

BioHybrid Devices

Biohybrid Devices: Prototyping Interactive Devices with Growable Materials

by Madalina Nicolae
& Vivien Roussel



The BioHybrid Device is a video game controller created by fusing biological and digital manufacturing processes.

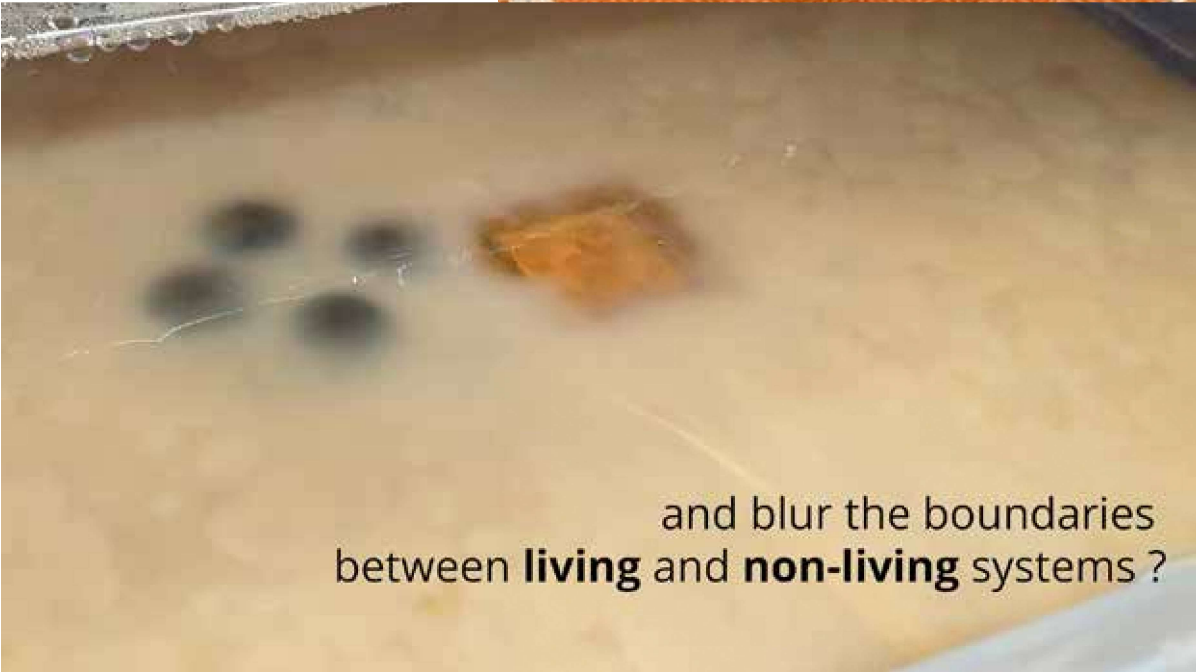
The controller slowly takes shape by integrating conductive elements, sensors and output components into material derived from the natural growth and reproduction processes of bacteria and yeast (SCOBY).



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and blur the boundaries
between **living** and **non-living** systems ?

Image extract to the video “BioHybrid Device – Grown Technology” at the 0.29 min. ©Madalina Nicolae & Vivien Roussel.

The project blurs the boundaries between living and non-living systems by using the manufacturing process of morphogenesis (biofabrication and bio-assembly) to encapsulate interactive electrical elements. The authors envision a future in which interactive objects can thrive. This project therefore aims to question the status of objects as well as that of current means of production, and to test the perception of interfaces and technological devices and their integration into our environment. This concrete, practical approach addresses the sustainability, limits and implications of a biotechnological future.

Living biomaterials are increasingly used in all areas of production (from food to textiles, from raw materials to synthetic cells), but the impact and consequences of this artificial yet sustainable world we’re moving towards are still totally uncertain.



Figure 5: Non-organic materials (NOM) can be embedded in 3 steps by taking advantage of bioassembling. We illustrate this here with a large conductive pad (3cm) that was 3D-printed using Protopasta carbon-based conductive PLA filament. ©Madalina Nicolae & Vivien Roussel



The stratification process of the device is slowly carried out by a living organism (bacteria), where each component (button and flex sensor) is inserted by hand, step by step, during the growth process. The touchpad was then inserted by adding a layer of bacterial cellulose to facilitate its insertion, particularly for cable routing. Finally, the dried cellulose was rolled up on itself and sewn onto the wedge to secure it as a base.



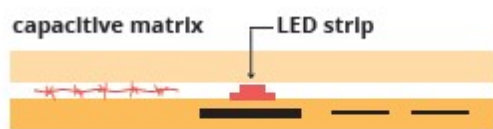
STEP 4

Fixation of the micro - controller at **INANIMATE** using snap buttons.



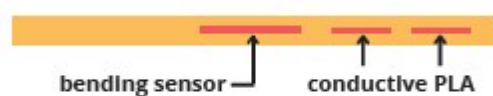
STEP 3

Final marking and assembling at **INANIMATE** using methods **Laser Engraving, Slicing & Inserting,** and **Sewing.**



STEP 2

Mutual capacitive matrix and LED strip embedded at **STABILIZATION** using method **Layering.**



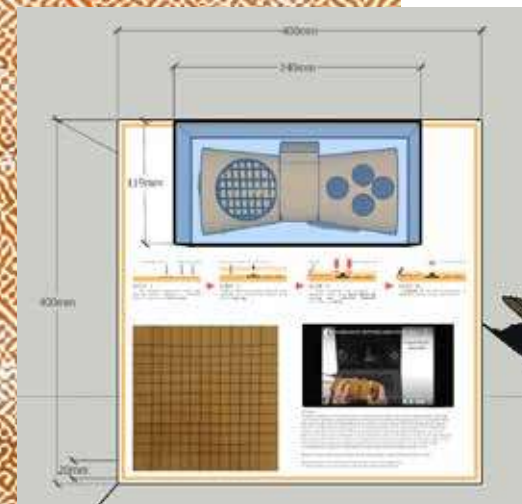
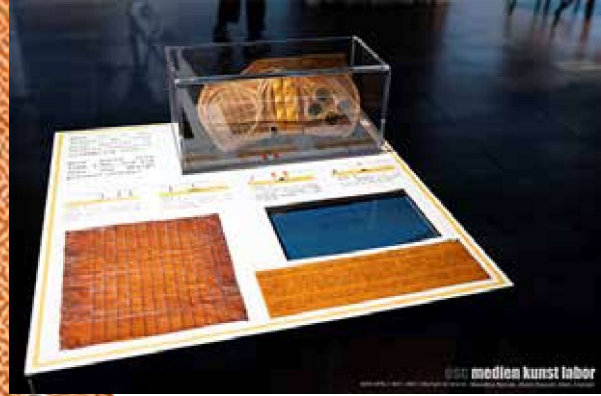
STEP 1

3D printed capacitive pads and bending sensor embedded at **GROWING** using method **Grow around.**

Figure 3: Example applications fabricated with our techniques: a shape-changing wearable accessory (left), a wearable interactive bracelet (center), and a deformable game controller (right). The fabrication steps and used techniques are visually summarized. Please refer to sections 4–6 for a detailed description of the fabrication techniques. ©Madalina Nicolae & Vivien Roussel

Exhibitions

- 19/10 to 27/10/2024 - *"The Symbiocene Forest - Coexistence"* at Dutch Design Week, BioArtLaboratories, Eindhoven, Netherland.
- 01/09 to 04/09/2024 - *"Biomaterials for Prototyping in HCI"* at Mensch und Computer 2024, Karlsruhe, Germany.
- 11/05 to 30/08/ 2024 - *"Wer Spielt mit uns? ..."* at ESC Medium Kunst Labor, Graz, Austria.
- 28/03/2024 - IHM 2024, Paris, France.
- 29/10 to 01/11 / 2023 - Jury Best demo, Honorable mention at UIST 23, Los Angeles, USA.





Madalina Nicolae

Designer and Researcher in HCI (Human Computer Interaction)

- Nationality: Romanian
- Sex: Female
- Year of birth: 1997

- Short biography:

Madalina Nicolae is a doctoral researcher working at the nexus of Human-Computer Interaction (HCI), Biodesign, and Embedded Systems. Through her work, she explores how organic and living matter can be leveraged to build a new generation of interactive devices that blur the boundaries between technology and biology. Her research interests include biomaterials, biofabrication, critical making, sustainable interaction design, and living media interfaces. Madalina shares her time between HCI Lab Saarland University (Germany), the Institute for Future Technologies (France) and the Polytechnic Institute of Paris (France), being advised by Prof. Jürgen Steimle, Dr. Marc Teyssier and Dr. Samuel Huron.

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Vivien Roussel

Biodesigner, Maker and Researcher in Design and Biology

- Nationality: French
- Sex: Male
- Year of birth: 1985

- Short biography:

Vivien Roussel is a biodesigner and digital sculptor. He is working on a PhD in living materials engineering, design and biology at IFT (Institute for Future Technology) Paris and the University of Nîmes (Projekt / UPR Chrome). He is interested in narratives that expose our links with technology, questioning our modernity (through the figure of Robinson Crusoe) or "social sculpture" (through the co-creation of fab labs in France). In residence in China in 2014, he explored the "productive world" of makers from Shenzhen to Shanghai - questioning digital tools. In recent years, inspired by techno-aesthetics, he has turned his attention to the living as a technological artifact (synthetic life); developing biomaterials in the company of microbes and machines, rethinking the agencies between the living and the non-living in the age of biotechnologies and climatic crisis.

Diplomas :

PhD Candidate in Resilient Futures group at the Institute for Future Technologies & University of Nîmes, labo Chrome + Projekt, France. Master AIRE (Innovative Approach to Research in Education) from the Learning Planet Institut, Paris 7, France. Post-master in Arts "Creation and Globalization" at the Offshore School, China. Master Arts - DNSEP/ DNAP from ENSAD of Nancy, France.

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