Exploration of Modern Design of Traditional Ceramic Patterns Integrating Big Data and CAD Technology

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Abstract. In recent years, the combination of traditional ceramic pattern design and modern design has become an important topic for contemporary designers to explore and research. The development of big data and CAD technology has provided new solutions for traditional ceramic pattern design and modern design. This study is based on big data and CAD technology, using database storage, visualization technology, CAD modelling, virtual reality, and 3D printing techniques to design and analyze traditional ceramic patterns digitally. The experimental results indicate that integrating big data and CAD technology can provide more personalized design solutions for ceramic patterns. And this design practice can not only effectively improve the efficiency and quality of traditional ceramic pattern design. Moreover, it can achieve a digital virtual display of traditional ceramic patterns, providing new methods and ideas for modern ceramic pattern design. Meanwhile, this study can also provide some reference for the digital development of other related fields.

Keywords: Big Data; CAD Technology; Ceramics; Pattern Design; Intelligent Design
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1 INTRODUCTION

CAD technology provides precise digital tools for traditional ceramic pattern design, enabling designers to create complex patterns with unprecedented precision. Big data analysis can provide insight into consumers' personalized needs, combined with the flexibility and editability of CAD technology, enabling ceramic pattern design to balance personalized customization and efficient mass production [1]. This integration not only promotes the inheritance of traditional culture but also drives the innovative development of ceramic art. By mining historical ceramic pattern resources through big data and combining modern design concepts and CAD technology, new patterns can be created that retain the essence of traditional culture while incorporating modern aesthetic elements [2]. By combining big data, CAD technology, and machine vision, a comprehensive model can be constructed that is not limited to identifying defective products and continuously improving the manufacturing process but can also perform predictive analysis during the ceramic pattern design stage. The addition of big data provides designers with inspiration and design direction through massive design materials, market trend analysis, and consumer preference data, greatly improving design efficiency and market fit. This not only meets the modern market's pursuit of personalization but also ensures the economy and timeliness of production [3]. For example, after the pattern design is completed, machine vision can be used to quickly simulate rendering and preview the effect of the pattern under different materials and lighting conditions, reducing the cost of trial and error in actual production [4]. Introducing machine vision technology into ceramic pattern design and quality control can further enhance the precision of design and the automation level of production. Meanwhile, in the production process, machine vision can be used to monitor the pattern quality of ceramic surfaces in real-time, detect and correct defects promptly, and ensure that every product meets the design requirements [5]. In addition, the model can also predict the optimal production parameters based on production data, ensuring the perfect presentation of patterns on ceramic surfaces. By analyzing historical design data, market feedback, and consumer behaviour patterns, the model can predict which pattern designs are more popular in the market and which design elements need to be adjusted to optimize product performance [6].

Through the intuitive engineering (KE) method, some scholars have conducted in-depth research on the coupling relationship between user cognition and ceramic pattern design features, ensuring that the design meets both aesthetic standards and user needs. Using big data technology to analyze massive historical ceramic pattern data, market trends, consumer preferences, and other information, combined with the precise modelling capabilities of CAD technology, to systematically organize design elements [7]. When evaluating the design process, quantitative theory and KE model regression analysis are used, combined with complex network methods, to reveal the inherent connections between design features and identify key design features that affect user perception of image quality. CNN can automatically extract key features from images and learn the mapping relationship between user preferences and pattern features through training [8]. In the context of the integration of big data and CAD technology, some scholars have introduced machine learning techniques such as Convolutional Neural Networks (CNN) to predict and analyze users' perceived images of ceramic patterns in VR systems. Apply the above method to the modern design practice of traditional ceramic patterns and verify it through the human-machine interface design of the VR system [9]. The experimental results showed that the similarity between the multiple regression analysis of VR intent space and experimental testing was as high as about 97%, with minimal error, verifying the high correlation of the VR intent space model. The application of this technology not only improves the objectivity and accuracy of design evaluation but also provides designers with powerful design optimization tools. Meanwhile, the mean square error (MSE) of the CNN prediction model is only 0.0074, far below the threshold of 0.01, indicating that the model has extremely high accuracy and reliability in predicting user-perceived images [10].

In recent years, the combination of traditional ceramic pattern design and modern design has become an important direction for designers to explore and research. However, current research mainly focuses on feature analysis, pattern extraction, and digital design of ceramic pattern design. These studies have provided reference and inspiration for traditional ceramic pattern design to a certain extent, but have not proposed specific design methods and schemes. Therefore, how to effectively analyze and extract traditional ceramic patterns, and construct personalized and intelligent pattern design schemes, is currently an important issue facing us. Traditional ceramic patterns are a common art form in ceramic decoration in China, with certain historical and cultural value. To further inherit and promote Chinese traditional culture, designers need to fully consider their characteristics and rules when designing ceramic patterns, to meet the aesthetic concepts and needs of modern people. Therefore, traditional ceramic patterns must undergo reasonable analysis and processing by designers. However, current research mainly focuses on classifying, extracting, and analyzing traditional ceramic pattern libraries, without directly or indirectly proposing specific design solutions. Therefore, this article proposes a modern design method for traditional ceramic patterns that combines big data and CAD technology, based on the characteristics of traditional ceramic patterns. This article first classifies and extracts traditional ceramic pattern libraries; Then, based on technologies such as database storage, visualization, CAD modelling, virtual reality, and 3D printing, a new method for constructing a traditional ceramic pattern library is proposed. Finally, a new design scheme that integrates big data and CAD technology is adopted for the modern design of traditional ceramic patterns.

2 CURRENT RESEARCH STATUS AT HOME AND ABROAD

In the digital age, people's aesthetic awareness has been greatly improved, especially in inheriting and promoting traditional culture. In recent years, China's digital technology has developed rapidly, and the use of big data and CAD technology for the digital design of traditional ceramic patterns has become a popular research topic. Ma et al. [11] used 3D printing technology to create traditional ceramic pattern models and processed them accordingly. Scholars have conducted computer modeling and optimized ceramic pattern design to a certain extent. Some scholars have mainly studied how to use CAD technology for the digital design of ceramic patterns. In addition, some scholars have proposed using big data technology for personalized customization of ceramic patterns by analyzing its application in the field of traditional ceramic pattern design, providing certain reference values for the design and optimization of ceramic patterns. In terms of combining ceramic elements with design styles, some scholars have used computer technology to reconstruct traditional ceramic patterns and interpret the cultural connotations of traditional ceramic patterns. Marín et al. [12] used computer technology to create a three-dimensional model of ceramic patterns and designed corresponding virtual scenes based on it, thus realizing the virtual display of traditional ceramic patterns. At present, China's digital technology is developing rapidly and gradually being applied in various fields. For example, in the field of medicine, a digital display of traditional Chinese medicine theory has been achieved through computer technology. In the field of agriculture, relevant agricultural models have been constructed through computer technology. In addition, in the field of industrial ceramics, corresponding digital models have been constructed through computer technology, and traditional ceramic production processes have been optimized to a certain extent using computer technology, thus achieving a digital display of the traditional ceramic production process. Foreign scholars have conducted in-depth research on the application of digital technology in the field of traditional ceramic pattern design. For example, some scholars have used computer technology to digitally display traditional ceramic patterns and optimize them to a certain extent, ultimately achieving the design of traditional ceramic patterns. In addition, Ming et al. [13] visualized ceramic patterns through computer technology, thereby achieving the visualization display of traditional ceramic patterns. At present, there is relatively little research by domestic scholars in this area, and the development of digital technology abroad is also relatively complete. It mainly focuses on visualization, such as visualizing traditional ceramic patterns and combining them with computer technology for computer visualization simulation. Foreign scholars have visualized traditional ceramic patterns and utilized computer technology for virtual design, ultimately achieving a digital display of traditional ceramic patterns. In addition, in terms of the modern design of traditional ceramic patterns, domestic research mainly focuses on the digital display of traditional ceramic patterns, such as using digital technology to design corresponding virtual scenes or constructing corresponding virtual spaces through 3D modelling technology. However, there is still relatively little research on the combination of traditional ceramic pattern design and digital display.

Combining the advantages of big data and CAD technology, Shi et al. [14] proposed a sensory engineering-based virtual reality (VR) method. Aiming to construct a precise mapping relationship between ceramic pattern form elements and consumer emotions from a new dimension, namely whole, unit, interrelationship, and detail (OUID), providing strong support for modern design innovation of traditional ceramic patterns. By constructing a virtual reality environment, consumers can immerse themselves in the visual, tactile, and emotional experiences brought by different ceramic patterns. Based on the four dimensions of OUID, a detailed VR interactive experience process was designed to guide consumers to observe the overall layout of the pattern, the arrangement and combination of unit elements, the interrelationships between each element, and the exquisite details in the virtual space. By utilizing the powerful modelling capabilities of CAD technology, designers can quickly and accurately draw 3D models of ceramic patterns based on big data analysis results, achieving seamless integration of traditional and modern design techniques. Taking a series of carefully designed ceramic patterns as an example, we showcased their VR models, hand-drawn sketches, and high-definition images to different consumer groups, and collected their emotional feedback. After collecting sufficient VR experience data, they used multiple linear regression analysis and partial correlation analysis methods to deeply explore the complex relationship between ceramic pattern form elements and consumer-perceived images. During this process, VR systems can capture and analyze consumers' emotional response data in real time, providing a scientific basis for subsequent design optimization. These findings provide specific and powerful guidance for designers on how to adjust and optimize ceramic patterns in subsequent designs.

Big data technology provides unprecedented data support for ceramic pattern design. By analyzing historical sales data, market trends, consumer preferences, and behaviour patterns, Tao [15] accurately grasps market demand and provides data-driven inspiration and direction for design. When traditional ceramic pattern design combining big data and CAD technology encounters augmented reality technology, the user experience is elevated to a new level. AR technology allows users to directly overlay pre-designed ceramic patterns from 3D graphics onto real-world scenes, even creating immersive interactive experiences in the space between the user and the screen. CAD technology, with its powerful modelling and simulation capabilities, transforms designers' creativity into precise 3D models, ensuring that the implementation of design solutions meets aesthetic standards and functional requirements. Users are no longer just watching pictures or videos of products, but can personally "touch" and "feel" every detail of ceramic patterns in their physical environment. This immersive experience greatly enhances users' sense of participation and immersion. Experiments have shown that when ceramic patterns or moulds are integrated into users' real spaces in AR form, this environmental integration and spatial presence not only enhance users' perception of product usefulness. In the AR environment, the physical presence of users has become a key factor affecting perception and evaluation. It also significantly increases the experience of enjoyment (such as aesthetic pleasure, exploratory pleasure, etc.). This positive perceptual experience further enhances the comfort of purchasing decisions, making users more confident and satisfied when making purchasing decisions. This provides specific and powerful guidance on how to adjust and optimize ceramic patterns in subsequent designs.

In summary, digital technology is still in its early stages in the field of traditional ceramic pattern design. Although it can provide more innovative design solutions for traditional ceramic patterns to a certain extent, it is mainly limited to the study of the singularity of traditional ceramic patterns. Therefore, it is of great significance to combine traditional ceramic patterns with digital technology and achieve complementary advantages between the two.

3 CONSTRUCTION OF A TRADITIONAL CERAMIC PATTERN INTELLIGENT DESIGN SYSTEM BASED ON BIG DATA STRATEGY AND CAD TECHNOLOGY

3.1 Construction and Design Concept of Intelligent Design System for Ceramic Patterns

Traditional ceramic design mainly adopts the form of pattern design, but with the continuous improvement of people's living standards, traditional pattern design can no longer meet people's aesthetic needs. Therefore, in the process of modern design of traditional ceramic patterns, it is necessary to combine traditional ceramic patterns with modern design. By classifying and extracting traditional ceramic patterns and summarizing and organizing them based on their morphology, color, and other information, a new type of traditional ceramic pattern library is constructed. On this basis, in computer-aided design, corresponding optimization and improvement of the traditional ceramic pattern library are carried out to achieve innovation and development of traditional ceramic patterns. The common ceramic design effect is shown in Figure 1.

This study aims to construct an intelligent design system for traditional ceramic patterns based on big data strategies and CAD technology. The main idea is to extract and summarize the morphology of ceramic patterns, fully integrate computer-aided design technology, and innovate and develop it on this basis.

Figure 1: Common traditional ceramic pattern design effect.

In the process of design, the first step is to extract information, such as the shape and color of traditional ceramic patterns and combine computer-aided design technology to innovate and develop them. Based on this, computer-aided design technology is applied to innovate and develop traditional ceramic patterns. Secondly, in the specific application process, it is necessary to establish corresponding databases based on the morphological and colour characteristics of traditional ceramic patterns, to provide support for the innovation and development of ceramic patterns. Finally, in the innovation and development process of traditional ceramic patterns, different forms and styles of ceramic pattern design can be carried out based on actual needs and combined with different design software. This ceramic pattern intelligent design system also adopts an intelligent training model that can automatically match corresponding design elements according to different design styles. For example, in modern design, computer-aided design technology can be used to combine traditional ceramic patterns with modern design, thereby achieving innovation in traditional ceramic patterns and modern design. When innovating and developing traditional ceramic patterns, it is necessary to classify them and classify them into different categories based on the classification results. Then, computer-aided design technology is used to decompose and combine traditional ceramic patterns of different categories. Finally, corresponding ceramic pattern design renderings were generated based on this, and computer-aided design technology was used to optimize and improve them. Thus achieving innovation and development of traditional ceramic patterns, the entire design workflow is shown in Figure 2.

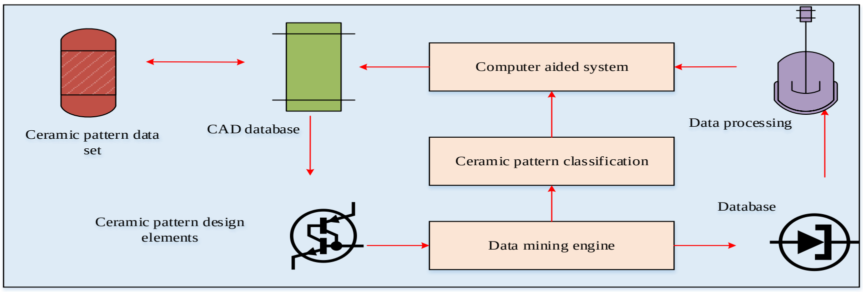

Figure 2: The construction process of an intelligent design system for a ceramic pattern.

3.2 Application of Big Data Strategy in the Intelligent Design System of Ceramic Patterns

The application of big data strategy in the intelligent design system of ceramic patterns. Big data strategy is a means of effectively collecting and analyzing massive amounts of data. In the intelligent design system for ceramic patterns, utilizing big data strategies can help designers discover and record historical information, user feedback, popular trends, and other data during the design process, thereby understanding user needs. In addition, big data can also help designers discover potential problems by recording users' historical behaviour and needs. Big data strategy is an intelligent approach that can help designers achieve an intelligent design process. In this process, designers only need to provide the necessary data for the system through big data strategies. In addition, big data can also predict user needs, trends, and other aspects through data analysis. The computational process in this process is shown in Figure 3.

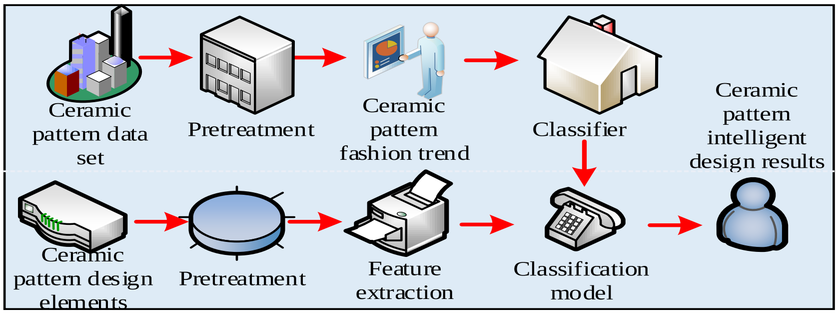

Figure 3: Operation flow of big data strategy in intelligent design system of ceramic pattern.

Firstly, in this ceramic pattern intelligent design system, a neural network model of the ceramic pattern intelligent design system can be constructed by inputting existing massive design data into the training dataset to effectively process and analyze the existing massive ceramic pattern design data. This model can be trained on existing massive design data to obtain a model that can design unknown ceramic patterns. The calculation process in this process is as follows: First, the corresponding superintensity function value needs to be calculated.

$$M(\alpha)=\frac{\eta e^{-\mu\alpha}}{\beta+e^{\alpha}}+e^{\alpha+\eta} \tag{1}$$

Next, after converting the values of the superintensity function, the normalized training value function can be obtained.

$$N(\alpha)=\frac{M(\alpha+1)\sum_{i=1}^{\beta}\alpha_i M(\alpha)}{\alpha+e^{\alpha}} \tag{2}$$

Then it is necessary to perform neural network input sequence solving on it and obtain the solving function and separation function.

$$B(\alpha)=\frac{M(\alpha)}{N(2\alpha)}*\frac{\beta^2\eta\alpha}{\eta+\mu e^{\alpha}} \tag{3}$$

$$C(\alpha)=\frac{\eta\alpha^{e+1}}{\beta+\alpha}+\frac{\mu\alpha}{\beta}+e^{\eta(2\alpha+\mu)} \tag{4}$$

Finally, when it is solved by rounding around the positive direction, its standardized normalization function is.

$$X(\alpha)=\left\|\frac{\sqrt{1+\lambda\alpha^{e+1}}+\sqrt{1+\beta\alpha^{e+1}}}{\beta+\lambda}\right\| \tag{5}$$

During this process, the staff only need to input the ceramic pattern to be designed into the model to complete the relevant steps. The trained model can automatically recognize and extract ceramic patterns, thereby achieving effective processing and analysis of existing design data. In addition, through this system, designers can also select corresponding algorithms for calculation based on user input design requirements. Thus, the construction of an intelligent design system for ceramic patterns was completed, and the simulation analysis results are shown in Figure 4.

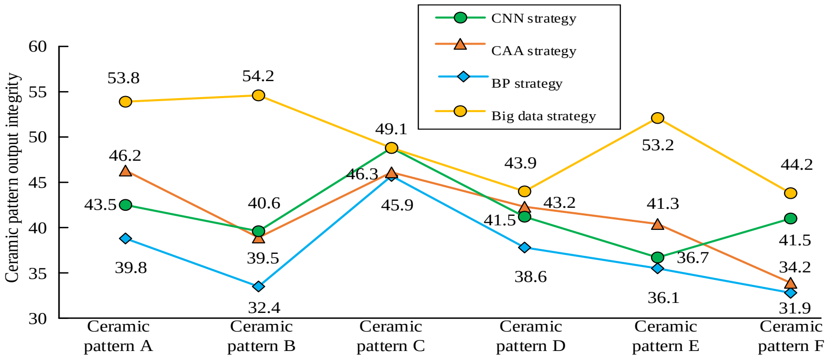

Figure 4: Simulation analysis results of the intelligent design system for ceramic pattern.

Secondly, in this ceramic pattern intelligent design system, a powerful big data intelligent model can be constructed by further analyzing and training these carefully selected design datasets. This model will have the ability to autonomously recognize and extract fine textures and features from ceramic patterns, enabling more efficient automation of pattern processing in the design process. In this process, the application of big data strategies can help designers identify potential problems in the design process and provide solutions for designers. The ultimate goal is to help designers improve their design efficiency, and the relevant calculation process during this process is as follows:

The first step is to calculate the intrinsic training set correlation function

$$L(\alpha) = \frac{\lambda^k \alpha_i + \varepsilon \alpha_{i+1} + \sqrt{\sum_{i=0}^{k-1} \left(\varphi + \alpha_i\right) \varepsilon^{\alpha}}}{\alpha + \beta + \varepsilon} \tag{6}$$

The second step is to perform feature saturation calculation on it, and the corresponding feature saturation calculation process is as follows:

$$K(\alpha) = \frac{\lambda L(\alpha) + \beta M(\alpha)}{\alpha e^{\lambda \alpha} + \beta e^{\alpha}} \tag{7}$$

Step three, solve the time dimension of the input array:

$$J(\alpha) = \frac{K(2\alpha) + L(1-\alpha) + M(\alpha+1)}{\beta} \tag{8}$$

After aligning and training correction, the corresponding model function can be obtained as follows:

$$H(\alpha) = \sqrt{1 + \left\| \frac{\beta J(\alpha) + \alpha^{e+1}}{\lambda} \right\|} \tag{9}$$

Among them, α, α_i are the raw data of different dimensions and η, β the correction coefficient of ceramic patterns. μ Is the calibration coefficient of the neural network, λ, φ is the ceramic data fusion coefficient, k is the normalized constant value, and ε is the perturbation factor.

In addition, big data strategies can also help designers improve their design capabilities. Through the application of big data strategies, designers can transform experience and skills into design materials, thus providing designers with more valuable design resources. The simulation analysis results during this process are shown in Figure 5.

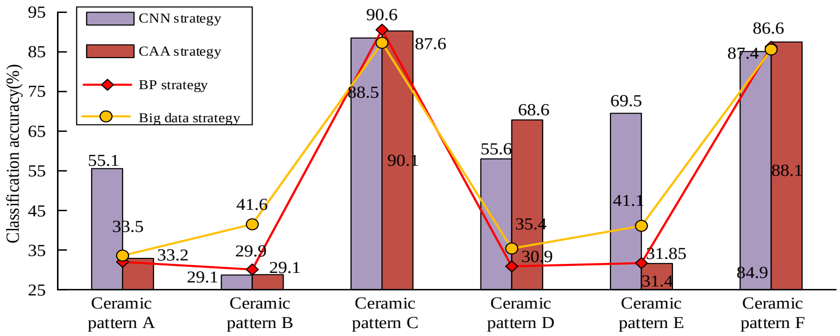

Figure 5: Simulation results of big data strategy in intelligent design system of ceramic pattern.

From Figures 4 and 5, it can be seen that when the intrinsic correlation quantification value is calculated, ceramic patterns that better meet current user needs can be designed based on their intrinsic data correlation. In addition, the intelligent design system for ceramic patterns can also help designers discover potential problems and provide solutions by recording users' historical behaviours and needs. For example, in recording users' historical behaviour and needs, the system can discover information such as users' preferences and changes in preferences, thereby providing designers with more accurate design directions. For example, big data strategies can also help designers gain new inspiration and design ceramic patterns that are more in line with modern aesthetics. In addition, big data can also help designers grasp current trends, providing more accurate directions for ceramic pattern design.

Finally, in this ceramic pattern intelligent design system, the application of big data strategies can also help designers quickly grasp user needs and usage habits, thereby better meeting user needs in the design process. When the system obtains the designer's relevant historical works and design styles, it first solves for their inherent data correlation, and then predicts future development trends based on their inherent data correlation. The calculation steps of this process are shown in the following formulas.

3.3 Application of CAD Technology in the Intelligent Design System of Ceramic Patterns

The existing relevant achievements indicate that the traditional ceramic pattern database established through big data strategy can provide materials for computer-aided design (CAD). CAD technology utilizes the principles of computer graphics, uses CAD software to process materials, simulates human visual perception through computers, and uses 3D virtual models to replace real objects for display. According to user needs, design schemes can be divided into two forms: plan drawings and 3D models, and presented through different CAD software. In the intelligent design system for ceramic patterns constructed by our research institute, traditional ceramic patterns are classified and then 3D-modelled using CAD software to complete the physical production. The calculation process in this process is shown in the following formula.

Firstly, calculate the intrinsic CAD 3D model scaling function

$$P(x) = \lambda x + \beta x_{i+1} + \varphi + x_i e^{x} \tag{10}$$

Secondly, perform feature saturation calculation on it, and the corresponding process for calculating feature saturation is as follows:

$$O(x) = \frac{\lambda P(x) + \beta M(x)}{1 + e^{-x} + e^{x}} \tag{11}$$

If it meets the requirements of 3D modelling at this time, then there are

$$P(x)+e \geq O(x) \quad (12)$$

The corresponding modulus relationship at this time is

$$\left\|\sqrt{1+P^2(x)}\right\|-e \geq \|O(x)\| \quad (13)$$

Among them, x, x_i, x_{i+1} are three-dimensional spatial data, β the correction coefficient of ceramic patterns, and λ, φ the fusion coefficient of ceramic data.

To achieve a digital virtual display of traditional ceramic patterns, this study is based on big data strategy and CAD technology, using database storage, visualization technology, CAD modelling, virtual reality, and 3D printing techniques to build a traditional ceramic pattern design system. Specifically, it can be divided into the following parts:

Firstly, by visualizing the design scheme, different CAD forms are constructed. Then analyze the morphological characteristics of different patterns, and compare different design schemes to divide them into two forms: plan view and 3D model. Then import different floor plans and 3D models into CAD software for virtual display. To facilitate the classification of ceramic patterns in this stage, it is necessary to use relevant theories and techniques of computer graphics to classify ceramic patterns. Different types of traditional ceramic patterns are stored and displayed using different CAD techniques.

Secondly, based on CAD database storage technology, different ceramic pattern structures are stored in the CAD database. After the CAD data package corresponding to the design scheme is determined, the visualization processing of the design scheme is completed using CAD software. In the process of a three-dimensional display of ceramic patterns, CAD modelling technology can be combined to achieve a virtual display of design schemes. Traditional ceramic patterns stored in the database can also be displayed in three dimensions through visualization technology. At this stage, it is necessary to combine CAD software and virtual reality technology to achieve a three-dimensional virtual display of traditional ceramic patterns. The simulation analysis results under different CAD intervention degrees (T=5/15/20/25/30) are shown in Figure 6.

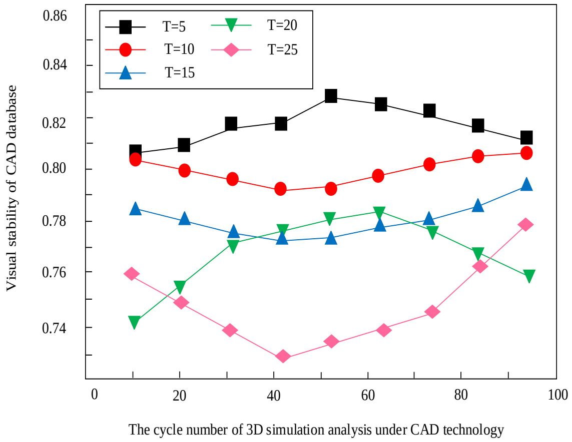

Figure 6: The 3D simulation results of traditional ceramic patterns are realized by combining CAD software and virtual reality technology.

From the results in Figure 6, it can be seen that the CAD database storage technology has a significant improvement effect on the intelligent design system of ceramic patterns. This can be mainly reflected in two aspects: firstly, the ability to display data packets in three dimensions. Secondly, use CAD software to render the data package in 3D. This is because, in this stage, it is necessary to visualize the data stored in the database to obtain graphic image data, and based on this, construct a 3D model of traditional ceramic patterns.

Finally, by combining virtual reality technology with CAD technology, a virtual display of ceramic patterns can be achieved, and the entire design system is completed through 3D printing technology to produce physical objects. The traditional ceramic pattern design system established using big data strategy and CAD technology includes three parts: database storage, visualization processing, and CAD modelling. After visualizing the patterns stored in the database, they are stored in CAD software and combined with virtual reality technology to achieve a virtual display of traditional ceramic patterns.

3.4 Optimization Process of Ceramic Pattern Intelligent Design System Based on Big Data Strategy and CAD Technology

The optimization process of the traditional ceramic pattern intelligent design system is based on big data strategy and CAD technology, which mainly refers to starting from optimizing the overall design process of the traditional ceramic pattern intelligent design system. Improve and perfect the CAD technology and big data strategy currently applied in the system. In the traditional ceramic pattern intelligent design system based on big data strategy and CAD technology, the database management system can effectively organize and manage the data of traditional ceramic patterns and ensure that relevant data information can be updated in real time. In this way, it is possible to avoid the impact of inaccurate data information on the normal progress of design work. Specifically, optimization can be achieved from three aspects.

Firstly, the traditional ceramic pattern intelligent design system based on big data strategy and CAD technology has a certain degree of openness and flexibility. It can manage and update data in real time through a database management system, thereby achieving optimization. At the same time, the traditional ceramic pattern intelligent design system of big data strategy and CAD technology can also be interconnected with other application systems through network interfaces, and the relevant relationships in this process should satisfy the following inequality:

$$\frac{L(\alpha)}{L(2\alpha)} \geq 1+e \tag{14}$$

$$\left\|\sqrt{M^2(\alpha)+L^2(\alpha)}\right\| \geq \frac{\left\|K^2(\alpha)\right\|+\left\|J^2(\alpha)\right\|}{2} \tag{15}$$

Among them, α, α_i refers to raw data of different dimensions. Secondly, the system optimizes the design process of traditional ceramic patterns, providing users with a more convenient and efficient design platform. On this basis, designers of traditional ceramic patterns can integrate their understanding and creativity into it, making traditional ceramic pattern designs more personalized and innovative.

Finally, the intelligent design system for traditional ceramic patterns using big data strategies and CAD technology can also provide a virtual display of traditional ceramic patterns. Users can virtually display traditional ceramic patterns by clicking with the mouse or touching the screen, thus gaining a more intuitive understanding of the design concepts and creativity of traditional ceramic patterns. At the same time, the system can not only achieve three-dimensional modelling of traditional ceramic patterns but also display three-dimensional models through virtual reality technology. It can also perform material analysis and surface treatment on traditional ceramic patterns. Thus, functional analysis and structural design of traditional ceramic patterns can be achieved, and the relevant data of modelling three-dimensional coordinates in this process are shown in Table 1.

Group	*Material analysis parameter*	*Surface treatment parameter*
X1	97.56	9.42
X2	98.56	8.36
X3	99.77	9.39
Y1	86.95	8.41
Y2	88.13	9.62
Y3	87.56	8.92
Z1	82.11	9.37
Z2	78.96	9.12
Z3	81.56	8.96

Table 1: Comparison results of modelling data.

4 ANALYSIS OF EXPERIMENTAL RESULTS AND APPLICATION EXAMPLES

4.1 Experimental Design Process and Experimental Results

Based on data collection in the early stage, this study uses CAD software to process ceramic design data and then conducts big data analysis on the processed data group. The experimental process is divided into three steps: Step 1: Select the CAD scheme corresponding to the four patterns. Step 2: Based on different patterns, design new products with different colours, patterns, and designs through software. The experimental results of the ceramic pattern display are shown in Figure 7. Step 3: Compare and analyze the new product with the original pattern, and the analysis results are shown in Figure 8.

Figure 7: The texture output of ceramic pattern intelligent design system.

From Figures 7 and 8, it can be seen that the four new products have significant differences from the original patterns in terms of colour, pattern, pattern, and pattern effects. Modern ceramic patterns have been innovatively designed based on tradition, giving them richer colours and higher decorative effects, meeting the aesthetic needs of different consumers. This is because all four new products in this experiment were redesigned from their original patterns using a computer. Innovation has been made based on tradition, giving it a higher decorative effect. The original patterns are mainly single-colour patterns, with a single and abstract variety of patterns, which cannot meet the aesthetic needs of different consumers for ceramic patterns. The four new products in this experiment, while retaining the original patterns, were redesigned using plant, geometric, and abstract patterns, giving the ceramic patterns higher decorative effects and richer colours.

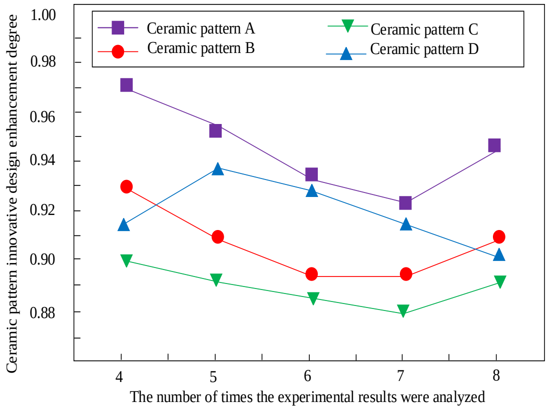

Figure 8: Experimental results of the intelligent design system for ceramic pattern.

4.2 Experimental Results

To further analyze the relevant data of the experimental results, this study conducted a multidimensional analysis of the experimental results, and the statistical data is shown in Table 2.

Group	*Pattern stability*	*Pattern reliability*	*Combined error rate*
1	0.96	0.98	1.8
2	0.97	0.96	1.6
3	0.98	0.96	1.2
4	0.95	0.95	1.7
5	0.94	0.97	1.5

Table 2: Experimental results.

The experimental analysis results are shown in Figure 9.

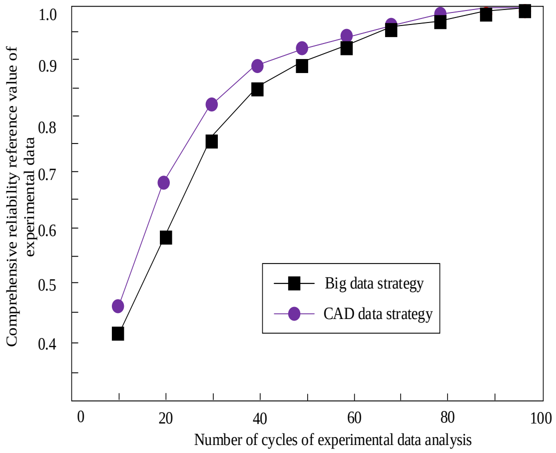

Figure 9: Experimental data analysis results of the intelligent design system for the ceramic pattern.

By analyzing the data results in Figure 9, it can be concluded that the modern design method of traditional ceramic patterns that integrates big data and CAD technology can effectively improve the efficiency and quality of traditional ceramic pattern design. This is because during the experimental process, traditional ceramic patterns are extracted and corresponding databases are established, which can provide designers with more personalized ceramic pattern design solutions. On the other hand, due to the different aesthetic preferences of users, personalized design solutions need to be established based on their needs. Based on this, design was carried out, so in the experimental process, traditional ceramic patterns were extracted from the existing data information in the database, and then the extracted data was classified and processed in the database. Finally, based on this, the existing ceramic patterns in the database were compared and analyzed with the design scheme. Therefore, the improvement effect of the method adopted in this study is more significant.

5 CONCLUSIONS

With the development of modern science and technology, big data and CAD technology are increasingly being applied in fields such as product design, virtual reality, and industrial design, which have had a significant impact on the quality and efficiency of product design. This study utilized database storage, visualization technology, CAD modelling, virtual reality, and 3D printing techniques to construct a modern design system for traditional ceramic patterns based on big data and CAD technology, providing new solutions and methods for the modern design of ceramic patterns. The experimental results show that this method has good applicability to traditional ceramic pattern design. At the same time, the modern design of digital ceramic patterns that integrates big data and CAD technology can also provide certain reference significance for the digital development of other related fields. In the future, this research will be further optimized and improved.

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