# Human Computer Interaction

# Chapter 11: Virtual Reality

Prof. Dr. Björn Eskofier
Machine Learning and Data Analytics (MaD) Lab
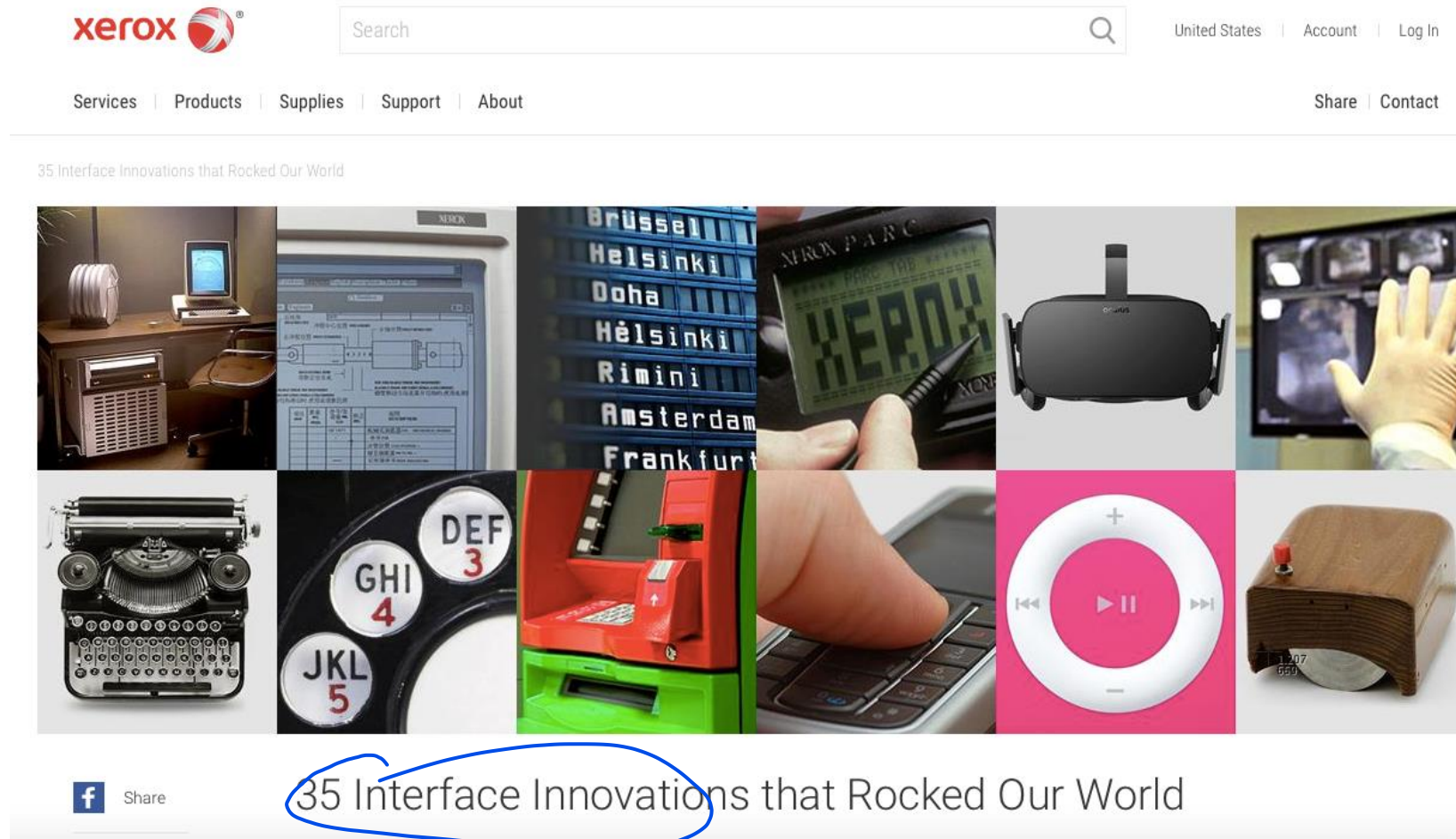Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU)
Summer Term 2024

# Overview

Machine Learning and Data Analytics Lab (MaD) in Erlangen

# Motivation

# Motivation



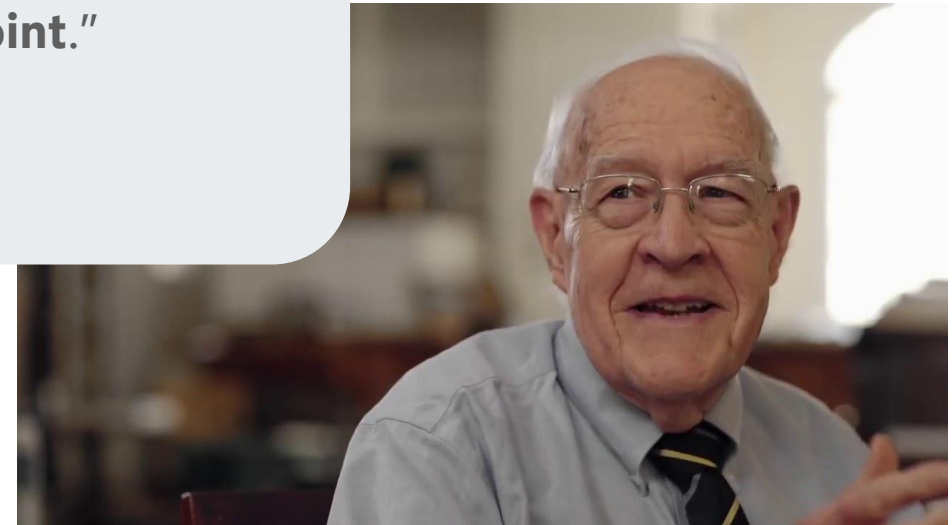https://www.xerox.com/en-us/insights/user-interface-examples

# Virtual Reality

*User immesed in responsive virtual world.*

> "I define a **virtual reality experience** as any in which the user is **effectively immersed** in a responsive virtual world.
> This implies user **dynamic control of viewpoint**."
>
> **Frederick P. Brooks, 1999**

http://www.cs.unc.edu/~brooks/WhatsReal.pdf
http://www.worldcat.org/wcpa/servlet/DCARead?standardNo=0471360899&standardNoType=1&excerpt=true
https://i.ytimg.com/vi/9oOCrAePJMs/maxresdefault.jpg
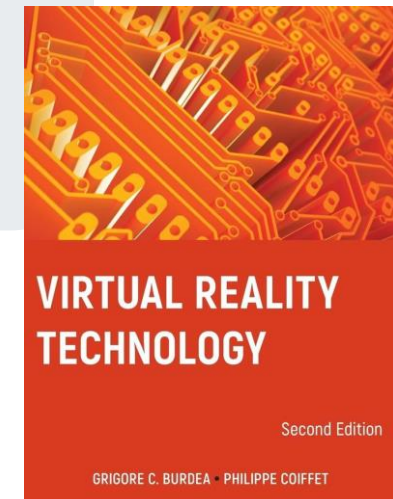
# Virtual Reality

*realistic looking world.*

*dynamic.*

It is a simulation in which computer graphics is used to create a **realistic-looking world**. Moreover, the synthetic world is **not static** but responds to the user's input (gesture, verbal command, etc.). This defines a key feature of virtual reality, which is **real-time interactivity**."

**Grigore C. Burdea & Philippe Coiffet, 2003**

http://www.cs.unc.edu/~brooks/WhatsReal.pdf
http://www.worldcat.org/wcpa/servlet/DCARead?standardNo=0471360899&standardNoType=1&excerpt=true

dream world.?

"VR is shared and objectively present like the physical world, composable like a work of art, and as **unlimited and harmless** as a dream. When VR becomes widely available around the turn of the century, it will not be seen as a medium used within physical reality but rather as an **additional reality**. VR opens up a **new  continent of ideas and possibilities**."

**Jaron Lanier, 1989**

# What is Virtual Reality?

What
is VR?

- Interaction with a **completely synthetic world**
- Display and interaction performed **in real-time**
- **Stereoscopic 3D graphics** are typically used
- User becomes part of the full virtual world (**immersion**)
- **Not limited to visual perception**, variety of senses
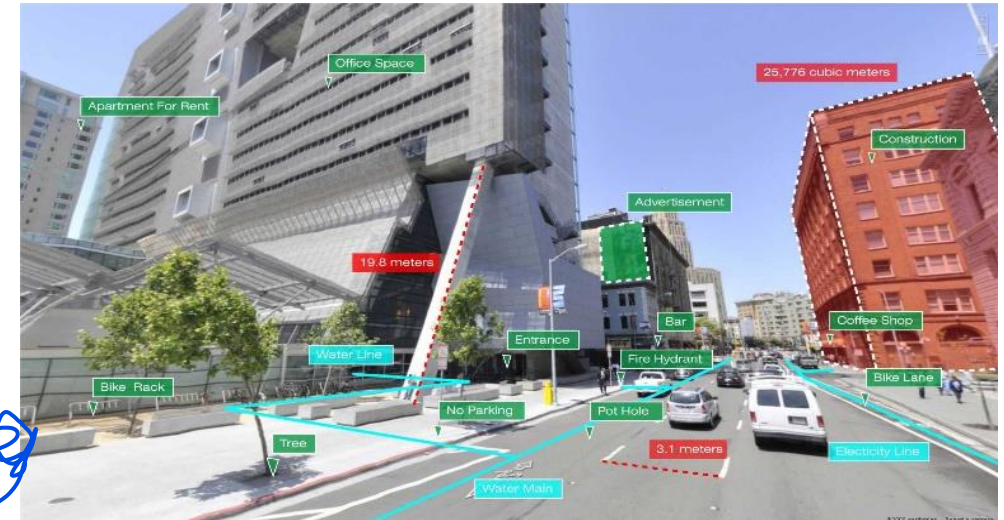
*Not just visual; other senses.*

# Augmented Reality - AR

"**Augmenting** natural feedback to the operator with simulated cues"
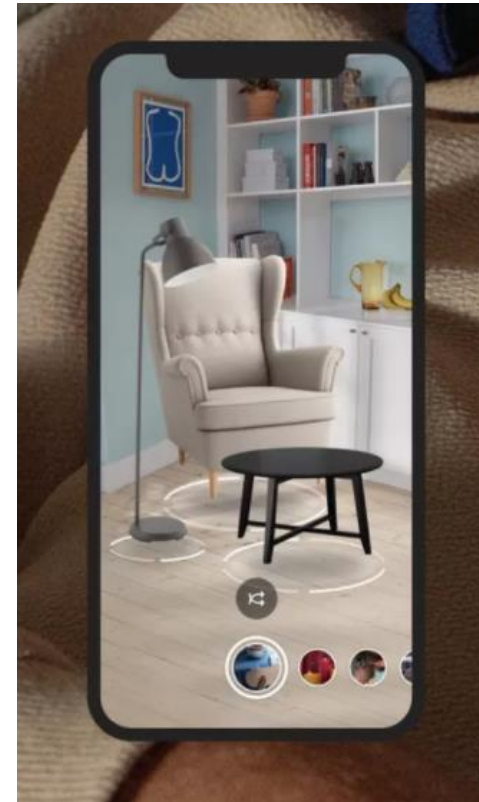Das, 1994

*Real world*

*Virtual objects*

"An **AR system** supplements the real world with virtual (computer-generated) objects that appear to coexist in the same space as the real world." Azuma, 2001

lioninside.com 30npire.com
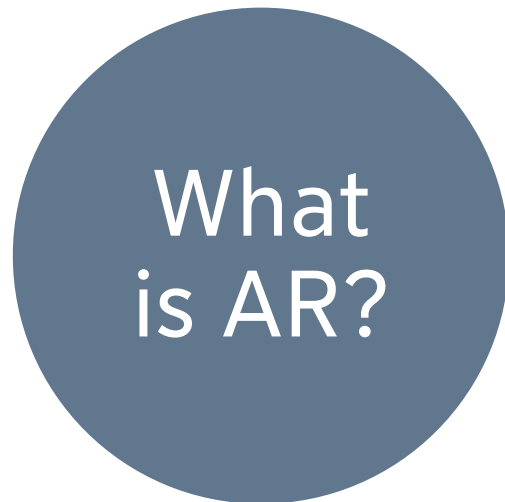
# Augmented Reality - AR



https://financesonline.com/augmented-reality-trends/



https://www.tomsguide.com/round-up/best-ar-apps

# What is Augmented Reality?

*enhancement of world*

## What is AR?

- Virtual **enhancement of the real world**, combining real and virtual

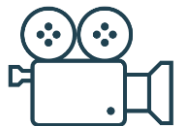- Adding **some amount of reality** (video or texture mapped)

- Combining direct view, stereoscopic video, stereoscopic graphics

- Class of displays consisting **primarily of real environment** with graphic enhancements or argumentations

- 3D virtual objects integrated into a 3D real environment in **real-time**

# Holo Lens 2



https://www.microsoft.com/de-de/p/holoLens-2/91pnzzznzwcp/?activetab=pivot%3aoverviewtab



https://www.youtube.com/watch?v=uIHPPtPBgHk

https://www.microsoft.com/de-de/hololens

# Augmented Virtuality - AV

*(handwritten: virtual environment is enhanced or augmented)*

**"Augmented Virtuality** *(AV) displays are those in which a* **virtual environment is enhanced, or augmented**, *through some addition of real world images or sensations."*

..............Paul Milgram, 1996

Additions could take form of directly viewed object

Combining VR with stereoscopic video

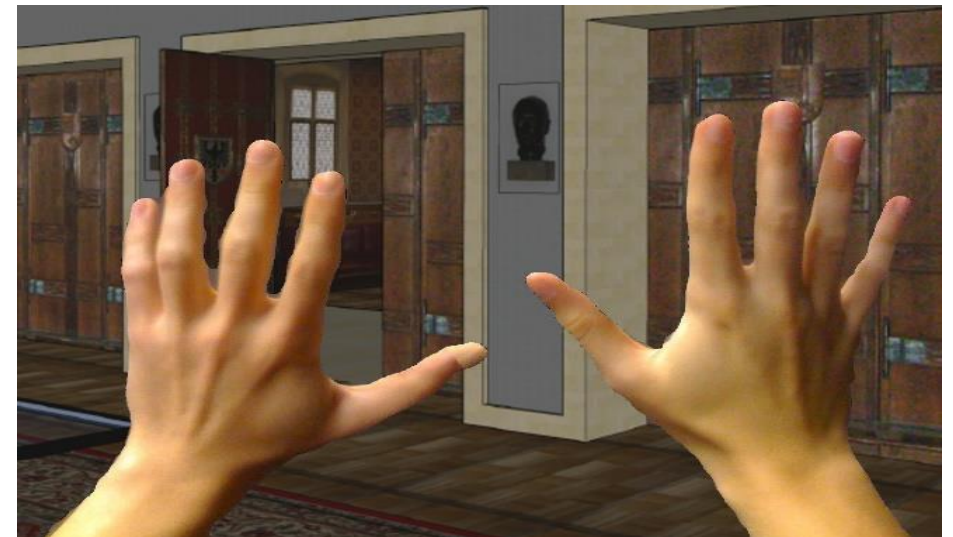https://www.algorand.com/resources/algorand-announcements/paul-milgrom-joins-algorand-advisor

## Augmented Reality

Reality with a bit of virtuality in it

## Augmented Virtuality

Virtual world with a bit of reality in it

# Reality – Virtuality Continuum

## Virtual Environment

— Participant-observer totally immersed
— Completely synthetic world
— Step out of bounds of physical reality
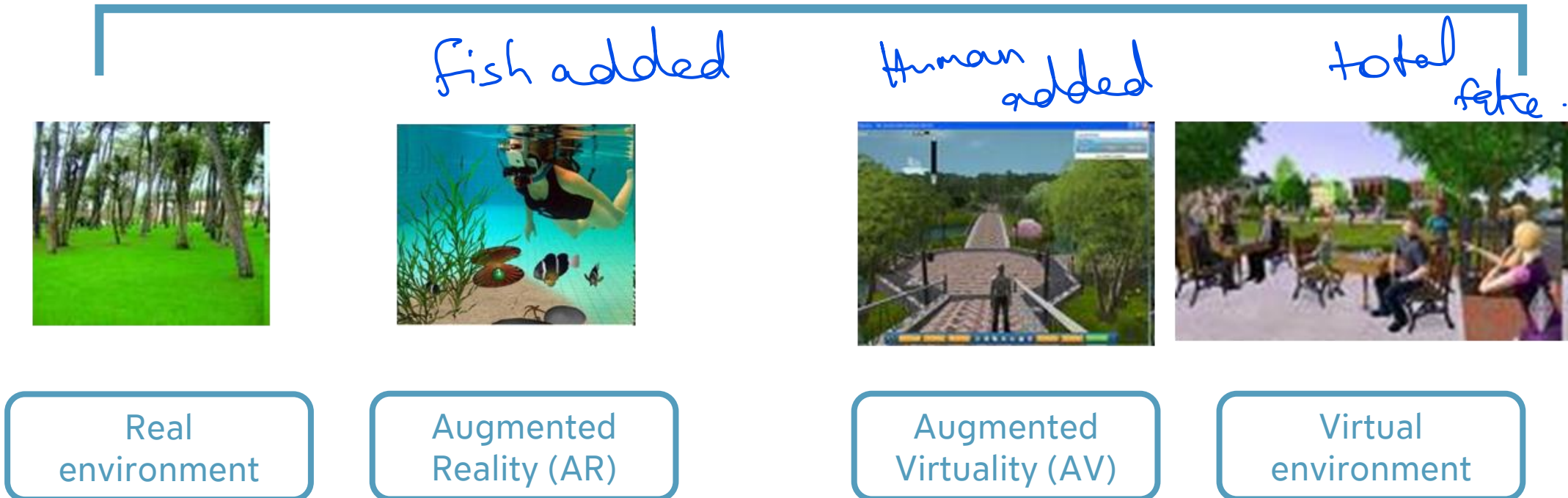
*Total Dream*

## Real-World Environment

— Constrained by laws of physics
— Consisting of real objects

## Mixed Reality Environment

— Real and Virtual objects presented together in one display

# Reality – Virtuality Continuum

## Mixed Reality

*fish added*          *Human added*          *total fete.*



| Real environment | Augmented Reality (AR) | Augmented Virtuality (AV) | Virtual environment |

# Mixed reality

*"Between the extremes of real life and Virtual Reality lies the spectrum of Mixed Reality, in which views of the real world are combined in some proportion with views of a virtual environment."*

.....Paul Milgram, 1996

Drascic, Milgram: "Perceptual issues in Mixed Reality", SPIE, vol. 2653: Stereoscopic Displays and Virtual Reality Systems, III, ed. Mark T. Bolas, Scott S. Fisher, and John O. Merritt, San Jose, February, 1996, pp. 123-34.

*The distinction between virtual worlds and the real world will continue to become ever more blurry resulting in an ever present mixed reality."*

.....Ronald H. Cohen, 2009

http://www.google.ch/patents/US20150199851

# What is Mixed reality?

*Real enhancement of virtual world.*
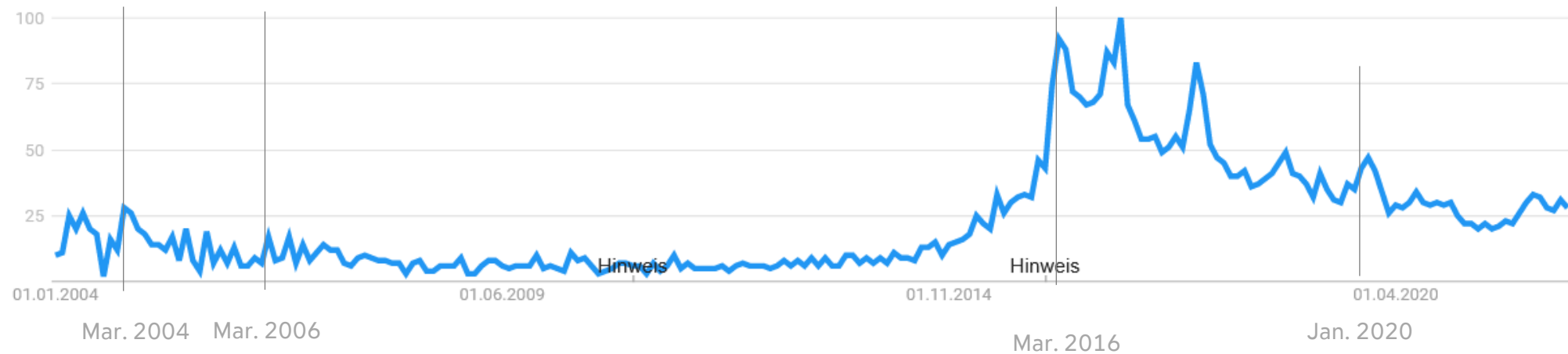
**What is MR?**

- **Real enhancement** of the virtual world

- Interaction with **mixed reality** objects whether they are real, virtual or a mix of both

- **Combination** of real environment and virtual reality

- **Coupling real world phenomena** to various information, represented within a computer

# Google Trends analysis of VR

## March 2004

— Psychology professor **Skip Rizzo** creates his **first virtual reality** (Iraq) to treat Post Traumatic Stress Disorder (PTSD) and trauma in veterans

## March 2006

— Multi-touch interaction by Jeff Han

# Google Trends analysis of VR

## March 2014

— Facebook purchased Oculus VR for $2 billion
— Sony announces Project Morpheus, a VR headset for the PlayStation 4
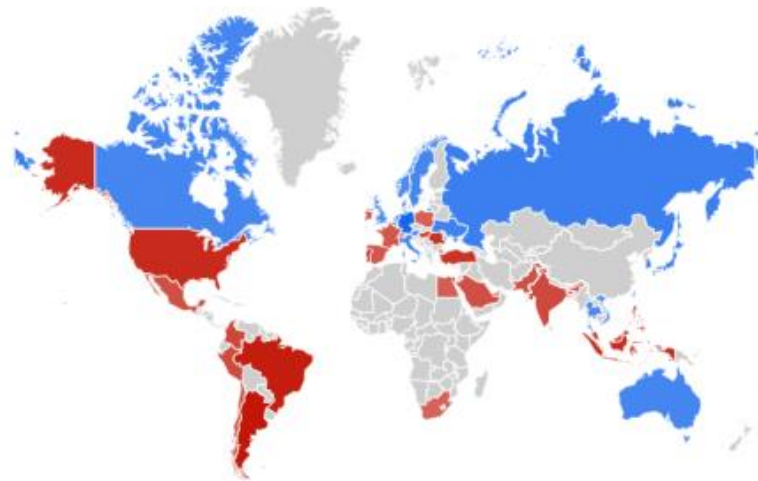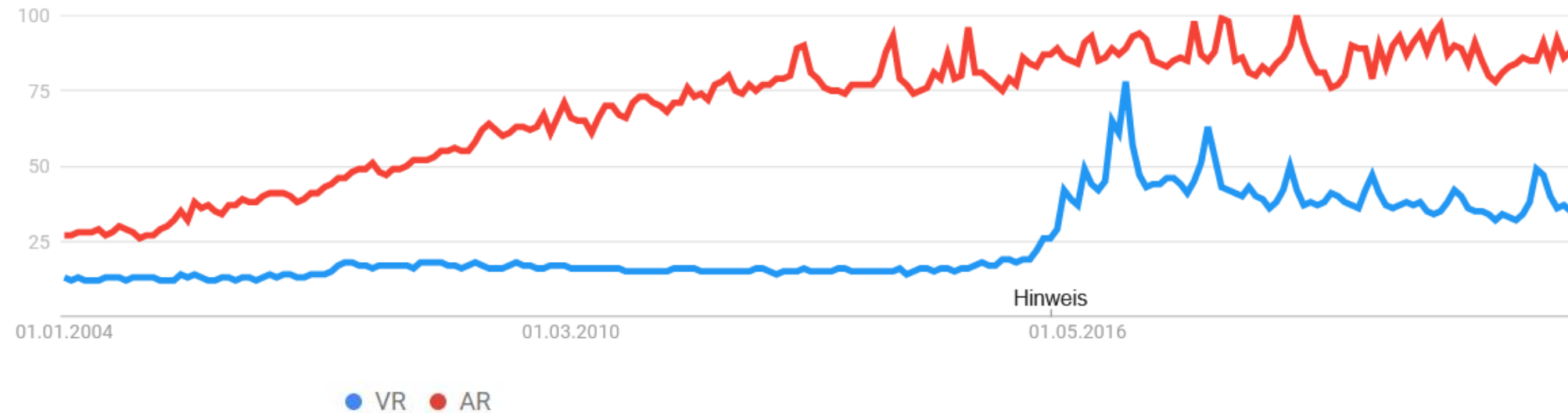— Google announces Cardboard: do-it-yourself stereoscopic viewer for smartphones

## April 2016

— HTC and Valve Corporation released the VR headset HTC Vive and controllers
— Gear VR is sold as bundle with every Samsung Galaxy S7 smartphone

## November 2016

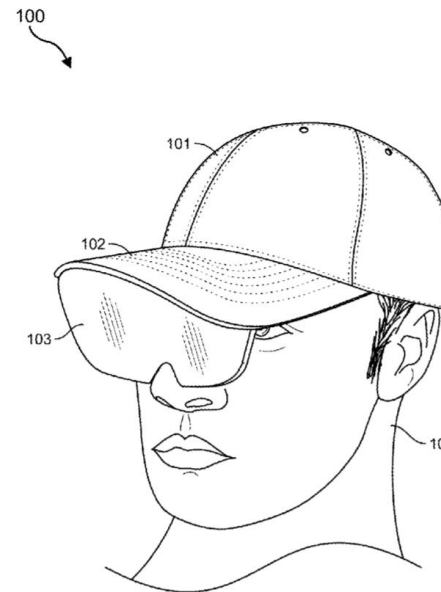— Google releases Daydream: Headset with controller for smartphones

# Google Trends analysis of VR and AR

# What is next?

— Increasing interest in AR/VR
— New AR/VR products announced or released weekly
— All-embracing application areas
— Available for almost every consumer
— New, unknown experiences for users



Metaverse
The New Reality



100
101
102
103
104

(10) Patent No.: US 11,039,651 B1
(45) Date of Patent: Jun. 22, 2021

theatlantic.com
https://www.leewayhertz.com/metaverse-the-new-reality/

https://pdfpiw.uspto.gov/.piw?PageNum=0&docid=11039651&IDKey=&HomeUrl=%2F

Machine Learning
Data Analytics

FAU

# Thank you
# for your attention