MOTORISED FINGER
FOR PARTIAL HAND PROSTHETICS

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AIMS/OBJECTIVES

The aim of this project is to design a simple but robust 3d printed finger that can be integrated to produce a upper limb hand prosthesis .
The project has the following objectives:

1. Review of Literature and designing 3D with a CAD software.
2. 3D printing a digit and assembling the units.
3. Integrating the electronic board, that is the controller, with the hand hardware Running repeated endurance, mechanical fatigue and weight tolerance tests.
4. Linking hand hardware and software with the electronic system that records muscle activity.

INTRODUCTION

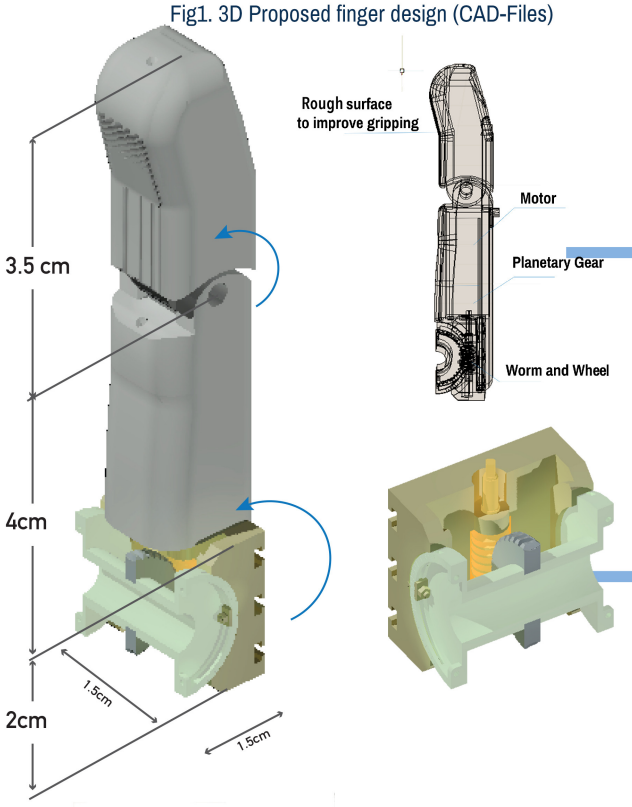
Partial hand amputation is by far the most common type of amputation worldwide, Nevertheless, regardless of their potential clinical and socio-economic impact, powered digits, have modestly progressed so far, and very few clinical solutions are available today.
Here, I present a mechanical architecture, an alternative to state-of-the-art solutions, which exploits high efficiency. A simple, but robust 3D printed finger has been designed to be used for partial hand amputees or integrated into a prosthetic hand.

Fig 3. Full Hand prosthesis [1]

APPROACH - DESIGN

The main objective of a prosthetic digit is to provide an acceptable level of motor function, mainly the restoration of the flexion or extension movement. The performance of the finger is inspired by the natural hand, the male index finger is used as a target size.
To achieve the desired size and mechanical power a low power and small motors is important as well as a efficient and simple worm and wheel gear.
The designed finger has two joints which differ from the human finger, but this design was assumed to give the digit a better performance according to the material properties.

Fig1. 3D Proposed finger design (CAD-Files)



A. KINEMATICS OF THE FINGER

The architecture of this digits is well-known for being efficiently and it has been used in many state of art powered digits and prosthesis hands. The finger was designed to be compatible of simple object sized to be griped by the human hand, as trajectory of this digits is expected to mimic the human finger during grasping.

B. ATTENUATION

An off-the-shelf motor Polulo Micro metal gear motor, with a planetary gear-head with a reduction ratio of 298:1 is used to attenuate the finger. Further attenuation is provided by the combination of resistors to limited the amount of current that will be provided to the finger.

C. WORM AND WHEEL

The designed face-gear is back-drivable, rotating and rolling worm. This gear and partly 3d printed and combined with a metal wheel to provide better rotation.

RESULTS

DESIGNING 3D WITH A CAD SOFTWARE

As seen on the figure 1, the 3d designing process was done by using AutoCAD software which allowed tan implementation with great dimensions' accuracy, as well allowed for motion simulation in order to confirm the design criteria. The design produced is unique in its aesthetics aswell as on the kinematics as currently there is not on the current on the market a purely 3d printed digits with a motor on the area of intermedia phalangs.

Fig 2. 3D Printed fingers, testing phase

3D PRINTING A HAND AND ASSEMBLING THE UNITS

The assembly process has been challenging as the accuracy present on the drawing design process can not be exactly reproduced by the 3d printing technologies available for this project.
The 3D machine extruder has an accuracy of about 1 mm/2mm whereas it is acceptable for big parts, it proved to be problematic for the smaller parts of the finger (e.g the worm and wheel). This difficulty can be overcome by using better 3D printer and continue testing with the current design.

REFERENCES

1. I. Imbinto , Et al, 2018. The S-Finger : A Synergetic Externally Powered Digit With Tactile Sensing and Feedback. IEEE
2. Thang010146. (2018). Swivel Table for Machine Tools The worm rotates around its axle and rolls on the worm wheel simultaneously. [Online Video]. 11 October 2016. Available from: youtube.com. [Accessed: 6 August 2018].
3. [1] Modulated humanoid hand/prosthests 2018 Pinterest [webpage]

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