



CSE 165: 3D User Interaction

Lecture #9:
Input Devices Part 3

Instructor:
Jurgen Schulze, Ph.D.

Announcements

- Homework Assignment #3
 - Due February 13th at 1:00pm
- Homework discussion
 - Tomorrow, February 4th, 4-5pm

Input Devices

3D Input Devices for Games



Nintendo Wiimote



PlayStation Move



Microsoft Kinect



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



Sensor Bar



Wii Zapper



Wii Wheel

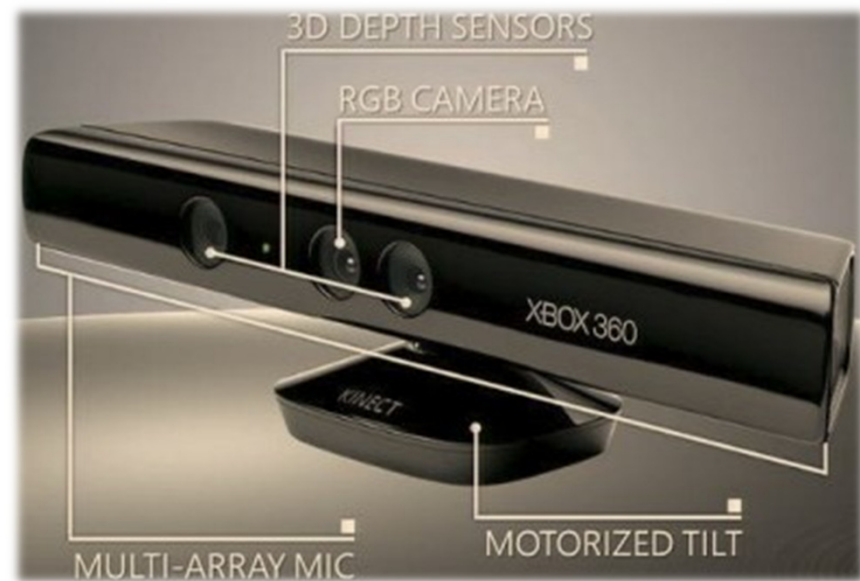
The Wii Motion Plus

- 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



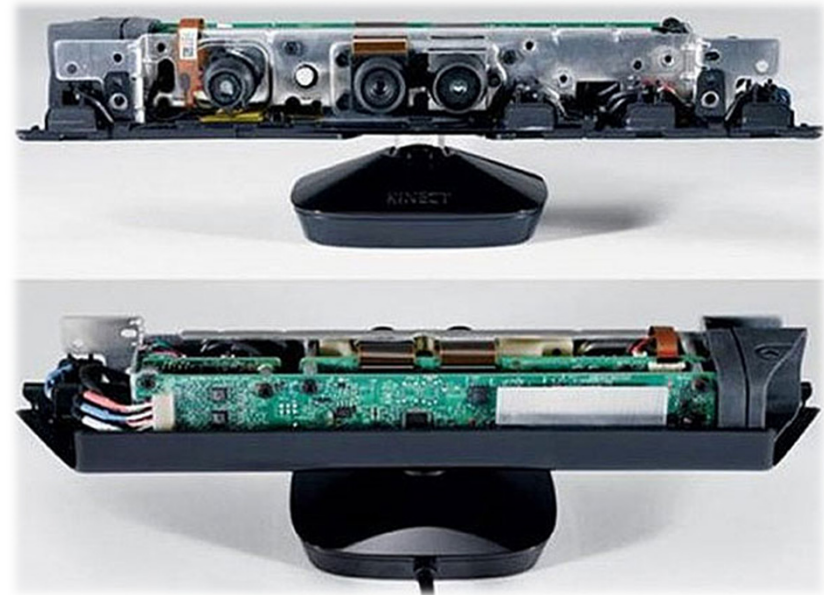
Microsoft Kinect

- 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
 - 27° up or down



www.hardwaresphere.com

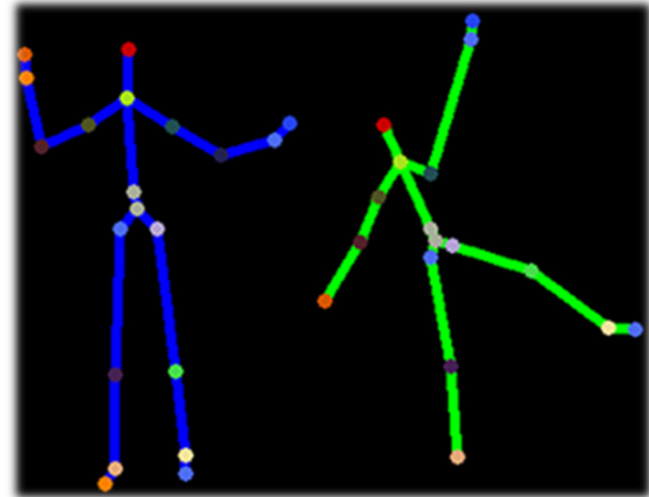
Kinect – Extracting 3D Depth

- 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



Kinect – Skeleton Tracking

- Combines depth information with human body kinematics
 - 20 joint positions
- Object recognition approach
 - per pixel classification
 - decision forests (GPU)
 - millions of training samples



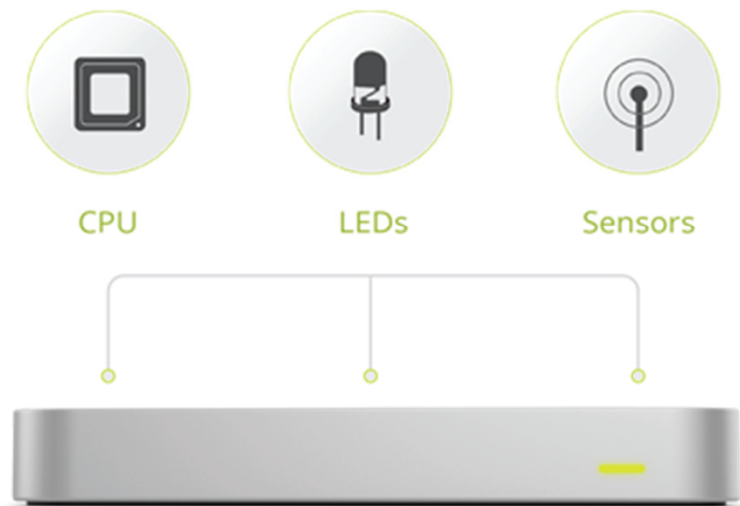
Leap Motion

- 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 access to depth map
- Two IR cameras + optimized image processing
- Inexpensive (~\$70)
- Drivers for Windows and Mac OS
- Well documented SDK



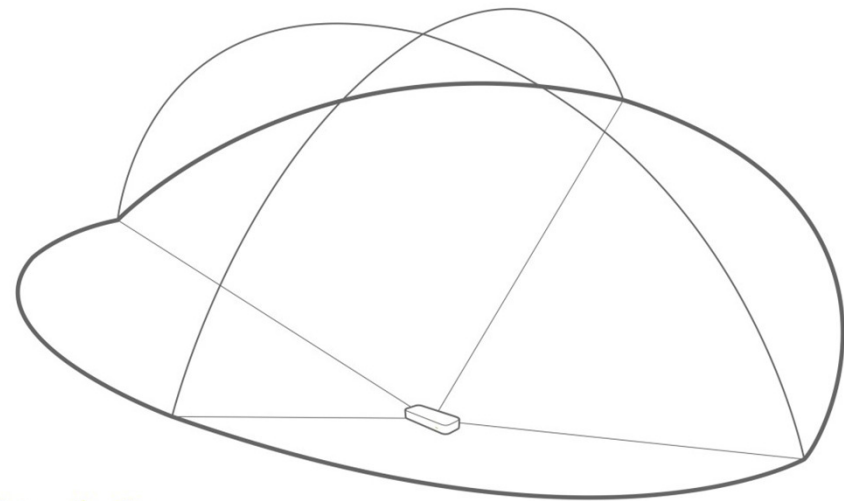
Leap Technology

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



Leap Tracking

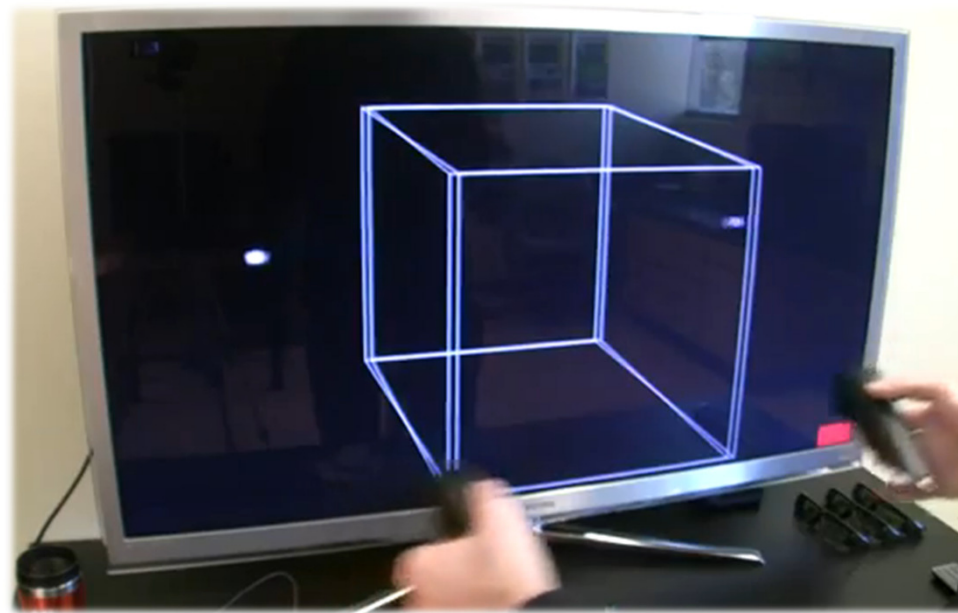
- USB controller reads sensor data into own local memory and performs resolution adjustments
- This data is streamed via USB to Leap Motion tracking software
- Images appear in grayscale
 - Intense sources or reflector of infrared light can make hands and fingers hard to distinguish and track

**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)

Razer Hydra Video

- Razer Hydra for low-cost 3D displays
 - By Oliver Kreylos, UCD
 - <http://www.youtube.com/watch?v=H5bSzVByLjM>



Razer Hydra

- Developed by Sixense Entertainment
- Released June 16, 2011
- Tracks absolute position and orientation (6 DOF)
 - Precision: 1mm and 1 degree
- Uses a weak electro-magnetic field
- Two wired input devices



STEM

- Wireless motion tracking
- Five tracking points
- Allows tracking of all four limbs plus the head – or any other configuration
- Optimized performance from the desktop to the living room, with an 8-foot radius (16-foot diameter) range from the Base
- Backward compatibility via the Sixense SDK: uses an updated version of the Sixense SDK that also supports games and applications developed for the Razer Hydra.



STEM Distortion Correction

- Electro-magnetic fields get distorted by metal in the environment
- This can be counteracted by calibration and software
 - <https://www.youtube.com/watch?v=y8e2LPfMGvI>

Myo

- Gesture control armband
- Expandable circumference
- Weight: 93 grams
- Thickness: 0.45 inches
- Bluetooth 4.0
- EMG muscle sensors
- Motion sensor
- Haptic feedback (vibration)
- \$199



Playstation Move

- <http://www.youtube.com/watch?v=hTKpgSpq-8o>



PlayStation Move

- Consists of
 - PlayStation Eye camera
 - up to 4 motion controllers
 - Cost for Eye + 1 controller: ~\$50
- Features
 - Combines camera tracking with motion sensing
 - 6 DOF tracking (position and orientation)
 - Several buttons on front of device
 - Analog button on back of device
 - Vibration feedback
 - Wireless and USB connectivity



PlayStation Move – Hardware

- PlayStation Eye
 - 640 x 480 (60Hz)
 - 320 x 240 (120Hz)
 - Microphone array (4 mics)
- Move Controller
 - 3-axis accelerometer
 - 3-axis gyroscope
 - Magnetometer: helps to calibrate and correct for drift
 - 44mm diameter sphere with RGB LEDs
 - Used for position tracking
 - Invariant to rotation
 - Provides own light source
 - Color ensures visual uniqueness



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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

