VRDC

Creating Mixed Realities with Tango, HoloLens, and Beyond!

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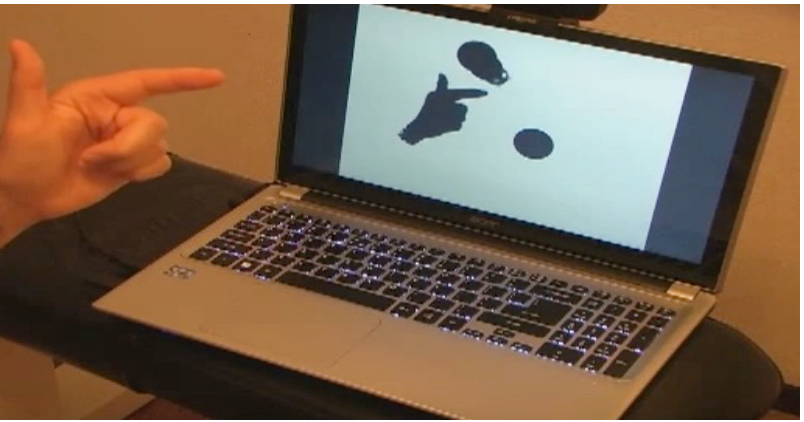
CRYSTAL DYNAMICS
STRATEGIC SIMULATIONS INC.®
INEVITABLE™
ENTERTAINMENT
MIDWAY
TRAIN ARTISAN™
GameDevelopers Conference 08
Acclaim®
CYRON
BIG HUGE PANDA
ANT HIVE GAMES

Prior AR Experience

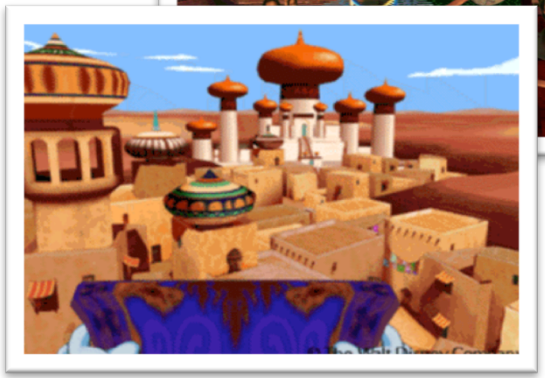
intel REALSENSE TECHNOLOGY

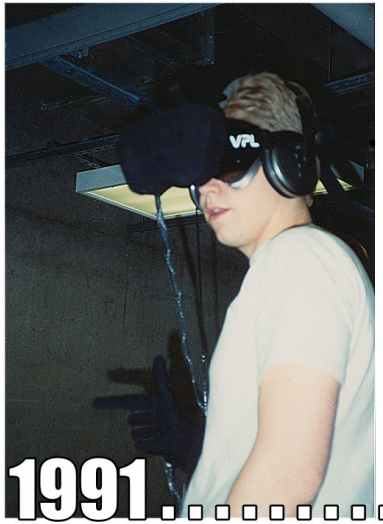


Aaron Pulkka

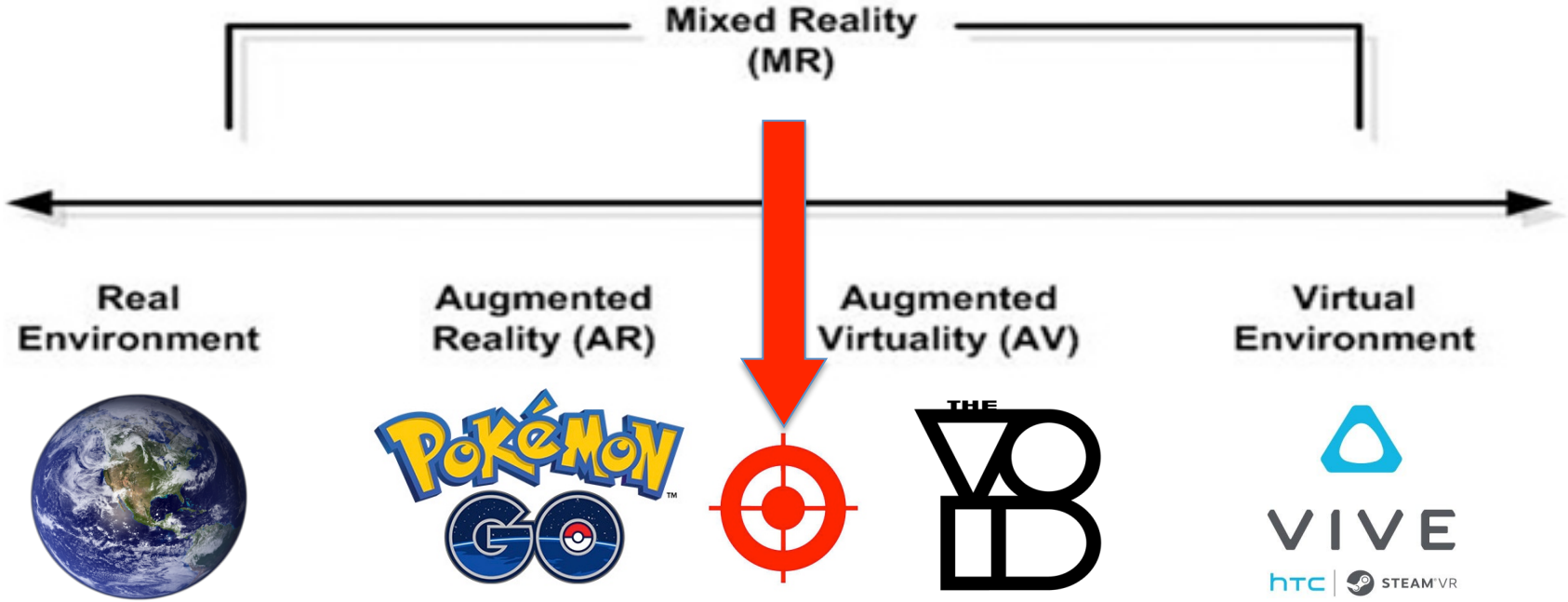
CYRON

Prior VR XP



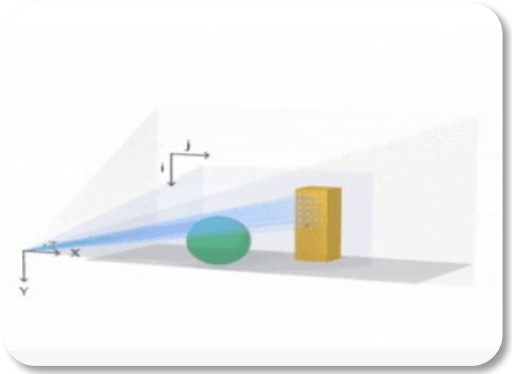


Mixed Reality



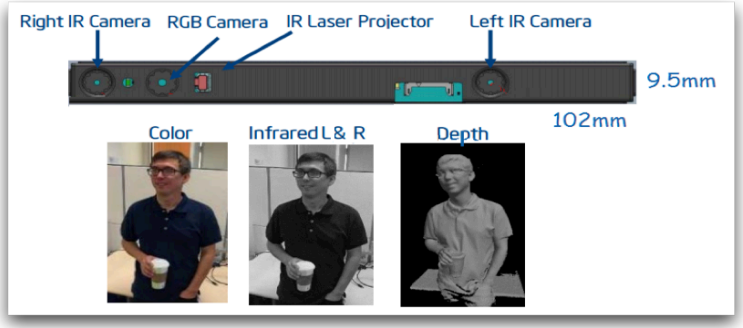
Spatial Awareness

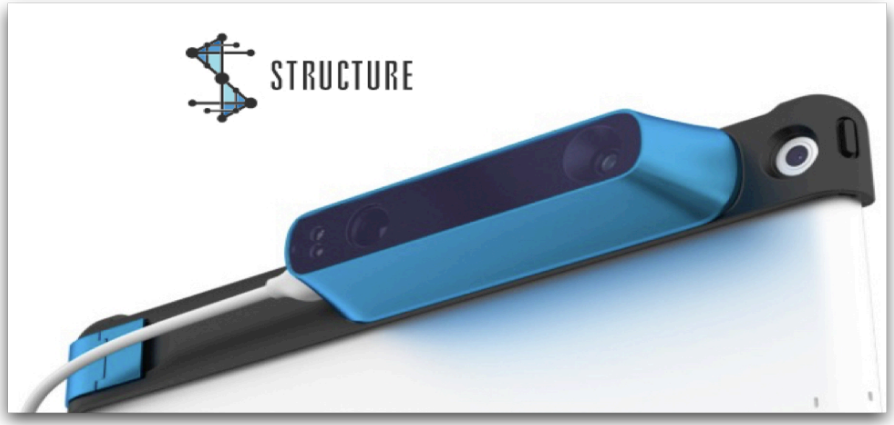
Motion Tracking – Depth Sensing – Area Learning



Surface Reconstruction – Plane & Void Detection

Spatially Aware Devices





Microsoft HoloLens

Tango

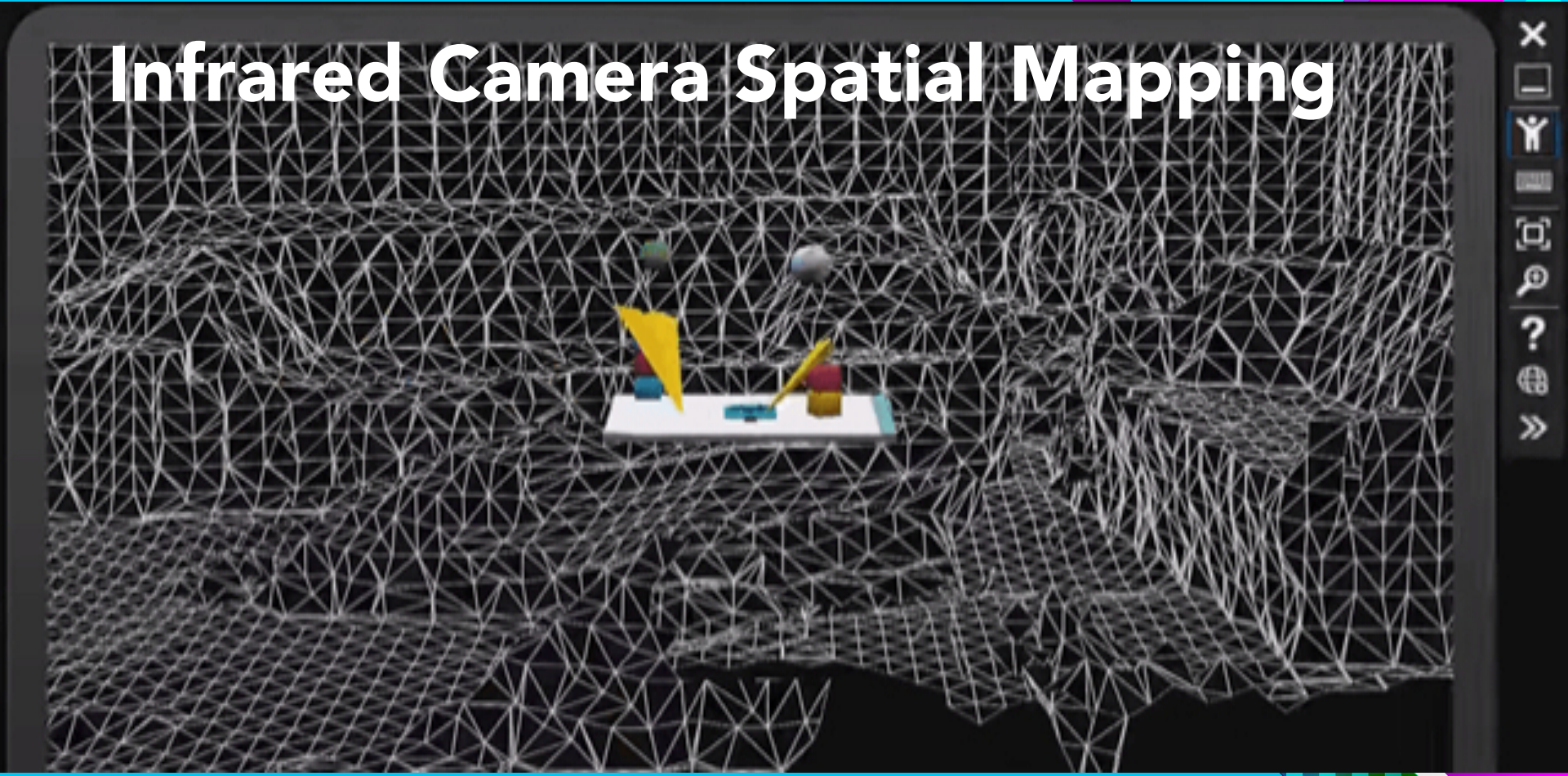
VRDC

Microsoft HoloLens

Now available in Australia, Canada, France, Germany, Ireland, New Zealand, United Kingdom, and United States.

Wearable Windows 10 PC

Infrared Camera Spatial Mapping



Motion and Gesture Tracking

Hands

ID	X	Y	Z	ISPRESSED
99	0.114871	-0.021094	-0.541399	true
188	-0.16518	-0.033638	-0.509941	false

Head Rotation Quaternion

CONST	I	J	K
0.999422	0.031709	0.011533	-0.004099

Origin Translation Vector

X	Y	Z
-0.020313	-0.032074	-0.164817

Speech Recognition

- System level commands
- User configurable commands

Microsoft HoloLens

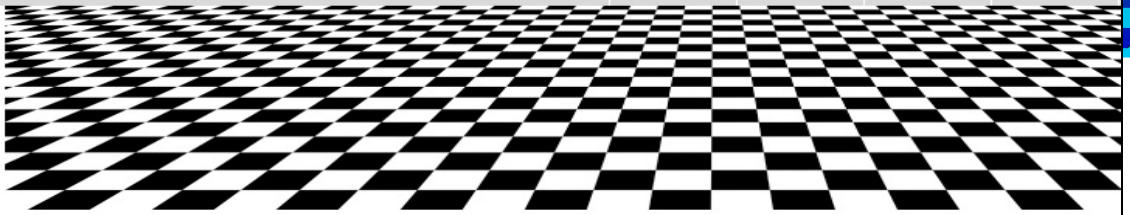
VIEWS
Home
3D View
Mixed Reality Capture

PERFORMANCE
Performance Tracing
Processes
System Performance

SYSTEM
Apps
App Crash Dumps
File Explorer
Logging
Simulation
Networking
Virtual Input

3D View

ONLINE | SHUTDOWN | RESTART | SECURITY



Rotate: left click + mouse; Pan: right click + mouse; Zoom: mouse scroll

Tracking options

- [ ] Force visual tracking
- [ ] Pause

View options

- [x] Show floor
- [x] Show frustum
- [ ] Show stabilization plane
- [x] Show mesh
- [x] Show spatial anchors
- [ ] First person view
- [x] Show details

Full screen

Surface reconstruction

Update

Save

Spatial Anchors

Update

Details

Hands

ID	X	Y	Z	ISPRESSED
99	0.114871	-0.021094	-0.541399	true
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X	Y	Z
-0.020313	-0.032074	-0.164817

REST API


CYRON
Best Spatial Mapping
WINNER
SFVR HoloLens Hackathon 2016
BEHEMOTH
SAVE YOUR WORLD FROM THEIRS
Microsoft HoloLens

Behemoth for HoloLens

- Enabling epic cinematic experiences anywhere!
- Discover mysterious dangers lurking beyond your walls
- Explore space for resources

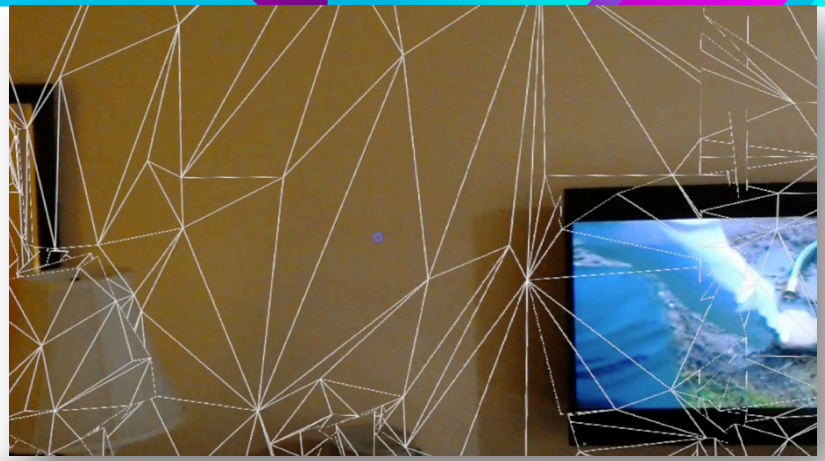
Mixed Reality UX

- Embrace 3D Space
- 3D Audio is Critical
- ReFlow to environment

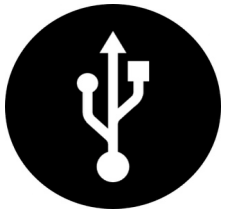
MxR ReFlow

Adapt to each space

- AI/CSS for MxR
- Mesh generation
- Plane extraction
- Feature identification
- Relative placement



HoloLens Development Environment



Microsoft UWP/ HoloToolKit / SpatialMapping \ SpatialProcessing

Spatial Processing

FLARE: Fast Layout for Augmented Reality Applications

Ran Gal* Microsoft Research
Lior Shapira† Microsoft Research
Eyal Ofek‡ Microsoft Research
Pushmeet Kohli§ Microsoft Research

(a) (b) (c) (d)

Figure 1: Designing an immersive augmented reality (AR) application such as a dynamic racing game is difficult. In our framework (a) declarative rules are used to define application elements and the rules governing them (b) in real-time we analyze an environment to extract scene geometry and horizontal and vertical planes (c) our move-making algorithm targets the application to the room (d) an additional result of our system in a different room with a longer track.

ABSTRACT

Creating a layout for an augmented reality (AR) application which embeds virtual objects in a physical environment is difficult as it must adapt to any physical space. We propose a rule-based framework for generating object layouts for AR applications. Under our framework, the developer of an AR application specifies a set of rules (constraints) which enforce self-consistency (rules regarding the inter-relationships of application components) and scene-consistency (application components are consistent with the physical environment they are placed in). When a user enters a new environment, we create, in real-time, a layout for the application, which is consistent with the defined constraints (as much as possible). We find the optimal configurations for each object by solving a constraint-satisfaction problem. Our stochastic move making algorithm is domain-aware, and allows us to efficiently converge to a solution for most rule-sets. In the paper we demonstrate several augmented reality applications that automatically adapt to different rooms and changing circumstances in each room.

Index Terms: F.4.1 [Mathematical Logic]: Logic and Constraint Programming—; G.3 [Probability and Statistics]: Markov Processes—;

1 INTRODUCTION

Augmented reality is a growing trend on mobile platforms, as well as on emerging wearable computing platforms. Yet, AR systems have struggled to make the transition from laboratory to the real world. A particular hindrance to the successful deployment of AR systems is the complex and variant nature of reality. AR applications must work in any environment the user finds herself in. Therefore, the layout of the different elements comprising the AR application must be consistent with the environment. Simple applications might consist of planar information overlaid on reality, or virtual objects hanging in free space in front of a user. However, creating an application which truly integrates with the environment, embedding virtual objects among real physical objects is much more complex.

Several issues make this task challenging: First, the layout of virtual objects must be consistent with the placement of other virtual objects, as well as with the geometry of the physical environment they are placed in. For example, an application might require that two elements be placed within two feet of each other, but also that both be placed on an elevated horizontal surface. Second, a user might deploy several applications in the same environment, all of which must be laid out successfully without interfering with each other. Finally, several users might be collaborating using an AR application in a shared environment, further complicating the layout of the application elements.

In this paper we describe FLARE (Fast Layout for Augmented Reality), an application development system that enables targeting of AR applications to a variety of environments. In this system the layout of an AR application is designed using declarative rules, describing the desired mapping of the application elements to an environment. Each element has a state defined by a set of properties (e.g. position, scale, color). The declarative rules refer to these properties and to environment properties, and have a cost function associated with them. Mapping an application to an environment consists of finding an optimal (or close to optimal) state for all elements, such that the overall cost of the rules is minimized. Targeting several applications to a single environment, or sharing an application between multiple users is translated in our system to additional rules constraining the system.

We capture the user's environment using a Kinect camera (RGB and depth streams), and process it using Kinect Fusion [25] to extract dense scene geometry. We detect planar surfaces in the room and label them as *vertical* (e.g. walls, cabinets), *horizontal* (e.g. floor, table) or *other*. Planar features are common in indoor scenes and are useful to many applications. Adding additional detectors (e.g. object detection, recognizing previously visited rooms) could enable more complex rules and applications. FLARE performs a real-time mapping of the application to the user's current environ-

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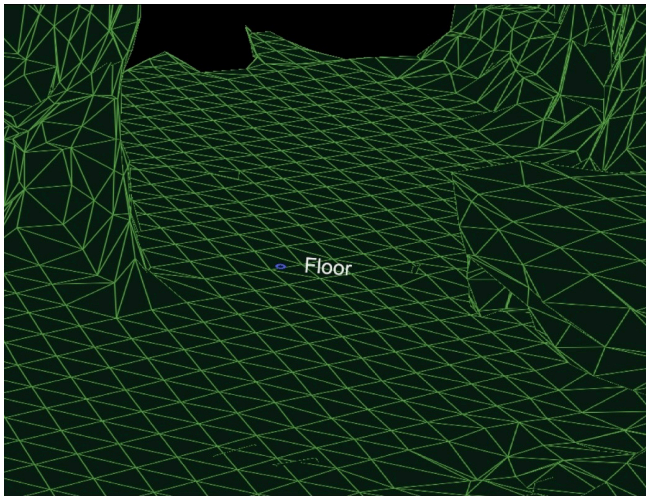
§e-mail:pkohli@microsoft.com

2014

ASOBO STUDIO

Spatial Processing HoloToolkit

- Basic Spatial Mapping
  - Access/Visualize Spatial Data
  - Save/Load Rooms
- Spatial Processing
  - Surface Meshes to Planes
    - wall, ceiling, floor, table, unknown
      - Floor Buffer
      - Ceiling Buffer
  - Custom Shape Definitions



VRDC

Tango

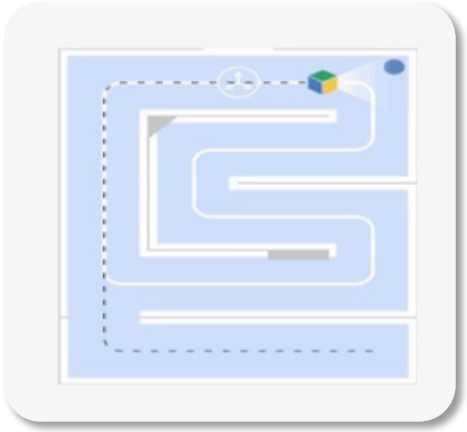
Development Kit
Launched in Select Countries
June 1st, 2014

Lenovo Phab2 Pro
Launched Worldwide
November 1st, 2016

Tango Motion Tracking

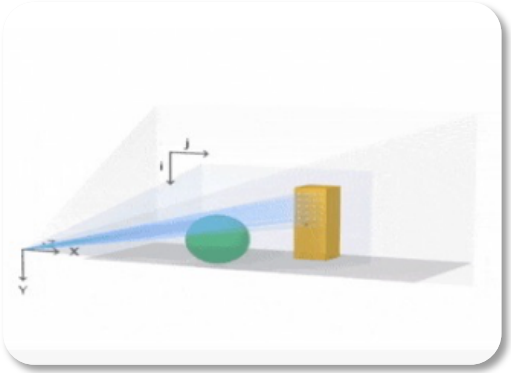
- Visual-Inertial Odometry (VIO)
  - Tracking image differences
  - Inertial motion sensors
  - Combined for greater accuracy
- ***Limits:***
  - ***Drift***
  - ***No memory***
  - ***Lighting***

Tango Area Learning



- Simultaneous Location and Mapping (SLAM)
  - Location memory
  - Drift correction
- *Limits:*
  - *Mapping time*
  - *Areas change over time*

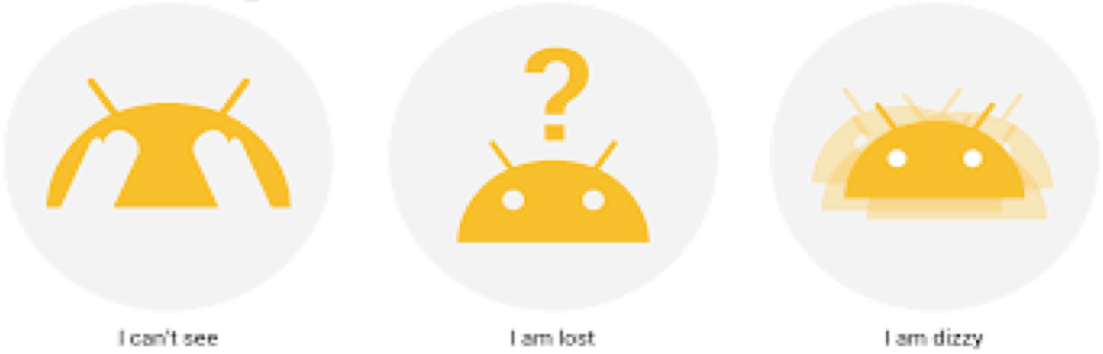
Tango Depth Sensing



- Point Cloud
  - Infrared light
  - Markerless AR
- *Limits:*
  - *Environmental*
  - *0.5 to 4 meters*

Environmental Issues

- "I can't see." – too dark
- "I am lost." – featureless
- "I am dizzy." – too fast



Tango Development Environment

- ✓ SDK Options
  - C, Java, Unity
- ✓ UX Framework
- ✓ Active Community









CYRON
GHOSTLY
MANSION
Best
Entertainment
WINNER
Project Tango App
Contest 2015
GET IT ON
Google play
Launched Worldwide
Nov 1st, 2016!
Tango


RESET LOCATION
MENU
Story-Driven Physical Hidden-Object Game
FIND THESE
WALK
RUN

Motion Tracking driven design

ROAD TO VR

"In this mystery sleuthing title, you play an imprisoned spirit, trying to find peace by solving the mystery of your own death."

androidcentral

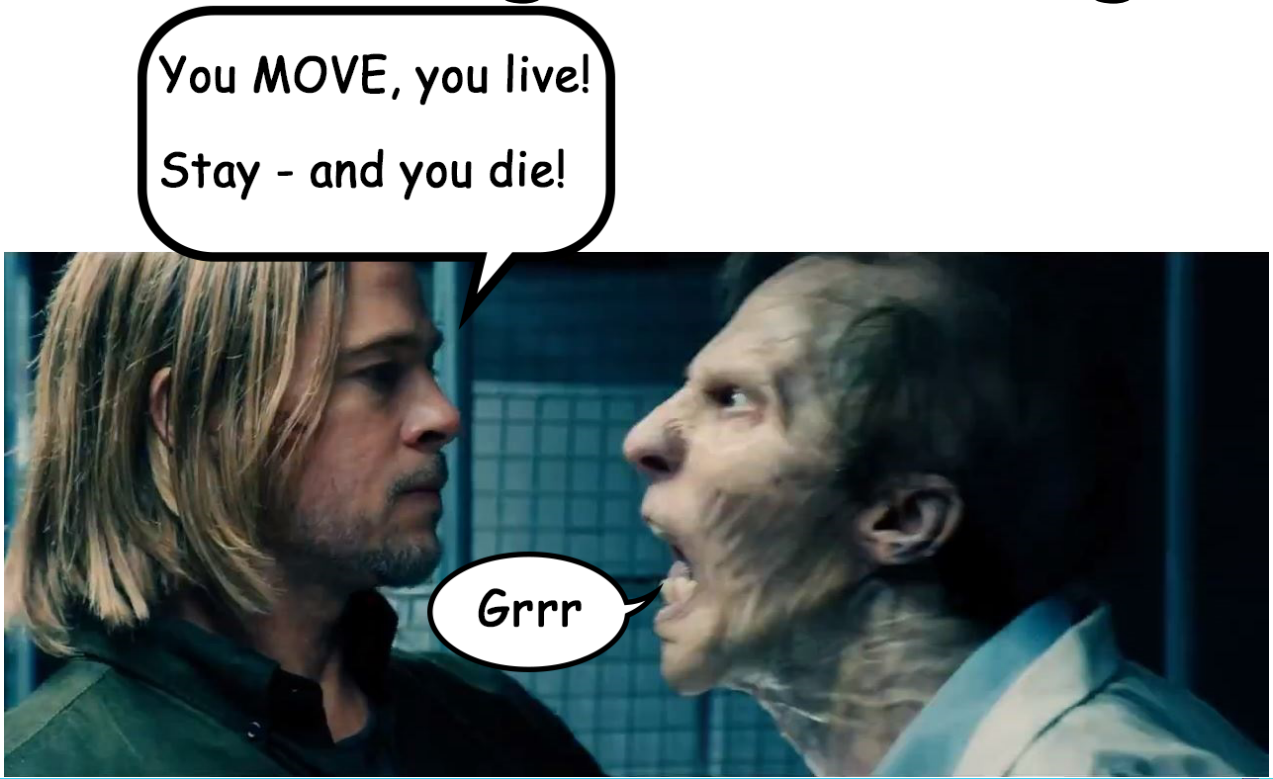
"The room is merely projected through the Phab 2 Pro's 6.4-inch display, but because of its motion tracking mechanisms, I was able to keep my head inside the game despite not having the phone physically strapped to my face."

THE VERGE

"It takes place in a spooky 3D mansion, and the entire game is controlled by walking around holding Tango."

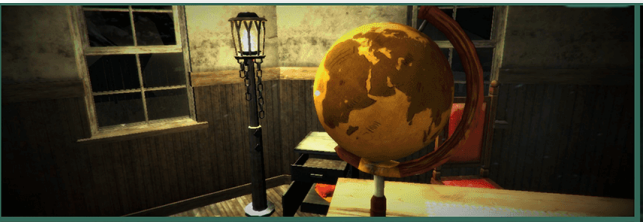
Motion Tracking driven design

Motion Tracking driven design

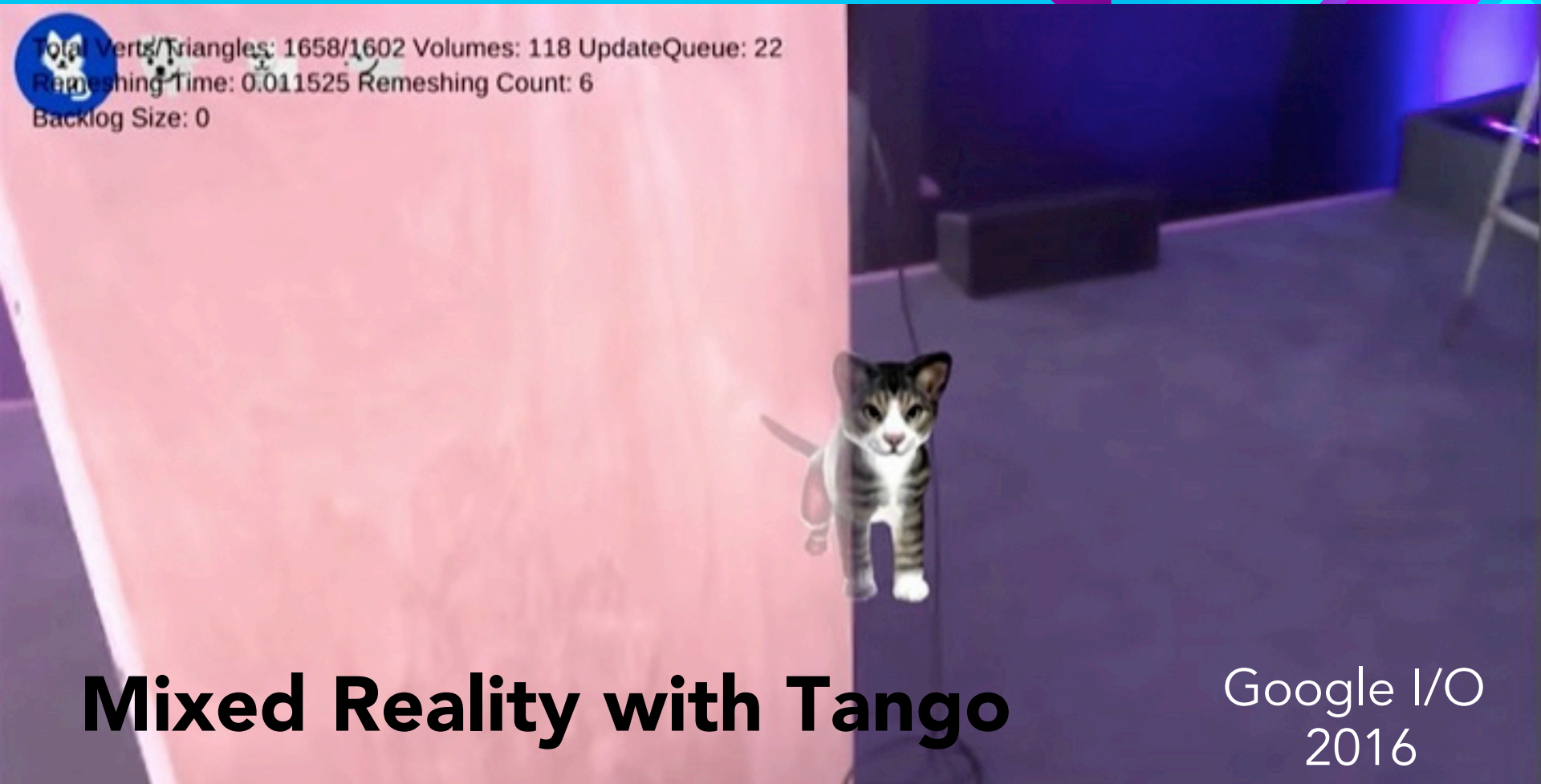


Motion Tracking driven design

- Must physically move to pick up items
- Level select by walking, not tapping
- Highly natural and intuitive!



Motion Tracking driven design



Mixed Reality with Tango

Google I/O 2016

Now – User Reliant Spatial Identification

- Walls
- Surfaces
- Objects

Next step - Spatial Understanding

- Spatial mesh – just gives you collision.
- Segmentation
- Classification

Designing for Arbitrary Spaces

- Traditional design based on specific placement
- Experience composition at the time of use
- Rules and constraints design pattern

Responsive Environment Design

- Environment Composition at the time of use
- Rules and constraints design pattern
- Solvers and AI based layout

Environment Re-visualization

Cyrus Lum
"Worlds Away"
FINALIST
Lenovo Tango
Hackathon
2016


Hackathon

Bending Reality – XR

- VR influenced by the real world
- Tactile presence
- Moving between – the real and the virtual

Subtraction = Magical

vs

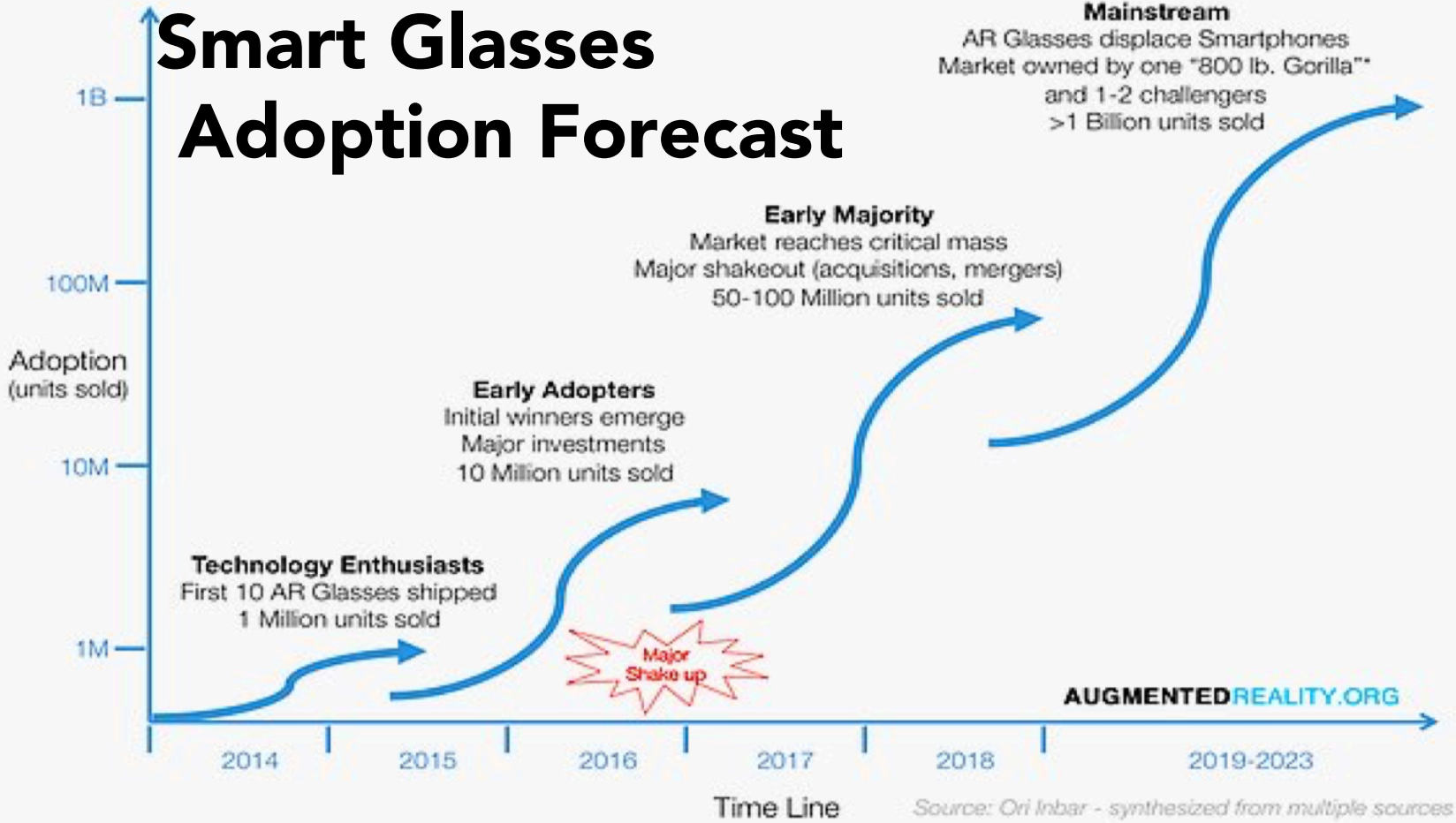
- Infrared mapping
- Visual tracking
- Phablet
- Touchscreen
- Android
- Consumer
- $499

- Infrared mapping
- Visual tracking
- Headset
- Gestures
- Windows
- Enterprise
- $3000

VRDC

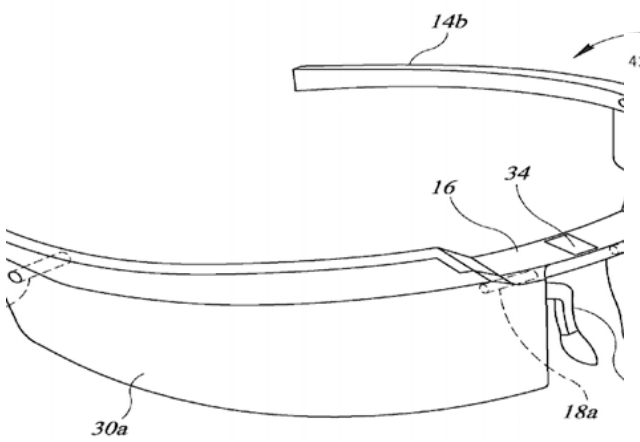
Beyond Tango & HoloLens

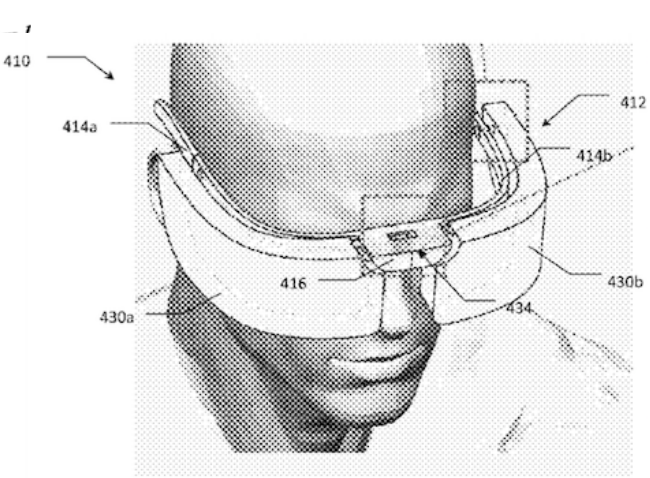
Smart Glasses Adoption Forecast

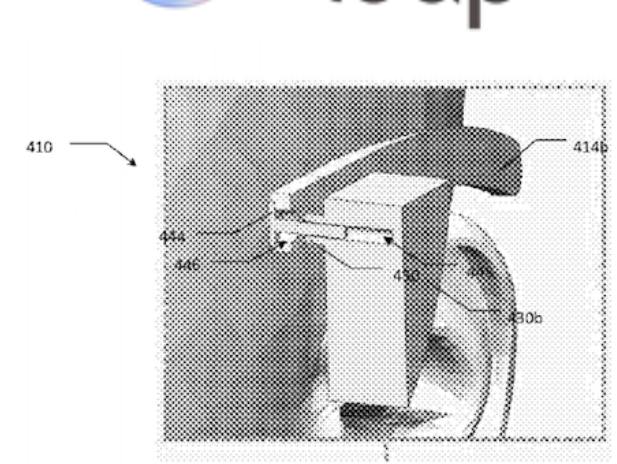


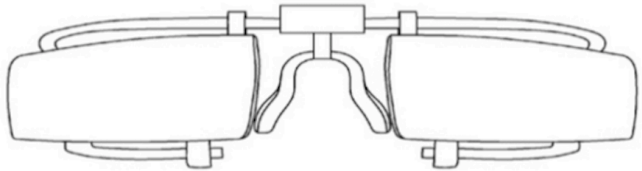
Ultimate AR Headset?

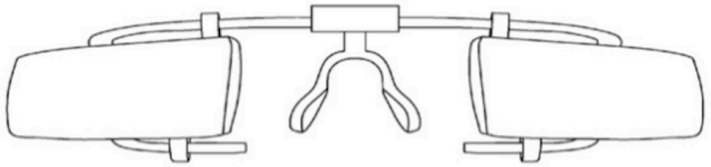
magic leap











occipital STRUCTURE SENSOR

MxR Dev Kit

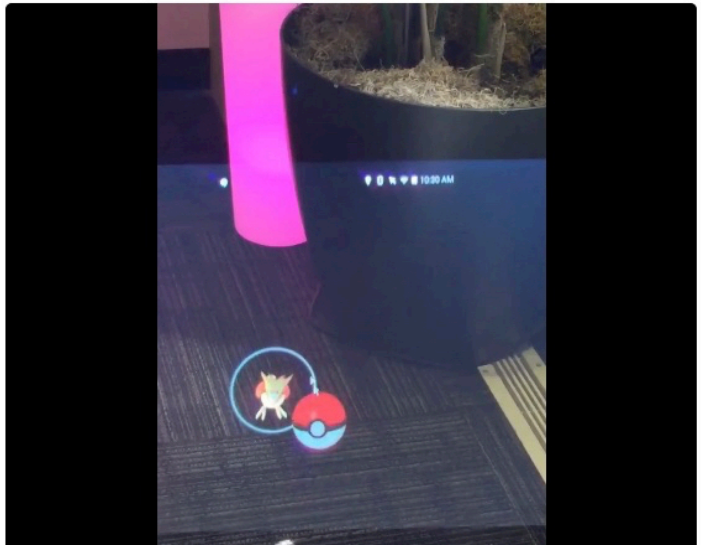
ODG

R-7 Smartglasses

OsterhoutDesignGroup
@OsterhoutGroup

Follow

Pokemon Go getting addictive with the R-7 glasses. Using ODG's ring controller to interact @CatchEmAll



Apple iPhone 7 Plus and Beyond

- Dual-cameras
- PrimeSense
- Metaio

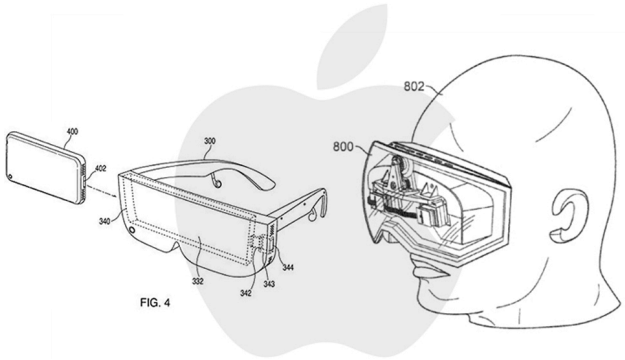
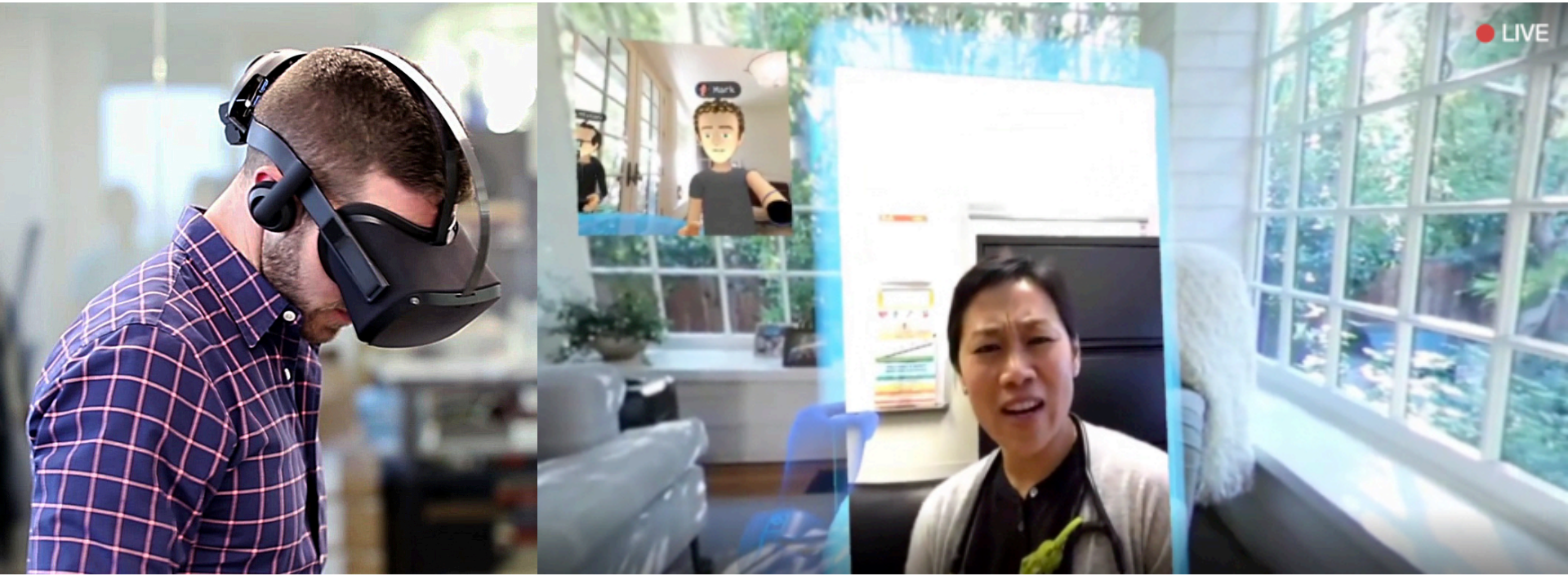


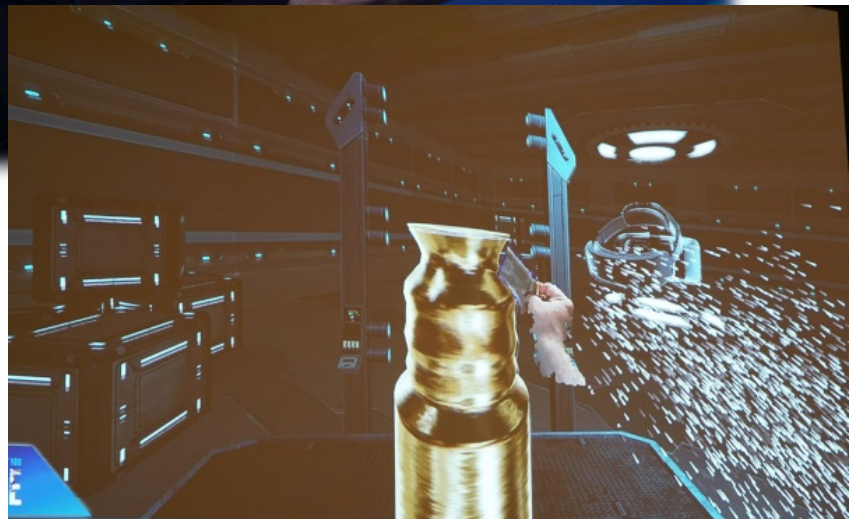
FIG. 4

VIVE
htc | STEAMVR

oculus Santa Cruz Prototype



Project Alloy



Microsoft Democratizing VR + MxR

Summary

- HoloLens – Enterprise MxR headset
- Tango – Consumer MxR handheld device
- Embrace 3D motion controls
- Design for arbitrary spaces
- Develop for the future, today!

VRDC

Questions?

Aaron Pulkka
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