CSE 190: Virtual Reality Technologies

LECTURE #15: HEAD MOUNTED DISPLAYS PART 3

VR Content Presentations

Josh Anthony: Haunted Rooms: Escape VR Game

- https://docs.google.com/presentation/d/1bf70Cd-c13Avt1wArEgyF_q1ff07HpNo_DWa8ttSrjs/edit?usp=sharing

Jonathan Pham: Sketchfab VR

- https://docs.google.com/presentation/d/12Fa-DjtrUtvlWrW114nPgL5T7uCH6Dqn0hCiwes3Pqw/edit?usp=sharing

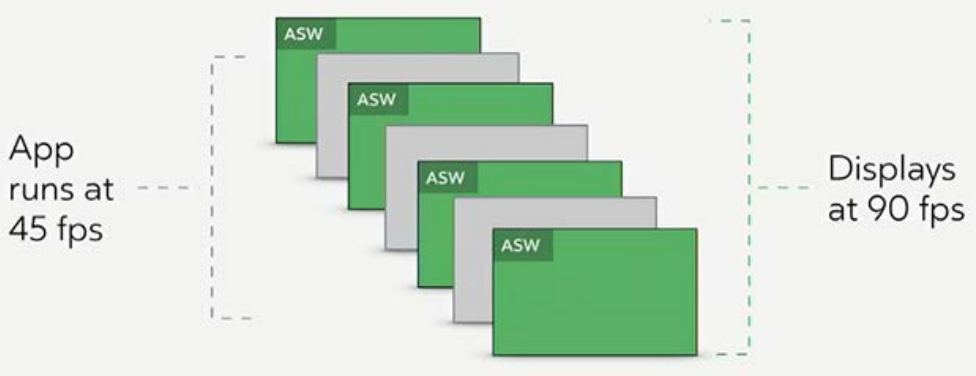
Announcements

Midterm Exam

- Thursday 2-3:20pm
- In regular classroom
- Closed book
  - Permitted: pen, pencil, eraser, ruler, blank scratch paper

No office hour this Thursday, moved to today 4-5pm

Optimizations: Asynchronous Space Warp



When an application fails to render frames at 90Hz, the Rift driver drops the application down to 45Hz with ASW providing each intermediate frame.

ASW works in tandem with ATW to cover all visual motion within the virtual reality experience.

ASW applies animation detection, camera translation, and head translation to previous frames in order to predict the next frame.

This includes character movement, camera movement, Touch controller movement, and the player's own positional movement.

ASW – Results

As a result, motion is smoothed and applications can run on lower performance hardware:

- Nvidia 960 or greater (down from GTX 970 or greater)
- Intel i3-6100 / AMD FX4350 or greater (down from Intel i5-4590 equivalent or greater)

ASW tends to predict linear motion better than non-linear motion.

ASW – Visual Artifacts

ASW has problems with:

- Quick brightness changes
- Rapidly-moving repeating patterns in the environment
- Head-locked elements that move too fast to track properly

Spacewarp is a band-aid rather than a real performance optimization

Alternatives to ASW:

- Reduce rendering resolution
- Reduce polygon complexity
- Reduce texture detail
- Reduce time spent on non-rendering tasks

Oculus Rift CV1 Teardown

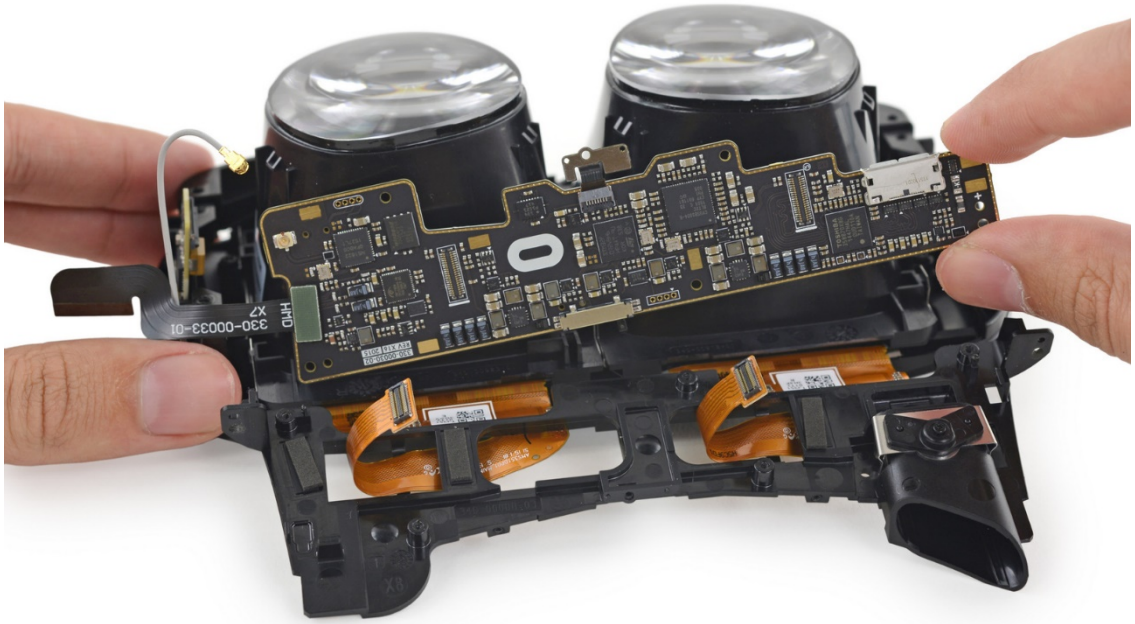
Oculus Rift: Ear Phones

Face Foam

Separable lens/electronics assembly

LEDs and Microphone

Motherboard



Separate lens/display assemblies

Lenses: DK2 vs. CV1

Circular vs. Asymmetric

CV1 Lens

Asymmetric

Hybrid Fresnel lens

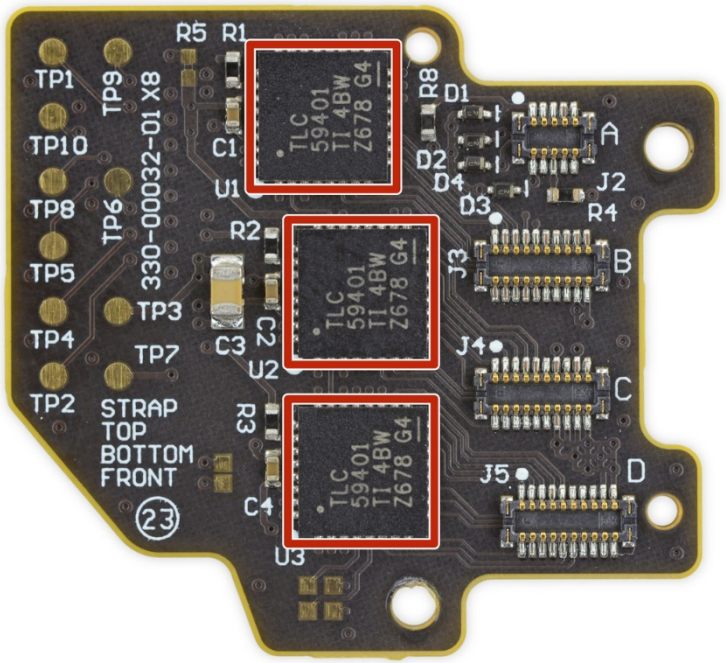
Focus varies along vertical axis of lens

→ Push lens higher or lower to focus

Adjustable IOD

Adjusts between 5 and 95 percentile of people's IPD (Inter Pupillary Distance)

LED Driver Board



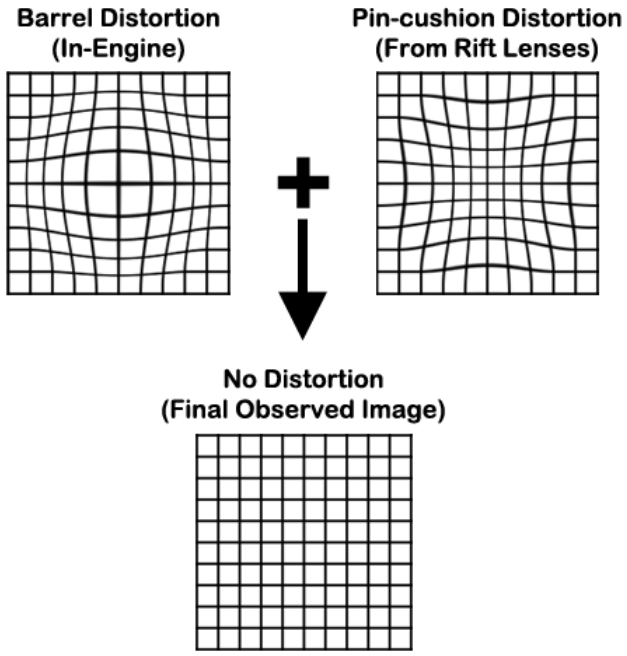
Headband Springs

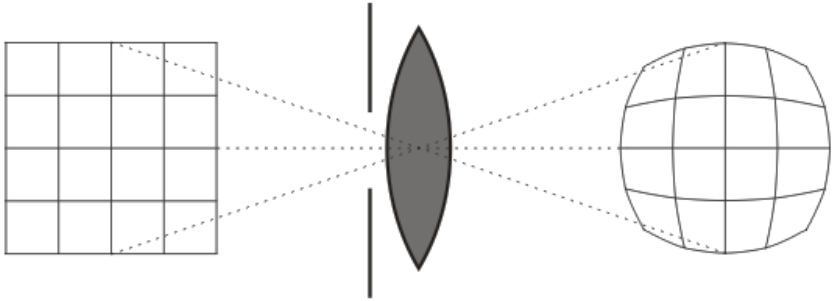
Give headband an extra inch of play

Lens Distortion

All VR HMDs have lenses which distort the image.

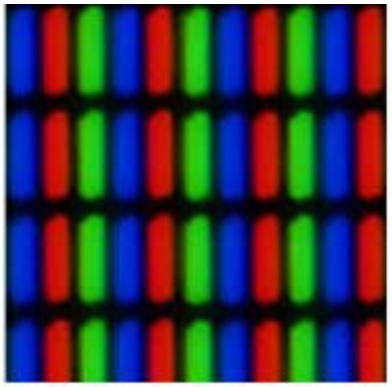
VR engine has to render a pre-distorted image so that the user will see a correct, undistorted image. A simple pixel shader can do this.



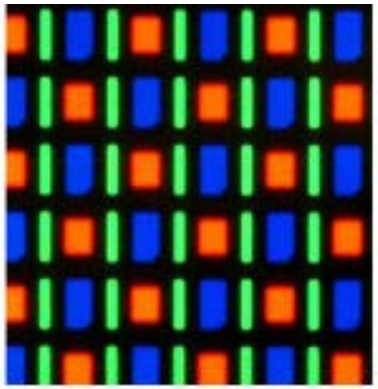


Screen Door Effect

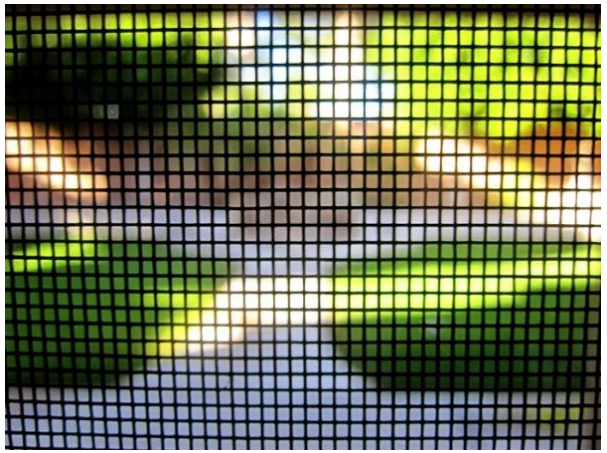
Because pixels on LCD and OLED displays have dead space in-between them image looks like looking through a screen door when looking at it through magnifying lenses.



LCD
DK1



OLED
DK2



Screen Door

Chromatic Aberration

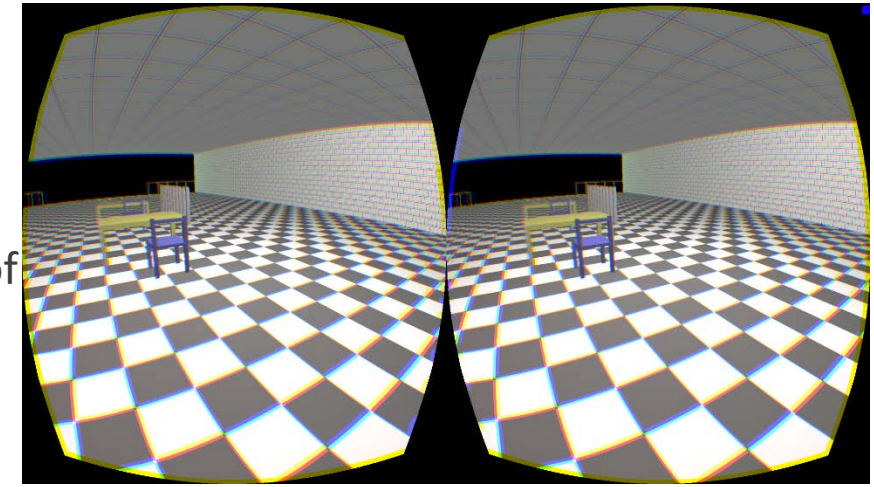
Arises from the inability of a lens to focus all colors in the same place.

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.



Related Technologies

Google Glass

Small display in front of one eye

Not designed for VR

Project ends in Jan 2015

Explorer Edition available for selected users ($1,500)

Built-in Android 4

640x360 pixels

Built-in 5 MP camera

Wi-Fi, Bluetooth

16GB RAM

Gyroscope, accelerometer, compass, light sensor

Augmented Reality

Some of the best AR goggles:

- Osterhout Design Group R-7: small (right)
- Microsoft HoloLens: great tracking (below, left)
- Meta 2: yet to be released (below, right)

Auto-Stereoscopic Displays

Lenticular

Volumetric

Holographic