Opportunities for Education in the Metaverse

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What is the Metaverse?

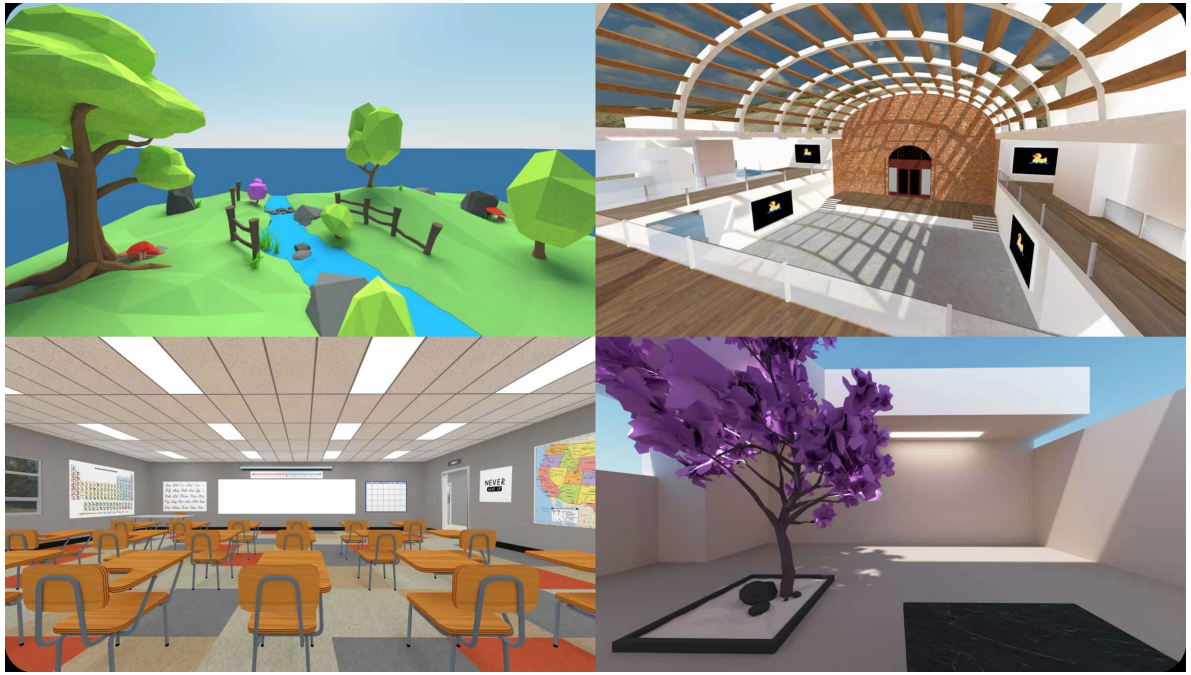
XR / VR in Learning and Development

- Virtual reality (VR) and related technologies support active learning in an immersive and hands-on environment.
- At the same time, it can be expensive and difficult to apply.
- Still, there are pilot projects being run around the world.

VR pilot exposes high school students to manufacturing, USA https://www.cbia.com/news/workforce-development/virtual-reality-pilot-program-students-manufacturing/

VR (Virtual Reality)

- Users enter a completely virtual world
- All sights, sounds, objects and actions are simulated
- Uses a headset like the Oculus or the Vive



Mozilla Hubs https://hubs.mozilla.com/

AR (Augmented Reality)

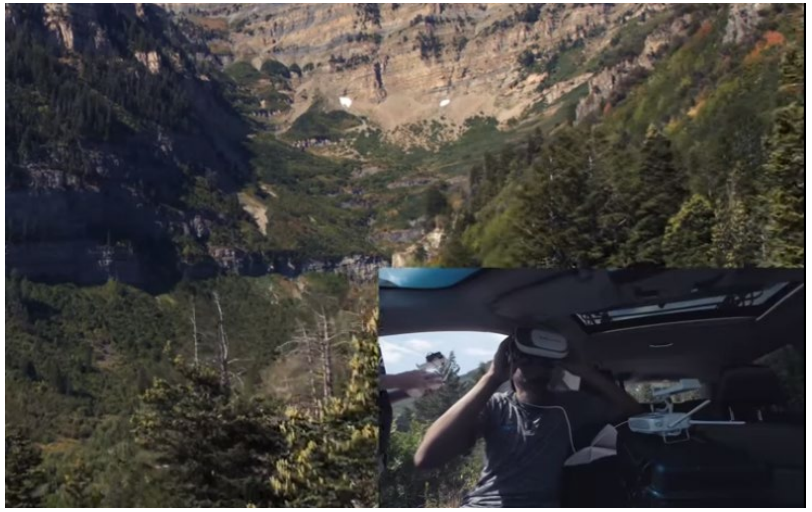
- Users see data projected alongside real-world objects
- See-through viewing device like Google Glass or Hololens
- Offers more information about what they are seeing

Augmented reality (AR) snapshop, NRC Canada
https://publications.gc.ca/collections/collection_2020/cnrc-nrc/NR16-294-2019-eng.pdf

MR (Mixed Reality)

- Merging of virtual and real environments
- Virtual and real objects interact in real time
- E.g. a virtual dashboard like Behance

https://www.forbes.com/sites/bernardmarr/2022/01/07/the-5-biggest-virtual-augmented-and-mixed-reality-trends-in-2022/?sh=2c68909d4542



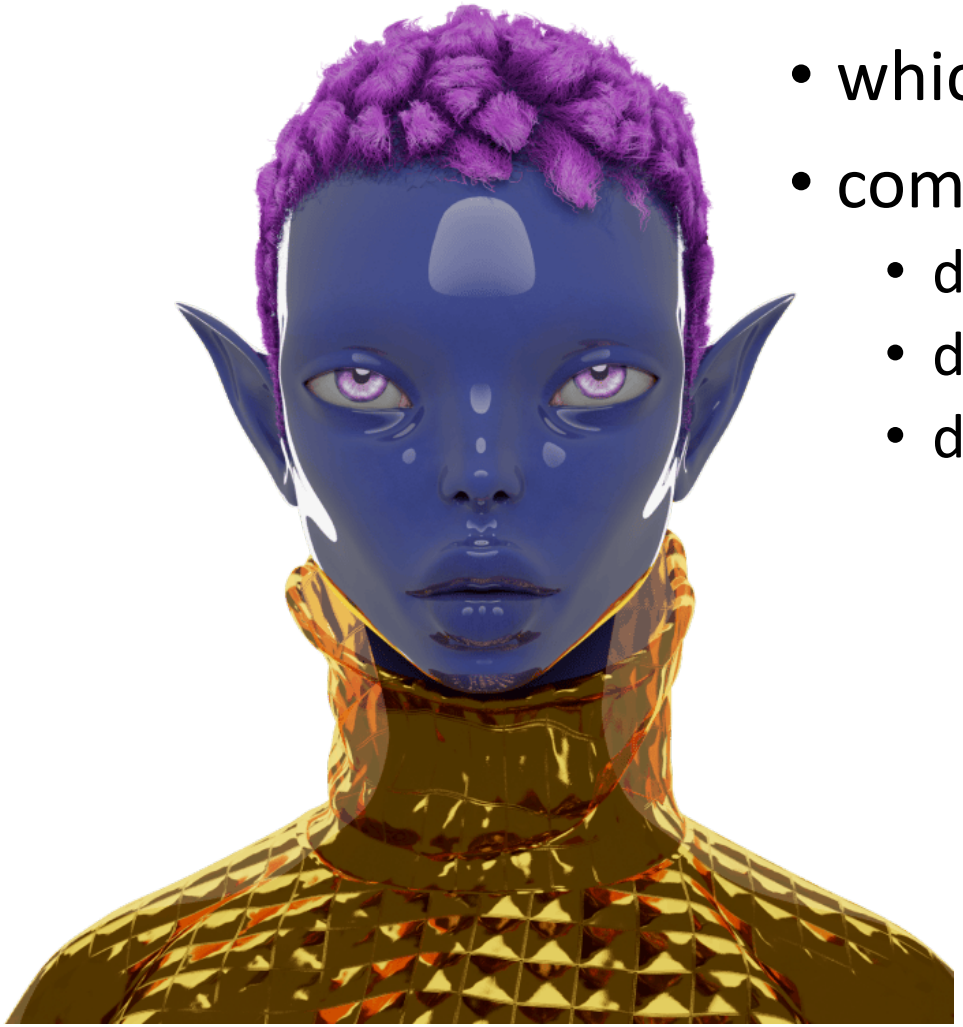
https://www.youtube.com/watch?v=z3zwAeBMbKU

XR (eXtended Reality)

- term that refers collectively to VR, AR and MR

Remote diagnosis & repair, Switz. & Ukraine
https://skywell.software/blog/mixed-reality-benefits-uses-in-manufacturing/

The Metaverse,



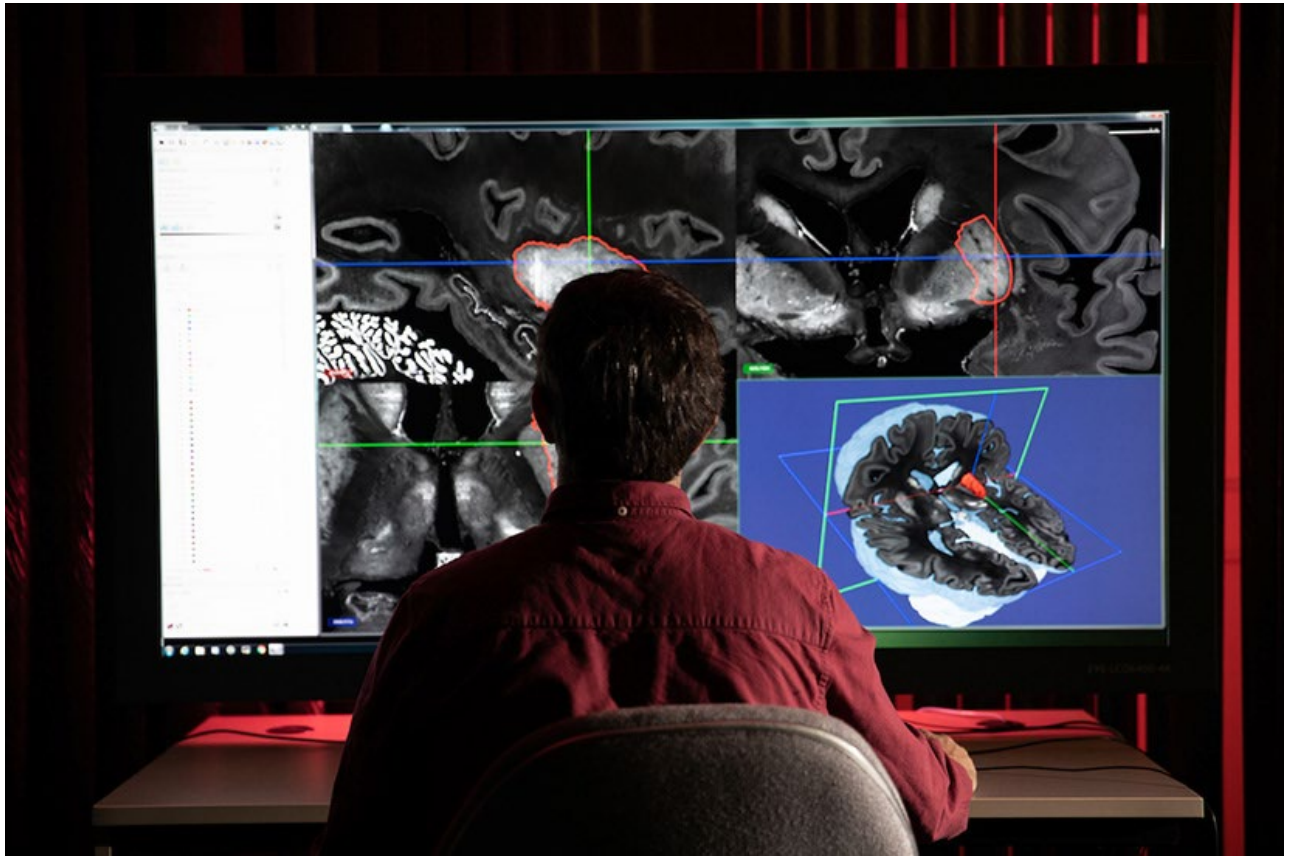
- which includes all XR technologies
- combines it with persistent digital objects:
  - digital currencies such as Bitcoin and Ethereum
  - digital identities
  - digital objects such as non-fungible tokens (NFTs).

How to enter the metaverse, Sensorium
https://sensoriumxr.com/articles/how-to-enter-the-metaverse

Applications of the Metaverse

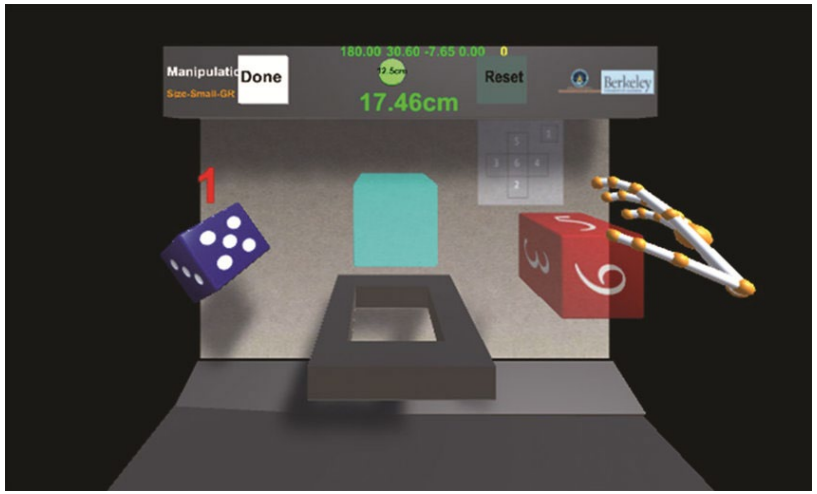
Visualization

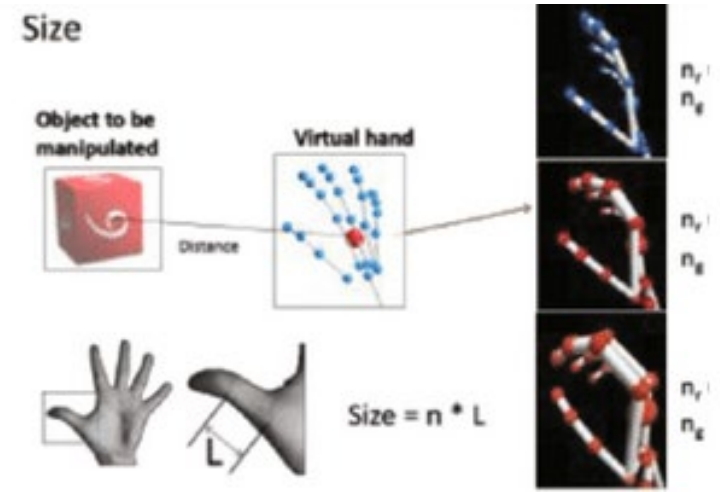
- Small things can be magnified
- We can look inside things
- Time can be sped up or slowed down



Computer vision and graphics, NRC Canada
https://nrc.canada.ca/en/research-development/products-services/technical-advisory-services/computer-vision-graphics

Interactivity





- Hands-on manipulation of objects
  - Illustrate mechanical or physical principles
  - Control devices or machines

Hand Gestures for Manipulating Objects in Virtual Reality, USA
https://www.researchgate.net/publication/317173375_Design_of_Hand_Gestures_for_Manipulating_Objects_in_Virtual_Reality

Safe Environments

- Observe and practice hazardous operations
  - flying a plane
  - fighting a fire
  - working with high-voltage equipment.

Design and Development for a First Responders VR Training System on Dangerous Goods Transportation Incidents, NRC Canada (forthcoming at https://2022.hci.international/)

(a) Emergency Response Guidebook.

(b) Simulation of a phone conversation with a single or multiple choices selection.

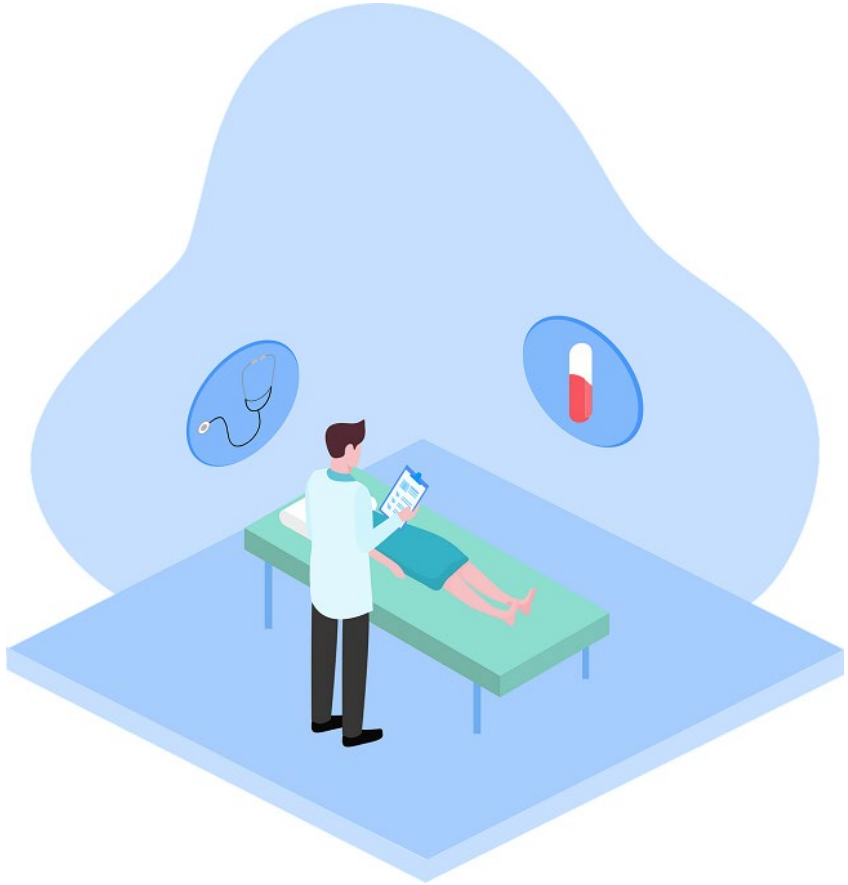
Fig. 3: Inventory Items (ERG and Phone).

(a) Binoculars inventory item.

(b) Binoculars in use.

Fig. 4: Inventory Items (Binoculars).

Accessibility



- Helps people…
  - with limited mobility
  - who live in remote regions
  - with time constraints

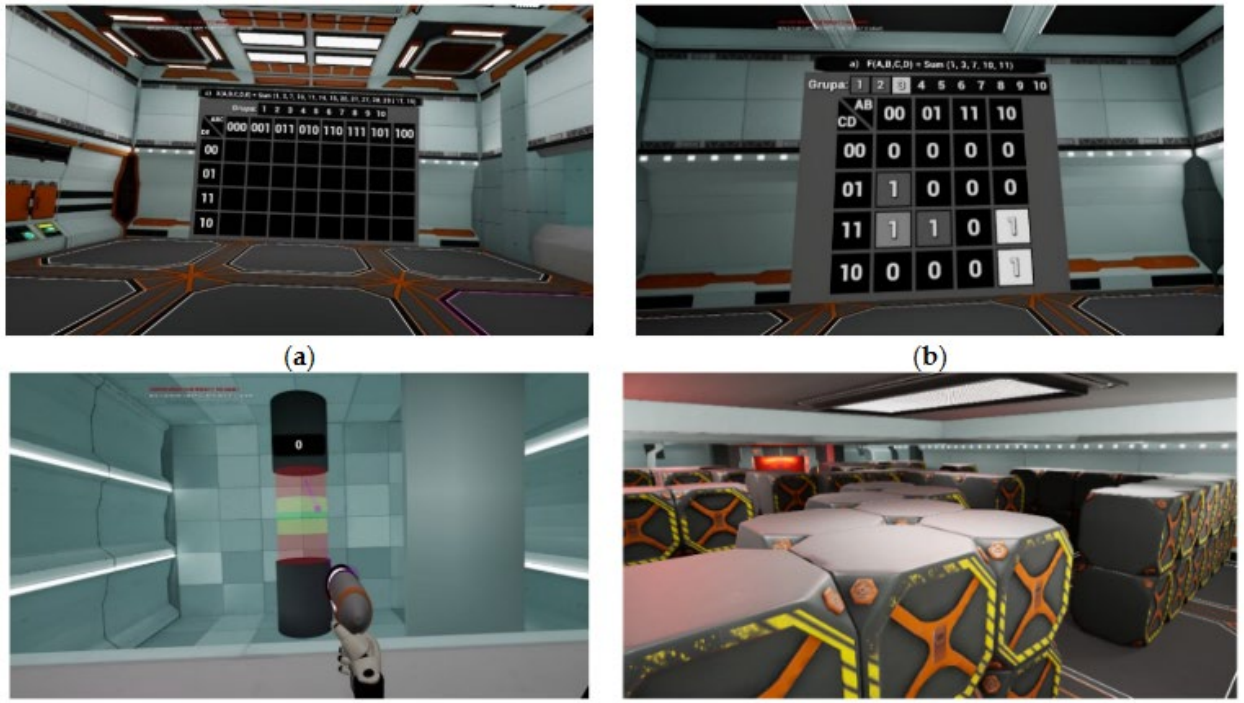
  where hands-on equipment is not available
- Helps people learn how to support diverse needs

VR for empathy-building and experiential education in hospitals, Canada https://cjni.net/journal/?p=8571

Improving cognitive ability using virtual reality (VR) and games, NRC Canada https://nrc.canada.ca/en/stories/virtual-reality-game-changer-neurodevelopmental-treatments

Remote Collaboration

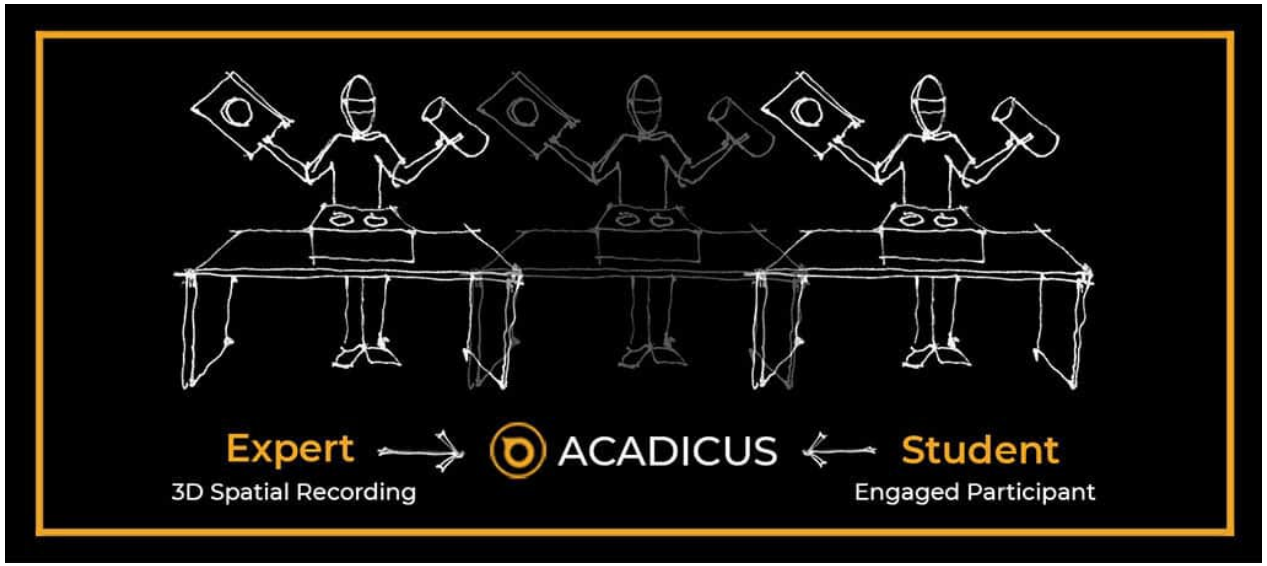
- Create or manipulate common digital objects
- Design buildings or equipment
- Co-create any other digital content.



Digital circuit design, Poland https://mdpi-res.com/d_attachment/energies/energies-15-00277/article_deploy/energies-15-00277-v2.pdf

Recordings

- Viewed later as objects for discussion
- Debrief or to be used as learning resources.



Adacus, USA https://acadicus.com/3d-spatial-recordings-for-enhanced-teaching-and-learning-in-vr/

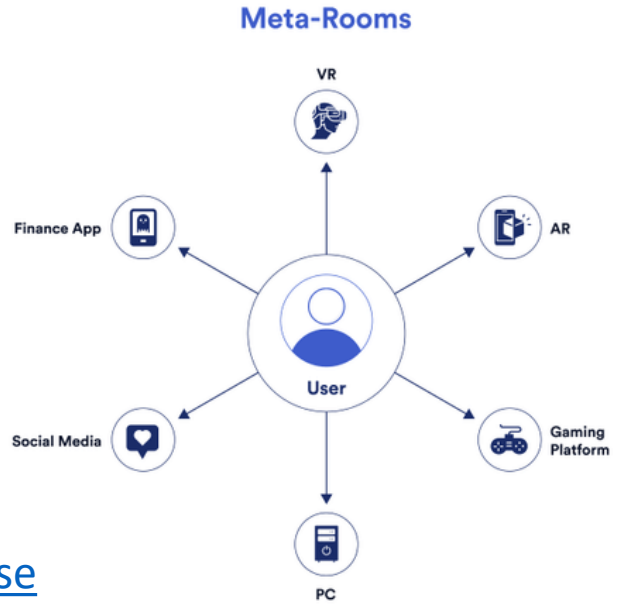
Combined with AI

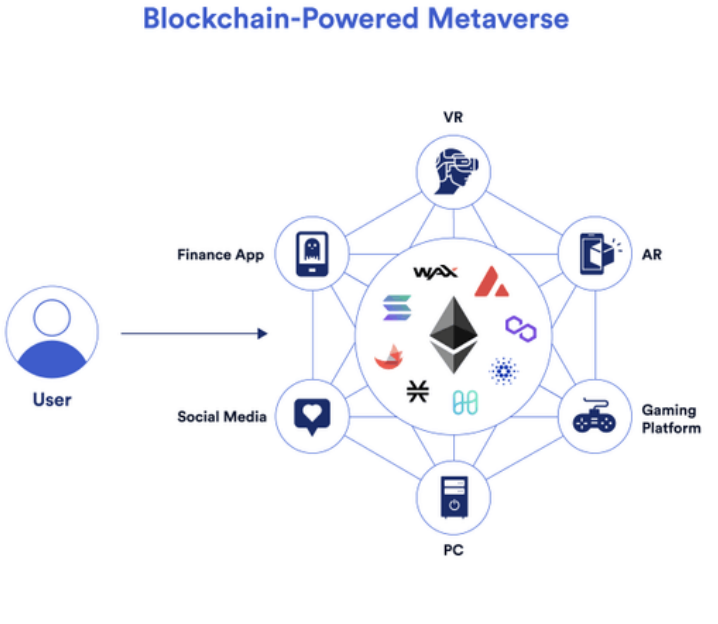
- Lifelike immersive environments
- Smart agents that can:
  - interact with users
  - generate tasks, resources
  - Make recommendations based on user activities.
- Evaluate learning in the XR environment.

AI enabled VR tuition, China
https://www.chinadailyhk.com/articles/80/86/192/1559976439971.html

Combined with Cryptography

- E.g. digital signatures and blockchain networks
- E.g. distributed and multi-user virtual environments
- These support massive simulations such as:
  - sporting events
  - financial markets
  - military exercises
  - climate change





https://chain.link/education/metaverse

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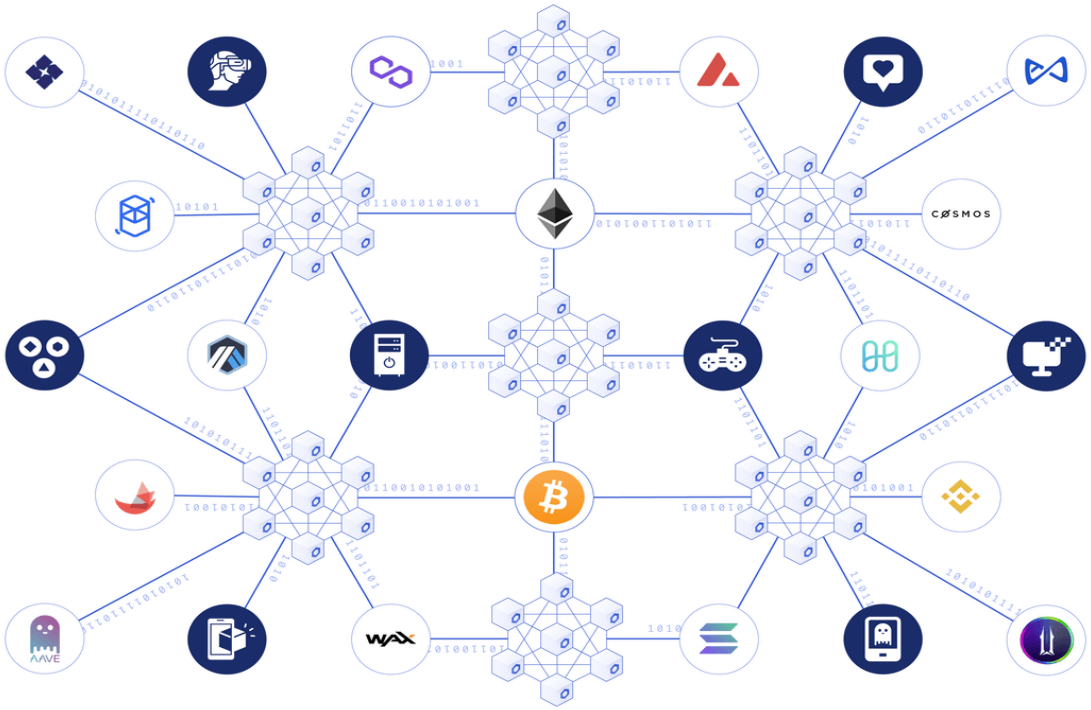

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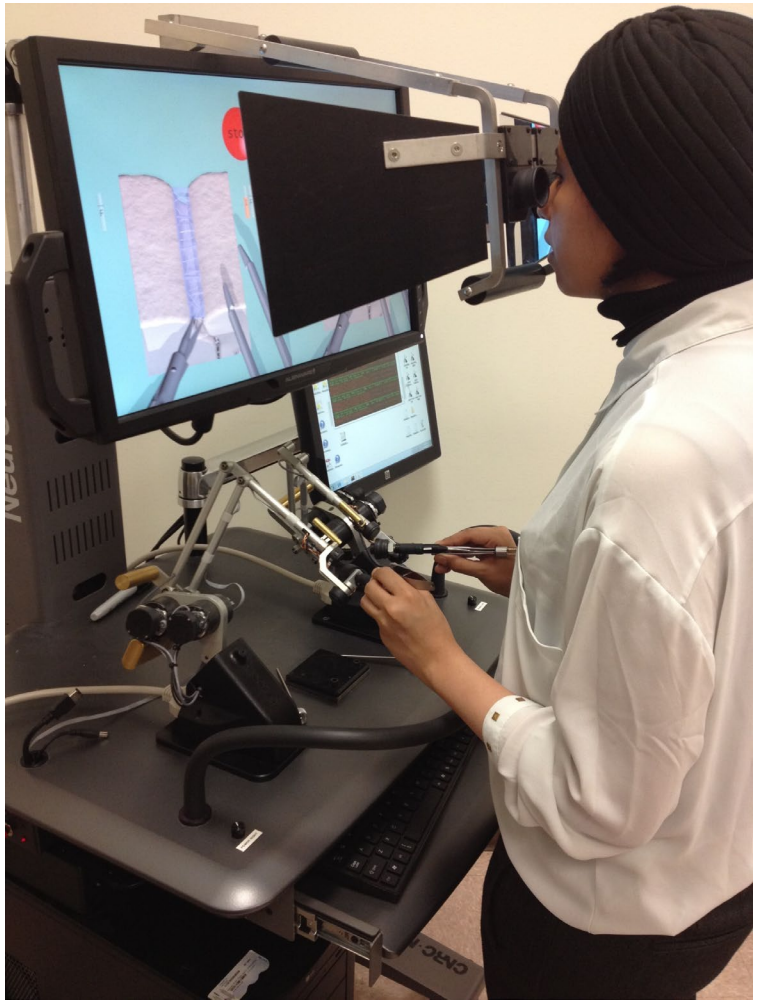
Combined with Real-Time Data

- Based on real-world models and statistics
- Enjoy an on-ice view or player's perspective of a hockey game
- Watch heart surgery from the perspective of the surgeon, or the heart

https://www.youtube.com/watch?v=nAzOBgpttZc

Combined with Haptics

- Other forms of sensory feedback
- Extends beyond the purely audio-visual
- E.g. ‘Hands-On’ medical examination simulation



NeuroVR (previously NeuroTouch) combines haptics with a virtual reality (VR) neurosurgical simulator, NRC Canada
https://neurosim.mcgill.ca/neurotouch

Risks and Potential Issues

Technology

- Cost is a major factor
- It takes time to learn how to use

https://indianexpress.com/article/technology/tech-news-technology/six-virtual-reality-experiences-that-dont-cost-too-much-4387265/

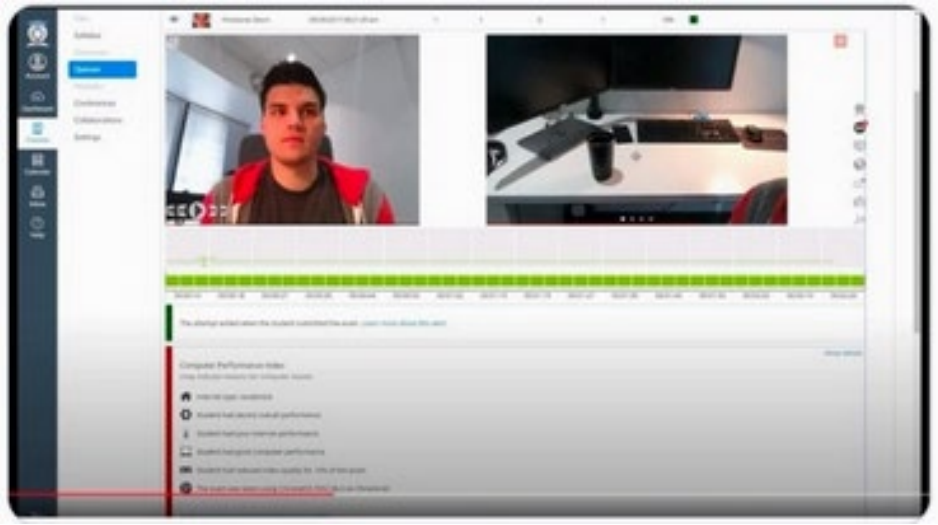
Health

- Stress and anxiety over virtual experiences
- Ergonomic issues
- Physical injury caused by falling or stumbling
- Nausea and other forms of cybersickness caused by latency issues

Cervical spine injury after virtual reality gaming: a case report
https://jmedicalcasereports.biomedcentral.com/articles/10.1186/s13256-021-02880-9

Bad Actors and Malpractice

- Misrepresentation of physical phenomena in a way that leads to incorrect beliefs
- Inappropriate use of XR surveillance technologies
- Harassment and Bullying by groups or individuals



Proctorio used DMCA to take down a student's critical tweets
https://techcrunch.com/2020/11/05/proctorio-dmca-copyright-critical-tweets/

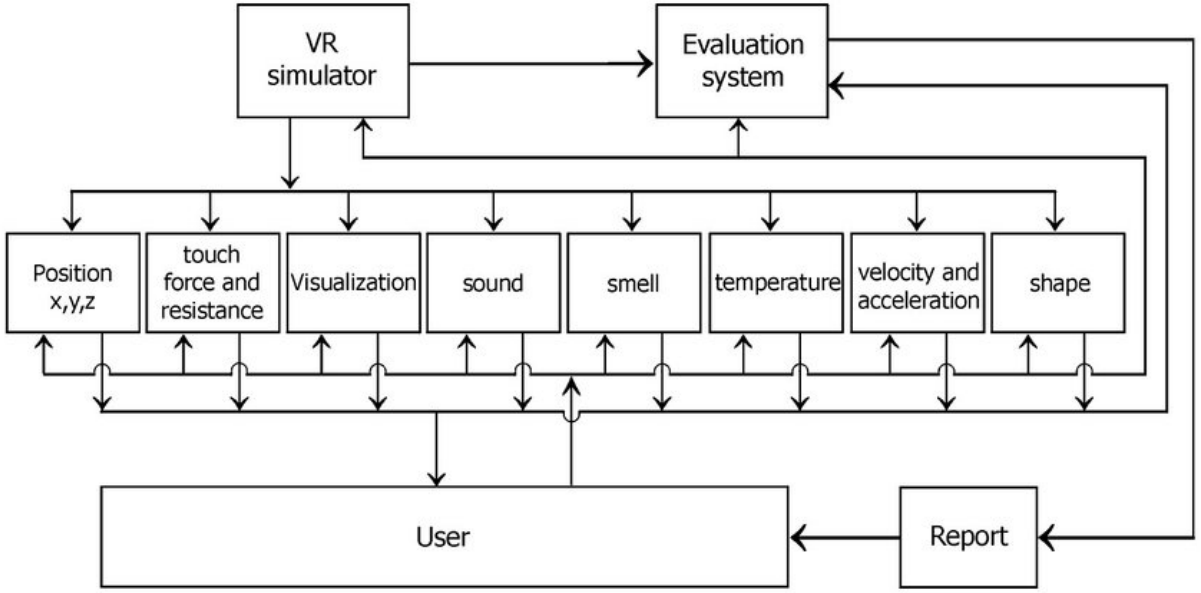
Social and Cultural Issues

- Desensitization to disturbing behaviours and events
- Cultural and ethical values may change through virtual world interactions

https://realnewworld.com/vr-fear-relief/

Issues Specific to Learning and Development

- Coaching and Mentoring is typically required to guide participants through a virtual reality experience
- Few metrics exist for evaluation of performance in XR environments and best practices have yet to be developed.



https://www.researchgate.net/figure/Evaluation-systems-collect-data-from-VR-based-simulations-to-evaluate-user-performance_fig5_267660585