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Research on Spatial Creative Expressions in Chinese Modern Video Art Design Based on Virtual Reality Technology

Yuan Meng[1] and Zanxuan Su[2,*]
[1] Faculty of Philology and Literature, University of Alcala, Madrid, 28801, Spain
[2] Department of Experimental Psychology, University of Granada, Granada, 18011, Spain
Corresponding authors: (e-mail: yuan.meng@edu.uah.es).

Abstract With the rapid development of virtual reality technology, the display form of video art has entered a new era. The immersive and interactive nature of virtual reality technology provides a richer creative space for video art, especially in the spatial creative expression in video art design. The research firstly constructs an interactive virtual image art space system, which adopts light space transformation technology combined with the immersive display of virtual reality. Secondly, the application effect of the system in video art display is verified through experiments. The results show that the system exhibits excellent performance in scene construction and interactive response, and the average response time of the optical space model construction is 67.2ms, which is much lower than that of the traditional multi-singular constraint system (260ms) and the mixed reality system (325ms). In addition, the system also achieved high ratings in terms of user experience, with interactivity, realism, and hierarchy scores of 93.97, 94.11, and 93.28, respectively, which were significantly higher than those of the comparison systems. The study shows that the application of virtual reality technology in video art display can not only provide richer spatial expressions, but also enhance the audience's immersion and interactive experience, thus promoting the development of video art display.

Index Terms Virtual reality technology, video art, spatial creativity, interactive display, light-space transformation, immersive experience

I. Introduction

Virtual Reality (VR) technology, known as spiritual realm technology or artificial environment, is a highly integrated high-tech with great application prospects [1], [2]. It integrates the results of computer graphics technology, sensor technology, ergonomics, human-computer interaction technology, display technology and many other technologies to form a realistic computer technology as the core of the integration of visual, auditory, haptic and other virtual environments, is a multi-source information fusion interactive three-dimensional dynamic visual scenery and entity behavior system simulation, with immersion, interactivity and conceptualization as the basic characteristics [3]-[6]. Since the introduction of this technology, it has been utilized in many fields, especially in the fields of art design, architectural design, and video games.

Modern video art, as the name suggests, is a new art discipline category that utilizes optical and electronic media as the basic means of artistic creation, which has always been more closely combined with conceptual art, and the novelty effect produced has also impacted people's visual life to a great extent [7]. The development of virtual reality technology has created a new virtual creative space for video art. Nowadays, the media is experiencing a transformation driven by technology. The connotation and extension of new media are iterating and breaking through, and the traditional media continue to reinvent themselves under pressure [8], [9]. Chinese modern video art, as a new form of creative industry development, is receiving more and more attention and research [10]. Intelligence, virtualization, and VR have become three new trends in the development of Chinese modern image art design media [11], [12]. The future of image art design is moving towards an immersive era.

As an emerging art form, video art's ever-changing presentation methods and audience's viewing needs make artists face new challenges in spatial creativity. With the progress of science and technology, especially the maturity of virtual reality technology, the traditional way of displaying video art has begun to expose its limitations. The display of video art not only needs to break through the boundaries of planarization, but also needs to provide the audience with a more realistic and immersive experience. The emergence of virtual reality technology makes this wish possible, which brings unprecedented viewing experience through the construction of three-dimensional virtual space and sensory stimulation. At present, the display environment of video art has gradually shifted from a two-dimensional exhibition space to a three-dimensional virtual space, and this transformation of spatial creativity is not only the embodiment of technological innovation, but also provides a new way of expression for the creation

of video art. The core of the research is to explore how virtual reality technology plays a role in video art design, especially in the application of spatial creative expression. Specifically, this paper will focus on how virtual reality technology can enhance the expressiveness of video art works through spatial construction, interaction design and immersion experience. The study firstly analyzes the current technical challenges and development trends in video art display; secondly, constructs a virtual reality-based video art display system and carries out a multi-dimensional experimental evaluation; finally, through comparative experiments, it evaluates the strengths and limitations of virtual reality technology in the spatial creative expression of video art and provides a theoretical basis for future art design.

II. Exhibition space in video art design

II. A. Concepts of space in video art and video art

II. A. 1) Video Art Design

Video art consists of two key words “video art” and “installation art”, it can be seen that the video installation art is a new form of art from the combination of two art forms [13]. This section expounds video installation art from the perspective of how to combine video art with installation art. "Installation art" first appeared in the early 1960s, and its emergence was inseparable from pop art, and later evolved into an independent and complete art form.

II. A. 2) Space in Video Art

Before “installation art”, the presentation of works of art was basically flat and on-shelf, and the museum display space was seen to play a minimal role, only in the size of the artwork's screen and the way it was hung, and the venue was not considered an integral part of the art display. The initial phase of video art also followed the visual principles of pictorial art, with the screen emerging as a substitute for the canvas. Nowadays, the arrival of the electronic age has enabled two-dimensional virtual images to be physically transformed into three-dimensional display forms. Video installation art combines two-dimensional images and three-dimensional carriers into a whole, and space also plays its role as part of the installation art.

The work cannot exist independently of the space, and the work of art must exist in a specific space. Accompanied by the progress of technology, the original space exhibition method appears to be rigid, and the border of two-dimensional paintings appears to be abrupt. More and more new art forms need to be integrated into the exhibition space, and these works blur the boundaries of space. Under such circumstances, the exhibition space needs to adapt to the new art environment, abandon the original flat display method, and develop an experimental spatial construction. On the other hand, the audience is exposed to new ways of viewing when visiting the exhibition, which will indirectly lead to the gradual decline of the traditional exhibition methods.

The exhibition space for video installation art consists of three parts: the video itself, the display medium or the device that carries it, and the space in which it is placed.

It is very important for the video artist to choose what device to construct the space and what venue to place the device. The importance of the artist is to create a better context through the construction of the space for the content of the image itself to be expressed. So that the audience can be immersed in the “unreal image” and “real space”.

In this paper, the space of video installation art refers to the physical reality space on the one hand, and on the other hand, it refers to the spiritual space of the field created by the fusion of subjective expression of the main body and the media and carriers in the process of video creation. When these two parts interact with each other, the audience can combine their own experience to stimulate the imagination space to communicate with the artist in spirit.

II. B. Film and television art space display based on virtual reality technology

"Immersion" is interpreted in The Laws of Design as "flow theory" [14]. The theory of mindstreaming refers to the mental state in which a person is fully engaged in an event, which produces an extremely high level of excitement and fulfillment. Immersion is the pleasure and fulfillment of focusing on the current goal (created by the designer), thus forgetting about the real world situation. The three-dimensional environment created by virtual reality creates multifaceted conditions that enable users to become immersed, and then when people are immersed in the virtual environment created by the designer, they gain an experiential mindstream.

(1) Sensory experience

For example, when people play roller coasters, bungee jumping, skydiving and other projects, they will feel the stimulation and heartbeat acceleration, which most of the brought stimulation comes from the sensory stimulation. When experiencing virtual reality content, even if you know in your heart that the story is not real, but the designer intentionally creates a situation for the user, it will still make the user dodge, exclaim, fear and other phenomena. This is the virtual reality technology consciously compressed the real space situation to zero to build the same

space presented in front of the user, let the audience think that this is a real reproduction. Sensory immersion utilizes the “five senses” to receive information from the outside world, and virtual reality enhances the sense of immersion from the technical point of view by utilizing the senses, i.e., the basic visual and auditory senses.

(2) Interactive experience

In traditional art, visual viewing is often the main and only way, and due to the reasonable protection of the original work, it is unlikely that visitors can make the most direct interaction with a painting or a device, while virtual reality art is built on its unique technology, which allows the experiencer to interact with the artist in the space created by him/her.

II. C.Design Strategies in Spatial Design of Film and Television Art

(1) Images

In order to better create a spatial atmosphere, the image specific setting can be composed of a distant image, a close-up image and a center image. It is made up of 360° ring images seamlessly connected, and the light elements are combined with the zenith and the ground to form a whole. The Medium View Image can be made up of a combination of 3D graphics and 2D flat images, but is more fowl than the Far View in terms of accuracy and resolution requirements. Near-view image, is pointed out that the experience of the user is located near the environment, the user is located in the position of back and forth movement, therefore, the near image of the set of three-dimensional, can be viewed in all directions and full perspective. At the same time, the near- and medium-view images will change back and forth with the movement of the experiencer, and the computer will automatically adjust according to the distance and orientation of the object from the experiencer, and the relative resolution and detail requirements are also the highest.

Therefore, in the immersive experience design, the image can be centered around perspective, spatial location tracking, screen update frequency for the composition of the far, near and mid-range images in several aspects, to create a sense of presence and immersion in the experience.

(2) Sound

Immersive experience design in film and television art, can be used in VR surround sound, surround sound and usually hear the difference between 3D stereo sound 3D stereo sound development is the source of the binaural effect, people hear the distribution of sound sources in the same space is the feeling of stereo formation. surround sound in VR is replayed through the headset and combined with the head tracking technology, real-time rendering, so that the user can do the rotation of the sound. Rendering, so that the user can hear the sound and changes from all directions when doing actions such as turning the head, compared with ordinary two-channel stereo, the experience can produce a sense of wrapping that is the sense of encirclement, so the sense of immersion experience is stronger. Therefore, designers can utilize the VR surround sound effect to give guidance to the experience in the work, thus enhancing the sense of immersion.

(3) Color

The audience in the installation art is in the closed, semi-closed circular space with the works of communication, interaction and experience, some are in the outdoor open space to experience the works, so the creation of color should be based on different spatial environments and the theme of the works for the design, and thus from the overall hue to grasp the macroscopic.

As far as the visual experience is concerned, the matching and rendering of color relationship together with the reasonable use of symbolic language can set a suitable tone for the installation space through the link between human visual psychology and emotion. Human's color feelings include the sense of warmth and coldness, strength and weakness, light and darkness, etc. Some of them are related to the properties of the color itself. Some of them are related to the properties of the color itself, some are related to the visual characteristics, and some are related to the emotional effect of the color. The emotional effect of color involves that color can stimulate the senses of the experiencer, but not only the physiological senses of the experiencer, but also includes a series of psychological activities related to the experiencer's memory, associative visual experience.

(4) Interaction Design

The word interaction is composed of the words "intersection" and "mutual", "intersection" is communication, "mutual" is interaction, and the VR interaction used in the installation art involved in this article has a more complex and comprehensive interaction environment, conditions and forms than the simple human-computer interface interaction. From task-oriented interaction in interface design, it is transformed to interaction in virtual environment for the purpose of immersion in installation artworks. The interaction in the installation space can utilize the motion capture, head tracking and position tracking technologies in virtual reality technology, of which the motion capture system contains gesture tracking and eye tracking technology, and Figure 1 shows the basic principle of gesture recognition. Through the tracking of eyeballs and position, the audience can better lock the content of the work,

and this way of interaction can make a comprehensive response to the human voice, action, position and movement, thus enhancing the interactive experience. Experience as if walking in the real environment, but also can interact with people or objects in the scene. It is an interaction with feedback. When experiencing the virtual space of the installation, they will be confronted with a variety of complex forms of interaction, such as helmet display touchpad, joystick interaction, and interface interaction, and so on. Experiencers need to familiarize themselves with the new environment first, and designers should consider how to reduce the cognitive burden of new things on experiencers.

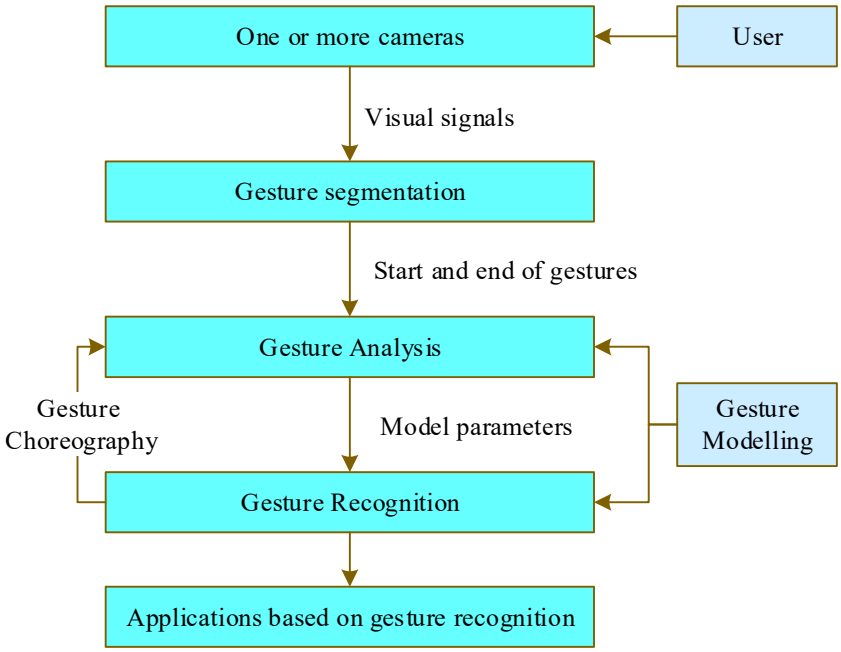

Figure 1: The basic principle of gesture recognition

(5) Combination of light elements with time and space

The visual arts psychologist Arnheim talks about it this way: “Light, almost one of the most brilliant and spectacular experiences available to the human senses.” Light is the most common element in our daily life, we are bathed in sunlight every day, light helps all living creatures to grow, light is not only nourishment and food, but also as an artistic medium into the work, in today's technologically advanced era, the light element can be technologically intervened in the installation art, combined with the concept of time and space, providing a new way of thinking for the design of immersive experience.

Designers can combine the light element with time and space, superimpose “time” on “three-dimensional” or even change the direction of “time” through the dynamics of light, so that when the audience is in the space, they will feel the tension between the subject and the object, and feel the tension between the subject and the object. When the audience is inside the space, the tension between the subject and the object is reversed and interchanged, and the experiencer is pulled by the power of the light at all times, and realizes the active control and guidance of time in the experience through their own participation, forming a complete sensory and psychological experience, so as to better realize the immersive experience.

III. Interactive virtual display based on optical space exchange technology

III. A. Establishment of interactive virtual space based on optical space transformation technology

III. A. 1) Interactive virtual image art space

Different kinds of digital resources in optical space have different physical properties and color properties. In the virtual display, different kinds of digital resources in the optical space can be interacted, such as lighting, projection and shadow effects on objects in the optical space to realize three-dimensional visual effects. Therefore, light space is not only a digital display technology, but also a new art creation method. In recent years, light space has been gradually applied to 3D modeling, architectural design, lighting design, virtual reality and other fields. The three-dimensional properties of light space and the real world have similarities, and the virtual display technology is a three-dimensional digital presentation of the two-dimensional scene in the real world through computer graphics

technology. In order to better show the effect of virtual display, it is necessary to establish an interactive virtual space. In order to achieve this purpose, it is necessary to establish an optical space model, which mainly consists of two parts: optical space model and virtual space model. Among them, the light space model includes two parts: the light and shadow of the object. The light of the object is captured by the camera and transmitted to the computer for calculation, according to the reflection of the light and the surface of the object to produce the corresponding projection effect; while the shadow part is captured by the camera and transmitted to the computer for calculation, according to the reflection of the surface of the object to produce the corresponding shadow effect.

Optical space transformation technology mainly refers to the use of light and the reflection relationship between the surface of the object to complete the simulation of the object lighting and shadow effects, and ultimately in the virtual space to present a realistic three-dimensional stereoscopic visual effects [15]. Taking the above figure as an example, the set of points controlling the overall shape is denoted as:

$$\Omega_1 = \{A, A_1, B, B_1, C, C_1\} \tag{1}$$

The set of points controlling the specific shape of the left view is denoted as:

$$\Omega_2 = \{A, A_1, A', A_1'\} \tag{2}$$

According to the above rules, the wall, top surface and other positions are drawn separately to realize the conversion process from 2D to 3D. Light space has strong artistic expression and visual impact, which can realize the three-dimensional presentation of the scene and give the audience a strong visual experience. In addition, the light space can also be displayed under different angles, distances and speeds according to user needs. Based on the light space transformation technology can realize the object in three-dimensional space for all-round, multi-angle, multi-level display, so that people can perceive and cognize the object in an all-round way. Through digital technology to realize the multi-dimensional presentation of things, so that people can understand things in a more intuitive, more three-dimensional and richer way.

III. A. 2) Interaction Point Extraction and Matching

The extraction and matching of interaction points in the optical spatial transformation technology refers to converting the point cloud data in the scene to the point cloud data in the optical spatial transformation model, and then converting the point cloud data back to the scene model to realize the purpose of interaction. The method is mainly divided into two steps, the first step is to extract the matched interaction points from the scene, and the second step is to cluster the matched point clouds to generate the optical space model. First, the OTSU algorithm is used to extract the interaction points in the scene. In the OTSU algorithm, the input image is first processed by mean filtering and then median filtering. The algorithm first performs median filtering on the input image to filter out some noise. Then the filtered image is binarized to extract the region that may match the interaction points. At this time, the pixel coordinates (x, y) of the point X in the optical space are denoted as:

$$\begin{cases} x = \dfrac{a - a_0}{j \cdot z(i) \cdot x(i)} = \dfrac{x}{dx} + V_x \\ y = \dfrac{b - b_0}{j \cdot z(i) \cdot y(i)} = \dfrac{y}{dy} + V_y \end{cases} \tag{3}$$

In the above equation, $x(i)$, $y(i)$ denote the wide angle of the point on different axes, $z(i)$ denotes the original wide angle, a, b denote the viewpoints of the point on different axes, a_0, b_0 denote the original viewpoints, dx, dy denote the size of the pixels of the point on different axes, V_x, V_y denote the resolution on different axes. Gaussian blurring is applied to each image and the blurred image is quadratically matched to the interaction point region. Finally, within the maximum window obtained, the optical space model coordinates (X, Y, Z) corresponding to each interaction point region are calculated and input into the optical space transformation model as interaction point model parameters. In the OTSU algorithm, the input image is smoothed to obtain the optical spatial model parameters (X, Y, Z), which can also be tracked and measured using the Kalman filter.

III. A. 3) Interactive virtual display design process

The interactive virtual display design process mainly includes the following aspects [16]:

(1) Establishing a three-dimensional model. Before modeling, understand the customer's needs and determine the display theme. For example, the theme of the display, the form of the display and the acceptance of the audience. In addition, it is also necessary to research and analyze the content of the display, such as: what are the

exhibits, what is the value of the exhibits, and what are the means of display. The collected information is modeled by computer software to construct a three-dimensional model. Pay attention to the accuracy and detail processing of the model when modeling, and consider the cost, efficiency and user experience of the model when optimizing the model.

(2) Rendering the scene. Render the scene through the renderer, render the built model into a 3D model that meets the customer's requirements, and import it into the virtual reality system to provide users with the required information.

(3) Interaction control. Interaction control refers to providing human-computer interaction function in the virtual reality system. The human-computer interaction function realizes the user's operation and experience of the virtual display content, and at the same time, the user can also freely choose the operation mode according to his own needs, such as: mouse operation, keyboard operation, gesture operation and so on. The overall process is shown in Figure 2.

In the process of display, it is also necessary to carry out video rendering and production. Video production mainly includes three parts: video material preparation, video post-editing, and video output. In the production of video, attention should be paid to avoiding situations such as lagging, and selecting the appropriate output method according to specific needs. In the video post-editing, attention should be paid to the editing rhythm, dubbing and other issues. Finally, the produced video is released to the network platform for publication, so as to complete the research of interactive virtual display technology based on light space transformation technology.

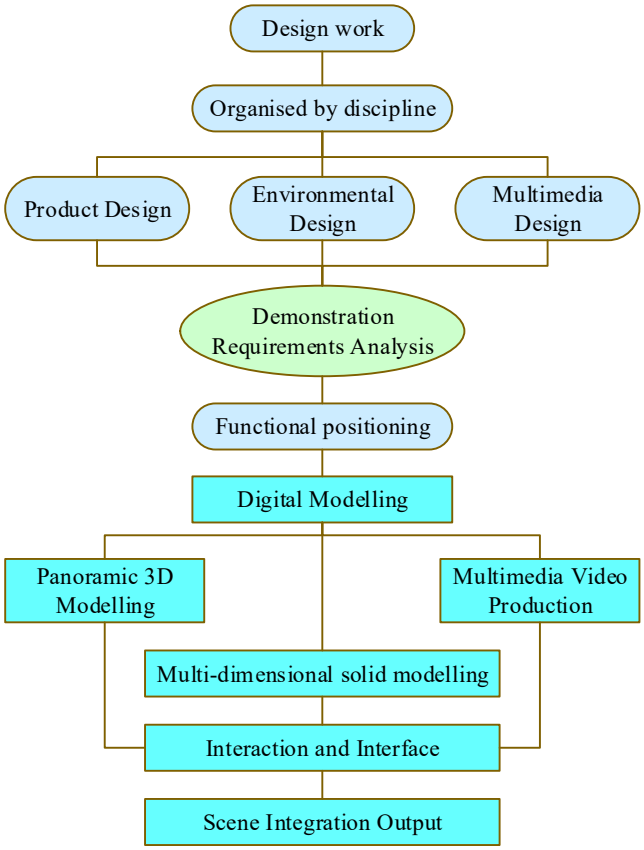

Figure 2: Interactive virtual display design process

III. B. Immersive interactive virtual image art space construction

The use of pre-trained classifiers for recognition can effectively improve the recognition efficiency during the test period.SVM classifiers need to be trained before the test, through the test platform to obtain the image of the hand unfolded and the image of the hand clenched in a fist and labeled, the optimization objective of the linear SVM classifier is a linear approximation of the logistic regression optimization objective, defined as:

$$\min_\theta C\sum_{i=1}^{m}\left[y^{(i)}\cos t_1\left(\theta^T x^{(i)}\right)+\left(1-y^{(i)}\right)\cos t_0\left(\theta^T x^{(i)}\right)\right]+\frac{1}{2}\sum_{j=1}^{n}\theta_j^2 \tag{4}$$

Among them:

$$\begin{cases}\cos t_1(\theta^T x^{(i)}) = -\log h_\theta(x^{(i)}) \\ \cos t_0(\theta^T x^{(i)}) = -\log[1 - h_\theta(x^{(i)})]\end{cases} \tag{5}$$

$$h_\theta(x) = \begin{cases}1, \theta^T x \geq 1 \\ 0, \theta^T x < -1\end{cases} \tag{6}$$

where, C is a constant term, m is the number of samples, n is the number of features, θ^T is the vector composed of features, $(x^{(i)}, y^{(i)})$ is the i th sample, and $h_\theta(x)$ is the hypothesized model of SVM.

The coordinates of the pixel points of the framed hand in the left and right images can be obtained by segmenting and recognizing the hand images in the left and right images. According to the principle of triangulation the spatial distance in the depth direction of the point can be calculated by parallax with the following formula:

$$\frac{D - (x_l - x_r)}{Z - f} = \frac{D}{Z} \tag{7}$$

where, D is the distance between the optical axes of the left and right cameras (m), Z is the depth information of the target under the vision system (m), f is the focal length (m), x_l is the transverse coordinate of the corresponding point in the left image (m), and x_r is the transverse coordinate of the corresponding point in the right image (m).

IV. 4. Spatial creativity research in video art design

IV. A. System testing

In order to test the effectiveness of the interactive film and television art space virtual system designed in this paper based on virtual reality technology to establish virtual scenes in art space, the computer configured with Inter Core i5 - 9600KF Core 6 CPU, 8 GB memory, and the operating system of Windows 10, and the Java language is selected to build the system in this paper.

Statistics using the system of this paper to build 10 different types of three-dimensional film and television art space virtual scene to perform different operations such as moving, zoom in, backward and so on the average response time, and will be the system of this paper and the multi-star constraints system as well as the mixed reality system comparison, Table 1 for the different systems of the response time comparison.

In this paper, the average response time for scene construction and various operations during the combination of light elements with time and space is lower than 90 ms, and the average time for space construction and the combination of light elements with time and space is 67.2 ms and 73.9 ms, respectively, while the average response time for scene construction and texture mapping using multi-star constraints system and mixed reality system is in the range of 260~325 ms, which is the same as that in this paper. 325ms, the system in this paper is significantly better than the other two systems, effectively verifying that the system in this paper has high real-time and interactive performance.

Table 1: Response time contrast of different systems(ms)

Image space scenario name	This method		Multistar constraint		Mixed reality	
	Space setup	The combination of light elements and time and space	Space setup	The combination of light elements and time and space	Space setup	The combination of light elements and time and space
Bedroom	58	65	246	284	237	383
Living Room	60	70	203	276	308	350
Toilet	50	74	267	293	326	298
Dining Room	67	72	298	220	345	269
Study	66	88	286	238	268	287
Bath Center	70	85	240	283	270	342
Reading Room	71	77	238	248	389	380
Landscape	70	80	268	269	357	293
Exhibition Hall	75	56	300	257	379	248
Cafe	85	72	259	269	353	293

In order to further verify the interactive performance of this paper's system, 50 architects were selected to evaluate the user experience of the 10 3D image art space virtual scenes established by this paper's system using the expert evaluation method, and the multi-star constraint system and mixed reality system were selected as the comparison systems, and the results of the comparison of user experience are shown in Table 2.

The average scores of interactivity, realism and hierarchy of the 10 different types of 3D video art space virtual scenes established by the system of this paper are 93.9666, 94.1113 and 93.2813 respectively. The three-dimensional image art space established by using the two methods of multi-singular constraints and hybrid realization are all below 90 points, and the experimental results show that the users have better experience in establishing the virtual scene of three-dimensional image art space by using the system of this paper, which again verifies the interactivity performance of this paper's system.

Table 2: User experience comparison

Image space scenario name	This method			Multistar constraint			Hybrid implementation		
	Interactivity	Veracity	Hierarchy	Interactivity	Veracity	Hierarchy	Interactivity	Veracity	Hierarchy
Bedroom	91.786	92.648	91.536	84.536	85.436	84.135	80.536	79.548	81.569
Living Room	92.599	92.485	91.636	86.598	85.348	82.569	81.548	78.436	82.468
Toilet	92.489	95.536	91.485	85.425	85.758	79.536	82.636	76.536	83.615
Dining Room	92.636	93.748	92.533	87.136	86.158	78.536	83.485	81.458	84.563
Study	94.593	93.123	93.548	86.248	87.466	83.458	86.264	83.536	85.626
Bath Center	93.348	95.346	94.866	84.663	85.366	81.598	82.636	86.425	81.485
Reading Room	94.859	95.636	94.636	87.469	81.269	84.669	79.458	82.366	79.536
Landscape	96.536	96.536	94.248	88.636	85.318	86.348	79.625	83.485	78.596
Exhibition Hall	94.165	94.266	96.789	88.465	86.425	81.569	84.596	81.658	79.569
Cafe	96.655	91.789	91.536	83.648	82.369	76.598	81.699	83.488	81.569
Average	93.9666	94.1113	93.2813	86.2824	85.0913	81.9016	82.2483	81.6936	81.8596

IV. B. Data Analysis of Audience Experience Test Results

The information related to the recruitment of the experimental subjects was released in an online form, and a total of 36 interested evaluators were recruited from the neighboring groups through QQ, WeChat, and Weibo to take part in the test, of which 18 were male evaluators and 18 were female evaluators. Since the questionnaire included a grading of the assessors' spatial expression base of modern Chinese video art design, individuals who had a complete mastery of the video plot or a strong subjective will for video art were not excluded from the recruitment process. Prior to participating in this experiment, none of the individual subjects had viewed or experienced immersive virtual modern images.

After all the assessors finished the assessment, a total of 36 responses were collected in this experiment, the number of valid questionnaires was 36, the questionnaire recovery rate and validity rate were 100%, all the data statistics and analysis in this experiment will be executed using SPSS software. After obtaining the information from the questionnaire, the questionnaire is first analyzed for reliability and validity. Validity analysis can determine whether the design of the test items of the questionnaire is reasonable or not, and reliability analysis can measure whether the answer results are reliable or not, that is, whether the respondents answered all the questions of the questionnaire truthfully or not, and the results of both analyses are the most effective for the questionnaires based on the scale data, which is especially applicable in this experiment.

IV. B. 1) Evaluation of the effect of virtual reality video art experience

The standard deviation of the scores of the detailed indicators falls within the range of 0.648~1.254, and the degree of dispersion of the data in each group is small, which indicates that the data results have a certain degree of statistical significance. The scale data show that the average value of the audience experience of virtual reality video art under the detailed indicators in each dimension is almost all above 4 points, and only the item of “perspective immersion” is 3.948, which indicates that most of the evaluators have a positive experience in this experiment, and give a high evaluation of the aspects of this work.

Under the single experience dimension, the weights of the detailed indicators are evenly distributed. The calculation and statistics of the ratings of the indicators and the overall mean value of the four dimensions can be

obtained in Figure 3. The chart shows that the total rating of each dimension of the creative audience experience of the virtual reality video art space is above 4. Among them, the audience's recognition of this work has the highest rating of 4.445, while the sensory experience of the work has the lowest rating, with a mean value of 4.111.

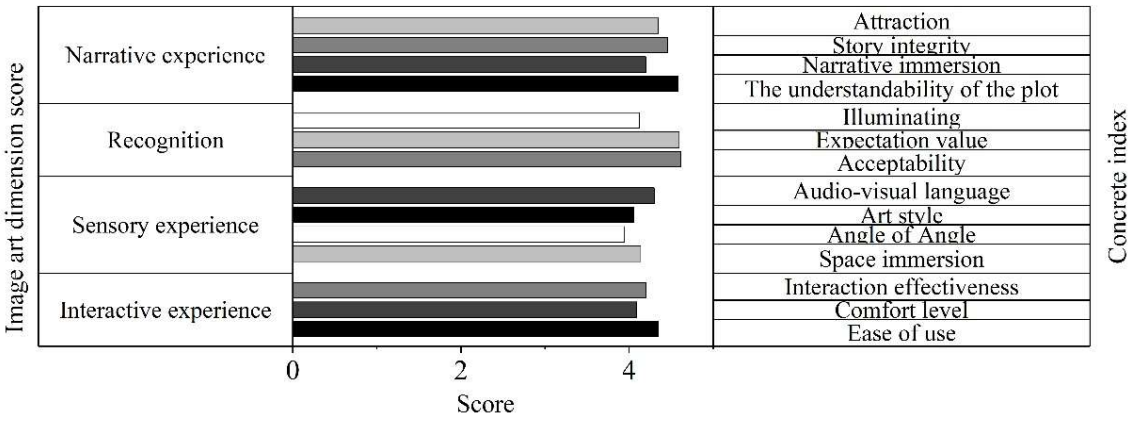

Figure 3: The virtual reality film and television art four dimensional score

IV. B. 2) Individual audience experience scores

There are two individual characteristic variables in the data dimensions of this study, one of which is the gender of the rater, and the other is the individual rater's interest in and knowledge of video art. The independent samples t-test was first conducted with the gender variable and the results are shown in Table 3. The t-test can compare whether the difference between the means of two groups of data is significant or not, using the size of the p-value in the table as a criterion for judgment, when $p<0.05$, it represents a difference in the means, and when $p<0.01$, it represents a significant difference in the means.

Among the assessment indicators, only “art style” showed a gender-related difference in mean values, with female raters giving this item a mean value 0.734 higher than male raters, P=0.034 less than 0.05. In addition, all of the mean values of the ratings for males were slightly lower than those for females, although no significant gender-related differences were shown on the other indicators. Due to the small total sample size, this situation may be related to individual low-scoring samples and is not indicative of the influence of gender factors on preference for virtual reality video art.

Table 3: Independent sample t test of gender variables

/	Gender(Mean±SD)		T	P
	Male(n=18)	Female(n=18)		
Ease of use	4.315±0.748	4.348±0.748	-0.148	0.859
Comfort level	4.048±0.645	4.066±0.648	-0.189	0.854
Interaction effectiveness	3.948±1.348	4.318±0.966	-1.089	0.215
Space immersion	3.994±1.188	4.315±0.948	-1.365	0.369
Angle of Angle	3.648±1.158	4.155±0.966	-1.274	0.248
Art style	3.635±1.025	4.369±0.948	-2.298	0.034*
Audio-visual language	4.189±0.975	4.235±1.025	-0.185	0.855
Acceptability	4.536±0.748	4.658±0.648	-0.348	0.748
Expectation value	4.485±1.036	4.605±0.865	-0.548	0.626
Illuminating	3.848±1.093	4.358±0.648	-1.648	0.148
The understandability of the plot	4.536±0.618	4.618±0.648	-0.189	0.818
Narrative immersion	3.948±1.065	4.498±0.898	-1.485	0.168
Story integrity	4.744±0.748	4.596±0.748	-0.248	0.849
Attraction	4.186±1.152	4.498±0.799	-0.548	0.486

Next, a one-way ANOVA was conducted using the individual's level of interest in and understanding of video art as the variable, as shown in Table 4. The scale analyzed the correlation between the individual interest of the raters and their scoring data on the two dimensions of recognition and narrative experience, and the results of the analysis were also based on the size of the p-value in the table as a checking criterion. From the table, it can be

seen that there is no significant correlation between the individual interest and the detailed index data on these two groups of dimensions, and the p-value ranges from 0.296 to 0.844, and the p-value is greater than 0.05. That is to say, the individual's degree of interest in and understanding of video art in this experiment does not significantly affect the individual's experience scores in the assessment experiment.

Table 4: Analysis of the single factor variance of the interest variables of the image art

/	Gender(Mean±SD)			F	P
	Lower level(n=13)	Medium level(n=20)	High level(n=3)		
Acceptability	4.548±0.848	4.785±0.636	4.054±0.155	1.248	0.296
Expectation value	4.569±1.185	4.566±0.748	4.058±1.485	0.369	0.648
Illuminating	3.948±1.169	4.266±0.789	4.054±0.087	0.618	0.525
The understandability of the plot	4.687±0.469	4.566±0.636	4.515±0.789	0.164	0.844
Narrative immersion	4.169±1.196	4.248±0.989	3.536±0.789	0.538	0.569
Story integrity	4.596±0.636	4.425±0.856	4.044±0.155	0.458	0.618
Attraction	4.198±1.196	4.415±0.859	4.000±0.000	0.348	0.678

V. Conclusion

By analyzing and testing the video art space display system based on virtual reality technology, the results show that the system shows strong advantages in several aspects. The average response time of the system is less than 90ms in both the light space building and light element combining process, in which the response time of the light space is 67.2ms. Compared with the traditional multi-singular constraint system (the response time is between 260ms and 325ms) as well as the mixed reality system (the response time is between 260ms and 325ms), the system in this paper has a significant real-time advantage. In addition, the user experience scores also show that the system's performance in terms of interactivity, realism and hierarchy far exceeds that of the comparison system, which are 93.97, 94.11 and 93.28, respectively.This suggests that the creative display of video art space based on virtual reality technology can have a positive impact on visual effect and audience experience, further promoting the innovative development of video art display.

References

[1] Wohlgenannt, I., Simons, A., & Stieglitz, S. (2020). Virtual reality. Business & Information Systems Engineering, 62, 455-461.

[2] Xie, B., Liu, H., Alghofaili, R., Zhang, Y., Jiang, Y., Lobo, F. D., ... & Yu, L. F. (2021). A review on virtual reality skill training applications. Frontiers in Virtual Reality, 2, 645153.

[3] Onyesolu, M. O., & Eze, F. U. (2011). Understanding virtual reality technology: advances and applications. Adv. Comput. Sci. Eng, 1, 53-70.

[4] Du, W., & Li, Q. (2022). Analysis of the Visual Design and Expression Effect of Virtual Reality and Three-Dimensional Space Technology in Art Space. Mathematical Problems in Engineering, 2022(1), 2065720.

[5] Hudson, S., Matson-Barkat, S., Pallamin, N., & Jegou, G. (2019). With or without you? Interaction and immersion in a virtual reality experience. Journal of business research, 100, 459-468.

[6] Suh, A., & Prophet, J. (2018). The state of immersive technology research: A literature analysis. Computers in Human behavior, 86, 77-90.

[7] Viktoriia, B. (2025). Creating Music for Shorts Videos as a Transition to a New Modern Art Form. Open Journal of Social Sciences, 13(4), 645-658.

[8] Zhang, L., Wang, Y., & Liu, J. (2023). Artistic Creation in Virtual Space. Technology and Language, 4(3), 40-48.

[9] Earnshaw, R. A. (2021). A new renaissance for creativity in technology and the arts in the context of virtual worlds. The Visual Computer, 37(12), 2921-2929.

[10] Liu, P., Song, C., Ma, X., & Tang, X. (2022). Visual Space Design of Digital Media Art Using Virtual Reality and Multidimensional Space. Mobile Information Systems, 2022(1), 8220572.

[11] Wang, Y. (2023, March). Intelligentization of Art Design System Based on Multidimensional Visual Image Reconstruction Algorithm. In 2023 3rd International Conference on Smart Data Intelligence (ICSMDI) (pp. 161-164). IEEE.

[12] Serna-Mendiburu, G. M., & Guerra-Tamez, C. R. (2024, April). Shaping the future of creative education: the transformative power of VR in art and design learning. In Frontiers in Education (Vol. 9, p. 1388483). Frontiers Media SA.

[13] Lyu Wen & Wei Ding. (2024). Innovative Approaches in Video Art Education: Peer Review Mechanism, Somaesthetics, and Evaluation System Reform. Frontiers in Art Research,6(9),

[14] GuerraTamez Cristobal Rodolfo. (2023). The Impact of Immersion through Virtual Reality in the Learning Experiences of Art and Design Students: The Mediating Effect of the Flow Experience. Education Sciences,13(2),185-185.

[15] Du Wei & Li Qian. (2022). Analysis of the Visual Design and Expression Effect of Virtual Reality and Three-Dimensional Space Technology in Art Space. Mathematical Problems in Engineering,2022,

[16] Li Manqi,Wang Guohua,Fu Xiao & Ren Lili. (2022). Interactive Design of Museum Display Space Based on Virtual and Reality Technology. Wireless Communications and Mobile Computing,2022.