Virtual reality

Ats Kurvet
Definition

• **Virtual Reality** — a three dimensional, computer generated simulation in which one can navigate around, interact with, and be immersed in another environment. (John Briggs - The Futurist)

• **Virtual Reality** — the use of computer technology to create the effect of an interactive three-dimensional world in which the objects have a sense of spatial presence. (Steve Bryson - NASA Ames)
Augmented reality

https://www.f35.com/about/capabilities/helmet
Presence & perception

- Presence is the feeling of really being someplace else.
- Different barriers of entry for different people.
Technical requirements for presence

• 6 degrees of freedom movement
  – rotational accuracy < $\frac{1}{4}$ degrees
  – Translational accuracy < 1mm
  – rock–solid tracking
• > 90 frames per second
  – low pixel persistence < 3ms
• < 20ms latency – motion-to-photon time
• > 1k resolution per eye
• > 110 degree field of view
• Calibrated, quality optics
http://www.destructoid.com/crescent-bay-gives-me-hope-for-the-consumer-oculus-rift-283475.phtml
Tracking

• Inertial Measurement Unit at 1kHz
  • gyroscope
  • magnetometer
  • accelerometer
  – Can not do absolute tracking

• Tracking camera
  – 60Hz
  – 19ms latency, 2ms for vision processing
  – Absolute tracking combined with IMU data and predictions
Low persistence

• Rolling shutter
  – 3ms band of light moving across the screen from right to left
  – Temporal offset for eyes

• Global display would be nice.
Resolution and field of view
Optical distortion correction
Optical distortion correction example
Timewarp

- Reproject frame before sending it to the display.

Unreal engine integration
Audio

- Binaural audio
- Oculus licensed
  RealSpace 3D Audio by Visisonics
  - Uses head-related transfer function.

http://www.neumann.com/?lang=en&id=current_microphones&cid=ku100_description
Input

• Unsolved with no clear end goal in sight
  – Track what and how
  – Latency
  – Haptic feedback
• Optical vs magnetic vs something else?
Design considerations

• Design for what input?
• Stairs are bad and other cases of motion sickness.
• Sitting experience/limited movement.
• Social interaction

• Sprites look bad so do normal maps
• Performance is at a premium
• Design visuals around lower resolution
• Uncanny valley
• Use real world dimensions
Cave Automatic Virtual Environment
Sources & Extras

- [http://design.osu.edu/carlson/history/lesson17.html](http://design.osu.edu/carlson/history/lesson17.html)
- [https://de45xmedrsdbp.cloudfront.net/Resources/files/UE4-Integration-and-Demos_OC-100270768.pptx](https://de45xmedrsdbp.cloudfront.net/Resources/files/UE4-Integration-and-Demos_OC-100270768.pptx)
- [http://doc-ok.org/?p=1057](http://doc-ok.org/?p=1057)