FROM AUGMENTED TO EXTENDED: A STUDY OF AR, VR, MR AND XR THE REALITIES

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ABSTRECT

This is an era of modernization and technology VR, AR, MR and XR are important terms in immersive technology that describe different kinds of computer-generated experiences, with varying levels of immersion. However, whereas VR, AR and MR describe as a specific technologies and XR is an umbrella term that refers to all these technologies, and the diverse kinds of computer-generated experiences which they build. Immersive technology is a term used to describe technologies that create a sense of immersion or presence, which is the feeling of being fully present in a digital or virtual environment. Immersive technology can include VR, AR, and MR, as well as other technologies that provide an interactive or enhanced experience of reality. Immersive technology is already being used in a wide range of applications, including gaming, healthcare sector, defense sector, education sector and industrial training sector and so on. So, our aim is to provide comprehensive analysis of AR, MR, VR and XR through this research paper

Keywords: - Types of (AR, MR, VR and XR), benefits of (AR, MR, VR and XR), advantages and disadvantages of (AR, MR, VR and XR), use cases of(AR, MR, VR and XR) and comprehensive analysis of AR, MR, VR and XR.

1. INTRODUCTION

Throughout history, human beings have always looked for visual ways to express their imagination, creativity and desire to go beyond the physical world. The goal is to represent scenes, moments and experiences that allow others to experience them with all of their senses, offering the opportunity to realise dreams, ambitions and visions – or even to live in imaginary worlds.

With the support of technology, we can have more real and concrete experiences with total immersion for our senses. This is possible through the virtualization and augmentation of our realities, or by combining both in a mixed environment. In this research paper we're going to discuss extended reality (XR), which covers virtual reality (VR), augmented reality (AR) and mixed reality (MR).

2. OVERVIEW

2.1 AUGMENTED REALITY

What is Augmented Reality?

This is a world where the real and virtual environments are combined to give you a computer-generated environment. It is where the digital objects are laid in the real environment.

In this reality, the different visual, auditory, and sensory elements are delivered to the end users via digital technology. The users can connect with the elements in real-time, and it helps enhance the 3D abilities of the objects.

The digital blocks are blended into the perceived real environment to enable better information flow, data access, and insight building.

Types of AR- There are four types of Augmented Reality accessible to the users

Location-based AR	The location and sensors within the smart device are used to blend the 3D digital objects into the real world at the location where the user is present.
Projection-based AR	This is used for a specific region where you can lay the digital elements in the real world. You will need to place the user around the area where a projector and tracking camera are placed to blend the environments.
Overlay AR	The original image is replaced with an updated and informative 3D virtual image that can help offer the requisite information to the user.
Contour AR	It is used for specific situations where an outline of the system guides the user and helps them overcome problems.

Benefits of AR

Improves Customer Experiences	You can create unique and immersive experiences without needing external hardware. For example, by pointing at an object in the museum, the user can get complete information, which improves their viewing experience.
Offers Better Support	You won't need to go through the manuals or documents to gain information. The AR support can help you get information at the touch of your finger, and improve your comprehension ability. It reduces cognitive overload.
Better Engagement	When you incorporate AR into your business product, people will engage more and stay longer. They will be in the museum for a long while if you can implement AR in the museum app.

Advantages of augmented reality (AR):

• Increase Sales: Apps such as lens-kart are AR based app which enables the customer to check if the product justifies his/her need or not. Hence AR helps in increasing sales by increased customer interaction. A recent start-up called "StyledotMe" got the momentum in jewellery industry.
• Enriches Content: Unlike VR, AR is much more interactive with the real world which enriches the experience and content both at the same time
• It can be used for training and skill development applications in various industries such as military, loco-pilot training, nuclear plant trainings etc. As it is having human interaction with virtual and real world as well.

Limitations of Augmented reality

• In some specific cases, it becomes too ambiguous to implement. As the number of layers increases, sometimes it looks not mixing of not fulfilling the exact environment needs and loses its user friendly charm.
• Content may obscure or narrow a user's interests or tastes.
• Privacy control is a big challenge with AR.

Use Cases of Augmented Reality

There are several applications for AR, including:
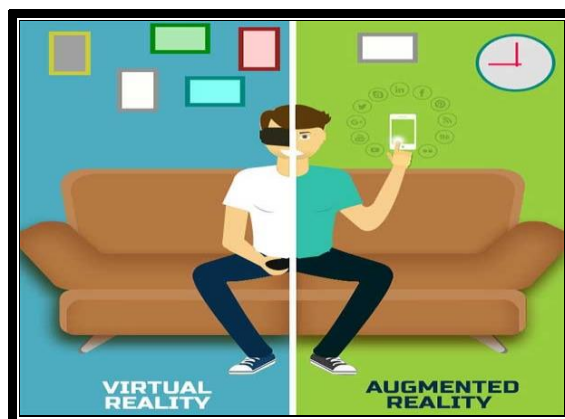
Retail and eCommerce	• Retail and e-commerce firms can employ augmented reality to improve the buying experience. Customers can use augmented reality to digitally put on makeup or envision how a piece of furniture will look in their home.
Gaming	• Games that incorporate the real environment, like Pokemon Go, can be made using augmented reality.
Education and training	AR can be utilised to develop interactive learning environments, such as simulations or virtual field trips. Additionally, it can be used to teach people for a variety of occupations, including the military, aviation, and healthcare.
Marketing and advertising	Businesses can utilize augmented reality to develop interactive marketing campaigns or adverts

Well, there is a solution for every problem available in the world. And to these cons of augmented reality, that is MR.

2.2 VIRTUAL REALITY

What is Virtual Reality?

Virtual Reality is a computer-simulated environment in which the user is present within the virtual environment. The user needs to use gadgets such as Oculus Rift, Samsung Gear, and others to create the simulated environment. The technology uses head and body tracking to take the user from the real world into the immersive virtual world. There are several places where VR is used to help users better understand the world. For instance, you can use VR to get an oceanic experience and learn more about underwater elements. In some cases, along with vision, the computer-generated program also simulates the touch taking the immersive environment to the next level.

Types of VR

You are almost part of this virtual reality, which is segmented into three categories

Non-immersive	In this case, while the user is in the simulated environment, they are aware of their reality. They aren't completely submerged in the virtual environment. For example, if you are playing a video game using the VR tool and control units, you will be part of the non-immersive reality
Semi-immersive	In this, the user is located in a partially virtual environment. While the user believes they are part of the virtual world, they aren't fully disconnected from the real world. For example, when you are learning a new theory or are part of a classroom, you are in a sub-immersive VR environment.
Fully immersive	This is when the lines between real and virtual are completely blurred. The user has no control over the real world and is fully part of the virtual world. It offers a complete 3D image of the world and provides exciting experiences. When we talk about oceanic experiences, we are talking about a fully immersive environment

Benefits of VR

There are several benefits of incorporating VR into your business solutions. It can enhance experiences, engage people and convert them into loyal customers.

Almost Real Experience	Whether you are shopping or playing, you are in the environment. This can take the business to the next level. The user will feel like they are with the store owner, bank manager, or company representative in person. This will help them learn more about the product, gain first-hand information and improve decision-making.
Simulated Environment	This will improve the learning abilities of the user. For example, instead of learning how to drive a car directly on the road, you can learn it in a simulated environment. It is similar to the actual road but not the road.
Competitive Edge	When you incorporate VR into your business, you offer an edge. When you move online, there is a limitation to our engagement. However, with VR, you can overcome this and be present for your users.
Cost-efficient	Imagine prototyping a product in the real world and then building it. You will know the exact flaws and issues immediately. As a result, it will save you time and money otherwise spent on rectifying the developed product.

Advantages of VR:

➤ Virtual reality provides the diverse types of data available in instant forms.
➤ It provides images from many different points of views.
➤ It is able to demonstrate the non-visible data to the user like in case of geochemistry.
➤ Allows a person to 'visit' the places normally inaccessible to individuals.
➤ Provides an experience which can be repeated and revised.

Limitations of Virtual Reality

➤ It only creates imaginary world or an artificial world, but can't deal with the real world objects.
Though having capabilities of being used for educational purposes, it devalues the importance of human connections and synergy in education.
➤ Virtual Reality is rigid and lacks flexibility

Use Cases of Virtual Reality

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Gaming	Because VR enables players to fully immerse themselves in a digital environment and interact with it in a more natural way, it is frequently utilized for gaming.
Immersive Learning	VR can be used to create immersive learning experiences, including simulations or virtual field excursions, for education and training. Additionally, it can be used to teach people for a variety of occupations, including the military, aviation, and healthcare.
Therapy	VR is being investigated as a therapeutic method for a number of mental health issues; including anxiety, phobias, and post-traumatic stress disorder (PTSD). It can also be utilized to assist in the rehabilitation of those who have physical impairments or injuries.
Entertainment	VR can be used to make immersive entertainment experiences, such as virtual concerts or functions.

We all know that necessity is the mother of invention. That's why for overcoming all these cons of Virtual reality, techno experts have introduced an update called Augmented Reality.

2.3 MIXED REALITY

What is Mixed Reality?

It is a mixed reality when the real and virtual worlds blend to produce new and highly immersive environments. It is where the digital and physical objects interact with each other in real-time to improve engagement and enhance experiences.

In short, it is when AR and VR combine to produce a new type of reality. This is a more advanced system where all technologies, including cloud computing, come together to create immersive realities.
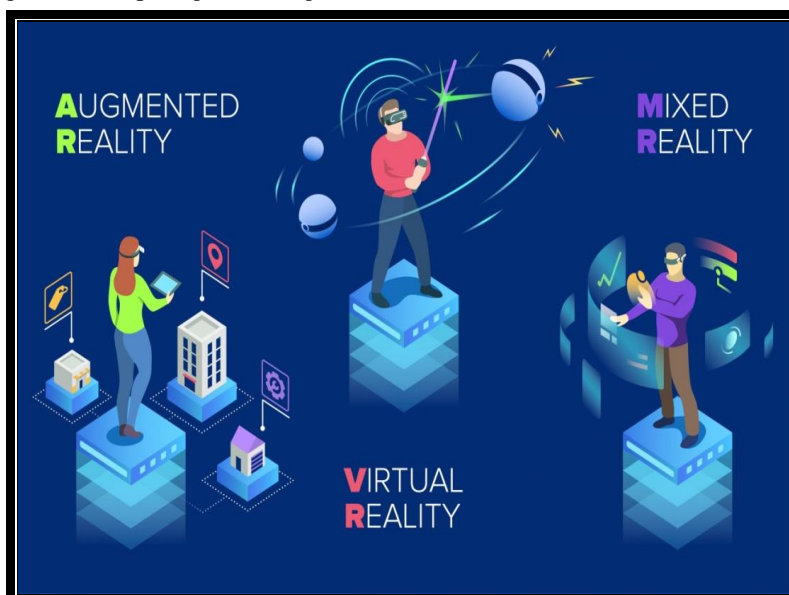
Types of MR

Blended Environment	You recognize and recreate the original environment and create a digital layer along the space. Only a few elements from the real world are translated into digital formats.
Enhanced Environment	As the name suggests, this is more like an enhanced overlay. The user will not move away from the current environment, and you will place the virtual world in the existing environment.
Immersive Environment	In this case, the virtual world controls the existing environment completely. The idea is to give the user a complete simulation of the altered reality.

Benefits of MR

No Technology Required	Unlike VR, you don't need expensive technology to use MR. At the same time, you don't create a regular and overlaid environment without the tech. It combines AR and VR without tech intervention
Personalized Experience	You can create a more customized and nurturing experience for the target audience based on their requirements.
Engaging Interactions	It is almost akin to visiting the real world for the store or site. This leads to better engagement and enhances sales for the business.

Major advantages of mixed reality:

• What make MR stand out are its highly interactive aspect, and the realistic rendering of the projection it adds to our surroundings. Instead of depending solely on remote controllers or phone screens, we can interact with the immersive content using natural body and finger gestures.
• Mixed reality eliminates the disadvantages of both VR and AR.

Disadvantages of Mixed reality:

• Equipment cost for MR is too expensive
• Large file sizes and low resolution content problems
• It may affect the social life adversely just like a bad addiction
• For using Mixed reality in business, one needs a sound technical team as well otherwise issues may not be addressed at a time

Use Case of Mixed Reality:

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| • Mixed reality can take interactive product content management (IPCM) to some other level. |
| • Mixed reality allows a global workforce of remote teams to work together and tackle an organization's business challenges. |
| • Mixed reality helps manufacturing sector a lot by creating mock-ups of processes. |
| • In health sector, MR can do better with the help of smart glasses. Surgeries have become too much easy and flexible. |
| • MR will make us move from e-learning to simulation based learning, which ultimately will transform the way of modern education. |

2.4 EXTENDED REALITY

What is Extended Reality?

Extended reality defines any technology (fully immersive or sub-immersive) that can alter reality and blur the lines between virtual and reality. It is used to modernize applications, enhance experiences and improve communication.

AR, VR, MR, and all the other realities yet to be defined/discovered are part of the extended reality. This is not a complete technology; there is scope for evolution. When new realities are added, the world of XR will extend further.

You should hire a VR app development company to incorporate this technology into your business solution to further experience.
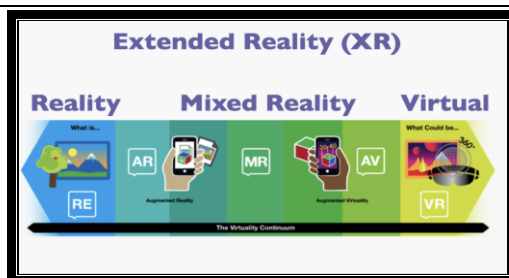
Types of XR

We cannot call AR, VR, and other realities types of XR. However, these are forms of reality that are part of XR.

Augmented Reality	as the name suggests, the virtual environment is augmented as part of the real environment. These two overlap to create this format.
Virtual Reality	The lines differentiating virtual and real are completely blurred when you are in a fully-immersive environment.
Mixed Reality	The two worlds co-exist in this case. The virtual and real worlds are not completely different or overlapping; they live harmoniously.

Benefits of XR

Improves Engagement	When you implement XR in your products, you tend to keep the user hooked to the application for a long while. It can help increase the time spent on the product, which eventually translates to better profits.
Reduced Overhead Expenses	Whether you train a user or showcase the product, you won't need to spend on the infrastructure. With 3D immersive viewing, you can lower the spending on unnecessary elements.
Seamless Accessibility	Whether it is data or information, you can seamlessly access elements in the virtual environment with this reality. It helps your business perform well in remote environments.

The Advantages of XR Reality

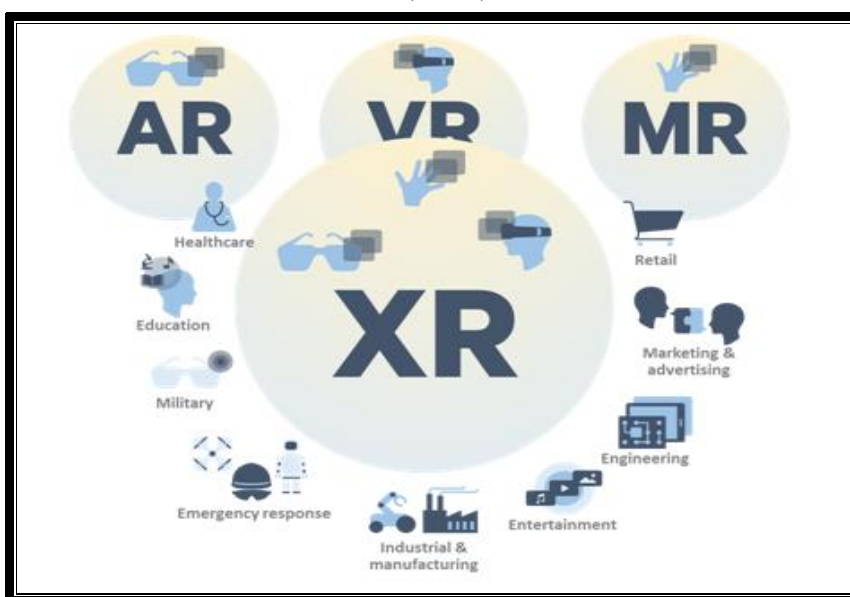| |
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| • The provision of an unusual experience. A dive into a radically different reality allows companies to provide their users with the possibility of visiting places of interest or experiment something without leaving the house. |
| • Efficient information uptake. XR provides its users with a more realistic view of their subject matter, which allows them to be trained in a more effective manner. |
| Safe training. Those who need to practice in high-risk conditions, such as military or chemists, can train safely from conventional classrooms. |
| • Seamless data access. XR removes distance barriers, which is why humans can smoothly access remote data. |

The Disadvantages of XR Reality

In spite of the above-mentioned tempting opportunities of XR, it has some drawbacks:

• Compromised privacy. As with any other technology, XR is prone to cyber-attacks, in particular, to data hacks. It can result in serious damage, since XR-related solutions have access to tons of private information.
• Reduced social engagement. Extended reality provides numerous ways of amusement, which may completely engross human minds and may threaten to eliminate the necessity for communication. Although XR allows people to communicate, it enables it in a different way that lacks contact and personal interaction.
• Physical harm. Long-term application of VR devices and augmented reality glasses may cause eye disorders, nausea, faintness and headache.
• The high cost of implementation. The development and implementation of XR solutions and devices that support this technology are extremely expensive, which is why it may come at a high cost.

USE CASE of Extended Reality

• This will help doctors and people in the medical field get a 3D real view of the scans and understand the health issues better. It will help them diagnose the issues better.
• From design to prototyping, XR can help identify the design flaws and issue corrections in the prototyping stage.
• Retailers can create more immersive experiences and make the user feel like they are shopping in the store with XR. This will improve engagement and convenience.

3. COMPREHENSIVE ANALYSIS OF AR, MR, VR AND XR

Comparison Point	Augmented Reality	Virtual Reality	Mixed Reality	Extended Reality
Definition	Overlays digital objects in the real world	Places the user in a different virtual environment using computer-generated simulation	The combination of AR and VR, where the virtual environment is blended with the real environment.	It alters reality by adding digital elements to the real world. It is the umbrella that comprises VR, AR, and MR, along with other realities.
User Experience	You are in control of your environment	It extends a fully immersive experience	It allows you immersive experiences while giving you control of the real world	You can choose the experience depending on the application
Gadgets Needed	You need a smartphone	You need a VR headset	Hololens is required to embrace mixed reality.	Depending on the application, you can choose the gear. You can even use it.
Real-time Interactions	Yes	Not always	Yes	Not always
Use Cases	In marketing, it can help with location-based deals and discounts	It Helps you check how a particular dress would look on your body by being present in the virtual environment	You can get a complete 3D view of the patient's body or their scans with the hololens	Allows users to step into the store virtual and look around for the products

4. CONCLUSION

Thus, Augmented Reality and Mixed Reality are not interchangeable terms. The general distinction is: all MR is AR, but not all AR is MR. AR is a composite. MR is interactive.

Hence, VR, AR, MR, and XR are immersive technologies that aim to enhance the user experience. They differ in the level of presence, interaction, and simulation of virtual elements in the real world. While they share some common features and requirements, each has its own unique purpose and underlying technology.

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