Ten Things You Need to Know About Augmented Reality (AR) and Virtual Reality (VR)

Confused about what's what in the virtual world? If so, you're certainly not alone.

The simplest way to think about augmented reality (AR) and virtual reality (VR) is that they are a bridge between the digital and physical worlds, letting you take in information and content visually — the same way you take in the world.

The following is a handy guide to deciphering what's what in the high-tech world of AR and VR.

01 Augmented Reality (AR) and Virtual Reality (VR)

Augmented reality (AR) lets the user experience the real world, which has been digitally augmented or enhanced in some way. You can look at a car engine, for example, and the AR glasses you wear will explain all the parts, their functions and, on command, how to replace specific parts.

Virtual reality (VR) removes the user from the real-world experience, replacing that experience with a completely simulated one. The user experiences the world as if she or he were somewhere else (e.g. a museum, on a roller coaster, on a beach).

When AR and VR are combined, the result is mixed reality (MR).

02 The Difference Between AR and VR

The differences are best explained by looking at uses. VR applications are best suited for simulation or complete immersion on another experience. Think of a remote collaboration with 3D elements, point-of-view training — "What does it look and feel like to be at a crime scene?" — and virtual tours. One example is the guided tour of the Van Gogh Museum in Amsterdam.

AR applications, on the other hand, are best suited for technical training. Companies that are facing knowledge gaps and expertise loss as workers retire are capturing that knowledge digitally and sharing it with less-experienced workers via AR tools. Honeywell is one example.

03 Extended Reality (XR)

XR is an emerging umbrella term for all the immersive technologies, including those we already have — augmented reality (AR), virtual reality (VR) and mixed reality (MR) — as well as those that are yet to be created. All immersive technologies extend the reality we experience, either by blending the virtual and real worlds or by creating a fully immersive experience.

Mixed reality is a combination of real space augmented with digital information and virtual reality. This requires special equipment (e.g., Microsoft's HoloLens, approximately $3,000) and a great deal of programming.

In some cases, users enter a space in which the walls have been painted with a green coating, which enables images to be projected onto them, so that the user is immersed in the images and feels that they are in a different place. When combined with AR and VR technologies, this "different space" can be a hospital operating theatre, an aircraft flight deck or a factory.

04 There is a Lot of Interest in AR/VR and XR Technologies

As more baby boomers retire and birth rates fall in the developed world, skills are in demand and in short supply. AR enables skills transfer from experienced workers to novices with real-time, real-world practical advice and information conveyed "just in time." A new worker can stand in front of a complex machine and be guided by an experienced expert in the effective use of the equipment, reducing errors and cutting costs.

5G, the superfast broadband now available in many urban areas across Canada, enables AR/VR to be deployed more easily. 5G enables the Internet of Things (IoT) and AR/VR to be available on such fast networks.

There are other advantages:

- "See what I see" videoconferencing to share activities and skills
- Field service support to provide technical information and skills to someone in a remote location
- Efficient on-the-job training
- Advanced healthcare applications

The AR/VR market is growing very quickly. According to MarketsandMarkets, the AR market is projected to grow from USD $15.3 billion in 2020 to USD $77.0 billion by 2025 — which is a compound annual growth rate (CAGR) of 38.1% from 2020 to 2025. The VR market is projected to grow from USD $6.1 billion in 2020 to USD $20.9 billion by 2025 — a CAGR of 27.9% from 2020 to 2025.

05 The Importance of Content Development for AR/VR

The key challenge is to develop appropriate and meaningful content for AV/VR.

For AR, the following is required:

- Image capture and processing
- Creation of the script/material to be layered onto the image
- Cleaning and ensuring the accuracy of the material layered onto the image
- Testing and refining the material and images
- Deploying AR through an app that is compatible with the equipment being used

Depending on the complexity of the scenes being created, it will take between 1,000 and 3,000 hours of programming to design, develop and deploy an AR application (approximately US$150,000 to US$450,000). Smaller applications involving simple models and layering can be done faster — about 180-250 hours (US$27,000 to $37,500).

VR applications (simulations or tours) depend on complexity. There are several steps:

- Development of a flowchart and script
- Instructional design of the experience
- Creating and layering visuals and audio
- Editing and testing

Creating VR can be done with some simple tools such as Adobe Captivate, Amazon Sumarian, Aframe.io, which are becoming easier to use. Some simple VR simulations can be created in 150-200 hours.

06 Examples of AR and VR

VR has been deployed in education for some time. Many teachers have used Google Expeditions to "take" students on field trips, explore the lives of scientists or take a close look at space. Here are some other examples:

- Wisconsin police departments are now using VR to train officers to hone their skills in de-escalating crisis situations.
- Produced for the BBC by Immersive VR Education, 1943 Berlin Blitz in 360° uses real-life footage from a nighttime raid of Nazi Germany to help students understand what it was like to live through a significant historical event.
- The SkyView app allows students to explore the universe using AR overlays of the night sky. With SkyView, anyone can point their mobile device upward to identify stars, constellations, planets and even satellites.
- A teacher can now use augmented reality to create a tornado, then bring the funnel right into the classroom so students can experience these destructive storms close up. Students can also take a VR tour of a beehive to see its inner workings and explore how bees work together to support the community.
    - An apprentice can be walked through an engine repair using AR glasses or get help to complete a weld through a combination of AR and real-time connection to an instructor at a remote location.

07 Limitations of AR/VR

The major challenge faced by AR manufacturers is to provide a wide field of view (FOV). The field of view is defined as the extent of the observable world at any given moment. Ideally, a human eye has a visual field of ~200° horizontally and 135° vertically, although AR and VR can provide a FOV of up to 90°, currently. For AR devices to create immersive experiences, they must capture as much of the FOV as possible.

Another major challenge for the AR/VR device and application manufacturers is to offer low-latency displays. The errors caused by latency (speed of image to eye and speed for a new image to replace another) often lead to image lagging. While playing a game, high input lag makes the gameplay feel sluggish and unresponsive. A lower input lag level allows gamers to enjoy a seamless control experience, as movements on the screen respond instantly to the commands. This has been one of the biggest technical challenges faced by AR manufacturers, especially since these devices are largely being adopted by healthcare and aerospace and defense applications, where any late response would have catastrophic results.

08 Equipment for AR/VR

For AR there are a range of smart glasses equipped with an audio component that enables a user to see and experience the real world with an overlay of images, sounds and text. These glasses, ranging from $500 to $3000 per set, are available from brands such as Epson, Google, Toshiba, and Vuzix

For VR there are specialized headsets that insert into a Smartphone or connect to a computer or gaming console. They include the Occulus Rift gaming headset (CAN $716) and the smartphone VR headset (CAN $50-$200). AR devices keep us connected with the real world; VR devices seek to block out the real world.

09 Education Materials for AR/VR

A range of commercial developers are partnering with post-secondary institutions and training organizations to develop and deploy AR/VR technologies for teaching and learning. ClassVR from Avantis Systems has undertaken significant projects around the world and gained a strong positive following. InstaVR has also worked worldwide in a similar way, focused largely on training. They partnered with Emporia State University to support the deployment of AR/VR across several departments.

In Canada, Brock University partnered with Etobicoke AR/VR firm UP360, which supported their use of AR for projects in marketing.

Mohawk College has partnered with EON Reality Inc to create the XR Development Centre, developing XR solutions for industry and education.

Many institutions are developing their AR/VR deployments through the use of appropriate software and internal support.

10 Developing and Deploying AR/VR

People seeking to develop the skills and competencies required for AR/VR development have no shortage of options for learning. Learning opportunities range from microlearning through YouTube, short (10-week) courses leading to certification using standard tools to create both AR and VR applications to full time college courses. There is also a range of massive open online courses (MOOCs) at a variety of skill levels.