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The Five Pillars of Presence: Guidelines to Reach Presence

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Abstract

This paper presents our theoretical point of view on presence and the way to reach it. We wish to debunk the dominant idea in virtual reality that the feeling of presence can only be reach thanks to more and more realistic rendering and complex interfaces. We will argue that the key point for the presence is not the realism but the credibility of the proposed experiment. Credibility is central if we want users accept to get caught up in the experience. To succeed in this search for credibility, we can lean on the five following pillars: immersion, interaction, consistency of the sensorimotor loop, emotions and cognitive sciences. The ins and the outs of each pillar will be explaining.

Keywords--- **Five pillars of presence - Virtual Reality – Credibility**

1. Introduction

It's in 1980 that Minsky [1] introduced the concept of *being there* in mediated environments. Since that time, a large number of definitions [2, 3, 4] were proposed to define the concept of presence. Lombard and Ditton [5] will come to create a consensus by defining presence as the *"perceptual illusion of non mediation"*. A complete overview on presence can be found in the book [7] edited by Riva, Davide and IJsselsteijn..

Once the scientific community globally in agreement on a set of key concepts defining presence, and thus clear about the goal to reach, it remains to establish the main factors on which to lean on. [6] propose a classification of these factors in 4 points: the *media form* which includes two points: the fidelity and the consistency of sensory informations, the *media content* which concerns the intrinsic interest of the application and finally *user's characteristics*. We will propose in section 2 a more generic and slightly different identification of the factors through five pillars which combine human and technological factors. Each pillar constitutes a guideline for developers in order to create credible virtual environments, the word credible has to be understood here from users point of view. The pillars will be describe in the third section.

2. Presence - our vision

For a better understanding of our vision on presence, we think useful to enunciate our view on virtual reality. A virtual reality system aims at plunging one or more users in the heart of an artificial environment where they will be able to feel and interact in real-time thanks to sensorimotor interfaces. The experience will have to be credible enough to delude user's perception in order to create, as an ultimate goal, a feeling of presence of the virtual objects, but also a feeling of user's self-presence in the virtual environment.

In this way presence corresponds to the indubitable feeling for users to exist within a world other than the real world in which they are located at the time of the experiment. Here is some explanations on our definition.

Still, the feeling of presence can only appear if users forget themselves in the experiment, are as one with the experience. By perceiving, thinking and acting in a natural way they can incarnate the role the application intends for them. This idea of *"incarnate the role"* is present in our definition through the verb *"exist"*. This last idea is close to the concept of RAVE: Real Actions in Virtual Environment [8].

By using the term of *"feeling"* we wish to include the 2 underlying meanings of this word: the first one, close to the origin of the word, refers to self and environment-awareness obtained through perception thanks to our senses. The 2nd one more usual, related to affectivity, corresponds to users' sensibility, their state of mind for being concerned by something, here by the experiment. This duality of the word *feeling* is well adapted to our definition of presence since it shows, on the one hand that presence needs sensory perception, this lies with the sensorimotor interfaces which have to delude user's senses. On the other hand that points out the importance of human aspect since user must feel disposed to receive the virtual experiment. In other words users must accept to get caught up in the experiment and it is definitely not just with technique that we will be able to succeed. It's here that our emotion pillar can be useful. Thus, our point of view is in contradiction with Slater [9] who argue that *content* (close to emotions pillar in this paper) has nothing to do with presence, but is corroborated by several studies [10], [11] and [12].

Finally, the obvious opposition in our definition between the weakness of the word *"feeling"* and the strength of the term *"indubitable"* well points out that presence is a difficult (impossible?) stage to reach and even more to maintain. This is why it would be more reasonable to say than one tends towards presence. Therefore, in order to approach presence, we can lean on the five pillars which will be describe in the following section.

3. The five pillars of presence

These five pillars: immersion, interaction, consistency of the sensorimotor loop, emotions and cognitive sciences, enable through synergy, to arouse the feeling of presence. These pillars are like the primary colors, any other factor could result from a mix of them. We point the fact that there is no hierarchy between the pillars, some are technical, others are more human side, sometimes they work on their own, sometimes they work in conjunction. Their heterogeneity is an asset in order to address credibility and presence on different approach.
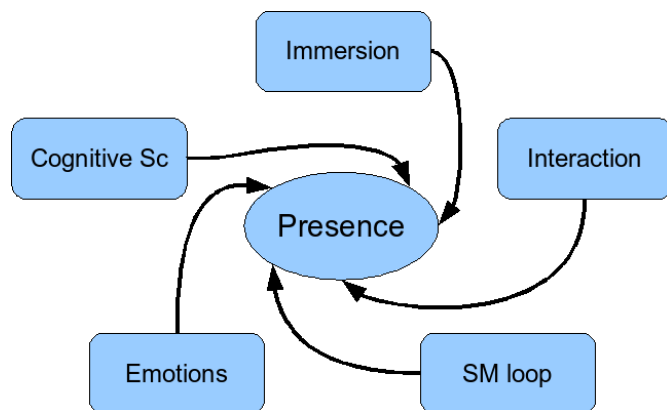

Figure 1 The five pillars of presence

3.1. Immersion

Immersion is often confused with presence, that's why we think necessary to clearly establish the difference. Immersion is achieved through the stimulation of user's senses in order to generate the sensations which enable, sometimes thanks to an illusion, the perception of the virtual environment. From this perception will ensue for users the proper comprehension of the virtual environment and consequently its appropriation. We could say that the aim of the immersion consists in plunging [13] user in the virtual environment and the method to achieve this goal is "simply" to delude the senses.

At the stage of immersion there is absolutely no talk of *presence* or *being there*. The quality or the effectiveness of an immersion is objective, measurable: does the system provide a stereoscopic display ? a 3D sound spatialization ? use a sensory substitution ? *etc*. At this step our pillar is close to the notion of *vividness* [14] but we will extend it with the ideas presented in the next two paragraphs. Of course, thanks to the predominance of certain senses and to the contribution from other pillars, we do not need a fully sensory immersion to reach presence.
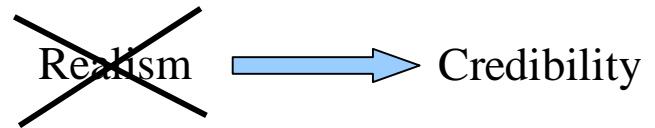

Figure 2 Realism vs credibility

Another common mistake when the topic of immersion is addressed, the matter of the realism. Often it is considered that presence will be reached if the immersion is realistic and sometimes, in a way even more restrictive, if the visual representation of the environment is realistic. However, firstly we just said that feeling of presence could only appear if user agreed to get caught up in the experiment. Secondly we have just put forward that the aim of the immersion is to delude the senses. Therefore we can argue that the key point of immersion is not its realism but its credibility. The point is: does the immersion or more generally the experiment that I provide to users is sufficiently credible so that they will be agree to get caught up in the experiment ? Once again many studies will have to be done to evaluate this sufficient degree of credibility needed to reach an effective immersion.

Last point concerning immersion, as we already said, immersion consists in plunging users in the virtual environment. Most of the time this is done by reproducing, through sensory perceptions, the virtual environment such as it would be if users were not there. We forget too often, that if they are plunging in a virtual environment, by their simple inactive presence they have an effect on their environment. And this independently from any interaction with the environment with the aim of acquiring or providing informations. That's why we remain in the immersion pillar and not in the interaction one. Thus, by rendering the impact of user's presence on the virtual environment, we can advance that immersion must be bidirectional and this may improve credibility. Following this point of view, here are some research directions to explore: to extract the real silhouette from users, to project their virtual shadow in the scene, to be able to test the echo of a room with their own voices, to see their real reflection in a mirror *etc.*

3.2. Interaction

Interaction devices must enable a communication between users and their virtual environment. This communication consists in two tasks: to acquire and to provide information. This bi-directional communication, by inducing that users and virtual environment exist, will improve the feeling of presence. If we refer to the concept of *"perceptual illusion of non mediation"* from [5] we understand that it is central that the interaction tools must be as transparent and natural as possible until being able to be forgotten. Gesture capture without marker seems to be one good solution which can become more natural

if associated with a multimodal stimuli able to generate [15] a tactile perception (pseudo haptic illusion). Moreover, natural body interaction could improve presence if we are able to match the virtual reality system response with real proprioceptive and kinesthetic feedback. For exemple a virtual movement could correspond with a real movement, [16] and [17] are some examples for walking.

Being able to communicate or to establish some eye-contact during the experiment with autonomous agents or other human will signify that you exist for someone else and then may increase the feeling of self-presence.

3.3. Consistency of the action-perception loop

In order to maintain the consistency of the action-perception loop or sensorimotor loop, it will be necessary to respect two main points. Firstly, we will have to take care to not break the causality link between user's actions and the system's feedback. This means we have to implement real-time algorithms and provide high frequency displays. Secondly, we must maintain the time and place consistency among various sensory modalities associated with an event or a virtual object. This third pillar constitutes a link between the first two ones but can also include works related to synesthesia, cross-modal illusion *etc.*

3.4. Emotions

Even by providing some high quality immersion and interaction which respect the consistency of the action-perception loop, it will probably remains a distance between users and the role they are suppose to incarnate in the experiment. This distance may have several causes: the shortcomings of the system, real world distractions [18] or just because the experiment is annoying or free of emotions. Emotions will help to reduce this distance by distracting user's attention from these disturbances and thus may encourage users to get caught up.

3.4.1. Emotions and presence, discussion

The emotions pillar is close to "*media content*" [6] but we prefer talking about emotions because it's more generic and more human centered. Second observation, how domains like cinema [19] or reading [20] which offer a quite reduced immersion and no interaction are able to transport spectators or readers, to frighten them or to make them cry ? Obviously thanks to the creator's capacity to tell stories, to create emotions. That's why researchers have been interested in storytelling [21].

Like us, other researchers [10][12] argue that technology can not, on its own, create the feeling of presence and claim we must be helped by emotions. We do follow Slater when he writes [9]:"*Presence is separable from emotion*", we do not confound presence and emotions, but we point emotions as one of the five pillars which may help to reach and maintain

presence. Our intuition is confirmed by several works [11], [22] which point out that a low level immersion can be compensate if you are able to provide a rich emotional experiment ("*stereoscopic presentation is not as critical and technological factors are more relevant for non-emotional environments*"). [23] request researcher to not restrict virtual reality research to technology with the aim to provide more and more realistic environment. For them, more relevance may induce more presence. Our point of view is, an experiment which has a sens, which carries emotions, will be found relevant and then may implies presence.

Several papers quote involvement [24] as a factor of presence. As we already mentioned we seek to propose a generic point of view on presence through the five pillars. So we argue that emotion (like fear, interest *etc.*) is one of the factors of presence and involvement is rather located on the side of the result of the five pillars. You are involved because you appreciate the immersion or because the emotions offered are pleasant or for other pillars combination.

Finally, we think, that emotions and presence self support themselves in a virtuous circle way: firstly, emotion enables to reach presence more easily and then presence permits to feel more intensely emotions. Our intuition is support by [12].

3.5. Cognitive sciences

In virtual reality and *a fortiori* in presence research we have to be human centered. It's primordial to understand the different mechanisms related to perception, attention, learning process, mental representation *etc*. This understanding is crucial in order to delude senses more easily or to provide a more credible experiment. There are several studies which take advantage of a better comprehension of human perception, we could cite [25] about a perceptual audio rendering engine, [26] about multi-modality with the aim to simulate self-motion perception or [15] about cross-modal illusion. That's why cognitive sciences deserve to be a pillar on their own. This pillar will help to improve or to create new methods in relation with the other pillars.

Conclusion

In this paper we wished to propose a generic and slightly different perspective on the feeling of presence. Therefore we propose our own definition of presence and have identified five generic factors, named the five pillars of presence. Each pillar constitutes a guideline for developers in order to create credible virtual environments. The credibility of the virtual environment is the key, not its realism. We want to point again that the five pillars work jointly and enable creation of presence in a synergistic manner.

Even if we can lean on the five pillars, the level to reach on each pillar will vary according to the kind of the application. Moreover the pillar structure enable to make up for a certain pillar lack with a high level in another one. That means pillars can work together to balance a lack on a specific pillar.

Finally, there is still a lot of studies to conduct in order to identify the minimum level to reach in a pillar or set of pillars to be able to experience presence. These studies could enable to establish, according to the application, some radar diagrams (see Figure 3) where each axes represent a pillar and point the level to reach on this pillar to experience presence.
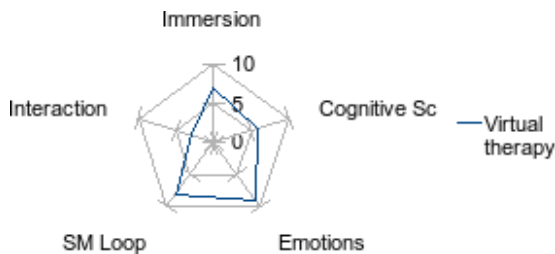

Figure 3 Example of expFigure 3 Exàìected diagram

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