

Overview of AR Headsets

Tue, June 30 (Week 2)

Revisit of the Definition of AR

Azuma's Definition:

1. Combine the real and the virtual.
2. Support interactions in real time.
3. Register the virtual to the real in 3D.

The Basic Structure of AR Headsets

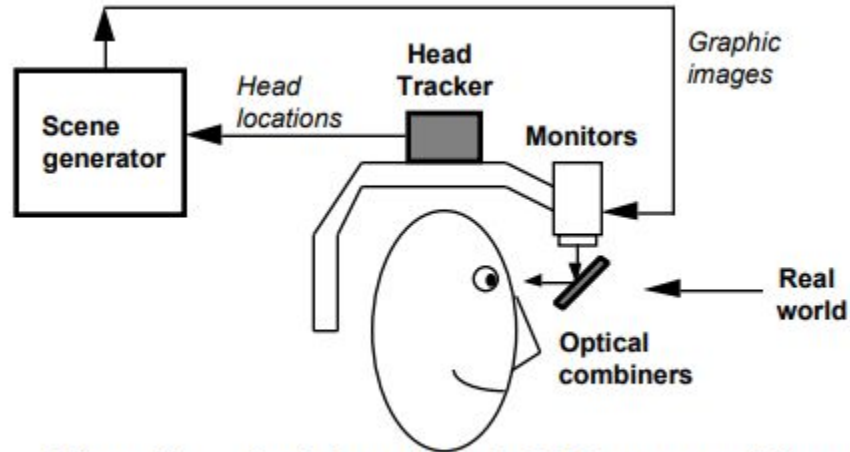


Figure 11: Optical see-through HMD conceptual diagram

The Basic Structure of AR Headsets

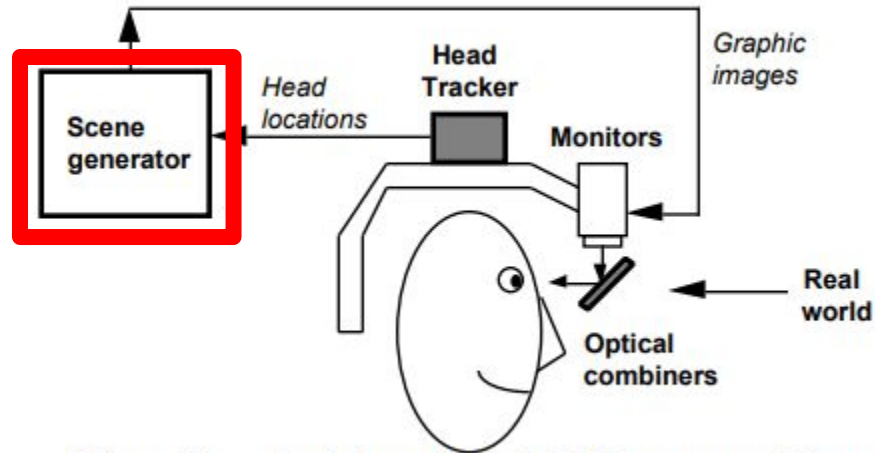


Figure 11: Optical see-through HMD conceptual diagram

Mathematical Wonderland





UNREAL ENGINE 5



<https://youtu.be/qC5KtatMcUw>

Graphics



Texturing



Fig. 2. Simple gridwork texture pattern: left-hand side shows texture pattern; right-hand side shows textured object.

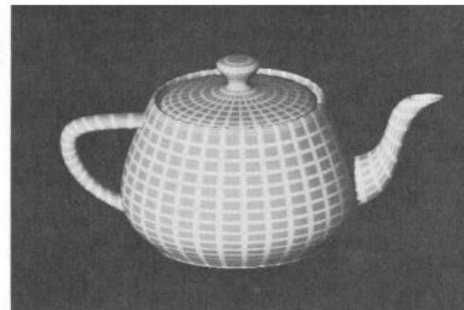
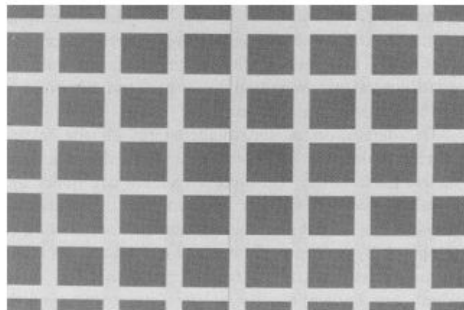
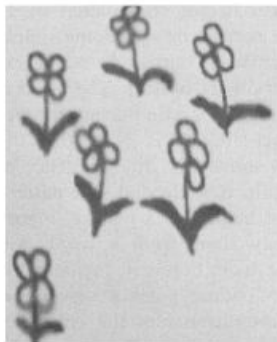


Fig. 3. Hand sketched texture pattern: left-hand side shows texture pattern; right-hand side shows textured object.



Lighting



CPUs/GPUs



SoC (= CPU + GPU + etc.)



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CPU	CPU Clock Speed: Up to 2.96 GHz	Cellular Technology	Cellular Technology: WCDMA (DB-DC-HSDPA, DC-HSUPA), TD-SCDMA, GSM/EDGE	Camera	Image Signal Processor: Qualcomm Spectra™ 280 image signal processor, Dual 14-bit ISPs
	CPU Cores: Qualcomm® Kryo™ 385 CPU, Octa-core CPU		LTE Technology: LTE FDD, LTE TDD including CBRS support, LAA, LT		Dual Camera: Up to 16 MP
	CPU Architecture: 64-bit				Single Camera: Up to 32 MP
Process	Process Technology: 10 nm (2nd generation)	Wi-Fi	Wi-Fi Standards: 802.11ad, 802.11ac Wave 2, 802.11a/b/g, 802.11n	Video	Camera Features: Active Depth Sensing, Hardware Accelerated Face Detection, Hybrid Autofocus, Multi-frame Noise Reduction (MFNR)
			Wi-Fi Spectral Bands: 2.4 GHz, 5 GHz, 60 GHz		Video Capture (30 FPS): 4K Ultra HD video capture
			Peak Speed: 867 Mbps		Slow Motion Video Capture: 720p @ 480 FPS
DSP	DSP Technology: Qualcomm® Hexagon™ 685 DSP, Qualcomm AIWays		Channel Utilization: 20/40/80 MHz		Video Capture Formats: HDR10, HLG, HEVC
			MIMO Configuration: 2x2 (2-stream)		
			Peak QAM: 256 QAM		Codec Support: H.265 (HEVC)
Cellular Modem	Modem Name: Qualcomm® Snapdragon™ X20 LTE modem		Wi-Fi Features: MU-MIMO, Multi-gigabit Wi-Fi, Dual-band simultane	Display	Video Software: Accelerated Electronic Image Stabilization, Motion Compensated Temporal Filtering (MCTF)
	Multi SIM: Dual SIM Dual VoLTE (DSDV)		baseband		
LTE Category	Downlink LTE Category: LTE Category 18	Bluetooth	Bluetooth Version: Bluetooth 5.0		Max On-Device Display: 4K Ultra HD
	Uplink LTE Category: LTE Category 13				Max External Display: 4K Ultra HD
					UI FPS: Up to 60 FPS
LTE Downlink Features	Downlink LTE Streams: Maximum 12 spatial streams	NFC	Near Field Communications: Supported		Standards: ULTRA HD PREMIUM-ready
	Downlink Carrier Aggregation: 5x20 MHz carrier aggregation				
	Downlink LTE MIMO: Up to 4x4 MIMO on three carriers				
LTE Uplink Features	Downlink QAM: Up to 256-QAM	Location	Satellite Systems Support: Beidou, Galileo, GLONASS, GPS, QZSS, S	General Audio	Audio Technology: Qualcomm TrueWireless™ Technology, Qualcomm Aqstic™ audio technology, Qualcomm® aptX™ audio technology
	Uplink Technology: Qualcomm® Snapdragon™ Upload+, Uplink Data Cc		Location Support: Qualcomm® Location		Qualcomm® aptX™ audio playback support: Qualcomm® aptX™, Qualcomm® aptX™ HD
	Uplink Carrier Aggregation: 2x20 MHz carrier aggregation		Global Emergency Services Support: Assisted GPS, OTDOA (LTE-bas		Voice Services Support: Microsoft Cortana
LTE Speed	Uplink QAM: Up to 64-QAM	RF	Advanced Location Features: Sensor-assisted Navigation, Low Power Tracking, Pedestrian Navigation	Audio Playback	Playback Dynamic Range: 130dB
					Total Harmonic Distortion + Noise (THD+N), Playback: -109dB
	LTE Peak Download Speed: 12 Gbps		RFFE: Qualcomm® RF Front-End (RFFE) solution		Sampling, Playback: 44,1kHz
	LTE Peak Upload Speed: 150 Mbps	USB	USB Version: USB 3.1		PCM, Playback: Up to 192kHz/24bit

AR Headset's Scene Generator



- Windows 10
- Custom-built Microsoft Holographic Processing Unit (HPU 1.0)
- 64GB Flash
- 2GB RAM (1GB CPU and 1GB HPU)
- x86 architecture

HoloLens MLB
(Main Logic Board)

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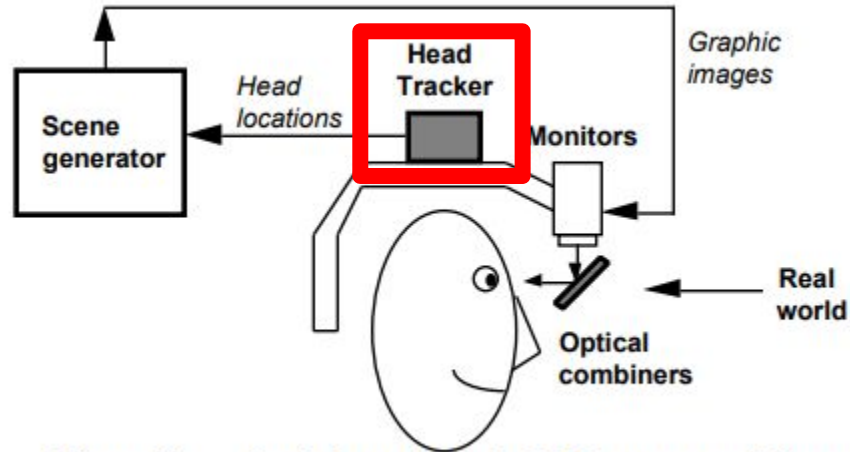


Figure 11: Optical see-through HMD conceptual diagram

Tracking = Position + Rotation



3DoF



6DoF



Inertial Measurement Unit (IMU)

Accelerometer + Gyroscope + Magnetometer

Accelerometer: direction of acceleration

Gyroscope: direction of rotation

Magnetometer: direction of the magnetic field

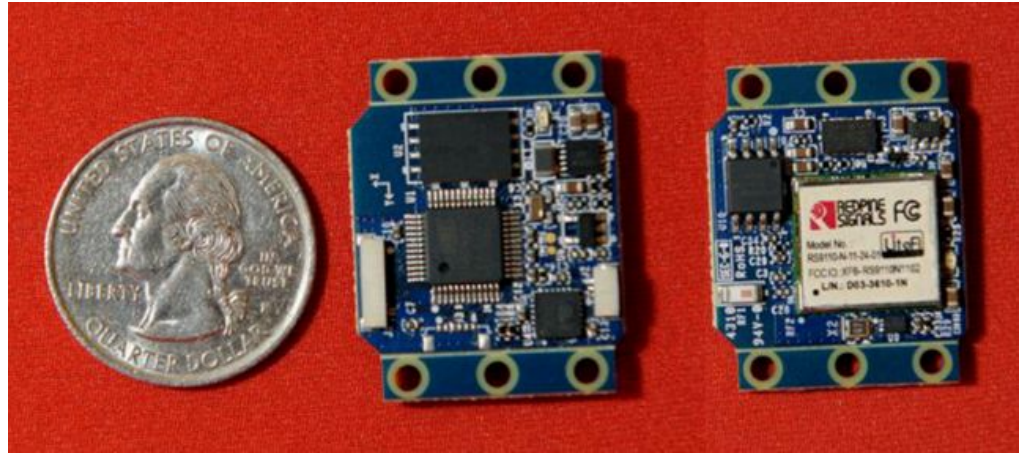
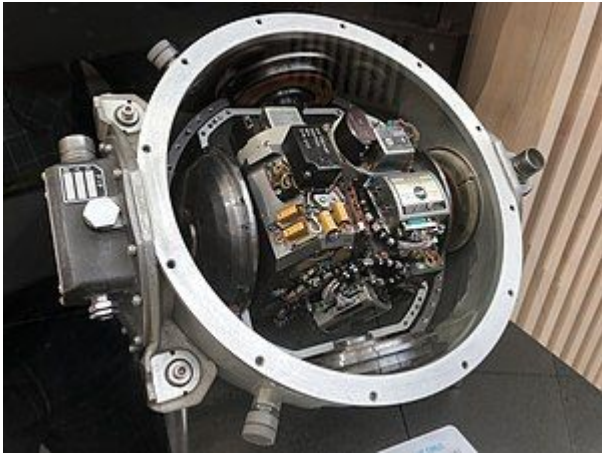
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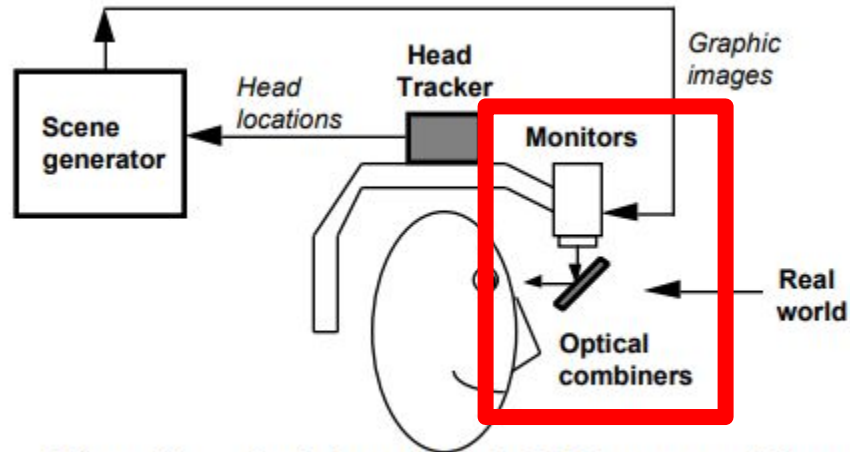
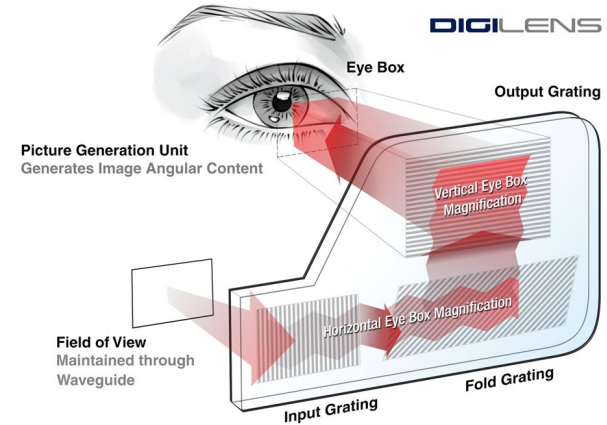
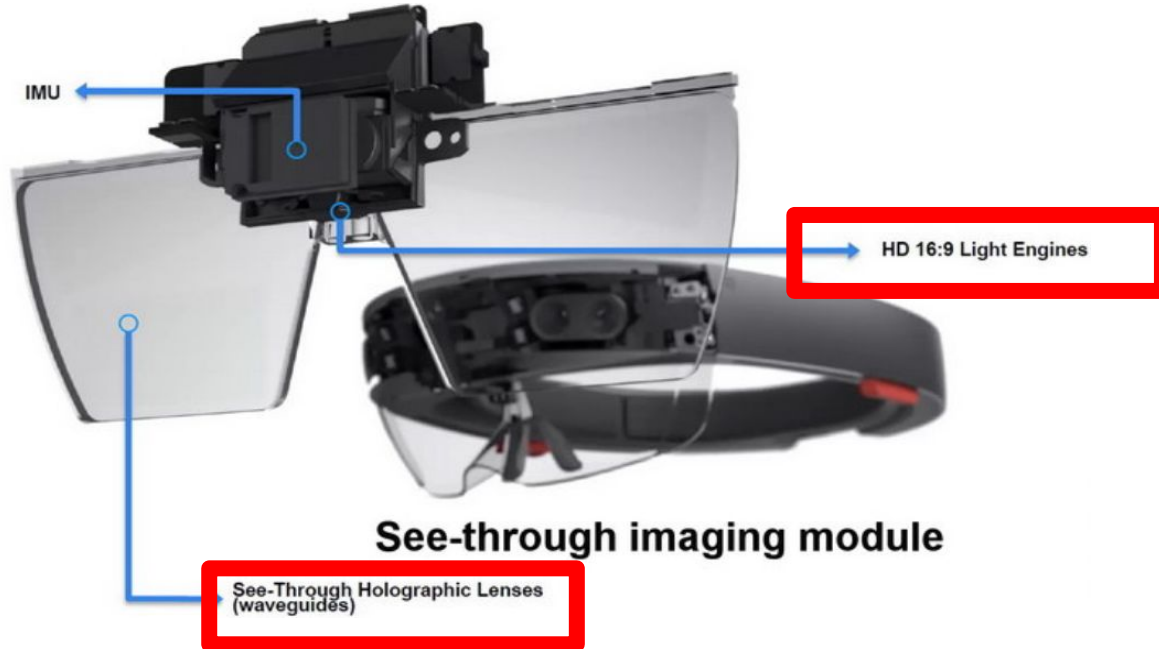


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Optical Devices

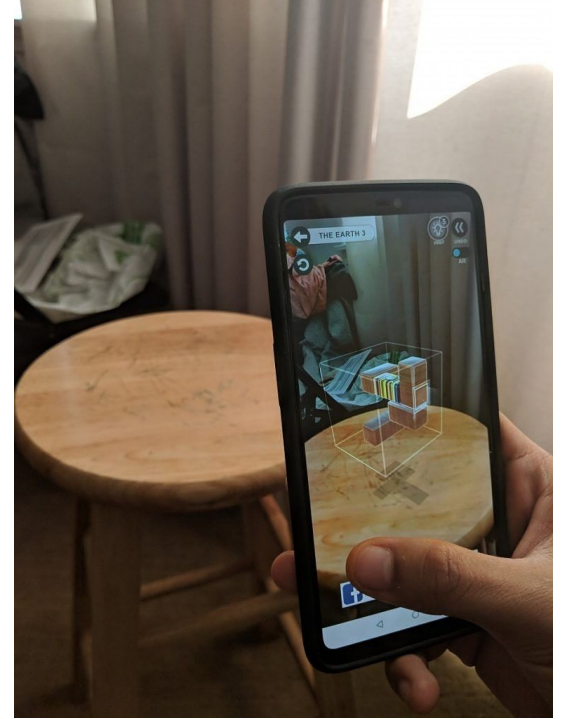
Monitors -> Light Engines

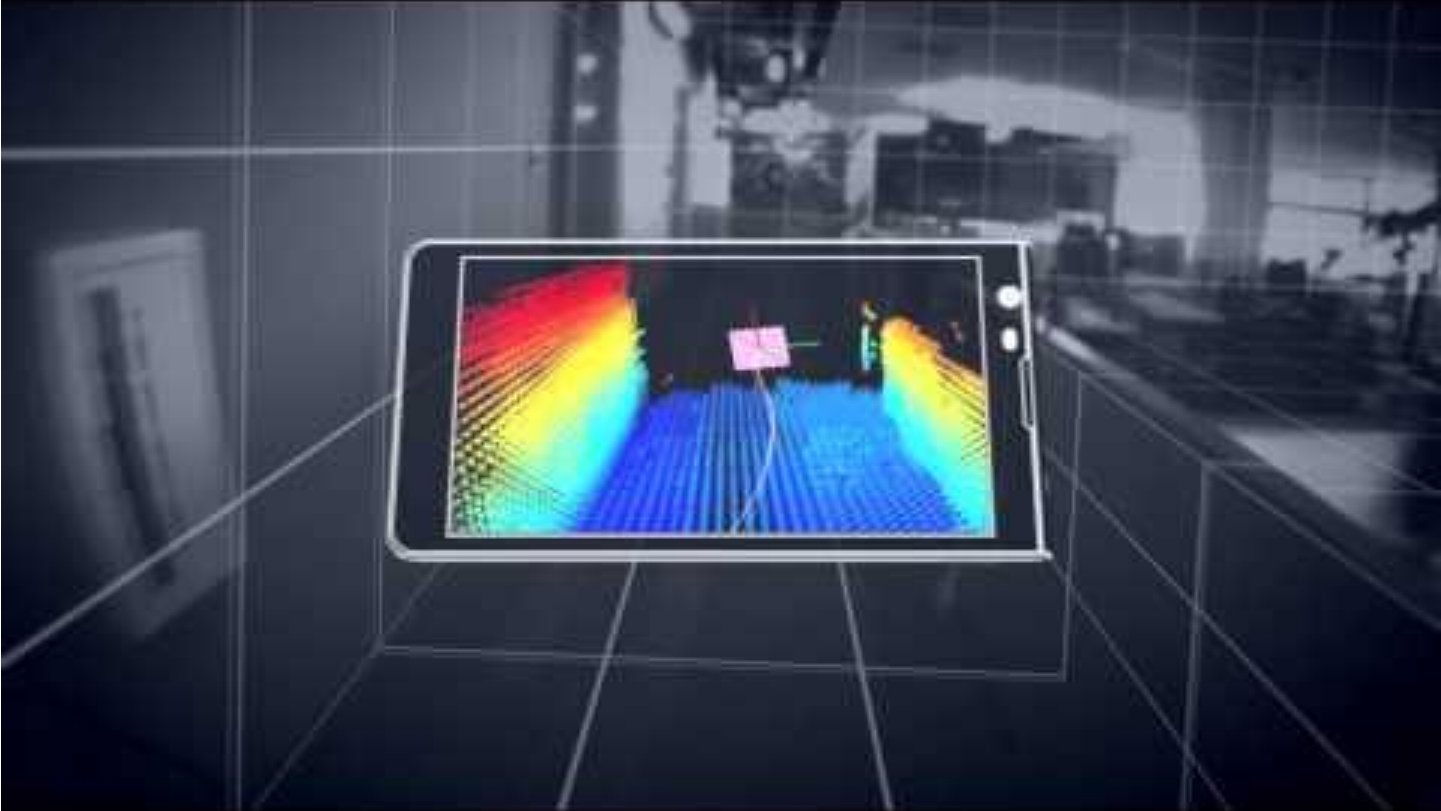
Optical Combiners -> Waveguides



Camera Tracking

HoloLens Sensor Bar





<https://youtu.be/Qe10ExwzCqk>

Summary

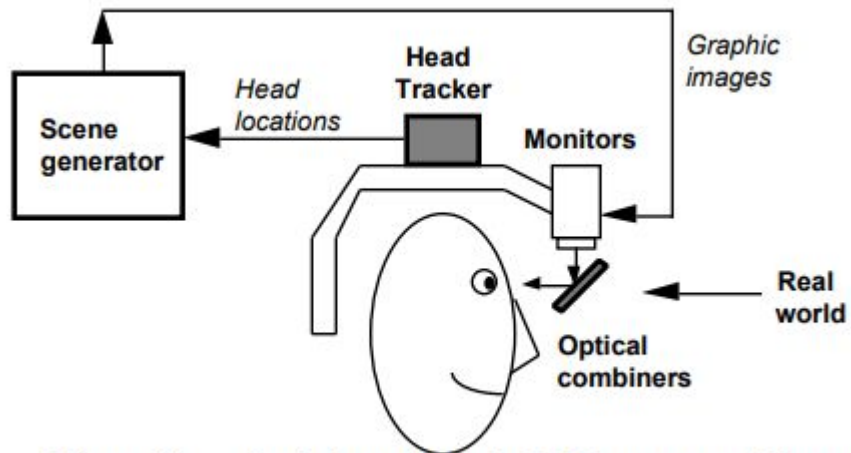


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