SASTA OLIPHANT SCIENCE AWARDS

SOUTH AUSTRALIAN SCIENCE TEACHERS ASSOCIATION

Highly Commended

Programming, Apps & Robotics

Year 9-10

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Report 2025 (Robotic Hand)

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Scientific purpose and aim of entry

The purpose of this project is to design and develop a low-cost and efficient robotic hand that can serve as both a functional prosthetic aid and an interactive educational device. The main goal is to create a hand that mimics human finger movement using servos, string tension systems, and microcontroller logic while keeping the build simple and accessible to the public.

This project is inspired by the growing need for affordable assistive technologies, especially prosthetic devices, which are often very expensive and remain out of reach for many people around the world. By using commonly available materials such as 3D printed parts, affordable microcontrollers like the Raspberry Pi, and programmable servo motors, this project shows how science and engineering can be applied to create meaningful and practical solutions for both medical and non-medical use.

The robotic hand also includes a voice-controlled system, which expands its usability for people who have limited hand movement. This allows users to control the hand with simple spoken commands like "open" and "close," making the design more inclusive and easier to use.

In addition to its potential use as a prosthetic prototype, the hand is also suitable for educators and students who are interested in robotics, biomedical engineering, or coding. The aim is to keep the total cost below 200 dollars while still delivering reliable movement, easy control, and a comfortable design.

Why I made the Robotic hand

I decided to make a robotic hand because I wanted to create something that could help people while also being a strong example of real-world science, engineering, and technology. Prosthetic hands are often very expensive, which makes them hard for many people to afford. My goal was to design a robotic hand that is affordable, comfortable, and easy to use, while still being functional and smart. I also wanted to explore voice control, which could make the hand easier to use for people with limited movement. On top of that, I was interested in learning more about programming, electronics, and mechanical design. This project gave me the chance to combine all those skills into something useful that can be shown at the Oliphant Science Awards and possibly even bigger competitions in the future. Even if I don’t win, I have learned a lot on the way, which will benefit me in the future.

What Did I use in the arm?

To build my robotic hand, I used a variety of electronics, mechanical parts, and custom designed components.

- Raspberry Pi 4 Model B

This acts as the brain of the robotic hand. It runs the voice recognition software and controls the movement of the servos. It allows the system to respond to voice commands like "open" and "close" without delay or connection to the internet.

- 5x Goteck Micro Metal Gear Servos (2.5kg/cm torque)

These are used to control the movement of each finger. The servos pull and release strings inside the fingers to make them open and close. They are small but strong enough for testing light gripping and finger motion.

- Adafruit 16-Channel 12-bit PWM Servo Driver

This device connects to the Raspberry Pi and lets it control multiple servos at once. It sends precise signals to the servos so they can move smoothly. It also protects the Raspberry Pi from the high power demands of the motors.

- Shimano Power Pro Braid Line (275m, White)

I used this strong fishing line inside the fingers to create the tendon-like motion. The line connects to the servos and tightens when they rotate, allowing the fingers to curl and hold objects.

- 3D Printed Parts

I designed and 3D printed all the main parts of the robotic hand, including the fingers, palm, and servo mounts. Every design was created by me over the course of 3 months, using my own measurements and models.

This combination of electronics, string tension, and 3D design made it possible to build a low cost and fully working robotic hand that can move in response to voice commands.

What Software Did I Use?

To make the robotic hand respond to voice commands, I used Vosk, which is an offline speech recognition engine. Vosk allows the Raspberry Pi to understand spoken words like “open” and “close” without needing an internet connection. This makes it faster, safer, and more reliable for real-time use, especially in places where Wi-Fi is not available.

For programming, I used Python, which is a popular and beginner-friendly coding language. Python made it easier to control the servos, process voice input, and send

signals through the Adafruit PWM Servo Driver. I wrote custom Python scripts that connect all the parts and allow the robotic hand to move based on what it hears.

I also used Vosk's Python library to help the voice recognition system detect specific keywords. This software combination allowed me to build a fully working voice-controlled system that fits on the Raspberry Pi.

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