Augmented Reality

Theory and Practice of Tangible User Interfaces

Tuesday, Week 9

Outline

- **Overview**
- Examples
- Theory
- Examples
- Supporting AR Designs
- Examples
- Theory

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First Down Line in Football Games

Virtual Laser Keyboard

Eye Toy [sony]

- Eye Toy Demo
- Eye Toy Review
- Eye Toy Cups [2:30]

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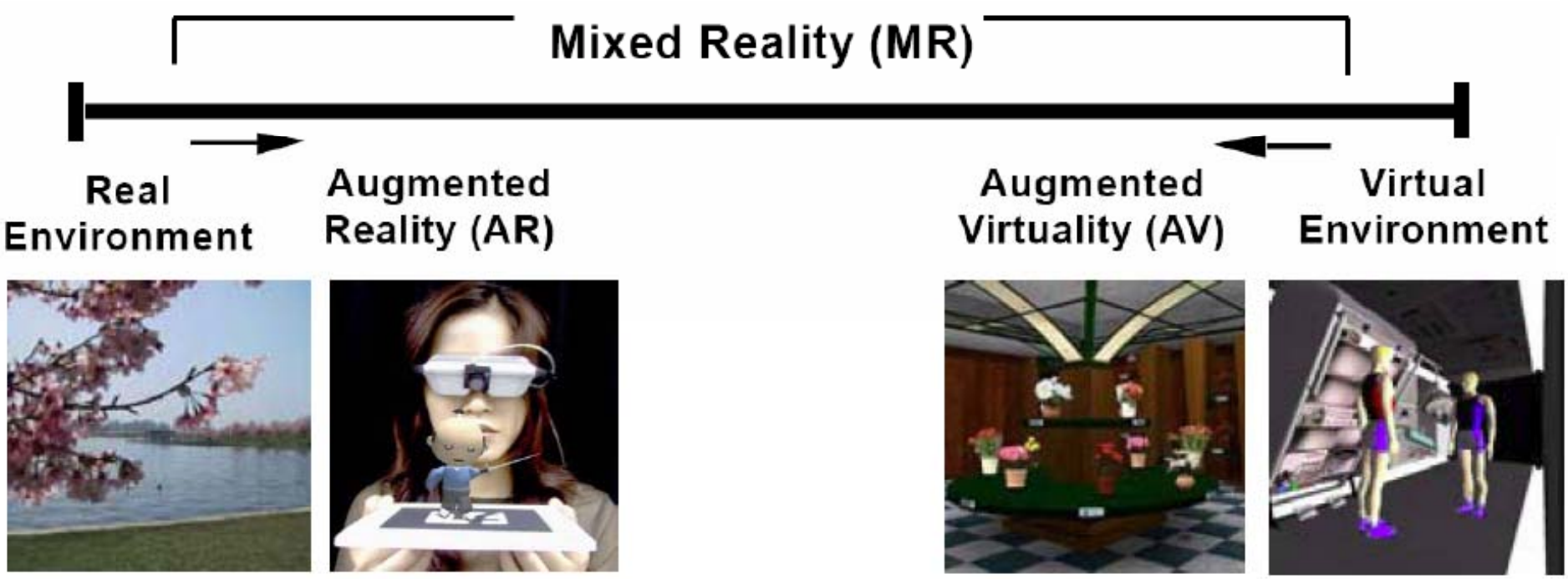
Reality-Virtuality (RV) Continuum

[Milgram et al., 1994]

"Augmenting natural feedback to the operator with simulated cues" (Milgram et al., 1994)



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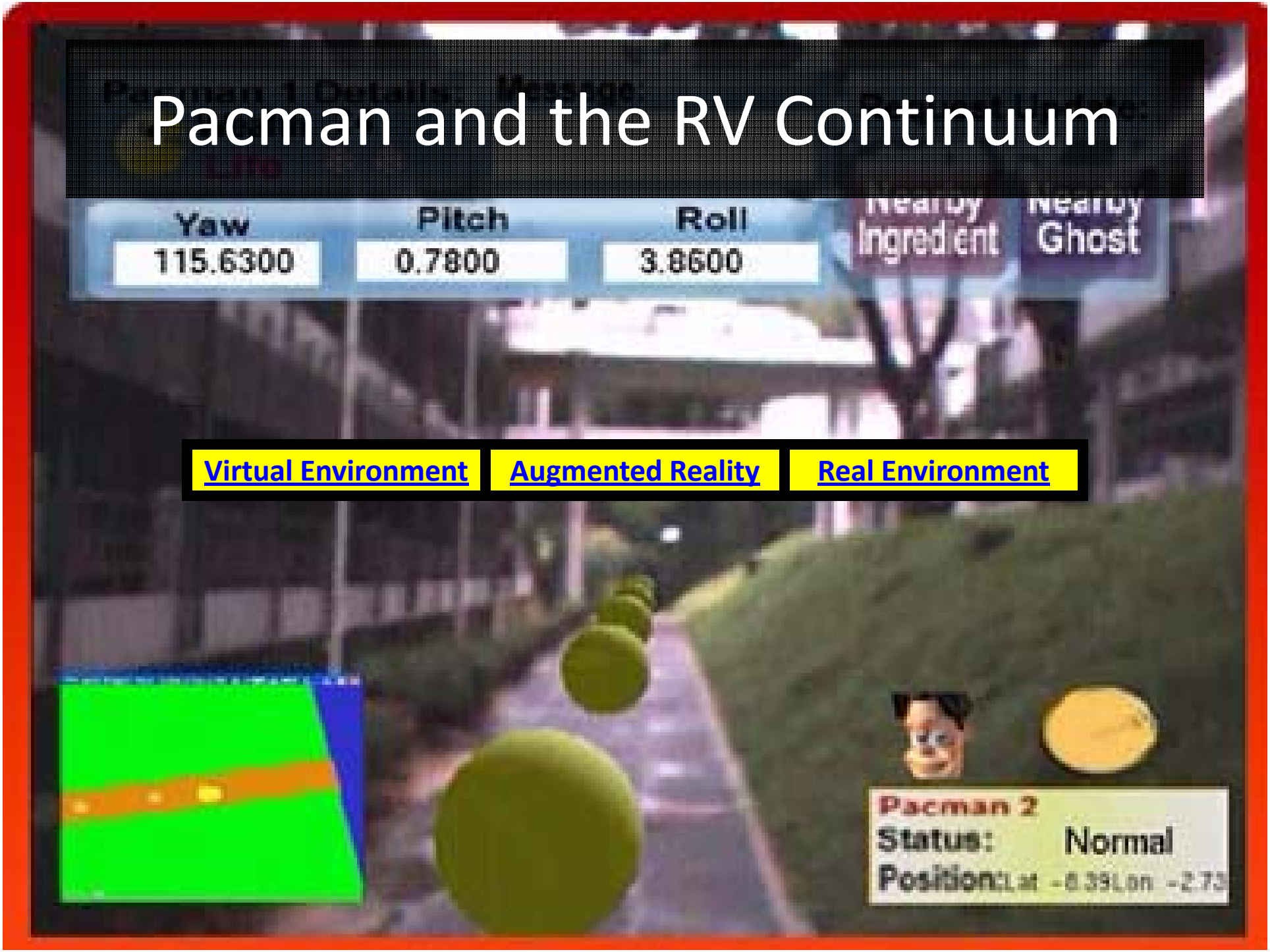
Pacman and the RV Continuum

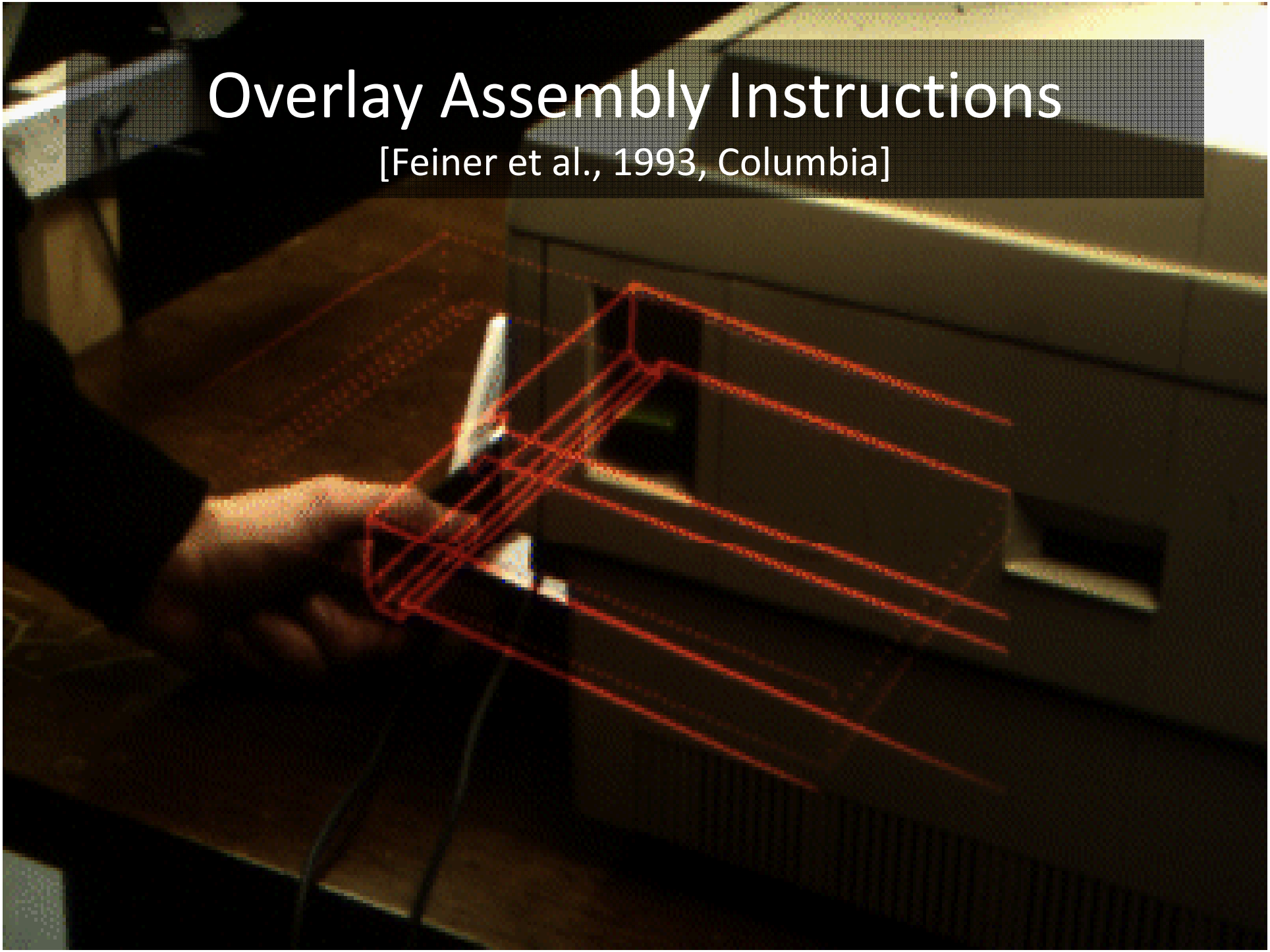


Support Archeological Field Work

[Benko et al, 2005, Columbia]

Overlay Assembly Instructions

[Feiner et al., 1993, Columbia]



Overlay Assembly Instructions

[Zauner et al., 2003, Austria]

Augmented Reality Kitchen

[Lee et al., 2005, MIT Media Lab]

MARA: Mobile AR

[Nokia Research]

Surface Drawing

[Schkolne and Keefe, 2001, Caltech]

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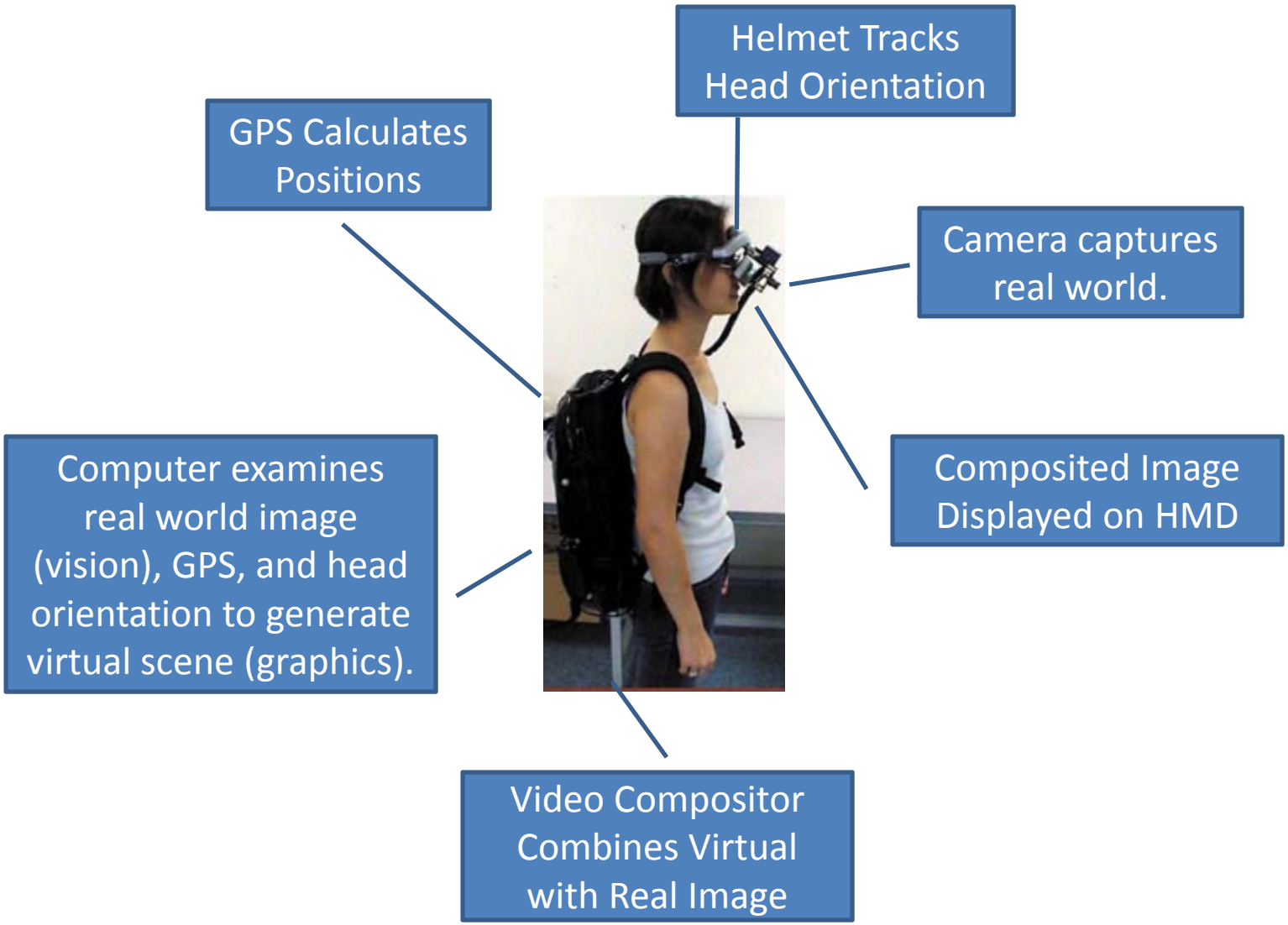
Building AR Systems is HARD



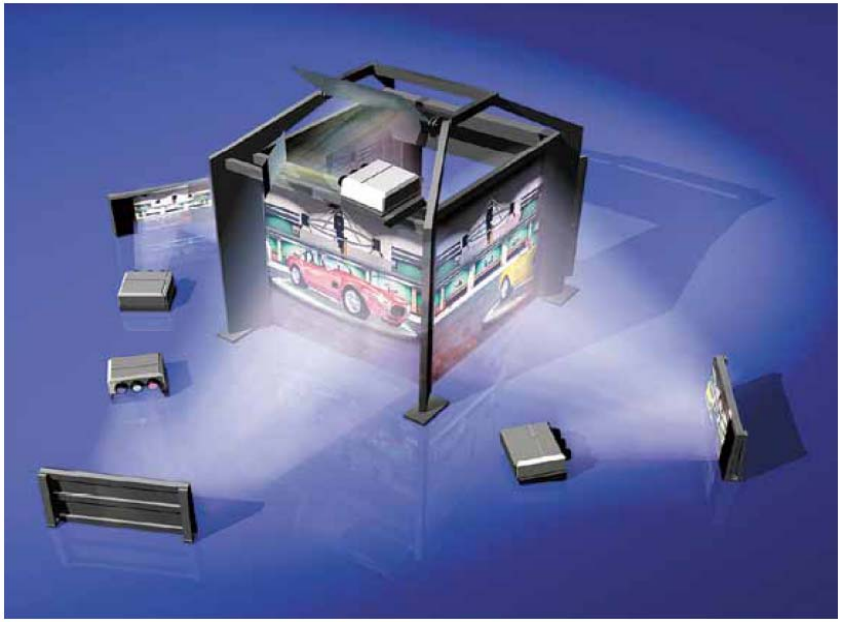
Supporting AR Design

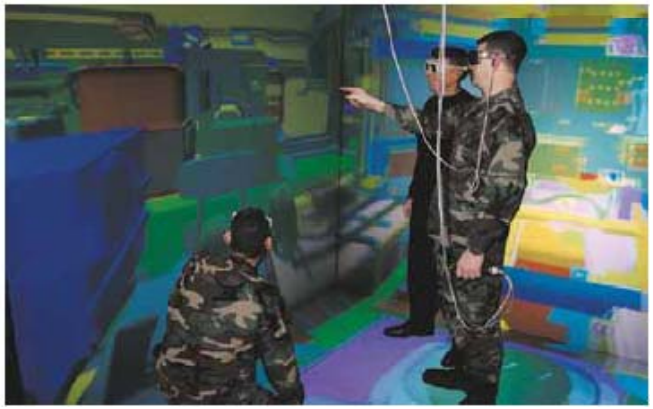
- Hardware
  - Use of advanced displays (head mounted, stereoscopic, novel projection)
  - Sensors to detect real environment actions
  - Actuators to affect the world
- Software Requirements
  - Computer Vision systems
  - 3D rendering systems
  - All in REAL-TIME
- Interaction Requirements
  - Complex domain of possible actions/reaction

Standard Displays

Stereoscopic 3D Displays

Immersive Displays: CAVEs

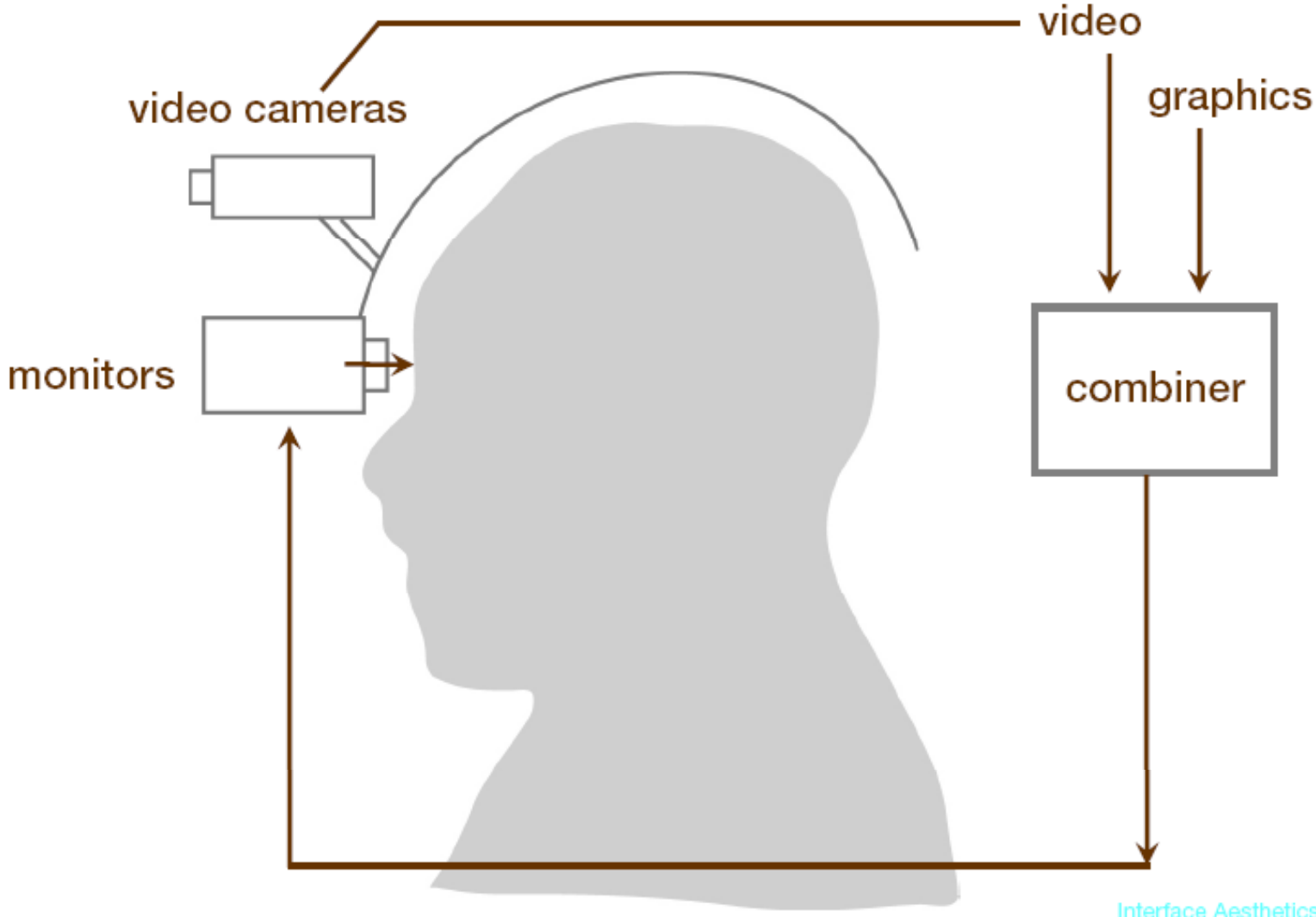




AUGMENTED REALITY

Video see through HMD

[adopted from Billinghurst & Ollila]



AUGMENTED REALITY

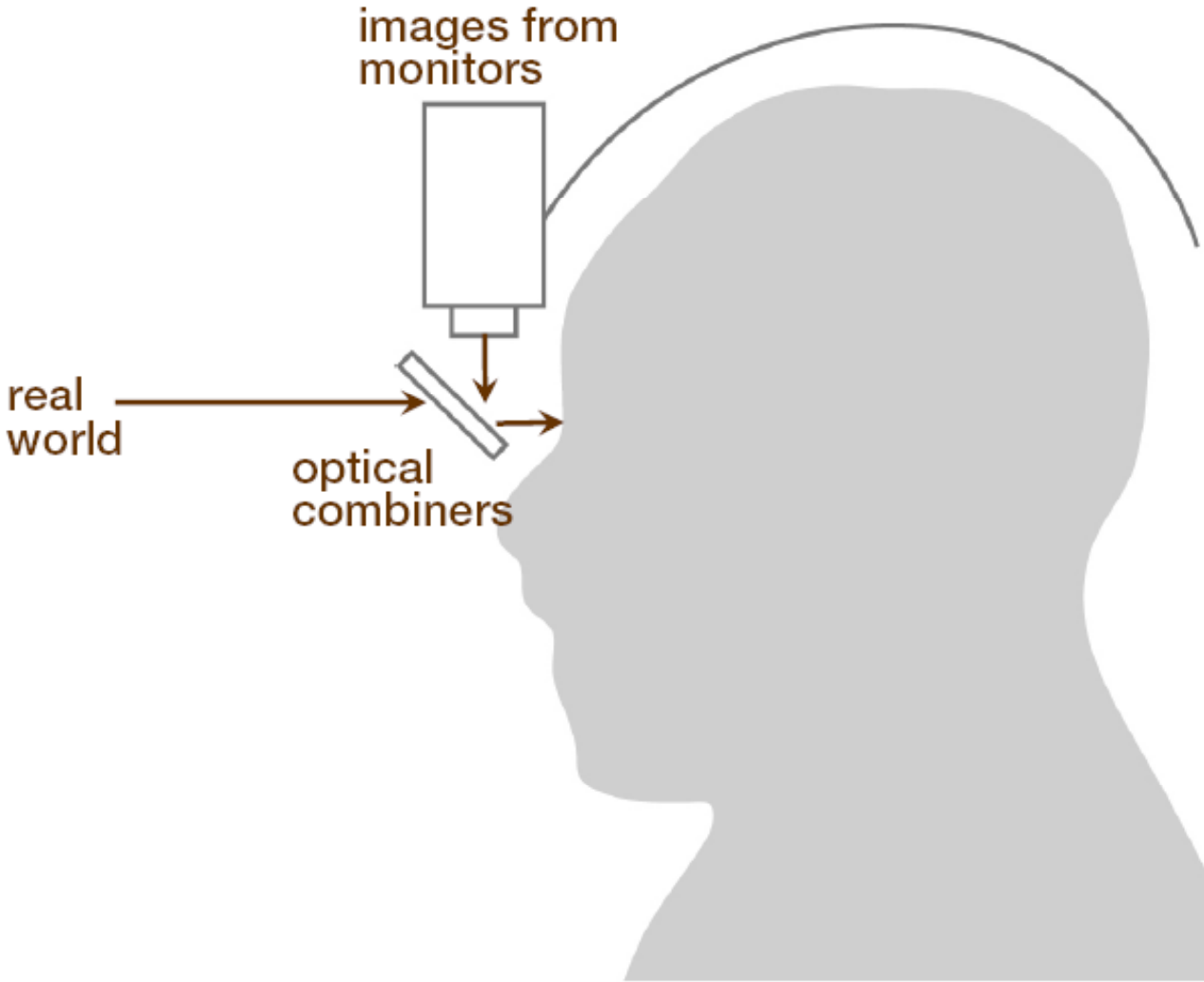
Video see through HMD

Sony Glasstron HMD with video camera and head tracker [courtesy of Piekarski]

AUGMENTED REALITY

Optical see through HMD

[adopted from Billinghurst & Ollila]



Toshiba Head-Dome Display

- “Ludicrous Speed, Go!”
- “I have seem the future, and it is lame”
- “about as glamorous as wearing an old-style TV set on your head” -USA Today

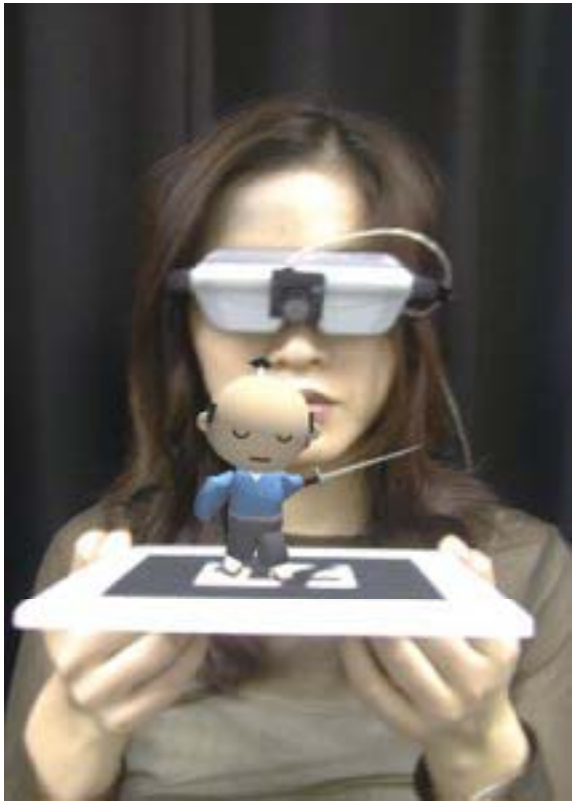
Head Mounted Displays

Corporate Support: Total Immersion

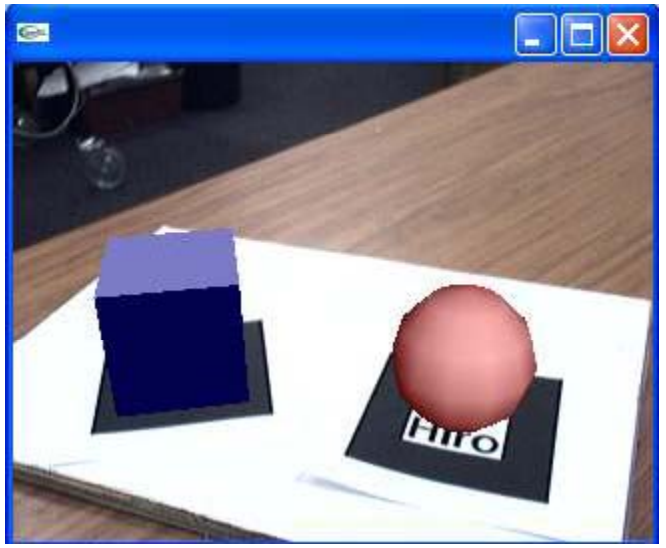
[video]

Software Support: ARToolKit

(HIT Lab, Washington and New Zealand)



- Everything you need to draw stuff on cards (fiducials markers)



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Collaboration: Magic Meeting

[Shared-Reality, Germany]

3D Popup Book

[HIT Lab, New Zealand]

Support Botanical Field Work

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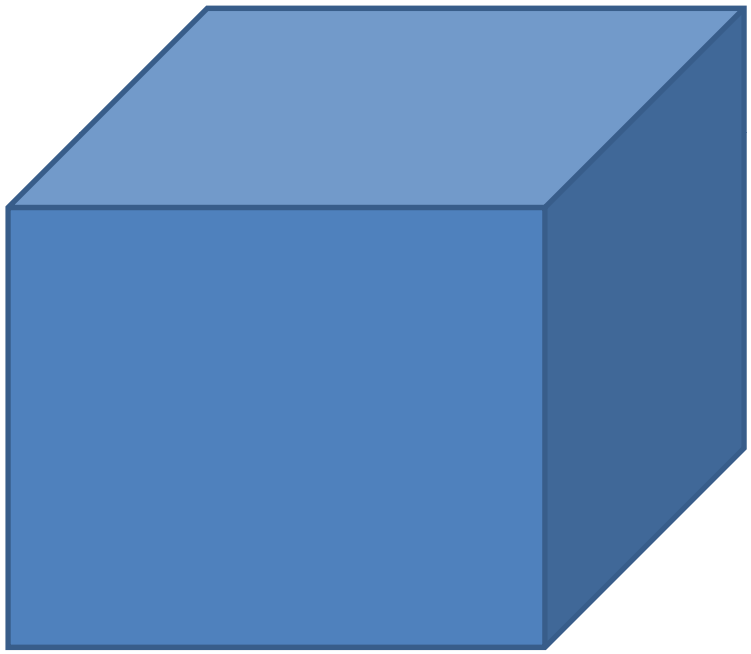
Taxonomy of Mixed Reality Systems

[Milgram et al., 1994]



Extent of Presence Metaphor

Extent of Presence Metaphor
The extent to which the observer is intended to feel "present" within the displayed scene.

Taxonomy of Mixed Reality Systems

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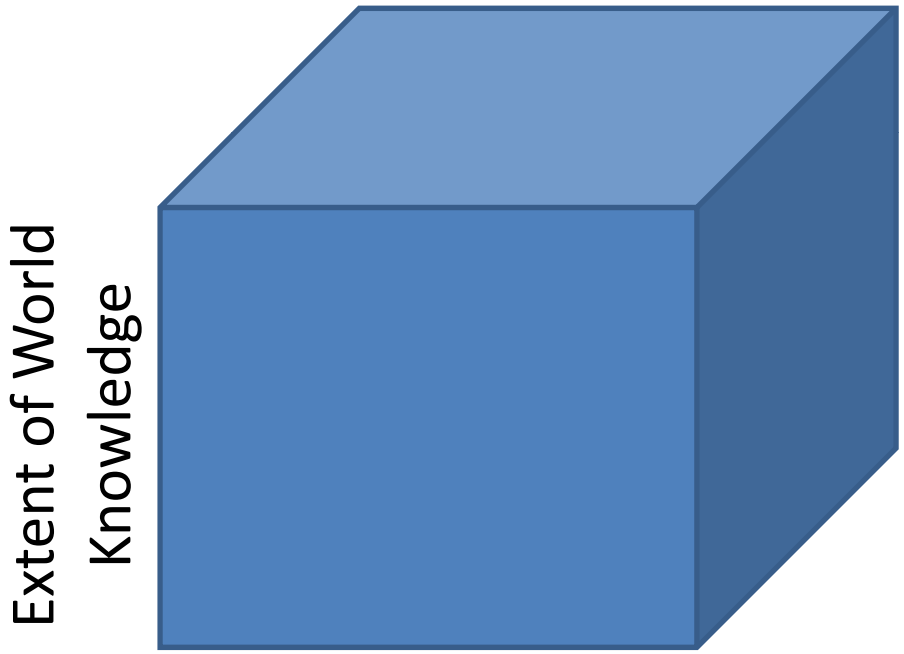

Extent of World Knowledge
How much we [the computer] actually know about the objects and the world in which they are displayed.

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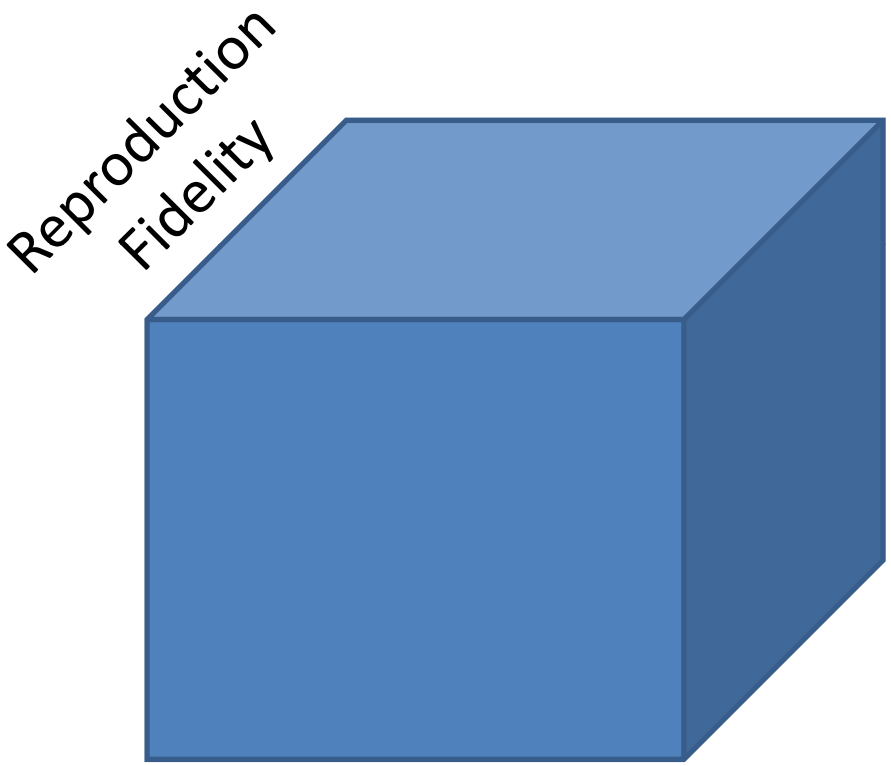

Reproduction Fidelity
The relative quality with which the synthesizing display is able to reproduce the actual or intended images of the objects being displayed.

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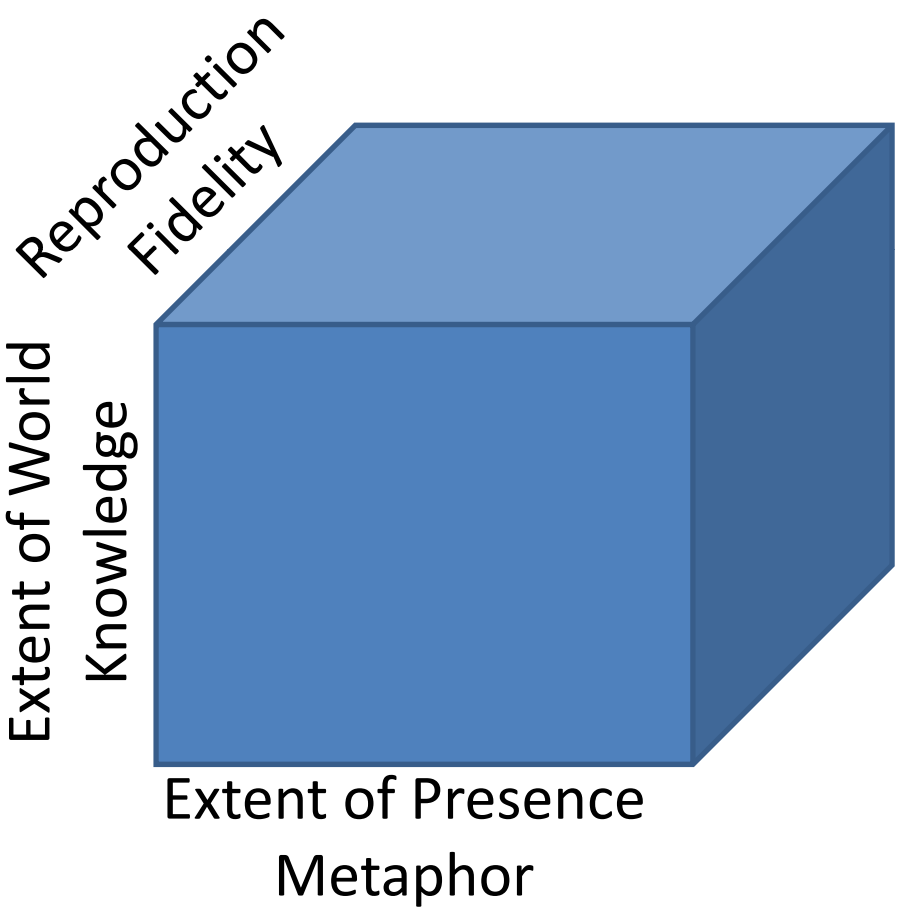

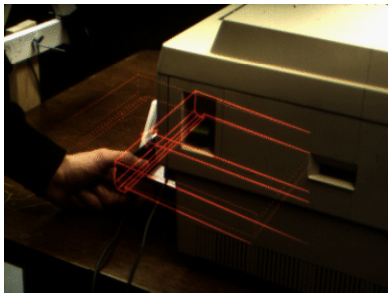

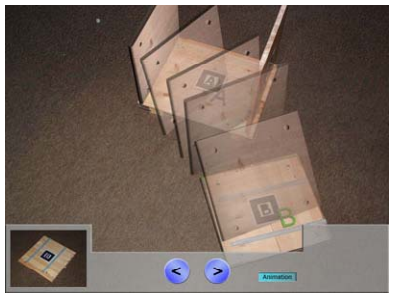

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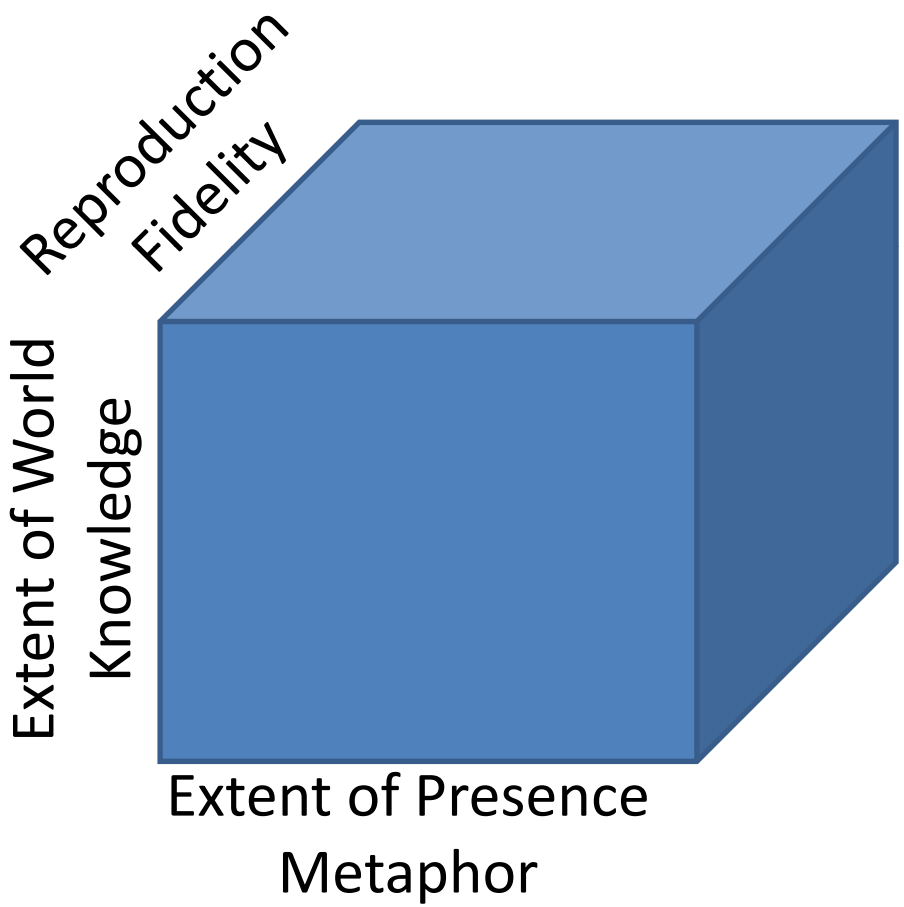

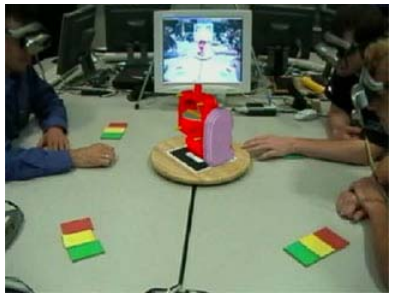

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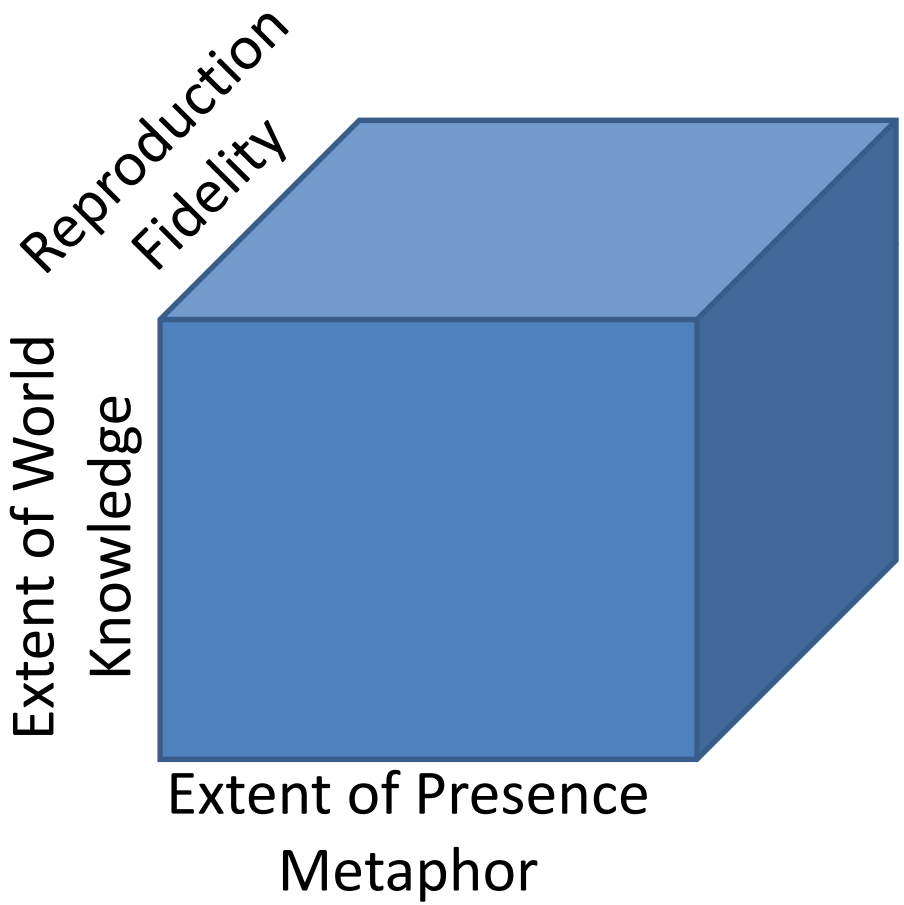
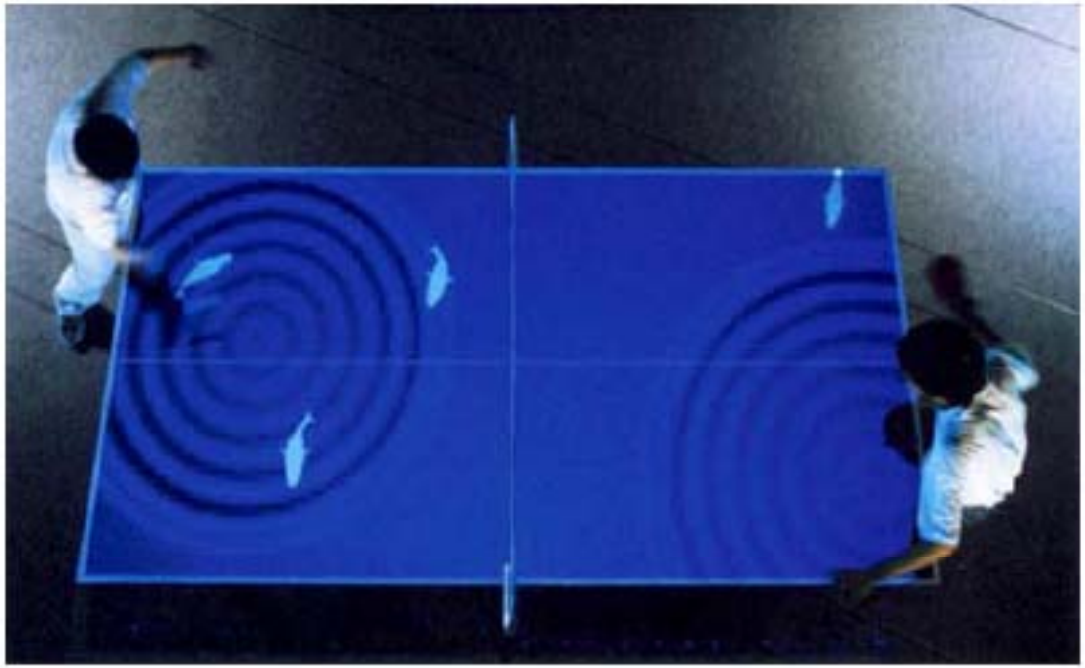


Do you think this is a useful taxonomy for interaction design?

Ping Pong Plus

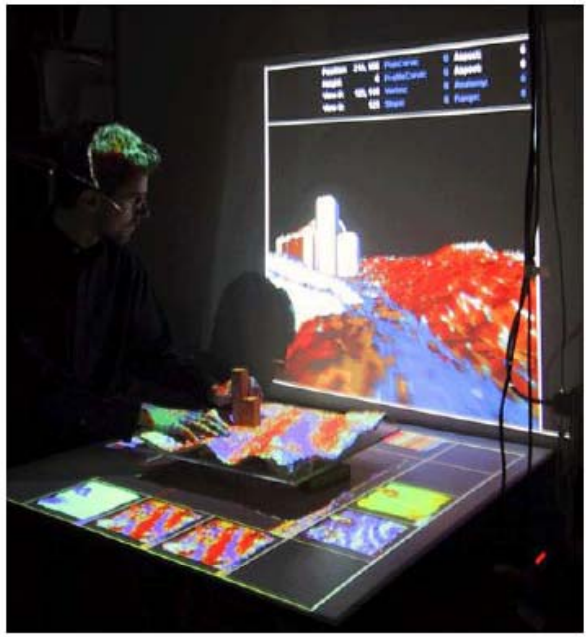
[Ishii et al., 1999, MIT Media Lab]

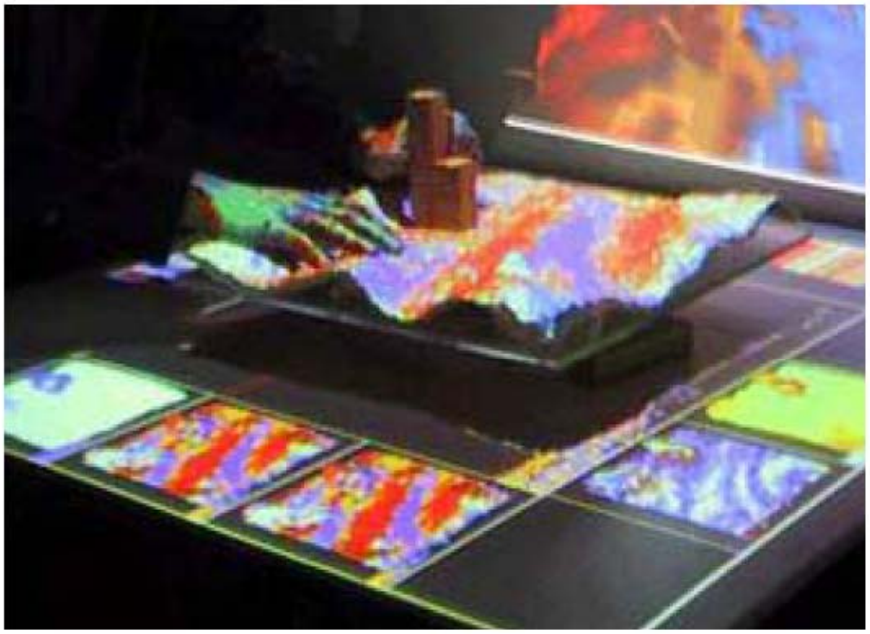


Ping Pong Plus

Illuminating Clay

[Piper et al., 2002, MIT Media Lab]

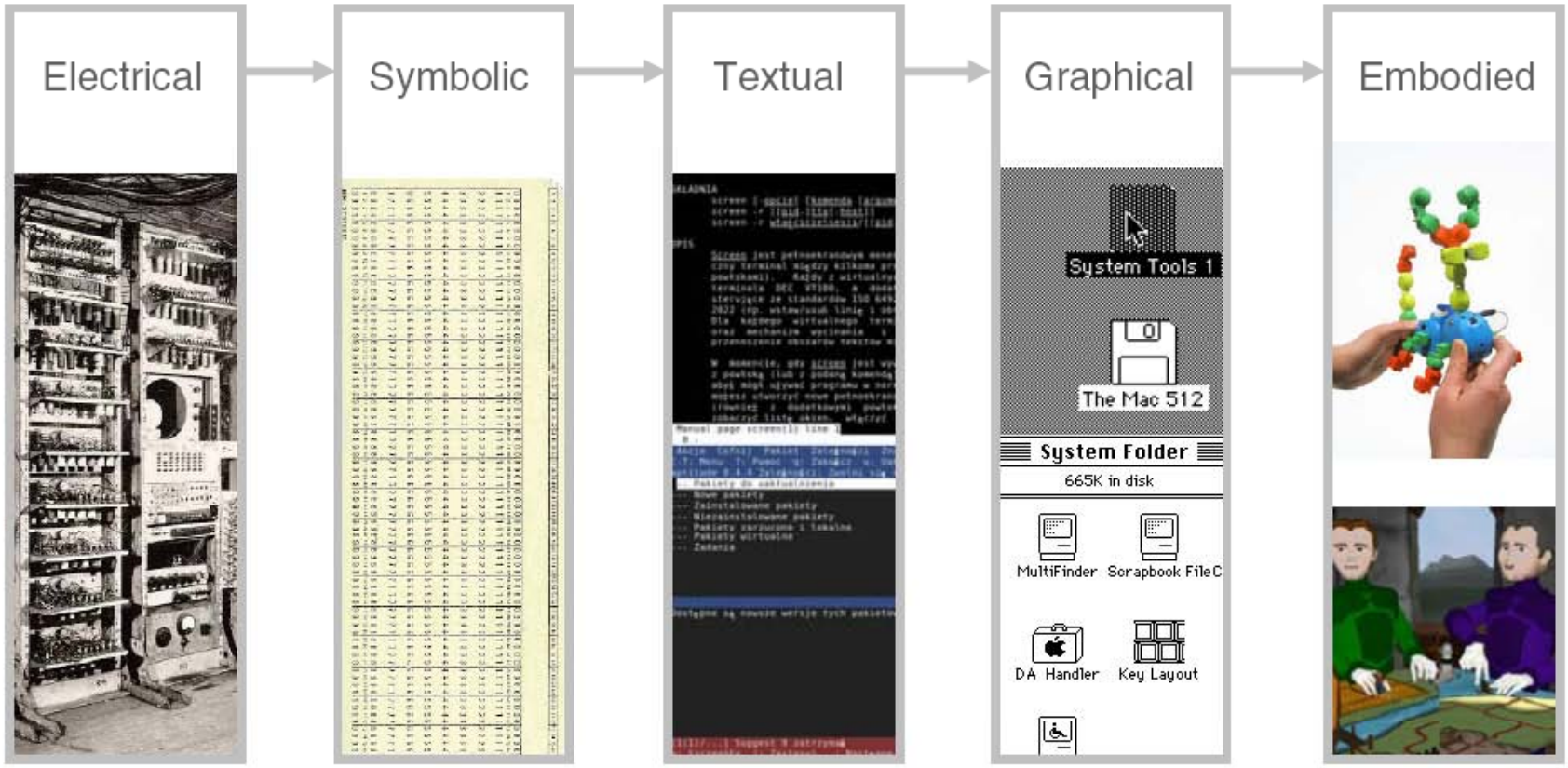




Illuminating Clay

Wait a minute. What's going on here?

Historical Development of UI



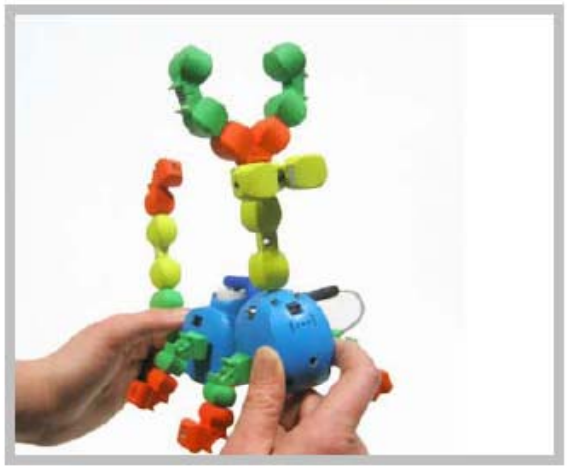
From *Where the Action Is* (Dourish, 2001)

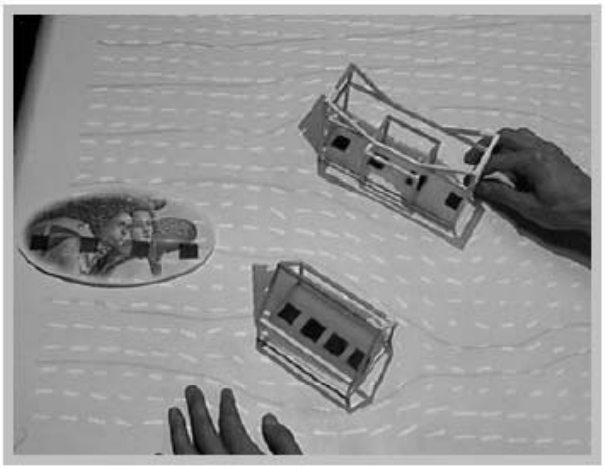
"Computer reaching out"

The scope of human-computer interaction is expanding to include larger-scale, longer-term phenomena of computer use. Interaction moves from being directly focused on the physical machine to incorporating more and more of the user's world and the social setting in which the user is embedded. (Dourish, 2004)

Historical Development of HCI

Tangible Interaction





- Computation that moves beyond desktop
- Interaction is incorporated more richly in our daily experience of the physical world

Reality-Virtuality (RV) Continuum

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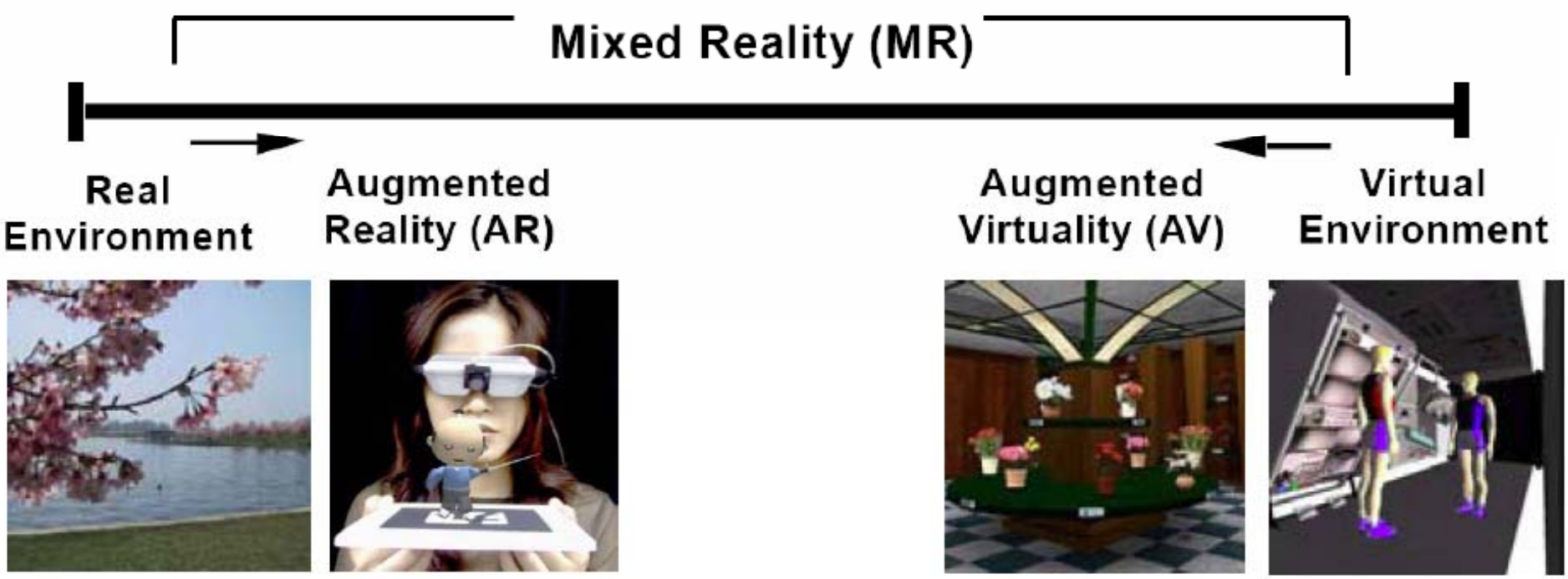

TUI vs. AR: Is there a difference? What is it?

Difference

[nguyen, today, tui Class]

Both Tangible User Interface (TUI) and Augmented Reality (AR) designs seek to move computation beyond the desktop. The primary difference between the two lies in the approach. TUI seeks to **inject** computation **into** the physical world while AR seeks to **overlay** computation **onto** the physical world. However, the two approaches are not orthogonal.