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WHAT IS EXTENDED REALITY?

Without getting too bogged down in technical details – after all, this isn't a tech book – it's worth spending some time exploring the different technologies that sit under the XR umbrella. Therefore, this chapter gives you a basic grounding in the XR spectrum, including how the various XR technologies work, and what they can do.

A Word About XR Definitions

My goal in this book is to showcase the world of XR, and how XR technologies are changing our lives and our businesses. What I'm not trying to do is rigidly define each type of XR and draw distinct boundaries between the different technologies.

Remember, XR is a spectrum

This is important because XR is still very much a developing field, and it's not always clear where one XR technology ends and another begins. For example, experts can get far too caught up in whether something should be classified as augmented reality (AR) or mixed reality (MR). To me, that just isn't useful, nor is it particularly relevant. At least, not from a business perspective. I imagine you, the

reader, want to grasp the potential of XR and understand how it can improve certain elements of your business – and you don't much care where the boundary between AR and MR lies. I make the assumption that you're interested in uses, results and outcomes, as opposed to academic debate.

It's also worth noting that, just as the boundary between the real world and the digital world is becoming more blurred, so too are the boundaries between the different XR technologies. As XR advances, the various technologies that sit under the XR umbrella will become more and more linked, and users will be able to seamlessly move from one technology to another.

So, in the future you may use AR to bring information to life in the real world, then switch to VR to deepen that experience. Say, for example, you're taking a (real-life) holiday on a Greek island. Using AR, you could point your phone at some impressive marble columns and the information onscreen will tell you those columns once formed the entrance to a site where mysterious ancient rituals were performed. Flip on some VR goggles and you could then immediately step into this world and move among the people of Ancient Greece – no toga required! In the final chapter of this book, I talk more about the future of XR, but one of the key developments I expect to see is a more seamless blending of XR technologies.

XR technology is constantly evolving

What's more, this technology will evolve in ways we can't yet imagine. Remember the fairly brief but intense craze for all things 3D a few years back? 3D movies like *Avatar* and *Gravity* blurred the boundaries between the normal moviegoing experience and something altogether more immersive. Then people started buying 3D TVs for their own home, expecting the home viewing experience to move in a

similarly immersive direction. But the concept didn't really take off as expected, and manufacturers quietly shelved their production of 3D TVs. Now, holographic displays are beginning to emerge that revive this notion of immersive home viewing and take it in a new direction. Holographic displays are being developed that can project 3D holograms from the screen, without the viewer having to don clunky glasses (a major downside of the previous 3D wave). This shows us how technology is constantly moving forward, toward a future in which everything in our lives becomes more immersive, more digital – but the specifics of how that technology works, what it's capable of, and even what it's called will change. The same sort of thing may happen within the XR spectrum; for example, it's possible that digital displays will be able to project virtual content onto the real world, without us needing special headsets or apps.

All this means precise definitions will likely become less useful as XR evolves and the boundaries between different technologies become more blurred. That's why we shouldn't get too bogged down in definitions of and differences between concepts like AR, VR and MR. What matters is how we can apply the technology in the real world.

That said, in the interest of breaking up the rest of this chapter into manageable chunks, I'll now attempt to create some loose distinctions between AR, VR and MR. Let's start with AR.

Augmented Reality: The Most Accessible of the XR Technologies

For me, AR has the biggest potential in the short term, because it doesn't have to involve a special kit like goggles or headsets. In many cases, a simple smartphone, laptop or tablet, something with a camera and digitally enabled screen, will do. (Saying that, there are specially designed AR glasses, like Google glass, which will crop up in examples throughout this book.)

What is AR?

Whether it's using specially designed glasses or a simple smartphone, AR involves the projection of digital elements – such as information, graphics, animation or images – onto the real world, so that the digital content being superimposed looks like it is part of the physical world. I've already mentioned Pokémon GO as one example of this technology in action; those Snapchat filters that overlay cute animal ears over your own are another basic example. There's also Google's SkyMap app, which tells you about the constellations as you point your smartphone camera at the sky. Or how about the IKEA Place app, which lets you digitally place IKEA's furniture in your room, so you can check out whether it fits (and how it looks in that space) before you buy.

Because the digital element is superimposed onto reality, the user is still very much in touch with the real world in front of them (unlike, say, a VR experience, where the world created around the user is entirely digital). Yet, thanks to the AR projection, the real world has become enhanced – more informative, more entertaining, or more interactive, for instance.

Head-up displays, which project information onto a windshield, are another interesting example of AR in action. The technology was initially developed for fighter jets, so that the pilot could keep looking ahead while accessing relevant info. Now, cars and trucks are beginning to use head-up displays as a safety feature, in order to help reduce driver distraction. These displays project real-time information such as GPS maps or vehicle information either directly onto the windshield itself (in cases where the technology is included in the vehicle as standard) or onto a film that's been added to the windshield (in cases where the technology has been retrofitted). Just as in those fighter jets, the idea is to keep the driver's eyes front and center, giving them the info they need at a glance, without hindering their view of the road ahead.

How does AR work?

AR needs a live camera feed in order to add digital content on top of the real-world elements. The camera feed is what allows the AR system to understand the physical world, so that it can add the right digital content in the right place (a puppy nose over your real nose, for instance). This is all possible thanks to computer vision, also known as machine vision – essentially, a subset of artificial intelligence (AI) that helps machines "see" the world around them and respond accordingly.

Once it has the live, real-time camera feed (be it of a building, the street, your friend's face, or whatever), the AR system then renders digital content on top of the relevant real-life content, making sure it overlaps correctly and is located in the right place. This is updated in real time as the camera feed changes – say, as you're walking down the street holding up your phone.

Stepping into a More Immersive Environment with Virtual Reality

VR offers a far more immersive experience than AR, but, in order to do that, it requires more technology and infrastructure (at the very least, a VR headset). The good news is that this kit is getting lighter, better and less cumbersome. We no longer need heavy headsets with lots of cables that connect to a computer. Now, we can have a lightweight, standalone headset or head-mounted display that doesn't need to be plugged into a main computer. The technology is getting cheaper, too – for just a few dollars, you can get a basic Google Cardboard VR viewer that, along with an accompanying app, transforms your smartphone into a VR device. Of course, for the best VR experience, you currently still need fairly elaborate gear, such as headsets, controllers and speakers. But there's no doubt that the technology is generally shrinking, and getting cheaper and simpler – all of which helps to make VR rapidly more accessible.

What is VR?

While AR is rooted in the real world, VR creates a 3D, 360-degree experience of an artificial, computer-simulated ecosystem. Strap on a VR headset and you're completely transported into this artificial world – whether it's being underwater and exploring a coral reef, walking on the Moon, visiting Ancient Egypt, or whatever. Meanwhile, the real world around you is totally blocked out. Such VR headsets include the Oculus Rift, HTC Vive, GearVR and the previously mentioned Google Cardboard (which is, you guessed it, made of cardboard). These vary in sophistication in terms of how slick and seamless the experience is.

The world of gaming was an early adopter of VR technology, and is perhaps still the first thing people think of when it comes to VR experiences. But, as you'll see in this book, many other industries are now beginning to harness the possibilities of creating fully immersive experiences for customers and colleagues alike.

One recent VR example is the Spatial app. This is a virtual meeting space that lets you meet up with colleagues or friends, whether or not you have a VR headset. If you don't have a headset, you can simply join using a web browser on your phone, tablet or computer. This is an important leap forward because it means people without a special VR kit can still join in the experience. Spatial is also free and open to everyone (a paid-for, enterprise version with enhanced features is also available).

With Spatial, you can meet with others in a beautiful virtual meeting space, and, thanks to virtual avatars – you can take a picture of your face to create your own personalized digital avatar – it feels like you're really in the room together. What's more, your avatar can move around the room and gesticulate as you talk. As you can probably imagine, this is a far cry from the average Zoom or Skype experience,

where you're just looking at a wall of 2D faces. Spatial says it has experienced a huge surge in demand – approximately a 1,000 percent increase – in the wake of COVID-19.[i] I'm not surprised. Tools like this will revolutionize remote working.

(As an aside, the use of personalized avatars is particularly interesting to me, and something that we're likely to see a lot more of across various XR technologies. In the future, we could all have different avatars for different digital settings. For example, you could have a smartly dressed avatar for your virtual work meetings. You could have a completely different avatar [animal, human, whatever] for gaming and hanging out with friends online. And you could also have a very realistic avatar, one that accurately reflects your real-life size and shape, which you could use to virtually try on clothes before you buy.)

How does VR work? The super-quick version

Vision is key to creating an immersive 3D environment, which is why special VR headsets are needed. Therefore, a VR headset is, in essence, a small screen (or it could be two screens, one for each eye). Sound effects are also key to creating a consistent, engaging experience, which is where speakers and headphones come into play. Then you have head- and eye-tracking technology to track the user's movements. This may use laser points and infrared LED lights within a headset, or sensors within a mobile phone – or, in very sophisticated systems, special cameras and sensors can be installed in the room to monitor movement.

Merging the Real and Digital Worlds with Mixed (Hybrid) Reality

I've already mentioned how the line between reality and the digital world is becoming increasingly blurred. MR – sometimes referred to

as hybrid reality – plays on this notion and takes it to a new level by combining elements from VR and AR. MR is by far the least mature of the three XR technologies featured in this book. However, as we'll discover, companies are already beginning to use MR to solve their business challenges, support new initiatives and improve business processes.

What is MR?

There are lots of confusing definitions surrounding MR and, in particular, some debate over what constitutes MR versus AR. For me, the distinction is this: MR blends components of the digital world with the real world in real time, to the extent that you can interact with the digital elements as if they were real objects. This creates a more immersive experience than straightforward AR. For example, instead of seeing a projection of a digital object on top of the real world (as you would in AR), MR would let you move that digital object with your hands, turn it around to inspect it from different angles, make it bigger or smaller, and so on. With MR, you don't fully block out the real world, as you would in a VR experience. Rather, you're able to experience a virtual environment and the real world at the same time.

One example of MR in action comes from British company BAE Systems, which uses MR to enhance its production of electric bus batteries. Using Microsoft's HoloLens MR headset, BAE workers can project 3D images and instructions onto their workspace, and follow the digital instructions to construct the complex batteries. According to BAE, the use of MR has reduced the time it takes to build batteries by up to 40 percent.[ii]

How does MR work?

MR requires a dedicated MR headset and a lot more processing power than VR or AR. It may also require the use of controllers and motion

tracking technology, such as gloves that track your hand movements so you can interact with digital objects.

At the time of writing, the Microsoft HoloLens is the main MR headset on the market, and it comprises holographic lenses, a depth camera, a variety of sensors, plus speakers. With the HoloLens, you look through the headset and see your normal surroundings. But you'll also see holograms (for example, virtual beings, information or objects) overlayed on top of the real world – and, using hand controllers or specific gestures, you can play around with these holograms as if they were real. For instance, you might see a digital to-do list beamed onto your office wall and be able to wipe items off the list as you complete them.

Where Is XR Technology Heading?

As I've already mentioned, in the future I believe AR, VR and MR will all merge together to create more immersive user experiences, where you can move from one device to the next to deepen the experience. Where you can move from an experience that's more rooted in the real world to one that's fully digital. This blending of technology will eventually allow us to see the world however we fancy – to turn the real world around us into whatever we want. Pink trees instead of green. A cartoon avatar instead of your boss. A rainforest instead of a bland conference room . . .

And the technology itself will change. Right now, to get a fully immersive VR experience, you need special gloves or even full body suits to track your movements and simulate the feeling of touch. In the future, everyday cameras will be able to integrate with XR experiences and track our movements. Beyond that, brain–computer interfaces could be used to simulate the feeling of touch, without needing any external technology at all. Then we'll have the integration of smell, and freer movement (thanks to things like omnidirectional treadmills, that let you carry on walking in whatever direction you want).

You can read more about this futuristic vision of an XR-driven world in Chapter 13. For now, the key message is this: although it's obviously helpful to understand what XR technology can do right now, it's vital we remember XR will evolve in ways we can't yet imagine.

Key Takeaways

In this chapter, we've learned:

- XR is a spectrum and, as such, it's not always clear where one XR technology ends and another one begins. This book therefore focuses on real-world applications of the various XR technologies, rather than prescriptive, academic definitions that have little relevance in the real world.
- As XR advances, I believe the various technologies that sit under the XR umbrella will become more and more linked, and users will be able to seamlessly move from one experience to another – for example, moving from AR or MR to VR, and back again.
- AR, which involves the projection of digital elements (such as text or images) onto the real world, has the biggest potential in the short term, because it doesn't necessarily involve special equipment. In many cases, a smartphone is all you need.
- While AR is rooted in the real world, VR creates a much more immersive, completely simulated ecosystem. Strap on a VR headset and you're transported into a 3D, 360-degree artificial environment – while the real world around you is blocked out.
- MR blends VR and AR to create a hybrid reality, in which users can interact with digital elements being superimposed over the real world, as if they were real objects.

I've already set the scene for where I believe XR technology is headed. But what about where it has come from? How did we get to this point, where the line between the real world and the digital one has become so blurry? Turn to the next chapter to trace the evolution of XR.

Endnotes

i. You Can Now Attend VR Meetings – No Headset Required; Wired; https://www.wired.com/story/spatial-vr-ar-collaborative-spaces/
ii. MR Is Leaving AR in the Dust; Iflexion; https://www.iflexion.com/blog/mixed-reality-examples