Effects of Wedge Design, Interaction Mode, and Viewing Perspective on User Wayfinding Behavior within a 3D Virtual Environment

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1. Introduction

To most of us, conduct wayfinding behavior within a virtual environment using a smart mobile device has become a common task in our daily life. Various visual designs together with different interaction modes are available in these smart devices. The purpose of this study is to investigate the effects of wedge visual design on user interaction mode within a 3D virtual environment. This study adopted the wedge design concept proposed by Gustafson, Baudisch, Gutwin, and Irani (2008) whose wedge design can illustrate visualized information regarding distance and direction to the user. Nonetheless, their study was conducted within a 2D environment. This study is conducted based on the concept from Gustafson et al. (2008) but using a 3D virtual environment with different research variables. There are two types of viewing perspectives adopted in this study, i.e., the 1st person perspective (1PP) and the 3rd person perspective (3PP). This is because research indicated that human uses difference neuro-processes with different viewing perspectives (Ruby, & Decety, 2001; Vogeley, May, Ritzi, Falkai, Zilles, & Fink, 2004). More specifically, the 1PP treats the user as an avatar while looking and searching within a virtual environment. It is often used in shooting games without paying too much attention on the surrounding environment. The 3PP is like the manipulation of a puppy. Users often watch the avatar’s back head to help explore the environment. The 3PP can provide wider vision than the 1PP. It can be a good facilitator for the design of virtual environment for hearing- or haptic-impaired persons. Fabricatore, Nussbaum, and Rosas (2002) also argue that the 3PP can support large scale strategic advantages.

2. The Experiment

The visual design of the experiment adopts a visualizing technique proposed by Gustafson et al. (2008). The created a wedge design to help users’ wayfinding task. The wedge is a visual tool which provides users with both distance and orientation information on the display (see Figure 1). By comparing to halo visual design, the wedge design can support users with better wayfinding performance. Nonetheless, the wedge design was tested in a 2D environment and had never been used in a 3D virtual environment. Therefore, this research study is intended to extend their experiment by adopting wedge design in a 3D virtual environment together with other design variables. The variables under investigation are wedge visual design (2D and 3D designs), interaction mode (touch sensitive and body movement), and visual angle (1st and 3rd persons) (see Figure 2). A total of 80 participants (38 women and 42 men) were invited to take part in a between-subjects wayfinding experiment based on convenient sampling method.

![Figure 1. The calculation of wedge angle proposed by Gustafson et al. (2008).](image-url)
According to Ni, Bowman and Chen (2006), the nature of a task can be defined to possess abstract information and perceptual information. These two types of information can be integrated into a task repeatedly to form many kinds of task categories. For example, they can be abstract information followed by additional related abstract information (A-A), abstract information followed by perceptual information, and then by additional abstract information (A-P-A), and perceptual information followed by perceptual information (P-P-P), etc. Therefore, based on the above task categories, the wayfinding tasks conducted in the experiment were created by using three levels of difficulties. That is, participants were asked to conduct three different types of tasks (i.e., A-A, A-P-A, and P-P).

Figure 2. The wayfinding scenes used in the experiment. The 1PP with 2D wedge is shown on the left. The 3PP with 3D wedge is illustrated on the right.

3. Results and Discussions

The generated results revealed that: (1) In terms of the wedge visual designs, participants performed better by using the 2D wedge than the 3D wedge. The 2D wedge was also easier to understand and discriminate than the 3D wedge. The results collected from the system usability scale (SUS) questionnaire also indicated that the 2D wedge provided better interface usability than the 3D wedge. Participants using the 2D wedge consumed less mental workload than the 3D wedge as well. (2) In terms of the interaction modes, the statistical results revealed no statistical significance between the touch sensitive interaction mode and body movement interaction mode in the participant’s objective task performance. Nonetheless, the results generated from the SUS questionnaire showed that the touch sensitive interaction mode provided better interface usability than the body movement interaction mode to the participant. Participants using the touch sensitive interaction mode also consumed less mental workload than the body movement interaction mode. (3) In terms of the visual angles, participants adopting the 3PP performed better than the 1PP in their task performance. The 3PP afforded better understanding and discrimination than the 1PP as well. Based on the research findings, it is suggested that adopting the 2D wedge visual design and using the 3PP can provide users better wayfinding performance in a 3D visual virtual environment.

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References


