System Construction in the Mobile Virtual Environment

Pramual Suteecharuwat Masayuki Nakajima

Graduate School of Information Science and Engineering
Tokyo Institute of Technology

1 Introduction

Research and development in virtual reality (VR) have been done for many decades, but the real deployment are still in primitive state. Most of researchers are focusing on the technology, with less attention to the effectiveness of the systems to convey information [3]. This, in turn, has led the conventional deployment of VR systems interact with users in unrealistic sense. The goal of VR is to develop systems that can be integrated naturally into the human activities to enhance the users the feeling of presence in the virtual world, however, the limitations of current technology have led the researchers to a doubtful direction. For instance, in order to track the participant's position and movement, it is needed to install either the position tracking devices into a limit-sized working area or to tether the participants with the devices such as cyber-gloves, cables, and mechanical linkages. A participant may use a device such as a wand or a 3D-mouse to control the virtual environments to trot forward, backward, turn left or right. However, relatively to the physical visual display, the participant does not actually move. These conventional implementations are seemed to be acceptable in many applications, but the cumbersome burden and the style of navigation, on the other hand, cannot make the participants believe that they are really immersed in the virtual world. The environments are obviously not realistic.

In this paper, two new terms are defined; **participant-centered** and **environment-centered** VR. The former means the conventional way we developed the technology by focusing on the participants, whereas the latter means the way to develop the technology by focusing on the virtual environments. We propose the concept of environment-centered VR in order to describe how to produce new VR systems that are more realistic to the human sense. For instance, in contrast to the typical VR, if we develop a virtual library, a participant is supposed to actually walk to a computer-generated virtual bookshelf if they want to look for a virtual book. This is a more natural way for a human to interact with the virtual world, although it is still difficult to be implemented with the current technology.

Based on the concept of environment-centered VR, we proposed a new virtual navigation paradigm by implementing the Mobile Virtual Environments (MVE). Besides a short introduction to environment-centered VR, this paper shows the system construction of our first MVE prototype. The conceptual design, the merits and its limitations, as well as some recommendations for further study are presented.

2 Mobile Virtual Environment

Mobile Virtual Environment (MVE) is our newly proposed user interface device. It was devised to support the environment-centered navigation paradigm. In stead of the close-loop interaction characteristics [4], which can be found in most of conventional VR systems, a participant can drive the MVE as if driving a small car to navigate the computer-generated virtual environments, see Figure 1. The conceptual design of our first MVE was inspired by an idea to equip a conventional CAVE system upon a driving mechanism that has at least 3 degree of freedoms, for moving in forward-backward, left-right, and rotation direction. Figure 2 illustrates the conceptual design of the MVE.

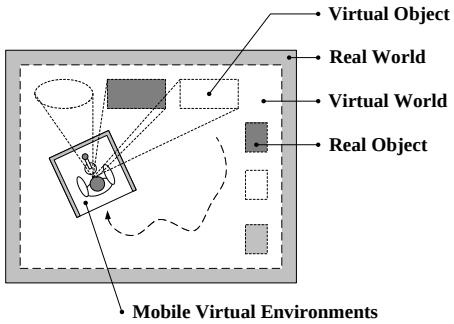

Figure 1: Navigation with the MVE.

3 System Construction of MVE

Our first MVE was implemented on The Vuton II [1]. The displaying system was implemented on one soft screen with a PLUS V-807 video projector that supports 15-85 kHz for the horizontal synch range. Therefore our first MVE prototype is currently a non-stereoscopic type. The sample application was developed with Java3D on the PC platform. Currently, it

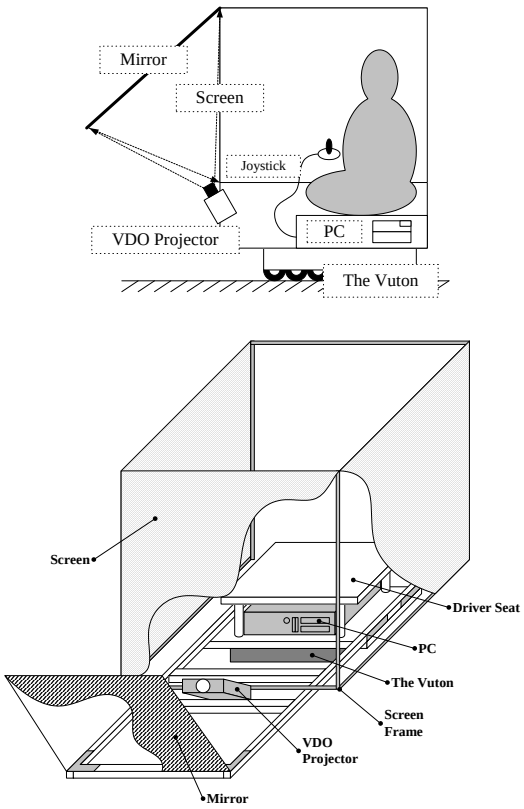

Figure 2: Conceptual Design of MVE.

is a desktop PC with Intel Pentium4 2.2GHz, NVidia GForce4 MX graphics board, and 512 MB of memory.

4 Experimentult Results

Implementation of our first MVE is shown in Figure 3. Our Java3D application, in accordance with the control software for the Vuton II, runs smoothly on the sample machine. Both the rendering speed and response rate are acceptable. Upgrading to a faster platform should also produce better results. MVE was designed with the modular concept, therefore, it does not depend on any specific equipments, or platforms. Extensions and replacements can be done with small effort. Using the MVE as a new medium for virtual navigation applications has a good potential to be a practical alternative. However, there are also some design problems of the MVE that can be summarized into weight, screen declination, and vibration problem. If MVE was implemented with too heavy weight, it will be difficult to control the Vuton II to move correctly, whereas implemented it too light would produce more vibration that has effect to the displaying system. Declination of the soft screen vinyl sheet also caused re-adjustment from time to time.

5 Conclusions

Environment-centered VR is our proposed concept for producing interface systems that communicate with

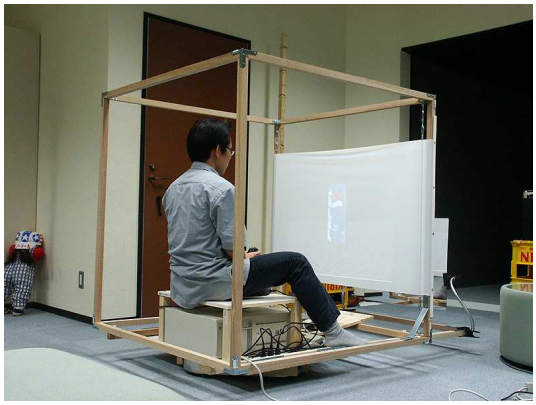

Figure 3: Experimentation.

participants in more natural and realistic way to the human sense. We provide in this paper with conventional concept of VR, the participant-centered, point out its flaws that perhaps led to the inconsistency of the current technology. We propose the MVE, a new user interface paradigm, with regards to the environment-centered concept. MVE is a movable VE systems. It was designed to be a vehicle for virtual navigation. Although the VE application we tested with the MVE was a simple one, but a more detailed with more specific behavior is technically possible. There are many potential applications that can be done with the MVE, such as game, training, virtual manufacturing, and telepresence. In order to enhance the practical used of MVE, there are also many awaiting research need to be explore, such as the users' mental side-effect, ergonomics, psychology testing, etc. For ease of operation, a more easier GUI is also required to be developed.

References

[1] R. Damoto, W. Cheng, and S. Hirose. "Holonomic Omni Directional Vehicle with New Omni-Wheel Mechanism", Proc. of IEEE International Conference on Robotics and Automation 2001, pp.773-778, 2001.

[2] P. Suteecharuwat, R. Damoto, and M. Nakajima, "A Design of Mobile Vertual Environments", Proceeding of the 2002 IEICE General Conference, Waseda University, Japan, March 27-30, 2002.

[3] A. van Dam, A. S. Forsberg, D. H. Laidlaw, J. J. LaViola, and R. M. Simpson. "Immersive VR for Scientific Visualization: A Progress Report", IEEE Computer Graphics and Applications, Vol. 20, No. 6, Nov/Dev, 2000.

[4] C. D. Wickens and M. P. Baker. "Cognitive Issues for Virtual Reality", in Virtual Environments and Advanced Interface Design, W. Barfield and T. Furness (eds.), Oxford University Press, 1995.