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Innovative application of virtual display technique in virtual museum

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Abstract. Virtual museum refers to display and simulate the functions of real museum on the Internet in the form of 3 Dimensions virtual reality by applying interactive programs. Based on Virtual Reality Modeling Language, virtual museum building and its effective interaction with the offline museum lie in making full use of 3 Dimensions panorama technique, virtual reality technique and augmented reality technique, and innovatively taking advantages of dynamic environment modeling technique, real-time 3 Dimensions graphics generating technique, system integration technique and other key virtual reality techniques to make sure the overall design of virtual museum. 3 Dimensions panorama technique, also known as panoramic photography or virtual reality, is a technique based on static images of the reality. Virtual reality technique is a kind of computer simulation system which can create and experience the interactive 3 Dimensions dynamic visual world. Augmented reality, also known as mixed reality, is a technique which simulates and mixes the information (visual, sound, taste, touch, etc.) that is difficult for human to experience in reality. These technologies make virtual museum come true. It will not only bring better experience and convenience to the public, but also be conducive to improve the influence and cultural functions of the real museum.

1 Introduction
Virtual museum refers to display and simulate the functions of real museum on the Internet in the form of 3 Dimensions virtual reality by applying interactive programs. This new type of museum is created by combining the virtual reality technique, Internet and traditional museums. It can greatly save expenses, close the distance between the city residents and the museum, realize visiting the museum without going out; and also can be used as its guidance and audience relationship management platform by traditional museum to attract more visitors.[16]

2 The demand of virtual exhibition technique in virtual museum
The construction of virtual museum needs to make full use of the characteristics of virtual display technique, such as three-dimensional panorama technique, virtual reality technique, augmented reality technique and so on, which are emerging techniques with rapid development, so it is a very challenging task to take advantages of them.

2.1 3 Dimensions panorama technique
3 Dimensions panorama technique, also known as panoramic photography or virtual reality, is a technique based on static images of the reality. [2,15]Splicing a set of images from the camera ring 360 ° into a panoramic image, with special player software on the Internet, this technique can make sure the audiences use the mouse to control their view direction, left or right, near or far to view
objects or scenes. According to the order of taking images-digitalizing-splicing-generating scene, 3 Dimensions panorama technique establishes the virtual environment by using real photos, is simple and practical. [5]Using 3 Dimensions panoramic technique needs to take advantages of the following characteristics[8], shown as Table I:

| No. | Characteristic | Description |
|-----|----------------|-------------|
| 1   | Field shooting | 3 Dimensions display based on the real scene. |
| 2   | Strong interaction | The audiences can use the mouse to control their own perspectives. |
| 3   | Small program | A small JAVA program without the plug-in can show the panoramic photos on internet, or the audiences can use the QuickTime player to watch directly. |
| 4   | Small file | The file is small, generally only 100-150k, easy to transmit on internet.[10] |

2.2 Virtual reality technique
Virtual reality (VR) technique is a kind of computer simulation system which can create and experience the interactive 3 Dimensions dynamic visual world. [3,6]Virtual reality is a comprehensive technique including real-time 3 Dimensions computer graphics technique, wide-angle stereo display technique, human’s motion tracking technique and tactile / haptic feedback, stereo, internet transmission, voice input and output technique etc.[17,19]To use of virtual reality technique, we need to take advantage of following characteristics, shown as Table II:

| No. | Characteristic | Description |
|-----|----------------|-------------|
| 1   | Folding perception | In addition to the general computer vision perception, there are auditory perception, tactile perception, motion perception, and even taste, smell, etc.. The ideal virtual reality should have human's all perception function.[14] |
| 2   | Folding presence | It refers to the true sense to which the user feels as a protagonist in a simulated environment. The ideal simulated environment can make users feel like being in reality. |
| 3   | Folding interaction | It refers to the extent to which the users can operate the simulated environment and the feedback from the environment. |
| 4   | Folding Autonomy | It refers to the extent to which an object in virtual environment moves according to the laws of motion in reality. |

2.3 Augmented reality technique
Augmented reality (AR), also known as mixed reality, is a technique which simulates and mixes the information(visual, sound, taste, touch, etc.) that is difficult for human to experience in reality. Be added in the real world again, these simulated information can be perceived by human with sensual experience beyond the reality. [1]It not only shows the information in real world, but also displays the virtual information at the same time, which two kinds of information complement each other.[9]Head mounted displays, tracking systems, and mobile computing capabilities are three components to
augmented reality system. In visual augmented reality, users can experience the real world around by a helmet mounted display device which combines the real world with computer graphics together.[11] With computer graphics and visualization technique, augmented reality can generate virtual object that does not exist in reality, and place it accurately in real environment. It presents the users with a new sense of the effect of the real environment through display device which splicing virtual objects and real environments together. Therefore, the augmented reality system has the characteristics of virtual reality and real time interaction.

3. Classic case-Suzhou mobile virtual museum
Making the perfect use of the virtual display techniques, Suzhou Museum has built the great mobile virtual museum which is helpful to implement the idea of “be conducive to inherit and pass on traditional and regional civilization, be conducive to improve the image and taste of the city, be conducive to meet people’s cultural needs”, and therefore named “the most innovative museum in China”. In order to reflect the concept of "first-class building with first-class exhibition", Suzhou Museum use the key virtual reality techniques based on the Virtual Reality Modeling Language to display overall design of the museum and bring a totally new experience for audiences.[7]

Suzhou mobile virtual museum has created a series of commercial value. First of all, the first-class architectural tour experience on Internet which provides users with the opportunity to enjoy master’s design with the high quality virtual building 3 Dimensions model. [12]Smooth HD 360 panoramic indoor tour can break the space constraints of exhibition halls to achieve the maximum effect of cultural communication. Secondly, the first-class digital heritages show on Internet is a good way to represent the details, texture and sense of culture of exhibits. It can make users to view the exhibits freely on mobile devices without any obstacle or waiting, which meets the audiences habits better.[13] Thirdly, the adoption of application of WeChat is easy to promote without install any programs. Based on the development of H5, the entire mobile virtual museum system can be easily viewed and shared in WeChat platform. Meanwhile, the system can also be applied to offline digital touch device, official website and public accounts of WeChat.

4. Innovative Application of Virtual Reality technique in Virtual Museum

4.1 Dynamic environment modeling technique
Establishing virtual environment is the core of virtual reality technique. Dynamic environment modeling technique is used to acquire 3 Dimensions data of real environment and build corresponding virtual environment according to the actual needs. 3 Dimensions data acquisition can be realized by CAD technique (under regular environment), but it is more popular to use non-contact visual modeling technique under the majority of environment. The efficiency of data acquisition can be improved effectively by using both of them.

4.2 Real-time 3 Dimensions graphic generating technique
How to realize "the real time" function is the key to 3D graphic technique. In order to achieve the real-time purpose, it should be ensured that the graphics refresh rate is no less than 15 frames/second, and higher than 30 frames/second is better. Under the premise of keeping the quality and complexity of the graphics, how to improve the refresh frequency will be the key to this technique.

4.3 Application system development tools
The key to the application of virtual reality is to find the suitable occasion and object, namely, how to inspire users’ imagination and creativity. [20] With the application system development tools, we can greatly improve productivity, reduce labor intensity and improve the product quality.
4.4 System integrating technique
Because of the large number of perceptual information and models, the integration technique plays an important role in virtual reality. Integration technique includes information synchronization, model calibration, data transformation, data management model, identification and synthesis, etc.

5. Virtual Reality Modeling Language
Virtual Reality Modeling Language is developed to create a virtual reality scene based on browser with the characteristic of real-time roaming, it realizes the interaction between 3 Dimensions animation based on B/S structure and the users based on object, which not only changes the shortcomings of traditional web pages such as monotony and poor interactivity but also achieve the immersion and interaction of virtual reality technique according to different levels of requirements.

To construct the virtual museum with Virtual Reality Modeling Language technique, the directions are as follows.

Firstly, enhance the interactivity of the virtual museum. Virtual Reality Modeling Language technology is of strong interactivity, users can manipulate virtual objects by mouse and keyboard, the scene varies with audiences. Unlike traditional virtual scenes to be viewed in a fixed route, Virtual Reality Modeling Language makes it come true to view the objects freely in virtual scene. Besides, Virtual Reality Modeling Language supports multi users mode, different users can substitute and communicate in the same virtual scene with stereo visual effect and 3 Dimensions sound effect, which is the real virtualization of the reality.

Secondly, make good use of scripting support function of Virtual Reality Modeling Language. The script node in the Virtual Reality Modeling Language can be added to a variety of scripts, and also can communicate with Java Applet embedded in a web page through the EAI interface, which provides the technical foundation for the realization of real-time interactive and generation of dynamic scene.

Thirdly, take advantages of the small web traffic of Virtual Reality Modeling Language. Virtual Reality Modeling Language is a kind of ACSII description language, which transmit text file only in wrl format to the client, namely, only send the model description of the scene while keep the animation in the local computer. This not only reduces the web traffic and overcomes the problem of web congestion caused by the large traffic in transmitting images, but also makes full use of the hardware resources of the client to ensure smooth effect of 3 Dimensions.

Virtual display technique and virtual reality modeling language have greatly promoted the development of virtual museum. It will not only bring better experience and convenience to the public, but also be conducive to improve the influence and cultural functions of the real museum.

6. Conclusion
Virtual museum is created by combining the virtual reality technique, Internet and traditional museums. It can greatly save expenses, close the distance between the city residents and the museum, realize visiting the museum without going out; and also can be used as its guidance and audience relationship management platform by traditional museum to attract more visitors. These technologies make virtual museum come true. It will not only bring better experience and convenience to the public, but also be conducive to improve the influence and cultural functions of the real museum. It needs to make full use of the characteristics of virtual display technique, such as three-dimensional panorama technique, virtual reality technique, augmented reality technique and so on, which are emerging techniques with rapid development, so it is a very challenging task to take advantages of them.

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References
[1] Chen Jing, Wang Yongtian, “Digital reconstruction of Yuan Ming Yuan based on augmented reality technology”, Journal of system simulation, 2, pp. 424-428, (2010).
[2] Duan Xinxing, Liu Xueli, “3D display technique of virtual Yin Ruin’s museum”, Journal of system simulation, 9, pp. 2187-2190, (2005).
[3] Huang Dongjin, Tang Pengbin, “Personality-oriented recommendation and virtual display for 3D home design based on interaction history”, Journal of applied sciences-electronics and information engineering, 4, pp. 407-418, (2015).
[4] HE Laikun, “Virtual Reality Modeling Language and Its Application”, Journal of Hangzhou Normal University (NATURAL SCIENCE EDITION), 4, pp. 157-160, (2005).
[5] Ji Hong, Shen Yun, “The application of 3D scanning technology in the virtual display of Yongle Bell”, Journal of Beijing union university, 3, pp. 15-19, (2015).
[6] Ke ying, “Research development on key technology of museum costume virtual display based on Web3D technology”, Journal of clothing research, 2, pp. 176-181, (2016).
[7] Liu Huifen, “Cultural communication of museums by the Internet—case studies in the Netherlands”, Journal of Nanjing University of Posts and Telecommunications (SOCIAL SCIENCE EDITION), 3, pp. 16-19, (2011).
[8] Liu Jun, “Research on 3D virtual exhibition of the Archaeological sites”, Journal of Weinan normal university, 2, pp. (2013).
[9] LV Taosha, Tang Wen, Wan Taoruan, “Application research for history museum exhibition based on augmented reality interaction technology”, Journal of Xi’an polytechnic university, 12, pp. 728-732, (2015).
[10] Ping Qing, “360°Panoramic Technology Applications in Digital Museum”, Digital Technology and Applications, 9, pp. 87, (2015).
[11] Shi Guowei, Wang Yongtian, Liu Yue, “Digital conservation of culture heritage using augmented reality”, Journal of system simulation, 7, pp. 2090-2097, (2009).
[12] Sun Jiayue, “The New Trend of Museum Display -- Virtual Museum”, Art Education Research, 4, pp. 94-95, (2016).
[13] Wang Yue, “Research on Realization of Virtual Display of the Museum”, Communications world, 2, pp. 59-60, (2016).
[14] Tian Shibin, Liu Gang, “Virtual display of digital animation on the revolutionary site in Jinzhai”, Journal of Chaohu College, 4, pp. 76-79, (2014).
[15] Yang Jianjie, “Research on the Realization of Virtual Display of Museum Based on Panoramic Technology”, Museum Research, 3, pp. 10-15, (2015).
[16] Yan Xiaofeng, “The Application and Implementation of Virtual Reality Technology in the Virtual Museum”, Computer Knowledge and Technology, 12, pp. 217-218, (2015).
[17] Yu Zhanglin, “The study of product of WEB virtual display based on Java 3D technology”, Journal of Hubei university of technology, 4, pp. 42-44, (2010).
[18] Zhou Bo, “Research on Innovative Display Design Based on Virtual Reality Technology”, Modern Decoration (Theory), 9, pp. 2-3, (2011).
[19] Zhao Hongxia, Cai Zhihui, He shan, “The relationship between online merchandise displaying, online interaction and impulsive buying based on virtual tactility”, Chinese journal of management, 1, pp. 133-141, (2014).
[20] Zhang Yongchun, “The Application of Virtual Reality Technology in Museum – the process of building Zhejiang Virtual Museum”, Chinese Information Circles, 7, pp. 32-34, (2010).