Making “growing” prosthetics for growing Children

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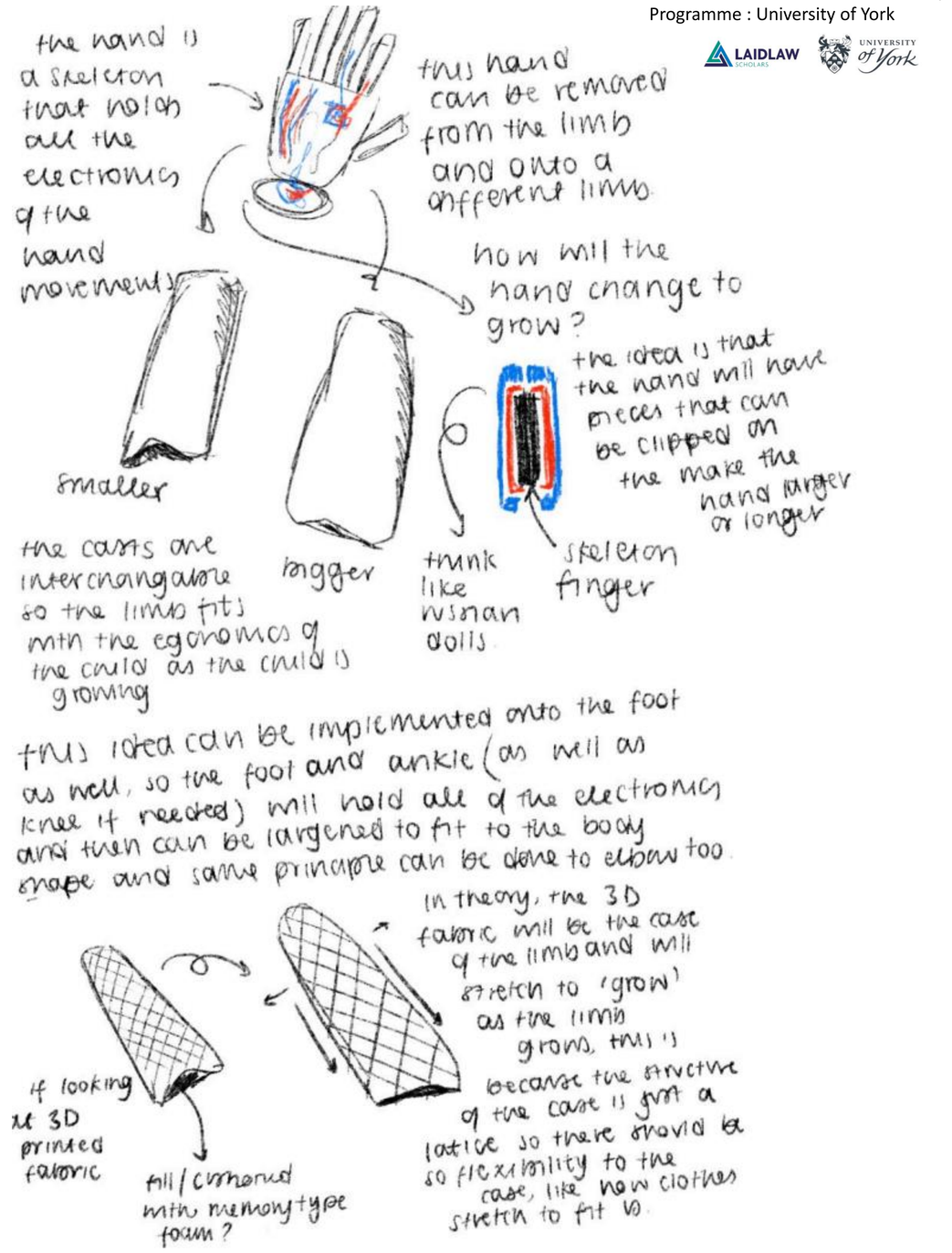
From birth to old age, humans are constantly physically changing, these changes are more minimal from adulthood. The stage this project focuses on is when the human is in the stage of development where there's the most changes; childhood. In childhood, the human body is constantly growing and developing with sudden growth spurts as well, an amputee or a child born without a ligament would be constantly needing their prosthetic limbs to updated and changed, this can be expensive and very time consuming in manufacturing.
Therefore, what I will be focusing on is coming up with a solution to reduce the need to constantly needing to update the prosthetic, so instead of the child needing the prosthetic needing a new prosthetic every 3 to 6 months, for the prosthetic to last up a 1 year or longer if possible. Doing this will reduce the amount of expenses needed to manufacture the prosthetic, additionally making the “growing prosthetic” to develop alongside the child if added AI is integrated into the prosthetic.

The two different aspects that I'm looking at this project from that could also be potentially combined with each other.
•Firstly looking at materials that could be “growable” meaning the material has enough elasticity in the material to expand and grow - similar to how memory foam remembers and holds the shape of the user. One potential material that could be looked at is different polymers and different techniques used in 3d printing, e.g. how 3d printed fabric is made
•If the limb is a hand, have integrated AI within a prosthetic and to keep the hand size to fit to the size of the body, have different sized outer shell cases that can be changed to change the hand size and same with fingers. The same approach can be done for a foot, mainly focusing on the ankle and knee if the user has no upper leg.

3D printing Technique	How it works	Materials	Cost	Advantages	Disadvantages
Inkjet 3D printing	With the use of thermal or acoustic force, the printer ejects small sizes of substrate	Natural polymers, such as collagen. Hydro gels	low	High printing res, low costs, fast printing speeds	Poor mechanical properties in printed objects
Fusion deposition Modelling (FDM)	Using liquid thermoplastics, the material is placed on the bed in a layered pattern	Thermoplastics	Medium	Low cost and large range of materials to work with	Only able to use thermoplastics
Extrusion Based 3D printing	Materials is extruded from one or more nozzles, under control, in a layered pattern	Most natural polymers, synthetic polymers	Low	Large range of materials to work with, flexible properties	Moderate resolutions in printed products
Stereolithography (SLA)	Free form technology is used on a photosensitive polymer under a formulation beam	Photopolymers	Low	High printing res, fasting printing speeds.	Cytotoxicity of the laser beam, difficult to work with
Digital Light processing (DLP)	Free form technology is used on a photosensitive polymer under a formulation beam	Photopolymers	low	High printing res, fasting printing speeds.	Cytotoxicity of the laser beam, difficult to work with
Laser – based 3D printing	High pressure is made from laser pulses which will bubble the material together	Natural polymers e.g. gelatine, polymers e.g. PCL and PLGA	High	High printing resolutions	High printing resolutions

Refences ; F. Liu and X. Wang, “Synthetic Polymers for Organ 3D Printing,” *Polymers*, vol. 12, no. 8, p. 1765, Aug. 2020, doi: 10.3390/polym12081765.



Using from the table on the left hands side, we can conduct which printing process can be used to make and prototype the prosthetic. The 3D printing processes will then lead to which kind of fabricating process is best used for the designs that can be seen above. Using all the research that was conducted, from the report turns into a basic design specification and guide on prototyping the firsts of the “growing” prosthetic, on which can be changed as the prototype is developed.