Virtual and Augmented Reality: from Promise to Productivity
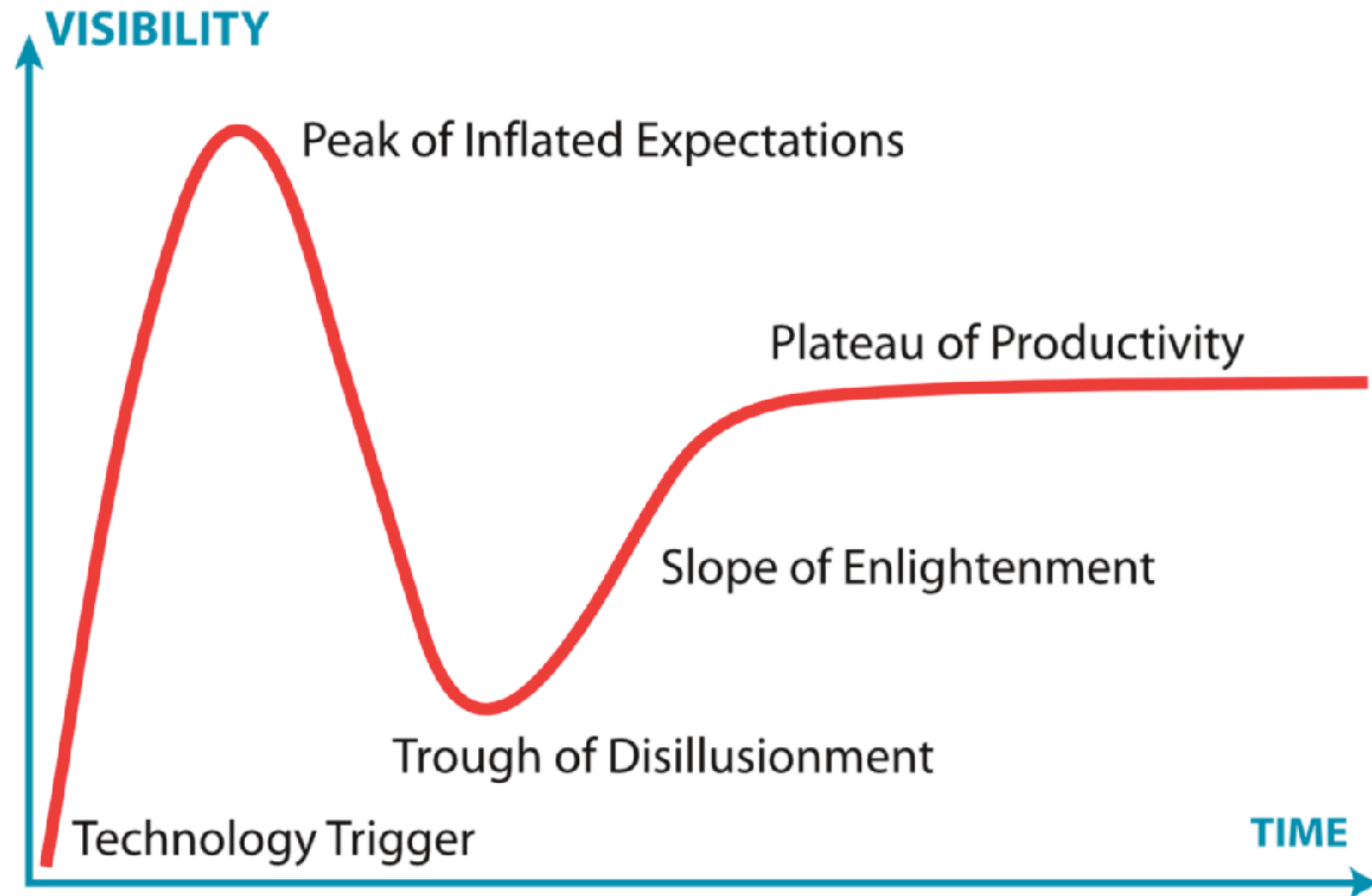
7 September 2018

James Oliver, Director
Virtual Reality Applications Center
Human Computer Interaction Graduate Program
Iowa State University

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A walk through VR history

1516 — 'Sala delle Prospettive' created by Baldassare Tommaso Peruzzi Villa Farnesina in Rome

1960 — Morton Heilig creates 'Sensorama' a multi-sensory simulator

1968 — "The Sword of Damocles" created by Ivan Sutherland first AR HMD system

1978 — Andy Lippman's team at MIT create the Aspen Movie Map

1982 — Thomas Furness develops Visually Coupled Airborne Systems Simulator

1982 — Steven Lisberger's TRON is released

1984 — William Gibson publishes 'Neuromancer'

1985 — Data Glove for commercial use developed by VPL Research Inc.

1987 — "Virtual Reality" coined by Jaron Lanier of VPL Research Inc.

1988 — Eyephone HMD for commercial use developed by VPL Research Inc.

1988 — Star Trek: The Next Generation introduces "the holodeck"

1992 — Brett Leonard's The Lawnmower Man

1993 — Sega announce Sega VR prototype for Mega Drive console

1995 — CAVE Automatic Virtual Environment

1999 — The Wachowski Brothers' The Matrix is released

2003 — Linden Labs releases Second Life

2007 — Google introduces Street View

2013 — Nintendo files patent for VR 3D technology

2014 — Google invest US$500 million into Magic Leap

2014 — Facebook buy Oculus VR for US$2 billion from Palmer Luckey

2015... — To Infinity & Beyond

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https://immersivelifeblog.files.wordpress.com/2015/04/vr_history.jpg
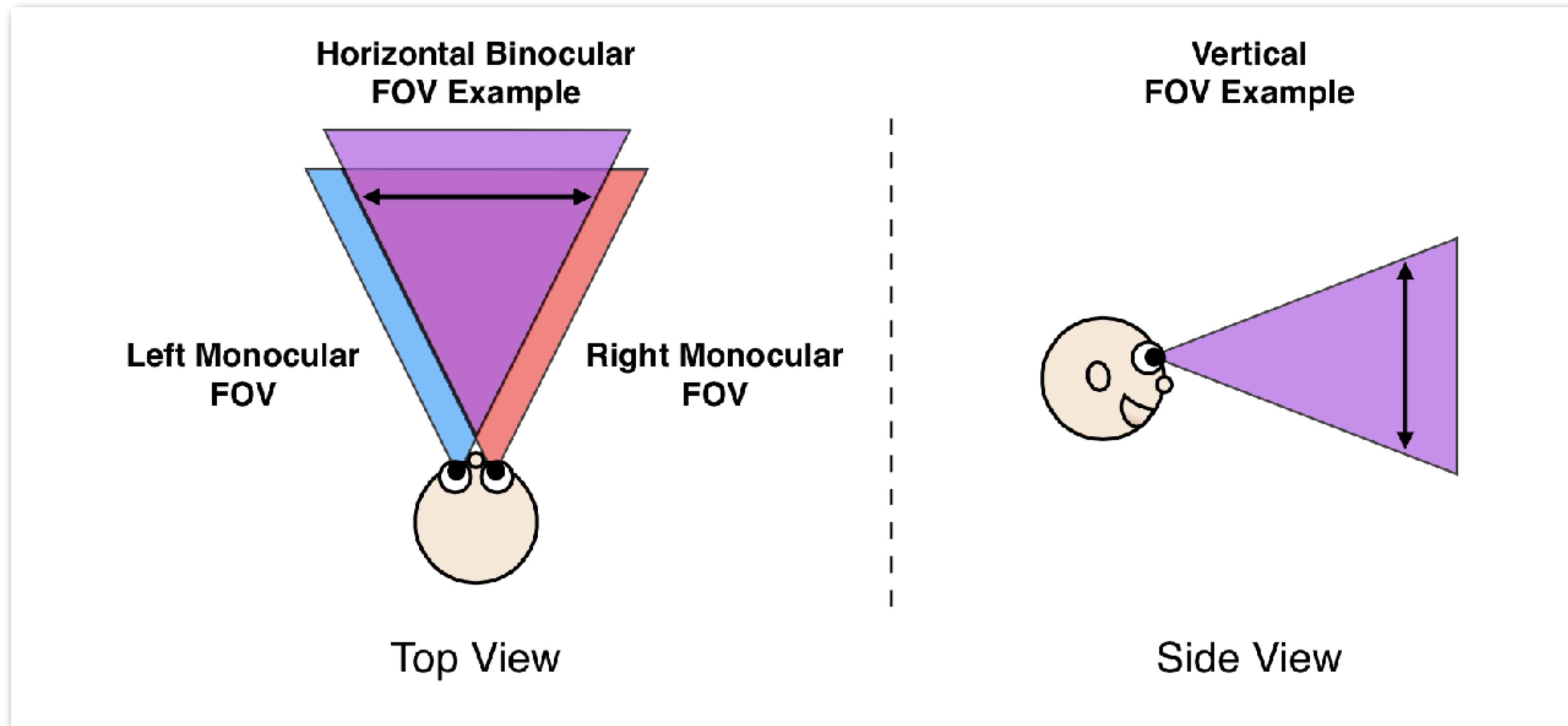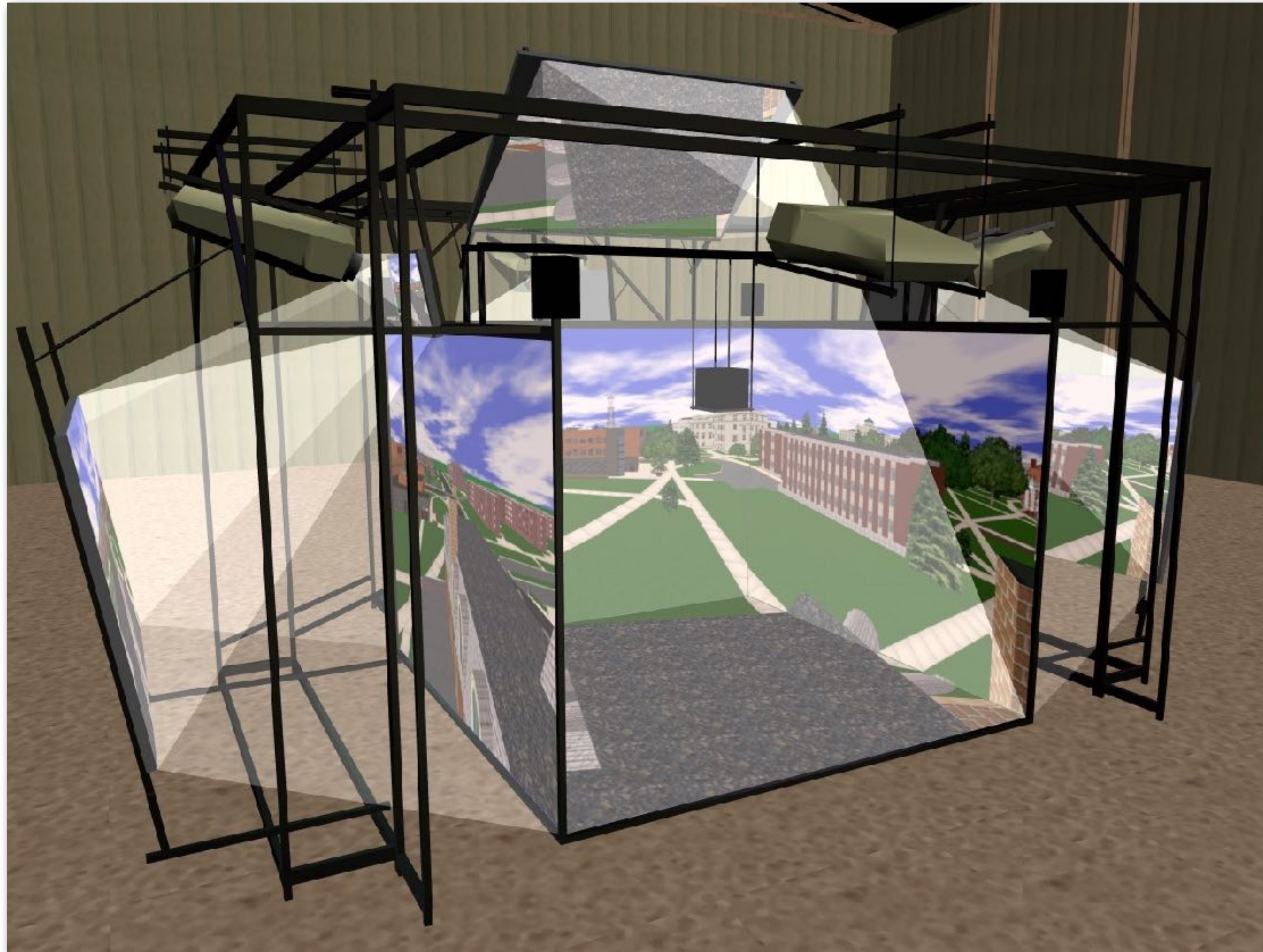
"Hype-Cycle"

Virtuality Continuum

Milgram, Paul; H. Takemura; A. Utsumi; F. Kishino (1994). "Augmented Reality: A class of displays on the reality-virtuality continuum," *Proceedings of Telemanipulator and Telepresence Technologies.*
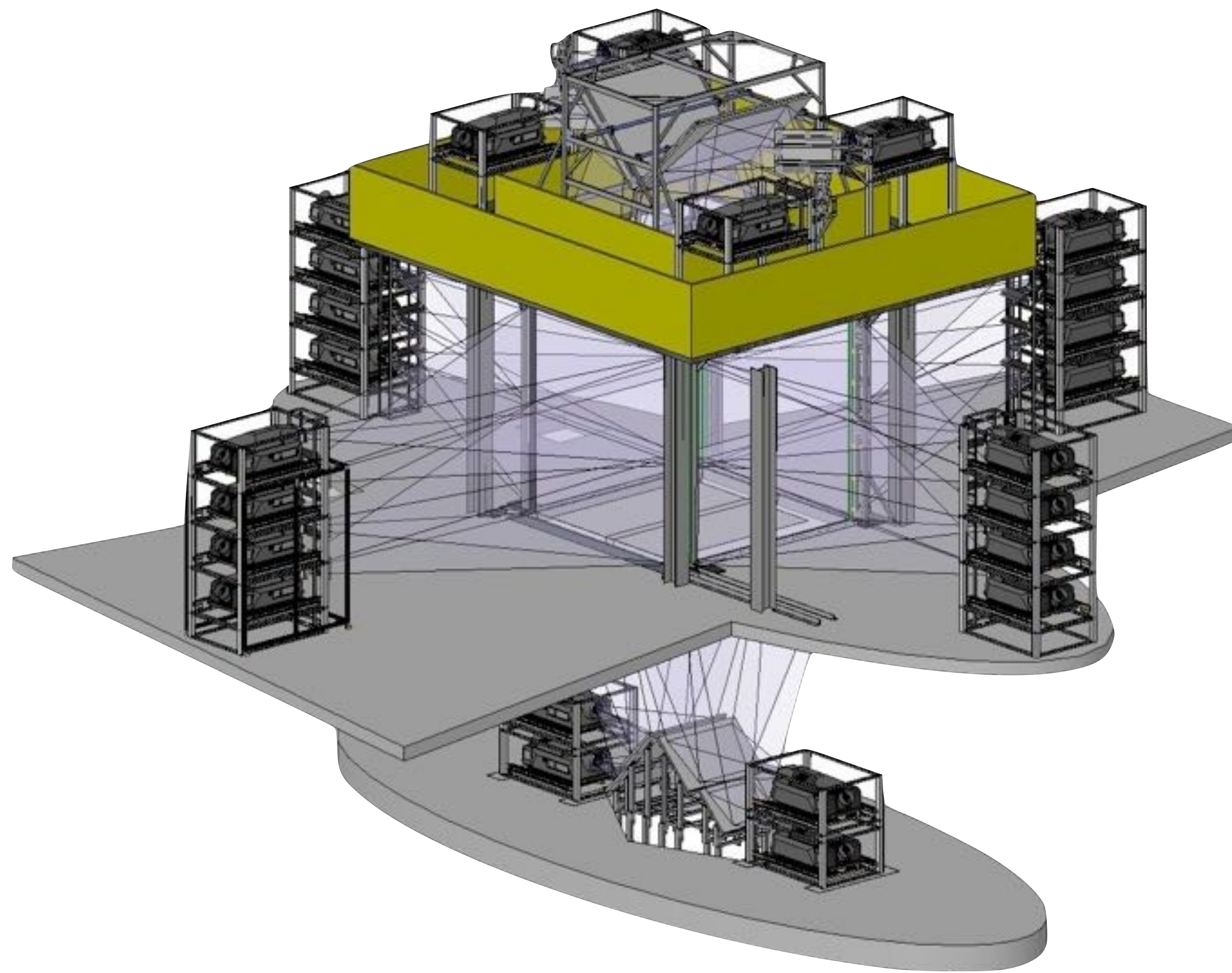
HMD

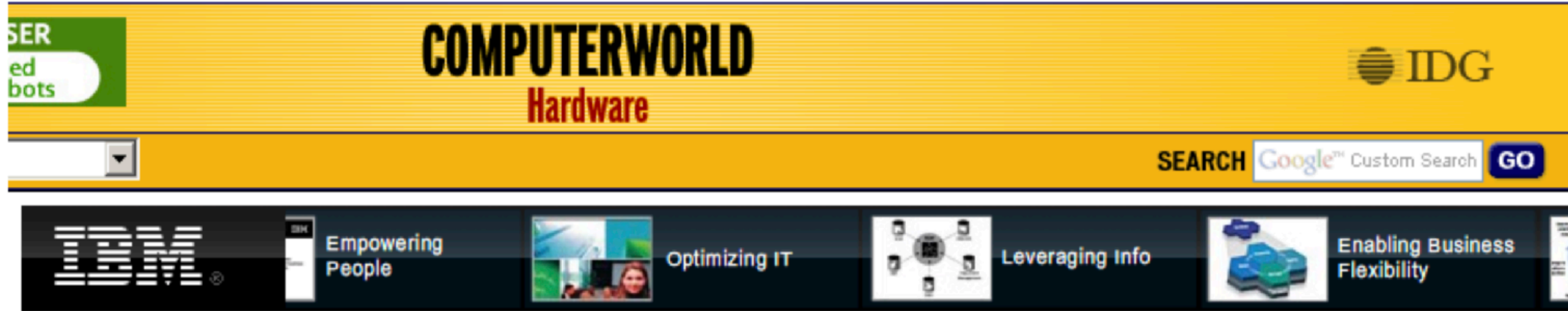Horizontal Binocular FOV Example

Vertical FOV Example

Left Monocular FOV

Right Monocular FOV

Top View

Side View

HMD vs CAVE

C6

C6

The end?

COMPUTERWORLD
Hardware

IBM — Empowering People · Optimizing IT · Leveraging Info · Enabling Business Flexibility

Don't Believe the Hype: The 21 Biggest Technology Flops

We fondly recall 21 overpromoted products and technologies that utterly failed to live up to their hype -- and we give you a chance to choose the biggest flop of all.

David Haskin   Today's Top Stories ▸   or   Other Hardware Stories ▸

- April 2007 Computer World
  - VR Voted 7th on list of 21 biggest technology flops

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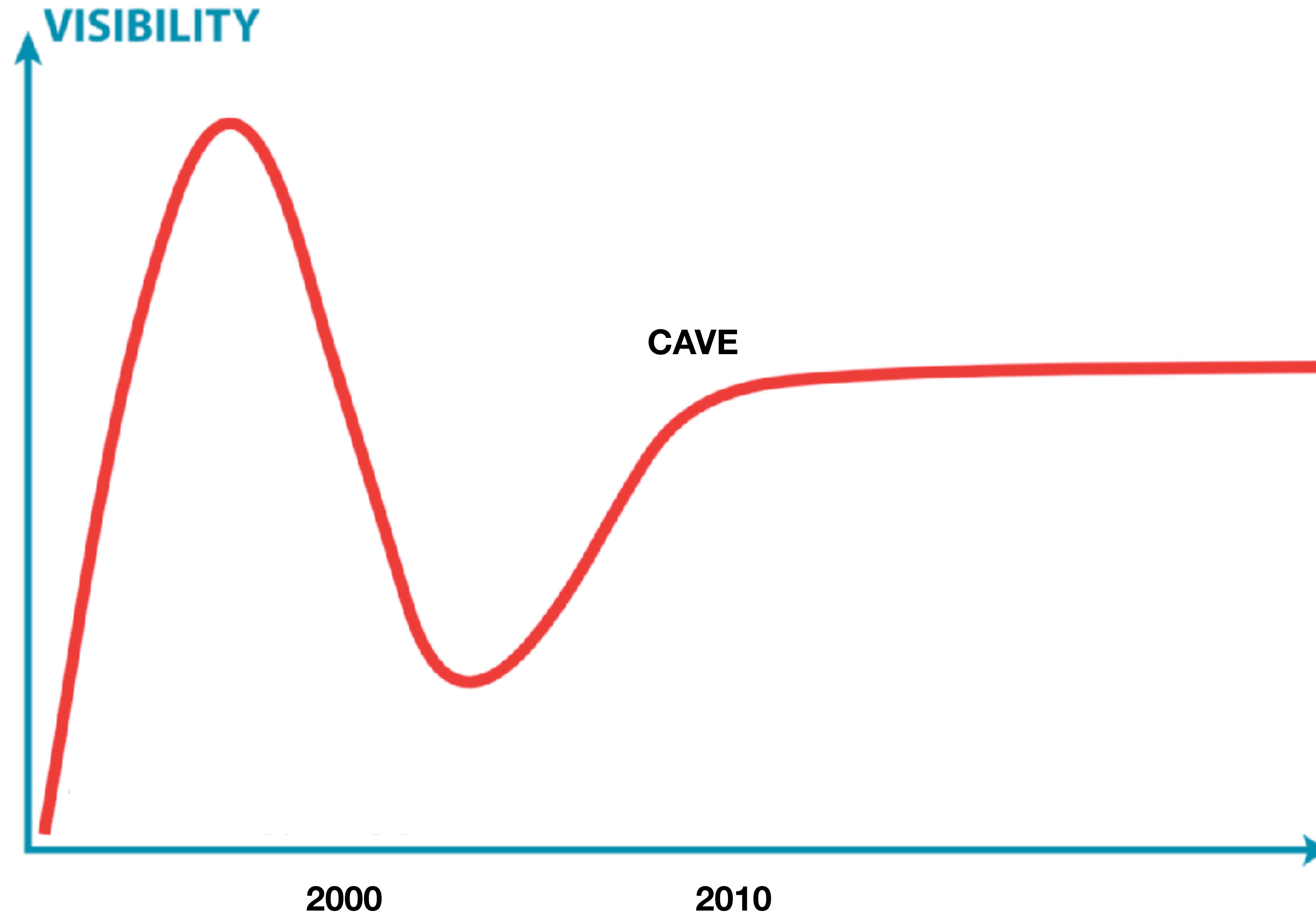
What's next?

What's next?
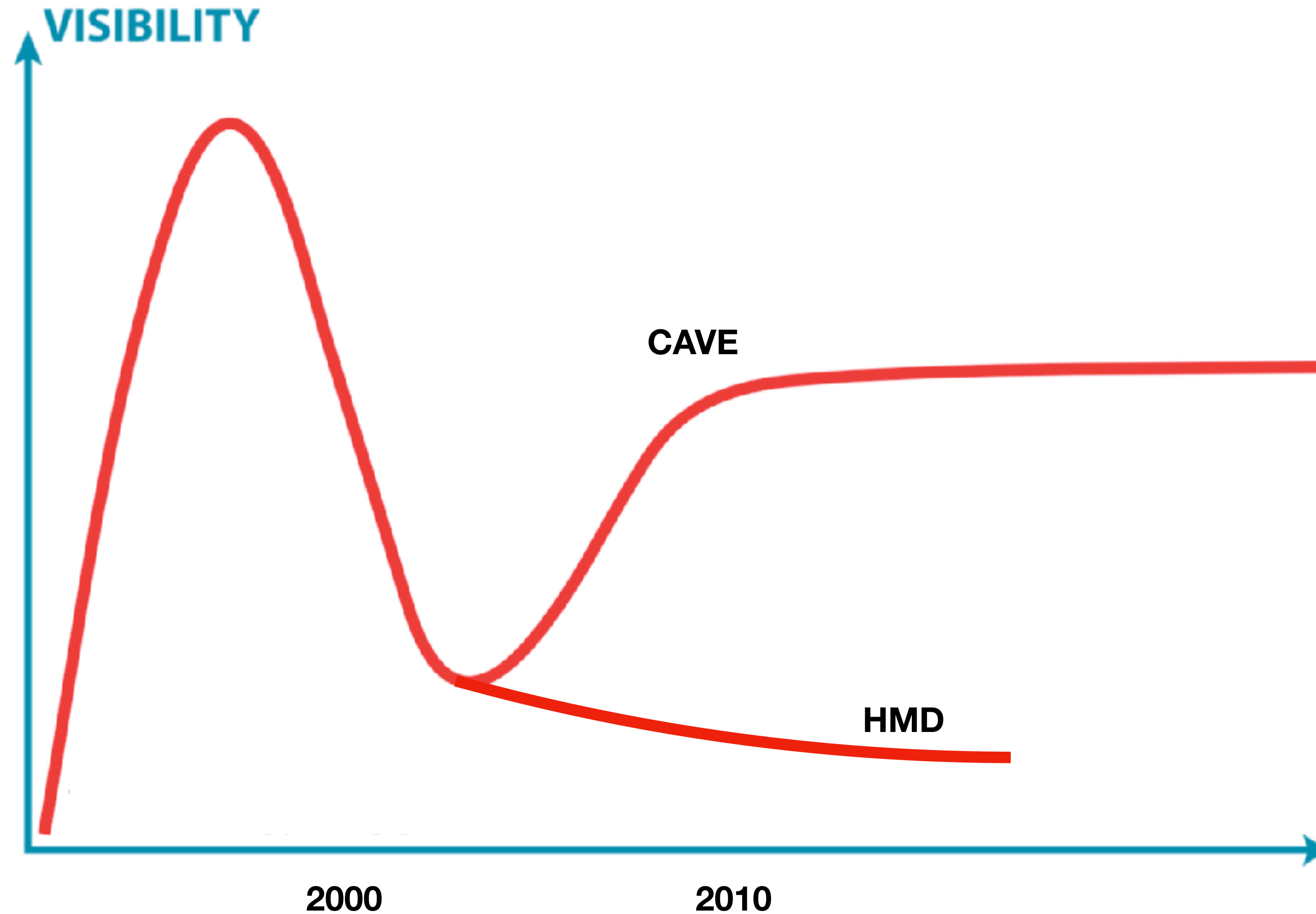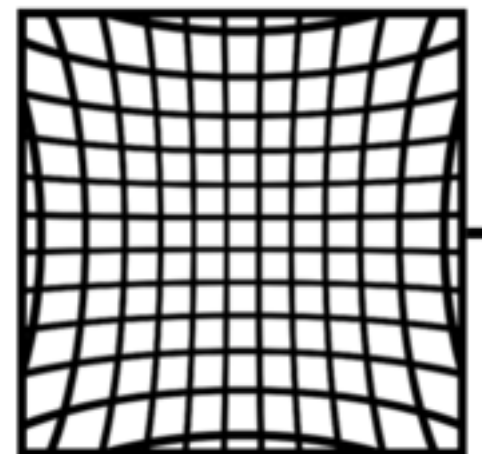
What goes around…

LEEP Optics (1979)

Large Expanse, Extra Perspective Optics
- Developed by Eric Howlett
- High resolution center, lower in periphery
- Basis for most VR HMDs



Virtual images

Left   Right

90° direct field

140° corneal field

Compressed real images
film or video source

What goes around…

LEEP Optics (1979)

Lens   image generator   final image

Large Expanse, Extra Perspective Optics

- Developed by Eric Howlett
- High resolution center, lower in periphery
- Basis for most VR HMDs

Pincushion   **Barrel**   **Ideal**

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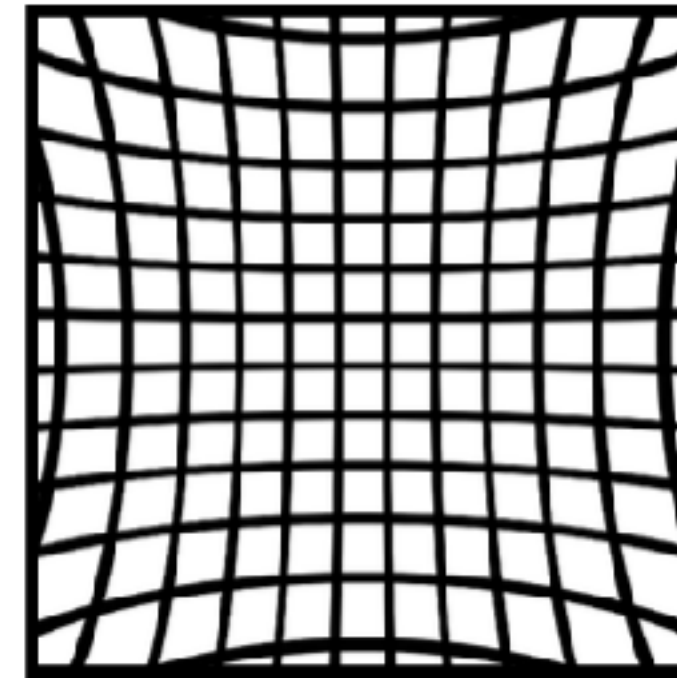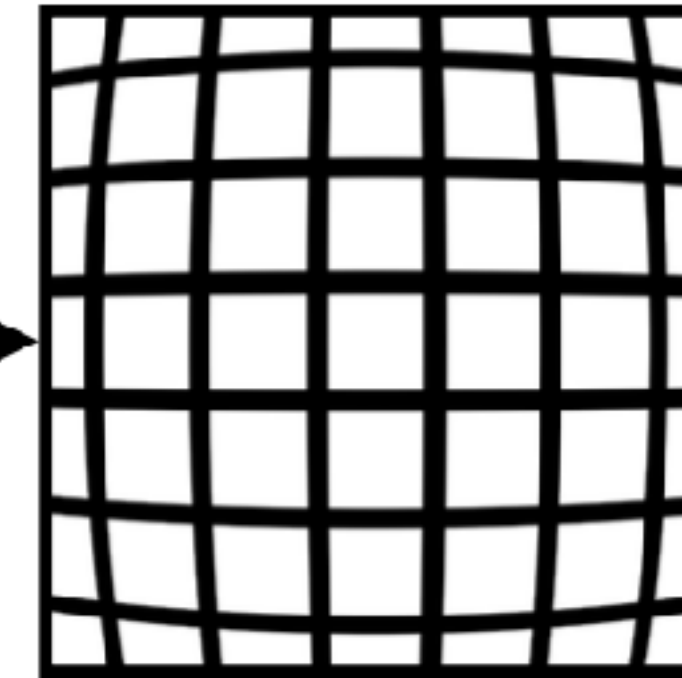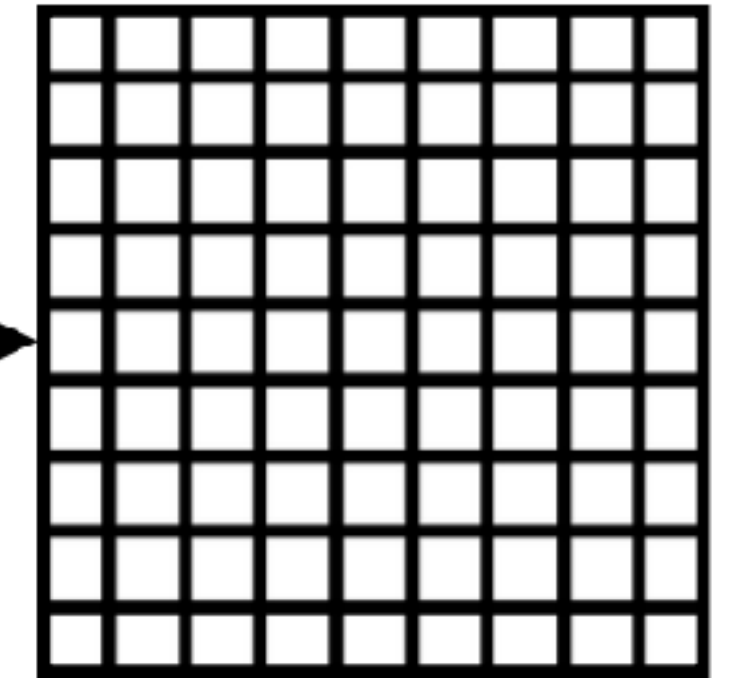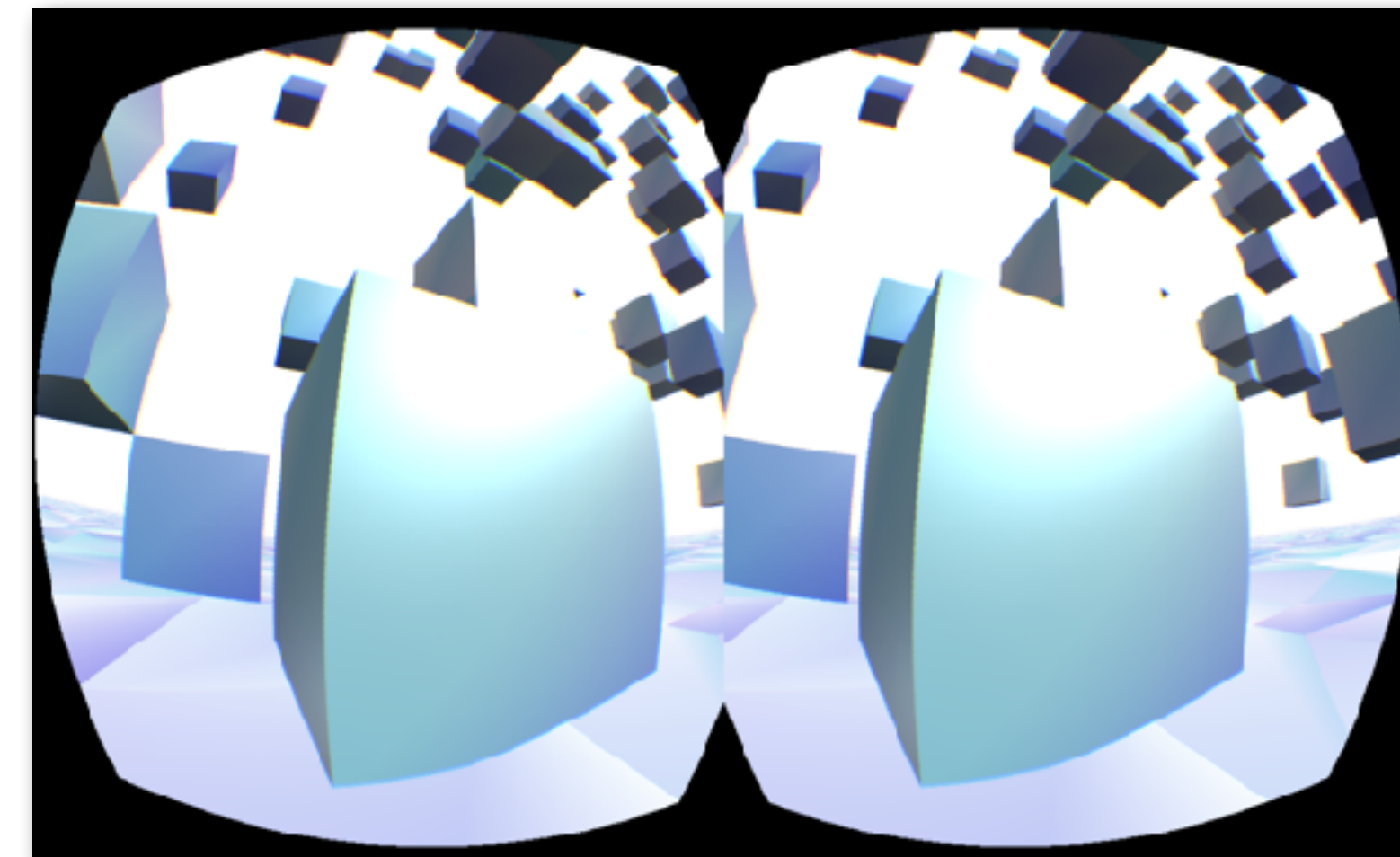
Facebook in $2 Billion Deal for Virtual Reality Company

By NICK WINGFIELD and VINDU GOEL   MARCH 25, 2014

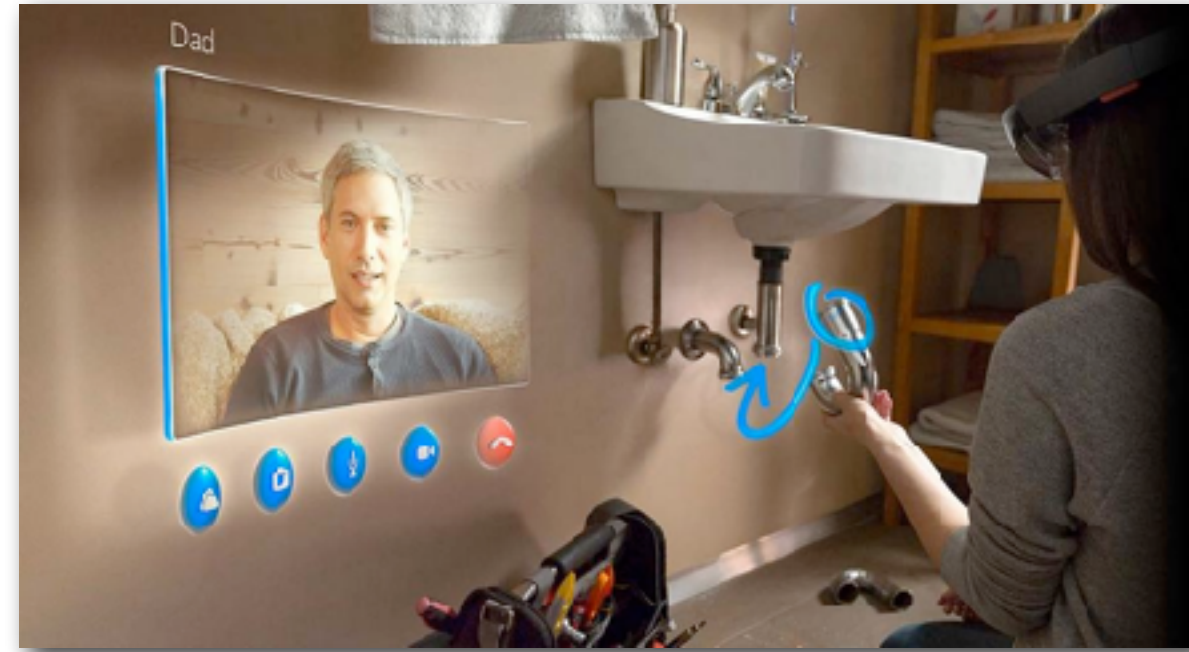Oculus VR's headset, seen here at a game developer conference last week, started as a Kickstarter project.
Jason Henry for The New York Times

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Other big bets…

Microsoft HoloLens

Sony's Playstation VR

magicleap™

Forbes / Tech

10 Stocks

MAY 30, 2015 @ 12:54 PM   5,977 VIEWS

Apple Further Legitimizes Augmented Reality Tech
With Acquistion Of Metaio

Daqri

Google Daydream

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Applications/markets

2025 total addressable market

Games -	$11.6B
Live events -	$4.1B
Video entertainment -	$3.2B
Retail -	$1.6B
Real estate -	$2.6B
Education -	$0.7B
Health care -	$5.1B
Military -	$1.4B
Engineering -	$4.7B
Software TAM	$35.0B
Hardware TAM	$45.0B

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What's different this time?

Vergence/Accommodation
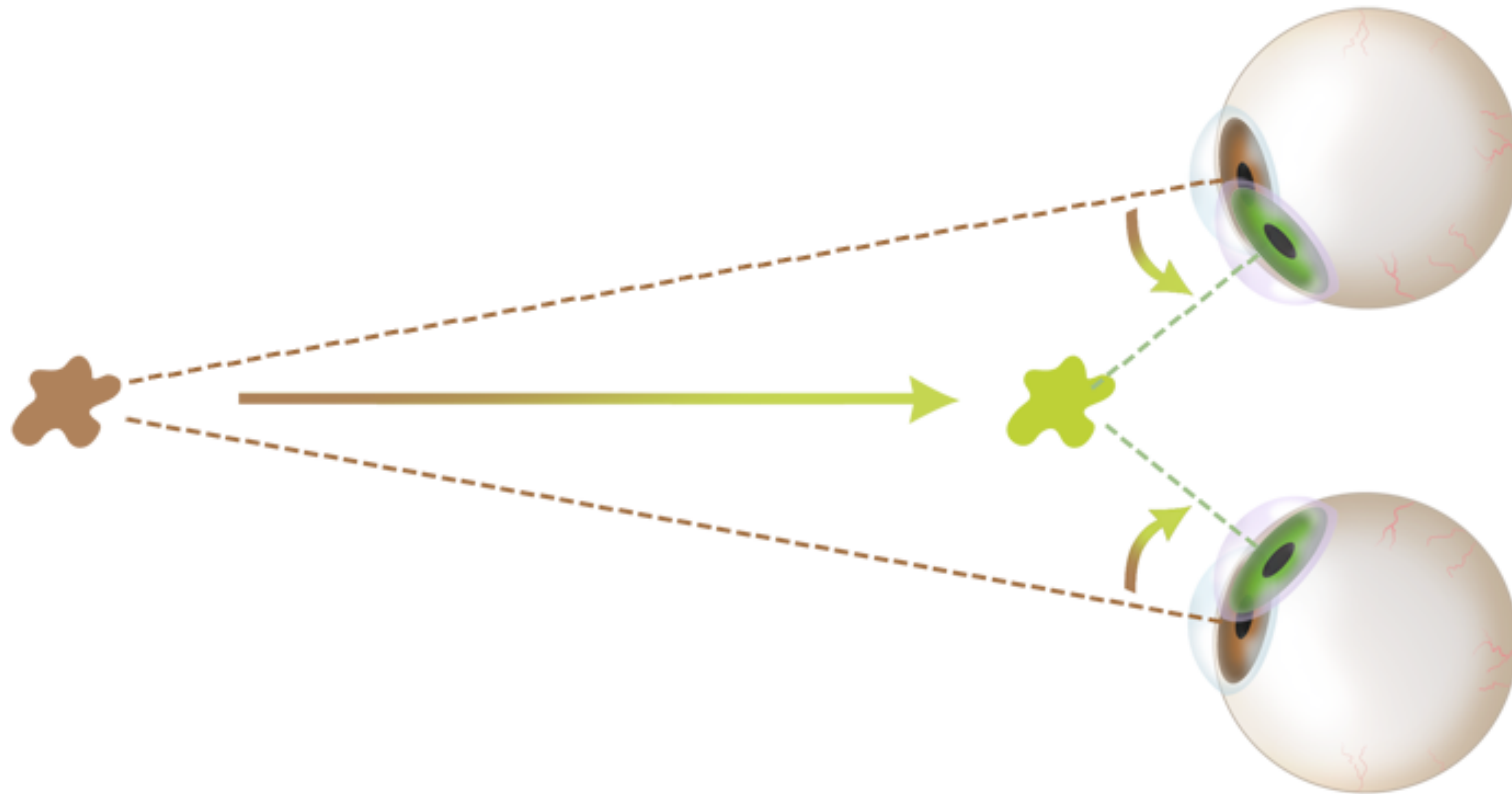
■ CONVERGENCE

©e(ye)BRAIN 2011

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http://www.eyebrainpedia.com

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Vergence/Accommodation

■ CONVERGENCE

©e(ye)BRAIN 2011

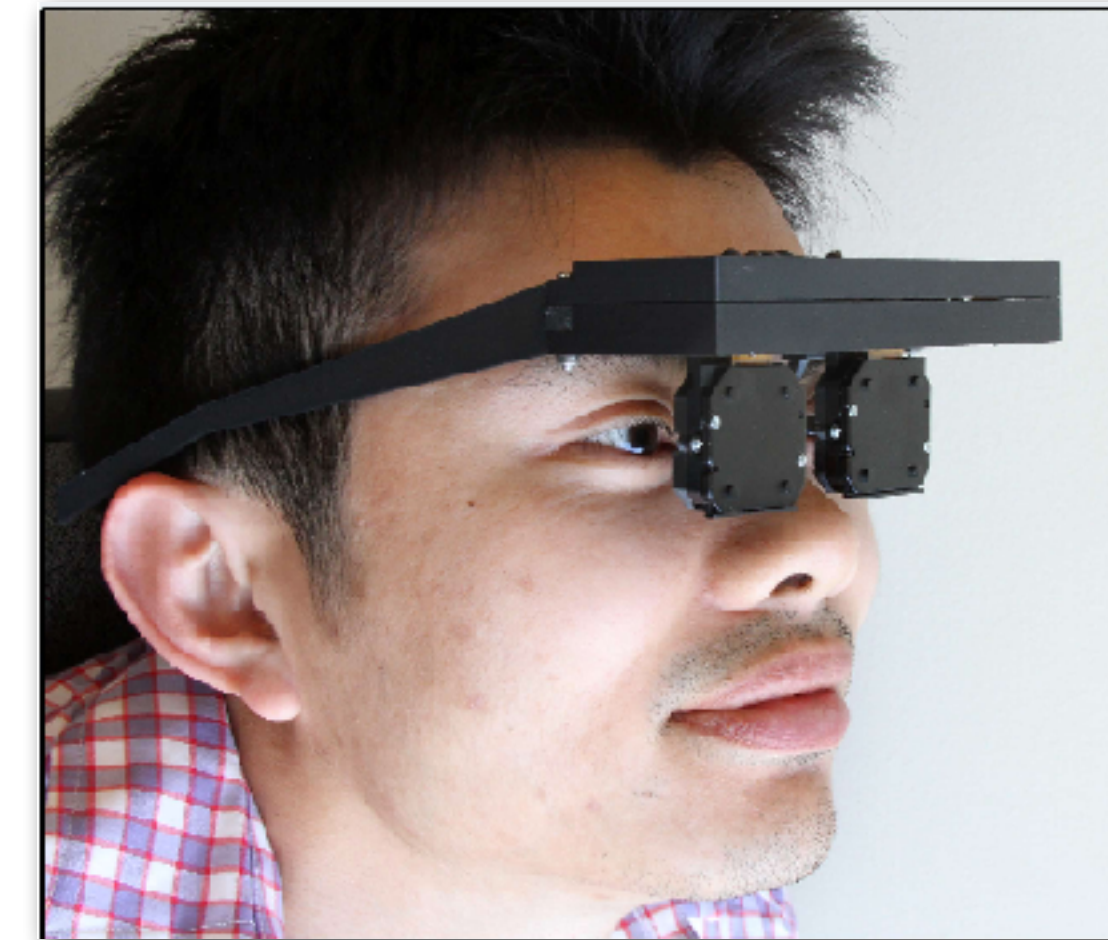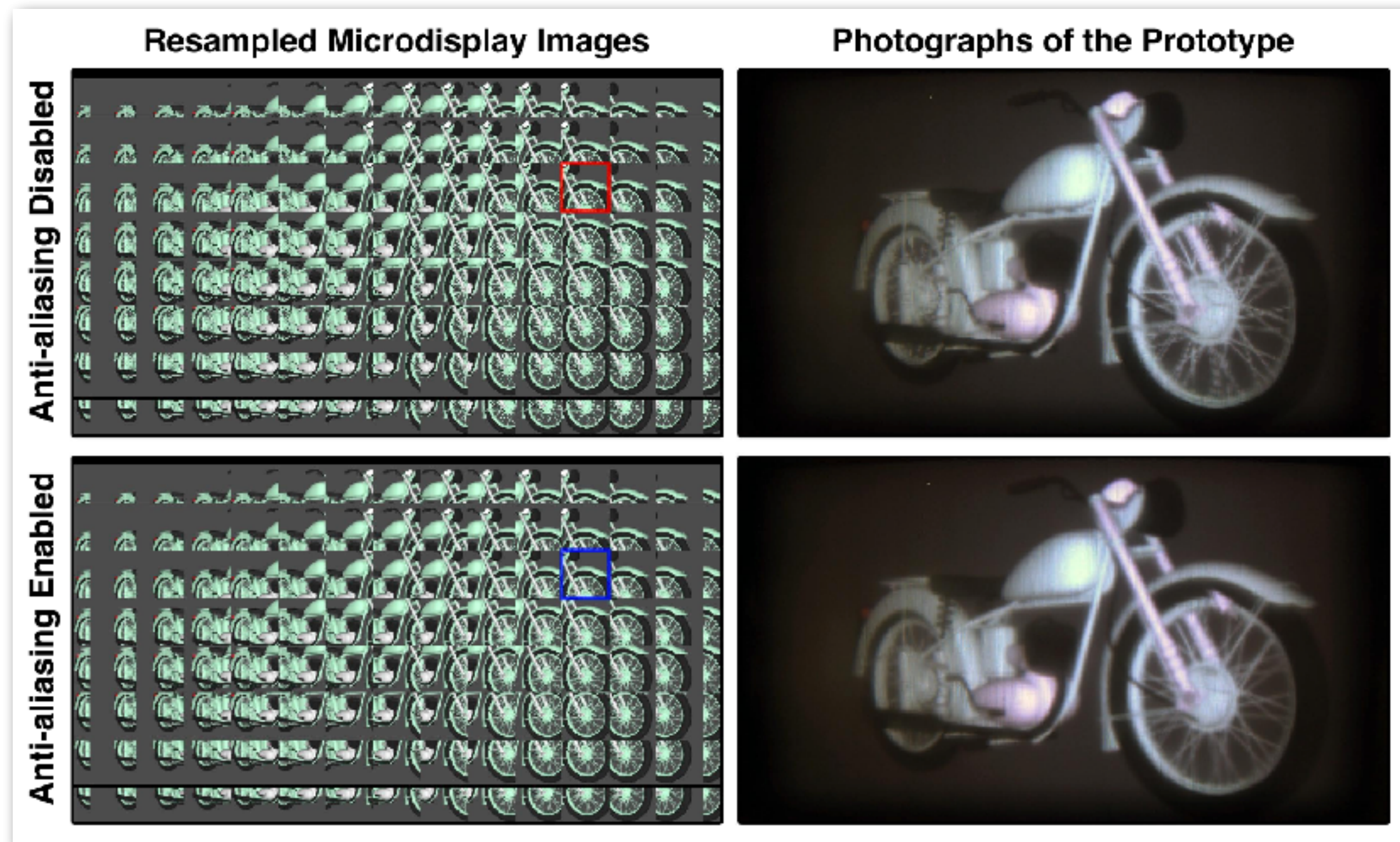Virtual Reality Applications Center

http://www.eyebrainpedia.com
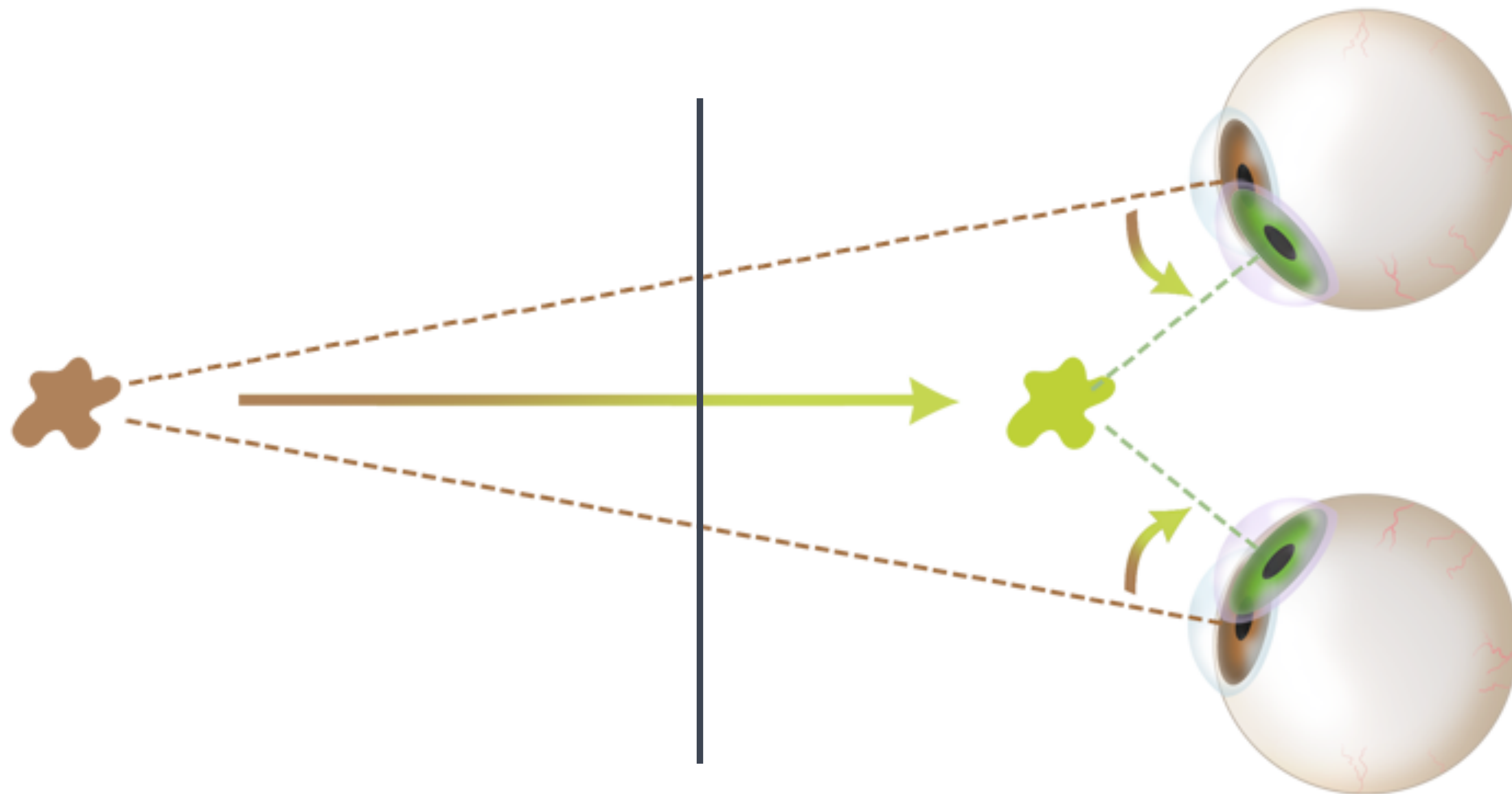
Light field camera

Near-Eye Light Field Displays

OLED mircodisplays

As with light field cameras, our design supports continuous accommodation of the eye throughout a finite depth of field; as a result, binocular configurations provide a means to address the accommodation-convergence conflict occurring with existing stereoscopic displays.
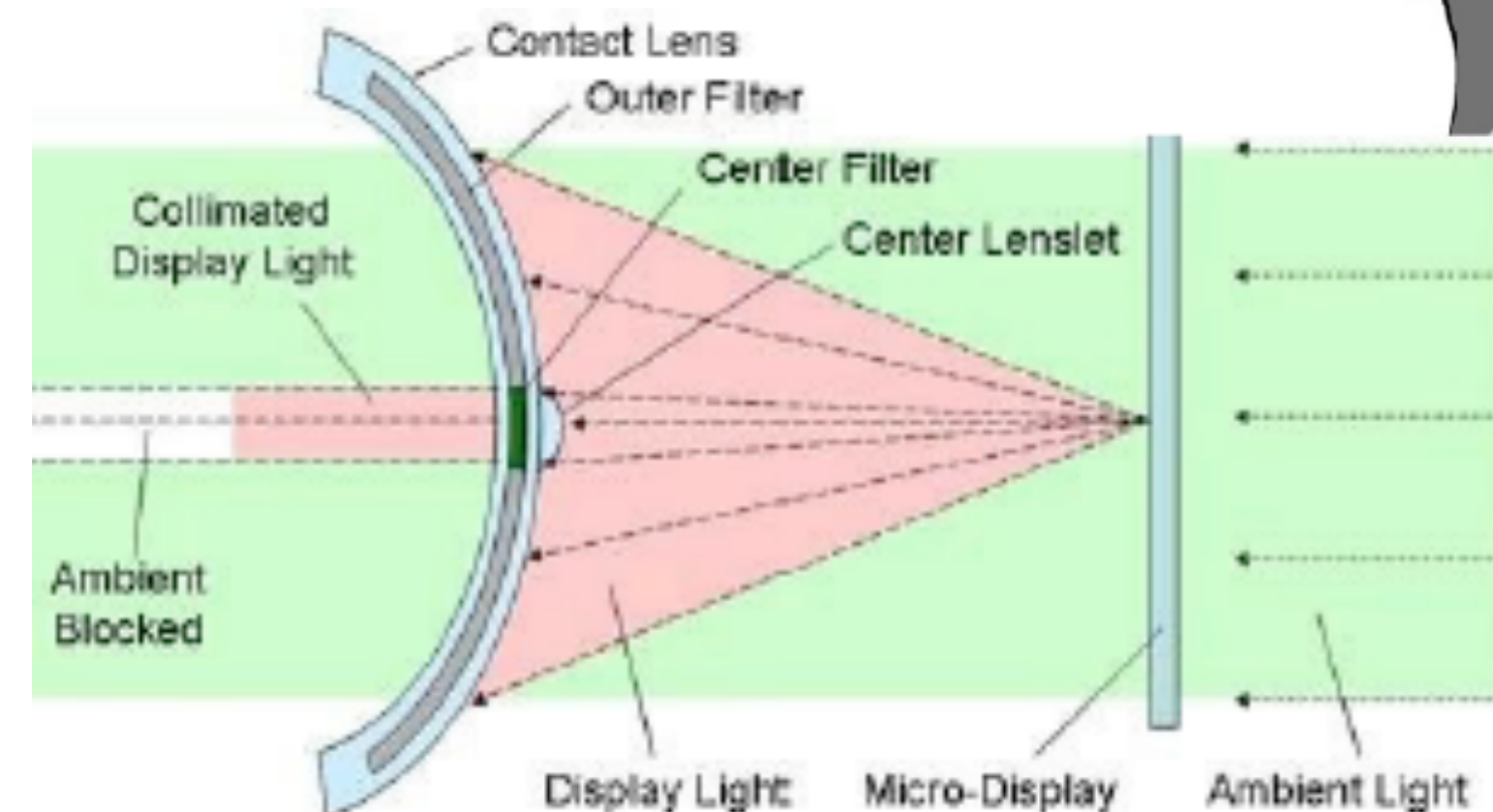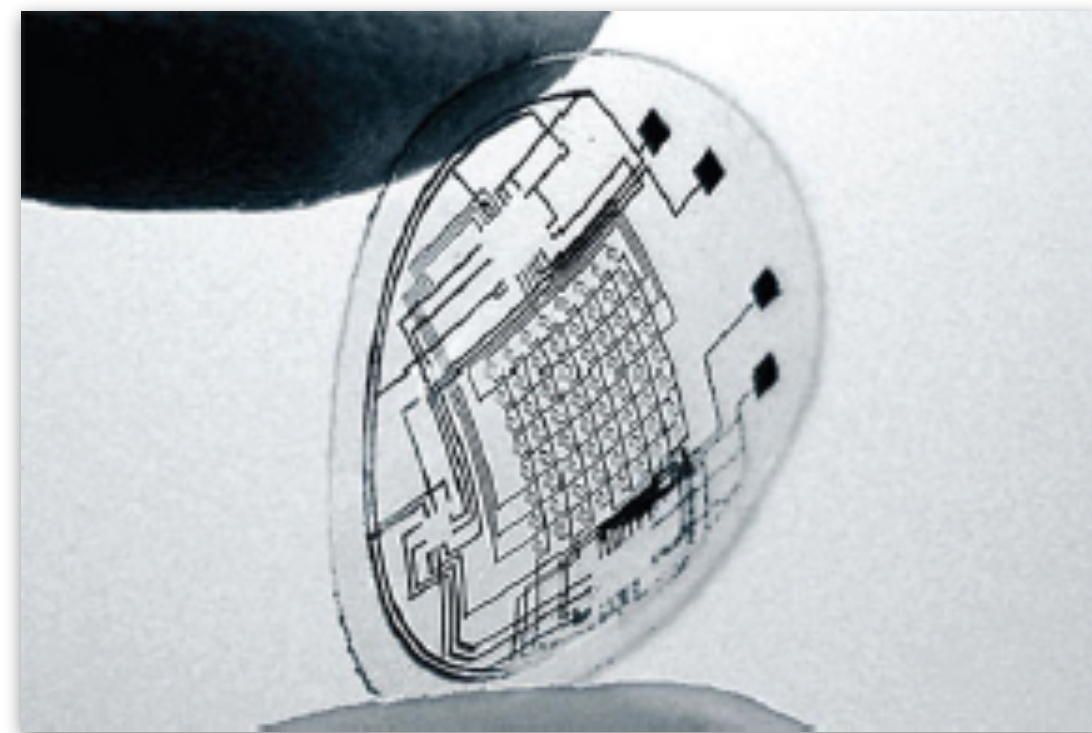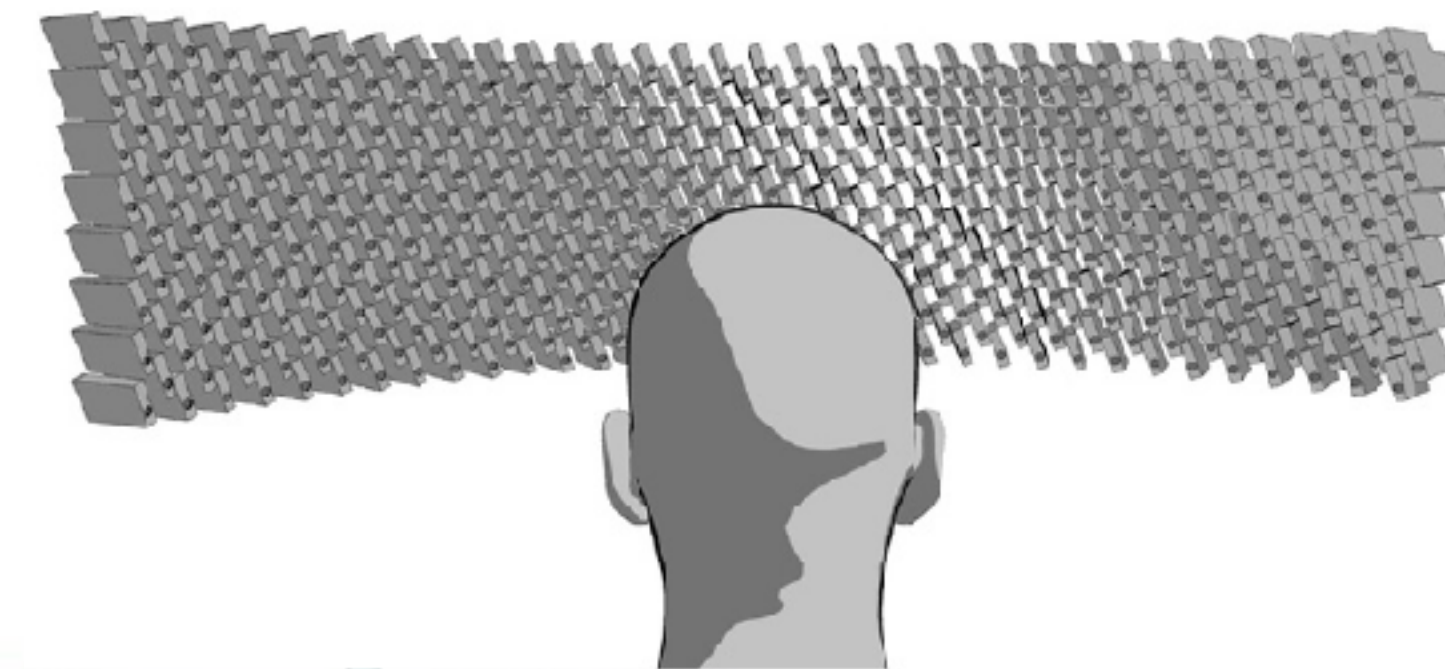
"Near-eye Light Field Displays," Douglas Lanman and David Luebke, in ACM Transactions on Graphics (TOG), Volume 32 Issue 6, November 2013 (Proceedings of SIGGRAPH Asia), November 2013

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Future of VR/AR displays

Current
    Handheld
    Lightweight head mounted

Future
    Wide FOV see-through (3+ years)
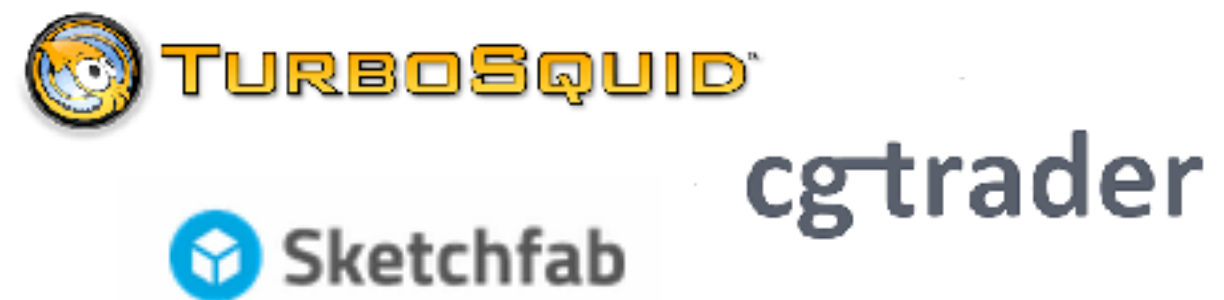   Retinal displays (5+ years)
    Contact lens (10-15+ years)

Contact Lens
Outer Filter
Center Filter
Center Lenslet
Collimated Display Light
Ambient Blocked
Display Light
Micro-Display
Ambient Light

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Content creation

Sources

Interaction Authoring

Any 3D Model:

CAD/CAM/CAE/AEC

PyMol

Online:

360 Video:
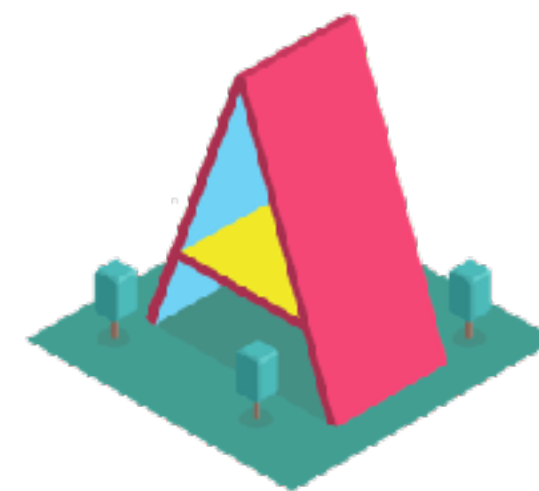
A-frame

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Touch

providing haptics to walls
and other heavy objects
in virtual reality using
electrical muscle stimulation

HPI

Pedro Lopes, Sijing You, Lung-Pan Cheng,
Sebastian Marwecki and Patrick Baudisch

Touch

providing haptics to walls
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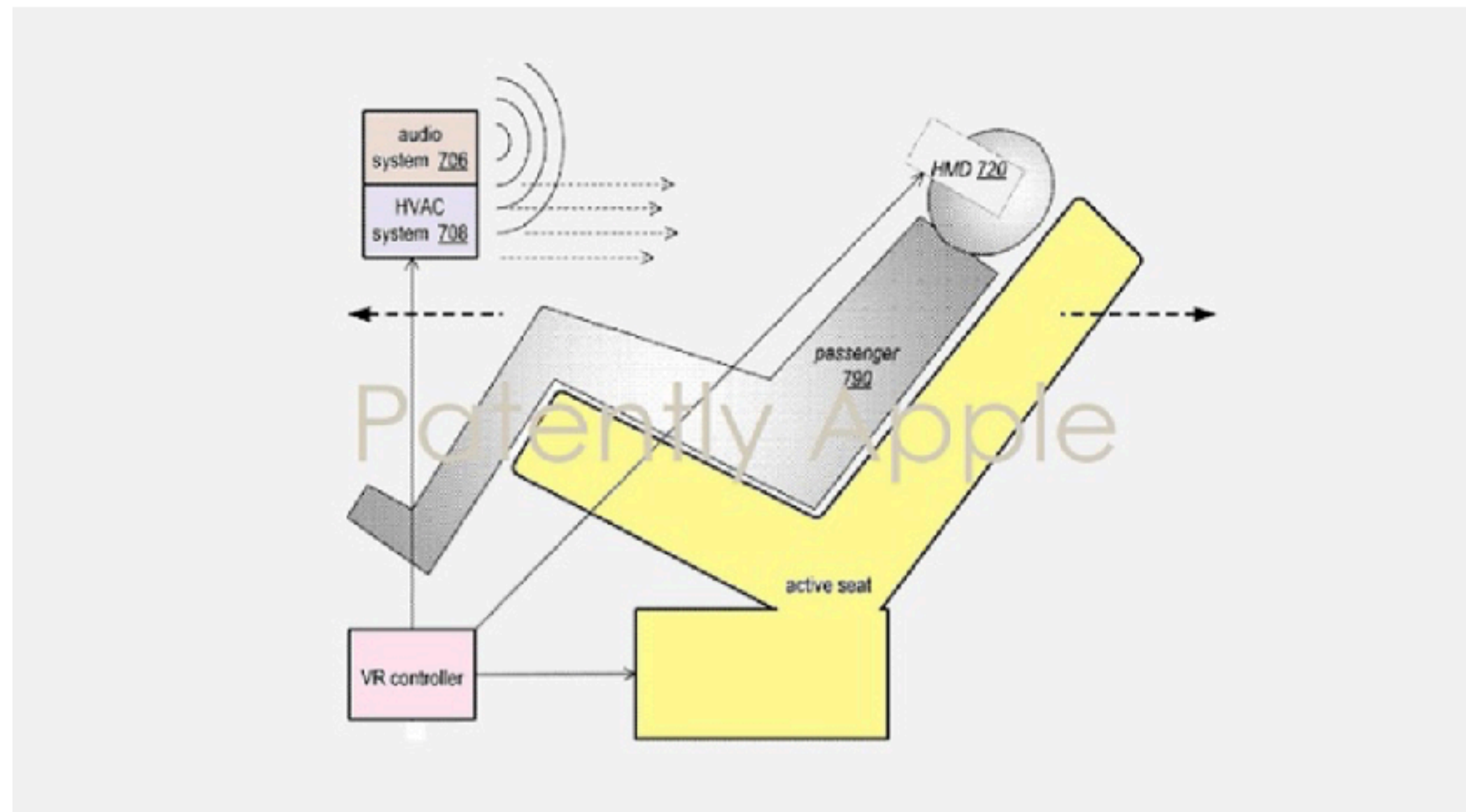electrical muscle stimulation

HPI

Pedro Lopes, Sijing You, Lung-Pan Cheng,
Sebastian Marwecki and Patrick Baudisch

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https://www.youtube.com/watch?v=MYH--QGUFn8

VR Patents
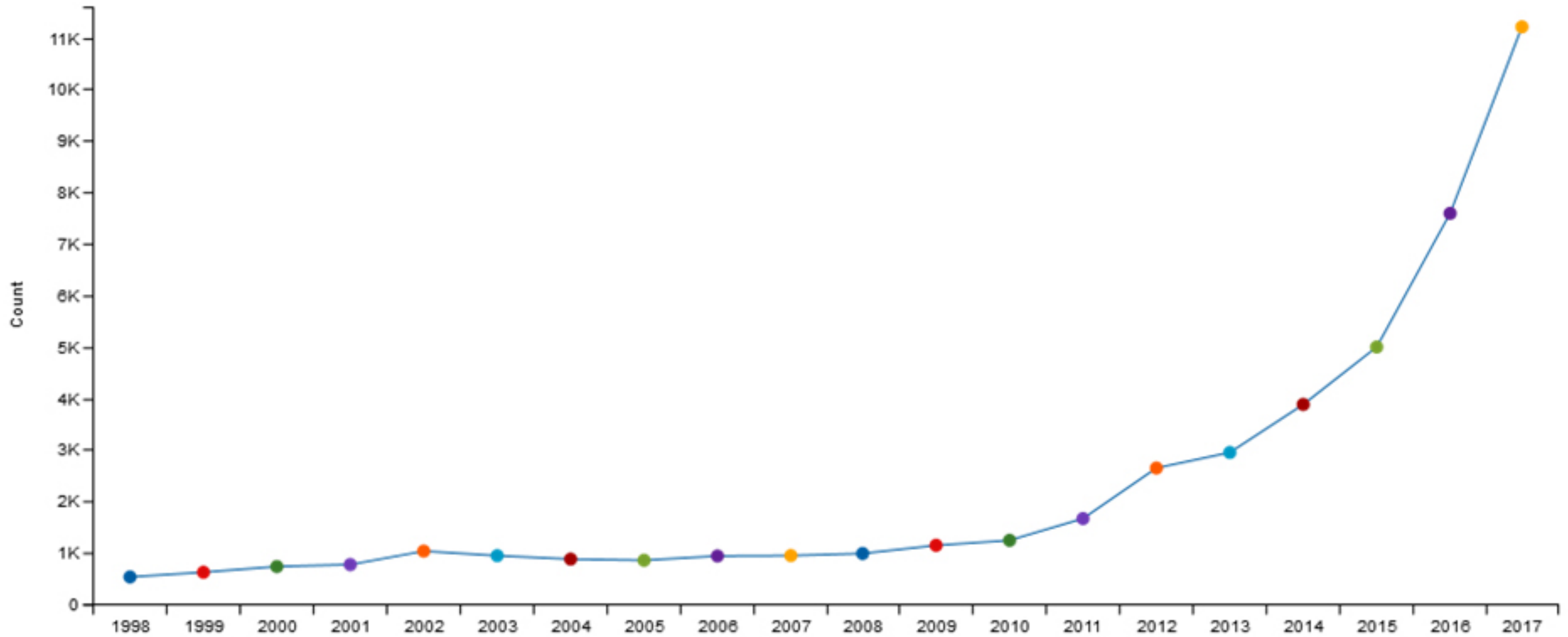
Patent of the Decade: Apple Reveals an Unbelievable VR Experience System for Next-Gen Autonomous Vehicles

Cybersickness?

FIG. 6

FIG. 15

In addition, a VR experience provided through the VR system may provide passengers with the sensation that they are actually riding in a larger vehicle than the actual size of the autonomous vehicle, which may provide the passengers with a more pleasant and secure-feeling experience when riding in a small **autonomous vehicle.**

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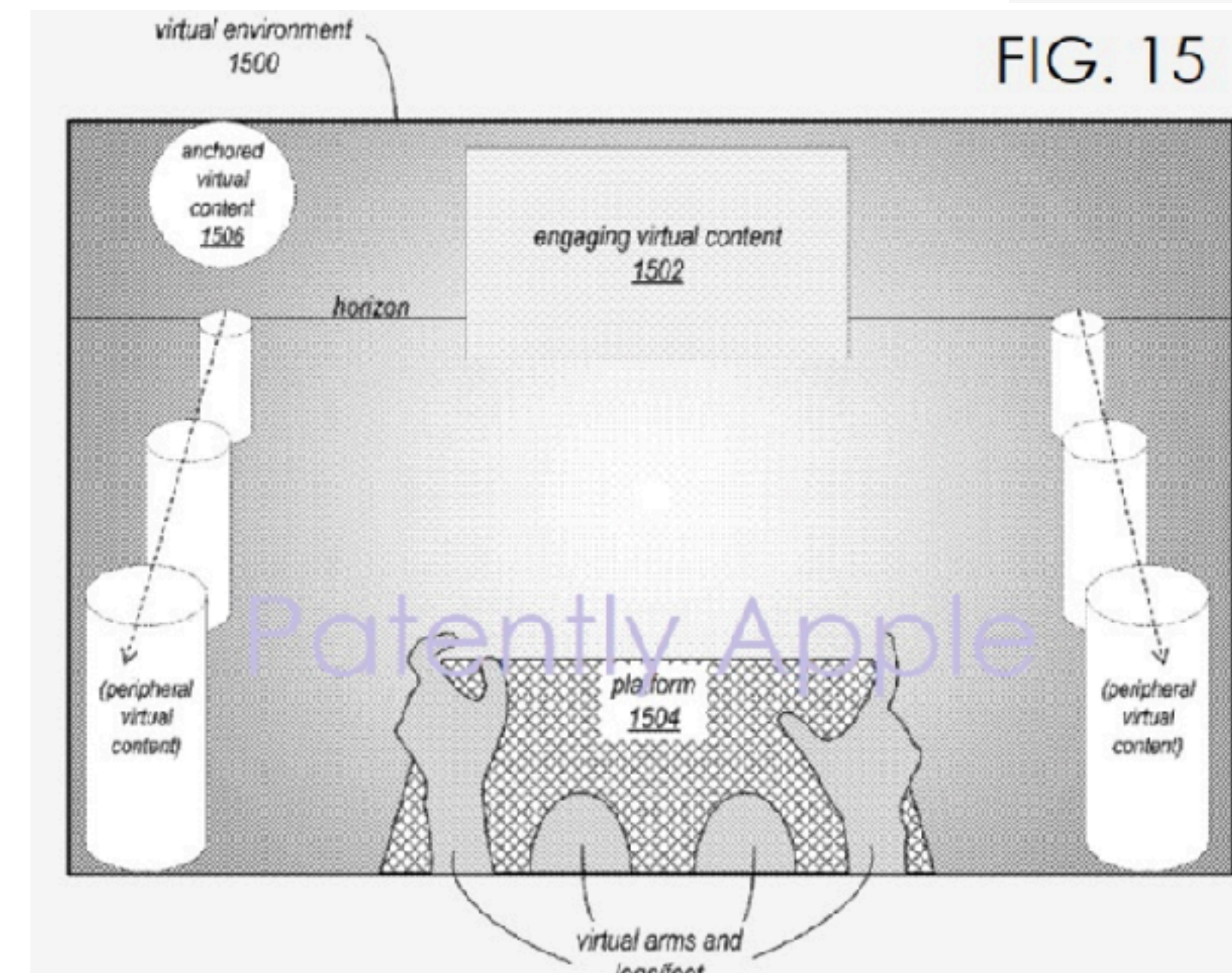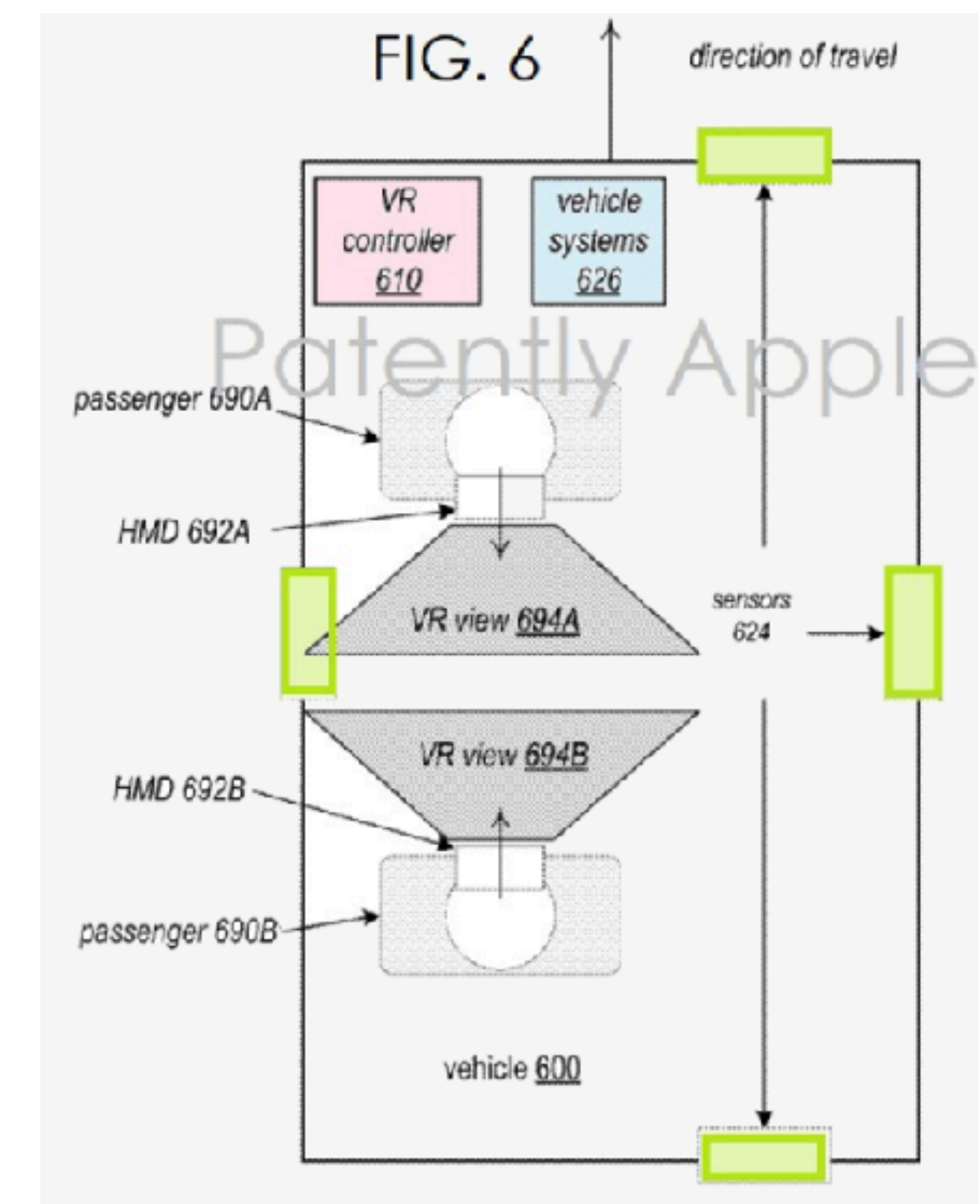
# Uber Wants to Fill the Boredom of Self-Driving Cars With VR

(19) **United States**
(12) **Patent Application Publication** (10) Pub. No.: US 2018/0040162 A1
Donnelly et al. (43) Pub. Date: Feb. 8, 2018

(54) **VIRTUAL REALITY EXPERIENCE FOR A VEHICLE**

(71) Applicant: **Uber Technologies, Inc.**, San Francisco, CA (US)

(52) **U.S. Cl.**
CPC *G06T 19/006* (2013.01); *G02B 27/0179* (2013.01); *G02B 27/0093* (2013.01); *G05D 1/0246* (2013.01); *G05D 1/0278* (2013.01); *G02B 2027/0187* (2013.01); *G05D 2201/0212* (2013.01)
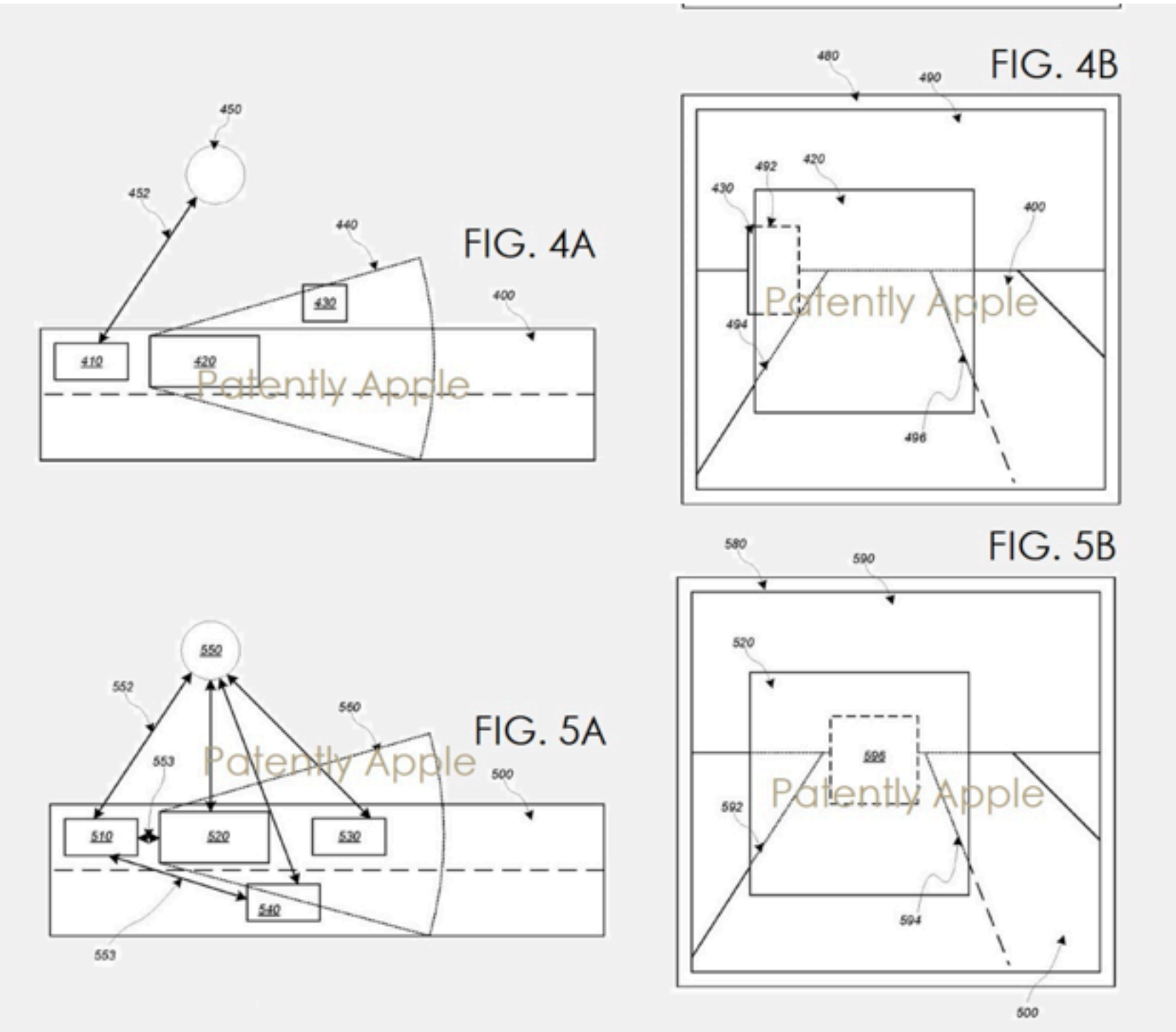
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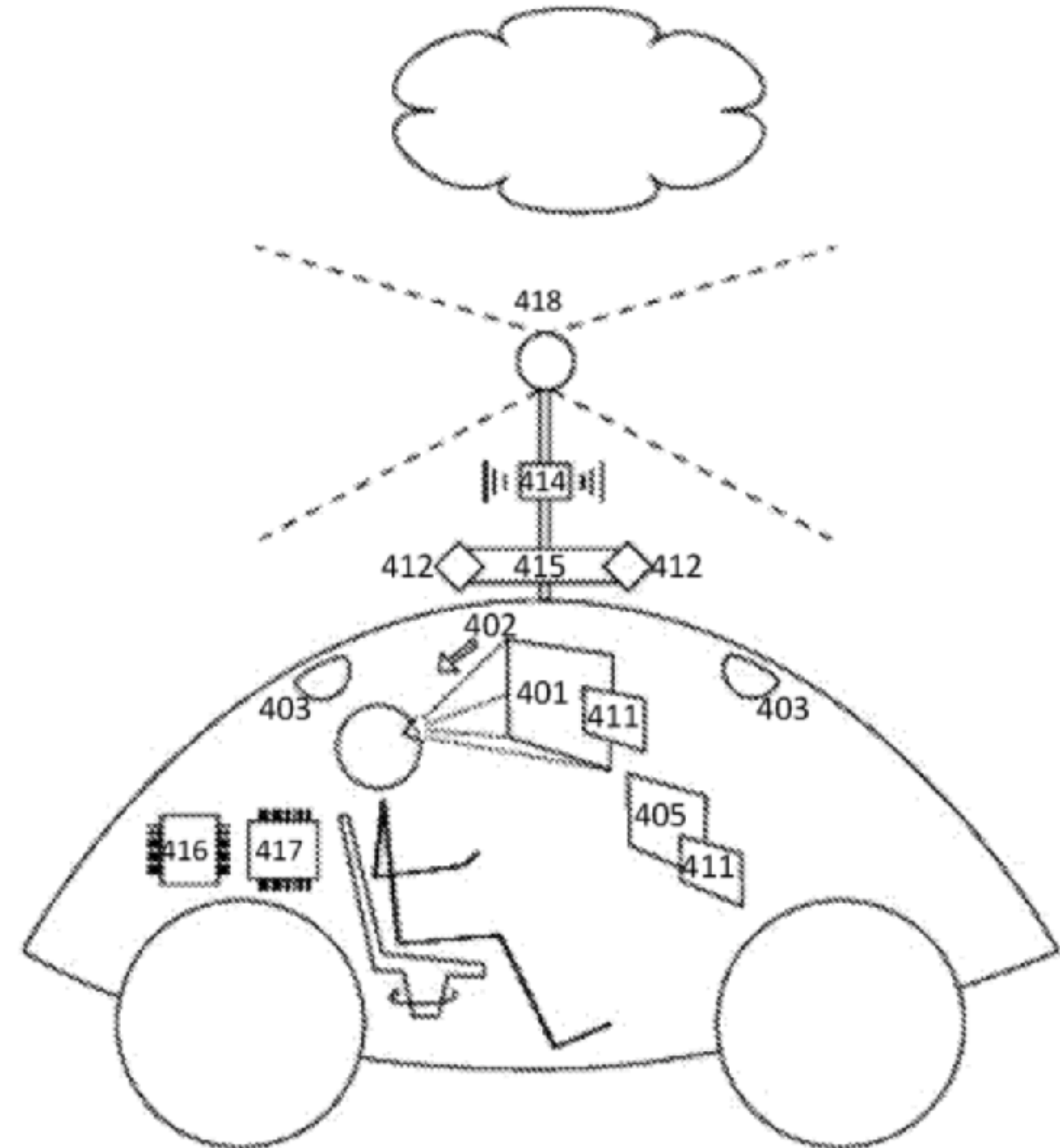
Apple Invents an Augmented Reality Windshield that will even Support FaceTime Calls between Different Vehicles
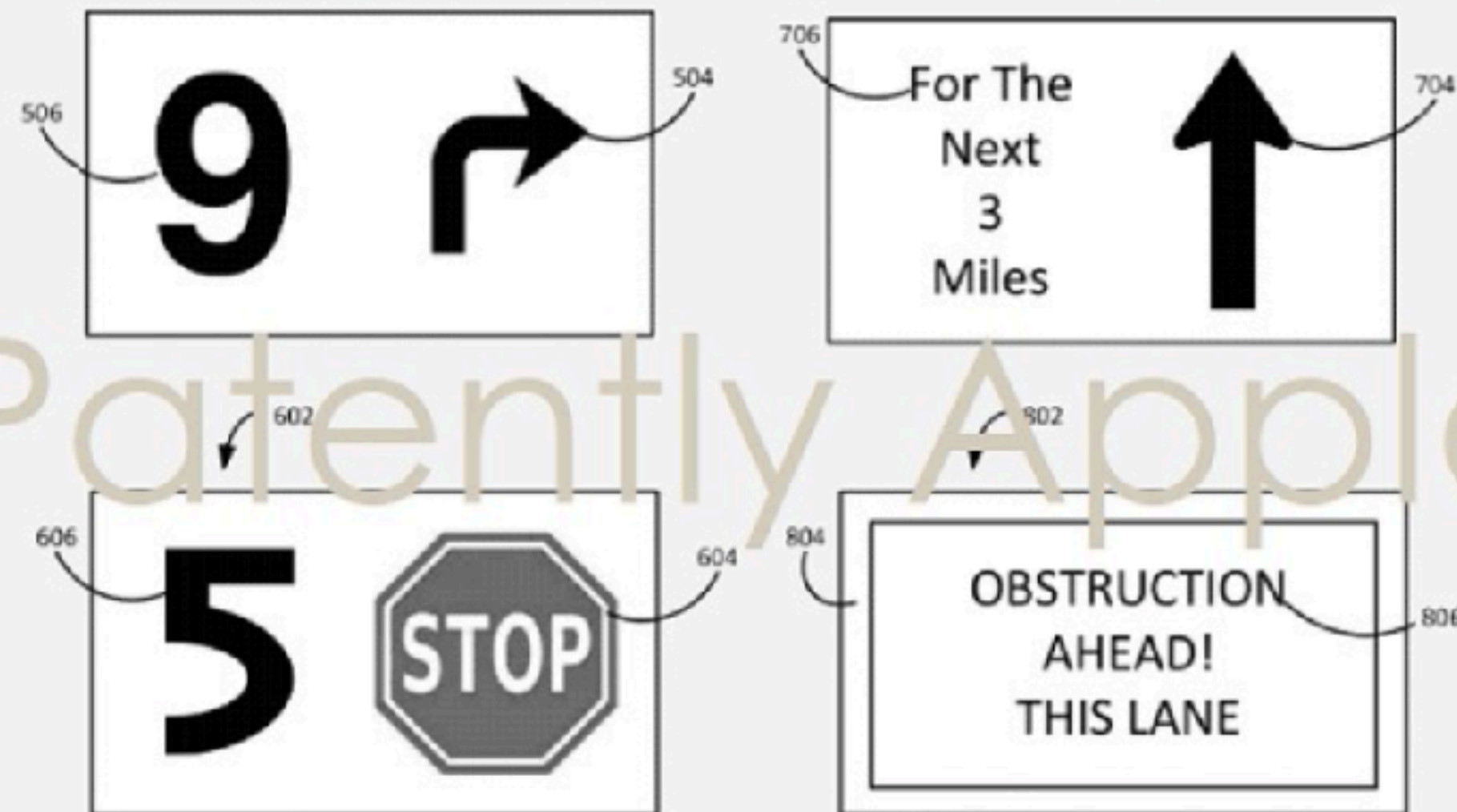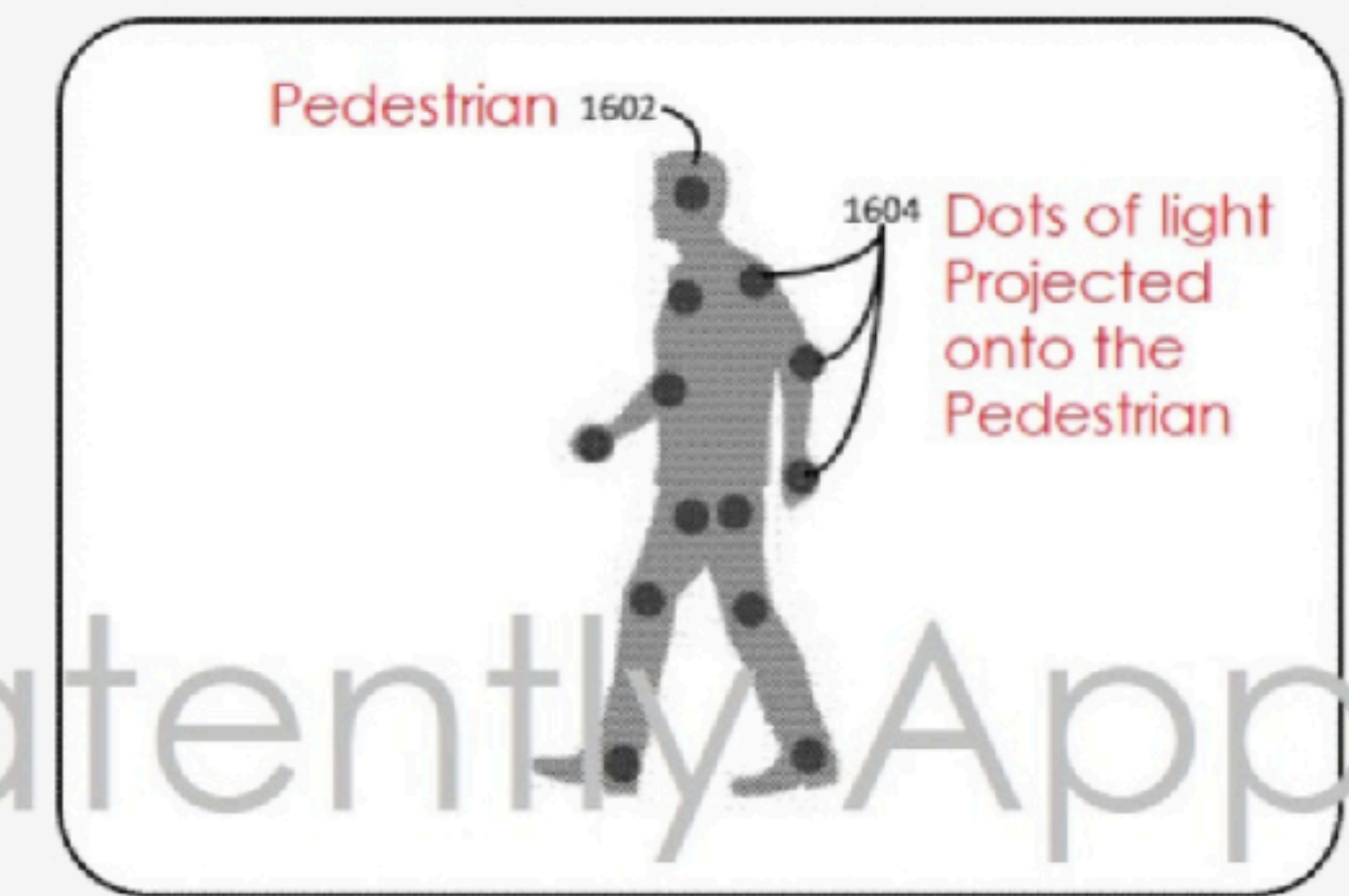

Panicky Occupant Detection

Apple's Autonomous Cars will Introduce a Unique 'Countdown Indicator' that Prepares Passengers of a coming Maneuver

Apple Reinvents a Vehicle's Headlight System that Focuses on Illuminating Objects & Advances a Live Windshield

More specifically, the invention relates to the reinvention of a headlight system from a basic light bulb system to a smart, machine learning based system that could recognize specific object to highlight to provide drivers with better vision at night and especially during times of fog and/or rain. The system is also able to recognize humans at a distance by projecting dots of light onto subjects much like Apple uses a dot projector for Face ID but on a massive scale.

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Here we go again?

This VR cycle is dead

Natasha Lomas @riptari / Aug 26, 2017

https://techcrunch.com/2017/08/26/this-vr-cycle-is-dead/

ZDNet

Virtual reality shipments crater in Q2, but IDC says don't worry

IDC remains optimistic about VR—especially for the enterprise—but the data doesn't look so hot.

By Larry Dignan for Between the Lines | September 5, 2018 -- 14:12 GMT (15:12 BST) | Topic: Virtual Reality

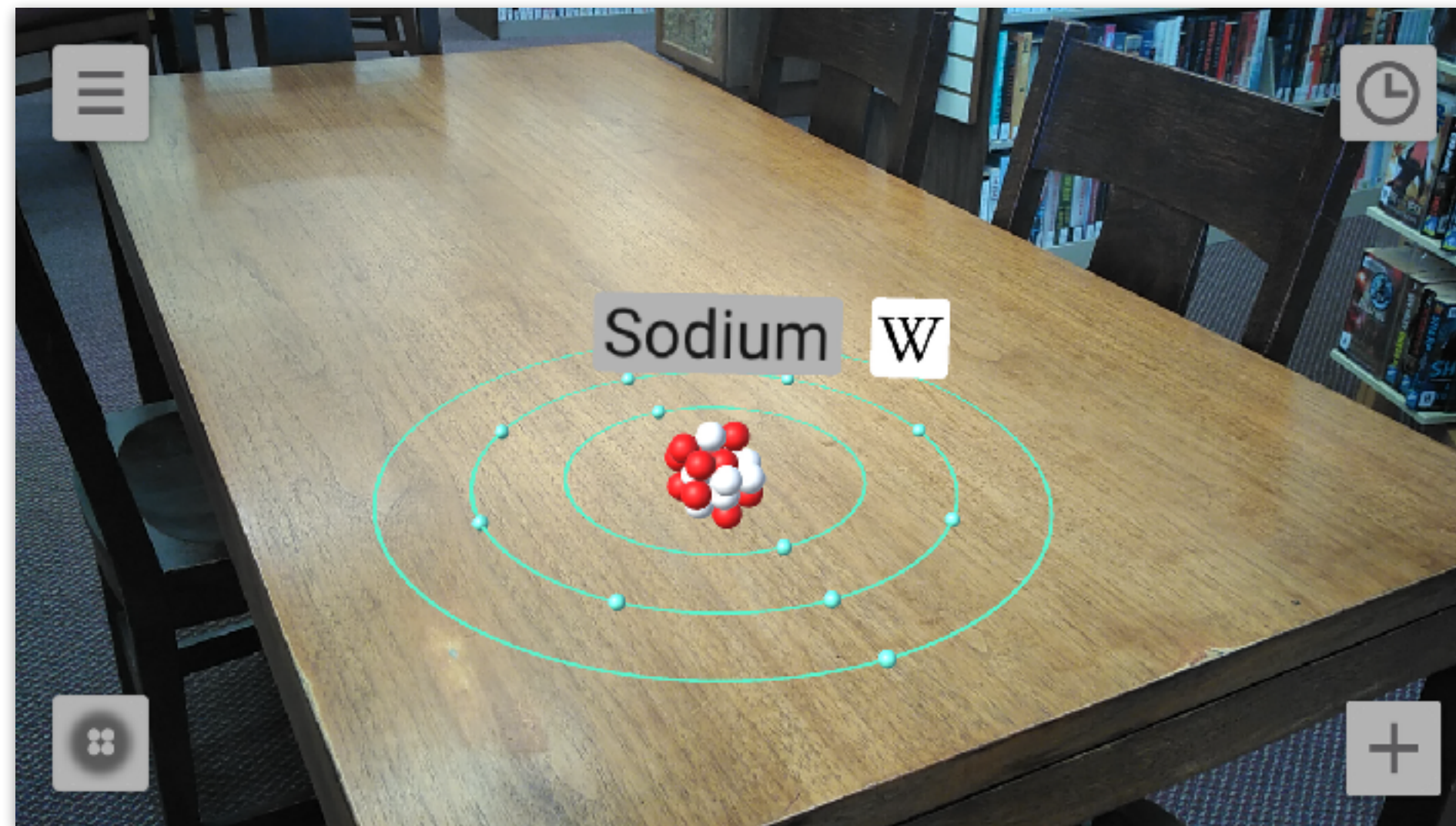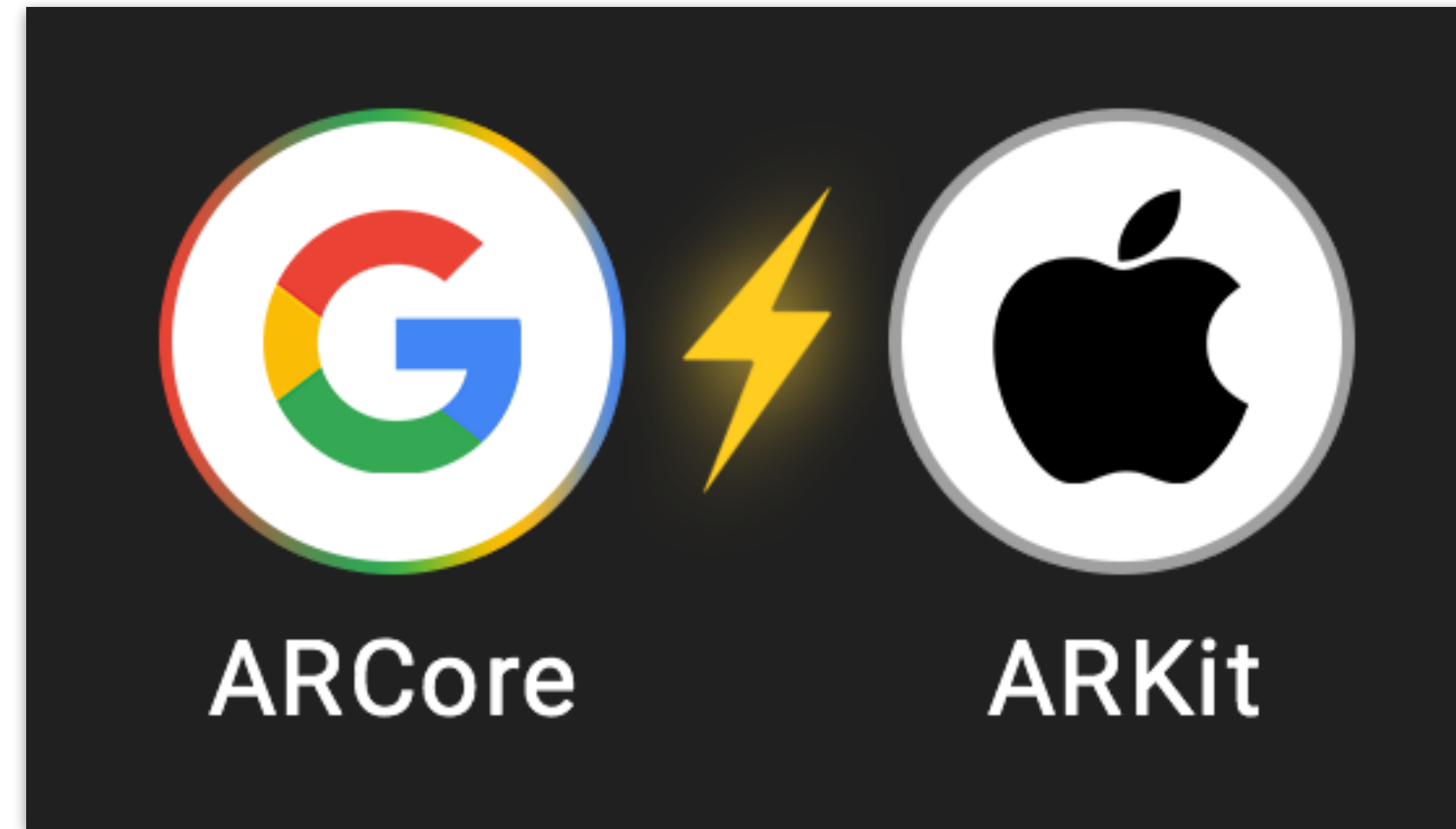### Oculus Go Sales Ranking (Amazon)

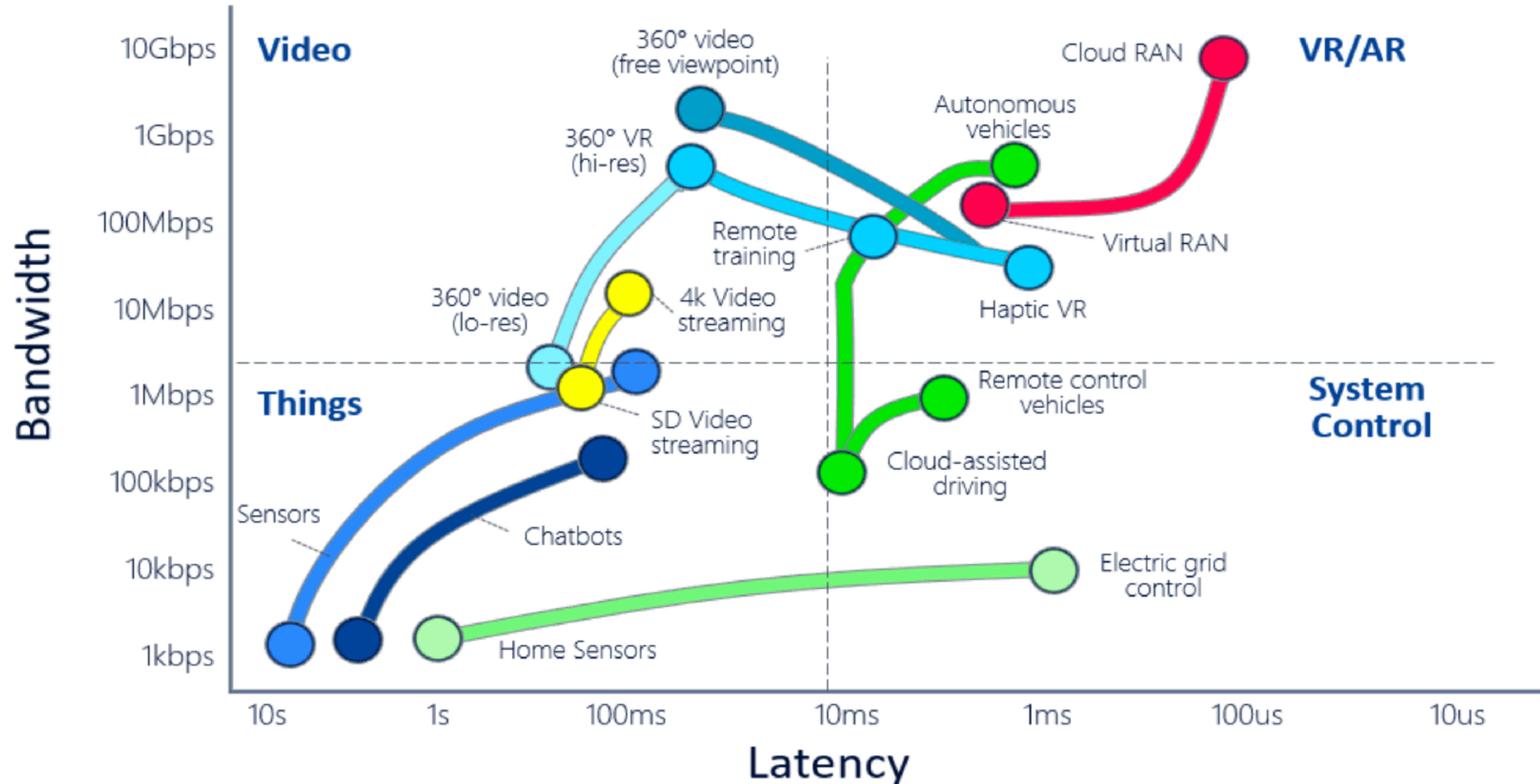https://media.thinknum.com/articles/sales-data-shows-that-consumer-interest-in-vr-is-waning/

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AR Eco-system

That "geek" factor

FIRST LOOK — VAUNT

Intel Glasses   FM:The Verge Feb 5, 2018

LBS Projector

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Platforms for Advanced Wireless Research

Takeaways

- Commoditization requires…

- Huge potential market, which leads to

- Huge investment, and…

- Rapid technological advancement

- Many new opportunities

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