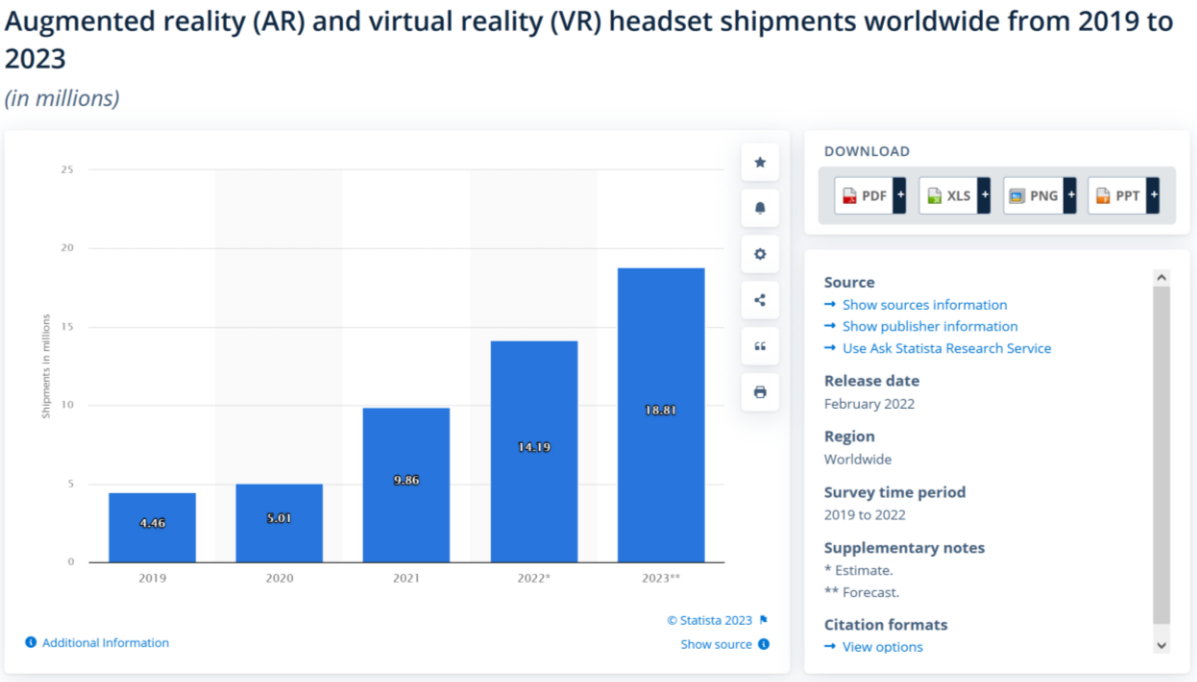
Virtual Reality
PSY/CS 484/684

Prof. Paul MacNeilage, Psychology

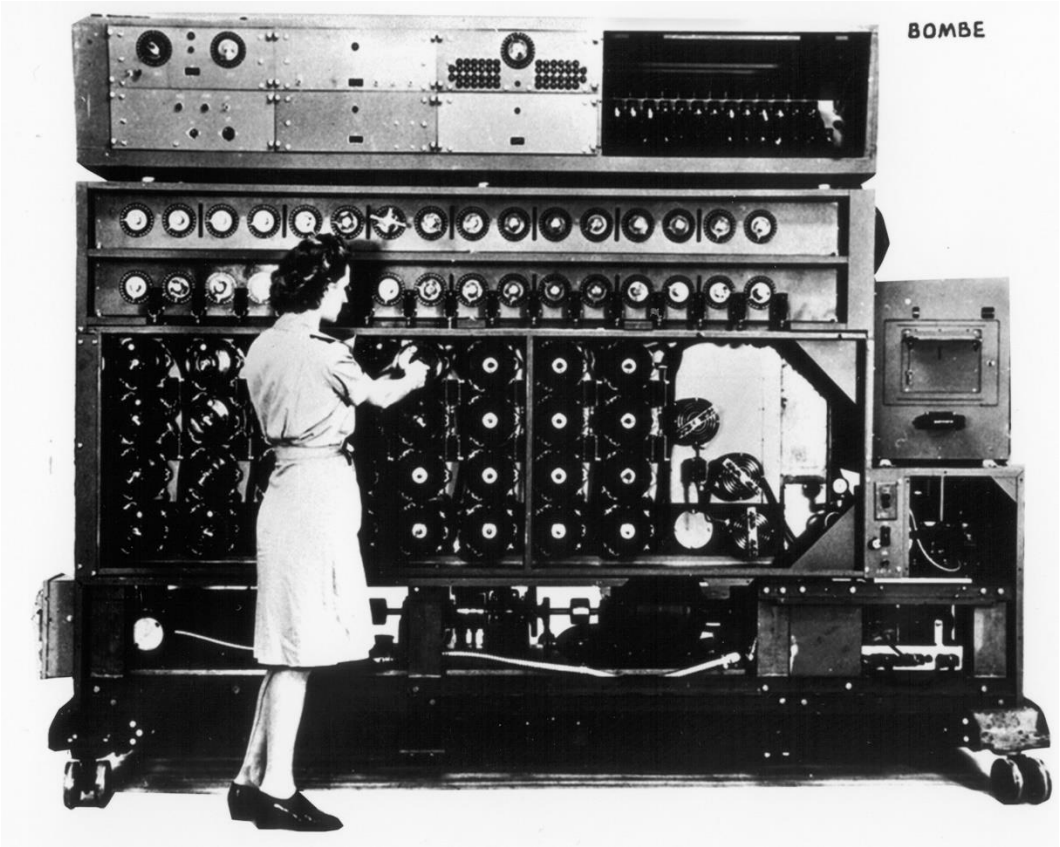
Prof. Eelke Folmer, Computer Science and Engineering

VR / AR Industry



- Major growth since 2014
- All major tech companies have VR/AR efforts
- Why?

Human-machine interaction



Human-machine Interaction

Human-machine Interaction

Human-machine Interaction

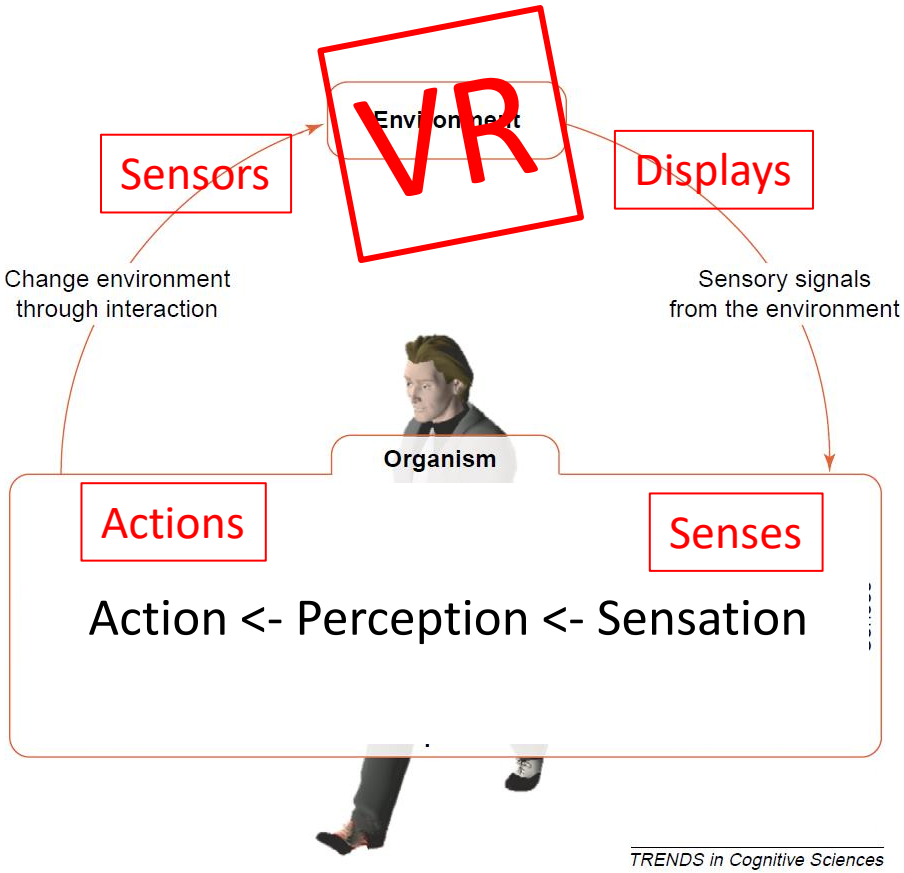
Human-machine Interaction

- What's next? This?

Human-machine Interaction

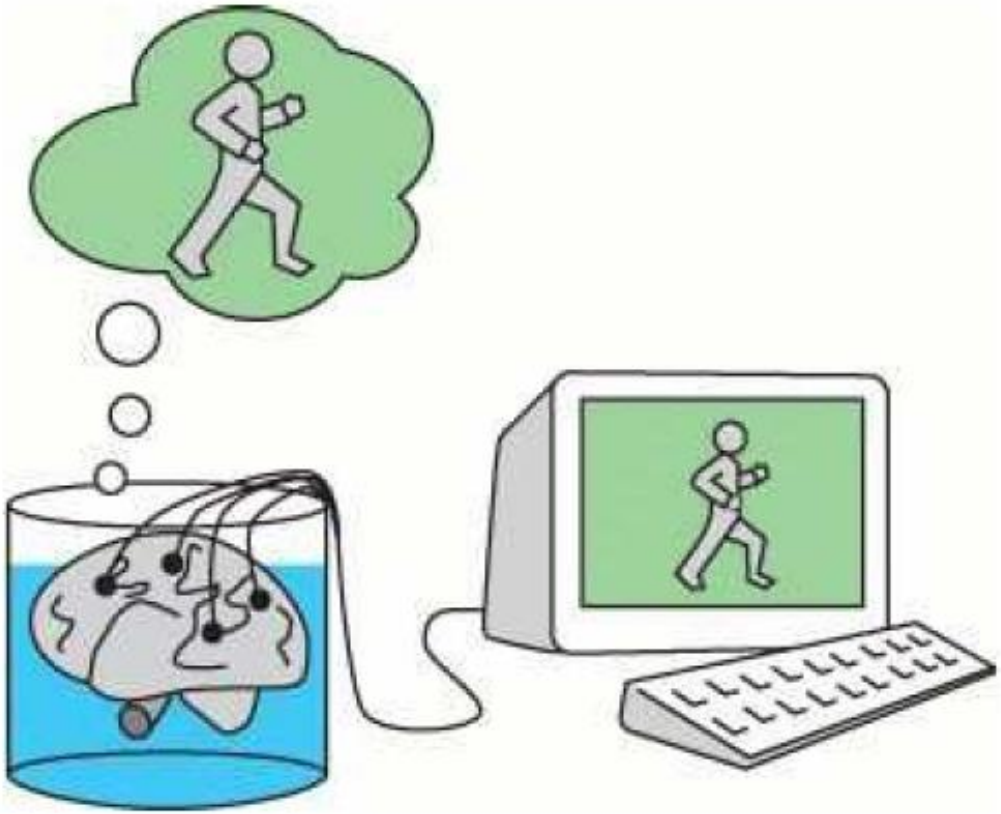
- What's next? Or this?

Human-machine Interaction



Ernst & Buelthoff 2004

The Brain in a Vat



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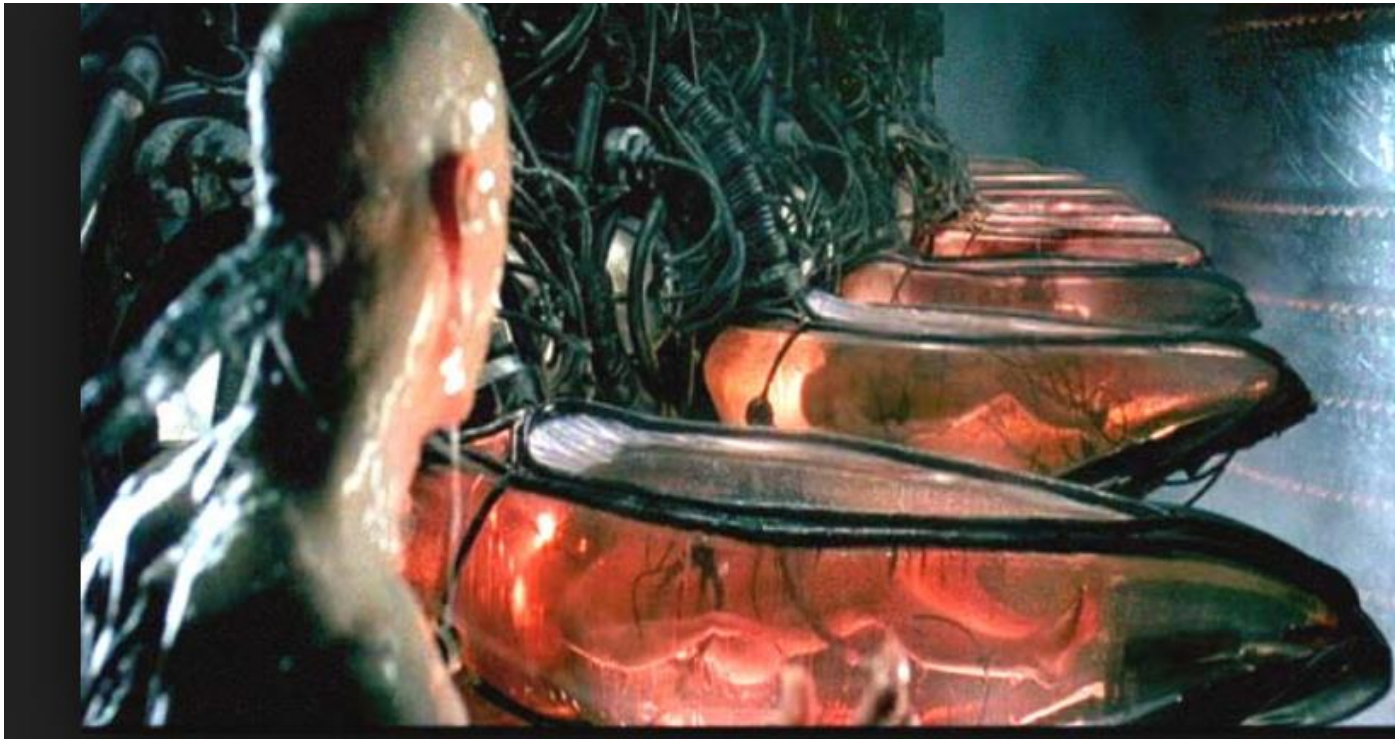
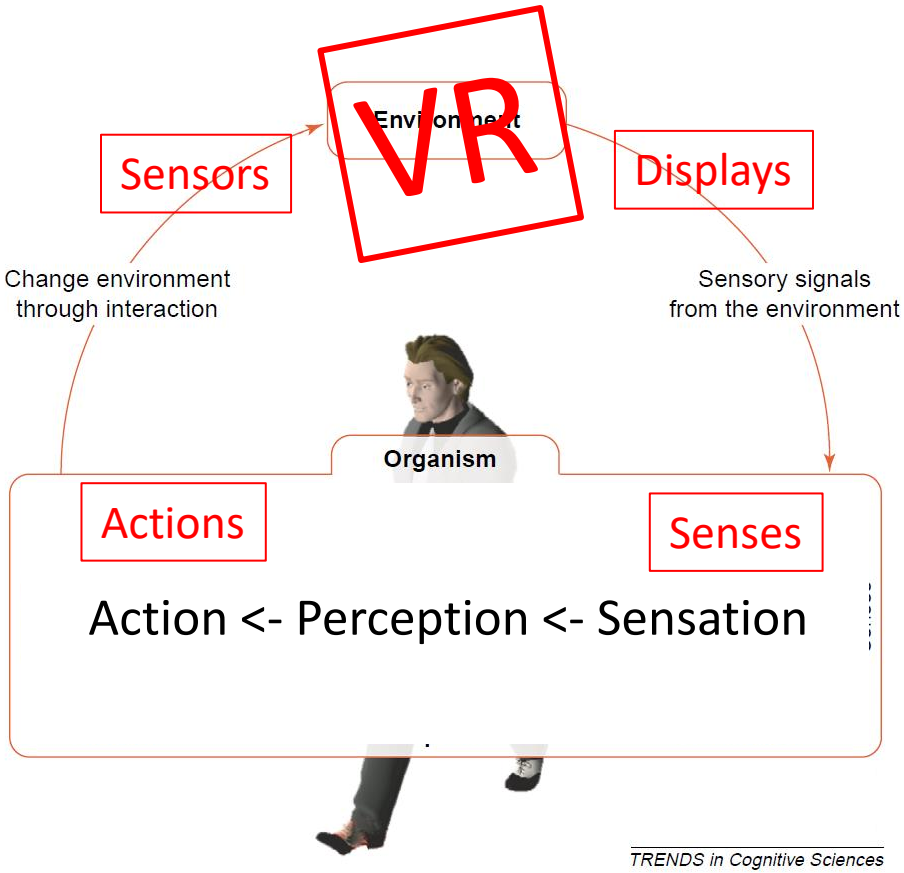



The Sunday Globe
GAMES UNVEILS THE OASIS
SINCE 2021 MORE THEN 20 MILLION VR HEADSETS SOLD
HAVE YOU WASHED YOUR HANDS?

Human-machine Interaction

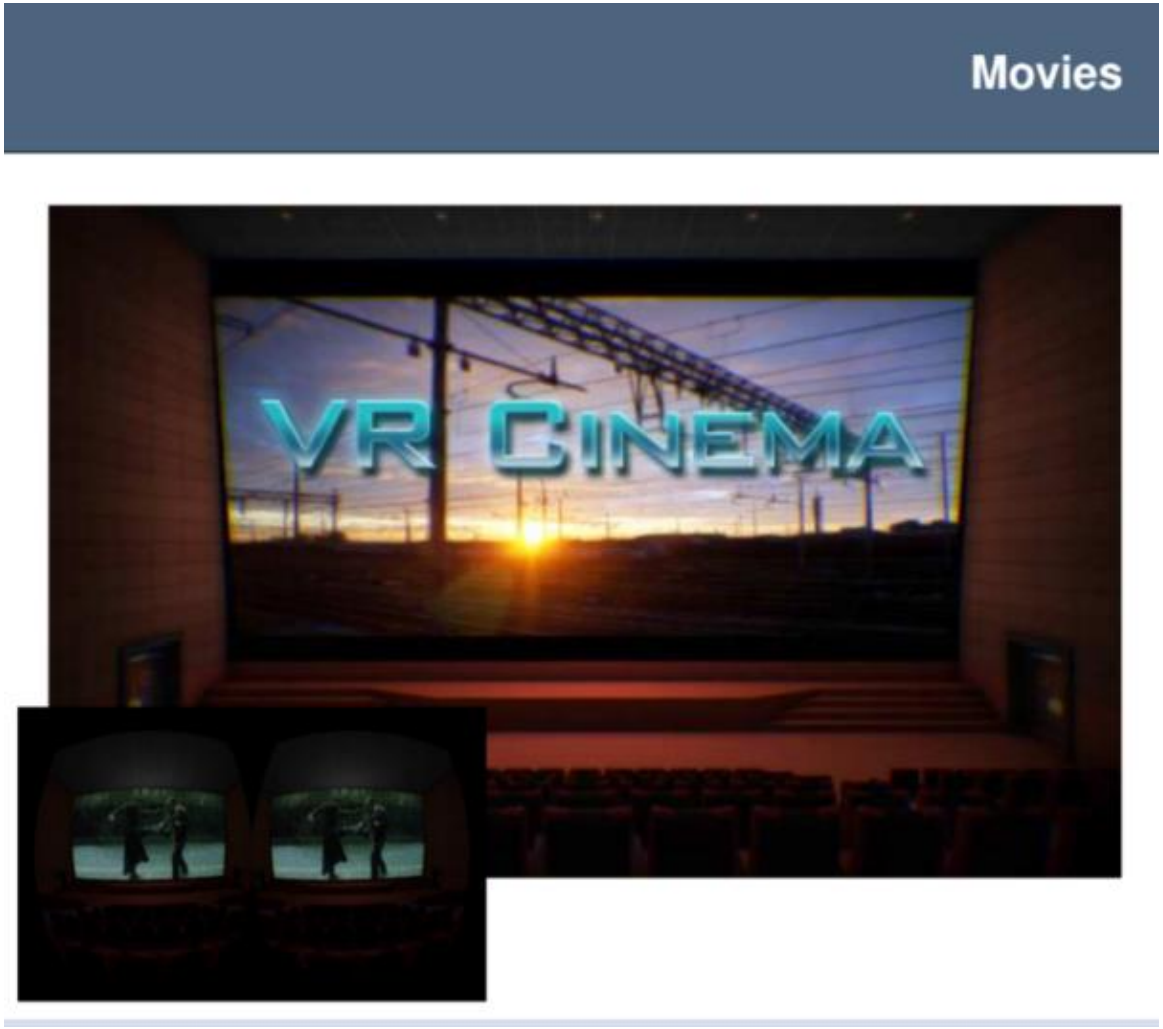


- Computer science: human-in-the-loop
- Psychology: computer-in-the-loop

Ernst & Buelthoff 2004

Head Tracking -> Visual Display

Oh, the possibilities…



Slide credit: Anna Yershova: http://vr.cs.uiuc.edu/

Oh, the possibilities…

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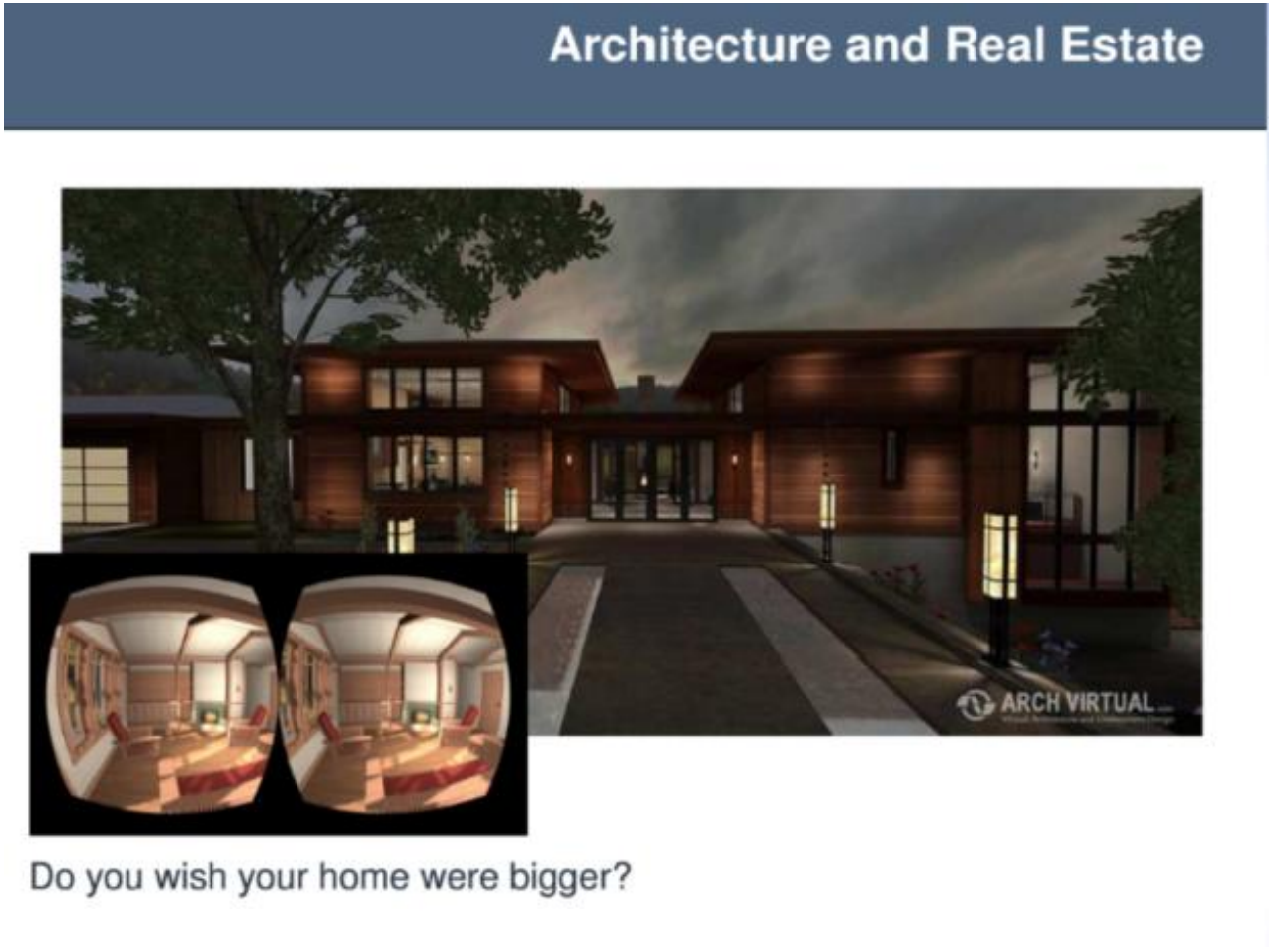

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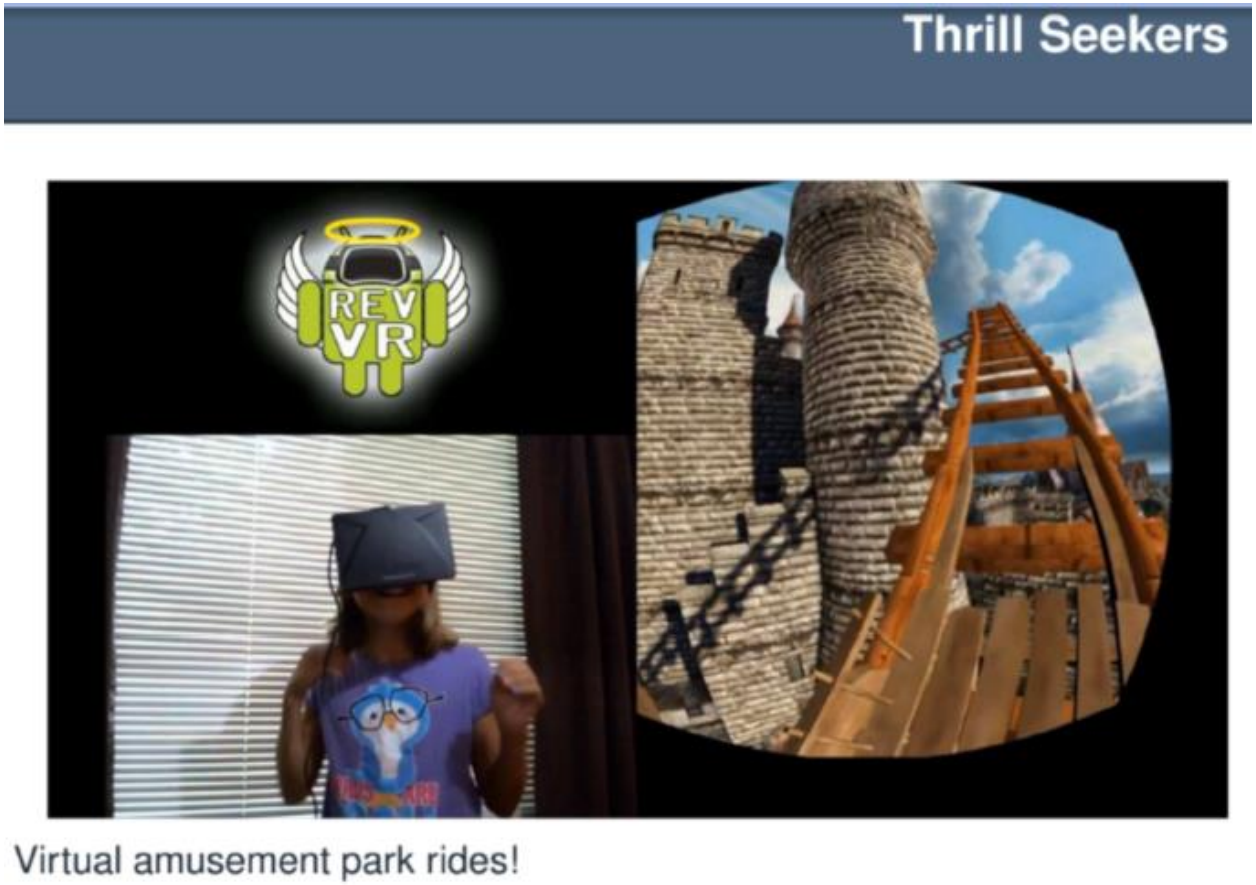


Slide credit: Anna Yershova: http://vr.cs.uiuc.edu/

Oh, the possibilities…

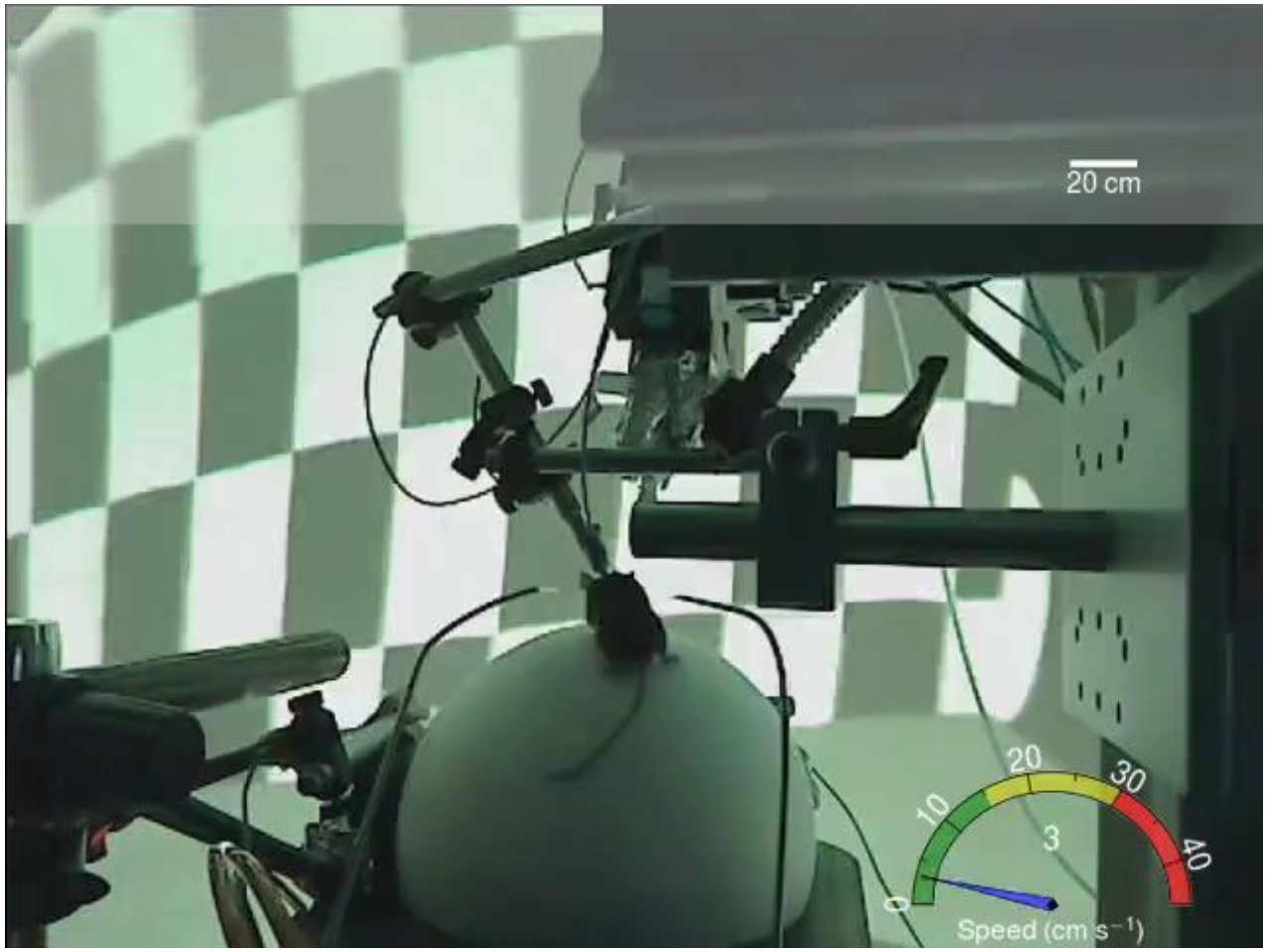
Ever wonder how Louis XVI must have felt?

Slide credit: Anna Yershova: http://vr.cs.uiuc.edu/

Oh, the possibilities…

Slide credit: Anna Yershova: http://vr.cs.uiuc.edu/

VR for Animals



Schmidt-Hieber & Haeusser (2013) *Nat. Neuroscience*

What's the course about?

Virtual reality holds great promise, but technological development is challenging. The challenge lies in understanding

1) how we experience the world around us
2) what is required for these experiences to be "realistic"
3) how we can develop technology to satisfy these requirements.

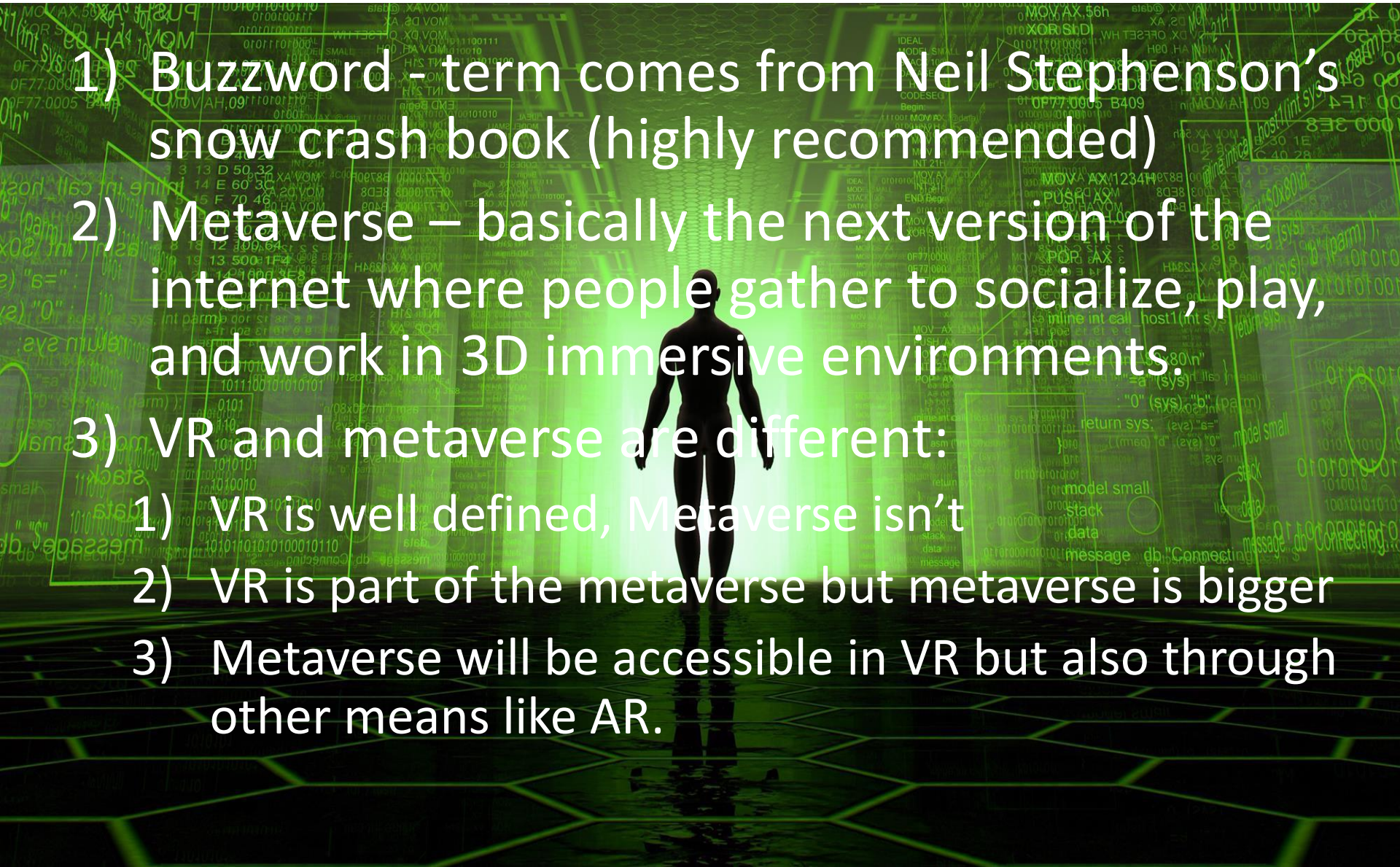
This interdisciplinary course will explore how these challenges can be addressed using knowledge from psychology, neuroscience, and computer science.

Definition of VR?

Textbook: “Inducing targeted behavior in an organism by using artificial sensory stimulation, while the organism has little or no awareness of the interference.”

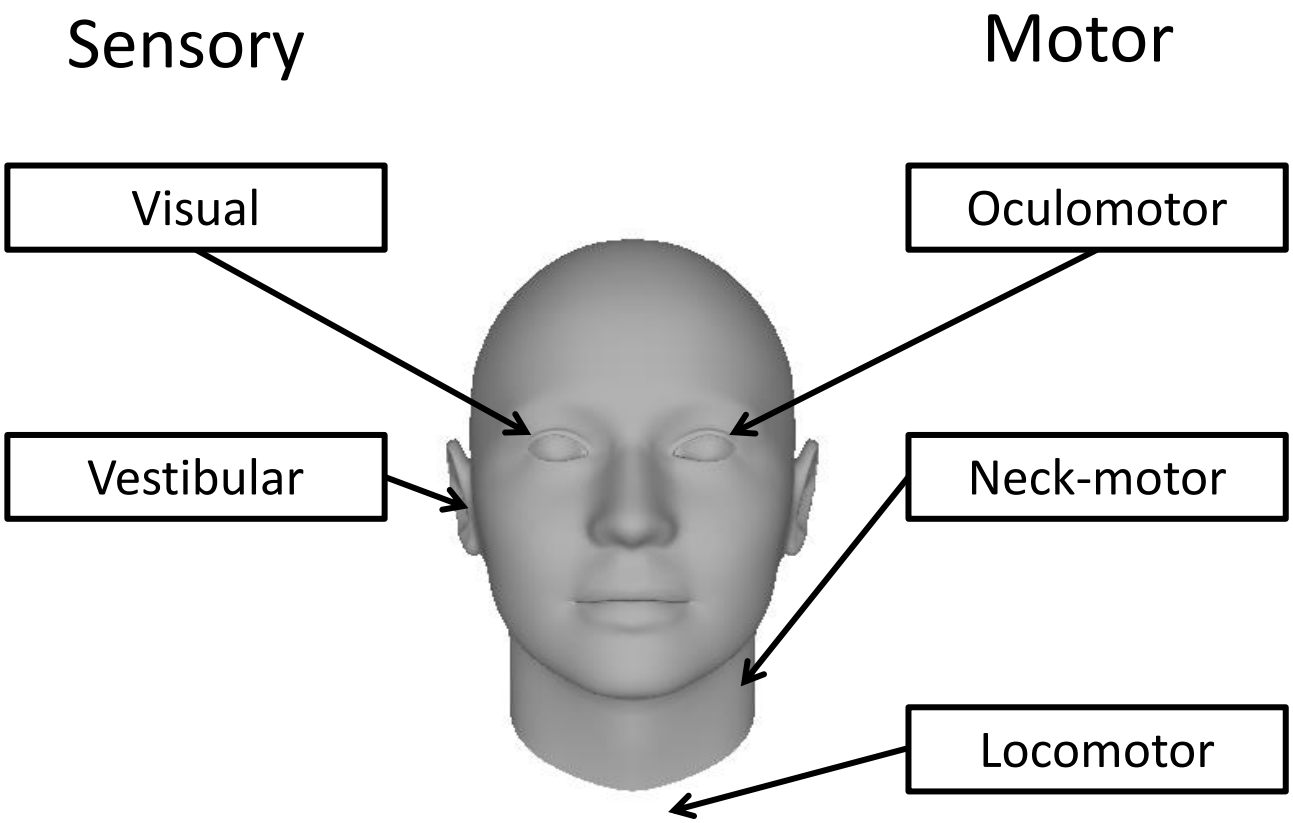
1) Targeted behavior: designed experience
2) Organism: human or animal
3) Artificial stimulation: senses are ‘hijacked’
4) Awareness: organism is fooled, sense of ‘presence’

Metaverse

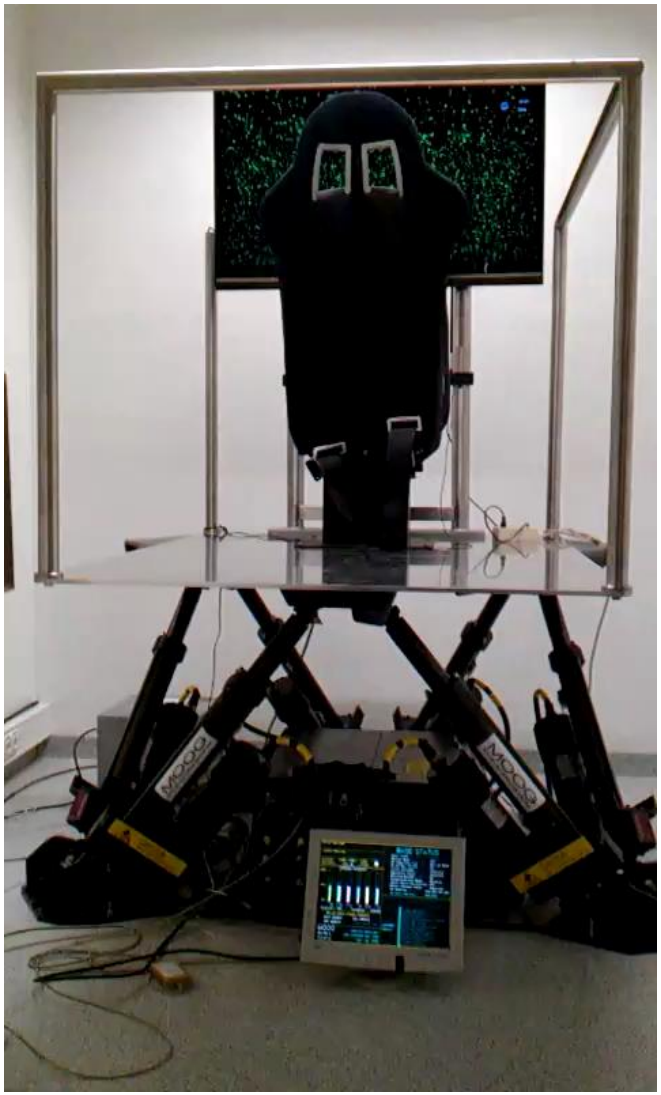


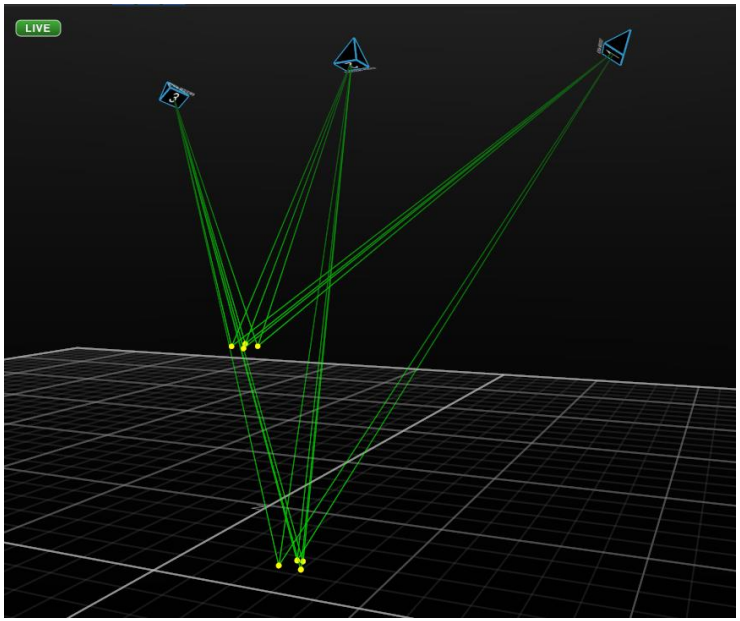
1) Buzzword - term comes from Neil Stephenson's snow crash book (highly recommended)
2) Metaverse – basically the next version of the internet where people gather to socialize, play, and work in 3D immersive environments.
3) VR and metaverse are different:
    1) VR is well defined, Metaverse isn't
    2) VR is part of the metaverse but metaverse is bigger
    3) Metaverse will be accessible in VR but also through other means like AR.

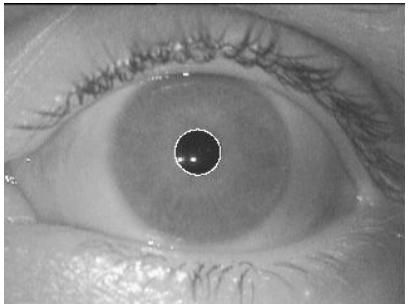
The Self-motion Lab



Self-motion Lab

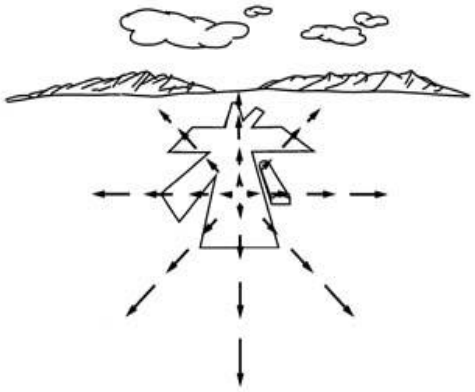






Visual-vestibular Conflict

Visual



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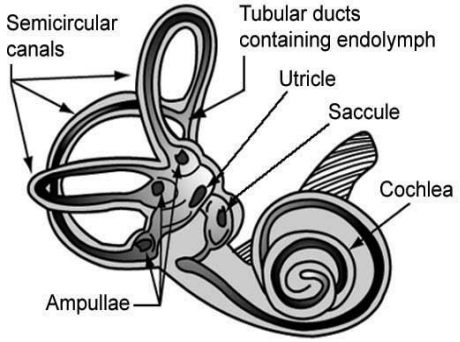
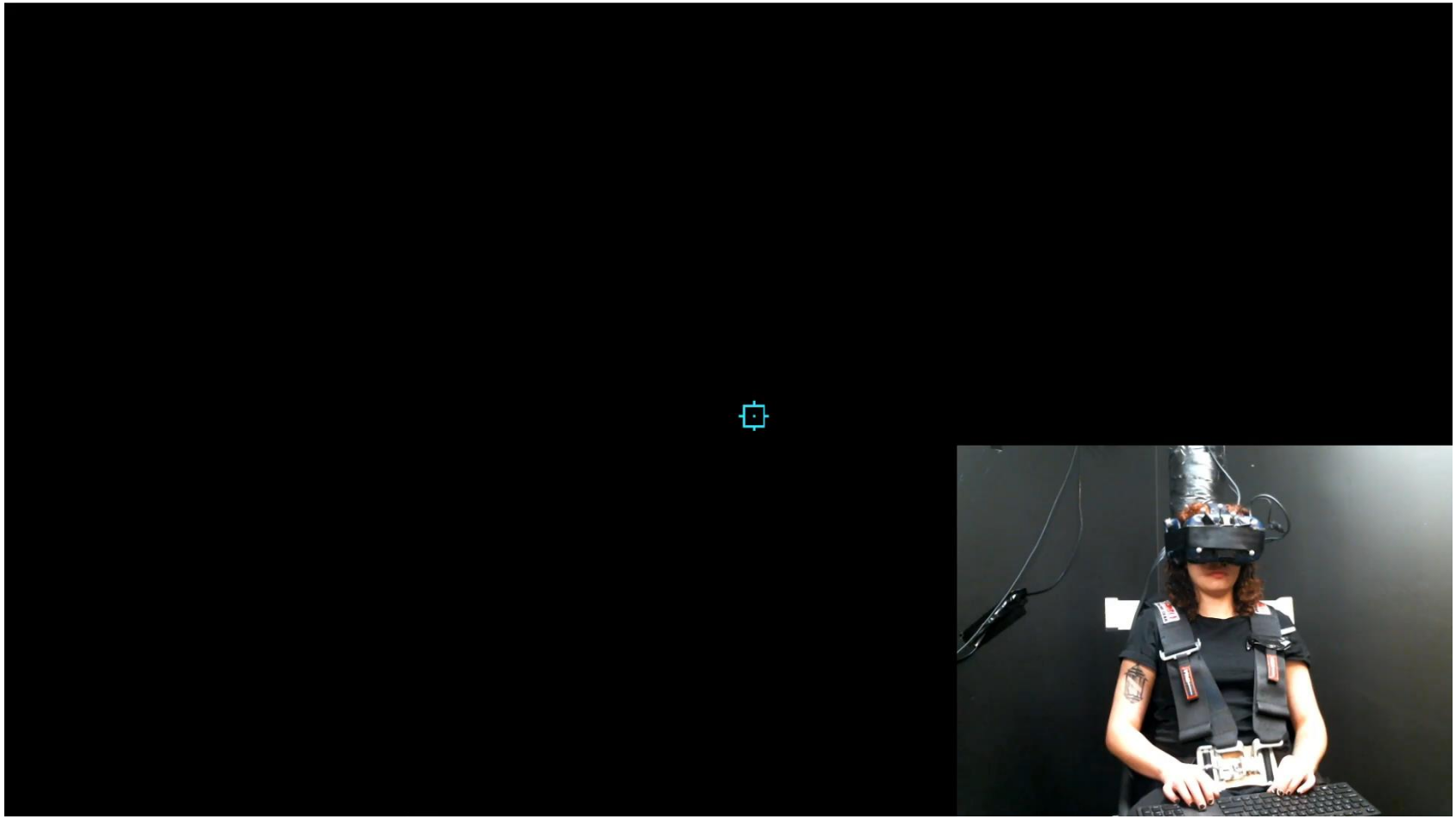
Vestibular



- Causes
  - Vehicular travel
  - Visual displays
  - Vestibular dysfunction
- Consequences
  - Dizziness / vertigo
  - Nausea
  - Other physiological responses

Visual-vestibular Conflict



Conflict and Sickness

Journal of Vision (2023) 23(14):7, 1–15

Impaired stationarity perception is associated with increased virtual reality sickness

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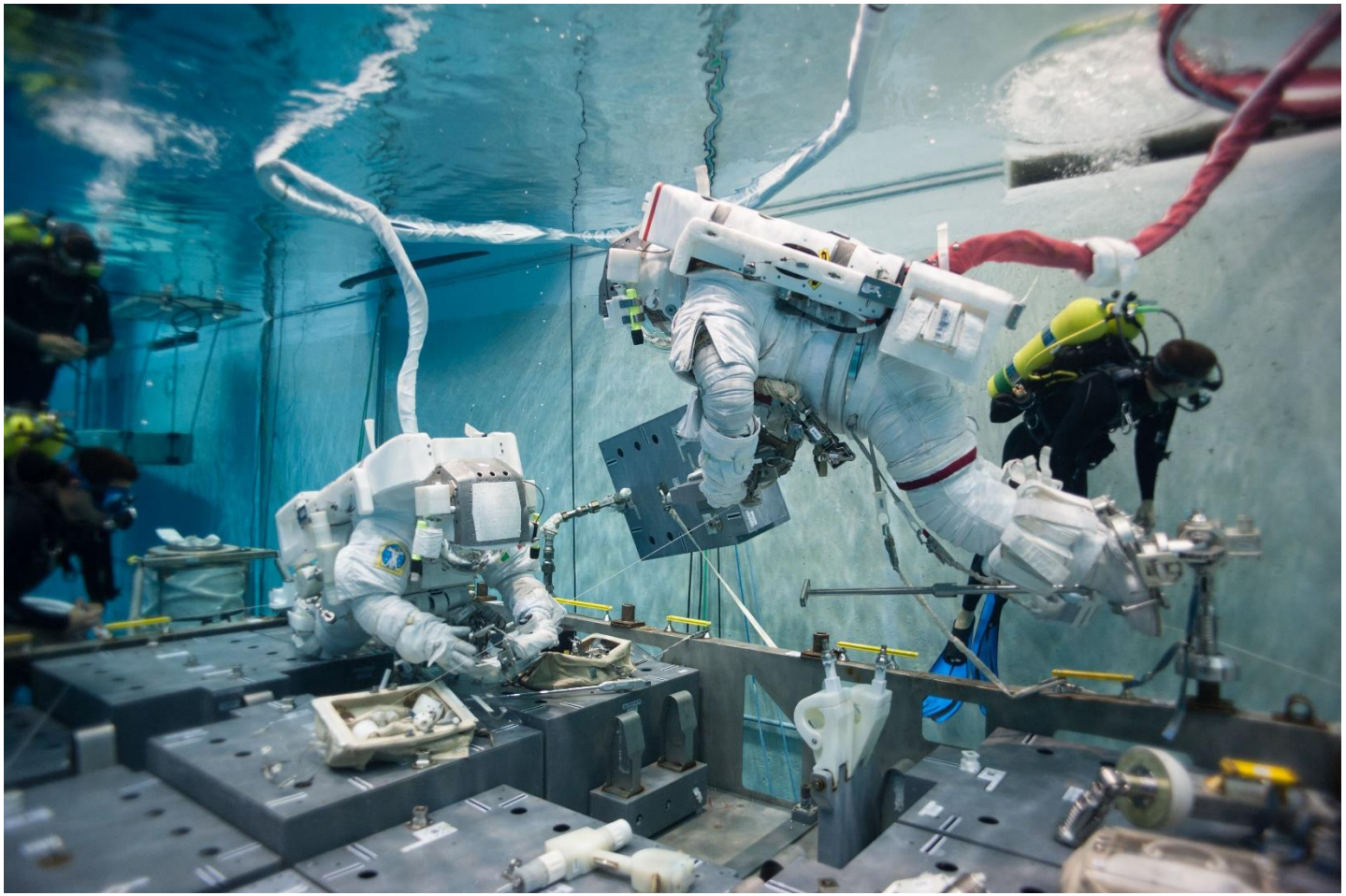
Astronaut Training Underwater



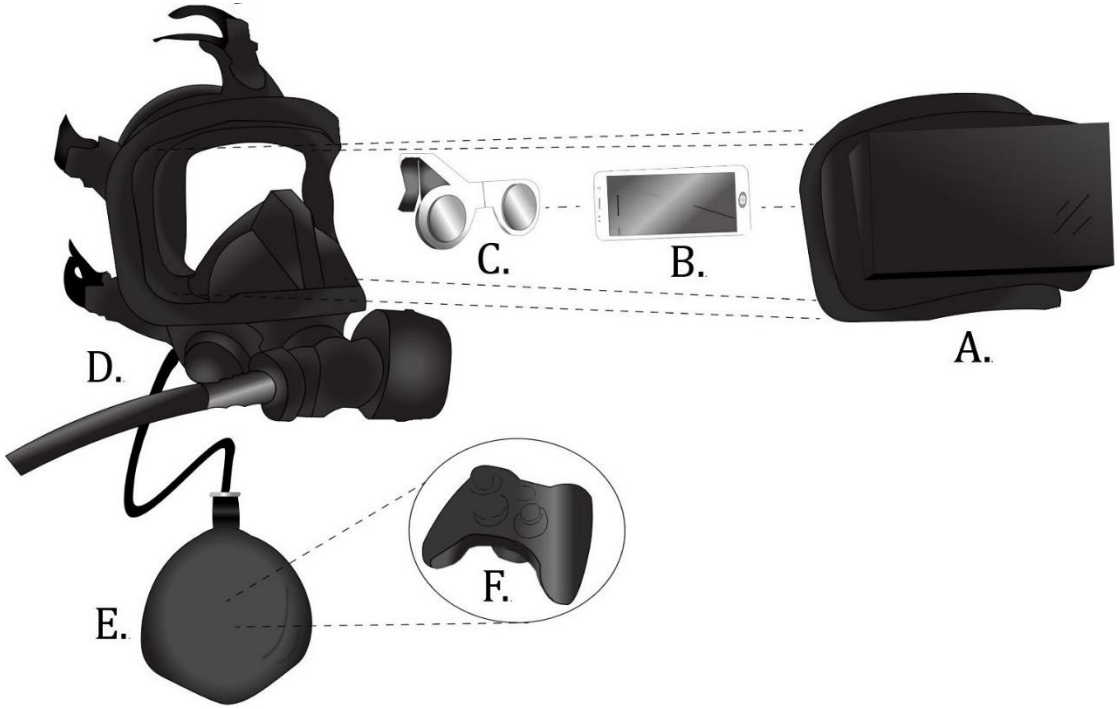
Underwater VR for Astronaut Training

- NBL training of astronauts is expensive
- Can we accomplish the same thing using VR?

1) Make dive mask into HMD

2) Simulate a spacewalk

Underwater VR for Astronaut Training



Visual Experience Database

- Natural co-occurrence of self-motion signals?
  - Measure it

Head movement

Vestibular

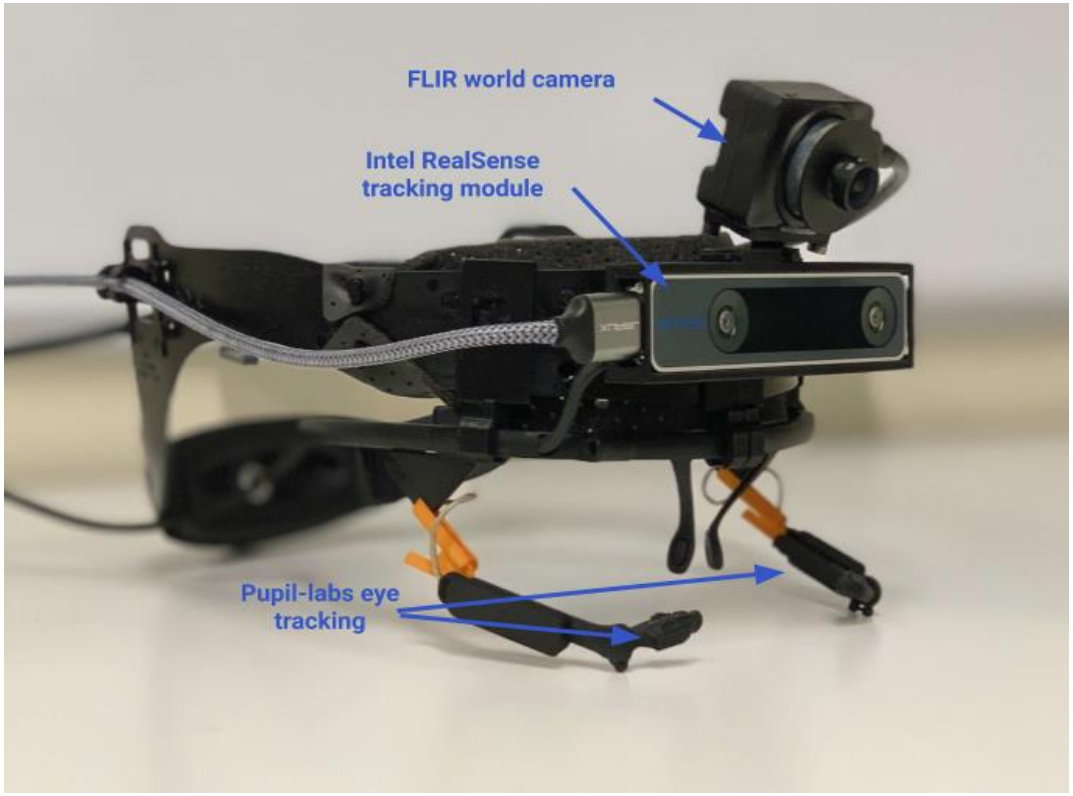
Eye movement

Oculomotor

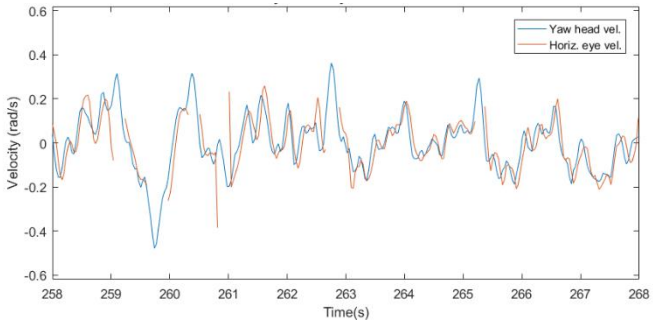
Head/Eye-centered video

Visual

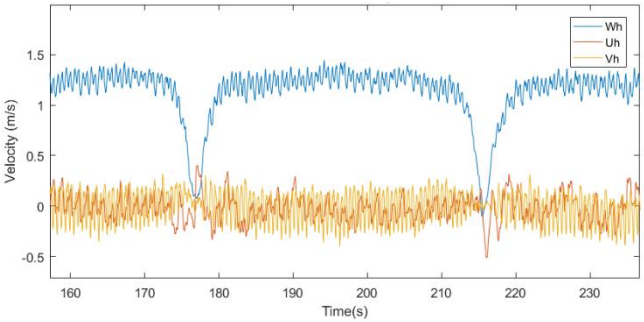
VEDB Headset



Rotational Eye and Head Velocity



Translational Head Velocity



Visual Experience Database

- Gaze-overlaid scene video

HCI lab @ University of Nevada

hcilab.cse.unr.edu

- Human-Computer Interaction (HCI) focusing on the domain of VR/AR
  - HCI: the science of how humans interact with computers
  - Focusing on intuitive, user-friendly interfaces for VR/AR applications.
  - Designing for immersive environments, considering 3D interaction models and spatial navigation.

Terminology

- **User-Centered Design**: HCI is about understanding the needs, abilities, and limitations of users. This understanding is central to designing user interfaces that are effective, efficient, and satisfying.
- **User Experience** (UX) refers to a person's emotions and attitudes about using a particular product, system, or service

Important Qualities

- **Usability:** This is about how easy and intuitive a system is to navigate and use. Usability is a key component of overall UX and includes aspects like user interface design, ease of learning, and efficiency of use.
- **Accessibility:** Ensuring that products are usable by people of varied abilities, including those with disabilities. This involves designing products that are accessible to as many people as possible.

Qualities unique to VR

- **Presence:** refers to the feeling of being physically and mentally immersed in a virtual environment, to the extent that the user may perceive it as a real place and naturally interact with it.
- **Immersion:** the technical aspect of VR, where the technology itself (like VR headsets, spatial audio, haptic feedback) creates a convincingly realistic virtual environment. High-quality graphics, 360-degree views, and responsive interactions contribute to the level of immersion.

HCI lab @ University of Nevada

- Usability & Presence of **virtual locomotion**
- Virtual locomotion refers to the methods and techniques used to simulate movement within a virtual environment.
  - Teleportation
  - Controller
  - Walking in place
  - Treadmill


3:56 ESCORT THE PAYLOAD
FARU
TYCKO
5 PLAYER KILL STREAK!
ESCORT
HEALING +6
ELIMINATED TYCKO 18
600 / 600
92
4.5


3


LIPS.COM

HCI lab @ University of Nevada

- Solving the virtual locomotion problem
  - Key problems:
    - VR sickness (optical flow)
    - Space constraints (living rooms)
    - Lack of Presence (teleport)
    - Physical demanding (Walk in place)
    - Accessibility (what if in a wheelchair)
    - Cost (treadmills are expensive)
    - Safety concerns (walk into walls)
    - Learning curve (non intuitive controls)

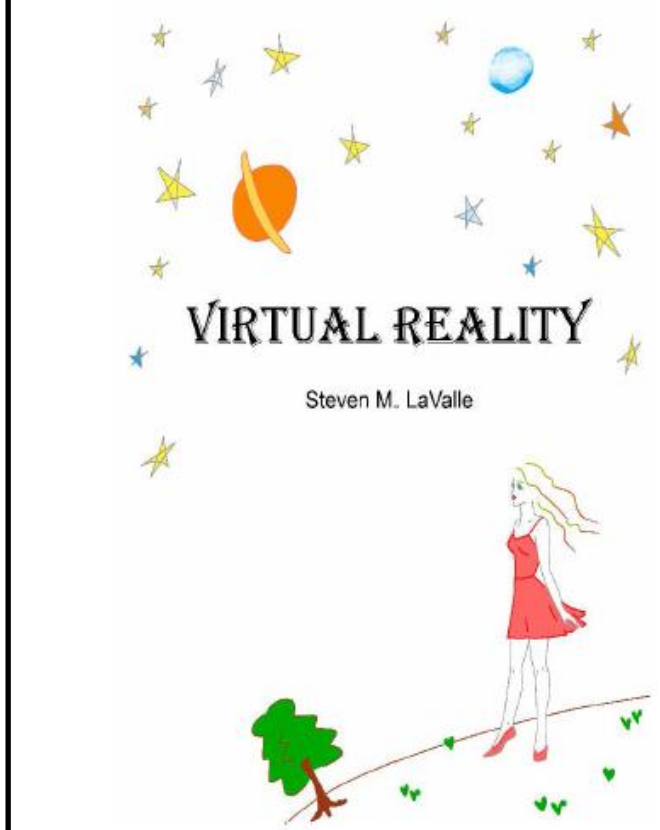
  Will show a ton of movies when we get to locomotion.

User study

User study on understanding ground plane target selection accuracy in VR
Takes approximately 20 minutes.
Minimal risk of VR sickness (no locomotion)
Choice between $10 amazon or extra credit .

Interested? study@Eelke.com

Textbook



VIRTUAL REALITY

Steven M. LaValle

University of Illinois

Available for downloading at **http://vr.cs.uiuc.edu/**

To be published by Cambridge University Press

DRAFT
November 24, 2016

Top link in Canvas

Access to VR

- Oculus Quest 2 for each group
- Your own VR system (Oculus, HTC Vive, etc.)
- @Reality in the Knowledge Center
  - Limited availability
- Checkout from @One or DeLaMare

Course Evaluation

Assignment	Date	484 (U-grad.)	684 (Grad.)
Weekly questions	Every week	10%	10%
Dive into VR	Feb 18	10%	5%
Midterm	Mar 11	20%	20%
Unity tutorial	Feb 18-25	10%	5%
Final Paper	April 29		20%
Final Project	May 8	25%	20%
Final Exam	May 1	25%	20%

Example Final Projects

- Stizly: https://simmer.io/@Stizly/cs484-project
- Metal: https://simmer.io/@lanceallred/metal
- Spider simulator: https://leecbryant.com/SpiderSimulator/

Final Project Milestones (tentative)

- Groups formed – 1 Psych, 1 CS students – Feb 4th
- Proposal submitted – March 18th
- Virtual Experience Design Specifications submitted – April 3rd
- Final project submitted – May 8th
- Final project presentations (in class) – May 8th
- Peer-rating of final projects – May 16th
- Grades due – May 19th

Visit the CS/PSY 484 discord