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
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
- **CPU Core:** Qualcomm® Kryo™ 205, 805 CPU, Octa-core CPU
- **CPU Architecture:** 64-bit

**Process**
- **Process Technology:** 10 nm (2nd generation)

**DSP**
- **DSP Technology:** Qualcomm® Hexagon™ 685 DSP, Qualcomm® All-Way

**Cellular Modem**
- **Model Name:** Qualcomm® Snapdragon™ X20, LTE modem
- **Multi SIM:** Dual SIM Dual VoLTE (DSDV)

**LTE Category**
- **Downlink LTE Category:** LTE Category 18
- **Uplink LTE Category:** LTE Category 13

**LTE Downlink Features**
- **Downlink LTE Streams:** Maximum 12 spatial streams
- **Downlink Carrier Aggregation:** 5x20 MHz carrier aggregation
- **Downlink LTE MIMO:** Up to 4x4 MIMO on three carriers
- **Downlink QAM:** Up to 256-QAM

**LTE Uplink Features**
- **Uplink Technology:** Qualcomm® Snapdragon™ X20, Uplink Data Cr
- **Uplink Carrier Aggregation:** 2x20 MHz carrier aggregation
- **Uplink QAM:** Up to 64-QAM

**LTE Speed**
- **LTE Peak Download Speed:** 1.2 Gbps
- **LTE Peak Upload Speed:** 150 Mbps

**Cellular Technology**
- **Cellular Technology:** WCDMA (BB-DC-HSDPA, DC-HSUPA), TD-SCG/GSM/EDGE
- **LTE Technology:** LTE FDD, LTE TDD including CBRS support, LAA, LT
- **Wi-Fi Standards:** 802.11ad, 802.11n, Wave 2, 802.11b/g/n, 802.11ac
- **Wi-Fi Spectral Band:** 2.4 GHz, 5 GHz, 60 GHz
- **Channel Utilization:** 20/40/80 MHz
- **MIMO Configuration:** 2x2 (2-stream)

**Bluetooth**
- **Bluetooth Version:** Bluetooth 5.0

**NFC**
- **Near Field Communications:** Supported

**Location**
- **Location Support:** Qualcomm® Location

**Satellite Systems Support:** Beidou, Galileo, GLONASS, GPS, QZSS, s

**General Audio**
- **Audio Technology:** Qualcomm TrueWireless™ Technology, Qualcomm AptX™ audio technology, Qualcomm AptX™ audio technology
- **Global Emergency Services Support:** Assisted GPS, OTDOA (LTE-based)
- **Advanced Location Features:** Sensor-assisted Navigation, Low Power Tracking, Pedestrian Navigation
- **RF:** Qualcomm® RF Front-End (RFFE) solution
- **USB Version:** USB 3.1

**USB**
- **Type:** USB 3.1

**Camera**
- **Image Signal Processor:** Qualcomm Spectra™ 280 image signal processor, Dual 12-bit ISP
- **Dual Camera:** Up to 16 MP
- **Single Camera:** Up to 32 MP
- **Camera Features:** Active Depth Sensing, hardware accelerated Face Detection, Hybrid Autofocus, multi-frame noise reduction (MFR)
- **Video Capture (3GPP):** 4K Ultra HD video capture
- **Slow Motion Video Capture:** 720p @ 480 FPS
- **Video Capture Format:** HDR10, HLG, HEVC

**Codec Support:** H.265 (HEVC)

**Video Software:** Accelerated Electronic Image Stabilization, Motion Compensated Temporal Filtering (MCTF)

**Max On-Device Display:** 4K Ultra HD
**Max External Display:** 4K Ultra HD
**UI FPS:** Up to 60 FPS
**Standards:** ULTRA HD PREMIUM-ready

**Audio Technology:** Qualcomm TrueWireless™ Technology, Qualcomm AptX™ audio technology

**Qualcomm® aptX™ audio playback support:** Qualcomm® aptX™, Qualcomm® aptX™ HD

**Voice Services Support:** Microsoft Cortana

**Playback Dynamic Range:** 130dB
**Total Harmonic Distortion + Noise (THD+N), Playback:** 100dB
**Sampling, Playback:** 44.1kHz
**PCM, Playback:** Up to 192kHz/24bit
AR Headset’s Scene Generator

- Windows 10
- Custom-Applied Microsoft Holographic Processing Unit (HPU 1.0)
- 64GB Flash
- 3GB 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
Inertial Measurement Unit (IMU)

Accelerometer + Gyroscope + Magnetometer

Accelerometer: direction of acceleration
Gyroscope: direction of rotation
Magnetometer: direction of the magnetic field
Inertial Measurement Unit (IMU)

Accelerometer + Gyroscope + Magnetometer
Inertial Measurement Unit (IMU)

Accelerometer + Gyroscope + Magnetometer
Inertial Measurement Unit (IMU)

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![Diagram of AR Headset Structure](image)

**Figure 11:** Optical see-through HMD conceptual diagram
Optical Devices

Monitors -> Light Engines
Optical Combiners -> Waveguides
Camera Tracking

HoloLens Sensor Bar
Summary

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