Experiential Learning in Automation and Robotics

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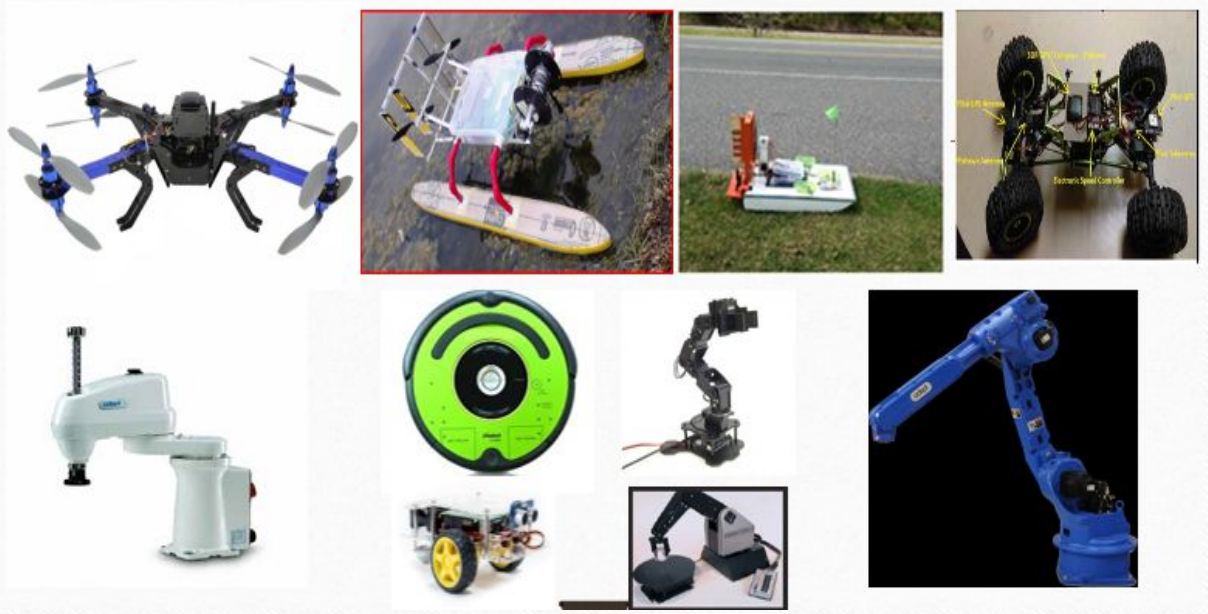
Outline

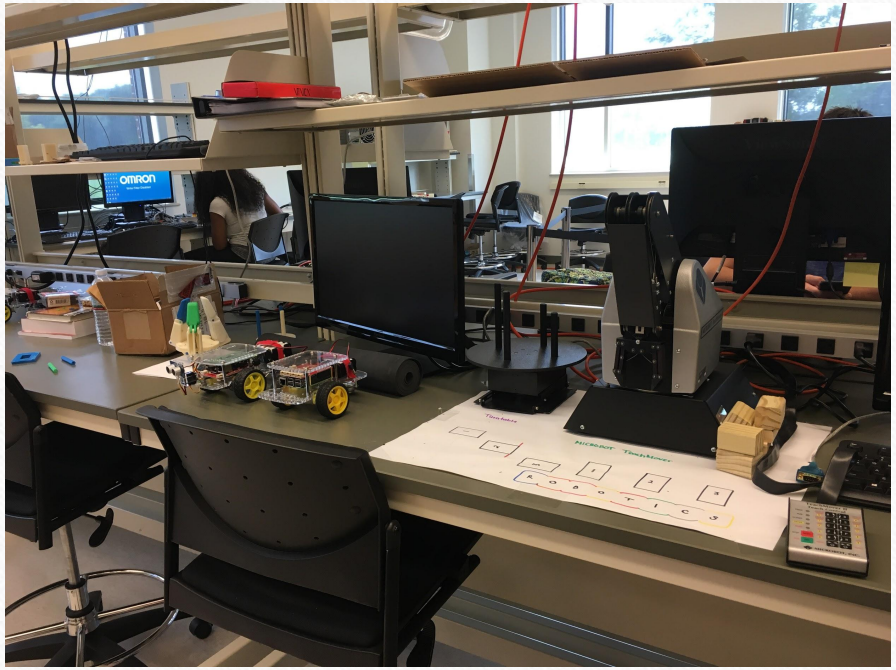
- Robotics
  - iRobot Create 2
  - Adept Cobra s350
- CAD/3D Printing
  - Three finger Gripper
  - Two finger Gripper
- Outreach
  - Summer BRIDGE Program



Robotics at UMES

Objectives

- Research
  - Content knowledge in Robotics/Applications/Programming skills
- Effective Communication
  - Oral presentation
  - Abstract writing
  - Conference Proceeding American Society of Engineering Education (ASEE) Annual Meeting 2019 (Future)
- Outreach
  - Summer BRIDGE Program (supported by MDSGC)
    - CAD/3D Printing
    - Robotics



Robotics Automation Manufacturing (RAM) Lab

Robotics

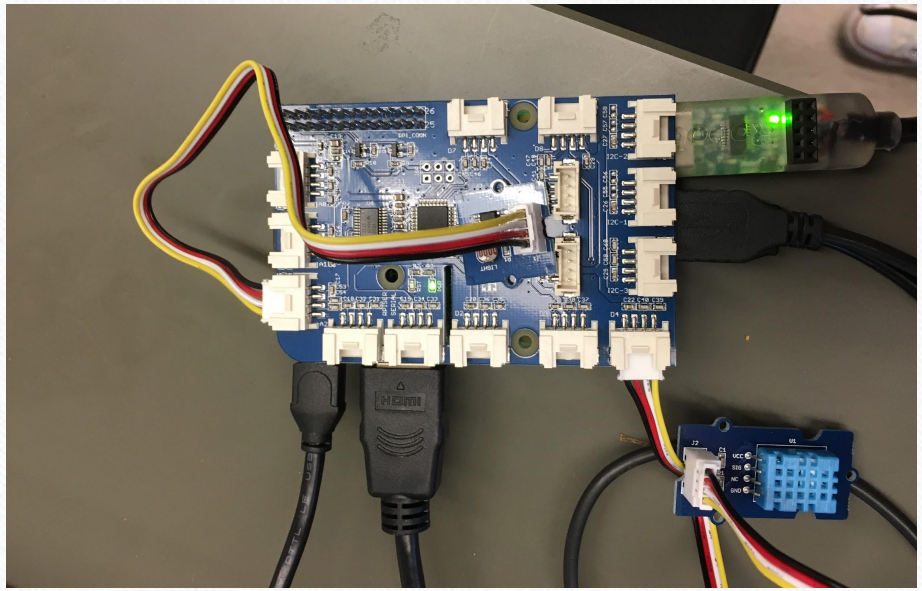
- iRobot Create 2
  - Mobile Platform
  - Programmable Roomba
  - Wrote movement code for the robot using BreezyCreate2 Library[1] in Python
  - Collected data using a light sensor and a temperature and humidity sensor
  - Currently working on wall sensor code to avoid obstacles using the Pycreate2 Library[2]

iRobot Create 2

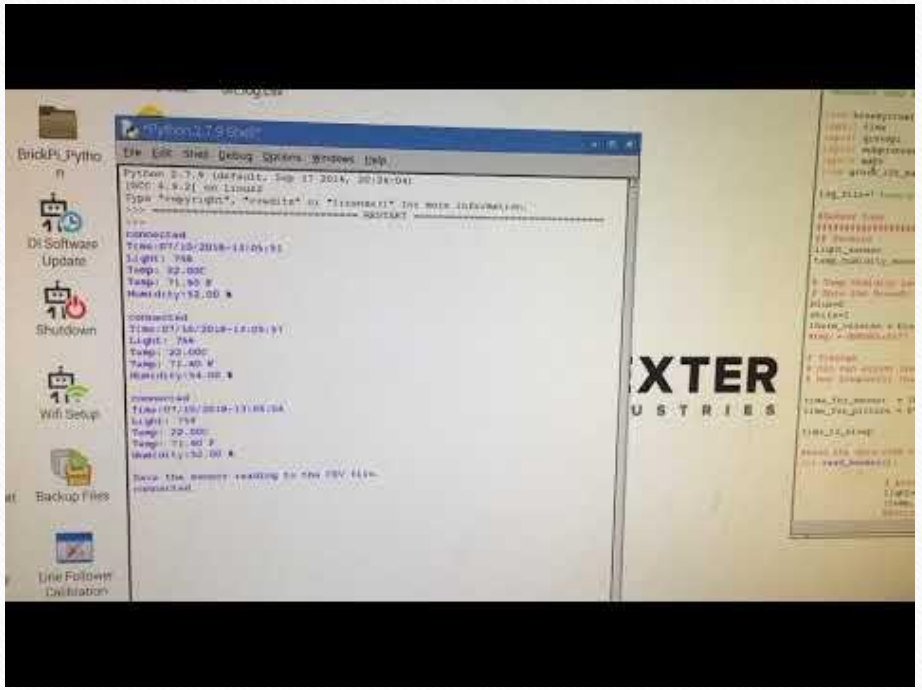
[1] Levy, Simon, *BreezyCreate2*, (2017), GitHub repository, https://github.com/simondlevy/BreezyCreate2

[2] Walchko, *pycreate2*, (2017), GitHub repository, https://github.com/MomsFriendlyRobotCompany/pycreate2

Robotics



Raspberry Pi with GrovePi Board and Sensors



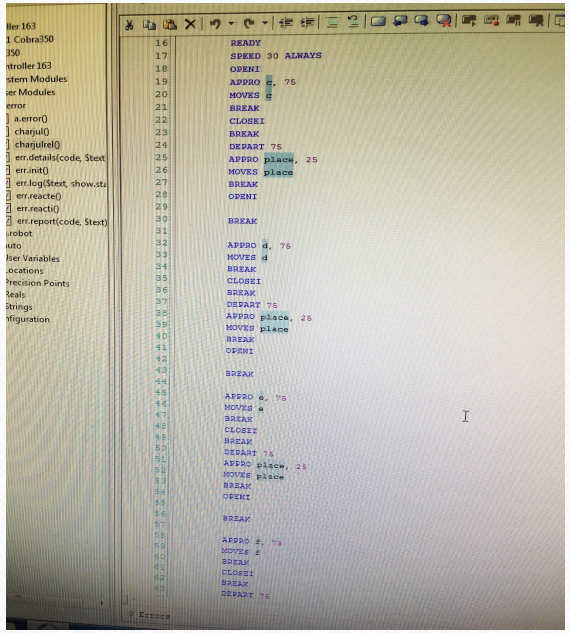
iRobot Create 2 Collecting and Transmitting Data

Robotics

- Adept Cobra S350
  - 4-axis robot
  - High-performance Selective Compliance Articulated Robotic Arm (SCARA)
  - 3D printed gripper
  - Skills learned:
    - Relative transform
    - V+ Language

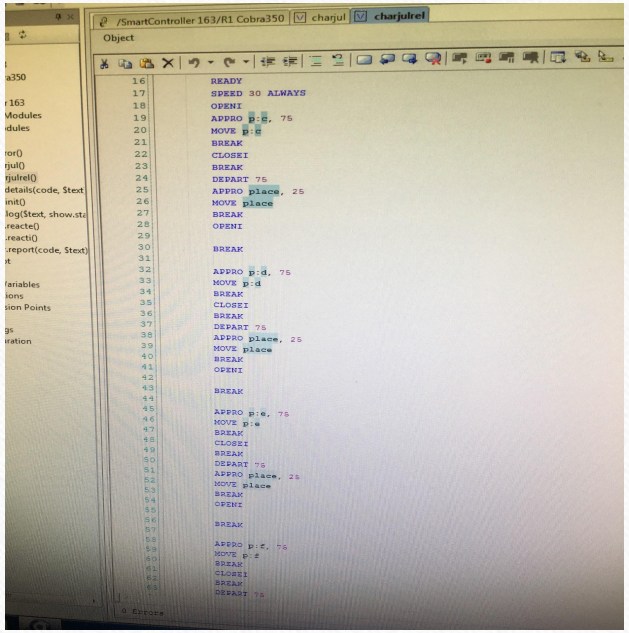
Adept Cobra S350

Robotics



Pick and Place V+ Code

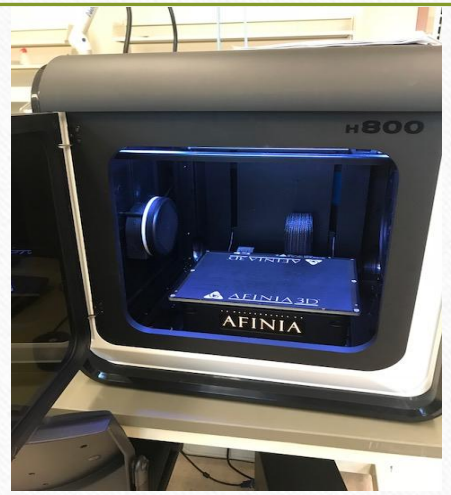
Relative Transform



Relative Transform V+ Code

CAD/3D Printing

- Underactuated Robotic Gripper
- Followed the framework of *An Open-Source 3D Printed Underactuated Robotic Gripper* [3]
- Interfaced the gripper on the Adept Cobra
- All parts were 3D printed at UMES

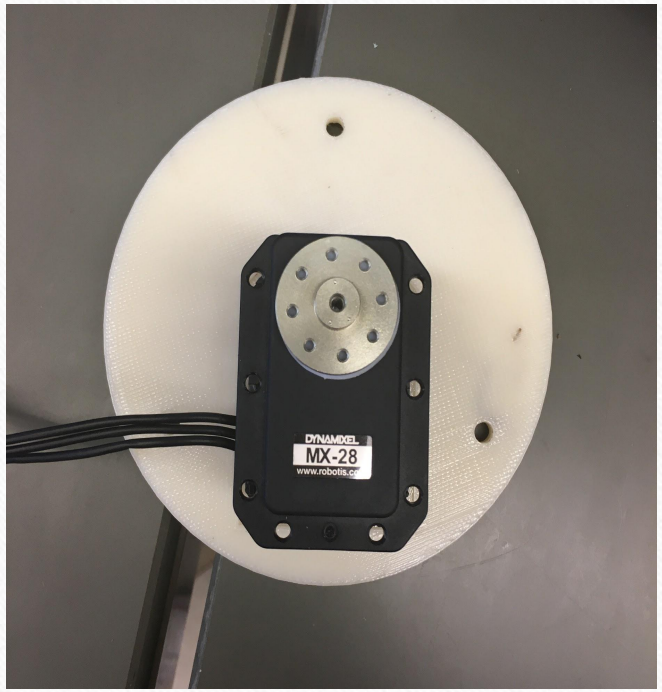


Afina Desktop 3D Printer

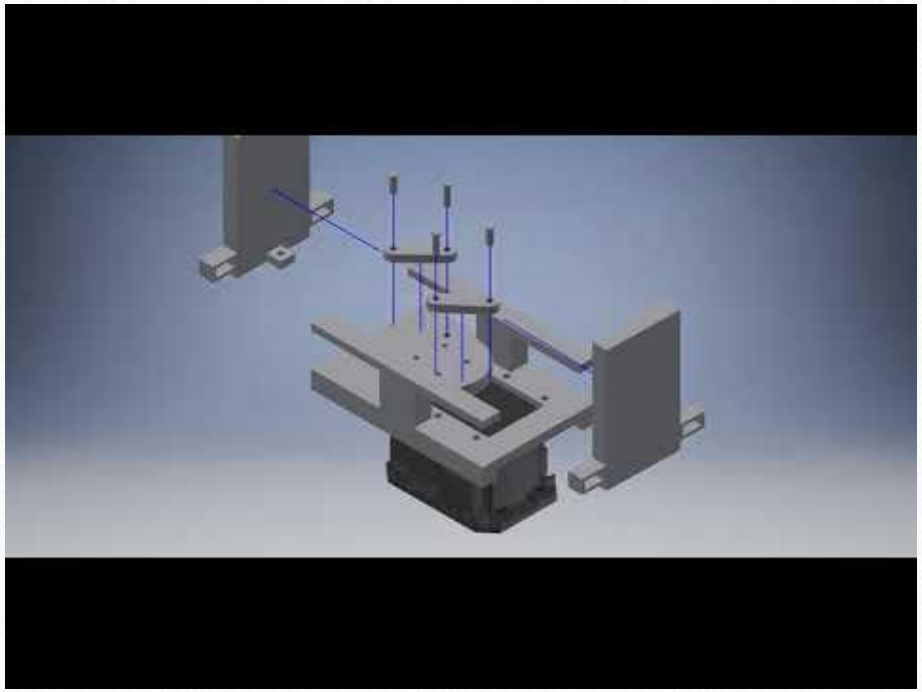
3D Printed Gripper

[3] Tlegenov, Yedige, et al. *An Open-Source 3D Printed Underactuated Robotic Gripper.* Astana: Print. 010000

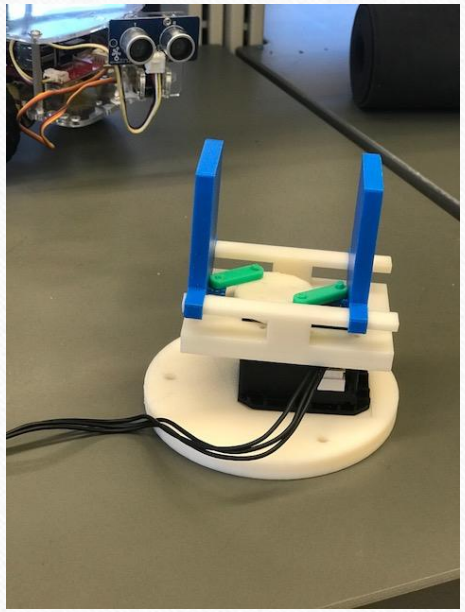
Robotic Gripper



Arbotix MX-28 Motor



Exploded Presentation of Slider Crank Gripper



Two-Finger Gripper

Robotic Gripper

- ArbotiX-M controller
- MX-28T servo
  - Programmed the servo
    - Followed the sample code provided by the Arbotix-M libraries[4]

MatlabControl

```
int high = -1;
int low = -1;

void setup()
{
  serial.begin(9600);
}

void loop()
{
  if(serial.available()>1)
  {
    low=serial.read();
    high=serial.read();

    SetPosition(1, low+high*256);
    delay(3000);

    serial.write(ax12GetRegister(1,30,1));
    serial.write(ax12GetRegister(1,31,1));
  }
}
```

positionSet.m

```
function [ position ] = positionSet( serial, goalPos )
%UNTITLED Summary of this function goes here
%   This function takes in serial connection (serial) and
%   goal position (goalPos) between the range of 0 to 1023.
%   It returns the posiion that the servo has returned to

    low = mod(goalPos,256)
    high = floor(goal/Pos)

    fwrite(serial, low);
    fwrite (serial, high);

    position = fread(serial, 1) + fread(serial,1)*256;
end
```

Arduino sketch coupled with the Matlab function required to drive the gripper

[4] "ArbotiX-M: The Arduino Compatible Board for Robots with Dynamixel Servos." Arbotix-M Board for Compatible Robots with Dynamixel Servos, Nootrix, nootrix.com/diy-tutos/arbotix-arduino/. Accessed 20 July 2018.

Outreach - BRIDGE

Exposed the incoming freshmen to robotics, CAD, 3D printing, and aviation sciences to prepare them for college level STEM courses

Outreach - BRIDGE

Scratch program compiled by students

Internship Outcomes

Academic Skills

- Increased knowledge of robotics
- Further development of software skills
  - SolidWorks
  - V+
  - Python
  - Arduino
- Honing of oral presentation and writing skills

Life Skills/Civic Responsibility

- Adapting to a new campus environment
- Fostering interdisciplinary collaboration and team building skills
- Enhancement of pedagogical skills through mentor/mentee experiences
- Exposure to small Unmanned Aerial Systems (sUAS) and Autonomous Surface Boats (ABS)s
- Awareness of sustainability and environmental stewardship

Acknowledgments

- Maryland Space Grant Consortium
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- Nathan Bane, University of Maryland Eastern Shore
- Virginia Heath, University of Maryland Eastern Shore
- Dr. Mary Bowden, University of Maryland College Park
- Dr. Guangming Chen, Morgan State University

Questions?

https://www.huffingtonpost.com/barbara-jacoby/asking-questions-is-really-hard_b_7052722.html