Final Project Report
Team Vacu-Cast System
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Vacu-cast System:
A cheap system for effective socket production.

Background:

For amputees all around the world, the defining attributes for a prosthetic limb is comfort. For prosthesis to feel like a natural extension of the body, the socket, which is the part that makes contact with the body, must be as comfortable as possible. The defining characteristics of a stump are important but a patient's continued use a system is dependent on the quality of the socket.

Thus, it is most important that a well-fitted socket is developed by prosthetists, especially in developing countries where the stumps are usually very basic. In the developed world, sockets are made from expensive carbon fiber or polyethylene using wet plaster of Paris (POP) mold. Our Vacu-cast team is however trying to improve on the vacuum casting system, which does not involve the use of POP for the molding.

This 'vacuum casting system' is cheaper, efficient and with minimal waste. Using a vacuum pump, a bag filled with polystyrene beads, negative molds could be readily created for a final socket production. Our team focuses particularly on testing different materials to make the polystyrene bag component of the system more self-contained and greener. Our goal is to make the very comfortable sockets from accurate molds with the cheapest and most effective materials possible.

Innovation in Technology:

The present Vacuum Casting System uses vacuum created about a bag containing polystyrene beads to produce the negative mold of a stump. However, two plastic bags are used in this process; one for hygienic reasons as the stump is not directly placed in contact with the bag containing the beads and the other is used to contain the whole unit.

Our focus is to make the whole process much more self-contained and thereby reduce the amount of plastic bags used every time without jeopardizing the effectiveness and hygienic steps taken. Furthermore, our team was able to design a two-way cap, which is meant to reduce inefficiencies developed by the loss of vacuum around the negative and positive molds. We have created a CAD image of the cap, which is ready to be 3-D printed to begin with. After which, we aim to produce some units to test in the field. With the cap, we can guarantee that the one-way valve is always well positioned (in the previous system, the valve could get clogged with the plastic bag if not properly positioned) and we can create the best vacuum.

Progress:

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To begin with, the Vacu-cast team tried to find different kinds of plastic bags apart from the one presently used by Dr. Wu for the integrated system. We bought different kinds of trash bags of different thickness in addition to a "Stretchlon" with which we ran experiments. We cut each of the plastic bags so that they could perfectly fit around the bag containing the glass beads. We realized that the thicker plastic bags were not as ideal once the vacuum was created because of the creases formed in the vacuum. This would not be good for creating a perfectly fitting mould. The "Stretchlon" and plastic bags of smaller thickness were the most effective for forming the kind of mould we imagined.

In addition we developed a new attachment for connecting trash bags and a hose to the polystyrene bag inside the trash bag. See below,

This attachement is an improvement since it improves the quality of the seal that is needed to make a longer lasting negative mold. This project will be developed further as time progresses by making 3D molds and other various connectors to improve the all in one socket system.

Initially, we had plans for multiple other projects. We originally wanted to work on "Developing an Improved Pyramid for a Socket," using the "Fablab Casting Method used for production of cost effective sockets," and establishing a "Force simulation of a socket."

Future plans:

Our team members are going to be working on this project over the next couple of years. David and Todd plan to work on this in graduate school whilst Leslie is considering being a UROP over the next couple of years to see this project to be developed. In our conversations with Dr. Wu, we have decided that with modifications on the product, we will take the system to places as remote as India and Sierra Leone. Once we are able to get an improved version of this product, we plan to have studies

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