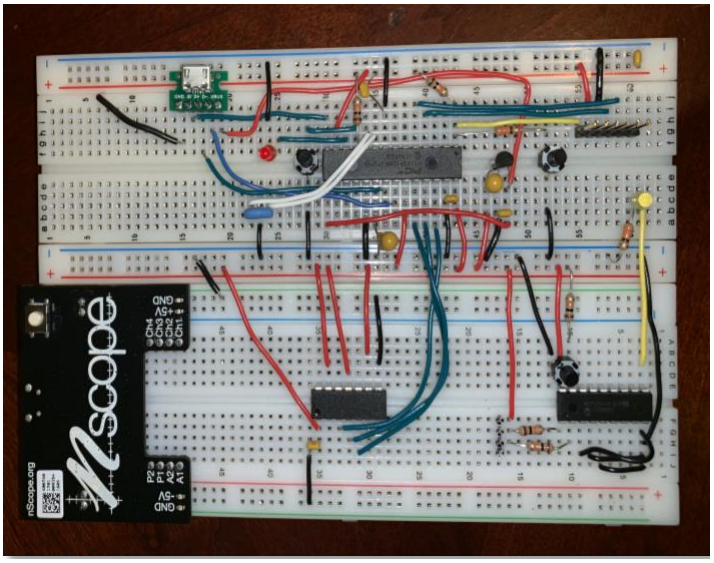
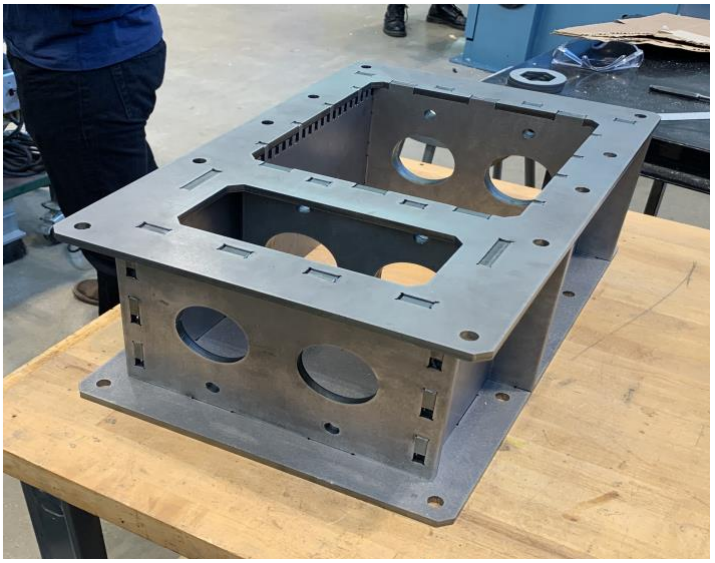
Caleb Lang

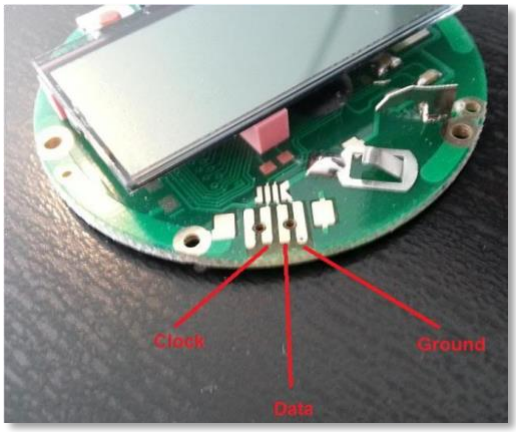


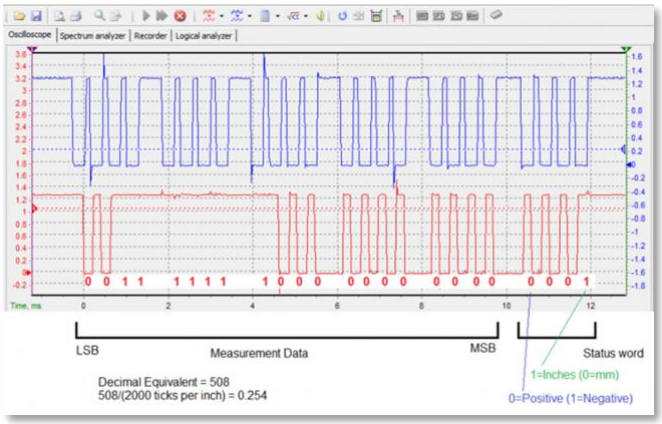


B.S. Mechanical Engineering

Northwestern University Class of 2020

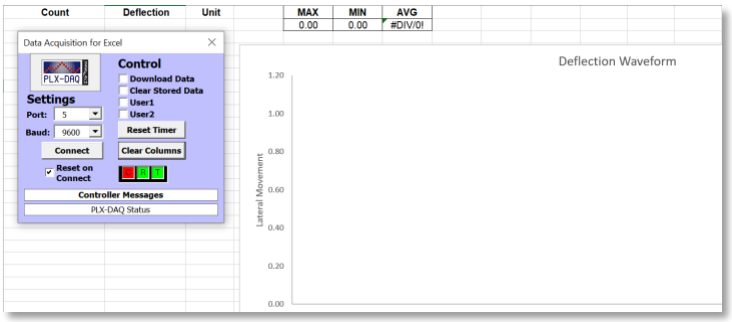
Dial Indicator Project (Peloton)





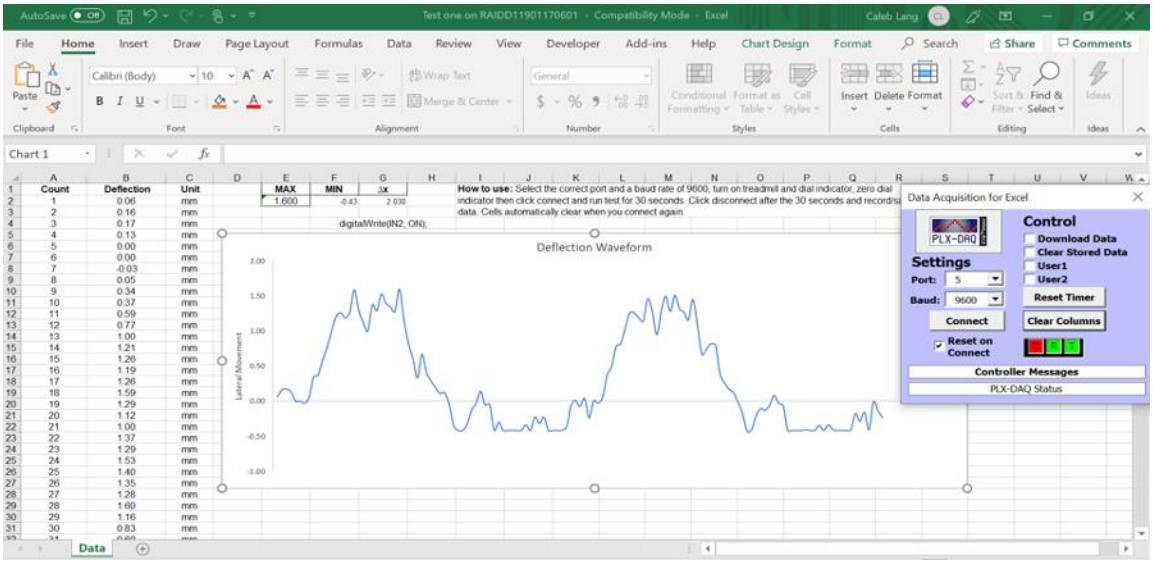
Hacking Dial Indicator

I opened up a digital dial indicator and discovered how it read data. It came with a proprietary plug that read data into excel when a read button was pressed; however, we wanted to read data continuously to develop waveform that tracked displacement. Probed dial indicator clock and data pins to see how it reads data and what communication protocol it used.



Programming Arduino

Used an Arduino to read incoming data from the dial indicator. Dial indicator function on 1.5V logic while the Arduino has 5V logic, therefore I had to use the Arduino's Analog-to-Digital-Converter to detect signals above .75V as 1s and signals below .75V as 0s. I had to speed up the Arduinos ADC sample rate access functionality available on the Arduinos microcontroller that Arduino does not make readily available. After reading the DATA bits I then wrote a simple function to convert these bits to a value. Additionally, I think used Parallax-DAQ, a Microsoft Excel Plug-In that interfaces with Arduino, to write data from the Arduino to Excel over a serial port. The data could then be analyzed in Excel.

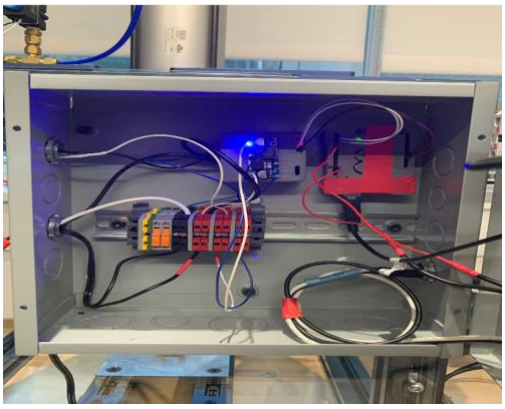


Example of collected data

The system was then attached to various test fixtures that I manufactured, and 3D printed to be used in a number of applications.

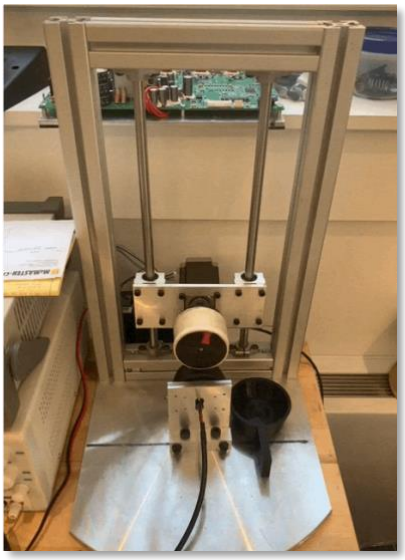
The data above shows an example of a waveform collected from a test.

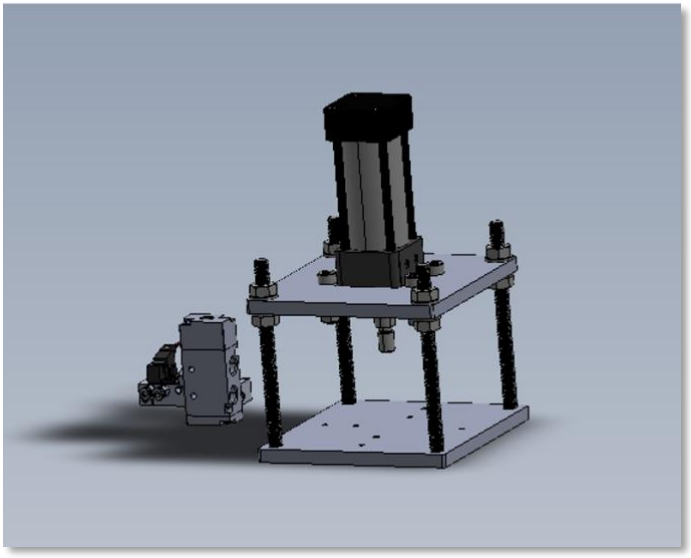
Other Peloton Projects



Incline Motor Testing

Another test involved using a large pneumatic cylinder to apply loads to various incline motors. I used a microcontroller and relays to control the incline motor (up and down), and solenoid valves to control the pneumatic pressure. I also included a human-machine interface to set and run various test recipes to help identify which incline motor to include in the next PVT. Pictured above is the electronics box built featuring two relays and an Arduino.

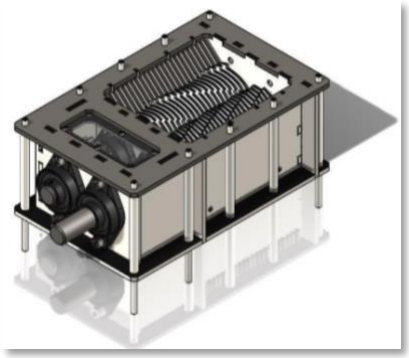


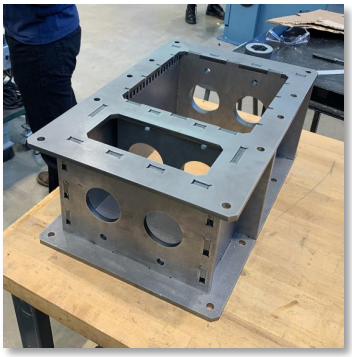


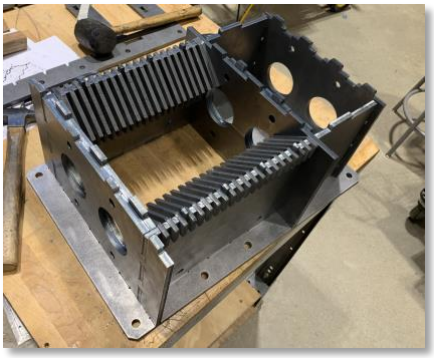
Knob Turning and Button Testing

Did not develop test or test fixtures but updated and added functionality to test systems. Added an LCD screen (not pictured) to not the cycle number and rpm speed for the knob turner (left). Changed out a two-position pneumatic piston to a single-action piston for the button presser to reduce energy use and increase efficiency (right).

Shredder Project (Senior Capstone)

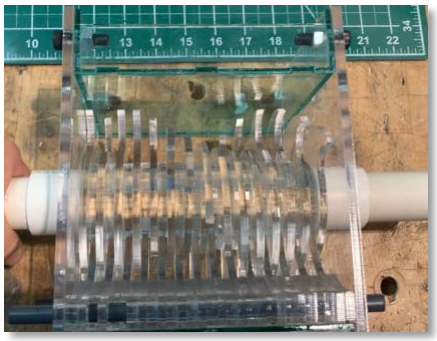






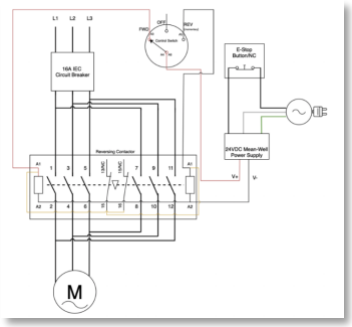
Shredder Housing

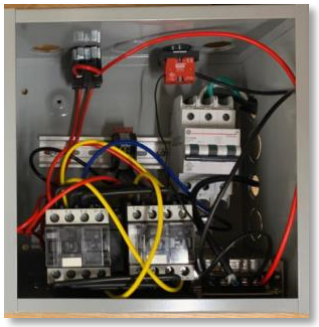
Designed, laser cut, and assembled shredder housing. Key features include a double-axis design, geared shafts to rotate at difference speeds, static teeth, and the six-tooth and thirteen-tooth dynamic blades.



Shredder Mockups and Prototypes

Plastic, wood, and metal prototypes developed for shredder project. Used to determine final blade design, spacing, etc.

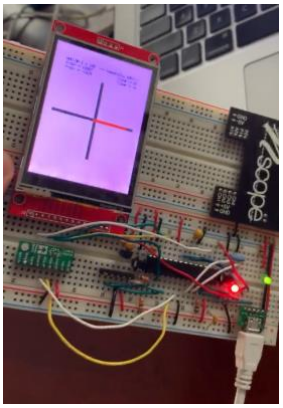




Shredder Electronics

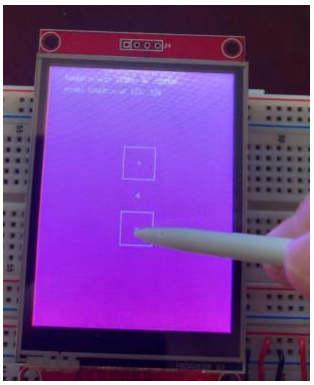
I wired the electronics to control the gearmotor with three-phase power. Admittedly messy electronics box on the right.

Advanced Mechatronics

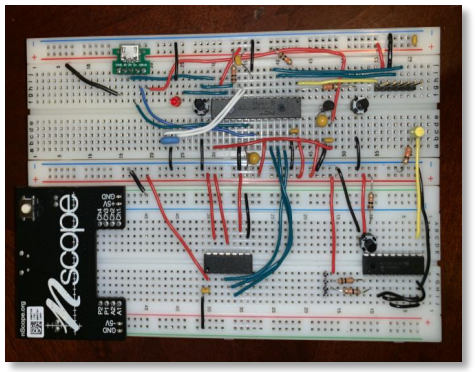


Reading IMU and using LCD screen

Here I used a PIC32 microcontroller and an LCD screen to plot readings from a Polulu IMU.



Using ILI LCD touchscreen capabilities



Circuit I made for a PID motor control project