AUGMENTED AND MIXED REALITY

Corso Realtà Virtuale 2023/2024

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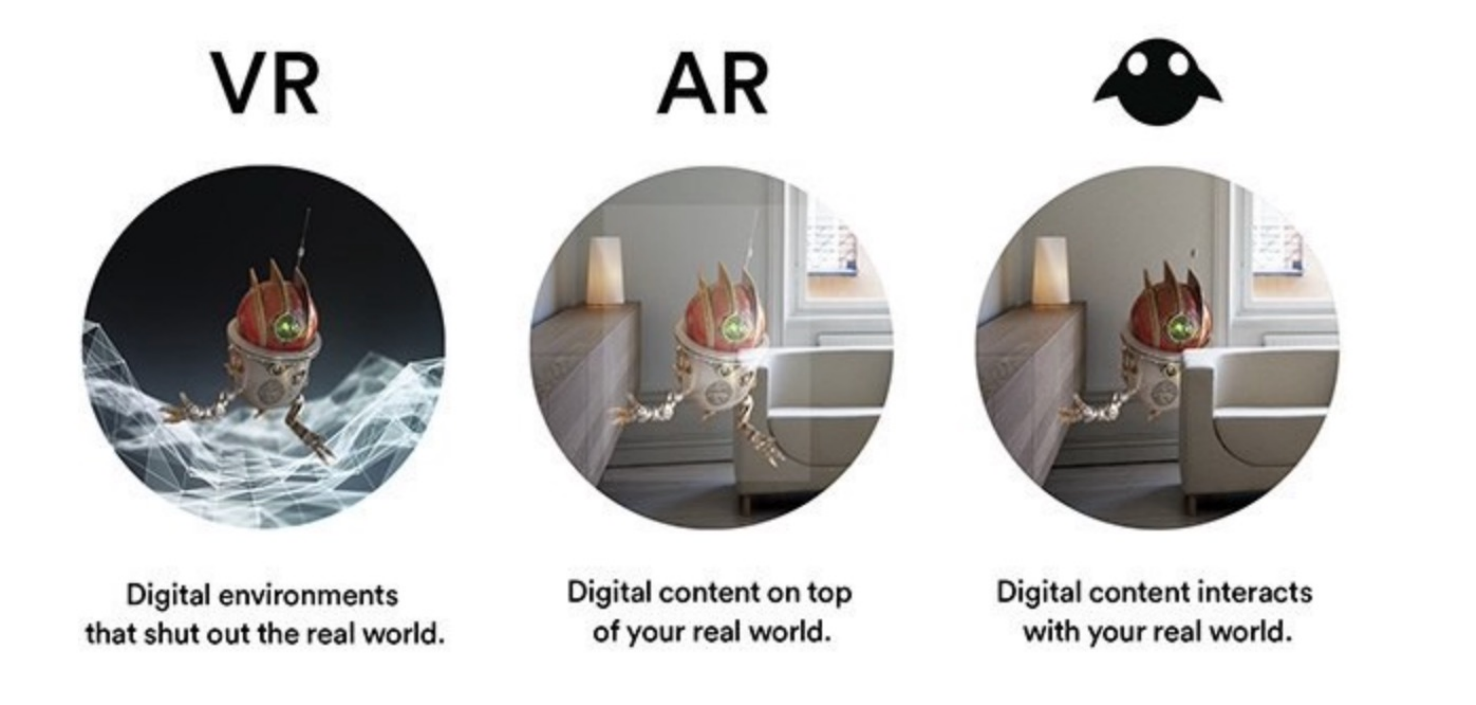
AR, MR or VR ?

AR, MR AND VR



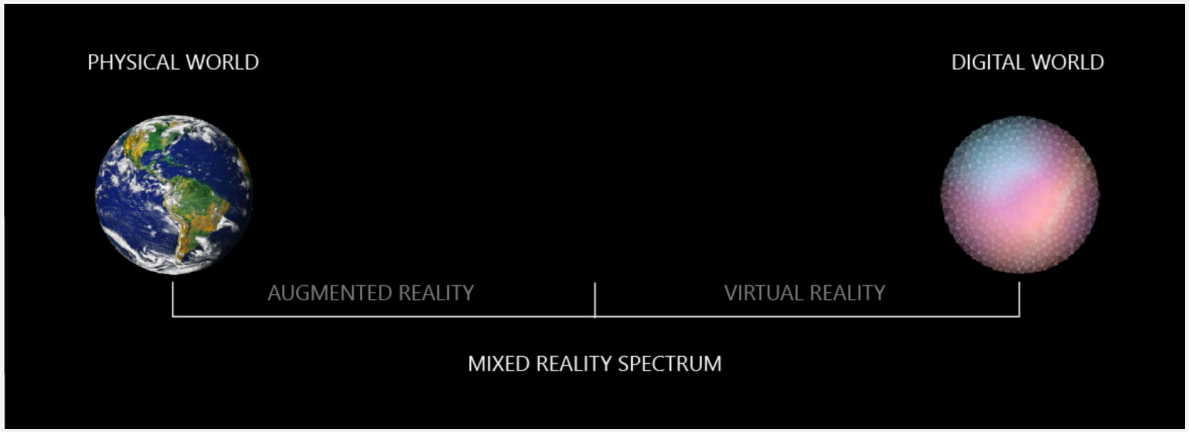
https://medium.com/@valendu/what-is-the-difference-between-virtual-reality-augmented-reality-and-mixed-reality-67dfec904c64

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



MR AND HOLOGRAMS

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.

This type of rendering demands more processing power than AR.

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.

AUGMENTED REALITY

AUGMENTED REALITY

Augmented Reality applications are used to put additional virtual elements on the real world.

The virtual elements can include images, buttons and texts.

The ar app can be used for different purposes, from entertainment, as video-games, to business, as an ar app labeling objects or an ar app supporting marketing.

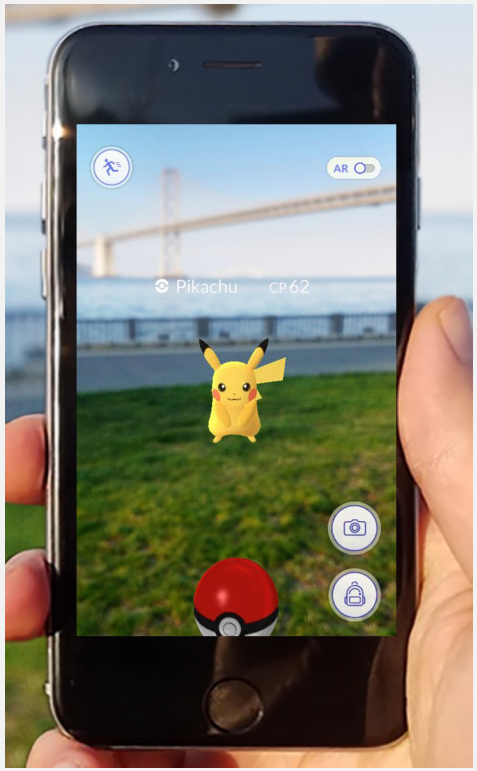


Image from https://pokemongolive.com/it/

AUGMENTED REALITY

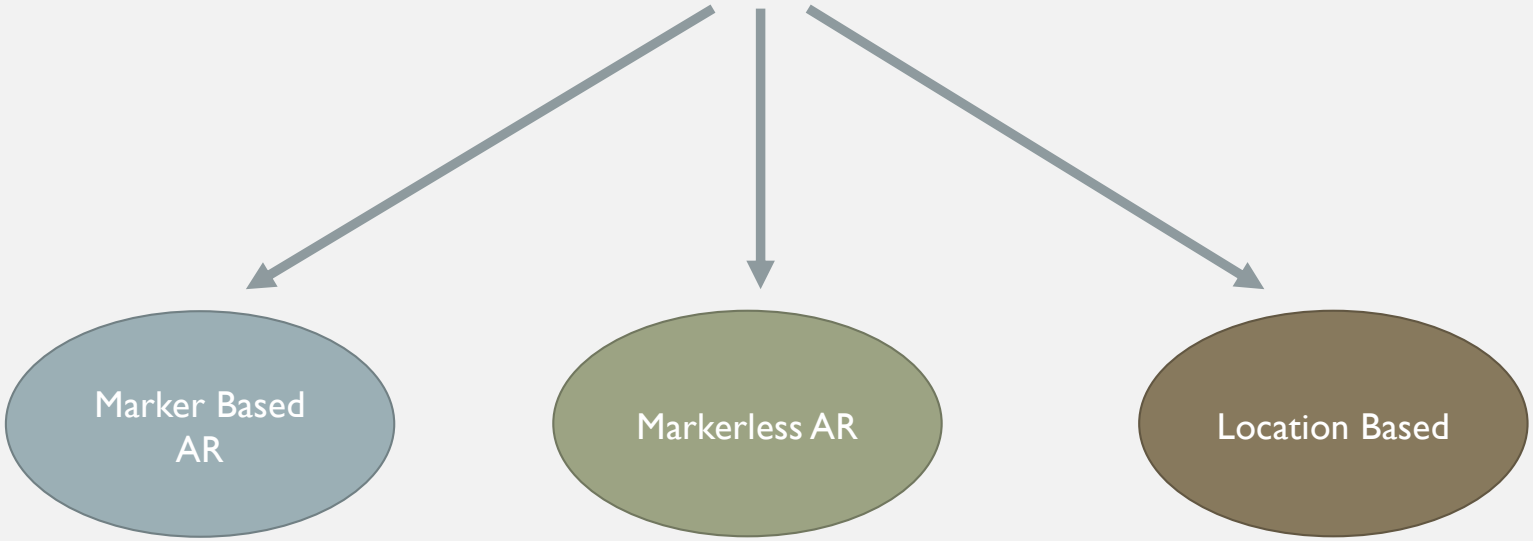
Augmented Reality app can be developed for mobile phones.

Frameworks:

- Android: ARCore [2]
- iOS: ARKit [3]
- Unity: ARFoundation [4] supporting ARCore and ARKit XR plugins, and Windows XR plugin for HoloLens
- Vuforia SDK [5], supports both native Android / iOS and Unity AR development as well as XR development for Hololens

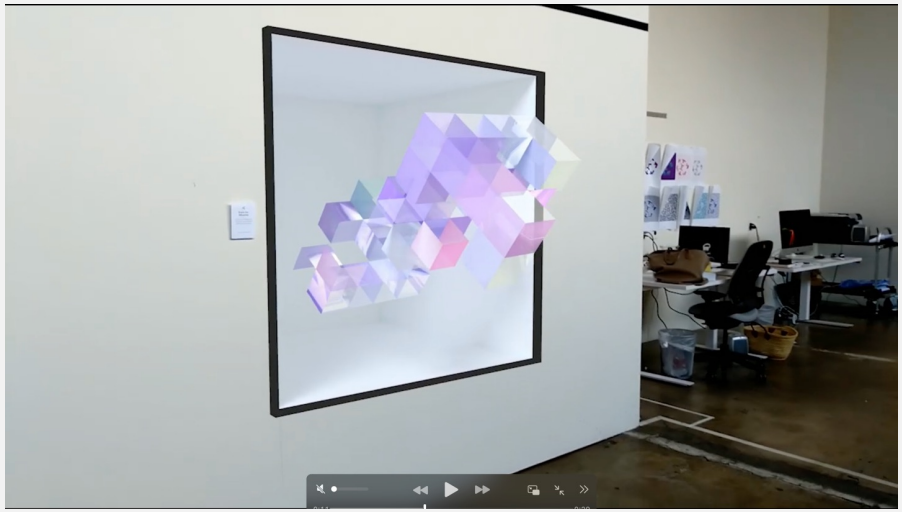
1. https://www.microsoft.com/it-it/hololens
2. https://developers.google.com/ar
3. https://www.apple.com/it/augmented-reality/
4. https://docs.unity3d.com/Packages/com.unity.xr.arfoundation@4.1/manual/
5. https://developer.vuforia.com/downloads/sdk

AUGMENTED REALITY TYPES



MARKER BASED

In **Marker based AR** (image tracking) a distinctive picture or page should be put in the real world. The picture is recognized though the device camera (pointing on the picture), and the additional virtual elements are shown on screen (on top of the image in the real world).
The marker can be anything, as a QR code or a particular Picture, but it should have enough unique visual points.
Mobile smartphones libraries (as ARCore and ARKit) support image tracking.



https://developers.google.com/ar/develop/augmented-images

MARKER BASED

The images to be recognized are usually stored in a Reference Image Library structure.

Example from ARFoundation:
https://github.com/Unity-Technologies/arfoundation-samples/tree/main/Assets/Scenes/ImageTracking

Documentation on image tracking:

https://docs.unity3d.com/Packages/com.unity.xr.arfoundation@4.2/manual/tracked-image-manager.html

MARKER BASED

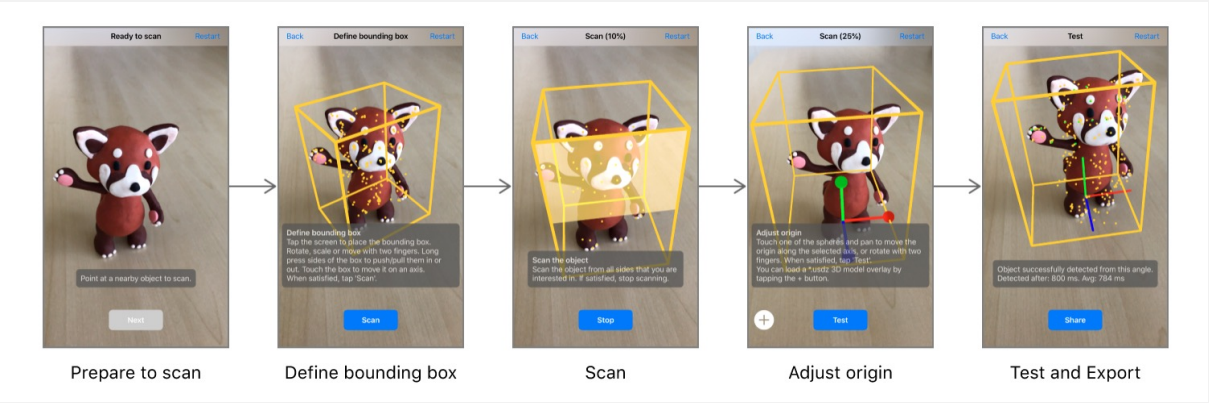
Recently also 3D **object tracking** is available with ARKit:

The structure is the same, a Object Reference Library contains the "object data" of each *reference object* to be recognized.

The "object data" is defined as "ARKit Object Reference", you can scan objects in real world with a iOS mobile device and then send the resulting file to a PC.

The documentation and the code for the demo application for mobile devices to scan objects and create the ARKit Object Reference file is available here:

https://developer.apple.com/documentation/arkit/content_anchors/scanning_and_detecting_3d_objects



MARKERLESS BASED AR

Markerless based AR eliminates the need for capturing markers to trigger virtual interaction. Applications based on markerless AR exploit the device's sensors to gain data useful for AR, as tracking user's motion/ plane detection ...

Markerless AR merges digital data with real-time and real-world inputs. The technology combines software, audio, and video graphics with a smartphone's or headset's cameras, gyroscope, accelerometer, haptic sensors, and location services to show virtual object in 3D graphics upon the real world. ARCore and ARKit offers markerless AR, scanning the environment and creating maps of where to place virtual 3D objects.

Useful links:

- ARFoundation Plane Detection Setup
  https://docs.unity3d.com/Packages/com.unity.xr.arfoundation@5.1/manual/features/plane-detection.html
- Unity Learn:
- https://learn.unity.com/tutorial/configuring-plane-detection-for-ar-foundation/?tab=overview
- ARCore
  https://developers.google.com/ar/develop/fundamentals
- ARKit
  https://developer.apple.com/videos/play/wwdc2018/610/

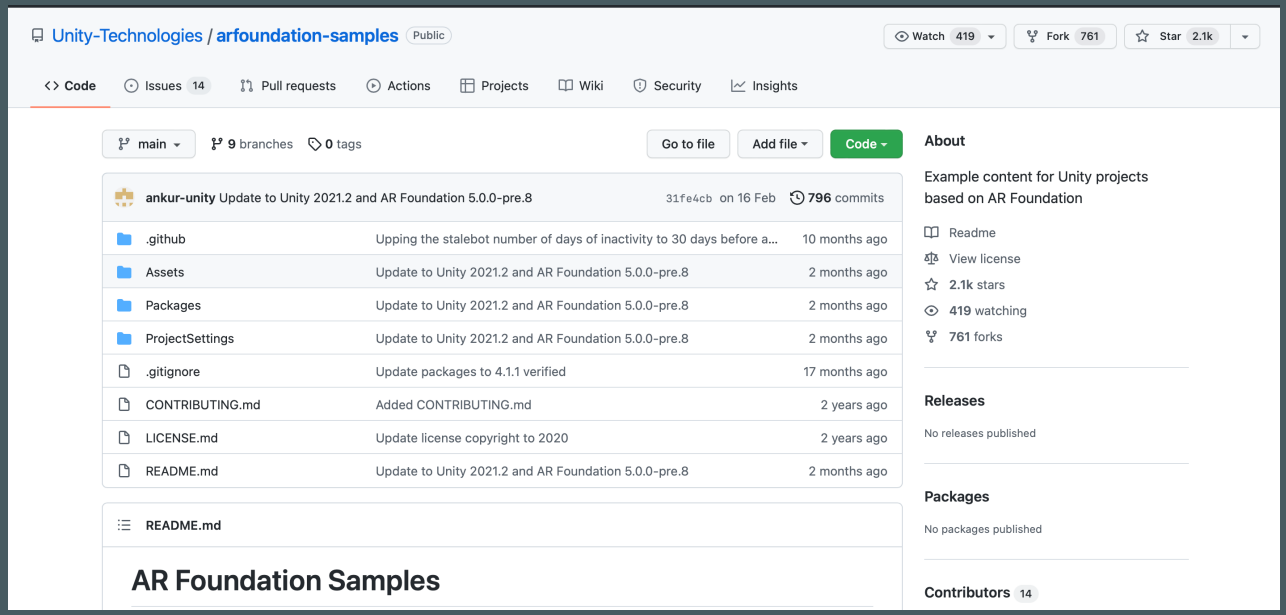
LOCATION BASED

Location based AR exploit location technologies (GPS data, compass sensors of mobile phones,…) to place augmented reality content in a specific location.

This type of AR is usually exploited for commercial purposes, cultural heritage (as interactive maps thet guide people through the city), and gaming (a famous example is Pokemon Go).

The ARFoundation GitHub repository collects all samples (with the corresponding documentation) of ARFoudation, and it includes Plane Detection, Image Tracking and Object tracking.

https://github.com/Unity-Technologies/arfoundation-samples



ARFOUNDATION XR SIMULATOR

AR foundation from latest 2022 allows to simulate AR projections on an emulated environment in your Unity Project using the Editor Run

Enable XR Simulation:

- Go to Edit > Project Settings to open the Project Settings window.
- In the Project Settings window, select XR Plug-in Management.
- Under Plug-in Providers, enable XR Simulation.

https://docs.unity3d.com/Packages/com.unity.xr.arfoundation@5.1/manual/xr-simulation/simulation.html