TCSL-70130 Lecture 07: 3D/VR/AR/MR in Education
3D/虛擬/擴增/混合實境之教育應用

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Lecture Topics

2

- An overview of 3D/VR/AR/MR technologies
- 3D/VR/AR/MR in education
- Commonalities and differences
- 3D/VR/AR/MR tools
- Case studies

3

How does 3D work?

- Have you ever seen the movie **Avatar(2009)**? In **3D** ?
- Remember the floating "Hallelujah Mountains" ?

4

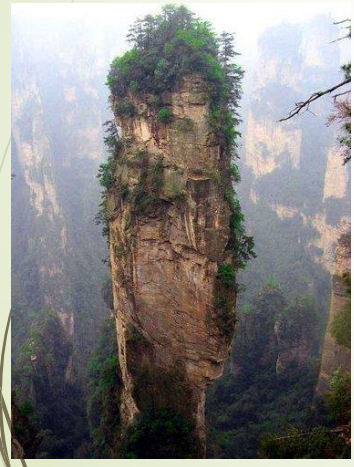
3D Movies Show

- Let's take a look at the floating mountains in Avatar.
- Even without 3D glasses, it is still amazing!
- https://www.youtube.com/watch?v=tj-eeLVVq3g
- https://www.youtube.com/watch?v=enak5_Tr_J0

5

Pandora on Earth

- Pandora's landscape was modeled after Zhangjiajie (張家界國家森林公園) in the Hunan of China.




6

How does 3D work?

- 3D vision comes the Binocular Parallax(雙眼視差) and Motion Parallax(移動視差).
- Human eyes are horizontally separated by about 50–75 mm. Thus, each eye has a slightly different view of the world (binocular disparity).
- The brain uses binocular parallax to extract depth information to form 3D vision.
- Try to close left and right eyes in turn to experience the parallax. (next slide)

3D Vision from Binocular Parallax

7

《詩經》與科技狂想_7 蒹葭

3D Vision from Binocular Parallax

8

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9

3D Vision from Parallax

- The previous example is taken from https://pic.pimg.tw/travis0501/4010475b9bf55b7308680b06d8d44f5c.gif
- Similarly, motion also creates parallax effect and form 3D vision by our brain.
- Many examples on YouTube.

10

3D Images/Movies

- 3D images or films are done by shooting with special camera with multiple lenses.
- The camera captures both left-eye and right-eye views of a scene.
- When playing, both views are projected on the screen at the same time.
- With special polarizing glasses(偏光鏡) or methods, our left and right eyes get the corresponding view.
- Our brain forms the 3D image/movie automatically.

11

How does VR work?

- VR(Virtual Reality) is the computer generated virtual scene (may come from 360 degree VR camera on real world, or computer generated 3D VR content).
- Through a VR Headset, users can have immersive experience.
- With many sensors in the headset, users can turn to view different angles or even move around.
- https://www.youtube.com/watch?v=-Kovxf6g0mo

12

"Real" VR

- In an immersive world, we can turn and see things from different angles or even move around.
- We should be able to interact with virtual characters in the VR world.
- Even better is to provide multiple senses such as smell, touch, taste, …
- VR is getting popular in entertainment, science/engineering, medical applications, remote services, training, education, …

13

Augmented Reality (AR)

- **AR** is the augmentation of computer generated content in real world scene.
- Users can see the real world and augmented content melt together.
- The key is SLAM (Simultaneous Localization and Mapping)

14

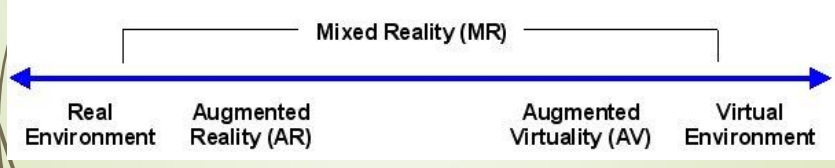
Two Good Videos

- How Augmented Reality Works // A Beginner's Guide to AR (https://www.youtube.com/watch?v=H7ZHemE2nRs)
- What is Augmented Reality? By Global Tech Council (https://www.youtube.com/watch?v=4uuK0jlbRX0)

15

Mixed Reality (MR)

- The integration of VR and AR.
- Also known as Hybrid Reality.
- It also includes Augmented Virtuality(AV) which is to merge real-world objects into virtual world.
- Reality–virtuality continuum



16

Billion Dollars Dream or Fraud?

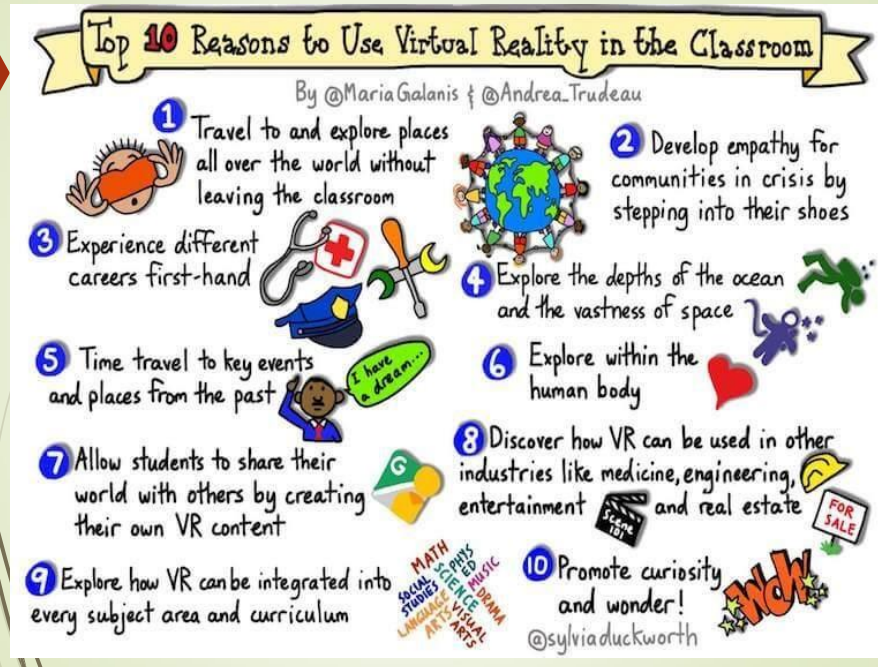
- Magic Leap raise billions of dollars with the following dream.
- https://www.youtube.com/watch?v=Zkm51r3o7dg
- We are still waiting for that to happen.

17

VR/AR/MR in Education

- VR/AR/MR is expected to revolutionizing the way we teach and learn.
- Can create an immersive and interactive learning experience without the use of textbooks.
- Empower learners to explore and learn at their own pace, thus stimulating learning and comprehension and enhance critical retention.

18



19

VR Education Statistics

- 97% of students would like to study a VR course.
- Education is expected to be the 4th biggest sector for VR investments.
- VR in education is predicted to be a $200 million industry by 2020 and $700 million by 2025.
- Almost 80% of teachers have access to VR devices, but only 6.87% use them regularly in classes.
- 93% of teachers said that their students would be excited to use VR.
- 7 out of 10 teachers want to use VR to simulate experiences relevant to the class material.

20

Benefits of VR/AR in Education

- Facilitates student learning through gamification and interactivity
- Keeps students engaged even while learning difficult topics
- Enhances creative thinking
- Fewer distractions
- Fosters increased collaboration
- Can be used for practical training
- Expanded teaching possibilities with 3D design, modeling, and presentations

21

Benefits of VR/AR in Education

- Increased engagement/immersion via interactivity
- Inclusivity: A salvation for special people
  - The Near Sighted VR Augmented Aid helps students with visual impairments.
  - The SignAloud gloves allow to communicate via sign language in a VR environment and translate into a human speech.
- "The only source of knowledge is experience." (Albert Einstein)

22

Case Studies(edu.google.com)

- United States Military Academy at West Point use VR to study historic battles from the view on the ground. (https://edu.google.com/why-google/case-studies/west-point/?modal_active=none)
- New York University's School of Professional Studies enable creative professionals to create new AR/VR product prototypes in a matter of days. (https://edu.google.com/why-google/case-studies/nyu-sps/?modal_active=none)

23

Case Studies(edu.google.com)

- University of Southern California student journalists use VR for immersive storytelling.(https://edu.google.com/why-google/case-studies/usc/?modal_active=none)
- NYU's Tandon School of Engineering gives admitted students an insider glimpse at campus life with VR.(https://edu.google.com/why-google/case-studies/nyu-tandon/?modal_active=none)

24

Case Studies(edu.google.com)

- Brown University uses VR to immerse students in American history. (https://edu.google.com/why-google/case-studies/brown-vr/?modal_active=none)

25

VR/AR Challenges

- Cost-effectiveness of implementing VR/AR technologies in education and training.
  - Need to invest into gear (see Appendix)
  - Need to invest in AR/VR content development
  - Need to invest time/money into training teachers
- Quality VR/AR content development
  - Basic VR/AR tools aren't sufficient enough
  - Teachers can't do immersive experiences on their own (need outsourced developers)
  - Need to adjust content to target audience

26

Health Issues

- The question of health
- VR/AR impact on mental and physical health hasn't been widely studied.
- This is a serious issue with adults and the matters double down when it comes to children.
- The mass "epidemic" of Pokemon hunters seemed to be fine. But the players may be so engrossed and forget the real world dangers.

27

Concluding Remarks

- According to Goldman Sachs, in 2020 the revenue for VR/AR educational software would be around $300 million. This figure is expected to grow to $700 million by 2025.
- AR/VR technology has the potential of being the biggest breakthrough in the education system in the 21st century.
- Allow students to learn through active participation and experience.
- Need to study aspects of VR/AR to find the right tools for using them in education.

28

VR Equipment – Oculus Rift

OCULUS RIFT

The Oculus Rift was one of the very first commercially available VR headsets. Now owned by Facebook, Oculus is an integrated headset that requires a tethered connection to an external PC. Oculus is primarily a gaming device and as such has limited educational content.

oculus

ADVANTAGES	LIMITATIONS
High Performance Device	PC Required to Operate
Headset Positional Tracking	Primarily a Gaming Device
Immersive Experience	Expensive
	No Curriculum Content
	No Classroom Controls

29

VR Equipment – HTV Vive

HTC VIVE

Backed by mobile phone maker HTC, Vive is an integrated VR headset driven by a Windows PC or Mac. Vive predominantly targets the gaming market, but has recently started targeting education with the Vive Group Edition bundle of headsets and PCs.

ADVANTAGES	LIMITATIONS
Top Quality Experience	High Price
Active Developer Community	Limited Educational Content
Wide Range of Hardware Peripherals	Requires High-end PC
	Complex Setup & Management
	External Sensors Needed
	No Classroom Management

30

VR Equipment – SONY Playstation VR

SONY PLAYSTATION VR

A dedicated headset for Sony's PlayStation video games console. The PSVR headset provides a simple way for home users to experience high quality VR gaming.

ADVANTAGES	LIMITATIONS
Lower cost Relative to PC-Based Headsets	No Educational Content
Simple Setup & Configuration	Tethered by Wire to a Required PlayStation Console
High Quality Games Available	Requires Monitor or TV for Setup
	Closed Ecosystem & Content
	No Classroom Management

31

VR Equipment – SAMSUNG GEAR VR

SAMSUNG GEAR VR

In collaboration with Oculus, Samsung GearVR combines a Samsung mobile phone with an active headset to deliver a high-quality VR experience. Access to Google Expeditions and some educational apps make it suitable for the classroom.

SAMSUNG

ADVANTAGES	LIMITATIONS
High Availability	Requires Mobile Device
Tether-free Operation	High Cost
	Overheating Devices Cause Lesson Disruption
	No Classroom Management

32

VR Equipment – Google Cardboard

GOOGLE EXPEDITIONS

The Google Cardboard initiative uses mobile phones in special visors to provide an entry-level VR experience. Google are encouraging the use of Cardboard devices in schools through their Expeditions app, which provides panoramic pictures to support educational themes.

ADVANTAGES	LIMITATIONS
Low Equipment Cost	Requires Mobile Device
Tether-free Operation	Physical Setup Takes Time
Centralised Content Delivery for Expeditions	Overheating Devices Cause Lesson Disruption
	No Device Management

33

VR Equipment – Avantis ClassVR

AVANTIS CLASSVR

ClassVR is the first fully dedicated end to end classroom VR & AR system. It comprises a standalone headset, a storage and charging unit, pre-installed 360 degree images and videos, a classroom management and control portal and the ability for schools to upload their own content.

CLASSVR®

ADVANTAGES	LIMITATIONS
Low Cost Standalone System	No Positional Tracking
Classroom Device & Content Management	
Curriculum Aligned Resources	
Ability to Create Own Content	
Supports VR & AR	