HOLOGRAM FRAGMENTS

@noahfeehan

aka.farm


HOLOGRAM FRAGMENTS
syncwalk.city || sourdough.city
sublime.cloud || hi-hi-hi.com

Who I am

Visual and Environmental Studies

Hyperinstruments Group

Who I am

Visual and Environmental Studies

Hyperinstruments Group

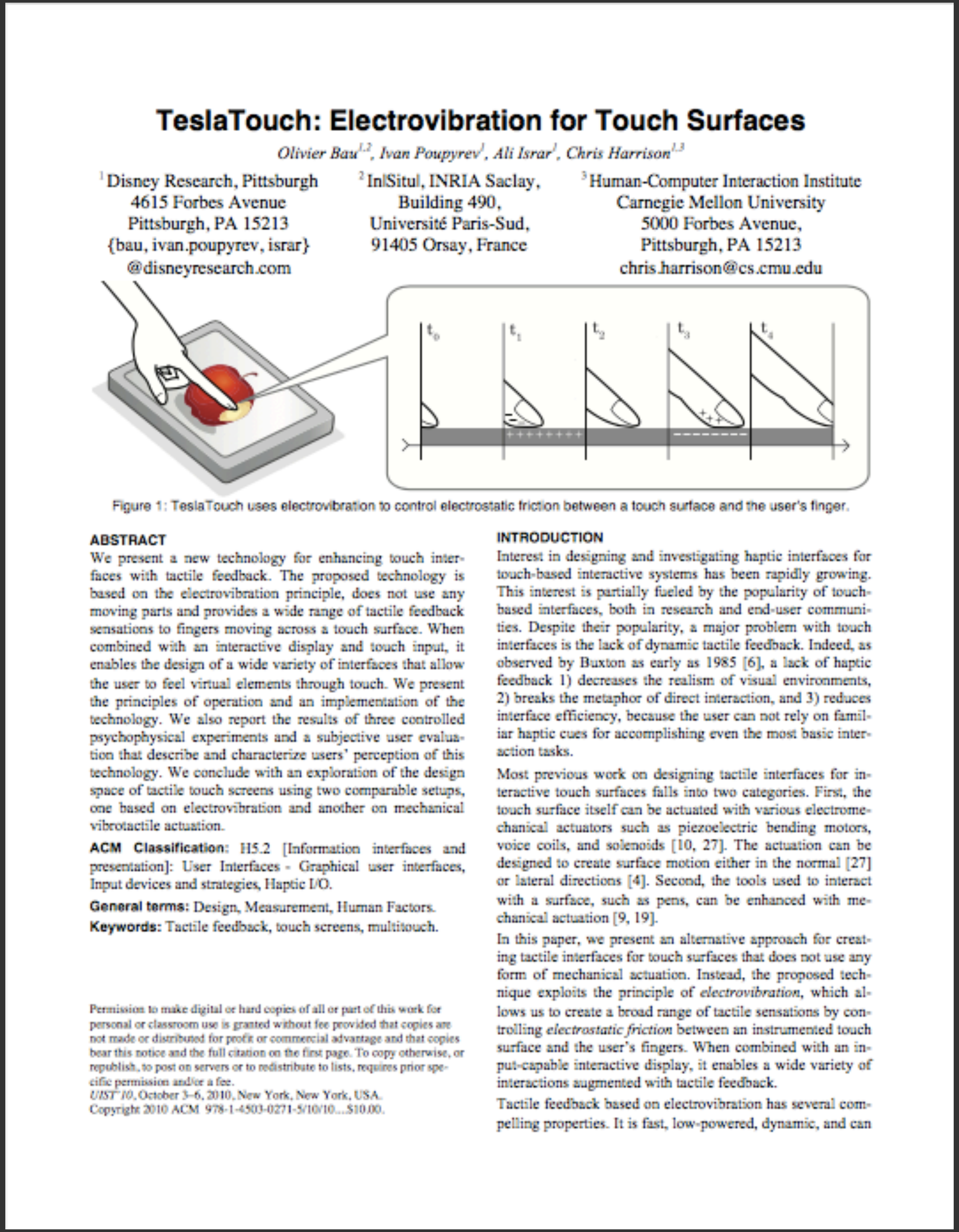
Electrovibration

Dynamically change the perceived texture of a surface

Dynamically change the perceived texture of a surface(!!)

Disney Research
TeslaTouch

Olivier Bau, Ivan Poupyrev,
Ali Israr, Chris Harrison



TeslaTouch: Electrovibration for Touch Surfaces

Olivier Bau[1,2], *Ivan Poupyrev*[1], *Ali Israr*[1], *Chris Harrison*[1,3]

[1] Disney Research, Pittsburgh
4615 Forbes Avenue
Pittsburgh, PA 15213
{bau, ivan.poupyrev, israr}
@disneyresearch.com

[2] In|Situ|, INRIA Saclay,
Building 490,
Université Paris-Sud,
91405 Orsay, France

[3] Human-Computer Interaction Institute
Carnegie Mellon University
5000 Forbes Avenue,
Pittsburgh, PA 15213
chris.harrison@cs.cmu.edu

Figure 1: TeslaTouch uses electrovibration to control electrostatic friction between a touch surface and the user's finger.

ABSTRACT

We present a new technology for enhancing touch interfaces with tactile feedback. The proposed technology is based on the electrovibration principle, does not use any moving parts and provides a wide range of tactile feedback sensations to fingers moving across a touch surface. When combined with an interactive display and touch input, it enables the design of a wide variety of interfaces that allow the user to feel virtual elements through touch. We present the principles of operation and an implementation of the technology. We also report the results of three controlled psychophysical experiments and a subjective user evaluation that describe and characterize users' perception of this technology. We conclude with an exploration of the design space of tactile touch screens using two comparable setups, one based on electrovibration and another on mechanical vibrotactile actuation.

ACM Classification: H5.2 [Information interfaces and presentation]: User Interfaces - Graphical user interfaces, Input devices and strategies, Haptic I/O.

General terms: Design, Measurement, Human Factors.

Keywords: Tactile feedback, touch screens, multitouch.

INTRODUCTION

Interest in designing and investigating haptic interfaces for touch-based interactive systems has been rapidly growing. This interest is partially fueled by the popularity of touch-based interfaces, both in research and end-user communities. Despite their popularity, a major problem with touch interfaces is the lack of dynamic tactile feedback. Indeed, as observed by Buxton as early as 1985 [6], a lack of haptic feedback 1) decreases the realism of visual environments, 2) breaks the metaphor of direct interaction, and 3) reduces interface efficiency, because the user can not rely on familiar haptic cues for accomplishing even the most basic interaction tasks.

Most previous work on designing tactile interfaces for interactive touch surfaces falls into two categories. First, the touch surface itself can be actuated with various electromechanical actuators such as piezoelectric bending motors, voice coils, and solenoids [10, 27]. The actuation can be designed to create surface motion either in the normal [27] or lateral directions [4]. Second, the tools used to interact with a surface, such as pens, can be enhanced with mechanical actuation [9, 19].

In this paper, we present an alternative approach for creating tactile interfaces for touch surfaces that does not use any form of mechanical actuation. Instead, the proposed technique exploits the principle of *electrovibration*, which allows us to create a broad range of tactile sensations by controlling *electrostatic friction* between an instrumented touch surface and the user's fingers. When combined with an input-capable interactive display, it enables a wide variety of interactions augmented with tactile feedback.

Tactile feedback based on electrovibration has several compelling properties. It is fast, low-powered, dynamic, and can

Disney Research
REVEL

Olivier Bau, Ivan Poupyrev

REVEL: Tactile Feedback Technology for Augmented Reality

Olivier Bau[*]
Disney Research, Pittsburgh

Ivan Poupyrev[†]
Disney Research, Pittsburgh

Abstract

REVEL is an augmented reality (AR) tactile technology that allows for change to the tactile feeling of real objects by augmenting them with virtual tactile textures using a device worn by the user. Unlike previous attempts to enhance AR environments with haptics, we neither physically actuate objects or use any force- or tactile-feedback devices, nor require users to wear tactile gloves or other apparatus on their hands. Instead, we employ the principle of *reverse electrovibration* where we inject a weak electrical signal anywhere on the user body creating an oscillating electrical field around the user's fingers. When sliding his or her fingers on a surface of the object, the user perceives highly distinctive tactile textures augmenting the physical object. By tracking the objects and location of the touch, we associate dynamic tactile sensations to the interaction context. REVEL is built upon our previous work on designing electrovibration-based tactile feedback for touch surfaces [Bau, et al. 2010]. In this paper we expand tactile interfaces based on electrovibration beyond touch surfaces and bring them into the real world. We demonstrate a broad range of application scenarios where our technology can be used to enhance AR interaction with dynamic and unobtrusive tactile feedback.

CR Categories: H5.2 [Information interfaces and presentation]: User Interfaces - Graphical user interfaces, Input devices and strategies, Haptic I/O.

Keywords: augmented reality, haptics, tactile displays, tangible interfaces, augmented surfaces, touch interaction.

Links: DL PDF

1. Introduction

Augmented Reality has recently emerged as one of the key application areas of interactive computer graphics and is rapidly expanding from research laboratories into everyday use. The fundamental premise of AR is to enable us to interact with virtual objects immediately and directly, seeing, feeling and manipulating them just as we do with physical objects. Most AR applications, however, provide only visual augmentation of the real world and do not provide the means to let the user *feel* tactile, physical properties of virtual objects or to enhance the physical world with computer-generated tactile textures. The absence of tactile feedback does not allow us to take advantage of the powerful mechanisms of the human sense of touch and diminishes the quality of the experience.

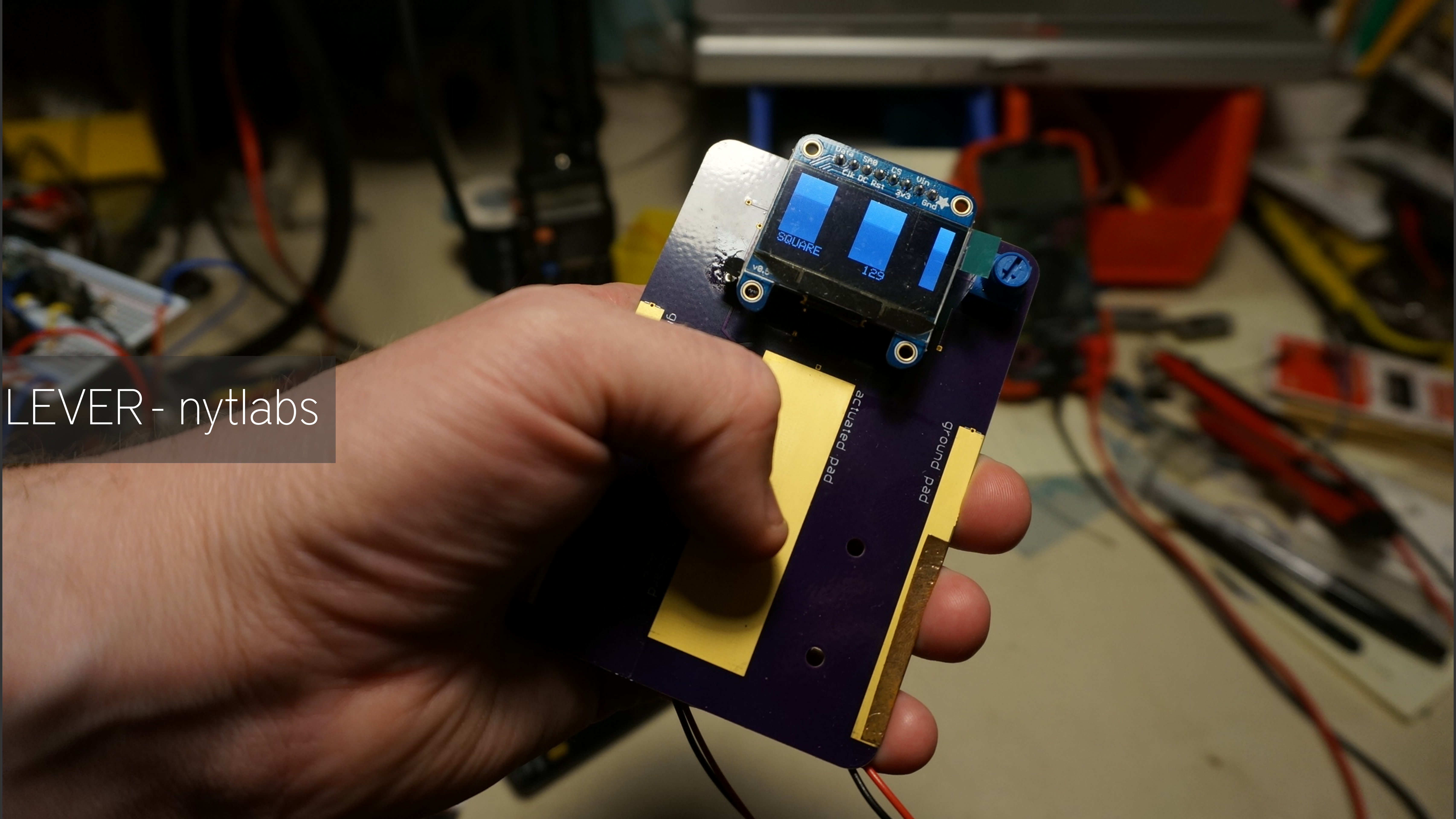
REVEL is an augmented reality (AR) tactile technology that allows us to change the tactile feeling of real world objects by augmenting them with virtual tactile textures (Figure 1). It is based on the principle of *reverse electrovibration* where a weak electrical signal is injected anywhere on the user's body, creating an oscillating electrical field around the user's fingers. As the user then slides his or her fingers on the surface of an object, the user perceives highly distinctive tactile textures overlying the physical object. By tracking touch locations, tactile textures can be dynamically modified in real time and enhanced with visual augmentation if required. The user's hands remain free and unencumbered, so that users can continue their natural interaction with the world around them, unconstrained by tactile feedback technology. In a broad sense we are programmatically controlling the user's tactile perception.

REVEL advances our previous research on electrovibration-based tactile displays for touch surfaces, i.e., TeslaTouch [Bau, Poupyrev, et al. 2010]. In TeslaTouch the electrical signal was injected into the surface electrode of the touch screens, the classic technique to design tactile displays based on electrovibration, e.g., devices for the blind proposed in the early 70s [Strong, 1970]. In all these displays, including TeslaTouch, the tactile sensation is localized within a specific device augmented with tactile feedback, which is not scalable. Indeed, to add virtual tactile sensations to more objects or devices, all of them must be instrumented with tactile feedback apparatus. REVEL produces the same tactile effect, but reverses this dependency on individual object instrumentation. It instead injects tactile signals directly into the user's body, so that the user becomes the carrier of the tactile signal at all times. The world and objects remain passive, requiring no instrumentation with additional technology. Therefore, this technology potentially allows for the creation of truly ubiquitous tactile interfaces that can be used anywhere and anytime.

Figure 1: *The user feels virtual tactile textures on a real object while observing them on a AR display. Note, that the object is not instrumented with any tactile actuation apparatus.*

[*] bau@disneyresearch.com
[†] ivan.poupyrev@disneyresearch.com

ACM Reference Format
Bau, O., Poupyrev, I. 2012. REVEL: Tactile Feedback Technology for Augmented Reality. *ACM Trans. Graph.* 31 4, Article 89 (July 2012), 11 pages. DOI = 10.1145/2185520.2185585 http://doi.acm.org/10.1145/2185520.2185585.


LEVER - nytlabs
SQUARE
129
actuated pad
ground pad
Data SA0 CS Vin
Clk DC Rst 3v3 Gnd

How does it work?

How does it work?

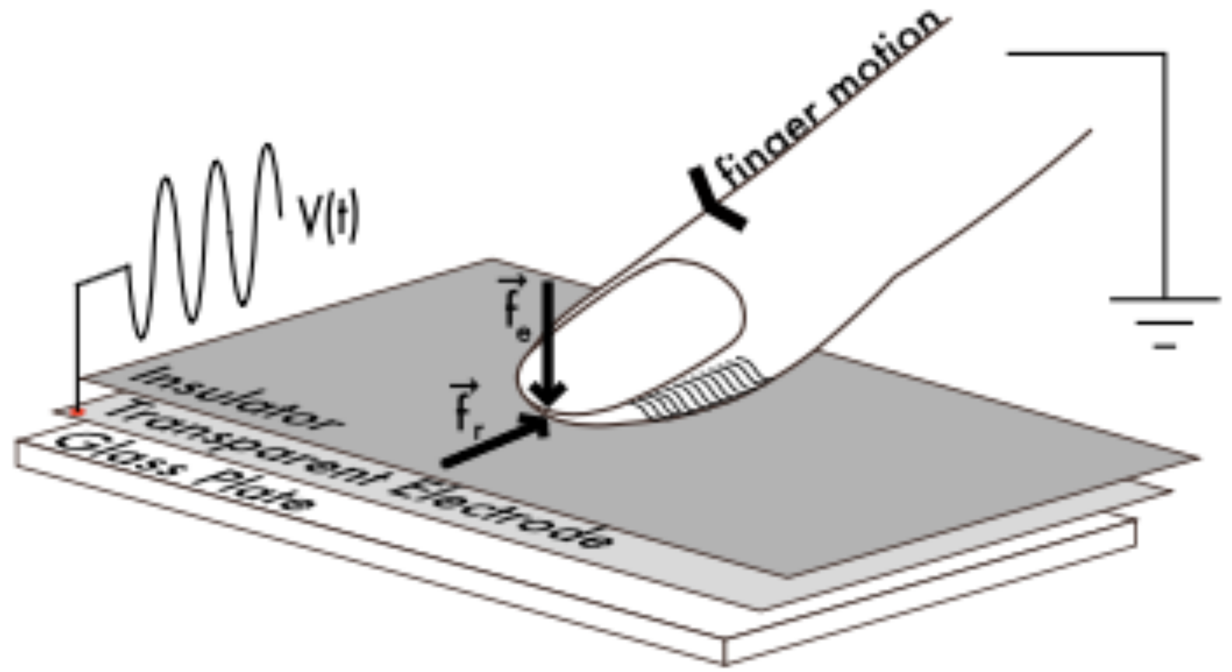


Figure 2: TeslaTouch operating principle.

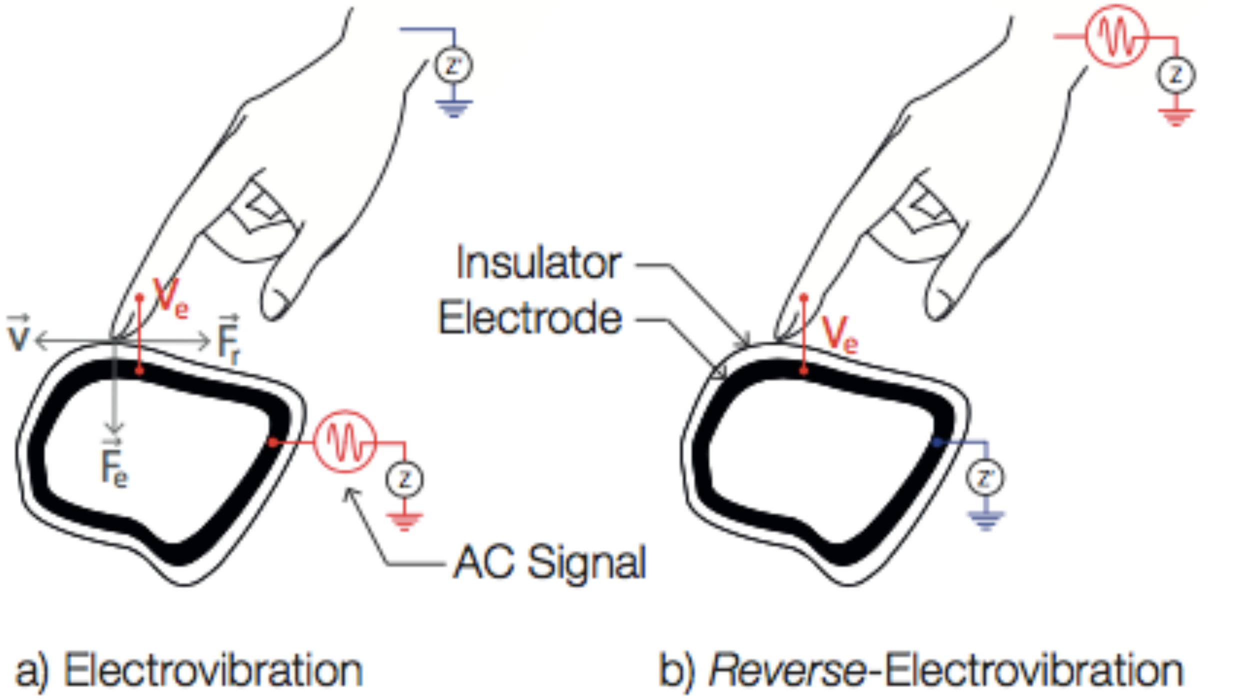
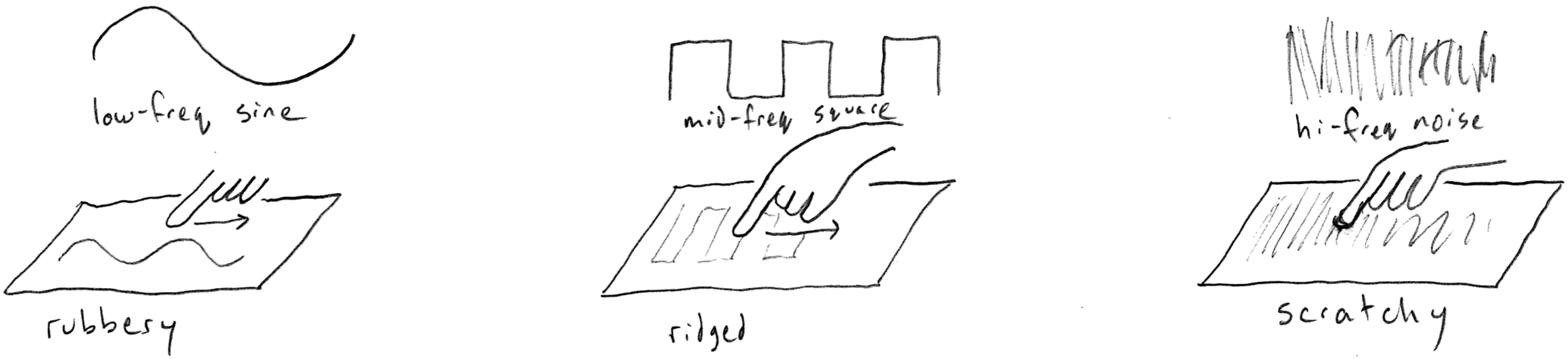


Figure 3: *Electrovibration versus Reverse electrovibration: (a) AC signal is injected into the object; (b) AC signal is injected into the user. Both produce equivalent tactile sensation.*


low-freq sine
rubbery
mid-freq square
ridged
hi-freq noise
scratchy

How does it feel?

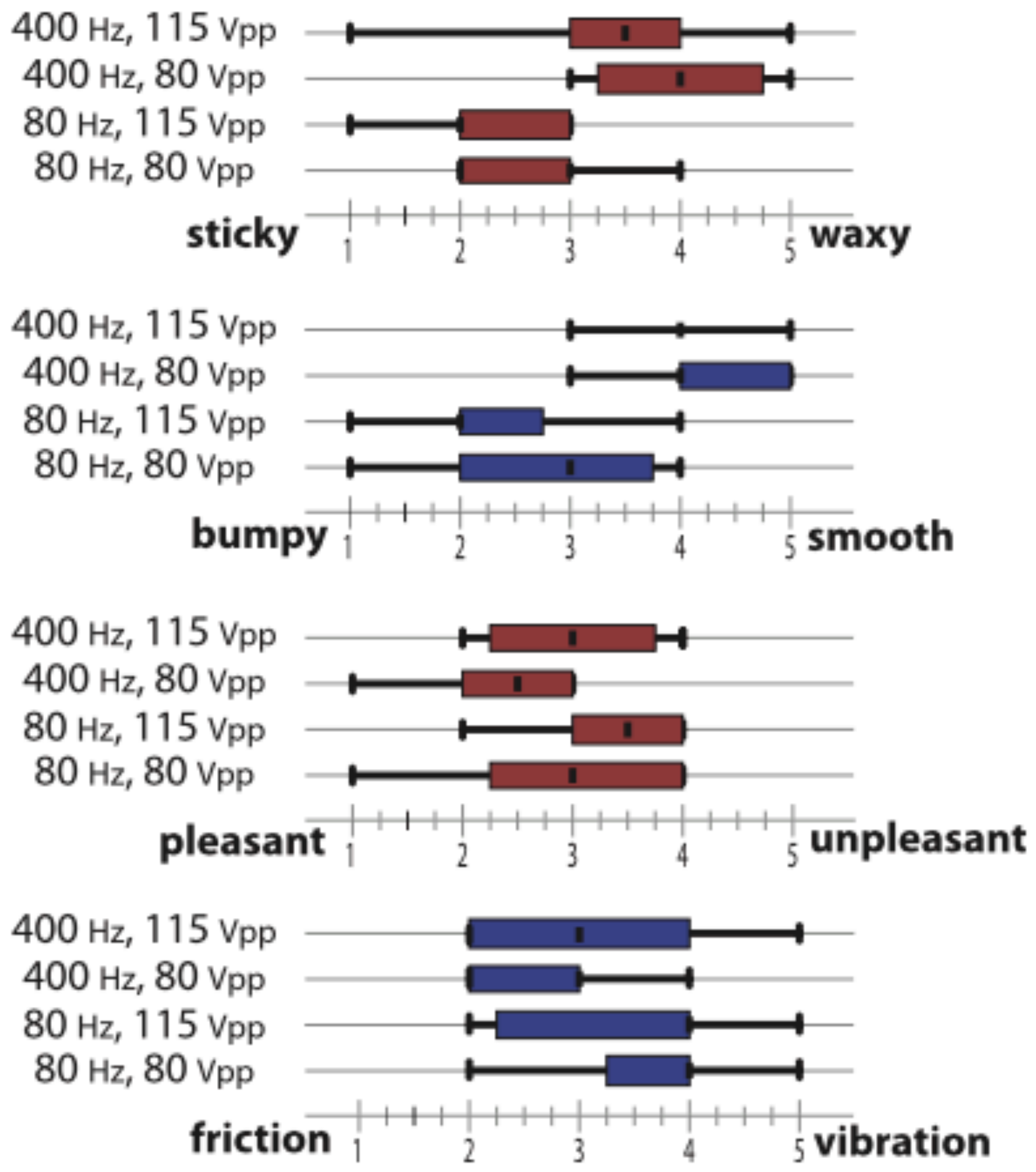
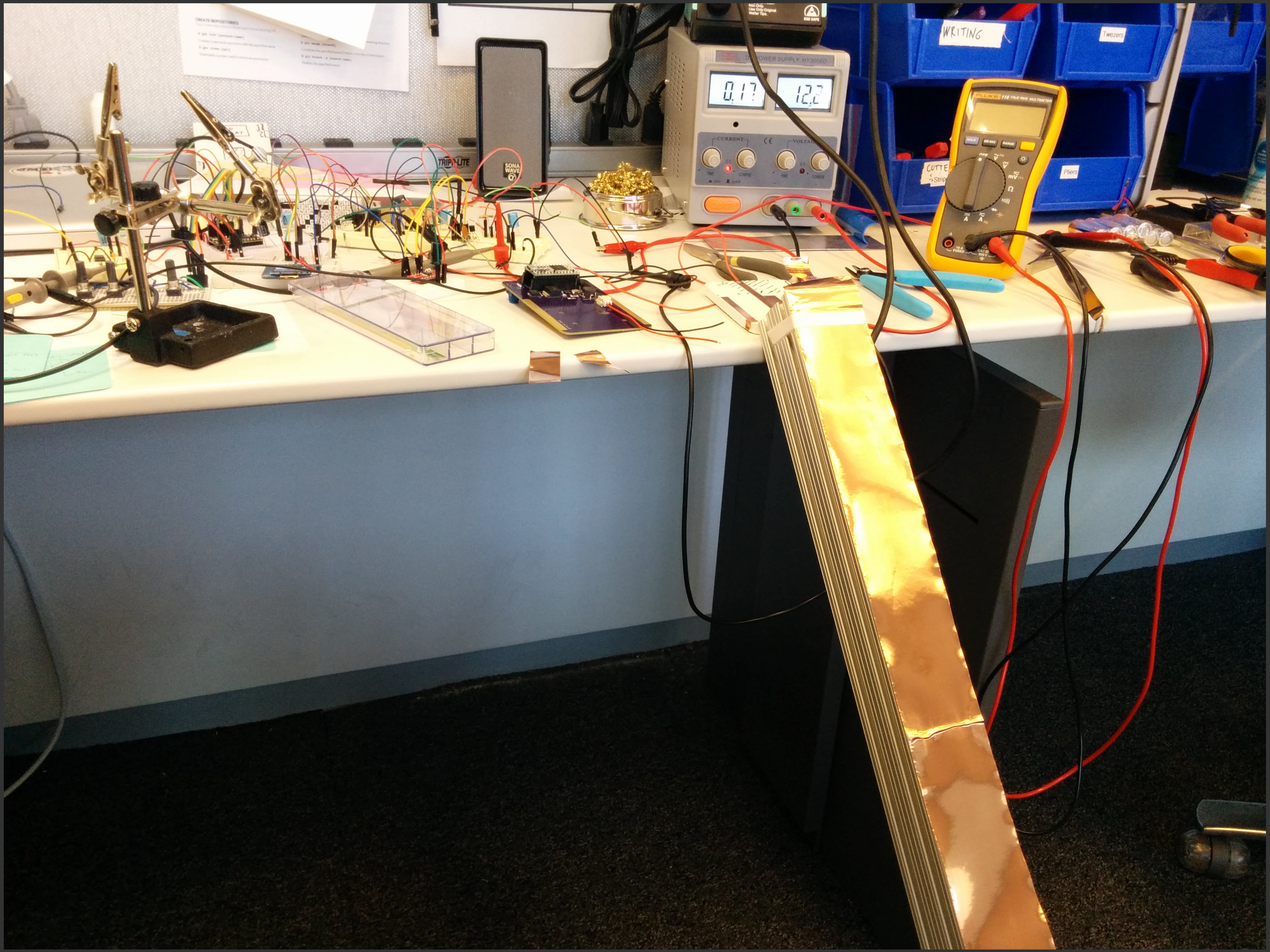
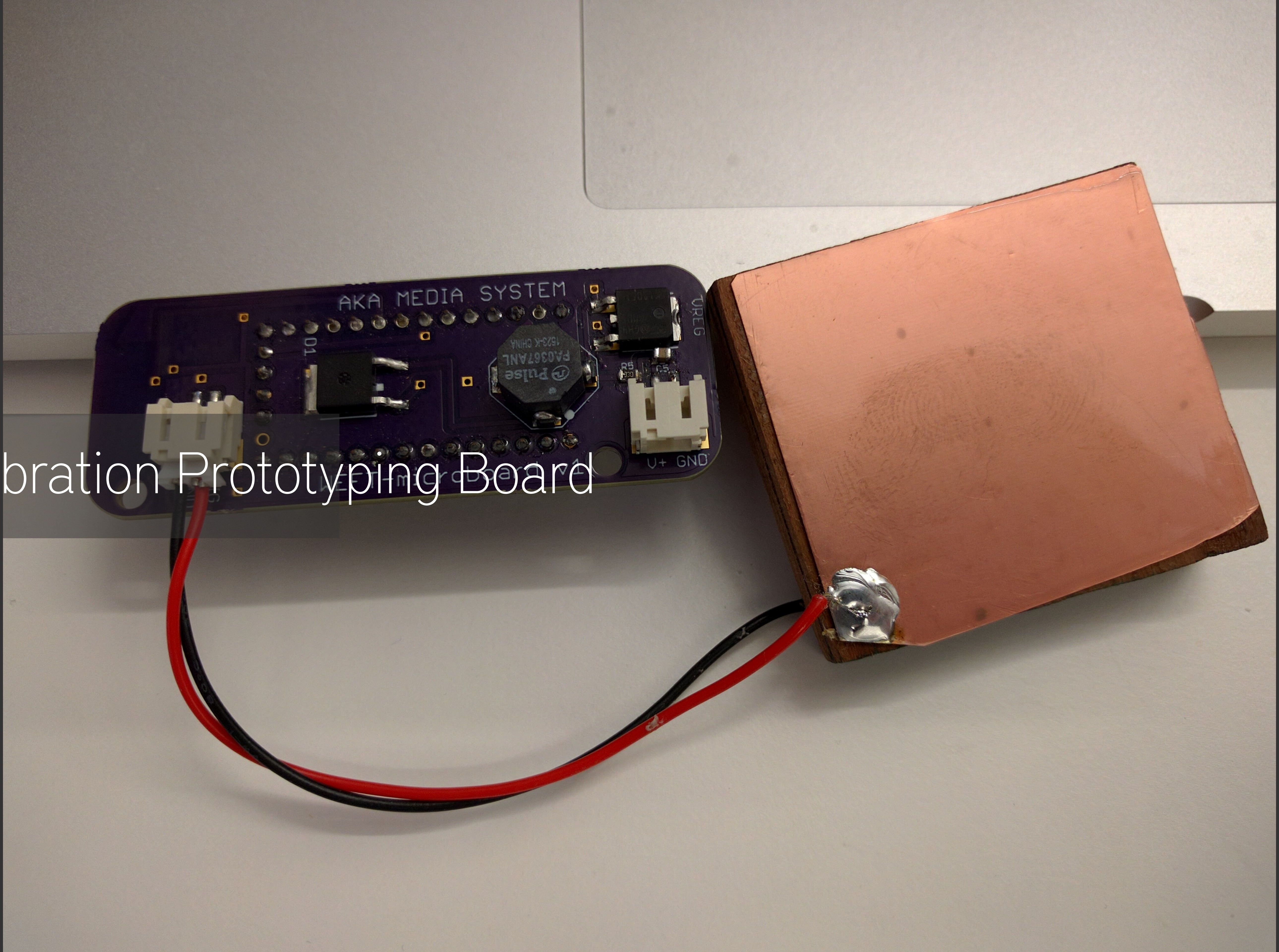


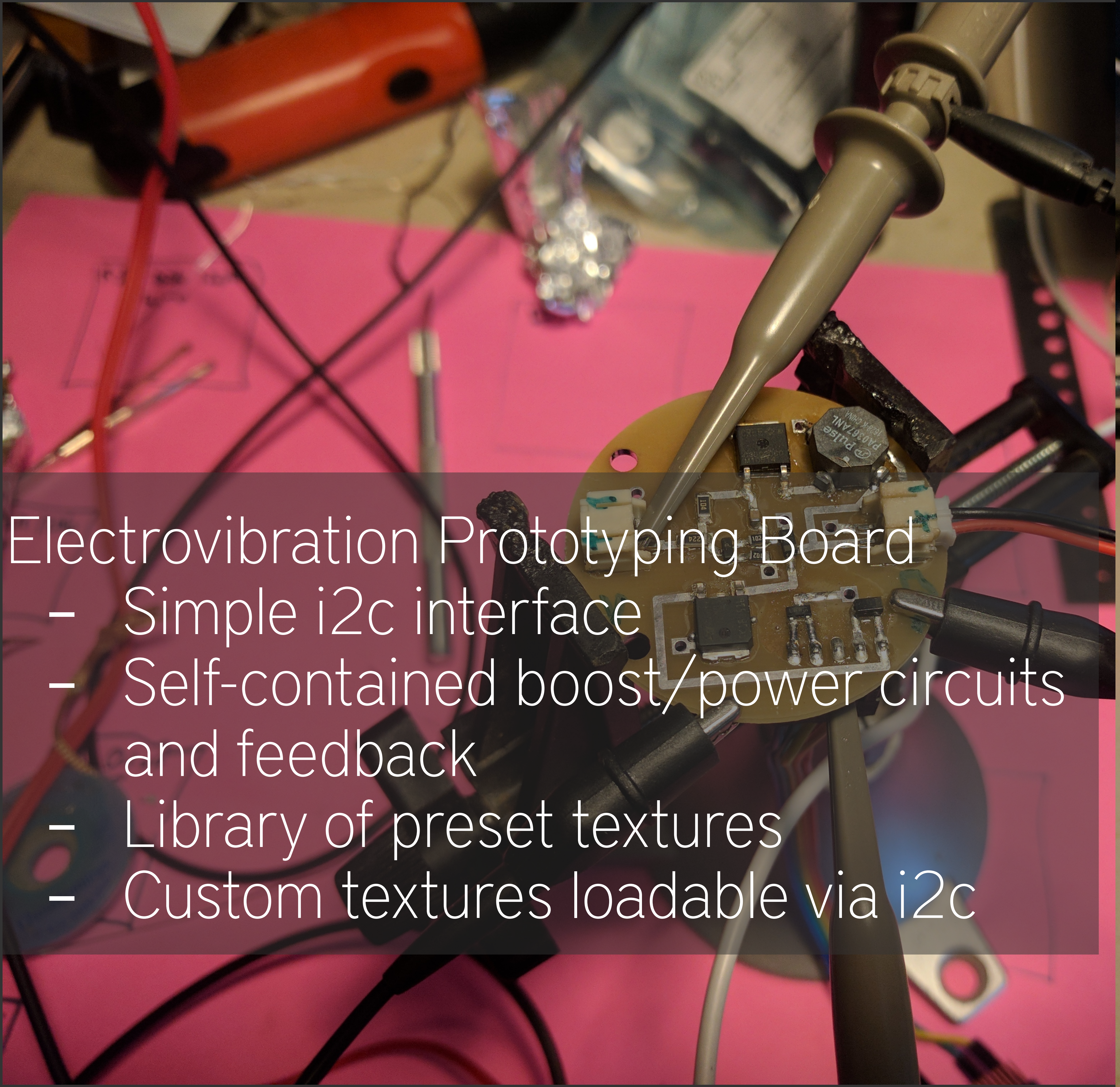
Figure 4: Ratings of stickiness, smoothness, pleasure and level of friction vs. vibration.

(Wu-Tang rig)



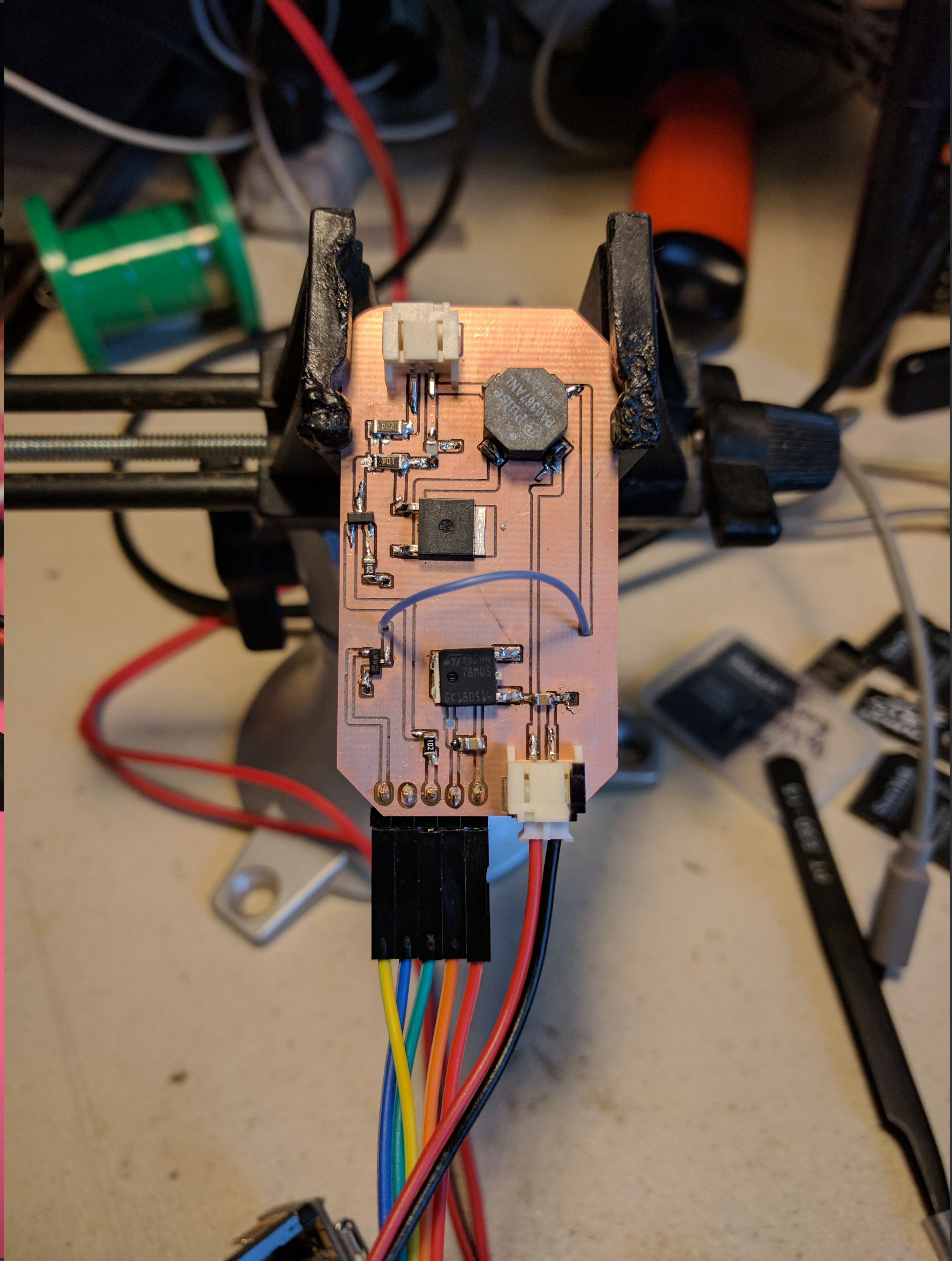
Electrovibration Prototyping Board





Electrovibration Prototyping Board

- Simple i2c interface
- Self-contained boost/power circuits and feedback
- Library of preset textures
- Custom textures loadable via i2c



Challenges

Challenges

- feedback circuit / normalization across different bodies
- manufacturability (conformal coating, potting)
- marketing and promotion (ie, me)
- support / desirability

Exciting

Exciting

- build a team of people I love working with
- grow beyond prototyping
- make something long-wanted but newly-possible

But wait!! There’s more

Prototyping board

- solve EE problems
- learn from initial users
- test market interest

Prototyping board

- solve EE problems
- learn from initial users
- test market interest

Wearable Device

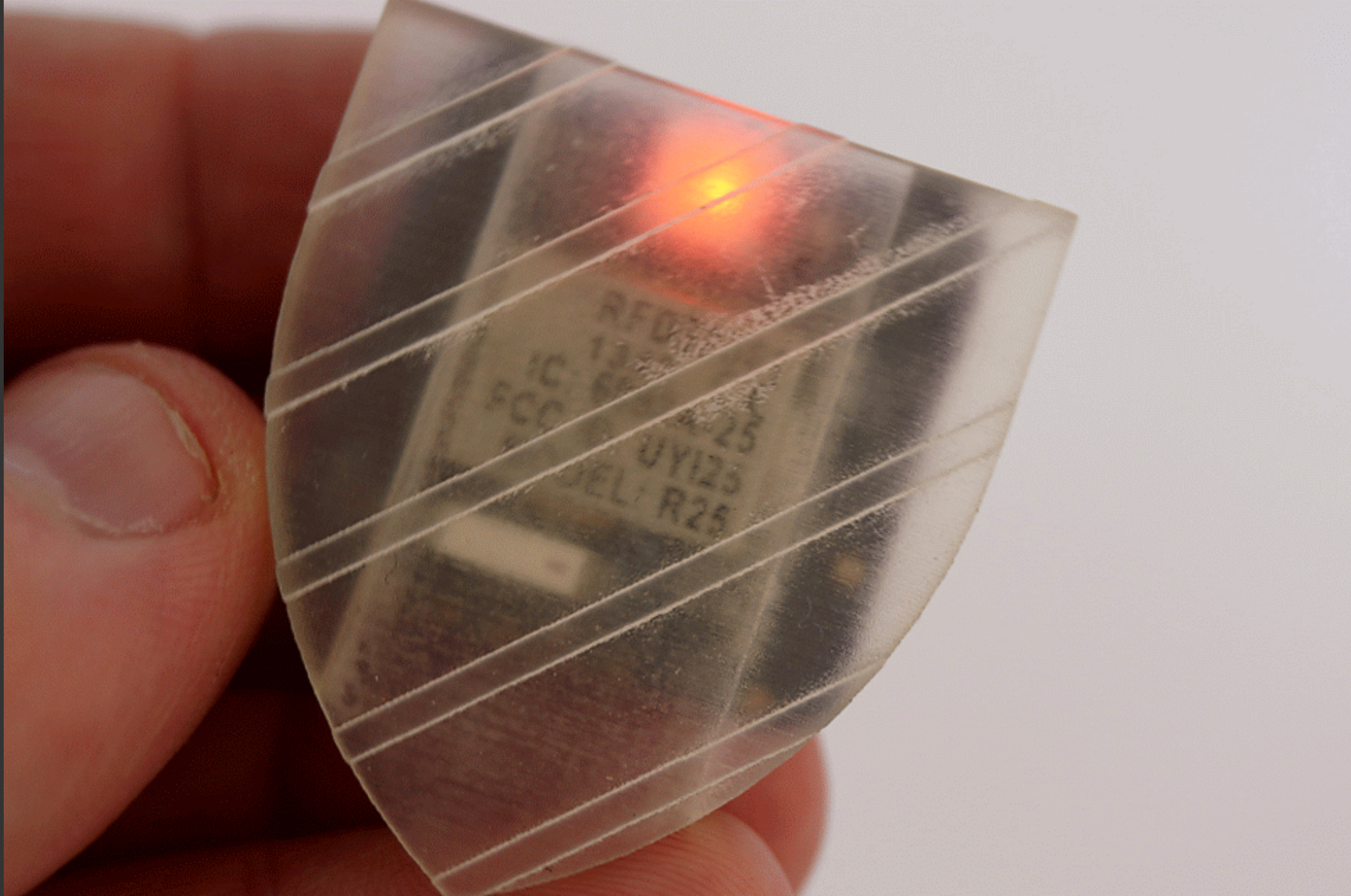
- scale improved design
- hone product-mkt fit
- get…funding?

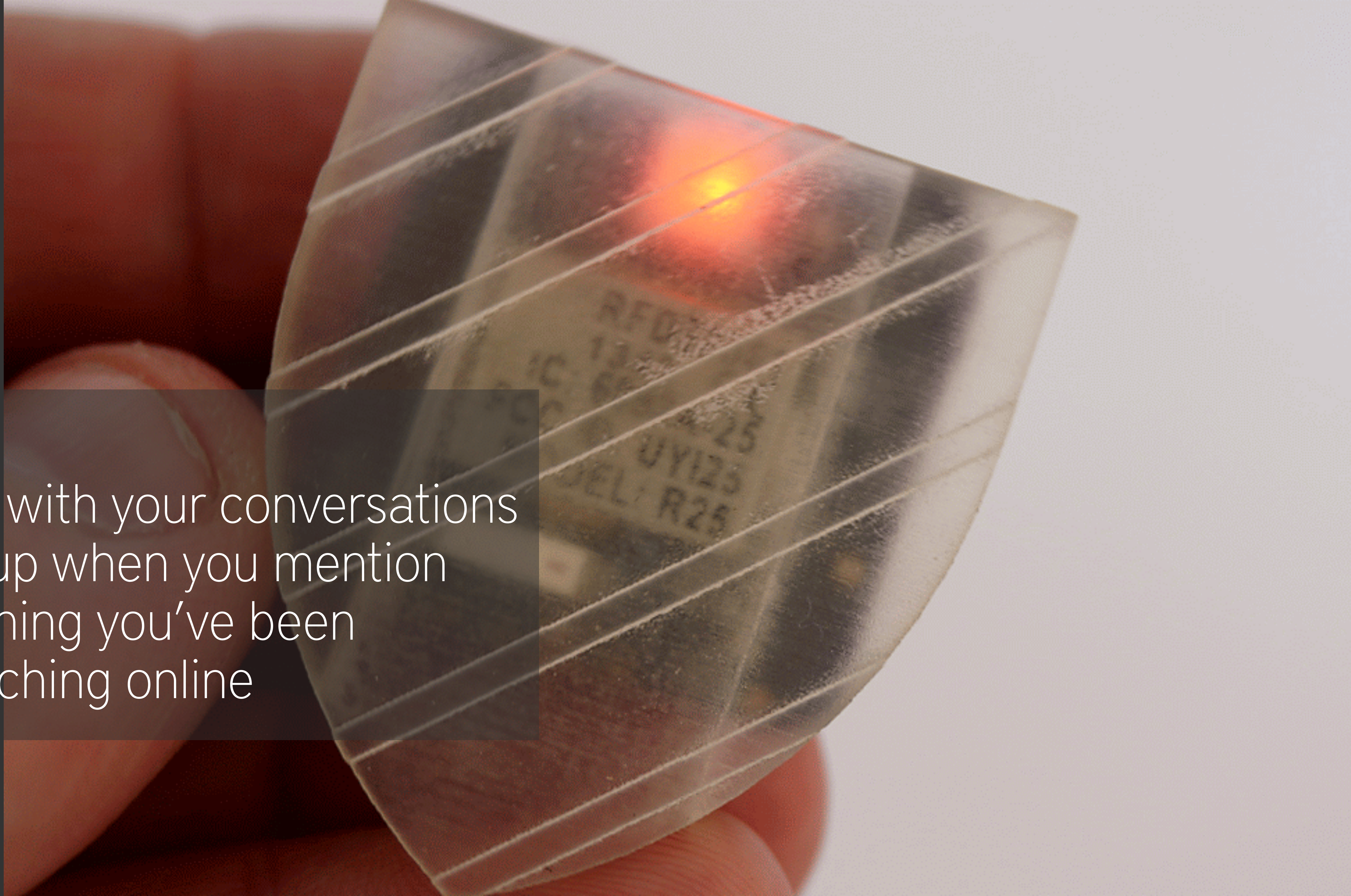
A pet theory: Social Wearables

Social Wearables

objects you carry on your person not for their "listening" function (ie, activity trackers, photo/audio recorders), but for their ability to enhance interpersonal interactions

BLUSH

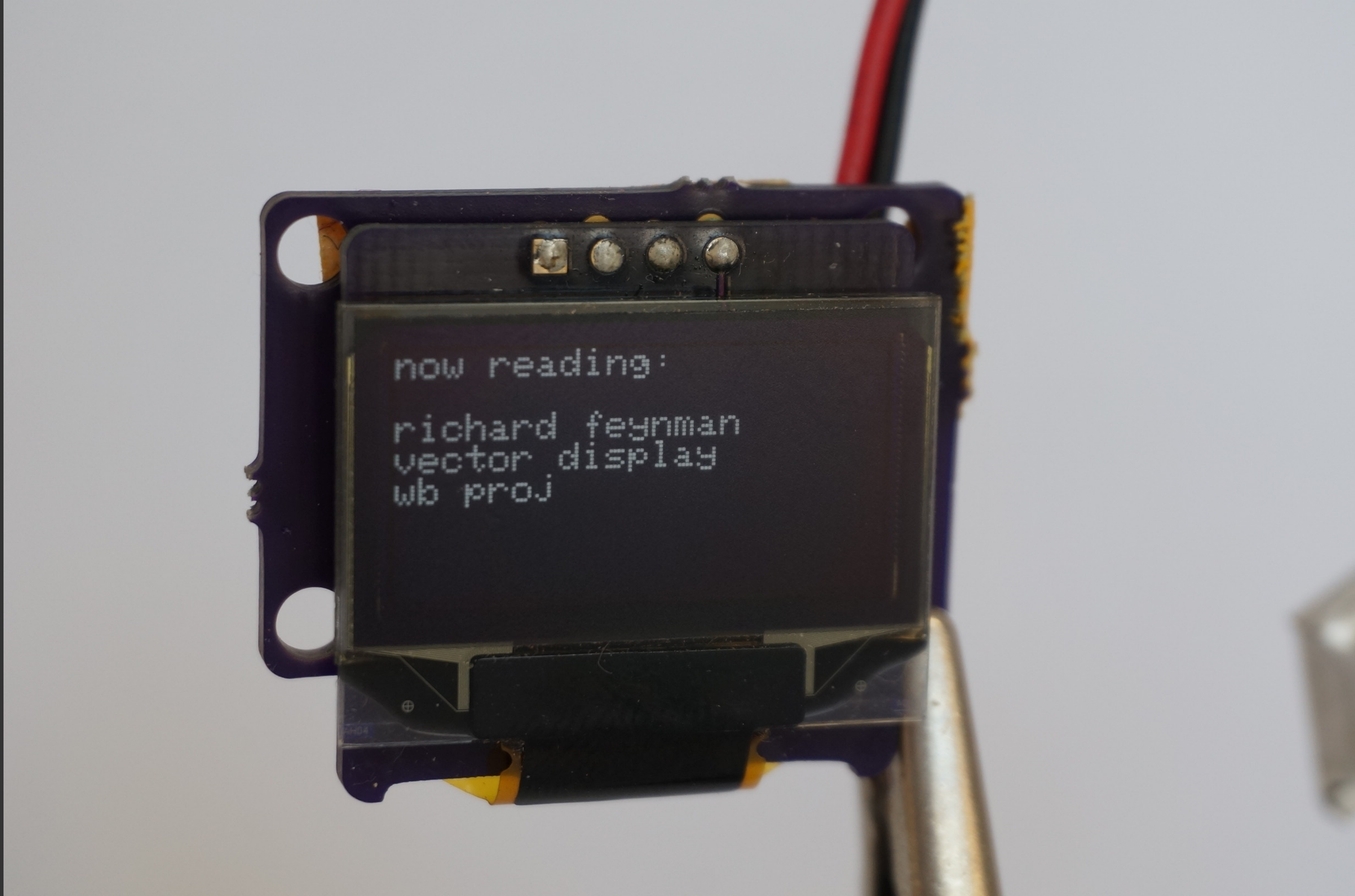




BLUSH

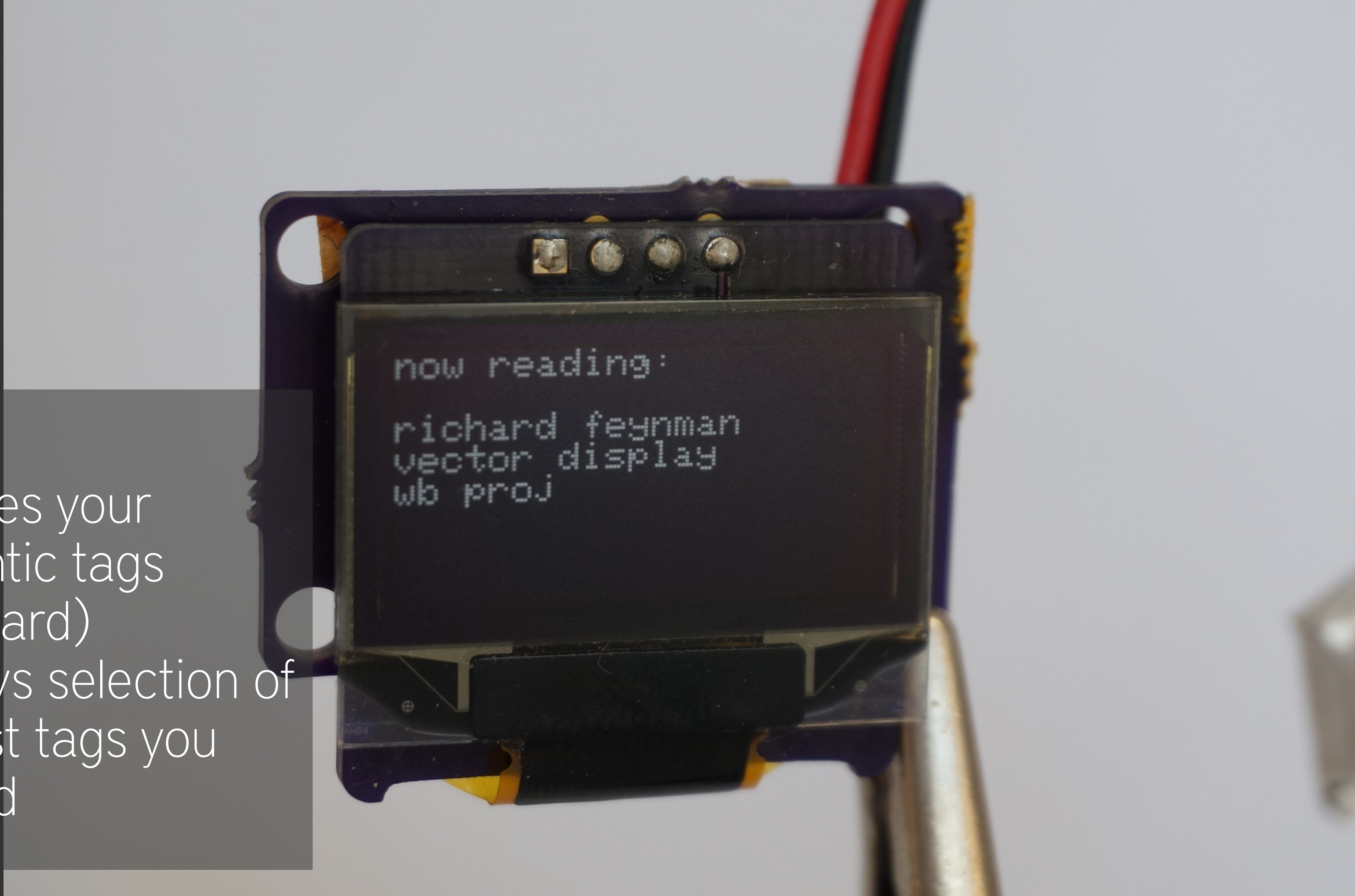
- listens with your conversations
- lights up when you mention something you've been researching online

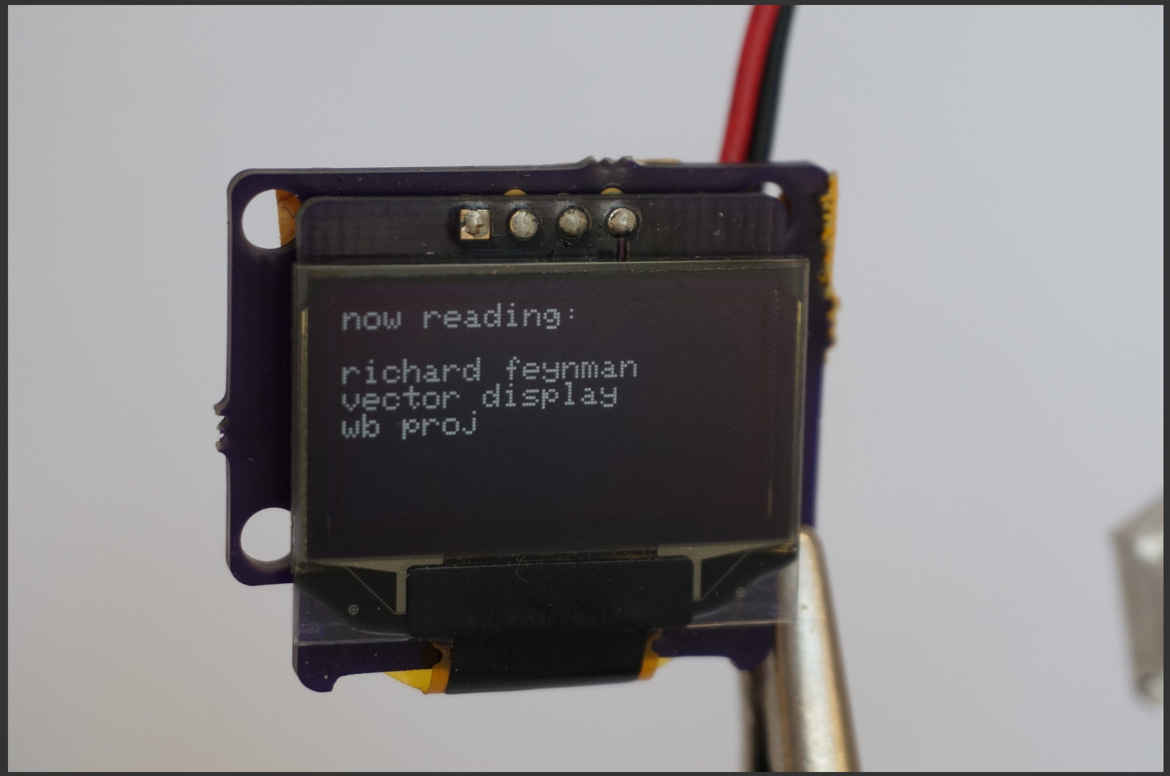
CLIP-E

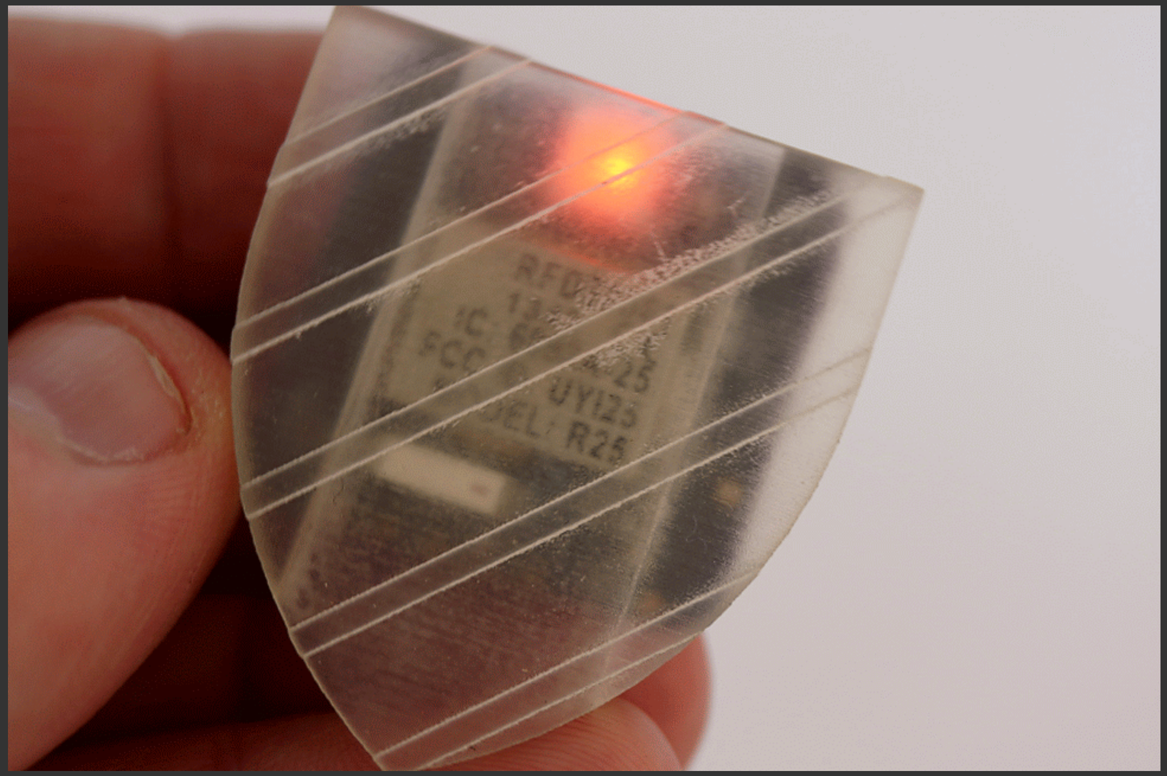


CLIP-E

- watches your semantic tags (pinboard)
- displays selection of the last tags you applied







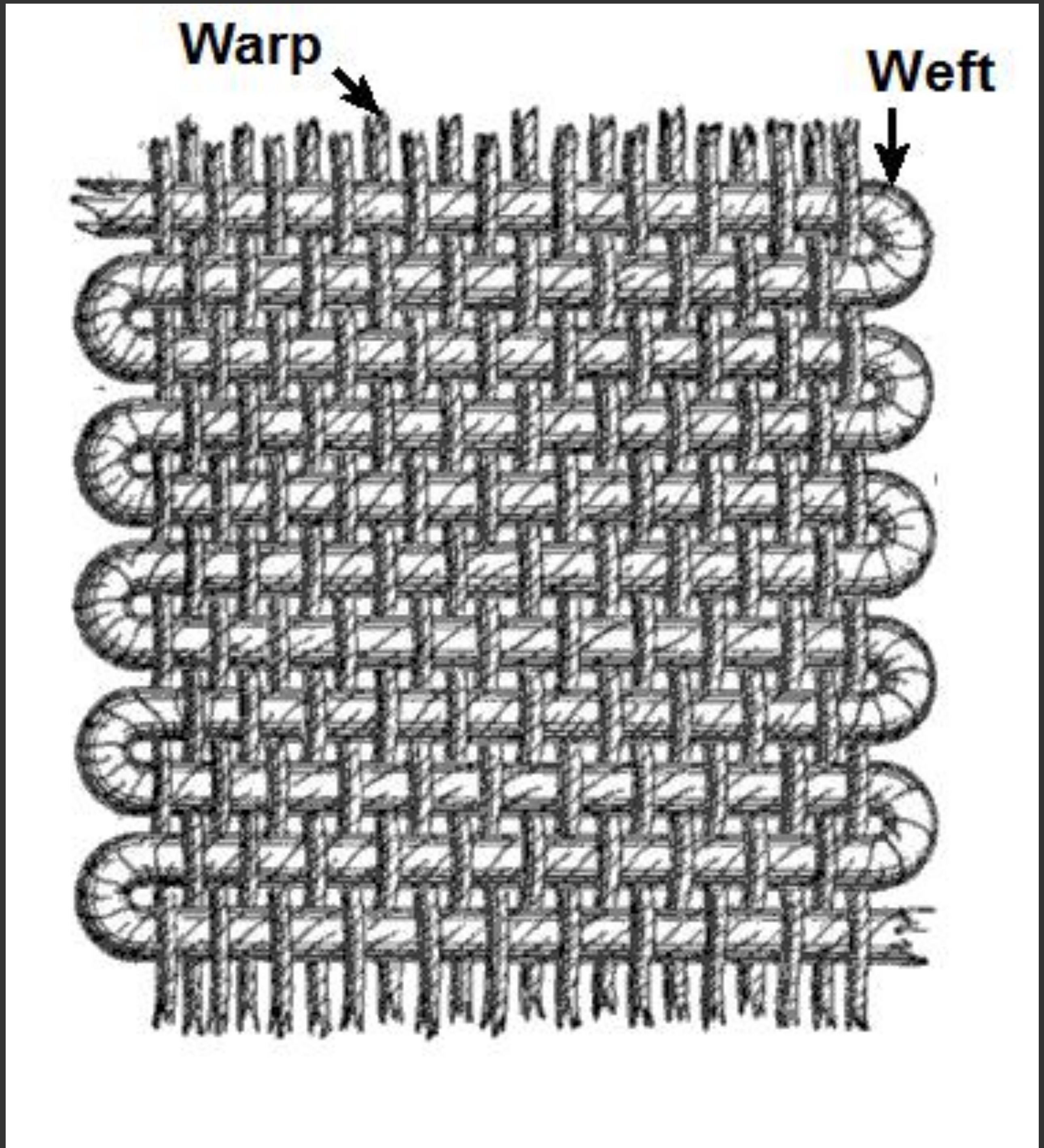
CLIP-E

- explicit
- asynchronous
- elicits questions / starts conversations

BLUSH

- implicit signals
- synchronous
- enormous, unworkable consent problem
- elicits questions / starts conversations

WEFT
BLE-enabled electrovibration wearable



WEFT
touchable notification summaries

Challenge: how to focus on what’s around me, rather than what’s on my phone

Challenge: how to focus on what’s around me, rather than what’s on my phone

...without FOMO

Passive (user decides when
to query device)

Covert (checking status is not
distracting or off-putting)

Expressive / nonbinary

How will people prototype with this?

How will people find out about it?

Can you build critical hardware as a business, not an academic/art pursuit??

New customs / new spaces

"What's the wifi here?"

photo: https://www.flickr.com/photos/nnova/2405193997

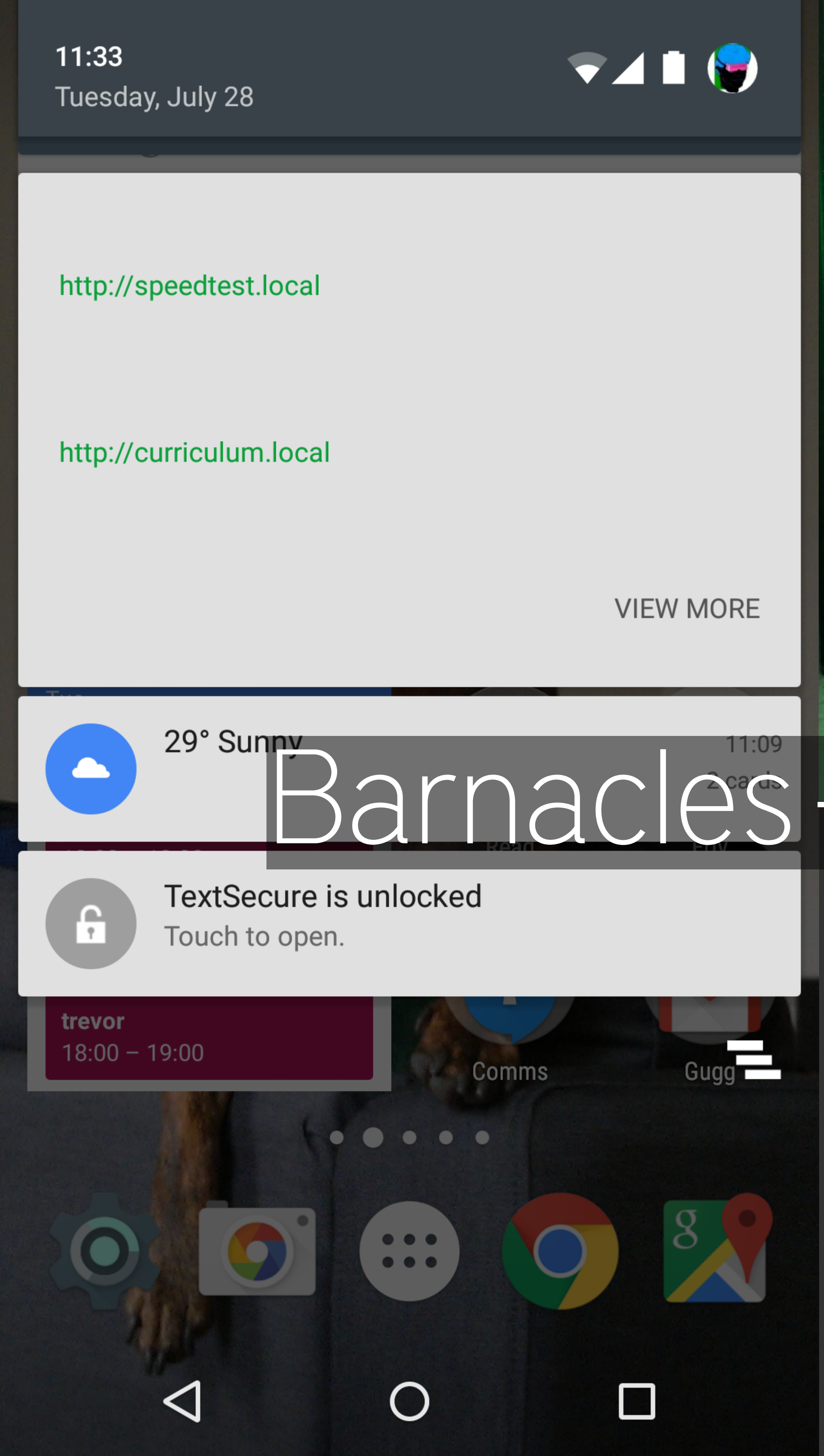
Teen burglar wakes up California couple, asks to use their Wi-Fi

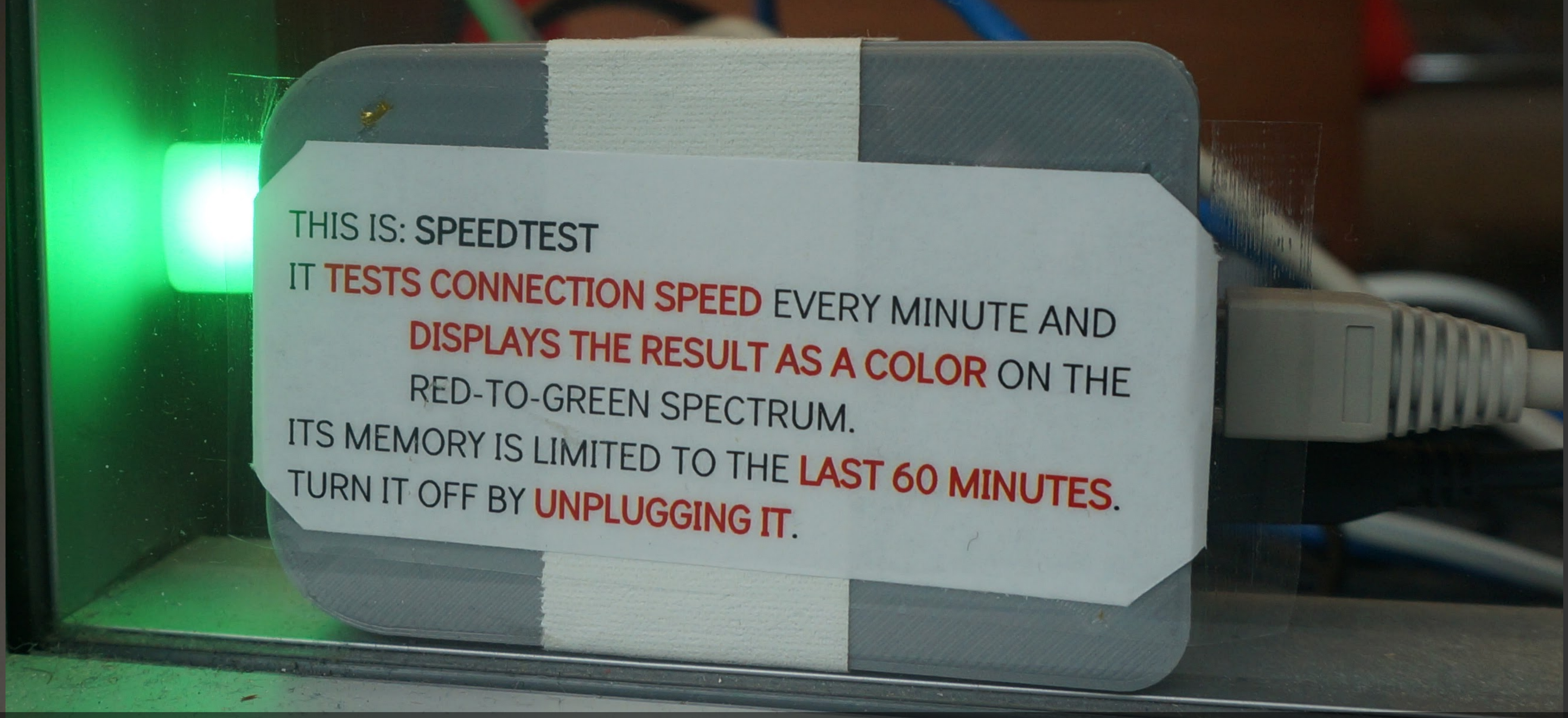
by BRYAN CLARK — 1 day ago in SECURITY

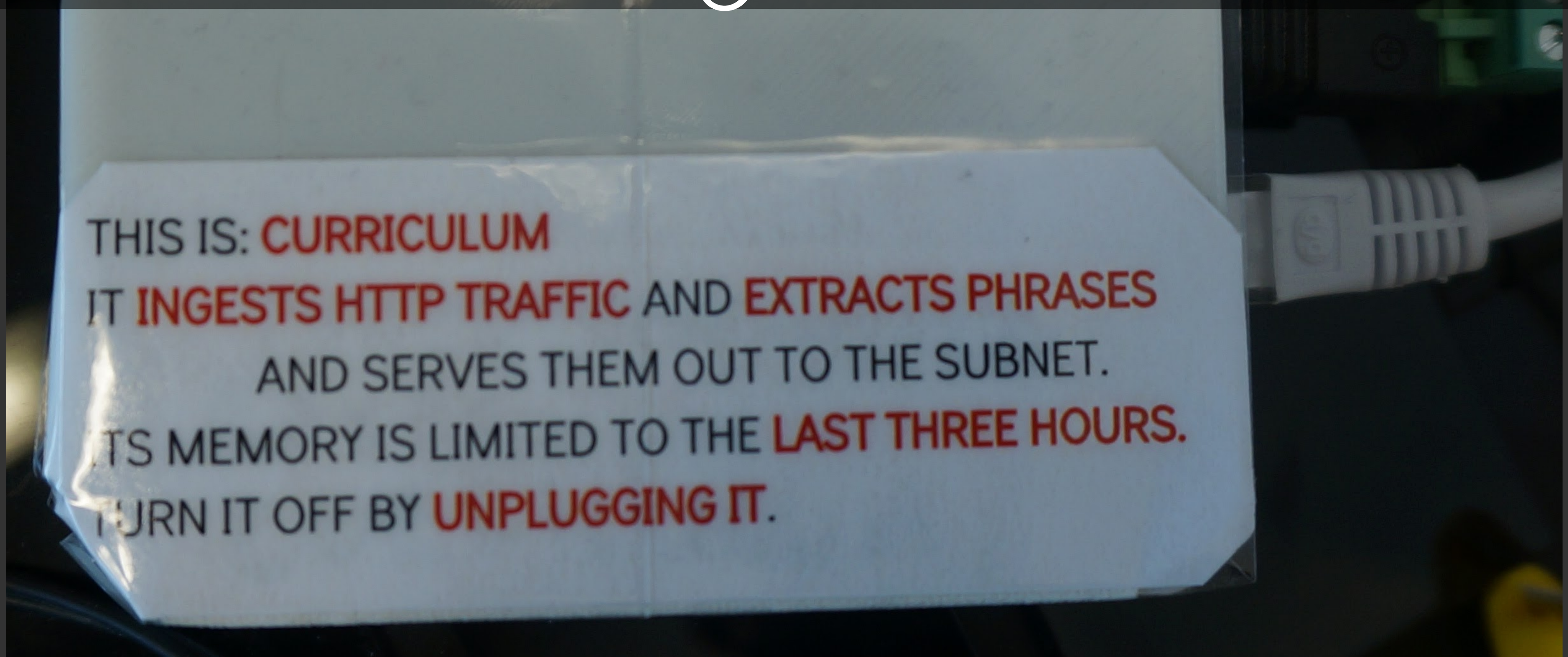
Network-space as a site of hospitality

photo: https://www.flickr.com/photos/nnova/2405193997

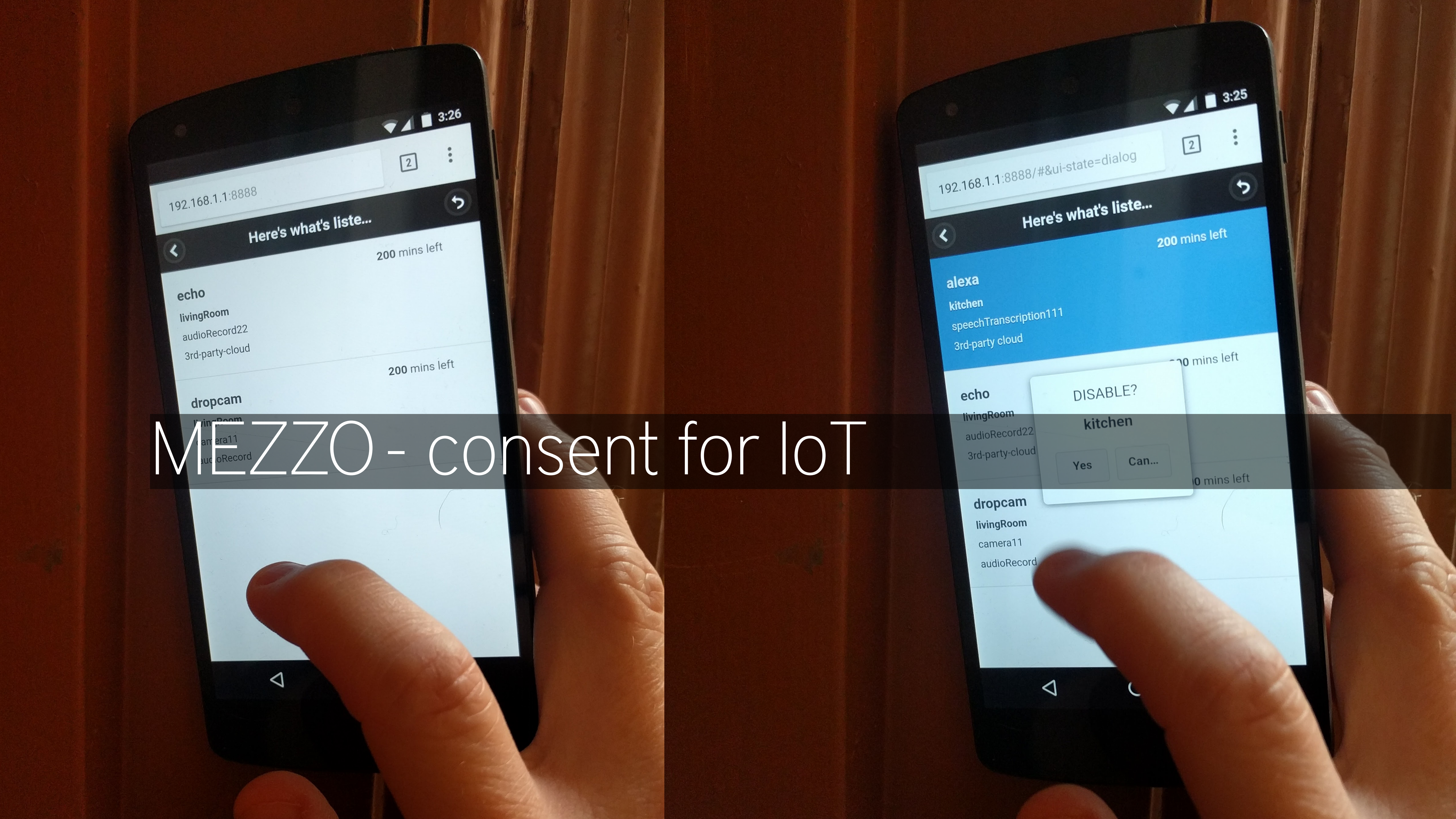
Barnacles - useful wifi hangers-on



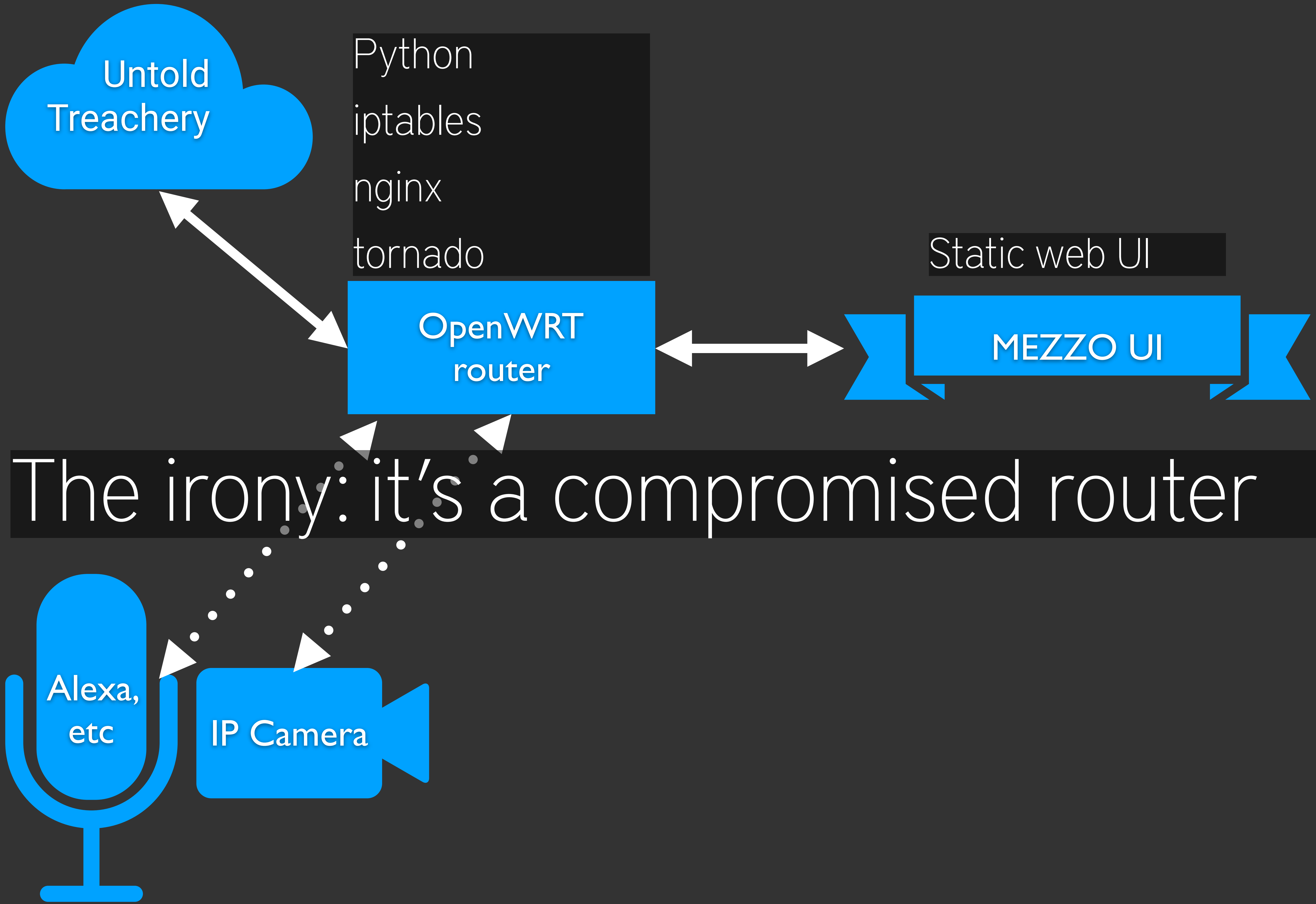




“Oh BTW Alexa’s recording everything”


MEZZO - consent for IoT
3:26
192.168.1.1:8888
Here's what's liste...
200 mins left
echo
livingRoom
audioRecord22
3rd-party-cloud
200 mins left
dropcam
3:25
192.168.1.1:8888/#&ui-state=dialog
Here's what's liste...
200 mins left
alexa
kitchen
speechTranscription111
3rd-party cloud
echo
livingRoom
audioRecord22
3rd-party-cloud
DISABLE?
kitchen
Yes
Can...
dropcam
livingRoom
camera11
audioRecord

The irony: it's a compromised router

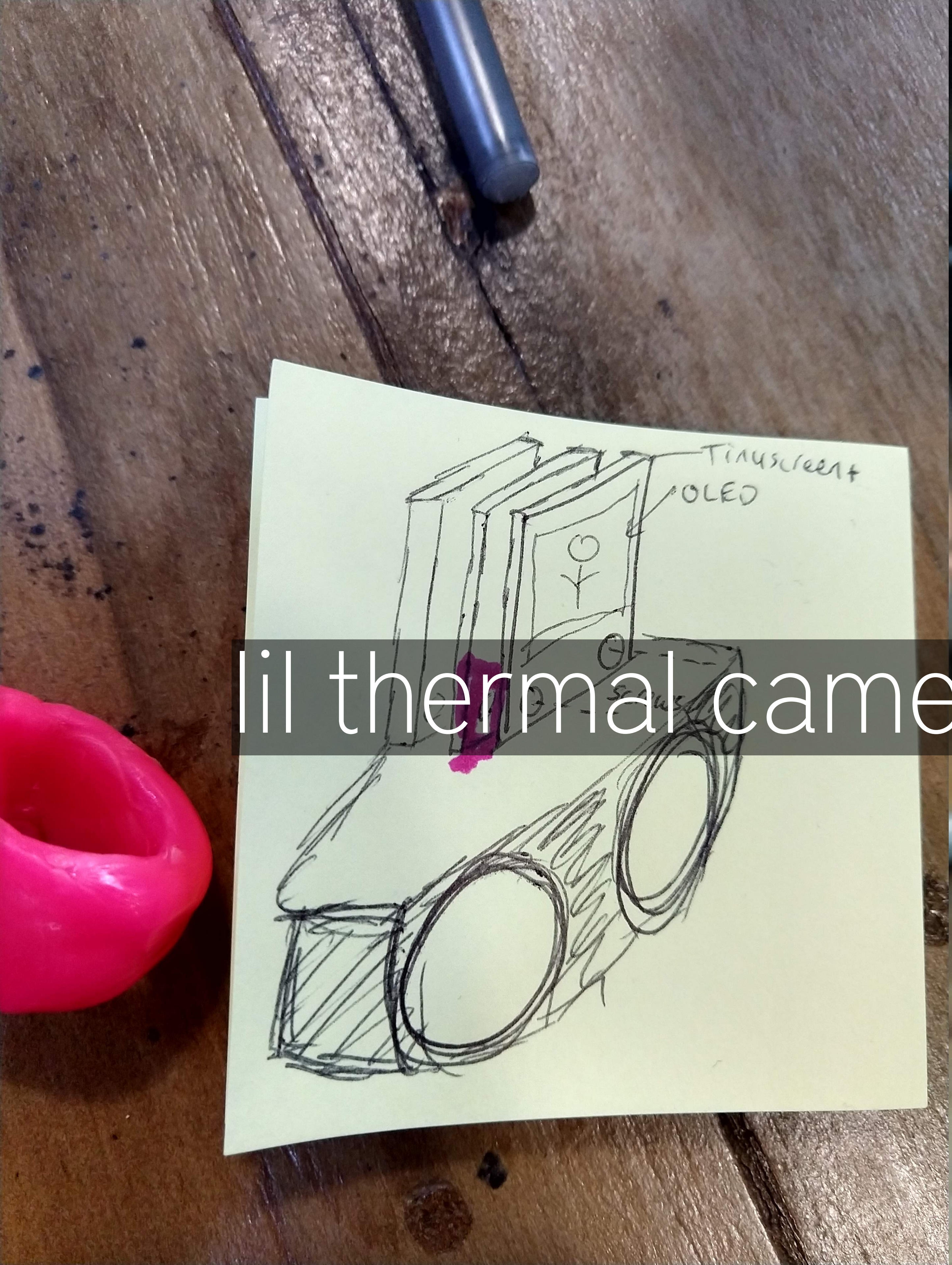


“Consent mezuzah”

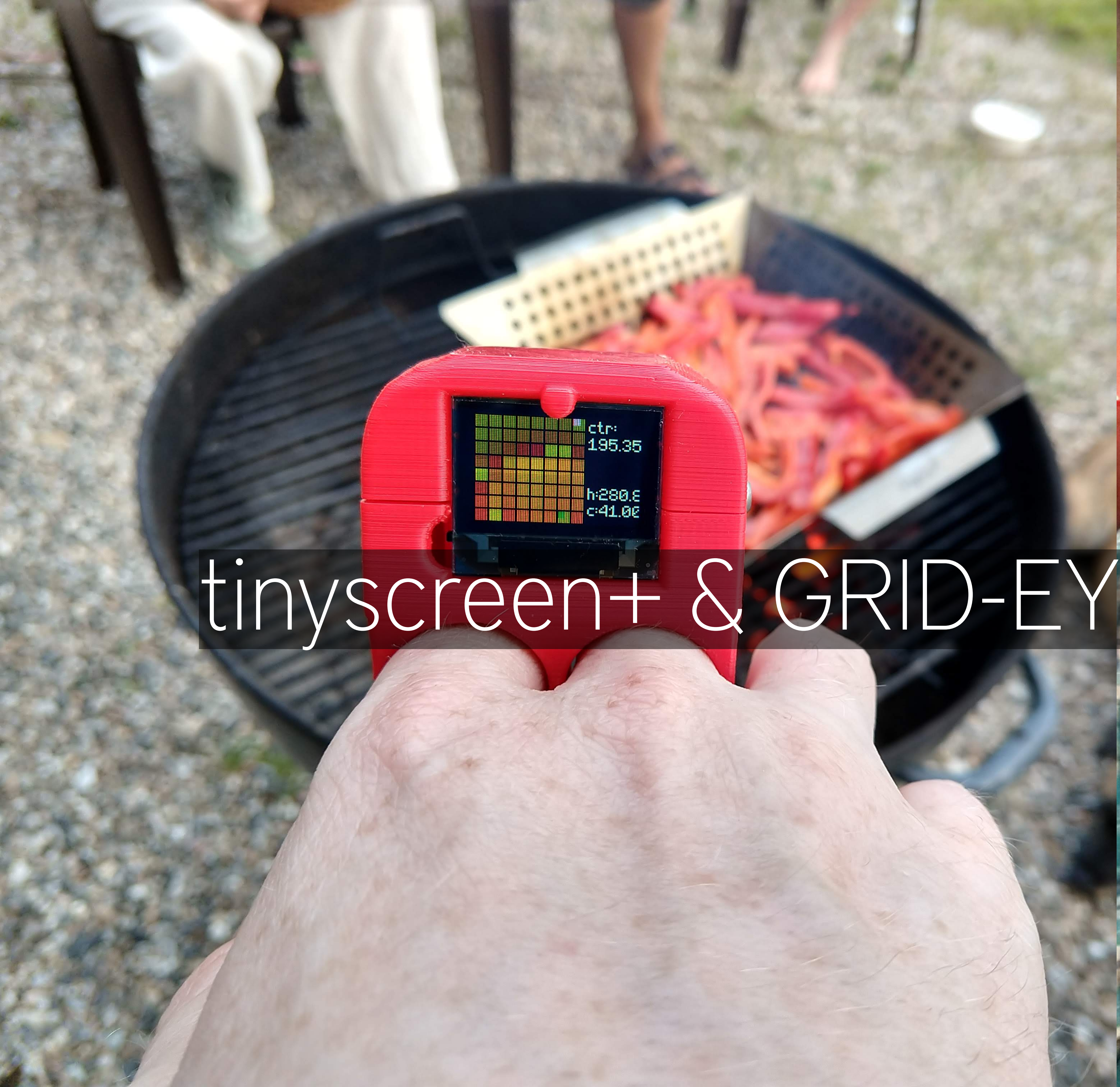
“Enchant us, Mezzo!”

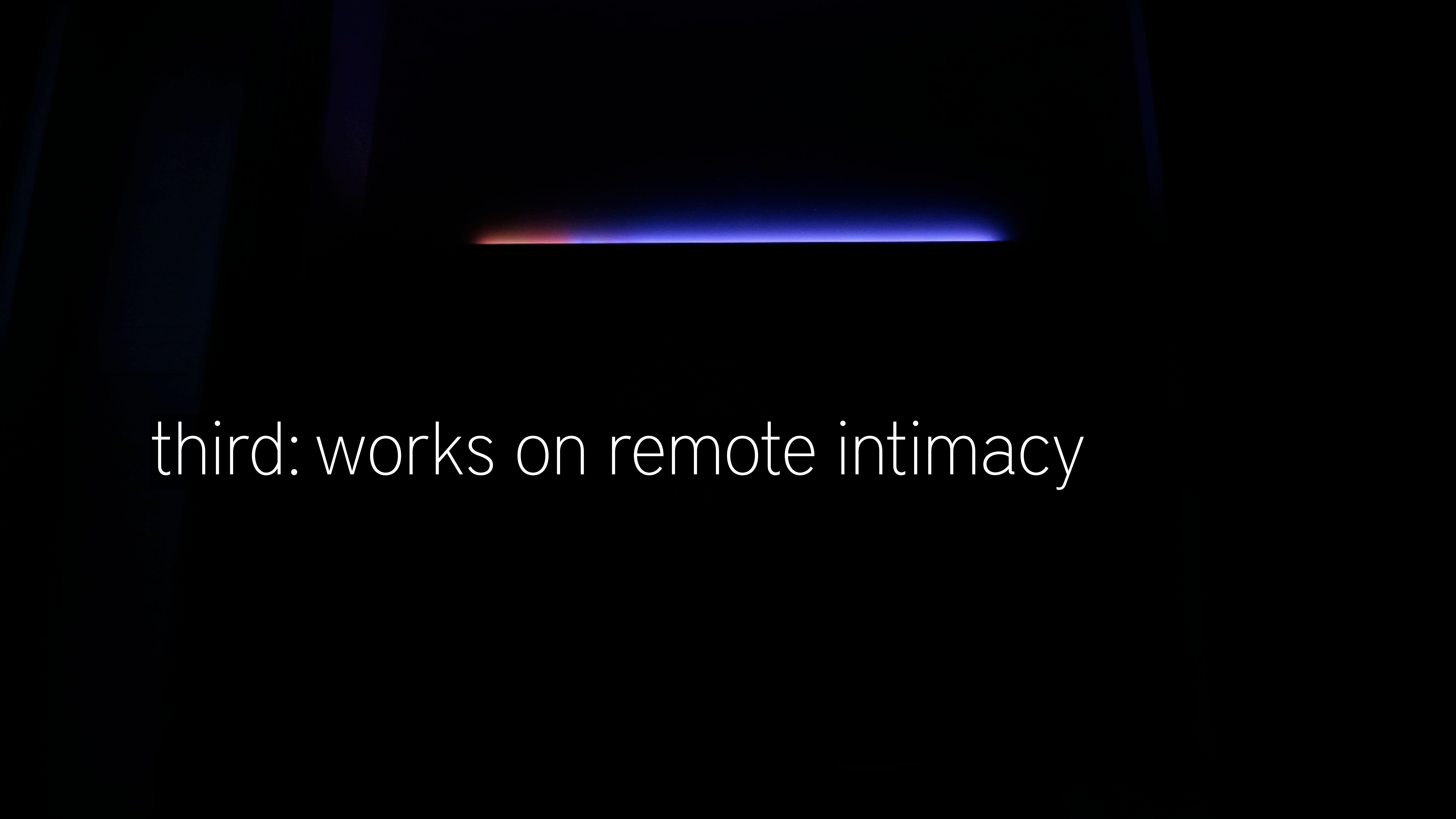

78.80
125.1
61.25
pointy.cam

lil thermal camera

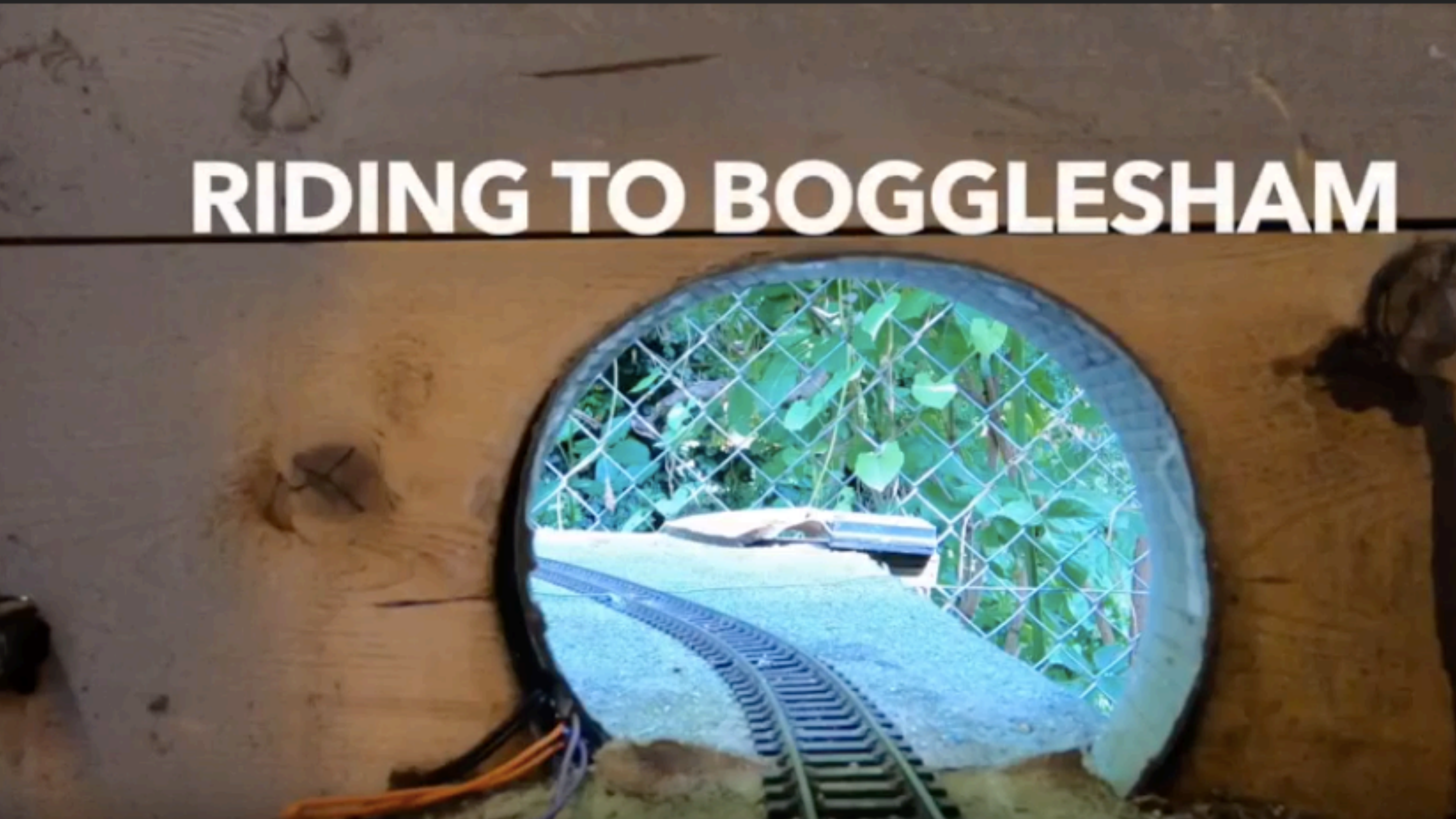


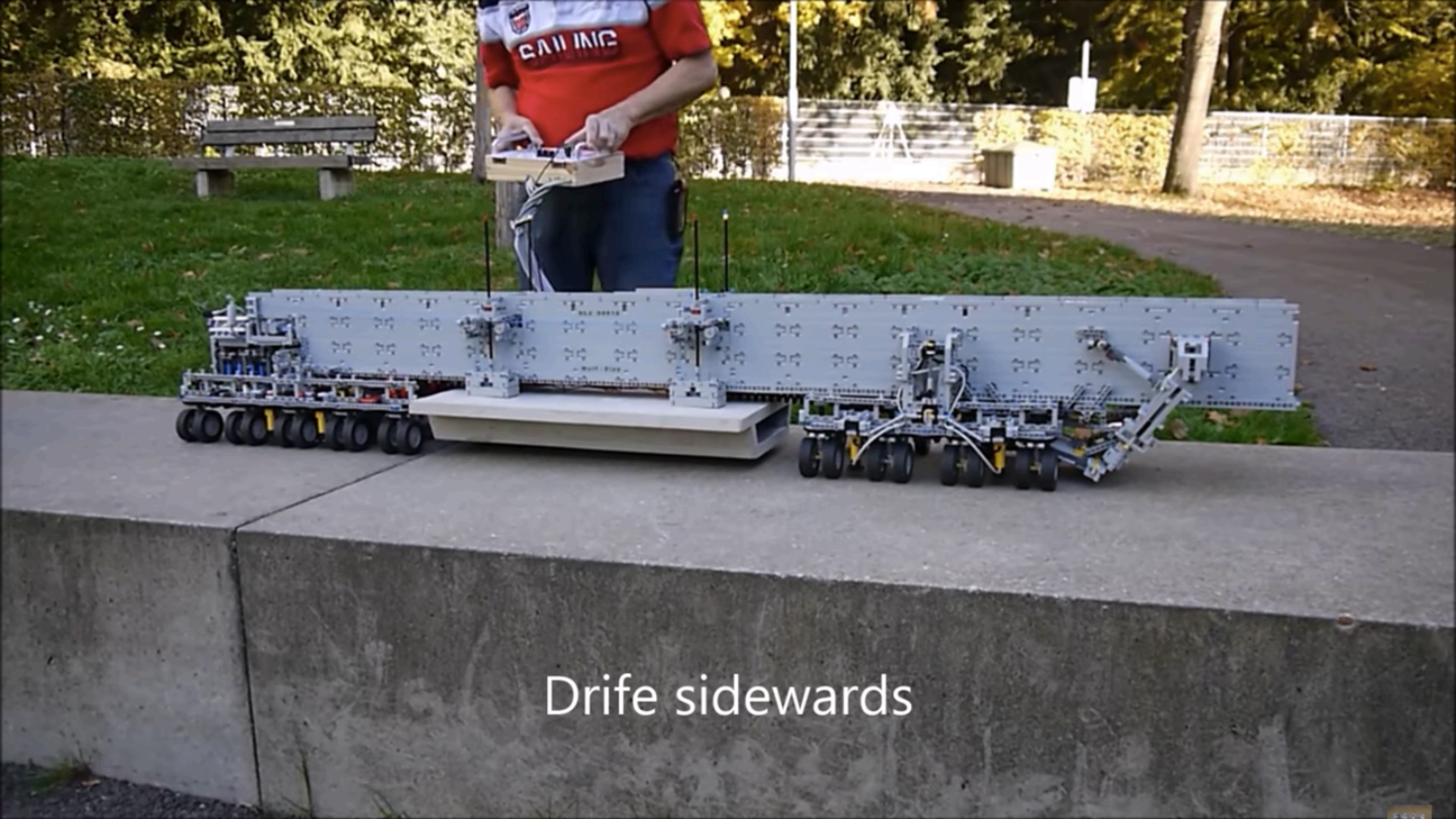
tinyscreen+ & GRID-EYE

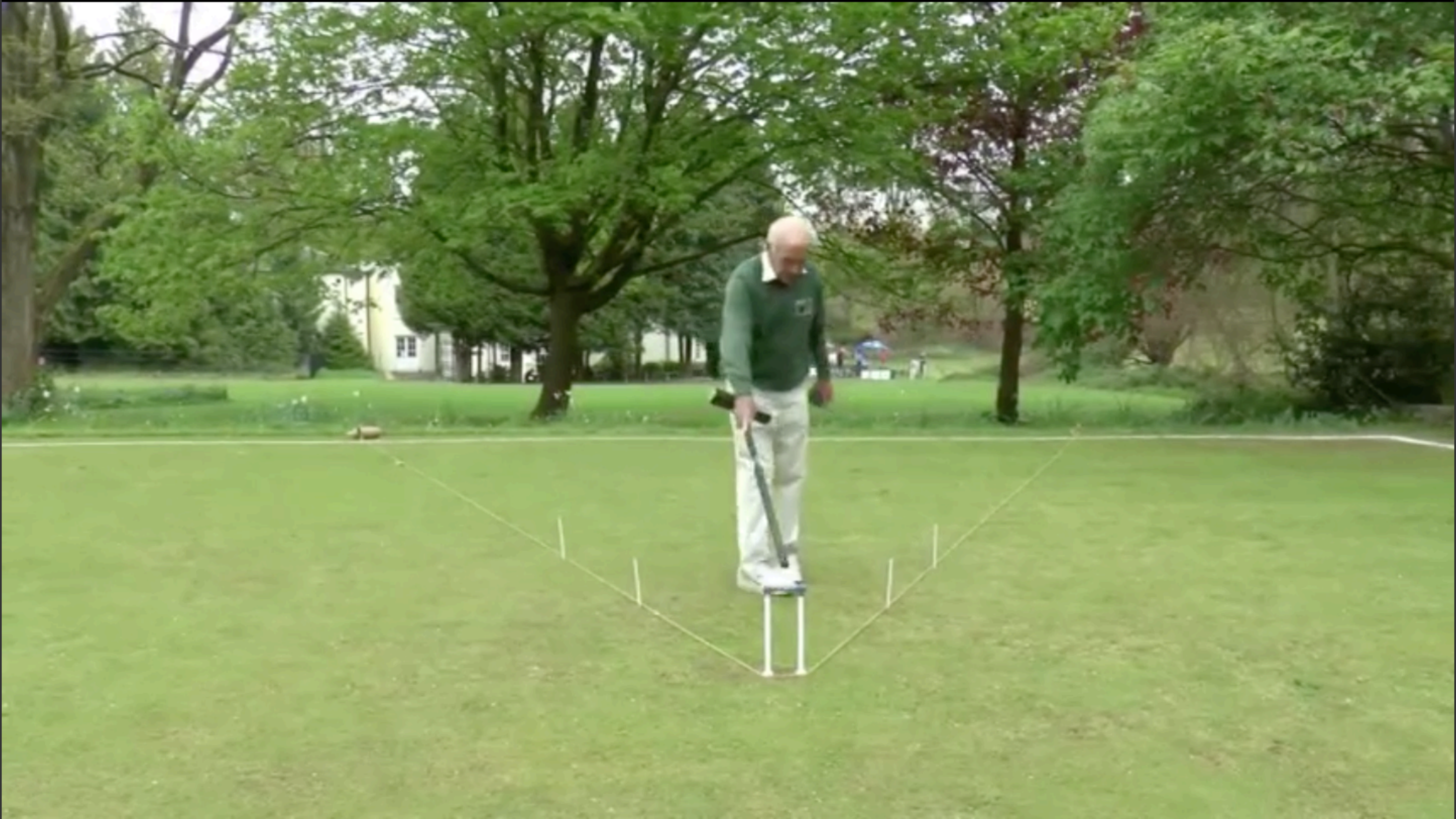



third: works on remote intimacy


FIXTURE
Continuous linear mapping between display and phone accel values;
A taut line between the space and the device
BAOFENG


RIDING TO BOGGLESHAM


Drife sidewards

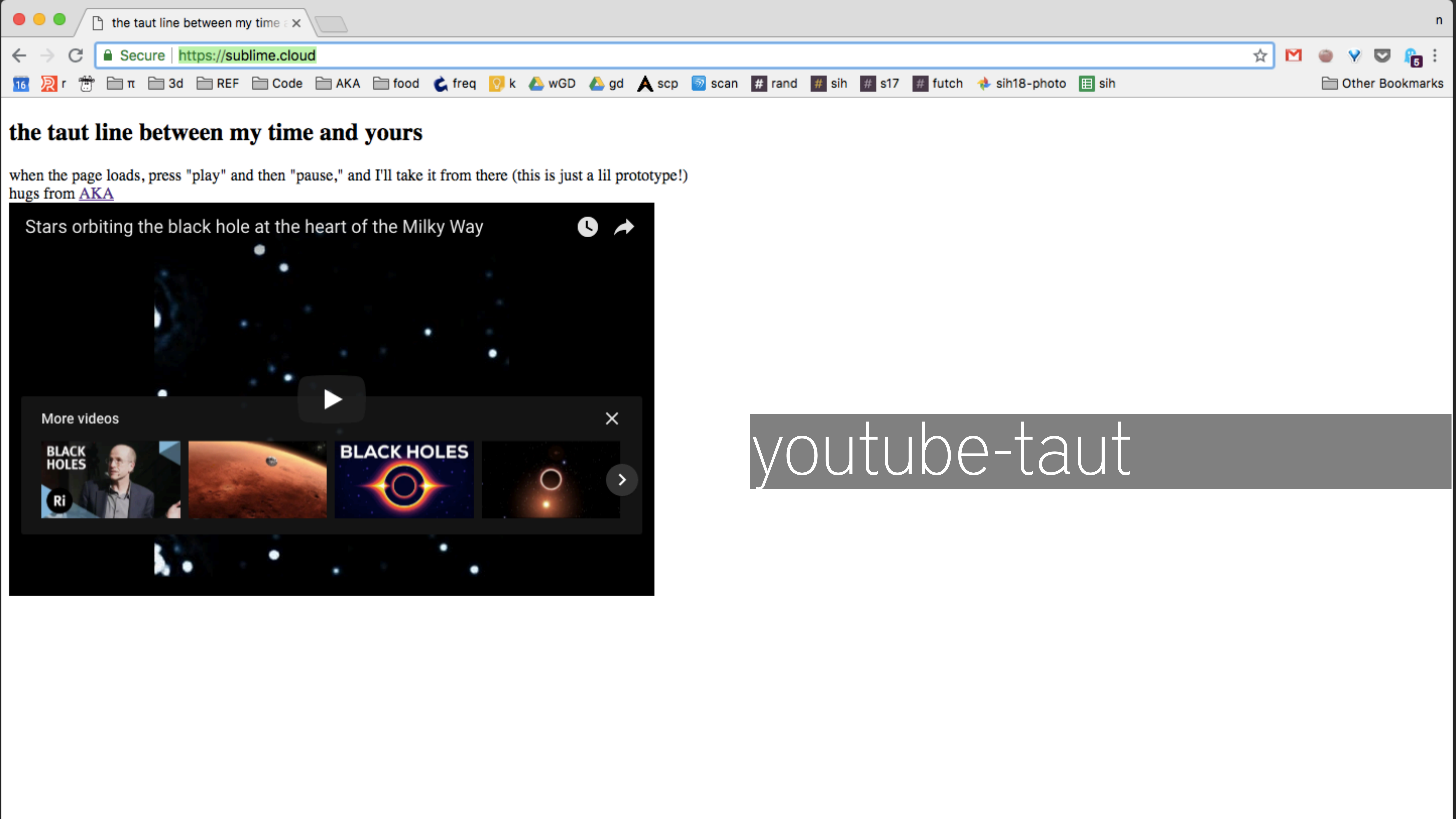


Why Do Horses Push On People?


Close to the sweat spot

Basic Association Croquet - Basingstoke Croquet Club

7:48 / 10:38


the taut line between my time
https://sublime.cloud
the taut line between my time and yours
when the page loads, press "play" and then "pause," and I'll take it from there (this is just a lil prototype!)
hugs from AKA
Stars orbiting the black hole at the heart of the Milky Way
More videos
BLACK HOLES
BLACK HOLES
youtube-taut

https://sublime.cloud

github.com/akamediasystem/youtube-taut

Voltage Regulators

Inbox × Projects ×

Rob Faludi
to me
Sat, Jul 21, 5:07 PM (3 days ago)

I'm learning a lot about MacBook repair today. Also YouTube now recommends me videos based upon what you watch. That's new...

noah feehan / AKA
Sat, Jul 21, 5:07 PM (3 days ago)
oh amazing!! you caught a semantic STD from this!

noah feehan / AKA <nfeehan@gmail.com>
to Rob
Sat, Jul 21, 5:08 PM (3 days ago)

PS I am in love with Fred the steeplejack!!

•••


Drinking and Climbing


Drinking and Climbing

and now for something broader

Landscape with a piping shepherd. Claude Lorrain

BLACK MIRROR

Landscape with a piping shepherd. Claude Lorrain

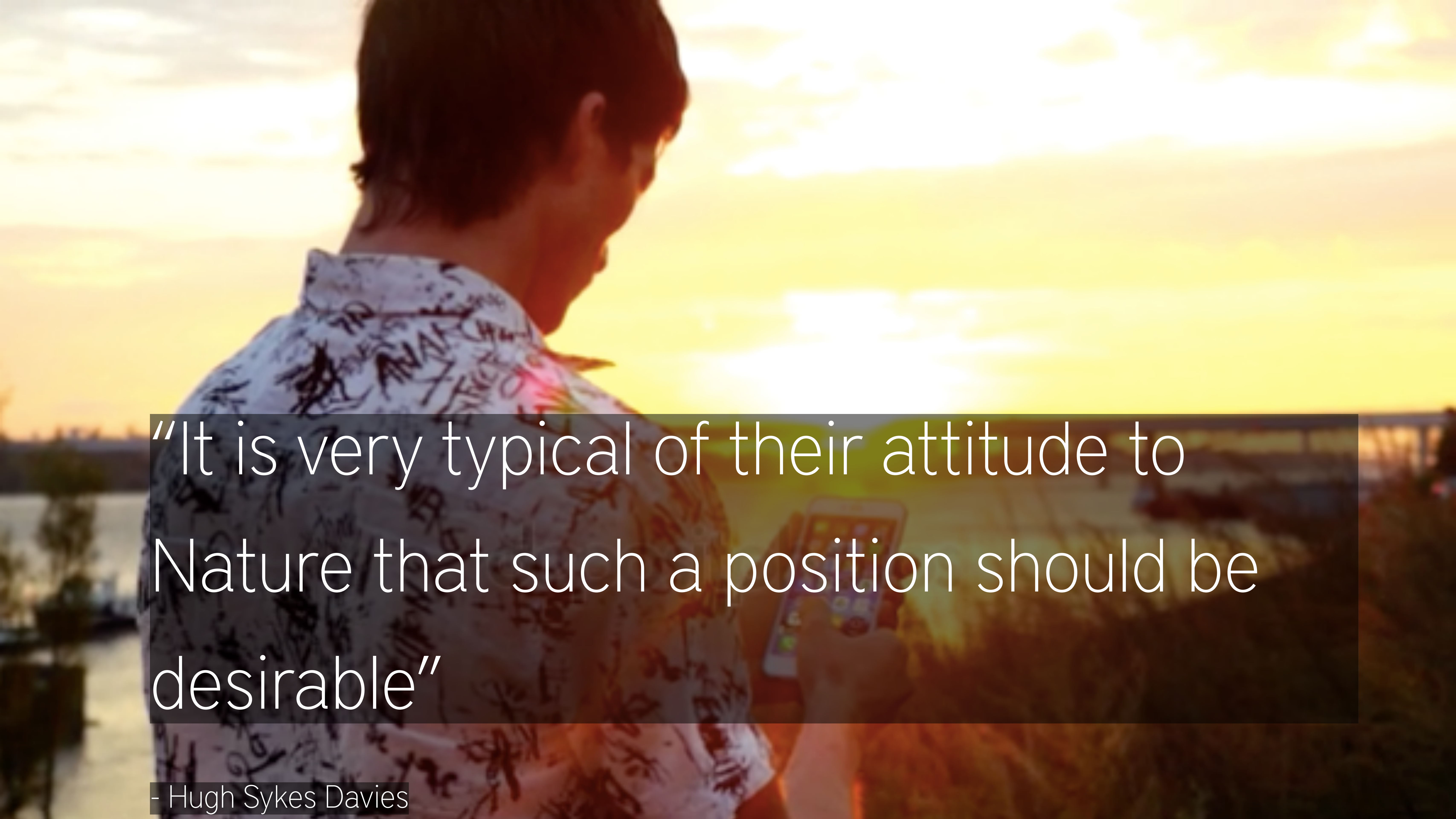
MAKE YOUR OWN CLAUDE GLASS OR BLACK MIRROR

By gmjhowe in Technology > Photography 82,626 197 20 Featured

Published Apr. 30, 2012

BLACK MIRROR

https://www.instructables.com/id/Make-your-own-Claude-Glass-or-Black-Mirror/

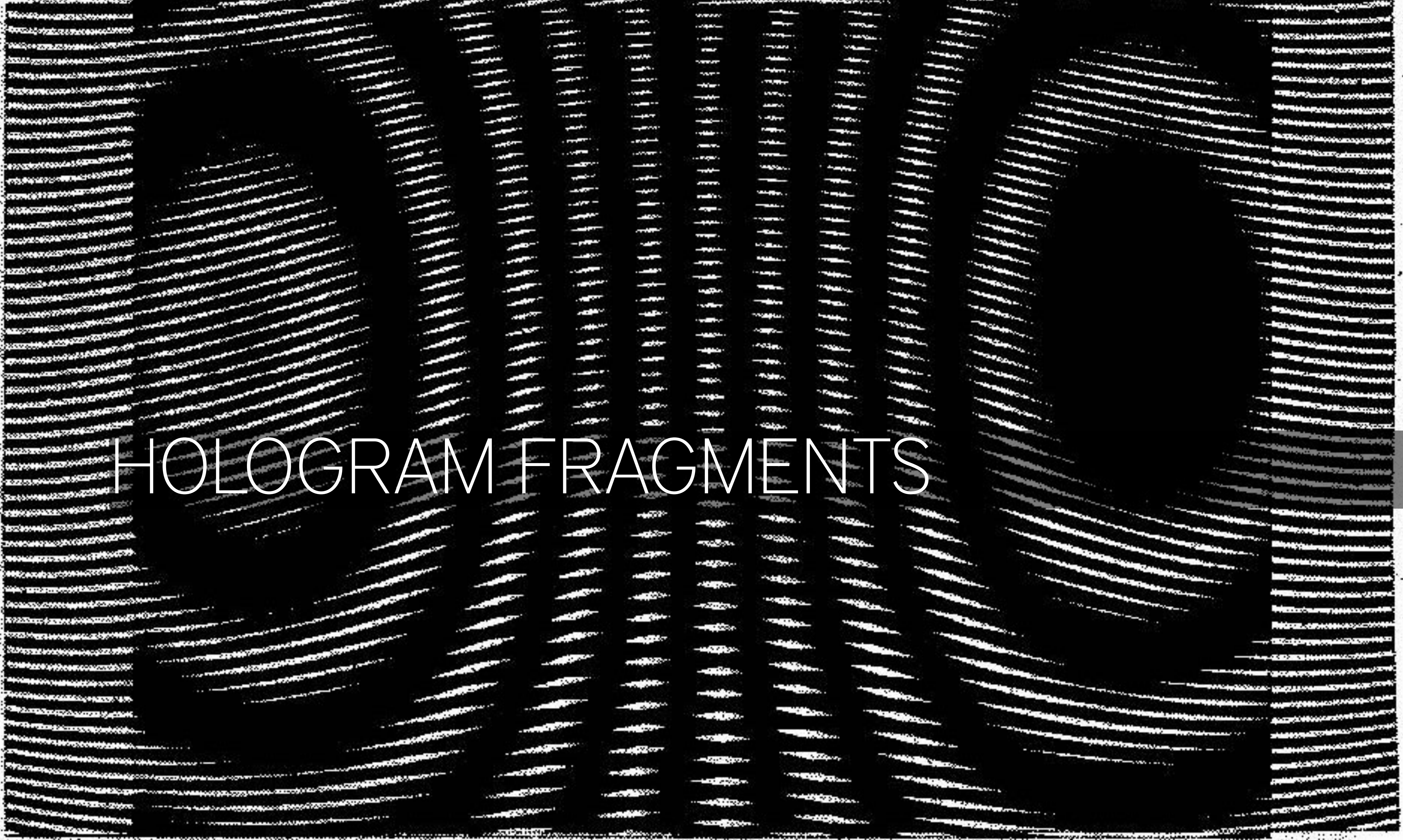


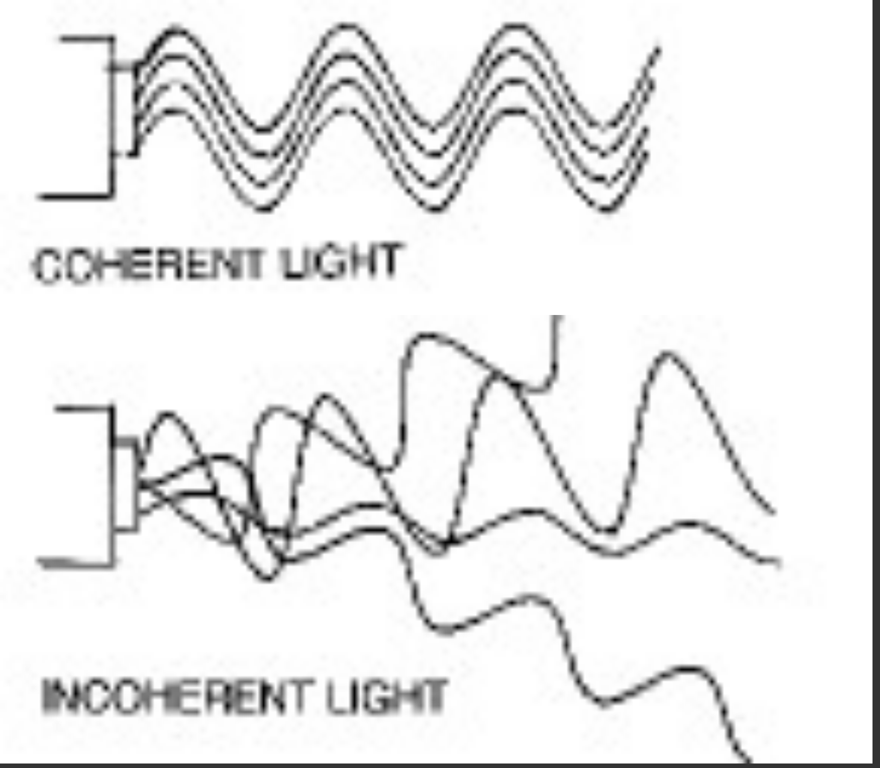
"It is very typical of their attitude to Nature that such a position should be desirable"

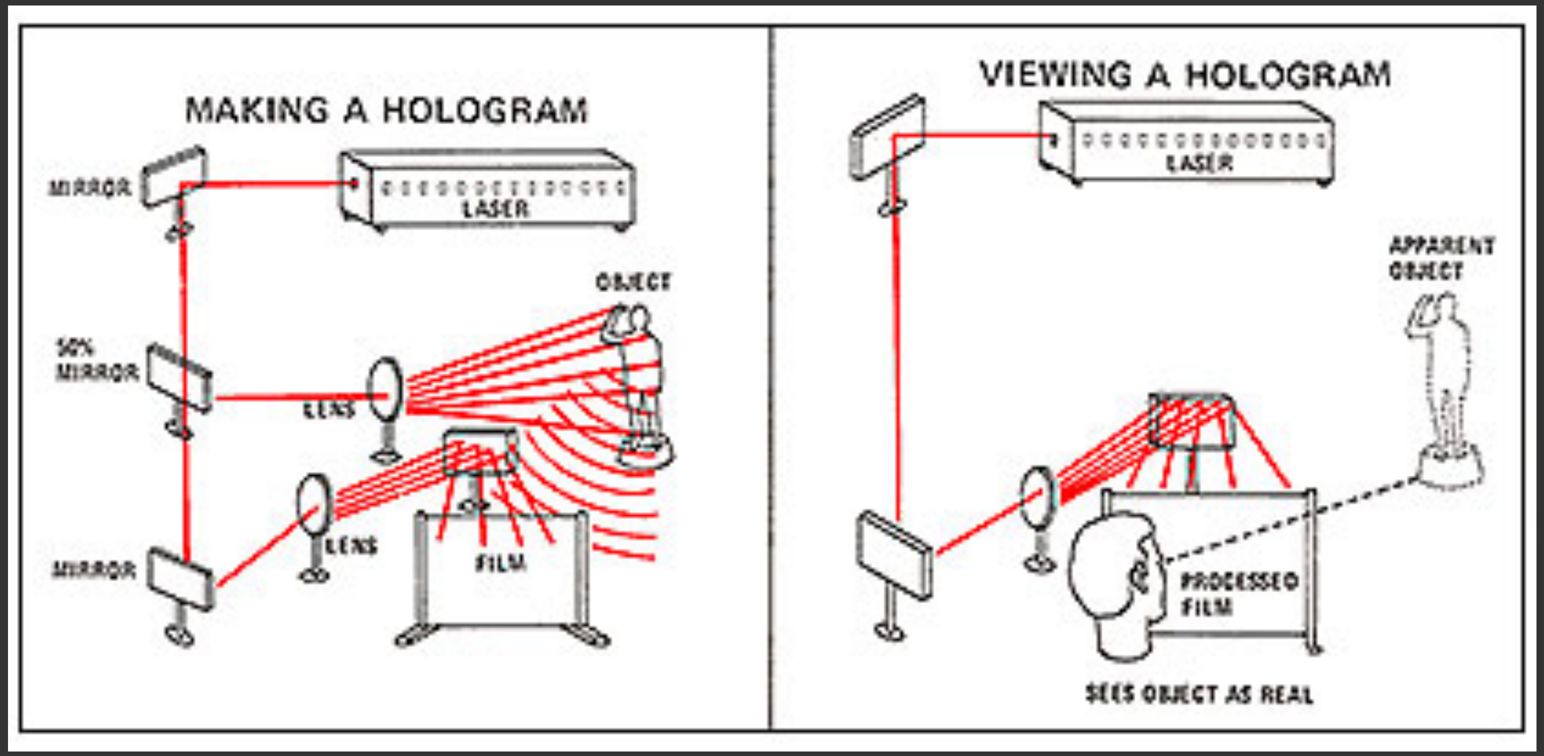
- Hugh Sykes Davies

OBJECT METONYMY

HOLOGRAM FRAGMENTS







HOLOGRAM FRAGMENTS

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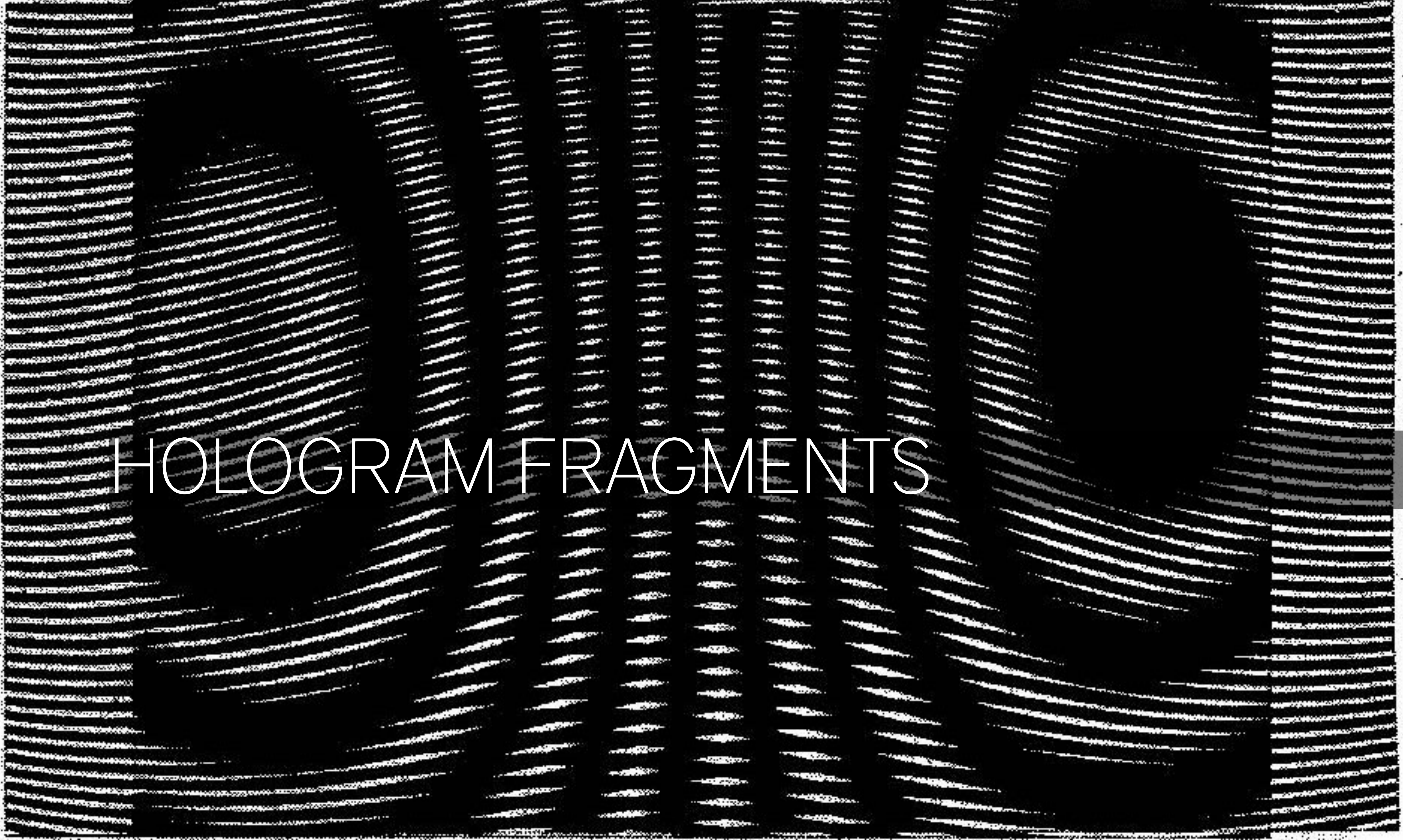

Thanks!

@noahfeehan

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linkedin.com/in/akamediasystem/

Sources + more:

pinboard.in/u:akamediasystem/t:sketching18