SYNAPSWEAR

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FABRICADEMY PROJECT

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FABRICADEMY
textile and technology academy

IBERO
PUEBLA
IDIT

CONTENT

01

THE PROJECT

WHAT IF TRAINING THE MIND COULD BE AS SIMPLE AS PLAYING?

The idea to create this project came form a personal desire of wanting to understand more about electronics, and being able to apply them.

I've always been curious about robotics, electronics, mechanics, and similar fields. Even though I find them fascinating, I've never had the chance to properly learn or explore them. That's why this project felt like the perfect moment to start exploring these areas and to combine what I learned in Fabricademy, specially in the weeks of wearables and e-textiles with my background as an industrial designer.

Synapswear is a project to develop a pair of gloves as an interface that allows the person wearing the gloves to work on different cognitive functions through visuomotor coordination.

The programming is the core of the project, since it defines the dynamics, the sequences, and the entire interaction experience; without the programming, the glove is just hardware; it's the code that turns it into a cognitive training tool.

***This project is exclusively for recreational use and should not be interpreted, applied, or relied upon for any medical purpose**

02

INTRODUCTION

RESEARCH

COORDINATION

Hand eye coordination is key to maintaining our independence. It is important to emphasize that even thought this process declines over time, we can improve our hand-eye coordination by exercising our minds," (Godman, H. (2021, 1 septmeber).

“Visuo-motor coordination (VMC) requires normal cognitive executive functionality, an ability to transform visual inputs into movement plans and motor-execution skills”
(Inzelberg, R., & Hocherman, S; 2008)

NEUROPLASTICITY

“ Neuroplasticity, or brain plasticity, is the nervous system's ability to modify its structure and function in response to new stimuli, learning, or injury. Brain plasticity operates at multiple levels: from microscopic changes in synaptic connections to massive reorganizations of entire brain areas” (De Medeiros, 2025).

COGNITIVE FUNCTIONS

Cognitive functions are what happened in the brain so we can process information and perform activities, this involves millions of neuronal connections distributed throughout the brain lobes, and depending on the task/stimulus the activation of different areas.

When do cognitive functions start to deteriorate?
Aging is the primary reason of this happening, now, how this process happens, along with health, functional capacities, depend on both the genetic structure and the environment that has surrounded us throughout our lives.

Of course, neurodegenerative diseases, neurodevelopmental disorders, mental illness, intellectual disabilities can also play a role in the deteriorate of this functions.

Can we preserve cognitive functions?
Yes, “it has been shown that this deterioration can slow down if we keep a healthy life, active, and stimulating environments, specially working on our abilities through cognitive stimulation practices and exercises”. (NeuronUP, n.d.)

GAMIFICATION

This term refers to the technique where game-design elements or strategies are used in non-game context.

To successfully apply this concept, it is needed to specify: - What is it that we want the people to do. What do we want to measure?

- Who is it going to “play”. What motivates them.
- What is the trajectory of activities. Small victories.
- What's the fun part?
- What techniques and tools are we going to do

(Escobar, C., 2024)

“Earlier studies have demonstrated that playing video games can benefit cognition. Cross-sectional and longitudinal studies have demonstrated that the experience of video gaming is associated with better cognitive function, specifically in terms of visual attention and short-term memory , reaction time, and working memory” (Brilliant, D. T., Nouchi, R., & Kawashima, R., 2019).

Taking the previous research as reference, playing games can stimulate the mind, and that is the core of this project, to develop a versatile interface that would allow play different dynamics though hand-eye coordination improving other cognitive functions. The variable changing to be able to play different games is the programming, whether speed reaction, or bimanual asymmetrical movements, or memory, or simply matching the color, etc.

INSPIRATION

The main sources of inspiration for this project were existing famous games and dynamics, which are off-body, hard options, since, as explained, the purpose of this project is not to create a new game, but the interface as a wearable that allows playing different dynamics with the same components.

FABULOUS FRED:

The popular game Fabulous Fred is a device developed in the 1980s by the company Coleco. This interactive game integrates visual and auditory stimulus with instant reactions to follow, which allow this toy to be used both for fun and recreative ends. Their characteristic design consist in color buttons, lights and auditory signals that activate according to the

selected game: the most common being follow the sequence, auditive recognition and visuomotor skills.
This game could work different aspects of mental process, such as working memory, information retention.

And the reproduction of progressing complex sequences; this making significant changes on temporal information manipulation, which are essentials to academic learning and the resolution of different everyday activities.

BOP IT:

Bop it is an electronic interactive game, designed by Hasbro in the 1990. This device consists in voicing the instructions “bop it” “twist it” “pull it”, the reactions had a limit of time to be done, each time the speed and complexity increases, making this toy a combination of both entertainment and cognitive significant stimulation, thus working on sustained attention and selective attention, because the participant must listen, discriminate and respond only to the relevant instruction within a continuous flow of auditory stimuli.

LIGHT REACTION/LIGHT SPEED

Light reaction games encompasses a variety of dynamics; They are a collection of electronic devices with luminous reaction as an interactive design to train the mind using only visual stimulus. It consists in a surface or panels with lights that flash randomly and rapidly, so the player is supposed to press them before they disappear, this game can include different dynamics, whether the tricky part is speed, number of lights on, a specific stimulus, etc.

03

ELECTRONICS

TESTS

I used a breadboard to make the multiple connections, pieces with copper tape (sensors), neo pixels and jumper for the connections.

I crafted the "sensors" by sticking a piece of conductive tape to a piece of foam, and stripping a wire, covering it with another piece of tape.

This were all the components I used to test the codes before transferring them to the actual project.

I placed each sensor with their corresponding neo pixel, declaring this order in the prompts, and one sensor connected directly to GND, so that when touching that one with whichever of the others, it would get the signal that the correct action was carried on.

To create the code, I instructed the AI (ChatGTP) to run the games by connecting a data wire to GND. The entire system works with **INPUT_PULLUP.** Touching the correct pin with GND sets it to **LOW.**

To make the code register that the action corresponded to the stimulus (neopixel), I made the pairs like this:

```
// ----- PINS -----
#define PIN_GND D4 // NeoPixel GND
#define PIN_C1 D1 // NeoPixel C1
#define PIN_C2 D2 // NeoPixel C2
#define PIN_C3 D3 // NeoPixel C3

#define WIRE1_IN D6 // Digital input WIRE 1
#define WIRE2_IN D7 // Digital input WIRE 2
#define WIRE3_IN D8 // Digital input WIRE 3

#define PIN_RESTART D9 // Reset button

#define NUMPIXELS 1
```

In this first stage I had thought that the dynamics would be referenced to a neopixel on the thumb, but for the final prototype I changed it so that only the other four fingers would have neopixels, and the thumb would remain only as GND.

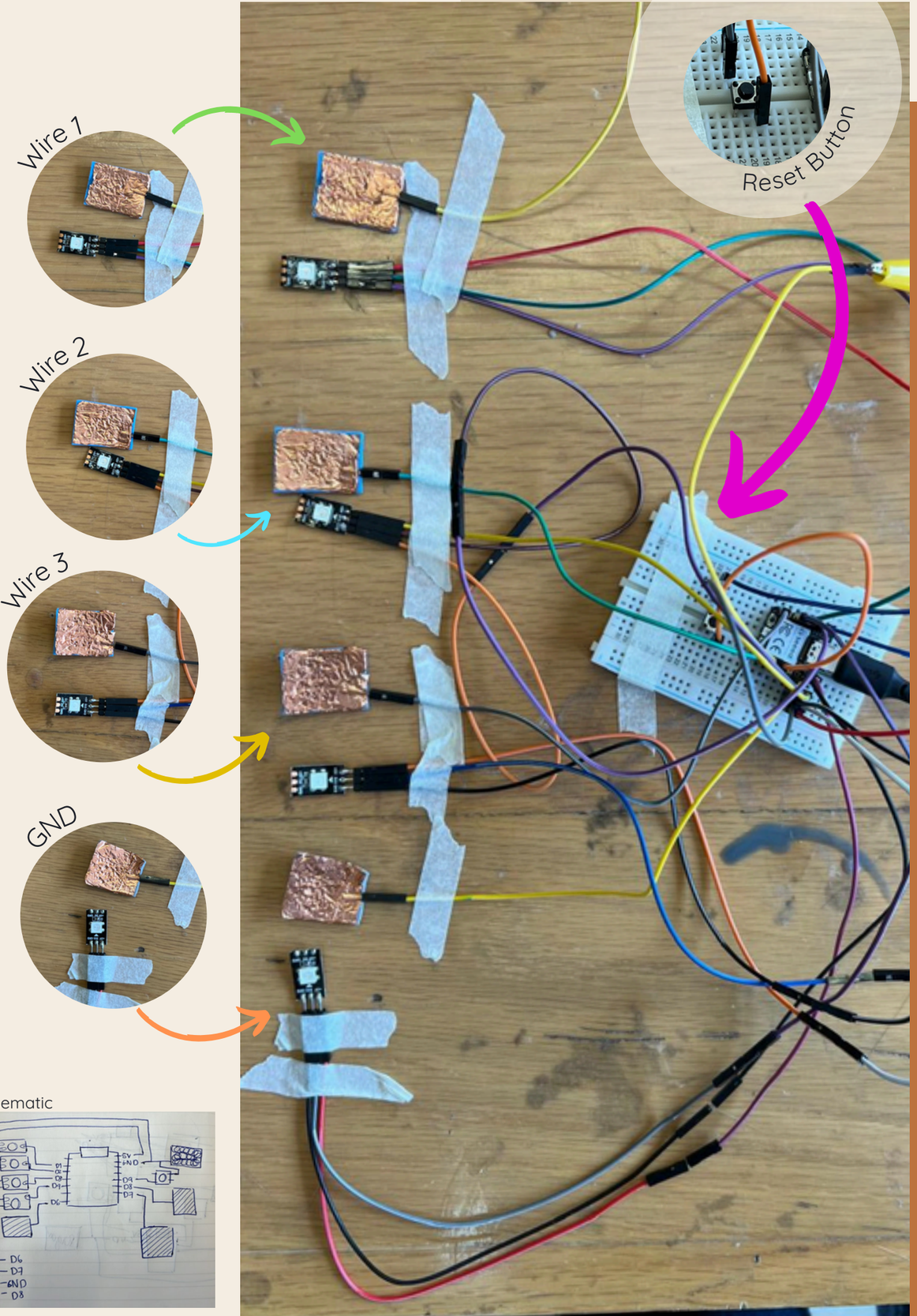
These were the pairs I made for the final codes:

```
// ----- PINS -----

#define PIN_C1      D1   // NeoPixel C1
#define PIN_C2      D2   // NeoPixel C2
#define PIN_C3      D3   // NeoPixel C3
#define PIN_C4      D4   // NeoPixel C4

#define WIRE1_IN   D5   // WIRE 1 input
#define WIRE2_IN   D8   // WIRE 2 input
#define WIRE3_IN   D9   // WIRE 3 input
#define WIRE4_IN   D10  // WIRE 4 input

#define NUMPIXELS 1
```



Schematic

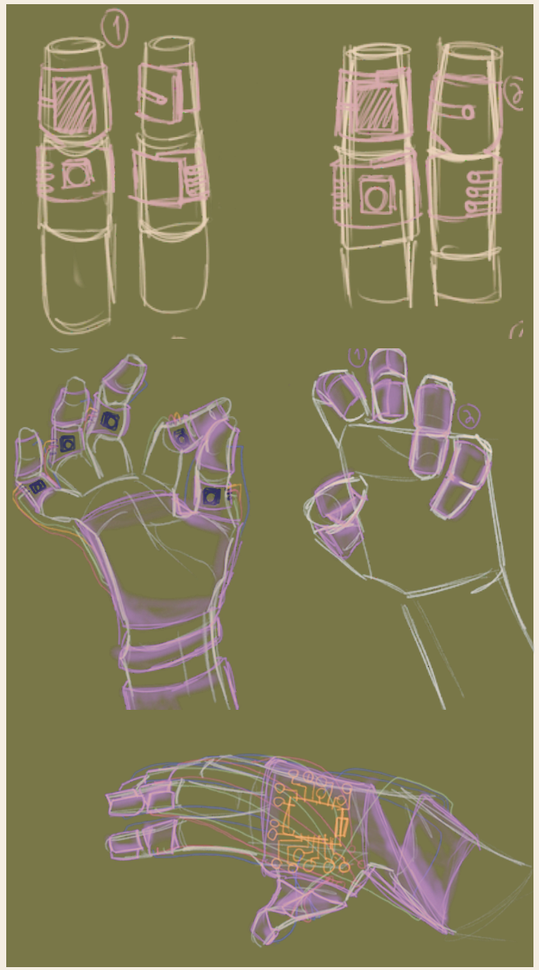
04

PHYSICAL FORM

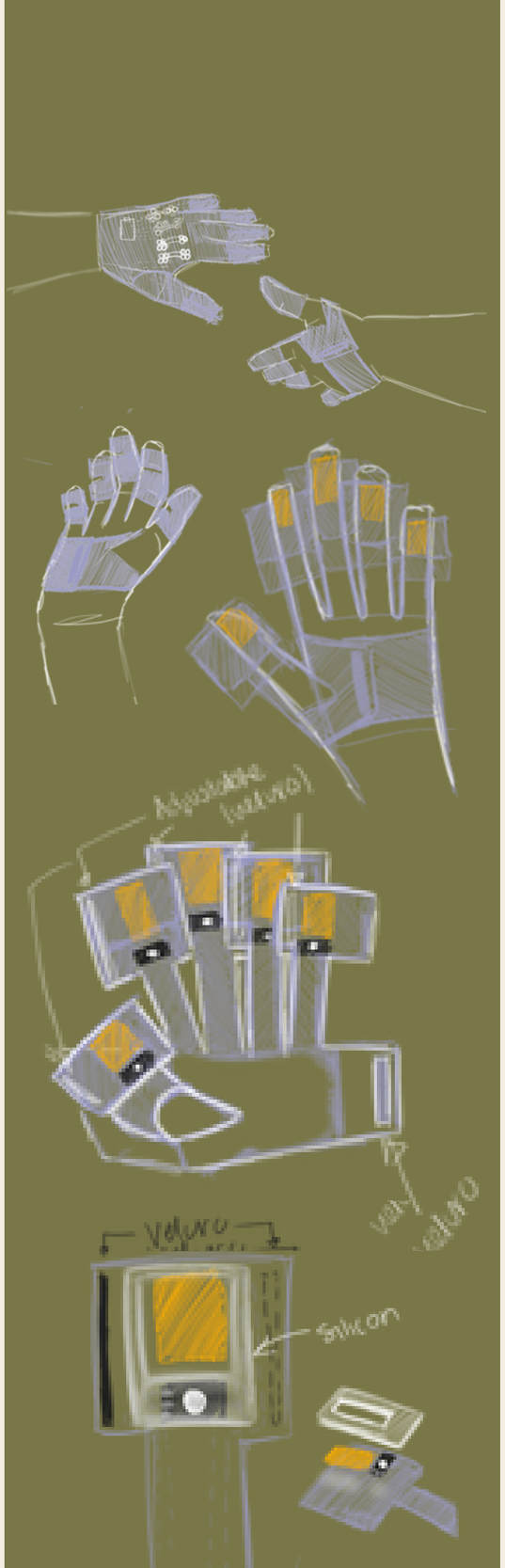
FIRST SKETCHES

To begin I started by narrowing the type of interaction I wanted the user to have to whatever the final design be. Opting for a kinesthesis interaction, processing the information thought a fisical experience, object manipulation and movement, receiving the information visually.

After making some interviews with close friends and explaining the project among with the ideas I produced, most told me that the gloves sounded interesting and if I could manage, a very challenging dynamic. I also talked with a phycologist about the idea to have a professional point of view before making a decision; her comments where that it would be an interesting approach to brain gymnastics, neuroplasticity, since there are few that use fine motor skills by simply focusing on the coordination of the fingers.



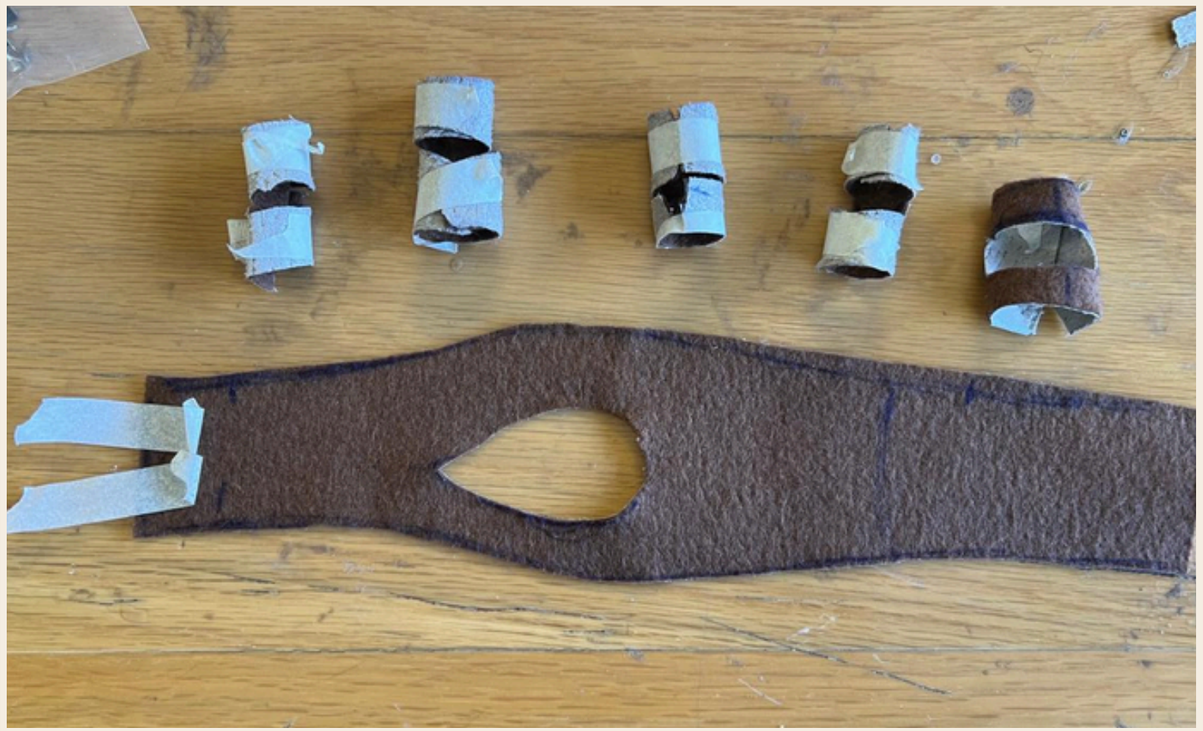
I was imagining placing the neo pixels on the middle part of the finger and the sensor on the fingertip, but I haven't considerate that when making the movement of tapping, that would make the person using them loose sight of the neo pixel for a fraction of time. So, I thought of using silicon to dissipate the light and make it able to see from the laterals, or even from behind, Unfortunately I didn't have time to apply this on the final prototype due the time.



FIRST PROTOTYPES

I made a first raw prototype to help me visualize more in a 3d space the dynamic of a “decompose” glove implicates, all the parts I needed to design, and how to arrange the components on the fingers like the microcontrollers and neo pixels. It also helped me to be able to have an idea of the space i had to place the components.



01. proposal




02. proposal



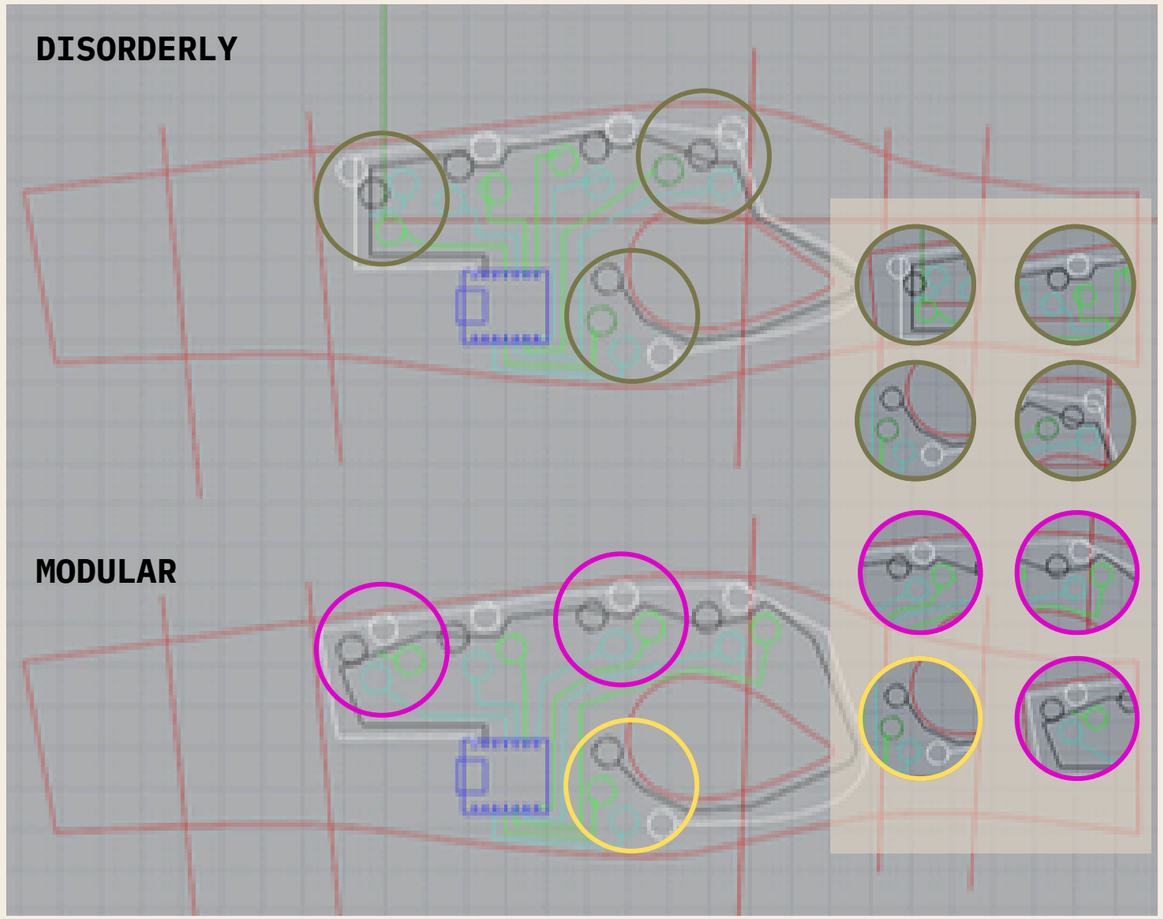

03. proposal

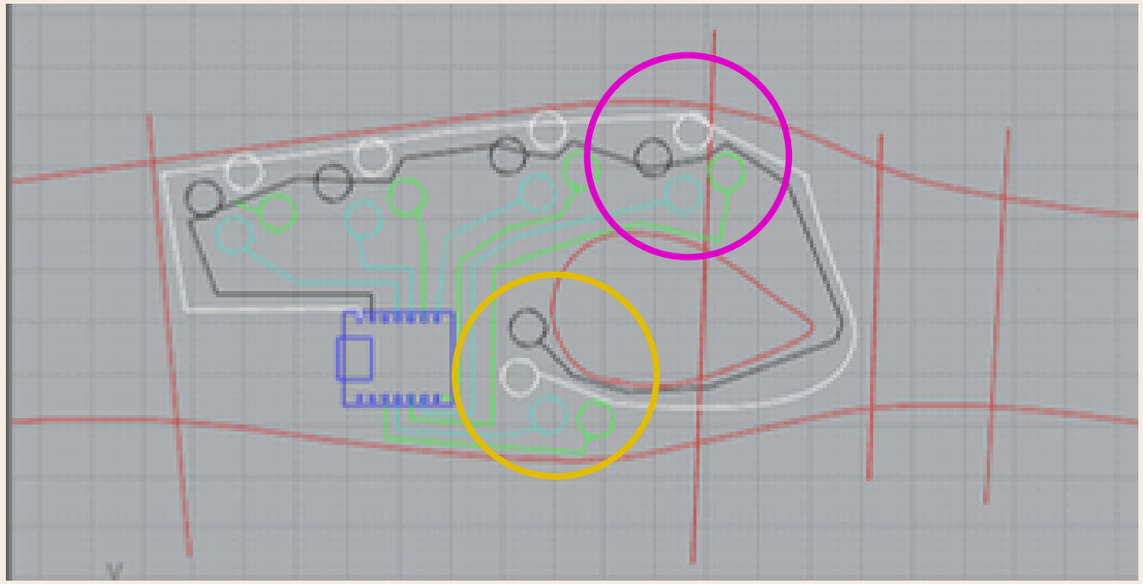


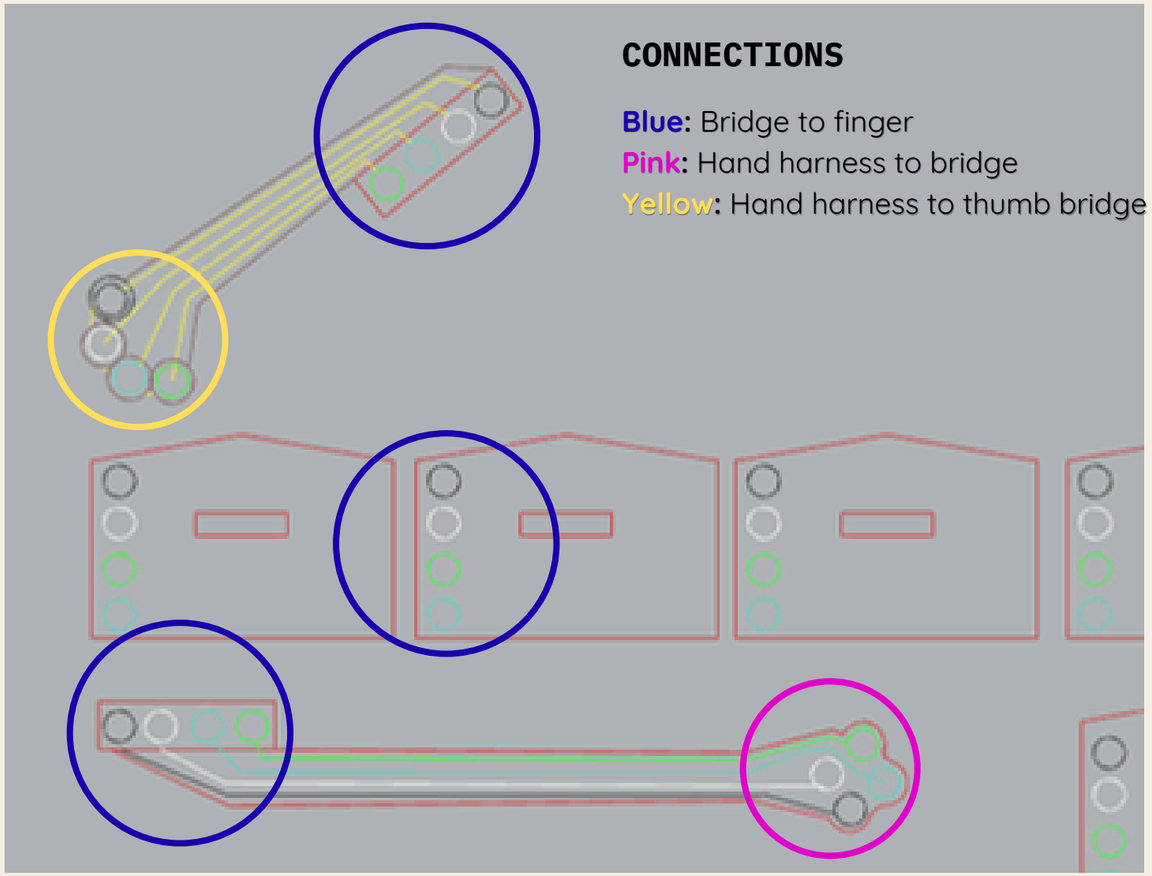


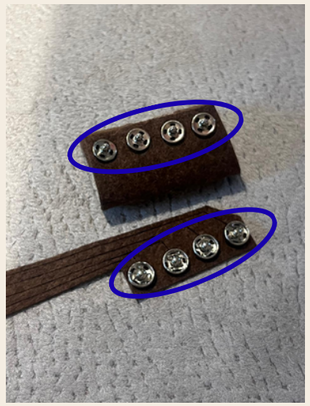
ELECTRONICS PROTOTYPE

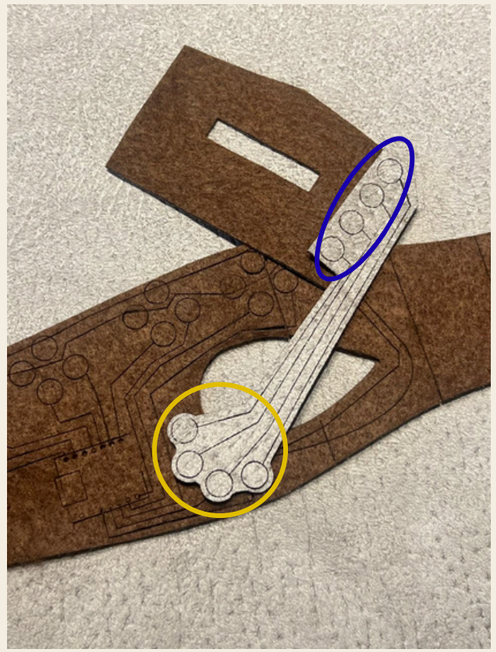
The next prototype was more focused on the electronics. I wanted to imitate a PCB to be able to distribute everything on the back of the hand. Using the model I previously made with the components, I displayed everything tracing the paths where the conductive thread would go, verifying that the space was enough to avoid contact between connections, that determinated the minimal size for the hand harness.

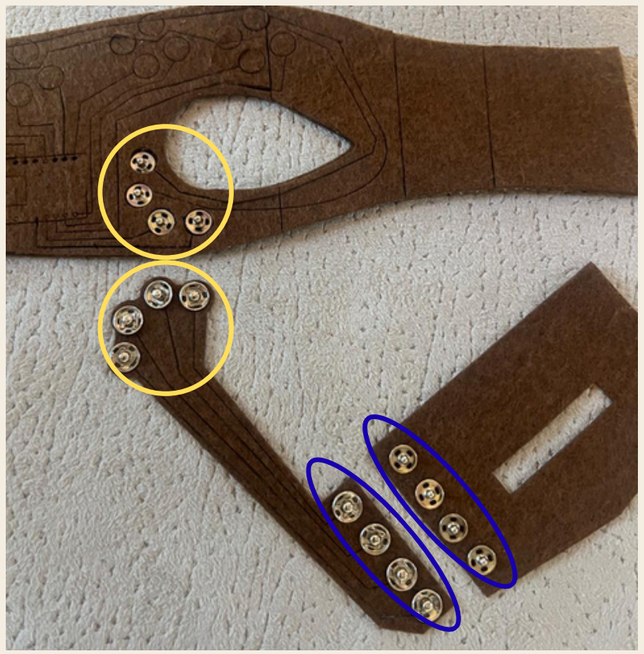


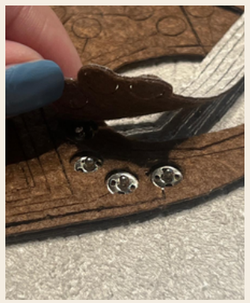




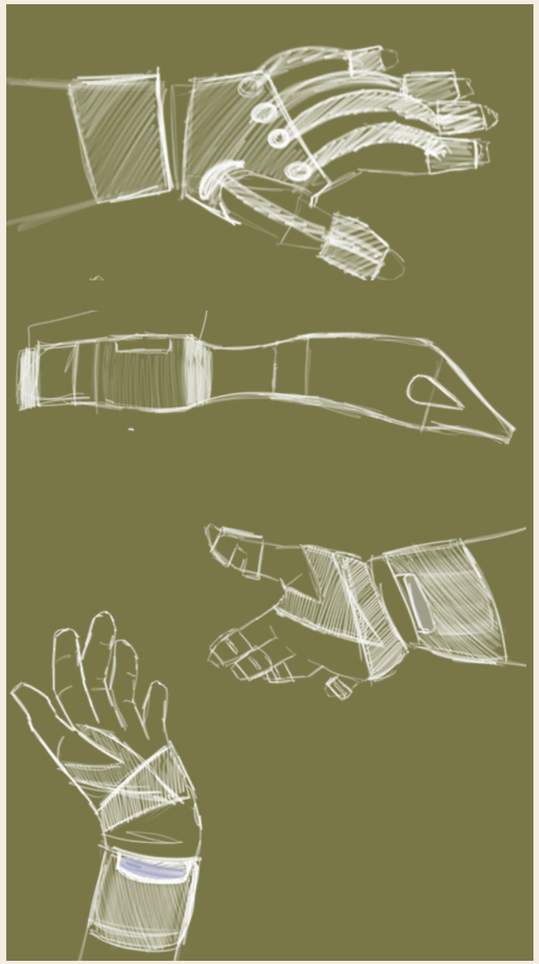


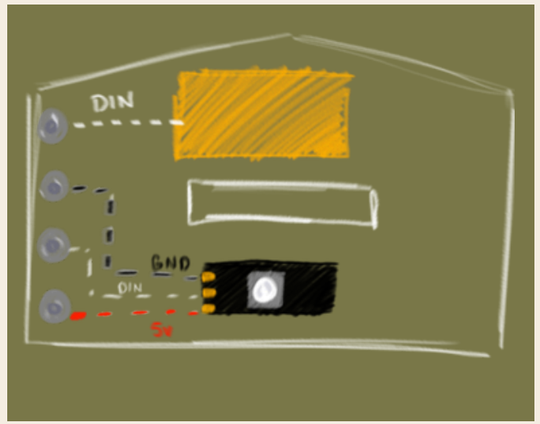


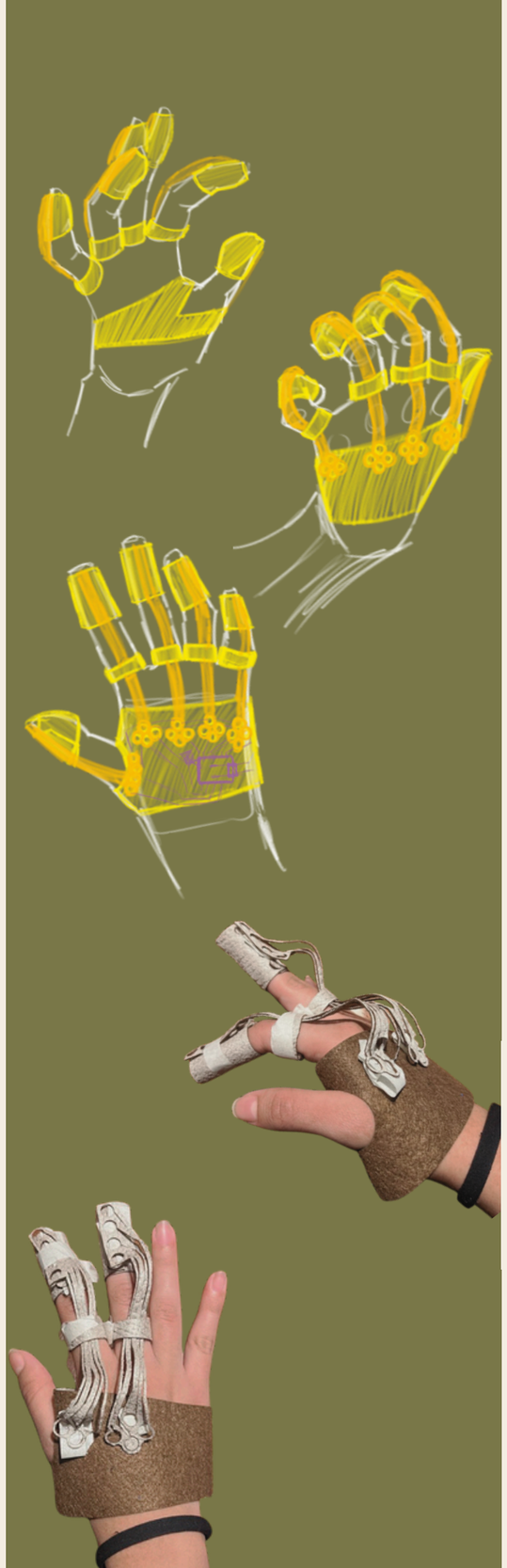


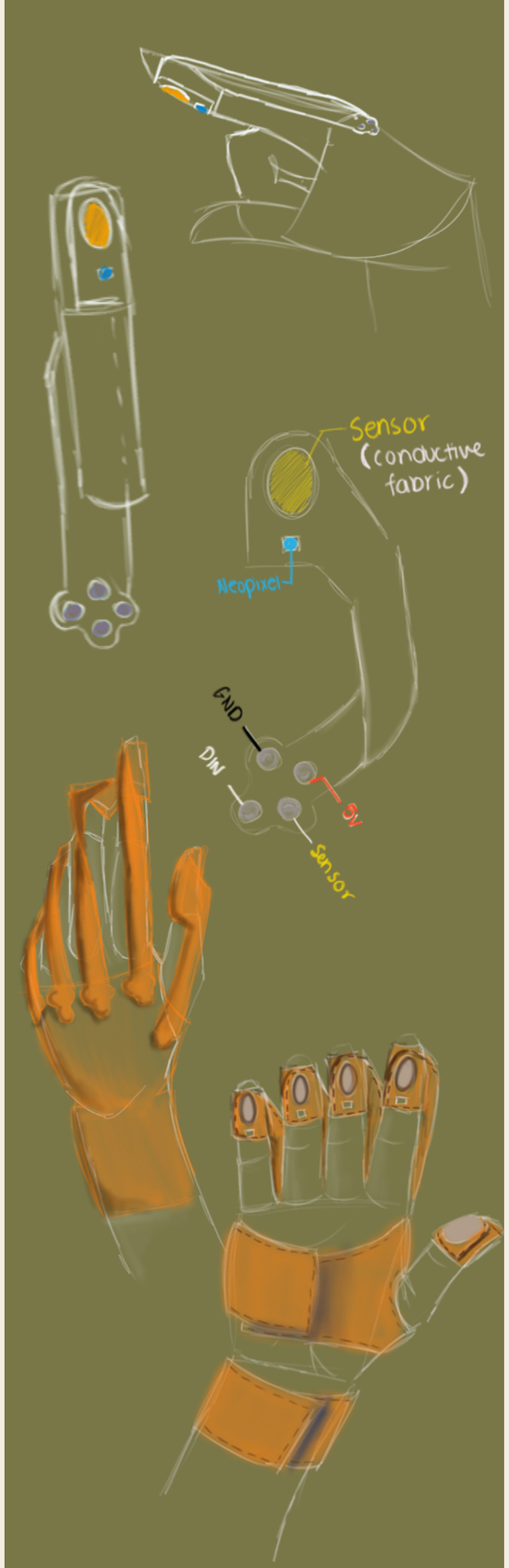


The design essentially kept the same through the iterations, there were just small details that I change to get to the final design. Instead of dividing in two different pieces the parts of the fingers, I made a more direct design, leaving only the connections from the hand harness to the long piece of fingers. Adding to the hand harness so that it could be secured at the wrist for a much more secure fit.









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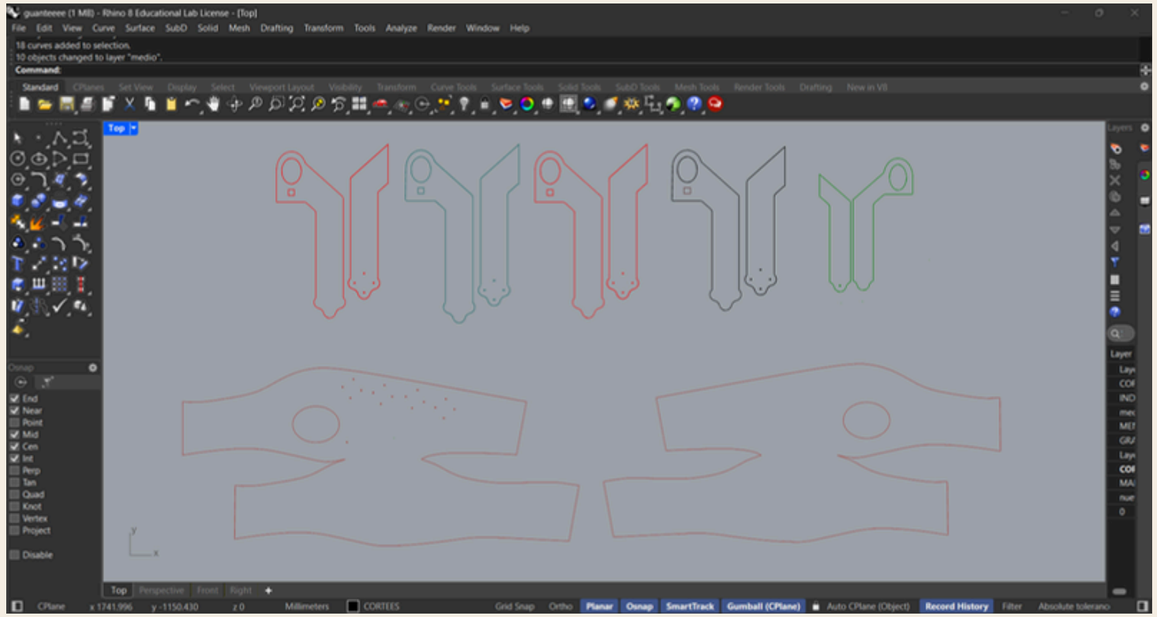
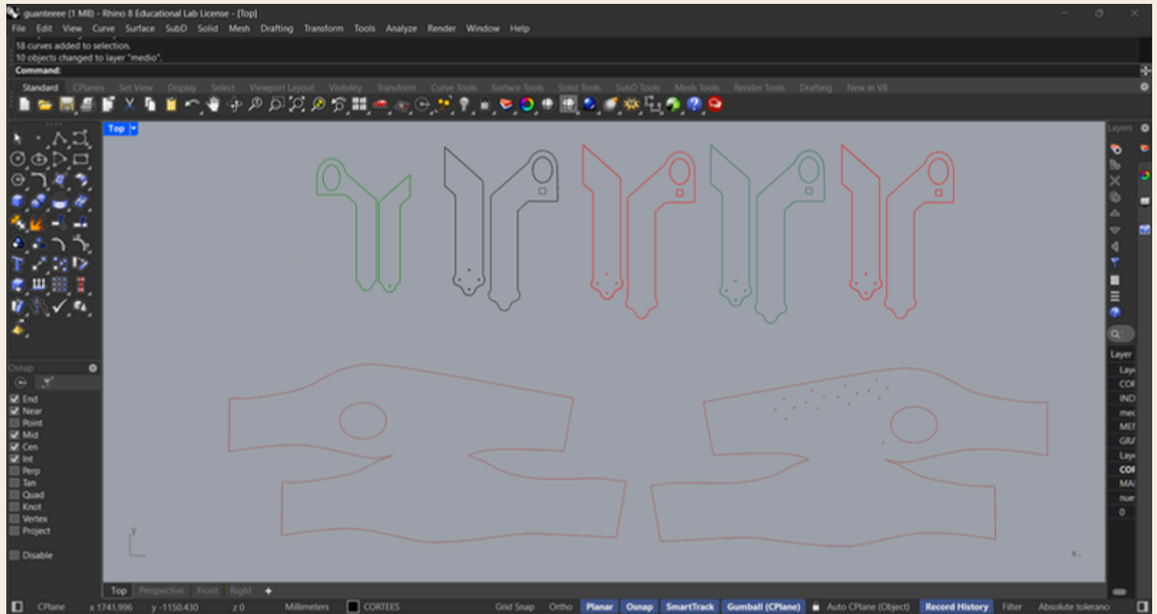
FINAL PROTOTYPE

PARTS

01 TRACE

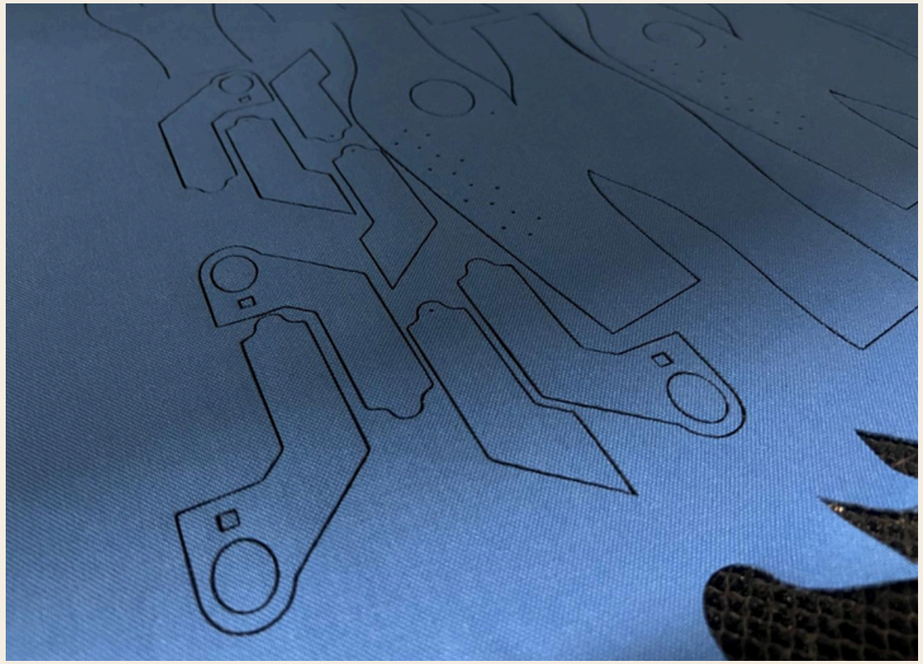
Created all the layouts of the pieces in Rhino and then export the curves to a DXF file for laser cutting.

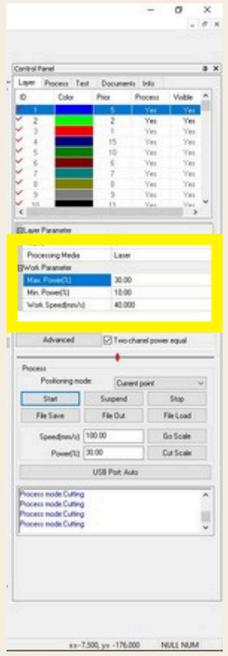




02 LASSER CUT

Before cutting the final pieces, I did some tests to determine which way to cut the fabric, since the spandex could cause them to deform losing structure and shape, and to determine de values of power and speed to work with.





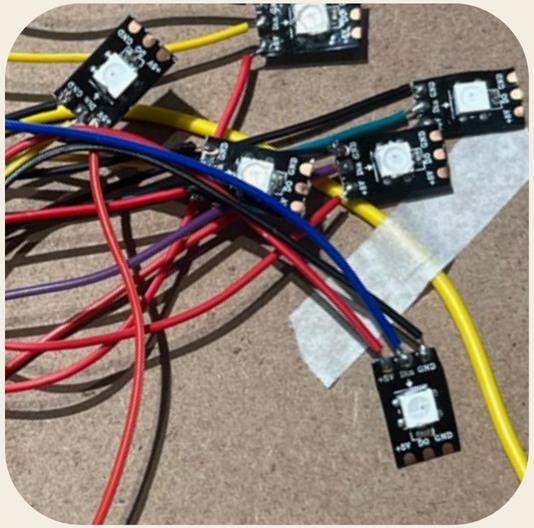
Max. Power (%)	30.00
Min. Power (%)	10.00
Work Speed (mm/s)	40.00

FINGERS

Each finger has a piece of conductive fabric at the fingertip, and underneath it, the NeoPixel.

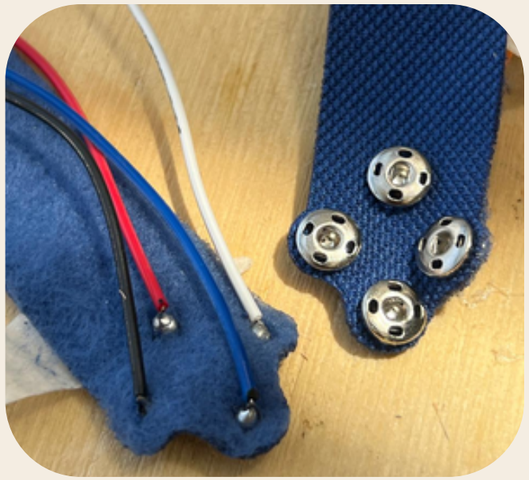
Connections run down to metal pins to connect to the hand harness.

01 NEOPIXELS



I started this process by soldering all the neopixels, leaving the wire long enough to reach the bottom part. I tried to use always red for 5V, black or grey for GNR, any vibrant color for DIN.

02 NEOPIXELS TO METALLIC SAFETY PINS



For this pieces I used the female part of the safety pins. Pasing the other end of the wiretrough the holes, since I couldn't solder directly in the fabric, because it would burn. Sewing them to recure them to the fabric.

03 CONDUCTIVE FABRIC AND NEOPIXELS

I placed a piece of conductive fabric and the neopixel in their corresponding place, securing them with little silicon and then sewing.

04 THIMBLES

To make the thimbles I used rectangles of 5mm of heigh, and the width depended on each finger. For better finishes the longer edges were the first to be sewn, then added the piece with conductive fabric and neopixel, secured them with pins.

05 LONG SECTIONS

Once I had all the pieces with the components, I sew first the longer sections, the bottom part with the metallic safety pins I had to hand sew to completely close them.

06 CLOSE THE THIMBLES

Finally sew to close the thimbels.

HAND HARNESS

The purpose of the hand harness is to house all the microcontroller connections and distribute them so that all fingers have access, since pins such as voltage and ground must be shared. It has a double closure, one at the palm and one at the wrist.

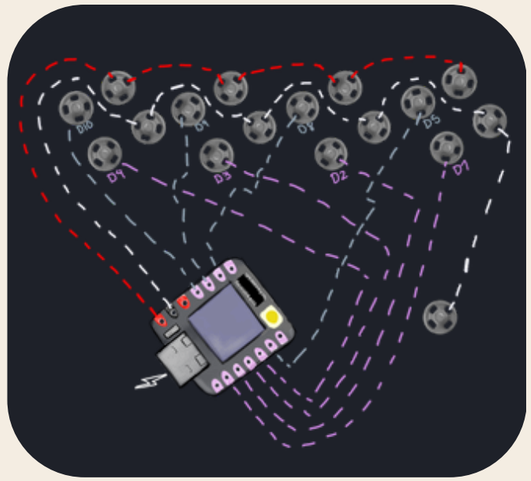
01 TOP EDGE

To begin the hand harness, I sew the top edge.

02 METALLIC SAFETY PINS

In the laser cut I traced a circle in the middle of where the safety pins would the located to have them as a reference, trying to center them as much as possible secure them to the fabric.

03 MAP CONNECTIONS



Since I was going to use conductive thread, it is like working with an open wire, so nothing could be near other connection. Before sewing I traced the routes and where they cross pathed, so I could know where to go under or over the fabric, creating the bridges.

04 LEATHER

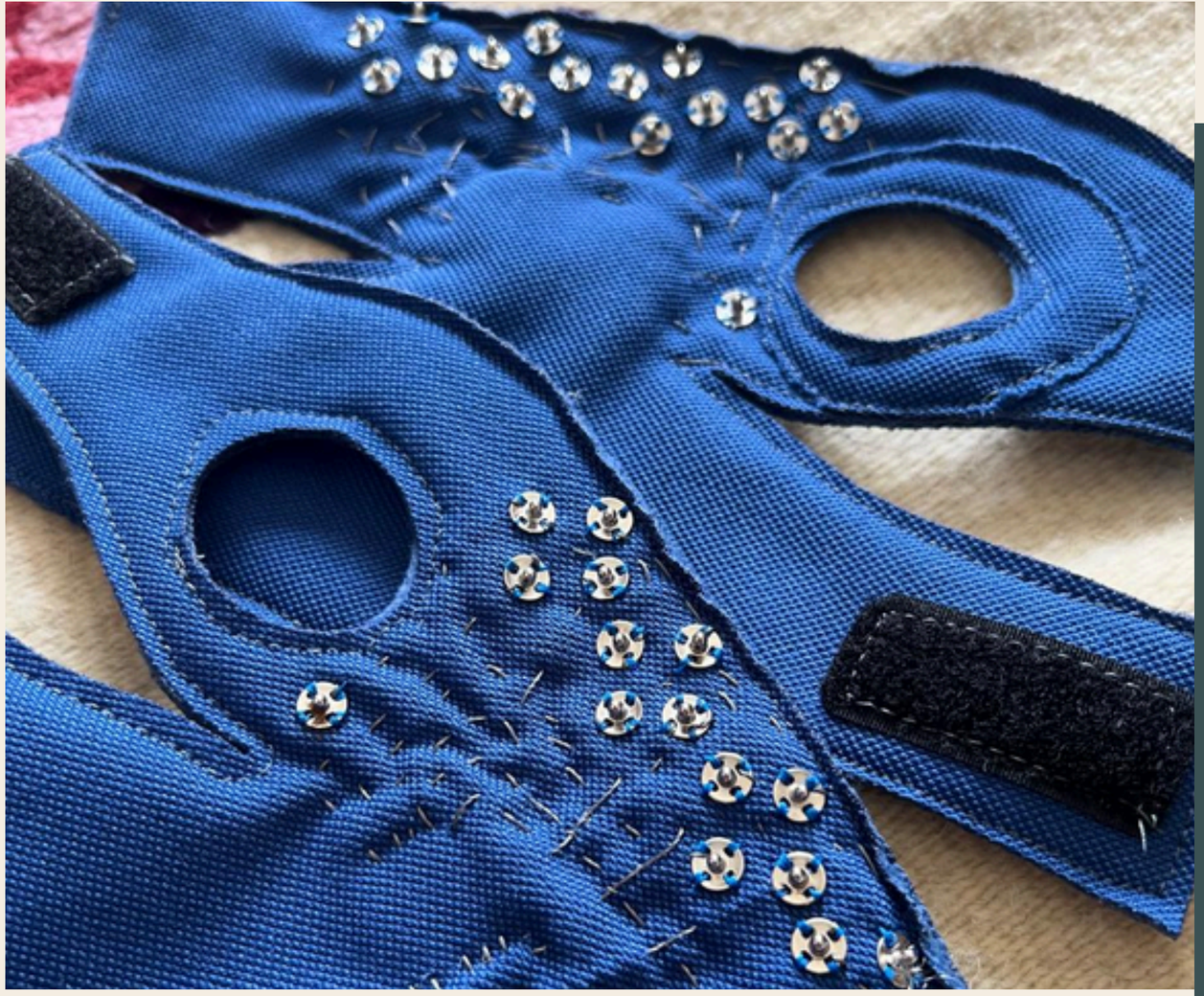
I used a piece of leather to distribute the connections from the microcontroller and prevent once again that something made contact.

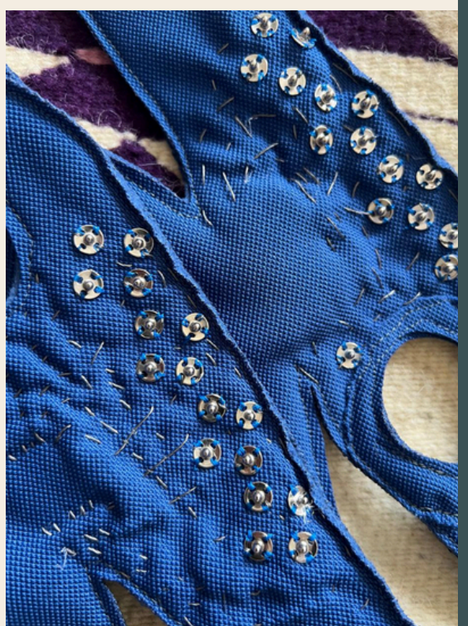
05 CONNECTIONS

Following the map, I sew the connections. After, I verify with a multimeter all the connections, and that the safety pins were conducting accordingly

06 VELCRO

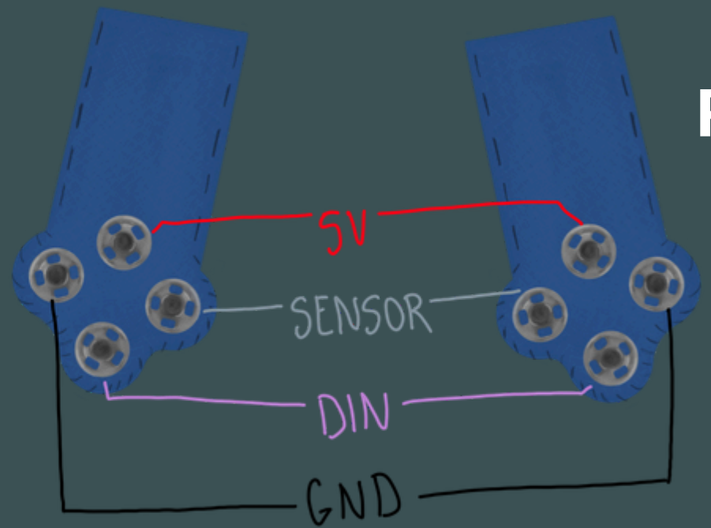
To close the hand harness around the hand and wrist I added Velcro on both ends and finally sew to close them.





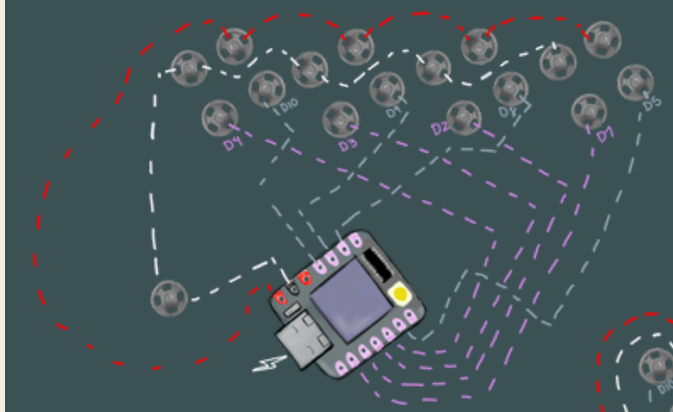
VISUALS

LEFT



RIGHT

LEFT



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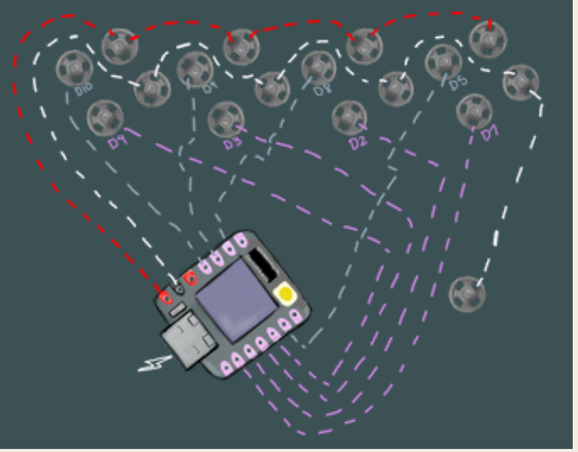
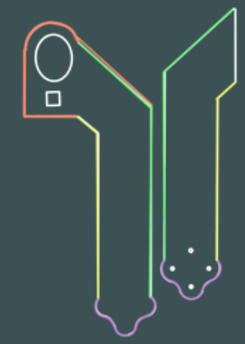


*These connection diagrams are like seeing it from the inside; they are the routes I followed to sew, so they should be interpreted in reverse when viewing the final result from the outside.

HOW TO SEW THE FINGER PIECES



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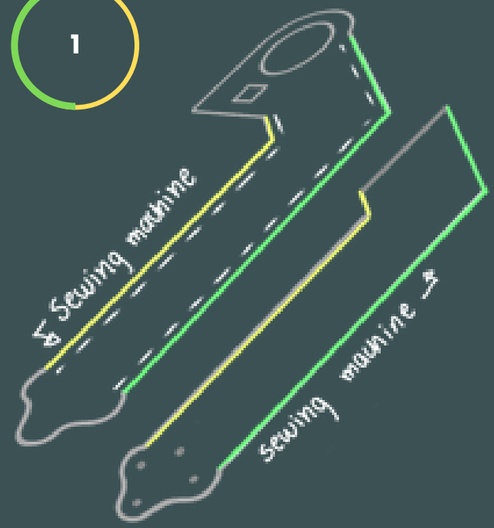

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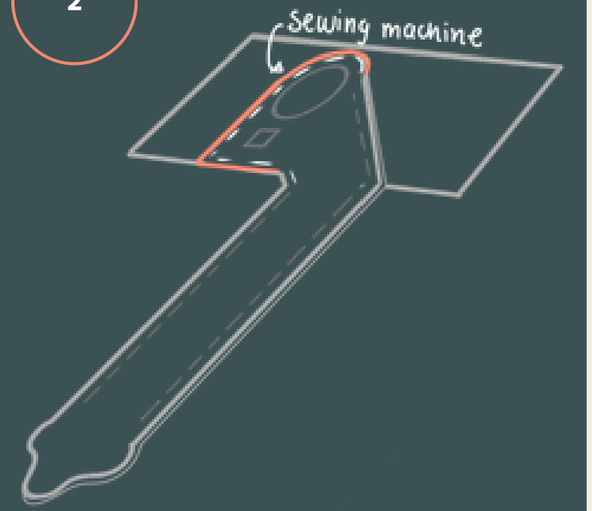

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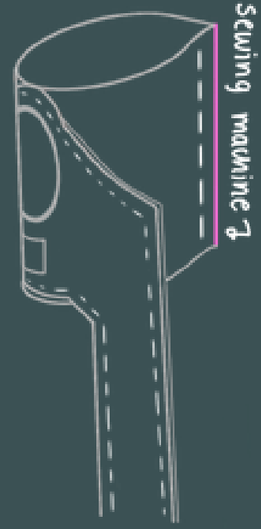

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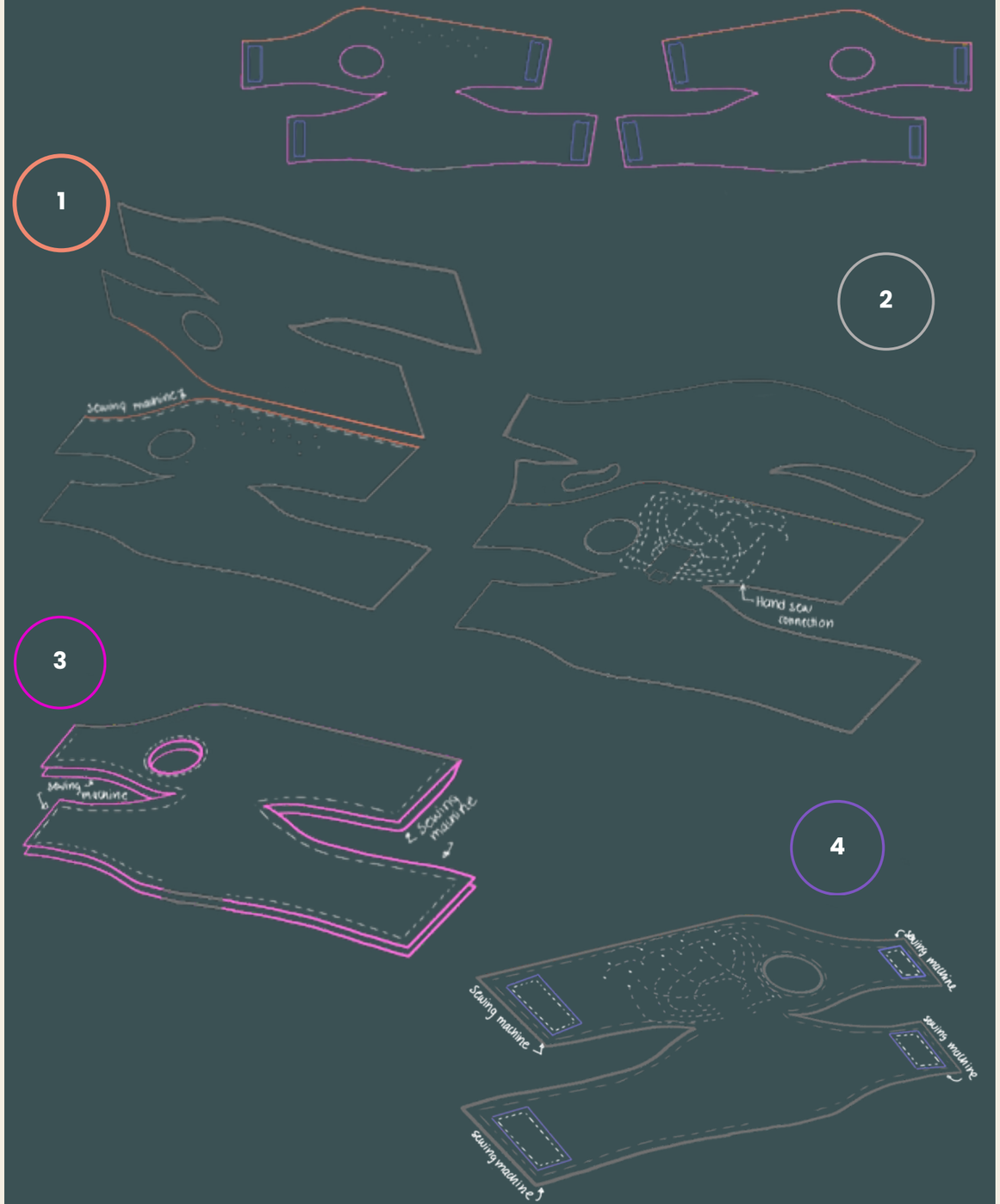
HOW TO SEW THE HAND HARNESS



BoM

MATERIAL	QTY	DESCRIPTION	PRICE (MXN)
Fabric	2m	Polyester	$200.00
Conductive thread	1pc	stainless steel	$270.51
Conductive Fabric	1pc	Zinc	$174.27
Conductive Tape	1pc	Copper (1in)	$305.99
Neopixels	8 pcs	ws2812b neopixel	$471.37
Microcontroller	2 pcs	XiaoEsp 32 S3	250.00
Welding	1pc	tin/lead (60/40)	$59.00
Metallic safety pins	34 pcs	Diameter 7.5mm, Zinc	$12.99
Powerbank	2pc	Power Bank de 5,000 mAh USB	$199.00

Machinery: Laser cutter, sewing machine.

Tools: Multimeter, fabric scissors, soldering iron, cutter, needles, pins.

GALLERY


CALVIN KLEIN
1968

06

REFERENCES

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SYNAPSWEAR

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FABRICADEMY PROJECT

2025-2026

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