

Cultural Heritage Reconstruction Based on Virtual Reality Technology: A Pilot Study of Taiwanese Historical Sites

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Abstract. In recent years, Taiwanese railway culture has been increasingly valued. The trend toward cultural preservation further inspires the public and the government to preserve traditional railway culture. In terms of technology, virtual reality (VR), a system that allows users to interact, move, watch, and get immersed in a 3D environment, is gaining ground. It has been applied successfully in a wide range of fields. These successful applications have further become popular commercial products. In this light, we apply VR technology to reconstruct Taiwanese historical sites, the nonextant historic east Taiwan railway stations, to develop a VR simulation system which provides an interactive environment for users to experience and appreciate the east Taiwan old railway stations and railway culture.

1 Introduction

Trains have the advantage of having the largest capacity of all transport systems, whether for short- or long-range transportation. Many Taiwanese cities first began to develop in the areas around their railway stations due to the resultant concentration of people and vehicles (Chen et al, 2016). In addition, railway station localities are home to commercial activities which further drive development. As a result, the station is both the center of a city and its portal (Chien, 2013).

In recent years Taiwanese railway culture has been increasingly valued. The trend toward cultural preservation further inspires the public and the government to preserve traditional railway culture (Chen et al, 2016). As historic east Taiwan railway stations boast a meaningful, significant and historical background, the project “East Railway Overall Performance Improvement Construction”, initiated in 2010 to renovate old railway stations, should follow the modern principle of preserving

historical sites well (Chen et al, 2016; Chien, 2013). Although the buildings of the east Taiwan old railway stations are not delicately decorated, the public and the government should provide various options or alternatives that can connect and even evoke mass memories of Taiwanese railway culture (Taitung Railway Art Village, 2017; Yuliman, 2017).

Given that several historic east Taiwan railway stations no longer exist (as shown in Figure 1), it is a delicate task to render the appearance of these buildings to enable people to experience and appreciate them (Chen et al, 2016; Hualien County Cultural Affairs Bureau, 2017; Yuliman, 2017). The task also involves effective application of new technologies to this trend, which remains a critical issue and calls for more research attention. Virtual reality (VR) is a system that allows users to interact, move, watch, and get immersed in a 3D environment (Lawson et al., 2016). Therefore, in this pilot study, we apply VR technology to reconstruct the historical sites (i.e. the nonextant historic east Taiwan railway stations) to develop a VR simulation system which provides an interactive environment for users to experience and appreciate the east Taiwan old railway stations and railway culture through time (Chen et al, 2016).



Fig. 1. The nonextant historic east Taiwan railway stations (Hualien and Taitung)

2 History of East Taiwan Railway and Railway Stations

It was not until 1910 that the east Taiwan railway was built, after several official evaluations because of its forbidden terrain and mountainous environment, and lack of economic values (Hung, 2011). It started as a narrow-gauge railway (the width of 762 mm), in comparison with a standard gauge railway (the width of 1,435 mm) (Yuliman, 2017). With the operation of North-link Line between Suao and Hualien stations in 1980s, the railway connection resulted in population growth, industrial development and commercial activities in east Taiwan. The railway station not only is the center or portal of a city but presents the image of a city on which the urban planning is focused. As the urban planning changed, the Hualien old railway station was dismantled in 1992 (Hung, 2011). This dismantlement entailed the relocation of the city center and crowd to other areas. On the other hand, the South-link Line was operated in 1991, when the “Beinan” station was renamed to “Taitungsin”. As the South-link Line increased capacity, the station saw a lack of hinterland, and the industrial structure started to change. In consequence, the Taitung old railway station was closed in 2001. It has become a historical site, and the “Taitungsin” station was

formally renamed to “Taitung” (Taitung Railway Art Village, 2017).

These historical sites were once closely connected to people’s life. While continuing to abide in their memory, they also offer rich cultural assets with splendid and magnificent scenery (Taitung Railway Art Village, 2017). How to work out a deliberate plan that combines urban development history, public activities, and cultural assets is a critical issue and a delicate task that calls for cooperation among Industry, Academia, and Government (Chen et al, 2016). Therefore, this pilot study attempts to pave the way for an interdisciplinary and cutting-edge cultural creation by applying a *new* technology (i.e. VR) to these *historical* sites to develop a VR simulation system.

3 VR Technology for Cultural Heritage Reconstruction

VR has been applied successfully in a wide range of fields, including Digital Marketing, Online Games, Product Design, and Biomedical Engineering (Lawson et al., 2016; Putrino et al., 2015). However, a successful application of VR system has to comprise three principles, that is, Immersion-Interaction-Imagination, called 3I of VR or VR Triangle (as shown in Figure 2(a)) (Stappers et al., 2001).

- (a) Immersion: the VR system can compellingly immerse users in the “virtual world” by utilizing high performance hardware, as shown in Figure 2(b), and inhibit users from being distracted by the real world around their surroundings.
- (b) Interaction: the interaction component of this high-end user interface involves multiple sensorial channels, such as the visual, auditory, haptic, smell, and taste ones.
- (c) Imagination: the capacity of users’ mind to perceive nonexistent things and create the illusion.

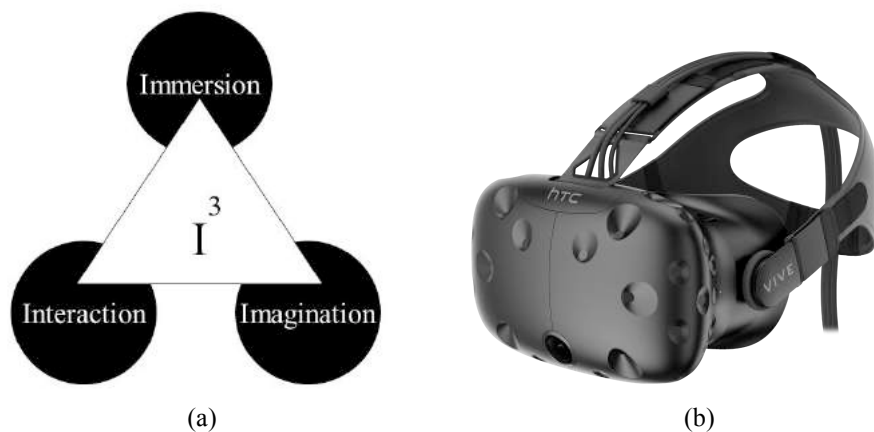


Fig. 2. The VR Triangle and the VR headset

In addition, Milgram et al. (1994) first proposed the Reality-Virtuality (RV) continuum concept, which encompasses all possible variations and compositions of real and virtual objects (as shown in Figure 3). Figure 3 shows the Mixed Reality (MR) consisting of both augmented reality, where the virtual augments the real, and augmented virtuality, where the real augments the virtual (Reality-virtuality Continuum, 2016).



Fig. 3. The concept of Reality-Virtuality (RV) continuum

VR presentation in a cultural heritage application was first used in 1994 (Higgins et al., 1996), when a museum visitor interpretation system provided an interactive “walk-through” of a 3D reconstruction of Dudley Castle in England as it was in 1550 (Virtual Reality, 2010). Following in these footsteps, we show how VR technology can help develop a VR simulation system to reconstruct Taiwanese Cultural Heritage of the nonextant historic east Taiwan railway stations. The main procedure of the VR simulation system built in this study is shown as follows (Chen et al, 2016; Chien, 2013; Regenbrecht, 1997):

- (a) Review the literature and relevant studies about the nonextant historic east Taiwan railway stations, and then form a focus group (including 5 experts) to define the boundary of the historic railway stations where the VR simulation system can be built, as shown in Figure 4 (Chien, 2013; Taitung Railway Art Village, 2017).

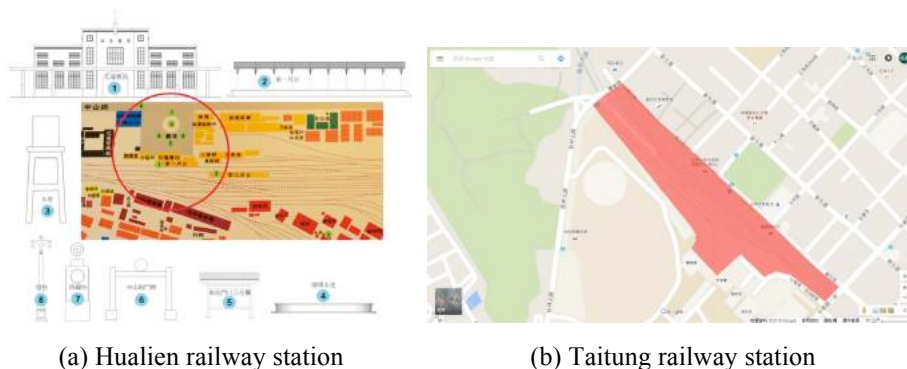


Fig. 4. The boundary of the nonextant historic east Taiwan railway stations

- (b) Sketch the outline of the main buildings of the historic railway stations, and then build 3D models using 3D software, such as 3DS Max, Maya and Sketch Up, as shown in Figure 5 (Chen et al, 2016; Chien, 2013).

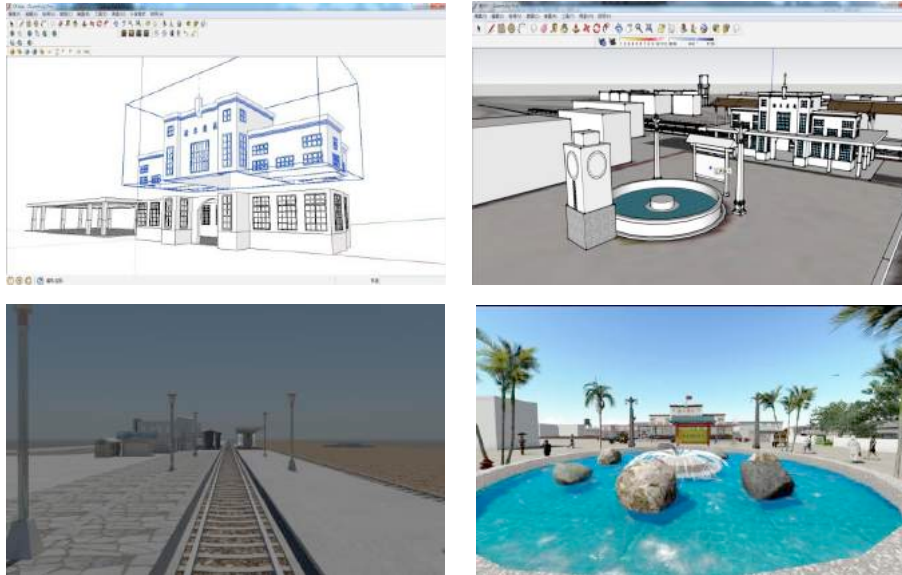


Fig. 5. 3D models built by 3DS Max, Maya and Sketch Up

- (c) Render the 3D models using the Sketch Up, Lumion, 3DS Max, and Maya software, and then develop the VR simulation system by the Unity software, as shown in Figures 6 and 7 (Chien, 2013).



Fig. 6. 3D models built for importing to the VR simulation system

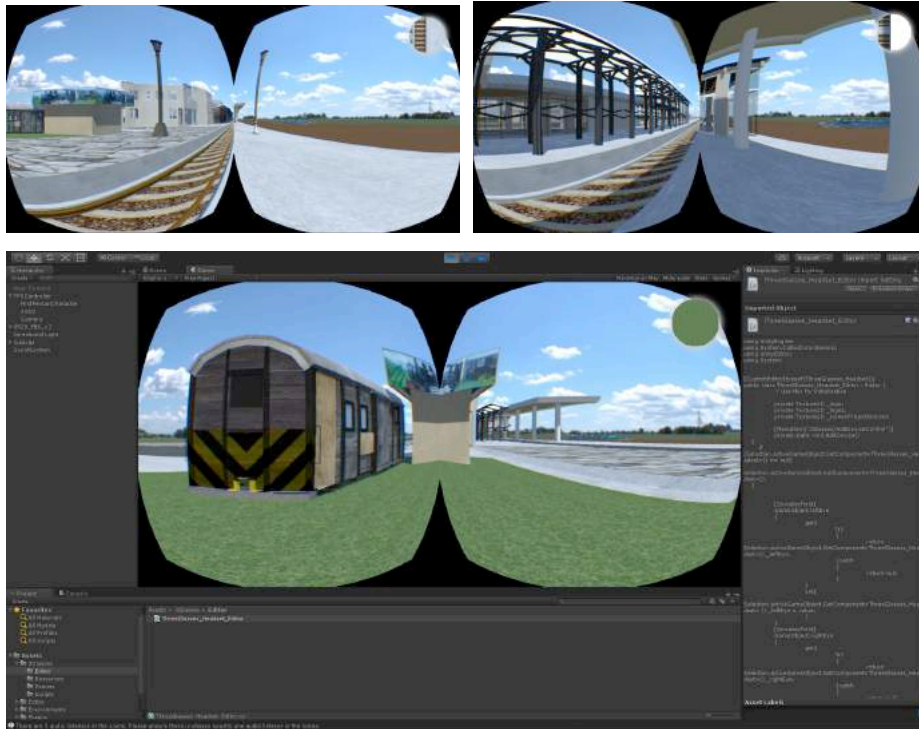


Fig. 7. The VR simulation system by the Unity software

4 Conclusion

We have applied VR technology to developing a VR simulation system to reconstruct the nonextant historic east Taiwan railway stations, i.e. the Hualien and Taitung old railway stations. The 3D software, such as 3DS Max, Maya and Sketch Up, are used to build and model the old railway stations, and the VR simulation system is developed with the Unity software. In this pilot study, we have incorporated the “new” VR technology with these “historical” sites. Effectively, the VR simulation system of the nonextant historic east Taiwan railway stations could connect and even evoke mass memories of Taiwanese railway culture.

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