CAVE를 이용한 도호쿠 지방 태평양 해역 지진의 실감 전시 방법
Presentation of the Great East Japan Earthquake with Ambience using CAVE

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Abstract: In this paper, we considered how record, store, preserve and show the Great East Japan Earthquake using virtual reality (VR) technique. We reviewed digital archive researches and VR researches applied or related to a disaster. We used panorama photos to present this disaster to users effectively. In order to give users more vivid ambience, panorama photos were displayed in CAVE.

Keywords: Disaster Presentation, Digital Archive, Virtual Reality, CAVE

1. Introduction

A magnitude 9.0 earthquake occurred at the Pacific cost of Japan 11 March 2011. The earthquake made huge tsunami waves of up to 40.5 meters. The tsunami caused series of fatal nuclear accidents and its fixing is not finished in 6 months. There were about 15000 deaths, 6000 injuries and 4000 missing, the Japanese National Police Agency has confirmed. It was one of most tragic disaster in modern history.

In this paper, recording, storing, preserving and showing of this disaster - the Great East Japan Earthquake - using virtual reality (VR) technique were considered. We reviewed digital archive researches and VR researches applied or related to a disaster. We used panorama photos to present this disaster to users effectively. In order to give users more vivid ambience, panorama photos were displayed in CAVE.

1.1. Digital Archive

There is a research filed named digital archive and many researches have been performed in this field. In a broad sense, digital archive contains studies about photos of a digital camera or recordings of a digital sound recorder. Furthermore, it contains all about digitalization of analog contents of real world.
One of good features of the digital contents is the preservation. They can preserve longer than the analog contents. And it needs smaller space than the analog ones. But the digitalization of analog contents can lose a typical feeling of analog one. There are many researches to preserve the sensation of analog.
It is not so long ago that our environment has been digitalized like photos of a digital camera. So it is important to archive and preserve analog contents that exist before starting the digitalization. Not only digitalizing but also storing, preserving and making it easy to access and retrieve are theme of this research filed.

Many contents made by human are produced in digital process nowadays. But it is also important to digitalize historical heritages or analog contents before digital device appears. There are many cases that need preprocessing more than simply taking digital photos or recordings.

Digital archive contains architecture, heritage, mass media, administration, laws, education, entertainment, etc. as the object. And it can be categorized text, image, sound, video, etc. – all the class of multimedia - as the type of dealing with. There have been many researches in various fields of digitalization of text like books, objects like statue and exhibits of museums, buildings like temples and churches.

The digital archiving of books, literature, newspapers and magazines are the digitalization of text. Among them, the digital archive of previous books and literature are the digitalization from analog contents.
Storing pages of books as the digital image format or scanning text are the methods of book digitalization. For example, old books are made to e-book in Gutenberg project [1] and old novels of Korea are digitally stored in Jikji project [2]. These works are more important recently because an e-book reader and a tablet device become more public.

Digital sound archive is also developing using digital and internet technologies. The British Library Sound Archive [3] has huge collection of recorded sound and video, music, wildlife, drama, literature, oral history and BBC broadcasts. It provides free access to this collection. Sori archive [4] collects and digitalizes the sound which has been stored in analog way. It is the archive of collecting, recording and preserving of audio.

There are also digital archives of nature or universe. The representative digital archive that digitalizes analog objects and has been organized well is NASA Images [5]. They digitalize universal photos, films, videos and make the archive since about 50 years ago. It is updated now and provided to public. Everyone can watch the vivid universe using this archive.

Law digital archive is the example of non-media digital archive. Westlaw® [6] constructs huge database of various cases and law information like precedents, the Constitution, laws and government regulations. There are many digital

archives of digital source. Digital archive from digital videos, images and music exists so many on the internet.

1.2. Disaster and Virtual Reality

From the start of virtual reality research, the application for disaster is one of main scenarios; a command and control center for disaster relief using VR was developed in The Intelligent Room Project [7]. The researches about disaster using VR technology can be categorized into virtual therapy, education/training and simulations as shown in (Figure 1).
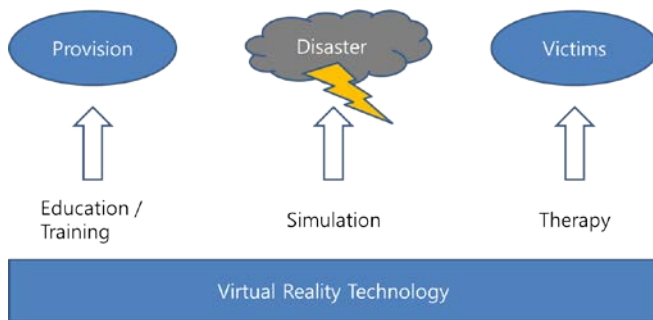

Figure 1: VR Applications related to Disaster

VR therapy is one of psychological therapy in medicine. The application of VR to the treatment of civilians and disaster workers who suffer from posttraumatic stress disorder (PTSD) following the WTC attack was showed in [8]. VR researches for PTSD and stress inoculation training (SIT) under disaster situations are well surveyed in [9].

The education and training for disaster management has been studied using VR. The VR technology was applied to education and training in the disaster management field in [10]. It focused on the role of presence and affective intensity. The VR system MediSim for training medical first responders was presented in [11]. The initial application of this system is to battlefield medicine. VR and telepresence technologies for military medicine were presented in [12]. When huge disaster occurs, the military is moved there and their dealing methods can be applied to and are similar to the dealing methods to a disaster.

There are many researches focusing the simulation of disaster environment. The simulation of occupant evacuation in an underground station when fire disaster occurs was presented in [13]. Their system simulated fire scene and evacuation process in a virtual environment. The RoboCup-Rescue Simulation Project [14] has been contributed to the disaster mitigation, search and rescue problem.

2. Presentation Disaster using CAVE

Because panorama photos contain whole environmental information, they are made of several common photos stitched. They are usually taken using a panoramic tripod head to be stitched after correctly and easily. Panorama photos are useful for users to feel the ambience of some place because they show all landscape in whole directions.

In this paper, panorama means not only horizontal but also vertical.

CAVE is very famous device in VR research field. It made of several screens and projectors. Because users are surrounded by screen images, they can feel the emersion in it. VR therapy is one of applications using CAVE's this feature. Using panorama photos with CAVE, we can give users the vivid ambience of a certain place effectively.

We have studied and developed the method of presenting panorama images on CAVE in [15][16][17]. Only one panoramic image is used in [15] and two panoramic images for left and right eye are used in [16]. The more efficient method for take picture of environment is improved with 3D panorama sweep function in [17]. Also the method and formulation of photographing panorama photos are presented in these papers. A virtual sphere surrounding CAVE was defined in graphic system. We took the panorama photos as texture and mapped into inside of the sphere.

3. Implementation

We used 4 sided CAVE and its name is K-CAVE [18]. It has 4 screens, 8 projectors for stereo output, a magnetic position sensor and a joy pad for manipulation. There are 5 Linux machines - one master and 4 renderer machines for each 2 stereo projectors. The system was developed using the OPENCabin library [18].

4. Results

The results of our system are shown in (Figure 2, 3, 4). They are the photos of the street ruined almost everything (Figure 2), the wrecked 2 stories building (Figure 3) and inside of a house (Figure 4).

5. Conclusions

In this paper, we considered how record, store, preserve and show the Great East Japan Earthquake using VR technique. We reviewed digital archive researches and VR researches applied or related to a disaster. We used panorama photos to present this disaster to users effectively. In order to give users more vivid ambience, panorama photos were displayed in CAVE.
In future, we consider the video or sound will be added. If the earthquake or tsunami simulation can be possible in our system, it will help the improvement.

Acknowledgement

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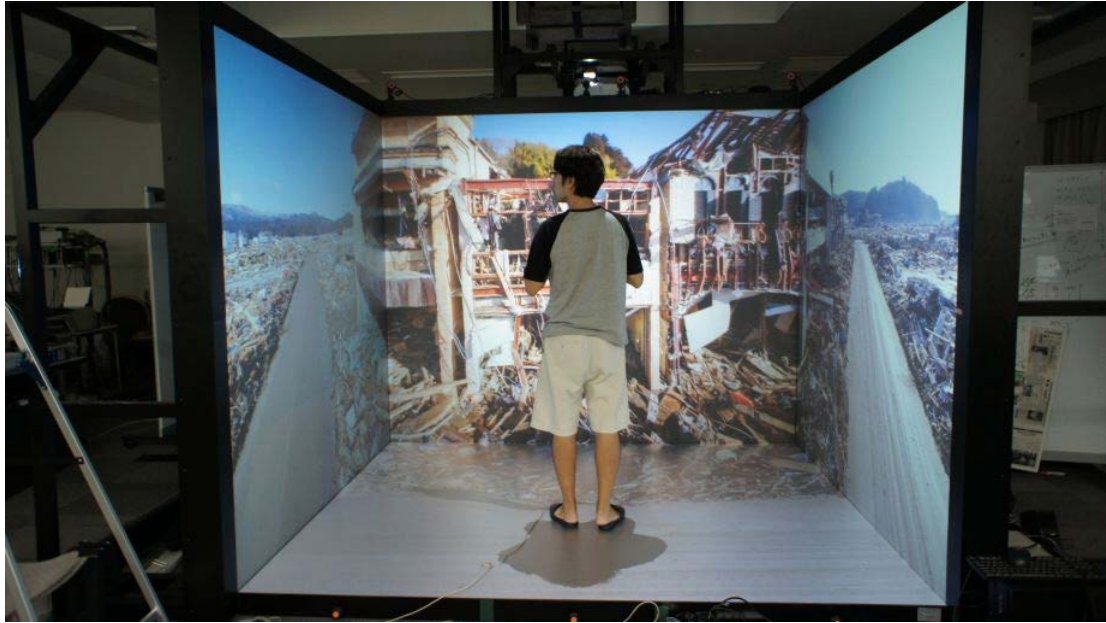**Figure 2: Presentation of the Great East Japan Earthquake - Street**

Figure 3: Presentation of the Great East Japan Earthquake - Building

Figure 4: Presentation of the Great East Japan Earthquake - Indoor