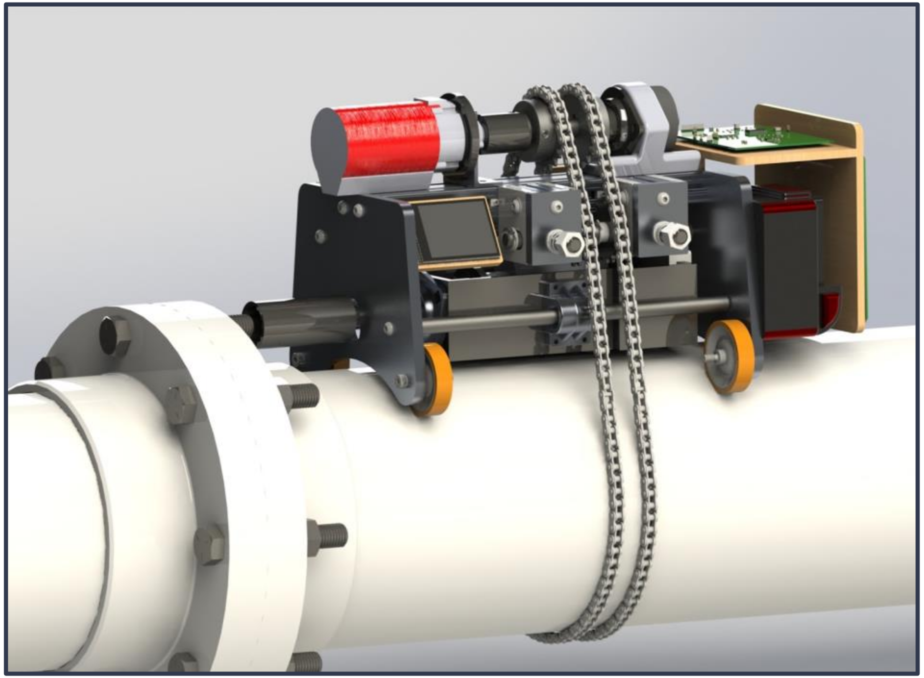
UCF COBOT – Robotic Flange Assembly

Senior Design 2018-2019

A Multidisciplinary Effort



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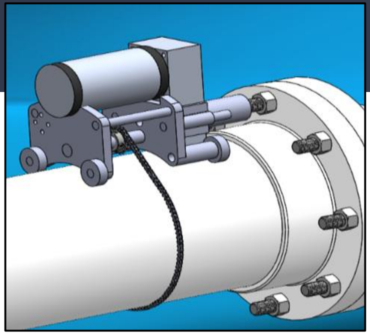
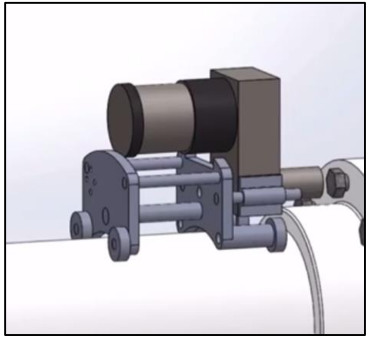
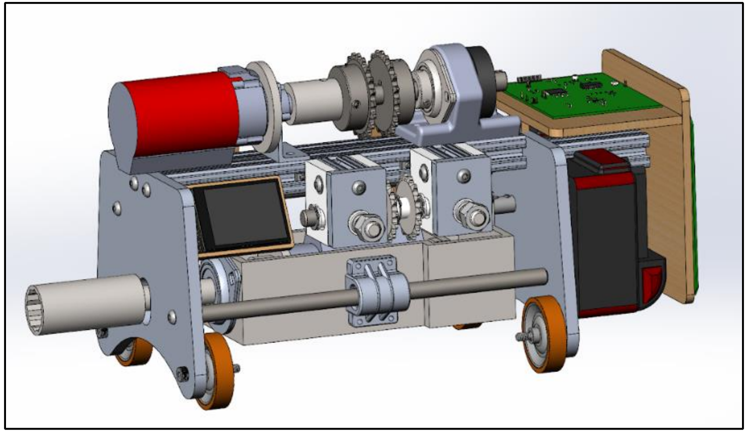
Cobot Evolution

V2

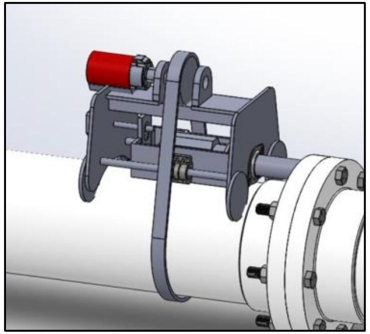


V1





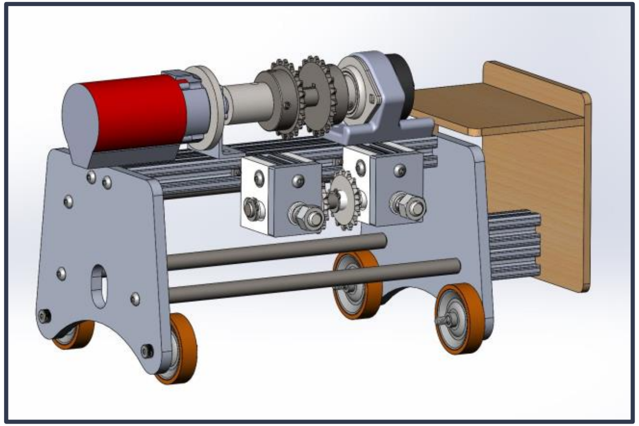
V3



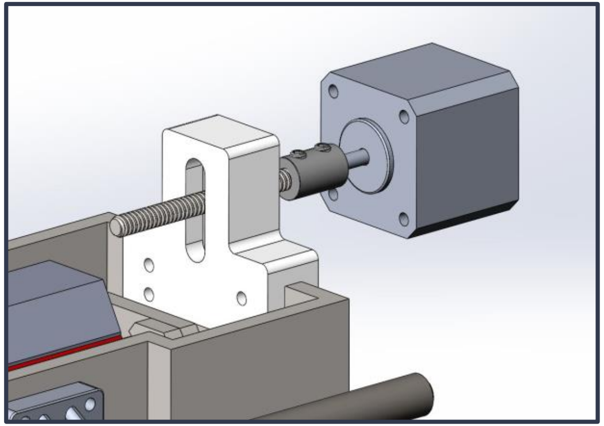
Mechanical Design

- Concept development
- Breakdown of Subsystems

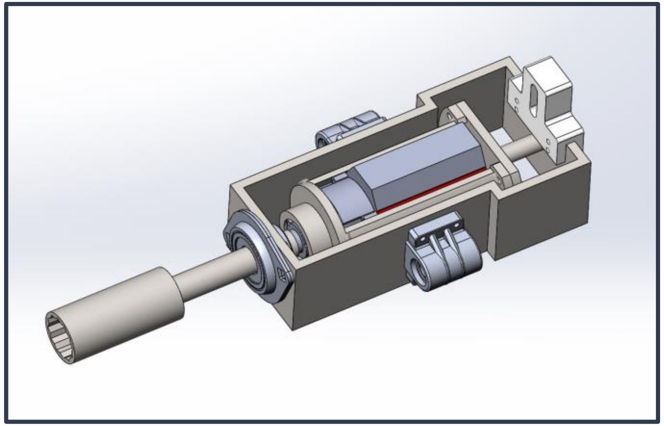
Carriage Subsystem



Articulation Subsystem

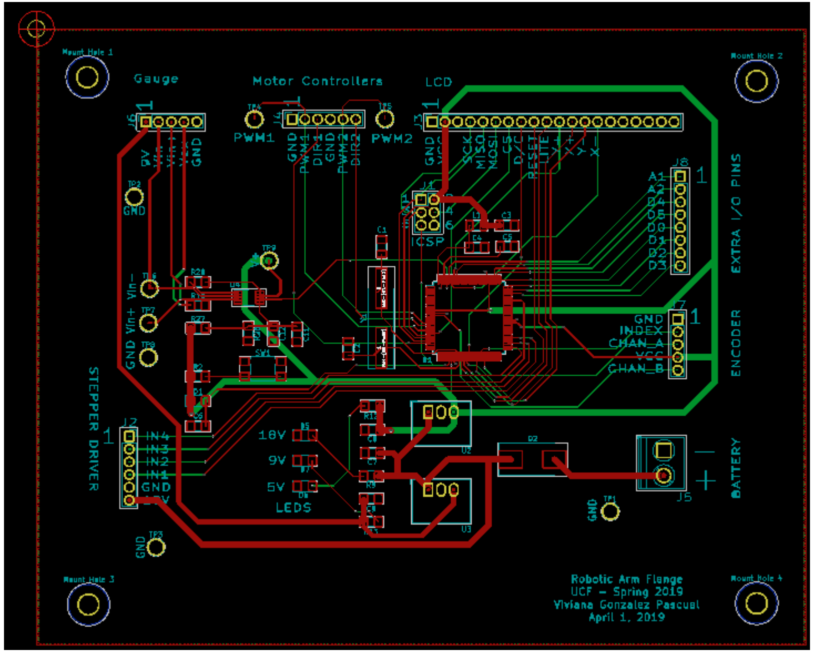


Torque Drive Subsystem



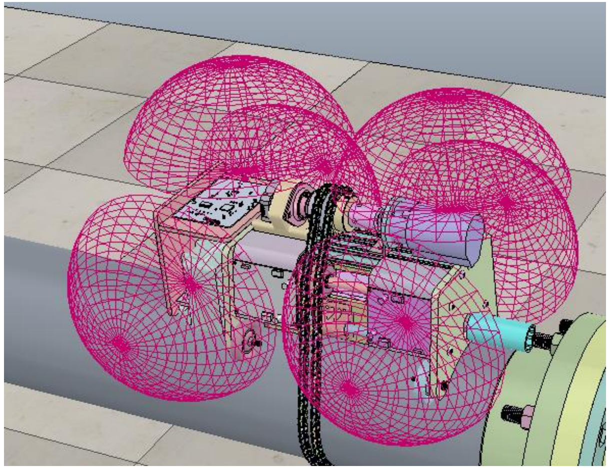
Electrical Components

- Components & hardware
- Feedback System
- PCB
- Power Supply



Simulation & Future Components

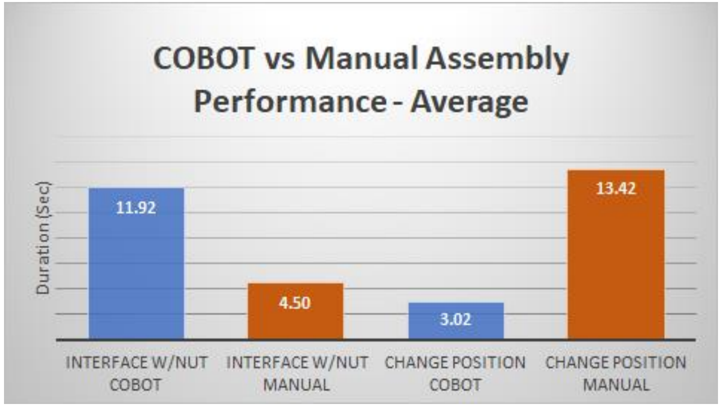
- Reference Simulation Monitor
- Finished features
  - Proximity sensors
  - Camera view
  - User Interface

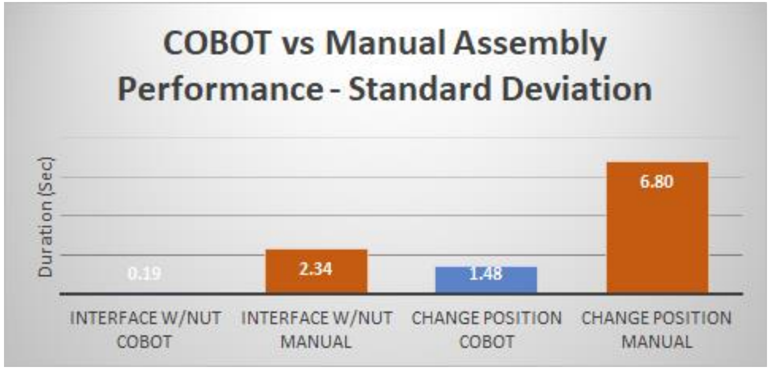


Results

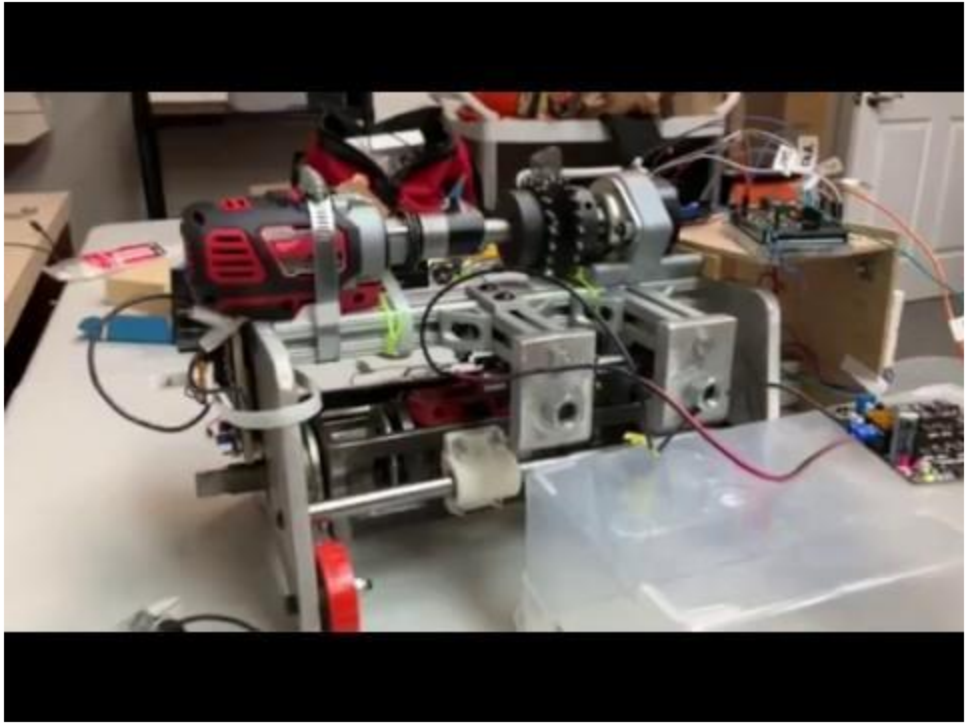
- Quality
  - Consistent bolt tightening
- Safety
  - Reduced fatigue
- Productivity
  - Reduced cycle time

Total Time	Manual	COBOT	% Difference
Interface w/nut	19.99	95.394	477%
Tighten first round	133.94	10.088	8%
Change Position	41.94	21.133	50%
Total	195.87	126.615	**65%**

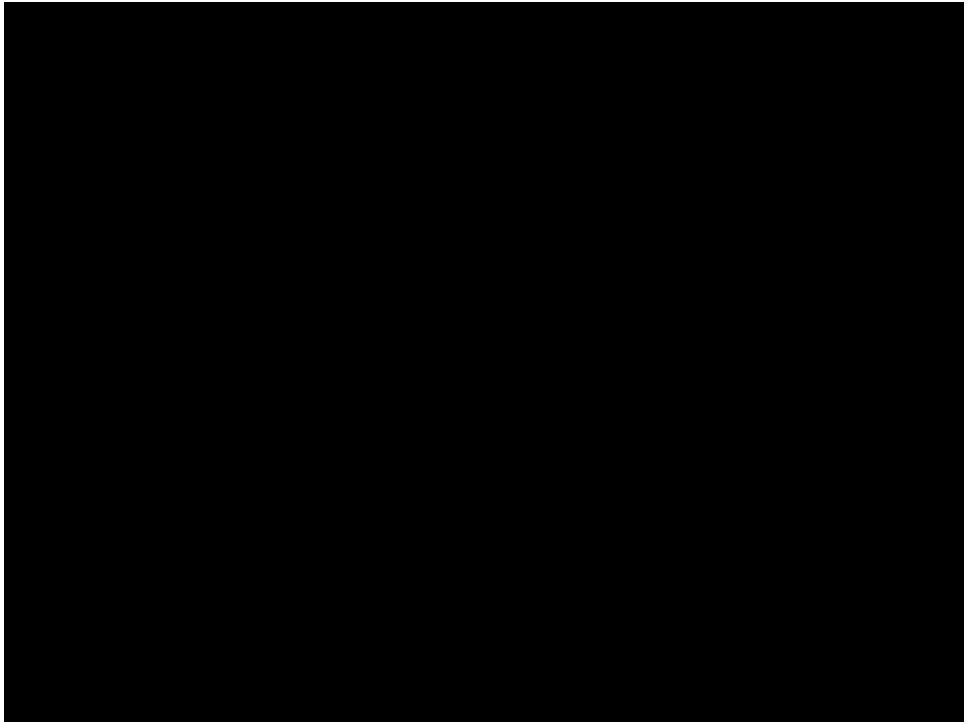




Static Test



Cobot Demonstration



Articulation System in Action

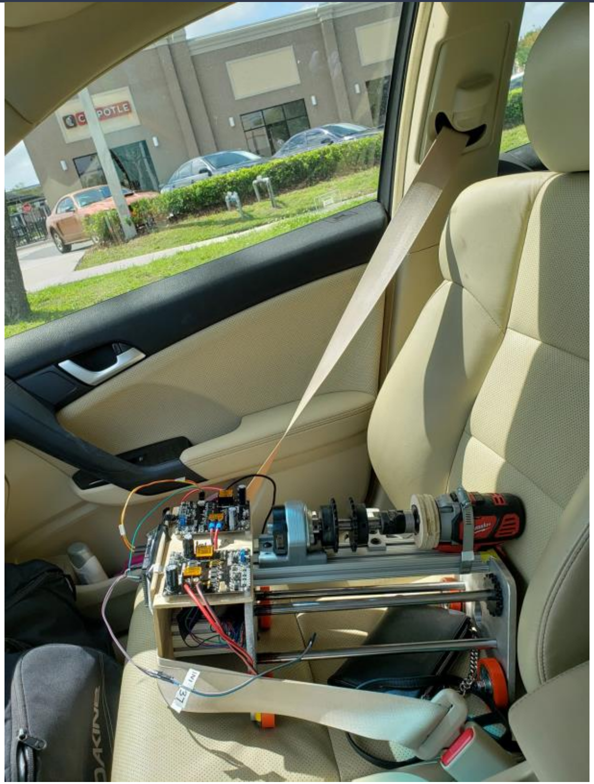
A Glimpse of Hope!

If only pipes are flat and bolts are playdoh...

It Smoked...

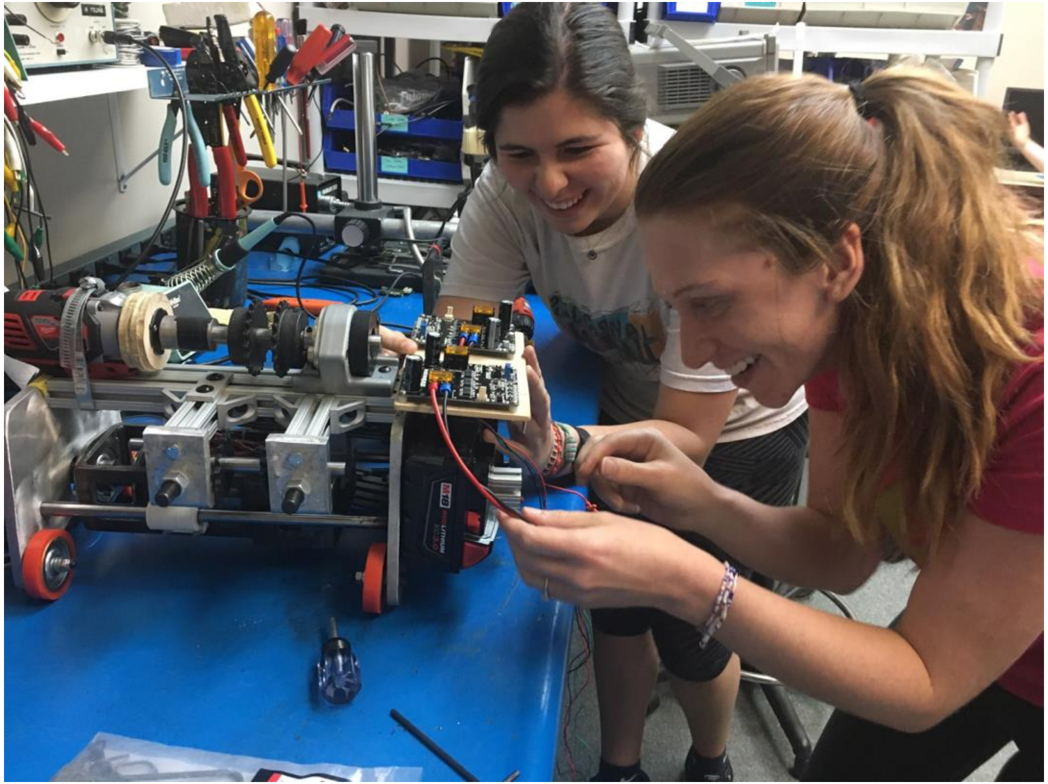
Out for a stroll

Even Cobots need a Chipotle break



The patient is prep for surgery

Girl Power!



How many ME does it take to hold a Cobot?

List of Components – Electrical/Computer

Component Name	Specs & Features	Purpose
Arduino Mega 2560	Additional pins are available	Support a flexible design approach
Cytron Motor Controller (2)	Current rating compatible with the high-current draw of the drill motors	Drive the M18 Drill Motors in Carriage and Torque Drive Subsystems
Easy Driver Stepper Motor Controller	Compatibility and user out-of-the-box implementation	Drive the Nema 17 Stepper Motor in the Articulation Subsystem

Software Functions for Subsystems

- activateTorqueMotor()
  - First Subassembly to run
  - Begins the process of tightening the bolt
- articulationSystemBackward()
  - Second Subassembly to run
  - Disengages the Torque Drive subsystem from the bolt

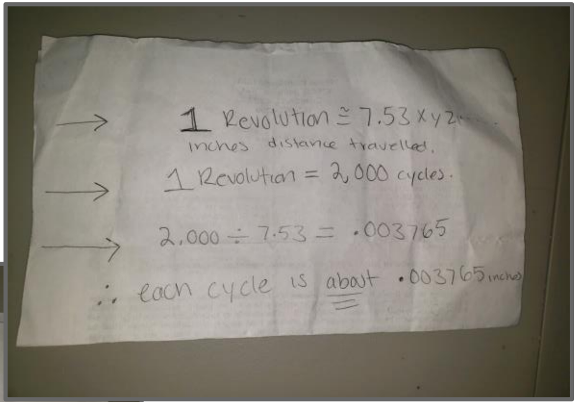
- startCarriageMotor()
  - Third Subassembly to run
  - Begins the process of circumnavigating around The pipe to find next bolt
- articulationSystemForward()
  - Fourth Subassembly to run
  - Engages the Torque Drive subsystem towards the bolt

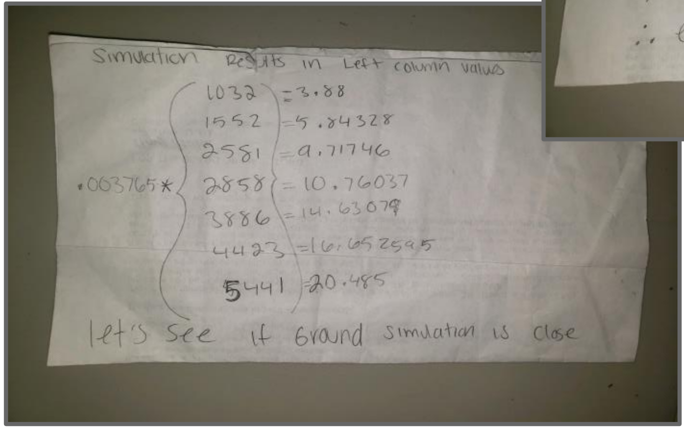
```
void articulationSystemBackward()
{
  Serial.println("Articulation System Activated");

  myStepper.setSpeed(SRPM);
  for(int i = 0; i < REVOLUTIONS; i++)
  {
          myStepper.step(-stepsPerRevolution);
          delayMicroseconds(DELAYMCRO);

  }
startCarriageMotor();

}

void startCarriageMotor()
 {
```

PLanning Out Software Logic

- Identify coordinates of bolts
- Using circumference of pipe to find distance
- Using peak diameter of gear and CPR for estimated travel
- Plan out path for torque sequencing
- Use Computer Science teammate suggestion for one direction travel

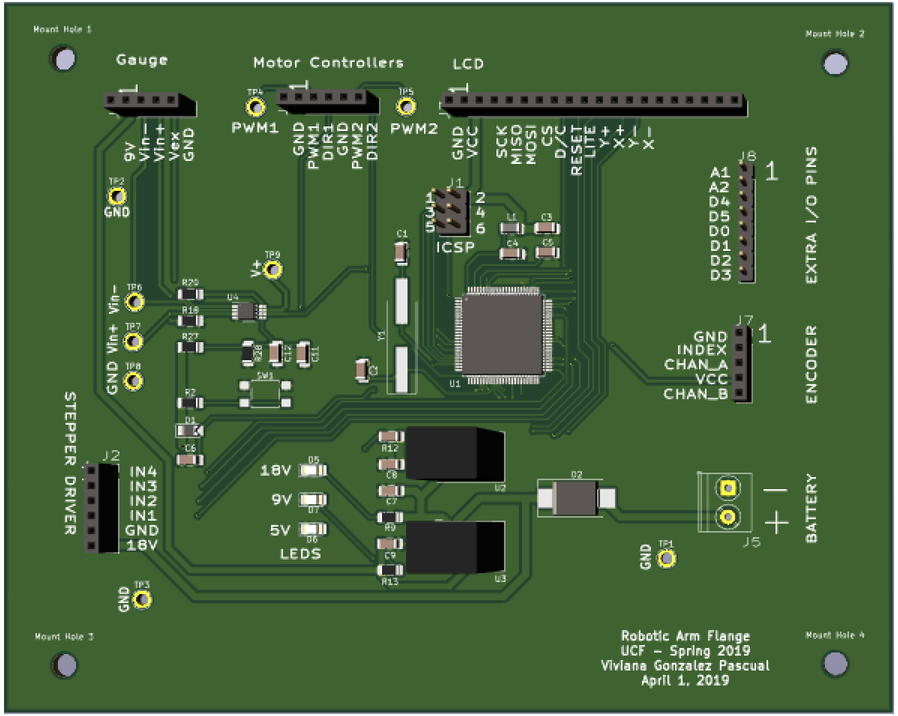
Multiply Cycles by estimated constant to define a distance





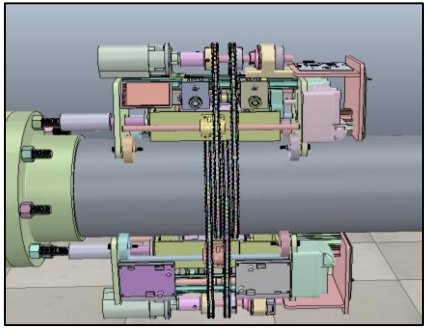
How it works – Electrical & Computer

- The interface between the mechanical hardware and electrical components.
  - Provides COBOT with logical control
  - Implements main electrical connections to subsystems
  - Regulates power given to certain components

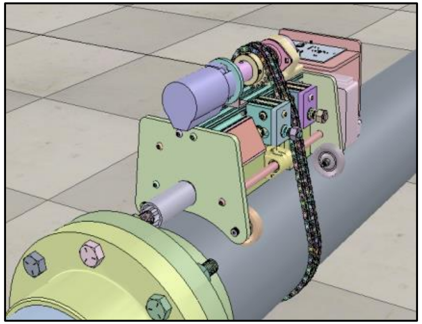


Simulation Scenarios

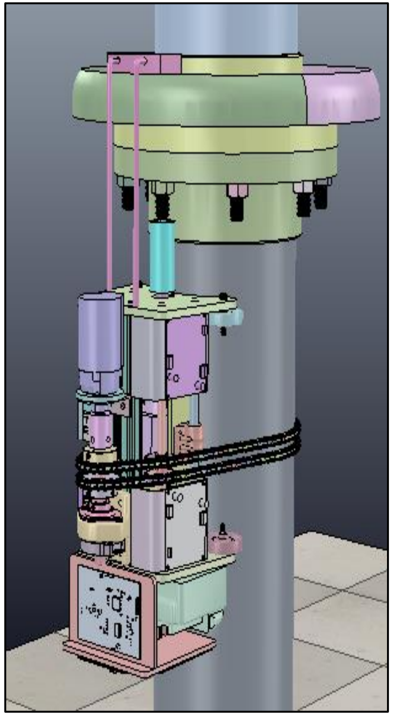
2-Cobot



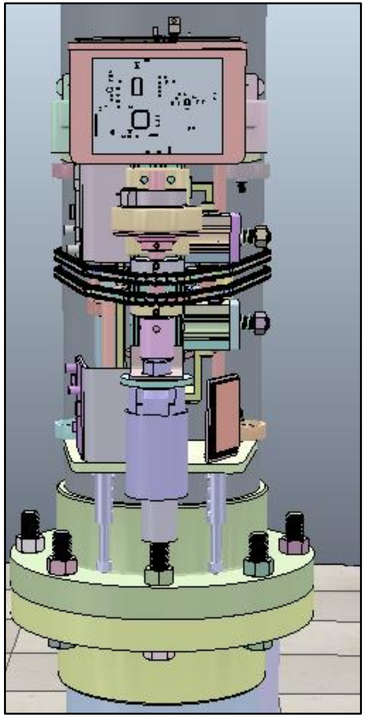
Proto-Cobot



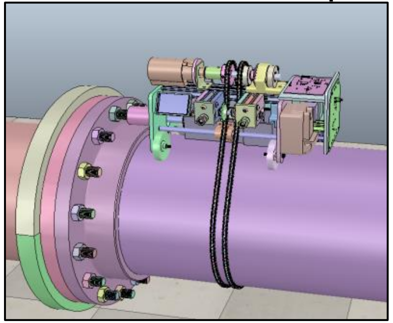
Upward Design



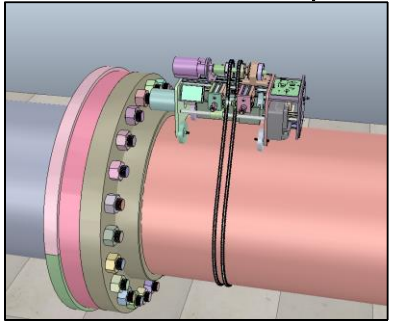
Downward Design



16-bolt Scale-up



24-bolt Scale-up



Features

- Finished
  - Full dynamic movement
  - Socket alignment
  - Torque drive positioning
  - Proximity sensors
  - Camera view
  - Data log
  - Expandable database
  - User Interface
    - User options
    - Dynamic results
    - Live progress
    - Estimated time to completion
- Future
  - Torque calibration
  - Precise time estimate
  - Alignment via camera
  - Perform in depth safety analysis
  - Test limitations of design