

OFF-SOUND

MASK ON SOUND OFF

TACITUS

our **silent** and **bold** statement



Abstract

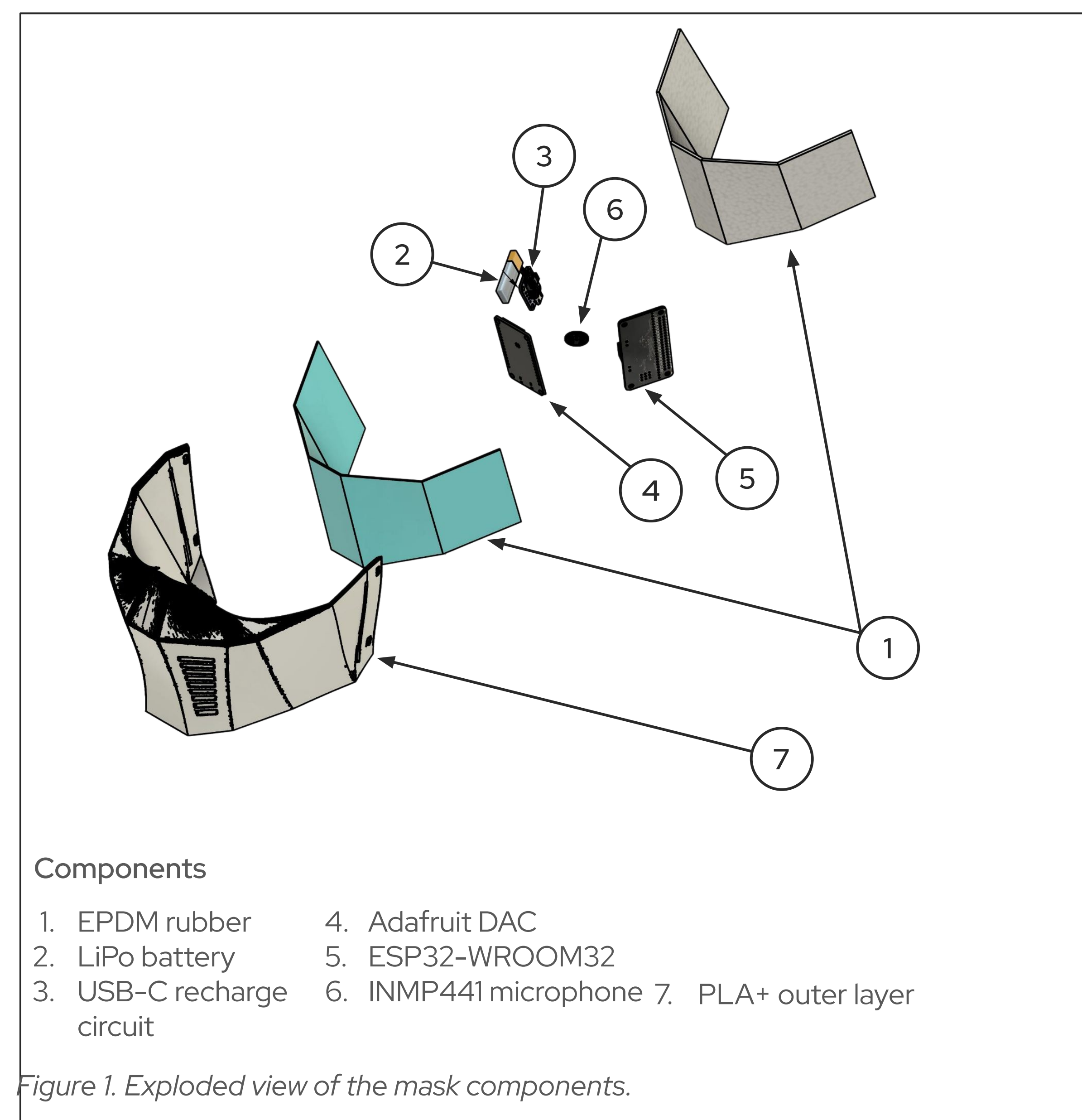
This work aims to develop a soundproof mask equipped with an integrated Bluetooth device that enables a user to carry out his phone calls in a private manner.

The system has the following design criteria:

- **Refined aesthetic:** Since our mask is classified as a wearable device, the design must be appealing to the user and should draw attention only in a positive way.
- **Weight efficient:** Our product must not encumber the user. A heavy solution can cause neck pain resulting in discomfort while using the device.
- **Ergonomy:** The mask should nicely fit the wearer's face. This way it can guarantee both comfort and sound absorption.
- **Sound dampening:** To enable the user to communicate privately, the mask should dampen the sound of the user's voice. We are aiming at dampening up to -30dB across frequencies 31 Hz and 6 kHz.
- **Wireless connection:** To connect the wearable to phones, PCs or other devices, no cables or dongles should be needed.

The current prototype is powered by a rechargeable lithium battery and uses EPDM rubber for sound absorption. The current design supports Bluetooth connections using HFP. The mask itself is 3D printed using PLA+.

The system



Wireless connection

The device is equipped with an ESP32-WROOM32 chip with Bluetooth 5.0 capabilities, and I2S decoding and encoding. In particular, the chip connects using the Hands-Free Profile (HFP).

In the second iteration, the system will also support Advanced Audio Distribution Profile (A2DP) to play multimedia files.

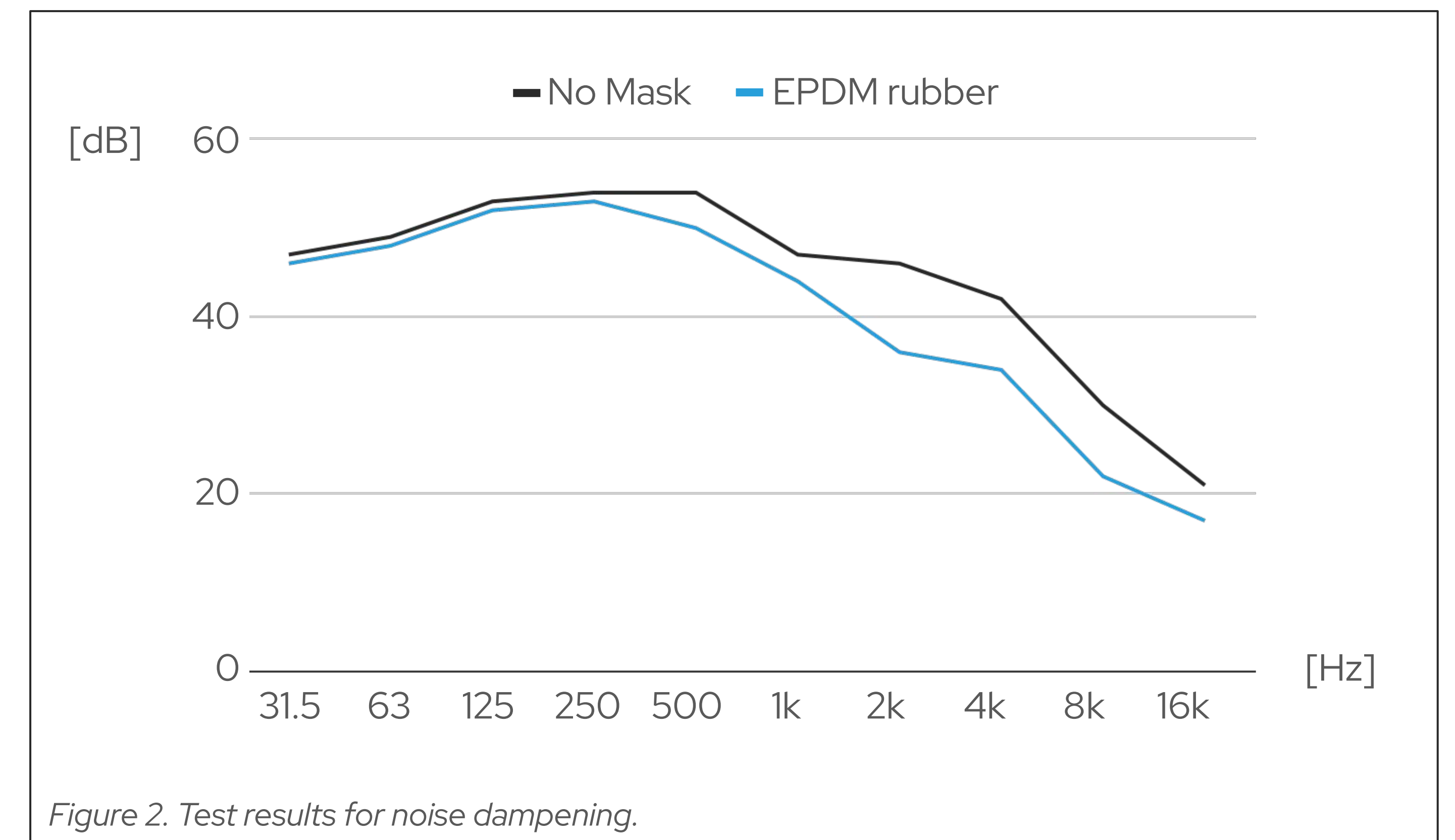
Furthermore, to cut costs both of material and code maintenance, we will migrate to a BTM308 QCC3008, a module implementing Bluetooth, I2S, and DAC (Digital Analog Converter) capabilities. This way we will also be able to replace the Adafruit Stereo Bonnet.

Sound dampening

To dampen the sound of the user's voice, 3 layers of EPDM rubber are currently used. A layer has a thickness of 10mm and a density of 1.250kg/m³.

Regarding acoustic isolation, the material can theoretically reduce sound intensity up to -40dB.

Current test results show that our prototype can reduce intensity up to -10db on higher frequencies. We are confident that by researching new materials, and implementing better mask-face fit, we will be able to reduce the intensity up to -30db.



These tests were carried out in the Multisensory Laboratory of the University of Trento, which features a soundproofed testing room. The measurements were taken using db-meter SC310 from Cesva.

Environmentally friendly cloth covers

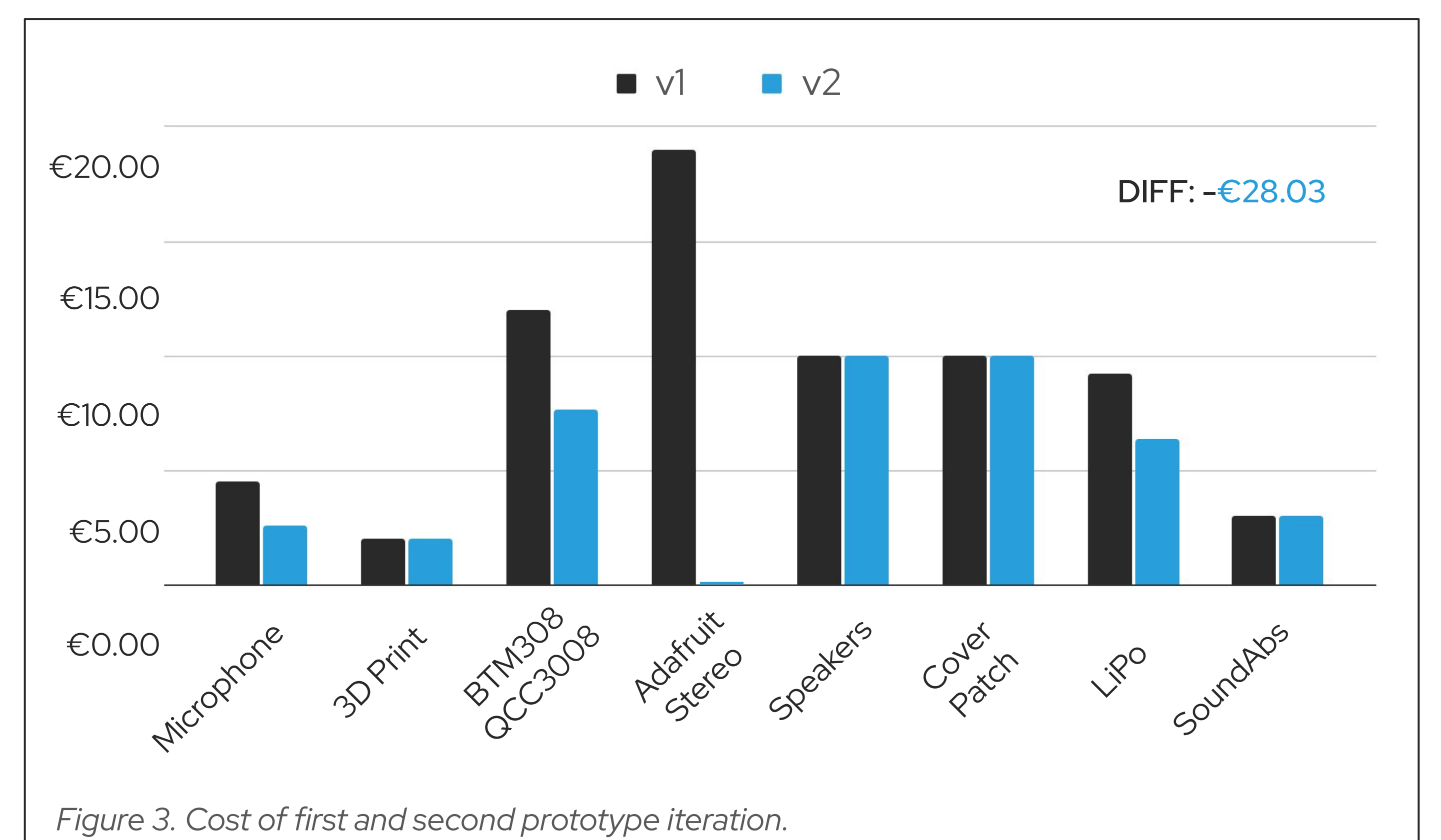
To provide customization and guarantee good hygienic conditions inside the mask, the second iteration will feature a cloth cover that will encase the entirety of the device.

Not only these customizable cloth patches will be easily swappable using magnetic joints, but also their manufacturing will have a minimal ecological footprint. This will be possible since we will use TENCEL™ Lyocell and Modal fibers produced by LENZING AG and integrated into our product by our partner DANZO SRL.

Costs

Bill of materials

Following, the graph shows how we are planning to cut costs from 69.70€ to 41.67€.



Future works

As specified in the previous sections, we are ready to cut costs, implement support for multimedia files, and launch customizable and switchable cloth covers.

Finally, we are starting to test the Bluetooth bridge that will enable the user to use their favorite Bluetooth earphones with our mask... and this solution will be a unique one on the market.

Contact offsound.mask@gmail.com
for further information