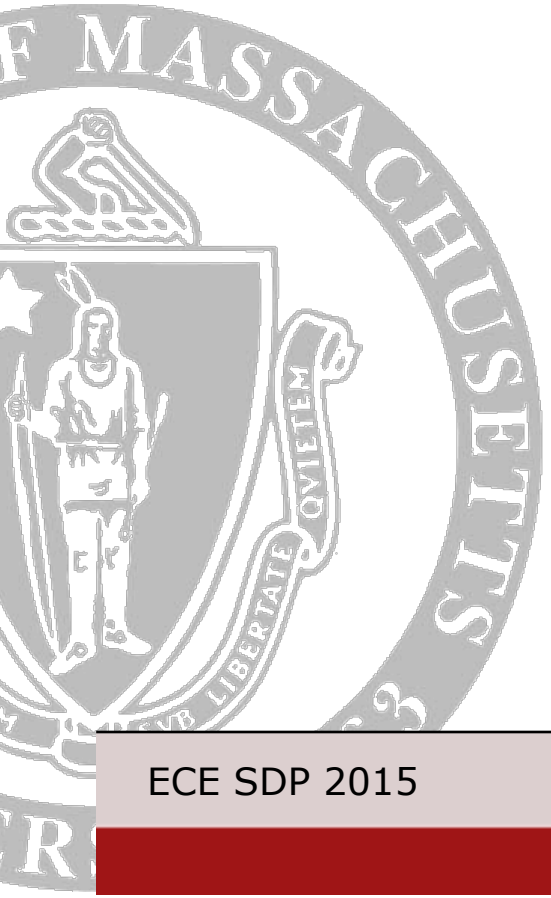
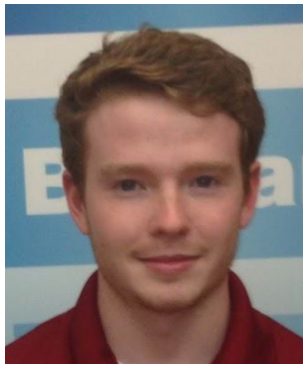
UMassAmherst

TrackStar:
Motion Tracking Stagelight Mount



Bradley Beady
Michael Bjorge
Ezra Dantowitz
Jason Gurney

Team 13



Bradley Beady, ME

Michael Bjorge, CSE

Ezra Dantowitz, EE

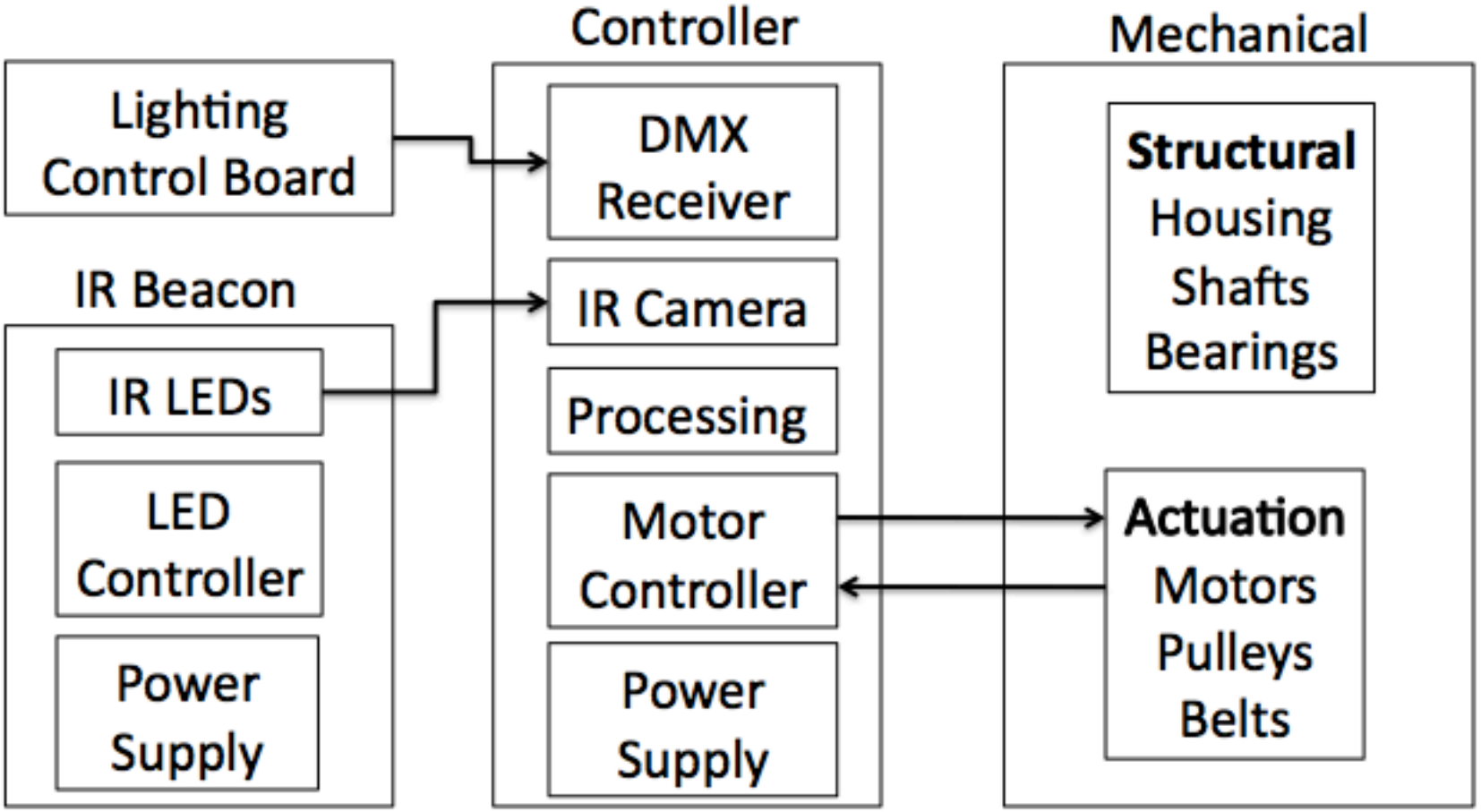
Jason Gurney, ME

Advisor: Tilman Wolf

Project Overview

- Mount for a previously fixed stage light
- System tracks performers in real time
- IR camera recognizes IR beacons
- Unique beacon pattern identifies desired target
- 2 modes: tracking and manual configuration

Block Diagram



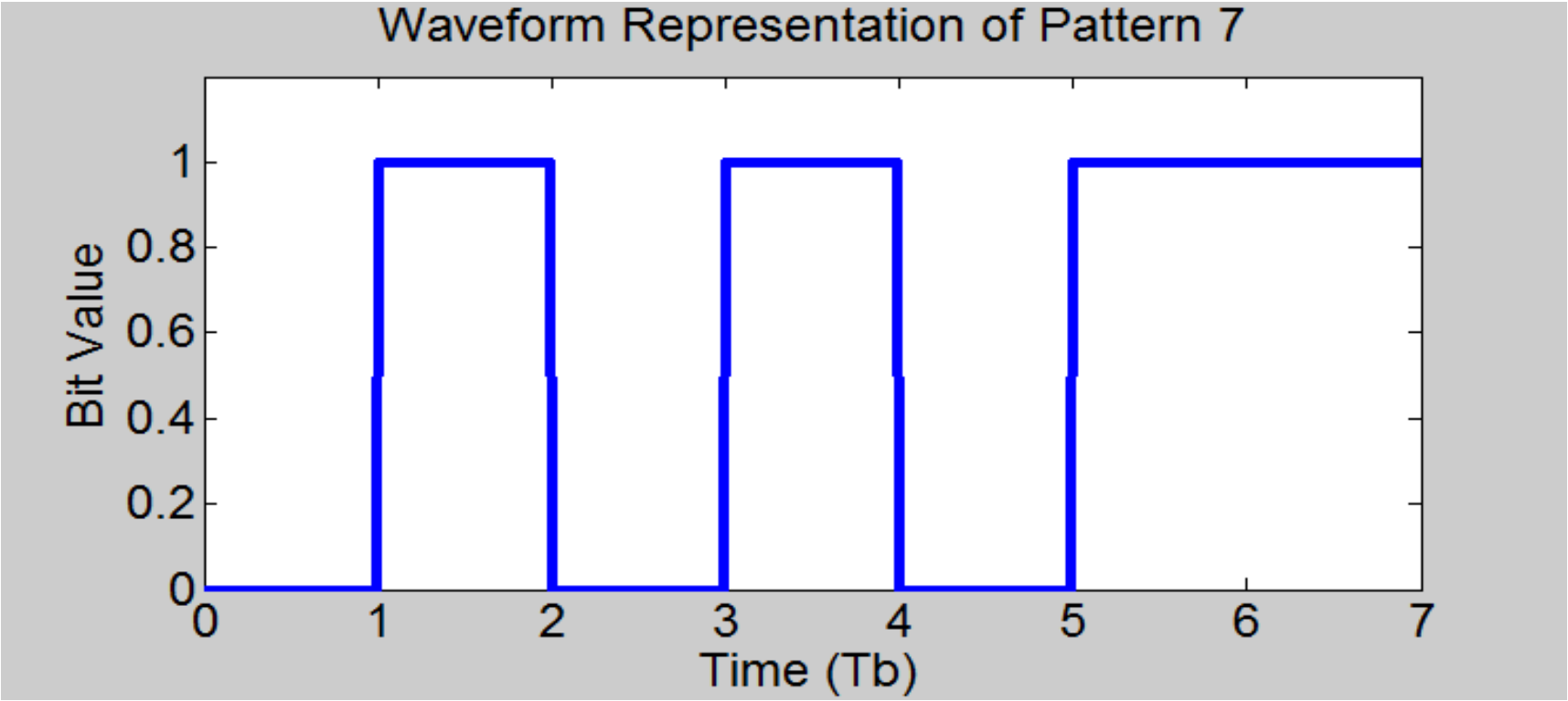
IR Tracking

- Patterns must be unique regardless of shifting
- Must be on more than half of the time

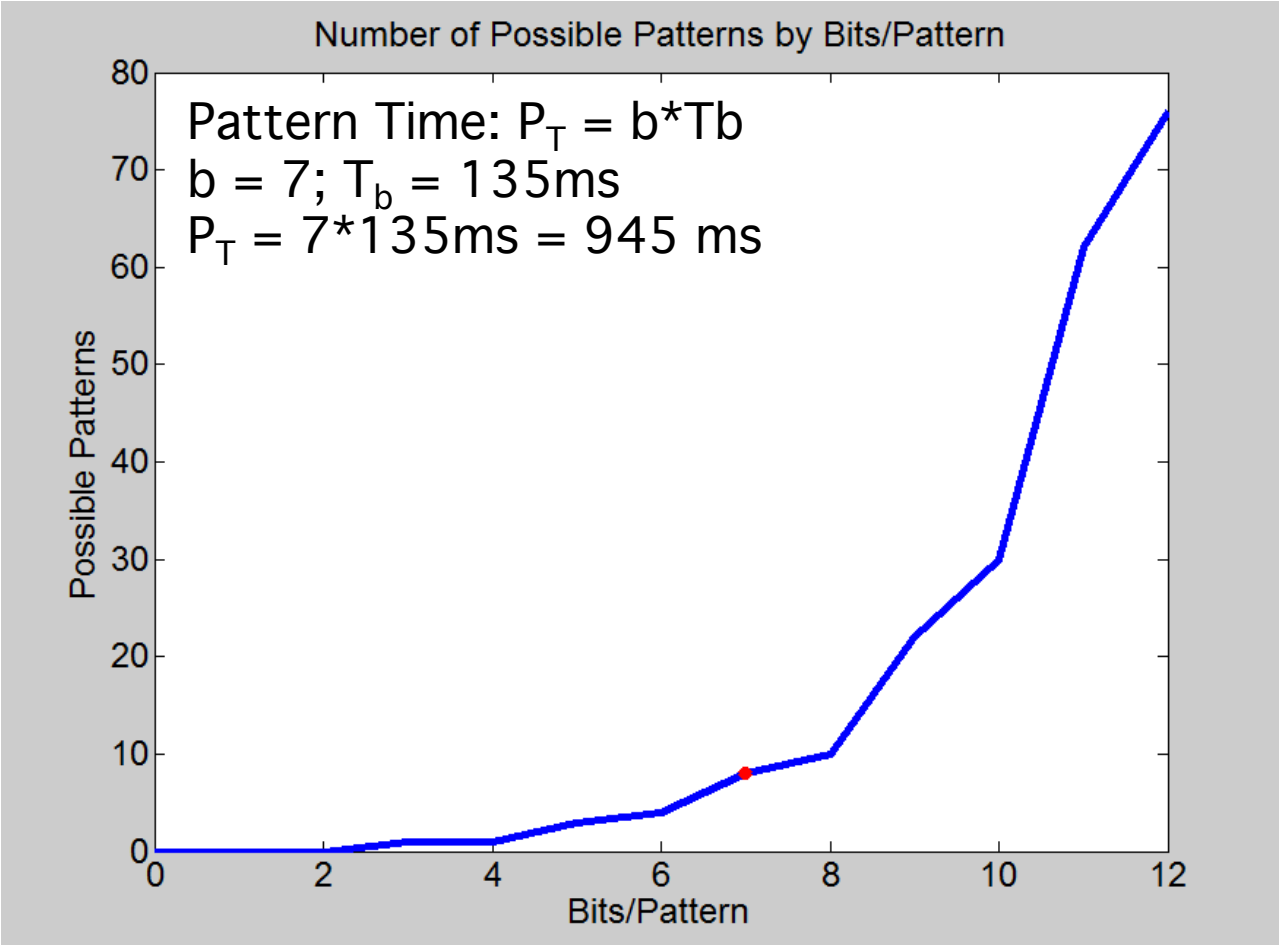
Patterns

0111111	0101111
0011111	0110111
0001111	0110011
0100111	0101011

Example Pattern



Choosing Appropriate Patterns



BeagleBone Black

- Performs image processing
- Interfaces with motor drivers
- Interfaces with DMX controller

Demonstration

- Videos
- Demos

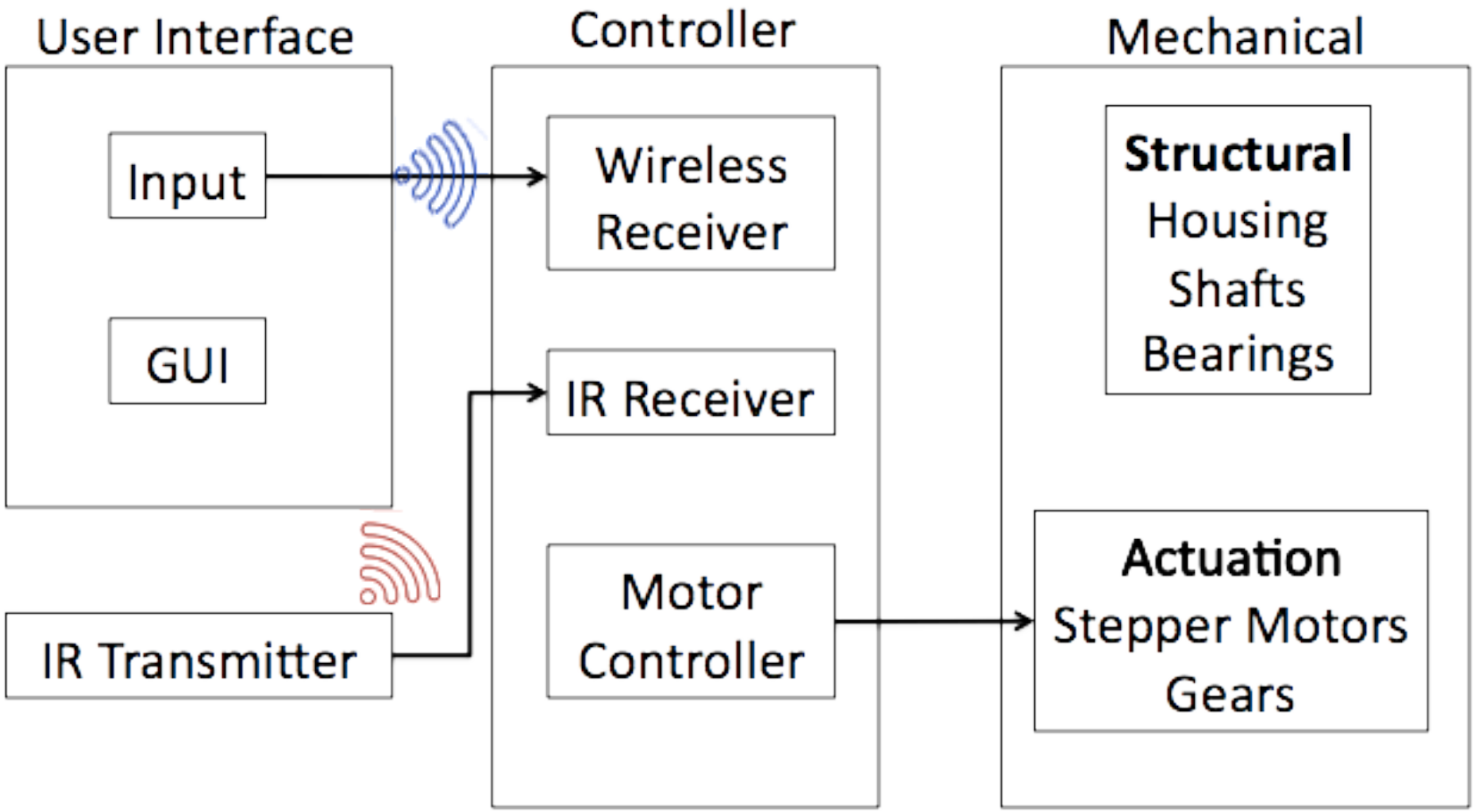
FPR Deliverables

- Tracks a performer in real time
- Distinguishes between multiple active beacons

- Electronics secured within base of mount
- Enclosures for IR Beacons
- Proto-board(s) for all wiring connections

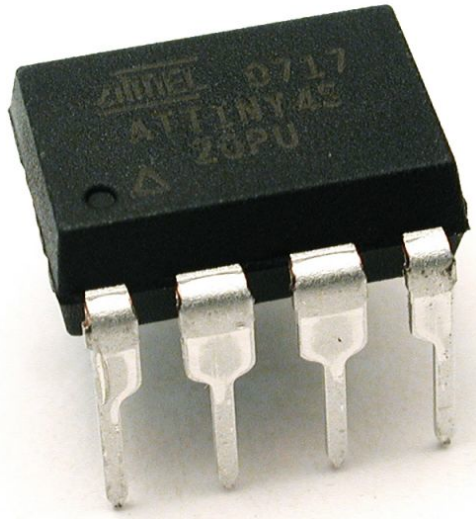
Questions

Previous Block Diagram



IR Beacon

- Blinks pattern on IR LEDs
- User selects one of 8 patterns
- Battery powered

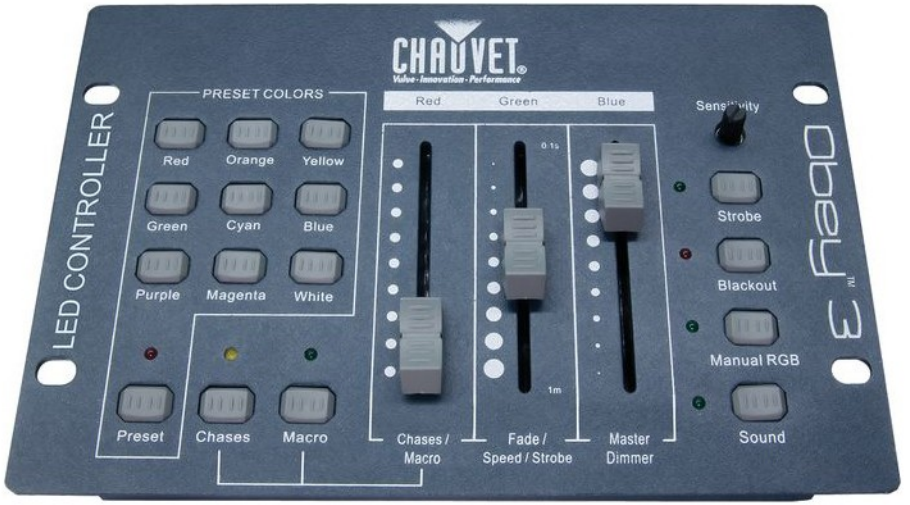


IR Tracking

- Camera with IR band pass filter
- Tracks an IR beacon
- Detects pattern of blinking beacon LEDs

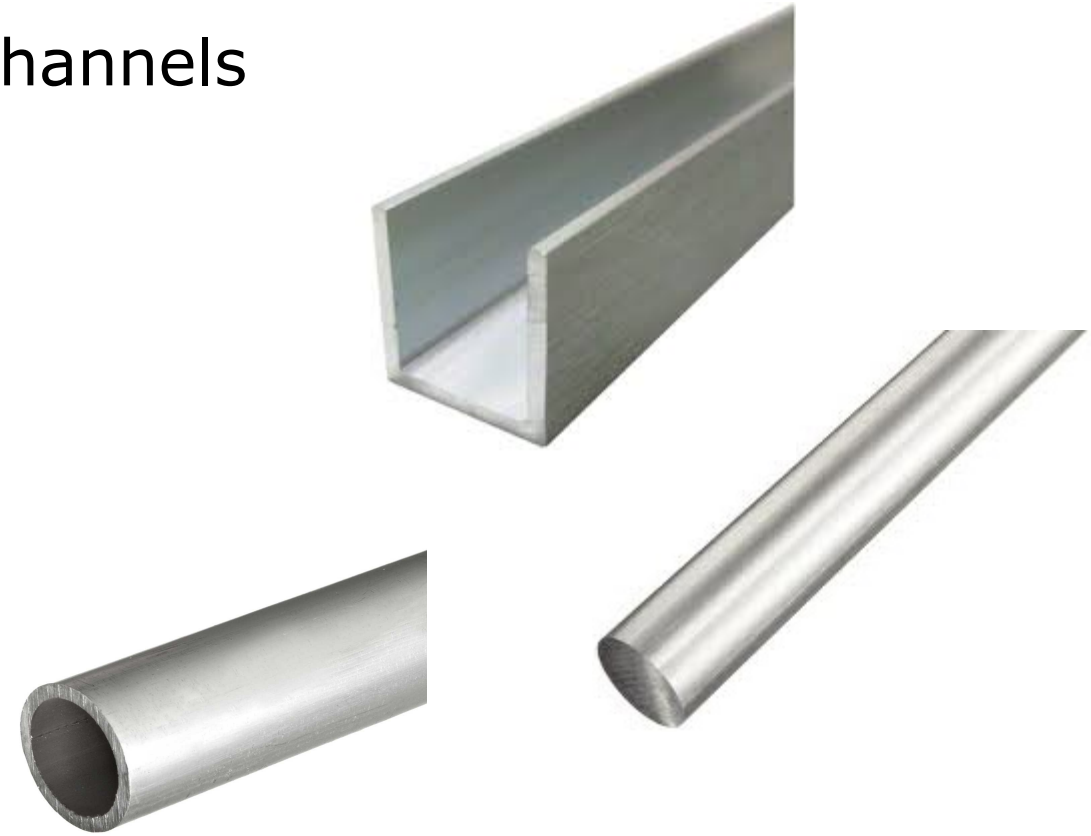
DMX

- Manual configure mode
  - Sets pan angle
  - Sets tilt angle
- IR Tracking mode
  - Selects pattern to track



Frame & Shafts

- Aluminum 6063 U-Channels
- Solid Pan Shafts
- Hollow Pan Shafts

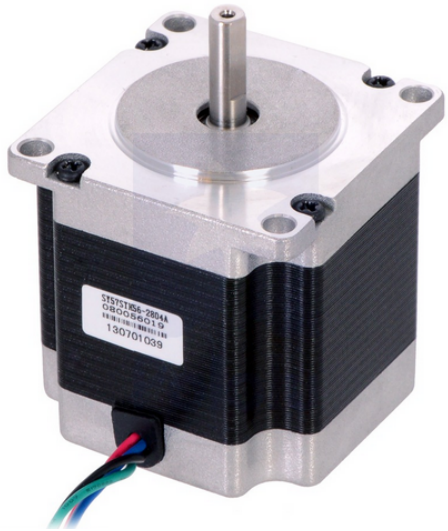


Bearings, Pulleys & Belts

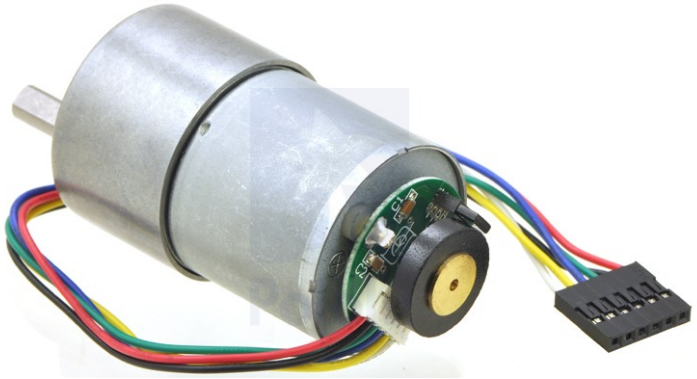
- Roller Bearings for Tilt Shafts
- Thrust Bearings for Pan Shaft
- 2:1 Flanged pulleys with belt

Motor Selection

- Stepper Motor
  - 11.25 in.-lb. Holding Torque
  - 200 Steps/Revolution
  - Phase draws 2.8 A at 2.5V



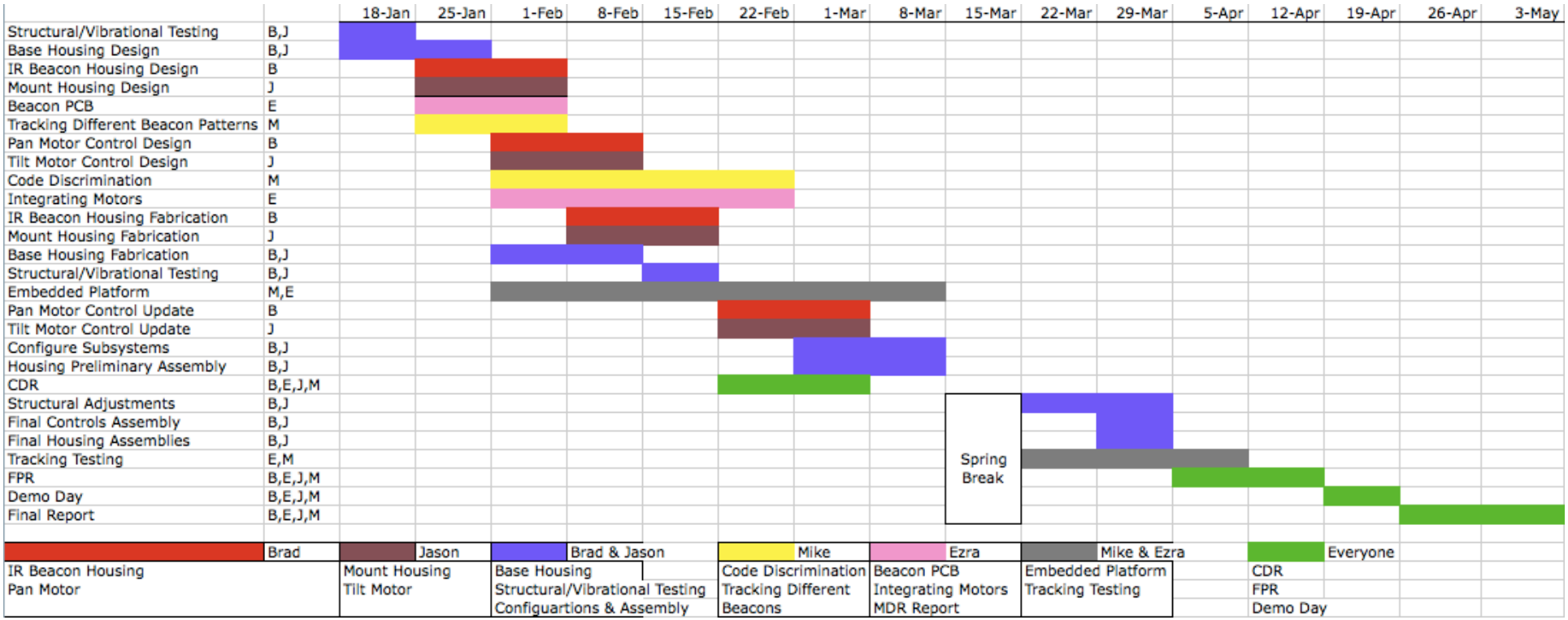
- Brushed DC Motor
  - 6.875 in.-lb. Stall Torque
  - 30:1 Gearbox
  - 64 CPR Encoder
  - 5A Stall Current at 12 V



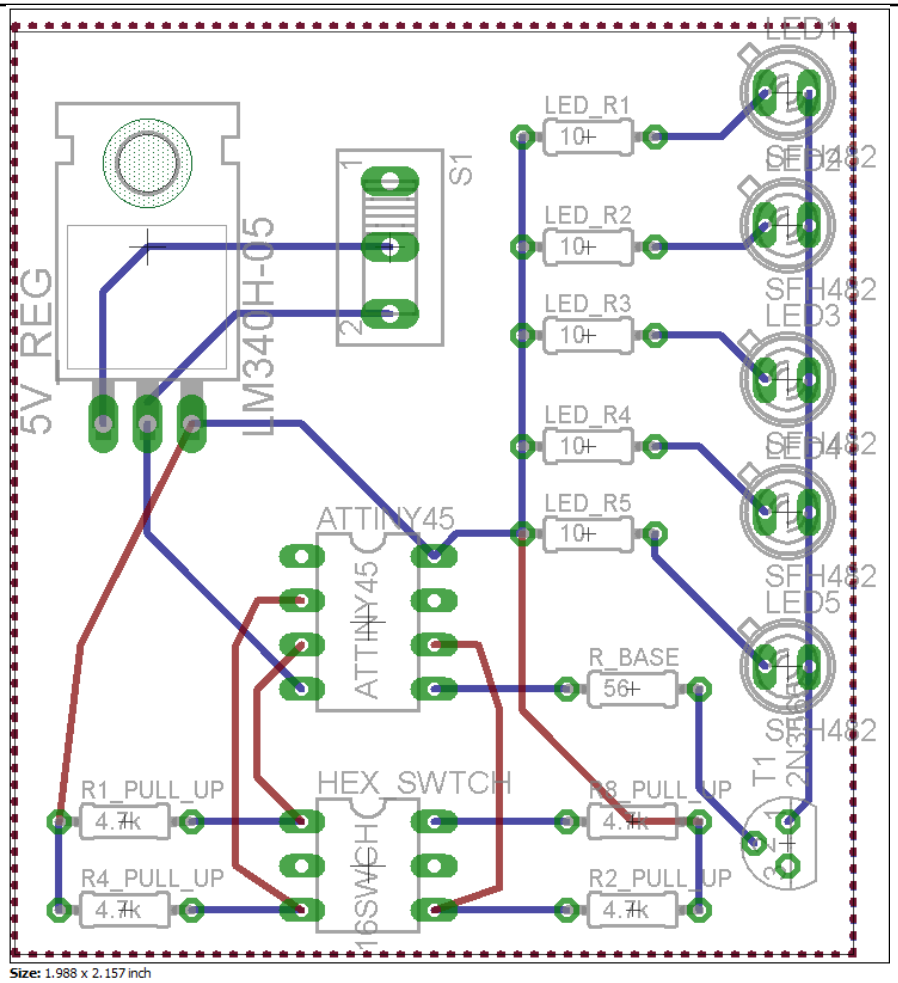
Fall Semester Schedule

- Finish PCB design
- MDR Report
- MIE Final Presentation
- MIE Poster Session
- MIE Final Report

Gantt Chart for Spring Semester



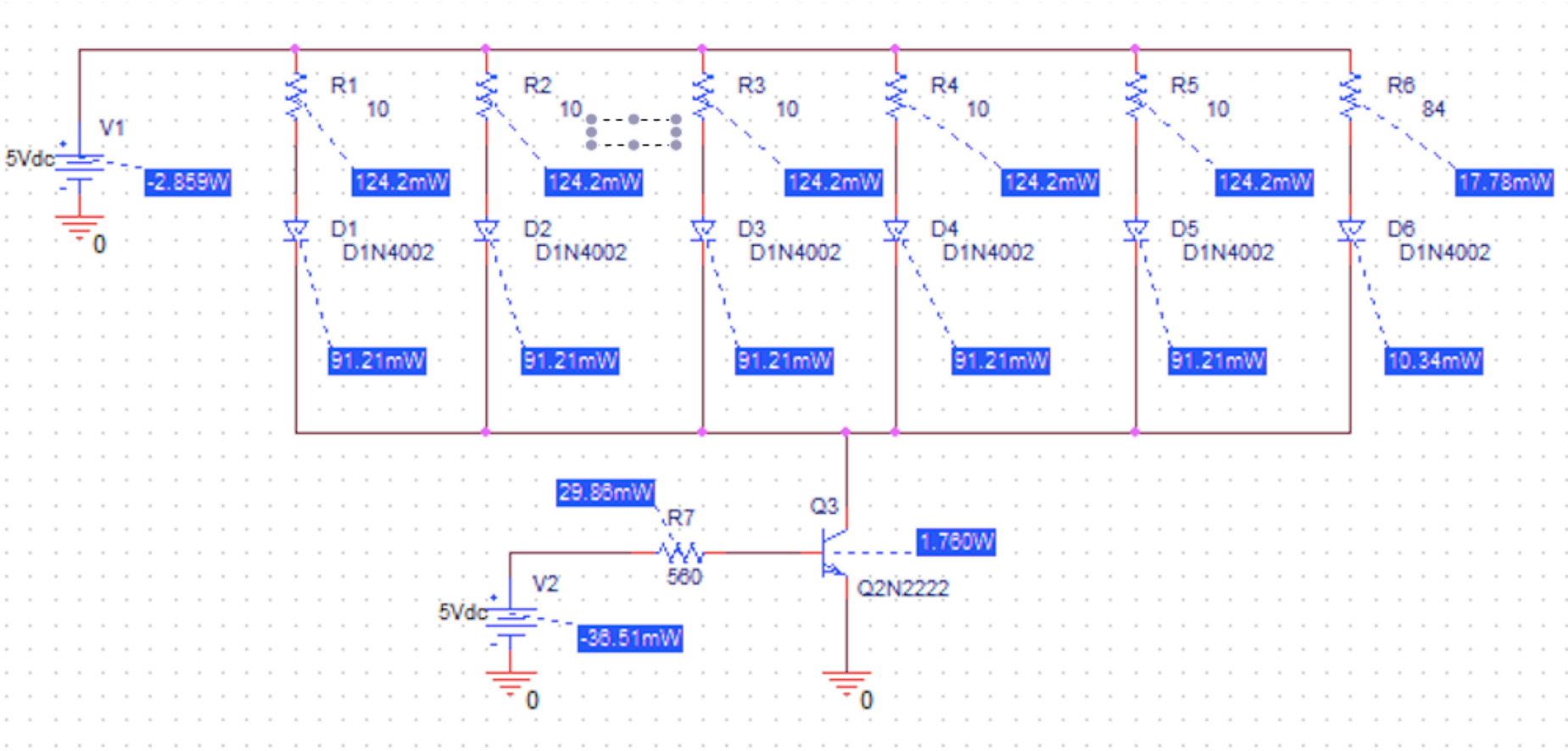
PCB


5V REG
LM340H-05
S1
LED_R1
LED_R2
LED_R3
LED_R4
LED_R5
10
ATTINY45
R_BASE
56
R1_PULL_UP
R4_PULL_UP
R3_PULL_UP
R2_PULL_UP
4.7k
HEX_SWTCH
T1
2N3906
SFH482
Size: 1.988 x 2.157 inch

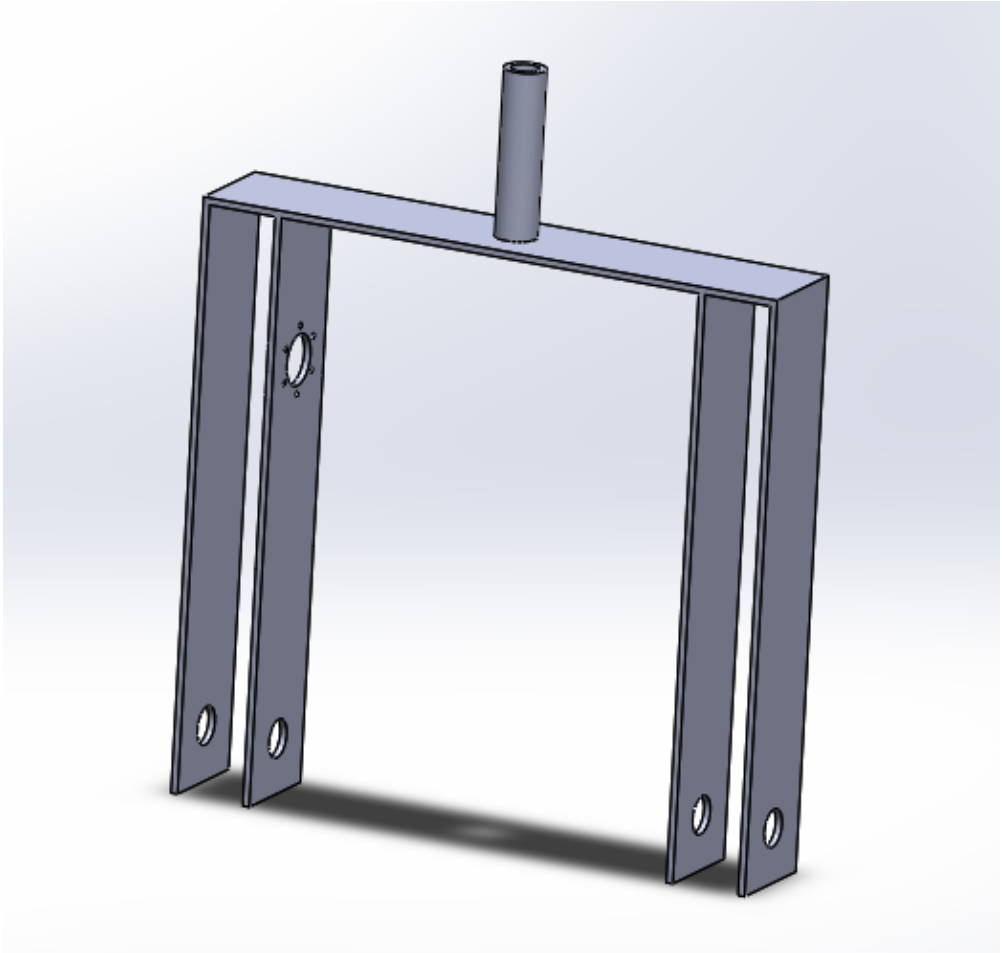
Power Calculations

- 280mA at 6V
  - (.280)*6 = 1.68W
- 4 AAA batteries at 860-1200 mAh
  - 3.44Ah-4.8Ah
  - Duty Cycle: 58%-86%
  - At least 14 hours

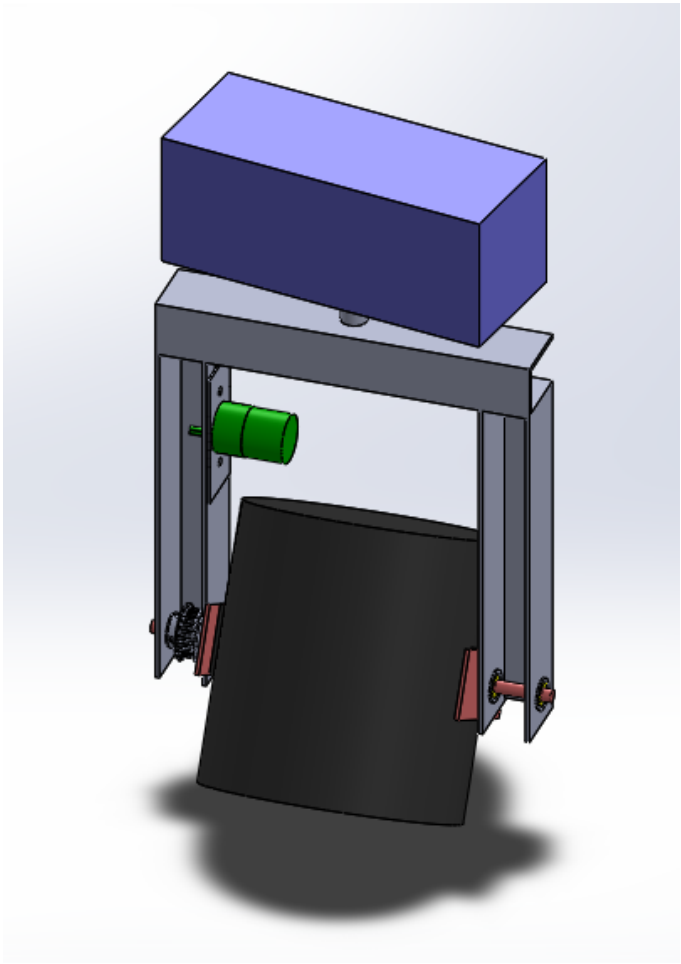
PSpice


V1
5Vdc
-2.859W
0
R1
10
124.2mW
D1
D1N4002
91.21mW
R2
10
124.2mW
D2
D1N4002
91.21mW
R3
10
124.2mW
D3
D1N4002
91.21mW
R4
10
124.2mW
D4
D1N4002
91.21mW
R5
10
124.2mW
D5
D1N4002
91.21mW
R6
84
17.78mW
D6
D1N4002
10.34mW
29.86mW
R7
560
Q3
1.760W
Q2N2222
V2
5Vdc
-38.51mW
0
0

Previous Design



Current Design



Torque Calculations

- $$T = J\alpha$$
$$\alpha = \frac{\omega_1 - \omega_0}{t}$$
$$J = \frac{m}{4}(r^2 + \frac{L^2}{3})$$
T = 8.5 in lbs.

Material Selection

- Stress = My/I
- M = 10 in lbs.
- y = D/2
- $I = \frac{\pi D^4}{64}$
- D = 3/8 in
- Stress = ~2000 psi