The Effect of Animated and Static Avatars on Distance Perception in Immersive Virtual Reality

Bezawit Moges[1], Grace Chen[2], Victoria Interrante[3]
Berea College[1], Duke University[2], University of Minnesota[3]

Introduction

Virtual Reality is a field of computer graphics which is utilized in several industries such as architecture. In order for these virtual environments to operate effectively, especially in architectural models, having a realistic perception of distance is crucial. Research conducted so far has generally indicated that people tend to have a compressed perception of distance in virtual environment than they have in the real world. To solve these problem, several groups at several institutions have attempted to find out the effect of several techniques, such as introducing self-embodiment and other static avatars as well as varying the order of their exposure to the virtual and real environment. Hence, this research attempts to examine how the presence of moving and static avatars in a virtual world affect people's perception of distance.

Previous Work

An investigation by Interrante *et al* [2006], has indicated that when participants are immersed in a virtual environment that is an exact replica of the environment they are currently occupying, their perception of distance improved significantly. This result is an indication that the perceived distance compression of a virtual environment was dependent more on the participants' cognitive acceptance of the virtual environment as a functional real world than the technology itself. Under this assumption several investigation have been conducted to explore ways that enhances the cognitive assumption of the virtual environment as a real world.

In 2008, Ries *et al* conducted an experiment of distance perception in a virtual environment by including self-embodiment and concluded that having a faithfully sized self-avatar in a virtual environment helps for a better perception of distance. They presume that this might be because of a sense of presence provided by the self-embodiment that enhances their cognitive acceptance of the environment as a real world.

On the contrary, an experiment conducted by McManus *et al* [2011] could not find a significant increase in distance perception of self-embodied participants. The experimenters have presumed that this phenomenon might have been caused by the fact that participants could actually see their self-avatar's faces in a virtual mirror which might have decreased their sense of self-embodiment. McManus *et al* also compared how the inclusion of an animated cone or an animated human avatar would affect distance perception and concluded that a character animation would not have any significant effect on distance estimation over an animated cone.

Our experiment is similar to McManus et al's in that we also make use of animated characters, but our research is geared towards exploring a comparison that McManus et al did not make in their investigation, i.e., distance perception between an environment with an animated avatar and one without any avatar. Hence, even though they have found no significant effect of an animated avatar over a cone avatar, there might still be an effect when compared with no avatar at all.

Apparatus

The virtual environment used in this experiment was a 3D model of a restricted access hallway located on the 4th floor of Walters Library. The virtual hallway utilized dimensional measurements that corresponded with the measurements of the real hallway and its textures were modeled after photographs taken from the real hallway including its lighting properties. The virtual hallway consisted of a section 30' long that aligned with the longer dimension of the lab space. Hence, the study of the subjects would primarily conducted within this distinguished

room while the part of the hallway that extended beyond this section was used to as space for animated avatars to move around.

The virtual environment also contains ten animated avatars that walk around the hallway in several directions. The avatars were imported from Vizard Complete Characters, a commercial collection of three dimensional human-like characters along with several kinds of animation. A walking animation was chosen and imported to Autodesk 3D Studio Max to be combined with the static mesh. The combined meshes were then imported to the virtual hallway and enabled to walk across the hallway in several directions.

Figure 1: The virtual hallway and a walking avatar as displayed in Unreal Engine 4.2

The virtual environment was rendered by using Unreal Engine 4.2, the latest version of the Unreal game development engines on a desktop computer with an Intel 3.20GHz processor with 6.0GB of RAM. The Head Mounted Device used in this experiment is an nVisor SX60 from NVIS with LCOS display technology, a resolution of 1280x1024 and a contrast level of 100:1. To track the head motion of participants we have used twelve MX40 T-Series cameras, and a Vicon Tracker software.

Methodology

The experiment is divided into two parts. The first part features a static avatar while the second one features an animated avatar. However, before the experiments, the participants will go through several trials of walking in the virtual environment to accustom themselves with the system. Data will not be gathered from these trials.

The first part of the experiment will have two groups by itself with the following specifications.

Group 1

a) Participants enter a virtual environment with static agent
b) Participants enter a virtual environment with no agent
c) Participants are taken to the real highway

Group 2

a) Participants enter a virtual environment with no agent
b) Participants enter a virtual environment with static agent
c) Participants are taken to the real highway

The aim of this part of the experiment is to see if adding a realistic static agent to an otherwise unoccupied virtual environment helps people perceive distances in that environment more accurately. For this purpose, comparisons are made between cases 1a and 1b as well as 2a and 2b to see how the presence of a static agent affects distance perception of the same participant. Cases 1 and 2 are in turn compared to see how the order of exposure to an environment with and without a static avatar makes a difference between the performances of the two groups.

The second part of the experiment also operates within the same framework of two groups and differs from the first part only for the replacement of the static agent with an animated agent.

The procedures of the experiment are as follows:

1. Participants wear a Head-mounted Display.
2. If their part of the experiment includes an animated avatar, the avatar corresponding to their position is played. If not, they proceed to the next step.
3. Once the animation terminates playing, the participants are shown a tape mark and a static avatar (or a tape mark without avatar) at a random distance from their position

4. Once participants announce that they are ready and their starting position is recorded by the system, they are told to close their eyes and walk to where they think the tape mark is. If the participants open their eyes, they still will not be able to see anything since the system will turn of the display in the head mounted device.

5. Once the participants announce that they have completed their walk, their end position is recorded by the system.

6. The participants are told to turn around and open their eyes while the tape mark is placed in front of them again for another trial.

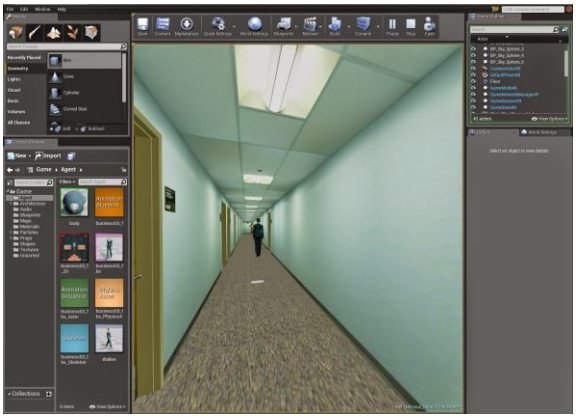

Figure 2: A tape mark displayed in the virtual hallway.

Future Work

Due to a delay in the approval of our research experiments, we were not able to run human subjects by the time the undergraduate research assistants completed our time. The remainder of the team will be running human subjects within the following months.

References

INTERRANTE, V., RIES, B., AND ANDERSON L. 2006. Distance Perception in Immersive Virtual Environments, Revisited. *In Proceedings of the IEEE Virtual Reality Conference (VR'06)*, 1-11.

RIES, B., INTERRANTE, V., KAEDING, M., AND ANDERSON, L. 2008. The effect of self-embodiment on distance perception in immersive virtual environments. *In Proceedings of the ACM Symposium on Virtual Reality Software and Technology*, 167–170.

MCMANUS, E., BODENHEIMER, B., STREUBER, S., DE LA ROSA, S., BULTHOFF H., MOHLER, B. 2011. The influence of avatar (self and character) animations on distance estimation, object interaction and locomotion in immersive virtual environments. *In Proceedings of the ACM SIGGRAPH Symposium on Applied Perception in Graphics and Visualization*, 37-44.