

Fall 2021 Portfolio: Modeling & Printing

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The following sections display the process, CAD models, and final products from each of my design projects in the fall semester of 2021.

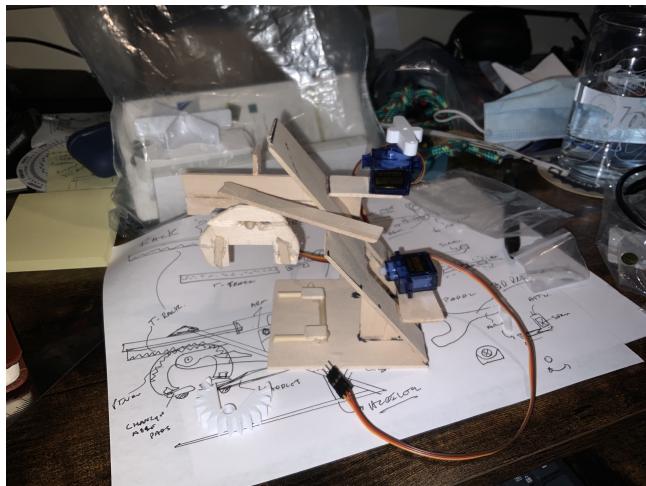
MEMS-312: Multidisciplinary Design and Prototyping

This was the second year that this course has been offered. The primary goal is to teach students of different technical backgrounds the ability to work with one another in design and prototyping to find solutions to unsolved problems. Each year this course has a theme that presents different problems. The theme for the fall semester of 2021 was accessible video game controllers.

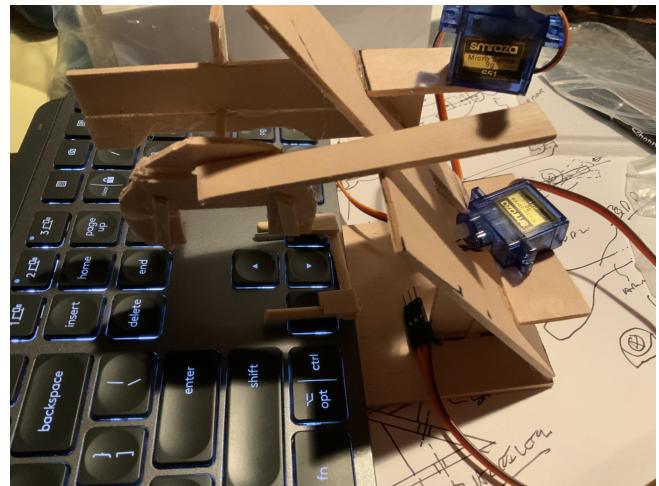
Project One: Assisted Joystick Controller

The first project in the course had the following challenge: Create a device using two servos and a joystick to control the up, down, left, and right arrows on a keyboard. The goal of this project is to create a device that will allow people with poor dexterity to control a joystick and be able to play Total Arcade Racing on a computer. The final analysis of this project was a classroom competition with time trials and an head to head event. I placed highest in the time trials and placed in first in the head to head event.

To begin, shown below is my first prototype, this was made out of balsa wood and used as a proof of concept for size and functionality for the left and right keys.



(a) Side view

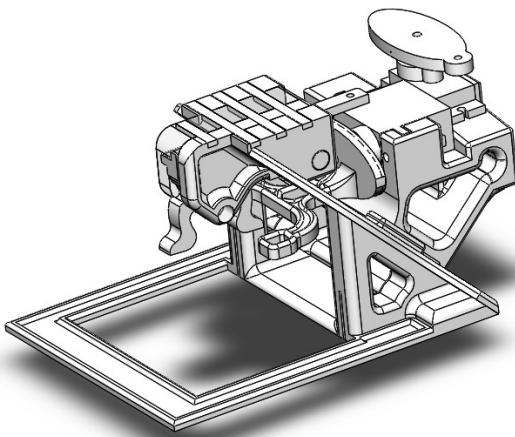


(b) Side view on keyboard

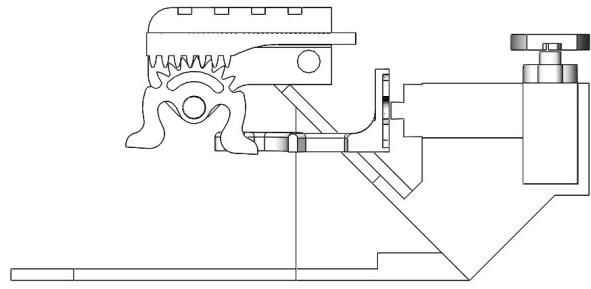
Figure 1: Initial prototype design

The proof of concept established a viable design. I began modeling this device, shown below, in SolidWorks. The base base of the device fits underneath the keyboard to resist the responsive force generated from the keys. The angled plate fits on the stand at a 45° angle. The first servo is mounted horizontally facing the keyboard. It uses paddles to actuate the left and right arrow keys. The range of motion required is very low considering the paddles sit on top of the keys. Thus, the

actuation of each key is very reliable, which is needed as these keys primarily control the steering. The up and down keys are controlled by a rack and pinion. Motion is generated from a linear movement by the rack, which is connected to a swing arm mounted on the vertical servo. The swing arm does not have to move a great distance to actuate the keys which control the forward and backward movement. The rack and pinion design is used to actuate the keys faster and keep the device small to conserve desk space.



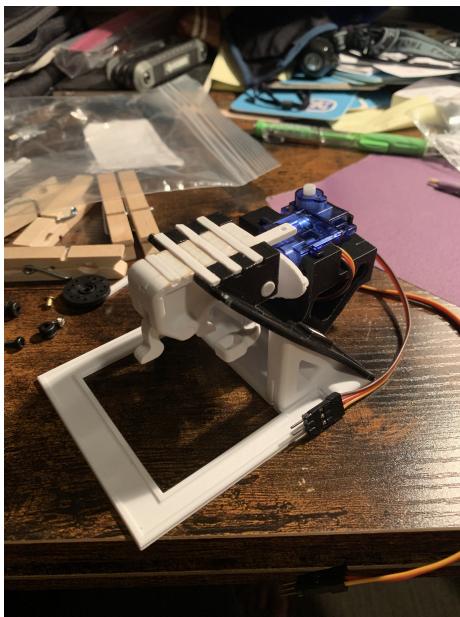
(a) Isometric view



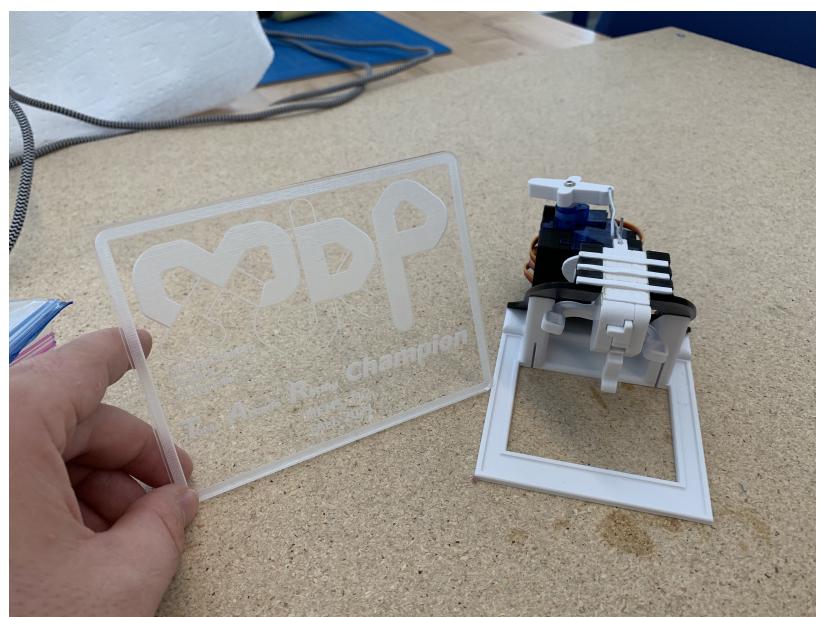
(b) Cross section view

Figure 2: Modeled design

The figures shown below are the second iteration of the device which was used for the competition. Figure 3b shows the award given for first place in the head to head event for Total Arcade Racing. This event included the four best players in time trials.



(a) Second iteration of device



(b) Award and device

Figure 3: The final iteration used for competition

MEMS-411: Senior Design

Q.T. B-BAR - Gambian Rat Trap

This was a semester long senior design project in a group of three people. We worked with a client, Dr. Stan Braude, to create a large rat trap to assist in his research efforts in Western Africa. His need was to have a large trap to catch large male and pregnant female rats. I worked as the designer on this project. I was responsible for modeling and fabricating the mechanical components in the trap. The primary materials used in this project were PVC pipe, PETG and PLA filament, fasteners, and adhesive. An additional goal for this project was to create a cost effective trap. One trap will cost \$21.47 in total and take less than 24 hours to build from start to finish.

Please note: A more in depth report is available upon request.

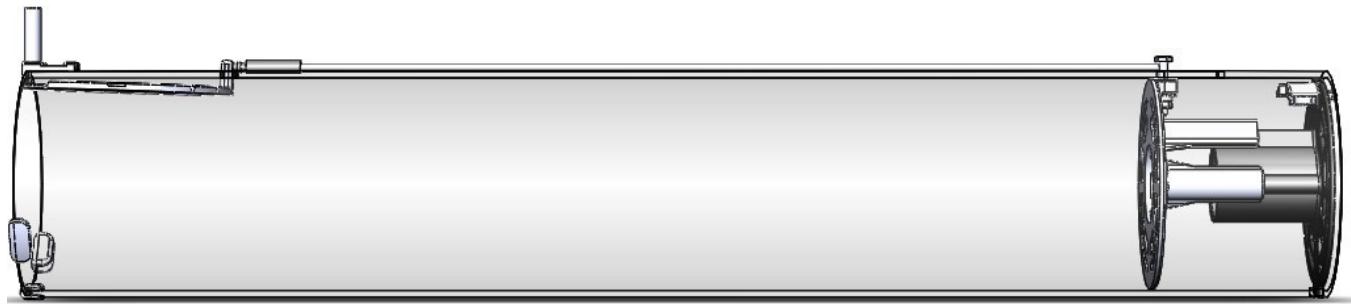


Figure 4: Transparent side view of the trap in an opened state.

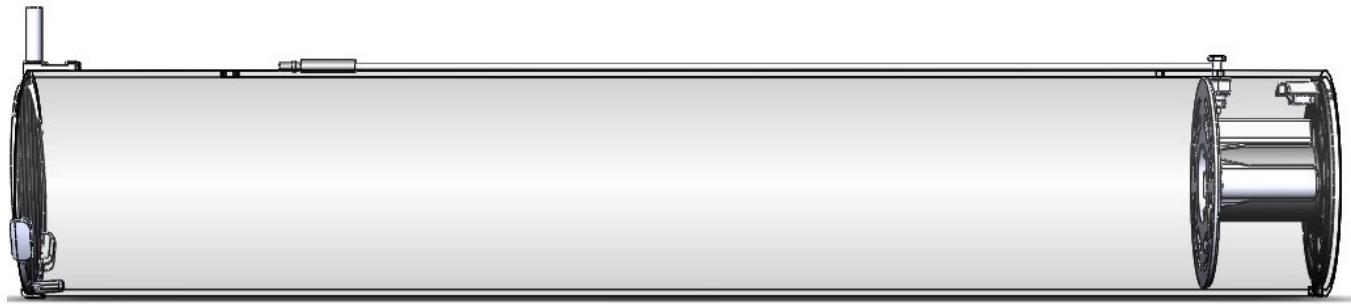


Figure 5: Transparent side view of the trap in a closed state.

Please note: A more in depth report is available upon request. Rendered images, and final product images are shown on the next page.



(a) Clear - Closed



(b) Green - Closed

Figure 6: Rendered images of the model



(a) Open



(b) Closed



(c) Open



(d) Closed

Figure 7: Final product from the front and rear view

MEMS-5104: Computer Aided Engineering

Topological Optimization

The following image displays two PLA 3D printed objects. Each object was modeled and optimized using SolidWorks and Altair Inspire, respectively. The optimization completed used Inspire's PolyNurbing tool to smooth the optimized area. The legs are the optimized area of the component. The structural support of the shelf is the design space for optimization, leaving the top space unchanged. The optimization for both parts maximized stiffness with the least amount of weight.



Figure 8: Topological optimized shelf and chair