

Virtual Exploring to Jing-Hang Grand Canal

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Abstract

This paper presents the digital interactive experience system of the Jing-Hang Grand Canal of China and introduces some related work. The purpose of this system is to attract users' interests in the history and culture of the Jing-Hang Grand Canal. We provide users with virtual exhibition and virtual exploring environment which make it possible that the disappeared ancient scenes and stories recur and interact with them. The system is made up of three parts as the main introduction about the Grand Canal, the landscape exhibition along the riverside and the virtual exploring part. The first two parts give a dynamical demonstration of the general knowledge of the Grand Canal and the third one provides interactive experience of the cultures, history, arts and stories along the side of the Grand Canal. Additionally, in order to make this system attractive and charming, the technique of digital storytelling is used, and an animation called water transportation story is composed to show the magnificent scene along the Jing-Hang Grand Canal.

1. Introduction

A large quantity of glorious cultural heritages has been handed down from generation to generation during the long human history. However some forms of artworks have disappeared or been destroyed by the rising affections of the human being's actions and with time elapsing. It has been a pressing worldwide problem that how to exhibit and preserve artworks of cultural heritage with novel methods.

The techniques of photographing and shooting have already been used in the early 70s to record the information of cultural heritage. However these files are difficult to preserve for a long period because of the reasons such as the degenerative effects of the films, moreover, the copy of images will bring distortions. In this background, the technique of multimedia and virtual reality brings a new dawn to the preservations of the cultural heritage. It will be

an important way to preserve artworks of cultural heritage with the digital processing techniques such as image indexing and impainting, immersive VR system and so forth.

In this paper, we first present the actual techniques of digital exhibition and preservation, which makes the digitization of cultural heritage possible, then we introduce our virtual exploring system of Jing-Hang Grand Canal in order to make a clear presentation about the content, process and methods of digitizing artworks of cultural heritage. (Here the Chinese character “京”(Jing) means Beijing(北京), while the Chinese character “杭”(Hang) means Hangzhou(杭州), the river is from Beijing to Hangzhou threading through many cities.) Finally the conclusion and future work are discussed.

2. Digitizing cultural heritage and pivotal technique

The process of digitizing real objects has been simplified a lot by the digital tools such as the scanner and the digital camera. And all these hardware equipments nowadays make the cultural heritage digitizing come true. Furthermore, more and more hardware companies are continuously producing new digital equipments which are of high precision and capability, it is sure that the digital manipulation will become much easier in the future.

The method of taking pictures from multi-points of view by using a movable camera and image impainting, which was proposed by Wolfgang Niem et al.[1] in 1999, can already show up the model of the real object again with a quite good quality. Ulas.Yýlamz et al.[2] succeed in rebuilding the 3D models based on the arithmetic above, by taking precise pictures from multi-points making use of a rotational table which circulates around the axes. The method of rebuilding with expansible pixel proposed by Steinbach et al.[3] achieved a good effect as well.

As for the current research situation of digital cultural heritage preservation, there are four main aspects focused by researchers all over the world. The first one is the

digitization, storage and display of cultural relics. The second aspect involves virtual museums on the Internet. Kwon[4] presented the key techniques of digital museum on the internet, and a general scheme of the modeling, management, storage and transmission of large quantity of data of digital museum. The third aspect is concerning how to create the avatar-based multi-user immersive virtual museum. Usaka[5] presented the prototype system of an immersive virtual museum. The terminal users can enter the virtual museum as avatars via Internet to visit all the exhibits in it and can communicate with other users. The fourth aspect is the application of large display projection in the real museums.

The image based rendering (IBR) [6] [7] is a kind of new technique to render 3D virtual scenes from 2D images. The image based modeling technology (IBM)[8] creates a 3D scene with several images. It has shortened the traditional process a lot which was done in the steps of modeling and rendering, and it has been applied to many projects. Hirose[9] introduced many IBR applications to digital museum. Youichi[10] presented a novel method to tour into the picture by making animation from a single picture using spidery mesh.

Many experts dedicated their work in the fourth International Conference of Virtual Reality System and Multi-media in 2002 (VSMM'02), which had a lot to do with improving the steps of the world's heritage preservations. It has also shown the great potential of the virtual reality technology, such as the technique of capture texture by laser scanning which was proposed by J-A Beraldin et al.[11], the technique of virtual museum constructing making use of interaction by Magata Shojiro et al.[12], the technique of virtual Artshop by A.M. Bonacchi et al.[13], the technique of involving intelligent person in to the virtual reality system by Meehae Song et al.[14]

The main points in the design and implementation of the Jing-Hang Grand Canal virtual exploring system include the client-server architecture design, the 3D interactive design and implementation, the scene modeling, the story telling design[15] and the multi-media design. We use Youichi's method to create animations by moving the viewpoint in the water transportation animation part to show the cultural landscape and the magnificent artworks along the river side. We also use IBR technique for virtual exhibitions in the demonstrations of the vagile experience part. Additionally we use the technique of TIP (tour into the picture)[16], which has already been utilized in preserving the cultural heritage [17] by State Key Lab of CAD/CD of Zhejiang University, to implement the tour into the old pictures and the landscape pictures of the Grand Canal, so that it can show again the disappeared scene of ancient days vividly.

3. Configuration of the digital interactive experience system

3.1. Outline

As one of the greatest water conservancy projects in Chinese history, the Jing-Hang Grand Canal is valued a lot for its popular scientific significance. The main content of this system is expended with a center of the Jing-Hang Grand Canal, with a clue of polt, and it vividly shows the history of the Grand Canal again. Moreover, it introduces a series of humanities knowledge and general knowledge which are related to the Jing-Hang Grand Canal. The education theory of "Hands-On, Minds-On"[18] and the theory of "Learn from Doing"[19] are worked into the virtual interactive system. The system can help the public, especially the youth, to improve their knowledge about the history and general science expediently. Because they can carry out practically the actions, such as good shipping, which only existed in the ancient times, and solve problems by using the scientific theories and methods in the virtual environment more than learning just from the textbooks, to get a better understanding.

The system includes three parts as follows: the main introduction about the Grand Canal, the landscape along the riverside and the vagile experience. The main purpose of the first two parts is to introduce some general knowledge of the Grand Canal by the dynamical demonstrations and interactions. The third part is mainly for experience, and it provides the users with interactive experience of the cultures, history, art and stories along the Jing-Hang Grand Canal. There are five experience items in all, which are water transportation, driving a boat, crossing the lock gate, the interaction of panorama and the interactive test of the Grand Canal knowledge.

3.2. The water transportation animation

The concrete scenes go as follows: the users immerse themselves in this part with their view following along with a wide river (the segment in Hangzhou of the Jing-Hang Grand Canal). The Jing-Hang Grand Canal was a water conservancy system and a canal which was utilized in the food and commodity supplies. This part gives the introductions of detailed and magnificent scenes along the Jing-Hang Grand Canal, for example many porters carried goods onto the boats by the riverside, and then boatmen ferried the goods along the river, and there are also some other locomotive objects in the river or by the riverside, such as carriages, mill wheels, pedestrians and other workers as shown in Figure 0 and 1. The animation includes several points as follows:

The first one is the cultural landscape of water transportation, with the representations of the important

water transporting landscapes, such as Randeng Pagoda, Sanjiao Temple, Bali Bridge, Li Zhuowu Grave and so forth. The Randeng Pagoda is the symbol of the city of Tongzhou and of the terminus of 500 kilometer water transporting journey as well. Bali Bridge is an offspring of

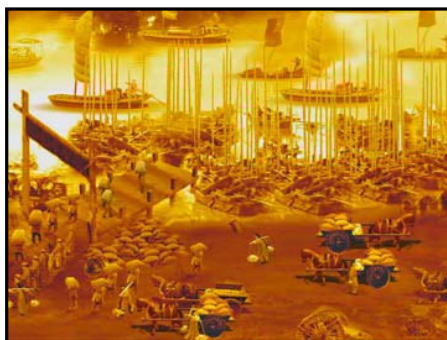


Figure 0: The pedestrians and workers along the Grand Canal



Figure1: The mill wheels and landscape along the Grand Canal

water transporting in the Grand Canal, and it is the traffic bridge of the building of the ancient capital.

The second one is the magnificent art culture of water transportation. The Tang artwork from powder and the kite king Liang Jun for examples, which have been handed down from generation to generation, are the representations of the charming art culture of the city of Tongzhou.

The third one is the folk culture, the water transportation of the Grand Canal brings different folk cultures from different places. Tongzhou is an ancient city which has special folk culture, also with folk music, nursery rhymes, adages, and various kinds of clarions of water transportation.

The fourth one is the shipside culture of the water transportation. The shipside of water transportation went through thousands of years, with the fabulous stories of different people, such as the famous writer Cao Xueqin and the well known poet Tang Xianzu and so on.

3.3. The vagile experience

The experience system is an advanced platform which fulfilled the theory of "Learn from doing", especially for the youth, this kind of platform will help them to learn the science and humanities knowledge in the interesting process of virtual practice. The experience system should be better not only of one bald style, but also include many interesting elements besides the traditional science, such as the humanities knowledge, legends and some applications. In addition, the exquisite interface, simple and exact manipulations and the originality of the polt are all absolutely necessary ingredients in empoldering a virtual experience system successfully.

This experience part includes five sections as follows: the water transportation experience, the driving experience, the lock gate crossing experience, the panorama experience and the interaction with the knowledge of the Grand Canal. The technologies related in the content above include multi-media technique, network technique, computer graphic technique, human-computer interaction technique, literae humaniores and art. Most of them provide plenty of interaction, such as the brake system of the boats gives a 3D display, and the animation of the water transportation will help the users not only understand the history and utilization of the Grand Canal but also increase the knowledge of geography and engineering.

There are two modes in each virtual exploring part: the displaying mode and the manipulating one. For example, in the part of crossing the lock gate of the Grand Canal in the experience section, it will first demonstrate an animation of crossing the lock gate with explanations, the users can manipulate after understanding the whole process, once there is any mistake, the program will prompt and restart. The five sections go as follows:

Firstly, the water transportation experience.

The water transportation animation: this part introduces the process of transporting goods from Hangzhou to Beijing by the Jing-Hang Grand Canal and the cultures along the riverside, it shows at the same time the ancient cities of Suzhou, Huai'an (Figure2) , Dezhou and Tongzhou.

The loading simulation: this part shows the users the process of loading in the water transportation system and some general knowledge of flotage. The users can select the goods which they load on the ship in the program which we implement by the Flash software. The waterline will change when the weight of the goods which the users chose is changed. Overweight will course a sinking and also cannot make an efficient loading if the goods are not enough, so they have to calculate the weight and design the way of loading. Figure 3

Secondly, the driving experience.



Figure 2: The Wentong Pagoda in Huai'an



Figure 4: The lock gate of the Grand Canal



Figure 3: The loading simulation

The driving theory demonstration: the users can obtain general knowledge about driving a boat in the water by the demonstration of the real way of driving in the Jing-Hang Grand Canal in ancient days.

The driving simulation: the users can drive a boat in the Grand Canal virtually, it will help users achieve the general knowledge and the process of driving in the Grand Canal. The users may drive the boat by the mouse and keyboard of the personal computer. At the same time, the elements involved such as the changes of the weather along the riverside which include rain, snow and wind, make the simulation much more immersing.

Thirdly, the lock gate crossing experience.

The lock gate crossing demonstration: the lock gate is one of the most common scenes in the Grand Canal, and shows a special culture of it (Figure4). The water levels between lock gates are different and the way of making the boats cross shows the wisdom of the ancient people. The

users can immerse in this dynamically demonstrating program which is implemented by the Web3D technology, Flash software and according to the theory of mechanical dynamics.

The lock gate crossing simulation: the basic theory of crossing the lock gate is shown as Figure 5. When the downriver boat goes through the lock gate to upriver: Firstly, open slowly the downriver lock gate and make the water level between upriver lock gate and down one equal; Secondly, close the downriver lock gate when the boat enters between the two lock gates; Thirdly, open slowly the upriver lock gate and make the water level between upriver lock gate and down one equal; Finally the boat goes upriver through the lock gate.

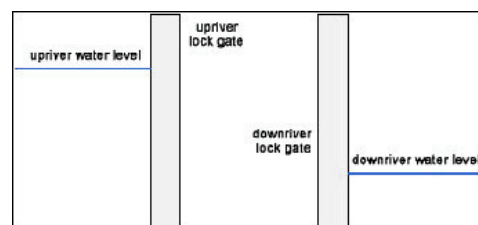


Figure 5: The picture of the theory of the lock gate crossing

Fourthly, the panorama experience.

The users can interact and immerse in this part by the panorama experiencing program as a tourist along the famous cities we present. It is implemented by the technology of Flash, VRML and Panorama. Figure 6 shows Slim Westlake in Yangzhou.

Fifthly, the interaction of the knowledge of Jing-Hang



Figure 6: The panorama of the Slim Westlake in Yangzhou

Grand Canal.

It provides the user interaction test in this part, which includes the general knowledge of the Jing-Hang Grand Canal, by drawing out the questions randomly, and the users may answer these questions by mouse of the personal computer and the system will give out a score which can inspire the users learn the knowledge better.

4. Conclusion and Future Work

A good experience system should not only tell simply the users certain knowledge, but also arouse their curiosity and interests constantly. This system includes rich knowledge of shipping such as the flotage and lock gate, which could stimulate the users' curiosity, as well as the knowledge of the Grand Canal.

For the organization of the data, the system is implemented following the clue of plots, which makes the experience an interesting risk and gives the users a sense of freshness so that they can focus on it more. So far, there is plenty of data about the Grand Canal, but it is a great pity that most of such data is quite scattered and there is not a good platform for them, so that less and less people pay attention to the Grand Canal. The top priority is to have a good platform which shows the history, cultures, functions and the technology of the Grand Canal.

For the technology, the system based on the traditional B/S based structure modeling technique, and integrates the images, words, sounds and videos into a coherent whole by Flash, which avoids just telling knowledge simply to the users and enables them to enjoy the course while learning. Meanwhile, the system provides the users with the vagile experience in the browser by the Java3D technique, which was seldom attempted before. Because it does not only need high scene modeling, but also have to solve the network transmission problems, 3D interaction and so forth. The panorama technique of this system overcomes the common shortcomings of the images, such as the limitation and distortion of the field of view. It is a specific application of virtual reality which enables the users to appreciate the landscape along the Grand Canal vividly.

For the interaction methods, we provide the users plenty of ways to interact. Users can look through and manipulate as well by the virtual exploring system. They can appreciate the landscape along the Grand Canal, drive and ship in the canal, load cargos by themselves and enjoy many kinds of natural environments including social customs. Because the Grand Canal is an immense project winding its way for thousands of kilometers, it will be quite difficult to take pleasure in the charms of it in person. What is more, as a great water conservancy project in history, much information of the Grand Canal, such as its ancient scenes which has disappeared, has to be shown by the way of multimedia. Therefore, it is necessary to provide a virtual exploring environment of the Grand Canal to give

the users an easy learning experience and a better understanding than only reading from the textbooks.

For the development of the system, a mechanism of renovation and the sustainable development have to be considered in the process of digitizing the cultural heritage. Software project development is a cycling course which emphasizes users' feedback and the system's ameliorations. The development of the system shows in two respects. One is the enlargement and improvement of contents, the other is the increase of interaction.

To realize the renovation in the future, we should take the two aspects following in mind: firstly, preserve data well, which include all of the words, images, animations, videos and so on, and all the codes should be given notes well in favor of subsequent development as well. Secondly, keep the interfaces, it can complete the renovation of the system with modifying simply some of its materials or codes but not the whole system.

To get a larger access to the application, we put it on line to make it easier for the user to connect and learn with the application, and we are planning to have hyperlink inside the application, add web-content links and collaborative work, so that different users can be in a single environment and share information, chat, interact with the same object, be on the same boat on the canal and learn together at the same time but using different personal computers linked by the internet or a local network.

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References

- [1] Niem Wolfgang. 1999 Automatic reconstruction of 3D objects using a mobile camera [C]. Image and Vision Computing.
- [2] Ulas.Yılmaz, ADEM YASAR MÜLAYİM, VOLKAN ATALAY, an image-based inexpensive 3D scanner[C]. international journal of image and graphics, Special Issue on Virtual Reality and Virtual Environment, to appear.
- [3] Steinbach E, Eisert P, Betz A, Girod B. 3-D Reconstruction of Real World Objects Using Extended Voxels [J]. IEEE international Conference on Image Processing, ICIP 2000, Vancouver, Canada, 2000, 1(9):569-572.
- [4] Y.M.Kwon, L.J.Kim, etc. Virtual Heritage System: Modeling, Database & Presentation. In Proc. Of VSMM'01, IEEE Press, 2001.
- [5] T.Usaka, K.Sakamura. A Design and Evaluation of the Multi-User Virtual Environment Server System for the

- Digital Museum. In Proceedings of the 13th TRON Project International Symposium, IEEE Press, 1996, pp 60-69.
- [6] Lifeng Wang, Zhigeng Pan, The advanced arithmetic of panorama[J], The Journal of Computer Application Research, 1999, 16 (6) : 59-61
 - [7] Dan Xu, Zhigeng Pan, Jiaoying Shi, Image based rendering technique in virtual reality [J].Journal of Image and Graphics, 1998, 3 (12) : 1005-1009.
 - [8] Shum Heung Yeung, Szeliaki Richard Construction of Panoramic Image Mosaics with Global and Local Alignment[J].International Journal of Computer Vision, 2000, 36(2):101-130.
 - [9] M.Hirose. Image-based virtual world generation. IEEE Multimedia.IEEE Press, 1997, 4(1), pp27-33
 - [10] H.Youichi, A.Kenichi, A.Kiyoshi. Tour into the picture: Using a spider mesh interface to make animation from a single image, Proceedings of the 24th Annual Conference on Computer Graphics and Interactive Techniques, New York, 1997, pp.225-232.
 - [11] Veraldin J-A, Picard M, El-Hakin S F, Godin G, Valzano V, Bandiera A, Virtualizing a Byzantine Crypt by Combining High-resolution Textures with Laser Scanner 3D data[C]. in Proceedings of VSMM2002:3-14.
 - [12] Magata Shojiro, Atsushi NAKAZAWA, Katsushi ISEUCHI. An Interactive Multiview Autostereoscopic Display System for Digital Image Archives in Tele/Cyber Heritage Museums[C]. in Proceedings of VSMM2002.
 - [13] Bonacchi A M, Cappellini V, Corsini M, Ross A De, Piva A, Barni M. Artshop: an artworks image processing tool[C]. in Proceedings of VSMM2002:89-97.
 - [14] Song Meehae, Muller-Witting Wolfgang, Chan Tony K Y. Reconstructing Peranakan Identities through Digital Heritage[c]. in Proceedings of VSMM2002 : 124-131.
 - [15] Zhigeng Pan, Gengdai Liu, Zhi Li, Virtual Presentation and Animation of Qingming Festival by The Riverside, Second Workshop on Digital Media and its Application in Museum & Heritage, IEEE Computer Society, 2007, 75, pp. 102-105
 - [16] Horry Y, Anjyo K, Arai K+Tour into the picture : using a spider mesh interface to make animation from a single image[A]. in : SIGGRAPH ' 97[C], Los Angeles, California, USA. 1997 : 225-232
 - [17] Zhiqing Cao, Jiaoying Shi, Image based TIP method, Thesis for Master's degree of Zhejiang University[M], 2005
 - [18] Dagang Wu, Rongrong Xiao, The analysis of the information system of C/S and B/S structure [J], Information Science, 2003, 3(21), pp.313-315.
 - [19] Liqi dong, The Internet based interactive network education platform design[J], Policy & Scientific Consult, 2007(14), 47