

# Hybrid Collaborative across Heterogeneous Devices

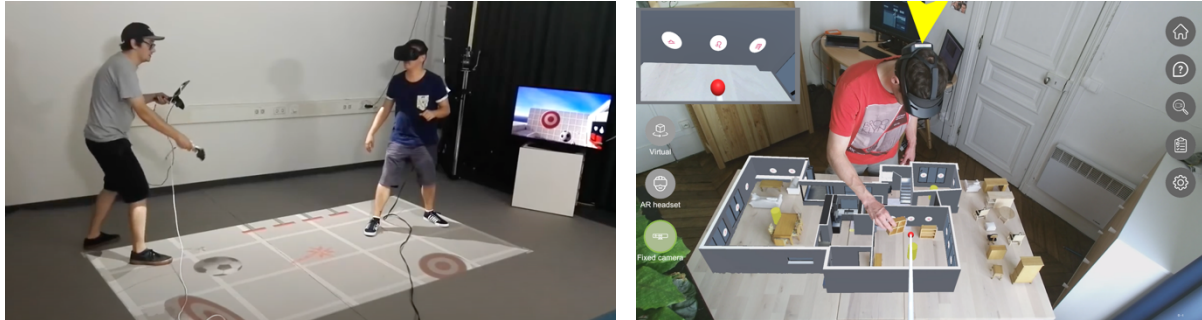
*Master level internship at IMT Atlantique (Brest)*

**Team and location:** INUIT team / Lab-STICC, IMT Atlantique, Brest campus, France

**Duration:** 5-6 months

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**Keywords:** Mixed Reality, collaboration, metaverse



**Context:** The massive development of display technologies brings a wide range of new devices, such as mobile phones, AR/VR headsets and large displays, available to the general public. These devices offer many opportunities for co-located and remote collaboration on physical and digital content. Some can handle groups of co-located users [10, 13], while others enable remote users to connect in various situations [3, 6, 11, 14]. For example, some previous systems allow users to use a mobile device to interact with a co-located partner wearing a VR headset [4, 7]. Other systems enable users in VR to guide a remote collaborator using an AR headset [1, 8, 9, 12].

**Problematic:** Most of these previous works deals exclusively with collaboration between two users and other works only address either co-located or remote collaboration, but not both at the same time. We want to target real-time collaboration between larger groups of participants, where some of them may be co-located while others may be remote. This direction raises new challenges regarding (1) how to integrate remote users to fully participate in the collaboration and (2) how to handle the device diversity to provide balanced perception and interaction capabilities among users. It is essential that they can all interact and communicate with each other in appropriate proportions to ensure effective collaboration. Without trying to mimic collaboration in the real world, we need to propose new ways of collaborating that take advantage of the specific capabilities of each device, in a similar spirit as the "Beyond being there" described by Hollan & Stornetta [5].

**Internship Goals:** In this internship, we plan to explore one specific scenario in such contexts. For example, a group of users can collaborate on a large display, while some other remote collaborators can join them with VR headsets displaying a virtual version of the content. In another example, AR users can work on a model that combines physical and virtual parts, while collaborating with remote partners who use mobile devices. In all scenarios, we will have to envision new solutions to build a common ground [2] among co-located and remote users. We must find appropriate ways to represent users' activities and share their workspace to ease the communication among them. We will also need to develop new interaction

techniques, including tangible or touch/haptic interaction, which can be adapted to each user's device. These techniques will leverage the potential of every device to allow users to have complementary interaction capabilities.

The intern will work on the following tasks:

- Do a literature review on collaborative situations among people using heterogeneous devices.
- Design a system in which the collaboration benefits from the use of different types of devices.
- Implement and evaluate this system.

**Requirements:** We are looking for students who are enthusiastic about AR technology and are interested in research in Human-Computer Interaction. The intern is expected to have solid programming skills, and ideally, previous experience with C# and Unity 3D. A background in computer graphics or networking will be a plus.

The internship could lead to a Ph.D. thesis.

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