Together in Aventicum VR

Degree programme: BSc in Computer Science
Thesis advisor: Prof. Marcus Hudritsch
Expert: Thomas Jäggi

As virtual reality (VR) evolves, the Computer Perception and Virtual Reality Laboratory at the BFH wanted to upgrade their existing Unity VR solution by adding networking capabilities. In addition to full-body avatars and grouped teleportation, multiple players in the same physical space must see their friends' avatars in their actual physical locations to enable real-time interactions.

Use cases

Two distinct use cases were considered during the development process to guide feature choices to be as generic as possible.

1. – This use case involves sending headsets to a school via a postal system, allowing children to virtually visit with friends the Cigognier temple of Aventicum, once the capital of Roman Switzerland, before exploring the existing ruins in person.
2. – The second one is a professional application where architects could present the current state of a project to their clients.

Features

Standalone

Even though using Android headsets like the Meta Quest comes with the downside of limited performance, which needs to be managed carefully, this makes the entire project versatile. Removing the requirement for a computer reduces the project's size, keeping it simple and future-proof. Additionally, it makes the headsets easier to send through the post.

Calibration

Headsets need to be calibrated so that players can see each other's avatars in the same physical locations, enabling physical interactions between them. This calibration is done using two physical markers that each player selects using the headset's passthrough feature, which displays the camera feed to perform augmented reality.

Grouped Teleportation

If teleportation is not managed over the network, the calibration will be disrupted if a player teleports. To prevent this, teleportation is managed so that only one player can teleport at a time, and the ray displaying the teleportation destination is synchronized over the players.

Avatars

Virtual reality relies heavily on a sense of presence, making it crucial for players to notice minimal discrepancies from reality. Since this project emphasizes physical interaction, the visual representation must be highly accurate to enhance the sense of presence. Using inverse kinematics to compute bone positions based on the headset and hand positions, a customized full-body avatar is displayed for each player.

Result

The result is a lightweight yet convincing solution with modular components that can be stacked together for various functionalities. Whether you need calibration, grouped teleportation, network-managed scenes, or full-body avatars scaled to the player's size at the start, each component is designed to integrate seamlessly. Each component includes a special menu where players can opt out of the teleportation group and recalibrate their avatar or physical position.

Dan Nathan Simonin
Computer Perception and Virtual Reality
simonindan@gmail.com