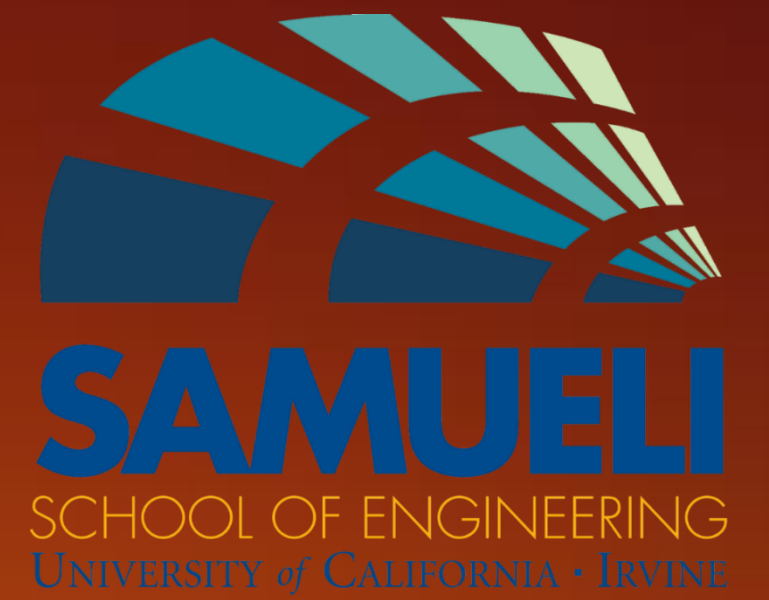


Thumb Exoskeleton

Robotic Rehabilitation — The independent patient.
Advisor: Professor David Reinkensmeyer, Ph. D.

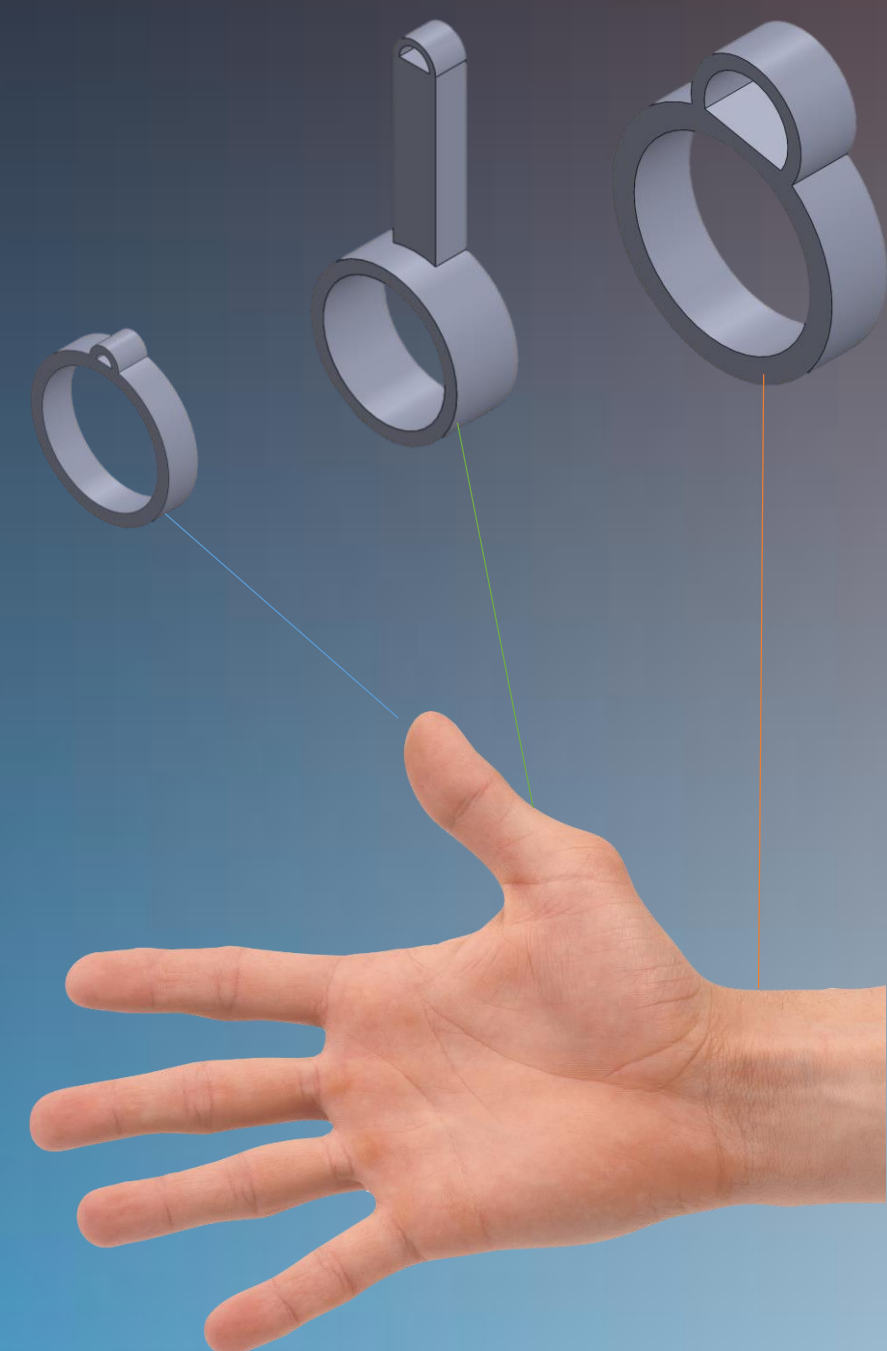


Background

One of the many difficulties that stroke patients tend to have is the inability to use their arms and hands properly. Recovering the movement can either range from being extremely difficult to a permanent loss of movement. There have been inventions made excellent for assisting patients on using their hands, however, they are usually costly and are not for independent use since they need either a secondary person such as a physical therapist or a machine the patient is connected to.

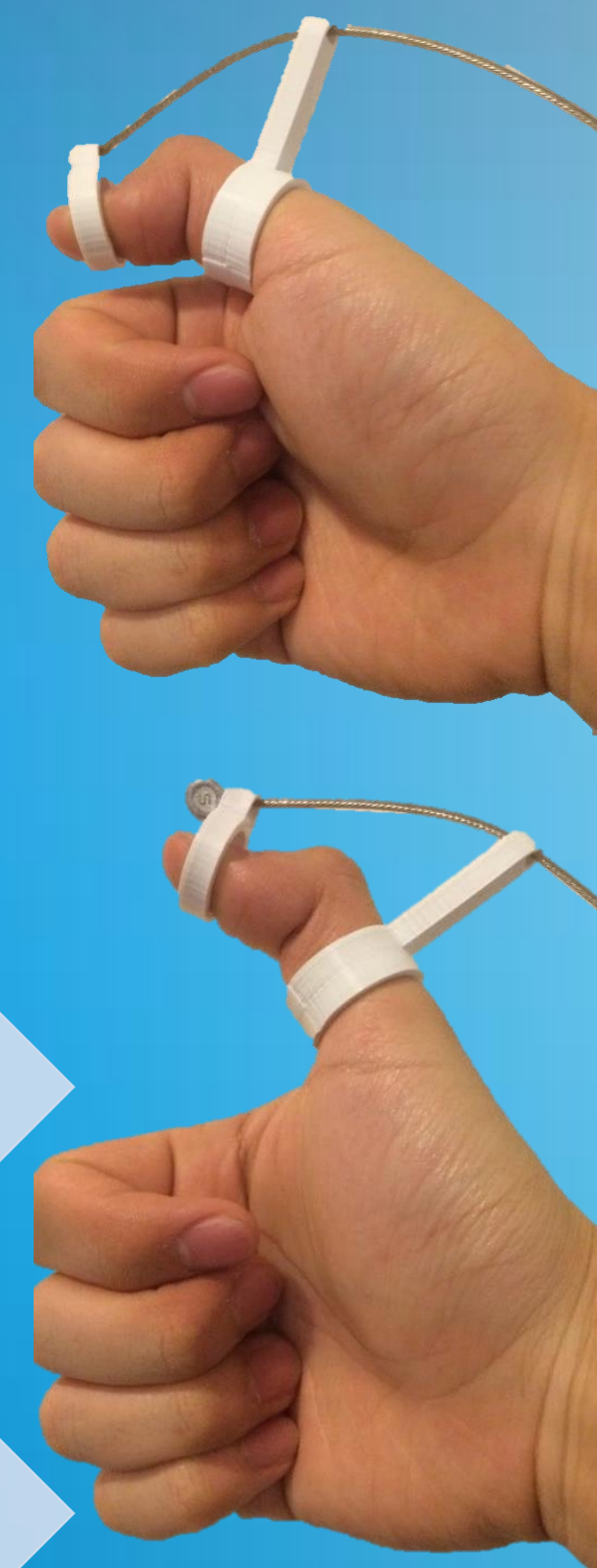
Project Goals

- Design an exoskeleton aimed at assisting a simple up-down movement of the patient's thumb that is both effective and comfortable.
- Methodize for a portable project that can be controlled by the patient without any secondary human or machine assistance with either a self-harness or other application.
- Test out the product with stroke patients and analyze the results of its use.
- Improve the overall design of the project after various modifications and tests.
- Innovate the project with usage of thermal and electromagnetic approaches, instead of mechanical.



Design

The design on the left demonstrates where each "ring" would be placed on the thumb/hand. One will fit at the tip of the thumb, while another one serves as the pulley structure in the middle. The last ring goes around the patient's wrist to act as a fixed point to allow for a better path of the wire guiding the movement.



Mechanism

Initial Position: The patient's thumb starts out on a "down" position naturally due to the after-effects of surviving a stroke. In order to move the thumb, a certain amount of force needs to act on it to assist the patient on moving it.

Final Position: The next step would be figuring out how to lift the thumb to an "up" position. Here, we used a mechanical pulley set up in order to achieve the motion.

Alternative Project Methods

Mechanical

The use of bike brake cable and its housing will be the main path for the applied force caused by a patient's shoulder and/or arm.

Thermal

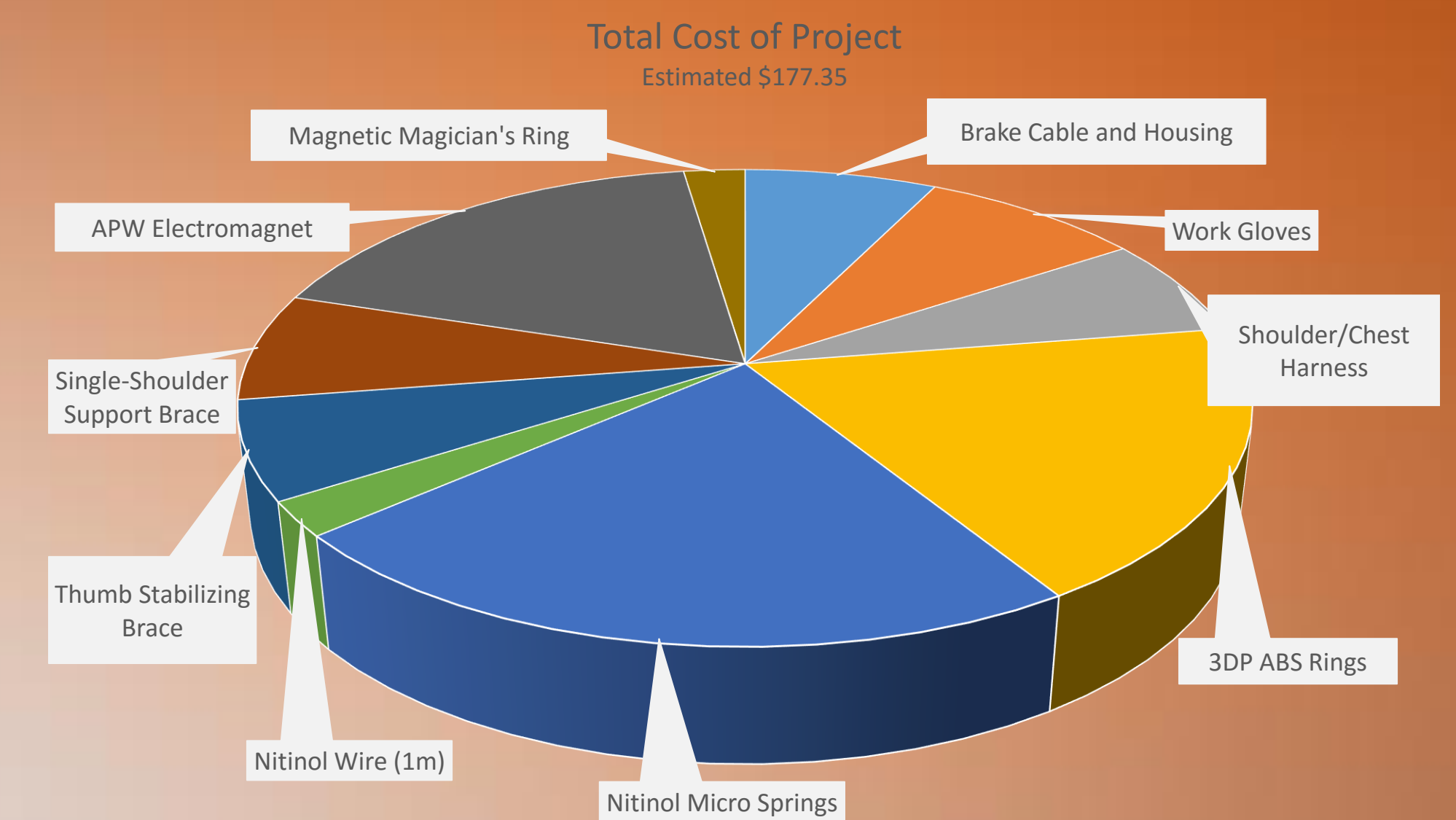
Applying both Nitinol string and springs will allow the exoskeleton to be shaped and altered by applying heat to the frame around the patient's thumb.

Electromagnetic

Combining an EM producing a current with a magnetic ring placed on the patient's thumb causes the movement desired. The EM will control the movement with either attraction or repulsion.

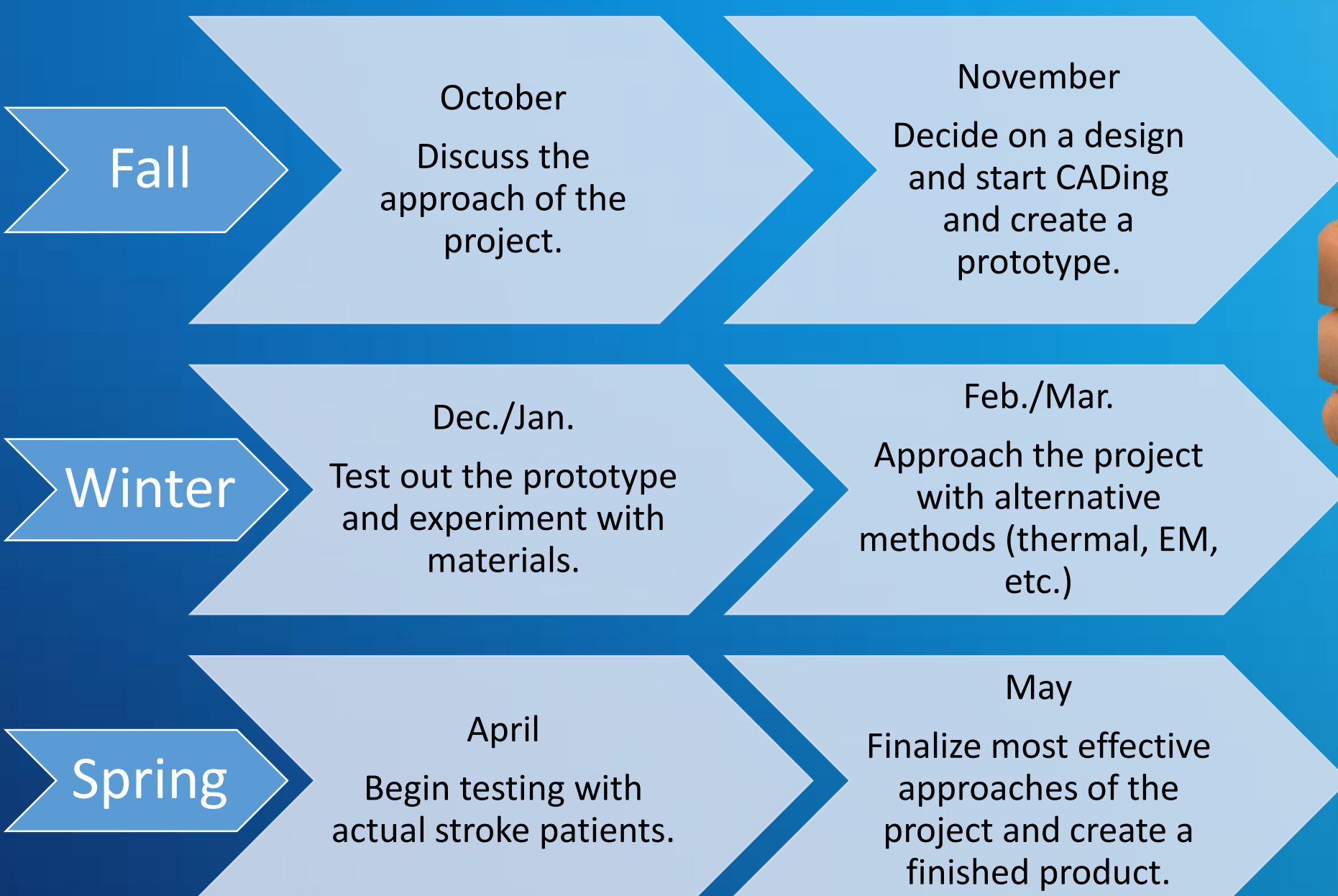
Current Progress

So far we have tested a prototype for the mechanical design of the thumb exoskeleton. We are improving the effectiveness of how well the thumb can be lifted and supported by the materials being used. These materials are 3D printed ABS Plastic and steel wire running through a housing material attached to a chest or shoulder harness.



Project Significance

Every year, more than 795,000 Americans have a stroke and 8 out of the 10 survivors will suffer from Hemiparesis, or one-sided weakness in the body. This weakness throughout the body leads to difficulty in walking, coordination, balance and force in muscle movements. Knowing the amount of people who would be helped just in the US opens the doors for the rest of the world to benefit from this project. Since the project is aimed at designing a portable and economic product, there is a bigger opportunity for many patients to be able to afford and use the product on a day-to-day basis.



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