

CSE 190: Virtual Reality Technologies

LECTURE #10: 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

Instructor's office hour

- Moving from Thursday to Tuesday this week, 3:30-4:30pm

Jobs and internships at BrainCorp (Sorrento Valley)

New script to fix folder access problem when running Oculus driver:

- "OCULUS_APRIL_FIX" is on the desktop
- Run as admin then open OCULUS after the file has run
- If the file is not on the desktop running the command "gpupdate" will put it there

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 model	and Innolux HJ070IA-02D 7" LCD	Samsung Galaxy Note 3
Latency	50ms – 60ms	20ms – 40ms (presumed)



	DK1	DK2
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

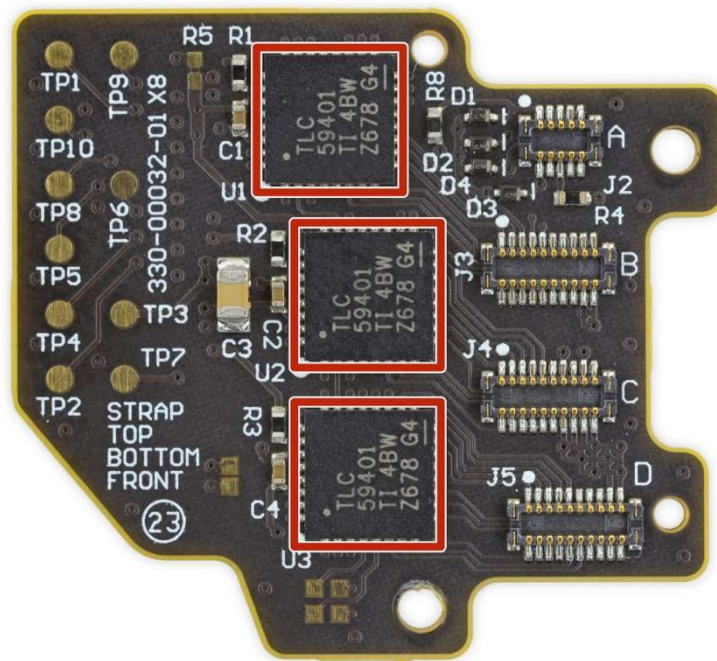


Adjustable IOD

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

