

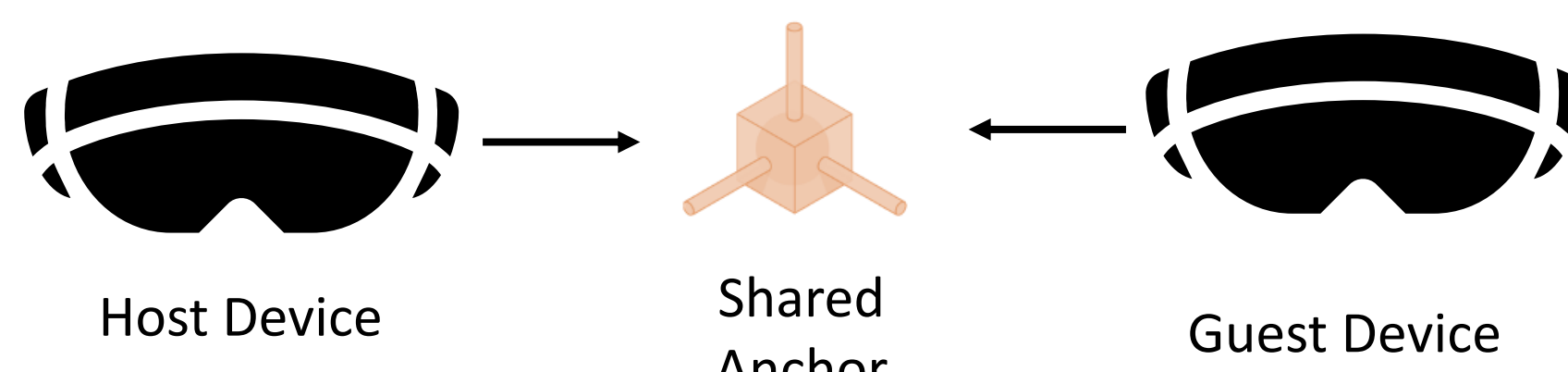
Multi-User Spatial Anchor Consistency in Meta Quest Mixed Reality

Department of Computer Science and Engineering – REU – IMEC²
Song, D., Nikolaos, N. (PhD), Sravya, G.

Research Overview

- Collaborative mixed reality requires multiple devices to place shared virtual content in a consistent physical location.
- This project uses a Unity-based Meta Quest prototype to study cross-device spatial alignment in a two-user colocated session.
- The system supports a host–guest workflow in which a shared spatial reference is established, transferred, and then observed after guest-side loading.
- Runtime logging is used to record post-load behavior and support analysis of how the two devices align during live use.

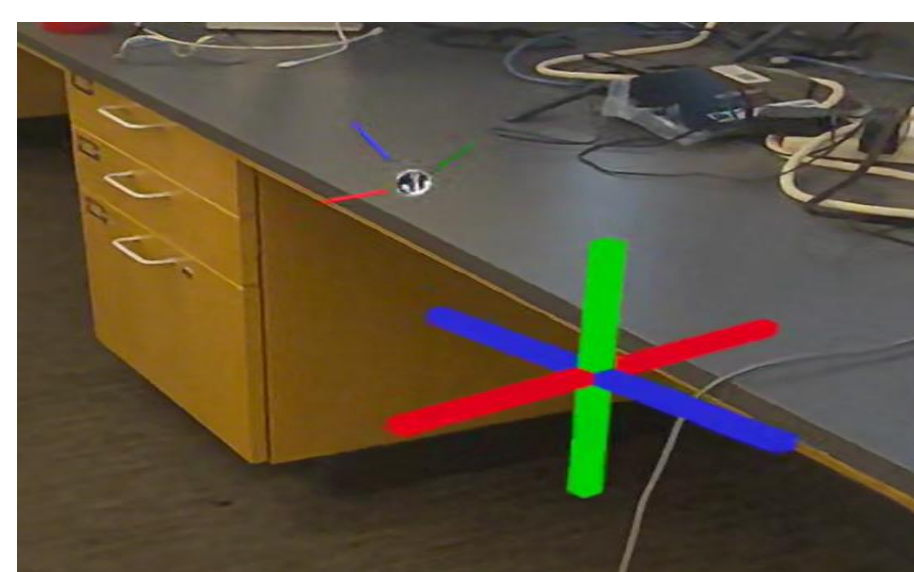
Figure 1. Conceptual view of two devices referencing a shared spatial anchor.



Motivation

- In collaborative mixed reality, users expect shared virtual content to appear in the same physical location for all participants.
- On Meta Quest, each headset tracks the environment from its own local coordinate frame, so matching application coordinates do not automatically imply matching physical placement across devices.
- A practical challenge in multi-user MR is therefore establishing a shared spatial reference that allows users to view the same content in a consistent location.
- This project studies that challenge through a two-device Meta Quest prototype that supports host–guest alignment and post-load runtime observation in a colocated session.

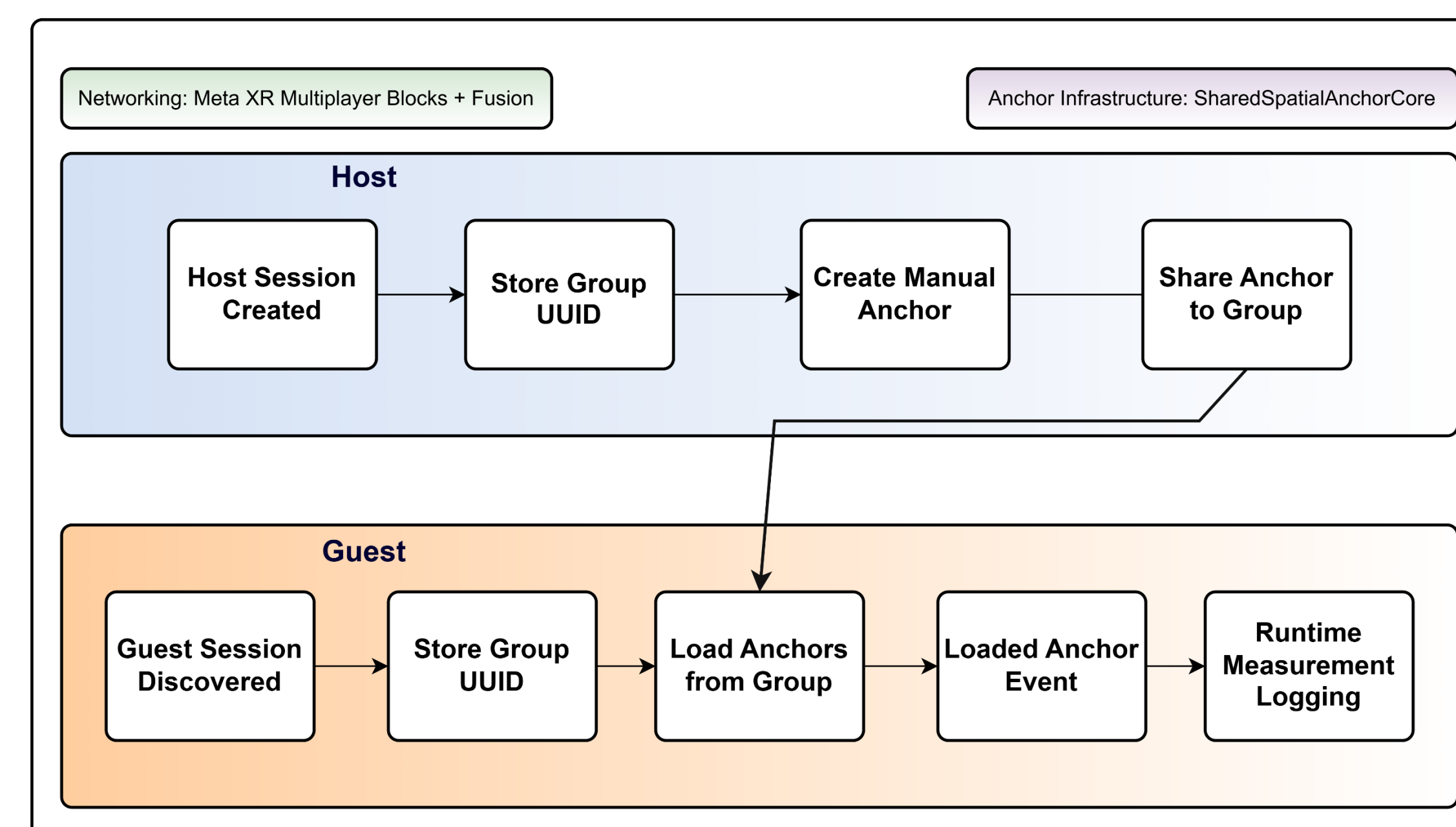
Figure 2. Illustrative demonstration of spatial anchor in live session



System Architecture

- The system uses Unity on Meta Quest to support a two-user host–guest mixed reality session. Multiplayer session management coordinates device discovery and session entry, while the shared-reference pipeline handles creation, sharing, and loading of the alignment reference across devices.
- On the host side, the shared reference is created and associated with the active group session; on the guest side, the same session is used to load that reference after discovery. Once loading completes, runtime logging records post-load behavior for later analysis of cross-device spatial alignment.

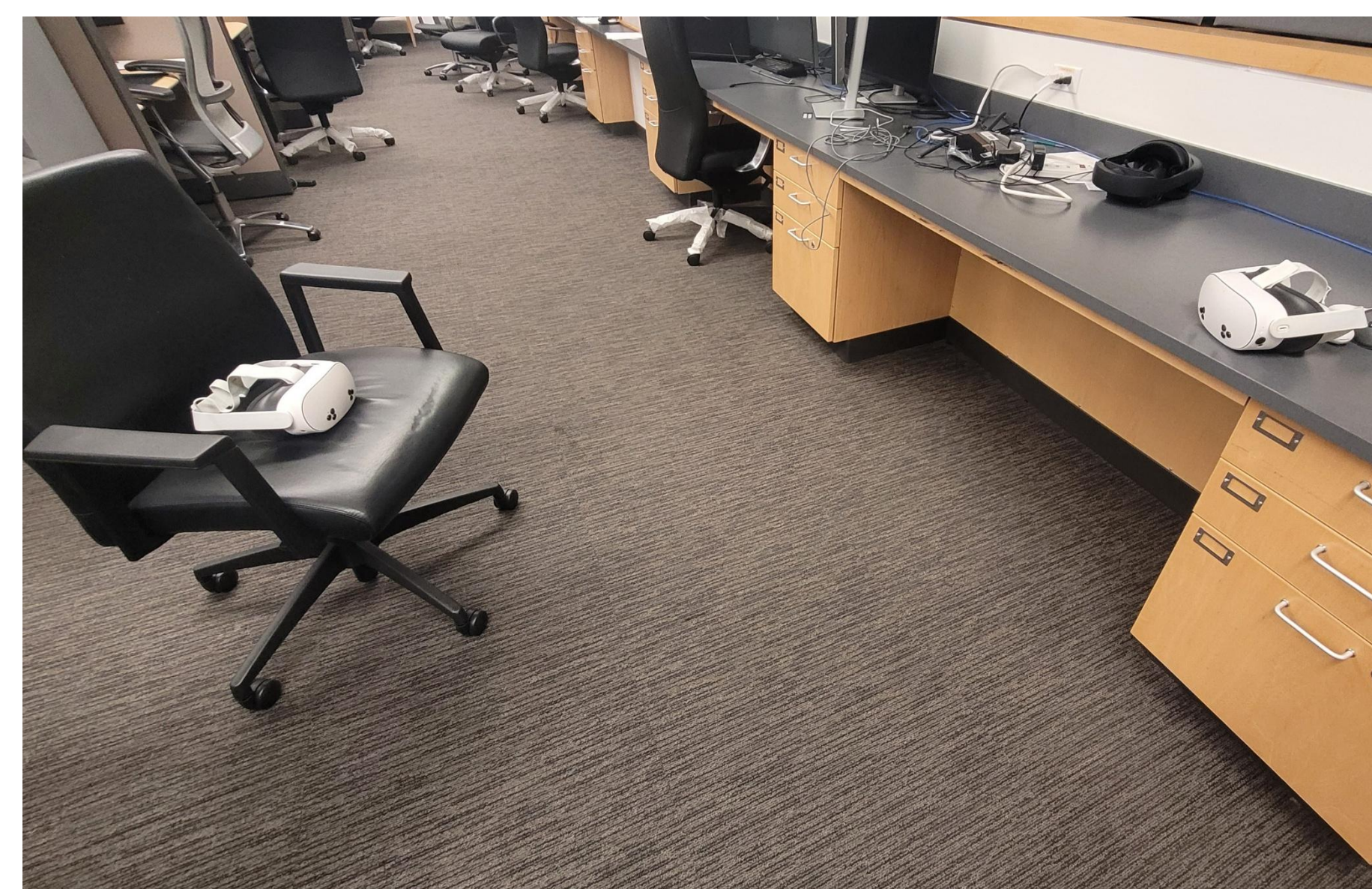
Figure 3. System architecture of the two-user shared-anchor prototype



Experimental Setup And Procedure

- Two Meta Quest 3S devices were used in a shared indoor test space.
- The same Unity-based multi-user mixed reality application was launched on both devices.
- Before each run, adb logs were cleared, and runtime behavior was recorded through logcat and in-device screenshots or video.
- For each session, the host was started first, followed by the guest; after shared-anchor transfer/loading, the devices were repositioned to capture anchor observations from different viewpoints.

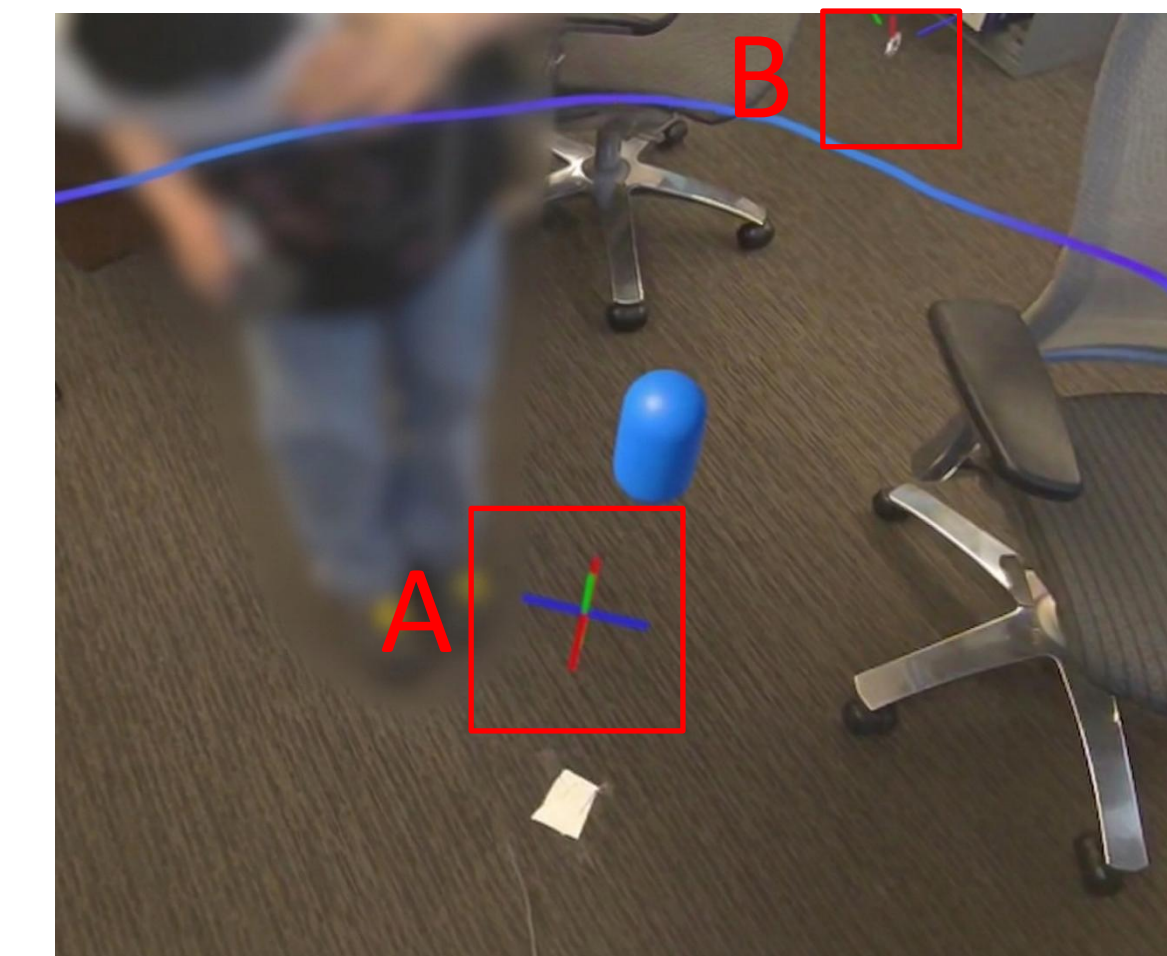
Figure 4. Experimental setup used in the representative two-user session.



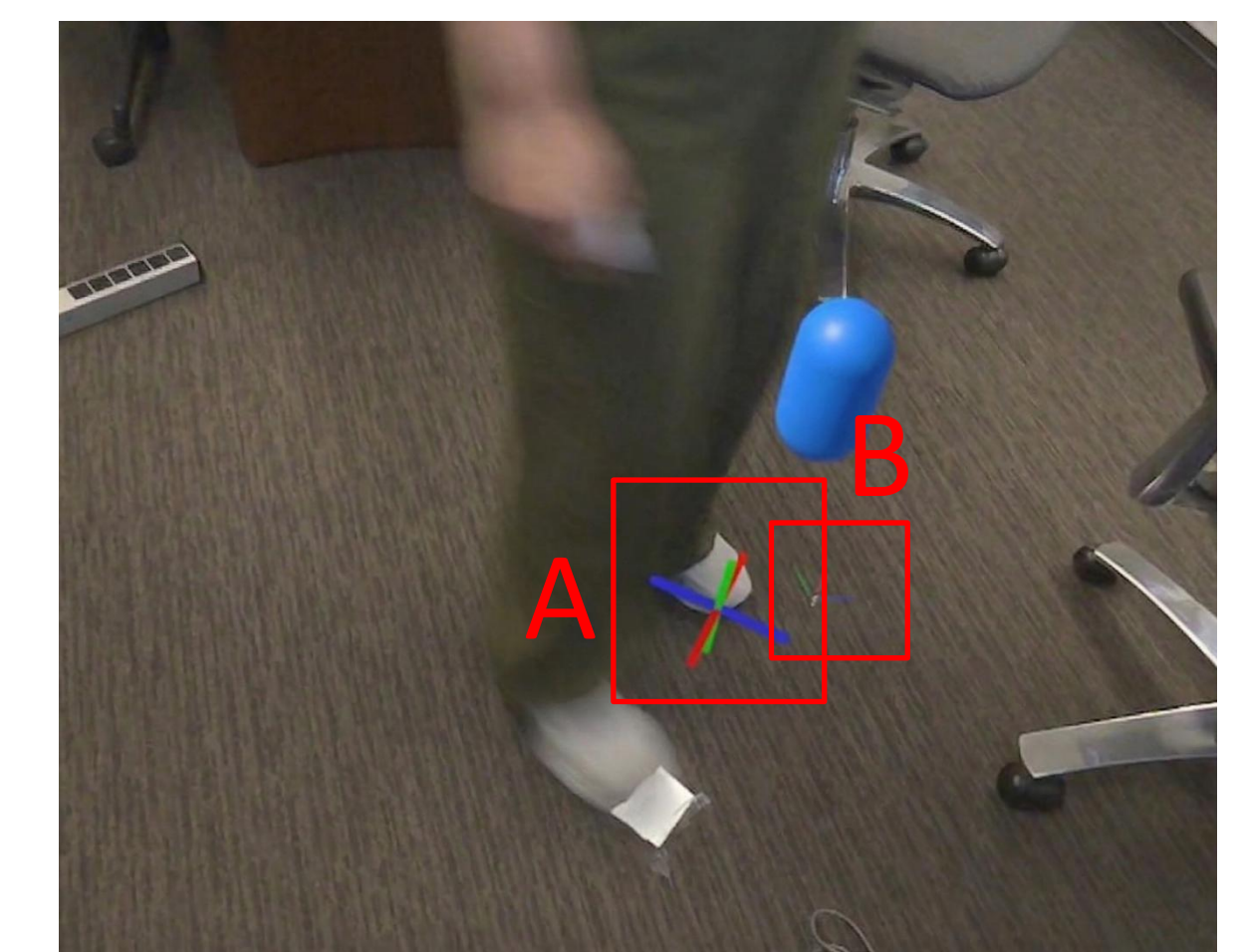
Representative Two-User Session Results

- A representative two-user session showed that the prototype could complete the host–guest alignment workflow, from shared-reference transfer and guest-side loading to post-load runtime observation.

Figure 5. Representative host and guest views showing the origin anchor (A) and a secondary shared anchor (B) during a two-user session.



Anchor region observed on host



Anchor region observed on guest

Conclusions & Future Work

- In this work, we present a two-user Meta Quest mixed reality prototype for studying cross-device spatial alignment in a common session. The system supports a host–guest workflow that establishes a shared spatial reference, transfers it across devices, and enables post-load runtime observation in a live colocated setting. Current results show that the prototype can complete the intended alignment workflow between host and guest, providing a practical foundation for future spatial-consistency studies.
- Future work will investigate multiple shared references, refine reference-specific measurement design, and collect controlled repeated trials for cross-device drift and spatial-consistency analysis. The representative session suggested an inconsistency for the additional shared reference, but additional controlled trials are needed before attributing it to a specific mechanism.

References

1. Meta. *Multiplayer Building Blocks Setup Guide*. Meta Horizon Developer Documentation, 2026.
2. Meta. *Spatial Anchors Overview*. Meta Horizon Developer Documentation, 2025.
3. Miller, J., Soltanaghai, E., Duvall, R., Chen, J., Bhat, V., Pereira, N., and Rowe, A. G. *Multi-User Augmented Reality with Infrastructure-free Collaborative Localization*. arXiv:2111.00174, 2021.
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