Exoskeleton for people with C6/C7 injuries

Codename Bevos Next Door
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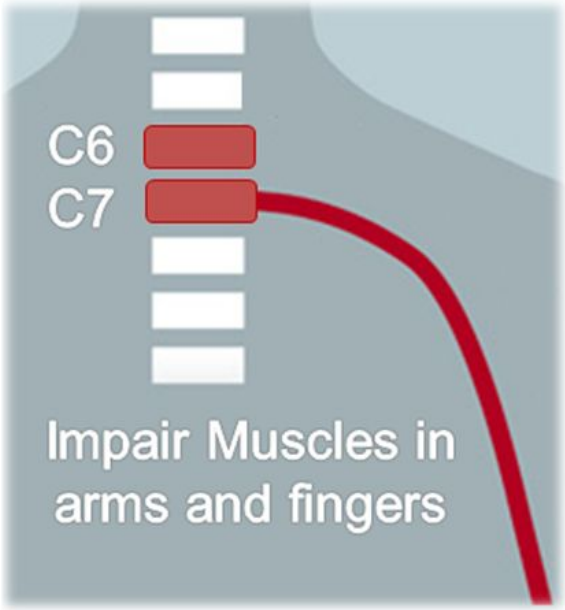
Recap: What is C6/C7 Injury?



- **Problem**: People with C6/C7 vertebrae injuries have almost no capability of being self dependent due to inability to use fingers.

Research Problem and Solution

- **Objective:** Create a device that allows users to perform two most used/important grasps (pinch and power).

- (http://grasp.xief.net/documents/THMS_taxonomy.pdf)
- (https://www.spinalcord.com/c6-c7-c8-vertebrae-spinal-cord-injury)
- (http://www.aboutonehandtyping.com/statistics.html)

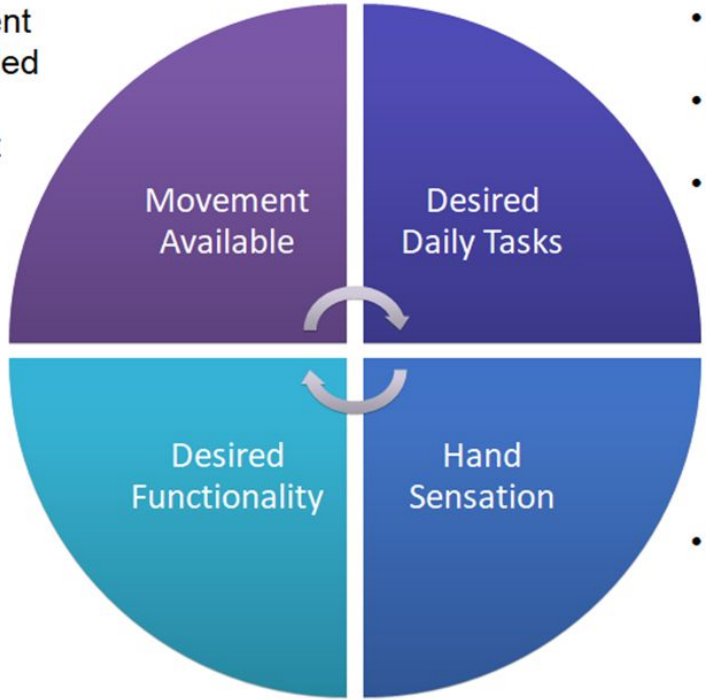
Current Exoskeletons

- Low joint reaction forces at the finger joints with large range of motion
- Bowden-cable based series elastic actuator for accurate torque control
- Force-control based control
  - Active effort for rehabilitation(therapy based)
- Pure position based control
  - Guide movement to follow predefined trajectory(skill based)
- Passive compliances for safe and comfortable interactions for human hand.
  - Form of a Bowden-cable based

(Agarwal et al, International Journal of Robotics Research, 2015)
http://grab.diem.unibo.it/?Research&Biomechanics&List

Patient Feedback

- Limited movement
- Initial force needed to open
- Curled fingers at starting position

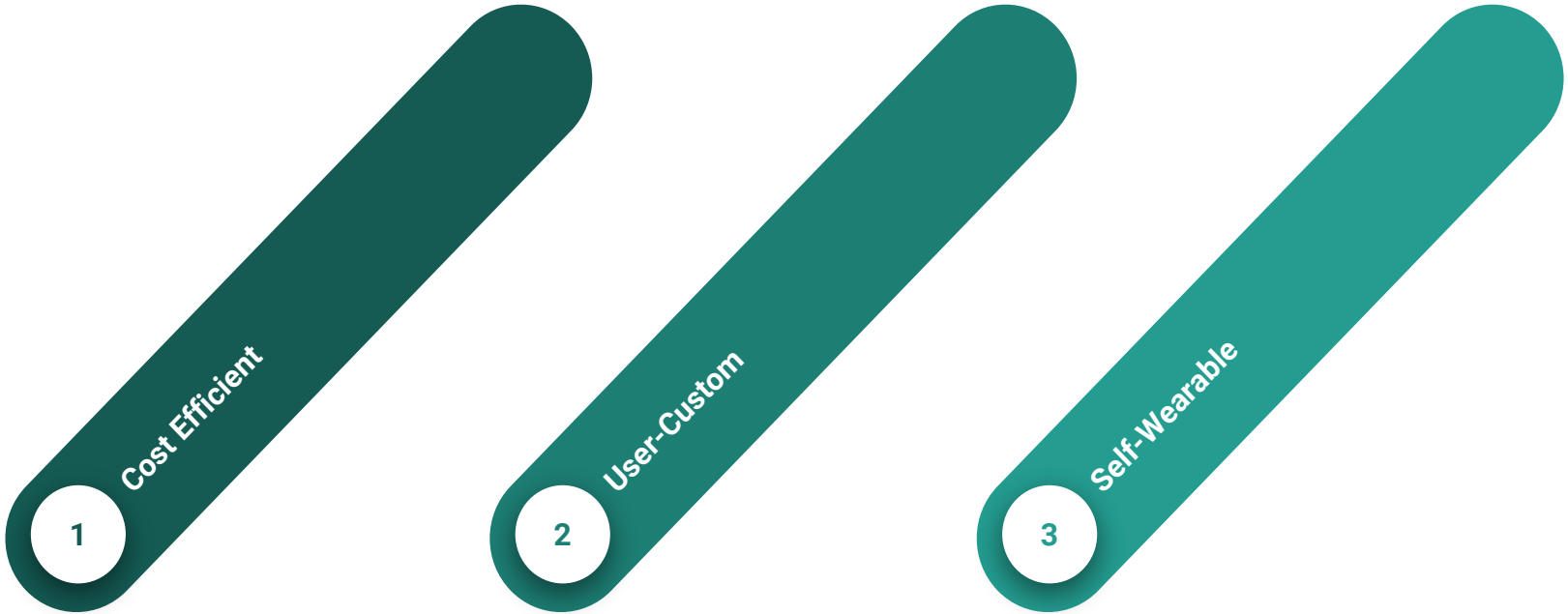


- Healthcare [bowel movement]
- Relationship interactions
- Daily toiletry activities

- Self-wearable glove without assistance

- No hypersensitivity with temperature

Design & Process



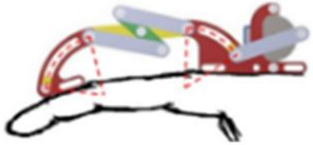
Design Process

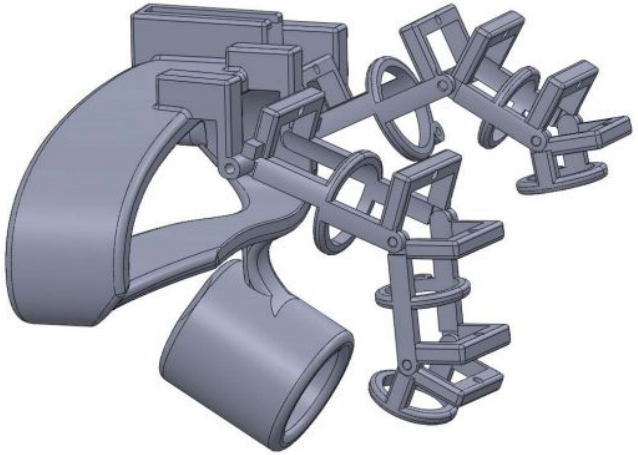
1) Press Button to start and to control speed and force

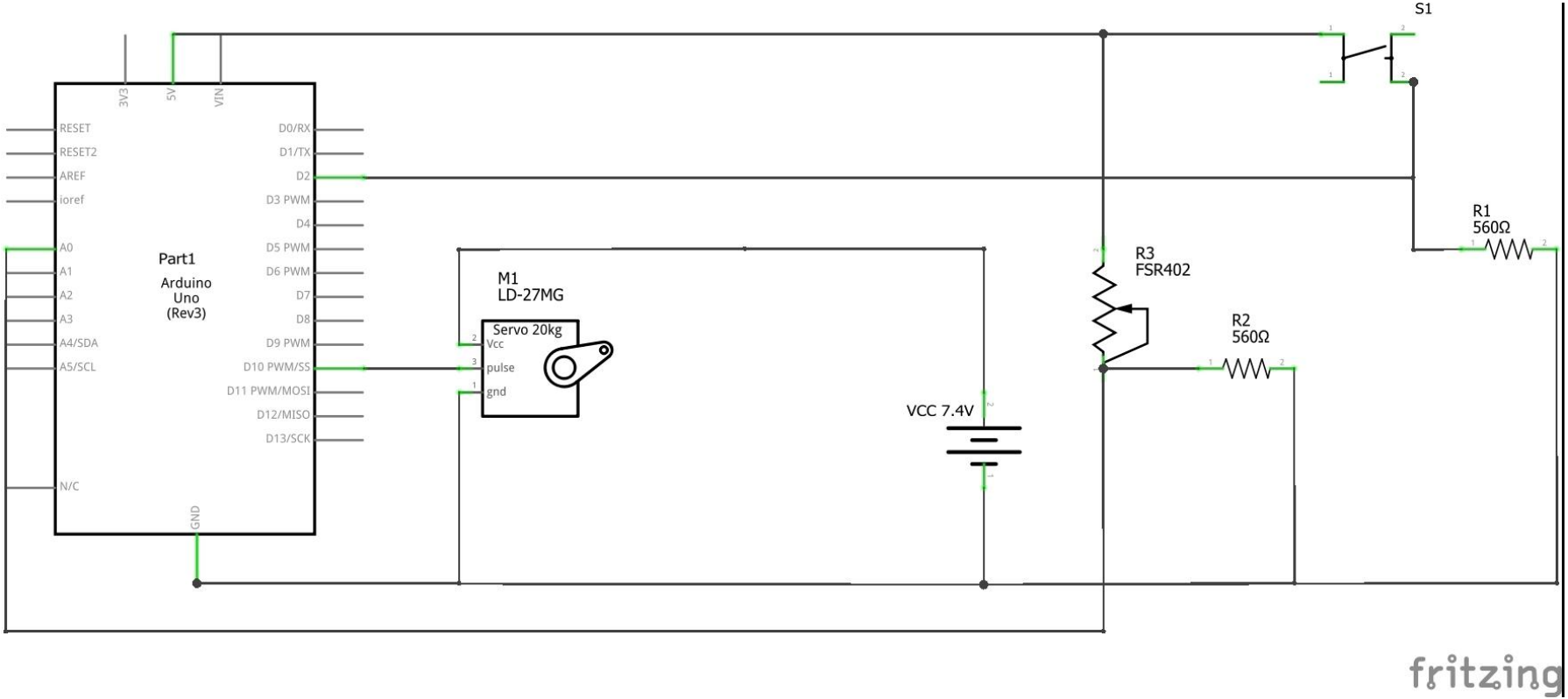
2) Servo controls cables to close fingers

3) Resistive Sensor stops servo to complete grasping

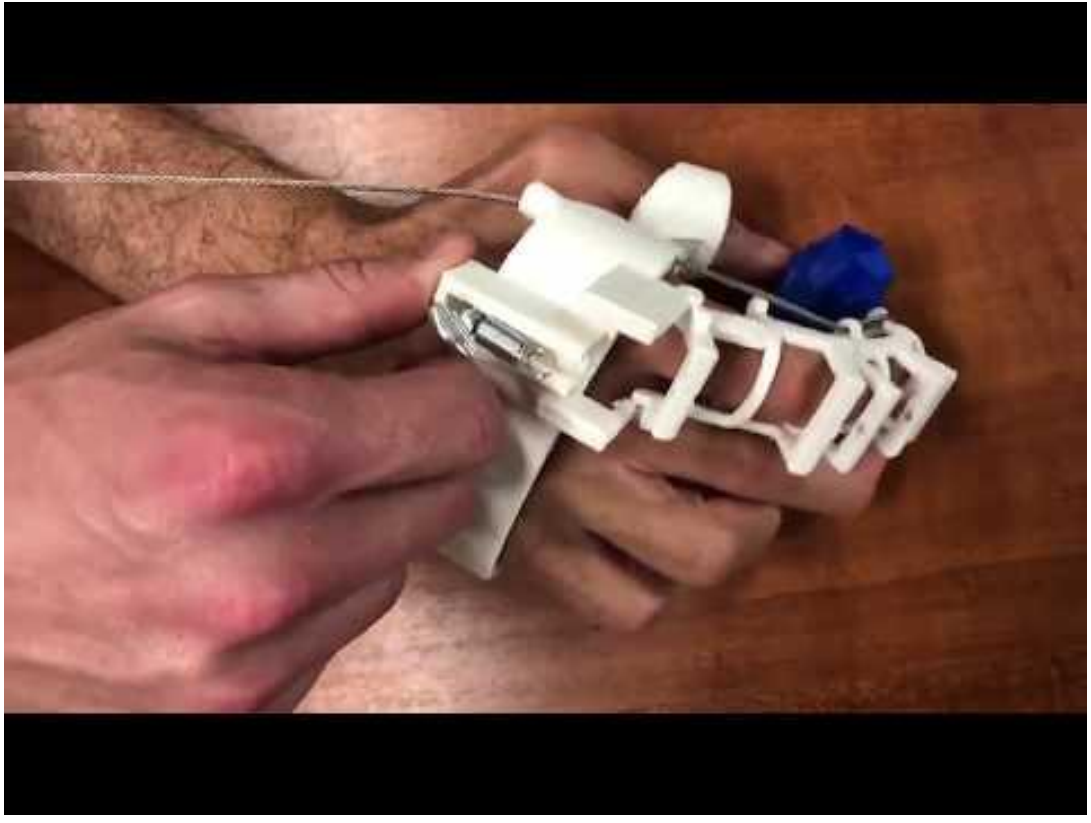
4) Press Button Again to release cables to starting position





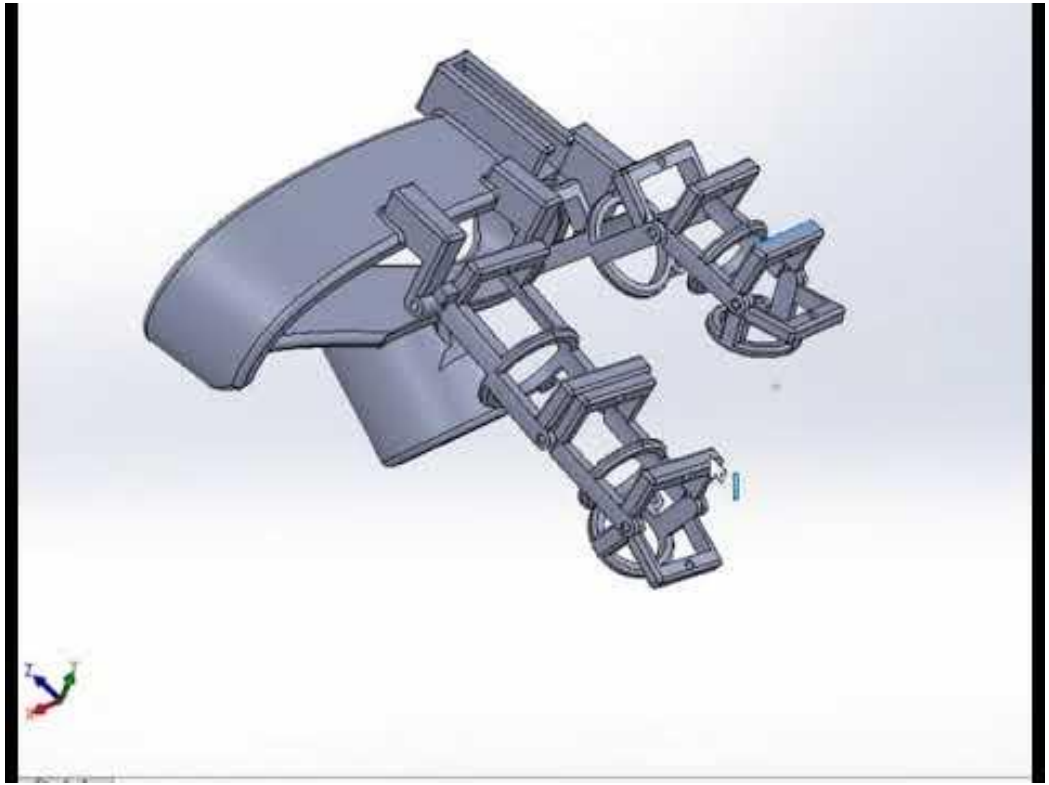

S1
3V3
5V
VIN
RESET
RESET2
AREF
ioref
A0
A1
A2
A3
A4/SDA
A5/SCL
N/C
GND
D0/RX
D1/TX
D2
D3 PWM
D4
D5 PWM
D6 PWM
D7
D8
D9 PWM
D10 PWM/SS
D11 PWM/MOSI
D12/MISO
D13/SCK
Part1
Arduino
Uno
(Rev3)
M1
LD-27MG
Servo 20kg
Vcc
pulse
gnd
VCC 7.4V
R1
560Ω
R3
FSR402
R2
560Ω
fritzing

Patient Feedback on Prototype

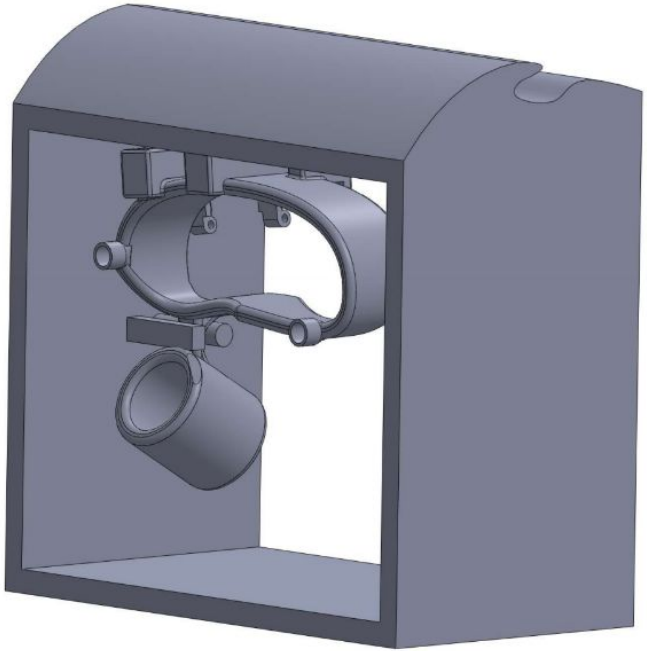


360 View

2-finger Joints



Limitations and Improvements



Questions

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