



Integration of Prosthetic Hands and DC Motor Control



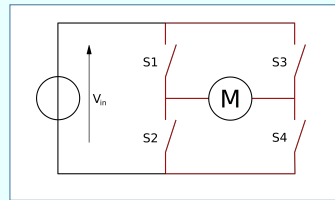
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ABSTRACT

Prosthetic hands have been in development for many years; however, with the recent uprising of 3D printers, it has become possible to make modular, cost effective, and efficient prosthetics. Although prosthetics can be used without aiding electronics, many prosthetic hands gain higher levels of functionality when paired with electric motors, microprocessors, and various electromechanical systems. Modular hand designs consist of different motor configurations ranging from a simple design that controls all fingers at once, to a more complex design that simultaneously controls and monitors the movement of each finger individually. Regardless of the configuration, DC motors require proper control to allow the hand to open and close at the proper rate, to apply correct pressure to pick up objects, and to ensure the safety of the end user. All motors will be controlled by a microprocessor, similar to those found in an Arduino development board.

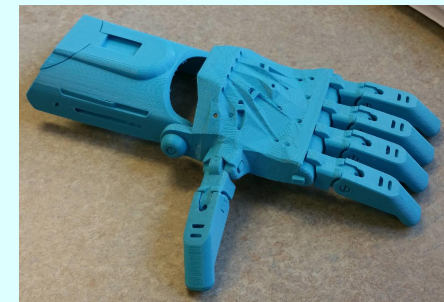
HARDWARE

- ❖ Adding the ability for single joint movement would make an imperative improvement to the prosthetic hand
- ❖ Small DC motors must be used in parallel with Piezo pressure transducers (sensors)
 - ❖ When pressure is applied by an individual, the motors will run forward to close the hand
 - ❖ When no pressure is applied, the hand retracts back to an set position determined by a limit switch
- ❖ Forward and reverse motion was possible by use of an NPN transistor H-bridge circuit



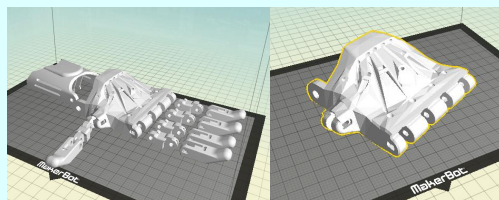
Efficiency

- ❖ Measured by motor control
- ❖ Ability for the fingers to not over extend
- ❖ Added simplicity for end user
- ❖ Simplicity is the overall aim



3D PRINTING

- ❖ Recently commercialized
- ❖ Innovative form of printing
- **Hardware:**
 - ❖ Bipolar DC stepper motors
 - ❖ Extruder head assembly
 - ❖ Build platform
- **Software:**
 - ❖ Arduino based firmware design
 - ❖ 3D modelling package
 - ❖ SolidWorks, Autodesk Inventor, etc..
 - ❖ G-Code Slicer to decipher provided STL file



SOFTWARE

- ❖ Software development using a microcontroller
- ❖ For simplicity and overall design efficiency, an Arduino Mega 2560 was used
- ❖ Arduino acts as the link between hardware and software
 - ❖ Recognizes motor positions at all times
 - ❖ Senses current draw to determine grabbing force on objects
 - ❖ Reverses motor when pressure sensor is not pressed, allowing for hand retraction
- ❖ Allows for modular development catered for the needs of each individual
 - ❖ Additional motors can be added easily depending on the desired usability of the hand
 - ❖ Open source code allows for anyone to edit and make improvements

```

//avoid nuisance actuating
if(state>3){
  //amount of pressure needed
  if(state > 500){
    digitalWrite(F1, HIGH);
    digitalWrite(F2, HIGH);
    digitalWrite(R1, LOW);
    digitalWrite(R2, LOW);
    delay(10);
    limit=digitalRead(A7);
  }
  else
  {
    limit=digitalRead(A7);
    digitalWrite(F1, LOW);
    digitalWrite(F2, LOW);
    digitalWrite(R1, HIGH);
    digitalWrite(R2, HIGH);
    delay(10);
  }
}

```

Future Work

- ❖ Redesigning the thumb to include ball & socket versatility
 - ❖ Increased efficiency with multiple degrees of motion
- ❖ Versatile motor control for thumb movement
- ❖ Modular hand components that can easily be changed and adjusted
 - ❖ Additional motors can be added for individual finger control
 - ❖ As a child grows, the hand can be altered to essentially grow with the child
- ❖ Extend this idea to other body limbs

References/Acknowledgments

'E-Nabling The Future' -- Provided all 3D printed files
 National Science Foundation
 Choose Ohio First
 Academic Advisor: Daniel Simon