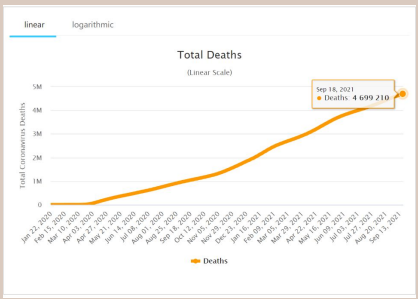
CRITERIA A1-CURRENT SITUATION:

Since 2019 Covid-19 has become the largest pandemic for the whole world. According to the statistics 4.55 million people have died from Covid-19.



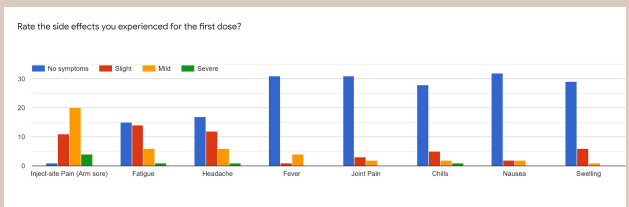
Fg.1 Number of novel coronavirus (COVID-19) deaths worldwide as of September 13, 2021.

My personal experience of after receiving the vaccine is extremely arm sour, which had affected my daily routine, could not raise my arm properly. Therefore, I consider that many people might have the similar problem with me, as well as the Covid still going on, vaccination could take a large part in the future, I thought of designing product that could ameliorate the pain might help the people who had the similar problem with me.

PROBLEM STATEMENT:

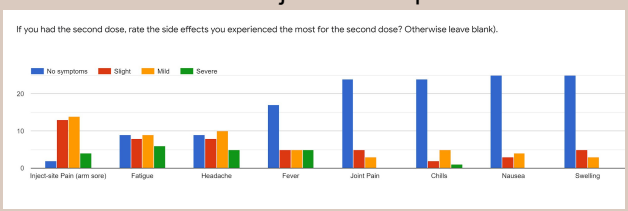
Injection-site pain has been confirmed as the most common side effect for covid vaccination. However, there are very less product that is designed for amilorement the arm pain.

SURVEY ON VACCINATION SIDE-EFFECTS



Fg.5 Side effects for First dose

From this statistic it can prove that the most serious side effect is Injection-site pain.



Fg.6 Side effects for second dose

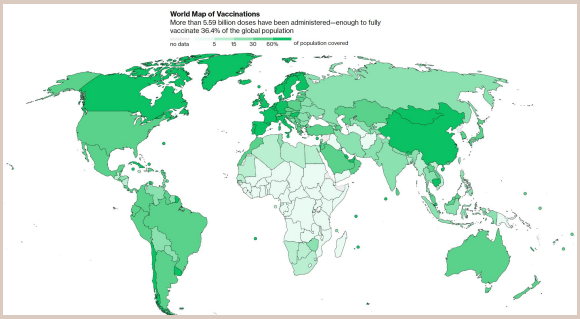
However, for the second does the first three side effect become more intense. The most serious one is still injection side pain.

I also investigate whether people try to reduce the side effects they have. However, majority of the people had used panadol. One of them had done some stretching. This investigation had encourage us to develop our solution even further.

TARGET AUDIENCE:

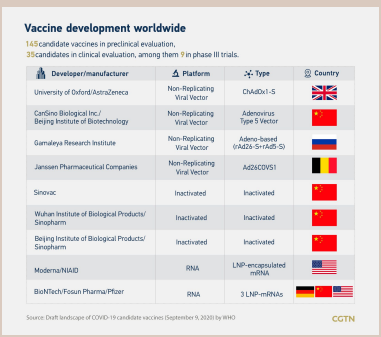
Target audience from Age 12-60+ no gender limitation.

In 2021, there is still Covid-19 which needs people to accept vaccines to prevent infection. The global population now vaccinated has reached 5.59 billion (as of September 2021). Shown in Fg.2.

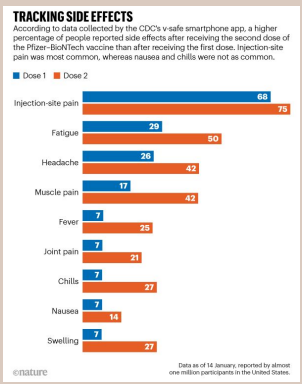


Fg.2 World map of vaccination

However, vaccination also leads to side effects because of the biological reaction inside our body. There are different types of vaccinations (Fg.3) and here is the graph that statistic the most side effects, According to the statistic (Fg.4), the most common side effect is injection-site pain.



Fg.3 Vaccine types



Fg.4 Side effect static

INTERVIEWED EXPERT:

Q: Have you ever done any vaccination for other people?
We need Need special training, I did injection before, however that's different from the Covid Vaccine.
Q: Have you received any vaccine? Are there any side effects?
Arm pain, could not move the arm, headache, tired, just want to sleep
Q: Do you have any ways to ameliorate the side effects, for example injection-site area?
There are not many ways, more about resting because it is about the inflammation, you could use an ice pack to cool it down. But there is not much way to totally reduce it.
Q: Is there any Similar medical product we can use to ameliorate the pain?
You can use some ice packs, or like Cooling gel that you can apply on the pain site.

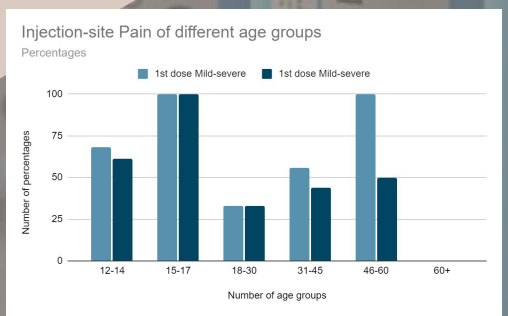


Fig. 7 The Bar chart statistics the number of people in different age groups receiving the Mid-Severe injection-site pain.

Fg.8 interview with school nurse

CRITERIA A2-DESIGN BRIEF:

There are currently no products to ameliorate the injection-site pain after the Covid vaccination. (“Tips to reduce side effect after getting the Covid-19 Vaccine”) According to the research, ice or hot compression as well as exercise (Dunford) can help to mitigate the pain, help people conduct a daily routine; confirmed by my own interview with a nurse (Fig.8) and personal experiments (Fig.9.1, 9.2).

Therefore, I will design a one-off, fully functioning prototype, which will encourage the vaccinated people to conduct a series of exercise, and temperature treatment and massage to help alleviate injection-site pain and reduce swelling on the arm. This will be achieved develop system to administer cold pack, vibration massage as well as encourage exercise.

Fig.7 shows the symptoms of injection site pain across age groups. Although the validity of some of the age groups can be questioned due to the low number of respondents, the chart shows the injection-site pain is not limited by age or gender.

My target market therefore will be focused on the age between 12-60 of people in Hong Kong. All genders.

Fg.9.1, 9.2 candidate trying out the ice compression

DATA COLLECTION:

For the size measurement I had use BodySize to collect my static Data, and using Photoshop to measure out Dynamic dataset shown in figure 10 to 19.

Fig.10.1 Static Data

	Small percentile (5)	large percentil (95)
Reach	Chinese urban female 533 mm	US male Hi income 722 mm
Arm Circumference	US female 275 mm	US male 410 mm
Grip circumference	US female 40 mm	US male 55 mm
Grip strength	Female (11-14) 124.54 N	US male (18-25) 400 N

Fig.10.2 Dynamic Data

Range of movement	Shoulder flexion-extension	360-158.1=201.9 degree
	Shoulder abduction-adduction	360-173.2=186.8 degree
	Shoulder horizontal abduction-adduction	174.1 degree
	Shoulder external & Internal rotation	158.1 degree
	Shoulder D2 flexion-extension	360-158.5=201.8 degree

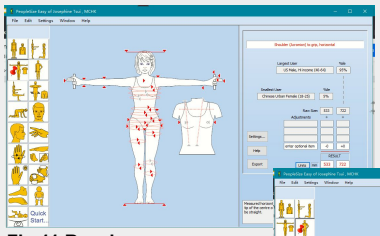


Fig.11 Reach measurement

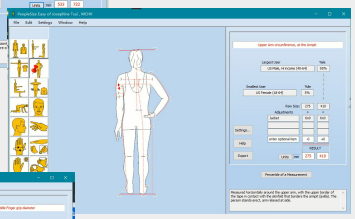


Fig.12 Arm Circumference measurement

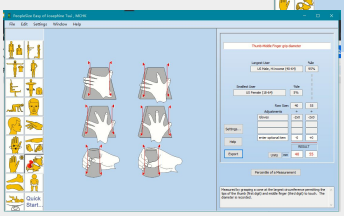
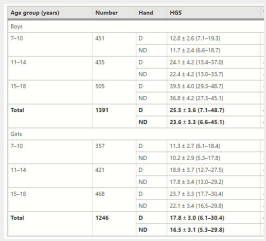


Fig.13 Grip Circumference measurement



Age group (years)	Number	Hand	HGS
Boys			
7–10	451	D	12.8 ± 2.6 (7.1–19.3)
		ND	11.7 ± 2.4 (6.6–18.7)
11–14	435	D	24.1 ± 4.2 (13.4–37.0)
		ND	22.4 ± 4.2 (13.0–33.7)
15–18	505	D	39.5 ± 4.0 (29.3–48.7)
		ND	36.8 ± 4.2 (27.3–45.1)
Total	**1391**	**D**	**25.5 ± 3.6 (17.1–48.7)**
		ND	**23.6 ± 3.3 (6.6–45.1)**
Girls			
7–10	357	D	11.3 ± 2.7 (6.1–18.4)
		ND	10.2 ± 2.9 (5.3–17.8)
11–14	421	D	18.9 ± 3.7 (12.7–27.5)
		ND	17.8 ± 3.4 (13.0–29.2)
15–18	468	D	23.7 ± 3.3 (17.7–30.4)
		ND	22.1 ± 3.4 (15.3–29.8)
Total	**1246**	**D**	**17.8 ± 3.0 (6.1–30.4)**
		ND	**16.5 ± 3.1 (5.3–29.8)**

Fig.14 Grip strength Data collection

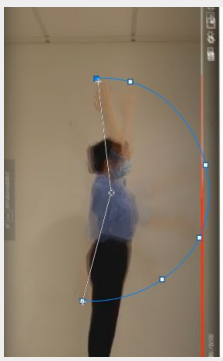


Fig.15 Shoulder flexion-extension angle range measurement

Fig.16 Shoulder abduction-adduction angle range measurement

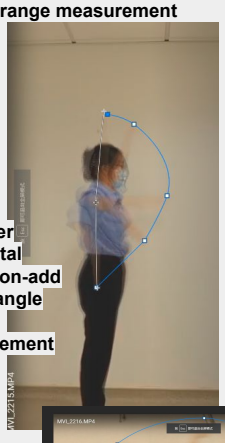


Fig.17 Shoulder horizontal abduction-adduction angle range measurement

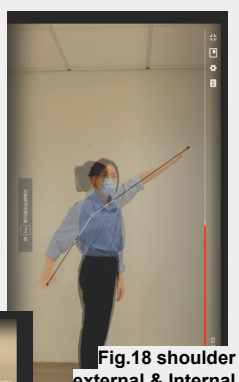


Fig.18 shoulder external & Internal rotation angle range measurement

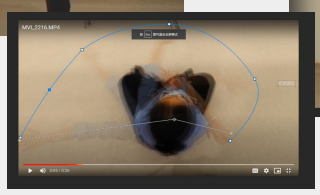


Fig.19 Shoulder D2 flexion-extension angle range measurement

COLOR SELECTION FOR MEDICAL PRODUCT C:

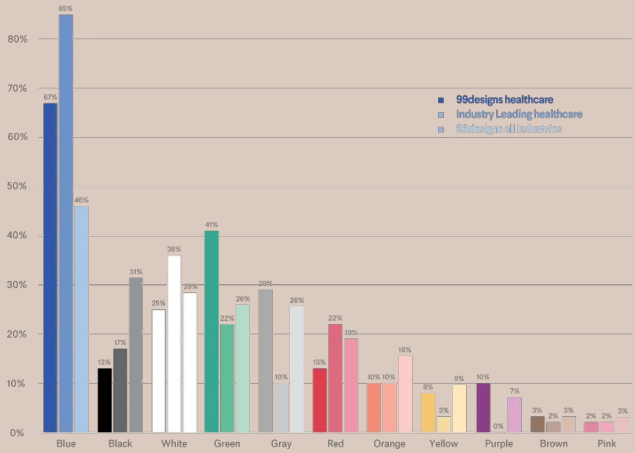


Fig.20 The color statistic on medical use

COMPETITORS:

The first competitor contains elasticity which allows adjustability. However, the ice packs need time to for cooling, that means the users must to wait.

The second competitor is designed very small dimension where it is easy to carry around.

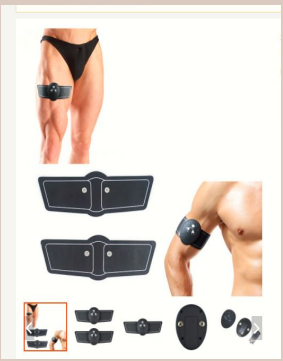


Fig.21.1 Wrist Wrap with ice pack Fig.21.2 Arm Wrap stimulator fitness

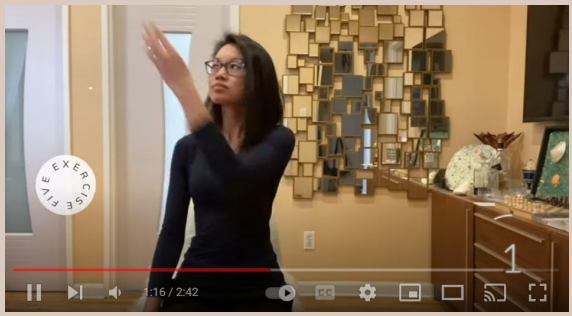


Fig.22 Excercises to ameliorate arm pain after vaccine *youtube*

Fig.22 Temperature intuition

Fabric	Ice pack temperature (℃)	Begin temperature	Temperature after 15 mins	**15 mins temperature difference**	Ending temperature after 30 mins	**30 mins temperature difference**
Spandex	-3.1	7.1	12.7	**5.6**	13.4	**6.3**
Lycra	-3.1	6.3	5.7	**-0.6**	8.8	**2.5**
Neoprene	-3.1	9.1	8.9	**-0.2**	8.9	**0.2**
Ripstop Nylon	-3.1	3.2	4.3	**1.1**	6.6	**3.4**

Fig.23 Comfortability

Fabric	Comfortability scale 1-5
Spandex	4.5
Lycra	4
Neoprene	3
Ripstop Nylon	2

Fig.24 Elasticity

Fabric	Original (mm)	1 kg elastic length (mm)	**Result (mm)**
Spandex	273	462	**189**
Lycra	275	394	**119**
Neoprene	294	Not bearable	**0**
Ripstop Nylon	272	273	**1**

Fig.26 Temperature test for Lycra

Fig.27 Elasticity test for Neoprene

Fig.28 Neoprene fabric break during testing

Fig.25 Weight

Fabric	**Weight (g)**
Spandex	**16.56**
Lycra	**13.10**
Neoprene	**33.27**
Ripstop Nylon	**35.1**

Fig.29 weight measure for Ripstop Nylon

Fig.30 Comfortability test for Spandex

CRITERION A3 - SPECIFICATION

		Specification point	Justification of requirements and evidence	Research source	Priority	Testing methods
1. Aesthetics	1.1	Color will be Green or Blue that is admitted by medical systems. The hexadecimal color code for blue is 3257a8, 6d92c7, a8c7e8, and green is 37a794, 63bd9a, b5dcca.	This is based on the secondary research from figure.21	99designs.com Medical trends gathered.	17 	Nurse interview and questionnaire
	1.2	Branding (Reliability, comfortability, safety)	Using emotional branding could provide the difference from similar products, accredit the product be personalized, genuinely connect with our audience, and increase the amount of ROI.	Chris Zafeiris	18	Nurse interview and questionnaire
2. Function	2.1	Allow the users to conduct up to four shoulder arm exercises	Shows in the Fig.16-20, fig. 22 (Shoulder flexion-extension, Shoulder abduction-adduction, Shoulder horizontal abduction-adduction, Shoulder external & Internal rotation, Shoulder D2 flexion-extension)	*6 Simple Exercises to Solve Your Vaccine Arm Soreness - Youtube*.	4	User trial - can users conduct range of excercises
	2.2	Allow the user to apply cold temperature for the injection-site pain	From this research I explored that cold temperature could help injection-site to release tumidness. However, warm temperature will not help the relaxation. (Fig.11) shown personal trial.	“Ice Packs vs. Warm Compresses for Pain.”	3	Performance testing - measure with thrmometer
	2.3	Adjustability to suit different user size’s percentile range	Graph shows the different range of age group affected by injection site pain. Size’s different to different gender, racial and age.	(Fig.7) (Fig.12)	2	User trial - can users adjust a fit the percentile
	2.4	The maximum force applied to the elastic should be 400 Newtons, minimum should be 222 Newtons.	According to the study of “Isometric pull-push strengths in workspace: 1. Strength profiles” the data for maximum pull strength is 400 Newtons, and the minimum is 222 Newtons.	Y Das B Wang.	10	Performance test of elasticity of material
3. Product constraints	3.1	Elastic reach range of the 5th to 95th percentile users	Adjustability of the elastic Elastic needs to be adjustable to allow a range of users to exercise successfully.	(Fig.11 reach data)	9	User trial - can range of users successfully stretch

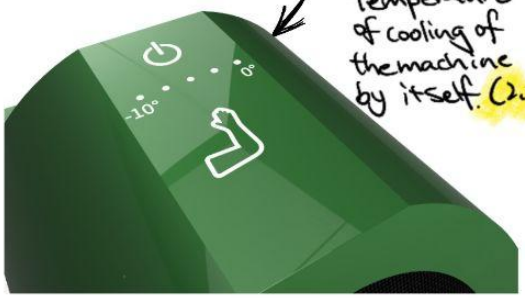
CRITERION A3 - SPECIFICATION

		Specification point	Justification of requirements and evidence	Research source	Priority	Testing methods
	4.1	Needs to be adjustable to be used by 5th to 95th percentile (275-410mm)	Arm circumference of 5th - 275mm 95th - 410mm	(Fig.12 Arm circumference body measurement).		Ask the user to adjust the product to ensure a tight fit and respond on the questionnaire.
	4.2	Stretched length of the elastic should be easy for the 5th percentile and bearable for the 95 percentile.	Reach data 5th - 533mm, 95th - 722mm.	(Fig.13 reach data)		User trial for excercise with stretched component
	4.3	Size of the gripped component should be in between 40mm to 55mm.	Size of grip length 5th - 40mm to 95th -55mm	(Fig.14 grip length measurement)		User trial with grip strength
		Dynamic Data (Fig.10.2)				
	4.5	Range of movement for flexion extension 201.9 degrees	Testing shows the range of movement for this exercise.	(Fig.15 Range of movement for flexion extension)	12	User trial and questionnaire
	4.6	Range of movement for abduction-adduction 186.8 degrees	Testing shows the range of movement for this exercise.	(Fig.16 Range of movement for abduction-adduction)		User trial and questionnaire
	4.7	Range of movement for horizontal abduction-adduction 174.1 degrees	Testing shows the range of movement for this exercise.	(Fig.17 Range of movement for horizontal abduction-adduction)		User trial and questionnaire
	4.8	Range of movement for external and internal rotation 158.1 degrees	Testing shows the range of movement for this exercise.	(Fig.18 Range of movement for external and internal rotation)		User trial and questionnaire
	4.9	Range of movement for D2 flexion-extension 201.8 degrees	Testing shows the range of movement for this exercise.	(Fig.19 Range of movement for D2 flexion-extension)		User trial and questionnaire
5. Quantity	5.1	10% of Hong Kong vaccinated people	7.482 million of Hong Kong population, 80 percent for prediction fully-vaccinated. Which is 5.985 million people, aiming for 10 percent of fully vaccinated people in Hong Kong, the batch produces around 6 hundred thousand.	“Hong Kong Won’t Open Up Before Vaccination Hits at Least 80%.”	8	Quesionnaire for user, rating and question on where availability is
6. Target audience	6.1	Age 12 to 60+	All the age groups received vaccine side effects.	(Fig.7 statistic of age group that received vaccine side effects)	6	Observation of percentile range to collect qualitative
	6.2	No gender limitation	This news showed that both genders report vaccine side effects. However, 75% are reported by women.	Akau, Ke'ala.	5	Observation of gender use
	6.3	Hong Kong Chinese	Prototype will be rolled out initially in Hong Kong. Ethnicity in Hong Kong of Chinese is 92%.	“Demographics of Hong Kong.”	7	Observation of ethnic group

CRITERION A3 - SPECIFICATION

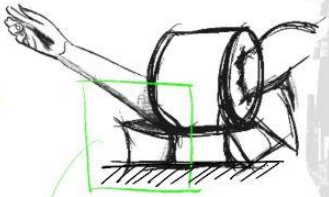
	Specification point		Justification of requirements and evidence	Research source	Priority	Testing methods
7. Material selection	7.1	Elasticity of Spandex	Elasticity will help the fabric to stretch by the user without any damage to itself. The best elasticity is contained by fabric “Spandex”.	(Fig.24) (Fig.27, 28) Elasticity experiment	16	Performance/ material testing
	7.2	Comfortability of Spandex	The comfortability for fabric is important because it is a product that uses near skin. The best comfortability is “Spandex”, because it is soft and contains coldness itself at the same time.	(Fig.23) (Fig.30) Comfortability experiment	13	Survey on comfortability of user range
	7.3	Light Weight of Lycra	Light weight will reduce all the burden for users. The most light weighted fabric is “Lycra”.	(Fig.25) (Fig.29) Weight experiment	14	Survey on weighting of user range
	7.4	High thermal Resistance (Good insulation) of Neoprene	The High thermal insulation will maintain the cold without any heat transfer to help users to cool down their pain. The fabric that requires the highest thermal insulation is “Neoprene”.	(Fig.22) (Fig.26) Temperature experiment	15	Performance test with thermometer
8. Competitors (USP)	8.1	Product must have combine function of cooling compression with massage feature.	Some products contain cooling functions or massage feature. However, none of the products had combined both functions for medical use.	(Fig.21.1, 21.2) Competitors research	1	Competitor comparison

B1: IDEA 1:



Users can adjust the Temperature of cooling of the machine by itself. (2.2)

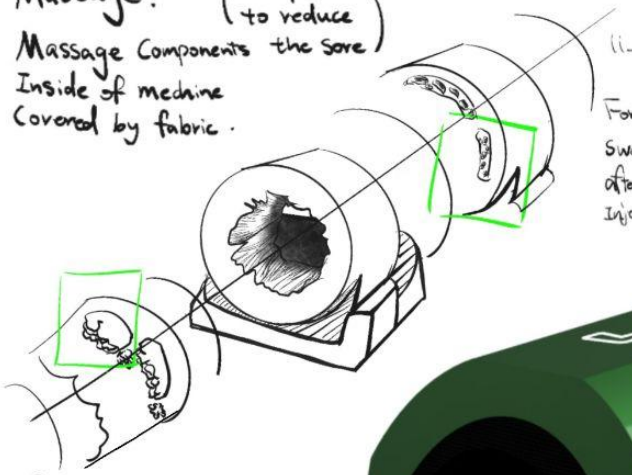
No elasticity because →



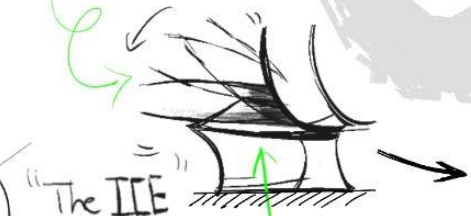
It will allows you to do a range of exercise, the elbow section is still actable.

The massage Function could help Users to stretch their muscles Even though Users are Not exercising itself

"Massage!" (help you to reduce Massage Components the sore Inside of medicine Covered by fabric.



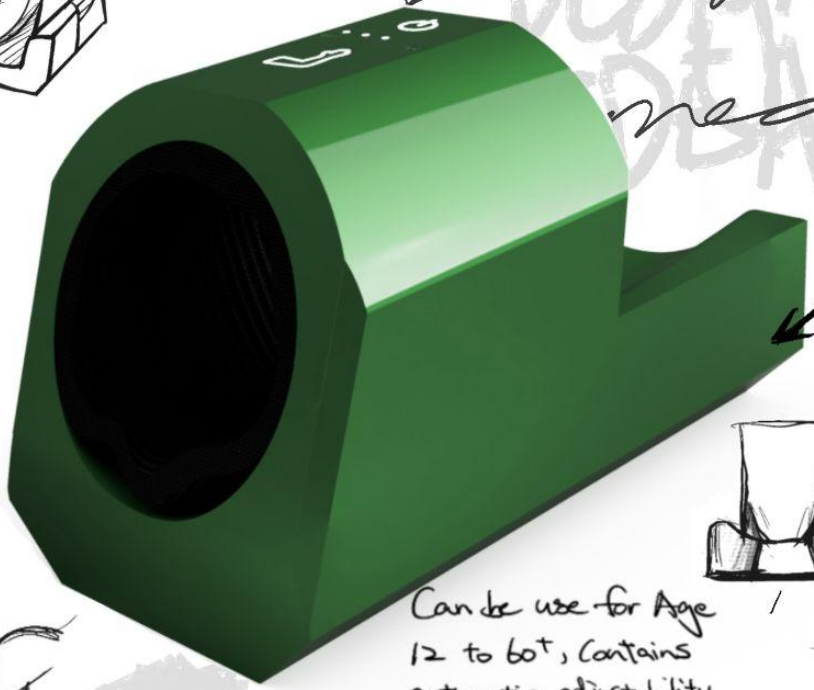
"The IIE" For Cooling the swallowing down after receiving the Injection side pain!



How User could Put & Relax their arm while Cooling & massage.

Design Brief

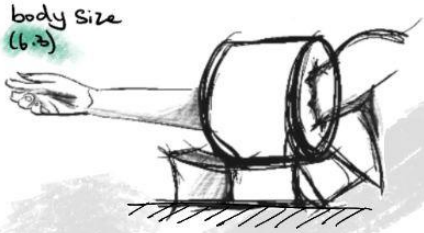
Combine function of cooling Compression with Stretching exercise. (8.1)



Can be adjust by Size of Users' arm by Internal Couch Component Inflate to match User's arm size The machine is designed in 95th percentile, which Can be easily adjust for Majority of the users. (2.3.4.1)

Uses "Green" the color that is admitted by medical system. (1.1)

Measured in Hong Kong Chinese body size (6.3)

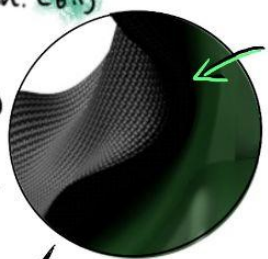


Perspectives

Can be use for Age 12 to 60+, Contains automatic adjustability & easy instruction. (6.1)

Can be largely produced for the 10%. However, It is better to use in the hospital Clinics or Community Vaccine Centres rather than at home. This would mean a smaller initial batch production size. (5.1)

No gender limitation (6.2) uses for all range of people under 98% percentile.



BN/PVA fabric used here because →

High thermal Resistance. Coldness could be Consistently transmitted. (7.4)

Ø 90mm (95 percentile of arm width)

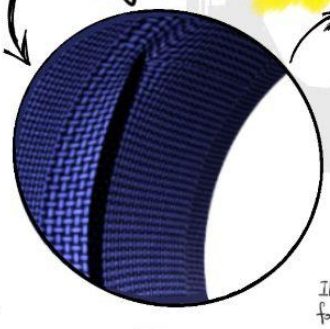
Arm rest!

Air compression creates a cushioning effect for Comfortability. (7.2) + The design of curved arm rest to let the user's elbow to be supported during massage.

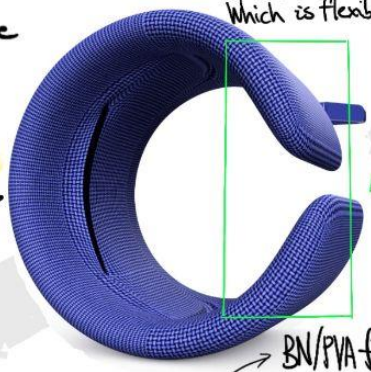
		Specification				☑
1	Aesthetics	1.1	1.2			1/2
2	Function	2.1	2.2	2.3	2.4	2/4
3	Constrains	3.1				0/1
4	Size. S	4.1	4.2	4.3		1/3
	Size. D	4.5	4.6	4.7	4.8 4.9	0/5
5	Quantity	5.1				0.5/1
6	Audience	6.1	6.2	6.3		2/3
7	Material	7.1	7.2	7.3	7.4	2/4
8	Competitors	8.1				1/1

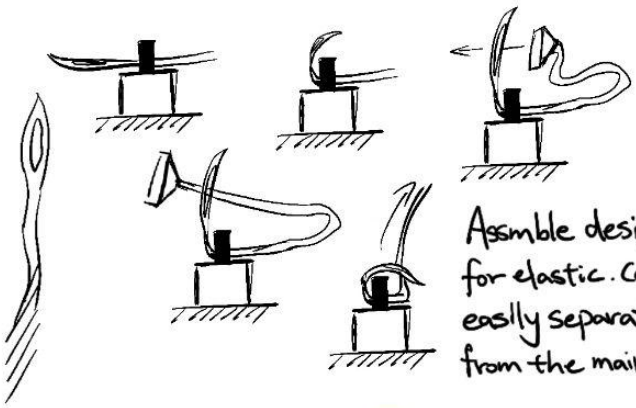
B1: IDEA 2:

Allow the user to apply cold temperature → the cold pad for reduce swelling around the Injection-site. (2.2)



Designed as Velcro (4.1, 2.3) which is flexible and can be adjusted to suit different users' arm size.



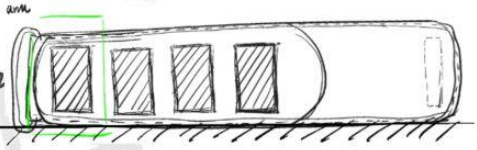


Assemble design for elastic. Can be easily separate from the main body.

BN/PVA fabric with cushion texture inside Increase comfortability (7.2)

Also contains High thermal Resistance (7.4)

ICE Packs for cooling down inside of the arm warp

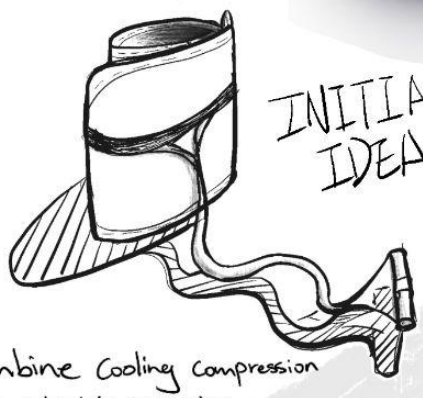


Dorsey

Color "Blue" (1.1)

The color that is admitted by medical system. Contains medical use representation.

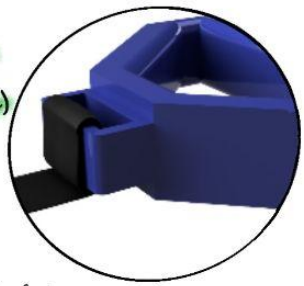
Simple material with light weight (7.3) product could be produce as quantity production for 10% of Hong Kong Population. (5.1)



INITIAL IDEA

+ It can be produced by the Injection moulding which would help meet production for the market size. (5.1)

No age limitation (6.1)
No gender limitation (6.2)
Suitable for All types of user to use.

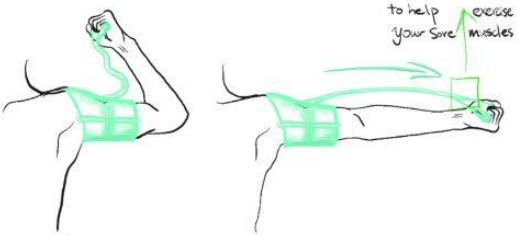


Size measured in Hong Kong chinese percentile. (6.3)

Combine cooling compression with stretch exercise

Elastic could reach the range from 5th to 95th percentile users. (3.1) (4.2) (7.1)

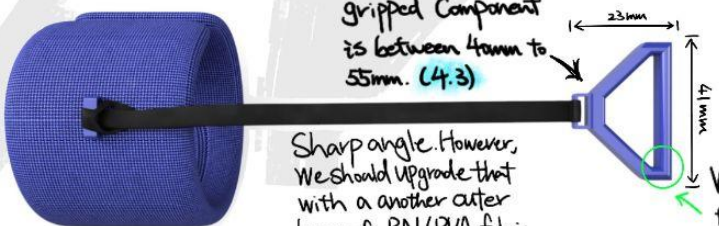
Function:



Should be able to handle the maximum force 400N & Minimum 222N. (2.4)

Allow the users to conduct up to four different exercise to help stretch & reduce the pain. (2.1) (4.5 - 4.9)

Size of gripped Component is between 40mm to 55mm. (4.3)

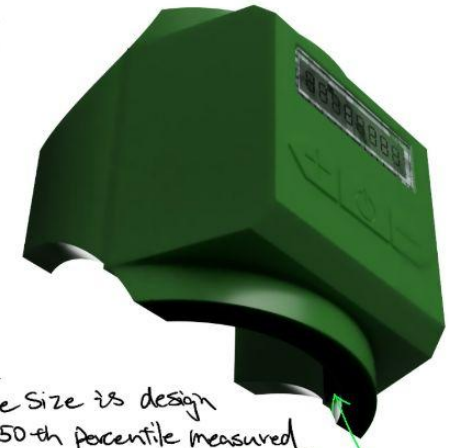


Sharp angle. However, We should upgrade that with a another outer layer of BN/PVA fabric to improve the Comfortability!

We had designed the gripped component into curve shape to protect user's hand to be hurt from

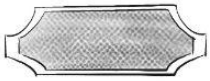
	Specification	☑
1 Aesthetics	1.1 1.2	1/2
2 Function	2.1 2.2 2.3 2.4	3/4
3 Constrains	3.1	1/1
4 Size. S	4.1 4.2 4.3	2/3
Size. D	4.5 4.6 4.7 4.8 4.9	5/5
5 Quantity	5.1	1/1
6 Audience	6.1 6.2 6.3	3/3
7 Material	7.1 7.2 7.3 7.4	3/4
8 Competitors	8.1	1/1

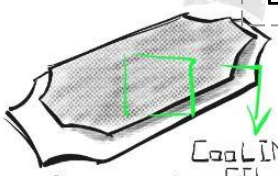
B1: IDEA 3



The size is design in 50th percentile measured in Hong Kong Chinese. (6.2, 6.3) It will NOT be suitable for 5 or 95 percentiles users. However, there are no gender limitation both gender around 50th percentile could use it.

Ø65mm

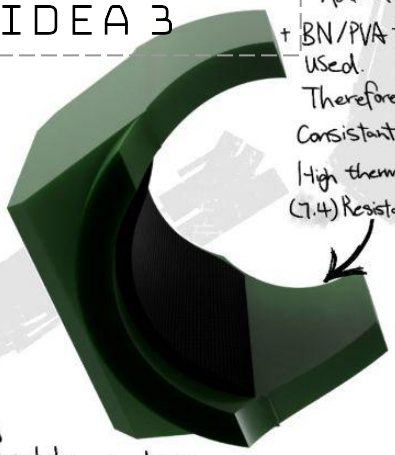




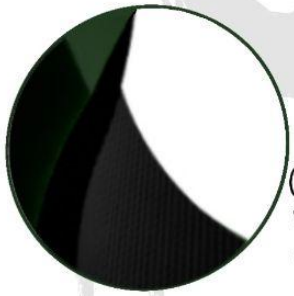
Function: To cool down the swollen muscles.

The most inside layer connect to the outer fabric

Automatic! + BN/PVA fabric used. Therefore it is consistant with High thermal (7.4) Resistance.



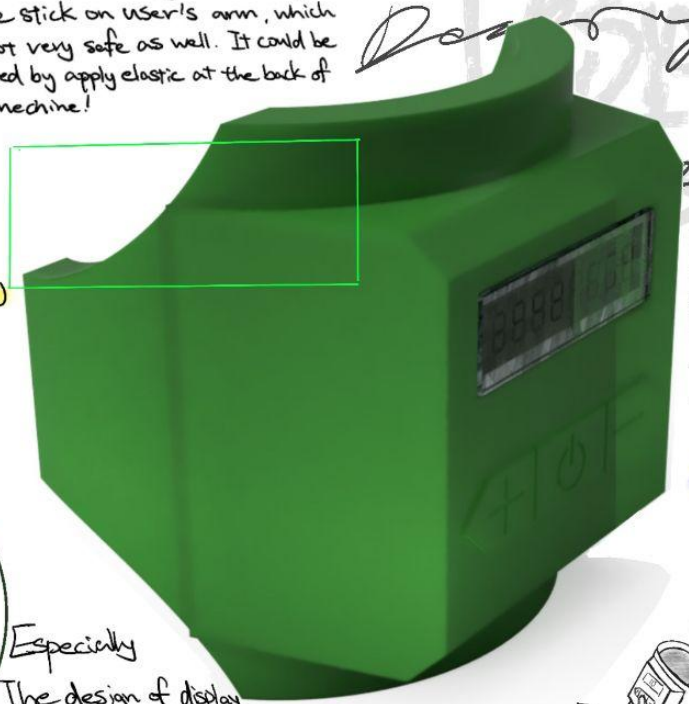
Allow users to apply cold temperature for Injection-site pain. (2.2)



Confortability produce by the soft texture of the cooling pad in the internal layer. (7.2)

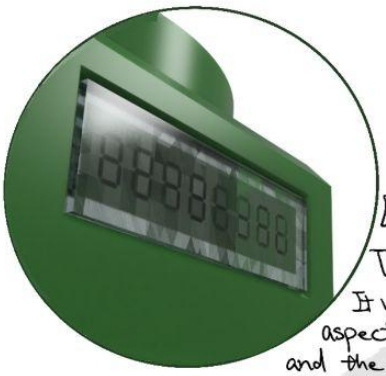
The back of the machine doesn't require adjustability. It is designed to be stick on user's arm, which is not very safe as well. It could be improved by apply elastic at the back of the machine!

Color "Green" (1.1) is used in this product It is the approved Color admitted by the medical system. Higher level of medical impact from visual.

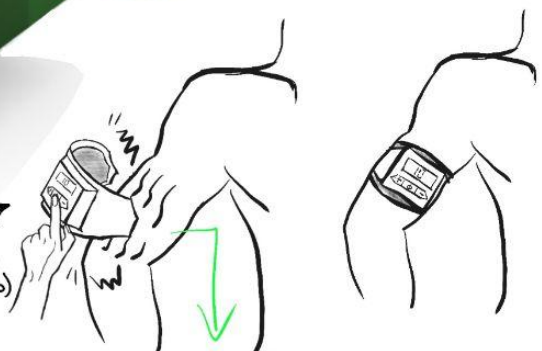


Will be Stabbed on the part of the upper arm. Which will be convient for doing all the exercise. (2.1) (4.5 - 4.9)

Due to the Small Size of the Object the product will convient to produce. However, the component inside, especially to the Vibrator & Cooling keeper it is difficult to create as essential. (5.1)



Especially The design of display. It will increase both technical aspect to be more complex and the cost aspect to be more expandsive. Thus, it will be even difficult to meet project amount for market size. (5.1)

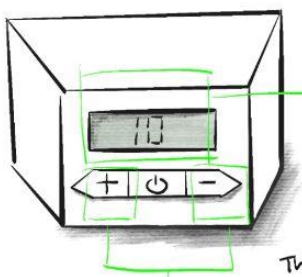


Small volume light weight! (7.3)

Very simple design only need to press on/off botton to start the machine for stimulation. It will be directly massaging the sore muscles.

Material of case: ABS

Property: + High hardness & toughness
+ Light weighted (7.3)
+ require range of color
+ Can be Injection moulded.



The strength of the massage Stimulator Min 1 to Max 10. To reduce the soreness from the injection side pain.

Simple instructions which allows a range of Ages to use it. (6.1)

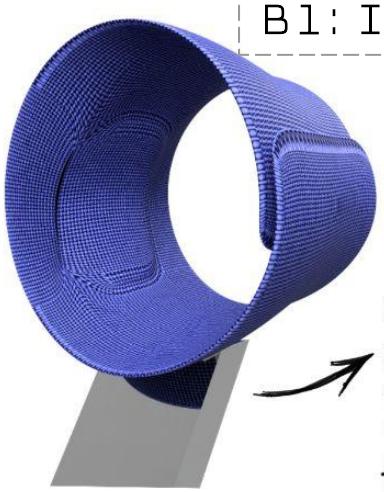
The botton to Click for changing the strength of the massage Stimulator.

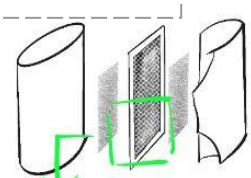
Combine massage function reduce Injection -site pain & Cooling Compression function. (8.1)

Very top!

	Specification	☑
1 Aesthetics	1.1 ✓ 1.2	1/2
2 Function	2.1 ✓ 2.2 ✓ 2.3 2.4	2/4
3 Constrains	3.1	0/1
4 Size. S	4.1 4.2 4.3	0/3
Size. D	4.5 ✓ 4.6 ✓ 4.7 ✓ 4.8 ✓ 4.9	5/5
5 Quantity	5.1	0.5/1
6 Audience	6.1 6.2 ✓ 6.3	2/3
7 Material	7.1 7.2 ✓ 7.3 7.4 ✓	3/4
8 Competitors	8.1	1/1

B1: IDEA 4:





"COOLING GEL" for coding down the swollen
Inside the fabric layers

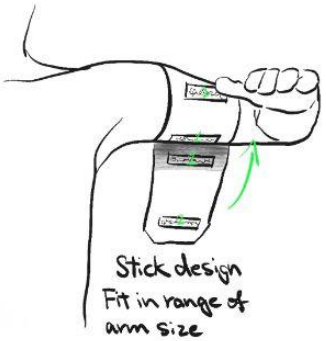
We had insert the cool gel inside the fabric because we found out coding could help the users to reduce swelling from the research. Therefore, in this product we designed the cooling function inside the the arm section. This could help the users to reduce swelling while they doing the exercise. (2.2)

Adjustability applied to different size's command. (2.3)

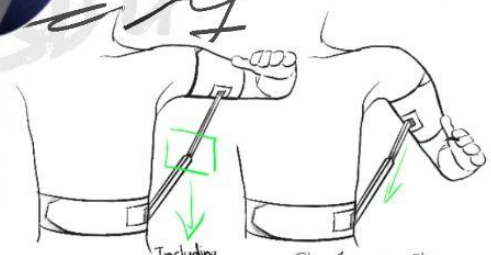
Velcro design can be easily shaped by users. It is used in our product Inside the fabric.

Combine the function of cooling compression and stretching exercise (8.1)

It Doesn't allow the users to do four shoulder arm exercise. However, It does help to release the Injection-site pain after actual testing on the soreness after Vaccine Injection.



Stick design
Fit in range of arm size



Including Spring design every time Push down it will automatically spring back

Step 1 ↔ Step 2

Step 1 Push your arm down

Step 2 Spring back by the machine & Push again

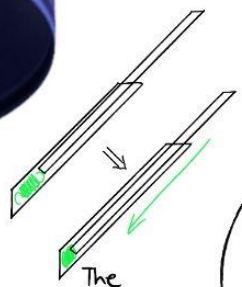
Target audience:

Includes all the people who receive Injection-Site Pain after Vaccine. Therefore It can be used by all the users that can fit into the Product's size.

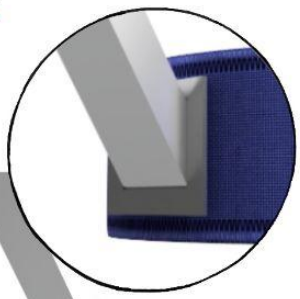
All percentile measured in Hong Kong Chinese body size. Therefore are very much suitable for Hong Kong users to use. (6.3)

Used the material: BN/PVA

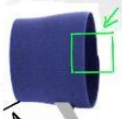
Property: Textile material
+ Comfortable (soft)
+ High thermal Resistance (Good Insulation)



The Spring



Measured in 95th percentile Which with the velcro design it can be adjust into smaller size to fit smaller percentiles. (4.1)



Ø59-80mm

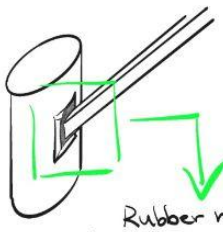
259-350mm

However the metal part doesn't require adjustability. It won't fit in all age range.

Simple material used with light weight (7.3) could be mass product for 10% of the Hong Kong population. (5.1)

Ø171-283mm

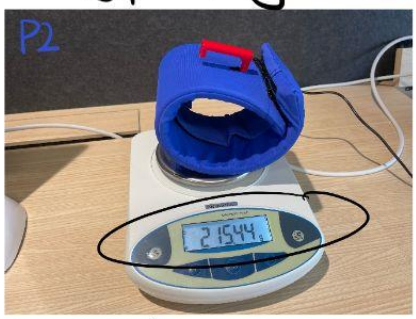
Color "Blue" The color that is admitted by medical system. Has medical use representation. (1.1)

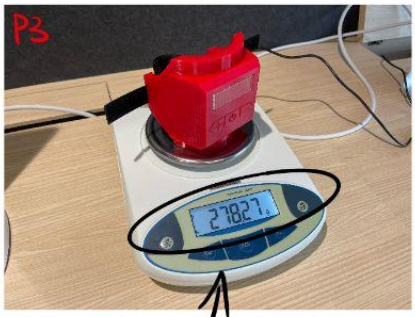


Rubber material
- for connection between fabric and equipment with 'rivet' supported
- And Use as fixator to make the equipment stable

		Specification	☑
1	Aesthetics	1.1 1.2	1/2
2	Function	2.1 2.2 2.3 2.4	2/4
3	Constrains	3.1	0/1
4	Size. S	4.1 4.2 4.3	1/3
	Size. D	4.5 4.6 4.7 4.8 4.9	0/5
5	Quantity	5.1	0/1
6	Audience	6.1 6.2 6.3	3/3
7	Material	7.1 7.2 7.3 7.4	3/4
8	Competitors	8.1	1/1

Prototype Weight Test (7.3)





Without Elastic & Handle Weight

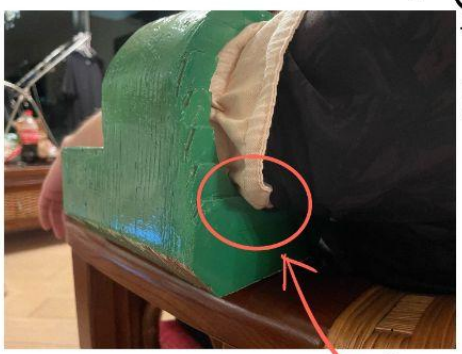
FIRST USER TRIAL:
ARM SIZE (CIRCUMFERENCE): 36
AGE: 25
WEIGHT: 180
HEIGHT: 183
GENDER: MALE
(6.2)

Base on the balance P3 has the lightest weight (7.3) = most convenient for Travel

Whole Product Weight

Prototype 1

Not enough Length to put Arm



No space for the elastic (4.1) (2.3)

Not enough Length Hurts more (4.3)

Users Can Not Do any exerise with P1 (2.1) (4.5-4.9)

ADD Length!

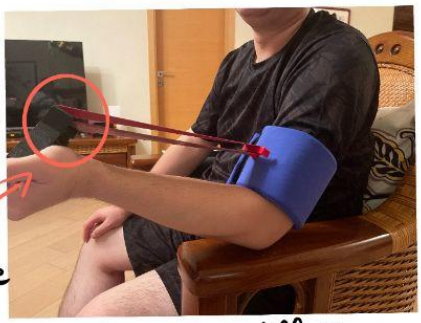
Here is for the elbow But too short. No Adjustability (2.3) (4.1)

People Upper Arm is in Angle

It is In Angle, Not Straight

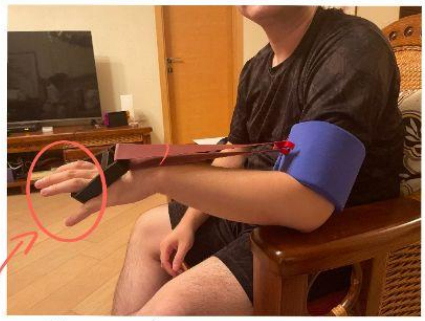
Prototype 2

Too small for the User (2.3) (4.1)

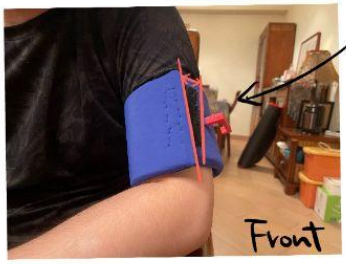


Handle Design

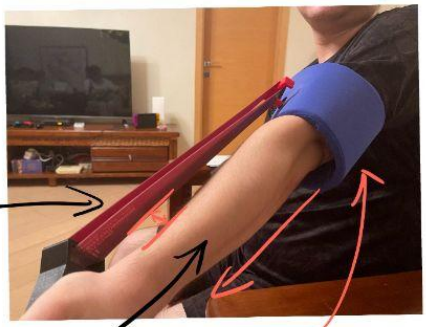
Into 90° is very diffcult for user to hold & pull. (4.3)



Handle Width is Too Small for the User (2.3)



In the front still sees the gap. (6.2)



After Pulling the elastic is very close to the skin, might Hurt the skin (4.3)

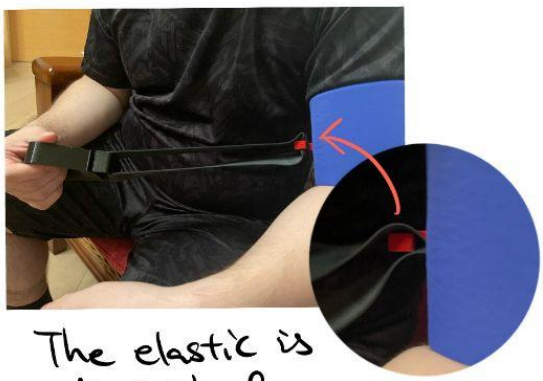
Exercise the Forearm Instead of Upper Arm

Material Spandex is too slippery as a exercise equipment (7.2)

The Angle of Pulling is very uncomfortable for the User. (4.3)

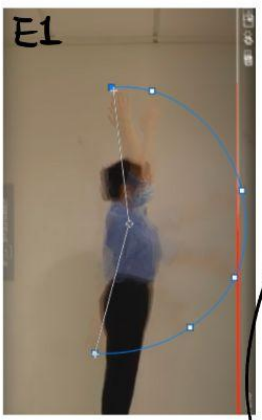
Using the other Hand to workout will be More logic for Human engineering.

Use the other Hand to Actually help to exercise the upper Arm



The elastic is adjustable for Different User. (3.1)

Exercise Test (2.1)



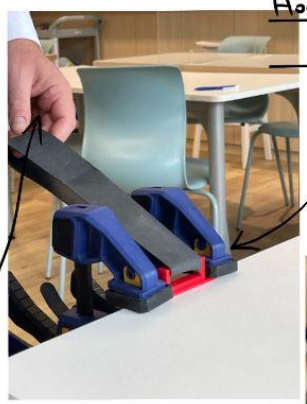
Not straight, Doesn't work well (4.5)

Product Didn't help the exercise (4.6)

Works, but the elastic too close to the skin

Not in side Angle

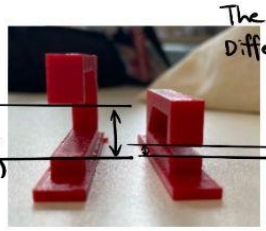
Resistance Band Hook Practical Test



Tested by manually force

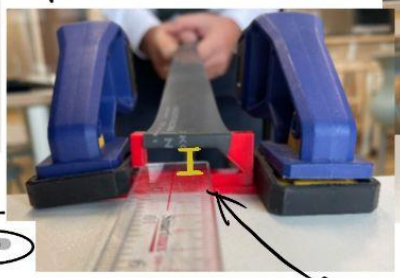
TH (Tall Hook)

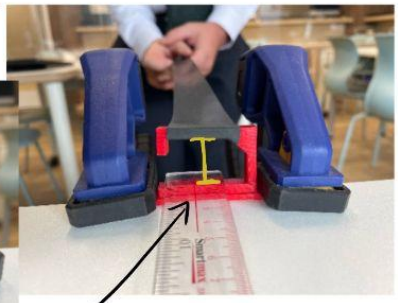
SH (short Hook)



The gap Difference

Stabled with Cliper on the desk





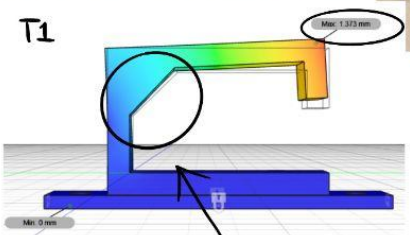
Conclusion of the experiment = Shorter Height of a Hook = More Stiff (4.3) less deflection

Hook Model Test

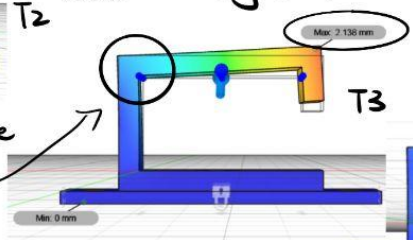
SH

SH is more Stiff & less deflection than TH

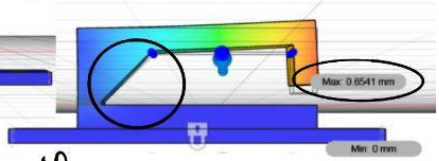
T1



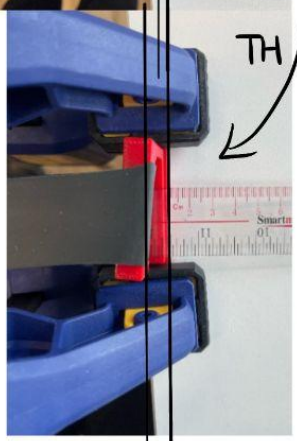
T2



T3

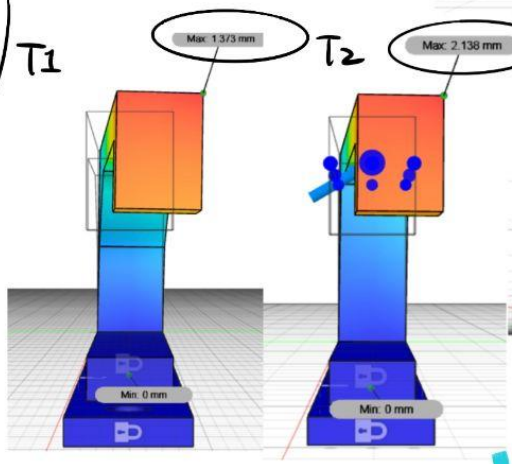


With resistance Angle > Right Angle



TH

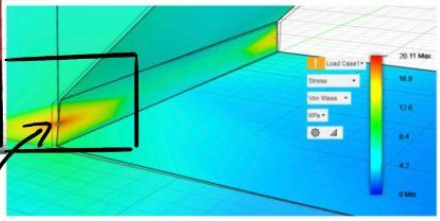
T1



T2

T3

After comparison "T3" is the design with the least deflection.



The closer the Angle towards the bottom = The stronger the Hook Holds.

ICE PACK Test

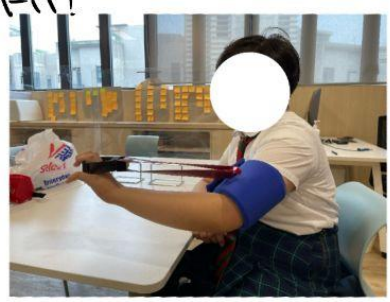
Couldfit in However Couldn't feel the temperature by User's skin.

Fit perfectly

Doesn't Fit!

User Age Test

USER'S TRIAL:
ARM SIZE: 27
AGE: 12
WEIGHT: 46
HEIGHT: 152
GENDER: FEMALE

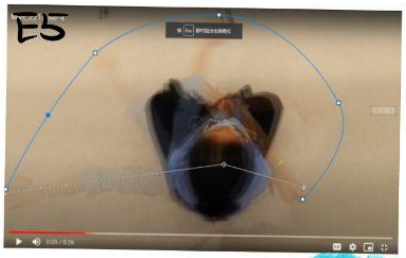


(4.7)

Very loose

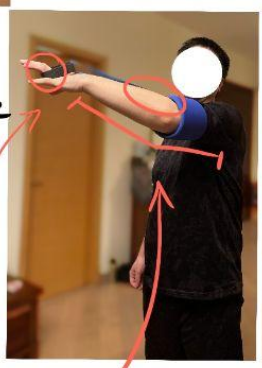
Still work but in uncomfortable Angle

Twist in a weird Angle



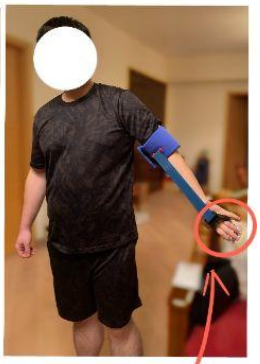
(4.9)

Slides down a little



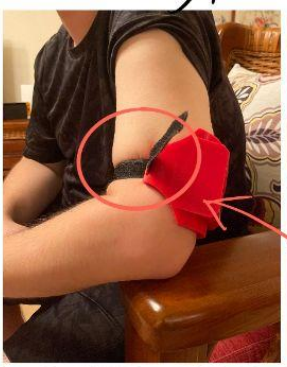
Elastic Pretty much on the skin (weird position)

Not Straight (4.8)



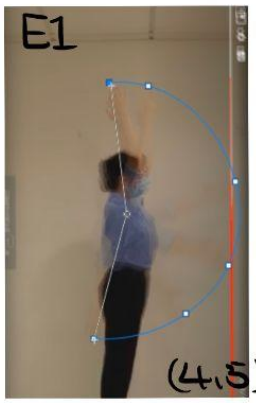
Hands in a uncomfortable Angle (4.3)

Prototype 3



Sharp Corners suppress the skin are Painful (4.3) (7.2) (7.1)

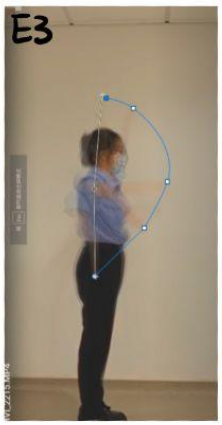
Too Tight For my 95th Percentile. (4.1) (2.3)

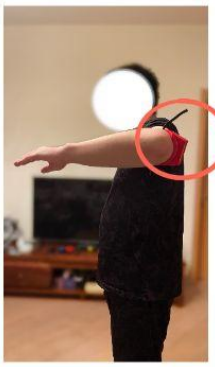


(4.5)

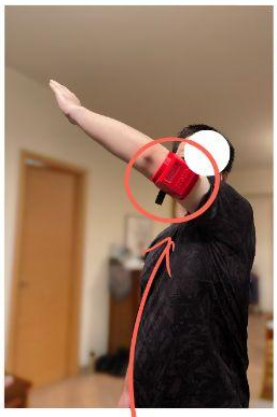
Works ok!

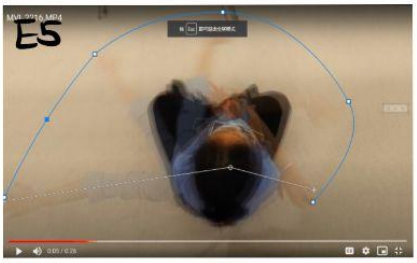
Stays very well on the Arm, Doesn't Affect the movement too. (4.6)





Wok pretty well with the prototype (4.7)





Prototype 1

Fits very well on User's arm while He Does the movement. (4.8) (4.9)

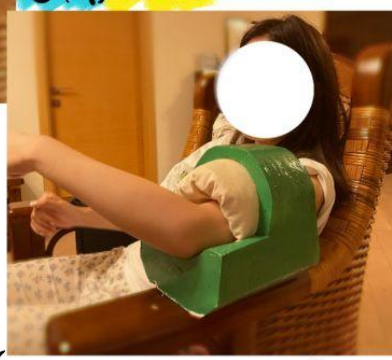
SECOND USER TRIAL:
ARM SIZE (CIRCUMFERENCE): 23
AGE: 22
WEIGHT: 115
HEIGHT: 168
GENDER: FEMALE
(6.2)

Sharpe edges still Suppresses user's Skin, Uncomfortable. (4.3)

Has More space then the 95th Percentile.

Not Specifically reaching the elbow. (4.1) (2.3)

Has space for the Elastic Adjustability (4.1) (2.3)



The Hook should be more to the middle.

Should have a larger range of option for Velcro

The User will be seating diagonally when they use this prototype. (The pedestal should be Thicker)

The edge of the Design is suppressing User's Arm (4.3)

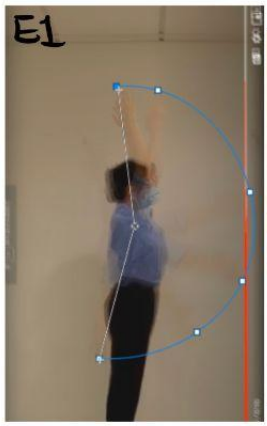
To big of space for ≥50th Percentiles

Prototype 2

From both of the Size and material persepective, the prototype slides Down When it's used. (2.3) (4.1)

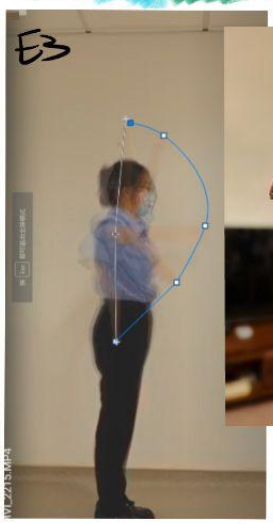
Exercise Test (2.1)

The protype Contains Adjustability Users could serve themselves. (3.1)



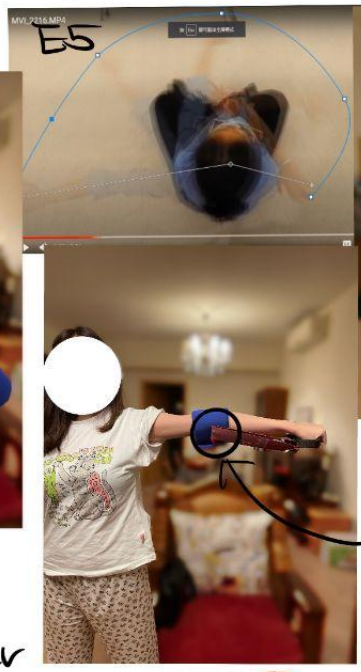
This exercise won't work for this Prototype, it will fall down once the arm is. (4.5) (6.2) (4.1)

The Arm is in Angle Not Striaght because of the illogical design. the Exercise is Not successful. (4.6)

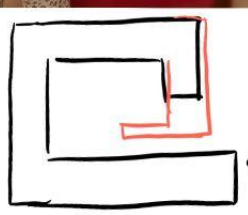


This exercise works However the prototype is Not Utilized during the exercise. (4.7)

When it is up it is Fine However, it is too loose for the User to put her Arm Down. (4.8)



Prototype can be used During this movement. However the Elastic is easy to get off from the Hook. (4.9)

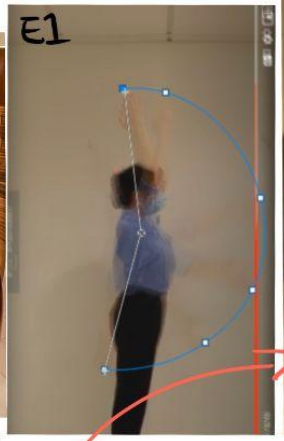


(+) Could make the Hook close more.

Prototype 3

Little Heavy for People to Wear for 15-20 mins. (7.3)

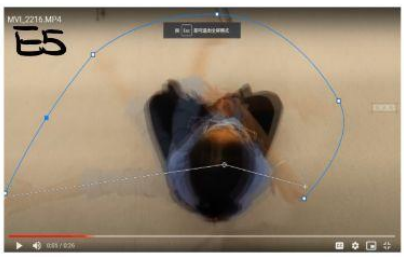
Texture hard and Rough. (+) Better to have a Inside Liner. (7.2)



Will be a little loose for Small Percentile Women. (2.3)(4.1)(6.2)
But, it Does not affect the product itself to work. (4.5)(4.6)

The prototype Doesn't stick onto the skin Due to the Stiff material it has. (7.2)(7.1)
Which means the function of the protype won't work During the exercise. (4.7)

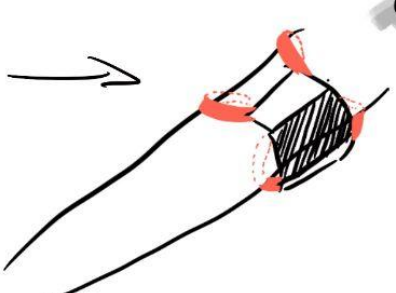
When Arm goes up the prototype works (4.8)



(4.9)
Prototype moves on User's Arm

(+) Improve the Stability on the Material or make the Velcro into multiple fixator

However, When the Arm goes down, it drops.
(+) Velcro should be Improved & Change to a material that is more Comfortable (7.2)



APPEARANCE INSPIRATION COMING FROM: EYE MASSAGE

FURTHER DEVELOPMENT: INITIAL CAD:

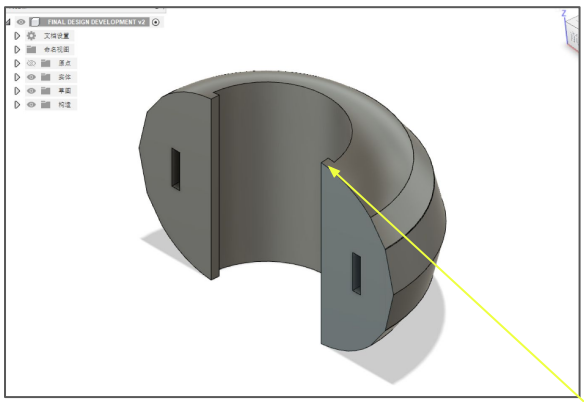


Fig.31 Development of the shape of the product.

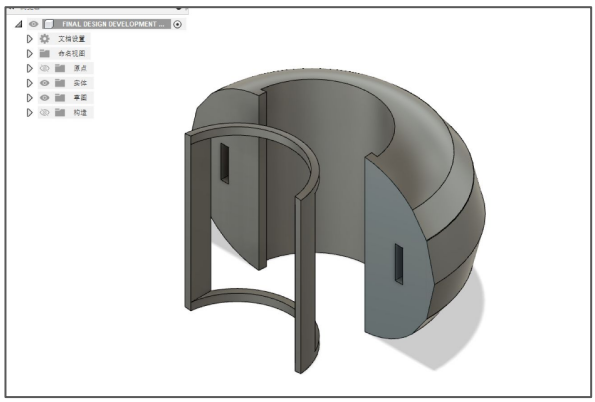


Fig.32 Development of the clip to hold the ice pack.

FIRST TESTING: USER AGE: 13

Fig.33 and 34 initial prototype testing on user

The diameter is too small for 5 percentile users arms to fit in.

The diameter need to be increased to 95 percentile.

Too chunky, make slimmer.

Adjust components (band) testing:

Fig.35 & 36 testing the adjustability of the two band mechanisms

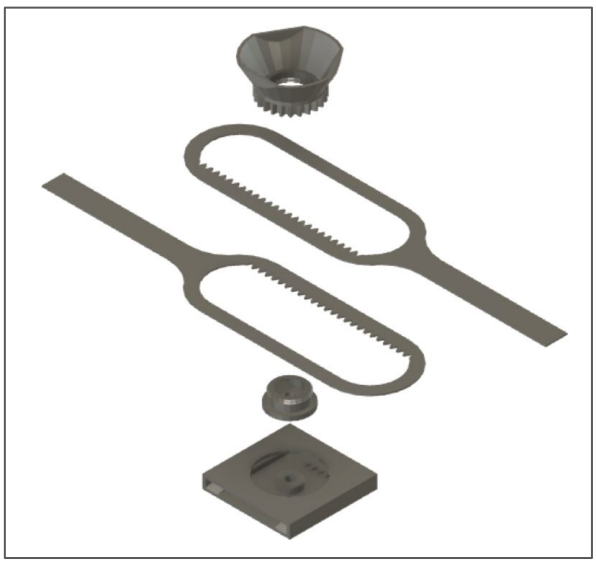


Fig.37 Band mechanism No.1

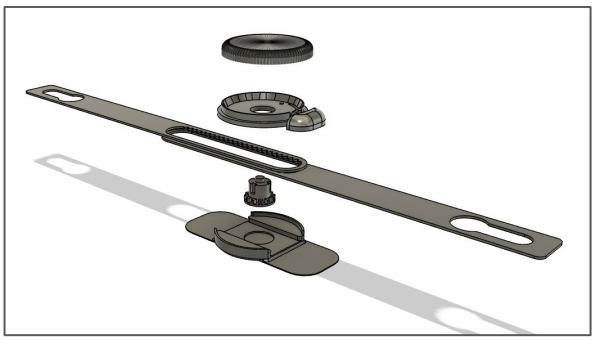


Fig.38 Band mechanism No.2

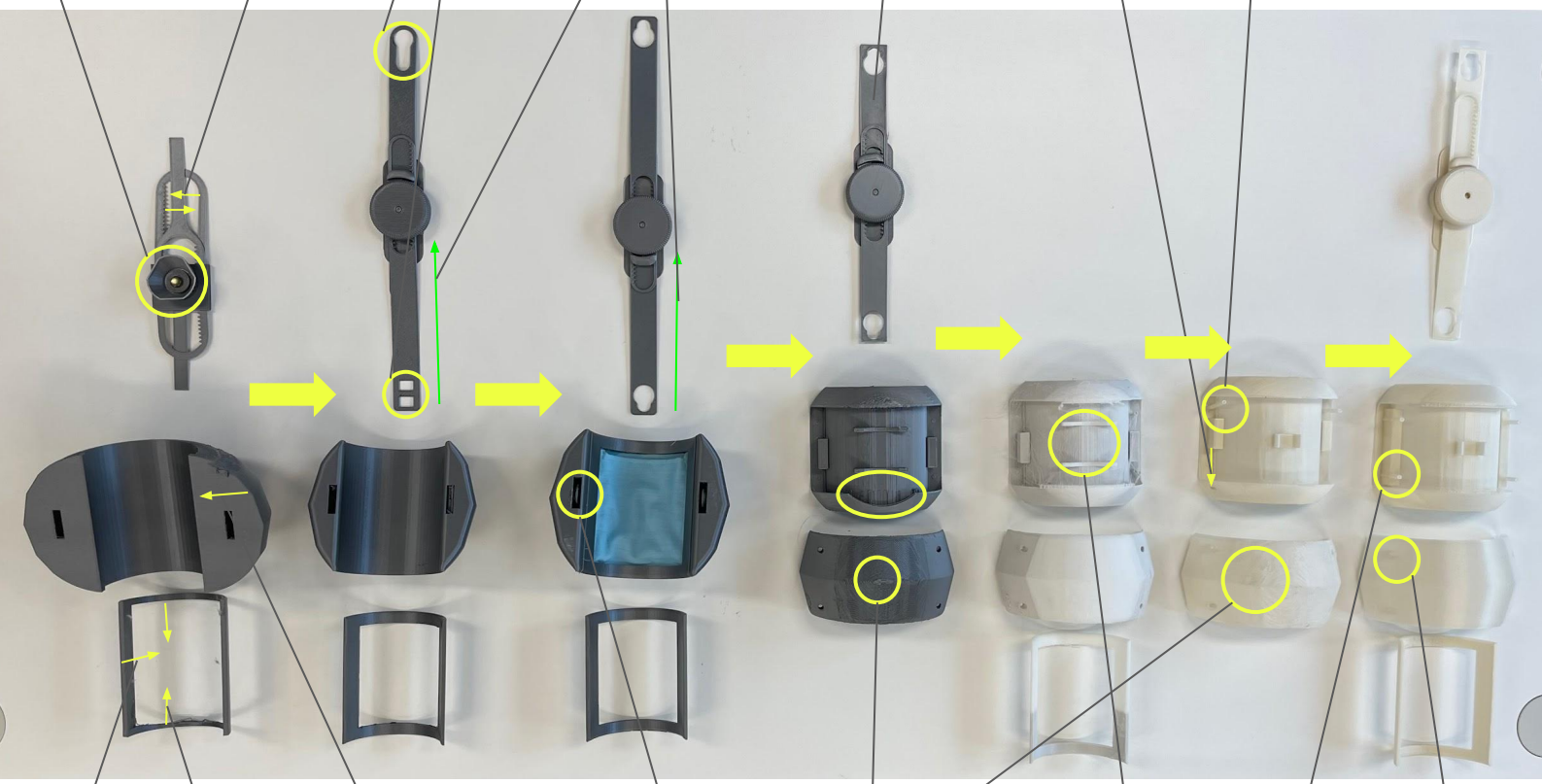
Doesn't line up with the skin, but a smaller angle than component No.2. Difficult to adjust with one hand.

Not fully line up with the skin, but relatively easier to spin with one hand

Fig.39.1 & 39.2 Testing mechanism 1

Fig.39.3 & 39.4 Testing mechanism 2

B2: CONCEPT MODELLING: RAPID PROTOTYPE ITERATIONS



Iterations and improvements based on testing

B2: GRAPHICAL MODELLING - BRANDING DEVELOPMENT OF THE LOGO: MYO

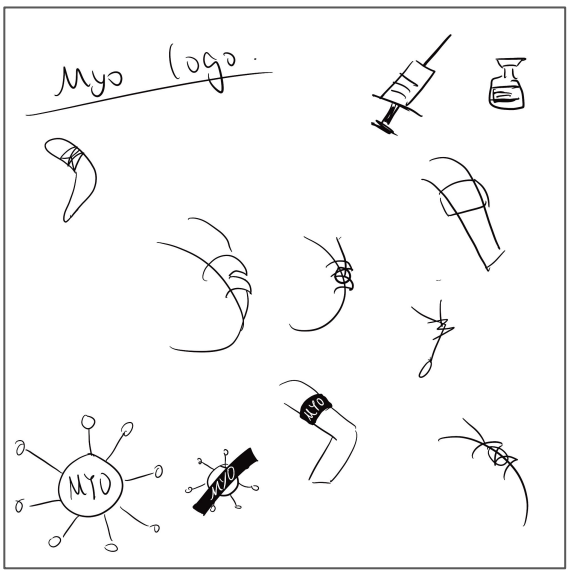


Fig.40 Initial logo idea

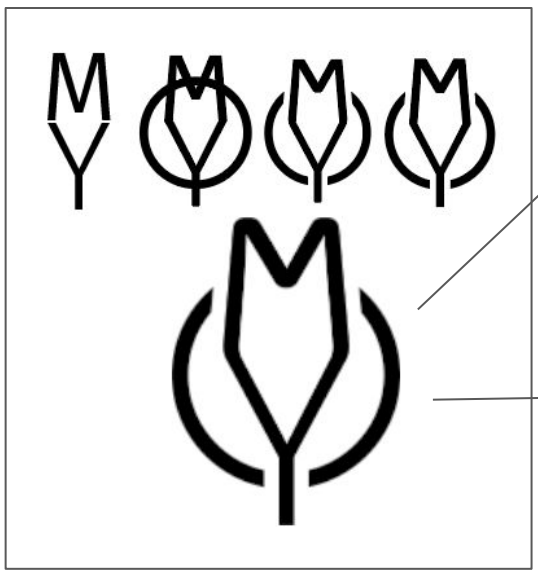


Fig.41 Logo development

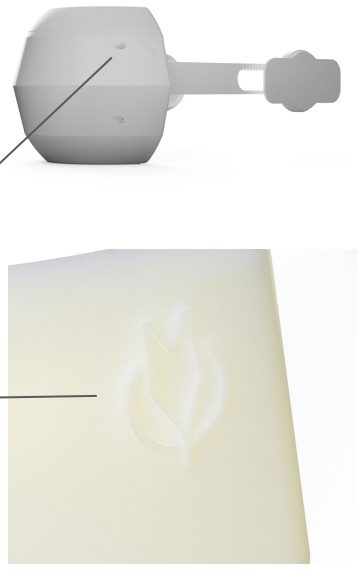
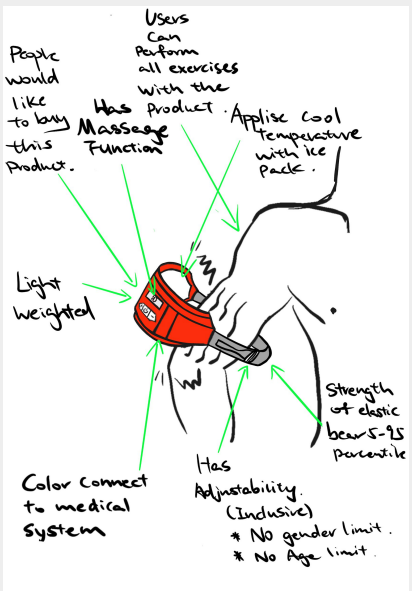


Fig.42 Logo on product in CAD

CRITERION B3 - JUSTIFICATION OF CHOSEN IDEA

Specification properties		Question for testing	Results			
			1	2	3	4
1. Aesthetics	1.1	Is the color of the product is connected to medical field?	N	M	N	N
	1.2	Branding - N/A	N/A			
2. Function	2.1	Can users do some exercises with this product? (tested by 4.5-4.9)	N	Y	Y	Y
	2.2	Can this product apply a cold temperature ice pack inside?	Y	Y	N	Y
	2.3	Can this product be adjusted into different size? (tested by 4.1)	N	M	M	N
	2.4	Can strength of the elastic bear 5-95 percentile (tested by 4.2)	Y	N	Y	N
3. Constraints	3.1	Can we adjust the strength of the elastic for different users?	N	Y	N	N
4. Size	4.1	Can it be adjusted to fit in different sizes of users? (very similar with 2.3)	N	N	M	Y
	4.2	Will it change shape or even break if different users uses it?	N	Y	N	Y
	4.3	Can a range of people use the components comfortability?	Y	N	Y	N
	4.5	flexion extension Movement 1 testing	N	N	Y	N
	4.6	Abduction-adduction movement 2 test	N	N	Y	N
	4.7	horizontal abduction-adduction movement 3 test	N	N	Y	Y
	4.8	external and internal rotation movement 4 test	N	Y	Y	N
	4.9	Flexion-extension movement 5 test	N	Y	Y	N
5. Quantity	5.1	Would users like to buy this product if this is in the market?	M	N	Y	N
6. Target audience	6.1	How many age of audience have I included?	Y	Y	Y	Y
	6.2	Can this be used by both women and men?	Y	N	Y	N
	6.3	This is for mostly HK people, can most chinese users fit in?	Y	N	M	Y
7. Material selection	7.1	Elasticity of product material	N	Y	N	N
	7.2	Comfortability of product material	6	2	0	N
	7.3	Light Weight of product material	686	279	278	-
	7.4	High thermal Resistance (Good insulation) of product material	Y	Y	Y	Y
8. Competitor	8.1	Combine function of cooling compression with stretching exercise	Y	Y	N	Y



JUSTIFICATION:

The third option is the one I ultimately decide to move forward with manufacturing because it has a distinctive design that hasn't been widely used in the market before. And it calls for the highest ranking possible in terms of the standard, such as combining chilling compression technology with massage function. Additionally, due to its small weight, it enables the user to do a range of stretching exercises. For the user who has pain at the injection site, it is difficult for them to lift their arm easily, and if the product is too complex, it is also difficult for them to apply and travel. This is why the from the testing it is expressing high hopes and a strong reputation. And this design's strong user reputation had demonstrated its viability as a potential development. For development, we would like the product's design to be smoother, with less sharp corners and soft, pliable material inside, as this will increase the product's comfortability. In addition, a soft, flexible material that could be adjusted for a variety of users may be produced for the strap.

MATERIALS SELECTION: 3D PRINTING MATERIAL FOR MASSAGE BODY

Desired properties: High hardness, mechanical resistance, elasticity, lightweight

I need the main body of the product to be plastic and the another fabric that can hold the ice pack. Need the plastic to have high hardness so it will prevent scratch and plastic deformation. It has to be low density as well to ensure comfort for the user, need to be electrical resistance so components such as batteries and motor can be placed inside. The 3D printer available in the workshop is Prusa. Material selected from the chart in (Fig.43).

High deflection temperature - the motor might cause the casing to heat up

High impact resistance

High tensile strength for the band to be adjustable for users arm

Relatively high cost

Fig.43 Chart of Prusa 3D print filament materials

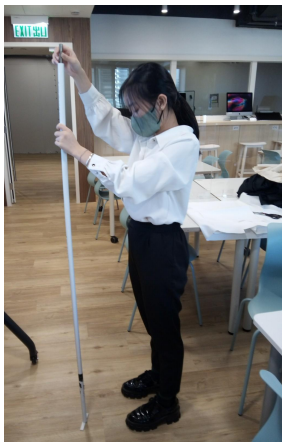


Fig.44.1, 44.2 Hardness testing

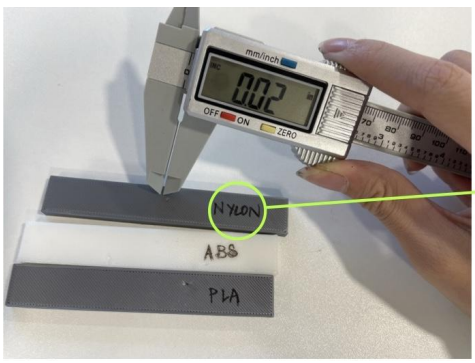


Fig.45 Measuring indentation of three 3D printed samples

HARDNESS TESTING

The chosen material is Nylon because the indentation is the smallest

MATERIALS SELECTION: FABRIC MATERIAL FOR ICE PACK POCKET

Desired fabric properties: Can be glued, Thin, high thermal resistance, soft, high density (tight knit structure), enough comfortability for the user.

Cotton: soft, cool, known as breathable fibers and absorbent, against abrasion wear and high temperature, but thick and heavy
Silk: lightweight, elasticity, Thermal regulation, fast dry
Satin: soft, lustrous surface on onside and duller surface on the other side, light weighted
Linen: feels cool, breathable, stronger and more lustrous than cottons, thermal regulation, great abrasion resistance, strength, absorbency, thin
Rayon: versible fiber comfortable, versatile, low-cost, soft, absorbent, thin
Chenille: fluffy, warm, velvety pile, lightweight, durable
Poplin: Smooth and even feel, Lightweight, Durable, Inexpensive, thin

After the experiment of thermal resistance and tensile strength the chosen material is **linen,** because it has the best thermal resistance out of the fabrics tested, it also acquires high density with a high tensile strength.

C1: JUSTIFIES THE MATERIAL AND COMPONENTS

(FIG.46) THERMAL RESISTANCE TEST:				
Fabric name	Ice initial temperature	Trial 1 (after 2)	Trial 2 (after 4)	Trial 3 (after 6)
Silk	-0.3	11.3	12.3	13.4
Cotton	-2.9	0.8	1.2	1.8
Linen	10.8	11.5	11.3	10.3
Polyester	9.4	10.6	11.3	12.0

Fig 47.1 Thermal resistance test

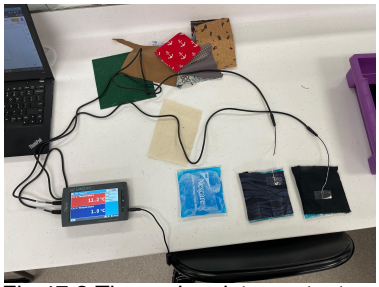
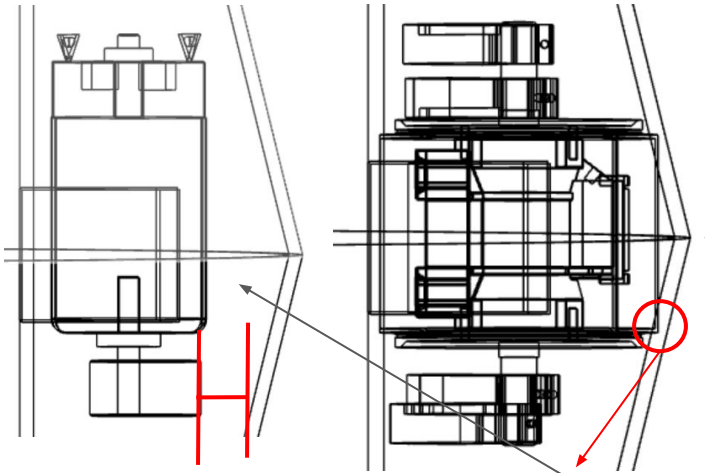


Fig 47.2 Thermal resistance test

VIRTUAL TESTING OF MOTOR SIZE:



Adequate space for the Tatoko N20 Motor

Case will touch double shaft motor

MOTOR COMPONENT CHOICE:

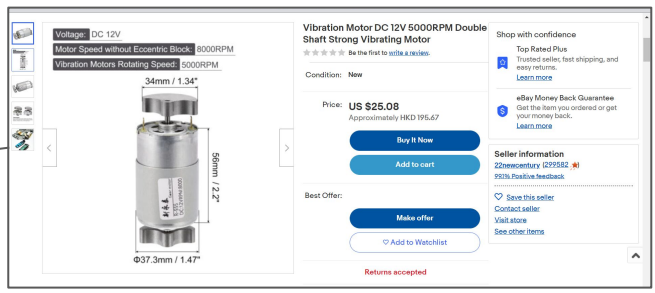


Fig.49.1 Vibration Motor DC 12V 5000RPM Double Shaft Strong Vibrating motor
https://www.ebay.com/itm/314001316006

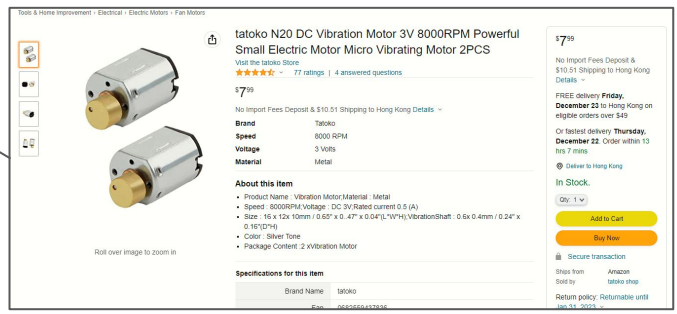


Fig.49.2 Tatoko N20 DC Vibration Motor 3V 8000RPM Powerful Small Electric Motor Micro Vibrating Motor
https://www.amazon.com/tatoko-Vibration-Powerful-Electric-Vibrating/dp/B07Q71F4L9

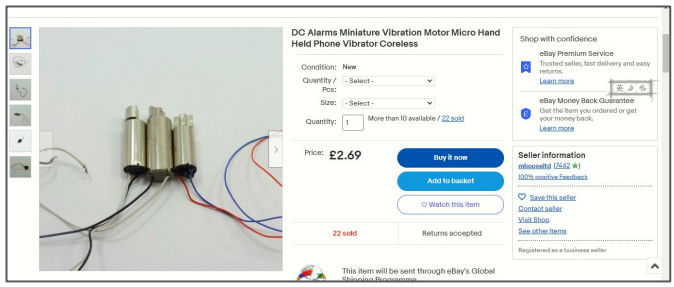
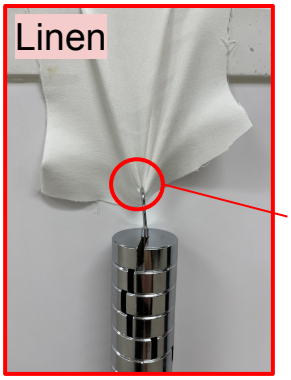


Fig.49.3 DC Alarms Miniature Vibration Motor Micro Hand Held Phone Vibrator Coreless
https://www.ebay.co.uk/itm/302791155173

TENSILE STRENGTH TEST:

Tensile strength test using the weight of 1kg to test fabrics tensile strength



Linen has the best tensile strength added comfort for the user

Fig.48.1, 48.2, 48.3 & 48.4 Materials that is tested by added weight

MASSAGE MOTOR MATERIAL INVESTIGATION:

After the investigation on the Massage motor, the chosen material is the Tatoko N20 DC Vibration Motor, it is because the size are the most feasible one to be put inside of the massage body, and the cheapest cost.

C1: JUSTIFIES THE MANUFACTURE TECHNIQUES

3D PRINTING TECHNIQUES

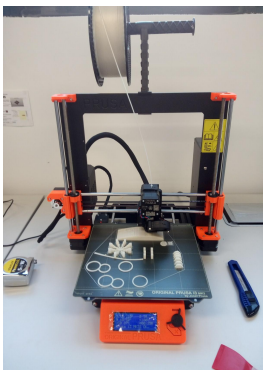


Fig.50.1, 50.2
Prusa i3,
Positives: High resistant print, support easy to remove and finish well, Nylon available.
Negatives: Slow print speed, expensive filament.

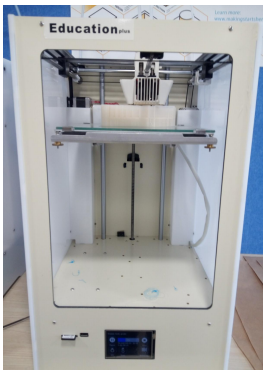


Fig.50.3, 50.4
Education Plus
Positives: Good quality with PLA, separate HIPS support material can be melted
Negatives: Slow speed, poor print result with nylon, high maintenance

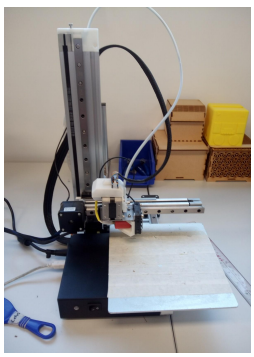


Fig.50.5, 50.6
Cetus 3DP
Positives: Good print quality, range of color, inexpensive filament
Negatives: Small print plate, support difficult to remove, cannot print Nylon.

The final choice is **Prusa i3** due to the reason of its High resistance where product can be used in a long period. Primarily it can be printed by the material chosen ;Nylon.

FABRIC POCKET - TYPES OF STITCHING

Fig.51.1 straight stitch is a Straight row of stitches that are close together

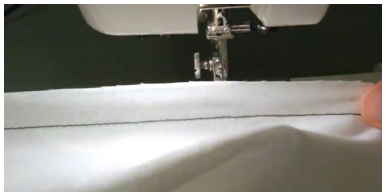


Fig.51.2 Zig zag stitch is an essential stitch when hemming stretchy or loosely woven fabrics.

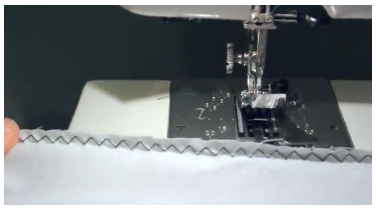


Fig.51.3 Overlock stitch finishes the edge of a piece of fabric while hemming it.

Fig.51.4 Basting stitch is a temporary stitch that's easy to remove just by pulling.

The chosen stitch type will be **Straight line stitch**, because ice pack are in straight lines, thus the pocket only require straight lines, the thickness in addition also need it to be strictly restricted in thin layer so it can fit inside the clip.

ICE PACKS - TYPES OF ICE PACK

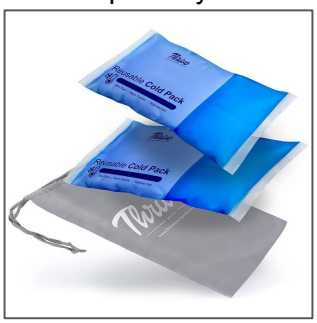


Fig.52.1 Reusable ice compress pack

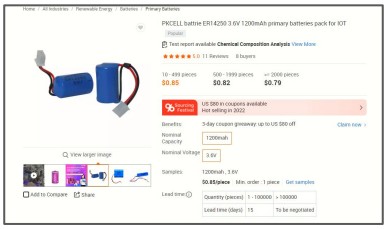
Fig.52.2 Hot and cold ice pack

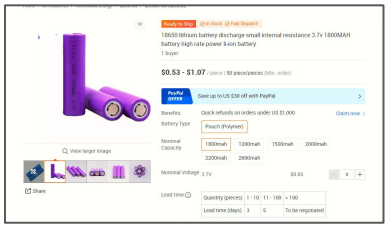
Fig.52.3 Instant cold pack

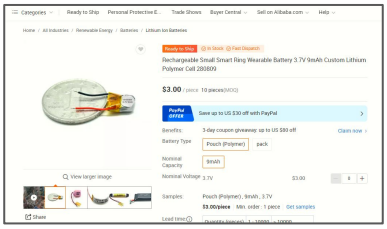
The chosen one is Reusable ice compress pack, it has to be controlled in the size smaller than the clip in terms to let it fit in. Chosen is because hot is not require inside of this design and I need the cold effect to be consistent, thus both second and third ice packs will not be suitable for this design.

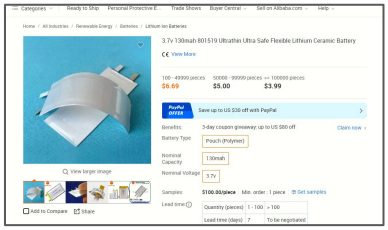
BATTERY - TYPES OF BATTERIES

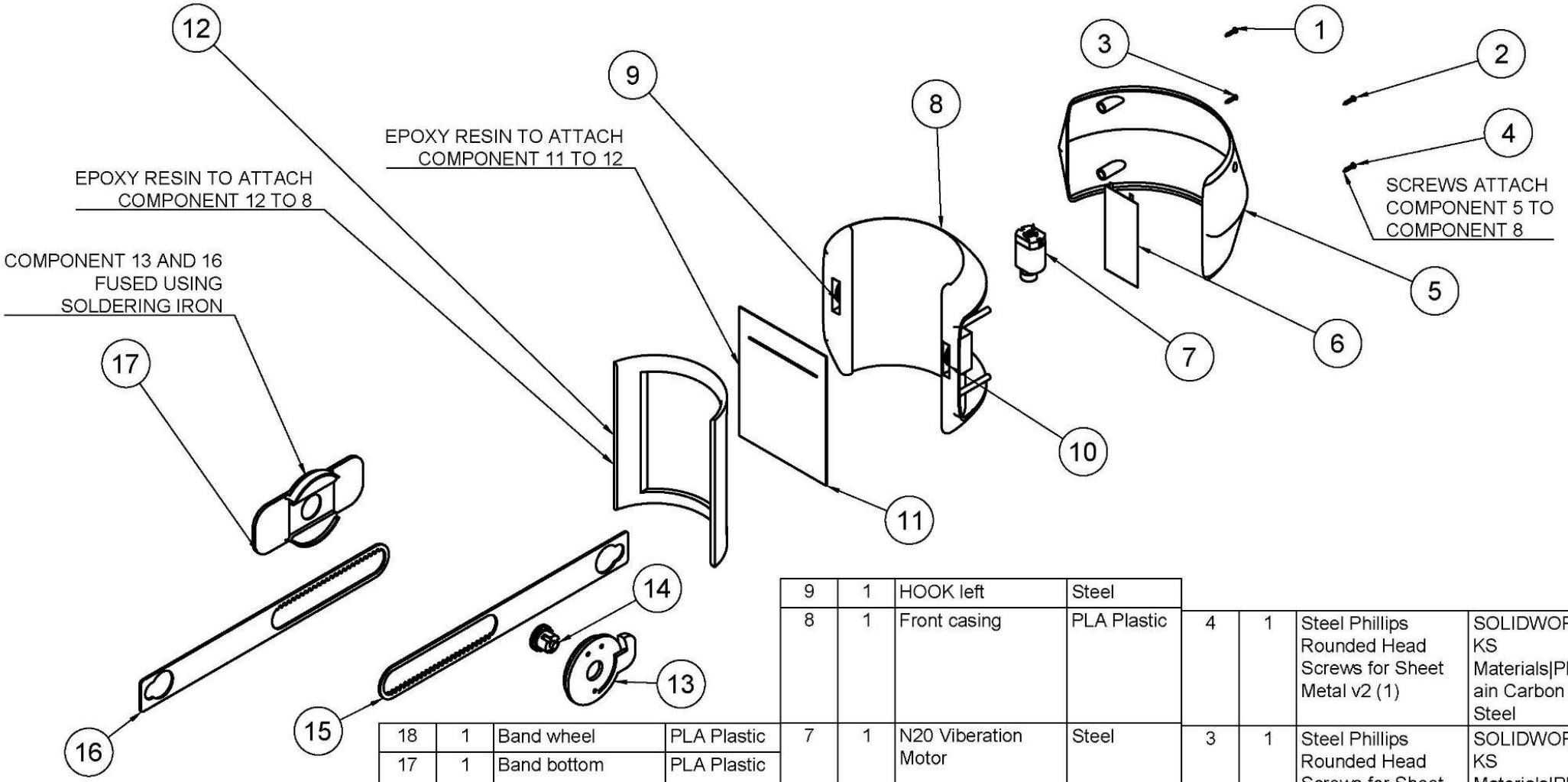
The chosen one is Flexible batteries (rechargable): 3.7v 130mah 801519 Ultrathin Ultra safe flexible Lithium ceramic battery, because the massage casing shaped in a curve way, thus flexible batteries will fit the most. (Fig.53.1 - 53.4)











Item	Qty	Part Number	Material
18	1	Band wheel	PLA Plastic
17	1	Band bottom	PLA Plastic
16	1	Band_left	PLA Plastic
15	1	Band_right	PLA Plastic
14	1	Band gear	PLA Plastic
13	1	Band middle	PLA Plastic
12	1	Clip	PLA Plastic
11	1	Fabric pocket	Linen, White
10	1	HOOK right	Steel

Parts List

Item	Qty	Part Number	Material
9	1	HOOK left	Steel
8	1	Front casing	PLA Plastic
7	1	N20 Viberation Motor	Steel
6	1	3.7v 130 mah 801519 Ultrethin Ultra safe flexible lithium ceramic battery	Steel
5	1	Back casing	PLA Plastic

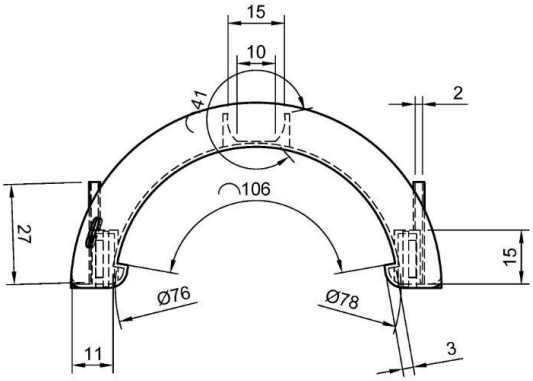
Parts List

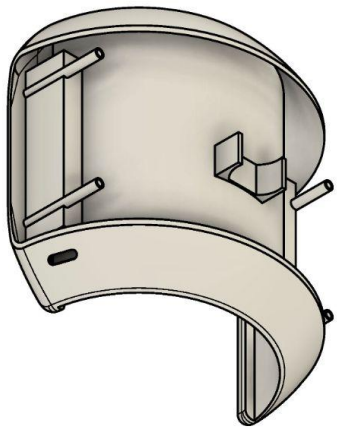
Item	Qty	Part Number	Material
4	1	Steel Phillips Rounded Head Screws for Sheet Metal v2 (1)	SOLIDWORKS Materials|Plain Carbon Steel
3	1	Steel Phillips Rounded Head Screws for Sheet Metal v2 (2)	SOLIDWORKS Materials|Plain Carbon Steel
2	1	Steel Phillips Rounded Head Screws for Sheet Metal v2	SOLIDWORKS Materials|Plain Carbon Steel
1	1	Steel Phillips Rounded Head Screws for Sheet Metal v2 (3)	SOLIDWORKS Materials|Plain Carbon Steel

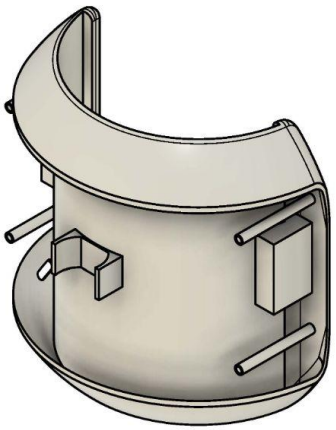
Parts List

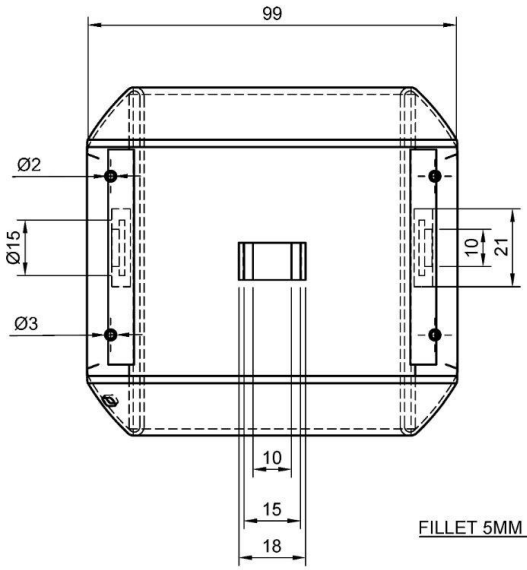
C2: DEVELOPS AN ACCURATE DESIGN PROPOSAL IN DETAIL FOR MANUFACTURE

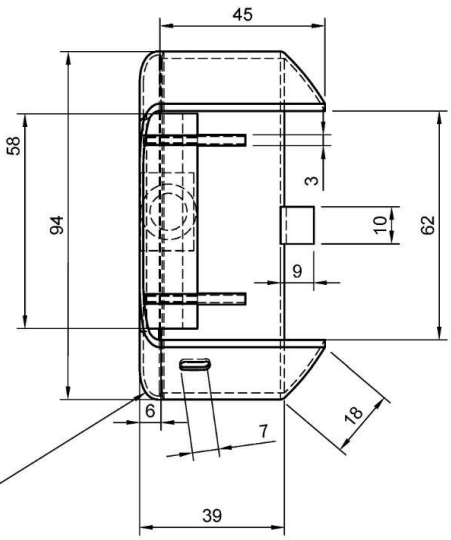
PART 8: FRONT CASING



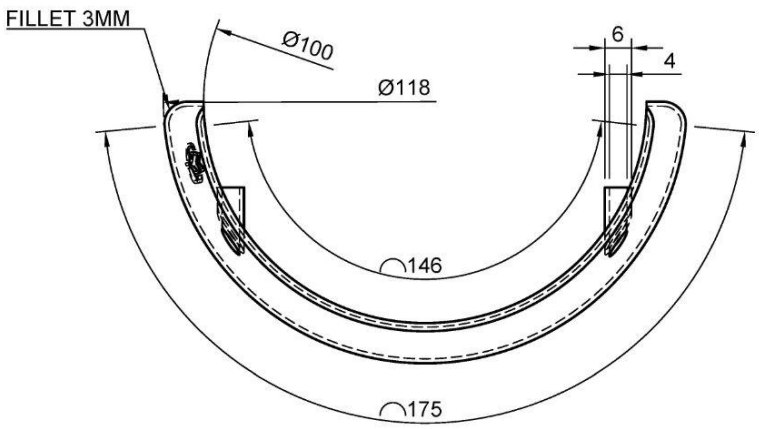


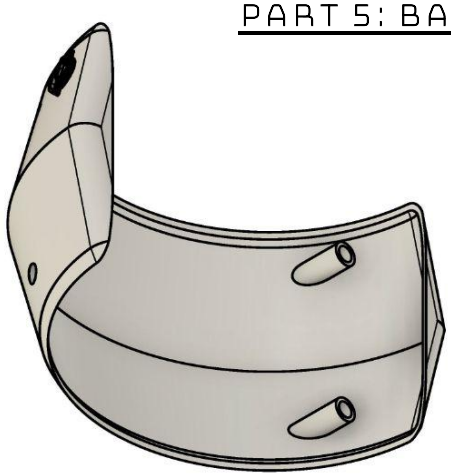


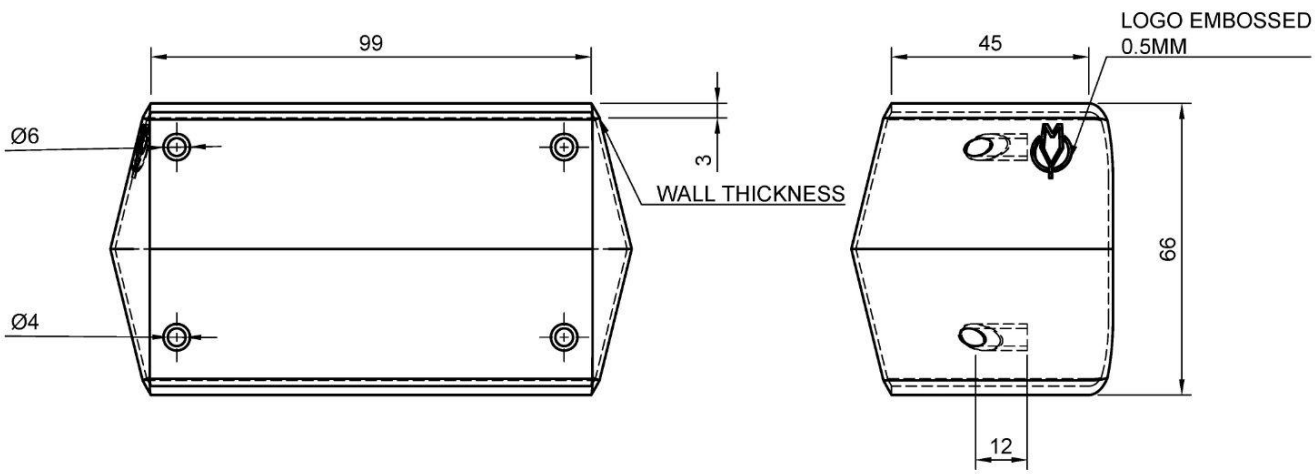




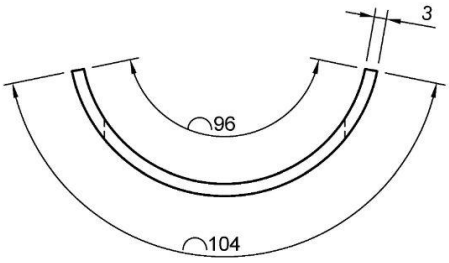
PART 5: BACK CASING

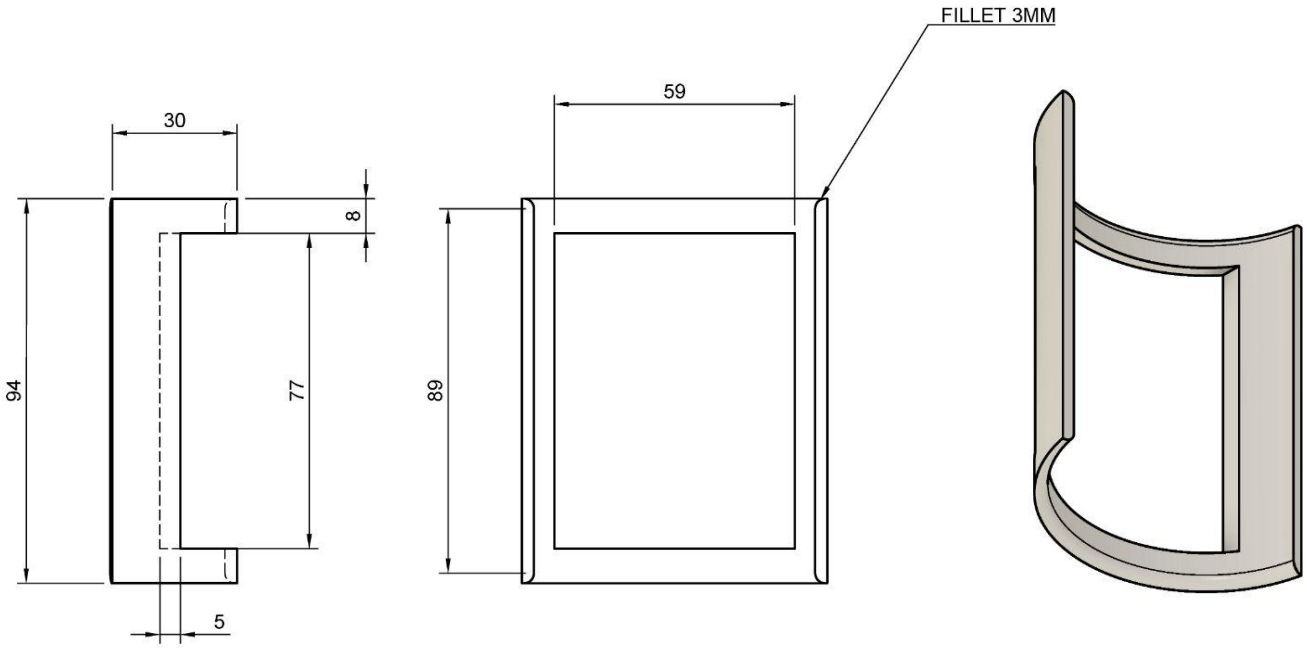




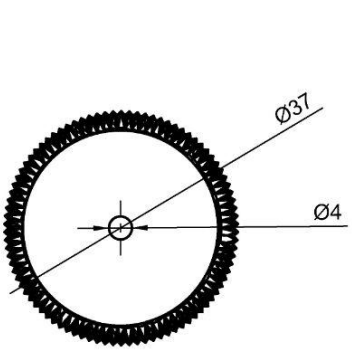


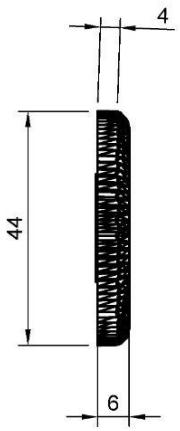
PART 12: CLIP

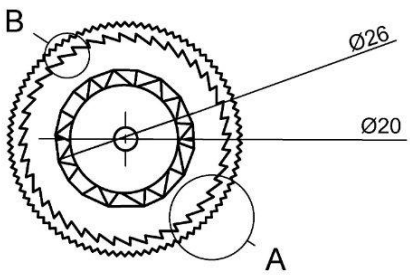


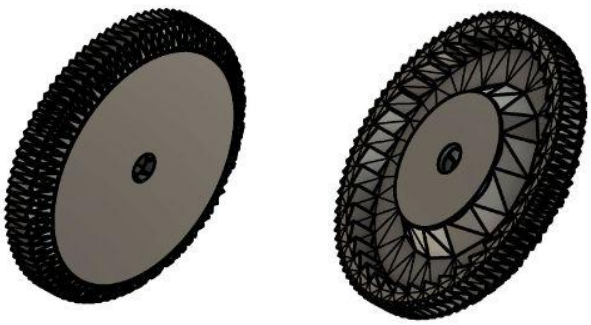


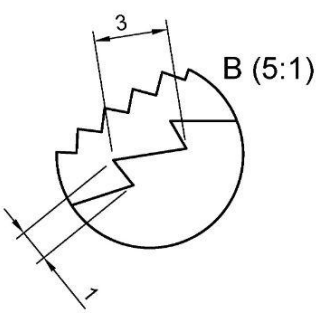
BAND ISOMETRIC PART 6: WHEEL

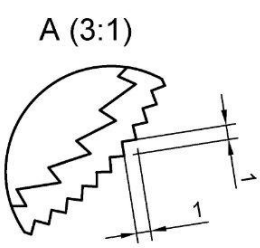




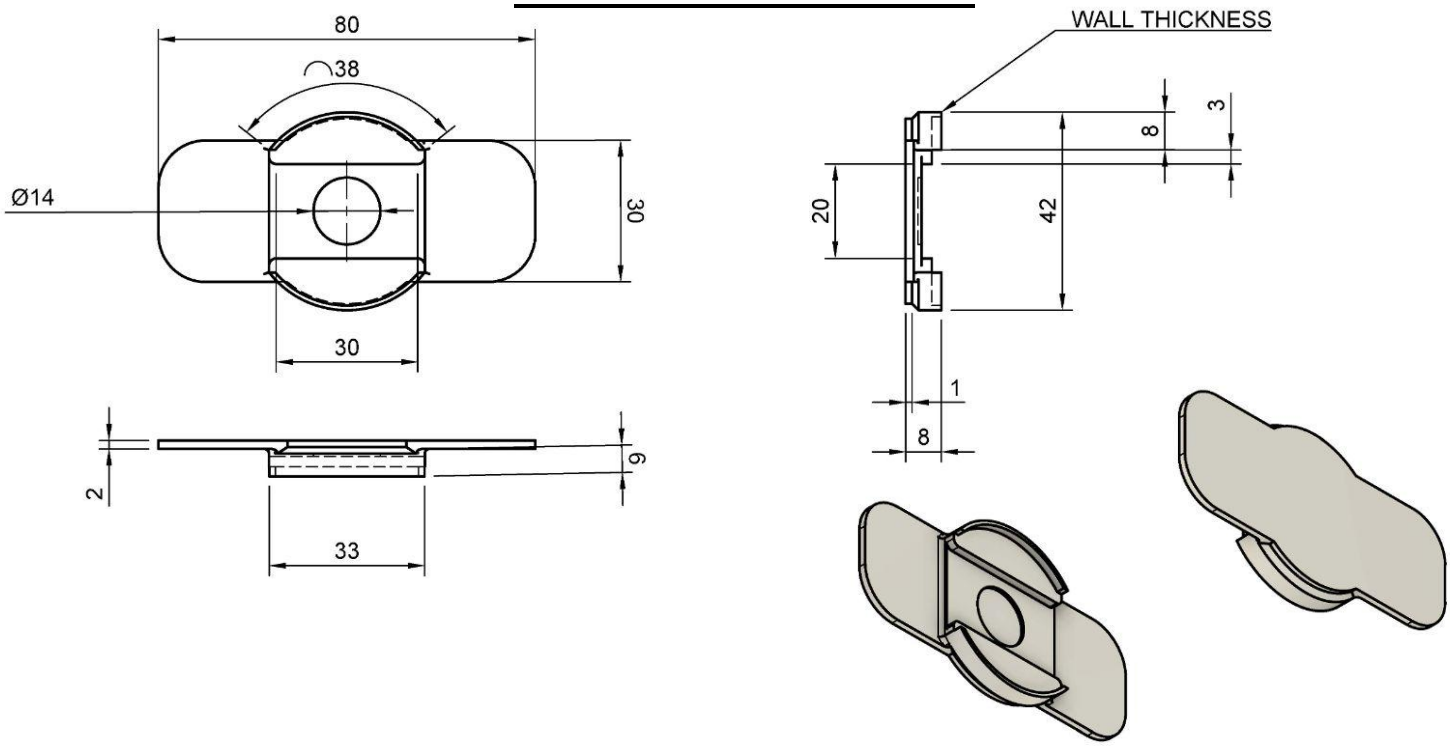




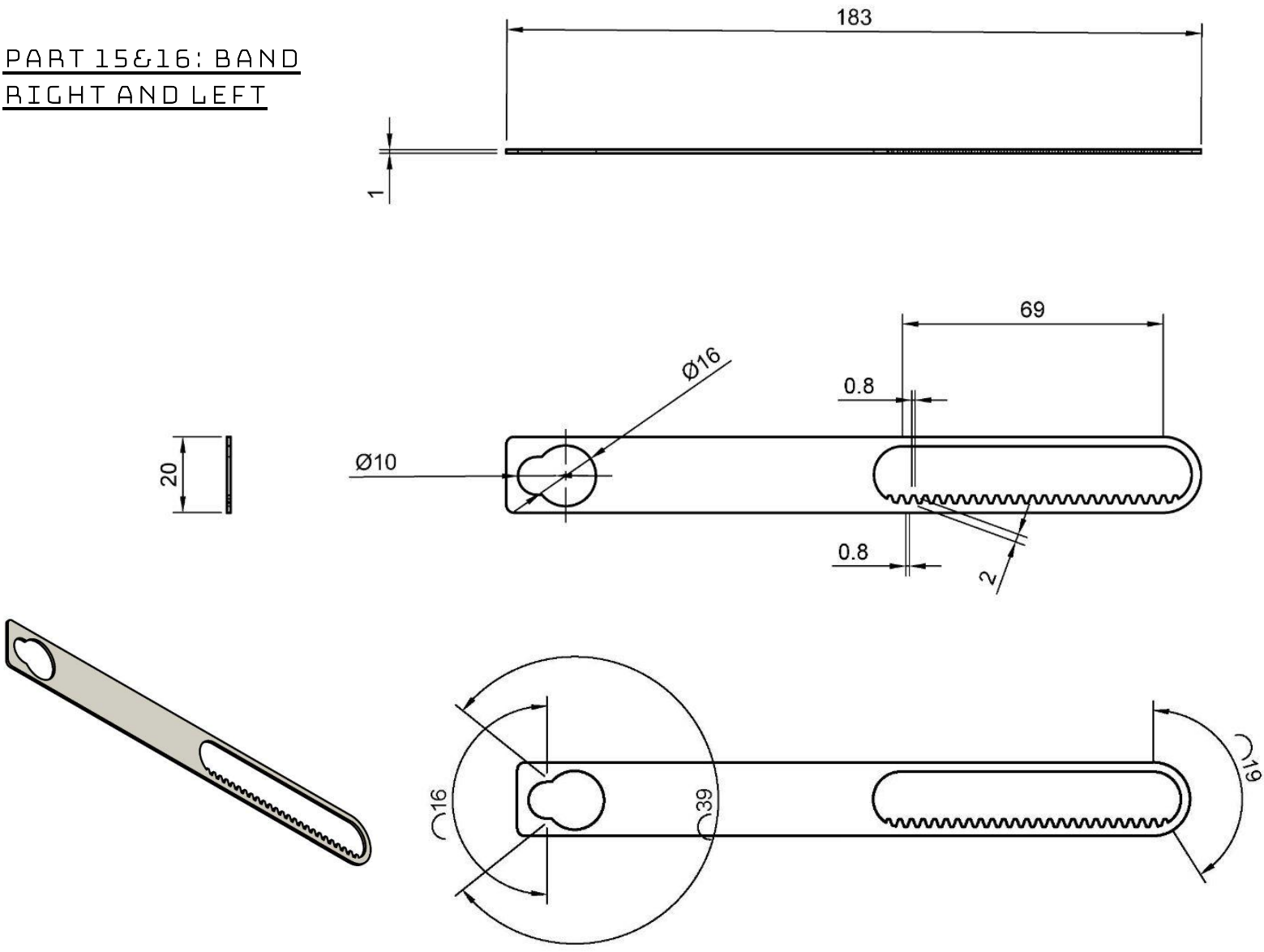




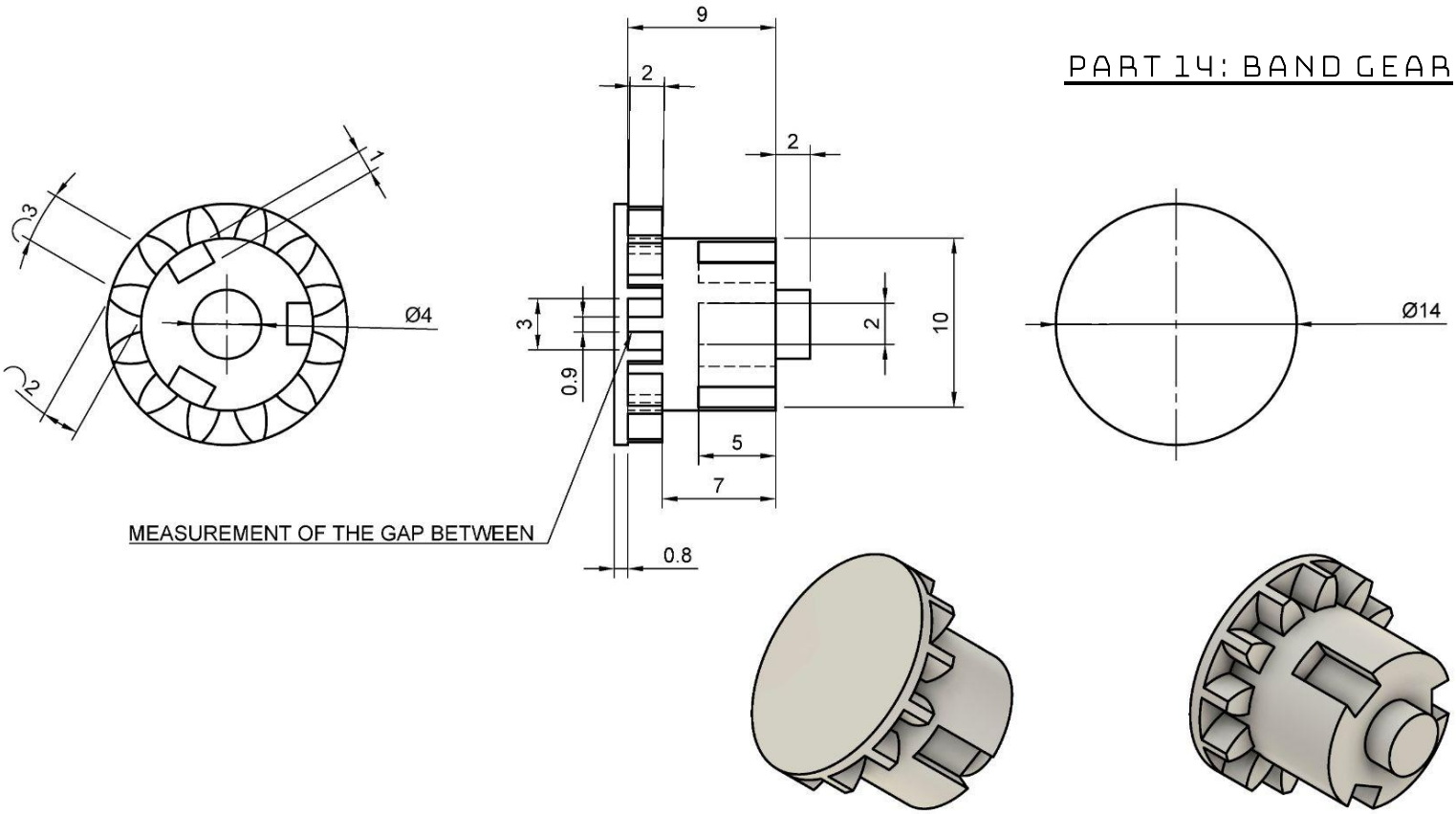
PART 17: BAND BOTTOM



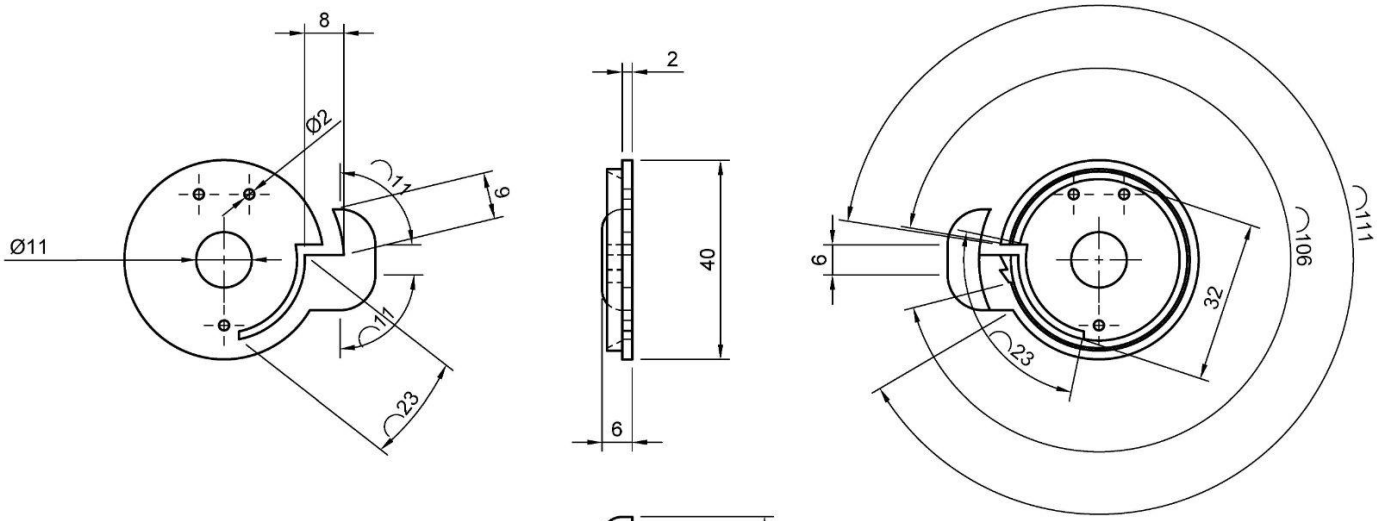
PART 15&16: BAND RIGHT AND LEFT

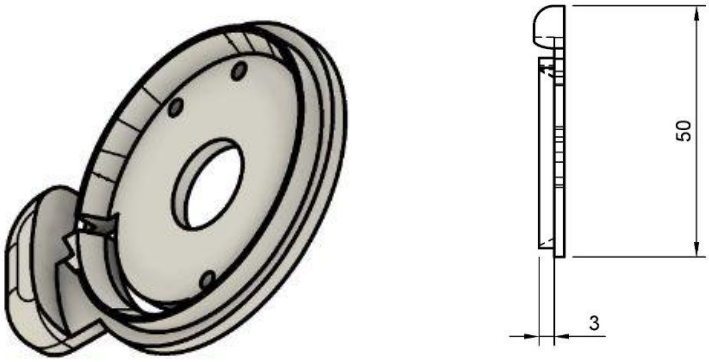


PART 14: BAND GEAR

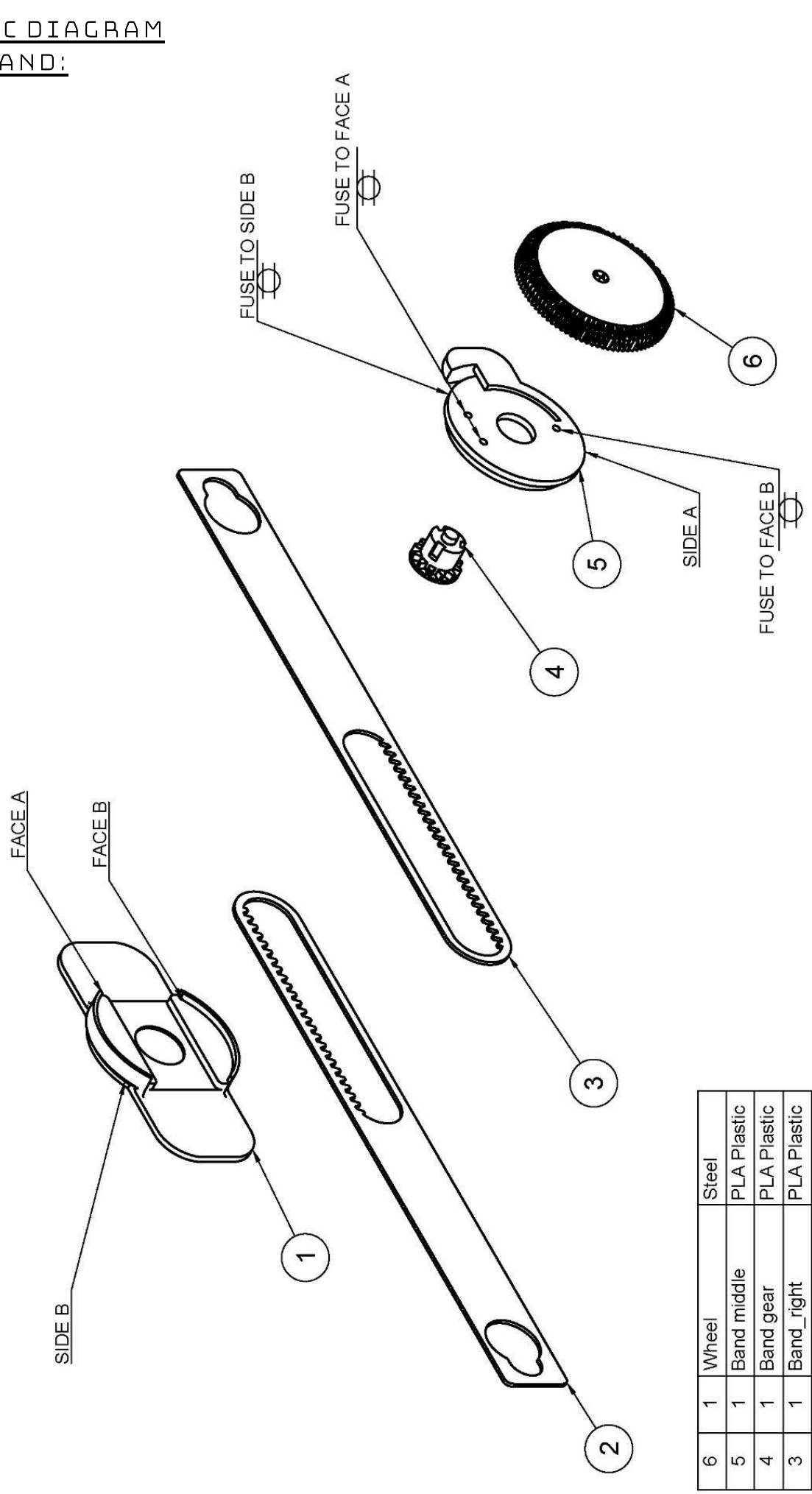


PART 13: BAND MIDDLE





ISOMETRIC DIAGRAM FOR THE BAND:



Item	Qty	Part Number	Material
6	1	Wheel	Steel
5	1	Band middle	PLA Plastic
4	1	Band gear	PLA Plastic
3	1	Band_right	PLA Plastic
2	1	Band_left	PLA Plastic
1	1	Band bottom	PLA Plastic

Parts List

C2 BILL OF MATERIALS

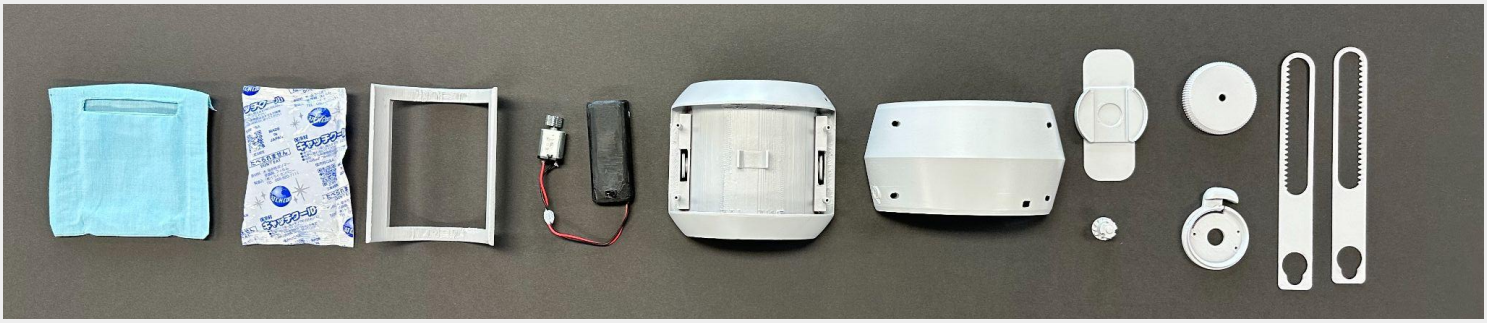


Fig.54 assembled components and test printse

Components	QTY	Cost
Front Casing	1	$ 2.69
N20 Vibration Motor	1	$ 7.99
Battery	1	$ 6.69
Back casing	1	$ 0.65
Clip	1	$ 0.77
Fabric pocket	1	$ 0.13
Band	1	$ 0.75
Screws	4	$ 0.92
Total cost one unit	$ 20.6	

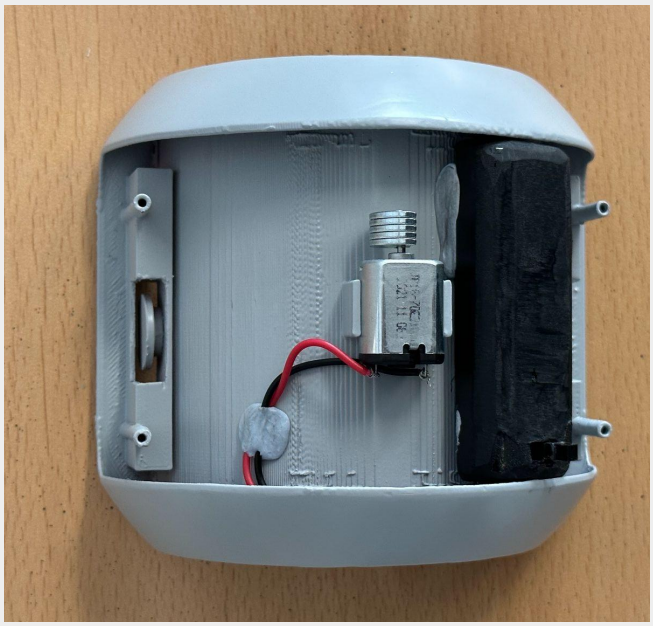


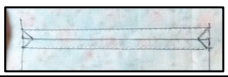
Fig.55 initial testing components in the prototype

C3 PRODUCES A DETAILED PLAN FOR THE MANUFACTURE OF THE PROTOTYPE

Part	Processes	Equipment	Scheduling	Quality control	Risk assessment
Front Casing	Draw the shape on Fusion	Fusion	1h		No risk
	Download as STL and send it to the computer that connects to 3D printer	Fusion	10 secs	Check if it is STL and if product you selected is correct and complete	No risk
	Open PrusaSlincer software: 1. Import the STL of the front casing	PrusaSlincer software	3 mins	Check stl against original solidmodel	No risk
	2. Select material PLA 3. Rotate x-axis into 90 degree 4. Setting select 0.1mm	PrusaSlincer software	1 min	try different orientations to minimise support. Extrude some filament first to check the colour and flow.	No risk
	5. Filament Select Prusament PLA load 6. Select support everywhere 7. Infill select 20%	PrusaSlincer software	1 min	Test extruse to check flow	No risk
	8. Press slice Now 9. Export the G-code	PrusaSlincer software	0.5 min	Check G-code for errors	No risk

C3 PRODUCES A DETAILED PLAN FOR THE MANUFACTURE OF THE PROTOTYPE

Part	Processes	Equipment	Scheduling	Quality control	Risk assessment
Front Casing (cont)	Open G-code software: 1. Import the G-code that had downloaded 2. Ensure print speed 100 and print flow 100 3. Open the 3D printer and Connects to the printer 4. Load PLA filament 5. Click print	G-code software , 3D printer	2 mins	Lay first layer to check bed level and print equality	Be careful of the 3D printer, don't touch with your hands and click start after you checked the printer
	3D printing starts	3D printer	5 mins	Check the distance between the printer nozzle and the bed by check the first layer it prints and adjust the Z axis of the bed	Be careful around the printer, hands away, the heat might burn your hand
	Remove the supported materials	Hand , pliers	5 mins	Finger check for roughness remain support	Wear gloves and goggles
	Abrade all the surface into smooth surface	Sand paper	20 mins	Check for smooth finish with finger	Wear gloves and goggles and mask
Back casing	As above				
Clip	As above				
Fabric Pocket	Select the Linen fabric	Linen Fabric	3 mins	Check if the fabric has the same quality as the one we tested	No risk
	Measure the length and width of inside curve face of the front casing	Use Fusion/ Paper with rule	30 secs	Check to see if the lines are straight, if the angle is 90 degree because if not it will not be sew well together	No risk
	Draw the measurement onto fabric - With adding on 10 mm onto the measurement for all sides - Double the length into a long piece to make into a main fabric	Fabric Chalk, ruler	5 mins	Check lines and angle, also see if it can fit between clip and front casing	No risk

Part	Processes	Equipment	Scheduling	Quality control	Risk assessment
Fabric Pocket (cont)	Draw a opening that can fit in the ice pack on the upper middle part of main fabric	Fabric Chalk, ruler	3 mins	Check lines and angle, also see if the ice pack can fit in or not	No risk
	Draw a small piece of rectangle with double the measurement of the opening	Fabric Chalk, ruler	5 mins	Check lines and angle with ruler	No risk
	Cut all the sewing patterns that is draw on the fabric 	Scissor	2 mins	Check no pen outline remains and check against rler	Be careful with the scissor, underage please use with adult
	Sew the small piece of rectangle with the main fabric follow by the pattern draw on the opening	Sewing machine	2 mins	Check lines and angle with set square	Be care the needle inside sewing machine, do not pull very hard on the thread it might rip the needle and get hurt
	Cut a opening with one line and four angle [>——<]	Fabric scissor	1 mins	Check lines and angle against pattern	Be careful with the scissor, underage please use with adult
	Sew again around the opening in the distance of 5 mm	Sewing machine	3 mins	Check to see if the lines are straight and space are leaved out correctly	Be care the needle inside sewing machine
	Use the scissor to cut off the extra fabric small piece of rectangle has	Scissor	2 mins	Eyes check if any remaining fabric	Be careful with the scissor, underage please use with adult
	Fold the main fabric and let the side that does not have the extra fabric to be inside the fold	/	10 secs	Check if the fabric are well matched together with all edge line up straight together	No risk
	Sew around the main fabric around the side without the bottom side, leave out 8mm space on the edge	Sewing machine	5 mins	Check to see if the lines are straight and space are leaved out correctly	Be care the needle inside sewing machine

D1 JUSTIFIES A TESTING STRATEGY TO MEASURE THE SUCCESS OF THE PROTOTYPE

		Testing method and justification	Type of data	Data collection
1. Aesthetics	1.1	1. Expert appraisal, Nurse as an expert will give feedback on medical color. 2. Comparison to similar product	Qualitative	Interview questions, Is the color suggest medical? Spoken interview or questionnaire.
	1.2	1. Expert appraisal, Nurse as an expert will give feedback on medical branding. 2. Comparison to similar product	Qualitative	What emotional reaction do you feel when you see the logo?
2. Function	2.1	Users trial, tested by asking users to process the exercise with utilizing the product.	Quantitative	Haven't meet this specification point
	2.2	Performance testing, use the digital thermometer to test how much coolness it contains.	Quantitative	Measure with the thermometer to see whether it is below than the ideal cooling temperature 13.6 degree.
	2.3	Users trial, test if 5th to 95th percentile using observation and survey to see if they could fit in the size.	Quantitative	Collect data result or create a survey: Does it fit? Yes / No
	2.4	No test	-	Product did not incorporate elastic.
	2.5	Users trial, collect ordinal scale data to let the users to give feedback on how much they feel comfortable with the vibration	Quantitative	Test 5-95th percentiles of both gender Hong Kong chinese using ordinal scale, how comfortable was it scale 1-5.
3. Product constraints	3.1	No test	-	The product do not support for this test
4. Size		**Static Data**		
	4.1	User trial, testing adjustability.	Quantitative	Ask the user to adjust the product to ensure a tight fit and respond on the questionnaire.
	4.2	Users trial, tested by asking users to process the exercise with utilizing the product.	Quantitative	Ask the user to conduct exercise and respond on the questionnaire.
	4.3			
		Dynamic Data		
	4.5	Users trial, tested by asking users to process the exercise with utilizing the product.	Quantitative	Ask the user to conduct exercise and respond on the questionnaire.
	4.6	Users trial, tested by asking users to process the exercise with utilizing the product.	Quantitative	Ask the user to conduct exercise and respond on the questionnaire.
	4.7			
	4.8			
	4.9			
5. Quantity	5.1	User questionnaire	Quantitative	Ask the user: where would you use this product if available? Home, clinic, hospital, vaccination centre, none.
6. Target audience	6.1	Observation, observe how product is used by users in different age groups	Observation	Collecting the qualitative data from users in various age groups, see the suitability and usability of product on user's body.
	6.2			
	6.3			
7. Material selection	7.1	Resistance band was not integrated in the final product		No test
	7.2			

7. Material selection	7.2.1	Users trial, collect ordinal scale data to let the users to give feedback on how much they feel comfortable with the material	Qualitative	Test 5-95th percentiles of both gender Hong Kong chinese using ordinal scale, how comfortable was it scale 1-5.
	7.3	Thermal Insulation test	-Quantitative	Test the fabric component with the ice pack at 5, 10 and 15 minutes to judge the thermal loss.
	7.4			
	7.4.1	Users trial, collect ordinal scale data to let the users to give feedback on how much they feel comfortable with the cooling function	Qualitative	Test 5-95th percentiles of both gender Hong Kong chinese using ordinal scale, how comfortable was it scale 1-5.
8. Competitors (USP)	8.1	Performance test, test if the level vibration could reach the aim of massage and cooling function aim the purpose of pain relief	Quantitative	Biomechanic test on users relief after cooling and massage, asking feedback from the user Test 5-95th percentiles of both gender Hong Kong chinese using ordinal scale.

D2: EXPERT APPRAISAL:

Fig.56.1 Me interviewing medical expert

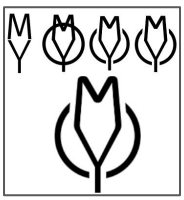


Fig.56.2 My brand

Fig.56.4 Injection site should be three finger away from the shoulder

Fig.56.3 The example medical brands (all pattern show the function directly or connects to cross signature of medicine.)

By interviewing an medical expert, I have listed the questions below for her to comment on my product to make further improvement.

1. When you see the color of this product would you think it is for medical use? (1.1)

The color of grey do connects to medicine, however adding White and red might gives a stronger vision.

2. When you see the brand, do you consider it is a medical product and what make you feel when you see this branding? (1.2)

Branding looks nice, if it can adds on more obvious elements with medicine such as pattern above, I noticed that your idea was to create a pattern like a syringe, you may consider to make it even more obvious.

3. Will doing exercise help to reduce the injection site pain? (2.1)

Vibration already helps, the best action to do after receiving the vaccine is to get a large amount of rest, massage and cooling will definitely help and will be enough for the patients to relief their pain while they are resting their arms, the injection-site pain do not need any extra exercise to help to reduce the pain.

4. Is these exercises logical to do while you are massaged by the product? (4.2 - 4.9)

The exercises are logical, however this product does not need extra exercise to support anymore, the patients should receive enough treatment by using this product.

5. What can I do to improve the product to further help the people with injection site pain?

Both function are great and the design of the product could allow people to use it while doing other activities, I would use this product if I could. However, the the injection-site should be three fingers away from your shoulder, which means your product should be placed even higher, as well as the size, it needs to be bigger to fit in a larger size male adult. With the ice pack, it needs to be at least 3 in a pack in terms to be enough for the user the refill. (4.1)

Fig.57 Thermal resistance test using digital thermometer

THERMAL RESISTANCE TEST (2.2, 7.4.1, 8.1)				
Minutes	Initial temperature	5	10	15
Temperature	14.0	16.3	17.1	18.5

Although the initial temperature was not the ideal temperature I am looking for, but the temperature lost is very minoral throughout the entire testing process. Thus, the fabric of linen and the product has well thermal resistance property and can provide users a long period of cooling treatment. (2.2)

(2.3) Fitness Test:

It squeezes the Users arm, and hurt their skin.

USER TRIAL NO.1 (6.1 - 6.3)
PROFILE: 50th percentile
AGE: 50
GENDER: FEMALE
ETHNICITY: CHINESE
ARM CIRCUMFERENCE: 30CM

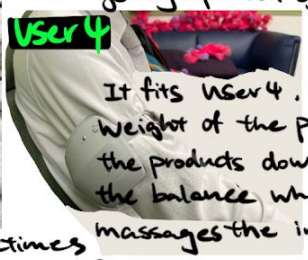
Too small for the User No.1.

Need fabric to cover the skin to prevent the skin from getting squeezed by the product.

No space for No.2 User

USER TRIAL NO.2
PROFILE: 50th percentile
AGE: 17
GENDER: FEMALE
ETHNICITY: CHINESE
ARM CIRCUMFERENCE: 29CM

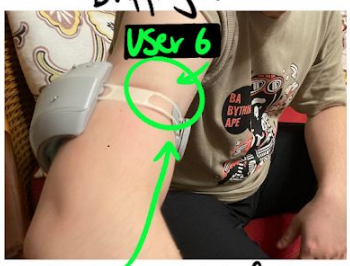
Dripping down sometimes



It fits User 4. However the weight of the product drags the products down and loses the balance where it doesn't massages the injection site anymore.

USER TRIAL NO.3
PROFILE: 50th percentile
AGE: 17
GENDER: MALE
ETHNICITY: HK CHINESE
ARM CIRCUMFERENCE: 28CM

It is too close to the User's body, especially when the user is too skinny



It is too tight for our 95th percentile.

There are still space left for my 5th Percentile.

USER TRIAL NO.4
PROFILE: 50th percentile
AGE: 17
GENDER: MALE
ETHNICITY: HK CHINESE
ARM CIRCUMFERENCE: 29CM

USER TRIAL NO.5
PROFILE: 50th percentile
AGE: 38
GENDER: MALE
ETHNICITY: HK CHINESE
ARM CIRCUMFERENCE: 29CM

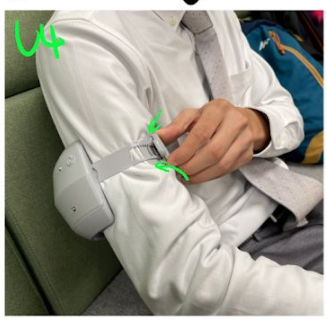
USER TRIAL NO.6
PROFILE: 95th percentile
AGE: 26
GENDER: MALE
ETHNICITY: CHINESE
ARM CIRCUMFERENCE: 35CM

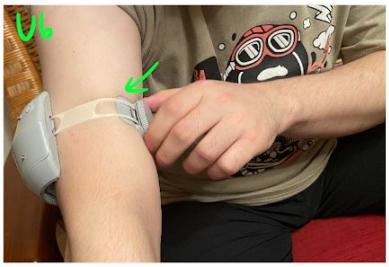
USER TRIAL NO.7
PROFILE: 5th percentile
AGE: 13
GENDER: FEMALE
ETHNICITY: HK CHINESE
ARM CIRCUMFERENCE: 20CM

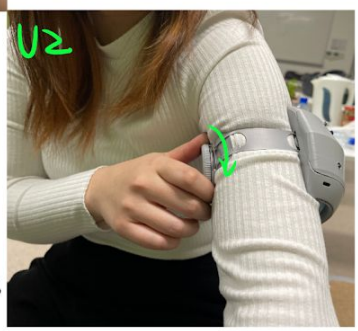
(4.1) Adjustability Test:

It was broken during testing by my No.6 User, proven the Inefficiency of the Adjustability of the product.

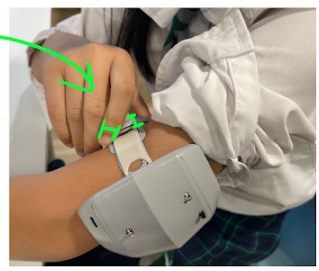
Need my assist to adjust the product. Which means the Product is too heavy for the <50th percentile to adjust by themselves



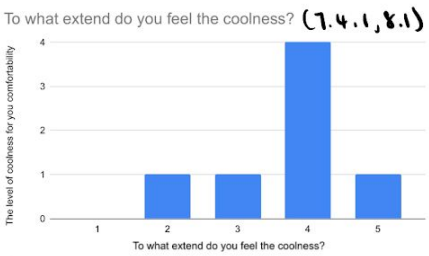




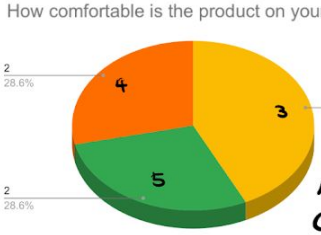
U1, U2, U4, & U6 Users Adjusted succefully by themselves



The width of the wheel fits my 5th percentile user's finger.

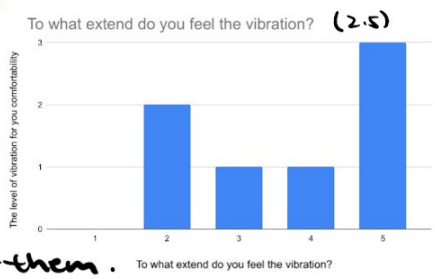


Most users feel the Coolness of level 4. Majority of the user Prefer to use the product in Vaccine Centre.



Most users considering "3" as their comfortable level.

(Scale 1-5, 1 = Non-comfortable, 5 = very comfortable)

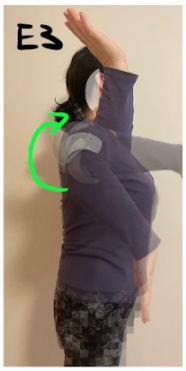


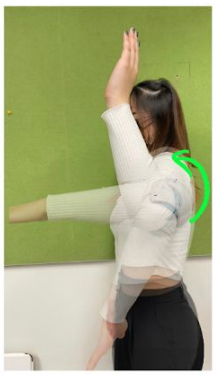
Most users considering the vibration is enough for them.

Exercise Performance Test : (2.1) (4.2 ↓ 4.9)

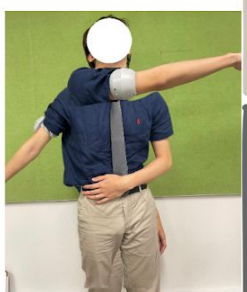
All users successfully did the exercise with the product.
However, for user NO.3 product had obviously slide down during the exercise.

The product doesn't stop the user from doing the exercise. However, it didn't help either.

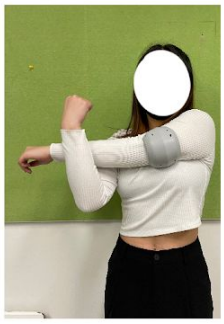




Product stays on users arm very well by doing this exercise. However it slides rotationally instead of vertically.



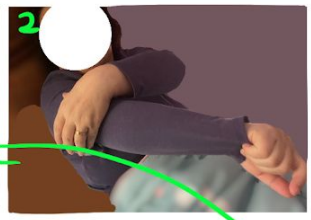
Exercise has been successfully processed by the users.



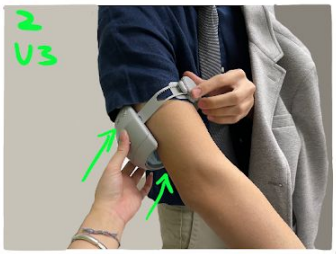
All users successfully processed movement Exercise No.5. Despite the product doesn't make an instruction.

For user NO.1 it might be a bit too tight for them to use.

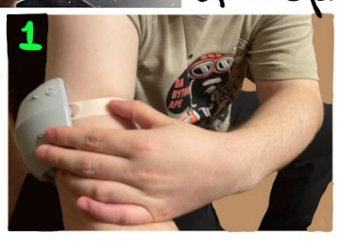
Usability Test : (6.1 – 6.3)



Compare all users, majority of the user are more used to grip the band to put on the product instead of the main body. However, U3 & U5 users then needed extra help to hold the main body proven the heavy weight and imbalance weakness of the product.



The band was losen while the user trying to took it off it shows the lack of elasticity of the band.



D3 PROTOTYPE IMPROVEMENTS

SUMMARY OF IMPROVEMENTS:

After the variety of testing I finalize the weaknesses of my product, here are the five areas that I received from my testing.

Band - the band of the product is very difficult to use through user trial, the hook was difficult for the band to lock in, as well as wheel, it is tough to use by the user with one hand, especially for the users who are using the product for the first time. Thus, I thought back to the idea of blood pressure machine, where I used velcro for testing, it will be easier for a variety of users to adjust.

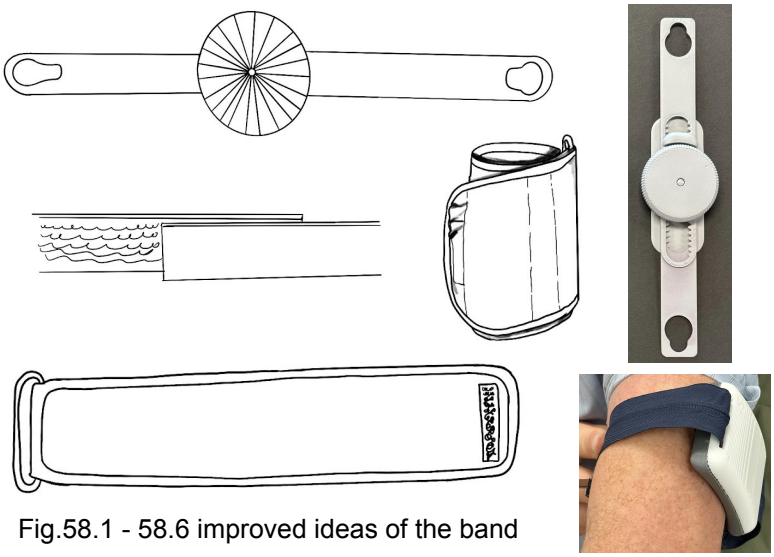


Fig.58.1 - 58.6 improved ideas of the band

Weight - The weight of the product is another problem I found out after user trial testing, the main body of product is much heavier than the band, it will cause the product to slide down while the users is making movement, users also feels more pressure on their arm with the product which is tried for them to carried around. In terms to reduce the weight of the product, I thought about dematerialise of the main body with only fit the components.

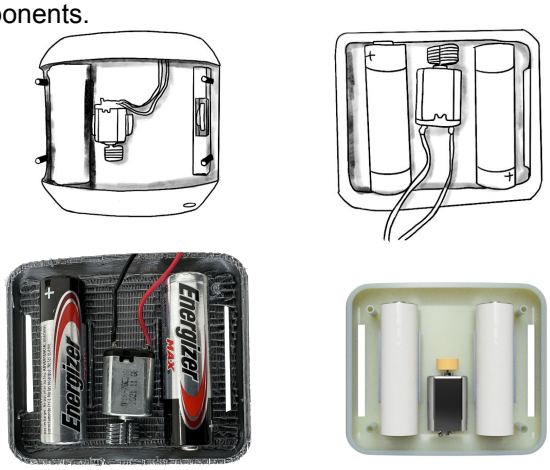
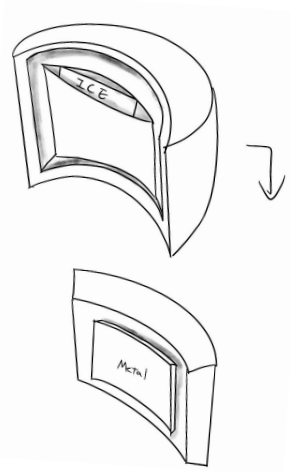


Fig.59.1 - 59.4 dematerialization of the components

Cooling system - Another consideration of reducing the size will be improving the cooling components, additionally according to the expert interview, the ice pack will need to be commercialized in a pack, this is because it needs to exchanged. Thus, instead of ice pack that needs fabric to hold, I can change it to stainless steel (ferrous metal which has good thermal insulate material) that can cool by freezer and connect to the product using magnet, additionally towards the setting of the product, it can be easy sterilisation in medical environments for this component as it can be easily removed.



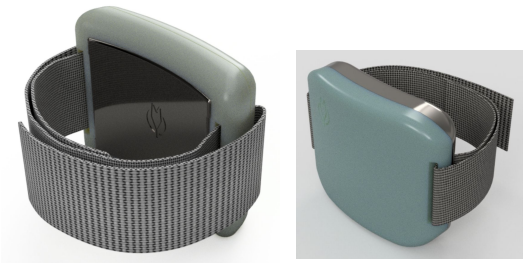


Fig.61.1 - 61.4 improved cooling system design

Curve - Curve as another problem explored by user trials and expert interview, it is hurting my 50+th percentile skin, this will be even worse for my 95th percentile, thus in terms to fit in more users, the design can be develop into a flatter shape to increase the inclusiveness.

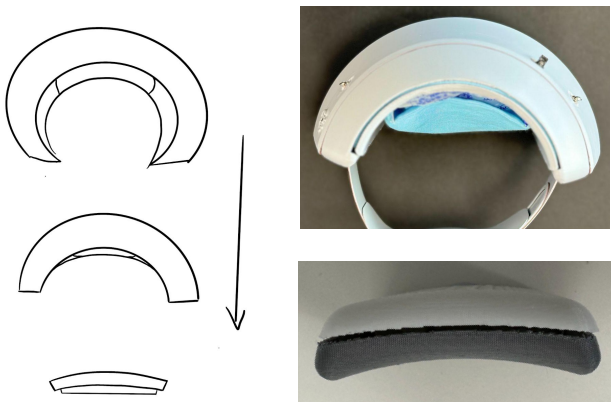


Fig.60.1 - 60.3 improved curveness

Colours/branding

- After expert interview, I acknowledge the signature of medical products, the color was not as significant as the branding, instead of symbolized patterns, the more identical and meaningful pattern will more likely to be a medical brand.

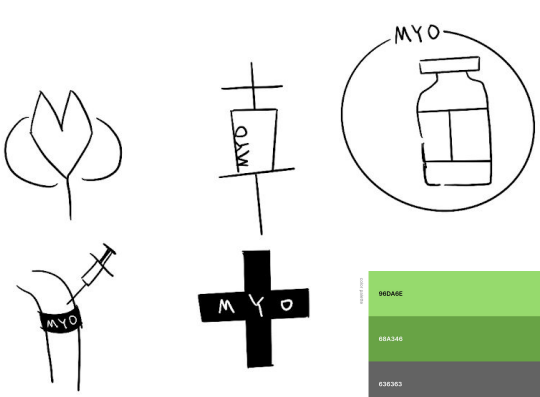


Fig.63 Improved branding logo

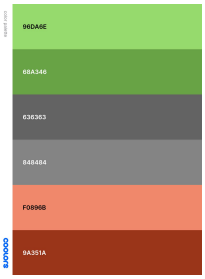
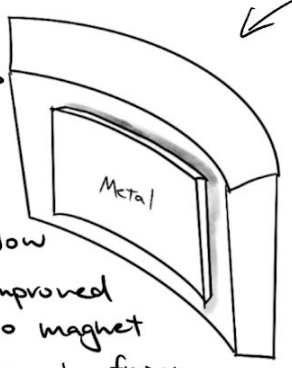


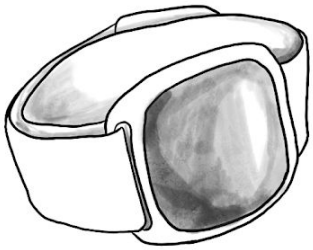
Fig.62.1 - 62.5 improved color choices & color palette

D3 PROTOTYPE IMPROVEMENTS

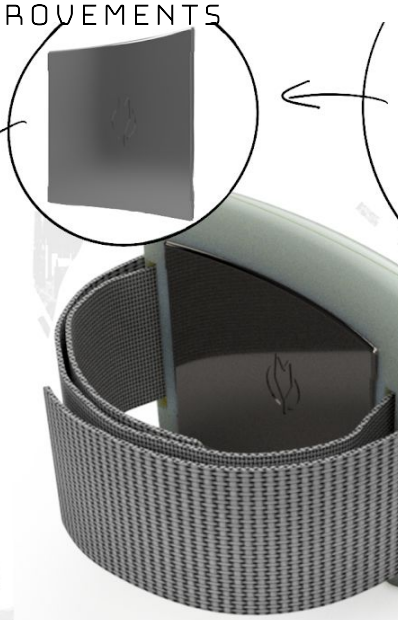
Improved the degree of crook of the product to fit it more user's arm.



However, Now I have Improved our work to magnet metal that can be frozen more quickly as well as having a higher Thermal resistance rate.



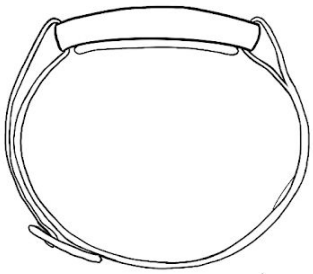
- It is waterproof → can be sterilised.
High versability.



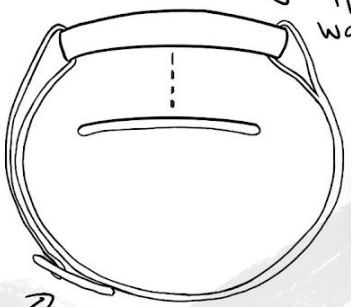
The orginally Design was having Ice Pack as a combination with the Product.

Logo as LED Light swith.

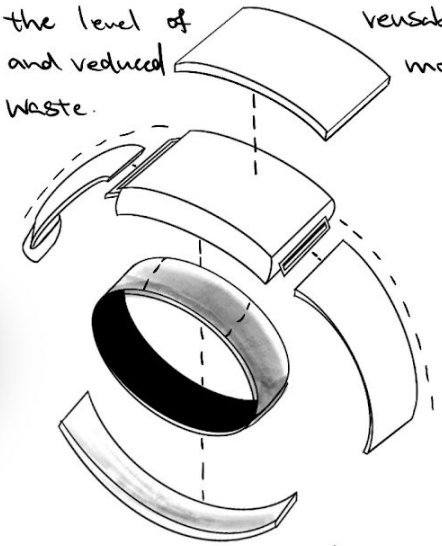
The Inspiration of the function is coming from body stimulator



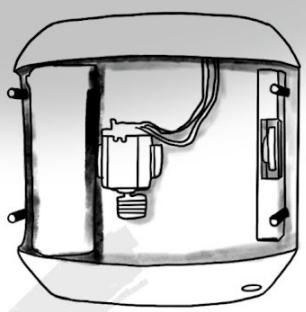
Where the shape was Inspired by Apple watch.



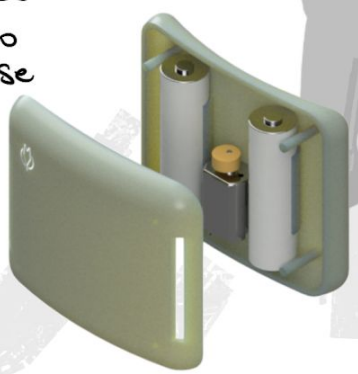
Product is Designed to be assembled. It improved the level of versability and reduced more waste.

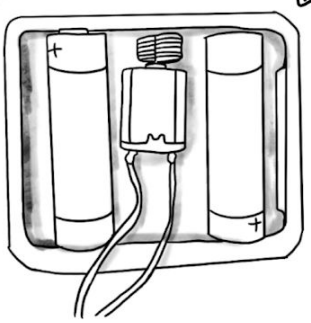


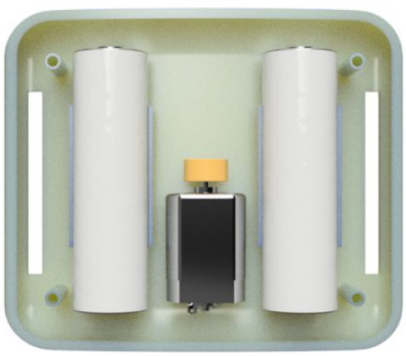
The band Improved Into Velcro, easy for the Majority of the User to use



The size decreased in the new design. I have also change the battery to be a more common one for users to replace it more easily.







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