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*Retraction*

# Retracted: Appearance Design Method of Ceramic Art Based on VR Visualization Technology

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets 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 own 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] H. Li, "Appearance Design Method of Ceramic Art Based on VR Visualization Technology," *Journal of Robotics*, vol. 2022, Article ID 7664404, 11 pages, 2022.

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*Research Article*

# Appearance Design Method of Ceramic Art Based on VR Visualization Technology

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In order to improve the effect of ceramic art appearance design, this work studies the appearance design method of ceramic art combined with VR visualization technology and builds an intelligent model. According to the needs of the industrial site and the requirements of the lighting system, the area type of the lighting area is determined in this study, and the light of the virtual ceramic product is irradiated on the target detection plane through the refraction of the lens. Based on the Lambertian luminescence characteristics of the point light source virtual ceramic products and the uniform distribution of illuminance on the lighting surface, a mathematical model of the lighting system is established. Taking the realization of a rectangular lighting area with high uniformity as the main goal, the mathematical model is used to construct a system of partial differential equations of free-form surfaces, and the effect of the method in this study is verified by combining with the simulation research. The experimental research shows that the appearance design system of ceramic art based on VR visualization technology proposed in this study has a good effect and can effectively improve the interaction effect of appearance design of ceramic art.



## 1. Introduction

As a branch of artistic design, ceramic art creation is the material and spiritual result of production. It not only meets people's material needs but also meets people's spiritual needs. It is a perfect combination of aesthetic and practical functions. Art design is a highly comprehensive independent art discipline, mainly involving social, economic, cultural, technological, commercial, and other factors. Moreover, its aesthetic cognition and creative needs change with the changes of various factors such as these. Creative ability is one of the most important elements in art design, and it is the comprehensive performance of the designer's comprehensive quality, that is, expressive ability, perception ability, and imagination ability. Although the design of each major is different, the basic elements that make up the art are the same. The creation of ceramic art has roughly the same requirements for aesthetic cognition, metrical order, and rhythm. Therefore, it can be said that the creation of ceramic art integrates the two aspects of material creation and spiritual creation in the development of human society and is an indispensable product in social civilization.

Composition means that the visual elements in the two-dimensional space of the visual plane, according to the beautiful visual effects, use the principles of mechanics to rearrange and combine points, lines, and surfaces and create images based on rational and logical reasoning. The principle of orderly arrangement between shapes. Although it is not a study of the interior of an object, but a study of the manifestation of the external form of the object, it requires the shape to reflect the internal principle [1]. In modern design activities, the composition language is reflected in all fields of design and almost covers all kinds of design modeling methods. No design can be separated from a constitutive language. The composition language stimulates the designer's rich imagination and creativity and opens up different design ideas from the past [2]. On the basis of rational thinking, constitutive language has strong visual laws and artistic expression in the teaching theory of "Bauhaus." This theoretical system of composition has influenced many countries such as the Netherlands, Switzerland, Hungary, the United States, and Japan [3]. Constructivism expresses the basic elements of modeling, and the condition required for its modeling is to abandon general forms and strip away those expressive qualities and subjective diagrams. This stripped shape becomes a conceptual form without characteristics. The recombined graph has all the attributes that make up the language [4]. According to the principle of composition, any form can be rearranged and combined. The forms that constitute objects mainly include natural forms and abstract forms. Therefore, the composition is divided into the natural form and the abstract form [5]. The composition of natural form is a form based on the natural form itself. This method of composition maintains the characteristics of the original form and reconstructs another image by breaking up, separating, ordering, and reconstructing the whole or part of the image [6]. The composition of abstract forms is based on abstract geometric images, that is, elements such as language points, lines, and surfaces are formed, and various arrangements and reorganization of geometric figures are carried out. The method is to use the geometric form as the constituent element and then make a regular combination and arrangement [7]. Modern pottery creation is a utensil and medium through which artists use clay as a material carrier to convey aesthetic emotions and realize individual spiritual value, while modeling is the physical gesture of pottery works created by various artistic means. The most important carrier of aesthetic taste is also the most intuitive visual element that works present to people. The characteristics of modern pottery modeling and the aesthetic performance effect presented are the embodiments of the artist's comprehensive ability. Different modeling structures produce different tension effects, resulting in different visual impacts and psychological feelings. Therefore, modeling has become the most critical factor for an artist to express tension [8].

Vision is most sensitive to color, and color is more perceptual than shape. The emotion aroused by color itself is an internal psychological tension, so under certain conditions, color is more tense than shape [9]. In modern pottery art, color always accompanies all stages of creation; from different clay materials, different metal glazes, to different firing forms, each stage produces different color changes, but color is very important in modern pottery art. It must be attached to a certain morphological space to express emotions, which requires artists to cooperate with the shape of the work according to the physical properties and emotional needs of color when creating, and skillfully use firing, a special link that is different from other art categories, to create color. The contrast changes between them thus trigger the tension performance, which can clearly show the characteristics of the work and the theme of the design, impress the viewer, and convey the information while giving people a sense of aesthetic enjoyment [10].

Ceramic modeling detail design includes two meanings of ceramic modeling design and detail design. The former is the design of the overall ceramic shape, including height, size, and proportion, and the ceramic shape design is considered from an overall perspective; the latter is some parts included in the overall ceramic shape, such as shoulders, mouths, feet, buttons, and abdomen. The design of the partial close-up [11]. Specifically, for the details of a ceramic utensil, such as the handle and the pot flow, which are reflected in the overall ceramic utensils, by better controlling the detail design, the entire utensil will be more aesthetically perfect, making it more perfect. The information on display is richer, making the appreciator more obsessed with him. Ceramic modeling is a basic form of independent existence of ceramics for daily use and furnishings. The generation and development of this form are closely related to human production and life activities [12]. In order to meet the needs of people's daily production and life and with the development and progress of society, the improvement of human living conditions and the improvement of ceramic shapes are also enriched and diversified. It is more in line with its function and aesthetic value. With its own unique form, ceramic modeling brings people the enjoyment of beauty and enriches people's spiritual and cultural life [13]. At the beginning of the creation, the main purpose of the shape of pottery was to meet the practicality. With the differentiation of social classes, the shape of some utensils was separated from the practical function and then transformed into ritual utensils and even developed into pure display. Up to now, ceramics of different shapes and functions have been created. With the demand for aesthetics, people have created various types and forms of ceramic shapes to enrich their lives. Therefore, ceramic modeling is not only the needs of human material life but also serves the spiritual and cultural life of human beings. Its production, development, enrichment, and innovation are inseparable from human life [14]. In contemporary times, ceramic modeling art is a category of art. With the introduction of modern art concepts, the boundary between the practical function and the display function of ceramic modeling is becoming more and more blurred, and even integrated, and more designers are designers. Or the emotional expression and emotional communication of ceramic artists for ceramic plastic arts [15]. Detail design can also be referred to as design detail. The design here is perceptual design, artistic creation, and detail design is perceptual artistic creation of small links. It includes artistic practice and artistic creation in people's daily life and is embodied in some designs that can serve people's production and life, such as architecture, plane, sculpture, industry, and other fields [16].

In order to improve the effect of appearance design of ceramic art, this work studies the method of appearance design of ceramic art combined with VR visualization technology and constructs an intelligent model to promote the development of appearance design of ceramic art technology.

## 2. VR Visualization Technology

### 2.1. Basic Concepts of Nonimaging Optics

*2.1.1. Luminous Flux and Luminous Efficiency.* The luminous flux represents the amount of light emitted from the LED light-emitting surface per unit time, and its unit is lumens (lm). Luminous flux is generally discussed with luminous efficiency. The unit of luminous efficiency is lumens/watt (lm/W), which represents the amount of light emitted by a unit of power LED in a unit of time. As a new type of high-efficiency light source, the luminous efficiency of LED is generally above 100 lm/W.

*2.1.2. Luminous Intensity.* Luminous intensity, also known as light intensity, refers to the average Poynting vector flowing through a point in the light field. In photometry, it refers to the size of the luminous flux $d\phi$ within a unit solid angle $d\omega$, the unit is candela, and its abbreviation is cd, which is represented by $I$.

$$I = \frac{d\phi}{d\omega}. \tag{1}$$

*2.1.3. Illumination.* Different from light intensity, in photometry, illuminance characterizes the luminous flux $d\phi$ received on a unit area $dS$, and the unit is Lux, which is represented by $E$ in this study.

$$E_T = \frac{d\phi}{dS}. \tag{2}$$

*2.1.4. Brightness.* Brightness describes the reflective ability of an object in a lighting environment, representing the luminous intensity per unit projected area $dA \cos\theta$. Different from irradiance, brightness represents the reflection intensity of the illuminated object in the human eye, which is a concept describing the senses. When the human eye sees the illuminated object in a certain direction, the brightness is equal to the ratio of the light intensity of the object in this direction to the unit projected area of the object in this direction, usually expressed by $L$, and the unit is candela/square meter $(c\ d/m^2)$.

$$L = \frac{d\phi}{d\omega dA \cos\theta}, \tag{3}$$

where $dA$ represents the unit area, $d\omega$ represents the unit solid angle, and $\theta$ is the angle between the given direction and the normal direction of the unit area $dA$.

*2.1.5. Radiation Intensity.* The radiant intensity belongs to radiometry, and its meaning refers to the radiant flux $E$ emitted by a point light source within a unit solid angle $d\omega$ in a transmission direction, and the unit is $W/sr$, which is expressed by $I_e$ in this study:

$$I_e = \frac{d\phi}{d\omega}. \tag{4}$$

*2.1.6. Irradiance and Irradiance Uniformity.* Irradiance refers to the radiant flux received on a unit plane, and its unit is $W/m^2$, which is expressed by $E_e$ in this study. On the other hand, the radiant output degree represents the radiant flux emitted to the hemispherical space per unit area $dS$ in the unit time $dt$.

$$E_e = \frac{d\phi}{dS}. \tag{5}$$

Irradiance uniformity is an important evaluation index in the field of lighting design. Its meaning is the ratio of the average irradiance value $E_{\mathrm{Ave}}$ to the maximum irradiance value $E_{\mathrm{Max}}$ on the target lighting surface:

$$\overline{E} = \frac{E_{\mathrm{Ave}}}{E_{\mathrm{Max}}}. \tag{6}$$

*2.1.7. Lighting Efficiency.* Lighting efficiency is another important evaluation index in the field of lighting design. In this study, lighting efficiency refers to the ratio of the emitted luminous flux $\phi_r$ of the LED light source received by the target lighting surface to the total luminous flux $\phi_s$ emitted by the LED light source in the experimental results:

$$Q = \frac{\phi_r}{\phi_s}. \tag{7}$$

*2.1.8. Bidirectional Reflection Distribution Function.* The bidirectional reflection distribution function (BRDF) characterizes the reflection characteristics of an object surface reflecting light energy from any incident direction to any viewpoint direction. There is a proportional relationship between the irradiance value of the emitted light of the LED light source irradiating the discrete point of diffuse reflection and the radiation output $E_e$ reflected from the point, and this proportional relationship is the reflectivity $\rho$. In this study, the BRDF function is introduced to describe the optical characteristics of the diffuse reflection surface, and the Lambertian model is used as the outgoing model of the diffuse reflection material. It is not difficult to obtain:

$$\begin{cases} \phi_e = \int d\phi_e = \int I_e d\omega = \int L_e dS \cos\theta d\omega = \int L_e dS \cos\theta \sin\theta d\theta d\varphi = \pi L_e S, \\ E_T = \dfrac{\phi_e}{S} = \rho E_e. \end{cases} \tag{8}$$

Among them, $\phi_e$ represents the radiant flux, $L_e$ represents the radiance, $\omega$ represents the solid angle, and $\rho$ represents the reflectivity of the diffuse reflection material. It is not difficult to deduce the expression of BRDF from (8) as

$$\text{BRDF} = \frac{\rho}{\pi}. \tag{9}$$

*2.2. Design Method of LED Secondary Optics.* An LED is a solid-state semiconductor device that converts electrical energy directly into light energy. LED lights have many features, including low operating voltage, low power consumption, high luminous efficiency, and long life. In terms of energy saving, since the power consumption of LED is 20% of that of incandescent lamps and 50% of that of fluorescent energy-saving lamps, it can be seen that LED will become the main light source in the field of energy-saving lighting.

The free-form surface lighting design of the lens follows two basic laws: Snell's law and the law of conservation of energy. Snell's law specifies the deflection of light by the curved surface, which realizes the redistribution of light energy. The law of energy conservation defines the relationship between the incident light energy and the output light energy of the free-form surface lighting system and determines the energy transmission efficiency of the system.

Free-form surface design is generally carried out using three methods.

The first method is trial and error. Initially, the basic outline of the free-form surface is determined, and then, repeated changes of the value are used to perform multiple inspections and resolve errors to achieve the best results for the data it presents. This continuous process of change and observational analysis is carried out by computer programs. When designing free-form surfaces by this method, the mold that has been used as a real object is often used. Then, the free-form lens is automatically optimized by the Monte Carlo simulation method or differential evolution algorithm on the computer, or the improved design of the lens is directly performed by the nonimaging condenser. However, for the free-form surface directly represented by the spline curve, it is necessary to use the data of constantly changing nodes on the curve to optimize. In different classical free-form surface designs, the method of determining the initial point and then continuously modifying it is an efficient method that often achieves results. Since the design surface cannot be expressed by specific equations, it is impossible to manually correct the data to obtain a good optimization. Of course, it adds a lot of difficulties in the design and makes the optimization process more cumbersome and wastes a lot of time.

The second method is the analytical method of partial differential equations. That is, the free surface is designed by solving a set of partial differential equations. The establishment of this equation system is determined by the position of the light source point of the lighting fixture and the lighting surface. Its parameters are based on the normal vector and tangent vector on the free-form surface, so by means of the equation result obtained by the equation, the design value of the design surface can be directly obtained to achieve the ideal lighting result. This avoids the time wasted by the trial and error method and greatly improves the work efficiency of the designer.

The third method is simultaneous multiple surface, or SMS for short, which means that multiple optical surfaces can be designed simultaneously. The principle is actually similar to the second method, but it is aimed at the modeling calculation of the area surface.

First, it is necessary to establish a coordinate system including the light source, free-form surface, and illumination area, as shown in Figure 1.

The coordinate system is established with point $0, 0'$ as the coordinate origin, and if 0 is the center of the $C - \gamma$ ball, $0'(x_1, y_1, z_1)$ can be expressed as the following equations:

$$\begin{cases} x_1 = \rho(C,\gamma)\cos C \sin \gamma, \\ y_1 = \rho(C,\gamma)\sin C \sin \gamma, \\ z_1 = \rho(C,\gamma)\cos \gamma. \end{cases} \tag{10}$$

Then, the algebraic expression of the incident ray $00'$ can be expressed by the coordinates of the above formula $0'(x, y, z)$ as given in the following equation:

$$\overrightarrow{I} = xi + yj + zk. \tag{11}$$

Equation (12) is obtained by substituting equation (10) into equation (11), and by unitizing the incident ray $00'$,

$$\overrightarrow{I} = i\rho(C,\gamma)\cos C \sin \gamma + j\rho(C,\gamma)\sin C \sin \gamma + k\rho(C,\gamma)\cos \gamma, \tag{12}$$

$$\overrightarrow{I}' = i \cos C \sin \gamma + \sin C \sin \gamma + k \cos \gamma. \tag{13}$$

Taking $0'$ as the center of ball $\theta - \varphi$, $R(x_2, y_2, z_2)$ can be expressed as

$$\begin{cases} x_2 - x_1 = \rho(\theta,\varphi)\cos \theta \sin \varphi, \\ y_2 - y_1 = \rho(\theta,\varphi)\sin \theta \sin \varphi, \quad \theta\varepsilon[0, 2\pi]\varphi\varepsilon[0, \pi], \\ z_2 - z_1 = \rho(\theta,\varphi)co\varphi. \end{cases} \tag{14}$$

Then, the coordinate $O'(x, y, z)$ of the above formula can represent the refracted ray, and in the same way, the unit algebra of the outgoing ray $O'R$ can be expressed as

$$\overrightarrow{I}' = i \cos \theta \sin \varphi + j \sin \theta \sin \varphi + k \cos \varphi. \tag{15}$$

The following equation is derived from Snell's law.

$$\overrightarrow{N} = n_R\overrightarrow{R} - n_I\overrightarrow{I}'. \tag{16}$$

In the equation, $n_R$ is the refractive index of the medium where the refracted light is located, and $n_I$ is the refractive index of the medium where the incident light is located. Then, the normal vector on the free-form surface is

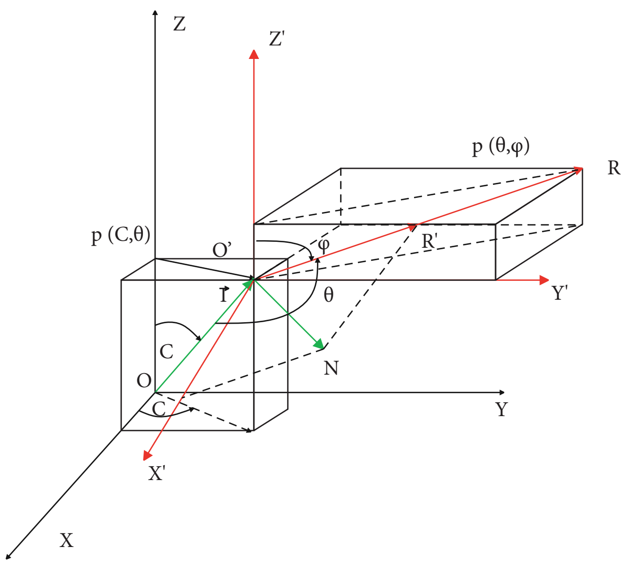



Figure 1: Light refraction path in a dual coordinate system.

$$\overrightarrow{N}\left(N_x, N_y, N_z\right) = \begin{cases} n_R \cos\theta \sin\varphi - n_I \cos C \sin\gamma, \\ n_R \sin\theta \sin\varphi - n_I \sin C \sin\gamma, \\ n \cos\varphi - n \cos\gamma. \end{cases} \quad (17)$$

Since $\overrightarrow{N}$ is a normal vector on the surface, the tangent vector $\overrightarrow{T}$ of the surface should be perpendicular to it, that is,

$$\overrightarrow{N} * \overrightarrow{T} = 0. \quad (18)$$

If it is assumed that there are any two points $A(x_a, y_a, z_a), B(x_b, y_b, z_b)$ on the free-form surface and the two points $AB$ are close enough, the tangent vector $\overrightarrow{T}$ here can be expressed as

$$\overrightarrow{T} = (x_b - x_a)i + (y_b - y_a)j + (z_b - z_a)k. \quad (19)$$

The tangent vector can be expressed as

$$\begin{cases} (x_b - x_a) = \Delta\rho \times \dfrac{\partial x}{\partial \rho}, \\ (y_b - y_a) = \Delta\rho \times \dfrac{\partial y}{\partial \rho}, \\ (z_b - z_a) = \Delta\rho \times \dfrac{\partial z}{\partial \rho}. \end{cases} \quad (20)$$

Equation (20) is substituted into equation (19) to obtain

$$\overrightarrow{T} = \Delta\rho\left(\frac{\partial x}{\partial \rho} i + \frac{\partial y}{\partial \rho} j + \frac{\partial z}{\partial \rho} k\right). \quad (21)$$

By deriving, transforming, and substituting the partial differential of equation (10) into equation (21) and then substituting it into equation (18), the following partial differential equation of the correlation between the free-form surface and the light-emitting angle of the light source is obtained through simplification.

$$\frac{\partial \rho}{\partial C} = \frac{\rho \cdot n_R \sin\gamma \sin\varphi \sin(\theta - C)}{n_I - n_R(\sin\gamma \sin\varphi \cos(\theta - C) + \cos\gamma \cos\varphi)}, \quad (22)$$

$$\frac{\partial \rho}{\partial \gamma} = \frac{\rho \cdot (n_R \sin\gamma \sin\varphi - n_R \cos\gamma \sin\varphi \cos(\theta - C))}{n_R(\sin\gamma \sin\varphi \cos(\theta - C) + \cos\gamma \cos\varphi) - n_I}. \quad (23)$$

## 3. Appearance Design Virtual System of Ceramic Art

The specific process of 2D image modeling generation and evaluation is shown in Figure 2. In the design process, the ellipse Fourier coefficient data of the preliminary individual two-dimensional modeling plan completed by the designer is added to the data matrix of the overall modeling sample, and its principal component score is calculated. The data perturbation of the added individual scheme to the principal component data matrix of the overall modeling sample is very small and can be ignored. Therefore, the key principal component score of the individual scheme corresponding to each target image is substituted into the modeling image prediction model based on the key principal component, and the target image value of the scheme is obtained. Then, the target image values of the remaining plans are calculated in sequence, and the perceptual image evaluation of all the two-dimensional modeling plans is completed. After that, the optimal two-dimensional modeling scheme is determined with reference to the overall design objectives. If the optimal solution still does not meet the overall design objectives, after comparing the differences, determine the optimization direction of the optimal solution. In the process of clarifying the optimization direction, it is judged whether there is a consistent correlation between the key principal component scores of the optimal plan and the target image data. If the correlation exists, the key principal component scores of the changed optimal solution are refitted to generate a new optimal two-dimensional modeling solution. Conversely, the scheme is optimized by adjusting the associated modeling features associated with the target image. In this process, a normality test is first performed on the principal component scores of the overall modeling sample.

In order to support image-oriented color generation and evaluation, a comprehensive evaluation model based on color imagery and a color multi-image optimization model based on gray correlation analysis are proposed, as shown in Figure 3.

The simulation system sets the system functions according to the implementation program of the ceramic product appearance image design technology. It includes four functional modules: sample information, target image, multiobjective optimization, and multiattribute decision-making. In order to realize the functions of each module of the simulation system, the four modules are used as independent modules to be programmed with MATLAB software, respectively, during development, as shown in Figure 4.

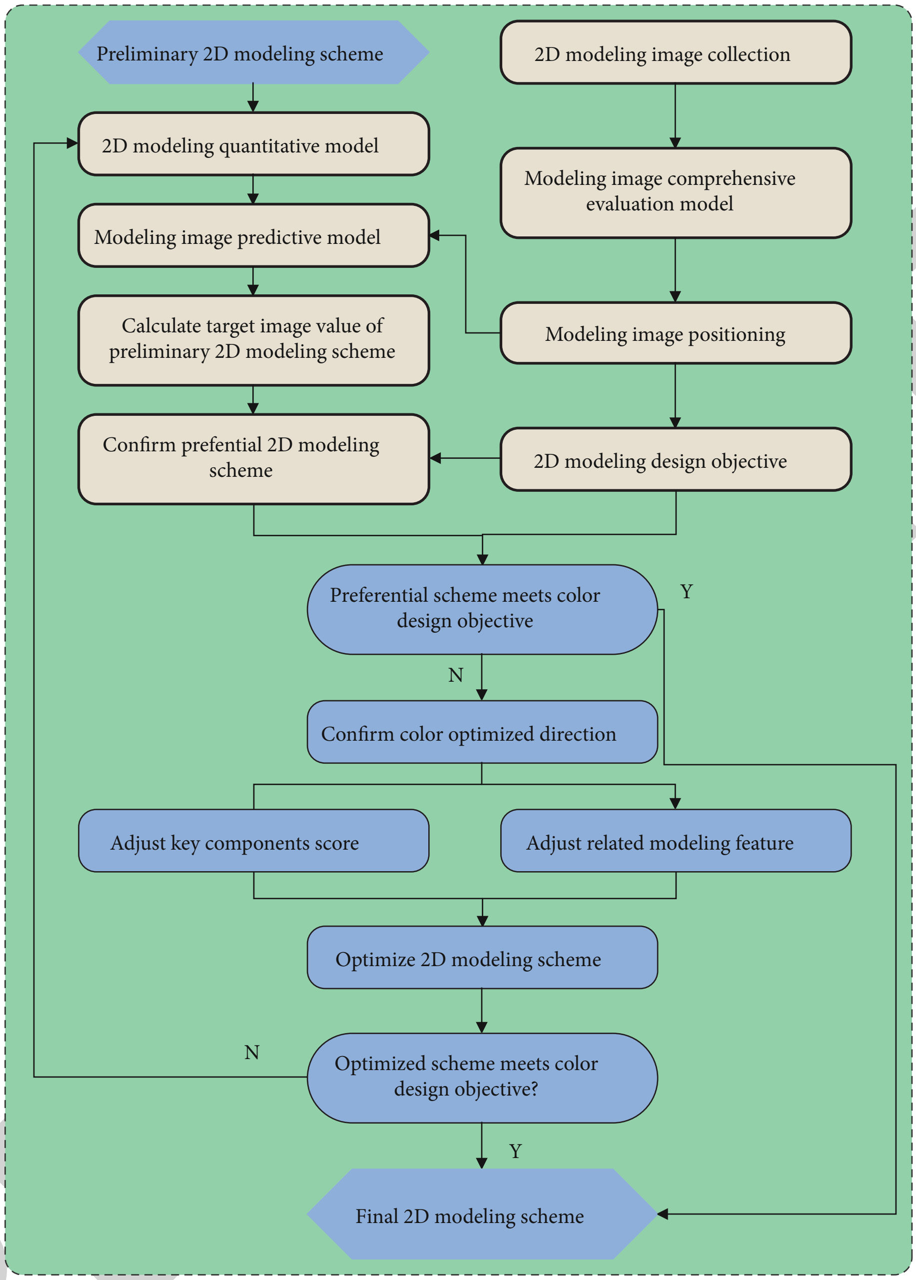



Figure 2: Modeling generation and evaluation process.

The structure of the real-time data simulation system is shown in Figure 5. It is divided into a three-dimensional display module, a network communication module, a data communication module, and a data synchronization module.

The modeling image of ceramic art products is the emotional response of users triggered by the modeling part of the appearance of ceramic art products. The purpose of positioning is to determine the typical representative emotional responses of users to the overall modeling samples of the target ceramic art product and use several modeling target image adjectives and their perceptual image evaluation data matrix as the quantitative output of the positioning results. The scientific positioning of modeling image is of great significance to the image modeling design of ceramic art products oriented to user sensibility. The output data can truthfully reflect consumers' diverse emotional needs for ceramic art product modeling and provide reliable modeling image data and clear design goals for data-driven ceramic art product appearance image design, as shown in Figure 6.

Modern ceramic art creation adds modern elements on the basis of traditional ceramic art, so that ceramic art works show ever-changing and colorful personalities. Moreover, most of the modern ceramic art creations use elements such as points, lines, and surfaces to create some three-dimensional, two-dimensional, or three-dimensional and two-dimensional modern decorative works. This makes more

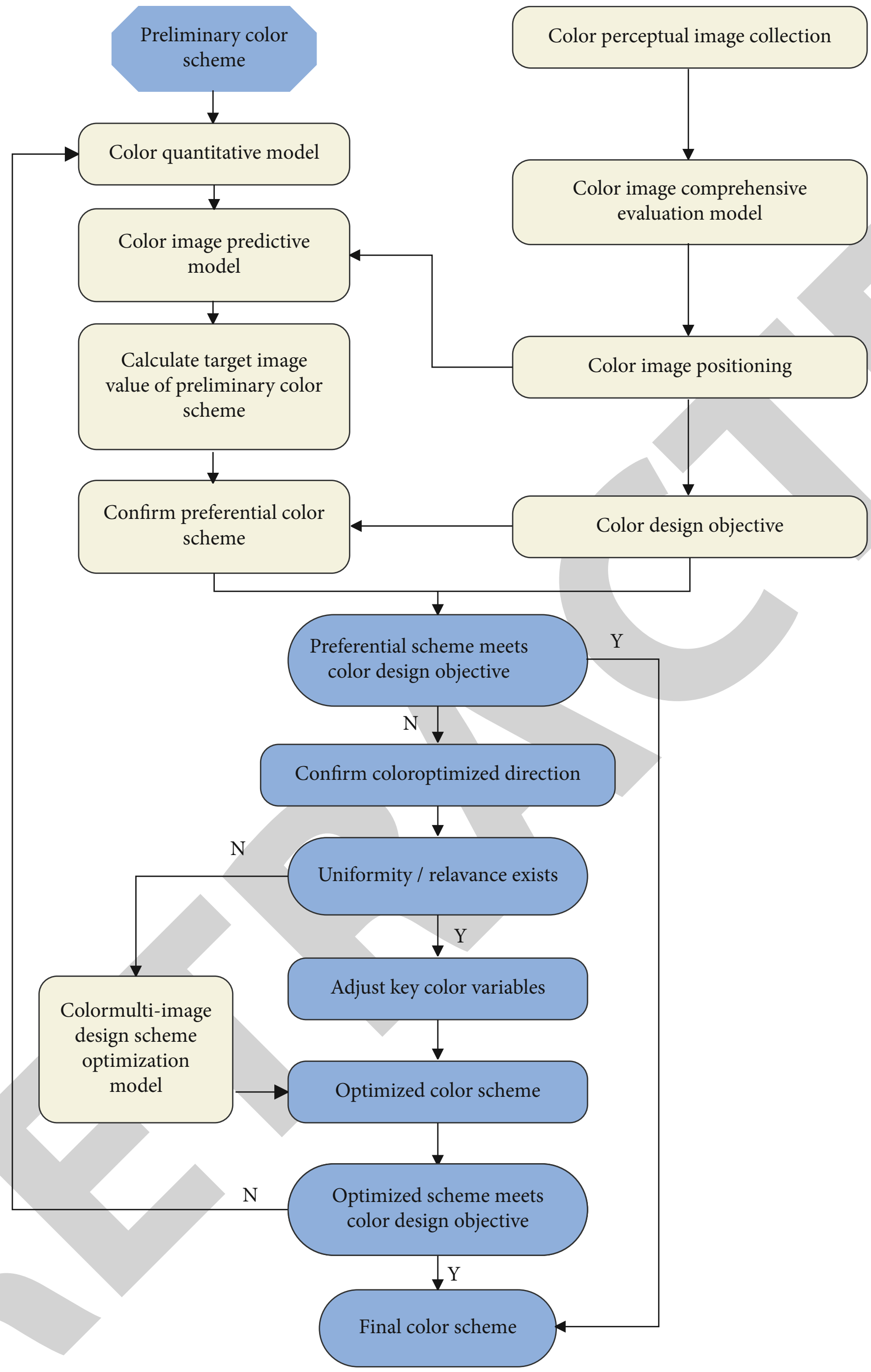



Figure 3: The process of color generation and evaluation of ceramic art.

and more modern ceramic art works form a simple but not simple unique charm and appeal. Through the method of three-dimensional construction, the plane material is cut, folded, hollowed out, and other construction means, so that the plane material can produce a three-dimensional effect. This creative element is reflected in ceramic works not only for the decoration of ceramic surfaces but also in the shape of ceramic art works. It can be said that point, line, and surface elements are ubiquitous for modern design, and the rational use of composition techniques can make modern ceramic art more in line with the characteristics of the times. As shown in Figure 7, the appearance design of ceramic art is carried out in combination with VR visualization technology, as shown in Figure 7.

The three-dimensional composition method is also expressed in various ways in ceramic decoration (Figure 8). It can use the stacking of colored glaze and pottery mud, or it can be cut, hollowed out, stacked, and other texture expressions on the surface of the body to form a unique decorative effect. The use of dots is more obvious in

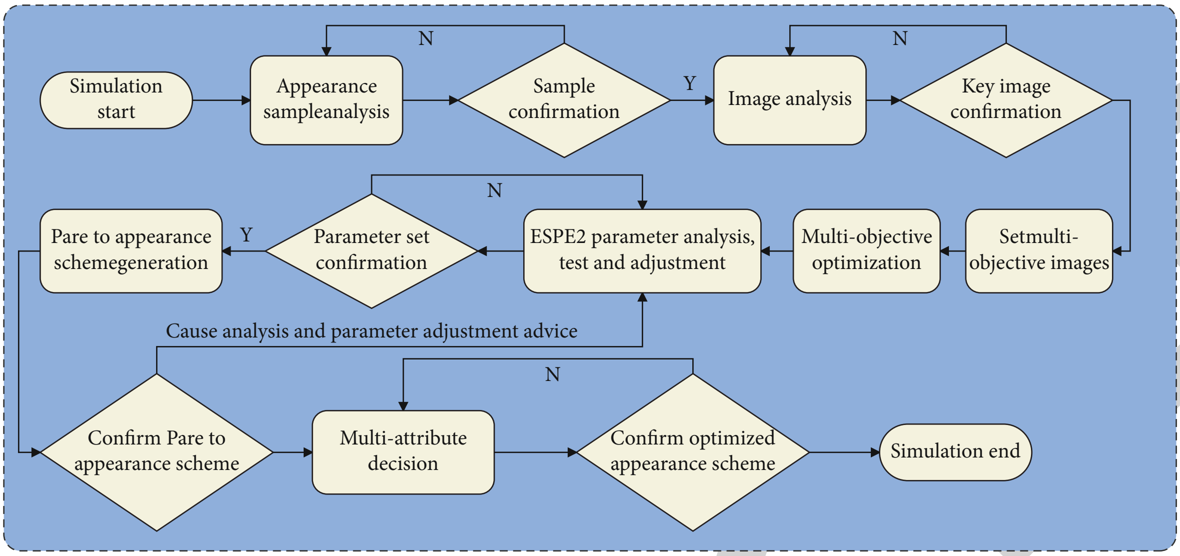



Figure 4: Application process of the simulation system.

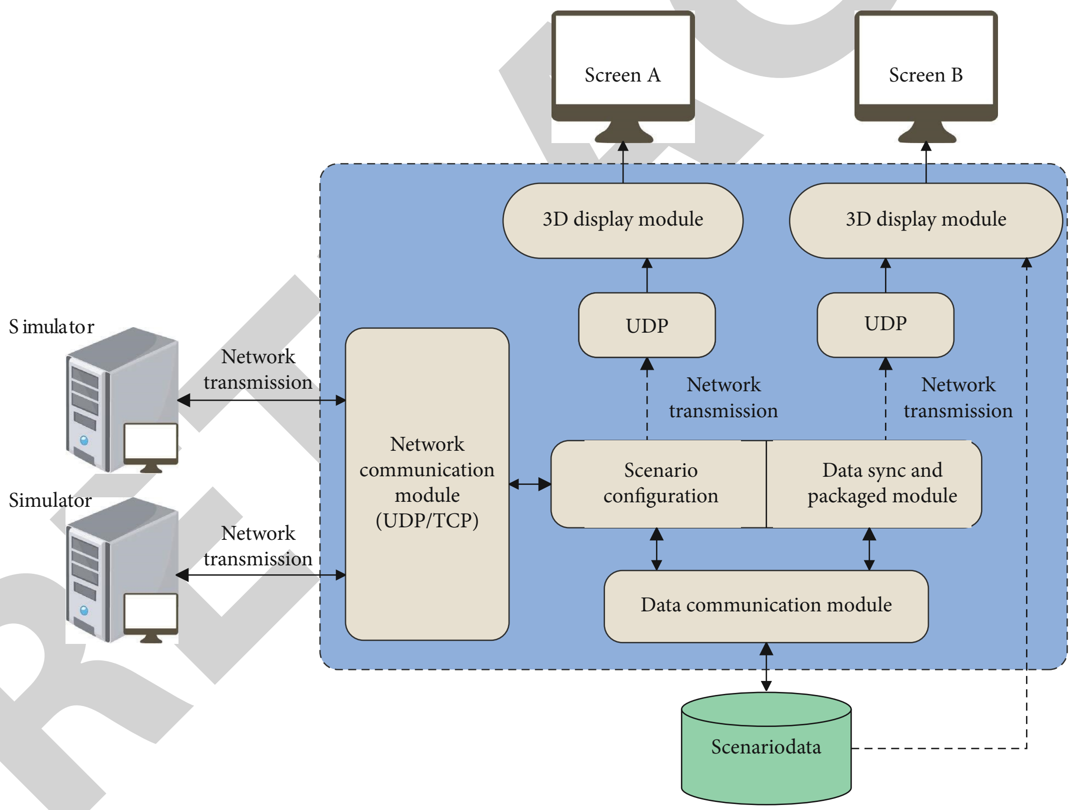



Figure 5: Simulation design module of real-time data.

decoration than in modeling. It reflects the personality of movement and stillness in modern ceramic art through the virtuality, density, size, color, shape, and texture of the dots. There are several ways of expressing lines in decoration, such as the calmness and composure of horizontal lines, the majesty and toughness of vertical lines, the softness of curves, the stuttering of broken lines, and the tension and transformation of intersecting lines. These add a bit of dynamism to the artistic language of modern ceramic art. The lines drawn using blue and white, pastel, and other materials in the creation of modern ceramic art are both modern and traditional. The three-dimensional lines form a rhythmic sense of staggered heights, lined with each other, and dense and dense with the help of the easy-to-form characteristics of the ceramic art material itself. The surface can be expressed by the combination of dots and lines in the decoration of ceramic art. With the shape of the ceramic art, a reasonable layout is carried out to make the utensils more

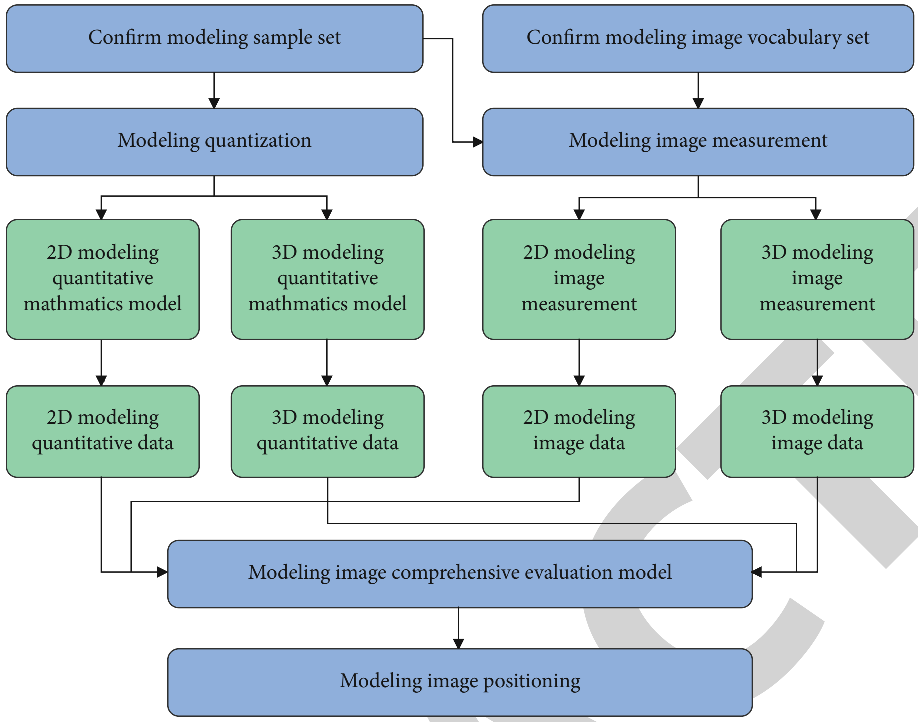
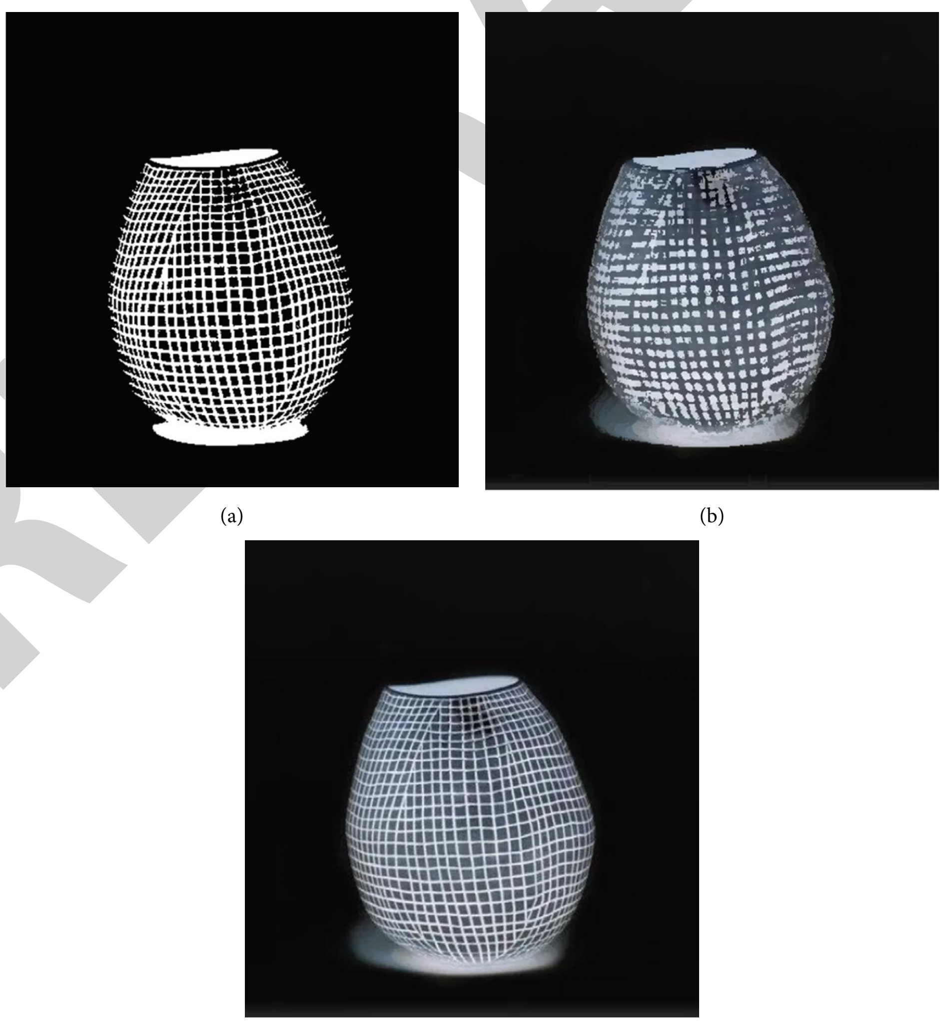



Figure 6: The positioning process of ceramic art product modeling image.



(a) (b) (c)

Figure 7: Example of appearance design of ceramic art. (a) Sketch design. (b) Preliminary rendering. (c) Finished product structure.

Figure 8: Example of three-dimensional structure design.

Table 1: Evaluation of the effect of appearance design of ceramic art based on VR visualization technology.

| Number | Design effect | Number | Design effect | Number | Design effect |
|---|---|---|---|---|---|
| 1 | 86.52 | 20 | 85.62 | 39 | 88.55 |
| 2 | 88.09 | 21 | 88.70 | 40 | 90.34 |
| 3 | 90.05 | 22 | 89.74 | 41 | 87.49 |
| 4 | 84.42 | 23 | 89.15 | 42 | 89.60 |
| 5 | 86.31 | 24 | 89.28 | 43 | 86.19 |
| 6 | 90.70 | 25 | 90.04 | 44 | 88.21 |
| 7 | 90.04 | 26 | 84.48 | 45 | 85.14 |
| 8 | 87.89 | 27 | 88.78 | 46 | 83.10 |
| 9 | 84.43 | 28 | 87.33 | 47 | 86.77 |
| 10 | 88.22 | 29 | 86.95 | 48 | 83.54 |
| 11 | 83.40 | 30 | 85.73 | 49 | 88.09 |
| 12 | 86.61 | 31 | 84.70 | 50 | 90.99 |
| 13 | 88.75 | 32 | 85.55 | 51 | 86.76 |
| 14 | 90.15 | 33 | 89.76 | 52 | 84.22 |
| 15 | 89.08 | 34 | 86.86 | 53 | 83.99 |
| 16 | 87.75 | 35 | 89.86 | 54 | 87.72 |
| 17 | 83.57 | 36 | 89.36 | 55 | 90.68 |
| 18 | 84.64 | 37 | 84.74 | 56 | 85.12 |
| 19 | 88.92 | 38 | 89.31 | 57 | 89.49 |

complete, concise, and generous. The combination of points, lines, and surfaces can make the original rigid objects more vivid, and at the same time, it adds a little more beauty, which adds more fashion elements to the original seemingly traditional artistic image. The seemingly simple elements of point, line, and surface are inseparable from our life and art. The rational use of them, directly or indirectly, affects our aesthetic ability and artistic creation ability. It is the rational application of point, line, and surface elements in modern ceramic art design that can make modern ceramic art have a strong artistic appeal and a unique image and temperament of ceramics.

Through the design of multiple groups of cases, the effect of the appearance design of the ceramic art method based on VR visualization technology proposed in this study is verified, as shown in Table 1.

From the above research, we can see that the appearance design system of ceramic art based on VR visualization technology proposed in this study has a good effect and can effectively improve the interaction effect of appearance design of ceramic art.

## 4. Conclusion

In the creation of modern ceramic art, the characteristics of color composition and three-dimensional composition are reflected in terms of shape and color. These are the keys to modern ceramic art design. The characteristics of modern ceramic art are not only reflected in the shape, glaze, and decoration of ceramic daily necessities but also should pay attention to the concept of the creator. The shape is novel and the decoration is interesting, so that the works created are not lacking in modernity. Moreover, this can not only reflect the author's freedom, creativity, experimentation, and its outstanding humanization but also can use the environment to set off the charm of the work. This work studies the method of appearance design of ceramic art combined with VR visualization technology and builds an intelligent model. Through the experimental research, it can be seen that the appearance design system of ceramic art based on VR visualization technology proposed in this study has a good effect and can effectively improve the interaction effect of appearance design of ceramic art.

## Data Availability

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

## Conflicts of Interest

The author declares that there are no conflicts of interest.

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