

# Augmented and Virtual Reality

**CSCI 3907/6907**

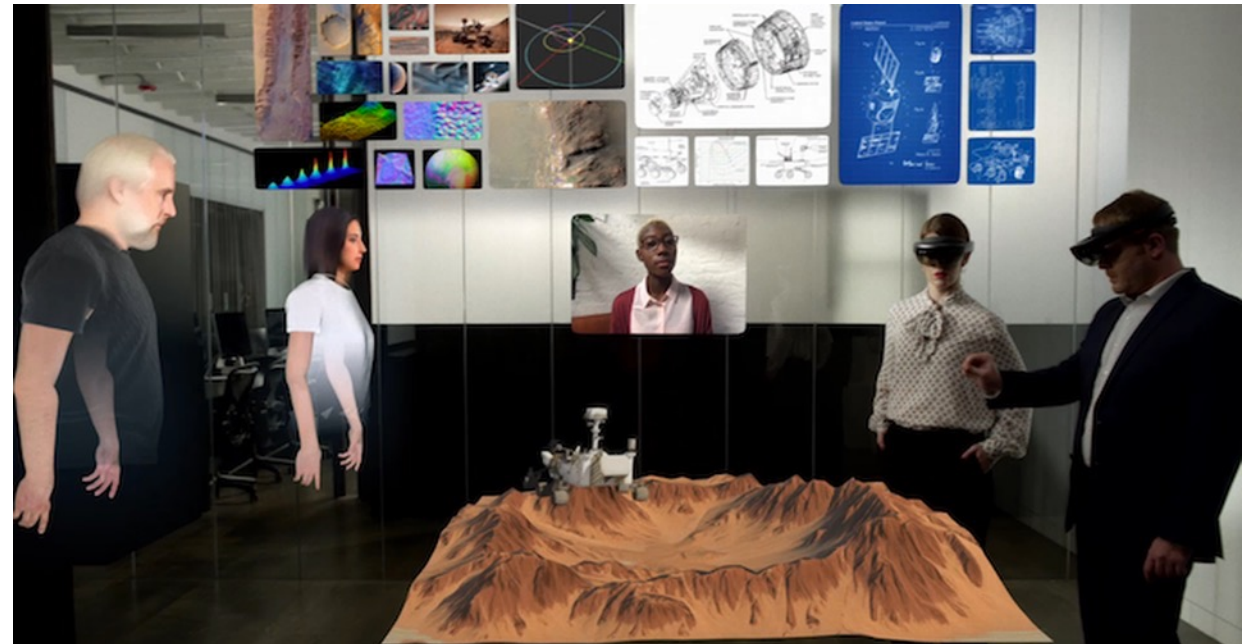
**Spring 2022**

**3:30 PM - 6:00 PM, Thursdays**

**Week 6**

**Dr. Hurriyet Ok**

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# VR Playground - Preview VR projects

Demonstrate these scenarios:

- An interaction with a virtual object in a scene.
- Background music and/or a sound effect.
- A text instructions (e.g. pops up like an info bubble)



# Overview of VR Project Deliverables

01/27: VR Concept Note

02/10: Submit VR development status update

03/03: Publish your VR app and produce a 2 min promo video

03/03: Provide project completion report

03/03: Present your VR app in the classroom

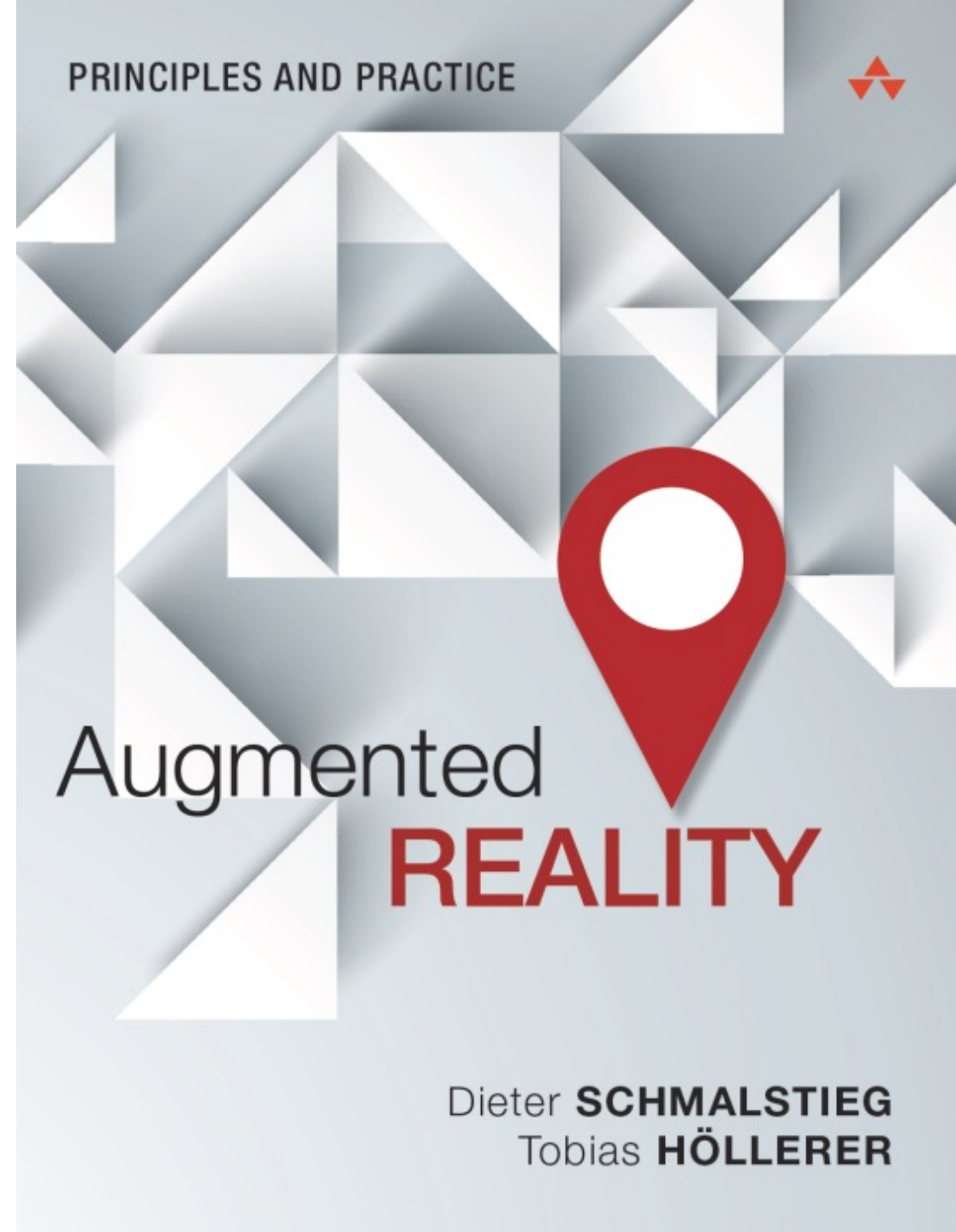
03/07: Provide your peer evaluation of three VR app design

All due by 3:30 PM

# Chapter 12: Collaboration

Augmented Reality – Principles and Practice

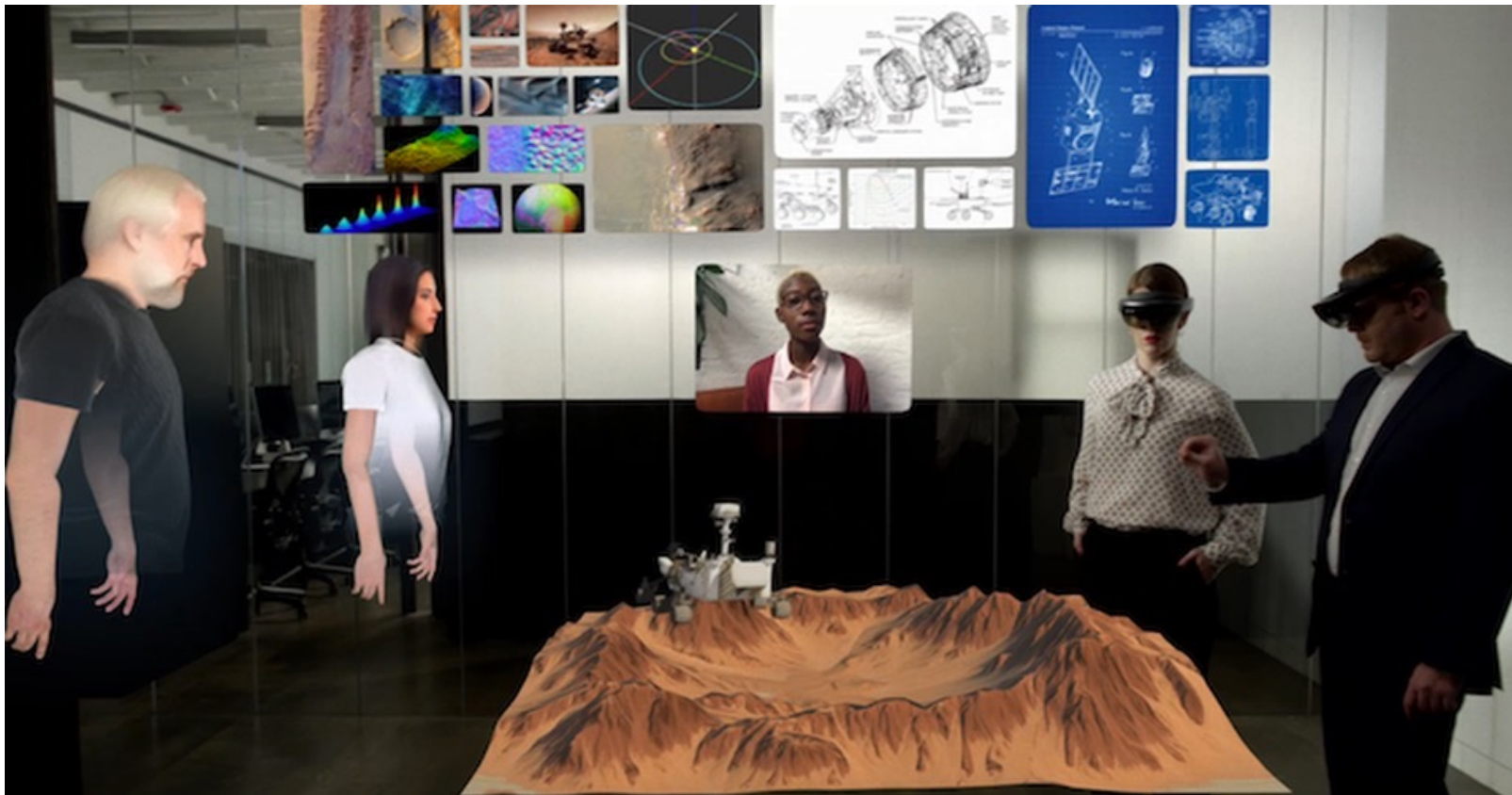
<http://www.augmentedrealitybook.org>





# Spatial - Collaborate from Anywhere in AR

<https://youtu.be/PG3tQYIZ6JQ>



Source: <https://spatial.io>

# Spatial - New Virtual Office



Source: <https://youtu.be/1t0t0gwjdfU>

# Computer-Supported Cooperative Work in Relation to AR

	<b>Co-located</b>	<b>Remote</b>
<b>Synchronous</b>	AR shared space	AR telepresence
<b>Asynchronous</b>	AR annotating/browsing (in-situ)	Generic sharing

# Classifying Communication and Task Space

Communication Space	Task Space	Unified Spaces	Example
Co-located	Real	No	Classroom lecturing
Co-located	Virtual	No	Joint work on one desktop computer
Remote	Real	No	Video conference
Remote	Virtual	No	Video conference with desktop sharing
Co-located	Real	Yes	Playing a real game of chess
Co-located	Virtual	Yes	<b>Shared space</b>
Remote	Real	Yes	<b>Telepresence</b>
Remote	Virtual	Yes	Immersive telepresence, online game



# Co-Located Collaborative Visualization

A shared space setup enables users wearing HMDs to establish an individual view on virtual objects, as with the mathematical visualization shown in the image



Image: Anton Fuhrmann

# Shared Space Memory Game



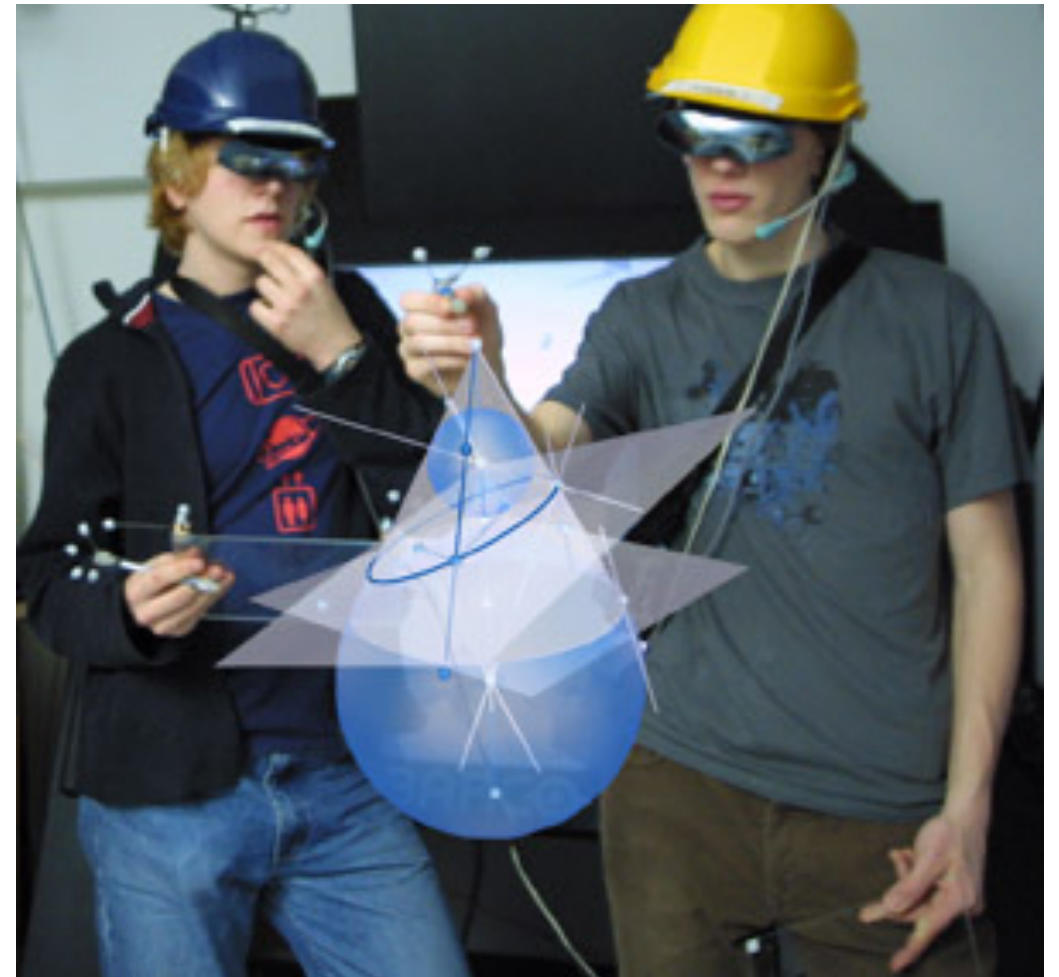
Users with HMDs playing a collaborative memory game  
Image: Mark Billinghurst

# Construct3D

Geometry education can benefit from being able to explore the geometric constructs in 3D (here: tangential planes)

Roles: teacher sees solution, students don't

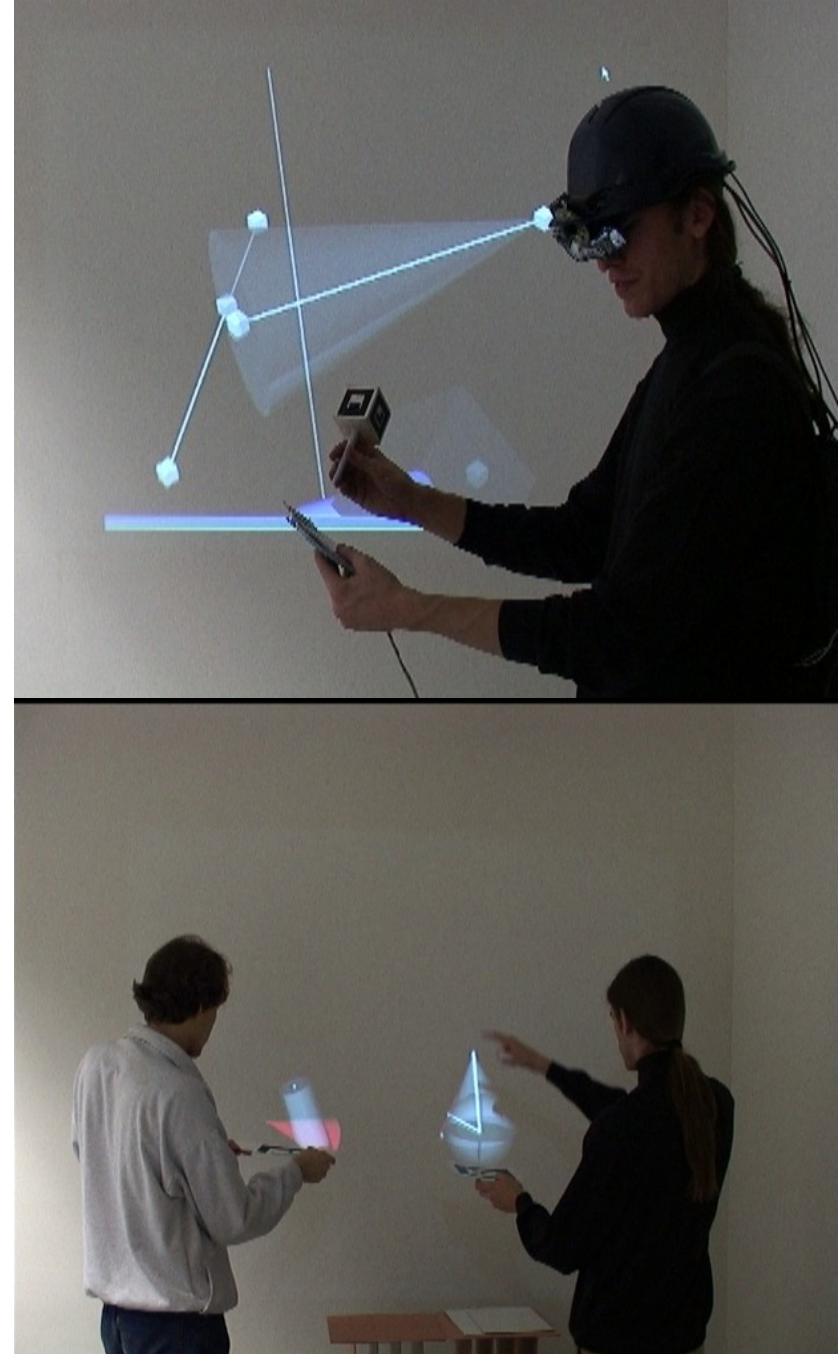
Image: Hannes Kaufmann





# Augmented Classroom

- Projection screen
- Teacher or student works with HMD
- Class watches projection
- Use of markers for manipulating finished work without HMD





# EMMIE: Augmented conferencing

- “Hybrid User Interface”
- Conferencing assisted by multiple computing devices
- HMD, projection screen, notebook, tablet/PDA
- Place virtual objects in 3D space
- Shared “virtual ether” metaphor

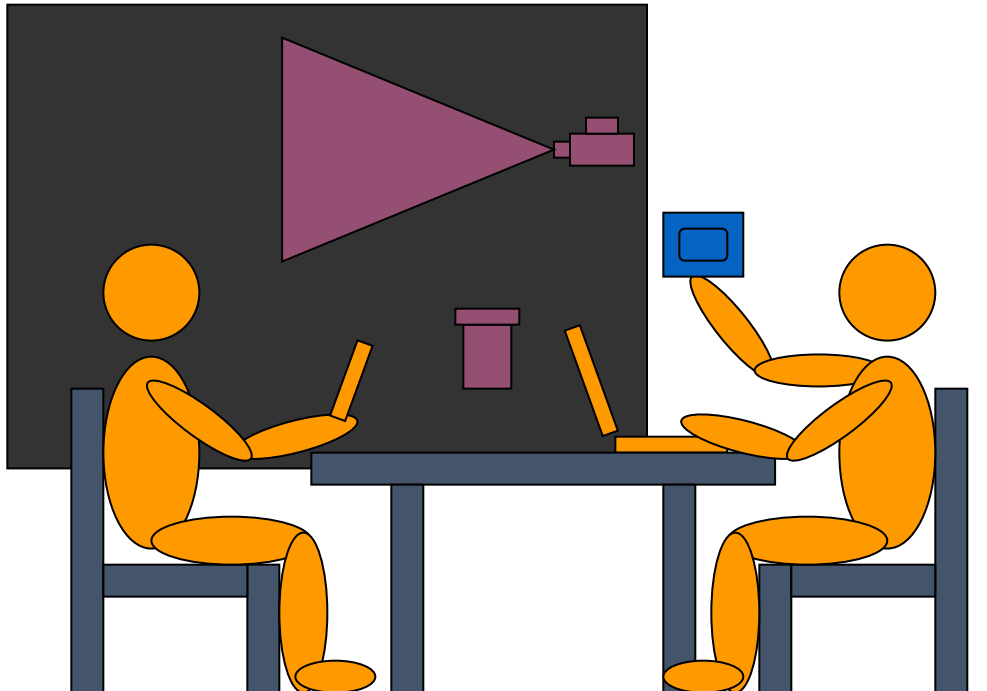


Image: Andreas Butz

# Vampire Mirror

A vampire mirror with selected objects (notepad and video tape icons) made private

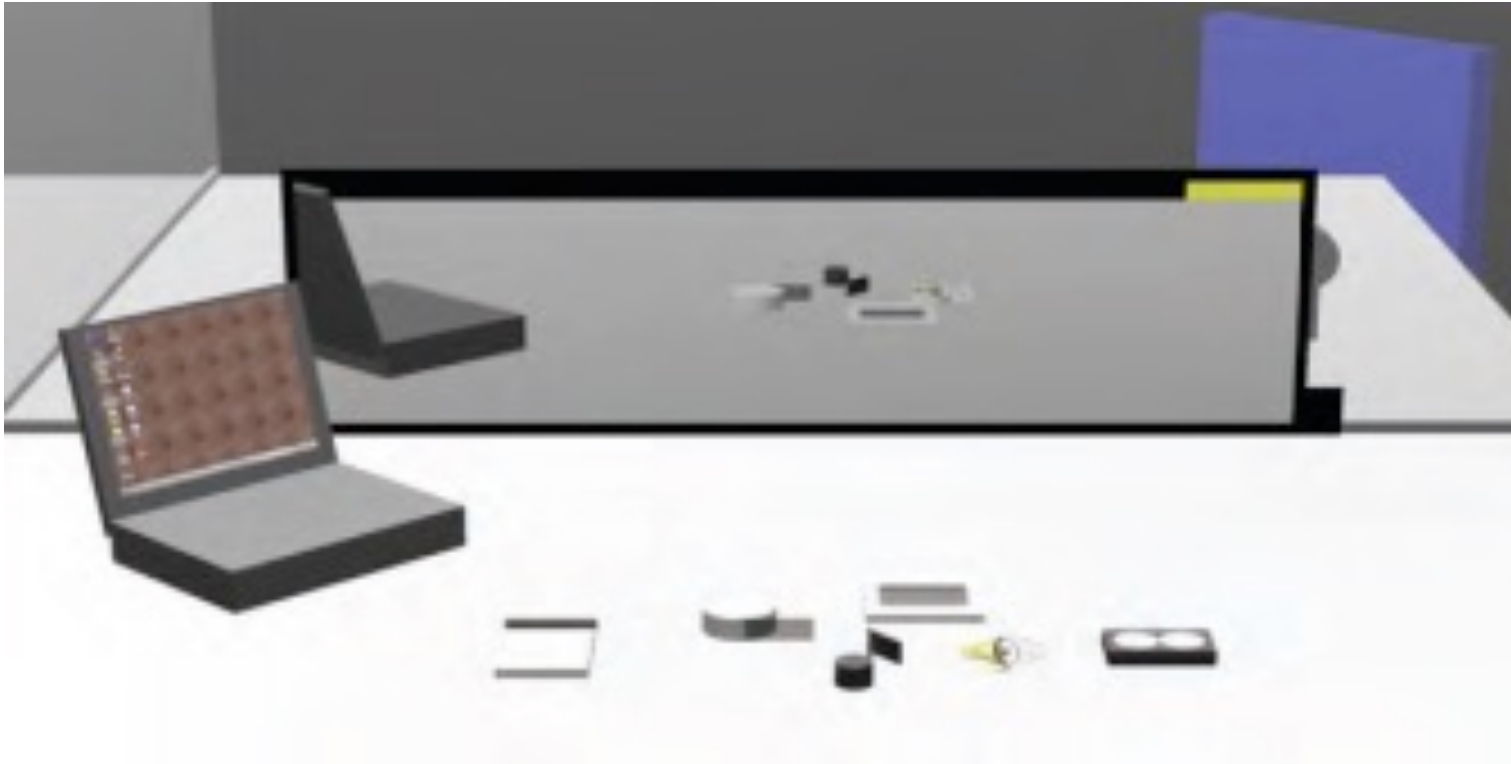
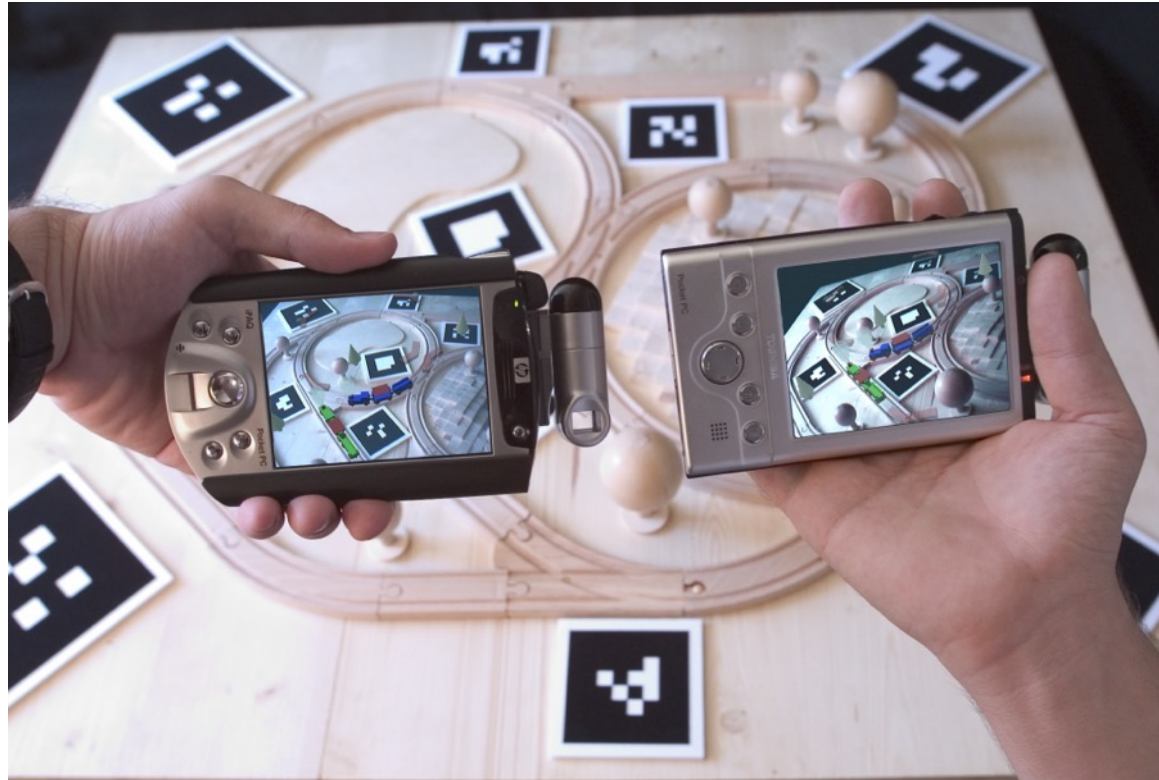


Image: Andreas Butz and Columbia University

# Agile Collaboration in a Shared Space



Multiple users move in the playfield and control invisible trains on real tracks

# Collaborative Manipulation of 3D Virtual Objects in Augmented Reality Scenarios using Mobile Devices

Interaction in augmented reality environments may be very complex, depending on the degrees of freedom (DOFs) required for the task. In this work we present a 3D user interface for collaborative manipulation of virtual objects in augmented reality (AR) environments. It maps position – acquired with a camera and fiducial markers – and touchscreen input of a handheld device into gestures to select, move, rotate and scale virtual objects. As these transformations require the control of multiple DOFs, collaboration is proposed as a solution to coordinate the modification of each and all the available DOFs. Users are free to decide their own manipulation roles. All virtual elements are displayed directly on the mobile device as an overlay of the camera capture, providing an individual point of view of the AR environment to each user.

<https://youtu.be/IXSAkIv9e0>



**2017 3DUI CONTEST WINNER**

Source: <http://people.duke.edu/~jg421/publications/CollaborativeAR-3DUI2017/CollaborativeAR-3DUI2017.html>



# Agile Collaboration in the Cows vs Aliens Game

One player tries to slow down an opponent by covering the camera of the opponent's device with one hand, thereby preventing the opponent from interacting with the fiducial marker.

Image: Alessandro Mulloni



# MapLens

Snapshots from the collaborative use of augmented maps in *MapLens*, a multiuser outdoor game played on smartphones



Image: Ann Morrison

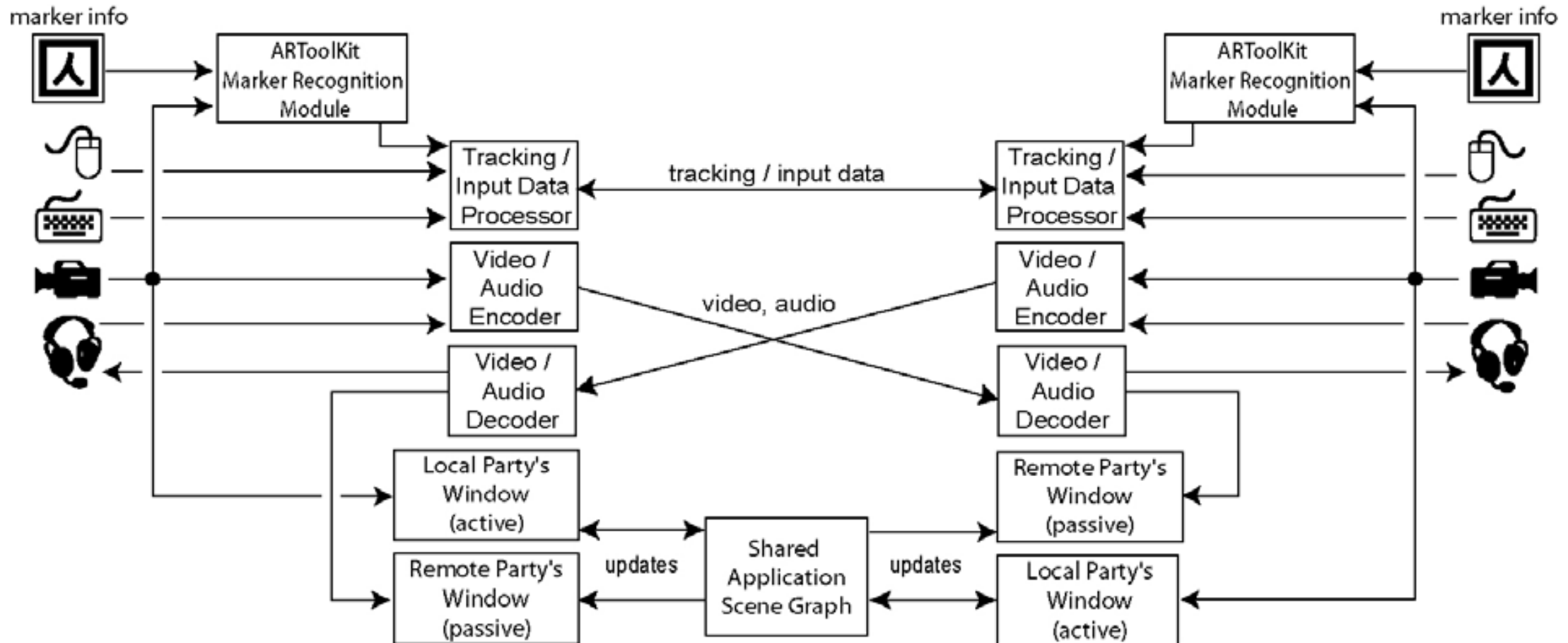
# Augmented Video Collaboration

Two physicians can collaborate by combining AR video conferencing with local, fast volume rendering of medical data sets. Courtesy of István Barakonyi



# Augmented Video Collaboration Framework

Courtesy of István Barakonyi



Besides the video stream, each side shares tracking information extracted from the video stream and updates it to a shared scene representation. This enables both sides to perform local AR rendering and compositing at the highest possible quality.



# Remote Collaboration Based on SLAM

The remote expert (right) can draw annotations directly into the mobile user's view. The live video feed is stabilized for the duration of the touch screen interaction while video updates continue, correctly projected onto the continuously updated model. Courtesy of Steffen Gauglitz.



# Hand of God

The stationary system records a user's pointing hand with cameras from multiple viewpoints



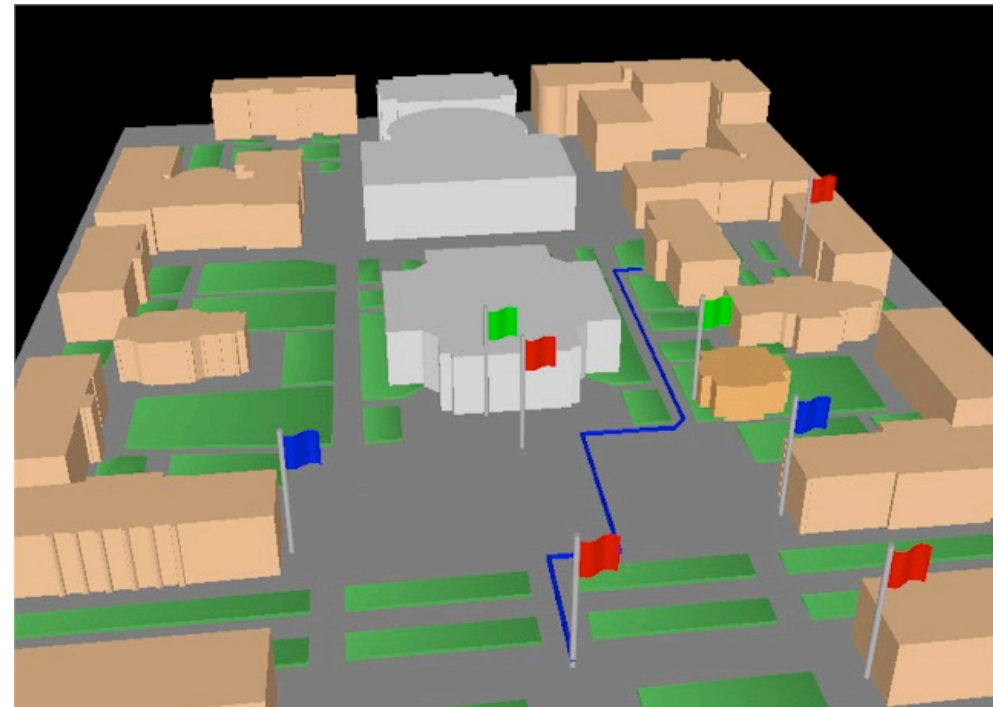
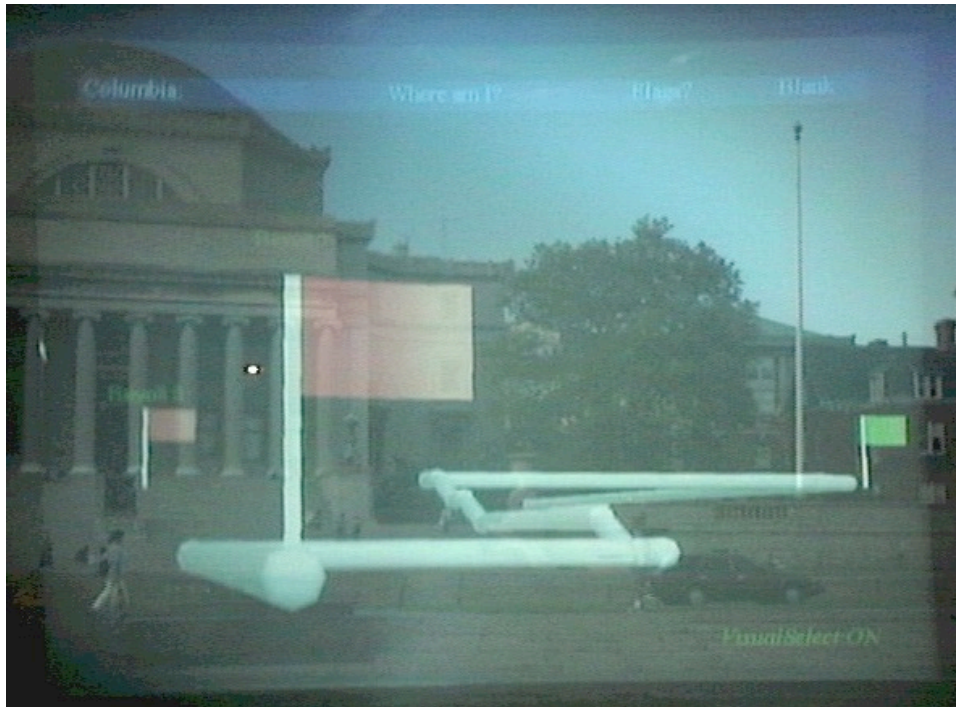
The Hand of God appears in the mobile user's AR view, marking a particular location



Image: Aaron Stafford and Bruce Thomas

# Indoor-Outdoor Collaboration

Collaboration of an outdoor user roaming a university campus (left, seen through an HMD) and a stationary user providing a path for the mobile user to follow (right, VR view).  
Courtesy of Columbia University





# Outdoor-Outdoor Collaboration: Studierstube Tour Guide

- Ad-hoc networking via WLAN
- Navigation with another user
  - Guiding
  - Meeting
  - Following
- Information browsing
  - Setting the filters of other users
  - Following the selection of other users
- Annotation
  - Icons appear for all users
  - Filtering based on author possible





# Case Study: Fixing a car with AR

<https://youtu.be/qIXmfDcrQGU>



Source: <https://atheerair.com/overview/>

# Summary

- AR is suitable for various types of collaborative interfaces.
- Synchronous collaboration: The augmented real world is experienced and manipulated together by two or more users.
- Shared space: Co-located AR users see the same real and virtual objects, but each user can assume an individual viewpoint.
  - Joint experience of virtual (or augmented) objects, without a particular need for sophisticated collaboration tools.
- Remote collaboration:
  - Virtual or augmented objects or presenting remote users as video avatars.
  - Asymmetric scenarios: One user captures live video and the other user provides feedback directly in the first user's view (remote expert consultation)

# Case Study: Toshiba dynaEdge AR glasses

[https://youtu.be/-oBf89t\\_JZ0](https://youtu.be/-oBf89t_JZ0)





# Toshiba dynaEdge AR glasses

Engadget Review: <https://youtu.be/9GqvUis6xLU>





# Hands-on: Virtual Worlds and Collaboration

## A brave new world with virtual worlds

How virtual worlds are the next evolution in communication and collaboration

By Ilan V. Cook, Kaitlyn Kuczer

Read the article online:

<https://www2.deloitte.com/us/en/insights/topics/emerging-technologies/virtual-world-for-business.html>

Download the report as PDF:

[https://www2.deloitte.com/content/dam/insights/us/articles/6927\\_cir-bridge-from-digital-reality-to-virtual-worlds/DI\\_A-brave-new-world-with-virtual-worlds.pdf](https://www2.deloitte.com/content/dam/insights/us/articles/6927_cir-bridge-from-digital-reality-to-virtual-worlds/DI_A-brave-new-world-with-virtual-worlds.pdf)

Answer the questions (to be provided) related to the Deloitte article in the virtual classroom on using [spatial.io](https://spatial.io) AR/VR Platform for collaboration.

# Spatial.io Quick Guide

New to Spatial? Start here!

<https://support.spatial.io/hc/en-us/articles/360060057511-New-to-Spatial-Start-here->

How do I create a Spatial account?

<https://support.spatial.io/hc/en-us/articles/360035342311-How-do-I-create-a-Spatial-account->

Choose “Login with Google”

Use your [student@gwmail.gwu.edu](mailto:student@gwmail.gwu.edu) account to create your Spatial Account

# Spatial.io Quick Guide

## Device Setup

<https://support.spatial.io/hc/en-us/categories/360002794051-Device-Set-Up>

How to join a Spatial meeting from your desktop or phone

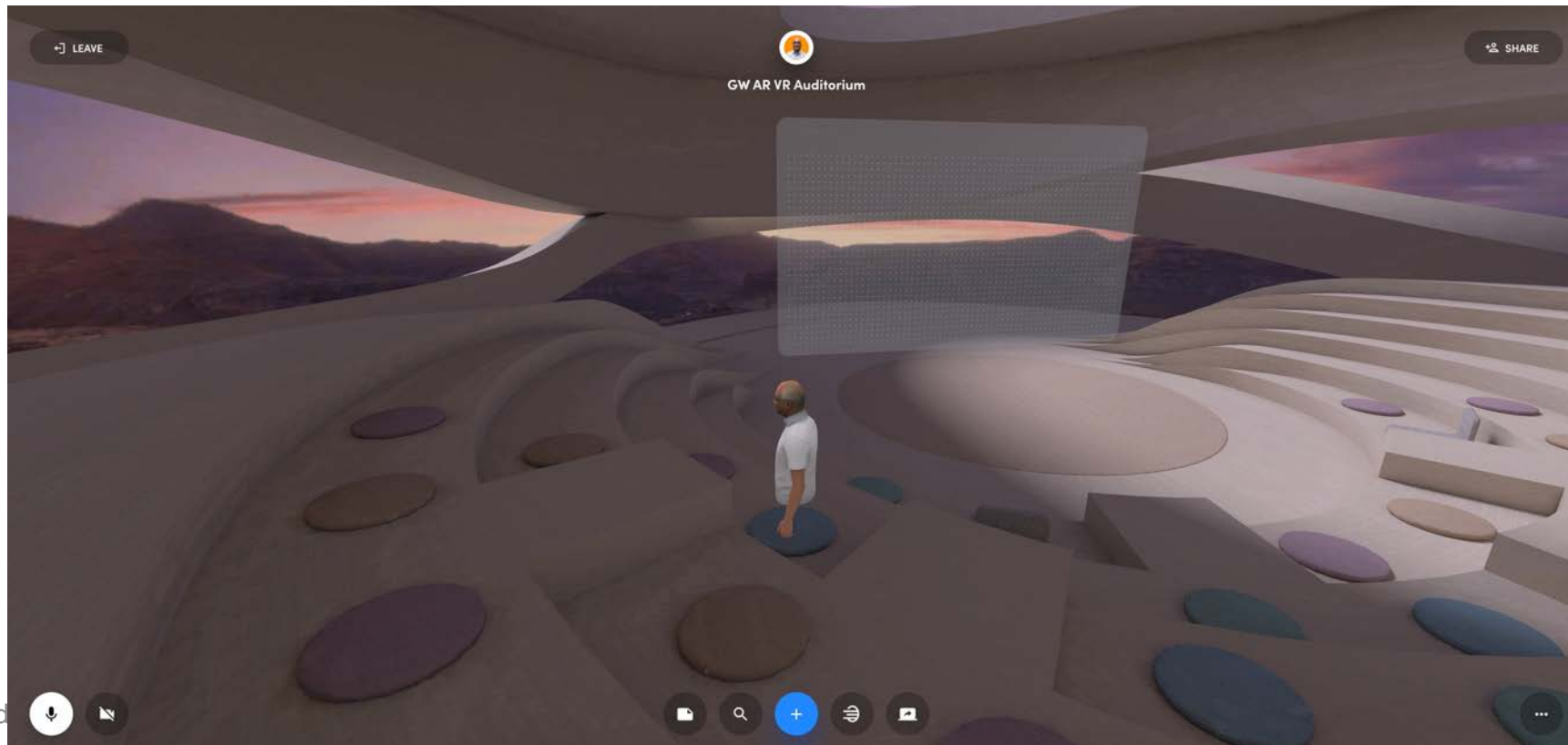
[How to join the web app / desktop](#)

[Spatial's Mobile App on iOS and Android](#)

# Ready for 3D Collaboration!

**Enter the Spatial Room: “GW AV VR Auditorium”**

<https://app.spatial.io/rooms/618b350c41b26f00013f8f60>





# Textbook Case Studies – Reading Assignment

- Read Chapter 4 Computer Vision for Augmented Reality. Particularly, review these case studies on  
**Marker Tracking** (pages 123-132) and  
**Simultaneous Localization And Mapping (SLAM)** (pages 156-164, 170-176)
- Reviewing the information in blue boxes is encouraged but not required for the purpose of testing.
- You will answer the questions (to be provided) related to these two cases on February 17<sup>th</sup>