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A Visual Approach to Pseudo Unseen Presence in the Metaverse Using HMD

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Abstract

You may sometimes sense an unseen-presence when someone is behind you. We propose a novel method to show pseudo-presence through visual perception using only a standard HMD. This goal is not to promote a clear perception of the five senses, but rather to somehow subconsciously perceive a sense of presence.

CCS Concepts

• ***Human-centered computing*** → ***Interaction design;*** *Empirical studies in interaction design;*

1. Introduction

You may sometimes sense an unseen presence when someone is behind you. Interaction in the metaverse has been increasing in recent years as living and working at home have become more commonplace. In the same the way that some information processed by the brain is subconscious, presence is one of them. Previous studies show a presence-like sensation by humidity and water vapor [HKKT17], a part of sound emphasis [ZIK*12], a quasi-static electric field near CRT [SAS20], and an electrostatic field using Van de Graaf generators [KK21]. These goals are not to promote a clear perception of the five senses, but rather to somehow subconsciously perceive a sense of presence. Hopefully these techniques will be applied to the Metaverse. However, it is difficult to implement these methods into the home-use metaverse because they require special equipment or environments. In this study, we propose a novel method to show pseudo presence through visual perception using only a standard HMD.

2. A METHOD TO SHOW PSEUDO PRESENCE

The human visual field can be divided into a central vision, in which the shape and color of objects can be clearly recognized, and a peripheral vision, in which the shape and color of objects cannot be recognized. The peripheral vision has lower spatial resolution and poorer hue perception compared to the central vision. However, the peripheral vision is more sensitive than the central vision to the perception of motion and at low light levels, and information can be processed unconsciously. Therefore, a light-colored, translucent silhouette of a human shape is superimposed at a position of, for example, 40 degrees in the peripheral vision area of the HMD (Figure 1) when a person appears behind to the left or right. The silhouette should be displayed as transparent for as short a time as possible so as not to be aware of it (Figure 2 and 3).

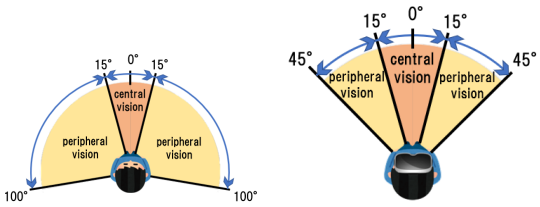

Figure 1: *Horizontal vision in; (left) real space, (right) HMD*

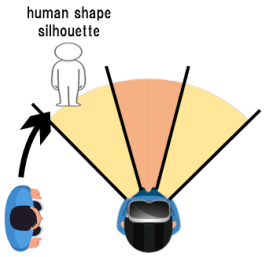

Figure 2: *Schematic depiction of pseudo presence*

3. EXPERIMENTS

The effectiveness of the proposed method was verified through experiments using HMD; Oculus Rift (Figure 4). The silhouette transparency α was set in 10 different values from 0.005 to 0.050 at intervals of 0.005 ($\alpha = 0$ is completely transparent and $\alpha = 1$ is completely opaque, and the α is 0.040 in the Figure 3), the display duration time t was set in 5 values from 1 to 5 at 1 second intervals, and there were 50 patterns in total. Each of the 10 subjects was randomly assigned 25 patterns. Each pattern was assigned 5

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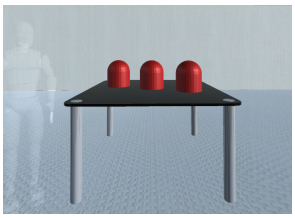

Figure 3: *View of visual pseudo presence in HMD*

Figure 4: *Appearance of experiment*

times, there were 250 trials in total. The start time of the silhouette display was randomly set from 3 to 8 seconds after the start of the trial depending on the display duration, so that the timing of the silhouette display was not predictable and one trial was completed in 10 seconds. The direction of display was also random. Note that there were no people around the subjects at the time of the experiment, and the actual presence of people did not affect the results. Subjects were asked to play a *three-shell game* in which they kept looking at a cup containing a ball to avoid looking at the silhouette in their central vision. After each trial, subjects reported the visibility of silhouette, direction of presence, and unseen presence itself. For each pattern, count the following number of times.

V : the silhouette is visible
N : the unseen presence itself was not felt (invisible)
P : the direction of presence is correct (felt and invisible)
F : the direction of presence is false (felt and invisible)

Note that since the presence is not always felt and is not always correct, the number N and F are not considered in this study. The difference between P and V for each α and t combination is shown in Table 1 and Figure 5. The number P is relatively large and V is close to zero when the transparency α is less than 0.020 and the display time t is around 3 to 4 seconds, and when α is around 0.030 to 0.035 and t is less than 3. The dark silhouette is easily perceived under consciousness even in the peripheral vision, but the shorter display time may have stimulated reflexive perception. The light silhouette is consciously less recognizable in short display times, but the slightly longer display time may have stimulated unconscious perception. The result suggests that a translucent silhouette displayed for a short time would be effective as a pseudo presence, around the transparency and time (α, t) from (0.035, 1) to (0.005, 4) via (0.020, 3) in this experiment.

4. CONCLUSION

In this study, we proposed a novel method to represent pseudo presence in the metaverse using HMD. The body of pseudo presence is a human shape silhouette with a short display time and translucent color. The experiments suggested that the silhouette is effective as pseudo presence at appropriate display times and transparencies. However, these times and transparencies would also depend on the background. In the future, we would like to consider the influence of background type and color, and attempt to dynamically control the display time and transparency.

Table 1: *Difference between P and V (P−V) for each α and t*

t[s] / α	1	2	3	4	5
0.005	0−0= 0	0−0= 0	1−0= 1	3−0= 3	1−0= 1
0.010	1−0= 1	0−0= 0	2−0= 2	2−0= 2	2−0= 2
0.015	2−0= 2	0−2=−2	2−1= 1	2−1= 1	1−1= 0
0.020	1−0= 1	2−1= 1	4−0= 4	3−1= 2	2−2= 0
0.025	2−2= 0	1−3=−2	1−2=−1	2−1= 1	0−5=−5
0.030	3−1= 2	3−1= 2	3−1= 2	1−4=−3	1−4=−3
0.035	4−0= 4	3−1= 2	3−2= 1	2−3=−1	1−3=−2
0.040	3−2= 1	2−3=−1	1−4=−3	0−4=−4	0−5=−5
0.045	1−4=−3	2−3=−1	0−5=−5	0−5=−5	1−4=−3
0.050	2−3=−1	1−3=−2	0−5=−5	0−5=−5	0−4=−4

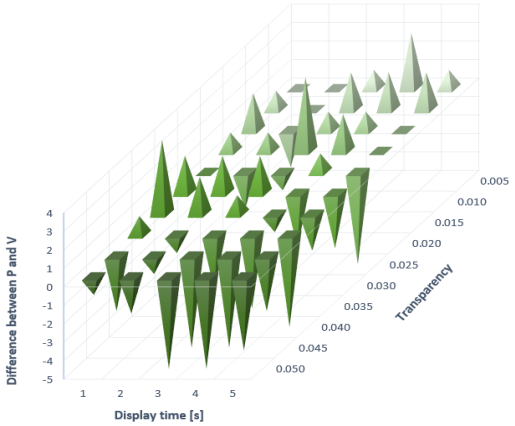

Figure 5: *Graph of difference between P and V (P−V)*

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