CSE 190: Virtual Reality Technologies

LECTURE #9: HIGH-END HEAD-MOUNTED DISPLAYS

Announcements

Homework project 2

- Due Friday, May 3rd at 2pm
  - To be demonstrated in VR lab B210
  - Upload code to Ted by 2pm

Office hour

- Moving from Thursday to today after class 3:30-4:30pm

Jobs and internships at BrainCorp

Oculus Tray Tool

"It's harder to sell a robot than to build a robot."

Dr. Eugene Izhikevich

Transforming everyday machines into autonomous solutions

High-End HMDs

Oculus Rift DK1

Released March 2013

Single LCD screen

Focus on fast gyroscope for head tracking

Head orientation tracking only

Field of view: 110 degrees

Oculus Rift DK2

Released July 2014

Single OLED screen

Same gyroscope as DK1

Adds camera for location tracking

Field of view: 95 x 105 degrees

	DK1	DK2
Screen Resolution:	1280 x 800	1920 x 1080
Pixel Layout	RGB	Pentile
OLED	NO	YES
Screen Size	7”	5.7”
Screen Manufacturer and model	Innolux HJ070IA-02D 7″ LCD	Samsung Galaxy Note 3
Latency	50ms – 60ms	20ms – 40ms (presumed)

Low Persistence	NO	YES
Refresh Rate	60Hz	75Hz
Orientation Tracking	YES	YES
Positional Tracking	NO	YES
Gyroscope, Accelerometer, Magnetometer	YES	YES
FOV	110	100
3D	Stereoscopic	Stereoscopic

HTC Vive

Oculus Rift CV1

Sony Playstation VR

Sold for Play Station 4

1920x1080 pixels

OLED

Field of view: 100 degrees

Innovative head strap

Uses Move controllers

New VR Aim controller, released 5/16, $60

	HTC Vive	Oculus Rift	PlayStation VR
Display Type & Size	Dual low-persistence Samsung AMOLED (Diamond PenTile subpixel matrix*)	Dual low-persistence Samsung AMOLED (Diamond PenTile subpixel matrix*)	Low-persistence AMOLED (RGB subpixel matrix)
Display Size	91.9 mm × 2, 447 ppi	90 mm × 2, 456 ppi	5.7-inch
Resolution	1200 × 1080 (per eye)	1200 × 1080 (per eye)	960 × 1080 (per eye)
Refresh Rate	90Hz	90Hz	90Hz, 120Hz
Field of View	~110H × 113V-degrees at optimal 8 mm lens-to-eye distance	~94H × 93V-degrees at optimal 12 mm lens-to-eye distance	~100-degrees at optimal lens-to-eye distance

Source: http://www.tomshardware.co.uk/vive-rift-playstation-vr-comparison,review-33556-3.html

	HTC Vive	Oculus Rift	PlayStation VR
Lens Type	Fresnel	Hybrid Fresnel	Standard
Lens Adjustment	IPD (60.8-74.6 mm), lens-to-eye distance ("eye-relief" adjustment)	IPD (58-72 mm), lens-to-eye distance (adjustable with optional glasses spacer)	Software IPD, lens-to-eye distance
Sensors	Accelerometer, gyroscope	Accelerometer, gyroscope, magnetometer	Accelerometer, gyroscope
Tracking Technology	6 DOF IR Laser-based 360-degree tracking using "Lighthouse" Base Stations	6 DOF Constellation camera optical 360-degree IR LED tracking	6 DOF PlayStation Camera optical 360-degree LED tracking

	HTC Vive	Oculus Rift	PlayStation VR
Integrated Camera	Yes	No	No
Audio	Microphone, jack for external headphones	Microphone, integrated supra-aural 3D spatial audio headphones (removable)	Microphone, jack for external headphones
Wireless	Bluetooth 4.1 (in Link Box for Base Stations and cell phone)	Bluetooth for remote (and for Touch controllers later)	TBA
HMD Ports	HDMI 1.4, USB 3.0 x 2	Proprietary headset connector (HDMI/USB 3.0)	None

	HTC Vive	Oculus Rift	PlayStation VR
HMD Cable Length	5 m (plus 1 m from Link Box to PC)	4 m	~4 m (plus ~2 m from Processing Unit to PlayStation 4)
Materials Used	Plastic, glass, foam rubber	Plastic, IR-transparent fabric, glass, foam rubber	Plastic, glass, foam rubber
Dimensions	~190mm × ~127mm × ~89 – 127mm (W × H × L, length excludes headband, min eye-relief to max eye-relief)	~171 (~216) × ~102 mm (W (width including headphones) × D)	187 × 185 × 277 mm (W × H × L, excludes largest projection, headband at the shortest)
Weight	563g (excluding cable)	470g (excluding cable)	~610g (excluding cable)

Oculus Rift CV1 Teardown

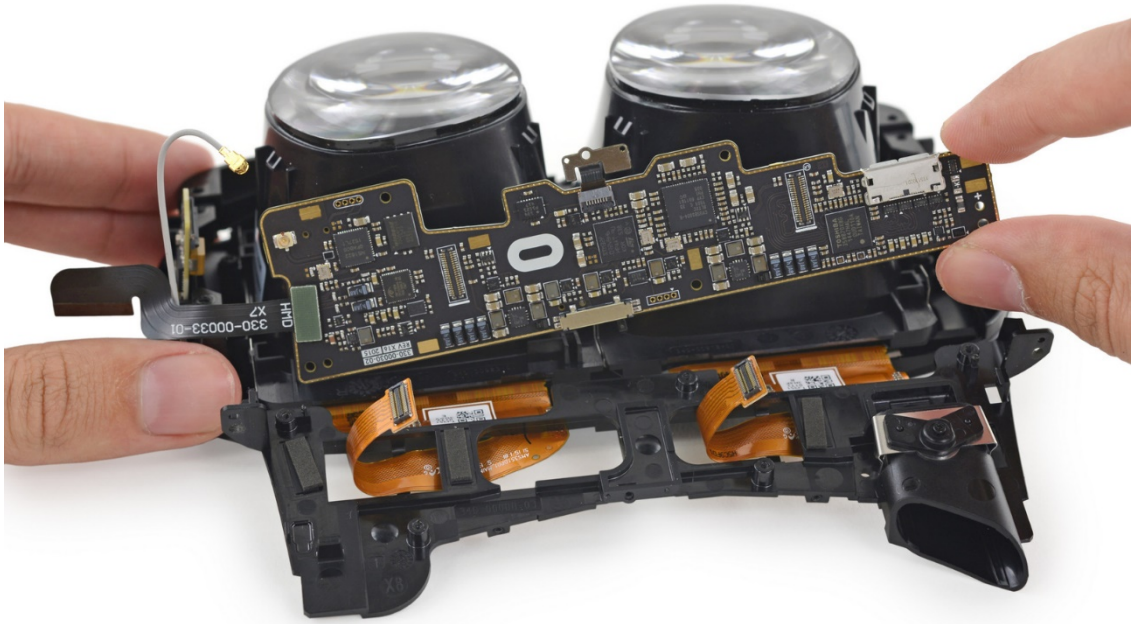
Oculus Rift: Ear Phones

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

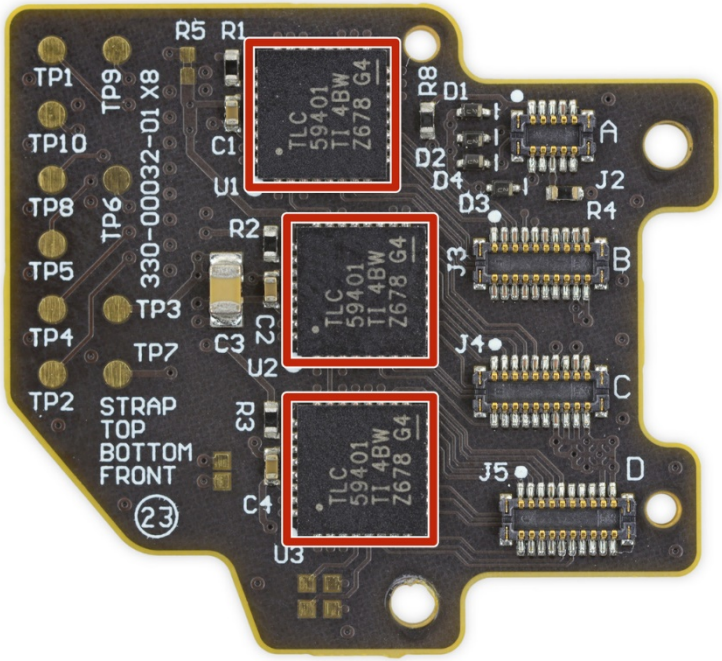
Focus varies along vertical axis of lens

→ 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

Microsoft Mixed Reality

VR HMDs
- No augmented reality

Specifications by Microsoft

Dual 6 DOF controllers

Inside-out 6 DOF tracking

HMDs built by:
- Samsung
- Dell
- HP
- Lenovo
- Acer
- Asus

HTC Vive Pro

Built-in stereo cameras for AR

1440x1600 pixels per eye

90Hz

110 degrees FOV

Integrated headphones and microphones

Accelerometer, gyroscope, proximity sensor, IPD sensor

HTC Vive Focus

Standalone VR HMD

1440x1600 pixels per eye

75 Hz refresh rate

110 degrees FOV

Qualcomm Snapdragon 835

Built-in headphones, microphones

3 hours battery life

Hand-held controller