MIXED REALITY

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Holograms

The hologram is a virtual object made entirely of light that partially acts as the physical (real) object in the world:

Holographic objects can be viewed from different angles and distances, just like physical objects. They can also interact with the environment (e.g., bouncing ball on a table)

However, holograms do not offer any physical resistance when touched or pushed because they don't have a mass.
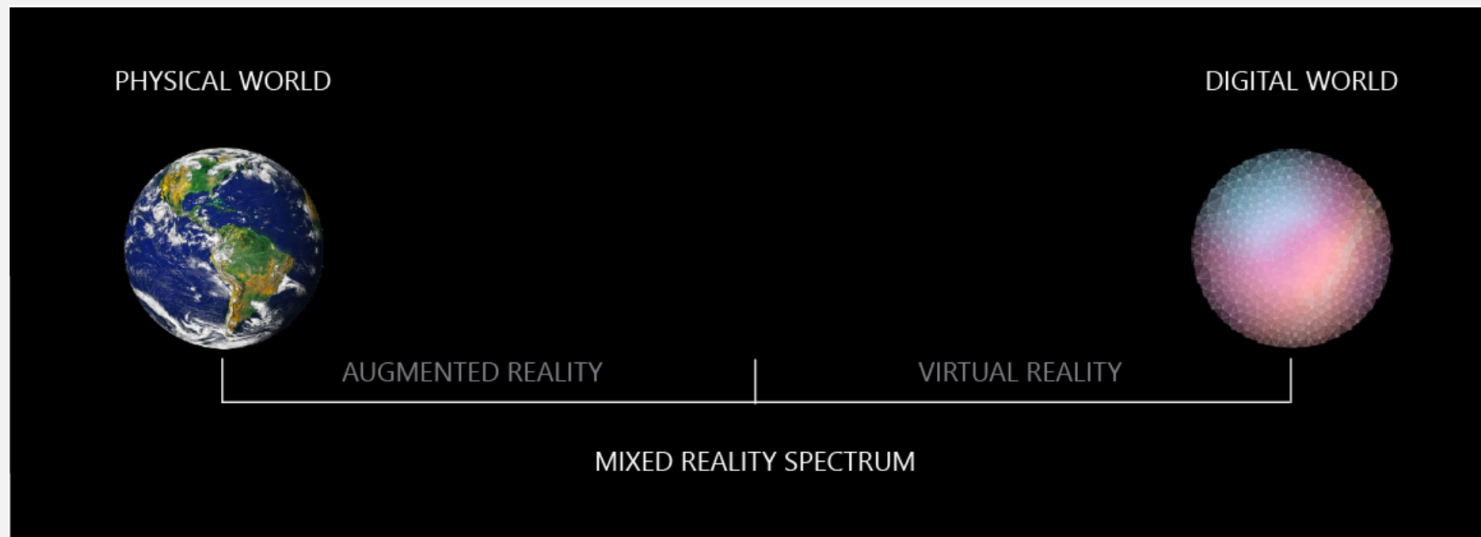
AR, MR AND VR

MR blends elements of the real and digital world. In mixed reality, you can interact and move elements and environments, both physical and virtual.

It offers the possibility of having one foot in the real world and the other in an imaginary place, breaking down the basic concepts of reality and imagination.

https://www.intel.it/content/www/it/it/tech-tips-and-tricks/virtual-reality-vs-augmented-reality.html

Holograms

In AR the digital content is displayed on top of visible real environment.

In MR the virtual objects are integrated into and responsive to the real world. For instance, a virtual ball under the desk would be blocked from a user's view.

MR takes the best qualities of AR and VR to create an immersive interface that overlays upon the user's reality. Rather than displaying simple images like AR, MR strives to put fully digital objects that are trackable and intractable in the user's environment.

Users can view and manipulate things from different angles which is as complex as an anatomy model. This type of rendering demands more processing power than AR, which is one main reason MR applications and devices are still in the proof-of-concept phase and far from consumer availability.

AR experiences aren't limited to visual additions to our world. You can create augmented experiences that are only audio additions to your physical world, or both audio and visual.
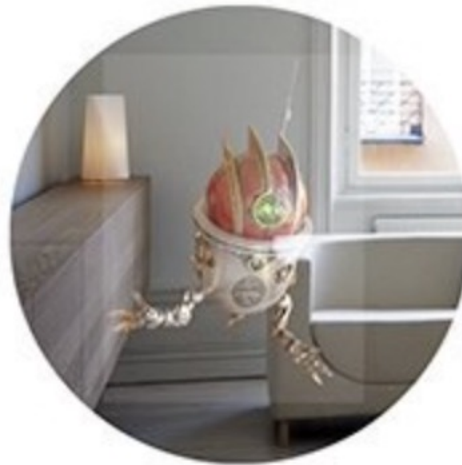
AR, MR AND VR

Hololens Spatial Awareness

- The Spatial Awareness system provides real-world environmental awareness in mixed reality applications. On Microsoft HoloLens, Spatial Awareness provided a collection of meshes, representing the geometry of the environment, which allowed for compelling interactions between holograms and the real-world
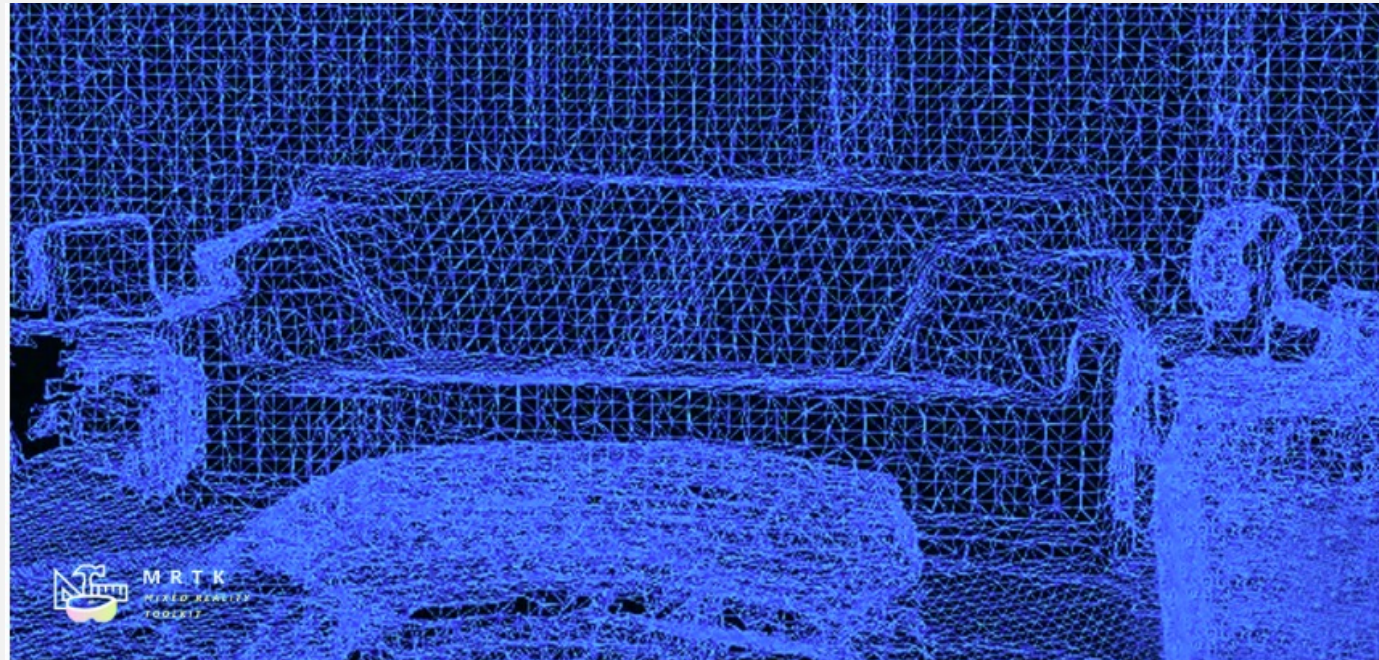
Hololens (1ˢᵗ gen)

Microsoft HoloLens is the first head mounted (holographic) MR device running Windows 10 (released in 2016).

It is completely unattached – no wires, phones, or connection to a PC needed.

Microsoft HoloLens allows user to pin holograms in the physical environment and provides a new way to see his world.

Microsoft HoloLens support augmented reality.

It supports:

- Gaze tracking
- Voice support
- Hand gestures

https://docs.microsoft.com/it-it/hololens/hololens1-hardware

Hololens (1ˢᵗ gen)
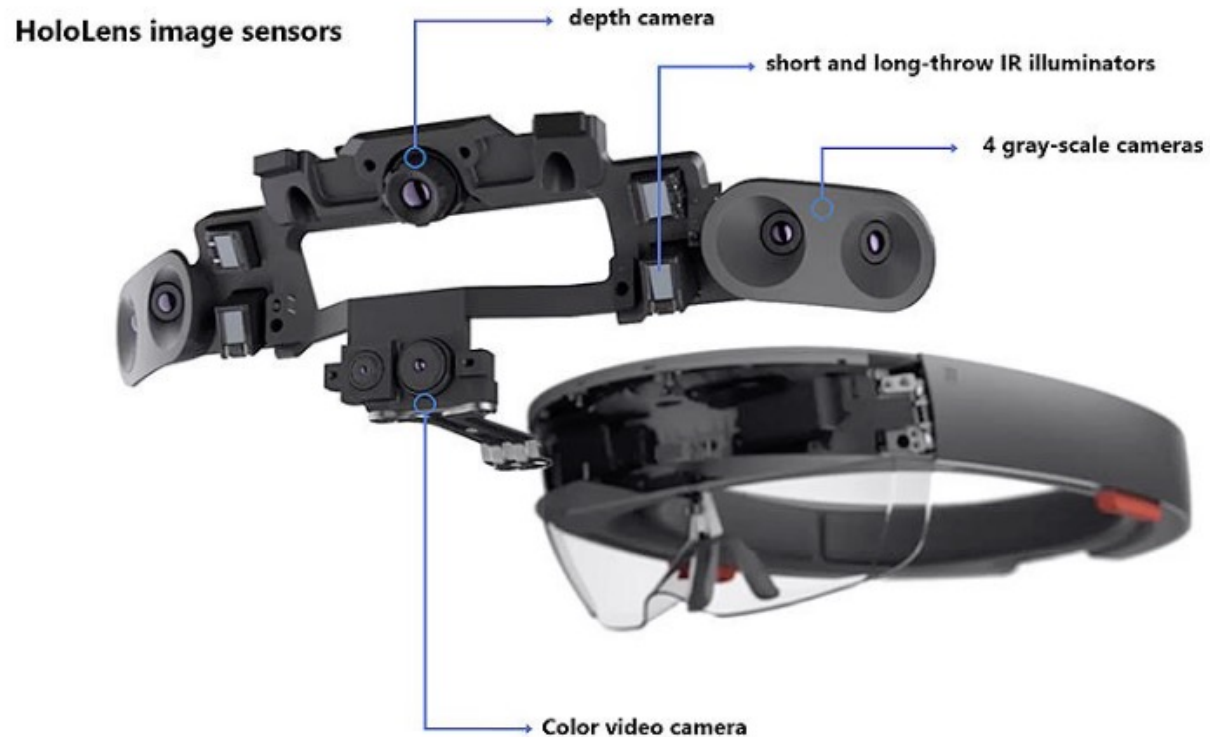
Display

Optics	See-through holographic lenses (waveguides)
Holographic resolution	2 HD 16:9 light engines producing 2.3M total light points
Holographic density	>2.5k radiants (light points per radian)
Eye-based rendering	Automatic pupillary distance calibration

https://docs.microsoft.com/it-it/hololens/hololens1-hardware

Hololens (1ˢᵗ gen)

HoloLens image sensors

- depth camera
- short and long-throw IR illuminators
- 4 gray-scale cameras
- Color video camera

Sensors:

- Gyroscope
- Magnetometer
- Accelerometer
- Ambient Light Detector
- Microphone Array (4 mics)
- Grayscale Cameras (4)
- RGB cameras (1)
- Depth sensor (1)

https://docs.microsoft.com/it-it/hololens/hololens1-hardware

Hololens (1ˢᵗ gen)

- Input: GGV paradigm
  - Gaze (look at)
  - Gesture (e.g., air tap)
  - Voice (speech)
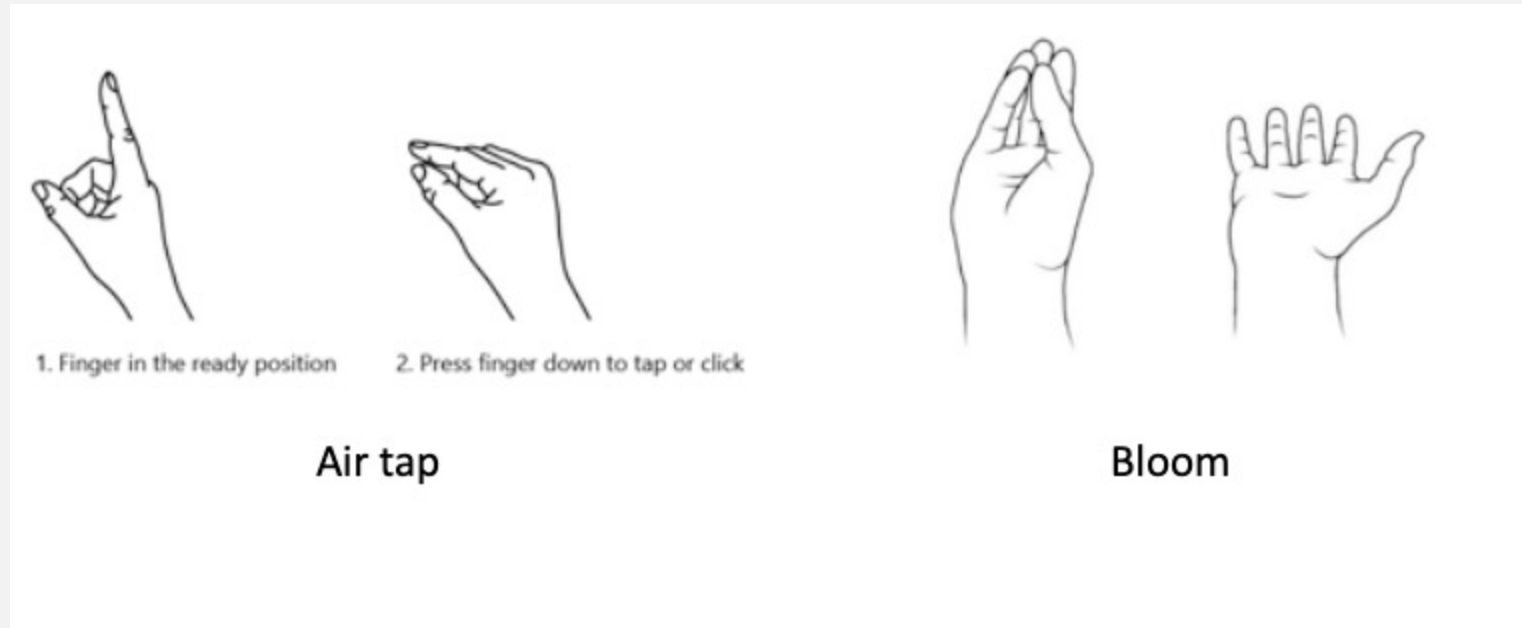- Output
  - Two see-through lenses
  - Spatial Sound

https://docs.microsoft.com/it-it/hololens/hololens1-hardware

Hololens Gestures

- HoloLens 1 recognizes two core component gestures: **Air tap** and **Bloom**.

1. Finger in the ready position
2. Press finger down to tap or click

Air tap

Bloom

Hololens Gestures

Gaze-and-commit :

- Hand gestures use head gaze as the targeting mechanism. The combination of Gaze and the Air tap gesture results in a gaze-and-commit interaction.

- Hololens supports a hands recognition within a specific frame, when you use your hands, you'll need to keep them inside that frame, or HoloLens won't see them. As you move around, the frame moves with you.


https://docs.microsoft.com/en-us/hololens/hololens1-basic-usage
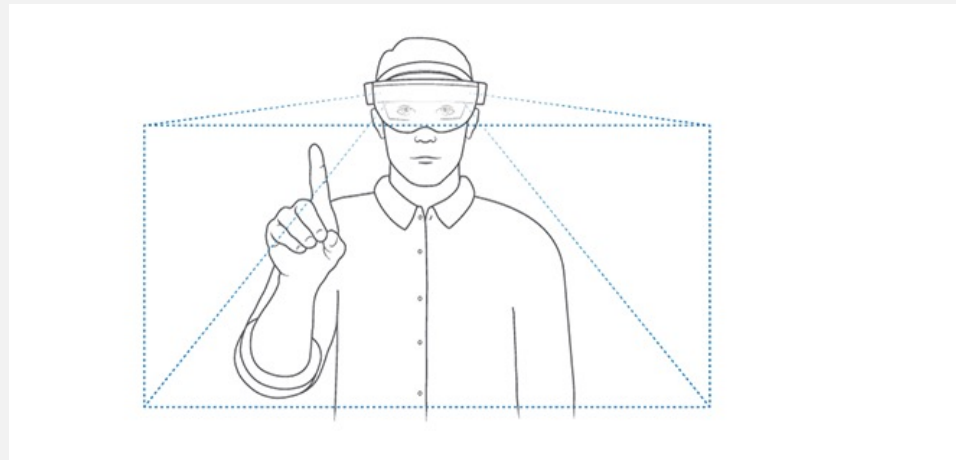
Hololens Clicker

- HoloLens 1 supports also a remote clicker. Clicker gestures are small wrist rotations:

- **Select**. To select a hologram, button, or other element, gaze at it, then click.

- **Click and hold**. Click and hold your thumb down on the button to do some of the same things you would with tap and hold, such as move or resize a hologram.

- **Scroll**. On the app bar, select Scroll Tool. Click and hold, then rotate the clicker up, down, left, or right. To scroll faster, move your hand farther from the center of the scroll tool.

- **Zoom**. On the app bar, select Zoom Tool. Click and hold, then rotate the clicker up to zoom in, or down to zoom out.

https://docs.microsoft.com/en-us/hololens/hololens1-clicker
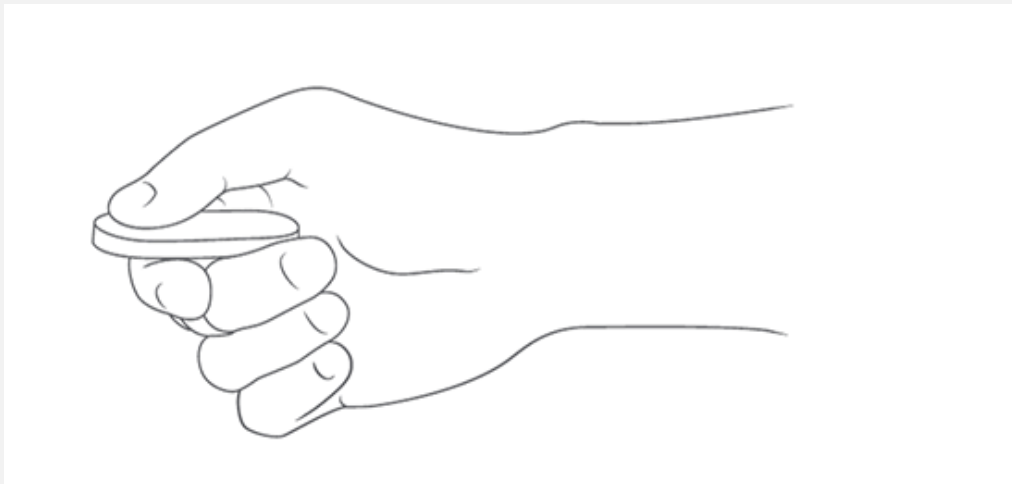
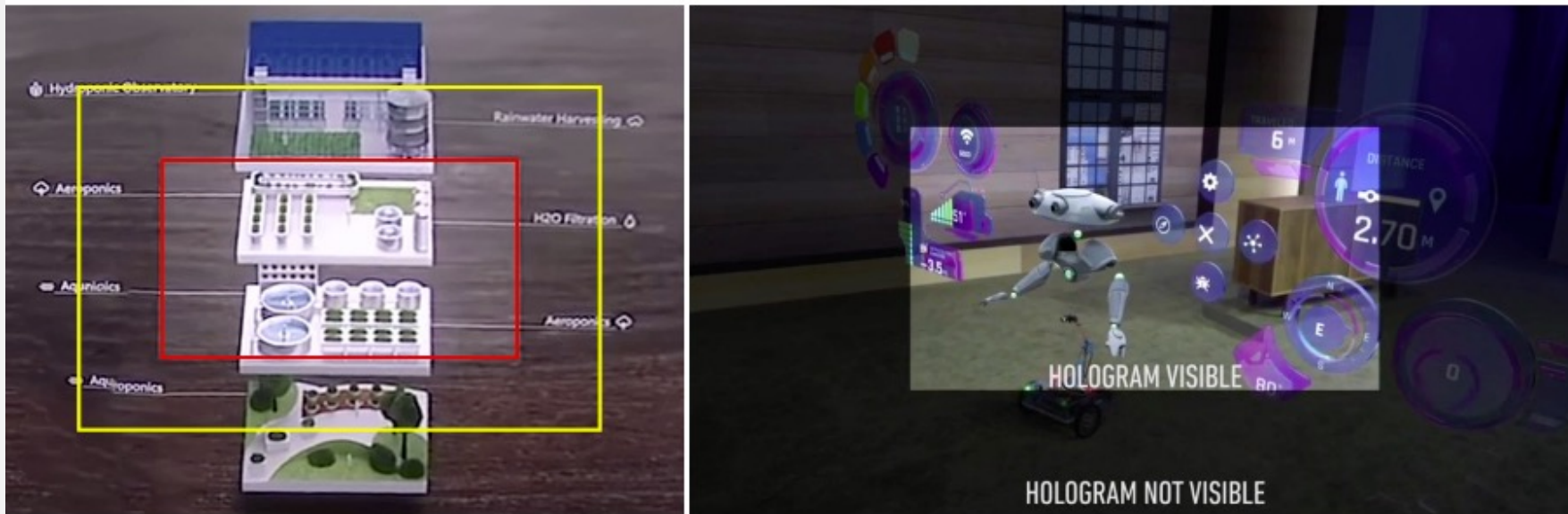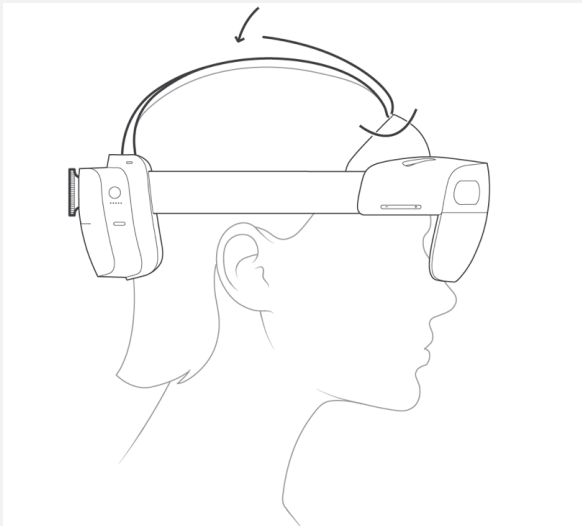# Hololens (1st gen) Pros and Cons

- Pros:
  - No wires
  - First head mounted device supporting MR
- Cons:
  - Narrow field of view (in the picture red is 1st gen. Hololens, yellow is 2nd gen.)

Hololens (2nd gen)

- The HoloLens 2 (released in 2019 only for enterprise use) combines several key aspects that improve its wearing time and comfortability. Not only the weight of the device was reduced, but also the regulating mechanism was moved to the back of the head making the whole device.

- HoloLens 2 has an improved gesture recognizer allowing users to interact with the holograms in a natural way:

  - Resizing and scaling (using both hands as if unfolding a map)

  - Grabbing, dragging, holding (as if taking a cup of tea)

https://docs.microsoft.com/en-us/hololens/hololens2-hardware