MECHANICAL HAND

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THE PROBLEM

What artificial alternatives for limbs and/or hands could be made, to serve amputee & accident victims?

01

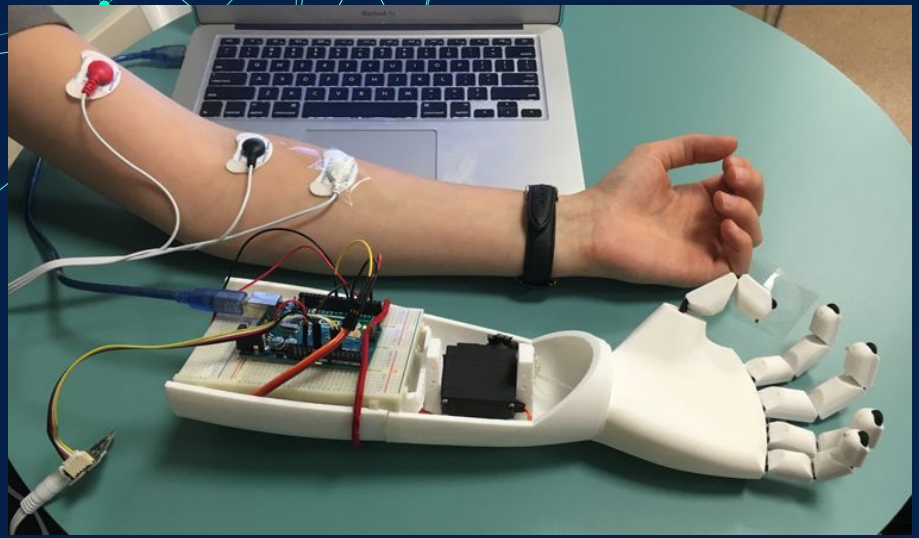
Background

General

Prosthetics are artifical devices that replace a missing body part, which may be lost through trauma, disease, or other conditions. Their main purpose are to replace and mimic the function of the lost body part. Rehabilitation of prosthetics are done along with physical, occupation, and physiatric therapy to insure optimal transition. Prosthetics can be aesthetic or functional-- depending upon the part. Decision to use prosthetics are balanced against other lifestyle and socioeconomic factors.

History

Earliest records of limb prosthetics record back to 3000 BC in Ancient Egypt and Iran. Mentions of prosthetics are also found within the stories of Herodotus and the Rigveda-- with the trend continuing amongst Roman generals. There were usually iron or wooden limbs. However, majority of these early prosthetics were not functional. It was during the Renaissance, that functional prosthetics developed with the use of newer materials and mechanical knowledge.



Modern Prosthetics

Modern prosthetics are myoelectric prosthetics. These are often externally powered prosthetics which are controlled by the natural electric currents developed by the muscles. They can be combined with biofeedback mechanism, which allow the patients to actually “feel”. These prosthetics are being further advanced through incorporating robotic biosensors. Pentagon and John Hopkins are leading these future strides.

02

Design Requirements

The goal of the prosthetic hand is that it must be able to lift its fingers with the gear system. The cost of the created solution must be minimal, with readily available items. The utilized materials should be durable and should not be fragile. The overall dimension of the project should be near the size of a human hand (7.6 inches), to optimize its possibility as a prosthetic. The solution should also be easy to use, with minimal inputs to replicate the hand movements. Finally, the solution should be able to replicate its actions multiple times.

03

Brainstorm

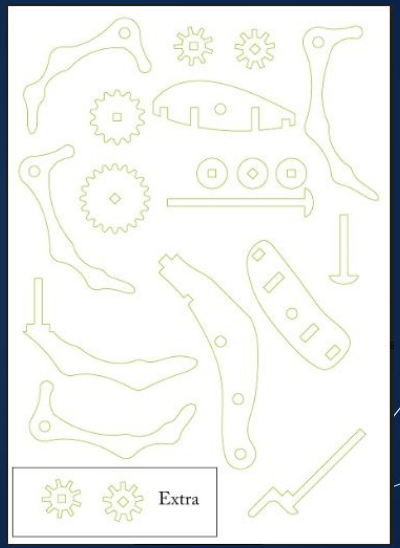
There are two central solutions to creating prosthetics: electrical or non-electrical. Electrical solution may utilize motors, batteries, arduino and possibly outside computer programs. This solution would be extremely optimal in respect to activity. However, it would not be cost effective due to its resources. A non-electrical solution may utilize gears and axles to move the parts. While weaker in respect to activity compared to the electrical solution, the solution would be extremely viable in terms of cost and time.

03

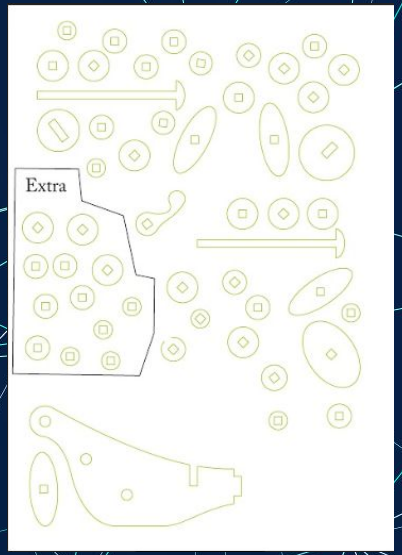
Brainstorm: Drawings

Materials Required:

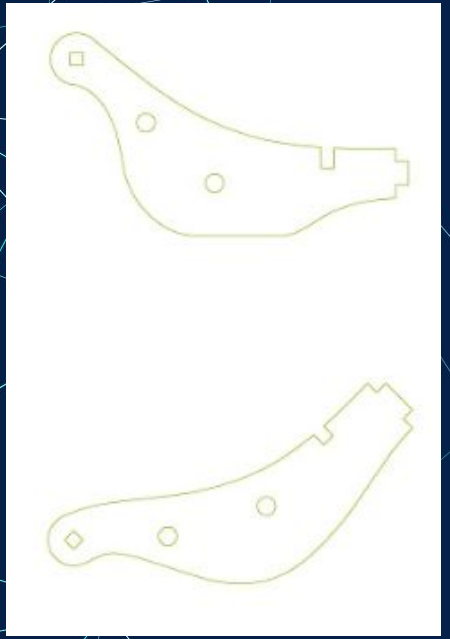
Cardboard (2 boxes)
Scissors
Glue



This includes the final parts of the hand shell, the central gears, and the fingers



The two axles, tiny circular tightening gears, oval shaped gears for the fingers, and in the bottom, one of parts for the shell.



The two outermost parts of the “hand” shell.

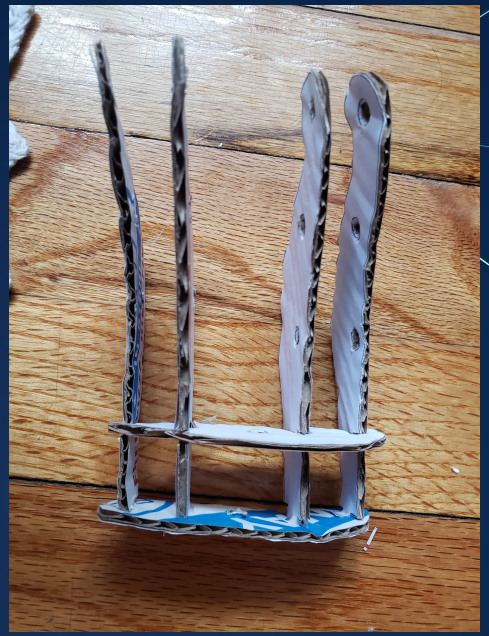
04

Best Solution

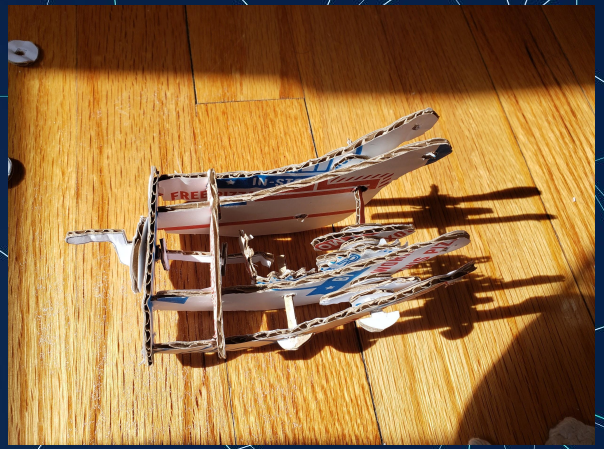
Given the monetary and time constraints, the non-electrical solutions is the best solution. It does not require a sophisticated knowledge of specific field (mainly computer programming) to create. It can also be created through normal materials, which are readily available. The materials are also cheap, unlike the ones required in electrical solution. Alongside the availability of the resources, non-electrical solution is extremely functional and viable as a primary step towards creating prosthetics.

Development Work

Individual Parts, cut out from cardboard.



Exterior shell of the hand, with the two base (or “wrist”) elements.

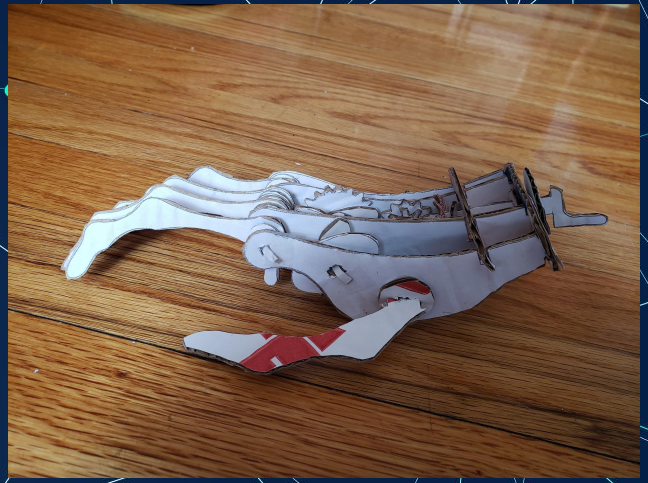


Exterior Shell with preliminary gears included (the ones from the side). The main gear which comes from the bottom of the wrist is also attached.

Development Work

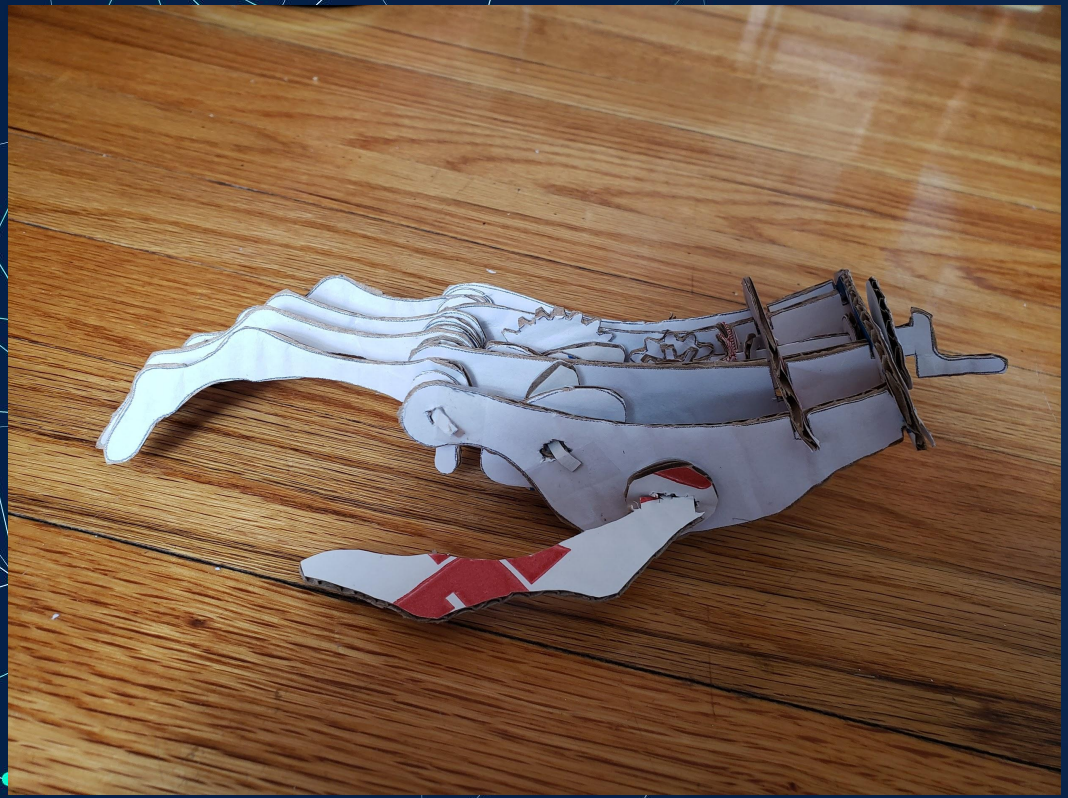
The hand with the four fingers attached, and individual support gears.

The hand with the thumb attached, and the some of the gears associated with it. Certain gears for the center region have still yet to be attached.



The finished hand. All the gears have been attached including the central ones, and the ones for the thumb.

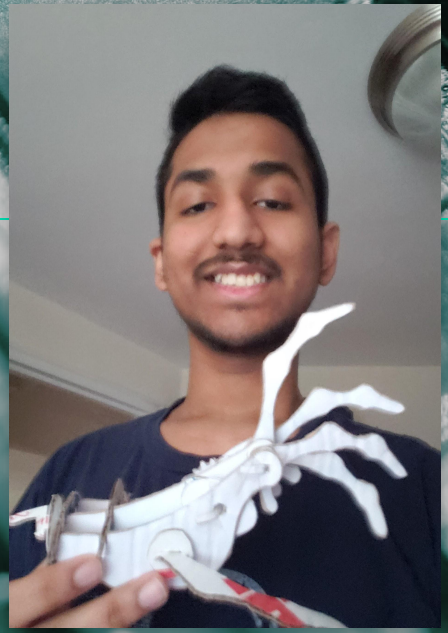
Prototype

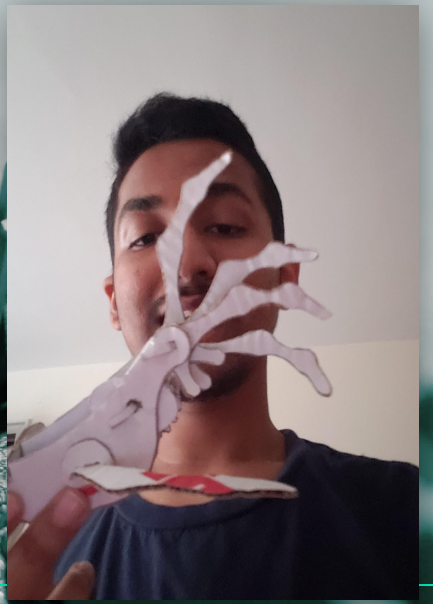


This is a side view of the mechanical hand prototype. The created prototype had a length of 18 cm (7.1 inches) and the width of 8.1 cm (3.2 inches). Each finger is the length of 10.1 cm (4 inches), and the “palm” was the length of 7.9 cm (3.1 inches).

Testing

- The testing was successful, and the prototype was able to lift up its fingers with the side gears. Therefore, the goal for the project was met. However, the lifting of the fingers were weak, and slow, probably due to the material. The fingers were not able to stay in one position for long. Future directions for the prototype may include incorporating better material (possibly plastic or wood) so that the movement is faster and could be sustained.





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3. Geetanjali, Purushothaman. “Myoelectric Control of Prosthetic Hands” *Dove Press: Medical Devices and Research*. Accessed 22 March 2020
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