Chapter Five

Augmented Reality (AR)

Learning outcomes

After completing this lesson you should be able to
- Explain augmented reality
- Explain the features of augmented reality
- Explain the difference between AR, VR, and MR
- Explain the architecture of augmented reality systems
- Describe the application areas of augmented reality

Overview of Augmented reality (AR)

- The fundamental idea of AR is to combine, or mix, the view of the real environment with additional, virtual content that is presented through computer graphics.
- AR is a form of emerging technology that allows users to overlay computer-generated content in the real world.
- AR refers to a live view of a physical real-world environment whose elements are merged with augmented computer-generated images creating a mixed reality.
- Augmented reality is the integration of digital information with the user's environment in real-time.

Virtual reality , Augmented Reality vs Mixed reality
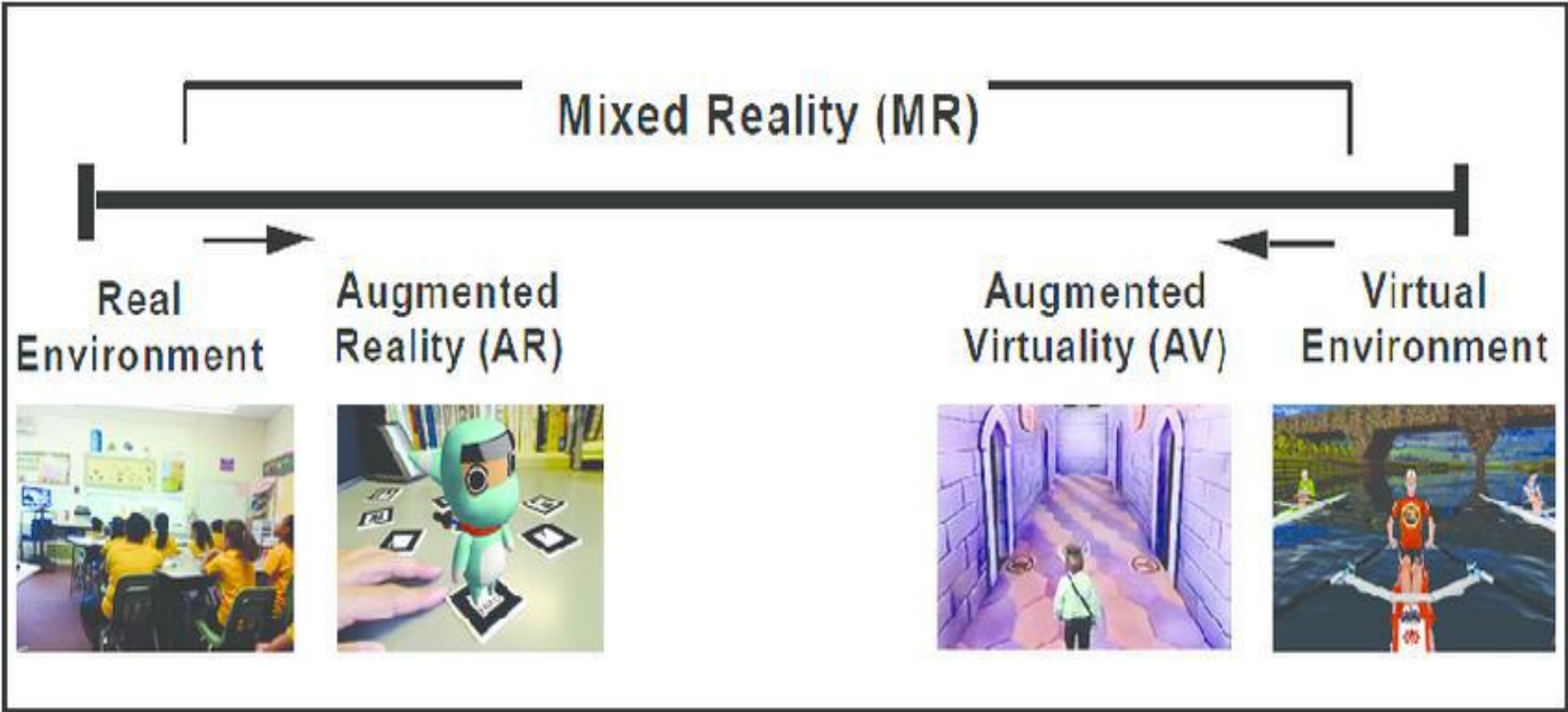
Virtual Reality (VR)

- **VR** is fully immersive, which tricks your senses into thinking you're in a different environment or world apart from the real world.
- Using a head-mounted display (HMD) or headset, you'll experience a computer-generated world of imagery and sounds in which you can manipulate objects and move around using haptic controllers while tethered to a console or PC.
- It is also called a computer-simulated reality.

Example of Immersive Technology

VR Case that Inserts a Smartphone

Augmented Reality (AR)

- In AR, users see and interact with the real world while digital content is added to it. If you own a modern smart phone, you can easily download an AR app and try this technology.

- There's a different way to experience augmented reality, though – with special AR headsets, such as Google Glass, where digital content is displayed on a tiny screen in front of a user's eye.

- AR adds digital elements to a live view often by using the camera on a smart phone. Examples of augmented reality experiences include Snapchat lenses and the game Pokemon Go.

Direct and Indirect Augmentation of Objects

Mixed Reality (MR)

- **MR**, sometimes referred to as hybrid reality, is the merging of real and virtual worlds to produce new environments and visualizations where physical and digital objects co-exist and interact in real-time.
- In mixed reality, you interact with and manipulate both physical and virtual items and environments, using next-generation sensing and imaging technologies.
- The key characteristic of MR is that the synthetic content and the real-world content are able to react to each other in a real-time.

Mixed Reality in Engineering and Medicine

Mixed Reality in Entertainment

The architecture of AR Systems

The first Augmented Reality Systems (ARS) were usually designed with a basis on THREE main blocks:
     (1) Infrastructure Tracker Unit
     (2) Processing Unit
     (3) Visual Unit.

1. Tracker Unit : Collecting data from the real world, sending them to the Processing Unit .
2. Processing Unit : Mix up the virtual content with the real content and sent the result to the Video Out module of the Visual Unit .
3. Visual Unit : Visualize the content.

Augmented Reality Systems (ARS) standard architecture
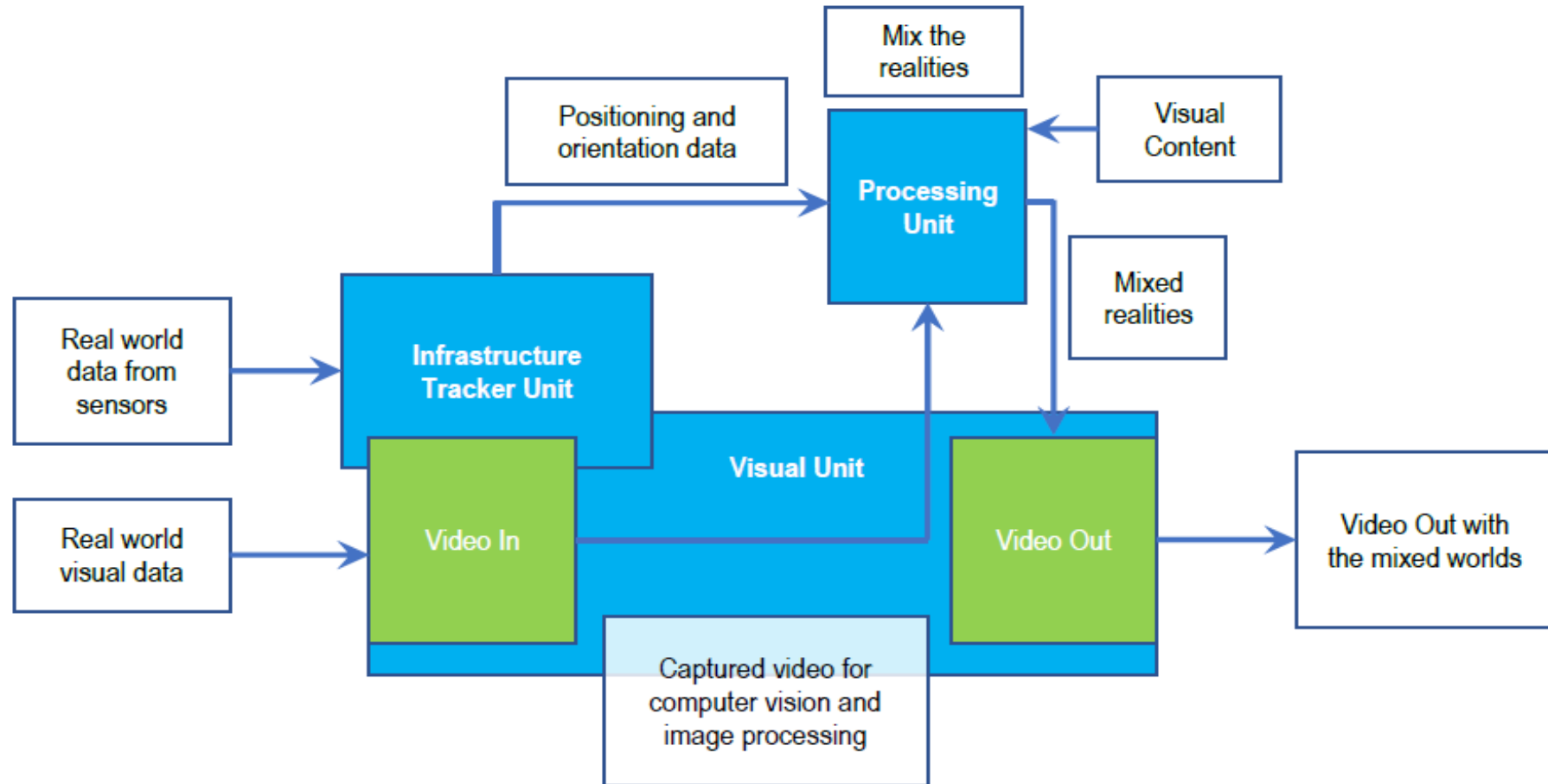
Cont'd….

- The Visual Unit can be classified into two types of system, depending on the followed visualization technology:

1. Video see-through:

∗ It uses a Head-Mounted Display (HMD) that employs a video-mixing and displays the merged images on a closed-view HMD.

2. Optical see-through:

∗ It uses an HMD that employs optical combiners to merge the images within an open-view HMD.

∗ HMDs are currently the dominant display technology in the AR field.

Applications of AR Systems

AR In education :

- ***Affordable learning materials***
  - ✓ Posters, digital illustrations, physical models, prototypes are very expensive and impossible for schools to purchase.
  - ✓ AR technology allows for avoiding investments in physical materials.
- ***Interactive lessons***
  - ✓ when AR technology is used in classrooms, students can view models on their own smart phones and get a better idea of the concepts they are studying.
  - ✓ That increases engagements and reinforces the learning.

Applications of AR

- ***Higher engagement***
  - ✓ when teachers integrate augmented reality into their lectures, they attract the attention of their students and make lessons more effective.
  - ✓ When students are interested, it is much easier to make them work more productively.
- ***Higher retention***
  - ✓ Using the AR app, students can get access to augmented models that represent any real objects from a famous monument or work of art to a molecule.
- with AR technology, students use different senses and retain more knowledge for a long time.

Applications of AR Cont. .

- **Boost intellectual curiosity**
  ✓ Augmented reality makes students more excited about learning certain subjects.
  ✓ Modern students were born in a digital era so they will always be excited with innovative technologies that can help them learn new ideas and develop their critical thinking skills.

Applications of AR Cont. .

AR In Medicine :

- *Describing symptoms*
  - ✓ when it was hard to describe to the doctor what was bothering you.
  - ✓ Medical app AyeDecide is using augmented reality to show the simulation of the vision, harmed by the different diseases.
  - ✓ It helps patients to understand their conditions and describe correctly their symptoms.

Applications of AR Cont. .

- *Nursing care*
  - ✓ About 40% of the first intravenous injections fail, and this ratio is even higher in the case of children and elderly patients.
  - ✓ The AccuVein uses augmented reality to cope with this negative statistic.

- *Surgery*
  - ✓ In no sphere augmented reality does not have such practical application as in the medicine, especially in surgery, where it literally helps to save lives.
  - ✓ Three-dimensional reconstructions of organs or tumors will help surgeons become more efficient at surgery operations.

Applications of AR Cont. .

- ***Ultrasounds***
  - ✓ A few AR software companies developed handy ultrasound scanner, which with the help of smart glasses works as a traditional one.
- ***Diabetes management***
  - ✓ In 2017, the number of people struggle with diabetes reached up to 425 million adults worldwide.
- In 2014, Google revealed the plans for creating a smart contact lens (Google 92 Contact Lens), in which the main function will be to measure the glucose levels in the tears.

Applications of AR Cont. .

- *Navigation*
  - ✓ The using AR in navigation apps has already become a "traditional" way.
  - ✓ AR can be useful to provide information about the nearest hospitals.

Applications of AR Cont. .

AR In Entertainment

- *AR in games*
  - ✓ The AR games were praised for increasing physical activity in people – you actually have to move around to find your target, Ex: Pokémon Go.

- *AR in music*
  - ✓ Augmented reality can providing complete information on the track or its performer including   the performers' bios, the lyrics of the song, the making of the recording or the music video.

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Applications of AR Cont. .

- ***AR on TV***
  - ✓ One way of integrating augmented reality in television is adding supplementary information to what is going on the TV screen – such as match scores, betting options, and the like.

- ***AR in eSports***
  - ✓ Augmented reality turns eSports shows into interactive experiences allowing the watchers to become participants.

Applications of AR Cont. .

- ***AR in the theater***
  - ✓ Augmented reality can serve not only for entertainment purposes but also for the purposes of accessibility.
  - ✓ The possibility to overlay virtual objects over the real environment can be used, for example, for subtitling in various theater shows.
  - ✓ Now, many theaters use LED displays either to provide subtitles for translation or to assist hearing-impaired visitors.

Review Questions

- Briefly explain AR, VR and MR?
- What is the difference between AR, VR and MR?
- Briefly explain the architecture of AR?
- Write down the characteristics of AR?
- How is augmented, virtual and mixed reality achieved?
- What is the benefit of augmented, virtual and mixed reality?
- How Can AR, VR, and MR improve engineering instructions?
- Can VR be a substitute for Real Life Experience?
- What is the impact of VR on Educational Learning rather than games?
- What is the most technical challenge for MR?
- Write down some applications of AR system in education, entertainment and medicine?

1) What is the difference between AR, VR and MR?
2) Augmented reality refers to
   A) Our increased ability to better understand our situations thanks to easy Internet search.
   B) How we lose track of time when we are engrossed in video games.
   C) Digital overlays of information onto a screen that is showing the real world
   D) Increased capacities for the disabled thanks to digital technologies

3) Define the term 'virtual reality'

A) Where parts of a person's body are used for identification purposes. They are unique

B) A software environment that recreates a real-world or imaginary scenario like a game

C) The use of computers to encrypt data so that messages can be sent with complete privacy

D) Where images are made to appear three-dimensional and have 'depth'

4. _____ overlay digital information onto the real world.
   A. Augmented Reality   C. Virtual Reality
   B. Mixed Reality   D. BCI

5. _____means computer-generated environments for you to interact with, and be immersed in.
   A. Augmented Reality   C. Virtual Reality
   B. Mixed Reality   D. BCI

6. Pokémon Go is an example of
   A. AR   B. VR   C.MR   D.BCI

1. What is the difference between AR, VR and MR?
2. Which one of the following statements not true?
   A. Virtual Reality help to access the internet.
   B. Virtual reality stimulates environment of reality.
   C. VR and AR have the remarkable ability to alter our perception of the world.
   D. None of the above