



Virtual Reality Introduction

CS 415: Game Development

Professor Eric Shaffer

vir·tu·al re·al·i·ty

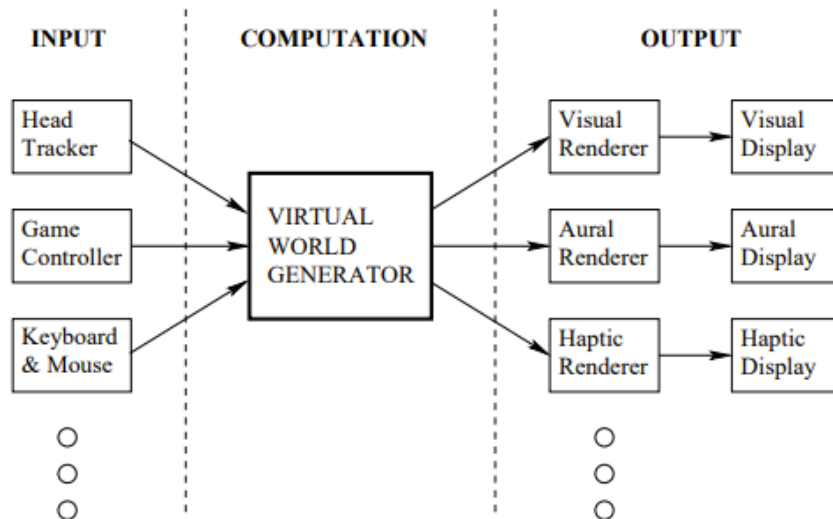
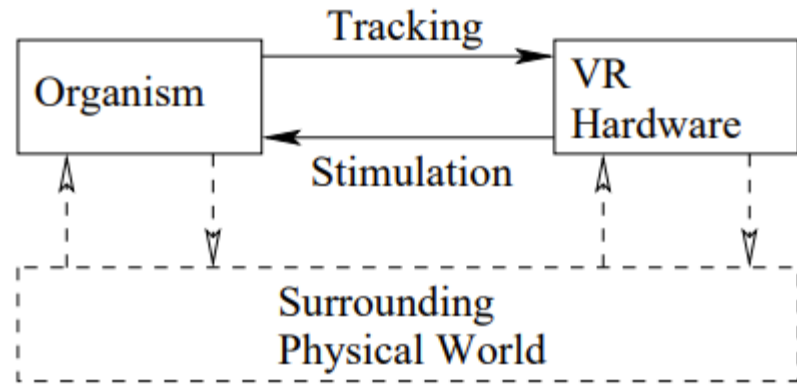
vir·tu·al re·al·i·ty

vərCH(əw)əl rē'alədē

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



Schematic of a VR System



Applications

simulation & training



visualization & entertainment



remote control of vehicles, e.g. drones



gaming



robotic surgery



architecture walkthroughs



education



virtual travel



a trip down the rabbit hole



A Brief History of Virtual Reality

Stereoscopes
Wheatstone, Brewster, ...



VR & AR
Ivan Sutherland



Nintendo
Virtual Boy



VR explosion
Oculus, Sony, HTC, MS, ...



1838

1968

1995

2012-2022

???



Ivan Sutherland's HMD

- optical see-through AR, including:
 - displays (2x 1" CRTs)
 - rendering
 - head tracking
 - interaction
 - model generation
- computer graphics
- human-computer interaction

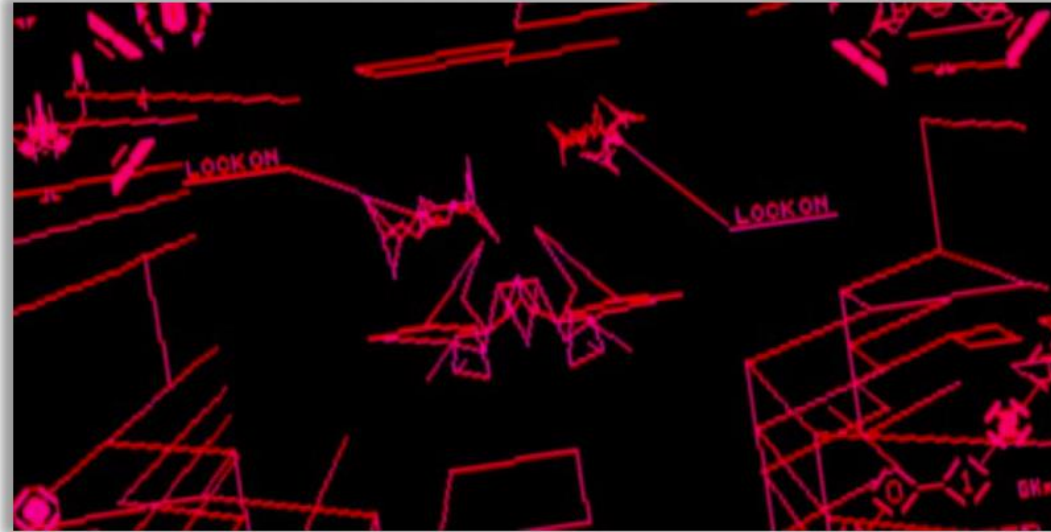


I. Sutherland "A head-mounted three-dimensional display", Fall Joint Computer Conference 1968



Nintendo Virtual Boy

- computer graphics & GPUs were not ready yet!



Game: Red Alarm

- 1995
- Monochrome
- No tracking

“Electronic Engineering Times and CMP Media's TechWeb speculated that using any immersive headset such as the Virtual Boy could cause sickness, flashbacks, and even permanent brain damage.” -Wikipedia



- Color Display
- Decent Resolution
- Low Latency Rendering
- IMU for Tracking



Oculus Quest 2



- Released 2020
- Untethered
- 1832×1920 pixels-per-eye
- No Eye-tracking
- No HDR
- 90 degree FOV
- Inside-out tracking
- Hand Tracking
- \$300



Meta Quest Pro



- Untethered
- 1800×1920 per-eye
- Eye-tracking
- Improved lenses, CPU, more storage
- 106 degree FOV
- Inside-out tracking
- Oct 25, 2022
- \$1500?



By **Brian X. Chen**

Brian X. Chen, who has covered consumer technology for The Times for more than a decade, has worn eight virtual reality headsets.

Oct. 19, 2022, 9:00 a.m. ET

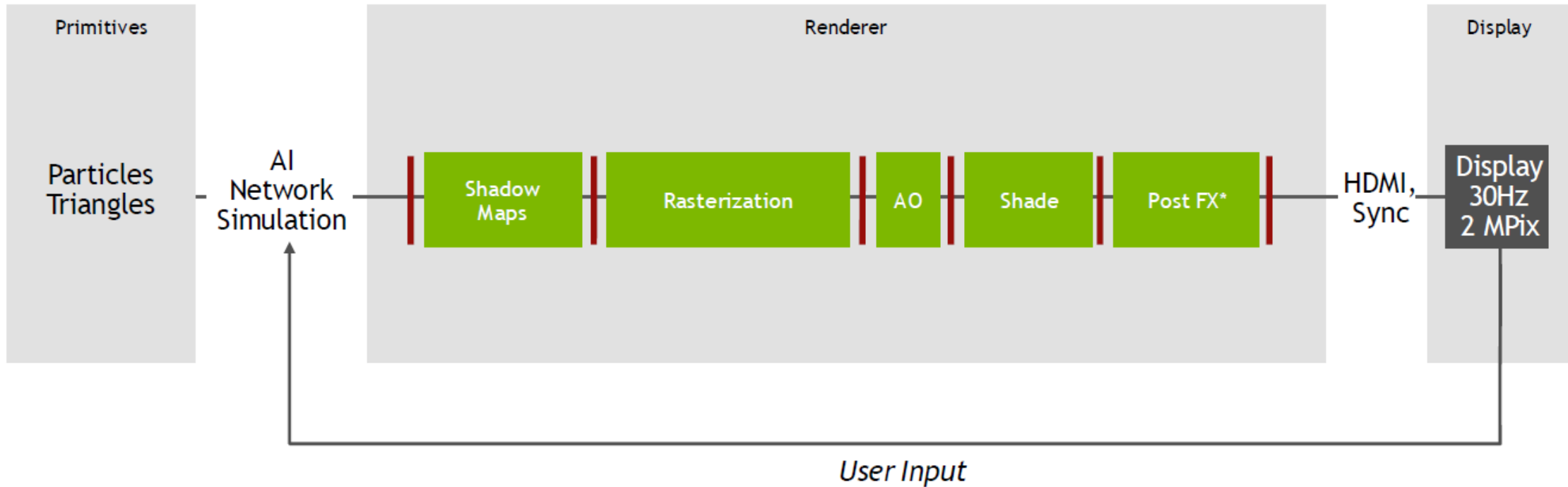
BURLINGAME, Calif. — Good news, readers: After using nearly every virtual reality headset made in the last seven years, including the latest \$1,500 goggles from Mark Zuckerberg’s Meta, I’ve seen the best of what the metaverse could offer.

Yes, the best is already here, and has been for quite some time.

It’s video games.

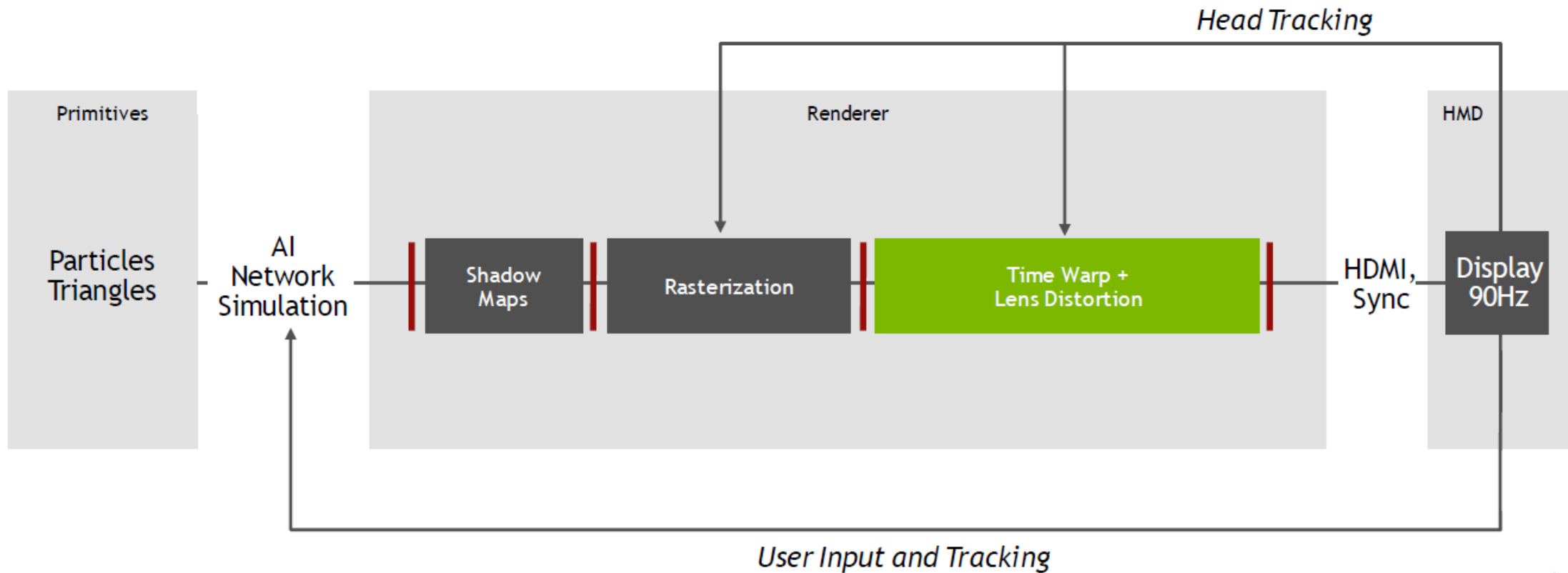


Typical 3D Game Graphics Processing



* Includes depth of field, reflections, fog, color grading, motion blur, antialiasing

Modern VR Graphics Processing



Latency becomes a big concern...view changes rapidly and people get sick if the rendering lags behind the view change

Interface Design: Vection

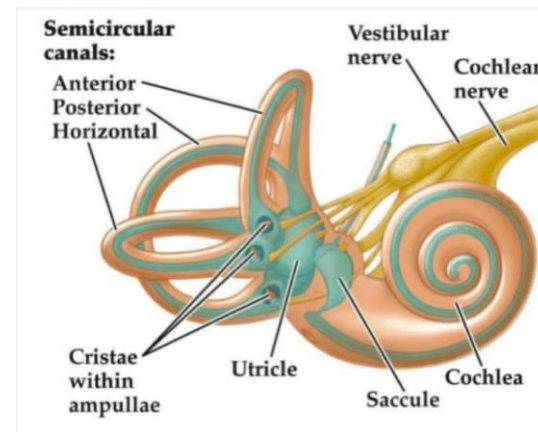
Vection is an illusion of self-motion

Results in mismatch in motion perception between vision and vestibular senses

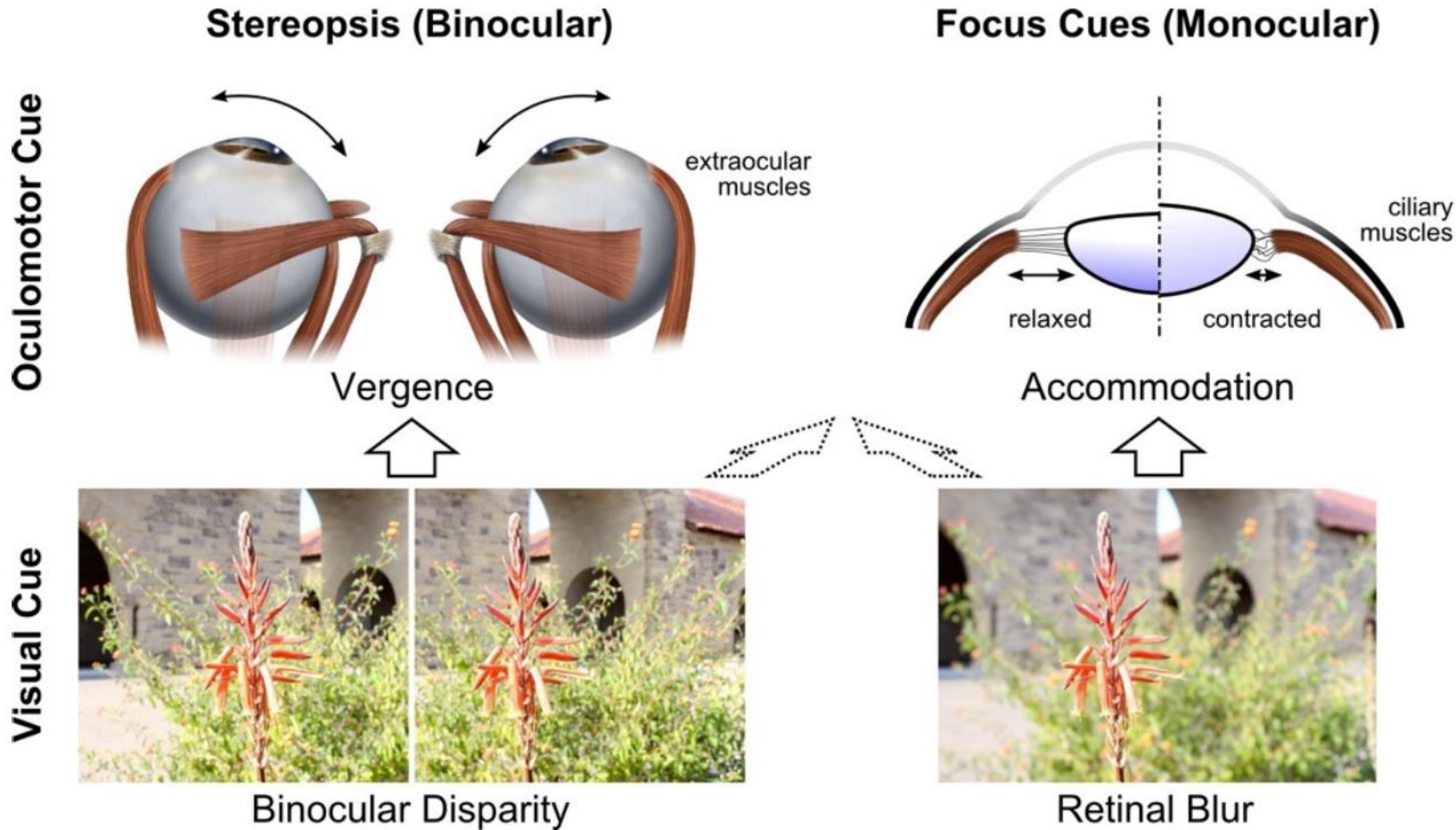
Often induces nausea

UI design tip: use teleportation instead of visual acceleration

The vestibular system is **a sensory system that is responsible for providing our brain with information about motion, head position, and spatial orientation**; it also is involved with motor functions that allow us to keep our balance, stabilize our head and body during movement, and maintain posture.



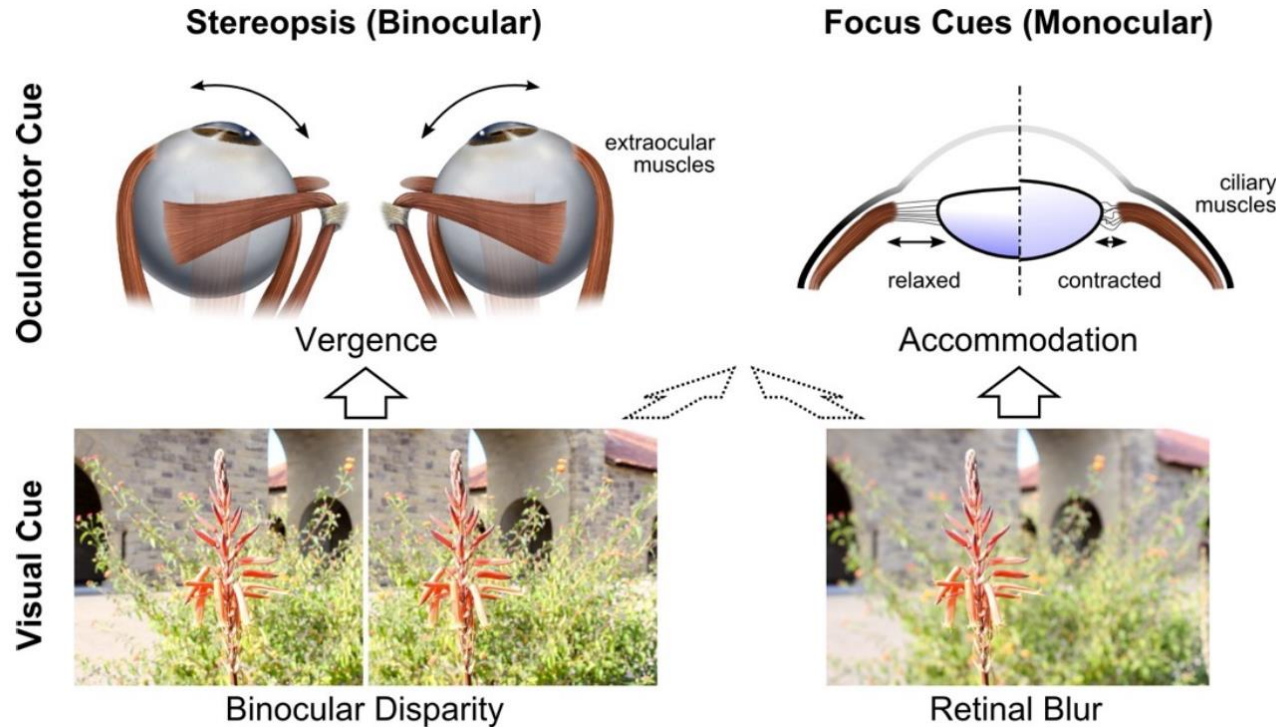
Vergence and Accommodation Mismatch



Vergence-accommodation conflict occurs when your brain receives mismatching cues between the distance of a virtual 3D object (vergence), and the focusing distance (accommodation) required for the eyes to focus on that object.



Interface Design: VAC Conflict



1. Move objects in and out of depth slowly (ish)
2. Try not to stack multiple smaller objects at widely-varying depths overlapping each other.
- 3...and more...consult VR design guides