CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

Natalie R. Dean

Project Number

38002

Project Title

What Does a Simple, Low-cost, 3D-printed Design for an Automated Robotic Prosthetic Look Like (Phases 1b, II, and III)?

Abstract

Objectives/Goals

Using commercially-available software, hardware, and components, a simple 3D-printed design for a robotic hand will be created. In Phase I of the design (a previous project), a typical 3D printer and software were used to generate, optimize, and print a child-sized model hand. In Phase II, a significantly improved 3D-printed model (Phase Ib) will be fitted with robotic parts such that the hand will function with individual finger movements. Finally, in Phase III, the robotic hand will be retrofitted with automation in order to direct the hand's activities using computer commands. Ultimately, the prosthetic should be able to perform simple tasks, such as gripping an object, picking up an object, and sequenced movements of the fingers.

Methods/Materials

In Phase Ib, commercially-available software and hardware were used to substantially optimize the previous 3D-printed design (from Phase I) for a robotic hand to fit a child. The Phase Ib design allowed the hand to open and close more completely and easily. In Phase II, the improved hand was fitted with parts such that it functioned mechanically with individual finger movements. In Phase III, the prosthetic was fitted with automation parts in order to direct the hand#s activities using computer commands.

Results

Once CAD designs were modified or created for each of the parts needed to 3D-print the significantly improved model, and after all robotic and automation components were selected and tested, the individual items needed to build the entire hand were recorded (cost per unit), along with time to print the 3D-printed parts. Total cost and total time were calculated based on the number of each item needed. As proposed in the hypothesis/solution and as required by the design constraints, total material costs for this automated robotic hand were low ($72.39 if not commercially printed). Total time to print all 3D-printed parts was 36.3 hours.

Conclusions/Discussion

The prosthetic functioned automatically with individual finger movements. Automated movements for simple tasks such as grabbing and pinching (picking up an object) were achieved. Phases Ib, II, and III resulted in a low-cost and effective design solution. The overall design requirements for the automated, robotic prosthetic were achieved, although the designed hand had much more range of possible movement than currently occurred using the selected servo motors.

Summary Statement

I designed, built, and tested a functioning, child-sized robotic prosthetic using CAD software, 3D-printing, mechanical parts, and automation hardware and software.

Help Received

Dr. Alexa Alborzi of Alborzi Orthodontics donated orthodontic elastic bands. A staff member at Turner's Outdoorsman in Fountain Valley, CA, provided his knowledge and donated microfilament fishing line. Sean Kilmer at Maker Tree 3D provided support and quick turnaround time for commercial 3D-printing.