The Mobile Manipulation Challenge, Results

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Introduction

Win a Fetch!

- In May, Fetch Robotics held a robotic manipulation competition at ICRA 2019 in Montreal
- 1st place team won a Fetch mobile manipulator robot

Why another robotics competition?

- Industrial application: kit filling, machine tending, bin picking
- Fetch robot eligible for many competitions, but not a perfect fit
  - ERL: Only open to Europeans, rules don't fit our use cases
  - RoboCup@Work: Designed for Kuka YouBot, environment size not ideal
  - RoboCup@Home: Slow moving, focused on general-purpose service robots
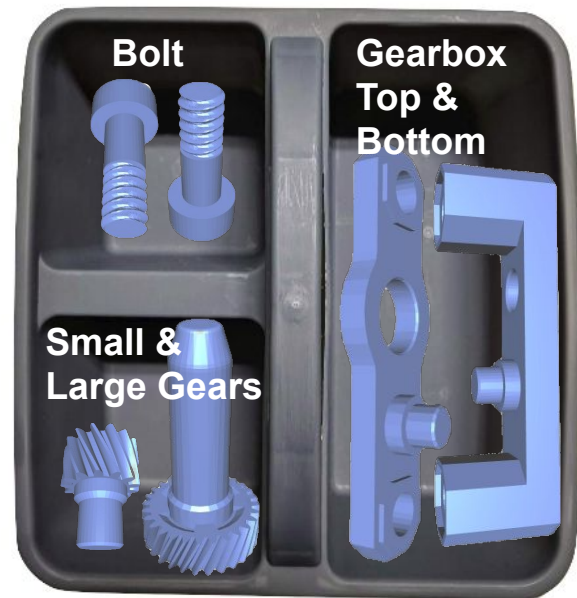 - ACRV Picking Benchmark: Great benchmark, wanted more industrial applications
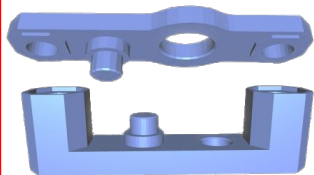
Competition Overview

Task:

- Pick parts from station/bin
  - 3D printed parts: https://github.com/fetchrobotics/fetchit
- Simulate machining task
  - /schunk_machine/goal
- Place parts in kit
- Place kit at drop-off location
- Trigger camera to inspect kit
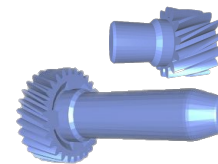 - /sick_camera/goal

Complete as many kits as possible in 45 min

Competition Overview

Gearbox Pick Station

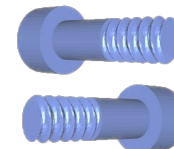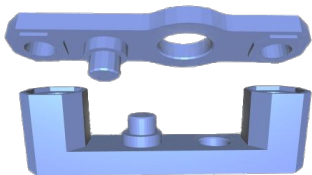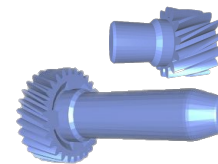Kit Station

Schunk Machine & Gear Pick Station

Kit Drop-Off

Screw Bin Pick Station
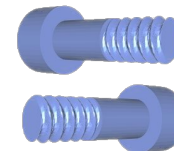
Competition Overview

Gearbox Pick Station

Schunk Machine & Gear Pick Station

Kit Station

Kit Drop-Off

Screw Bin Pick Station

Competition Overview
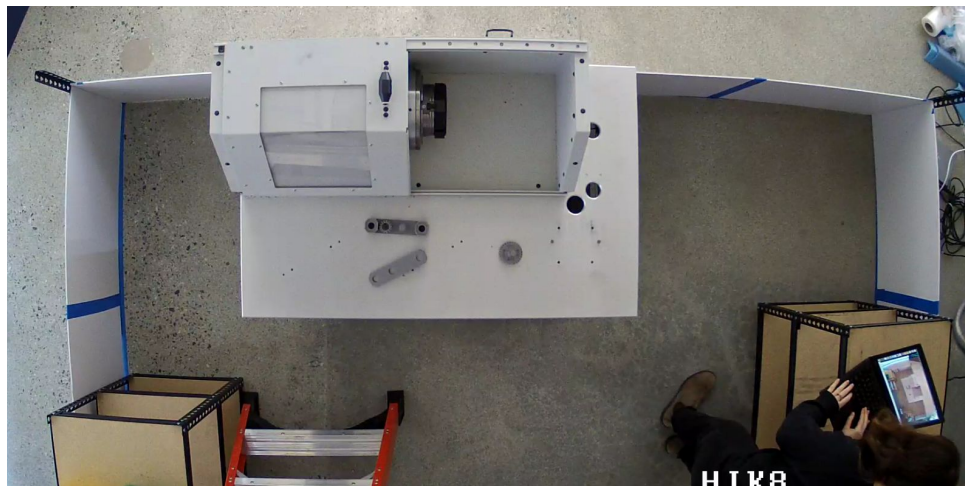
Items Not Touching

Schunk Machine
(simulated machining task)

Remote Arena

View from an overhead camera

Remote access arena

- VPN access to robot
  - Needs TCP/UDP on all ports for subscribers/service
- Ceiling-mounted cameras

Competition Overview

| Action	Points
Full kit delivered (all 6 items and kit at drop-off station)	**7**
Closing the SCHUNK machine door with Large Gear inside	+3
Delivering the kit to SICK Inspector, and trigger inspection	+1
Dropped Item	-1
Collision with Environment (minor)	-1
Kit delivered with extra item(s)	-1 (per extra item)
Kit delivered with item in incorrect section of kit	-1 (per misplaced item)
Kit delivered with item(s) missing	**0**

Full rulebook for this year's competition available at:
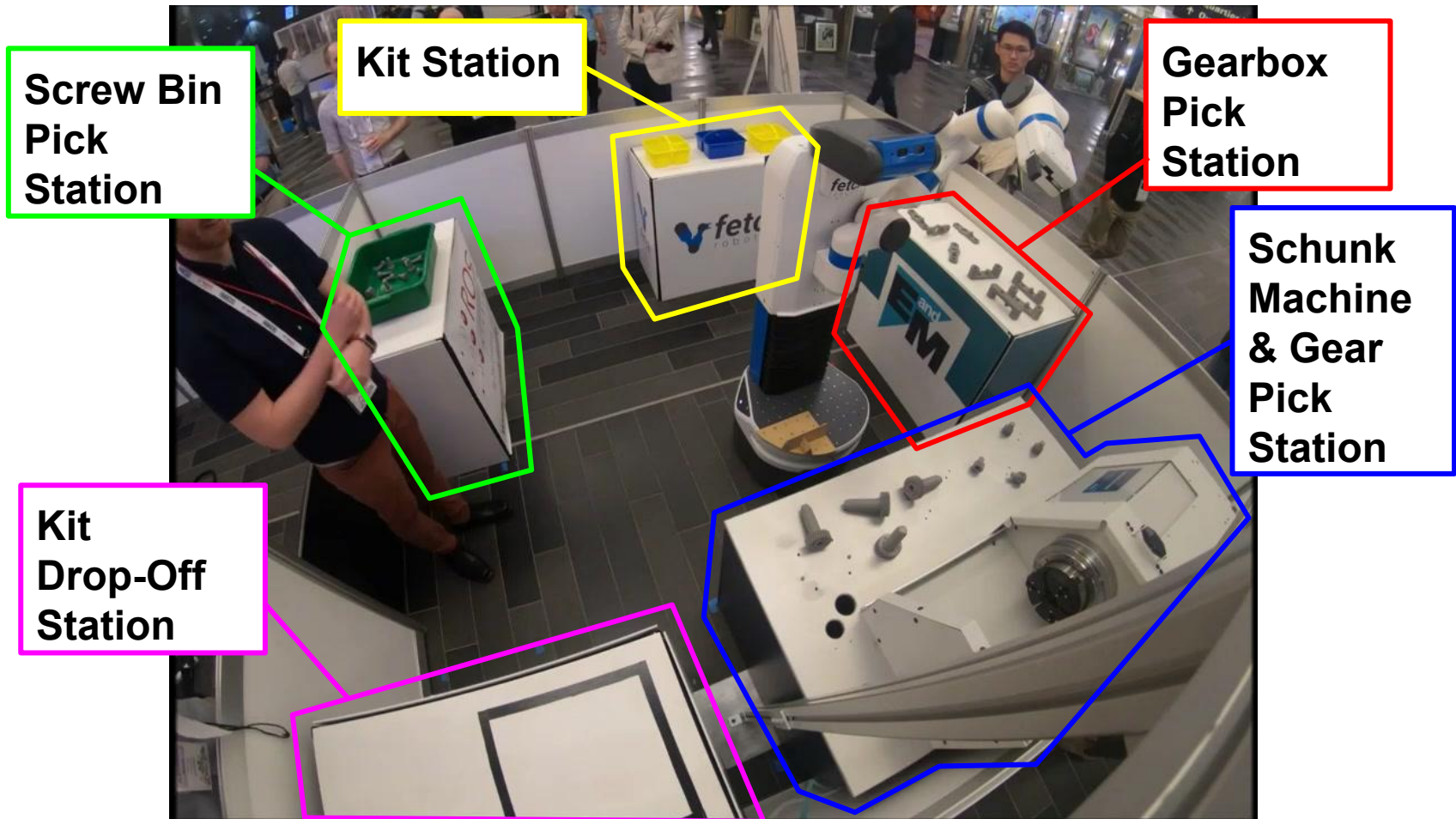opensource.fetchrobotics.com/assets/Rulebook2019.pdf

Competition Results

1st Place: Georgia Tech

Prizes:
Fetch Mobile Manipulation Research Robot
$7K Schunk Bucks
SICK MRS1000 4-layer LiDAR and TiM561 LiDAR
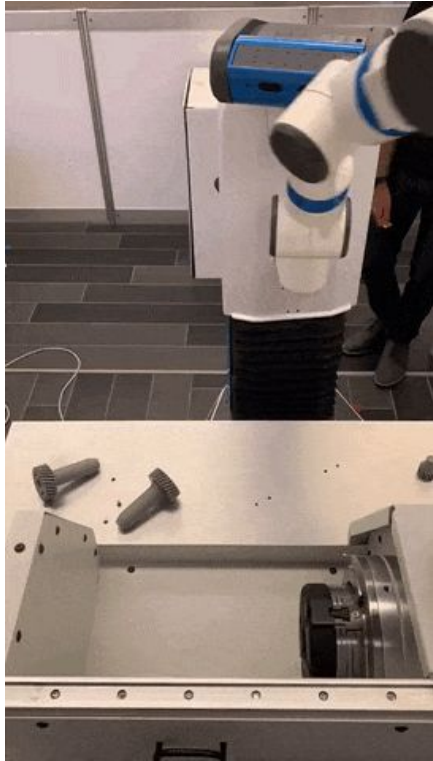

2nd Place: UMass Lowell
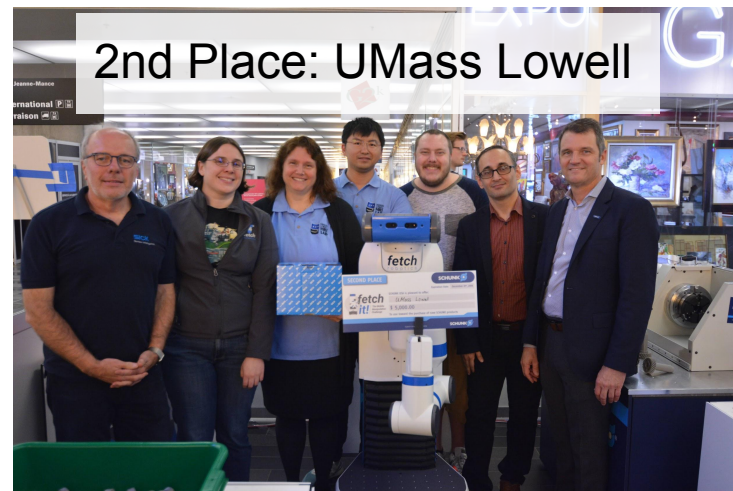
Prizes:
$5K Schunk Bucks
SICK MRS1000 4-layer LiDAR and TiM561 LiDAR

Other participants: Columbia, Case Western, Fido

GT Complete Kit Example Video
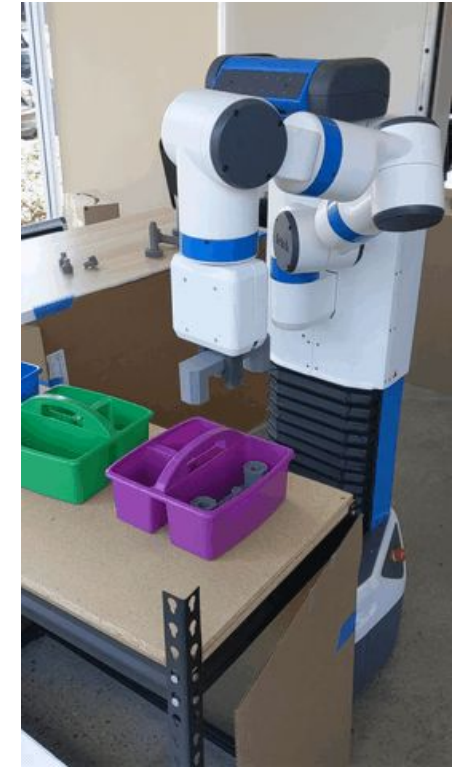

Kit Station

Screw Bin Pick Station

Gearbox Pick Station

Schunk Machine & Gear Pick Station

Kit Drop-Off Station

Manipulation Strategies

Physically triangulating the chuck

Using the torso lift/lower for faster manipulation

Software Tools

- ROS Melodic:
  - Enforced using Melodic
  - Forced us to release Melodic for the Fetch
- Gazebo
  - Web-based simulation provided by The Construct
  - Sim code: https://github.com/fetchrobotics/fetch_gazebo -> fetchit_competition
- MoveIt
- Supported/Encourage use of Docker
- Teams Open Sourced Code:
  - Georgia Tech: https://github.com/GT-RAIL/derail-fetchit-public
  - UMass Lowell: https://github.com/uml-robotics/fetchit2019
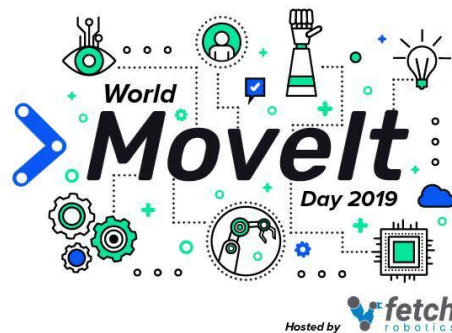
Lessons Learned

- Difficult for teams without robots to participate
- Higher fidelity simulation
    - Fetch Gazebo model needs improvement
    - Gazebo has out-improved our model
- Better remote access
    - Original camera setup had too much latency
    - Final camera setup didn't have enough cameras/viewpoints
    - Better network speeds
- Better internet at venue
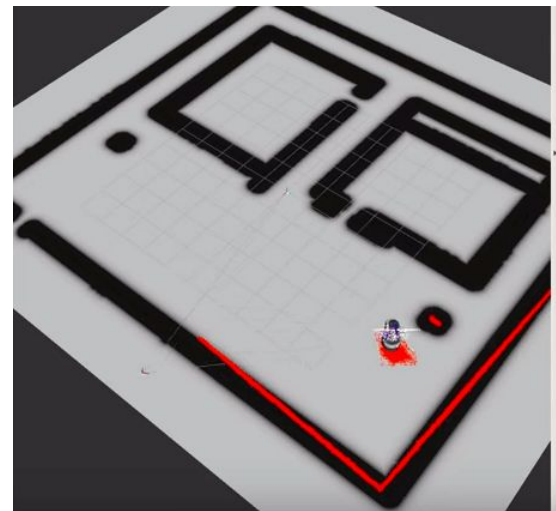
FetchIt! 2020

- Potential Locations:
  - IROS 2020: Las Vegas
  - ICRA 2020: Paris
- Rule Changes
  - Off the shelf items
  - More automation of competition environment, e.g. automatic Schunk Machine door
  - Greater focus on kitting, more realistic kit
  - Real bin-picking
- Improve Experience for Teams Without Robots Already
  - Loaner Robots
  - On-site Hackathons
  - Improvements to the robot in simulation
  - Improvements to remote access

Summary

We gave away a Fetch!

We want to give away another Fetch!

Don't buy a Fetch!

Win a Fetch!

Thanks to FetchIt! Sponsors: