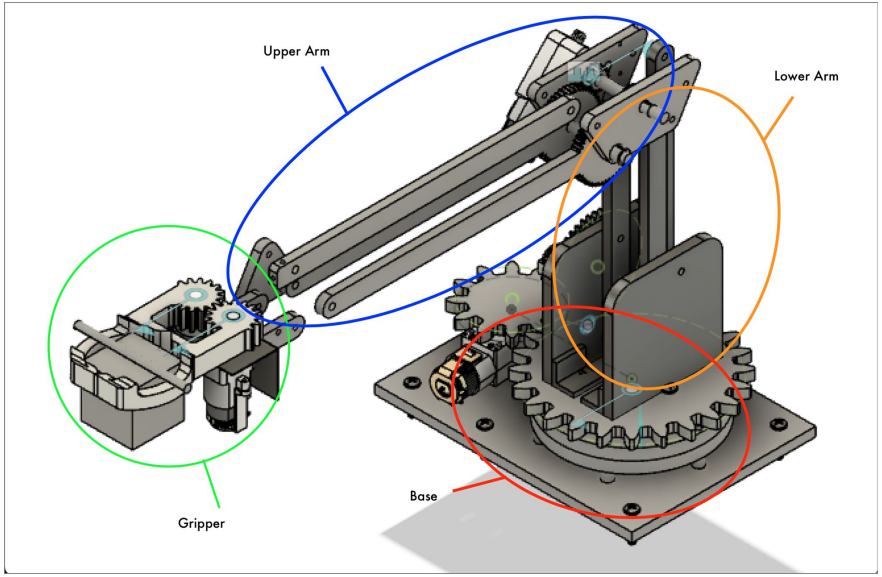
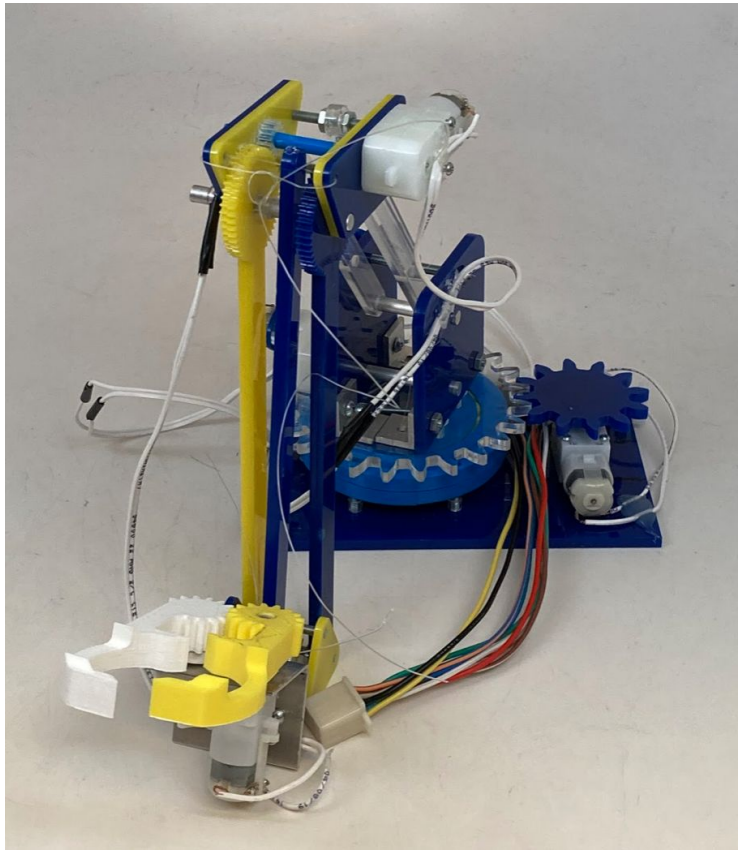
Roger

Team 20: Robotic Arm



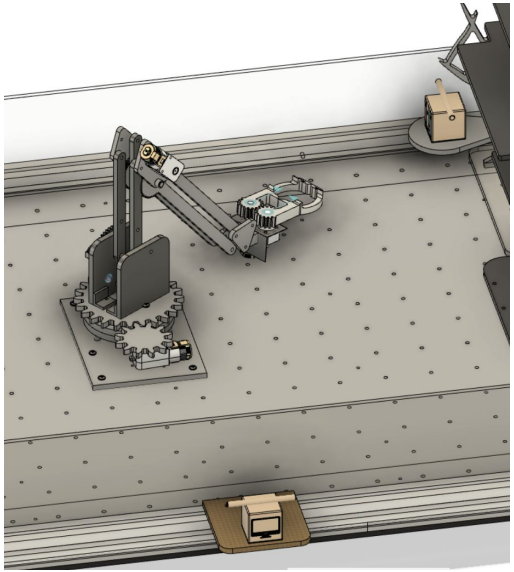


Minh Luc, Nick Ratto, Hsi-ruei Tsao, Roger Nguyen

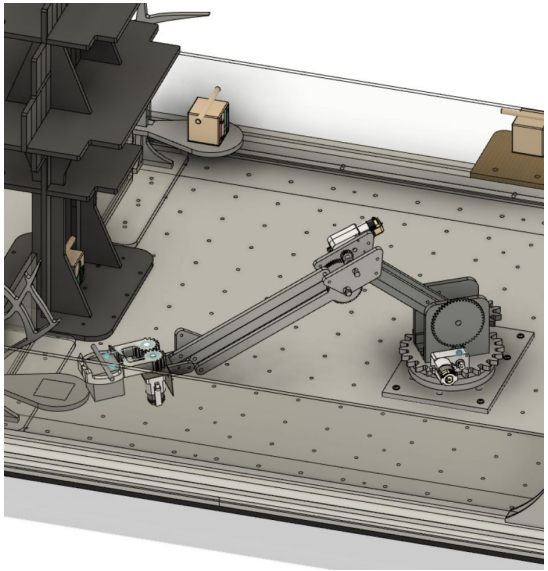
Nick

How Robot Arm Scores Points

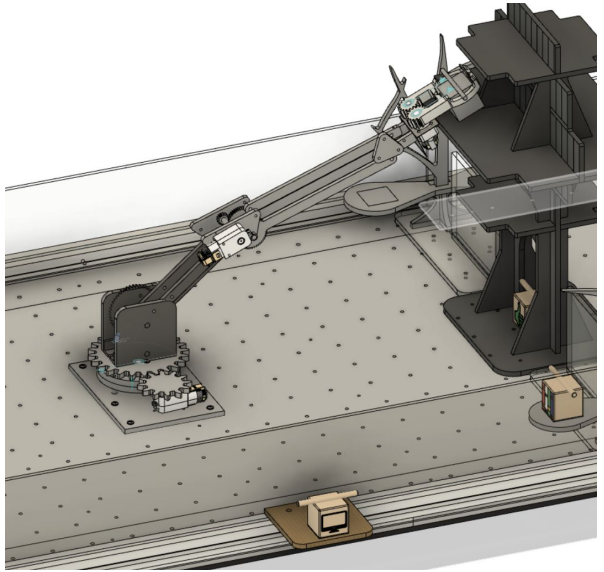
CAD of Robot Collapsing



CAD of Robot Picking Up Box

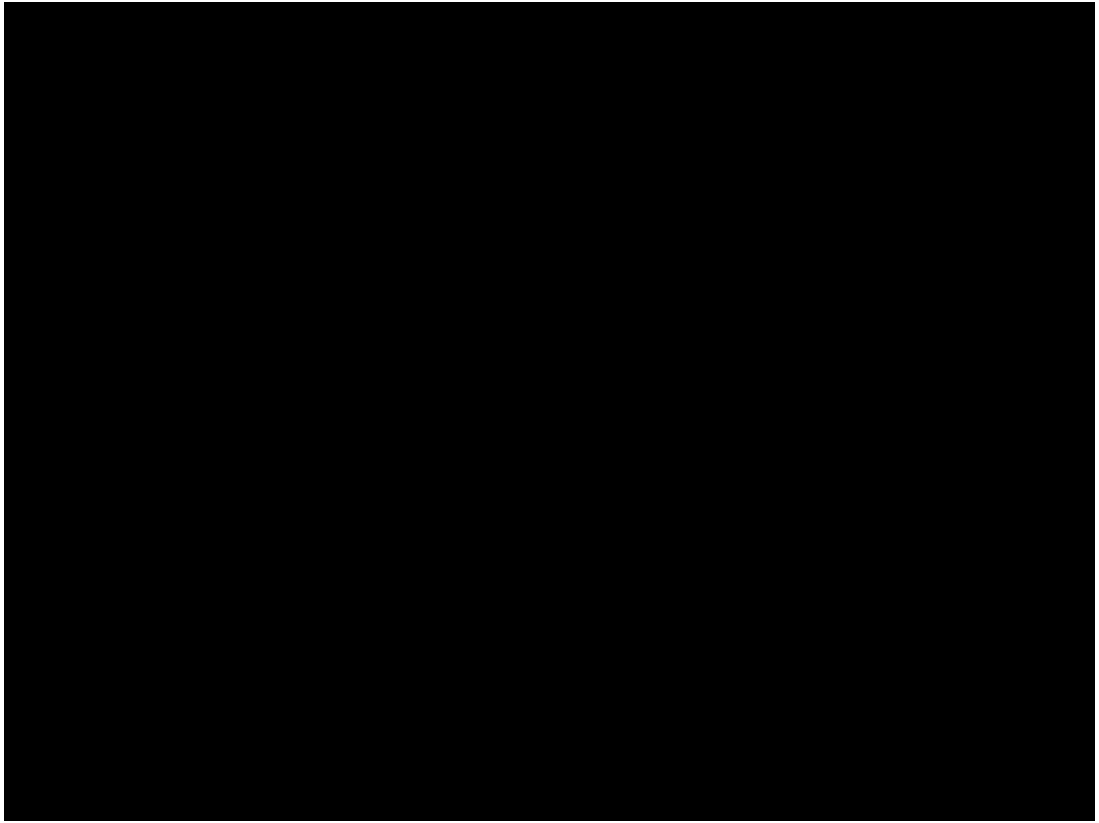


CAD of Robot Dropping Box



Bill

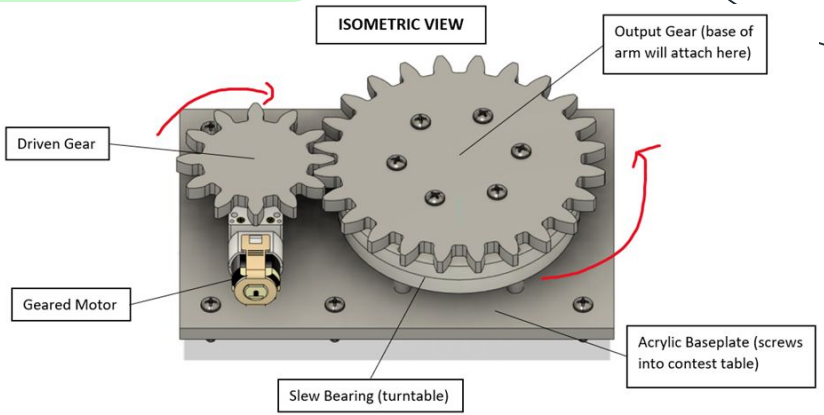
Animation of Robot in Action

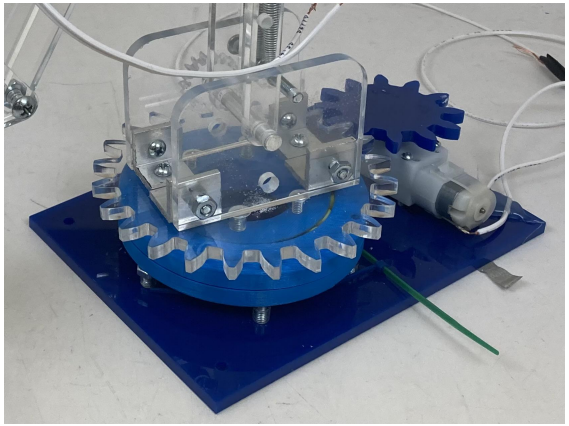


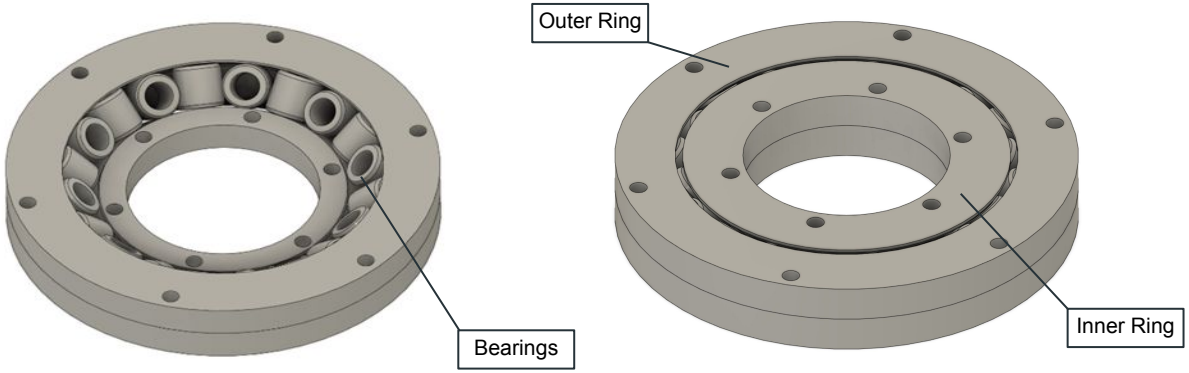
Nick

Turntable Base

- Responsible for rotation
  - Base of arm screws into driven gear
- Utilizes a gear train
- Utilizes a slew bearing
- Screws into table

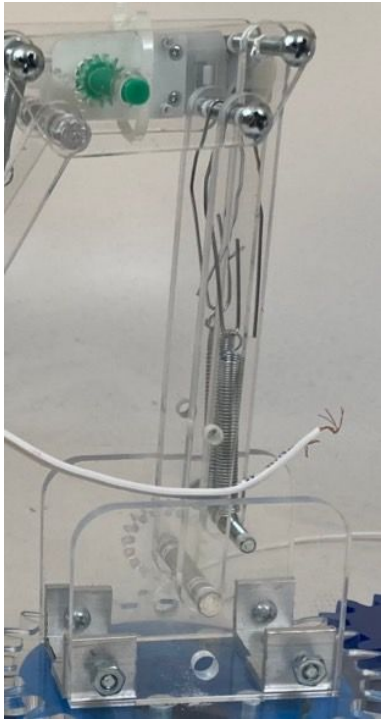


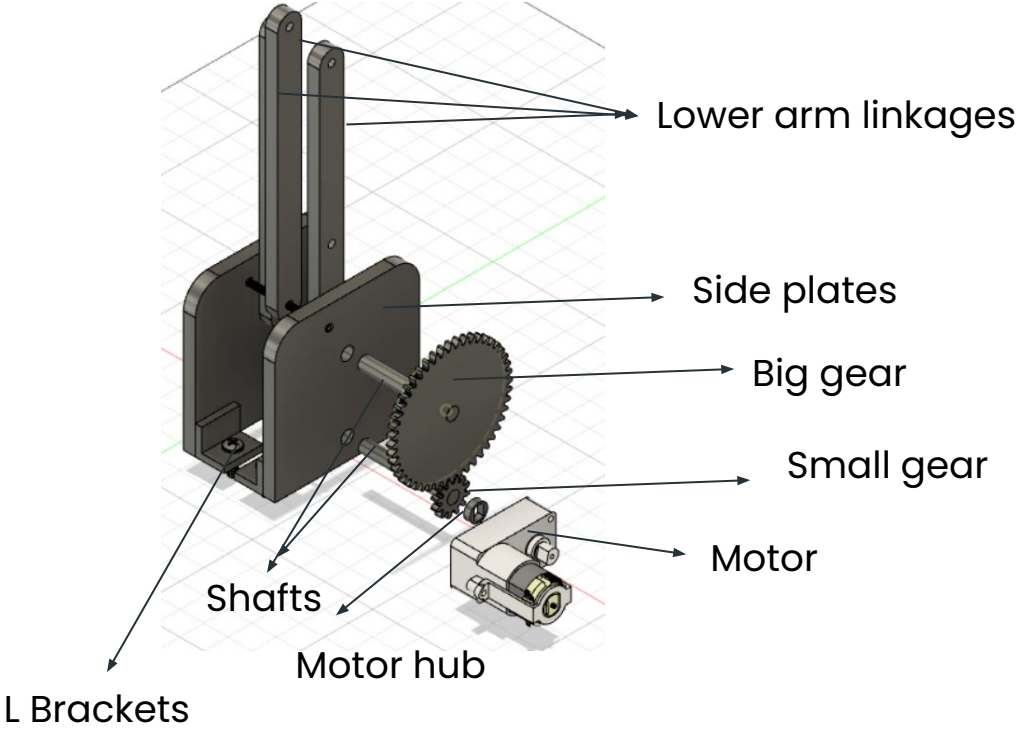




Lower Arm Extends

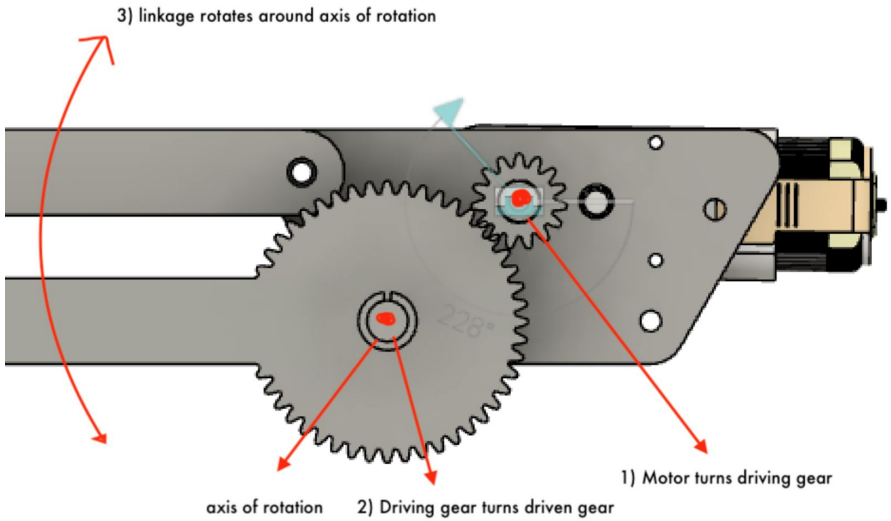
- Responsible for extension.
- Screws into rotating gear.

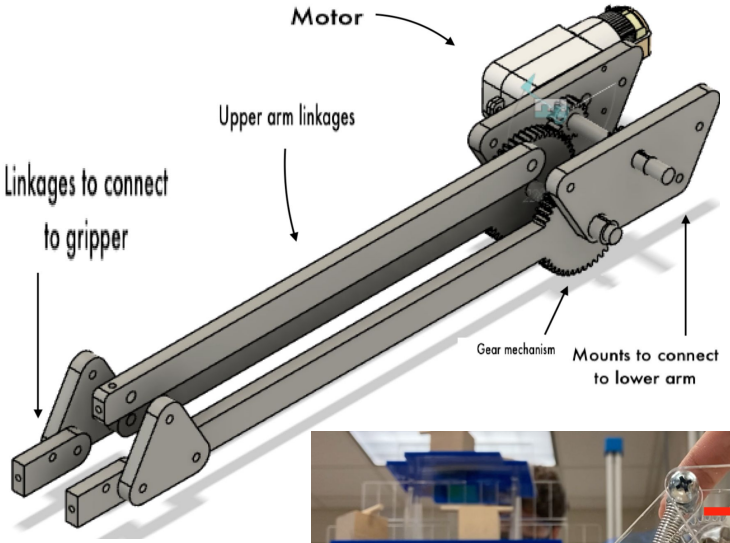


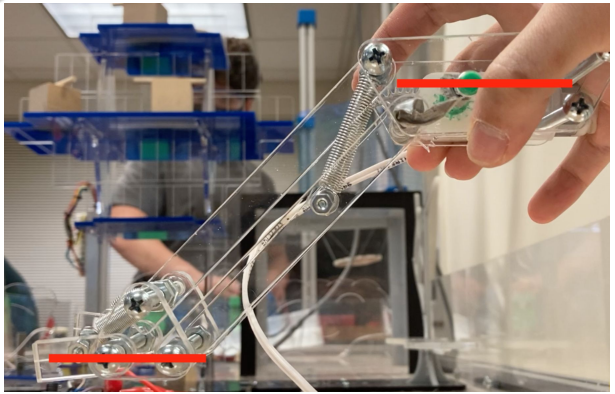


Upper Arm Extends Further

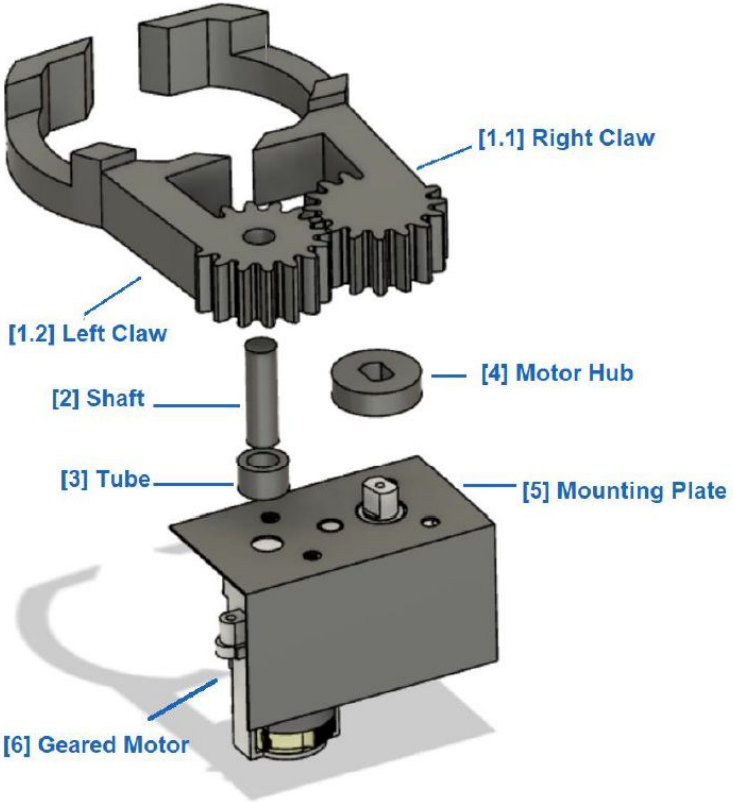
- Extension of the lower arm
- Uses four-bar linkage mechanism to ensure level gripper



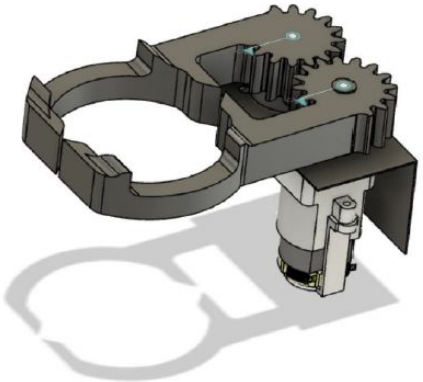


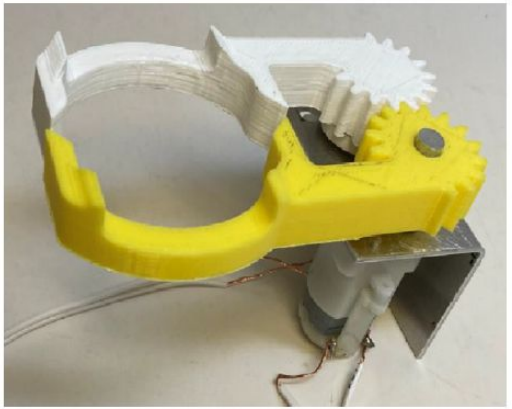


Gripper Grabs Box



- Actuation method: mechanical grasping.
- Power source: DC geared motor.
- Fabrication materials: PLA, metal sheet, aluminum rod.

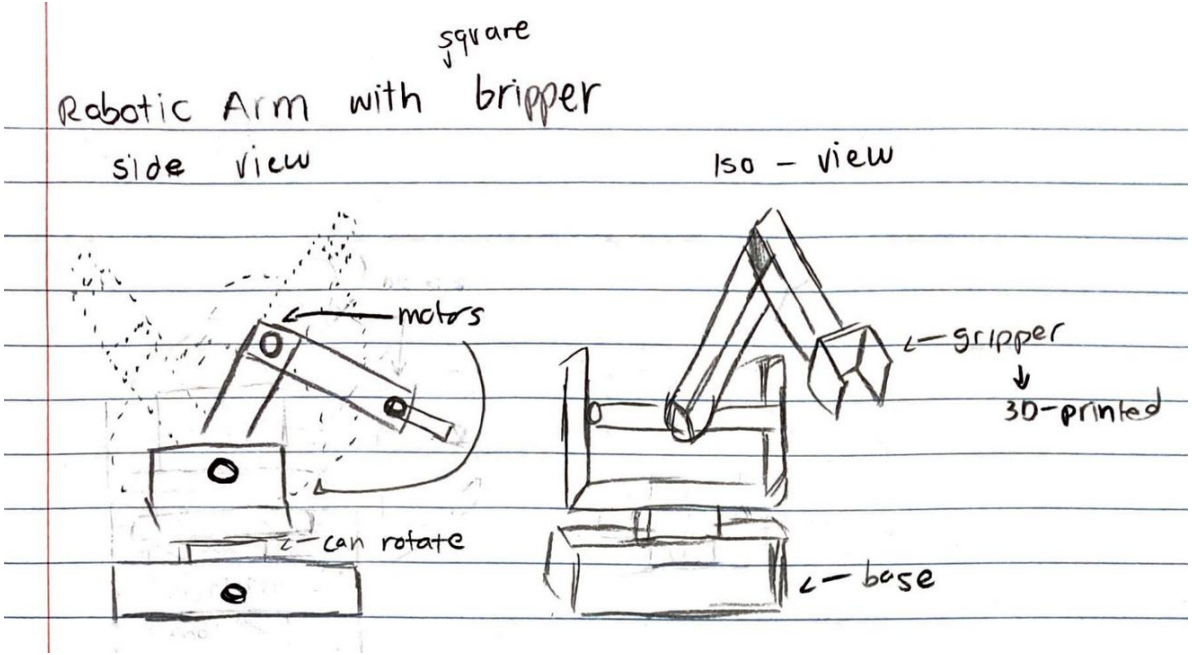


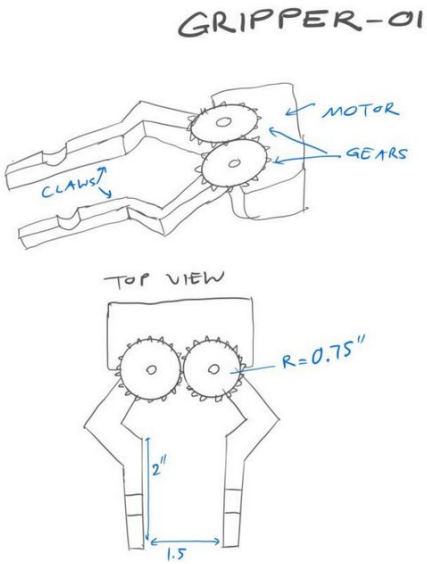


Minh

Importance of Initial Sketches

Initial sketching is an important step in the design process. Our initial idea was to create a robot arm which rotates around a base. The arm will have a gripper to grab the box.

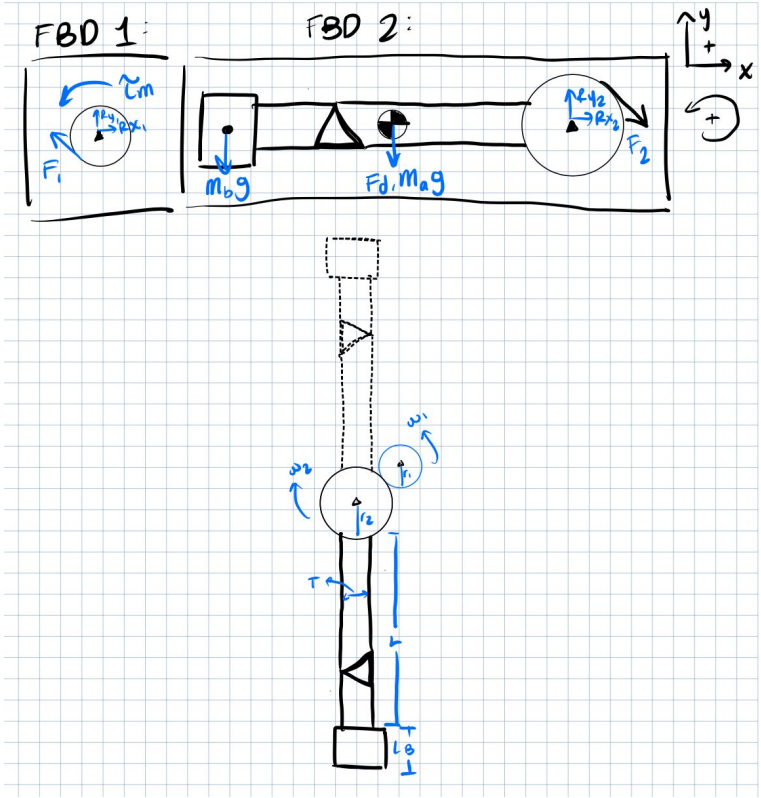




Minh

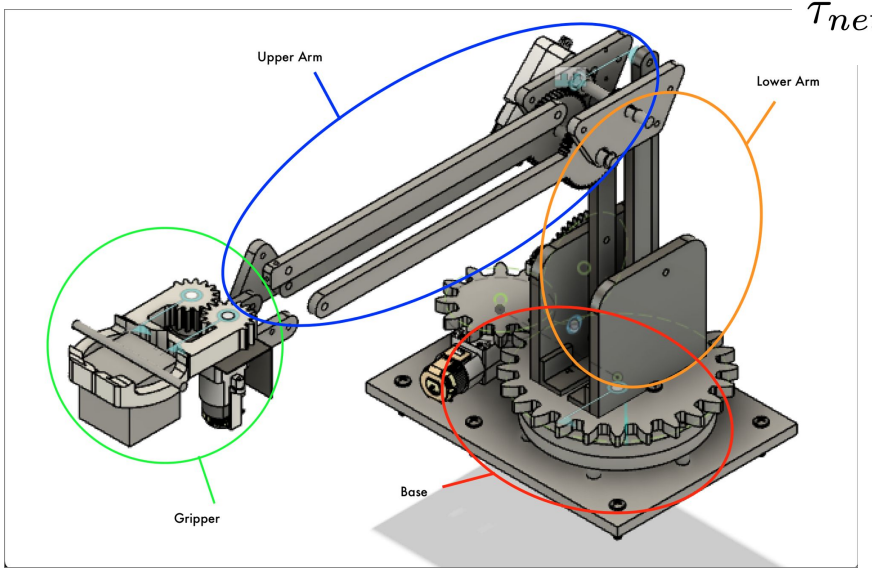
Roger

Speed Analysis of Upper Arm



- **Objective**: find the maximum angular velocity
- **Some Assumptions**:
  - Motor operates at no-stall torque (optimistic)
  - Linkages can be reduced to rectangular prism since they are symmetric along the midplane of the upper joint (conservative)

$$\tau_{net} = I\frac{d^2\theta}{dt^2}$$

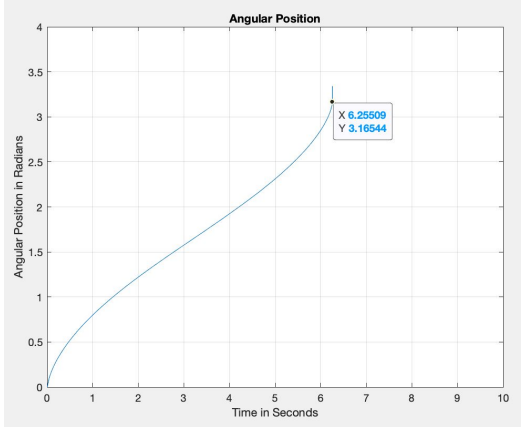


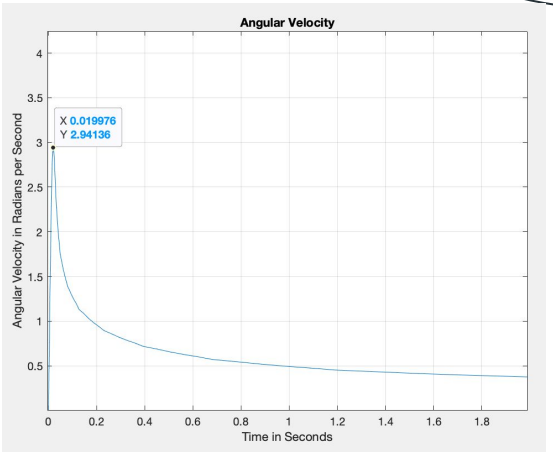
Bill

Nick

Speed Analysis Cont.

- **Calculated Values**:
  - 6.3 seconds for 180 degree rotation
  - maximum instantaneous angular velocity = 2.94 rad/s
  - average angular velocity = 0.5067 rad/s
- **Experimental Values**:
  - 3.7 seconds for 180 degree rotation
  - average angular velocity = 1.357 rad/s
- **Percent Error (respect to instant)**: 117%
- **Percent Error (respect to average)**: 167%
- **Factor of Safety**: 3.46
- **Potential Sources of Error**:
  - Human error
  - Rigid body too conservative





$$I\frac{d^2\theta}{dt^2} + \frac{C\rho(-0.0007453\theta^2 + 0.1341\theta + 0.6732)sin(\theta)}{2r_1}(\frac{d\theta}{dt})^2 - (\tau_{motor} - r_1 Mgsin(\theta) - r_2 m_b gsin(\theta)) = 0$$

Robot in Action

Our robot was able to score 70 points (2 boxes on the Top and Second floor) in 60s on its second attempt