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Innovative Algorithm of Immersive Artistic Experience Integrating CAD and Virtual Reality

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Abstract. With the continuous development and application of technology, immersive art experience will become an important trend of art exhibition in the future. This paper aims to combine CAD (Computer Aided Design) and VR (Virtual Reality) technologies to propose an innovative immersive art experience algorithm. Firstly, this paper introduces an improved discrete algorithm, which realizes a highly realistic immersive experience through accurate character modeling and environment rendering technology. Secondly, in view of the shortcomings of traditional VR technology, this algorithm introduces a variety of sensory feedback design, including vision, hearing and touch, so as to further enhance the user's immersion experience. The results show that the stability of the algorithm can basically be maintained at about 90% when the data set is large. This high stability is very important in many application fields. In addition, compared with the existing technology, the immersive art experience innovation algorithm proposed in this paper has significant advantages in real-time and user experience. User feedback shows that the algorithm can provide a more realistic and vivid artistic experience, and effectively improve the effect and attraction of artistic display.

Keywords: Computer Aided Design; Virtual Reality; Immersive Artistic Experience; Discrete Algorithm; Innovate
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1 INTRODUCTION

In today's era of rapid growth of digital technology, people's demand and pursuit for artistic experience is also growing. By using digital models, Banfi [1] can more accurately simulate and predict the physical characteristics, structure, and performance of buildings. In addition, digital models also provide an interactive platform for the public to evaluate and provide feedback on architectural design in a virtual environment. This interactivity not only enhances public participation, but also provides valuable feedback to designers to help improve and optimize design solutions. The

application of VR in architectural culture has brought a new immersive experience. By utilizing VR technology, the public can explore buildings in a virtual environment and appreciate their aesthetics and functionality from different perspectives and perspectives. This experience not only allows the public to better understand architectural design, but also helps them identify and solve potential problems before actual construction. In addition, VR technology provides designers with a platform to test and validate design concepts, thereby accelerating the design process and reducing costs. Traditional art exhibition methods, such as galleries, museums and theaters, can meet the needs of some audiences, but they can't cover everyone. With the introduction of CAD and VR technology, the boundary of artistic experience has been completely broken, and a brand-new immersive artistic experience is quietly emerging. Computer aided design (CAD) plays an important role in industrial design education. It can help students more accurately simulate product performance, conduct virtual testing, and optimize design solutions during the design process. Specifically, CAD software can be used for the production of digital models, virtual reality technology, and digital manufacturing. Digital modeling is one of the core functions of CAD software, which can help students quickly and accurately construct, modify, and evaluate design solutions during the design process. Virtual reality technology can enable students to experience design results in a three-dimensional environment, better understanding design intent and performance. Digital manufacturing is a key step in transforming design into actual products, which can be achieved through technologies such as computer numerical control (CNC) machine tools and 3D printing. Bernardo and Duarte [2] immersive virtual reality technology can provide an immersive learning experience that enhances students' interest and engagement in learning. For example, by using virtual reality technology to simulate the entire process of product design, students can master the knowledge and skills of various stages in practice. This kind of experience can not only make the audience perceive and understand the works of art in a more vivid and intuitive way, but also realize the interaction between the artist and the audience, thus enhancing the audience's artistic experience and sense of participation. In today's digital age, the importance of information literacy and creative thinking is becoming increasingly prominent. As an important platform for innovation practice and cross-border cooperation, Maker Space provides people with an opportunity to transform their imagination into reality. The continuous development of digital image technology has made it possible to combine information literacy with fiber art pattern design. Carmen [3] explored how to apply digital image technology to the teaching practice of information literacy and fiber art pattern design through maker spaces. Maker space provides a good platform for the practice of digital image technology. Digital image technology refers to the use of computers or other digital devices for image processing and analysis. This technology can be applied to the field of fiber art pattern design, providing more possibilities for maker spaces. Digital image technology can be applied to various aspects of fiber art pattern design. Firstly, computer-aided design software can quickly generate various complex patterns, providing more creative resources for creators. In addition, digital image technology can also digitize traditional fiber art patterns for more accurate analysis and redesign.

Immersive artistic experience refers to letting the audience completely immerse themselves in the creative environment and feel the emotions and atmosphere expressed by works of art in the most intuitive and vivid way. The Multi User Virtual Reality Art Therapy (VRAT) system is an innovative treatment approach that provides art therapy services to patients through virtual reality technology. Chung et al. [4] explored the application of user centered design in VRAT systems to ensure that the system meets the needs of both patients and artists. For patients, they need to feel safe, comfortable, and supportive in order to freely express themselves in a virtual reality environment. In addition, they hope to receive feedback and guidance during the treatment process, in order to better understand their creative process and gain growth from it. For artists, they need to have sufficient flexibility to adapt to the needs of different patients. In addition, they should be able to provide positive feedback and guidance to help patients gain more confidence and expression in the artistic creation process. Utilize virtual reality technology to provide patients with a safe and immersive artistic creation environment. Through virtual reality, patients can perceive and interact in new ways, stimulating their creativity and self-expression. Interaction between art therapists and patients: To ensure the effectiveness of treatment, art therapists need to interact in real-time with

patients in a virtual environment. This includes providing creative suggestions, guiding patients to express their thoughts and emotions, and providing feedback. It breaks the space and time limit between the audience and the works of art, and enables the audience to immerse themselves in the world of art anytime and anywhere and feel the charm and emotion brought by art. At present, immersive artistic experience has become a hot topic. Deng et al. [5] used VR technology to design a 3D modeling system for tourism product CAD. Virtual reality technology is a computer technology that can create and experience virtual worlds. It simulates human auditory and tactile senses, allowing users to immerse themselves in a highly realistic virtual environment. In the field of tourism, VR technology can be used to showcase tourism products, simulate tourism experiences, and even build virtual tourist attractions. Through VR technology, tourism product designers can more intuitively display the characteristics and advantages of tourism products, providing better services for tourists. The tourism product CAD three-dimensional modeling system is a system that utilizes computer-aided design software to create tourism product models. This system can display the appearance, structure, and characteristics of tourism products through 3D models, while also providing virtual roaming and interactive experiences. In the field of tourism, the application of CAD 3D modeling systems can effectively improve the design and manufacturing level of tourism products, and enhance the experience and experience of tourists.

In the era of digital media, it is an important direction of combining art and technology to integrate the audience into works of art through technical means and let them feel the charm of art more intuitively and vividly. Among many technologies, the combination of CAD and VR technology is of great significance for the innovation of immersive artistic experience. CAD and VR technology are two different technologies. CAD technology is widely used in architecture, product design and other fields because of its accuracy and high efficiency. And VR technology attracts more and more attention because of its immersive and interactive characteristics. Traditional parameterized CAD modeling and virtual reality freeform modeling are two highly representative technologies. Traditional parameterized CAD modeling is designed through precise parameter settings, while virtual reality freeform modeling is designed through an intuitive modeling process. Fang and Kao [6] will compare and analyze the differences between these two modeling methods in terms of emotional response, flow experience, and operational performance. Traditional parameterized CAD modeling often brings users a calm and objective emotional experience due to its high rationality and accuracy. This experience stems from precise manipulation of parameters and strict adherence to design rules. However, this calmness may also lead to confusion and frustration among users when facing complex design problems. Virtual reality free form modeling brings users a richer emotional experience. By directly manipulating virtual objects, users can immediately gain an intuitive feeling of the design results, thereby stimulating their passion and creativity for design. Immersive natural finger interaction is an emerging human-computer interaction technology that utilizes gesture recognition and natural language processing technology to enable users to interact with computers through gestures and speech. In CAD assembly modeling, immersive natural finger interaction enables users to intuitively manipulate parts and components through gestures, such as grasping, moving, rotating, etc. In addition, this technology can also simplify the operation process by recognizing user instructions through voice recognition. However, immersive natural finger interaction may be limited by the accuracy of gesture and speech recognition in practical applications. In a comparative evaluation, Fechter et al. [7] found that WIMP and immersive natural finger interaction have their own advantages and disadvantages in CAD assembly modeling. WIMP interactive operation is simple, easy to learn, and suitable for beginners to quickly get started. However, in complex 3D space operations, it may not appear intuitive and convenient enough. In contrast, immersive natural finger interaction can provide a more natural and intuitive interaction experience, especially suitable for operations in three-dimensional space. However, the learning cost of this technology is relatively high and is limited by the current development status of gesture and speech recognition technologies.

This paper aims to discuss the innovation and improvement brought by the combination of CAD and VR technology, and the possible application fields in the future. In this paper, an innovative algorithm of immersive artistic experience based on CAD and VR technology will be constructed. In this way, the audience will be able to understand and appreciate the works of art from a new

perspective, so as to feel a deeper and more real artistic experience. This paper first introduces the application of CAD and VR technology in immersive artistic experience, and then expounds how innovative algorithms can enhance artistic experience by combining these two technologies. Finally, the feasibility and effectiveness of the immersive art experience innovation algorithm in combining CAD and VR technology are verified by experiments. The results show that the algorithm can provide more realistic and vivid artistic experience, and has high stability and reliability.

2 RELATED WORK

Through virtual reality technology, designers can simulate various potential security risks in product design and take corresponding preventive measures. This technology not only improves product safety, but also reduces security risks during the product development phase. Virtual reality technology can help enterprises achieve energy conservation and environmental protection goals by simulating the energy consumption and environmental impact of the entire product lifecycle. Through this approach, companies can identify problems in the early stages of product design and take effective measures to reduce energy consumption and environmental impact. Virtual reality technology has high requirements for hardware performance, including computer processing ability, graphics rendering ability, and real-time interaction ability. Currently, many virtual reality devices are expensive and need to be used in conjunction with high-performance computers, which increases hardware investment costs [8]. Virtual reality technology is a computer technology that can create and experience virtual worlds. It simulates human auditory and tactile senses, allowing users to immerse themselves in a highly realistic virtual environment. In the psychology experimental teaching system, the application of virtual reality technology helps to improve the fidelity and participation of experiments, while reducing the difficulty and cost of experiments. Han and Ge [9] use CAD software to establish various models required for experiments, such as characters, scenes, instruments, etc. Utilize virtual reality technology to import these models into a virtual environment and construct a highly realistic experimental scene. In terms of computer-aided applications, the use of CAD technology can effectively create virtual reality scenes and construct experimental models. At the same time, through programming and technical implementation, experimental data collection and visualization processing can be completed. These data can be used for statistics and analysis of psychological experimental results, providing strong support for scientific research.

5G and ultra-low latency communication will also drive the evolution of AR and VR games. The traditional game controller will be replaced by the user's own body movements and surrounding environment. Players can experience virtual game elements in real space, such as the size, shape, and mass of objects. This will completely change our understanding of games and open up a new gaming experience. The ultra-high speed and ubiquitous connectivity of 5G will make remote education and remote work possible. Through AR and VR technology, we can participate in meetings, studies, or work anytime and anywhere, without geographical limitations [10]. Horvat et al. [11] analyzed the potential performance of immersive virtual reality in design education. The application scenarios of immersive virtual reality in education are very extensive. Among them, real-time interaction and immersive education are the two most important application scenarios. In terms of real-time interaction, teachers and students can engage in online interaction through immersive virtual reality technology, achieving remote communication and collaboration. In terms of immersive education, students can learn in highly simulated virtual environments to enhance their interest and effectiveness in learning. For example, architecture students can experience the entire process of building design and construction in an immersive virtual environment, improving their practical operational skills. The design elements of immersive virtual reality include visual effects, sound effects, interactivity, and narrative. These design elements can affect the user's learning experience. In terms of visual effects, it is necessary to ensure that the images in the virtual environment are clear and realistic, allowing users to have an immersive feeling. In terms of sound effects, it is necessary to ensure that the sound effects in the virtual environment are clear and vivid, which can create a better learning atmosphere. In terms of interactivity and narrative, it is necessary to ensure that the interactive links and storylines in the virtual environment are vivid and interesting, and can

attract students' attention. The real-time and dynamic nature of the model is also an important factor affecting the usability of 3D model learning. Real time means that students can learn at any time and place, without being limited by time and place. Dynamicity means that the model can change according to students' operations, providing a richer and more vivid learning experience. For example, in car design, students can understand the working principles and design ideas of cars by operating dynamic 3D models in real-time, thereby better mastering the skills and knowledge of car design. The real-time and dynamic nature of the model is also an important factor affecting the usability of 3D model learning. Real time means that students can learn at any time and place, without being limited by time and place. Dynamicity means that the model can change according to students' operations, providing a richer and more vivid learning experience. For example, in car design, students can understand the working principles and design ideas of cars by operating dynamic 3D models in real-time, thereby better mastering the skills and knowledge of car design [12].

Virtual reality technology is a computer technology that can create and experience virtual worlds. It simulates human hearing, hearing, and touch, making users feel as if they are in a brand new virtual environment. Visual art design refers to conveying the designer's thoughts and emotions through visual elements, thereby arousing resonance and attention from users. Applying virtual reality technology to visual art design can make art design more vivid, three-dimensional, and interactive. Li [13] will research visual art design methods based on virtual reality, aiming to explore how to combine virtual reality technology with visual art design to improve the expressive power and user experience of visual art design. Through virtual reality technology, more exquisite and high-definition images can be presented, bringing users a more shocking and realistic visual experience. Through natural and humanized interaction design, users can interact with virtual environments more intuitively and conveniently, improving user experience and engagement. Visual art design based on virtual reality provides designers with a broader creative space, allowing them to express ideas and emotions more freely, enriching the content of the design. The teaching model centered on creativity has important significance and role in contemporary art computer-aided design teaching. It can not only improve students' computer skills and artistic qualities, but also cultivate their innovative and practical abilities. Therefore, teachers should pay attention to the development of students' personalities, stimulate their creativity and cultivate their practical abilities in teaching, and strive to explore and try various teaching methods and means to better adapt to the development of the times and the needs of students. Through the discussion in this article, Liu and Yang [14] see the importance of a creative centered teaching model in contemporary art computer-aided design. In this mode, students can not only learn and master computer-aided design technology, but also stimulate their creative potential and improve their overall artistic quality through practical operations. For teachers, this model reminds them to pay attention to students' creative stimulation and practical operation ability cultivation. At the same time, it is also necessary to continuously update teaching resources and technologies to adapt to the development of the times and the needs of students. The Cultural Experience Museum is a digital immersive interactive experience design case for museum cultural heritage based on virtual reality technology. The experience hall successfully reproduces the historical and cultural features of the Palace Museum through 360-degree panoramic photography and 3D modeling technology. At the same time, combining the interactivity and storytelling of virtual reality technology, viewers can gain an understanding of the historical evolution, architectural features, cultural relics collection, and other aspects of the Forbidden City through the experience. Deaf and hard of hearing individuals face many challenges in their daily lives, as they are unable to obtain information through hearing like ordinary people. However, with the development of virtual reality technology, we can compensate for this deficiency through other senses. Mirzaei et al. [15] explored how to use virtual reality technology to provide ear tactile experiences for deaf and hard of hearing individuals, in order to help them better understand and adapt to their surroundings.

Immersive virtual reality technology has brought enormous innovation opportunities to the construction, engineering, and construction industries. It can expand the potential of building information modeling, improve design quality, reduce project risks, and promote more effective

learning and collaboration. However, to achieve this potential, we need to address some key challenges, such as technology costs, user experience, data security, and industry acceptance. Safikhani et al. [16] By combining BIM with VR, we can create more realistic models and scenes, enabling designers, engineers, and stakeholders to understand and interact in a more intuitive way. This combination helps to improve decision-making speed and quality, reduce misunderstandings and conflicts, and reduce project risks. Secondly, VR can also be used for building performance simulation. By simulating the performance of buildings under different conditions, we can predict potential problems and take corresponding preventive measures before actual construction. This not only helps to improve the sustainability and functionality of buildings, but also saves time and costs. With the development of technology, digital technology has penetrated into various fields, bringing great convenience to our lives. Especially in the field of historical building protection, the application of digital technology has enabled many precious cultural relics to be permanently preserved and displayed. Soto et al. [17] explore the methods of digital reconstruction of historical buildings and virtual integration of murals, as well as how to create interactive and immersive experiences in virtual reality. Digital reconstruction is a process of using computer technology to conduct three-dimensional modeling and simulation of historical buildings. In this way, we can reproduce the original appearance of historical buildings, providing convenience for research, protection, and display. The application range of digital reconstruction technology is very wide, including archaeology, cultural relic protection, urban planning, and other fields. In the process of digital reconstruction, we usually use technologies such as laser scanning, 3D modeling, and virtual reality to comprehensively collect and model historical buildings. In addition, digital reconstruction can also help us carry out structural analysis, reinforcement, and restoration of historical buildings, improving the preservation level of cultural relics.

Dunhuang is located in Gansu Province, China, with a long history and rich cultural relics. Its unique geographical location and the integration of multiple ethnic cultures make Dunhuang a valuable resource for the study of interior design art. Su et al. [18] drew the following conclusion through their research on modern interior design art in Dunhuang: firstly, the unique historical and cultural background of Dunhuang provides rich materials and sources of inspiration for modern interior design. Secondly, the application of virtual reality technology provides a new platform for the inheritance and development of modern interior design art in Dunhuang. By constructing and experiencing virtual scenes, designers and consumers can more intuitively experience the effectiveness of design solutions, thereby improving design quality and communication efficiency. Helping to inherit and develop the unique historical and cultural heritage of Dunhuang. At the same time, the application of virtual reality technology will also bring more business opportunities and market competitiveness to the modern interior design industry in Dunhuang. Computer graphics and image assisted design have complementarity in art design teaching. Computer graphics mainly cultivates students' spatial thinking and modeling abilities, while image assisted design emphasizes students' creative thinking and expressive abilities. Combining Zhang and Rui [19] in teaching can complement each other's strengths and improve teaching effectiveness. In specific practice, teachers can guide students to use computer graphics knowledge to conceptualize and model space and form, while using image assisted design techniques to adjust visual factors such as color, brightness, and contrast, presenting the design scheme in a more expressive form. This teaching method can stimulate students' interest and creativity in learning, and cultivate their ability to comprehensively apply knowledge and skills. In the appearance design of agricultural product packaging art style, elements such as color, graphics, text, and layout are key. Among them, color can directly attract consumers' attention, and a reasonable color combination can make the packaging more eye-catching. Graphic design can convey the characteristics of agricultural products through concise and clear patterns. Text can provide detailed information about the product, helping consumers understand the product. The rationality of layout design directly affects the artistic effect of the entire packaging. With the development of artificial intelligence technology, intelligent computer-aided design has been widely applied in the appearance design of agricultural product packaging art style. Intelligent computer-aided design methods mainly include artificial intelligence algorithms, computer graphics, and virtual reality technology. Through these methods, Zhao et al. [20] can quickly carry

out packaging design, improve design efficiency, and also achieve more accurate market analysis and user feedback, providing strong support for further optimizing packaging design.

In recent years, there are more and more innovative algorithms for immersive artistic experience. These algorithms mainly focus on how to improve the rendering quality and performance of virtual environment, and how to enhance the immersive experience through technologies such as images or audio. For example, some algorithms can improve the realism of virtual environment by optimizing the lighting model; Some algorithms focus on how to realize more natural interaction through head-mounted devices and improve the audience's participation and immersion. Although some achievements have been made in this field, there are still many problems that need further study and discussion. For example, how to further improve the realism and immersion of the virtual environment, and how to solve the complexity and performance problems of the algorithm. Based on the existing literature, this paper discusses the innovative algorithm of immersive art experience integrating CAD and VR, and verifies the feasibility and effectiveness of the innovative algorithm of immersive art experience in combining CAD and VR technology through experiments.

3 THEORETICAL BASIS OF CAD AND VR

Immersive artistic experience means to make the audience integrate into the works of art through technical means, and to perceive and comprehend the artistic connotation in a more vivid and three-dimensional way. Among them, CAD and VR technology are the key to realize the immersive artistic experience. CAD is a technology that uses computer technology to carry out design work. In the field of art, CAD software can be used to make works of art, such as paintings and sculptures. Moreover, CAD software can also be used in immersive art experience, and create a realistic artistic space for the audience by modeling and rendering the virtual environment. VR is a computer technology that can create and experience virtual worlds. By simulating people's audio-visual and tactile sense, it makes users seem to be immersed in a highly realistic virtual environment. In the immersive art experience, VR technology can be used to create a virtual exhibition space for art works, so that users can freely explore and feel the artistic connotation.

In the immersive art experience, CAD and VR technology have the following significance and feasibility: improving the efficiency of artistic creation; CAD software can help artists to quickly create virtual models of artistic works and preview and adjust them in the virtual environment. This greatly shortens the time period of artistic creation and improves the efficiency of creation. Enhance the exhibition effect: VR technology can create a highly realistic virtual environment, and integrate artistic works into the environment, so that the audience can feel the artistic connotation more vividly and comprehensively. Realize interactive experience: Through data gloves, head tracking and other technologies, the audience can interact with works of art in the virtual environment, which enhances the audience's sense of participation and experience.

In the immersive art experience, the application of CAD and VR technology can bring the following practical effects: (1) Innovative art display mode: By integrating art works into the virtual environment, the display mode of art works can be innovated to make it more suitable for the audience's needs in the digital age. (2) Expanding artistic creation space: CAD and VR technology can help artists expand artistic creation space and realize free creation and display in virtual environment. (3) Immersive art education: Using CAD and VR technology, the audience can more intuitively understand the works of art and the stories behind them, and improve the interest and effectiveness of art education. Moreover, this technology can also be applied to skills training, scientific research and other fields. (4) Cross-border cooperation and innovation: CAD and VR technology can enable artists, designers and scientists in different fields to carry out cross-border cooperation and innovation and promote the growth of art, technology and society. For example, in the field of architectural design, architects can use CAD and VR technology to design and display architectural models, and communicate and cooperate with customers and developers more intuitively. (5) Personalized and customized experience: Through data gloves, head tracking and other technologies, the audience can customize the personalized exhibition route and experience

mode according to their own needs and preferences in the virtual environment, which improves the audience's sense of participation and satisfaction.

4 INNOVATIVE ALGORITHM OF IMMERSIVE ARTISTIC EXPERIENCE

The innovative algorithm of immersive artistic experience is based on VR technology, which allows the audience to enter the virtual environment generated by the computer in an immersive way through interactive devices such as headsets and handles. The algorithm mainly involves the following three steps: (1) Virtual environment modeling. Using CAD technology to digitally model the real world can generate a highly realistic virtual environment. In order to enable the audience to perceive the virtual environment in all directions, it is necessary to use high-precision image rendering and ray tracing technology to simulate the effects of lighting, shadows and materials in the real world. In addition, in order to make the audience move freely in the virtual environment, six-degree-of-freedom tracking technology is needed to realize the dynamic tracking of the audience's head and hands.

3D modeling of multi-angle images of artworks can be defined as the process of recovering 3D structural information of artworks from multiple multi-angle images by computer means. From the point of view of known information about artworks, this paper makes full use of this information, collects the prototype of artworks, and through data processing and other processes, creates a virtual 3D model with the shape and structure of artworks. A typical camera calibration model reference is shown in Figure 1, and the vertex of each small square on the model is the characteristic point of the model. Generally speaking, the coordinates of each feature point on the reference object in the world coordinate system must be accurately determined in advance, and the coordinates of feature points in the image need to be extracted by edges.

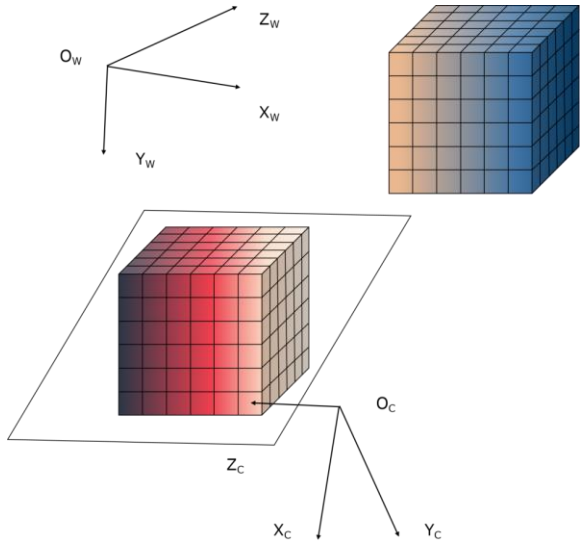

Figure 1: Calibration reference.

Given any point on the image plane, the corresponding points on the two calibration planes can be calculated, so as to determine the light projected on the image plane to produce the image point. For each calibration plane, an independent interpolation formula is established by using a set of calibration points. In linear interpolation, the coordinates of corresponding points on the calibration plane are expressed as a linear combination of image point coordinates, namely:

$$C_i = A_i \times U \quad i = 1,2 \tag{1}$$

Where $U = (u, v, 1)^T$ is the homogeneous coordinate of the image point; $C_i = (x_i, y_i, z_i)^T$ is the corresponding point on the i calibration plane; A_i is a 3×3 regression parameter matrix.

(2) Interactive experience design. In order to make the audience interact with the virtual environment naturally, it is necessary to design a set of interactive experience based on physical principles. In the virtual environment, the audience can grasp, move and rotate objects through the handle. Moreover, through the dynamic tracking of the head and hands, the audience can realize more intuitive interactive ways, such as looking up and waving. This interactive experience not only enhances the audience's sense of participation, but also improves the realism of immersive experience. (3) Real-time rendering and updating. In order to ensure the fluency and stability of virtual environment, efficient real-time rendering technology is needed. This technology can dynamically update and render the virtual environment to ensure that the audience can see the changes related to their own behavior. In addition, in order to make the audience browse the virtual environment more naturally, it is necessary to adopt high-quality audio processing technology to provide various sound effects such as surround sound and stereo sound.

Aiming at the problems of large calculation and poor model expansibility when using the current algorithm to model, this paper puts forward an innovative algorithm of immersive artistic experience based on improved discrete algorithm, and uses this algorithm to model multi-angle images in 3D. Discretization algorithm is an algorithm for processing continuous data, and its goal is to convert continuous data values into discrete forms for subsequent analysis and processing. Common discretization algorithms include equidistant discretization method, constant frequency discretization method, K-means model discretization method, quantile discretization method, binary discretization method, chi-square split-based discretization method and 1R discretization method. In this paper, chi-square test is used to discretize the data, that is, the data is divided according to the size of chi-square value, and the group with chi-square value greater than a certain threshold is treated as a discrete value.

In addition, this paper adopts the practical 3D modeling technology applied to product appearance, omitting the dense matching, dense modeling and texture mapping steps of traditional 3D modeling technology, and generates the 3D solid model by processing the point cloud data from point to line, line to surface and surface to body in Rhino. Finally, the output is in STL file format, which can be directly applied to the rapid prototyping machine to manufacture the model, realizing the seamless combination with RP technology. In this paper, firstly, the multi-angle prototype of a large building is collected; secondly, the multi-angle image discrete network model of the artwork is established by analyzing the topological relationship between the original data points; finally, the 3D coordinates of the corresponding points of the artwork from different angles in 3D space are calculated by combining the principle of binocular stereo vision imaging, and the 3D modeling of the multi-angle image of the artwork is realized. In this paper, the event system formed by connecting nodes through routing makes the 3D virtual simulation scene have dynamic interaction ability, and this interaction mechanism is shown in Figure 2.

Record the origin of coordinates as:

$$O = (0,0,0) \tag{2}$$

The image point coordinates of the space point A are:

$$a = (x_a, y_a, f) \tag{3}$$

Then the linear equation of the straight line OA can be written as:

$$\frac{x}{x_a} = \frac{y}{y_a} = \frac{z}{f} \tag{4}$$

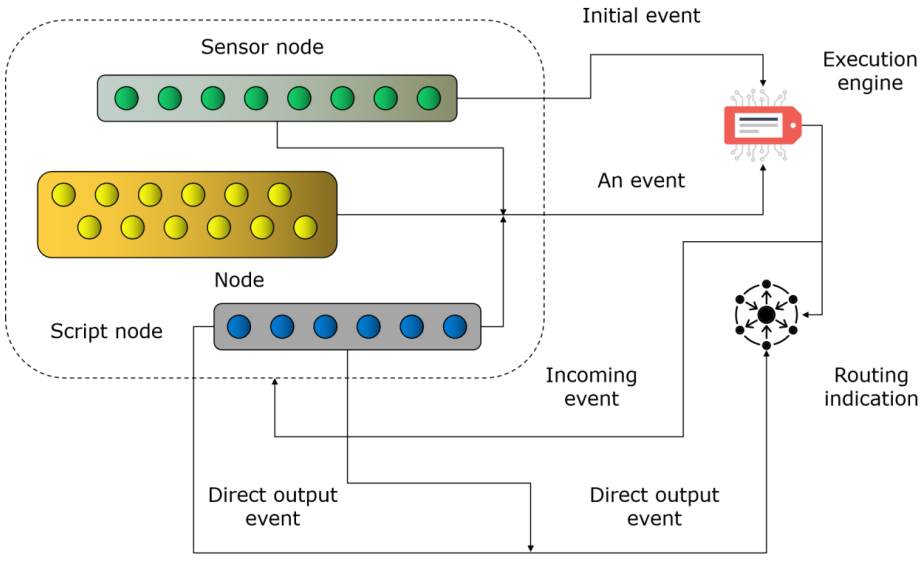

Figure 2: Interaction mechanism.

If the normal vector of the space plane is known:

$$n=(B,C,D) \tag{5}$$

The coordinates of a point on the plane are:

$$(x_0,y_0,z_0) \tag{6}$$

The equation of the plane can be expressed as:

$$B(x-x_0)+C(y-y_0)+D(z-z_0)=0 \tag{7}$$

According to Formula (4) and Formula (7), the coordinate values of point A in space can be solved:

$$A=(kx_{a,}kx_{a,}kf) \tag{8}$$

Where:

$$k=(Bx_0+Cy_0+Dz_0)/(Bx_a+Cy_a+Df) \tag{9}$$

Data point extraction: make the projection center in the center of the image, and the difference between the coordinate values of the image point A in the display user area and the image center in the user area is the coordinate values of the image point in the image coordinate system, that is:

$$A=(x-lWidth/2,y-lHeight/2) \tag{10}$$

Where (x,y) is the coordinate of the point in the user area; $lWidth$ is the length of the image; $lHeight$ is the height of the image. In the optimization process of 3D modeling of artwork images, a quadratic interpolation function is constructed and expressed by the following formula:

$$L_2(x)=y_{k-1}l_{k-1}(x)+y_kl_k(x)+y_{k-1}l_{k+1}(x) \tag{11}$$

Among them, the following formula is expressed as the linear interpolation basis function in the optimization process of 3D modeling of artwork images:

$$l_k(x)=\frac{(x-x_{k-1})(x-x_{k+1})}{(x_k-x_{k-1})(x_k-x_{k+1})} \tag{12}$$

In the optimization process of 3D modeling of artwork image, the function value represented by $L_2(x')$ is calculated for the point x' in the interval represented by $[x_{k-1},x_k]$, and the new control point of artwork entity image represented by $(x',L_2(x'))$ is obtained.

When building a graphic simulation model, users define the spatial position of each icon to be transformed into a 3D scene and store it as the spatial attribute of the icon in a spatial position data table. When the 3D model is introduced into the scene, its spatial information is read from the table, so as to control the position of the 3D model in the scene. In the optimization process of 3D modeling of multi-angle images of artworks, the spatial coordinates of 3D points of multi-angle images of artworks can be expressed by the following formula:

$$\begin{cases} x=zx_1/f_1 \\ y=zy_1/f_1 \end{cases} \tag{13}$$

$$\begin{aligned} z&=\frac{f_1(f_2t_x-x_2t_z)}{x_2(r_7x_1+r_8y_1+f_1r_9)-f_2(r_1x_1+r_2y_1+f_1r_3)} \\ &=\frac{f_1(f_2t_x-y_2t_z)}{y_2(r_7x_1+r_8y_1+f_1r_9)-f_2(r_4x_1+r_5y_1+f_1r_6)} \end{aligned} \tag{14}$$

After the calculation of 3D coordinates, a point cloud data consisting of discrete and sparse 3D coordinates of object feature points will be obtained. Firstly, the point cloud file is imported into Rhino; Then the scattered and sparse point clouds are connected by related commands to generate a wireframe model composed of points; Then the patch model is composed of wireframe model, and finally it becomes a 3D entity of art through Boolean operation.

5 SIMULATION ANALYSIS OF INNOVATIVE ALGORITHM OF IMMERSIVE ARTISTIC EXPERIENCE

Based on the improved discrete algorithm, the innovative algorithm of immersive artistic experience realizes the modeling of characters and the construction of scenes through CAD technology, and provides users with highly realistic immersive experience by using VR technology. In addition, the algorithm also introduces a variety of sensory feedback designs, including vision, hearing and touch, to enhance the user's immersion experience. This section aims to explore the application effect of the innovative algorithm of immersive artistic experience in the combination of CAD and VR technology, so as to realize a more realistic and vivid artistic experience. The purpose of the experiment is to verify the feasibility and effectiveness of the algorithm, and analyze its performance in different conditions and environments, so as to provide reference for future practical applications.

The materials needed for the experiment include high-performance computers, VR devices, sensors and digital data of works of art. The experimental methods are as follows: (1) Prepare the digital data and equipment needed for the experiment, and debug the equipment; (2) Creating VR scenes and personas by applying the innovative algorithm of immersive artistic experience; (3) Immersive experience through VR equipment, and record user's behavior and feedback; (4) Analyze and evaluate the experimental data, and get the experimental results.

First of all, in order to verify the superiority of the innovative algorithm of immersive art experience, 3D modeling experiments of multi-angle images of artworks are carried out in the same coordinate system. The measured values of different algorithms are compared with those of the actual algorithm, and the comparison results are shown in Figure 3 and Figure 4.

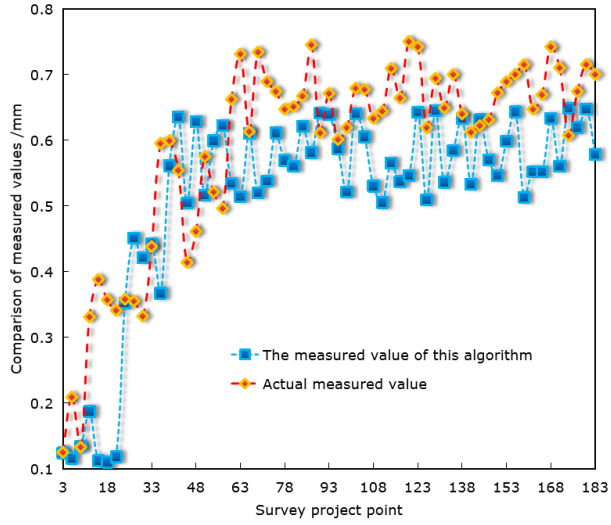

Figure 3: Algorithm modeling measurement comparison results.

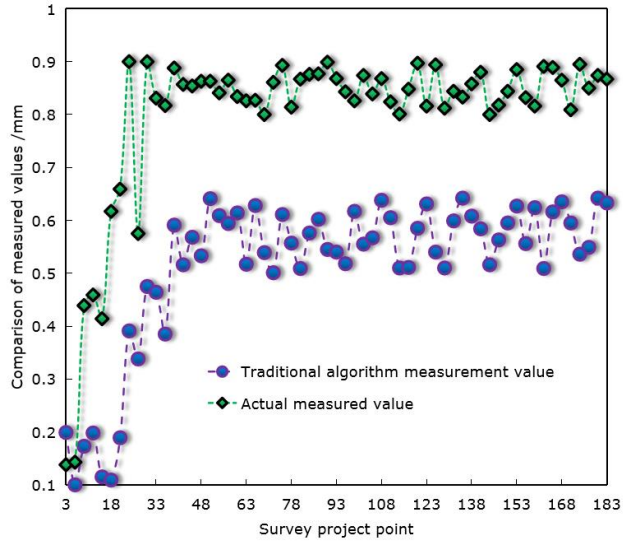

Figure 4: Traditional algorithm modeling measurement comparison results.

The measurement accuracy of the 3D modeling experiment of artwork image using the immersive art experience innovation algorithm is obviously higher than that of the traditional algorithm. This is because the immersive art experience innovation algorithm first collects the original data of the multi-angle image model of the artwork, and then analyzes the topological relationship between the original data points, and establishes the multi-angle image discrete network model of the artwork, which ensures the accuracy of the algorithm modeling. Figure 5 shows the stability of the immersive art experience innovation algorithm.

In Figure 5, the stability of the immersive art experience innovation algorithm is shown, and the results show that the algorithm can basically maintain around 90% in the case of a large data set.

This high stability is very important in many application fields, especially for immersive artistic experience.

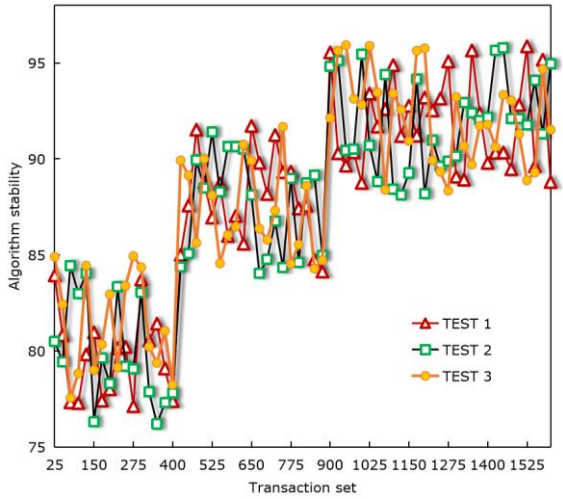

Figure 5: The stability of the innovative algorithm of immersive artistic experience.

First of all, this stability result is obtained through a lot of experiments and tests. In the experiment, it is found that the stability of the algorithm is quite high regardless of the size of the data set. This high stability is mainly attributed to the design and implementation of the algorithm. The innovative algorithm of immersive artistic experience in this paper adopts advanced data processing technology, which can effectively process various types of data and make adaptive adjustments according to the characteristics of the data. Moreover, the advantages of CAD and VR technology are also used, which makes the algorithm more realistic and vivid to present artistic experience.

In order to explore whether the innovative algorithm can improve the user's satisfaction in the immersive art experience, this paper adopts the method of questionnaire survey to collect data and analyze it. Figure 6 shows the user's satisfaction with the immersive art experience innovation algorithm proposed in this paper.

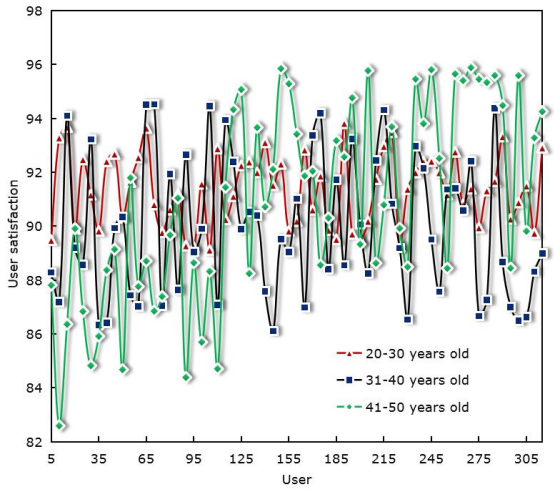

Figure 6: User satisfaction of the innovative algorithm of immersive art experience proposed in this paper.

The user's satisfaction with the immersive art experience innovation algorithm proposed in this paper is high, which can basically reach more than 89%, which is an ideal situation. First of all, the main reason for high satisfaction is that the algorithm can provide a more real and vivid artistic experience. By combining CAD and VR technology, the algorithm can create a virtual environment similar to the real world, so that users can feel and understand works of art more deeply. Compared with the traditional art exhibition, the immersive art experience innovation algorithm breaks the limitation of space and time, and enables users to enjoy the fun brought by art at any time and any place. Secondly, the results of the questionnaire survey also show that users also give high praise to the interactive experience design of the algorithm. Through the dynamic tracking technology of handles, heads and hands, users can interact with works of art in the virtual environment, which enables users to experience the charm of works of art more naturally. This interactive experience design not only improves the user's sense of participation, but also makes the user understand the works of art more deeply.

In order to show the advantages of immersive art experience innovation algorithm more intuitively, this section compares this method with the traditional method. Figure 7 shows the comparison results of the two methods in terms of user satisfaction, and it can be seen that the satisfaction of using the immersive art experience innovation algorithm proposed in this paper is obviously higher than that of the traditional method.

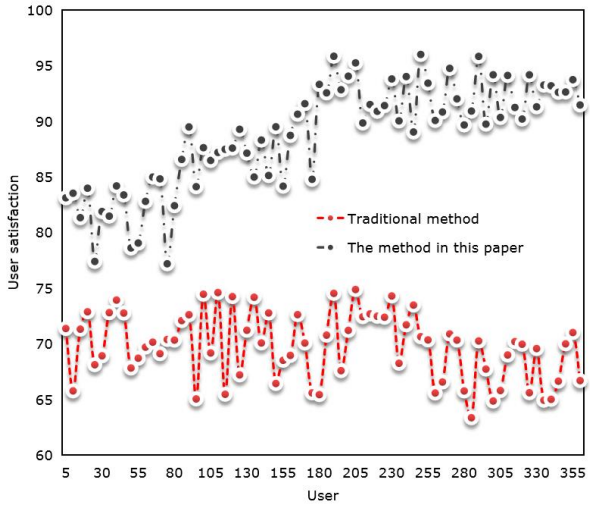

Figure 7: Comparison of user satisfaction with different methods.

As can be seen from Figure 7, the satisfaction of the traditional method is low, basically between 60% and 70%. This is because in the traditional art exhibition, the audience can only appreciate the works of art from a limited perspective or distance, and can't fully and deeply feel and understand the works. In addition, the traditional art exhibition method can't provide interactive experience, and the audience can only passively accept the works and can't interact with them, which further reduces the audience's satisfaction. In contrast, the immersive art experience innovation algorithm has obvious advantages. Through the combination of CAD and VR technology, the algorithm creates a highly realistic virtual environment for the audience, so that the audience can enjoy the works of art from all directions and angles. Moreover, through dynamic tracking technology and interactive design, the audience can also interact with the works, which improves the audience's sense of participation and experience. Therefore, the user satisfaction with the innovative algorithm of immersive art experience is obviously higher than that of the traditional method. This result further shows the effectiveness of the algorithm in this paper.

Generally speaking, the simulation results in this section prove that the 3D modeling method of multi-angle images of artworks based on improved discrete algorithm has high accuracy and strong practicability. Moreover, the algorithm also has good robustness. This means that the algorithm can still maintain high stability even when there are noises or outliers in the data. This is very important for practical application, because in practical application, we often encounter various unpredictable situations, such as data quality problems and equipment failures. Therefore, the robustness of the algorithm is the key factor to ensure its stability in practical applications. In addition, by comparing with traditional methods, the advantages of immersive art experience innovation algorithm in improving user satisfaction are further verified. This method can not only provide a more realistic and vivid artistic experience, but also realize the interaction between users and works of art, thus improving users' sense of participation and experience.

6 CONCLUSIONS

In this paper, an innovative algorithm of immersive artistic experience based on improved discrete algorithm is proposed by combining CAD and VR technology. Through the analysis and experiment of this algorithm, the following conclusions can be drawn: First, the innovative algorithm of immersive art experience proposed in this paper effectively solves the limitations and problems in traditional immersive art experience. By improving the discrete algorithm, we can create more realistic characters and scenes in the virtual environment, and provide more diversified sensory feedback, thus further enhancing the user's immersion experience. Secondly, through the analysis of experimental data, it is found that the immersive art experience innovation algorithm shows high stability and effectiveness when combining CAD and VR technology. Compared with traditional VR technology, this algorithm can provide a more realistic and vivid artistic experience, and effectively improve the effect and attraction of artistic display. Finally, the innovative algorithm of immersive artistic experience studied in this paper has important practical application value. In the future, the algorithm will be further improved to improve its reliability and optimization, so as to better meet the needs of users for artistic experience.

With the continuous development and improvement of technology, the application of CAD and VR technology in immersive artistic experience will be more and more extensive. In the future, it can be predicted that this technology will be applied to more artistic fields, such as the immersive experience of dynamic art such as drama and dance, and the digital protection and inheritance of cultural heritage. Moreover, with the continuous innovation and progress of technology, I believe that the immersive artistic experience will bring more rich and profound sensory experience and emotional resonance to the audience.

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