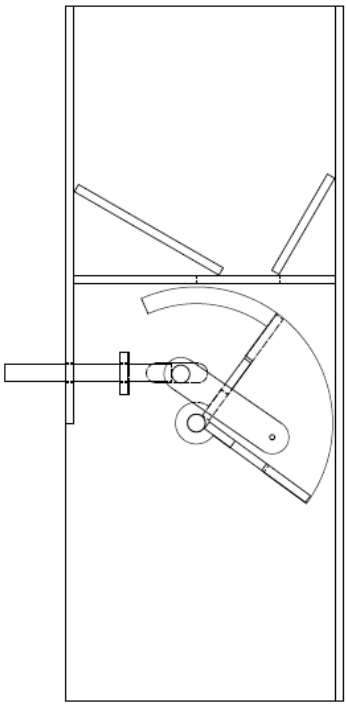
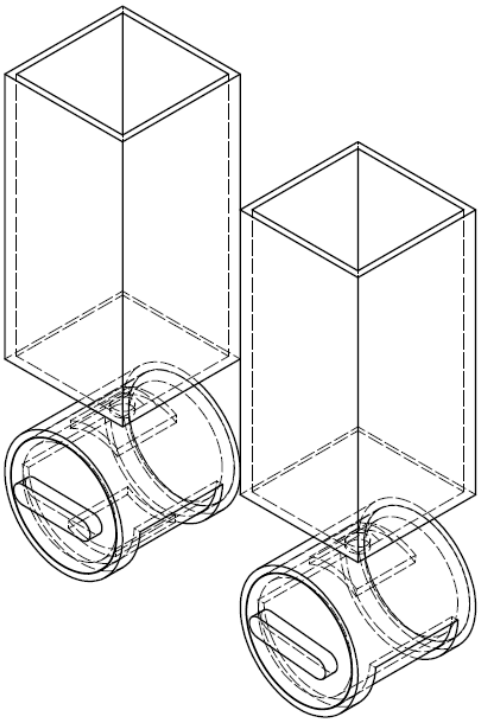
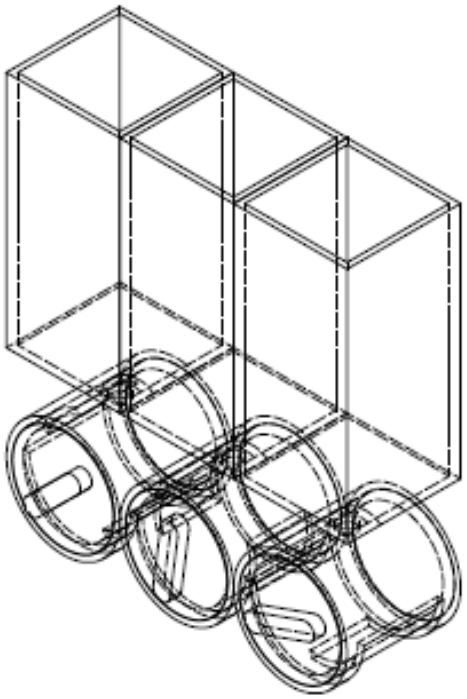
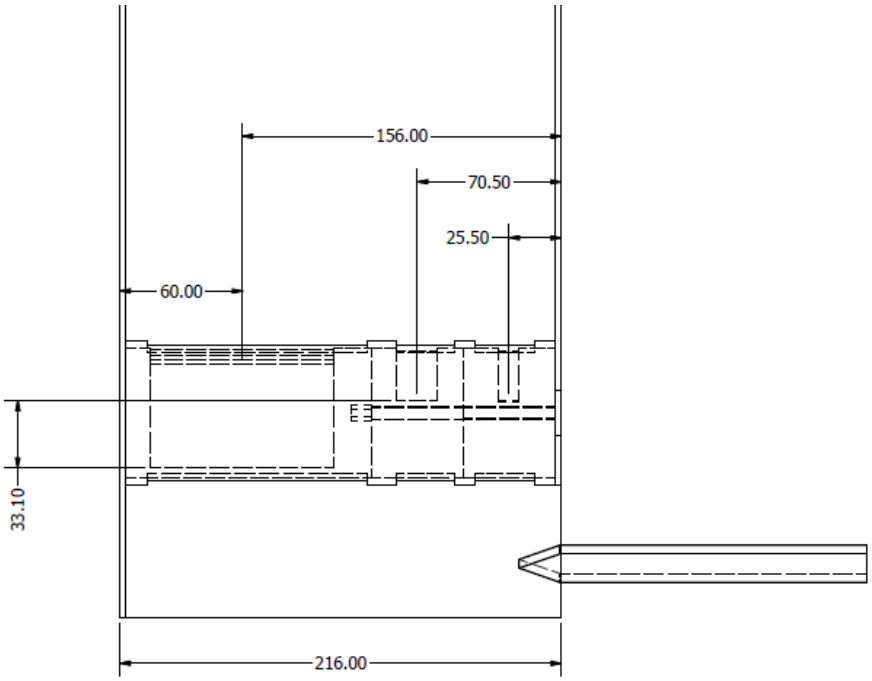
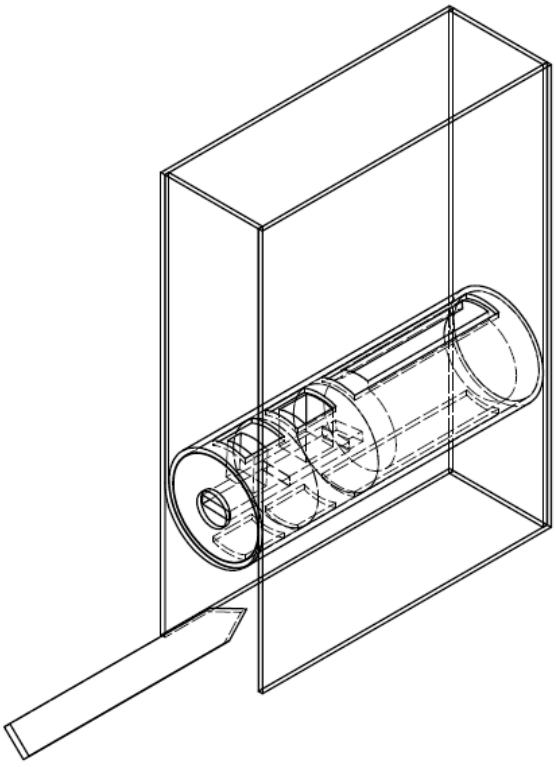
2. Ingredient Dispenser (first model)



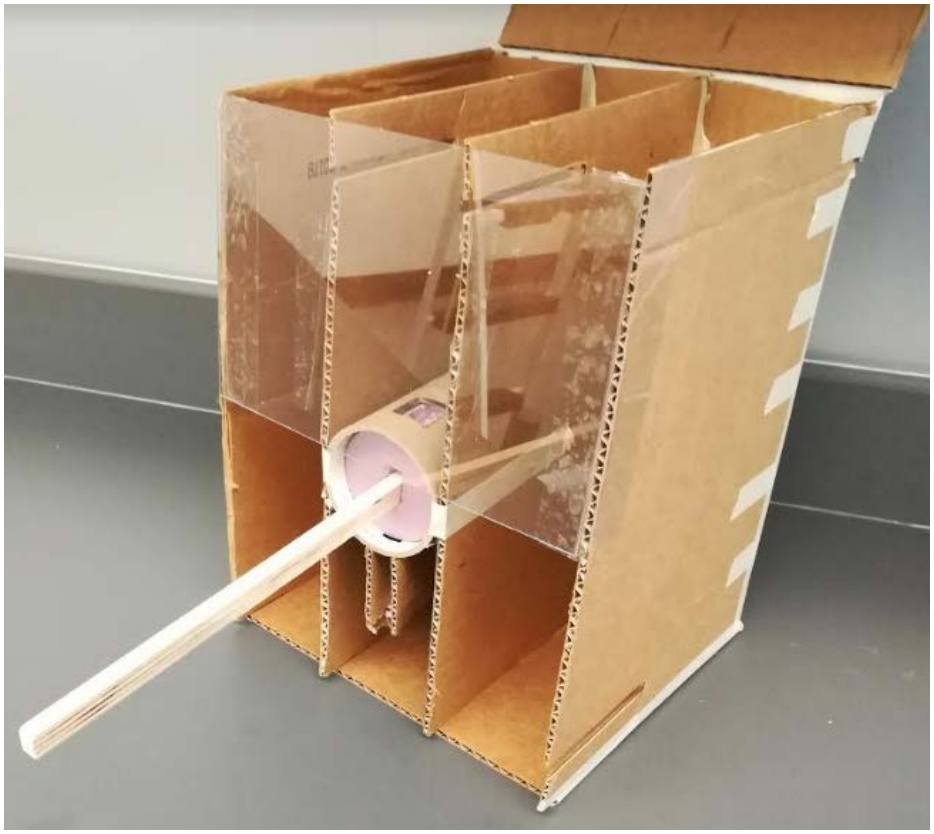


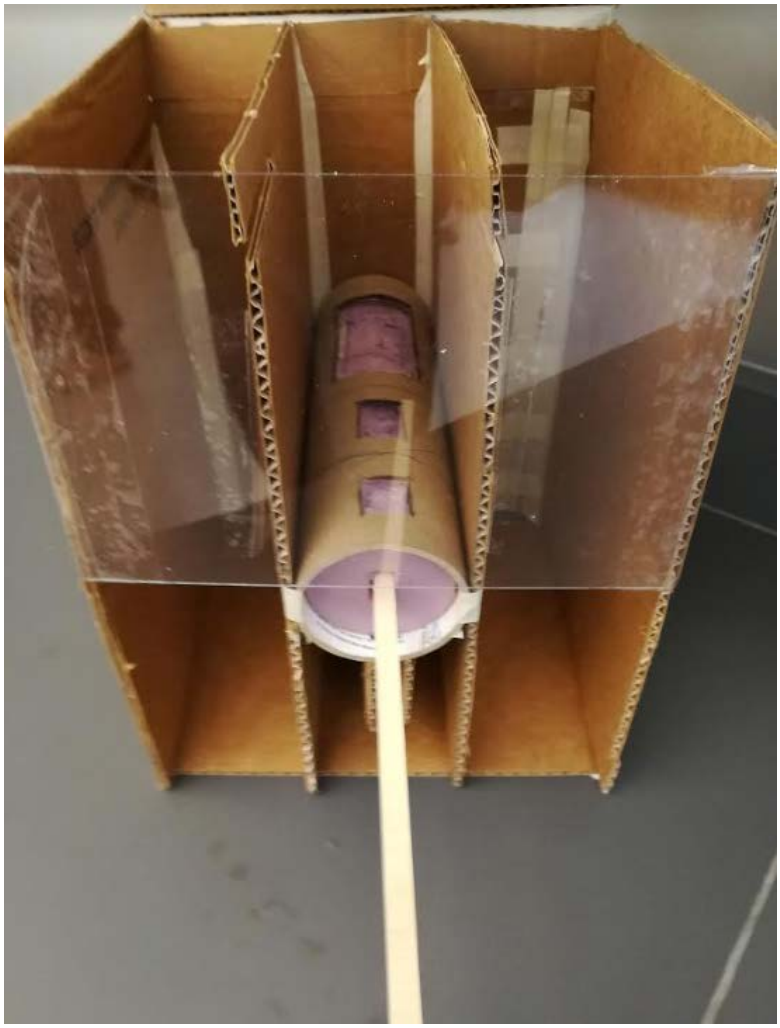




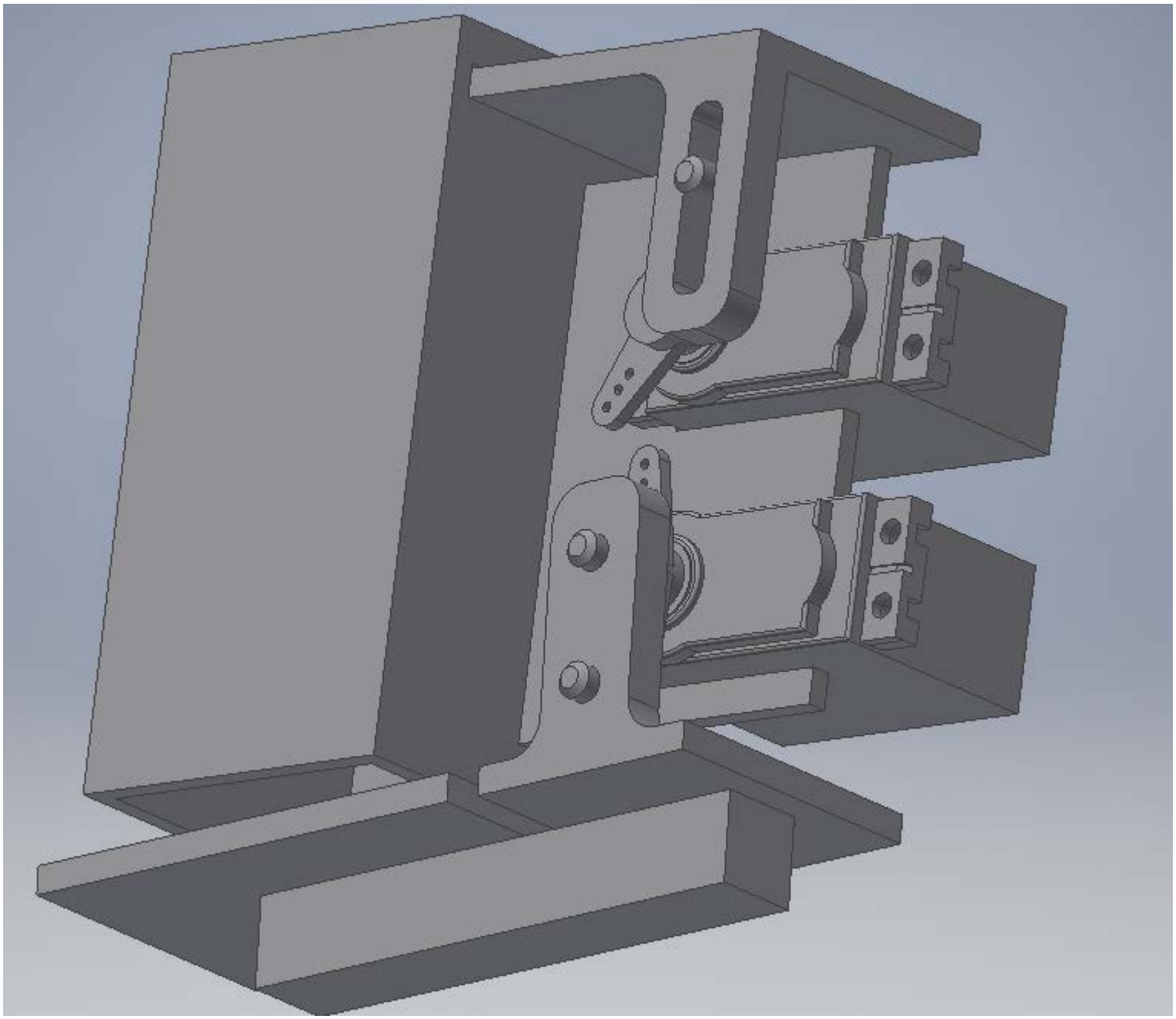


Sketch Model of Ingredient Dispenser

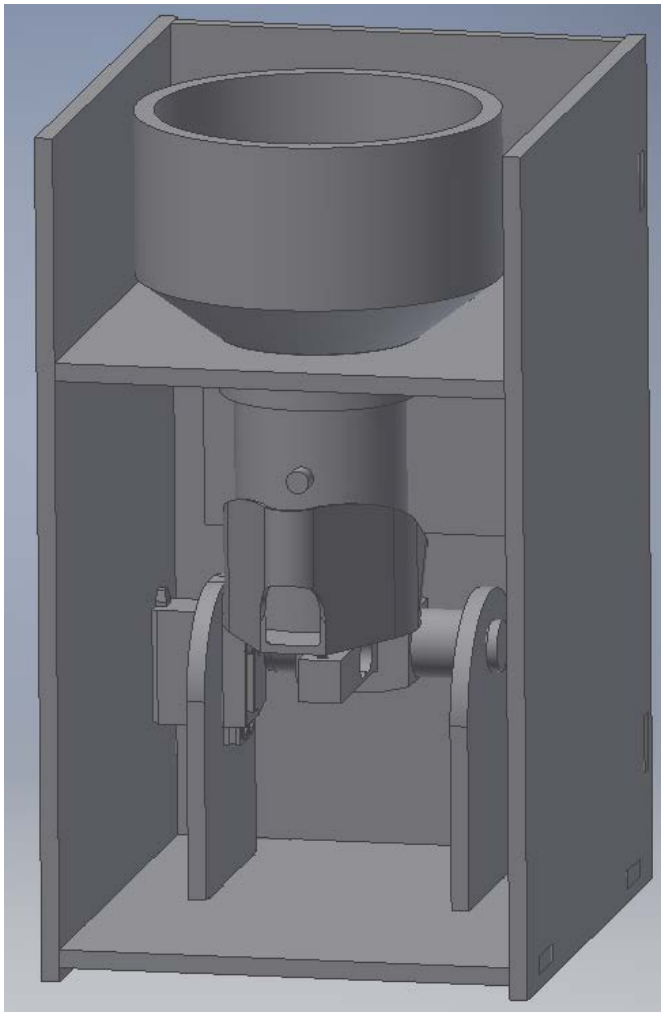


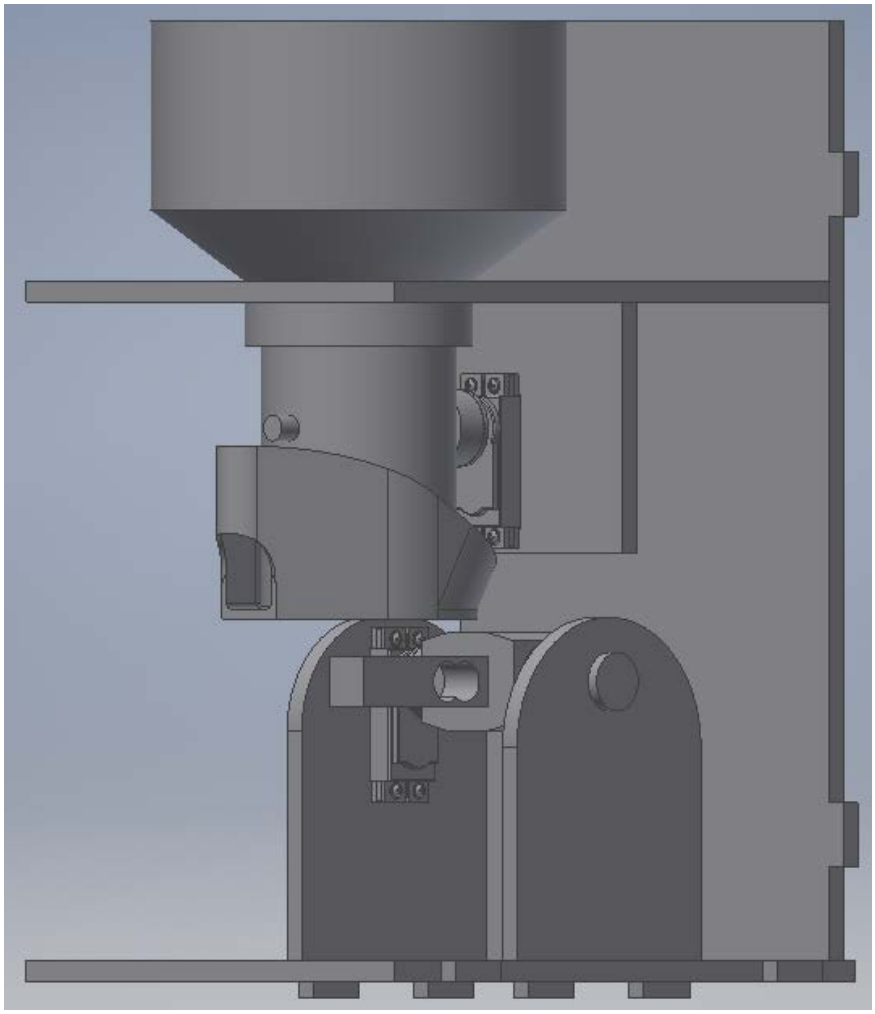


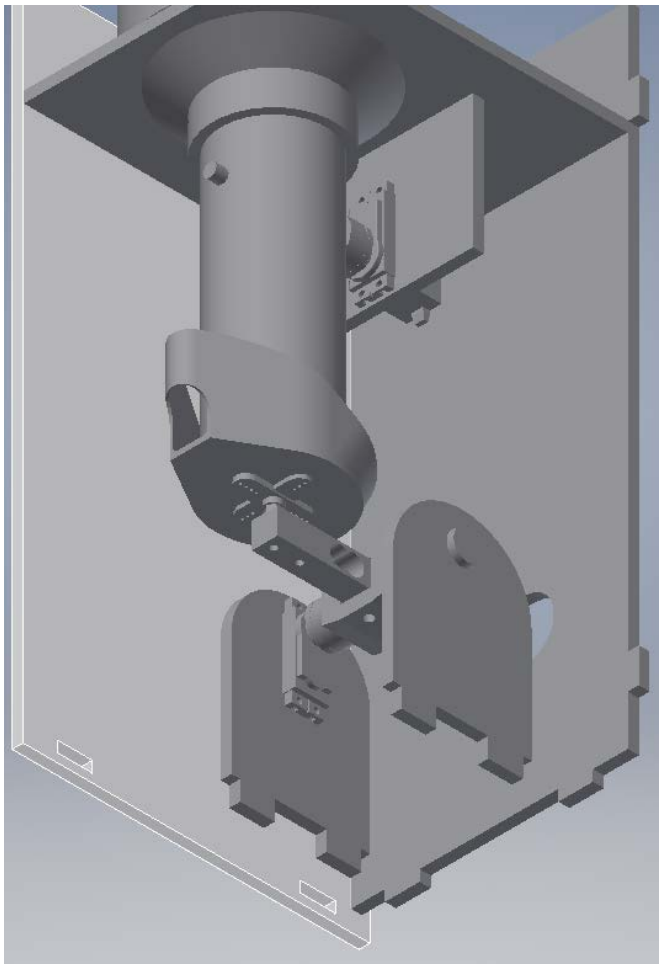
Week #10 (Kana’s model)

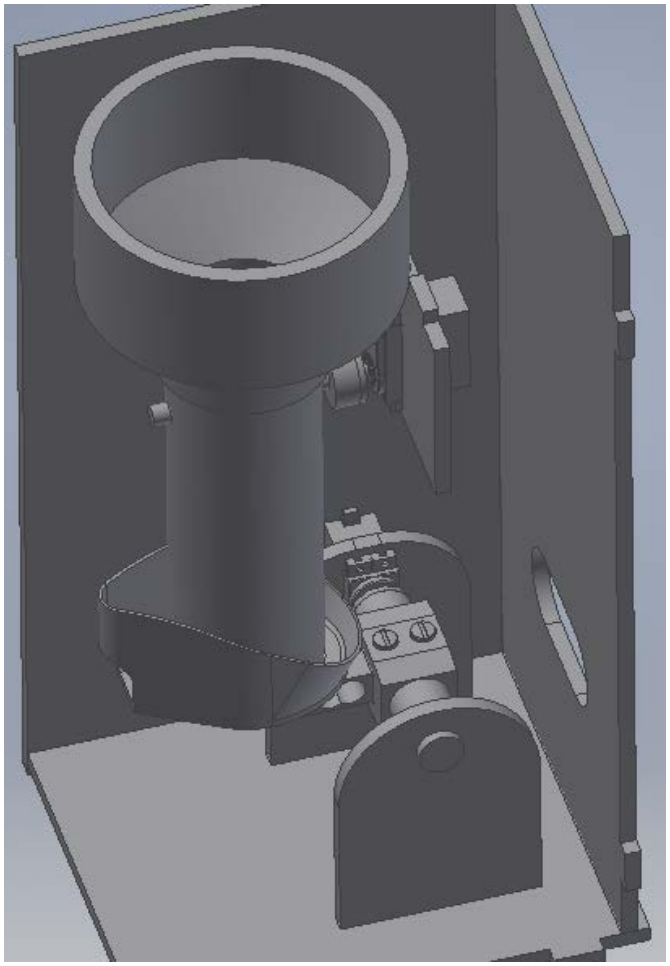


2nd model (Ante's model, team voted to be fabricated)

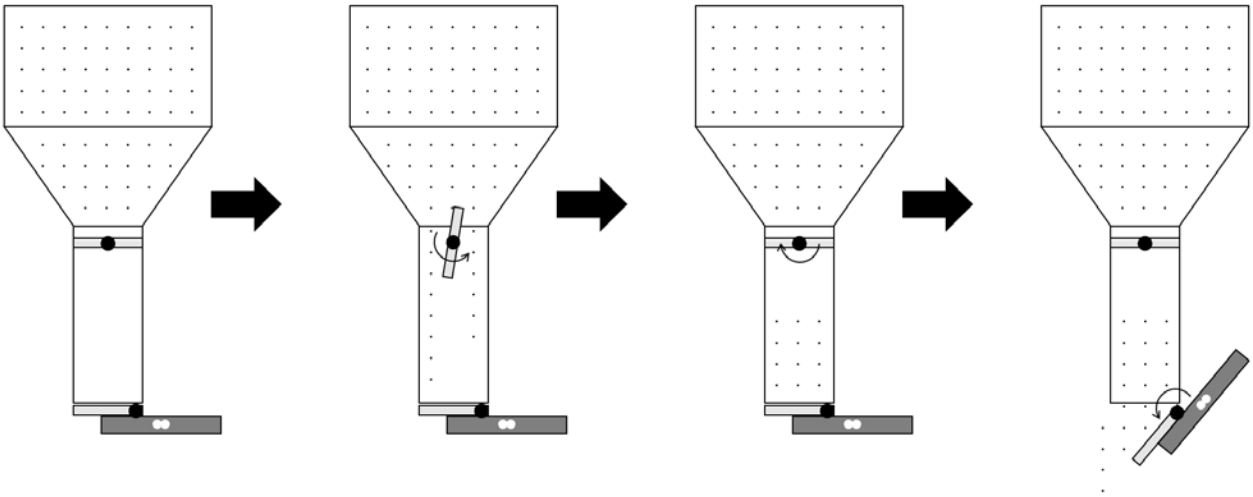






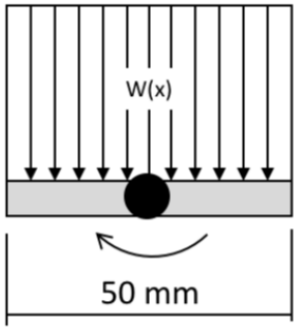


Functional Model Analysis



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

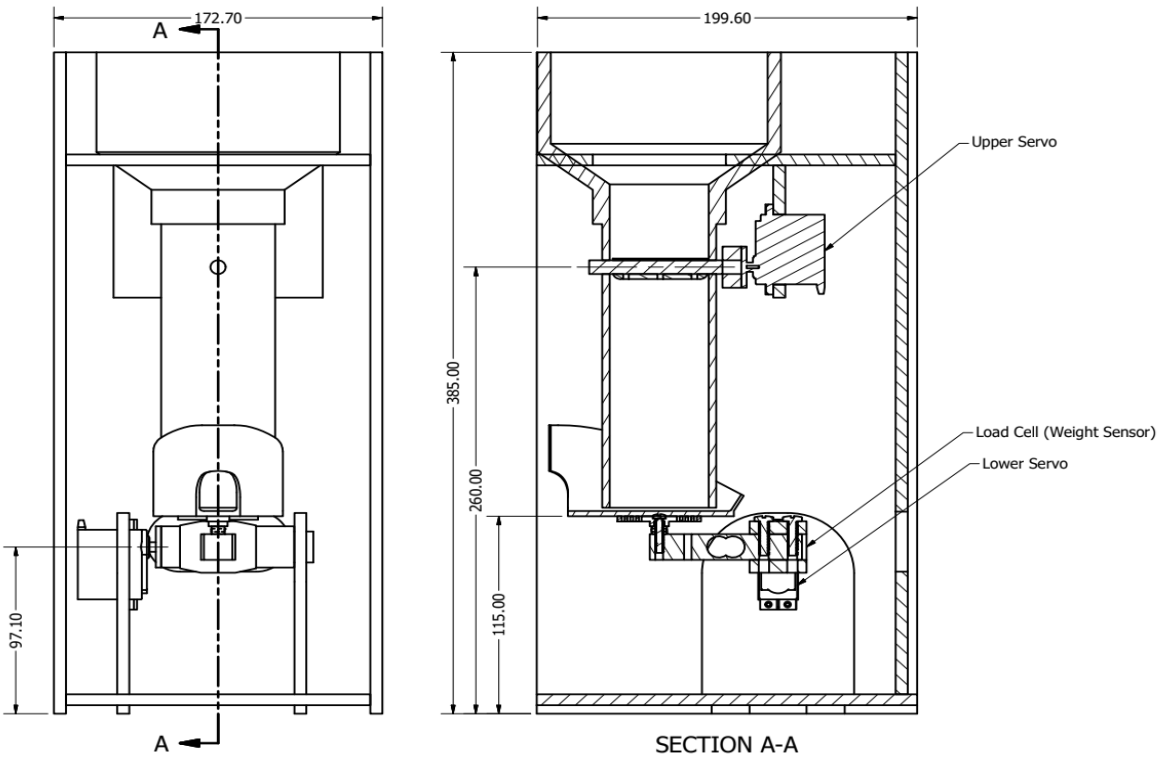
Lower Servo Torque Analysis
Find maximum distance from the servo to the dispenser

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

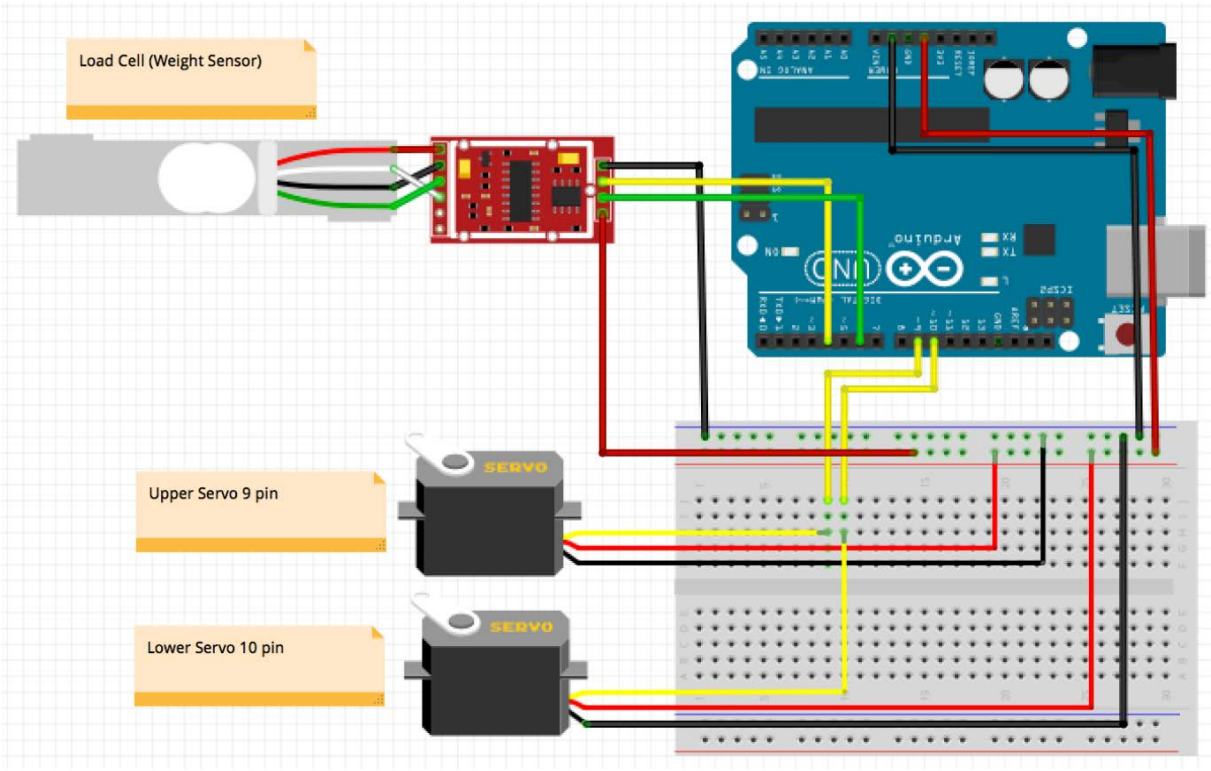
Actual
$x = 62.5\ mm$ distance from the servo to the dispenser

$62.5\ mm < 178\ mm\ OK$

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

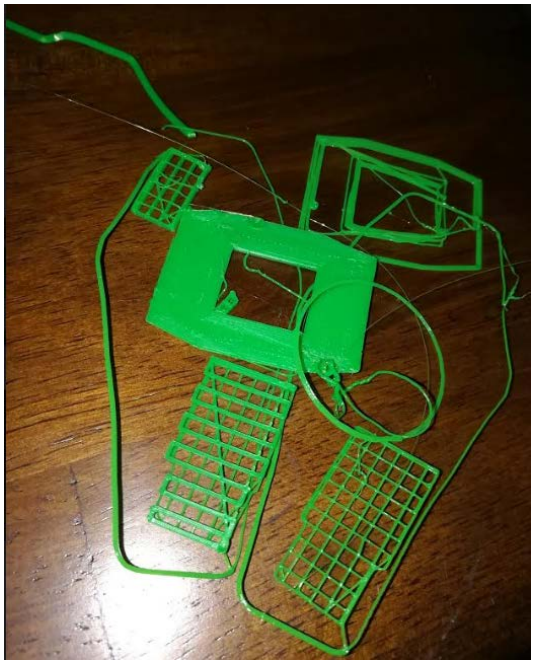
Servos:

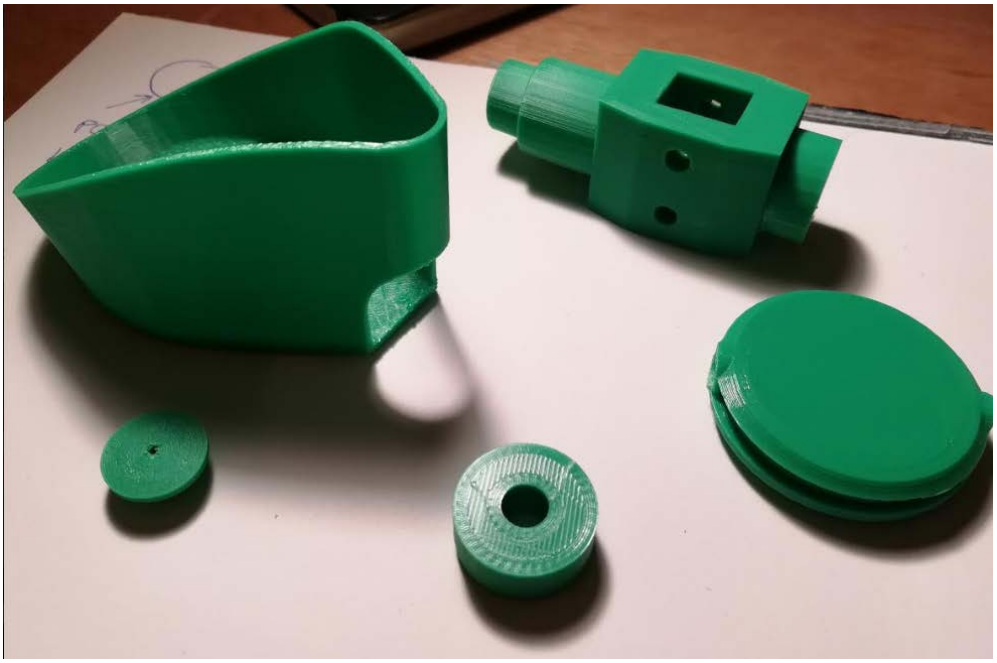
Arduino Uno:

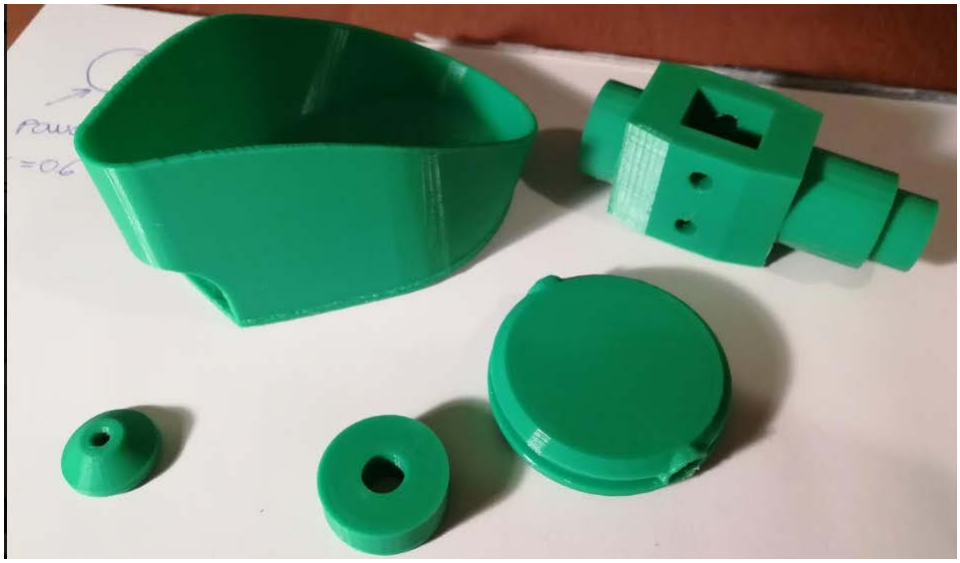
Features of the Arduino UNO:

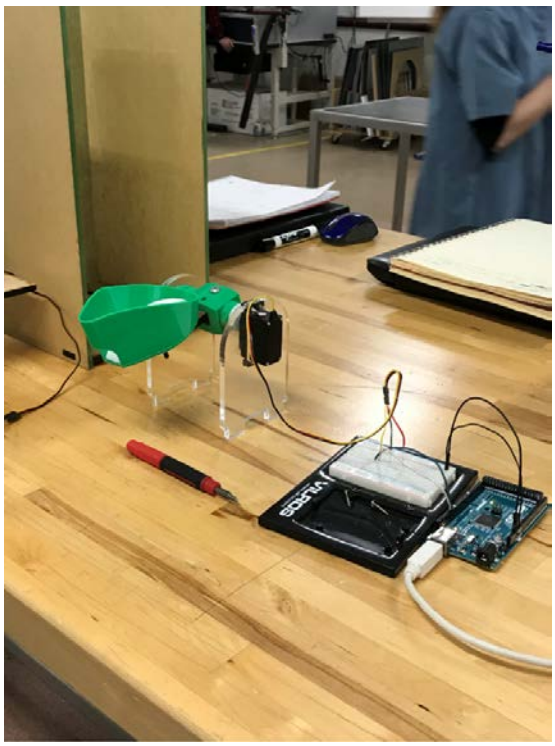
- Microcontroller: ATmega328
- Operating Voltage: 5V
- Input Voltage (recommended): 7-12V
- Input Voltage (limits): 6-20V
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- Analog Input Pins: 6
- DC Current per I/O Pin: 40 mA
- DC Current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB of which 0.5 KB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

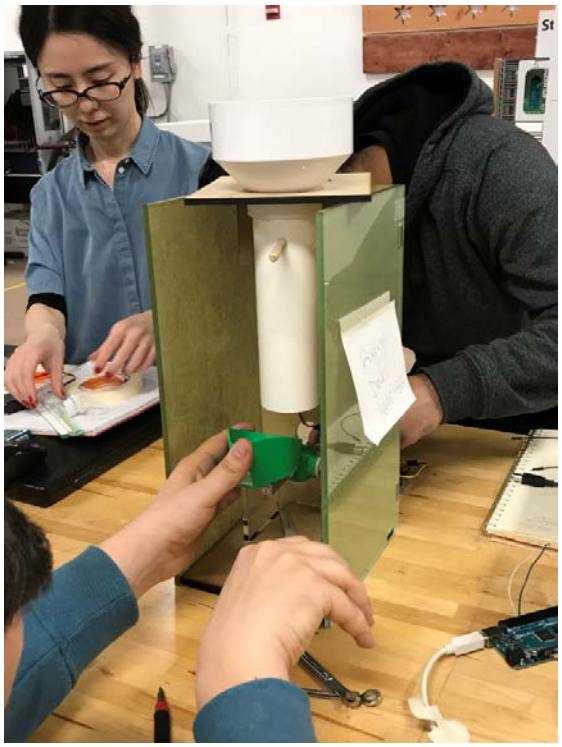
Printing Parts and Fabricating



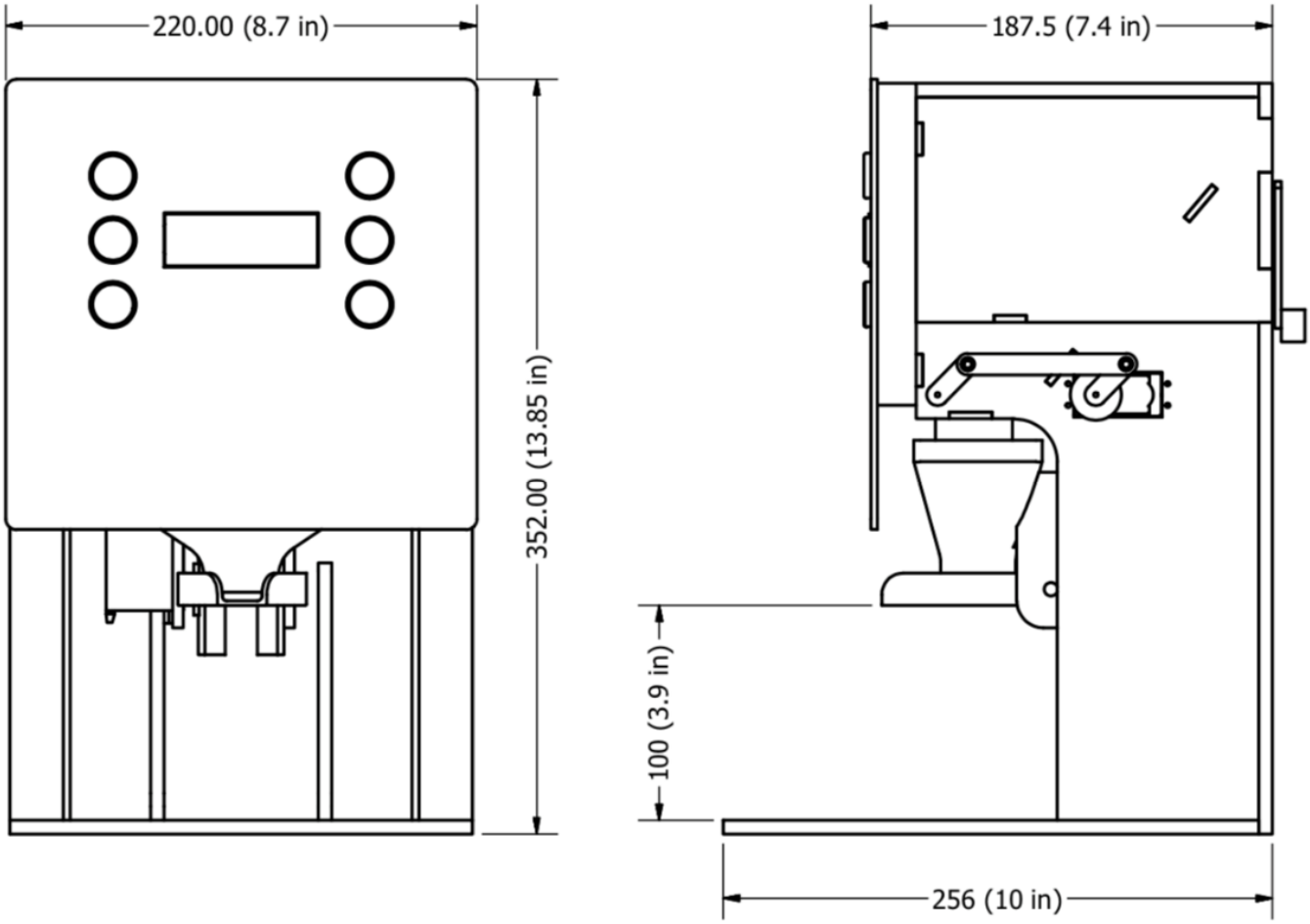


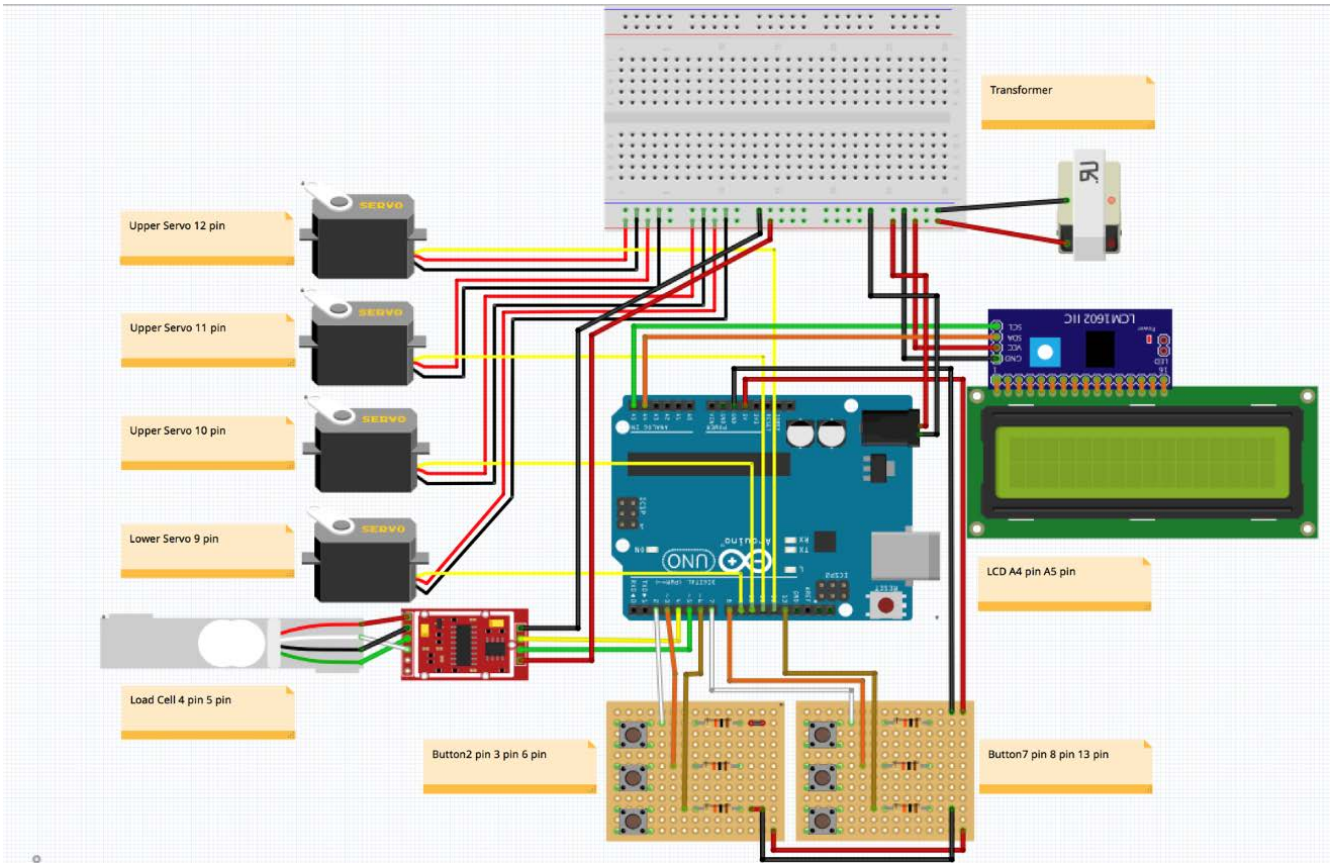




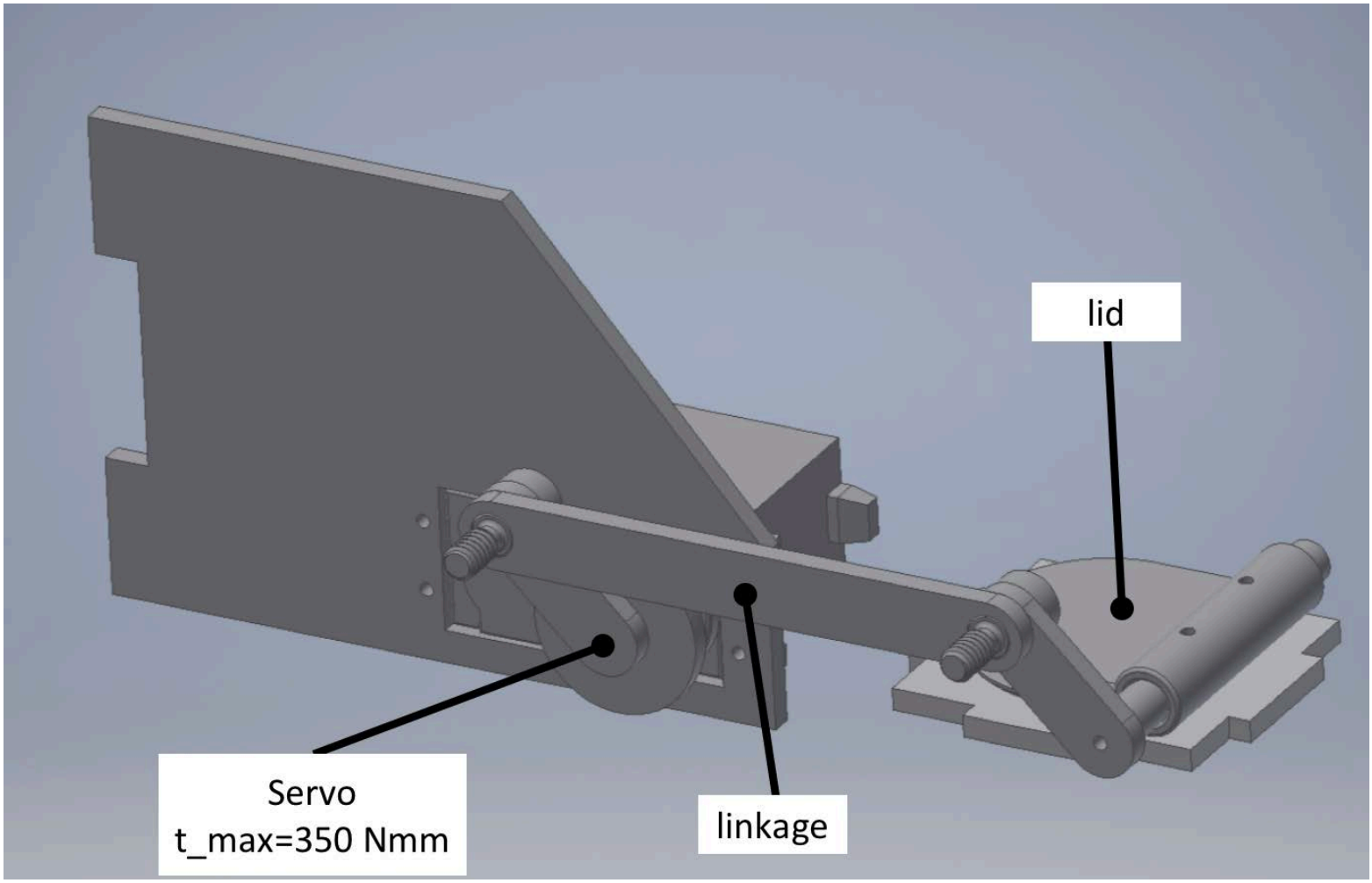


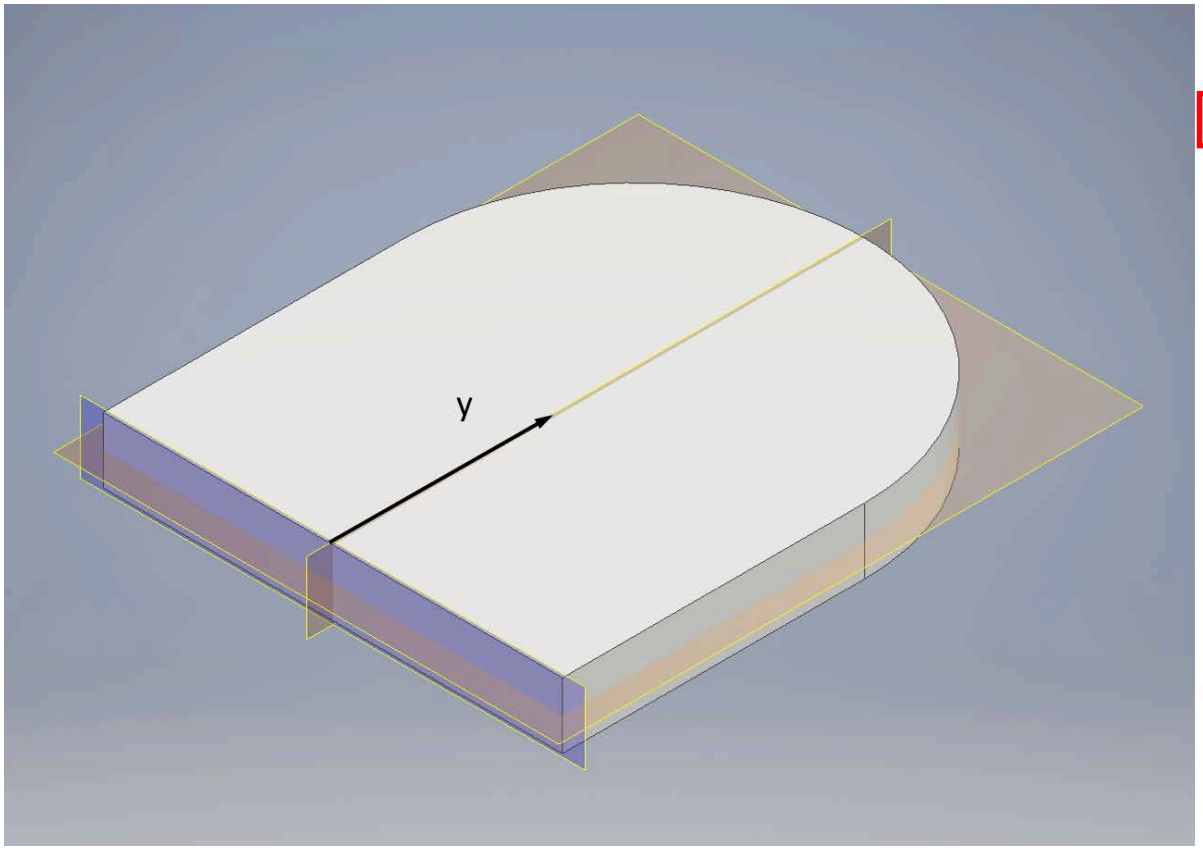
Final model (week #14)





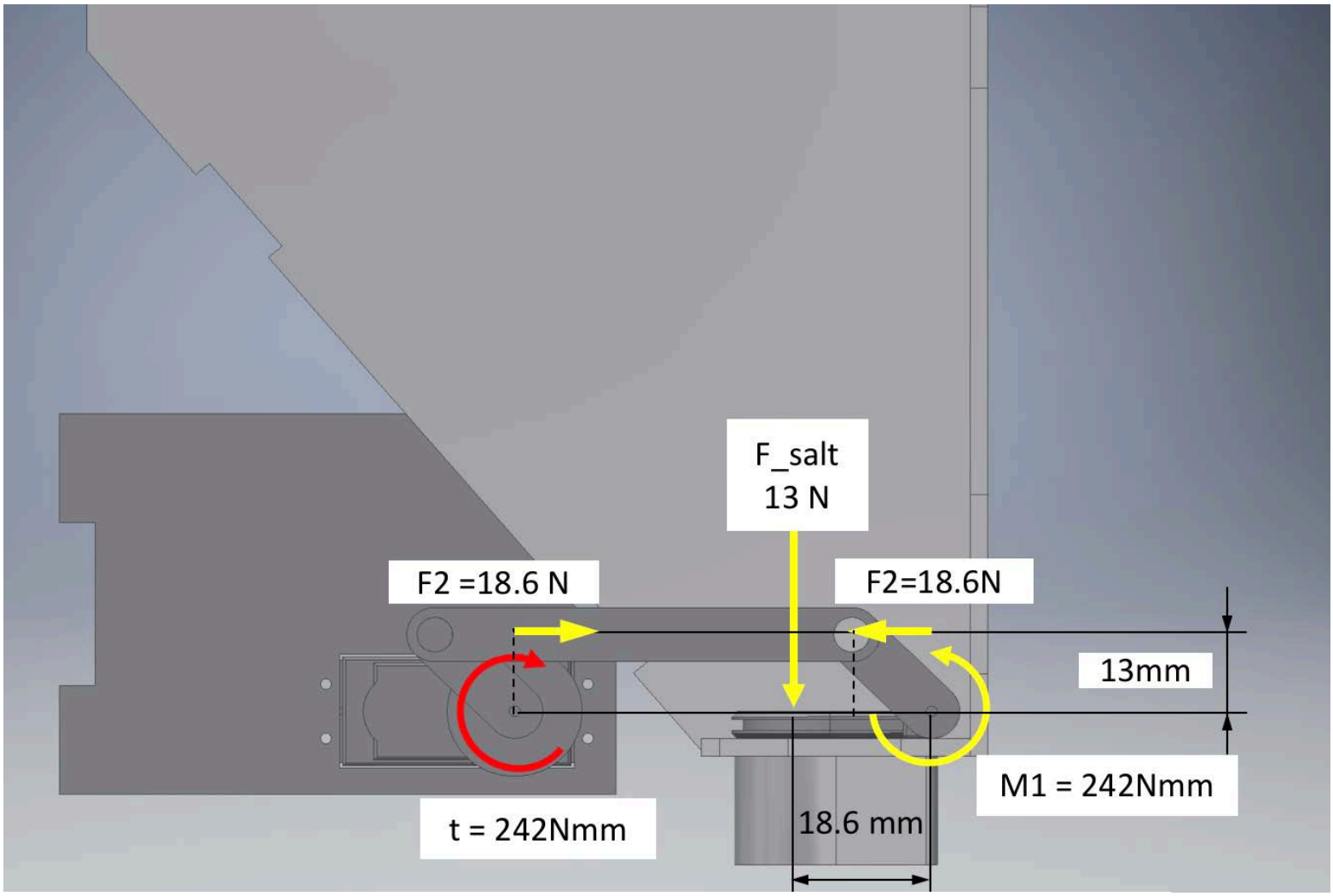
Torque Analysis #1





Center of Gravity

X	0.000 mm (Relative
Y	18.580 mm (Relative
Z	0.000 mm (Relative



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

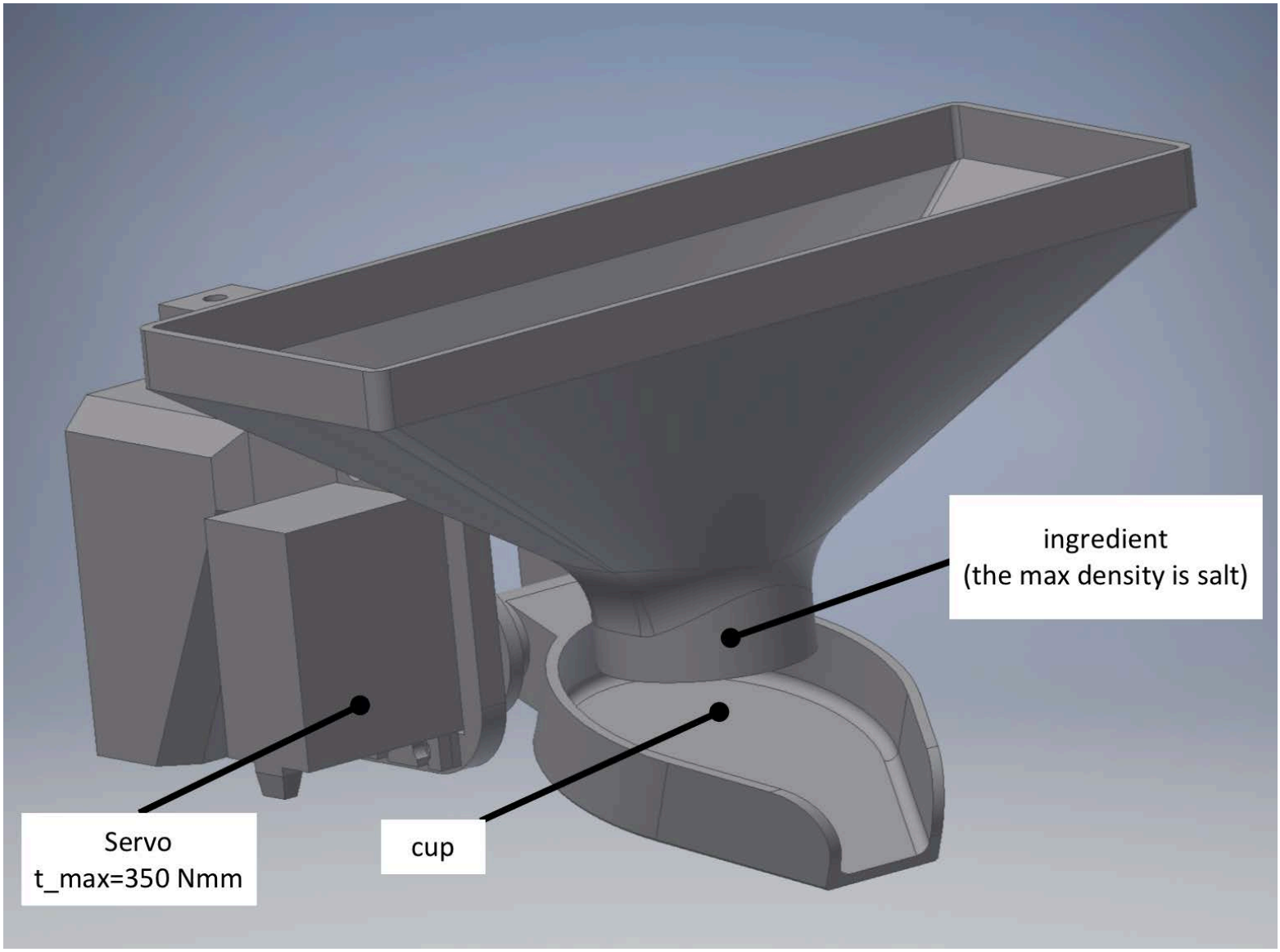
Step 3: Find the force at the linkage

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

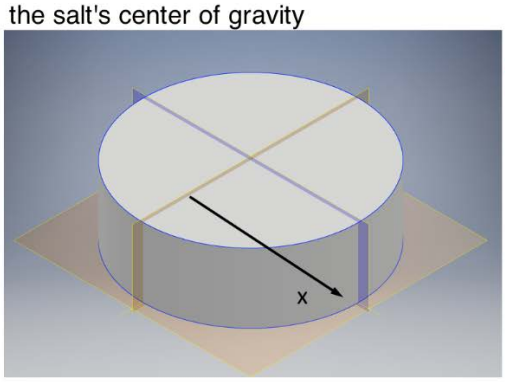
Step 4: Find the moment at the servo

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

Torque Analysis #2

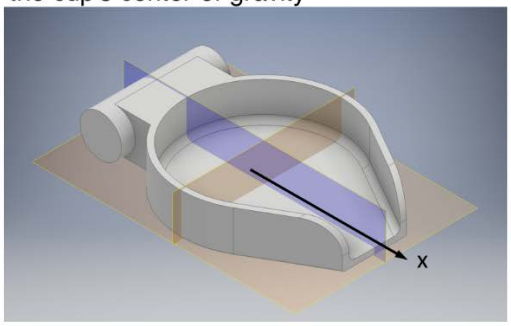


the salt's center of gravity

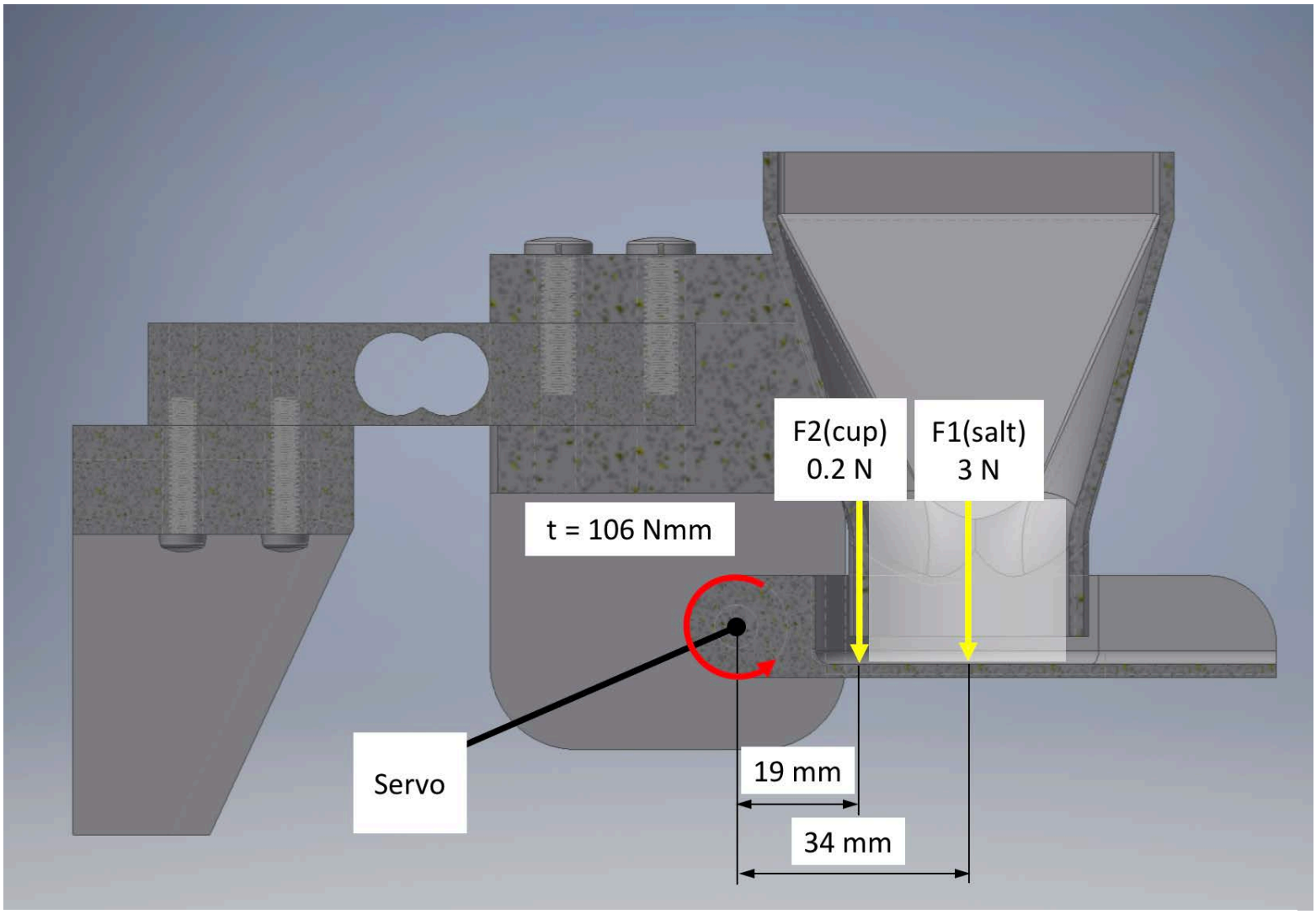


Center of Gravity
X -0.000 mm (Relative
Y 0.000 mm (Relative
Z 5.000 mm (Relative

the cup's center of gravity



Material
ABS Plastic
Clipboard
Density
1.060 g/cm^3
Requested Accuracy
Low
General Properties
Center of Gravity
Mass 0.021 kg (Relative E
X -15.052 mm (Relativ
Area 13377.247 mm^2 (R
Y -0.239 mm (Relative
Volume 19895.926 mm^3 (R
Z 5.575 mm (Relative



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

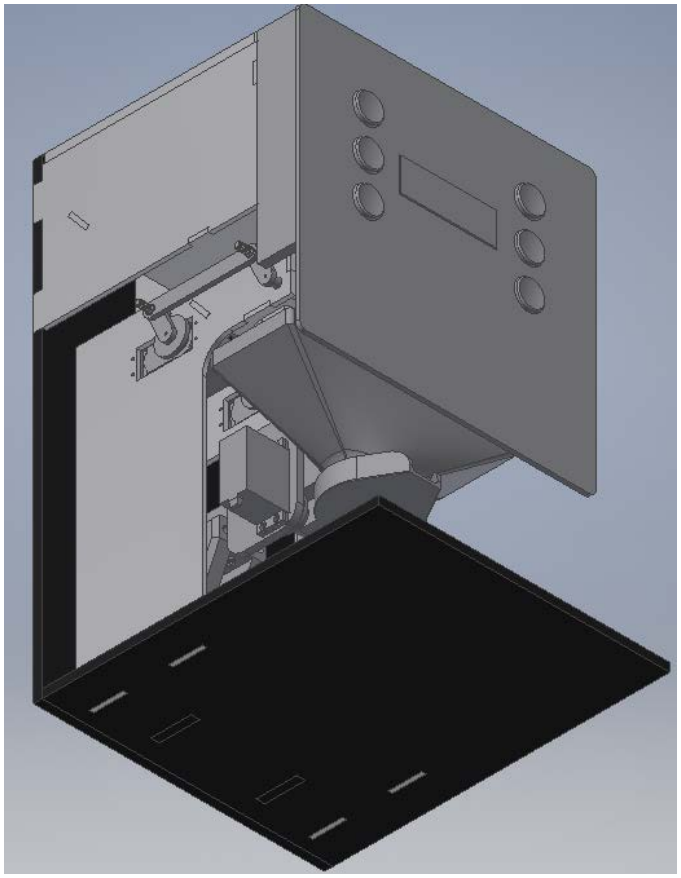
Step 2: Find the torque

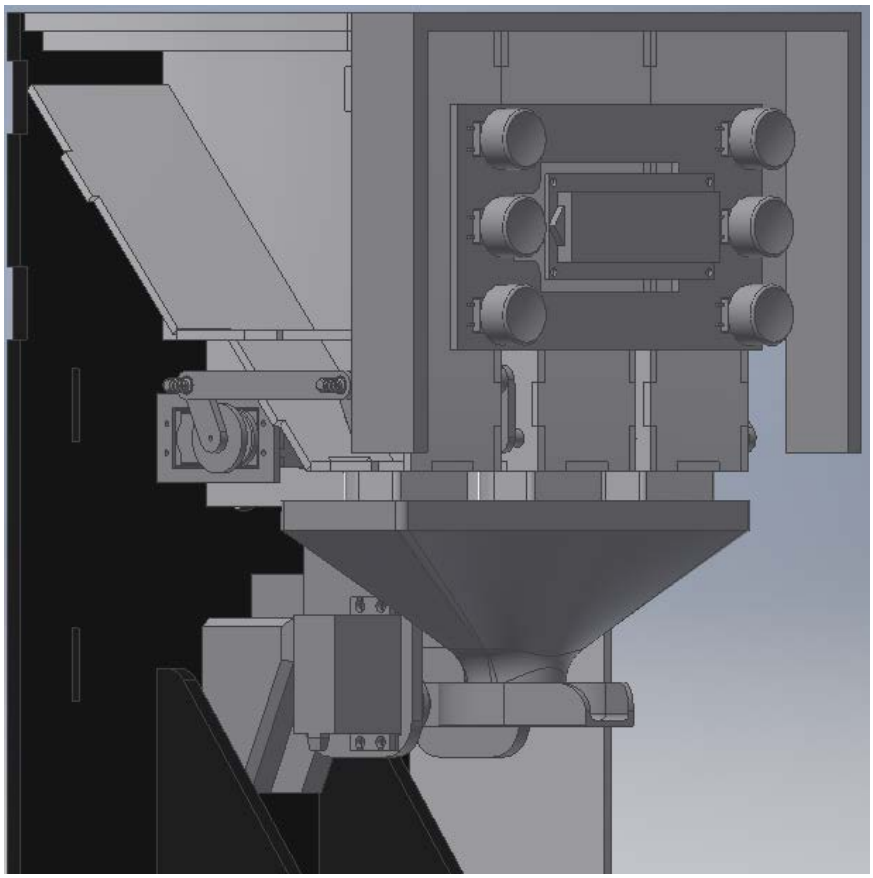
F1 = (0.304 kg)(9.8 m/s^2) = 3.00 N
M1 = (3.00 N)(34 mm) = 102 Nmm

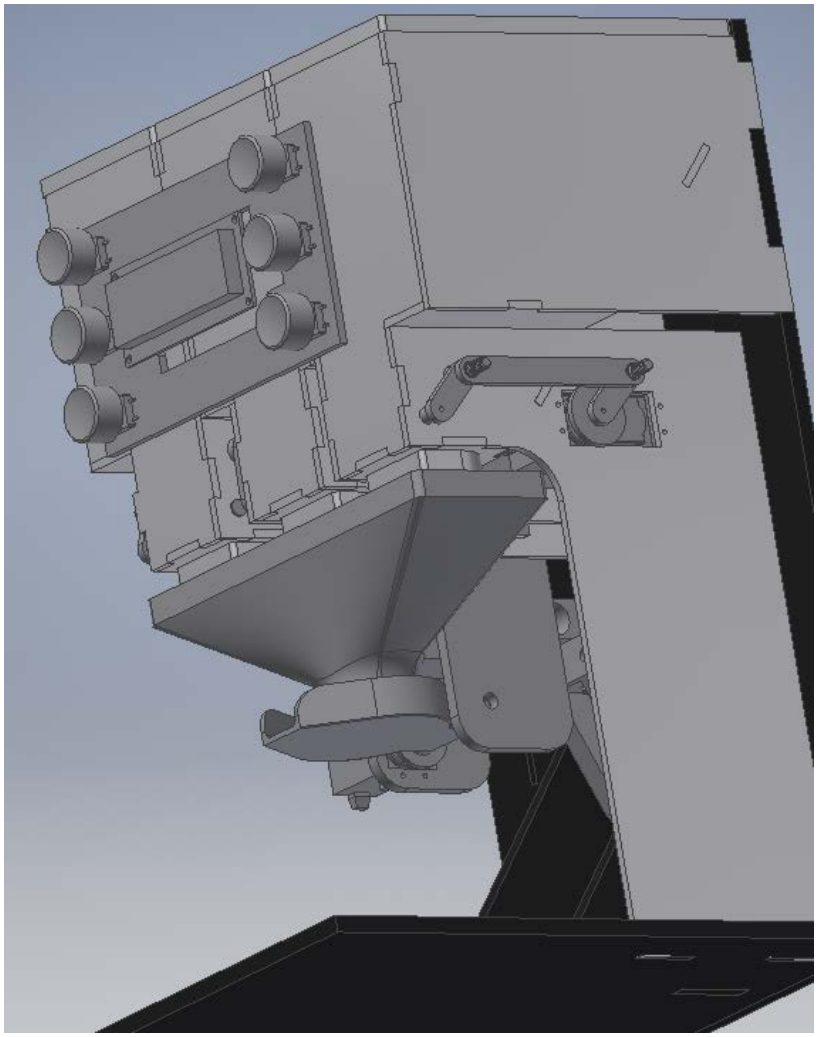
F2 = (0.02 kg)(9.8 m/s^2) = 0.2 N
M2 = (0.2 N)(19 mm) = 3.8 Nmm

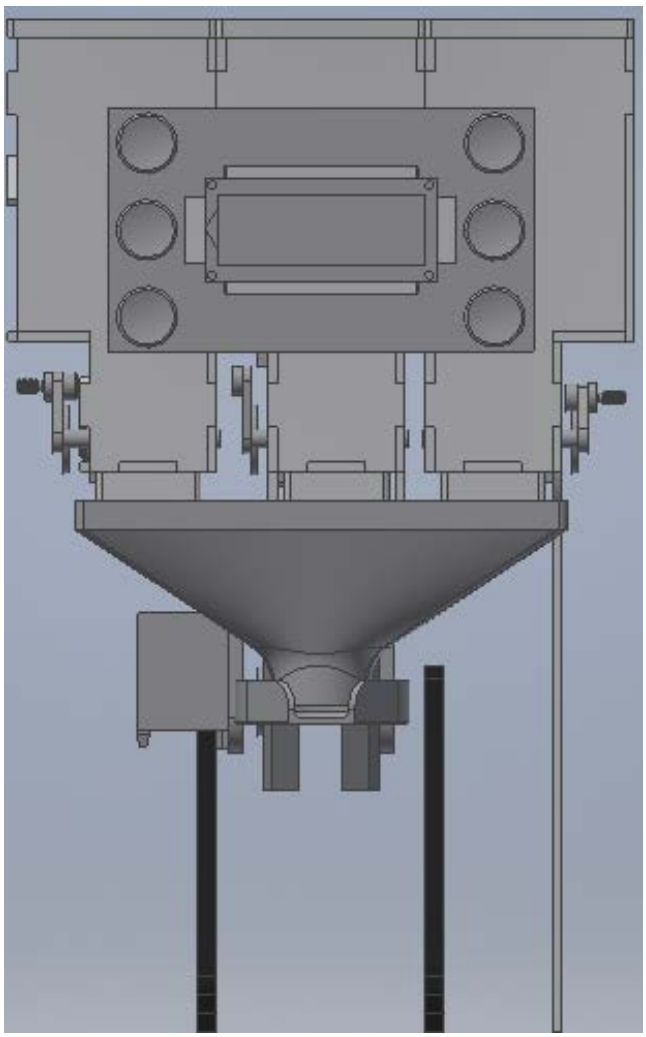
t = M1+M2 = 102 +3.8 = 106 Nmm < 350 N mm
n = 350 / 106 = 3.3

Alpha Model CAD Assembly

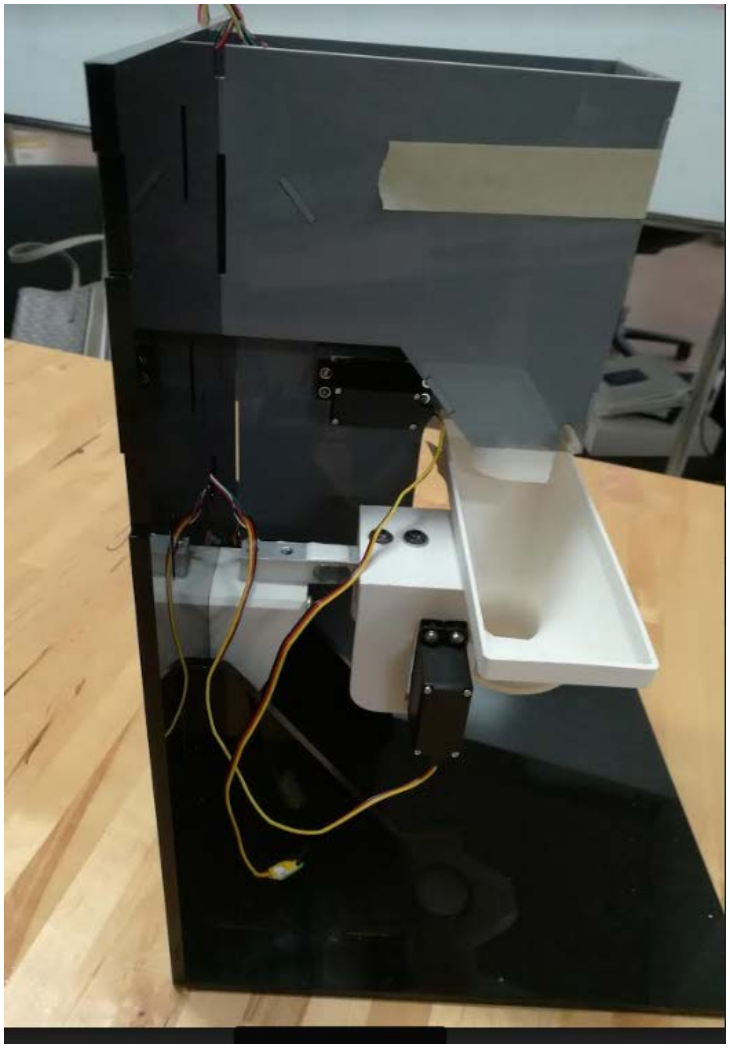


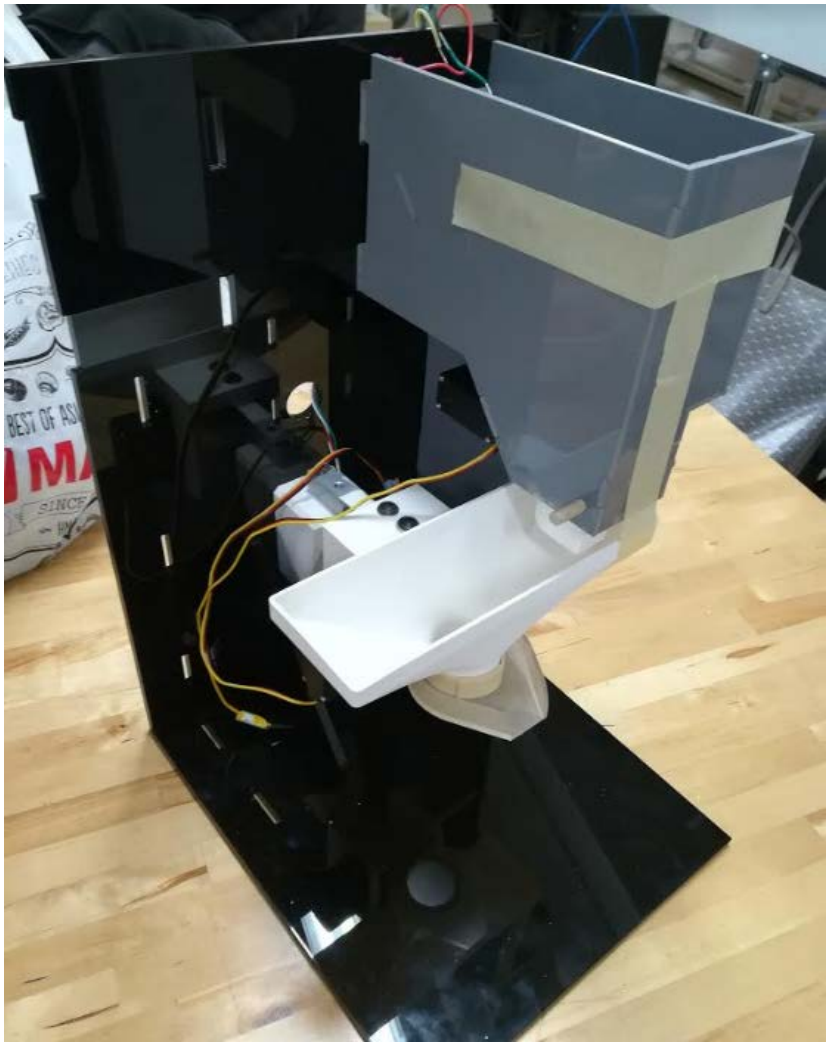


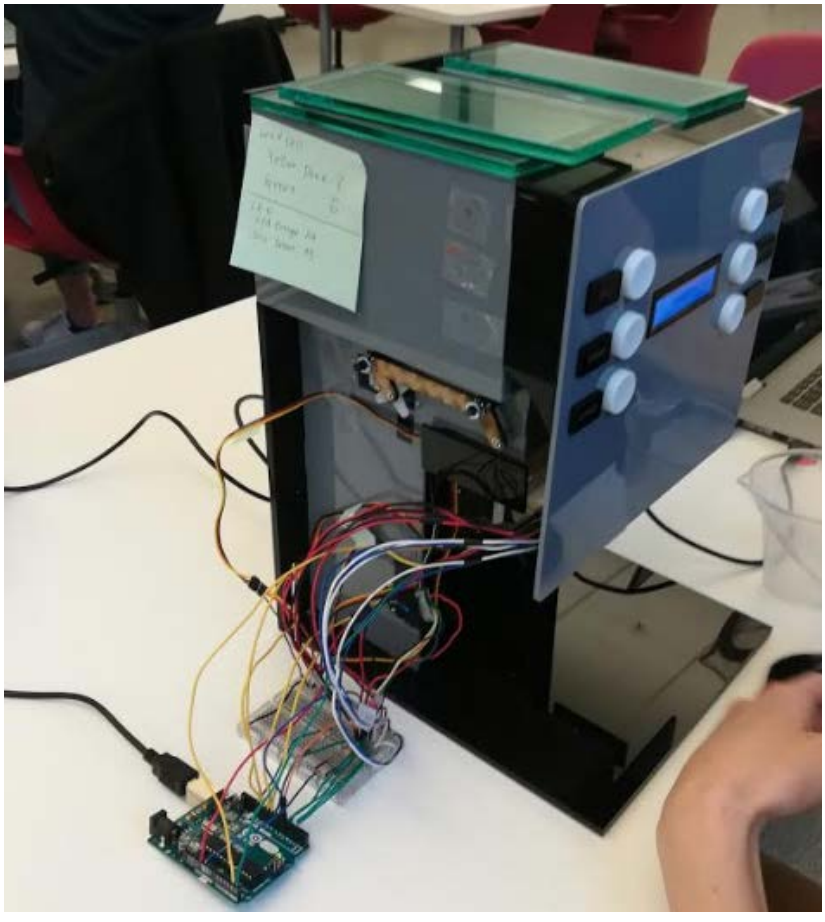


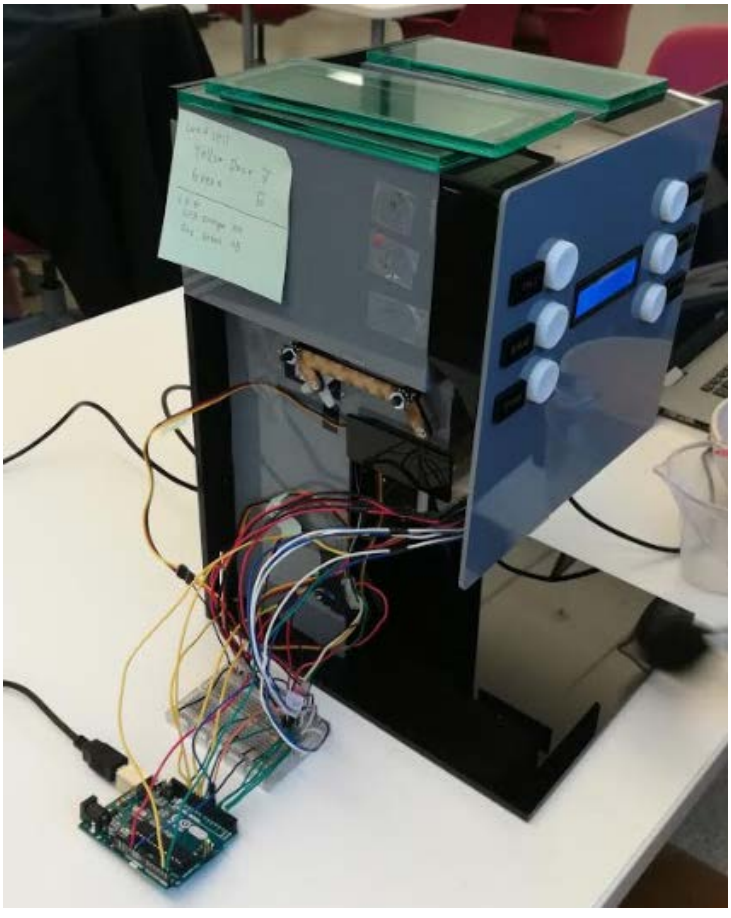


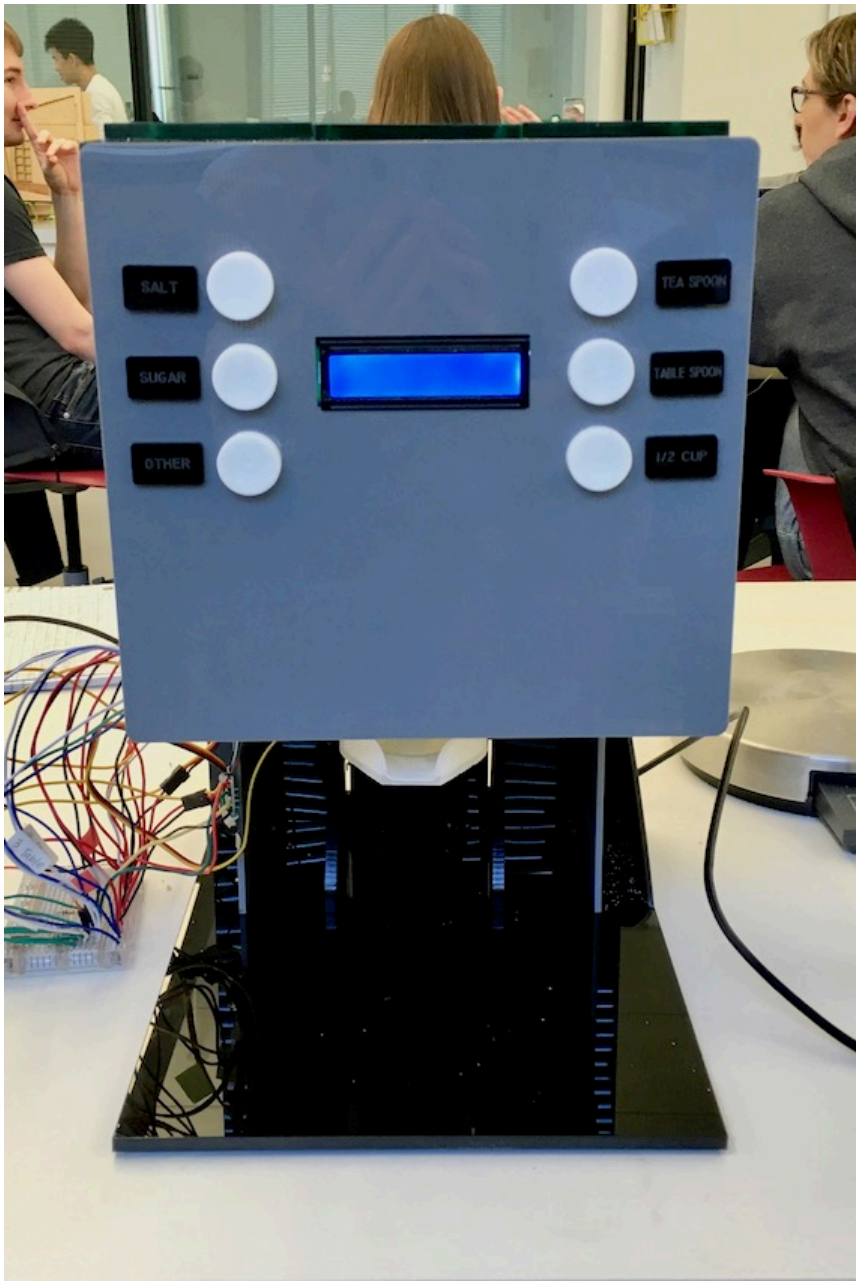
Alpha Prototype photos











- 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%