

A LOW COST VEIN DETECTOR FOR INDIAN SCENARIOS

TRIVIKRAM ANNAMALAI

136130013
(2013-2015)

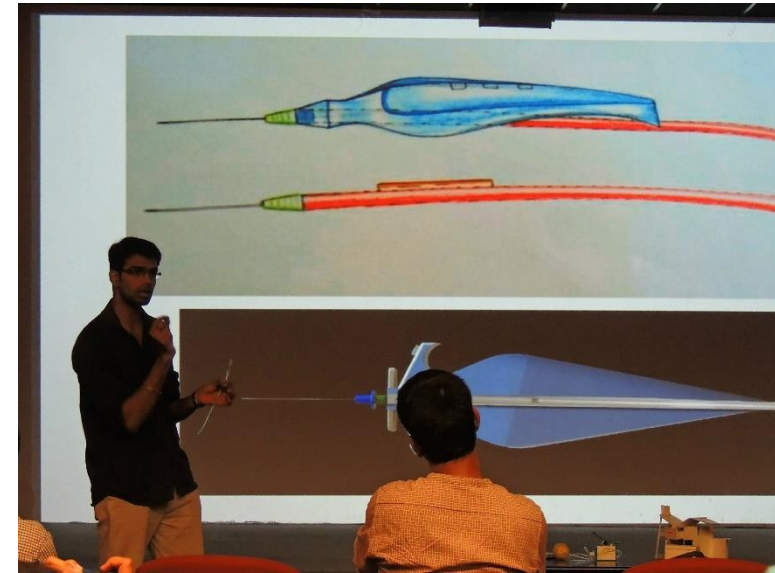
GUIDE: PROF. B.K. CHAKRAVARTHY

CO-GUIDE : PROF. PURBA JOSHI

*“ He who has health has hope,
he who has hope has everything ”*

- Thomas Carlyle

‘Collaborative Innovation’



THE NEED

16/100 have multiple veni-puncture

Average number of attempts in child **2.35**

8.2 mins - Average Time lost

16/100 have multiple veni-puncture

Average number of attempts in child **2.35**

8.2 mins - Average Time lost

Multiple veni-puncture leads to:

- Swelling
- Irritation
- Bleeding
- Blackening of skin
- Blood clots, etc

TARGET USERS



Doctors and Nurses

Primary Users



Children



Geriatrics



Obese



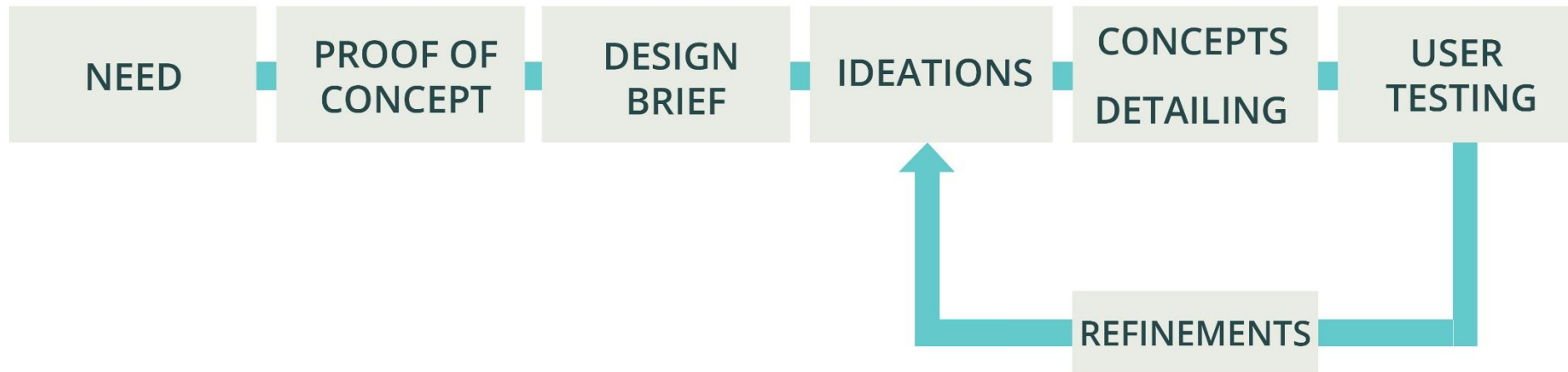
Deep Veined

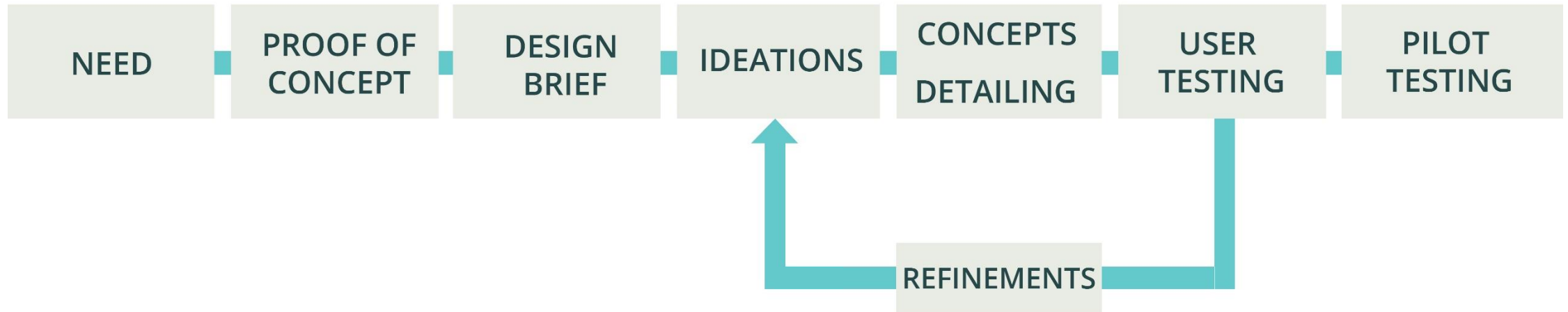
Secondary Users

**COLLABORATIVE
INNOVATION**

2_{nd} Sem

NEED





PARALLEL PRODUCT STUDY

Venoscope



Contact device

Accuvein



Non-contact device

R & D



VeinEZ

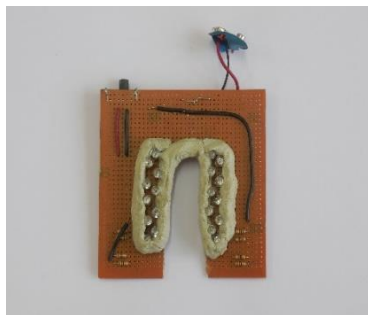


Think Biosolutions

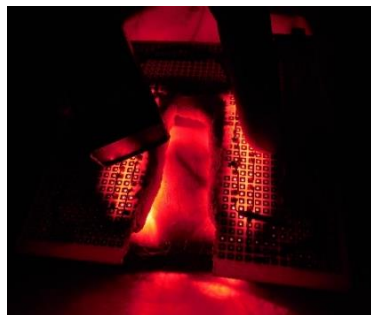


PROOF OF CONCEPT

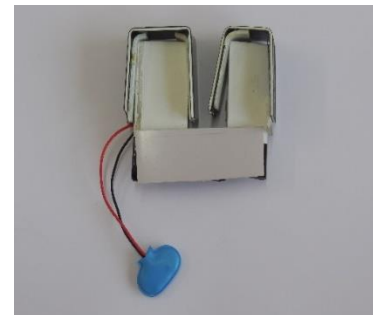
Circuit



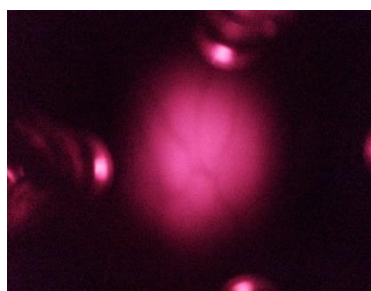
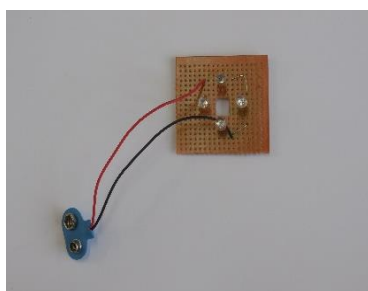
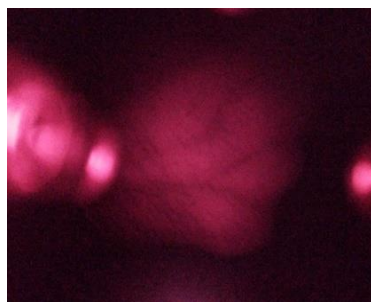
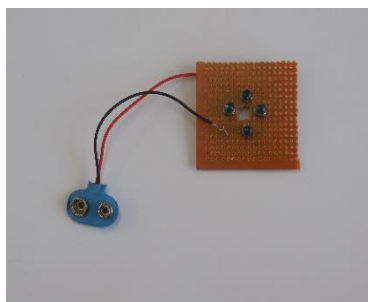
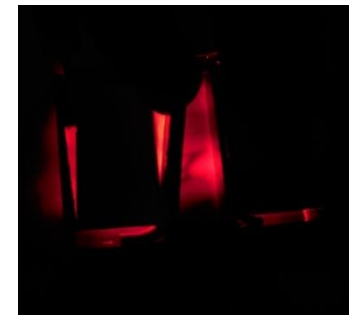
Result



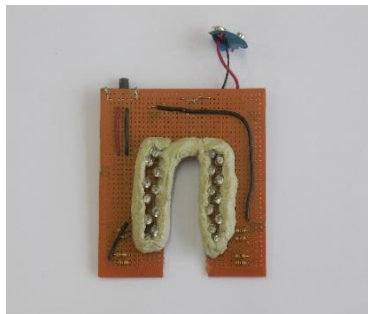
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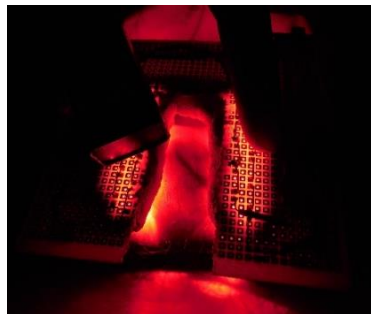
Result



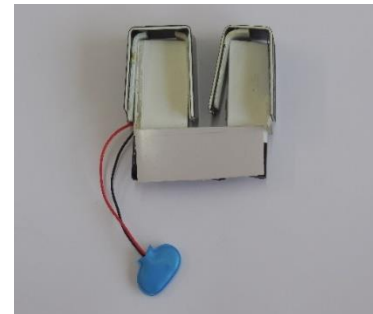
Circuit



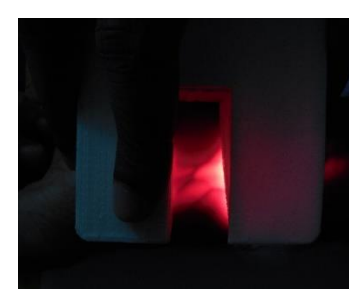
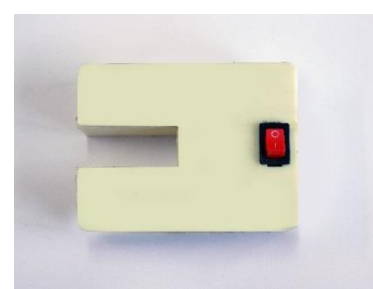
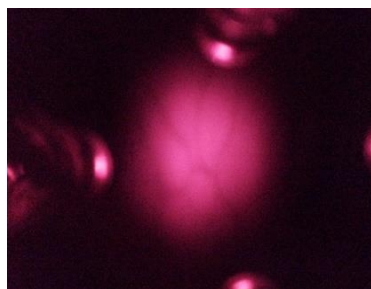
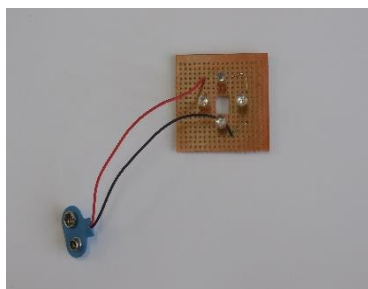
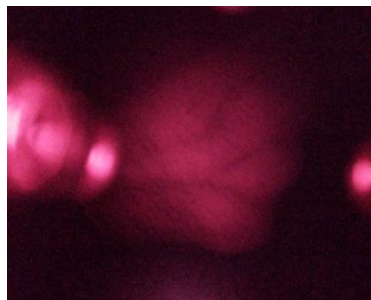
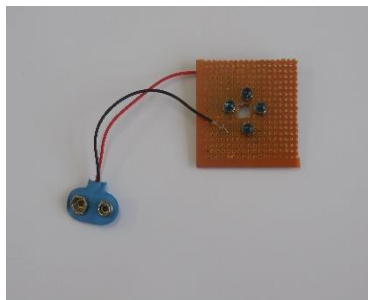
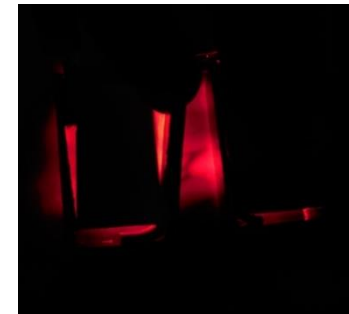
Result



Circuit



Result



PRINCIPLE

- Veins carry oxygenated blood and de-oxygenated blood, when Red/Infra red LEDs are incident on the veins due to selective absorption,

De-oxygenated blood **absorbs** all the radiation and appears **dark**

Oxygenated blood **reflect** the radiation and appear **transparent**

- The optical window capable of vein viewing is 850-900nm
- The penetration depth of the radiation is 3-6mm

QUESTIONNAIRE

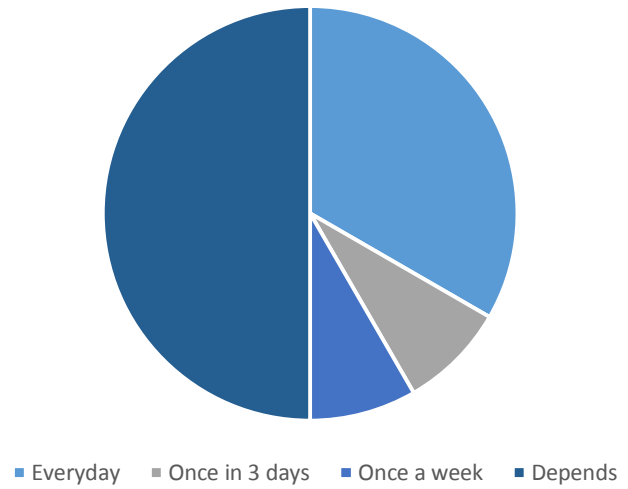
People interviewed	21, Doctors = 8, Nurses = 13
Hospital Type	Government hospital : 2 Private Hospital : 4 Blood Banks : 1
Average age of Users	32.75 Years
Average experience of the Users	7.8 Years

AIM:

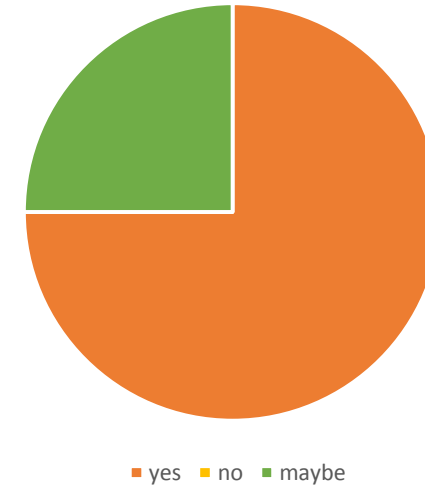
Awareness and Affordability

Expert advice and suggestions for improvement

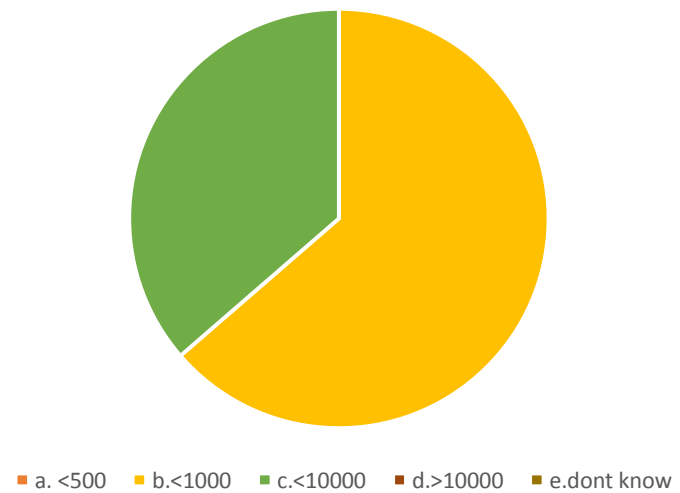
Frequency of difficulty in Vein detection



Acceptance of an electronic device for vein finding



Affordability for a vein detector device



Design Brief



Works on diverse users



Affordable product



Usage needs minimal training



Considers healthcare standards

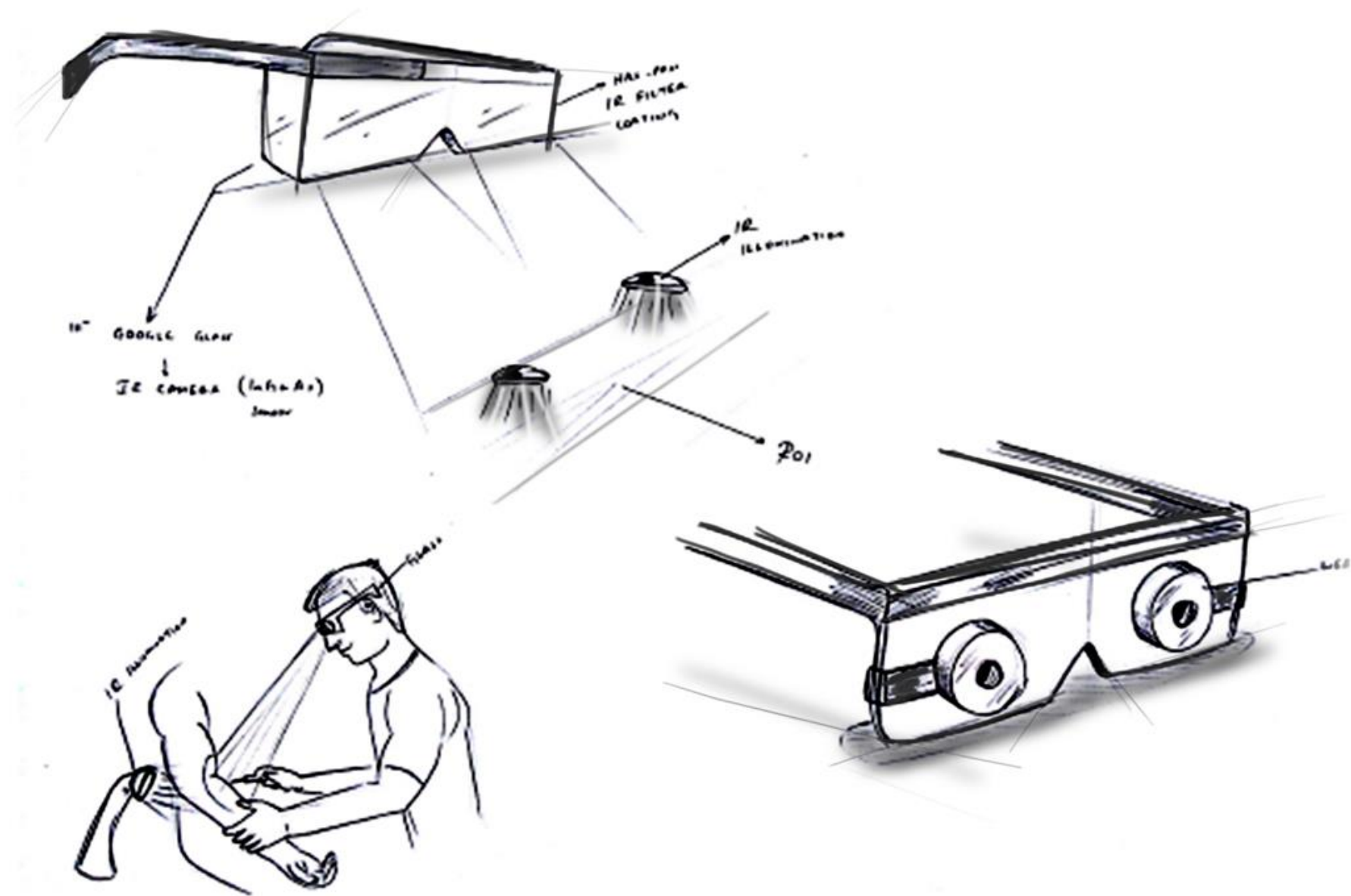


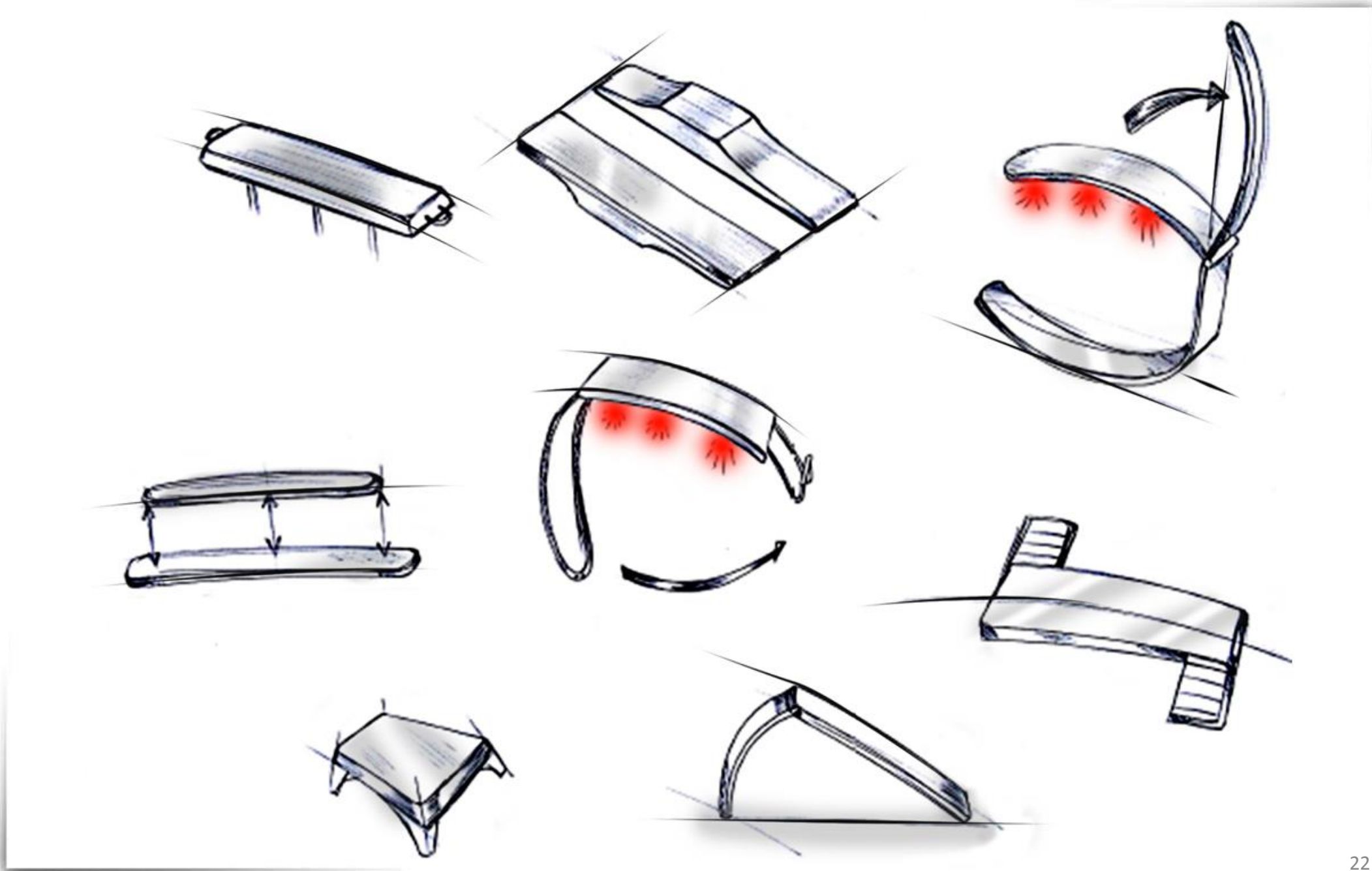
Device is portable

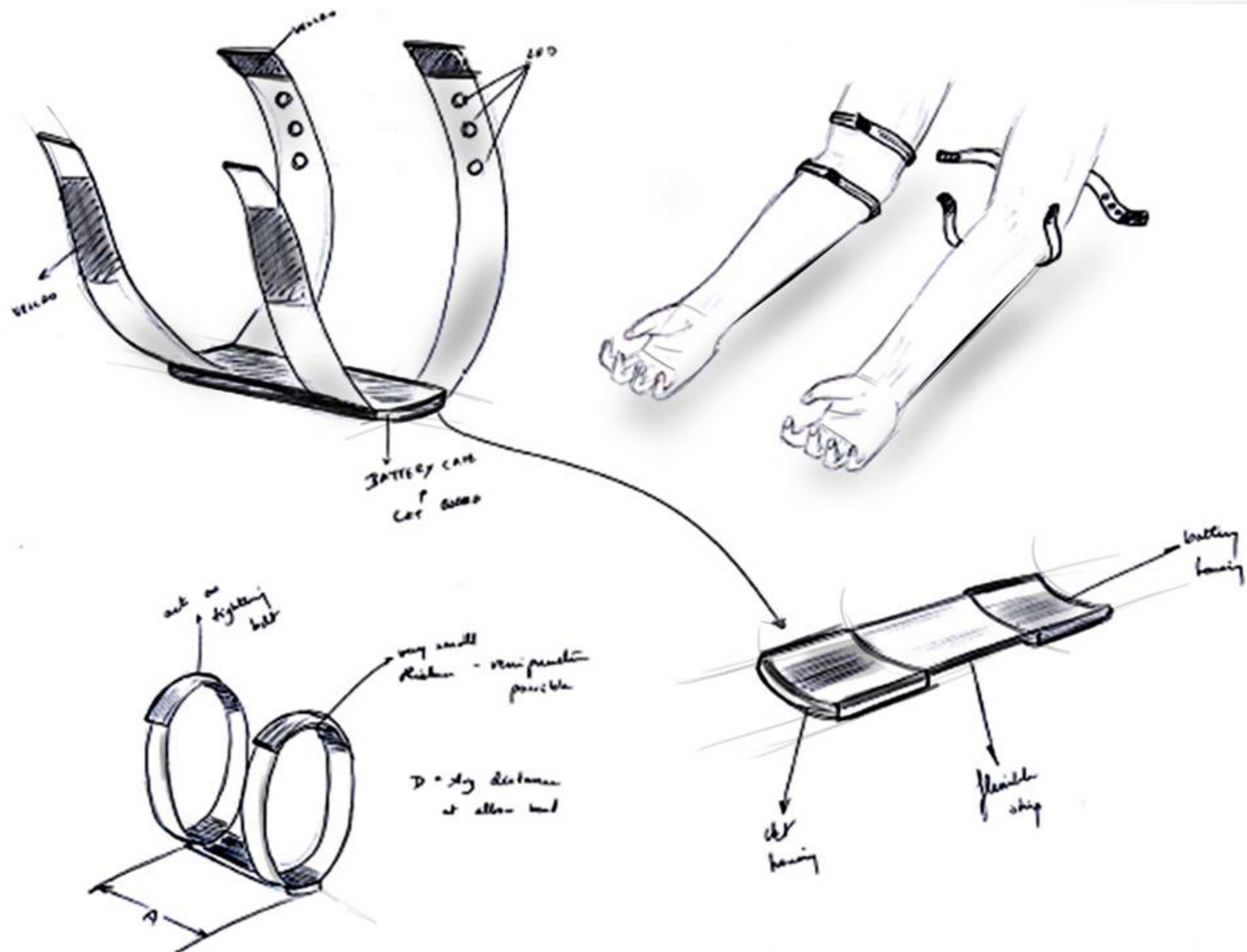


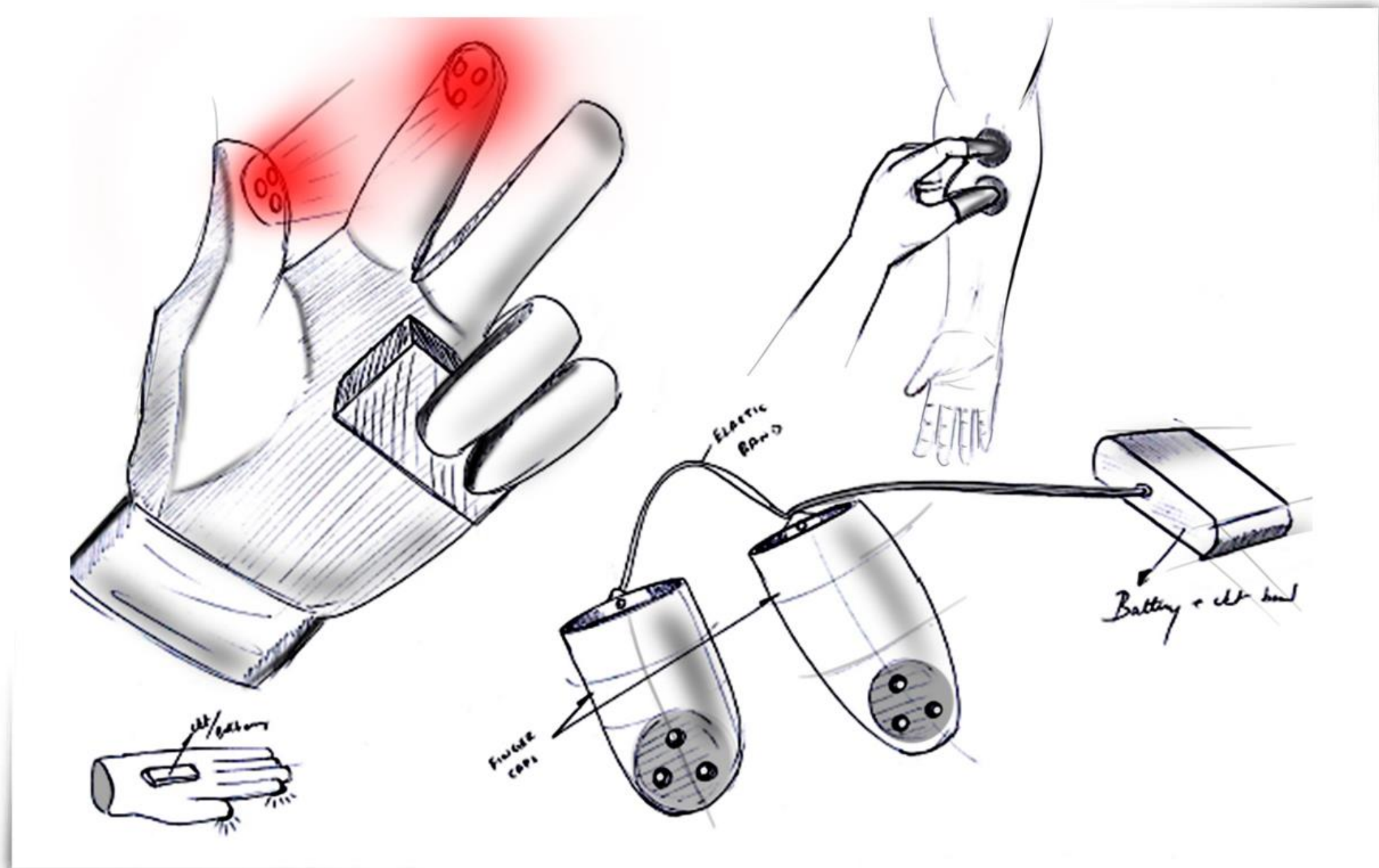
Has healthcare aesthetics

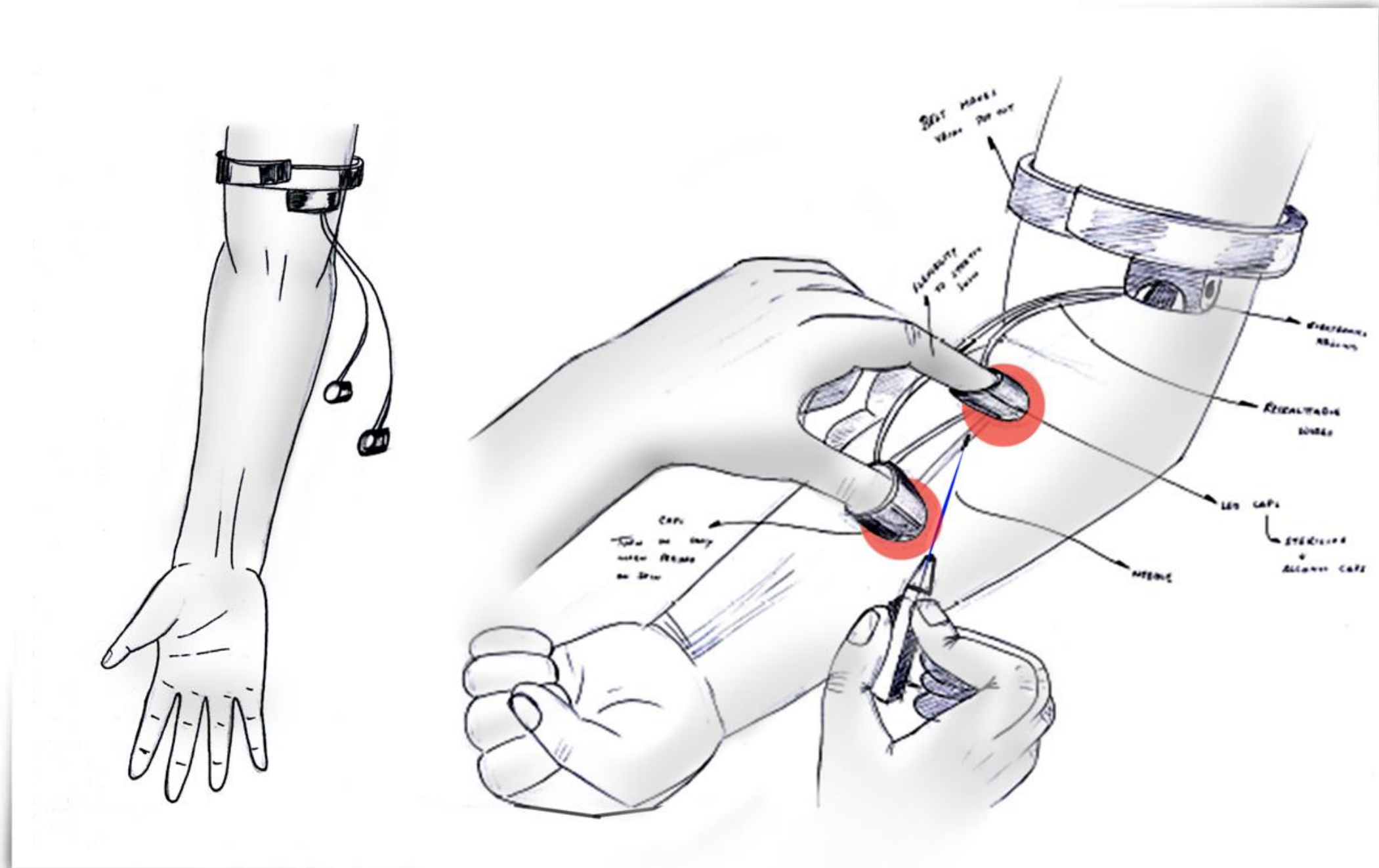
IDEATIONS

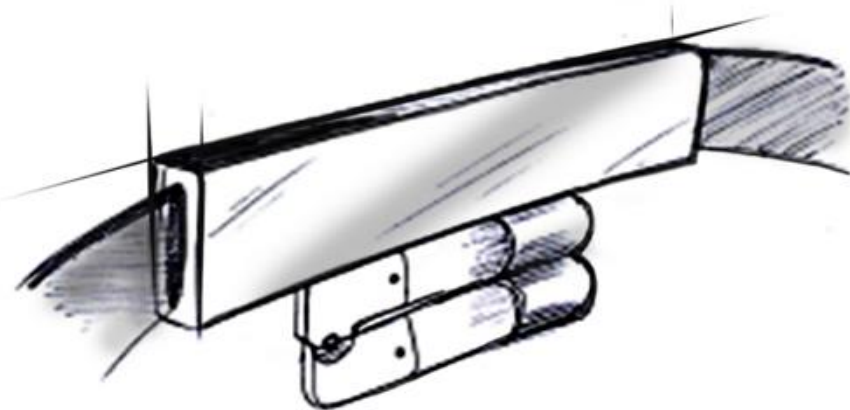
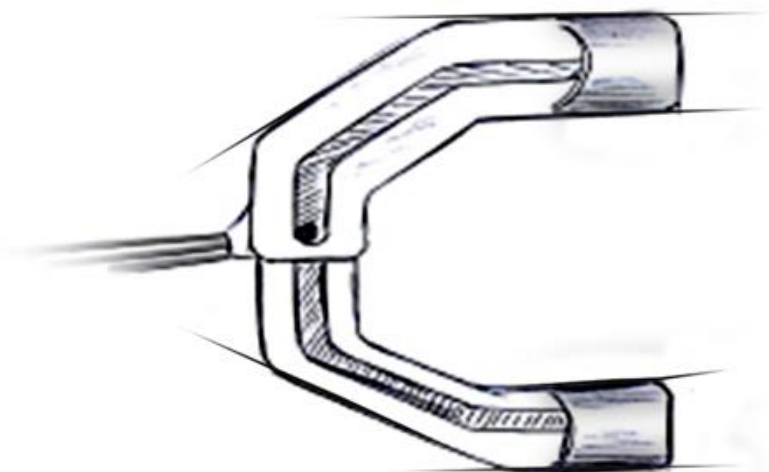
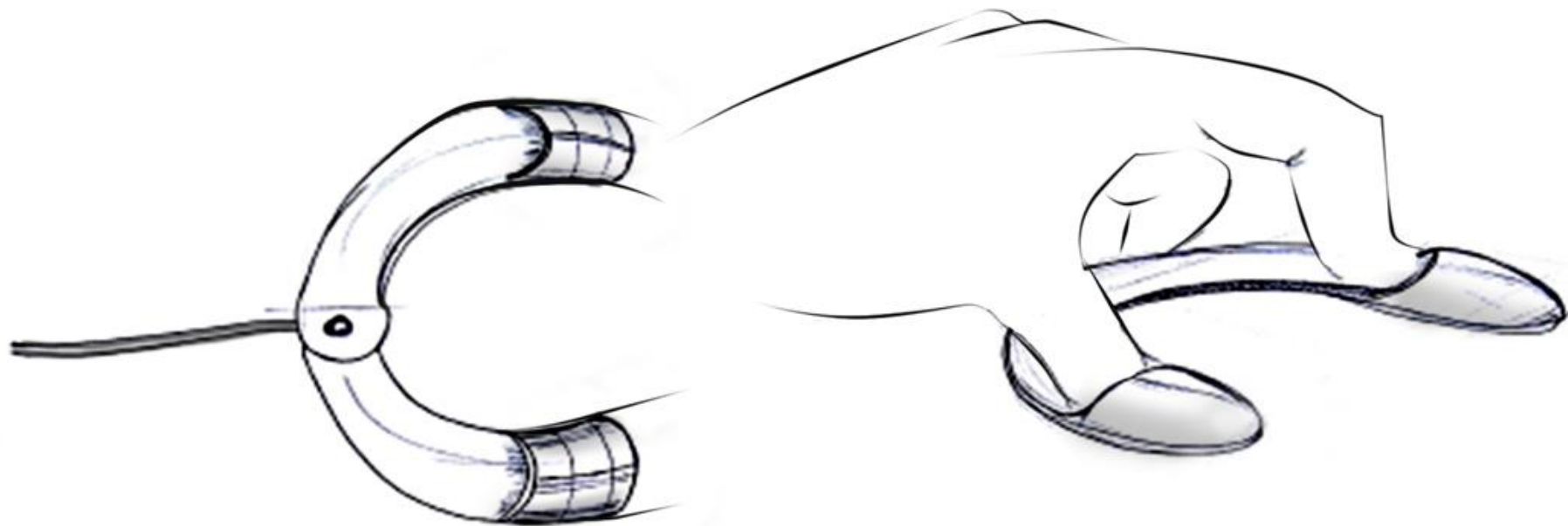


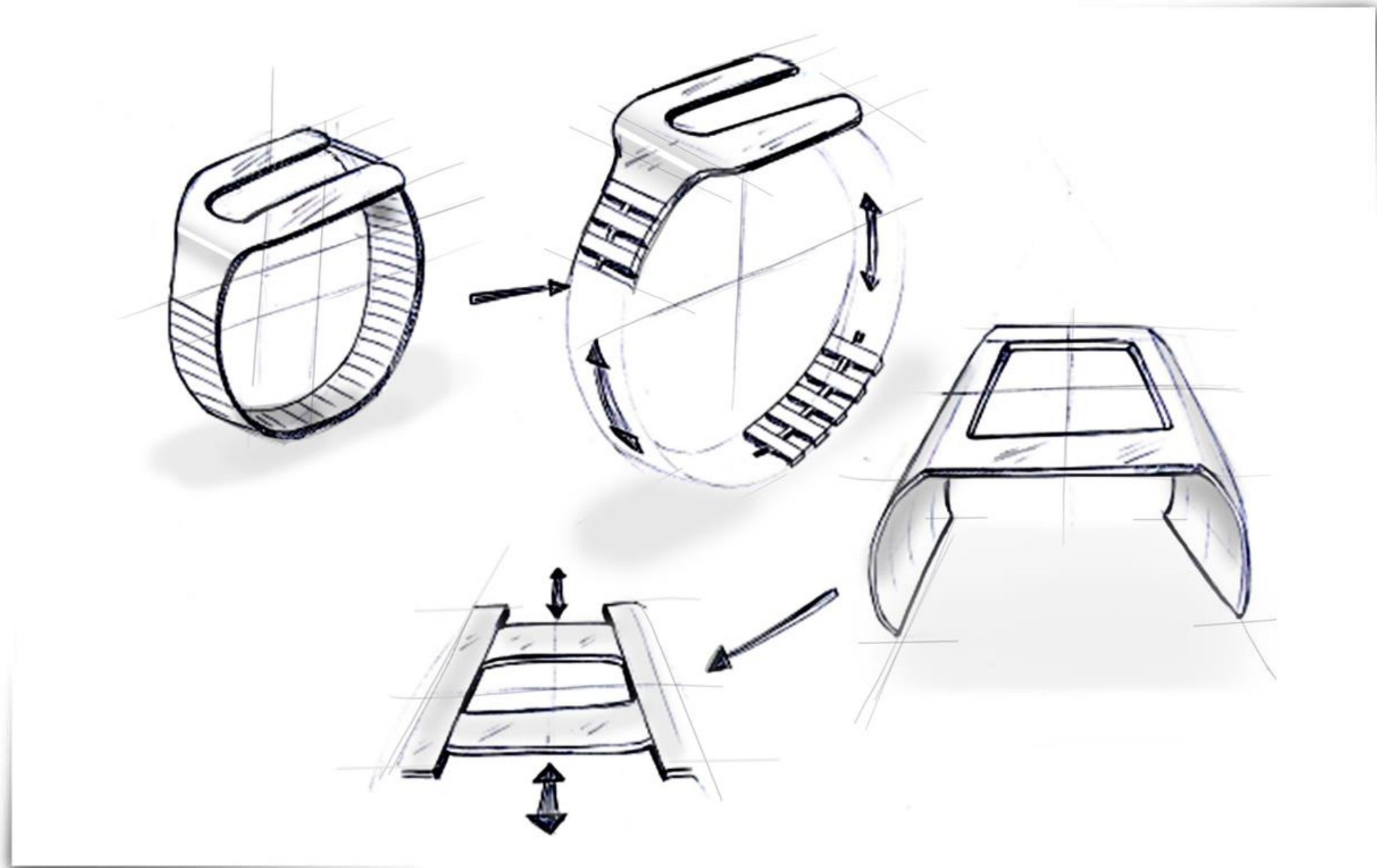


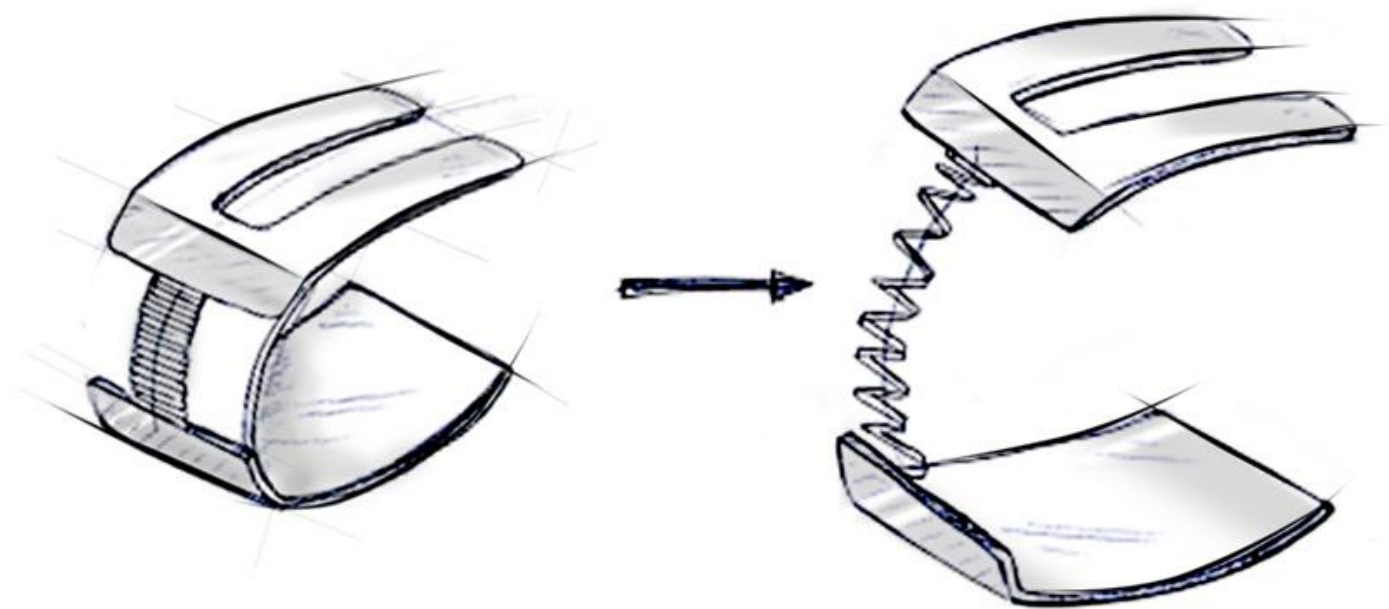


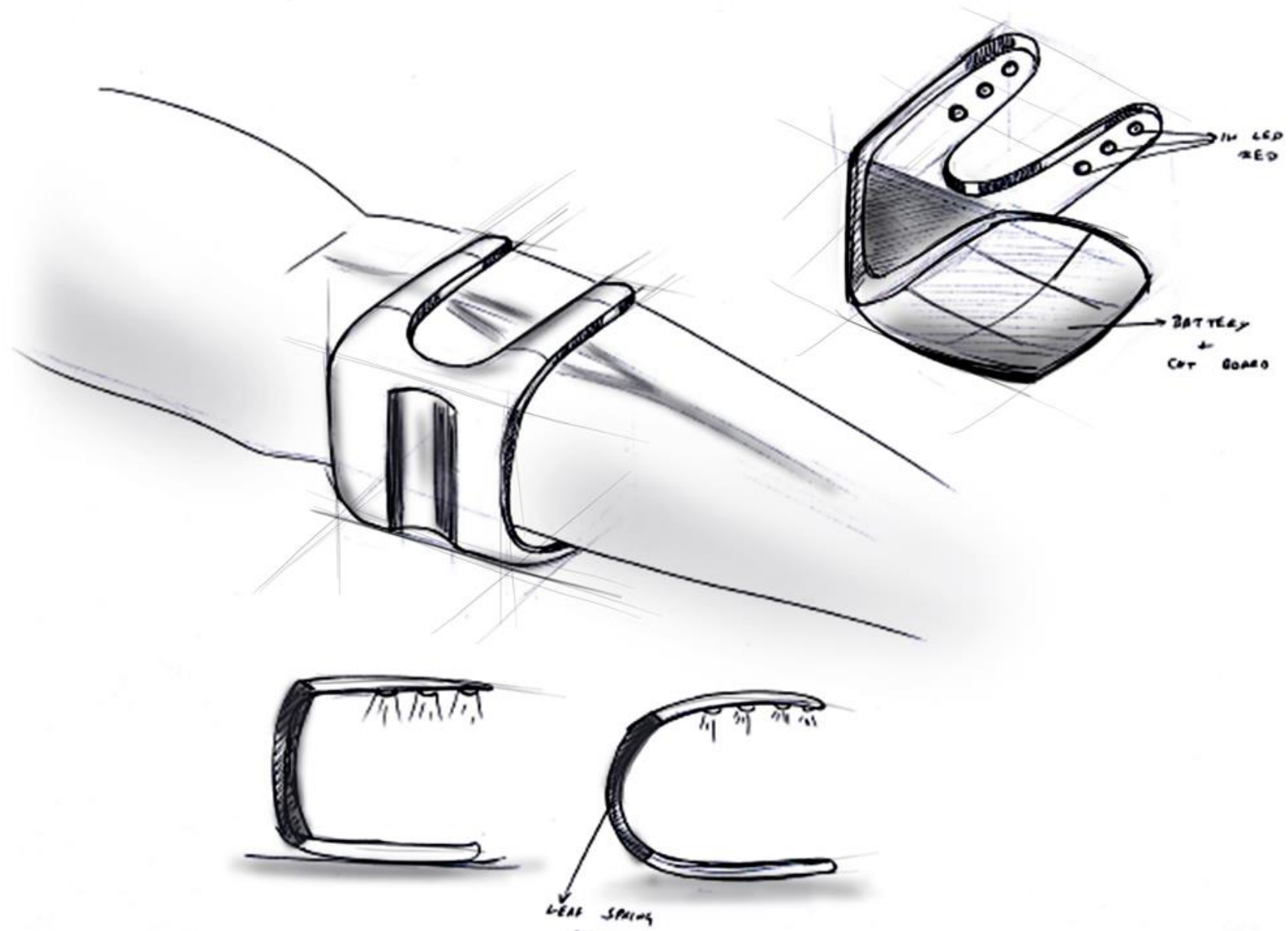






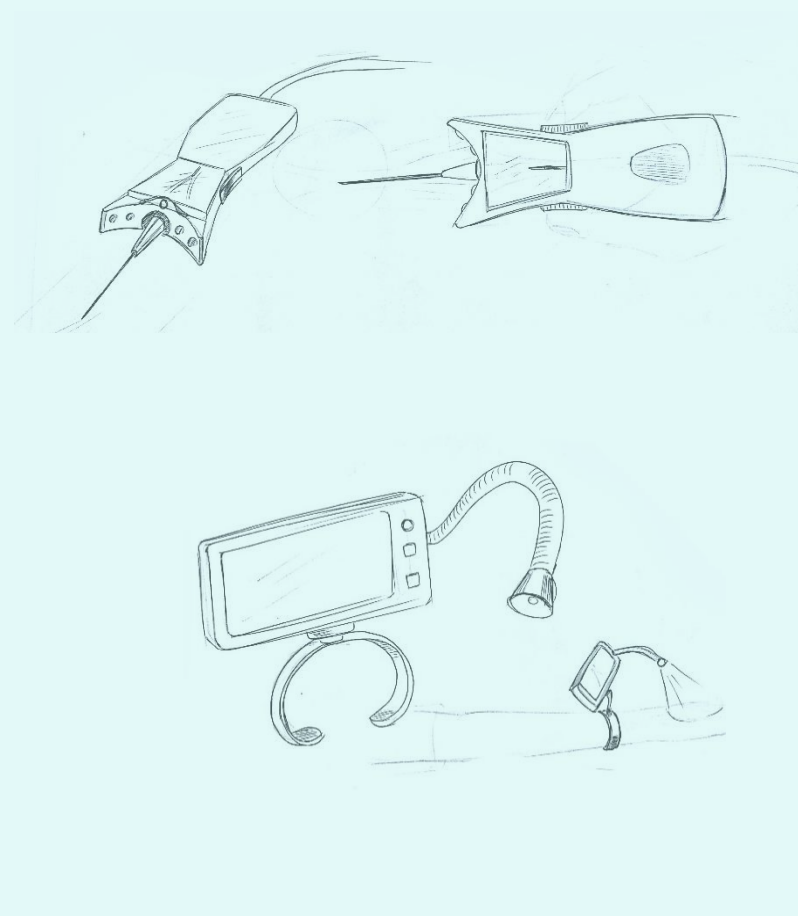




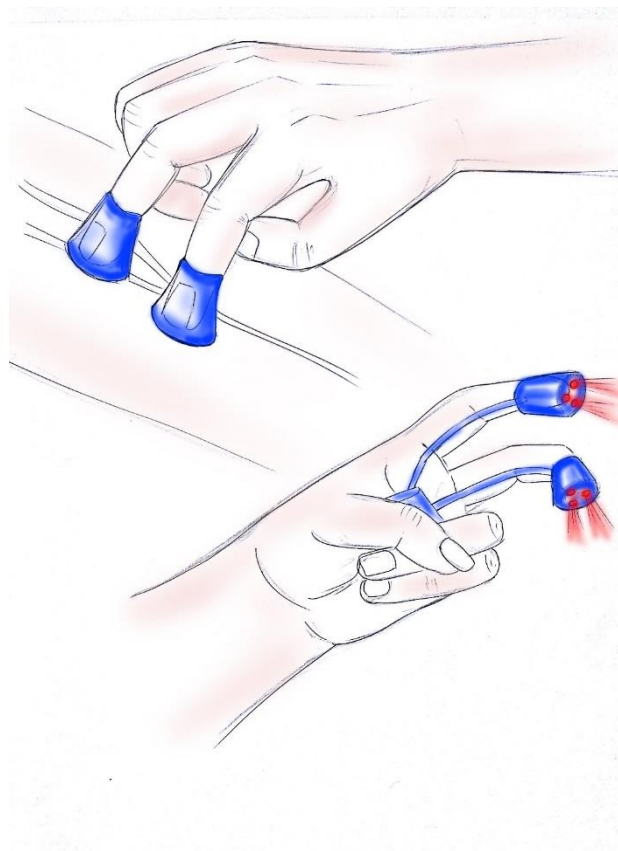


DESIGN DIRECTIONS

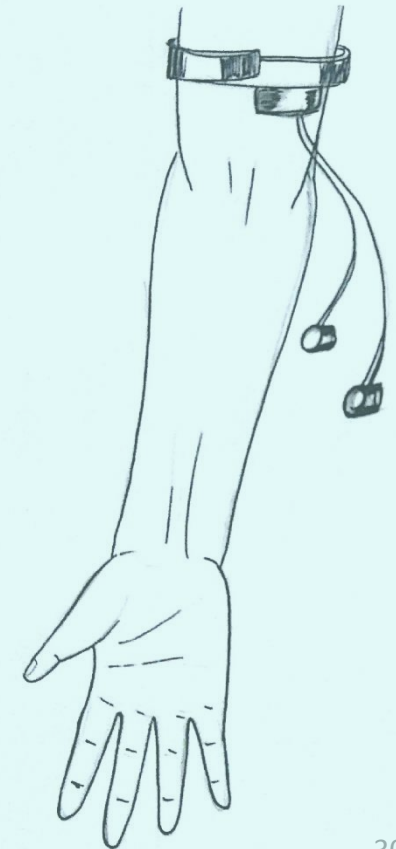
Non-Contact Devices



Trans-illumination Devices



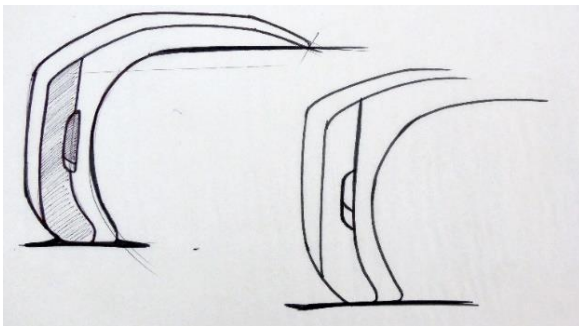
Add on Devices



ERGONOMICS AND ANTHROPOMETRY

Hand dimensions	Min.	Max.	Mean	SD	CV	Skewness	Percentile		
							5 th	50 th	95 th
Wrist circumference	252.00	305.00	277.65	10.57	3.81	-0.093	259.00	280.00	305.00
Hand circumference	225.00	265.00	243.82	8.52	3.49	-0.100	228.00	245.00	262.00
Max. hand circumference	310.00	379.00	344.50	12.87	3.74	-0.251	319.00	346.00	373.00
Index finger circumference	60.00	77.00	67.28	3.76	5.59	-0.075	61.00	68.00	74.00
Wrist circumference	149.00	185.00	164.54	6.92	4.21	0.153	152.00	165.00	180.00
Arm length	692.00	847.00	771.16	27.36	3.55	-0.025	727.00	776.00	821.00
Elbow length	423.00	501.00	459.91	15.70	3.41	0.260	434.00	462.00	493.00
Elbow flexed	223.00	320.00	263.72	18.11	6.87	0.113	234.00	266.00	295.00
Max. internal grip diameter	35.00	52.00	42.68	4.05	9.49	0.163	35.00	44.00	50.00
Middle finger palm grip diameter	12.00	22.50	16.33	2.47	15.12	0.188	12.50	17.50	21.00

Anthropometric table of hand dimensions
Source: ispub.com



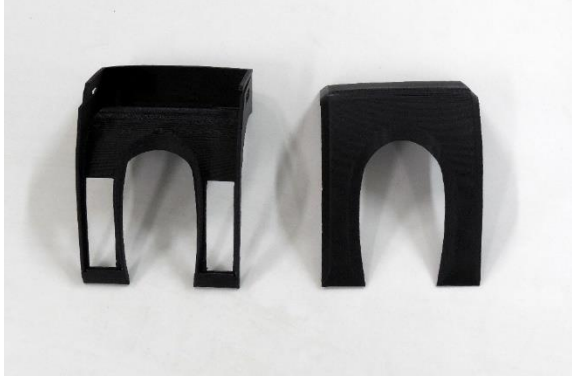
side profile and switch positions

- Dimensions of the 95th percentile hand circumference were taken into account.

The ergonomic factors considered during the design of the device were:

- The optimum width of the device
- The thickness of the LED surface
- The position of the switch and intensity knob
- The optimum vein viewing area

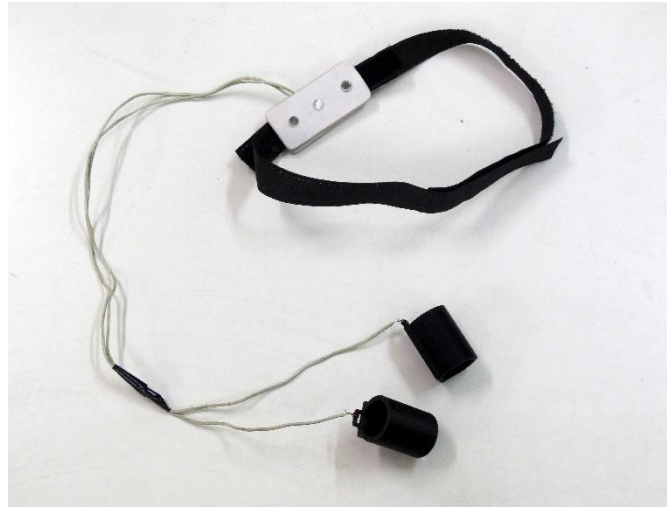
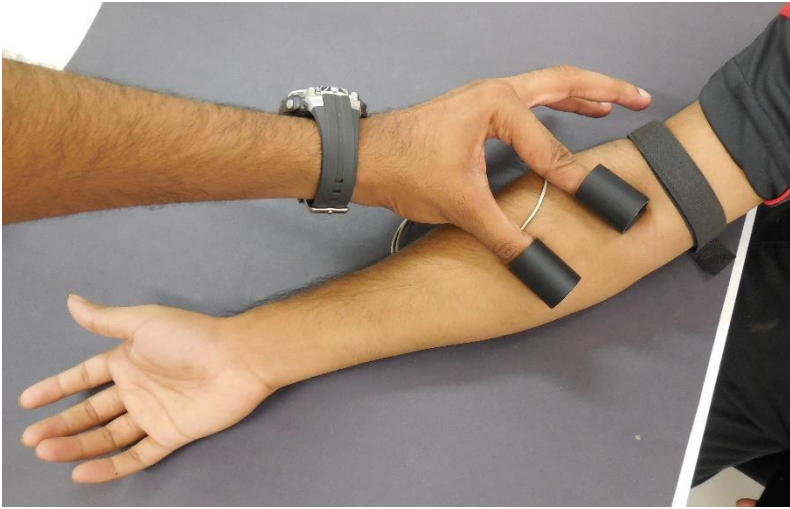
MOCK UPS



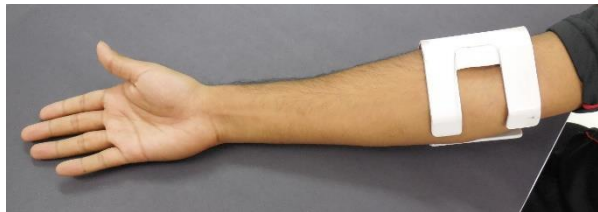
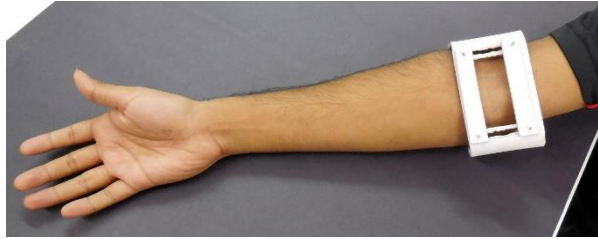
Mock up were tested to evaluate :

Optimum dimensions for ease of use and incorporating the electronics





- Comfort to the user
- Ease of veni-puncture



- Form evolved with usability factors

ACTIVITY ANALYSIS

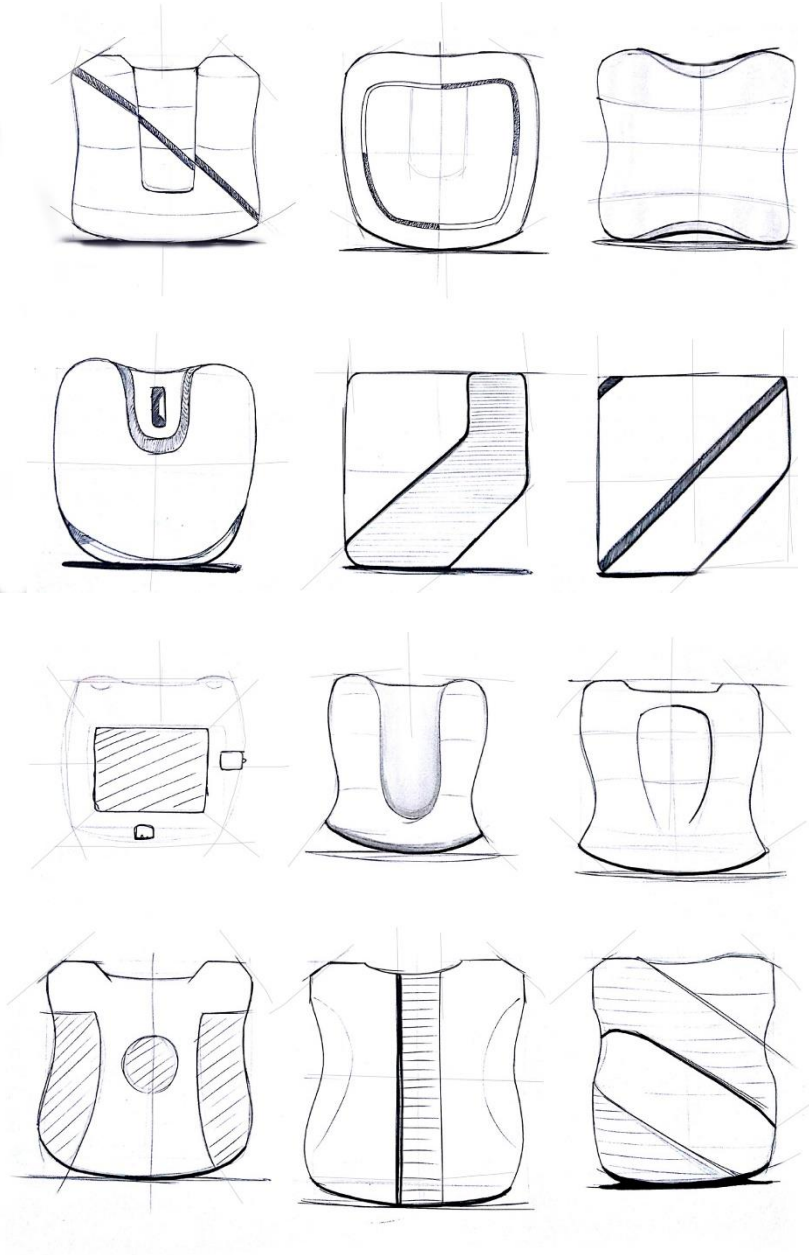
ACTIVITY ANALYSIS



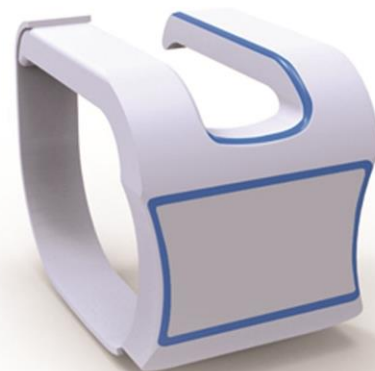
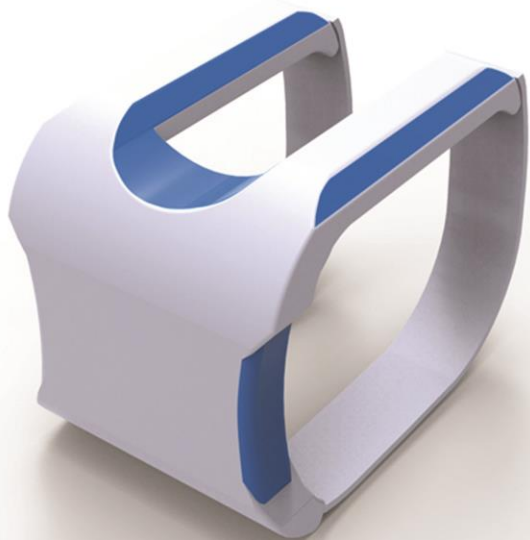
- Simulation of conventional veni-puncture process
- Testing of mock ups, to understand their feasibility

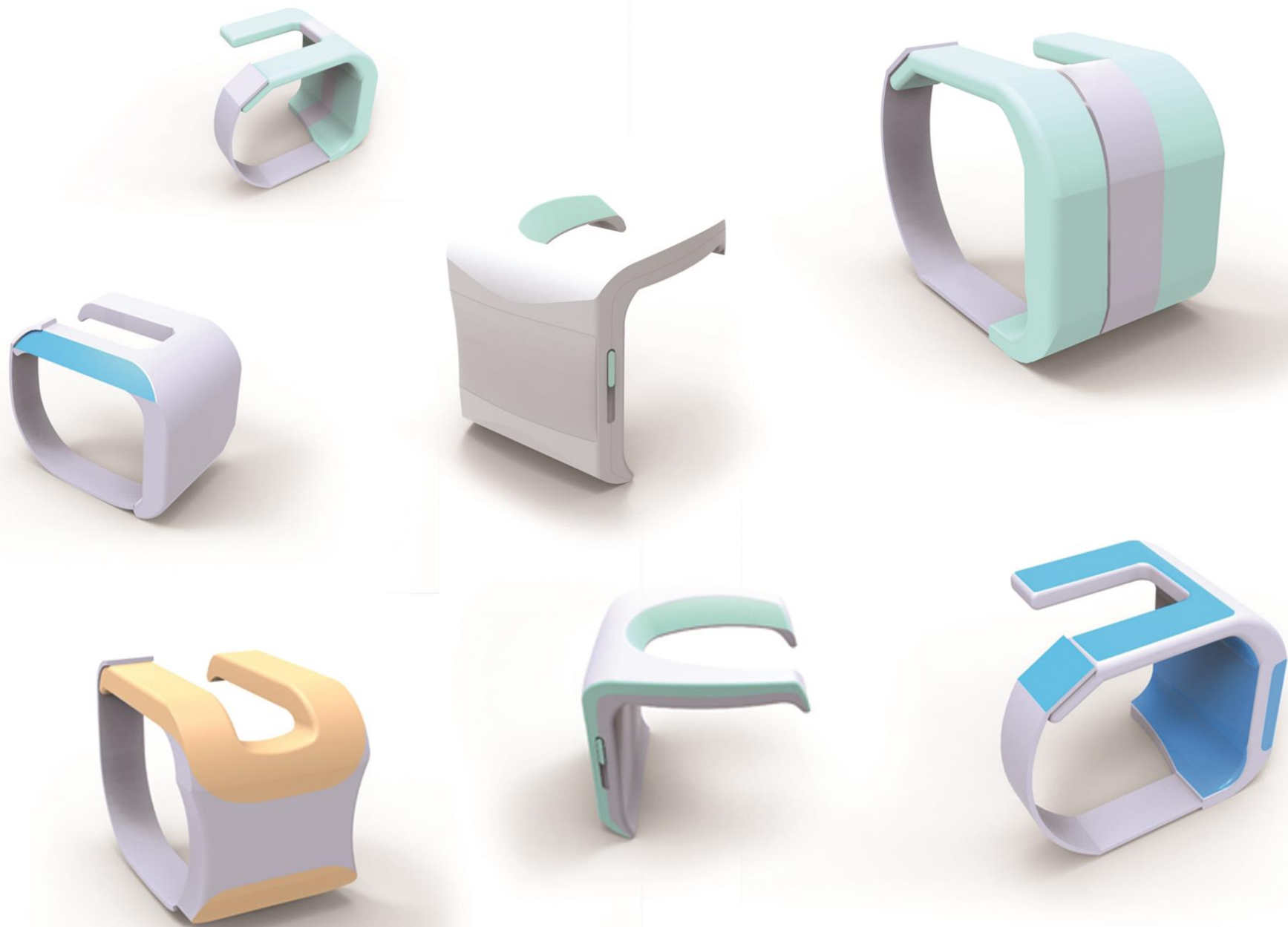
FORM EXPLORATIONS

HEIRARCHY OF PARAMETERS FOR FORM EXPLORATIONS

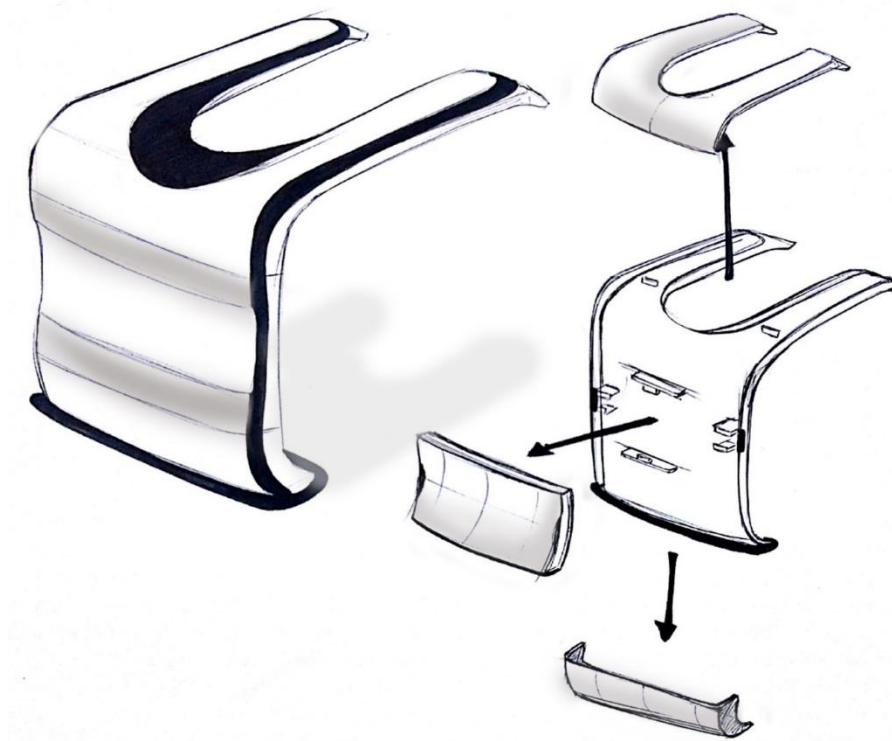
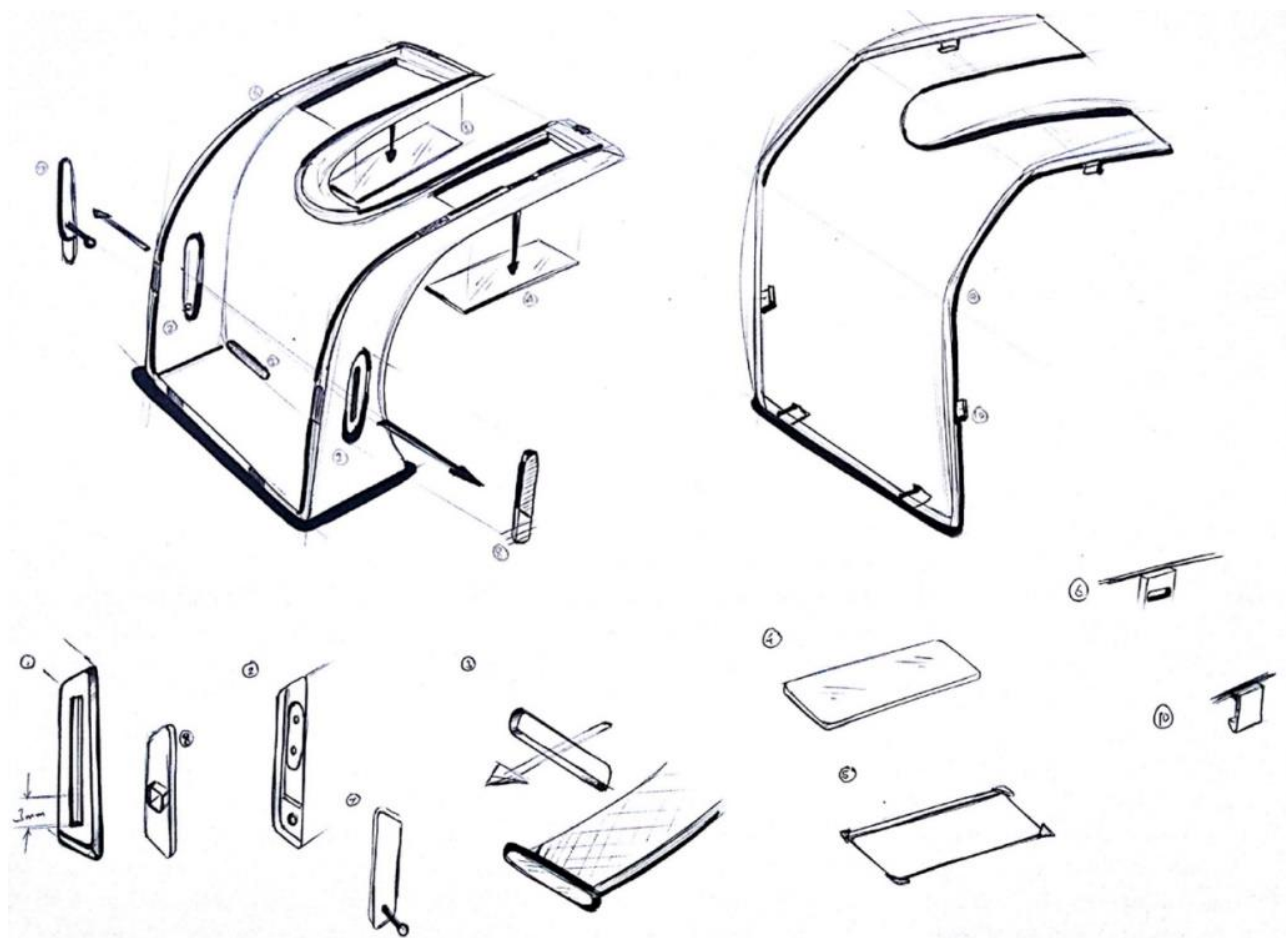


1. Usability
2. Effectiveness of vein viewing
3. Accommodating inner components
4. Manufacturability
5. Visual appeal

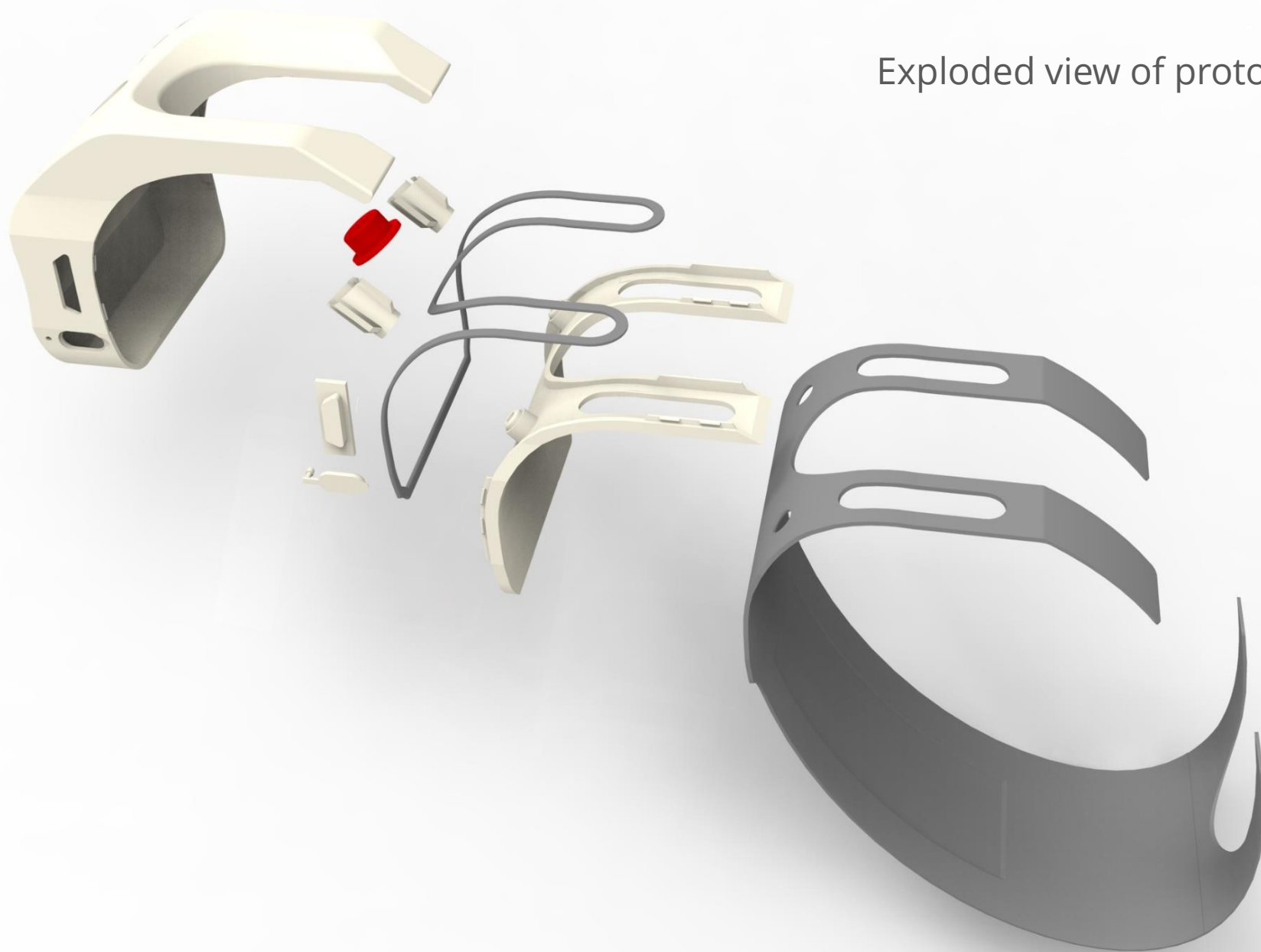


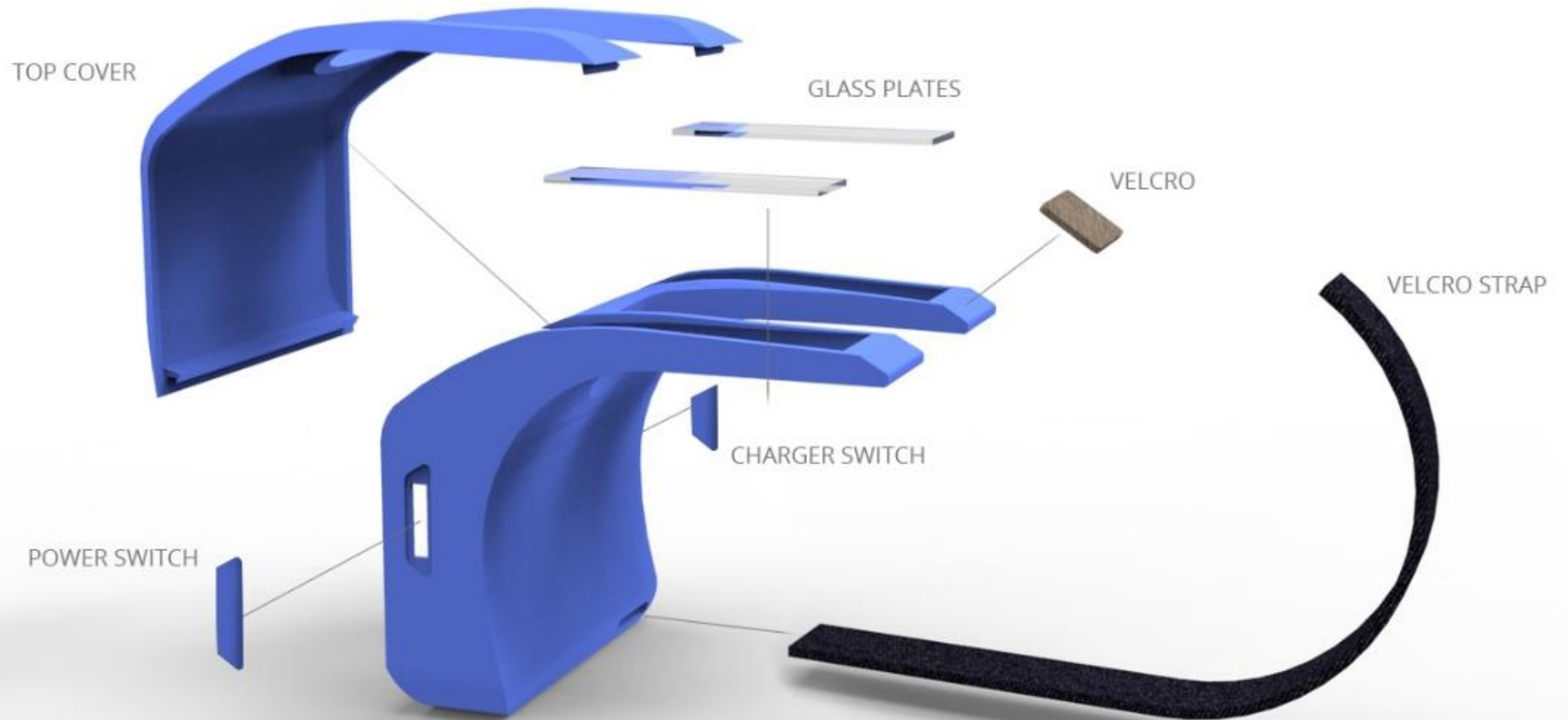


PRODUCT DETAILING

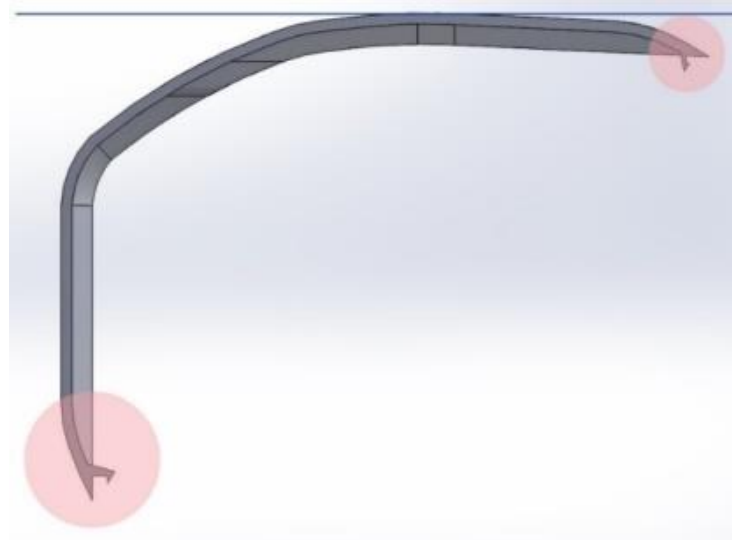
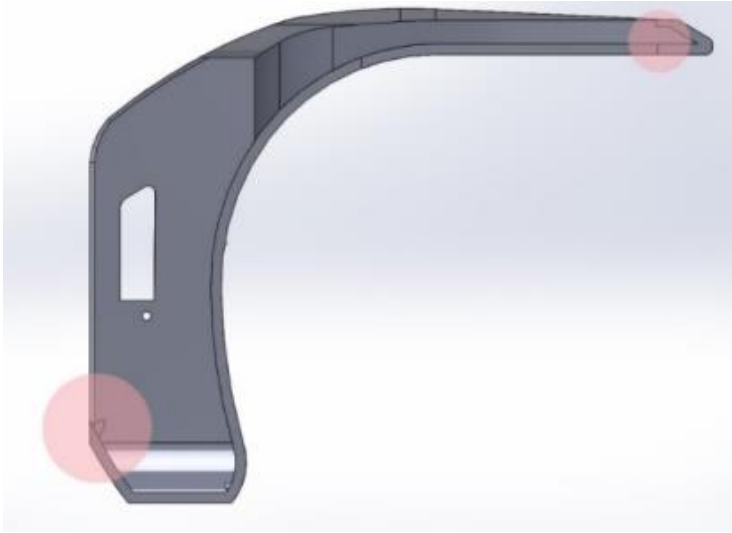


Exploded view of prototype Version 2.0





Exploded view of prototype Version 3.0



MATERIAL

Overall Body : ABS (Acrylonitrile Butadiene Styrene)

Non toxic

High strength

Inner Surface : Silicone film

Bio-compatible

Offers Grip

MANUFACTURING

Injection moulded components

Method of joining: Snap-on and screw

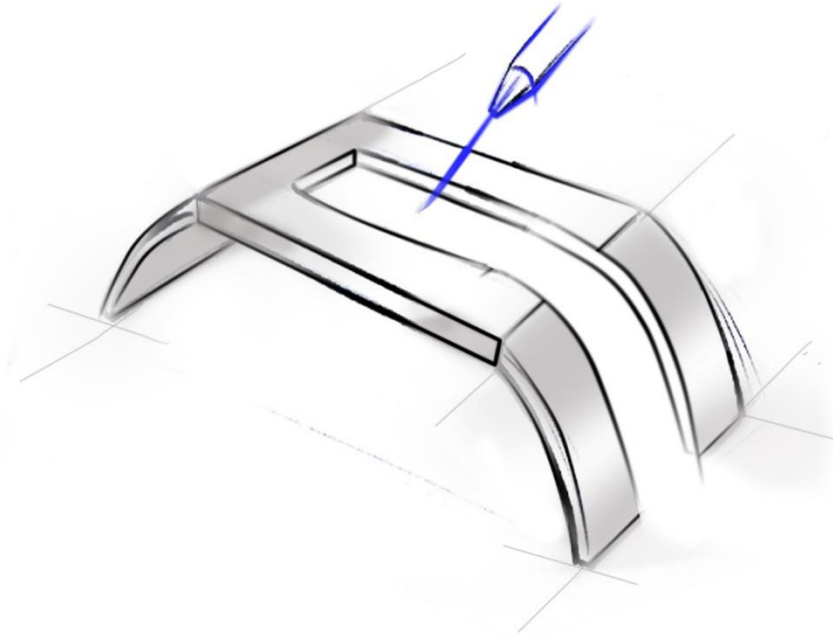
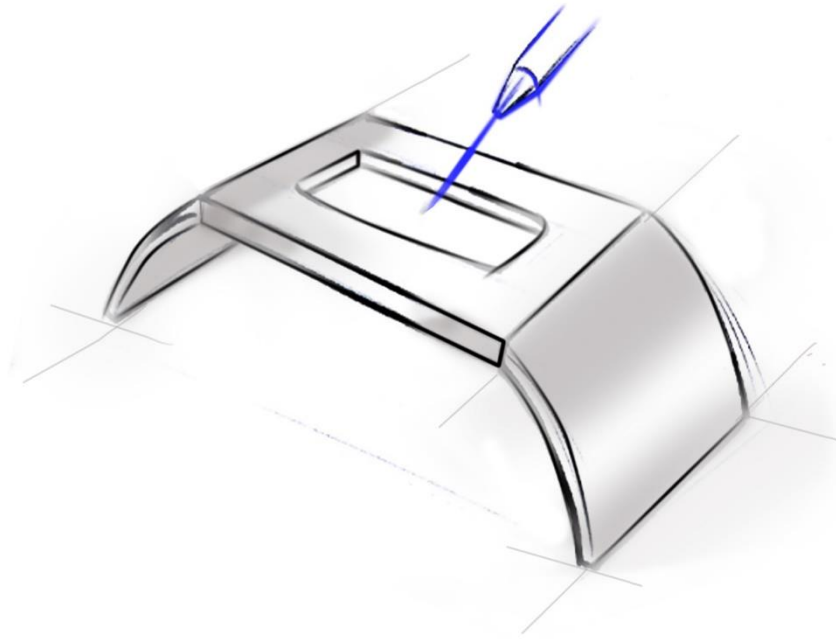
FEEDBACK FROM THE USER TESTING

Inclusion and exclusion criteria

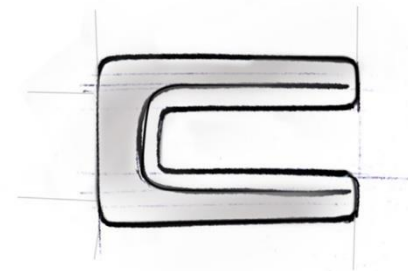
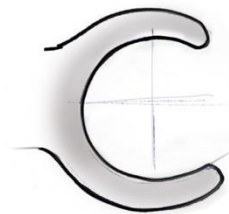
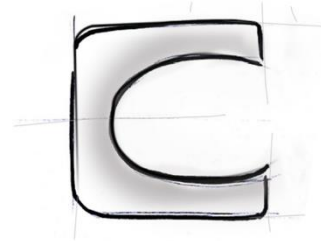
- Brightness of the LEDs
- Need for a strap
- Thinner U-top
- Cognitive Load on the user

CHALLENGES

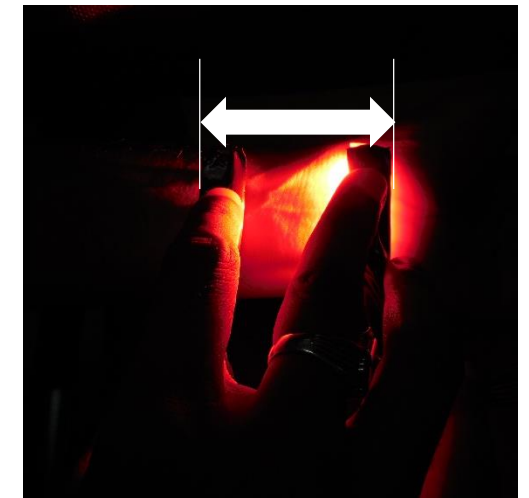
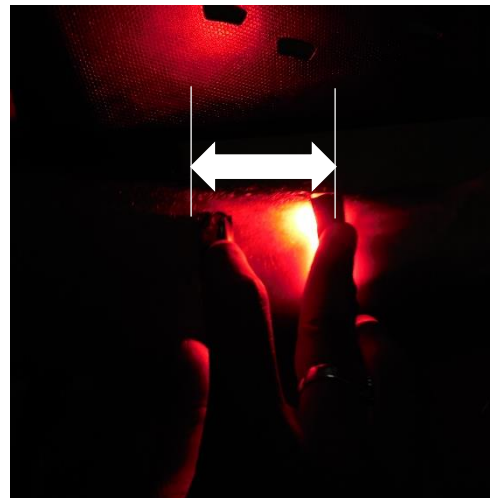
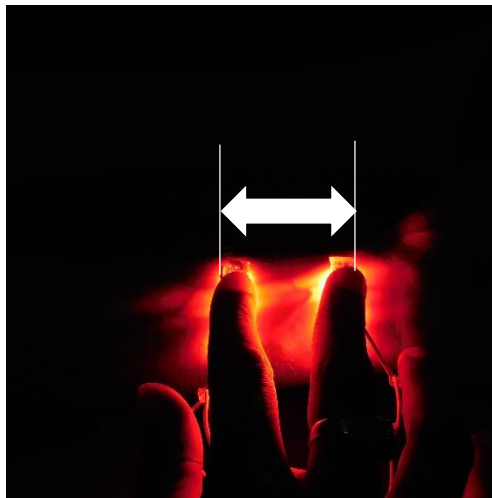
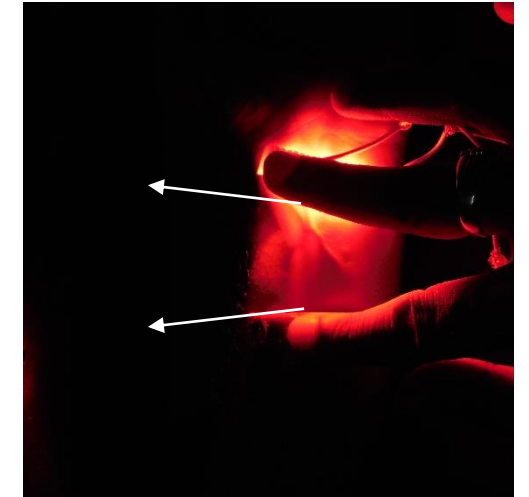
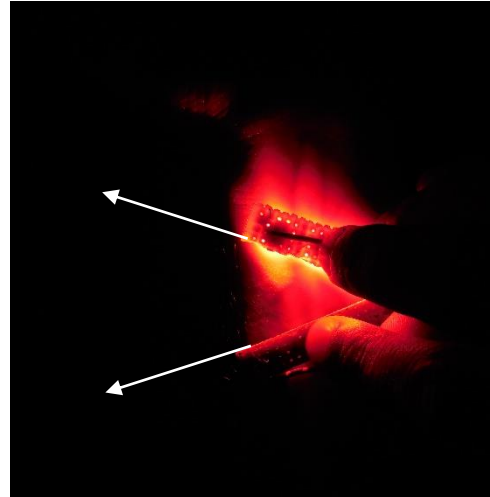
Optimum vein viewing shape and area



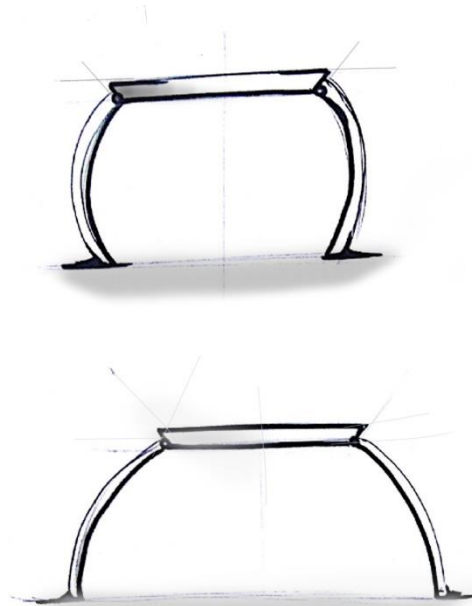
Options explored



Optimum vein viewing shape and area



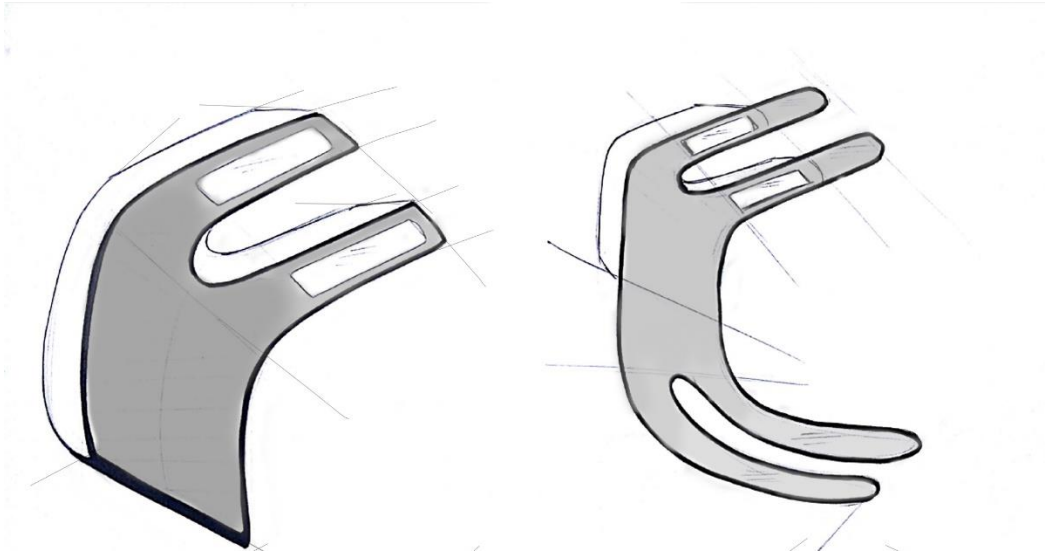
Clamping of the device



- Should fit on different percentile users
- Avoid many moving mechanism
- Should be a low cost option

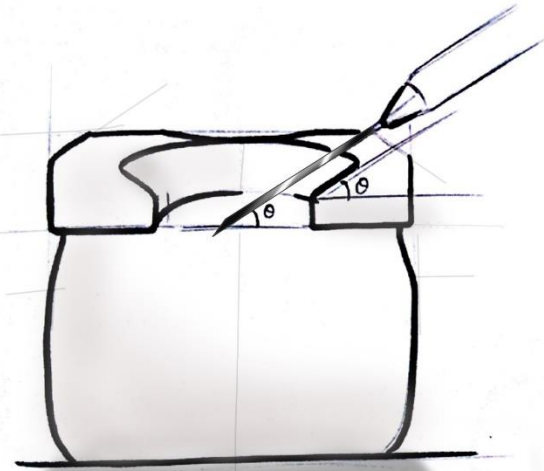
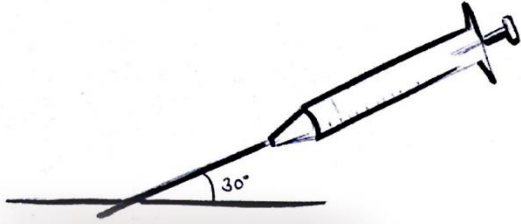


Hygiene factor



- Patients hand is made sterile
- Not an invasive procedure
- Avoid dirt accumulating details
- Single sheet of silicone on the inner body

Veni-puncture angle



- Prescribed angle of veni-puncture is 15° to 35°
- Chances of missing the vein increases otherwise

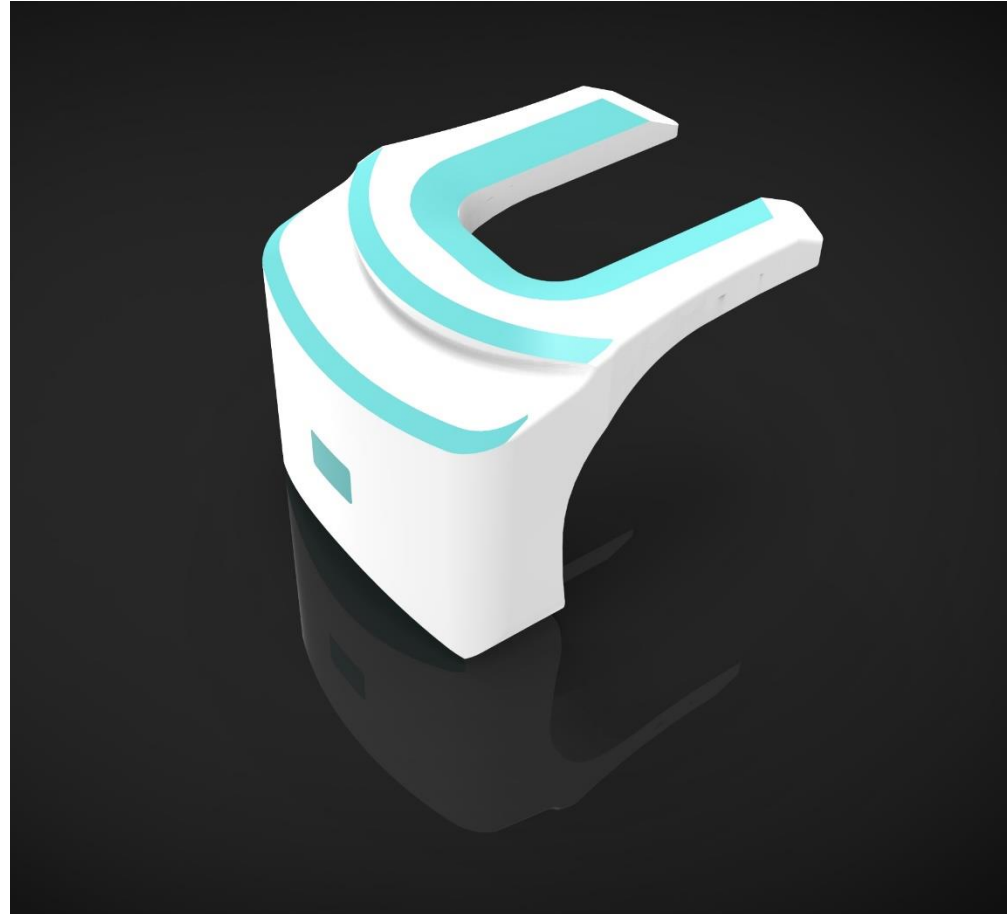
Solution :

- To make the 'U' top as thin as possible
- To chamfer the inner edge at an angle to act as a guide to perform veni-puncture.



FEATURES OF THE PRODUCT

- Touch Sensors
- No protruding controls
- Silicone layer



- Ergonomic
- Low cost
- Adjustable Brightness

BRANDING

- Vein-one
- Veintrix
- Vein fix
- **Veincare**
- VeinX
- Veinpact
- Veinsoft
- **Vein it**
- Veiner
- Vein pro
- **Vein-al**
- VEinfind
- Inveint
- Veinpact
- Veinaid
- **Veinsure**
- Veinjoy
- Veinspot
- **Cvein**

C-VEIN

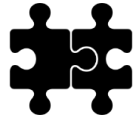
Re-look at the Design Brief



Works on diverse users



Affordable product



Usage needs minimal training



Considers healthcare standards



Device is portable



Aesthetics

Re-look at the Design Brief



Works on diverse users



Re-look at the Design Brief



Affordable product



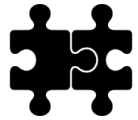
Moulded body parts : ₹700

Circuitry : ₹350

Battery : ₹500

₹1550

Re-look at the Design Brief



Usage needs minimal training



Re-look at the Design Brief



Considers healthcare standards



Photo-biological safety standards

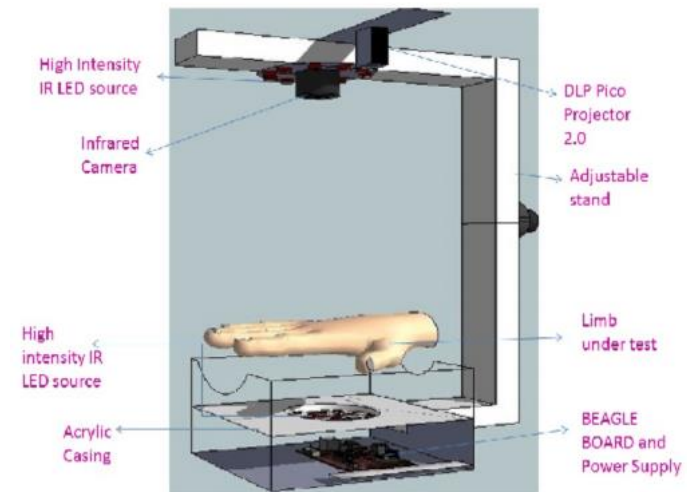
Hazard	Wavelength range (nm)	Max. reported risk group
Actinic UV	200-400	RG3
Near UV	315-400	RG3
Blue light	300-700	RG2
Retinal thermal	380-1400	Exempt/ RG1
IR eye	780-3000	RG3

Risk Group	Philosophical Basis
Exempt	No photobiological hazard
RG1	No photobiological hazard under normal behavioral limitation
RG2	Does not pose a hazard due to aversion response to bright light or thermal discomfort
RG3	Hazardous even for momentary exposure

Re-look at the Design Brief



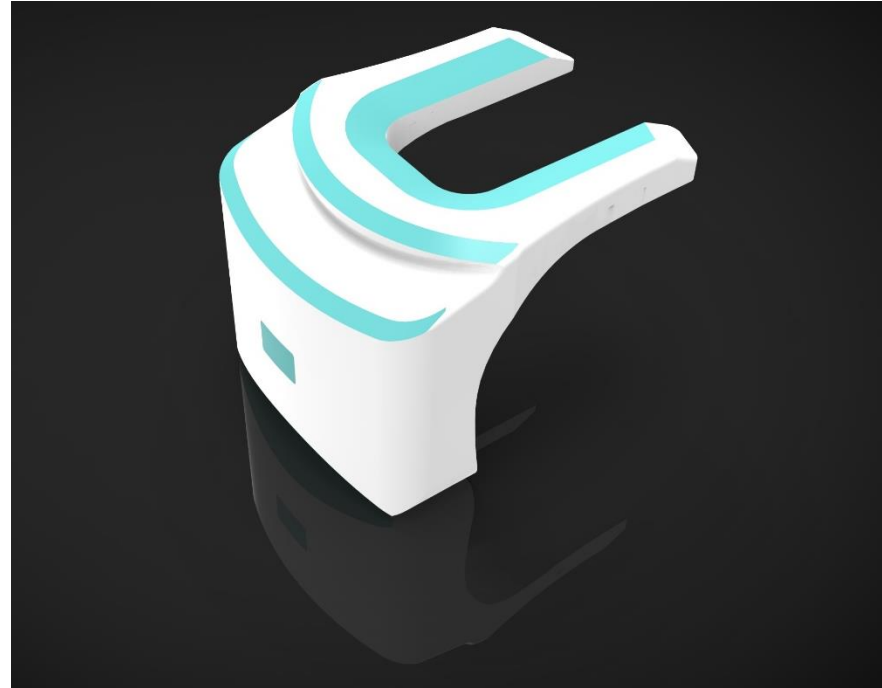
Device is portable



Re-look at the Design Brief



Aesthetics



LEARNINGS FROM THE PROJECT

- Choice of area of work – Healthcare
- God is in detailing
- Functional yet minimalistic

FUTURE WORK

- To make the 'U' top thickness lesser (in terms of 0.5mm)
- Have a variable vein viewing area
- Make custom made components
- Pilot Testing

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