

# Multiuser Virtual Experiences powered by Holoportation Technologies and Multimodal Human-Computer Interaction (HCI)

Author: Mohamad Kassem Hjeij(i2CAT Foundation, Universitat Politècnica de Catalunya UPC)

Advisors: Mario Montagud (i2CAT Foundation, Universitat de València), Dr. David Rincón Rivera(UPC)

## Introduction and motivation

- High potential and relevance of SocialVR/ XR
- Realistic representations provide benefits compared to avatar-based representations, but still encounter limitations in term of resolution and performance.
- Main focus on human-to-human comms, but less on shared activities powered by multi-modal interactions features.



## Technological Pillars

Multi-modal interactions :

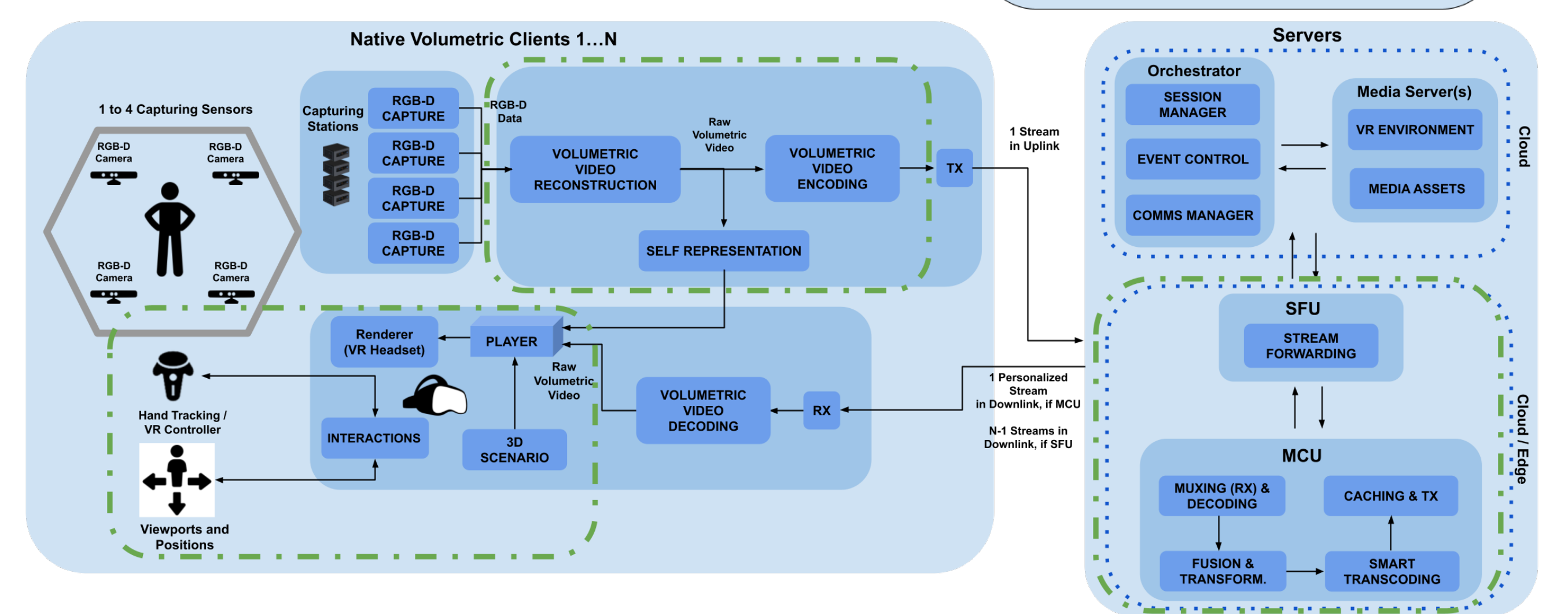
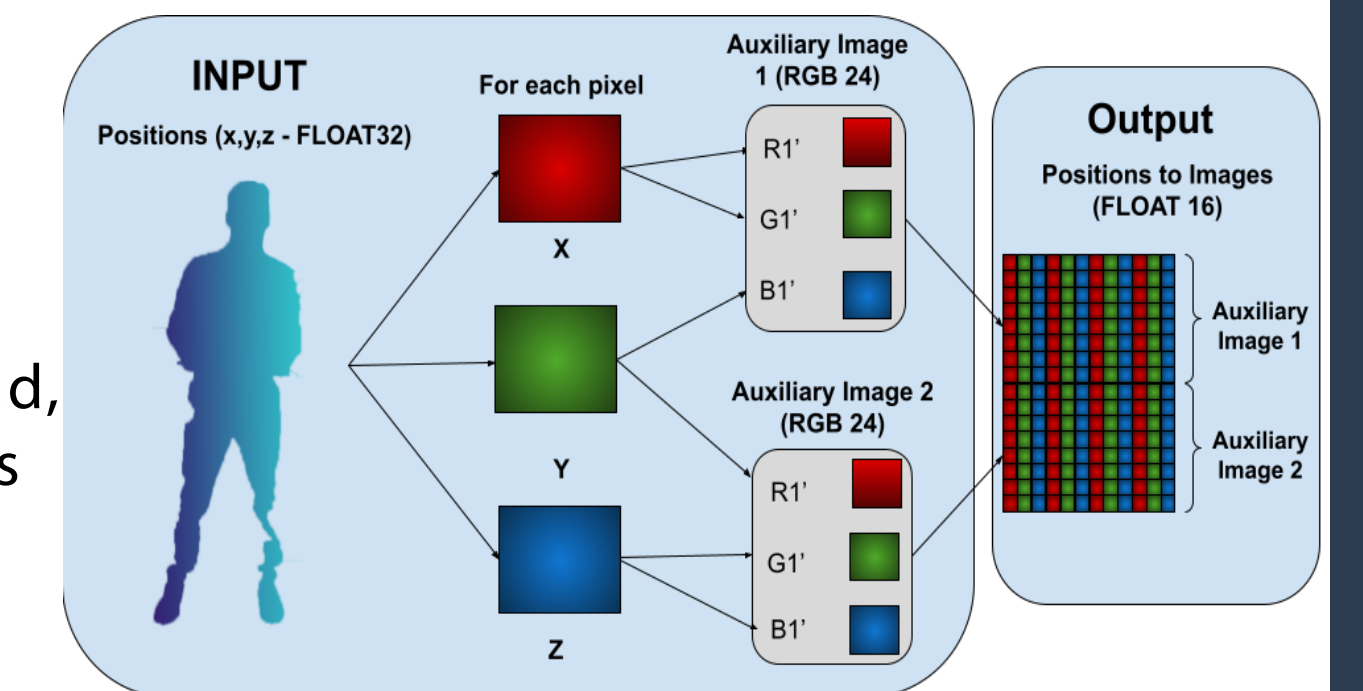
- provides satisfactory usability.
- contribute to a satisfactory gamification of Social VR experiences
- can be an effective means to acquire rich and comprehensive information about virtual environments.
- contribute to meaningful shared and collaborative experiences
- can be effective and provide added value in different multi-modal VR environments

Volumetric Users' representation :

- Full volumetric users' representations provide increased levels of presence, co-presence and quality of interaction than partial volumetric users' representation for the frontal view.
- An increase of the (photo-)realism and resolution of the users' representation contributes to increase the levels of presence, co-presence and quality of interaction.

Network-based media processing:

- Which quality levels to provide?
- How to provide optimized streams to the involved clients?
- By offloading media processing functions to the Edge / Cloud, can the performance be improved while minimizing resources consumption on the client side?



## Objectives

The main objective of the doctoral thesis is the design, development, and evaluation of innovative technological contributions to effectively enable gamified and collaborative experiences in virtual environments through multi-user realistic holoportation technology and multimodal Human-Computer Interaction (HCI)

**SO1.** Design, implementation, and evaluation of a novel real-time and high-resolution VV pipeline and its integration into an existing Social VR platform.

**SO2.** Design, implementation, and evaluation of in-cloud processing components to enhance scalability and interoperability of Social VR services.

**SO3.** Design, implementation, and evaluation of group-based multi-modal interaction features to gamify Social VR experiences with a key focus on collaboration

**H1 - Multi-modal Interaction Efficacy in VR:** Investigating the effectiveness of using advanced VR controllers for enhancing usability, information acquisition, shared experiences, and value across various VR applications.

**H2 - Realistic User Representation Impact in Social VR:** Assessing the influence of realistic user representations on presence and interaction quality, aiming to address limitations in existing volumetric video pipelines with a novel, lightweight solution.

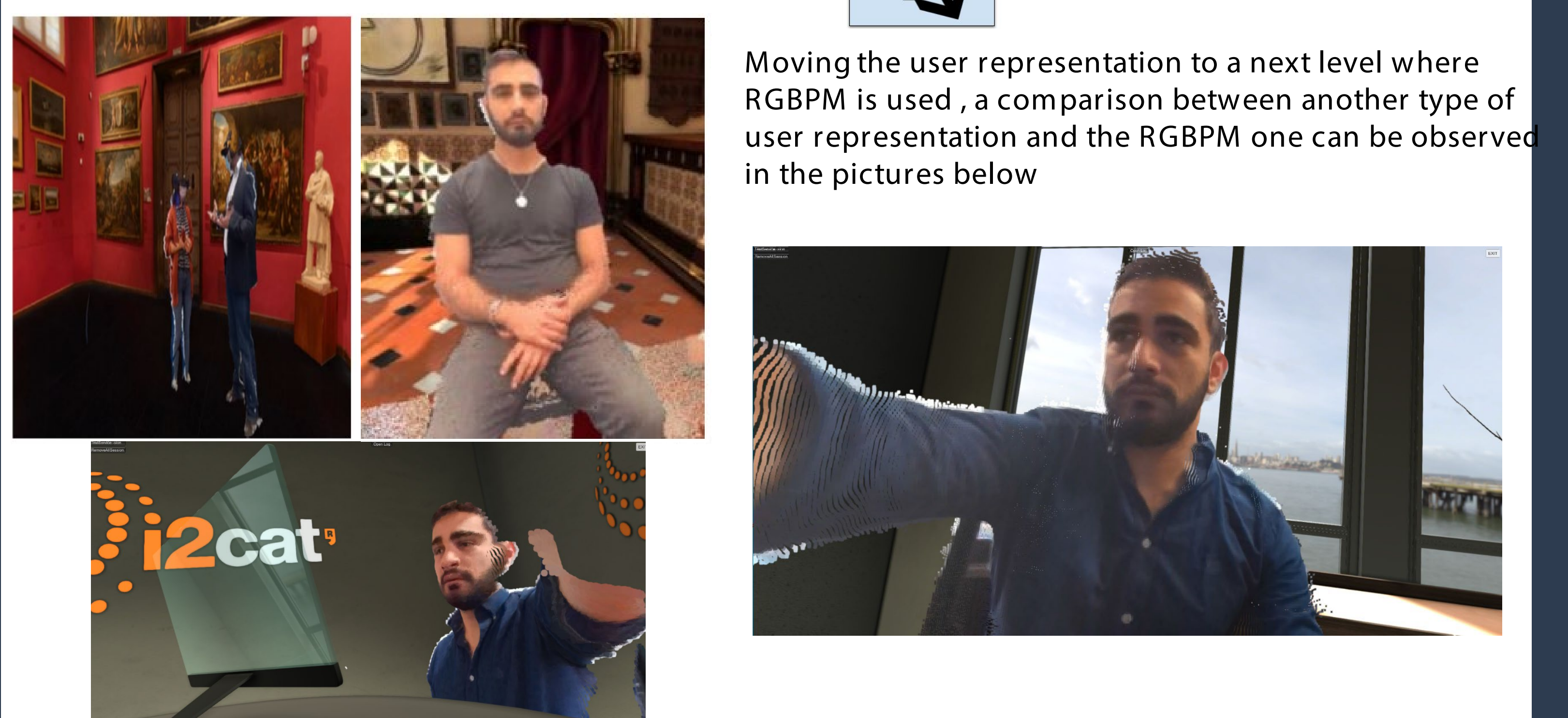
**H3 - Network-based Media Processing in Social VR Scalability:** Examining how network-based media processing technologies can enhance scalability and interoperability in Social VR, while maintaining satisfactory user experience levels through integration of diverse in-cloud media processing functions.

## Use Cases and Evaluation Methodology

### Objective Evaluation



### Subjective Evaluation



Moving the user representation to a next level where RGBPM is used, a comparison between another type of user representation and the RGBPM one can be observed in the pictures below

## Acknowledgements

This work is supervised by Prof. Mario Montagud from i2CAT Foundation & University of Valencia (Spain) and Prof. David Rincón from Polytechnic University of Catalonia (Spain). This work received funding from the Generalitat de Catalunya and the European Social Fund (Juan Oro Grants to hire research staff in training FI 2022). This work has been also partially funded by the European Union's Horizon Europe program under agreement nº 101070250 (XRECO project) and nº 101135025 (PRESENCE project), and by Agencia Estatal de Investigación (AEI), in the framework of Proyecto Estratégico Orientado a la Transición Ecológica y a la Transición Digital (TED) 2021, under agreement TED2021-131690B-C32 and TED2021-131690A-C33 (REVOLUTION project). The work of Mario Montagud has been funded by MCIN/AEI/10.13039/501100011033 under Grant RYC2020-030679-I and by "the European Social Fund (ESF) Investing in Your Future".

