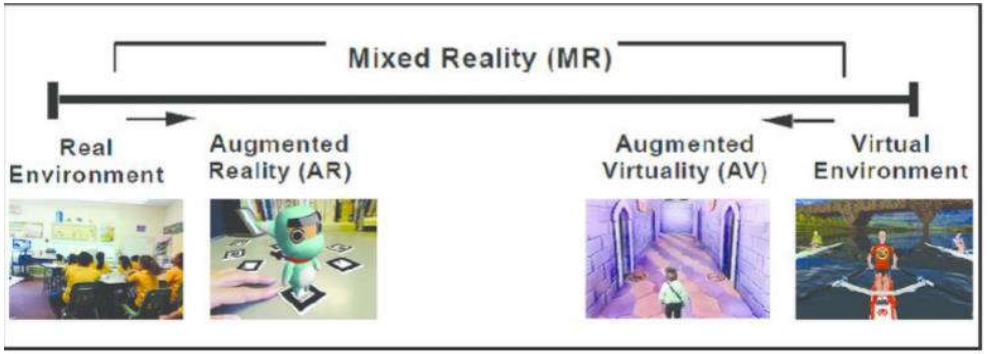
CHAPTER 5
AUGMENTED REALITY (AR)



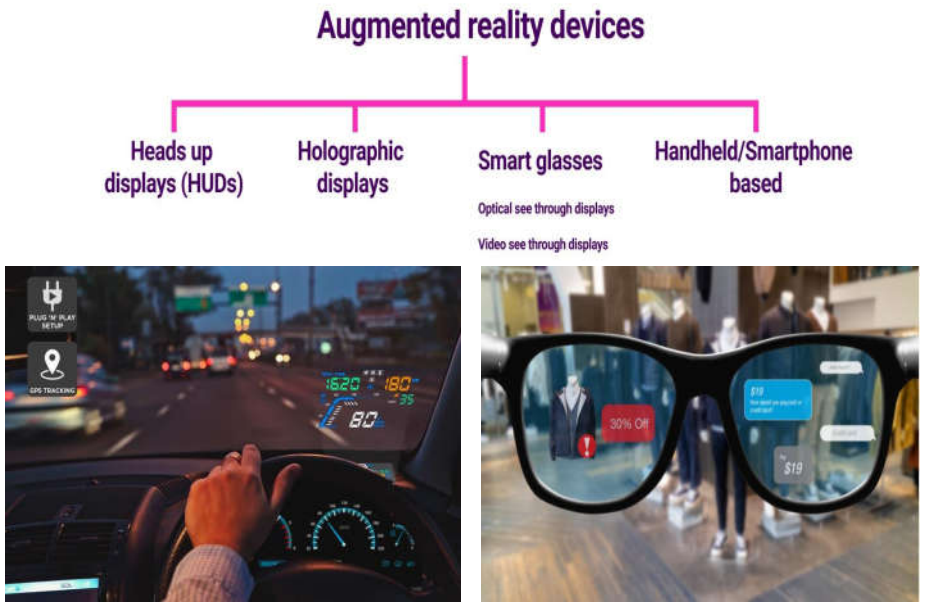
Andualem T.

Introduction to AR

- The idea of AR is to combine or mix the view of the real environment with additional virtual content that is presented through computer graphics.
- Augmented reality (AR) is a form of emerging technology that allows users to overlay computer generated virtual graphical 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.

Introduction to AR

- Through augmented vision, the information about the surrounding real world helps the user can digitally interact with and adjust information about their surrounding environment.
- Augmented reality is the integration of digital information with the user's environment in real time.
- Example: Snapchat



And what is VR?

- VR tricks your senses into thinking you are in different environment or world apart from real world
- VR is a general term for immersive experiences and content via a VR headset or HMD (head-mounted display).
- It refers to computer technologies using reality headsets to generate realistic sounds, images and other sensations that replicate a real environment or create an imaginary world.
- The content is 100% digital and computer-generated. It is also called a **computer-simulated reality.**

And what is VR?

- Advanced VR environment engage all five senses (**taste**, **sight**, **smell**, **touch**, **sound**), but it is important to say that this is not always possible
- Most VR Devices **tethered** which are connected to a computer and some of them are **standalone** devices like Google Cardboard is among the most popular) and the remaining's are **Smartphone VR**.
- Using VR devices such as HTC Vive, Oculus Rift or Google Cardboard, users can be transported into a number of real-world and imagined environments

And what is VR?

- VR technology creates an environment in which the user feels and seems to be moving inside a computer-created virtual world in the same way people move inside the natural environment.
- Example: dragons

VR devices

Standalone

smartphone

tethered

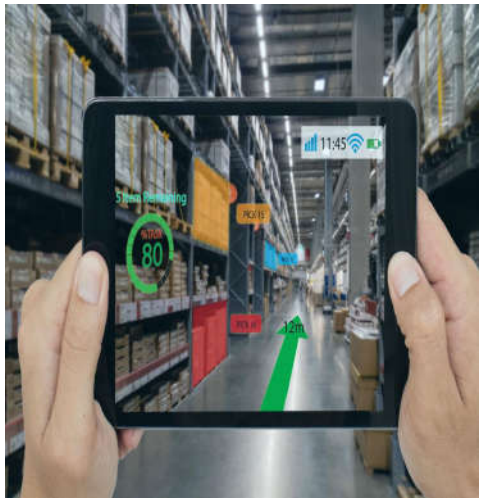
Mixed Reality

- Mixed Reality (MR), 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.
- It allows for digital content to integrate, enrich and interact with the user's real-world environment.
- MR lenses or headsets present an overlay of digital content that interacts with objects in the real world in real-time.

Mixed Reality

- The key characteristic of MR is that the synthetic content and the real-world content are able to react to each other in real-time.
- The products are, in most cases, in the research and development phase, but MR is viewed through transparent wearable glasses.
- Mixed Reality removes the boundaries between real and virtual worlds using **occlusion**: the computer-generated objects can be visibly obscured by objects in the physical environment from the user's point of view.

Mixed Reality Examples



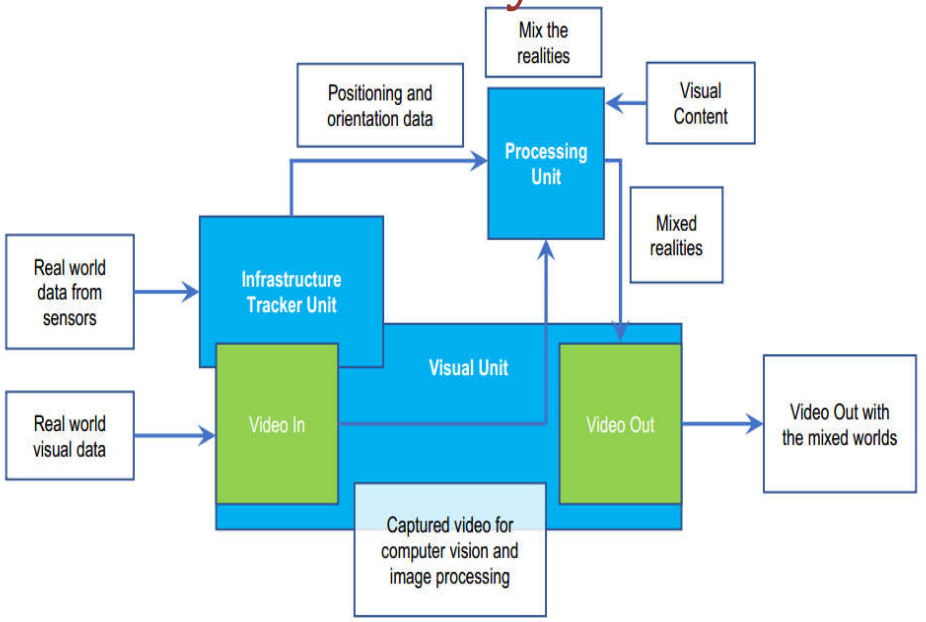
AR vs VR vs MR

- **Virtual Reality:** VR is content which is 100% digital and can be enjoyed in a fully immersive environment.
- **Augmented Reality:** AR overlays digital content on top of the real-world.
- **Mixed Reality:** MR is a digital overlay that allows interactive virtual elements to integrate and interact with the real-world environment.

Architecture of AR Systems

- The first Augmented Reality Systems (ARS) were usually designed with a basis on **three main blocks**.
  - **Infrastructure Tracker Unit**
  - **Processing Unit**
  - **Visual Unit**

Architecture of AR Systems

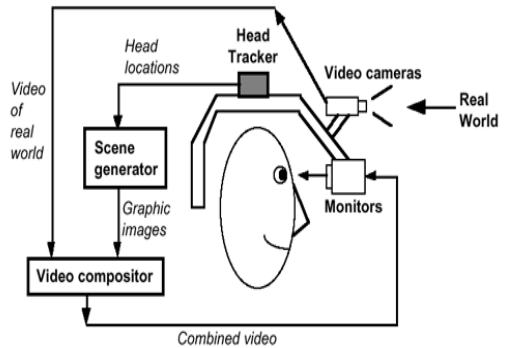


Architecture of AR Systems

- **Infrastructure Tracker Unit**; is responsible for collecting data from the real world, sending them to the Processing Unit.
- **Processing Unit:** which mix the virtual content with the real content and sent the result to the Video Out module of the Visual Unit.
- **Visual Unit:** the Visual Unit can be classified into two types of system, depending on the followed visualization technology: **video see through** and **optical see through**

Architecture of AR Systems

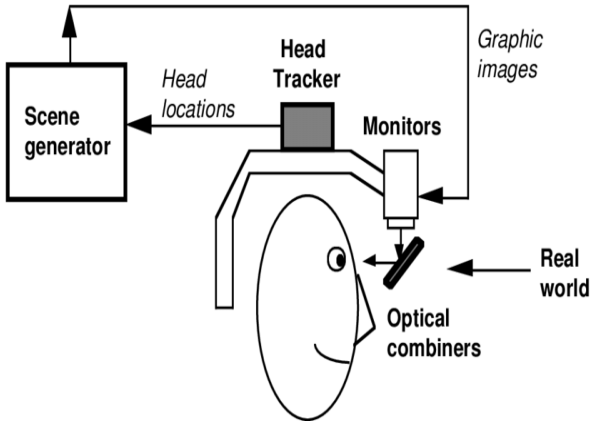
1. Video see-through: It uses a Head-Mounted Display (HMD) that employs a video-mixing and displays the merged images on a closed-view HMD.



Video see-through HMD conceptual diagram

Architecture of AR Systems

2. Optical see-through: It uses an HMD that employs optical combiners to merge the images within an open-view HMD.



Applications of AR Systems

1. **Educational Purpose:** AR supplements educational sector the following benefits:
   - Affordable learning materials
   - Interactive lessons
   - Higher engagement
   - Higher retention
   - Boost intellectual curiosity

Applications of AR Systems

2. Medical Purpose: AR provides Health and medical sector the following benefits:

- Describing symptoms
- Nursing care
- Surgery
- Ultrasounds
- Diabetes management
- Navigation

Applications of AR Systems

3. AR in Entertainment: AR could be used in various entertainment activities.

- Games
- Music
- Tv
- esports
- theater

END OF CHAPTER FIVE

Next: Chapter Six: