History and the Evolution of the Prosthetic Hand and its Functionality

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Introduction

Background

The hand is a fundamental part of the human body with an unimaginable number of advantages. Although the hand has basic gross and fine motor skills for physical resistance, it is an essential element of social performance and promotes reception, preparation, aesthetic articulation and correspondence. Losing a hand or two in this regard is an incredible experience that requires critical mental support and physical recovery (Dechey, Cleghom and Naumann, 2001). Most removed weapons occur in working-age men, mainly due to work accidents or casualties during combat. For centuries, people have used innovative innovations to structure intelligent devices and to promote the reintegration of amputees into society. The current article provides verifiable progress in reaching the missing hand, from the first arm wrestling intended for combat to the current standard myoelectric prosthesis on the body and progress in restoring sensorimotor control with reconstruction and a targeted arm transplant (Cardozo, 2016).

There are many ways to operate a robot hand. There is a method of controlling by air pressure, using a motor, and using a rubber band to drive a thread. We chose to use a thread to drive our hands. The reason is that we have limited costs. I also tried to use the simplest method to drive it. We wanted to create a robot hand that could hold soft objects among the tasks that the hands had to do. We looked at the structure of human hands before designing robotic hands. Of the five fingers that make up a human hand, the thumb is facing in a different direction and can move in a different direction. The thumb can move in a direction that touches other fingers, so the thumb is the most important part when doing a task of holding an object. Therefore, we focused more on thumbs design. Also, we designed the knuckles to be easy to assemble and disassemble. The reason for this design is that first, ready-made robot hands have the difficulty of changing all parts when one part is broken. Second, the length and thickness of each person's hands are different, but they are too formal. This does not satisfy the satisfaction of the robot hand users. Finally, we can make kids into a kit like Lego, so that they can satisfy their curiosity. Our report said, first, why did we come up with this idea? The second is thumbs design. Lastly, I will make the first prototype and explain the problems that occurred here and the last design that was solved.

Research question

How prosthetic hand evolved over the period with its advancements in technology and design?

Aims and Objectives

The objective of the study is to determine the advancements in the technology which helped handicapped people to get another chance to live their lives happily with the help of Robotic prosthetic hands

Aims

To get the idea about the advancements in the technology in the field of Robotics

How robotics is increasing the standard of living

How technology is serving for the betterment of human mankind

Our robot hand's idea is to have flexibility and design each branch to separate and assemble. The reason why I wanted to design flexible hands is to avoid shock when I grab something soft (e.g., eggs or empty plastic bottles). To increase flexibility, I tried to design by using flexible materials and creating space in the middle when designing fingers.

Rationale

A hand is a multiple fingered structure that is farthest from the end of a human body. The fingers are the most extravagant source of sensing the material they are absolutely the densest areas of nerve endings in the body and have the best position in the body. It has a sense of touch, which is connected with the palm. Every hand is severely restricted by the opposite side of half the brain hemisphere, so Solo exercises such as writing which reflects the unique function of the brain. An individual can also exercise, e.g. drive and hold. Since there are people who are born without hands or who have sometimes lost their hands, this research is underway to build and improve a prosthetic hand system that is cheaper, easier to repair, lighter and with better critical body pressure. Using Computer-Aided Design (CAD), the prosthesis arm is structured and printed using a 3D printer that is used to create the prosthesis arm (Cardozo, 2016). This test uses adaptive fibres and ABS fibres when designing the part. Certain fasteners, nuts, bolts, and pastes are used to secure the parts. The prosthetic hand is triggered by the strength of the body and breaks in a coordinated frame. This test examines the mechanical technology used to manufacture an artificial hand which is also called a prosthetic hand (Saikia et al., 2016).

Literature Review

Theoretical Framework

A valuable prosthesis offers comprehensive benefits and is aesthetically satisfactory, but at the same time serves to remove the integrity of the user. The prosthesis was both a clinical device and a delicious consolation at the time, so the historical context of the prosthesis is not only a logical story but also the narrative of people who were born, injured or frozen from the start of progress. You are missing something (Gailey and Clemens, 2017).

Restoration of the whole

The most accurate case of a prosthesis ever found is not a foot, hand, or even a false eye, but the toe. The big toe, which had a place with an aristocrat, was found in Egypt and dated between 950 and 710. Overall, we understand that the toes are important, but it is fascinating that our most precise physical case in the historical context of the prosthesis is the toe and not something that seems increasingly important with one foot or one hand. The big toe was particularly critical of an Egyptian because it was important to wear ordinary Egyptian shoes. This toe, worn almost 3000 years ago, represents the historical basis of the prosthesis, which applies to both functionality and appearance. The big toe ended the lady, but also the Egyptian (Mota, 2017). It may have been easier and cheaper to design a different type of shoe, but we can hope that wearing classic Egyptian shoes was so important that the character of this contemporary woman requires the development of this early prosthesis (Afshar, 2017).

B.C.E.

The most famous ancient Roman in the entire existence of prostheses is General Marcus Sergius, who is considered the main user of the prosthesis. During the next Punic War, Sergio lost his right arm and received an iron prosthesis that gave him the strength to hold his shield and continue the fight. A limb was lost immediately after a possibly long military call (Hannibal caught him twice and withdrew several times) (Kathryn, Laurentis and Constantinos).

1500 - 1800

The historical context of prostheses is closely related to the historical context of the struggle and the struggle of the warriors. Medieval models show how moderately advanced the prosthesis field was. The woman's iron hands go no further than the prosthesis that General Sergio wore thousands of years ago (Laurentis and Mavroidis, 2002). In the mid-16th century, the specialist Amboise Paré made decisive progress in the medical extraction and improvement of dentures. He was the first to insert a prosthetic arm and leg with a locked knee joint. Unfortunately, these changes and their sophisticated strategies for connecting members are still quite common in today's prosthetics (Geethanjali, 2016). Although little progress was made in the extremities between the 1500s and 1800s, the advances in the medical extraction process that was introduced in the mid-19th century allowed experts to shape the excess limbs so that they gradually open around the dentures connect to. The limbs did not improve much, but life gradually became more pleasant for those who used them (Geethanjali, 2016).

Methodology

Examination and construction of the hand of the upper limb The overall structure of this arm prosthesis was treated as continuous improvement of the current arm prosthesis plan. After a thorough study of the basics and testing of the available elements. When planning, the structures of the right arm of the upper extremity. The character alluded to the shape of our prosthetic hand. All parts of the prosthesis hand are structured and created using software. The measurement is mainly intended for adult customers (Kirkley et al., 2017). The prosthetic arm for this task includes the palm, phalanx or fingers, forearm and wrist. Each of the four parts of the finger, except the thumb, is made as an equivalent. The thumb is an important part of an arm prosthesis because it helps to solve the problems even better. The development of the thumb is constantly in conflict with different fingers, which allows the hand to pick up objects and pick up things (Kirkley et al., 2017). The main goal of this task is to restore usefulness to people who have the harmful effects of infections that require withdrawal or disability from birth

The prosthetic arm was carefully processed and thought out from all points of view. The thumb structure should ensure a constant grip, which is also suitable for tilting the palm of an object. Falanga or so-called toes are constructional structures because they tend to bend at a point of 30° (Wang, Oskoei and Hu, 2017). The structure helps and improves the phase of each finger and can reduce the ergonomic barrier. The problem usually occurs when the third and fourth fingers have problems controlling small objects. The most obvious concern for people when it comes to expanding innovation is well-being. There are concerns about well-being in different ranges. The most important concern is the activity itself (Atzori, Cognolato and Muller, 2016). The structure of the finger extension not only includes the aesthetic respect of this company but also covers the finger of the small confused target in the middle of the joints. This extends the life of the prosthesis arm and reduces maintenance. Also, this structure is extremely well protected because no wire transplantation in the focus sensor system is required to work on the prosthesis arm. The parts of the finger are brought by a system that moves the body to allow the finger to develop autonomously. This provides an arm prosthesis and is effective at all times (Atzori, Cognolato and Muller, 2016).

Mechanism Parts Design

An essential part of a nourished body depends on the development of the body. In this task, the intestinal structure requires the development of an elbow that pulls the intestine and thus the opening and closing of the arm. It was seen that plans of the parts of the instrument for the construction of the arms which shows the use of space as a host for the arm and continues as an aid to the structure (Pizzolato et al., 2017).

Sample Designs of a Hand

Remember that the hand adjustment fingers had 3 handcuffs for each finger, which is close to what you would expect from a human hand and a human finger, and that the capacity level also includes the palm. This is only as a main concern to keep consumption as low as possible. The materials and devices that can be used for this arm are: Soft, compressible and elastic plastic for 3D printing (this is the most expensive part). Servo motor for every finger in order to move it. Silicone thumb for support, like a human hand. The elastic cables are closed to connect the fingers. Other updates can be done later by performing an ECG (electrocardiogram). This makes it perfect for use. A disabled person who has essentially lost an arm by adding an ECG to the last nerves and for control obviously needs more effort and experimentation to stretch the arm and how each nerve varnish is compared to the development of the hand or finger.

In addition, the palm selection level is to give your fingers the ability to move slightly to the side. This depends on the adaptability of the material from which the hand is printed. Although great strides have been made in the construction of prosthetic arms, the lack of mechanical quality still limits the widespread introduction of the robotic arm.

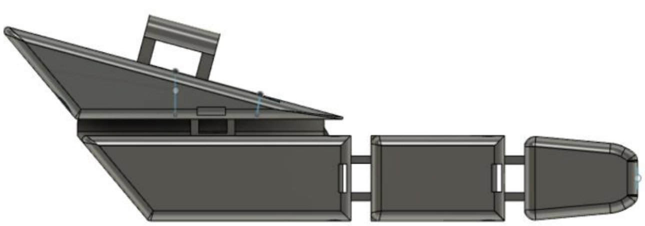
The manual link structure, which is offered with a simple structure, has different levels of conformity. The basic settings are structured so that the finger levels can adaptively move the fingers when recording. The robot arm is printed with a 3D printer.

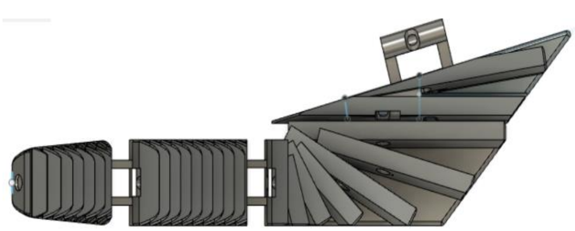
Our robot hand's idea is to have flexibility and design each branch to separate and assemble. The reason why I wanted to design flexible hands is to avoid shock when I grab something soft (e.g., eggs or empty plastic bottles). To increase flexibility, I tried to design by using flexible materials and creating space in the middle when designing fingers.

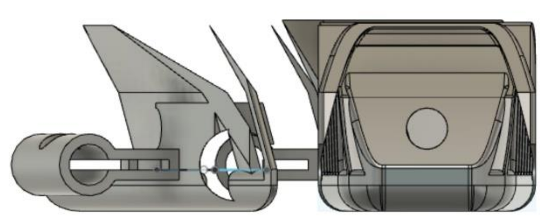
The reason why we made the joint part is that each person has a different length and thickness of their fingers. However, the robotic hands that are being used now require a lot of money to use formalized or self-matched hands. Also, growing children grow every year, so it's expensive to change hands as much as they grow every year. And once you break your finger, you must replace a lot of parts, so it's also expensive. But with the jaws, we can separate the joints of the fingers, and if it's designed simply, the problems that we talked about earlier disappear. If it is commercialized, it can be made by finger thickness and length so that people can choose the length and thickness of fingers they want. You can use a 3D printer for a specific part of what you want, which will satisfy many users. It can also be used as a robot hand kit that can be used by both children and adults due to its easy separation and formal shape. If you experiment by changing the length, thickness, and even shape that children want, you will be able to satisfy their curiosity and curiosity.

Thumb

Thumbs play a very important role in grabbing objects with other fingers and structures. The degree of freedom of thumb determines the size of the object you can hold. Hence, we're going to give another degree of freedom to the thumb. I made one more joint at the bottom of the thumb (by making two different angles(35 degree, 50 degree)), and I made it possible to use both ways to fold it close to the thumb and to fold it away from the thumb. Therefore, if the size of the object is small, we can use a knuckle that folds close to the thumb, and if we use a large object, we can choose a way that folds away from the thumb. The reason why we chose this method is that there is a limit to the cost we can use. I thought about this idea to make it as efficient as possible at a limited cost, although more motors can be designed to move more precisely.







Problems and Solutions of the First Prototype

The first idea and second idea were that the bottom of the hand was filled with cotton. (Figure: second design of finger) I made it by making it into a 3D printer. However, the thickness of the sides was too thick to have the flexibility I wanted. Hence, I drew a 3D design with the second type, reducing the thickness of all sides. However, I was thinking about a better way to be more flexible, and I thought that getting rid of the side of the palm would help me to be more flexible. Because if there is a side of the palm, the sides will be unified into one, which will reduce the flexibility of the hands by moving together. That's how I came up with this idea. In fact, when people use it, they use latex gloves or silicon to cover the human hand with a different model. However, it allows users to use hands that are more lifelike. The reason why we didn't create housing and didn't simulate it is because we're going to use something so thin that housing doesn't affect design and we must make a whole hand.

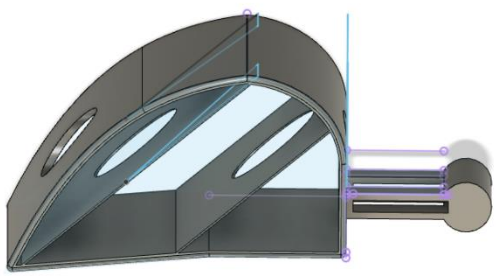


Figure: second design of finger

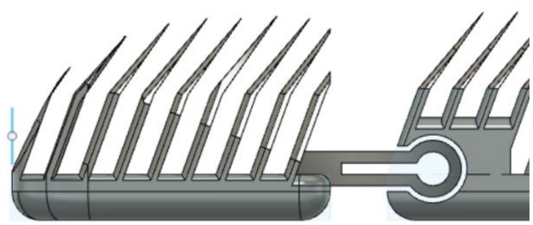


Figure: side of fingers

Also, the angles on the sides are different from the angles below (70 degrees) and above (50 degrees), as shown in Figure: side of fingers. This is because the human hand becomes harder and harder as it goes towards the back of the hand. Our robot also chose this design to absorb the impact by increasing the flexibility of the part where the object touches, gradually reducing the flexibility. We also chose to make the product thinner and thinner to give it more flexibility.

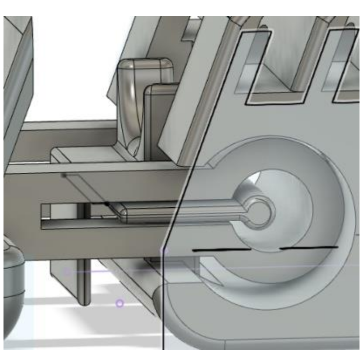


Figure: how to lock the joint

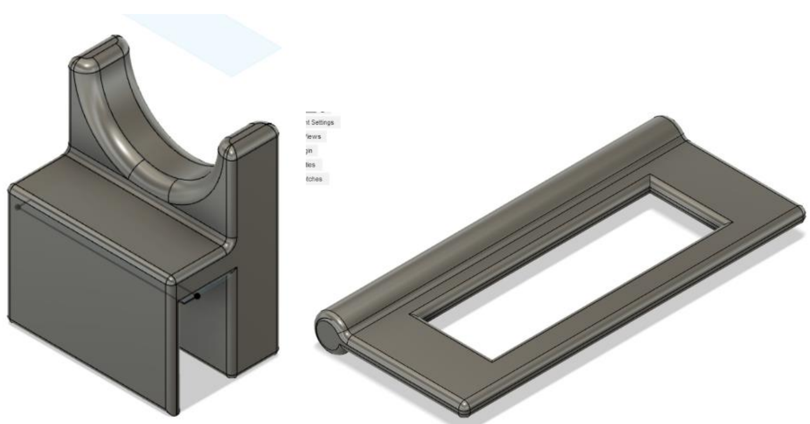


figure: locker design

Another problem with the first protocol part was the joint part. The joint part was not fixed because it didn't do its job. Therefore, I made a part that can lock the joint part. The lock part is divided into two parts and is designed to be easily worn and taken away.

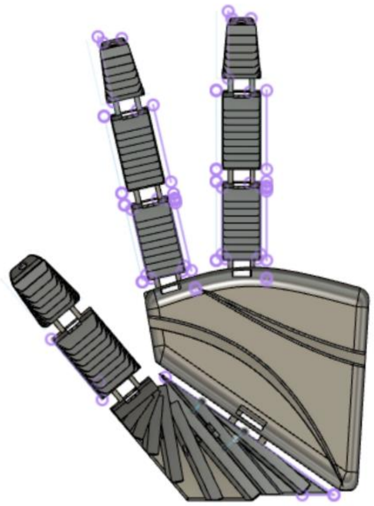


Figure: final design

Simulation

In this the designed hand will go through testing and simulation to determine the designed hand usability and specifications; determining its mechanical properties. The hand is designed to be able to be 3D printed using the flexible printing filament called PolyFlex (TPU95) [1]. TPU stands for thermoplastic polyurethane with 95 shore hardness, which is a measure of the hardness of flexible materials [2].

Such flexible materials yields different mechanical properties fro testing which requires extra modifications, special treatment and considerations to bare in mind. The first thing we might encounter with dealing with a flexible material is that it yields different mechanical properties unlike normal rigid nonflexible materials. Most normal materials has a ultimate tensile strength which is larger than yield strength, however in case of this flexible material it is the opposite yield strength is larger than ultimae tensile strength according to this book [3].

In general thermoplastic polyurethane mechanical property varies depending on its composites. The glass filled type is used in injection and moulding whih is simlar to 3D printing or additive manufacturing method which works by adding multiple layers over each forming the required shapr no matter how complex it is. So the properties of this material are obatined from this webpage [4], this website also stores most of the properties of all material usedi manufacturing also mentioning where you can obtain it from. The most important parameters in our simulation are ultimate tensile strength, yield strength, and Modulus of elasticity. The 3D printing filament can be found and bought from this website including its mechanical properties, printing settings, and any additional notes [5]. The website only mentions the Modulus of elasticity, Ultimate tensile strength (UTS) and elongation break. From these data and the data obtained from the materials website [4] we can deduce the material yield strength using linear interpolation these results are an estimate for the actual material as much as possible actual printing specifications might be different.

The filament for 3D printing mechanical properties are:

Modulus of elasticity

9.4 Mpa

Tensile Strength, Ultimate:
29 Mpa

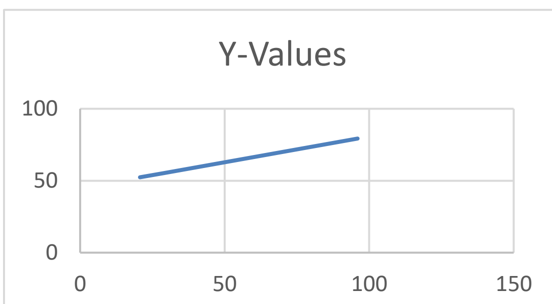
The Thermoplastic Polyurethane, Elastomer, Glass Filled mechanical properties are:

Tensile Strength, Ultimate:

20.7 - 96.0 MPa

Tensile Strength, Yield:

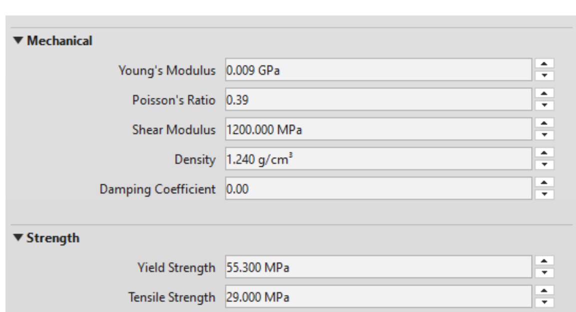
52.4 - 79.3 MPa



$$\frac{96 - 20.7}{29 - 20.7} = \frac{79.3 - 52.4}{x - 52.4}$$

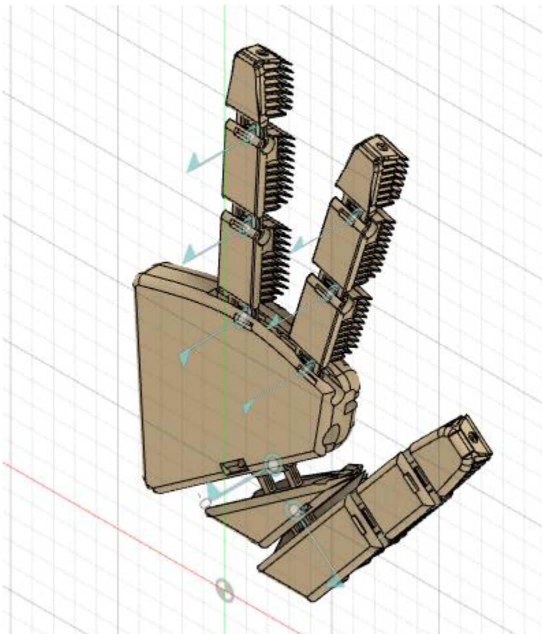
$$x = 55.36$$

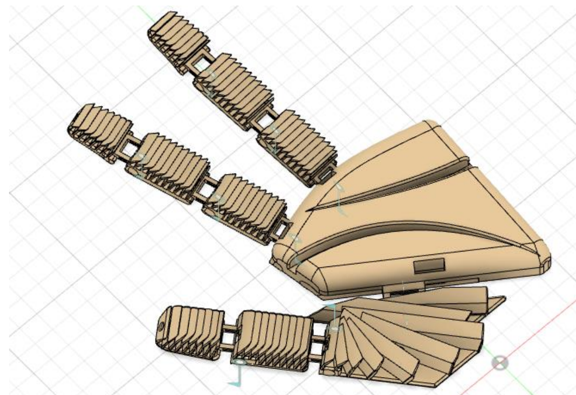
So we can assume that Tensile Strength, Yield is equal to 55.36, now we can feed the following information into the simulation parameters for testing.



Now we fed the data lets start simulating.

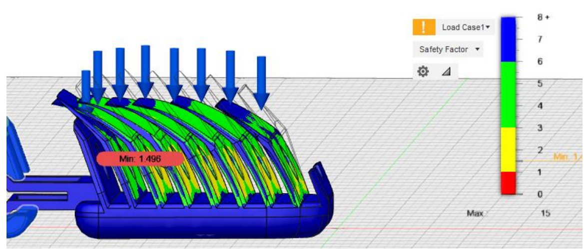
The design consists mainly of 3 basic fingers and a palm, 2 normal fingers and a thumb that supports multiple degree of freedom, as shown in the picture below.





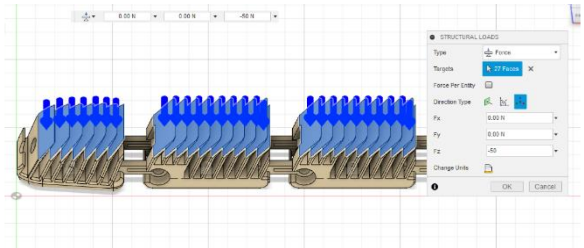
This hand consists of 11 parts that can be easily assembled by only sliding the part joint in its slot. It has a lot of empty spaces for 2 reasons, the first reason is to make the design as light as possible so it does not apply additional weight to the user and the second reason is to give empty space for the wave structures to deform to as it is elastic and deformation is expected from the wave structures.

Now let us start simulation on each finger starting with the finger joints. A 20 N $\approx 2\ kg$ distributed force is applied across the wave structures.

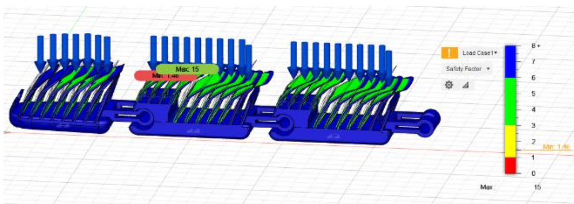


at 20 N force is distributed along wave structures the above figure shows the deflection of the wave structures. The above figure shows the safety factor of the applied force.

The safety factor for this hand is very minimum as it is required to be as light and printable at home as well which results in making it have low mechanical strength properties. This is the minimum force required for the wave structures of the finger, so they do not deform permanently.

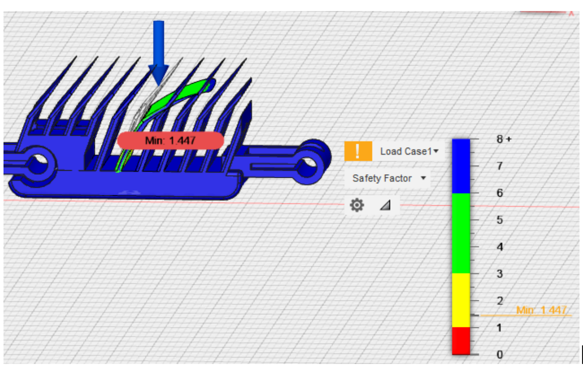
Now we will extend the test and apply equal force across the whole finger simulating a normal force across all the wave structures equally such as pressing on a flat book using the whole finger surface. As the picture below. 

After applying a force of 50 N $\approx 5\ kg$ the whole finger deflects within the range of the elastic region that prevent it from permanently deforming. With a safety factor of 1.46

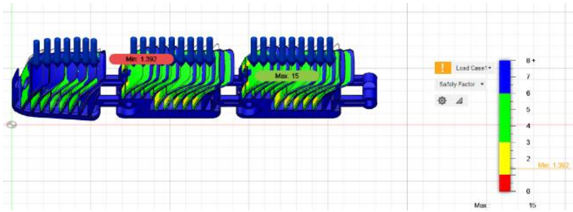


The deflection that happens is a good thing in our application making the structure to be elastic so it could grip onto irregular objects firmly and easily.

Additional testis made on one wave structure also for demonstration how strong can it withstand if force is applied on it determining the force per wave structure.

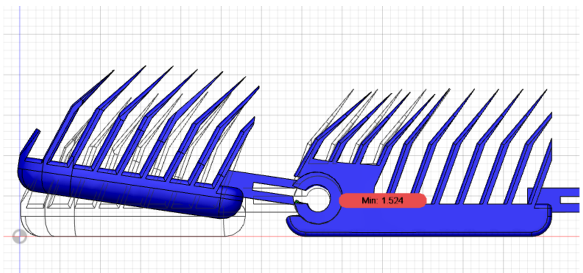


It can only withstand a force of 2.5 N which is an acceptable amount of force compared to an individual flange with a safety factor of 1.4.

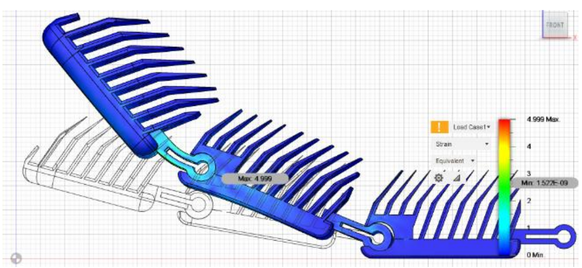
The exact same simulation results and specifications apply to the second finger as they are almost identical. 

The above figure is the simulations of the second finger which yields similar results.

Now let us demonstrate applying moment on the joints of the finger and how it will behave in the figure below a moment of 80 N.mm is applied on the first joint

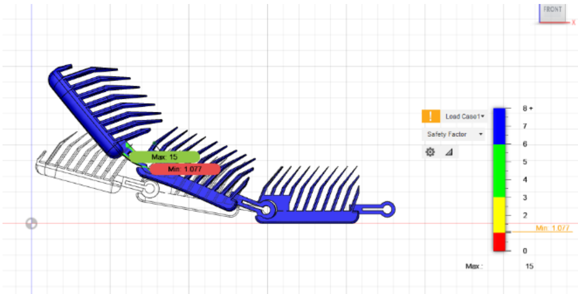


Once the joint hit the upper surface of the second part of the finger it starts to deform closing the hand grip



Furthem moment force is applied to the finger so it could bend even more a moment of 90 N.mm is applied to the first joint and a moment of 250 N.mm is applied to the second joint showing the stress applied the joint and to what extend they could bend having in mind these are the maximum moment that could be applied to the finger without being permamantely deformed.

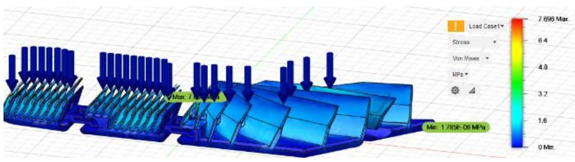
The servomotors that will be used for each finger, the micro servo motor of 2.2 kg.cm $\approx 215.7463\ N.mm$ as not the maximum amount of torque would be applied an will exert sufficient torque to rotate the finger.



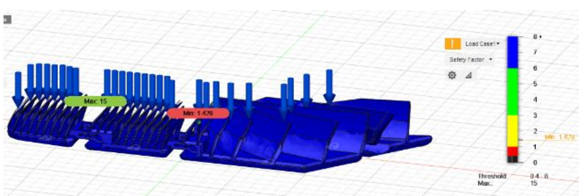
25 n.mm on tip one

70 n.mm on middle one

Now we have finshed simulating the 2 finger lets simulate the thumb applying force to its structure. A force of 30 N ≈ 3 kg in pressed against the thumb

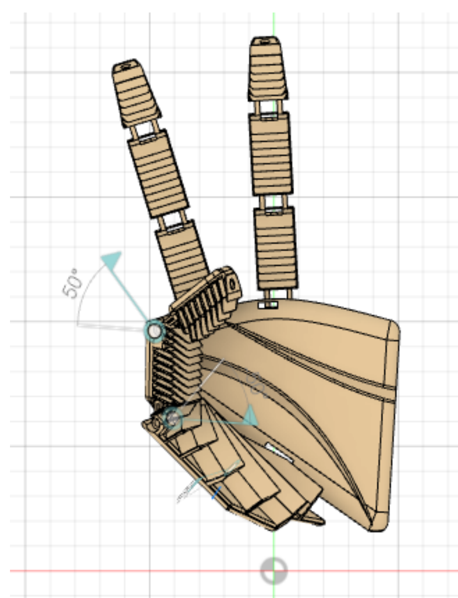


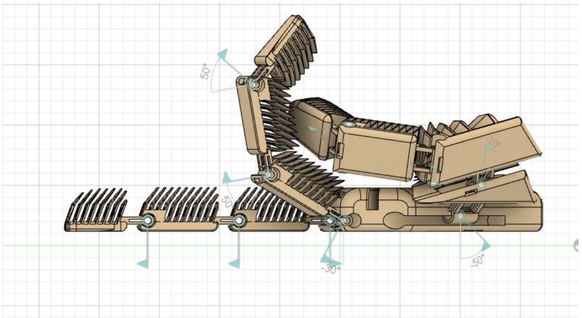
The above sigure shows the stress exetrted on each wave structure and the below figure shows the saftey factor of the force applied which is about 1.429.



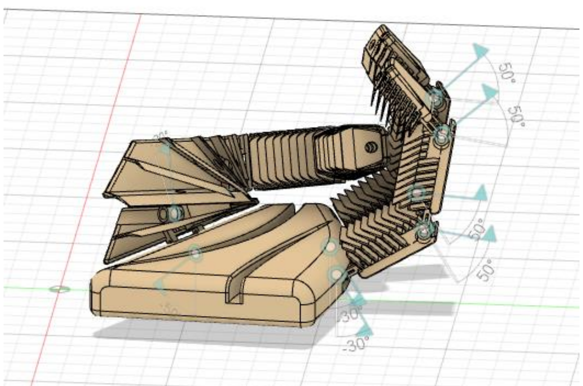
Motion study

Now the next couple of figures will show motion simulation of the hand in action as its fingers rotates demonstrating its degree of freedom. Thumb closed make the hand pointing number 2.

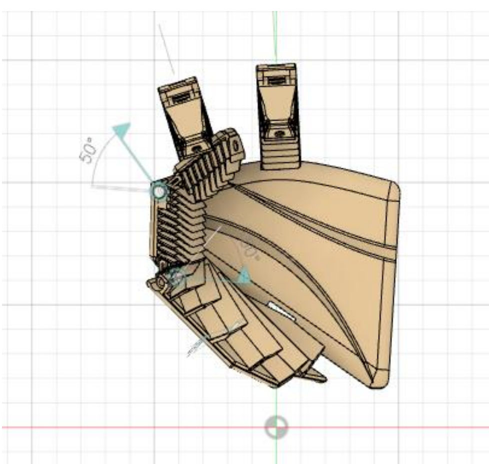


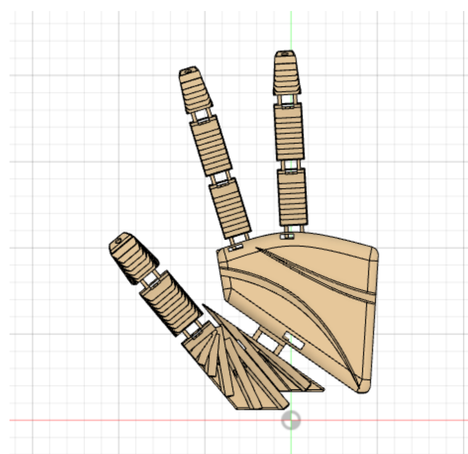


This figure shows the thumb and first finger closing making almost a fist



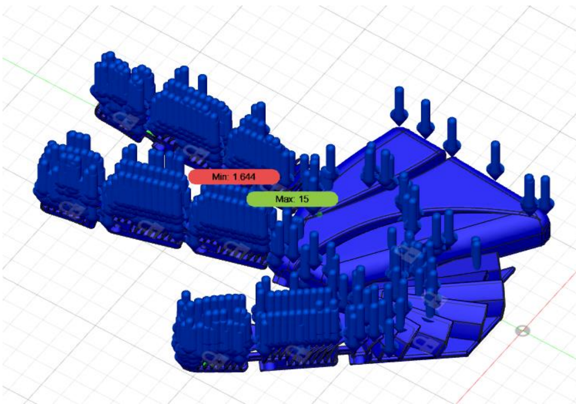
The last figure shows all fingers closed to they extent of their gergree of freedom, furthey torque and force needs to be applied for the finger to twist more towards the palm.

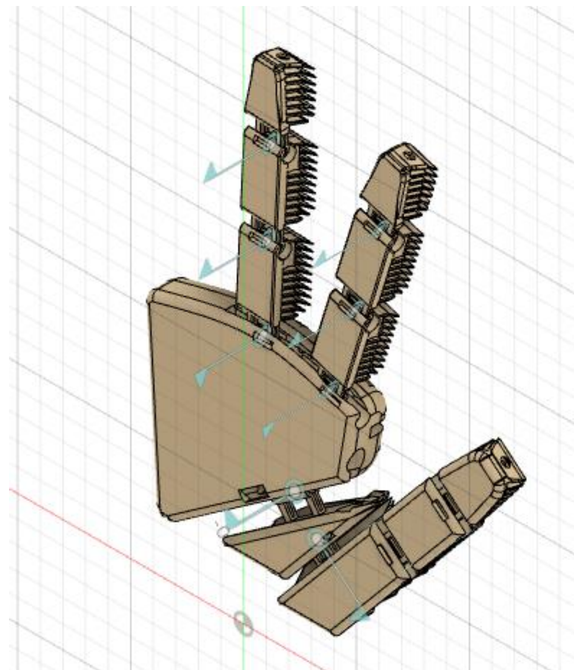




The left figure shows top view of the closed hand fist and the right figure demonstrates the top view of an open hand fist.

Isometric view of the hand simulation





Final part is to apply a compression force across the whole hand to figure out how mush of a pushing force can the user exert on the hand, applying an equal steady comppesion force acros the whole hand of 800N ≈ 80 kg the hand will be able to withstand such pushing (compression force) with as safety factor of 1.64.

Materials Preparation

In this study, PLA and ABS fibres are used in the manufacture of parts using a 3D printer. There are practically a few factors that can help you choose the materials for this task. ABS is characterised by acrylonitrile-butadiene-styrene, which is made from active ingredients based on oil. It is a cloudy thermoplastic that has a different mix of properties, for example, high protection against synthetic mix, heat and effects. ABS materials are hard, extreme and inflexible. ABS also has a high liquefaction point (Pizzolato et al., 2017). Its solid and hard quality can keep its shape for a long time and cannot be twisted due to the heat from the outside. It is also extremely practical and has a long lifespan. Also, PLA, which is characterised by environmentally harmful corrosion, is a type of biodegradable plastic that has its unique properties. PLA consists of herbal ingredients, such as corn starch or sugar cane. Offers a large surface for a lighter and smoother surface. PLA material is an environmentally friendly material with no harmful leakage when printing (Kathryn, Laurentis and Constantinos). Another important device for an arm prosthesis is a handmade glue gun. A heated glue gun accompanies the liquefaction rod with electrical and mechanical parts. The firearms for supply are obtained from the energy source, and when the melting rod begins to melt, it is pushed through the weapon by a mechanical shot system. A simple gun ensures the safety of the joints and the dough is quickly fried and repaired. Some types of closures are also used, e.g. B. fasteners, nuts and screws to connect the hands (Kirkley et al., 2017). An 8mm x 8cm earthquake is used to connect the wrist parts, 8mm x 4cm is used to fix the thumb, 8mm x 6cm is used to move the hand, while 3mm x earthquake Rounds are 2 cm for all fingers. The bowel movement is used to connect the blades of the fingers behind the hand, which allows us to move and move the hand (Gailey and Clemens, 2017).

Open and Close Test

Several tests are carried out on this prosthetic arm. The tests are based on our goals, which are managed and maintained. The main test is carried out to ensure that the prosthetic arm can move, ie open and close, the fingers. The post-test is designed to test the hand's ability to perform a simple task such as gripping and holding. Opening and Closing Test This test was performed to confirm the ability of the prosthetic arm to move the fingers (Laurentis and Mavroidis, 2002). A person with a shorter arm length, as opposed to a prosthetic arm length, was subjected to this test. The analyser arm was integrated into the prosthesis arm. A Person tried to put his hand on his elbow. At first, the arm and forearm were flat. The edge was estimated at 180° (Dechey, Cleghom and Naumann, 2001). The development of the fingers was tested by bending the elbow. The edge gradually decreases from 180 ° to less than 90 °. When the tip falls off, the fingers turn and form a handle. To make twisting the fingers easier, the elbow rolls off the forearm and arm.

Improvement of Grasping and Holding:

The test showed that the hand was not suitable for playing the grip mode correctly. The objects tried to slip out of the handshake, which proves that the structure of the 3D printed hand has an elusive surface. Therefore, sticky non-slip protection was placed on the palm. The additional surface of the non-slip protective adhesive seemed to hold the prostheses in place, which was to be expected under the given circumstances. The elastic surface of the anti-skid surface is packaged efficiently and has a shockproof lining. The Skid Protector adhesive guides allowed the prosthetic hand to hold the traction brush and were ready to lift the brush without falling (Cardozo, 2016).

Research Analysis

Stress calculation When a material is exposed to a pile, it bends or twists, regardless of its strength and luminosity. If the stack is small, the bandage will likely disappear when the stack is ejected. The strength or degree of humiliation is called tension. To ensure that the prosthetic arm can continue with the forces to which it will ultimately be exposed, a calculation was carried out to ensure that the materials of which it is made are sufficient. There are essentially two types of anxiety that are exposed to prosthetic fingers (Saikia et al., 2016). Compression and shear. When the finger is in a straight line, the cutting pressure is more extreme. If the finger is vertical, the pressure is more visible. In this way, the highest pressure occurs when the finger is on a 45-degree edge, in which both types of pressure are involved. The recipe for determining fear is as follows:

$$S_{compression} = \frac{F \cos \theta}{A}$$

$$S_{shear} = \frac{F \sin \theta}{A}$$

Where F is the applied force, θ is the point between the force and the finger and A is the cross-section of the finger. The resistance estimate is specified by load height tests (Mota, 2017). The most extreme load that an arm prosthesis can lift is 600g, which corresponds to 6N.

Table 1 Stress in Horizontal Fingers

Finger	Area (m^2)	Force (N)	Compression Stress (N/m^2)	Shear stress (N/m^2)
Thumb	$5.41x\ 10^{-4}$	7	0	11299
Index	$4.94x\ 10^{-4}$	7	0	12212
Middle	$3.56x\ 10^{-4}$	7	0	17341
Ring	$3.56x\ 10^{-4}$	7	0	17341
Little	$2.94x\ 10^{-4}$	7	0	21127

Table 2 Stress in Vertical Fingers

Finger	Area (m^2)	Force (N)	Compression Stress (N/m^2)	Shear stress (N/m^2)
Thumb	$5.41x\ 10^{-4}$	7	11239	0
Index	$4.94x\ 10^{-4}$	7	12240	0
Middle	$3.56x\ 10^{-4}$	7	17451	0
Ring	$3.56x\ 10^{-4}$	7	17351	0
Little	$2.94x\ 10^{-4}$	7	21129	0

Table 3 Stress in Half Inclined Fingers

Finger	Area (m^2)	Force (N)	Compression Stress (N/m^2)	Shear stress (N/m^2)
Thumb	$5.41x\ 10^{-4}$	30	7995	7995
Index	$4.94x\ 10^{-4}$	25	8651	8651
Middle	$3.56x\ 10^{-4}$	22	12267	12267
Ring	$3.56x\ 10^{-4}$	15	12267	12267
Little	$2.94x\ 10^{-4}$	12	14940	14940

Several tests focus on this prosthetic arm. The tests are based on our goals, namely control and maintenance. The primary test is performed to ensure that the prosthetic arm can move, i.e open and close, the fingers. A post-test is performed to test a hand's ability to perform a basic task, e.g. B. Gripping and holding. Opening and Closing Test This test was performed to check the ability of the prosthetic hand to move the fingers (Saikia et al., 2016). A person with a shorter arm length, as opposed to a prosthetic arm length, was subjected to this test. The analyser arm was integrated into the prosthesis arm. He tried to put his hand on his elbow. At first, the arm and forearm were flat. The point is estimated at 180 °. The development of the fingers was tested by rotating the elbow. The edge gradually decreases from 180 ° to less than 90 °. When the point drops, the fingers turn and shape the development of the handle. To reduce the inclination of the fingers, the elbow bends the forearm and arm (Afshar, 2017).

After the prosthetic arm collection was completed, several assessments were made to assess the prosthetic arm capacity. The first examination of open and closed doors was carried out to ensure the usefulness of the prosthetic arm, which is firmly in the fingers to open and close. When the elbow is twisted, it exerts a tensile force that leads to tension in the intestine. When this happens, the gut will shrink, distorting the structure of the fingers and palm and forming a "lock". To "open" the arm, the elbow is fixed to release the energy that puts pressure on the intestinal marrow so that the structure of the arm can regain its basic development. Another important perspective that is broken is understanding (Afshar, 2017). Four retention modes were considered and tested during research and testing, namely Power Grip, Key Grip, Ball Grip and Load Hold. Given the posture and posture tests, a prosthetic hand or finger may not work as well as a typical person. You cannot lift the brush and the ability to handle the element is not completely compromised. As can be seen from the energy retention mode, two tests showed that the prosthesis arm was able to lift the brush as soon as the protective cover was attached to the finger and palm of the prosthesis. It has been shown that, by attaching non-slip cement protection, the outside of the palm and the prosthetic finger can be ground, which enables the object to be checked with suitable manipulation. After the keys, the ball and the load have been attached, it can be concluded that the ability to handle the object is much better if the protective layer of cement is attached to the prosthesis arm (Geethanjali, 2016).

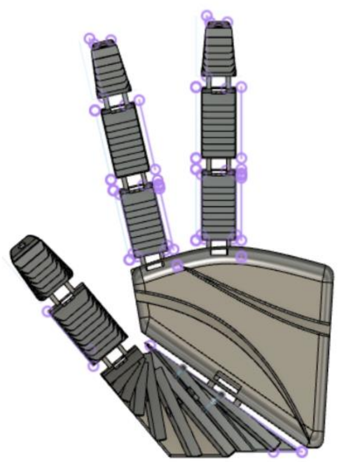


Figure: final design

Conclusion

The capacity of an arm prosthesis with a controlled body is the breaking point. Hand prosthesis tests show that the prosthesis arm can only handle and hold objects. In all cases, the prosthetic arm is always ready to set up a daily schedule, e.g. vacuuming or cleaning the floor, drinking water and taking a light object with you as it can be attached under a load of 6N. There are several ways to understand what this arm prosthesis cannot achieve, namely accuracy and listing.

For precise gripping methods, the prosthetic arm should be able to hold extremely small items such as coins or cords, while the backrest and prosthetic arm should be able to press the latch or put together a book on the phone. A portable prosthetic instrument that is controlled by using the body limits its capacity. To comfort a person who has lost an arm, this prosthetic arm is extremely useful because it is easy to manufacture and is only used by a controlled body. It is extremely helpful to help this person feel comfortable handling and holding objects.

The picture above is the final design of our robot hand. We designed thumb, stop, and index finger. The robot hand's method is to fix the thread at the fingertip and fix the thread in the other direction to the dc motor, so that the finger folds inward when the thread is wound. The method of spreading the hand again is to use the elastic force of the material at the joint to turn the motor back when the thread is released. However, if there is a problem that doesn't unfold when I make it, I will fix the rubber band at the joint to increase elasticity. The index and stop were driven by a single motor and thread. The thumb was one of the most important parts. Because it plays the most important role in catching objects. Therefore, we made another joint at the end of the thumb, and we used two motors and threads to move the inner part (50 degrees) to move the thumb closer to the index finger when the object is small, and when we need to catch a large object, we designed the thumb to go as far as the ring finger as possible. If there is no limit to the cost, I would like to use threads and motors for each joint to make more sophisticated movements. The final goal of our design was to catch soft objects and to make it easier to assemble and disassemble fingers, so that the robot hand users could easily replace them when their hands were broken or when their hands were large in childhood or adolescence. (in such a way that the user freely forms and assembles or extends the joint)

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