Online Communication in the Digital Age
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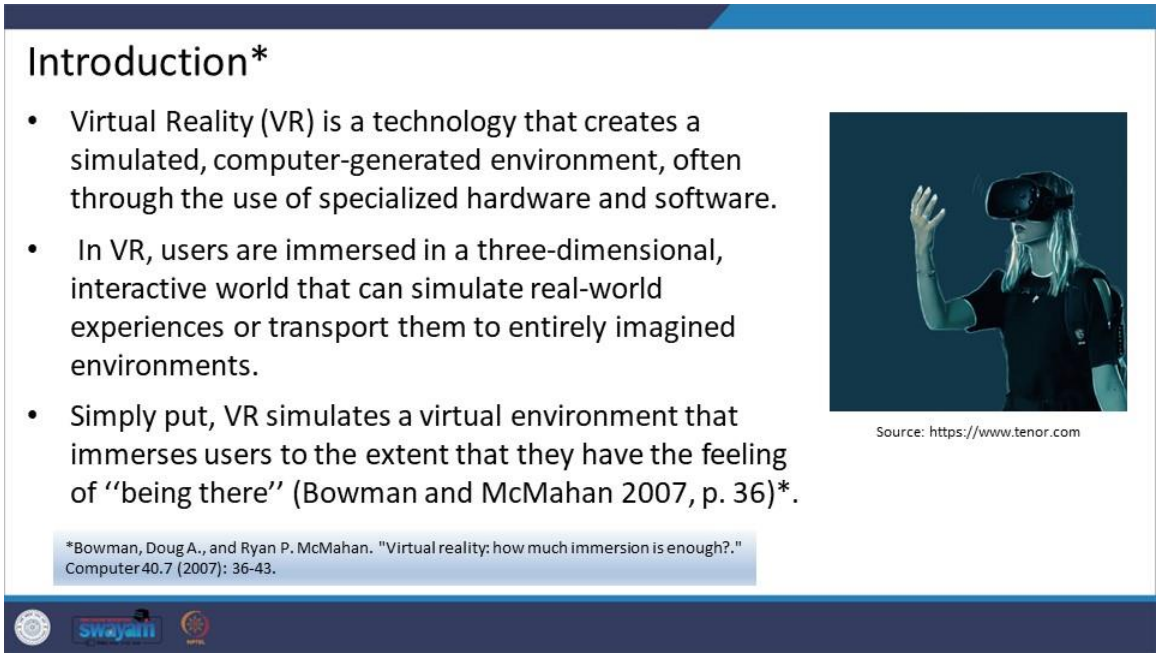
Lecture – 58
Virtual Reality and the Metaverse

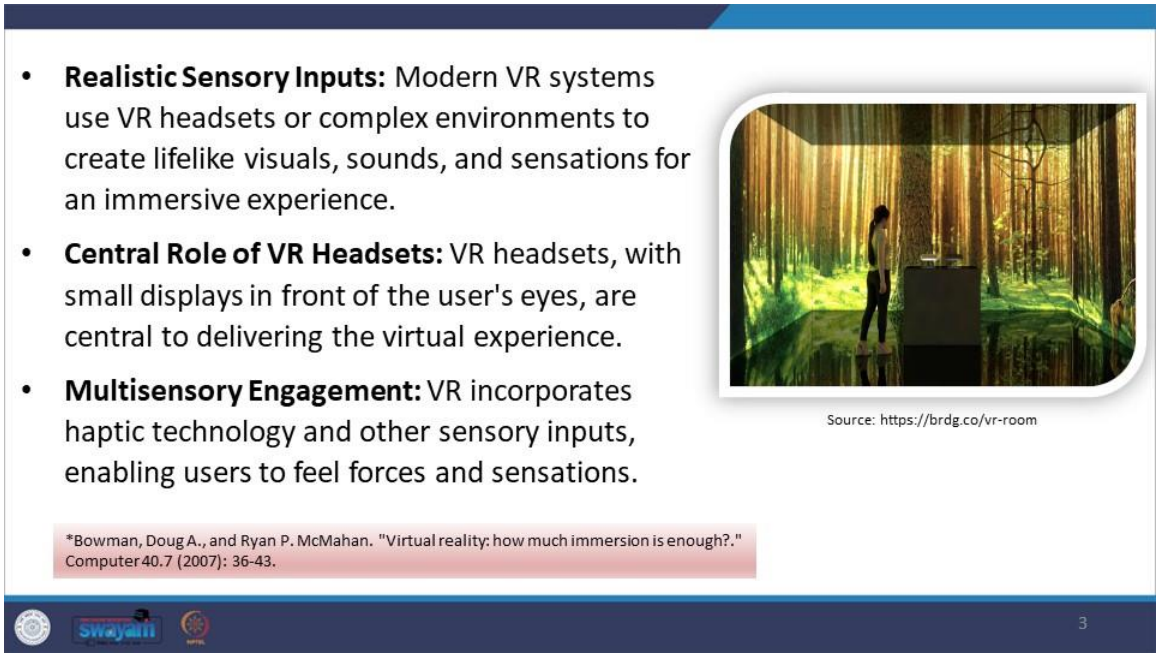
Good morning dear friends and welcome to this module today. We have discussed augmented reality and its various applications in the previous module. Today, we shall look at the concept of virtual reality. In fact, virtual reality is an offshoot of the same experimentation that had given birth to AR earlier. Virtual reality, though not new, is a re-emerging concept that is transforming how we perceive and interact with digital environments. It immerses users in simulated worlds offering exciting possibilities across industries from gaming to education and beyond.



So VR is a technology that creates a simulated and computer-generated environment, often through the use of specialized hardware and software. In virtual reality, users are immersed in a three-dimensional interactive world that can simulate the real-world experience or transport them to entirely imagined environments. We can say that VR simulates a virtual environment that immerses users to the extent that they have the feeling of actually being there.

The primary goal of VR is to provide an immersive and interactive experience that blurs the line between the physical and the digital realms.

It engages users in ways that traditional media cannot simply imagine.



Modern VR systems use VR headsets or complex environments to create life-like visuals, sounds and sensations for an immersive experience. VR headsets with small displays in front of the user's eyes are central to delivering the virtual experience. It also incorporates haptic technology and other sensory inputs, which enable us to feel forces and sensations in a multi-sensory engagement.

The etymology of virtual reality is a journey through language and technology. The term virtual is etymologically derived from a Latin root, virtues, which means virtue. It has roots in the mid-1400s, signifying something in essence, but not in actuality or in fact. However, it was in 1959 that for the first time in English language, the term virtual reality emerged. In the computerized sense of not physically existing, but made to appear by software, it took another couple of decades. It initiated the concept that transcends the boundaries of reality itself.

Etymology

- In 1938, Antonin Artaud coined "la réalité virtuelle" to depict theater's illusory nature in *Le Théâtre et son double*.
- The term's English debut was in 1958 through the translation of this work (Artaud, 1958)*.
- Damien Broderick introduced "virtual reality" in 1982 in *The Judas Mandala* in a science fiction context.
- The late 1980s witnessed Jaron Lanier's contributions via VPL Research, popularizing the term.
- The 1992 film *Lawnmower Man* played a pivotal role in mainstream recognition, marking "virtual reality" as a cultural phenomenon (Faisal, 2017)**.

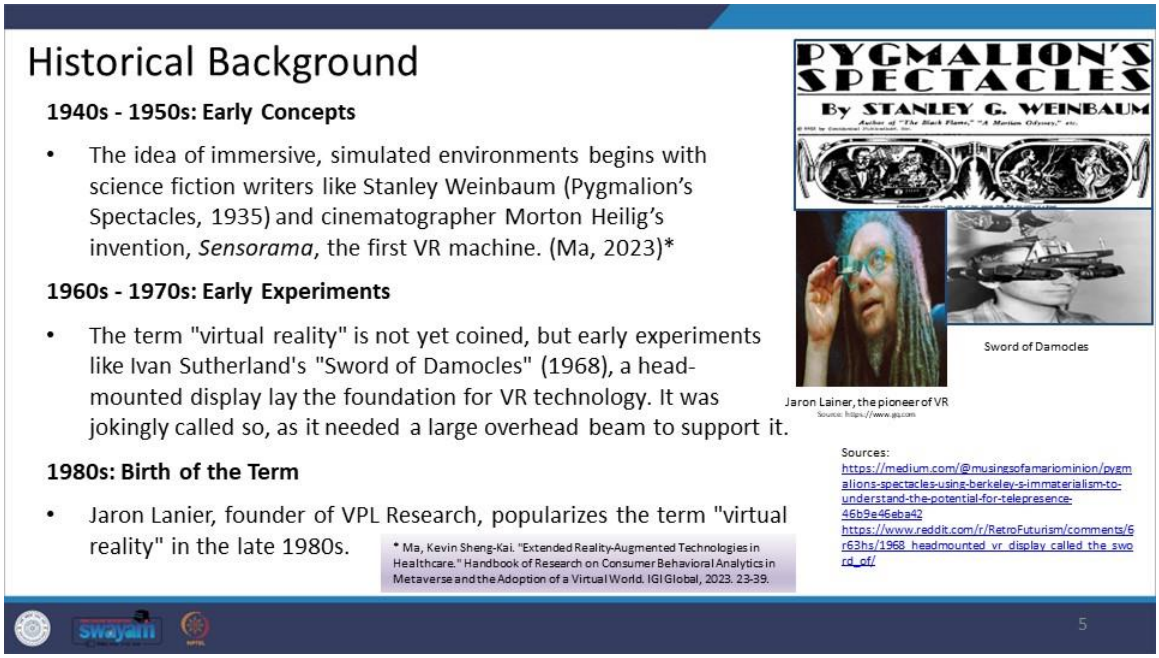
Source: https://www.galignani.fr

*Artaud, Antonin. "The Theatre and its Double, trans." Mary Caroline Richards (New York: Grove, 1958) 124 (1958).

**Faisal, Aldo. "Computer science: Visionary of virtual reality." Nature 551.7680 (2017): 298-299.

The term was first of all used in French. It was Artaud who coined the phrase, la realitie virtuelle, to depict the theatre's illusory nature in his book. It was through the English translation of this book, which came out in 1958, that the phrase was introduced to English. It was Broderick who introduced virtual reality in 1982 in the Judas Mandela that was in the context of science fiction. The late 1980s witnessed Lenier's contributions via VPL research, popularizing the term further. The 1992 film Lawnmower Man played a pivotal role to mainstream recognition, marking virtual reality as a cultural phenomenon.

The history of virtual reality is a captivating journey that combines human imagination with technological advancements. It traces its roots from the imaginative worlds of early science fiction to groundbreaking experiments in the 1960s and 70s.



It was during this time that the early concepts about virtual reality started to emerge. The idea of immersive simulated environments begins with science fiction writers like Weinbaum's Pygmalion's Spectacles, the famous story which was published in 1935, and cinematographer Morton Hellig's invention, Sensorama, the first VR machine. During the 60s and 70s, we find that the term virtual reality is not yet coined, but early experiments like Sutherland's Sort of Democles in 1968 came very close to it. Sort of Democles was a head-mounted display which had laid the foundation for VR technology. It was termed jokingly like it as it needed a large overhead beam to support it. In the 1980s, specifically in the late 1980s, we find that Jaron Lanier, who is considered to be the founder of the VPL research, popularized the term virtual reality.

The 1990s marked a turning point in the history of VR. In the 1990s, we look at the evolution of VR from the early experiments of the 1960s and 70s to an era when it gained widespread attention.

1990s: Rise and Fall

- VR gains attention with devices like the Virtual Boy (1995), a 32-bit tabletop portable video game console by Nintendo and VR arcades but faces a setback due to high costs and limited content.

2000s - 2010s: Rebirth and Advancements

- Advances in computing power, graphics, and mobile technology lead to a resurgence of interest in VR, with the introduction of the Oculus Rift (2012) and other VR headsets (Wohlgenannt et al., 2020)*

2020s: Integration and Expansion

- VR becomes more accessible and is integrated into various fields, from gaming and education to healthcare and remote work.

Oculus Rift
Source: https://en.wikipedia.org

*Wohlgenannt, Isabell, Alexander Simons, and Stefan Stieglitz. "Virtual reality." Business & Information Systems Engineering 62 (2020): 455-461.

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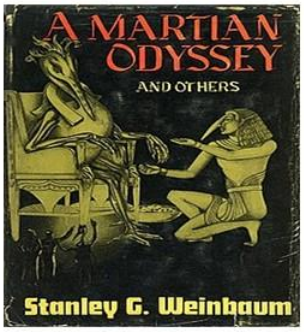
We find that the concept gains attention with the invention of devices like Virtual Boy in 1995. However, it also faced a setback due to the high costs and limited content. The Virtual Boy was a 32-bit tabletop portable video game console. Advances in computing power, graphics, and mobile technology during the early decades of the 21st century led to a resurgence of interest in VR with the introduction of the Oculus Rift in 2012 and other VR headsets, etc. In 2020s, we look at the scenario where VR becomes more accessible and is integrated into various fields from gaming and education to healthcare and remote work. That is, now it is becoming a compulsory part of digital communication in different fields.

Pygmalion's Spectacles was a concept which was introduced by Stanley Weinbaum in 1935. It planted the seeds of virtual reality and gradually we find that it also became a scientific reality.

*Pygmalion's Spectacles**

- ***Pygmalion's Spectacles*** is a pioneering science fiction short story taken from Stanley G. Weinbaum's work ***A Martian Odyssey and Others*** published in 1949
- It introduced the concept of a head-mounted display, a precursor to modern virtual reality systems.
- The story revolves around a device created by a Professor Moe that allows wearers to not only see and hear a recorded virtual world but also experience other senses, including touch, taste, and smell.
- Weinbaum's story explored ideas that were remarkably ahead of its time, including the use of technology for virtual reality experiences.



Source: https://en.wikipedia.org

*Weinbaum, Stanley Grauman. A Martian Odyssey and Others. Reading, PA: Fantasy Press, 1949.

So, Pygmalion's Spectacles is a famous and well-known science fiction short story. It was republished in the volume titled A Martian, Odissi, and Others, which was published in 1949. It had introduced the concept of a head-mounted display, which can be taken as a precursor to modern virtual reality systems. The story revolves around a device which has been created by the fictional character Professor Mo that allows wearers not only to see and hear a recorded virtual world, but also experience other senses including touch, taste, and smell. This story explored ideas that were remarkably ahead of its time, including the use of technology for virtual reality experiences. These imaginary spectacles offered the wearer an immersive audio-visual experiences foreshadowing the transformative role technology would play in shaping modern VR, where reality and imagination converge in digital realms. Similarly, Morton Hellig' Sensorama laid crucial foundations for the VR technology as we know and are acquainted with today.

Sensorama

- The Sensorama, introduced by Morton Heilig in 1962, stands as one of the earliest instances of immersive, multimodal technology.
- This pioneering technology is recognized as one of the precursors to modern virtual reality systems.
- The Sensorama was a mechanical device, which incorporated a stereoscopic display, fans, scent emitters, stereo sound, and a motion chair.
- It simulated a New York motorcycle ride with a virtual experience that simulated the noise and smell of the city. (Regrebsubla, 2016)*

* Regrebsubla, Namron. Determinants of Diffusion of Virtual Reality. GRIN Verlag, 2016.

Source: https://www.researchgate.net

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In understanding VR, it is essential to grasp its core components that transport users to immersive digital realms. From medium to sensory feedback, each element plays a crucial role in transporting users to digital realms that blur the line between fiction and reality.

Key Elements of a VR Experience

- **A Virtual World (Medium):** Biocca and Levy's (1995)* definition characterizes the virtual world as a computer-generated space where one or more users engage with each other through various graphical representations, including two-dimensional or three-dimensional elements.
- **Immersion**:**
  - Passive Immersion: Users only receive information with no interaction (e.g. watching a movie)
  - Active Immersion: Includes interacting with objects (e.g. artist concentrated on creating a scene)

* Biocca, Frank, and Mark R. Levy, eds. Communication in the age of virtual reality. Routledge, 2013.

** Nakatsu, Ryohei, and Naoko Tosa. "Active immersion: the goal of communications with interactive agents." KES'2000. Fourth International Conference on Knowledge-Based Intelligent Engineering Systems and Allied Technologies. Proceedings (Cat. No. 00TH8516). Vol. 1. IEEE, 2000.

So what are the key elements of a VR experience? So a virtual world can be defined as a computer-generated space where one or more users engage with each other through various graphical representations, including two or three-dimensional elements. Immersion can be either passive or active. In passive immersion, users only receive information with no interaction. In the active immersion, we find that the users can interact with objects. For example, artists concentrated on creating and developing a scene.

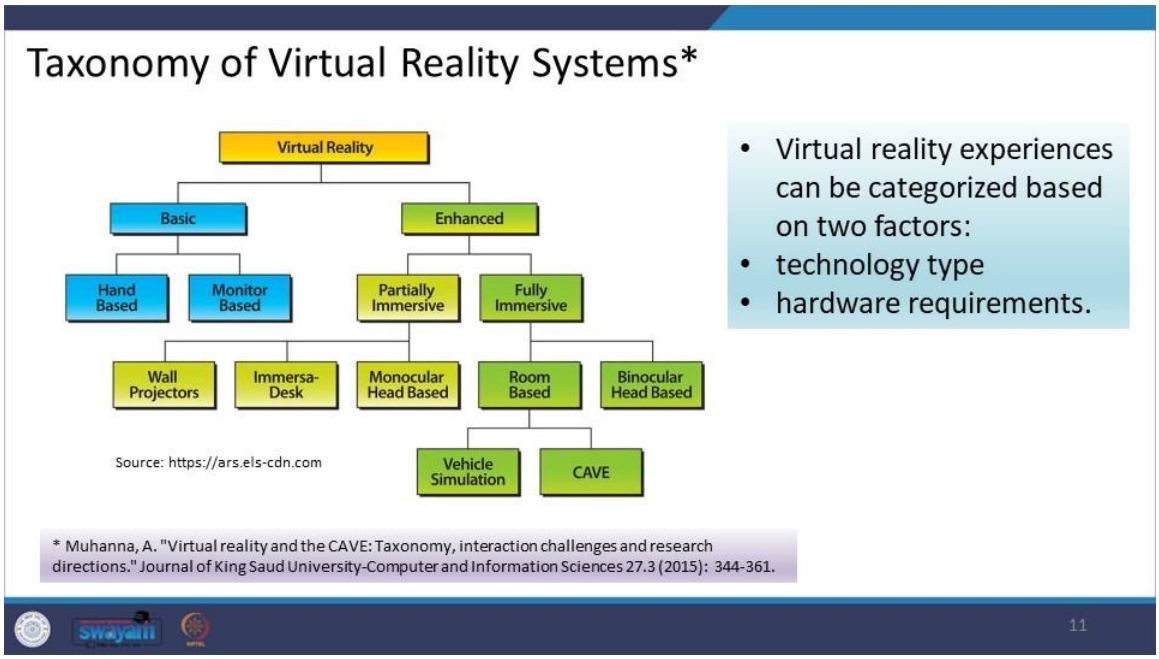
- **Feedback:** Feedback empowers participants to witness the outcomes of their actions. For instance, in a virtual display, when a participant moves their head, the displayed image should dynamically update in response to their movement. (Sherman and Craig, 2003)*
- **Interactivity**:**
  - Viewpoint Motion Control: Gives participant the ability to navigate in the virtual world
  - Manipulation: Interaction is achieved through selecting a virtual object and manipulating its state

* Sherman, William R., and Alan B. Craig. Understanding virtual reality: Interface, application, and design. Morgan Kaufmann, 2018.

** Bowman, Doug A., and Larry F. Hodges. "Formalizing the design, evaluation, and application of interaction techniques for immersive virtual environments." Journal of Visual Languages & Computing 10.1 (1999): 37-53.

Feedback empowers participants to witness the outcome of their actions. For instance, in a virtual display, when a participant moves their head, the displayed image should dynamically update in response to their movement. Interactivity can be understood either as viewpoint motion control or as manipulation. So the viewpoint motion control gives participants the ability to navigate in the virtual world. Manipulation is achieved through selecting a virtual object and manipulating its state.

Navigating the diverse landscape of VR systems requires a clear taxonomy. By classifying VR systems, we gain insights into their capabilities and potential applications.

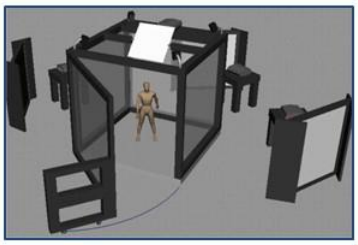


Virtual reality experiences can be categorized based on two factors. It can be the technology type or there may be hardware requirements also. The particular graph which we can see illustrates it further.

This categorization system helps us to understand the variations in VR from basic systems without specialized hardware to enhanced setups offering full immersion. CAVE automated virtual environments or cave systems have revolutionized the immersive experiences. CAVEs can transport users to entirely new dimensions, making them a powerful tool for research, design, as well as entertainment.

Cave Automated Virtual Environment (CAVE)

- The CAVE was created in 1992 by researchers at the University of Illinois's Electronic Visualization Lab (Cruz-Neira et al. 2023).
- CAVE typically consists of multiple walls where 3D computer-generated images are projected, creating a 360-degree immersive environment.
- Users wear special glasses to experience depth perception and realistic 3D visuals.
- Modern CAVE systems expand immersion by projecting scenes on ceilings, creating six-wall CAVEs.



Source: https://ars.els-cdn.com

* Cruz-Neira, Carolina, Daniel J. Sandin, and Thomas A. DeFanti. "Surround-screen projection-based virtual reality: the design and implementation of the CAVE." Seminal Graphics Papers: Pushing the Boundaries, Volume 2. 2023. 51-58.

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The video which we will be showing now demonstrates this concept in action.

Source: Idaho National Laboratory **Video Link:** https://www.youtube.com/watch?v=M16mz8Pc_OM

Using glasses to create depth perception and holding a wand to move and rotate images, users can delve into data. With the cave, engineers, scientists and others can literally walk into their data and interact with it, allowing them to gain new insight into a model or problem. This technology allows advanced test reactor personnel to understand how the reactor vessel and other pieces of the plant are assembled. It allows us to effectively and efficiently and safely perform work in a virtual environment and then bring that technology or that information or understanding back to the plant so that we can effectively and efficiently use it in our daily work.

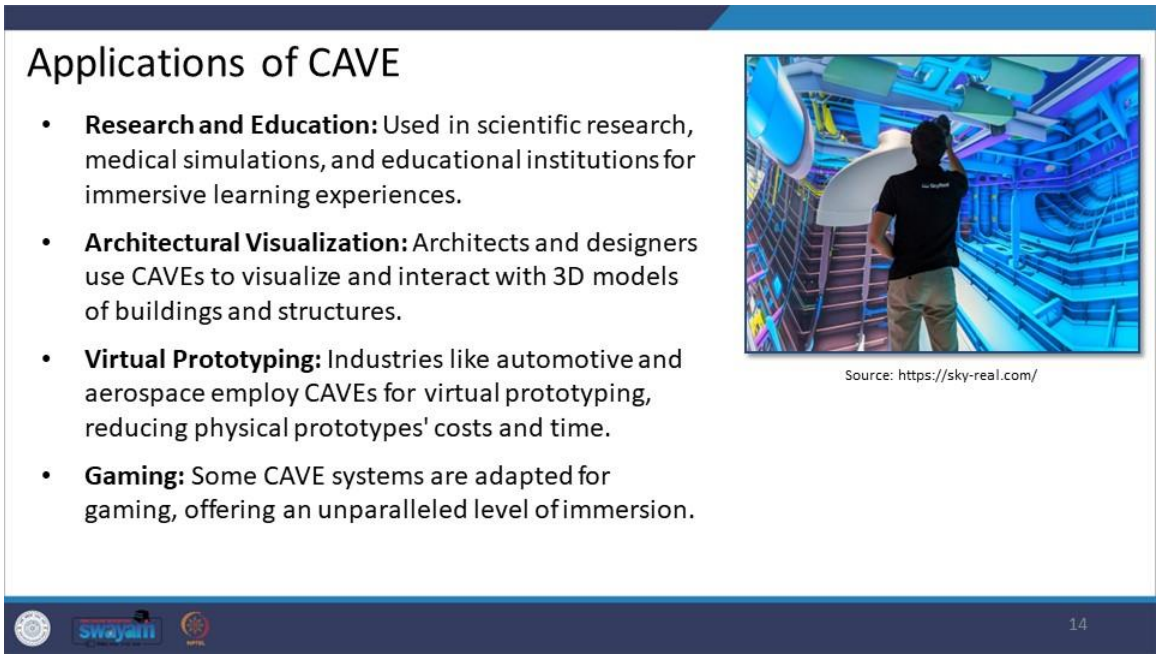
Caves Geofluids Energy Science researchers use the cave to examine the layers of rock at Milad Gorge and whether similar formations could someday act as underground storage for carbon dioxide. LiDAR data of the gorge, which was produced with laser scans, provides them with a precise model that took days to create. We use the cave as a surrogate because we're collecting all this detailed data from the field and we can run our models and see what kind of results we get and if we're not sure of a small area, instead of driving all the way back to the field area, we could go in the cave and look at small areas in detail and we could refine our models and go back through and try to run things again to get a better result. This is the only facility in Idaho, Montana and Utah with a cave. Caves operates the cave as a user facility so industry, universities, government agencies and others can access it.

Idaho Falls Power uses it to examine a new transmission line route it wants to build north of the city. By taking LiDAR data of the route and overlaying it with images of proposed power lines, the utility has been able to understand how the project would affect vegetation, road access points and individual landowners. For what we do as a matter of communicating with people, we live in a visual world and the biggest selling point for any project is our ability to communicate with the public and the agencies that we are impacting with a particular alignment and so to be able to present that to them in a three-dimensional world is I think a phenomenal tool that we hope to learn to use effectively and efficiently as we move forward with the different technology. In addition to being a powerful research tool, the cave is aiding INL and K's in their mission to increase the number of students entering the science, technology, engineering and math fields. Students are able to visualize science and math and understand how computer modeling is aiding research.

The cave here in the K's facility is one of the gems that everybody likes to see and likes to visit. It's visited extensively by people from the community, from around the state, from industry partners and from people within the laboratory. The thing that people really walk away from the cave with is a new appreciation for these advanced

capabilities. The ability to see their data in this three-dimensional space opens the door to all kinds of new exciting research and collaborations.

Consequently, we can note that the applications of cave automated virtual environments extend far beyond entertainment. From architectural design and scientific research to education, caves offer immersive solutions that bridge the gap between the physical and the digital worlds.



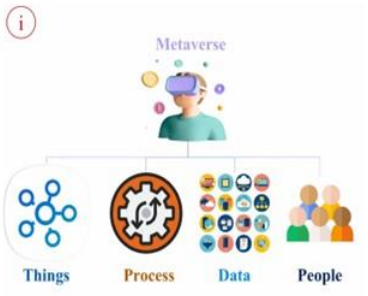
So what can be the applications of CAVE in our real-life communication in the professional world? It is used in scientific research, medical simulations and educational institutions for immersive learning experiences. Architects and designers use CAVEs to visualize and interact with 3D models of buildings and structures. Industries like automotive and aerospace employ caves for virtual prototyping, reducing physical prototypes costs and time. Some CAVE systems are adapted for gaming, offering an unparalleled level of immersion.

VR has influenced the birth of virtual worlds. In turn, this phenomenon has created what is today known as the metaverse. The metaverse is an evolving digital frontier that transcends traditional concepts of virtual reality. Originating from science fiction and propelled by technological advancements, the metaverse represents a convergence of digital, social and economic landscapes.

The Metaverse

- The term “Metaverse” combines “meta” (from Greek, signifying transcending) and "verse" (meaning universe).
- The metaverse refers to a collective virtual shared space of interconnected virtual environments inhabited by digital representations of people (avatars).
- The Metaverse isn't a mere replica of the real world; it's a multidimensional, immersive virtual space that goes beyond conventional notions of space and time. (Mystakidis, 2022)*

*Mystakidis, S. "Metaverse. Encyclopedia, 2, 486–497." (2022).



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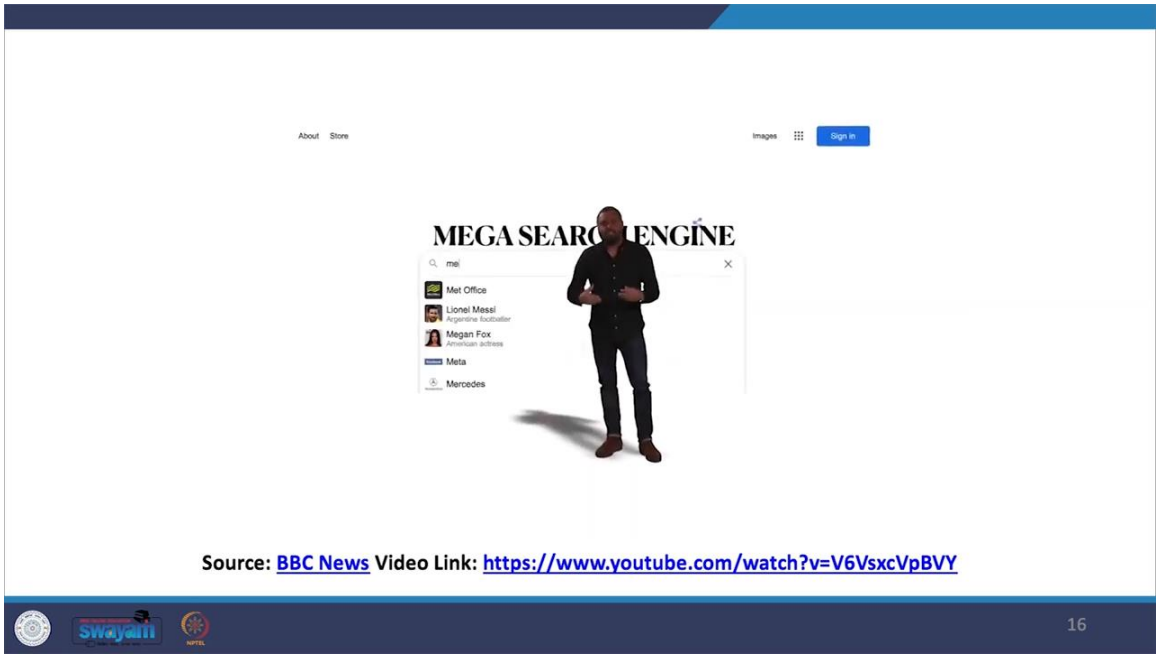
The term metaverse is a combination of meta and verse. Meta has derived from Greek which signifies transcending and verse means universe. The term metaverse refers to a collective virtual shared space of interconnected virtual environments inhabited by digital representation of people. The metaverse is not a mere replica of the real world. It is a multidimensional immersive virtual space that goes beyond conventional notions of space and time.

Let us now take a look at a video that expands upon this concept further.



Bob, what will we actually do? OK, so, here we are in what might be considered a representation of what the metaverse could be. Yeah, for us the metaverse is a spatial construct as opposed to the previous web, which was really a very linear kind of 2D flat thing. We want this one to be immersive. Now, of course, it doesn't mean it has to be virtual reality. It could also just be on a phone or on a desktop computer.

You might have noticed that we're using the tools of the metaverse to create a good portion of this item. My avatar has been created by a couple of companies, Ready Player Me and Oz. They already create tools for people to make avatars from a photo. It's this virtual version of ours which will travel between online experiences in any metaverse. And then over time, what I'm most excited about is an economy there.

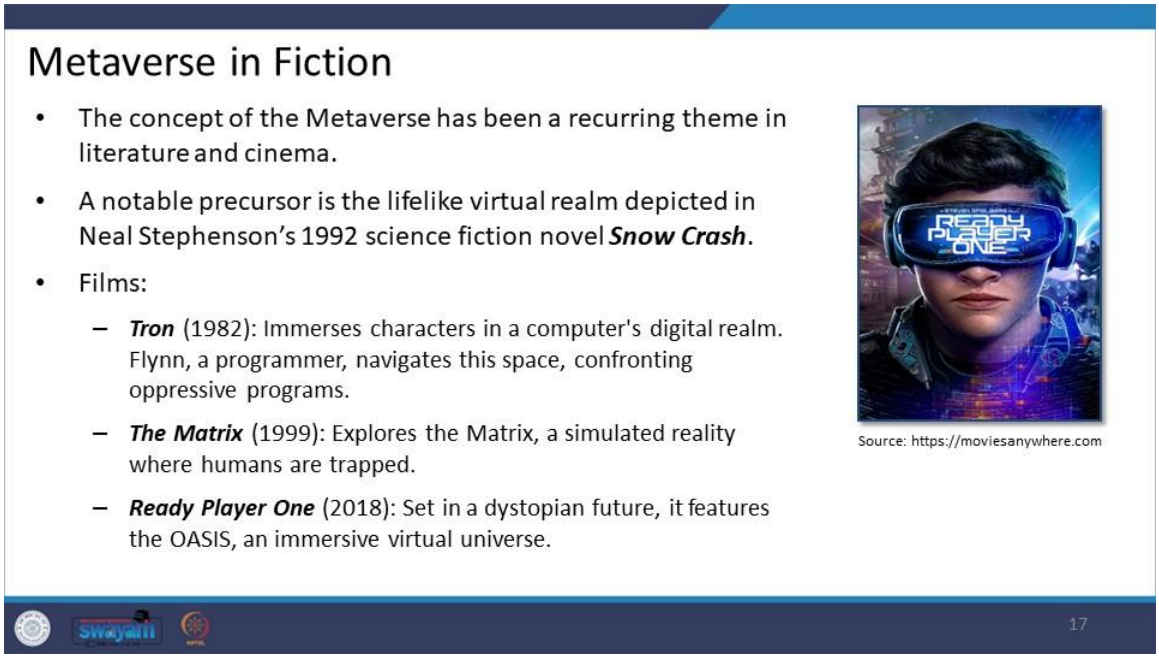
And I mean an economy not just of digital goods, sure, and entertainment, that's great, but also services. In an immersive environment, I'm going to have an avatar. I'm going to need a stylist. I'm going to have a home space. Microsoft has adapted its workplace meeting software, Teams, for the metaverse by creating a system called Mesh.

It's designed to work with a variety of different devices, including virtual and augmented reality. AR, as it's known, projects graphics on top of the real world using headsets like Microsoft's HoloLens or mobile phones. There's quite a few people that have got fatigued by having to have video chat meetings and things of that nature and that they realise they now crave human contact. Human communication is about 5%, speech is about 95% everything else. I've been in my living room with the entire team around the table, making eye contact, where all the gestures are coming into the right

place.

So it changes completely the, you know, call it the screen fatigue we're feeling today. The next piece of the metaverse puzzle isn't just about seeing these virtual worlds, but feeling them as well. Meta has revealed that it's been working on a glove that will let the user feel sensations like holding an object. The glove has a number of sensors that measure the wearer's movements and air pockets across the glove surface inflate to create sensation. These gloves aren't quite ready for prime time yet, but they're an indicator of the kind of research that's going on behind the scenes.

The metaverse has long captured the imagination of writers and filmmakers serving as a canvas for speculative fiction. From early literary works and envisioning immersive digital realms to iconic science fiction novels like Snow Crash and cinematic masterpieces like The Matrix, fiction has both shaped and reflected society's fascination with the potential of the metaverse.



This suggests that the concept of the metaverse is a recurring theme, both in literature and cinema. A notable precursor is the lifelike virtual realm depicted in Neal Stephenson's 1992 science fiction novel Snow Crash. There are several films which we can also refer to which depict this idea. For example, Tron, The Matrix and Ready Player One.

The conception of the metaverse is a remarkable fusion of emerging technologies and visionary goals. Rooted in the foundations of Web 3.0 and powered by blockchain, it seeks to redefine our digital experiences.

Conception of Metaverse

- Builds upon the developments of Web 3.0 that rely on blockchain technology.
- Web 3.0 aims to enrich social interactions with immersive virtual worlds, democratizing access to products and services.
- The Metaverse, a digital AI platform, offers an advanced 3D user interface, promoting virtual coexistence and natural conversations through AI-powered avatars. (Huynh-The et al., 2022)
- The Metaverse is an evolution of conversational AI like Alexa as it merges it with VR and blockchain, which is crucial for accelerated Web3 growth. (Wang et al., 2022)

Source: https://ars.els-cdn.com/content/image/1-s2.0-S0278612522001959-gr2_lrg.jpg

* Huynh-The T, Pham QV, Pham XQ, Nguyen TT, Han Z, Kim DS. Artificial intelligence for the metaverse: a survey. arXiv Prepr arXiv 2022;2202:10336.

** Wang Y, Su Z, Zhang N, Xing R, Liu D, Luan TH, et al. A survey on metaverse: fundamentals, security, and privacy. IEEE Commun Surv Tutor 2022.

Web 3.0 aims to enrich social interactions with immersive virtual worlds, democratizing thus access to products and services. The metaverse, a digital AI platform, offers an advanced 3D user interface promoting virtual coexistence and natural conversations through AI-powered avatars. The metaverse is an evolution of conversational AI like Alexa, for example, as it merges with VR and blockchain, which is crucial for accelerated Web 3.0 growth. The metaverse is an intricate digital landscape that comprises a myriad of essential elements from immersive VR environments and interconnected social networks to blockchain technology and AI-powered avatars. These elements coalesce to create a multidimensional digital reality. Understanding these core components is crucial in comprehending the vast potential and far reaching implications of the metaverse. These implications are reshaping our digital experiences and the way we interact at a social and digital level.

The Metaverse is shaped by four pivotal elements*:

- **Immersion:** Immersive technology blends physical and virtual worlds, offering immersion through AR and VR, enhancing learning, creativity, and engagement.
- **Advanced Computing:** Incorporating advanced computing, high bandwidth, and AI capabilities within the metaverse cultivates immersive, interactive experiences, fostering engagement with intelligent agents.
- **Socialization:** Learners can craft digital avatars and profiles, facilitating online socialization, collaborative projects, entertainment, problem-solving, and authentic experiences.
- **Decentralization:** Blockchain and cryptocurrencies are widespread for transactions, and non-fungible tokens (NFTs) enable people to manage assets and digital certificates without a centralized authority.

Source: https://ars.els-cdn.com/content/image/1-s2.0-S0278612522001959-gr3_lrg.jpg

*Ng, Davy Tsz Kit. "What is the metaverse? Definitions, technologies and the community of inquiry." Australasian Journal of Educational Technology 38.4 (2022): 190-205.

Let us look at the four pivotal elements immersion, advanced computing, socialization and decentralization. Immersive technology blends physical and virtual worlds offering immersion through AR and VR enhancing learning, creativity and engagement of the people. The metaverse cultivates immersive and interactive experiences incorporating advanced computing, high bandwidth and AI capabilities and thus fosters engagement with intelligent agents. Socialization suggests that learners can craft digital avatars and profiles facilitating online socialization, collaborative projects, entertainment, problem solving and authentic experiences. So, blockchain and cryptocurrencies are widespread for transactions and non-fungible tokens, which enable people to manage assets and digital certificates without a centralized authority. This aspect has come into some criticism also and there are several countries, for example, our own country which do not allow the use of cryptocurrency.

Virtual social worlds represent the next frontier in digital connectivity. In these immersive 3D environments, users transcend traditional social networks delving into fully interactive simulations. Avatars become our digital embodiments navigating virtual landscapes, attending events and even conducting currency transactions.

Virtual Social Worlds*

- The merger of social networks and VR has birthed virtual social worlds—interactive 3-D realms expanding content-oriented networks.
- These worlds are intricate cyber-physical-social systems uniting real and virtual spaces.
- The virtual social world must meet four design requirements:
  - Realism: Users should feel emotions in the virtual world.
  - Ubiquity: Accessible across devices and locations, maintaining users' virtual identities.
  - Interoperability: Seamless teleportation between virtual locations.
  - Scalability: Efficiently handle many users without disruptions.

Source: https://en.wikipedia.org

*Wang, Yuntao, et al. "A survey on metaverse: Fundamentals, security, and privacy." IEEE Communications Surveys & Tutorials (2022).

The merger of social networks and VR has given birth to virtual social worlds, interactive 3D realms expanding content-oriented networks. These worlds are intricate cyber physical social systems uniting real and virtual spaces. The virtual social world must meet four design requirements. Firstly, realism that is the users should feel emotions in the virtual world. Secondly, it should be accessible across devices and locations maintaining users virtual identities. Thirdly, there should be a seamless teleportation between virtual locations, which is known as interoperability. Scalability suggests that it can be efficiently handled by many users without disruptions.

As the Metaverse continues its ascent in the digital realm, it brings forth an array of transformative possibilities. However, along with these opportunities, there are also some pressing concerns about privacy. Similar to AR, the convergence of real and virtual worlds in this digital space today introduces complex challenges. Unlike traditional social networks, the metaverse complex virtual spaces defy conventional privacy controls, raising questions about data security, identity protection and personal boundaries.

Privacy Concerns*

- In the social Metaverse, digital traces of users can unveil their true identity, along with sensitive data like location, shopping habits, and financial information.
- Privacy is vital, but conventional protection methods may not apply, making privacy safeguarding more complex.
- For instance, avatar tracking of purchases and travel history poses real-world privacy risks.

Source: https://arpost.co

*F. O'Brolcháin, T. Jacquemard, D. Monaghan, N. O'Connor, P. Novitzky, and B. Gordijn, "The convergence of virtual reality and social networks: Threats to privacy and autonomy," Sci. Eng. Ethics, vol. 22, no. 1, pp. 1–29, 2016.

Digital traces of users can reveal the true identity in the social metaverse along with the sensitive data like location, their shopping habits, and also financial information about them. And therefore, privacy is vital, but conventional protection methods may not necessarily apply and therefore safeguarding privacy has become more complex in this world. For instance, avatar tracking of purchases and travel history poses real world privacy risks.

As the metaverse converges with real life experiences, it promises radical shifts in communication, work, entertainment, and several other fields.

Future of the Metaverse

- Approximately 30% of global organizations are expected to offer metaverse-related products by 2026. (Park and Kim, 2022)*
- Companies like Meta Platforms, Microsoft, and NVIDIA are developing their versions.
- However, true metaverse attributes like decentralization, persistence, and full interoperability are yet to be fully realized. (Dionisio, 2022)**
- The metaverse is envisioned as device-agnostic, boasting a virtual economy facilitated by digital currencies and NFTs (Non-Fungible Tokens).

Source: https://hrme.economictimes.indiatimes.com

*Park SM, Kim YG. A metaverse: taxonomy, components, applications, and open challenges. IEEE Access 2022;10:4209–51.

**Dionisio JDN, III WGB, Gilbert R. 3D virtual worlds and the metaverse: current status and future possibilities. ACM Comput Surv (CSUR) 2013;45(3):1–38.

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Approximately 30% of global organizations are expected to offer metaverse related products by 2026. Companies like meta platforms, Microsoft and Nvidia are developing their versions. However, true metaverse attributes like decentralization, persistence, and full interoperability are yet to be fully realized. The metaverse is envisioned as device agnostic, boasting a virtual economy facilitated by digital currencies and NFTs.

In conclusion, virtual reality and the metaverse represent two entwined technological frontiers poised to reshape our digital and physical realities.

Conclusion

- VR has traversed a remarkable journey from early experiments to mainstream applications, redefining gaming, archaeology, and tourism, among others.
- It offers immersive experiences, blurring the line between real and digital realms.
- Conversely, the Metaverse extends beyond VR, forging a comprehensive interconnected digital universe.
- It is driven by technology, and holds the promise of revolutionizing how we interact, work, and collaborate.
- However, it also presents complex challenges, particularly concerning privacy and ethical considerations.

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We can say that VR has transversed a remarkable journey from early experiments to mainstream applications, redefining gaming, archeology, and tourism among others. It offers immersive experiences blurring the lines between the digital and the real realms. Conversely, the metaverse extends beyond VR, forging a comprehensive interconnected digital universe. It is driven by technology and holds the promise of revolutionizing how we interact, work, and collaborate in the field of digital communication. However, it also presents complex challenges, particularly concerning privacy as well as the considerations of ethical obligations.

As we navigate these digital frontiers, it is evident that both VR and the metaverse are catalysts for innovation, transformation, and new modes of human connectivity. Their potential remains limitless with ongoing research and development poised to unravel even greater possibilities. We will continue our discussion on the metaverse in the next module by expanding upon the role of avatars in modern digital communication.

Thank you.