

Advancing Co-located and Distributed Multi-user Mixed Reality

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Motivation

Multi-user MR blends co-located and remote interaction.

Perception and communication are mediated by technology, making social interaction in MR fundamentally different and unique.

- ▶ **Technological complexity** (devices, setups, limitations) creates challenges for design and deployment
- ▶ Complex tasks require **rich interaction** techniques, which can disrupt collaboration and social flow
- ▶ Understanding and supporting **social & perceptual awareness** is key to enabling effective MR communication

Research Questions

- RQ1** What **design and research challenges** emerge in co-located, distributed, and hybrid multi-user systems?
- RQ2** How can **social and perceptual awareness** be maintained in demanding, **collaborative interaction** scenarios?
- RQ3** How can **perceptual awareness of the self and others** be supported to facilitate communication?
- RQ4** How can multi-user systems **influence and advance social interaction** and interpersonal dynamics?

Research Projects



CleAR Sight - Advancing Collaborative Interaction Devices



RQ2 RQ3



Full Paper Krug et al., CleAR Sight: Exploring the Potential of Interacting with Transparent Tablets in Augmented Reality, *ISMAR '22*
Demo Büschel et al., Demonstrating CleAR Sight: Transparent Interaction Panels for Augmented Reality, *CHI'23, EA*

Developed a transparent interaction panel for co-located multi-user MR

Additional input device to improve interaction precision without obstructing context, collaborators, and social cues

Supports collaboration while **preserving social and contextual awareness**

Mixed Presence - Charting the Challenges



RQ1 RQ2 RQ3



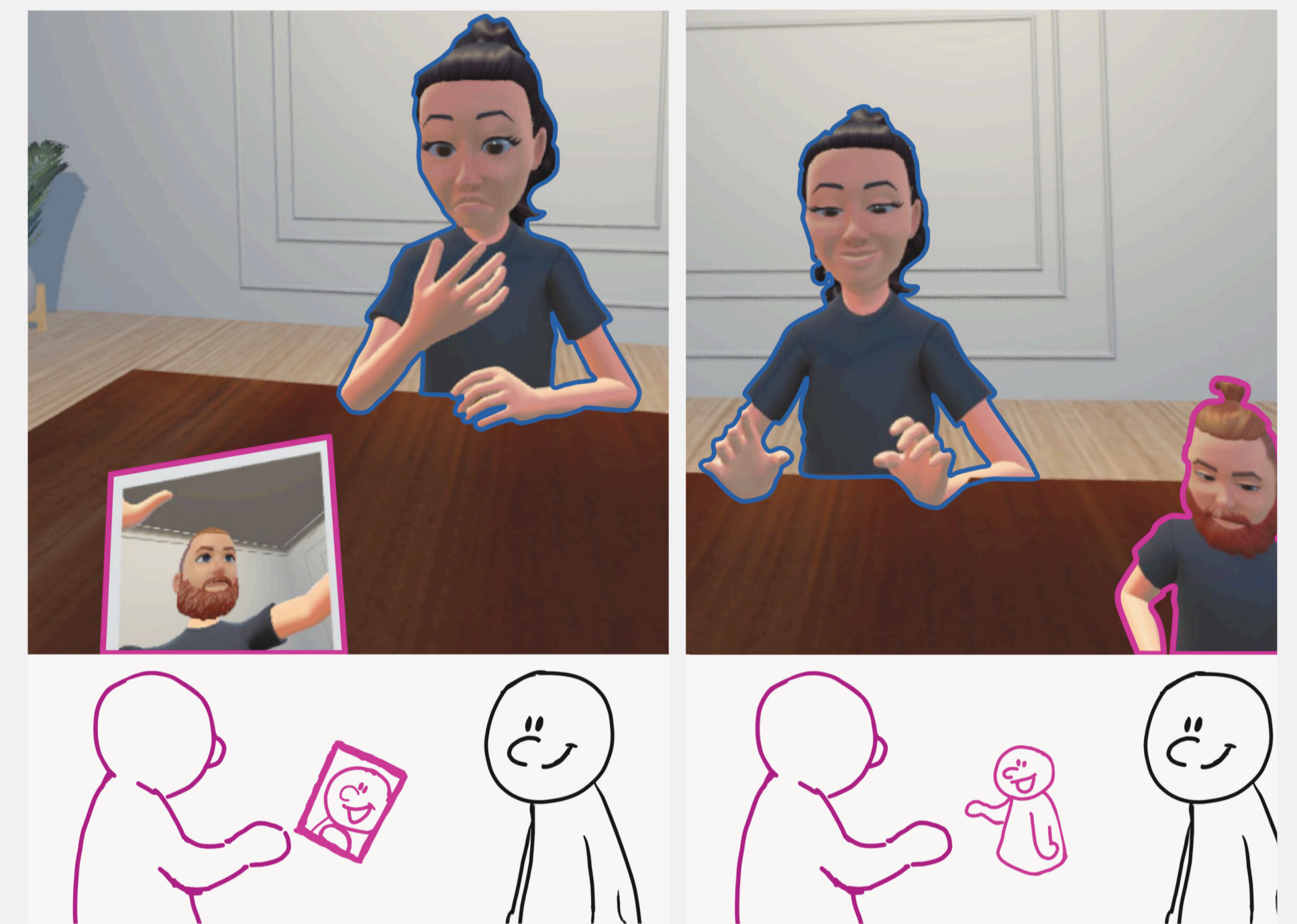
Full Paper Krug et al., Mixed Presence in Mixed Reality: Charting the Challenges and Opportunities, *CHI'25*
Workshop Paper Büschel et al., A Research Platform for Studying Mixed-Presence Collaboration, *ISMAR '24, Adjunct*

Conducted a systematic literature review (147 papers) to formalize components of Mixed Presence (MP)

Mixed Presence lacks a consistent definition and unified solution across existing research

Identified **key challenges**, derived **future research directions**, and built a **toolkit** for studying MR collaboration

Mirror Me - Investigating Self-Perception as Avatars



RQ3 RQ4



Full Paper Krug et al., Mirror Me: Exploring Avatar Self-Views in Multi-User Virtual Reality, *PACMHCI'25 for ISS'25/26*

Conducted user study (N=32) on avatar self-views in multi-user VR, compared three self-view types

Prior work shows self-views in video-conferences can affect attention, confidence, and fatigue

Our results show **benefits of VR self-views for expressive communication** and inform self-view design guidelines

Next Steps

Target **RQ3** and **RQ4**:

- ▶ Explore MR visualizations to support procedural structure (e.g., time, agenda, speaker flow, task priority) of face-to-face gatherings
- ▶ Study how MR can enhance interpersonal awareness without disrupting interaction
- ▶ Examine how visualizing emotional and social states can support reflection and group dynamics



Hi, I'm **Katja Krug!**
I'm a fourth-year Ph.D. student at the *Interactive Media Lab Dresden*, at TUD Dresden University of Technology. My supervisor is Prof. Raimund Dachselt.

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My research revolves around social interaction and collaboration in multi-user Mixed Reality. Within this context, my interests are broad and touch on diverse aspects, such as accessibility and inclusivity, social fatigue, emotional expression, and consent. Scan the QR code for an overview of my research.

