Overview

The current crutch design for chronic users lacks efficiency in moving forward, stability, safety, and comfort. Although each of these are important issues from the standpoint of the user, the primary focuses for the new design will be energy return, or forward movement, and stability. As a secondary focus, comfort will be considered as well.

Objectives

To address the aspects of energy return, stability and safety, and comfort, the crutch redesign was considered in parts. To improve energy return, the leg and foot were changed. The foot design was altered to increase safety and stability. The arm portion was adjusted for more user comfort.

Approach

- Visited the Adventures in Training site to take measurements and have a better problem definition
- Discussed the issues with both the client and the user of interest to prioritize current issues
- Acquired data (forward distance traveled & current foot area) and measurements from the user for prototyping and engineering specifications
- Reviewed current patents and existing products for design ideas and verification of potential copyright conflicts
- Potential designs were created through collaboration with the team and client using SolidWorks
- Final design was testing using COMSOL for validation of energy return and areas of stress accumulation
- Prototyping was performed using carbon fiber and various other materials (epoxies, foams, rubber, attachments, etc.)
- Testing was done to validate the new design. Surface area was measured, and the spring constant was obtained
- Results from physical testing were compared to engineering specifications

Outcomes

- Energy return was increased in the prototype as verified by the spring constant. However, future manufacturing would require reinforcements, more carbon fiber layers, or stronger carbon fiber
- Foot surface area was increased for improved stability and safety
- Padding added to the arm support and adjustment of handle angle increased user comfort