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Research Article

Multimedia Drama Imaging Technology Based on Big Data Information System

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Opera is a unique comprehensive stage art form in China. As a traditional Chinese drama style, it is known as the three ancient drama cultures in the world together with the tragicomedy of ancient Greece and the Sanskrit drama of India. However, in the trend of the new era, Chinese opera is facing a severe existential crisis. How to innovate the opera and make people fall in love with the opera again is a problem worthy of research and analysis at present. This study takes the research of multimedia opera image technology as the object, aims to improve the perception and experience of opera, and studies how to use modern technology to improve opera image. First, this study briefly expounds on the presentation methods and current situation of traditional opera video technology. This study then describes in detail the imaging technology that combines opera and modern technology and then establishes the algorithm model of virtual reality imaging technology. And it then describes in detail the video technology that combines Chinese opera with multimedia technologies such as projection and virtual reality interaction. It then established a virtual reality technology algorithm model for opera images. This study then experiments, analyzes, and improves the multimedia opera video technology based on virtual reality. Finally, by means of a questionnaire survey, it investigates and analyzes the viewing attitude of opera images based on virtual reality technology. Through the research of virtual reality image technology and the investigation of citizens, this study obtains the methods and models to improve traditional opera images and effectively innovates opera. In a survey of citizens, it was found that nearly 70% of the respondents held a positive and optimistic attitude toward the virtual reality-based opera video technology, indicating that people are willing to accept the combination of traditional culture and modern technology. In the element loss detection experiment, it was found that nearly 70% of the interviewees were very interested in the method of combining traditional opera with modern technology. The model of virtual opera scene construction was improved so that the element loss rate was lower than 4%. The element representation delay is less than 3%, which improves the smoothness of the picture and maintains a good viewing experience.

1. Introduction

The art of opera is a unique cultural art and cultural heritage. Its long cultural history, unique art form, and excellent performance skills have achieved an irreplaceable position in classical art. In the era of various media, opera is used as a carrier and bridge to communicate and dialogue with popular culture, which has become a very important factor in inheriting traditional culture. However, in recent years, the art of opera is suffering from an unprecedented crisis of survival and development, and "inheritance" and "innovation" are the keys to the continuation of opera. At the same time, as an emerging technology, big data is developing rapidly. The emergence of big data and multimedia has brought new vitality to the inheritance of opera. Relying on advanced science and technology, the big data information system continuously injects new ideas and new technologies. Especially in the image presentation of opera, it completely subverts the single and flat presentation of traditional opera. The application of holographic imaging technology, virtual reality technology, and 3D technology in multimedia technology makes the visual effect of opera more ornamental. Therefore, the research on the multimedia opera image technology based on the big data information system is of great significance for the inheritance, innovation, and development of opera.

The performance form of opera has changed from hand-to-mouth to stage performance, to the popularization of film and television and the wide spread of new media. The traditional opera presentation form has undergone tremendous changes. For the original single mode of dissemination and a separate stage performance form, the constraints of time and space in opera make it difficult for it to be disseminated on a large scale. Big data and multimedia are unique in merging popular forms of entertainment. For example, when Huangmei opera is sung, it absorbs the unique form of opera and re-creates it so that opera can return to the public's vision in a more popular form. The drainage from popular to classical has made the masses pay attention to the inheritance and development of opera again. Big data and multimedia have injected new vigor and vitality into opera.

In the process of research and investigation of multimedia opera video technology based on big data information system, several results can be obtained. (1) This study compares the traditional opera image presentation technology with the traditional opera image presentation technology combined with modern technology. It highlights the advantages of the improved opera image presentation technology. The improved opera images are more enjoyable to watch, with a stronger sense of experience and interaction. It is liked by more people. (2) This study uses modern technologies such as projection technology and virtual reality technology to improve the image of opera, which enhances the appreciation of opera performance and optimizes the experience of opera.

2. Related Work

Many scholars have paid attention to the research of multimedia opera image technology. Suandi et al. used multimedia technology to study Balinese dance, an intangible cultural heritage. The user survey results show that the use of multimedia technology is very helpful to the viewing experience of Balinese dance [1]. Thomas has studied the influence of multimedia technology and big data analysis system on image imaging, and this research has achieved good results [2]. Deng et al. provided a comprehensive overview of image technology and feature selection techniques for text classification, introducing some popular image technology and document representation schemes, and similarity measures used in image and text classification. He ended by discussing the advantages and disadvantages of state-of-the-art feature selection methods [3]. Ge and Persia surveyed the multimedia information systems and recommender system communities and proposed a series of research challenges for image technology improvement and image dissemination, which can be used to suggest future research directions for multimedia recommender systems. For each research challenge, he also provided insights on how to conduct follow-up research [4]. However, the guidance models of these methods are not accurate enough, and the accuracy of the output results is not high enough.

Virtual reality technology can increase the diversity of opera images and enhance the experience of opera performance. Tian realized the design of an immersive 5G virtual reality visual display system through big data information technology. He designed and implemented an immersive virtual reality visualization system from the visual, auditory, and tactile three-dimensional display modes. It creates a realistic and interactive 3D visualization environment for users [5]. Raouf et al. built a 3D virtual maze developed based on the MazeSuite app, and he navigated healthy adult participants using fMRI-compatible equipment. He took this measure to find the location of hidden objects by adapting the virtual image to the surrounding environment [6]. Hussain studied the techniques and methods necessary to display 2D and 3D virtual reality images on multimedia devices. Devices such as computers and smartphones convey content through realistic and useful videos, images or sounds, and these electronic devices can capture these contents from different locations on a virtual site [7]. Škola and Liarokapis studied the effects of virtual reality on image generation in the human brain. He used an experimental design with subjects with sham control stimuli. He investigated the effect of anodal transcranial direct current stimulation of brain regions associated with bodily self-processing on the subjective intensity of virtual representations and their principal components [8]. However, these studies require a large amount of data as support and are complicated to operate.

3. Presentation Method of Multimedia Opera Video Technology

3.1. Traditional Media Drama Image Presentation Technology

3.1.1. TV Media. Television media is the media platform with the widest audience at present, and it has the responsibility of public opinion guidance and cultural dissemination [9]. In previous TV dramas, TV and drama were essentially separate, and drama was only presented to the audience through the medium of television. Opera should not be played passively in the form of video. If only the images of operas are standardized and the stories are presented in a cookie-cutter form, it is easy to cause visual fatigue and reduce the appreciation of operas [10]. Therefore, if we want to carry out innovation, we can only achieve a win-win situation by combining TV media and traditional opera art.

At first, television was only used as a platform for the art of opera. The general forms include opera competitions, opera programs, opera interviews, etc., as shown in Figure 1. The form of expression is relatively monotonous, hence its rise over time and other interesting programming forms. The ratings for these dramas plummeted. The popularization of TV media enables the dissemination and promotion of opera through the TV platform. However, viewership is the lifeblood of a TV show, and if no viewers watch it, the TV show has no value. Therefore, in the era of entertainment, the presentation of opera must be changed and innovated. It can be integrated into the modern environment and be known and loved by the public.

Figure 1: Traditional TV media drama images.

3.1.2. Film and Television Media

(1) Opera and Animation. Opera is often integrated into animation with elements such as music and character modeling. The combination of opera and animation can not only enrich the senses but also promote the culture of opera [11]. The more typical ones are "Havoc in Heaven," "Autumn River," and so on, as shown in Figure 2. On the one hand, animation can break away from the rules of reality, get rid of the constraints of time and space, and use computer technology to create innovative images, sounds, shapes, and other elements; and scenes that could not be shown onstage originally can be clearly shown in the animation. On the other hand, the exaggerated expression of animation can also magnify the characteristics of opera. It makes the picture more impactful, the characters are more vivid, and the artistic effect is better displayed [12]. For example, when making animated images of operas, unreal stories can be used as scripts. Therefore, the artistic features of opera can be well expressed in surreal scenes.

(2) Opera and Movies. At the beginning of the last century, both movies and operas were in a stage of rapid development, so scenes combining movies and operas were not uncommon [13]. In 1905, China's first film "Dingjun Mountain" was born. This film combines a large number of opera elements to create a unique Chinese style and show traditional Chinese culture. In recent years, excellent films such as "Farewell My Concubine" and "Women-Demon-Human" that directly show the stories of opera characters have appeared in front of the audience, making opera dramas regain a strong vitality, as shown in Figure 3. The fusion of opera elements in films can be divided into two categories: one appears in a specific form, such as music, modeling, and movement, and becomes a symbol of traditional Chinese culture; the other is based on an existing complete opera story, adapted into a movie and put on the screen directly, such as the movie "The Orphan of Zhao."

Movies were born under the development of modern industry and science and technology. While enriching people's entertainment life, they also had a certain impact on traditional opera [14]. Opera can present ideological connotations through a freer film language. The process of transforming the art of opera into a film is itself a process of polishing and improving the expressive power of opera. The current development trend is the multi-faceted and deep integration of film and traditional opera. On the one hand, films can use opera elements to enrich their form and expressive content. On the other hand, opera has been widely disseminated through movies, which can be better integrated into the trend of entertainment culture development.

3.2. Emerging Multimedia Opera Image Presentation Methods Based on Big Data

3.2.1. Definition of New Media. Multimedia of emerging technologies is also called new media. It is a form of communication that uses digital technology to provide users with information and services through computer networks, mobile phones, digital TV, and other channels. The presentation form of new media is constantly being redefined with the development of science and technology [15, 16]. For newspapers, radio is the new medium. For broadcasting, television is the new medium. For TV, the Internet is new media, so the medium of new media is not fixed. The classification of new media is shown in Figure 4.

As shown in Figure 4, new media can be roughly divided into four categories: network new media, mobile new media, new TV media, and other new media, including Internet TV, short message services, and media information inquiries in detail.

3.2.2. Projected Image. Among theater equipment, projectors are the cheapest and most common multimedia equipment [17]. It has space to put a projector and a curtain, and it can put on a wonderful audio-visual performance in a limited space. Coupled with the effective combination of splendid lighting effects, wonderful interpretation of characters and other elements, the sensory experience of the audience can be greatly improved. It allows the simplest stage installations to have the greatest effect.

The collage of 3D illusory images is one of the functions of multi-screen projection, which expands Wumart's creative freedom and shows the perfect fusion of surreal and realistic scenes. The people and things presented by the projector are real, but the relative relationship between them is not real. This makes the surreal scenes provide infinite possibilities for the innovation of opera. The audience's eyes

Figure 2: Animation "Havoc in Heaven" and "Autumn River."

Figure 3: Movies "Farewell My Concubine" and "Women-Demon-Human."

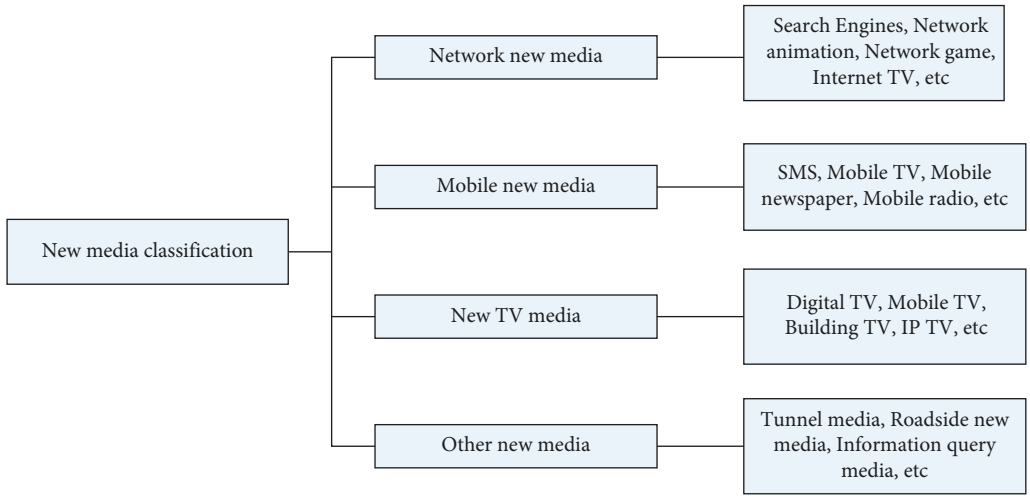

Figure 4: Classification of new media.

blur the boundaries between reality and virtuality, and they travel freely between the two worlds of reality and non-reality.

The combination of dynamic and quiet onstage is often one of the ways to enhance emotional expression and promote audience resonance. By combining moving images with static backgrounds using projection, it enhances the texture of the picture. The layout of the projection and the selection of the curtain will also bring more possibilities to the display effect. The use of a translucent curtain can enhance the visual contrast and enhance the visual experience.

Regarding the production of projected images, it still follows the basic visual production modes such as traditional photography and photos. For lighting, the lighting arranged on-site and the lighting presented by the image need to be considered together. In good work, the lighting is vivid and emotional. It can set off the atmosphere of the scene, mobilize the senses of the audience, and bring the audience into the story completely. Sound is also an indispensable element, narration dubbing and background music sound effects are the most commonly used means to match video presentations.

With the maturity of technology, the holographic projection known as three-dimensional space projection technology is also gradually improving, which makes the performance of opera almost subverts the traditional. The holographic projection breaks the wall between the audience and the opera, stimulates people's fantasy, and provides

space for more potential possibilities. For example, the theatrical performance "Today's Anren" extends the story scene created by the drama. Through space design and digital media technology empowerment, it has created a new "Republic of China Cultural Dynamic Museum" and "Mansion Fantasy Garden." Together they build a multi-dimensional dramatic mystery. It allows the audience to have a cross-time and space dialogue with the culture of the Republic of China under three different experience modes. It uses technology, art, and close-up drama to create an immersive viewing experience for the audience. The scene of the applied projection technology is shown in Figure 5.

3.2.3. LED Electronic Display. With the advancement of technology, LED technology is widely used in many fields. The LED electronic display is a new type of electronic imaging equipment, which arranges light-emitting diodes in a specific order. Nowadays, embedding LED screens into actual scenes is popular everywhere. It replaces the scene layout with an electronic screen, which cooperates with the actors' performances. It can interact with the audience, allowing them to travel freely between the real space and the virtual scene and experience it freely. Through the use of LED technology, the emotions of the audience can be intuitively affected, which maximizes the stimulation and resonance of the audience.

In the play "Echo" jointly designed and produced by the art team MINBRE and visual designer, the LED electronic display used is 8 meters wide and 11 meters high. It also uses a special processing system to generate real-time 3D images to accurately and timely capture the movements of the actors. It is then played in real-time on the LED electronic display. This interaction between actors and multimedia devices constitutes the main means of expression in the drama, and at the same time, the audience can obtain a visual experience that is completely different from everyday life [18]. With the development of digitization, people have become more pursuing spiritual stimulation, and creators can also open up new horizons and create new works. The scene of using an LED electronic display screen in an opera performance is shown in Figure 6.

It has many advantages in integrating LED displays into opera performances: (1) It can choose light-emitting tubes with high color saturation to enhance visual stimulation. (2) It makes the change of light and color smooth, the connection is natural, and the operation is simple. (3) It is safe and energy-saving, and the light source is environmentally friendly. At the same time, it also has some disadvantages: (1) The heat dissipation performance is low, and there is a risk of burning. (2) The cost is higher. (3) The requirements for the venue environment and temperature are relatively high. (4) The lamp tube is easily damaged.

3.2.4. Virtual Reality Interaction. Compared with the traditional opera stage space, the environmental opera stage space pursues to create a realistic, multi-dimensional, and dynamic visual effect. It hopes to set off the atmosphere of the opera by truly reproducing the environment of the opera at that time [19]. The immersive choreography of audio-visual language is the sensory experience that new media art and opera art jointly pursue to give the audience. There is a contrast between virtual images and real stage elements, and the contrast in time and space is stronger in the dynamic state of motion. These video technologies do not exist as stage sets but participate in the structure of these media elements.

Interactive media art emphasizes the high participation of the audience and the interaction between the audience and the media. The core difference between interactive media art and other art forms is the new interactive relationship between creators, audiences, and works in the interaction. It is a new form of artistic expression produced with the development of emerging technologies and the continuous innovation of artistic concepts. Environmental theater and interactive media technology have three things in common, that is, they both need to be displayed in a three-dimensional space instead of a flat two-dimensional stage space.

The simple geometry changes size and position with the performer's movements. These are determined by the transmission sensor carried by the performer to capture the movement and position in real-time to determine the angle and coordinates of the projection. This interaction between body and influence also opens up new modes of performance. It puts forward deeper and more difficult requirements for performers' performance skills, and inspires the innovative ideas of countless art creators. The development of interactive technology can realize image capture and real-time output, and the use of film language can realize the switching of time and space. The real-life performance and the virtual space-time blend and interact, making the audience immersed in it, blurring the boundary between true and false, and unable to distinguish the difference between reality and fantasy.

An AR interactive opera "Love Letter" came out in 2015, and the audience was experiencing this opera performance. It only needs to open the "AR Love Letter" software of the mobile terminal and point the front camera of the mobile terminal at the stage model. It then clicks a button on the interface to choose a different track to play. The virtual actors can then perform onstage. Audiences can also choose from lighting, virtual backgrounds, and stage effects. Audiences who are in a passive state in traditional opera viewing have gained an interactive and diversified new interactive experience in such performances. Figure 7 shows the scene using virtual reality technology.

3.3. Virtual Reality Technology Algorithm of Opera Images. In virtual technology, images mainly include two-dimensional images and three-dimensional models. If it wants to modify the properties of objects in the virtual scene, it needs to transform elements such as position, size, and rotation [20]. This is mainly changed according to the corresponding geometric mathematical model.

Figure 5: The scene of the projection technology used in the opera performance "Today's Anren."

Figure 6: The scene of using LED electronic display screen in opera performance.

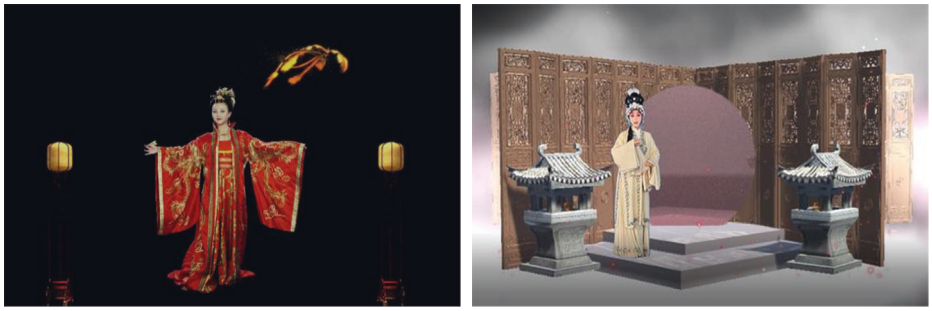

Figure 7: Drama performance based on virtual reality technology.

3.3.1. Transformation of Two-Dimensional Images. Image transformation usually refers to the proess of changing the geometric information of the graphics after geometric transformation, thereby generating new graphics. When the image is transformed, the coordinate system does not change, the image changes, and the coordinate values in the coordinate system change accordingly. Since the image is represented by homogeneous coordinates, the transformation matrix is used to transform the image. Let $[a\ b\ 1]$ be the coordinates of the two-dimensional image before transformation and $[a'\ b'\ 1]$ after transformation.

(1) Two-dimensional image transformation matrix is as follows:

$$U_{2d} = \begin{bmatrix} e & f & k \\ f & i & l \\ g & j & m \end{bmatrix}. \tag{1}$$

Formula (1) is divided into four submatrices $\begin{bmatrix} e & h \\ f & i \end{bmatrix}$, $[g\ \ j]$, $\begin{bmatrix} k \\ l \end{bmatrix}$, $[m]$, $\begin{bmatrix} e & h \\ f & i \end{bmatrix}$ is the operation of scaling, rotation, symmetry, etc. on the image, $[\,g\ \ j\,]$ is the translation transformation, $\begin{bmatrix} k \\ l \end{bmatrix}$ is the projection transformation, and $[m]$ is to scale the entire image U_{2d} is a Cartesian coordinate system that defines a two-dimensional space. It can be regarded

as three-row vectors, [1 0 0] is the infinity point on the a-axis, [0 1 0] is the infinity point on the b-axis, and [0 0 1] is the coordinate origin.

(2) Translation transformation is as follows:

$$\begin{aligned}\begin{bmatrix} a' & b' & 1 \end{bmatrix} &= \begin{bmatrix} a & b & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ g & j & 0 \end{bmatrix} \\ &= [a + U_a b + U_b 1].\end{aligned} \tag{2}$$

(3) Scale transformation is as follows:

$$\begin{aligned}\begin{bmatrix} a' & b' & 1 \end{bmatrix} &= \begin{bmatrix} a & b & 1 \end{bmatrix} \begin{bmatrix} P_a & 0 & 0 \\ 0 & P_a & 0 \\ 0 & 0 & 1 \end{bmatrix} \\ &= [a + U_a b + U_b 1].\end{aligned} \tag{3}$$

(4) Symmetric transformation is as follows:

$$\begin{aligned}\begin{bmatrix} a' & b' & 1 \end{bmatrix} &= \begin{bmatrix} a & b & 1 \end{bmatrix} \begin{bmatrix} e & h & 0 \\ f & i & 0 \\ 0 & 0 & 1 \end{bmatrix} \\ &= [ea + fb\, ha + ib\, 1].\end{aligned} \tag{4}$$

(5) Rotation transformation is as follows:

$$\begin{aligned}\begin{bmatrix} a' & b' & 1 \end{bmatrix} &= \begin{bmatrix} a & b & 1 \end{bmatrix} \begin{bmatrix} \cos\alpha & \sin\alpha & 0 \\ -\sin\alpha & \cos\alpha & 0 \\ 0 & 0 & 1 \end{bmatrix} \\ &= [a \cdot \cos\alpha - b \cdot \sin\alpha\, a \cdot \sin\alpha + b \cdot \cos\alpha 1].\end{aligned} \tag{5}$$

3.3.2. Transformation of Three-Dimensional Images

(1) Transformation matrix is as follows:

Using U_{3d} to represent the geometric transformation matrix of the three-dimensional image, we get:

$$[U_{3d}] = \begin{bmatrix} e_{22} & e_{24} & e_{26} & e_{28} \\ e_{42} & e_{44} & e_{46} & e_{48} \\ e_{62} & e_{64} & e_{66} & e_{68} \\ e_{82} & e_{84} & e_{86} & e_{88} \end{bmatrix}. \tag{6}$$

It divides the formula (6) into four sub-matrices $\begin{bmatrix} e_{22}e_{24}e_{26} \\ e_{42}e_{44}e_{46} \\ e_{62}e_{64}e_{66} \\ e_{82}e_{84}e_{86} \end{bmatrix}$, and generates geometric transformations such as scale, rotation, and staggered cut. Among them, $\begin{bmatrix} e_{82} & e_{84} & e_{86} \end{bmatrix}$ produce translation, $\begin{bmatrix} e_{28} \\ e_{48} \\ e_{68} \end{bmatrix}$ produces projection, and $[e_{88}]$ produces the overall scale transformation of the 3D image.

(2) Translation transformation is as follows:

$$\begin{aligned}\begin{bmatrix} a' & b' & c' & 1 \end{bmatrix} &= \begin{bmatrix} a & b & c & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ U_a & U_b & U_c & 1 \end{bmatrix} \\ &= [a + U_a b + U_b c + U_c 1].\end{aligned} \tag{7}$$

(3) Scale transformation is as follows:

Assuming the reference point is $(A_j B_j C_j)$, we get

$$\begin{aligned}&\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ -A_j & -B_j & -C_j & 1 \end{bmatrix} \begin{bmatrix} P_a & 0 & 0 & 0 \\ 0 & P_b & 0 & 0 \\ 0 & 0 & P_C & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ A_j & B_j & C_j & 1 \end{bmatrix} \\ &= \begin{bmatrix} P_a & 0 & 0 & 0 \\ 0 & P_b & 0 & 0 \\ 0 & 0 & P_c & 0 \\ (1 - P_a) \cdot A_j & (1 - P_b) \cdot B_j & (1 - P_c) \cdot C_j & 1 \end{bmatrix}.\end{aligned} \tag{8}$$

(4) Rotating of the coordinate axis is as follows:

(a) Rotating around the a-axis,

$$\begin{bmatrix} a' & b' & c' & 1 \end{bmatrix} = \begin{bmatrix} a & b & c & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos\alpha & \sin\alpha & 0 \\ 0 & -\sin\alpha & \cos\alpha & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}. \tag{9}$$

(b) Rotating around the b-axis,

$$\begin{bmatrix} a' & b' & c' & 1 \end{bmatrix} = \begin{bmatrix} a & b & c & 1 \end{bmatrix} \begin{bmatrix} \cos\alpha & 0 & -\sin\alpha & 0 \\ 0 & 1 & 0 & 0 \\ \sin\alpha & 0 & \cos\alpha & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}. \tag{10}$$

(c) Rotating around the c-axis,

$$\begin{bmatrix} a' & b' & c' & 1 \end{bmatrix} = \begin{bmatrix} a & b & c & 1 \end{bmatrix} \begin{bmatrix} \cos\alpha & \sin\alpha & 0 & 0 \\ -\sin\alpha & \cos\alpha 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}. \tag{11}$$

By establishing the formula of virtual reality opera imaging technology, it constructs a complete and scientific virtual opera scene model, and then the model will be tested and analyzed to test the picture effect and fluency of the model.

3.3.3. Collision Detection. The position, size, and rotation of objects in the virtual scene must be transformed according to the corresponding mathematical model [21]. When the object moves, the image space will be disturbed by two-dimensional objects and three-dimensional objects. Virtual reality is the reproduction of the real physical world. If there is penetration between objects, it will not conform to the rules of the real world and will appear abnormally fake.

From the perspective of the space domain, it can be divided into two categories: object space and image space. There are four types of bounding boxes: bounding sphere, AABB, OBB, and K-Dop, as shown in Figure 8.

(1) *Bounding the Ball.* The bounding sphere refers to the smallest spherical space of the object, that is, the smallest sphere that contains the object, and the center of the bounding sphere is the maximum and minimum values of the vertex coordinates. Let $(A_{\max}, B_{\max}, C_{\max})$ be the maximum value of the vertex coordinates, $(A_{\min}, B_{\min}, C_{\min})$ the minimum value, the center of the sphere (O_A, O_B, O_C), and the radius be R.

$$O_A = \frac{1}{2}(A_{\max} + A_{\min}),$$
$$O_B = \frac{1}{2}(B_{\max} + B_{\min}), \tag{12}$$
$$O_C = \frac{1}{2}(C_{\max} + C_{\min}).$$

The radius is

$$R = \frac{1}{2}\sqrt{(A_{\max} - A_{\min})^2 + (B_{\max} - B_{\min})^2 + (C_{\max} - C_{\min})^2}. \tag{13}$$

Suppose there are bounding spheres (S_1, R_1) and (S_2, R_2) of two objects in the virtual space, and judge whether they intersect. It only needs to compare the radius values of the two sphere centers and the distance d between $(R_1 + R_2)$ and the two sphere centers. If $d < (R_1 + R_2)$, the objects intersect, and if $d > (R_1 + R_2)$, they do not intersect.

(2) *Bounding Box*

(a) *Intersection Test of OBB Bounding Boxes*
Figure 9 is a schematic diagram of an OBB bounding box intersection test. E and F represent the OBB bounding box, S is the unit vector parallel to the separation axis, and V is the distance between the centers of E and F. R_E and R_F are the projection radii of E and F on S, and $|V \cdot S|$ represents the distance after E and F are projected. e_k and f_k are the radii of E and F, respectively, and E_k and F_k are the axis unit vectors of E and F, then

$$|V \cdot S| > (R_E + R_F) = \sum_{k=1}^{3} |e_k \cdot E_k \cdot S| + \sum_{k=1}^{3} |f_k \cdot F_k \cdot S|. \tag{14}$$

Formula (14) means that the bounding box of E and the bounding box of F do not intersect.

(b) *Comparison of Different Bounding Box Features.* The feature comparison of four commonly used bounding boxes is shown in Table 1:
As can be seen from Table 1, the bounding sphere is simpler and does not need to be updated, but the tightness is poor. The AABB bounding box is simple, compact, and the rotation update speed is fast, and its performance is better. The OBB bounding box is tight but complex and the rotation update is slow, and it is the only one that does not apply to soft bodies; the K-Dop bounding box is tight but complex and the rotation update is also slow.

(c) *Intersection Test of Different Bounding Boxes.* The intersection test of different bounding boxes is mainly the intersection test of the bounding sphere and the OBB bounding box, as shown in Figure 10.
C and D represent the OBB bounding box and the bounding sphere, S is the unit vector parallel to the separation axis, V is the distance between the centers of C and D, and R_C, R_D is the projection radius of C and D on S. $|V \cdot S|$ represents the distance between C and D after projection, c_k is the radius of C, and C_k is the axis unit vector of C, then

$$|V \cdot S| > (R_C + R_D) = \sum_{k=1}^{3} |c_k \cdot C_k \cdot S| + R_D. \tag{15}$$

Formula (15) indicates that the bounding sphere and the OBB bounding box do not intersect.

3.3.4. Dissimilar Imaging in Projection System. In a projection system, the projector chip and the screen are conjugated to each other, and the pixels on the chip are projected onto the ring screen through the lens. When the opening angle of the ring screen is large, set the width of the projection chip to be m and the height to be n. It obtains the image height of the lens in the meridional and sagittal directions:

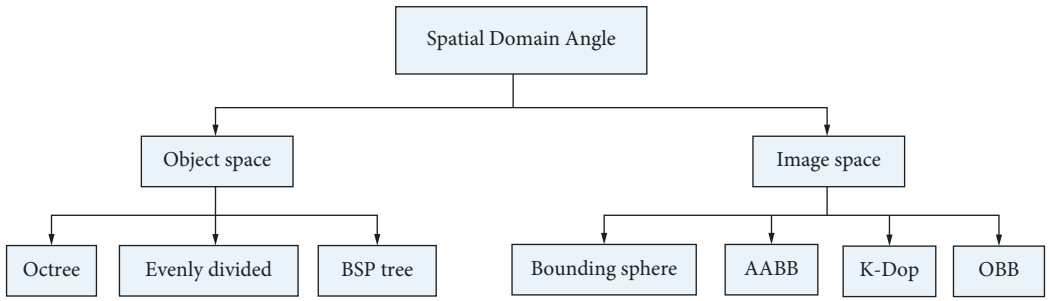

Figure 8: Spatial domain classification.

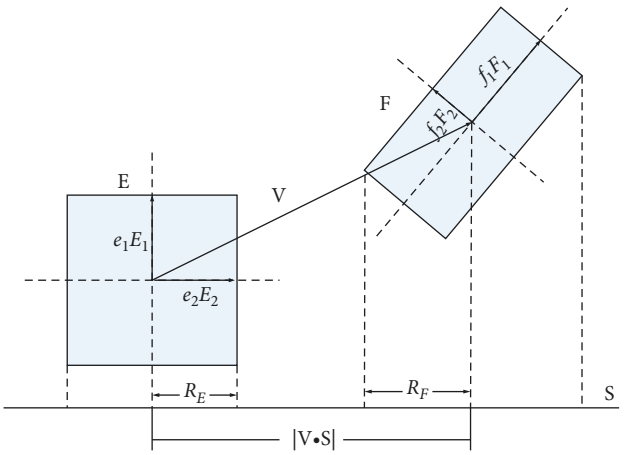

Figure 9: OBB bounding box intersection test.

$$\begin{cases} g_w' = -tf'\left(\dfrac{\mu_w \pi}{360}\right) \\ \qquad\qquad , 0.8 < t < 1, \\ g_r' = -tf'\left(\dfrac{\mu_r \pi}{360}\right) \end{cases} \tag{16}$$

g_w' is the half-field meridional image height, g_r' is the half-field sagittal image height, and the domain boundaries are m/2 and n/2. μ_w and others are the full field of view in the meridional direction of the lens, and μ_r is the sagittal direction. t is the distortion adjustment coefficient. If it wants to maximize pixel utilization, then

$$\begin{cases} \dfrac{m}{2} = -tf'\left(\dfrac{\mu_w \pi}{360}\right) \\ \qquad\qquad , 0.8 < t < 1. \\ \dfrac{n}{2} = -tf'\left(\dfrac{\mu_r \pi}{360}\right) \end{cases} \tag{17}$$

To make formula (17) hold, in any case, it is necessary to change the mapping law F to get

$$\begin{cases} g_w' = -t_w f_w'\left(\dfrac{\mu_w \pi}{360}\right), 0.8 < t_w < 1, \\ \\ g_r' = -t_r f_r'\left(\dfrac{\mu_r \pi}{360}\right), 0.8 < t_r < 1. \end{cases} \tag{18}$$

or

$$\begin{cases} g_w' = -f_w' \tan\left(\dfrac{\mu_w}{2}\right), \\ \\ g_r' = -2f_r' \tan\left(\dfrac{\mu_r}{2}\right), \end{cases} \tag{19}$$

or

$$\begin{cases} g_w' = -f_w' \tan\left(\dfrac{\mu_w}{2}\right), \\ \\ g_r' = -t_r f_r'\left(\dfrac{\mu_r \pi}{360}\right), 0.8 < t_r < 1. \end{cases} \tag{20}$$

When the meridional field of view of the lens is small, the Gaussian ideal imaging formula can be used in the meridional direction, such as formulas (19-20). Therefore, the utilization rate of the pixels can also be increased accordingly.

4. Experiment, Investigation of Multimedia Opera Video Technology Based on Virtual Reality

4.1. Real-Time Motion Capture Experiment of Opera Actors Based on Virtual Reality Technology. In opera performances based on virtual reality technology, it is often necessary to track the movement trajectory of performers in real-time and capture the performers' positions and movements in the real world through devices such as sensors and real-time image collectors. It transmits the data to the background, and after real-time calculation in the background, it transmits the results to the performers and the virtual reality devices arranged in the venue, and adjusts the visual presentation effect of the performance in real-time. Performer occlusion is a major problem for multi-person tracking when capturing motion and position. It takes shadow as an important factor and combines skeleton information to conduct real-time tracking experiments of multi-person positions.

In virtual reality systems based on multi-person interaction, Kinect is often used to track the used objects [22]. The shadow of the person moves with the person, so the shadow can be used to calculate the position of the occluded

Table 1: Feature comparison of four bounding boxes.

Bounding box type	Bounding sphere	AABB bounding box	OBB bounding box	K-dop bounding box
Simplicity	Simple	Relatively simple	Relatively complex	Complex
Tightness	Not tight	Relatively close	Close	Close
Rotation update	No update required	Fast	Slow	Slow
For rigid bodies	Yes	Yes	Yes	Yes
For software	Yes	Yes	No	Yes

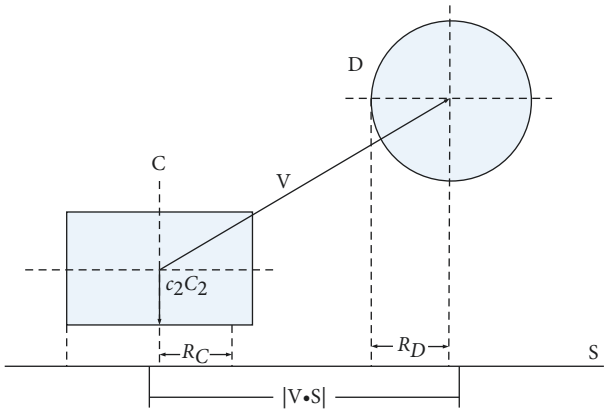

Figure 10: Intersection test of bounding sphere and OBB bounding box.

performer. When the performer moves arbitrarily along the coordinate system where the Kinect is located at different speeds, the tracking trajectory of the performer generated by the Kinect and the tracking trajectory obtained by calculating the shadow are obtained, and then the two trajectories are compared. The comparison results are shown in Figure 11.

By comparing the results, it can be concluded that the tracking trajectory of the performer based on the shadow calculation is very close to the tracking trajectory obtained from the skeleton data. Therefore, when the performer cannot be tracked due to being occluded, the performer's shadow can be used to continue tracking, thereby realizing real-time tracking of the performer.

Considering that the light source will affect the position of the shadow, it will affect the stability of the shadow tracking. And in most cases, the original skeleton tracking method is feasible in the system of multi-person interaction. Therefore, this experiment is mainly based on skeleton tracking to track the performer's position in real-time. Only when the performer's skeleton tracking fails, will shadow tracking be assisted for localization.

4.2. Element Loss Detection Experiment. If the opera performance scene established by using virtual reality technology wants smooth scene transformation and a better sense of realism, it is necessary to solve the problem of missing elements [23] and optimize the texture of the picture.

The observation interval is set as $S_{obs} = 1h$, and the data of element loss and element representation demonstration data that appear in each time interval of the ontology-based virtual opera scene within a week are recorded, as shown in Figure 12.

It can be seen from Figure 12 that the percentage of missing elements in the virtual drama scene test is scattered, with a maximum of no more than 4%, and the characterization delay of the virtual drama scene test shows a fluctuating trend, with a maximum of no more than 8%. It can be seen from Figure 12(a) that in the 60 intervals, the loss rate during the experiment of the ontology-based virtual opera scene is below 4%. Two-thirds of the observation intervals were below 1%, and only three observation intervals were greater than 3%. The average dropout rate is 0.64%, the annotation difference is 0.31, and the longest stable interval is 6. It shows that the algorithm in this study can satisfy the fluency and realism of virtual opera scenes.

As can be seen in Figure 12(b), in the 60-time intervals, the characterization delay in the process of the ontology-based virtual opera scene experiment is all below 6 s, and only one observation interval is 5 s. The average delay is 2.21 s and the standard deviation is 0.246. Compared with the modeling latency based on the original model, the performance is further improved. It can satisfy the fluency and realism of virtual opera scenes.

Therefore, the method based on virtual reality can completely simulate the whole process of opera performance. It establishes some specific scenes to truly and effectively improve the accuracy and realism of the virtual set so that the element loss rate is lower than 4%, and the element representation delay is lower than 3% [24, 25].

4.3. Survey on the Viewing Attitude of Opera Images Based on Virtual Reality Technology. This article takes the virtual reality opera film "Sanchakou" produced by Beijing Rhyme Data Project as an example. This study conducts a survey on the viewing attitude of Chinese opera films and the viewing attitude of Chinese opera images based on virtual reality technology for citizens of all walks of life in Haidian District, Beijing. A total of 1200 valid questionnaires were obtained. Among these respondents, 10% are under 20 years old, 35% are 20–40 years old, 38% are 40–60 years old, and 17% are over 60 years old. The occupations of the respondents include civil servants, employees of public institutions, employees of enterprises, students, retirees, teachers, self-employed persons, and freelancers. For the convenience of statistics, this article collectively refers to the occupations of the respondents as the following major types: government employees, public institution employees, enterprise employees, self-employed households, freelancers, students,

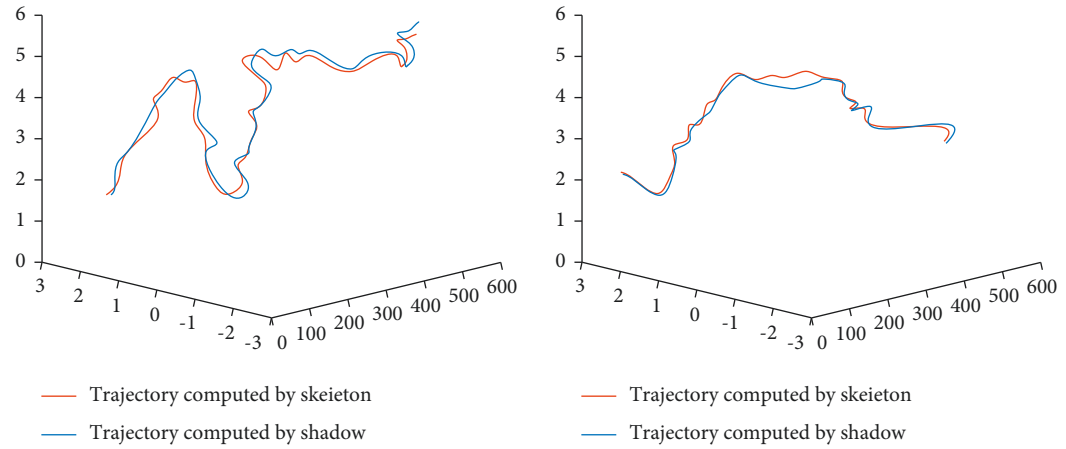

Figure 11: The tracking trajectory of the performer moving in any direction obtained by kinect.

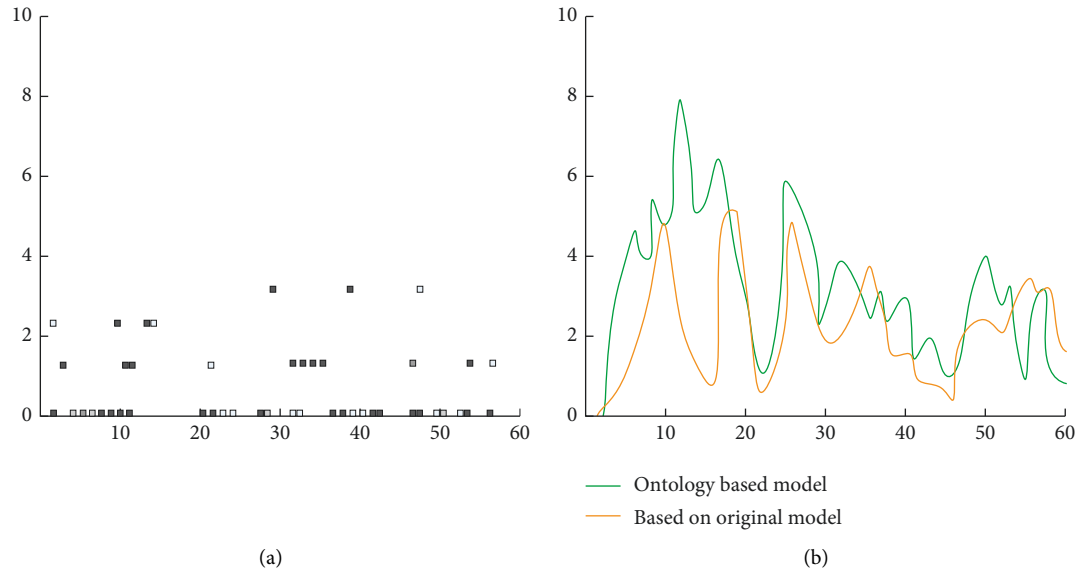

Figure 12: The results of the virtual opera scene test during the observation time. (a) Percentage of missing elements in virtual opera scene test. (b) Characterization delay of virtual opera scene test.

and retirees. Among them, 7% are government employees, 10% are public institutions, 28% are enterprise employees, 7% are self-employed, 16% are freelancers, 19% are students, and 13% are retirees. Among the respondents, 56% were male and 44% were female, and the age structure was relatively average. The composition of the interviewees is shown in Table 2.

From the survey results before watching the film, it can be concluded that 35% of citizens are interested in traditional opera, and 65% are not interested in traditional opera. The citizens who know about virtual reality technology account for 27%, and those who do not know virtual reality technology or know but do not understand account for 73%. About 83% of citizens want to know about virtual reality-based opera performances, and 17% do not want to know about virtual reality-based opera performances. According to the survey results after watching the film, 71% think that

Table 2: Composition of interviewees.

Gender	
Male	56%
Female	44%
Age	
Below 20	10%
20–40	35%
40–60	38%
More than 60	17%
Profession	
Government workers	7%
Employees of public institutions	10%
Enterprise staff	28%
Individual proprietor	7%
Freelance	16%
Student	19%
Retiree	13%

Table 3: Summary of survey results on the viewing attitude of Chinese opera images based on virtual reality technology.

	Before watching the opera video						After watching the opera video					
The type of investigation	Interested in traditional opera	Not interested in traditional opera	Know about virtual reality technology	Don't know about virtual reality technology	Want to know about opera performances based on virtual reality technology	Don't want to know about virtual reality-based opera performances	The opera performance based on virtual reality technology has a good appreciation	The traditional opera performance based on virtual reality technology has a poor appreciation	Willing to spend time and money watching	Unwilling to spend time and money watching	Be optimistic about the development prospect of the combination of opera and high technology	Be pessimistic about the development prospect of the combination of opera and high technology
The number of people	420	780	324	876	996	204	852	384	768	432	1080	120

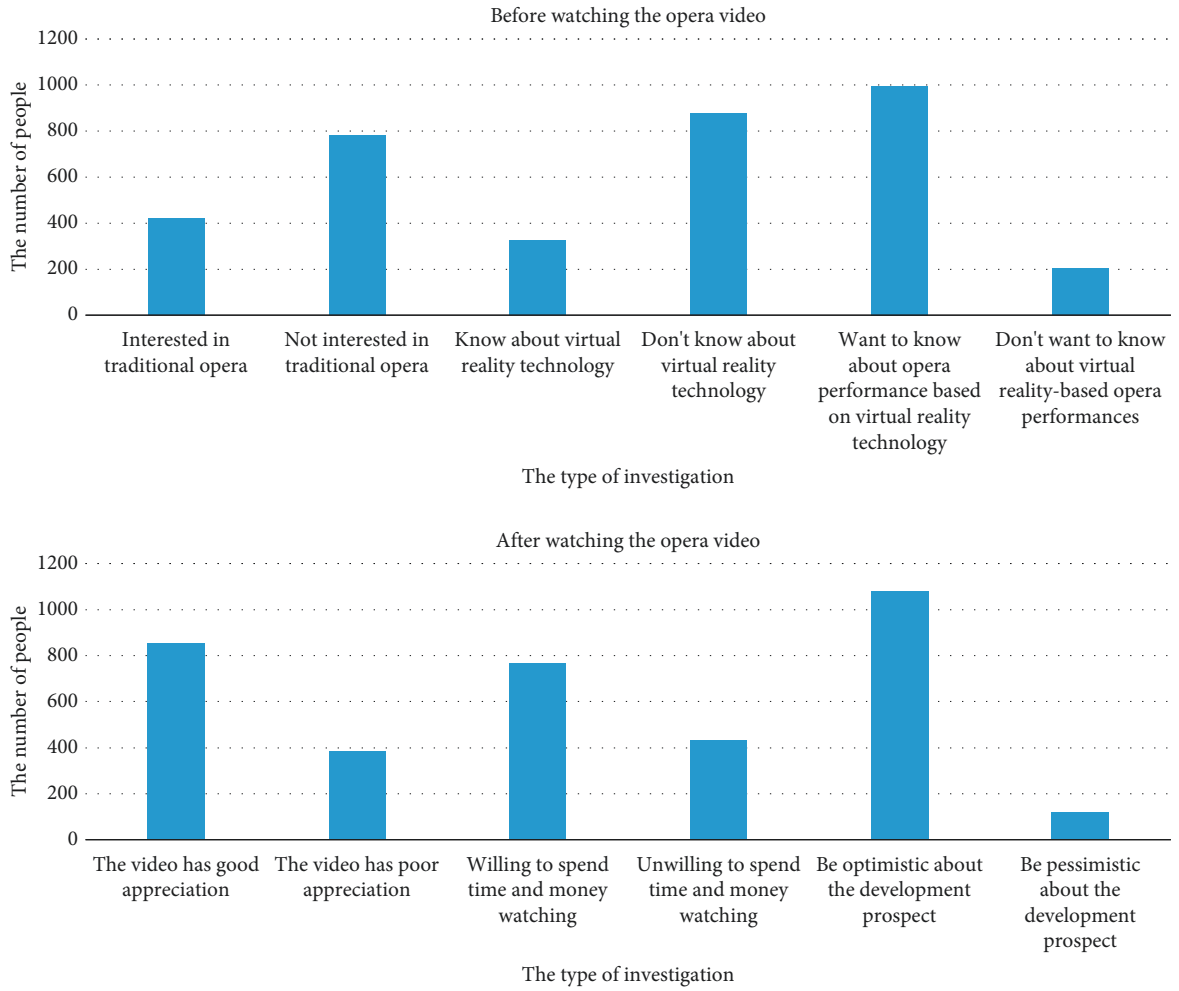

Figure 13: Graph of the survey results of the viewing attitude of Chinese opera images based on virtual reality technology.

the opera performance based on virtual reality technology is good to watch and the picture is exquisite, and 29% think that the drama performance based on virtual reality technology is poor to watch and the picture is not beautiful. If there is an opera performance based on virtual reality technology in a nearby theater, 64% are willing to spend time and money to watch it, and 36% are unwilling to spend time and money to watch it. About 90% are optimistic about the development prospect of the combination of opera and high technology, and 10% are pessimistic about the development prospect of the combination of drama and high technology. The survey results are shown in Table 3.

From Figure 13, it can be seen more intuitively that citizens are less interested in traditional opera performances. However, they are very interested in performing operas based on virtual reality technology. Before watching the film, nearly three-quarters of the interviewees were not interested in traditional operas. More than three-quarters of the interviewees wanted to know about virtual reality-based opera performances. After watching the video, two-thirds of the respondents believed that the opera performance based on virtual reality technology was good to watch and the pictures were exquisite, and they were willing to spend time and money to watch related opera performances in the future. This fully proves that people are attracted by new technologies such as virtual reality, and have a desire to understand, watch and experience new technologies. It has a very strong demand for sensory stimulation, innovation in imaging technology, and interactive experience. Therefore, the integration with modern technology has a positive role in promoting the inheritance and innovation of opera. It uses emerging media technology as a breakthrough point, transforms traditional opera into modern trends, and makes people fall in love with opera again [26].

5. Discussion

Opera has a long history and profound cultural heritage. It promotes excellent traditional culture and inherits the crystallization of human wisdom. However, with the change of the times and the rapid development of science and technology, opera has been lonely for a long time in the atmosphere of modern entertainment trends and the era of big data information. Therefore, how to make opera come alive again and be loved by the public, especially young people, has become a topic worthy of research. The future

development and inheritance of opera are inseparable from the help of science and technology. As a product of technological development in the new era, big data information technology and new media technology are gradually maturing and extending into various fields [27]. Its promotion of the digitization of opera culture is an inevitable trend to promote the development of opera. By using new era technologies such as holographic imaging technology and virtual reality technology to optimize and innovate opera images. It creates a virtual opera scene that breaks through the limitations of time and space, with exquisite and impactful pictures, and enhances the audience's sense of experience and interaction. It can truly realize the inheritance and development of opera in the modern information society. The development of culture has broadened the field of science and technology, and the progress of science and technology has promoted the prosperity of culture [28]. By combining traditional opera with modern technology, it can make opera radiate infinite vitality and make opera fly farther.

6. Conclusion

Through the analysis of this study, the following conclusions are drawn: (1) The traditional opera video technology is relatively old, and the presentation forms are the same, which can easily cause visual fatigue and reduce the appreciation of opera. (2) As emerging technologies, big data and new media play a very important role in optimizing the presentation and dissemination of opera images. It can rejuvenate traditional opera with new vitality. (3) The upgraded three-dimensional space projection technology based on traditional projection equipment breaks the barriers between the audience and opera, and enriches people's fantasy. It provides a broad space for more potential possibilities. (4) Virtual reality technology can create a realistic, multi-dimensional, and dynamic opera presentation effect. It can not only break through the limitations of time and space, turn the fantasy in the mind into a real picture, but also resonate emotionally with the audience, giving the audience a shocking visual feast. (5) To build a smooth and realistic virtual reality opera image, it needs to establish an algorithm model, perform collision detection and element loss experiments, and perform real-time motion capture for actors. Only by perfecting and optimizing the presentation of virtual reality opera performances can the audience truly appreciate the improved opera and rekindle their enthusiasm and love for opera. (6) In the investigation and experiment part, people have a strong interest in the presentation of opera images based on virtual reality technology. More than 60% of citizens are willing to learn more and are willing to spend time and money to watch opera performances based on virtual reality technology. Up to 90% of the citizens hold an optimistic attitude toward the development prospect of the combination of opera and high technology. (7) In the element loss detection experiment, it verifies that the element loss rate of the opera scene constructed by virtual reality is lower than 4%. The element characterization delay is less than 3% and less than 6s. It shows that the picture fluency of this opera scene is high and the viewing experience is good.

Data Availability

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

Conflicts of Interest

The author states that this article has no conflicts of interest.

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