

Virtual Reality (VR)

Introducing VR interfaces and
discussing relevant research

Today

- Virtual Reality (VR)
- VR technologies
- Interaction in VR
- Research paper

"Virtual Reality: How Much Immersion Is Enough?"



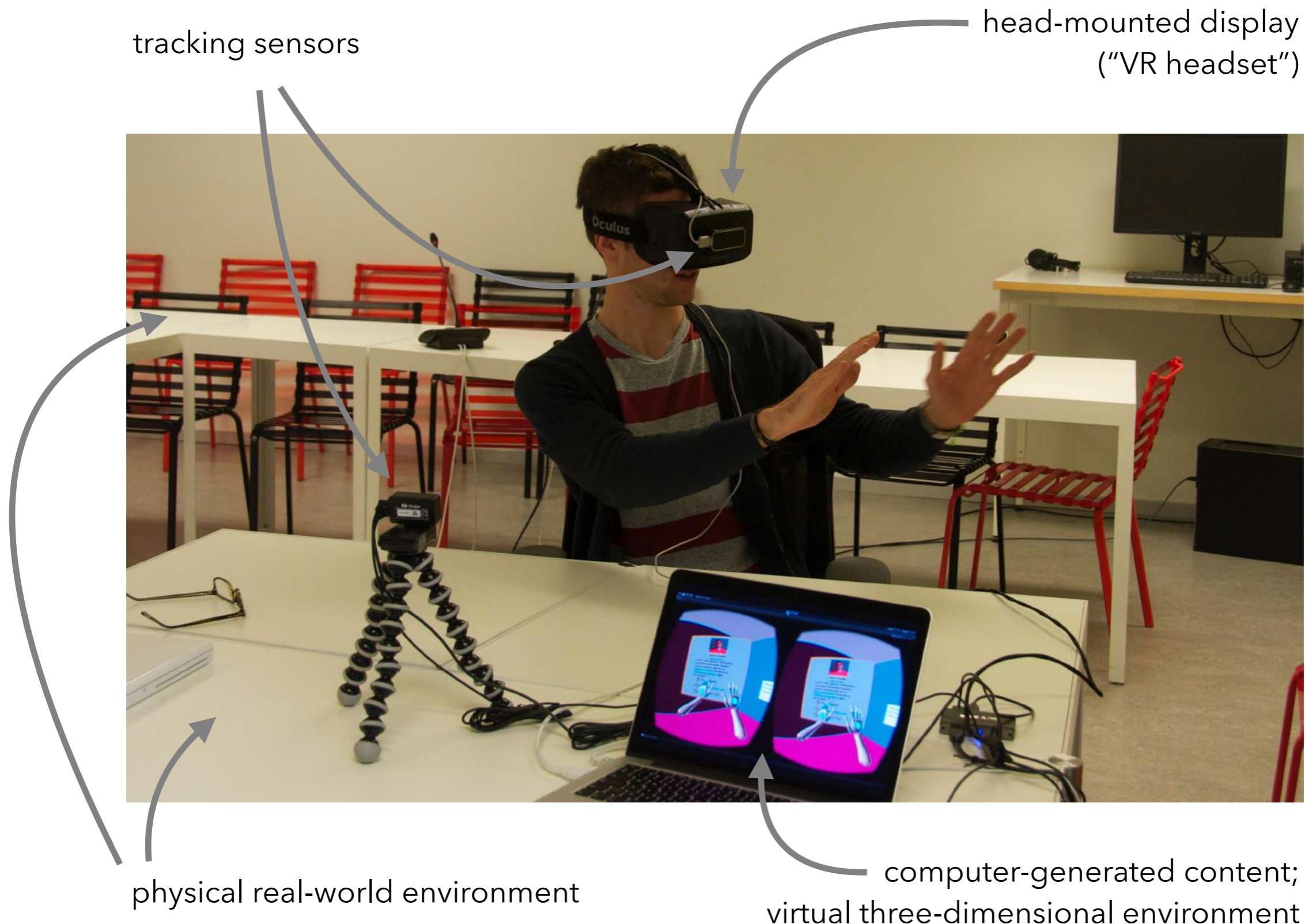
virtual |'və:tʃu(ə)|, |'və:tjʊəl|

Computing not physically existing as such but made by software to appear to do so

virtual reality

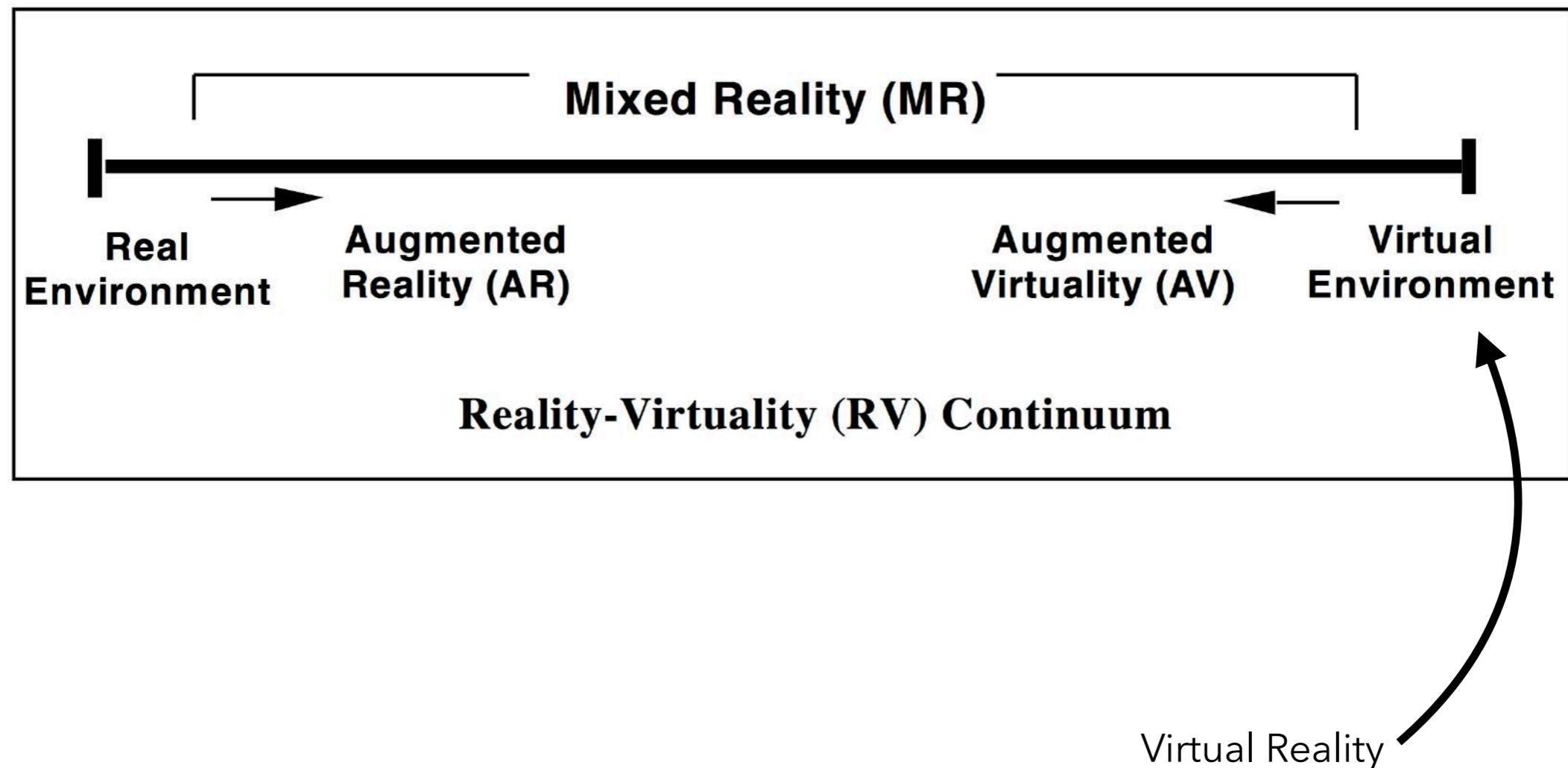
noun [mass noun]

the computer-generated simulation of a three-dimensional image or environment that can be interacted with in a seemingly real or physical way by a person using special electronic equipment, such as a helmet with a screen inside or gloves fitted with sensors.



Reality-Virtuality Continuum

Virtual Reality (VR)



Immersion

"Immersion refers to the objective level of sensory fidelity a VR system provides."

Presence

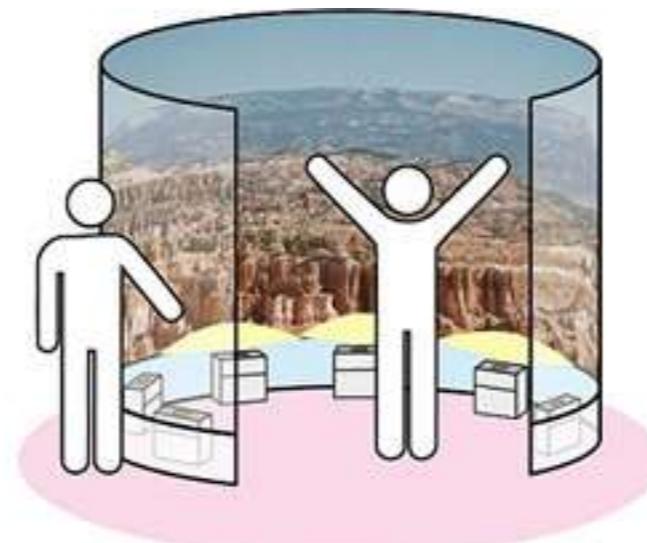
"Presence refers to a user's subjective psychological response to a VR system."

User feels like being **in** the virtual world.

The user experiences a **sense of presence**, "being there".



360deg. Signage



Immersive Projection



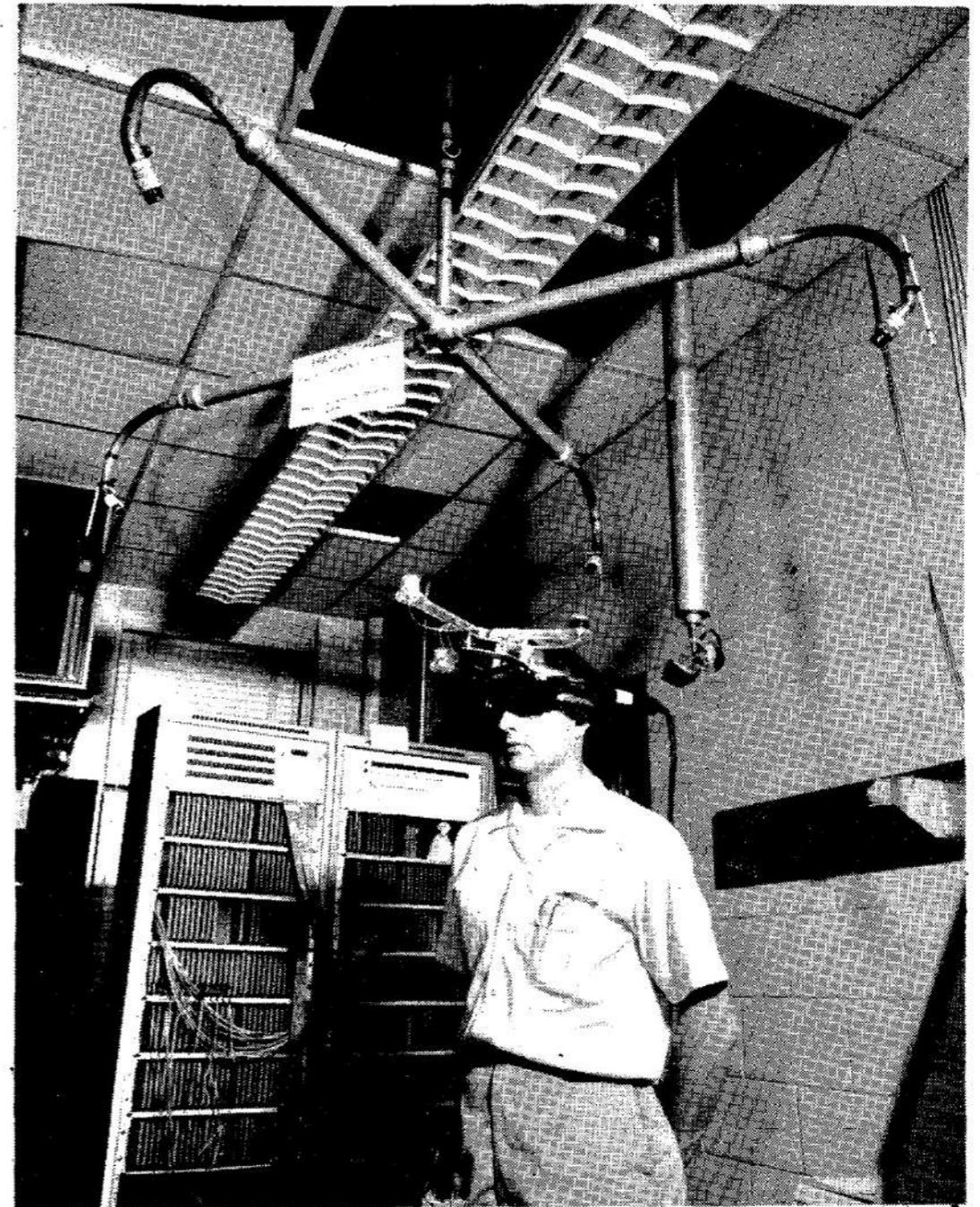
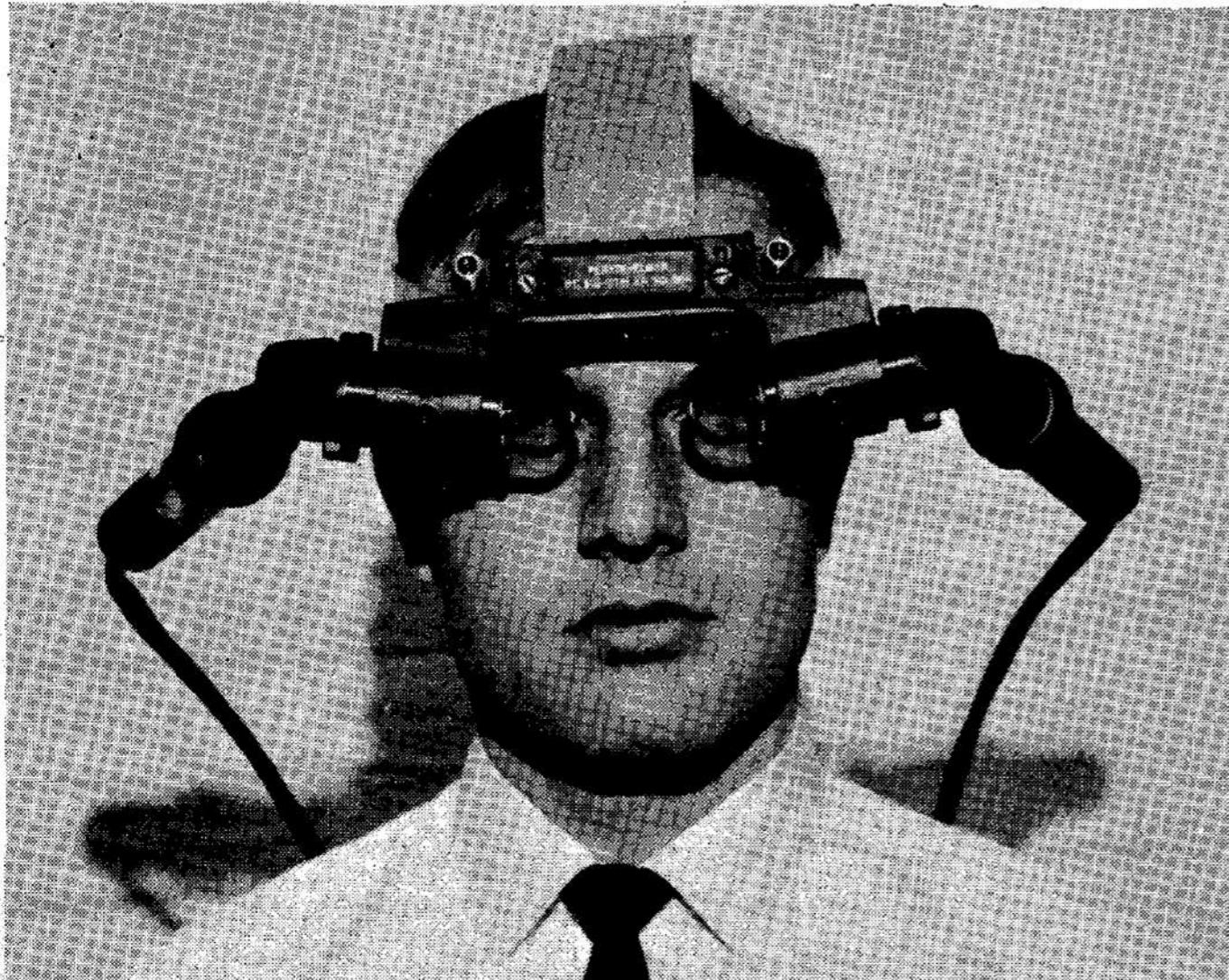




The very first VR/AR HMD by I. Sutherland:
"The Sword of Damocles"

4ME306-VT17

VR vs Cross-Media



via bit.ly/HMD-Sutherland68 and bit.ly/HMD-Sutherland-VideoDemo



via bit.ly/VR-Oculus



via bit.ly/Vive-DevFuture



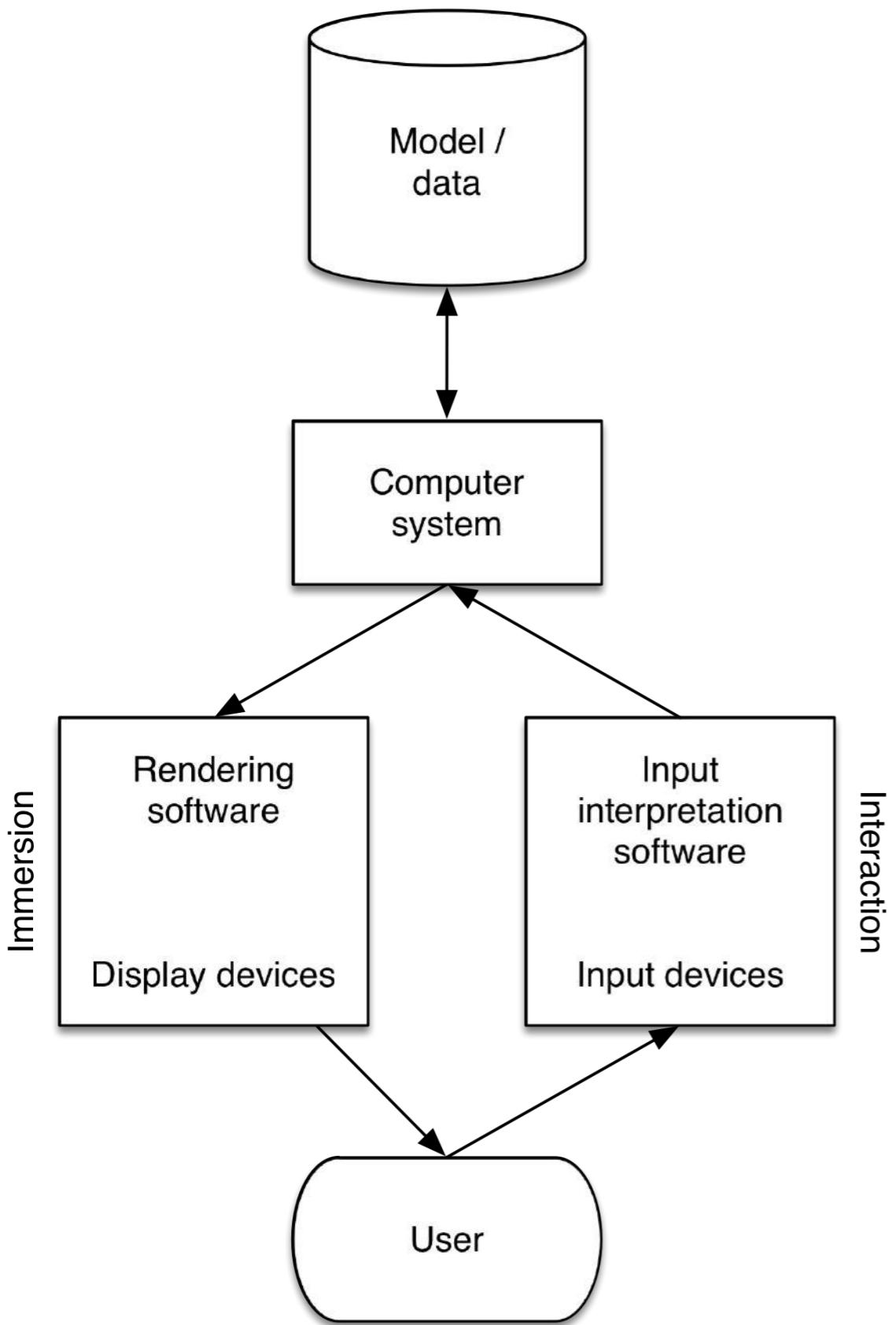
via bit.ly/PS-VR

HMD: Google Cardboard

Virtual Reality (VR)



via bit.ly/VR-GoogleCardboard

**Human-Virtual Environment Interaction Loop**

Doug A. Bowman and Ryan P. McMahan.

Virtual Reality: How Much Immersion Is Enough?

Computer, 40(7):36-43, July 2007.



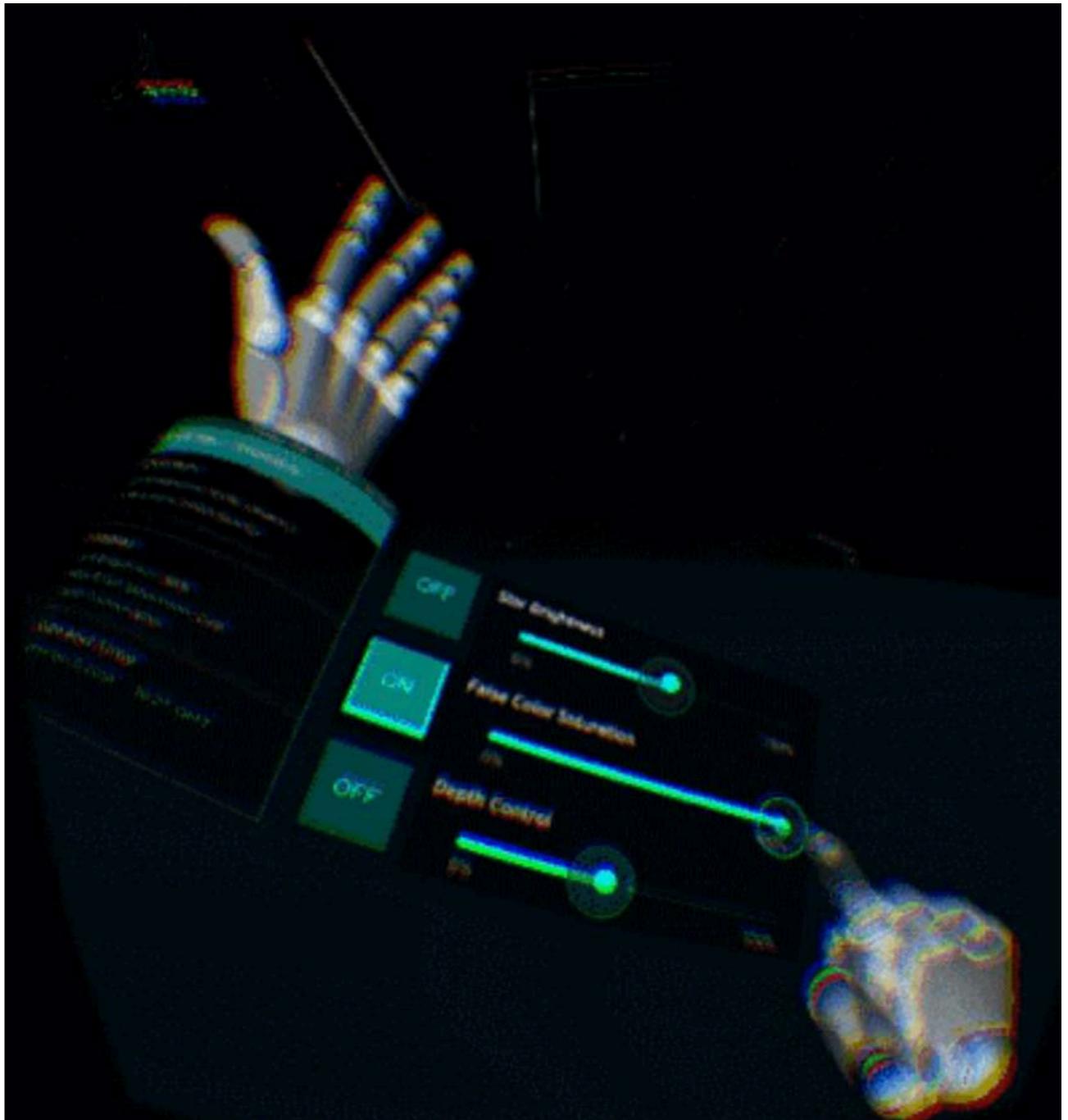
via play.google.com



via roadtovr.com



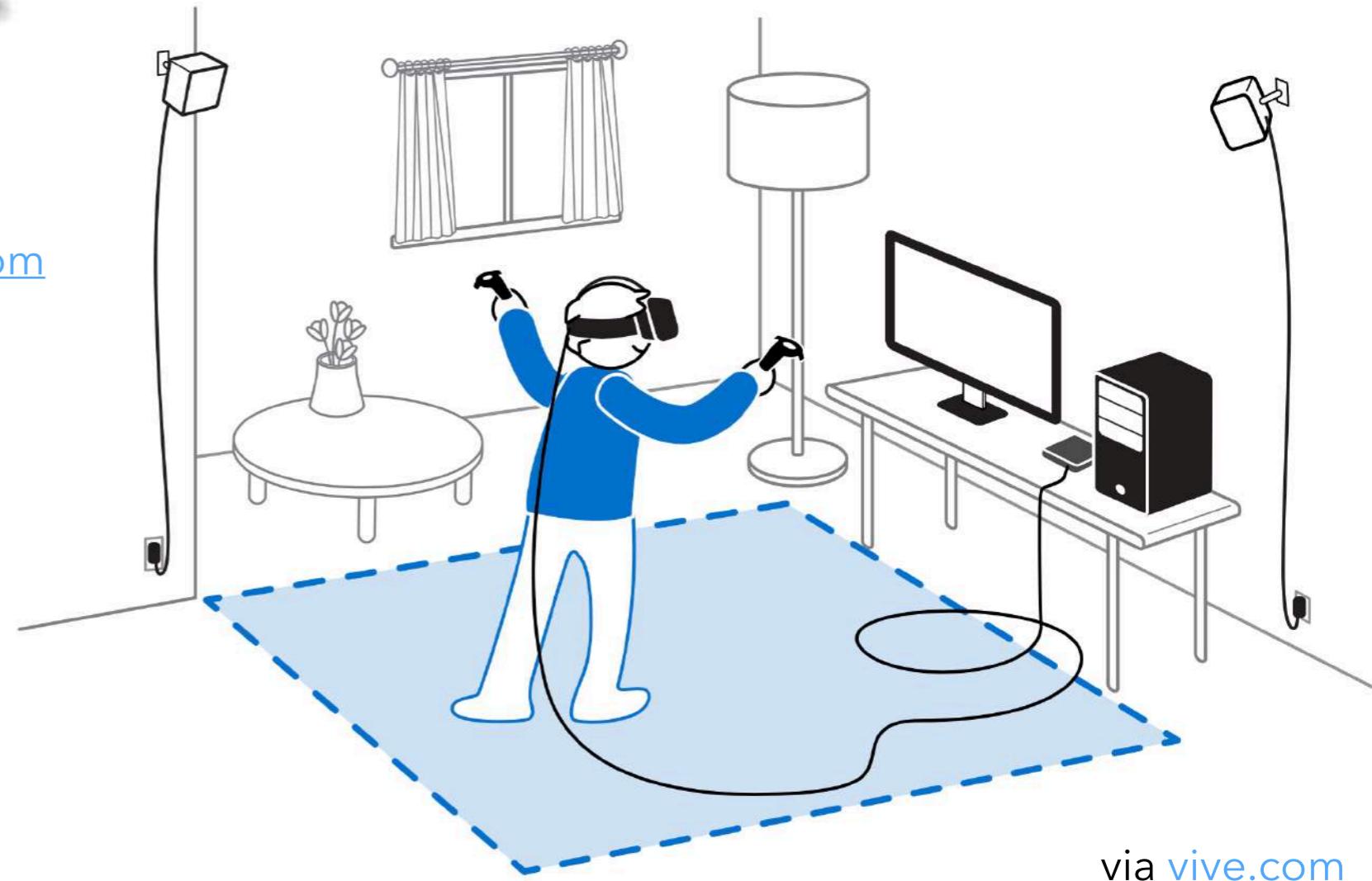
via oculus.com



via blog.leapmotion.com



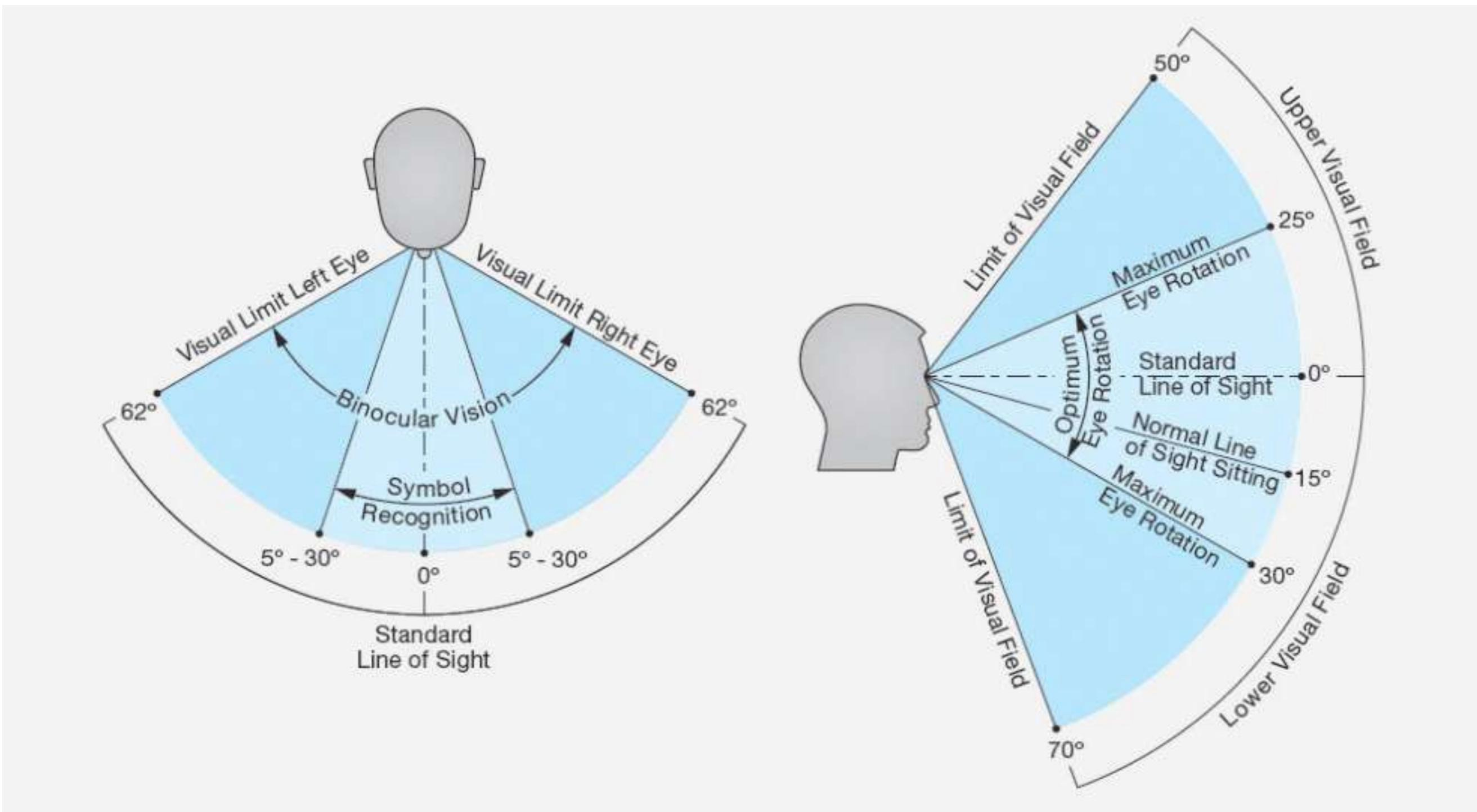
via tomshardware.com



via vive.com

Human field of vision

Virtual Reality (VR)



D. A. Bowman and McMahan, R. P.,
["Virtual Reality: How Much Immersion is Enough?",](#)
IEEE Computer, vol. 40, pp. 36-43, 2007.

Initial VR Advantages

- users react strongly when first experiencing immersive VR...
- ... although VR technologies (3D visual, auditory, and haptic displays; position tracking systems; input devices) still have usability and fidelity issues
- research has shown:
users behave and feel differently in immersive VR

Success Stories: Phobia Therapy

- e.g. fear of public speaking
- practice in virtual conference room
- realistic environment likely to trigger same fear structures as in reality
- less expensive; less time-consuming; less risky; less embarrassing

Success Stories: Military Training

- e.g. train infantry in urban combat tactics
- good compromise between classroom-based training and real-world training exercises
- due to detailed intel and location data (e.g. through satellite imagery), operation area can be virtually build and experienced (low resources; more flexible; low costs)
- level of realism is not possible in classroom scenario (VR enables trainees to gain better spatial understanding, even memory, of the operation area)

Success Stories: Entertainment

- more limited and costly back in 2007,
e.g. [DisneyQuest](#) placed visitors inside the game world in huge interactive, immersive theme park areas
- more accessible and affordable in 2018 due to entertainment industries push towards VR
- lots of different VR experiences available (education, edutainment/infotainment, entertainment, games, cross-media / supplemental experiences, artistic, experimental, movies)

High level of immersion → Sense of presence → Success ?

(Other) Potential Benefits of Immersion

- spatial understanding
human brain is highly optimized for reconstructing 3D scenes; immersive VR provides many depth cues; greater spatial understanding can result in greater effectiveness for many applications (scientific visualization, design review, ...)

- decrease in information clutter
more space/resolution for placing virtual content such as texts, numbers, icons, windows, controls, notifications, and other elements familiar from your computer desktop

Demonstrating Immersion's Benefits

- need for controlled empirical studies
- an option: two step approach
 1. study with drastic difference in immersion
 2. if 1. is successful, investigate in more detail, especially controlling the different components of immersion

Demonstrating Immersion's Benefits: Example

VR-based information visualization:

1. investigate user's task performance (speed and accuracy) on low-immersion (desktop) and high-immersion (CAVE) system
2. independently vary components of immersion,
e.g. stereoscopy, head tracking, field of regard

Thoughts and Remarks

- (high level of) immersion is not always necessary/better, e.g. immersion might not make a difference for simpler tasks, or some tasks might not be performed accurately in either (low-/high-immersion) condition
- investigating not just components of immersion, but also input technologies and interaction design
- understand how different components of immersion affect measurable user performance, understanding, and preference

D. A. Bowman and McMahan, R. P.,
"Virtual Reality: How Much Immersion is Enough?",
IEEE Computer, vol. 40, pp. 36-43, 2007.



Today: 2018. What has changed?

- [Building Virtual Reality](#)
by Jody Medich and Daniel Plemmons
- [VRCH - Virtual Reality Architecture](#)
by Daniel Voshart
- [Immersive Design: Learning to let go of the screen](#)
by Matt Sundstrom
- [VIRTUAL REALITY](#)
by Steven M. LaValle

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CA98 308C 6772 4499 B061 D75B)



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Additional references

Portal icons in the presentation available via

bit.ly/portaliconpack