

Research Article

Application of Traditional Architectural Decoration Elements in Modern Interior Design Based on 3D Virtual Imaging

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China's long history has produced magnificent culture, and Chinese traditional architecture, as a separate development system, has a long history and distinct style. With the gradual rise of "modern Chinese style" in recent years, architects have been constantly exploring and excavating the rich in humanistic connotation residential space form of traditional folk houses in order to adapt it to the contemporary residential life mode. Human civilization is accompanied by living behavior, and the ideal of living environment is destined to evolve in tandem with human civilization. In recent months, more and more 3D virtual technologies, such as e-commerce, interactive communities, and web games, have appeared in the Internet and construction industry as a result of the advancement of modern network technology. People are attempting to rely on computer networks and virtual reality technology to create a more diverse space environment and enjoy the virtual world's colorful visual feast. The study of how to quickly construct a 3D scene has proven to be very fruitful.

1. Introduction

With the rapid development of modern city construction, the living mode of human beings is undergoing rapid replacement and innovation, and the optimized living environment improves the living quality. However, people's pursuit of living space environment is not only the satisfaction of materialized space, but the pursuit of truly poetic space and cultural connotation [1]. The design concept contained in Chinese traditional architecture, as the material carrier of Chinese excellent traditional art, is a reflection of China's unique cultural accumulation and philosophical thought in building activities [2]. The exploration and practice of "Chinese-style" architecture has never been separated from the history of modern Chinese architecture [3]. Building Chinese garden landscapes, adding symbolic Chinese symbols to architecture, and improving Chinese architecture are all examples of "Chinese-style residential" architecture. The Chinese traditional folk house is a pluralistic and complicated concept [4]. It includes people's perceptions and practices of the environment they live in, as well as the natural and social environment, people's survival, production,

communication, development, and aesthetic requirements for architecture, as well as national and regional characteristics, contacts, and beliefs. Aspects of the mind include psychological and other mental factors. China is a 5000-year-old civilization with a rich culture [5]. Many civilizations and glories have vanished throughout history as dynasties come and go. At the same time, many cultural legacies have been preserved, with architectural elements serving as examples. Traditional architecture has outstanding achievements and a distinct style, and it holds a significant place in world architecture history. However, in today's world, people prefer a more free-spirited lifestyle, and traditional elements are gradually being forgotten. As a result, we should digitize traditional structures and use modern technology to combine modern and traditional architectural methods with three-dimensional virtual imaging technology to create a diverse modern architecture [6].

In recent years, with the rapid development of information technology and computer vision theory, the information related to 3D reconstruction has become an important research direction in the field of computer vision [7]. Especially, due to the defects of manual 3D model construction,

3D model reconstruction technology came into being. At the same time, some 3D modeling software with user-friendly interface has occupied the market in the competition and won a large number of users. Virtual reality technology is a highly comprehensive technology, which involves the fields of graphics and image representation, human-computer interaction technology, artificial intelligence technology, visual and physical perception technology, etc. It uses human as the main body and uses the computer system platform to create vivid visual, auditory, feelings, etc., and can interact with the virtual world [8]. The computer creates an artificial virtual environment, which is a three-dimensional space composed of computer graphics, or compiles other real environments into the computer to create a realistic “virtual environment,” which is a feature of this technology. If all three-dimensional modeling methods are used to create virtual scenes, problems such as high model complexity, large modulus, high computer hardware requirements, and slow response speed in the application of virtual scenes will inevitably arise [9]. Its advancement not only fundamentally alters people’s work and lifestyles but also integrates work and leisure. People work in a fun environment and enjoy themselves while doing so, but virtual reality technology is also linked to modern interior design and traditional architectural elements. People, on the other hand, are more concerned with the combination of practicality and culture. Traditional beauty and modern culture will undoubtedly have limitations, and there will be some unnecessary conflicts and collisions. As a result, encapsulating the Chinese essence in 3D technology is a problem worth investigating right now [10]. First and foremost, we must examine traditional architecture, extracting, reconstructing, and changing elements that conform to modern aesthetics and applying them to the new situation of modern design. Traditional Chinese decorative elements are a unique cultural legacy left by forefathers. They represent our traditional culture by combining “form,” “meaning,” and “beauty.” They contain the original spirit of our ancient nation’s creation and aesthetics, and they cannot be replaced by other art forms [11]. They have a wide range of themes, profound connotations, and diverse forms, bear historical accumulation, contain the original spirit of our ancient nation’s creation and aesthetics, and cannot be replaced by other art forms. Traditional elements in modern applications can only be more rationalized by integrating traditional architecture, and Chinese culture will be passed down, which is of great importance to the construction industry and will bring subversive changes [12].

The world’s countries are becoming increasingly intertwined in their exchanges. Our Chinese nation’s cultural allure draws visitors from all over the world. Traditional Chinese decorative elements have been widely used in the works of top designers in various fields around the world as an important part of Chinese culture. Foreign economy and culture are constantly “invading” China’s vast and ancient territory. In the last decade, China’s housing industry has undergone significant changes in many aspects, including housing system, land system, main body of investment and construction, and consumption concept and

mode, as the country’s urbanization process has accelerated. Modern interior design examines the humanistic value of traditional elements from various perspectives and uses various methods to realize that value. Using three-dimensional virtual imaging technology, this paper investigates modern design and traditional elements and combines the two modeling. Yes, current culture can be developed, Chinese culture can be preserved, and China’s allure can be seen throughout the world.

2. Literature Review at Home and Abroad

Reference [13] recognizes that in the courtyard space of traditional courtyard houses, there are many places worth exploring and analyzing, and there are far too many elements worth referencing and excavating. To emphasize the deep-seated cultural connotation and historical heritage of buildings, the in-depth development of modern Chinese houses should be reflected in the inheritance and expression of the courtyard space of folk houses. According to reference [14], three-dimensional virtual imaging combines natural and artificial beauty in a realistic material space that blends social life, natural environment, and transcendental ideal and is “expected to be feasible” and “can travel and live.” The spirit of traditional residential culture, according to literature [15], cannot be fully realized against the backdrop of modern society. The study is based on the fact that the most important characteristic of urban residential development is commercial behavior, and there is no link between one-step construction and independent residential families, which leads to the finalization of the mode of the external form of bedroom space. According to reference [16], current 3D reconstruction technology has produced many promising research results, but there are still many flaws in 3D reconstruction technology due to its limitations and high requirements for environmental equipment and raw materials. In the requirements of modern architecture, reference [17], three-dimensional technology does not simply stay at the interface from the start. Current technology allows for the creation of comprehensive elements in a short amount of time, with simple, quick, and flexible operation. As shown in document [18], virtual reality technology has greatly improved its feasibility and popularity when compared to the widely used Windows operating system and traditional software technology. It can give people a real sense of interactive experience, so that people can self-explore design and use more freely. Reference [19] proposed that computer-aided design technology organically combines human creative thinking with the high-performance processing ability of computer to realize product innovative design, which is one of the most active research directions in the field of computer application in recent years. Reference [20] shows that interior design is based on the use nature, purpose, environment, and corresponding standards of buildings, using material technology and artistic means to create an indoor environment with reasonable functions, comfort, and beauty, meeting people’s physiological and psychological requirements, making users happy and convenient for production and life. Reference [21] says that virtual reality

technology has been widely used in the construction field, such as building model design, internal decoration rendering, and virtual building internal roaming, which has brought great changes to the technology of the construction industry. Virtual reality technology has become one of the important ways to improve the construction level, avoid major waste, speed up the project progress, and improve the management ability. According to reference [22], virtual reality technology has been widely used in the construction field, which has brought great changes to the technology of the construction industry. Virtual reality technology has become one of the important ways to improve the construction level, avoid major waste, speed up the project progress, and improve the management ability.

To summarize, it can be seen that the construction industry in other countries is still developing faster than in China and that China's development is slow because it started late. Of course, under the influence of western classical architecture, a large number of construction workers used scientific methods to divide and summarize the elements of Chinese classical architecture. Modern techniques have also been used to improve traditional architectural elements. Combining modern and traditional materials is the current trend. The current development trend can also be seen in the above literature review. Now, it is up to us to bring the two together and spread the evolution of ancient culture.

3. Concept and Development of Modern and Traditional Architecture

3.1. Traditional Architectural Elements. What are the elements of Chinese classical architecture? This is a simple and complicated question. However, it can be said for sure that the elements of Chinese classical architecture include two important aspects: emptiness and reality. For the concept of "tradition," different scholars have put forward different interpretations from different disciplines, and some think it is the driving force for the formation of tradition; others think it is the cultural heritage or culture that has been formed [22]. In the process of human social development, the culture of social ideology is the reflection of social background and social development at that time, including social and political background and economic development, which promoted the development of society. Chinese classical architecture is also famous for its unique rammed civil structure system. For this reason, although the elements of Chinese classical architecture alternate with the times and regions and the rise and fall of culture, they must have different times and regional characteristics [23]. China's land is vast expanse, where there are many nationalities, and the topography and people's way of life are different in different places, forming different forms of residential buildings in different places. Among these traditional residential buildings, the quadrangles in Beijing, caves in the northwest Loess Plateau, ancient residential houses in Anhui, Hakka earth buildings in Fujian and Guangdong, and yurts in Inner Mongolia are the most distinctive ones [24]. Traditional building components mainly include all kinds of partitions,

doors and windows, walls, railings, illuminated walls, roofs, gauze partitions, flower covers, beam structures, ceilings, and hanging and falling. Traditional decorative elements are the product of the development of human society, history, and culture. They contain human labor creation, cultural accumulation, and spiritual ideas from ancient times to the present. They condense religion, thought, morality, art, aesthetics, value, social reality, customs, and so on and become the epitome of the times. They are highly decorative and applicable. Because of the regional differences of cultural elements, they form a decorative art system with unique national characteristics [25]. Element system analysis is shown in Figure 1.

The tradition of Chinese classical architecture has a long history, and a large number of architectural relics dating back to prehistoric times demonstrate that China has had a distinct architectural culture since prehistoric times. Chinese architecture has had a profound influence on the architecture of neighboring countries such as Japan, South Korea, and Vietnam, thanks to its unique architectural culture of rammed earth structures. Traditional building components meet practical requirements while also reflecting feminine harmony. The composition density is appropriate, the patterns are rich and colorful, and the simple outline is contrasted with fine details. Both decorative themes and decorative techniques have different characteristics, cultures, and aesthetic tastes, resulting in complex and diverse artistic forms tied to Chinese history and culture. The stages of its development can be roughly divided into three categories: primitive social architecture, slave social architecture, and feudal social architecture. Tradition is a way of doing things passed down from generation to generation in various fields of human activity, a cultural force with normative function and moral appeal to social behavior, as well as the emergence of human creative imagination over time. The cognitive development of traditional architecture is shown in Figure 2.

Tradition, as a social factor passed down from generation to generation and established by convention, also has four major characteristics: first, its universality, which embodies the common material and cultural heritage of a nation and is the carrier and manifestation of human spirit. It frequently appears in the sight of the public and also revolves around the development of everyone's life. For example, evergreen trees at home, cranes, and wishful patterns are all classical symbols. The second is his inheritance. Every ancient culture has been passed down through thousands of years, and it has been passed down by the combination of cultures of different periods. The third is his evolution. From the fire in the dinosaur era to the present, natural gas and gas are all evolutionary processes, which will be adjusted, researched, and developed in every era and spread. Before each dynasty, tribes will continue to absorb each other's essence and derive and develop. The last point is that this kind of culture is not followed by everyone according to specific terms, nor does it mean that there are prescribed cultural models in every era, which all evolved through the development of originality. This is his unwritten nature. Culture is gradually formed by human beings in the process of seeking to understand the way of life, and it is the

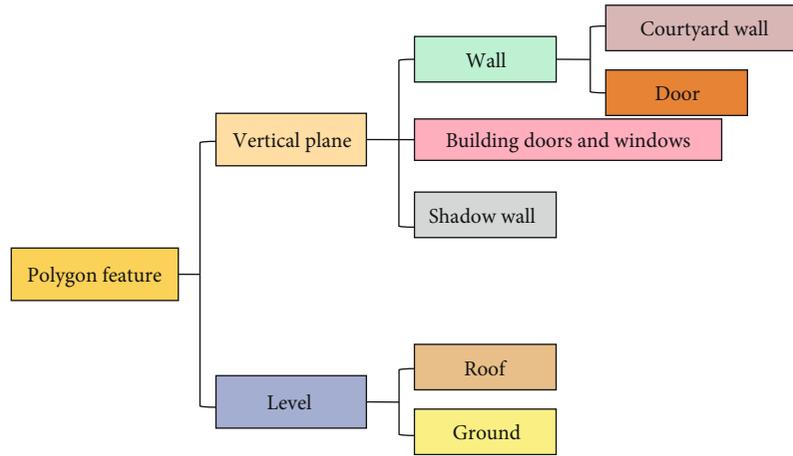


FIGURE 1: Analysis of surface element system.

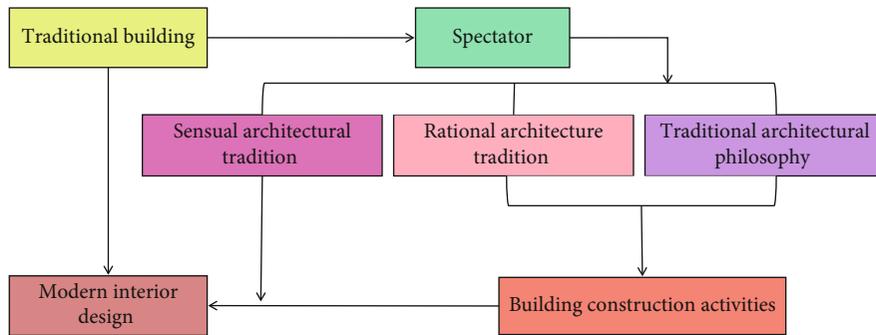


FIGURE 2: The development of cognition of traditional architecture.

spirit of the whole nation. Because of the differences in region, language, and race, it also has its own differences, but at the same time, culture is relatively stable and accumulated, which creates the possibility for inheritance.

3.2. Modern Interior Design Architecture. In today’s world, with the progress of science and technology, smooth information, new cultural knowledge, and ideas are constantly emerging, and traditional culture is shaken by the impact of modern civilization. Since the middle of the last century, the work of building new courtyard houses has been gradually stopped in large- and medium-sized cities in China. Many courtyard houses have appeared in China’s large- and medium-sized cities as a result of social factors such as the elimination of feudal ideas, the study of the Soviet model, and the implementation of a standardized production model. Tradition and modernity have a dialectical relationship: accumulated traditions have tenacious vitality, and some of the rich and colorful traditions will inevitably become indispensable components of the new culture. “High technology brings high emotion,” people will say as the process of modernization continues. People’s demands for diversification are increasing as the world progresses through modernization, thanks to the advances in science and technology. It is self-evident that uniformity and consistency can no longer satisfy modern people’s aesthetic

demands. “Everything can’t be separated from its tradition”; however, any meaningful innovation is based on the tradition of constant change, constant accumulation, and constant metabolism that has evolved to the present day. Diversification necessitates a diverse artificial environment to adapt to it—living space is not the same; people can accept changes in their material lives quickly, but changes in their spiritual lives and customs take time. The popular development trend of modern interior design is shown in Figure 3.

At present, we are stepping into an information and global society. With the rapid development of information transmission speed and methods, the boundaries of world culture are becoming increasingly blurred. Today, simple retro architecture has been difficult to adapt to the development of the times. However, the application of Chinese classical architectural elements extracted from classical architecture in the teahouse space can not only play a purely decorative role but also have cultural inheritance. Many designers strive to use traditional Chinese decorative elements to embody the indoor cultural connotation or natural, harmonious, and humanistic environment in expensive and luxurious Chinese interior designs, especially in residential interiors. Among them, the most important thing is the application of modern materials. With the development of society, the progress of science and technology, and the

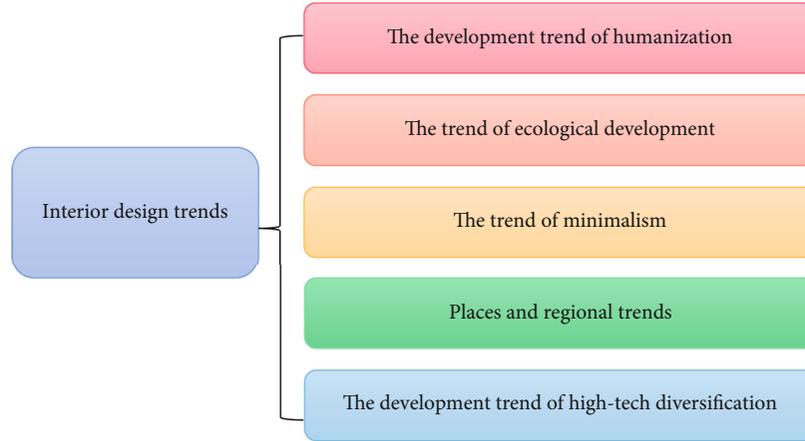


FIGURE 3: The popular development trend of modern interior design.

rapid development of material flow, new materials are constantly emerging. There are both natural materials and artificial materials in nature. In order to inherit history and culture in modern cultural design, traditional elements are the most important. Combined with the above, we can see that materials are also a way to convey emotions. One of the most important natural materials is wood, which can tell powerful stories to users through the ingenious carving way of living alone. However, many modern indoor technologies are plan drawings, which are difficult for ordinary users to understand. Therefore, it is necessary to use 3D virtual imaging to build models, so that buildings have a lot of realism.

3.3. 3D Virtual Imaging Modeling. Virtual reality modeling language is a tool for creating graphics, a simple text language for describing interactive environment, a cross platform language that can publish web pages, and a language that can provide more natural experience, including interactivity, dynamic effect, continuity, and user participation in exploration. It is the latest technology in the computer field. Any complex shape can be represented by the addition and subtraction combination of several simple shapes, or any complex shape can be obtained by the regular set operation between simple shapes. The main 3D reconstruction algorithms include projection reconstruction, affine reconstruction, and Euclidean reconstruction. Firstly, we build a point $P(x, y, z)$ in three-dimensional space, which is expressed as $(x, y, Z, 1)$ in homogeneous coordinates, and the transformed coordinates are $(x^*, y^*, Z^*, 1)$, and the corresponding transformation matrix is 4×4 square matrix of

$$T = \begin{bmatrix} a & b & c & p \\ d & e & f & q \\ h & i & j & r \\ i & m & n & s \end{bmatrix}. \quad (1)$$

Basic transformations make up all complex transformations. The order of transformation matrices cannot be

arbitrarily reversed because matrix multiplication violates the commutative law, so special attention should be paid to the order of transformation. Proportional transformation, symmetric transformation, rotation transformation, translation transformation, and staggered transformation are the most common basic transformations. The most complicated symmetry transformation and rotation transformation formulas are as follows:

$$\begin{aligned} T_{m,xoy} &= \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} & T_{m,xoz} &= \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} & T_{m,yoz} \\ &= \begin{bmatrix} -1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}, & & \\ T_{rx} &= \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos \alpha & \sin \alpha & 0 \\ 0 & -\sin \alpha & \cos \alpha & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} & T_{ry} &= \begin{bmatrix} \cos \beta & 0 & -\sin \beta & 0 \\ 0 & 1 & 0 & 0 \\ \sin \beta & 0 & \cos \beta & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} & T_{rz} \\ &= \begin{bmatrix} \cos \gamma & \sin \gamma & 0 & 0 \\ -\sin \gamma & \cos \gamma & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}. & & & & (2) \end{aligned}$$

These two methods can realize plane symmetric transformation and transformation in different spaces. They can transform two-dimensional, three-dimensional, and even high-level points to another point, which facilitates the transformation of graphics by virtual imaging.

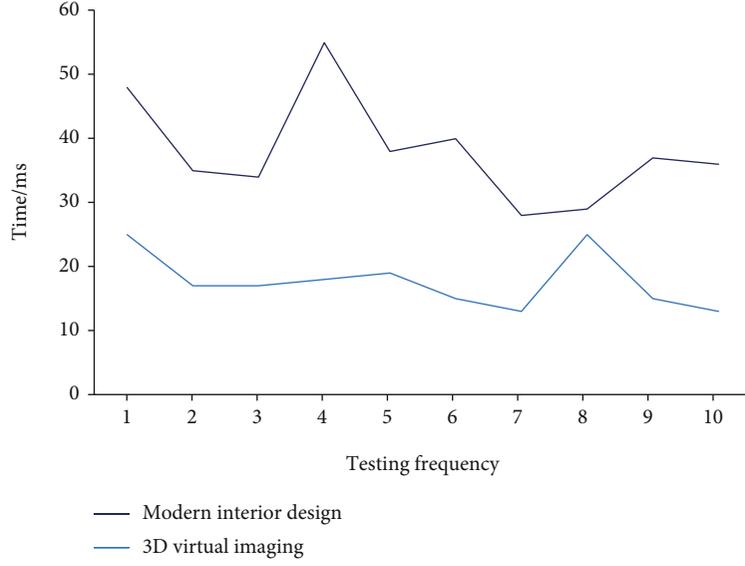


FIGURE 4: Comparison of 3D technology of traditional architecture and interior design architecture.

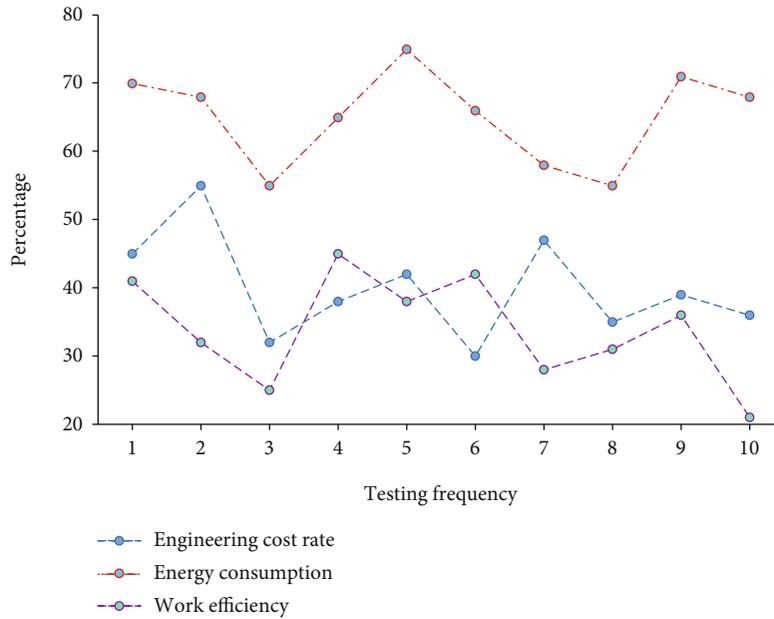


FIGURE 5: Details of modern architectural design.

Next, let us talk about the three-dimensional imaging process. Through the Euclidean motion theory mentioned above, we can clearly explain the three-dimensional and two-dimensional shutdown, and we can also use three-dimensional coordinate points to represent the spatial points. The formula is as follows:

$$X = [X_1, X_2, X_3]^T = \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} \in R^3. \quad (3)$$

For two points P and Q in the space, their coordinates

are X and Y, respectively, and then, the inner product of the two vectors $v = Y - X \in R^3$ in the vector $v, u \in R^3$ space composed of P and Q is expressed as follows:

$$\langle u, v \rangle = u^T v = u_1 v_1 + u_2 v_2 + u_3 v_3, \forall u, v \in R^3. \quad (4)$$

And their cross product is expressed as

$$u \times v = \begin{bmatrix} u_2 v_3 - u_3 v_2 \\ u_3 v_1 - u_1 v_3 \\ u_1 v_2 - u_2 v_1 \end{bmatrix} \in R^{3 \times 3}. \quad (5)$$

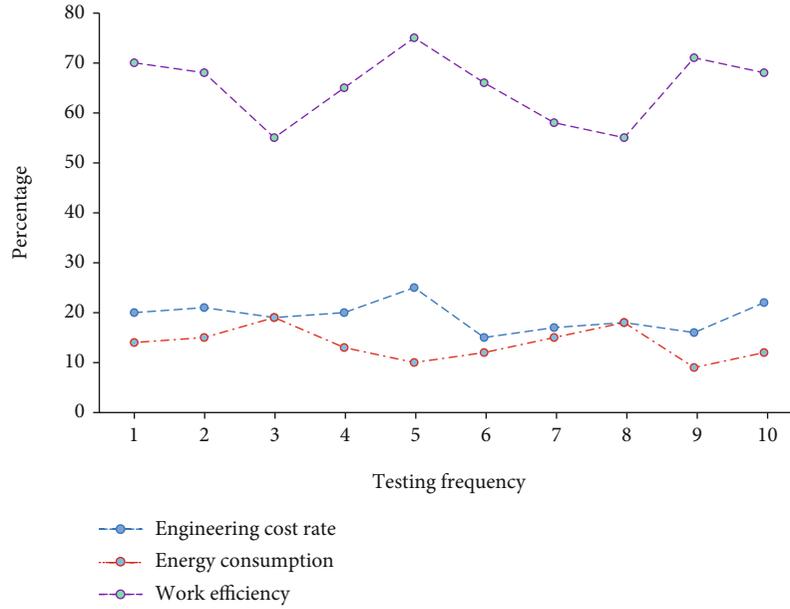


FIGURE 6: Detail of 3D virtual imaging.

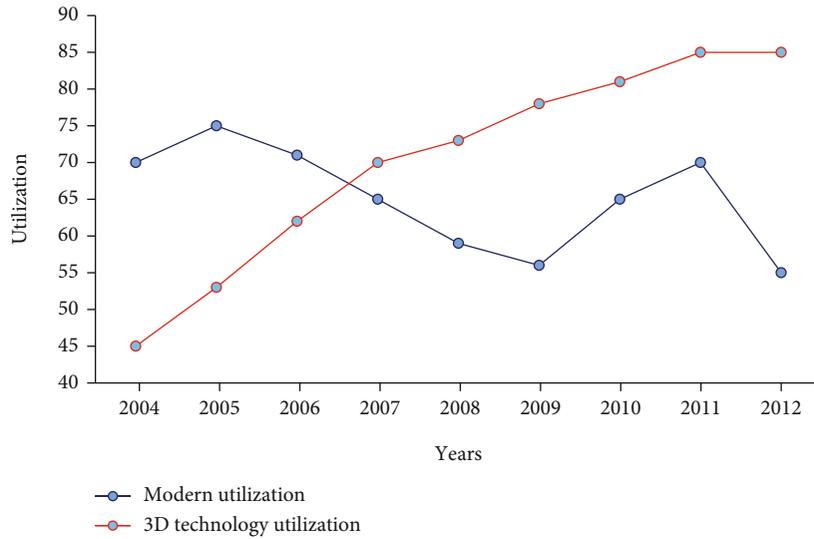


FIGURE 7: Utilization of 3D technology and interior design.

In addition, we define such a matrix $\hat{u} \in R^{3 \times 3}$:

$$\hat{u} = \begin{bmatrix} 0 & -u_i & u_2 \\ u_3 & 0 & -u_i \\ -u_2 & u_i & 0 \end{bmatrix} \in R^{3 \times 3}. \quad (6)$$

Then, the cross product can be directly expressed as $u \times u = \hat{u}v$.

There is a corresponding relationship between 3D pixel coordinate technology and 2D pixel coordinates. Of course, the corresponding relationship needs the above algorithm to calculate the parameters, so as to truly calculate the numerical value of 3D coordinates.

4. Simulation Experiment Test

Three-dimensional virtual imaging technology is a new comprehensive information technology. It integrates the latest development achievements of several branches of information technology, such as digital image processing, computer graphics, artificial intelligence, multimedia technology, sensors, and network and parallel processing technology, and provides strong support for us to create and experience virtual worlds, thus greatly promoting the development of computer technology. In order to verify the authenticity of 3D virtual simulation, the buildings containing elements of traditional architecture are compared with those of interior design, as shown in Figure 4.

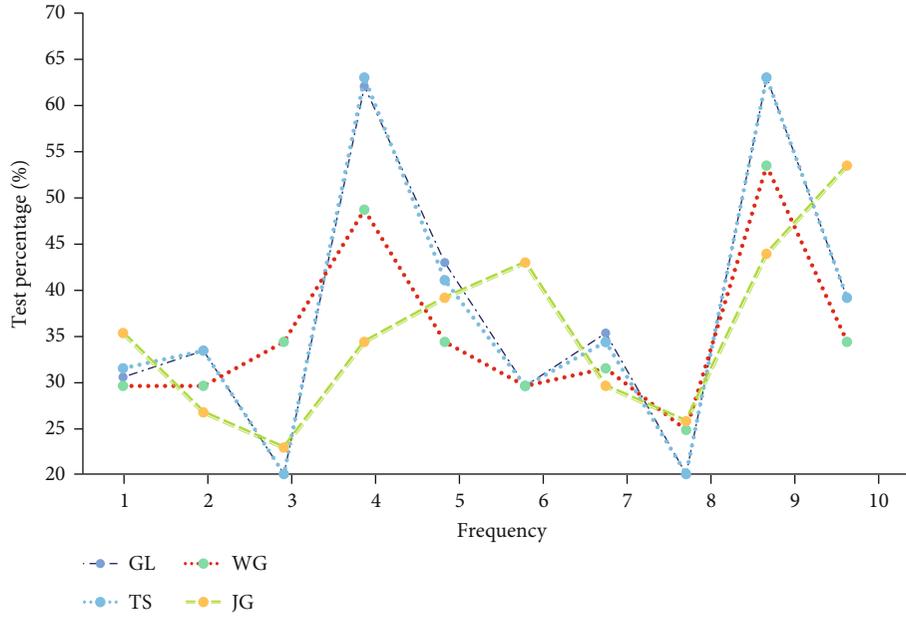


FIGURE 8: Calculation time for three angles.

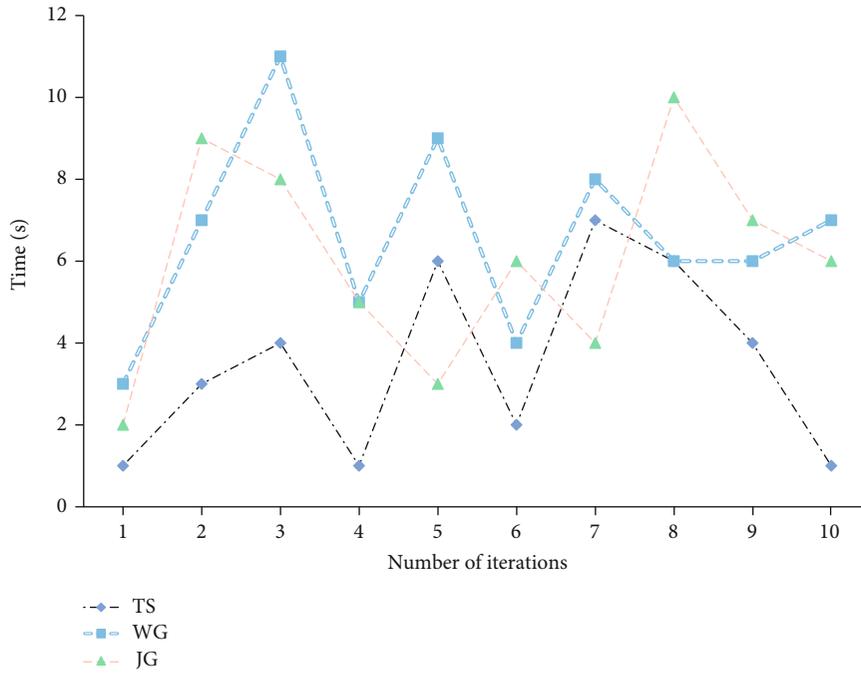


FIGURE 9: Accuracy of three calculations for 3D calculation.

It can be seen from the Figure 4 that the 3D virtual imaging technology mentioned in this paper consumes far less time in the process of drawing than modern indoor technology and has higher processing efficiency. In addition to the research on methods, there are also simulation experiments aiming at the project cost, energy consumption, and operation efficiency, as shown in Figures 5 and 6.

It can be seen from the Figures 5 and 6 that in the process of modern architectural design, the cost rate is too high, the energy consumption is high, the operation efficiency is

low, and the performance is poor to better save time and cost and have higher advantages.

In order to verify the effective use of 3D virtual imaging technology, I integrated the architectural regional environment of modern interior design and used 3D virtual imaging technology to study the combined utilization rate of interior design and interior design buildings, as shown in Figure 7.

It can be seen from the Figure 7 that with the running-in of three-dimensional technology over time, more and more architects have used it, showing the regionality more

realistically, conforming to the modern design, and catering to the public's love.

In fact, in 3D virtual technology, the higher the accuracy of extracted image matching points and the higher the accuracy of 3D virtual imaging of reconstructed 3D model, the more accurate the 3D virtual imaging of optical flow direction angle calculation is. For example, traditional buildings have a saying that the door faces south, and the door facing south can greatly allow the house to receive more light, making everyone more comfortable during the living process. The illumination can be calculated using the three-dimensional imaging spatial transformation algorithm mentioned earlier. However, the market now includes more than just 3D algorithms with multiple angles, such as WebGL's directional angle, perspective angle, and structural scene structure. Each angle will have an effect on the structure. As a result, this paper conducts three types of simulation research on 3D technology. The test results and time of three kinds of calculations are shown in Figures 8 and 9.

In the diagram, GL stands for optical flow direction, and TS stands for a 3D virtual imaging reconstruction method based on augmented reality perspectives. WebGL technology is used to represent a 3D virtual imaging reconstruction method. JG stands for a structured scene-based 3D virtual imaging reconstruction method. The three-dimensional imaging mode of perspective line can be seen in Figure 8 to be more accurate and consistent with the calculated optical flow direction angle. The accuracy is nearly identical, making it more appropriate for modern interior design requirements.

5. Conclusion

The indoor space where people live in real life is the object of concern in many fields, and its design and development involves many fields such as science and technology, humanities, art, and society. It needs some creative and translation skills to interpret. The modern translation of traditional courtyard-style residential space is not a simple imitation or an exaggerated and abstract deformation, decomposition, and reorganization, but a deeper pursuit of exploring the traditional national cultural connotation, philosophical thought, and spiritual factors. With the globalization of the world economy and the rapid development of the information industry, the phenomenon of architectural culture convergence is becoming more and more obvious, which leads to the worrying situation of "one thousand cities." In the future design activities, we must not abandon the traditional Chinese architectural elements that have been associated with tea culture for thousands of years. Chinese traditional decorative elements contain unique cultural connotations and aesthetic habits in the long history of thousands of years in China. They are regional and national, rich in connotation, far-reaching in significance, and of high practical and aesthetic value. At the same time, they also provide valuable design materials for modern interior design. This paper uses the modeling method of 3D virtual imaging technology to combine the design elements of modern interior design with traditional architecture, reorganize

modern materials and ancient culture, attach importance to geography and culture, deduce the meaning of traditional elements, and give new interpretations. Because of the time problem, this paper has not studied it in depth and will continue to study this point in the future.

Data Availability

The data used to support the findings of this study are included within the article.

Conflicts of Interest

The author does not have any possible conflicts of interest.

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