
Association for Computing Machinery at
Southeast Missouri State University
VIRTUAL REALITY
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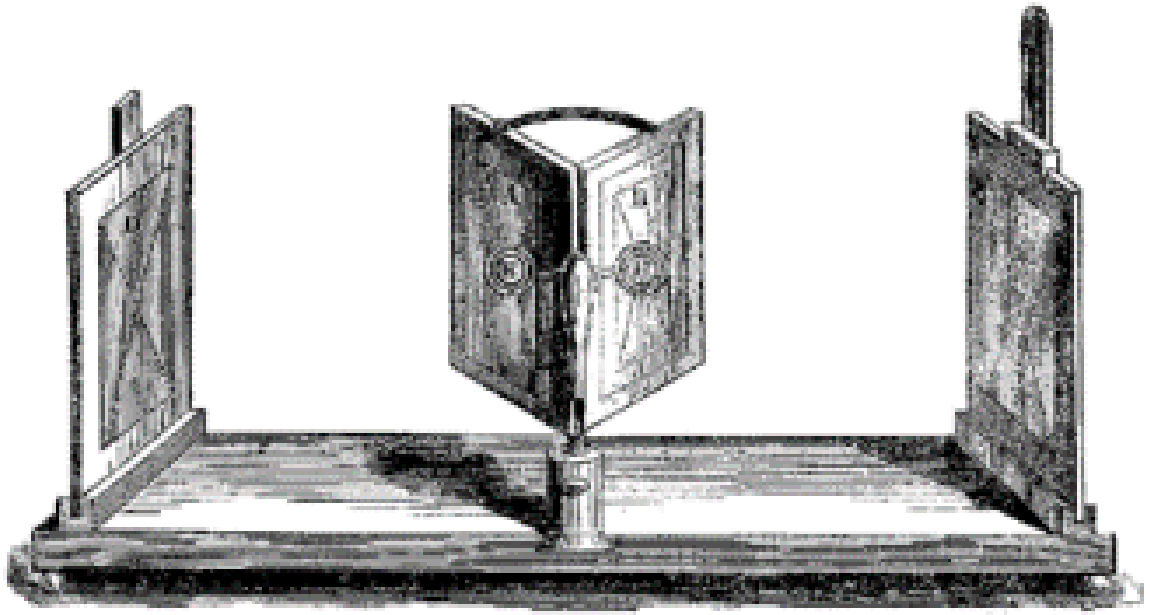
Virtual Reality

- History
- How it Works
- Tools of VR
- How it's Used

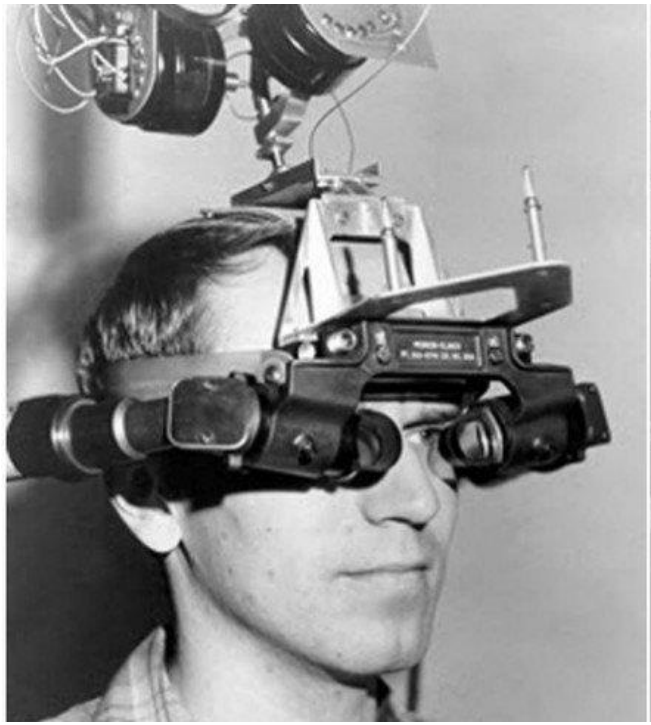
History - 1838

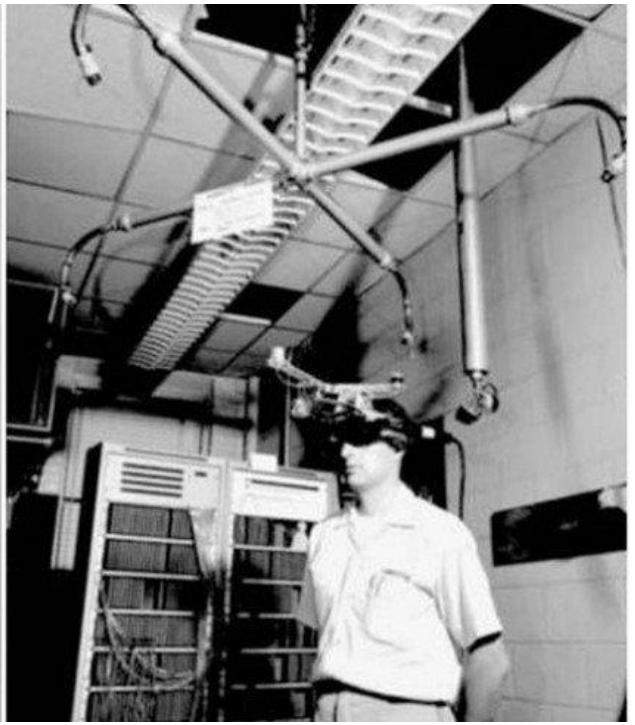
The stereoscope was invented by Sir Charles Wheatstone. This was the first invention of a 3D display.



History - 1968

The Sword of Damocles was the first VR device ever created. Made by Ivan Sutherland of MIT.





History - 1995

Nintendo launches the Virtual Boy, the first consumer VR device to hit the shelves.

It is a commercial failure due to the uncomfortable stationary design, monochromatic red, and high price tag.

History – Honorable Mentions

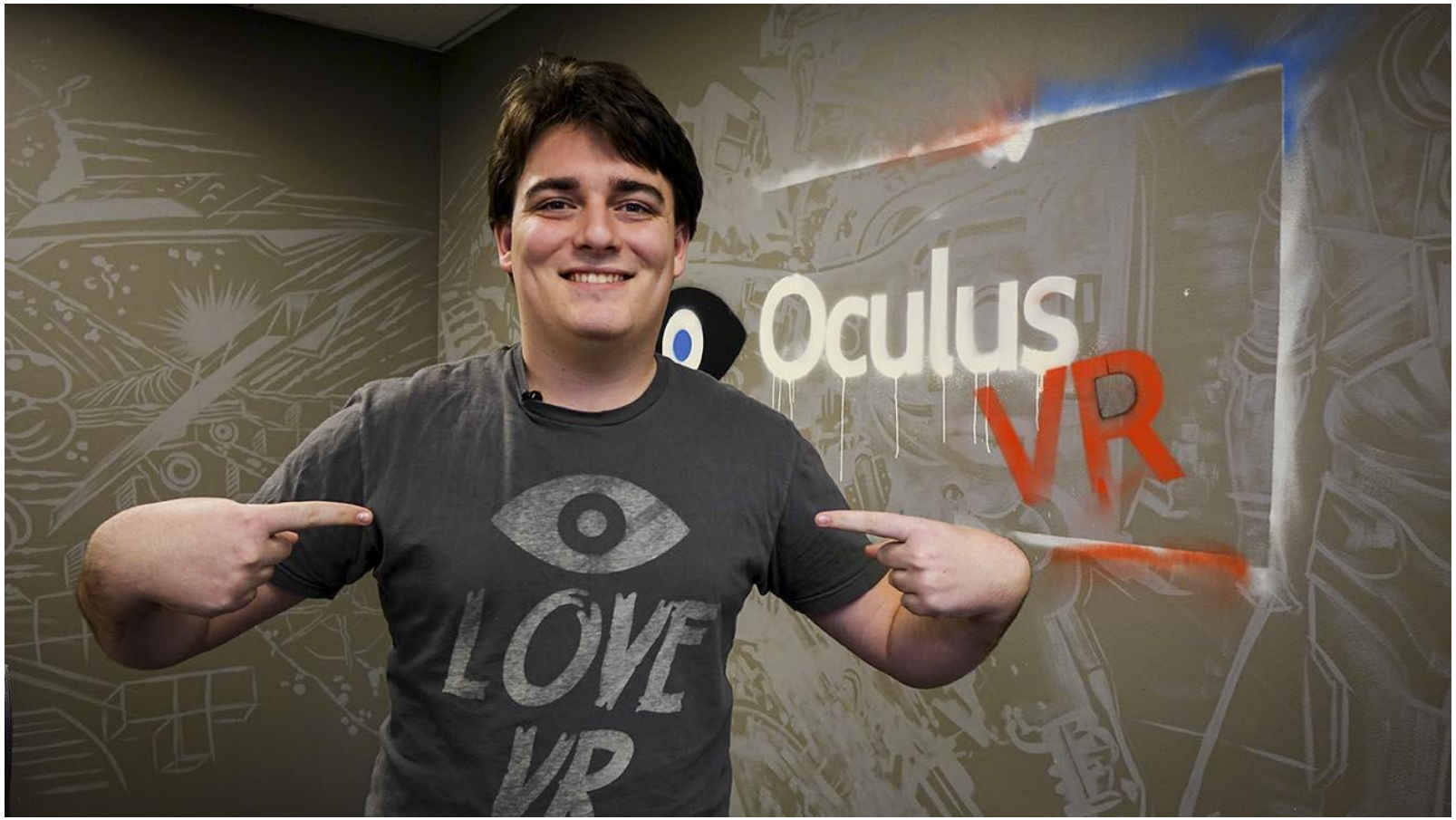
- View-Master 1939
  - Consumer device for stereoscopic reels
- Project Headsight 1961
  - Stereoscopic HMD for the military
- Sensorama 1962
  - 3D multisensory theater
- Virtuality Arcade 1991
  - Arcade with built-in VR headset
- Sega VR Glasses 1993

History - 2012

Oculus hits Kickstarter and raises $2.4 million. Nearly %1000 of the original target.

The low cost solution of utilizing smart phone components along with exposure to several gaming conventions helped launch its popularity.

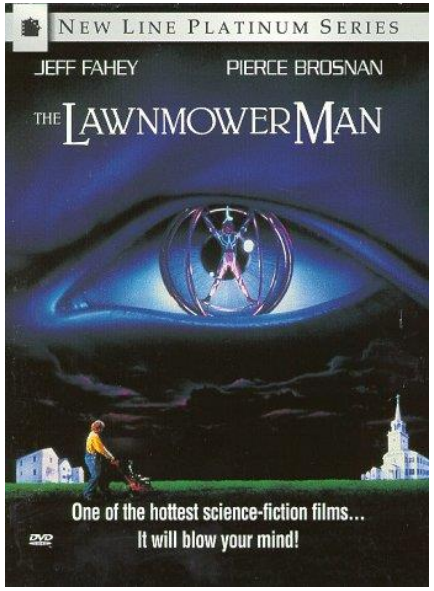
Palmer Luckey

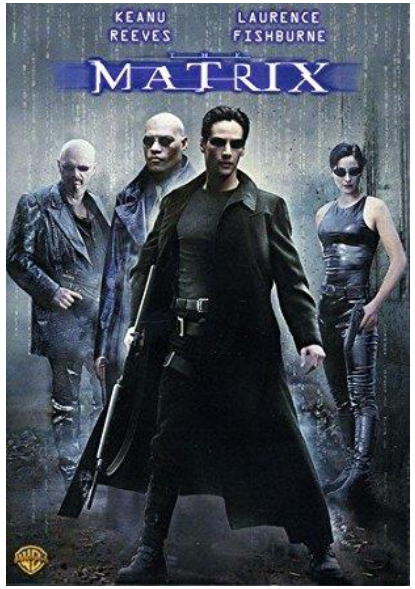


1990s VR vs. Present VR

Popular Virtual Reality Movies / Series

- Tron 1982
- Lawnmower Man 1992
- The Matrix 1999
- Sword Art Online 2012
- Log Horizon 2013
- Ready Player One 2018





How it Works

How it Works

Required

- Optics
- Focal Length
- Field of View
- Stereoscopy
- Rotational Tracking

Not Required

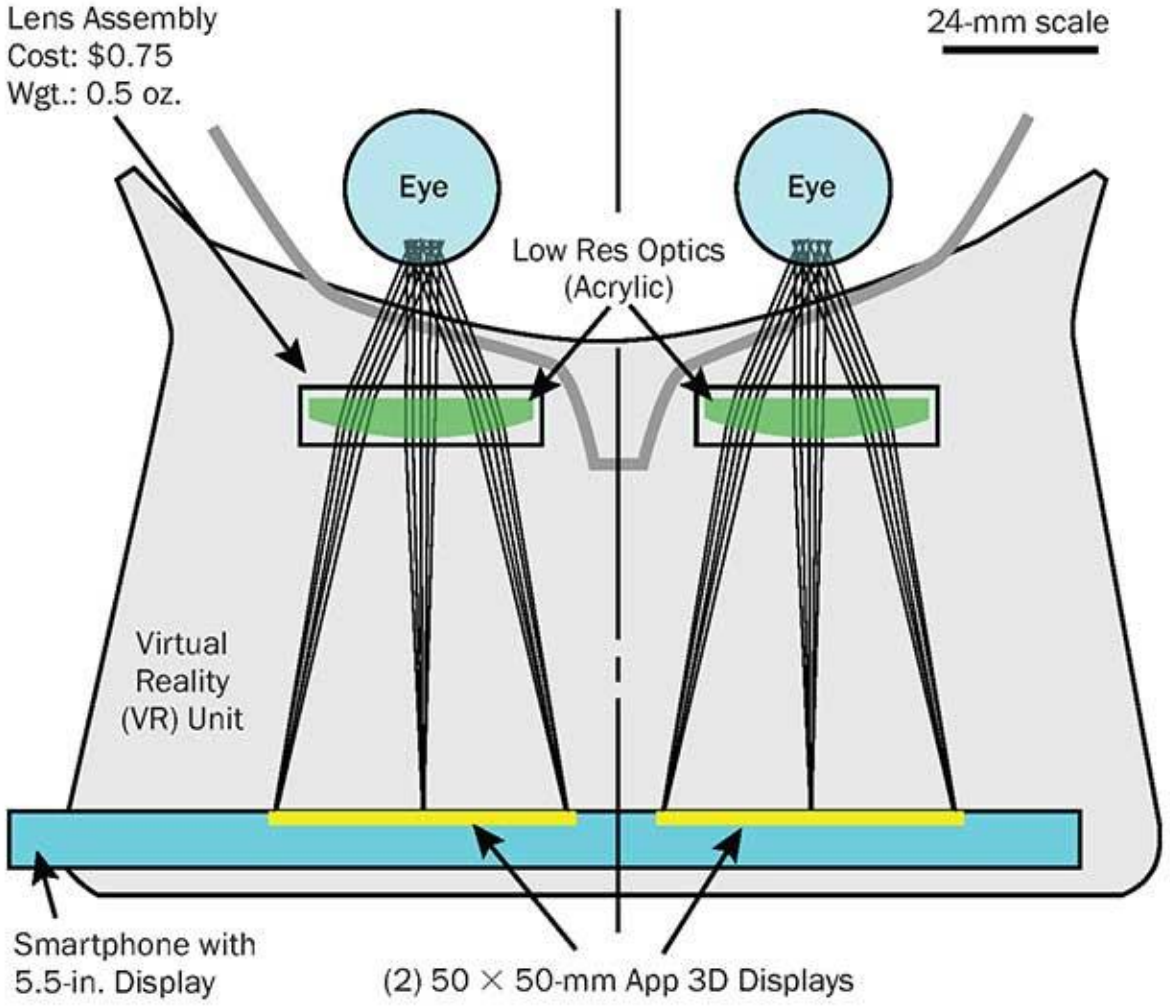
- Low Persistence*
- Spatial Audio
- Positional Tracking
- Haptic Feedback
- Eye Tracking

How it Works

- Low Persistence
  - Displays a moving slice at high fps
  - Reduces motion blur which, in turn reduces motion sickness
- Example

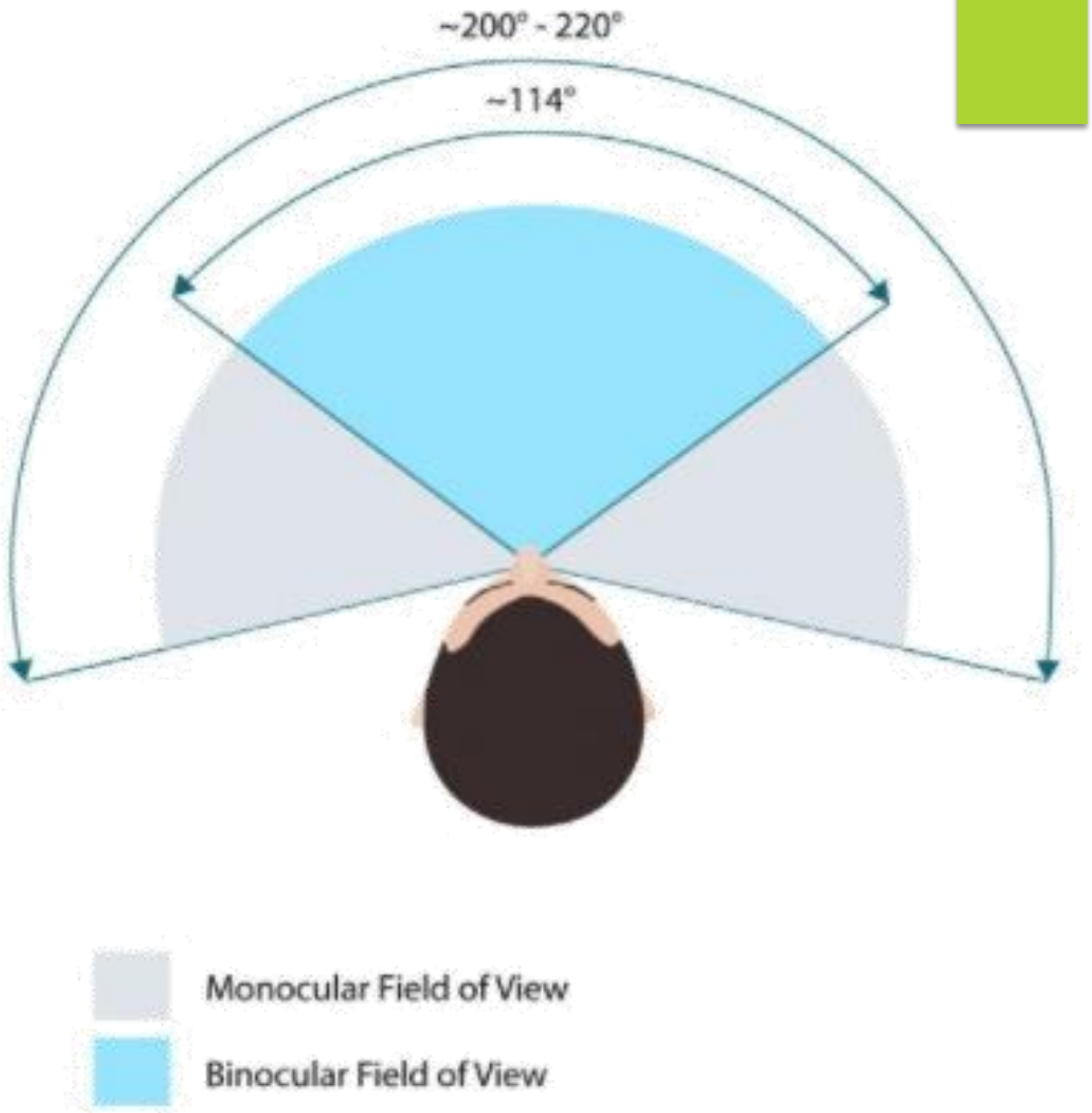
How it Works

- Optics
  - Thin acrylic lenses for small HMD
  - Thick plastic lenses for large HMD
- Focal Length
  - Distance between human eye, optics, and the screen



How it Works

- Field of View (FOV)
  - Average human has ~200 degree FOV
  - Perceive symbols at 60 degree and read text at 10 degrees
  - We only care about the binocular FOV
  - VR Headsets typically range from 90 – 110 degree FOV

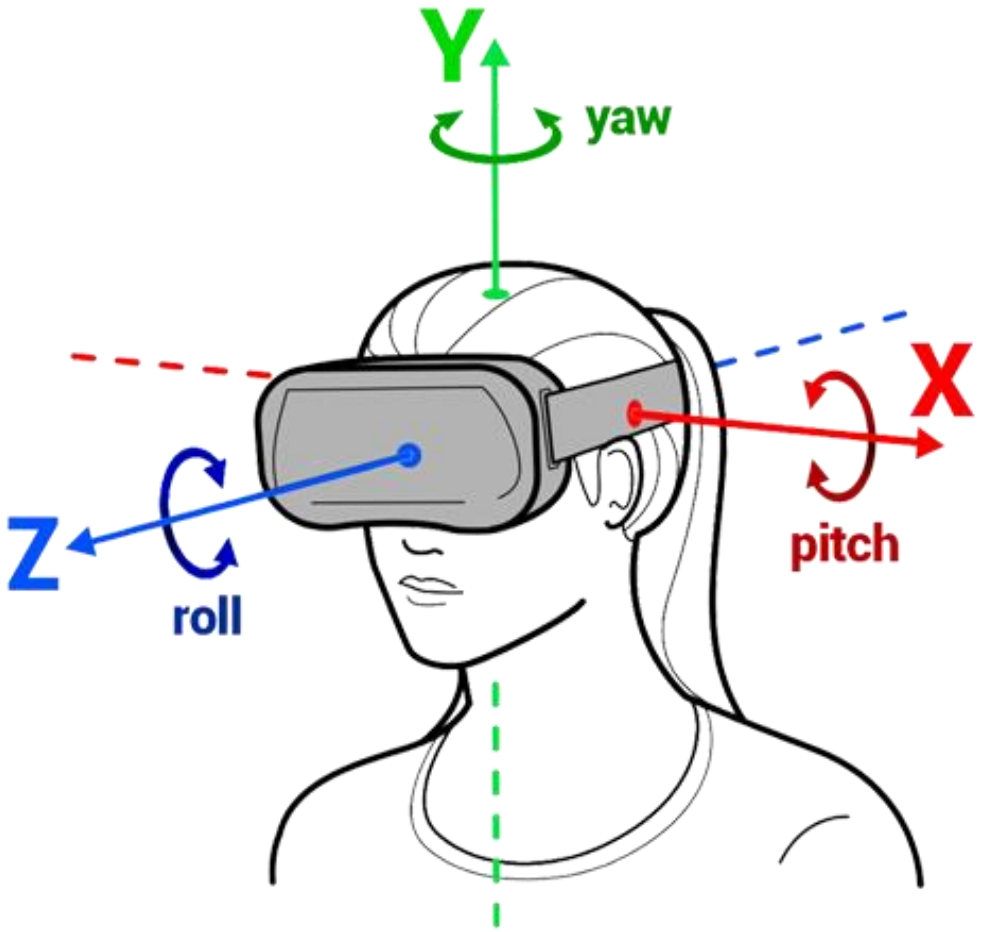


How it Works

- Stereoscopy – the seeing of objects in three dimensions
  - Creates two offset images to imitate what our eyes do
  - If lined up correctly, our brain will handle the rest of the processing

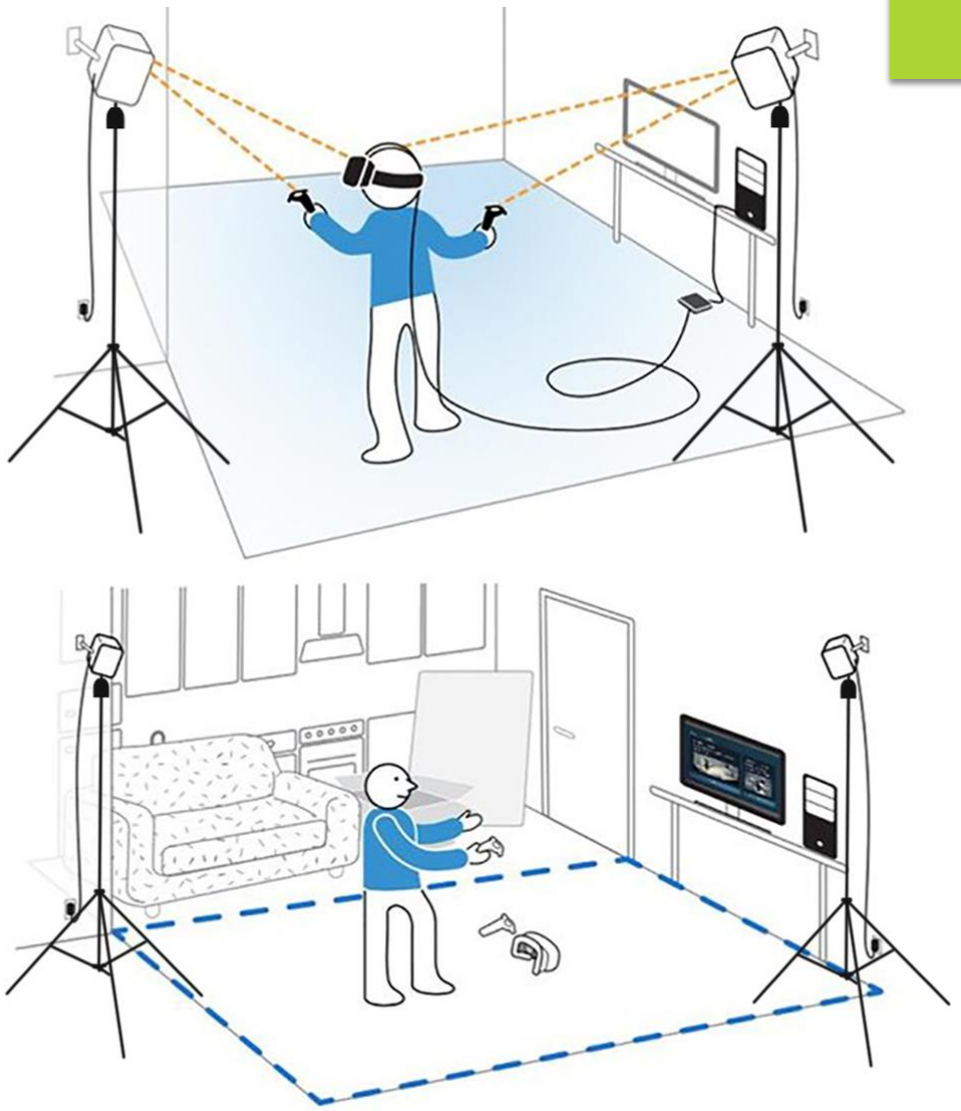
How it Works

- Rotational Tracking
  - Inertial Measurement Units (IMU)
  - Accelerometer
  - Magnetometer
  - Gyroscope



How it Works

- Positional Tracking
  - Oculus Constellation
  - Vive Lighthouse
  - Inside-Out Tracking
- Link to video



How it Works

3 DoF

- Measures Rotation of X, Y, and Z-axis
- Used for Mobile VR

6 DoF

- Additionally measures Position of X, Y, and Z-axis
- Used for Desktop VR

Tools of VR

Tools of VR – Headset Desktop

Oculus Rift

Oculus Go

Tools of VR – Headset Desktop

HTC Vive

HTC Vive Pro

Tools of VR – Headset Desktop

Windows Mixed Reality Devices

Tools of VR – Headset Mobile

Google Cardboard

Google Daydream

Tools of VR – 360 Treadmill

Omni by Virtuix

Tools of VR – Haptics

Hardlight VR Suit

Teslasuit

Tools of VR – Haptics

Taclim Shoes

Haptx Gloves

Tools of VR – Frameworks

Unity3D Engine

Unreal Engine 4

Tools of VR - Frameworks

How is VR being used?

How it's Used – Social VR

Facebook Spaces

VR Chat

BigScreen VR

How it's Used - Education

Virtual Tours	Chemistry	Math
Architecture	Welding	Surgery

Other Fields of Use

- Gaming
- Spatial Audio
- Painting
- Physical Therapy
- Therapy for Mental Illnesses
- Psychology / Anthropology Studies
- Virtual Shopping
- Machine Learning for Human Behavior

Questions?