2025/10/29
The Hong Kong University of science and technology - Guangzhou

香港科技大学(广州)
THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY (GUANGZHOU)

# KiCAD at the Intersection of Open Source and Art: FLOSS CAD for Contemporary Musical Instruments and Installations

Computational Media and Arts

Speaker:
Nicolò Merendino
Assistant Professor of Practice
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1 Intro ----▸ 2 Multimedia arts and technology ----▸ 3 Examples

4 Research (CAD, FLOSS and DMIs) ----▸ 5 Case studies ----▸ 6 FLOSS related Theoretical Frameworks ----▸ 7 Conclusions

# Nicolò Merendino
明允成
(Aka **Chi ha ucciso Il Conte?**)

Assistant professor of practice
Computational Media and Arts
HKUST-GZ

Interaction Design

Physical Computing

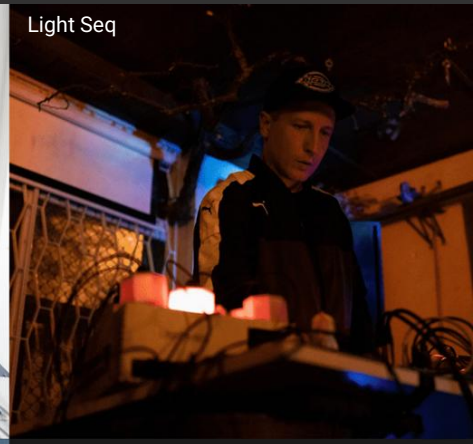
Digital Fabrication

Digital Musical Instruments Design

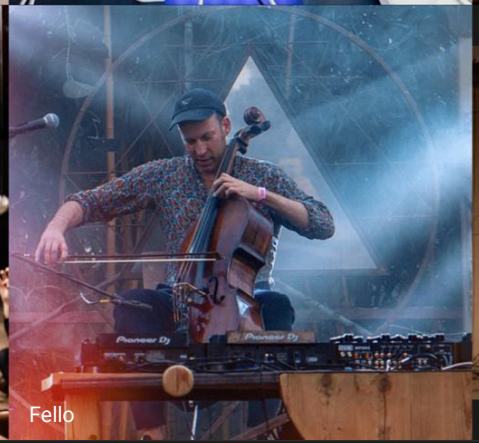
Sustainable practices


Knurl


MotionComposer


Light Seq


Lampyridae


Fello


Strophonion

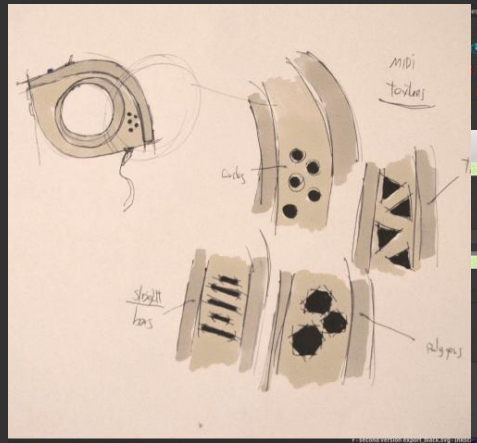
## Main skills:

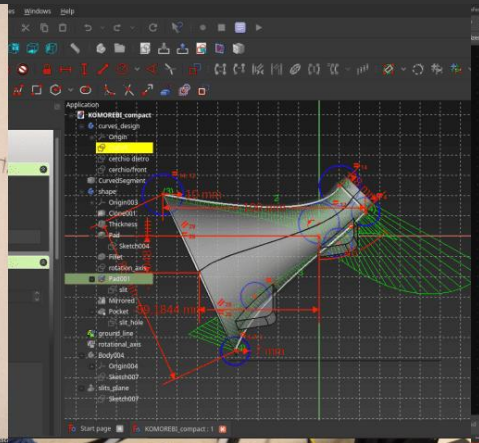
Theoretical knowledge and manual Design skills

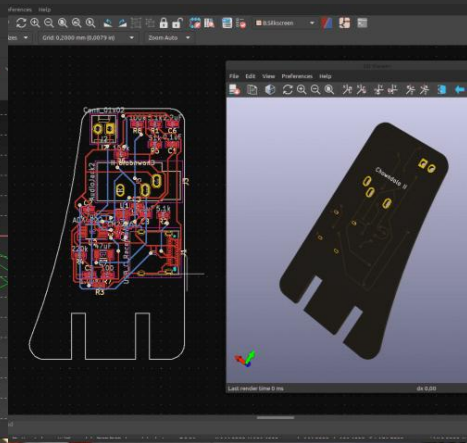
Computer/AI aided Design skills (specialised in FLOSS)

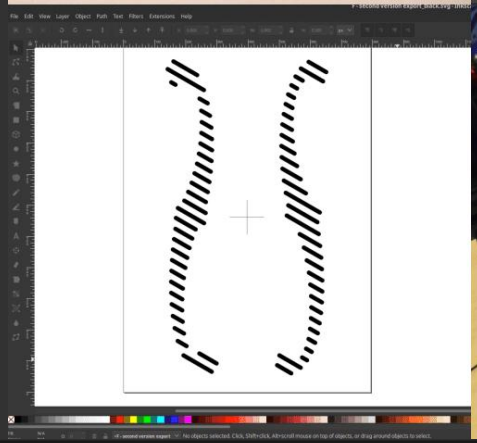
Coding and electronics

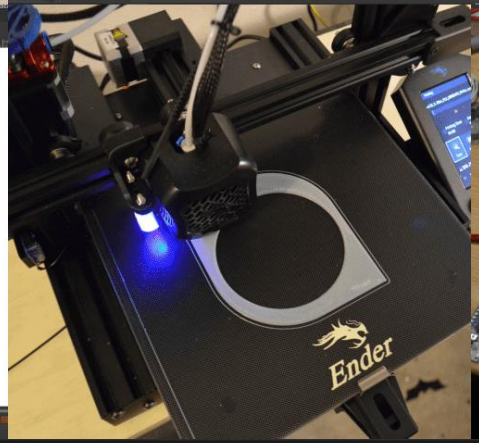
Digital Fabrication

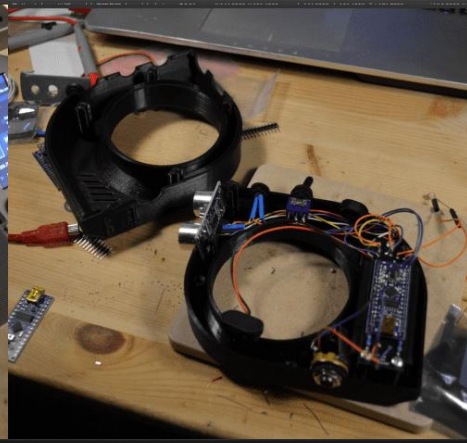








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# Multimedia Arts as a Driver for Technological Exploration

Artists use interactive and multimedia art practices to **prototype**, **critique**, **and reimagine technology** (Edmonds 2010).

Art–tech collaborations historically **foster novel solutions in interfaces, visualization, and computation** from Experiments in Art and Technology (Shanken 2015).

Contemporary multimedia artists **integrate state-of-the-art tech (such as AI, AR/VR)**, and generative systems to question ethics, embodiment, and perception in emerging tech (Grau 2003; Penny 2017, Magnusson 2019).

Artistic experimentation **serves as a "sandbox" for societal reflection** and pre-commercial R&D in human–technology relations (Penny 2017; Edmonds 2010).

# Digital Musical Instruments (DMIs):

“a system that uses digital technology to map a performer’s physical gestures into sound, typically comprising three key components — **a controller interface** (input), a **mapping layer** (processing), and a **sound synthesis engine** (output).”

(Wanderley & Depalle, 2004)

*“the practice of designing and building instruments became a crucial part of contemporary audio production”*

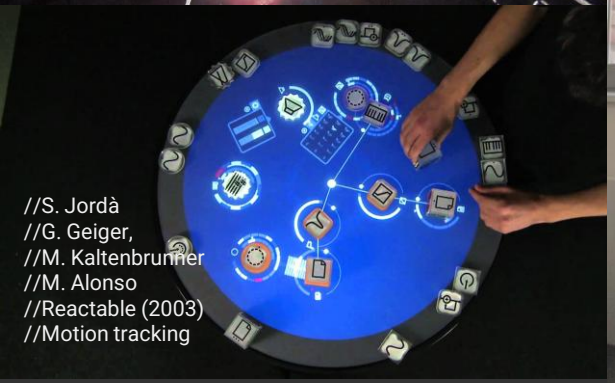
(Thor Magnusson , 2019)

# Key Definitions in contemporary DMI design

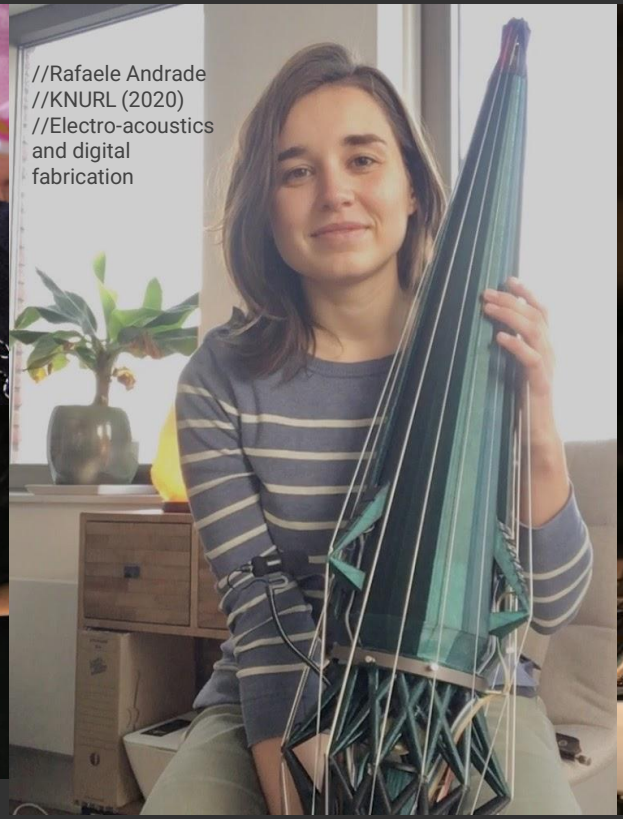
Digital Luthiery
Designing and crafting digital musical instruments as **integrated, expressive musical computers with attention to ergonomics, technology, and design.** (Jorda 2005)

NIMEcraft
The subtle, micro-scale differences between ostensibly identical digital instruments and their design processes. (Armitage, Morreale & McPherson, 2017)
Note: NIME - New Interfaces for Musical Expression

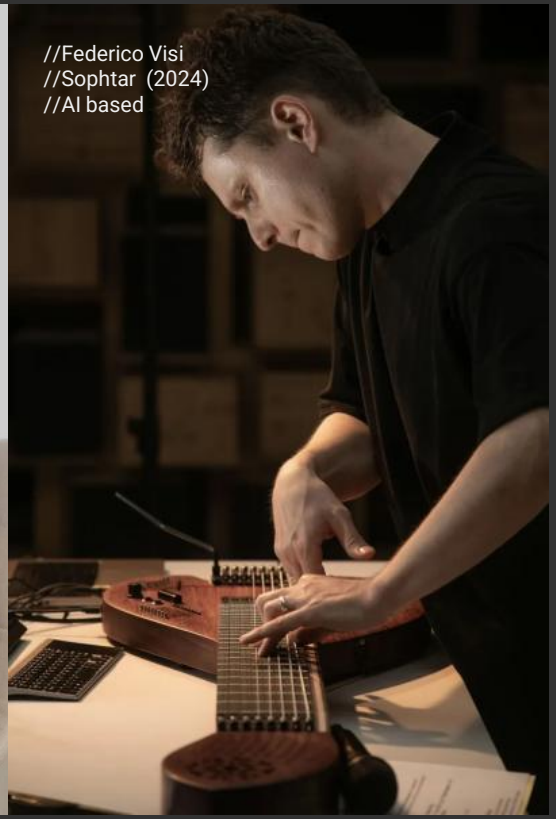
//KOBAKANT
//Crying dress (2012)
//e-textiles



//S. Jordà
//G. Geiger,
//M. Kaltenbrunner
//M. Alonso
//Reactable (2003)
//Motion tracking



//Rafaele Andrade
//KNURL (2020)
//Electro-acoustics and digital fabrication



//Federico Visi
//Sophtar (2024)
//AI based

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# Project Fello:
(custom made for a single artist)

Artist:
Andi Otto (DE)

A system that allows the performer to play the cello, live sampling and modulating sound by moving it's bow

# Project Fello:
(custom made for a single artist)

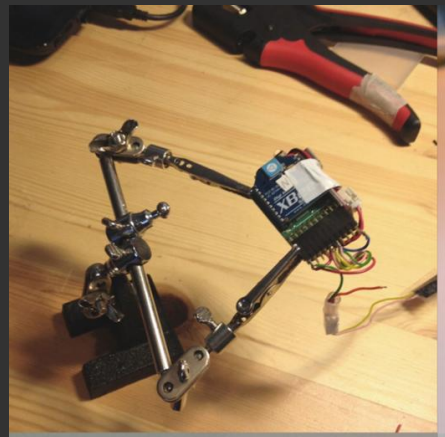
A system that allows the performer to play the cello, live sampling and modulating sound by moving it's bow

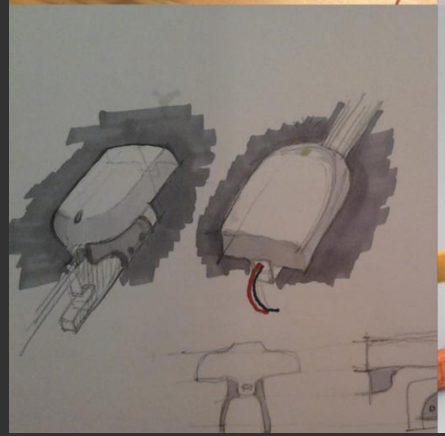
# Project Fello:

- Can live sample the sounds emitted by the cello
- Can modulate the sound of the msample by moving the bow
- Based on an ATmega328 + gyroscope + Rosa software (developed by STEIM foundation)
- Networked through an xbee RF Module

# Project Fello:

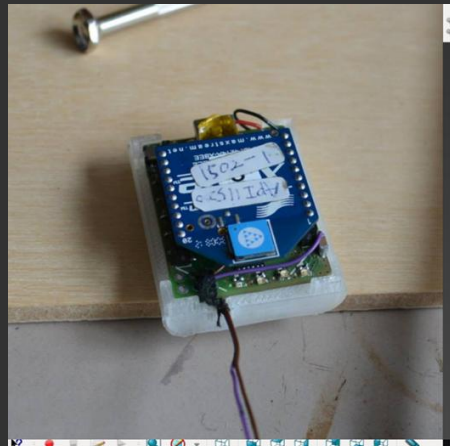
Initial sketches and prototypes

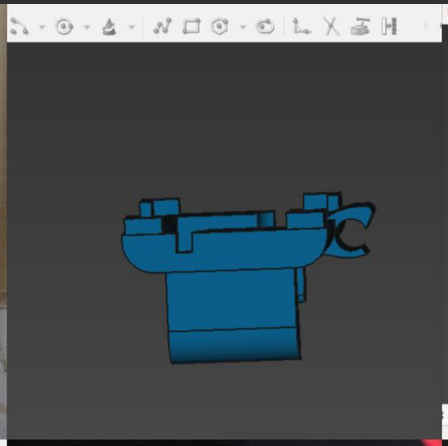


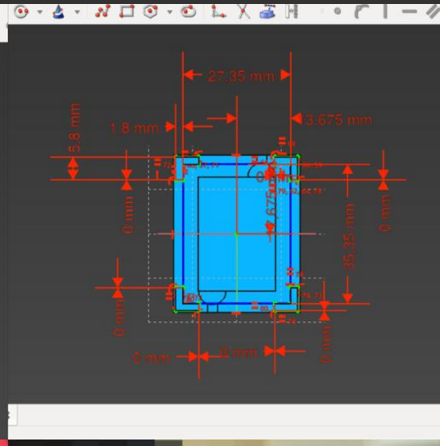



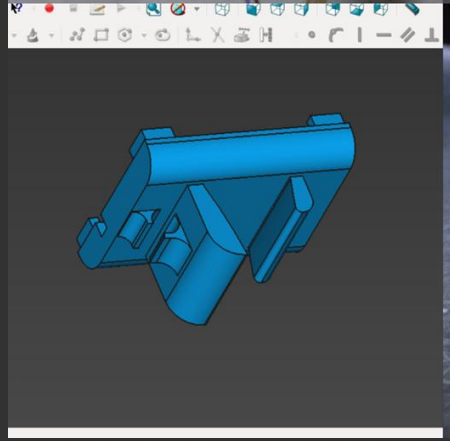
# Project Fello:

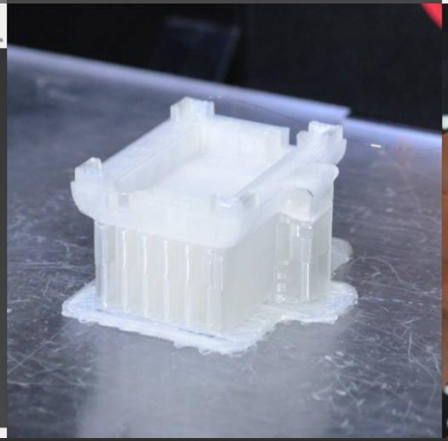
development

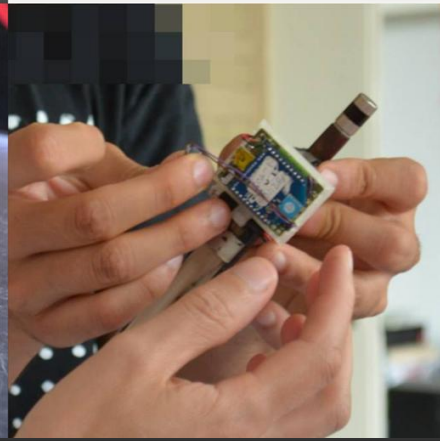






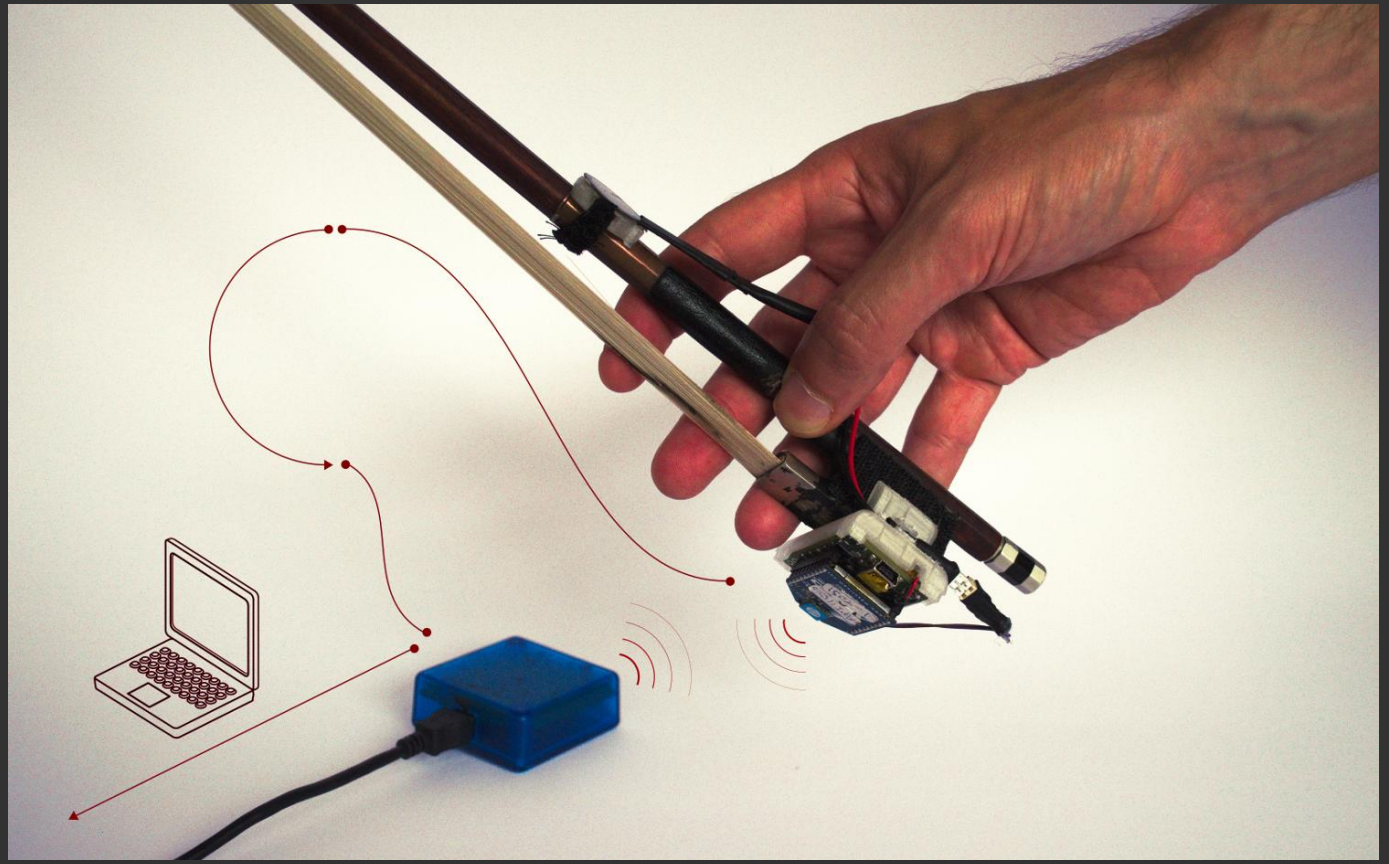







# Project Fello:

Final Product



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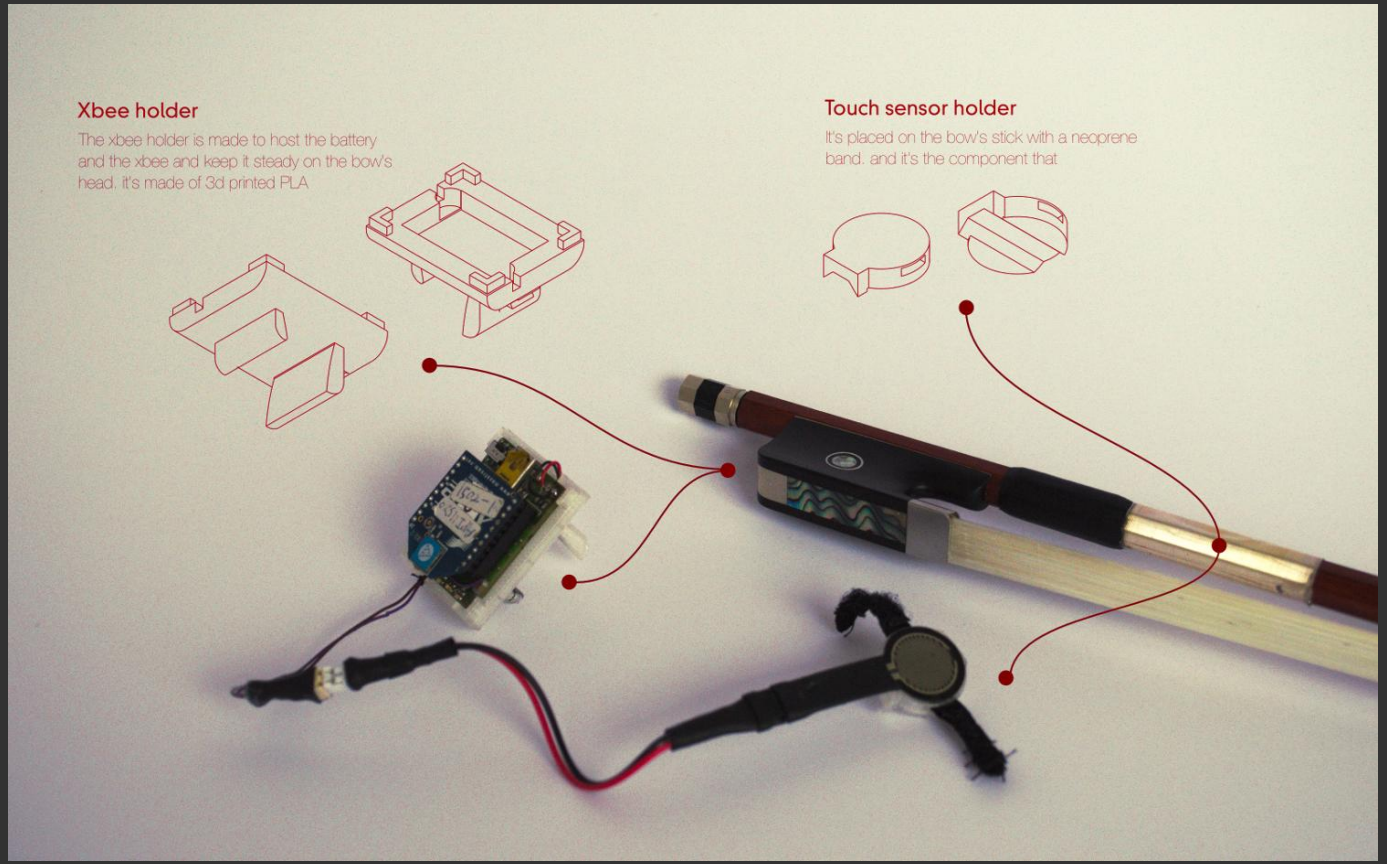

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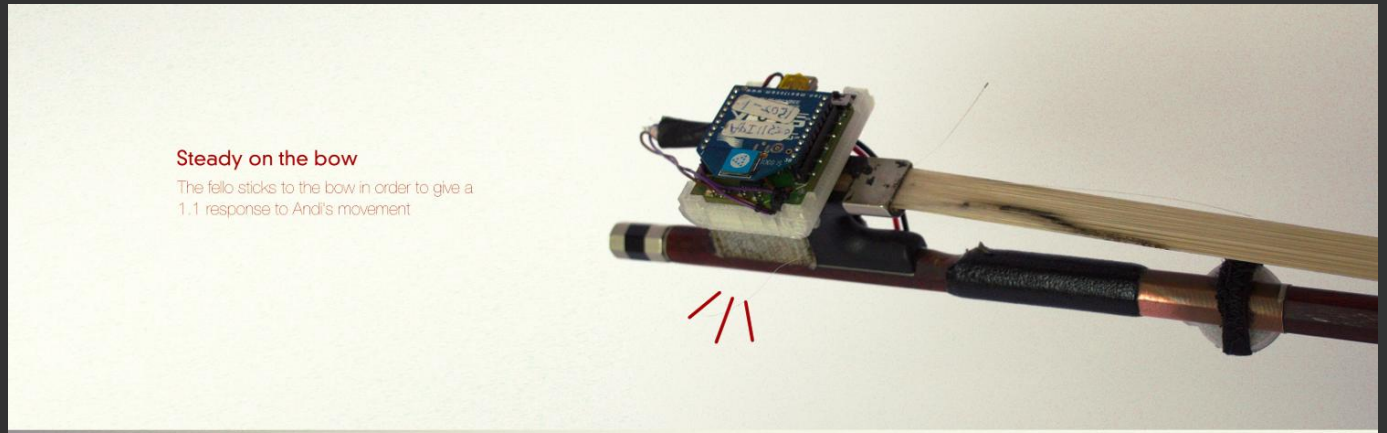
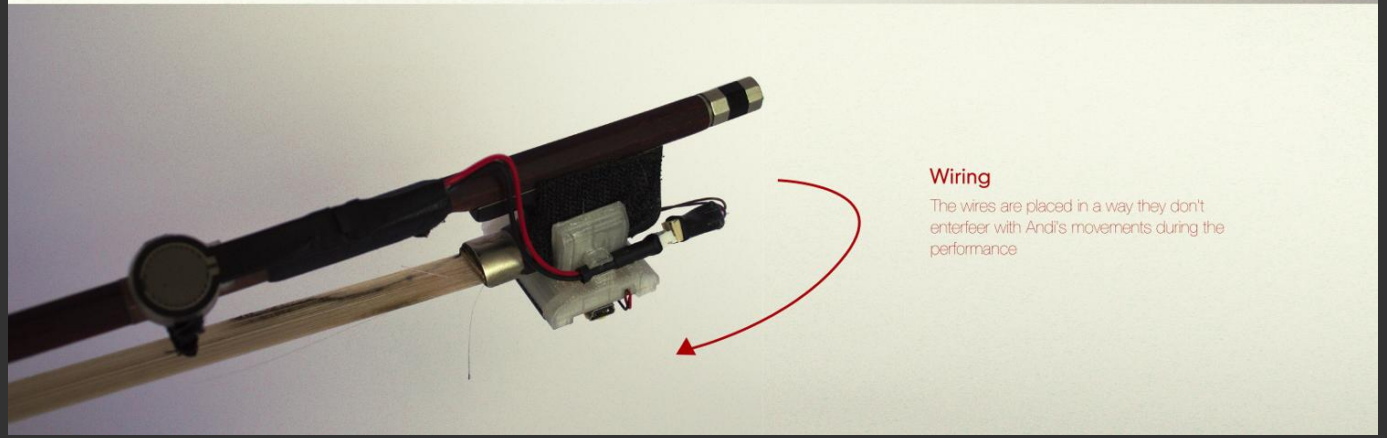


# Project Lampyridae:
(a larger scale project)

Artists
M. Marangoni and Dieter Vandoren
Lampyridae is a participatory experience in which humans facilitate the establishment of a society of artificial entities called Lampyridae

# Project Lampyridae:

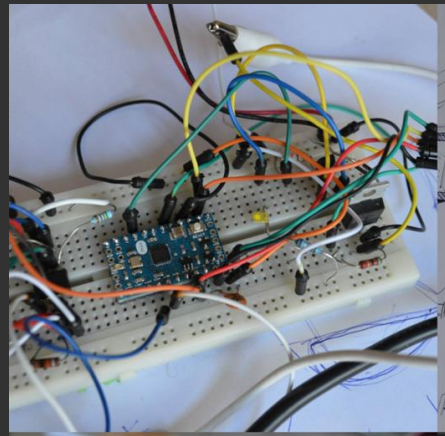
Lampyridae is a participatory experience in which humans facilitate the establishment of a society of artificial entities called Lampyridae

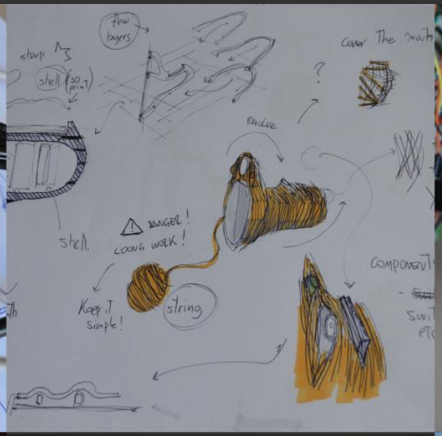
# Project Lampyridae:
(a larger scale project)

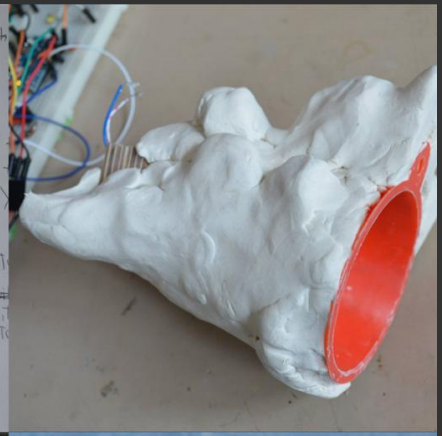
- Made out of 100 devices
- Devices generate a soundscape by interacting with each other
- Based on ATmega328 + light, ldr, speaker and microphone

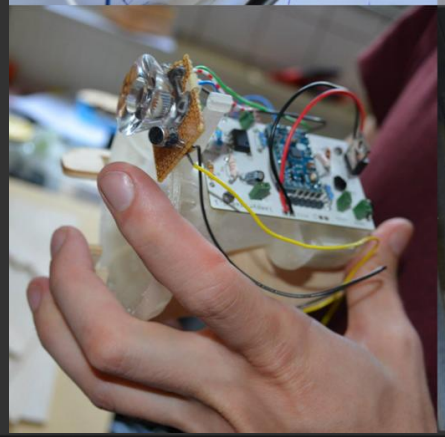
# Project Lampyridae:

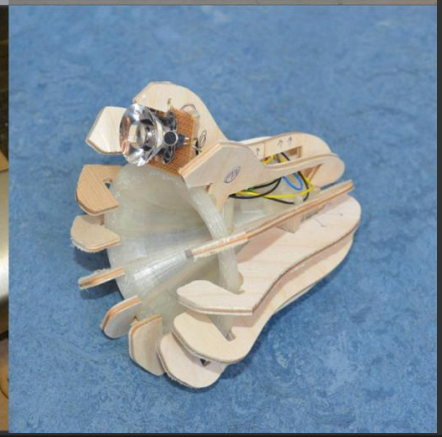
Initial sketches and prototypes





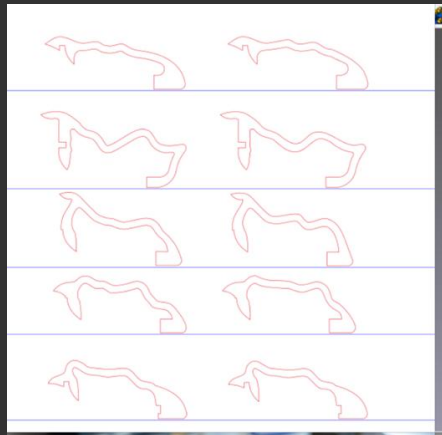



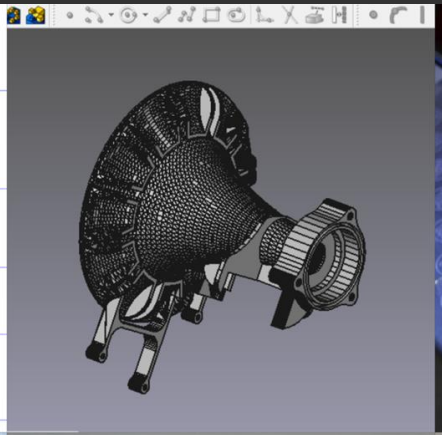


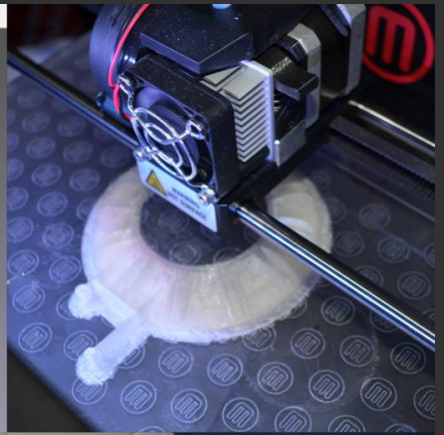


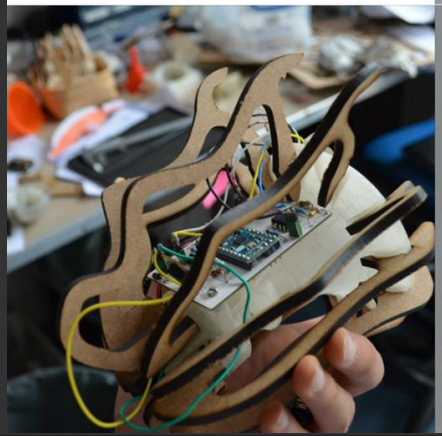
# Project Lampyridae:

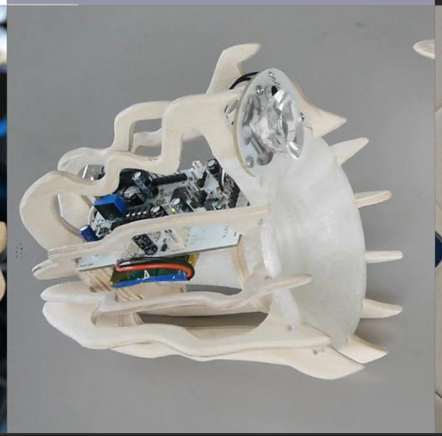
development











# Project Lampyridae:

Final Product

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Research:

| Research Topics | | Research Outcomes |
|---|---|---|
| - Sustainability of DMIs | ----▸ | - Theoretical frameworks |
| - Longevity of DMIs | | - Case studies |

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# Case study DCM:

## Designing an interface using FLOSS - Only

N. Merendino and A. Rodã, "**Defining an Open Source CAD Workflow for Experimental Music and Media Arts**," Proceedings of the 10th International Conference on Digital and Interactive Media Arts and Sciences, 2024.

Case study
DCM:

**RQ** - can a DMI be designed using exclusively FLOSS?

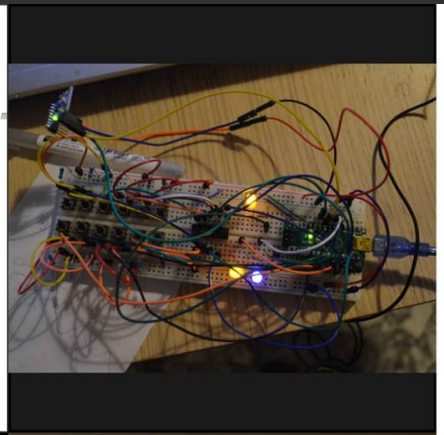
**Methodology:**
Reflection on action

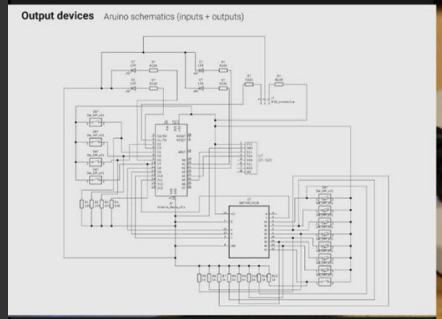
N. Merendino and A. Rodà, "**Defining an Open Source CAD Workflow for Experimental Music and Media Arts**," Proceedings of the 10th International Conference on Digital and Interactive Media Arts and Sciences, 2024.

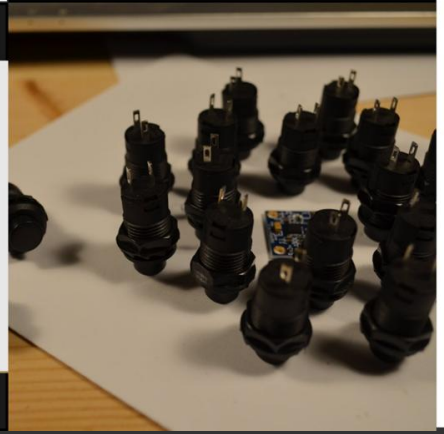
# Case study DCM:

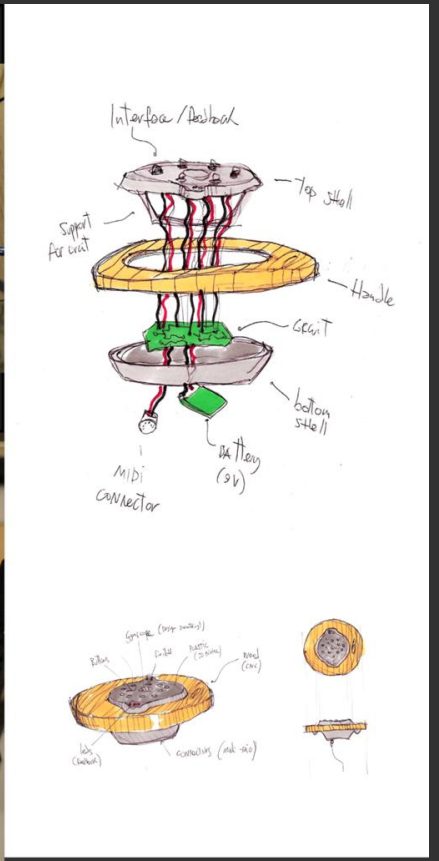
Going from a basic prototype to a usable TUI using FLOSS only

```
#include <SPI.h>
#include <Wire.h>
#include <MIDI.h>
#define MPU 0x68  // I2C address of the MPU-6050

const byte input = 11;   // digital input to arduino from m
const byte c=10;
const byte b=9;
const byte a=8;

const int button1Pin = 4;
const int button2Pin = 5;
const int button3Pin = 2;
const int button4Pin = 7;

const int DEFAULT_MIDI_CHANNEL = 1;
MIDI_CREATE_DEFAULT_INSTANCE();


int button1State = 0;
int button2State = 0;
```



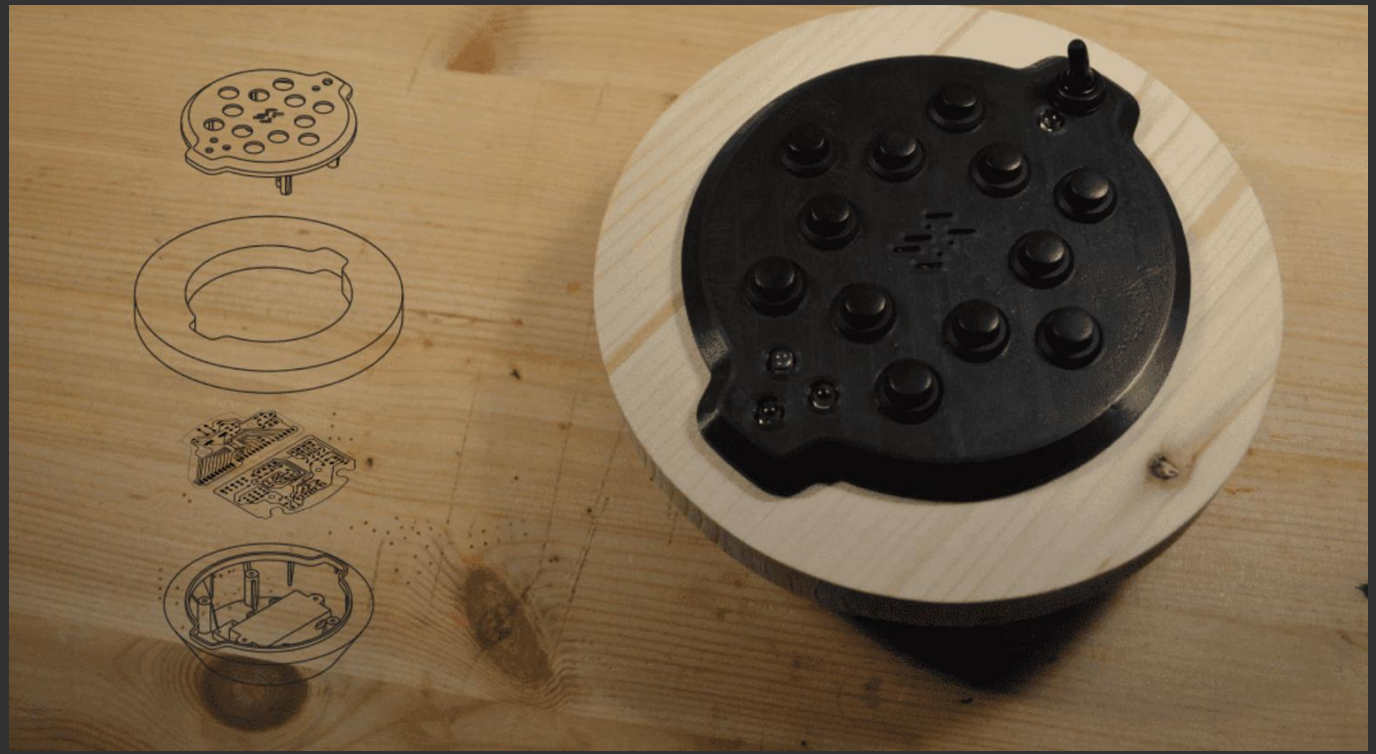




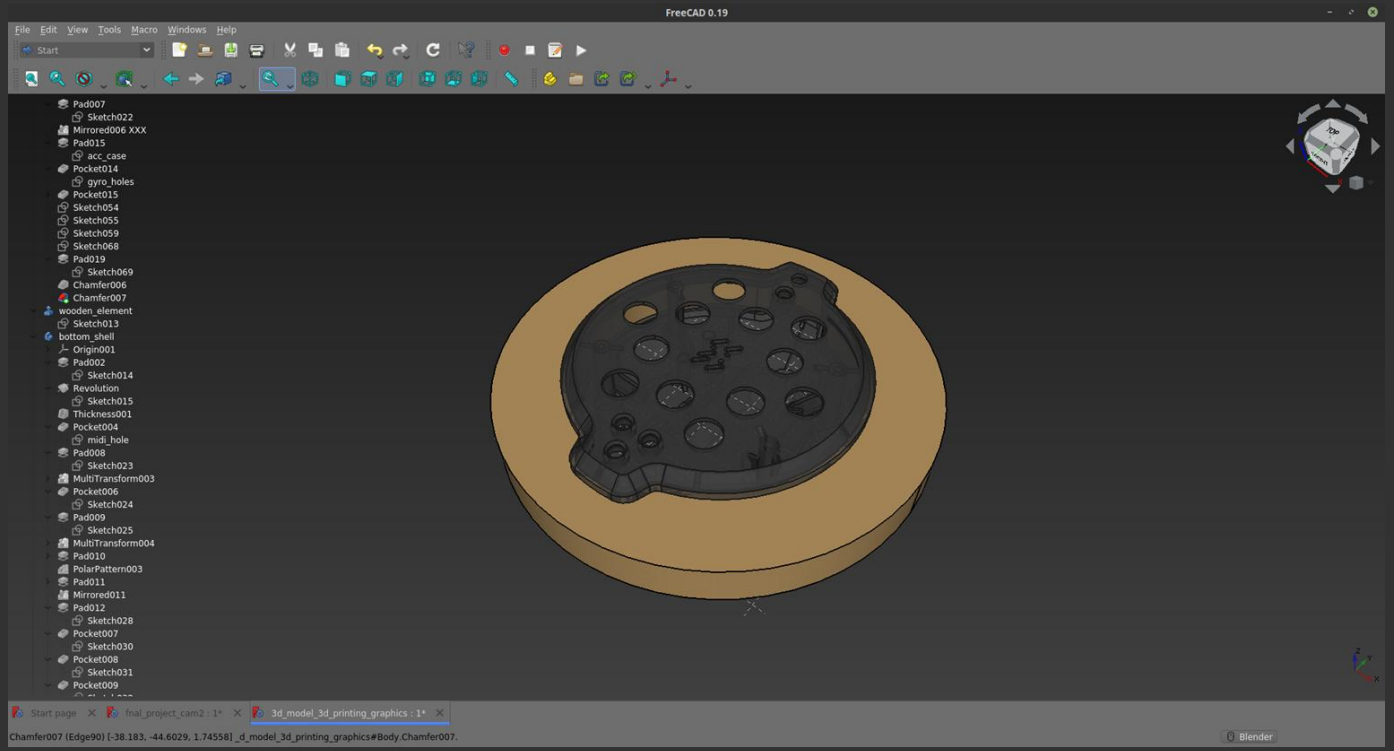
# Case study DCM:

## Main structure



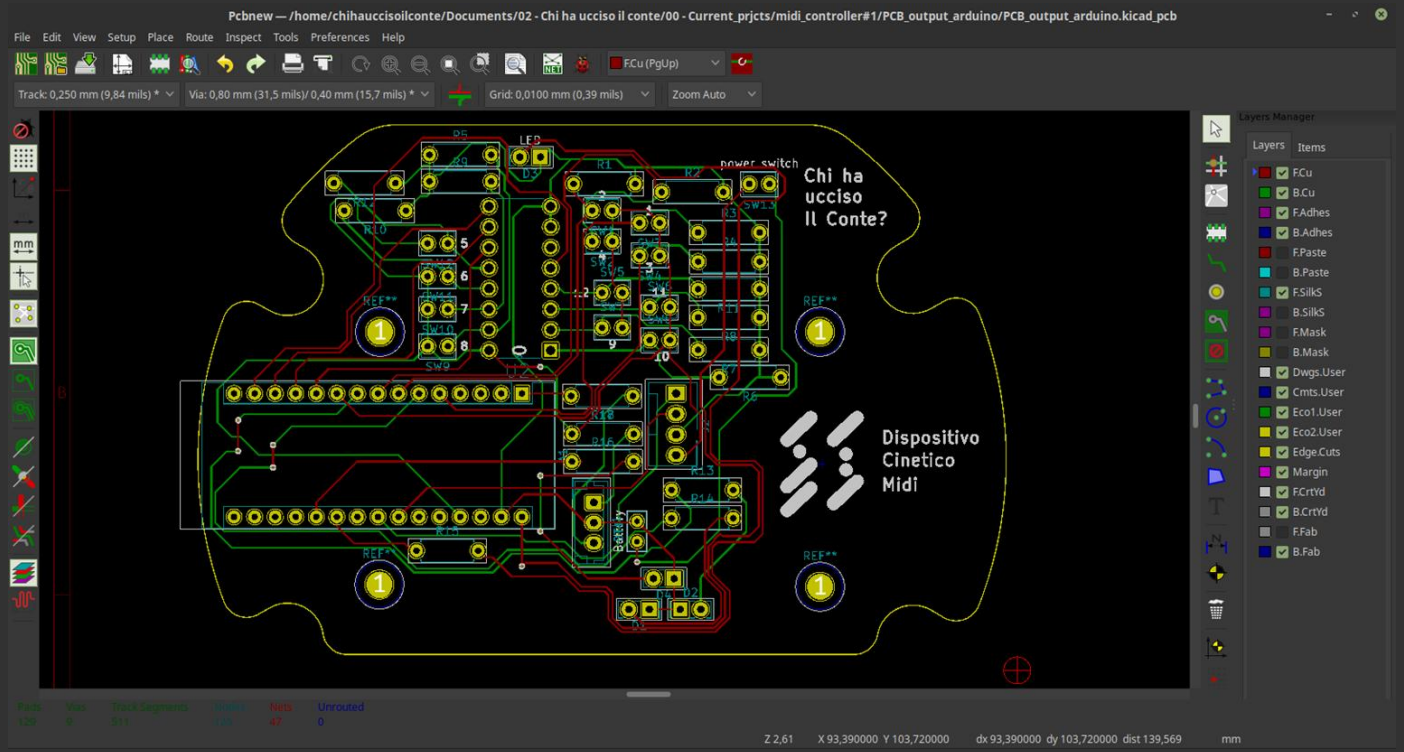
# Case study DCM:

## FreeCAD for 3D modeling



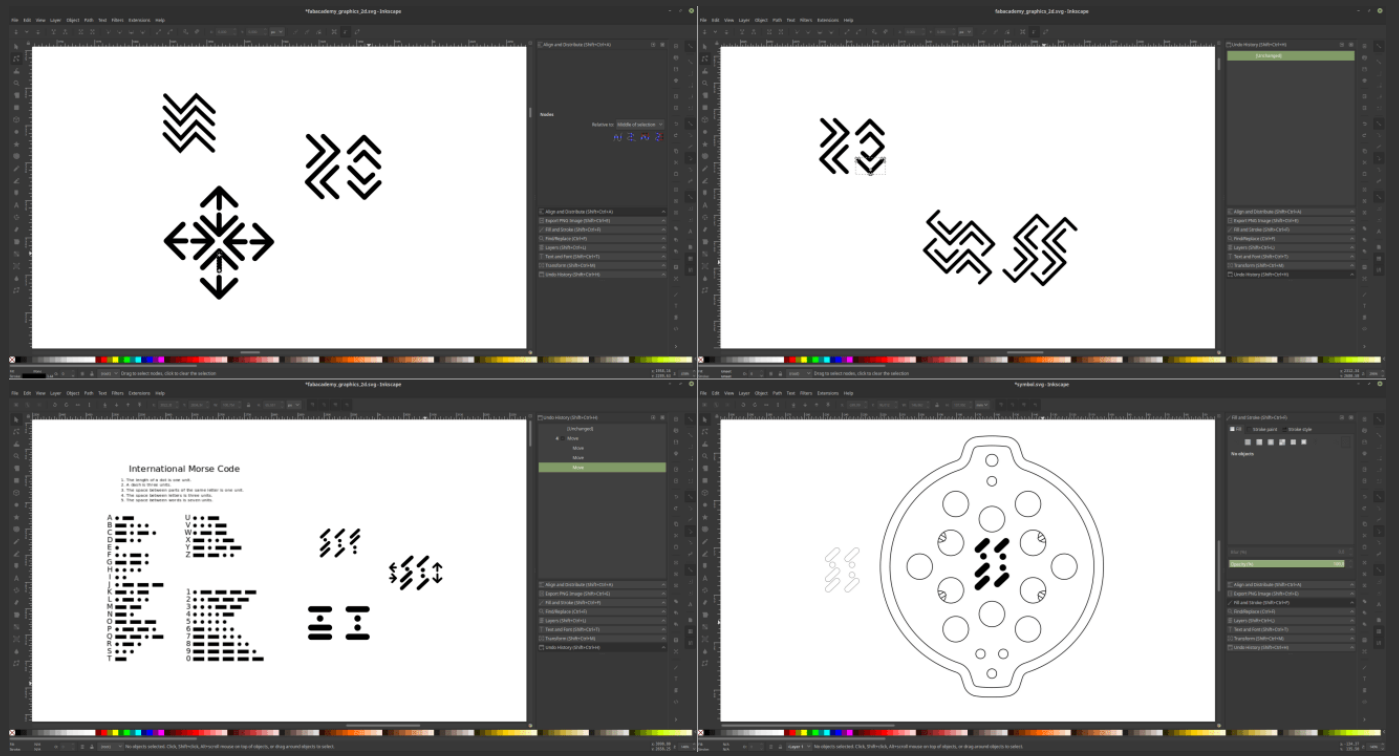
# Case study DCM:

## KiCAD for PCB Design



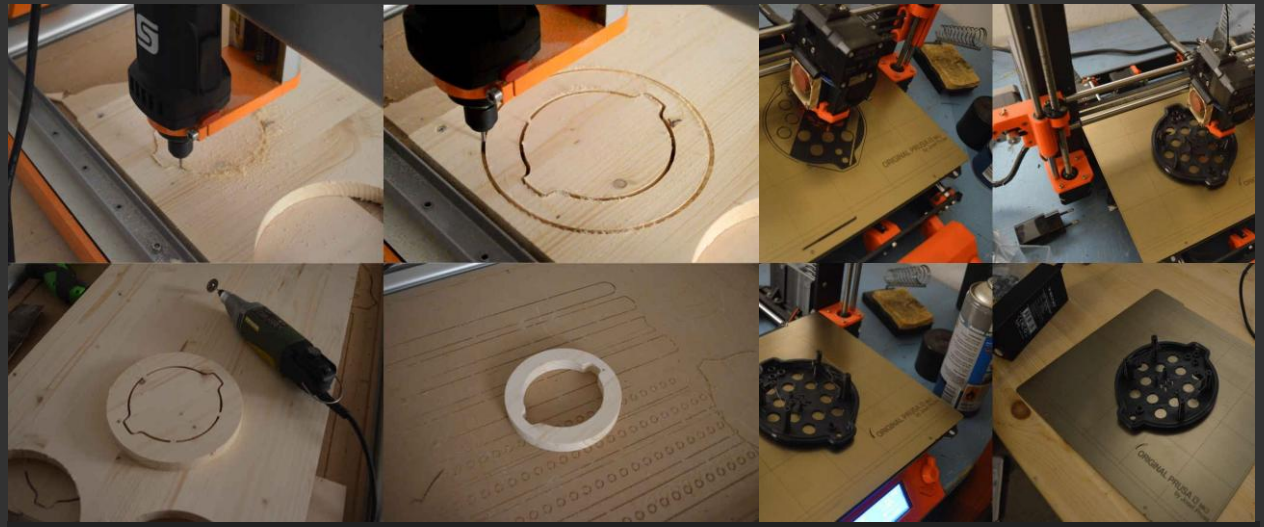
# Case study DCM:

Inkscape for Vector graphics



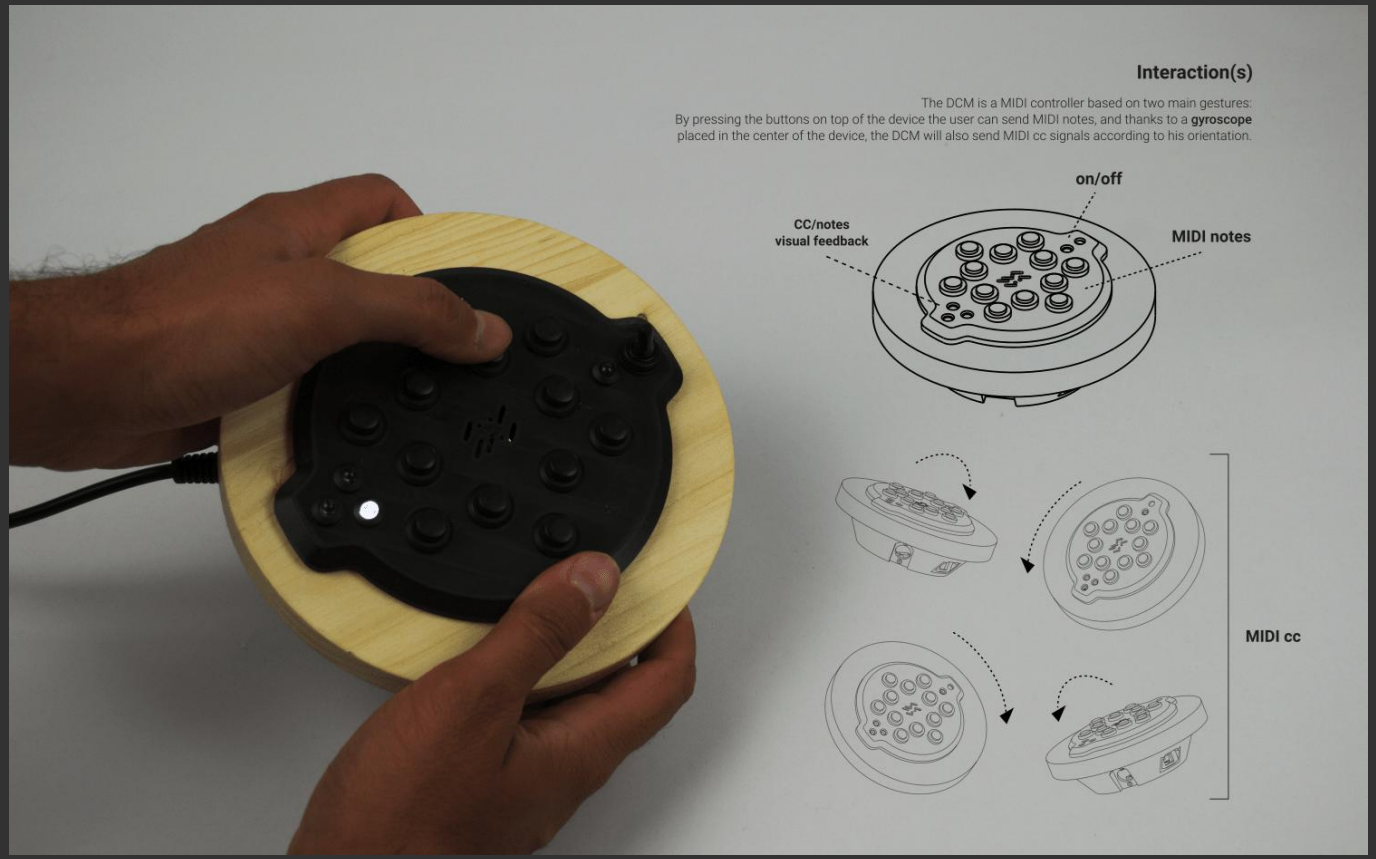
# Case study DCM:

## Fabrication and assembly



# Case study DCM:

## Final product



# Case study DCM:

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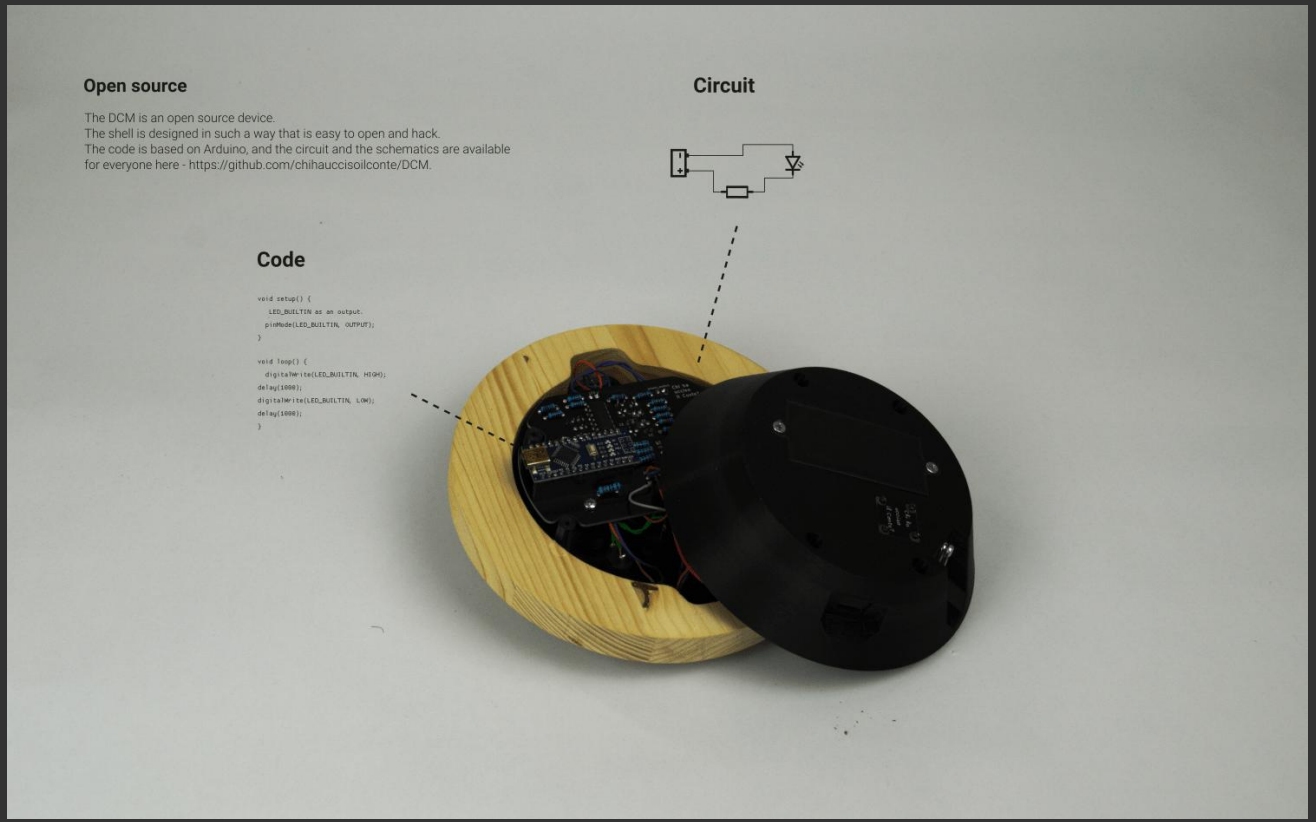
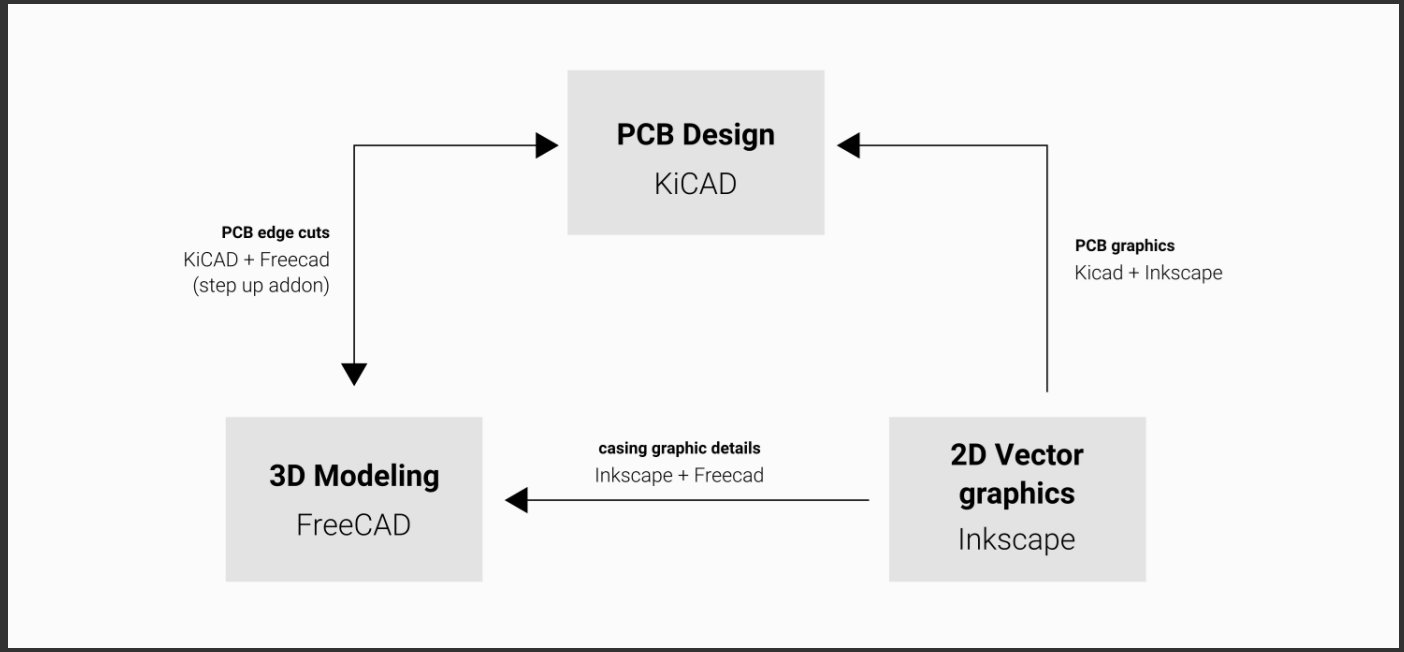


# Case study DCM:

## Results:



# Case study Below 58BPM:

## Designing an Internet of Musical Things (IoMusT) based system fostering accessibility and sustainability

N. Merendino, A. Rodă, and R. Masu, "**'Below 58 BPM': Involving Real-Time Monitoring and Self-Medication Practices in Music Performance Through IoT Technology,**" Frontiers in Computer Science, vol. 6, Art. no. 1187933, 2024.

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Case study
Below 58BPM:

**RQ** - is it possible Design of an IomusT system aimed at reducing physical stress while performing?

**Methodology:**
- ideographic design
- Co-design sessions

N. Merendino, A. Rodă, and R. Masu, "**'Below 58 BPM': Involving Real-Time Monitoring and Self-Medication Practices in Music Performance Through IoT Technology,**" Frontiers in Computer Science, vol. 6, Art. no. 1187933, 2024.

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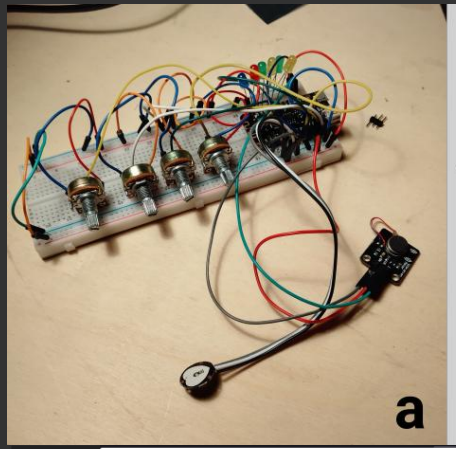
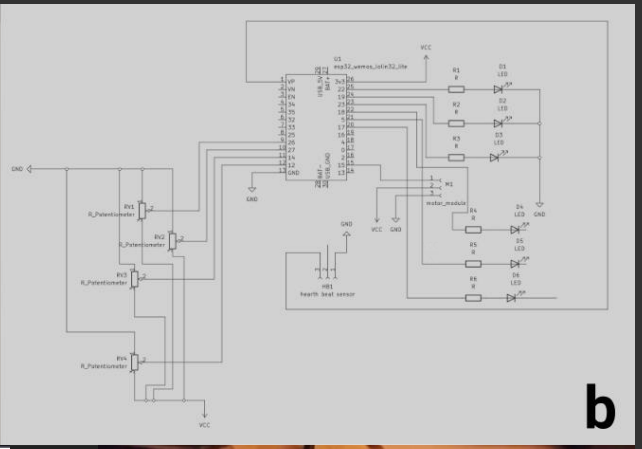
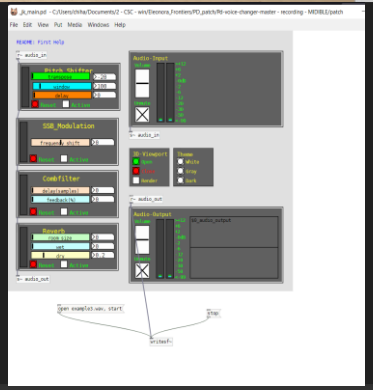
# Case study
# Below 58BPM:

Design sessions with the artist



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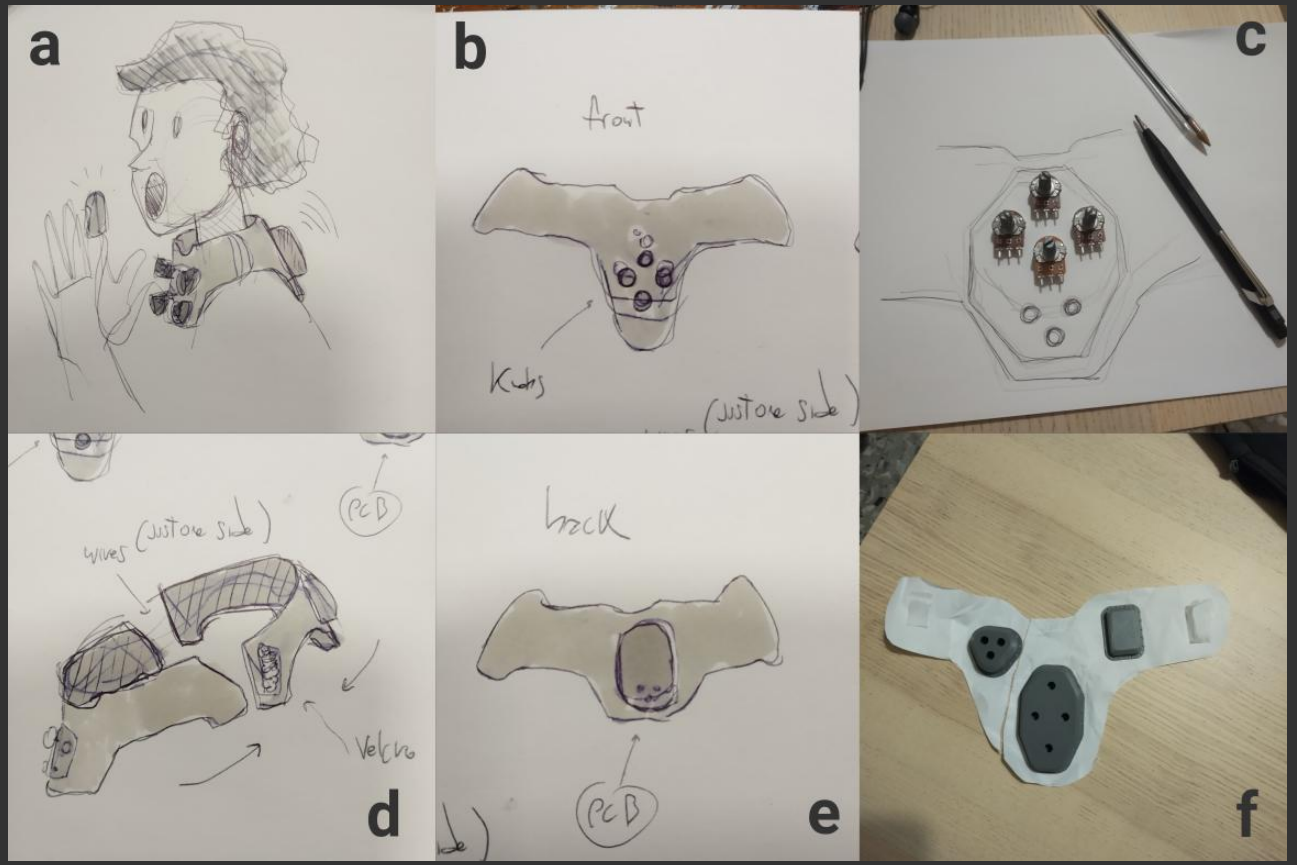
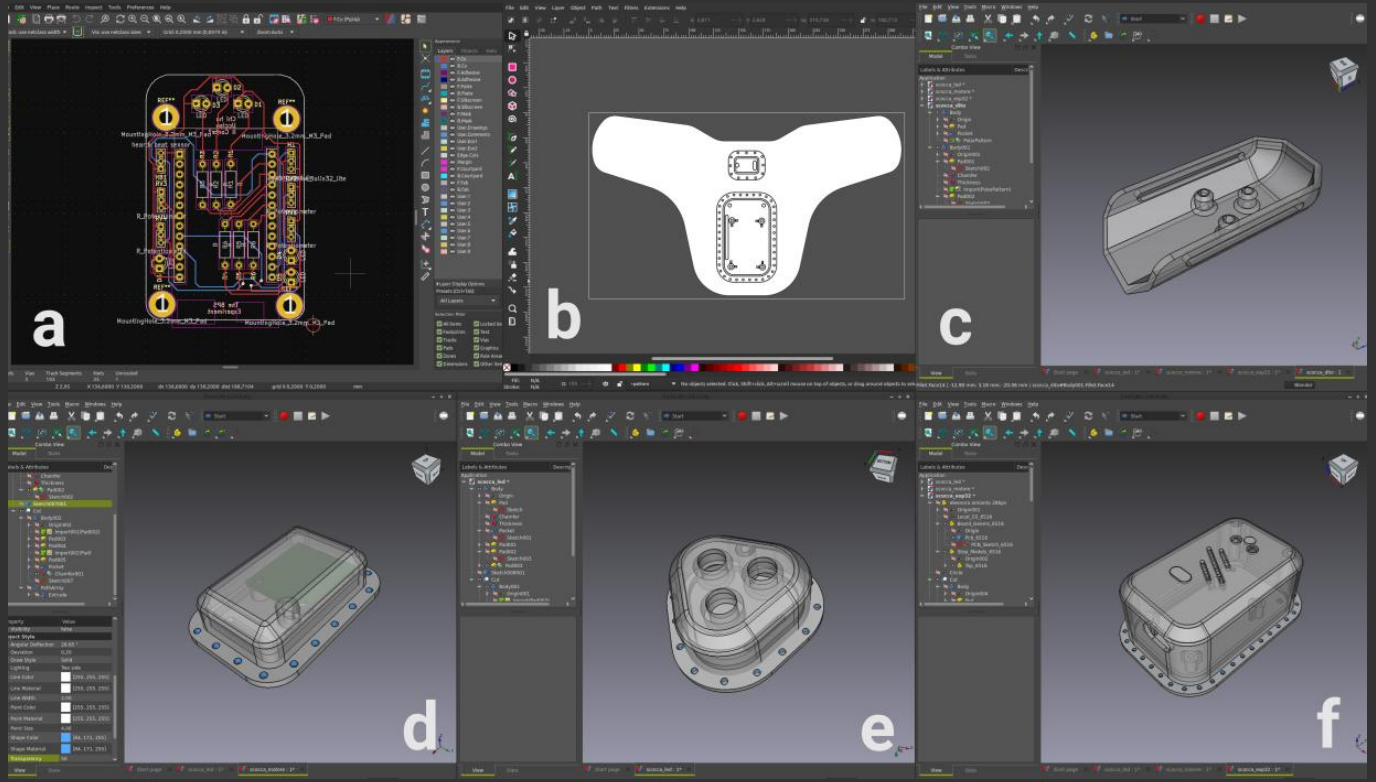


# Case study
# Below 58BPM:

## Development



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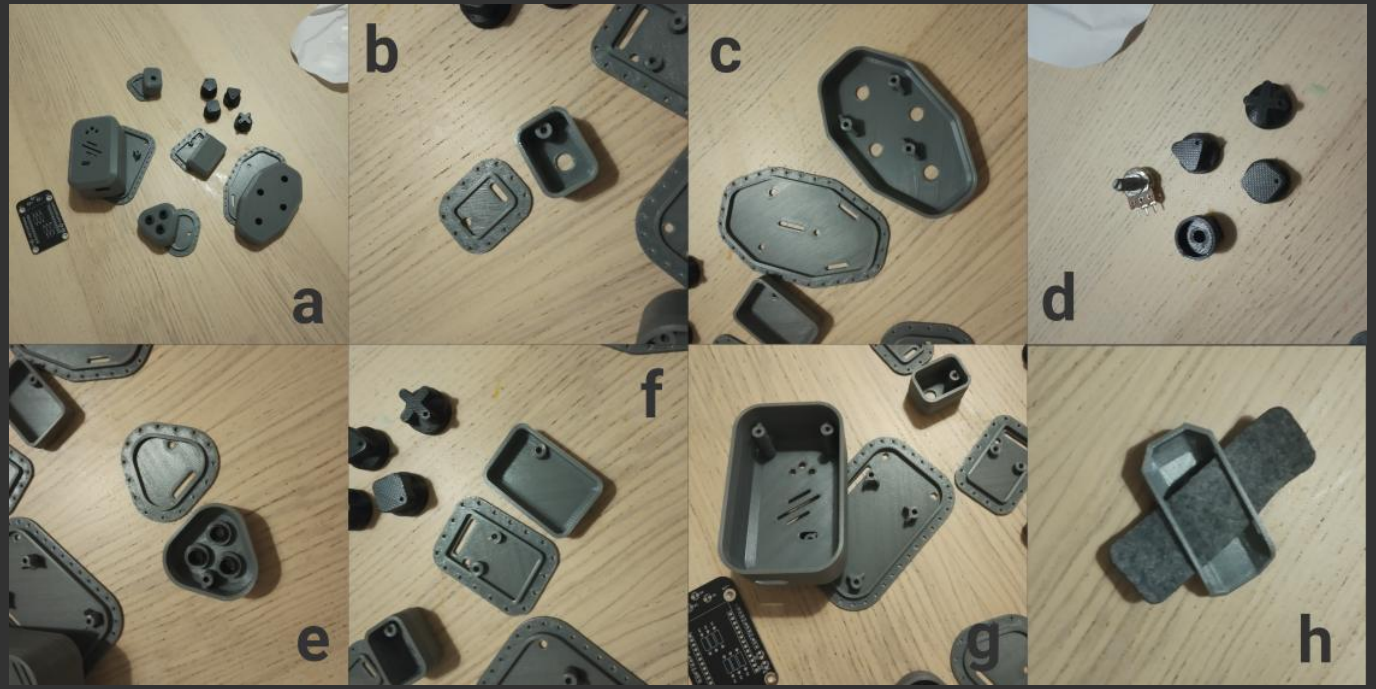
## Development



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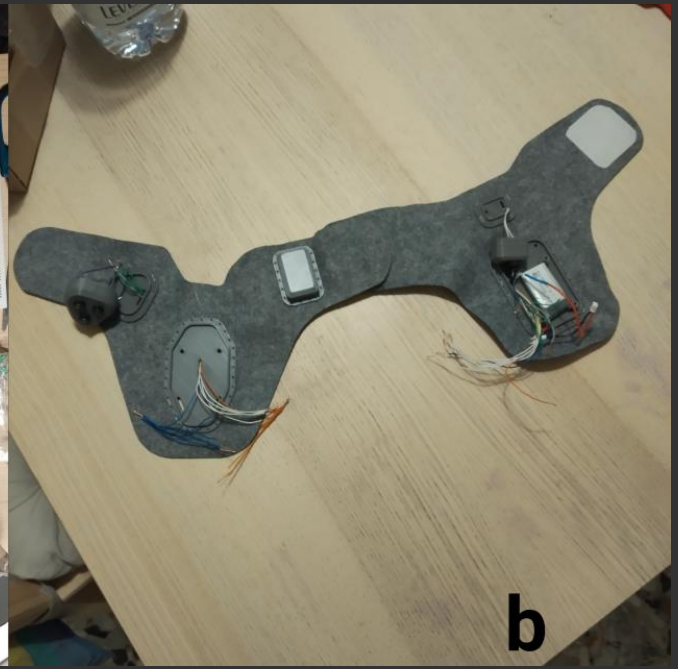
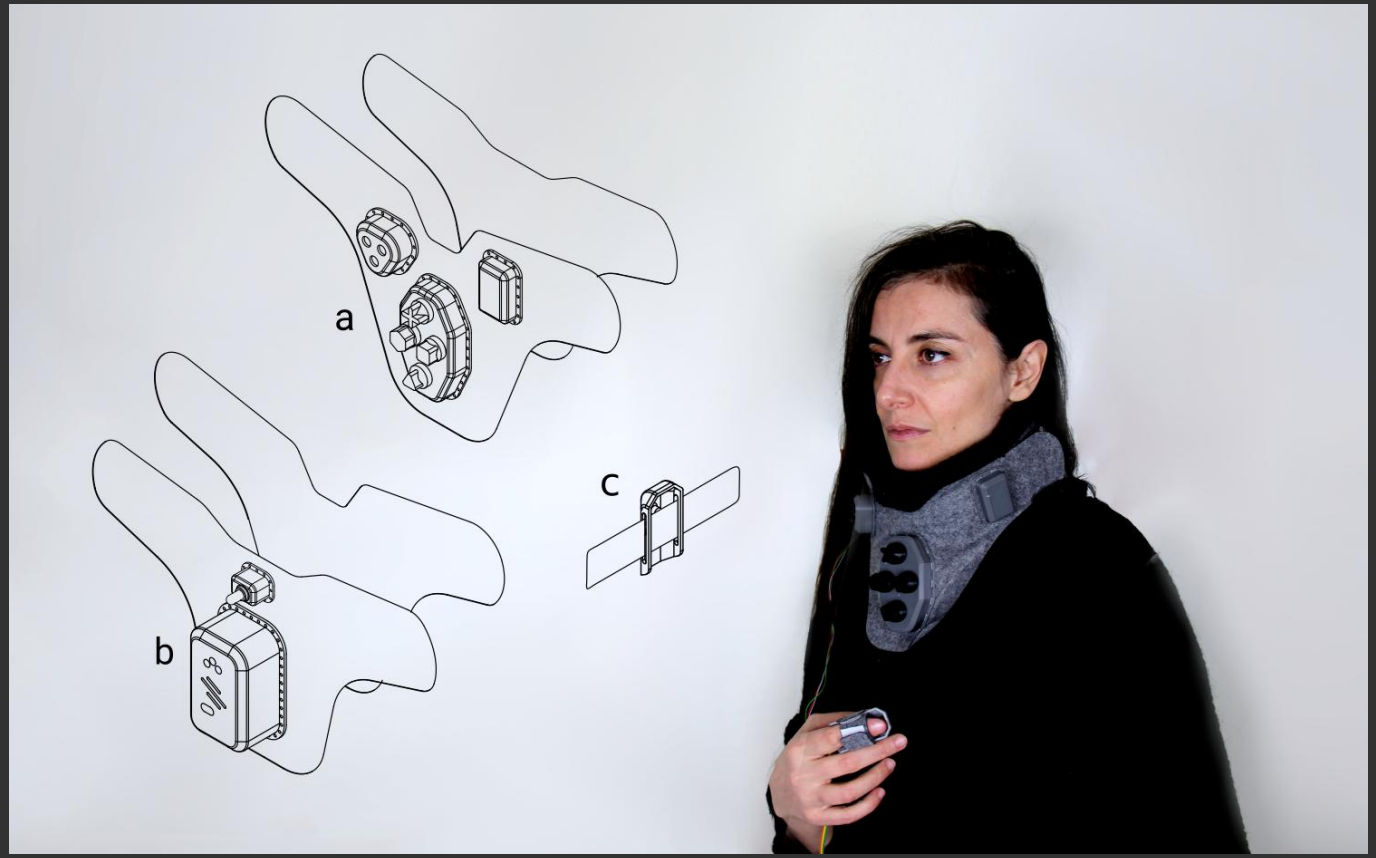
# Below 58BPM:

## Development

# Case study Below 58BPM:

## Final product



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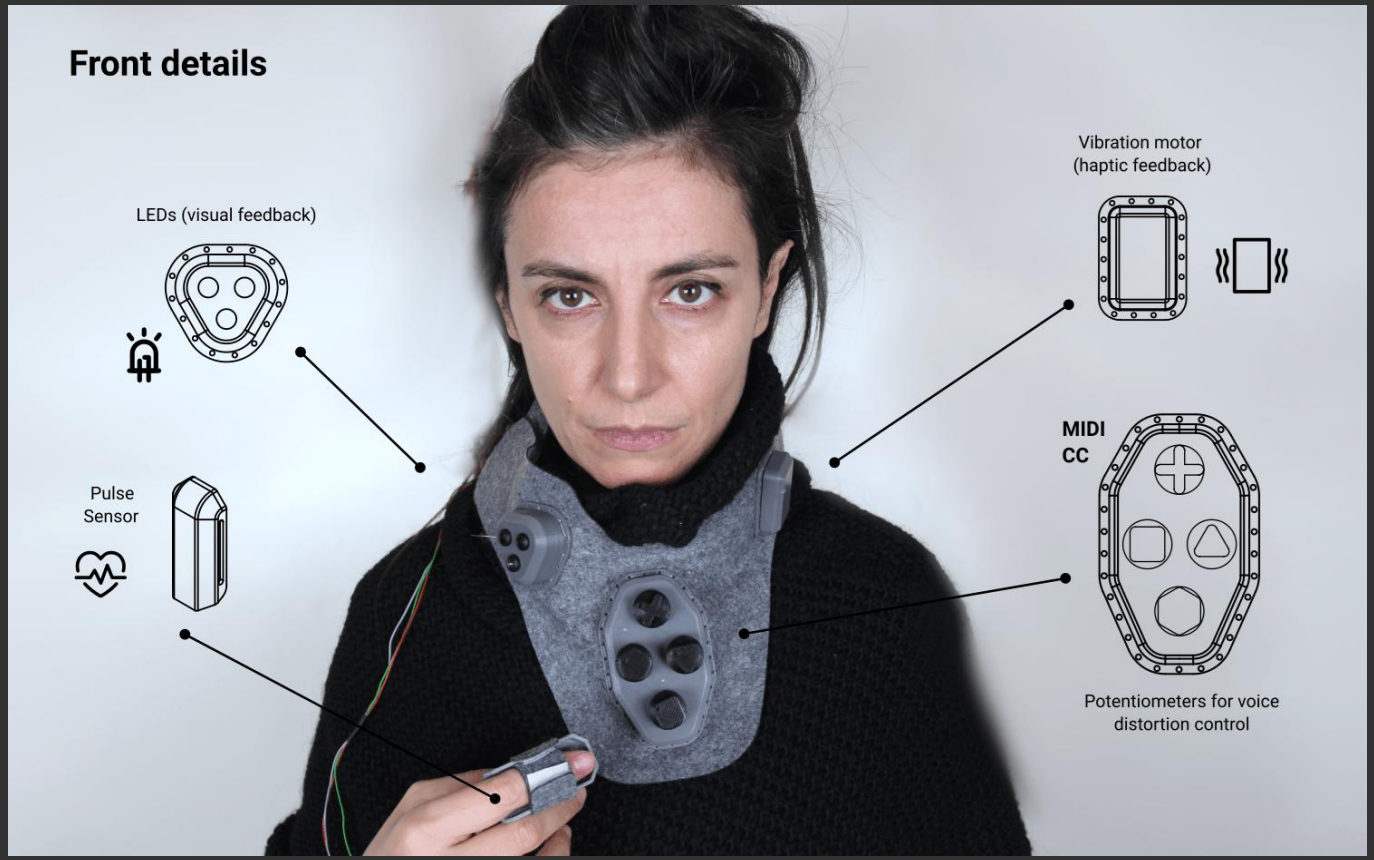
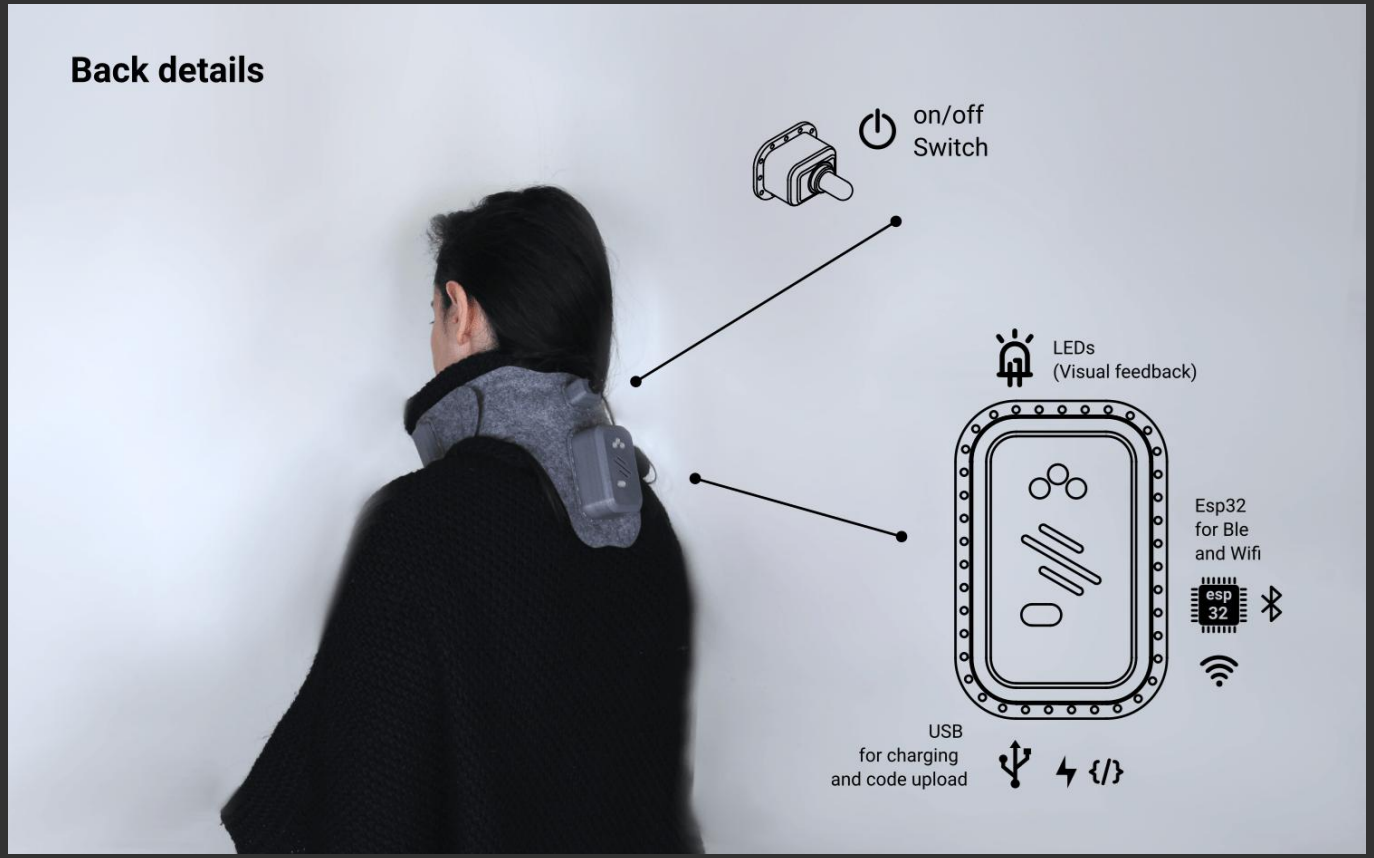
## Final product



# Case study Below 58BPM:

## Final product



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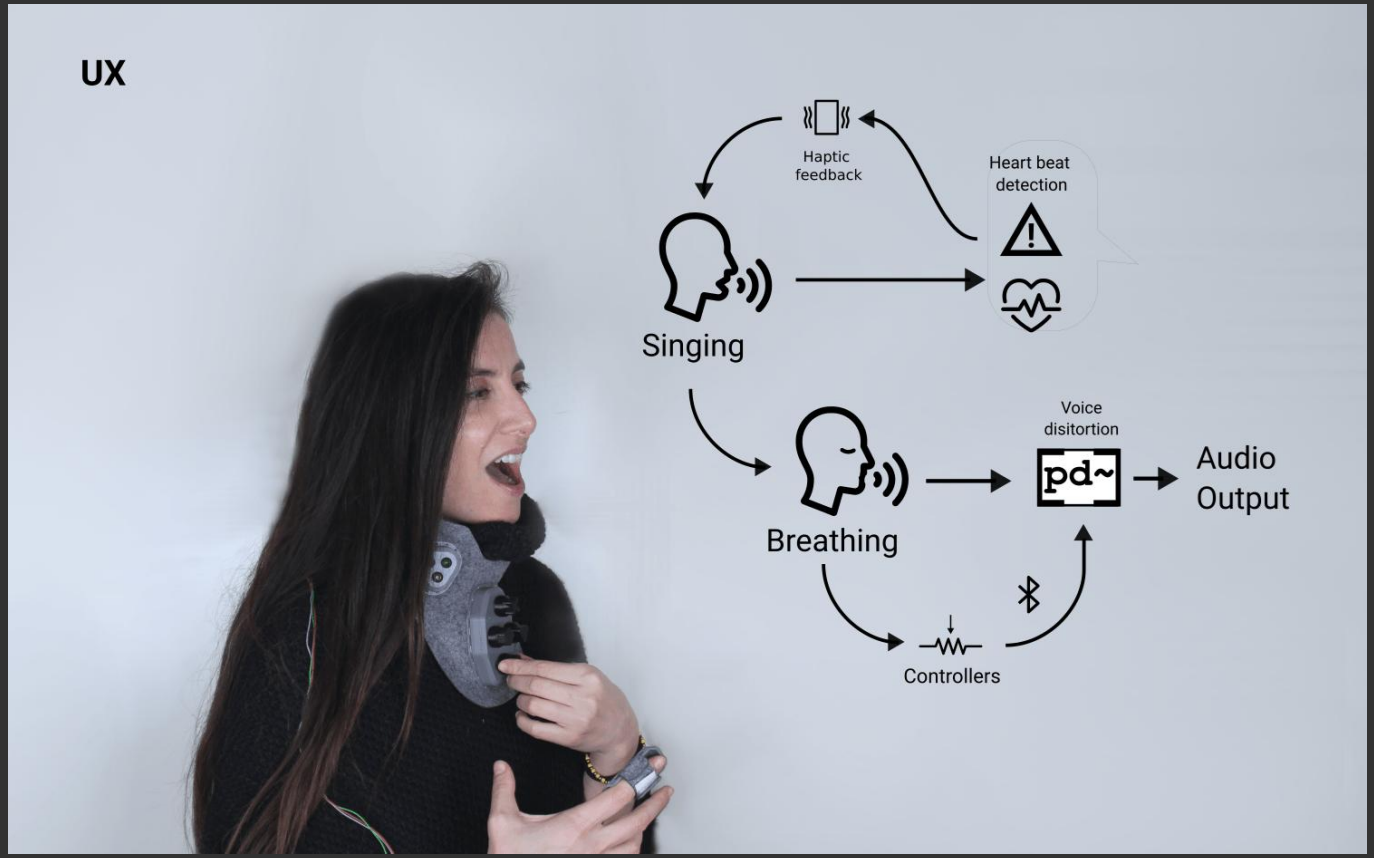
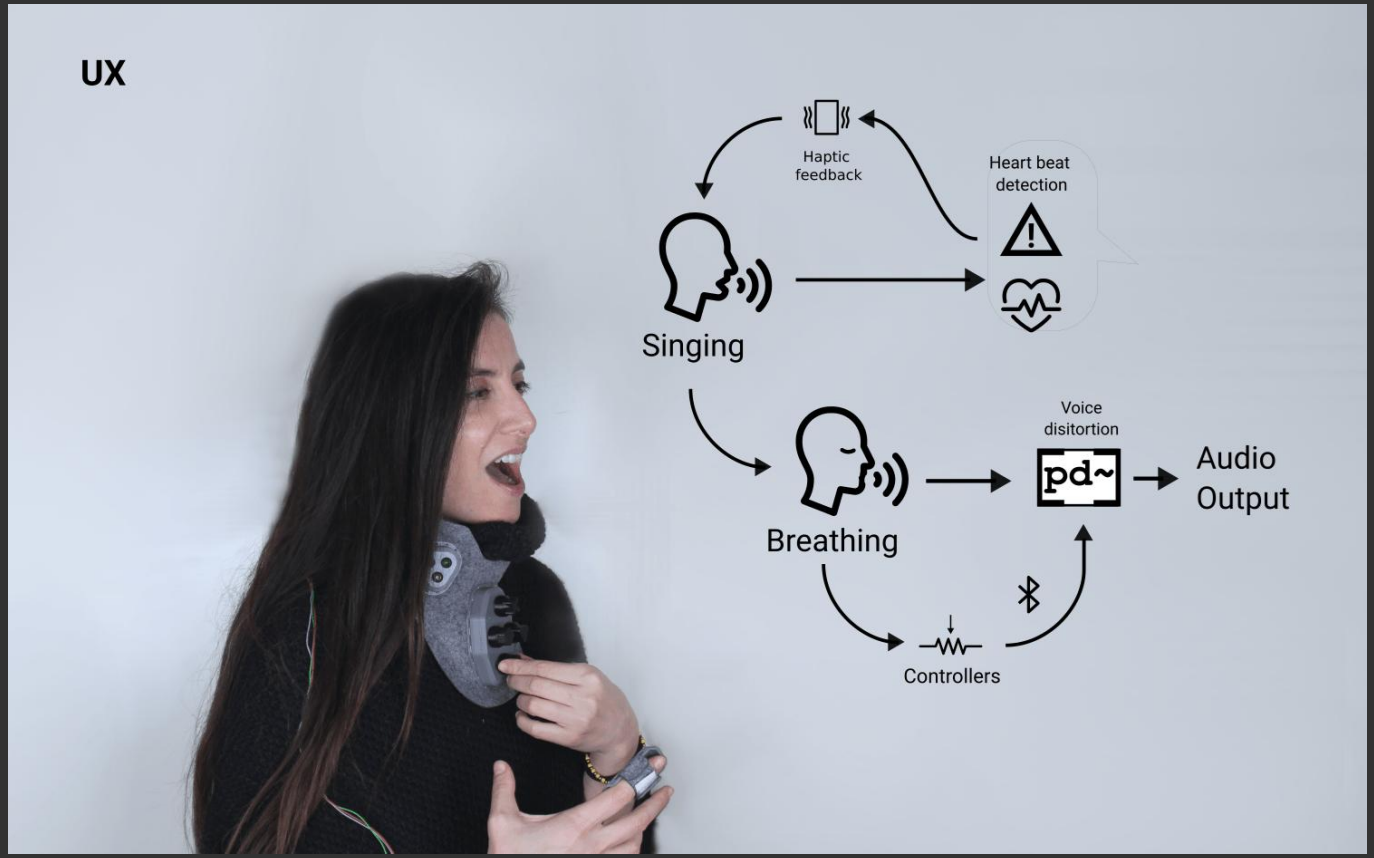
## Final product



# Case study Below 58BPM:

## Results:
(Thematic Analysis of data collected in the design process)

- Reflection on IoMusT system in relation to the existing debates on inclusively, social sustainability, and environmental sustainability.



Research:

**Thematic analysis**

1 Intro ----▸ 2 Multimedia arts and technology ----▸ 3 Examples

4 Research (CAD, FLOSS and DMIs) ----▸ 5 Case studies ----▸ 6 FLOSS related Theoretical Frameworks ----▸ 7 Conclusions

# Theoretical Framework:

Nine sustainability strategies for DMI production with digital fabrication

| | Making | | | Avoid Disposal | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1 Optimize fabrication process | 2 Optimize logistics | 3 Rely on recycled or sustainable materials | 4 Document | 5 Rely on modularity | 6 Rely on Standard and interoperability | 7 Consider affordability of reparation | 8 Optimize and account for durability | 9 Rely on FLOSS for fabrication |
| 3D Printing | | | | | | | | | |
| Lasercutting | | | | | | | | | |
| CNC Milling | | | | | | | | | |
| Circuit Production | | | | | | | | | |

N. Merendino, M. Bettega, A. P. Melbye, J. Sullivan, A. Rodã, and R. Masu, **"Sustainable Digital Fabrication in NIME: Nine Sustainability Strategies for DMI Production**," Proceedings of the International Conference on New Interfaces for Musical Expression, 2024.

# Add workshop with iii

1 Intro ----▸ 2 Multimedia arts and technology ----▸ 3 Examples

4 Research (CAD, FLOSS and DMIs) ----▸ 5 Case studies ----▸ 6 FLOSS related Theoretical Frameworks ----▸ 7 Conclusions

# Recap:

- Multimedia arts (and particularly DMIs) can be a gateway to explore technology such as AI, XR, IoT systems
- Artists, organizations and companies have explored cutting edge technology to develop their artistic projects
- By adopting practice-based methodologies, it is possible to conduct research based on multi-media arts development

## Refs link:

2025/10/29
The Hong Kong University of science and technology - Guangzhou

香港科技大学(广州)
THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY (GUANGZHOU)

# Thank you!

Any questions?

Computational Media and Arts

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