Research and Design of Prosthetic Lower Limb Components
School of Science, Engineering, and Health Symposium

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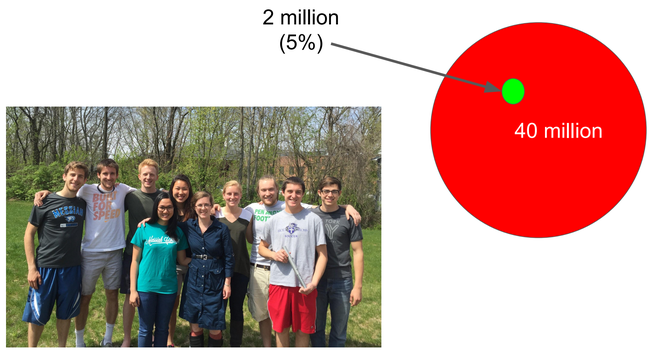
Introduction

- The need for affordable prosthetics is a major issue, especially in third-world countries.
- Much greater demand for prosthetics due to disease, natural disasters, and war
- Supply does not meet the current demand-- only about 5% of the 40 million amputees in third-world countries receive prosthetics [1].
- Challenges [2]
  - Lack of materials
  - Not enough highly-trained prosthetists
  - Need to tailor prosthetics to cultural factors



Partners

https://cure.org/

"Healing the Sick and Proclaiming the Kingdom of God"

- Cure international is a non-profit organization that operates charitable hospitals and programs in 30 countries worldwide.
- Since their first hospital opened in Kenya in 1998, Cure International have had over 2.8 million outpatient visits, provided over 204,000 life-changing surgeries, and trained over 7,200 medical professionals.

http://kijabehospital.org/

- The mission of AIC Kijabe Hospital that is to glorify God through the provision of compassionate health care, excellent medical training, and spiritual ministry in Jesus Christ.

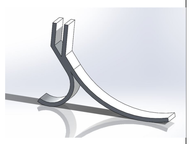
Foot/Ankle

Old Model

- Made using Delrin
- 3D-Printed: Less available, environmental concerns
- Focus on high-tech functionality, not manufacturability
- Not practical for our goal

New Model

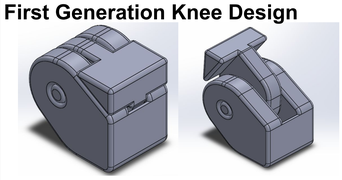
- Made using locally available materials- rubber and aluminum.
- Simple design: easily manufacturable
- Absorbs energy upon impact: lowers risk of failure
- Releases energy as the foot leaves the ground- more natural stride
- Prototype



Knee

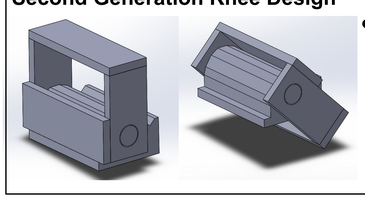
- Made with locally available material like aluminum

First Generation Knee Design



- Initial design
  - Difficult to manufacture
  - Too many contours

Second Generation Knee Design



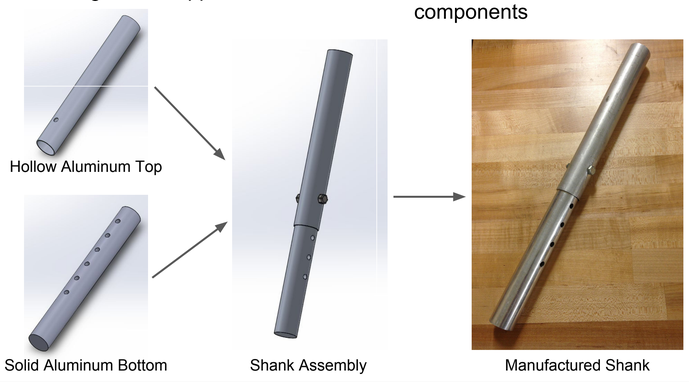
- Redesigned knee
  - Reduced contours, thus increases manufacturability
  - Reduced shear stress on the pin
  - Less materials are needed to build the knee

Shank

- Adjustable shaft lengthens useful lifetime of prosthetic for growing patients
- Very simple to manufacture
- Designed to support 180 lbs

Interfaces

- Top shank piece welds directly to lower knee piece
- Bottom shank piece will fit between the two foot pieces. A bolt or clamp will fasten the foot and shank components



Conclusion

- All three lower limb components-knee, shank, and foot- have been designed or redesigned to be easily manufactured in locations like Kijabe, Kenya where supplies and machining technology are limited.
- The group was not able to assemble a completely manufactured limb, but the shank component is done, and the knee is nearly done being made.

Moving Forward

- Because of growth in the biomedical concentration, the BioSTEP group will separate into smaller groups.
- Compared to the current BioSTEP project, the new groups will be more client-driven.
- These new groups include a prosthetic knee redesign group and a clubfoot orthotic brace group.

References

[1] https://www.limbsinternational.org/why-limbs.php
[2] http://ieeexplore.ieee.org/xpls/icp.jsp?arnumber=7343953

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