GW SCHOOL OF ENGINEERING & APPLIED SCIENCE

Augmented and Virtual Reality

CSCI 3907/6907

Spring 2022

Week 11

Dr. Hurriyet Ok

Final Exam

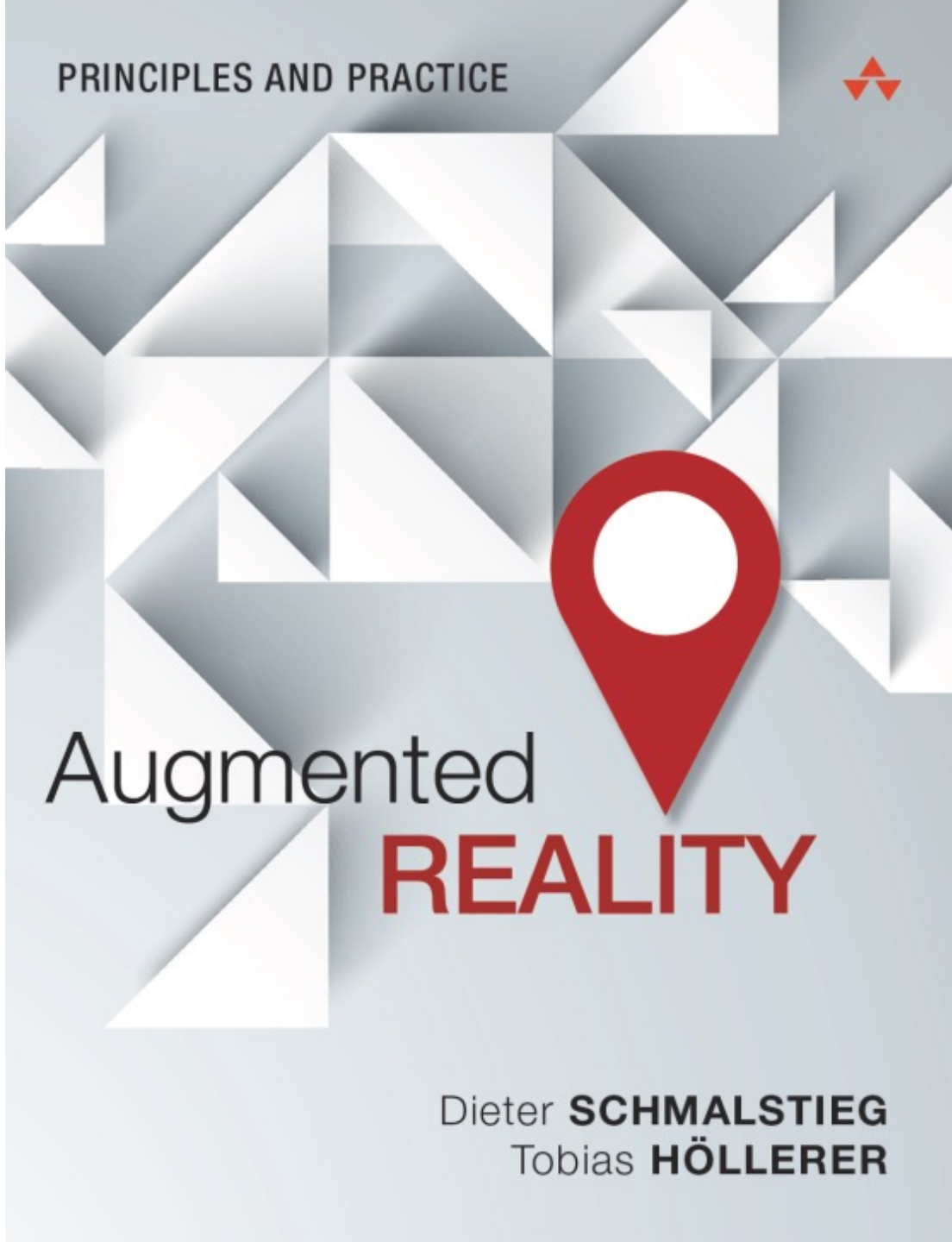
TOMP	402	Thursday, May 5, 2022	5:20pm-7:20pm

GW SCHOOL OF ENGINEERING & APPLIED SCIENCE

Chapter 8: Interaction

Augmented Reality – Principles and Practice

http://www.augmentedrealitybook.org



Interaction

AR Input - Computer Vision Techniques

AR Output - Computer Graphics

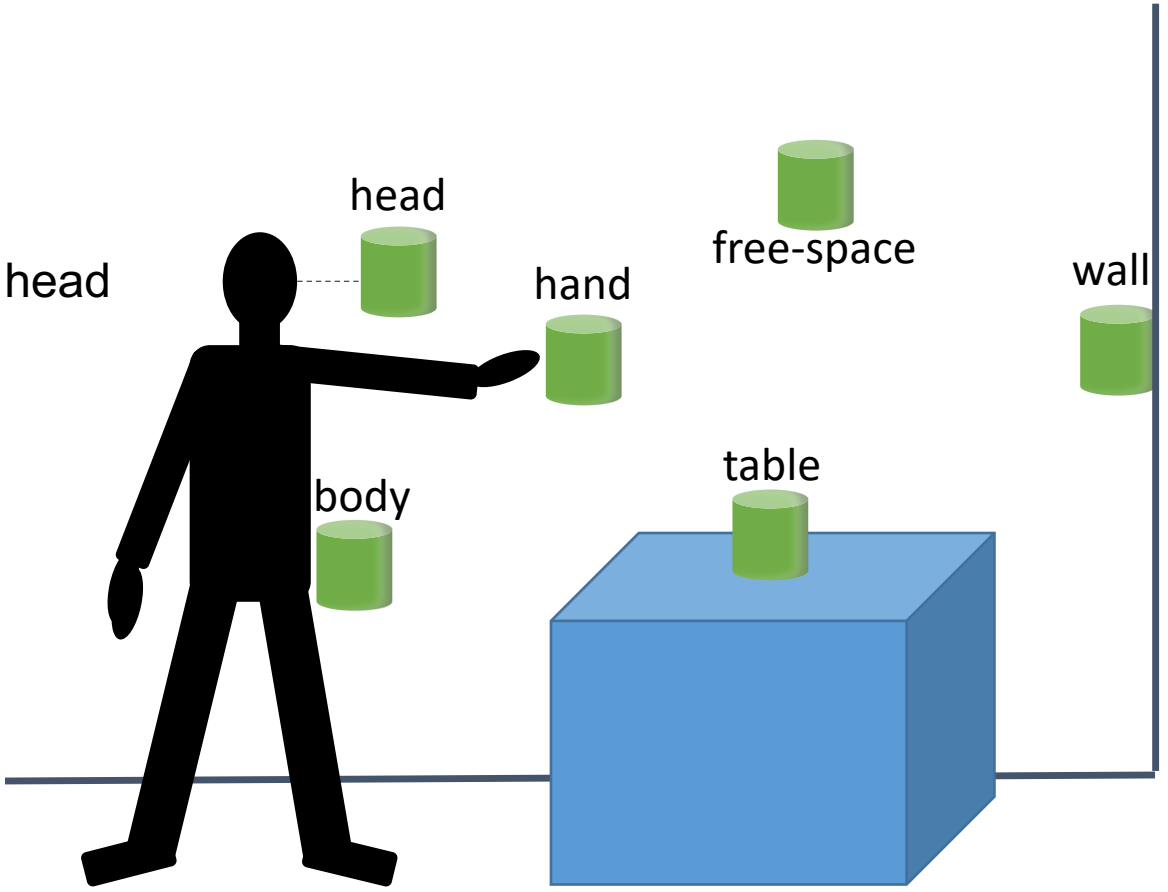
Human-Computer Interaction -The link between input and output

Output Modalities

Considerations where augmentations can be placed

Augmentation Placement

Augmentations can be placed relative to the user's head or body, or relative to the environment.



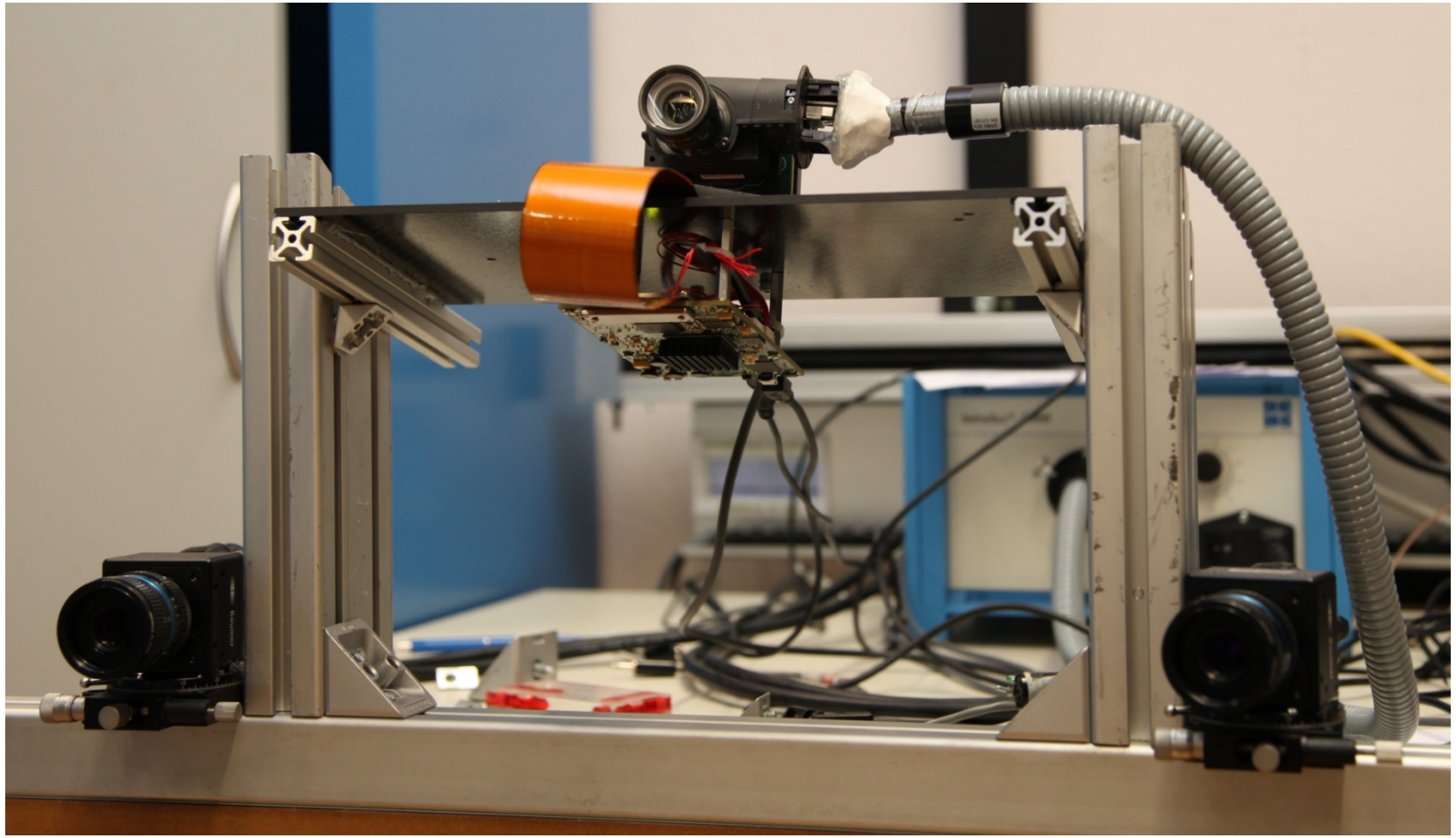
Skeleton tracking

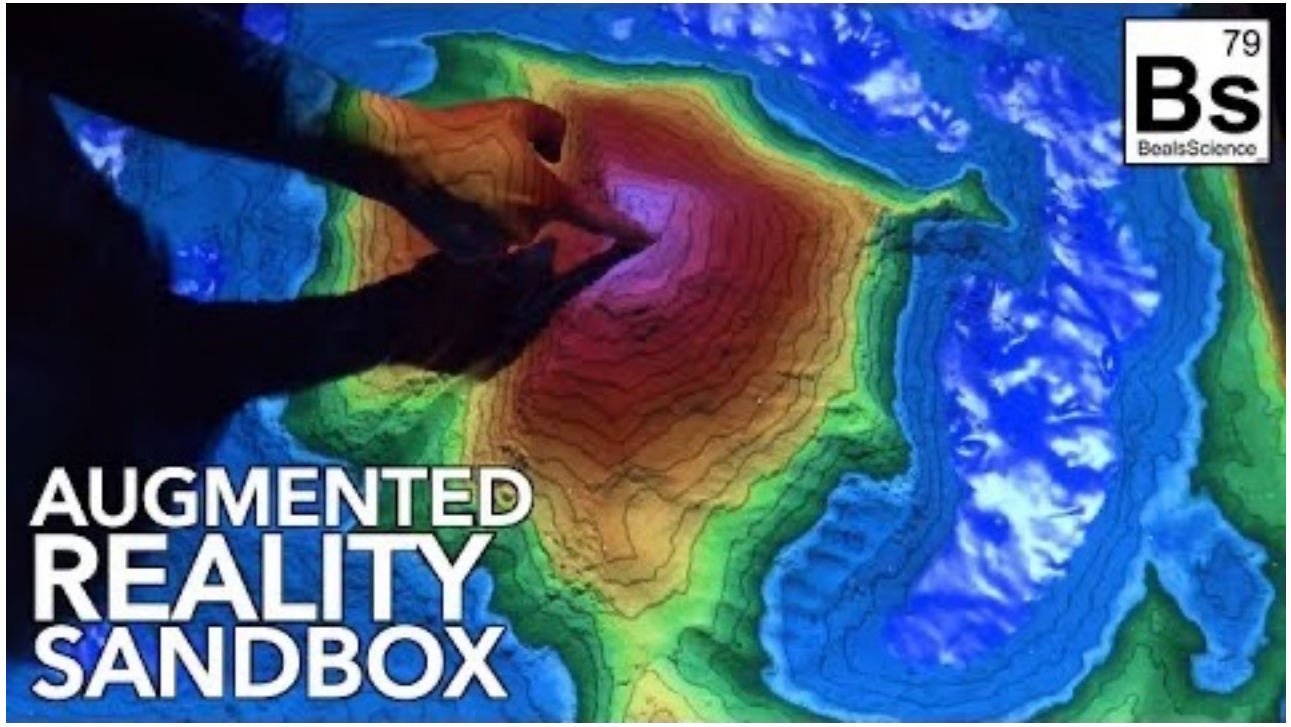
Skeleton tracking provides whole-body input

The user's body motions have been transformed into arrows

Projector-camera system

A projector–camera system consisting of a compact projector and a set of stereo cameras

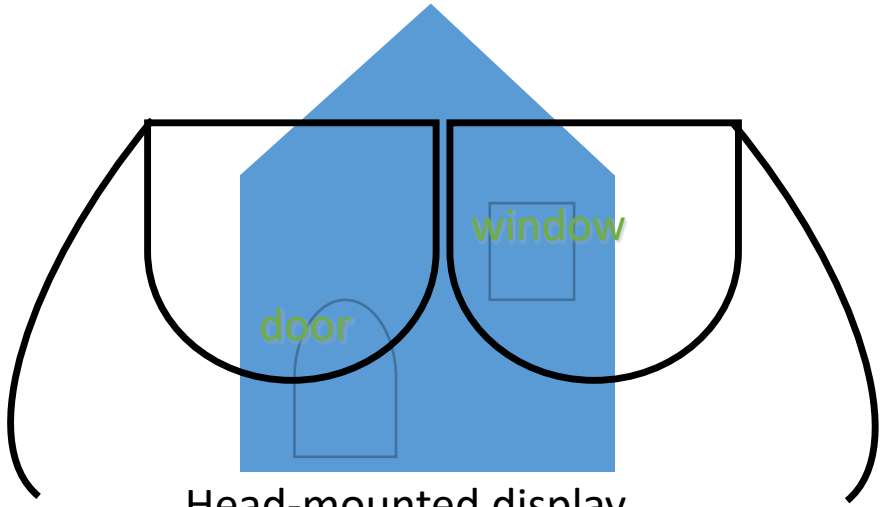




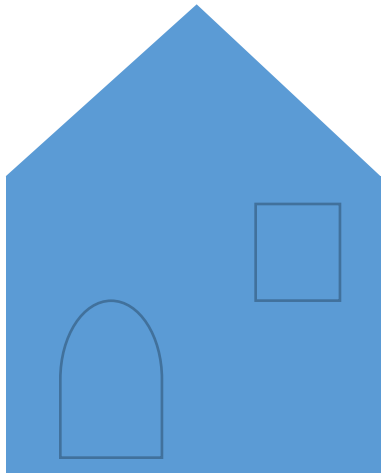
Augmented Reality Sandbox
https://youtu.be/bA4uvkAStPc

'Le Petit Chef' projection
https://www.youtube.com/watch?v=yBJEP4lsRFY

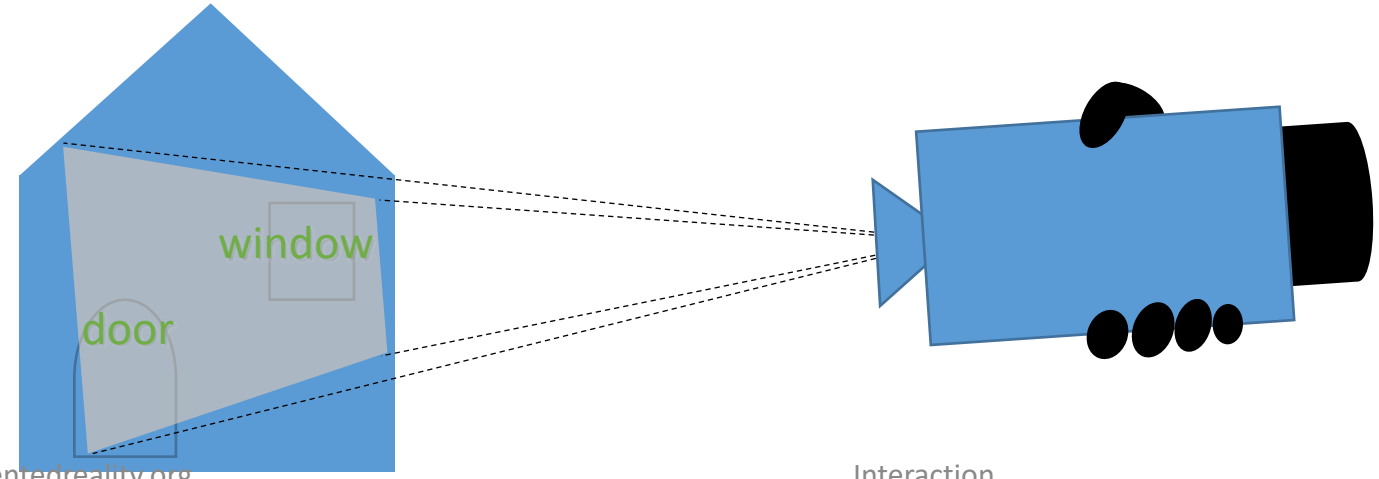
Agile Displays



Head-mounted display



Hand-held display



Hand-held projector

https://www.zenka.org/#/augmented-reality/

AR browser

Many important use cases of AR are essentially based on browsing – for example, medical diagnosis, navigation, tourism, and underground inspection.

The Columbia Touring Machine was the first AR browser

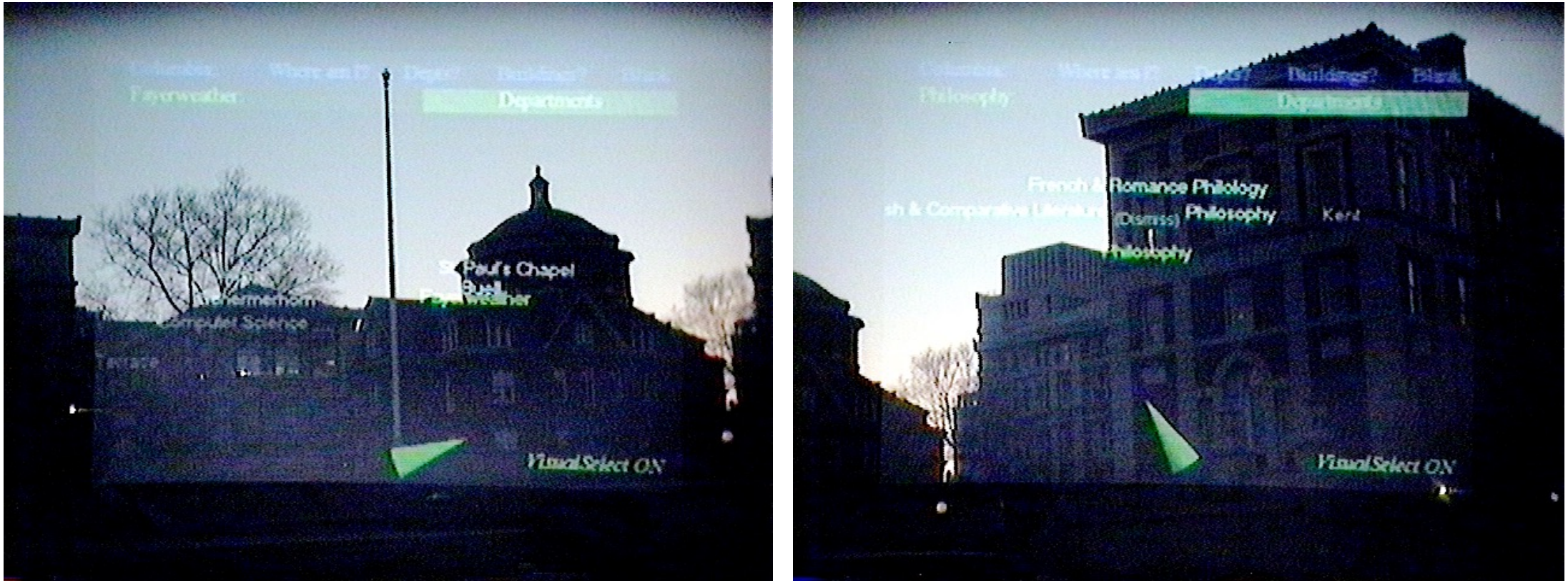


Image: Columbia University

Magic lens

A magic lens lets the user perceive the skeleton structure of a person

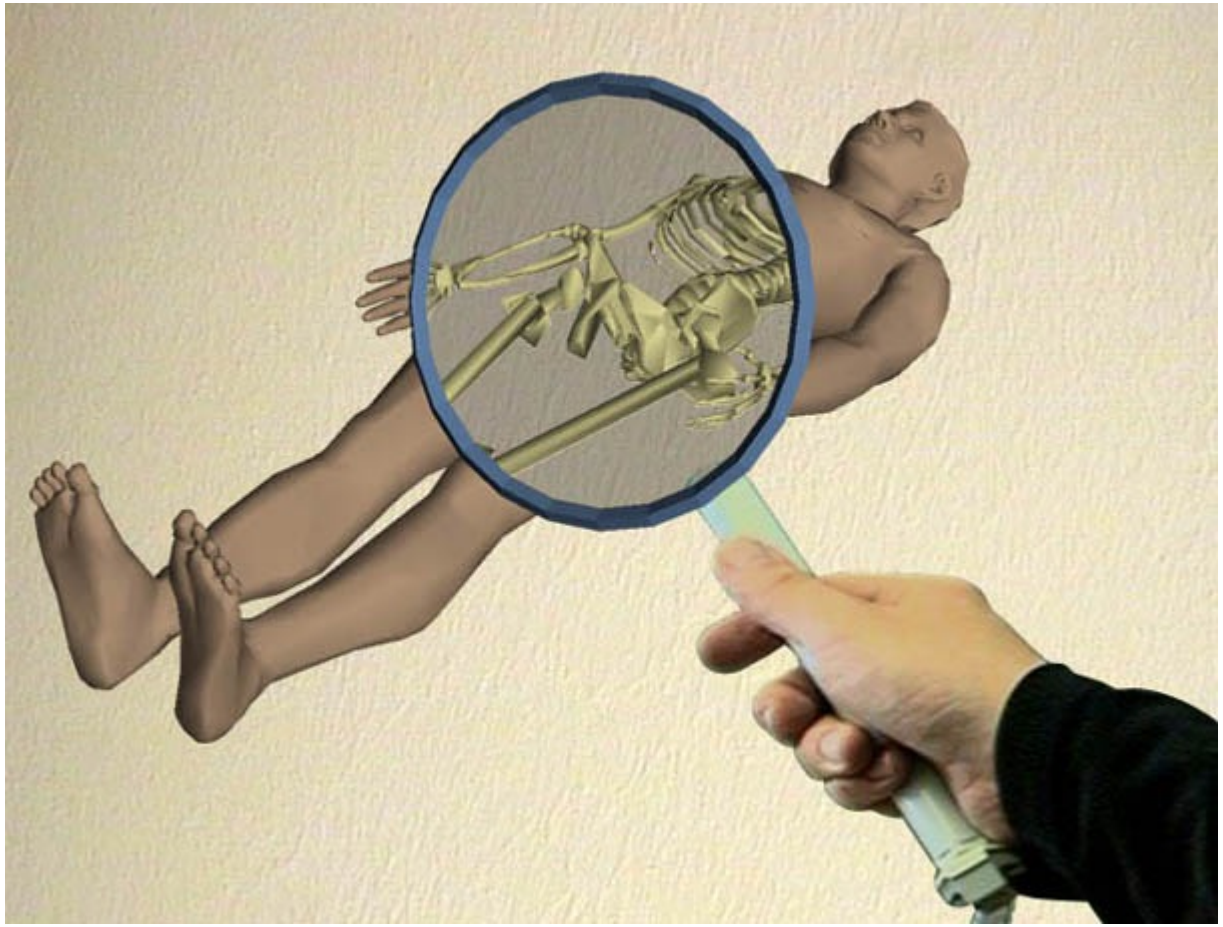


Image: Anton Fuhrmann

HYPER-REALITY

An “always on” augmentation can be disturbing in cluttered environments. The user should at least have an easy way of switching the augmentation on and off.

HYPER-REALITY

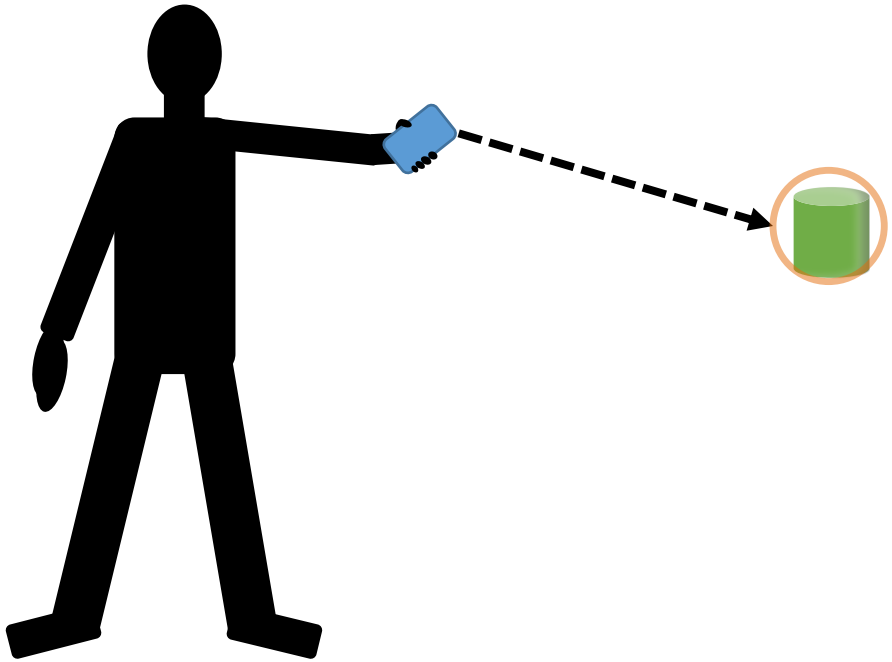
Hyper-Reality is a concept film by Keiichi Matsuda. It presents a provocative and kaleidoscopic new vision of the future, where physical and virtual realities have merged, and the city is saturated in media. Our physical and virtual realities are becoming increasingly intertwined.

https://vimeo.com/166807261

Technologies such as VR, augmented reality, wearables, and the internet of things are pointing to a world where technology will envelop every aspect of our lives. It will be the glue between every interaction and experience, offering amazing possibilities, while also controlling the way we understand the world. Hyper-Reality attempts to explore this exciting but dangerous trajectory. It was crowdfunded, and shot on location in Medellín, Colombia.

Selection by Ray-Casting and Touch

Selection by touching



Selection by raycasting

Input Modalities

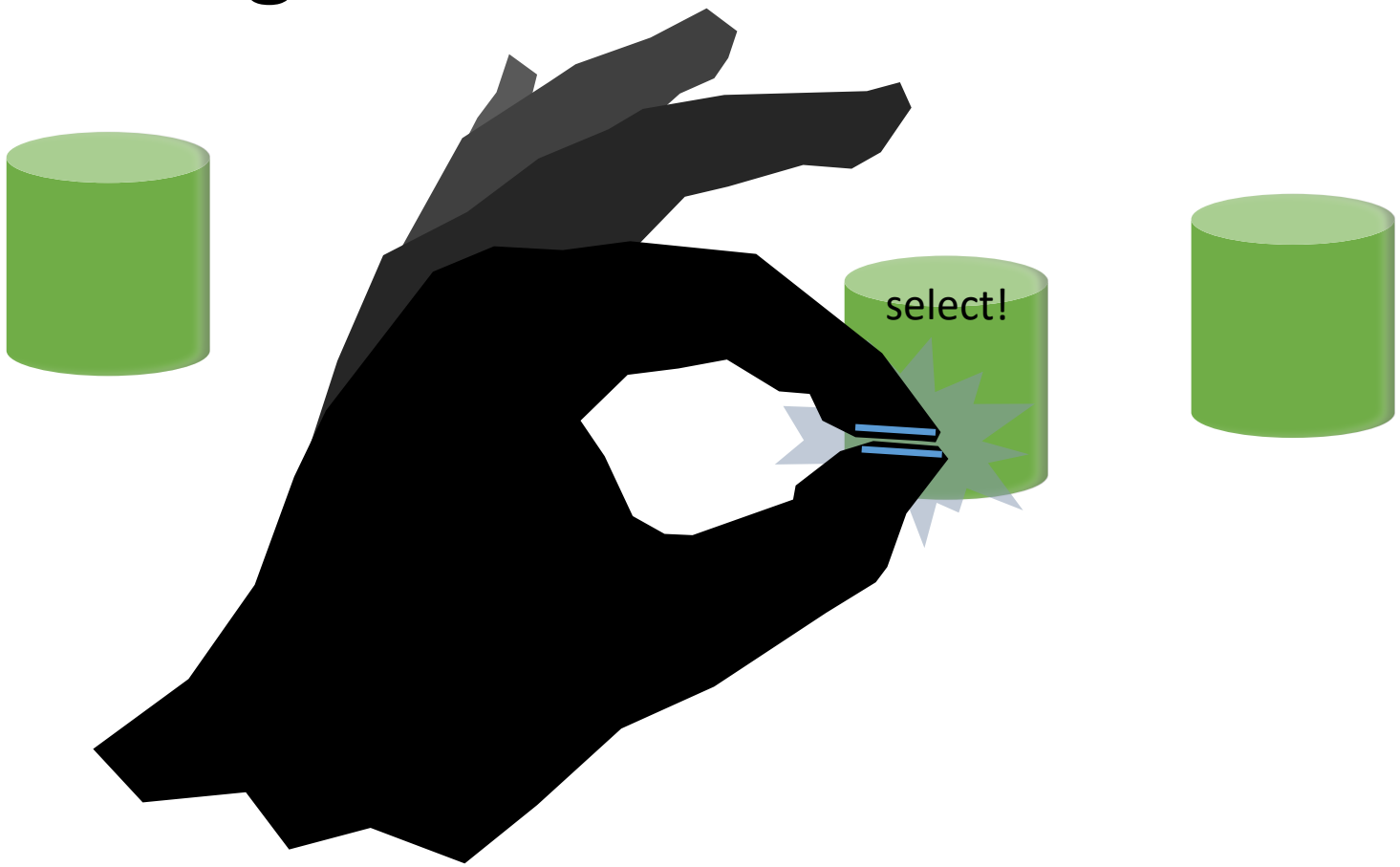
Considerations of suitable input devices and methods.

“AR can draw from the rich variety of techniques that have been developed for both VR and for natural user interfaces.”

Tracking and Manipulation of Rigid Objects

The Nintendo Wiimote is a 3D input device for consumer video games

Hand Tracking

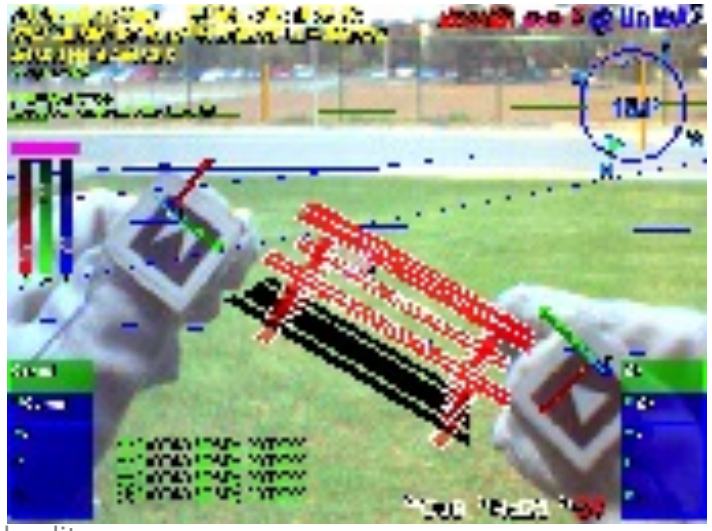


Pinch Gloves detect when the user presses fingertips together and interpret this gesture as a selection

Pinch Gloves

- Pinch gloves
  - Hierarchical menu
- 6D tracking with ARToolkit markers
  - 2 points for image plane techniques

Image: Wayne Piekarski



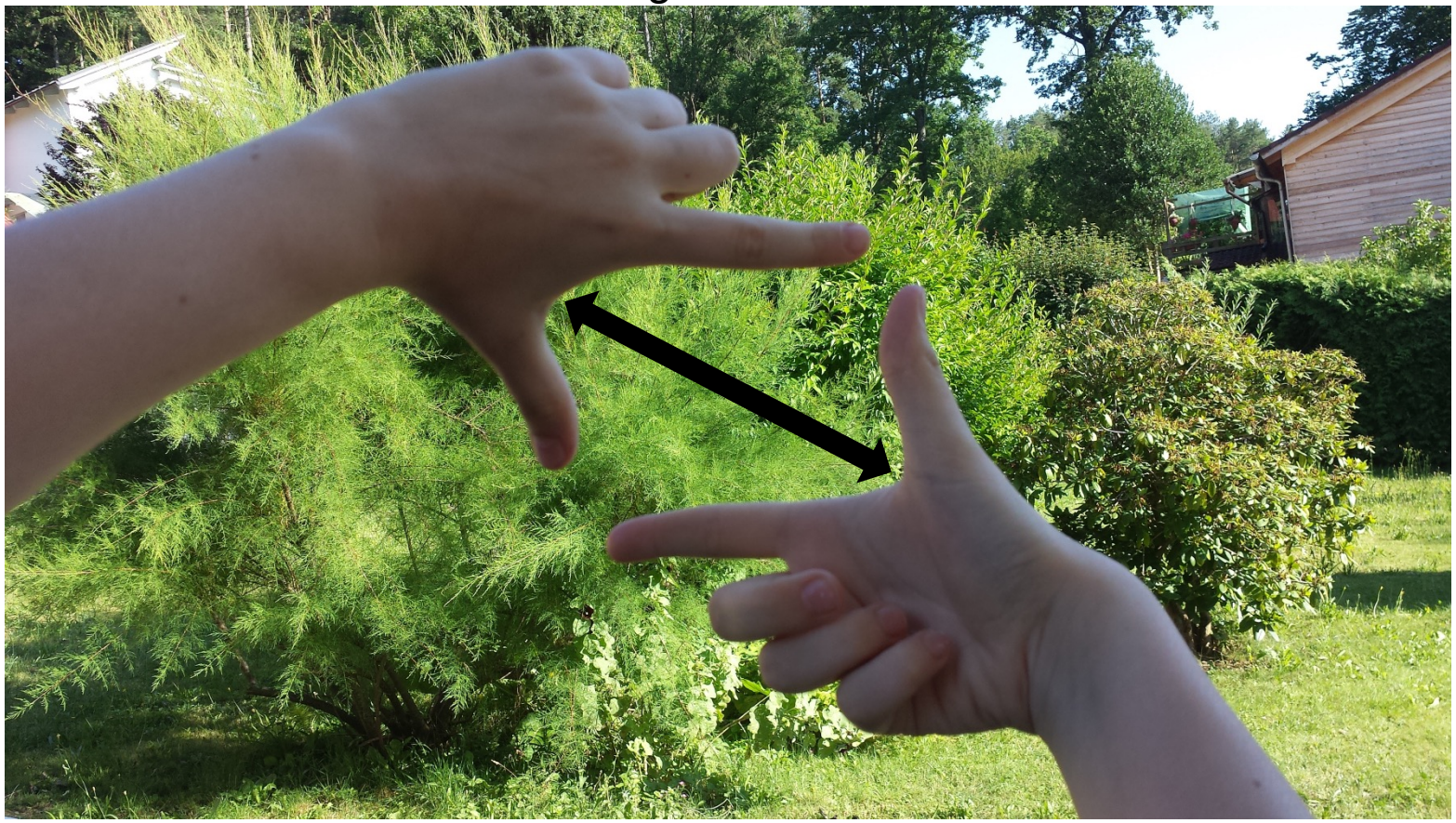
Hand Tracking

Hand and finger tracking
with a depth camera

Image: Markus Oberweger

Viewfinder Gesture

Define a rectangle with both hands



Handy AR

HandyAR uses the hand as a reference coordinate system for interaction with objects

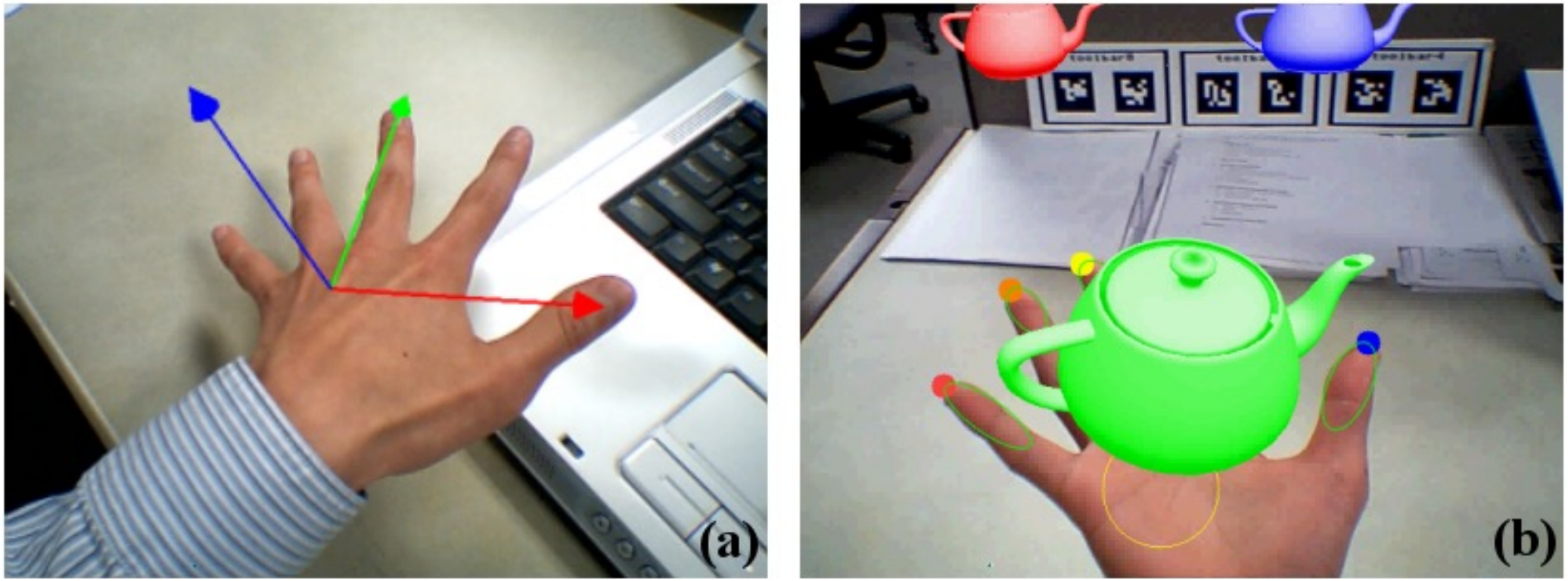
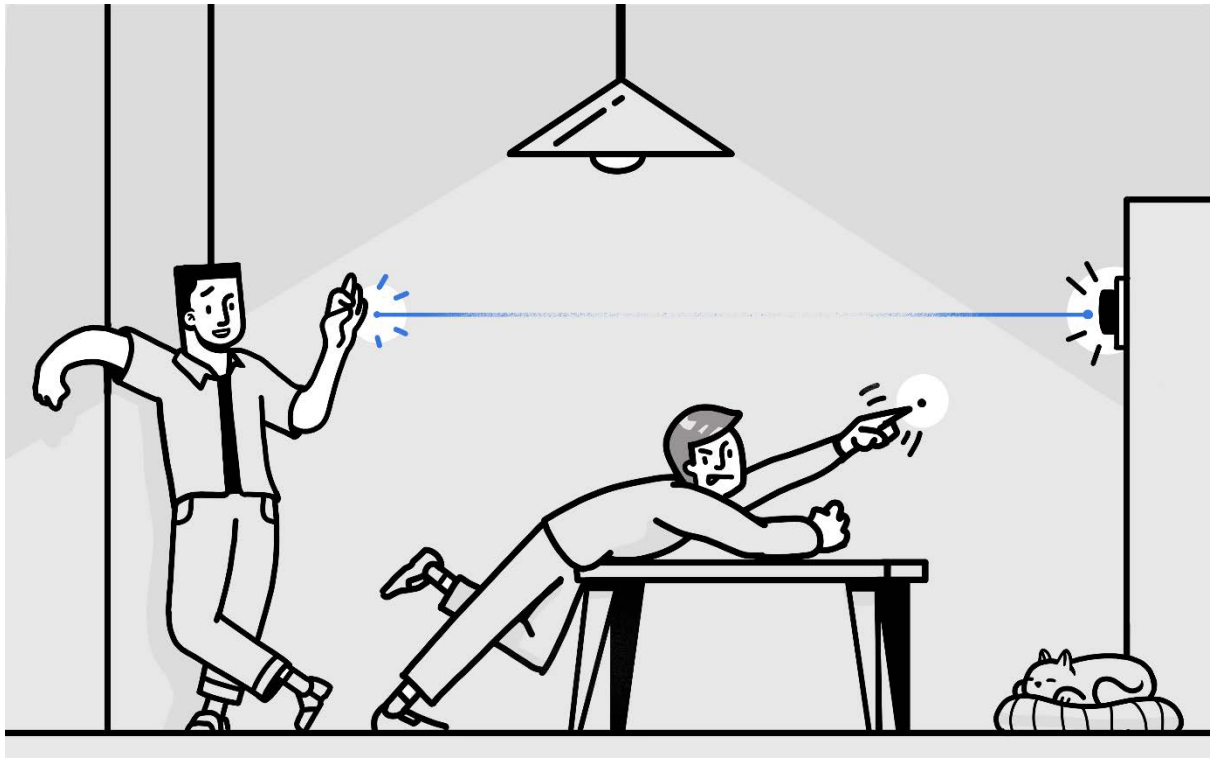


Image: Taehee Lee

Hand Tracking - Interactions



https://developer.oculus.com/learn/hands-design-intro/
https://developer.oculus.com/learn/hands-design-interactions/

Hand Tracking

The Benefits

- Hands are a highly approachable and low-friction input that require no additional hardware
- Unlike other input devices, they are automatically present as soon as you put on a headset
- Self and social presence are more rich in experiences where you're able to use your real hands
- Your hands aren't holding anything, leaving them free to make adjustments to physical objects like your headset

The Challenges

- There are inherent technological limitations, like limited tracking volume and issues with occlusion
- Virtual objects don't provide the tactile feedback that we rely on when interacting with real-life objects
- Choosing hand gestures that activate the system without accidental triggers can be difficult, since hands form all sorts of poses throughout the course of regular conversation

The Capabilities

To be an effective input modality, hands need to allow for the following interaction primitives, or basic tasks:

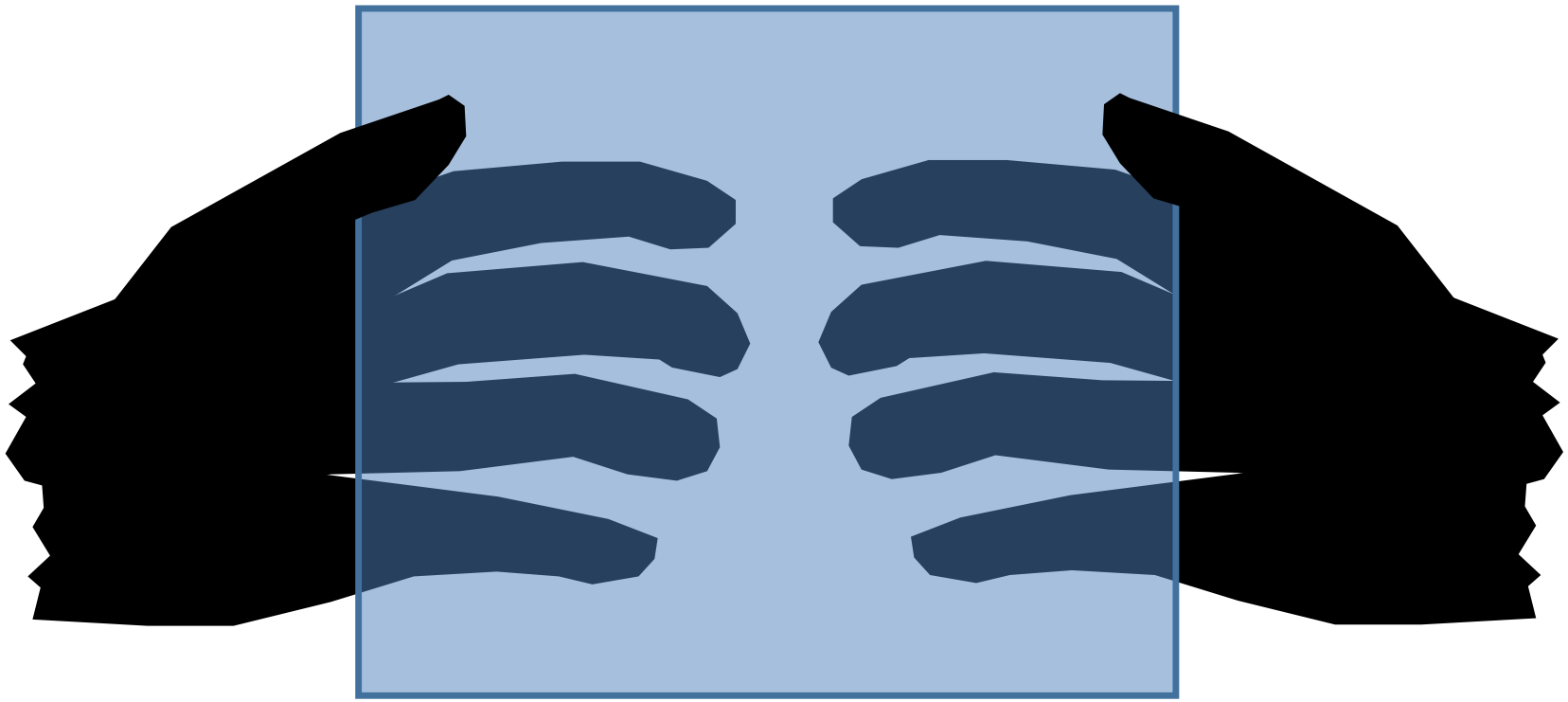
- **Targeting**, which moves focus to a specific object
- **Selection**, which lets users choose or activate that object
- **Manipulation**, or moving, rotating, or scaling the object in space

These interactions can be performed **directly**, using your hands as you might in real life to poke and pinch at items, or they can be performed through **raycasting**, which directs a raycast at objects or two-dimensional panels.

Human ergonomics, technological constraints and disproportionate user expectations all make for challenging design problems. Hand tracking has the potential to fundamentally change the way people interact with the virtual world around them.

Lucid Touch

LucidTouch simulates a semi-transparent screen with a touch interface on the back



EverywhereDisplay

Turning an ordinary surface into a touchscreen with a projector–camera system.

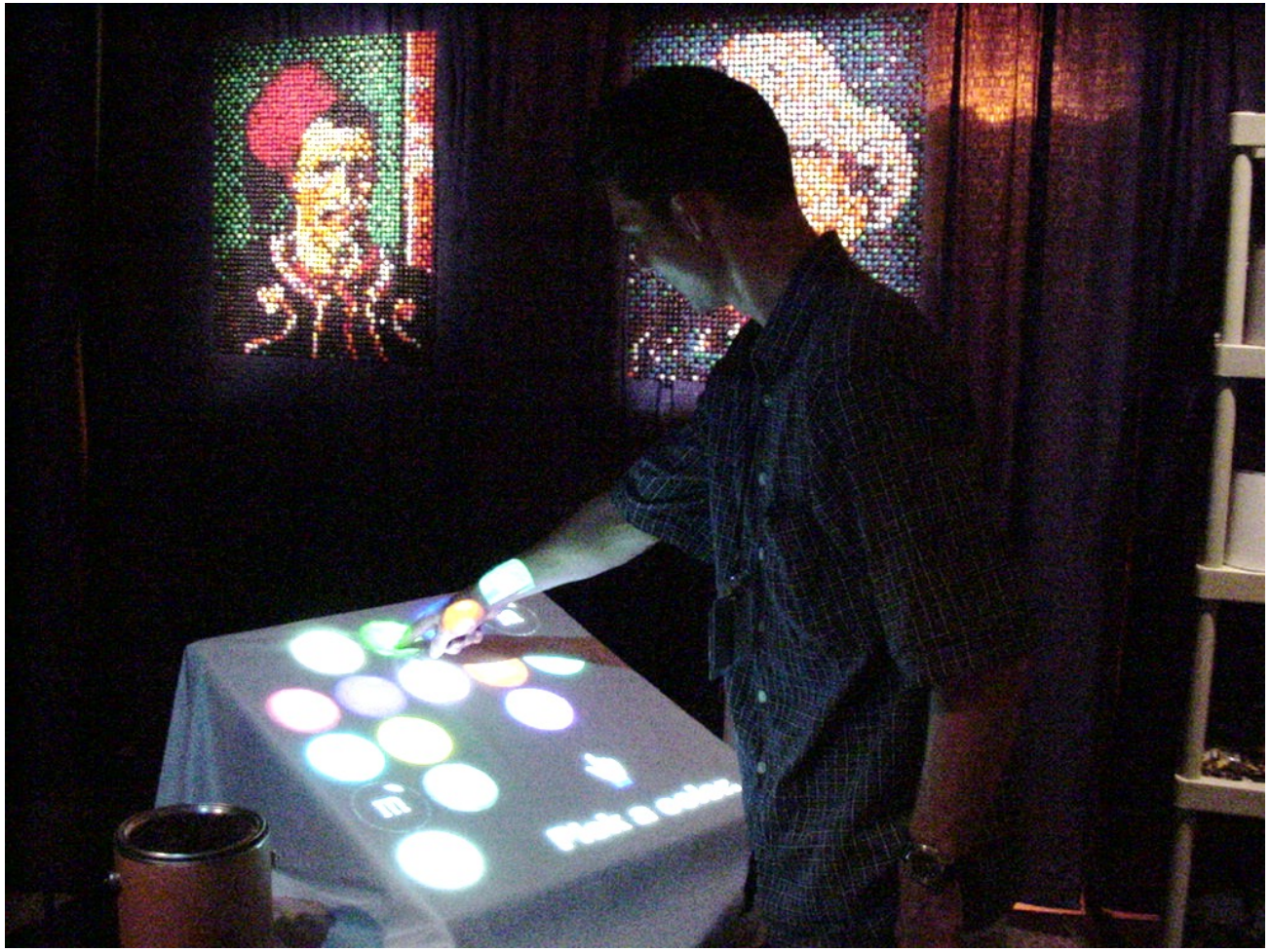
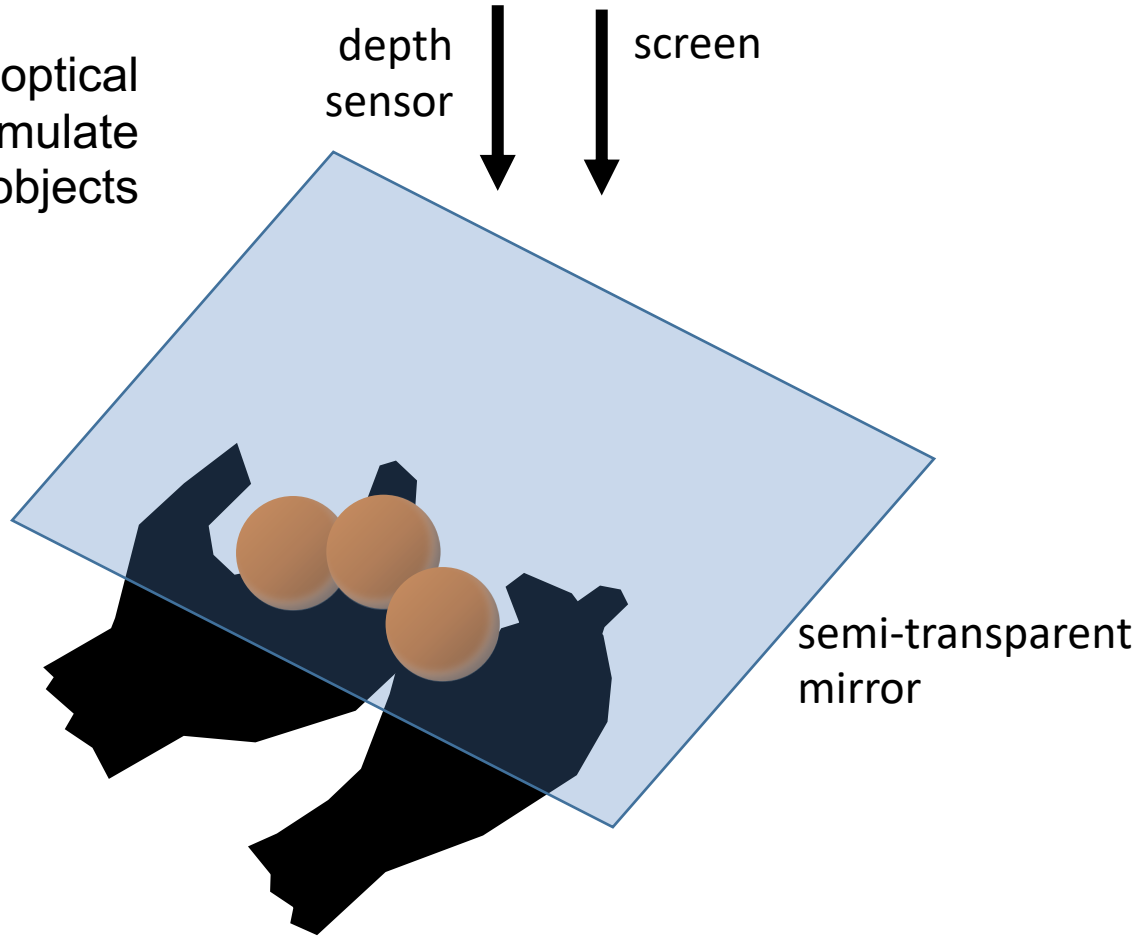


Image: Claudio Pinhanez (© IBM 2001)

HoloDesk

The HoloDesk uses a combination of a stationary optical see-through display with a depth sensor to simulate physical interaction of the user's hands with virtual objects



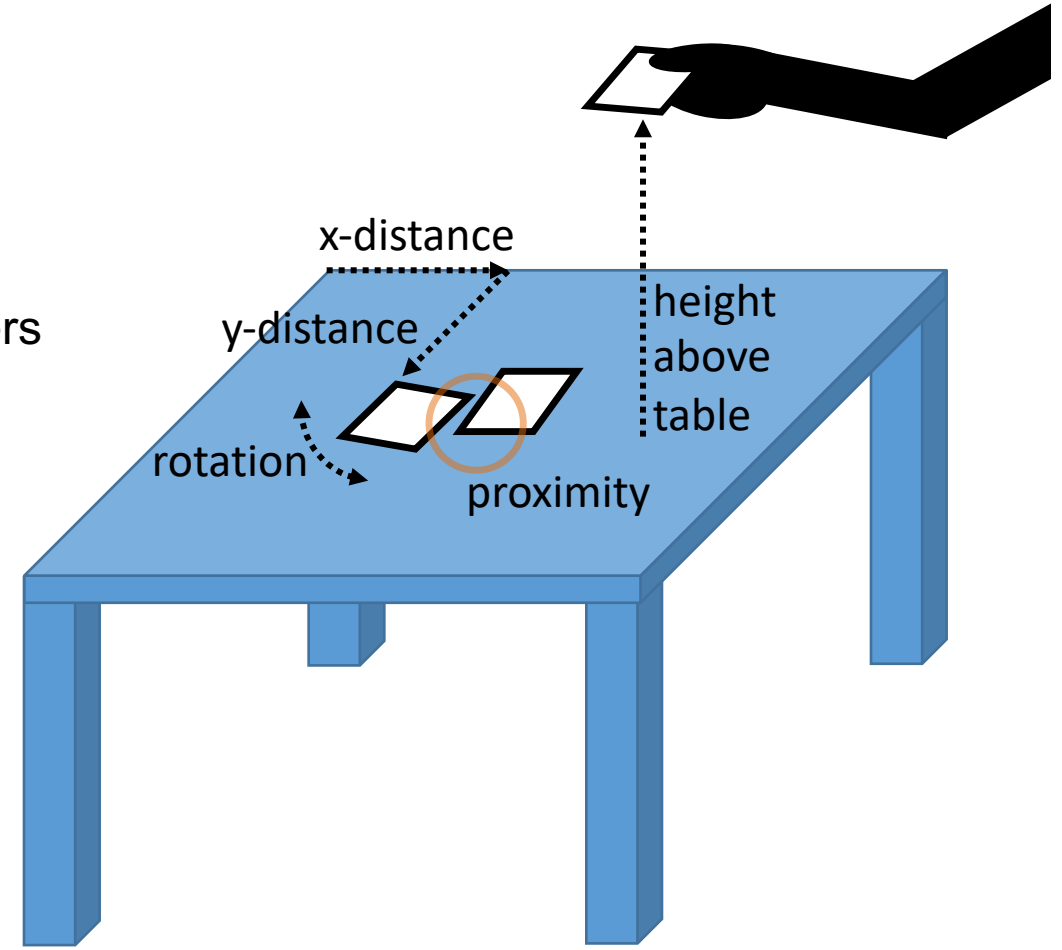
Generic Tangibles

Markers used to collaboratively manipulate virtual objects

Image: Gerhard Reitmayr and Hannes Kaufmann

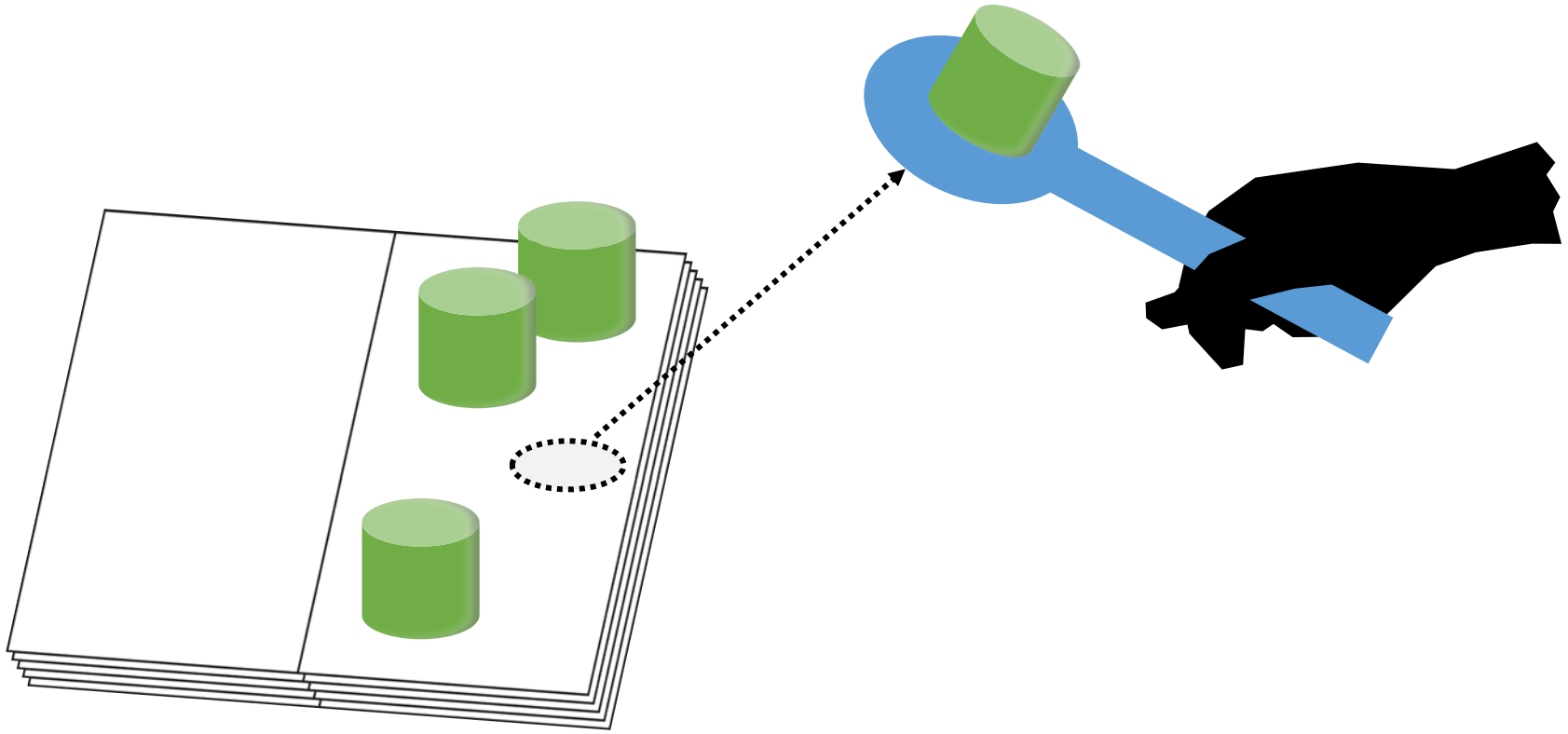
Tangible operations

Tangible operations and their associated parameters



Magic Book and Paddle

Picking an object from a “magic book” catalog with a paddle



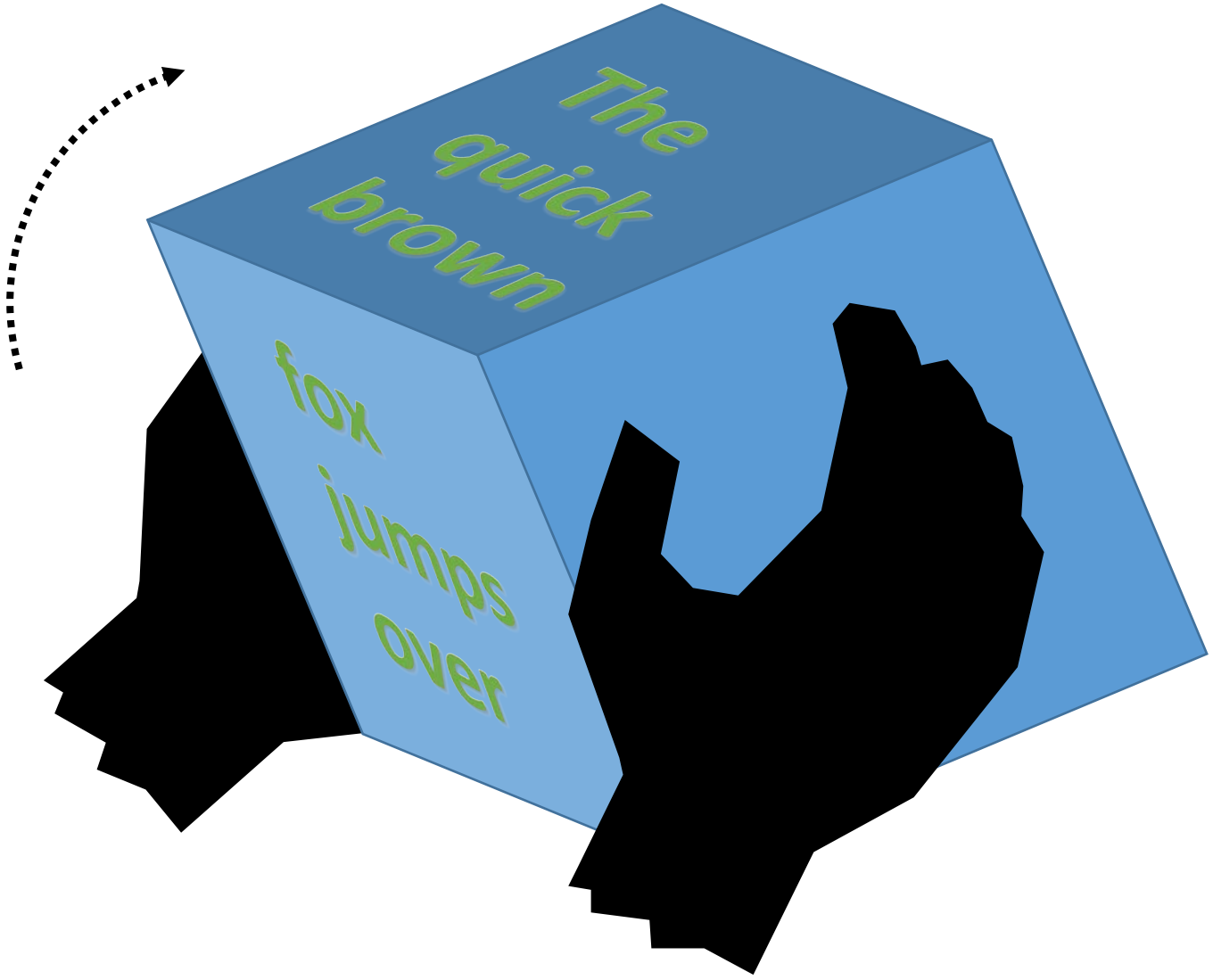
MagicMeeting

Displaying a CAD model on a rotating platter

Image: Holger Regenbrecht

CoCube

A tangible object, which can show either virtual 3D objects inside the cube or 2D information, such as text, on its surfaces



Digital Desk

- Touch leads to surfaces
- Often using projection
- Treat paper and electronic documents as the same

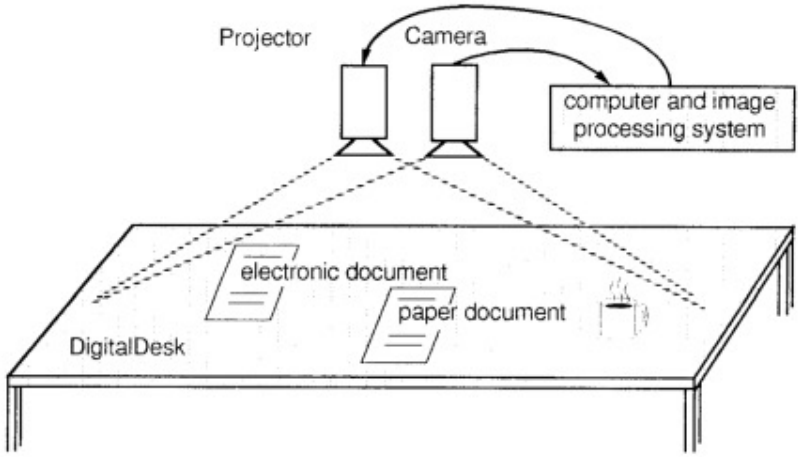


Image: Paul Wellner

OmniTouch

OmniTouch uses a projector and depth camera to turn the user's own hand into a touchscreen

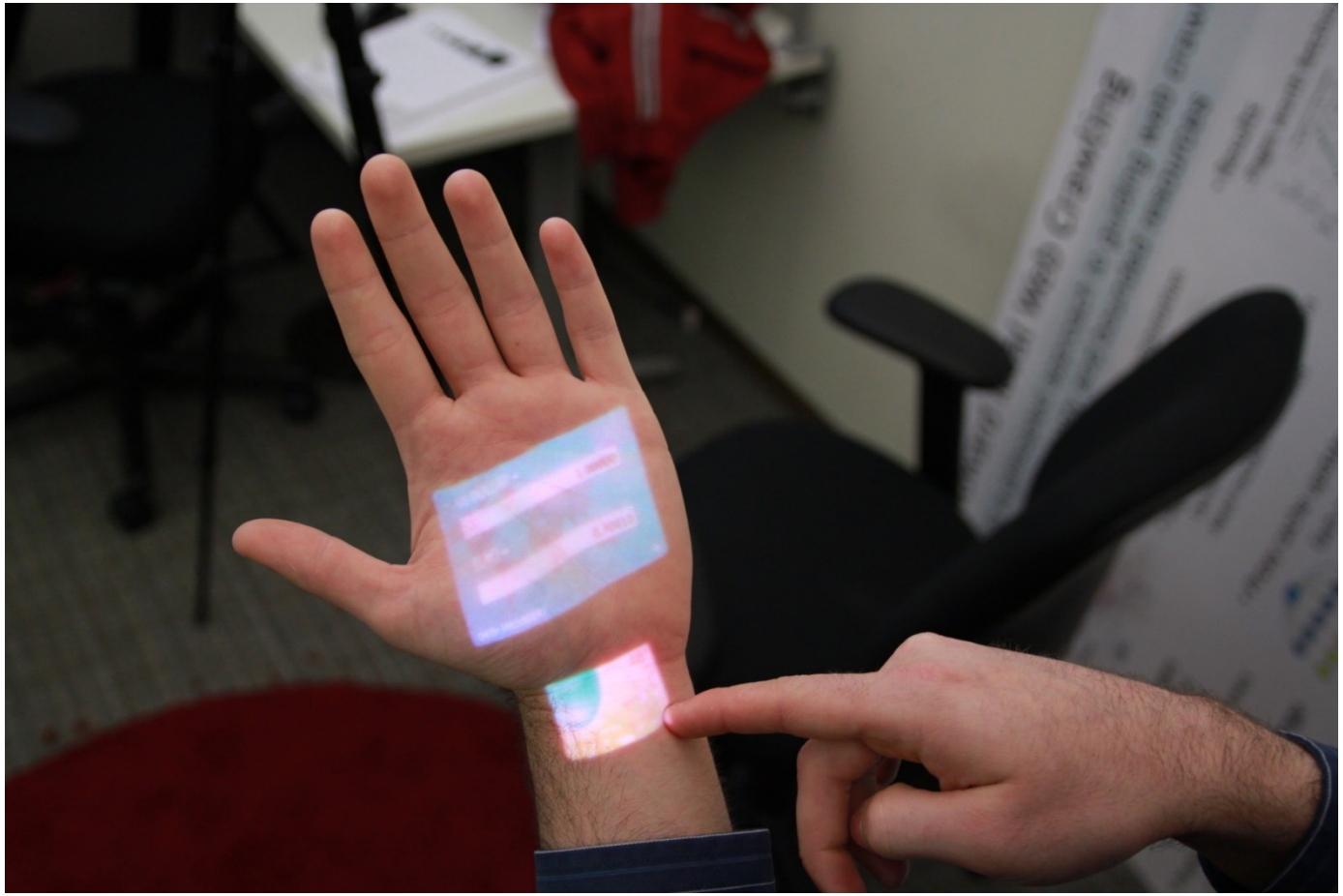


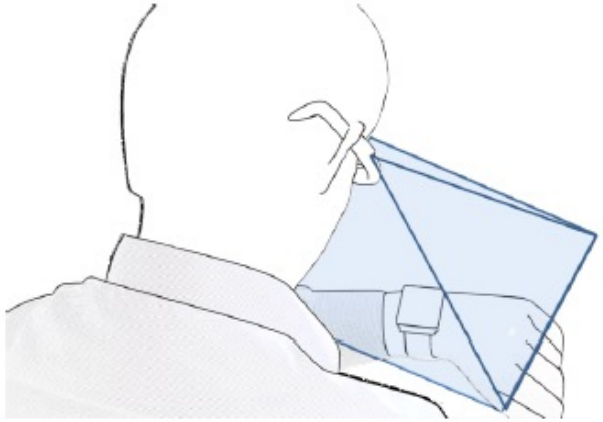
Image: Microsoft Research

Augmented Maps

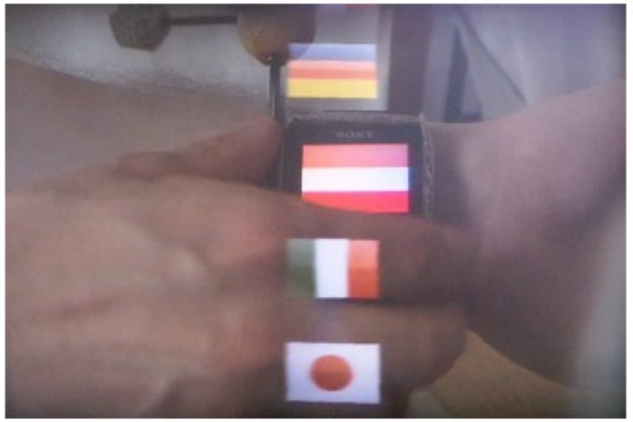
Augmented maps consists of a conventional paper map and projected interactive content.

Image: Gerhard Reitmayr, Ethan Eade, and Tom Drummond

MultiFi – Combining HMD and Smartwatch



Ring menu



Virtual folding screen

A smartphone picks up an icon from the lower arm

Image: Jens Grubert

World in Miniature

The world-in-miniature shows an overview of an environment,while the first-person view shows labels directly in the world.

Image: Columbia University

In-Class Assignment

Provide your AR Device, Platform and Computer OS on the sheet:
https://docs.google.com/spreadsheets/d/1o4hEWz8ufiotcjflHSvtoIeDtKU2KNbavCy_oOs8jyU/edit?usp=sharing

AR Device	**Platform/SDK**	**Computer**
Examples	**Examples**	**Examples**
Samsung Galaxy S10+	Unity/Vuforia	Macbook
iPhone 11	Unity/ARKit	Macbook Pro
Mi 11 Ultra	ARCore	Windows 10