Prosthetic Hand Using Microcomputers and Sensors

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INTRODUCTION AND ENGINEERING GOAL

In my 2022 Science Fair Project, I am building a Prosthetic Hand using Microcomputers and Sensors. The goal of building this prosthetic hand is to make a prosthetic hand that can complete many functions that a normal hand would be able perform, and functions that other, more expensive, prosthetic hands are able to perform.

This Prosthetic hand's goals is to complete functions that a normal hand could so that people who need a prosthetic hand will be able to complete many of the same functions that someone else with a hand would be able to do.

Engineering Goal:
Build a Prosthetic Hand that can complete many functions that a normal hand can, while making it as cheap and innovative as possible.

PHOTOS

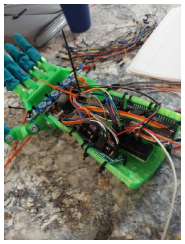
Caption:
Prosthetic Hand progress when it was first starting to be put together.

This is the top of the hand as well as the phalanges for each finger and the thumb.

Cite: Taken by Shanae Osguthorpe (with permission)

Caption:
The Prosthetic top hand part had been connected to the Gaunt part that will control where the strings that move the fingers and the phalanges go.

Cite: Taken by Jeron Osguthorpe (myself)



Caption:
The Inside Wiring of the hand itself.

Cite: Taken by Jeron Osguthorpe (myself)

METHODS

For the project, the first step was to assemble my materials. Some of those materials are including the 3D Printed project files, so I also had to print those out using a 3D Printer. The next part was to assemble the hand together. Once the hand was put together using screws and fishing line, the next step was to put the Raspberry Pi Inside the hand so that it can still be plugged in correctly. The best way that was found to do this is to have the USB ports that Microbit, Mouse and Keyboard all plug into, inside the hand part, with the rest of the Raspberry Pi (the HDMI and Micro-USB Port and the Micro SD Port) facing outside the hand part and above the gauntlet. Afterwards, the goal was to assemble each of the 5 motor driver boards inside the gauntlet, on the side walls, so that all the wires from the motors can go through the top of the gauntlet. Afterwards, the goal was to assemble each of the 61 individual Male-to-Male, Male-to-Female and Female-to-Female wires from the driver boards into the dedicated GPIO pins on the Raspberry Pi and into the power. Afterwards, we connected the touch sensors to the middle of the hand from the thumb phalange to the other end of the hand using some of the Erector Set pieces as well as zip ties. Afterwards, connect the sensors to the power, ground, and dedicated GPIO Pins on the Raspberry Pi. After that has finished, we carefully wrapped the entire hand up with medical wrap so that the wires would not be able to move and get dislodged, and so that the touch sensors would work whenever anything comes against it. Afterwards, connect the motors to an Erector Set Base Platform so that you can have the strings (fishing line) wrap around the motors and then connect the base platform to the hand by using zip ties, bolts, and screws. The next part of the project was to put in the code. We use python to create files that can move the motors, receive data from the serial data from the Micro:Bit, and to receive data from the touch sensors. After this is done, use the Micro:Bit data codes, such as B'1' to make functions that use the motors to do the selected tasks, such as shake someone's hand, push buttons, and more.

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RESULTS

Throughout the project, many of the results were kind a weird. Many times, while 3D printing the hand, it would fail or have some kind of problem. However, through many trials and a lot of time, I was able to get the perfect printing settings for the project.

The goal of the hand is to make it so that a cheap prosthetic hand, can still complete many of the same functions and a normal hand, or an expensive prosthetic hand can complete.

Because of this, we ran some tests based off of everyday functions that the hand can do, such as:

- Pick Up an Item
- Hold a Pencil
- Shake someone's hand
- Make a Fist
- Tap or Push Buttons
- Point
- Show Numbers Using the Hand
- Some Hand Gestures

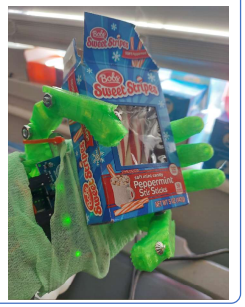
Test	Result
Pick Up an Item	Successful
Hold a Pencil	Successful
Shake Someone's Hand	Successful
Make a Fist	Successful
Tap or Push Buttons	Successful
Point	Successful
Show numbers using the hand	Successful
Some Hand Gestures	Successful

Caption: Hand Shaking Someone's Hand

Cite: Taken by Jeron Osguthorpe (myself)

Caption: Hand Holding a Box of Peppermint Stir Sticks.

Cite: Taken by Jeron Osguthorpe (myself)



CONCLUSION

As for conclusions in the project, the goal of the project was to create a relatively cheap prosthetic hand that would be able to complete many of the same functions that a normal hand or an expensive prosthetic hand would cost. In relation to a normal prosthetic hand, the average prosthetic hand in the world costs around "without insurance you can expect to pay around $5,000 for a cosmetic prosthetic, $10,000 for a functional prosthetic with a hook, and between $20,000 to $100,000 for the latest myoelectric arm technology" (Medical Center for Orthotics & Prosthetics). Before we compare, let me explain what "Myoelectric technology" is. "' Myoelectric' is the term for electric properties of muscles" (Ottobockus). This means that Myoelectric Technology in prosthetics is replicating the muscle properties and how the muscles move in the actual body. Now compared to just a simple 3D printed prosthetic hand, it costs "as little as $50" (Riedel) to create one of these. My project in comparison to the functionality of the hand is between the prosthetic with a hook and the myoelectric arm technology. This means that my hand can complete functions that are a little more advanced than the hand with a hook, but a little less advanced than the hand that uses myoelectric technology. Now in comparison to pricewise, what would usually cost around $9,000-$40,000 (plus or minus some), would cost the consumer of my hand $105 to be created. The median of 9,000-40,000 is $24,500. $105 out of $24,500 is about 0.429% of the cost.

In conclusion, this project has seemed in that it has completed the goal of being a relatively cheap prosthetic hand that can complete many of the same functions as a normal or expensive prosthetic hand. The project has been able to do this by using cheap, but strong parts and using code to achieve only 0.429% of the cost relative to other hands and has been able to be quite functional relative to normal hands and expensive prosthetic hands, as seen by the results.