LIVING DEVICES

THE SILKWORM PROJECT, MACHINE I

THE SILKWORM PROJECT, MACHINE II, 1-2

THE SILKWORM PROJECT, MACHINE III

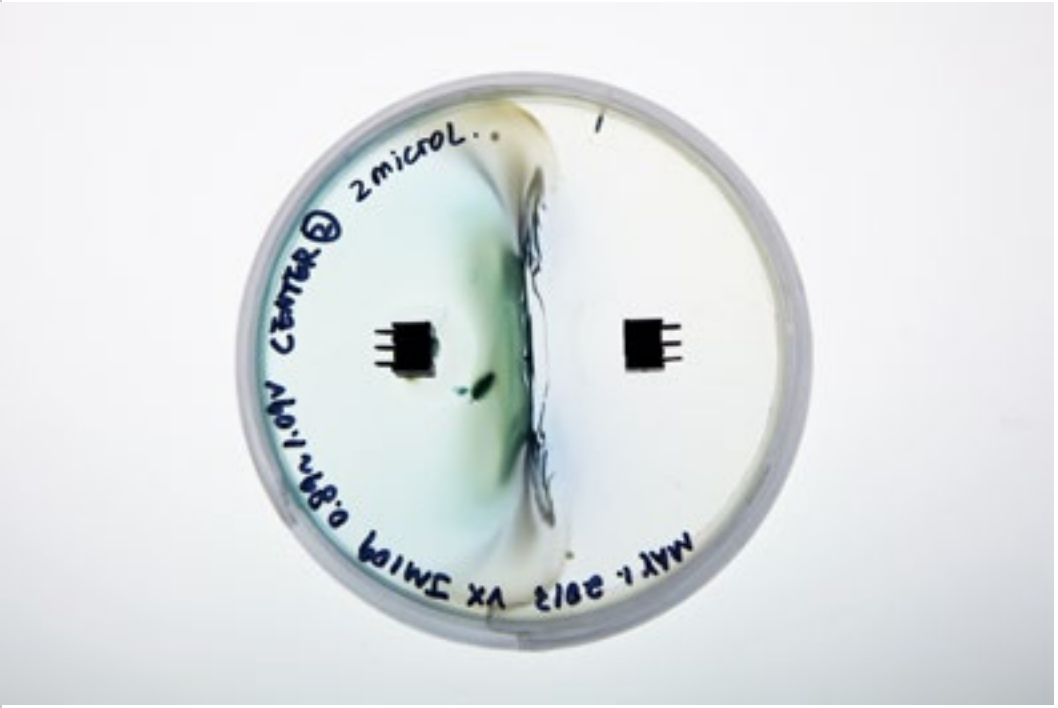
SKIN SERIES, ELECTRIC SKIN

SKIN SERIES, SONIC SKIN

THE BIOHARMONIC QUARTET

ART, RESEARCH, PERFORMANCE

VIVIAN XU SELECTED PORTFOLIO



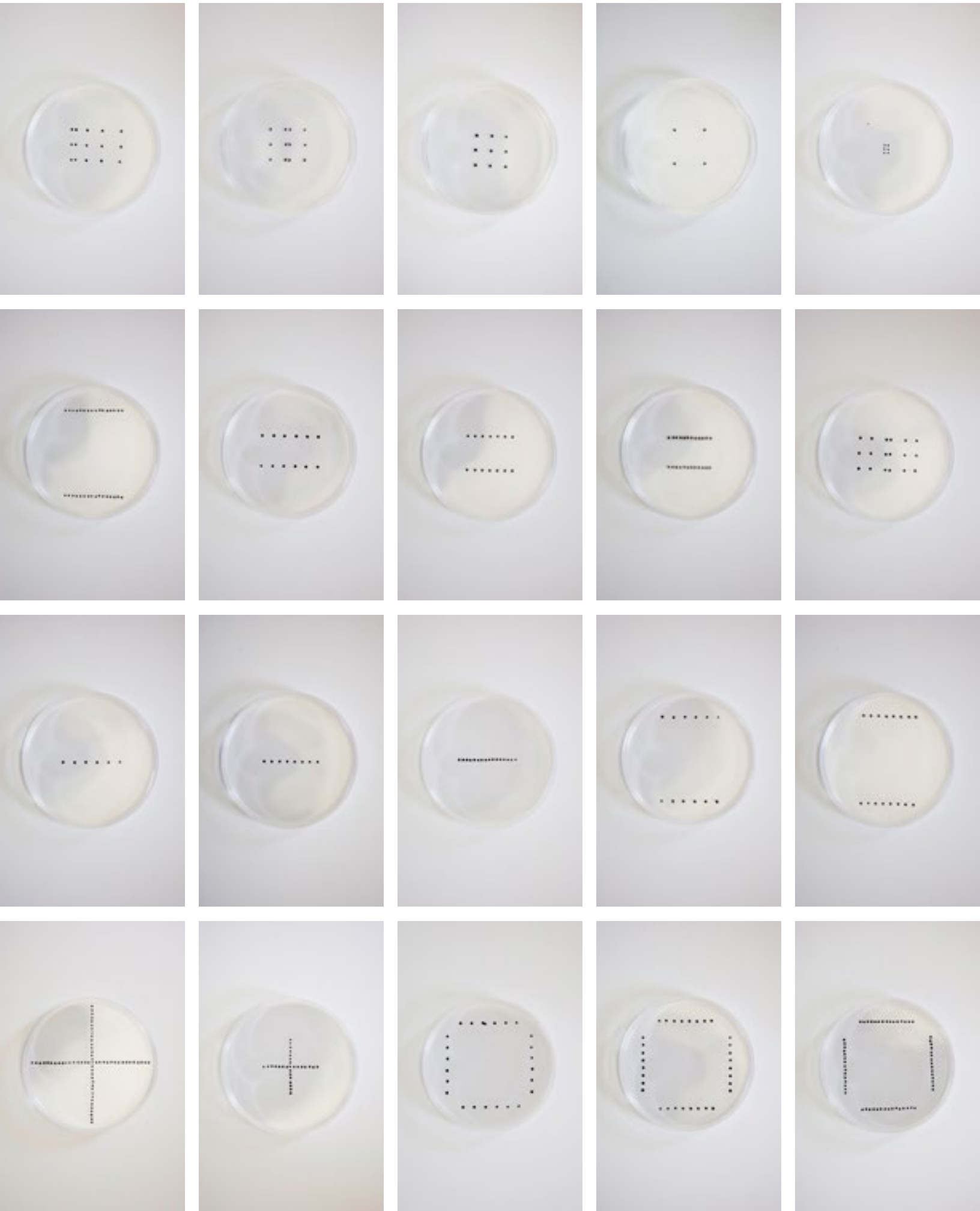
Living Devices
Materials: bacteria (E. coli JM109), electronics, petri plates
2012 - 2013

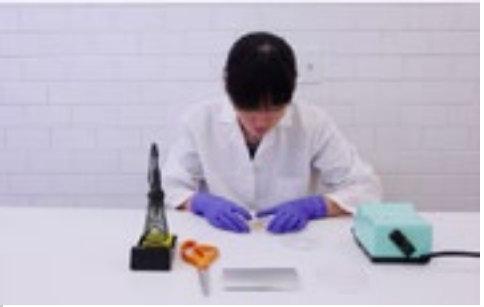
Living Devices is a series of research methods, lab protocols, hardware devices and experiment specimens that seek to break down the barrier between machine and organism by transforming electric signals into emergent bacteria growth patterns within a single device. The device allows access into the living system of bacteria through electric stimulation and manipulate their growth outcome to form visual patterns.

A set of protocols were developed to easily interface petri dish cultures with electrical stimulation. The interfacing system allows control of individual electrodes within a multi-node configuration to generate non-unified, diverse and dynamic electric voltage environments for testing.

The case study of 2013 utilizes the JM109 strain of E. coli to obtain knowledge of preliminary bacterial responses. Stimulation experiments have resulted in finding electric ranges that create new growth results. Future research seeks to expand into other species of single cell organisms.

Electrode Configuration Design Blueprints







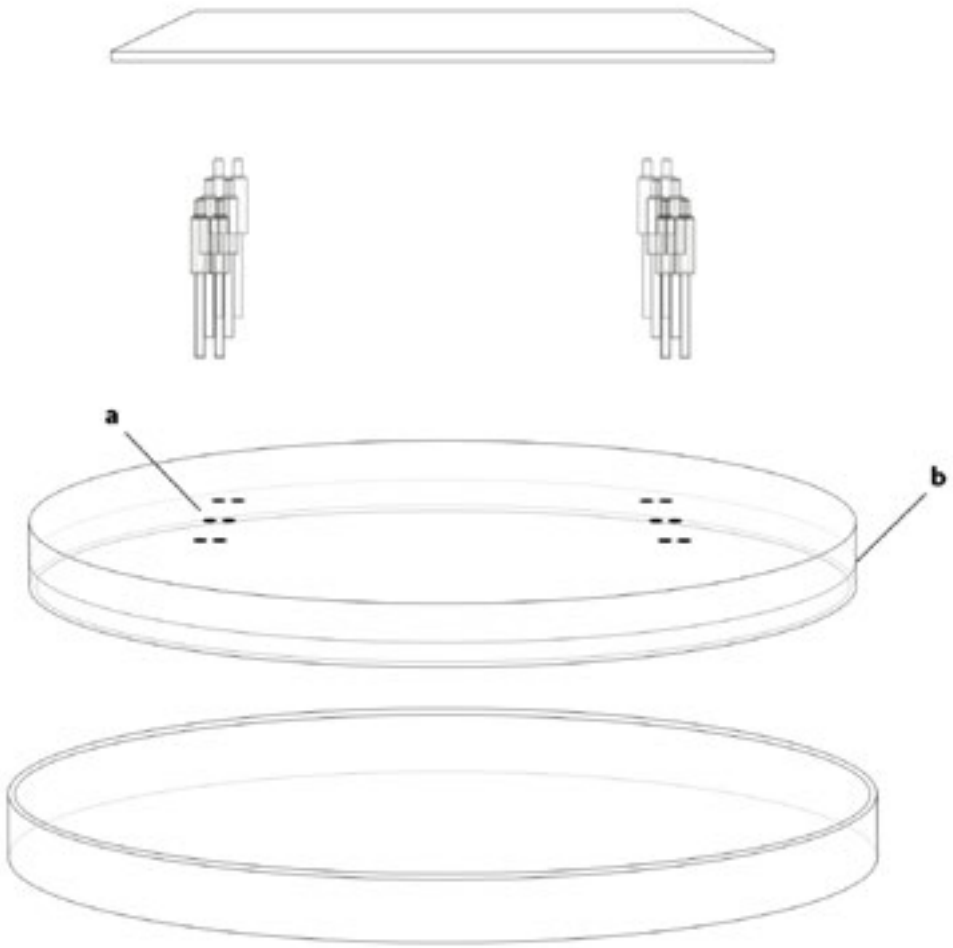







Three main protocals developed were necessary for creating the modified petri plates and electronics, and for executing the experiments. **The first** to create electric plates, **the second** to seed the bacteria solution onto the agar, and **the third** to provide sustained direct current electro-stimulation.

The images above were extracted from the performance video demonstrating the process.

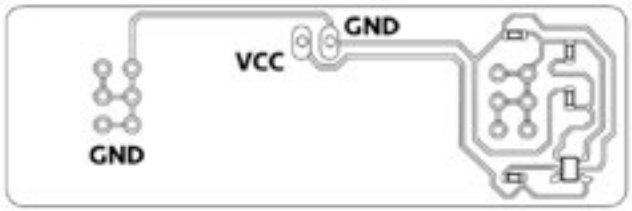


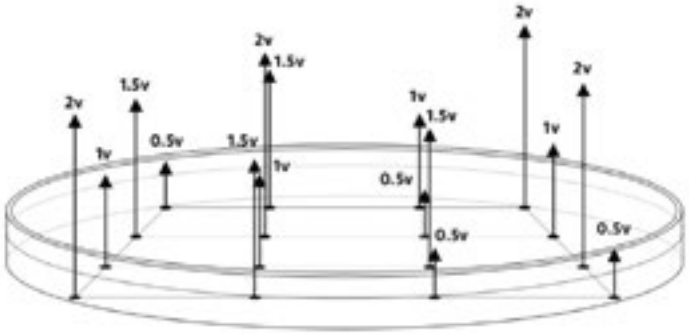
1 电压控制板
Voltage Control Circuit

2 电极
Electrode for Stimulation

3 细菌培养和容器，含琼脂营养物
Petri Dish with Agar

4 细菌培养层盖子
Petri Dish Lid


GND
VCC
GND


2v
1.5v
2v
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1v
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Electronic Plates
Modified petri plates that provides electro-stimulation to culture.

Silkworm Project Machine I, Printing in Flat Space

The Silkworm Project
2014 - Ongoing

The Silkworm Project explores the possibilities of designing a series of hybrid bio machines that are capable of generating self-organized silk structures. The silk machines utilize a closed feedback loop system between the organic and the artificial, where the biological - in this case the silkworms, and the computational - the electronic and digital systems that house the worms, form one ecosystem that demonstrates automated production that is autonomous in its nature.

Research in the history of computation and its entanglement with the technological development of the loom, the artist is interested in finding a critical and artistic intersection between the organization of silk and the organization of information. This comparison between old and new technologies, between one of the world's oldest materials - silk, and the its newest medium - data, brings up new questions of production in the present day where our tools, food, clothing, and even houses can potentially be printed with the click of a button. The artist tackles this question through a series of machines that addresses 2D, 3D printing and printing on the body.

The Silkworm Project I : Printing in Flat Space
Materials: silkworms, electronics, wood

The Silkworm Project I: Printing in Flat Space machine design was based on the simple fact that put into a wide enough flat plane, silkworms are unable to create 3 dimensional structures and can only spinn flat silk surfaces. Under normal circumstances, the sheets of silk spun by one or more worms is unified and fairly even in its silk distribution.

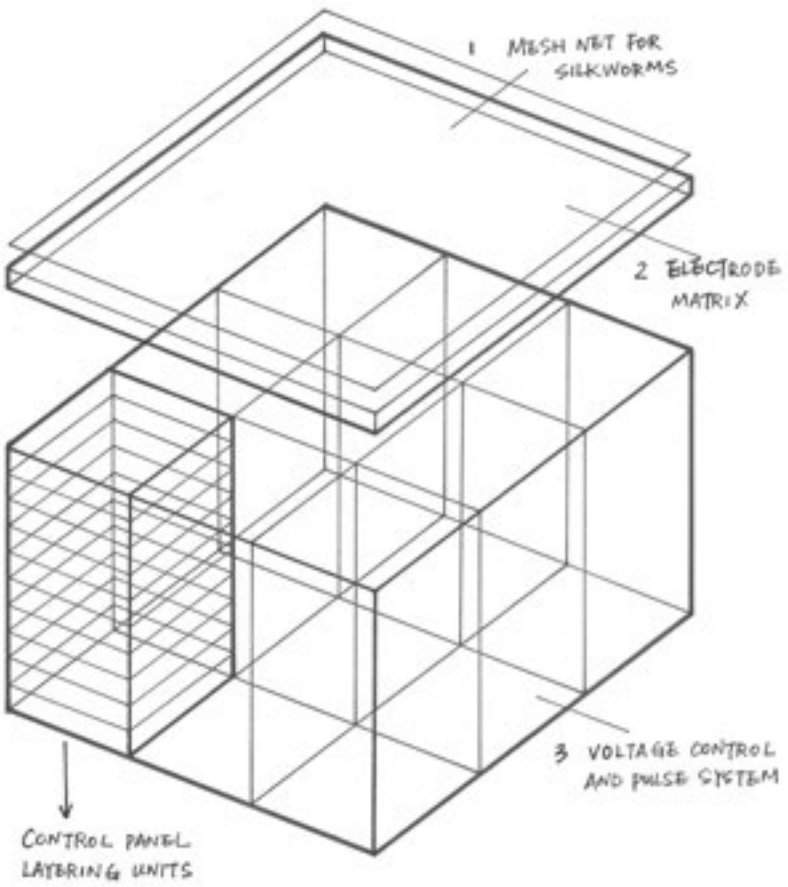
The machine environment essentially creates a cartesian grid for the silkworm where each position within the grid is addressable by the machine via electrodes. The worm is placed on a piece of silk screen sitting over the matrix of electrodes. Through an overhead camera, the silkworm's position is captured and this information is sent to the computer which begins to activate the electrodes underneath the worm, building up a mild stimulation. The worm is herded across the matrix, and the interaction is documented through silk.

In spring of 2014 and 2015, I began experimenting with natural spun colored silk. I wanted to be able to produce multiple colored silk for two reasons: 1) to use as a research tool in tracking how two silkworms negotiated space while spinning their cocoons, and 2) to incorporate in the final artistic presentation of a 3D spinning machine.

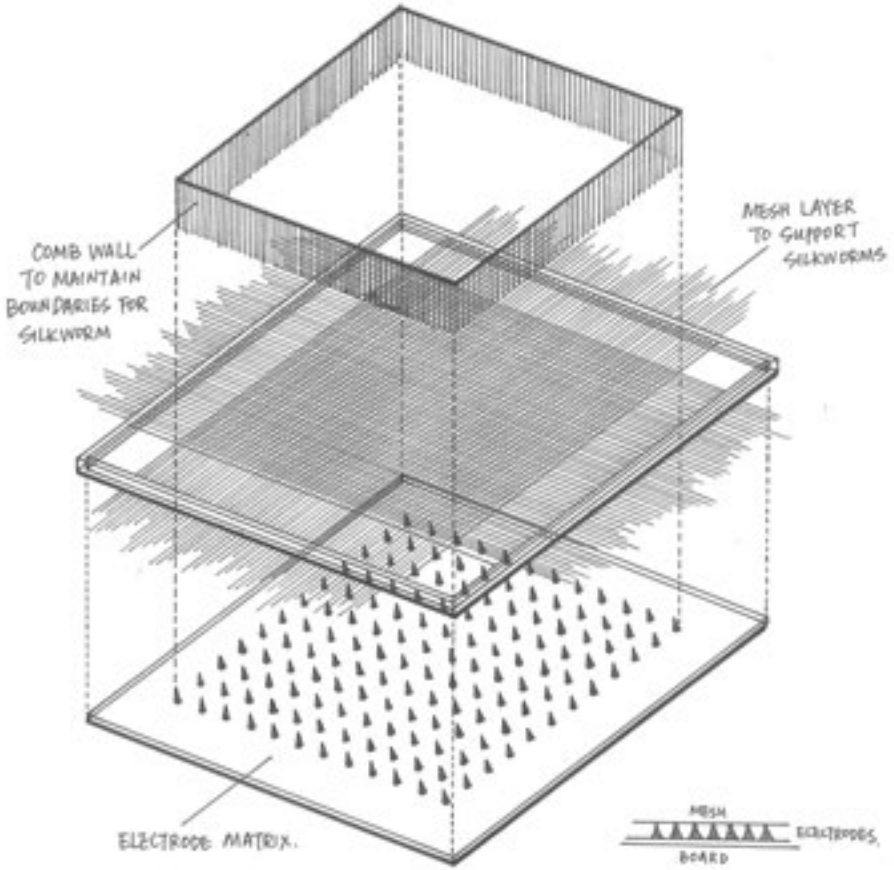
Researchers in Singapore developed a method of naturally dying silk within the silkworm's body by feeding it dyed foods during its larvae stage. When the time came for silkworms to spin their cocoons, the silk came out in the color of the foods. I experimented in raising violet silkworms in the spring of 2014 using this method, the results were not ideal: silkworms often died before they could spin and the silk produced were very pale in color. Spring of 2015, I came across new research conducted by Japanese scientists who genetically engineered silkworms capable of spinning colored silk that was much more vibrant, and under UV light could glow in the dark. Japanese designers were even able to create glow-in-the-dark silk kimonos from this material. I was able to raise a batch of these genetic worms this spring with satisfying results.

Purple silkworm raised using the Singapore method.
Raised Spring 2014

Genetially colored silkworm developed by Japanese scientists.
Raised Spring 2015

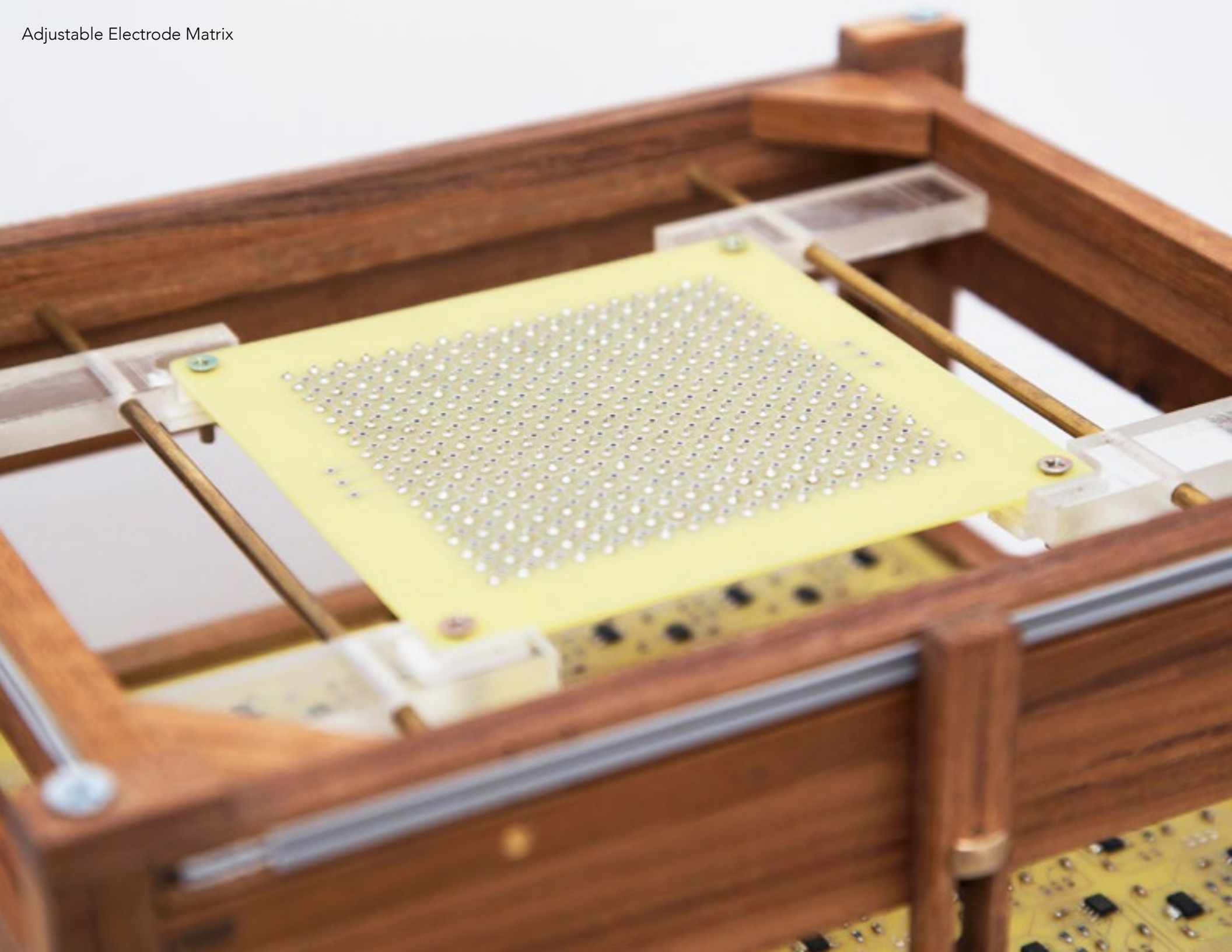


Stimulation Output System



Electrode Matrix & Mesh Design

Adjustable Electrode Matrix



Simple Spinning Mechanism Design
The Silkworm Project Machine II - 1, Printing in Space, Horizontal
2016

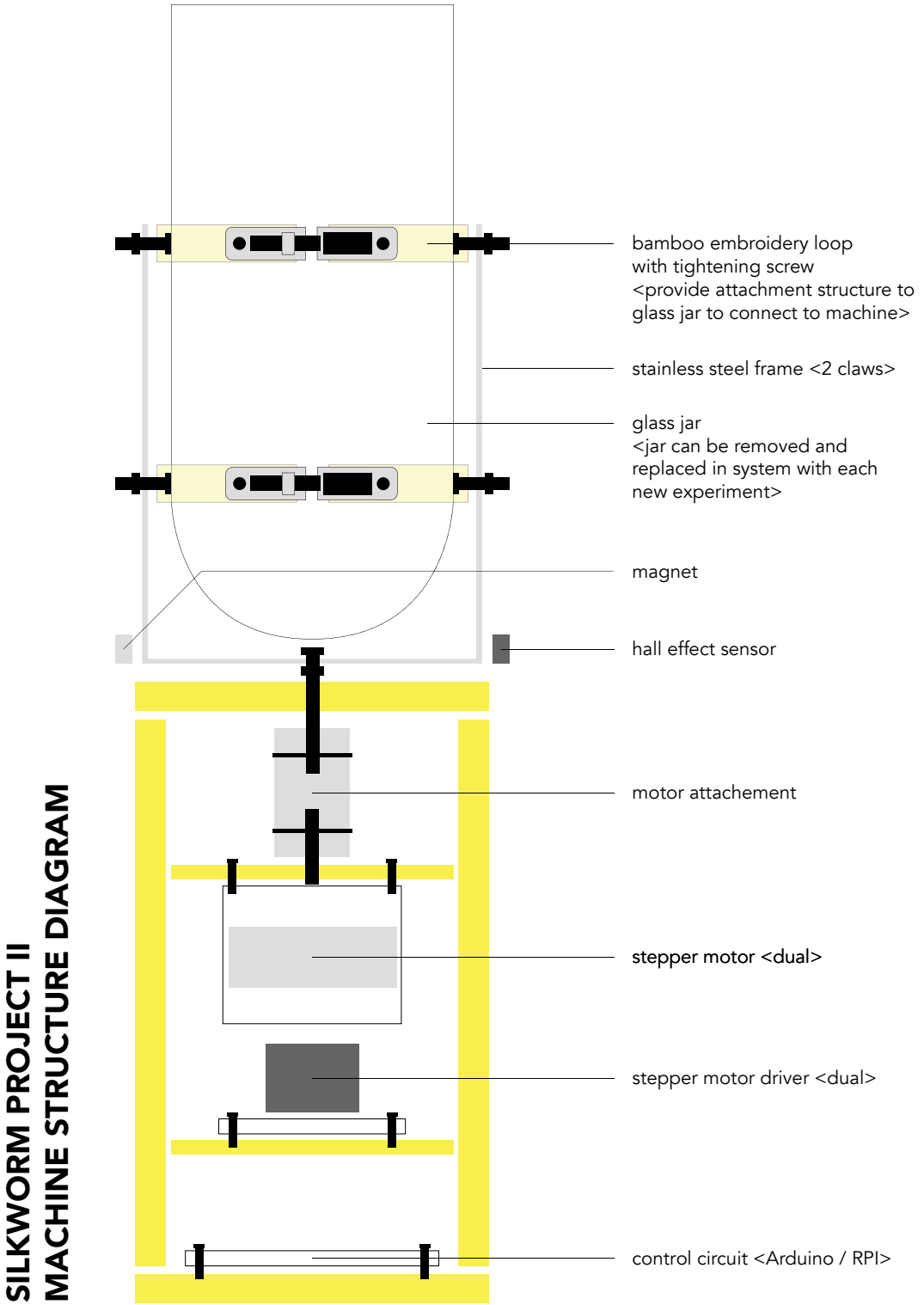
The Silkworm Project II : Printing in Space
Materials: silkworms, electronics, glass, wood

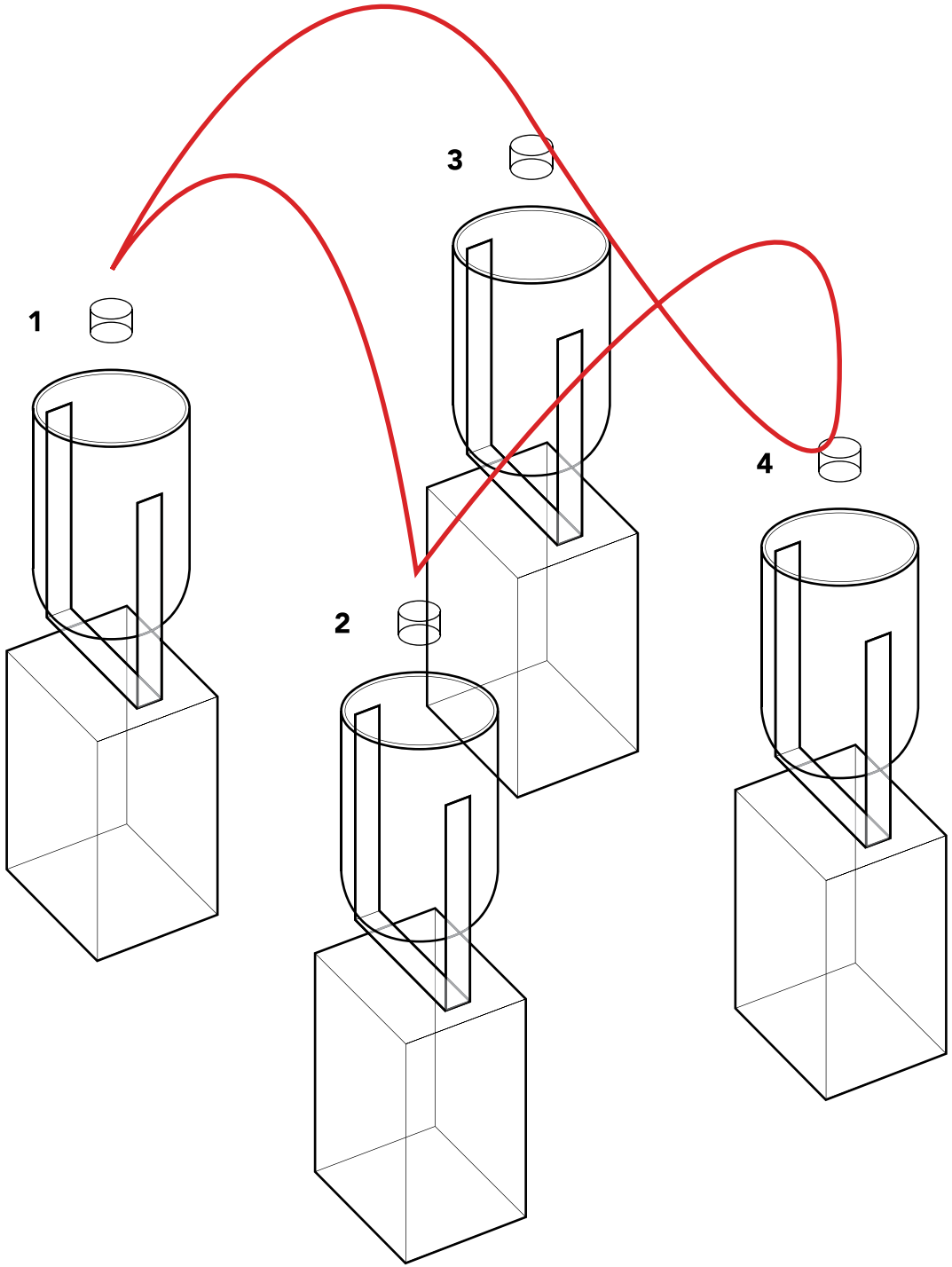
The Silkworm Project: Printing in Space is mainly based on the silkworm's spinning behavior in a wide enough circular environment without any angles and with little edges. When placed in such an environment (for instance, a cup with a diameter of 8-9cm), the insect spins spiral-like structures with occasional cell-like concaves of silk while trying to form a cocoon. The final design of the machine will be a series of spinning contraptions that house the silkworms in tube-shaped vitrines or jars.

The Silkworm Project III: Printing on the Body

The Silkworm Project: Printing on the Body looks at the realm of wearable technology and speculates on how printing technology and biology can inform, change and revolutionize the production of garments. I am interested in creating wearable machines that harness silkworm behavior in creating silk structures of different textures and spatial configurations from the worm's mouth directly on the body. By looking at the rich history of weaving technology and techniques, and today's industry of printed garments and inventive machines, *Printing on the Body* explores new concepts of fabric, weaving and wearables. The research and design for this third installment will be conducted in 2017.

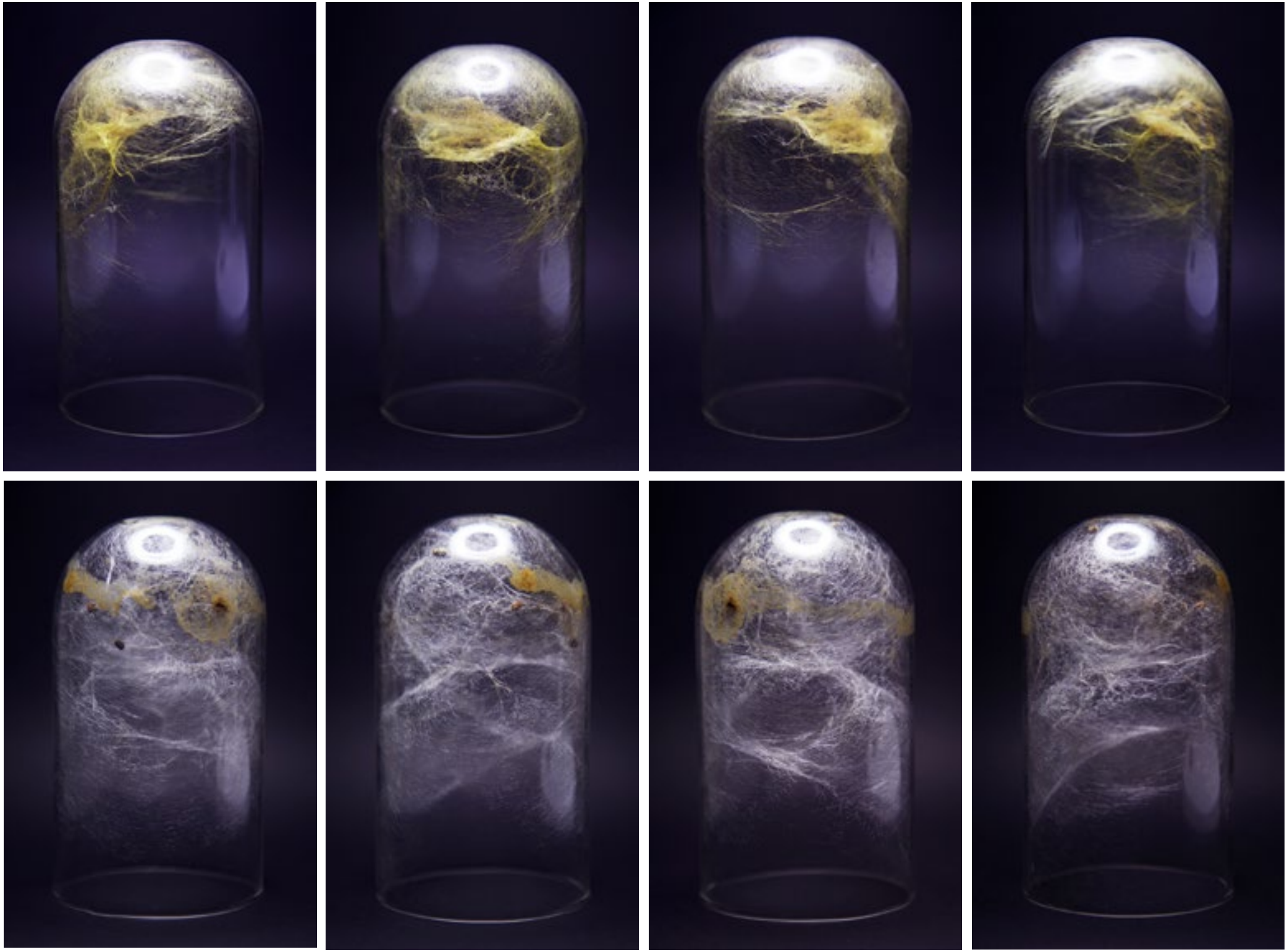
In *Printing in Space* machines are driven by the silkworms via a small camera that captures the silkworm's movement and sends that data to the control circuit that drives the spinning machine. Multiple spinning machines can be put into a matrix to create a network of machines that can communicate and effect each other through the hall effect sensors and magnets. In *The Silkworm Project II*, I am mainly interested in creating a insect-driven machine system that consists of smaller simple machines, that through the larger network, can generate chaotic and complex behavior.




1
2
3
4

Silkworm Spinning in Spinning Machine Contraption

Simple Spinning Mechanism Design
The Silkworm Project Machine II - 2, Printing in Space, Vertical
2017



Silkworm Project Experiment Results 2016-2017

Vivian Xu, Silkworm Project, 2013–ongoing, multimedia installation. Trees of Life – Knowledge in Material (2018), NTU Centre for Contemporary Art Singapore. Courtesy NTU CCA Singapore.

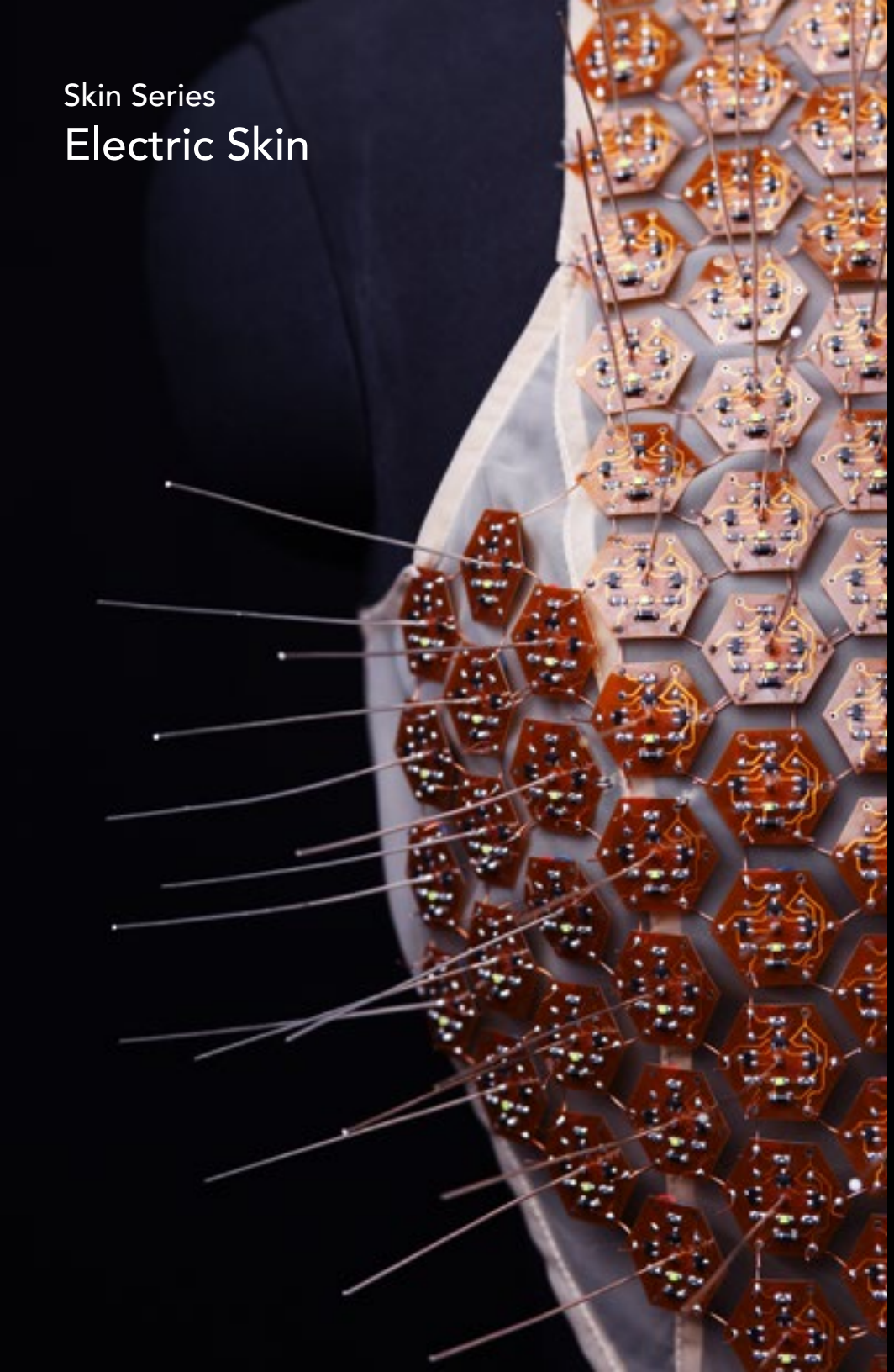
Trees of Life – Knowledge in Material, 21 July – 30 September 2018, NTU Centre for Contemporary Art Singapore, installation view. Courtesy NTU CCA Singapore.

Silkworm Project Machine III, 2019, early prototype of a magnetically-driven spinning machine, 2019
Production supported by Art Laboratory Berlin.

The original design of this machine was a levitating spinning machine with its own gravitational environment for the silkworm that is dynamic and changing. This early prototype was not able to achieve full levitation and spinning, but only magnetically driven spinning motion with the support of axises.

Skin Series

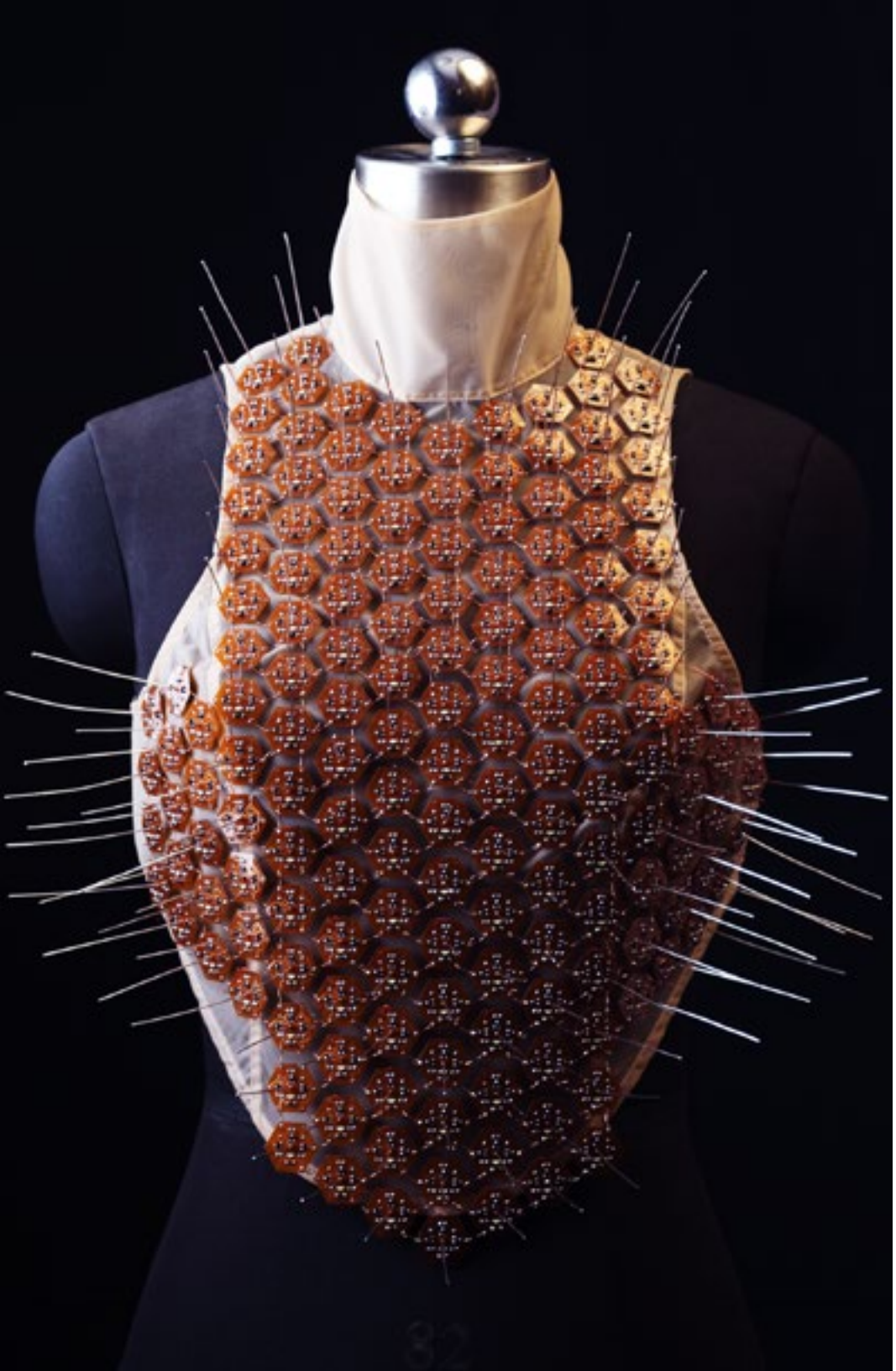
Electric Skin



Skin Series

Sonic Skin

Skin Series is a collection of wearables that explores the skin as interface, and speculates on the technological evolution of human sensory ecology. The artist's interest lies in the epidermis, the largest organ on the human body - the boundary between the internal and external, self and other - and how new technologies can blur, manipulate and reinvent that boundary, and with it, human perception and behavior. The series currently consists of two wearables, the Electric Skin and the Sonic Skin. The final collection will include four biomimicry pieces that each investigate an animal sensory system that is alien to the human experience.



The Electric Skin
Materials: electronics
2016

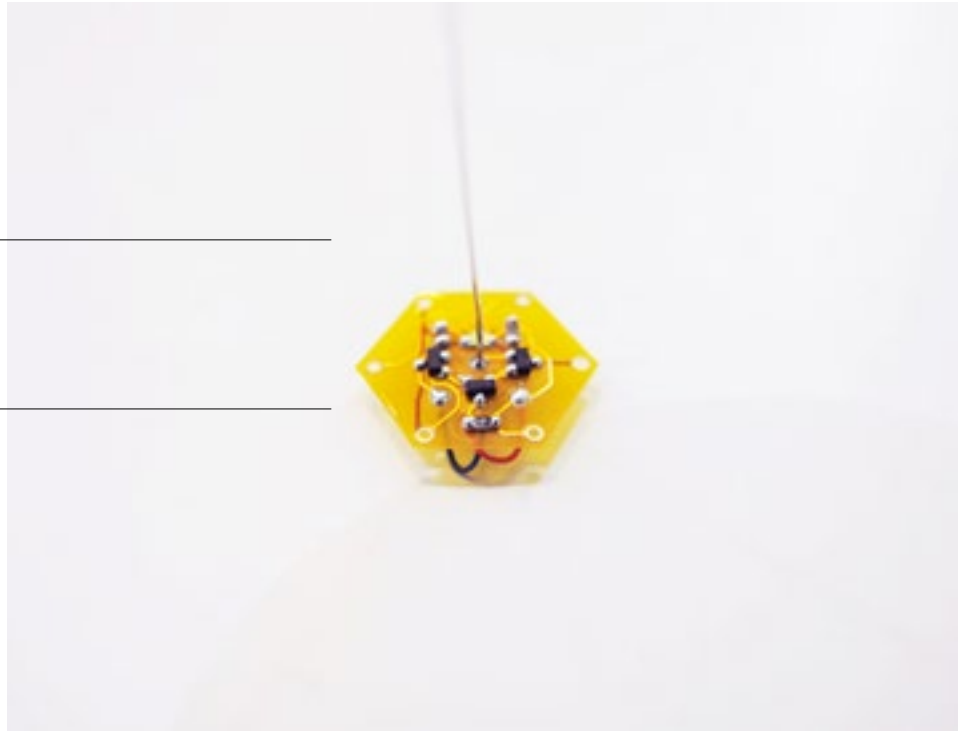
The invisible landscape of electromagnetic signals has changed with the development and proliferation of electronic technology. It is more omnipresent in our surrounding environment than ever before, and is a major part of the fabric of our contemporary lives. But for better or worse, as our habitat changes with technology, are we prone to change with it as well? This is the question that lies at the center of *The Electric Skin Project*.

The Electric Skin Project explores the possibility of creating a wearable that extends the functionality of the skin to sense electromagnetic fields (mostly within the radio spectrum) and translate that information into touch sensation. The wearable consists of two main functional parts: 1) A matrix of omnidirectional antennas that act as sensors and probes and 2) corresponding electrodes that stimulate the skin of the wearer. Through this artificial "skin" or "exoskeleton", the wearable changes our experience, perception, and understanding of space and movement, and in doing so, our interactions. The project speculates on the possible co-evolution of man and technology and draws attention to the role of environmental influence on our own bodily development and behavior.

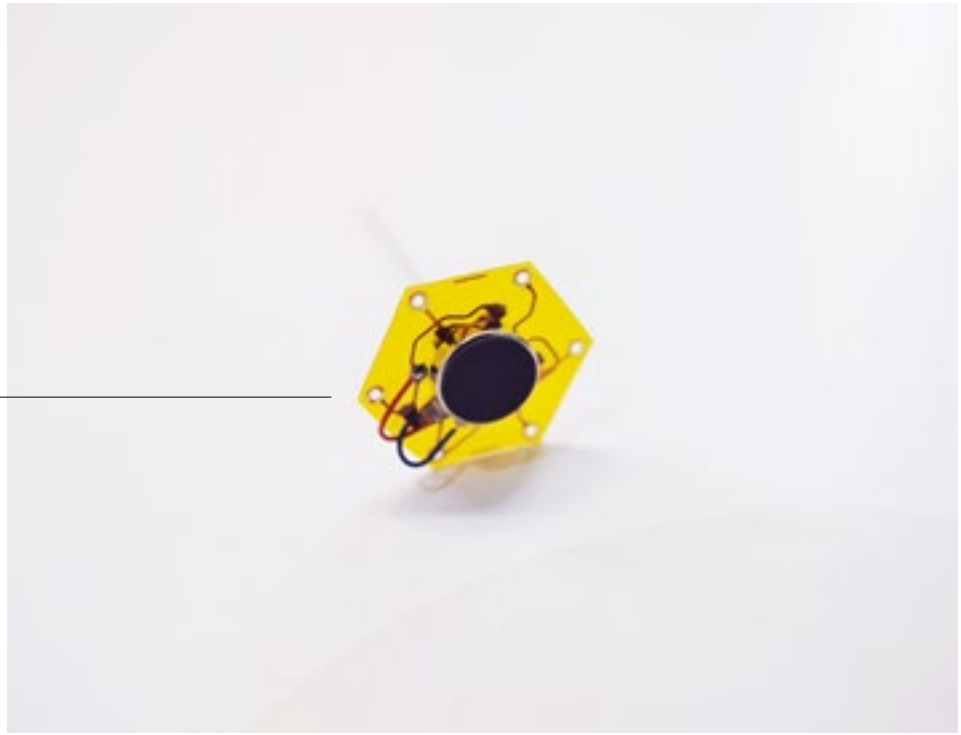
Photographed by Harauld Sextus.

Antenna detects slight fluxuations in the static-electro field

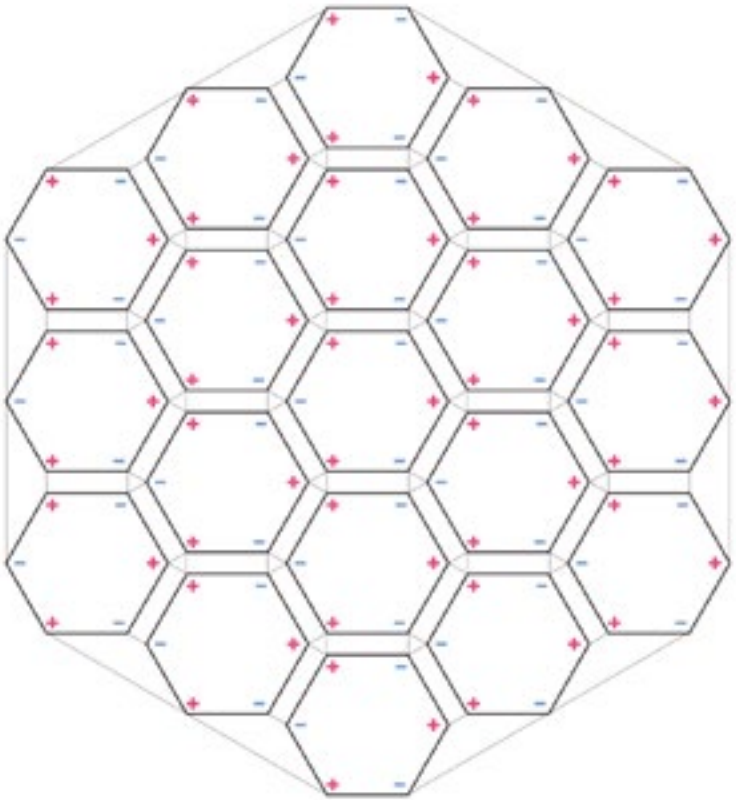
Circuit amplifies the signal and uses it as a trigger

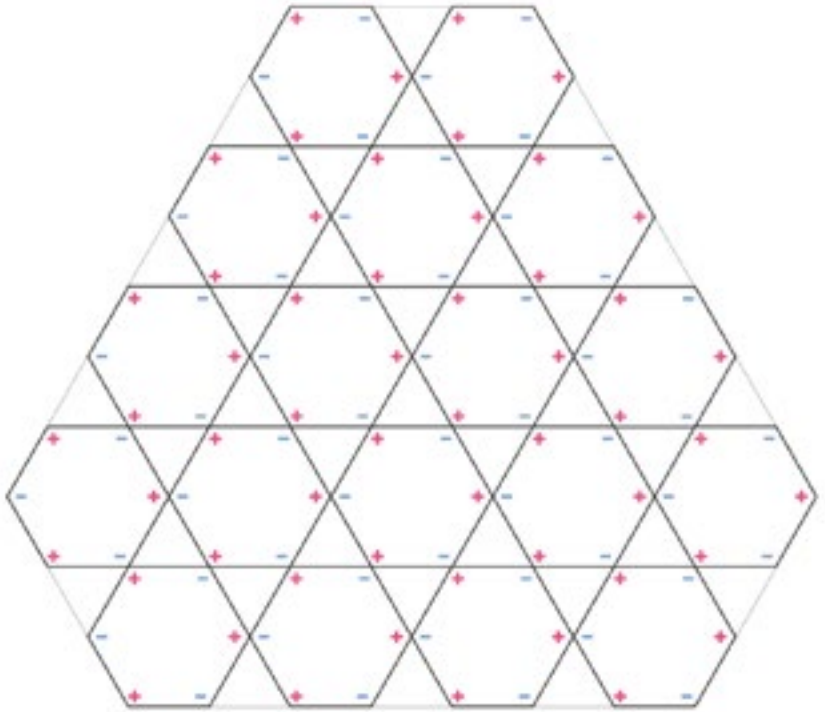


The vibration motor under the circuit is activated to stimulate the wearer's skin

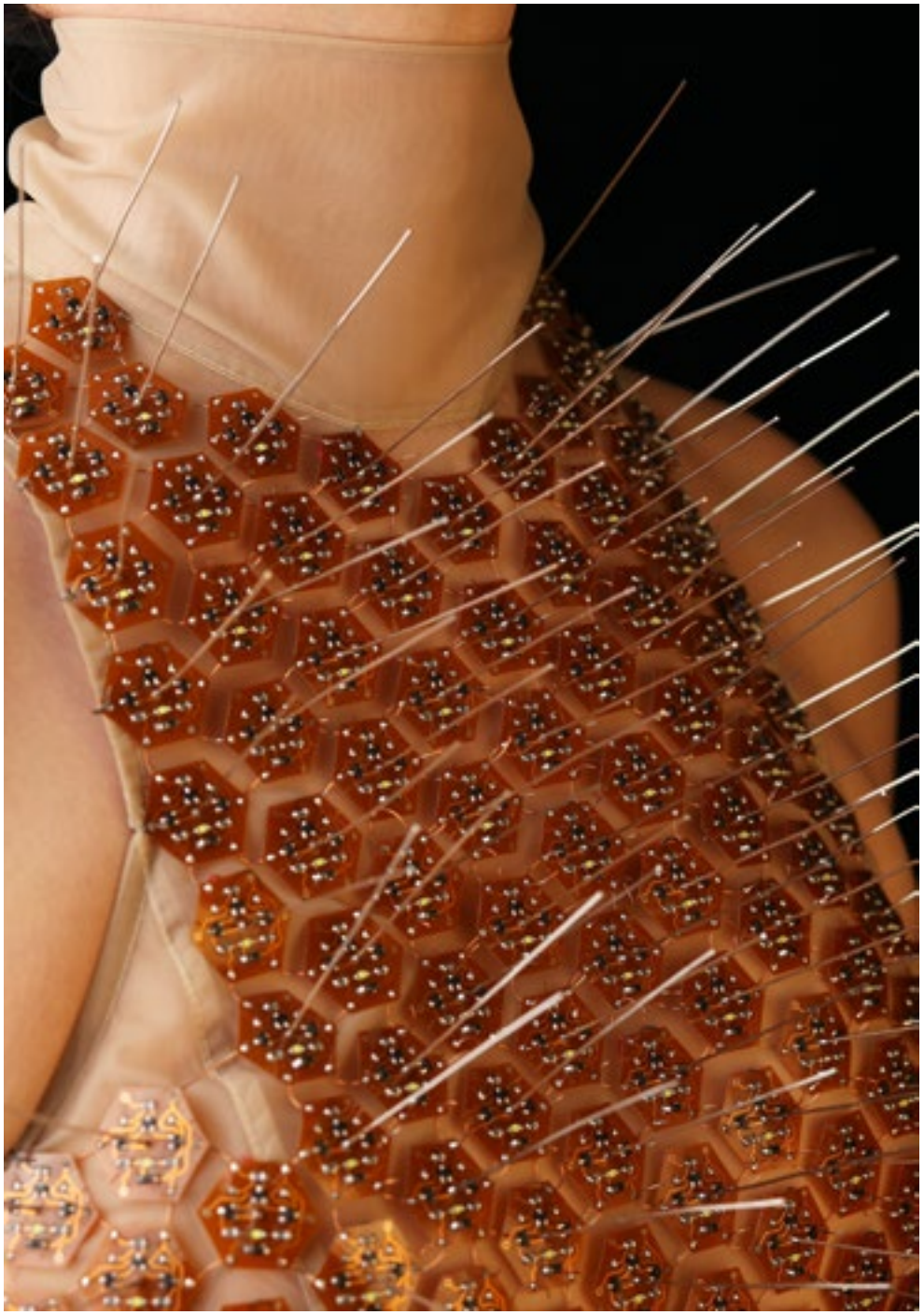


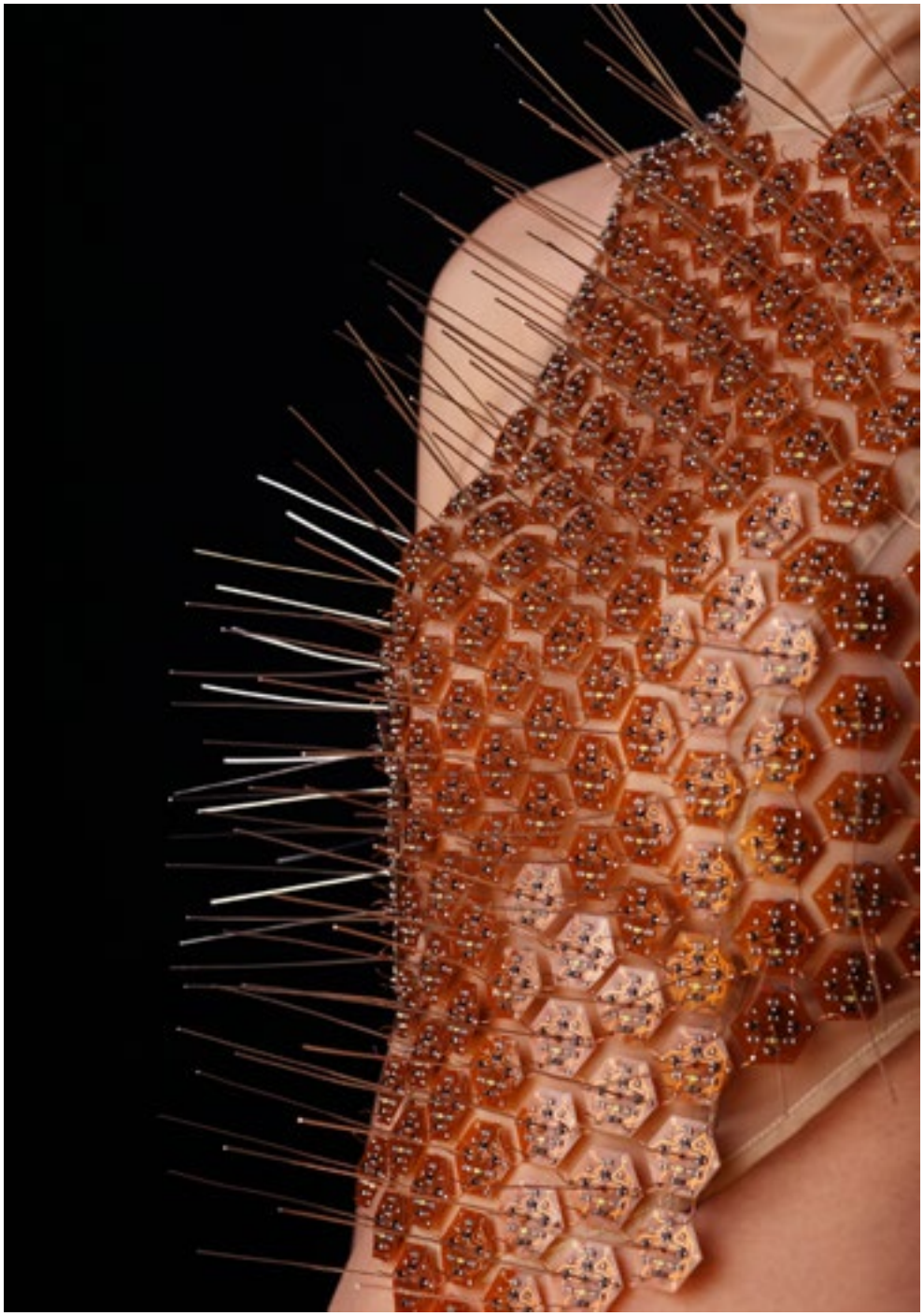
Electric Skin Project
Single Sensory Circuit





Electric Skin Project
Matrixing sensory circuits to create electric skin fabric.





Electric Skin
Worn by artist, photographed by Harauld Sextus.

The Sonic Skin
Materials: electronics, PVC
2018

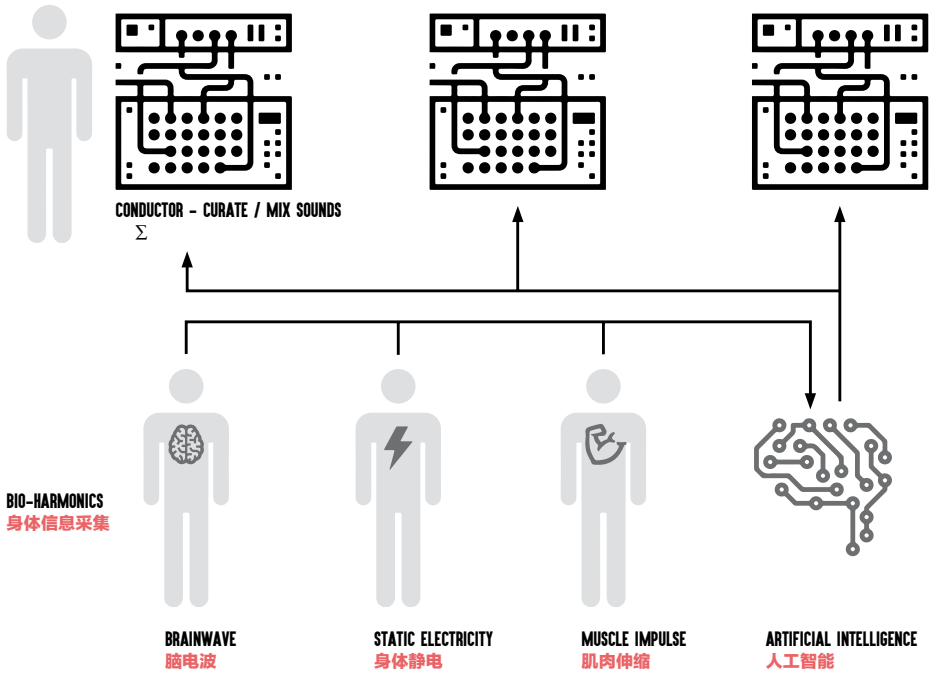
The Sonic Skin is a sound and wearable art piece that explores the concept of human-machine co-evolution. It is the second wearable piece of the artist's Skin Series, consisting of the Electric Skin and the Sonic Skin. The Sonic Skin is articial second skin designed by the artist to project directional sound, much like a bat's sonar system, where the reection and journey of the sound illustrates the relationship between wearer and environment. Following the tragectory of the Electric Skin, the Sonic Skin explores the relationship between body, movement and space, and questions whether there could be a heightened future human sensability and sensory systems with the help of wearable technology.

Worn by artist, photographed by Harauld Sextus.

Sonic Skin
Worn by artist, photographed by Harauld Sextus.

THE 身体四重奏 BIO-HARMONICS QUARTET

DESIGNED
AND BUILT BY
BENJAMIN BACON
AND **VIVIAN XU**



The Bio-harminic Quartet links together a number of musicians and artists via a biofeedback network. This network acts as a musical interface and uses the collective data of participants' bodily adtivities to generate music and soundscapes in collaboration with an AI.

The goal is to put music production into the context of the increasingly important debates happening between man and machine. It also strives to explore news concepts of musical performance and production utilizing developing technologies.

This performance debuted at the Shanghai Symphony Orchestra,
in collaboration with musician B6 (Lou Nanli) July 2018.

vivian xu
2019