

Open-Source 3D Printed Foot Prosthesis

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Team 18F04
10/15/2018**

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Project Description

- **Team goal:**

- Our team goal is to create and design an 3D printed foot prosthesis leg for below-knee amputees that easy to install and remove, inexpensive, and reachable.

- **Stakeholders:**

- E-nable Company

- **Sponsor**

- Northern Arizona University.

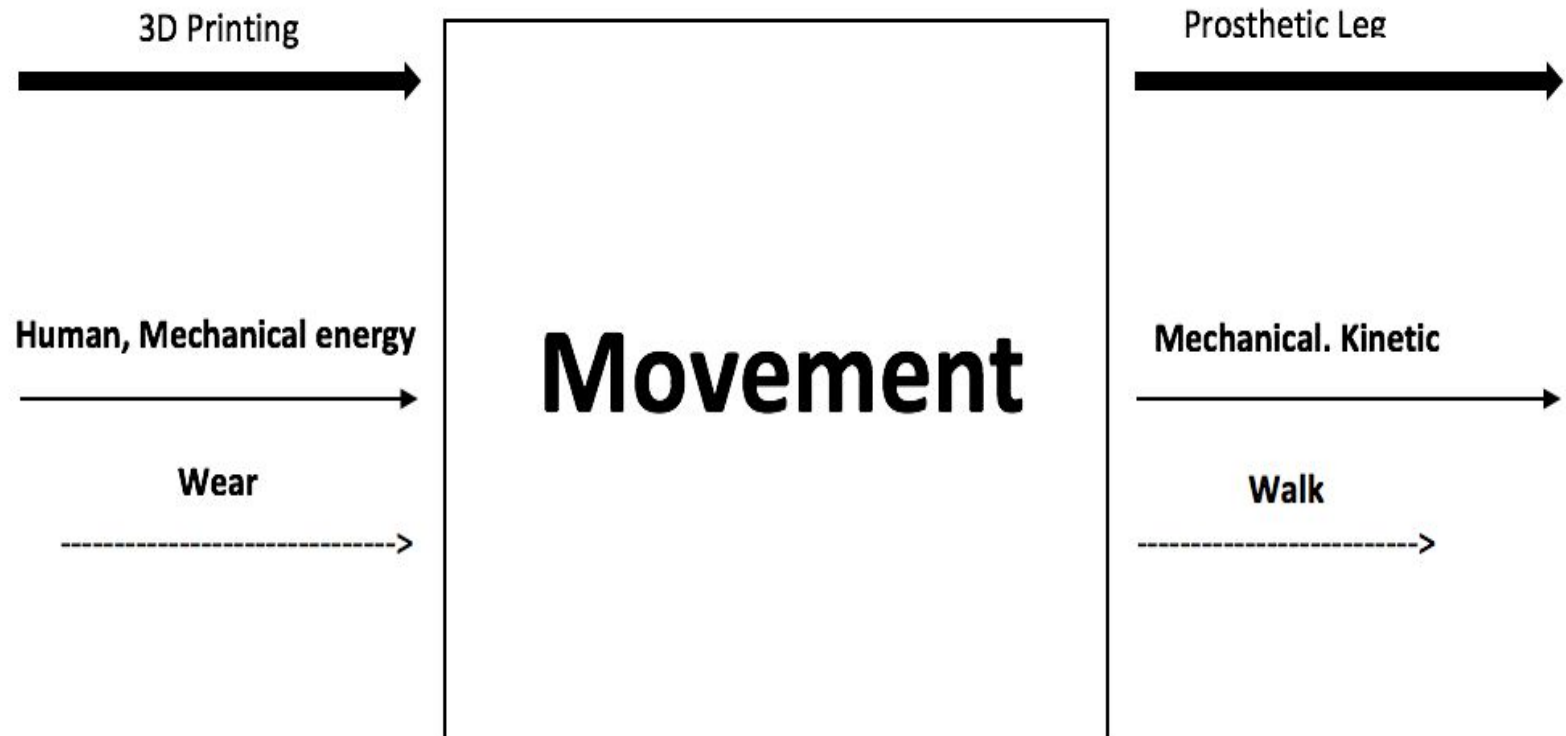


[2]

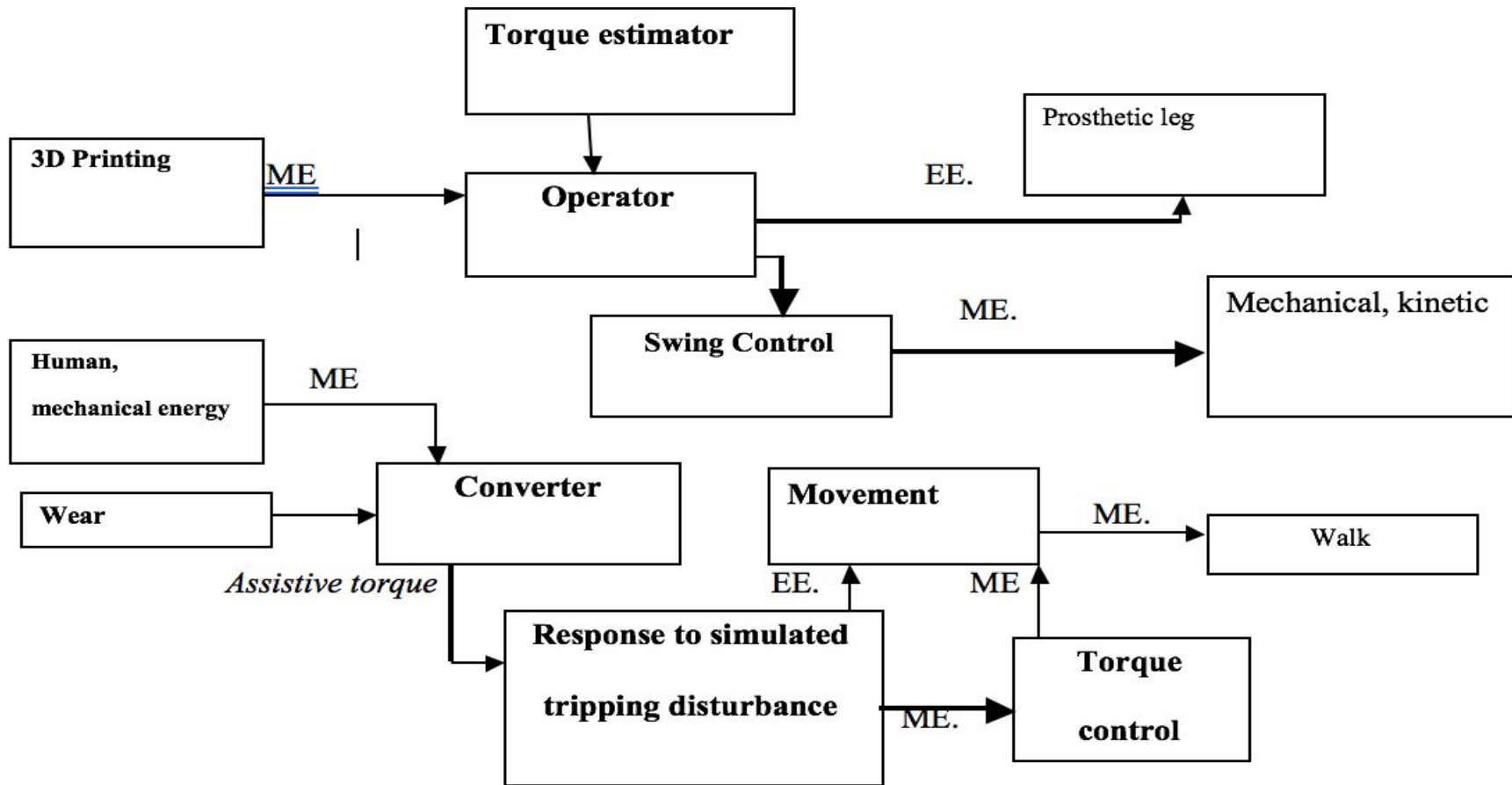


[1]

BLACK BOX MODEL



FUNCTIONAL MODEL

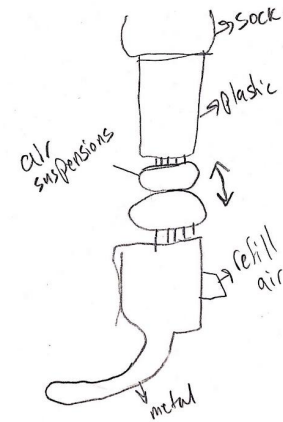


DESIGNS CONSIDERED (1)

Seahorse



Air

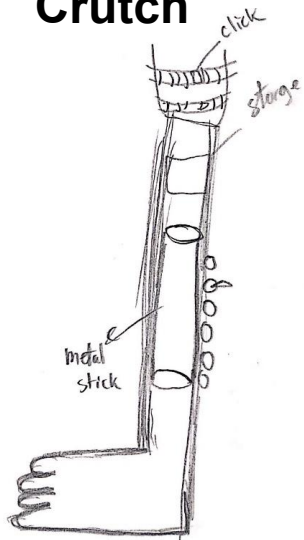


Advantages	Disadvantages
Athletic use	Hard to build
Bio-inspired	One height
Light weight	Not comfortable
Adjustable to weather	Not for daily use

Advantages	Disadvantages
Adjustable height	Expensive
Easy to build (ABS, Carbon Fiber)	Heavy
Comfortable	Maintenance required

DESIGNS CONSIDERED (2)

Crutch



Spider web



Advantages

Adjustable height

Comfortable

Easy to Build

Disadvantages

Heavy

Multiple parts

Advantages

Light weight

Comfortable

Bio-inspired

Disadvantages

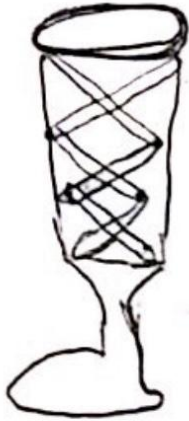
Hard to build

Can't withstand 200LB

Must be cleaned

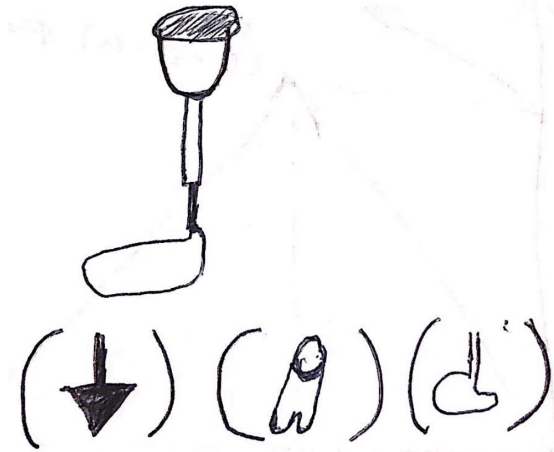
DESIGNS CONSIDERED (3)

Gate Wall



Advantages	Disadvantages
Adjustable height	Hard to Install
Comfortable	Heavy weight
Daily use	Must be cleaned

Versatile



Advantages	Disadvantages
Weather adjustable	Several parts
Multiple uses	Hard to use
Easy to install	Age restriction

Customer Requirements vs Engineering Requirements

CR'S











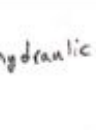
- Below Knee
- Holds up to 200 lb adult male
- Must be printed from 3D printer
- Weights 7 lb at most
- Limited filament materials
- Fits different height sizes
- Comfortable
- Safety

ER'S

- Below Knee
- Prosthetic leg must holds up to 200lb
- Can be printed in any 3D printer
- Must weight at most 7lb
- Limited filament materials (ABS, HIPS, Carbon Fiber)
- Fits different height ranges from 5'-0" till 6'-5"
- Resistant to weather
- Free age uses from 13 and higher
- Does not damage the person leg
- Comfortable to wear and use

PUGH CHART

Table 1: Pugh Chart

Concept											
Criteria	1	2	3	4	5	6	7	8	9	10	10
Fits different height sizes	-	-	-	+	S	D	-	+	S	-	-
Comfortable	-	-	+	+	S		+	S	-	+	+
Limited filament material	S	-	S	S	-	A	S	S	-	S	S
Weight 7lb at most	S	S	+	+	-		S	-	-	-	+
Holds up to 200lb person	S	S	-	+	S	T	S	+	+	S	S
Factor of safety	-	S	-	S	S		-	+	S	+	+
$\Sigma +$	0	0	2	4	0	U	1	3	1	3	3
$\Sigma -$	3	3	3	0	2		2	1	3	1	1
ΣS	3	3	1	2	4	M	3	2	2	2	2

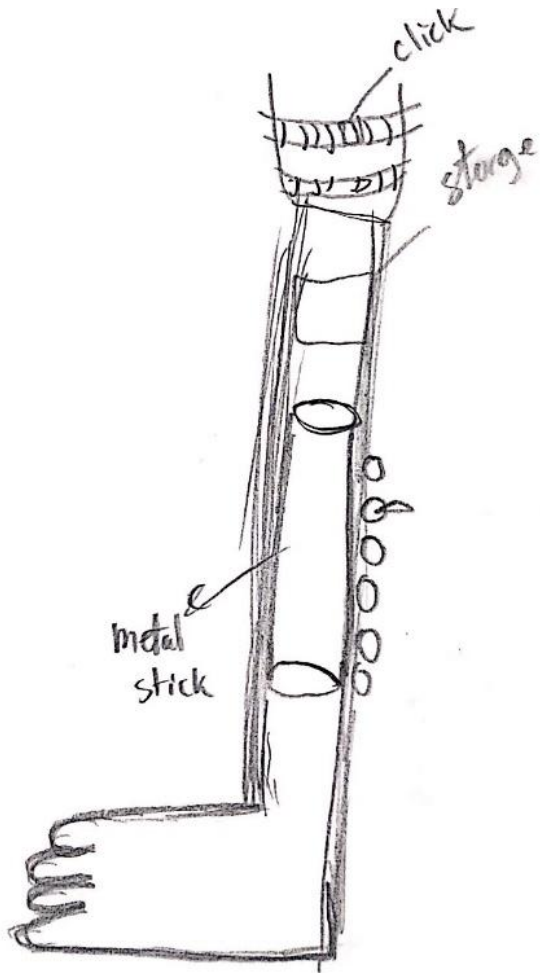
DECISION MATRIX

Table 2: Decision Matrix

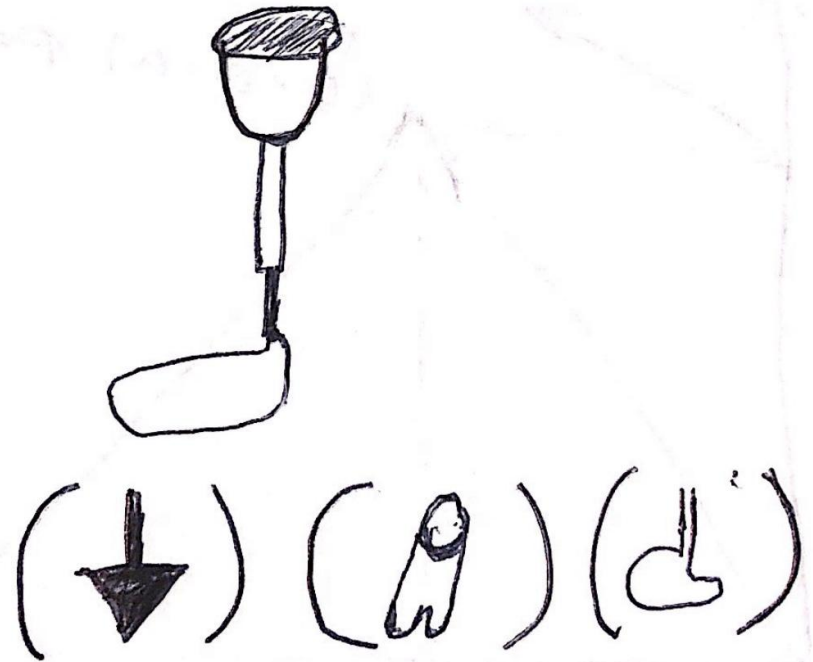
	Weight	Variant 4		Variant 6		Variant 8		Variant 10	
Criterion									
1. Fits different height sizes	0.18	100	18	80	14.4	100	18	60	10.8
2. Comfortable	0.1	70	7	70	7	50	5	50	5
3. Limited filament material	0.2	90	18	40	8	60	12	80	16
4. Weight 7lb at most	0.14	70	9.8	100	14	30	4.2	100	14
5. Holds up to 200lb person	0.24	90	21.6	70	16.8	100	24	90	21.6
6. Factor of safety	0.14	100	14	80	11.2	70	9.8	100	14
Totals	1		88.4		71.4		73		81.4
Relative Rank			1		4		3		2

DESIGN SELECTED

Crutch



Versatile



SCHEDULE

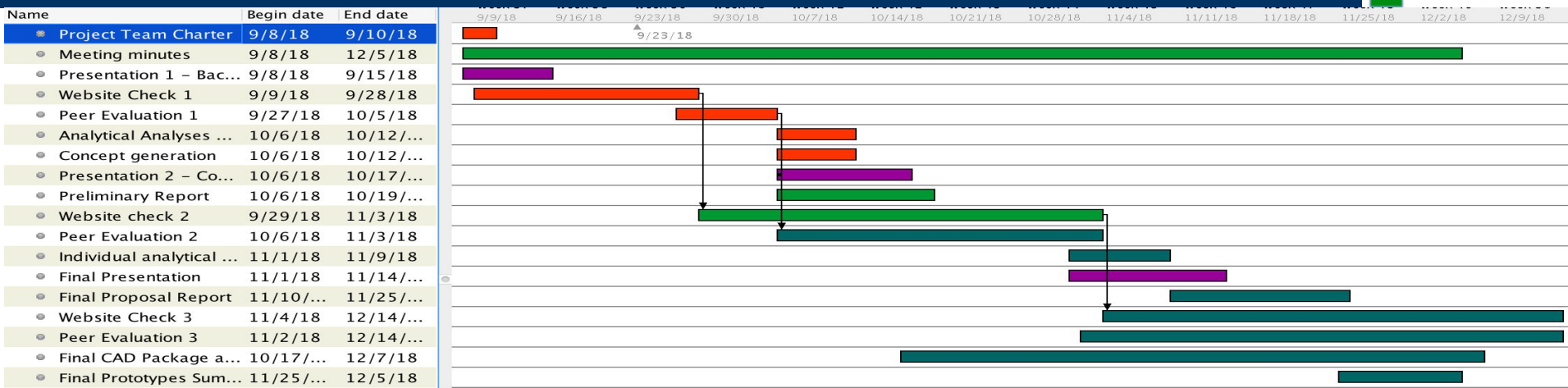
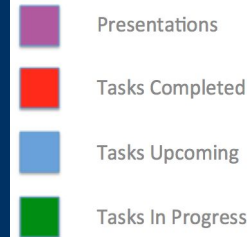


Figure 1&2: Gantt Chart

BUDGET



[3]


Estimation Based on :

1. Labor.
2. Materials.
(ABS & Nylon, ABS, Carbon fiber, Nylon)
3. Renting the 3D printer.

Minimum \$1000 / Maximum \$5000

References

- [1]“Man with Left Leg below Knee Amputation Is Using a Wheelchair.” *123RF*, www.123rf.com/photo_68480340_stock-vector-man-with-left-leg-below-knee-amputation-is-using-a-wheelchair.html.
- [2] Witt, M. (2018, August 29). In with the new: NAU welcomes two new deans. Retrieved from http://www.jackcentral.org/news/in-with-the-new-nau-welcomes-two-new-deans/article_3bc2e738-c5ea-59e0-bc98-7cdc5162d216.html
- [3] 3D Printing Service - Dream | Design | Deliver - Stax3D printing. (n.d.). Retrieved from <https://stax3d.com/>



THANK
You