration to furniture design, it can also provide a new unified way of comfort and beauty for home design.

## 5. Conclusion

This paper describes the combination of ceramic furniture and wardrobe—Keramos. The problem of bright color matching and low age of audience group is solved. The redundant pixels of ceramic material color are removed by image difference prediction model, and multiple judgments are made for color display. The new color matching is predicted according to the data of the collected points on the initial color. After image difference prediction, the color saturation of the changed ceramic combination wardrobe is greatly reduced. Compared with the bright red, yellow, and blue of the primary color, the color value orientation of the new color is lower. However, due to the permeability of ceramic glaze, the predicted color of ceramic materials still maintains flexibility and elegance. By removing the pixels of ceramic material color, some decisions are made on color display. Based on the data collected from the initial color, the experiment finally predicts a new color matching of ceramic wardrobe combination, which is more suitable for the "minimalist" and "quiet" styles. From the results, the color matching of the new ceramic materials calculated by image difference prediction has achieved the expected results. Based on the original bright color matching and young customer base, it is predicted that the color matching of ceramic wardrobe will be more suitable for the current popular style, thus greatly expanding the market. In the future home decoration, more attention should be paid to the use of ceramic art; the embellishment of ceramic art should be better reflected, so that ceramic art decoration can be better displayed in the indoor space, bringing better and more aesthetic living space to the residents.

## Data Availability

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

## Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Acknowledgments

This work was supported in part by the Applied Characteristic Disciplines of Electronic Science and Technology of Xiangnan University (XNXY20221210).

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