CSE 165: 3D User Interaction

Lecture #7:
Tracking Technologies

Announcements

- Homework Project 2a
  - Due Friday February 1st at 3pm
  - Solo project
  - Teams not allowed

Overview

- Degrees of freedom
- 2-DOF devices
- Relative 6-DOF devices
- Absolute 6-DOF devices
  - mechanical
  - electromagnetic
  - inertial
  - optical
  - ultrasound
  - hybrid
  - special purpose

Keyboard (binary n-DOF) and Mouse (2-DOF)

- Some VR applications are designed for keyboard, mouse or game pads
- Can work well for walk/fly-through applications
- Doesn't work well for 3D selection and manipulation

3 DOF: GPS

- GPS = Global Positioning Satellite system
- GPS receivers determine exactly how long it takes for the signals to travel from each satellite
- Result:
  - Latitude
  - Longitude
  - Altitude

Touch or Pen-based Tablets

- Absolute 2D position
  - 2 DOF
- Microsoft Surface Dial
  - Adds 1 DOF

6-DOF Relative Devices

- Relative position and orientation
- 3dconnexion/Logitech

Spaceball

Space
Navigator

Mechanical 6-DOF Tracking

- Fakespace Boom: doubles as a stereo display
- Geomagic Touch: doubles as a haptic feedback device

Fakespace Boom

Geomagic Touch

Electro-magnetic Tracking

- Fixed transmitter generates low-level magnetic field from 3 orthogonal coils
- Fields generate current in smaller receiver unit(s) worn by user
- 6-DOF tracking achieved by analyzing signal strength in receiving coils
- Advantage: no line of sight restrictions
- Disadvantage: metal in environment can cause interference

Razer Hydra

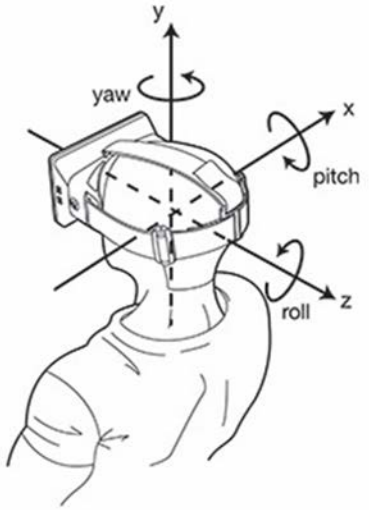
Razer Hydra

- 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

Inertial Tracking

- Trackers use miniature gyroscopes to measure orientation changes: 3-DOF
- Accelerometers can help calibrate, add position tracking
- Disadvantage: drift between actual and reported values, accumulates over time

Gyro in Oculus Rift DK1



3 Rotational DOF

Optical Tracking: Mocap Devices

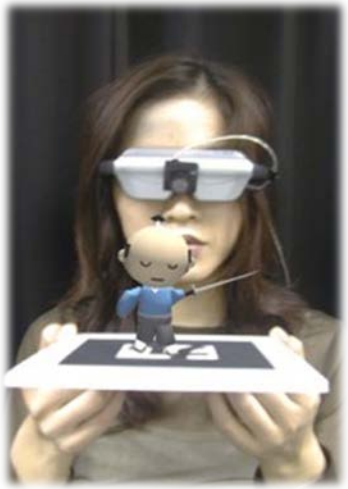
- Infrared (IR) cameras illuminate scene for easier detection of markers
- Multiple markers (highly reflective spheres) arranged in fixed, known configurations allow for 6 DOF tracking

ART Tracking System

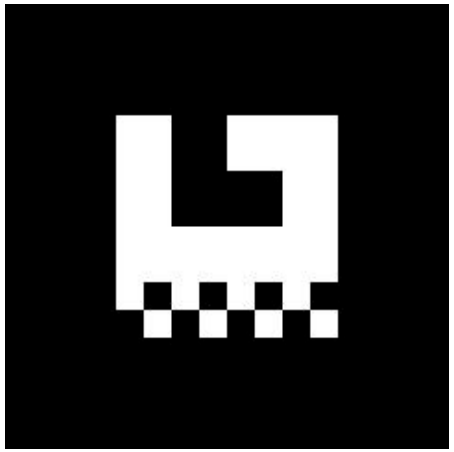
Vicon Tracking System

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



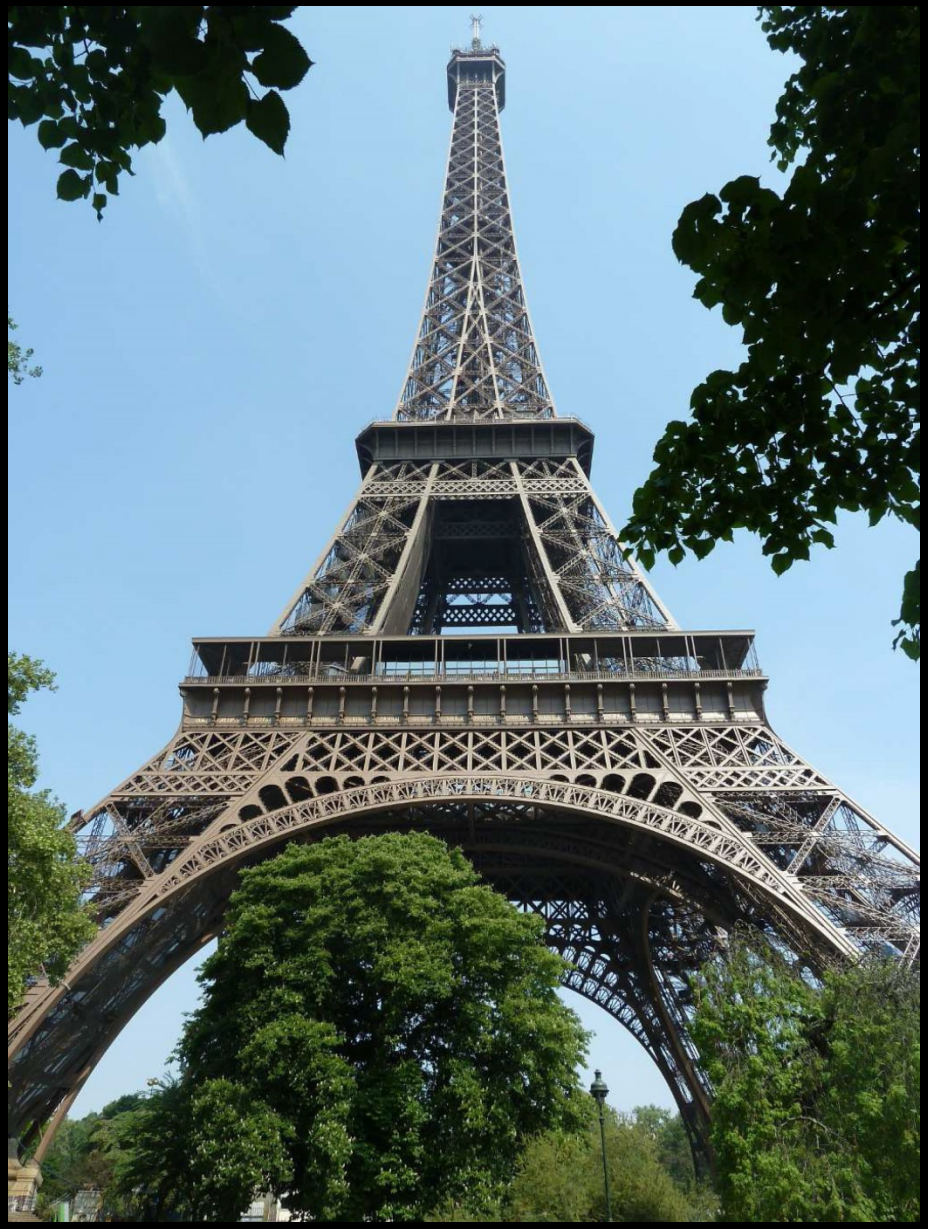
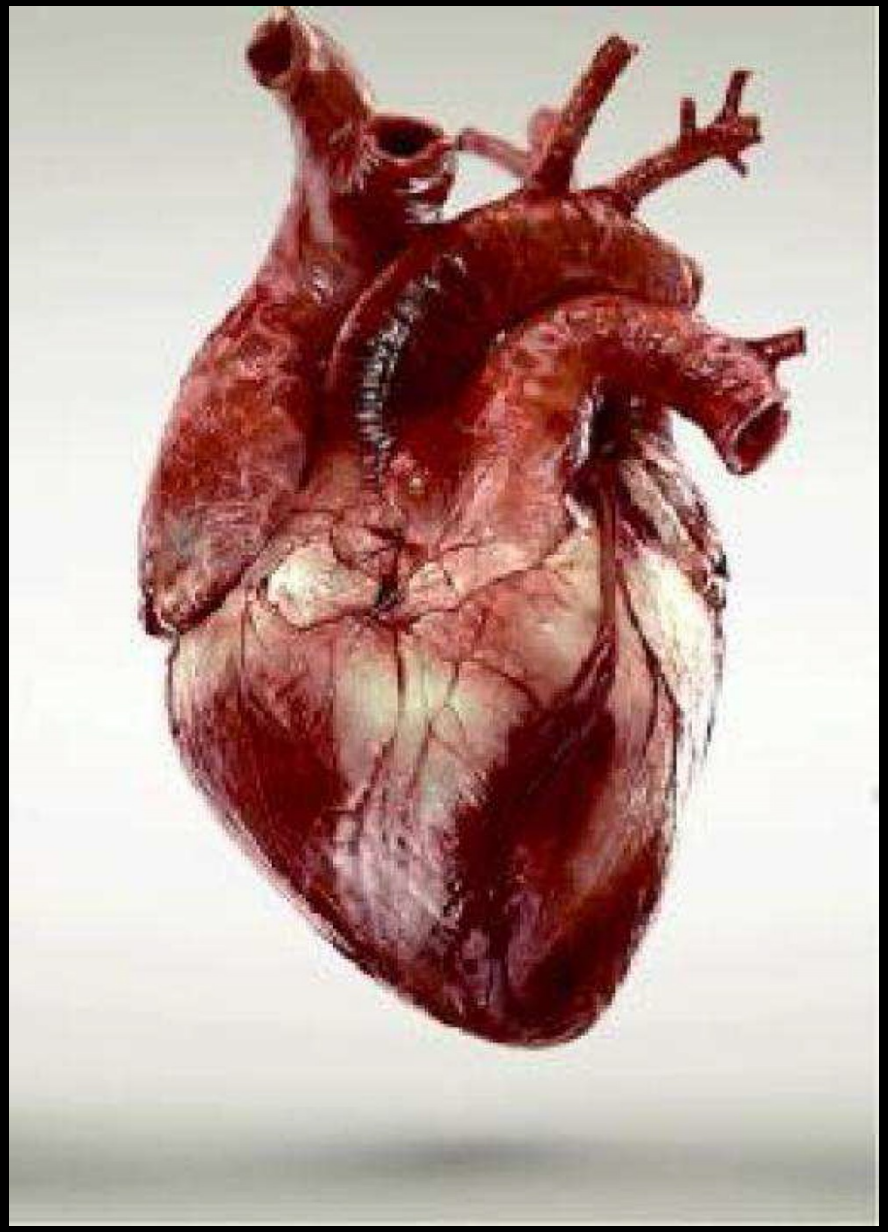
ARToolKit



ARToolKit marker

ARToolKit Video

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

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