

CSE 190: Virtual Reality Technologies

LECTURE #11: AUGMENTED REALITY SYSTEMS

Announcements

Homework project 3

- Due Friday, May 17th at 2pm
 - To be demonstrated in VR lab B210
 - Upload code to TritonEd by 2pm

Midterm exam next Thursday, May 23rd

- In-class during lecture
- Closed-book
- Allowed: pen, pencil, eraser, ruler, scrap paper
- Follows the format of last two years' exams (can be found on course schedule)

Google Glass: Almost AR

Small see-through display in front of one eye

- Overlay image, size similar to rear-view mirror in car

Android 4.4 on ARMv7 CPU

Single display: 640x360 pixels, right eye only

5 MP camera, 720p video recording

Wi-Fi, Bluetooth

2 GB RAM, 16 GB flash memory

Gyroscope, accelerometer, compass, light sensor

“Bone conduction” speaker

579 mAh battery (2-3 hours of use)

Sold April 2013 until January 2015 for \$1,500

Since July 2017: Enterprise Edition

- 32GB, 780 mAh battery, GPS, barometer, Intel Atom



Epson Moverio BT-300

Released 2016

Price: \$699

1280 x 720 pixel OLED display

5 MP camera

Drone edition provides FPV to operate drones

Dedicated controller

32GB microSD card

FOV: 23 degrees

Video:

https://www.youtube.com/watch?time_continue=49&v=hhYPqF3aHUs



Meta 2 by Meta

Released Dec 2016 for \$1,500

Requires Windows PC with Nvidia GTX 960+

90 degrees field of view

2560 x 1440 pixels at 60Hz

Inside-out tracking with IMU and cameras

- In practice tracking is not as good as HoloLens

720p RGB camera

9 ft cable for video, data & power

4 surround sound speakers

3 microphones

Weight: 1.1 lbs

Meta became insolvent in January 2019, sold to unknown buyer



Osterhaut Design Group ODG R-9

Pre-orders for \$2,000, but never shipped

Qualcomm Snapdragon 835

Dual 1920x1080 pixels at 60Hz

50° FOV

GNSS (GPS/GLONASS)

IMU

Sensors for: humidity, altitude, ambient light

13MP autofocus camera (1080p @ 120fps, 4k @ 60fps)

Dual 5MP cameras for depth tracking

Fisheye camera for tracking

2 microphones (Environment & User)

Built-In stereo speakers

Company went out of business, asset and patent sale in January 2019



Magic Leap One: Creator Edition

Released August 2018

Stereo goggles “Lightwear” using multi-focal
lightfield technology

Wired to compute+battery box “Lightpack”

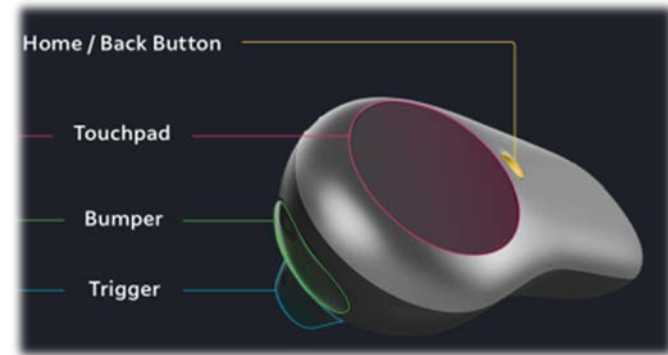
Includes 6 DoF controller called “Control”

Video:

<https://www.youtube.com/watch?v=HD9jeo9M8vo>



Magic Leap One Specs based on API



Operating System: Lumin OS

Eye Tracking: Fixation point position and eye centers, blinks

Graphics: OpenGL ES and Vulkan

Hand Gestures & Key Point Tracking: Hand poses (gestures) and position of identifiable points on hands such as tip of index fingers

Head Tracking: Headpose is tracked in full six degrees of freedom (DOF).

Image Tracking: Track position and orientation of specified image targets (markers)

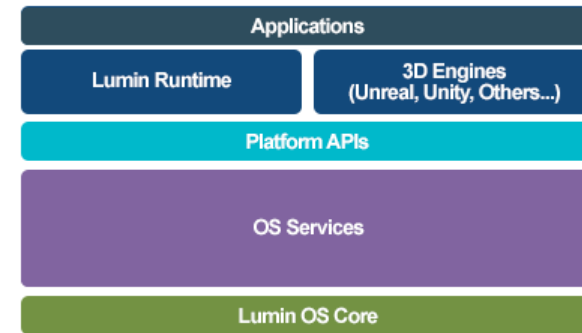
Input: Full 6 DOF from controller: trigger (analog), 2 buttons, touchpad, haptic vibration, LED ring feedback

Light Tracking: Detects luminance and global color temperature of user's environment

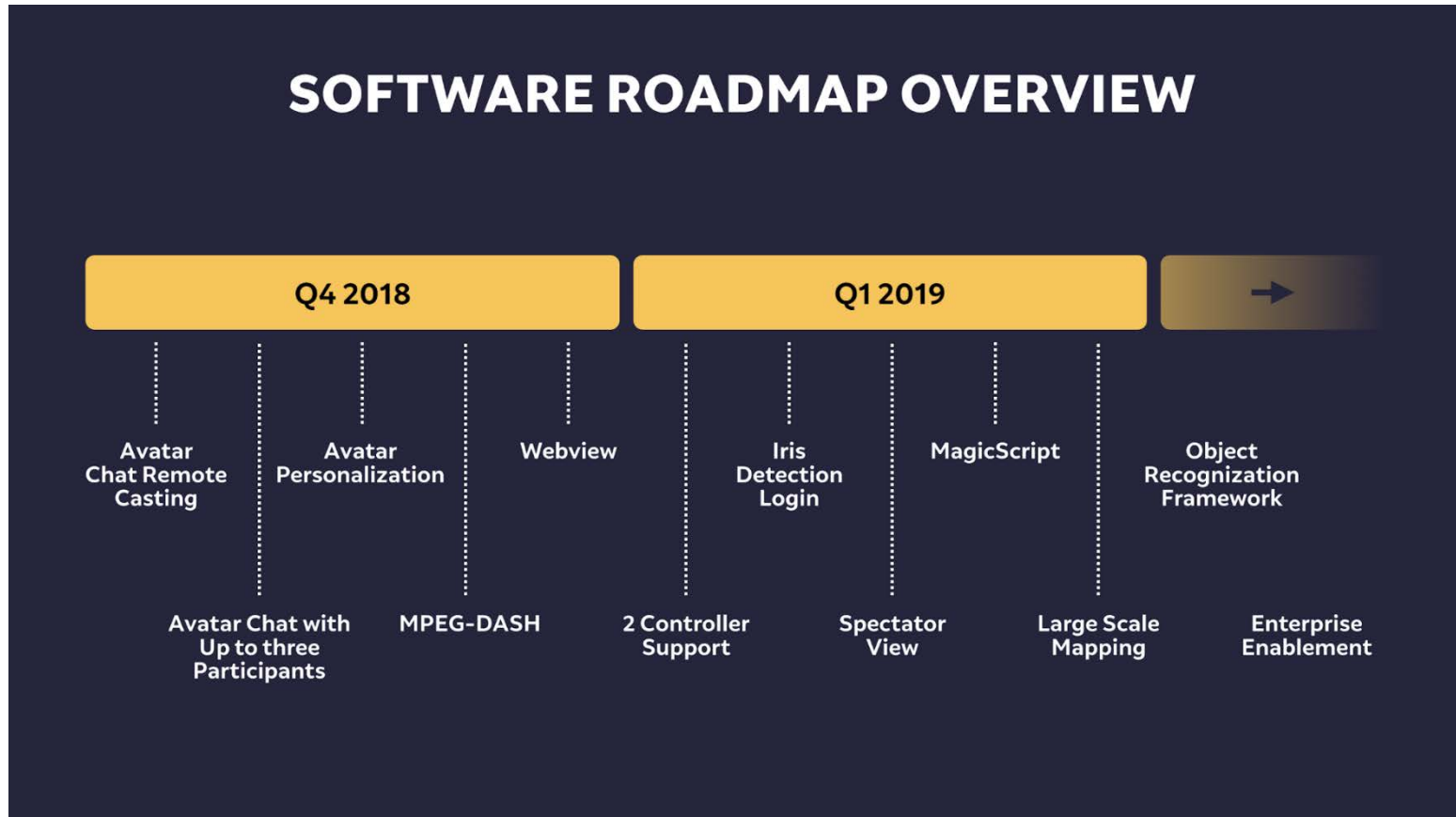
Meshing: Converts depth data into triangle mesh

Occlusion: Interface for using depth data for hardware occlusion

Planes: Recognizes planar surfaces for placing content. Includes semantic tagging for ceilings, floors, walls



Software Roadmap



Software roadmap presented at L.E.A.P. Conference in October 2018

Microsoft HoloLens



Released March 2016 for \$3,000

True AR: superimposes images onto real world

Wireless, self-contained

Stereo displays, 30x17 degrees FOV (34 degrees diagonal)

Angular resolution: 47 pixels per degree

2-3 hours battery life

6 DoF tracking with IMU and 120x120 degrees depth camera

2.4MP RGB camera

4-microphone array

Ambient light sensor

Intel CPU with integrated GPU and 1GB RAM

Custom Microsoft Holographic Processing Unit (HPU) with 1GB RAM and 28 custom DSPs for inside-out tracking and mapping

8GB RAM, 64GB flash memory

Videos:

- <https://www.youtube.com/watch?v=QRQv74J7oSk>
- <https://www.youtube.com/watch?v=SkVpdl-WcD0>



HoloLens Clicker

Microsoft HoloLens 2



Announced Feb 2019, to be released later in 2019

Price: \$3,500

Qualcomm Snapdragon 850 with Adreno 630 GPU

OS: Windows 10 Holographic

Field of view: 52 degrees (diagonal)

Angular resolution: 47 pixels per degree

USB-C connection

Video: <https://www.microsoft.com/en-us/hololens/#>



Lenovo ThinkReality A6

Announced May 14, 2019

Available later in 2019

Stand-alone headset, for business applications

HMD + tethered compute unit

Qualcomm Snapdragon 845 in compute unit

Android OS

Intel Movidius VPU on the headset

1920x1080 pixels per eye

40 degrees diagonal field of view



VR/AR Headset Comparison

<https://www.aniwaa.com/comparison/vr-ar/>