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COURSE
82406A

Augmented Reality, Cybersecurity Foundations, and Risk Management

From augmented reality applications in business to the ever-present threat of cyberattacks, this course covers technologies that are directly affecting how organizations operate and protect themselves. You'll explore practical uses of augmented reality, then build a solid foundation in cybersecurity concepts, common threats, and the management strategies organizations use to reduce risk. For CPAs and tax professionals responsible for advising clients or safeguarding sensitive financial data, understanding cybersecurity isn't optional—it's essential.

CREDIT HOURS **2** | FIELD OF STUDY **BUSINESS** | EXAM QUESTIONS **10**

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Assignment

- Study the full course materials included here.
- Complete the review questions after each chapter.
- Answer 10 final exam questions.
- Final exam is scored immediately, 70% or better passes.
- Certificate of completion is available in your account.
- Failed exams can be retaken free of charge.

Course Objectives

- Identify the differences between augmented and virtual reality.
- Recall various cybersecurity methods.
- Identify the three parts of the NIST framework.

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Chapter 1: AUGMENTED REALITY

Chapter Objective

After completing this chapter, you should be able to:

- Identify the differences between augmented and virtual reality.

Here are a few examples of how augmented reality is currently used in various industries a part from entertainment and training.

Arcadia Earth, New York City, using augmented reality, spread awareness about the impact of climate change[1].

Nreal, a Chinese augmented reality start-up, is launching its Nreal air glasses in the U.K[2].

Snap, the company behind Snapchat, has launched three generations of smart glasses since 2016. Snap expects everyone to be wearing augmented reality spectacles by 2032[3].

New World Inc., an augmented reality art NFT company, recently partnered with Pure Spirits, a distillery specializing in craft products, such as white-label vodka and tequila. Together they provide an augmented reality Formula 1 race car experience that users activate through the artwork on the label[4].

IKEA – the IKEA Place app lets you place digital furniture anywhere. The app lets you change wall color, place shelving systems and decorations, export the design in 3D or 2D, and send it to others for approval[5].

VIRTUAL VERSUS AUGMENTED REALITY

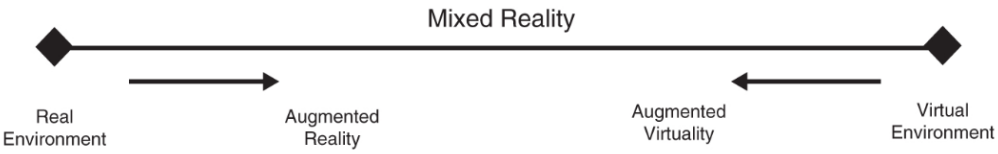
Two similar yet different technologies that have changed how we view the real world are virtual and augmented reality. Virtual reality immerses the user in an entirely virtual world, while augmented reality places virtual items in the real world. These two technologies have been popular in the entertainment industry for a while. However, organizations are recognizing how these technologies add value and create competitive advantage by changing how products are designed, improving the customer experience, and training employees.

Paul Milgram and Fumio Kishino introduced a popular depiction of reality and virtuality as a continuum used today[6]. As shown in Figure 13.1, the two endpoints in the continuum are:

- The real environment

• The virtual environment

FIGURE 13.1 MILGRAM'S REALITY–VIRTUALITY CONTINUUM



Augmented reality is closer to the real environment, whereas augmented virtuality is closer to the virtual environment. According to the continuum, a virtual environment or virtual reality completely immerses an individual in a synthetic world without seeing the real world. On the other hand, AR technology augments the user's experience in the real world by superimposing virtual objects on the real world in real time.

Virtual reality (VR) uses computer technology to place a user in a three-dimensional simulated environment. Instead of looking at a computer screen, most commonly, you would use a virtual reality headset to immerse yourself in an experience. Virtual reality headsets can be used with other handheld devices to give users a fully immersive experience. For example, you could wear virtual reality headsets and use a handheld device to play tennis in your living room. The three types of VR headsets are as follows[7].

1. **PC-based VR headsets.** These headsets offer high-quality sound, image, and head tracking for a more realistic experience. These headsets usually use cables to connect to a PC and are powered by external hardware.
2. **Standalone VR headsets**. These headsets do not require a PC or smartphone to deliver a VR experience. These headsets have a built-in processor, sensors, battery, memory, displays, and graphic processing units (GPU). As a result, they are less powerful than PC-based headsets.
3. **Mobile headsets**. These are shell devices used with a smartphone. The lenses in these devices separate the screen to create a stereoscopic image, giving an illusion of depth.

Users can combine VR headsets with various accessories such as a 3D mouse, optical trackers, wired gloves, motion controllers, body suits, treadmills, and smelling devices to enhance their experience.

On the other hand, augmented reality (AR) is a mixed reality between the digital or virtual world and the real world. AR is defined as a real-time direct or indirect view of a physical, real-world environment that "has been enhanced or augmented by adding virtual computer-generated information[8]." Characteristics of an AR system are:

1. The ability to combine real objects with virtual objects in a real environment.
2. The ability to align real and virtual objects with each other.

3. The ability to maintain a three-dimensional environment.
4. The ability to interact with both the virtual and the physical world.
5. The ability to run in real time.

AR is not limited to a particular technology or a particular device. Even though current AR products primarily use sight, AR can integrate all senses, including hearing, touch, and smell.

Although there are many similarities between virtual reality and augmented reality, there are several differences between them. Table 13.1 compares various characteristics of virtual reality with augmented reality.

TABLE 13.1 COMPARISON BETWEEN VIRTUAL REALITY AND AUGMENTED REALITY

Virtual Reality	Augmented Reality
The user is immersed in a simulated environment.	The user is immersed in the real or physical environment.
Creates a new experience.	Adds to the current experience.
The digital environment may reflect a real place. However, it exists apart from the current physical reality.	The current real physical world is enhanced with digital objects in real time.
Users are controlled by the system.	Users can control their presence in the real world.
Users can interact with the digital environment. However, it does not have an impact on the real environment.	Users interact with the real environment, thus impacting the real environment.
Needs a headset.	Accessible with a smartphone.
Virtual reality headsets take over your vision to give you the impression you are somewhere else.	Augmented reality headsets add to your vision with additional objects or information over the real objects.

History

Various technical advances over the years have contributed to the development of virtual and augmented reality technology. The 1960s marked one of the first achievements in the field. Ivan Sutherland and his students created the first 3D graphics, which changed images as the user moved. In the 1970s and 1980s, many devices, such as the Walkman, digital watches, and organizers, started

to become mobile, opening the door for wearable devices. In the 1990s, devices like the PalmPilot were small portable computers. These technologies provided the foundation for augmented reality. In the late 1990s Boeing scientists Caudell and Mizell first used the term augmented reality after they developed an AR prototype. The progress we see today can be attributed to AR becoming a distinct field of research during the late 1990s, leading to greater collaboration among researchers. Virtual and augmented reality technology is not a single software or hardware. It is a combination of various software and hardware devices. VR and AR continues to depend on the advances in multiple fields of study to provide users with a fully immersive experience[9].

AUGMENTED REALITY EQUIPMENT

A variety of technologies make AR possible. AR uses a combination of hardware devices, such as displays, and software, which enables image processing, tracking, overlaying, and displaying.

Types of Displays

Unlike VR, AR integrates the real world; therefore, the displays need to be mobile. AR displays can be categorized into the following three categories based on the positioning of the display[10].

1. **Head-worn**. These displays are attached to the user's head. Some head-worn displays have limited mobility because they must be connected to computers, such as a laptop. Some displays move computation to the cloud and connect using Bluetooth, lengthening the battery life.
2. **Handheld**. These displays can be bulkier than head-worn displays. However, handheld displays have the greatest potential to introduce AR to the mass market.
3. **Spatial**. These displays are placed within the environment and provide limited interactions. Spatial displays are helpful for large exhibitions or presentations. For example, television commentators, using a camera feed, can overlay visuals highlighting a route or player during a play of sporting events. A drawback of spatial displays is that when individuals move around, the objects may appear misaligned.

The most common AR devices integrate sight and sound into their applications. Other senses require further development before widespread use. AR displays can also be categorized based on which human sensory input is used or enhanced[11].

1. **Visual**. There are three types of visual displays. The first type of display uses a digitized video feed of the real world and overlays other digital images on the video feed. For example, the game Pokémon Go uses the video from the camera and overlays images of the creatures onto the mobile screen. The second option uses a wearable headset with a see-through front, such as eyewear, where the virtual feed overlays reality. The third option uses projective displays, which do not require any eyewear. Virtual images are projected on real images in a room for a large audience.

2. **Aural (sound)**. Sound is an increasingly important part of virtual and augmented reality. Currently, aural displays are used more in virtual environments and are in development for augmented environments. Another concept in development is to make the user feel sound waves.
3. **Haptic (touch)**. These interfaces are bidirectional, programmable communication that uses touch. Haptic devices use kinesthetic senses, such as force and motion, and the tactile sense.
4. **Olfactory (smell) and gustatory (taste)**. These displays are still in the very early stages of development.

Interactions with Users

AR systems have to determine the orientation of a user, track the user's movement, and sense the environment to combine reality with virtual objects. Interactions with users can be broadly categorized into positional tracking and interactions with users.

Positional Tracking

An AR system must track the user's movement with six degrees of freedom: three variables for positioning and three angles for orientation. There are several ways to track user movement. Each method has its benefits and limitations[12].

1. **Mechanical, ultrasound, and magnetic**. These techniques measure distance using static devices that send and receive sound waves or electromagnetic fields around the user. This method is limited to indoor use.
2. **Global positioning systems**. GPS uses the satellite positioning techniques used by other navigation devices.
3. **Radio**. This method places active radio frequency identification chips inside structures to track and position.
4. **Inertial**. This method uses a computer, motion sensors, and rotation sensors to continuously calculate an object's position, orientation, and velocity.
5. **Optical**. This method uses one or two tiny cameras to recognize landmarks or determine movement.
6. **Hybrid**. The hybrid tracking methods use a combination of the methods and provide the most promising way to deal with limitations posed by indoor or outdoor mobile AR environments.

User Interfaces

Another important component of AR is the user interface (UI). Users need a way to interact with both virtual and real-world objects. AR systems should enable users to select, annotate, or manipulate physical objects. Also, AR interfaces need to support selecting, positioning, and rotating