Research and Development of Second Generation Virtual Reality

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ABSTRACT

Novel VR technology (second generation VR) is introduced. After short review of technological advances to date, the author discusses benefits of VR in the areas of education and training that are expected as major application of VR technology.

1 INTRODUCTION

VR (Virtual Reality) is the technology of getting into the visual world created by a computer and trying various simulated experiences there.

The term "VR" has been used the first time in the technical context dates back to until 1989. It is the beginning that VPL (Virtual Programing Language) Research company announced a strange telecommunication system called "Reality built for Two (RB2)" as shown in **Fig.1**. The system uses a goggle-like display device called HMD (Head Mounted Display) consisted of a compact optical system and small solid-state display devices so that it can provide surrounding view of 3D image to the user. In addition, a glove-like device called DataGlove was used as an interaction device. The device equipped with an optical fiber to trace hand/finger motion using transparency changes due to finger bending. By using this device, we can manipulate an object displayed in the HMD.

Fig. 1 VPL's Reality Built for Two (RB2)

Now, after 30 years, VR technology is getting public attention from our society again. Significant cost reduction has been achieved, for example, although the first VPL HMD cost 2-30 thousand dollars, current HMDs can be obtained at 5-60 dollars or so. Recent smart phones have most of the functions that an HMD should have. In particular, some of Apple's iPhone models even handle AR functions.

Other than that, the entire technology ecosystem such as 3D sensing, global positioning system and high speed networking became more and more realistic. We can say we are in the age of second generation VR, VR2.0.

2 CLOSS-MODAL TECHNOLOGY

VR is sometimes called technology of the five senses. Giving artificially synthesized sensory input to human's five senses by some means is one of the major research topics in VR technology . By this reason, VR technology has a close relationship to the psychology.

Recently, one of the hot topics is closs-modal technology such as the theory of Pseudo Haptics [1] which generates force sensation by using interaction deformation in visual sensation. **Fig.2** shows "Yubi-Toko"[2] which can display resistance force when we walk snow road without using any haptic device (just by tablet computer).

Fig.2 Yubi-Toko[2]

Closs-modal displays using such a series of illusion plays very important role in VR2.0 technology. **Fig.3** is

"Meta-Cookie" [3] which is another example of closs-modal display. The Meta-Cookie is a taste display composed by visual and olfactory displays.

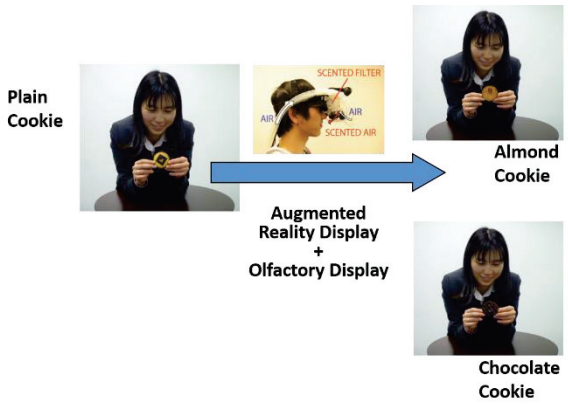

Fig.3 Meta-Cookie[3]

A technology called "Redirection" is also unique in VR2.0. This is a technique to minimize movement in the real space when moving in a large space. Suppose that when you go straight in the real space, VR space is programmed to go shift to the right. In this case, if the user want to walk straight in the VR space, he has to walk to the right in the real space. This program gives us an infinite VR space which is confined to a finite real space. **Fig.4** is "Unlimited Corridor" [4], a walk-through system which can provide huge (almost infinite) walkable space by utilizing the principle of redirection.

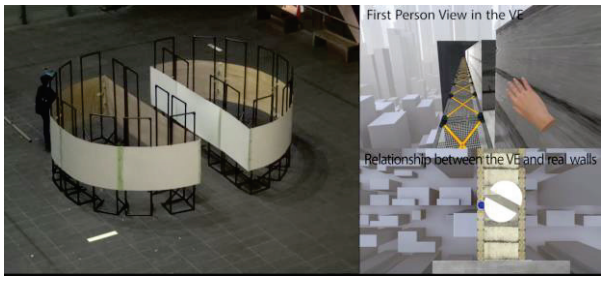

Fig. 4 Unlimited Corridor[4]

3 VR AS EXPERIENCE-BASED EDUCATION MEDIA

Let's write about the application of VR technology. The biggest feature of VR technology can be explained by the keyword "experience". In most case of science and engineering education in the university, it is said that experience-based learning, such as experiments and exercises, is important and indispensable.

Until now, digital devices have been introduced into practical training in areas where it is permissible to spend money on per-person training such as training for pilots and doctors. The introduction of VR technology would be expected to extend the application field of digital practice training. For example, in the case of airlines, other than pilot training, may it be possible to introduce digital training to general occupations such as cabin crew training or ground staff training.

Other than a cost down, there are many effects unique to digital training system. For example, various events happened during virtual training can be recorded without the additional sensors. This big data can be analyze data at a very fine level, such as which trainee's skills are lacking. For example, in the case of nursing care work, it is said that the carer must always look at the patient's eyes. To measure the availability job training is required to newly install a Sensor, but for digital trainer, it is already in place.

More specifically, if there is a turning point that makes a successful work fail, it is almost impossible in practice to return to that point and resume training. It goes without saying that time retrogression is possible in digital. The realization of this kind of "controlled" diversity is a very important factor in training.

4 SERVICE VR TRAINER

Very recently, our laboratory is working on "Service VR Trainer" under the sponsorship of SIP Project (National Project). (**Fig.5**) The trainer is focused on training of "one-on-one" service. Essential component in the interpersonal service is a model of a customer expressed as an avatar who changes its behavior by the reaction of the trainee. Reactions may be physical actions such as the gaze, posture and also include language. This kind of VR system may be said to be an attempt to explore the possibility of merging VR and AI (artificial intelligence) technology. Of course, AI used here is not necessary to be perfect, because it is just used in training process.

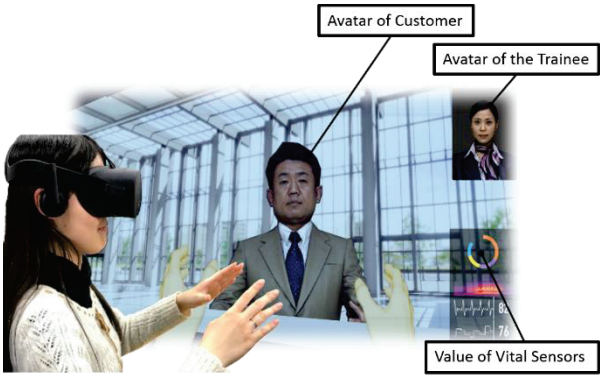

Fig.5 Service VR Trainer

One of the interesting attempt of this project is "Fused Body". This refers to the situation where two people share a single body. In the body-motion teaching situation, first, a trainee body is operated by a trainer completely, then after several trials, the trainee will eventually control himself and finally he can move the body only by himself. The trainer and trainee can make

this change continuously. In the real world, “Fused Body” is impossible, but it will be easily implemented in VR environment.

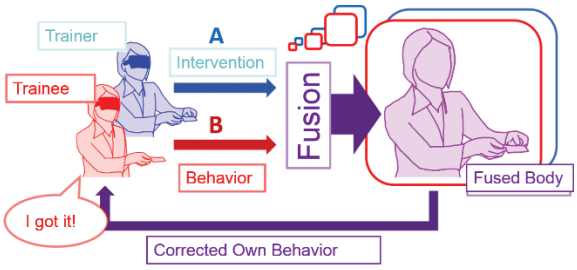

Fig.6 Concept of Fused Body

Changing the task difficulty will be also a unique feature in VR training. If the trainee is a novice and his ability is insufficient, he will not complete the training task. In the real training, training task should be restarted from the beginning. However, in the VR training, trainee can continue training to the end just by making the task level easier. Of course, information such as the change in the task level should later be fed back to the trainer and trainee. This is important in maintaining trainee’s self-efficacy.

Thus, the education and training system utilizing VR has several advantages as compared to the training system in the real world.

5 CONCLUSIONS

As mentioned at the beginning, the feature of VR technology must be to simulate the real world. However, what VR made possible is not a simulated simple copy of reality. It is important that the technology of VR can do what is impossible in the real world. The paper ran out the space to describe another application cases. In this paper, the author discussed only education and training application. For other application examples, I want to entrust to the appropriate extension inference of the reader.

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