



CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

Name(s) Alexander Nguyen	Project Number J0321
Project Title Exoskeleton Actuation	
<p style="text-align: center;">Abstract</p> <p>Objectives For this project, I constructed a motorized arm attachment that will aid in carrying loads. It is a continuation of last year's science project to implement the motorized or actuation of an exoskeleton. By having a small motor perform the heavy lifting, this extension of the body opens a whole new spectrum of possibilities. The chassis can be used for multiple purposes by helping the paraplegic people move or rehabilitate the injured. Creating a fully motorized exoskeleton to gain superhuman capabilities is a arduous task, to say the least. The project's main goal is to use servo actuation to aid a person lift 10 pounds of load and remain somewhat comfortable. The design used gear arrangements to create torque. It was important to create maximum torque for a given servo motor and maintain the smallest size possible. Also, safety and precautions such as reinforcing where the joint should stop were imperative. If the motor for some reason decided to continue to move in a way the arm does not normally move, the user would not end up with a broken arm.</p> <p>Methods Constraints of costs, time, work skills and safety were some of the main roadblocks. I could not purchase expensive materials, so I had to use materials that are readily available around the house and home depot. All of the parts could not just be 3D printed and they had to be fabricated by hand. Wood, aluminum and servo motors were used. Getting supplies, designing and assembly were chunked out over long periods of time</p> <p>Results To test the effectiveness of the arm, multiple combinations of weights were loaded onto the forearm. The weights ranged from 3 pounds to 11. The arm was held down by a helping hand and it was determined if the arm could lift it from the bottom up, or not. The minimal voltage needed to lift the weight was also measured. The Vex 393 servo motor had a thermal breaker installed to stop the motor before it ever gets close to its limit, so the system can only lift the maximum of 11 pounds. I also tested the relationship between current and weight.</p> <p>Conclusions In the end, the project was a success. The arm lifted to 11 pounds on its own before the thermal breaker kicks in and cuts the current to the motor. The next step is to improve and refine the exoskeleton actuation by replication the motorized arm for all other joints. A harmonic gear could be used to reduce the size and increase the torque. The motor and the chassis can be sized down, so that it would not be too heavy and</p>	
Summary Statement I designed, built and tested a geared and servo controlled arm joint of an exoskeleton suit.	
Help Received I researched, developed concepts, designed, built and tested the servo controlled arm joint of an exoskeleton suit by myself. My dad taught me about the design process, how to research to learn about mechanics, dynamics, and servo motors. I also researched about DARPA projects.	