CSE 190: Virtual Reality Technologies

LECTURE #15: ISSUES WITH VR DISPLAYS

Upcoming Deadlines

Sunday, May 23: Project 3 due

Monday, May 24: Discussion Project 4

Sunday, May 30: Project 4 original due date

Monday, May 31: Memorial Day (no discussion)

Sunday, June 6: Project 4 due

App Presentations

Manxin Zhang

- Multibrush

Haozhe Luo

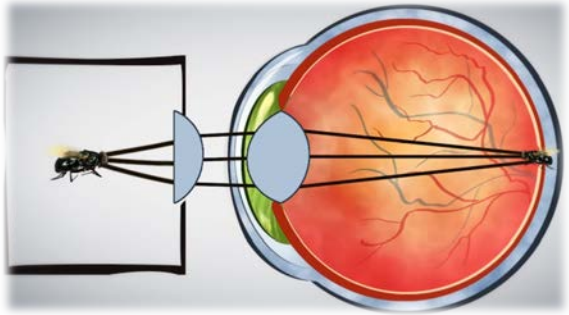
- Google Earth

Edward Xie

- Hand Physics Lab

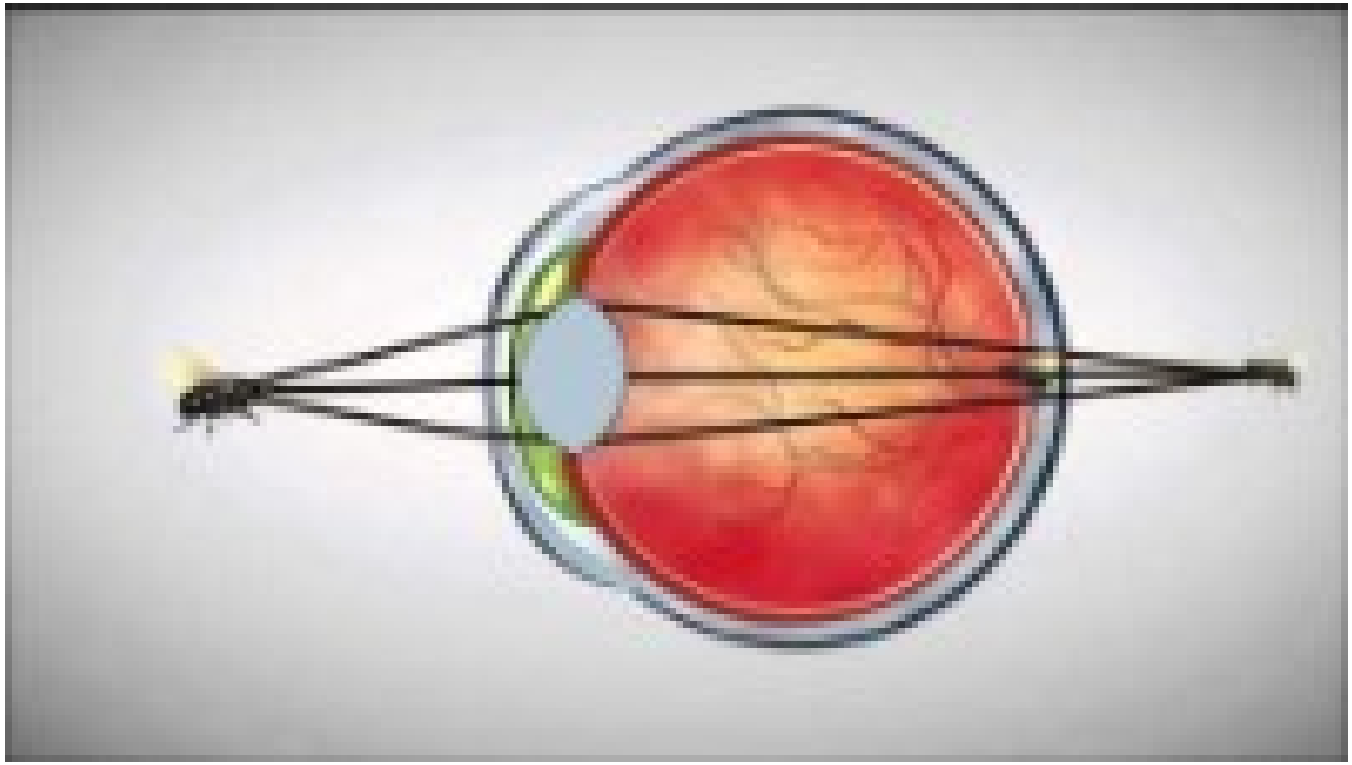
Issues with VR Displays

Lenses for VR HMDs



How lenses for VR HMDs work:

- https://www.youtube.com/watch?v=NCBEYaC876A



Focal Distance

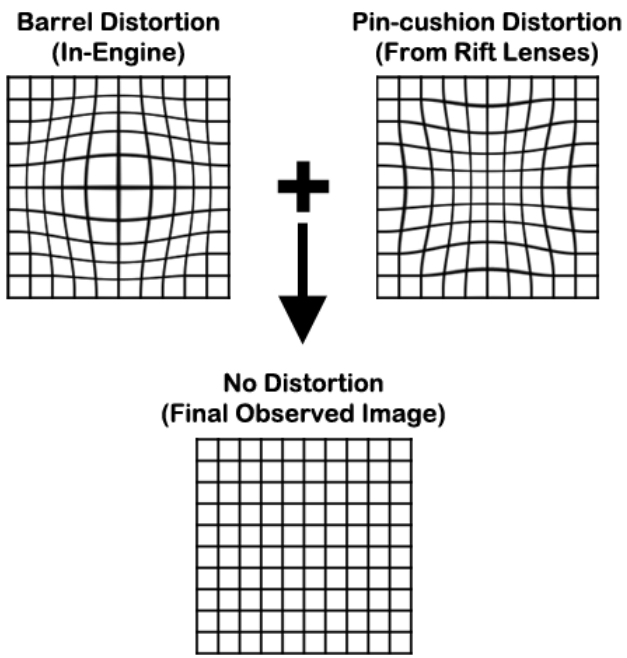
Apparent distance from eye to where the pixels are in focus.

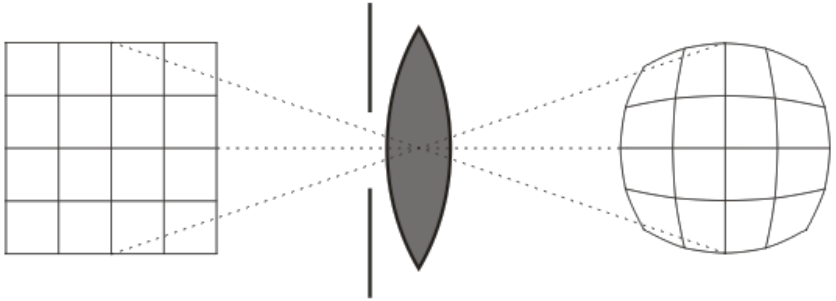
HMD	Focal Distance
Oculus DK1	Infinity
Oculus DK2	1.4 meters
Oculus CV1	2 meters
Oculus Quest 1 and 2	2 meters
HTC Vive, Vive Pro	~1 meter
Valve Index	~1.8 meters

Lens Distortion

All VR HMDs have lenses which distort the image.

VR engine has to render a pre-distorted image so that the user will see a correct, undistorted image. A simple pixel shader can do this.



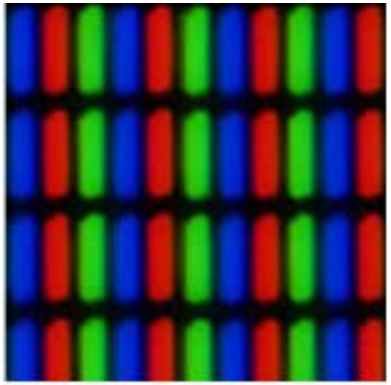


Lens Distortion

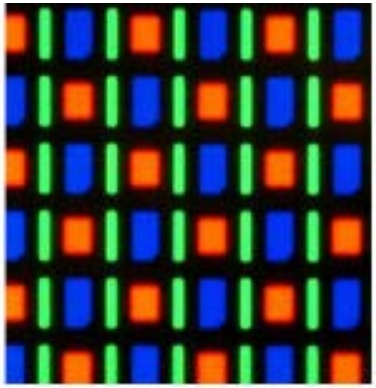
https://youtu.be/B7qrgrrHry0

Screen Door Effect

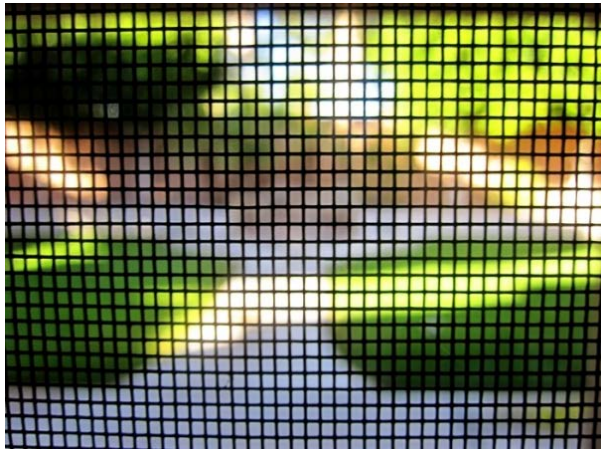
Because pixels on LCD and OLED displays have dead space in-between them image looks like looking through a screen door when looking at it through magnifying lenses.



LCD
DK1



OLED
DK2



Screen Door

Chromatic Aberration

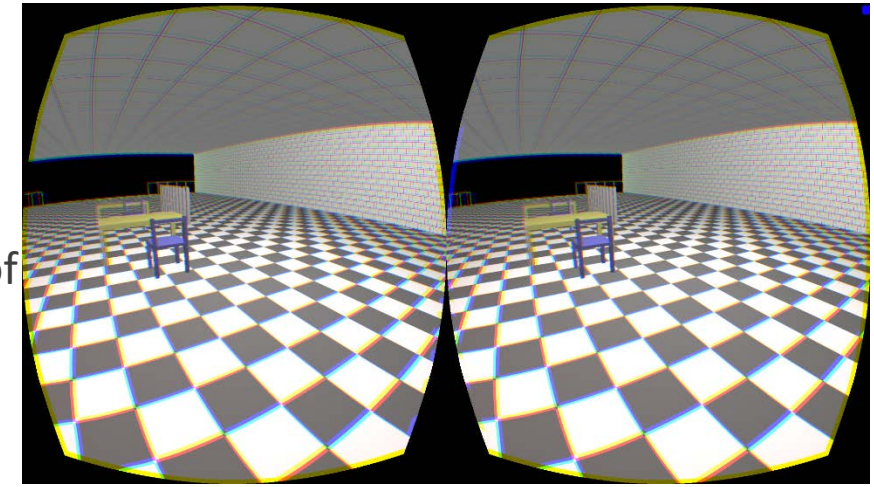
Arises from the inability of a lens to focus all colors in the same place.

FOcal length depends on refraction.

blue and red light have different indexes of refraction → their focal length is also slightly different.

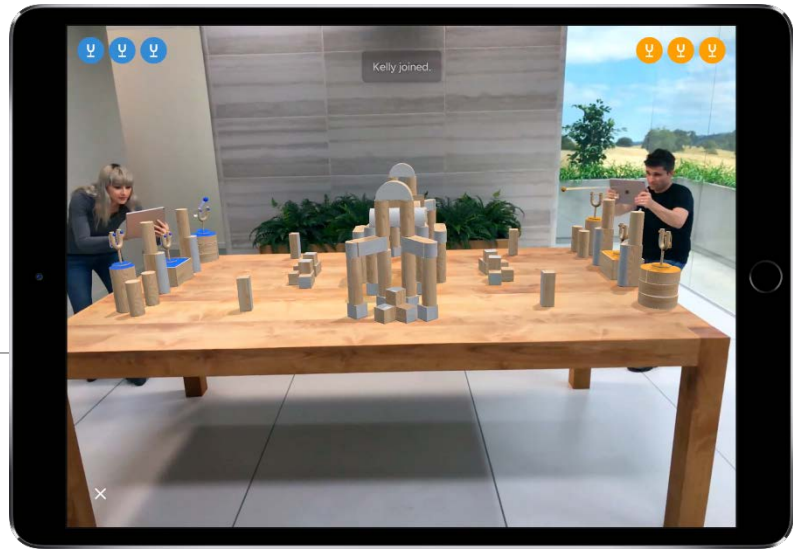
Chromatic aberration is clearly visible on photographs or video as the color channels are not perfectly aligned.

Remedy: apply “Brown's model” distortion correction formula to each color channel independently.



AR on Mobile Phones

Apple ARKit



ARKit 1 supported by any device with iOS 11

ARKit 2 available since iOS 12

Persistent AR Experiences:

- Provide AR experiences that persist between sessions, and can be resumed at a later time

Shared AR Experiences:

- Multiple users can use their iOS device to simultaneously view AR experiences or play multiplayer games. Bystanders can spectate AR games being played by multiple participants.

Object Detection and Tracking:

- ARKit 1.5 added support for 2D image detection, letting you trigger an AR experience based on 2D images like posters, artwork, or signs. ARKit 2 offers full 2D image tracking, so you can incorporate movable objects like product boxes or magazines into your AR experiences. ARKit 2 also adds the ability to detect known 3D objects like sculptures, toys, or furniture.

ARKit Video

https://www.youtube.com/watch?v=-o7qr1NpeNI

Google ARCore

Motion tracking:

- understand and track the phone’s position relative to the world

Environmental understanding:

- detect the size and location of all type of surfaces: horizontal, vertical and angled surfaces like the ground, a coffee table or walls

Light estimation:

- estimate the environment's lighting conditions

ARCore Video

https://www.youtube.com/watch?v=ttdPqly4OF8