3D Interaction in Mixed Reality

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Concepts, Theories and Applications

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Virtual Reality

Virtual reality has beginnings that preceded the time that the concept was coined and formalised. In this detailed history of virtual reality we look at how technology has evolved and how key pioneers have paved the path for virtual reality as we know it today, such as stereo pictures (1838), and flight simulators (1930's).

https://www.vrs.org.uk/virtual-reality/history.html

Virtual Reality

VR Applications

Training

Tactical Iraqi Language & Culture Training System (TILTS)

https://www.alelo.com/tilts/

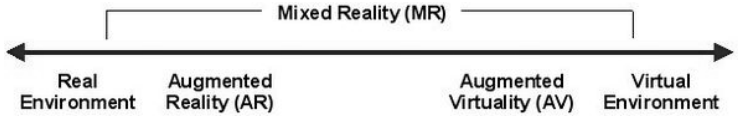
VR Exposure Therapy

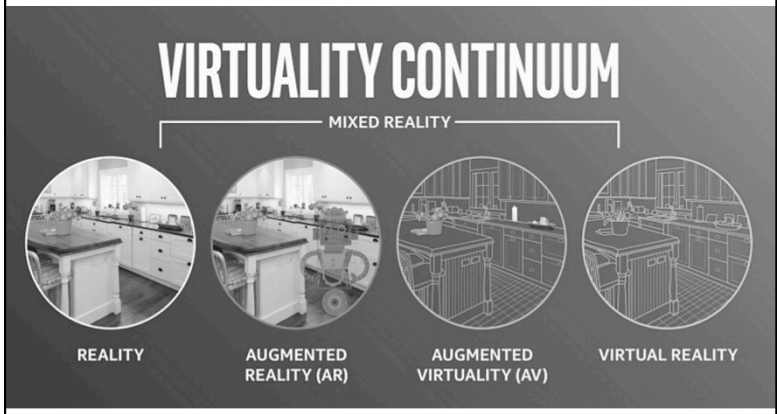
https://alexishuefner.wordpress.com/coursework/spring-2014/mind-machine-consciousness/virtual-reality/

Mixed Reality (MR)

- "Augmented Reality: A class of displays on the reality-virtuality continuum". Proceedings of Telemanipulator and Telepresence Technologies. pp. 2351–34. Retrieved 2007-03-15.

Introduced the concept of Reality-Virtuality continuum



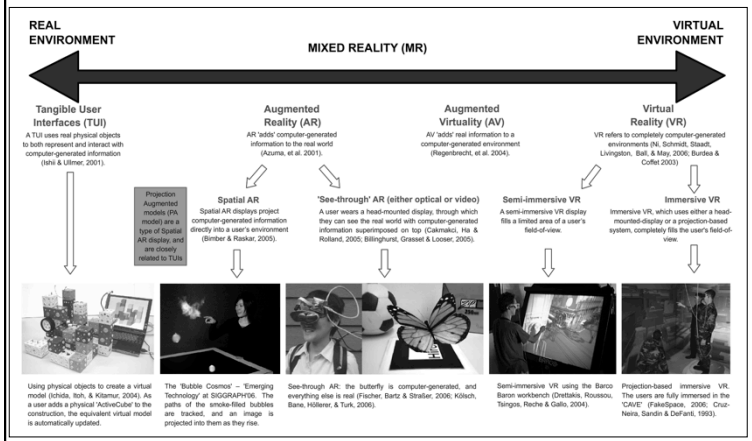


https://medium.com/@Maria_Nova/4rs-or-get-your-head-around-virtuality-continuum-625e256ddd1d

What is Augmented Reality?

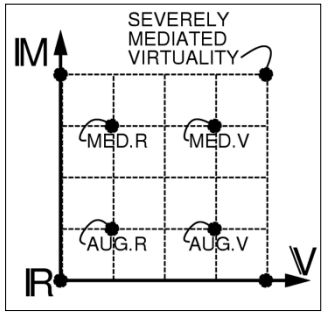
- According to Ronald T. Azuma:
  - Teleoperators and Virtual Environments 6, 4 (August 1997), 355-385.
- AR is a variation of VR (Virtual Reality) or VE (Virtual Environment), where the user can see the real world with virtual objects superimposed upon or composited with the real world.
- AR supplements reality rather than completely replacing it.

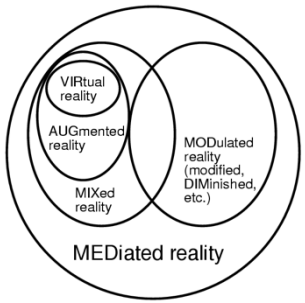
Augmented Virtuality is not commonly used yet.



https://www.slideshare.net/YasminZahir/hci-virtual-reality-augmented-mixed-reality

Mediated Reality



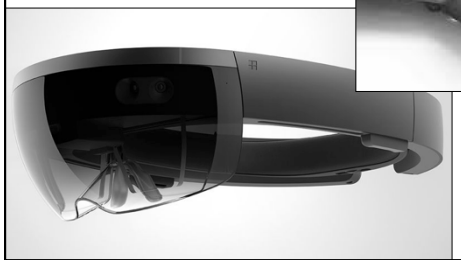


http://wearcam.org/presence-connect/

Concepts

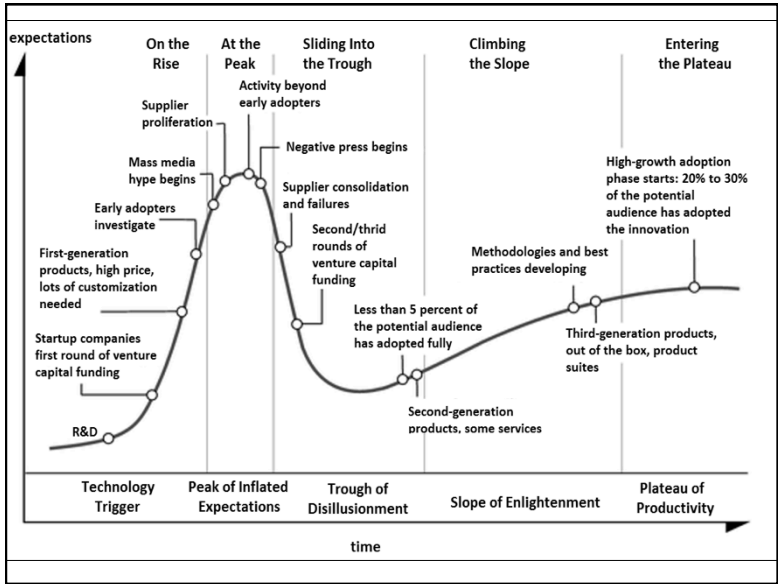
- Augmented Reality: system where the user interacts with an “augmented” version of reality. “Augmented” things are virtual (computer generated).
- Mixed Reality: system where the user interacts with real objects, virtual objects, and information.
  - Mixed Reality Continuum (Paul Milgram 1994)
  - Real reality, Augmented reality, Augmented virtuality and Virtual Reality.

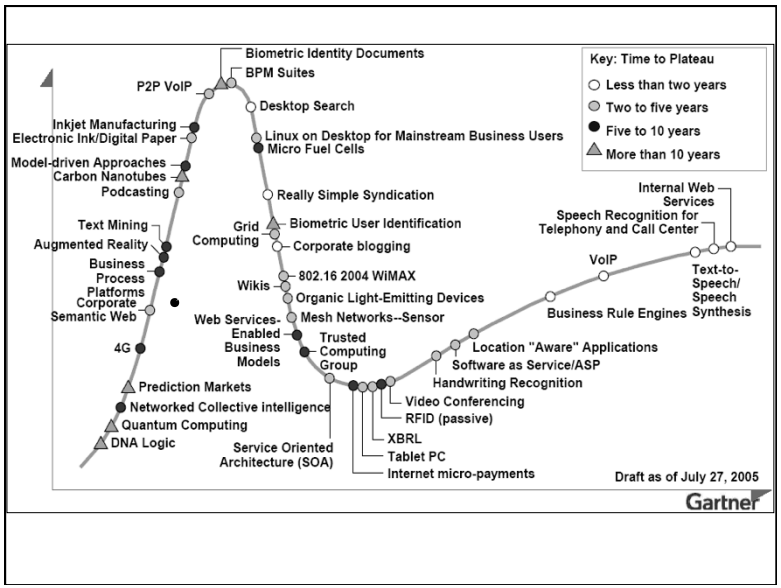
Wearable Technologies

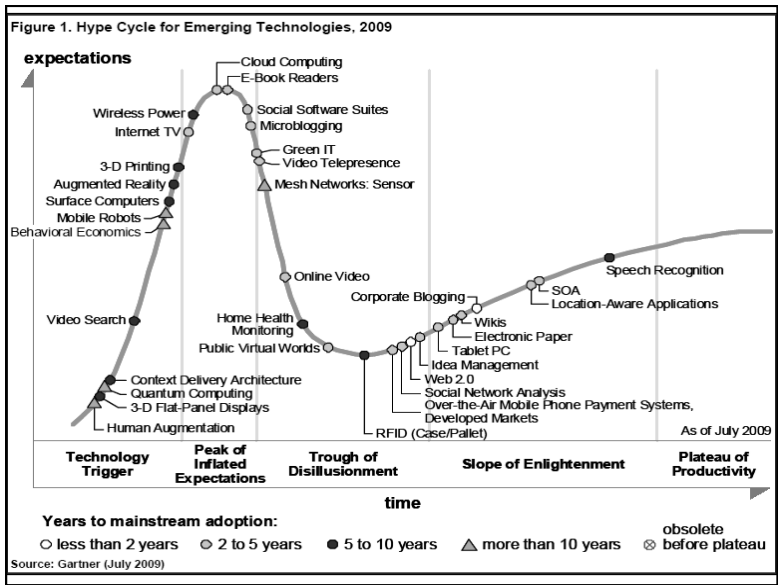


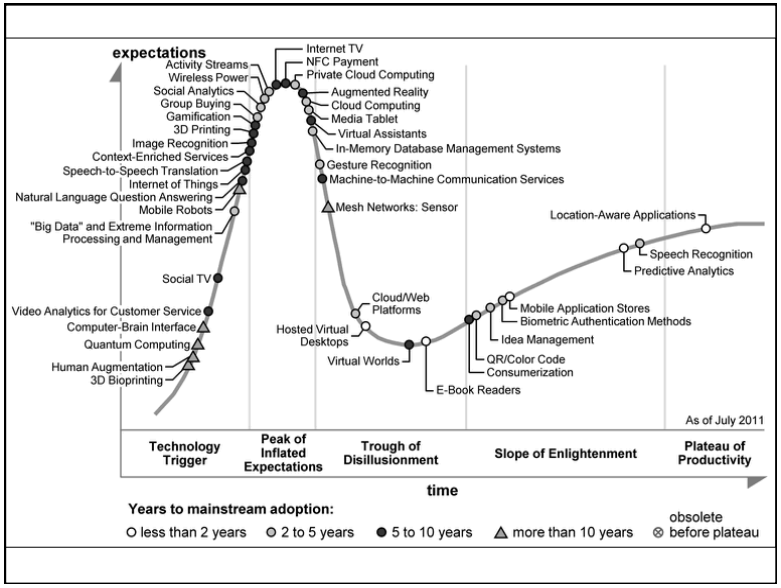
Does AR requires Head Mounted Display?

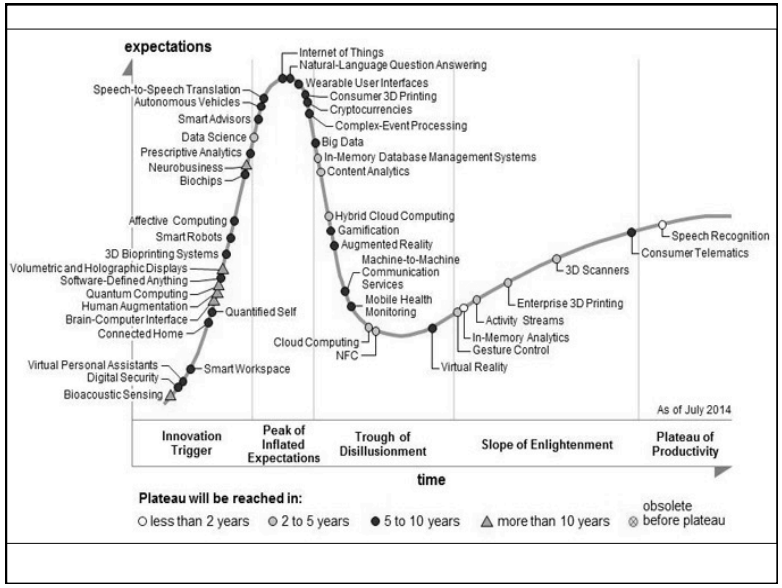
Are we ready for AR?

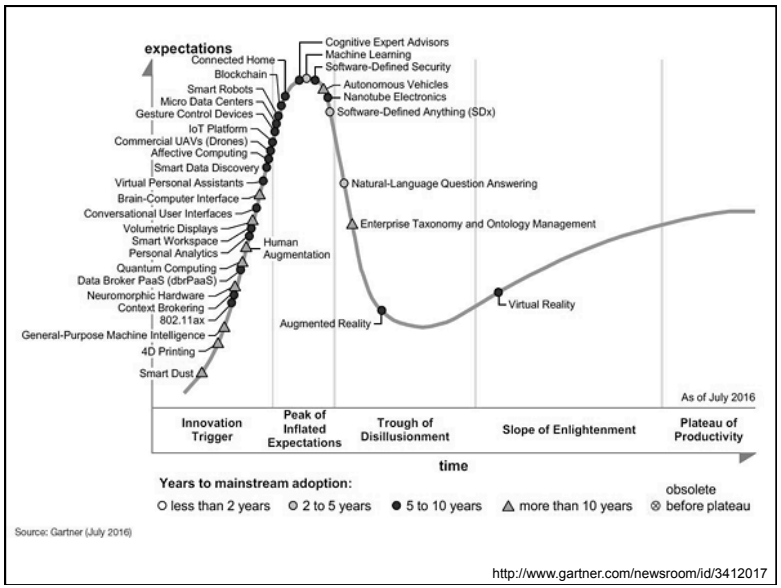




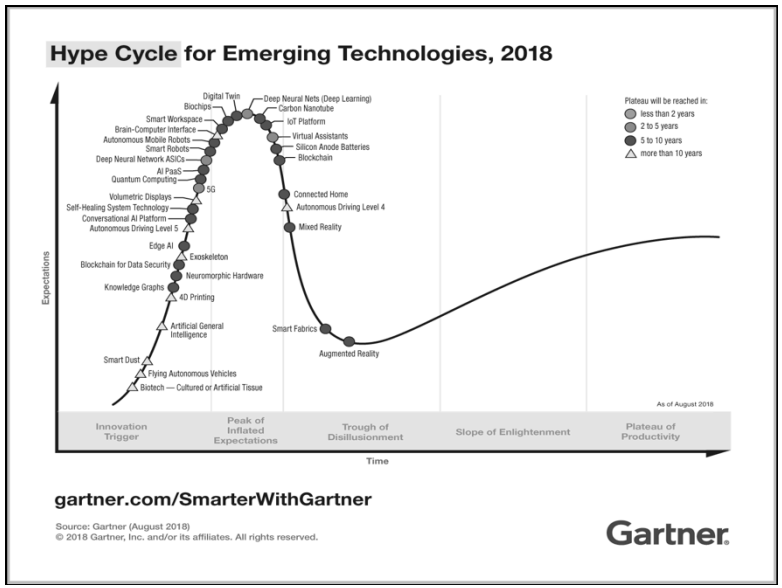








http://www.gartner.com/newsroom/id/3412017



AR characteristics

1 - Combines real and virtual
2 - Interactive in real time
3 - Registered in 3D

- Therefore
  - Films are not AR
  - 2D overlays are not AR
    -

https://www.scientificamerican.com/article/is-pokemon-go-really-augmented-reality/

Applications

- Maintenance
- Training
- Travel
- Entertainment
- Design
- Architecture
- Construction
- Military

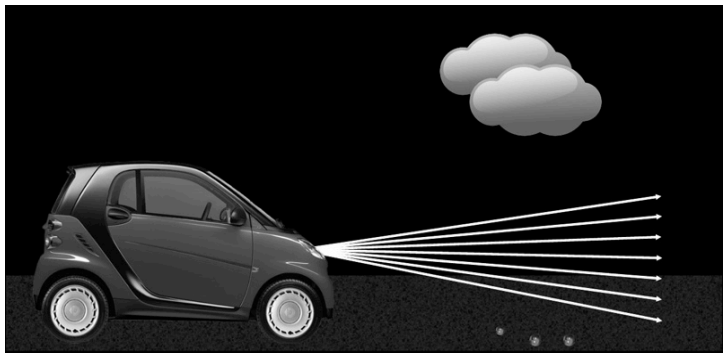
iOnRoad

http://www.roadtraffic-technology.com/news/newsionroad-releases-real-time-navigation-app-for-ios-6

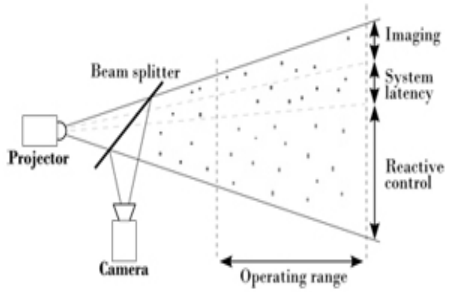
AR Windshield

http://www.augmentedrealitytrends.com/augmented-reality/virtual-windscreen.html

Smart Headlights (CMU)



Overall Approach



The headlight is a co-located imaging and illumination system consisting of a projector, camera, and 50/50 beamsplitter. The camera images the precipitation at the top of the field of view, the processor determines the future locations of the particles and the projector reacts to dis-illuminate the particles. The entire process from capture to reaction takes about 13 ms.

Google

- Google Earth
- Google Translate
- Zygote Body (was Google Body Browser)
- Sky map
- Ingress (AR Game)

- not to mention cardboard

and many more...

- Yelp
- Layar
- Wikitude browser
- Ink hunter
- Snap chat
- Quiver

How to combine real and virtual?

- Requires object models (computer graphics)
- Knowledge of their locations and optical properties of the objects and the cameras and the displays (computer vision)
- System calibration

Placing Assets

- Use of Markers
  - Register 3D models with 3D scene locations (using markers)
  - Track the markers, the user, the interactions of the user with the markers and scene.

Without markers

Google Project Tango

Use depth camera

ARCore

Tracking using inertial sensors

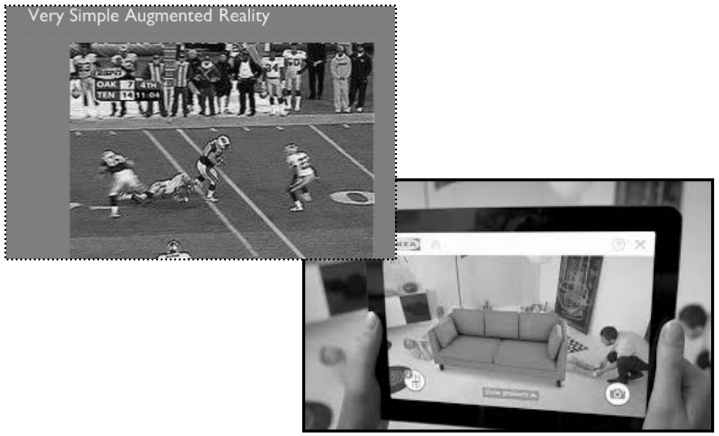
Plane detection

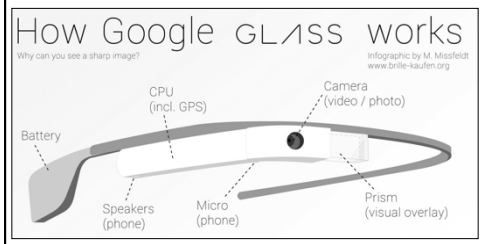
AR is only about graphics?

Display technologies

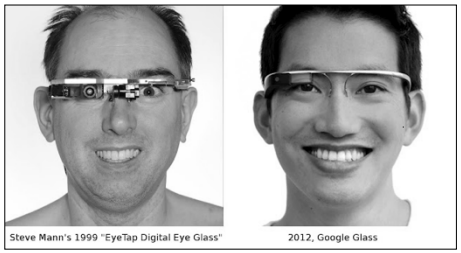
- Display
  - Mobile (smartphones and tablets)
  - Notebooks
  - projectors
- Head mounted
  - Video see-through
  - Optical see-through

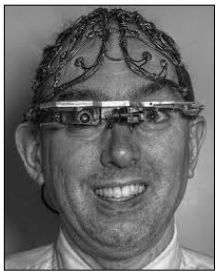
AR using displays



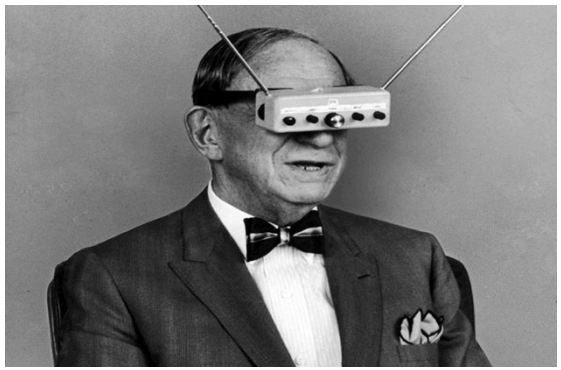


Fun facts





Steve Mann



Hugo Gernsback (of "Hugo Awards" fame), wearing his TV Glasses in a 1963 Life magazine shoot.

https://github.com/grrrwaaa/courses/blob/master/film6246/vr.md

Input Technology

- Gloves
- Chorded Keyboard
- Switches
- Hand and head gestures
- Eye Gaze

Technology Challenges

- Placement
- Scaling
- Illumination, shading, shadows
- Occlusion
- Context and Collision
- Size
- Power
- Heat

HCI Problems

- 3D Interaction
  - User interface x user experience
- Display Limitations (output)
  - Tracking precision and seamless rendering
- Control Limitations (input)
  - Tracking precision and seamless rendering