An Active Prosthetic Device: Final Proposal

By: Jannell Broderick, Allison Cutler, Felicity Escarzaga, Toni Goss

Project Description

Felicity E.
Team 18F12 Active Prosthetic

Project Description:

This project aims to provide below-elbow amputees with an affordable prosthetic, that provides them with haptic feedback.

Importance

A prosthetic does more than replace a limb. It has the ability to make the wearer feel whole, have sense of belonging, feel unique, and enable their independence.

Sponsor

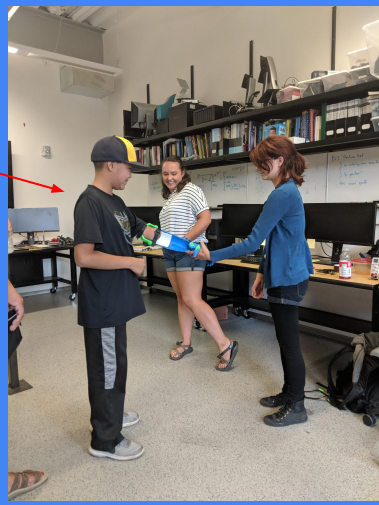
Dr. Winfree

Dr. Kyle Winfree is the director of the Wearable Informatics Lab (WIL) and heads the Go Baby Go project at Northern Arizona University (NAU).

Recipient

Nate

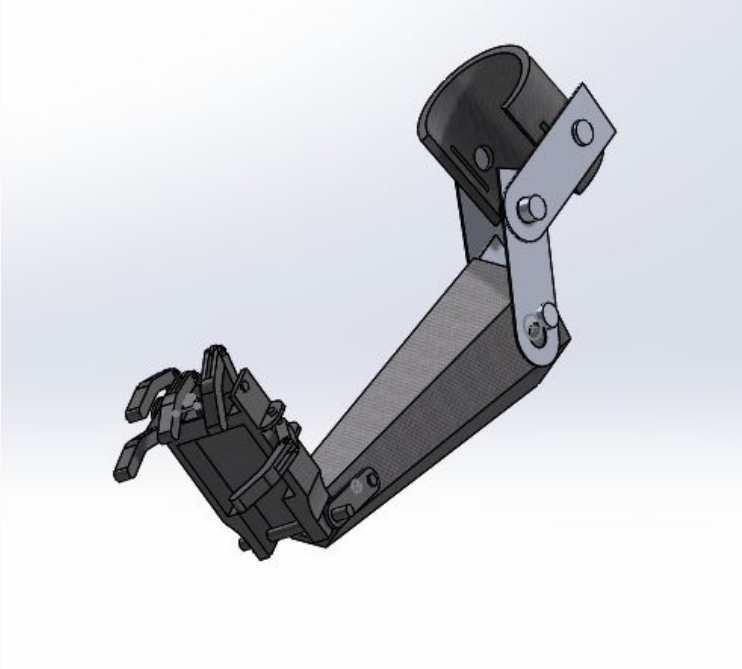
Nate received a mechanical prosthetic arm over the summer and has volunteered to receive this new active design.



Design Description

Toni G.
Team 18F12 Active Prosthetic

CAD Design and BOM



Toni G.
Team 18F12 Active Prosthetic

Function and Implementation

- Connected to foot using bluetooth
- Motors on each finger for best control
- Able to understand walking function and turn itself off
- Ability to sense touch using sensors on fingertips
- Able to open and close from wire through fingers
- Cuff at bottom is used to attach to arm with velcro securing it in place

Toni G.
Team 18F12 Active Prosthetic

Design Requirements

Jannell B.
Team 18F12 Active Prosthetic

Customer/Engineering Requirements

- Aesthetically pleasing
- No pain or discomfort or strain
- Haptic sensing system
- Scalable
- Customization
- Easy to clean
- Light weight
- Durable
- User command

Final Design Features

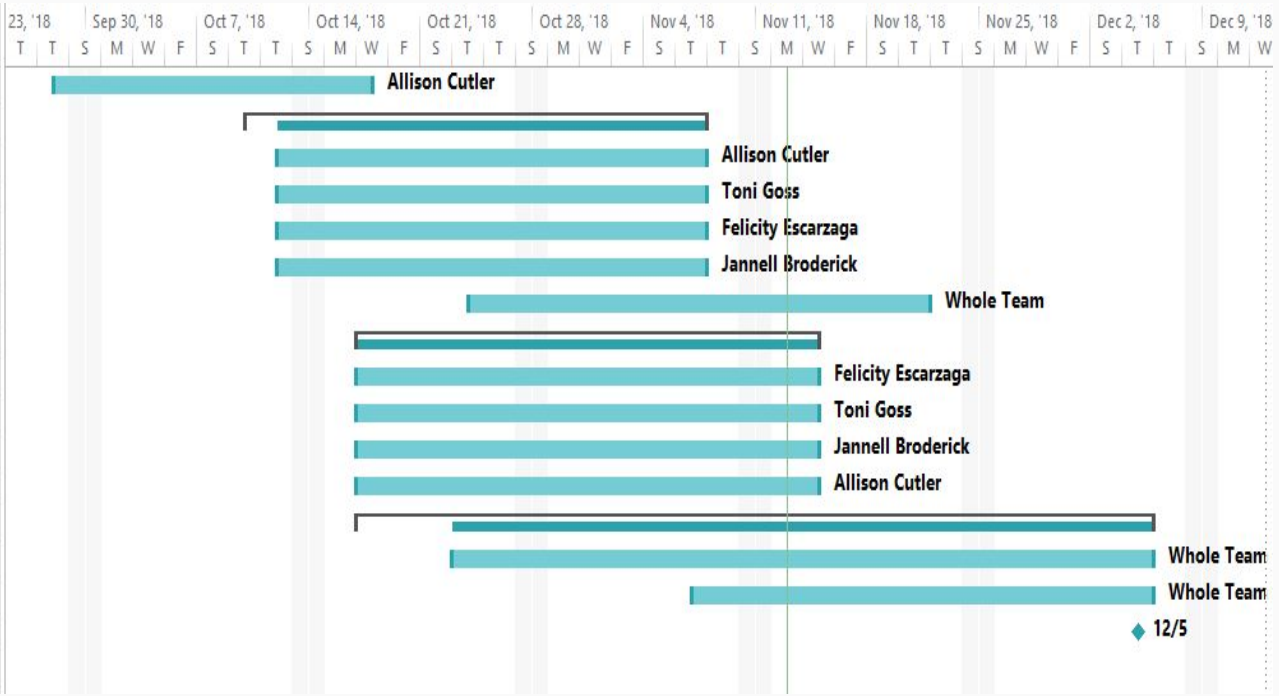
- Shaped like a Human Hand
- Straps/ velcro comfortably wraps around arm
- Vibrating motors that respond to the touch at ends of fingers
- Downloadable Solidworks CAD and thermoforming plastic is alterable for each individual
- Made from 3D printed plastics that are easy to clean
- Lightweight 3D Plastics
- Strong 3D Plastics (we broke stuff!)
- Foot control

Jannell B.
Team 18F12 Active Prosthetic

Schedule & Budget

Allison C.
Team 18F12 Active Prosthetic

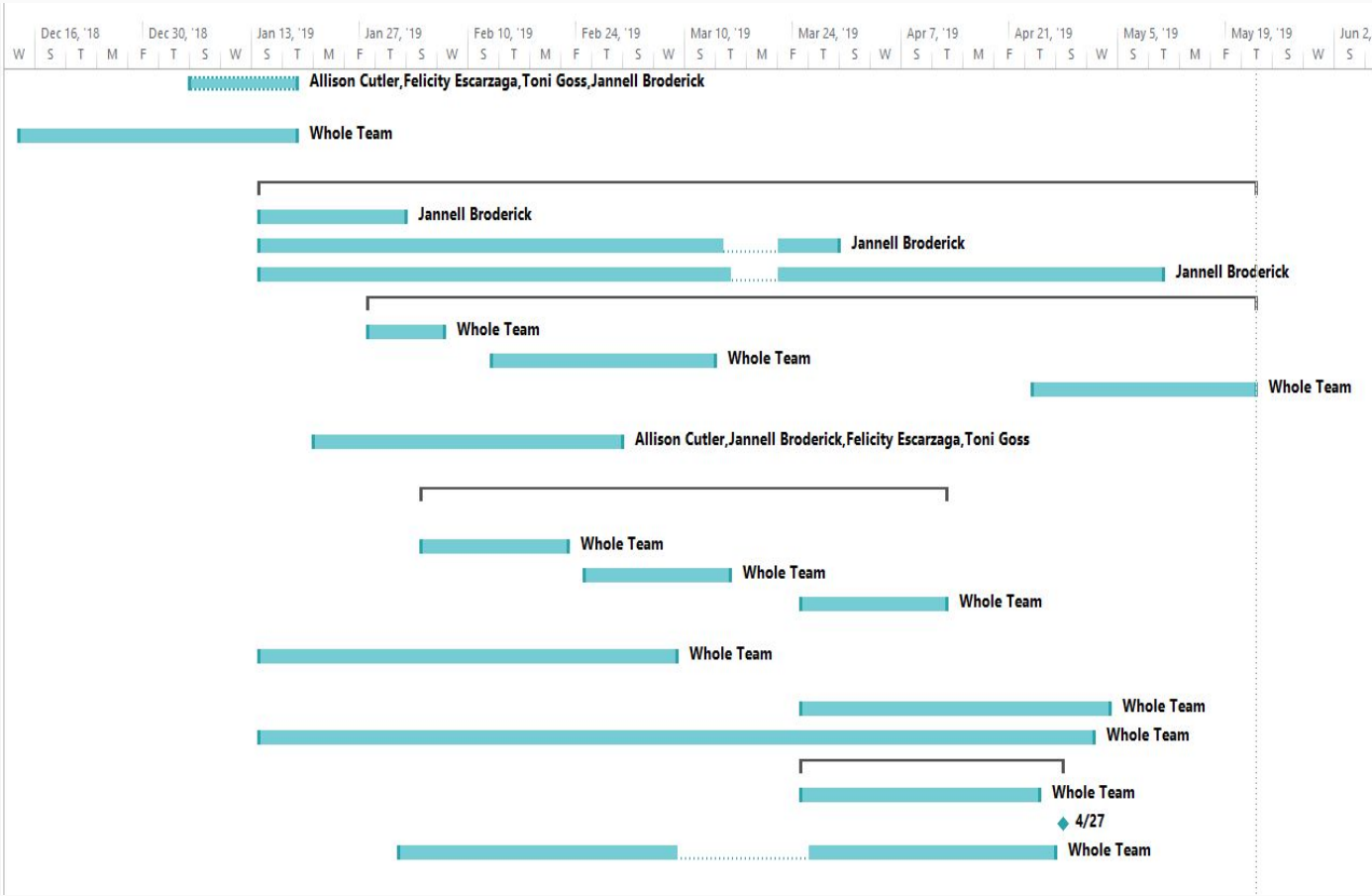
Task Name	Durat	Start	Finish
Sections 3.1 & 4	14 days	Fri 9/28/18	Wed 10/17/18
Analytical Report	**21 days**	**Wed 10/10/18**	**Wed 11/7/18**
% Infill	19 days	Fri 10/12/18	Wed 11/7/18
Thermo and Strength	19 days	Fri 10/12/18	Wed 11/7/18
Arduino Code	19 days	Fri 10/12/18	Wed 11/7/18
Mechanical Forces	19 days	Fri 10/12/18	Wed 11/7/18
Final Report	21 days	Wed 10/24/18	Wed 11/21/18
Presentation 3	**21 days**	**Wed 10/17/18**	**Wed 11/14/18**
Project Description	21 days	Wed 10/17/18	Wed 11/14/18
Design Description	21 days	Wed 10/17/18	Wed 11/14/18
Design Requirements	21 days	Wed 10/17/18	Wed 11/14/18
Schedule & Budget	21 days	Wed 10/17/18	Wed 11/14/18
Prototype	**36 days**	**Wed 10/17/18**	**Wed 12/5/18**
Meet EE Team	32 days	Tue 10/23/18	Wed 12/5/18
Purchase/Print Materials	21 days	Wed 11/7/18	Wed 12/5/18
Prototype Demo	0 days	Wed 12/5/18	Wed 12/5/18



- On track with our design, but design still very susceptible to change due to EE team
  - Potentially behind on prototyping- mechanics are there, sensing is not
- Focus EE side of design next semester

Allison C.
Team 18F12 Active Prosthetic

Task Name	Duration	Start	Finish	Resource Names
Individual Post Mortem	11 days	Sat 1/5/19	Fri 1/18/19	Allison Cutler, Felicity
Final Proposal Rewrite	26 days	Fri 12/14/18	Fri 1/18/19	Whole Team
Website Checks	**93 days**	**Mon 1/14/19**	**Wed 5/22/19**	**Jannell Broderic**
Check 1	15 days	Mon 1/14/19	Fri 2/1/19	Jannell Broderic
Check 2	50 days	Mon 1/14/19	Fri 3/29/19	Jannell Broderic
Check 3	81 days	Mon 1/14/19	Fri 5/10/19	Jannell Broderic
Presentations	**83 days**	**Mon 1/28/19**	**Wed 5/22/19**	
Presentation 1	8 days	Mon 1/28/19	Wed 2/6/19	Whole Team
Presentation 2	21 days	Wed 2/13/19	Wed 3/13/19	Whole Team
Final Presentation	21 days	Wed 4/24/19	Wed 5/22/19	Whole Team
Individual Analysis 2	30 days	Mon 1/21/19	Fri 3/1/19	Allison Cutler, Jannell
Hardware Reviews	**50 days**	**Mon 2/4/19**	**Fri 4/12/19**	
HR1	15 days	Mon 2/4/19	Fri 2/22/19	Whole Team
HR2	15 days	Mon 2/25/19	Fri 3/15/19	Whole Team
Final Product Testing	15 days	Mon 3/25/19	Fri 4/12/19	Whole Team
Midpoint Report	40 days	Mon 1/14/19	Fri 3/8/19	Whole Team
Final Report	30 days	Mon 3/25/19	Fri 5/3/19	Whole Team
CAD	78 days	Mon 1/14/19	Wed 5/1/19	Whole Team
UGRADS	**25 days**	**Mon 3/25/19**	**Sat 4/27/19**	
Poster	23 days	Mon 3/25/19	Wed 4/24/19	Whole Team
Presentation	0 days	Sat 4/27/19	Sat 4/27/19	Whole Team
Operations Manual	50 days	Fri 2/1/19	Fri 4/26/19	Whole Team



- Coordinate with EE team to finalize sensor and motor details
- Work with Nate (client) as we prototype
- Ensure foot insole sensors can be programmed to allow motion in hand as intended
  - Further coordination with EE team
- Lots of prototyping and revisiting design as needed
- Assuming no work to be done over Spring Break

- Budget from Dr. Winfree:
  $500.00
- Can use Capstone funds if deemed necessary
- The sensor type and motor type and quantity are still arbitrary due to coordination with EE team

Part	Qty	Cost ($)	
Printing material (kg)	1 per arm	$15	
	x 5 full arms	$75	
Motor (arduino-uno, arduino-zero)	1 to 6		Need EE Team Input
	min	$30-60	
	max	$180-360	
Sensors	5 hand	$35	
	~5 foot	$35	
Bluetooth RED Boards	TBD	$20-$30	
Shipping		TBD	
Insoles	TBD	$5/ 2 pack	at Target
Batteries (12V)	TBD	$5/ 2 pack	at Target
	TOTAL	$545	

- Estimated total exceeds Dr. Winfree's funds

For 1 Arm

Material	Quantity	Quantitiy/Pack	Cost/Part	Cost	Vender Link
PLA Filament	1	1 ct	15.99	15.99	3D Solutech Silv
Small rubber bands	1	100 ct	4.75	4.75	https://www.ama
Velcro Straps	1	24 ct	8.99	8.99	https://www.ama
Foam pad	1	6 ft	12.79	12.79	https://www.ama
Arudino: Duo	1	1 ct	35.5	35.5	Duo
Large Motor	1	1 ct	24.95	24.95	131:1 Metal Gea
Small Motor	5	1 ct	8.99	44.95	Racerstar Racin
Motor Driver	1	1 ct	19.95	19.95	Adafruit Motor/St
Pressure Sensor	10	1 ct	7	70	https://www.adaf
Battery	2	2 ct	6.59	6.59	https://www.ama
Battery connector	1	5 ct	5.39	5.39	https://www.ama
Insoles	1	1 pair	9.23	9.23	https://www.ama
				259.08	

References

[1]Arnold, a. (2018). Injured Animals Get Second Chance With 3-D Printed Limbs. [online] News.nationalgeographic.com. Available at: https://news.nationalgeographic.com/2016/08/prosthetics-animals-rescued-3d-dogs-cats/ [Accessed 17 Sep. 2018].

[2]Canner, L. (2018). *New 'e-dermis' brings sense of touch, pain to prosthetic hands: Electronic 'skin' will enable amputees to perceive through prosthetic fingertips*. [online] ScienceDaily. Available at: https://www.sciencedaily.com/releases/2018/06/180620171004.htm [Accessed 17 Sep. 2018].

[3]Clements, "How Prosthetic Limbs Work" 25 June 2008.HowStuffWorks.com. <https://science.howstuffworks.com/prosthetic-limb.htm> 16 September 2018

[4]Heilman,Rattner. "Medical Miracles," Redbook. May, 1991, p. 124+.

[5]LLC,“How Much Does A Prosthetic Arm Cost - Is It Really Expensive?,” *Discover Devices*, https://discoverdevices.com/reviews/how-much-does-a-prosthetic-arm-cost-below-knee-prosthesis-types/.

[6]Owen, J. (2018). *Enabling The Future*. [online] Enabling The Future. Available at: http://enablingthefuture.org/ [Accessed 17 Sep. 2018].

[7] Sparkfun Electronics, Gella-Arduino, Megan Arnold-Blade, Pete, https://www.sparkfun.com/

Questions?