SOFT CIRCUITS

– E-Textiles Workshop – Fabricademy Bootcamp 2025– Rebekka Jochem

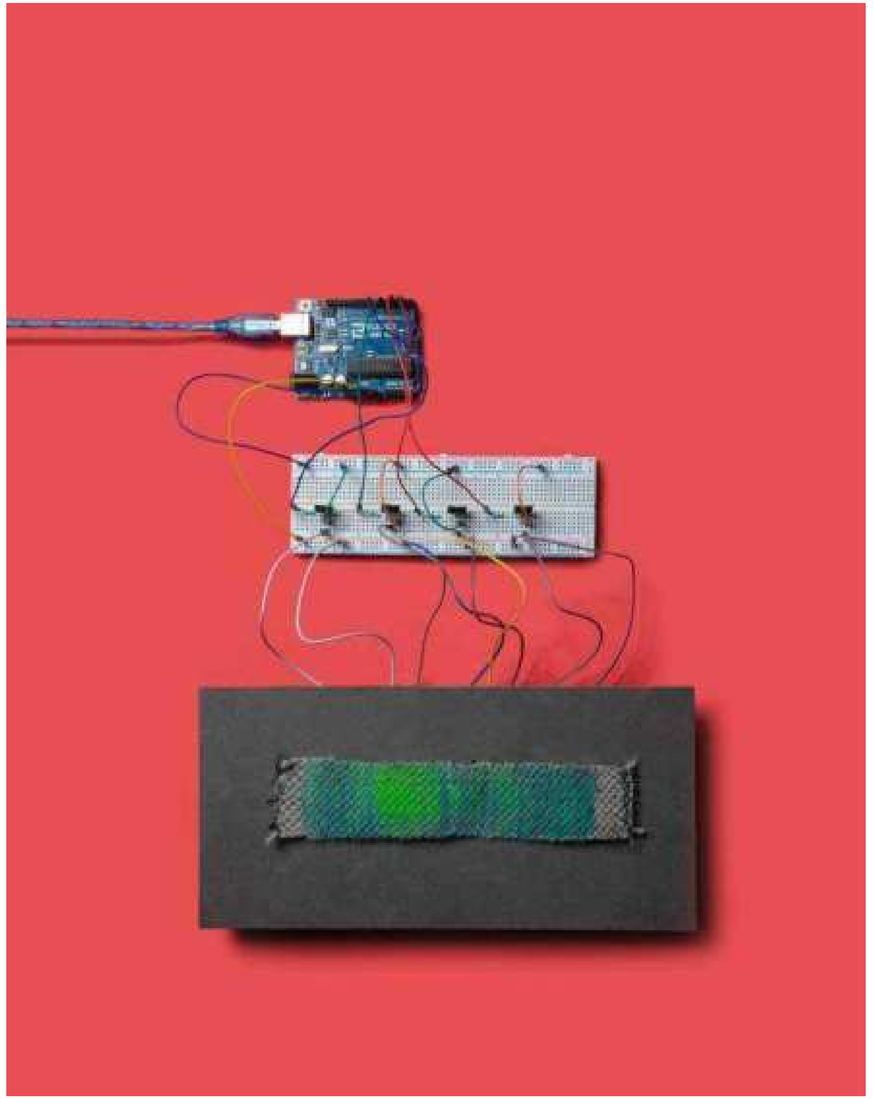
WELCOME!

– Introduction

What are E-Textiles?

– Soft Electronics 101

– Practical Experimentation



Textile Display/Rebekka Jochem/2019

The Computer Girls

A trainee gets $8,000 a year ...a girl "senior systems analyst" gets $20,000—and up! Maybe it's time to investigate....

Figure 1

Figure 2

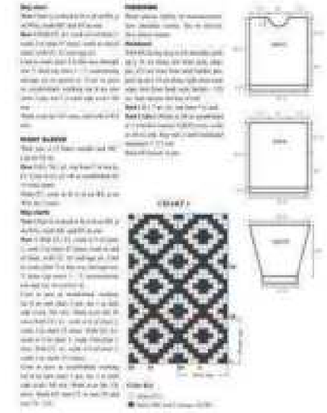
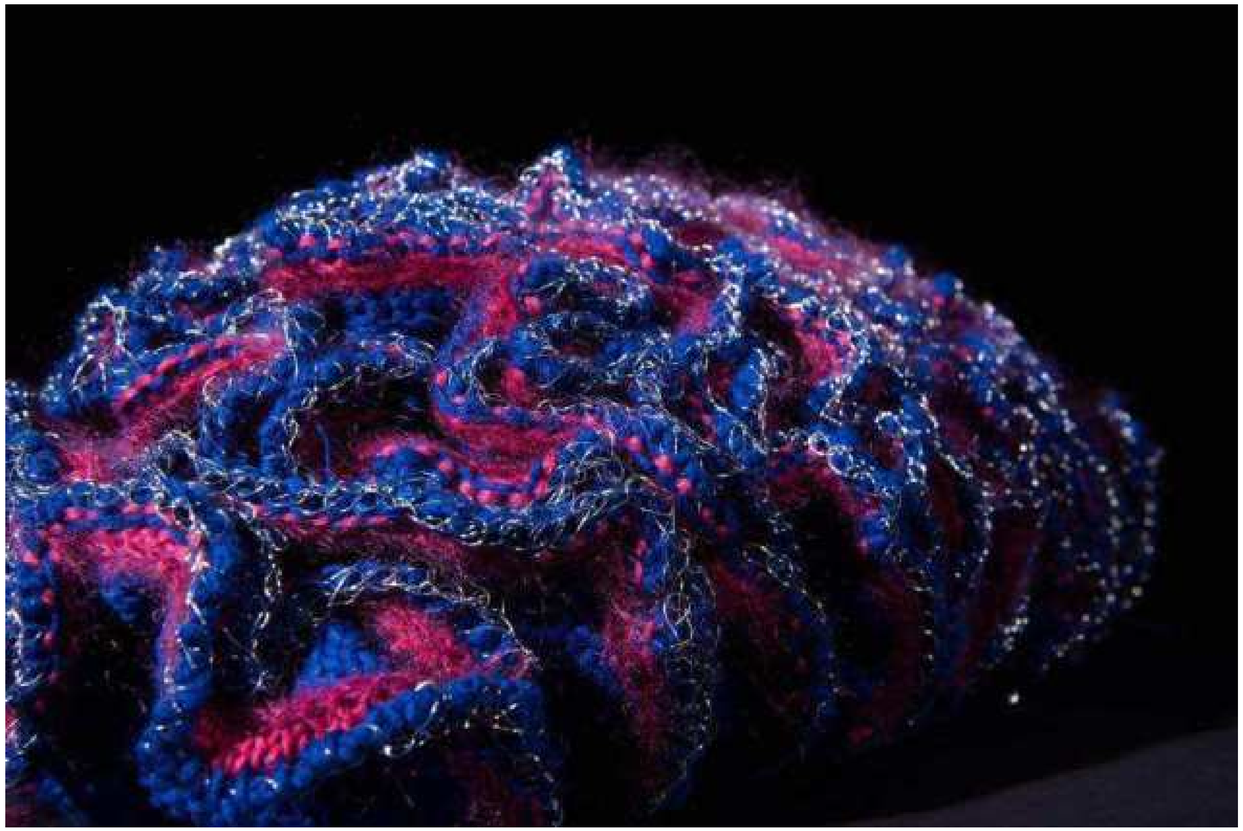
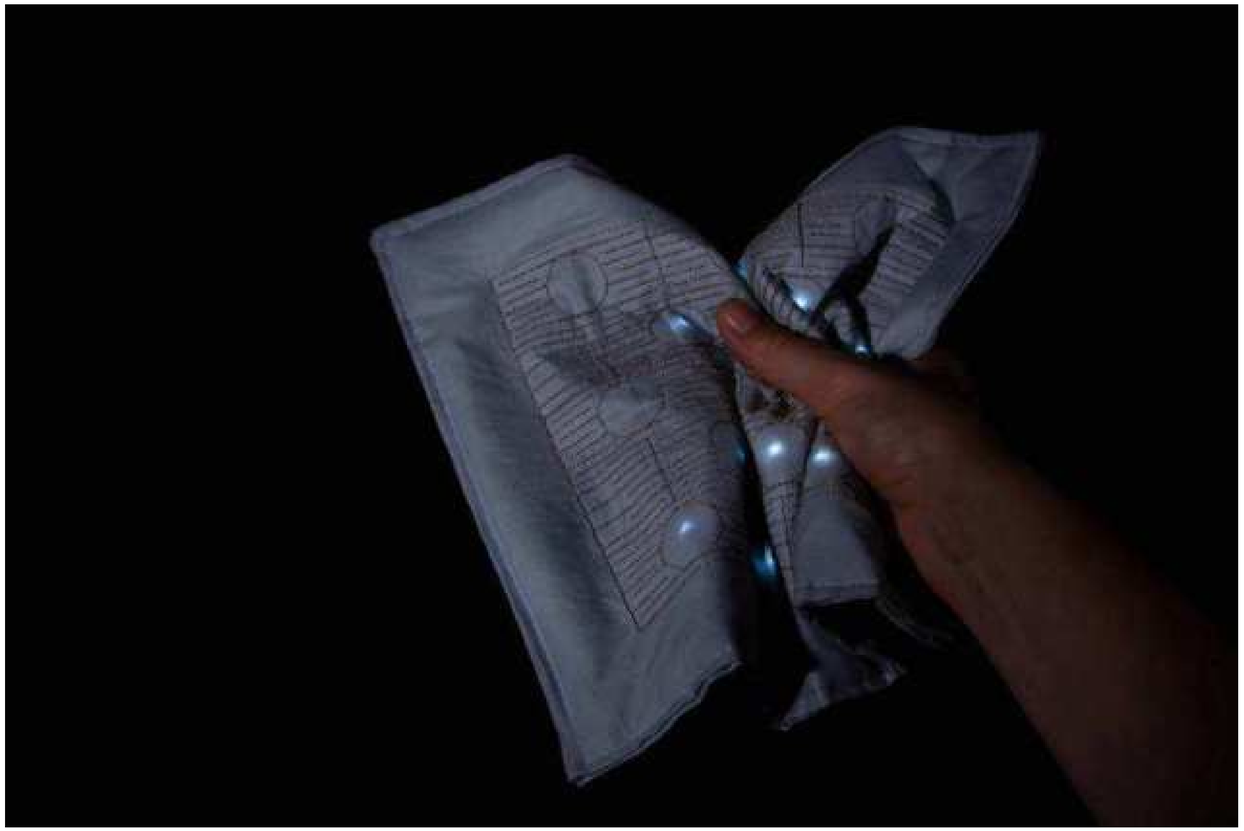


Figure 3

Figure 1: Article published 1967 in the Cosmopolitan Magazine, advertising computer programming as a promising career for young women.
Figure 2: Image from an advertisment for Fairchild Semiconductors (1969) , framing the assembly of electronics in their factory as the modern extension of indigenous crafts and reproductive labor.
Figure 3: The knitting instructions for Irene Posch's and Ebru Kurbak's Knitted Radio, which is a fully textile FM Transmitter that can also be worn as a sweater.
Sources: Figure 1, Figure 2, Figure 3.





Breaking Code/Rebekka Jochem/2020


↗ Snapchat

↗ Google Maps

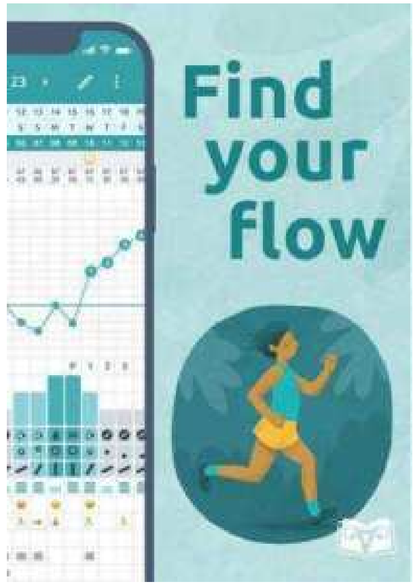
↗ Period Tracker

Make choices that are right for you

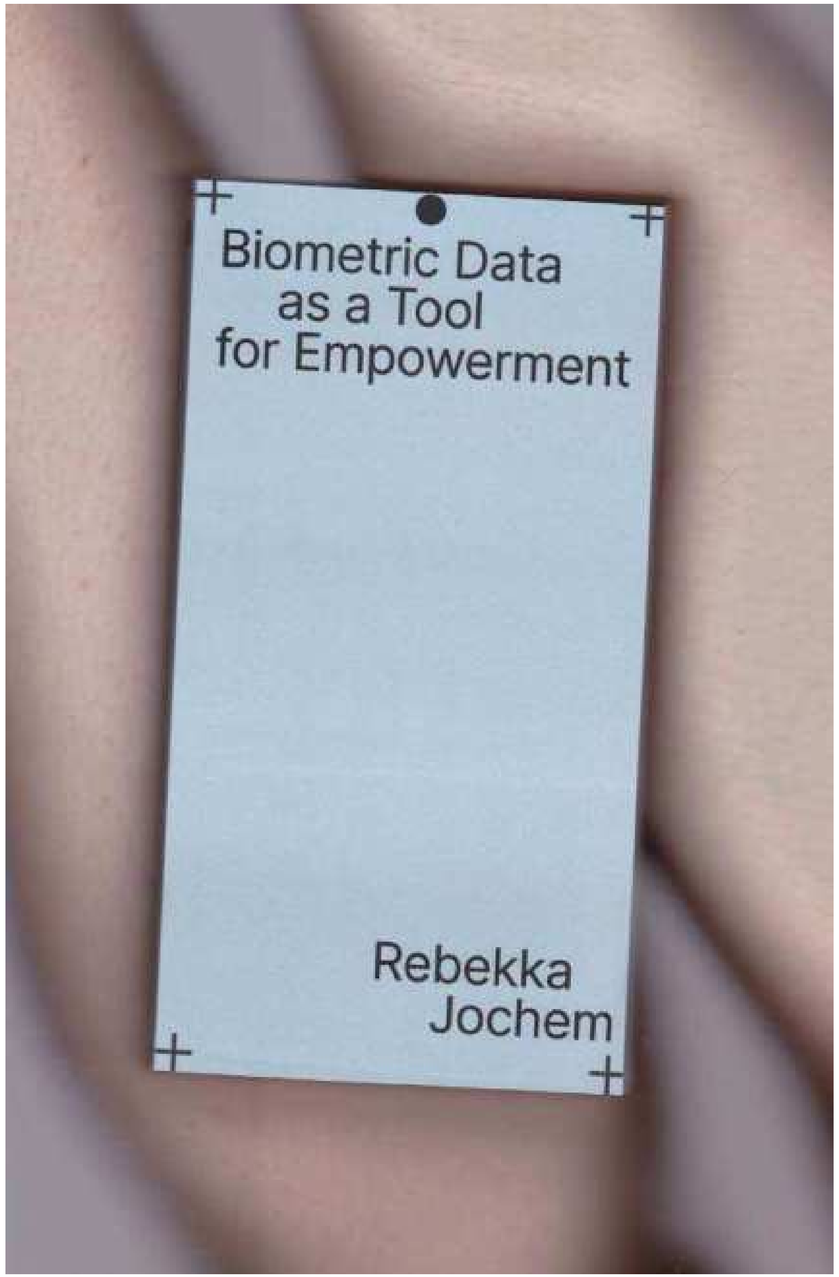
Learn about your body from the data in your app and our science-based articles to make informed health choices.

↗ Clue

↗ Flo Health



↗ Read your body

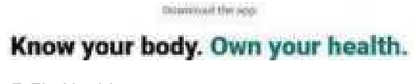


↗ Flo Health

↗ Garmin

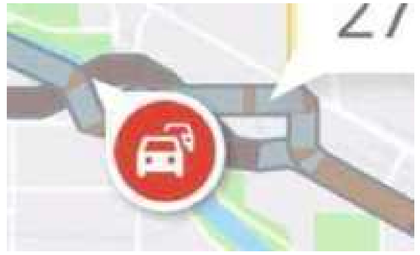
↗ Perfect365

↗ Bellabeat



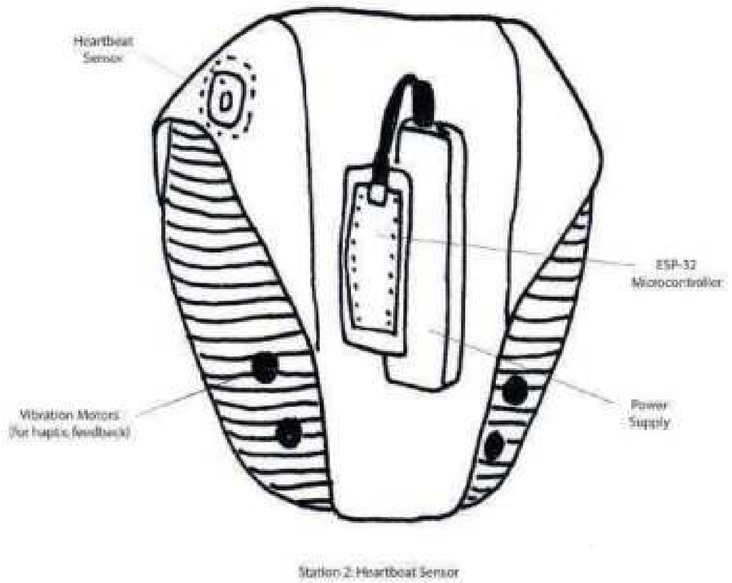
↗ Flo Health

↗ Strava



↗ Google Maps

Research on Biometric Data/ Rebekka Jochem/ 2024



Station 2: Heartbeat Sensor

You+/Rebekka Jochem/2024

Repatterning/Rebekka Jochem & Agnetha Jaunich/2025

WHAT ARE E-TEXTILES?

Textiles ❤ Electronics = Endless Possibilities

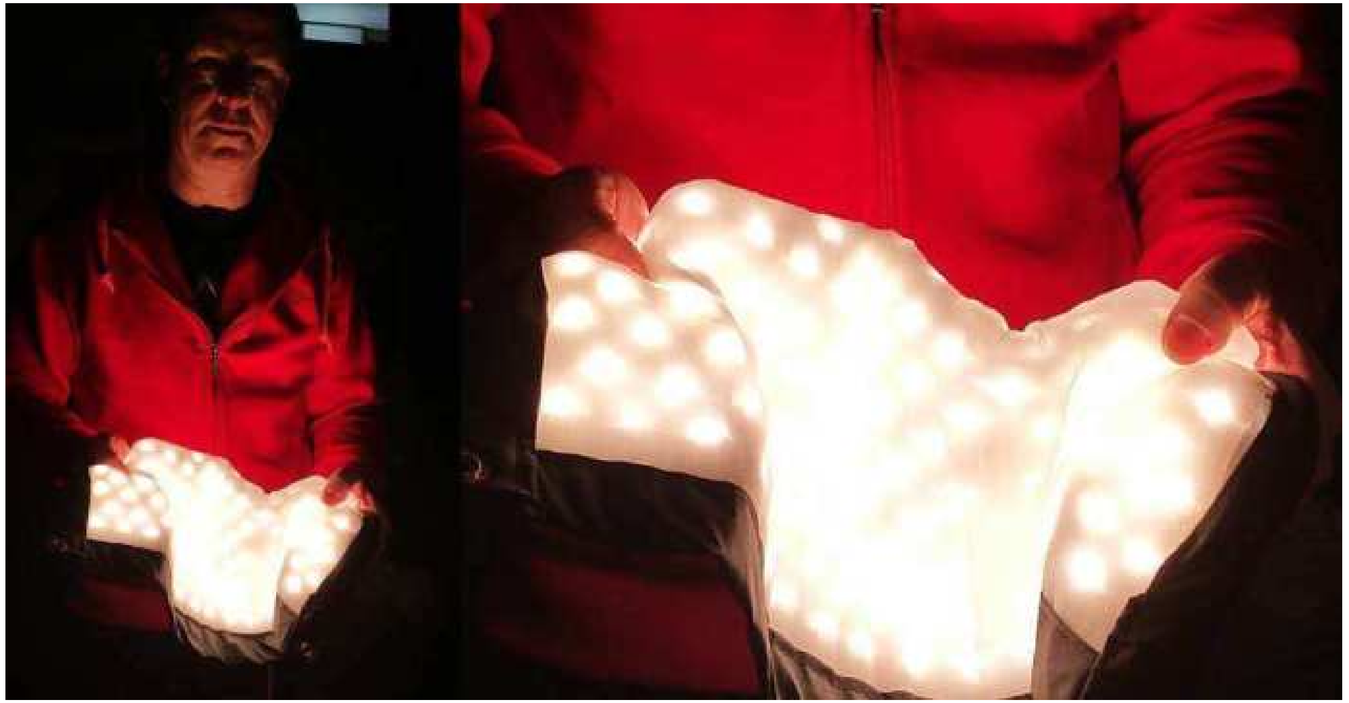
SPACE TRAVEL

I-Suit Spacesuit Gloves / ILC Dover Inc. & SOFTSWITCH Ltd. / 2001

FITNESS TRACKING

SKINETIX/2025

FILM LIGHTING

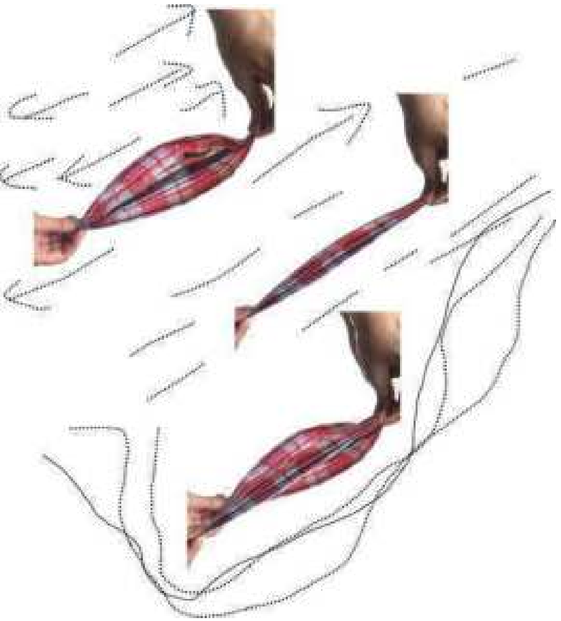


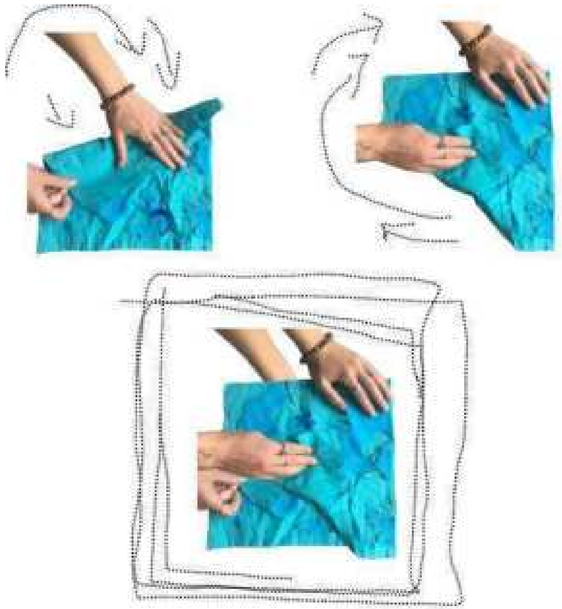
Carpet Light

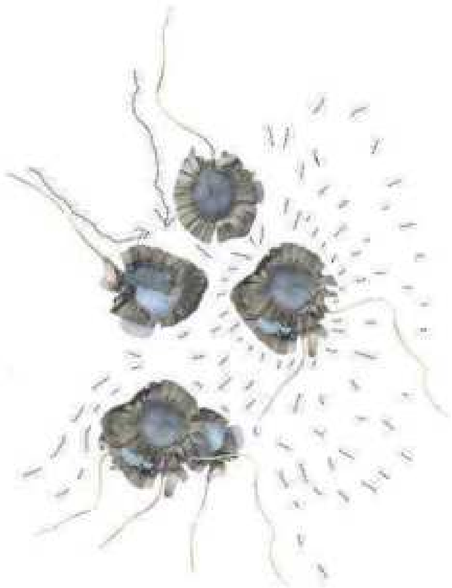
EDUCATION

Soft MP3 Player Workshop / Lavoslava Bencic

INTERACTION DESIGN





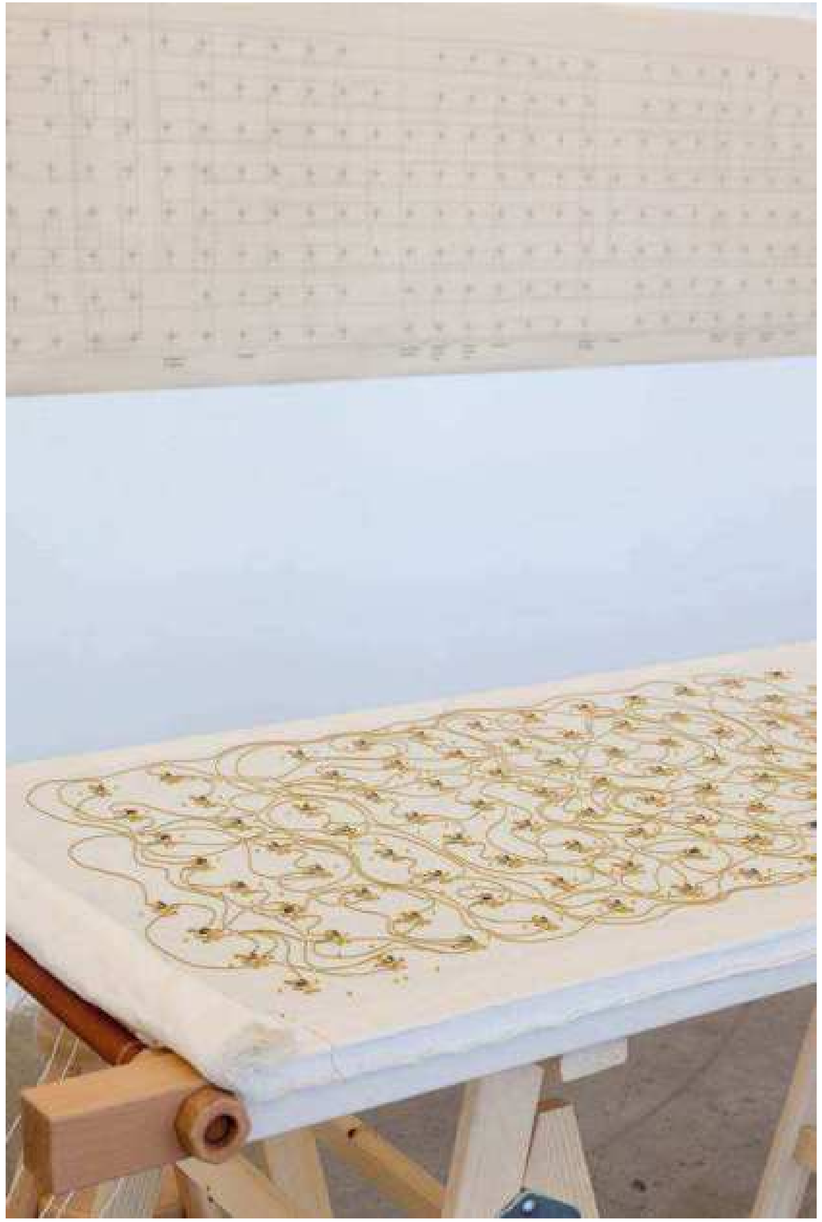


Alternative Buttons Workshop / Constant/ 2024

DESIGN RESEARCH

Crafted Logic / Ebru Kurbak & Irene Posch

DESIGN RESEARCH



Embroidered Computer / Ebru Kurbak & Irene Posch

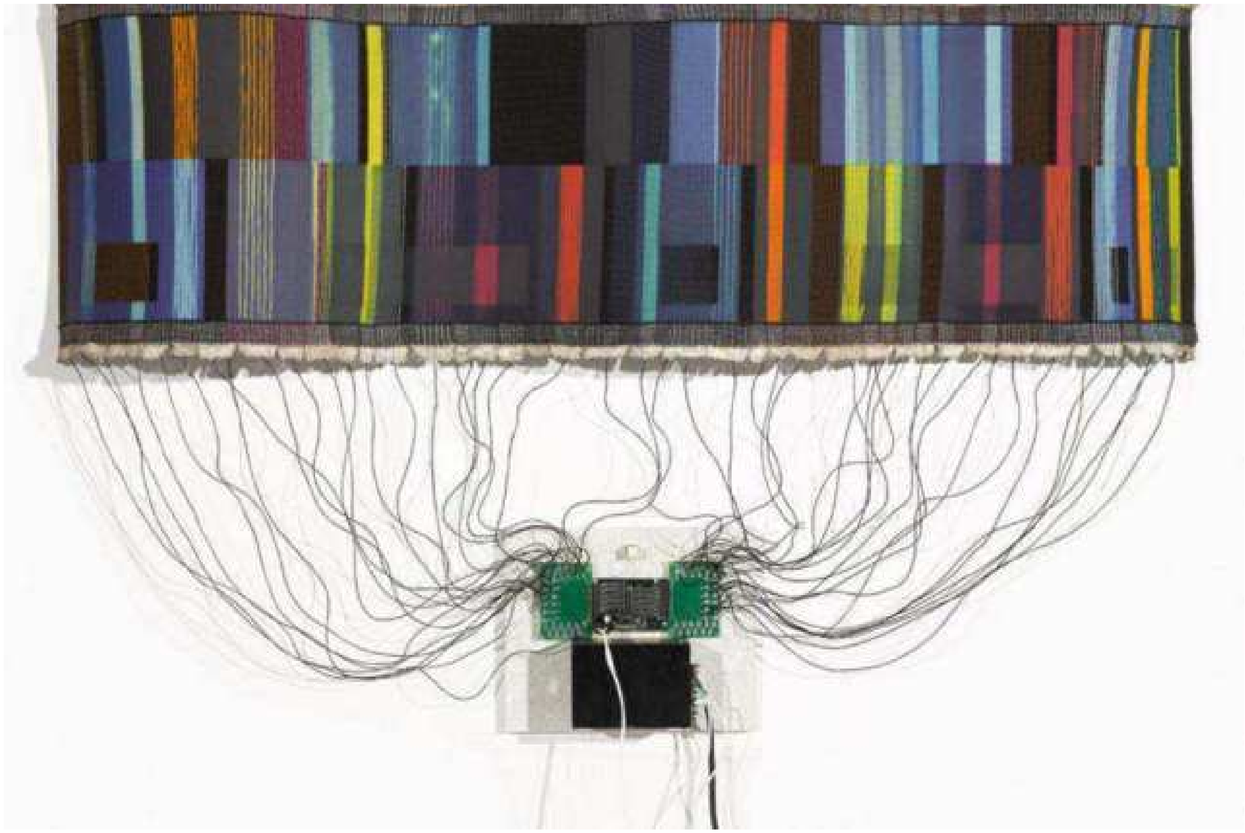
FASHION

Solar Shirt / Pauline van Dongen

FASHION

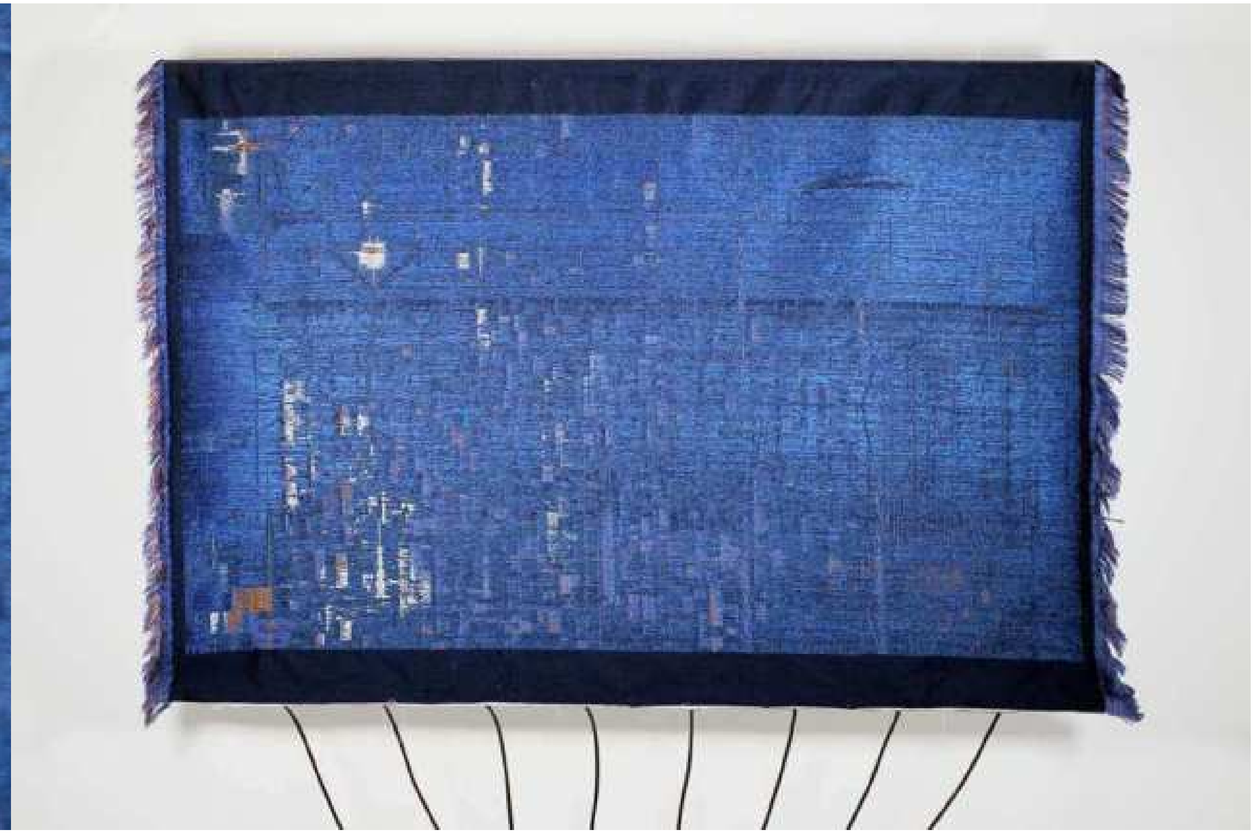
Kunihiko Morinaga for Anrealage / Fall 2025

ART



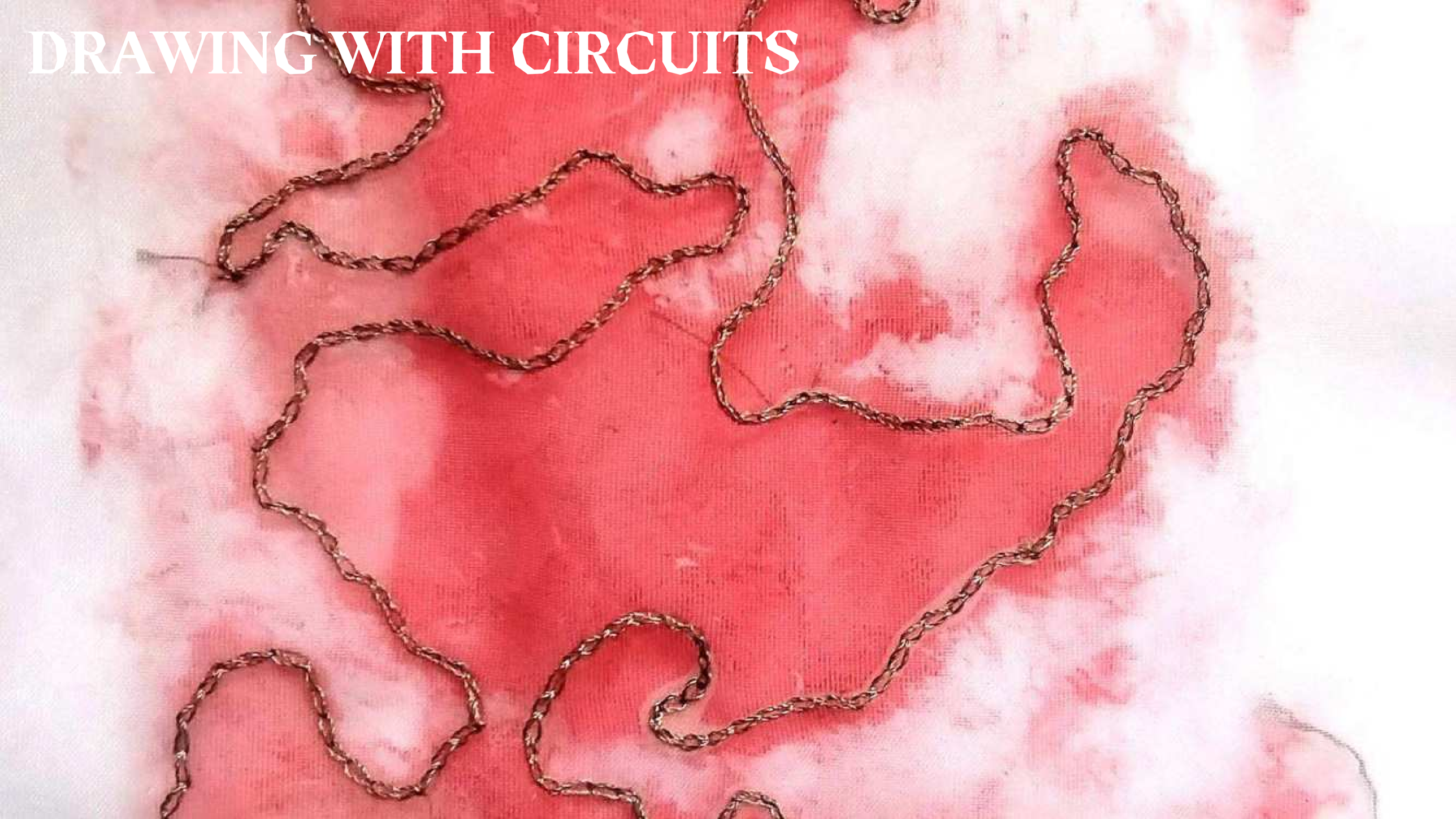
101 Electronic Art Years / Maggie Orth

ART



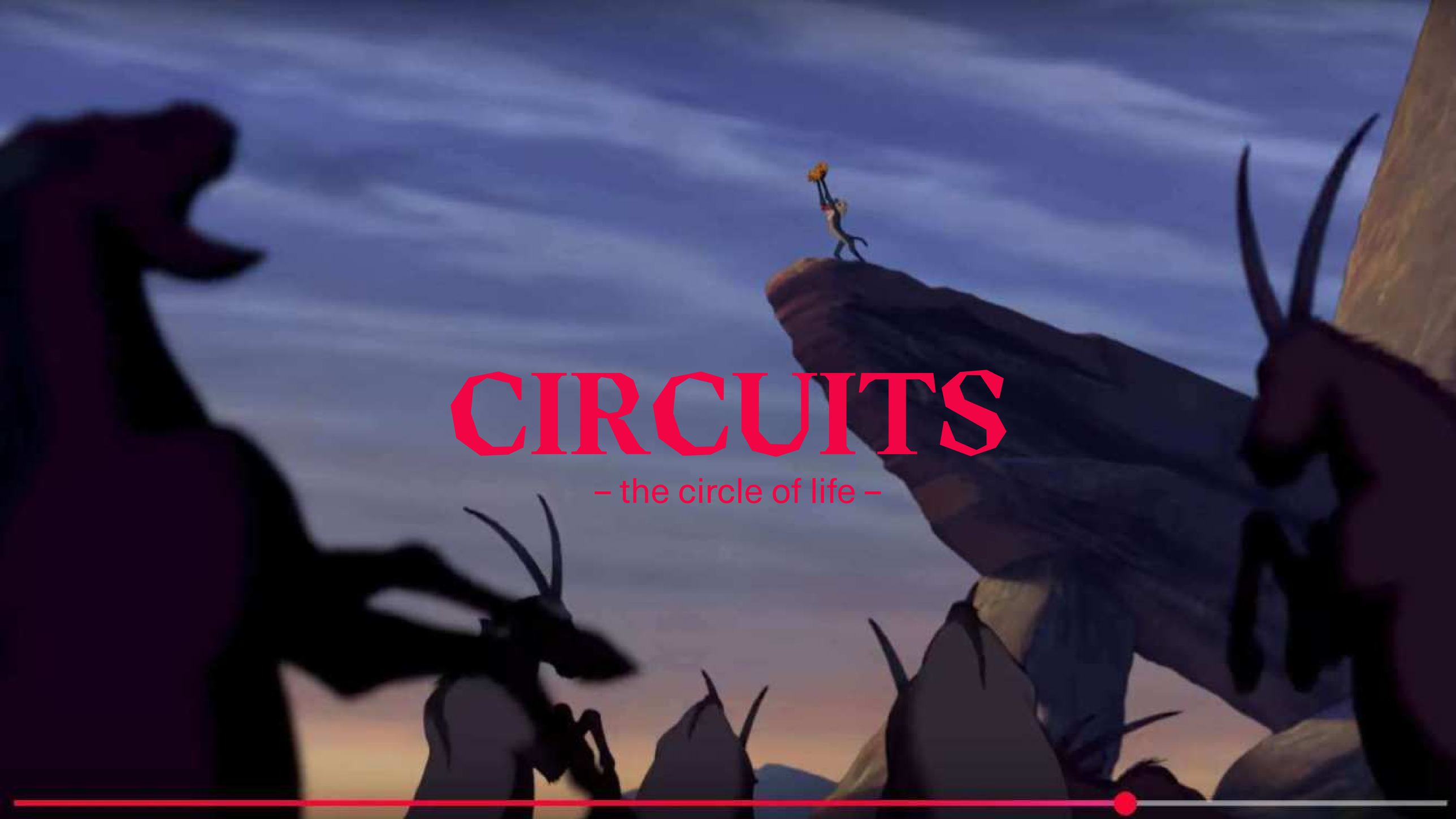
Wifi Tapestry / Richard Vijgen

DRAWING WITH CIRCUITS



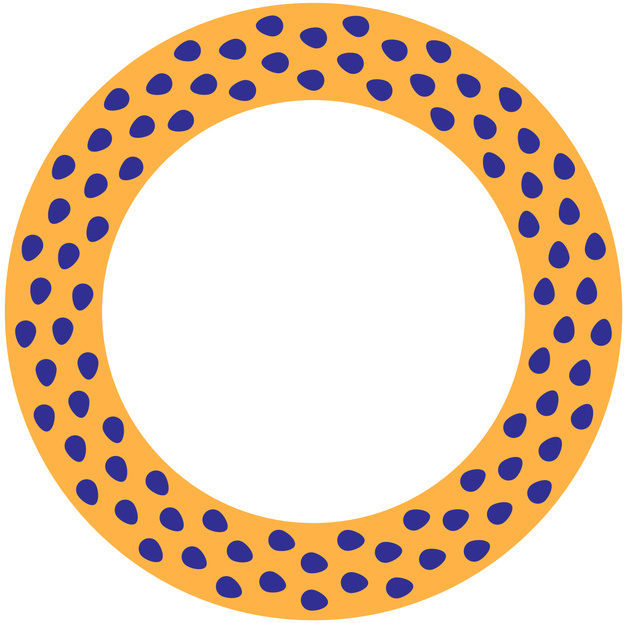
ELECTRONICS 101

– explained using pop songs –

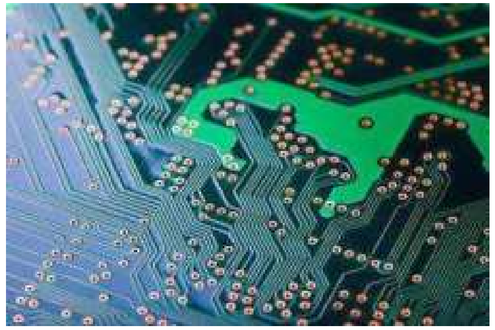

CIRCUITS
– the circle of life –

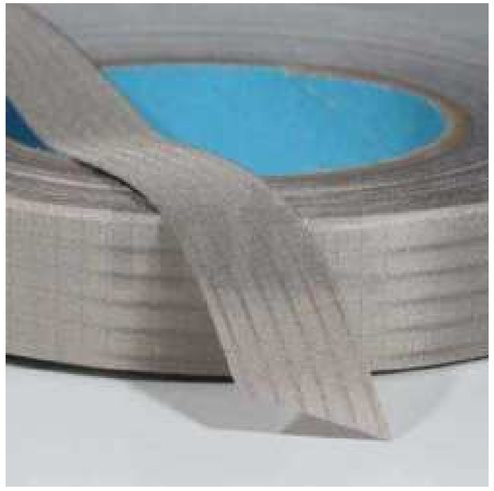
AN ELECTRICAL CIRCUIT

A closed conductive loop that features some electrical components, like a power source and a load.



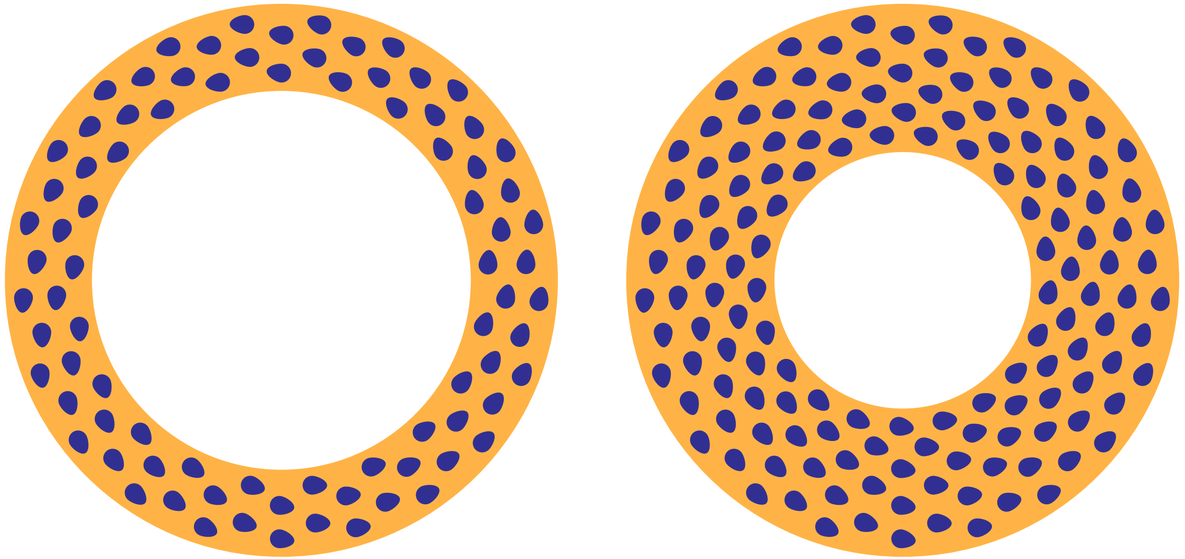
CONDUCTIVE MATERIALS





CURRENT

Property of a Circuit
~ how much electrical charge is moving through the circuit?
Unit: Ampère (A)

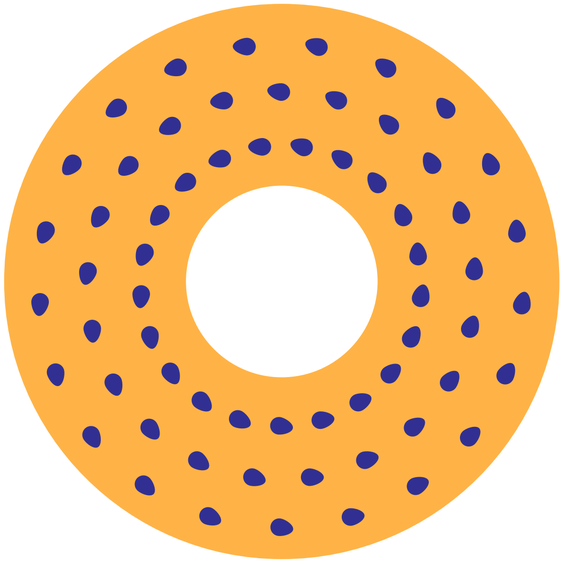



Simba & Timon & Pumbaa


the whole animal kingdom

VOLTAGE

Property of a Circuit
~ motivation for the electrical charge to move
Unit: Volt (V)
Electrical components are usually rated a a certain voltage.

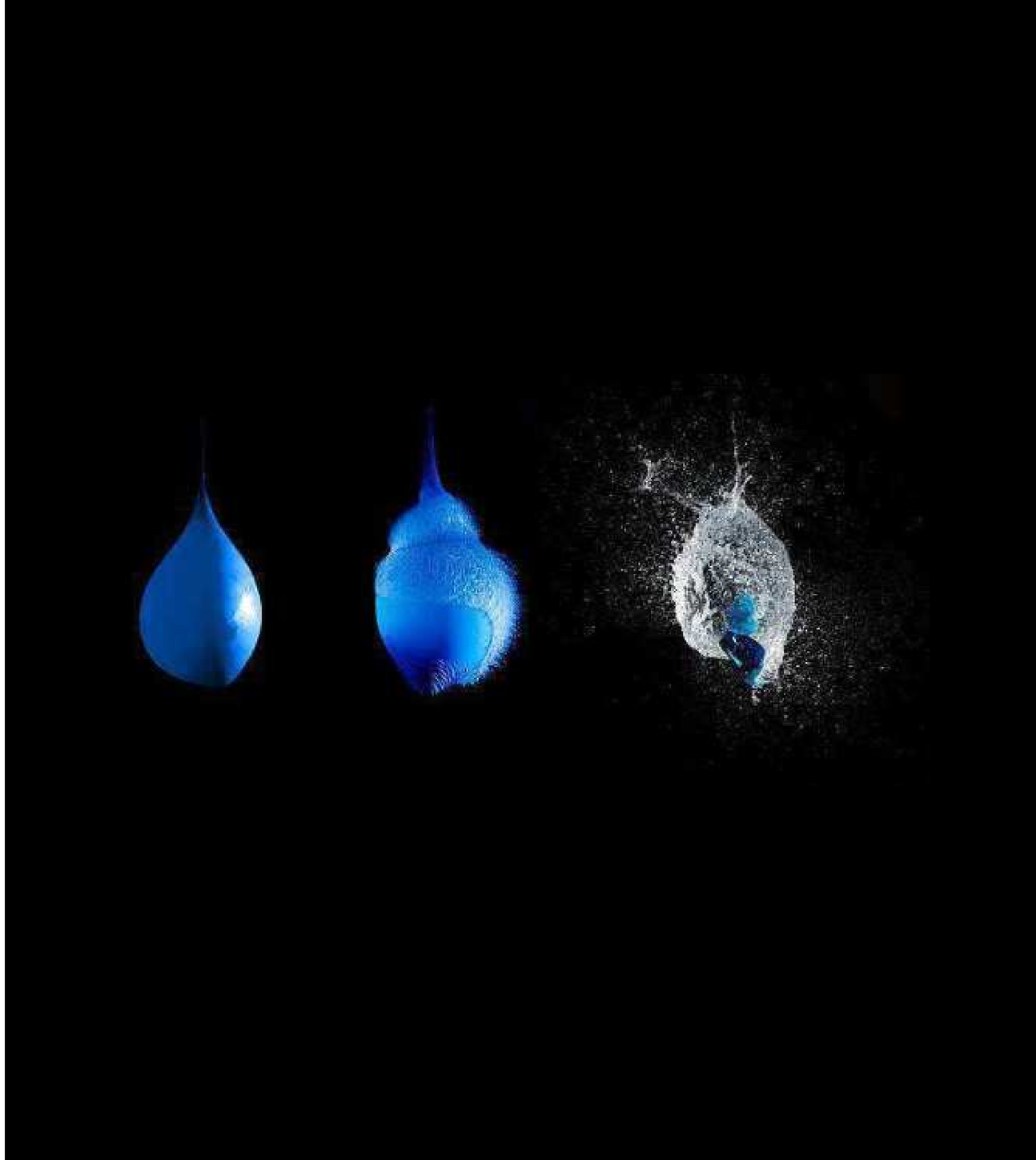


less motivation to move

high motivation to move


QUEEN INTERLUDE
– under pressure –

voltage ~ pressure difference:
particles move to equalize pressure differences



RECAP

A functional circuit needs to be closed.

Current (Ampère) :
How much is moving?

Voltage (Volt) :
How high is the motivation to move?

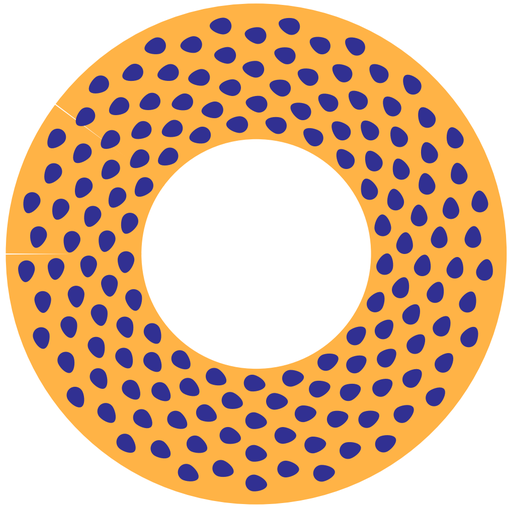

SWITCHES
– hot‘n‘cold –
vevo

SWITCH

A component to open and close the circuit in a controlled way.

Fullfill societal expectations:
get married, have kids.
-> current is flowing, components
can perform as expected

Run away:
find happiness elsewhere.
-> no current is flowing,
components are not functional



Once the circuit is broken, no current will flow anywhere
-> it doesn‘t matter where the switch is placed

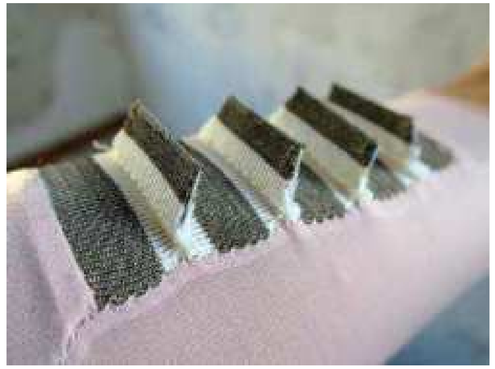
SOFT SWITCHES

Toggle Switch - Liza Stark

Tilt Switch - Kobakant

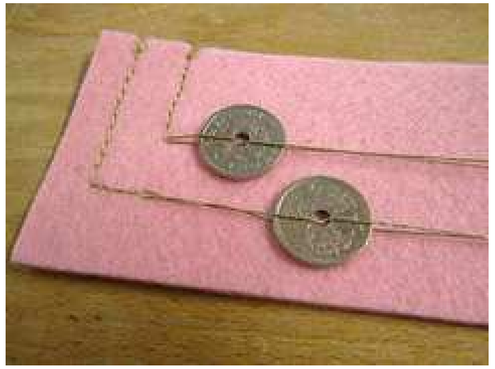
Zipper Slider - Joo Youen Paek/ Kobakant

Neoprene Switch - Kobakant



Stroke Switch - Kobakant

Stroke Switch - Liza Stark



Sliding Danish Crown Switch - Kobakant

Push Button - Kobakant

Velcro Switch

Button Switch

POWER SUPPLIES

– power –

POWER SUPPLY

A component that
provides energy for the circuit.

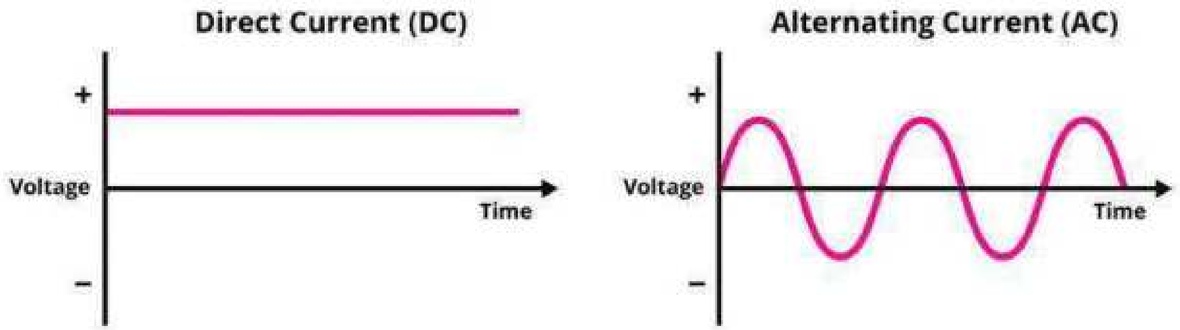
Usually rated with:
- voltage
- maximum current


ACDC
INTERLUDE
– thunderstruck –

AC vs DC

Direct Current:
More for senstitive electronics & storage

Alternating Current:
Used for electric grids & heavy machinery



~ DC:
Angus performs the
„duckwalk“ in same direction

~ AC:
Angus keeps switching directions

WHAT'S IMPORTANT:

We will use DC current at max 5V.
-> safe to handle and touch
Still:
Careful with short circuits (🔥)

POWER SOURCES / SUPPLIES

Disposable Vape Batteries

Heliatex – Flexible Solar Panels

Automatic Watch – Hand movements of wearer are used to generate power

Grandfather clock using gravity as power source

Suntex – Pauline van Dongen – Woven Solar Panels

Computational Compost – Marina Ottero – Using compost as a power source for datacenters


RESISTORS
– it‘s getting hotting in herre –
vevo

RESISTORS

A component that limits the amount of current in a circuit.

Important because:
No resistance -> unlimited current -> short circuit

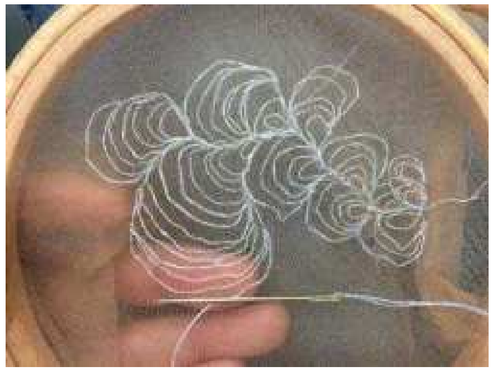

resistor ~ the bouncer at the club

RESISTANCE

Property of materials
~How well does current pass through?
Unit: Ω (ohm)

THREADED RESISTANCE

The resistance of conductive thread depends on several factors:
– blend of fibres
– tension
– > technique




vevo

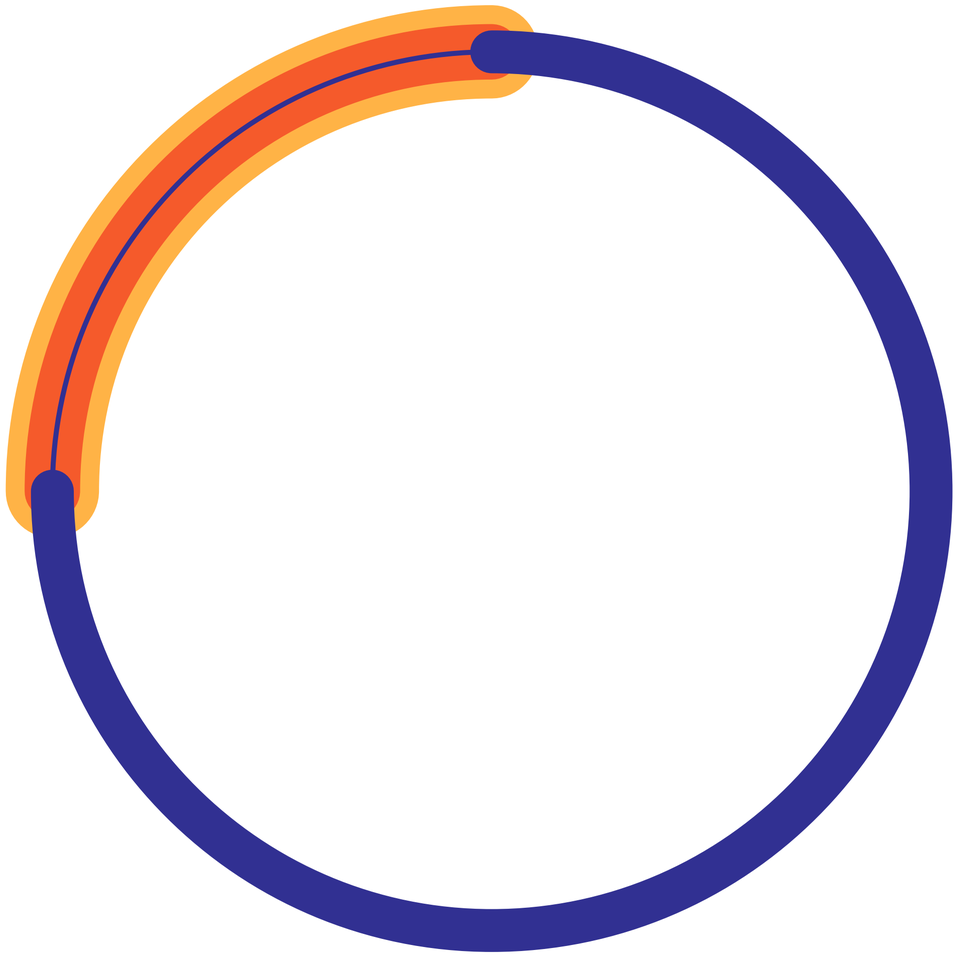
EXCESS HEAT

the electrical energy
dissipates as heat

~ things getting hot
from friction.

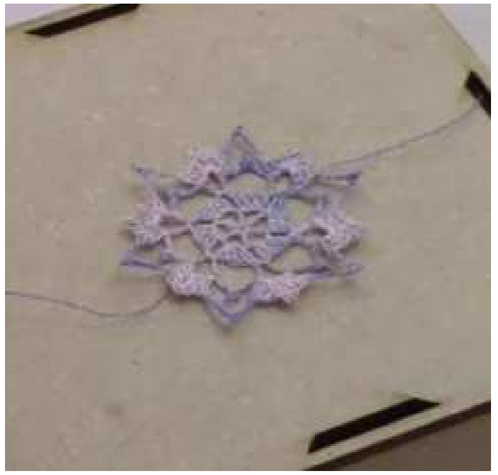
The total resistance limits the current in the ~whole circuit

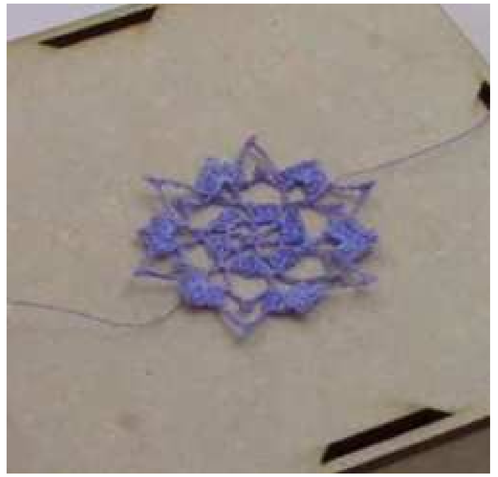
-> heat dissipates where the resistance is high.

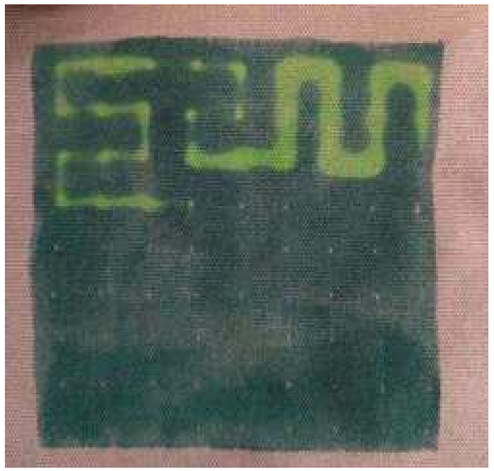


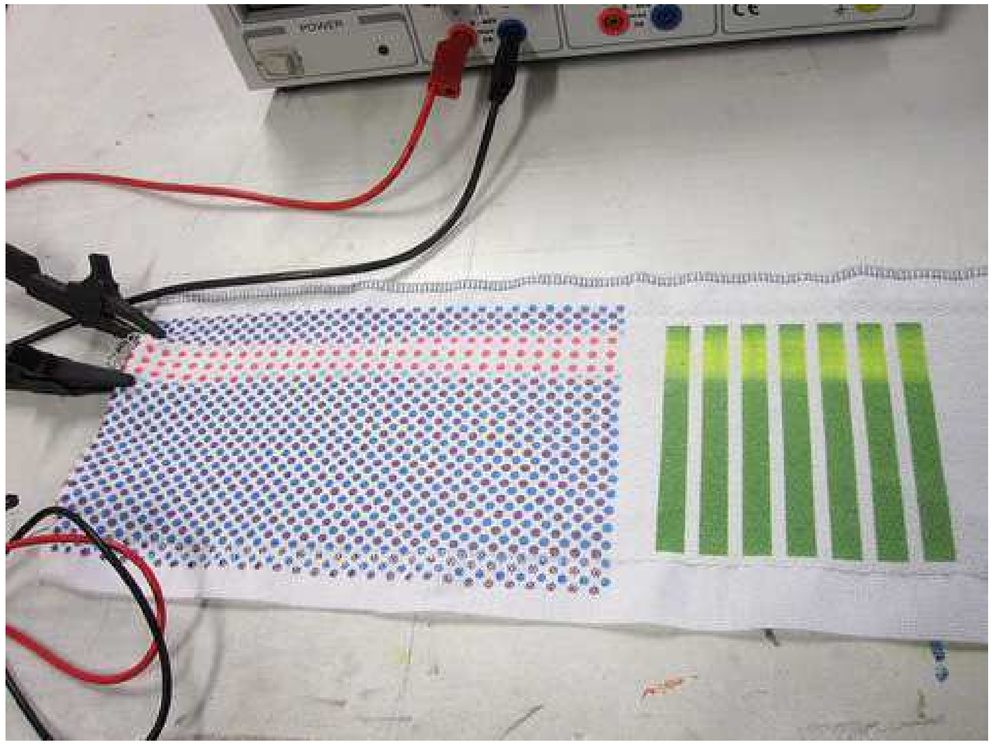
LET'S GET PRACTICAL!

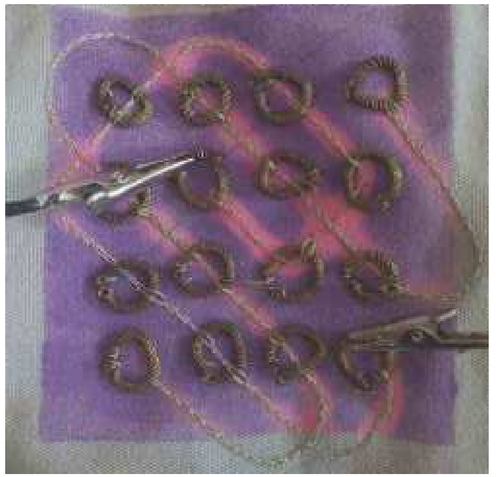
THERMOCHROMATIC INK

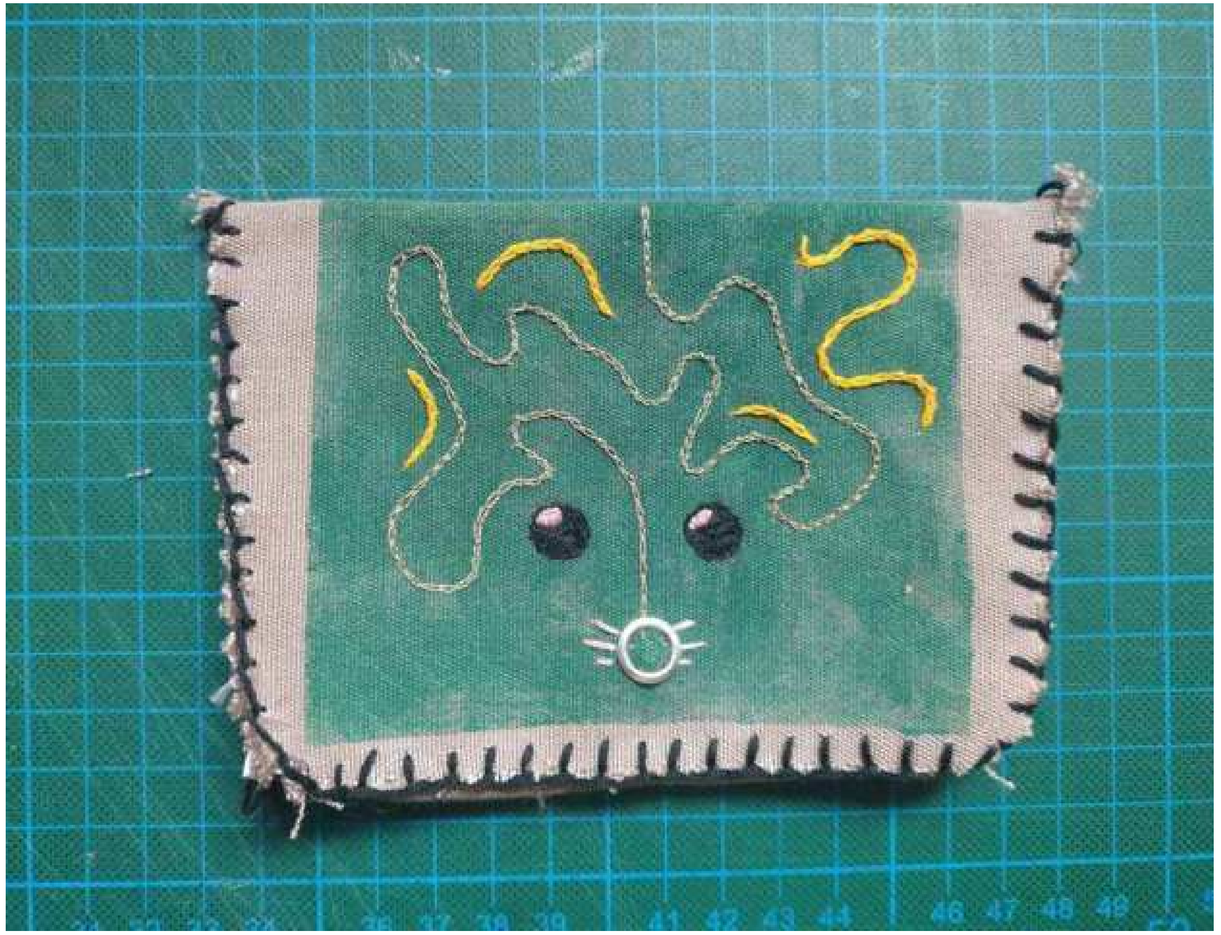




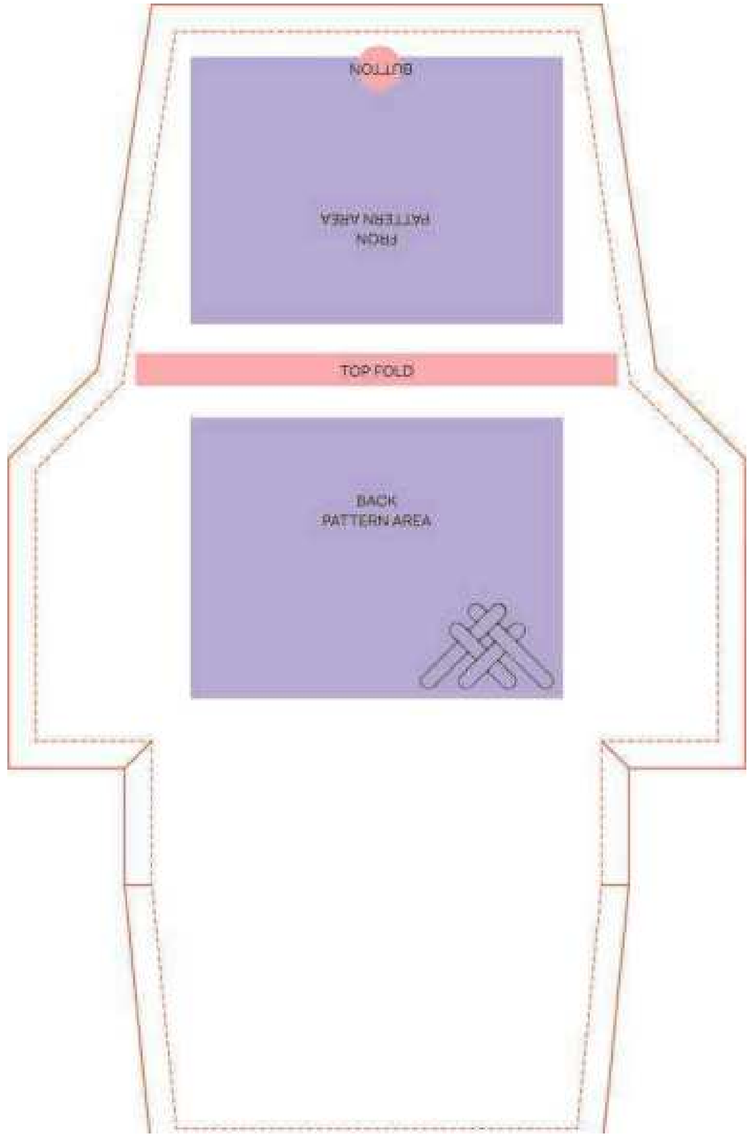






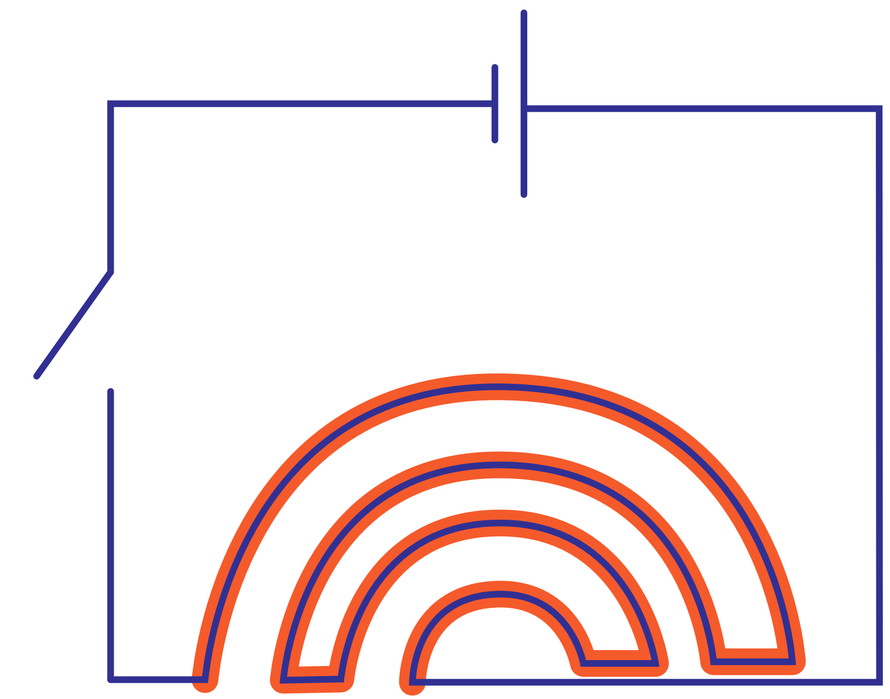


THE POUCH

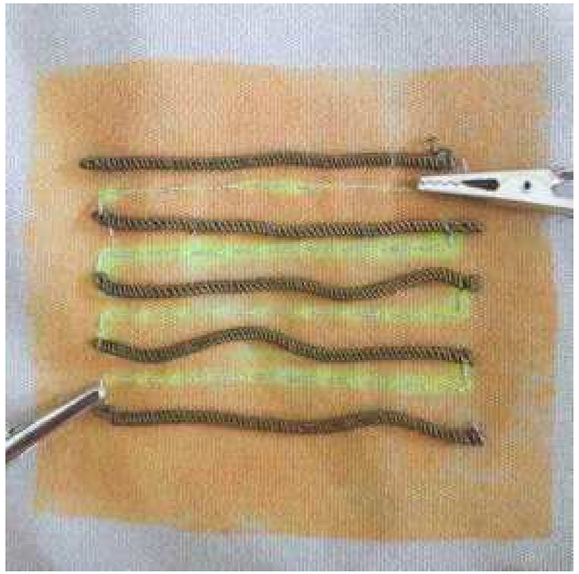


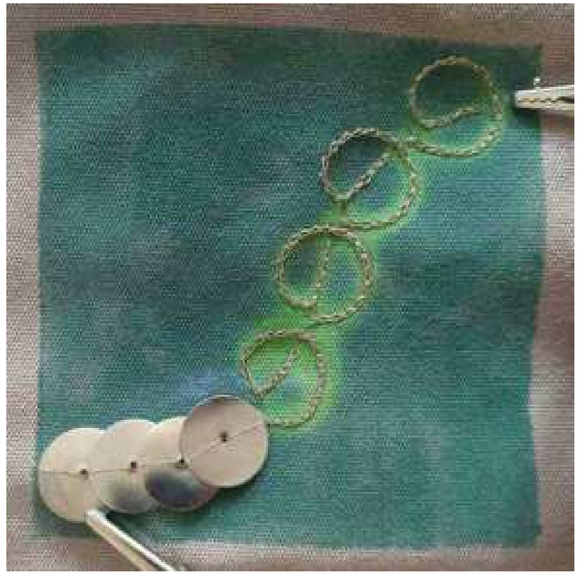
(A4-size)

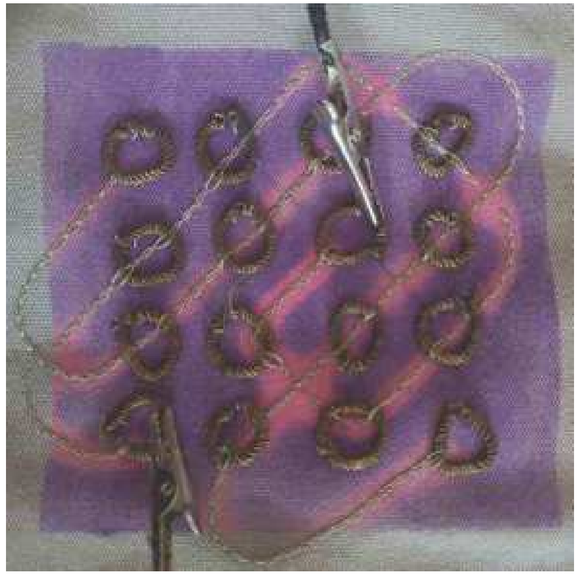
THE CIRCUIT

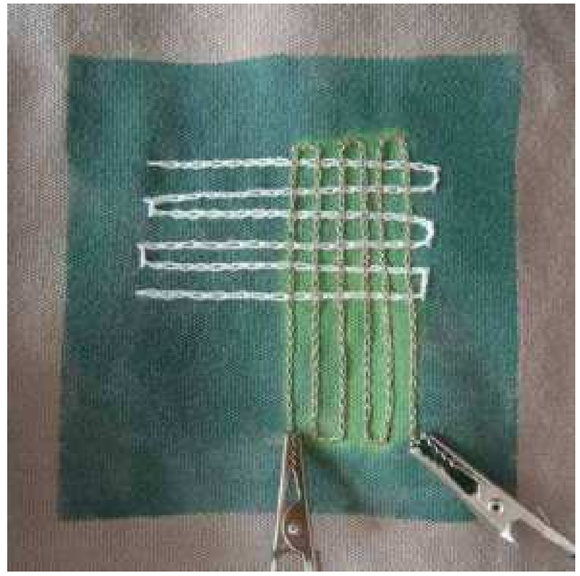


PATTERN EXAMPLES









DESIGNING THE CIRCUIT

Basic requirements:

a closed circuit between the
+ and - of the battery.

a total resistance that‘s higher than 5 Ω
(otherwise 🔥)

a total resistance that‘s lower than ~85 Ω

HOW TO MEASURE RESISTANCE

1. Set the multimeter on the Ω symbol
2. Touch the beginning and end of the resistor you would like to measure

THE SET-UP

Create an embroidered pouch with a color-changing design that is revealed when the pouch is closed

1. Design a color-changing circuit, using a battery, a button as a switch and conductive thread as a resistor on the pattern of the pouch.
2. Embroider it on the thermochromatic fabric with the conductive thread.
3. Assemble the pouch!

EMBROIDERY STITCHES

Running Stitch

1 thread = 1R

Back Stitch

1 + 2 threads = 1/3 R

Chain Stitch

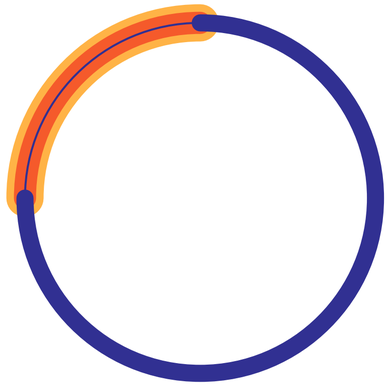
2 + 1 threads = 1/3 R

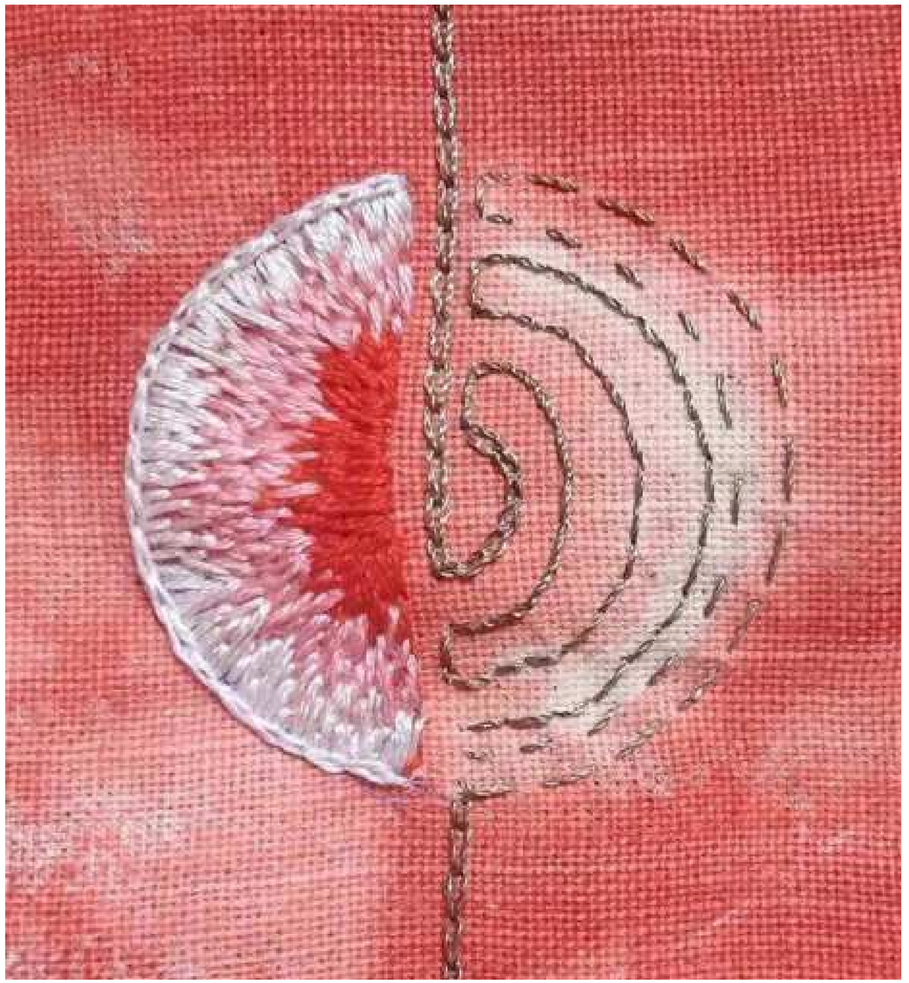
Whipped Back Stitch

2 + 2 threads = 1/4 R

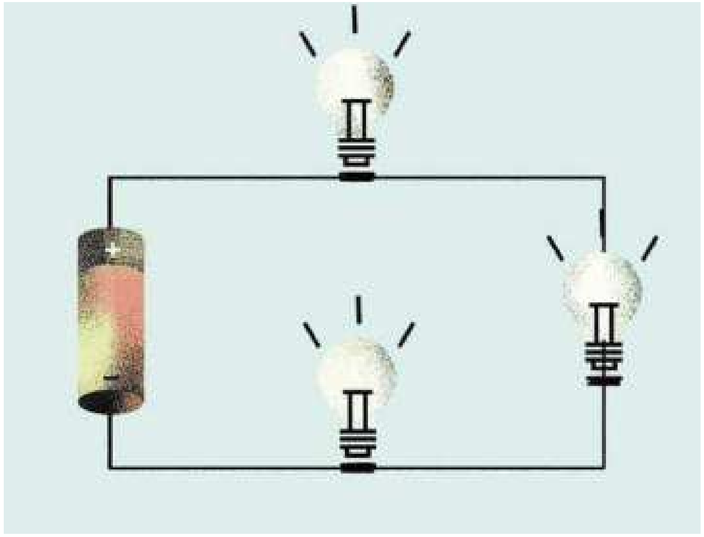
DIRECTING THE COLOR CHANGE

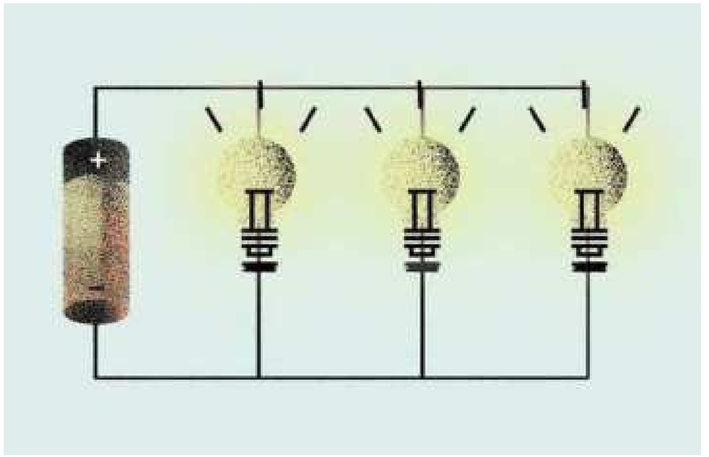
if you mix stitches
-> more color change around stitches with high resistance





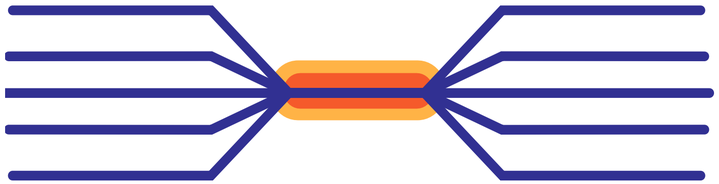
SERIES vs PARALLEL CIRCUITS

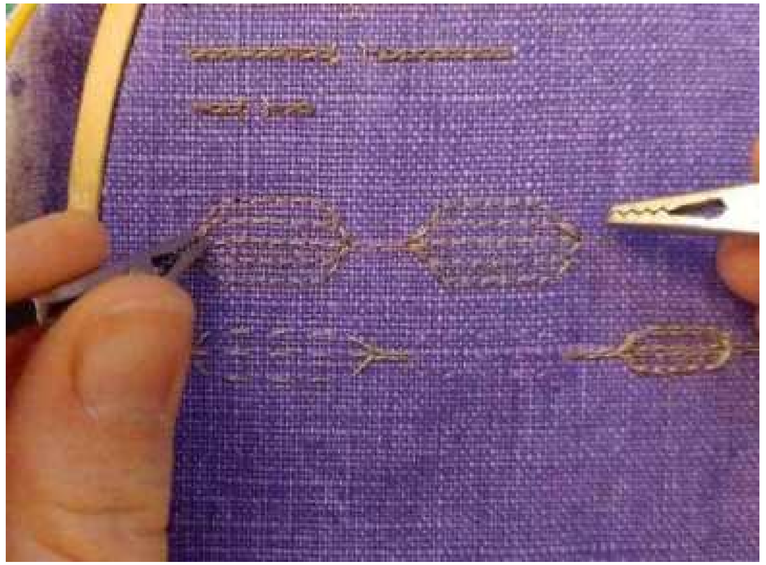


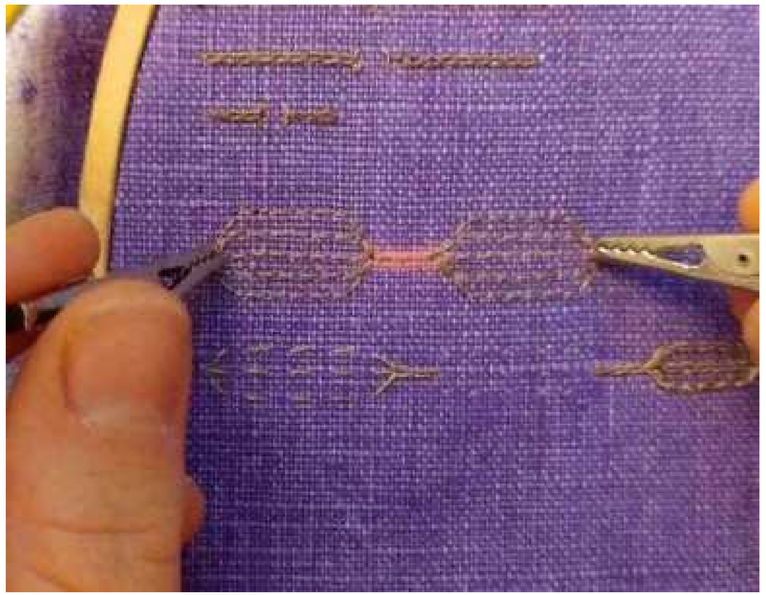


PARALLEL CIRCUITS

the current is split among several paths
-> less total resistance



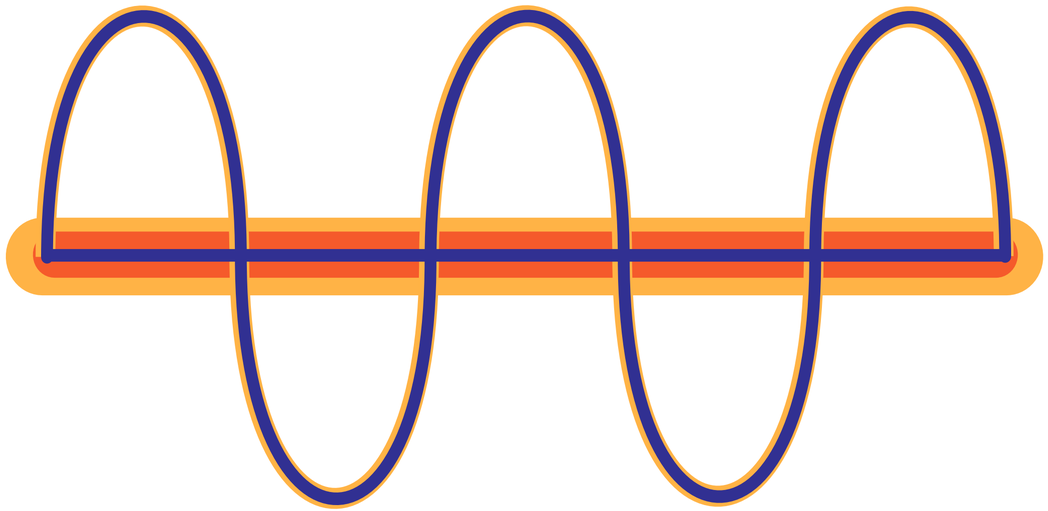




PARALLEL CIRCUITS II

the current is split proportionally to the resistance of the individual paths

-> the current will primarily chose the path of least resistance



THANK YOU & LETS KEEP IN TOUCH! :)

Rebekka Jochem
www.rebekkajochem.com
reb.jochem@googlemail.com