

**Virtual reality**



**Virtual reality**

Virtual reality (VR) is a computer-generated scenario that simulates a realistic experience. The immersive environment can be similar to the real world in order to create a lifelike experience grounded in reality or sci-fi. Augmented reality systems may also be considered a form of VR that layers virtual information over a live camera feed into a headset, or through a smartphone or tablet device.

Current VR technology most commonly uses virtual reality headsets or multi-projected environments, sometimes in combination with physical environments or props, to generate realistic images, sounds and other sensations that simulate a user's physical presence in a virtual or imaginary 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.

VR systems that include transmission of vibrations and other sensations to the user through a game controller or other devices are known as haptic systems. This tactile information is generally known as force feedback in medical, video gaming and military training applications.

**Etymology and terminology**

Paramount for the sensation of immersion into virtual reality are a high frame rate (at least 95 fps), as well as a low latency.

"Virtual" has had the meaning "being something in essence or effect, though not actually or in fact" since the mid-1400s.[1] The term "virtual" has been used in the computer sense of "not physically existing but made to appear by software" since 1959.[1] In 1938, Antonin Artaud described the illusory nature of characters and objects in the theatre as "la réalité virtuelle" in a collection of essays, Le Théâtre et son double. The English translation of this book, published in 1958 as The Theater and its Double,[2] is the earliest published use of the term "virtual reality". The term "artificial reality", coined by Myron Krueger, has been in use since the 1970s. The term "virtual reality" was first used in a science fiction context in The Judas Mandala, a 1982 novel by Damien Broderick.

**A "cyberspace" is a networked virtual reality.**

Virtual reality shares some elements with "augmented reality" (or AR).[4] AR is a type of virtual reality technology that blends what the user sees in their real surroundings with digital content generated by computer software. The additional software-generated images with the virtual scene typically enhance how the real surroundings look in some way. Some AR systems use a camera to capture the user's surroundings or some type of display screen which the user looks at (e.g., Microsoft's HoloLens, Magic Leap.

**Technology**

The Virtual Reality Modelling Language (VRML), first introduced in 1994, was intended for the development of "virtual worlds" without dependency on headsets.[5] The Web3D consortium was subsequently founded in 1997 for the development of industry standards for web-based 3D graphics. The consortium subsequently developed X3D from the VRML framework as an archival, open-source standard for web-based distribution of VR content.

All modern VR displays are based on technology developed for smartphones including: gyroscopes and motion sensors for tracking head, hand, and body positions; small HD screens for stereoscopic displays; and small, lightweight and fast processors. These components led to relative affordability for independent VR developers, and lead to the 2012 Oculus Rift kickstarter offering the first independently developed VR headset.[7]

Independent production of VR images and video has increased by the development of omnidirectional cameras, also known as 360-degree cameras or VR cameras, that have the ability to record in all directions, although at low-resolutions or in highly compressed formats for online streaming.[8] In contrast, photogrammetry is increasingly used to combine several high-resolution photographs for the creation of detailed 3D objects and environments in VR applications.

**History**

The exact origins of virtual reality are disputed, partly because of how difficult it has been to formulate a definition for the concept of an alternative existence.[11] Elements of virtual reality appeared as early as the 1860s. French avant-garde playwright Antonin Artaud took the view that illusion was not distinct from reality, advocating that spectators at a play should suspend disbelief and regard the drama on stage as reality.[12] The first references to the more modern concept of virtual reality came from science fiction.

Laurence Manning's 1933 series of short stories, "The Men Who Awoke"—later a novel—describes a time when people ask to be connected to a machine that replaces all their senses with electrical impulses and, thus, live a virtual life chosen by them (à la "The Matrix", but voluntary, not imposed).

Stanley G. Weinbaum's 1935 short story "Pygmalion's Spectacles"[13] describes a goggle-based virtual reality system with holographic recording of fictional experiences, including smell and touch.

1950–1970

Morton Heilig wrote in the 1950s of an "Experience Theatre" that could encompass all the senses in an effective manner, thus drawing the viewer into the onscreen activity. He built a prototype of his vision dubbed the Sensorama in 1962, along with five short films to be displayed in it while engaging multiple senses (sight, sound, smell, and touch). Predating digital computing, the Sensorama was a mechanical device. Heilig also developed what he referred to as the "Telesphere Mask" (patented in 1960). The patent application described the device as "a telescopic television apparatus for individual use...The spectator is given a complete sensation of reality, i.e. moving three dimensional images which may be in colour, with 100% peripheral vision, binaural sound, scents and air breezes".[14]

Around the same time, Douglas Engelbart used computer screens both as input and output devices. In 1968, Ivan Sutherland, with the help of his student Bob Sproull, created what was widely considered to be the first head-mounted display (HMD) system for use in immersive simulation applications. It was primitive both in terms of user interface and realism, and the HMD to be worn by the user was so heavy that it had to be suspended from the ceiling. The graphics comprising the virtual environment were simple wire-frame model rooms. The formidable appearance of the device inspired its name, The Sword of Damocles.

Battlezone, an arcade video game from 1980, used 3D vector graphics to immerse the player in a VR world.(Atari).

Also notable among the earlier hypermedia and virtual reality systems was the Aspen Movie Map, which was created at MIT in 1978. The program was a crude virtual simulation of Aspen, Colorado in which users could wander the streets in one of the three modes: summer, winter, and polygons. The first two were based on photographs—the researchers actually photographed every possible movement through the city's street grid in both seasons—and the third was a basic 3-D model of the city. Atari founded a research lab for virtual reality in 1982, but the lab was closed after two years due to Atari Shock (North American video game crash of 1983). However, its hired employees, such as Tom Zimmerman, Scott Fisher, Jaron Lanier and Brenda Laurel, kept their research and development on VR-related technologies. By the 1980s the term "virtual reality" was popularized by Jaron Lanier, one of the modern pioneers of the field. Lanier had founded the company VPL Research in 1985. VPL Research has developed several VR devices like the Data Glove, the Eye Phone, and the Audio Sphere. VPL licensed the Data Glove technology to Mattel, which used it to make an accessory known as the Power Glove. While the Power Glove was hard to use and not popular, at US$75, it was an early affordable VR device.

The VR industry mainly provided VR devices for medical, flight simulation, automobile industry design, and military training purposes from 1970 to 1990.

1990–2000

In 1991, Carolina Cruz-Neira, Daniel J. Sandin and Thomas A. DeFanti from the Electronic Visualization Laboratory created the first cubic immersive room, The Cave. Developed as Cruz-Neira's PhD thesis, it involved a multi-projected environment, similar to the holodeck, allowing people to see their own bodies in relation to others in the room.

In 1992 researcher Louis Rosenberg created the Virtual Fixtures system at the U.S. Air Force’s Armstrong Labs using a full upper-body exoskeleton, enabling a physically realistic virtual reality in 3D. The system enabled the overlay of physically real 3D virtual objects registered with a user's direct view of the real world, producing the first true augmented reality experience enabling sight, sound, and touch.

A VPL Research DataSuit, a full-body outfit with sensors for measuring the movement of arms, legs, and trunk. Developed circa 1989. Displayed at the Nissho Iwai showroom in Tokyo

The 1990s saw the first widespread commercial releases of consumer headsets. In 1991, Sega announced the Sega VR headset for arcade games and the Mega Drive console. It used LCD screens in the visor, stereo headphones, and inertial sensors that allowed the system to track and react to the movements of the user's head. In the same year, Virtuality launched and went on to become the first mass-produced, networked, multiplayer VR entertainment system. It was released in many countries, including a dedicated VR arcade at Embarcadero Center in San Francisco. Costing up to $73,000 per multi-pod Virtuality system, they featured headsets and exoskeleton gloves that gave one of the first "immersive" VR experiences.[21] Antonio Medina, a MIT graduate and NASA scientist, designed a virtual reality system to "drive" Mars rovers from Earth in apparent real time despite the substantial delay of Mars-Earth-Mars signals.[22]

In 1991, Computer Gaming World predicted "Affordable VR by 1994".[23] By 1994, Sega released the Sega VR-1 motion simulator arcade attraction, in SegaWorld amusement arcades. It was able to track head movement and featured 3D polygon graphics in stereoscopic 3D, powered by the Sega Model 1 arcade system board.[26] Also in 1994 Apple released QuickTime VR, which, despite using the term "VR", was unable to represent virtual reality, and instead displayed 360 photographic panoramas.

The Virtual Boy was created by Nintendo and was released in Japan on July 21, 1995 and in North America on August 15, 1995.[27] Also in 1995, a group in Seattle created public demonstrations of a "CAVE-like" 270 degree immersive projection room called the Virtual Environment Theater, produced by entrepreneurs Chet Dagit and Bob Jacobson.[28] The same system was shown in 1996 in tradeshow exhibits sponsored by Netscape Communications.[citation needed] Forte released the VFX1, a PC-powered virtual reality headset in 1995, which was supported by games including Descent, Star Wars: Dark Forces, System Shock and Quake.

In 1999, entrepreneur Philip Rosedale formed Linden Lab with an initial focus on the development of VR hardware. In its earliest form, the company struggled to produce a commercial version of "The Rig", which was realized in prototype form as a clunky steel contraption with several computer monitors that users could wear on their shoulders. The concept was later adapted into the personal computer-based, 3D virtual world Second Life.

A 2013 developer version of Oculus Rift from Oculus VR, the company Facebook acquired in 2014 for $2 billion

2000–2015

In 2001, SAS3 or SAS Cube became the first PC based cubic room, developed by Z-A Production (Maurice Benayoun, David Nahon), Barco, Clarté, installed in Laval France in April 2001. The SAS library gave birth to Virtools VRPack. By 2007, Google introduced Street View, a service that shows panoramic views of an increasing number of worldwide positions such as roads, indoor buildings and rural areas. It also features a stereoscopic 3D mode, introduced in 2010.[30]

In 2010, Palmer Luckey designed the first prototype of the Oculus Rift. This prototype, built on a shell of another virtual reality headset, was only capable of rotational tracking. However, it boasted a 90-degree field of vision that was previously unseen in the consumer market at the time. This initial design would later serve as a basis from which the later designs came.

In 2013, Valve discovered and freely shared the breakthrough of low-persistence displays which make lag-free and smear-free display of VR content possible. This was adopted by Oculus and was used in all their future headsets.

In early 2014, Valve showed off their SteamSight prototype, the precursor to both consumer headsets released in 2016. It shared major features with the consumer headsets including separate 1K displays per eye, low persistence, positional tracking over a large area, and fresnel lenses.

**2015–present**

By 2016 there were at least 230 companies developing VR-related products. Facebook has 400 employees focused on VR development; Google, Apple, Amazon, Microsoft, Sony and Samsung all had dedicated AR and VR groups. Dynamic binaural audio was common to most headsets released that year. However, haptic interfaces were not well developed, and most hardware packages incorporated button-operated handsets for touch-based interactivity. Visually, displays were still of a low-enough resolution and frame-rate that images were still identifiable as virtual.[7] On April 5, 2016, HTC shipped its first units of the HTC VIVE SteamVR headset.[43] This marked the first major commercial release of sensor-based tracking, allowing for free movement of users within a defined space.[44]

In early 2017, a patent filed by Sony showed they were developing a similar location tracking technology to the VIVE for PlayStation VR, with the potential for the development of a wireless headset.

**Applications**

U.S. Navy personnel using a VR parachute training simulator.

VR has many applications in a variety of fields. It is most commonly used in entertainment applications such as gaming and 3D cinema. Consumer virtual reality headsets were first released by video game companies in the early-mid 1990's. Beginning in the 2010's, next-generation commercial tethered headsets were released by Oculus, the HTC Vive and PlayStation VR, setting off a new wave of application development.[46]

3D cinema has been used for sporting events, pornography, fine art, music videos and short films. Since 2015, virtual reality has been installed onto a number of roller coasters and theme parks]

In robotics, virtual reality has been used to control robots in telepresence and telerobotic systems.

In social sciences and psychology, virtual reality offers a cost-effective tool to study and replicate interactions in a controlled environment.

"World Skin, A Photo Safari in the Land of War" - Maurice Benayoun, Jean-Baptiste Barrière, Virtual Reality Installation - 1997

Surgery training can be done through virtual reality.[50][51] Other medical uses include virtual reality exposure therapy (VRET), a form of exposure therapy for treating anxiety disorders such as post traumatic stress disorder (PTSD) and phobias.[52][53] In some cases, patients no longer meet the DSM-V criteria for PTSD after a series of treatments with VRET.

VR can simulate real spaces for workplace occupational safety and health purposes, educational purposes, and training purposes. It can be used to provide learners with a virtual environment where they can develop their skills without the real-world consequences of failing. It has been used and studied in primary education,[55] military,[56][57] astronaut training,[58][59][60] flight simulators[61] and driver training.[62]

The first fine art virtual world was created in the 1970s.[63] As the technology developed, more artistic programs were produced throughout the 1990s. When commercially available technology became more widespread, VR festivals began to emerge in the mid-2010s. The first uses of VR in museum settings began in the 1990s, seeing significant increase in the mid-2010s. Additionally museums have begun making some of their content virtual reality accessible.[64][65] Immersive VR engineering systems enable engineers to see virtual prototypes prior to the availability of any physical prototypes.