Dylan Lam

Arduino Prosthetic Hand

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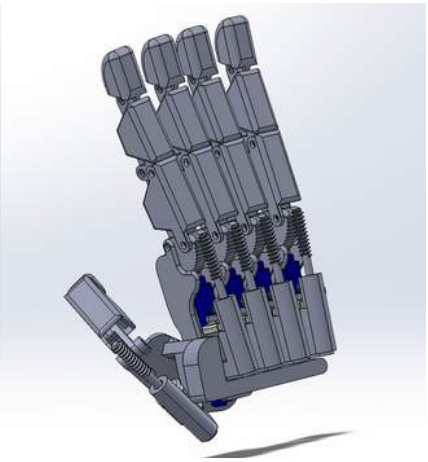
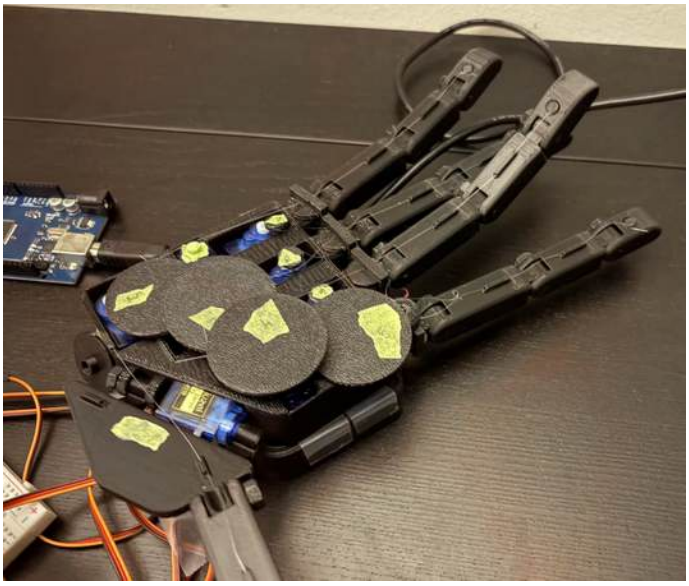
Each finger has two axis of control: flexion/extension and abduction/abduction

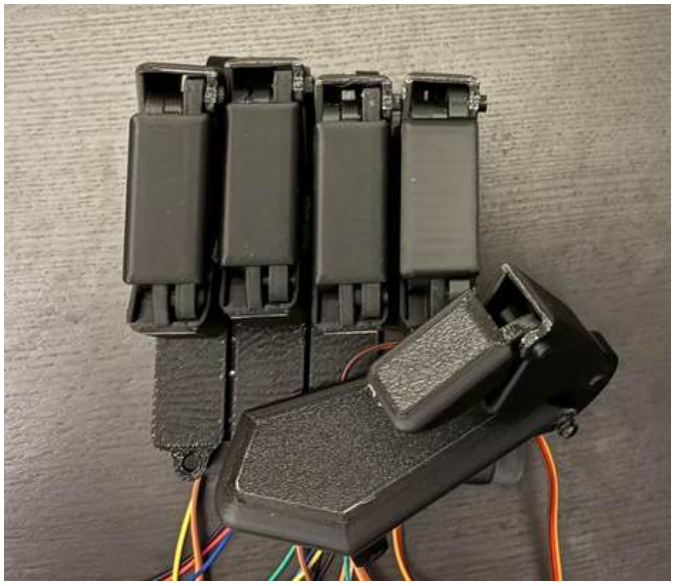
Designed a prosthetic hand that houses all of its **electronics** within its palm.

Designed in **SolidWorks**, **3D printed** with PLA, and coded using an **Arduino**





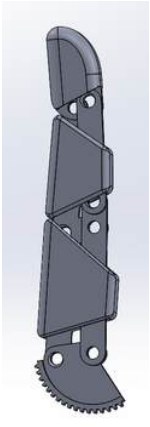
Earlier iterations utilized cables to move fingers

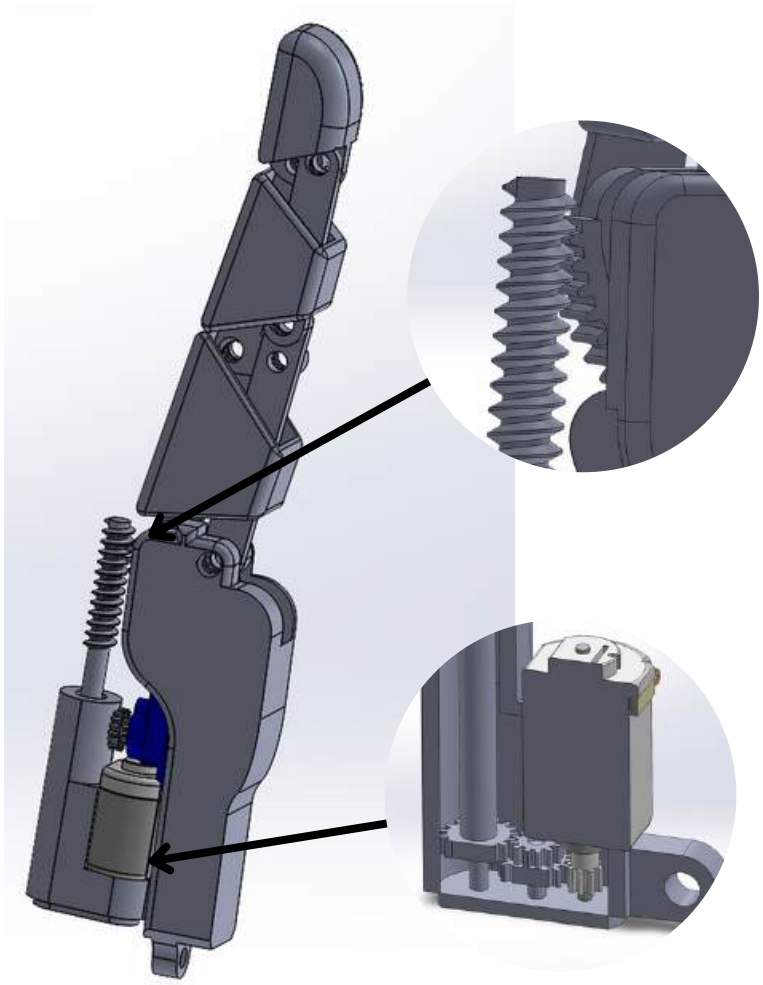


Newer designs utilized 3D printed segments to move the figures for greater rigidity

Utilized **inverse kinematics** to design the configuration and length of moving segments, ensuring **uniform motion** between the joints of the finger

Due to the added rigidity, the hand was able to hold a **20 pound** dumbbell





A **linear actuator** was implemented to drive the flexion/extension of the finger.

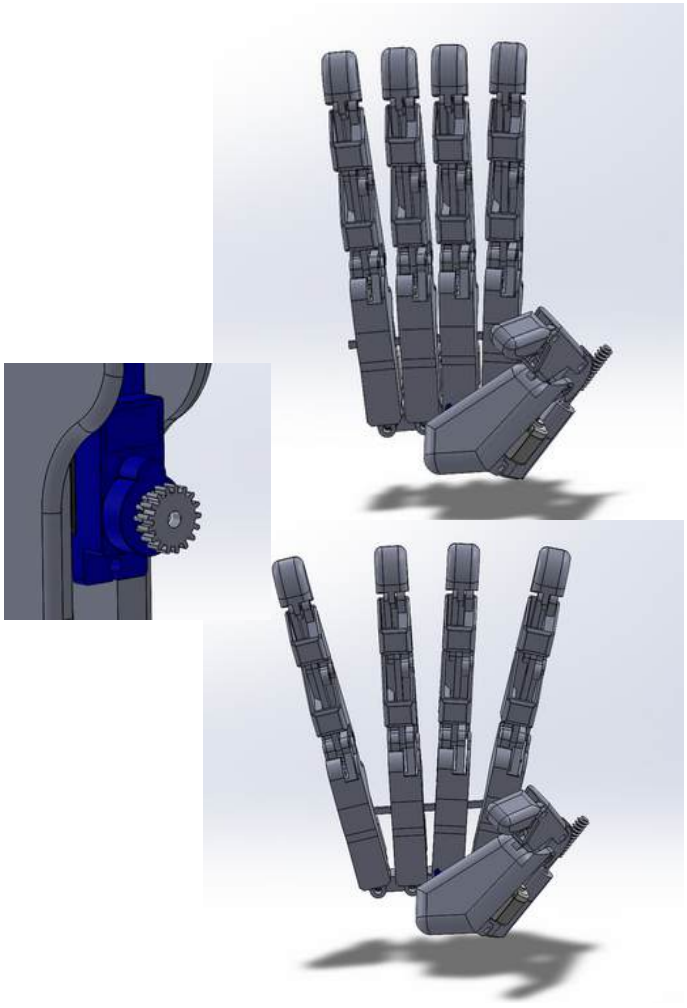
Utilized a **worm gear** to transfer momentum across two different rotational axis

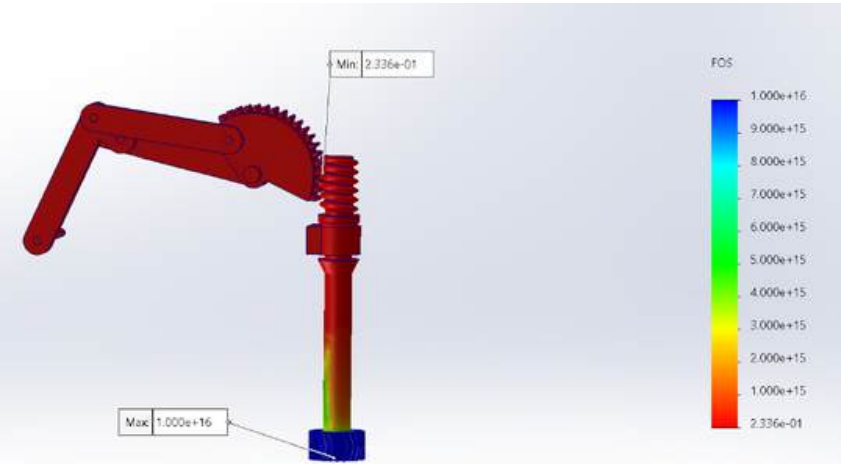
A **rotary encoder** was incorporated within the actuator to give **position feedback** of the actuator

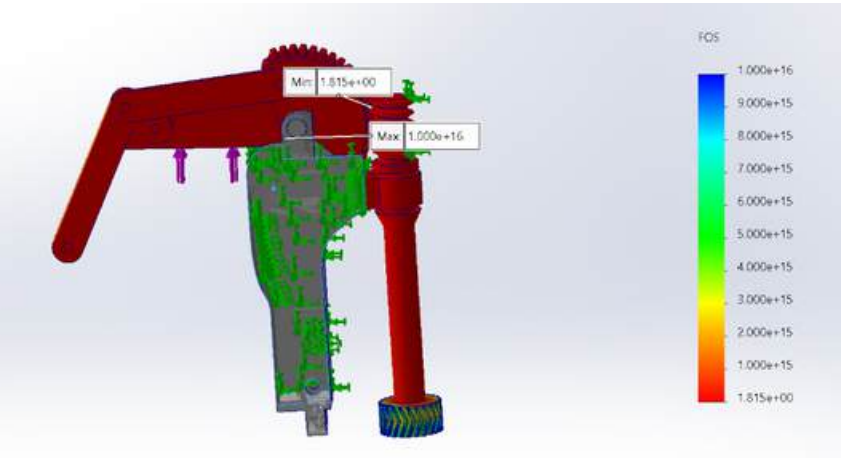
Fabricated a gear system that converts the high speed of the DC motor to a lower speed, **higher torque output**

Implemented a **gear and track** system to control abduction/adduction of fingers

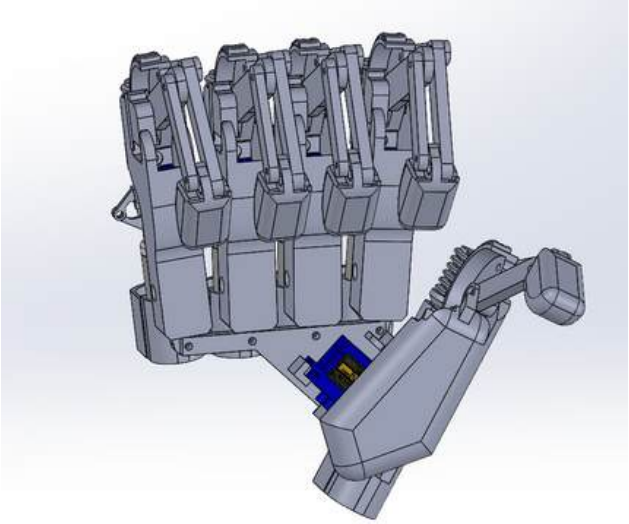
Gears were controlled by a **servo motor**, allowing precision control within a small space.







SolidWorks FEA was used to maximize the load that the hand could hold without damage to its structure or electronics. The intended load of 40 pounds was applied (divided across four fingers). Initially, it only had a f**actor of safety of 0.23**, however, through reiteration, a f**actor of safety of 1.8** was achieved. The finger segments were cut on a **3 axis CNC** however the other components will require a 5 axis CNC. As a next step, the rest of the hand will be cut and a safety factor of 3 will be reached.



The newest rendition of the hand has reinforced components, especially in the worm gear. In addition, it uses m3 screw instead of PLA pins for extra strength.

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BLDC Motor

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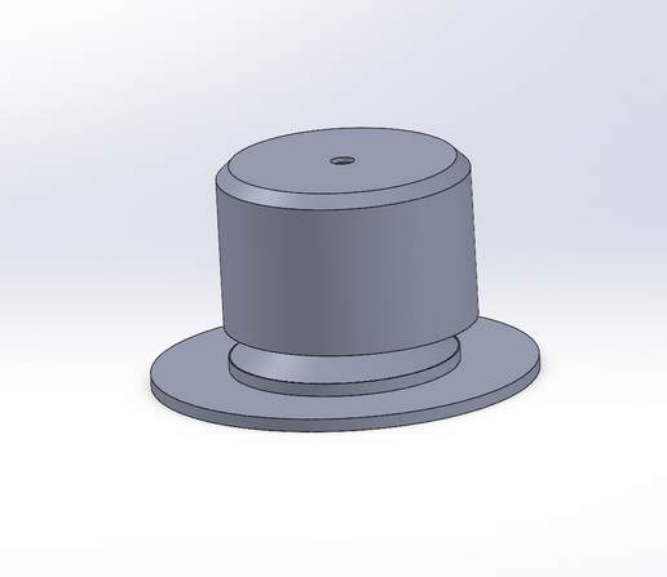
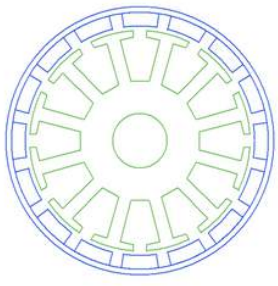
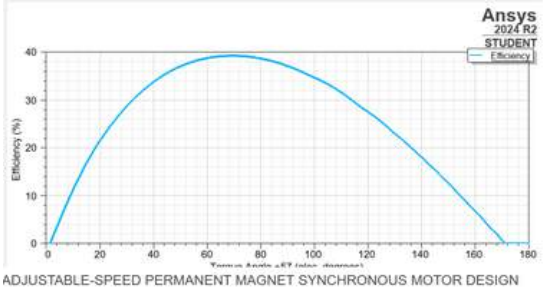
Motor was first created in **SolidWorks** which was then imported into **Ansys Electronics.**



The motor initially was operating at a **29% efficiency**. Through the course of over **50 reiterations** in Ansys, a **75% efficiency** was achieved. This was accomplish by modifying wire gauge, rotor to stator spacing, magnet size, stator teeth dimensions, number of windings, Rotor thickness, and choice of electronic components.

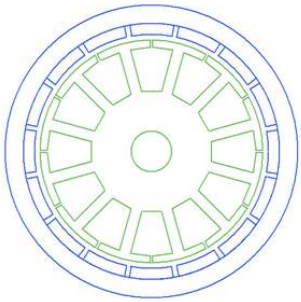
29% efficiency:

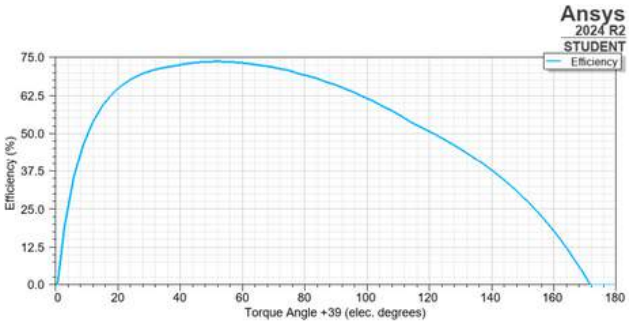




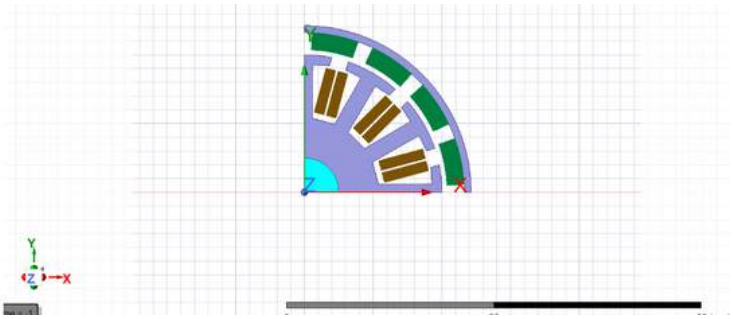
ADJUSTABLE-SPEED PERMANENT MAGNET SYNCHRONOUS MOTOR DESIGN

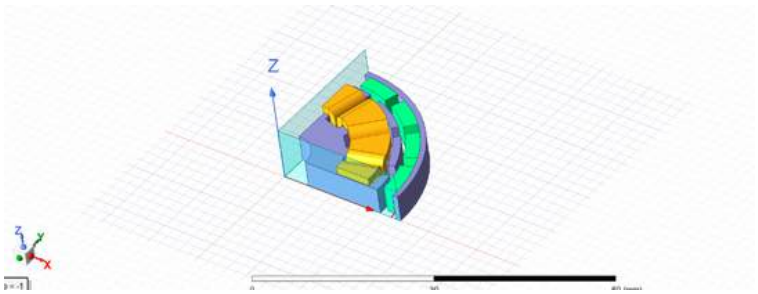
75% efficiency



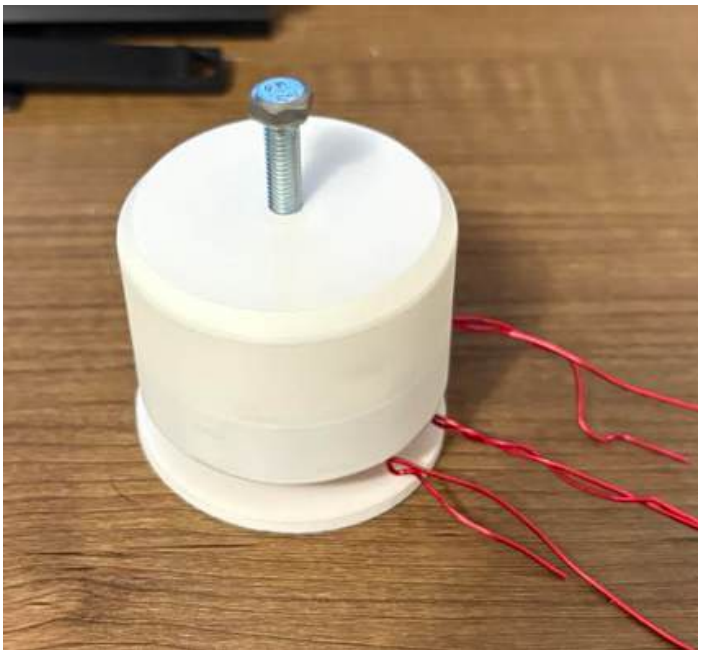


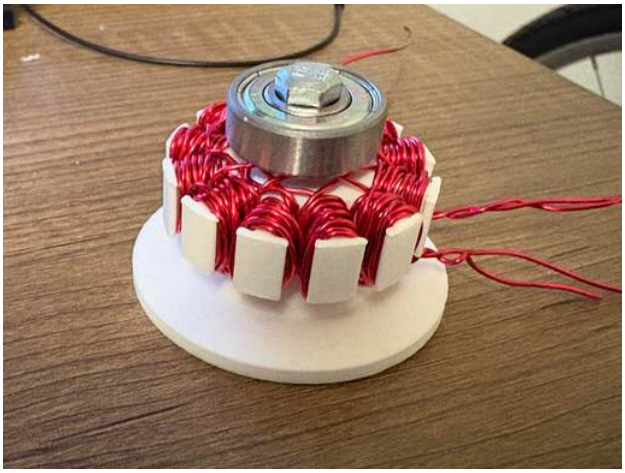
Utilized **Ansys Maxwell** to render 3D and 2D models of the rotor.





The optimized model was prototyped using a 3D printer using PLA. The motor has 3 phases, was winded with 22 gauge copper wire, and uses neodymium magnets. The upcoming prototype will utilize a **ferromagnetic core** such a silicon steel. Instead of a solid piece, the stator will be comprised of insulated plates in order to **reduce Edy currents.**





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PCB Drill Press

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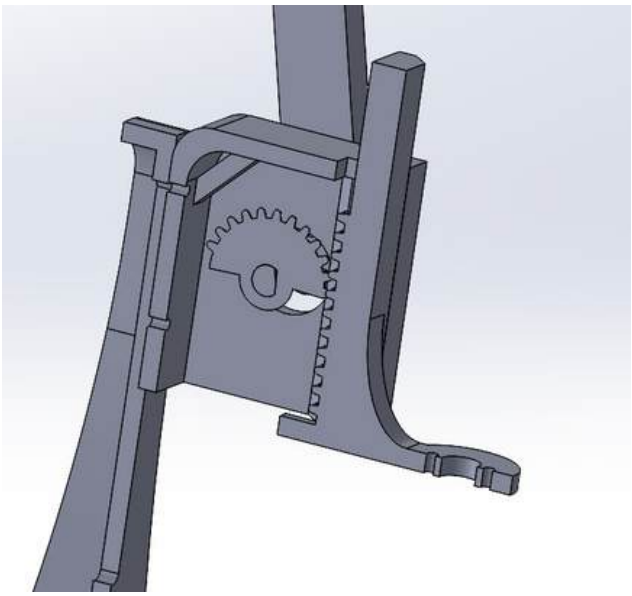
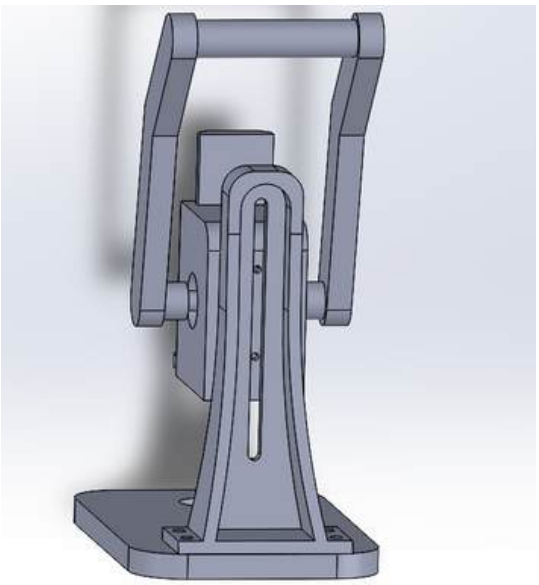
Runs on a **DC motor** attached to a drill bit using a **3D printed** adapter.

Made to be used with standard **metric screws,** ensuring compatibility with variety of common tools.



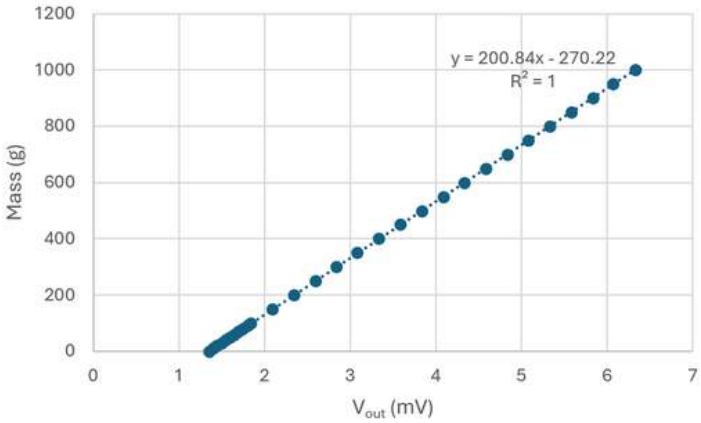
Designed a **gear system** that converts the rotational force of the lever arm to linear force, moving the drill head linearly.

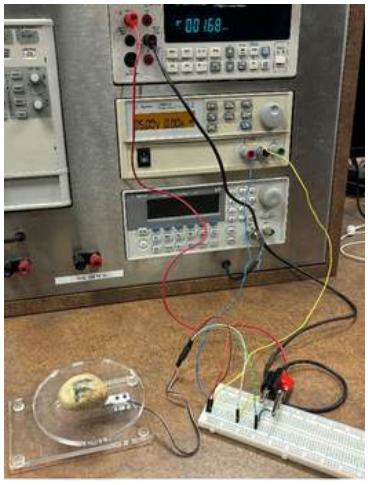


Screw holes were added to the rear end to allow the user to adjust the height of the drill based on material thickness

A spring was installed withing the drill so that the machine would stay still when no force is applied

The spring constant was calculated with a load cell. Before the load cell could be used, its voltage reading needed to be converted into mass. This was accomplished by applying various known loads onto a load cell and reading its voltage. The relationship was linear and the relationship between the two can be expressed in terms of an equation. This equation was used to measure the force that was applied onto a spring. Relating the force applied on the spring to its length gives its spring constant. Using **spring simulation** in SolidWorks, the drill was made to accommodate for the given spring constant.





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Paper Airplane Launcher

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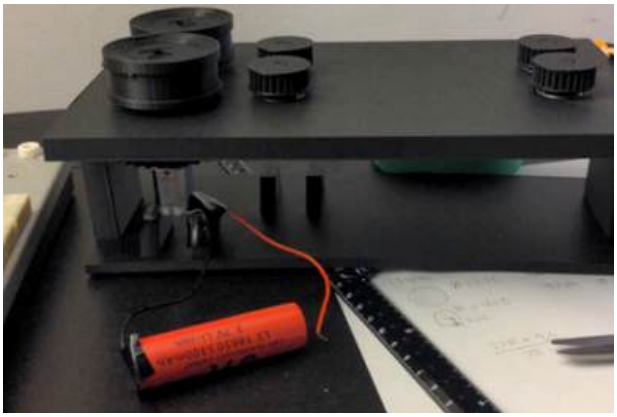
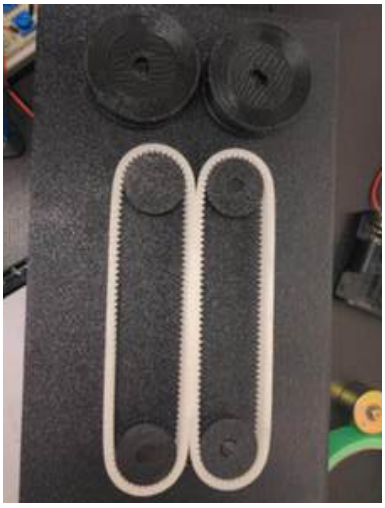


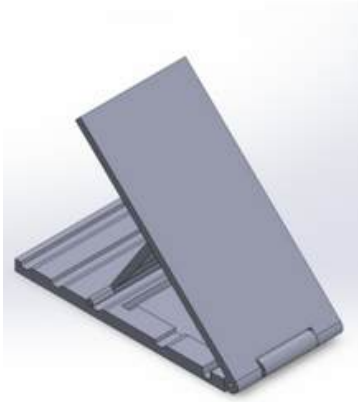
Worked in a team of 5 to develop a airplane launcher powered by flywheels.

Prototyped the design using a **3D printer** with the intention of **machining** the flywheels using a **lathe**.

To prevent physical contact between the user and flywheels, a conveyer belt was implemented, allowing the user to load planes safely.

TPU was chosen as the belt's material due to its flexible properties





Mechanical Keychain

Designed a mechanical keychain in SolidWorks using a blueprint.

Machined individual parts using a **lathe**, **mill**, and **drill press**