The Application and Innovation of Virtual Reality Technology in Art Creation and Performance

Jie Chen[1] (iD)

[1]Academy of Fine Arts, Anyang Normal University, Anyang, Henan 455000, China, 00813@aynu.edu.cn

Corresponding author: Jie Chen, 00813@aynu.edu.cn

Abstract. Virtual reality technology is a computer-aided technology used for multidimensional simulation. CAD virtual technology is increasingly valued in modern art display and creation. This article highlights the superiority of virtual reality technology by analyzing its application and artistic expression in modern display art. This article constructs a computer-aided visualization platform based on 3D image VR to promote the digital protection of traditional art and the ecological construction of artistic creation and performance. The art creation performance modeling method proposed in the experiment has an accuracy improvement of 27.85% compared to the algorithm model of support vector machine. This system has strong frame tracking ability, clear 3D image reconstruction, and high resolution. Therefore, applying computer-aided VR visualization models to the ecological construction of artistic creation and performance will promote the dissemination and inheritance of traditional art and culture.

1 INTRODUCTION

In modern display art, it no longer solely relies on static display methods such as display boards or cabinets. On the contrary, it utilizes a large amount of multimedia technology to present dynamic and interactive display methods. Viewers can not only view the exhibits from multiple dimensions, but also operate and interact with them, thereby gaining a more direct understanding of the product's functions and characteristics. This modern display technology based on computer-aided multimedia technology has multiple means. Enable users to observe things in the space in real-time like face-to-face and generate various interactive behaviors. The immersion, interactivity, and imagination of VR enable people to immerse themselves in it, forming a multi-dimensional information environment with interactive functions. In modern display art, computer-aided virtual reality technology has only just begun to be applied.

VR utilizes relevant hardware devices to feedback 2D images to users with realistic effects, allowing users to interact with the virtual environment through visual, auditory, and tactile senses,

thereby creating an immersive feeling for users. Baía et al. [1] established an art platform using video conferencing and computer-aided virtual reality. And an interactive experience simulation was conducted on the audience's artistic creation, outlining the online virtual overview survey of artistic creation. Cabero et al. [2] conducted a mixed education augmented reality evaluation of computer-assisted 3D objects. By integrating computer virtual assistance technology into the education process, the artistic expression of augmented virtual reality has been achieved. Chatzimparmpas et al. [3] constructed an interactive visualization enhanced ML model for machine learning. This model enhances its complex application in the field of artistic creation and increases the demand for reliable visualization tools related to trust in ML models. At the same time, this survey is beneficial for visualization researchers whose interests involve making ML models more trustworthy. De Freitas et al. [4] analyzed the availability of computer-aided virtual reality. The process of evaluating the usability and ease of use of virtual reality systems under different conditions. The purpose of usability testing is to identify problems and deficiencies in the system and make improvements to improve its usability and usability. De Luca et al. [5] analyzed the security risks of information dissemination in computer-aided virtual reality. The process of evaluating the usability and ease of use of virtual reality systems under different conditions. The purpose of its usability testing is to identify problems and deficiencies in the system and make improvements to improve its usability and usability.

This article proposes a strategy of art visualization based on 3D image VR to achieve the digital protection, inheritance and growth of Art creation. The main innovations and contributions of this research are as follows:

(1) This article analyzes the lattice cloud information of 3D cloud images and removes image noise through VR and frame synchronization techniques. Research has improved the quality of 3D image design.

(2) In the reconstruction process, adjust the point cloud data to Gaussian normal distribution items, effectively shorten the reconstruction difference between the image foreground and background, and realize 3D image reconstruction.

2   RELATED WORK

Feng [6] simulated the architectural model with CAD virtual technology. Through the analysis of the internal structure and spatial layout, it optimized the teaching of architectural design. Gonzalez et al. [7] conducted an augmented reality reconstruction of cultural customs. A technical system evaluation was conducted to determine whether the use of AR can enhance students' motivation to learn CH related topics. It determines the technical system construction of hybrid reality. Gonz á lez et al. [8] discussed and analyzed the immersive technology of innovative art. Virtual reality technology can help students conduct art design experiments and experiments, improving their practical abilities and creativity. In a virtual reality environment, students can experiment and try more freely without worrying about actual costs and risks. Hui et al. [9] analyzed the scene characteristics of using CAD virtual reality technology in animation production. For example, in character animation production, CAD virtual reality technology can be used to create character motion trajectories and special effects, thereby improving the effectiveness and quality of animation production. The research results of Kaimal et al. [10] indicate that the development of visual expression based on virtual reality has unique visual expression and artistic imagination response. By exploring and analyzing the unique characteristics of art therapy, virtual reality can bring a strong sense of mental health and happiness. The application of CAD virtual reality technology in artistic creation is very extensive. Virtual reality art works are digital art works created using virtual reality technology. By using CAD virtual reality technology, more realistic and refined virtual scenes and characters can be created on computers, thereby achieving richer artistic expressions. Kim and Lee [11] examine the motivations and consequences of using CAD virtual reality technology to view 360-degree VR art. The results indicate that in role-playing, CAD technology can be used to create more realistic and fluid game scenes and characters.

Lei et al. [12] evaluated CAD virtual systems using system evaluation and meta-analysis. Introduce students into a virtual art world, allowing them to express their thoughts and emotions through shaping artistic images. At the same time, you can also appreciate more art works and improve your artistic aesthetic ability. Liu and Phongsatha [13] utilized CAD virtual assistance to enhance students' ability to perceive and imagine images. Teachers must use various vivid and interesting teaching aids. The use of computer multimedia assisted teaching can enhance the fun of teaching and help teachers better impart knowledge. Immersive virtual reality, as a visual art education, can provide a richer artistic context. Further enhance students' practical abilities and creativity, stimulate their learning enthusiasm and imagination, and promote the popularization and diversification of art education. Paatela [14] uses immersive art education to provide a more vivid and realistic artistic experience. Encourage students to actively participate in artistic creation and design, and stimulate their learning enthusiasm and imagination. Sansom and See [15] explored the application of computer-aided virtual reality technology in art appreciation teaching. This can enhance students' artistic appreciation ability and learning interest, while also enhancing the fun and effectiveness of teaching. Shi and Niu [16] introduced realistic simulation technology and its practical applications. In environmental art teaching, realistic simulation technology can be used to simulate the actual environment, allowing students to experience the real environmental space through virtual reality technology, which can better understand spatial design and composition, and master relevant skills.

3   METHODOLOGY

3.1   The Application Value of VR in Art Creation

Computer assisted virtual reality technology is consistent with many artistic expression characteristics in creating atmosphere. In computer-aided art creation, more and more digital media artworks are highly intuitive in expression, and creators hope that their works can be disseminated and appreciated more quickly. With the development of network technology, more and more artists have found that using network technology can make their artworks more vivid. In addition, artistic creations based on computer-aided virtual system technology present authentic and interactive works of art. We obtain real sensations and perceive things through senses such as sight and smell. Artistic works based on computer-aided virtual reality technology use human text, allowing viewers to immerse themselves in the artwork and further experience it.

Computer assisted virtual reality can bring new interactive experiences to the audience. The purpose of data visualization is to "let the data speak", so that the graphically designed data can help people more easily feel the characteristics and rules behind it, thus helping people to design data visualization in an important computer-assisted VR environment. It images every item of data in the database and combines and structures these images into a complete data image. Through computer-aided interaction design, people can interact with data to meet the needs of different observation dimensions. The three-dimensional interactive model for the digital protection and utilization of art resources in artistic creation is shown in Figure 1.

In terms of cultural development, artistic creation is an important cultural treasure in China. The neglect in recent years has led to the loss of traditional culture. With the participation and production of computer-aided VR systems, the cultural heritage of artistic creation will become increasingly rich. In the actual computer-aided data visualization design art, it is still abstract to find a balance between aesthetic design and rigorous data. This requires long-term joint polishing of data visualization design in different fields to provide people with corresponding experience. Through the application of computer-aided VR, the growth of artistic creation will be smoother, the dissemination speed will accelerate, the audience will expand, and the commercial value will expand.
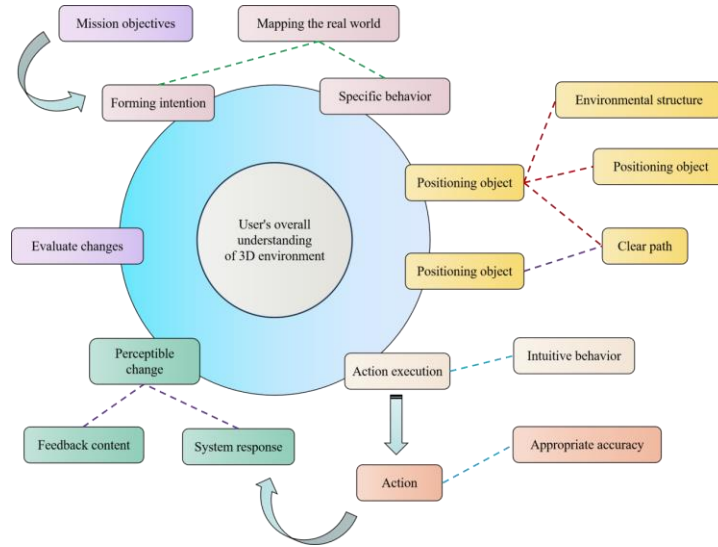
Figure 1: Three-dimensional interactive model of digital protection and utilization of Art creation artistic resources.

3.2 Computer Aided VR Visual Modeling for Artistic Creation and Performance

In the current situation of promoting cultural development, traditional art enjoys many favorable policies, such as promoting excellent traditional culture, promoting the protection of intangible cultural heritage, and flourishing literary and artistic creation. However, due to its shortcomings in expression and communication methods. With the changes of the times, a major issue faced by artistic innovation is how to inherit and carry forward the traditions of national art, making it shine with new brilliance. The functional framework of the 3D image reconstruction system is shown in Figure 2. During the display process, multi angle analysis of 3D images can be achieved through movement, rotation, and other methods. In computer-aided virtual reality environments, users need to use actions to interact with the scene, thereby affecting the content of the scene. Users can apply sensing technology to enter virtual environments, creating an immersive experience that further enhances the realism of computer-aided VR technology.

As a representative technology of emerging digital media, VR gives full play to the characteristics of virtual world, such as flexibility, vividness and rapidity, and can be used as a brand-new form to introduce the traditional art of art, thus opening up a brand-new chapter for the growth of art.

$$N = \frac{\sum n_k a_k}{\sum a_k} \tag{1}$$

$$n = \frac{N}{|N|} \tag{2}$$

$$x = \frac{\sum x_k a_k}{\sum a_k} \tag{3}$$

$$d(P,TM) = \min\left(d(P,X)\right) \tag{4}$$

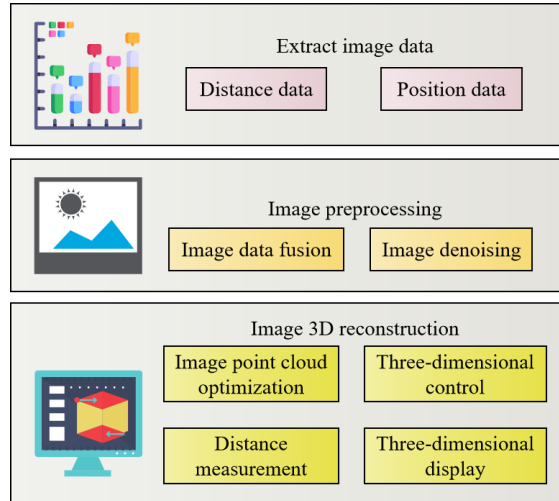$$n_i \quad (i = 1,2,3,\ldots,k) \tag{5}$$

Figure 2: 3D image reconstruction system based on VR.

Define the normal vector of vertex P as the average of all triangle normal vectors around it, and n_p represents the normal vector of vertex P, then:

$$n_p = \frac{1}{k}\sum_{i=1}^{k} n_i \tag{6}$$

Normalize it:

$$n_p = n_p / |n_p| = \frac{n_{px}\vec{i} + n_{py}\vec{j} + n_{pz}\vec{k}}{\sqrt{(n_{px})^2 + (n_{py})^2 + (n_{pz})^2}} \tag{7}$$

By matching the position of artistic creation performance in real scenes and the three-dimensional coordinates in computer-aided virtual scenes. It can be more closely combined with artistic creation performance and scene environment. In order to ensure the real-time display of virtual museum scenes, it is necessary to optimize the scene model, and computer-aided scene loading and scheduling management are the key to solving this problem. The CNN based VR modeling system for artistic creation and performance is shown in Figure 3.
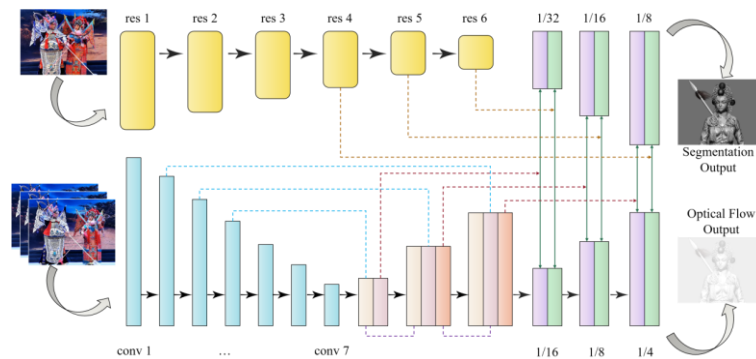

Figure 3: VR modeling based on CNN.

Using computer-aided VR, frame synchronization, and fusion of original point cloud data to achieve point cloud information fusion of original point cloud images. The study analyzed the original point computer-aided cloud map. At the same time, the preprocessed point cloud data was preprocessed using median filtering technology. The output value after preprocessing is:

$$\psi_{i,j} = median\big[\Lambda_{i+m,j=n}; (m,n) \in w\big]\big\{\Lambda_{ij}; (i,j) \in Z^2\big\} \tag{8}$$

Drama and virtual reality have some similarities. Virtual reality will create a parallel space, while drama simulates a fixed scene, a virtual environment, and tells a virtual story through specific people and behaviors, which is highly compatible with virtual reality itself. Many hotspots can be formed in VR theaters, VR drama education, or traditional craft protection related to drama. By strengthening the interaction between computer-aided VR and art, the one-way linear relationship between media and users can be effectively changed. Form a comprehensive content dissemination, making information dissemination more natural. The virtual environment architecture of virtual reality is shown in Figure 4.
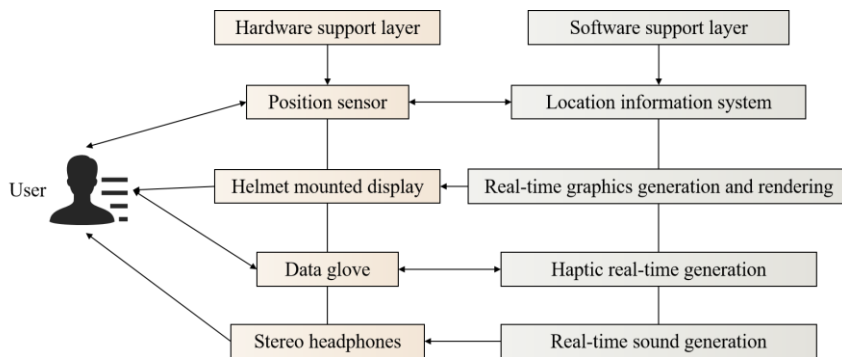

Figure 4: Virtual environment architecture.

4   RESULT ANALYSIS AND DISCUSSION

With the development of the times, digital technology has greatly changed people's old understanding of art. It not only does not affect people's understanding and pursuit of art, but also leads the sustainable development of art with new concepts, dimensions, and levels. The unique charm of art itself also affects the development and application of virtual reality. As an experimenter, the most important experience in virtual reality is to feel the content that you can personally participate in and relate to, and art can provide such a source of ideas for virtual reality. In order to verify the effectiveness and practicality of the interactive computer-aided virtual reality system in this article, this section conducted computer-aided testing and analysis of the system's performance. Figure 5 shows the consumption time of art image retrieval with different numbers of nodes.

Figure 5 shows the time consumption of image retrieval. With the help of VR network carrier and various media methods, a new contemporary culture is created, which is also the biggest difference between VR and traditional art. Its artistic expression is sublimated after absorbing the wisdom of different nationalities and groups, and it can be used as the carrier of cultural inheritance. Through digital experiential expression, the audience can have a strong 3D animation demonstration experience that simulates the real environment. Using character animation to simulate the real environment can simulate the movement trajectory and body structure of characters, making the animation more realistic. Through the above methods, an artistic 3D animation demonstration of a real environment can be simulated, allowing the audience to have a

deeper understanding and experience of the realism and details of the virtual environment. The interactive scoring results of the system are shown in Table 1 and Figure 6.
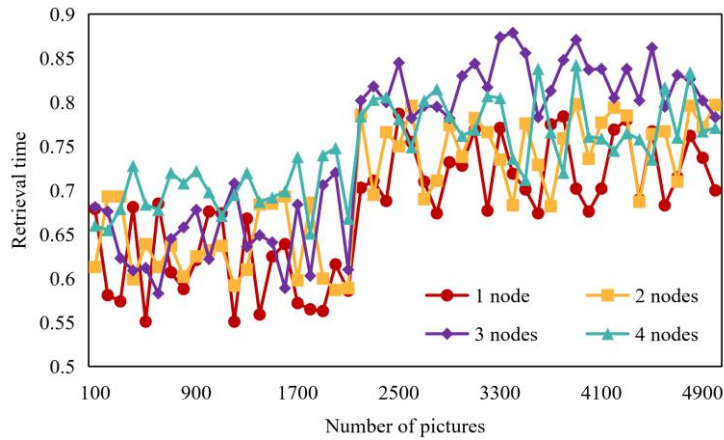

Figure 5: The consumption time of art image retrieval with different numbers of nodes.

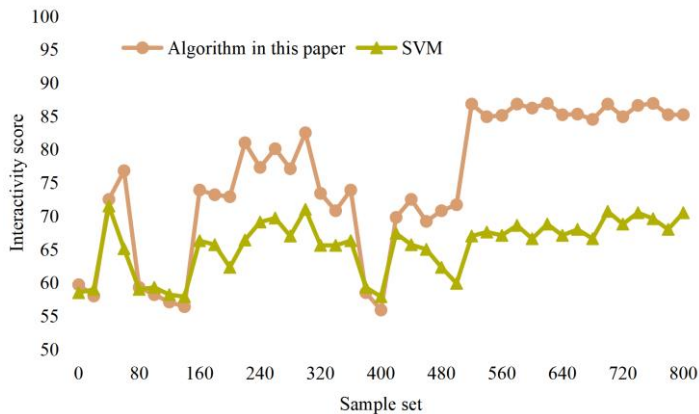| Sample set	Algorithm in this paper	SVM
20	58	59
40	72.5	71.5
60	76.8	65.1
80	59.3	59
100	58.2	59.3
120	57.1	58.2
140	56.4	57.9
160	73.9	66.3
180	73.2	65.7
200	72.9	62.3

Table 1: System interactivity score.

Figure 6: System interactivity score.

The experience change from the audience to the stage not only brings about a change in the audience's experience effect, but also enables the audience to appreciate the charm of art art at a close distance, and more importantly, it brings about a change in the stage performance of art. Such changes have different requirements for actors' performances, so that actors must constantly adapt their own performance characteristics, especially the emphasis on detailed movements, and be prepared to accept the audience's close appreciation. Such changes will inevitably have a certain impact on the stage performance of traditional Chinese art. Table 2 and Figure 7 show the subjective assessment test results given by observers on VR images of Art creation performances.

Sample set	Methods in this article	SVM
1	9.5	8.6
2	9.3	7.5
3	9.6	7.9
4	9.3	8.5
5	9.7	7.1
6	9.4	7.6
7	9.2	8.1
8	8.9	7.8
9	8.8	7.4
10	9.2	7.8

Table 2: Observers' subjective assessment of VR images of Art creation performances.
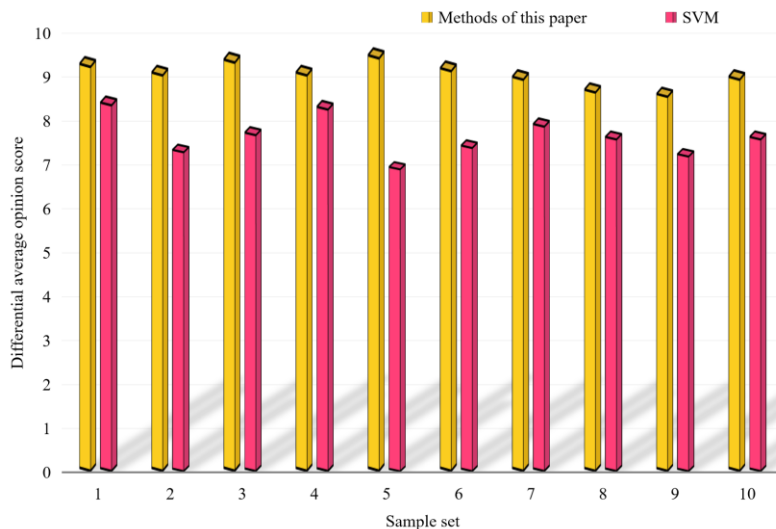

Figure 7: Subjective assessment of VR images of Art creation by observers.

Traditional arts and crafts, skills, etc. can be passed down from generation to generation, and these arts and cultures have been passed down to this day.

In this kind of performance, because there is a certain physical space distance between the audience's seat and the stage, what the audience appreciates is more about the performance of the actor's figure and the ups and downs of the plot, and more performance details of the actor are not the key points. Figure 8 shows the comparison of modeling accuracy of different algorithms.
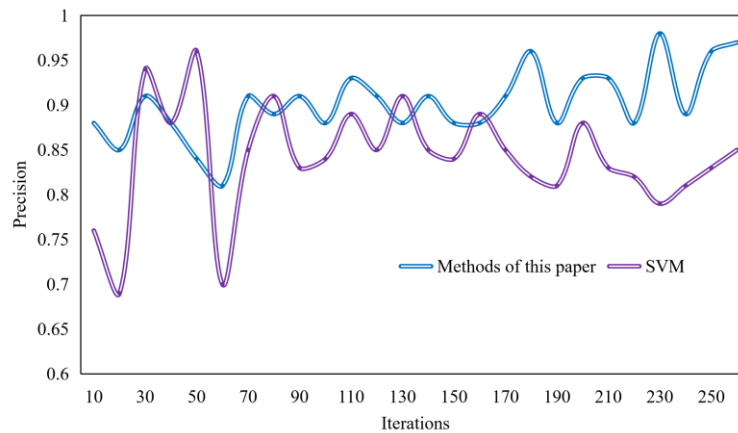
Figure 8: Accuracy results of different algorithms.

The results of this article indicate that the proposed performance model can maintain high VR clarity. This effectively solves the problem of artistic creation algorithms in stereo images. Compared with the SVM algorithm, the algorithm model in this paper has the highest efficiency, improving by 27.85%. The study extended the rendering details of the model scene to meet the real-time and immersive needs of the scene, and compared and analyzed image processing using different methods. As shown in Figure 9.
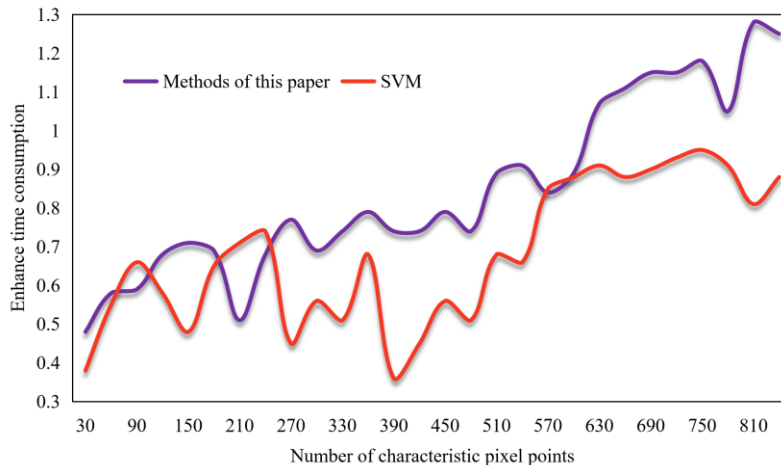

Figure 9: Time-consuming comparison results of enhanced image processing effects of different methods.

From Figure 9, it can be seen that more information pixels are displayed, which makes the processing effect of artistic performance images stronger and stronger. The VR digital image quality proposed in this article is also constantly improving, which has strong advantages compared to SVM. As a typical application of modern digital media technology, VR is organically combined with traditional art, relying on digital programs for new art design, which makes the reproduction and secondary processing of traditional art simpler and more efficient. On the one

hand, VR makes the creator's creation easier and faster, while on the other hand, the art and culture it shows are displayed in more and wider fields in a more real and rich state.

5   CONCLUSIONS

VR simulates a virtual environment through a computer three-dimensional simulation system, realizes the combination of virtual and reality, and makes people immerse themselves in it and experience real feelings in the virtual world. Because of these characteristics, it is possible to combine the traditional art form of China art with the advanced VR. This article puts forward the visualization strategy of art based on 3D image VR to realize the digital protection, inheritance and growth of Art creation. VR based 3D image reconstruction in art creation is one of the applications of VR technology in art creation. In VR technology, scene modeling is the most crucial step as it determines the realism and details of the final virtual scene. Traditional modeling methods typically require the use of professional 3D modeling software. But this software require a lot of time and effort, and the built models need to be adjusted and optimized in the later stage, otherwise there may be problems such as inaccurate models and uneven lighting. This article designs a VR based 3D image system for artistic creation, which utilizes filtering technology and inverse noise analysis of artistic images. VR based 3D image reconstruction technology can directly extract 3D information of the scene from 2D images from multiple perspectives, and then convert the 2D image into 3D model through projection, transformation and other algorithms in computer graphics. The research results indicate that the artistic creation images proposed in this article have relatively high image clarity, effectively solving the problems of image clarity and stereoscopy. Combining VR with local art communication can enrich the means of communication, promote international communication, and promote the inheritance, protection, innovation and growth of local art from the means of communication, while retaining the creative law of art art itself.

Jie Chen, https://orcid.org/0009-0000-1464-1157

REFERENCES

[1]   Baía, R.-A.; Ashmore, M.: From video streaming to virtual reality worlds: an academic, reflective, and creative study on live theatre and performance in the metaverse, International Journal of Performance Arts and Digital Media, 18(1), 2022, 7-28. https://doi.org/10.1080/14794713.2021.2024398
[2]   Cabero, A.-J.; Llorente, C.-C.; Martinez, R.-R.: The use of mixed, augmented and virtual reality in history of art teaching: A case study, Applied System Innovation, 5(3), 2022, 44. https://doi.org/10.3390/asi5030044
[3]   Chatzimparmpas, A.; Martins, R.-M.; Jusufi, I.; Kucher, K.; Rossi, F.; Kerren, A.: The state of the art in enhancing trust in machine learning models with the use of visualizations, In Computer Graphics Forum, 39(3), 2020, 713-756. https://doi.org/10.1111/cgf.14034
[4]   De Freitas, F.-V.; Gomes, M.-V.-M.; Winkler, I.: Benefits and challenges of virtual-reality-based industrial usability testing and design reviews: A patents landscape and literature review, Applied Sciences, 12(3), 2022, 1755. https://doi.org/10.3390/app12031755
[5]   De, L.-V.; Gatto, C.; Liaci, S.; Corchia, L.; Chiarello, S.; Faggiano, F.; De, P.-L.-T.: Virtual Reality and Spatial Augmented Reality for Social Inclusion: The "Includiamoci" Project, Information, 14(1), 2023, 38. https://doi.org/10.3390/info14010038
[6]   Feng, C.: An intelligent virtual reality technology in the teaching of art creation and design in colleges and universities, Journal of Intelligent & Fuzzy Systems, 40(2), 2021, 3699-3710. https://doi.org/10.3233/JIFS-189404
[7]   Gonzalez, V.-J.-C.; Fabregat, R.; Carrillo, R.-A.; Jové, T.: Survey: Using augmented reality to improve learning motivation in cultural heritage studies, Applied Sciences, 10(3), 2020, 897. https://doi.org/10.3390/app10030897

[8] González, Z.-M.-D.; Abad, S.-E.: Implications of virtual reality in arts education: Research analysis in the context of higher education, Education Sciences, 10(9), 2020, 225. https://doi.org/10.3390/educsci10090225

[9] Hui, J.; Zhou, Y.; Oubibi, M.; Di, W.; Zhang, L.; Zhang, S.: Research on art teaching practice supported by Virtual Reality (VR) technology in the primary schools, Sustainability, 14(3), 2022, 1246. https://doi.org/10.3390/su14031246

[10] Kaimal, G.; Carroll, H.-K.; Berberian, M.; Dougherty, A.; Carlton, N.; Ramakrishnan, A.: Virtual reality in art therapy: a pilot qualitative study of the novel medium and implications for practice, Art Therapy, 37(1), 2020, 16-24. https://doi.org/10.1080/07421656.2019.1659662

[11] Kim, Y.; Lee, H.: Falling in love with virtual reality art: A new perspective on 3D immersive virtual reality for future sustaining art consumption, International Journal of Human–Computer Interaction, 38(4), 2022, 371-382. https://doi.org/10.1080/10447318.2021.1944534

[12] Lei, Y.; Su, Z.; He, X.; Cheng, C.: Immersive virtual reality application for intelligent manufacturing: Applications and art design, Mathematical Biosciences and Engineering, 20(3), 2023, 4353-4387. https://doi.org/10.3934/mbe.2023202

[13] Liu, P.; Phongsatha, S.: Application Research on Enhancing the Cognitive Ability of Art Appreciation of Senior High School Students in Chengdu through Virtual Reality Technology, International Journal of Innovative Research and Scientific Studies, 5(3), 2022, 236-248. https://doi.org/10.53894/ijirss.v5i3.676

[14] Paatela, N.-M.: Remixing real and imaginary in art education with fully immersive virtual reality, International Journal of Education through Art, 17(3), 2021, 415-431. https://doi.org/10.1386/eta_00077_1

[15] Sansom, M.; See, Z.-S.: Translating performative mediated art into virtual reality: A case study, Virtual Creativity, 11(1), 2021, 53-65. https://doi.org/10.1386/vcr_00042_1

[16] Shi, H.; Niu, D.: Application research of virtual reality technology in ocean environmental art design, Journal of Coastal Research, 104(sp1), 2020, 296-301. https://doi.org/10.2112/JCR-SI104-054.1