Design and Development of an Open-Source, Myo-Electric Robotic Upper Limb Prosthesis Using Additive Manufacturing

Lothamer, Benjamin (School: Mid-Prairie Home School Education Center)

Background: Developing functional prostheses for the upper limb has historically posed challenges. Amputation of the hand due to military combat injury, disease, or other trauma carries significant psychosocial implications, warranting exploration within orthotics and prosthetics. Timely access to prostheses influences patient usage, rehabilitation, cost-effectiveness, and healthcare burden. Problem: This project addresses key issues in the prosthetics industry, focusing on the accessibility and cost-effectiveness of upper limb prostheses while ensuring functionality and reliability. Engineering Design Process: Research and development of this prosthesis encompasses considerations of anatomy, physiology, prosthetics, orthotics, biomechanical engineering, robotics, and psychosocial factors. Employing Computer-Aided Design (CAD) and programming logic, the project aims to reduce wait times for replacement parts and functionality through iterative design processes, leveraging off-the-shelf products and FDM 3-D printing. Solution: The current iteration features a tendon-based finger system, which allows the hand to employ the full force of each motor while retaining the adaptability that is vital to completing all 7 primary grip patterns. The control system mimics natural hand movements by segmenting into three sections. Specifically, the thumb employs dual motors, while the remaining fingers optimize for precision and strength. Additive manufacturing techniques are explored to reduce costs, emphasizing use of readily available off-the-shelf components for efficient replacement part sourcing. Applications include usage as a training device for the period between receiving a commercial prosthesis, as a temporary prosthesis, and as a more accessible prosthetic device.

Awards Won:
Third Award of $1,000