Study of a Virtual Conference in a Mirror World with Avatars and HMD

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Abstract. We propose in this paper to conduct an experiment in a virtual conference with avatars in a mirror world with HMD, with a particular study of the sense of presence (or psychological immersion) in this virtual conference. For this, we first describe our theoretical framework, then we expose our experiment, we give our results, the limits of our research and our future research prospects.

Keywords: Mirror world · Avatars · HMD · Virtual conference with HMD

1 Introduction

Virtual conferences have already been tested on the 3D platform "second life", however, an immersive conference in a mixed reality in a mirror world has never been experienced.

To meet the challenges of the city of tomorrow, especially in expanding digital urban services and create value, it seems important to test this kind of new technologies for conference. The purpose of our experiment is to test the ability to hybridize physical reality and virtual reality in these mirror worlds for mixed use offered two types of lecturers present and distant, to understand the prospects of tomorrow's uses.

In the literature, there is a gap in the study of sense of presence in a mirror world, it's the reason why, we want to look this problem more precisely. So we will study the sense of presence and communication with avatars in our experiment of testing a virtual conference with other participants present and absent and represented by avatars in a mirror world. We first present our theoretical framework, then we write our experiment, and we then give our methodology and results.

2 Framework

2.1 Mirror Worlds

The concept of mirror world was invented by David Gelernter computer scientist at the University of Yale. He speaks for the first time of a hypothetical mirror world in 1991 in his book "Mirror worlds".

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A mirror world is a representation of the real world in a digital form. It allows to map the real-world structures in an accurate and geographically. The mirror worlds offer a software model of real human environments.

The concept of "mirror worlds" differs from that of "virtual worlds" because they are not in direct connection with real models and are described as fictions, while the mirrors worlds are connected to real models and range closer to reality. A mirror world is closely related to augmented reality, but a mirror world can also be seen as an autonomous manifestation of the digital reality and may contain virtual items or other forms in which information will be integrated. For example, programs like Google Earth, Microsoft Virtual Earth or Google Street View are mirrors in 3D worlds (Fig. 1).

Fig. 1. Dive Real, the mirror world of our experiment. The picture below shows avatars immersed in a "mirror world" Google Street View kind; these avatars are superimposed on the space that is a real mirror of the world photographed beforehand.

2.2 Immersion and Sense of Presence

In the literature, there are two types of immersion: the technological immersion and the psychological immersion.

The technological immersion (Cadoz 1994) made possible by the device and caused particularly by 360 degrees. In this school of thought, immersion would strongly linked to technology. (Bystrom et al. 1999; Draper et al. 1998; Slater and Wilber 1997).

The psychological immersion (Slater et al. 2001) is independent of the device (for example, a book, projecting us in a virtual world, we can provoke a psychological immersion, without technological and physical immersion). This type of immersion is called "sense of presence" and approaches the concept of "flow" (Csikszent-mihalyi 1990) which

wastes the user's sense of time and space. We explain in our article the exploration of our experiment, questioning us on this issue of immersion and sense of presence.

Witmer and Singer (1998) considers immersion as a psychological condition, like perception of "being in", of "being surrounded by", immersion suppose for these authors:

1. The insulation of the physical environment
2. The perception of feel "included" in the virtual environment
3. The "natural" state of interactions and perception of control
4. The perception of movement in a virtual environment.

In our study we will take the first definition of Witmer and Singer (1998) to describe the sense of presence studied.

There are 7 factors identified in the literature that affect this type of sense of presence:

1. Ease of interaction: interaction correlates with the sense of presence felt in the virtual environment and (Billinhurst Weghorst (1995))
2. The user control class: the sense of presence increases with the sense of control and shares in the virtual environment (Witmer and Singer 1998)
3. Realism of the image: the more realistic virtual environment is, the more the sense of presence is strong (Witmer and Singer 1998; Welch et al. (1996).)
4. Duration of the exhibition: prolonged exposure beyond 15 min with the virtual environment does not give the best result for the sense of presence (Stanney (2000)) and there is even a negative correlation between the prolonged exposure in the virtual environment and the sense of presence (Witmer and Singer 1998), which is explained by discomfort associated with prolonged use of a head-mounted display (nausea, headache, dizziness), experimentation advocated was therefore of maximum 15 min with HMD.
5. Social presence and social presence factors: the social presence of other individuals (real or avatars), and the ability to interact with these individuals increases the sense of presence (Heeter 1992).
6. Individual perception factors of information and entertainment systems: individual differences in terms of perception and representation of information between individuals are key factors in the sense of presence: Slater and Usoh (1993) shown by example that people regarded as visuals were more likely to have a high sense of presence that individuals kinesthetic or auditory individuals.
7. Quality of the virtual environment: quality, realism, the ability of the environment to be fluid, to create interaction are key factors in the sense of presence of the user (Slater and Usoh 1993; Hendrix and Barfield 1996). These factors affecting the sense of presence are considered in the presence of two questionnaires that we used (Fig. 2).

Fig. 2. During our experiment

3 Experiment

Experiment in partnership with the city of Antibes and the company Orange will take place at the Convention Palace, it aims to:

- test during a virtual conference with Dive Real in mirror world will include analysis of:
- meetings between avatars in the mirror world Exhibition Centre,

- meetings between avatars in the mirror world Exhibition Centre during the virtual conference,
- meetings mixing avatars present in the mirror world Exhibition Centre and people actually on site at the Congress Centre;
- evaluate the user experience in the proposed course and to deduce the areas of progress, or targeting scenarios uses. This analysis will be performed by measuring inter alia the sense of presence (psychological immersion) for the various combinations of situations and devices available to users.

A first step of our experiment was to test the first version of our device during the Science Festival in October 2015 (in parallel to the site of Valencia and Antibes), we used the head-mounted immersive DK2 allowing a 360 degrees in the virtual environment to test the sense of presence (psychological immersion).

4 Methodology

We will present in our article the results of this first experiment. Our first experiment was to present the Dive Real, which is a platform in a mirror world at the Science Festival at the Valencia site and on the site of Antibes (congress). We describe first the Dive Real platform. Dive Real is a platform where users can:

1. choose their avatar (male/female versus, with the choice between several types of men and women (ethnicity/age/style clothing
2. communicate through avatars chat
3. move in the virtual environment: walk, run, go right, left, turn, turn
4. teleport from one city to another one and from a city street at other. The experiment consisted of study the sense of psychological presence among users:
5. on the platform Dive Real, without the HMD
6. on the platform Dive Real, with HMD, and to compare the two groups.
7. We have devised the following typical scenario:

- Five minutes to explain the operation of the interface Dive Real
- Ten minutes where users had the task to teleport where they wanted to explore the environment and possibly communicate with the avatars around them, or join them in a specific location.
- Ten minutes of questionnaires.

To test the psychological sense of presence, we used two canonical questionnaires that have been tested several times in other research and are statistically significant:

– First, the canonical test of presence of Witmer and Singer (1994). This Questionnaire on the sense of presence, which tests the sense of presence by 24 questions on a 7-point scale (0–7), ranging from “not at strongly disagree” to “strongly agree”.

This test determines the degree of perceived presence and measure its effects depending on factors determining the sense of presence,

1. control and response of the virtual environment (sample question: “To what extent were you able to control the virtual environment?”),
2. interaction with the virtual environment (sample question: “to what extent the environment he was responsive to the actions you were doing there”),
3. locomotion in the virtual environment (sample question: “up how the movement sensation within the virtual environment he was realistic”)
4. and details of the interface (sample question: “to what extent the visual quality of the graphics equipment you she was inconvenienced in performing the required tasks?”). This test of presence therefore holds 6 subscales: **realism, ability to act, interface quality, opportunity to review, self-assessment of performance, hearing and sense haptic**. This first test measures the sense of presence, after experimentation. Second, Bouchard Canon test et al. 2014. The questionnaire consists of two parts: the first part, consisting of 6 items testing the sense of presence after the experiment, the second part, consisting of 38 items, testing sense of presence during the experiment. For each item, there are 5 scales ranging from “strongly disagree” to “strongly agree”. There are 4 factors that affect the sense of presence included in the questionnaire:

- the spatial presence,
- the feeling of being engaged,
- the realistic aspect of the environment,
- the negative effects of the environment.

19 items test the spatial presence (sample items: “I felt I was able to interact with the virtual environment”, 13 items testing the feeling of being committed by users (sample item: “I felt involved in the virtual environment”, five items test the natural and realistic environment (sample item: “the content seemed realistic”, 6 items test negative effects of the environment (sample item: “I felt disoriented”, “I felt tired”).

5 Results

We present in this article the results for the group with HMD.

5.1 Results of the First Test: Witmer and Singer (1998)

Results with Oculus, present test of Witmer and Singer (1998).
General results of all subjects (average).

- Realism: 4, 3 on 7
- Ability to act: 4, 7 on 7
- Interface quality: 4, 6 (inverse items) on 7
- Opportunity to review: 5, 2 on 7
- Self-assessment of performance: 4, 2 on 7

We have not tested the haptic and sound dimensions because it was not relevant to our experiment (no sound or haptic sense solicited).

5.2 Results of the Second Test, Test of Bouchard et al. (2014)

General results of all subjects (average).

Spatial presence, 1, 9 on 5
Feeling of being engaged, 2, 9 on 5
Realistic aspect of the environment, 2, 3 on 5
Negative effects of the environment. 1, 4 on 5

Discussions: Factors in favor of the sense of presence in the virtual environment in the mirror world. After the experience in the virtual environment, all users surveyed felt moderately sad that the experience is over, all would have liked the experience continues, all clearly remembered parts of the experience, most recommend experience to their friends. Some had the impression of a return trip

During their experience in any virtual environment felt "absorbed", all of the subjects felt involved in the virtual environment, all had fun in the virtual environment, all have felt to visit places in the virtual environment, not one felt tired. The content seemed realistic to fifty cents topics. All felt they were not just looking at something. No subject felt dizzy by experimentation. Most of the subjects were given the impression that the virtual environment was part of real life. All subjects felt that visited scenes could actually exist in the real world. No subject experienced eye strain, none felt nausea, felt none of headache. All the subjects had the impression that the characters were aware of their presence. All subjects responded emotionally to the virtual world. The content has pleased the majority of subjects. Most of the subjects felt able to change the course of events in the virtual environment. Most of the subjects had the impression of being in the same space as the characters and/or objects. Most of the subjects felt that some parts of the virtual environment (for example, the characters or objects) met their shares. Three quarters of the subjects had the impression that it was participating in life in the virtual environment.

Discussions: Factors working against the sense of presence during their experience in the virtual environment in a mirror world. No subject has lost track of time, very few subject has felt able to interact with the virtual environment, very few subject perceived the virtual environment as natural, none felt that the characters and/or objects could almost touch them. Very few have had the impression of being really "there" as if they were in real life. Very few have had the impression of moving in response to certain parts of the virtual environment (low interaction with the virtual environment). The experience in the virtual environment was moderately intense for half the subjects and very few have focused more attention on the virtual environment and their own thoughts (personal concerns, dreams, etc.). Very few have had the impression of being present (e) in the visited scenes. Half the subjects had the impression to be able to move objects in the virtual environment (low interactivity of the virtual environment). None felt the different characteristics of the virtual environment. Very few subjects felt wrapped by the virtual environment. No subjects felt that the people and objects were solid and real. Very few have had the impression that he could reach or touch objects.

6 Conclusion

We proposed in this paper to conduct an experiment in a virtual conference with avatars in a mirror world with HMD, in particular studying the sense of presence (psychological immersion) in this virtual community of avatars. For this, we first describe our theoretical framework, then we have exposed our experiment conducted in collaboration with Orange and Congress Centre d'Antibes, we gave the results of our first experiment, which took place during the festival of Science at the conference hall of Antibes and Talence.

We can now conclude that a large search site remains open on the study of virtual conference in a mirror world, which not only allow avatars to share knowledge and practices, but also to users to teleport from one world real to the virtual world and vice versa, for the moment only with real places and not images recorded in real time. We can also attach ourselves to the prospects opened such research when opportunities for avatars (and therefore to the real people behind the screens) will be multiplied when the user can, for example, is no longer teleport into a mirror mode already existing in the real world but in the real world in real time with their avatar. Analysis of the psychological sense of presence or immersion in these new contexts seems necessary, even indispensable, and opens new fields in the social, psychological and in the field of human interaction communication.

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