Using Microsoft Kinect Sensor in Our Research

Hao Zhang

Distributed Intelligence Laboratory
Dept. of Electrical Engineering and Computer Science
University of Tennessee, Knoxville

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Outline

- Introduction of Kinect Sensor
- Using Kinect in Our Research

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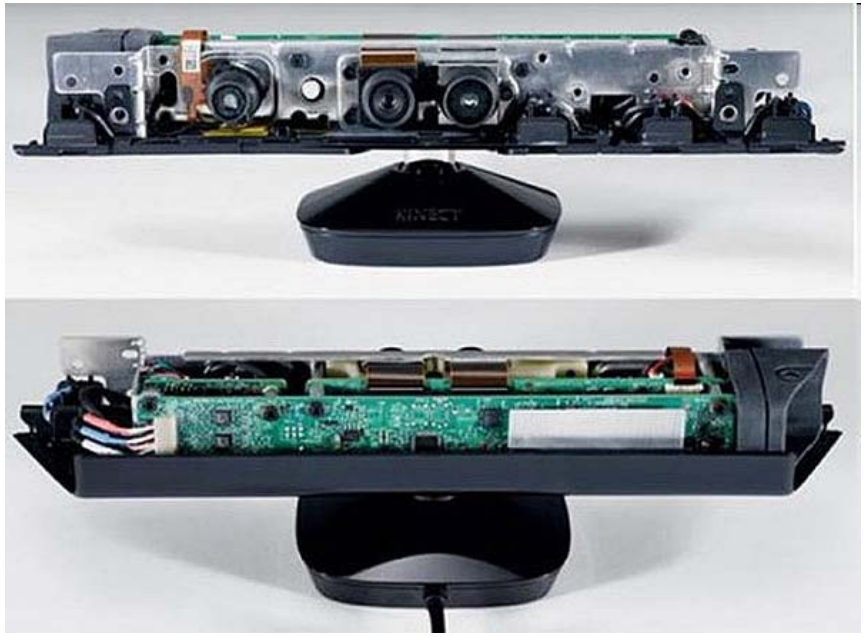
Microsoft Kinect Sensor

- What is a Kinect sensor?
  - Kinect is a motion sensing device by Microsoft for the Xbox 360 video game console.
  - Kinect contains a RGB camera, a depth sensor, multi-array microphones, and a motorized tilt.

- How does a Kinect sense depth?
  - The IR emitter projects an irregular pattern of IR dots of varying intensities.
  - The Depth Camera reconstructs a depth image by recognizing the distortion in this pattern.



- What's the accuracy of a Kinect sensor?
  - Data Stream
    - 640X480, 320X240 in Linux and Mac
    - 1024X768, 640X480, 320X240 in Windows 7
    - 30 frames/sec
  - Depth Camera
    - Field of View
      - Horizontal: 58°, Vertical: 45°, Diagonal: 70 °
    - Spatial X/Y resolution: 3mm
    - Depth Z resolution: 1cm
    - Operation range: 0.8m - 3.5m
  - Physical Tilt Range: ±27 degrees

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Use Kinect in Our Research

- Why do we choose Kinect?
  - Powerful
    - Capable of acquiring color, depth, and audio information
  - Not expensive
    - $150 each (a sensor and power supply)
  - Accessible
    - Available at game stores, computer stores, and supermarkets
  - Easy to setup and use

Use Kinect in Our Research

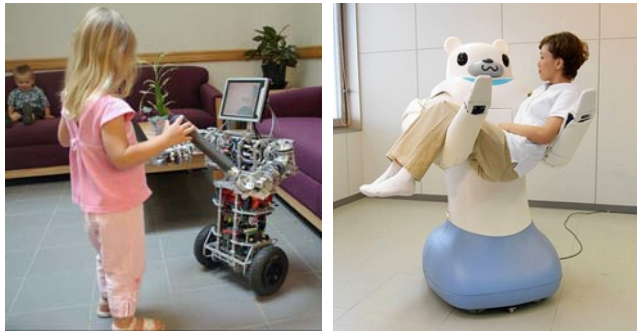
- First step toward making Kinect work:

  Install A Driver for Kinect Sensor and related dependencies

  – Kinect for Windows SDK
    – Support Windows 7 only

  – OpenKinect
    - OpenNI Kinect
    - Libfreenect
      – Supporting Windows, Mac and Linux
      – Combined in ROS

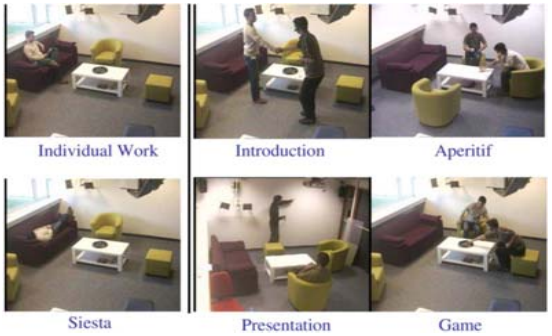
- Kinect in My Research
  - Human activity recognition: automated detection of ongoing events from visual data containing movements with particular semantic meanings



Service and Medical

Human-Machine Interface

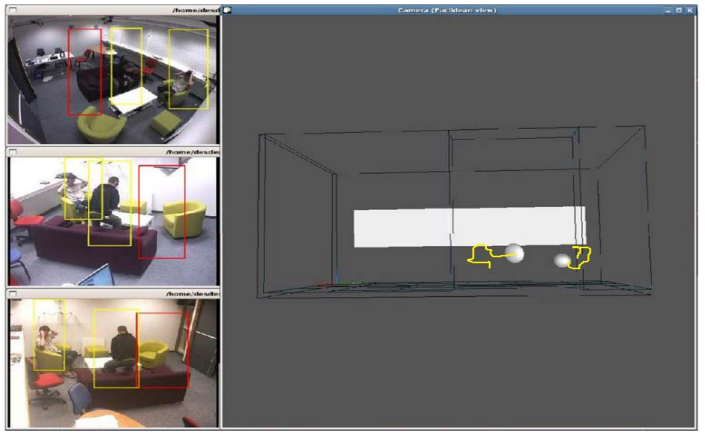
Security and Surveillance



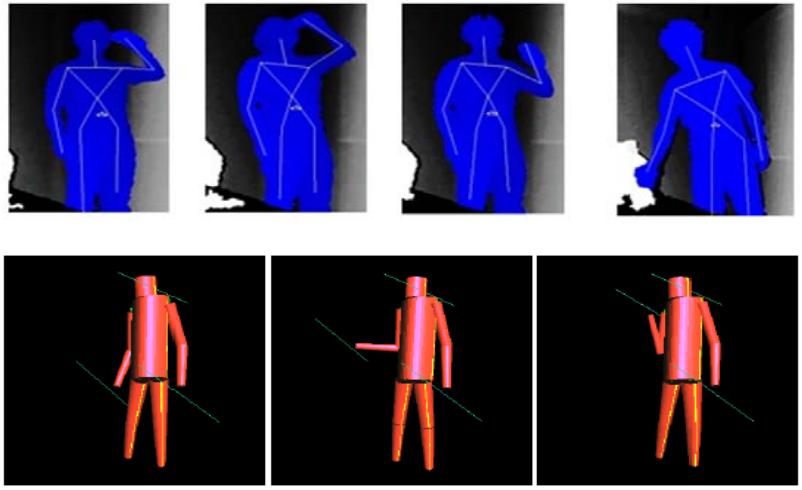
Smart Homes

Use Kinect in My Research - Human Activity Recognition

- Perception using Kinect (Feature extraction)
  - 3D centroid trajectory
  - 3D shape history
  - Motion sequence of 3D human models

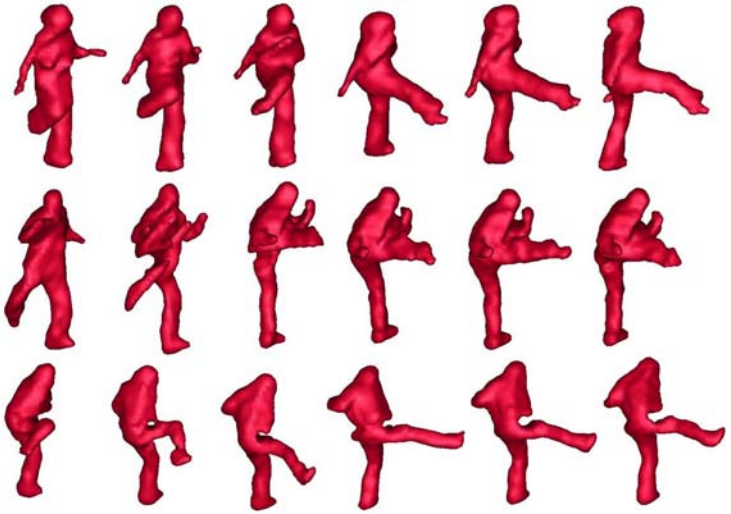


3D Trajectory (O. Brdiczka, 09)



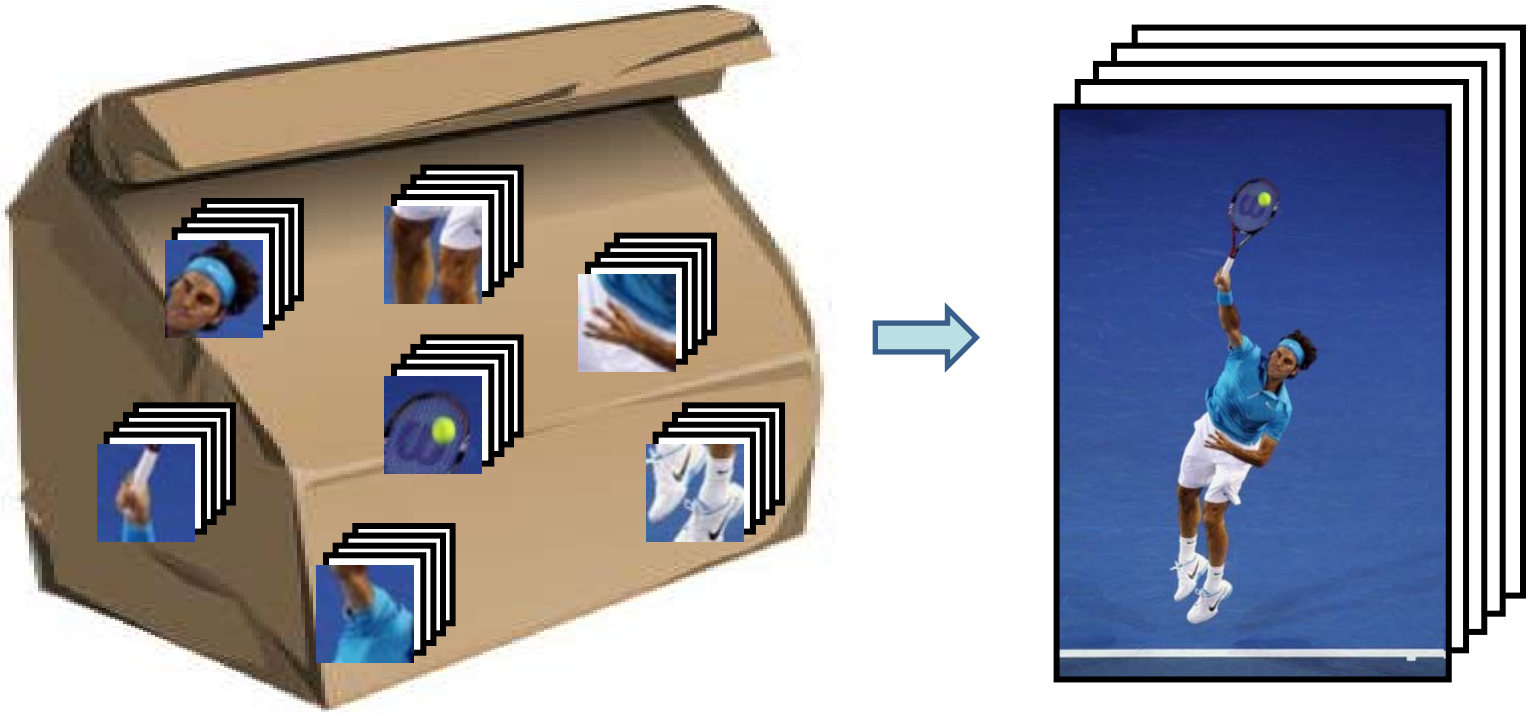
3D Human Models

(J. Y. Sung, PAIR11) & (S. Knoop, ICRA06)

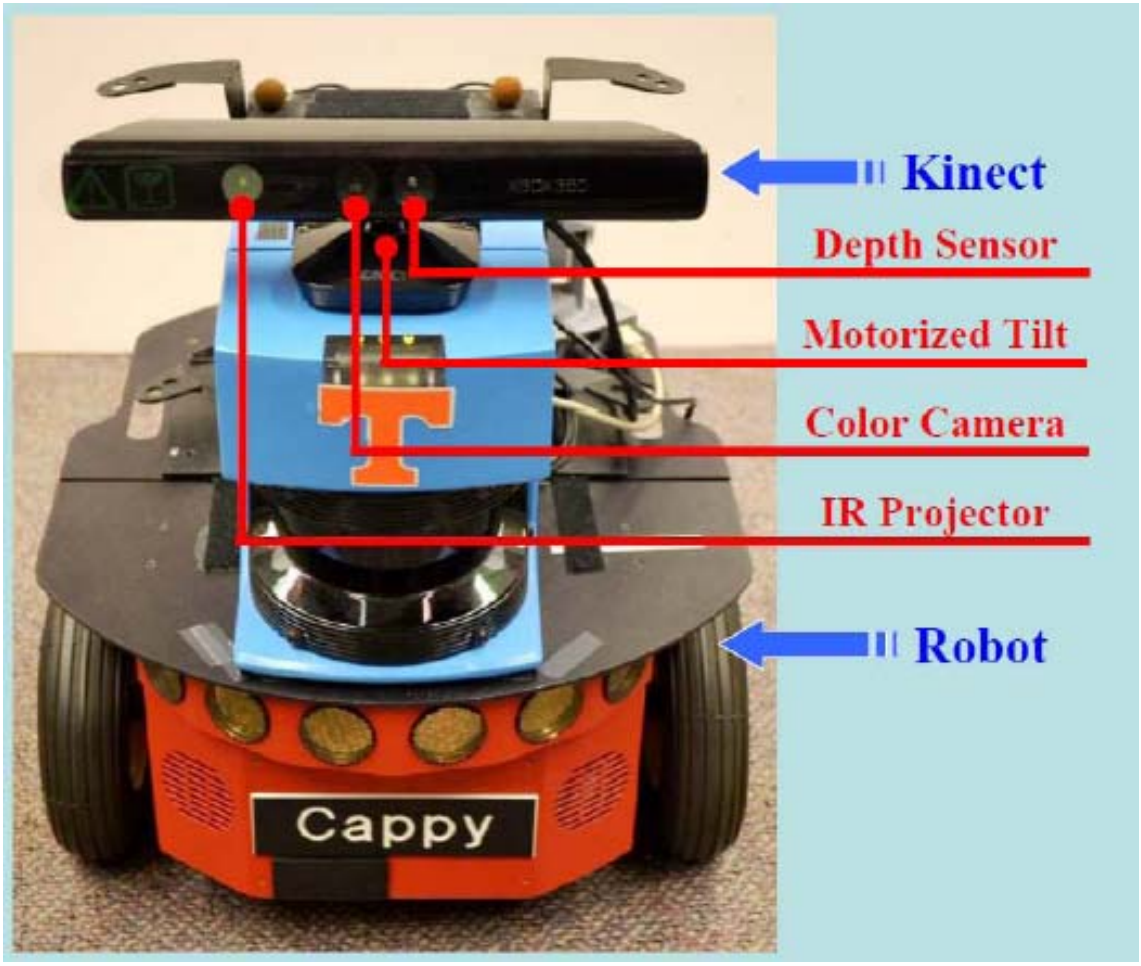


3D Shape Info. (P. Yan, CVPR08)

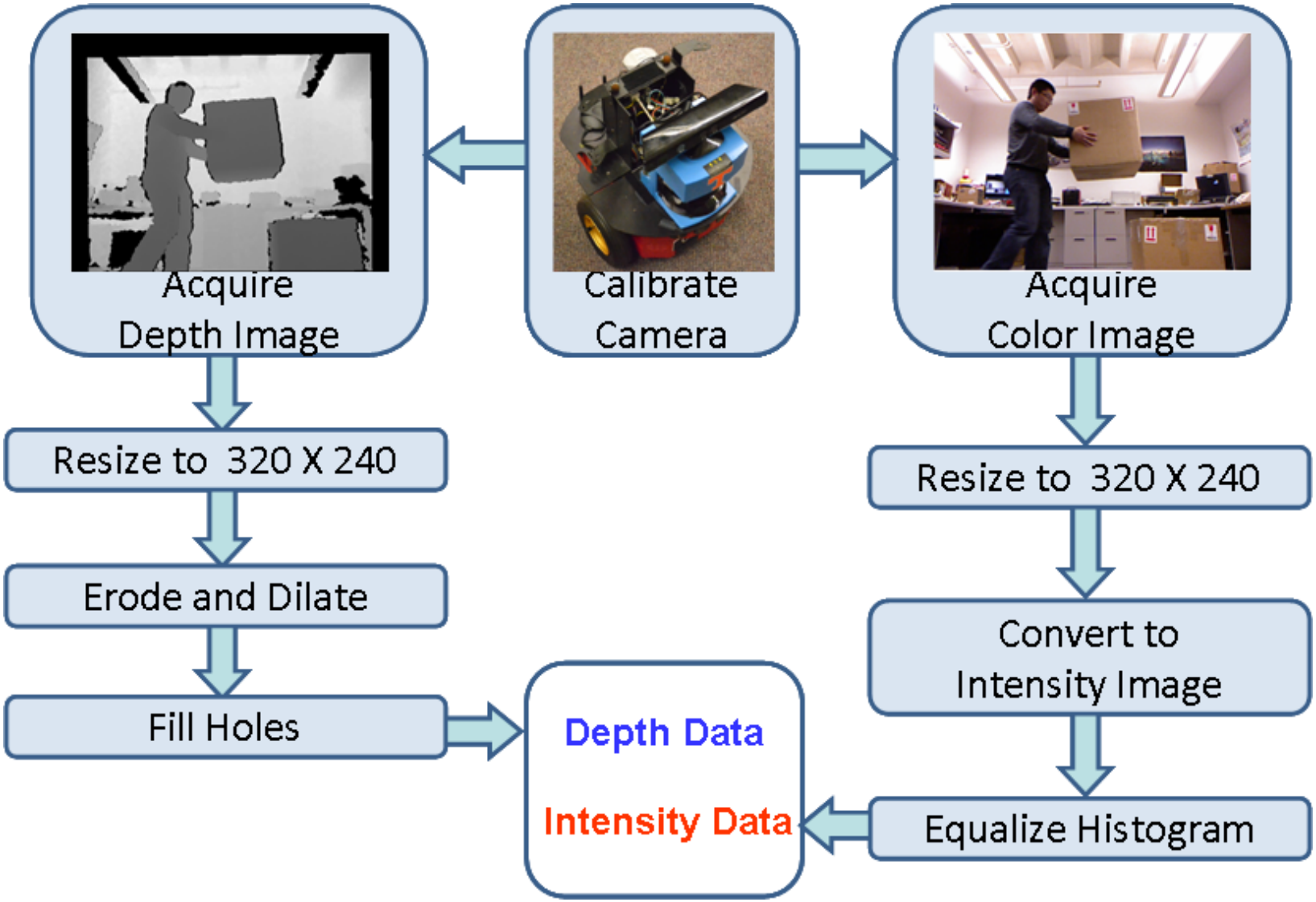
- 4D Local Spatio-Temporal (LST) Features
  - A LST feature can represent local texture and motion variations regardless of global human appearance and activity (locality assumption)
  - Visual data and human activity can be presented as a bag of LST features (representativeness assumption)



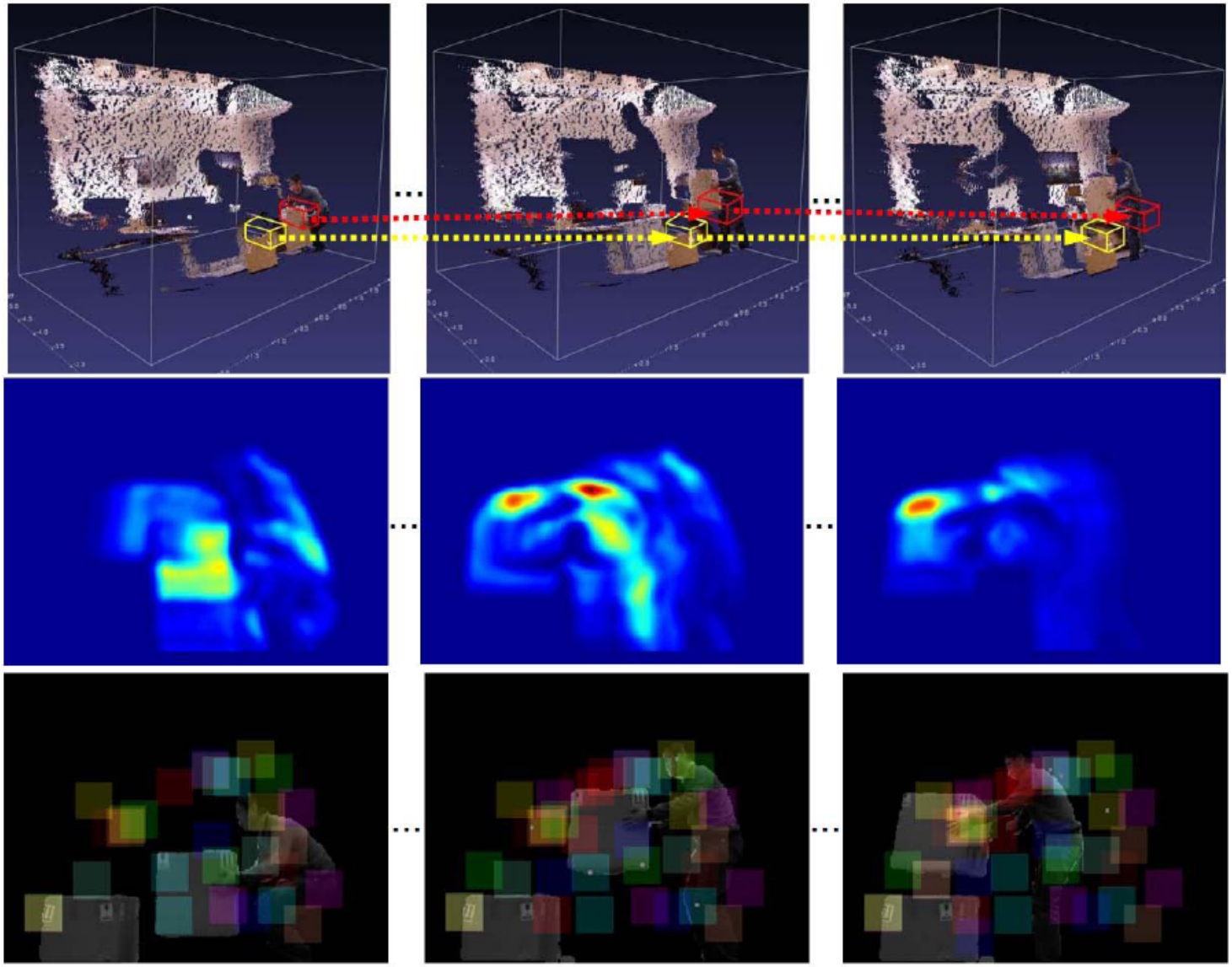
- Installation: on a Pioneer 3DX mobile robot



- Preprocessing of Kinect Data

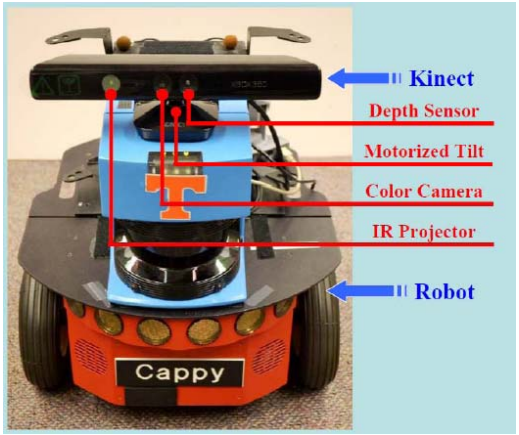


- Feature Extraction



Use Kinect in My Research - Human Activity Recognition

- Activity Dataset
  - 6 types of human activities
  - 33 samples for each activity
  - 2 ~ 4 seconds of each sample
  - Office and home environments

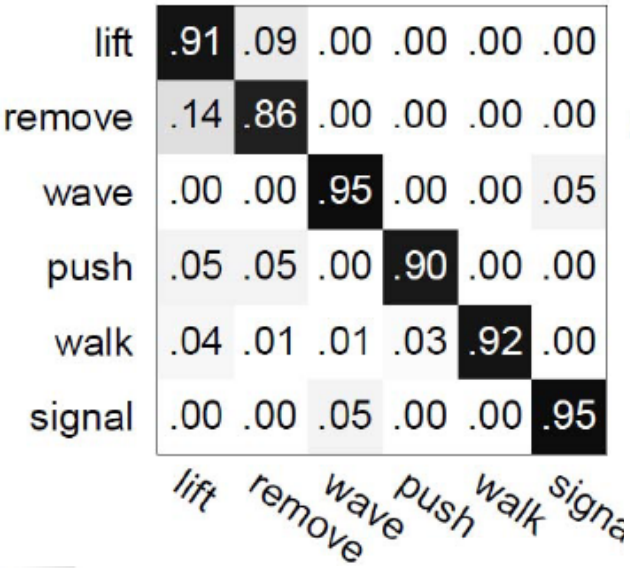


(a) Lifting (b) Removing (c) Waving (d) Pushing (e) Walking (f) Signaling

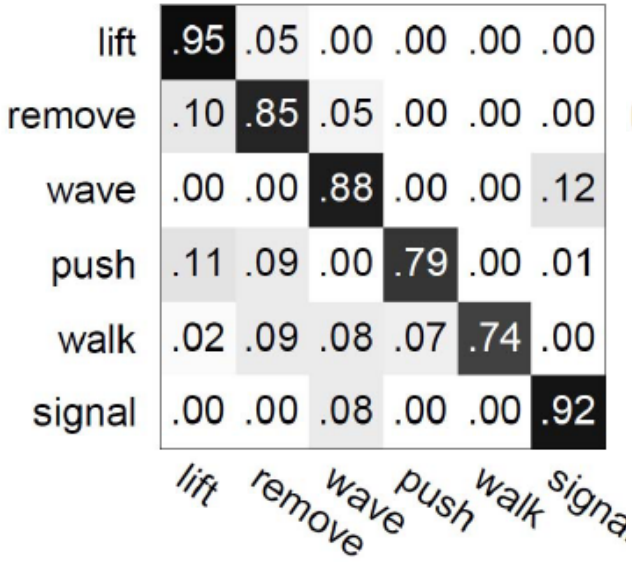
http://www.youtube.com/watch?v=ZYGmQYNvfnA

http://www.youtube.com/watch?v=puhG5gty0XA

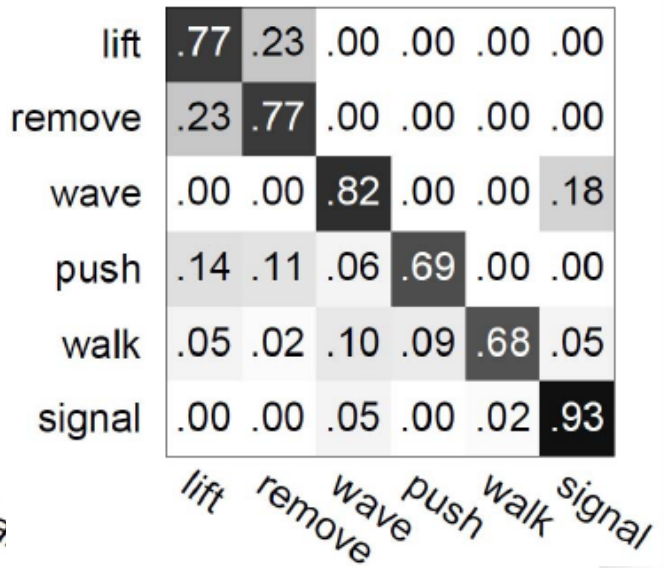
- Test Results
  - 4D-LST feature outperforms the features using only intensity or depth information
  - Depth information is more important than the intensity information for our database



Intensity & Depth Data (Average accuracy=91.50%)



Depth Data Only (Average accuracy = 85.50%)



Intensity Data Only (Average accuracy = 77.67%)

- Use Kinect in Your Robotics Projects
  - Humanoid Robot Control and Interaction
    http://www.youtube.com/watch?v=GdepIXZTJsw
  - Human Tracking and Following
    http://www.youtube.com/watch?v=3Z56JV9g6y4
  - Simultaneous Localization and Mapping
    http://www.youtube.com/watch?v=XejNctt2Fcs

Thank you!