



Augmented Reality

“ Extending reality! ”

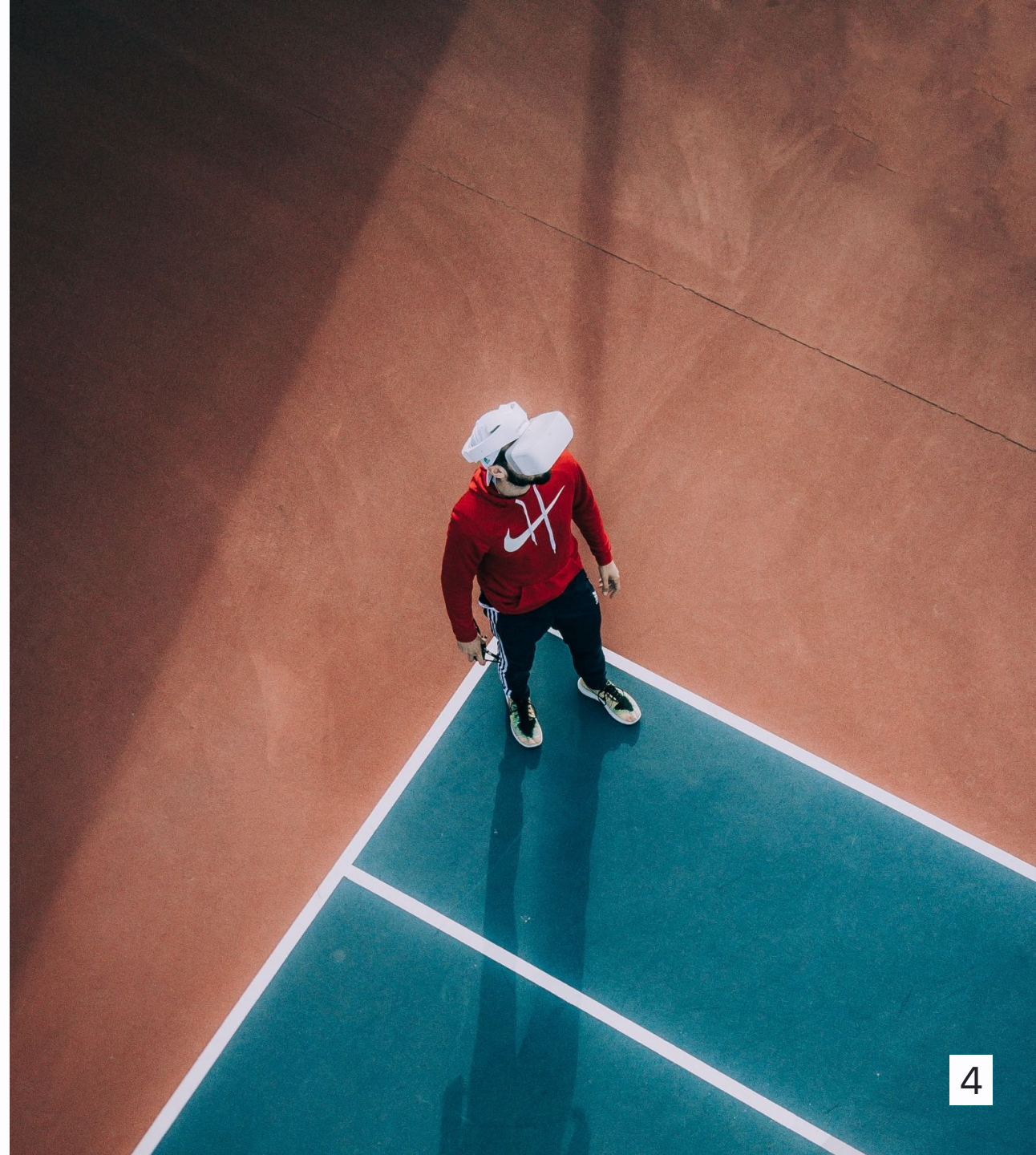
Immersive Technology

“ ...experience of submersion applied to representation,
fiction or simulation ”

Immersion

- Spatial
- Emotional
- Cognitive
- Sensory-Motoric

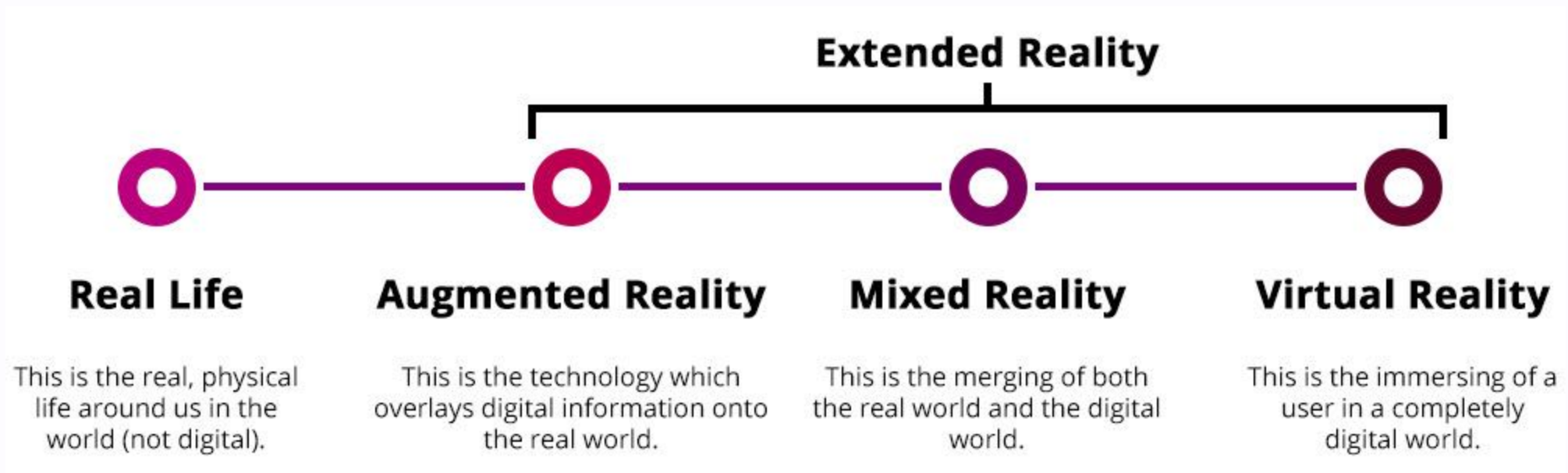
Source: [TECFA](#) & [Martin Sanchez](#)



Telepresence



Immersive Reality Spectrum

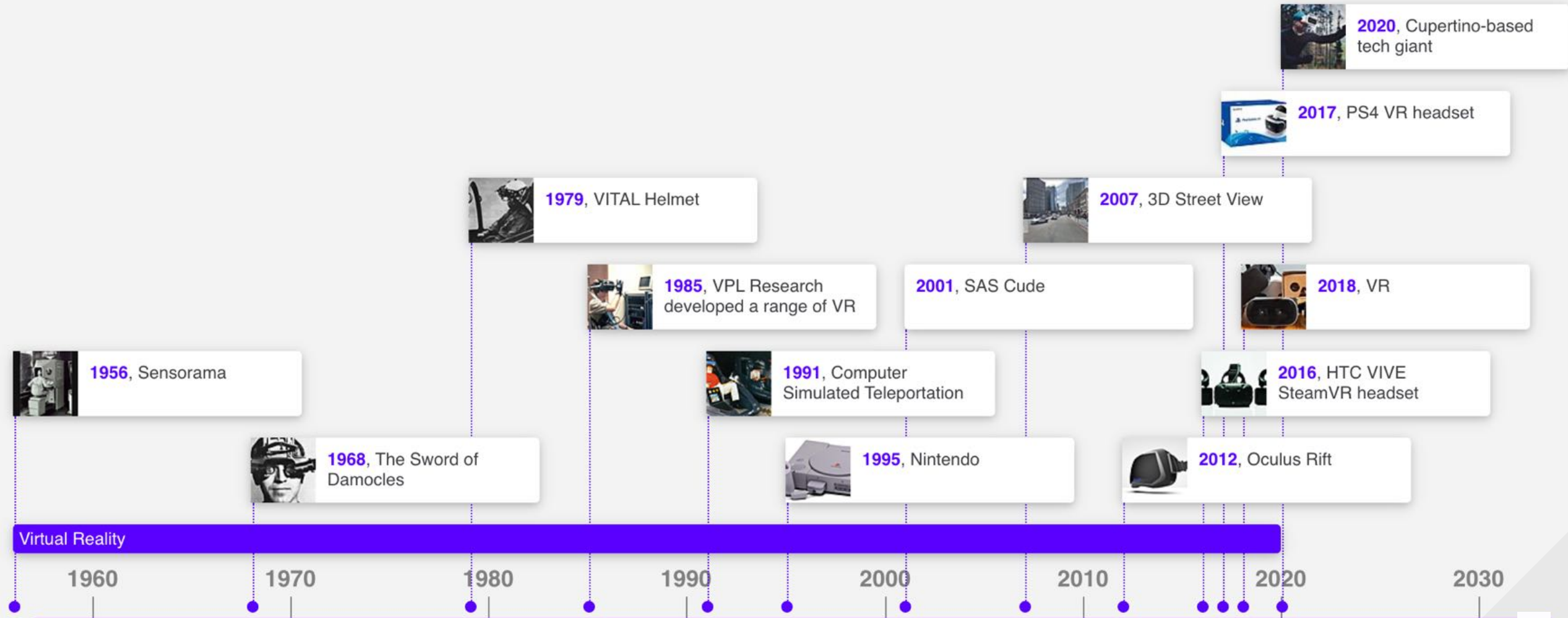




Augmented Reality

Source: [TVRLP](#)

A brief history...



Source: [timetoast](https://www.timetoast.com)



BE ORIGINAL.

BE POLAROID

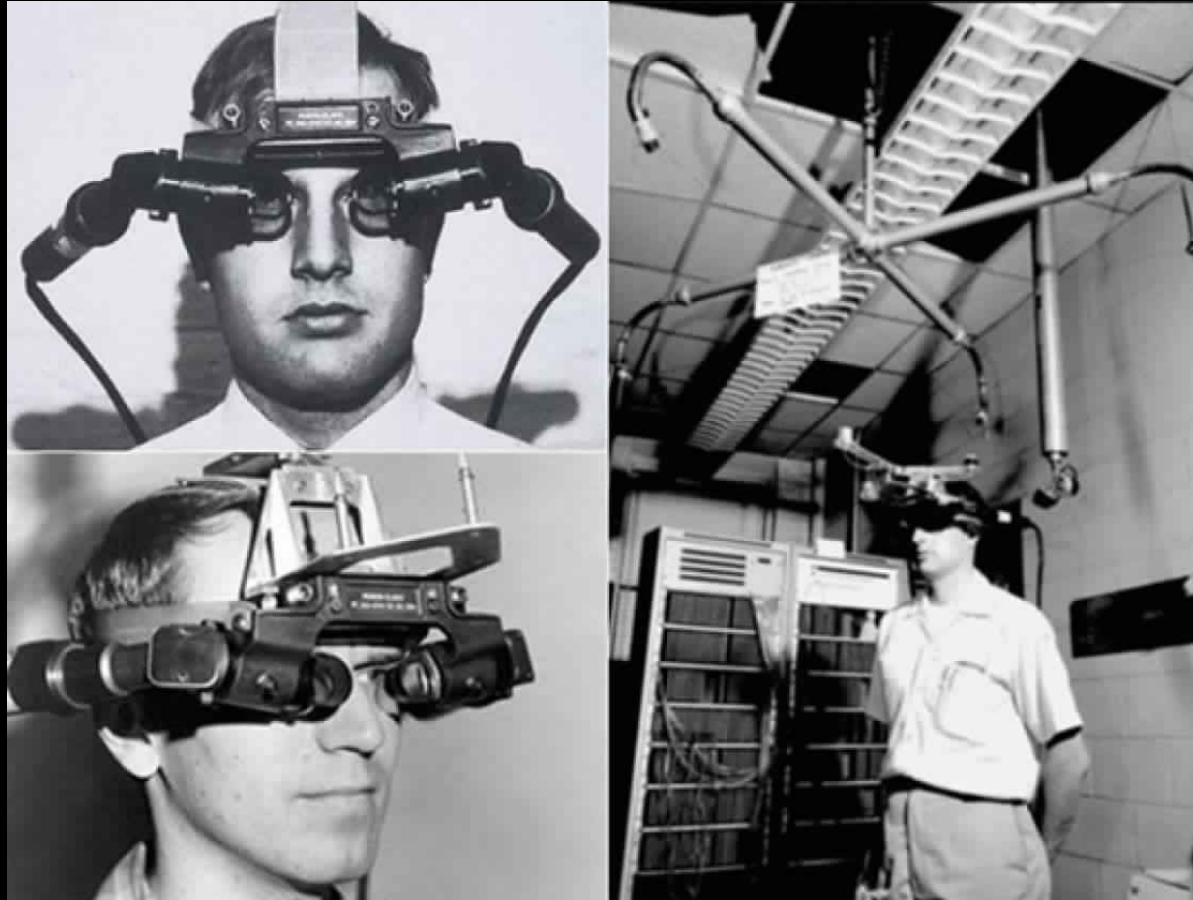
Kodak STEREO Camera

Kodak Anaston Lens
35mm f/3.5

Kodak Anaston Lens
35mm f/3.5

Source: lomography

1965 - Ultimate Display



Source: [Ivan Sutherland \(Sketchpad\)](#)

1985 - VPL Research



1998 - Sportvision (SMT)



2012 - Google Glass



Source: [theverge](#)

2016 - Microsoft HoloLens



Source: [edgy](#)

2016 - Pokémon Go



Source: [ft](#)

2017 - AR Kit (Apple)



Esper

ZHdK - IAD - Mobile User Interface

2018 - Magic Leap One



2021 - Apple Glasses 🙄



Shades of AR

- Screen Based
- Head-Mounted Display
- Audio Based
- Multi-Sensory
- Spatial

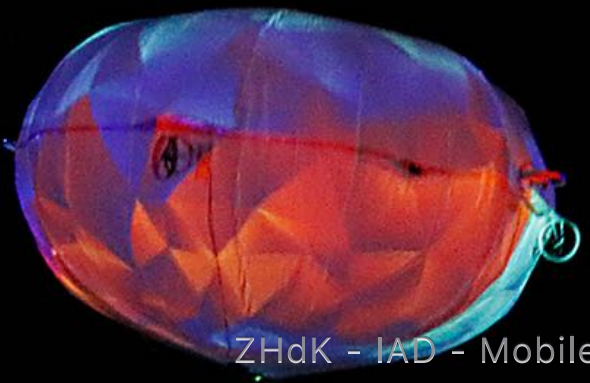
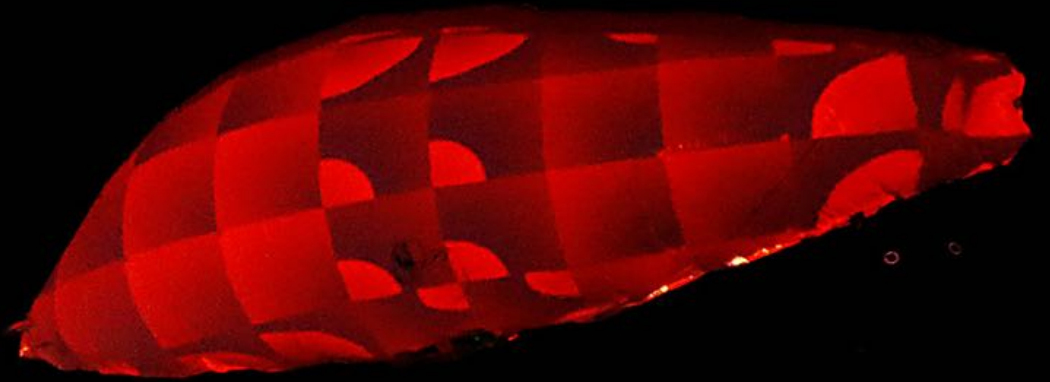
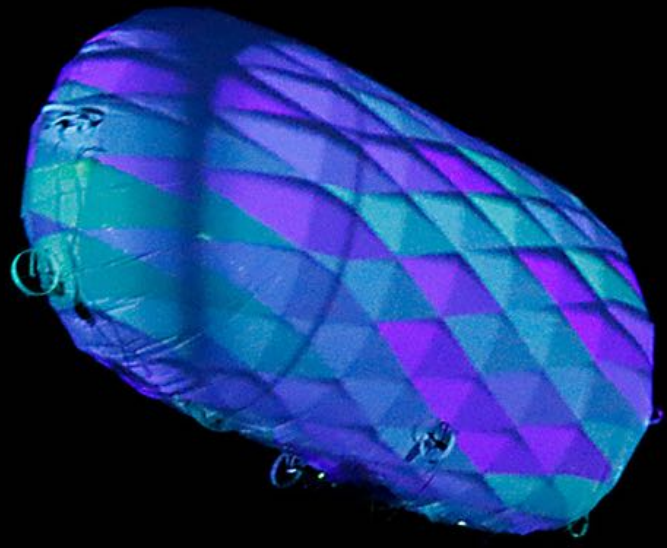
Augmented Bricklaying

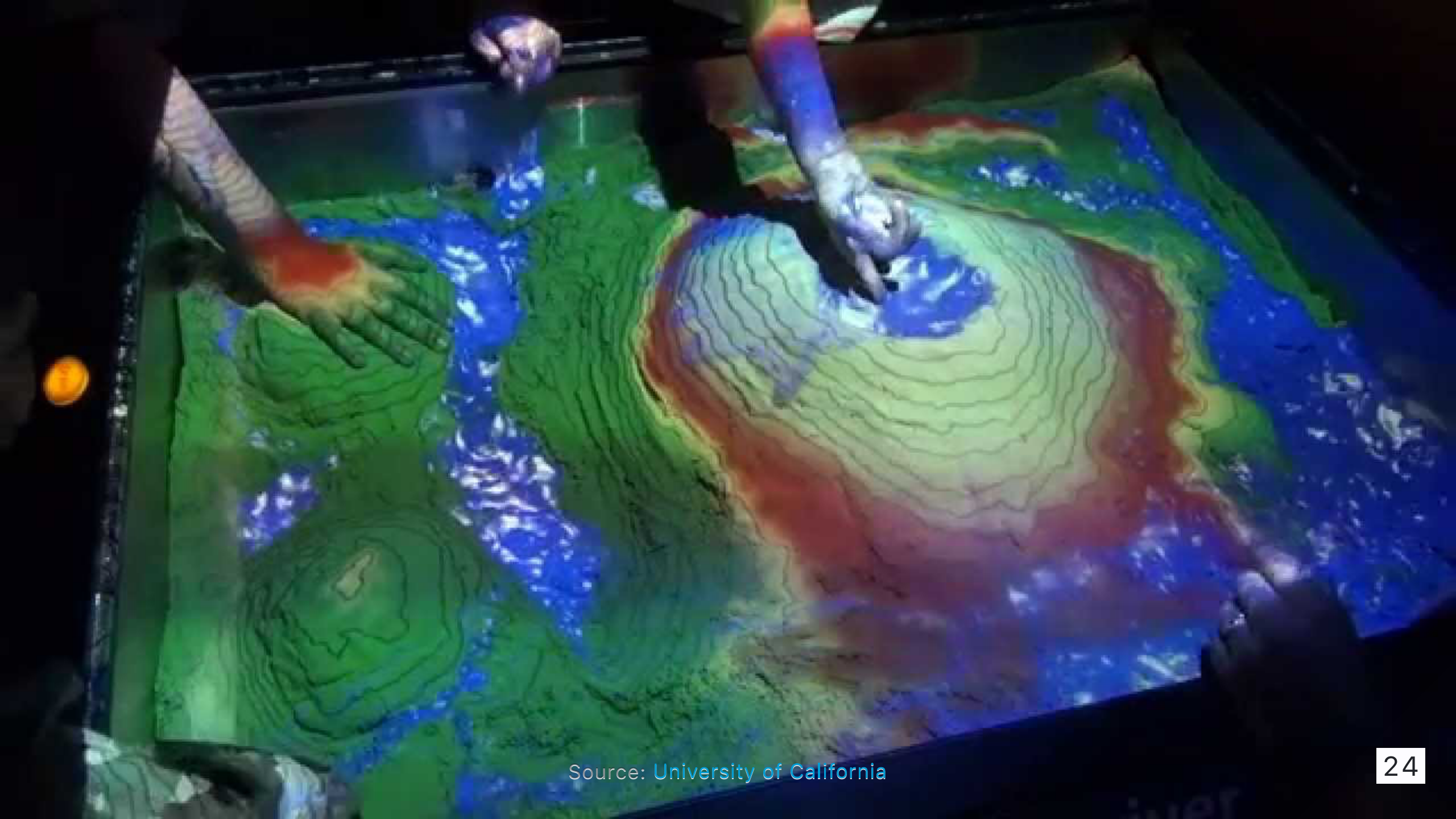


Source: [Gramazio Kohler Research, ETH Zurich](#)



Source: [Gramazio Kohler Research, ETH Zurich](#)



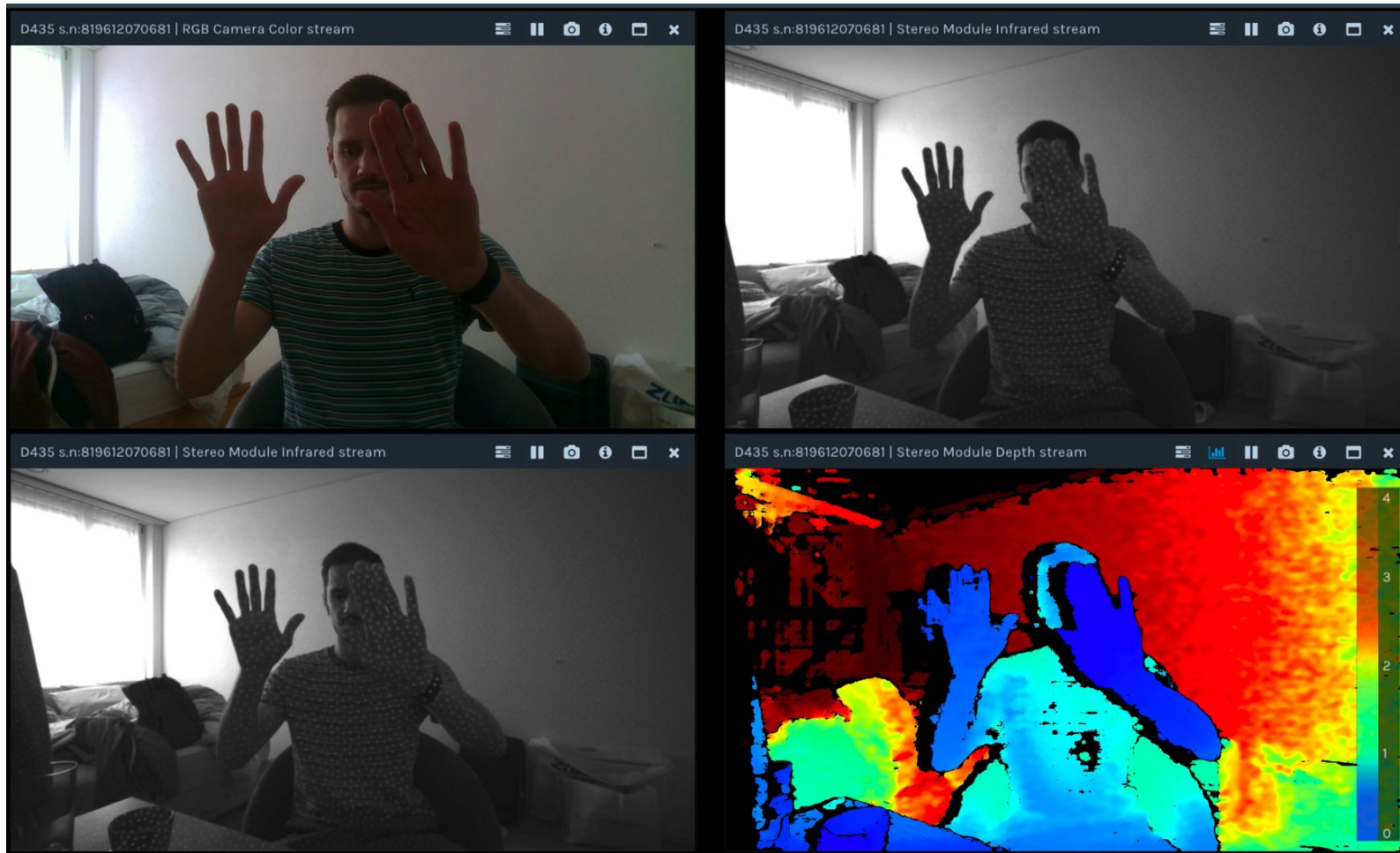


Source: University of California

How does AR work?

- Spatial understanding
 - IMU
 - Geolocation
 - Depth sensing
 - Object Recognition
- Sensor fusion

Depth Sensing



ENGINE - 96%

FORKLIFT - 98%



FORKLIFT - 95%



TOOLS - 97%



PERSON - 99%

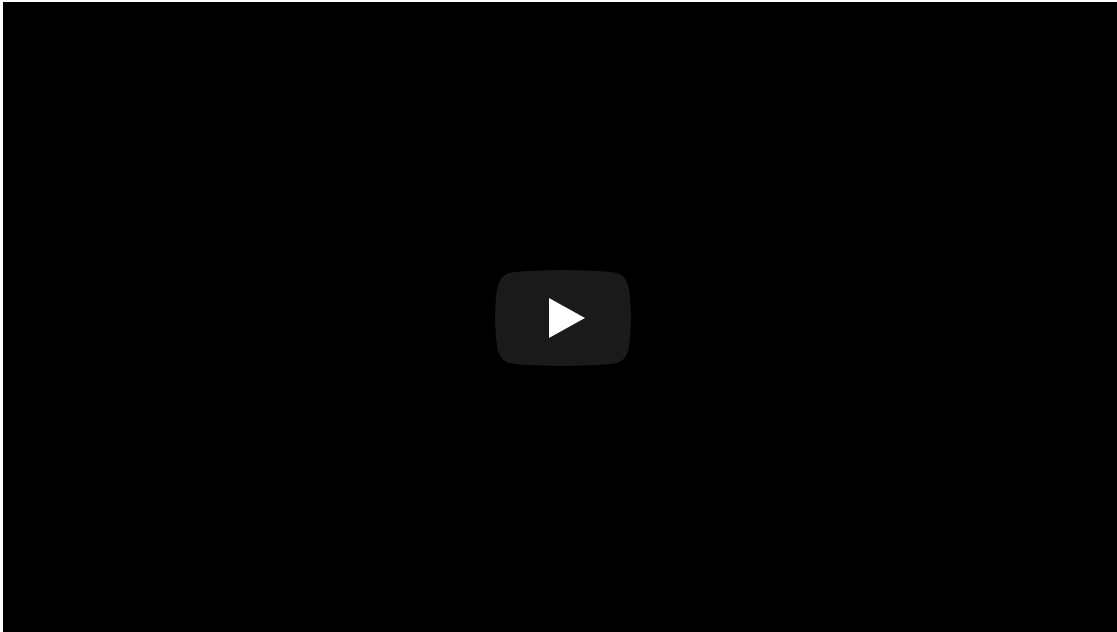
PERSON - 94%

PERSON - 98%

PERSON - 97%

ENGINE - 97%

Consistent Video Depth Estimation





AR Anchors

- Geolocation
- Marker (2d)
- Plane
- Object (3d)
 - Face
 - Hand



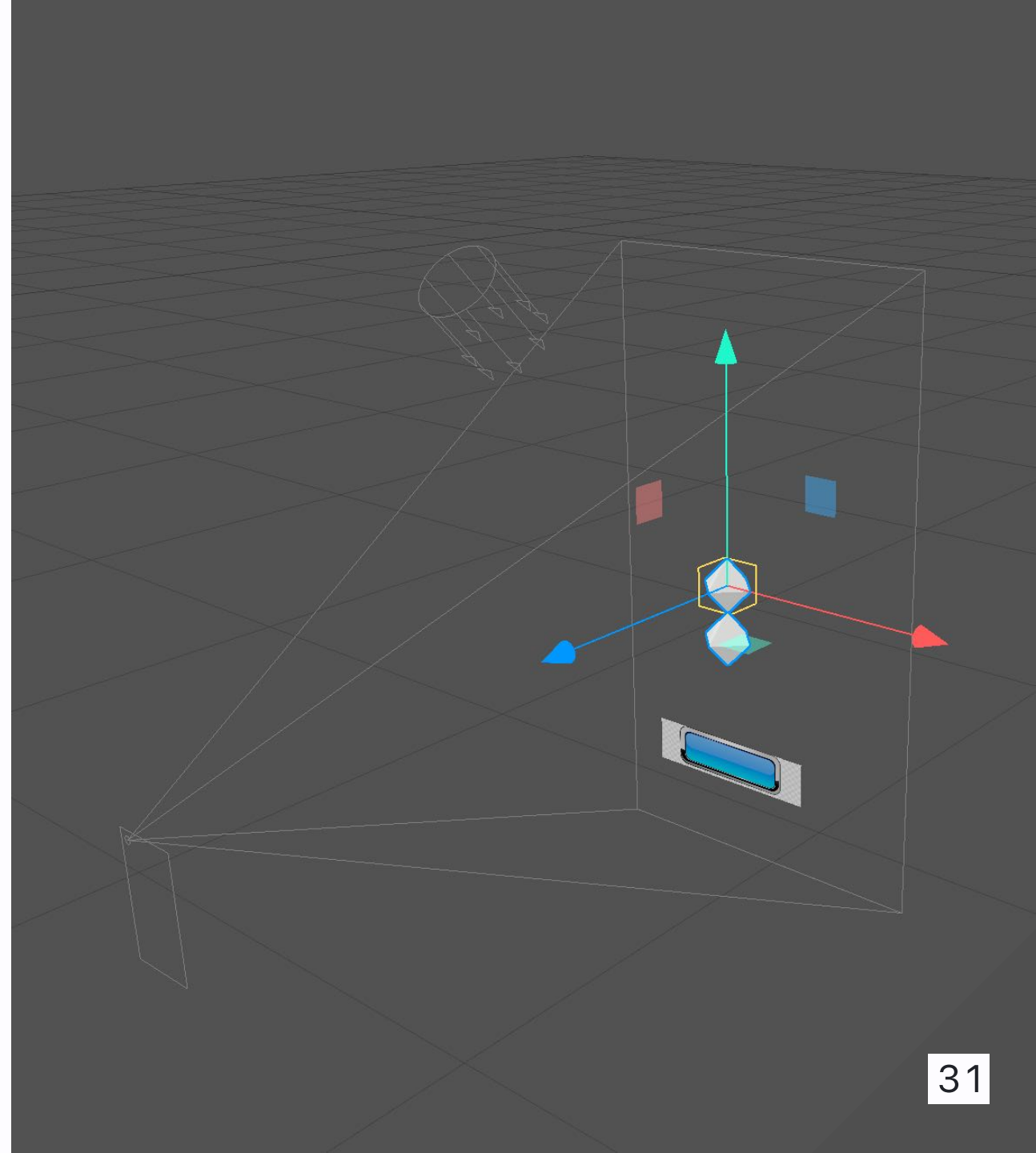
Design for 3D

2D challenges plus...

- Coordinate System
- Model
- Rendering
 - Shading
 - Lighting
 - Textures

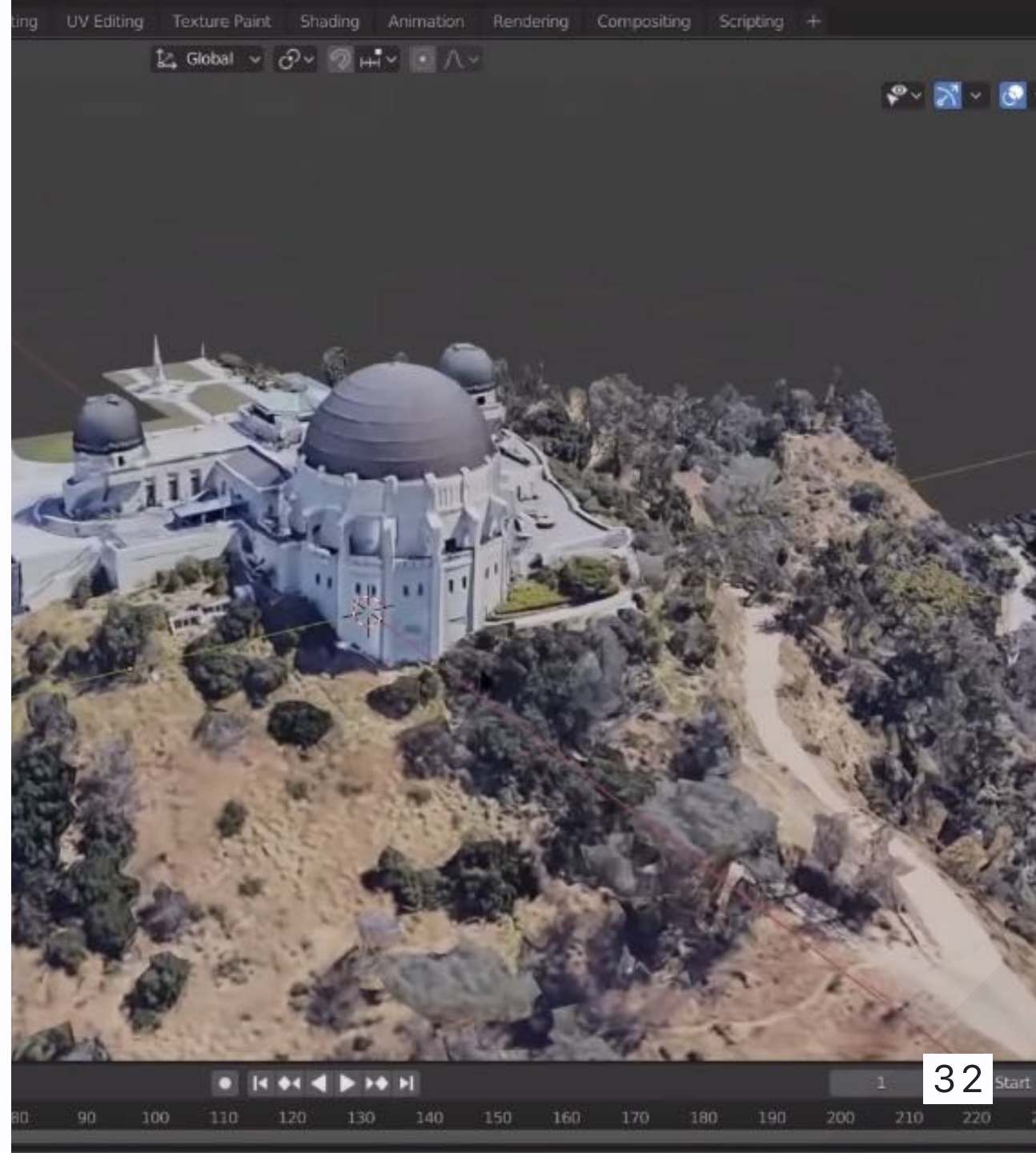
Coordinate System

- World Space
- Object Space (Local)
- Camera Space (2d)



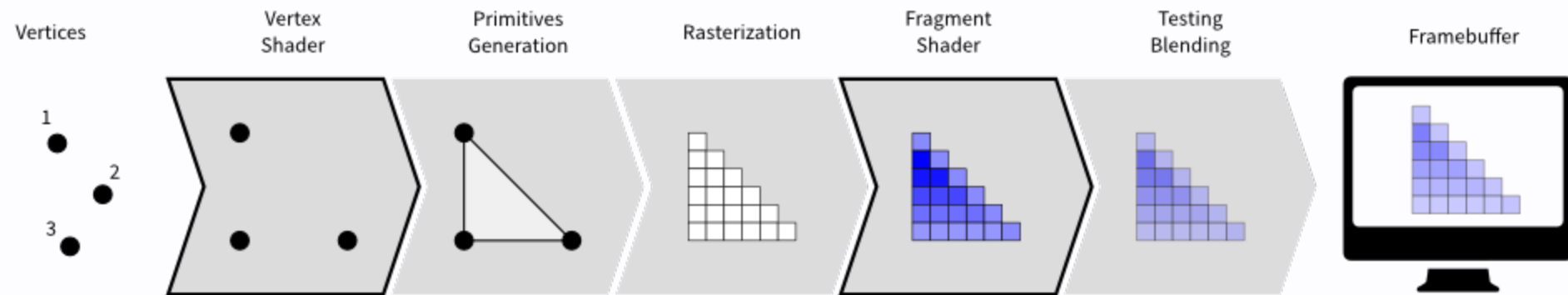
Model

- Modelling
 - Blender
 - Cinema4d
 - TinkerCad
- Libraries
 - Sketchfab
- Photogrammetry
 - Metashape
 - Reality Capture

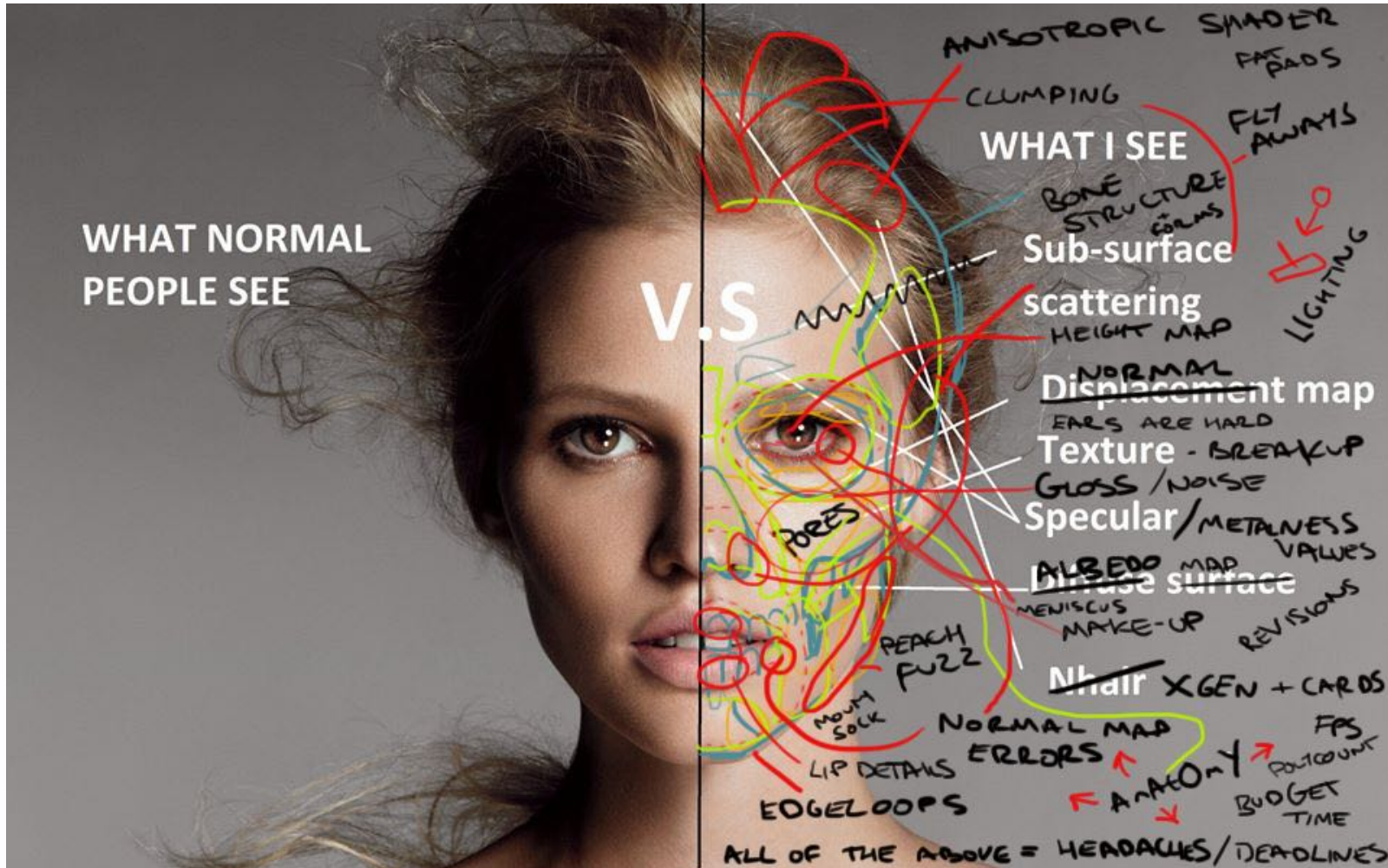




Rendering



Rendering



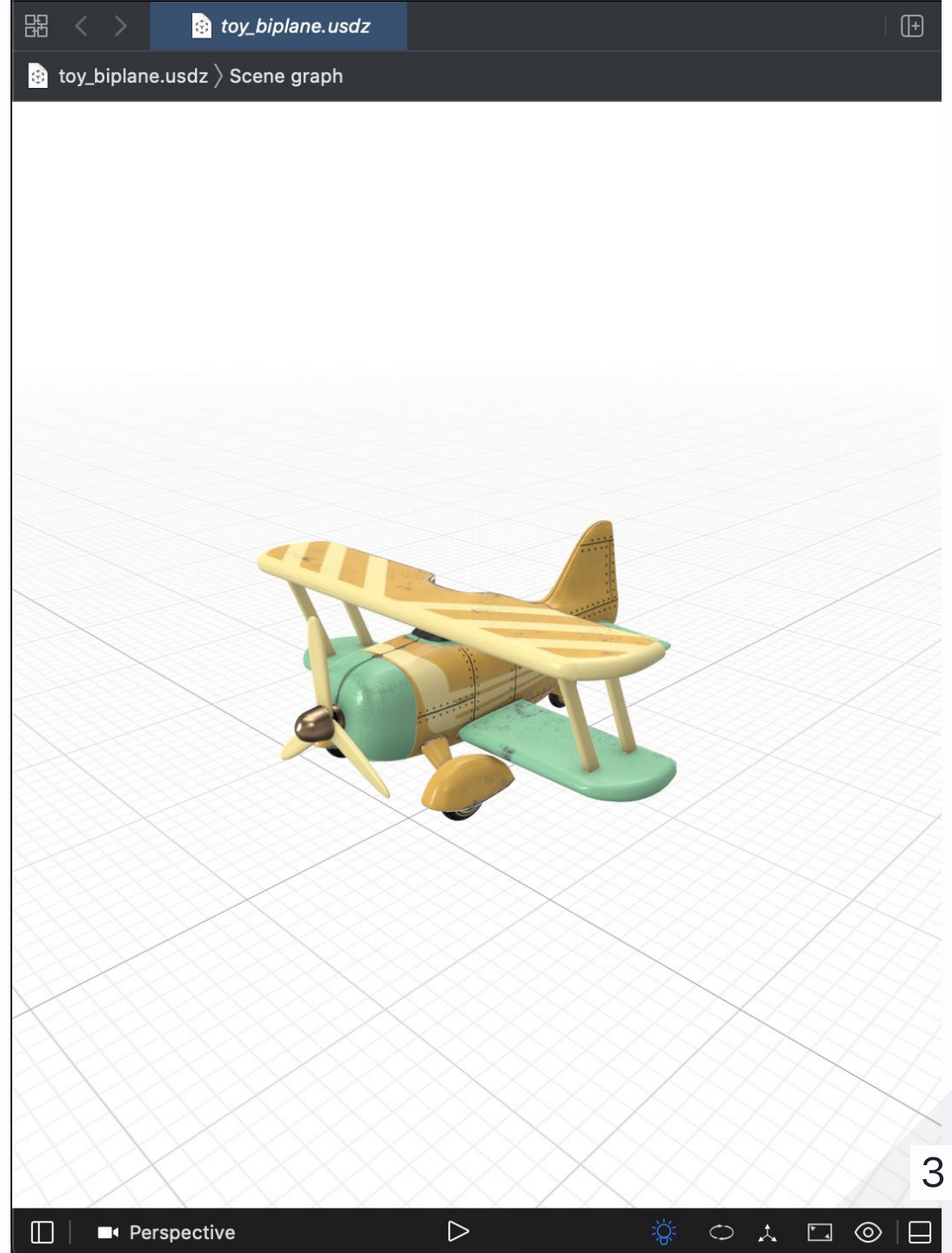
Frameworks

Tracking & Rendering

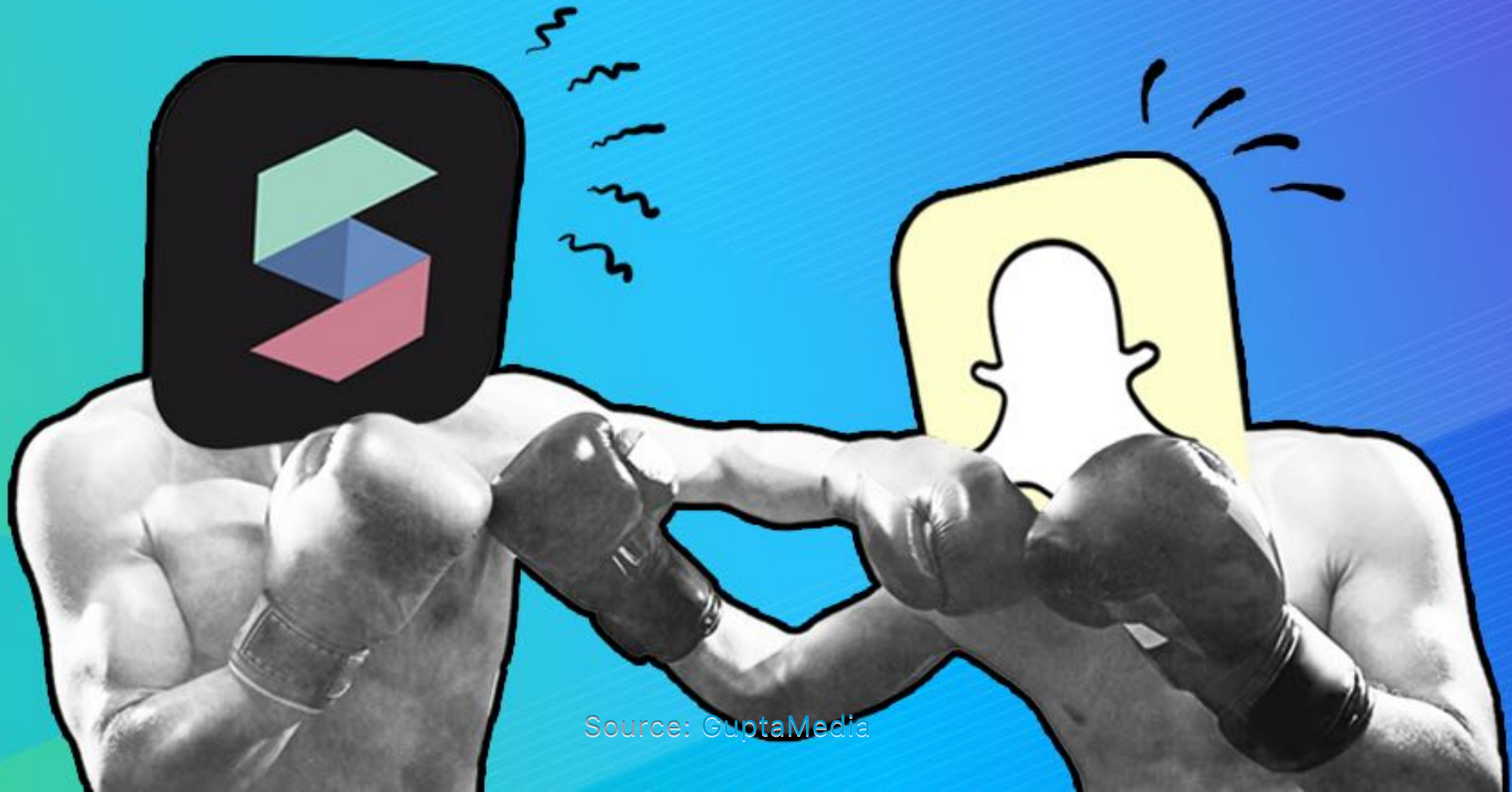
- AR Kit (Apple)
- AR Core (Google)
- AR Foundation (Unity)
- Vuforia
- Unreal Engine

WebAR

- ThreeJS / AFrame
- Lightweight Methods
 - **USDZ** (Pixar)
 - glTF (Krohnos)



Spark AR vs. Lens Studio: Competition Breeds Innovation



Source: GuptaMedia

Spark AR Studio



Questions?