Immersive Natives

Die Zukunft der virtuellen Realität

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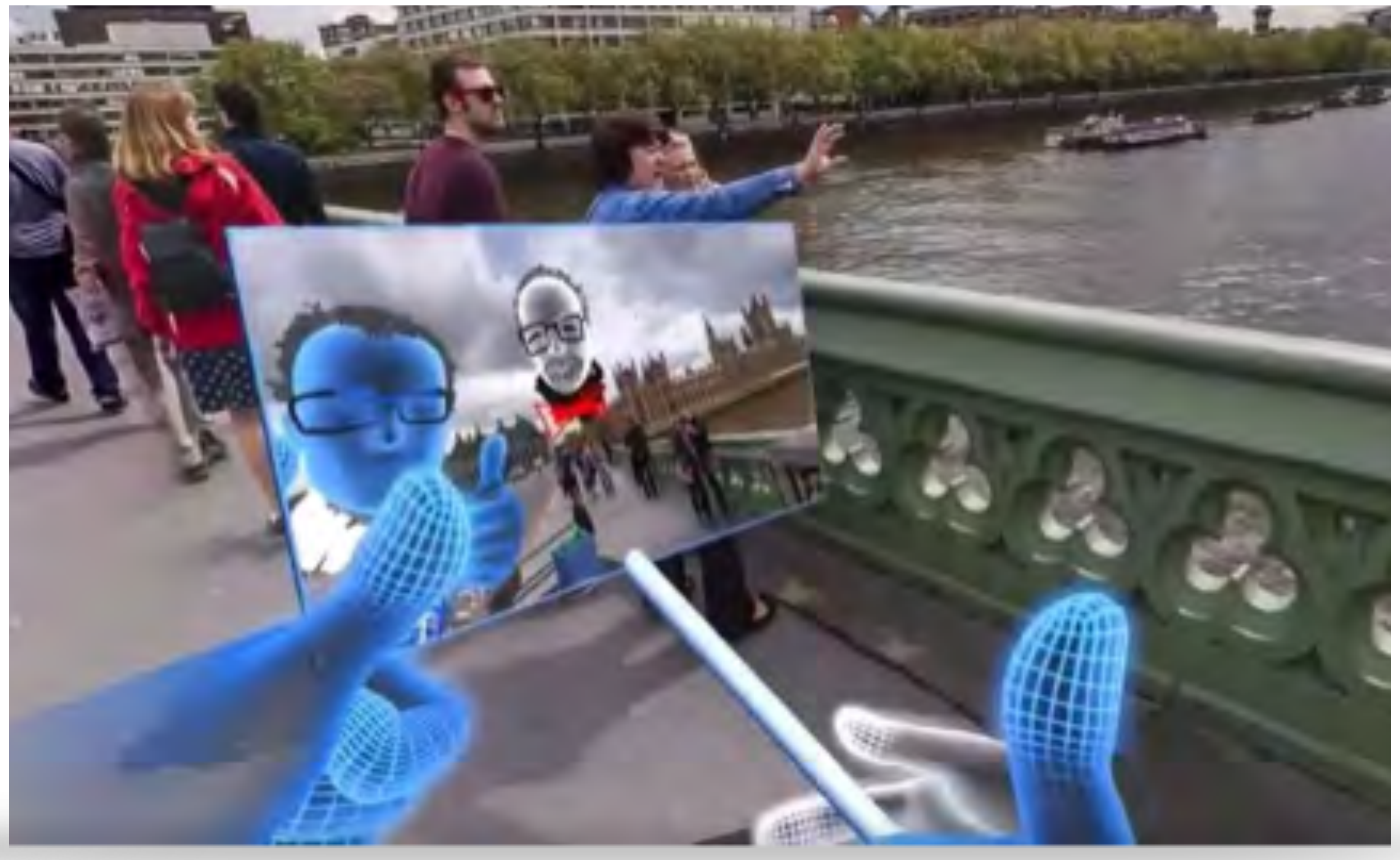
Immersion ⇒ **Presence**

Place Illusion + Plausibility Illusion + Social Presence

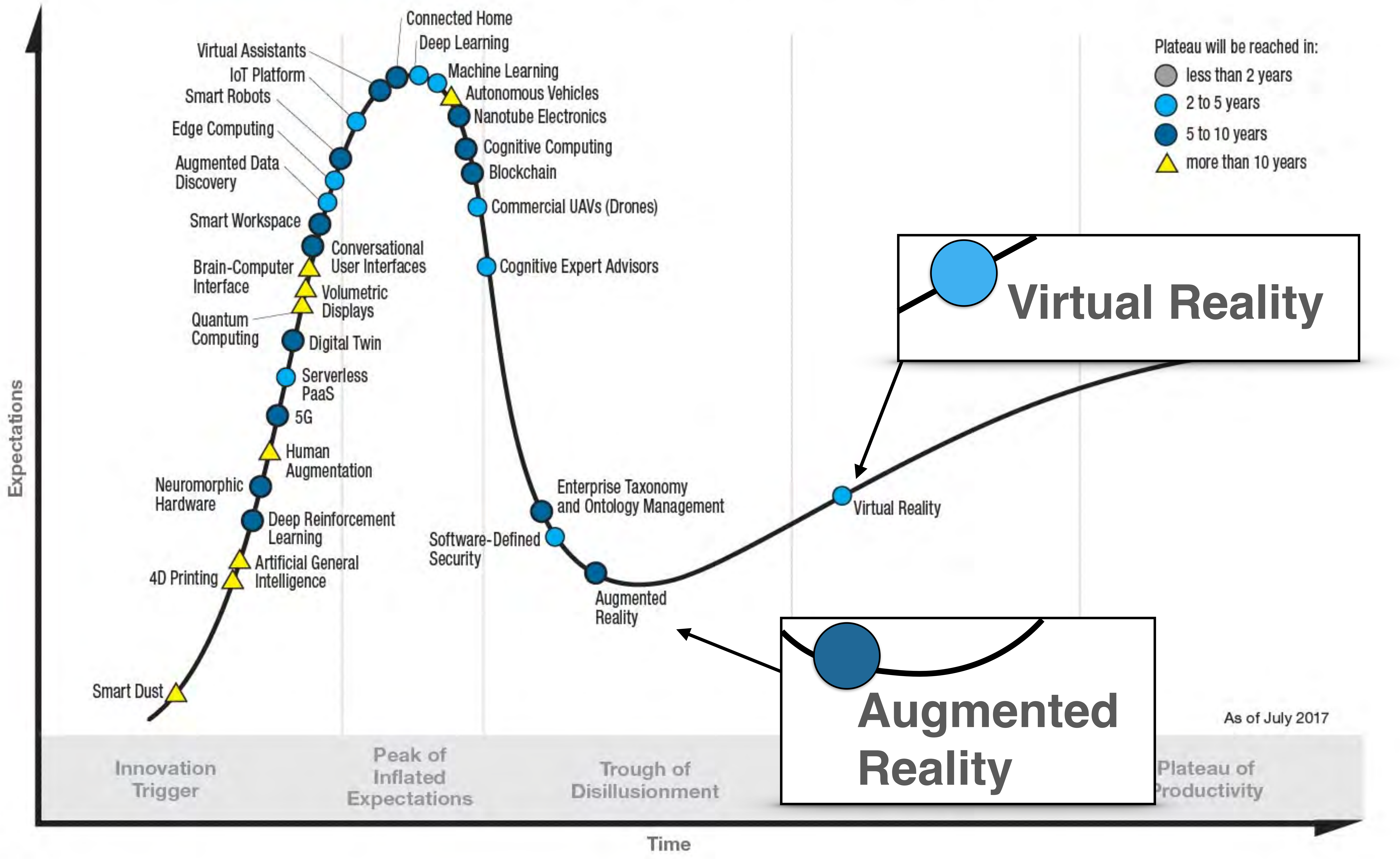
Immersive Disruption

Games / Entertainment

Real Estate / Architecture / Tourism



Social Media / Communication



Expectations
Time
Plateau will be reached in:
less than 2 years
2 to 5 years
5 to 10 years
more than 10 years
Connected Home
Deep Learning
Virtual Assistants
IoT Platform
Smart Robots
Machine Learning
Autonomous Vehicles
Nanotube Electronics
Edge Computing
Cognitive Computing
Augmented Data Discovery
Blockchain
Commercial UAVs (Drones)
Smart Workspace
Conversational User Interfaces
Brain-Computer Interface
Cognitive Expert Advisors
Volumetric Displays
Quantum Computing
Digital Twin
Serverless PaaS
5G
Human Augmentation
Neuromorphic Hardware
Enterprise Taxonomy and Ontology Management
Virtual Reality
Deep Reinforcement Learning
Software-Defined Security
Artificial General Intelligence
4D Printing
Augmented Reality
Smart Dust
Virtual Reality
Augmented Reality
As of July 2017
Innovation Trigger
Peak of Inflated Expectations
Trough of Disillusionment
Plateau of Productivity


VIRTUALITY
AUGMENTED
REALITY
DIGITAL
BLENDED
MIXED
Mixed
Virtuality
Augmented
REALITY
AUGMENTED
Digital
Blended

Mixed Reality (MR)

Reality-Virtuality Continuum

Real World (RW)	Augmented Reality (AR)	Augmented Virtuality (AV)	Virtual Reality (VR)

Gear 360
JAUNT
LYTRO

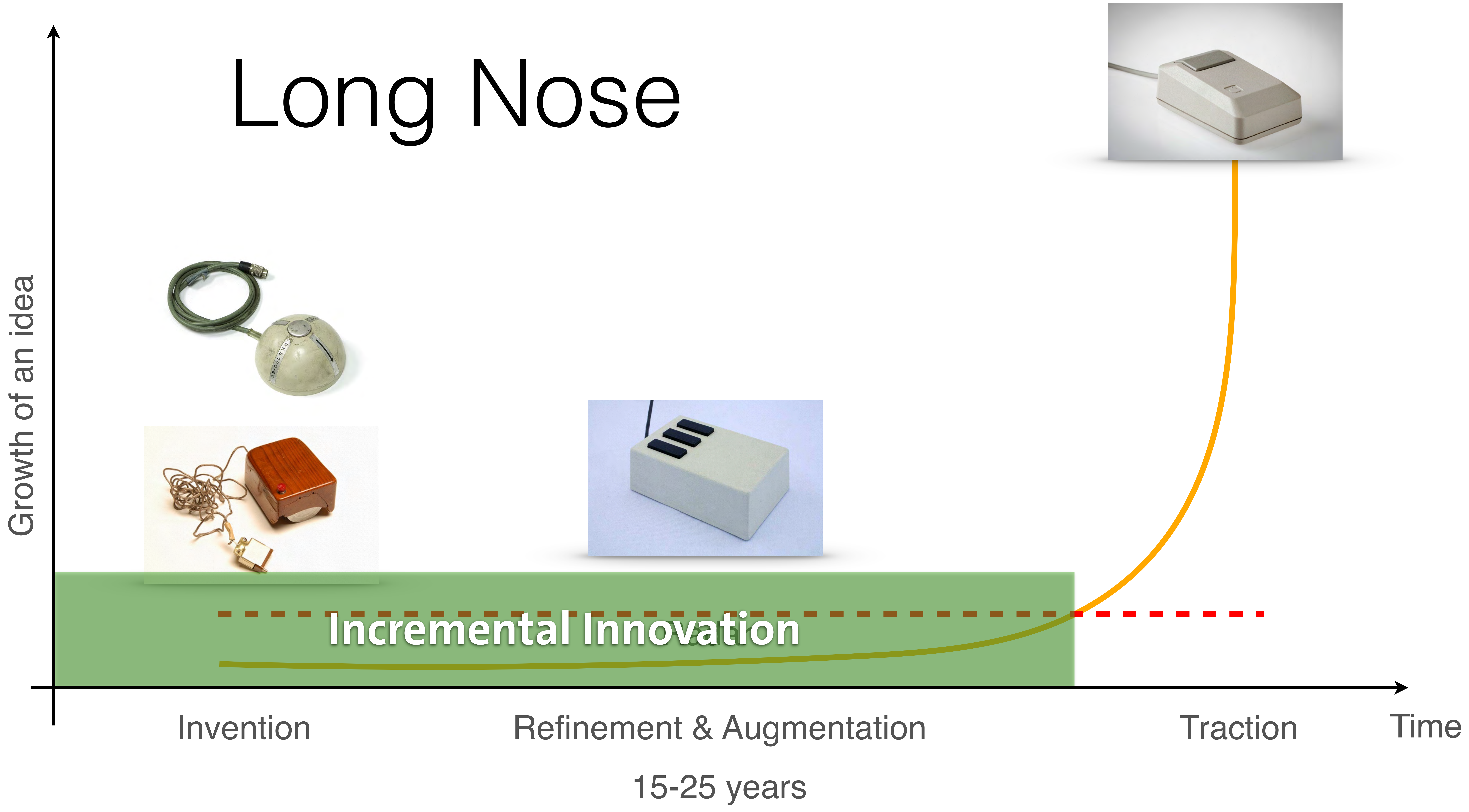
Microsoft HoloLens
META
magic leap

VRVANA
CINOPTICS

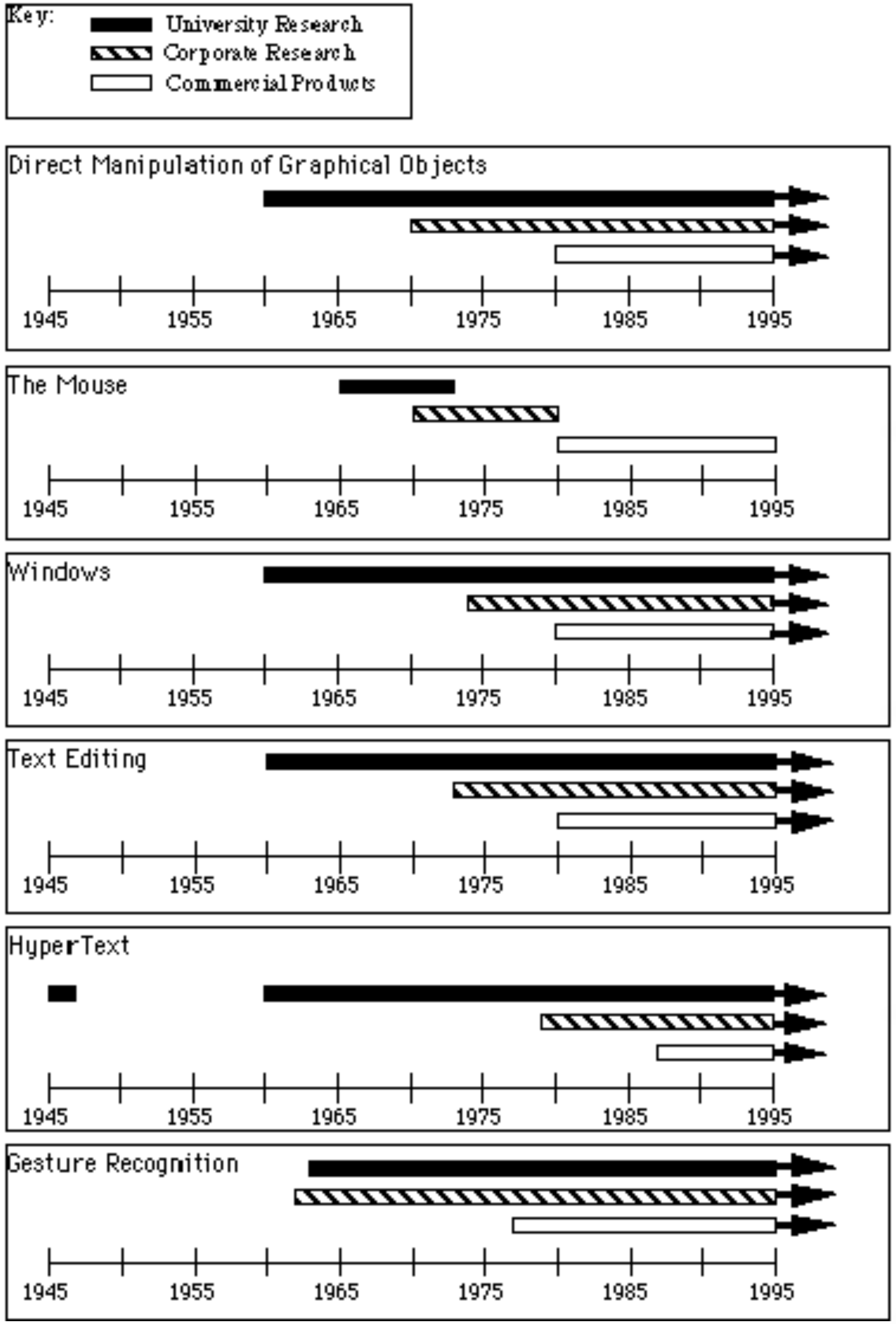
PlayStation.VR
Oculus
VIVE

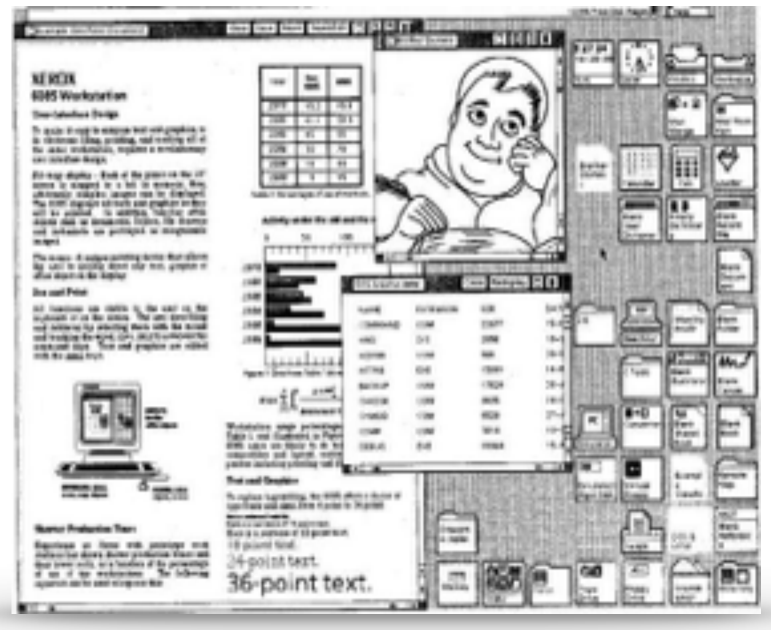
P. Milgram, F. Kishino: A taxonomy of mixed reality visual displays, IEICE Transactions on Information and Systems, Special issue on Networked Reality, 1994

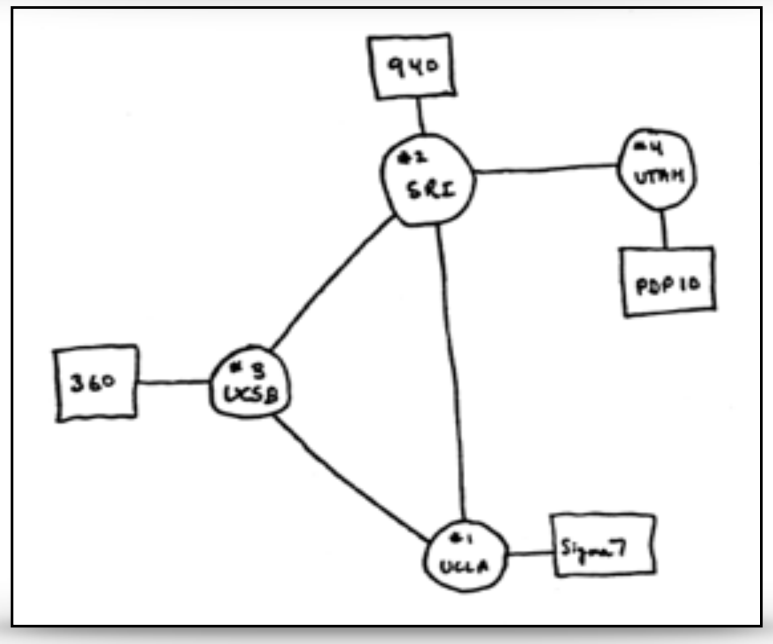
Long Nose



W. Buxton: The Long Nose of Innovation, Businessweek, 2008


Key:
University Research
Corporate Research
Commercial Products
Direct Manipulation of Graphical Objects
1945 1955 1965 1975 1985 1995
The Mouse
1945 1955 1965 1975 1985 1995
Windows
1945 1955 1965 1975 1985 1995
Text Editing
1945 1955 1965 1975 1985 1995
HyperText
1945 1955 1965 1975 1985 1995
Gesture Recognition
1945 1955 1965 1975 1985 1995


XEROX
36-point text.


940
#2 SRI
#4 UTAH
PDP 10
360
#3 UCSB
#1 UCLA
Sigma 7

The Ultimate Display

Ivan E. Sutherland

Information Processing Techniques
Office, ARPA, OSD

We live in a physical world whose properties we have come to know well through long familiarity. We sense an involvement with this physical world which gives us the ability to predict its properties well. For example, we can predict where objects will fall, how well-known shapes look from other angles, and how much force is required to push objects against friction. We lack corresponding familiarity with the forces on charged particles, forces in non-uniform fields, the effects of nonprojective geometric transformations, and high-inertia, low friction motion. A display connected to a digital computer gives us a chance to gain familiarity with concepts not realizable in the physical world. It is a looking glass into a mathematical wonderland.

Computer displays today cover a variety of capabilities. Some have only the fundamental ability to plot dots. Displays being sold now generally have built in line-drawing capability. An ability to draw simple curves would be useful. Some available displays are able to plot very short line segments in arbitrary directions, to form characters or more complex curves. Each of these abilities has a history and a known utility.

It is equally possible for a computer to construct a picture made up of colored areas. Knowlton's movie language, BEFLIX [1], is an excellent example of how computers can produce area-filling pictures. No display available commercially today has the ability to present such area-filling pictures for direct human use. It is likely that new display equipment will have area-filling capability. We have much to learn about how to make good use of this new ability.

The most common direct computer input today is the typewriter keyboard. Typewriters are inexpensive, reliable, and produce easily transmitted signals. As more and more on-line systems are used, it is likely that many more typewriter consoles will come into use. Tomorrow's computer user will interact with a computer through a typewriter. He ought to know how to touch type.

A variety of other manual-input devices are possible. The light pen or RAND Tablet stylus serve a very useful function in pointing to displayed items and in drawing or printing For input to the computer. The possibilities for very smooth interaction with the computer through these devices is only just beginning to be exploited. RAND Corporation has in operation today a debugging tool which recognizes printed changes of register contents, and simple pointing and moving motions for format relocation. Using RAND's techniques you can change a digit printed on the screen by merely writing what you want on top of it. If you want to move the contents of one displayed register into another, merely point to the first and "drag" it over to the second. The facility with which such an interaction system lets its user interact with the computer is remarkable.

Knobs and joysticks of various kinds serve a useful function in adjusting parameters of some computation going on. For example, adjustment of the viewing angle of a perspective view is conveniently handled through a three-rotation joystick. Push buttons with lights are often useful. Syllable voice input should not be ignored.

In many cases the computer program needs to know which part of a picture the man is pointing at. The two-dimensional nature of pictures makes it impossible to order the parts of a picture by neighborhood. Converting from display coordinates to find the object pointed at is, therefore, a time-consuming process. A light pen can interrupt at the time th at the display circuits transfer the item being pointed at, thus automatically indicating its address and coordinates. Special circuits on the RAND Tablet or other position input device can make it serve the same function.

What the program actually needs to know is where in memory is the structure which the man is pointing to. In a display with its own memory, a light pen return tells where in the display file the thing pointed to is, but not necessarily where in main memory. Worse yet, the program really needs to know which sub part of which part the man is pointing to. No existing display equipment computes the depths of recursions that are needed. New displays with analog memories may well lose the pointing ability altogether.

Other Types of Display

If the task of the display is to serve as a looking-glass into the mathematical wonderland constructed in computer memory, it should serve as many senses as possible. So far as I know, no one seriously proposes computer displays of smell, or taste. Excellent audio displays exist, but unfortunately we have little ability to have the computer produce meaningful sounds. I want to describe for you a kinesthetic display.

The force required to move a joystick could be computer controlled, just as the actuation force on the controls of a Link Trainer are changed to give the feel of a real airplane. With such a display, a computer model of particles in an electric field could combine manual control of the position, of a moving charge, replete with the sensation of forces on the charge, with visual presentation of the charge's position. Quite complicated "joysticks" with force feedback capability exist. For example, the controls on the General Electric "handyman" are nothing but joysticks with nearly as many degrees of freedom as the human arm. By use of such an input/output device, we can add a force display to our sight and sound capability.

“With appropriate programming such a display could literally be ***the Wonderland into which Alice walked.”***

I.E. Sutherland: Head-mounted 3D display, Fall Joint Computer Conference, 1968

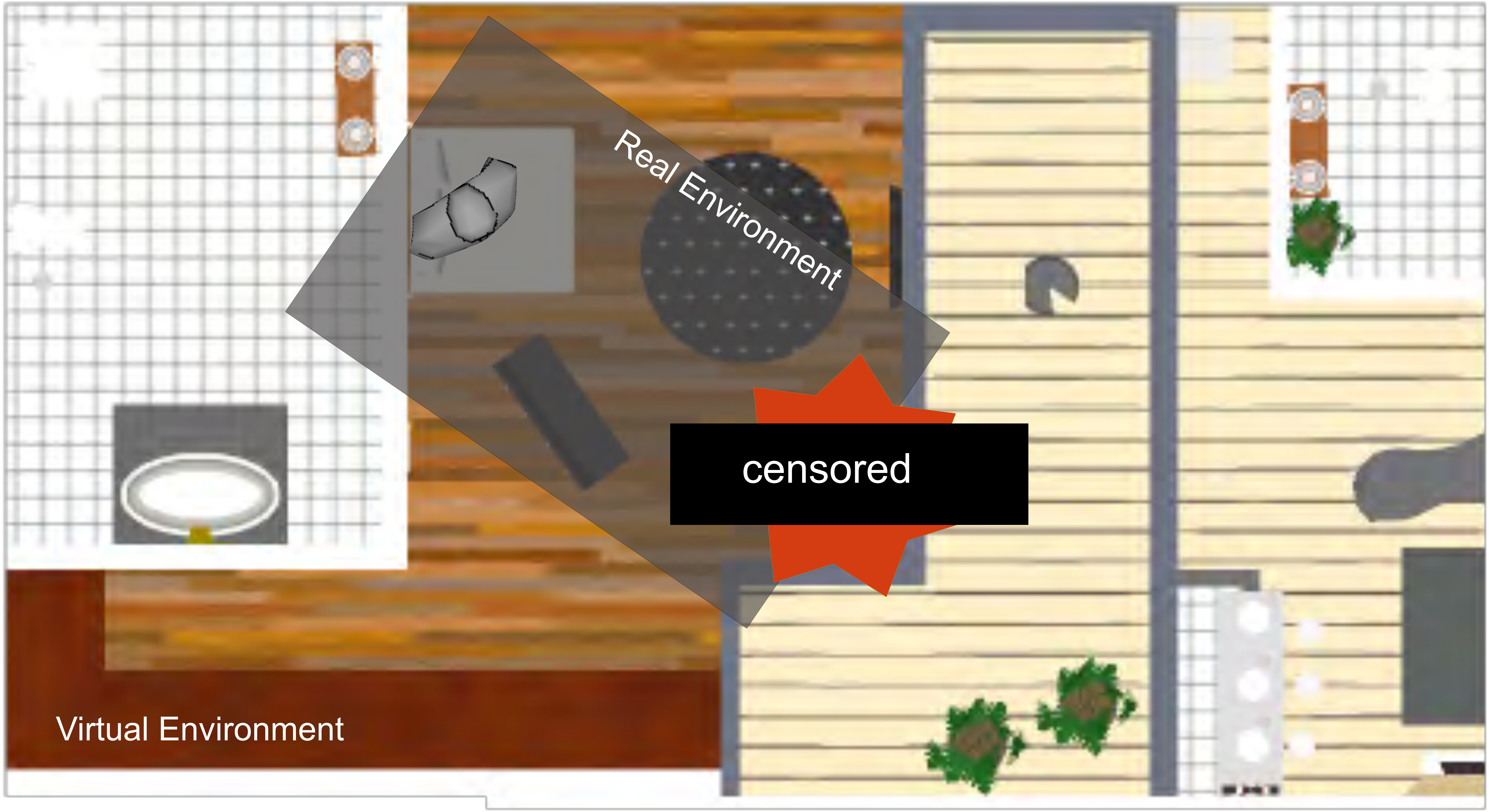

SAMSUNG
SAMSUNG
Gear VR
Oculus

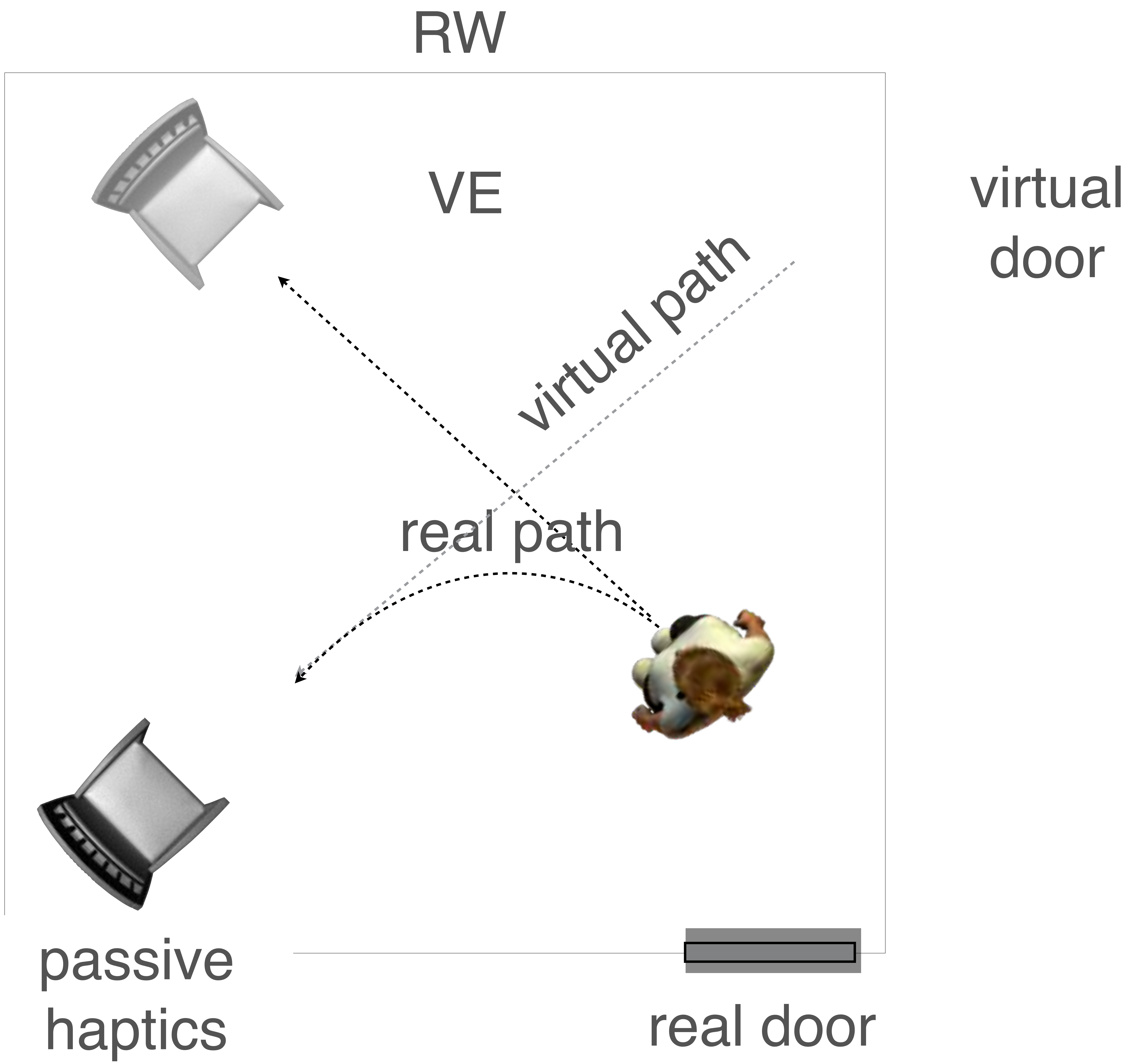
Oculus Rift	HTC Vive	PlayStation VR
		
OLED	OLED	OLED
2160 x 1200	2160 x 1200	1920 x 1080
90hz	90hz	120hz
110 degrees (approx)	110 degrees (approx)	100 degrees (approx)
Headphones & Micophone	Integrated Headphones	Integrated 3D Audio
Oculus Touch, Xbox One Controller	SteamVR, PC gamepad	PlayStation Move, Dual Shock 4 Controller
HDMI 1.3, 3x USB 3.0, 1x USB 2.0	HDMI 1.3, 2x USB 3.0	HDMI, USB
Accelerometer, gyroscope, magnetometer, external Constellation tracking sensor array	Accelerometer, gyroscope, laser position sensor, front-facing camera	Accelerometer, gyroscope, PlayStation Eye Tracking System

VR *is* ***NOT*** *only a* ***Medium****,...*

... but an ***Immersive Experience***

“With appropriate programming such a display could literally be ***the Wonderland into which Alice walked****.”*

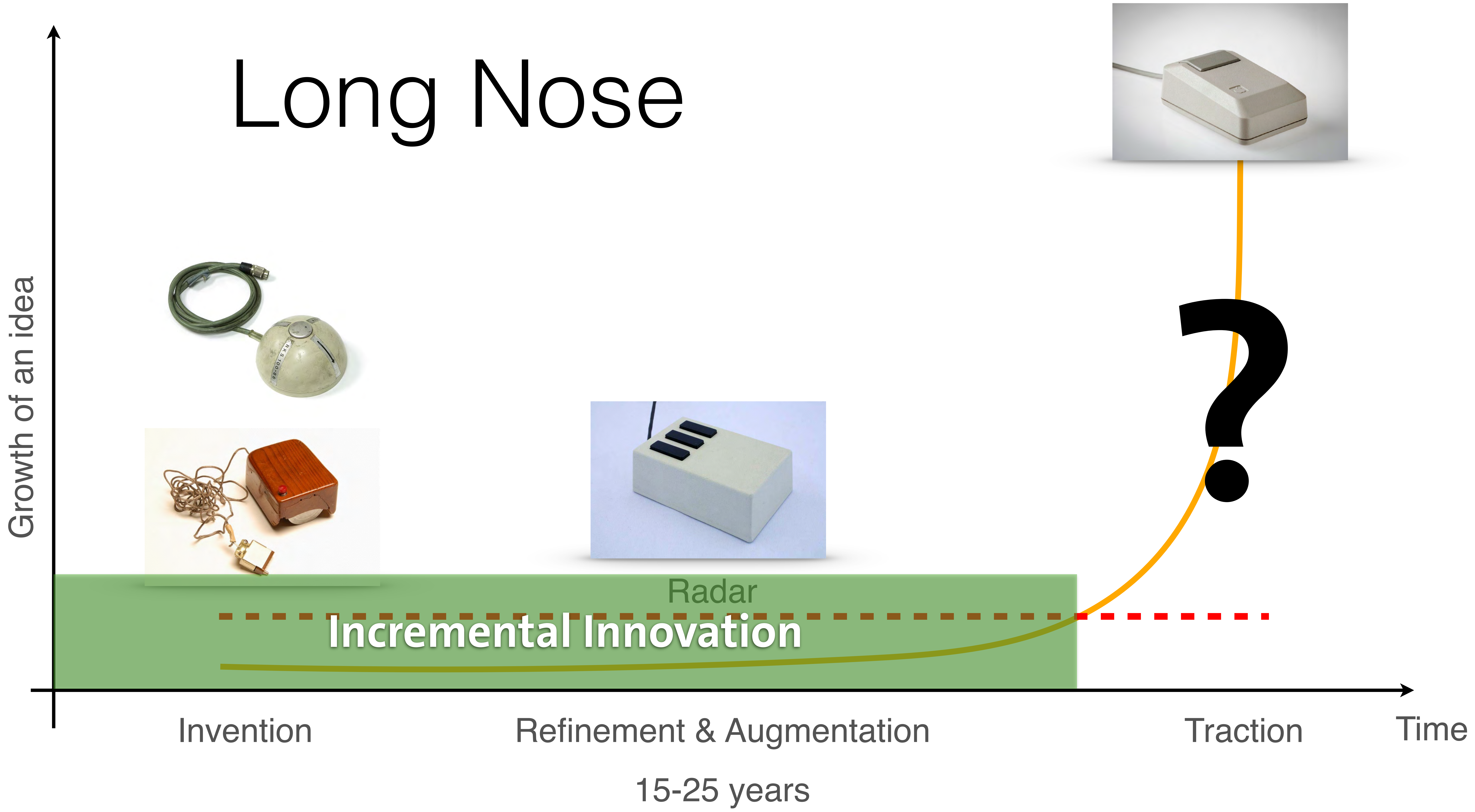

Real Environment
censored
Virtual Environment



RW
VE
virtual door
virtual path
real path
passive haptics
real door

Steinicke et al.: Estimation of Detection Thresholds for RDW, 2009

The **Ultimate Display** of the **Future**



W. Buxton: The Long Nose of Innovation, Businessweek, 2008

Ambalappuzha Sri Krishna Temple

Ambalappuzha Pal Payasam

Legend of Ambalappuzha Pal Payasam

•	• •	• • • •	• • • • • • • •	• • • • • • • • • • • • • • • •	32	64	128
256	512	1024	2048	4096	8192	16,384	32,868
64K	128K	256K	512K	1M	2M	4M	8M
16M	32M	64M	128M	256M	512M	1G	2G
4G	8G	16G	32G	64G	128G	256G	512G
1T	2T	4T	8T	16T	32T	64T	128T
256T	512T	1P	2P	4P	8P	16P	32P
64P	128P	256P	512P	1E	2E	4E	8E

Exponential Growth

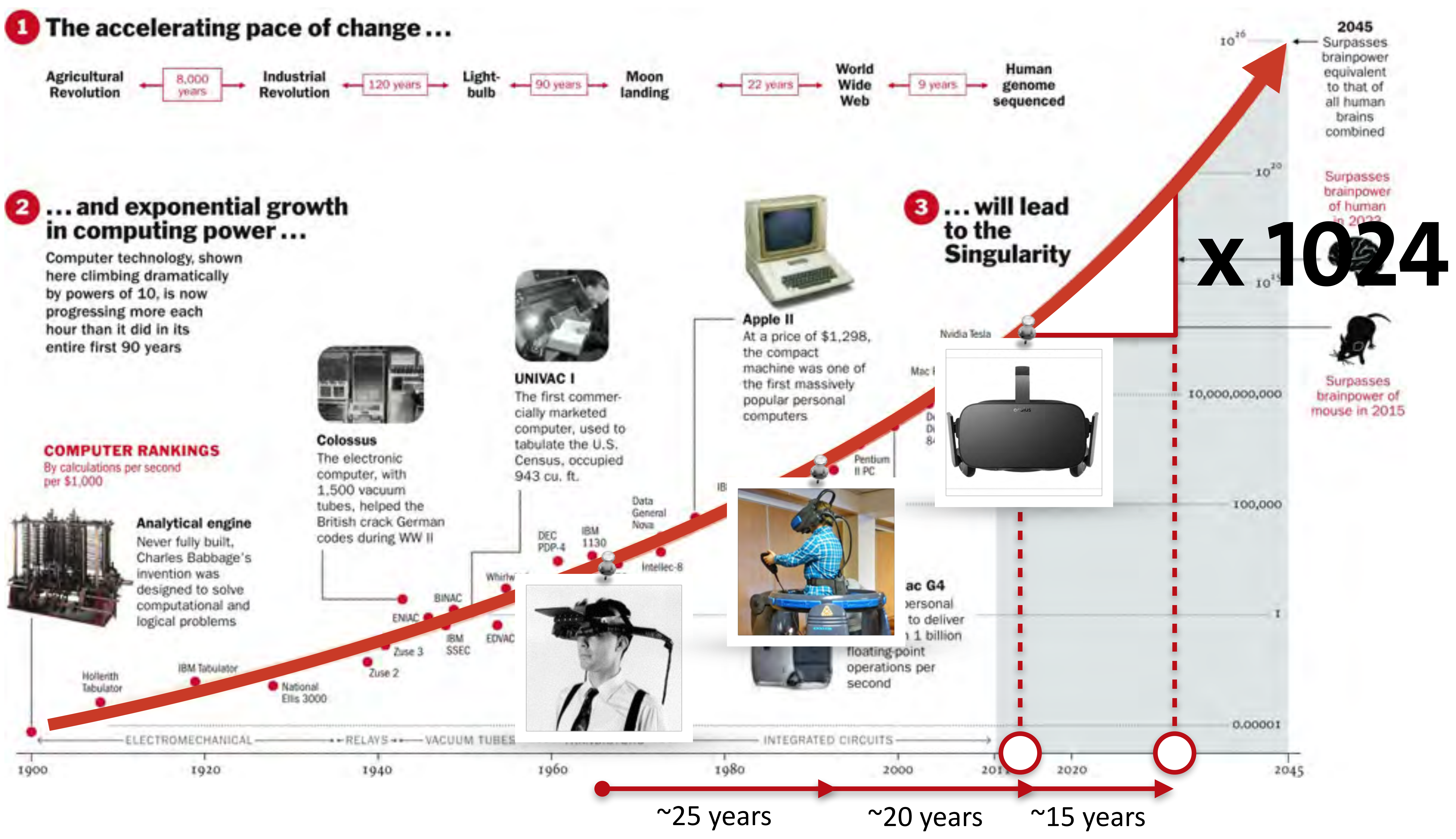
Example

Year	# index
1971	2,300
1972	3,500
1974	4,500
1976	8,500
1978	29,000

- Group 1: How large will the index be in 1989?
- Group 2: In which year will the index surpass 275,000?

W.A. Wagenaar, S.D. Sagaria: Misperception of exponential growth, Perception & Psychophysics, 1975

TIME: The Year Man Becomes Immortal, 2011



Graphics
Turing Test

M. McGuigan, Graphics Turing Test, 2006

1996 ... 2013 ... 2030

http://imgur.com/gallery/354XL


Smart glasses of ~2030
smart phones
smart glasses
thenextweb.com

Immersive Disruption

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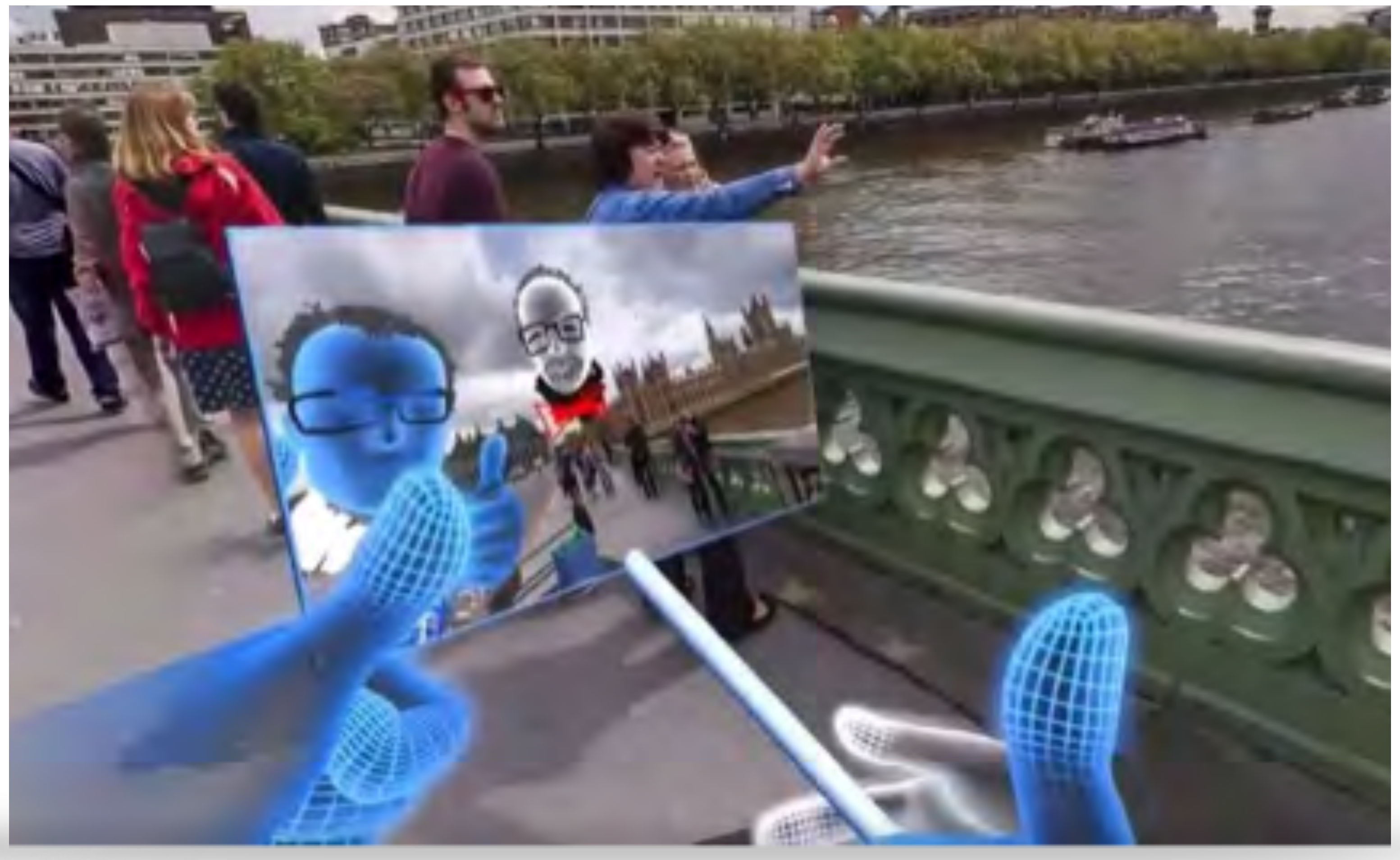
Real Estate / Architecture / Tourism



Social Media / Communication

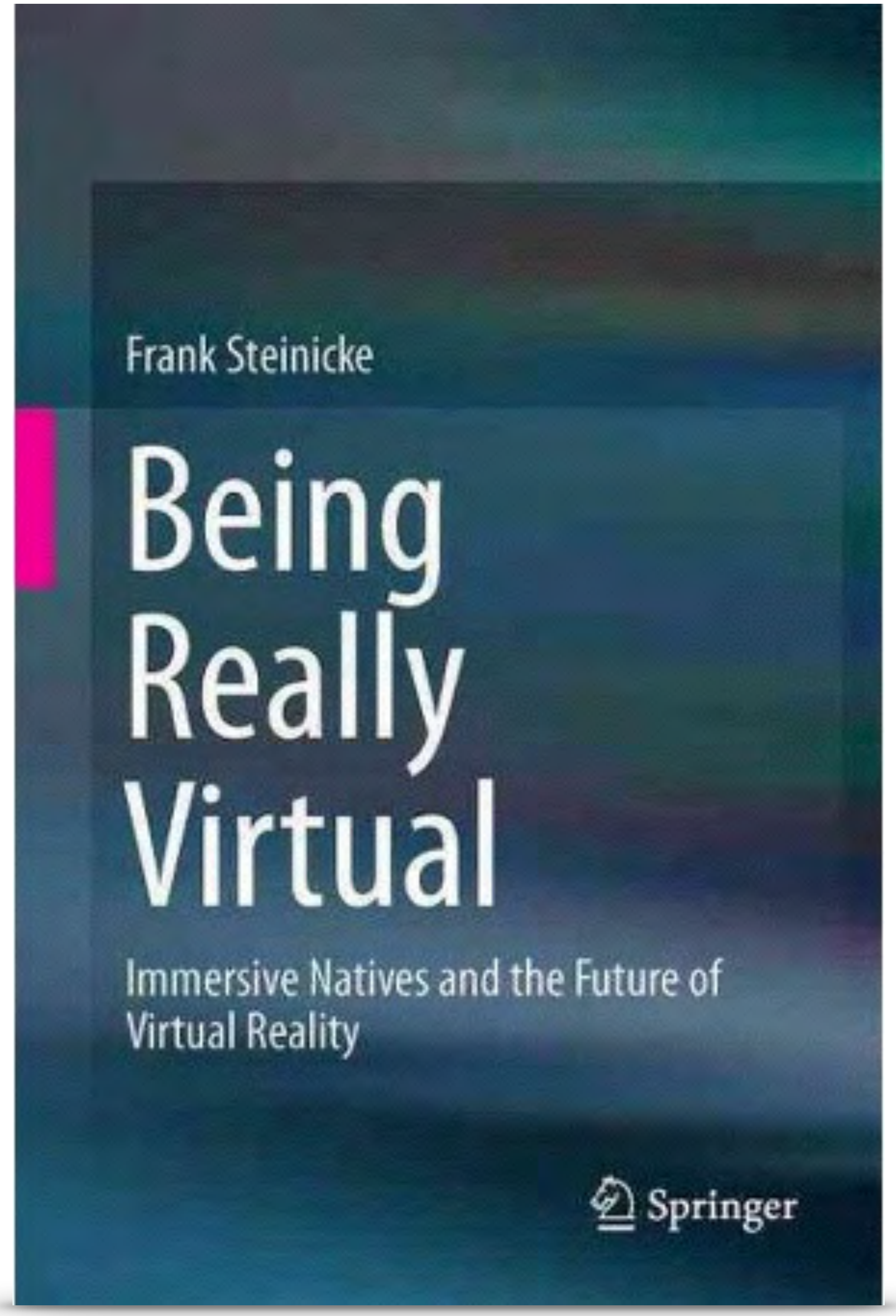
Ultimate Empathie Machine

The Machine to Be Another

Event Lab

Clouds Over Sidra

„VR is dead?“



… long live VR!

human-computer interaction

twitter.com/uhhhci

youtube.com/user/uhhhci

hci.informatik.uni-hamburg.de