# ROHINI COLLEGE OF ENGINEERING AND TECHNOLOGY

## DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE MATERIAL

COURSDE NAME: VIRTUAL REALITY

## WHAT IS VIRTUAL REALITY?

Virtual Reality (VR) is a computer-generated environment with scenes and objects that appear to be real, making the user feel they are immersed in their surroundings. This environment is perceived through a device known as a Virtual Reality headset or helmet. VR allows us to immerse ourselves in video games as if we were one of the characters, learn how to perform heart surgery or improve the quality of sports training to maximise performance.

Although this may seem extremely futuristic, its origins are not as recent as we might think. In fact, many people consider that one of the first Virtual Reality devices was called Sensorama, a machine with a built-in seat that played 3D movies, gave off odours and generated vibrations to make the experience as vivid as possible. **The invention dates back as far as the mid-1950s.** Subsequent technological and software developments over the following years brought with them a progressive evolution both in devices and in interface design.

## DIFFERENCES WITH AUGMENTED REALITY

Despite being a technology that originated decades ago, **many people are still unfamiliar with the concept of Virtual Reality.** It is also quite common to confuse the term Virtual Reality with augmented reality.

The main difference between the two is that VR builds the world in which we immerse ourselves through a specific headset. **It is fully immersive and everything we see is part of an environment artificially constructed through images, sounds, etc.** On the other hand, in **augmented reality (AR), our own world becomes the framework within which objects, images or similar are placed.** Everything we see is in a real environment and it may not be strictly

necessary to wear a headset. The clearest and most mainstream example of this concept is Pokémon Go.

However, there is also a combination of both realities called mixed reality. This hybrid technology makes it possible, for example, to **see virtual objects in the real world and build an experience in which the physical and the digital are practically indistinguishable.** MAIN APPLICATIONS OF VIRTUAL REALITY

That's enough about the theory that is projecting us into the future. Which sectors is Virtual Reality actually being used in today? Medicine, culture, education and architecture are some of the areas that have already taken advantage of this technology. From guided museum visits to the dissection of a muscle, VR allows us to cross boundaries that would otherwise be unimaginable.

FUTURE OF VIRTUAL REALITY

Virtual Reality is one of the technologies with the highest projected potential for growth. According to the latest forecasts from IDC Research (2018), **investment in VR and AR will multiply 21-fold over the next four years, reaching 15.5 billion euros by 2022.** In addition, both technologies will be key to companies' digital transformation plans and their spending in this area will exceed that of the consumer sector by 2019. It is, therefore **expected that by 2020 over half of the larger European companies will have a VR and RA strategy.**

Nowadays, the market is demanding applications that go beyond leisure, tourism or marketing and are more affordable for users. Virtual interfaces also need to be improved to avoid defects such as clipping, which makes certain solid objects appear as though they can be passed through. Or to minimise the effects that VR produces in people, among them motion sickness, which consists of a dizziness

induced by the mismatch between the movement of our body and what is being seen in the virtual world.

The big technology companies are already working to develop headsets that do not need cables and that allow images to be seen in HD. They are developing Virtual Reality headsets in 8K and with much more powerful processors. There is even talk that in the next few years they could integrate Artificial Intelligence. The latest 5G standard can also provide very interesting scenarios for the evolution of VR. This standard will allow **more devices and large user communities to be connected.** In addition, its almost imperceptible latency will make it possible for consumers to receive images in real time, almost as if they were seeing them with their own eyes.

All this means that Virtual Reality is no longer science fiction. It is integrated into our present and, in the coming years, it will lead to advances that will shape the future.

**Virtual reality** (**VR**) is a simulated experience that employs pose tracking and 3D near-eye displays to give the user an immersive feel of a virtual world. Applications of virtual reality include entertainment (particularly video games), education (such as medical or military training) and business (such as virtual meetings). Other distinct types of VR-style technology include augmented reality and mixed reality, sometimes referred to as extended reality or XR, although definitions are currently changing due to the nascence of the industry. Currently, standard virtual reality systems use either virtual reality headsets or multi-projected environments to generate realistic images, sounds and other sensations that simulate a user's physical presence in a virtual environment. A person using virtual reality equipment is able to look around the artificial world, move around in it, and interact with virtual features or items. The effect is commonly created by VR headsets consisting of a head-mounted display with a

small screen in front of the eyes, but can also be created through specially designed rooms with multiple large screens. Virtual reality typically incorporates auditory and video feedback, but may also allow other types of sensory and force feedback through haptic technology.

There are three main types of headsets:

- PC-Based VR Headsets: PC headsets tend to be the highest-priced devices because they offer the most immersive experiences. These headsets are usually cable-tethered from the headset and powered by external hardware. The dedicated display, built-in motion sensors and an external camera tracker offer high-quality sound and image and head tracking for greater realism.
- Standalone VR Headsets: All-in-one or standalone VR headsets are wireless, integrated pieces of hardware, such as tablets or phones. Wireless VR headsets are not always standalone. Some systems transmit information wirelessly from consoles or PCs in proximity, and others use wired packs carried in a pocket or clipped to clothing.
- Mobile Headsets: These shell devices use lenses that cover a smartphone. The lenses separate the screen to create a stereoscopic image that transforms a smartphone into a VR device. Mobile headsets are relatively inexpensive. Wires are not needed because the phone does the processing. Phones don't offer the best visual experiences and are underpowered by game console- or PC-based VR. They provide no positional tracking. The generated environment displays from a single point, and it is not possible to look around objects in a scene.

*VR Accessories*

VR accessories are hardware products that facilitate VR technology. New devices are always in development to improve the immersive experience. Today's accessories include the 3D mouse, optical trackers, wired gloves, motion controllers, bodysuits, treadmills, and even smelling devices.

These are some of the accessories used today in VR:

- 3D Mouse: A 3D mouse is a control and pointing device designed for movement in virtual 3D spaces. 3D mice employ several methods to control 3D movement and 2D pointing, including accelerometers, multi-axis sensors, IR sensors and lights.
- Optical Trackers: Visual devices monitors the user's position. The most common method for VR systems is to use one or multiple fixed video cameras to follow the tracked object or person.
- Wired Gloves: This type of device, worn on the hands, is also known as *cyber gloves* or *data gloves*. Various sensor technologies capture physical movement data. Like an inertial or magnetic tracking device, a motion tracker attaches to capture the glove's rotation and global position data. The glove software interprets movement. High-end versions provide haptic feedback or tactile stimulation, allowing a wired glove to be an output device.
- Motion Controllers: These accessories allow users to act in mixed reality. Controllers allow for fine-grained interaction with digital objects because they have a precise position in space.
- Omnidirectional Treadmills (ODTs): This accessory machine gives users the ability to move in any direction physically. ODTs allow users to move freely for a fully immersive experience in VR environments.
- Smelling Devices: Smell devices are one of the newer accessories in the VR world. Vaqso, a Tokyo-based company, offers a headset attachment that emits odors to convey the size and shape of a candy bar. The fan-equipped device holds several different smells that can change intensity based on the screen action.

**What Software Does Virtual Reality Use?**

Developers use various software to build VR. They include VR software development kits, visualization software, content management, game engines, social platforms, and training simulators.

- VR Content Management Systems Software: Companies use this workplace tool to collect, store and analyze VR content in a centralized location.

- VR Game Engine Software: Developers use the tools to create a VR video game experience.
- VR Software Development Kit (SDK): SDKs offer a base to design, build and test VR experiences.
- VR Social Platforms Software: Users collaborate from remote locations in VR with these tools.
- VR Training Simulator Software: This software works for almost any industry for employee training in immersive environments.
- VR Visualization Software: Users experience aggregated data in a virtual environment. to fully understand what data means.

*Non-Headset VR*

Napster's Trudgian points out another software technology that may someday disrupt headsets as a standard in VR: "Non-headset VR is coming, as demonstrated by the likes of Spatial, VRChat and RecRoom. "These apps allow users or players without headsets to connect to the same environment and interact with one another. Adding support for non-headset users serves virtual worlds well by adding a user base on universally accessible devices and platforms. In theory, if a virtual world is not reliant on headset-only users, it can expand in size tremendously; the amount of people who have access to a web browser or smartphone is far greater than that of any headset."

**Importance of Audio in Virtual Reality**

VR strives to emulate reality, so audio is vital role to creating credible experiences. Audio and visuals work together to add presence and space to the environment. Audio cues are also crucial for guiding users through their digital experience.

Convincing VR applications require more than graphics alone. Hearing and vision are also central to a person's perception of space. People react more rapidly to audio cues than to visual indicators. To produce truly immersive virtual

reality experiences, precise environmental noise and sounds as well as accurate spatial characteristics are required.

*Binaural or Spatial Audio in Virtual Reality Experience*

People hear in three dimensions. They can discern the direction sound comes from and the rough distance from the sound source. Simulation of aural sense delivers a more authentic multi-dimensional experience and is known as *biaural* or *spatial audio*.

Biaural or spatial audio emulates how human hearing functions. People have ears on both sides of the head and our brains adjust the sound accordingly. Sounds emanating from the right of the head reach the user's ear with a time delay, and vice versa. We, therefore, perceive sound as if positioned at a specific point in three-dimensional space.

Binaural and spatial audio lend a powerful sense of presence to any virtual world. To experience the binaural audio elements that comprise a VR experience, put on your best headphones and play around with this audio infographic published by The Verge.