Virtual Reality and Augmented Reality

Introduction to XR

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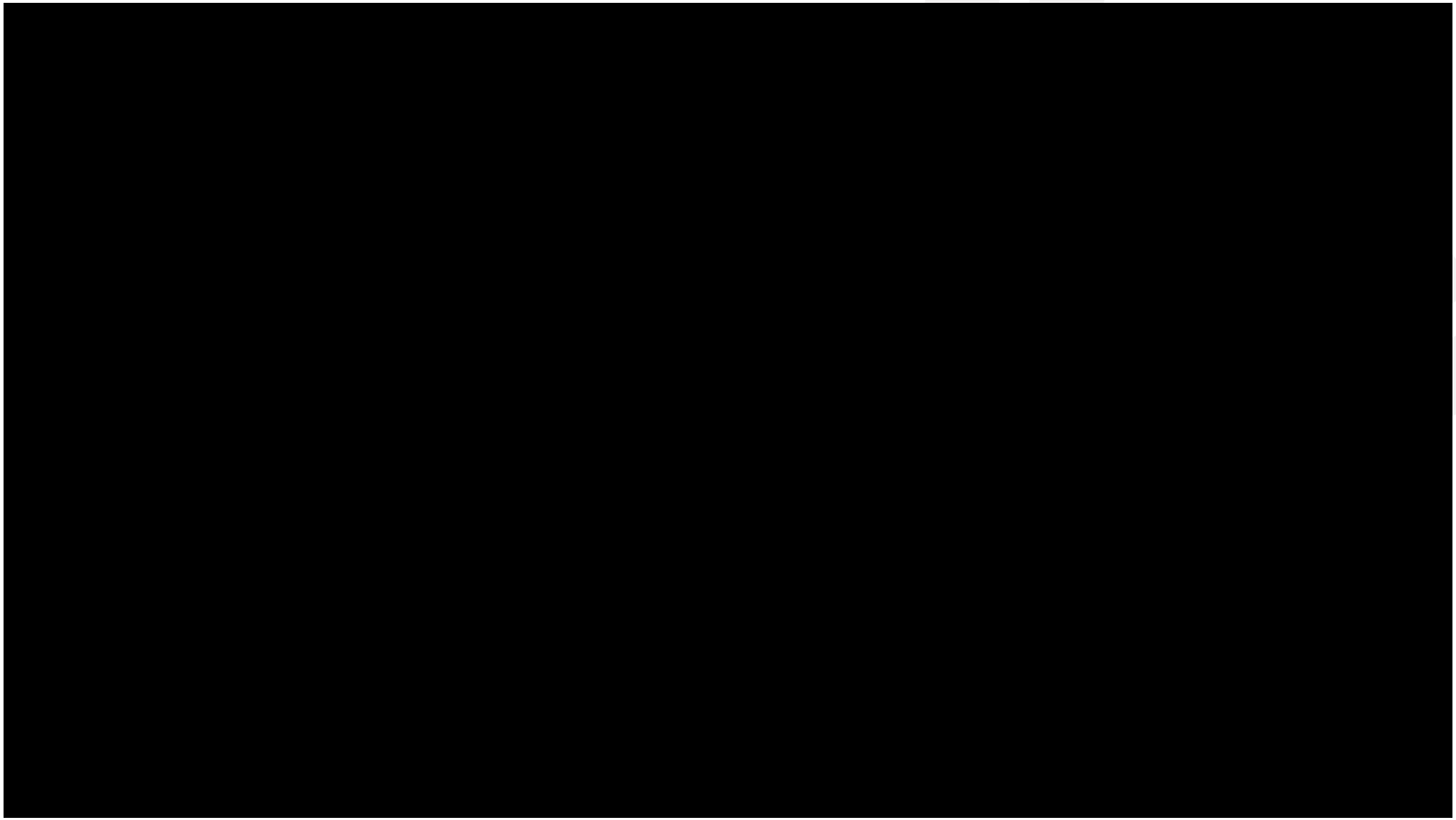
Introduction to XR

1967 – IBM 1401 – half of the computers in the world, $10,000/month to run


1401
IBM

2013 Google Glass



https://www.youtube.com/watch?v=eo29M8Yk3Qc

The Incredible Disappearing Computer

1960-70’s

Room

1970-80’s

Desk

1980-90’s

Lap

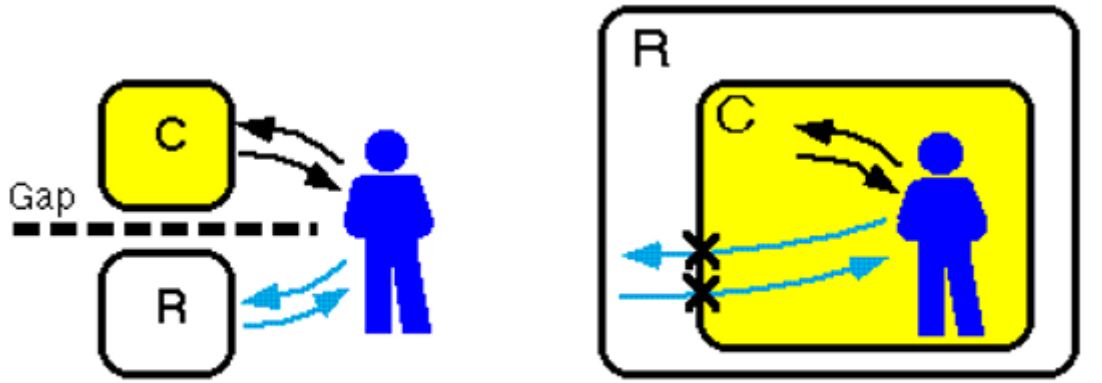
1990-2000’s

Hand

2010 -

Head

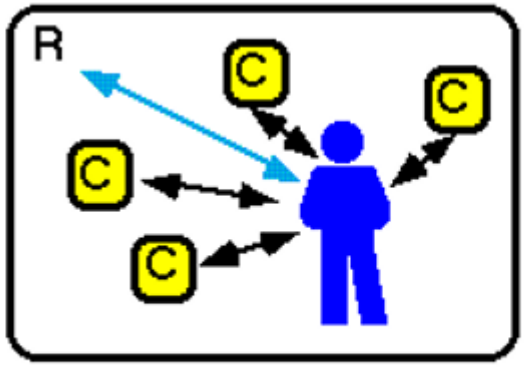
Making Interfaces Invisible



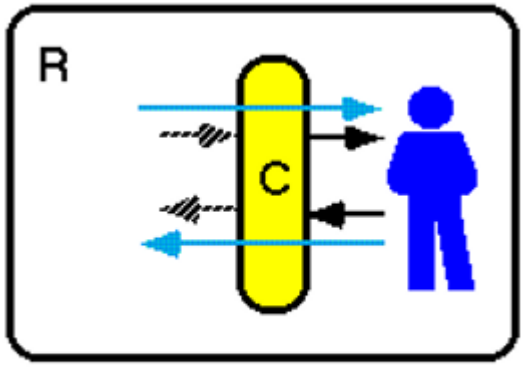
(a) GUI

(b) Virtual reality

(c) Internet of Things



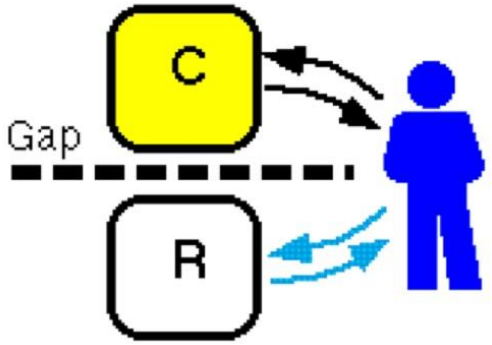
(c) Ubiquitous Computers



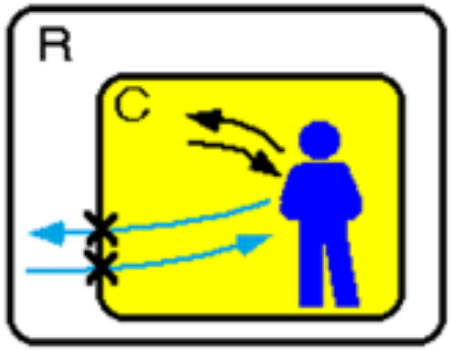
(d) Augmented interaction

Rekimoto, J. and Nagao, K. 1995. The world through the computer: computer augmented interaction with real world environments.

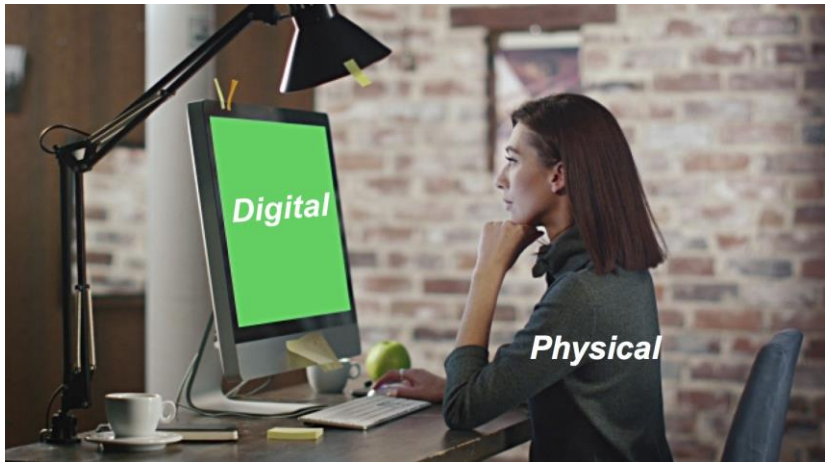
Making Interfaces Invisible



(a) GUI



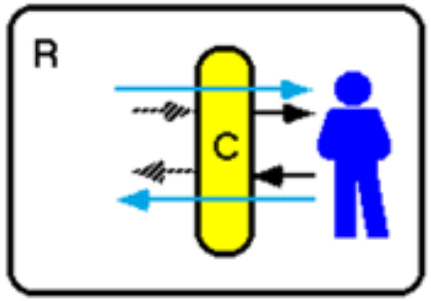
(b) Virtual reality



Separation between real and digital worlds

The computer surrounds the user completely and interaction between the user and the real world vanishes.

Making Interfaces Invisible



(d) Augmented interaction

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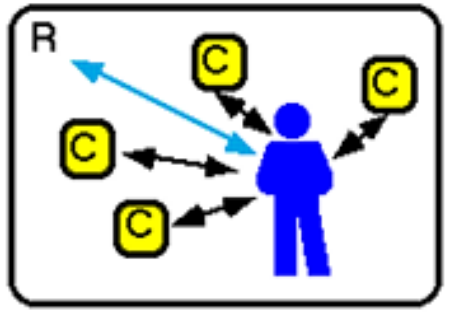
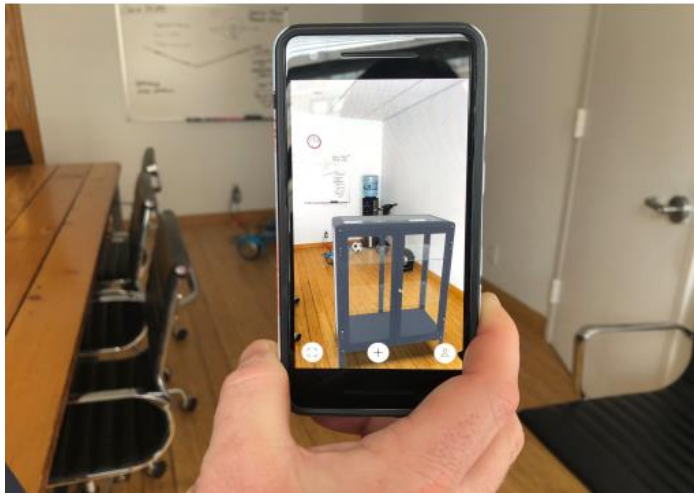
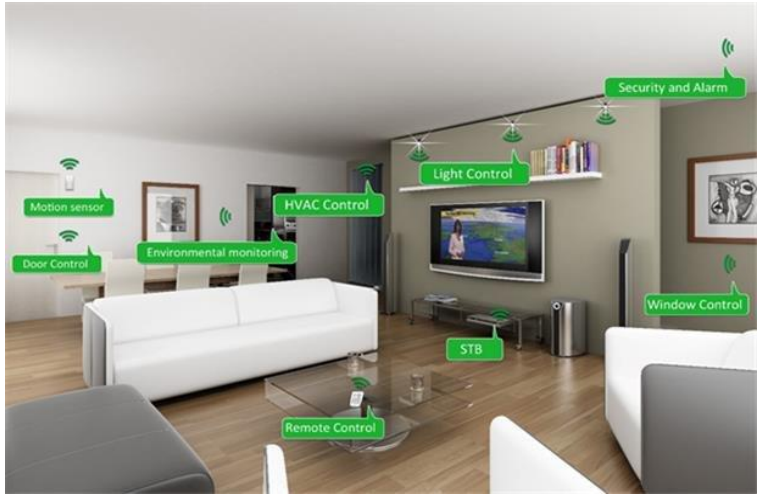


(c) Ubiquitous Computers

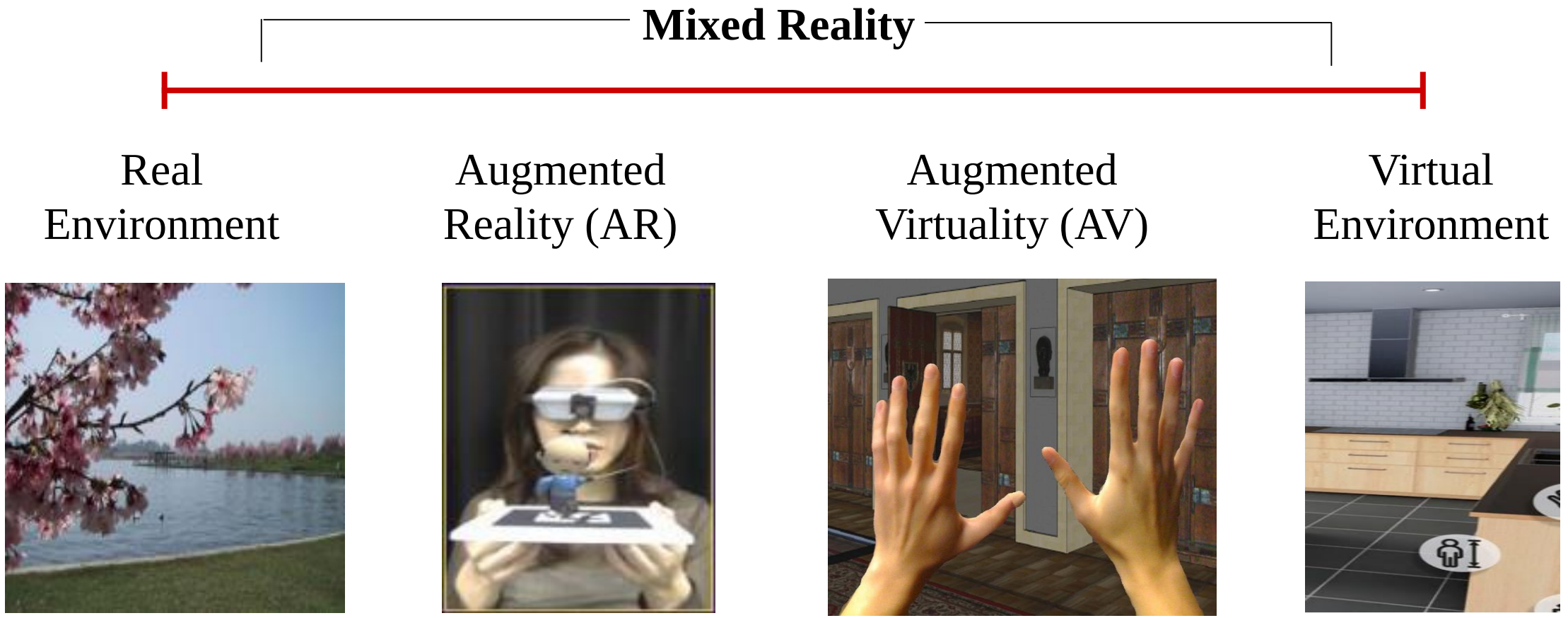


Blends what the user sees in their real world with digital content generated by computer software



Embed computing and sensing in real world

Milgram's Reality-Virtuality Continuum



P. Milgram and A. F. Kishino, Taxonomy of Mixed Reality Visual Displays IEICE Transactions on Information and Systems, E77-D(12), pp. 1321-1329, 1994.

Virtual Reality

Technology that creates immersive and interactive three-dimensional computer-generated environments, which can be navigated, manipulated, and interacted with by a user. (Users immersed in Computer Generated environment)

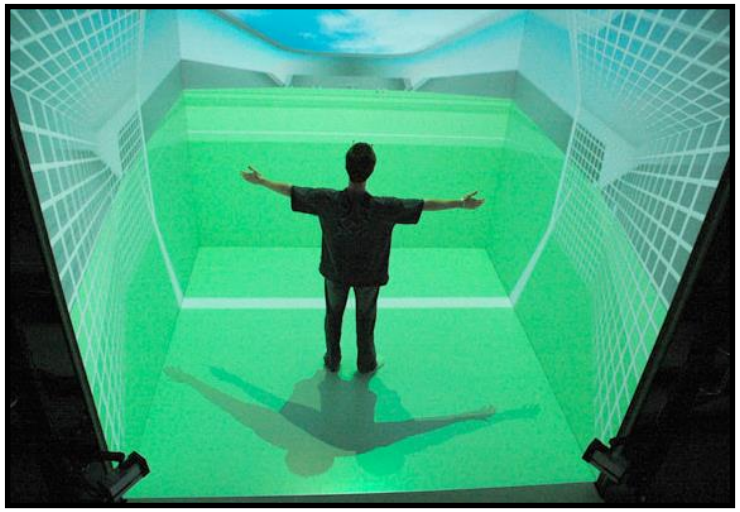
VR Demo

Virtual Reality Display Types

Non-immersive

Users engage with virtual content displayed on a screen.

Semi-immersive



Users engage with virtual content through large projection screens. *Cave automatic virtual environment (CAVE)*

Fully-immersive

Users engage with virtual content through VR head mount displays (HMD)

CAVE Demo

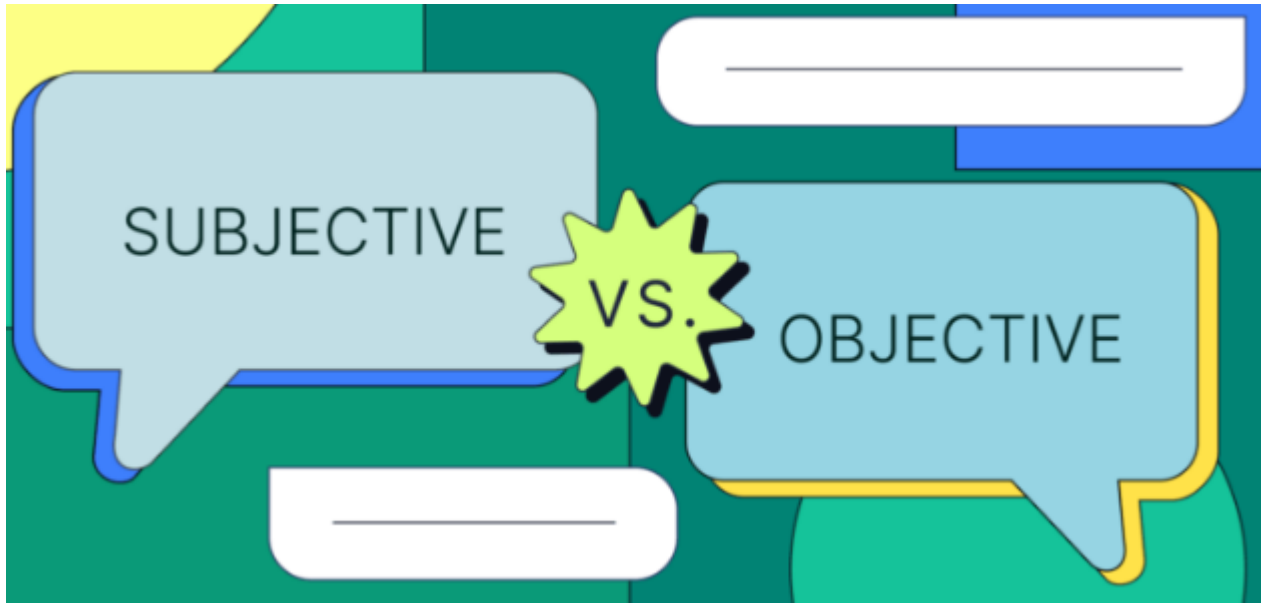
https://www.youtube.com/watch?v=aKL0urEdtPU

Fully Immersive VR Experience

- A fully immersive VR experience requires complete immersion in the virtual environment.
    - High quality video, audio, motion, touch, …

Omni treadmill being used at a VR convention

Virtual Reality Characteristics



- Opinion.
- Means affected by personal opinions and feelings and varies from person to person.

- Fact.
- Means not affected by personal opinions or feelings in considering or representing facts.

Virtual Reality Characteristics

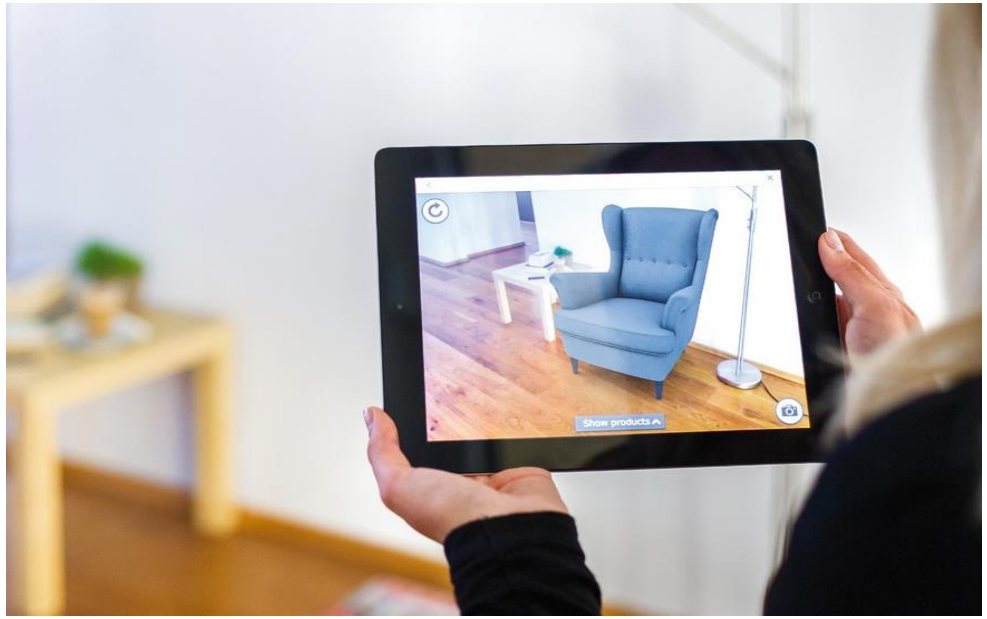
- Immersion
  - It is the ***objective*** description of technology and refers to the degree to which computer displays can create an environment that generates the illusion of reality.
  - It is a result of the capabilities of VR hardware.
- Presence
  - The ***subjective*** experience of being in one place or environment, even when one is physically situated in another.
  - *Immersion is often considered a key factor in inducing presence.*
- Interactivity
  - Describes the degree to which users can influence the content of the virtual environment.

National Academy of Engineering

- **“Enhance Virtual Reality”** is 1 of 14 NAE grand challenges in the 21st century
- All major tech companies (e.g., Facebook, Apple, Amazon, Microsoft, Google) are investing heavily in VR.

Augmented Reality

Technology that **blends** computer-generated 3-D virtual objects with the user's real-world environment in real-time.



Augmented Reality Characteristics

- Combines Real and Virtual Images

  Both can be seen at the same time.

- Interactive in real-time

  The virtual content can be interacted with.

- Registered in 3D

  Virtual objects appear fixed in space.

Azuma, R. T. (1997). A survey of augmented reality. Presence, 6(4), 355-385.

Strong vs. Weak AR

Weak AR

- Imprecise (inaccurate) tracking
- No knowledge of environment
- Limited interactivity
- **Handheld AR**

Strong AR

- Very accurate tracking
- Seamless integration into real world
- Natural interaction
- **Head mounted AR**


EXIT
BEGINS
MERIVALE
Locally
Owned & Operated
Welcome to our Restaurant

https://www.youtube.com/watch?v=thOxW19vsTg

https://www.youtube.com/watch?v=cCL3bFuC4IA

AR Frameworks

ARCore 

- A software development kit (SDK) developed by **Google** to build AR applications.
- Available on Android Studio, Unity, and Unreal engine for application development.
- Supported by a number of Android devices.
- Uses OpenGL and Vulkan for rendering

Link

https://developers.google.com/ar/

AR Frameworks

ARKit 

- A software development kit (SDK) developed by **Apple** to build AR applications.
- Available on Xcode, Unity, and Unreal engines for application development
- Supported by all iOS devices with an A9 or later chip
- Uses Metal for rendering

Link

https://developer.apple.com/arkit/

AR Frameworks

AR Foundation (Unity)

- A set of Unity packages that provide a common foundation for building AR applications **for both** Android and iOS devices
- Support for the ARCore and ARKit SDKs, and allows developers to build AR applications that can run on either platform using a single codebase
- Includes core features from ARKit, ARCore, Magic Leap, and HoloLens

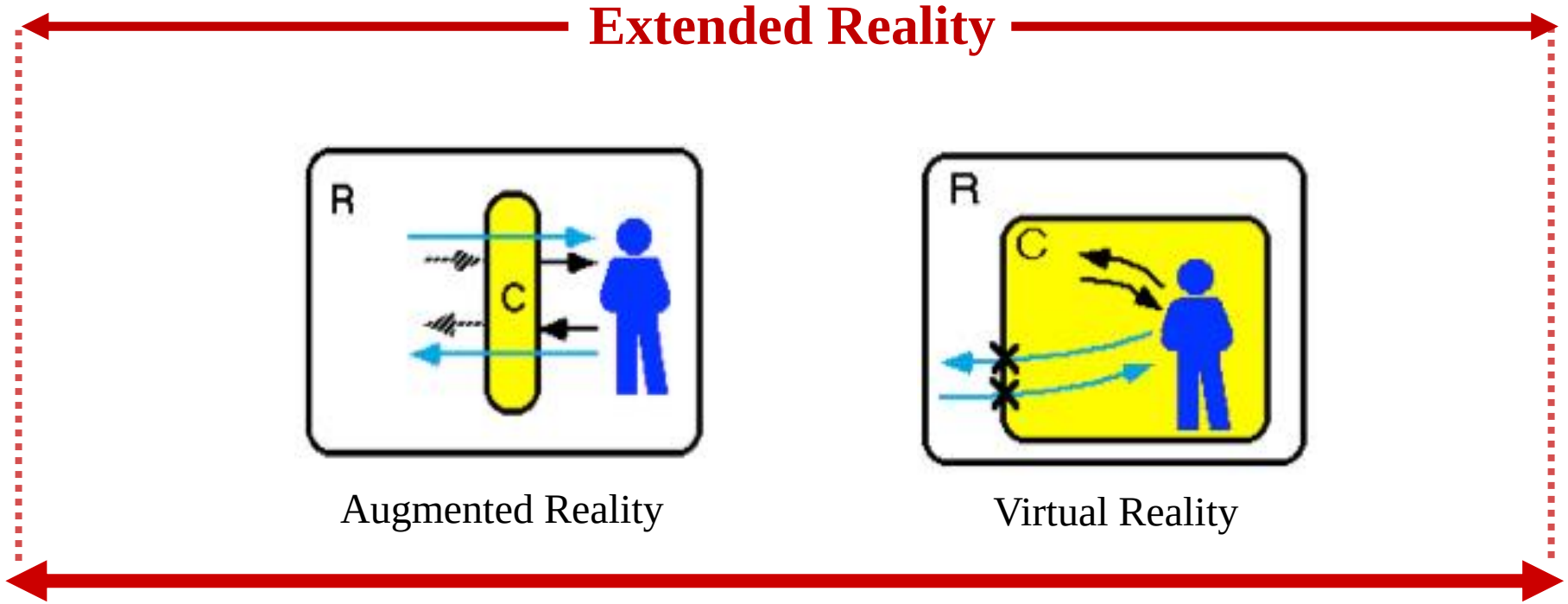
AR vs. VR

	Virtual Reality *Replaces Reality*	**Augmented Reality** *Enhances Reality*
Scene Generation	Requires realistic images	Minimal rendering okay
Display Device	Fully immersive, wide field of view	Non-immersive, small field of view
Tracking	Low to medium accuracy is okay	The highest accuracy possible

Extended Reality

Goal

Immersive, **realistic**, **interactive**, and **intelligent** digital experiences blending the physical and digital worlds



NEXT: Perception and Technology

THANK YOU