CSE 165: 3D User Interaction

Lecture #8:
Input Devices Part 3

Announcements

- Homework project 2 is due next Friday

3D Input Devices for Games

Nintendo Wiimote

PlayStation Move

Microsoft Kinect 2

Leap Motion

Razer Hydra

The Wiimote

- Uses Bluetooth for communication
- Senses acceleration along 3 axes
  - Used for sports games (tennis, bowling, etc.)
- 128x96 pixel monochrome camera with built-in image processing, requires sensor bar
  - Enables 2D on-screen pointer
- Standard buttons and trigger
- Provides audio and rumble feedback
- Up to 4 Wiimotes can be active simultaneously
- Connector for attachments
  - Nunchuck
  - Wii Zapper
  - Wii Wheel

Wii Wheel

Wii Zapper

Sensor Bar

The Wii Motion Plus

- Initially (June 2009) optional add-on, later built-in
- Uses 3-axis gyroscope
- Captures relative 3D orientation
- Improves pose and motion estimation
- Information captured by gyroscope can be used to distinguish true linear motion from accelerometer readings

Microsoft Kinect

- Microsoft sold 8 million units in first 60 days on market
  - Guinness World Record for “fastest selling consumer electronics device”
- Kinect features
  - RGB camera
  - Depth sensor
  - Microphone array
  - Motorized tilt
  - Connects via USB
- Enables controller-less user interface
- Full body tracking possible
- 2 versions:
  - Xbox (~$100)
  - Windows PC (~$200)

Kinect – Hardware Details

- RGB Camera
  - 640 x 480 RGB pixels at 30Hz
- Depth Sensor
  - 640 x 480 monochrome pixels with 11-bit depth CMOS sensor at 30 Hz
  - Field of view: 57 ° horizontally, 43° vertically
  - Infrared laser projector
  - 4-11 feet range, down to 16 inches in near mode (Windows version only)
- Multi-array mic
  - Four microphones
  - Multi-channel echo cancellation
  - Sound position tracking
- Motorized tilt
  - 27º up or down

www.hardwaresphere.com

Kinect – Extracting 3D Depth

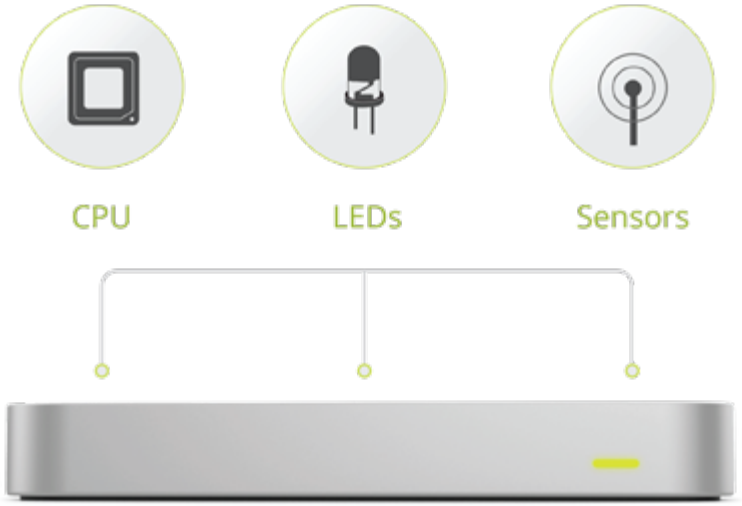
- Infrared laser projector emits known dot pattern
- CMOS sensor reads depth of all pixels
- Finds location of dots
- Computes depth information using stereo triangulation
  - Normally needs two cameras
  - Laser projector acts as second camera
- Depth image generation

Leap Motion

- http://www.youtube.com/watch?v=_d6KuiutelA

Leap Motion Overview

- Released July 2013
- Small form factor (3 x 1.2 x 0.5 inches)
- Short range finger tracking
- No depth map
- Two IR cameras
- Image processing on host PC
- Inexpensive (<$70)

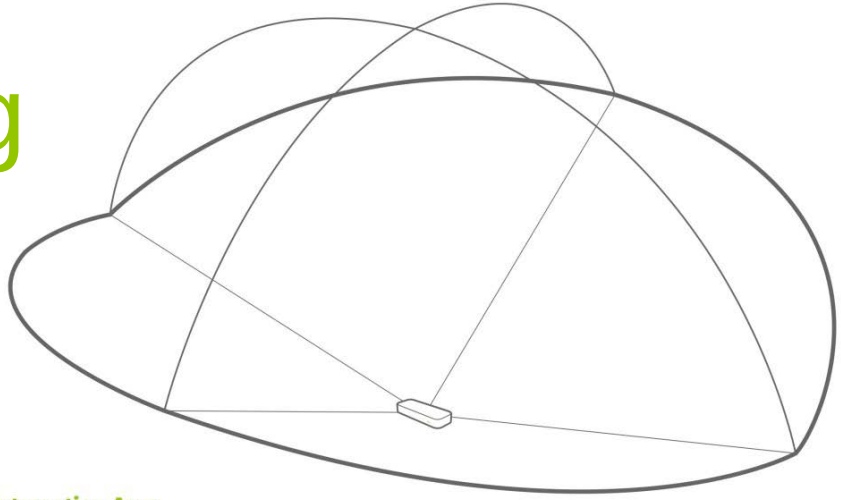


Leap Technology

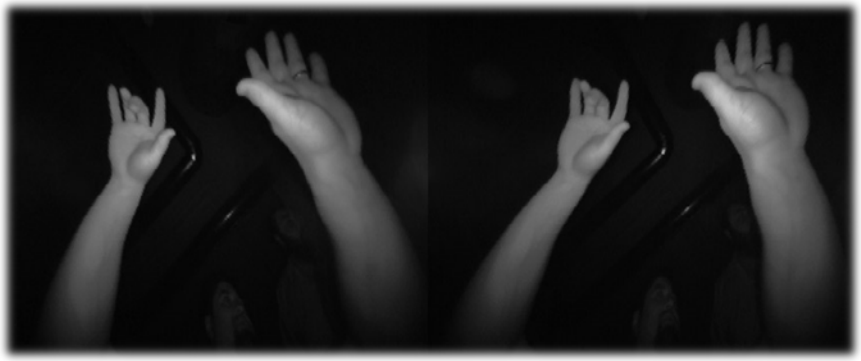
- 8 cubic feet of interactive space
- 2 cameras
- 3 IR LEDs
- 850 nm wavelength (invisible for the eye)

Leap Tracking

- USB controller reads sensor data into own local memory and performs resolution adjustments
- This data is streamed via USB to Leap Motion tracking software
- Images appear in grayscale
  - Intense sources or reflectors of infrared light can make hands and fingers hard to distinguish and track



Interaction Area
2 feet above the controller, by 2 feet wide on each side (150° angle), by 2 feet deep on each side (120° angle)

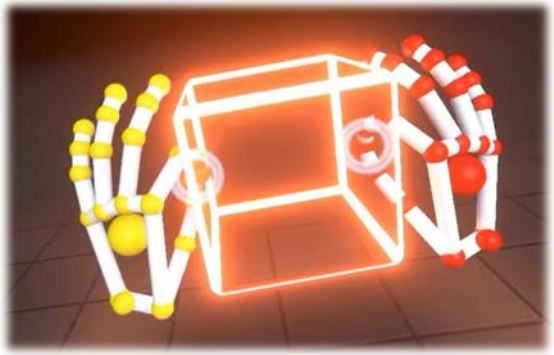


Leap Motion on Oculus Rift

- Leap makes plastic mount
- Mount glues to front of Rift
- Leap is removable
- Leap cable plugs in computer

Orion Driver for Leap Motion

- Released February 2016
- Complete re-write of driver
- Improved tracking
- Grab-and-drop interactions



https://www.youtube.com/watch?v=rnlCGw-0R8g

Selection by Dwell Time

- User points at object with any technique
  - Virtual pointer
  - Eye gaze
- Action is triggered after dwell time threshold is exceeded
- Works without physical buttons
- Frequently used in controller-less VR: Google Cardboard, Samsung Gear VR

3D UI With the Leap

- Selection
  - Hover w/timeout (dwell)
  - Trigger with non-dominant hand gesture
  - Two finger near-pinch
- Manipulation
  - Hand orientation
  - 3-finger orientation
  - 2-finger orientation (2 DOF)

General Tips for the Leap

- Finger pinches hard to detect
- More than 3 fingers hard to distinguish
- Fingers hard to distinguish when hand not viewed well from head
- Hand detection (left/right): need to carefully bring hands into FOV from bottom edge

Myo

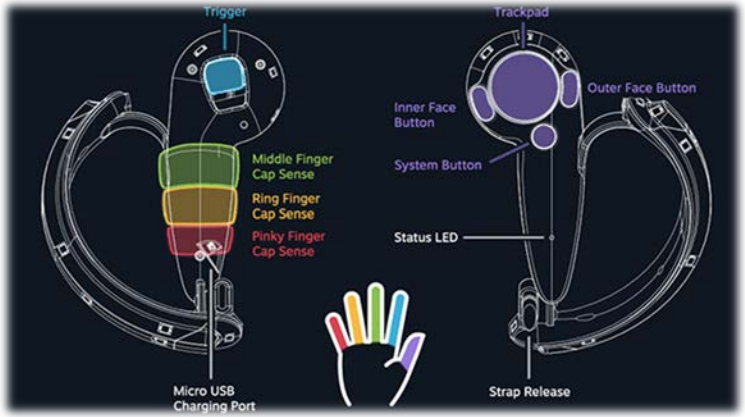
- Released March 2015
- Gesture control armband
- Expandable circumference
- Weight: 93 grams
- Thickness: 0.45 inches
- Bluetooth 4.0
- EMG muscle sensors
- Motion sensor
- Haptic feedback (vibration)
- https://www.youtube.com/watch?v=jOEcsNmTk7g

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

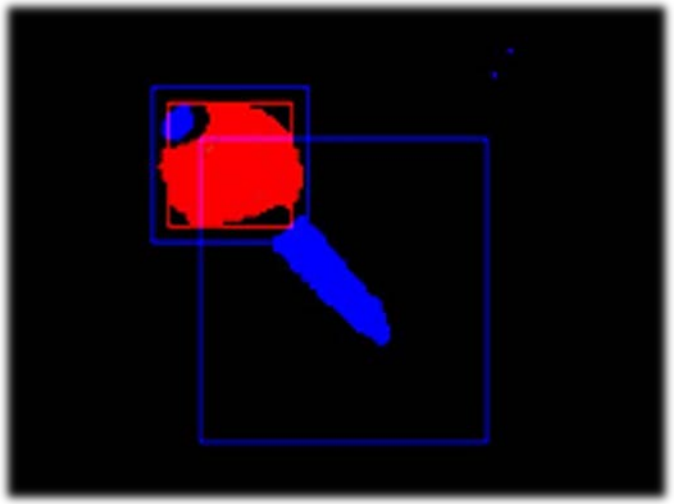
- Consists of
  - PlayStation Eye camera
  - up to 4 motion controllers
- Combines camera tracking with motion sensing for 6 DOF tracking
- Vibration feedback
- Wireless and USB connectivity
- Four buttons (Square, Triangle, Cross, Circle) on front
- Two buttons (Select on left, Start on right) on sides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