Lesson 5

Binocular fov is the combined visual span from the overlapping region as seen by both eyes
Monocular fov is the combined visual span but seen individually non overlapping region separately seen by each eye, like the peripheral vision
FOV also affected by individual differences like age and visual disorders

Lens distortions
-rendered view algorithms have incorporated distortion correction algorithms to counter the natural distortions introduced by the physical properties of the lens.
-the further the point is from the center, the more it needs to be shifted to counter the distortions introduced by the curved lens

Chromatic aberrations
-colour artifacts due to how different wavelengths of light reflect differently as they pass through the lens

Software components
-rendering
-physics
-inputs
-audio
-ai
-maybe networking if needed?
Use structured architecture like ECS

Variety of XR Devices

VR
- Meta Quest series
- HTC Vive series

AR
- Magic Leap
- Snap AR Spectacles
- Smartphones with camera feed

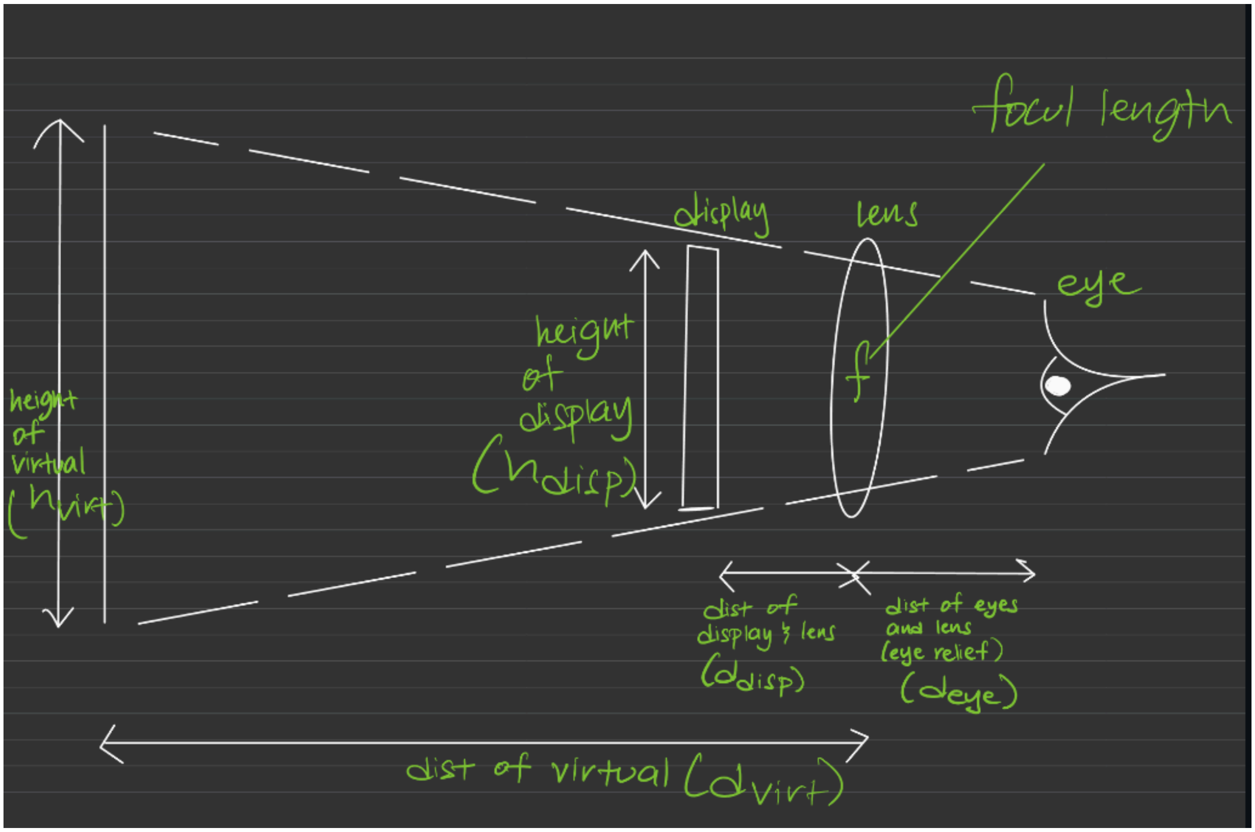
MR
- Microsoft holo lens

VR HMDs
- PC VR
- Standalone or all-in-one VR

AR HMDs
- Smartphones
- Smartglasses

XR HMDs (multi-form/hybrid)

HMDs
- Display screen
- two magnifier glasses
- Specialized controllers
  - emit infrared array lights
  - have motion tracking sensors to detect these lights
- Other motion tracking sensors in the HMD
- Cameras all over
- Battery
- Speakers
- GPU
- CPU
- Compact motherboard
- Other sensors that can be found on a smartphone


focul length
display
lens
eye
height of display (h_{disp})
height of virtual (h_{virt})
f
dist of display & lens (d_{disp})
dist of eyes and lens (eye relief) (d_{eye})
dist of virtual (d_{virt})

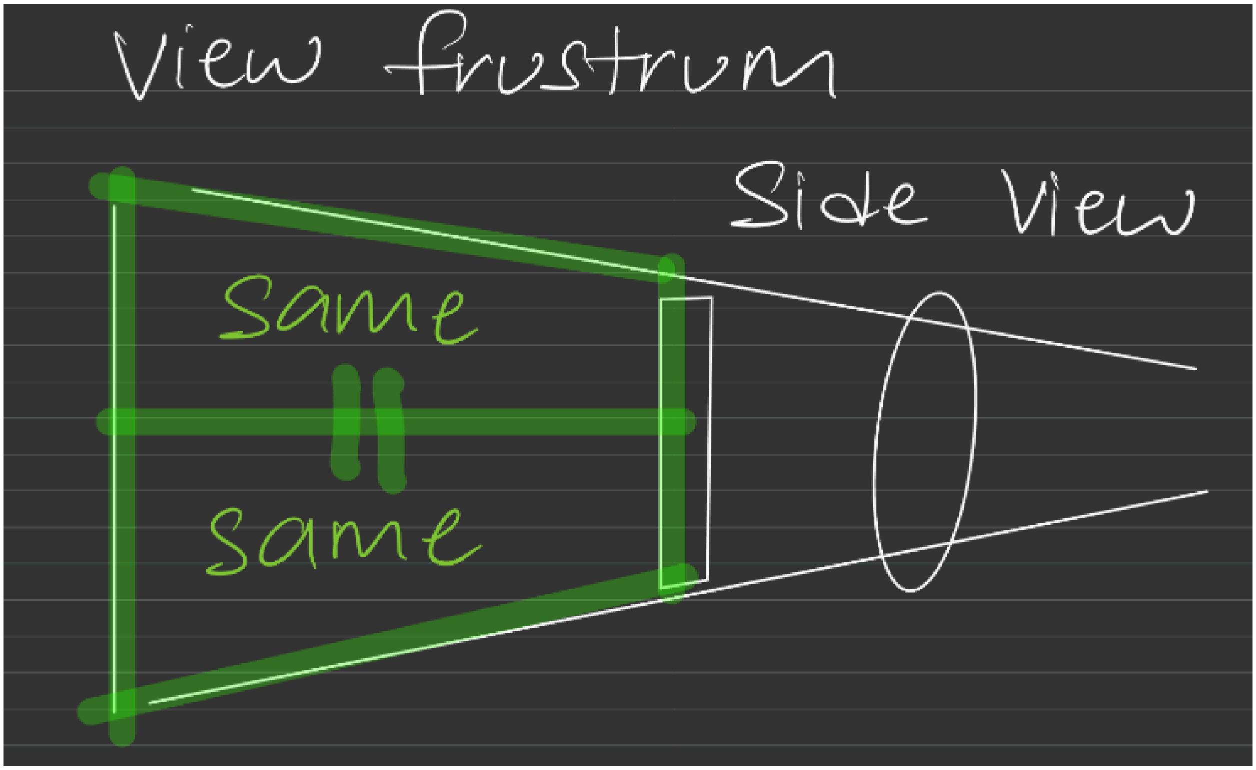
Gaussian Thin Lens formula

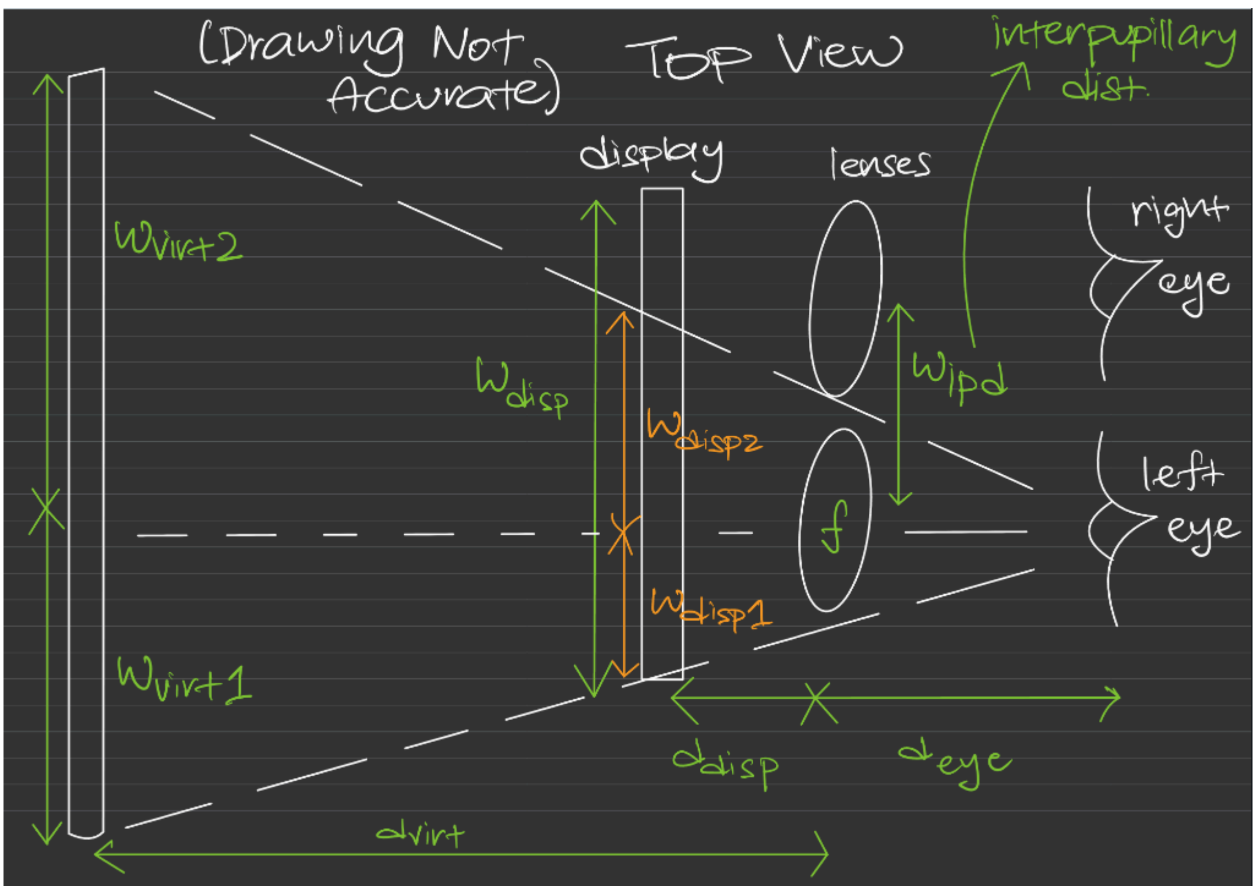
$$\frac{1}{d_{virt}} + \frac{1}{d_{disp}} = \frac{1}{f}$$

$$d_{virt} = \left| \frac{1}{\frac{1}{f} - \frac{1}{d_{disp}}} \right| \quad //$$

$$\text{Magnification } M = \frac{f}{f - d_{disp}}$$

$$h_{virt} = M \, h_{disp}$$


View frustrum
Side View
Same
Same


(Drawing Not Accurate)
Top View
interpupillary dist.
display
lenses
right eye
left eye
W_{virt2}
W_{virt1}
W_{disp}
W_{disp2}
W_{disp1}
W_{ipd}
f
d_{disp}
d_{eye}
d_{virt}

The closer the ipd of the device is to the ipd of your eyes, the better viewing experience

$$W_{virt2} = M\left(\frac{W_{ipd}}{2}\right)$$

$$W_{virt1} = M\left(\frac{W_{disp} - W_{ipd}}{2}\right)$$

$$Z = d_{disp} + d_{eye}, \quad d = d_{virt} + d_{eye}$$

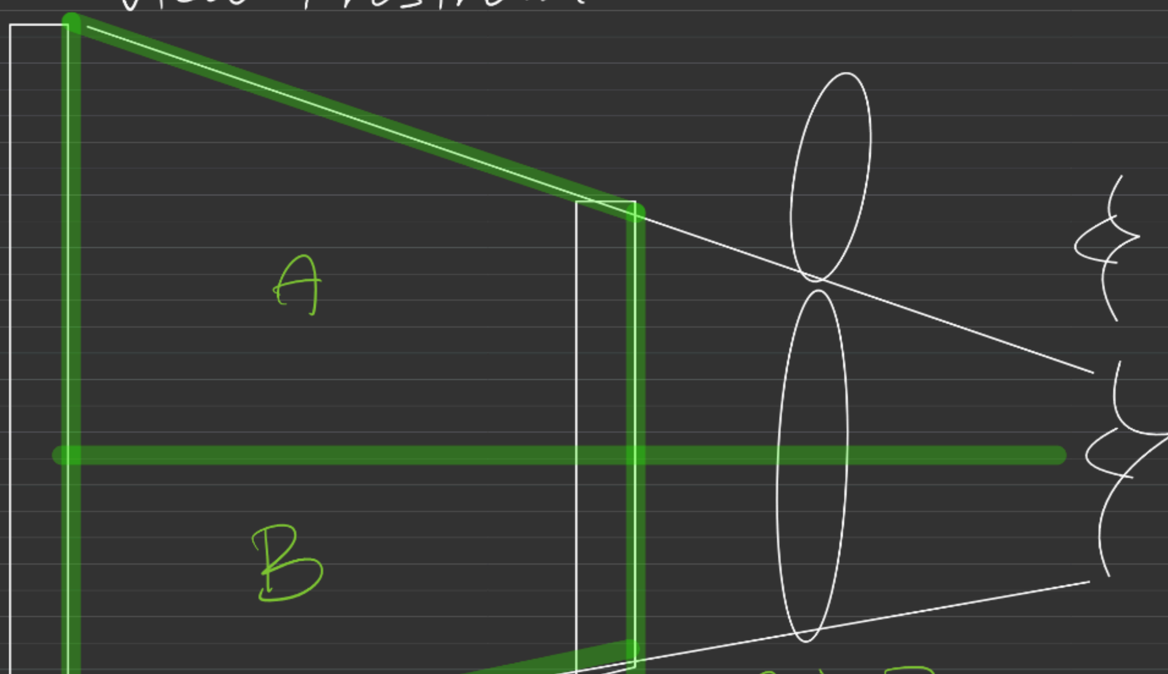
$$W_{disp2} = Z\left(\frac{W_{virt2}}{d}\right)$$

$$W_{disp1} = -Z\left(\frac{W_{virt1}}{d}\right)$$

For LEFT eye, $W_{virt1} > W_{virt2}$

For RIGHT eye, $W_{virt2} > W_{virt1}$

View Frustrum



$A \neq B$

*By right $B > A$ for left eye but I suck

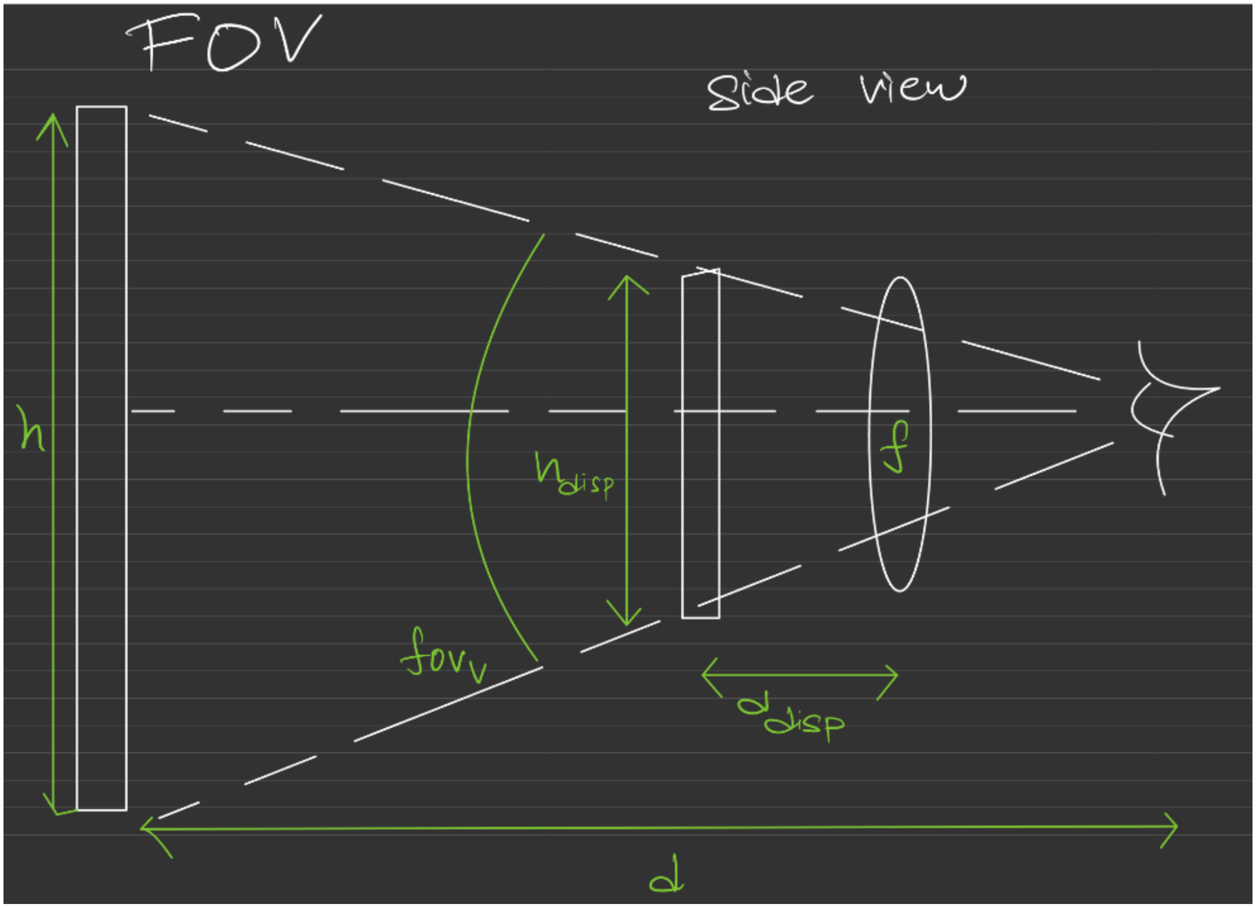
Vertically (side view), view frustrum symmetric

Horizontally (top view), view frustrum asymmetric

- Due to offset of the world formed
- i think at centre

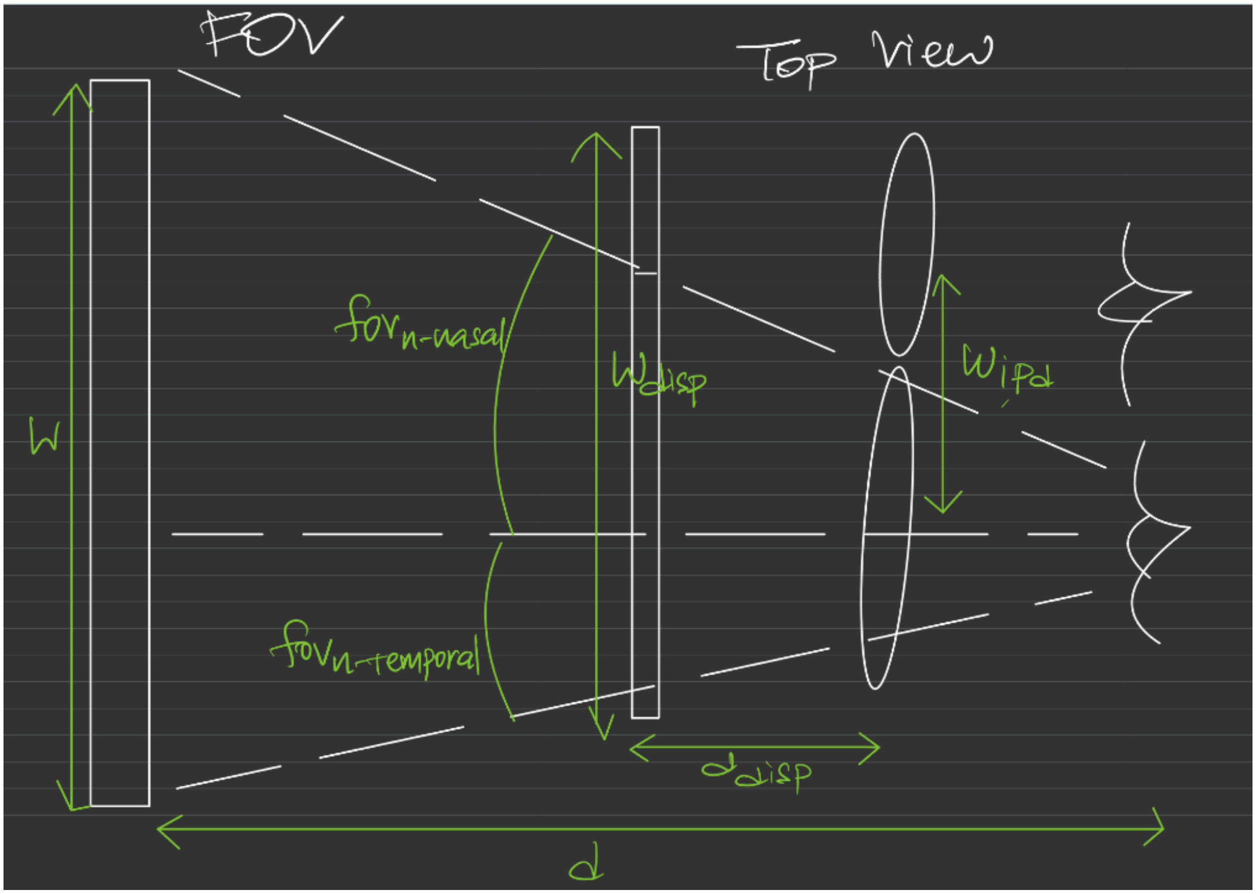
HMD key dimensions:

- focal length (f)
- IPD (w_{ipd})
- Screen-lens dist (d_{disp})
- eye relief (d_{eye})



$$M = \frac{f}{f - d_{disp}}$$

$$fov_v = 2\tan^{-1}\left(\frac{M\left(\frac{h}{2}\right)}{d}\right)$$

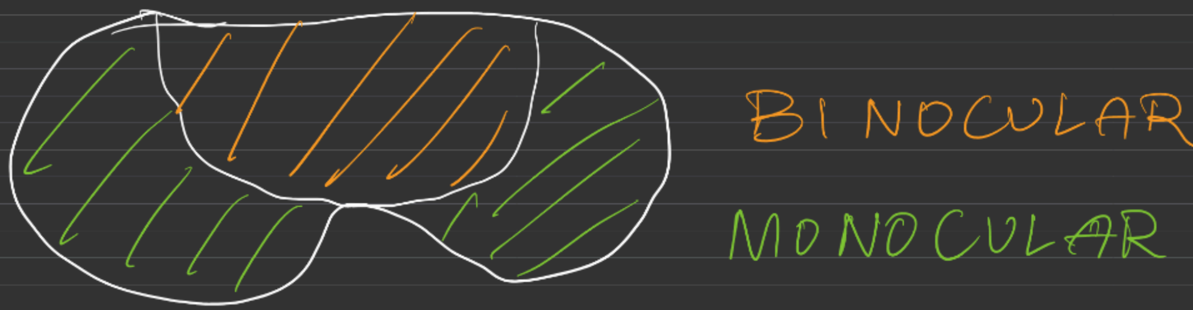

FOV
Top View
fov n-nasal
fov n-temporal
W
W disp
W ipd
d disp
d

$$fov_n = fov_{n\text{-nasal}} + fov_{n\text{-temporal}}$$

$$= \tan^{-1}\left(\frac{M\left(\frac{W_{ipd}}{2}\right)}{d}\right) + \tan^{-1}\left(\frac{M\left(\frac{W - W_{ipd}}{2}\right)}{d}\right)$$

Binocular FOV – combined visual span from the overlapping vision seen by both eyes

Monocular FOV – combined visual span seen individually by the non overlapping area, separately seen by each eye



Lens Distortion

- The further the point is from the centre, the more it needs to be shifted in order to counter the distortion introduced by the curved lenses
- Chromatic Aberration

Other modern Hardware

- Wearable motion trackers
  - Vive trackers
- Eye tracking

Video Games $\subseteq$ interactive real-time simulation

Software Components

- Rendering (Graphics) system
- Physics system
- Input hander
- Audio processor
- AI system
- Entity Component System (ECS)
- etc.