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RGB-D Capstone:

Doing Cool Things with **R****G****B**-**D** Cameras

Organization and Overview

Teaming and Project

- Teams of 3-4 students per project
 - We choose teams based on preference and expertise
- Most urgent steps
 - Provide preferences and background info
 - By tonight we'll put the teams together
 - You spend a lot of time tomorrow to brainstorm projects
 - Informal 10 min project presentation on Thursday
 - We'll provide feedback / guidance
 - Formal project presentation Thursday next week

Deliverables

- Each team maintains a project website
 - Lab notes updated at end of each week
 - Product Requirements Document (PRD)
 - Marketing brochure about the project (1-2 pages)
- Peer review: within and across teams
- Half time demo and final demo
- Project report

Week	Date	Location	Content	Assignments
#1	Sept 25	EEB 031	Organization and Overview	
#1	Sept 27	EEB 031	Project discussion: Create initial project ideas	
#2	Oct 2	EEB 031	Hardware and SDKs	
#2	Oct 4	EEB 031	Project presentation: Present refined project ideas	
#3	Oct 9	EEB 031	Xiaofeng Ren (Intel Research): RGB-D object recognition	
#3	Oct 11	CSE 003D	Lab session	Update project description / plan
#4	Oct 16	EEB 031	Andy Wilson (Microsoft Research): Interaction	
#4	Oct 18	CSE 003D	Lab session	Update project description / plan
#5	Oct 23	EEB 031	TBD	
#5	Oct 25	CSE 003D	Lab session	Update project description / plan
#6	EEB 031	Oct 30	TBD	
#6	Nov 1	CSE 003D	Lab session	Update project description / plan
#7	Nov 6	CSE 003D	Intermediate Project Demos	
#7	Nov 8	CSE 003D	Lab session	Update project description / plan
#8	Nov 13	EEB 031	TBD	
#8	Nov 15	CSE 003D	Lab session	Update project description / plan
#9	Nov 20	EEB 031	TBD	
#9	Nov 22		Thanksgiving Holiday	
#10	EEB 031	Nov 27	TBD	
#10	Nov 29	CSE 003D	Lab session	Update project description / plan
#11	EEB 031	Dec 4	TBD	
#11	Dec 6	CSE 003D	Lab session	Update project description / plan
#12	Dec 10	CSE 003D	Final Project Demos: 10:30 - 12:20	

RGB-D Cameras: Color + Dense Depth



RGB-D Cameras

- **Cheap** depth cameras with **high resolution, accuracy, and aligned color** ($>640 \times 480$, 30 Hz)
- **Key industry drivers**: Gaming, entertainment
- Two main techniques:
 - Structured light with stereo
 - Time of flight



PrimeSense / Kinect Depth Sensor

[Courtesy of Kurt Konolige, Willow Garage]

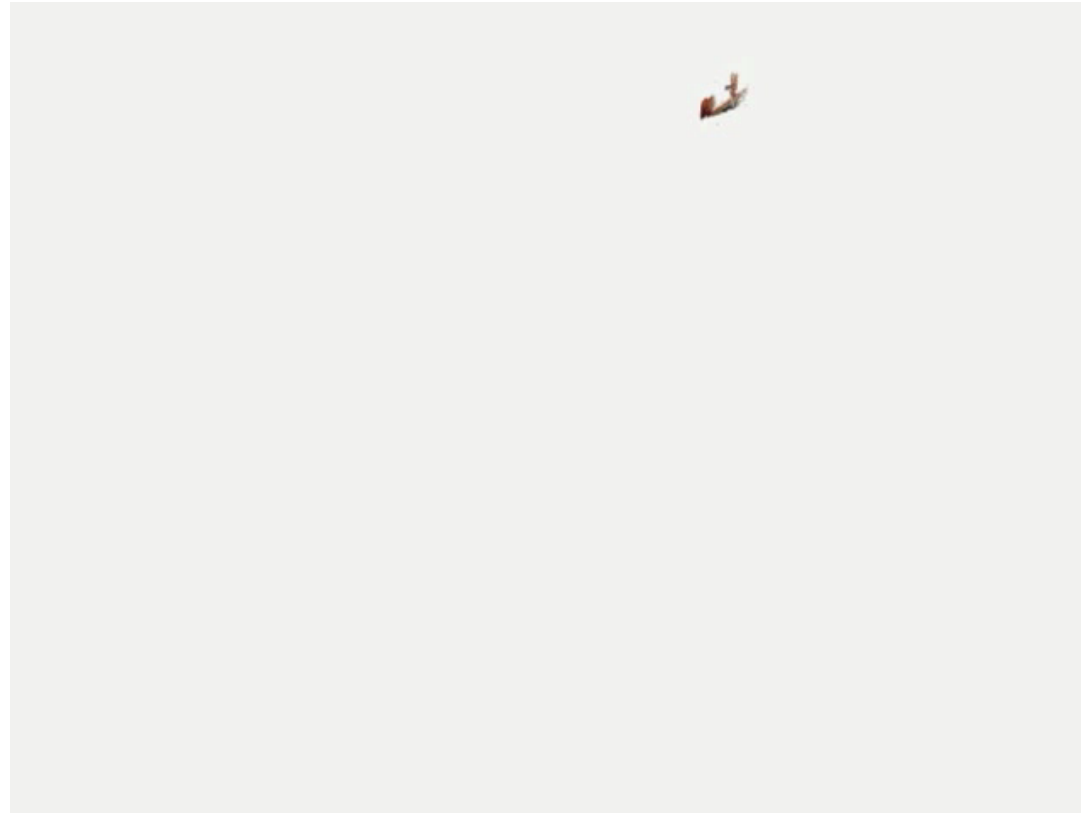


Issues: low quality webcam (blur, noise, rolling shutter), no time sync

Outline

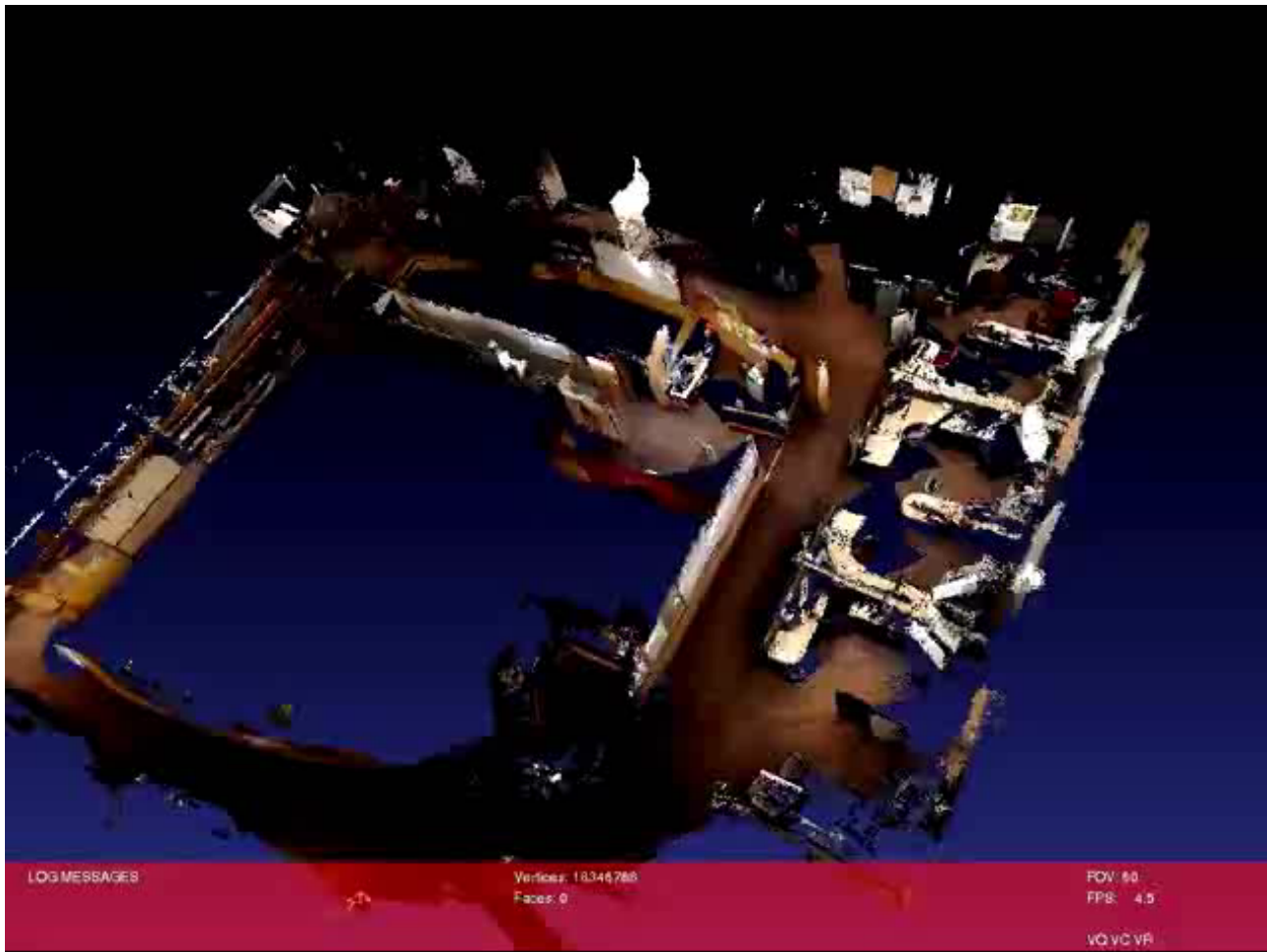
- Environments
- Objects
- People
- Discussion

RGBD-SLAM



- Alignment via color and depth, image and ICP based loop closure, SBA for global optimization

3D Map



RGB-D SLAM on Quadcopter



Interactive Mapping

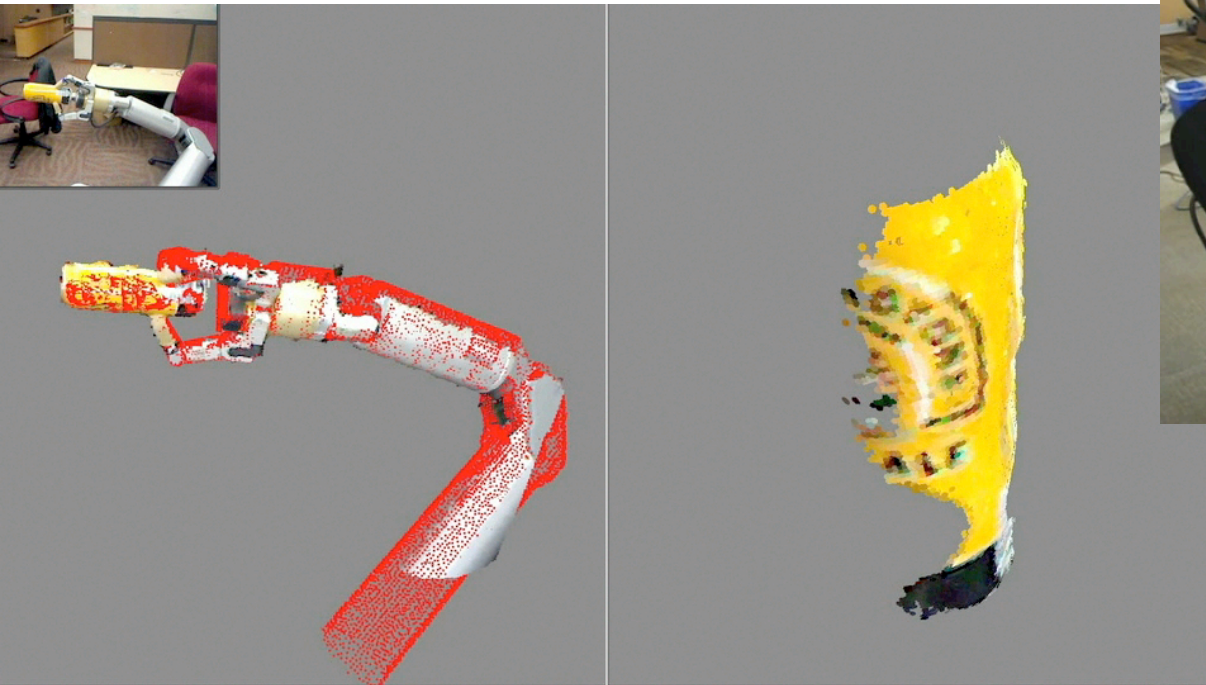


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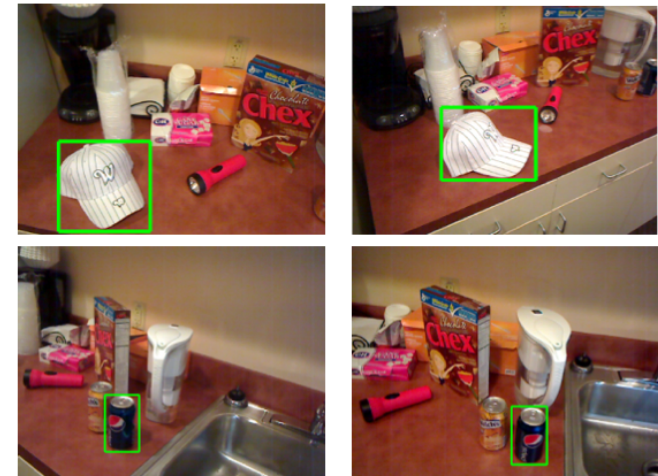
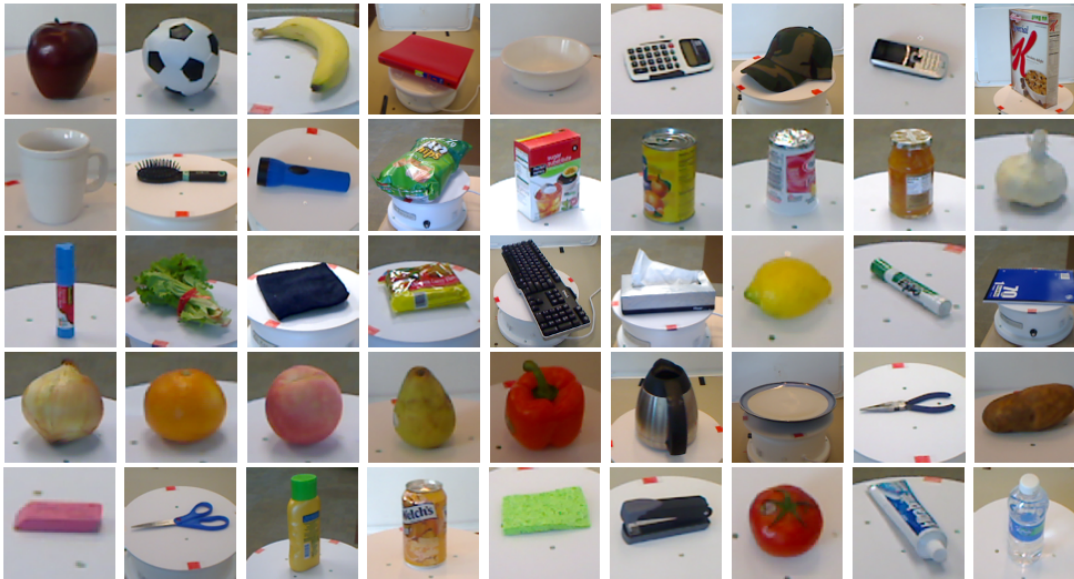


Autonomous Object Modeling



- Enable robots to **autonomously learn** about their environment
- Robot picks up objects and **builds models** of them
- Object models **can be shared!**

RGB-D Object Dataset



- Videos of 300 objects in 51 categories
- Take advantage of depth for segmentation
- Similar dataset by Willow Garage

Interactive Task Assistance and Playing: Kitchen OASIS



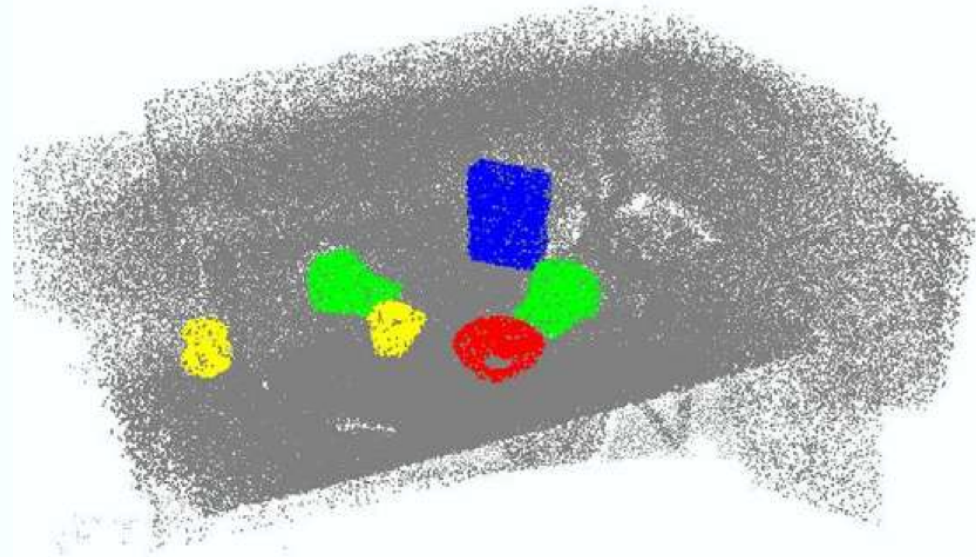
[Ziola-Grampurohit-Landes-Fogarty-Harrison: VL-HCC-11]

Interactive Task Assistance and Playing: Lego OASIS



Object Detection in 3D Scenes

[Lai et al]



Some Project Ideas

- World Wide Telescope
 - Navigate earth, solar system, universe
- Sound space
 - Find object or navigate through building blindfolded
- Game controllers
- Robotic Rubik's Cube solver
- Track people and learn motion / occupancy models
- Recognize American sign language
- ...

- Your name:

- Team
 - Who would you like to work with?

 - Who would you **not** like to work with?
Email: fox@cs.washington.edu

- Background / experience
 - Linux (1: no clue, 3: OK, 5: wizard):
 - Windows (1: no clue, 3: OK, 5: wizard):
 - Preference (1: Linux ... 5: Windows):
 - Other comments:

- Work preference (1: not interested, ..., 5: love it)
 - Technical :
 - Interaction:
 - Other remarks:

- Project preference (1: not interested, ..., 5: love it)
 - World Wide Telescope:
 - Interaction, game:
 - Technical:
 - Other: