New Representation for Arts and History in Humanities
Representación para artes e historia en humanidades

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ABSTRACT

Can history be digitally recorded and artificially replayed? Can fine art be created in a virtual reality display? It is maintained that objects can be represented digitally and perceived realistically. The level of reality depends upon the detail of reality reflected in the display, the sharpness of the image, and the saturation of the color schemes viewed in the digital environment. This article elaborates concepts for simulating history through visualization of a cultural ceremony. A virtual reality model of the Temple of Heaven in Beijing, China is used as a medium to explore this concept. Based on the observations, it is certain that information technology can be used to reconstruct history, express humanities, and manifest a new virtual art.

RESUMEN

¿Puede la historia ser registrada y reconstruirse artificialmente? ¿Puede ser el arte creada en una exhibición de realidad virtual? Esto es posible en al medida que puede ser representada digitalmente y percibida realisticamente. El nivel de realidad depende del detalle de realidad reflejada en la representación, la agudeza de la imagen y la saturación de los esquemas de color en el ambiente digital. Este articulo elabora conceptos para simulación histórica a través de la visualización de una ceremonia cultural. Un modelo de realidad virtual del Templo del Cielo en Beijing (China) es usado como un medio para explorar este concepto. Basado sobre observaciones, es cierto que la información tecnológica puede ser usada para reconstruir historia, expresar humanidades y manifestar una nueva arte virtual.
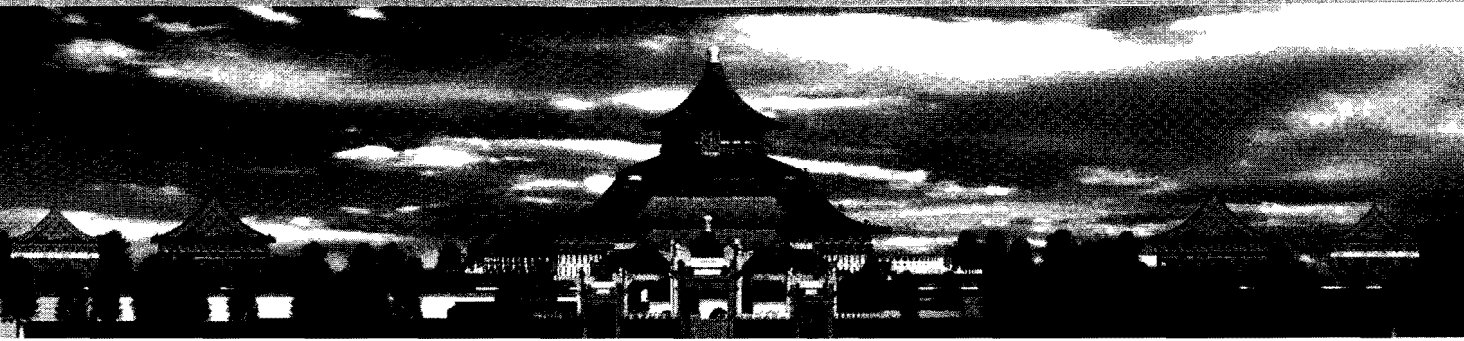
Entire south elevation view of the temple

1. Background

Studies in humanities attempt to answer questions regarding human qualities, concerns, thoughts, and relations in an effort to understand and interpret the meaning of man's nature and his place in the universe. In this article, two aspects of the humanities are selected as subject matter for study in an attempt to understand whether history and art can take on digital forms and be represented in a virtual environment.

History is a sequence of events in the life of a people, group, institution, or nation, a written record of past events in the form of narratives, plays, stories, or tales. Written materials may deteriorate through time or vanish due to unforeseen events or natural disasters. This research tries to explore a digital method for applying information technology in virtual reality to record and display history. Similar research has been done in this regard and has generated a number of interesting findings regarding issues of representation and methods of data acquisition[1]. This study concentrates on exploring methods of reflecting historical events in a full-scale immersive setting.

The second concern relates to the question of the expression of beauty in a digital form. In this article, art is defined as the craft of making things which display beauty, including painting, sculpture, architecture, music, literature, drama, and dance. In the followings, digital examples of a historic building — the Temple of Heaven — are given to demonstrate thoughts on digitizing history and arts, and to open new discussion on a definition for virtual art.

2. Roles of the Temple of Heaven

Temple of Heaven is one of the landmarks of the city of Beijing, one of the symbols of China and a national treasure, with United Nations recognition as a World Heritage Site. Built in 1421[2], it was used by the Emperors of the Ming and Qing dynasties for annual sacrifices to Heaven for rainfall in the summer, good harvests in the autumn, and to pray for prosperity blessings from ancestors in the winter[3].

Located in the inner city of Beijing, the Temple is a compound of several buildings with unique functionalities and design intentions implemented to show cultural significance. For instance, the geometric layouts of these buildings take the basic shapes of circles and squares to represent heaven and earth. Enclosed within a long wall, the northern part of the Temple is semicircular to symbolize the heavens, and the southern part is square to represent the earth. The northern part is higher than the southern part. This design shows that the heaven is high and the earth is low, and the design reflects ancient Chinese thought,[4] which says that «The heaven is round and the earth is square». At the center point of YuanQiu (the altar), the philosophy of combining heaven and human beings into one unit is fulfilled.

There are three major components of QiNianDian, YuanQiu, and HuangQiongYu, linked by a wide passageway (see Figure 1). YuanQiu is the circular altar with three layers of terraces. At this altar, the emperors would offer sacrifice to Heaven on the day of the Winter Solstice to thank Heaven and pray for the future. The stone placed in the center of the top tier of the Circular Mound Altar is named the Heart of Heavenly Stone. Around it there are nine circles, each circle containing a multiple of nine stones. The first inner layer has nine stones, for example, while the outer ninth layer has eighty-one. In traditional Chinese culture, the number of nine symbolically represents supreme rank. The entire surface has 3,402 pieces of identical size and appearance. These stones have remained intact for the past several hundred years[5].

QiNianDian is the place to pray for good harvests in the spring. At the central point under the dome of the roof is a special block of marble, installed for the emperor to pray during the ceremony. The three layers of columns inside the hall have symblic meanings. The four in the inner circle represent the four seasons of the year; the second layer (middle circle) of 12 columns represent 12 months of the year and the 12 pillars in the couter circle are 12 time periods of the day. The Leigong Pillar under the center of the ceiling represents the absolute power of the emperor[6].

The HuangQiongYu is the place to perform rites in honor of ancestors for prosperity blessings. The site was used to keep wooden tablets for worship. It is 19.5 meters high and 15.6 meters around at the base. Built entirely of wood, the vault is supported by eight pillars. The roof has no beams but a great number of brackets entwined within each other. The ceiling tapers upward to form a beautiful caisson.

Connecting these three components is 29.4 meters of ramp with three marble paths. The central path was reserved for divine gods, the path on the left was reserved for the emperor and the path on the right was used by court officials. The major function of the Temple of Heaven is to have three big national ceremonies offering sacrifices annually, which are not publicly visible. The ceremonial processes leaded by the emperor were very spiritual, involving a great deal of formality and accompanied by all officers in the court. The entire ceremony and the temple design reflect traditional Chinese culture, religion, and cosmology.

3. The nature of virtual reality

Virtual reality is a very sophisticated human-computer interface. It applies computers to create an immersive virtual environment. Currently, there are several methods of displaying virtual reality, for instance, a stereoscopic image seen through 3D goggles[7], 3D images seen through head-mounted display (HMD)[8], or 3D images seen through 3D shutter glasses or polarized glasses in an immersive environment of Workbench[9], Infinity Wall[10], CAVE[11,12], or C6[13].

Regardless of the equipment used to process virtual images, the creation of an immersive virtual scene and the addition of elements to create the appearance of a broader historical context will allow for a representation of historical events to be experienced virtually.

4. Methods

The foundation of a VR environment is a 3D model. While there are many different ways to create a three-dimensional model, the method used for this project was purposefully tailored to fit certain requirements for the full-scale C6 facilities (see Figure 2) as described in the followings.
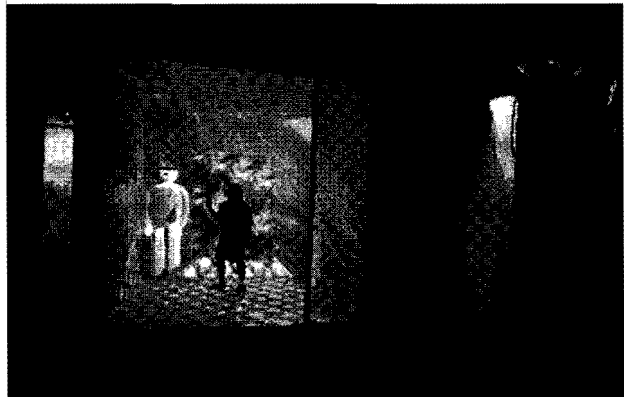

C6 facilities

1. Digital models were created first in AutoCAD for accurate surface meshes, and then exported to 3D Studio MAX for assigning realistic texture materials. The purposes of doing surface model in AutoCAD are to avoid extremely large file sizes, and because AutoCAD has the ability to achieve a high quality of accuracy, essential to a good virtual reality model. The purposes of assigning materials in MAX are due to the fact that MAX can generate good rendered images suitable for animation, and because MAX automatically creates a VRML file suitable for VR representation. These purposes yield animated digital products to show certain messages and a virtual reality product to show a 3D scene[14][14] Chan, C. S. Tong, Z. Dang, A. & Qian, J. (2003), Virtual Reality Modeling of Traditional Chinese Architecture. *Proceedings of the Virtual Systems and MultiMedia VSMM2003*, pp. 13-22.

2. The model files converted to VRML format will be displayed through the OpenSG system in the C6 facility. The VRML format could be displayed on the Internet for public access. However, the code in the VRML file needs to be modified for efficient execution and representation of the model in C6.

3. The processes of displaying the models and necessary peripherals for stereo 3D images and navigation were controlled and executed by VR Juggler[15] software, developed at Iowa State University. A VR Juggler application could also be developed to determine the speed of navigation, the representation of background images and the timing of any accompanying music. In C6, the scene was transformed from VRML through OpenSG via VR Juggler into 3D, viewed through a pair of 3D goggles. The same model and scene can also be displayed in C4, which is a newer version of a three-wall immersive environment.

As a result, a digital model of the Temple of Heaven, with three key components located along the central axis ramp surrounded by trees, was completed (see Figure 3) and ran smoothly in the C6 facilities. C6 is an full-scale immersive environment, but it lacks the power to: (1) directly generate sophisticated lighting effects, (2) combine texture maps to render a mixed material result, and (3) the ability to tolerate a large and complex model. It is thus necessary to find new methods to show messages expressing historical events. The methodology used to do so was as follows:

1. Apply methods to display trees in C6, develop lighting in the Juggler applications to get a special effect, utilize PNG files to implement transparency, minimizing the number of different textures used in the model to decrease rendering time to improve navigational speed.

2. Define animation paths to display the ceremonies performed by the emperor and conducted in the Temple, assinging music appropriate to the historical context of the ceremony itself, and adding sounds and ambient noises characteristic of the ceremony to more realistically represent the event.

This model, seen through 3D goggles in C6, allows the user to perceive symmetrical layouts three-dimensionally and the unique spatial proportions of the site in an aerial view, expresses traditional decorative features in full scale, and enhances understanding of Asian culture due to its immersive format.
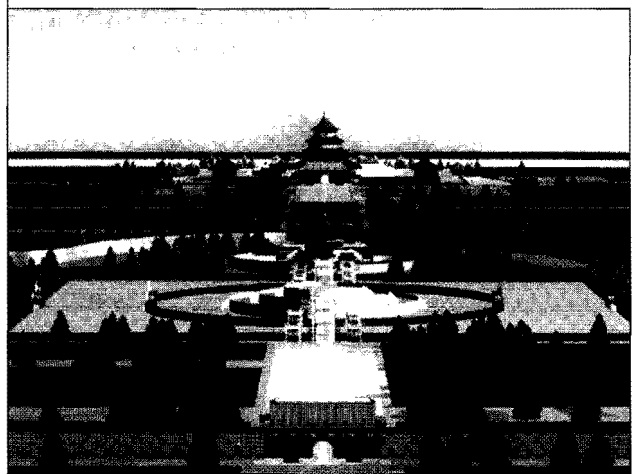
Digital models of the temple of heaven

5. Discussions

The last few generations have seen extremely rapid rates of technological advance, cultural change and development, with historic sites being demolished or changed beyond recognition due to the speed of development and the implementation of new technologies. It is critical to create a sense of historical awareness, as well as a method to preserve historic sites and maintain the common cultural heritage. What format, then, can best preserve cultural data for future generations? Virtual reality has unique advantages that allow it to: (1) create a historical record, (2) reconstruct past events in an immersive digital context, and (3) three-dimensionally recreate historical events. Virtual reality, then, becomes a tool for the imagination, transforming a written historical record into a living digital environment.

This project outlines the unique advantages of virtual reality in visualizing the historical record and maintaining cultural heritage. Aspects relating to the processes of making a historical and artistic representation of the digital model need to be further discussed.

5.1. The sense of history shown in the model

As mentioned earlier, history is a written record of events that happened in the past. A historical record, then, should reflect a sense of the passage of time. Since virtual reality attempts to display a realistic appearance, a historical virtual model must have certain features to represent the appropriate historical era. For example, styles, fashions, and customs of different periods can easily be used to identify periods.

If the materials used on a model to show objects possess vivid colors and homogenous clean textures, viewers will perceive the 'newness' of the construction. However, historical events will take place at some point in time after the construction of the facility. Therefore, it is suggested in this article that the virtual scene should not have homogenous clean textures, evenly pure colors, and fresh-looking objects. Instead, the textures will be given the appearance of aging by implementation of a technique called variegation, which will be applied to certain surface textures on a few visually dominant objects. The application of these techniques will allow an approximate representation of historical events in an electronic medium.

On the other end, events must be illustrated by means of certain media to highlight past events. There are various methods that can achieve these purposes. In this study, ancient drum music used during the ceremony and procedural orders given by the court officers were identified and included for experiment. Animations, used to specify the circulation paths of the emperor, officers, and servants, could demonstrate the differences between ranks and related religious connotations. Results showed clearly that the background sound provided some sense clues and associations to the context of time and space. The animation makes the cultural meanings embedded in the ceremonial sequences transparent. History, in this regard, emerges.

5.2. Art in virtual form

Contrary to popular belief that virtual reality models are technical objects and therefore lack artistic expression, there is actually ample opportunity for creativity and originality in constructing the model. In a VR model, scenes can be arranged appropriately, complexity can be simplified, chaos can be regulated, and colors can be enriched to show certain aesthetic values. For instance, a VR model can be modified, articulated, and revised by changing the composition of the scene (compare Figure 5 with Figure3), texture materials of the model, or lighting effects (compare Figures 6, 7, and 8) to create different but elegant appearances in the VR environment. The processes of creating a beautiful visual display possess the attribute of art. However, as the sense of reality decreases, the character of the model in this regard becomes more virtual art and less virtual reality.

C6 facilities A scene showing time through the effect of variegation.
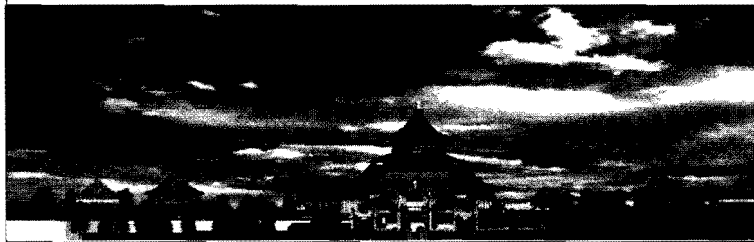
Entire south elevation view of the temple
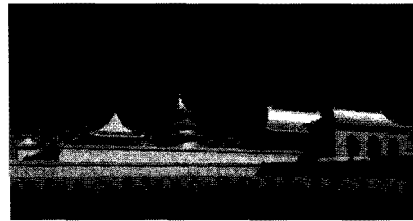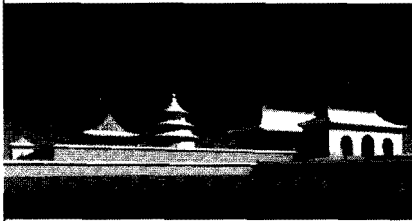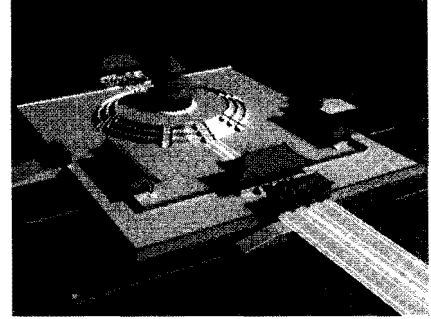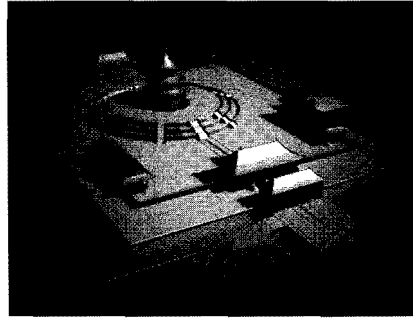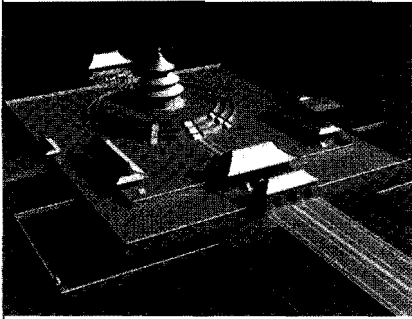
Change material texture   Change lighting and colors   Original VR model

In order to express beauty, several fundamental requirements need to be addressed to complete a more integrated representation:

1. The image of the scene has to be sharp, which relates to the resolution of the texture maps applied on the objects and viewed through the 3D goggle.

2. The speed of navigation in the model should be smooth. This issue relates to: (1) the size of the model, (2) the number of polygons constructed on the model, and (3) the CPU hardware speed.

3. The resolution of the color shown on the model needs to be vivid. This is determined by the quality of images projected through projectors, which relates to the display capacity of the hardware facilities.

4. The most important attribute is whether the scene evokes pleasant emotion in viewers. It can be argued that a scene that generates a strong, negative emotional response in viewers is a piece of art[1]. For the purposes of this discussion, however, good digital art will be defined as those works that provide a pleasant reaction for viewers.

Theoretically speaking, art in this study is operationally defined as any activity creating beauty, and has the quality to please or satisfy the mind. If a sculpture is viewed to be pleasant, a piece of music comforting, a drama entertaining, a dance delightful, then beauty exists in their performance. In virtual reality, artificial objects are constructed which possess a certain degree of beauty. Therefore, art in VR is the processes of creating a VR, which are the processes of making things.

6. Conclusions

A digital representation of historical events would allow these events to be redisplayed at any other time. Art, as well, can be displayed and redisplayed digitally within the visualization frame of the virtual reality environment.

A picture or painting is the work of an individual, and derives its artistic merit from the message it conveys, which may originate in its style of composition, technique or use of symbolism. A movie is the work of a group, with its message conveyed through dramatic plots, amusing themes, good musical background, or aesthetic scenes. A virtual reality environment, like a movie, is the work of a team, but conveys a message in a way similar to paintings, with the additional qualities of good navigation speed, vivid color, and realistic scenes. Under these criteria, a high quality VR model, which provides

a sense of the passage of time and conveys as its message a historical event, would digitally recreate history.

The work of composing a virtual reality environment requires a team to maintain computer hardware, develop software, construct 3D models, orchestrate media applications, and arrange messages to fulfill the intent of the model. It is a complex process that consists of various activities and decisions. The value lies in achieving a balance point that satisfies all parties. Thus, the fine arts in virtual reality are not only a representation of still images done by individuals, but has many factors interacting together through a group of participants. Thus, digital arts in virtual reality should be categorized as a form of art similar to filmmaking and called a dynamic art.

7. Acknowledgements

References

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[2] Wang, T. (2000), Tian Tan — Temple of Heaven, China Esperanto Press, Beijing.

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[4] Liu, D. (1980), The Ancient Chinese Architectural History, Chinese Architectural Industry Co., Beijing, pp. 347-354.

[5] See Web Page at: http://www.chinavista.com/travel/tiantan/stop6.html.

[6] See Web Page at: http://www.chinavista.com/travel/tiantan/stop11-1.html.

[7] See Web Page of DepthCharge at: http://www.vrex.com/depthcharge/.

[8] Completely immerse the user's personal viewpoint inside the virtual world. These immersive VR systems are often equipped with a Head Mounted Display (HMD), which is a helmet or a facemask that holds the visual and auditory displays.

[9] The computer-generated stereoscopic images are projected onto a tabletop via a projector-and-mirrors system. The users of the workbench wear shutter glasses to observe the 3D effect.

[10] It comprises a single 9 by 12 foot (or larger) screen. The images from the different pipes are rear-projected onto a large screen, to create a single 3200x2400 pixel resolution display. This is an one-wall VR format.

[11] Cruz-Neira, C. Sandin, D. & DeFani, T. (1993), Surround-Screen Projection-Based Virtual Reality: The Design and Implementation of the CAVE. *Proceedings of the ACM SIGGRAPH 93*, pp. 135-142.

[12] CAVE (Cave Automatic Virtual Environment) is a VR facility of 10 by 10 by 9 foot dimensions, with images rear-projected on 3 walls, and down onto the floor. Four projectors are connected to four high-end SGI workstations. Results showed 1024x768 stereoscopic images displayed on each screen at 96 Hz. See Web page of http://www.evl.uic.edu/research/index.php3. This is three walls VR format.

[13] C6 is a 10' x 10' x 10' cubic environment with 6 machines generating 6 images projected into the space through projectors. This six-walls-VR format is the world's first fully immersive six-sided virtual reality theater with wireless tracking and navigation.

[14] Chan, C. S. Tong, Z. Dang, A. & Qian, J. (2003), Virtual Reality Modeling of Traditional Chinese Architecture. *Proceedings of the Virtual Systems and MultiMedia VSMM2003*, pp. 13-22.

[15] See Web Page of http://www.vrjuggler.org.

[16] Performing arts is very subjective. All activities of creation can be treated as art. But, this article concerns the value of arts.