Extended Reality – Let's make it clear!

When we discuss about technologies enabling virtual activities, we tend to use (and, sometimes, misuse) terms such as Augmented and Virtual Reality. But what do they exactly mean? Are they synonyms? Are there other technologies that can complement them? Let us try to make it clear in this short article dedicated to Extended Reality and its main technologies: Virtual Reality, Augmented Reality, Augmented Virtuality and Mixed Reality.

What is Extended reality?

Among the several definitions of Extended Reality (XR) you can find, Sensorium defines it as an umbrella term for computer-generated environments that merge the physical and virtual worlds or create an entirely virtual experience for users. Human-machine interaction is a constituent part of XR.

The association *XR4Europe* provides the main structure of an XR system, that is built around the following steps:

- Application: the users perform a task by using an XR application.
- Interaction: the users interact with the scene and their interaction is captured with a range of input devices and sensors (audio, motion, etc.).
- Processing and rendering: The acquired data serve as input for the XR hardware, where further necessary processing in the rendering engine is performed. In the same report, an overview of the major algorithms and approaches is given. The rendering engine has also access to data from other sources (cloud servers, 3D, etc.).
- Feedback: The rendered scene is then fed back to the users to allow them to sense the scene.

The use of XR is not new, especially in gaming. To mention a worldwide example, everybody knows *Pokémon Go*, where players can see Pokémons in AR mode and catch them. However, before the Covid pandemic, the implementation of XR technologies was battling with some of the challenges to mainstream adoption, including price cutting and data protection. With the lockdowns implemented all over the world in 2020 and 2021, the need to meet, cooperate and develop projects at distance fostered the use of extended reality in different setting, including education, and overcame several of the issues referred above.

The different XR technologies

The XR spectrum ranges from one end where no digitization is involved to the other where find the metaverse. By blending XR technologies with Artificial Intelligence, Internet of Things and other future technologies, people will be more and more able to visit virtual environments and engage in

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experiences in an immersive and interactive way that can realistically match what they can access in the real world.

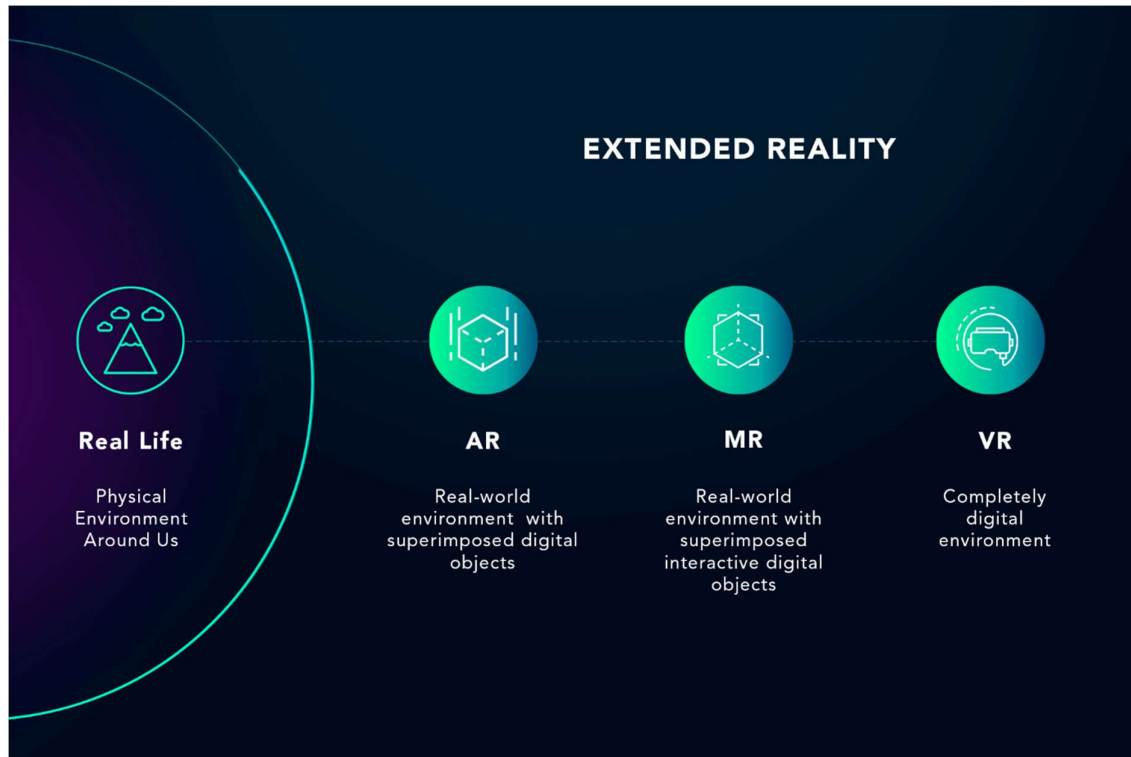Nowadays, we can rely on the XR technologies that are briefly described below[1].

Figure 1 - Extended Reality. Source: https://softengi.com/blog/the-future-of-community-media-is-extended-reality/

Virtual Reality (VR) is a 3D environment completely generated through computer technology where users can be fully immersed in simulated realities thanks to dedicated equipment. In several case, it can be a digital reproduction of the natural world.

VR enables the opportunity to building social connections in an artificial reality, making it optimal for education and training experiences. In addition, be a simulation of realities, VR allows users to practice by performing tasks for unlimited time and eliminating risks (ex: a medical student practicing before a surgery).

Unlike VR, **Augmented Reality (AR)** does not create a virtual reality, but rather it overlays images onto the real world, creating a physical environment that does not actually exists. With the use of specific

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[1] For reference in this section, please see the links at the end of the page.

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devices, the users can augment the real world visual with computer-generated elements such as graphics, audio and video.

A solid advantage of AR is that its costs are much lower than those of VR, making it accessible for anyone in possession of a smartphone. Every time we post a story on Instagram and we apply a filter, we are using AR. AR has become very popular also in e-commerce, where customers can enjoy the perception of a product despite the online experience, and thanks to its reduced costs, it has a great potential in education, in particular in learning by doing, supporting the gamification of the learning experience.

AR must not be confused with **Augmented Virtuality (AV)**. Less known that the other XR technologies, it integrates realistic inputs (video, audio, etc.) in a virtual environment.

Finally, **Mixed Reality (MR)** can be considered as an upgrade of AR, or the intersection of AR and VR. It challenges the concept of reality by creating new environments and visualizations where objects from both virtual world and real world coexist and interact with each other.

MR is less common than AR and VR; nevertheless, it will be common in the future, and people will be able to find themselves in two different physical environments at once, experiencing the best of both worlds. Some examples of possible MR experiences are job trainings and telepresence.

Find out more about Extended Reality!

What Is Extended Reality? Every Immersion Counts! (g2.com)

What Is Extended Reality? Everything You Need To Know - Roundtable Learning

What Is Extended Reality Technology? A Simple Explanation For Anyone (forbes.com)

What Is Extended Reality - XR Explained (sensoriumxr.com)

What is XR? - XR4EUROPE

xR, AR, VR, MR: What's the Difference in Reality? - Arm Blueprint

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