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Toward the Experiential VR Gallery using 2.5-D

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Abstract

Although VR is opening numerous new possibilities, the current widely used way of presenting works of art in virtual reality-based exhibitions is not much different from the way of presenting works in physical galleries. In this paper, we propose a method that transforms the viewer's artwork appreciation experience in virtual exhibitions from "viewing" to more "experiential". Also, we introduce a case study made by applying the proposed method. It aims to provide a more immersive aesthetic experience to visitors in virtual exhibitions.

Keywords

Virtual Reality, Virtual Exhibition, Digital Storytelling, New Media, User Experience

Introduction

Digital technology has been increasingly used in exhibitions to provide more immersive experience. Displaying images on a huge wall and/or animating some of the key elements in the picture are commonly used ways in order to provide new immersive experiences. Furthermore, HMD (Head-Mounted Display)-based VR (Virtual Reality) exhibits that have emerged in recent years can potentially provide much greater new immersive experiences due to the powerful hardware and software system that allows user interactions.

However, user experiences in the immersive VR exhibits still stay mostly in 'viewing 2-D images', which is similar to the way we experience in a physical gallery. In a typical VR gallery, a replica of a physical gallery is created in a virtual environment and audience are asked to appreciate the artworks in pretty much the same way as in the physical gallery, which is viewing 2-D images. Although exhibitions in virtual worlds provide many people, who have not been accessible to the artworks due to physical or economical limitations, with the new cultural experiences, there are lots of rooms for improvements from the user experience point of view, especially considering the capabilities of the recent powerful VR systems.

In this paper, we propose a method that transforms the viewer's artwork appreciation experience in virtual exhibitions from "viewing" to more "experiential" by reconstructing 2-D paintings into 2.5-D works. With this method, users can appreciate artworks in a more active and participatory way. We introduce an example of a work made by applying the proposed method. It aims to provide more immersive aesthetic experiences to visitors in virtual exhibitions.

Related Work

Virtual exhibition is a new form of exhibition that has been enabled by the development of information & communication technologies. Compared to the physical exhibition that requires certain facilities and trained people during certain hours, the virtual exhibition allows anyone in anywhere to appreciate artwork anytime through the Internet and VR/AR devices. Most common type of the virtual exhibition is to present digitized content of the images, films, objects, or commentary materials from the existing gallery archives.

The form of virtual exhibition has originated in the early web exhibition. Web exhibitions occur via cyberspace, accessible by digital devices such as computers or smartphones. This is communicated with audiences by digitizing information of real spaces into 2-D/3-D forms and by creating virtual media.

An exhibition in a virtual space is classified according to its purpose, type and medium, and the terms such as an online exhibition, a virtual exhibition, a virtual museum, and a digital exhibition are being used.

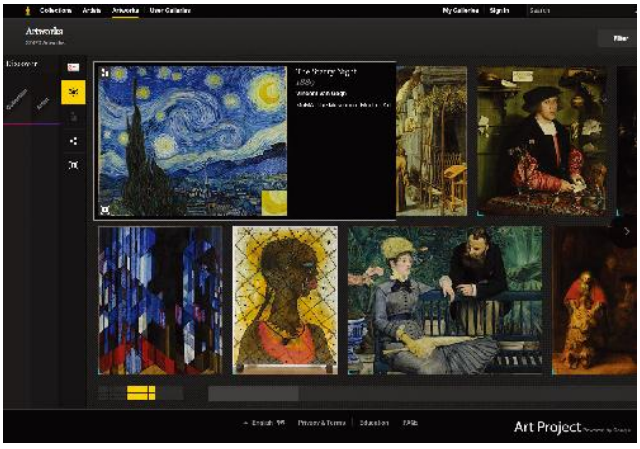

Figure 1. Google Art Project ©Google

Google Art Project is the most representative virtual exhibition project that aims to enable people all around the world to appreciate all the historical masterpieces with high resolution images. Audience can zoom in the high definition giga-pixel images and appreciate material, brushstroke, and

even paint crack vividly [9]. *Google Art Project* is well characterized in various interactive features of virtual art museums. Audience can share responses to works in Google+ and exchange opinions in a virtual chat room. Thus, people of various nationalities, cultures, backgrounds, and classes share ideas in real time. The virtual exhibition aims to overcome the limitations of existing physical exhibitions and increase the level of communication among audience.

Figure 2. Dali Museum ©Dali Museum.

The Dali Museum in Pittsburgh, PA, USA is currently using VR technology in a virtual exhibition. *Dreams of Dali* VR app allows audience to experience the full immersion into the paintings of Dali. Audience can experience moving images, audible scenery, and transformational atmosphere, etc. using various senses [10]. It is gradually being expanded for further experiences into new devices and applications utilizing virtual reality.

The Kremer Collection VR Museum is an example in which a museum exists only in virtual space for the first time. This museum uses photogrammetry technology to restore and display high-resolution images in virtual space [11]. Audiences can appreciate artworks' particularities at closer distances using the latest VR technology.

These virtual exhibitions have overcome the limitations of time and space in physical exhibitions. Anyone who has access to a computer connected to the Internet now can have similar experiences to visiting galleries in New York or Paris no matter where they live on earth and whenever they want to. In virtual exhibitions, large audiences can be accommodated flexibly and problems such as installation, transportation, maintenance, and insurance are no more the issues. Furthermore, virtual exhibitions can be customized to each individual based on the participant preferences for greater experiences.

Limitations

However, most of the virtual exhibitions still adopt the traditional ways of exhibiting artworks. That is, they typically create replicas of physical galleries and ask users in VR environments to appreciate the artworks in pretty much the same way as in the physical galleries, which is viewing 2-D images.

This is mostly because current virtual exhibitions, especially VR galleries, focus on simulating the real-world experiences in physical galleries. Thus, they create the 3-D models that look and feel similar to real physical galleries and display artworks as in physical galleries. Such content design naturally makes audience appreciate the artworks in the similar fashion as in physical galleries.

However, the user experiences in VR galleries do not have to mimic the ones in physical galleries. VR galleries open numerous new possibilities in terms of user experience design. Although the limitations of VR devices such as low screen resolution, dizziness, and inconvenience of wearing still have to be solved, new content design tailored specially for VR galleries could be more powerful in providing new immersive experience to VR gallery audience.

The new VR gallery design should also provide multiple sensory experiences, not biased to a sense of sight, as Marshall McLuhan said, 'not biased perception to one sense, but the recognized perception along with all senses is real perception' [2].

In this paper, we introduce a 2.5-D scene reconstruction-based VR gallery design for more active and experiential artwork appreciation.

Designing Experiential VR Galleries using 2.5D

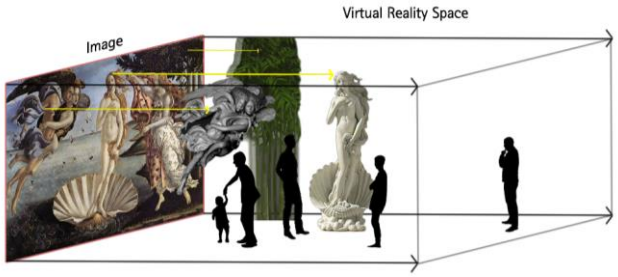

Figure 3. An example of scene reconstruction to 2.5-D © Si-Eun Park.

To make VR Exhibition more experiential, we propose the following method. First, we reconstruct a 2-D painting into a 2.5-D representation as seen in Figure 3, where the artwork is reformed in multiple layers of 2-D elements in depth according to the intention of the curator or the artist. Then, we make some of the elements to be interactive with users through animation or sound. Lastly, we install spatial sound sources in the 3-D space to maximize the sense of space and presence.

Reconstructing a 2-D painting into a 2.5-D representation requires careful planning. The first thing we consider is what story or message we want to communicate through the reconstruction. A good storytelling forms basis for immersive experience. The history of the artworks, the artist information, the curator's exhibition concept, etc. need to be considered at the stage.

The next step is to make decisions on what visual elements in the original 2-D artworks to make as separate layers and also how to place those in the 2.5-D representation. The knowledge about iconology plays important roles at this stage. A 2-D to 2.5-D transformation creates a unique visitor moving path. This newly generated moving path help audience have more active and participatory, thus more immersive experience in the VR galleries. Users can move around all the new spaces created by the reconstruction appreciating the artwork in a close, mid, and distant view and moving in and out of the artwork frame. This helps them experience inside and outside the work, understand the spatial dimension embedded in the work, and be immersed in the work. Curators or artists have to design the spatial layout of the elements in 2.5-D representations and each unique moving path created by the layout provides a unique experience to the user. In doing so, users can experience the artworks via performative behavior.

The other steps include making decisions on which visual elements to make as ones that users can interact through touch, voice, gesture, etc. The interaction output can be animated images, sound outputs, etc. The user interaction is one of the most important keys to making immersive experience as proven in computer games. Besides, spatial sound sources and their locations in the 3-D space need to be determined in order to maximize the sense of space and presence.

Case Study: "VR Liquid Nostalgia"

Figure 4. Tiffany Lee's *Liquid Nostalgia 5* © Tiffany Lee.

Figure 4 shows *Liquid Nostalgia 5* from Tiffany Lee's 'Liquid Nostalgia' series. The series of work were inspired by the Google Map's street view service. By allowing one to explore the different views of the streets throughout the world through the reconstructed photos, it makes one feel like he or she is actually walking around the real world. However, these views of the streets do not reflect the current condition since they were taken at some point in the past. It lets us roam around the streets of the past. The artist felt some kind of nostalgia within these images and decided to call this series of works as 'Liquid Nostalgia', borrowing Zygmunt Bauman's expression.

Figure 5. Google Street View and distance measures © Si-Eun Park.

Figure 6. *VR Liquid Nostalgia*. Three different views of the re-created version of Tiffany Lee's 2-D painting work *Liquid Nostalgia 5* by applying the proposed methods © Si-Eun Park.

VR Liquid Nostalgia is the re-creation of *Liquid Nostalgia 5* by Tiffany Lee. We applied the proposed methods to the original painting work and created the 2.5-D representation of it where users can walk around and appreciate the work in more experiential and immersive way. Figure 5 shows the original google street view image and the corresponding 2.5-D representations considering the depths of distant view, middle-range view, and close-range view in the original image. In this case, since the original painting was based on the

real-world buildings, trees, cars, etc., the decision on what to make as different layers and how to place those in the new space were relatively straightforward. Figure 6 shows three different views of the 2.5-D representation revealing how the 2-D visual elements are placed in the 3-D space. Since it is a 2.5-D representation, i.e., each element is a 2-D object with depth information, you can see that the red car or telephone booth gets thinner in certain views revealing that it is not a 3-D, but a 2-D object.

In addition, we have made the cloud and the color of the sky animated to give the user more physical presence. Also spatial sounds were installed such that the closer users get to the vehicle or the tree, the louder sound they hear that the engine or birds make. Such interaction was designed by the original artist to tell the story that she wanted to deliver and to enable audience to have more conversation with her artwork.

Audience Response

From December 13th to 19th, 2018, Tiffany Lee's solo exhibition *Liquid Nostalgia* was held at Art Space Tetra in Fukuoka, Japan. *VR Liquid Nostalgia* was unveiled for the first time in this exhibition.

Figure 7. The *Liquid Nostalgia* Exhibition © Tiffany Lee.

During the exhibition, the audience experienced *VR Liquid Nostalgia* by virtually walking around the 2.5-dimensional objects placed in a 3-dimensional space. Many audiences noted that this experience was rather impressive.

In particular, the audience showed great interests in 2.5-D objects arranged in parallel. The audience spent a great deal of time in walking around the scene while feeling the brushstrokes and texture of the original painting. In addition, the animation triggered by the user location and the spatial sound helped the audience get more immersed in the work.

On the other hand, the exhibition also helped the artist find new insights in communicating with users via VR/AR platforms motivating for future works.

Figure 8. *VR Liquid Nostalgia* exhibited at art space tetra in Fukuoka, JAPAN ©Tiffany Lee.

Conclusion

The emergence of virtual reality technology opens the possibilities of new exhibition methods. In this paper, we proposed a 2.5-D reconstruction based VR gallery design that can make a VR exhibition more experiential.

The process of turning a 2-D image into a layer of smaller 2-D visual elements with depth information doesn't require much artist time and is relatively simple process in terms of technology. However, turning the 2-D into the 2.5-D has profound impact in user experience. User behaviors change from 'viewing' to 'experiential'. They more actively participate in the exhibition.

This change has several implications for content design as well. One of them is the importance of storytelling design since the 2.5-D representation generates a certain visitor moving path, which is equivalent to the time dimension. A good storytelling design will form strong basis for immersive experience. Solid understanding on iconology and human behaviors will also become important for successful content design.

It is the limitation of the proposed approach that only a certain type of artworks can be applicable. Each artwork has unique message, context, and aesthetics. For each one, we should find a new way of having audience better communicate with the author. Through the exhibition design that fully exploits what the cutting-edge VR technology can offer, we can be provided with more immersive aesthetic experiences that cannot be substituted in the real-world gallery visits.

Acknowledgements

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