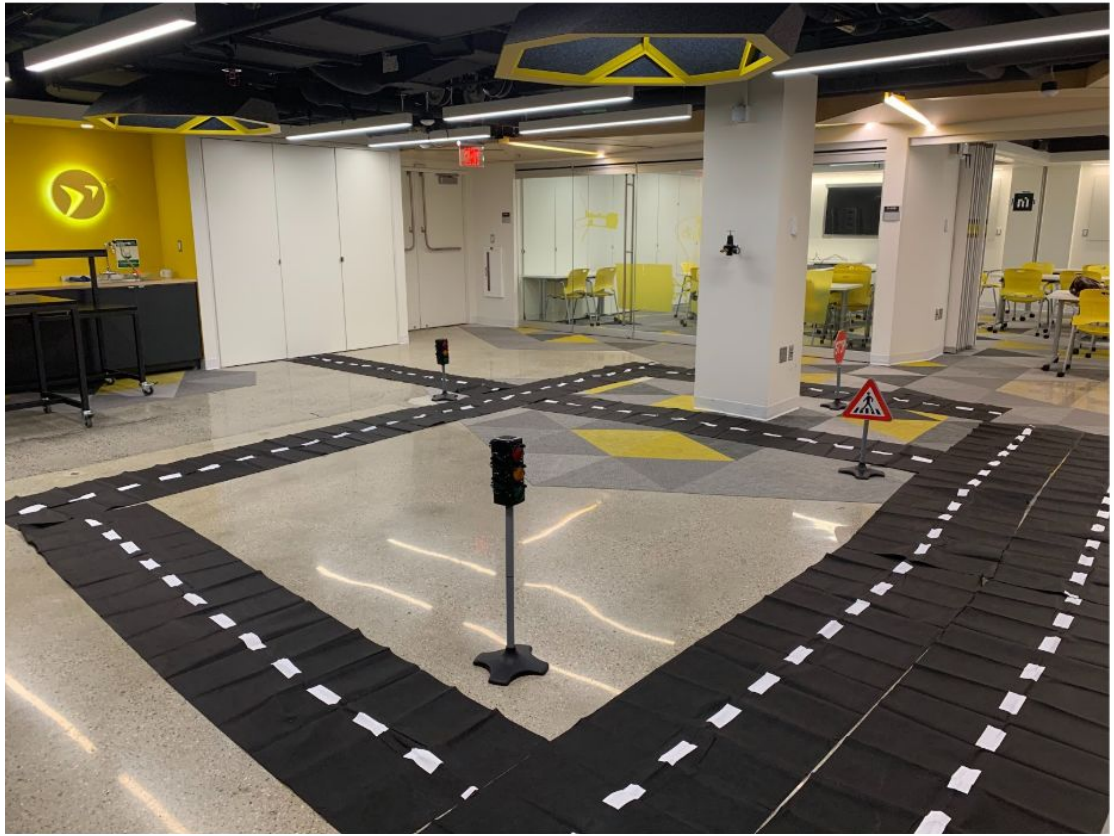
Autonomous Navigation of a Mock Roadway

Team 20



The Course

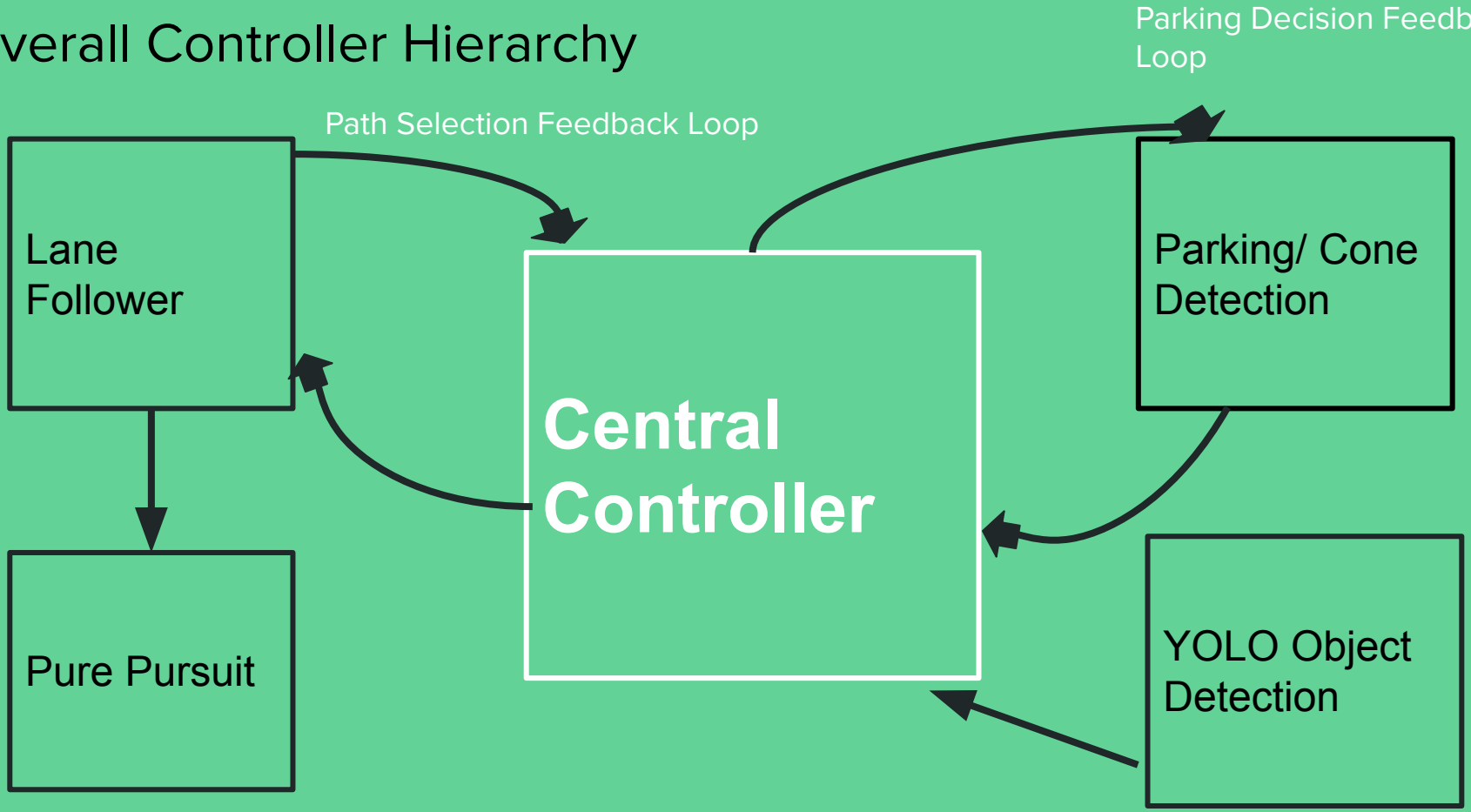
Vision and Detection

- Lanes
- Stoplights, signs
- Pedestrians
- Obstacles
- Other Cars

Motion Control and Decision Making

- Follow lanes
- Maintain correct distances
- Park
- Change lanes

Overall Controller Hierarchy



Lane Detection via Color Segmentation

Find largest dark contour (0-80 HSV luminance value) and use as mask

Select for bright luminance values (200-255) within the mask

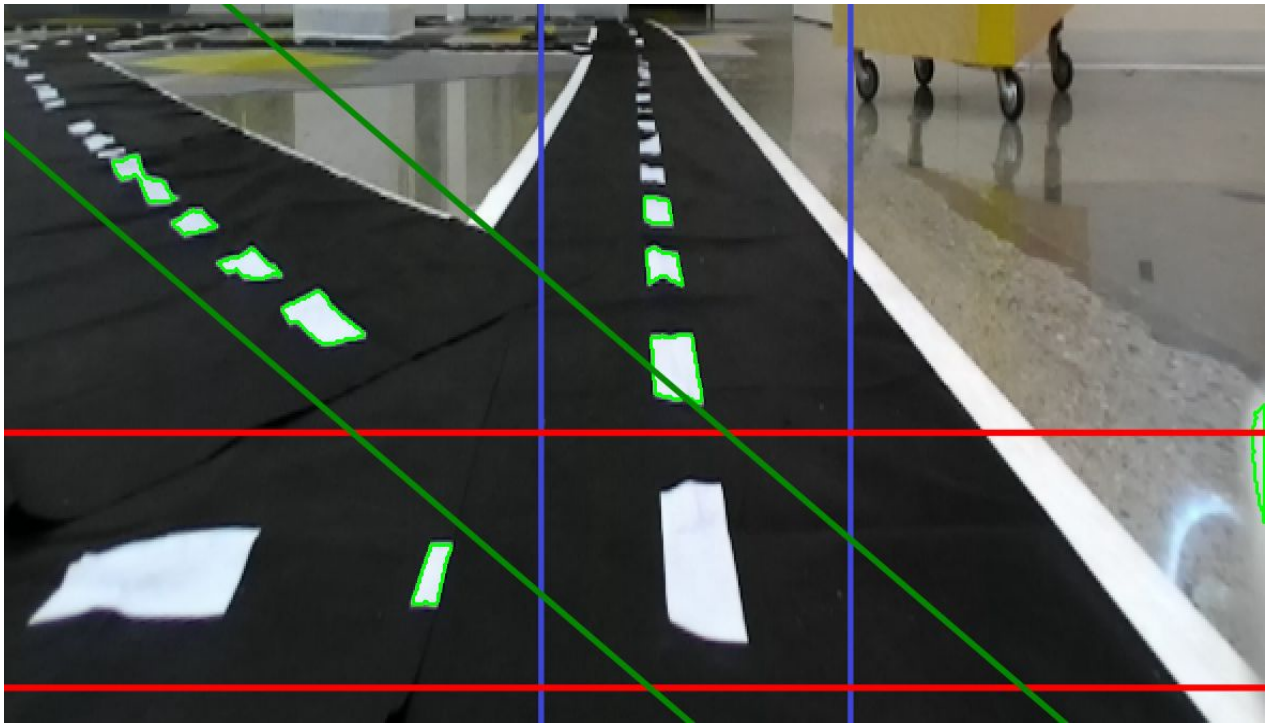
Treat dashes on the road as points on a path

Lane Choosing Using Bins

Take ticks within a threshold radius distance from the car

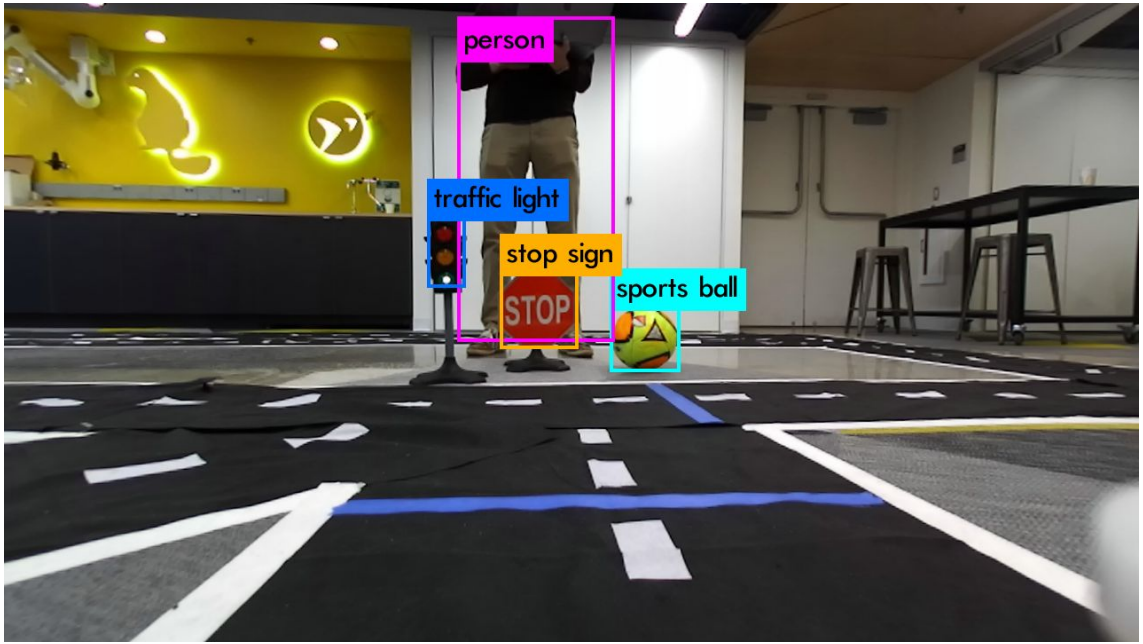
Group these ticks into one of 5 regions

Extract a trajectory using these groupings, and feed it to pure pursuit



Object Detection via YOLO

- Trimmed Coco to only classes we need:
  - Person, traffic light, stop sign, and sports ball
- Added new classes
  - Construction sign, Crosswalk sign, Racecar, and Handicap Sign
- Utilized darknet_ros to train and detect



Yolo Model Performance

Custom Trained Classes Only

- Loss of .06 over 64 images
- 84% AP in real life

Coco pre-trained Classes

- 92% AP in real life

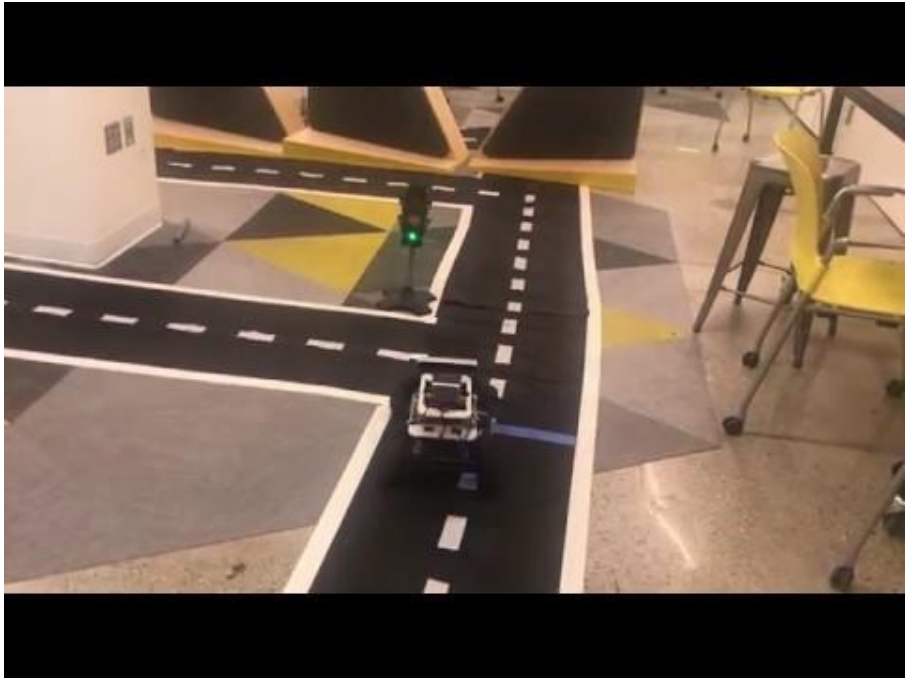
Combined Training set with only valid classes

- Loss of 2.03 over 64 images
- 98% accuracy with people, however 64% for other three classes, 6% for custom classes

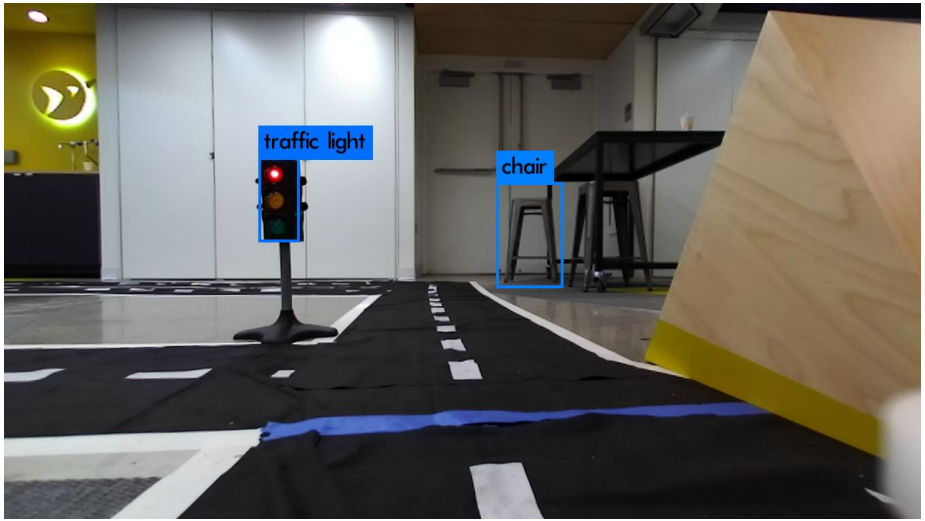
Demos

Intersections

Lane Following



Stop Light Segmentation



Red Light

Green

Segment the bottom third of the traffic light for green

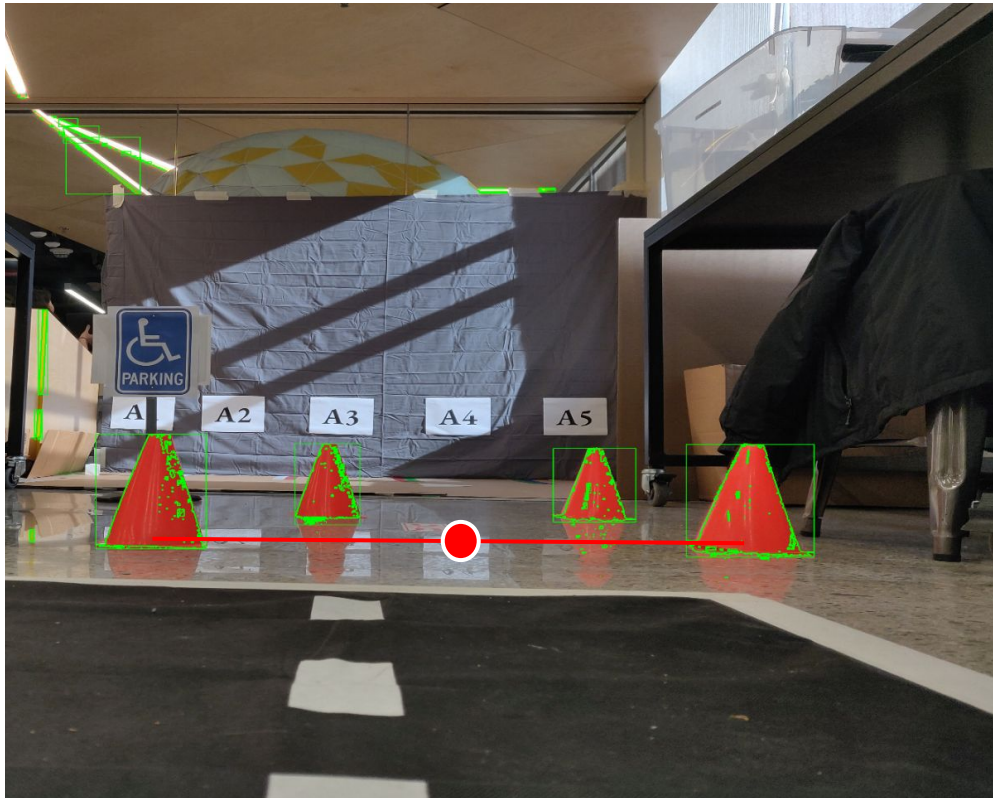
Look at the average value (in HSV) of the green pixels

Parking

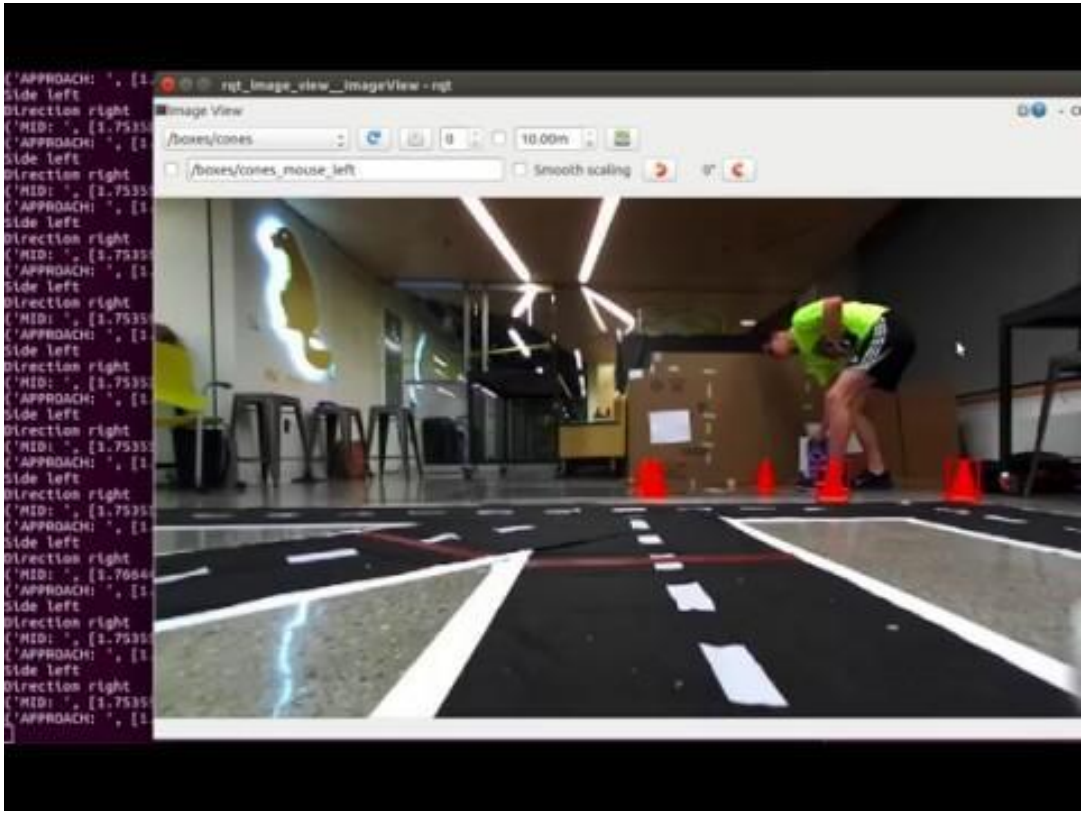
Uses image from camera to find cones.

Creates trajectory using midpoint of two cones.

YOLO gives “left” or “right” parking space as valid.



Parking Demo



Lessons Learned

- Object detection is hard with insufficient data: data needs to be comparable across all classes, and training is very time intensive especially for custom classes
- Lane detection based off of machine vision is difficult: homography was surprisingly accurate, but color segmentation sometimes lacks robustness even in a predetermined environment
- Parking/obstacle avoidance and other events proved difficult to trigger on demand with limited sensing