NEW INTERACTION OF DIGITAL EXHIBITION

Figures and spaces

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Abstract. The developments of digital media make the exhibition in museum different from the traditional one. According to this case study of the digitalization of sculptures, we attempt to create more interactions between each digitalized sculpture, and to display them in the media of Internet and of the VR CAVE.

1. Introduction

The origin of traditional museums was from Egypt, where the ruler of Alexandria kingdom treasured all kinds of collections as tributes to Muse, the goddess in 230 B. C. (Koshizuka and Sakamura, 2000). Afterwards, a museum became a personal place for Western nobles to store their collections. Until 1694, the public was allowed to enter Saint Vincent Abbey Curator Museum in Besançon, France to visit (Burcaw, 1997). This was the first museum that showed its collections to the public. Till now, a museum has become a multi-functional place for education, research, collection, exhibition, and entertainment（Falk and Dierking, 1992).

Recently, due to the importing of digital technology and the development of Internet, researchers are able to explore how to extend the way of displaying things in a physical museum (Hooper, 1995). They will even make radical changes on the research, collection and exhibition of arts. For example, by using the simulation of computer graphics, it is able to make an integrated visual display of archeological data of cave fresco and parts of the objects that were dug out (Tang, 2002a). Furthermore, the technology of

Stereo Image and Virtual Reality give visitors a feeling of true visions for virtual objects, and make them feel like they are immersed in the virtual environment (Tang, 2002b). With the support of interactive technologies, visitors' action can be recorded and digitalized by sensor devices, and visitors can have more interactions and connections with virtual objects and environments (Koshizuka and Sakamura, 2000). Based on the development of Internet, the physical space and the virtual one can co-exist and satisfy the demand for art exhibition for both physical and virtual community. The virtual, networked and distributed digital museums can further decentralize the large-scale traditional museums, which have many functions in one building. Therefore, the role of traditional museums will be transformed into a place where people can check out original objects (Mitchell, 1995).

2. Problem and Objective

There are three elements that affect the interaction between visitors and exhibits when visitors are viewing exhibits. The first one is the visitor's personal experience and viewpoint. The second is the social interactions between visitors. The third is the exhibits and environment in museums (Falk and Dierking, 1992). From the third aspect, there are different ways to display different kinds of artwork. For example, the ways to display paintings and sculptures might be different. As a result, visitors' focus and interaction are also different (Parent, 1999). On the contrary, digital museums, displaying things through the Internet, also have different ways of displaying. For example, visitors can view sculptures by using a mouse randomly and obtain related information quickly by using hyperlink.

However, are there still other kinds of possible interaction between visitors and exhibits in a digital museum? The goal of this research is based on a case study of sculpture work, and to create more ways of interaction for the digitalized sculpture work, which will be presented through two different kinds of media, Internet and VR CAVE.

3. Digital Media

3.1. 3D SCANNER

In the process of digitizing a physical free form, there are many kinds of method to obtain its 3D digital model. For example, using software Maya, 3D Max and so on or the so-called reverse engineering to create a similar form is the quantification of physical objects to the data of 3D digital model. By doing so, we can overcome the limitation of using 3D software directly

to create a model. For example, we need a higher preciseness of free form from a physical one. The instrument that has a higher preciseness project laser light to an object and then transform the returning laser light to a value in 3D coordinate of each point of the digital model (ITRI, 2002). There is another way also used in scanning a free form. The principle is the method of using image base that calculated the 3D data by a software from the pictures of an object (Shih, 2003). But its preciseness is less than the method of using laser scanning. However, laser scanning also has its faults. Laser light cannot reflect correctly when used to scan an object with dark surface. In contrast, when using image base, there is not that much limitation in the scanned material.

3.2. INTERACTIVE MEDIA

Computers interact with users with devices of output and input. Message output developed from a textual interface on a monitor, to a 2D graphic interface, to the display of real-time images in VR CAVE (Myers, 1998).

Message input developed from the keying of fingers in front of a monitor to the control by extremities in VR CAVE.   However, in order to make the interactive simulation in VR CAVE more natural, it depends on the development of positioning device. Now positioning devices can be categorized by the following four technologies:

Mechanical—Using a device like a mechanical arm, through its bending and rotation, to calculate the 3D position of a selected object in the space. Its preciseness is the best.

Supersonic—Using the difference of the returning supersonic, emanated from a supersonic sensor on a user to a receiver like microphone, to calculate the 3D position of a selected object in the space.

Magnetic— Using the different intensity of magnetism, emanated from a sensor on a user and received by 3 receivers, to calculate the 3D position of a selected object in the space.

Optical—Projecting infrared light to a marker on a user. Cameras around the VR CAVE can capture images with only light points and transmit them to a computer, which can transform images and calculate the 3D position of a selected object in the space (ITRI, 2002).

4. Case Study

This case study is a research of Applied Media, taking the artwork of a Taiwanese sculptor Mr. Pu as main exhibits. From the digitalization of artwork to the accomplishment of a digital museum, which can be shown on the Internet and in VR CAVE, there are several main steps:

4.1. MODELLING AND TEXTURE MAPPING

The first step is the digitalization of the physical sculptures. 20 pieces of Pu's most classic work are chosen. Every surface of them is completely scanned by a 3D scanner (figure 1) for the convenience of the second step. At the same time when scanning, a projective mapping of six side—upper, bottom, right, left, front and back—of every work is created. The second step is digital data processing. A 3D editing software TriD connects every model fragment (figure 2) derived from scanning as a complete digital model (figure 3). The third step is texture mapping of digital model. Transform the digital model in TriD to 3D animation software Maya, and paste the project mapping of six side, derived from the first step, to the digital model in a way of orthogonal project (figure 4). Finally, use 3D panting tool to adjust color. In this way, we can get rid of the problem—the uneven thickness of color between mappings, which always happens when mapping in a way of orthogonal project, and make the whole digitalized sculpture more realistic (figure 5).

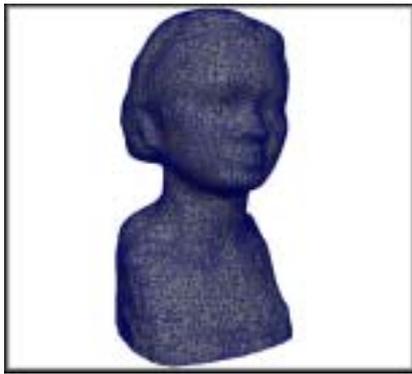*Figure 1. 3D scan*
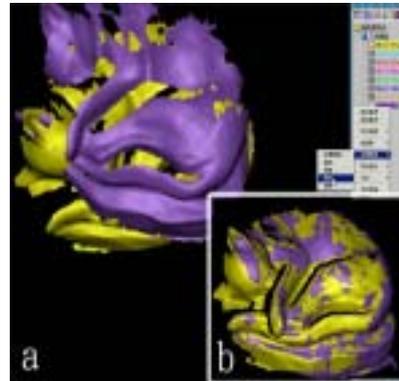
Figure 2. Surface merge

4

Figure 3. A digital sculpture

Figure 4.Texture project on the

Figure 5. A digital sculpture with texture

4.2. DISPLAYED ON THE INTERNET

Generally speaking, when thinking of a real-time interactive environment, most people will choose the developed application software like Virtools, or just use OpenGL/Direct X to develop C/C++. The former might be limited by the functions of application software, and the later might have to be finished by a team, which has the ability to write programs. Therefore, for a software which is not limited by the function provided, handy, and highly stretchable like C/C++, Macromedia's Director MX, which has the function of 3D VR, is the most suitable one. It can transform objects into the format of shockwave and display them on the Internet, making it easy for users to view through a browser. After mapping every digital sculpture in Maya, we can manually create a general museum known by the public. And then transform it into a W3D format, which can be read by Director. In Director, under the concept of object-oriented programming, we give digital

sculptures some fundamental interactive functions like "moving" and "rotation", so visitors can use a mouse to choose and control. We, according to the law of lighting in exhibition, design a main light, a side of light and a background of light for every sculpture. Users can adjust the position, direction and color of these three lights through a dragged bar. Its interface is shown in figure 6.
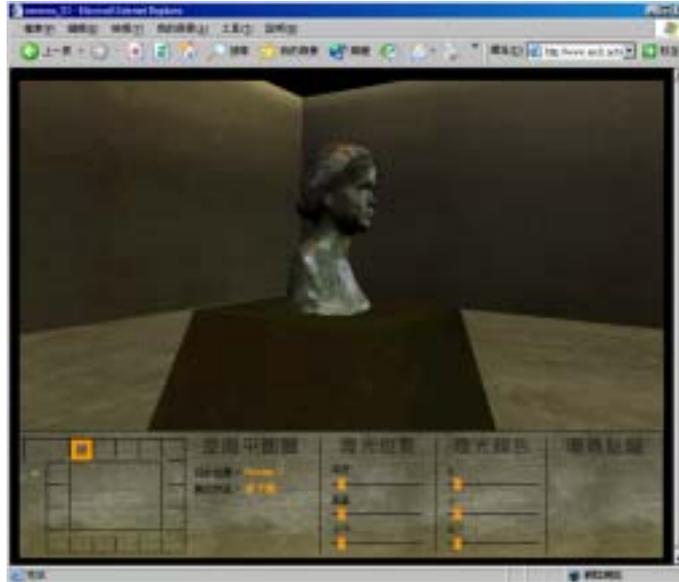

Figure 6. A digital sculpture displayed in the internet

4.3. DISPLAYED IN THE VR CAVE

In 3-2, visitors can choose a sculpture and control its moving and rotation in Director. However, when a sculpture is stereo presented by VR CAVE （figure 7）, the situation is different than that presented on the Internet, in which only a rendering of a camera is shown. This is because VR CAVE consists of three screens, and each screen receives images from two projectors. Thus, in the display system of VR CAVE(figure 9)（Wu, 2003）, a server-side software, Multiuser, in Director will send the data（position, rotation ）of sculpture and of camera to six client-side computers simultaneously. These six computers will calculate the images of cameras at different sites, and project the images, with their own projector, to the three screens of VR CAVE. Visitors wear the polarizing glasses, and control the sculptures interactively with a marker in hands. The 3D positioning(figure 10) of the marker is made by using 4 cameras to catch the images of markers and to put them into a positioning server, which is

6

responsible for computing the values of X, Y, Z axis of the images, and then by transforming these data of positioning from RS-232 to the main server. These data from RS-232 are transferred by Xtra in Director, and then an interactive cycle of input and output is formed.
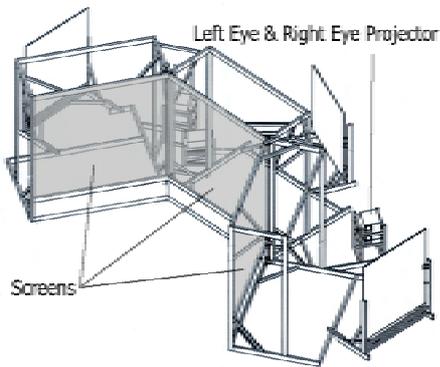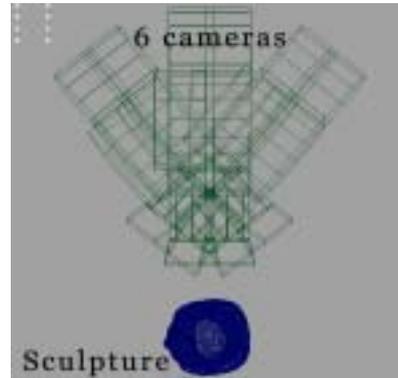

Figure 7. The device of VR CAVE

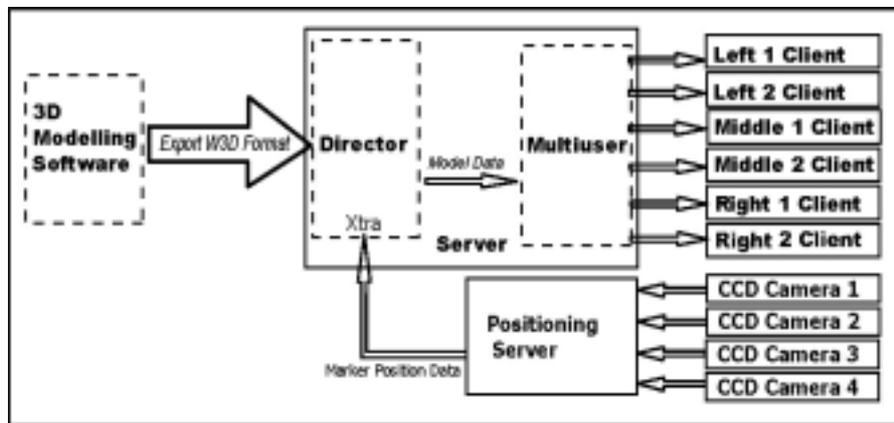**Figure 8. The layout of 6 cameras**

Figure 9. The structure of system of interactive VR CAVE

Figure 10. The system of positioning

Figure 11. Digital sculptures displayed in the VR CAVE

5. Conclusions

According to this case study, we finished a process of the practice in digitalizing physical sculptures. We also simulated the real interactions viewers will feel when looking at a sculpture, like the rotation and moving of it. In addition, the projection of light is an important element. In an exhibition of physical sculptures, it is hard for visitors to observe. As a result, if the exhibition is on the Internet, with real-time image process and easy adjustment of the light source, it will be easy for visitors to observe the change of shadow on the sculptures. When sculptures are displayed in VR

8

CAVE (figure 11), the stereographic technology demonstrated the scale, volume and the vision depth effect of the sculpture, making them realistic (wu, 2002). In future museum exhibition, there could be virtual display platforms, making visitors view the exhibits at more angles and in different ways. Also in future research, based on this digital museum, we can do research on the cognition differences of interactions when things are displayed in different environment—traditional museums, VR CAVE and the Internet.

Acknowledgements

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