Clemson University
Department of Bioengineering
BioE 850: Biomedical Engineering Design
401 Rhodes Hall
Clemson, SC 29634

Contact: John DesJardins, PhD
jdesjar@clemson.edu
(PH): 864.656.4178
(FX): 864.656.4466

Ankle Foot Orthosis (AFO) Testing Apparatus

BioE 850: Biomedical Engineering Design

Prepared For:
NISH ASEE-DEED Assistive Technology Development

Collaborators:
Orthotics and Prosthetics Department at the Shriners Hospitals for Children

Prepared By: **Barrett Hutto**
Dev Raghavan
Daniel Reed
Lee Sierad
Betsy Tedder

NISH ASEE-DEED Assistive Technology Development Application:

Proposed Objective

The Shriners Orthotics and Prosthetics Department makes thousands of AFOs every year for children with various diseases and disabilities in order to improve their quality of life and delay harmful surgeries that may have long-term ramifications. It is the hope of this project team that our apparatus can successfully document the AFO's mechanical response data and help in correlating the cut line to AFO ranges of motion. Our group believes that this will add consistency to the overall production of AFOs in a single production facility in addition to allowing the orthotist to produce AFOs that more effectively meet patients' clinical needs while minimizing the orthotists' manufacturing and final fitting times. If reproduced among all Shriners facilities, we hypothesize that this will aid in the training of new personnel and improve the national consistency of AFO production between facilities.

1) Work scope of design project

The objective will be accomplished by:

- Measuring the movement of the AFO
- Displaying the measurements for data entry and storage
- Graphically correlating specified cut lines to resulting AFO performance

The machine will be:

- Able to fit a wide range of AFO sizes and shapes
- Semi-portable, with removable fixation devices
- Durable
- Relatively light weight

The solution:

The device will measure the plantarflexion and dorsiflexion at the ankle and toes, the abduction and adduction at the ankle, and the inversion and eversion at the ankle. These measurements will be displayed on a screen and the data will either be manually or automatically entered into a database. The database will then be able to output a graphical correlation between the cut line of a particular AFO with its angles of bending and degrees of rotation. The input of measurements over time will continually update the database so that the correlation increases in accuracy every time new measurements are added. Using this graph the orthotists would get a better idea of the AFO's performance and reliability which will help in manufacturing AFO's with required consistency.

Analyses done:

- Market need and potential analysis
- Economic Analysis
- Risk Analysis

2) Schedule

The schedule for the project is shown in the Gantt chart in Figure 1. It describes the different stages of the project and the timeline for the project.

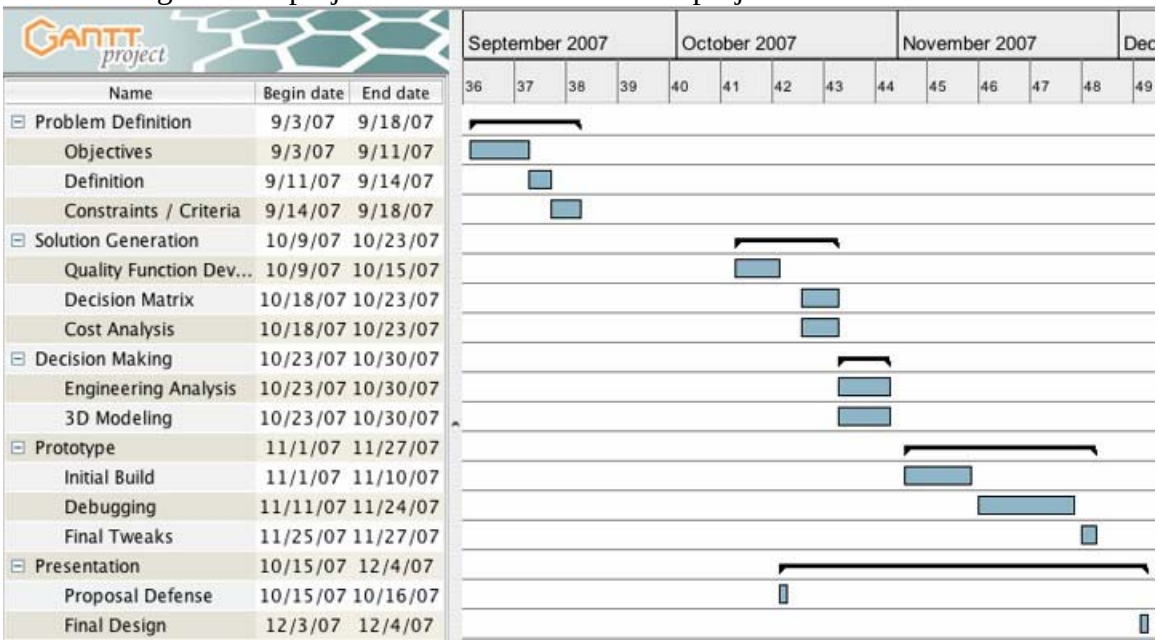

Figure 1: Gantt chart showing the timeline

3) Budget

The AFO testing apparatus requires varied range of mechanical and data acquisition equipment. We hope that the entire testing equipment would be fabricated under $2500.

4) Department Co-funding

Bioengineering department is funding the project ($500) as part of their undergraduate and graduate design curriculum. Dr. DesJardins is also supporting these design activities with a service learning faculty fellowship grant ($1,000) for assistance with community outreach and service learning activities in SC. It is anticipated that an additional $1,000 will be needed to complete the design, and that this grant will assist in this budget shortfall. In cooperation with the Orthotics and Prosthetics Laboratory, the Shriners Hospital for Children is able to offer services in kind, and assistance in construction and testing of the project design, and long-term maintenance of the design following installation at the facility.

5) Project team

The project team consists of students from Clemson University with varied specialization and background. Daniel Reed was an undergraduate in biosystems engineering and currently a 2nd year master candidate in bioengineering and serves in the army. Dev Raghavan was an undergraduate and a graduate in mechanical engineering and currently a 3rd year PhD candidate in bioengineering. Betsy Tedder has an undergraduate in biology/chemistry and went to two years for medical school. She is currently a 2nd year PhD candidate in bioengineering. Leslie Sierad was an undergraduate in biomedical engineering and currently a 1st year master's candidate

in bioengineering. Barrett Hutto is a senior undergraduate in mechanical engineering with minor in bioengineering.

6) **External collaboration**

Our project team is in collaboration with the orthotics and prosthetics department of Shriners Hospital. The orthotists define the needs that the design should be able to meet as well as give practical guidance in dealing with AFOs. This collaboration helps us to produce a design that meets actual clinical needs and better interacts with the different types of AFOs. Based on the approved design from our collaborators, we are producing an AFO testing apparatus.

7) **Faculty Advisor**

Dr. John D DesJardins is a Senior Lecturer in Bioengineering and Director of Bioengineering Abroad Programs. He teaches the course Biomedical Design BioE 850 and he is the faculty advisor and guide for this project. He can be reached at jdesjar@clemson.edu and the link for his webpage is as below:
http://www.ces.clemson.edu/bio/people/desjardins.html