

Architectural VR Realization using Game Engine

Hyungwoo Jin¹, Mijin Kim²

¹Dept. of Visual Contents, Dongseo University,
47 Jurye-ro, Sasang-gu, Busan 617-716, KOREA
chrisnio@naver.com

²Division of Digital Contents, Dongseo University,
47 Jurye-ro, Sasang-gu, Busan 617-716, KOREA
Corresponding Author : mjkim@dongseo.ac.kr

Abstract. In architecture, visualization has been evolved from the way to utilize existing images, the one with a video source, nowadays to the one in real time in order to provide the clients the visual, spatial information. To maximize the given information, there increases the production cases using virtual reality in virtual space and it needs conflating with other areas. This study investigates the existing architectural VR production process and the one using game engine. Comparing those two approaches, it would suggest the desirable development of architectural VR for future plan.

Keywords: Game Engine, Architecture, Virtual Reality

1 Introduction

Architectural Virtual Reality refers to pre-construct the architectural building environment and the content by using virtual space with CG (Computer Graphics) in architecture [1]. Virtual reality is one of the most popular issues in CG topics and especially the virtual space for VR simulation plays a role in expanding definite space in reality toward infinite one. In particular, Head Mounted Display is in use of visual involvement and has advantage of letting clients experience virtual space in advance [2]. The development of VR technology and the expansion of content increase people's wants for pre-experience and satisfy the needs for visual display with high quality.

In architecture, construction space has been visualized in order to offer more accurate, realistic data to clients by using single or multiple images. Those methods have limits in perception of warped space and low interaction because they convert data of 3-dimension to 2-dimension images. To eliminate such errors, an architectural visualization approach based on VR platform has been introduced and 360 Panoramic VR and Architectural Visualization Rendering are the most popular [3].

For displaying more realistic architectural VR, there are tried a variety of approaches and utilization of game engine is one of them. The game engines in the past are only available in big business or specific areas due to high cost. However, as the more game-engine production enterprises are involved in competition to make the programs free and progressed, the better quality in display is able to be offered to

remarkably increase users' accessibility. It leads more convergence with other industries such as healthcare, architecture, military and more trials to new production process, especially increasing use in architectural visualization with 3D graphic [4].

This study researches the existing VR production procedure and its utilization and architectural VR with game engine in use. Also, the study finds out pros and cons by comparing the existing and the new in utilizing game engine and suggests efficient way to use architectural VR.

2 Architectural VR

Architectural VR is a kind of content visualizing designs of building structure on virtual space with CG. In real construction, there is no concept of pre-construction so it is hard to figure out the errors in design. However, if using architectural VR, it is possible to simulate building structure in virtual space and correct the found errors. Also, it has advantage of time and cost efficiency. Depending on producer's skill level and experience, specific method varies but there are two the most commonly in use.

2.1 360 Panoramic VR

360 Panoramic VR makes it possible for images to rotate in 360 degree as shown in the Figure 1. With the photographing devices like smartphone or DSLR and the programs for stitching each photo, the actual environment is converted into Spherical Panorama. Then, uploading on the most accessible websites, mostly the real estate web pages, it is offered in Panoramic Virtual Tour form to customers [5]. It is possible for customers to manipulate panoramic virtual tour made of 2D still images. Without visiting actual spot, customer can check visually through the web in advance and it is the most noticeable merit.

Current devices for taking pictures are available in panoramic filming so it makes faster and easier to create image sources, and also more professional filming devices are in production.

Yet, there are an inconvenience of building model house to picture the panoramic photos and a limit of warp in virtual space because the images are expressed in spherical shape, so it is hard to provide space sense in height, width, thickness, and depth. In addition, it shows shaky movements or border lines, making it inaccurate without correction process [6, 7].

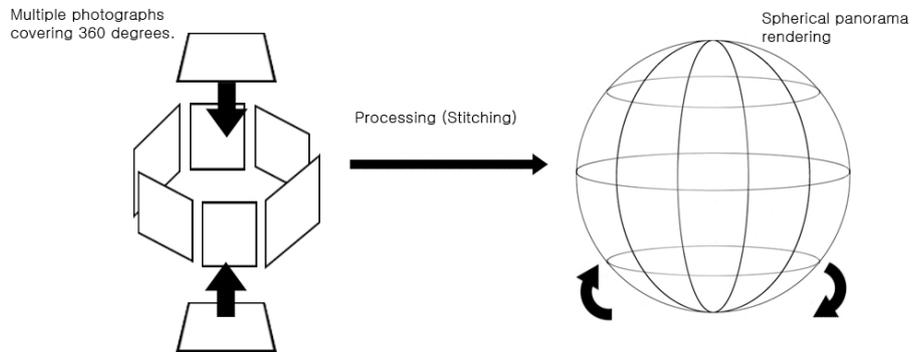


Fig. 1. 360 Panoramic VR

2.2 Architectural Visualization Rendering

With development of Renderer used in 3D application, it becomes possible to create still images or videos in high quality but it requires too much time and cost in rendering process. To complement those limits, AVR (Architectural Visualization Rendering), which can carry out real-time rendering, is introduced. AVR is an application of BIM (Building Information Modeling) for AEC (Architectural Engineering Construction) experts as shown in the Figure 2.

AVR offers more stable execution than 3D application and faster correction in real-time rendering and massive data processing. It is now mostly used in video or image-bird's eye view or perspective drawing- production. To create architectural VR with AVR, it needs 3D real-time environment for setting. After pre-production in 3D application, using AVR, the output of visualizing virtual space varies depending on producer's skill level and experience. Yet, it needs the assistant of the existing 3D application rendering due to the limited offering of tools in developing more functions, effect, and controlling animation of object.

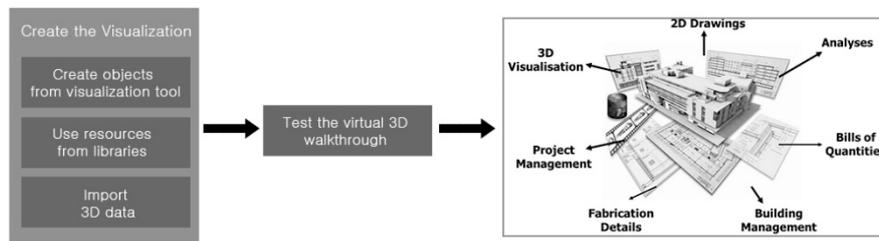


Fig. 2. Architectural Visualization Rendering

3 Production of Architectural VR using Game Engine

Like AVR, architectural VR production based on game engine has its advantage of creating outputs with high quality because of availability in massive data processing with real-time rendering and adding functions with programming.

After establishing the foundational environment by modeling in 3D application and texture production in 2D application, as AVR, it produces the output by adding shader production and elements in surrounding in 3D real-time production based environment. It has a merit of easy compatibility with other platform. However, in the perspective of the existing producers, or designers, it is hard to create VR with programming language and needs to know the whole structure of engine and how to produce shader for high quality VR using game engine, even though created in 3D foundational production like AVR [8].

Table 1 is the result of comparing the existing VR method and the new one using game engine, based on 4 criteria. Those criteria include Realization Method that becomes setting in VR production, Interactivity [9] that shows the degree of interaction with VR, Accessibility that presents how easily VR can be created, and Expandability that assesses the possibility of compatibility with other platforms. This study classifies the examination objects into ①360 Panoramic VR, ②AVR (Architectural Visualization Rendering) and ③Game Engine. Then it rates each of them in three steps; High, Medium, and Low.

Table 1. Comparison of Method to realize Architectural VR

Architectural VR	Realization Method	Interactivity	Accessibility	Expandability
①360 Panoramic VR	2D Still Image	Low	High	Medium
②AVR	3D Real-Time	Medium	Medium	Low
③Game Engine	3D Real-Time	High	Low	High

In case of Interactivity, it shows ③>②>① in order. Type③ presents high level of real-time communication when user reacts and for Type① displayed in 2D, it shows the least because it is only able in still image. Type② varies its effect based on output, but it falls short of the communication level compared to Type③.

In case of Accessibility, it shows ①>②>③ in order. When producing VR, Type① is the most commonly used due to its distinctiveness of using web. In establishing architectural VR with high quality, Type② is in use still Type③ is less popularized.

In case of Expandability, it shows ③>①>② in order. Type③ is available in all new hardware of VR due to regular technology support and shows excellent compatibility with other platforms. Type② has a limit in available platform because it offers less functions even if varies in the type of development program. Type① is recently common on web or mobile and in development through circle vision.

In conclusion, there are found three features in architectural VR using game engine.

- Real-time Rendering offers time efficiency in re-correction. It works in real-time rendering like AVR, but it has more capacity to process massive data because game engine can utilize programming support so control real-time rendering.

- It is easy to interlock with other platforms including web, even though considering each engine is supported by different parts. As smartphone is developing, anyone who carries smartphone platform such as iOS or Android can work applications, which game engine is easily able to make as output.

- For producers, it has them produce algorithm using programming language to make interactive step by step. Not still images but movements or sounds can be applied and the environment similar to the reality can be adjusted, including weather or changes in color, so it makes users feel convenient and lifelike. Furthermore, recently using visual interactive device (HMD) and behavioral interactive device (VR Treadmill) with complexity, it enhances involvement in virtual space by offering direct simulation to users [10].

4 Conclusion

This study compares three types of architectural VR production process including 360 Panoramic VR, AVR, and the one using game engine, based on 4 criteria; Realization Method, Interactivity, Accessibility, Expandability. In our analysis, architectural VR production with game engine is more available in terms of the level of interactivity and expandability than the existing production process. The high level of interactivity makes it possible to interact with user's behavior in architectural VR and expandability would be an advantage in terms of compatibility with other platforms. Higher attention in quality improvement of design when creating architectural VR requires complement in technical area. In such context, architectural VR production with game engine forms complementary relation of design and technology due to combination of platforms.

However, when utilizing game engine, in terms of accessibility it show low expectation because of high cost and psychological resistance to new entrance barrier. Thus, it is an urgent challenge to convert public perception in accessibility when utilizing game engine in architectural VR production. It is expected to lead further development with other industries if changing public perception in architectural VR and improving accessibility through a variety of cooperative development and utilization with other industries such as architecture and game.

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