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DEPARTMENT OF CIVIL ENGINEERING

19CET308- AR/VR in Civil Engineering

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AR/VR

Introduction to VR

History of VR

AR & VR

Augmented reality (AR) combines the real and virtual worlds, while virtual reality (VR) is completely virtual. AR enhances the real world with digital elements, while VR creates a fully-immersive digital environment.

Features:

AR

- **Combines digital and physical worlds, allows real-time interactions, and accurately identifies virtual and real objects.**

VR

- **Creates a computer-generated world that feels genuine, with realistic visuals, spatial audio, and multi-sensory haptic equipments.**

Mixed reality:

- **A hybrid of AR and VR that allows users to interact with a virtual environment while still seeing and immersing themselves in the real world**

INTRODUCTION TO VR

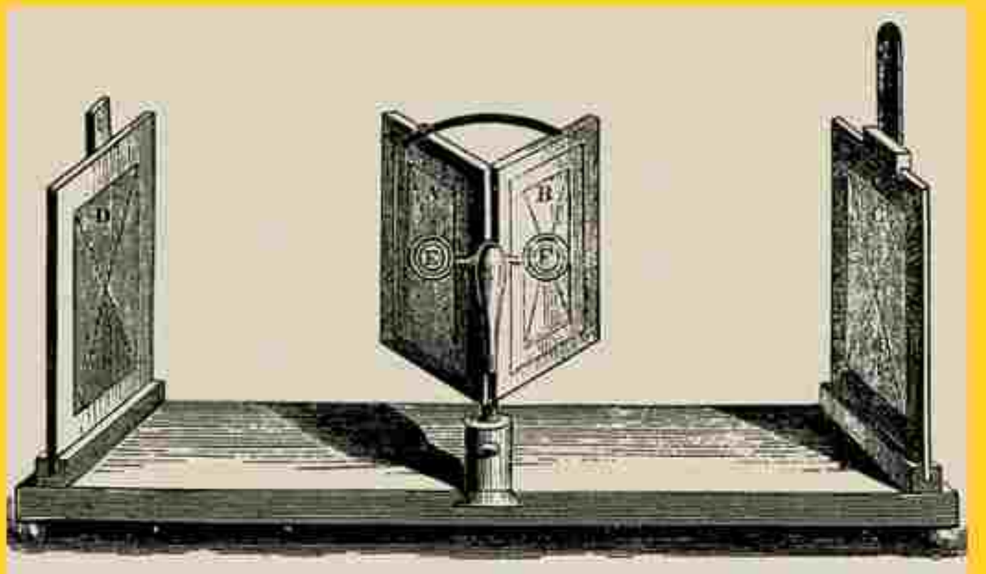
- Virtual reality (VR) is a simulated experience that employs 3D near-eye displays and pose tracking to give the user an immersive feel of a virtual world. Applications of virtual reality include entertainment (particularly video games), education (such as medical, safety or military training) and business (such as virtual meetings).
- VR is one of the key technologies in the reality-virtuality continuum. As such, it is different from other digital visualization solutions, such as augmented virtuality and augmented reality.
- Currently, standard virtual reality systems use either virtual reality headsets or multi-projected environments to generate some 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

HISTORY OF VR – TIMELINE OF EVENTS AND TECH DEVELOPMENT

The first VR technical developments were in the 1830s, so this is where our timeline starts:

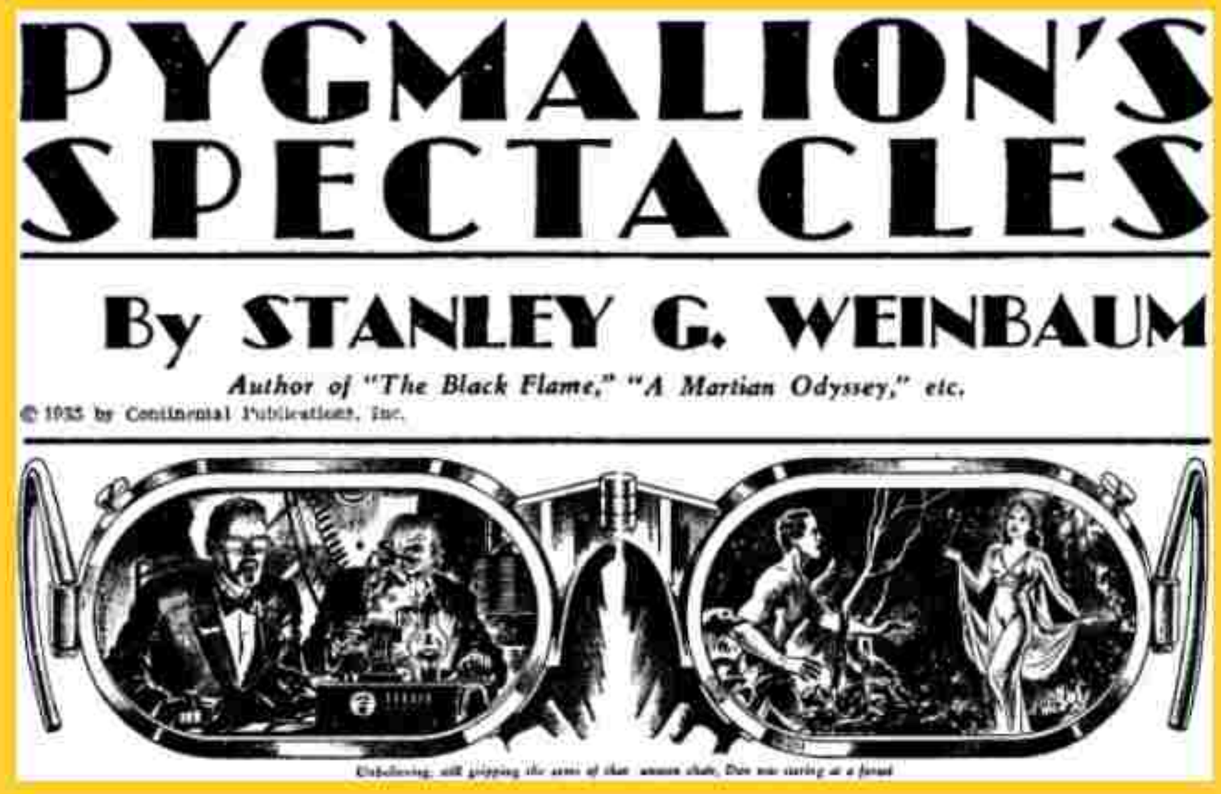
1838

- Sir Charles Wheatstone was the first to describe stereopsis in 1838 and was awarded the Royal Medal of the Royal Society in 1840 for his explanation of binocular vision, a research which led him to construct the stereoscope.



1935

In 1935 American science fiction writer Stanley Weinbaum presented a fictional model for VR in his short story Pygmalion's Spectacles.



PYGMALION'S SPECTACLES

By STANLEY G. WEINBAUM

Author of "The Black Flame," "A Martian Odyssey," etc.

1956

Cinematographer Morton Heilig created Sensorama, the first VR machine (patented in 1962). It was a large booth that could fit up to four people at a time. It combined multiple technologies to stimulate all of the senses: there was a combined full colour 3D video, audio, vibrations, smell and atmospheric effects, such as wind.

1960

Heilig also patented the Telesphere Mask which was the first head-mounted display (HMD). This provided stereoscopic 3D images with wide vision and stereo sound. There was no motion tracking in the headset at this point.

1961

Until Headsight was created by Comeau and Bryan, two Philco Corporation engineers. Headsight was the first motion tracking HMD. It had built-in video screens for each eye and a head-tracking system.

However, this wasn't used for virtual reality; it was developed for the military to allow them to remotely look at hazardous situations. A remote camera imitated the head movements so the user could look around the setting.

1965

Ivan Sutherland, a computer scientist, presented his vision of the Ultimate Display. The concept was of a virtual world viewed through an HMD which replicated reality so well that the user would not be able to differentiate from actual reality. This included the user being able to interact with objects. This concept featured computer hardware to form the virtual world and to keep it functioning in real-time. His paper is seen as the fundamental blueprint for VR.

1966

Thomas Furness, a military engineer, created the first flight simulator for the Air Force. This assisted in the progression of VR because the military subsequently provided a lot of funding for producing better flight simulators.

1968

Sutherland, with his student Bob Sproull, created the first virtual reality HMD, named The Sword of Damocles. This head-mount connected to a computer rather than a camera and was quite primitive as it could only show simple virtual wire-frame shapes.

1969

Myron Krueger, a computer artist, developed a succession of “artificial reality” experiences using computers and video systems. He created computer-generated environments that responded to the people in it. These projects led to VIDEOPLACE technology which is mentioned later.

1972

General Electric Corporation built a computerised flight simulator which featured a 180-degree field of vision by using three screens surrounding the cockpit.

1975

Krueger's VIDEOPLACE, the first interactive VR platform, was displayed at the Milwaukee Art Center. It used computer graphics, projectors, video cameras, video displays and position-sensing technology and it didn't use goggles or gloves. VIDEOPLACE consisted of dark rooms with large video screens to surround the user in "VR".

1977

Aspen Movie Map was created by MIT. This program enabled users to virtually wander through Aspen city in Colorado, like with Google Street View. There were three modes: summer, winter and polygons.

It was created using photographs from a car driving through the city. There were no HMDs but it was the use of first-person interactivity and it suggested that VR could transport people to other places.

1979

McDonnell-Douglas Corporation integrated VR into its HMD, the VITAL helmet, for military use. A head tracker in the HMD followed the pilot's eye movements to match computer-generated images.

1980

StereoGraphics company created stereo vision glasses.

1982

Sayre gloves were created by Sandin and Defanti. These gloves were the first wired gloves. They monitored hand movements by using light emitters and photocells in the gloves' fingers. So, when the user moved their fingers the amount of light hitting the photocell varied which then converted the finger movements into electrical signals. This may have been the beginning of gesture recognition.

Furness created a working model of a virtual flight simulator, for the military, called the Visually Coupled Airborne Systems Simulator (VCASS).

1985

Jaron Lanier and Thomas Zimmerman founded VPL Research, Inc. This company is known as the first company to sell VR goggles and gloves. They developed a range of VR equipment, such as, the DataGlove, EyePhone HMD and the Audio Sphere.

1986

Furness developed a flight simulator between 1986-1989 known as the Super Cockpit. The training cockpit featured: computer-generated 3D maps, advanced infrared and radar imagery and the pilot could see and hear in real-time.

The helmet's tracking system and sensors allowed the pilot to control the aircraft using gestures, speech and eye movements. Read more about Thomas Furness.

1987

British Aerospace used the HMD similarly to Furness' Super Cockpit and developed the Virtual Cockpit which also featured speech recognition.

Jaron Lanier popularised the term "Virtual Reality" while at VPL Research. The VR and graphics-related patents were later bought by Sun Microsystems.

The company Dimension International created a software that could build 3D worlds in a PC.

1989

Scott Foster founded Crystal River Engineering Inc after receiving a contract from NASA to develop the audio element of the Virtual Environment Workstation Project (VIEW) – a VR training simulator for astronauts. Through this company real-time binaural 3D audio processing was developed.

1990

Jonathan Waldern exhibited Virtuality, a VR arcade machine, at the Computer Graphics 90 exhibition in London.

1991

Antonio Medina, a NASA scientist, designed a VR system to drive the Mars robot rovers from Earth in supposed real-time despite signal delays between the planets. This system is called "Computer Simulated Teleoperation".

1994

SEGA released SEGA VR-1, a motion simulator arcade machine.

VictorMaxx released a VR headset called CyberMaxx.

1995

Nintendo launched the Virtual Boy console which played 3D monochrome video games. It was the first portable console to display 3D graphics. But it was a commercial failure due to:

- **The lack of colour graphics**
- **The lack of software support**
- **It wasn't comfortable to use**

1997

Georgia Tech and Emory University researchers used VR to create war zone scenarios for veterans receiving exposure therapy for PTSD. This was known-as Virtual Vietnam

2001

SAS Cube was the first PC based cubic room. It led to Virtools VR Pack.

2007

Google introduced Street View.

Immersive Media was identified as the contractor that captured the imagery for four of the five cities initially mapped by Street View, using its patented dodecahedral camera array on a moving car.

2010

Google introduced a stereoscopic 3D mode for Street View.

Palmer Luckey, an 18-year-old entrepreneur, created the first prototype of the Oculus Rift headset. It featured a 90-degree field of vision, which had never been seen before, and relied on a computer's processing power to deliver the images. This new development boosted and refreshed interest in VR.

2012

Luckey launched a Kickstarter campaign for the Oculus Rift which raised $2.4 million.

2014

Facebook bought the Oculus VR company for $2 billion. This was a defining moment in VR's history because VR gained momentum rapidly after this.

Sony announced that they were working on Project Morpheus, a VR headset for the PlayStation 4 (PS4).

Google released the Cardboard – a low-cost and do-it-yourself stereoscopic viewer for smartphones.

Samsung announced the Samsung Gear VR, a headset that uses a Samsung Galaxy smartphone as a viewer.

2015

VR possibilities started becoming widely available to the general public, for example:

- **The Wall Street Journal launched a VR roller coaster that followed the ups and downs of the Nasdaq Stock Market.**
- **The BBC created a 360-degree video where users view a Syrian migrant camp.**
- **The Washington Post released a VR experience of the Oval Office at the White House Correspondents' Association Dinner.**
- **RYOT, a media company, exhibited Confinement, a short VR film about solitary confinement in US prisons.**

2016

By 2016 hundreds of companies were developing VR products.

Most of the headsets had dynamic binaural audio.

Haptic interfaces were underdeveloped. Haptic interfaces are systems that allow humans to interact with a computer using their touch and movements – like the Gloveone gloves that were being developed. This meant that handsets were typically button-operated.

HTC released its HTC VIVE SteamVR headset. This was the first commercial release of a headset with sensor-based tracking which allowed users to move freely in a space.

2017

Many companies are developing their own VR headsets, including HTC, Google, Apple, Amazon, Microsoft Sony, Samsung etc.

Sony may be developing a similar location tracking tech to HTC's VIVE for the PlayStation 4.

2018

At Facebook F8, Oculus demonstrated a new headset prototype, the Half Dome. This is a varifocal headset with a 140 degrees field of vision.

Virtual reality has significantly progressed and is now being used in a variety of ways, from providing immersive gaming experiences, to helping treat psychological disorders, to teaching new skills and even taking terminally ill people on virtual journeys. VR has many applications and with the rise in smartphone technology VR will be even more accessible.

2019

Forbes describes this as The Year Virtual Reality Gets Real. Oculus Quest, Facebook's standalone headset, created a lot of interest and momentum, selling out in many locations and generating $5 million worth of content sales.

The shift from tethered to standalone VR headsets represented a shift within the immersive ecosystem, as standalone headsets are much easier to use for the average consumer.

Road to VR reported that the monthly-connected VR headsets on Steam had surpassed 1 million for the first time.

Nintendo entered the VR market with the Labo: VR kit for Nintendo Switch on April 12.

In March, Beat Saber became the first application to sell over 1 million copies in under a year.

2020

The Oculus Quest 2 was unveiled on September 16, 2020, during the Facebook Connect 7 event.

The Quest 2 received mostly positive reviews as an incremental update to the Quest and continues to sell in the millions around the world.

2021

Pico launches the Pico Neo 3 headset, a competitor to the Oculus Quest 2 headset.

The Chinese company ByteDance, which owns TikTok, acquired Pico in a push to diversify its business.

Facebook (now Meta) plans to spend at least $10 billion this year on Facebook Reality Labs, its metaverse division tasked with creating AR and VR hardware, software, and content.

2023

Apple announced its entry into the VR market with the Apple Vision Pro, an upcoming mixed-reality headset announced on June 5, 2023, at its 2023 Worldwide Developers Conference (WWDC). The headset will sell for $3,499.

Meta announced the Meta Quest 3 on June 1, 2023, and it was launched on October 10. The Meta Quest 3 is a mixed-reality headset featuring significant advancements in display quality, processing power, and tracking capabilities. It boasts a resolution of 2160 x 2160 per eye (compared to 1832 x 1920 in the Quest 2), the Snapdragon XR2+ processor, and inside-out tracking with improved accuracy and field of view. The headset is available for $499.

2024

On February 2nd, 2024, the highly anticipated Apple Vision Pro arrived in the hands of eager early adopters in the US. The release generated significant excitement, with the internet flooded with videos and testimonials showcasing the device in various settings. While some saw it as a potential catalyst for mainstream VR adoption, others raised concerns about its accessibility and content ecosystem.

Thankyou