

Experimenting techniques for Sonic Implicit Interactions: A real time sonification of body-textile heat exchange with sound augmented fabrics



Vincenzo Madaghiele and Sandra Pauletto
KTH Royal Institute of Technology, Sweden
{vmad, pauletto}@kth.se

Sound for Energy Project

Developing everyday sonic interactions to facilitate and promote energy efficiency

Madaghiele, V. & Pauletto, S. (June, 2022) The Sonic Carpet: real-time feedback of energy consumption and emission data through sonic interaction design, *International Conference on Auditory Displays*.

Seznec, Y., & Pauletto, S. (2022). The Singing Shower: A melody-sensitive interface for physical interaction and efficient energy consumption. In *Sound and Music Computing Conference*.

Selfridge, R., Barone, C., & Pauletto, S. (2022). Sonifying an Office Gadget to Indicate Air Quality. In *Sound and Music Computing Conference*.

www.soundforenergy.net



Background and related work

- **Designing interfaces for the home:** shifting the focus of design - encouraging creativity, playfulness and wonder
- **Implicit interactions:** an action performed by the user that is not primarily aimed to interact with a computerised system but which such a system understands as input

Y. Strengers (July 2014) "Smart energy in everyday life: are you designing for resource man?" *Interactions*, vol. 21, no. 4, pp. 24–31

J. Pierce and E. Paulos (2010) "Materializing energy," in *Proceedings of the 8th ACM Conference on Designing Interactive Systems - DIS '10*

W. Gaver (January 2002) "Designing for homo ludens," *I3 Magazine*, vol. 12

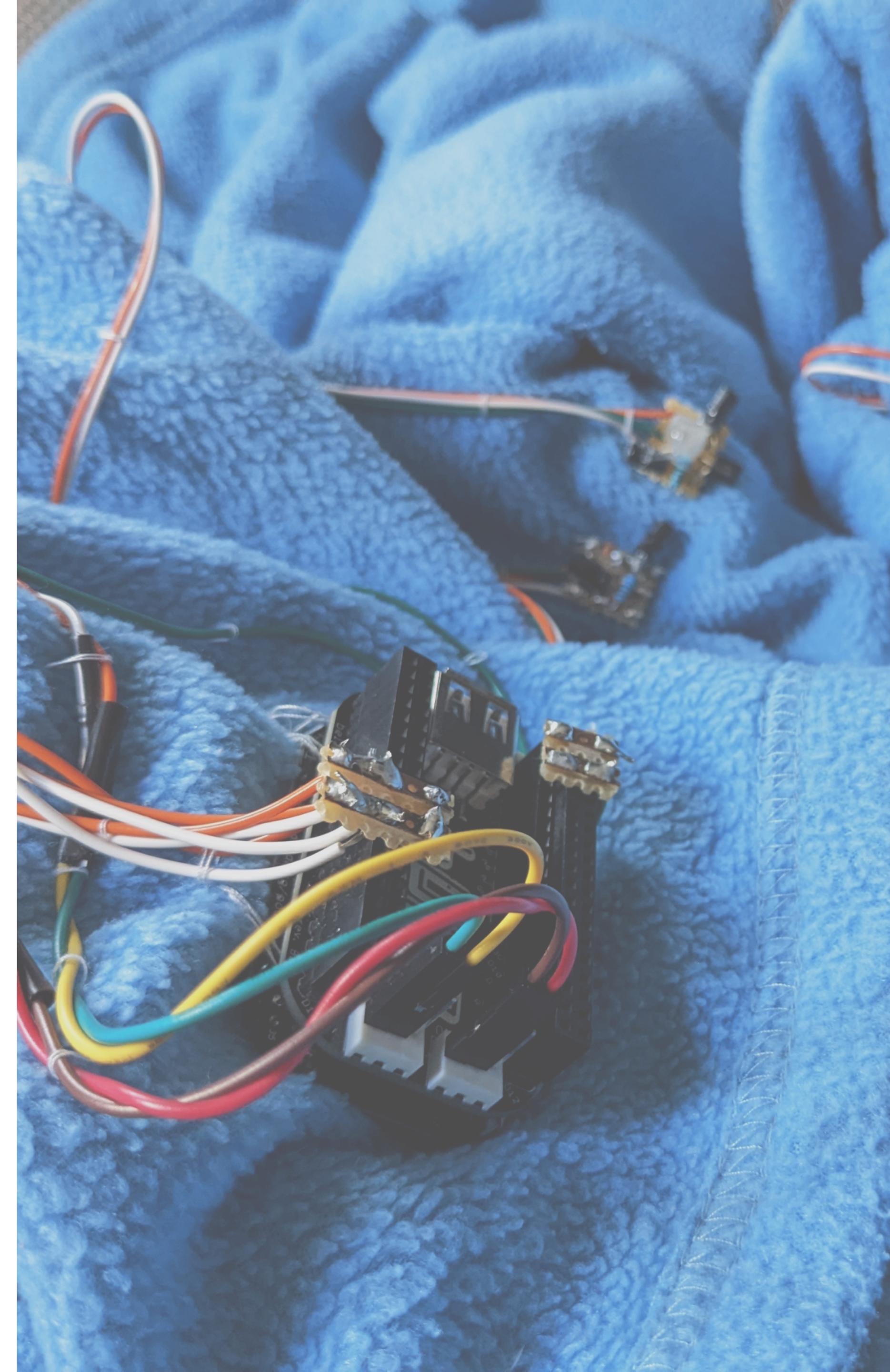
A. Schmidt (July 1999) "Implicit Human Computer Interaction Through Context," *Personal Technologies*, vol. 4



System design - Motivations and context

Not all energy is data: our artifact aims to inform about energy that is not usually quantified by digital systems

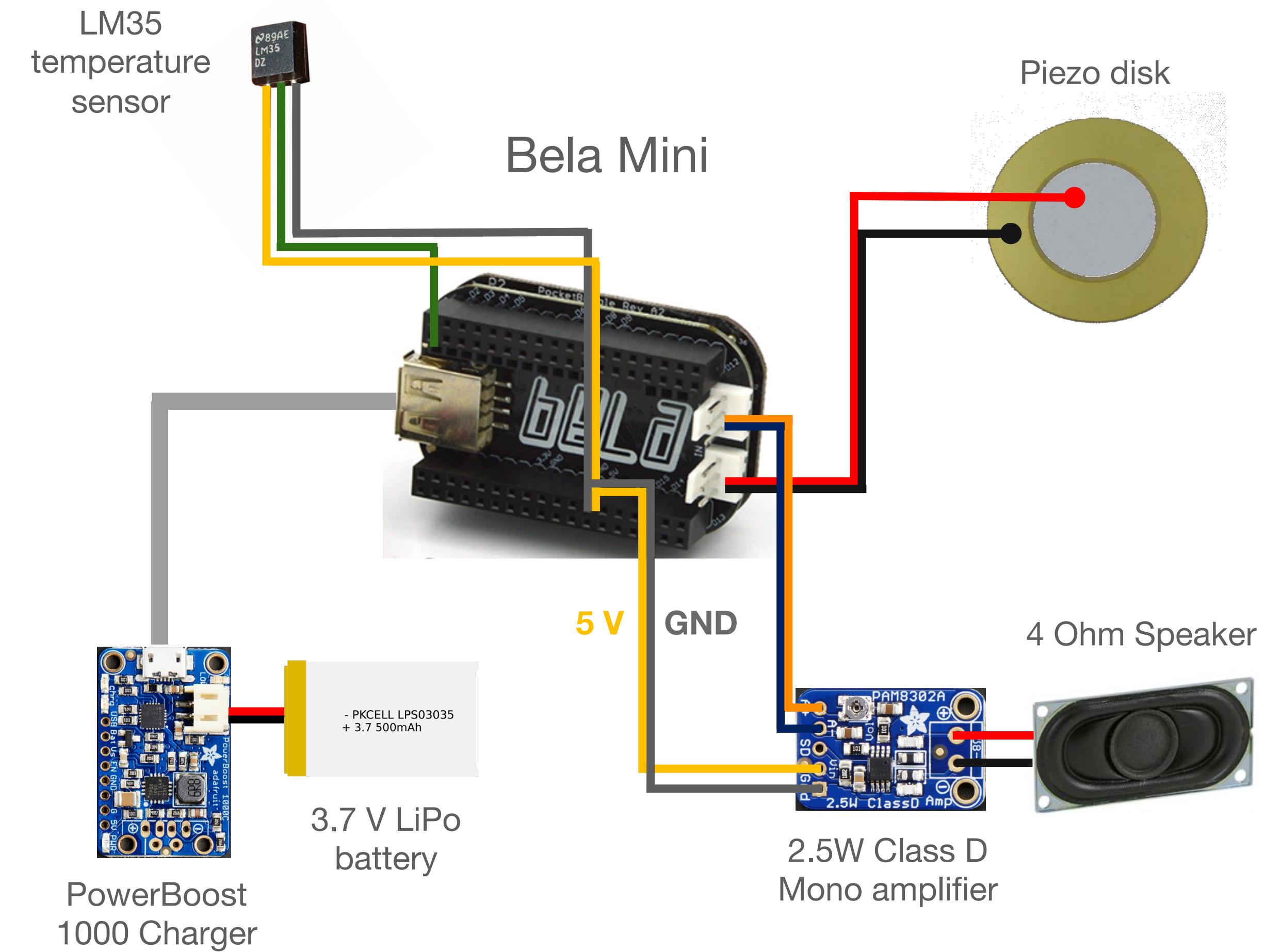
- Sonic augmentation of fabrics may be a non-intrusive channel to communicate bodily information
- Sound is used as a **medium of interaction** and as a **carrier of information**
- The flexibility of the blanket as an interface allows to investigate the **sense-making process** and the **affordances** of sonic augmentation



Video demonstration



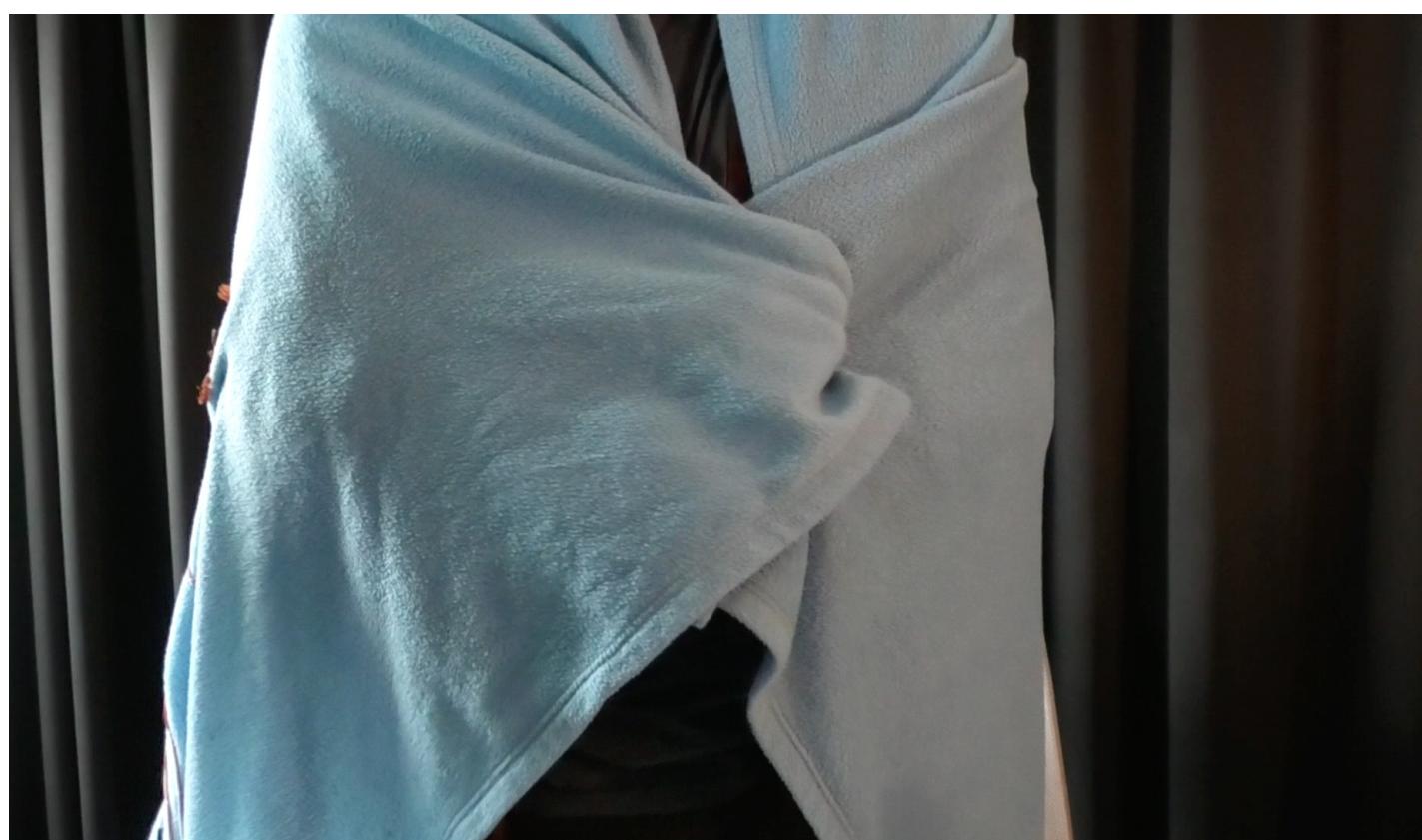
System design – Physical prototyping



System design - Real-time granular synth (Model 1)

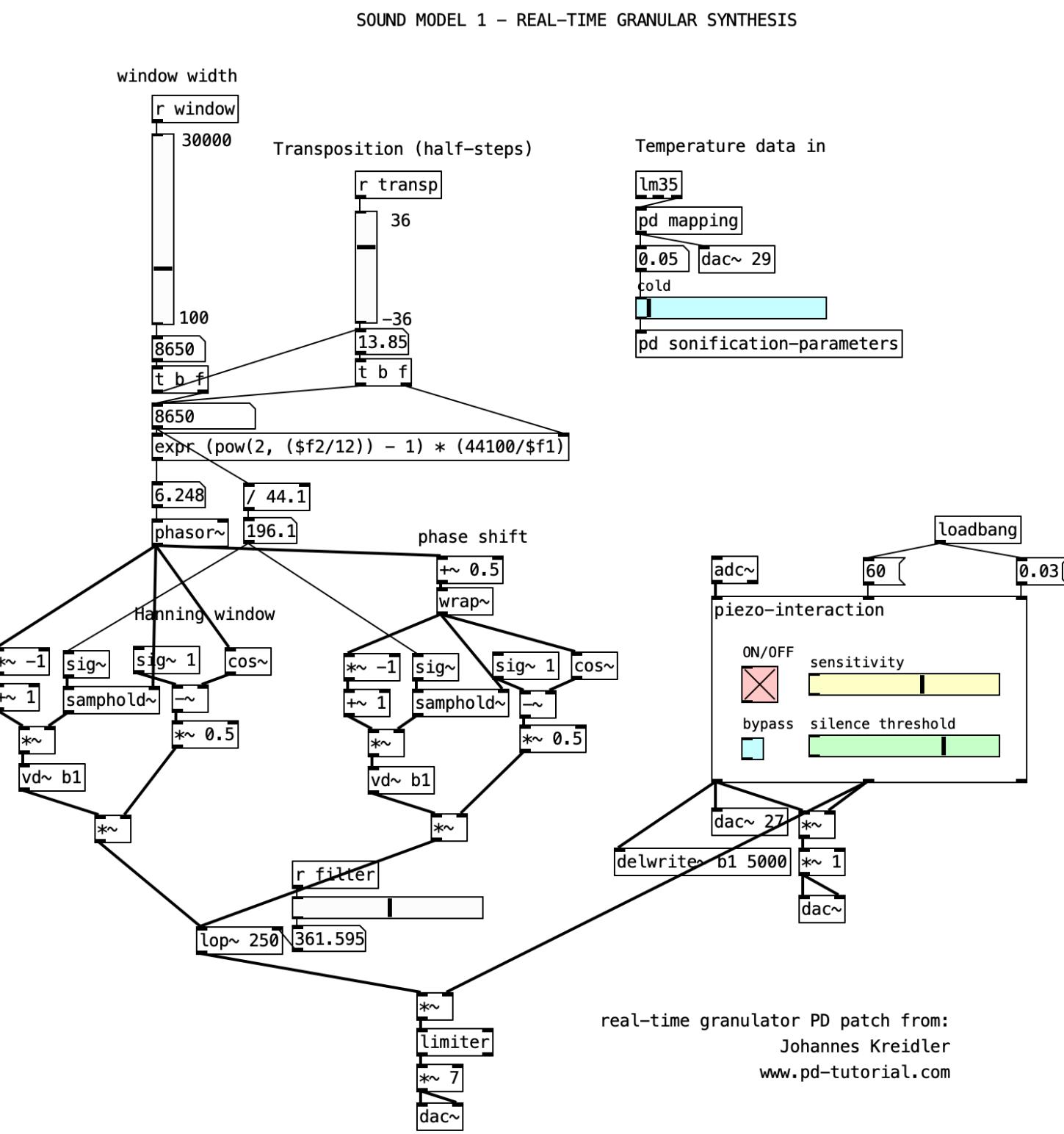
The piezo audio signal is used as the input of a real-time granular synthesizer.

The *warm* sonification obtained by mapping increases in heat exchange to higher **octave transposition** of the sound and a shorter **live-recording window**



Speaker icon Sound Model 1 - cold

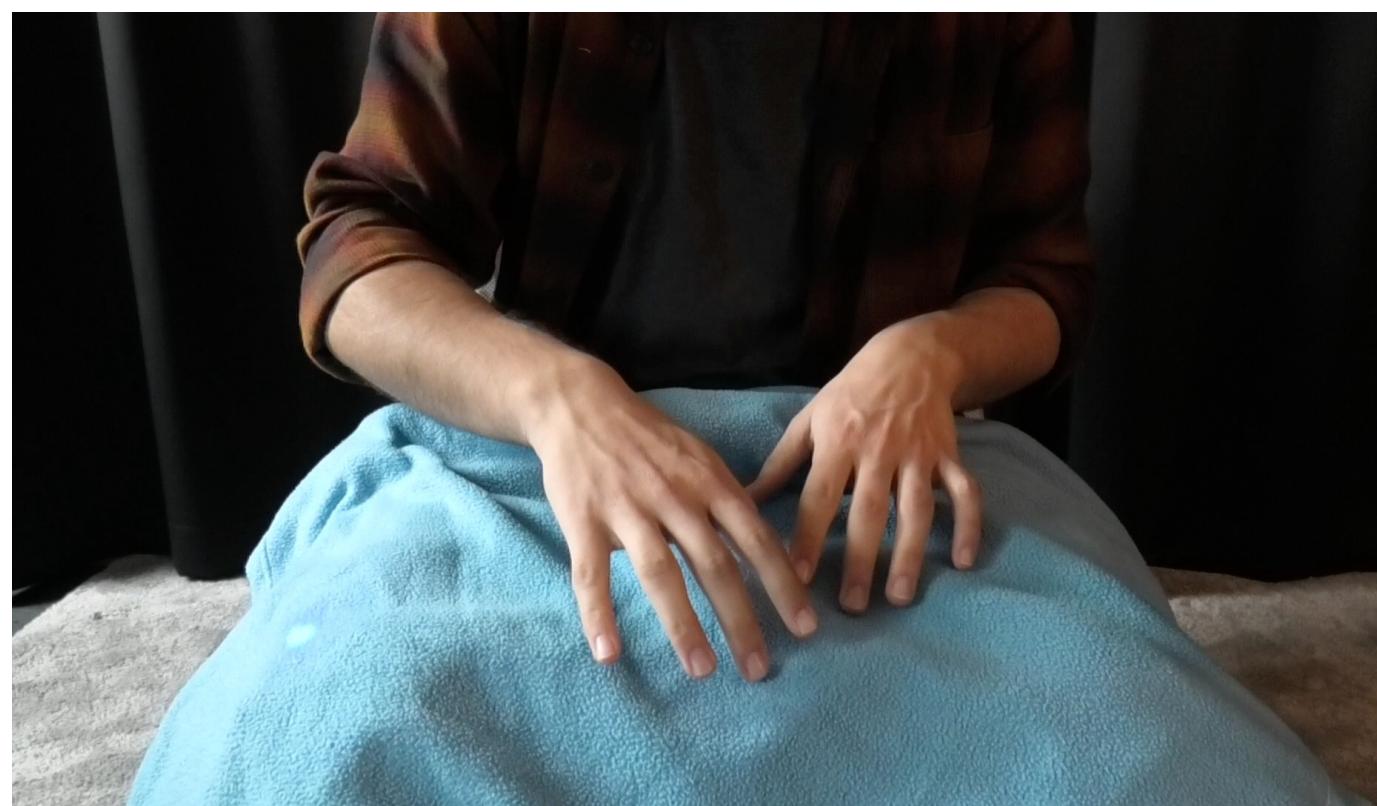
Speaker icon Sound Model 1 - warm



System design - Envelope follower (Model 2)

The audio signal from the piezo element is used to drive an envelope follower which controls the activation of a synthesizer – a bank of sawtooth oscillators with different tunings.

The *warm* metaphor is obtained by increasing the **amplitude** of the oscillators that are **detuned down** as the heat increases, and decreasing the amplitude of **higher harmonics** to obtain a richer spectrum with more low-end components.

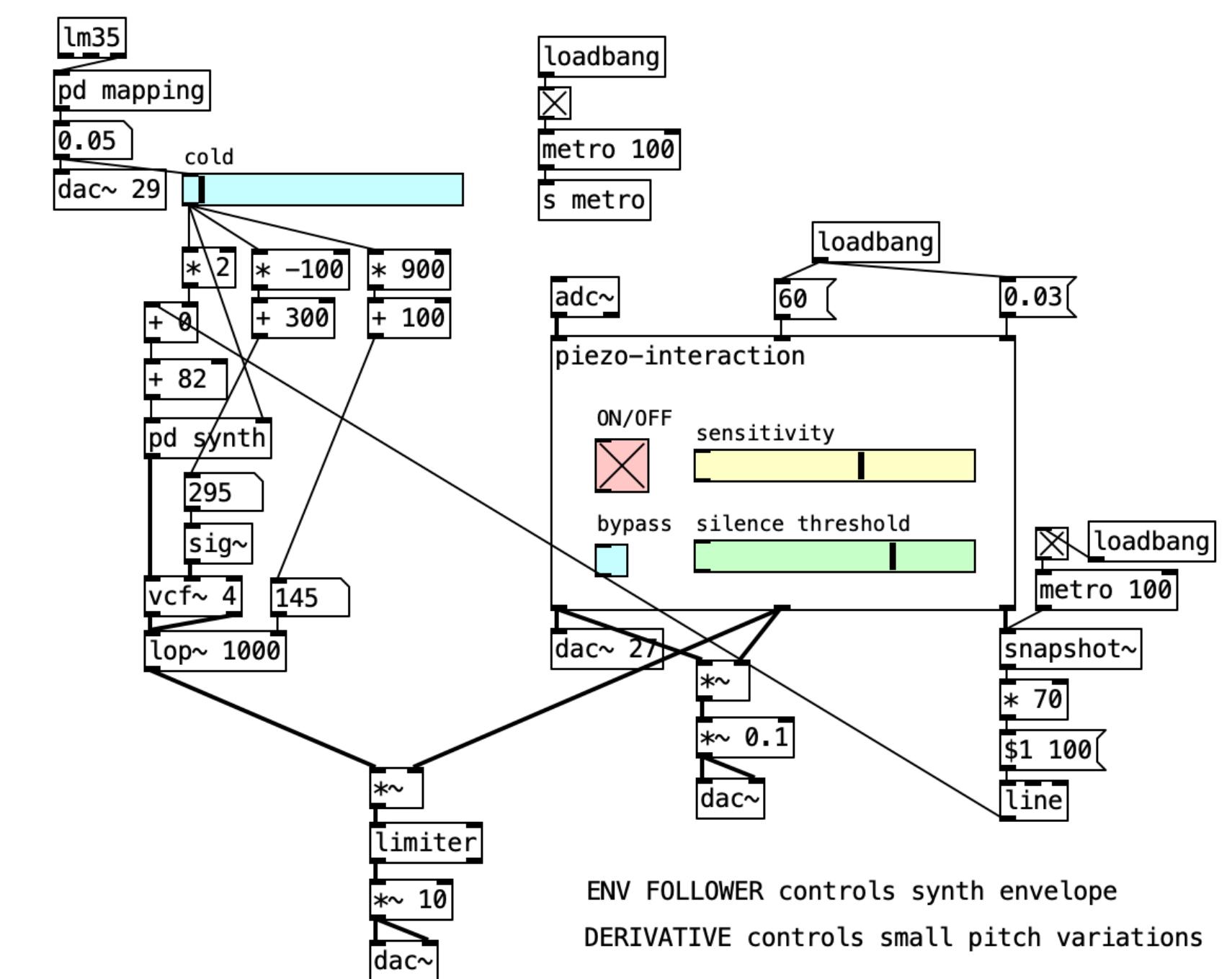


Sound Model 2 - cold



Sound Model 2 - warm

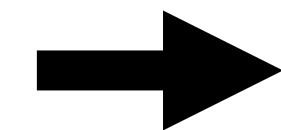
SOUND MODEL 2 – ENVELOPE-FOLLOWER



System evaluation – Method

Goals of evaluation:

- Initial approach and **sensemaking process** of sonic augmentation of a common household object
- **Afforded movements** of sonic augmentations
- Sound model characteristics for **sonic implicit interactions** – comparison between the two alternative sound models



Qualitative procedure

Participants were told that the sounds on the blanket would respond to their movements and the temperature between the fabric and the body, and they were given freedom to explore the object and move freely around the room.

Participants were six PhD researchers, three women and three men. The test lasted approximately 25 minutes.

System evaluation – Discussion

Initial approaches to sonic augmentation

- Two alternative approaches: sound as a consequence of movements, movements to explore sounds
- Exposed electronics limited the interactions

Affordances of sonic interaction models

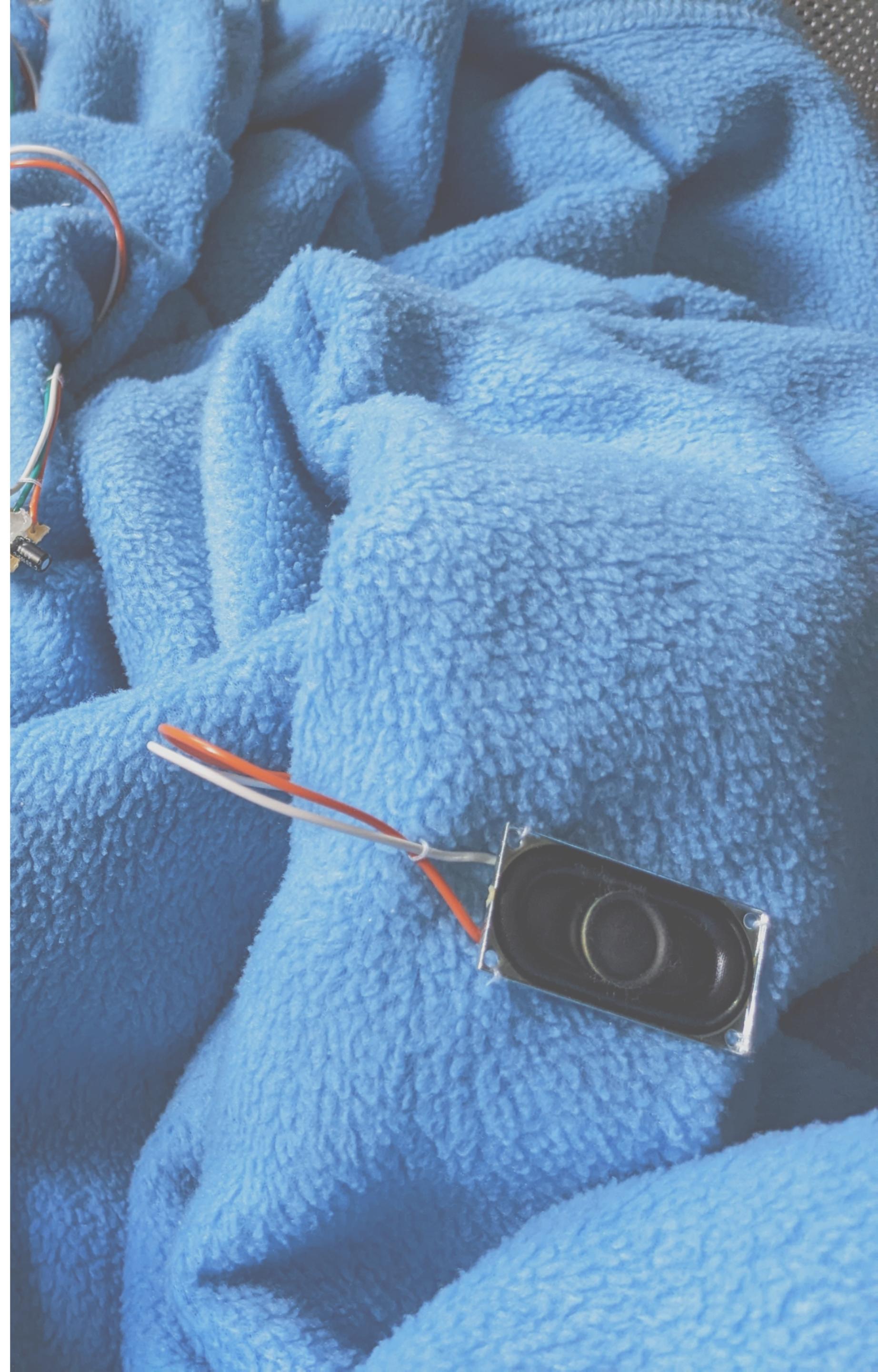
- Very personal interactions and use-cases
- Model 1 encouraged ample gestures and focused sonic exploration
- Model 2 stimulated repetitive, less demanding interactions

Ambiguity and function

- Connection between sound and temperature was not easily perceivable
- Ambiguity of the artifact in terms of function was frustrating to some participants
- A minimal degree of agency was attributed to the blanket

Conclusions

- The sonic augmentation techniques were **successfully responsive** and can radically **change the perceived affordances** of a common blanket
- The association between a change in sound and a change in temperature needs further improvement and evaluation
- The blanket was able to spark curiosity on a first approach and was used creatively by participants to develop a range of **simple** and very **personal aesthetic experiences**





Thank you!

The code for the project is available at:

<https://github.com/vincenzomadaghiele/Sound-augmented-fabrics>

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