The Application of Digital Interactive Technology in Shadow Play Art

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Abstract—The art of shadow play is on the verge of extinction. With the development of computer technology, digital shadow play has gradually become an effective means to protect shadow play art. This comprehensive performing art covers drama, music, fine arts, painting, sculpture, is China's precious intangible cultural heritage, with high historical value, artistic value, aesthetic value and cultural value. However, the traditional shadow play production process is complicated and the cycle is long, and shadow play has high requirements for the performance scene and the performer's skills. The impact of all kinds of modern art and the limitations of traditional shadow play art lead to the slow development of traditional shadow play art. In the long-term development, although the performing art of shadow play absorbs the strength of multi-culture and pursues innovation and modernization, multi-culture and entertainment methods still have a huge impact on its development. With the development of computer technology, digital shadow play has gradually become an effective means to protect shadow play art. In the fast-paced and fragmented modern society, fewer young people pay attention to shadow play culture. In order to make young people pay attention to shadow play culture again, inherit and develop the rich connotation of shadow play culture, this study takes the mode of motion-sense interaction as an innovative way, discusses the combination and development of shadow play culture with modern new media technology and interactive devices, and innovatively designs shadow play art through digital interactive technology.

Keywords-shadow play; interaction design; somatosensory interaction; kinect; animation

1 INTRODUCTION

Shadow play culture was one of the most popular literary and artistic activities in ancient times before it was impacted by films and television. Under the new historical conditions, with the impact of foreign culture and urban culture, the cultural soil of many folk arts is rapidly lost, and these folk arts that add color and laughter to our life are facing the dilemma of loss [1].

With the introduction and popularization of TV movies and animation in China, shadow play has gradually declined. Nowadays, most of the existing shadow puppets have been damaged to varying degrees, the skilled craftsmen are aging seriously, and the younger generation is gradually unwilling to pass on this craft.

Nowadays, shadow play is facing many problems such as lack of inheritors, loss of props and lack of audience. With the shadow play art being included in the list of world-class intangible cultural heritage of mankind, it shows the shadow play culture gradually falling into decline, and it is very difficult for people to pay attention to and protect it.

This paper hopes to creatively protect and inherit shadow play art through the combination of somatosensory interaction technology and shadow play art, so that it can play its unique charm and value in the current era.

2 BACKGROUND

2.1 Shadow Play Culture

As a traditional folk art in China, shadow play has a history of more than 2000 years since written records. Shadow puppetry is a theatrical form that allows the audience to watch a flat puppet performance of light shadows through a white curtain to achieve artistic effect. This art form is not only cheap, but also the performance form is not restricted by time and space, as long as there is light, shadow, and tools, you can perform anytime and anywhere. A shadow play performance can not be separated from the joint efforts of many people. Shadow play is not only a fusion of plane sculpture and art modeling, but also involves music and rap and other forms of artistic expression [2]. The plane puppet figures and scene props in shadow puppets are usually leather products made by folk artists with hand-carved and painted knives, so they are called shadow puppets[3].

There are many different theories about the origin of shadow play. According to the late writer Sun Kaidi, shadow play began in the middle and late Tang Dynasty or slightly later in the five Dynasties, when it was used to serve the Buddhist Dharma of proclaiming karma. The monks in monasteries use the figure as the soul of the dead when they expiate the sins of the dead. Some scholars also believe that shadow play began in the Song Dynasty, because according to the notes of Song Dynasty people, there are a lot of records about shadow play. In the "Records of Things", it is mentioned that during the reign of Emperor Renzong of the Song Dynasty, there were people in the city who were able to discuss the stories of the Three Kingdoms, someone used their stories to add decorations and made the shadow puppet. This was the first shadow play of the Wei Shu Wu War and has been passed down to this day. But it seems that the most highly respected statement is recorded in the Jin Dynasty's Ganbao "Soushenji" : "It is said that Shadow play started in the period of Emperor Wu of Han. After the death of his wife, Madame Li, Emperor Wu of Han's concubine, he was absent-minded all day long and ignored the government. Minister Li Shaoweng had a brainstorm and cut an image of Mrs. Li from cotton and silk, adding colors to the image and installing wooden poles at his hands and feet. In the evening, he used curtains as screens and candles as light sources to invite the emperor to watch the shadow play. Emperor Wu was very happy and loved Shadow play from then on. So now there is Shadow play." This story is about Emperor Wu of Han's missing for his concubine, which is believed to be the earliest origin of Shadow play [4].

Shadow play was once one of the most favorite literary and artistic activities of ancient people. The audience watching Shadow play can watch this unique form of lantern play with plane

figures through a white curtain. Looking at the evolution history of shadow play form, we can divide the performance of Shadow play into the following types[5-7]:

1.Watching across the screen: This is the most common shadow puppetry performance mode. The illumination of the light casts the shadow of the puppet onto a white cloth screen, and the audience admires through the cloth screen, unable to see the artist's movements behind the screen.

2.Watch from both sides of the screen: In some countries (such as Turkey), most viewers choose to watch from behind the screen. In Wayang Koulit shadow play in Indonesia, women watch from the front and men watch from behind the screen, which may be related to Islamic cultural traditions.

3.Performance without screen: The Wayang Lamah shadow puppetry in Bali, Indonesia performs during the day and does not require screen placement. The performer held up a huge flat puppet, and both actors and their puppets participated in the performance. The shadow cast by an actor onto the ground or stage background is also a part of the performance.

4.Surrounding viewing: During the primitive stage of religious commemoration ceremonies, the "hand shadow play" of the Song Dynasty in China, and the popular "hand shadow art" in Europe from the 17th to 18th centuries, the audience revolves around the performers to appreciate and participate in the performances.

2.2 Somatosensory Interaction Design

In 2006, Nintendo Corporation of Japan launched the Wii home gaming console. There is one game where people can complete game behaviors such as hitting and chopping by waving the Wii Remote controller. This novel game operation method allows players to experience the joy of human-computer interaction. However, obtaining user behavior through wearable devices such as sports helmets and data gloves only provides some comfort to players' hands and does not truly achieve tactile interaction [8].

In order to pursue better somatosensory interaction effect, non-contact interaction has now replaced contact interaction as the mainstream of somatosensory Interaction design. By utilizing infrared recognition technology and depth of field cameras to capture human motion data, users are completely liberated from wearable devices. Subsequently, in 2009, Microsoft launched the Kinect device. This device captures user action information through a series of cameras and can interact with games and other devices without the need for any controllers. Afterwards, in 2013, Leap, an American body sensation controller manufacturing company, released the Leap Motion body sensation detector, which enabled the body sensation device to recognize more complex and refined movements.

The development of somatosensory interaction in China started relatively late, but corresponding development work is also underway. Nanjing Huajie Amy Software Technology Co., Ltd. has explored human motion detection using its self-developed body sensation detection device "A100", and produced multiple body sensation interactive game products such as "Amy Hero" and "Amy Sports". Tianjin Fengshi Interactive Technology Co., Ltd. has launched a gesture detector called Micro Video Primary, which enables gesture operations such as card selection and issuance in the game "Hearthstone Legend" [9].

In recent years, more and more people have begun to pay attention to and protect the ancient art form of shadow play. Many researchers have combined shadow play with fashion design, conducted a detailed analysis and exploration of its artistic characteristics, and explored an effective design paradigm for the application of excellent traditional Chinese artistic elements in fashion design [10-12]. There are also many scholars who combine shadow play with cultural and creative product design, giving traditional shadow play the trend and innovation of cultural and creative products, so that traditional shadow play can spread and inherit with the help of cultural and creative brands [13-15]. Some researchers have organically integrated shadow play with digital illustration. As a flat visual art, shadow play has aesthetic characteristics representing the background of The Times and regional characteristics in its modeling features and style elements. Taking it as the creation subject, adding contemporary elements and using modern illustration creation techniques, a collision between classical and modern can be achieved [16].

3 DESIGN OF SENSORY INTERACTION SYSTEM

3.1 Structural Design

At present, the main way to protect shadow puppetry culture is to salvage existing shadow puppetry and then exhibit and visit them in museums. This protection method only seals up shadow puppetry culture, showcasing its past glory to people, and cannot present the performance skills, production techniques, and profound cultural heritage of the artists behind shadow puppetry culture. This article combines somatosensory interaction technology with shadow puppetry culture. On the one hand, shadow puppetry culture can be widely spread among people through new ways of dissemination, and on the other hand, by integrating shadow puppetry culture with somatosensory interaction technology, shadow puppetry culture can radiate fresh vitality in the new era.

The interaction framework designed in this article is mainly divided into three parts: input layer, interaction layer, and output layer, as shown in the figure 1.
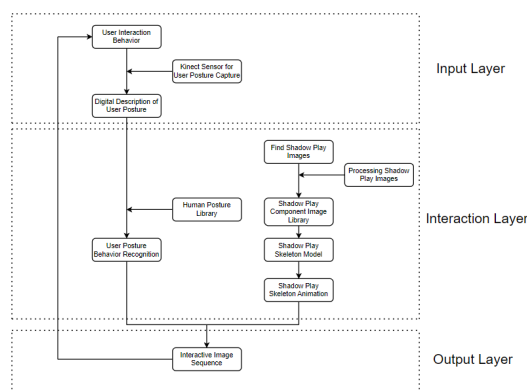

Figure 1. Interaction framework design.

The input layer mainly captures the natural features of user interaction actions in real time through Kinect sensors, and converts and digitizes the human posture. The Kinect plugin in Unity is used to convert and process the data input from the Kinect sensor, allowing the user's posture to be converted from image input to more easily processed digital input by the computer.

The interaction layer is captured by the Kinect posture capture function to capture the user's body posture. After the user stands in a specific location and chooses to enter the interactive interface, Kinect will recognize the user's location. By inputting the user's body posture contour into the Unity engine and capturing the human body range through a depth sensing camera, the human skeleton is recognized. Then capture the main joint points of human limbs and trunk through local search, and use line connections to generate the basic skeleton of the human body [17]. Then, by comparing the user's posture data with the human posture database data, the user's interactive posture can be accurately identified. The shadow Skeletal animation is produced by preprocessing the shadow image, and the user specific interaction posture is set as the trigger and feedback action of the shadow animation. Through feedback from shadow puppetry animation, users can clarify that their posture has interacted with the shadow puppetry interaction device.

In the output layer, the user interacts with the Kinect interaction device, and Kinect transfers the captured user action information to Unity and calculates the depth information. After analyzing the user's body movements, the action information is transmitted to the processor, which plays interactive images based on the action instructions issued by the user. Users gain a unique digital experience in shadow puppetry art through interactive images, thereby generating a strong interest in shadow puppetry culture and enhancing their understanding of it.

3.2 Image Processing and Animation Production

In the preliminary data investigation, a large number of image materials of shadow puppets were found. By using Photoshop software to process shadow puppetry images. Firstly, it is necessary to extract the shadow puppets from the image material. While extracting features, it is also necessary to avoid damaging the hollow features of the shadow puppets. Secondly, according to the needs of shadow puppetry animation, further separation of the limbs of shadow puppets is also necessary. As shown in Figure 2, the process of splitting and processing shadow puppetry images is shown.

Figure 2. Processing process of shadow play images.

After preliminary processing of shadow puppetry images, the next step is to design the animations that appear in the shadow puppetry interactive device. In Adobe Animate software, shadow animation can be made through Skeletal animation. Skeletal animation itself is developed from two animation modes: joint animation and keyframe animation. Joint animation considers a character as composed of several independent components, and achieves the effect of allowing the character to move by changing the displacement or angle information between the joints of different components. However, the visual effects produced by joint animation are often not realistic enough. Keyframe animation considers a character as a series of grids, and the position information of the character's parts is saved in each frame of the animation. Although the animation produced in this way is more realistic compared to joint animation, the relative motion between each joint is often not flexible enough. Skeletal animation combines the convenient motion of joint animation with the realistic effect of keyframe animation, and its manipulation is very similar to the motion of human body, making it easier to operate. Skeletal animation uses reverse dynamics to place the pose of the character with the mouse, and then reversely calculates the motion information and global transformation information of the upper level bone, and finally updates through the time series to generate animation. As shown in Figure 3, correspondence between Shadow Play Skeletons and Human Skeletons is shown.
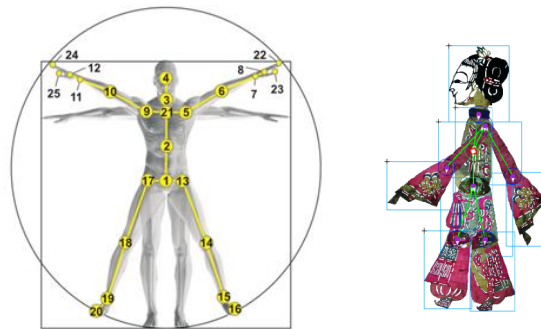

Figure 3.   Shadow Play Skeleton Mapping.

3.3 Hardware Usage

At present, there are three main ways of somatosensory interaction. The first way is to recognize the human body in the camera through AI algorithm, and then the computer can achieve the interaction effect by processing the Human skeleton model given by AI recognition. There are many drawbacks to this method. When the camera is obstructed and the human body is moving over a large range, the stability of AI algorithm detection heavily depends on the computer's own configuration, and the detection stability is also relatively poor. Especially in museums with limited lighting conditions, the stability and accuracy of AI detection will significantly decrease. The second method is to interact through the Leap Motion gesture sensor. However, because the effective working range of the Gesture recognition device is relatively close, only 25mm to 600mm. Due to the limitations of the recognition range of Leap Motion, it can only be used up close on a fixed device, which also affects the applicability of Leap Motion itself. Moreover, Leap Motion can only accurately recognize gestures and cannot track the

skeletal model of the entire body. Therefore, the shadow puppetry interaction device adopts a third interaction method, which is to track and recognize human posture through Kinect somatosensory recognition devices. The device is equipped with infrared depth camera, color camera, Microphone array and other devices, which can realize human bone tracking and other functions [18]. And because people can interact through Kinect sensors in space, it also avoids potential screen damage. Even in museums with limited lighting, Kinect sensors can still accurately recognize human movements. In addition, Kinect sensor data can realize human motion recognition without consuming a lot of computer computing power, and people's fluency in Progressive aspect interaction will be improved accordingly.

The main hardware devices used in this shadow play interaction device include Kinect sensors, audio devices, display devices, and computers. By connecting Kinect to a computer, the computer outputs the image. Project through a projector or connect to the large screen through a data cable. By utilizing computer processing systems and large screen displays, users can experience a good interaction experience. As shown in Figure 4, hardware device schematic is shown.
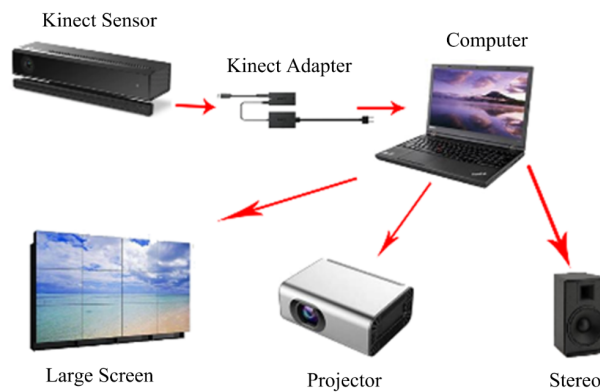

Figure 4. Hardware Device Schematic.

4 CONCLUSION

This article combines traditional shadow puppetry culture with modern new media art interactive devices, and through shadow puppetry interactive devices, re arouses people's attention and love for shadow puppetry culture. By combining sensory interaction technology with ancient shadow puppetry art, the forgotten traditional culture can be revitalized and make new contributions to the current era. We hope that with the development of interactive technology in the future, people can integrate traditional culture with technological innovation, providing strong scientific support for the inheritance and development of traditional art.

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