



University of Idaho

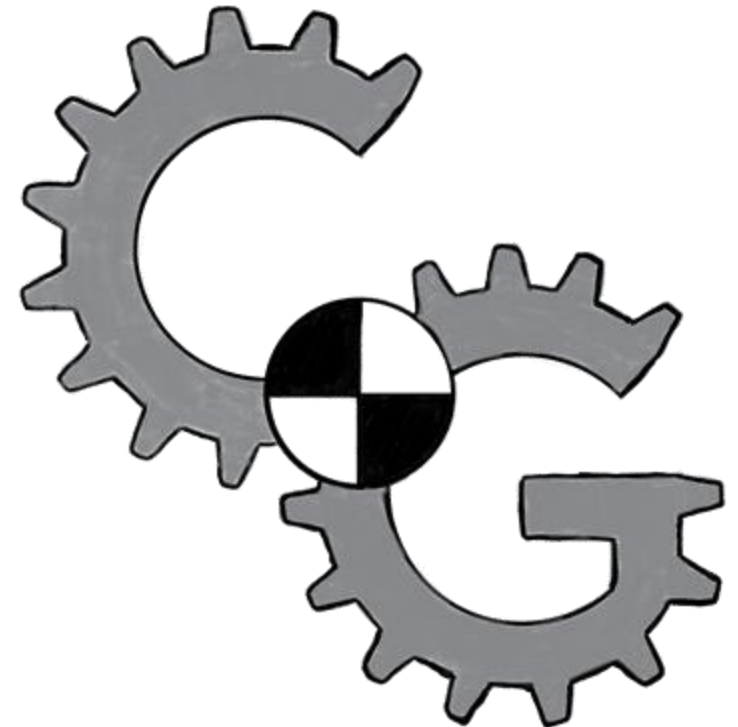
College of Engineering

3-AXIS CENTER OF GRAVITY INSTRUMENT

KALEB CARTIER

KENDALL GRAY

ERIC SMEAD



PROBLEM



SEL

- I** No method to calculate CG of relays
- I** Electrical components are difficult to locate

WHY IS THIS HELPFUL?



- I** Determine reasons for failure
- I** Design better products

PROJECT REQUIREMENTS

MECHANICAL

- I Automatic
- I 50 lbs
- I Re-creatable
- I Stretch goal: Vibration Test

ELECTRICAL

- I 120 VAC

SOFTWARE

- I Average Cartesian CG

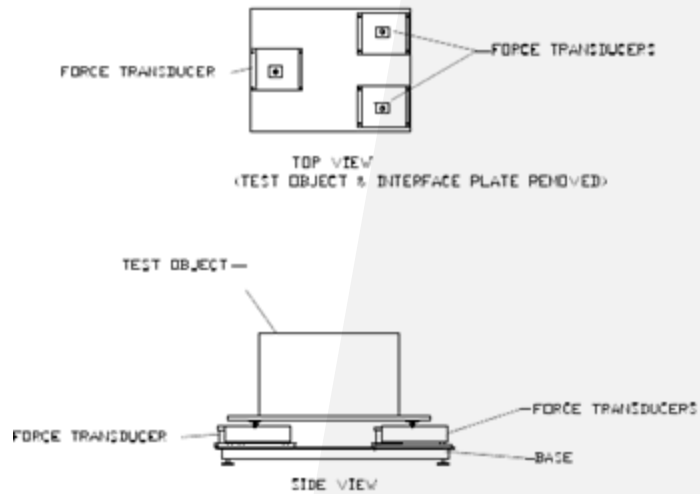
ENVIRONMENTAL

- I 60 to 85 °F

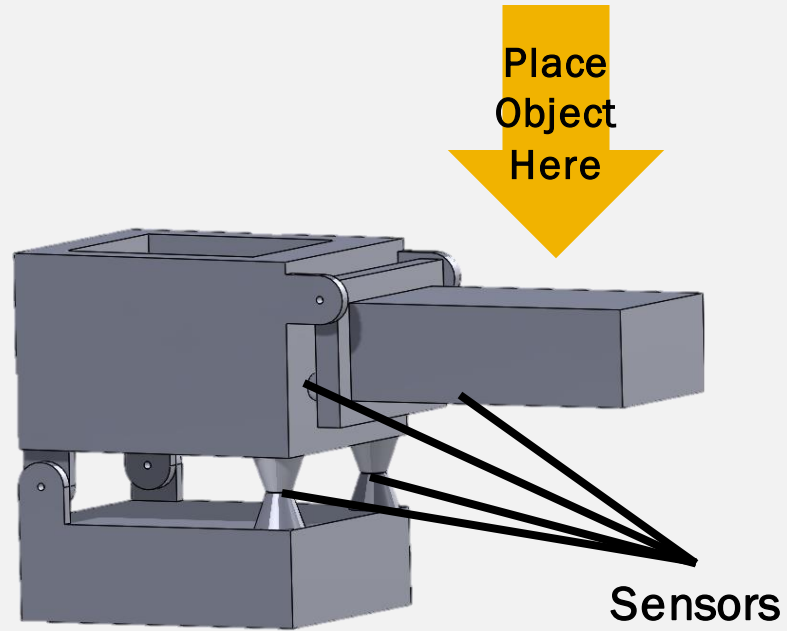
COST

- I \$1661

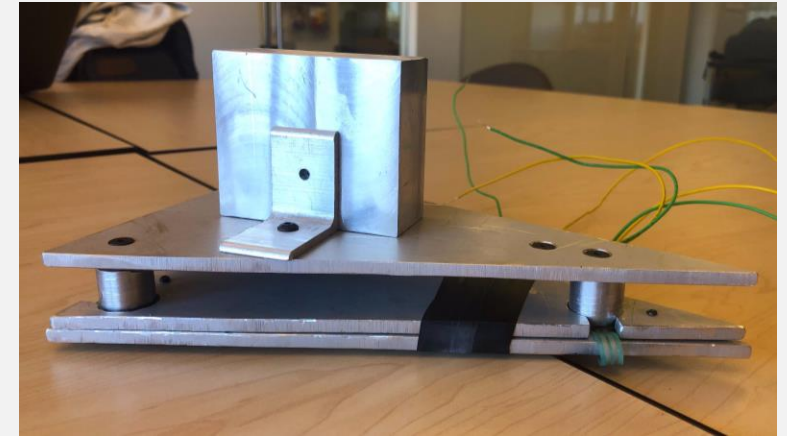
FIRST SEMESTER



September 2018

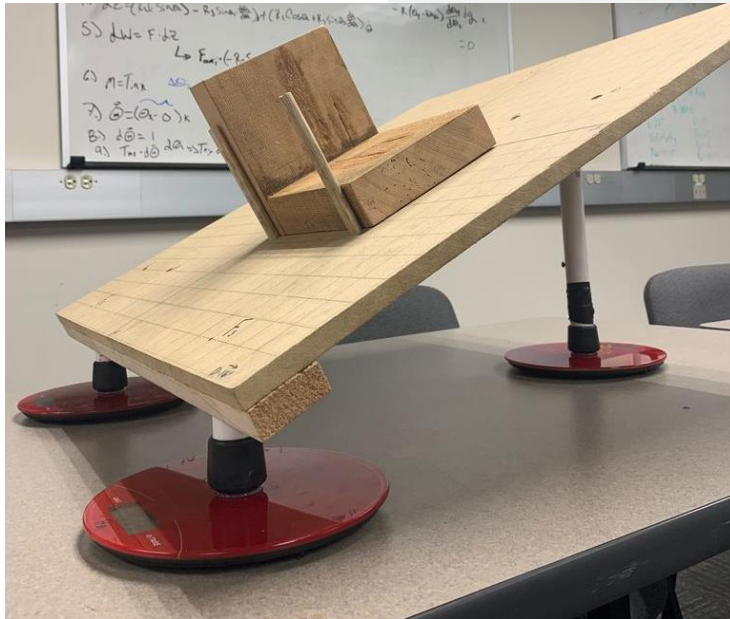


October 2018



November 2018

SECOND SEMESTER



January 2019



February 2019



April 2019

TESTING PROTOTYPE PROGRESSION



First Design Iteration



Second Design Iteration



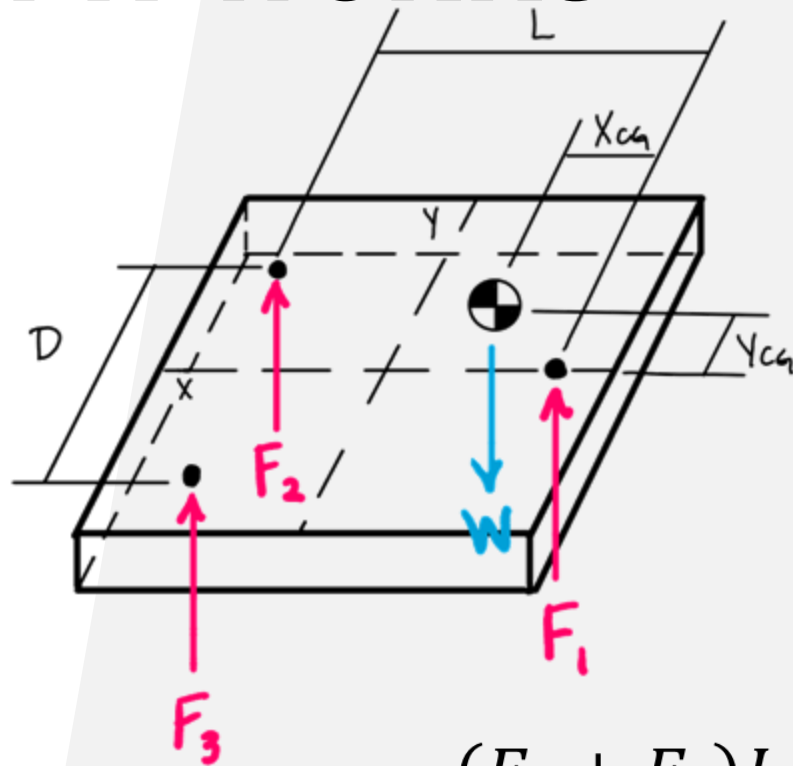
Final Design Iteration

CG TESTING DATA

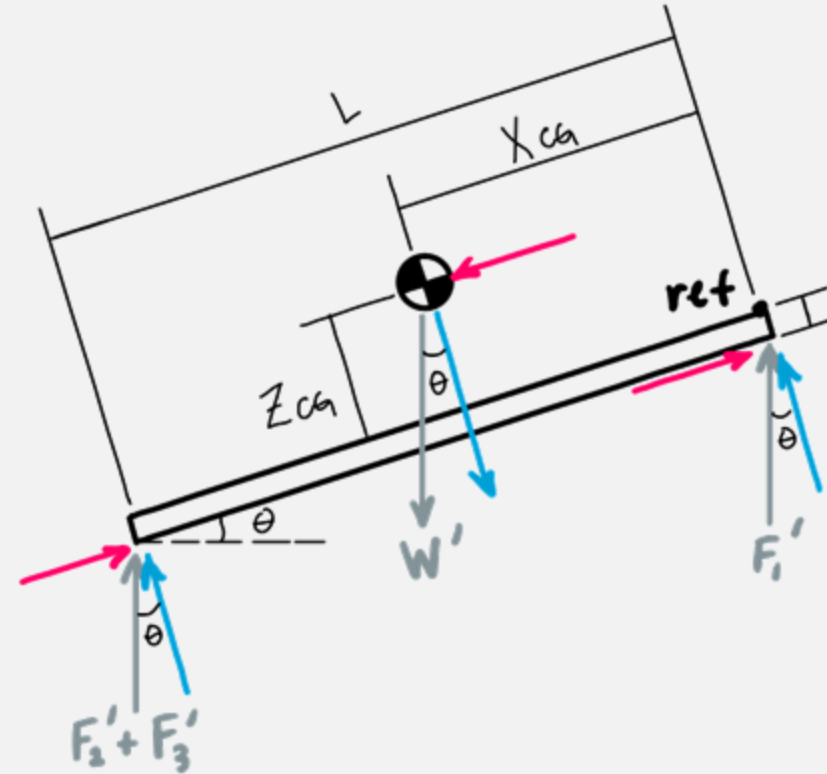
	Measured	Actual	Percent Error
X	2.7"	2.75"	1.85%
Y	2.6"	2.56"	1.54%
Z	1.8"	1.9"	5.56%



HOW IT WORKS



$$X_{CG} = \frac{(F_2 + F_3)L}{W}$$



$$Y_{CG} = \frac{(F_2 + F_3)D}{2W}$$

$$Z_{CG} = \frac{(F_2' + F_3') \cos \theta * L - W' (\sin \theta * t + \cos \theta * x_{cg})}{W' \sin \theta}$$

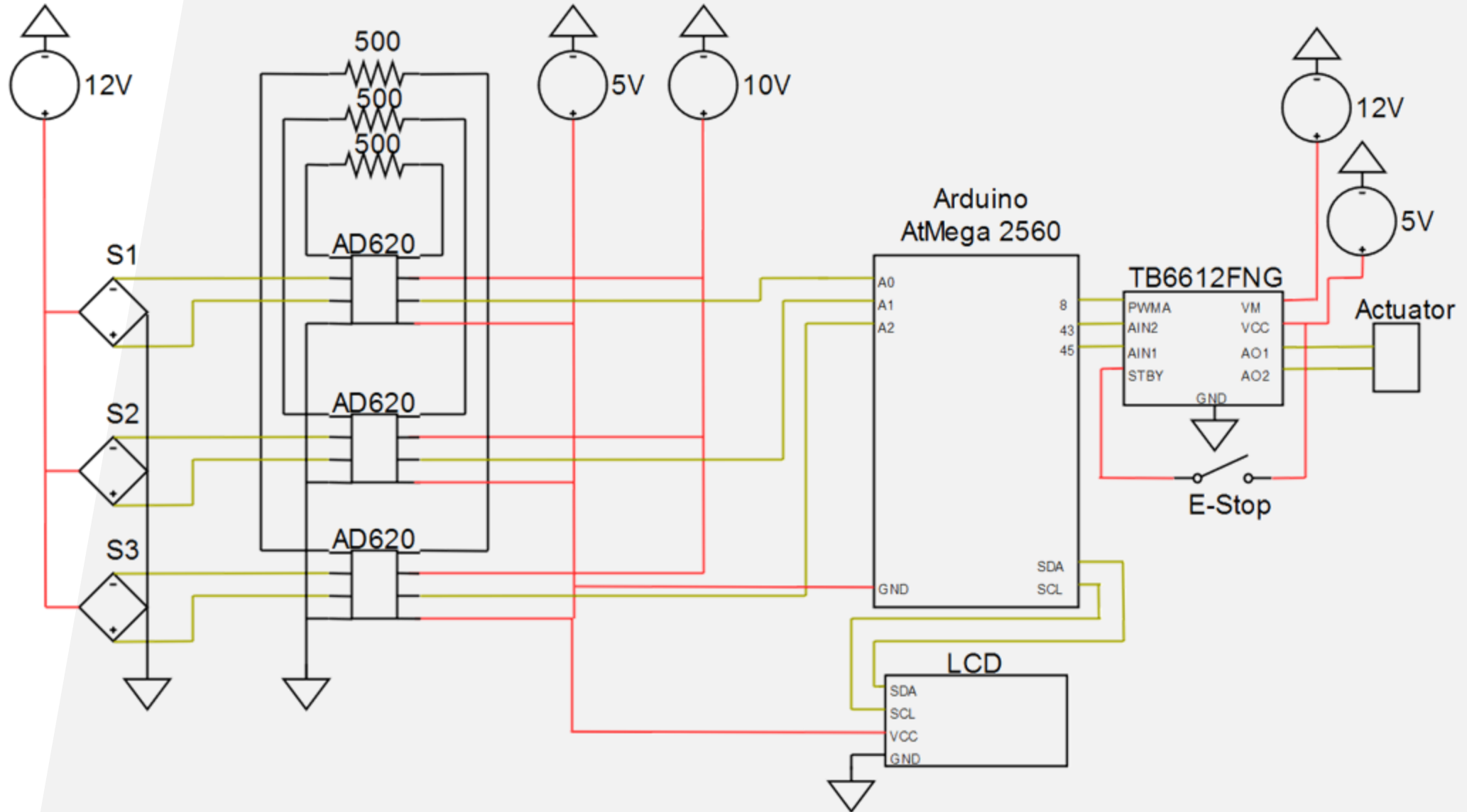
FINAL DESIGN



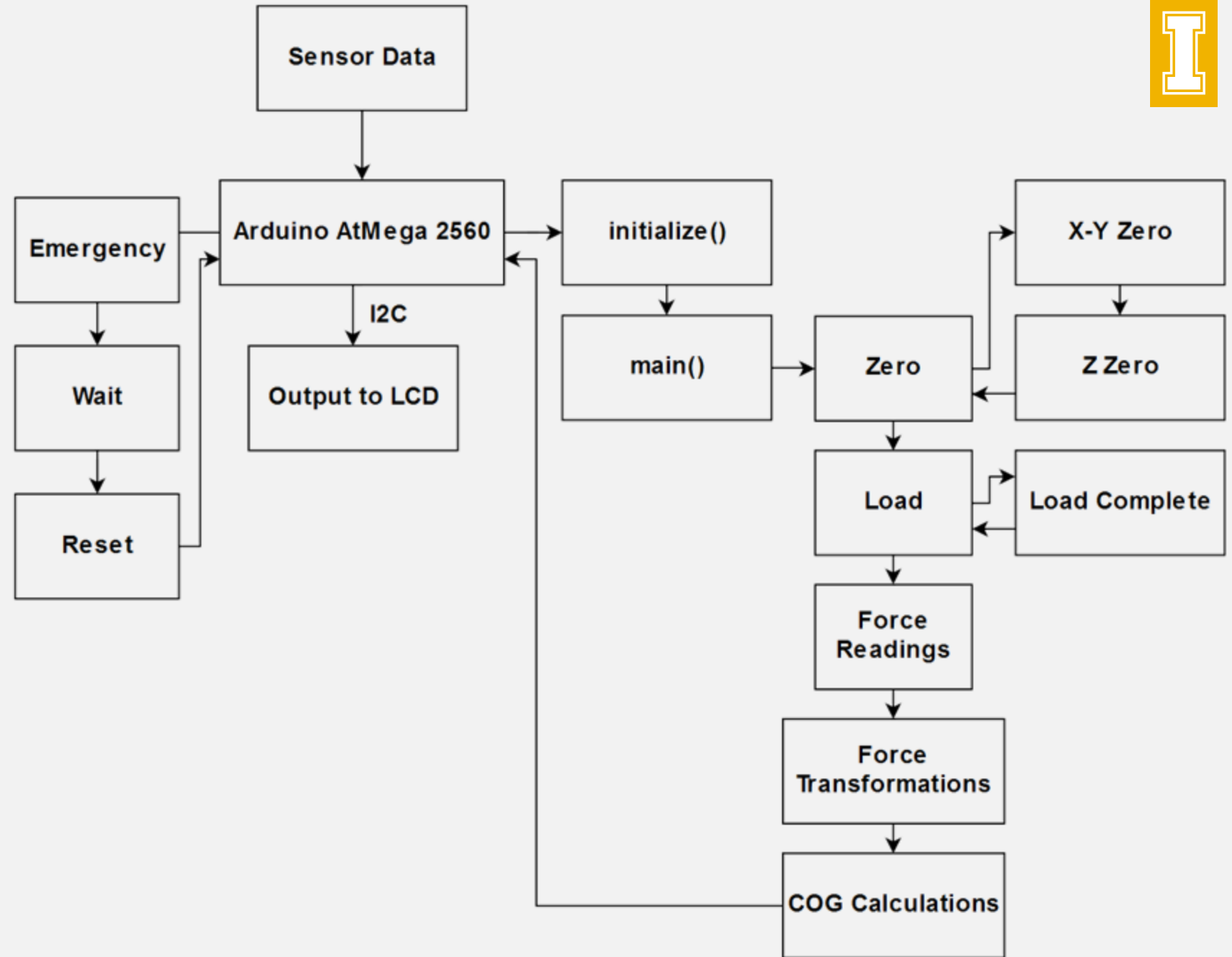
GENERAL SPECIFICATIONS

Weight	67.8 lbs
Size	24" x 24" x 33"
Maximum Angle	40°
Sensors	S-type Load Cell, 25 lb limit each
Actuator	150 lb ; 12 in stroke ; 0.37 in/sec Duty Cycle: 25% (5 min on/15 min off)

ELECTRICAL DESIGN



CODE STRUCTURE



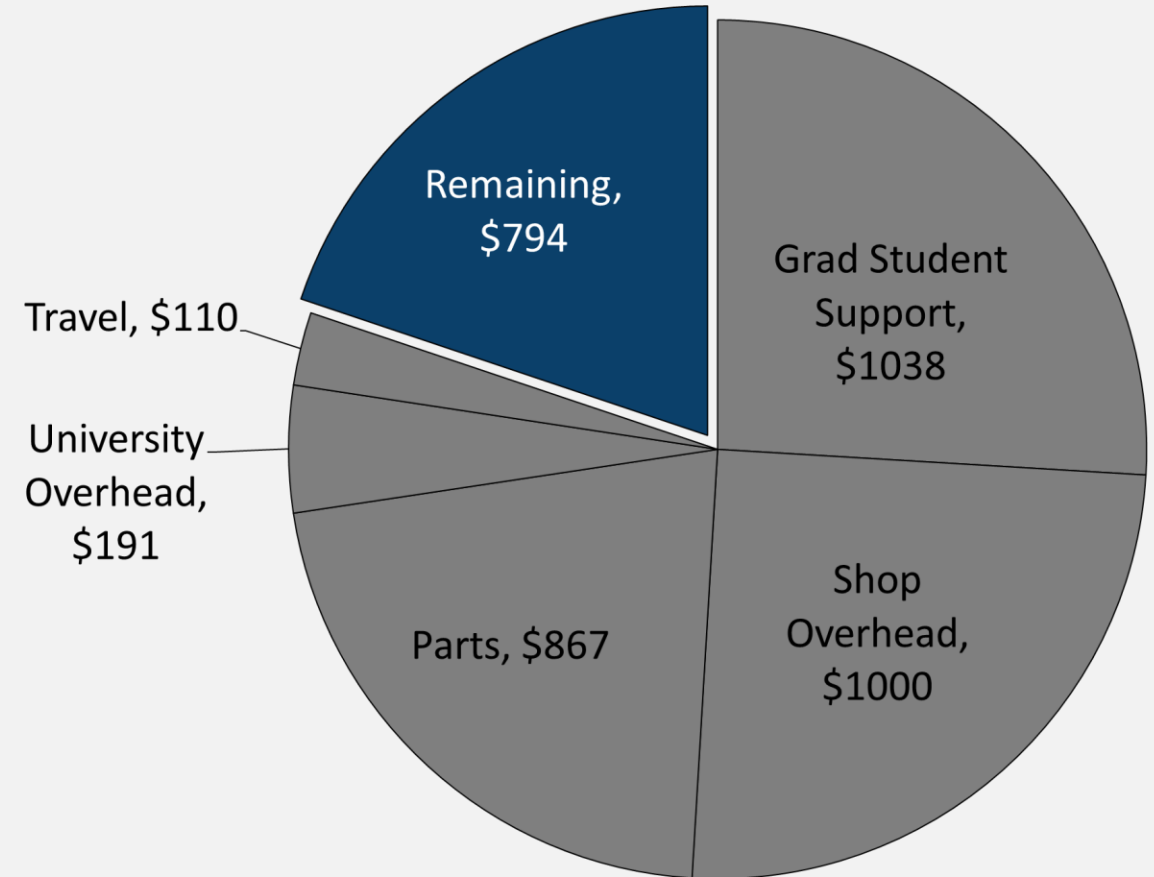
OPERATION INSTRUCTIONS

1. Turn on using red switch
2. Push button to start calibration
3. Relay is placed on top of device
4. Button is pushed again to start CG calculation
5. CG data is output to the LCD screen
6. Turn off the device

BUDGET

Budget Spending Distribution	
Grad Student Support	\$ 1038
Shop Overhead	\$ 1000
University Overhead	\$ 191
Parts	\$ 867
Travel	\$ 110

Cost Distribution + Remaining





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