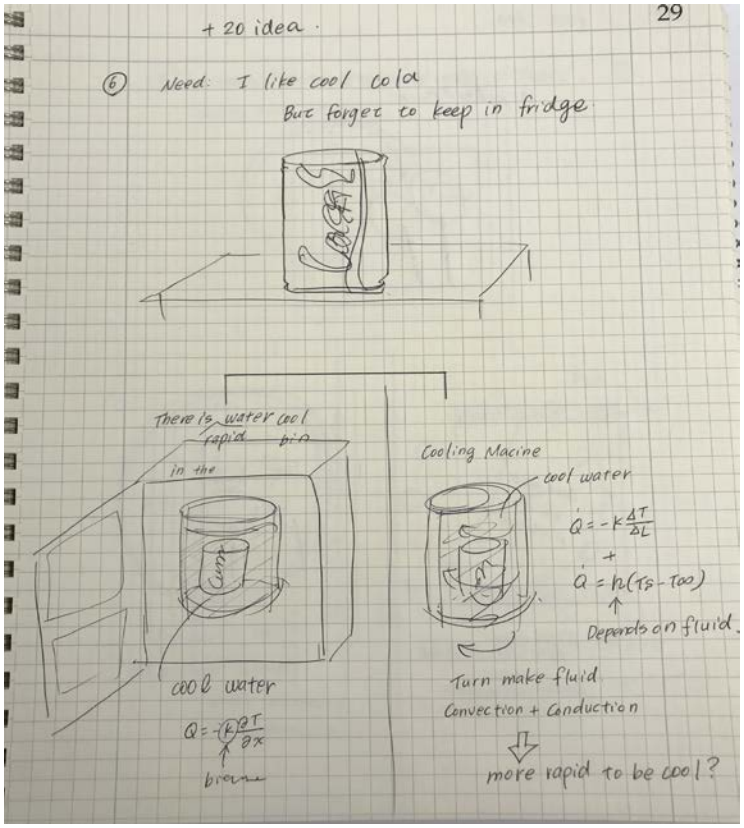
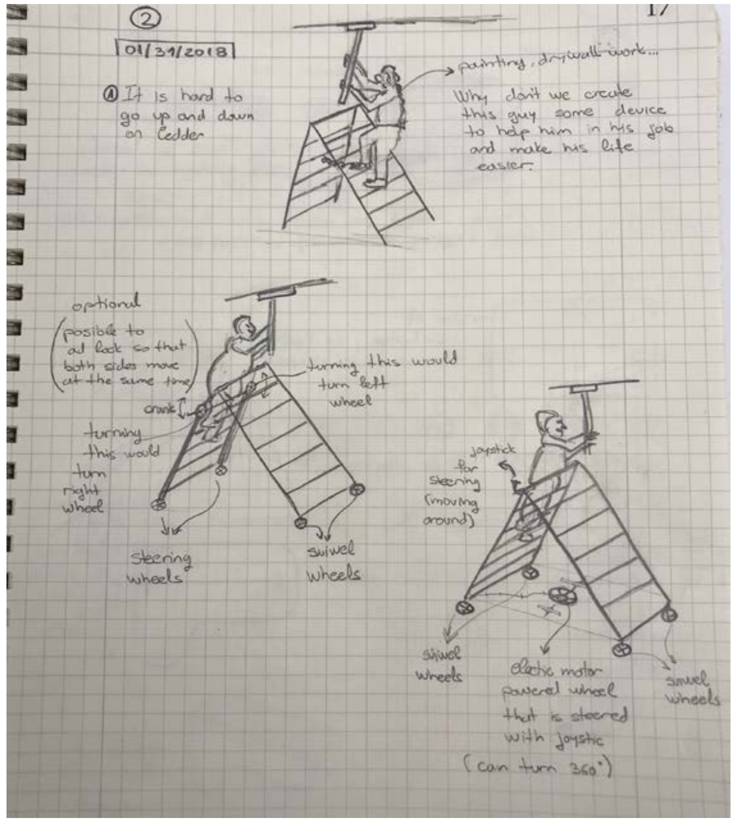
Kana and Jay

Idea: Fast Cooling



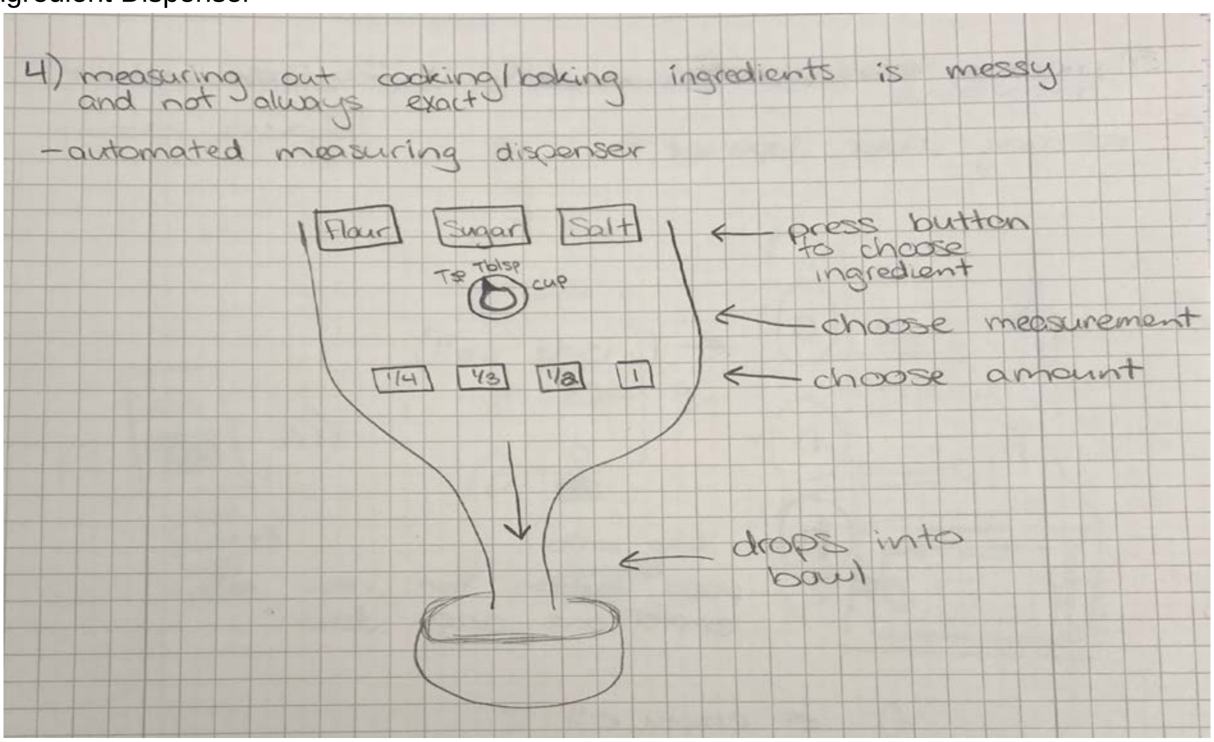
Ante

Idea: Motorized Ladder



Shannon

Idea: Ingredient Dispenser



3 Needs

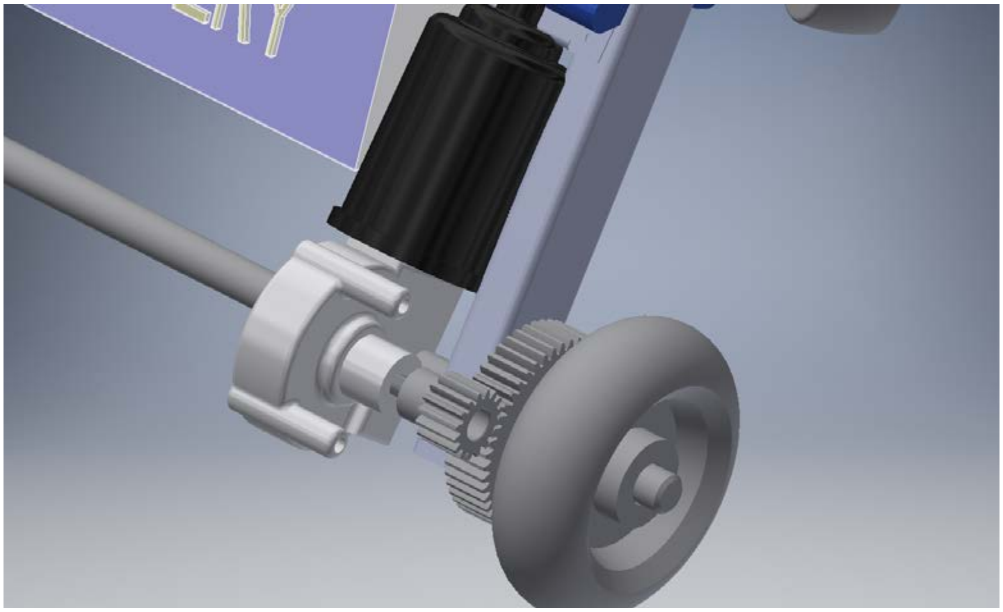
1. Waiting for something to cool down can take a lot of time (whole lunch hour).
    a. Functional Requirements
        i. Cold drinks: cool down 30 degrees Fahrenheit in 10-15 minutes
        ii. Hot drinks: cool down 30 degrees Fahrenheit in 5-10 minutes
    b. Potential Solutions
        i. Rapid air cooling
        ii. Rapid liquid cooling
    c. Analysis
        i. Cooling times
    d. Risks or Countermeasures
        i. Frozen beer and soda explode

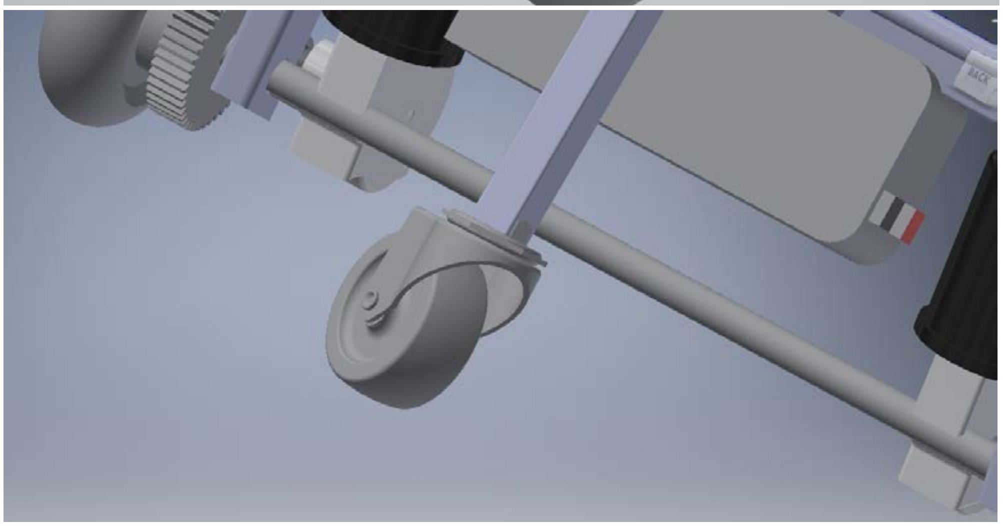
2. Going up and down a ladder is time consuming, tiresome, and dangerous.
    a. Functional Requirements
        i. Wheels must support 300 lbs combined (person and ladder)
        ii. Move 1 meter in 5 seconds
        iii. Turn 360 degrees in 10 seconds
    b. Potential Solutions
        i. Motorized ladder with wheels
    c. Analysis
        i. Test with step ladder
        ii. Torque
        iii. Wheel motor power
    d. Risks or Countermeasures
        i. Battery power
        ii. Electrical power
        iii. Could become unstable

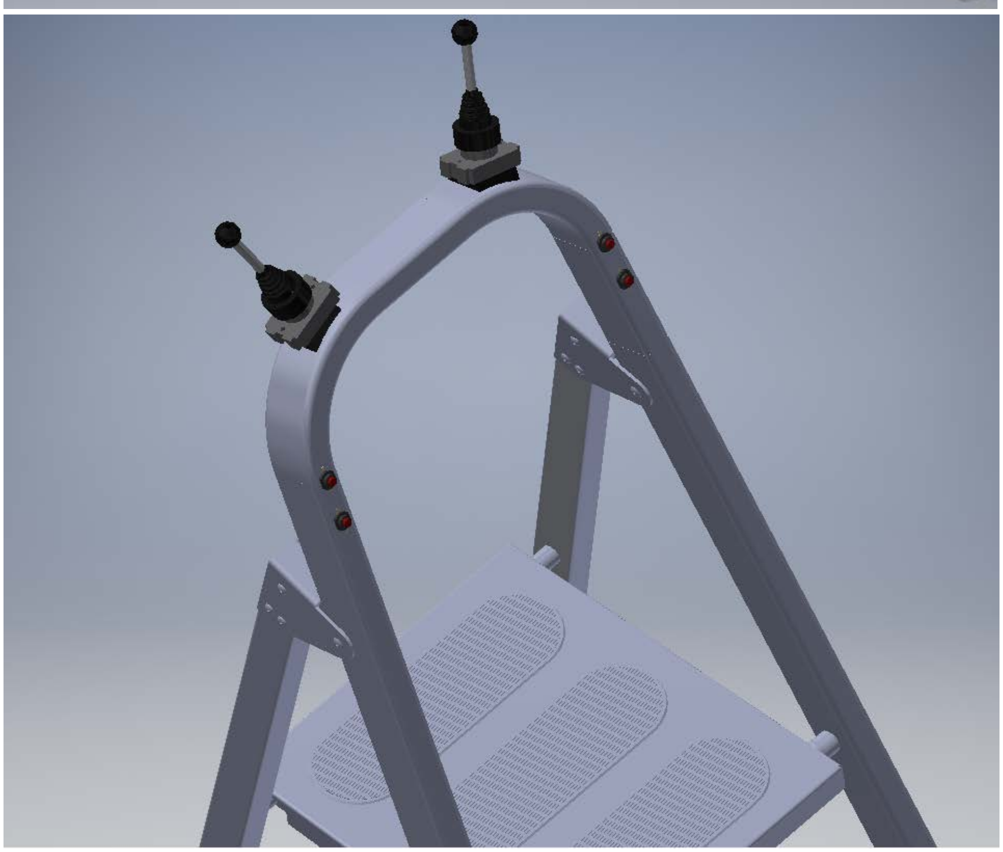
3. Measuring out ingredients is messy and not always accurate.
    a. Functional Requirements
        i. Dispense ingredients in 3 - 5 seconds
        ii. Dispense amount accurately and consistently
        iii. Possible liquid and solid dispensing
        iv. Something to show how much remains in the reservoir
    b. Potential Solutions
        i. Ingredient Dispenser
    c. Analysis
        i. Volume
        ii. Mass
        iii. Mechanical designs
    d. Risks or Countermeasures
        i. Not accurate
        ii. Parts cold get stuck or jam
        iii. Ingredients could get stuck
        iv. Sugar is sticky if comes into contact with liquids

Fast Cooling was abended as idea and team continue with Motorized Ladder and Ingredient Dispenser

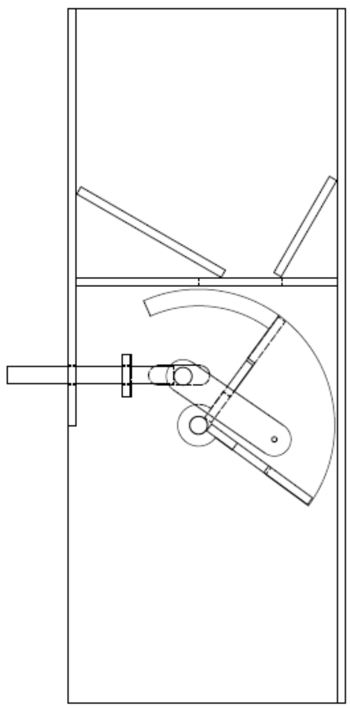
1.Motorized Ladder (first model)

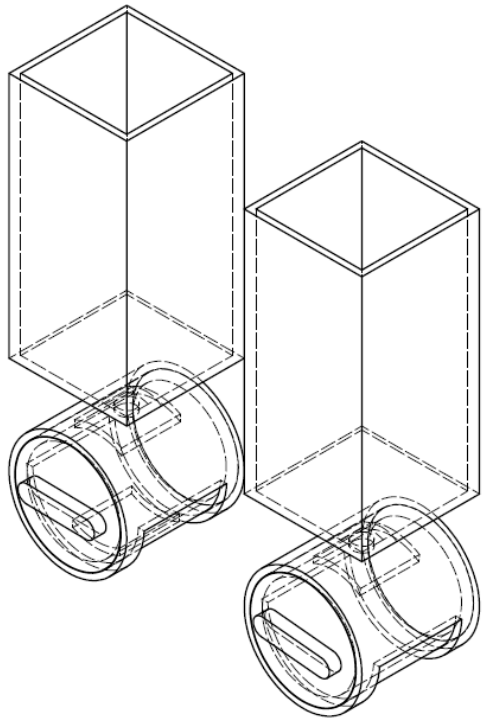


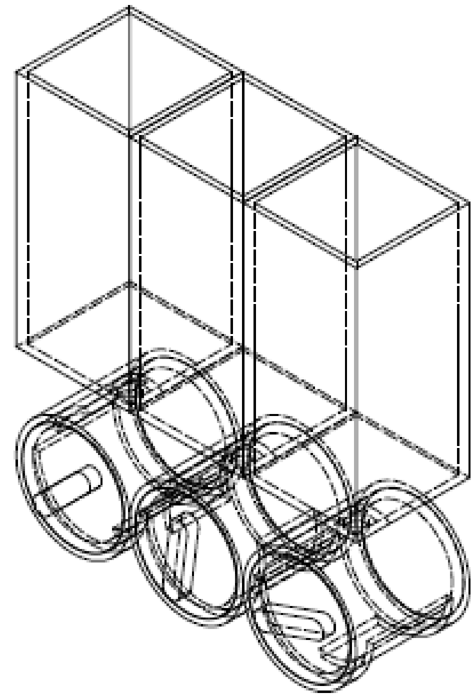


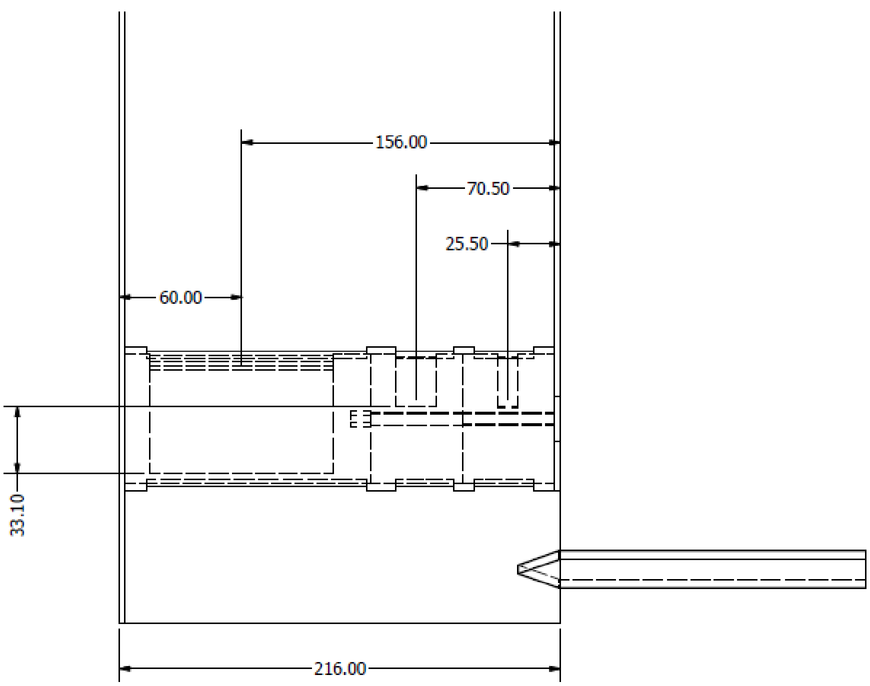


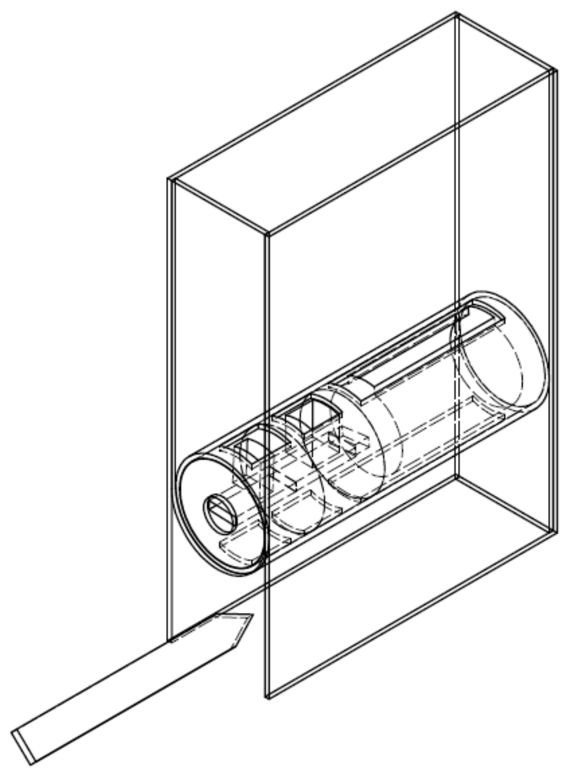
2. Ingredient Dispenser (first model)









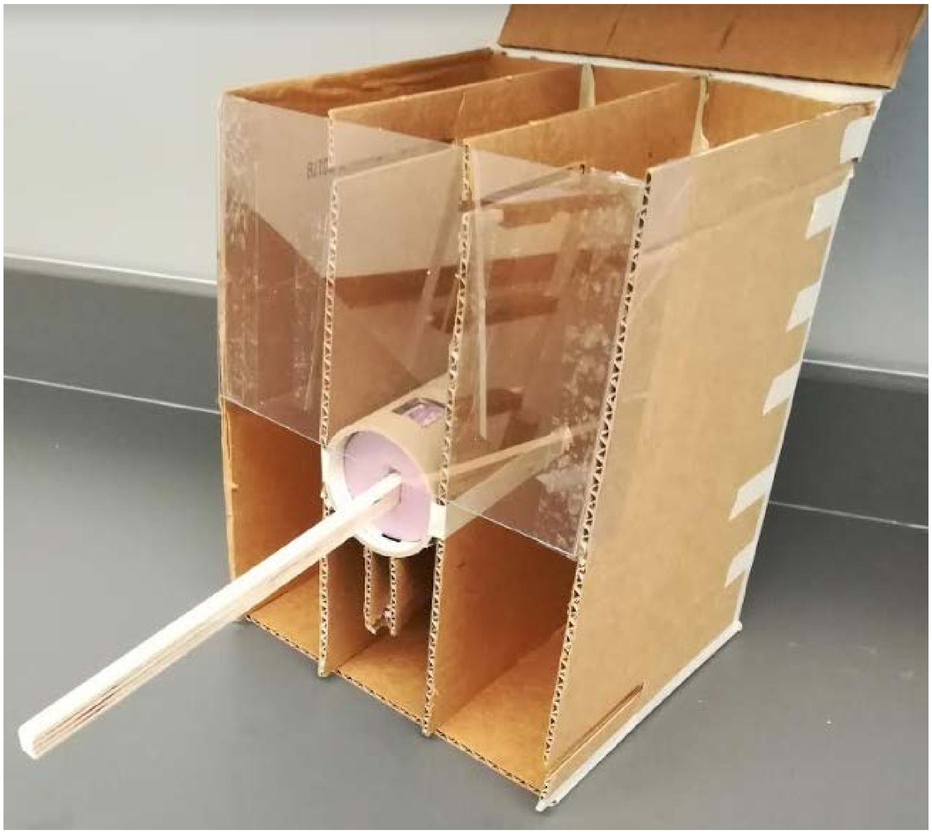


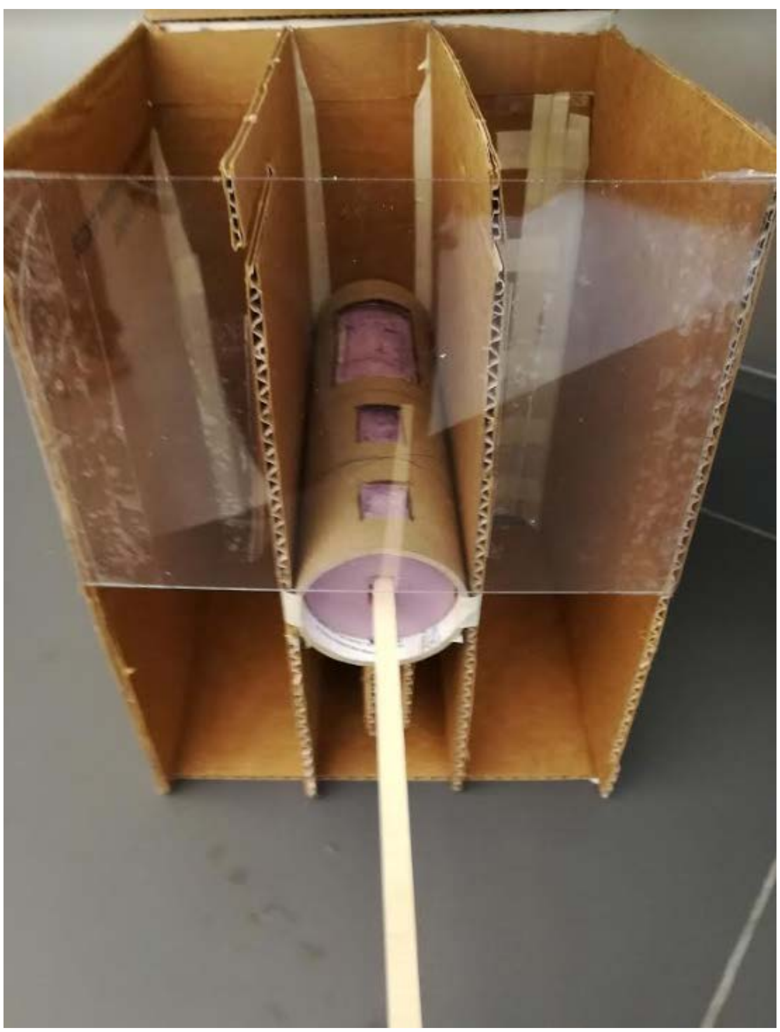
Sketch Model of Motorized Ladder





Sketch Model of Ingredient Dispenser





On 8th week team concluded that dispenser wins, and team continue to develop it as final project

Lab Week 8 3-2-18

- Narrow down to one idea: vote

ladder	dispenser
III	III

- talk to Vural about ideas
  pros + cons of both ideas
  develop dispenser idea further

- another vote

ladder	dispenser
II	III

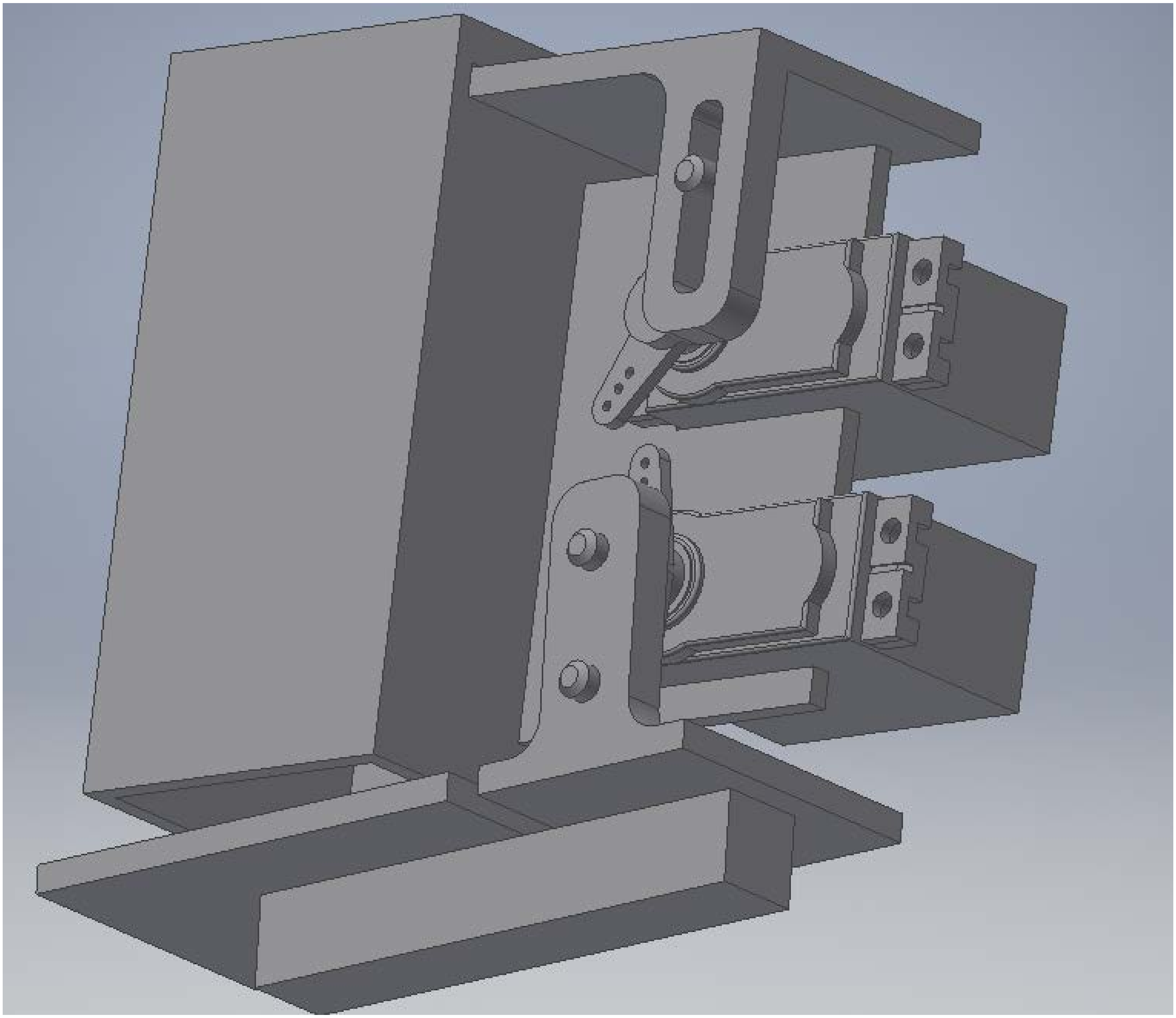
→ dispenser wins

- tasks:
  - 3D Model → Kana + Ante
  - weight/volume analysis → Shannon
  - research motors → Joe + Jay
  - research weight sensors → Joe
  - materials → Abe + Shannon
  - coding examples → Shannon + Jay

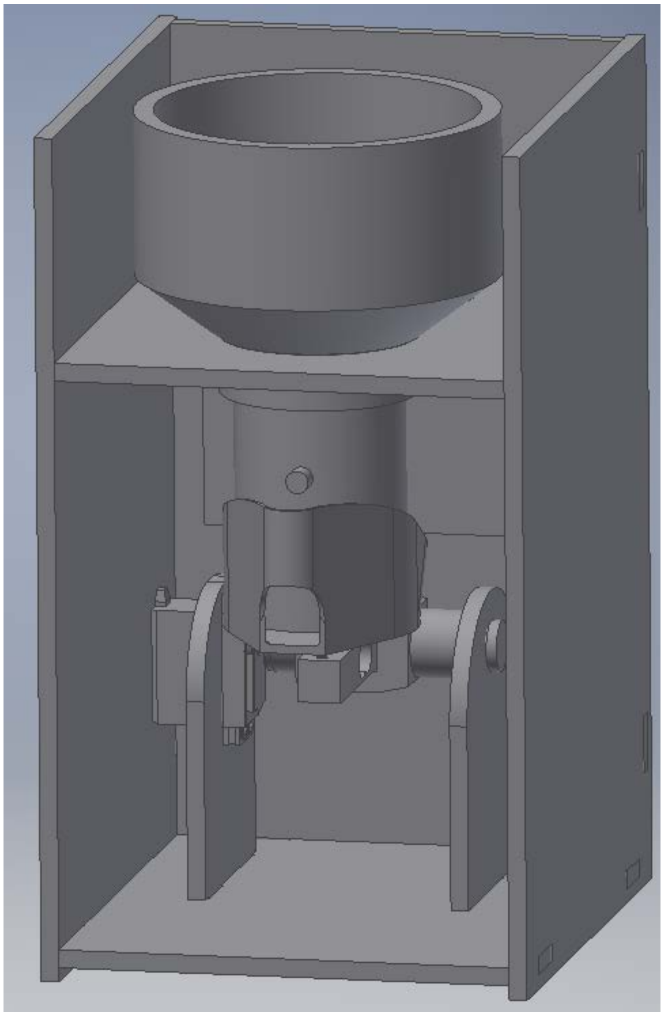
- complete tasks by monday (3/5) meeting

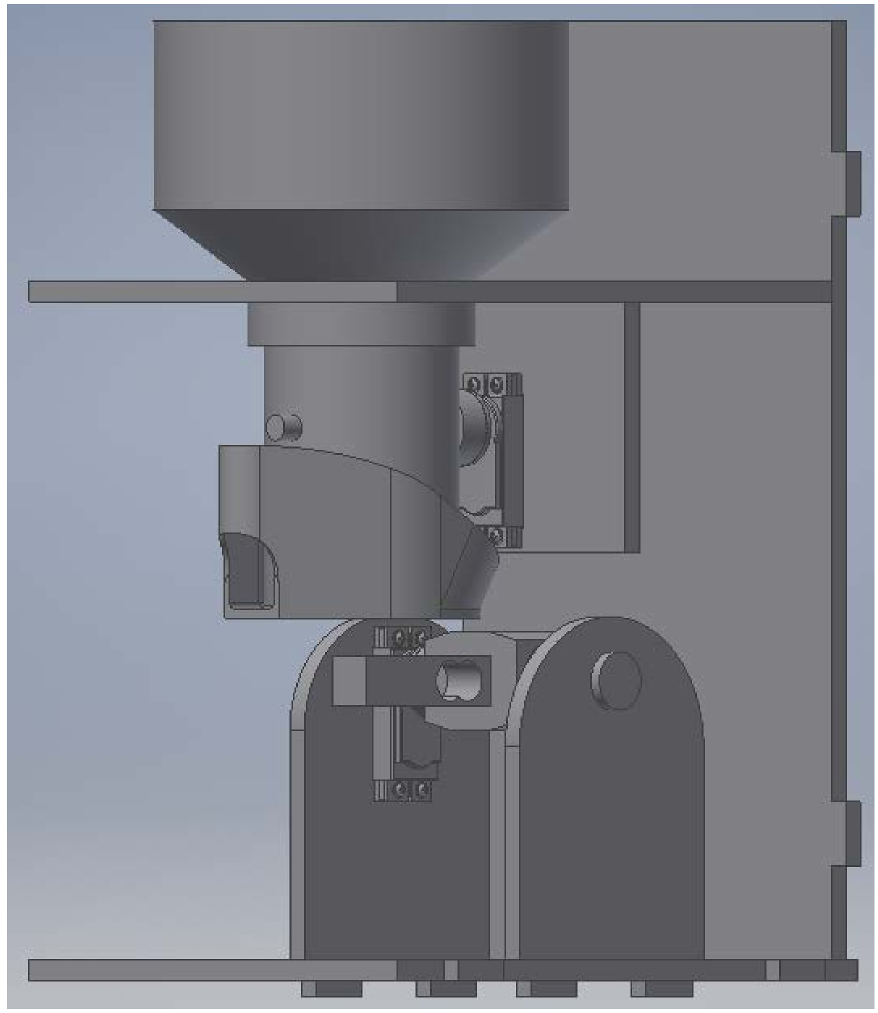
- Spring Break Meeting?
  yes from everyone
  need to see if IDEA Shop is open

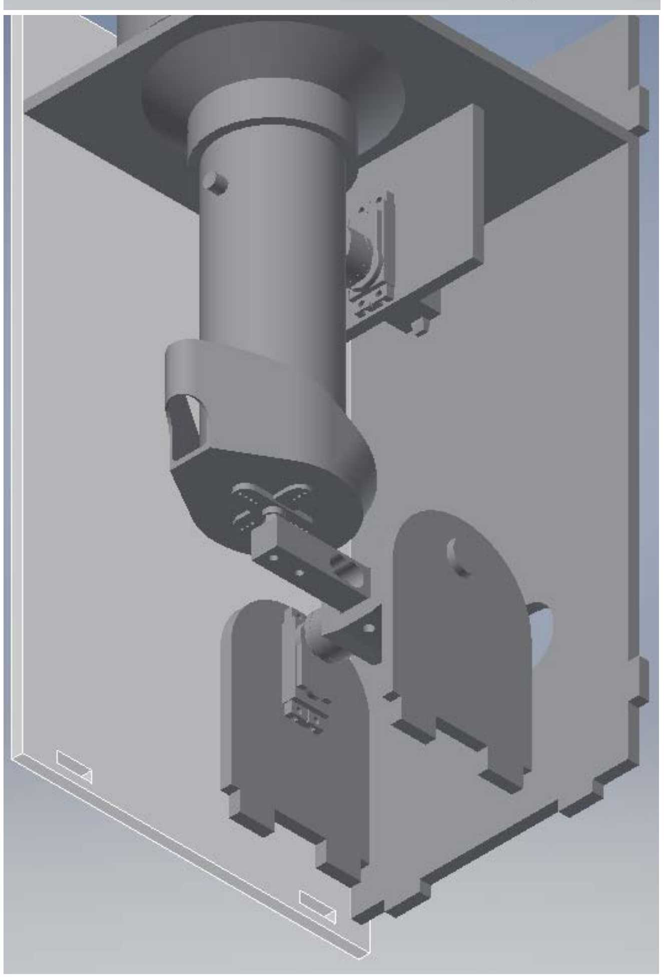
Week #10 (Kana's model)

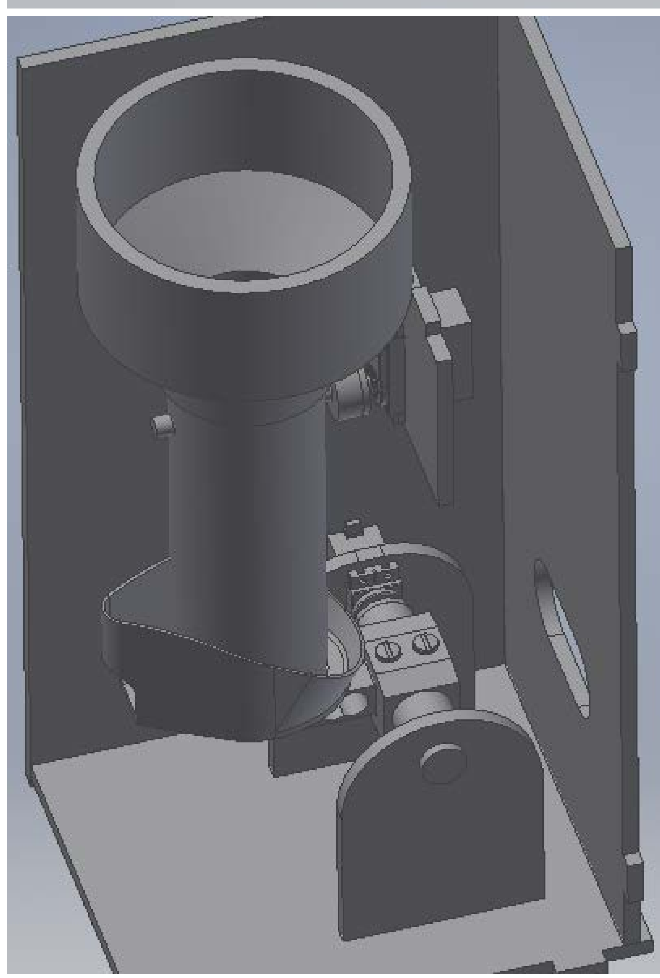


2nd model (Ante's model, team voted to be fabricated)

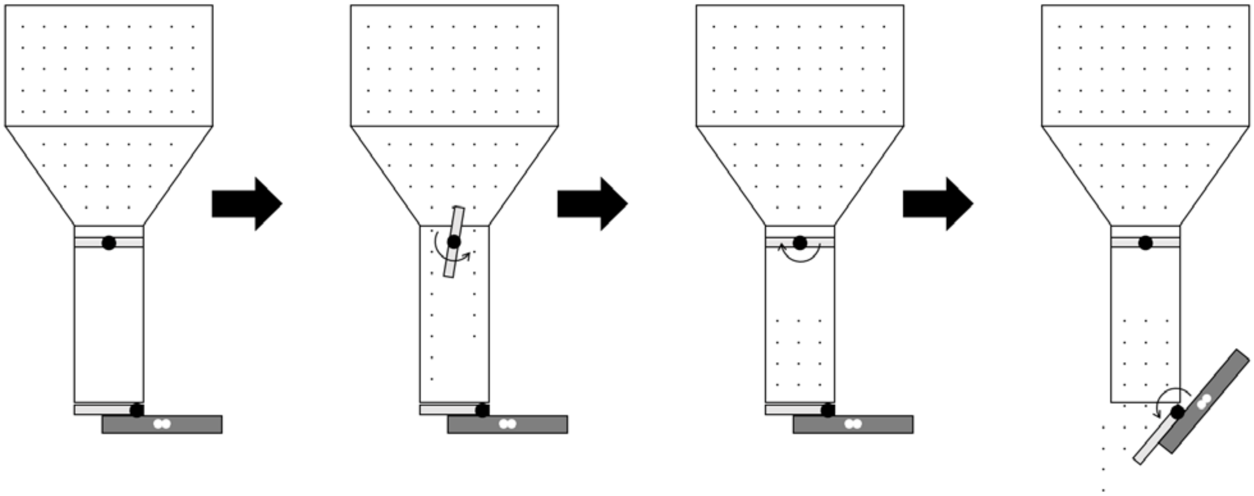








Functional Model Analysis



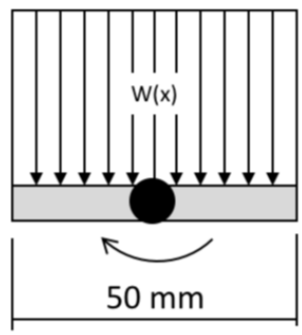
Upper Servo Torque Analysis

$w(x) = w < x - 0 >^0 + w < x - 25 >^0$
$V(x) = w < x - 0 >^1 + w < x - 25 >^1$
$M(x) = 0.5w < x - 0 >^2 + 0.5w < x - 25 >^2$

$M(25) = 0.5w < 25 >^2 = 312.5w < 350\ Nmm$
$w < 1.12\ N/mm$

Let $w = 1\ N/mm$
$W_{total} = (1 \frac{kg\ m}{mm\ s^2})(50mm)/(9.8\ \frac{m}{s^2})$=5.1 kg

Maximum ingredient weight in the dispenser is 5.1 kg



Torque Analysis
Servo $\tau = 350\ N \cdot mm$ according to specification

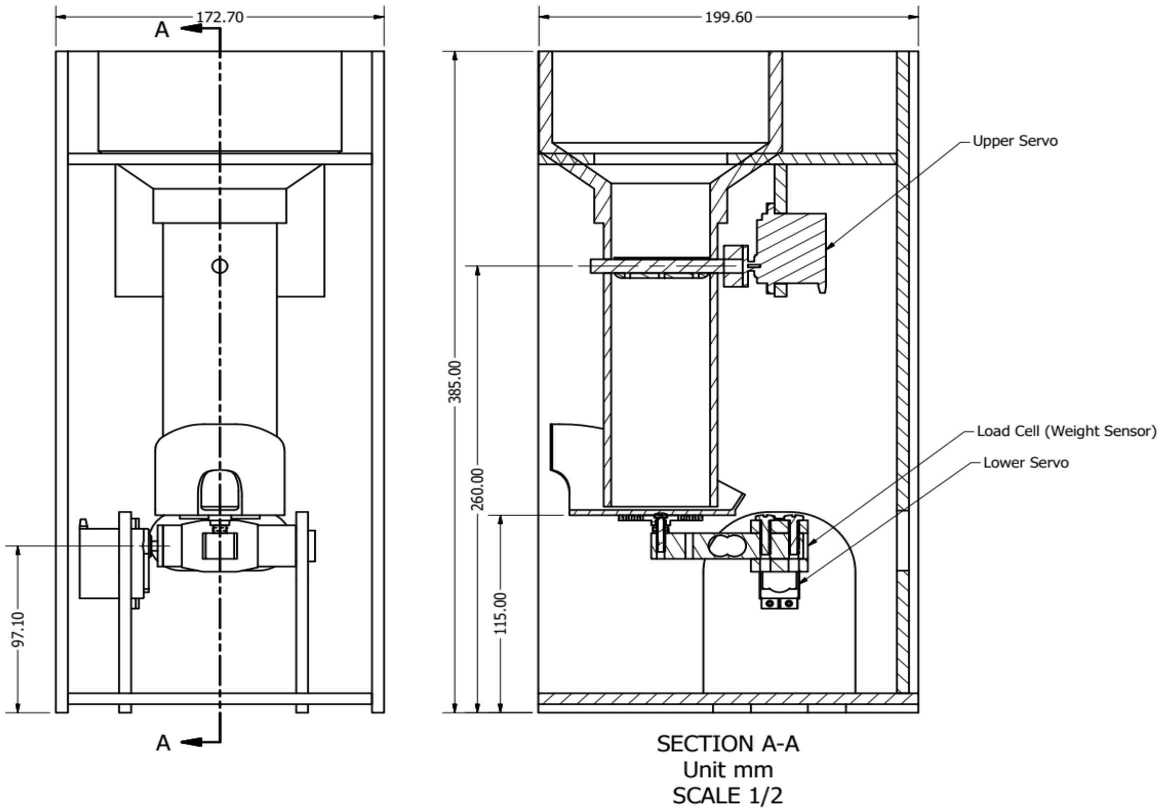
Lower Servo Torque Analysis
Find maximum distance from the servo to the dispenser

Theory
$350\ Nmm = (0.2)(9.8)x$
$x = 178\ mm$ maximum distance from the servo to the dispenser

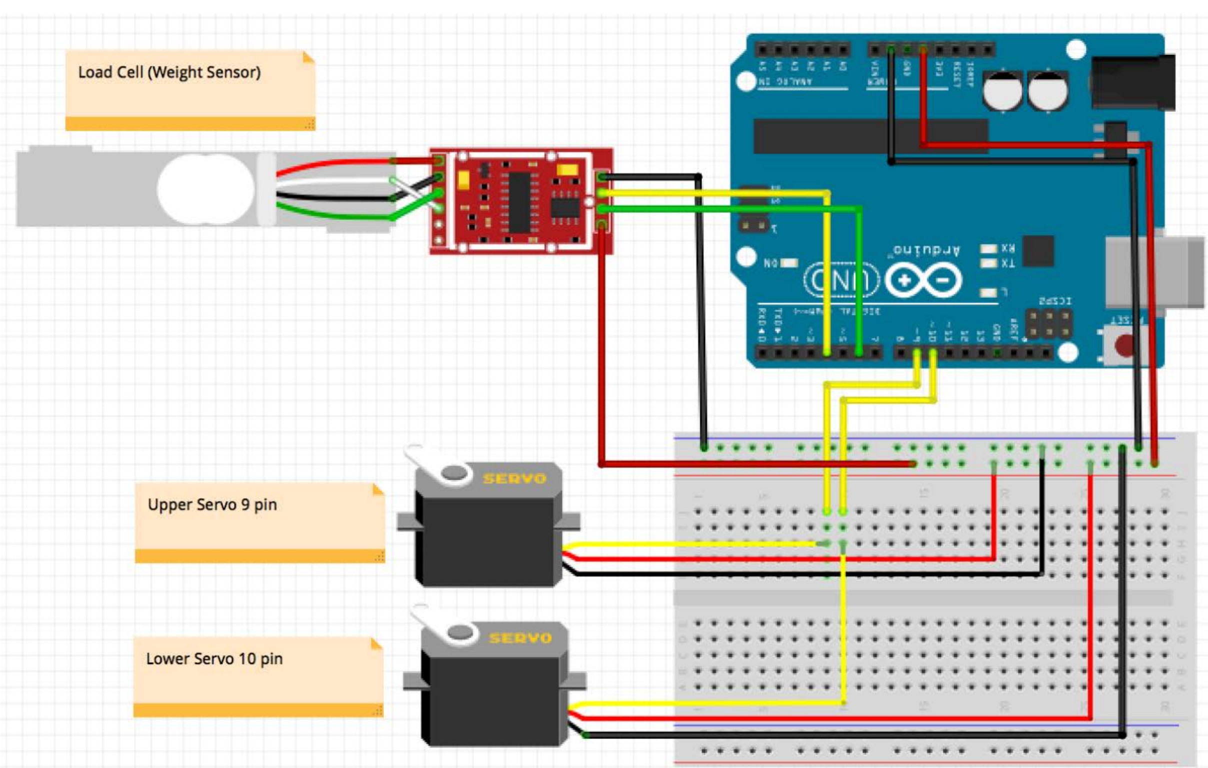
Actual
$x = 62.5\ mm$ distance from the servo to the dispenser

$62.5\ mm < 178\ mm\ OK$

Mechanical Components



Electrical Components



Load Cell:

Features

- Product name: load Cell; model: yzc-133; rated load: 10kg /22lb; rated output: 1+/-0. 15mV/V
- Input resistance: 1066 +/- 20 Ohm; output resistance: 1000 +/- 20 Ohm; insulation resistance: 2000 Ohm; working temperature: -20C to +65C
- Compensated temperature range: -10C to +50C; Safety overload: 120 percent F. S; recommend excitation Voltage: DC 5V; max excitation Voltage: DC 10V
- Total Size: 81 x 12. 5 x 12. 5mm /3. 1" x 0. 5" x 0. 5" (L*w*t); thread diameter: 3. 4mm / 0. 12"; Hole center distance: 40mm/1. 6", 70mm/2. 8"; cable Length: 240mm/ 9. 4"
- Material: aluminum alloy; color: Silver Tone; weight: 32G; package content: 1 x load Cell

Servos:

HS-425BB DELUXE SERVO

SPECIFICATIONS

- Dual Ball Bearing
- Indirect Drive
- Hitec Custom I.C.
- Operating Speed : 0.21sec/60° AT 4.8Volt
- Output Torque : 3.3kg.cm(46oz.in) AT 4.8Volt
- Weight : 45.5g(1.6oz)
- Size : 40 X 20 X 36mm (1.59 X 0.77 X 1.44)"

PARTS & ACCESSORIES

#56334 : Resin Gear Set
#56339 : Servo Case Set
#56315 : Horn Set
#56336 : Hardware Set
#57342 : "S" Type Servo Connector
#58471 : Ball Bearing
#58472 : Oilite Bearing

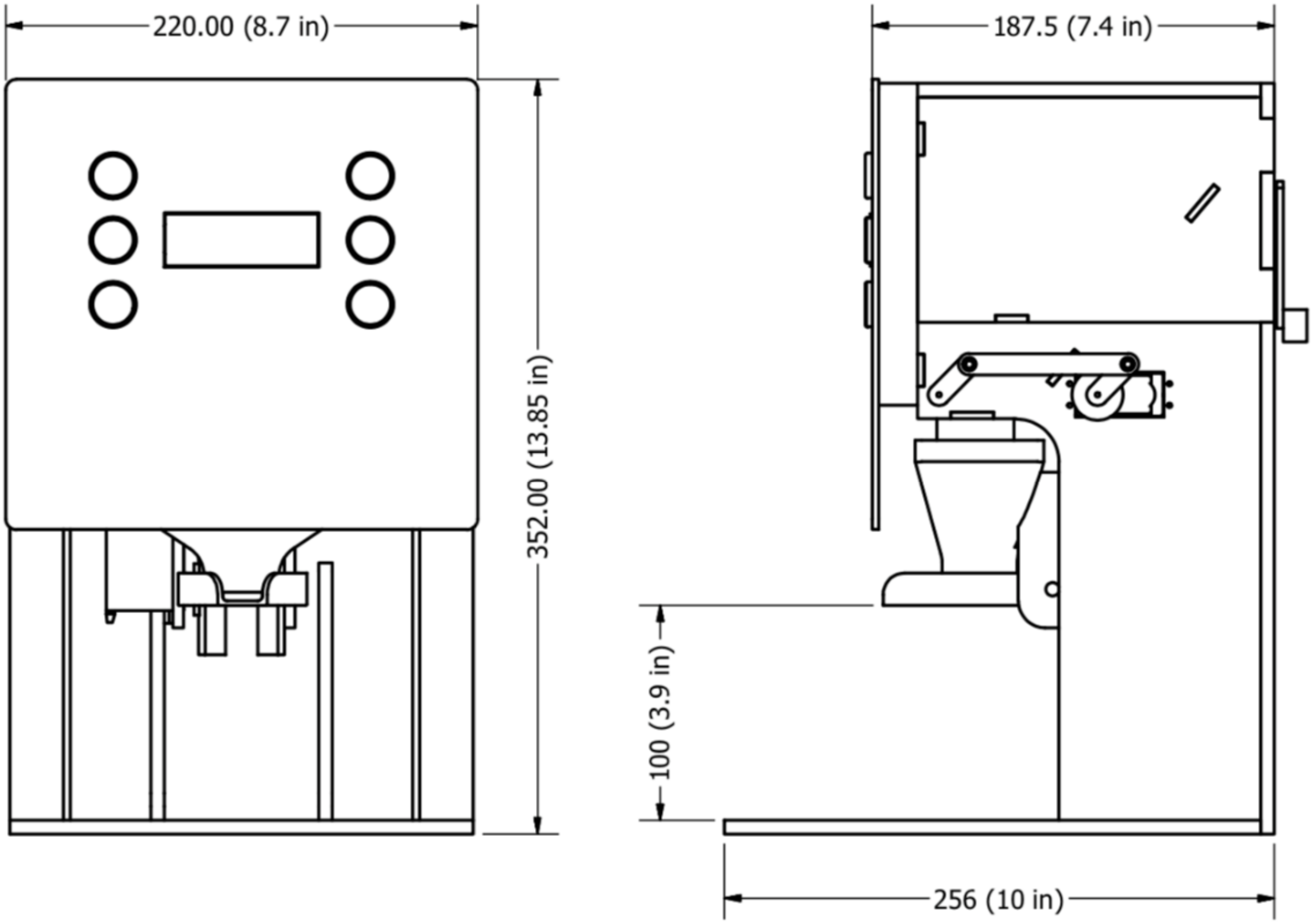
Arduino Uno:

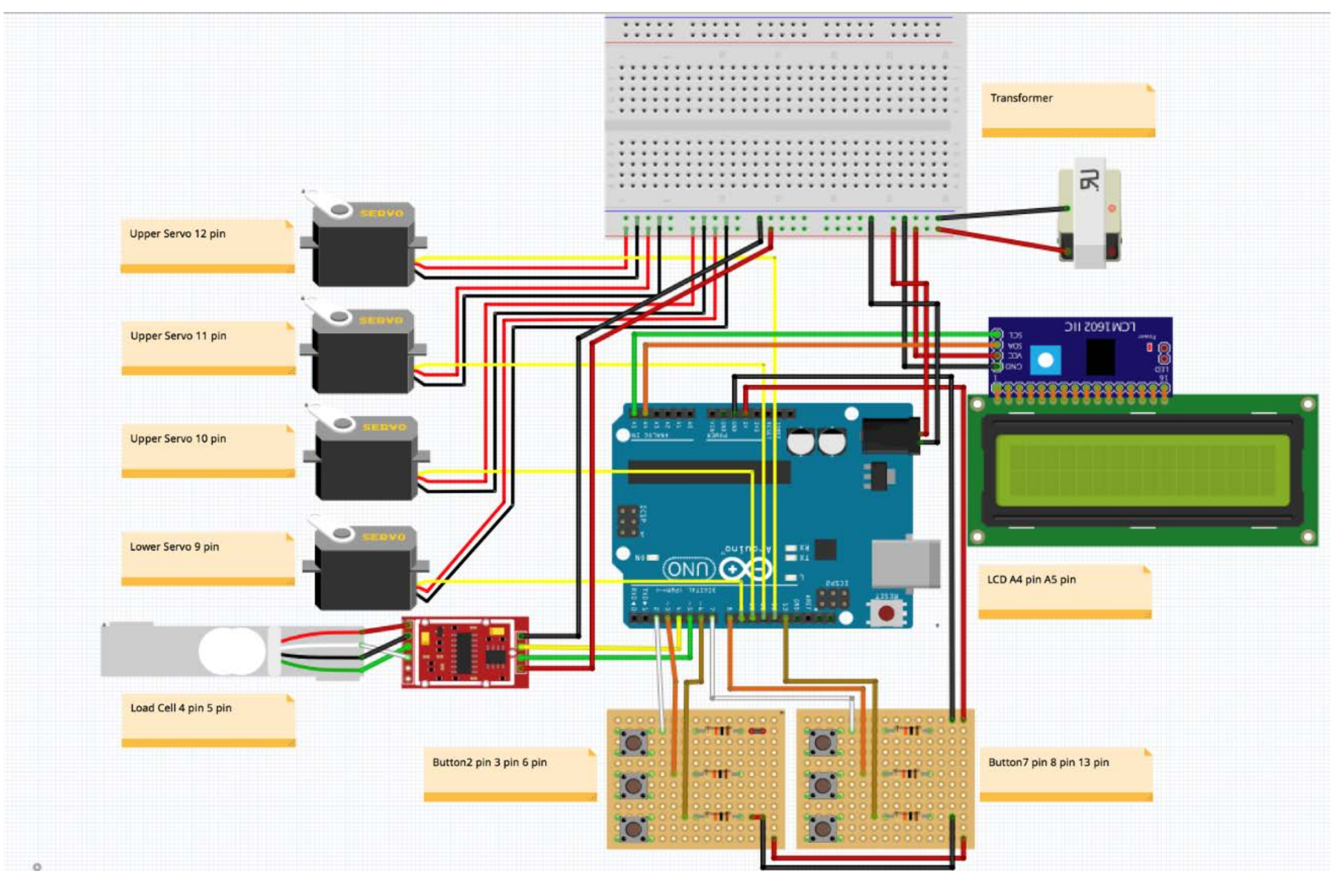
Features of the Arduino UNO:

- Microcontroller: ATmega328
- Operating Voltage: 5V
- Input Voltage (recommended): 7-12V
- Input Voltage (limits): 6-20V
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- Analog Input Pins: 6
- DC Current per I/O Pin: 40 mA
- DC Current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB of which 0.5 KB used by bootloader
- SRAM: 2 KB (ATmega328)
- EEPROM: 1 KB (ATmega328)
- Clock Speed: 16 MHz

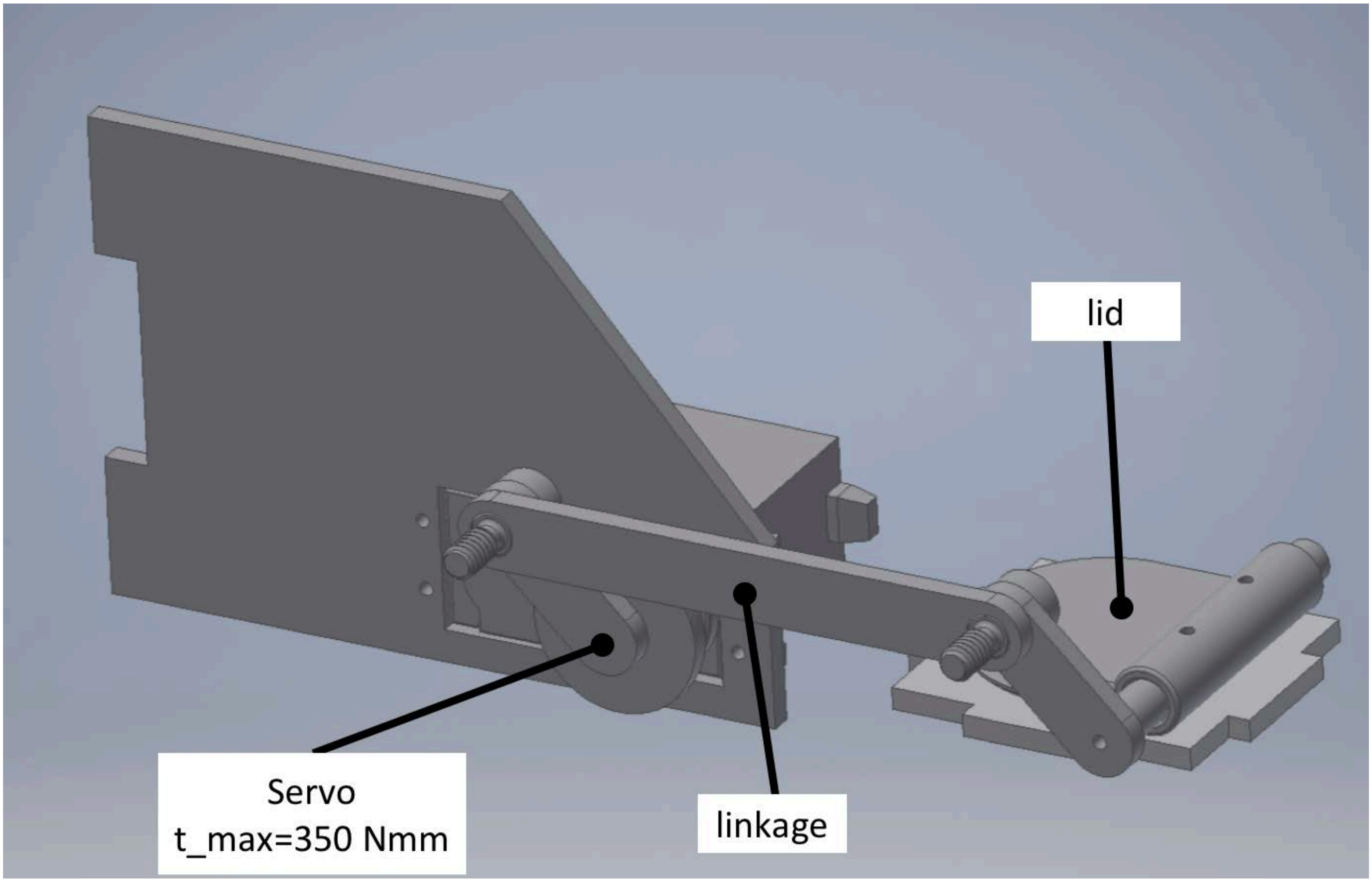
Printing Parts and Fabricating

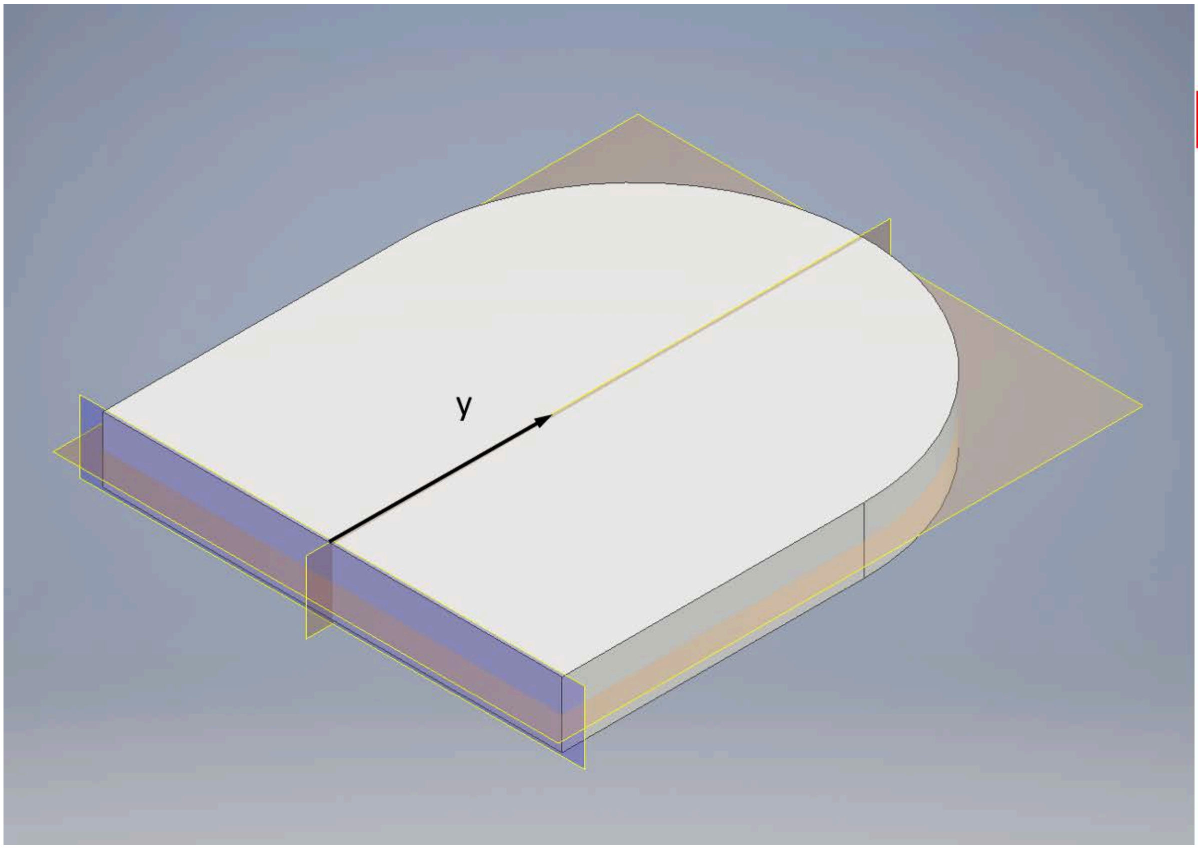
Final model (week #14)

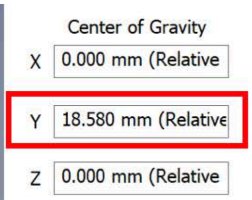


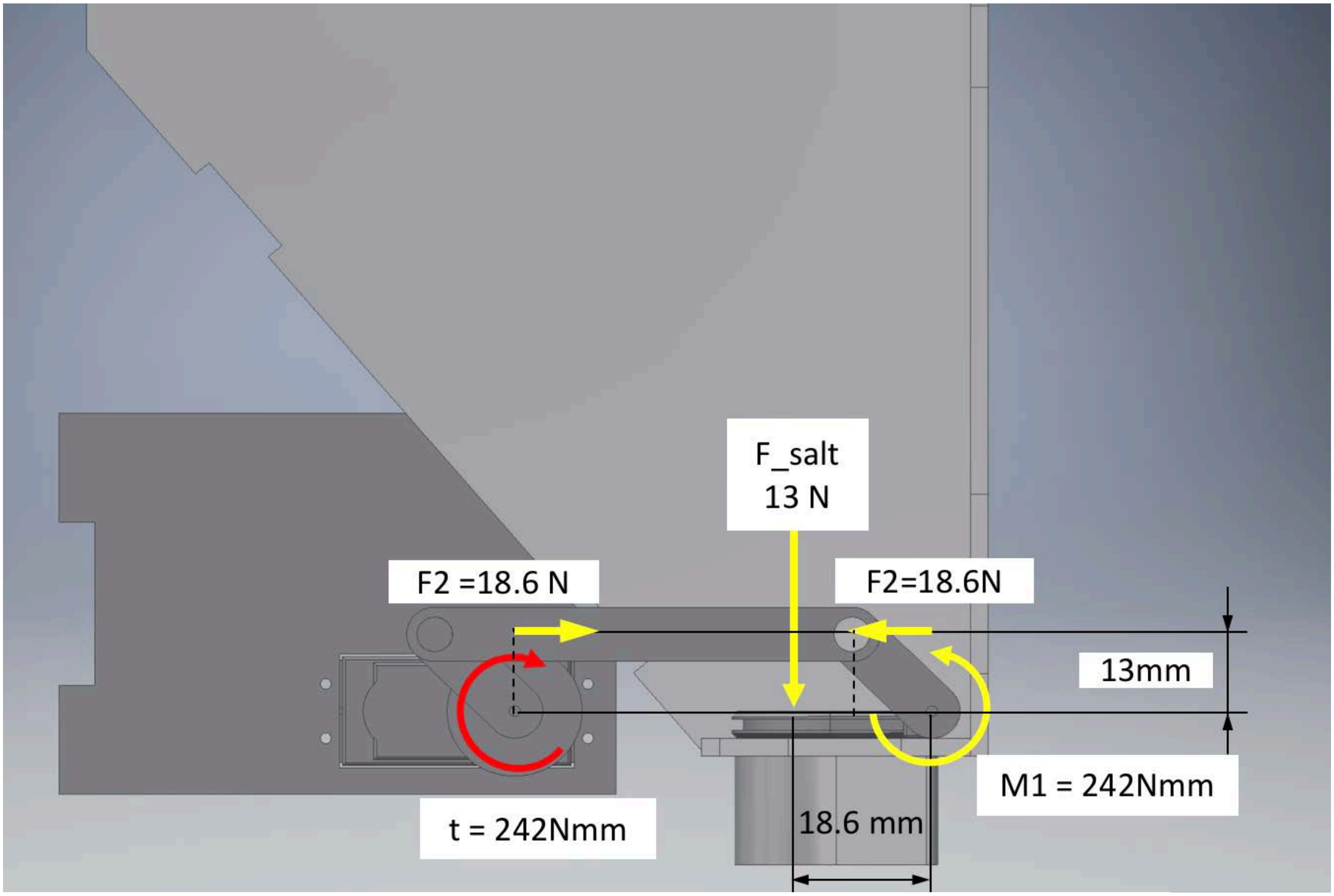


Torque Analysis #1









Torque Analysis 2

Step 1: Find the center of gravity

y1 = 18.60 mm: the salt's center of gravity from the y-axis
Y1 = 18.60 mm: the distance from the axis to the center of gravity

Step 2: Find the moment at the axis

F1 = (1.32 kg)(9.8 m/s^2) = 13 N
M1 = (13 N)(18.6 mm) = 242 Nmm

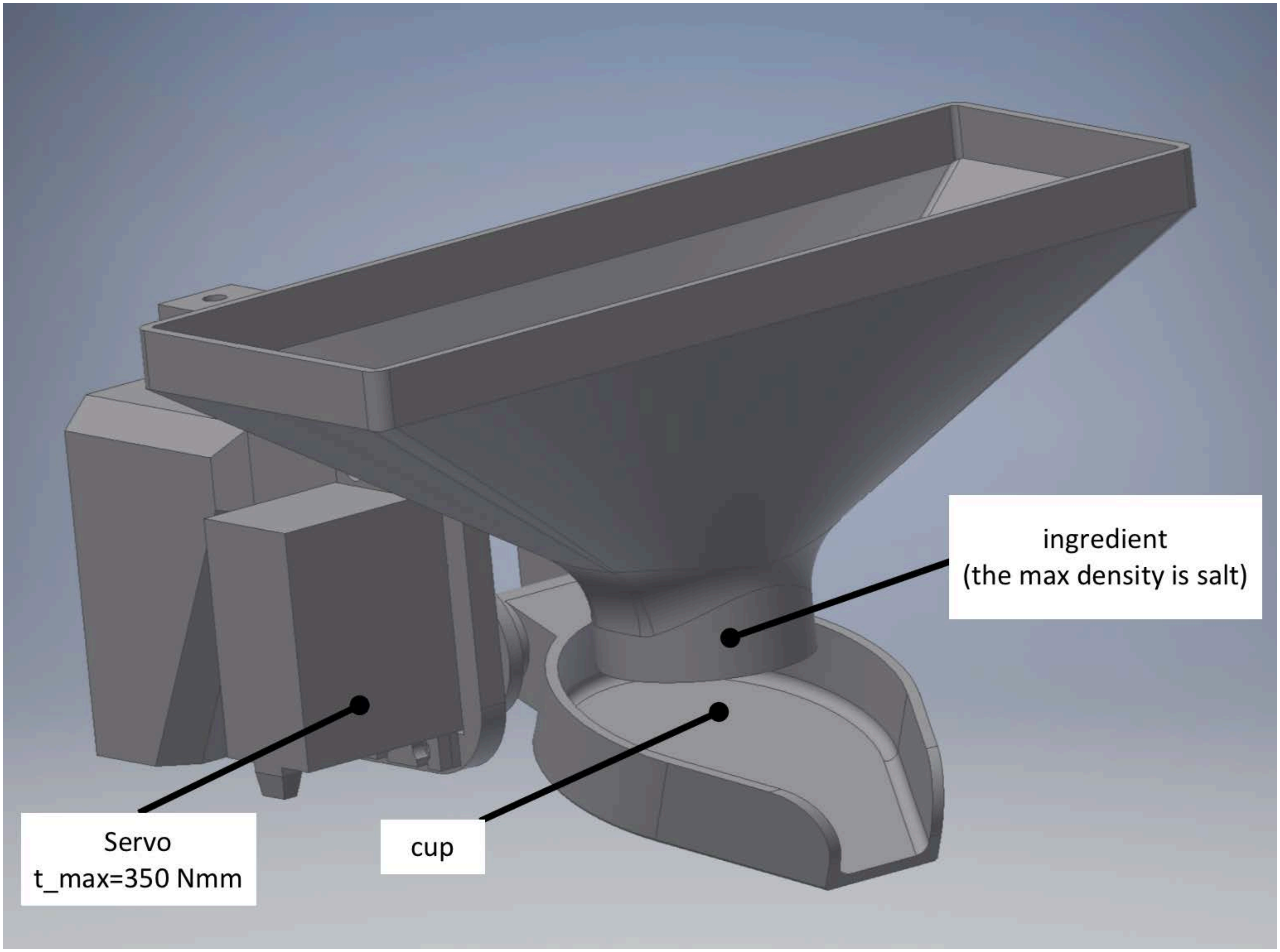
Step 3: Find the force at the linkage

242 Nmm = (F2)(13)
F2 = 18.6 N

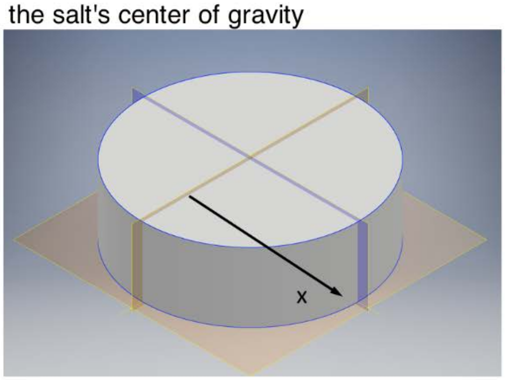
Step 4: Find the moment at the servo

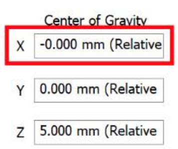
t = M2 = (18.6 N)(13 mm) = 242 Nmm < 350 N mm
n = 350 / 242 = 1.45

Torque Analysis #2

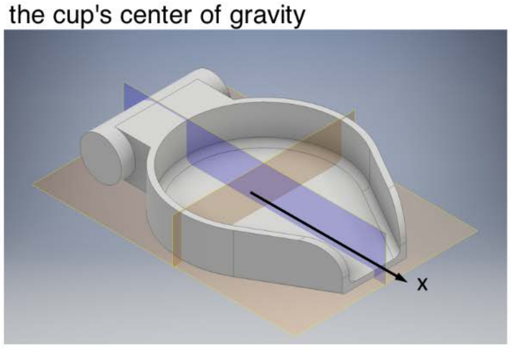


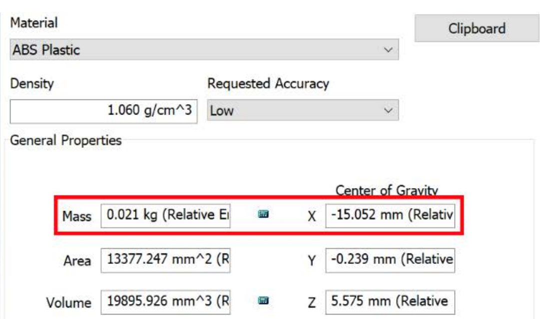
the salt's center of gravity

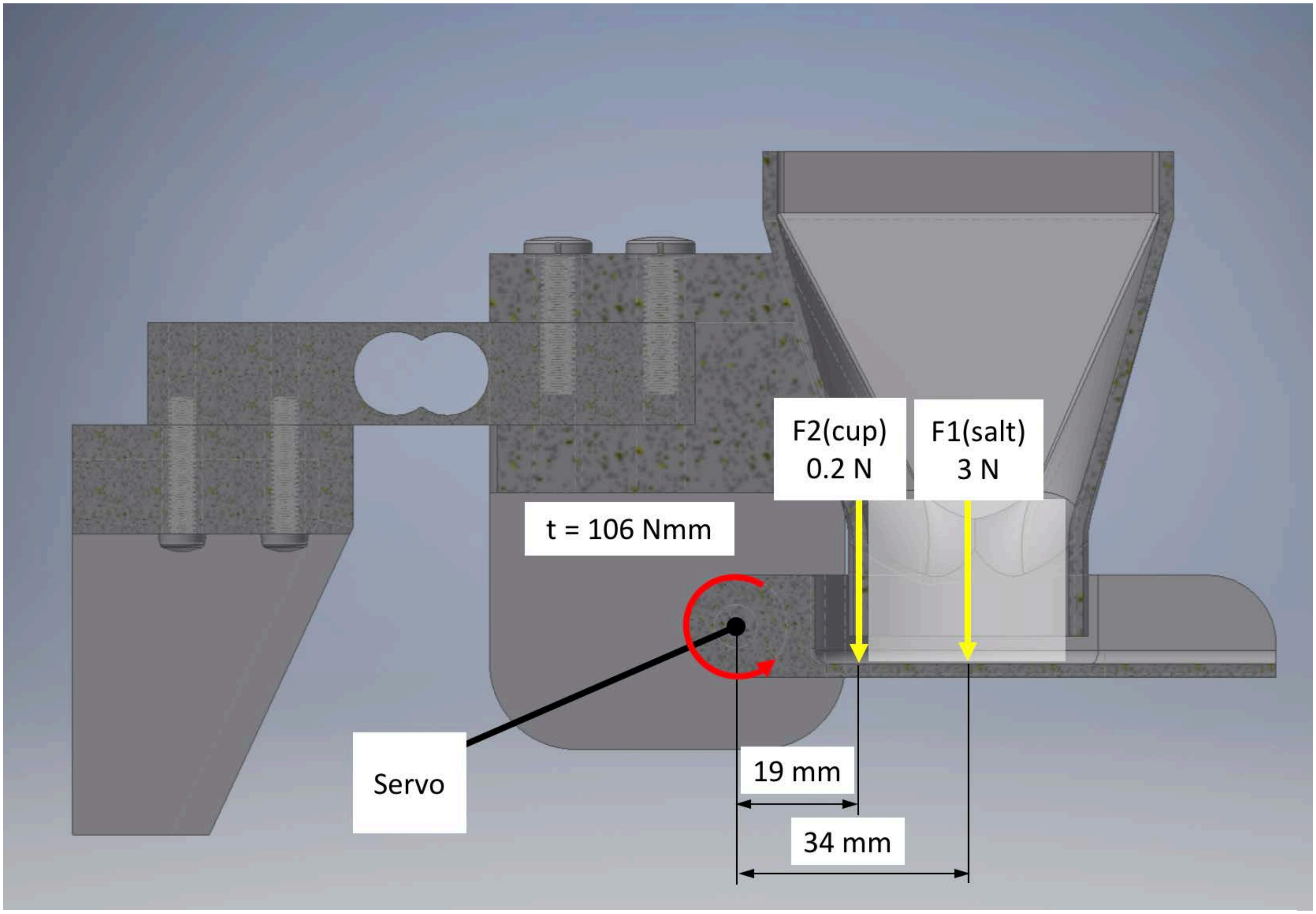




the cup's center of gravity







Torque Analysis 1

Step 1: Find the center of gravity

x1 = 0 mm: the salt's center of gravity from the x axis
X1 = 34 mm: the distance from the servo to the center of gravity

x2 = 15 mm: the cup's center of gravity from x axis
X2 = 34 - 15 = 19 mm: the distance from the servo to the center of gravity

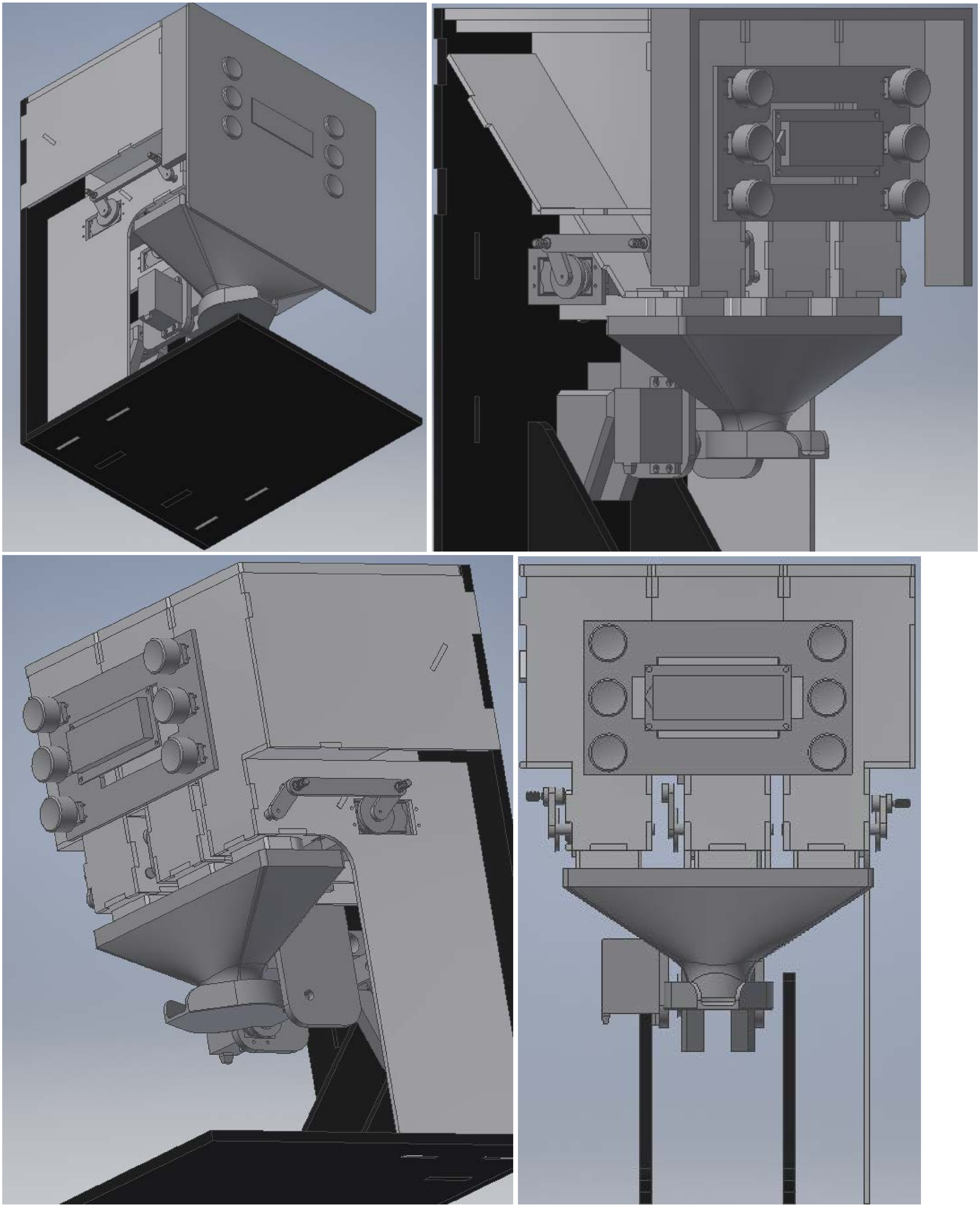
Step 2: Find the torque

F1 = (0.304 kg)(9.8 m/s^2) = 3.00 N
M1 = (3.00 N)(34 mm) = 102 Nmm

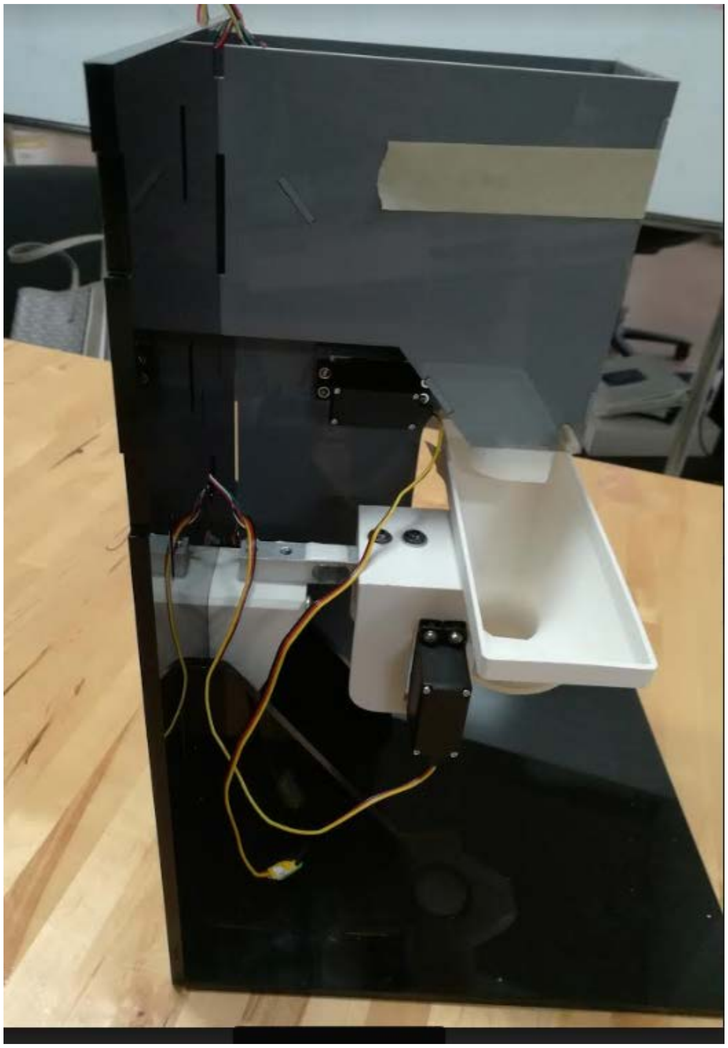
F2 = (0.02 kg)(9.8 m/s^2) = 0.2 N
M2 = (0.2 N)(19 mm) = 3.8 Nmm

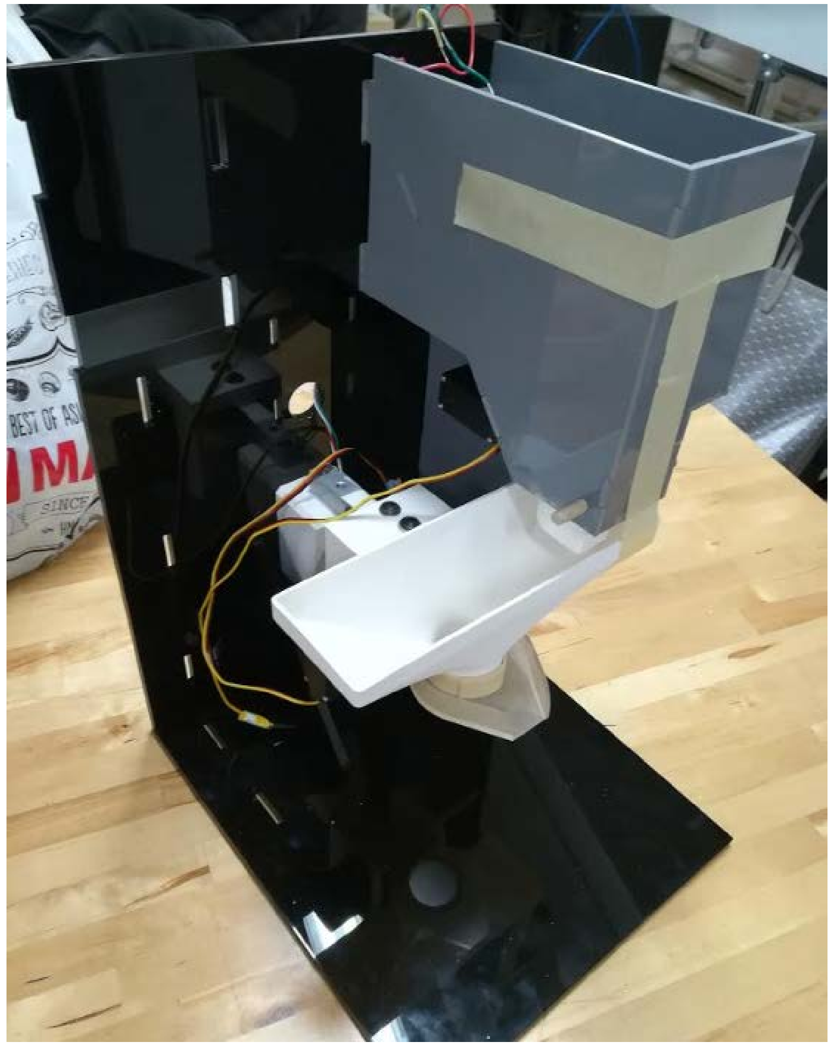
t = M1+M2 = 102 +3.8 = 106 Nmm < 350 N mm
n = 350 / 106 = 3.3

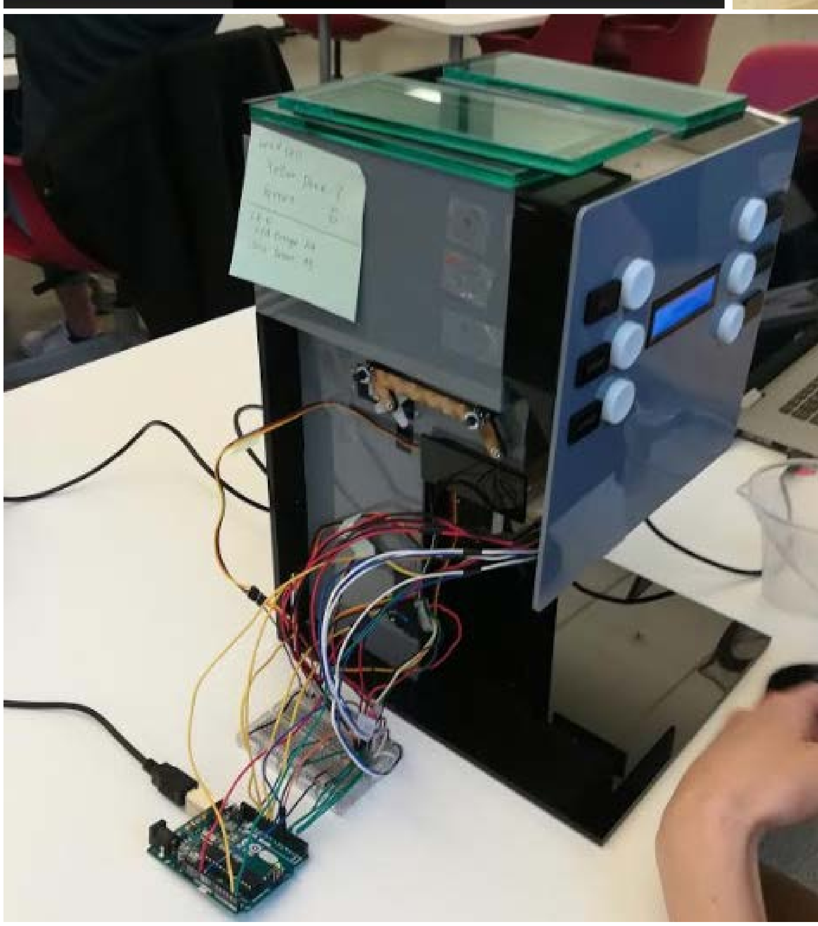
Alpha Model CAD Assembly

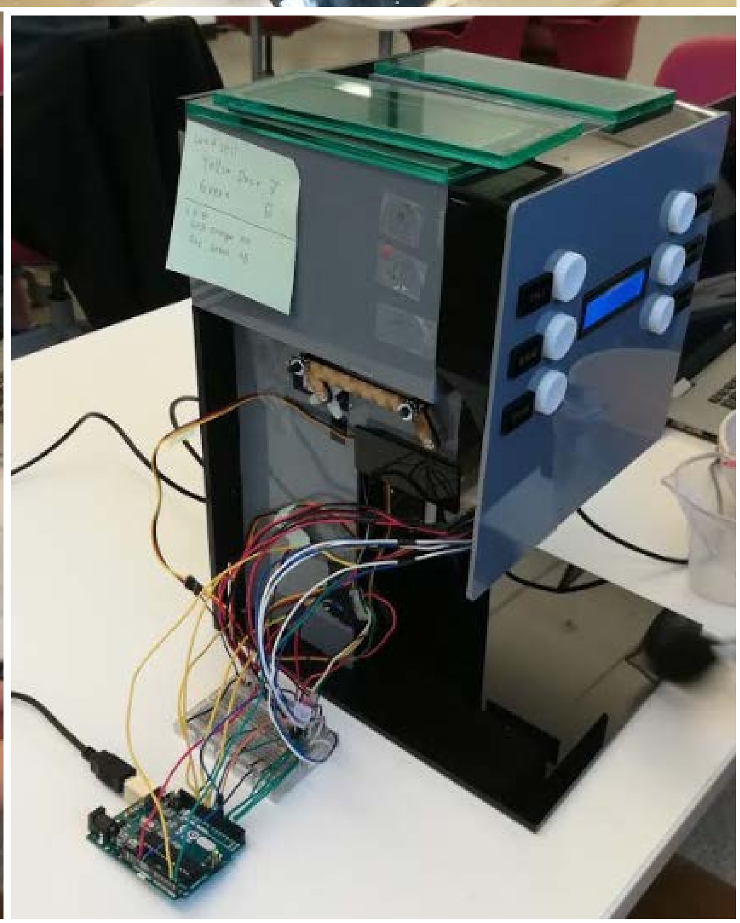


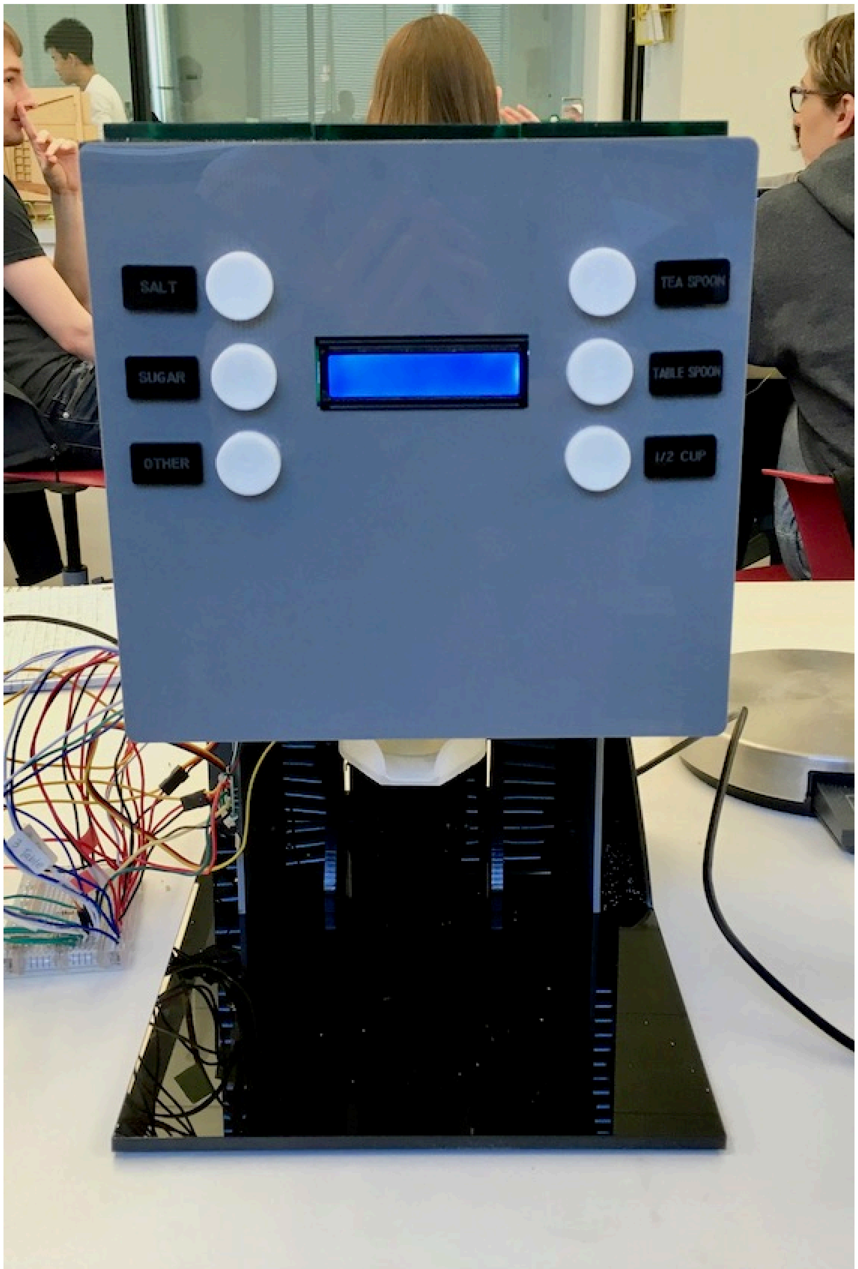
Alpha Prototype photos











- Results of the Testing We Did to Verify Our Design

Amount	1 tsp	1 tbsp	½ cup
Time (s)	7	9.3	16

Accuracy (% error)	1 tsp	1 tbsp	½ cup
Salt	2.41%	1.94%	1.62%
Sugar	4.2%	1.81%	0.95%
Couscous	3.54%	4.44%	2.02%