CSE 165: 3D User Interaction

Lecture #9: VR Controllers

Announcements

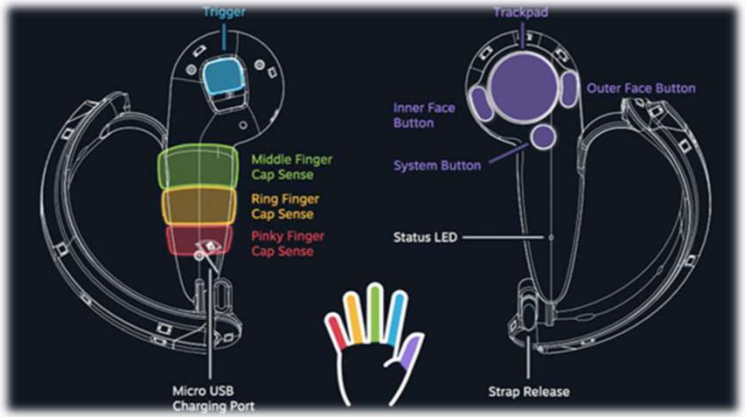
- Homework Assignment 3
  - Due next Friday at 3pm
- This Friday: late grading for project 2b

HTC Vive Controllers

- Released April 2016
- Wireless
- Rechargeable through mini USB
- Optical tracking (IR laser)
- Symmetric design
- 2 buttons on top
- Clickable touch pad
- Trigger for index finger
- Left and right grip buttons

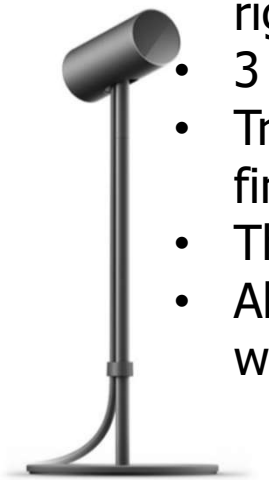
Valve "Knuckle" Controllers

- For HTC Vive
- Announced in Dec 2017
- Not released yet



Oculus Touch Controllers

- Released December 2016
- Wireless
- No recharge port
- Optical tracking (infrared cameras)
- Asymmetric design for left and right hand
- 3 buttons on top
- Triggers for index and middle fingers
- Thumb stick
- All buttons touch sensitive, as well as surface on top



Microsoft Mixed Reality

- Different HMDs
- Same controllers
  - hybrid between Rift and Vive controllers

Mobile VR Controllers

- Gear VR
- 3 DOF vs. 6 DOF

PlayStation Move

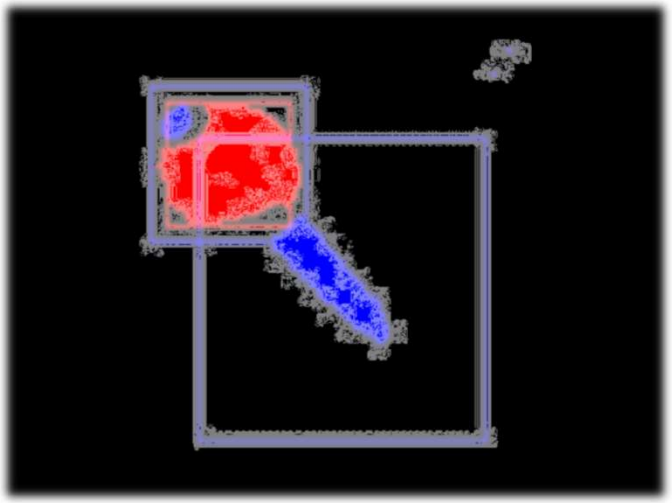
- Consists of
  - PlayStation Eye camera
  - up to 4 motion controllers
- Combines camera tracking with motion sensing for 6 DOF tracking
- Vibration feedback
- Wireless and USB connectivity
- Four buttons (Square, Triangle, Cross, Circle) on front
- Two buttons (Select on left, Start on right) on sides
- Big Move button front center
- Small PS button on front (power button)
- Analog trigger button on back

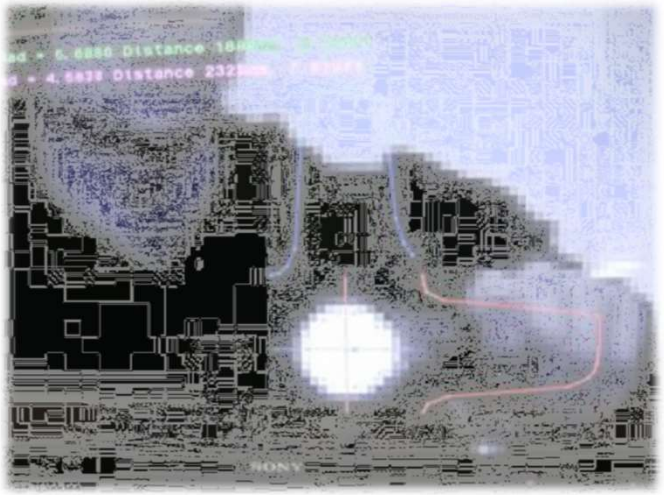
Move - Camera

- PlayStation Eye
  - 640 x 480 (60Hz)
  - 320 x 240 (120Hz)
  - Microphone array (4 mics)
  - Manual exposure control

PlayStation Move – 6 DOF Tracking

- Image Analysis
  - Find sphere in image with segmentation algorithm
  - Given known focal length and measured size of sphere in image, calculate 3D position
- Sensor Fusion
  - Combines results from image analysis with inertial sensors
    - Accelerometer
      - Gives pitch and roll angles when controller is stationary
      - Gives controller acceleration when orientation is known
    - Gyroscope
      - Measures angular velocity and acceleration





Playstation VR

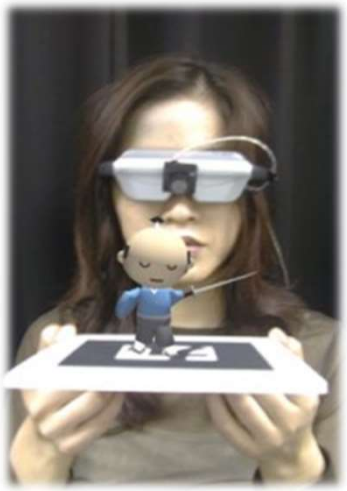
- Uses Move controllers as 6 DOF input devices
- HMD uses visible light for tracking
- HMD tracking camera also tracks Move controllers

Razer Hydra

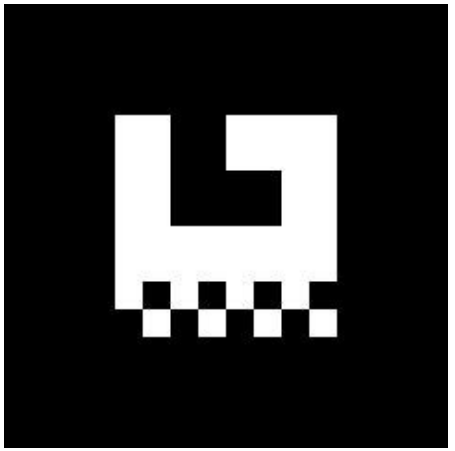
- Made by Sixense
- Two tethered controllers
- Electromagnetically tracked
- Two buttons on front
- Thumb stick
- 5 buttons on top
- Symmetric design for left/right hands
- Drivers for Windows, Linux

Optical Tracking: ARToolkit

- Developed in 1999 by Hirokazo Kato, HITLab, University of Washington
- Printable markers
- Camera based (webcam sufficient)
- Flexible marker design
- Simple programming interface
- 6 DOF tracking possible



ARToolKit



ARToolKit marker

ARToolKit Video

- Augmented Reality by Hitlab
  - https://www.youtube.com/watch?v=ZKw_Mp5YkaE

Optical Tracking: HiBall

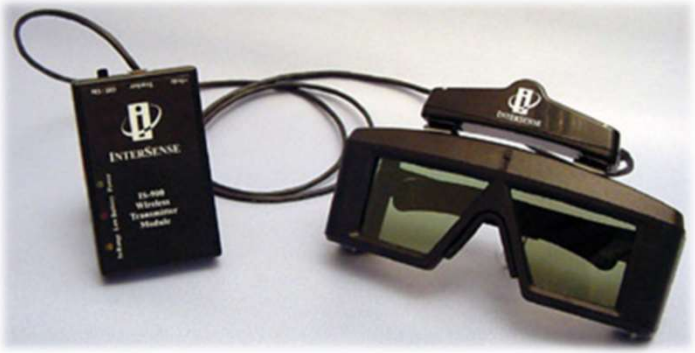
- HiBall-3100 tracker system, distributed by 3rd Tech
- Developed within wide-area tracking research project at UNC Chapel Hill
- System is composed of:
  - HiBall Optical Sensor
    - Views infrared LEDs in beacon arrays on ceiling with 6 lenses and photodiodes
    - Ceiling beacon arrays
- Tracker update rate: 2,000 Hz
- No metal or sound interference

HiBall beacon array

Ultrasonic Tracking

- Systems measure duration of an ultrasound signal to reach microphones.
- InterSense system uses combination of ultrasound and gyroscope.

Logitech 3D Mouse



InterSense IS-900 tracker

InterSense IS-900 Wand

Hybrid Devices: Haptic Feedback Devices

- PHANToM haptic device
- Force feedback joystick
- Exoskeleton-like devices

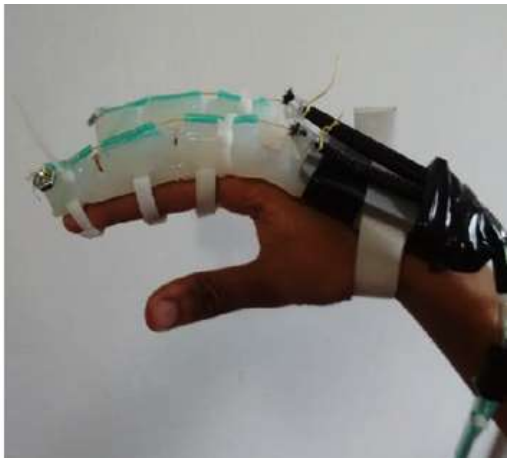
Immersion CyberForce

LEXOS: Frisoli et. al., Italy

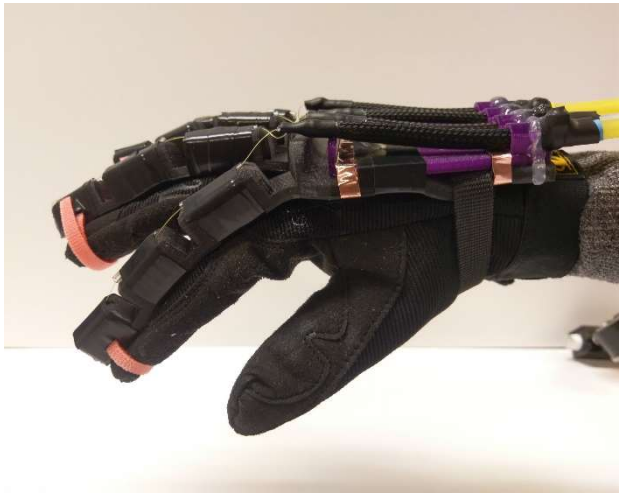
SensAble PHANToM

Microsoft force feedback joystick

Haptic glove with soft robotics components



Initial glove assembly

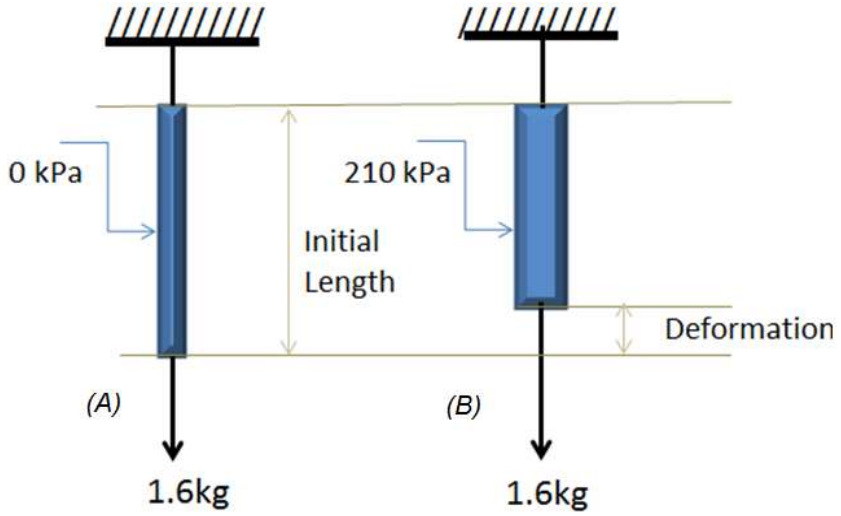


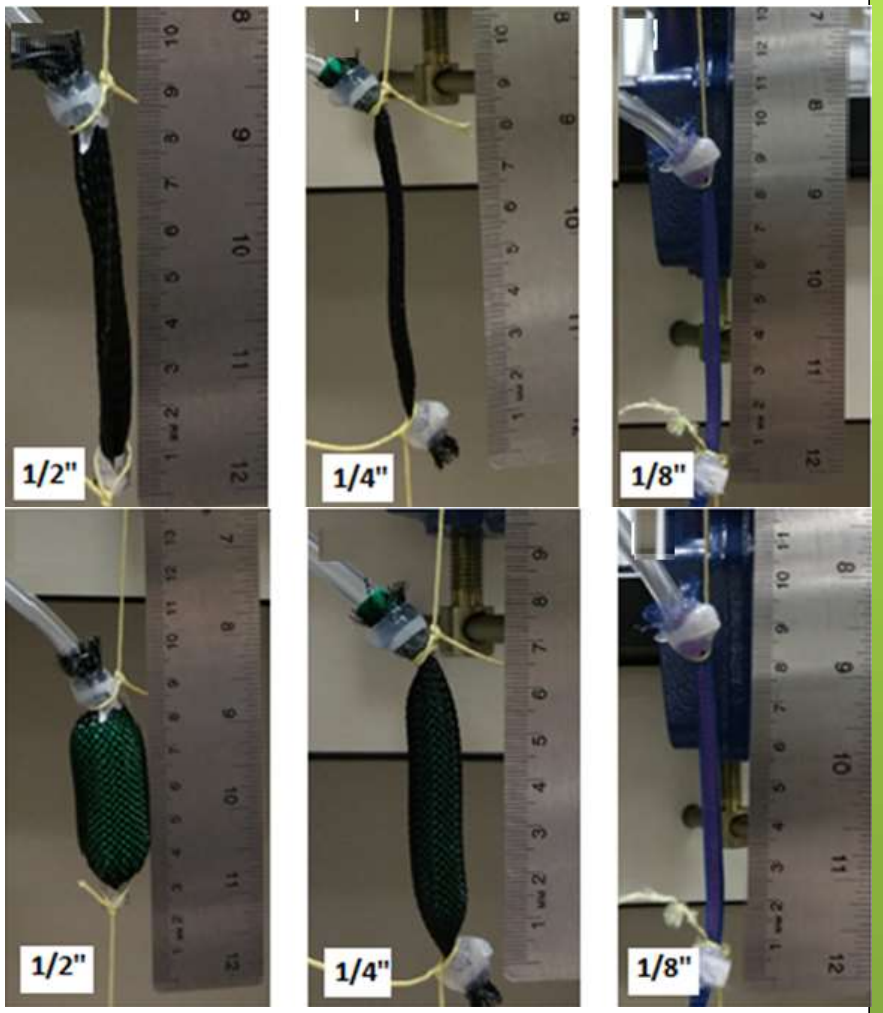
Designed by UCSD Master's student Saurabh Jadhav

Updated glove assembly

Design of the McKibben muscle

McKibben muscles testing setup:





McKibben muscles in unactuated (top) and actuated (bottom) positions

Use case: playing piano in VR

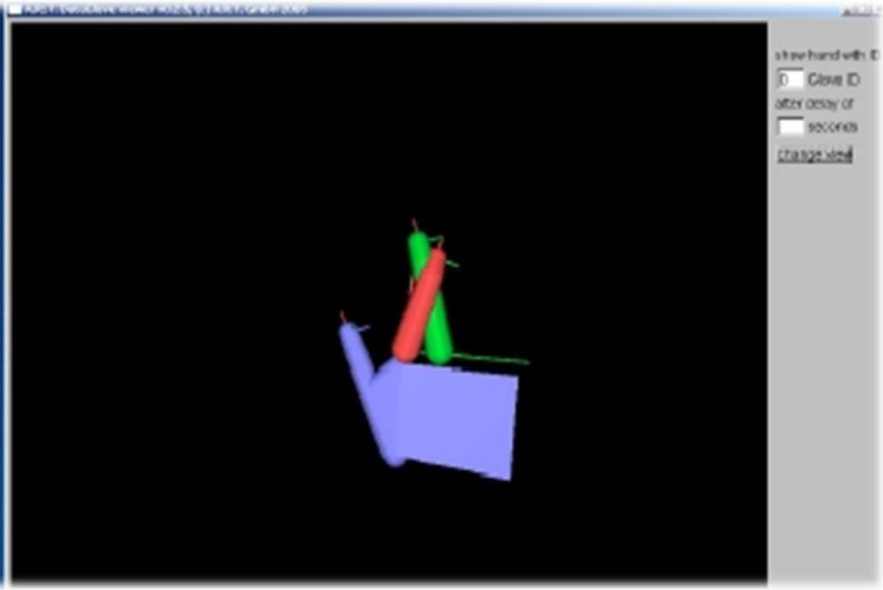
Pinch Gloves

- Determine if two or more fingertips are touching
- Use conductive cloth to close circuit
- Tethered to controller box
- Designed for pinching and grabbing gestures
- Recognize any gesture of 2 to 10 fingers touching, plus combinations of gestures

www.fakespacelabs.com

Optical Finger Tracking

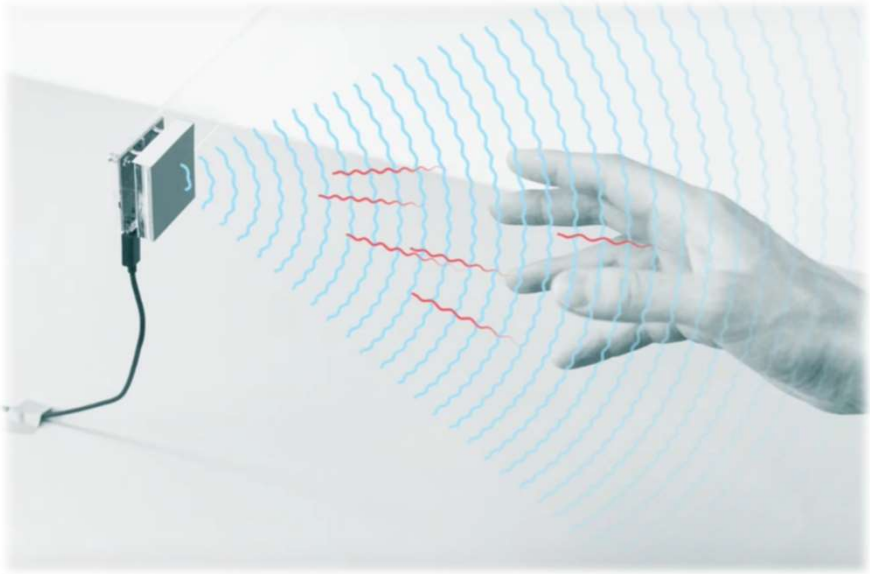
- Extension of ART system
- Tracks three fingers and the hand



Optical Finger Tracking

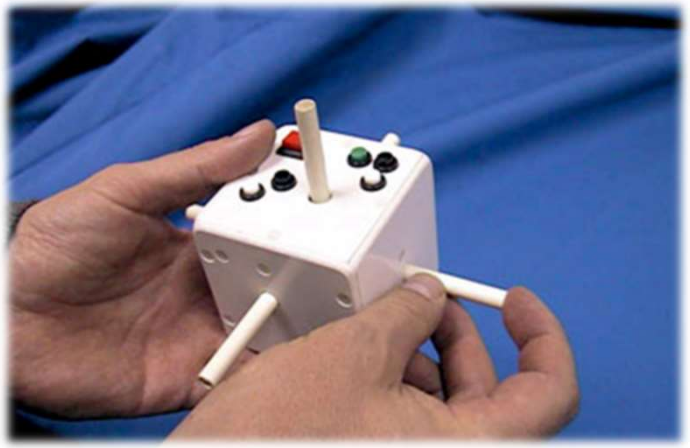
- Oblong Industries g-speak
  - Video: http://www.youtube.com/watch?v=9OpmxbPzDM0

Radar



- Project Soli
  - https://www.youtube.com/watch?v=0QNiZfSsPc0
- Soli sensor technology works by emitting electromagnetic waves in a broad beam
- Objects within the beam scatter this energy, reflecting some portion back towards the radar antenna
- Properties of the reflected signal, such as energy, time delay, and frequency shift capture information about the object's characteristics and dynamics, including size, shape, orientation, material, distance, and velocity

Special Purpose Device: Cubic Mouse



- Developed at Fraunhofer Institute by B. Frohlich and J. Plate
- Cube shaped box with three rods represents a physical coordinate system
- 6DOF tracker is inside cube
- Rods used to manipulate x-, y-, and z- coordinates of an object (built for controlling cutting planes)
- Target application area: volume rendering for oil and gas industry

Cubic Mouse Video

- http://www.youtube.com/watch?v=1WuH7ezv_Gs

Application-Specific Devices

- Virtual hang-gliding over Rio de Janeiro (L. Soares at. al.)
- Virtual canoe, Siggraph 2005
- https://www.youtube.com/watch?v=8kjZ-nKjfgE

Cave Painting

- Physical props (brush, color palette, bucket) allow intuitive painting
- Created by Daniel Keefe at Brown University (now Prof. at Univ. of Minnesota) in 2001
- Google Tilt Brush and Oculus Quill are modern versions for HMDs

Cave Painting Video

- http://www.youtube.com/watch?v=WQv-LnHrmwU

Augmented Reality

- Android app:
  - Download "Augmented Reality Try it Free" by CreativiTIC from Google Play Store
  - App uses Vuforia from Qualcomm for image recognition
- Then point at images on next slide