

VACHE - Virtual Asymmetric Collaboration with Hybrid Embodiment

Structure:

- City: Nantes (France). Host institution: Ecole Centrale de Nantes. Laboratory: LS2N (team PACCE)

Supervisors:

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Context:

While the “metaverse” seems to be the new buzzword in the ICT community, it nonetheless stresses the importance of Virtual and Augmented Reality technologies and the need to further investigate its potential. In particular, it is likely that the amount of shared virtual environments will increase in the near future, enabling multiple users to interact and collaborate through different media (Virtual Reality, Augmented Reality, desktop, mobile, etc.) using different modalities but sharing the same interaction space. In this proposal, we aim to tackle issues raised by the fundamental asymmetric collaboration of multiple users via their digital representations (avatars). Indeed, in collaborative environments the **user’s representation** is a key source of information for other collaborators. From a **social standpoint** [Latoschik17, Freeman21], it enables the identification of others, it is an enabler for communication, it provides social cues (e.g. non-verbal communication) and can even determine the status of the user (e.g. social status, role). From an **interaction standpoint**, it provides a spatial reference, information regarding the interaction capabilities of the user, and provides awareness about the task being performed. Finally, from a **personal standpoint**, the user representation can have a strong influence on how users interact and perceive their representations [Dewez21] and behaves [Yee07], and which is the information that the user wants to share with the others.

Scientific objectives:

In collaborative hybrid spaces, in which users collaborate using different VR/AR systems, the information available from the different user representations will vary due to the asymmetry of the VR/AR equipment, which may lead to a different perception as well as of capabilities of interaction and collaboration [Piumsomboon18]. To tackle this issue, this proposal focuses on the research and categorization of how **user representations** need to be adapted to efficiently support asymmetrical collaboration scenarios. This problem is complex, as a wide range of variables can drive the avatar representation: visual appearance (e.g., cartoon, iconic, realistic), tracking capabilities (ranging from head only to full body tracking or maybe even gyroscope only if users join from their smartphones), constraints of the medium (e.g., limited field of view in an AR context), interaction capabilities (e.g., controllers, or bare-hands). Moreover, in scenarios with a large number of concurrent users, the homogeneity of those representations is also a critical aspect, as it is still unclear how differences between avatar representations with the same group of users may influence the global experience or even how different interaction capabilities may hinder social interactions.

Approach and challenges:

Most previous work focus primarily on a specific modality of XR individually (e.g., VR, or AR, with a set of predefined devices). The novelty of our approach is to tackle the problem longitudinally: we want to explore simultaneously the possibilities of body representation and interaction on several platforms and their influence on users’ collaboration. . The idea is to propose a unified continuum of embodiment in XR, including rarely considered devices, such as e.g., smartphones. We will propose user studies to quantify and characterize embodiment along this continuum, as well as interaction techniques adapted to the studied systems.

There are two main challenges to this approach. First, we need to understand how differences between user avatars based on modality (VR, AR, Desktop, Smartphone) may influence cognitive processes related to the perception of self and others, such as the sense of social presence (the feeling of being with someone else), or the perception of self, such

as the sense of embodiment towards an avatar (the feeling of owning, controlling, and being spatially within a body). Second, interaction issues will be considered. The possibilities of interaction differ greatly depending on the device. However, we will propose novel methods to provide equivalent interactions in the different environments and devices in order to maximize embodiment and allow an embodied practice of the XR continuum.

Organization of the PhD project:

The PhD work will be organized according to the following steps:

- T0-T6: the PhD student will develop mixed reality environments to connect users from several platforms such as VR or AR HMDs, smartphones or desktop computers. He/she will also conduct a state-of-the-art analysis in parallel.
- T6-T18: the student will study body representation under several modalities and conduct user studies to evaluate the impact of such representations on cognitive processes related to the perception of self.
- T18-T30: the student will design and evaluate new interactions and propose some guidelines to design such interactions in hybrid environments. He/she will test the proposed interaction in more advanced scenarios including collaborative situations.
- T30-T36: the student will focus on writing the thesis manuscript and finalizing papers.

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