Analysis and Design of VR Immersive Art Experience System

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Abstract: Boundaries between virtuality and reality have become vague because of VR technology. VR immersive art can bring more amiable human-computer interaction experience to experiencers from multiple perspectives, including vision, hearing and touch, which can satisfy demands of both the creator and the experiencers. Through combination with current arts, VR technology can realize more visualized exchanges and interactions between artistic works and experiencers. In this way, experiencers can acquire corresponding art experience in immersive interactions.

1. Analysis of Experience and Feelings in VR Immersive Art

Immersive art is a new artistic form generated from integration of VR technology and human-computer interaction art. By realizing interactions between experiencers and art works through technological manners, immersive art can bring immersive-sense art activities to experiencers. VR immersive experience includes all-round multi-sense experience, including vision, hearing, smell and touch senses. By motivating experiencers' emotions and realizing interactions and communications with experiencers, it can bring an immersive feeling.

During the development history of human arts, creators would try different means in artistic creation, aiming to make visitors have immersive awareness of information conveyed by art works they create. As for audiences of VR immersive art, the VR immersive art works can bring all-around stereoscopic audio-visual effects as well as multi-sense information of touch, taste, smell and other senses. Audiences in the virtual environment will feel themselves immersive on the scene. Because of features such as immersion and interaction, VR can transform traditional appreciation art into dynamic art, enabling exploration of experiencers. Such progress will change people's awareness of traditional art, while art works can be presented to experiencers in a dynamic and non-linear manner. Such feeling cannot be perceived by us when we appreciate traditional art works at ordinary times.

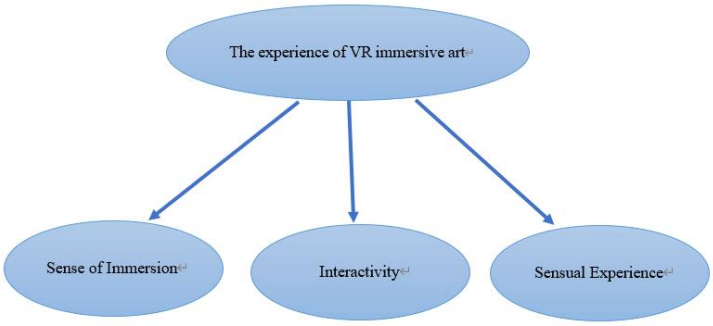

Figure 1: Analysis of experience and feelings in VR immersive art.

1.1. Sense of Immersion

In fact, the experience of immersion exists as a commonplace in some scenes of our daily life before invention of VR. For example, in some activities such as film watching, TV watching, book reading, recalling and thinking, we're deeply attracted and fall into fantasy, imaging that we're staying in a scene created rather than the real one we're experiencing. Then we may start thinking about how such feeling of immersion is generated. People receive information of the environment they stay in through their own sense organs, namely through manners such as watching, listening, touching, smelling and tasting, and then form the perception of the environment in their brain. The sense of immersion is formed and brought to people through replacement of brain perception with sense information. Based on the "immersive" feature of VR technologies, sense information with depth and breadth is provided for experiencers in a specific environment.

1.2. Interactivity

The second characteristic of VR immersive art is the interactivity between an experiencer and a machine interface. Specifically, "interactivity" means "people's operability towards objects in the virtual environment and the natural degree for them to get feedbacks in an environment". Based on different interactive modes between operators and machines, interactions can be divided into two types, namely "interactions on the visual level" and "interactions on the behavioral level".

People's interaction with work images from the visual level is called "visual interaction". In order to realize such visual interaction, VR system must be equipped with an advanced technology of real-time 3D graph generation and ensure a high refresh rate of graphs. For example, in a flight simulation system, images need to be refreshed in time as the flight speed would change correspondingly when an aircraft flies into different atmospheric layers. In order to simulate flight states in a real environment, the refresh rate of images must be equal to or higher than 15 frames per second, and the refresh rate higher than 30 frames per second is a relatively ideal choice.

The interaction between people and machines or equipment is classified as "behavioral interaction". VR immersive art can bring us a new type of experience simulating our thorough involvement in a virtual world. It is only a part of improvement of experience and feelings with VR. In virtual scenes, we can also participate in interactions and obtain the sense of control in the real world. This marks initiation of revolutionary experience. We can take the feeling brought by electronic games as an instance. A lot of game players are immersed in games mainly because games can bring the experience with a high degree of participation. Under vigorous support of powerful VR technology, human-computer behavioral interactions in aspects of eyeball tracking, motion capture, myoelectricity simulation and gesture tracking are realized with a series of

wearable devices such as helmet equipment. With the functions of computer image capture or scanning, subtle features of human eyes can be extracted for real-time tracking of eyeball changes, prediction of experiencers' states and demands and timely responding. In this way, the purpose of equipment control is realized. With the motion capture function, a series of time key points in an actual motion event can be recorded. Through combination of these time key points, independent math parameters can be obtained and then presented. In this way, the interaction with a participant is completed. In a VR scene, we can select our view angles and use various tools just like what we do in a real world. We can even adjust our postures and make different motions. Because of such sense of control, our brains can more easily believe the virtual perception at hand, so as to generate an in-depth sense of immersion.

1.3. Sensual Experience

Emergence of VR is another breakthrough in people's creation of spatial immersion senses. Upon emergence of films and TV, people start learning how to experience the sense of immersion in mobile frames. Thanks to technological development, we can see more exquisite frames, hear more vivid sound fields, and also get involved in the sense of immersion more easily. However, leaving from the scene is as easy as the entering as we can also receive other information by visual and audio senses. Hence, we can get distracted at any time. VR brings the experience which is completely isolated from that in the real world. Unless we decide to start, we can get away from any visual or audio information in the real world.

Under an immersive state, people can form spatial and temporal perception in the virtual world built by our brains. The dislocations between those two types of perceptions and the real world are the spatial immersion sense and the temporal immersion sense. VR immersive art can bring experiencers a very strong sense of spanning, namely spanning over limitations in time and space. In the real life, we cannot stay in two different spaces and moments at the same time. However, by virtue of the immersive experience, we can move from one space to another while staying indoors, so as to experience beautiful landscapes in the nature; and we can also "run across the space and time" to reach a real scene in Van Gogh's paintings, so as to explore sources of his artistic inspirations.

2. Design of Immersive Art Experience System

Immersive art works are mainly displayed at sites such as art venues, museums and public spaces and presented in human-computer interaction forms based on multiple senses and multimedia. Based on computer capture of multiple senses of a human (such as language, gesture, facial expression, posture, eye expression and touch), the system can make immediate feedbacks. Meanwhile, experiencers are "immersed" in the virtual environment and realize communications and exchanges with art works by multimedia and diversified technologies such as touchable or virtual human-computer interaction interfaces.

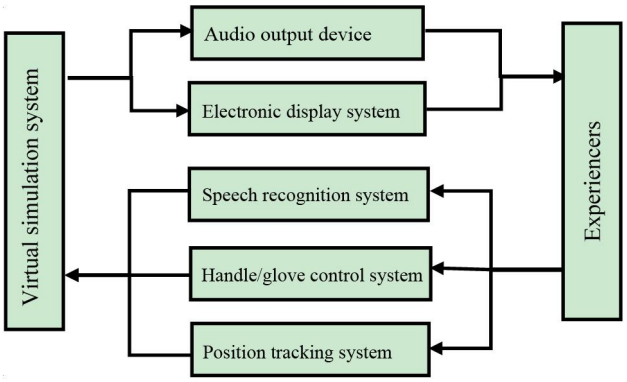

Figure 2: Interactive process between experiencers and artistic works taking the virtual simulation system as a carrier.

2.1. Virtual Simulation System

As for technological means, immersive experience is realized mainly by a CAVE immersive virtual simulation system which is a room-type virtual simulation collaborative environment. As a CAVE visual collaborative environment based on multi-channel visual synchronization technology, 3D spatial shaping and calibration algorithm, and stereoscopic display technology, the system provides a tetrahedral (or hexahedral) cubic projection display space with a room size, in which multiple persons can join interactions. In addition, all the participants are completely immersive in a virtual simulation environment enclosed by a 3D stereoscopic scene. With corresponding VR interaction devices (such as data gloves, force feedback devices and position trackers), participants can obtain 3D interactive experience with complete personal immersion.

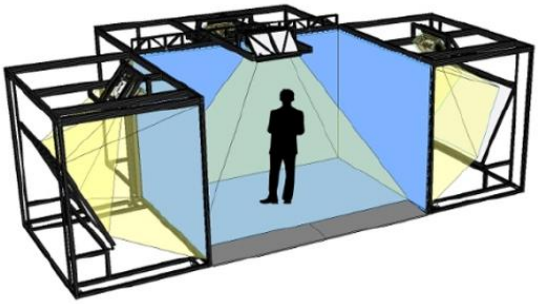

Figure 3: CAVE immersive virtual simulation system.

CAVE system is a display environment with unique design. With coverage of the entire view field of a participant, the CAVE display environment can bring users an unprecedented sense of immersion. Such stereoscopic display environment with complete immersion brings artists with thinking modes of unprecedented creativity.

Visual performance in VR immersive art is the first feeling brought to audiences who can get visualized perceptions of a work by eyes. Visual performance of such type of art has distinct features. Hearing is one of the important intuitions of human senses, ranking only second to vision. With sound, people can make communications and acquire information directly, so sound is an important carrier for information. In particular, sound inevitably plays a dominant role in art works which convey information mainly by sound. In immersive art, sound cannot constitute entire contents of a work, but it cannot be neglected. After certain visual impact is realized, the 3D surround background sound satisfying auditory requirements will soon make audiences get

immersed into the scene. In addition, it can set off atmospheres of the work to different degrees, becoming an important condition for creation of an immersive sense.

2.2. VR Interaction Equipment

VR immersive art completes human-computer interactions mainly through multiple technologies such as eyeball tracking, motion capture, touch feedback, gesture tracking, direction tracking and speech interaction.

The interaction mode of VR immersive art further emphasizes the sense of immersion and mainly relies on body sense interactions. It is necessary to apply the motion capture technology, so as to make an experiencer acquire the entire immersive sense and "enter" the virtual world. In fact, motion capture is "a course of recording a series of spatial key points in a real motion event, combining these key points, obtaining and finally displaying independent math parameters". Experiencers of immersive art can acquire the sense of experience mainly because a virtual environment can simulate a real scene and make people obtain sensory satisfaction approaching the real experience. Such implementation cannot do without the eyeball tracking technology. Specifically, subtle change characteristics of human eyes are collected and extracted with an image capture function of computers; and through real-time tracking of changes in eyes of users, the equipment can be controlled by eyes, such as EYESO Glasses, a head-mounted eye tracker product.

Figure 4: EYESO Glasses.

At present, gesture tracking is similar to screen-touch interaction on mobile equipment, which is a flexible and varied interaction mode limited in depth. Currently, gesture capture interactions are classified into those with optical tracking and those with data gloves of a sensor. Optical tracking directly integrates optical hand tracking to serve as an interaction mode for mobile scenes. In general, a data glove can replace an inertial sensor on the hand to track a user's arm motion. As a typical VR handle, Oculus Touch can realize accurate hand recognition and manipulation by a rocker, two buttons and a trigger on the semi-ring top. The motion experience is the same with that in a real environment.

Figure 5: Oculus Touch.

Tactile feedback technology is frequently applied in VR handles. Equipped with buttons and vibration feedbacks, it can simulate a real touch sense and make experiencers get rid of limits in visual sensing of the virtual environment. NeuroDigital Technologies has launched a VR glove called Gloveone. With a unique tactile feedback function, Gloveone can be compatible to different types of VR helmets. It can simulate real touch experience by vibration, so shape and weight of an object and force generated under impacts can be simulated. For example, while simulating piano playing with it, users can feel the touch sense of a piano; while catching an object, users can feel the weight of the object; and when users put their hand near a fire source in the virtual world, the glove will get hot in reality, and users can feel the heat emitted by the flame.

Figure 6: Gloveone.

Accurate interactions between users and machines can also be guaranteed by speech interactions. With such form of interactions, experiencers will not be confused by mass information in the virtual world; and such interaction will not interfere in the world experienced or influence users' immersive experience. Without moving their head or diverting their attention, experiencers can realize communications at different orientations. In this way, experiencers can make more natural communications with the VR world. Sensors can also sense changes in the virtual environment, so experiencers can make more natural interactions with virtual artworks.

3. Future Development of Human-computer Interaction of VR Immersive Art

Under unceasing development and updating, VR technology simulates a virtual world that is quite similar with the real one. In addition, in such virtual world, audiences feel themselves personally immersive at the scene. Boundaries between virtuality and reality become vague, so people feel even harder to distinguish these two worlds as what experiencers feel, see and hear in the VR world constructed with the technology can be changed. When people enter the environment completely and get immersed, they will present a new state of obtaining new experience and feelings. Supported by VR technology, immersive art will step into a new era and get closer to people's life. As recognized by many artistic creators, a wider platform will be brought to artistic creation as VR technology updates and develops. Therefore, besides giving artists the chance to show artistic talents, VR technology can also bring more authentic and practical art experience to us, the appreciators of art.

References

[1] Chen Ling, History of new media art. Beijing: Tsinghua University Press, 2017.
[2] Yang Hua, Ren Bingzhong, Gao Mingwu. Interactive Influence of New Media Art installation Art. Jinan: Shandong Fine Arts Publishing House, 2009.
[3] Liu Dan. A Brief History of VR [M]. Beijing: Posts and Telecommunications Press, 2016.