Project Portfolio

Siddharth Kurwa

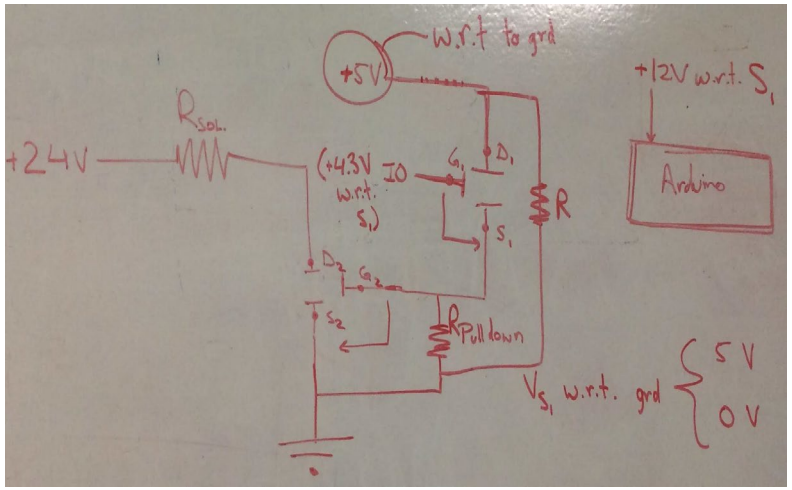
https://skurwa.github.io

Contents

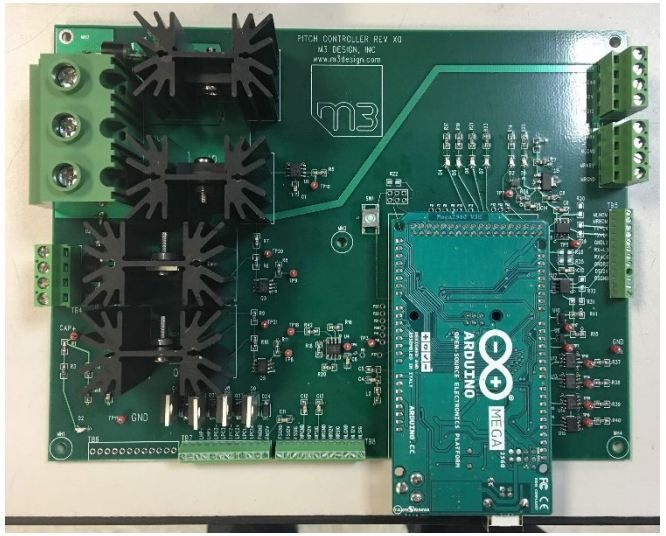
Professional Projects

Ball-Toss Machine

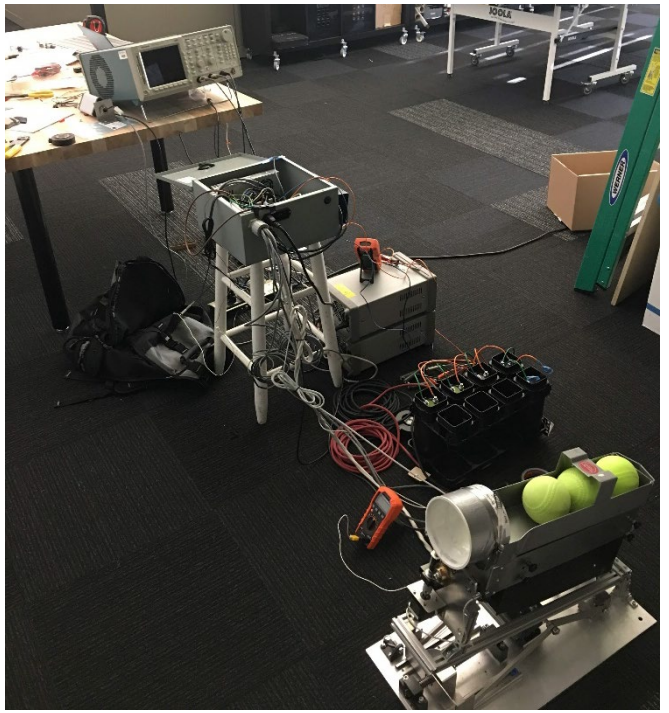
Performed electrical design, control programming, and prototyping to build an actuated and controllable ball-toss machine.



Whiteboarding of basic electrical design and control.



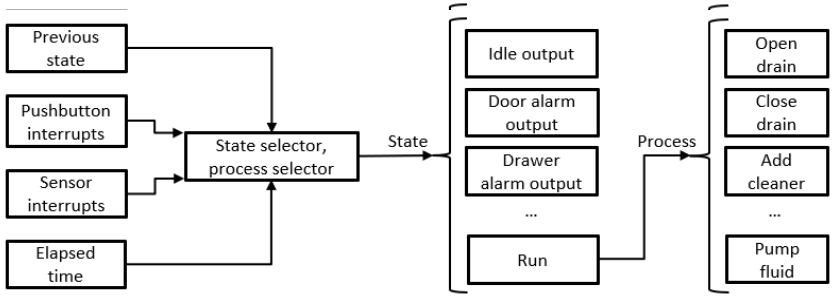
Surface-mount soldered 50+ circuit elements to PCB for ball-toss machine and programmed Arduino charge/discharge control.

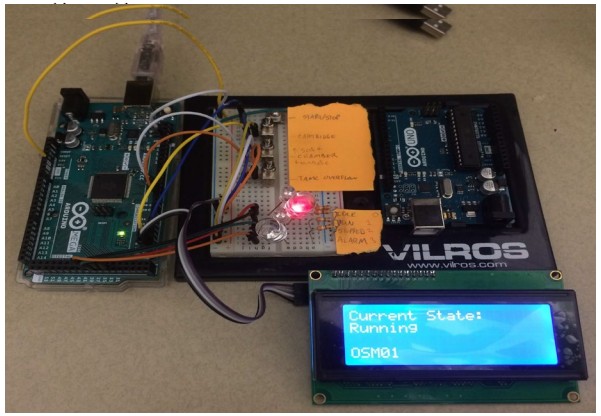


Debug and testing of prototype embodiment.

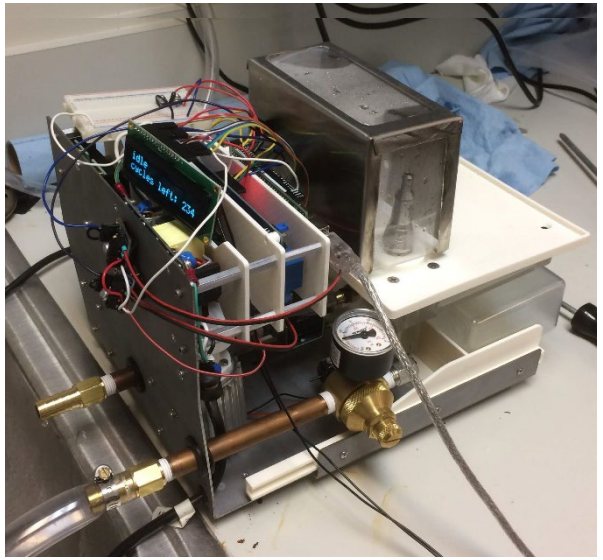
Automated Surgical Handpiece Cleaner

Developed controls architecture, integrated software into physical system, and worked with mechanical and industrial design teams to achieve product specifications.





Initial hierarchical state machine architecture design and basic mockup.



Integration, tuning, and debugging of controls with physical hardware (DC motors, sensors, valves, OLED display, and pushbuttons).

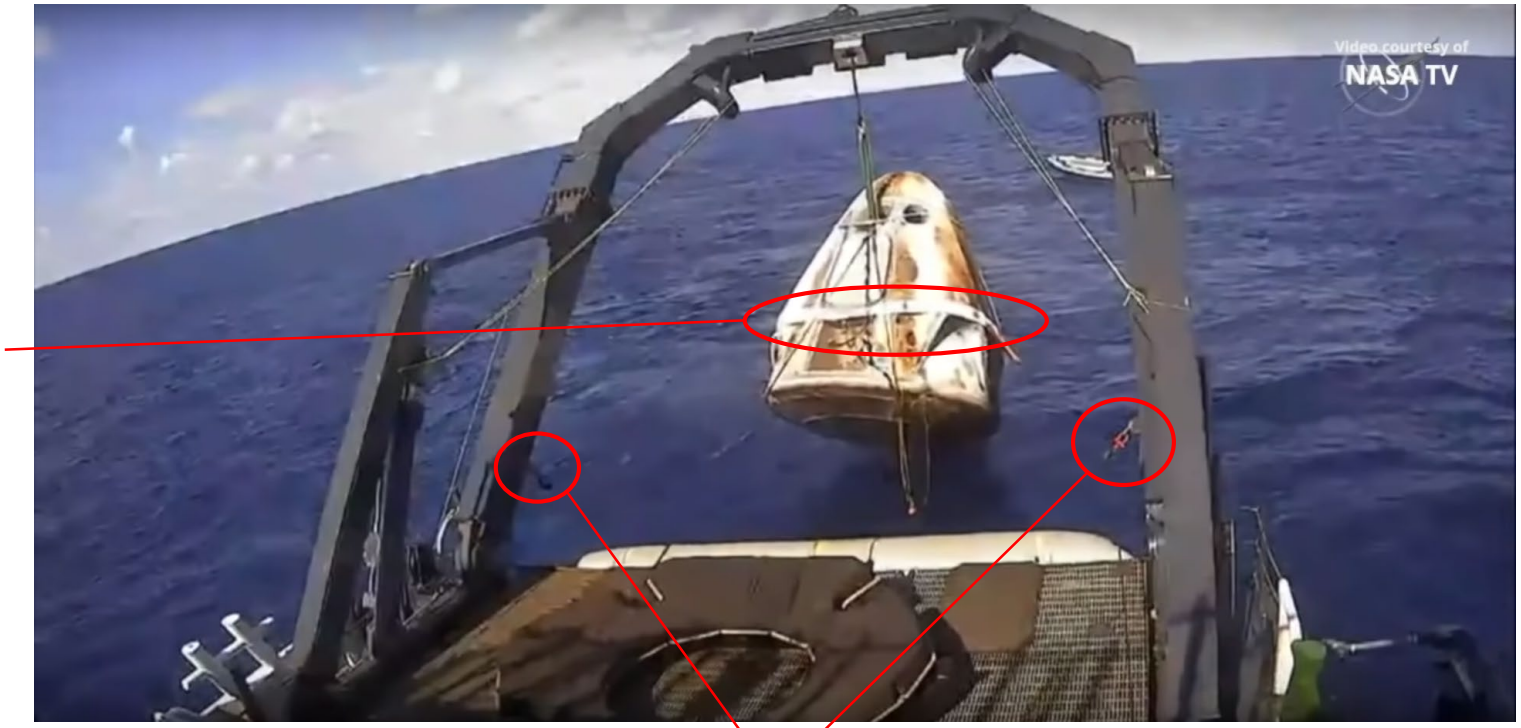
Incorporation of functional prototype into industrial design vision.

Crew Dragon Ocean Recovery

Designed, analyzed, and fabricated parts to support ocean recovery of Crew Dragon capsule.

Below image from the March 2019 Demo-1 mission depicts successful Crew Dragon hoist and ocean recovery.

Designed, analyzed, and ocean-tested “horse collar” design and operation prior to use on Crew Dragon Demo-1.



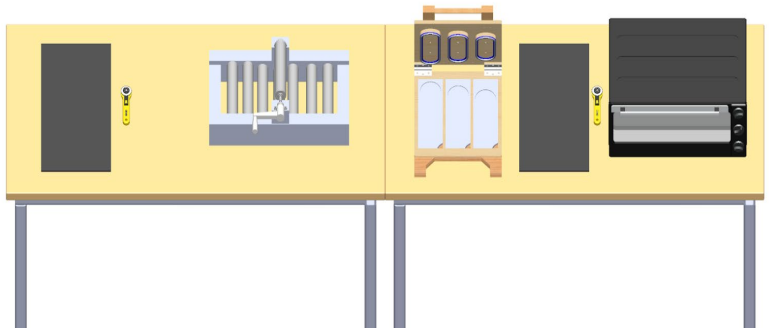
Designed, analyzed, and fabricated fairlead weldment used for hoist line routing (not pictured).

Designed in Siemens NX, analyzed in ANSYS, and fabricated lug weldments on vessel’s A-frame.

Academic Projects

Low-Cost Menstrual Pad Fabrication Prototype

Led team of 4 to develop a functional prototype process to enable Syrian refugees to locally fabricate low-cost menstrual pads.



Developed complete manufacturing process from raw material to finished product.

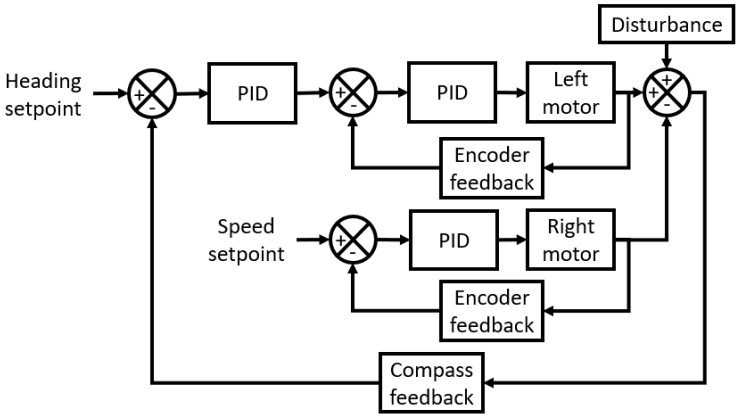
Led design and prototype of customizable thermoplastic heat sealer.

Ordered, tested, and selected suitable fabrics to scale low-cost menstrual pad fabrication.

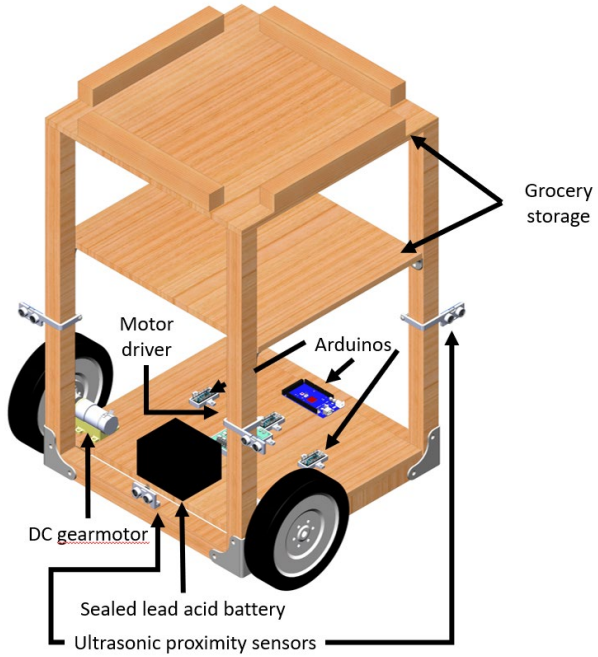
Design Review

Smart Cart

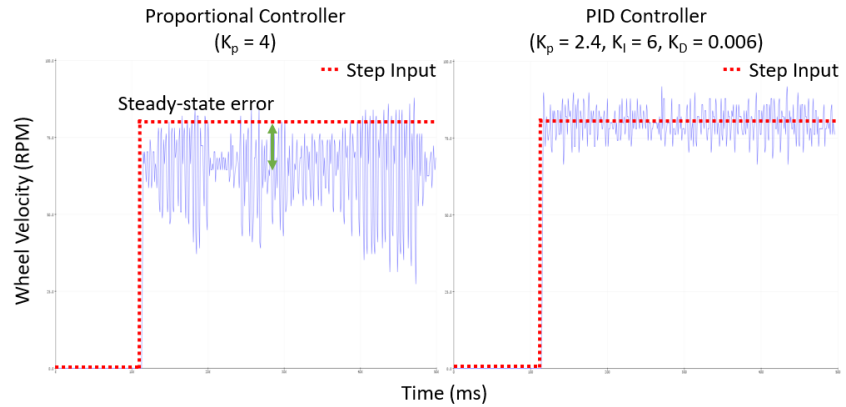
Independently designed, analyzed, and prototyped the mechanics, electronics, and software of an autonomous shopping cart.



Designed control system architecture for closed-loop obstacle avoidance, steering, and speed control.



Mechanical cart design in SolidWorks.



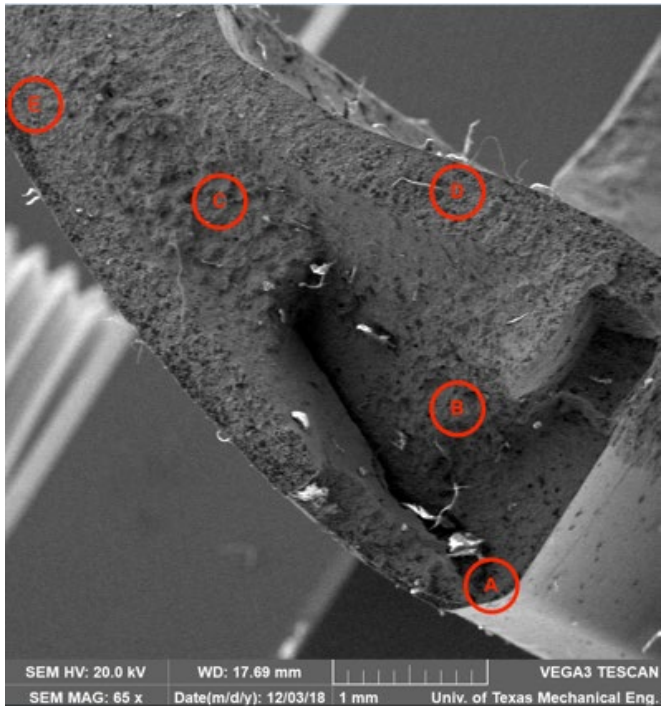
Used Ziegler-Nichols tuning to tune PID controller.

[Github Repository]

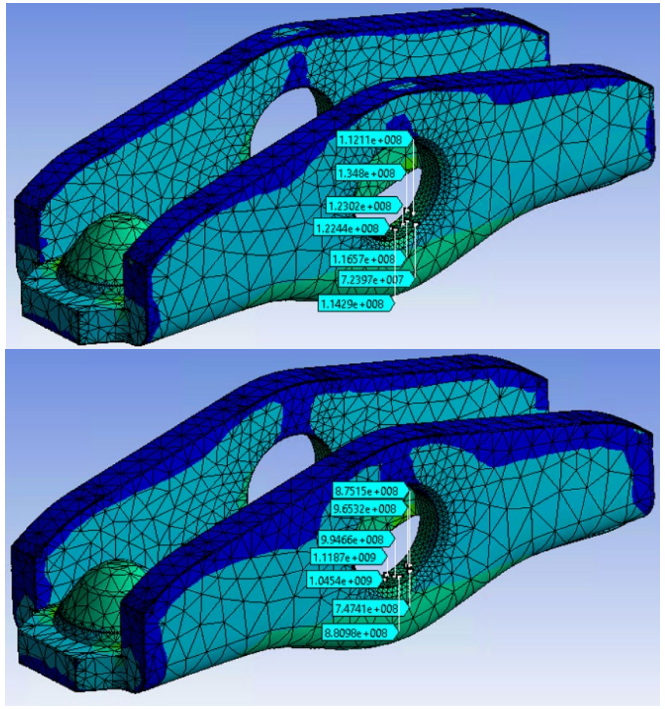
Failure Analysis of a Rocker Arm

Worked with team of 3 to analyze metallurgical properties, fractography, and loading to determine cause of rocker arm failure in 2015 Chevrolet Cruze 1.8L engine.

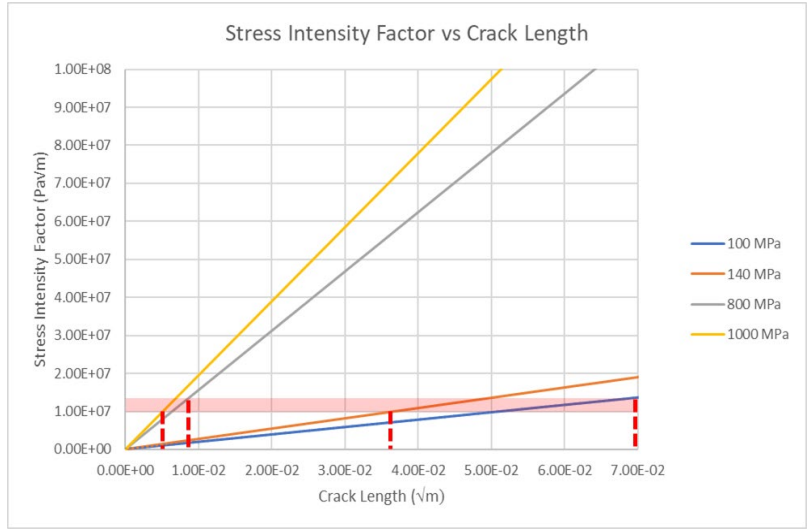
Failed rocker arm.



Used SEM to observe micro-mechanisms at 5 locations to identify brittle failure (intergranular fracture).



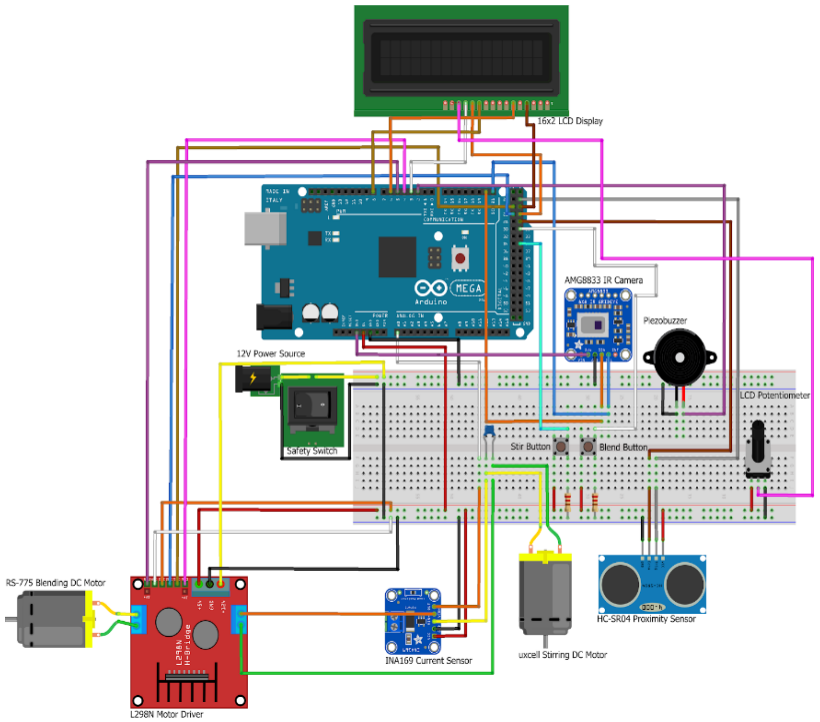
Estimated principal stresses at failure origin under normal operation (top) and overload using ANSYS static structural (bottom).



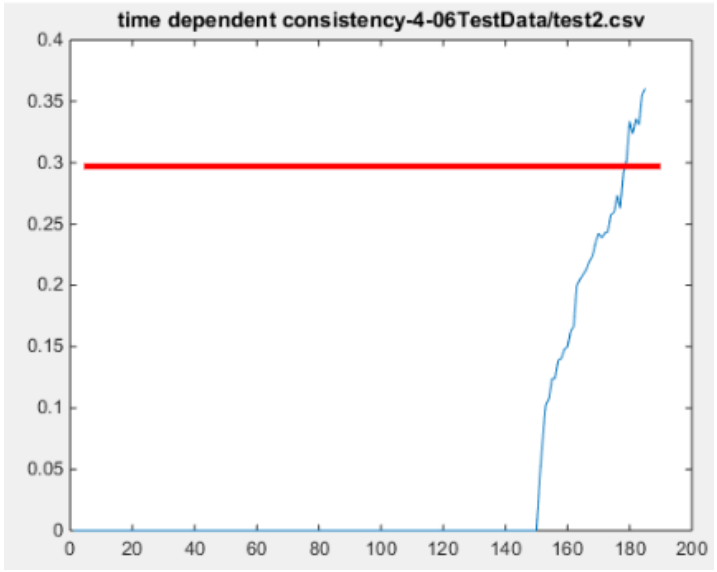
Determined necessary edge defect size for fracture under estimated stresses to approximate cause of failure based on linear elastic fracture mechanics.

VeganEgg Scrambler

Led team of 6 to develop a prototype device that whisks and scrambles an egg while monitoring changing consistency and temperature.



Executed electrical and software design, testing, and debug.



$$con_i = con_{i-1}(1-W) + [min(\overrightarrow{cur_i})(1 - \frac{t_i - t_0}{300}) + max(\overrightarrow{cur_i})(\frac{t_i - t_0}{300})]W$$

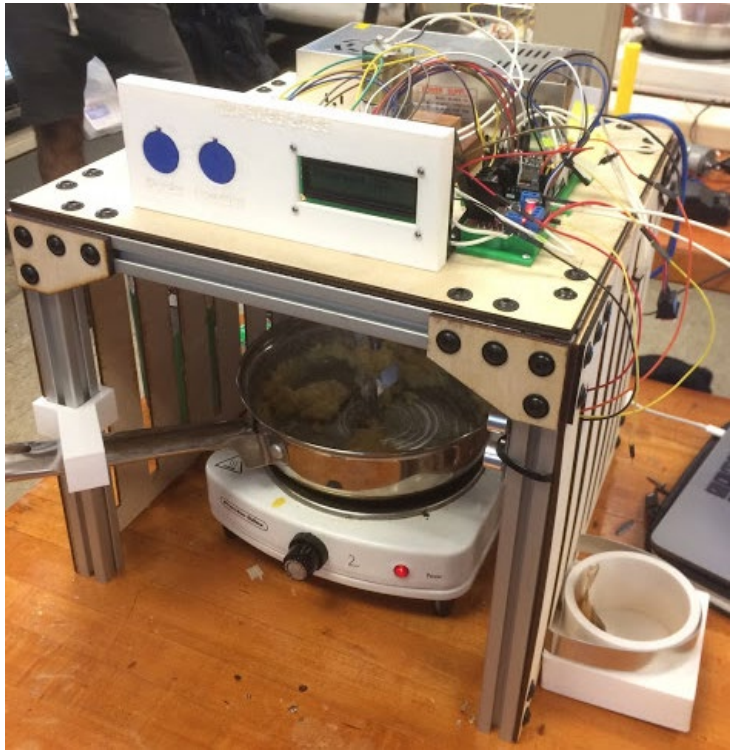
$con = consistency$

$cur = current$

$t_0 = initial\ time$

$W = filter\ weight$

Formed an empirical model for egg consistency using cooking time and motor torque by fitting test data.

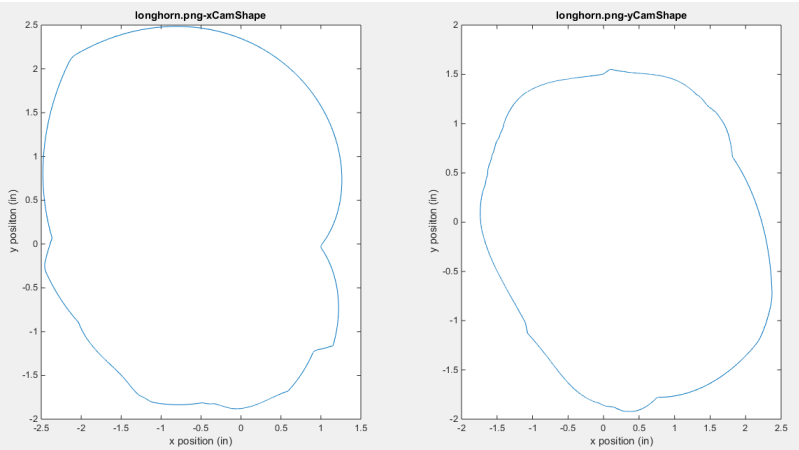


Led team of 6 to deliver successful prototype under budget and on schedule.

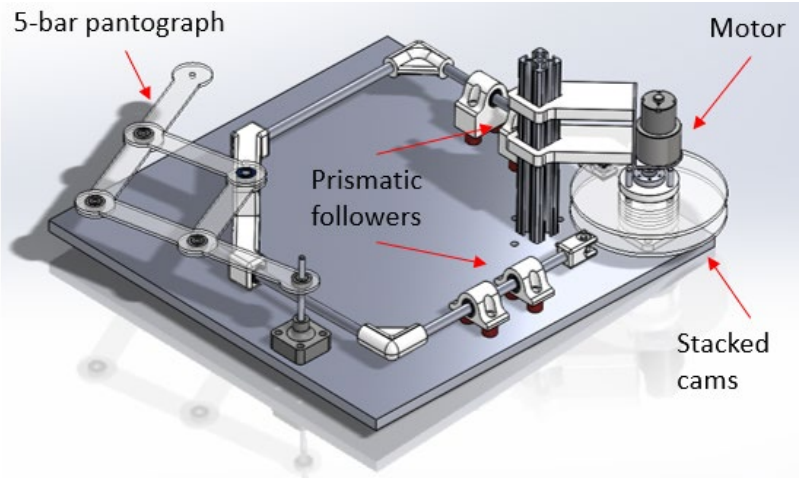
Final Presentation | Github Repository

CamSketch

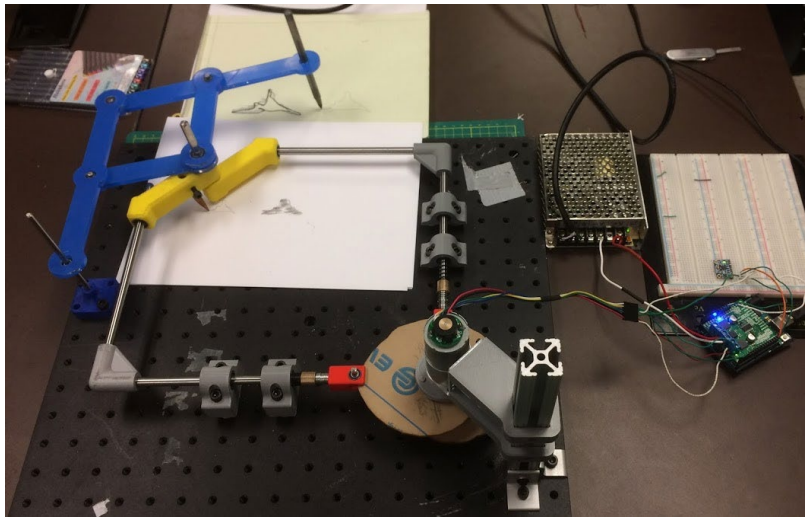
Led team of 3 to develop an accessible sketching mechanism for motor-impaired elementary school art students.



Wrote MATLAB fuction to generate cam profiles from an input image of a shape.



Collaborated to design and revise mechanical system in SolidWorks.

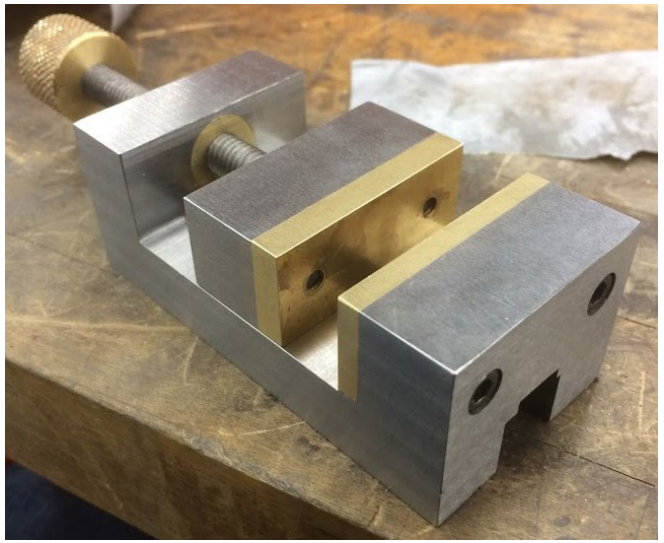


Iterated through prototypes to successfully achieve and demonstrate functional system.

Project Documentation | Github Repository

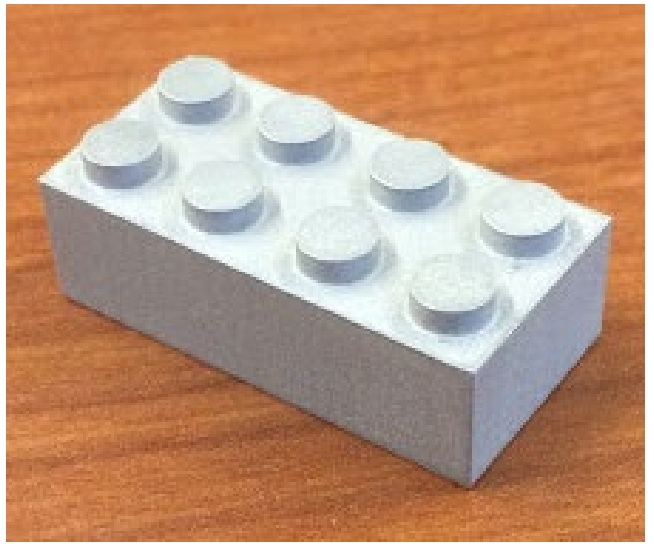
Machine Shop Projects

Build familiarity with shop equipment and basic manufacturing methods.



Manufactured 9 steel and brass parts with a manual mill, manual lathe, and a CNC mill and finished with a surface grinder.

Lost-foam casting of a mountain in aluminum.



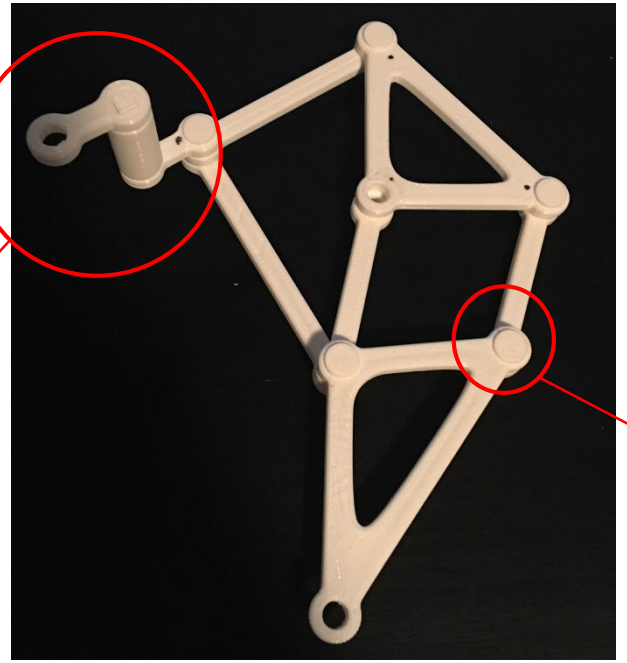
Generated toolpaths in Mastercam, CNC-milled, and beadblasted an aluminum Lego brick to scale.

Personal Projects

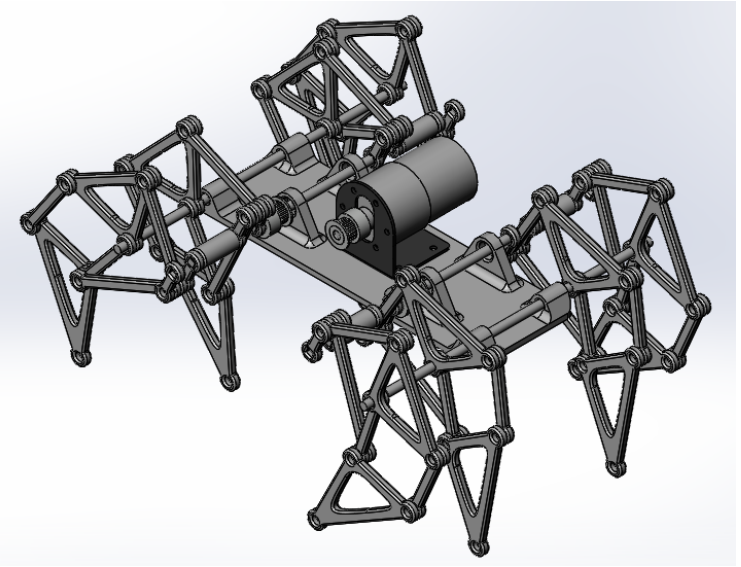
Walking Mechanism

Design and build a walking mechanism based on Theo Jansen's Strandbeest.

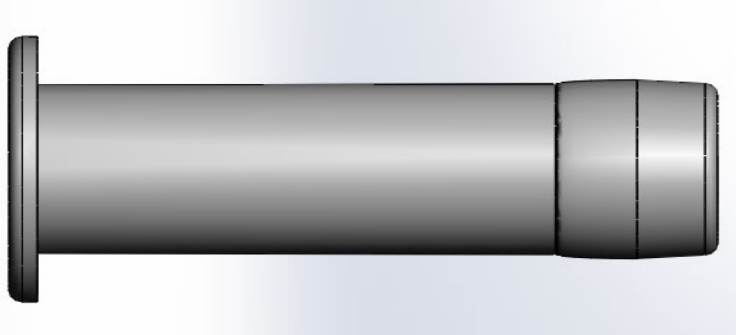
Prototyped test parts to optimize geometry for interference and slip fits.



3D-printed Jansen's linkage.



Mechanism design in Solidworks uses 8 Jansen's linkages, 2 belt-driven shafts, and 1 motor to walk.



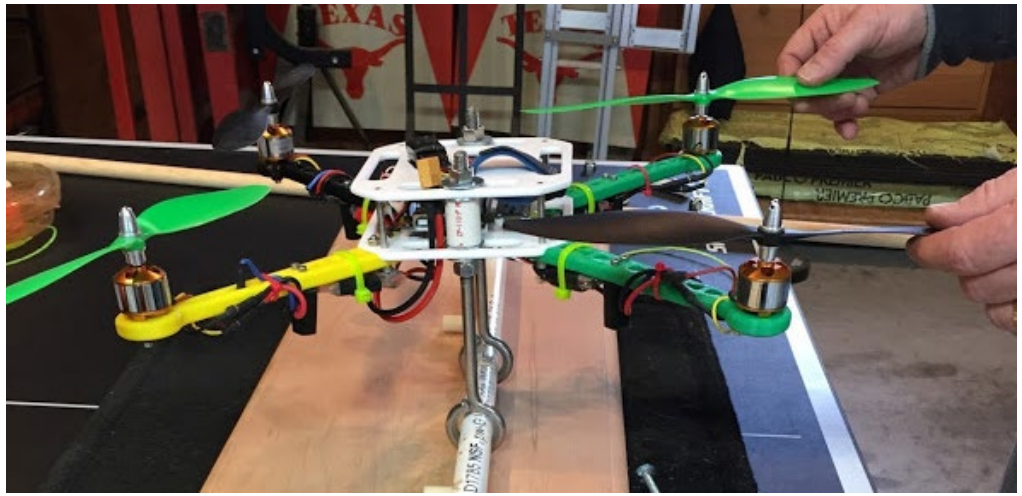
Detent on pin-end to create interference fit with outer link, easing assembly while maintaining a low-friction slip fit bearing surface.

CAD Files

Quadcopter

Designed, 3D-printed, and assembled mechanical assembly and supported controls development and testing.

Designed and prototyped mechanical assembly.

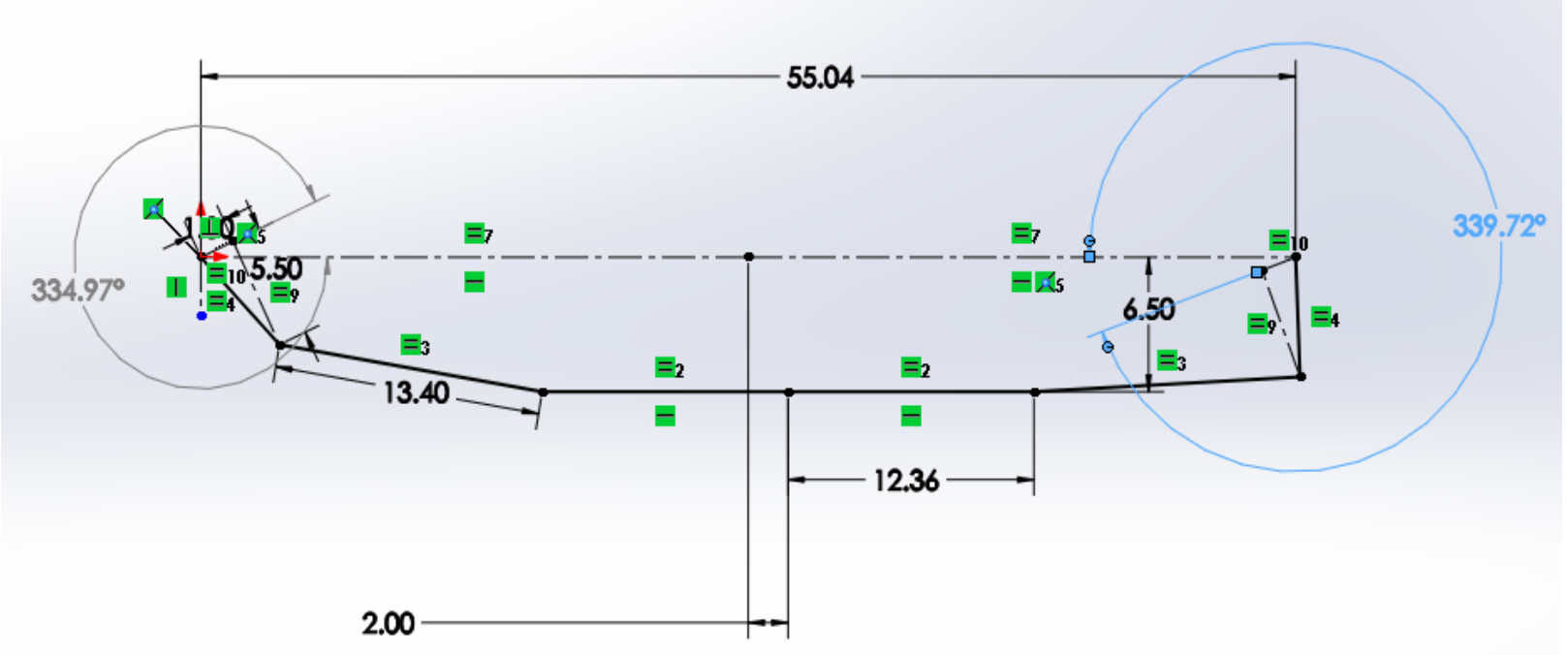


Test stand for PID and motor trim tuning.

Github Repository

Solar Vehicle Steering Design Tool

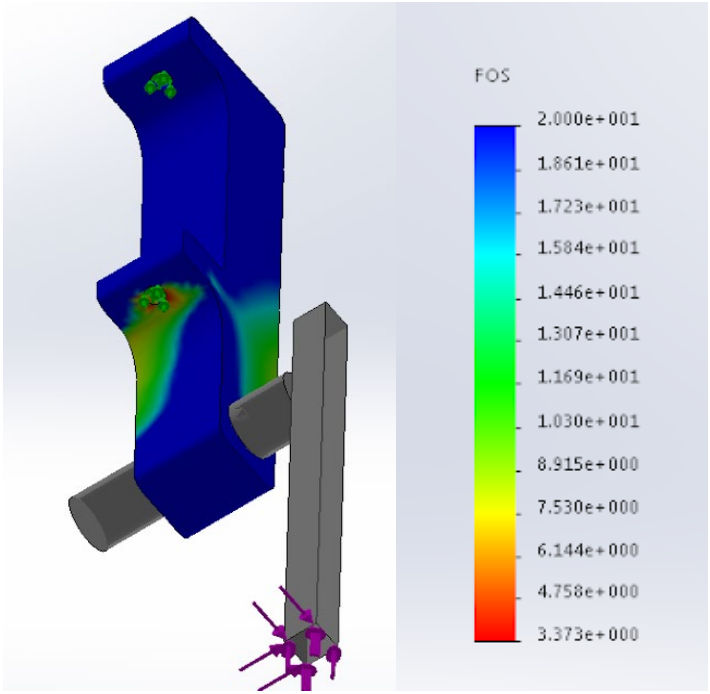
Design a tool to model the steering system for the Solar Vehicles Team.



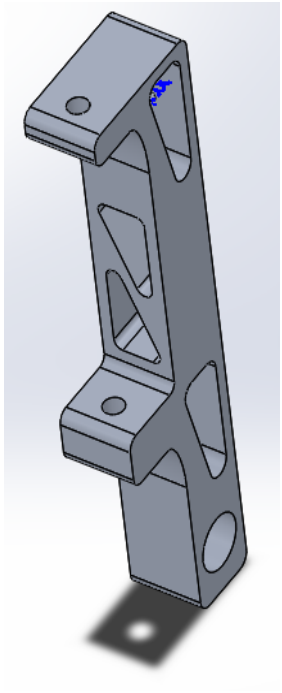
Solidworks sketch to model Ackermann steering linkages in order to properly specify required link lengths and pinion travel to achieve desired vehicle turn radius.

Solar Vehicle Upright Design

Designed lighter spindles for the Solar Vehicles Team while satisfying structural loading requirements.



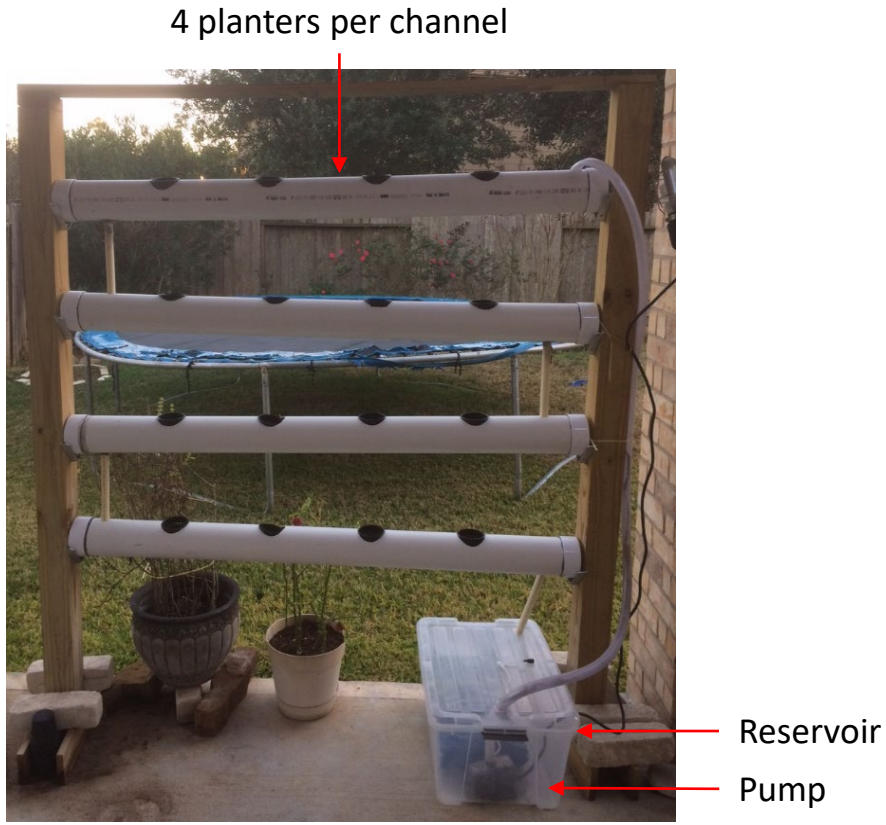
Used Solidworks static simulation to iterate through designs, optimizing for safety factor and weight.



Final spindle design in Solidworks with a 3.13 lb weight and a 3.1 minimum safety factor to yield.

Hydroponic Garden

Design and build a continuous flow hydroponic garden to enable low-maintenance gardening.



Calculated pump size and max allowable channel angle to achieve desired flow rate. Then, spec'd parts and built functional system.