

# SYNE

/master's  
thesis



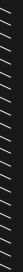
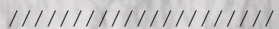
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# /intro to this\_project

For whoever reads this paper, I would like to make a disclaimer: This is not a normal thesis. It does not specify technical issues, it does not present a lot of data or references, it does not tell you how to develop such a project step by step, but it does not pretend to do so either. This is a summary of what my year at *MDEF* has been like, of the path (sometimes easy, sometimes difficult) that I have followed, of how I have faced new challenges and how I have grown as a maker and as a person.

In this thesis there are many reflections about myself, my ideals and what I want to fight for. Reflections on different presents that can create different futures, on issues that have an opportunity for action and that currently affect our society (*Weak Signals*), on what we can do and what is in our hands to make the world a better place by doing what we like to do.

Throughout these pages, we also present various interventions made during this year, explorations and artefacts created in order to validate our purpose. All of these form what in the end is my Master's Final Project, a combination of my learning and experimentation throughout this course. Each of its parts has been relevant in order to define the path that I have finally taken and that has led me to ***SYNE***, a project focused on vindicating and democratising the senses and extending our perception of the environment. But we'll talk about that later :)



# /what's\_in\_here?

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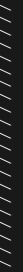
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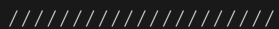
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# /chapter.0

defining\_the\_  
basis







# /my\_fight

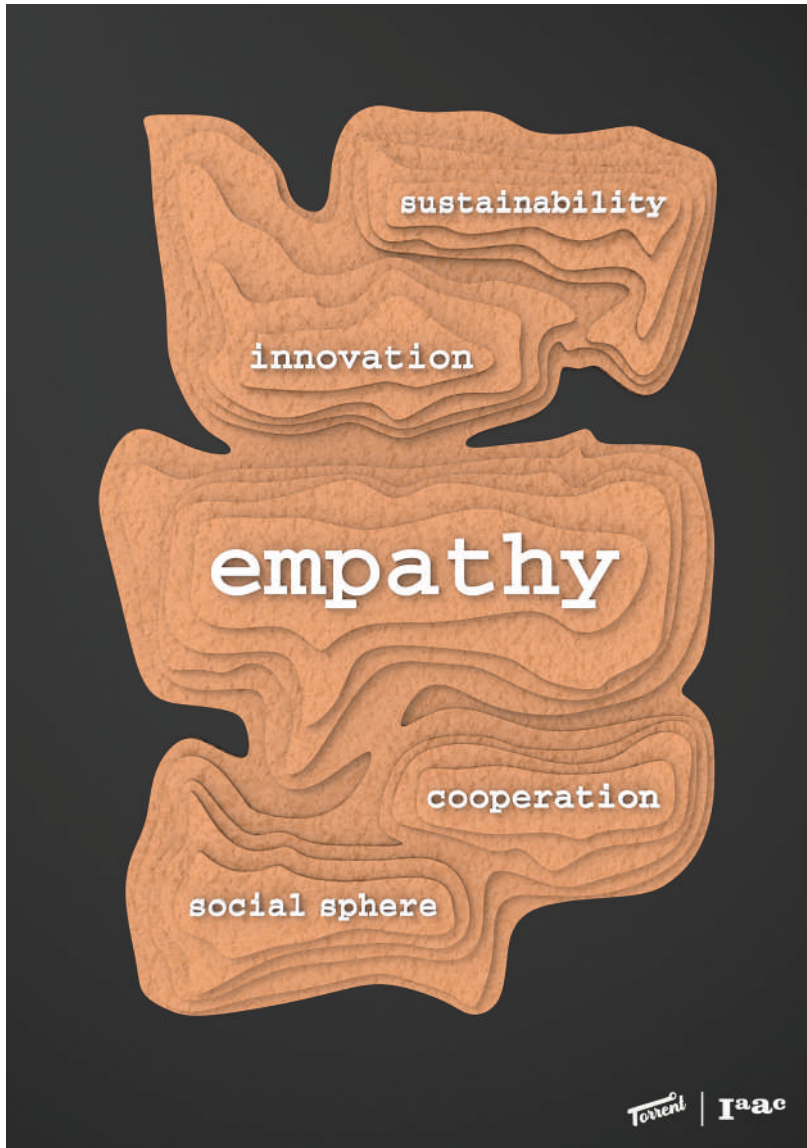


fig.1 'My fight' poster

My main fight is based on the **empathy** concept. Nowadays, our society has many problems because people forget about this value. No one puts his/herself in other people's shoes and everyone looks after the own interests. Many things would change if people would try to understand the realities of others, the situations they have to live through, the issues some people have to put up with. With empathy, wealth would be distributed in a better way, nobody would judge those outside the standards, we would all **think more about our environment and society** would work much smoothly.

As a designer, I want to bring the concept to my field. I believe that **good design only makes sense if it is empathetic**, if it has a function to improve living conditions, if it is capable of helping. And don't get me wrong, design based only on aesthetics is a relevant art form but, from my perspective, form always has to be tied to function, and this has to be the main goal.

Our creations are what define our environment, and **the more empathetic our environment is, the more empathetic we will be.**



# /personal\_development\_plan.

I would like to focus my strong personal development plan on the idea I had when I decided to choose this master's degree, which was to discover new fields and explore many different areas. My intention was to improve my resources as a **maker**, learning more about electronics and programming, materials and prototyping machines.

After these reflections I have realised that I also want to learn about **other fields** such as project documentation and communication, working with communities, discovering the world of AI, biology and agriculture, etc.

In conclusion, my personal development plan will be founded on getting to know in depth all these topics that I haven't yet had the opportunity to deal with and then be able to use them in my professional future.

In addition I have developed the process of analysis and reflection on myself and my expectations for this master's degree. As you can see in the diagram below, this process consists of 4 steps. The first two are the result of the work we did in the first Design Studio session and two others come out of the subsequent personal work. The subjects developed in this diagram are the following:

1. Description of my **identity** in terms of skills, knowledge and attitude.
2. Concepts that caught the attention from my classmates after doing the meetings and talking about our **skills, knowledge and attitude**.
3. **Desired professional identity** based on my vision and on the conversations with my classmates.
4. What **I want to learn** from the courses I will take during this master's degree.

# 1 skills

modelling  
learning facility  
resolute

3d printing  
design vision  
handcrafting

# knowledge

engineering  
digital fabrication  
socio-cultural sphere

politics  
design

# attitude

open-minded  
empathetic  
always aiming to learn

cooperative  
ambitious

# 2 meetings with classmates

communication skills  
looking forward to challenging herself  
passionate about biomaterials  
skilled in conceptualising and graphic design

keen on working with her own hands  
experience creation and storytelling  
interested in learning Grasshopper

fashion knowledge  
handcrafted ceramics  
interested in cognitive science and cognitive psychology

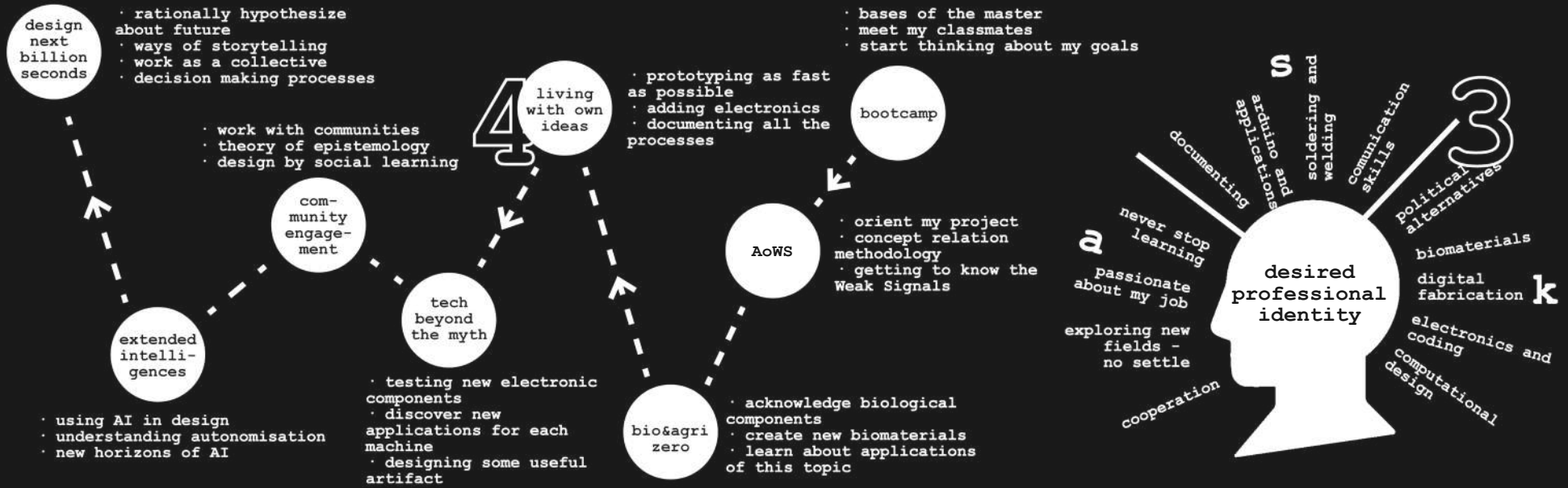
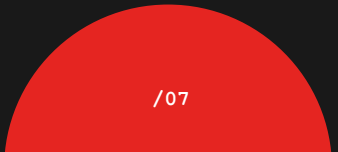


fig.2 Personal development plan diagram





# /chapter . 1

research\_  
through\_design



# /setting\_a\_workspace

One of the first tasks we had to do for the Design Studio was to create our own **Workspace** considering four main topics: materials, tools, infrastructure and people. These are the four pillars that sustain any design project. Reflecting on this subject, I started listing all the resources I had around me that could be useful in any of the main areas I wanted to focus on.

About **materials**, I thought of all the elements we use at **Ateneu de Fabricació** and that are commonly used also in any **FabLab**. However I also added some others that I might want to explore as textiles and metals.

Regarding the **tools**, I also took into consideration all the machinery FabLabs have, also adding some electronics, programs and objects to help with the documentation.

In terms of **infrastructure and people**, I listed some of the spaces where I would like to develop my project but also some places and people I can get information from or help in case I need it.



fig.3 My Workspace diagram

# /roles\_of\_prototyping

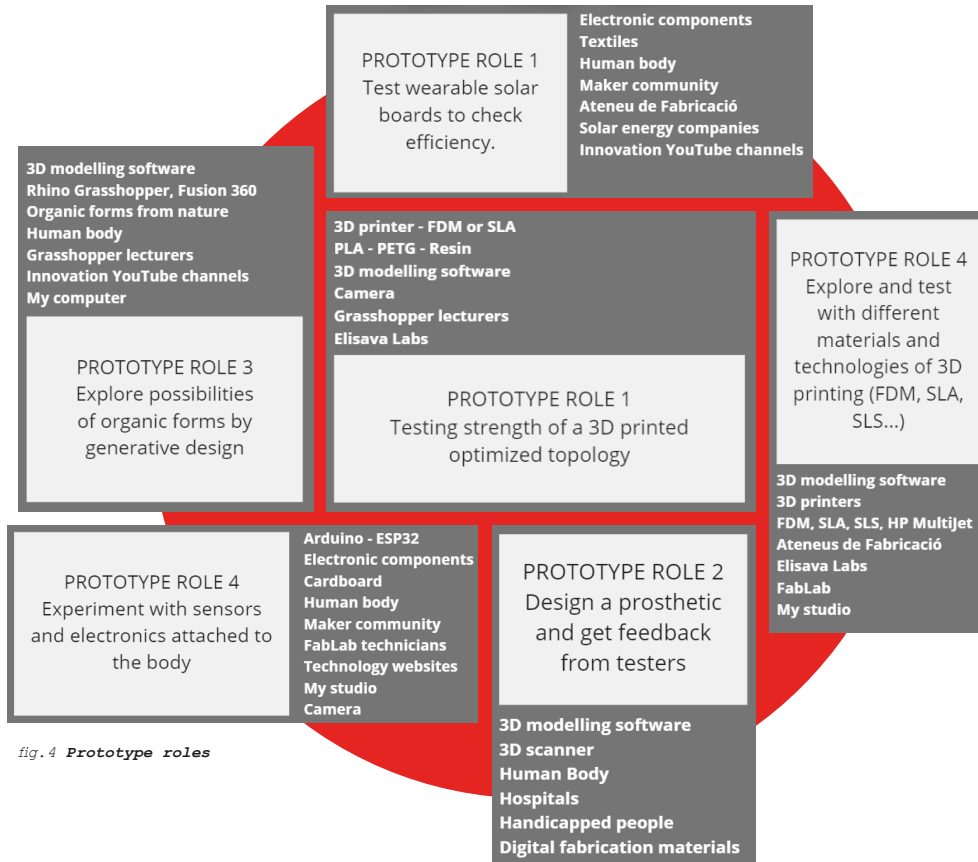


fig.4 Prototype roles

The **roles of prototyping** describe different ways of doing research through design. During this first term of the masters, we have been presented to four of them that are maybe the most significative ones:

- Role 1.** Prototype as an experimental component.
- Role 2.** Prototype as a mean of inquiry.
- Role 3.** Prototype as a research archetype.
- Role 4.** Prototype as a vehicle for inquiry.

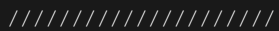
In this case, I used my Design Space to apply some of these roles of prototyping in order to get some information from the experiments. On the left, one can see how different roles are related to different topics (that I will comment later on the review of my Design Space), and also the necessary elements of the workspace I just explained that need to participate so as to make the experiment happen.

It is crucial to define which is the role of a prototype in order to get the appropriate information. For my experiment, I used *Role 1* and tested the strength of a 3D printed topology (pages 33-34).



# /chapter . 2

creating\_  
design\_spaces





# /design space.v1

In this first **Design Space** created during the AoWS week, I took as main topics **Long-Terminism**, **Tech for Equality** and **Rural Futures**. I wanted to explore these fields in relation to digital fabrication, right to repair and maker education, while at the same time enhancing the idea of decentralization and distributed desing.

The **multiscalar diagram** below recaps all these concepts into the different scales, adding some references from existing projects and has some ideas of what could be done.

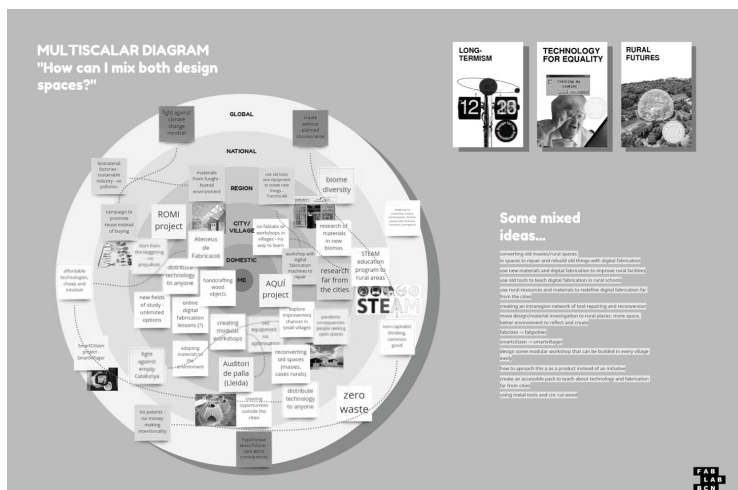


fig.5 Multiscalar diagram

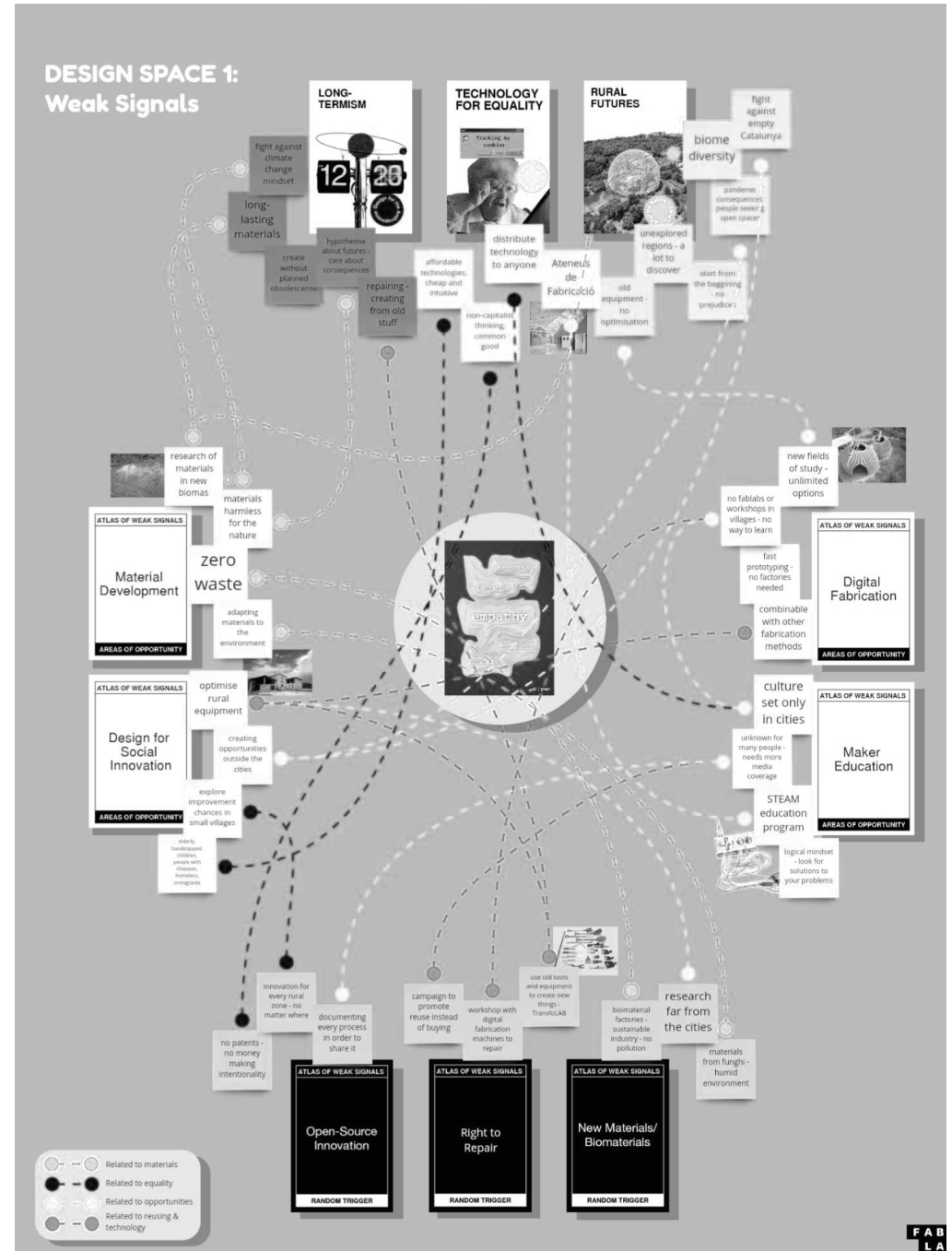
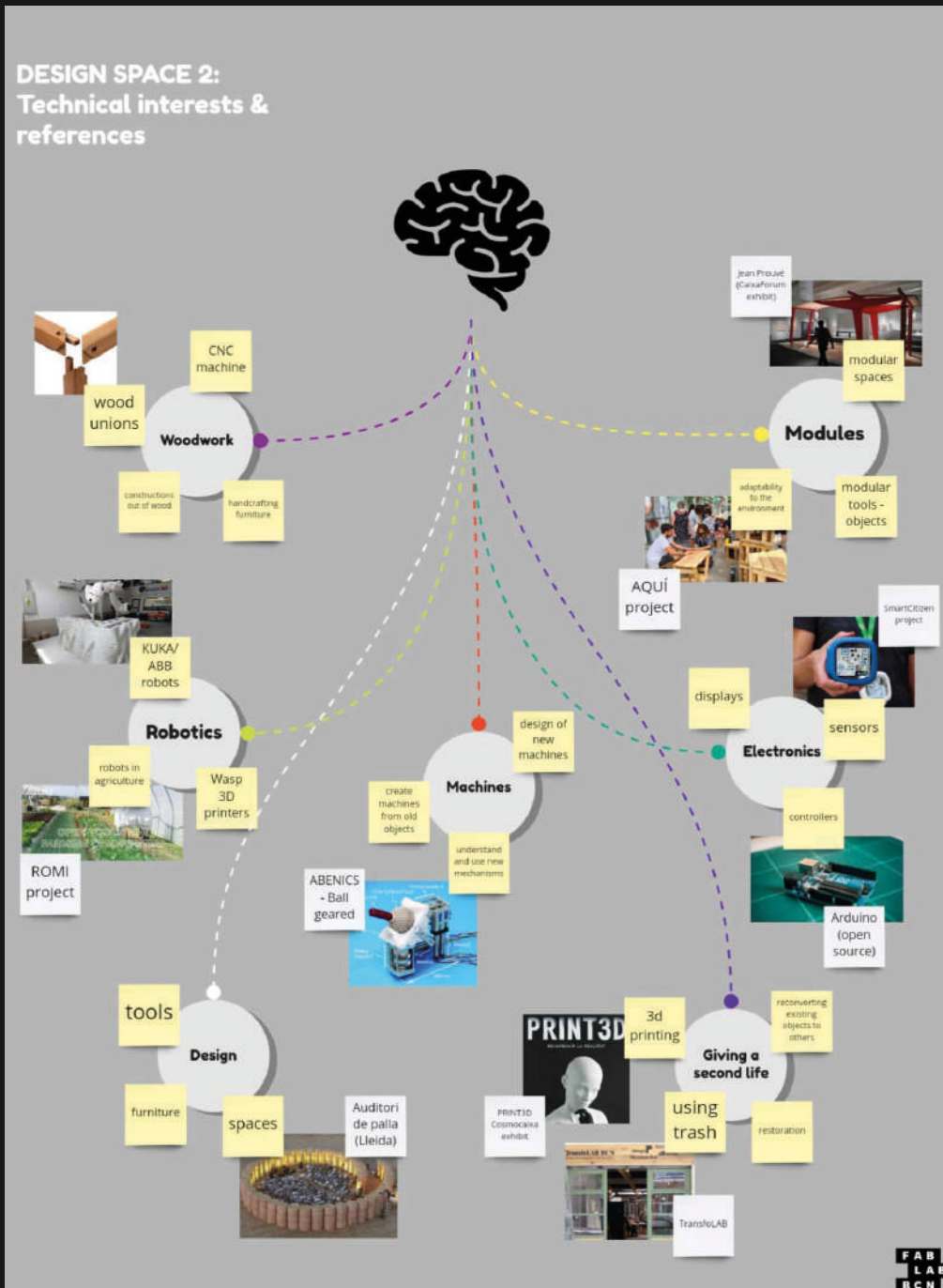


fig.6 Design Space with AOWS cards







# /areas\_of\_interest

Together with the first Design Space, I developed also this graphic that explains what are **my interests** in terms of technologies and themes I would like to include in my future projects. I created this diagram in order to define those interests that are not related to an specific topic but can be applied to any of the subjects I may or may not choose to work on.

We can summarize all these topics into two main concepts: **engineering and design**. These have always been my two passions in regards to my professional career, and every year I try to explore different branches of them. My interests now in terms of engineering would be electronics (sensors, controllers, coding...), creating new machines for diverse tasks, and robotics related to the creation of art (FabLab's KUKA, for example). Regarding design, I'm interested in the creation of spaces and products, organic and generative design and modularity.

Finally, I certainly want to dig into the topic of **giving a second life to obsolete or broken objects** or tools. Also redesigning them to make them last longer, maybe this time doing some other function.

fig.7 Interests and references

# /design space.v2

The week after AoWS, I found myself a bit lost with the topics I had chosen. I didn't feel motivated enough to explore more those fields so I decided to restart from scratch.

This second time, I kept the weak signal of **Technology for Equality** (as it is a topic that really catches my attention and that I want to investigate) but added another quite different from the others that I didn't even have considered before: **Reconfigure Your Body**.

The way I related this two subjects was based on using technology to help those people with some kind of disease or disfunction related to the body. Nowadays, we can see some prosthetics created with **generative design** and some others done by 3D printers. This is becoming a reality in medicine and I found it really interesting.

On the other hand, I was also thinking of doing something with **wearable devices** and **environment recognition**. I wanted to know more about people who call themselves cyborgs and how this could improve someone's life.

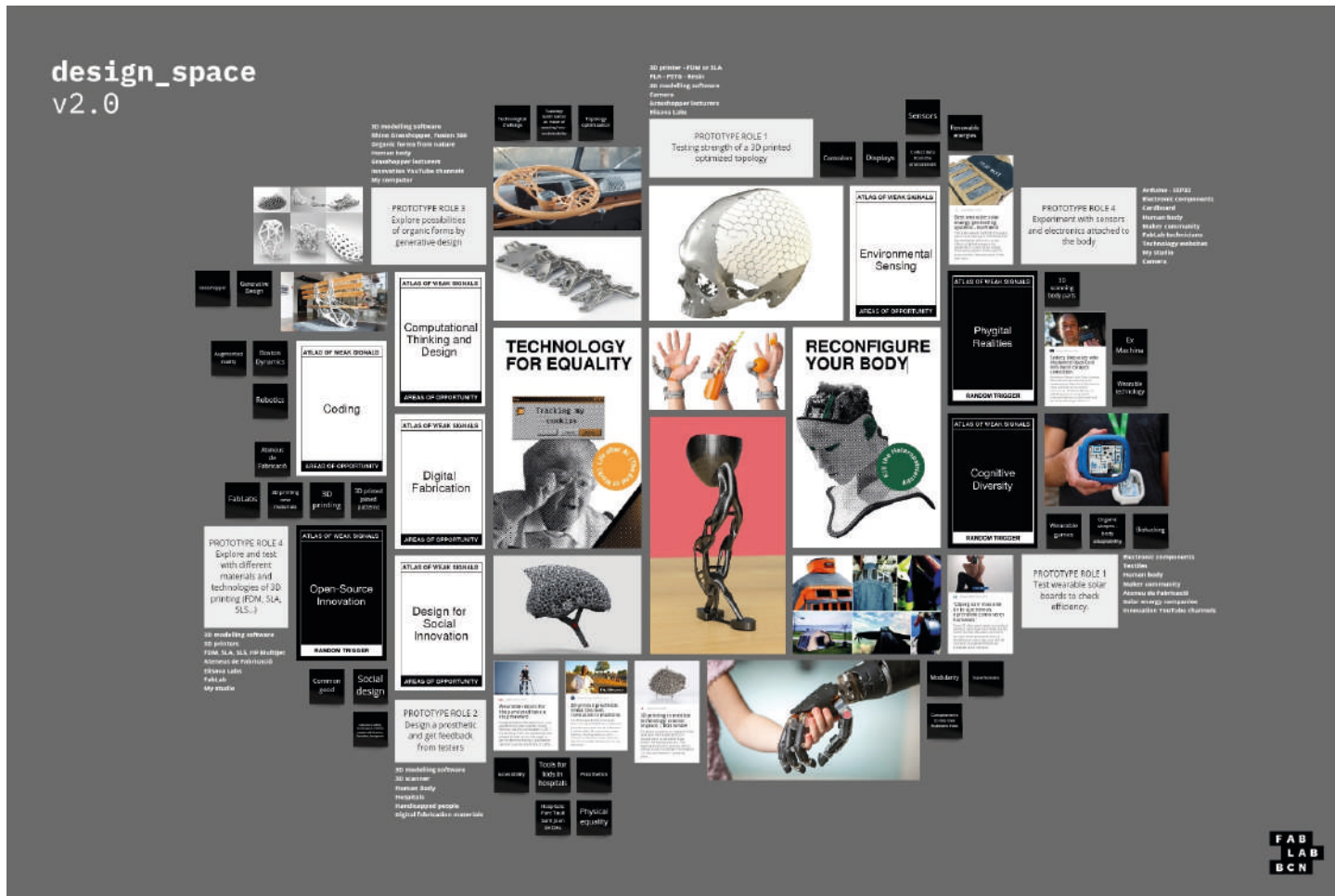


fig. 8 Second version of my Design Space

# /collective\_space

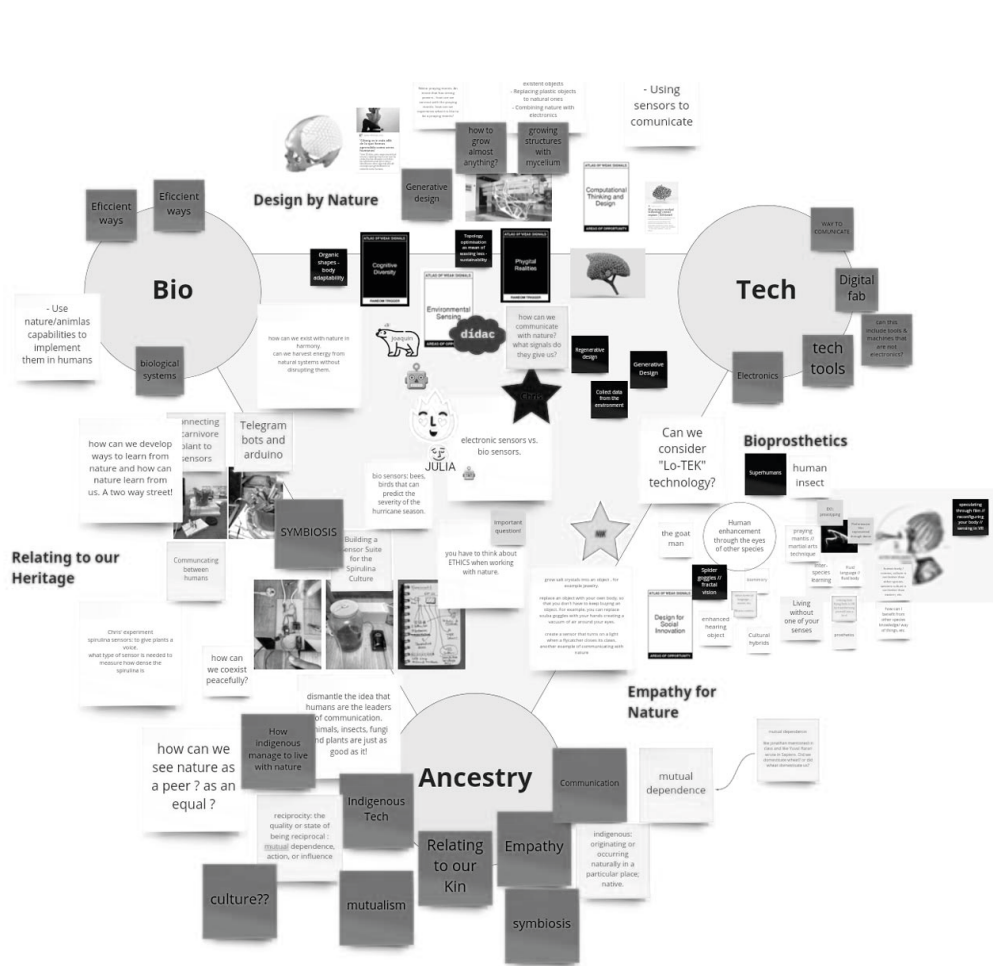


fig.9 Collective Design Space

After having our own Design Spaces, we created a **Collaborative Design Space** called **Bio, Tech and Ancestry**. In discussion, we felt that these three concepts generally grouped together, in one way or another, the concepts of our projects. The *Bio* part encompassed everything related to **nature** and living things, organic forms and biomaterials. *Technology* referred to **electronics and mechanics**, but also to innovation techniques and processes. Finally, *Ancestry* grouped the ideas of connection with the past or with other species, it also relates to **empathy** and the spiritual part.

In my case, my project would be situated between *Bio* and *Tech*. As I defined in my second Design Space, my main objective was to achieve organic shapes, perhaps adapted to the human body, modelled with generative design and topological optimisation and also adding some electronic components. This idea is a clear mix of these two concepts, the study of human biology and natural forms with 3D design technology that allows you to obtain computationally developed models and the electronics.



# /state\_of\_the\_art

In preparation for *Design Dialogues* we had to do an update of our poster we made at the beginning of the term related to our struggles. In my case, this was an opportunity to reflect on what I had been working on so far and whether or not I liked the path I was taking for my final master's project.

During these three months I think my interests have been changing a lot and I still haven't found the topics I would like to work on from now on. I developed a first Design Space about the rural world that didn't convince me and I changed it completely. Then I started another Design Space related to wearables and prosthetics and now I don't see very clearly that this is the path I want to follow.

I'm constantly **rethinking my interests** and the problem is that they are obviously changing as I learn and evolve throughout this master's degree.



fig.10 'My fight update' poster

# /state\_of\_the\_art

This, even though it is a problem given that in some things I fall behind and I can't teach how my work is going because it simply doesn't go, it is also making me learn and I am understanding that whatever I do in the future has to be **something I enjoy**, something that makes me feel good and that I can learn about different fields.

Also, thanks to the *Plant B* project, I have been able to see that what I really like is making things **with my own hands**, making with different machines and processes, designing scenarios and projects that look good and have a use.

On the other hand, I have realised that **giving a second life** to an object that is worn out or broken is something that I really like, and that it can also help to extend the life of something that was previously considered rubbish. I think this idea can point into something **social**, either because I'd be reducing waste but at the same time because this repaired elements could be used by someone who needs them.

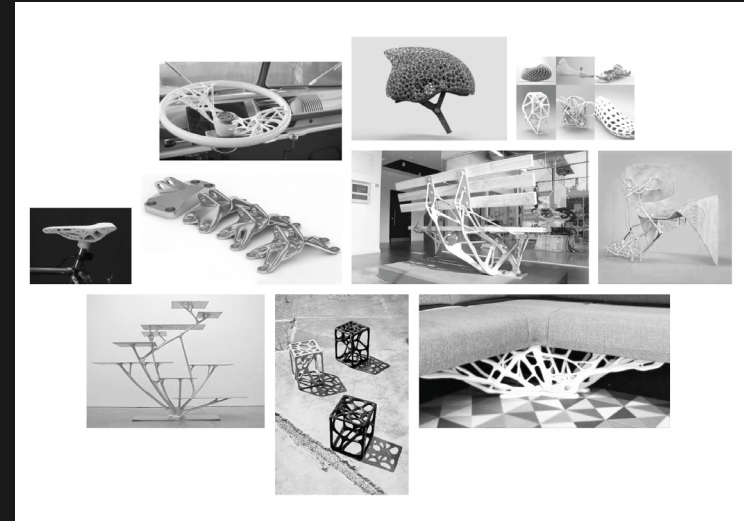


fig.11 Applications of generative design

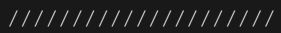
Finally, I want to **keep exploring technology** in all its meanings, I want to work with **generative design** and *Grasshopper* to give this second life to the trash I am talking about, combining repair and design. I want to play with the machines in the labs of *ELISAVA* and *FabLab*, and I want to learn about **electronics and programming**, going beyond the typical exercises to make something applied and useful.

I know that there is a lot of work to do and that it is not going to be easy, that's why I wanted to show this kind of labyrinth in the centre of my poster, and that I have many things in mind, but I know that I always end up finding the way and that in the end I will be happy and I will feel fulfilled with what I do.

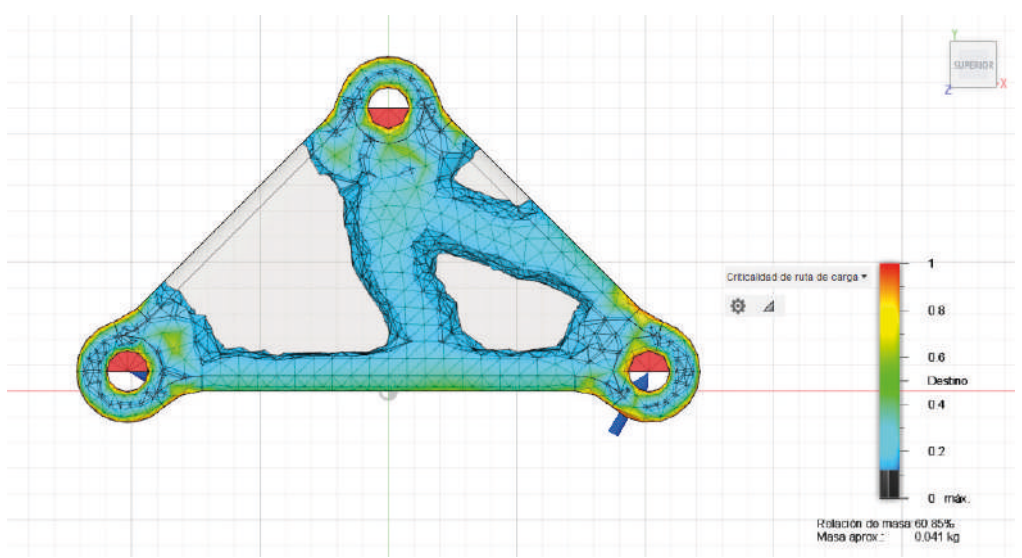
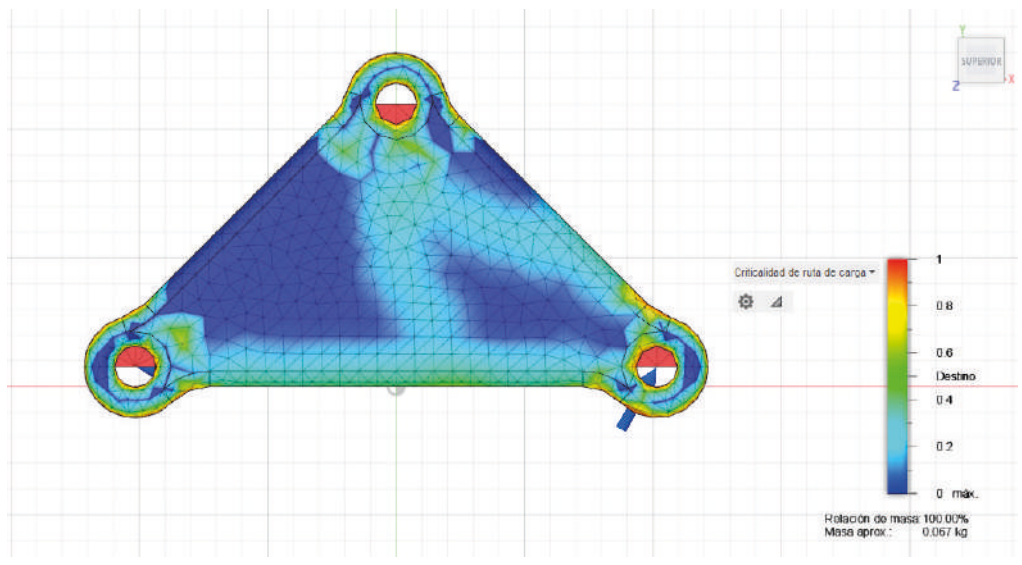


# /chapter . 3

first\_  
interventions



# /first experiment



For this experiment I used *Fusion 360* to carry out a first test on **topological optimization** in 3D printing. I modelled a very simple part where I applied some forces and after doing the structural analysis I used the generative design tool to optimize the part and leave only the necessary material so that the part can withstand the same stresses. In this case, the optimized topology's mass was only the 60% of the non-optimized one.

Finally I printed the two parts, the non-optimised one and the optimised one, and made an initial strength test with the resources I had at home and trying to apply the same forces that I had established in the previous structural analysis.

The purpose of this exercise was to check if **3D printing**, in this case FDM, can be a suitable medium to develop **generative design** and topological optimisation projects, two of the main topics of my Design Space and with which I would like to work more in depth. The next step would be to create a more complex and organic shape and see if 3D printing is still a possible manufacturing method in this process.

fig.12 Topology optimisation using simulation of internal forces

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# /wearing\_ weights

This intervention consisted in experimenting for **24 hours** what *First Person Perspective* means, within the framework of our Design Space if possible. In this short period of time we had to pose a question we wanted to explore and accompany it with a personal experimentation exercise. In my case I chose the question "What if some parts of our body were heavier?".

My main intention was to find out how I would feel if some of my body parts were heavier, and also to check if it would be comfortable or uncomfortable. Gathering this information was relevant to my project as my idea focuses on **wearables and prosthetics**, and having a sense of what it's like to have weight attached to your body is essential. Also to empathise with those people who have to carry extra weight due to basic needs or illnesses.

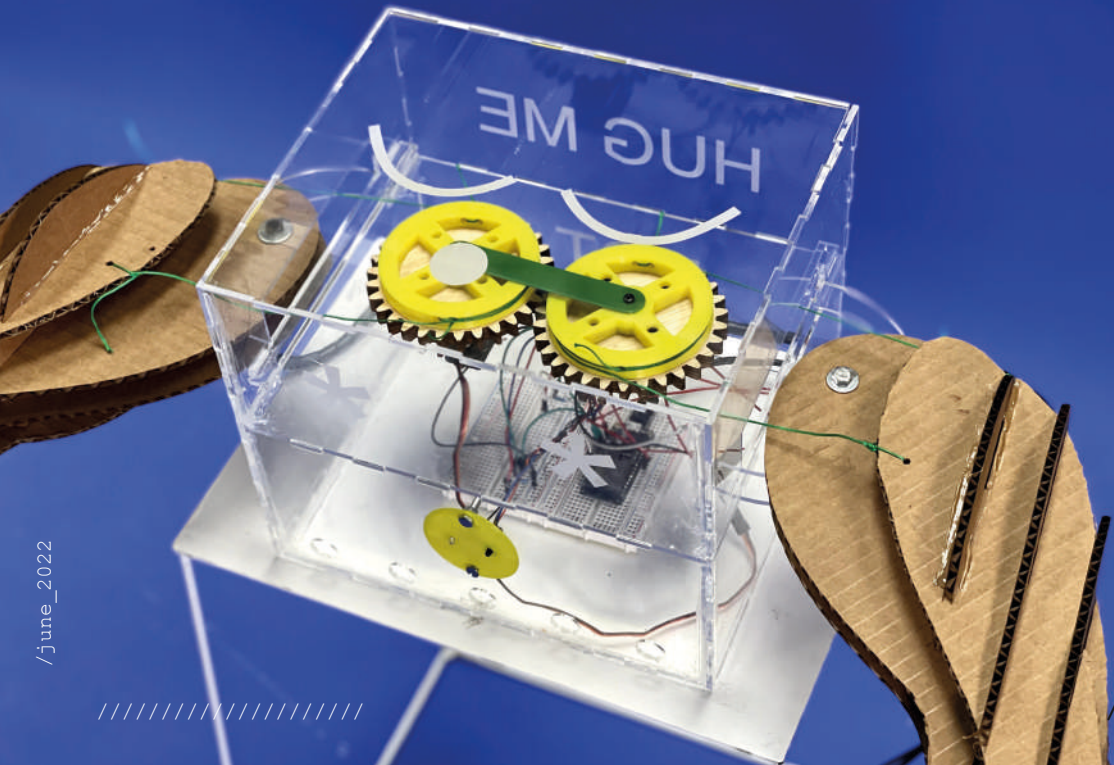
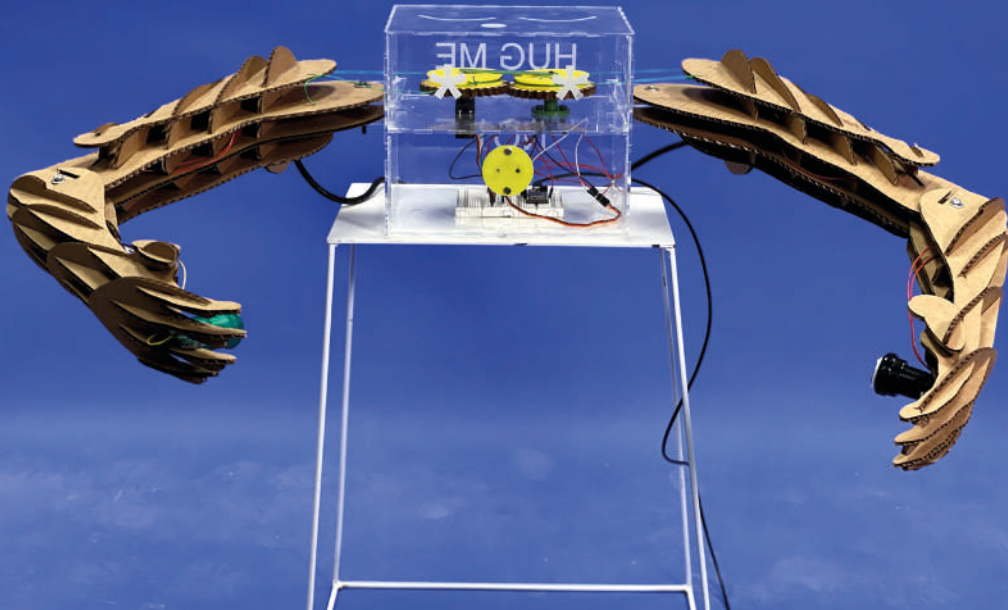
Clearly, putting yourself in the situation of your object of study is not only beneficial for gaining first-hand knowledge of the context, but also brings spontaneous and unexpected knowledge that you cannot get from working externally. Also, by being the instrument yourself, you can **empathise directly with your target** and feel what they feel.



fig.13  
Myself in different  
situations during  
'Wearing weights'  
intervention



# / HUG ME NOT ●●●



*HUG ME NOT* is a project born on the second week of *Tech Beyond the Myth*, devoted entirely to the workshop *Almost Useless Machines*. The aim of this workshop was to create a machine that was not very useful. A machine that was functional but not practical or useful in itself. It had to be an artefact created and thought from a feeling that we wanted to transmit to the user.

Our group, formed by Anna, Fiorella, Marina, Paula B., Rei and myself, decided to base our project on the emotions of **desperation, anticipation and discomfort**. In order to transmit these feelings, we thought of a machine that would give **hugs** but where **the arms would never close** nor would they ever touch the person they were theoretically hugging.

We created this machine using many different technologies (laser cut, 3D printing, Arduino, etc.) programs and materials. At the end, we managed to have this weird machine that pretended to give hugs using a quite complex flow diagram and a well-thought mechanism to move the arms. It was nearly mind-blowing seeing this project and the others and realising they had all been made in less than three days.

fig.14 *HUG ME NOT* machine

# Plant

For the final *Design Dialogues* event at the end of Term 1, Joaquin, Chris and I teamed up for the Collective Design Intervention. We were interested in the intersection between music, collaborative jamming, nature and how these things can be combined. We wanted to research how engaging in an intimate collaborative setting with plants could foster a meaningful **inter-species connections**. For that, we decided to enable an inter-species jam session, where the plants would be both musicians and instruments.

With the help of the *MakeyMakey*, some plants from the *FabLab* office and *Ableton Live*, we managed to get a first minimal viable product for a few classmates to test out. We managed to extract some interesting insights from these experiments. First of all, it was intriguing to see how the sounds produced did not only dramatically change the perception of the users towards this plant, but also the interaction that comes with it. Secondly, the perception of the experiment as a whole changed according to what musical mood we were aiming for: There proved to be a much different vibe between mysterious, atmospheric synthesizer and bell chimes samples on the one hand and some pulsing electronic lead synths on the other hand.

Throughout the process of making and developing our scenario, we kept changing ideas and details that we had previously considered. It was a **process of discovery** and also of adapting to the time we had, iterating on design and operation. The changes were mainly due to the fact that we were more and more clear about what we wanted to transmit and how we wanted to do it, an aspect that was obviously not very clear at the beginning.

The response to our intervention was overwhelming and for all of us everything but anticipated. We were fortunate to witness some very special moments of intimate interactions between passersby and plants to make music together. Especially **children were absolutely enchanted** by the concept of singing plants and were the most fearless when it came to interacting with the plants. Often, adults would be shy at first - but after inviting them in to join, they usually lost their initial hesitancy. Throughout all ages and genders, **people were amazed by this way of interacting with plants**, which was new for almost all of them.



fig.15 *Myself working on the fabrication of Plant B stands*

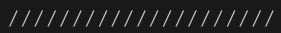






fig.16 Captured moments during 'Plant B' intervention

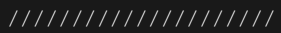
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# /chapter . 4

reframing\_  
the\_project



# /reframing\_the project

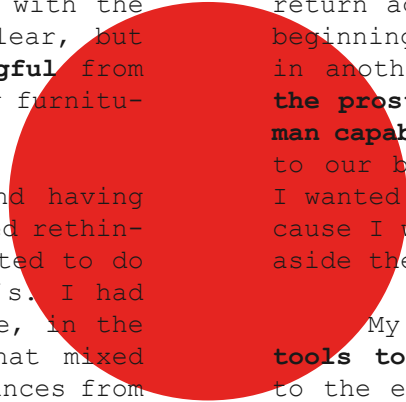
I started the second semester with one idea in mind: give second life to objects taken from trash. I gathered a lot of information about places that do this kind of stuff, explored how to redesign a broken or obsolete object and tried to create my own designs from old objects or at least that weren't functional anymore. However, I was struggling not with the purpose of this because that was clear, but with **how to create something meaningful** from the project that wasn't only repairing furniture.

After the first intervention and having done the first Microchallenge, I started rethinking what I was doing and what I wanted to do during the other half of the master's. I had another crisis with the topic because, in the end, I couldn't find an objective that mixed picking furniture and household appliances from the street and also included the topics I was interested in. This combined with having a short time to develop each intervention and the *Fab Academy* tasks made me stress a bit too much. I didn't find time to pick something up from the street, redesign it in a different way, or place it somewhere...

In any case, I know developing something like this is not impossible, but I was feeling less motivated every time, and at the same time my interest in wearables was increasing considerably again.

After reflecting intensively I decided to return again to the topic I had chosen at the beginning of the master's, now approaching it in another way. I returned to the **wearables, the prosthetics and the fact of extending human capabilities** with tools or devices attached to our bodies. However, this time I was sure I wanted to do **something with electronics** (because I wanted to learn about it) and also put aside the generative design topic.

My project then put the focus on **creating tools to extend human capabilities** in regard to the environment, using parametric and computational design, electronics and sensors and digital fabrication.





# /my\_journey \_so\_far

The first Term of the master's was a time for exploration, for discovery, a time for getting to know those things we are interested in and those that might not be that relevant to us. I lived this first semester with a bit of stress since many things were going on at the same moment, many different topics and methodologies that were completely new to me. Nevertheless, I indeed appreciate everything I learned and this sometimes uncomfortable feeling of doing something you are not used to doing because you have never done it before.

## /first\_person\_perspective- real\_interaction

Working from a *First Person Perspective* has been one (if not the most) important discovery for me. When I was coursing my degree, I missed a lot working on real projects and interacting with collectives and communities. Now that I'm starting to put this into practice, I'm realising this is fundamental if you intend to create **something meaningful and useful**.



fig.17 Walking with weight on my feet



fig.18 People playing music with Plant B

Of course, working from a *lpp* is not always easy and there are many situations where one just cannot put oneself into someone else's shoes, but for sure it is a manner of **empathising** and it can give a more realistic approach to the topic in question.

*Plant B* project was a good way to start having real interaction with people: just by playing music and touching plants we created this **collaborative and joyful atmosphere** we wanted to create. We also got some direct feedback that helped us improve the project, which is genuinely valuable.

Looking ahead, I will try to investigate this methodology more deeply, trying to **lose the "fear" of interaction**, setting aside laziness and being brave enough to perform meaningful interventions.

## **/emotions\_in\_design**

As an industrial engineer, I strongly believe in the sentence "**Form follows function**" as a way of facing design. However, there are many other things to consider apart from form and function: lifecycle, materials, colours, etc. This semester I discovered the importance of emotions in design. *Almost Useless Machines* made me understand how relevant is to think about **the emotion you want to provoke** with a product, which are the feelings and sensations people will have when touching it, seeing it, smelling it? How will people react while using it and interacting with it?

The exercise we did during *Tech Beyond the Myth* consisted of creating a machine from an emotion, but this isn't normally how things work. Generally, one chooses in the first place the topic and then starts thinking about how to approach it. This is why I think that emotions and feelings need to be taken into account in every step of a project and can never be left aside because **they can make a change** in a design.

From now on, I will consider this other aspect of design as a fundamental pillar of my projects and products, and also will try to dig more into how to provoke different sensations in people. People's minds are fascinating and I hope I can learn more from the subject with my projects.



fig.19 HUG ME NOT machine "hugging" Anna



# /documenting\_and\_reflecting

As almost everyone from the master, this thing of **documenting** has been a huge new experience for me. It has been sometimes a bit tough since I'm doing some of this documenting because it is mandatory and not just for me, but on the other hand, I'm learning a lot from doing the **reflections** and working on the Design Space.

Sincerely, I have never been the kind of person that has a personal journal that notes down every single link and book recommendation. I usually keep the information I think is relevant to me and that I think **might be useful in the future**. However, being forced to do this is helping me structure myself a bit more in my mind and define my interests and thus my choices.

Furthermore, I truly appreciate the way we are documenting our projects, using different techniques such as **video recording, sketches, notes, voice messages, websites, etc.** I believe this is making me a better designer because, as some say, if it isn't documented it doesn't exist.

I'm already starting using more documenting methods on my projects and now I want to improve my skills and go a step further, giving it more sense and structure.

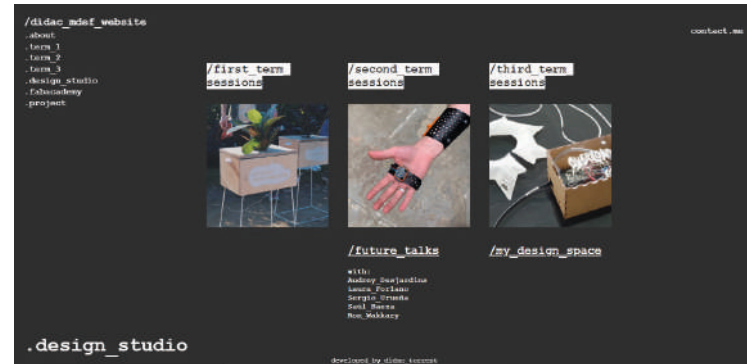


fig.20 Screenshot of my website

Apart from all these things I've just explained, there are many others that are also new to me such as working in a Design Space, using a multiscalar diagram, working with an **iterative design mindset**, dealing with short timings (for instance, the 24h intervention), etc.

However, each of these new experiences are helping me grow as a designer and as a person who wants to pursue a professional career based on developing and participating in innovative projects.

To sum up, I have huge expectations on what is to come, and hopefully I will be able to learn and put into practice many other things while I work in stuff I like. I will fight for that.





# /chapter . 5

interventions\_  
&\_explorations



# /checking\_the\_trash\_

This intervention had the aim of getting to know what every day **gets thrown on the streets of Barcelona**. I had been wanting to work with trash for a while but I still didn't know what kind of objects, furniture, devices, or materials I would be able to find on the streets during the trash collection day.

For some weeks, I checked the map of re-collection for each neighbourhood and **walked around** looking for the things people left on the street. Apart from the objects themselves, I also wanted to see the differences between each neighbourhood concerning the quality of the objects and their state, the amount, the style (old-fashioned or modern), etc.

After this intervention, I got to some conclusions regarding the trash on the streets:

1. There is a **huge amount of objects thrown** in each neighbourhood every single day.
2. Objects thrown are generally **made out of wood or wood conglomerates**. There are people who take the metal parts from the objects. There aren't many plastics or other materials.
3. Almost every object thrown is **furniture** like chairs, wardrobes, benches, beds, etc. There aren't many electronic devices or household appliances.
4. The things thrown in each neighbourhood are not really different from each other. The zone of the city apparently doesn't affect the style of trash.
5. A big trouble with picking objects from the streets is the **transportation**. Many objects are big and heavy.



fig.21 Trash on the streets of Barcelona



# /repairing with **MODBOX**

**MODBOX** was an experimentation project around repairing obsolete or broken objects, using the concept of modularity as the main point. I developed **MODBOX** together with Paula Bustos for the first Microchallenge of Fab Academy since we were both interested in the topic of repairing, **converting and redesigning objects from the trash** to give them a second life.

Since every furniture element has a different shape and it's made of different materials and processes, we explored the topic of **modularity** to create a suitable way of repairing that could be applied to as many objects as possible. By combining a module, one could create joints, and structural elements and even add some more parts to the current object. The idea was not only to give functionality to the module but also to **create a new aesthetic** for every product that included the cube or a combination of them.

Even though the project didn't find a good end, I think it was a nice starting point to test modularity and to think of different aesthetics that can be used when redesigning a product that is in bad conditions. **Functionality can go side by side with art and design.**

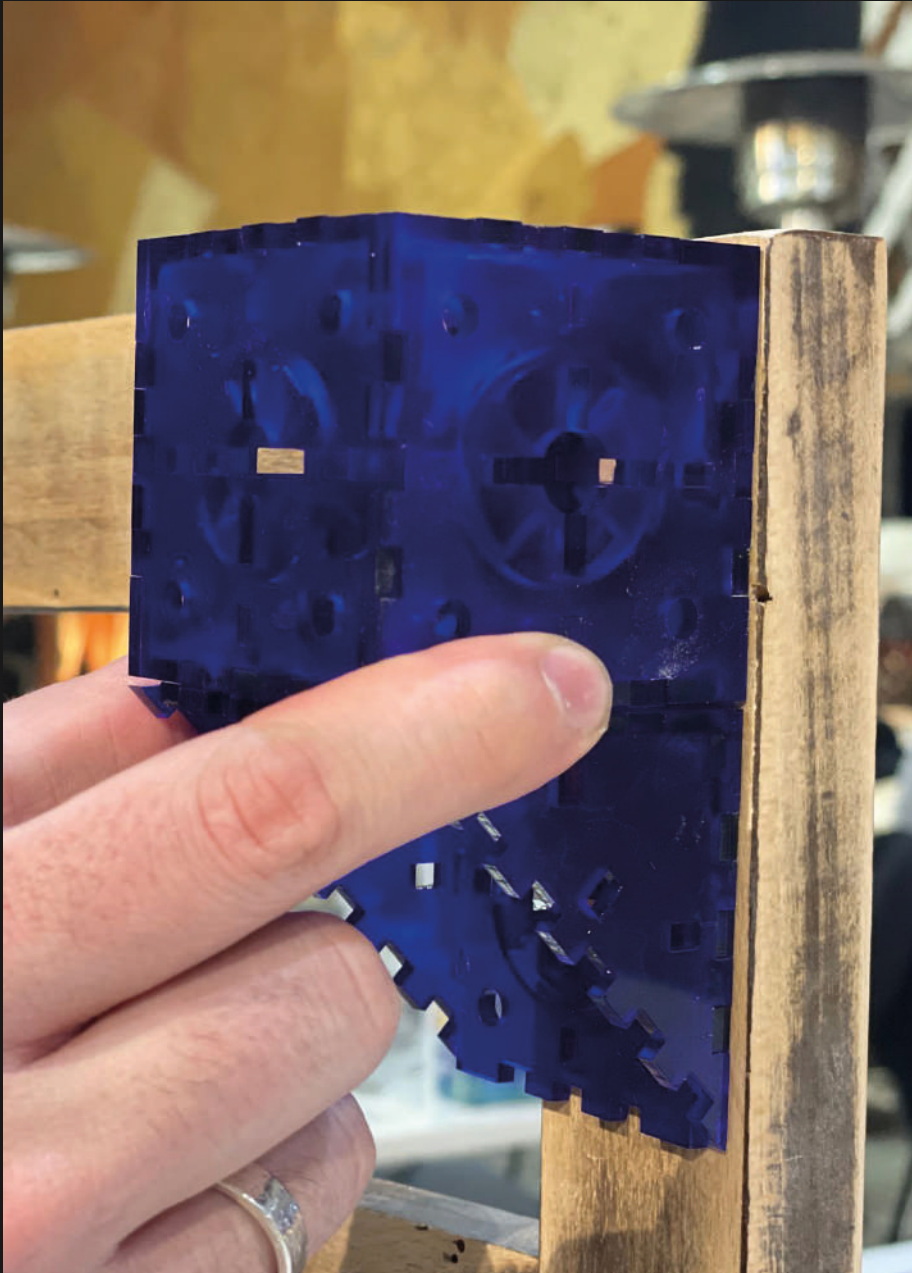


fig.22 Using MODBOX to repair a broken chair

# /thimble\_ tool

I started exploring how we could use our body as a tool by using complements attached to our extremities and articulations. I wanted to **give our bodies more functionalities** and adapt to the environment.

During an inspiring talk with Tomás Vivanco, we came to the idea of creating some gloves that could have tools such as screwdrivers, tweezers, scissors, etc. and transform our hands into a Swiss knife. The aim of this concept was to **experience how it would feel** to have these tools directly attached to the body, see if it is practical, and check other possibilities of wearables and tools.

I worked on a concept of a **modular thimble** that had to be placed on the index finger, and to which you could attach many different tools and utensils.

I designed the part and also some tools and 3D printed them. Since the hole on the thimble was a normalized hexagon, one could use any other screwdriver end. To see how the experience was, I let my family and friends use it to see their reactions and conclusions. I was also creating more tools and ends for other situations.



fig.23 The finger wearable and some tools

After this experiment, I got to the following conclusions:

1. The wearable **needs to adapt to human** behaviour, not the opposite. People seemed to be uncomfortable when using it because they had to change their normal behaviour.
2. It needs to be adaptable to any person. If we want to be **inclusive**, we need to design an adaptable wearable or at least many versions of it in diverse sizes.
3. **Modularity helps**. Being able to change the end gave the wearable much more sense and functionality. It also made the thimble more inclusive because the tool can be customized to the person wearing it.
4. It has to **improve human capabilities**. Sometimes, using this tool people felt restricted and constrained by the thimble itself.



# /extended\_organelles\_session

For this intervention, I teamed up with Vikrant. The project started out of curiosity about combining **prosthetics, experimental fabrication and ways of developing tools**. The ideas explore how the addition or elimination of senses could change the experience and trajectory of our daily lives. As the name might suggest, these prototypes are simple (yet digitally complex) extensions to our everyday body parts.

The basic points of curiosity revolved around making different electronic components and systems communicate with each other using sensors. **Sensors** were used to derive inputs from objects that don't radiate extractable digital data normally. The research simply aimed at exploring and extending possibilities that the human body offers as a tool.

This intervention consisted of a **codesign session** where people imagined, sketched and prototyped wearables based on certain inputs. Participants were divided into different groups and were given **three cards**, each of them with a different topic: **age group, type of sensor and random trigger**. Later, they had some time to ideate and conceptualize a wearable taking into account the three cards.

The aim of this project was to **create some examples of how wearables** could be in different realities. Since we wanted to keep exploring this topic, we wanted to see what other people and designers would do if they had to think of a wearable design, and how would they empathize with people in other contexts.



fig.24 Trigger cards for the codesign session

The whole experiment worked out really well. In the beginning, participants were puzzled by the weird combinations of cards given to them, but quickly they managed to brainstorm some ideas and find one possible solution to the situation. The ideation phase lasted for 10 minutes, then they started prototyping with the materials we had brought for them.

The second phase **converted those ideas into prototypes**. Of course, they were not functional, yet they gave a better idea of how the wearable would work. Some of the groups went more practical, some others more artistic, and each of them used the materials in one or another way. The results though **looked fun** and taking into account the short time of the activity, were quite well-developed.

To sum up, this intervention helped us see **how people would empathise with other realities** while designing from an **embodied perspective**. It was an inspiration for us, and it gave us some input ideas that were useful:

- 1. Design to artefacts to **connect people**.
- 2. Wearables as a way to **hide** someone's identity.
- 3. Placing wearables anywhere (shoe sole, shoulder, etc.).
- 4. Combining **functionality and aesthetics**.



fig.25 Paula wearing the artefact she designed with George





# /arm wearable



During the second Microchallenge, Vikrant and I further explored the possibilities of **wearables and environmental sensing**. We thought of a range of possible wearables to develop and we finally developed a tool that converted light and colour into sound using *P5.js*. The aim of this tool was to extend human capabilities of perception and complement the sight and touch senses. Thanks to this wearable, you could **get sounds from objects around while touching and seeing them**. For a visually impaired person, for instance, the tool could give them input from the colour of what is around, a piece of information that generally they cannot get.

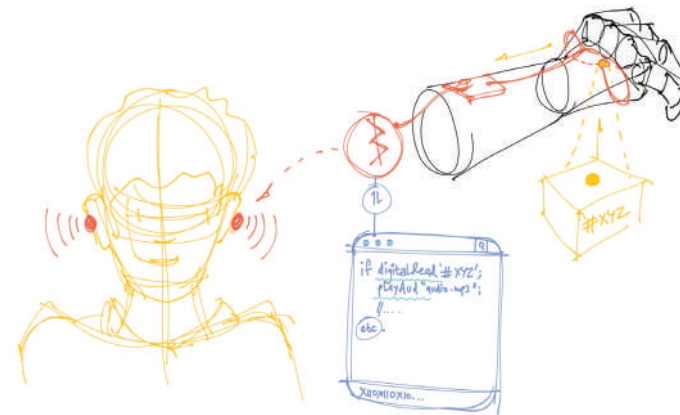


fig.26 Arm wearable on me | fig.27 Operation system of the artefact

This arm wearable was a key point for the development of my project. Thanks to a talk with Jonathan Minchin that brought me up the concept of "Synesthesia", we called the project *SYNE*. The concept of synesthesia represents the **connection between senses** and parts of the body, and that seemed a fascinating topic to me. By connecting senses, we can get more information from the environment, we can **perceive in another way and extend human capabilities**. We can become aware of things that are not obvious and understand the physical reality from another point of view.

Around all these reflections **I built the concept of my project**. I wanted to create tools and wearables with the aim of **democratising senses**, combining them to get more information from what is around us.

## /WAC performance

Angel in collaboration with Vikrant prepared an exhibition for the **WAC** event during the **Poblenou Open Day** that used the tool Vikrant and I had created. It consisted of an art exhibition where Angel was **painting live wearing the arm bracelet** that transformed her moves, brushes strokes and light changes into sounds. It was a perfect example of how to use this tool in an **artistic way**, and how to make people perceive more from a painting. Normally one can see just the painting. Sometimes one can also see the live painting and the brush strokes of the artist. With the tool, one could also get specific sounds from the painting. We were **opening new dimensions of perception**.



fig.28 Captures from the exhibition taken by Lina Sofia



# /alternative\_ present

With the latest interventions I have made around wearables and environmental sensing, I believe I am creating an alternative present where people have more tools in their bodies to **interact with the environment**, thus expanding human capabilities to perform certain tasks.

At the same time, I am also creating a present where **technology is used not to isolate** us from reality (as most of the electronic devices we use in our daily lives do) but to **perceive more** of it, or perceive it differently from the way we know it now. A present where we become aware of things that are not obvious, receiving more information from everything around us. This idea focuses at the same time on going against the *Metaverse*, a virtual reality that is not very inclusive and that totally **isolates people from the physical reality**, which is the one we live in.

The alternative present that I am creating at the end is based on **giving importance to our environment and on feeling**, experimenting, playing, and empathising more with our senses and our abilities.

The project also has a **social purpose** with respect to people who are limited due to a physical disability, thus promoting tools that are accessible to everyone and that, when applied in certain contexts, can mean an improvement in the capabilities of these groups. The bracelet, as we have mentioned, could help blind people to receive more input from the things they touch, being able to identify the colour of objects through sound.



fig.29 Connecting tech with nature and the environment





# /chapter . 6

updated\_vision\_  
&\_identity



For my vision of the future in relation to myself, I feel I'm getting more and more aware of **different realities** every time and I'm gaining experience and forming a profile based on **design, engineering and ethics**. I know I still have a lot to learn, and I'm trying to open my mind and take in all the knowledge I believe is relevant to me and my future. In the end, I have the same values as I had before, so I'm building my profile on top of these ideals that I commented at the beginning of my master's.

I know I have a lot to offer to the world. I'm ambitious and hopeful in regard to my future. I want to use all my knowledge and skills to make a difference and **design always for a better future, for equality and empathy**. Not for the ego but for eco. I joined this master's program to keep learning about other disciplines, to be able to experience and try out different stuff and thus become more **multidisciplinary** and wise.

I'm also learning about **incorporating art** into my designs. I think this experience has helped me open my mind to this topic, and I'm learning to create things just for the sake of making art, **making people feel** and get emotions. I'm giving more importance to the perception and leaving a bit aside from the strict functionality of each project.

Finally, I think we need to get back to the concept of **being happy** and living in harmony, now that we are just thinking about working, being productive, completing the tasks, etc. We need to work on our emotions and work on empathy. This is the beginning of everything.

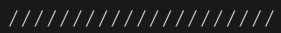
# /vision & identity.v2





# /chapter . 7

final\_interventions\_  
&\_artefacts





# OVERLOAD

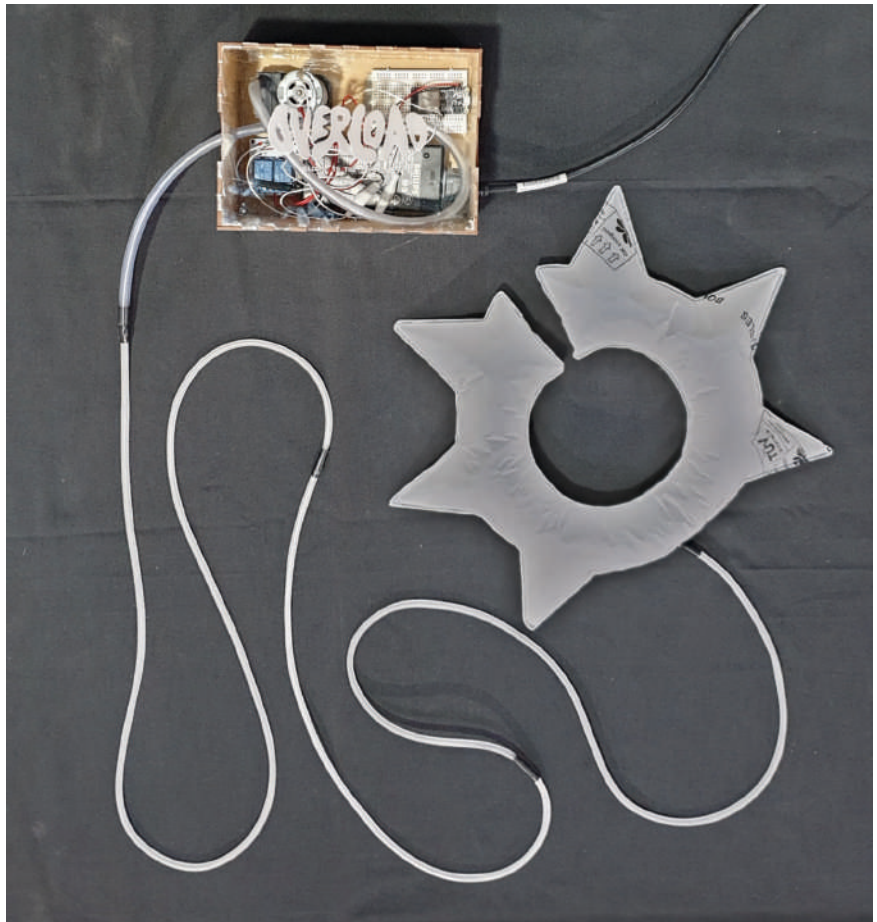


fig.30 Overload device inflated

From the topic of **social networks**, Aparna, Nikita and I teamed up for the third Microchallenge and started thinking about how to visually and physically represent how using all the typical apps affects us in our daily lives. We had to discuss this for a while since every one of us had different views and thoughts regarding the topic: from being influenced by the stereotypes shown in media, to the superficiality of what people show in media, to how the time we spend on our mobile phones makes us feel attached and trapped sometimes.

We finally decided to create a representation that could show all these feelings, based on the concept of an **inflatable** that could grow to represent all these thoughts that grow in our minds when we use these kinds of apps. We thought of different shapes but in the end, we chose a **neck brace** because we believed it was really explicit: something that inflates in the neck that chokes, that restricts the movement of the head, that is attached to you like a chain.

I was focused on wearables that can extend our perceptions, and this was a clear way to **make us physically feel things that, in a normal situation, we wouldn't**. Also, the fact of extending human capabilities, in this challenge turned into restricting human capabilities.

Thanks to overload, I started thinking about **how to connect the digital world with the physical one**, and the other way around. For this project, we developed an interface to interact directly with a wearable, and this opened the door to develop tools that would connect to another device or computer to reproduce visuals.

/june\_2022



# /SFEEL the sensing\_ball

For the last Microchallenge, I teamed up with Pippa and Borka. We all had in mind to create some tool that could **get information from the environment**. The concept moved around a **gamified audio-visual system**, to capture the different perceptions of different environments. Capturing movements, sounds and sensing of materials. **Visualizing the movements of the body in space**, and the connection with different materials in the natural or built environment.

We agreed to give that tool the **shape of a ball** that could have all the sensors needed inside (touch sensor, gyroscope, microphone, etc.). This form allowed us to move the device around in a really **interactive and intuitive** way for any kind of public, from kids to the elderly. We also included some materials to the sides in order to make people experiment with touch and, thanks to the sensor, see in which one people are more interested.

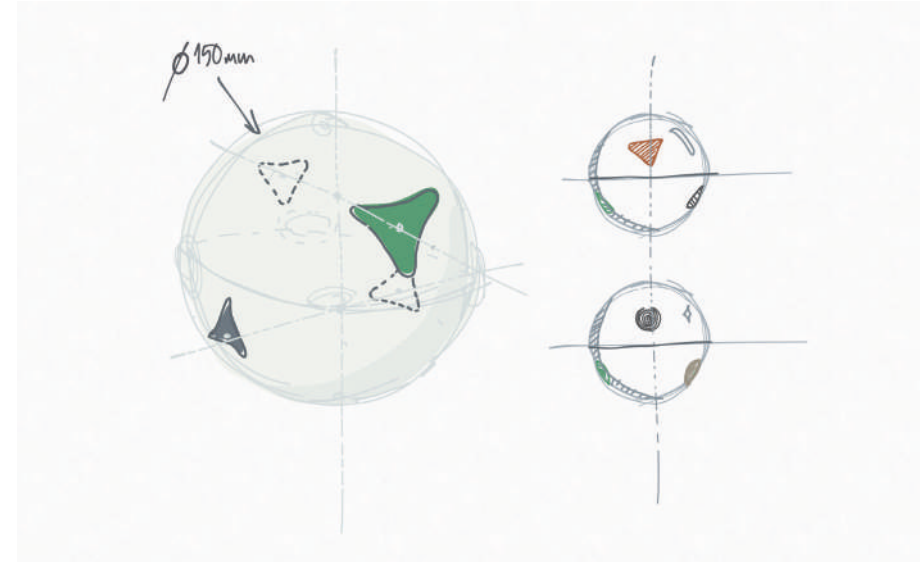


fig.31 Sketches of the final design



fig.32 First iteration of SFEEL finished

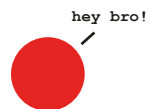




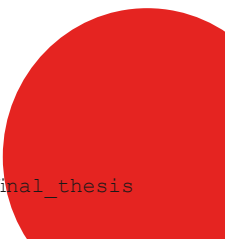
fig.33  
 Kids using SFEEL  
 at Montessori  
 school



The operation of this tool would be the following: Use the different sensors to **get data from the environment**, then use **Serial communication** to send all the values to *P5.js* and finally **create a visual representation** (either functional or abstract) of the data. Basically, we wanted to have this visual input from movements, touches and sounds that we normally get from a camera but without needing one. Also, we wanted to turn that data into something more artistic and less pragmatic.

## /montessori\_school\_application

Right after producing the ball, Pippa and Borika brought it to the *Montessori* school in Barcelona, to test it with kids and see how they **interacted with it**. They also wanted to analyse the movements of the ball in relation to the environment so as to create **meaningful spaces for the students**. They used the data collected from the sensors to visualise via *P5.js* the tendencies and paths followed by the kids and then analyse the meaning of each of them and how this could be translated into something meaningful when designing spaces.





# /PUZ (3D) \_ puzzle

In addition to the tools I've created during this master's, I also wanted to add a project I did a few years ago, as I thought it also fitted in very directly with the subject I am working on and could add a more functional part to it. **PUZ (3D)** is a tool oriented to children with birth blindness that allows them to **practice and play with their senses**. Despite being aimed at this group, it was designed to be **inclusive to any audience** and can be used in any context, whether they are people with or without disabilities.

This toy consisted of a 3D puzzle made up of nine cube-shaped pieces. Each of these pieces **could record and emit sound** and had a part of a puzzle with a relief on the top. The way it worked was as follows: the pieces were scattered around the room so that the child, by hearing, could **find them and put them together**. After this, they had to touch the relief of the upper part and try to place the pieces in the correct position.

In this whole process, different senses and abilities were practised: **hearing, touch, orientation and spatial ability**.

Another valuable aspect of this project is that the 3D puzzle drawing on top of the independent blocks was **replaceable** and substitutable by any other puzzle one wanted to design with 3D modelling software, and could be printed on a **3D printer** easily. The purpose of this was to be able to adapt the pieces to the needs of each child, to be able to change the complexity of these or even to **practice other skills and abilities**.

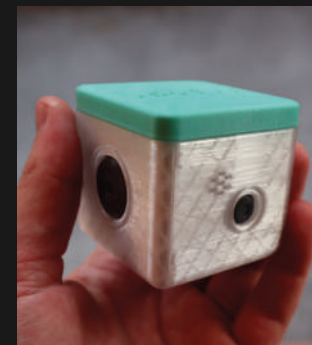


Fig. 34 PUZ (3D) with different puzzles on top







/the\_project /repo /contact

Here you can download the different artefacts created by the community. Replicate them and share the way you use them!



**/PUZ (3D)**

PUZ(3D) is an interactive game to put in practice every sense by using a 3D puzzle where each cube has independent sound. Try playing with your eyes closed!



**/C2S**

C2S is a wearable artefact able to transform colour into sound. Thanks to this, it can be used to perceive more from the environment in combination with the touch.



**/SFEEL**

SFEEL is ball thought to get as many information from the environment as possible and turn it into a visual representation.



Explore other projects created by our community. Download them and make them reach reach more people. Let's sense together!

/upload  
/contact  
/blog  
/support  
/account  
/about

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# /SYNE \_ repo

Having already created some tools related to the same theme, I decided to create a **repo-sitory** where I could have them all together so that anyone could get to know them and at the same time download the files and the necessary information in case they wanted to **reproduce** them.

I used the **SYNE** concept as an **umbrella** for this whole project since in the end all these tools are based on enhancing and highlighting the connection between senses, using the different combinations to **perceive more of the environment**. **SYNE** aims to be a platform where anyone who has more ideas that can contribute to this field can participate, either by using the tools created, thinking of new purposes and ways of working with them or contributing more devices and designs that help to empathise and work for this cause.

Within this page, for the moment there are **three projects**: **C2S** (the arm wearable), **SFEEL** and **PUZ(3D)**. All three have a different purpose and a totally different way of working, but in each of them they work with different senses and perceive things in a different way.

fig.35 Projects of SYNE repository

# /what\_the\_futures?!

To finish with the interventions and designs made during this year, I am going to take advantage of **MDEFest** to **exhibit and test** the gadgets and tools that I have developed this year. So far, my work has been basically based on the creation of devices to experiment with the senses but unfortunately, I haven't been able to find a good moment to test them with an audience outside MDEF. I also wanted to have all the devices developed so that the project would make more sense and could be understood as a concept beyond a single tool.

During the **What The Futures?!** days, I have planned two activities that will allow me to make the three tools in **SYNE** known: the first one will be an **exhibition in Palo Alto** where the devices will be shown and there will be an explanation of how each of them works (through brochures, videos or posters). There could be the possibility of a **live explanation**. The second activity will be a collaboration with the **Ateneu de Fabricació del Parc Tecnològic de Nou Barris** where the devices will be shown and they will also be able to be used and tested.

The audience for these interventions would be people related to digital fabrication, students, and people interested in technology and social design. I could also gather children and other groups who want to experiment with the devices.

Finally, with these interventions, I mainly want to **get feedback** on the tools, to see **how people feel** when using them and **if they are meaningful** or not. I would also like to get ideas about contexts and new applications for the devices, in which situations and with which groups they could be used to make the most of them.



fig.36 Poster of the event for MDEFest





# /chapter . 8

*SYNE'*s\_alternative\_  
present

# /SYNE's alternative present.

After completely defining my project and reflecting a lot on its purpose, I shaped an alternative present that is built above the concepts of sense, empathy and innovation, **fighting against the isolation** we suffer from our system, the devices that want to keep us far from the real world and the conventions that tell us how we have to **feel or perceive the environment**. This project follows the idea of democratising senses, adding capabilities to human perception, complementing the information we normally get from what is around us and letting us experiment and play.

So, which is the alternative present I am creating with all this? I believe I'm making a present where we **give to our senses the value they have and appreciate them**. Also, a present where we take more into consideration the importance the **physical world** has, and where we leave our phones, computers and TVs aside for a while to explore our surroundings and try to understand more about the physicality of our planet. As I commented on the last reflection, I'm not an enthusiast of the *Metaverse* because I don't think this is going to help our world.

We need humanity, **face-to-face interactions**, and being connected to the environment. I always like to remember the speech from Charles Chaplin in *The Great Dictator*:

*"We have developed speed, but we have shut ourselves in. Machinery that gives abundance has left us in want. Our knowledge has made us cynical. Our cleverness, hard and unkind. We think too much and feel too little. More than machinery we need humanity. More than cleverness we need kindness and gentleness. Without these qualities, life will be violent and all will be lost..."*

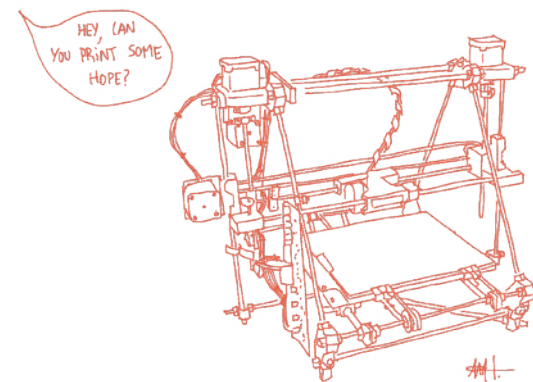


fig.37 Vignette I made for Making Sense and Meaning



Going back to the ideas of *My fight* that we did at the beginning of the master, I like to think that the alternative present that I am creating is a more empathetic present and that it can somehow **improve someone's living conditions**. During the Master's course, I had a hard time finding a social reason for the project, but I believe that this project has one and that the tools I have created can be used in many ways for social purposes and that they can have a positive impact on society. It's all a matter of letting your imagination run wild and exploring utilities.

Finally, I believe that with this project I have addressed several of the *Weak Signals* raised at the beginning of the course such as **Reconfigure Your Body**, creating wearables to extend capabilities, **Technology For Equality**, setting up this initiative, *SYNE*, to promote sensory empathy and **Human-Machine Creative Collaborations**, designing tools that allow us to connect our world with the digital one in an interactive and entertaining way.

Of course, all these ideas that I am grouping here are just hypotheses right now and I would like to be able to demonstrate in a more pragmatic and empirical way how this project can really contribute to making the world a better place. In any case, this has been my intention, and I believe that with more work, experimentation and receiving feedback, this alternative present would not have to be an alternative, it would be ours.



fig.48 The cards I used from the Atlas of Weak Signals



# /chapter.9

designing\_  
myself\_out



# /paths\_of\_ grow

As expected, *SYNE* is currently in an embryonic phase. The project has just been created and the intention of the project has been defined. During the weeks of *MDEFest*, I foresee that a community will start to build up around the project, of people interested in this field and in the **creation of sensory devices** with digital fabrication. Even so, it is interesting to consider how this project could be **scaled** up, to see where and in what ways it could go and in what contexts it could be most useful.

In the penultimate class of Design Studio, Clément Rames gave us an explanation of the procedure he followed to scale his project **AQUÍ**. Logically, each project is different and the way of externalising it depends a lot on how it is developed and the theme it deals with. In any case, he made us ask ourselves first of all the 5Ws: **why, what, who, where and when**.

## /why

For people to feel and perceive more of the environment. For people to explore, play and empathise with their senses. Against digital realities and devices that isolate us from the real world.

## /what

Create and collect tools to communicate with the environment and feel with the senses. Find spaces and contexts to use the tools in functional or artistic ways.

## /who

Wide range. The tools can be used by anyone, however, I think the people interested would be young people, students, designers, artists, people involved in digital fabrication, technology enthusiasts and collectives who think these tools could be useful for them (e.g. visually impaired people).

## /where

This is not a project that has to be established in a specific place. However, since I live in Barcelona and there is a lot of movement around digital fabrication, and design for social purposes, I think it would be a good place to start.

## /when

Digital realities are already in the process of development. In my opinion, these tools should scale at the same time, empowering physical realities in parallel to the technologies that want us to be isolated from them.

In order to understand it better, I have developed a diagram of the possible growth paths of this project answering the **how** to reach my purpose.



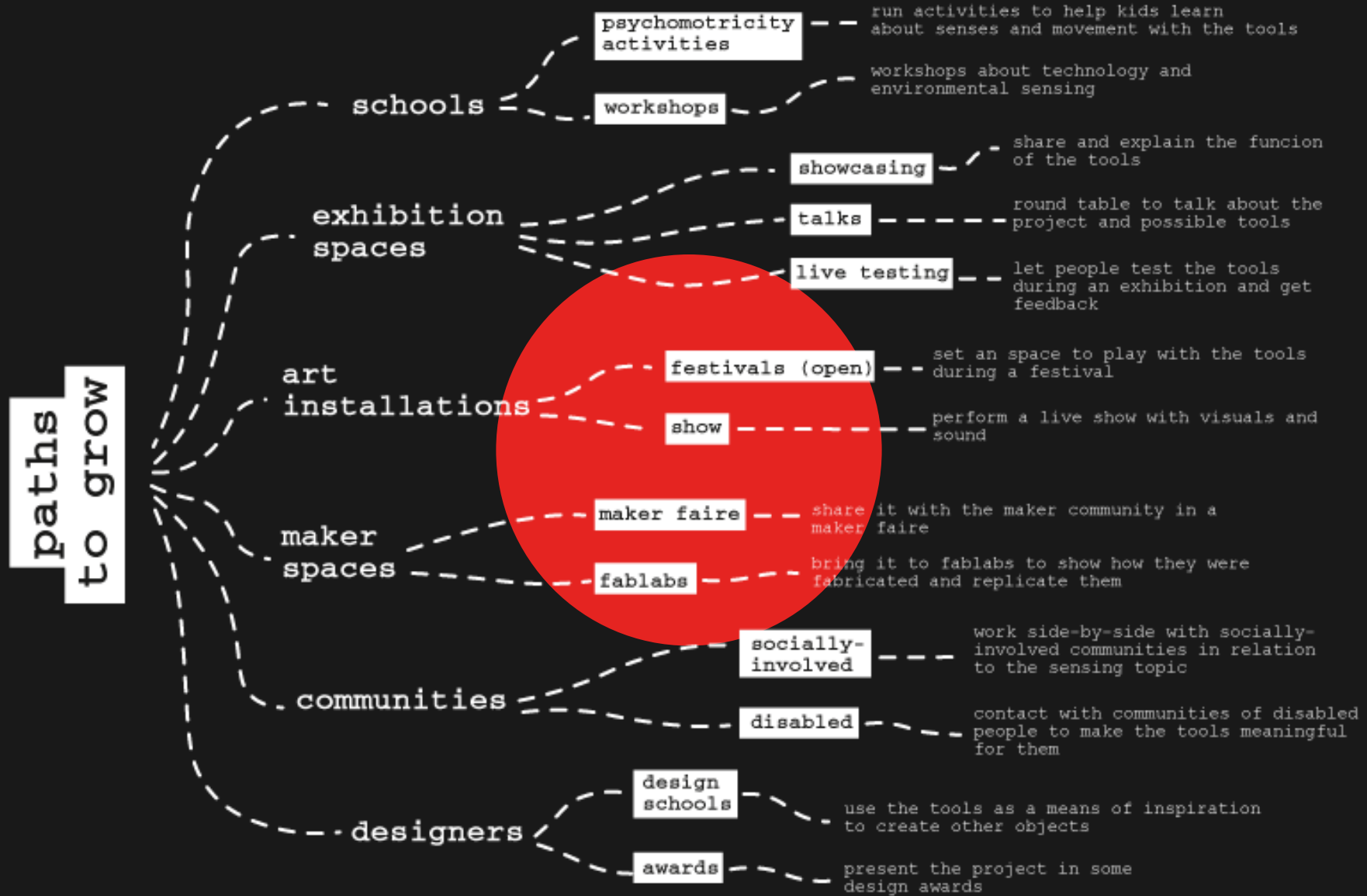


fig.39 Scaling my project and the possible paths of grow



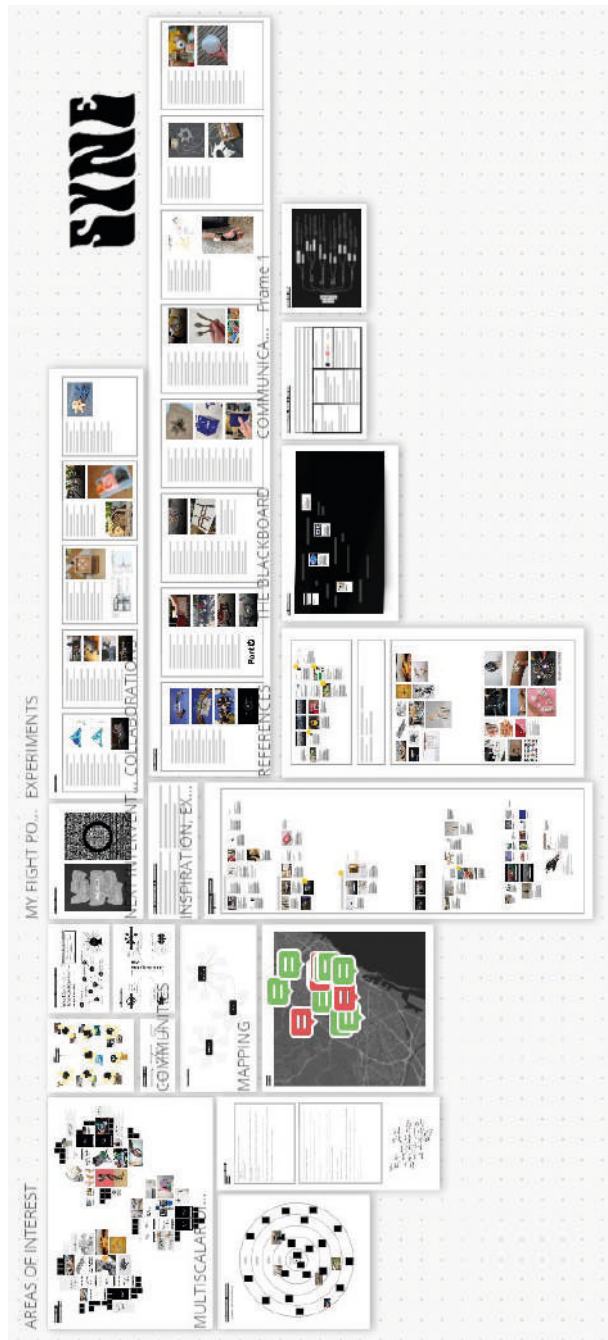


fig. 40 My Design Space at the end of the year

# /design space.v3

Finally, this is the state of my Design Space after all this year. There, we can find the different agents involved in this project on the multiscalar diagram, the **communities** mapped and all the **resources and interventions** that I've been collecting and doing during this year. I splitted the board into different topics to put a bit of order and easy finding each element.

I also have to say that having a Design Space like this hasn't really helped me. To be honest, I never found time to upload the Miro during the year because I was too busy doing other tasks and interventions. Also, I don't like the fact of having to zoom in and out, for me it's not visual and thus not practical.

On the other hand, I liked **having a place to gather all the information**, resources, explorations and connections. I think that was a key point to understand the direction of the project.

This is still a **work in progress** so I will try to use some other method to have a Design Space that fits better with my needs and my way of working.





# /chapter . 10

final\_  
reflections

# /final reflections

To end this thesis, I would like to reflect on a few issues that I believe are significant and that are the pillars of everything I have been building during this course in relation to *MDEF* and my project. Undoubtedly, it has been a year in which many things have happened and I would like to comment on them separately.

## /mdef

This master's degree has a lot to talk about. Honestly, when I started *MDEF* I didn't imagine that it would be such a complete and intense master's degree at the same time. The amount of topics covered in nine months is overwhelming, but at the same time, it allows you to learn about a huge number of **different fields**, all related in some way to the future and its possibilities, which you can focus on and specialise in if you want to. It also deals with issues with a **social background** that affects the society today with the *Atlas of Weak Signals* and always encourages collaboration and **active participation with the communities**. You could say that this master's degree is mind-opening.

In addition, it offers an **admirable amount of resources** both in the first term with experts in each subject and in the second and third terms, with the *FabLab* facilities and its professionals. With all these sources of knowledge and the machines and materials available in the Lab, projects can be carried out with much more body and meaning. The possibilities are really endless.

In any case, one of the factors that I have enjoyed most about this master's degree has undoubtedly been **the company and collaboration with my classmates**. I mentioned this before, but the fact that we all come from different places and backgrounds makes us complement each other much more when it comes to developing projects and coming up with solutions. The amount of things I have learned from my fellow students is simply unquantifiable, not only on a **technical level** but also on a **personal level**.

On the other side of the coin, this is a master's that takes up a lot of time and a lot of mental space. There are constant deliveries from *Design Studio*, *Fab Academy* and the other courses during the different trimesters, where you have to **reflect and often also be creative**. Unfortunately, combining all this work with interacting with communities, at least for me, is a **very complicated task**. We were told many times that we had to go out into the streets, get into the communities and work with them. But, how can I look for a community if I don't even know what my project is about? How am I going to get into a community if I can't offer them constancy and dedication? In my opinion, this process required more time.





fig. 41 Us during a Remixing Materials Class

Another thing that confused me a lot was the structure of the master's in some aspects. The fact that we had to **choose a theme** in the second week of the master's course and work based on this theme throughout the course seemed a bit premature to me. We hadn't done any course yet and we hadn't practically known the *FabLab*, and I think that all this has to be taken into account when developing a project that makes sense from start to finish. Otherwise, one ends up **making interventions** that perhaps don't make much sense in terms of the final project. I understand that in the end everything is created based on personal interests and that Design Space can always evolve, but at the same time, I think it's important to have foundations when making interventions, at least if we want them to be relevant.

Finally, I would like to say that, although I had moments of breakdown and was overwhelmed by all the work that was going on (apart from other personal issues), this master's degree has given me a lot of positive things and **has made me grow as a person and as a maker**. I've learned about many different subjects, I've started to document everything I do, I've used a thousand different technologies and manufacturing processes, I've designed all kinds of objects. All this will be very useful for the kind of professional career I want to take, related to FabLabs, social projects and design.

## /my\_project

The project has also been a topic that has given me a lot to reflect on during this master's degree. The **choice of the topic** was key from the beginning, and yet it was one of the most complicated and relevant decisions, since, in the end, everything was going to be related to it. In my case, it was a bit of a tough process because I had a hard time finding the key to what I wanted to do. In fact, it wasn't until the third Term that I decided on the objectives and the will of my project, finding the concept that would make sense of it all.

My process for choosing the theme was as follows: I started with the idea of working in the **rural world** and using digital fabrication to reuse tools and machines. However, this idea was short-lived and I soon changed to the idea of designing **wearables and prosthetics** using topological optimisation, also adding sensors to interact with the environment. I liked the concept of Cyborg and using technology to promote equal opportunities.





At the end of the first Term, I had the second breakdown where I wanted to completely change the direction of the project, to focus on **giving a second life to obsolete objects** and using the FabLabs to redesign and transform household appliances and furniture found in the trash. Again, in the middle of the second Term, I had a breakdown and changed the theme back to **wearables and environmental sensing**. This was the last change and from then on I simply set out to better develop the concept and purpose of the tools I wanted to create.

Jana and Roger told us in class about some of the processes that are followed when developing a project. From a linear process where everything is formed from an idea and evolves, to a chaotic process of probing where different inputs and related topics are sought. In my case, I think the **diagram of the evolution of my project** would be something like this:

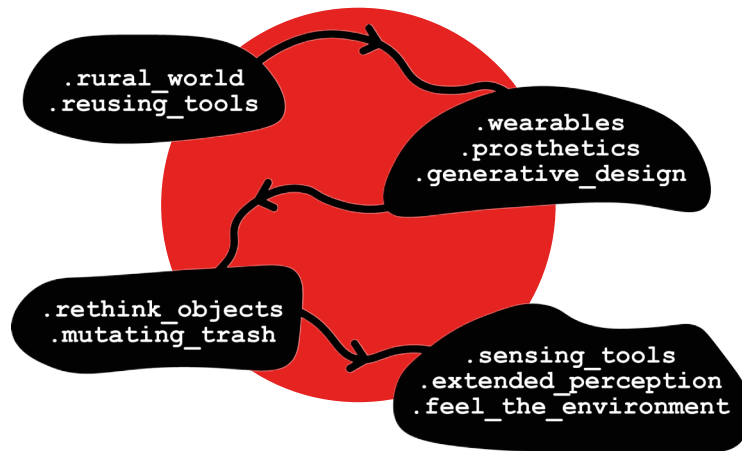


fig.42 Path I followed through the year

Although the path has been complicated, I think I have achieved the goal I wanted. I have been able to develop a **functional and at the same time artistic project** that also has a social character and uses digital fabrication as a means of production, which makes it replicable. I have been able to use many different manufacturing technologies, I have used **electronics** and I have even been introduced to *P5.js* with interface design. It's certainly quite a complete project that can have a **thousand different functionalities** and generate an alternative present, although it's obviously still in its embryonic stage.

Even so, the worst thing for me is that I have not been able to **form a community** around this project, at least not during this course. It is true that I would have liked to be able to **interact with more people** outside the master's and to collaborate with people interested in this topic or who could benefit from it. I'm looking forward to **receiving feedback** from the users of the tools and to knowing a bit more about people's perceptions of my designs. And, obviously, I want them to be useful and **make someone's life better**, that would be my main goal.





# / references

references\_&  
bibliography



# /references & bibliography



/didac\_mdef\_website. Retrieved June 16, 2022, from <https://didac-torrent.github.io/mdef/>

Fab Lab Barcelona. (2022, June 15). Retrieved June 16, 2022, from <https://fablabbcn.org/>

Sensewear Clothing. (n.d.). Retrieved June 16, 2022, from <http://sensewear.clothing/wordpress/>

Pianoglove. Adafruit Learning System. Retrieved June 16, 2022, from <https://learn.adafruit.com/pianoglove>

Haptic bracelets wearable devices. (n.d.). Retrieved June 16, 2022, from [https://www.researchgate.net/figure/Left-Haptic-Bracelets-wearable-devices-metronome-and-monitoring-units-and\\_fig2\\_346312694](https://www.researchgate.net/figure/Left-Haptic-Bracelets-wearable-devices-metronome-and-monitoring-units-and_fig2_346312694)

Ateneus de Fabricació. (n.d.). Retrieved June 16, 2022, from <https://ajuntament.barcelona.cat/ateneusdefabricacio/en/>

Color to sound with Arduino: A color sensor-based solution for the visually impaired. Elektor. Retrieved June 16, 2022, from <https://www.elektormagazine.com/articles/color-to-sound-arduino-color-sensor-solution>

Smart citizen. Smart Citizen. (n.d.). Retrieved June 16, 2022, from <https://smartcitizen.me/>

WAC Lab. Poblenou Urban District. (2020, October 15). Retrieved June 16, 2022, from <https://www.poblenouurbandistrict.com/en/wac-lab/>

