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Virtual Experiences of Metaverse Using Mobile Type Head-Mounted Displays and Their Applicability

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Abstract

The concept of a 3D experience using the Google Cardboard VR headset and cell phones is discussed in terms of its educational effect. As for the video component, content on YouTube as a 360°VR video is used. The following three topics are included in this project: skydiving, lunar exploration, and deep-sea exploration. In some organizations, groups of faculty and student members are asked to participate in such an activity to experience 3D using a cell phone and YouTube along with the VR headset. The authors plan to analyze the results using a 5-point scale. A similar experiment is already in progress. It involves the use of a different VR headset tool (Oculus Quest). Since the contents of both activities are similar, the purpose of this experiment is to compare and verify the advantages and disadvantages of using a VR cardboard headset and a cell phone, as well as to identify the advantages and disadvantages of using a cell phone.

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1. Introduction

Nowadays, metaverse attracts lots of people for various reasons. Metaverse is defined as the general term for virtual three-dimensional space built into the Internet [1-5]. Usually, avatars are active in the virtual space and communicate with other avatars on behalf of the individual users. Many activities can be carried out in metaverse, that are not possible to do in real space. Therefore, we previously used metaverse for various educational projects. When metaverse included Second Life (by Linden Lab located in San Francisco, the USA) we decided to use it [6-9]. Many educational activities were carried out by us in SL that related to Creative Engineering Design [10-20]. In Second Life, avatars perform activities in a three-dimensional virtual space on behalf of the users. The various functions of Second Life, such as chat, conversation through voice exchange, and the creation of structures in virtual space (called prims), combined with the language translation function, made it possible to develop a wide variety of educational activities. One example is PBL, which is very difficult to implement as an e-learning class in a virtual space from the viewpoint of increasing effectiveness because the face-to-face encounter is of major importance. We confirmed that this type of project can be done more realistically by using avatars. PBL in engineering education often involves designing and building structures using prims in a virtual space, allowing for manufacturing as well. Many of these activities have been successfully carried out by our students' avatars and are described in the authors' published papers. Several projects include asking the students to design and have their avatars build the typical house for the global warming period and cars that are safe, energy efficient, and environmentally friendly. Another creative activity involves the use of a language translation function. We used it to facilitate international discussions in SL with student groups from the United States, Japan, and Korea. Color-coded chairs were created in a virtual space using Google translate. For example, a student's avatar from Japan could be seated in a red chair. When he /she spoke, the words appeared on the computer screen in Japanese. They were also automatically translated into English and Korean and appeared on the computer screen too. The students' avatars from the United States and Korea sat in different colored chairs. When they spoke their words also appeared simultaneously on the computer screen in the three different languages.

For this paper we changed our perspective and envisioned an educational project using a new metaverse. The metaverse for this paper is a 3D space using a VR headset. In this case, we put ourselves into a 3D space and experienced it. As for the headset, the Google Cardboard VR headset was used [21-25]. Project results and plans are presented for the future.

2. The utilization of a Google Cardboard VR headset and its characteristics

The Google cardboard VR headset consists of a simple cardboard box with a built-in lens that fits in the palm of the hand.

The advantages of the Google cardboard VR headset are its affordability and the ability to construct and enter a 3D space without the need for special locations or equipment. Since it can be used with a cell phone, it does not require a special computer, and is characterized by the ability to enter 3D space anywhere and anytime. In this case, there are many ways to construct the 3D space. One of them is VR 360° virtual movies.

Most user-friendly of all is the ability to use YouTube programs that are developed on the cell phone. Since the penetration rate of cell phones is extremely high in Japan, this cardboard headset 3D experience (using cell phones) has an extremely high penetration rate. However, this trend is the same in all developed countries.

Even though the 3D 360° videos have been prepared and are also available on Facebook and other media, we chose YouTube videos, since we didn't have to join any special memberships there and used lots of content for free.

Using various search engines, for example, "VR space explorer Cardboard headset" will provide information on a variety of related sites, including YouTube. Selecting the appropriate YouTube link will take you to the desired video. When the video starts, it is split in two parts and is activated on the phone's screen. Immediately, the phone is

integrated into the cardboard VR headset and the video is viewed through the lens, allowing the user to experience the video in 3D.

3. Featured Educational Materials and their application to education for the future

Three distinctive 360° video experiences are presented. One of them is the virtual Skydiving experience. The site we visited was the movie entitled “Skydiving VR Google Cardboard Virtual Reality” [26]. The second was the movie entitled “VR Space mission: Moon Explorer (Google Cardboard)” [27]. And the third one was Deep Ocean explorer. (3D Ocean Explorer/ VR Google Carboard ,VR, Box , Gear VR , 3D SBS) [28]. These were provided as an application for smart phones.

These 360° VR videos provided us with interesting and exciting virtual experiences. In the first movie, we could enjoy the skydiving from the airplane. Then we felt as if we were skydiving in a real space. I was able to think about the relationship between buoyancy and propulsion, wind resistance, and the landscape of the Earth as seen from the sky.

In the second program, we were able to experience the lunar landscape and the Earth as seen from the Moon's surface in a virtual environment. Then we could observe our Earth and we were able to experience the importance of the atmosphere for life, water, and the protection and preservation of the global environment.

In the third program, we were able to experience deep-sea exploration. Visitors can experience the life in the deep sea and the environment of the deep sea, which is difficult for sunlight to reach. Life and the environment on Earth are linked to the movement of the entire planet. I felt that this would be an excellent first step to learning about this exciting topic.

In fact, there is a reason why I chose the above three themes. We have a similar project that we are simultaneously working on in another paper, which is a study of the application of metaverse and VR to education using the Oculus Quest headset and PC. In this case, we have selected three metaverse experiences to test their effectiveness: skydiving, space exploration, and ocean exploration. We intend to compare them. We have four educational effects by the metaverse that we would like to verify, as we did in that other paper. The first is impression, the second is curiosity, the third is knowledge, and the fourth is the motivation to learn. Therefore, we prepared the following questionnaires for the participating students and teachers.

Questionnaire 1: impression

----------:	----------:	----------:	----------:	----------:
Much impressed	pretty much impressed	neutral	less impressed.	Never impressed

Questionnaire 2: curiosity

----------:	----------:	----------:	----------:	----------:
Much curious	pretty much curious	neutral	less curious.	Never curious

Questionnaire 3: knowledge

----------:	----------:	----------:	----------:	----------:
Much learned	pretty much learned	neutral	less learned	Never learned

Questionnaire 4: motivation

----------:	----------:	----------:	----------:	----------:
Much motivated	pretty much motivated	neutral	less motivated.	Never motivated.

Fig.1 Questionnaires plans for sensation analyses

However, as we mentioned, we have a plan to compare the VR carboard headset 3D experience with Oculus quest 2 ones in this project. Therefore, we are going to add the following one.

We will ask the participants the following questions.

“When you compare the 3D experiences with the Google VR cardboard headset with those of the Oculus Quest, what kinds of impression do you have? Please answer the following questions, using the 5 step evaluations in the same way as you did for Fig.1. In addition to them, we will give them the following questionnaires.

Questionnaire 1: realism

----------:	----------:	----------:	----------:	----------:
Very strong	pretty strong	neutral	not so strong	not at all

Questionnaire 2: sound effect

----------:	----------:	----------:	----------:	----------:
Very strong	pretty strong	neutral	not so strong	not at all

Questionnaire 3: image

----------:	----------:	----------:	----------:	----------:
Very clear	pretty clear	neutral	not so clear	not at all

Questionnaire 4: ease of use

----------:	----------:	----------:	----------:	----------:
Very easy	pretty easy	neutral	not so easy	not easy at all

Questionnaire 5: Please write down your impression about the comparison freely.

Fig.2. The additional questionnaires for comparison between the VR Cardboard headset 3D experiences and the Oculus quest 2 ones.

The results will be summarized, using radar charts, first of all. And then, we will use Semantic Differential methods to analyze the results statistically. We already organized some small groups to participate in the project as shown in Fig.3 [29-32].

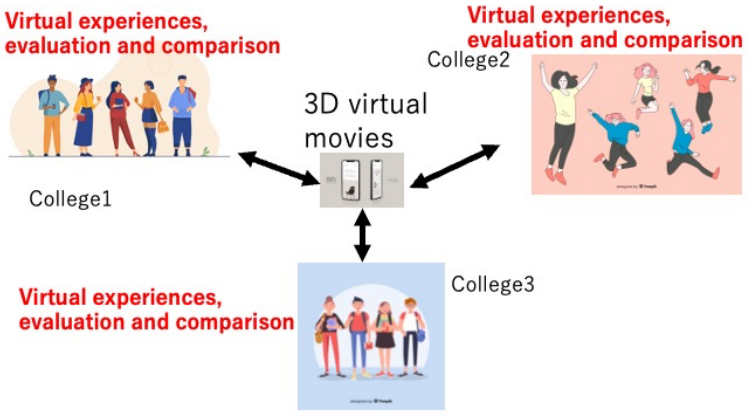

Fig.3 The concept of organizations for the educational project.

4. Conclusions

The concept of a 3D experience using the Google Cardboard VR headset and cell phones and the verification of its educational effect were discussed. As a video, content used on YouTube as a 360°VR video was used. The VR cardboard headset was very simple and didn't need any expensive apparatuses. It was a handy and easy-to-use tool that enabled the concept of 3D anytime and anywhere to be realized. However, its effectiveness must be verified in more detail in the near future, especially in terms of educational applications. A concrete plan for this method is described in this paper. More specific results and analysis will be presented later.

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