



strange little bits
i call home
(also known as
a monday)

marissa renteria

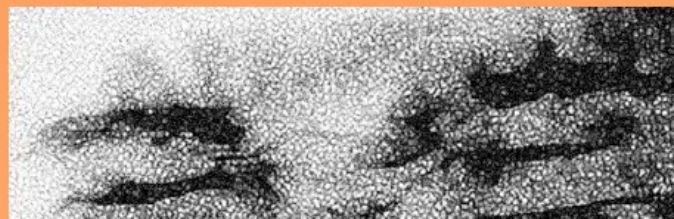
Biography

I'm teenage jeanette also known as Marissa. I'm a maker. My background is in film/art and aerospace engineering. I've always kind of shifted between passions; working as an engineer and moonlighting as an artist (or something like that) and vice versa. My practice is in merging art and engineering, craft and technology, past and present fabrication methodologies. I believe craft technology can unlock secrets in sustainable design, materials science, tangible embedded interaction, soft materials, robotics, textiles, and really the future of space technology. I truly believe by doing so we connect more with the natural world, each other, and ourselves.

I will be starting a graduate program in Industrial Design and Electrical Engineering in the next year where I will continue refining my sensibilities in e-textiles, embedded systems, instruments, soft materials for space or otherwise, and sustainable design. And zine-making. The latter might just be for me.



space coyote



Acknowledgements

As I say, making is a collaborative effort.

I want to thank the entire Fabricademy team for working with me on making Fabricademy a little bit more accessible. Thank you to **Waag Textile & Futurelab** in Amsterdam and **échoFab** in Montreal for offering me a place in their labs in the past years and for their understanding when I couldn't join them abroad.

I also want to thank **The Jessi Combs Foundation** for awarding me a scholarship to participate in Fabricademy and believing in me.

To my mentors **Louise Massacrier**, **Anoush Arshakyan**, and **Emma Pareschi** for their insight and expertise as I ideated and failed and built.

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To my external advisors:

Susan van Winkle, who taught me weaving basics and how to warp my loom. I really couldn't have done this without her.

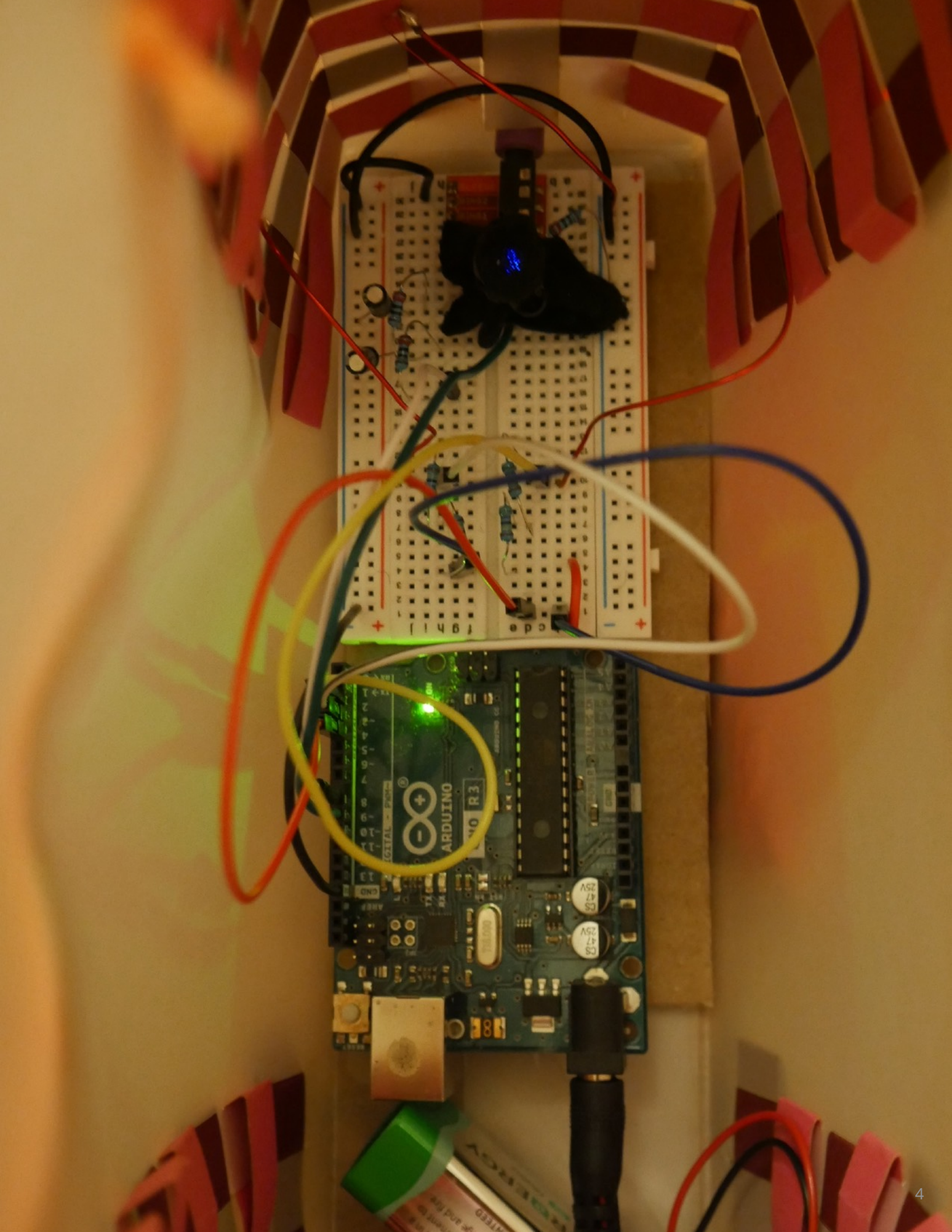
Nicoletta Favari and **Chris Salvito** from *Passepartout Duo*. Their early advice, willingness to help, experience in making synths and working with textiles was invaluable and inspirational.

Nicola Privato from the Intelligent Instruments Lab for offering insights in the DIY synth space that cleared up a lot of my confusions early on.

Michelle Vossen, a textile synth maker, for her advice and encouragement.

This is ultimately for my mother, grandmother, and women and men everywhere building or rebuilding their "home". This was initially dedicated primarily to women given their historical and cultural attachments to domestic spaces but men deserve the same.

To my boyfriend **Joshua Perez** for his support and understanding (and his camera) while I stressed and worked long hours to allow this work to come to fruition.



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Abstract

In this work, I explore my idea of “home” by encoding inter-generational reflections into a woven structure where binary data determines the weave pattern into a textile touch and touch-less electronic instrument (theremin).

I find “home” in many instances - experiences, interactions, jokes, sounds, smells, songs. Throughout my design and reflection process, I delved deeper. My exploration pivoted from representing the tangible with the intangible - things that make me feel at home with some "resonance" that has allowed me to feel at home and participate in the act of making a “home”, the act of “becoming”. This textile exploration is in effect a manifestation of this frequency, a materialization of existence through data, sound, and weaving. It's also an exercise in connection and loneliness, a microcosm of the current human experience with the advent of AI and the generational immigrant experience. In essence, this "frequency" is also a gratitude for the freedom and sentiments I've now been offered to explore what my own “home” is vs. what it used to be for Hispanic women in my family, culture and, truly, women at large.

Introduction

I first lived away from home and my family in 2012 when I started at the university as a wide-eyed undergraduate engineering student. My days at school were mired with a profound homesickness. I couldn't shake it. Until I began learning and healing more of myself years later. It's strange to think about it now but in retrospect I also understand what I was going through.

My own personal reflections about "home" or a sense of "home" have fascinated me probably since then. We often think of "home" as a physical and spatial reality and in many ways it is. For many centuries, people have been displaced, fought, and died for lands they call "home". Native Americans', for instance, are tied to their home—the land—and the land they're on is foundational to their identity, culture, and spirituality.

A home is also a very domestic space, particularly for women. In my culture, Hispanic women are more often than not expected to be "homemakers" wherein they tend to the children, adhere to the home's needs, the space's presentability. The home is, in effect, her identity. Through its maintenance and efficiency, she exists.

In 2012, Verlyn Klinkenborg pondered similar thoughts in his article "The Definition of Home" published in the *Smithsonian Magazine*. He acknowledges the physical and spatial nature of a "home" but asks whether "home" has been embedded in our human consciousness since our earliest existence. Is it instinctive since we started wandering the land as bipeds? The question almost undergoes this metamorphosis of inquiry that presents the mirror back on ourselves. *At my root, at my core — who am I? Who are **we as people**?*

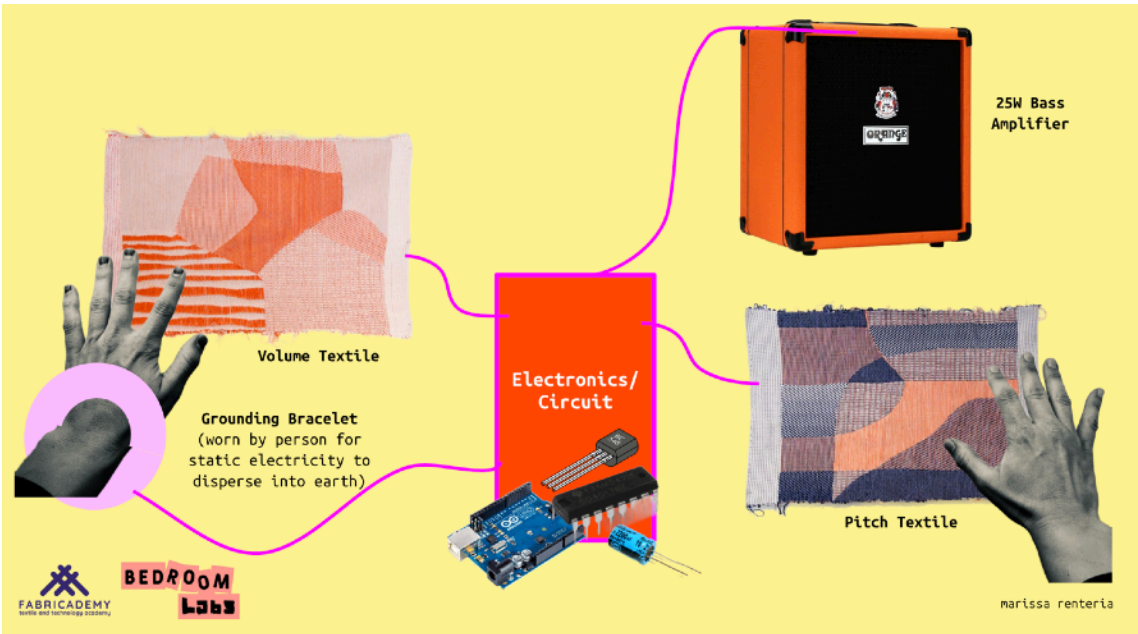
In the workshop and resulting paper *Data as a Material for Design: Alternative Narratives, Divergent Pathways, and Future Directions* (Matthew L. Lee-Smith, Jesse Josua Benjamin, Audrey Desjardins et al.), the authors/organizers argue that data is often used for utilitarian purposes to improve our lives but the conversations and efforts are actually diverting away from the latter. As they say "[That] data-interaction design space is expanding... Recent and ongoing research is []... proposing alternative narratives. These alternative narratives explore a variety of concepts and values such as ephemerality, decay, negotiation, diffraction and

(re)interpretation, subjectivity, locality, invisibility, and the interaction with analog data. When these narratives are embodied in design “outcomes” they allow us to experience other possible worlds where data is not only a straightforward means to an end but a malleable material that can be shaped to create a diverse range of experiences."

Data in effect becomes a smart material — it can be both collected and shaped into various tangible experiential or ideated forms e.g. “worlds" or "home".

In my personal reflections and explorations, aside from the aforementioned realities, I find “home” to be everywhere. The tangible everywhere, if you will — an art piece in the desert, a starry night, the smell of enchiladas, zines, talking with a close friend, classic Conan clips, the Her’s’ song “What Once Was”, etc. Indeed, “home” is the most genuine expression of your authentic self but it also didn’t form in a vacuum. I’m able to exercise and make my “home”, my sense of “self”, this act of “becoming”, only because of the sacrifices previous generations of women in my family had to undergo. There’s an intangible frequency that exists in “becoming”, intergenerationally as well, between past and present, pain and joy, connection and loneliness.

This textile exploration is a manifestation of this frequency; a materialization of existence and “becoming” through data, sound, and weaving.

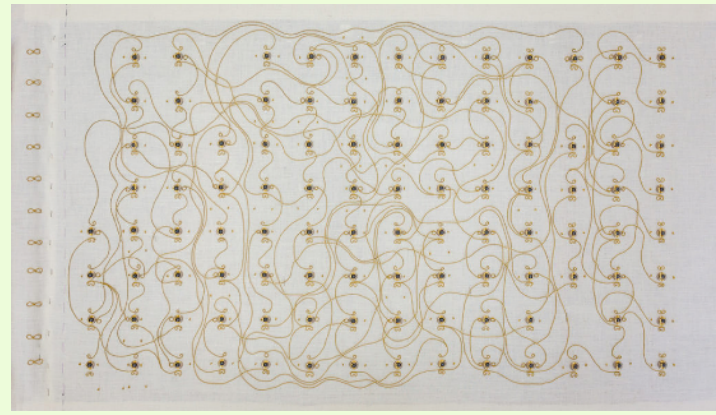


A close-up photograph of a fuzzy synth instrument. The instrument features a dense layer of brown, shaggy fur. Several black metal rods are visible, some with silver-colored ferrules. Three bright orange, cylindrical buttons are positioned on a green, textured surface. The lighting is warm and focused, highlighting the textures of the fur and the metallic components.

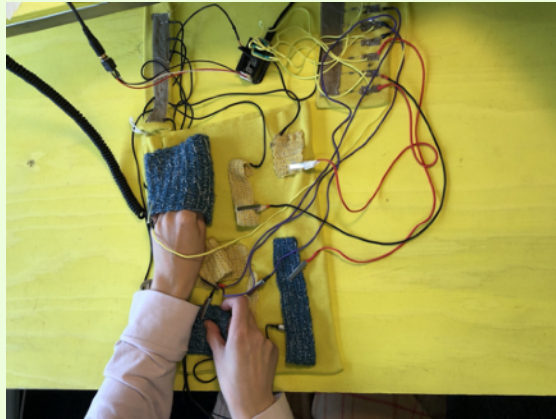
state of the art

Fuzzy Synth,
Passepartout Duo

**The Embroidered
Computer, Irene Posch**



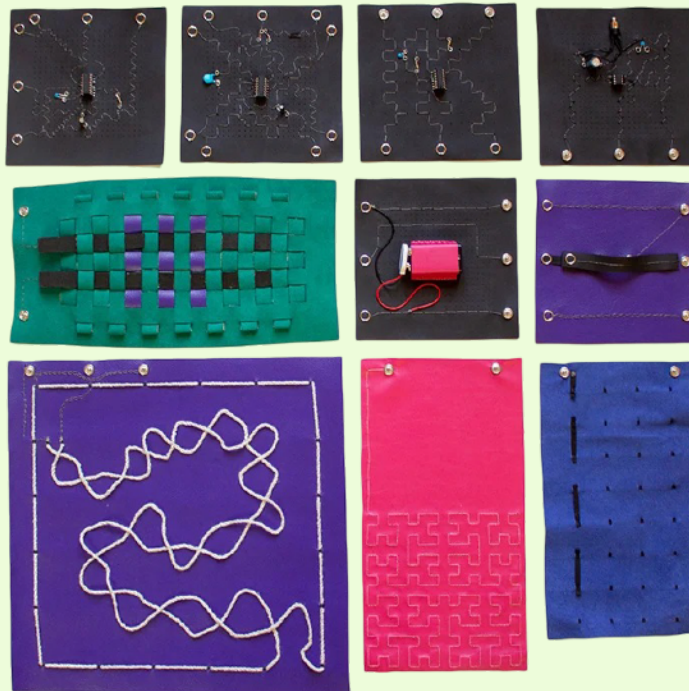
Left: **E-Textiles as Musical
Interfaces**, Sophie Skach



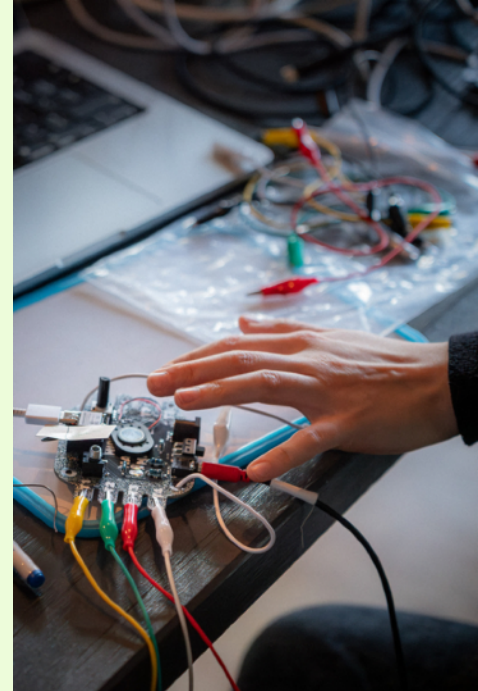
Right: **Theremin Tapestry**,
Chicks on Speed



Left: **Stitch Synth**,
Jessica Stanley



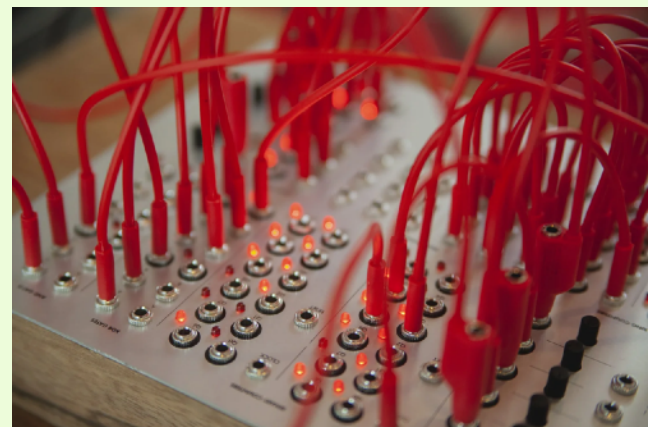
Right: **Atari
Punnik Console**,
Michelle Vossen

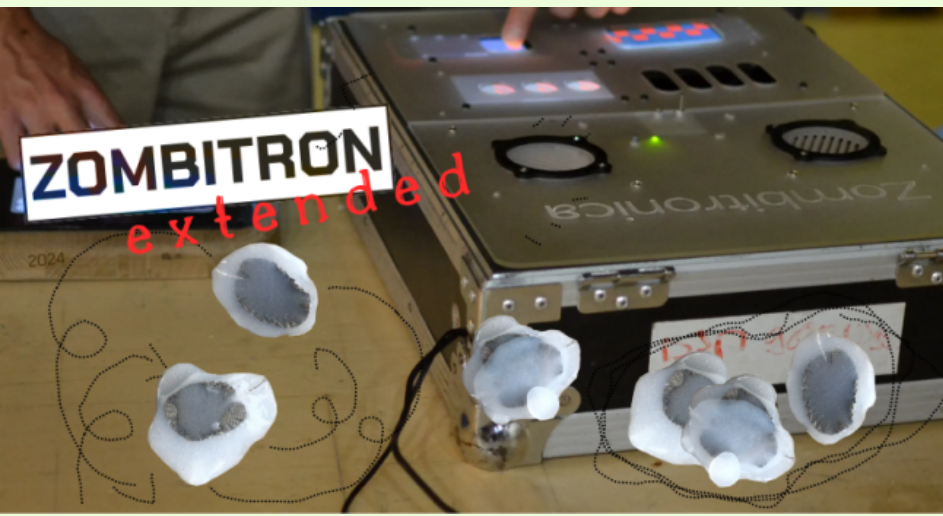


Left: **Fuzzy
Synth**,
Passepartout
Duo



Right: **40xx
Synth**,
Passepartout
Duo





Zombitron - Open Source Research Project, Clara Rigaud



A Fabric that Remembers, Unstable Design Lab



Knitted Keyboard, Irmandy Wicaksono

Oiko-nomic Threads, Afroditi Psarra, Maria Varela, and Marinos Koutsomichalis





research +
build process

Bill of Materials (BoM) - Final

Actual Unit Qty. Used	System	Item	Package Unit Price	Link
	Theremin (Final)			
4		5.6M Ohm Resistors	\$12.99	Link
3		220 Ohm Resistors (Variety, if needed)		**
2		10.0 uF Electrolytic Capacitors	\$21.90	Link
1		Blue LED		**
1		Photoresistor		**
1		9V Barrel Jack		**
1		9V Battery		**
1		3.5mm Audio Jack Breakout Board	\$8.39	Link
1		3.5mm Audio Cable	\$13.97	Link
1		Arduino Uno		**
9		Jumper Wires		**
4		Vellum paper sheets (110 lb.)		**
2		Colored cardstock sheets (130 lb.)		**
1		1/4" Jack Adapter		**
1		Breadboard		**
1		25W Bass Guitar Amp		**
	Textiles (Final)			
1		497 yd. 60% merino wool, 25% suri alpaca, 15% nylon - Cornflower Yarn	\$28.00	**
1		497 yd. 60% merino wool, 25% suri alpaca, 15% nylon - Vermillion Yarn	\$28.00	**
1		490 yd. 70% merino wool, 30% silk - Custard Yarn	\$40.00	**
1		490 yd. 100% wool - Mulberry Heather Yarn	\$11.00	**
1		Washi Paper	\$12.98	Link
1		30 AWG Enameled Copper Wire	\$12.98	Link
1		20 AWG Enameled Copper Wire	\$11.99	Link
1		PLA Filament (for 3D printing handloom for testing)		**
1-2		Thin Plywood Sheets (for lasercutting loom tools if needed)		**

** Items I personally owned.

Bill of Materials (BoM) - Testing

Actual Unit Qty. Used	System	Item	Package Unit Price	Link
	Theremin (Testing)			
6-13		Resistors (Variety)	\$12.99	**
5-6		Ceramic Capacitors (Variety)	\$9.99	Link
1-2		Electrolytic Capacitors (Variety)	\$21.90	Link
1		CD40106 CMOS Hex Schmitt-Trigger Inverter IC	\$7.99	Link
1		LM13700N Dual Operational Transconductance Amplifier IC	\$12.92	Link
1		LM386 Amplifier	\$6.99	Link
1		1N4148 Diodes	\$5.99	Link
1		9V batteries	\$9.98	Link
1		9V battery clip	\$4.98	Link
1		8 Ohm Speaker	\$8.99	Link
1		3.5mm Audio Jack Breakout Board	\$8.39	Link
1		3.5mm Audio Cable	\$13.97	Link
1		Arduino Uno		Link
10-20		Jumper Wires		**
4		Vellum paper sheets (110 lb.)		**
2		Colored cardstock sheets (130 lb.)		**
1		1/4" Jack Adapter		**

** Items I personally owned.



Tools

8-Shaft Table Structo Artcraft Loom

Threading Hook

Shuttles

Lease Sticks

3D Printer

Gluwphy 20W Laser Cutter

Arduino IDE

PyCharm

CirKit Designer

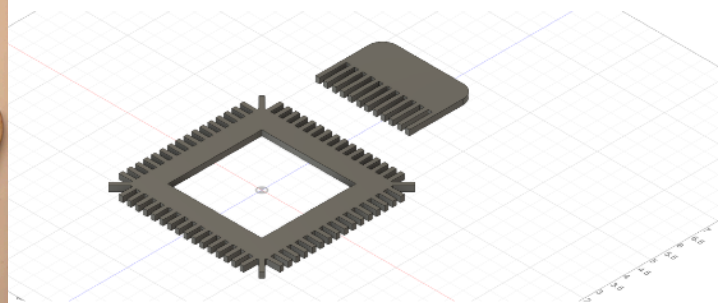
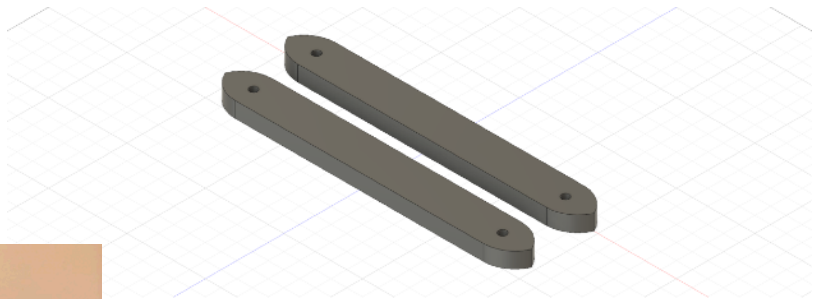
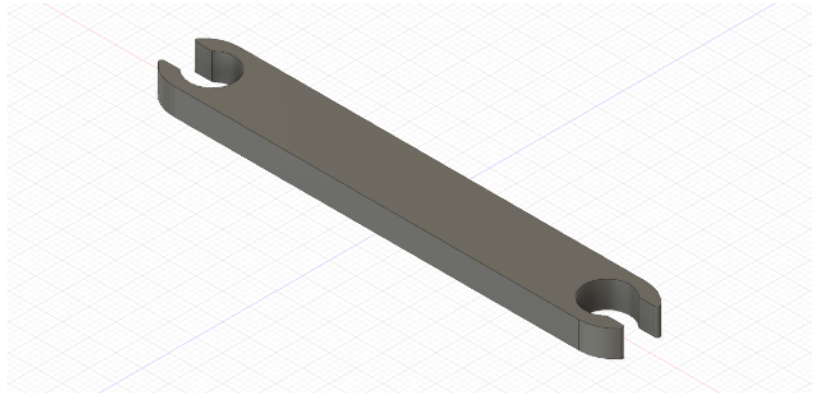
TinkerCAD

Fusion 360

Laser Cutting: Weaving Tools

In order to start weaving, I needed lease sticks, shuttles, and perhaps a hand loom with a comb for sample making.

I designed these tools on Fusion 360. They're about 7in in length, long enough for my table loom. I laser cut the lease sticks and shuttles on my 20W Gluiphy Laser Cutter and 3D printed my handloom and comb with traditional PLA filament. The sett of my hand loom wasn't quite accurate or usable but a start nonetheless.

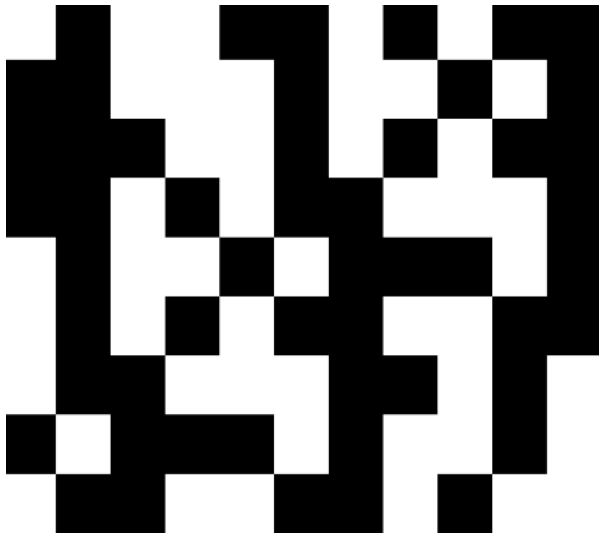


*Above: CAD files of tools,
Left: Cut and Printed Tools*

Coding: Weaving Draft

I wanted to weave with a metal 8-shaft table Structo Artcraft Loom I bought a summer ago for \$50 in Valencia, California. Nothing compared to a TC2 jacquard loom but I thought this would do for relative ease in warp preparation and portability (and is budget-friendly).

It's one thing to weave. It's another to weave according to binary data *with*



Digital Weaving Sample, 6"x6" of a Norm MacDonald bit (i.e. joke)

an 8-shaft loom and **not** a jacquard loom.

I coded something using python (on PyCharm) to print out a weaving draft .xlsx file that is 1-1; in other words, one cell in Excel represents one warp and one pick (weft yarn). Very much in the spirit of a jacquard loom.

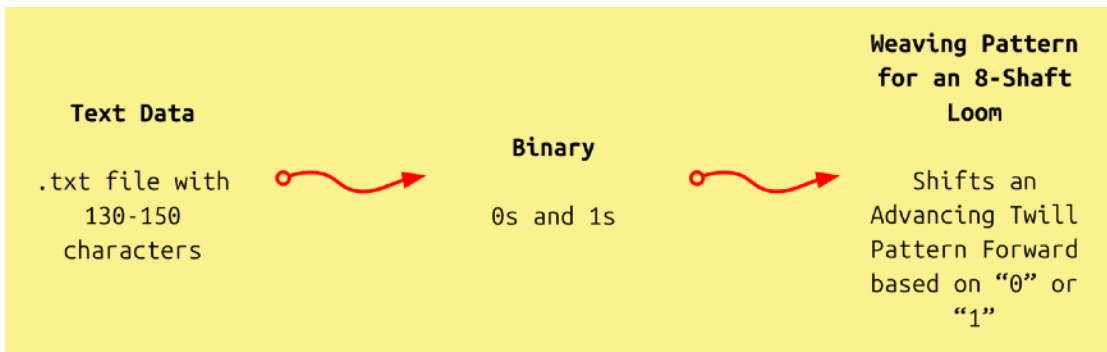
The image to the left was one of the first test iterations, producing a 6"x6" weaving sample of text data from one of my favorite Norm MacDonald bits (i.e. jokes).

I then started iterating the code to produce a weaving draft of pure shaft lifts since I'm working with 8 shafts and 8 shafts only. This would prove problematic as the code had no limit to how many floats in the weave would exist.

Much of this work would continue and I eventually incorporated the data's dictation of when a conductive yarn would be thrown.

Pick	Shaft 1	Shaft 2	Shaft 3	Shaft 4	Shaft 5	Shaft 6	Shaft 7	Shaft 8
1		█						█
2			█	█				
3		█	█		█	█		█
4		█	█			█	█	
5				█		█		
6		█	█		█			
7			█					
8		█	█			█	█	
9					█	█	█	█

Pure Shaft Lift Weaving Draft



Code Logic

Again, since I was working with 8 shafts, I only had so many bits I could work with. My final logic was taking text data (limited to 130-150 characters), convert it to binary, and generate a weaving draft in the form of an .xlsx file.

I formulated a few questions for my mother, grandmother, and myself to answer. Questions that would abide by my character limit. Remember, there's so many bits I can express given I'm using an 8 shaft loom not a jacquard loom. I recorded our answers in individual .txt files. I converted that data to binary and download a weaving draft that advances the twill pattern weaving forward or not based on the presence of a 0 or 1 in the newly converted binary data.

I decided to make a theremin instead of a binary-based synthesizer and so thought to collect 3 datasets of reflections - my grandmother's, my mother's, and my own. I needed to weave two antennas so at the least I could merge 2 data sets of the women

that came before me and my own as a singular piece.

Here's an explanation more or less of how the skeleton code works. For reference, code goes first, followed by the explanation.

```
# Converting data to binary to weaving
pattern using a 2/2 Twill pattern as a base
# Without a base pattern there will be floats
in the weave which would produce pretty big
inconsistencies
# The "lift_plan" is really just to remind
others what shafts to lift on an 8 shaft loom
repeatedly

import openpyxl
from openpyxl.styles import PatternFill
from openpyxl.utils import get_column_letter
```

These are libraries required to interact with Excel through Python. Specifically, filling in cells according to binary data.

```
EPI = 18
SAMPLE_SIZE_IN = 7
TOTAL_THREADS = EPI * SAMPLE_SIZE_IN # 126
SHAFTS = 8
MAX_FLOAT = 4

TEXT_FILE = "dataset.txt"
OUTPUT_FILE =
"weaving_6x6_8shaft_from_text.xlsx"
```

These are essentially our constraints. We want our dents per inch (or ends per inch) to be 18, seven inches for the sample. With washing, the sample should shrink to about 6in. Calculates to 126 total warp yarns in the loom.

I have an shaft loom so 8 shafts and no warp is allowed to float more than 4 picks. I'm using a sample "dataset.txt" file with a joke I really like. The output file is then named in OUTPUT_FILE.

```
def text_to_binary(filename):
    with open(filename, "r",
encoding="utf-8") as f:
        text = f.read()

        binary_stream = []
        for char in text:
            byte = format(ord(char), "08b") #
ASCII → 8-bit
                binary_stream.extend([int(b)
for b in byte])

        return binary_stream

binary_stream = text_to_binary(TEXT_FILE)
```

This reads everything in the dataset.txt file. Then for every character in the file, it's converted to a number via ASCII, and then converted to 8 bits (00100110). The binary data is then converted to one large stream of binary data.

```
wb = openpyxl.Workbook()
ws = wb.active
ws.title = "8-Shaft Weave Draft"

warp_color =
PatternFill(start_color="222222",
end_color="222222", fill_type="solid")
weft_color =
PatternFill(start_color="EEEEEE",
end_color="EEEEEE", fill_type="solid")
```

This sets up the excel file. Columns are warp threads, rows are weft picks. It's color-coded. Dark is for when warps are up and white is for when warps are down.

```
threading = [i % SHAFTS for i in
range(TOTAL_THREADS)]
```

This is really just for reference. Our threading is straight draw down. Meaning one warp per heddle eyelet, sequentially. The threading is for a very simple advancing twill and I think pretty easy for our purposes here.

```
BASE_LIFTS = [
    {0, 1, 2, 3},
    {1, 2, 3, 4},
    {2, 3, 4, 5},
    {3, 4, 5, 6},
    {4, 5, 6, 7},
    {5, 6, 7, 0},
    {6, 7, 0, 1},
    {7, 0, 1, 2},
]
```

This is again for our reference. We're advancing our weave with twill and always lifting 4 shafts at a time to potentially avoid long floats. This is our base weave. We lift shafts 1-4, throw shuttle, lift 2-5, throw shuttle, 3-6, throw shuttle, and so on until we start at the beginning once again.

```
warp_down_count = [0] * TOTAL_THREADS
```

This tracks how many picks has a warp been down. The max would be 4 as we stated at the top of the code. This reads 1 bit of data in which that 1 bit influences 1 pick. If bit equals 1 the weave rotates by one shaft (shifting the weave). If it equals 0, the weave remains the same (normal advancing twill weave).

```

for pick in range(TOTAL_THREADS):
    base_lift = BASE_LIFTS[pick % 8]
    bit = binary_stream[pick %
len(binary_stream)]

    # Data-driven modulation
    if bit == 1:
        lift = {(s + 1) % SHAFTS for s in
base_lift}
    else:
        lift = base_lift.copy()

```

This starts parsing for every weft in the total number of threads. The twill repeats every 8 picks.

```

for warp in range(TOTAL_THREADS):
    cell = ws.cell(row=pick + 1,
column=warp + 1)
    shaft = threading[warp]

    if shaft in lift:
        warp_down_count[warp] = 0
        cell.fill = warp_color
    else:
        warp_down_count[warp] += 1
        cell.fill = weft_color

```

If the shaft that the warp is threaded on is lifted the cell is filled (black), if warp is down the cell is not filled (white).

```

    # Enforce max float
    if warp_down_count[warp] >=
MAX_FLOAT:
        cell.fill = warp_color
        warp_down_count[warp] = 0

    ws.row_dimensions[pick + 1].height = 10

for col in range(1, TOTAL_THREADS + 1):
    ws.column_dimensions[get_column_letter(col)].
width = 1.5

wb.save(OUTPUT_FILE)

print(f"Weaving draft generated from text:
{OUTPUT_FILE}")

```

This makes sure we don't have more than 4 floats in a row for any warp and finally "prints" out the weaving draft.

Ultimately, the weaving drafts I generated were for my theremin's volume textile and pitch textile. The volume textile would consist of my mother and grandmother's data. The pitch textile would consist of my data.

Data Collected + Responses

7 Questions:

¿Qué cosa le diría a usted más joven si supiera lo que sabe ahora?

¿Cuándo o dónde se siente más como usted misma?

¿Qué le gusta de usted misma?

Si pudiera volver a vivir, ¿quién sería?

¿Qué es lo más doloroso que ha vivido? ¿Qué es lo más hermoso que ha vivido?

¿Cuál cree que es el propósito de su vida?

¿Cómo definiría "hogar"?

Grandmother

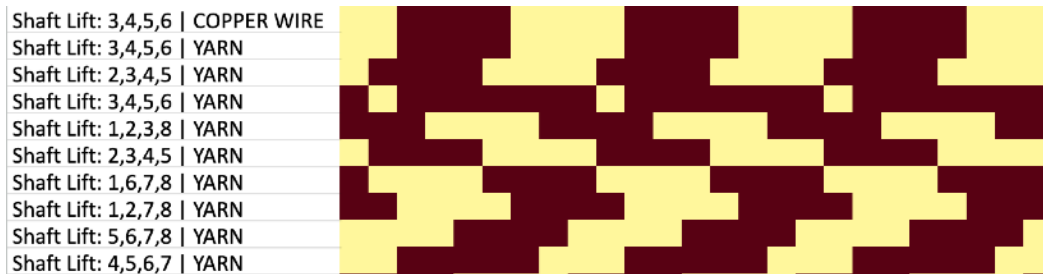
Esta de la fregada estar bien viejo uno.
Aqui en el valle.
Estar bromeando aunque no este cachonda.
Una persona mas diferente, mas alegre.
Tener el marido a chingue chingue. Tener unos sus hijos.
Que sus hijos no se condenen.
Cuando estoy con mi gente.

Mother

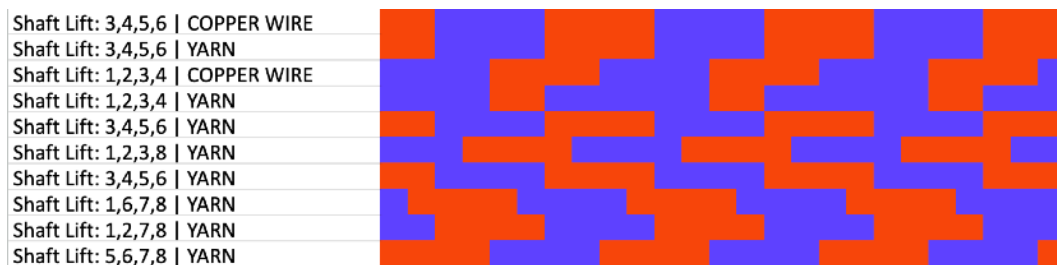
Nunca te rindas.
When I turned 30.
Honesty.
Yo misma. No me cambiaria el apellido.
Cuando mis hijos me hacen un desaire.
The mountains and my beautiful children.
To help others. Anybody.
Beautiful.

Daughter

Authenticity is worth gold.
When I write, make, and joke.
My radical optimism.
An astronaut.
Feeling unseen. Love.
To create beauty.
Genuine connection.



Grandmother-Mother - Volume Textile



Daughter - Pitch Textile

Weaving: Antennas

Susan Van Winkle, a local weaver in San Diego, taught me how to prepare my warp and sleigh it in to my loom. From then on, I went on a pretty in-depth quest in understanding



*Weaving with the woman, the myth, the legend - **Susan van Winkle***

weaving. Feel free to consult my learnings [here](#). I also created a super simple [balanced weave calculator](#) on Google Sheets. I'm still

building it out but I thought it would help others like it helped me.

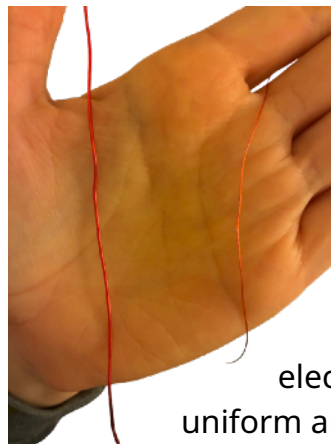
I wove an advancing twill pattern with a straight drawdown threading.

The twill pattern was really to act as a base weave I could use to code data off of and avoid floats that could destabilize the weavings.

To weave, I used super fine wool yarn, around 20-23 WPI for warp and weft.

For my copper wire weft, I used 30 AWG enameled copper wire.

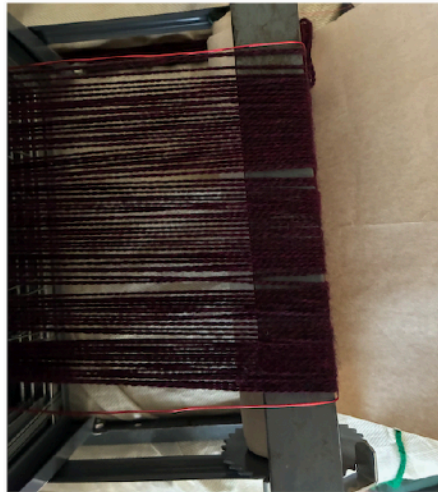
I also included two 20 AWG enameled copper wire floating selvages on the edge of the weave to connect the copper wefts together for 1) more or less straight edges and 2) a more electromagnetically uniform antenna.



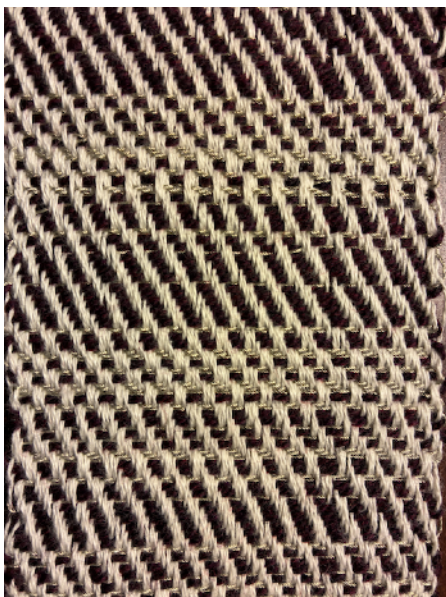
Left: 20 AWG, Right: 30 AWG
- Enameled Copper Wire

This was one of the first weaving prototypes using 24/2 white cotton yarn as warp and about 20 WPI weft yarn. I also used Jameco conductive yarn (50 Ohms per meter) I owned to throw when indicated in the weaving draft.

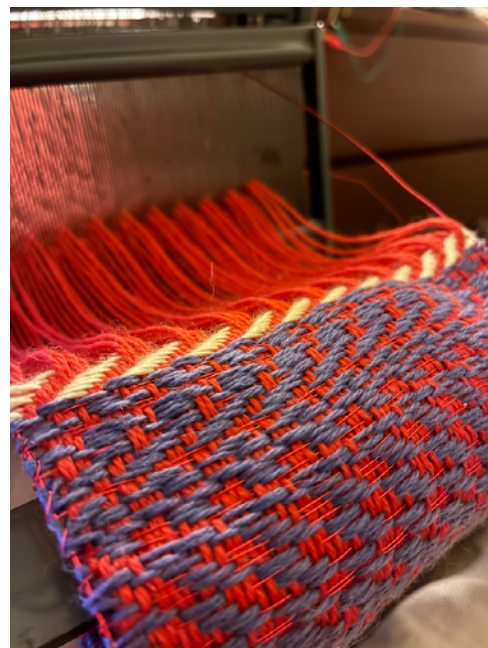
Once I refined my code, I was able to start weaving the antennas with the copper wire. Enamelled copper wire was used to prevent noise and shorting the circuit.



Volume Antenna Weaving



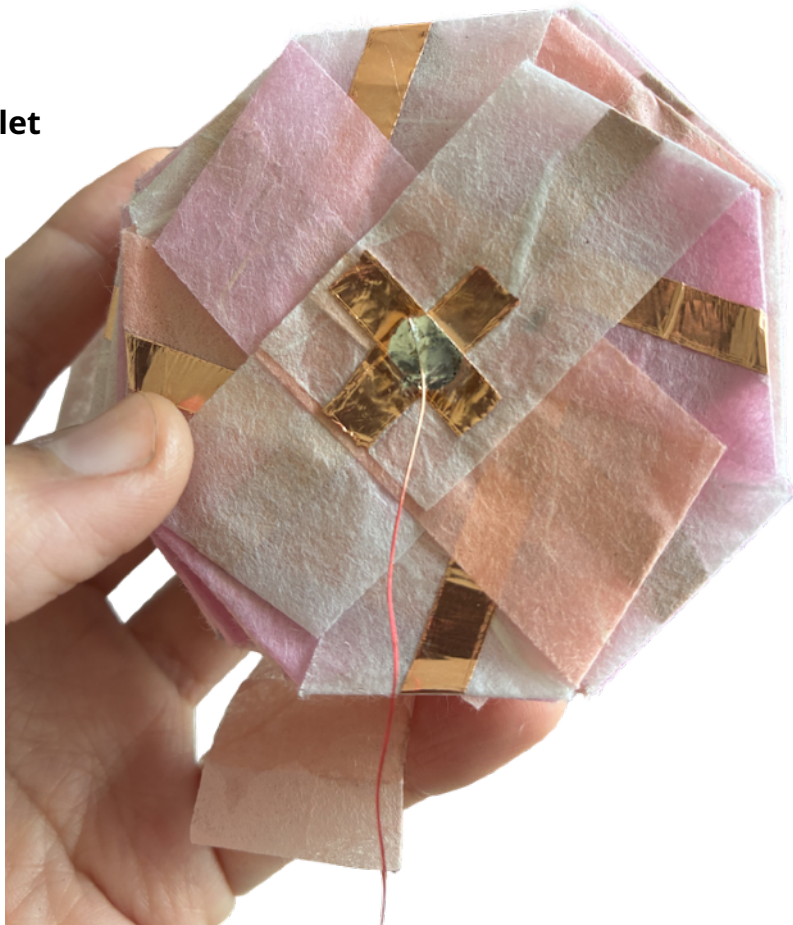
First "Glitch" Weaving - First Prototype



Pitch Antenna Weaving

Weaving: Grounding Bracelet

DIY analog synthesizers often need grounding from the player themselves in order to prevent damaging CMOS chips. Since my project started off as an analog synthesizer and then an analog theremin, I wanted to make a grounding bracelet. I got inspiration from palm leaf weaving during Palm Sunday I would see at church as a kid. I was really quite fascinated with them.



I used peach and pink colored washi paper. I cut that paper into strips, glued them to lengthen them, and wove over/under continuously. I put copper tape on one end and soldered an exposed end of the copper wire to it to then connect to ground in my circuit. The bracelet would have worked a tad better if the copper tape was consistently touching my skin and the bracelet was thinner at the wrist. I ended up sanding a bit of the enameled copper wire and wrapped it around my index finger while playing.

Weaving Grounding Bracelet with wash paper



Electronics

The theremin is an electronic instrument invented by Russian physicist Leon Theremin in the late 1910s. Contrary to largely, if not, the totality of touch-based instruments

field bubble. They would use their right hand to move closer or farther from the vertical antenna which changes capacitance. It alters the variable oscillator's frequency making higher or lower pitch notes. This, again, controls pitch.

Moog Theremin



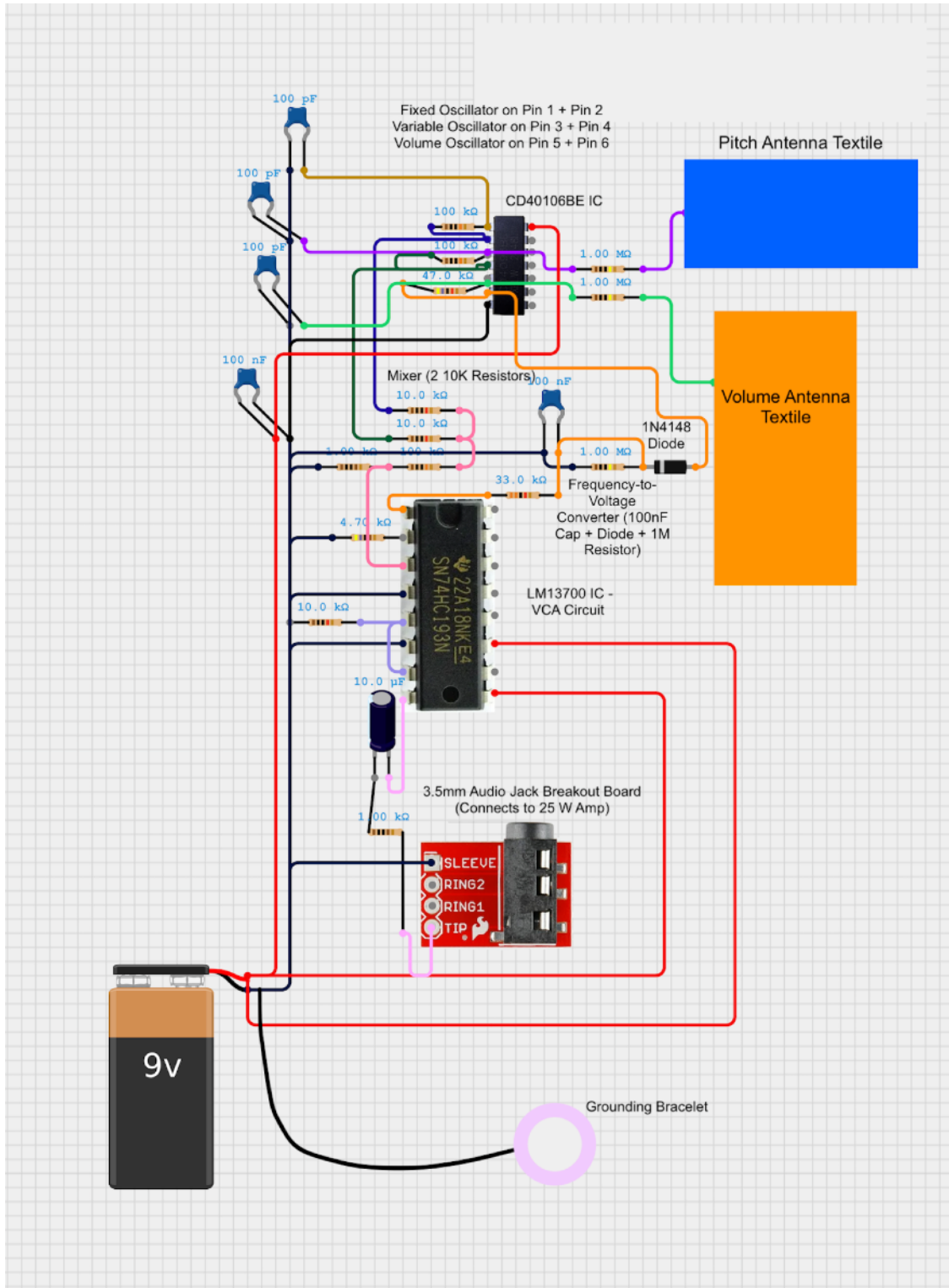
at the time, the theremin is touch-less. It uses 2 antennas to create invisible electromagnetic fields which allows a person to control pitch and volume through hand gestures and subtle hand gestures at that.

The vertical antenna is for pitch. The horizontal loop antenna is for volume. They create a sort of electromagnetic field. It contains 2 oscillators that produce electrical signals - one fixed and one variable.

A person's body acts as a capacitor which disrupts the electromagnetic

The left hand is near the horizontal loop antenna which affects volume. The closer you are, the quieter it is. The farther you are, the louder it is.

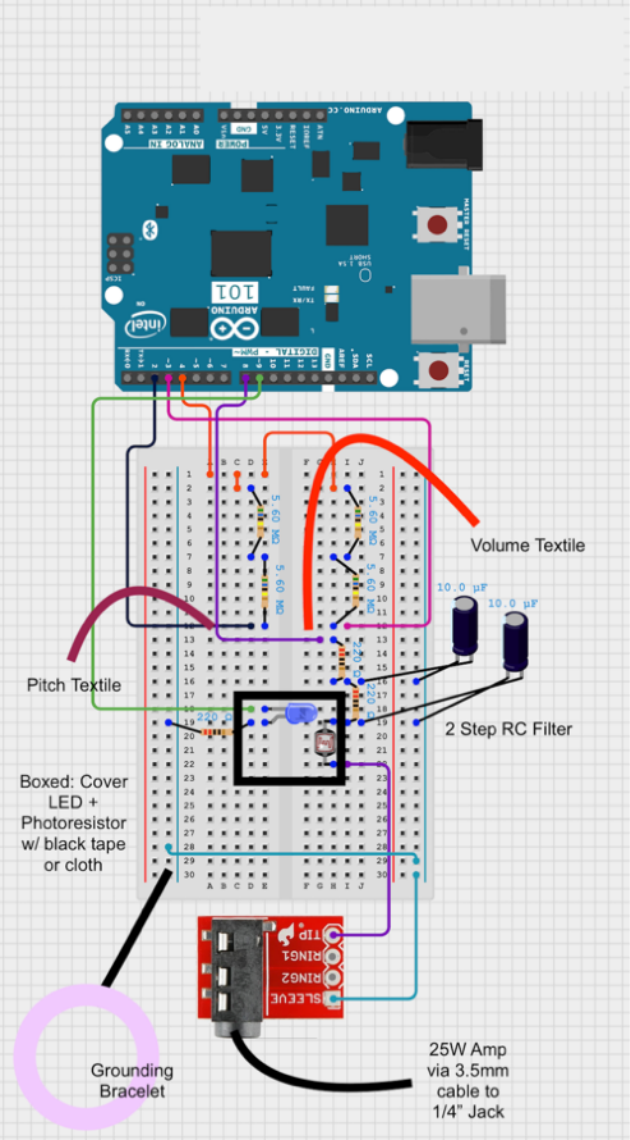
Then you have a mixing circuit which combines signals from both oscillators. The difference between both oscillators' frequencies which is the beat frequency is amplified and sent to a good ol' speaker. My initial approach was to develop an analog synth and then an analog theremin.



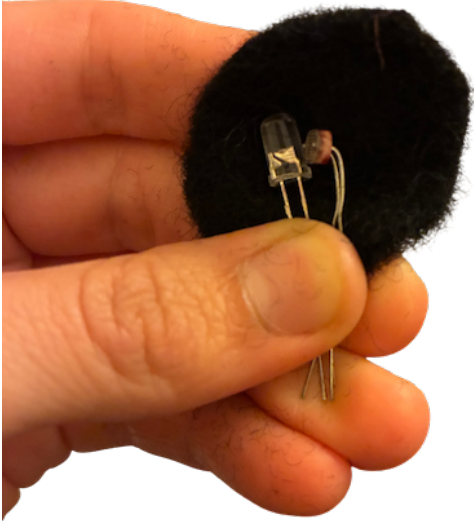
One of the analog theremin circuits I wired

Unfortunately, given the extreme sensitivity of analog DIY theremins I had to pivot from analog to digital.

I used an Arduino UNO for this conversion. You can find the [code](#) here. My inputs are my volume and pitch textile antennas, including a photo-resistor that detects changes in volume capacitance. Because pitch and volume may interfere with each other, I decided to output my volume changes through an LED, a photo-resistor sees this and feeds these changes directly into the circuit. I covered the LED and photoresist with a piece of black t-shirt and tying it with a hair tie. This is done so the photo-resistor measures the light from the LED and only the LED. So, my circuit outputs are the LED, my grounding bracelet, and sound from both the pitch and volume antennas.



Arduino Digital Theremin Circuit



LED + Photo-resistor



Bass Amplifier Settings (blue dots indicate where to turn the knob)

Coding: Digital Theremin

Transitioning to a digital theremin really converted the antennas to capacitive sensors. I coded using Arduino IDE. Highlighted comments describe what's happening.

```
#include <CapacitiveSensor.h> //
capacitive function library to create
capacitive sensors

// pin 4 sends signal to pins 2 and 3
where the latter pins listen for the
signal from pin 4
CapacitiveSensor pitchAntenna =
CapacitiveSensor(4,2);
CapacitiveSensor volAntenna =
CapacitiveSensor(4,3);

// variables to store smoothed raw
capacitive values
float smoothPitch = 500;
float smoothVol = 0;

void setup() {
  pinMode(8, OUTPUT); // pitch sound
output - sends sound through 2 step RC
filter to "TIP" of audio breakout board
  pinMode(9, OUTPUT); // LED "volume"

  TCCR1B = (TCCR1B & 0b11111000) | 0x01;
// pwm code to prevent LED flicker -
this I don't quite understand but I read
about it to smooth out the flicker of
the LED through the 25W amp (?) ... yes
i wish i had more for you
}

void loop() {
  // variables where raw capacitive
values are stored - 30 is kind of how
many samples the Arduino takes to
determine where your hand is
  long rawPitch =
pitchAntenna.capacitiveSensor(30);
  long rawVol =
volAntenna.capacitiveSensor(30);

  // if hand is near pitch textile,
exceeding the raw capacitive value of 50
  if (rawPitch > 50) { // you can change
50 to a lower number if you want to
activate sound from farther away
    // pitch section - smooth pitch
arduino can process 90% of old position
with 10% of new position
    smoothPitch = (smoothPitch * 0.95) +
(rawPitch * 0.05);
```

```
    int noteFreq = map(smoothPitch, 50,
1500, 450, 1600); // map functions takes
the variable value and allows
sensitivity between 50 and 1500 for a
frequency between 450Hz and 1600Hz
    float v = sin(millis() * 0.004) *
10; // for vibrato - change 0.004 to
change vibrato
    tone(8, noteFreq + v);

    // smoothing the volume (the LED)
    smoothVol = (smoothVol * 0.85) +
(rawVol * 0.15);

    // as hand approaches, LED gets
brighter at pin 9 which makes volume
louder - LED + photoresistor together
prevents noise from interrupting pitch
signal
    int brightness = map(smoothVol, 50,
1200, 0, 255);
    analogWrite(9, constrain(brightness,
0, 255));

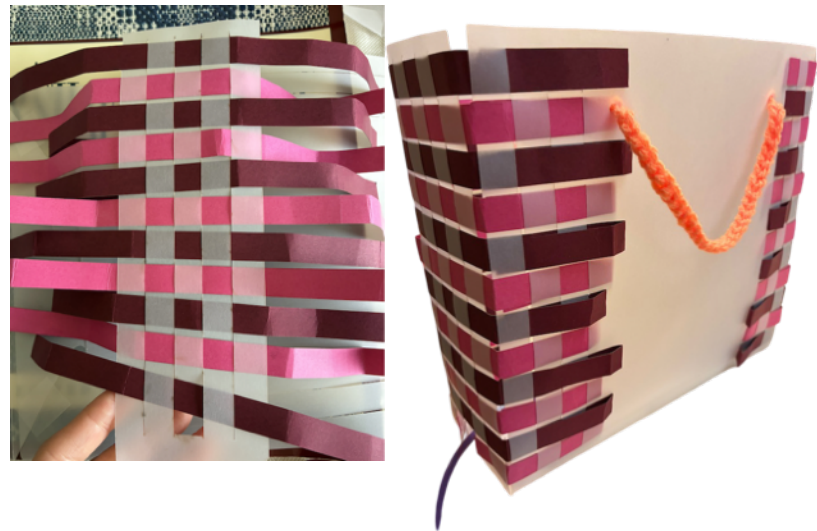
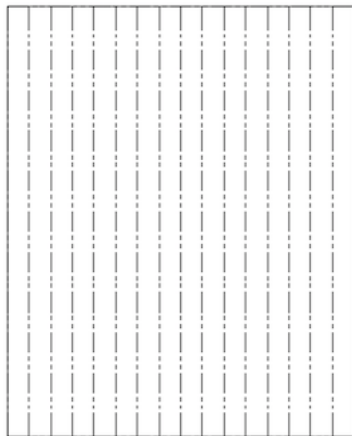
  } else {
    noTone(8);
    analogWrite(9, 0); // no light means
no sound, doesn't quite work, more
troubleshooting needed
  }
}
```

Laser Cutting: Circuit Enclosure

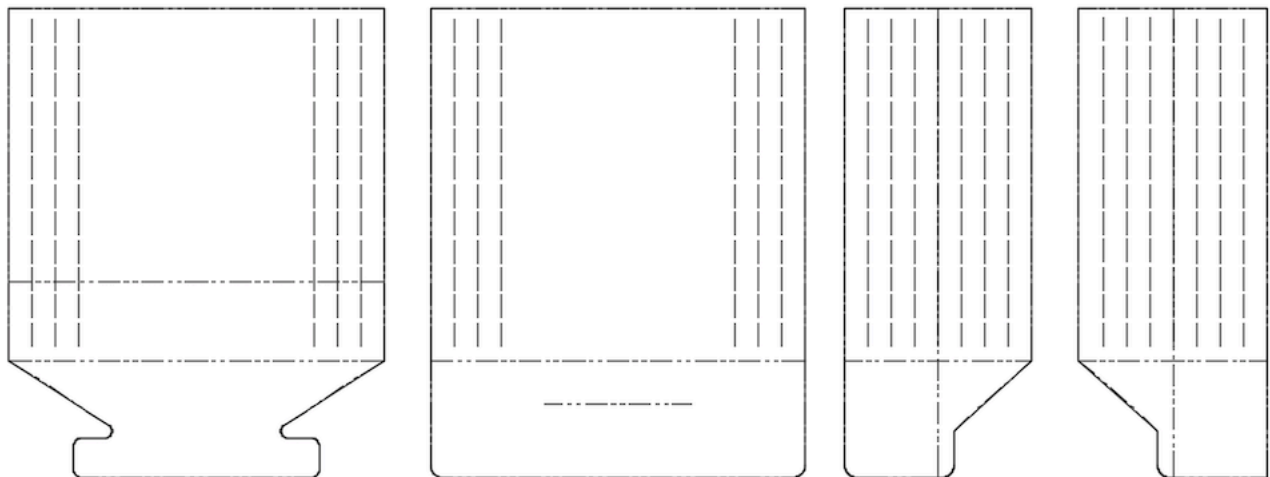
I tried various times to transfer my breadboard circuit to paper, a separate textile I wove on the Structo, a kapton sheet with copper tape - nothing worked, especially when considering I was still stuck on building a functional analog theremin at the time.

Ultimately, I ended up designing a circuit enclosure tote (inspired by the plastic basket woven grocery totes usually carried by Mexican women), laser cutting it on vellum and card stock paper, and weaving it together.

I crocheted about 30 chainstitches of ~5mm size acrylic yarn for each handle.



Circuit Enclosure designed on Fusion 360

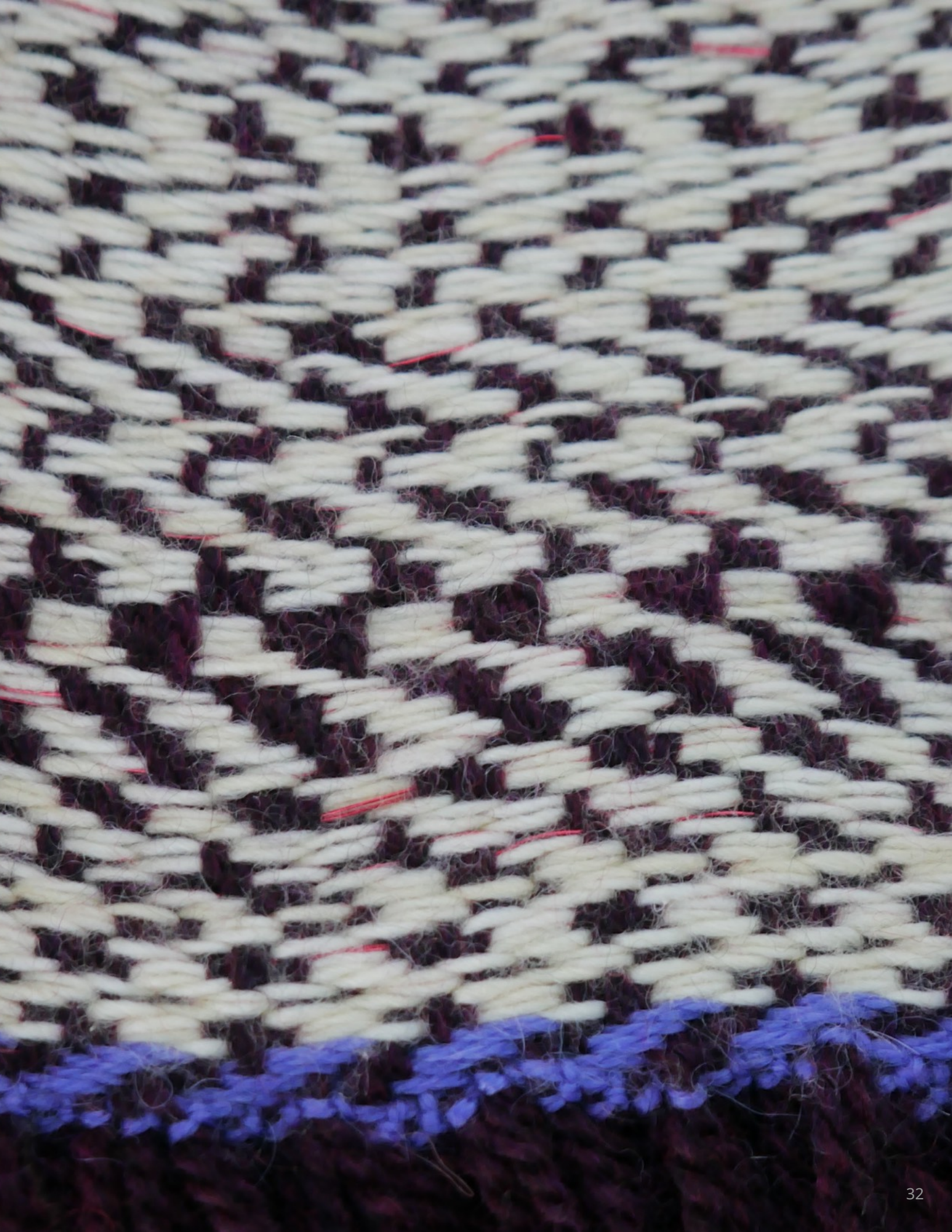


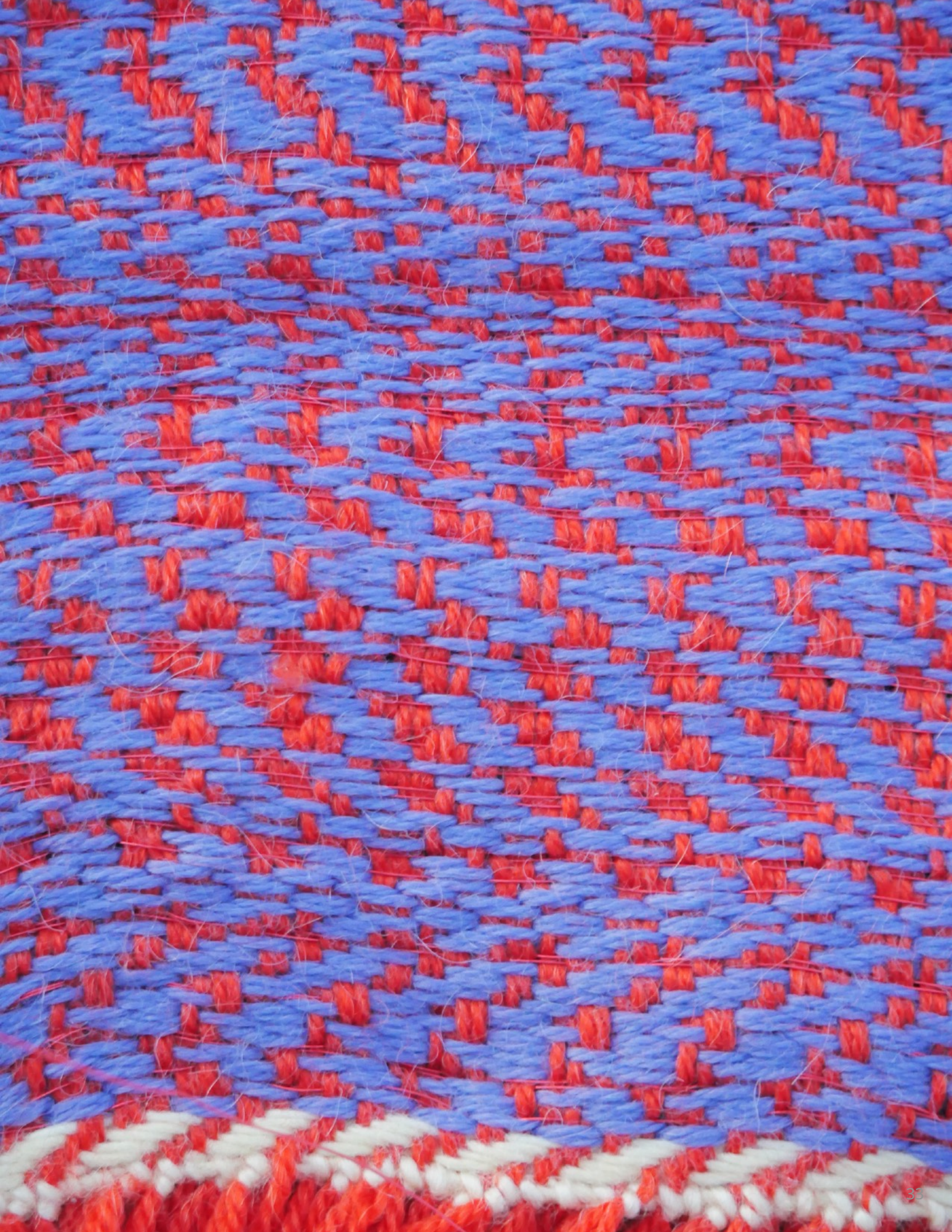
Basket-woven grocery tote

A close-up photograph of a woven textile, likely a rug or tapestry. The image shows a complex pattern of interlocking threads in vibrant red, deep blue, and off-white colors. The threads are tightly woven, creating a dense, textured surface. The lighting is soft, highlighting the individual fibers and the intricate details of the weave. The text "final outcomes" is overlaid on the left side of the image in a white, lowercase, sans-serif font.

final outcomes



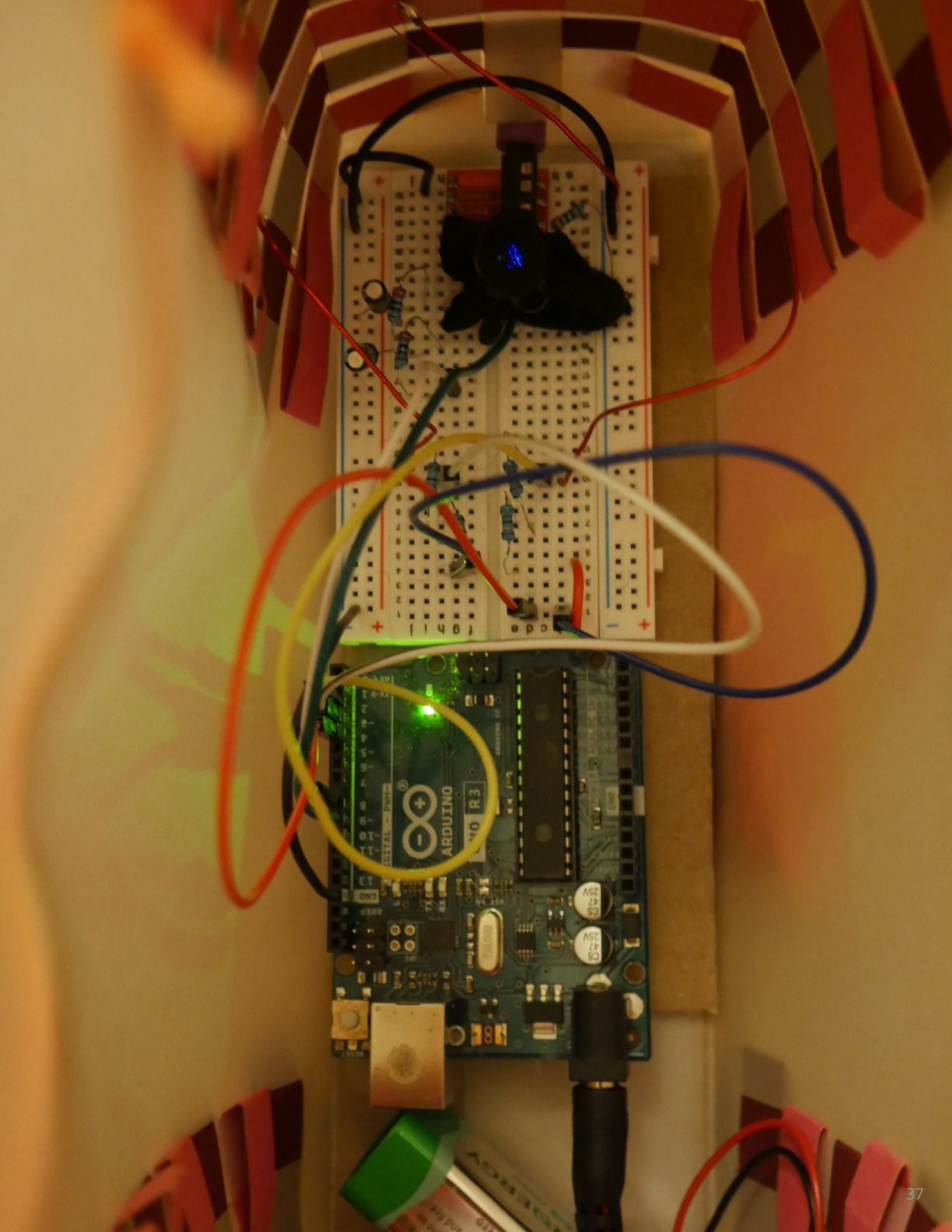




















mondays to **TUESDAYS:**
final thoughts

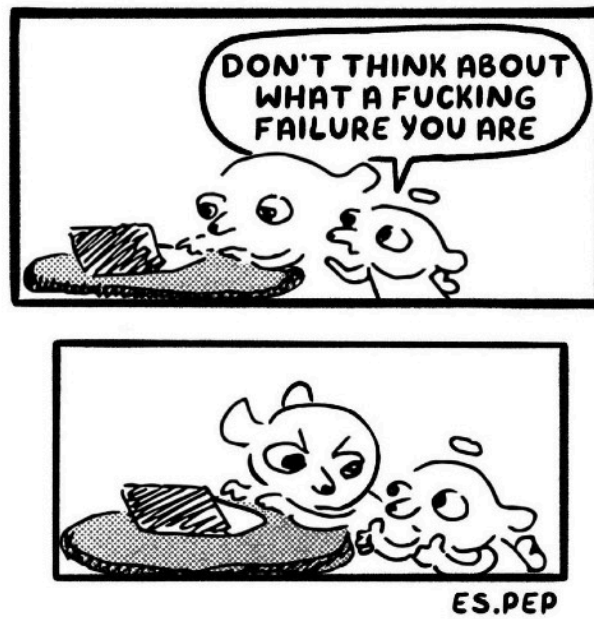
The outcome was personally favorable and truly just the start of something functional and beautiful. There's only so much one can do in a span of 3 months. Especially with regards to weaving, analog synthesizers, and a lack of access to a local fab lab or peers in Fabricademy near me. There were many lone nights I spent holed up in my room switching out CMOS chips, capacitors, and resistors in my circuit. Needless to say, there's quite a bit I wanted to develop but didn't have time to.

- Tightening the wrist size for the grounding bracelet
- Making a skin iteration of the grounding bracelet
- Programming color into the weaving pattern, making it more a part of the physical computing aspect of the project
- Making recycled paper either to embroider the circuit onto or enclose the circuit with
- Felting my own amplifier and speaker out of wool scraps
- Writing and illustrating a zine for those wanting to make one themselves
- Designing this project more like a portable kit for others perhaps wanting to reflect on their own sense of "home"

This particular exploration of "home" certainly contextualized the complexities, sensitivities, and weaknesses of working with e-textiles. It also allowed me to build a framework of reflections and methods I hope to experiment with in both furthering this work and continuing to build e-textile instruments and other textile interactions. Hopefully with my former Fabricademy peers, former alumni, external advisors, and others who think this making/art thing is worthwhile.

I will be presenting this work to the San Diego Creative Weavers Guild (SDCWG) and probably at the FAB26 Conference. This work is currently evolving to include a circuit enclosure and an amplifier made of wool, bio-textiles, and hand-made paper.

And so from just another mundane Monday, thinking and crafting in my sleep, I wake up to a typical Tuesday.



One of @es.pep's comics that encapsulates thoughts we all have.. Or is that just me

This comic is used with @es.pep's blessing and double thumbs up

References

1. Verlyn Klinkenborg. Smithsonian Magazine. 2012. *The Definition of Home*. <https://www.smithsonianmag.com/science-nature/the-definition-of-home-60692392/>
2. Irene Posch and Ebru Kurbak. 2016. *CRAFTED LOGIC Towards Hand-Crafting a Computer*. In Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems (CHI EA '16). ACM, New York, NY, USA, 3881-3884. <https://doi.org/10.1145/2851581.2891101>
3. Sophie Skach. *E-textiles as Musical Interfaces*. Intelligent Instruments Lab. <https://iil.is/research/etextiles>
4. Australian Tapestry Workshop - Chicks on Speed. *Theremin Tapestry*. <https://www.austapestry.com.au/content/theremin-tapestry>
5. Michelle Vossen. *Atari Punnik Console*. <https://michellevossen.com/electronics/>
6. Jessica Stanley. 2019. *Stitch Synth*. <https://class.textile-academy.org/2019/students/jessica.stanley/projects/00final-project/>
7. Passepartout Duo. *40XX Synth*. <https://passepartoutduo.com/40xx-synth>
8. Passepartout Duo. *Fuzzy Synth*. <https://passepartoutduo.com/fuzzy-synth>
9. Clara Rigaud. *Zombitron Extended*. <https://constantvzw.org/site/ZOMBITRON-e-x-t-e-n-d-e-d.html>
10. Wicaksono, I. and Paradiso, J.A., 2020. KnittedKeyboard: Digital Knitting of Electronic Textiles Musical Controller. In *New Interfaces for Musical Expression*.
11. Laura Devendorf, Sasha de Koninck, and Etta Sandry. 2022. An Introduction to Weave Structure for HCI: A How-to and Reflection on Modes of Exchange. In Proceedings of the 2022 ACM Designing Interactive Systems Conference (DIS '22). Association for Computing Machinery, New York, NY, USA, 629–642. <https://doi.org/10.1145/3532106.3534567>
12. Koutsomichalis, Marinos & Psarra, Afroditi. 2015. *Computer-aided weaving: from numerical data to algorithmic textiles*. In Ng, K., Bowen, J.P., Lambert N. (eds) Proceedings of the Electronic Visualisation and the Arts (EVA) Conference (London, GB) pp. 122-123. DOI: <https://10.14236/ewic/eva2015.59>
13. DX Softlab. n.d. *DX Softlab*. <https://www.dx-softlab.com/>
14. Music From Outer Space. n.d. *Home*. Retrieved April 14, 2026 from <https://musicfromouterspace.com/index.php?MAINTAB=HOME&VPW=1024&VPH=500>
15. @es.pep. "What does Radical self-acceptance mean??" Instagram, 14 April 2026, <https://www.instagram.com/p/DRXrO2kkdxj/>
16. Clement Zheng, HyunJoo Oh, Laura Devendorf, and Ellen Yi-Luen Do. 2019. *Sensing Kirigami*. In Proceedings of the 2019 on Designing Interactive Systems Conference (DIS '19). Association for Computing Machinery, New York, NY, USA, 921–934. <https://doi.org/10.1145/3322276.3323689>
17. Matthew L. Lee-Smith, Jesse Josua Benjamin, Audrey Desjardins, Mathias Funk, William Odom, Doenja Oogjes, Young-Woo Park, James Pierce, Pedro Sanches, and Vasiliki Tsaknaki. 2023. *Data as a Material for Design: Alternative Narratives, Divergent Pathways, and Future Directions*. In Extended Abstracts of the 2023 CHI Conference on Human Factors in Computing Systems (CHI EA '23). Association for Computing Machinery, New York, NY, USA, Article 342, 1–5. <https://doi.org/10.1145/3544549.3573817>
18. William Odom, Ron Wakkary, Jeroen Hol, Bram Naus, Pepijn Verburg, Tal Amram, and Amy Yo Sue Chen. 2019. *Investigating Slowness as a Frame to Design Longer-Term Experiences with Personal Data: A Field Study of Olly*. In Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems (CHI '19). Association for Computing Machinery, New York, NY, USA, Paper 34, 1–16. <https://doi.org/10.1145/3290605.3300264>
19. Audrey Desjardins, Jena McWhirter, Justin Petelka, Chandler Simon, Yuna Shin, Ruby K Peven, and Philbert Widjaja. 2023. *On the Making of Alternative Data Encounters: The Odd Interpreters*. In Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems (CHI '23). Association for Computing Machinery, New York, NY, USA, Article 155, 1–20. <https://doi.org/10.1145/3544548.3581323>

