



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

IMMERSIVE TECHNOLOGIES

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WHAT IS IMMERSIVE TECHNOLOGY?

Immersive technology refers to any technology that enhances or creates a new reality by utilizing 360-degree space.

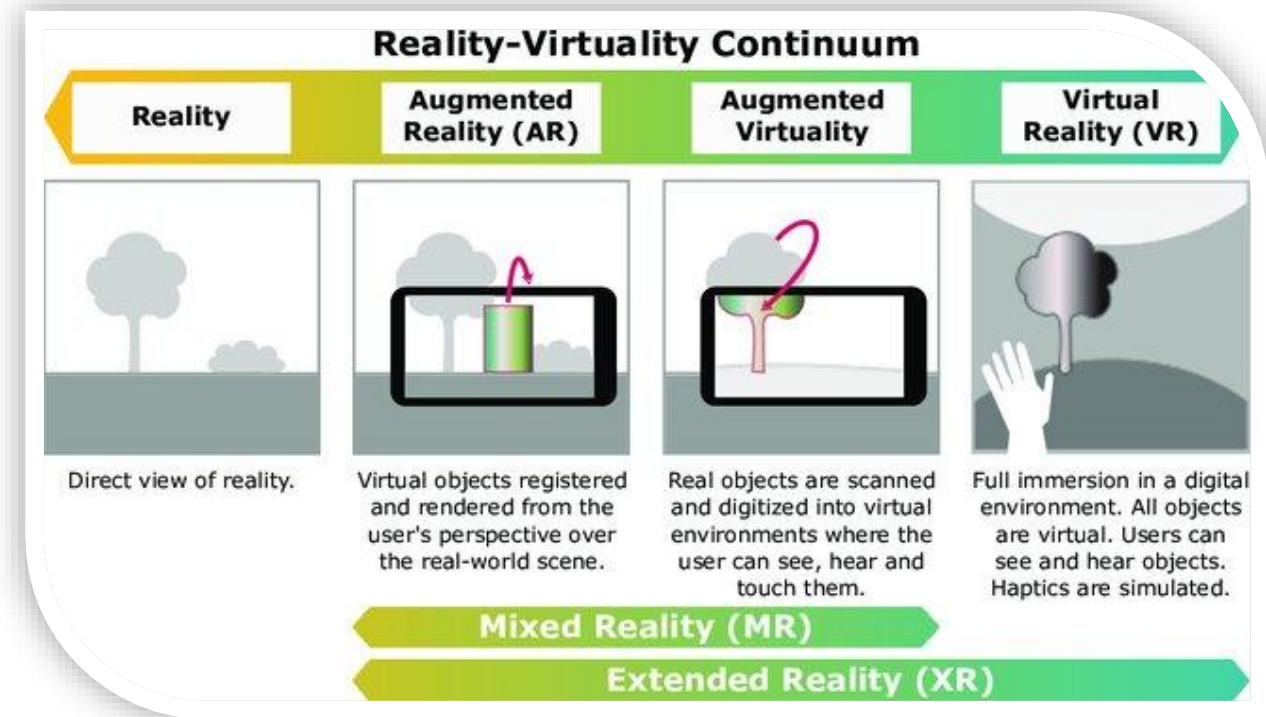
Immersive technology leverages 360-degree space, allowing users to look in any direction and experience content.

Some forms of immersive technology enhance reality by overlaying digital images onto the user's environment, while others create entirely new realities by isolating users from the physical world and immersing them in a fully digital environment.



EXTENDED REALITY: AN ENTIRE SPECTRUM OF REALITIES

- **XR** (Extended Reality) is an umbrella term encompassing various immersive technologies.
- At one end of the spectrum is **Physical Reality (PhiR)**, representing the real world. At the other end is **Virtual Reality (VR)**, where all visual imagery is computer-generated, and users are fully immersed in a digital environment
- Between these extremes lies **Mixed Reality (MR)**, where digital objects are overlaid onto the physical world, allowing users to visualize and interact with them.
- Within MR, we find **Augmented Reality (AR)**, which enhances the real world with digital elements, and **Augmented Virtuality (AV)**, where real-world elements are integrated into a predominantly virtual environment.



XR ON A SPECTRUM OF DEVICE

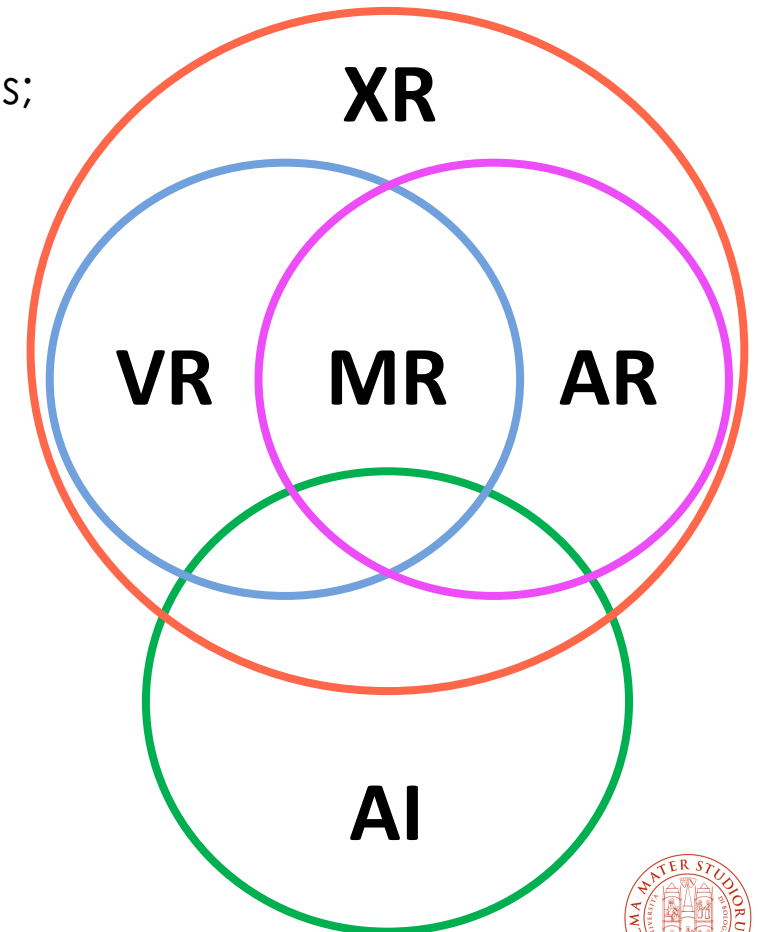
- **Head Mounted Displays: AR, MR, and VR** head mounted devices with several trade-off among performance and ergonomics;
- **Mobile XR:** smartphone used mostly for AR and VR experiences;



EXTENDED REALITY MEETS ARTIFICIAL INTELLIGENCE - EXTENDED INTELLIGENCE

Combining **AI** with **XR** enhances:

- **User interactions:** enabling more natural and responsive experiences;
- **Level of immersion:** creating realistic and adaptive environments;
- **Content awareness:** improving contextual understanding and personalization.



IMMERSIVE TECHNOLOGY TYPES

360

A panoramic experience allows users to look in all directions within a pre-recorded or computer-generated scene. It is typically viewed through VR headsets, web players, or mobile devices but lacks real-time interaction with the environment.

This format gives content creators more space to work with and allows viewers to **explore content by looking in any direction.**

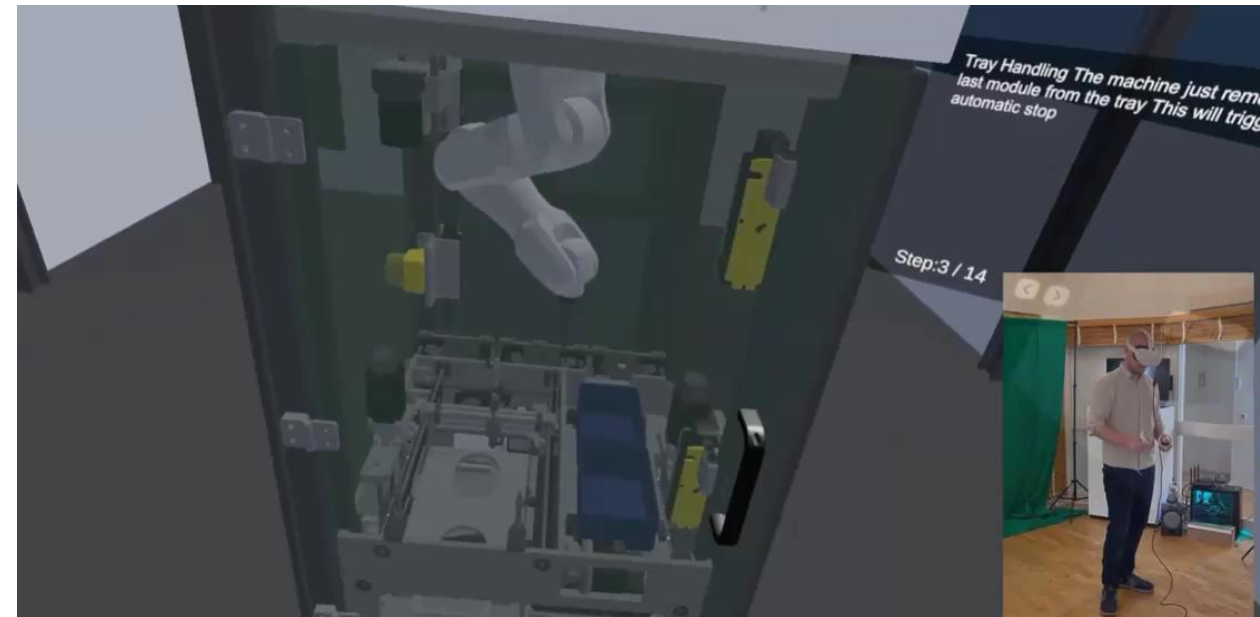


IMMERSIVE TECHNOLOGY TYPES

VR

A fully immersive digital environment that completely replaces the real world. Users wear VR headsets to enter a computer-generated space where they can move, interact, and engage with objects, often using controllers or hand tracking.

With **Virtual Reality (VR)**, users are completely isolated from the physical world and fully surrounded by digital content through a **head-mounted display (HMD)**. The content experienced within the headset becomes their "reality," allowing them to explore both real and imagined worlds as if they were truly there.



The world of Immersive Technology can be very complex because of all the terms involved.

360 VS 360 VR

360 VR content is essentially 360-degree media with a VR mode. In VR mode, users can view it through a headset like Cardboard or mobile VR devices.

Without VR mode, it can still be experienced on a mobile device without the need for HMD.



MOBILE VR

Mobile VR uses headsets that rely on smartphones for processing and display. Examples include the Samsung Gear VR, Google Daydream, and Google Cardboard.



IMMERSIVE TECHNOLOGY TYPES

TECHNOLOGY	DESCRIPTION	KEY FEATURES	APPLICATION
VR	Completely replaces your view with digital environment	Immersive experiences, interactive virtual worlds, complete sensory engagement	Gaming, training, simulation, virtual tours
AR	Overlays real-world surroundings with digital graphics and information	Enhances reality, real-time data integration, interactive virtual elements	Education, retail, navigation, industrial maintenance
MR	Combines elements of AR and VR, merging digital content with the physical world	Seamlessly blends virtual and real objects, interactive virtual-physical interactions	Design and prototyping, collaborative workspaces, visualization
XR	Encompasses AR, VR and MR, providing a spectrum of immersive experiences	Offers a comprehensive range of immersive technologies	Healthcare, entertainment, remote collaboration



TRUE VR

Due to the variety of terms associated with VR, the term **True VR** was coined to refer to "real" Virtual Reality. Why "real" or "true"? True VR uses headsets that **require powerful computers or consoles to function.**

Examples of True VR headsets include the HTC Vive, Oculus Rift, and PlayStation VR. These HMDs are so advanced that they also rely on external sensors (separate from the headset) to track a user's movements and their surroundings. The sensors then adjust the VR content based on what's present in the user's environment.

360 VR VS IN-VR

360 VR content is VR at its most basic. This means that users can use their device to explore content by looking in any direction but the content merely surrounds them. It doesn't take into consideration depth.

In-VR content, on the other hand, does take depth into consideration (it's **stereoscopic**). This means that when a person is viewing something "in-VR", they can **move closer to an Object or move further away and the content adjusts to that.** This is why In-VR experiences typically use CGI and 3D modeling.



IMMERSIVE TECHNOLOGY TYPES

AR

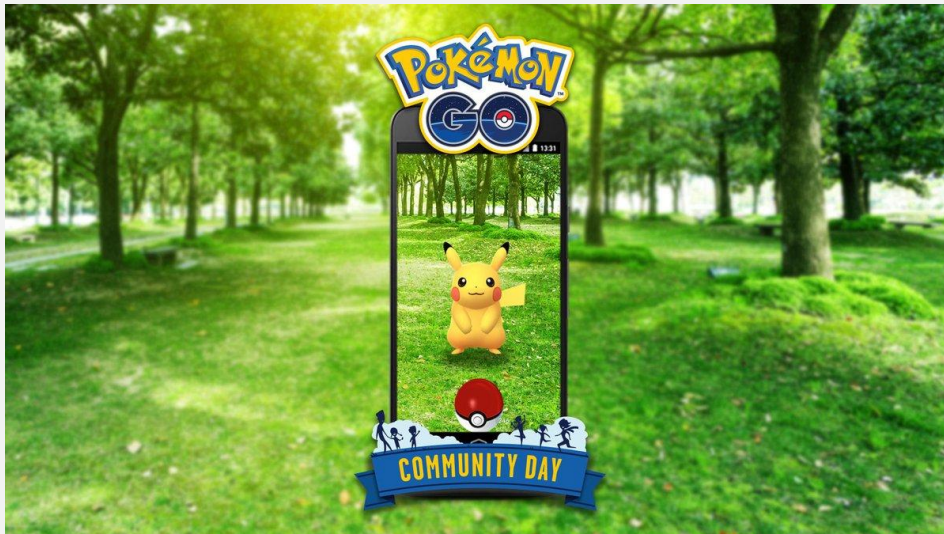
Augmented Reality is a different type of immersive technology where digital images are overlaid onto the real world. This means users engaging with AR are not completely isolated from their physical surroundings.

AR **extends** their reality by adding digital elements to the real world, enhancing their environment without fully immersing them in a virtual one.



A great example of **AR** is **Snapchat Filters**. With these filters, users can overlay digital images like a puppy, cat, movie star, etc., onto their face. You can even move your phone around to see effects like clouds or stars in your surroundings.

Another familiar example is **Pokémon Go**, where users can walk around their neighborhood with their mobile phones and find Pokémon overlaid onto the environment around them.



Even stores like **Ikea** have their own AR apps, where users can choose a product (such as a piece of furniture) and virtually place it in their homes. This allows them to test how the product looks with their existing furniture or get an idea of the size before making a purchase.

Essentially, it enables consumers to **"try out"** a product before buying it.



IMMERSIVE TECHNOLOGY TYPES

MR

Mixed Reality is a combination of AR and VR. Like VR, MR also uses an HMD (head-mounted display). However, unlike VR, MR does not completely isolate the user from the physical world, allowing them to interact with both the real and digital environments simultaneously.

Instead, the HMD in Mixed Reality is more like a pair of glasses that overlays digital images on top of your real-world environment, similar to how AR works, but with more interactive and immersive elements.



MR is sometimes referred to as AR 2.0.
Notable MR headsets currently available include the Microsoft HoloLens and the recently launched Magic Leap.



The question is: is MR "better" than the rest? Some say yes as MR takes Immersive Technology to the next level because it basically serves as the computer of the future.

On their website for the HoloLens, Microsoft describes it best by saying it is a "holographic computer." This takes "extending reality" to the next level and as Mixed Reality continues to evolve, we might just be looking into a future where desktops and laptops are no longer a thing and all of our computer work is done with the help of an MR headset.

WAYS TO USE IMMERSIVE TECHNOLOGY

Today, Immersive Technology has a wide range of applications and can be utilized by both brands and consumers in countless ways.



EXPLORATION OF PHYSICAL LOCATIONS

Immersive Technology offers travel brands a unique opportunity to tap into consumers' emotions in ways never possible before, while still showcasing the amenities and benefits of their destination.

It elevates the travel shopping experience, allowing consumers to virtually tour a destination before making a reservation. This makes it the perfect sales tool for travel advertisers.



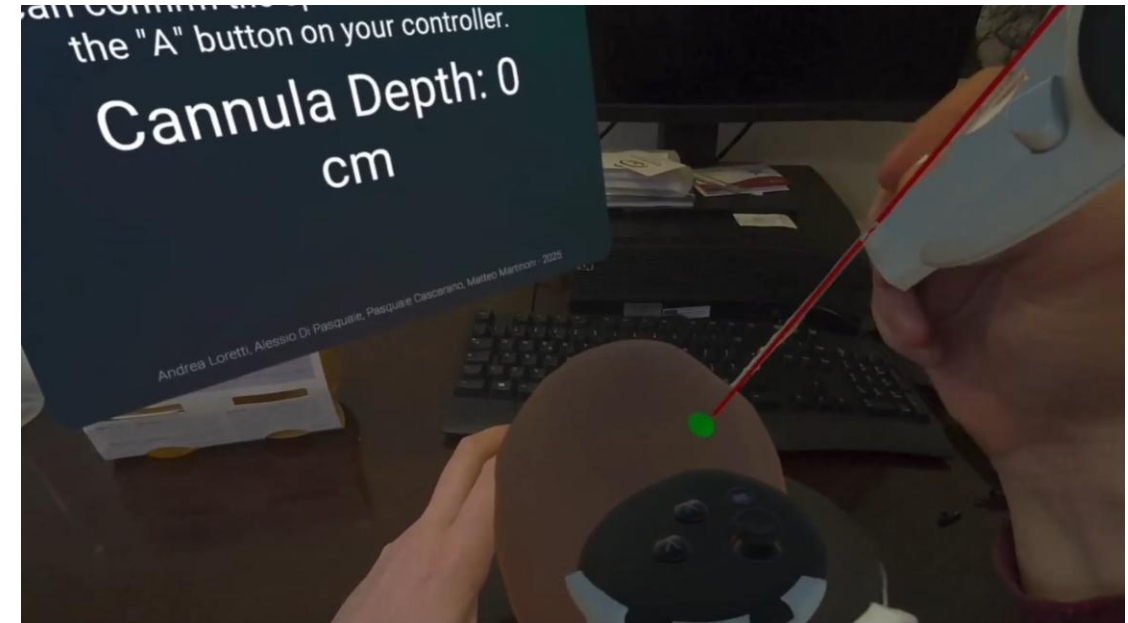
Another way travel brands can utilize Immersive Technology is by leveraging AR or MR to enhance the visitor experience while they are physically at a destination.

For example, tourists wearing immersive glasses could receive real-time information about historical events or fun facts related to specific locations, essentially acting as a virtual tour guide.

HEALTHCARE AND MEDICAL

The **Healthcare Sector** has always benefited from advancements in technology, and the arrival of **Immersive Technology** is no exception.

Doctors and healthcare providers have found that immersive experiences can help relieve a patient's pain by distracting them from the discomfort of medical procedures.



For example, students at a university in Canada developed a **VR game** designed to immerse cancer patients during chemotherapy, effectively distracting them from the pain.



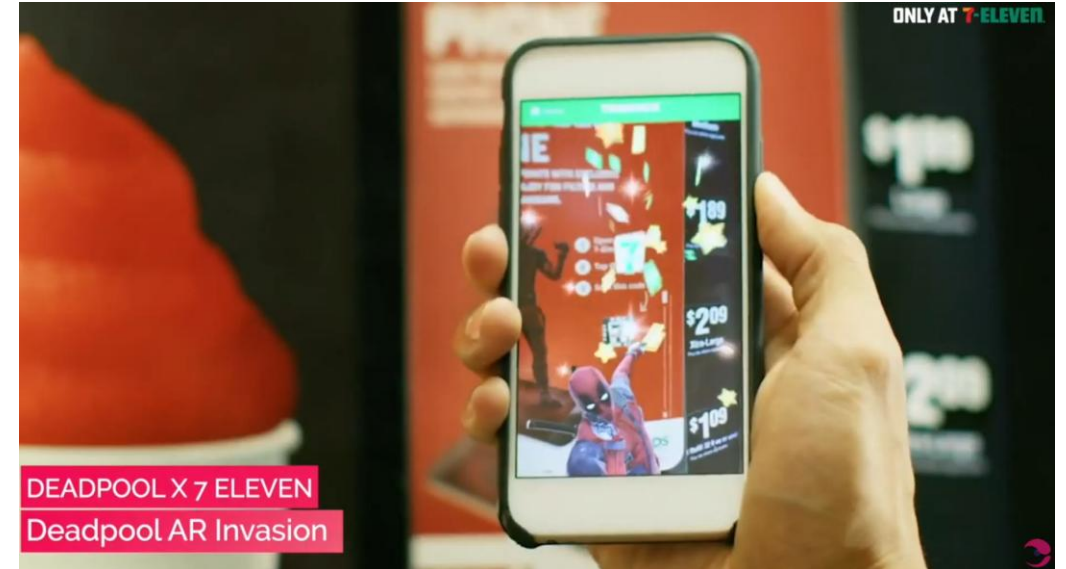
MARKETING AND ADVERTISING

It's been a while since a major technological shift in the ad industry, but the arrival of **Immersive Advertising** has changed that.

But what exactly is Immersive Advertising?

It is a completely new ad format that leverages Immersive Technology while still utilizing today's current advertising channels and ecosystems. This innovative ad technology takes advantage of a mobile phone's sensory inputs, such as its gyroscope, magnetometer, and accelerometer. These sensors allow the immersive ad to respond to device motion, making it highly effective for mobile advertising.

IMMERSIVE ADVERTISING



Because Immersive Ads are highly interactive, they can initiate and sustain greater ad engagement. They also enhance the ad experience for consumers, which is crucial given that the ad industry has been criticized for intrusive and irrelevant experiences.



Experiential marketing is one of the most common applications of Immersive Technology in business. Brands set up interactive booths at trade shows, county fairs, malls, or even sporting events, allowing people to try promotional **VR experiences**.

Some of these experiential marketing installations are so detailed that brands have created elaborate sets and included props to further elevate the immersive experience.



These promotional experiences can be based on an upcoming movie or show, or they can serve as promotional experiences for a product, offering an engaging way for consumers to interact with the brand.

MARKETING AND ADVERTISING

Immersive Ads work best on mobile devices and offer great flexibility, as they seamlessly function in both mobile web and in-app environments.

These ads allow consumers to explore a brand directly within the ad unit while browsing the internet, without being redirected to another page.

What's fantastic about Immersive Technology is that brands don't have to limit their reach to just Immersive Ads.

They can provide even larger and more immersive experiences through Immersive Web apps, fostering deeper engagement and interaction with consumers.

IMMERSIVE WEB APPS



Immersive Technology has redefined the term "**online shopping**".

Many stores are now using AR apps to **allow users to test out products** before purchasing.

Even in VR, brands, especially within the car industry, are utilizing virtual showrooms where consumers can explore cars, take virtual test drives, and even "**sit inside**" them.

The experience becomes even more immersive by letting users sit in actual car seats, making them feel as though they are truly inside a car.



In marketing & advertising, Immersive Technology allows brands to reach consumers in every stage of the consumer purchasing funnel.

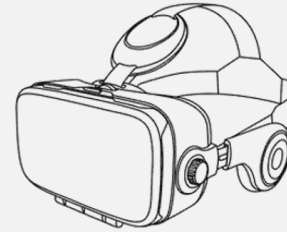
EXPERIENTIAL LEARNING



David Kolb's **Experiential Learning (EL)** cycle

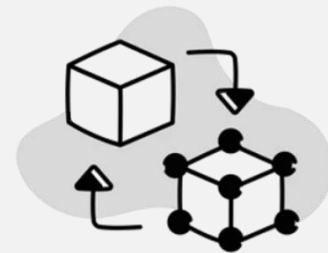


EL strongly relies on a **Learning-by-doing** paradigm



eXtended Reality (XR) enhances education by enabling hands-on learning through real-time interaction with virtual objects, supporting EL for skill development and knowledge transfer.

Digital Twins (DTs) virtual models of physical objects, allow learners to experiment in both virtual and physical spaces, offering dynamic, real-time guidance that improves learning retention and skill acquisition.



Sequential Instruction Learning: the Rubik's Cube



For solving the **Rubik's Cube** it's essential to know the **notation** that describes the face to be rotated and the rotation direction and, moreover, to practice with sequence of moves.

Examples of notation:

F : 90-degree clockwise rotation of the face facing you.

F': 90-degree counterclockwise rotation of the face facing you.

Research gap: while XR and DTs have been explored separately, to the best of our knowledge, no existing framework integrates **state-aware DTs** with **Mixed Reality (MR)** guidance for **sequential task learning**.

MR INTERFACES IN DETAIL

T-ANG (Textual-Annotation Guidance):

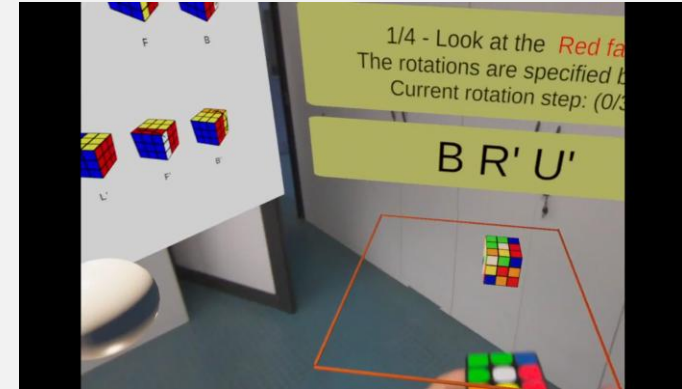
- Provides 2D textual annotations as guidance. Users perform the task on the physical Rubik's Cube, while the virtual cube counterpart mirrors their actions in real-time.

V-ANG (Visual-Annotation Guidance):

- Provides real-time visual cues like directional arrows and animated rotations to guide users. Users perform the task on the physical Rubik's Cube, while the virtual cube counterpart mirrors their actions in real-time.

I-ANG (Interactable-Annotation Guidance):

- Provides real-time visual cues like directional arrows and animated rotations to guide users. Users interact with the virtual Rubik's Cube first, followed by performing the same actions on the physical cube.



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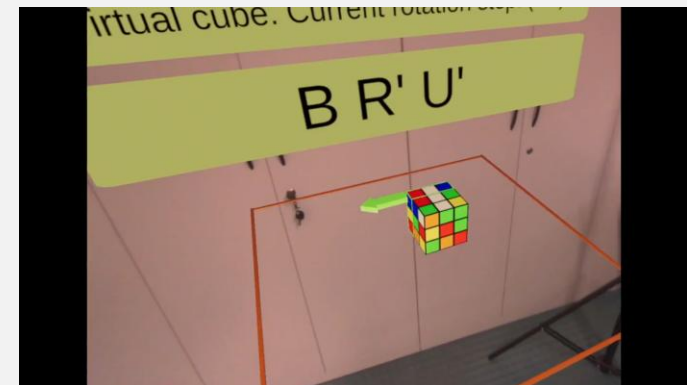
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ART

Many museums are finding that using Immersive Technologies allows visitors to engage with pieces and "feel a connection with the artist".

By revitalizing old works of art in the museum into virtual spaces, visitors no longer have to stand in line among large crowds in order to stare at a painting from 5 feet away. Now they can be immersed within a classic painter's studio or find themselves placed in the landscape of the painting.



With the help of AR, brands like Remy Martin are using virtual art and immersive technologies to create a stronger brand image. Therefore, allowing audiences to feel a deeper emotional connection to the brand and artworks.

MARKETING AND ADVERTISING

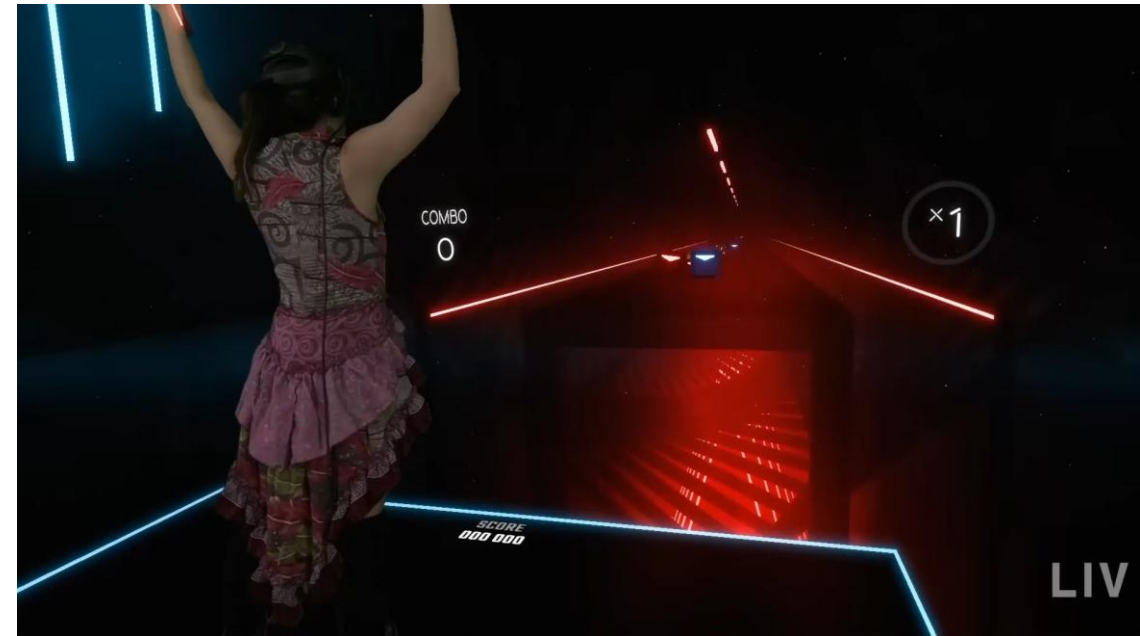
The **gaming industry** has been one of the first to adopt Immersive Technology.

Because of this, gaming and Immersive Technology have become almost synonymous, creating a barrier for other brands to leverage this technology.

Fortunately, this misconception has been slowly debunked as people begin to realize the wide range of benefits Immersive Technology offers.

Despite this, the gaming industry continues to thrive with immersive experiences.

GAMING



What is the Metaverse?

The term "metaverse" refers to a collective virtual shared space that is created by the convergence of physical and virtual reality;



In simpler terms, it's a digital universe where people can interact with each other and digital environments in real-time;



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