

Design of a Pre-prosthetic for Upper Extremity Amputee

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Project Background

A 16-year old patient, Megan, recently had her right arm amputated just above the elbow and is waiting on the configuration of an expensive, permanent prosthesis which could take several months. During this time (and afterward) an improved low-cost temporary prosthesis is needed for rehabilitation purposes, and to allow the continuation of regular hobbies including volleyball—which neither the current temporary nor permanent prosthesis can support.

Problem Statement

The current temporary prosthesis (figure 1), consisting of a thin plastic upper arm cuff and two aluminum rods, is inadequate for performing rehabilitation tasks properly, and does not allow the continuation of hobbies and everyday activities.

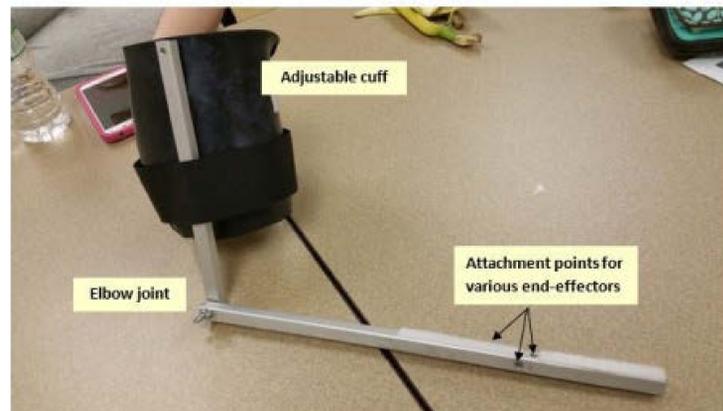


Figure 1: Initial prosthesis

Specifications

Customer Requirements

- Allow for proper rehabilitation through holding of various tools
- Enable lifting heavy objects
- Allow user to “bump” a volleyball

Engineering Specifications

- Minimize cost
- Lift up to 50lb
- Adjustable elbow joint
- Reconfigurable end effectors

Manufacturing Constraints

- Utilize COTS (commercial off-the-shelf) components
- Utilize Makerbot 2 Replicator 3D printer for custom components

Design Methodology

The design process implemented was an iterative one; an initial design was proposed, CAD models were generated using various 3D modeling software, and prototypes were made utilizing a Makerbot 3D printer. After gathering client feedback, generating and filtering additional concepts, and producing several more prototypes, a final design was reached which met the client’s requirements.



Figure 2: Concept generation

Prototyping



Figure 3: First iteration



Figure 4: Team discussing iterations



Figure 5: Various components of final prototype

Outcome



Figure 6: Megan using final device

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