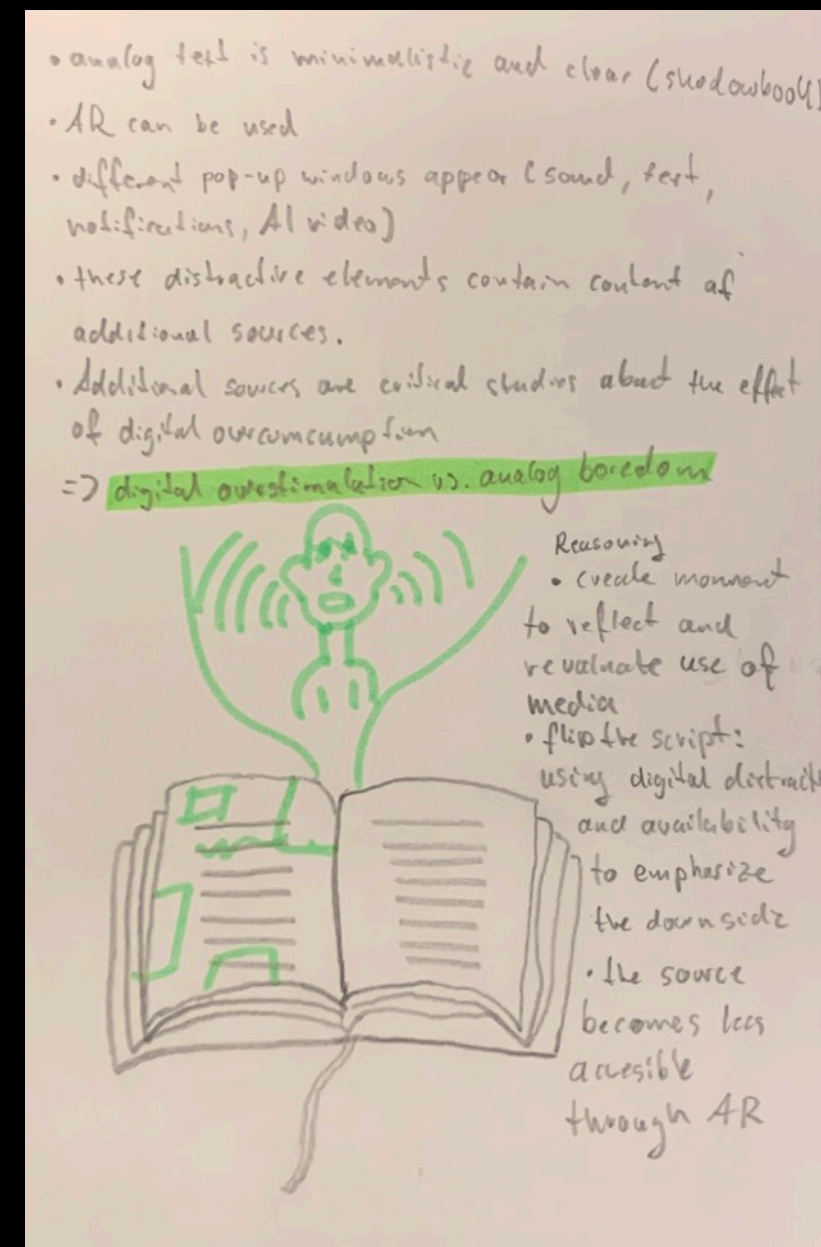
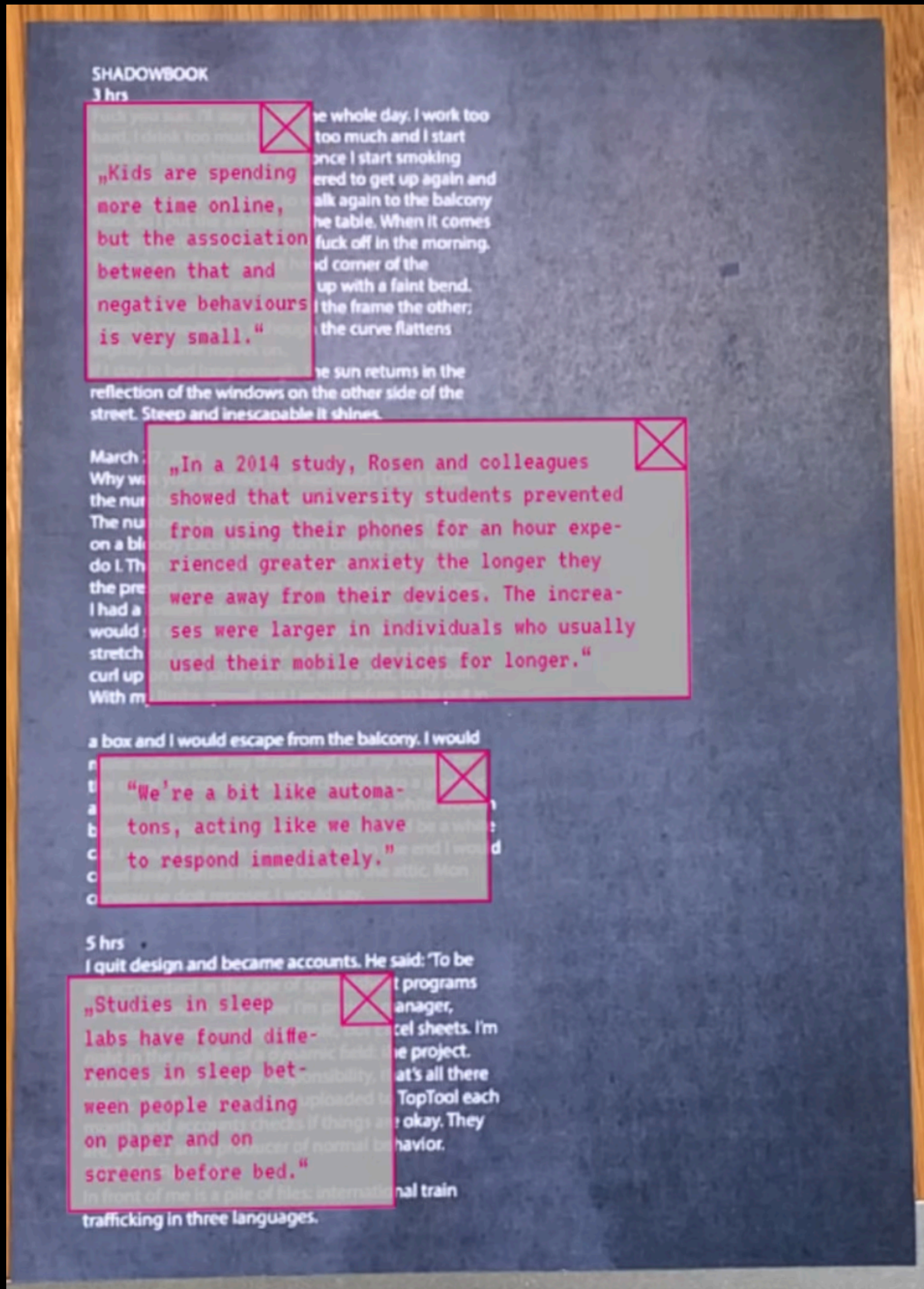


8 ITERATIONS

DESIGN QUESTION

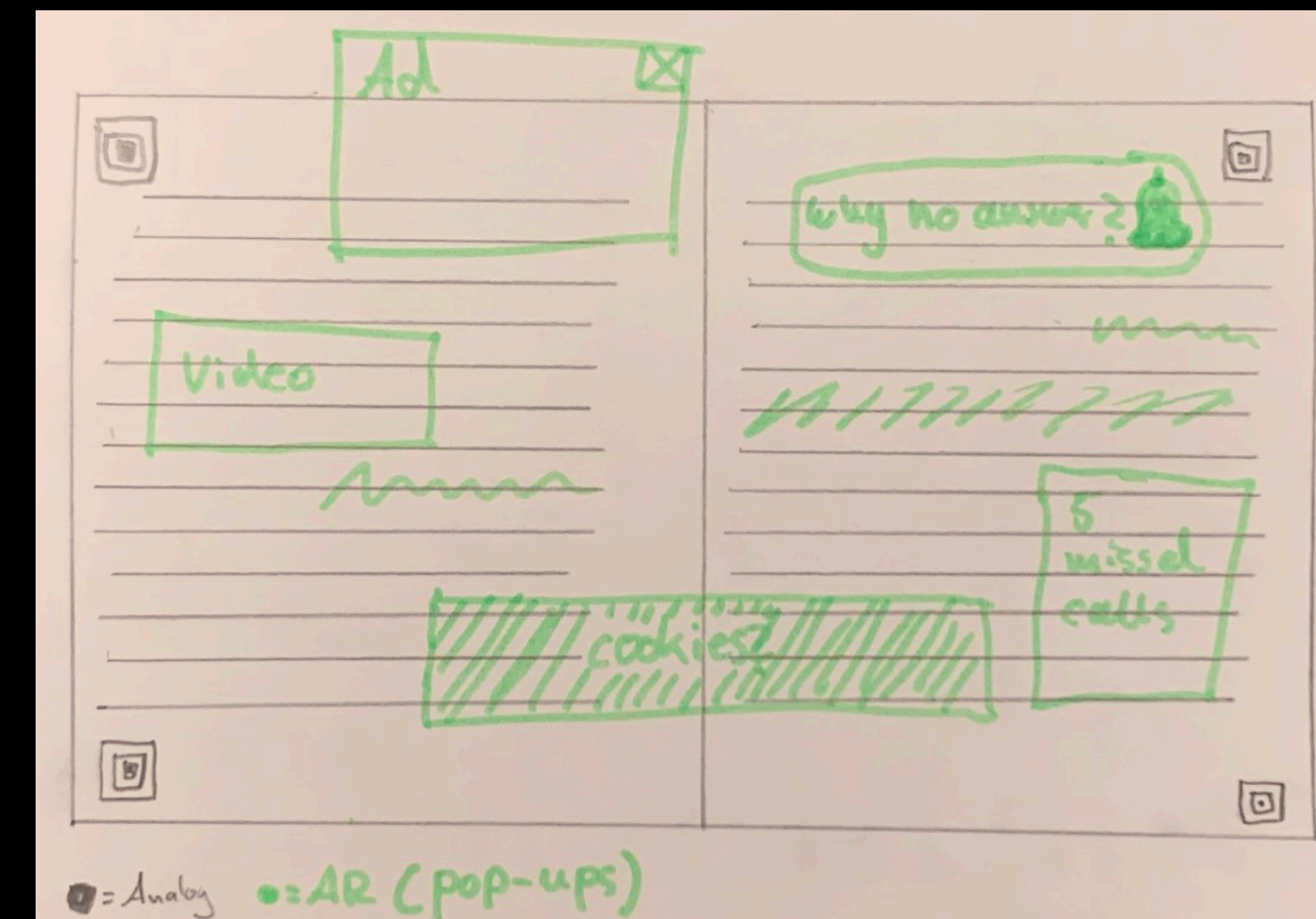
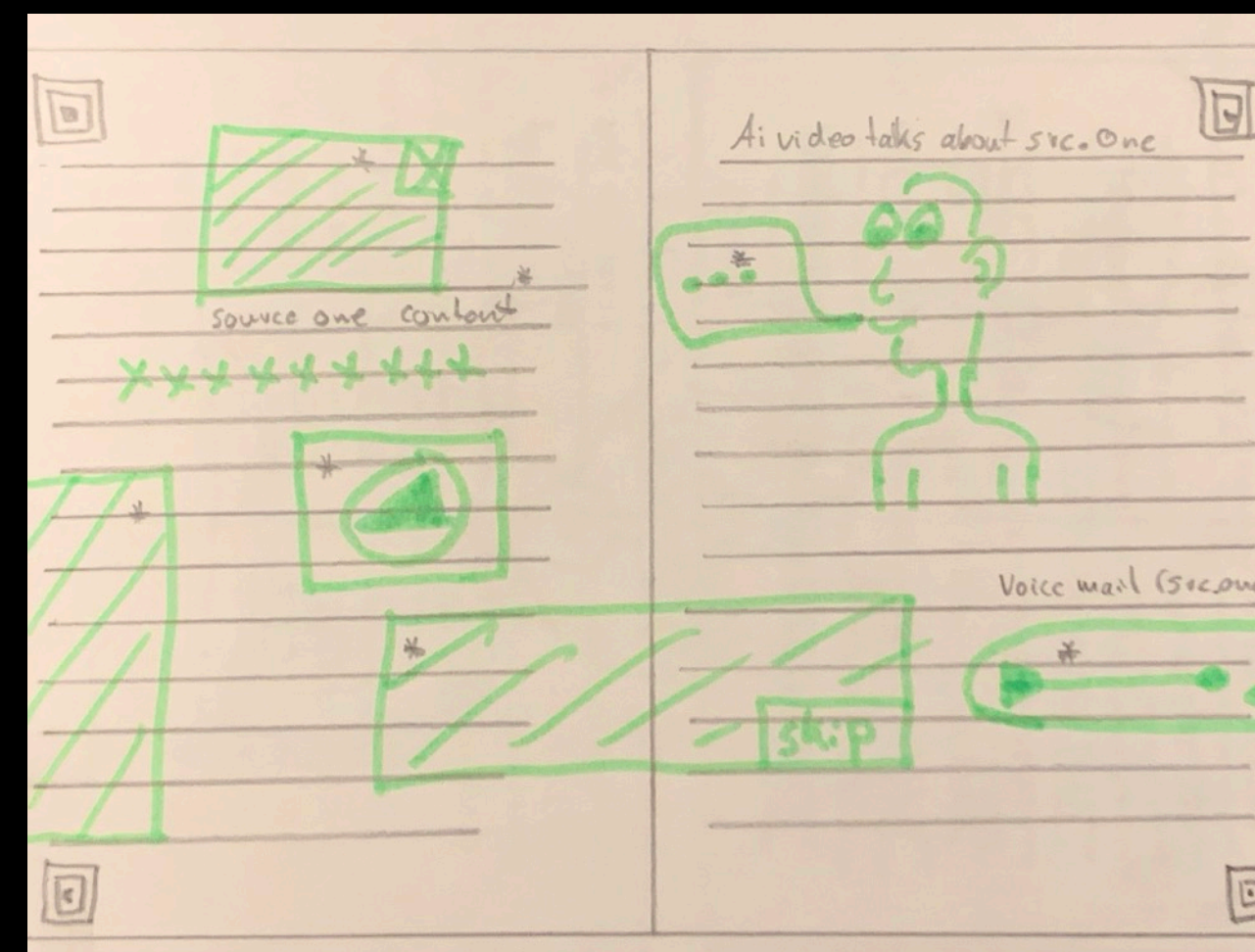
How can I raise awareness about the environmental impact that comes from devices required for digital communication, while also emphasizing the recyclable and mainly precious elements in e-waste (smartphones) that make it worth recycling?

1. DROPPING FIRST CONCEPT



Old design question:

How can I use the often attention-grabbing, distractive, and content-switching nature of the digital world to make the reader reevaluate their usage of digital media using augmented reality?

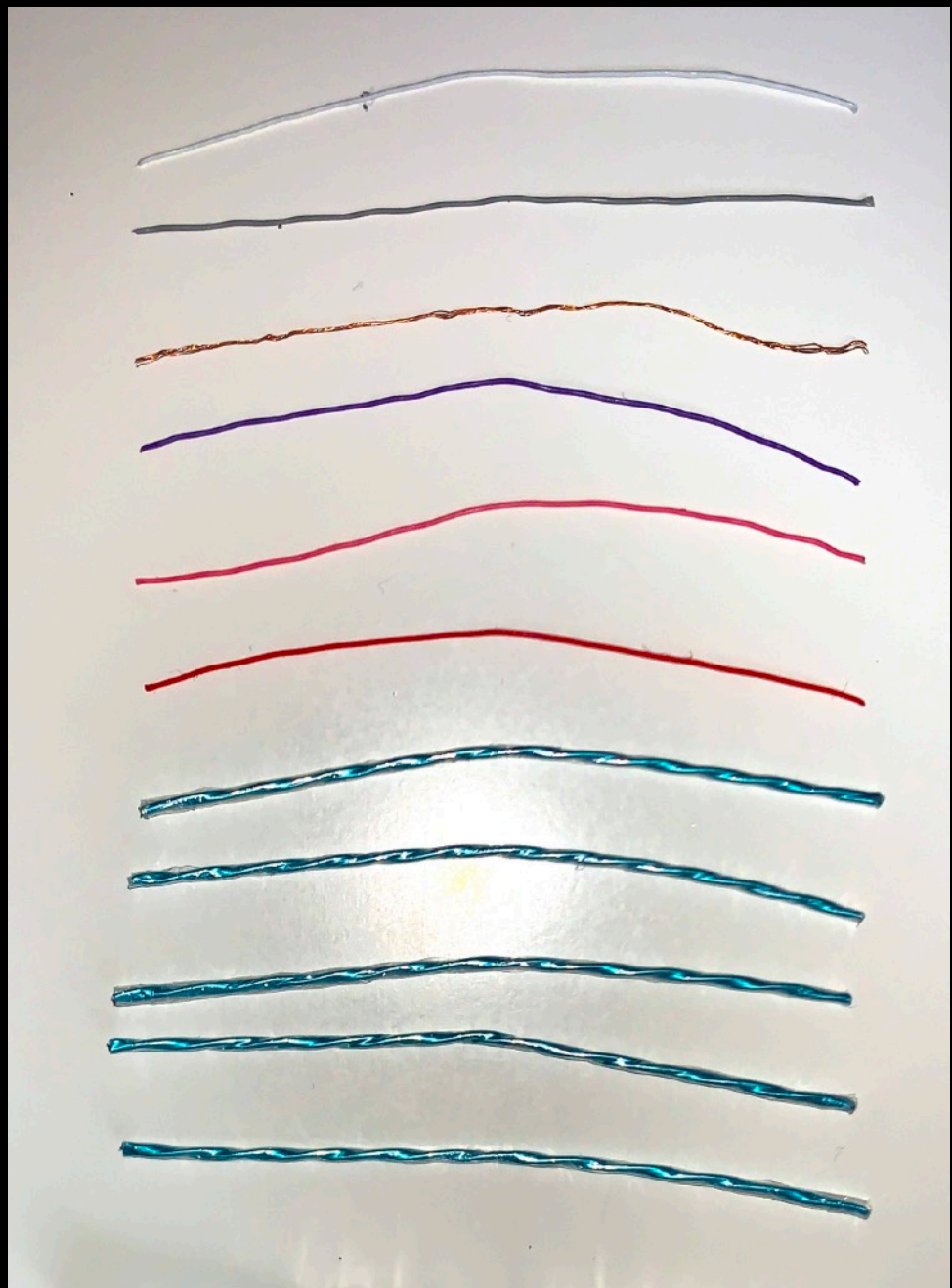


2. MATERIAL SOURCING AND DECONSTRUCTION

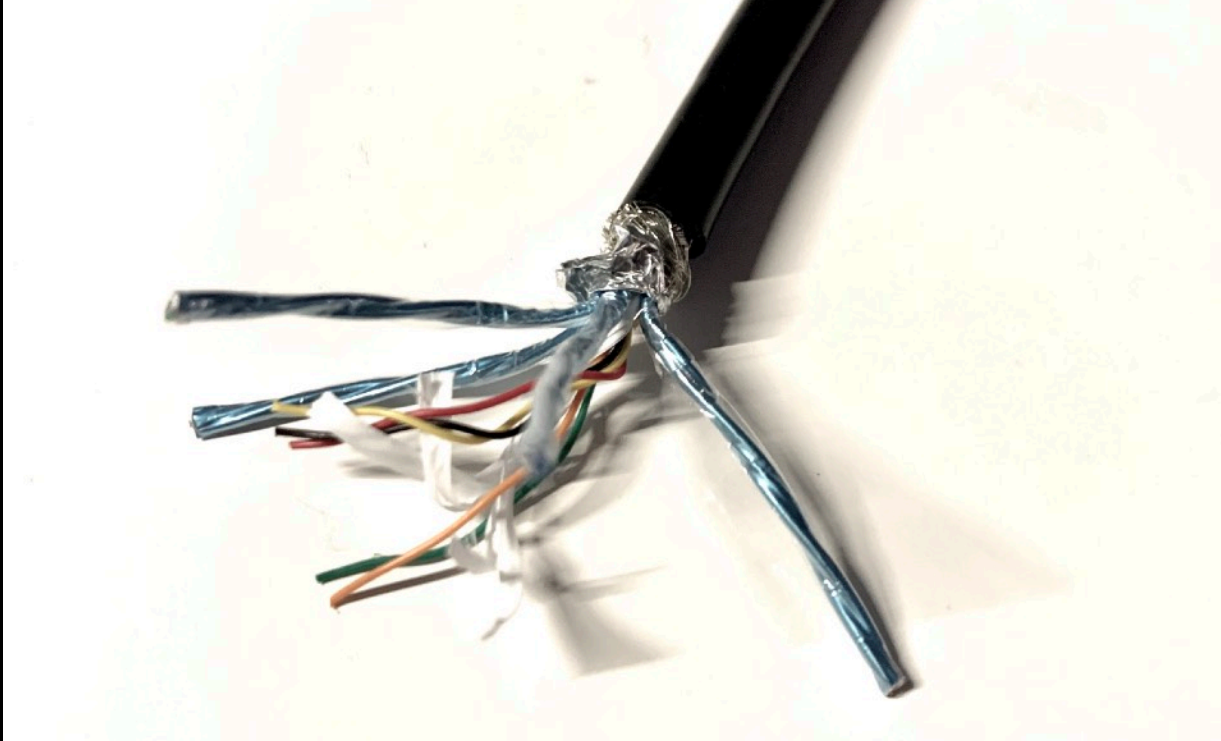


After deciding to address the materiality of digital communication (e-waste) I started to deconstruct old wires and devices in search of usable material.

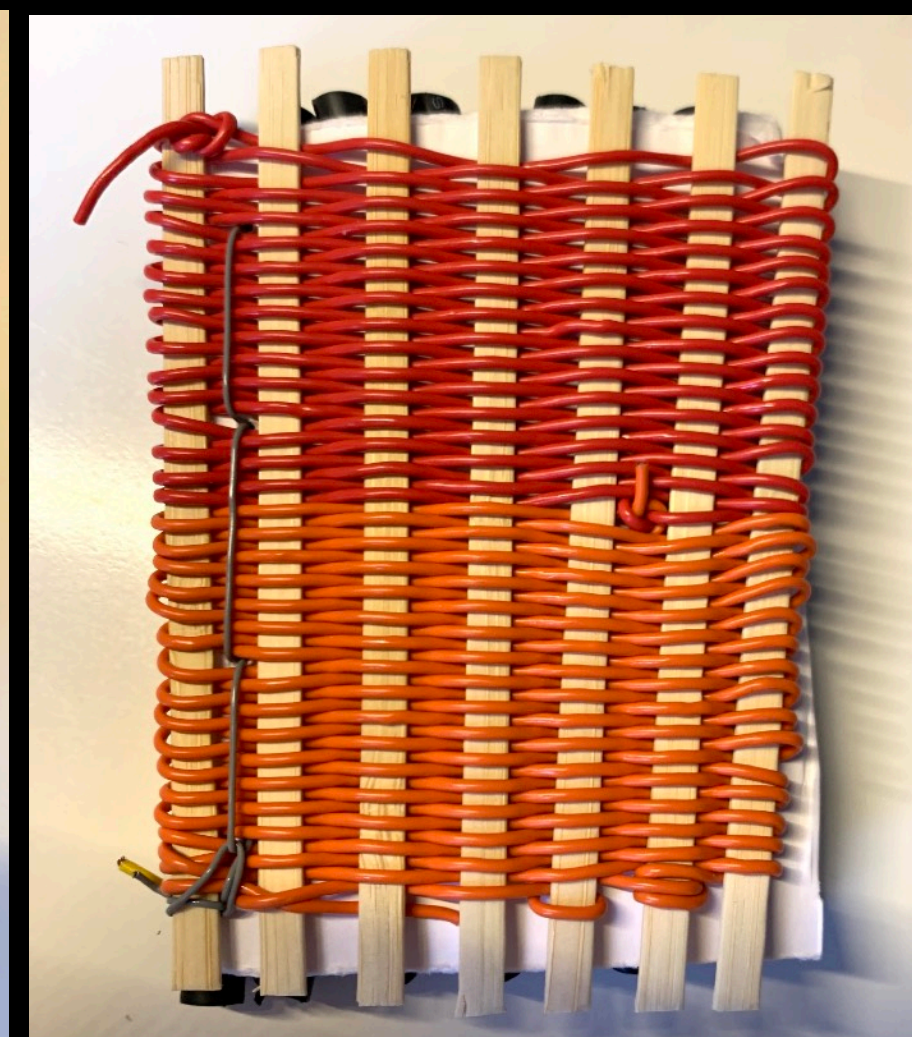
Finding out about the colorful small wires and materials inside of cables made me see their potential use in a publication.



Using these materials allowed me to confront the reader with e-waste and therefore contribute to answering the first part of my design question which is about raising awareness.



3. WEAVING EXPERIMENT



I started exploring the potential use of cables and wire to build a cover.

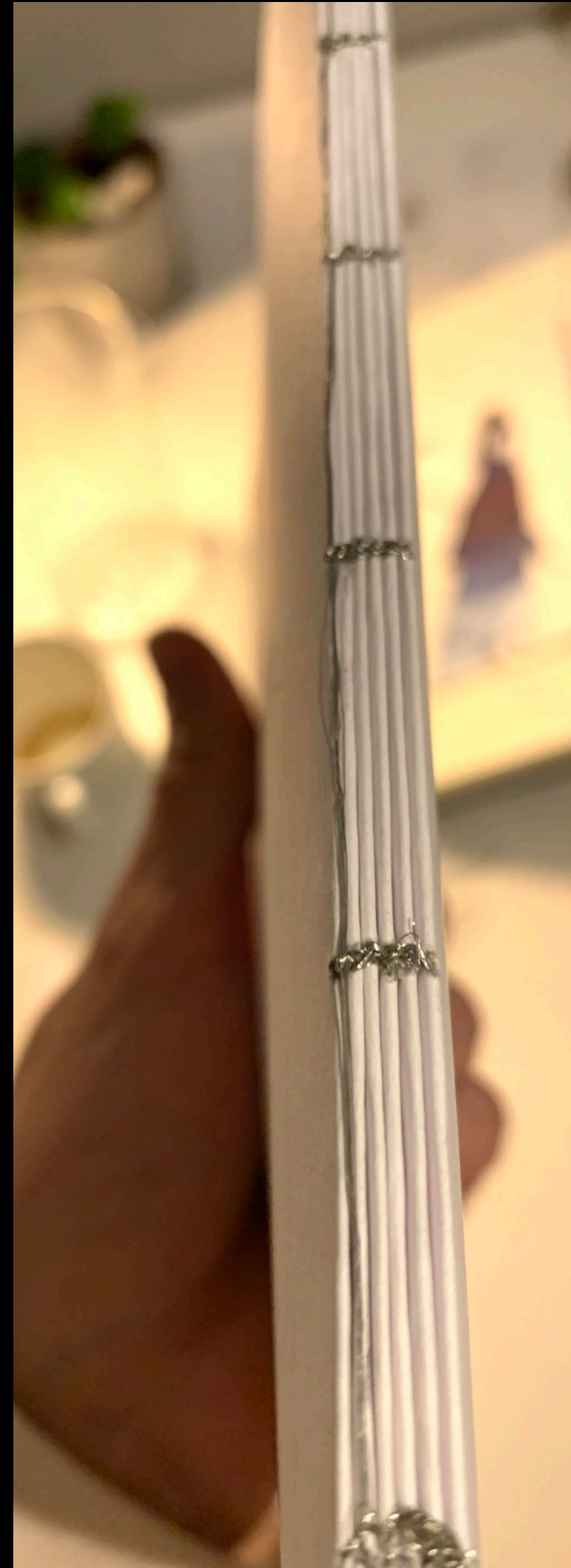
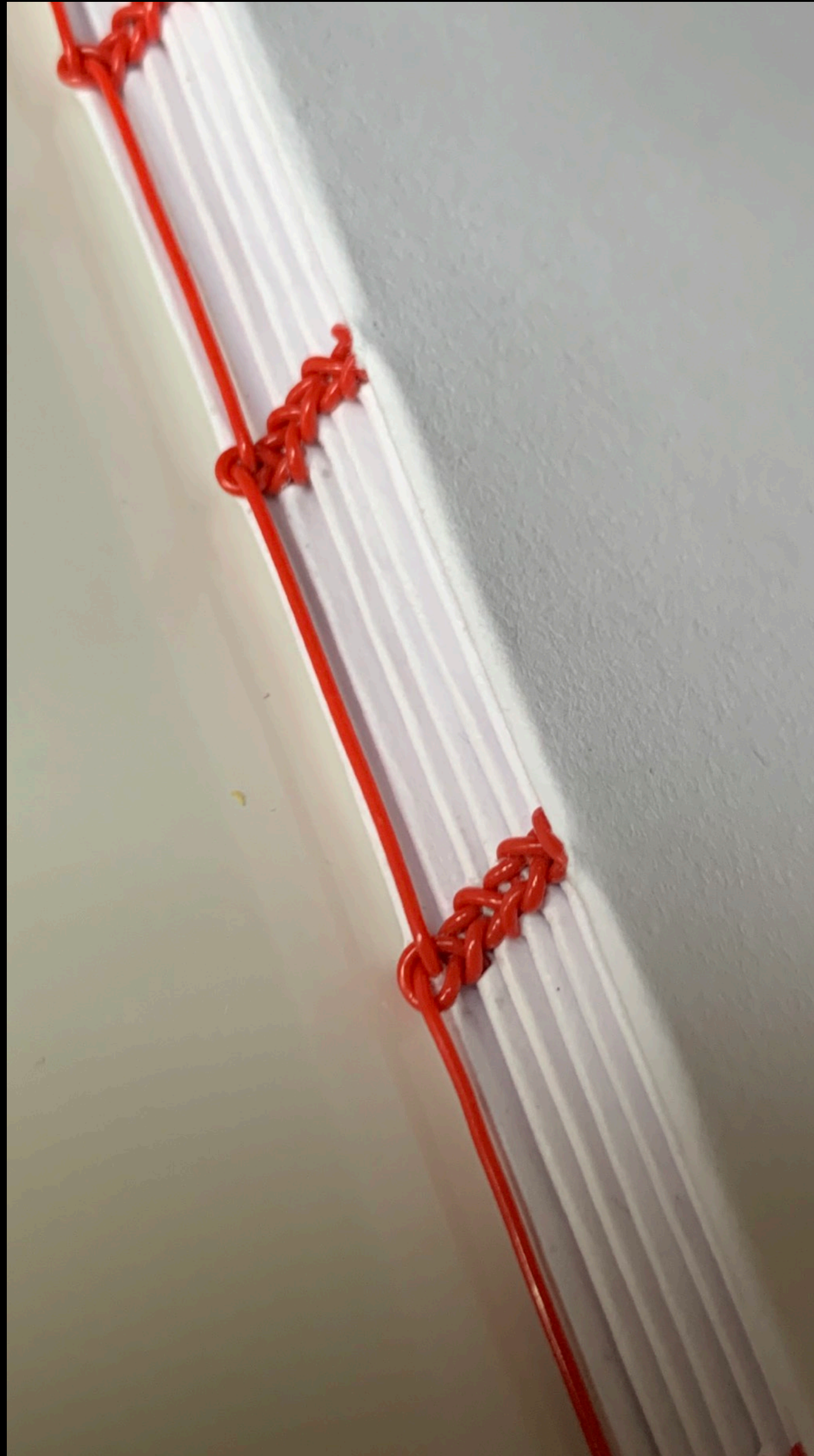
For that, I tested if it was possible to weave different types and parts of wires around the insulations of cables.

After some attempts, it turned out that by using this technique it was possible to create a strong and durable pad.

These insights were crucial to build my final cover in which I used thinner and more colorful wires to create an aesthetic cover.

Making an aesthetic cover helped me to display the worth and value of materials found in e-waste as mentioned in the second part of my design question.

4. BINDING WITH WIRE



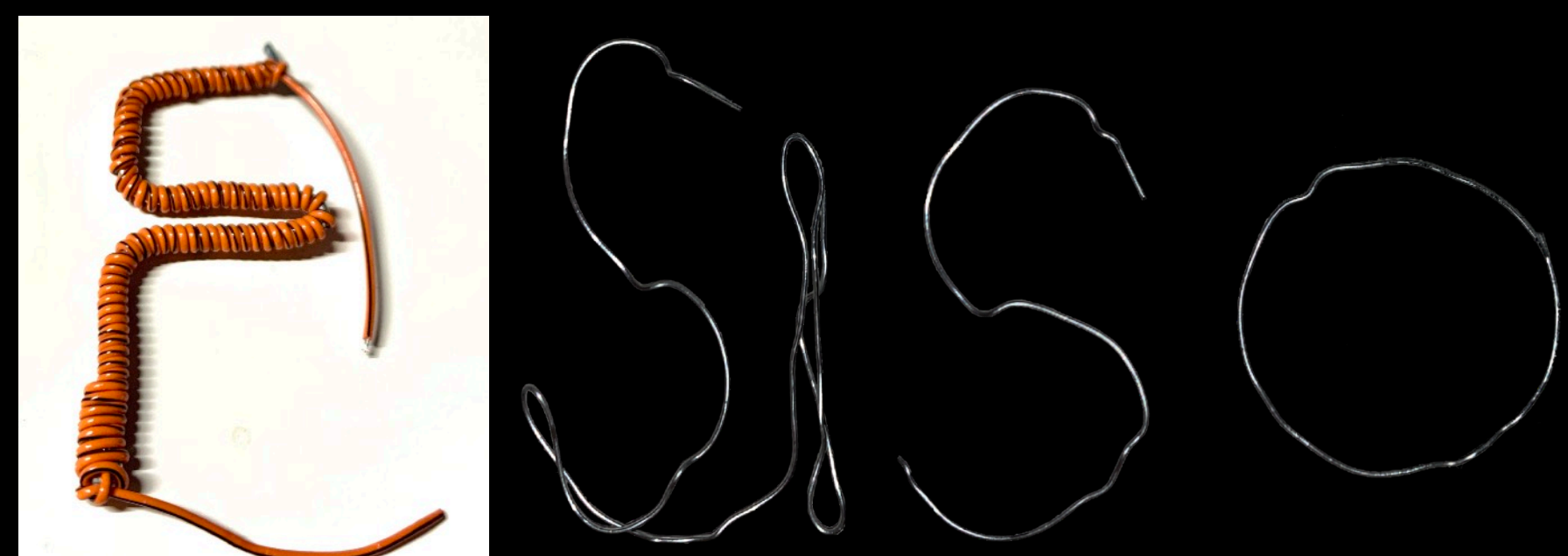
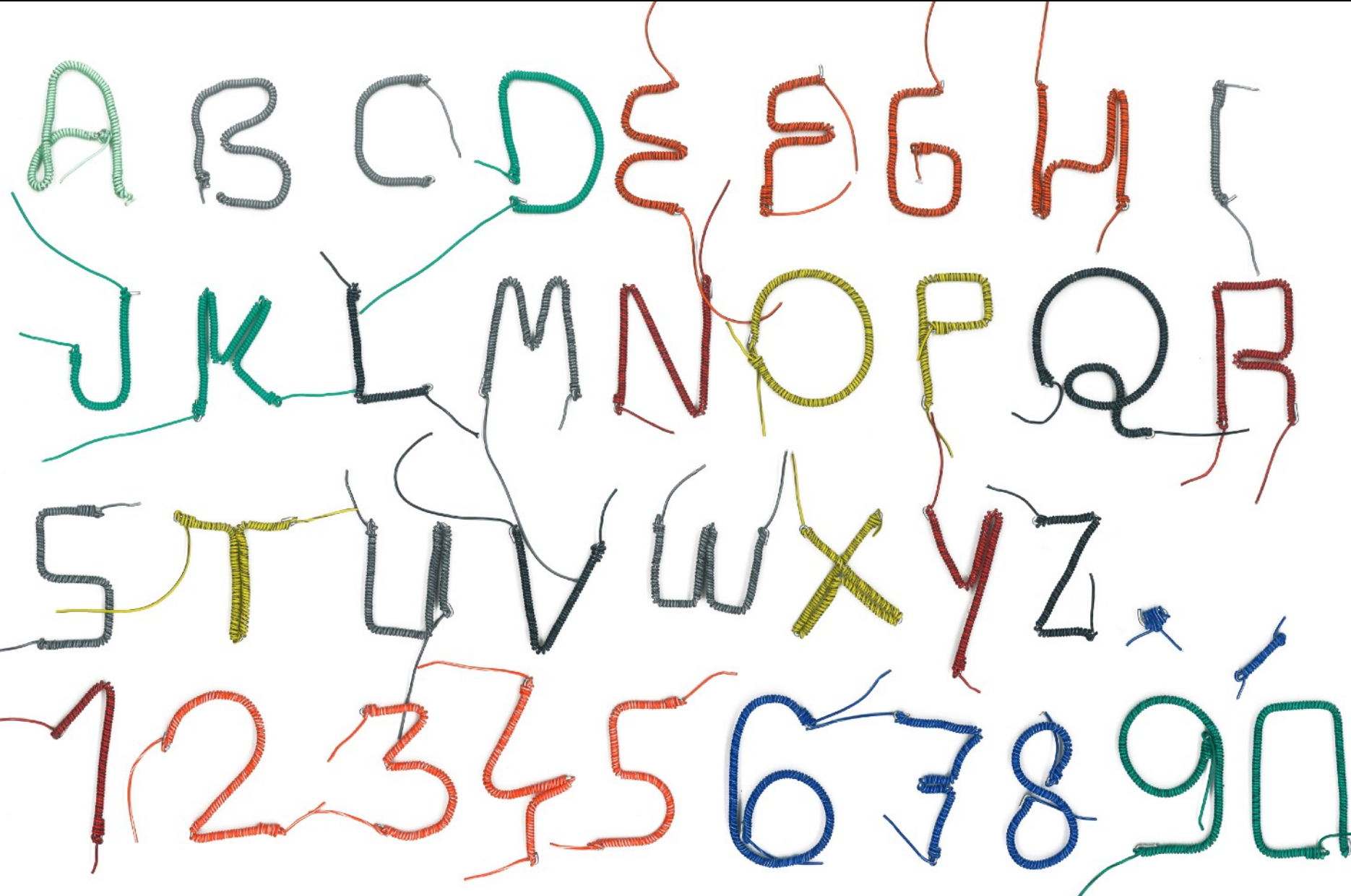
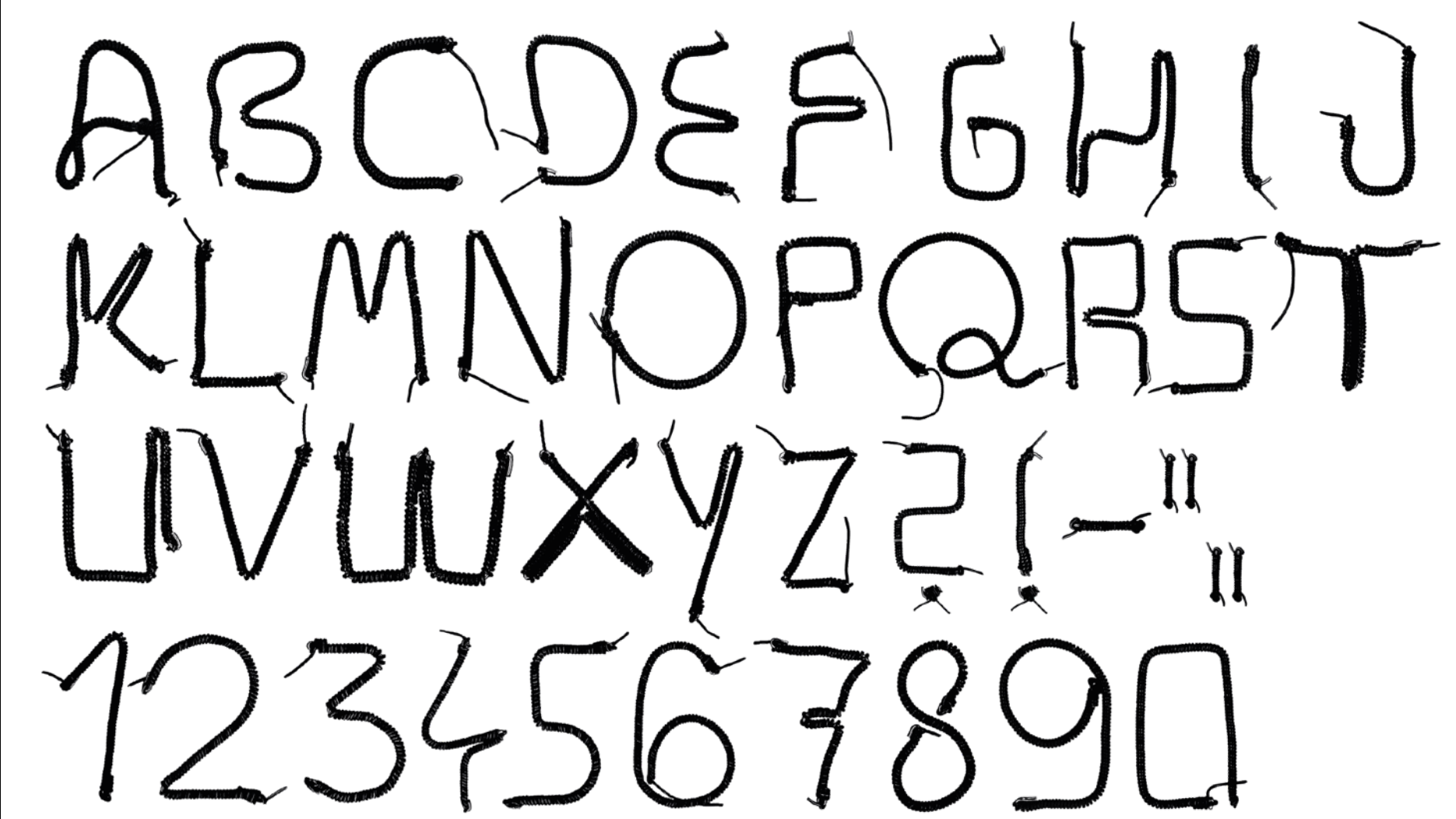
Testing the use of materials found in cable for bookbinding resulted in two prototypes. One uses a thread made of many thin aluminum strings and the other one uses a thin wire sourced from the inside of a cable.

It turned out that the aluminum strings would tangle and tear too often.

The wire on the other hand would emphasize the binding technique and look nice when visible.

These tests helped me to identify a suitable type of wire to bind the pages of my final publication.

5. TYPE FROM WIRE

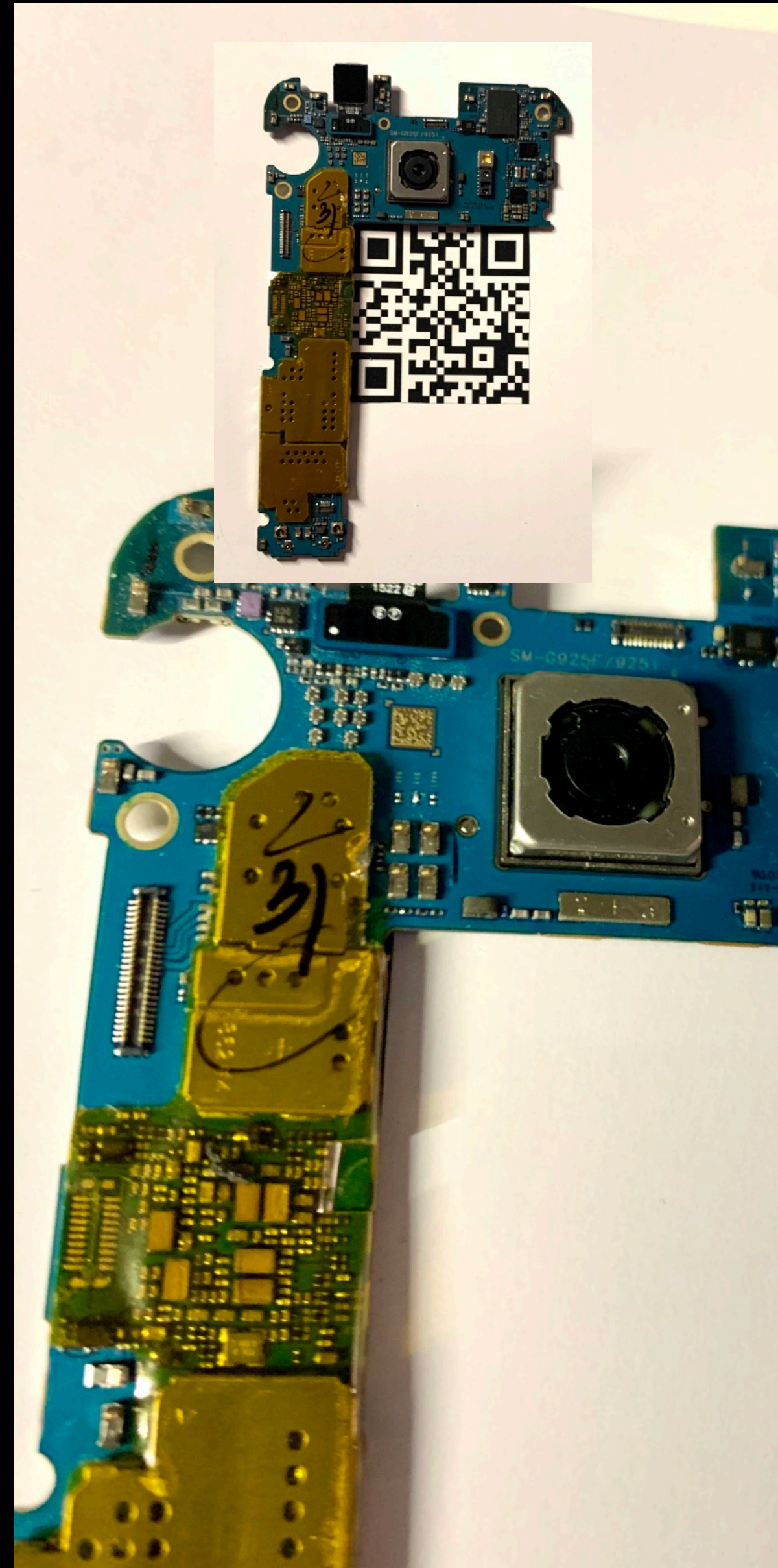
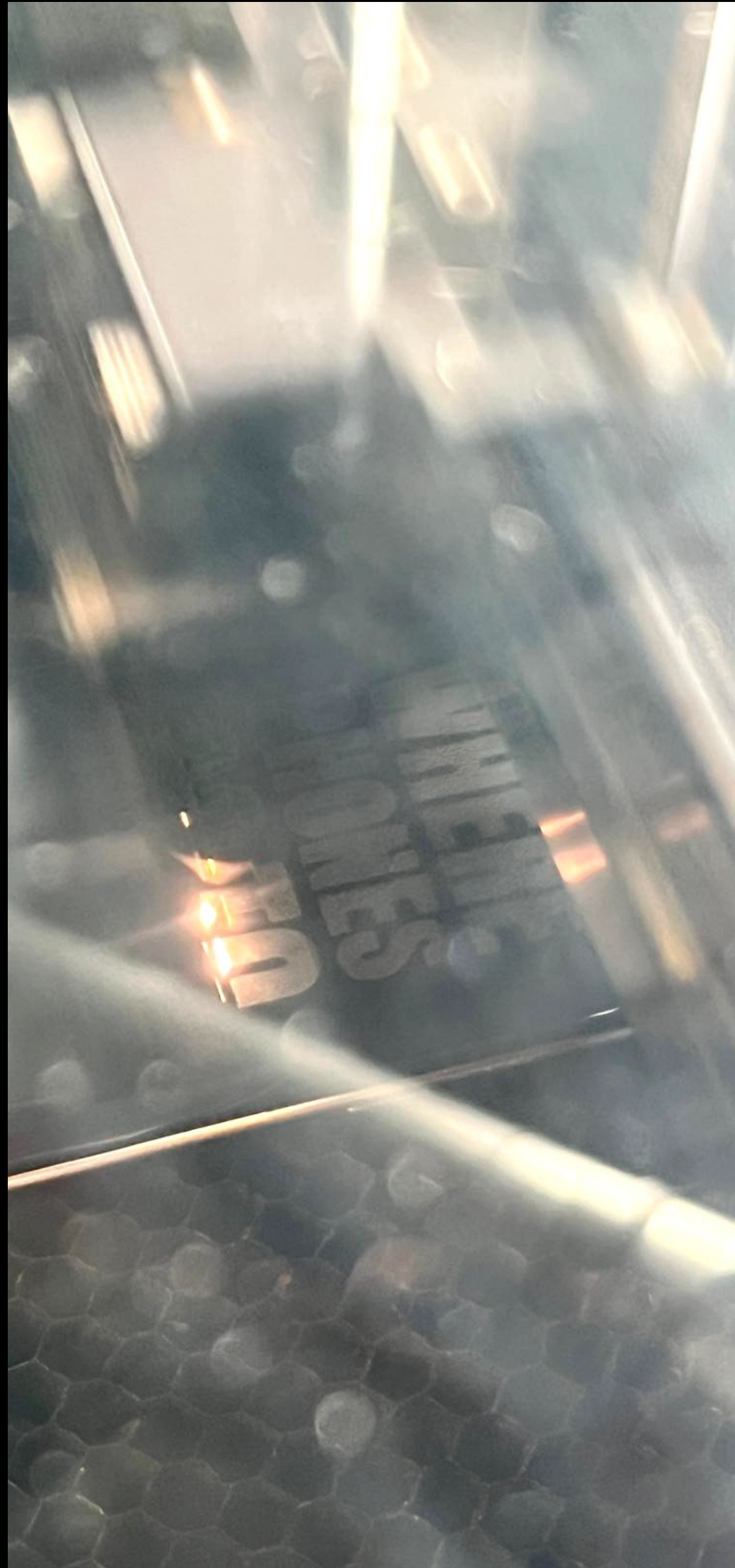


One of the key elements of my publication. Creating a type based on wire allowed me to bring the materiality of the cover into the contents of the publication.

This means continuing the visual language of the cover and therefore the presence of electrical waste. That contributes to visually answering the first part of my design question.

It found its use in headers and icons of the analog as well as the digital component of the publication.

6. FOCUS ON PHONES TO MAKE IT CONCRETE



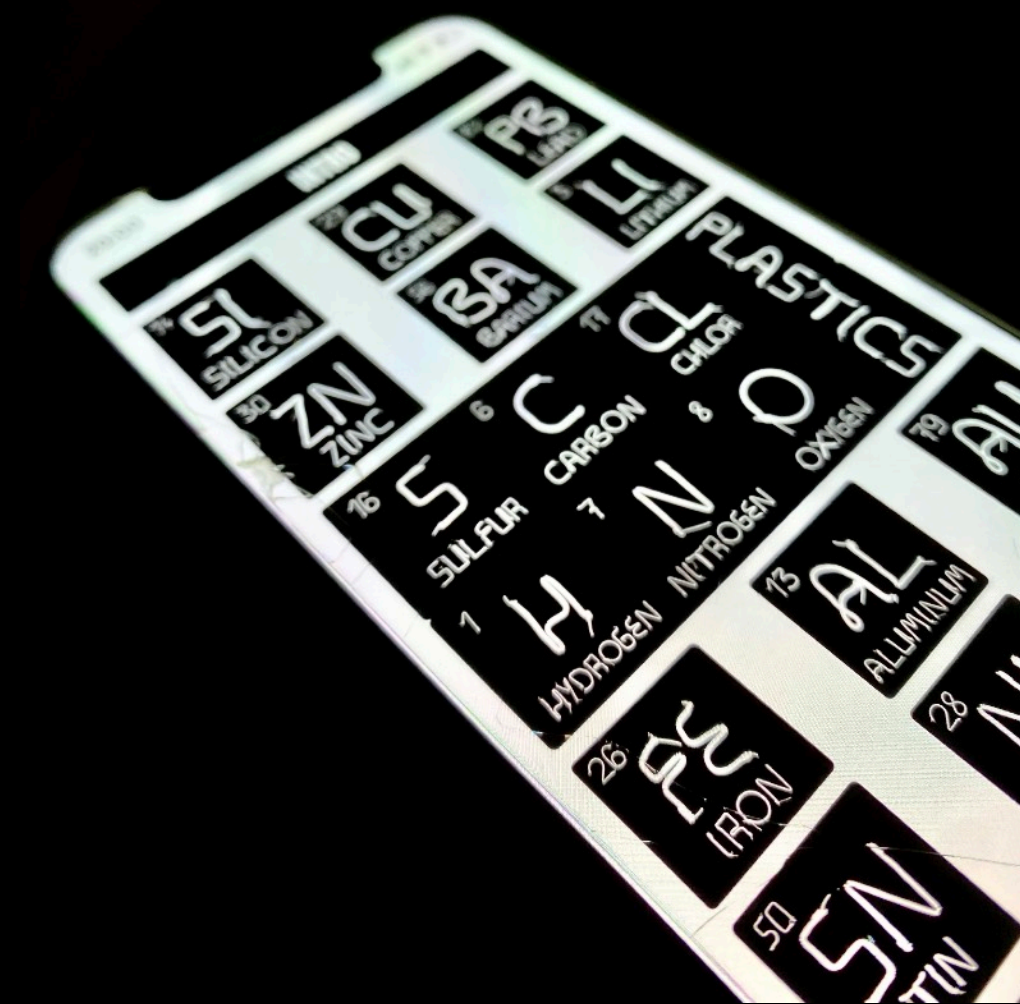
Focusing on the smartphone as only one source of e-waste allowed me to specify the information about the physical aspects of digital communication provided in the digital publication.

Having narrowed down my concept, also allowed me to specify visual choices on the analog publication. Like for example deconstructing my broken smartphone and laser cutting the title into the screen to use on the cover.

Further, I implemented the motherboard as decoration around the QR code to symbolically present the inside of a phone, which is thematically broken down into its elements in the digital publication.

7. USING ELEMENTS OF THE PERIODIC TABLE AS ICONS

82 Pb LEAD	30 Zn ZINC	79 Au GOLD	27 Co COBALT
14 Si SILICON	26 Fe IRON	13 Al ALUMINUM	29 Cu COPPER
50 Sn TIN	28 Ni NICKEL	56 Ba BARIUM	3 Li LITHIUM
16 S SULFUR	6 C CARBON	17 Cl CHLOR	PLASTICS
1 H HYDROGEN	7 N NITROGEN	8 O OXYGEN	



79
Au
GOLD

An average smartphone contains

<0,04g
of gold.

WHERE IS IT USED?

"Small amounts of gold are used to make the mobile phone circuit board" (MEC MINING, 2018).

"The micro-electrical components and wiring in the phone are composed mainly of copper, gold, and silver" (Brunning, 2014).

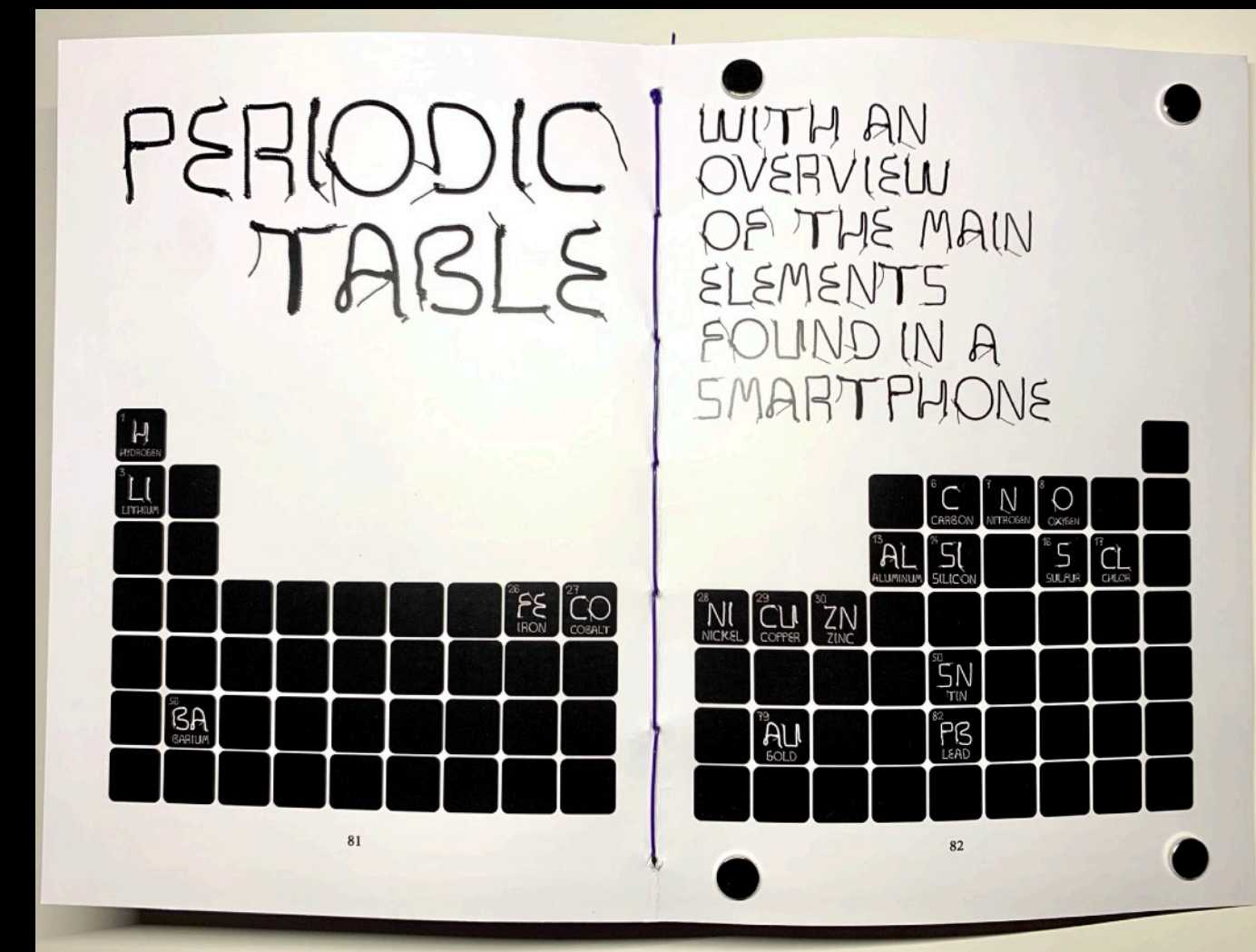
RECYCLABILITY

Using icons as references in the analog publication helped to connect it with the digital on a visual and conceptual level. The icons in the analog serve as little hints for the digital to make the reader wonder about the meaning and explore the digital extension in case they haven't done so.

It further suggests switching from analog to digital in order to read about the specific chemical element. Just to return to the analog until the next icon is referenced.

This way the reader can be conscious of the environmental impact that comes from devices required for digital communication, through reading the intriguing essays of "The Shadowbook".

That connects the reader to the elements used in a phone and therefore contributed to answering the second part of my design question (Emphasising precious materials to motivate recycling).



8. RESEARCH INTO RECYCLING AND USE OF ELEMENTS IN A SMARTPHONE

https://miro.com/app/board/o9J_lzrD2ZQ=/?share_link_id=772815519845

The sources are also listed at the bottom of the digital extension under “sources”

Iron Recycling - Cohen
Through iron recycling, you're conserving energy and saving landfill space. Cohen accepts all types of iron for recycling.

COHEN (2022) *Iron recycling, Cohen*. Available at: <https://www.cohenusa.com/recyclable-items/iron/> (Accessed: December 2022).

DYNACAST
Recycled Aluminium | Aluminium Alloy | Pure Aluminium
Understanding the difference between pure Aluminium and recycled Aluminium will help you save energy and cost, whilst helping the planet and your performance.

DYNACAST (no date) *Recycled aluminium: Aluminium alloy: Pure aluminium, Dynacast*. Available at: <https://www.dynacast.com/en-gb/resources/blog/recycled-aluminium-vs-pure-aluminium> (Accessed: December 2022).

What is Recycled Gold? | Gold Recycling Methods | The Bench
What is recycled gold, and how is it formed? Discover the methods and benefits behind using recycled precious metals in our guide. Read now.

Patel, N. (2021) *What is recycled gold? Gold Recycling Methods, The Bench*. Available at: <https://www.cooksongold.com/blog/learn/what-is-recycled-gold/#:~:text=It%20can%20be%20recycled%20without,a%20few%20mining%20regions%20left> (Accessed: December 2022).

Friends of the Earth Europe
About us - Friends of the Earth Europe
What do we do? What is our vision of the world? Our vision is of a peaceful and sustainable world based on justice, living in harmony with nature. We envision a society of interdependent people living in dignity, wholeness and fulfillment where equity is...

Friends of the Earth (2012) *Mining for smartphones: The true cost of tin, Friends of the Earth Europe*. Available at: <https://friendsoftheearth.eu/press-release/mining-for-smartphones-the-true-cost-of-tin/> (Accessed: December 2022).

RECYCLING - International Tin Association
Tin can be infinitely recycled to the same high quality due to its intrinsic properties and economic value. Closing metal loops by increasing reuse and recycling has the potential to improve resource productivity while reducing energy use, emissions, etc...

International Tin Association (2022) *Recycling, International Tin Association*. Available at: <https://www.internationaltin.org/recycling/#:~:text=Tin%20can%20be%20infinitely%20recycled,%2C%20emissions%2C%20and%20waste%20disposal> (Accessed: December 2022).

Research spotlight: Studying the end of the tin life cycle - Fairphone
Long before we made a single phone, Fairphone was working to better understand and improve mineral supply chains. Many years and three phones later, we're still focusing on our mission of driving important materials projects and pioneering research that...

Miquel (2021) *Research spotlight: Studying the end of the tin life cycle, Fairphone*. Available at: <https://www.fairphone.com/de/2020/09/28/tin-recycling/> (Accessed: December 2022).

Recycled Lead Market Size, Growth Report, Trends, 2022-2030
The global recycled lead market size was estimated at USD 16.8 billion in 2021 and is projected to reach around USD 20.4 billion by 2030 with a registered CAGR of 2.18% during the forecast period 2022 to 2030.

Precedence Research (2021) *Recycled lead market (by application: Battery, Rolls & extruded products, pigments & other compounds, others; by type: Soft lead, lead alloys, lead oxides; by industry type: Energy, transportation, data centers, electronics, construction, healthcare, others) - global industry analysis, size, share, growth, trends, regional outlook, and forecast 2022-2030, Precedence Research*. Available at: <https://www.precedenceresearch.com/recycled-lead-market#:~:text=Unlike%20many%20other%20materials%2C%20lead,element%20for%20the%20circular%20economy> (Accessed: December 2022).

About Us - ERI
Certified as ISO-manufacture, recycle, and refurbish every type of electronic device in an environmentally responsible manner, ERI today has the capacity to process more than a billion pounds of electronic waste annually at its eight certified locations...

ERI (2016) *5 hard facts about lead in e-waste, ERI*. Available at: <https://erirect.com/blog/2016/02/15-hard-facts-about-lead-in-e-waste/> (Accessed: December 2022).

From minerals to your mobile: barite
Barite, found in barite is used to make circuitboards in mobile phones.

National Museums Scotland (no date) *From minerals to your mobile: Barite, National Museums Scotland*. Available at: <https://www.nms.ac.uk/explore-our-collections/resources/from-minerals-to-your-mobile/minerals/barite/> (Accessed: December 2022).

Exploratory Health Assessment of Chemical Exposures at E-Waste Recycling and Scrapyard Facility in Ghana
Background: Ghana is one of several West African countries receiving high volumes of used electronic and electrical equipment and waste. While the rapid rate of e-waste generation has been the site of extensive recycling, handling, processing and storage...

Caravanos, J. et al. (2013) *Exploratory health assessment of chemical exposures at E-waste recycling and scrapyard facility in Ghana, Allen Press*. Available at: <https://meridian.allenpress.com/jhp/article/3/4/11/67380/Exploratory-Health-Assessment-of-Chemical> (Accessed: December 2022).

Are lithium ion batteries recyclable?
Lithium ion batteries will help power the shift to a renewable energy world, but recycling them is not yet an easy task. Learn more today.

Almerini, A. (2022) *Are lithium ion batteries recyclable?, Solar Reviews*. Available at: <https://www.solarreviews.com/blog/are-lithium-ion-batteries-recyclable#:~:text=While%20lithium%20batteries%20can%20be%20components%20make%20them%20highly%20flammable> (Accessed: December 2022).

Why is most plastic not recycled?
Did you know that 91 percent of plastic isn't recycled? Learn the factors that prevent higher rates of recycling and why some plastics are not recyclable.

Patoski, A. (2019) *Why is most plastic not recycled? - purpose rising blog, rePurpose Global*. Available at: <https://repurpose.global/blog/post/why-is-most-plastic-not-recycled> (Accessed: December 2022).

<https://www.giffgaff.com/blog/what-minerals-are-in-my-phone/#:~:text=Used%20to%20make%20electrodes%20in%20mobile%20phones%20batteries,&text=Every%20mobile%20phone%20is%20about%20to%20accessories%20like%20the%20charger>

Graham (2022) *Giffgaff.com*. Available at: <https://www.giffgaff.com/blog/what-minerals-are-in-my-phone/#:~:text=Used%20to%20make%20electrodes%20in%20mobile%20phones%20batteries,&text=Every%20mobile%20phone%20is%20about%20to%20accessories%20like%20the%20charger> (Accessed: December 2022).

Electronic Waste Facts
Electronic Revolution = E-Waste

The World Counts (2022) *Electronic Waste Facts*. Available at: <https://www.theworldcounts.com/stories/electronic-waste-facts> (Accessed: December 2022).

Mobile phones and the building e-waste mountain
Addressing the world's e-waste is critical to the mobile sector, to ensure we improve sustainability standards and address the supply chain shortage.

Steer-Stephenson, C. (2022) *Mobile phones and the building e-waste mountain, Mobile Magazine*. Available at: <https://mobile-magazine.com/articles/mobile-phones-and-the-rising-e-waste-mountain> (Accessed: December 2022).

Cell Phone Recycling Facts | NewTech Recycling
Cell phones are full of materials both valuable (like gold) and toxic (like lead). Instead of throwing all that away in landfills, call NewTech Recycling to discover a better option.

Sinclair, P. (2021) *Cell Phone Recycling Facts, NewTech Recycling*. Available at: <https://newtechrecycling.com/cell-phone-recycling-facts/#:~:text=Only%20a%20small%20percentage%20of%20cell%20phones%20are%20recycled&text=Patrick%20Sinclair%2C%20Founder%20and%20Tech%20Close%20to%20150%20million> (Accessed: December 2022).

E-waste: Five billion phones to be thrown away in 2022
Billions of phones will be hoarded in drawers and cupboards or thrown away rather than recycled, studies suggest.

Gill, V. (2022) *E-waste: Five billion phones to be thrown away in 2022, BBC News*. Available at: <https://www.bbc.com/news/science-environment-63245150> (Accessed: December 2022).

ELEMENTS OF A SMARTPHONE
The Chemical Elements of a Smartphone
There are an isolated few graphics online that look at elements involved in the manufacture of a smartphone - for example, this 'Periodic Table of iPhones' - but there's...

Bruning, A. (2014) *The chemical elements of a smartphone - Compound Interest, Compound Chem*. Available at: <https://www.compoundchem.com/2014/02/19/the-chemical-elements-of-a-smartphone/> (Accessed: December 2022).

Will my smartphone R.I.P.?
A smartphone's voyage in the afterlife

Coma, M. (2021) *Will my smartphone R.I.P.?, Meer*. Available at: <https://www.meer.com/en/65254-will-my-smartphone-r-dot-i-p-dot> (Accessed: December 2022).

Your mobile phone is powered by precious metals and minerals
The world's rarest mineral resources are in your hands.

Lotzof, K. (2020) *Your mobile phone is powered by precious metals and Minerals, Natural History Museum*. Available at: <https://www.nhm.ac.uk/discover/your-mobile-phone-is-powered-by-precious-metals-and-minerals.html> (Accessed: December 2022).

International Copper Association and the Copper Alliance® - Copper Alliance
The International Copper Association is the leading advocate for the copper industry. The Copper Alliance® represents a network of regional copper centers and their members.

Copper Association (2022) *Copper recycling20, Copper Alliance*. Available at: <https://copperalliance.org/resource/copper-recycling/> (Accessed: December 2022).

Your old electronics are poisoning people at this toxic dump in Ghana
A vast dump in central Accra is the final resting place for e-waste from all over the world, but it takes a serious toll on local residents.

Kwan, J. (2020) *Your old electronics are poisoning people at this toxic dump in Ghana, WIRED UK*. Available at: <https://www.wired.co.uk/article/hana-ewaste-dump-electronics> (Accessed: December 2022).

The Top 10 Metals And Minerals Powering Your Mobile Phone
Technological innovation has blessed us with many wonderful, modern gadgets, but have you ever considered what metals and minerals are used to power them?

MEC MINING (2018) *The top 10 metals and minerals powering your mobile phone, MEC Mining | TRUSTED EXPERTISE. PROVEN OUTCOMES*. Available at: <https://www.mecmining.com.au/the-top-10-metals-and-minerals-powering-your-mobile-phone/> (Accessed: December 2022).

Research spotlight: Studying the end of the tin life cycle - Fairphone
Long before we made a single phone, Fairphone was working to better understand and improve mineral supply chains. Many years and three phones later, we're still focusing on our mission of driving important materials projects and pioneering research that...

Miquel (2021) *Research spotlight: Studying the end of the tin life cycle, Fairphone*. Available at: <https://www.fairphone.com/de/2020/09/28/tin-recycling/> (Accessed: December 2022).

Mining electronics waste, a new life for used metals
Think of the largest cruise ship. Then imagine how much it weighs - just over 100,000 tonnes, in fact. Now think about 500 of those ships, and what they weigh. That is the staggering amount of new electronic waste that we generate every year.

Coates, G. (2022) *Mining Electronics Waste, a new life for used metals, Mining electronics waste*. Available at: <https://nickelinstute.org/en/blog/2022/january/mining-electronics-waste/> (Accessed: December 2022).

How much could battery recycling actually aid cobalt, lithium supply shortages? - MINING.COM
IDTechEx estimates that a combined total of 180,000 tonnes of lithium, cobalt, nickel, and manganese could be recovered by 2030 through Li-ion recycling.

MINING.COM (2022) *How much could battery recycling actually aid cobalt, lithium supply shortages?, MINING.COM*. Available at: <https://www.mining.com/how-much-could-battery-recycling-actually-aid-cobalt-lithium-supply-shortages/> (Accessed: December 2022).

Li-Ion Battery Recycling Market 2022-2042
Recycling recovers valuable metals from batteries and provides a sustainable route for end-of-life management. In 2042, 12 million tonnes of Li-ion batteries will be recycled with the potential to obtain \$51 billion USD in valuable metals. IDTechEx have...

IDTechEx (2021) *Li-Ion Battery Recycling Market 2022-2042, IDTechEx*. Available at: <https://www.idtechex.com/en/research-report/li-ion-battery-recycling-market-2022-2042/848> (Accessed: December 2022).