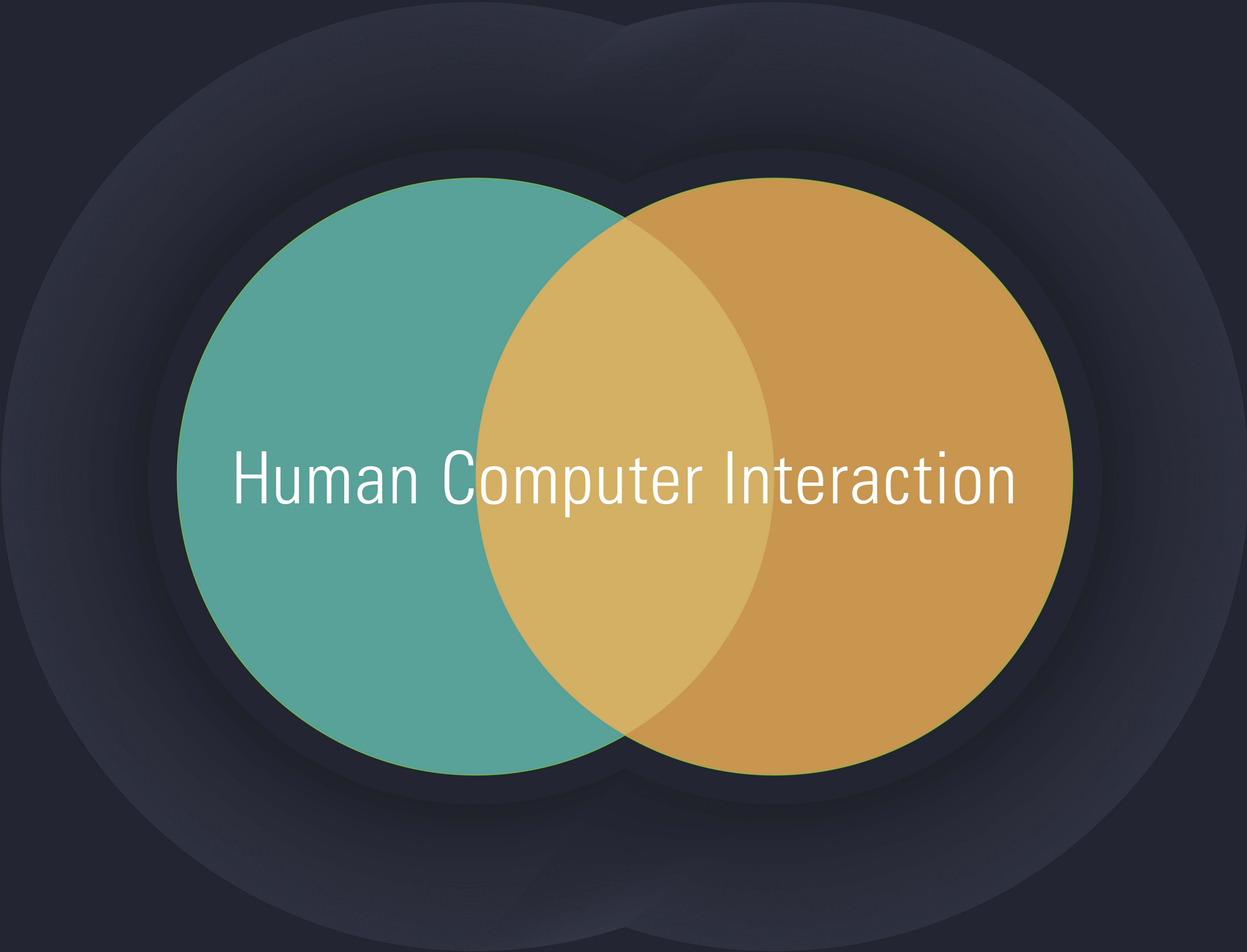# Human-Data Interfaces
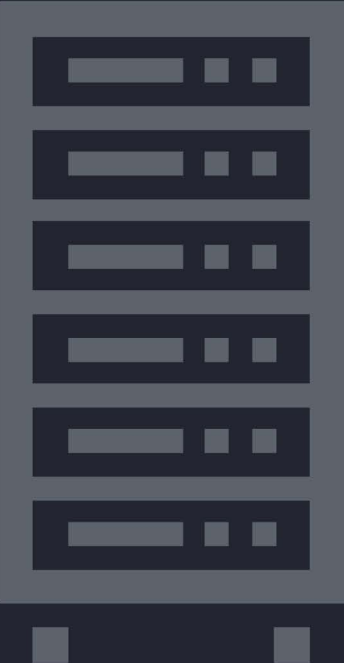
A CASE FOR
HARDWARE-DRIVEN
INNOVATION
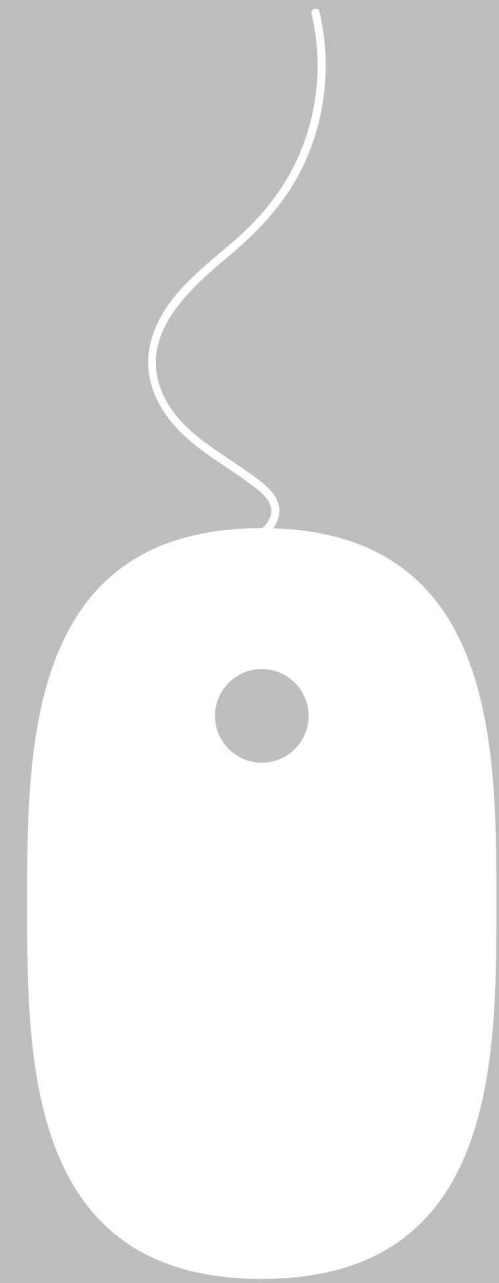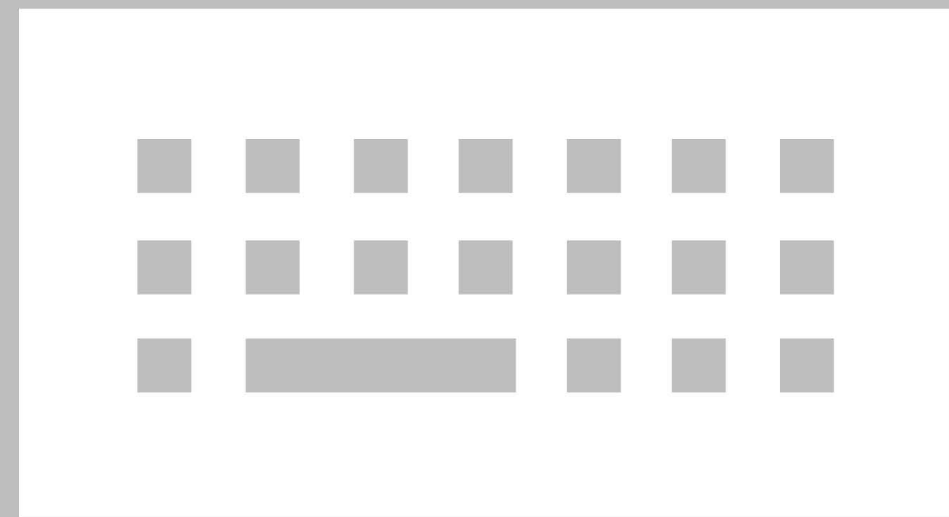
Aleksandar Bradic
Sketching in Hardware '19

Human Computer Interaction

0.1 second *is the response time limit if you want users to feel like their actions are directly causing something to happen on the screen.*

When the computer takes **more than 0.1 second but less than 1 second** *to respond to your input, it feels like the computer is causing the result to appear.*

Keystroke
two-at-a-time

Historical legacy
of the "two-key rollover"

PS/2 provides no
rollover restrictions

USB boot keyboard
reintroduces 6-key rollover

Point
& click

2D Continuous
Spatial Data Optimized

Alternating
control with a keyboard

Pointing to one screen
location at the time

Single-Threaded Control

15ms

Average Touch Stimulus
Reaction Time

17ms

Average Audio Stimulus
Reaction Time

25ms

Average Visual Stimulus
Reaction Time

50ms

Cloud Round Trip Latency
(USA)

250ms

Cloud Round Trip Latency
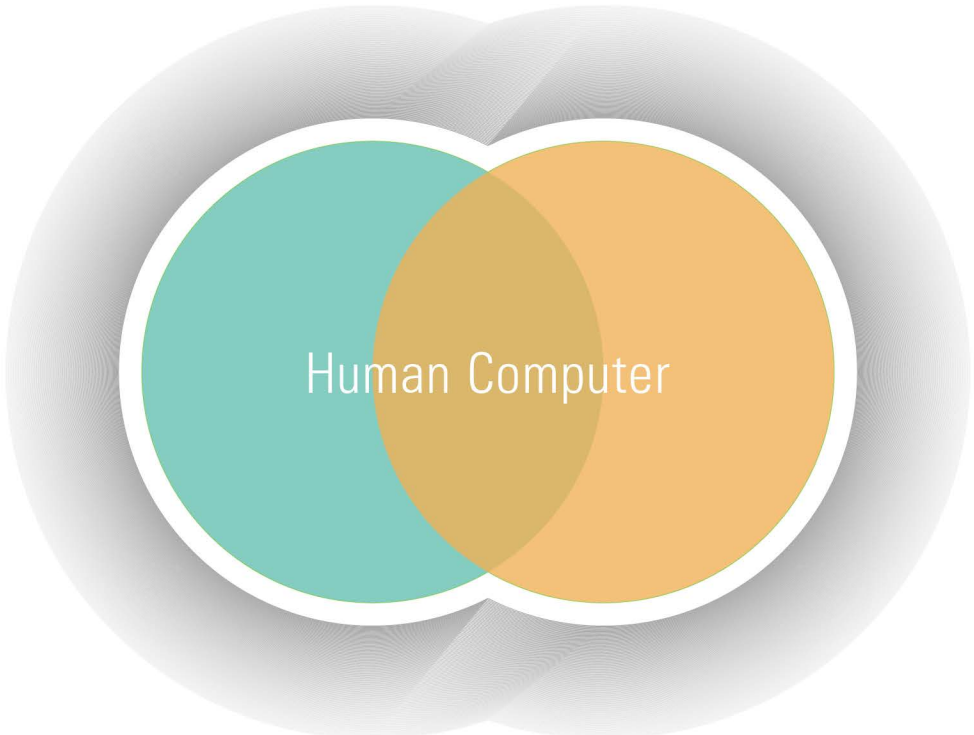(Australia)

8.66sec

Average Web page
full page load

Human   Computer   Cloud
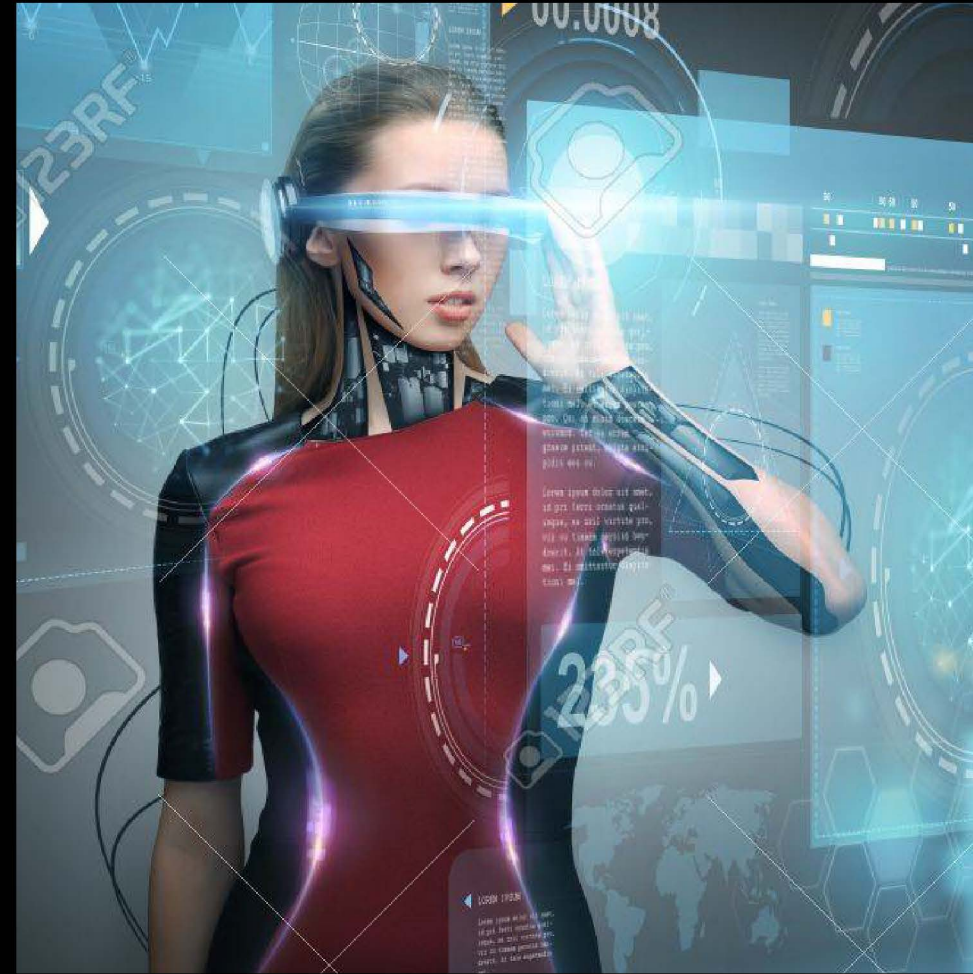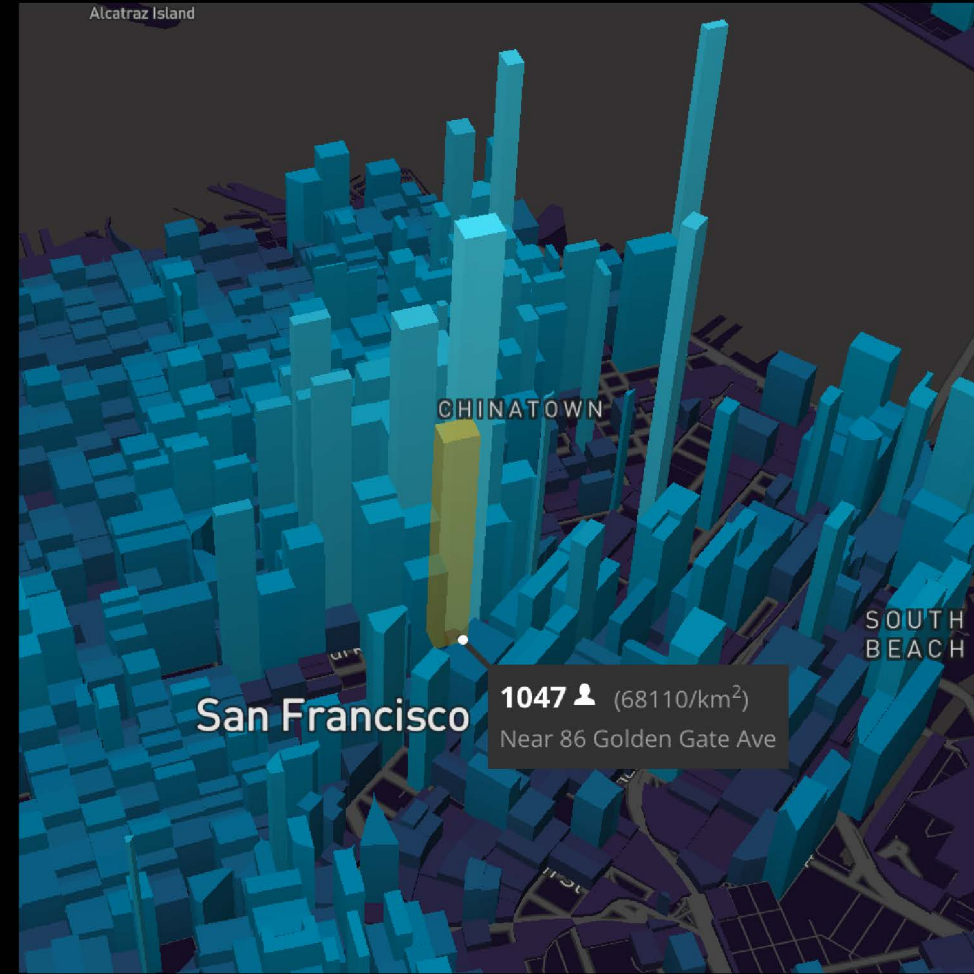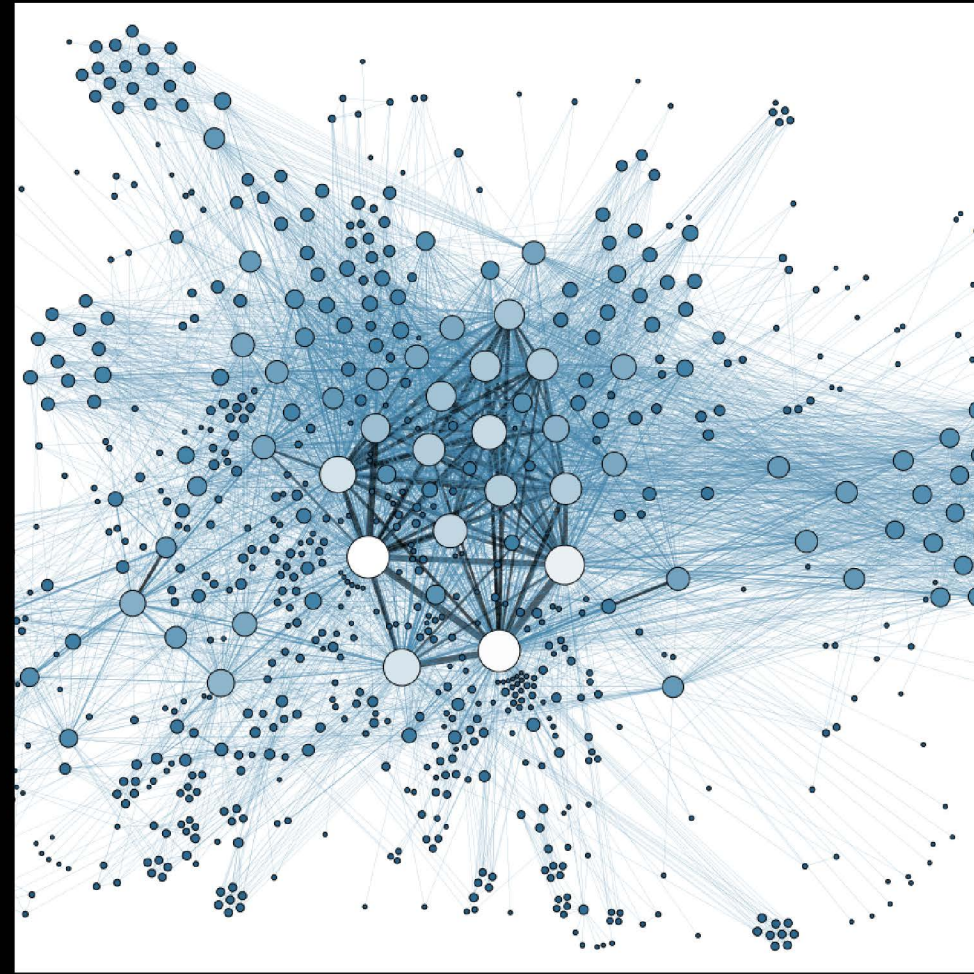Interaction ⟶ Transaction

DATA

The Unknowable

Interactive

Human Computer

Human-data Interaction (HDI)

It arises from the need, both ethical and practical, to engage users to a much greater degree with the collection, analysis, and trade of their personal data, in addition to providing them with an intuitive feedback mechanism direct data access.

The Hollywood trap

Contemporary datasets are
inherently high-dimensional

Our cognitive system is limited

Even 1,000 rows can feel like
"massive data"
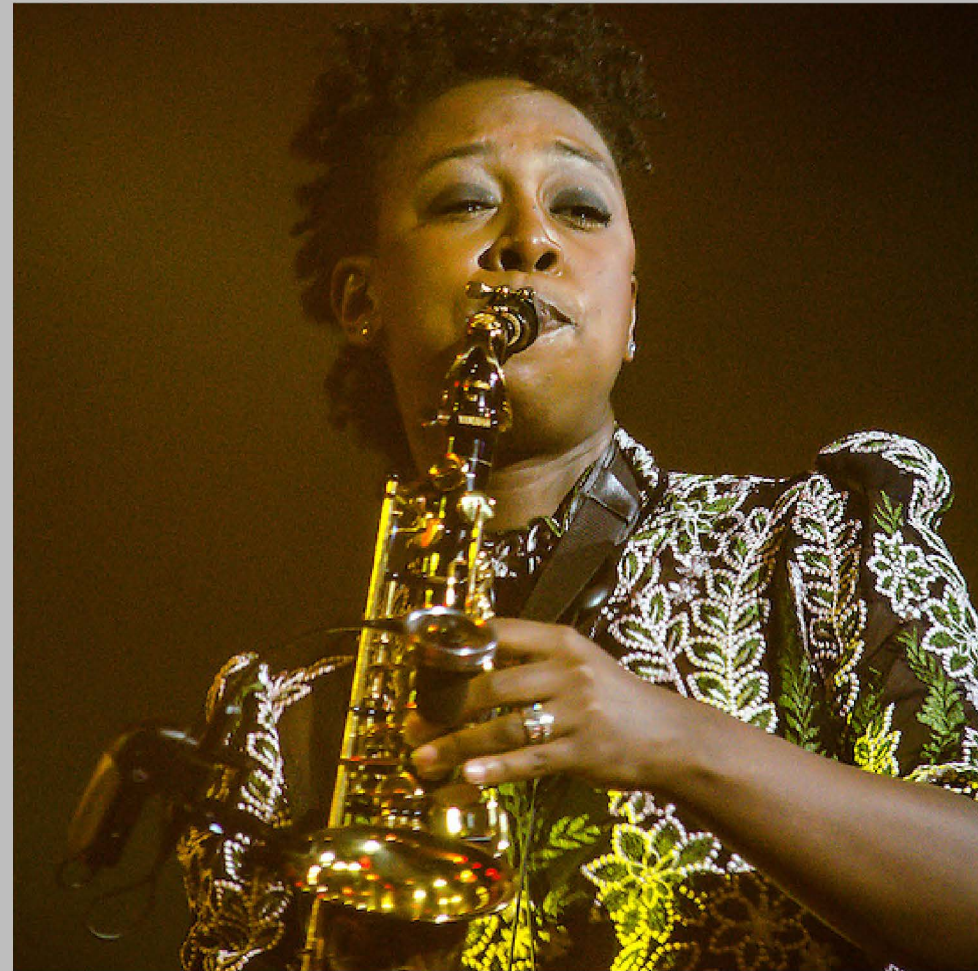
HOWEVER

We tend to put more and more
trust into "black box" models

Lack of intuition makes the user
feel like they're not in control

Interfaces for
developing intuition
for the observed
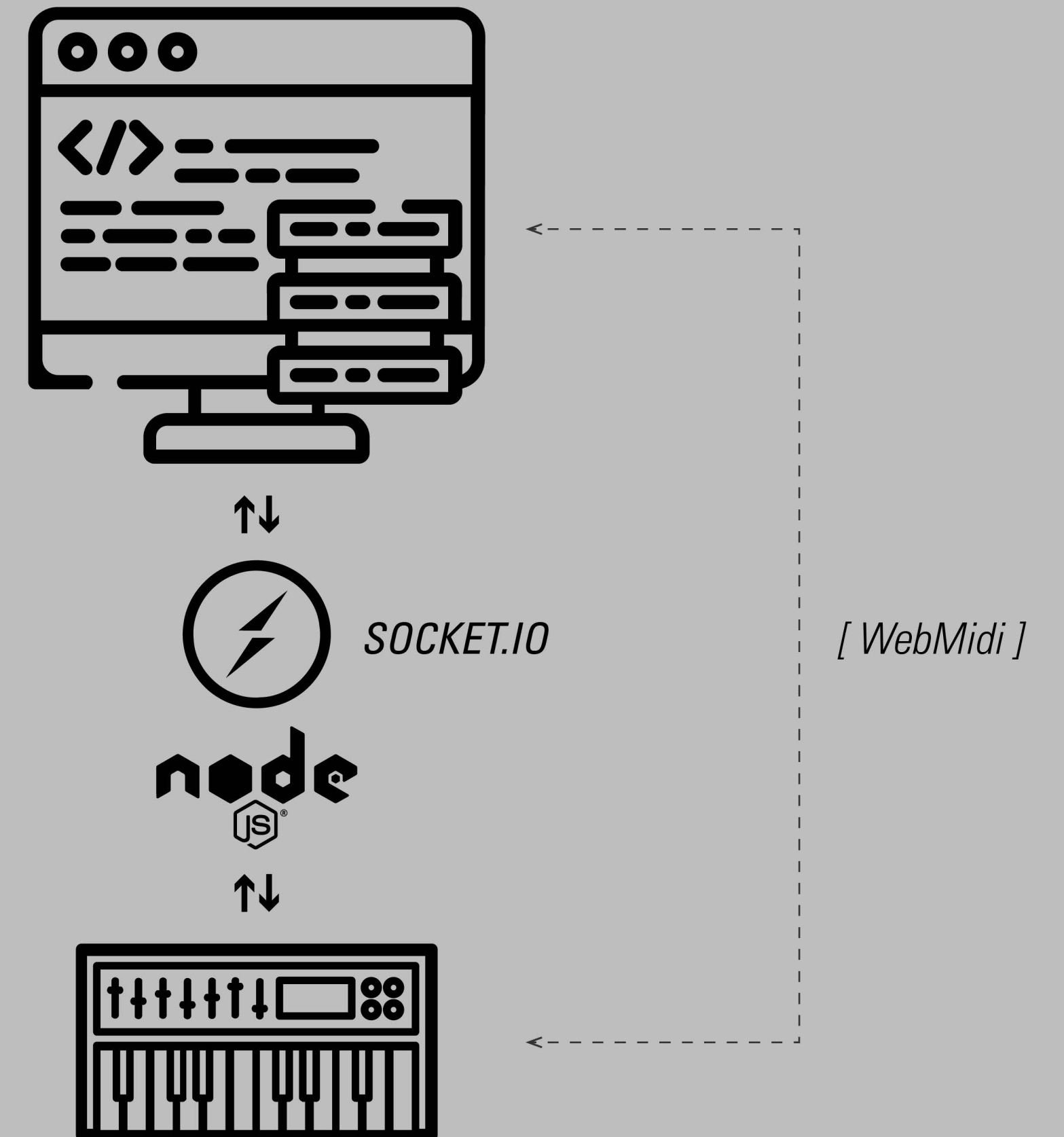raw data

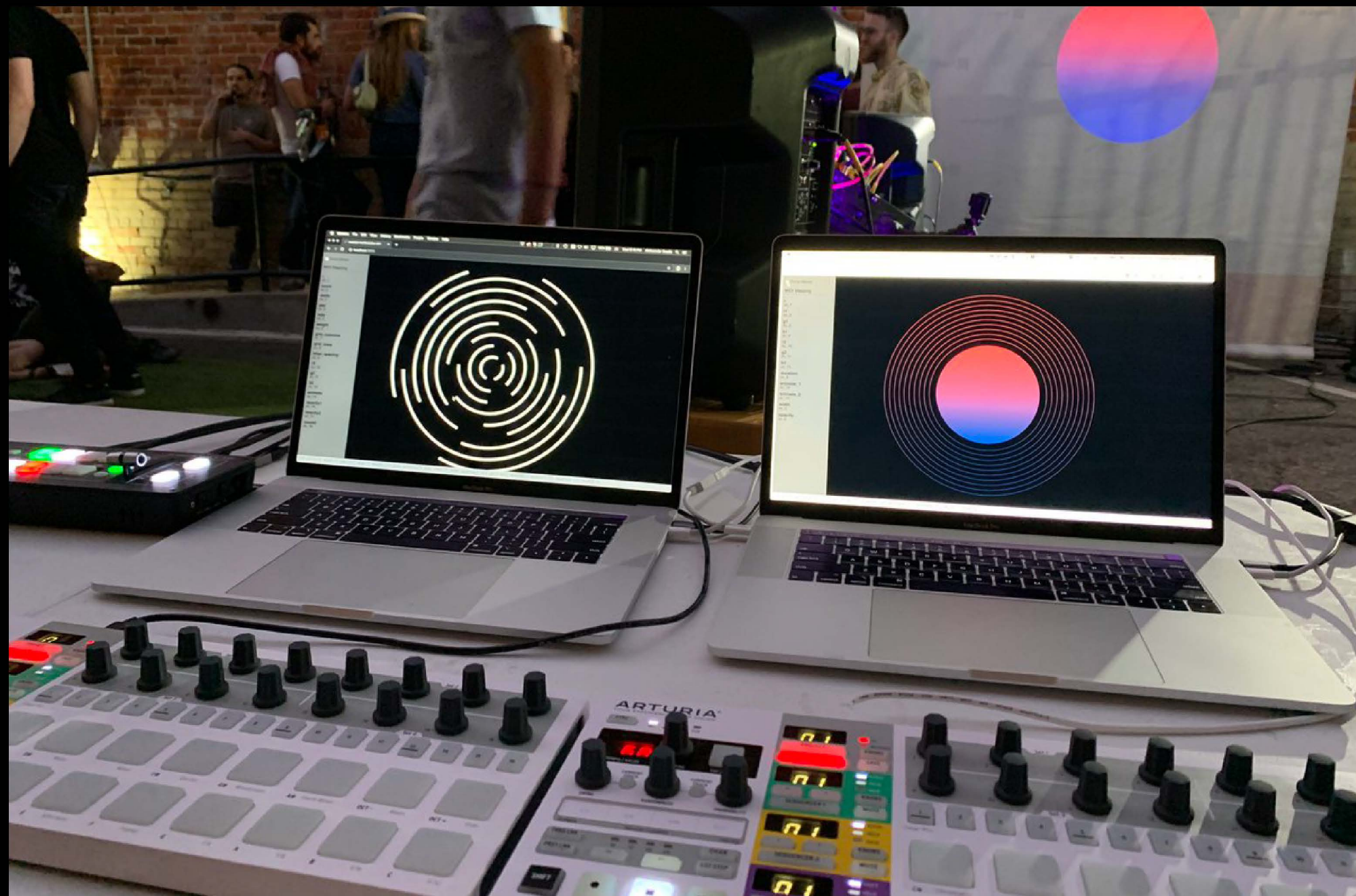*High-dimensional (sonic) space exploration*
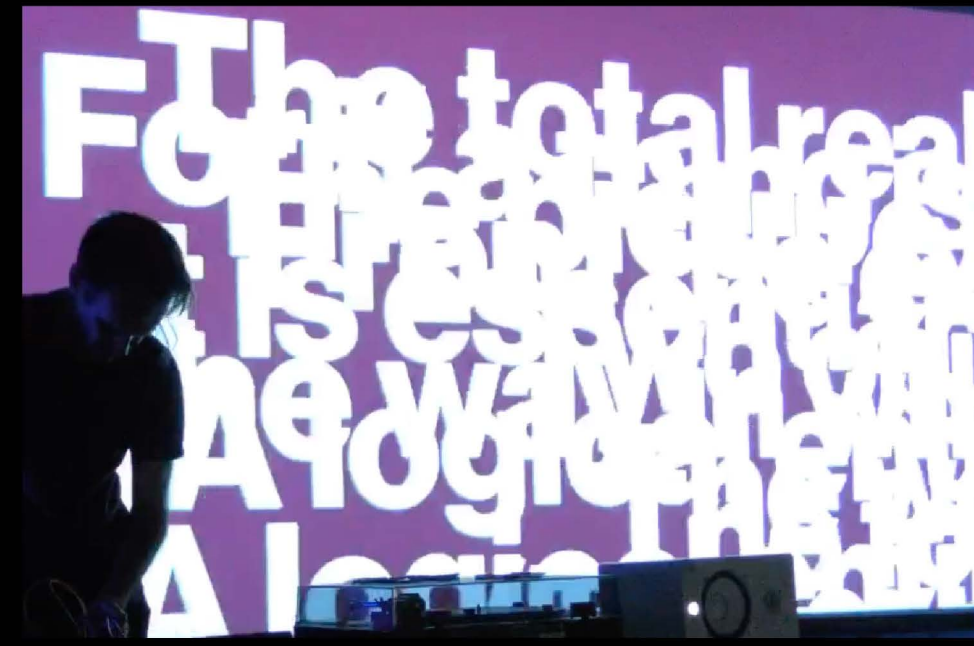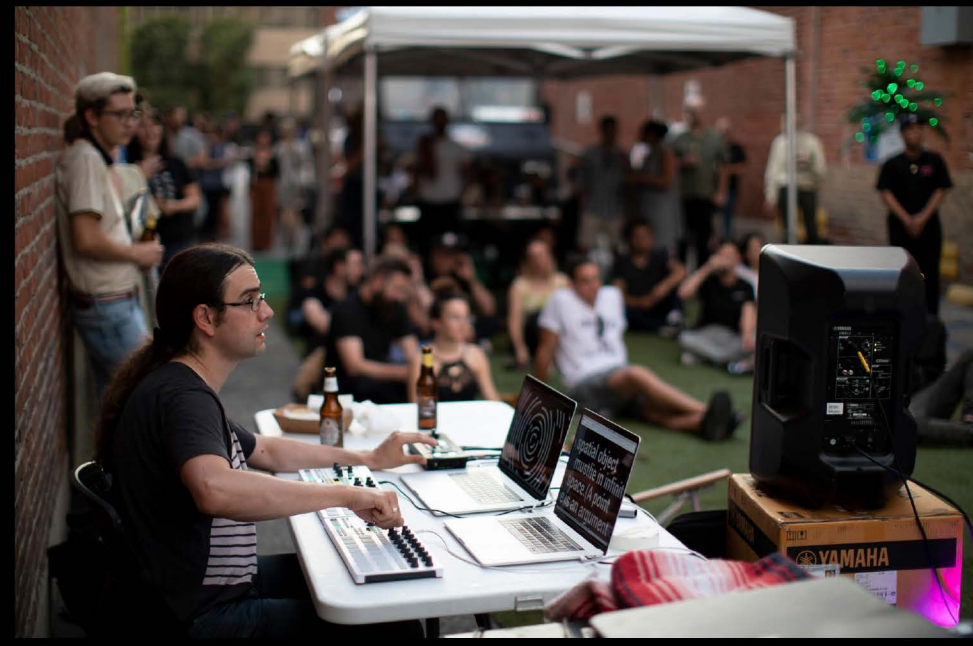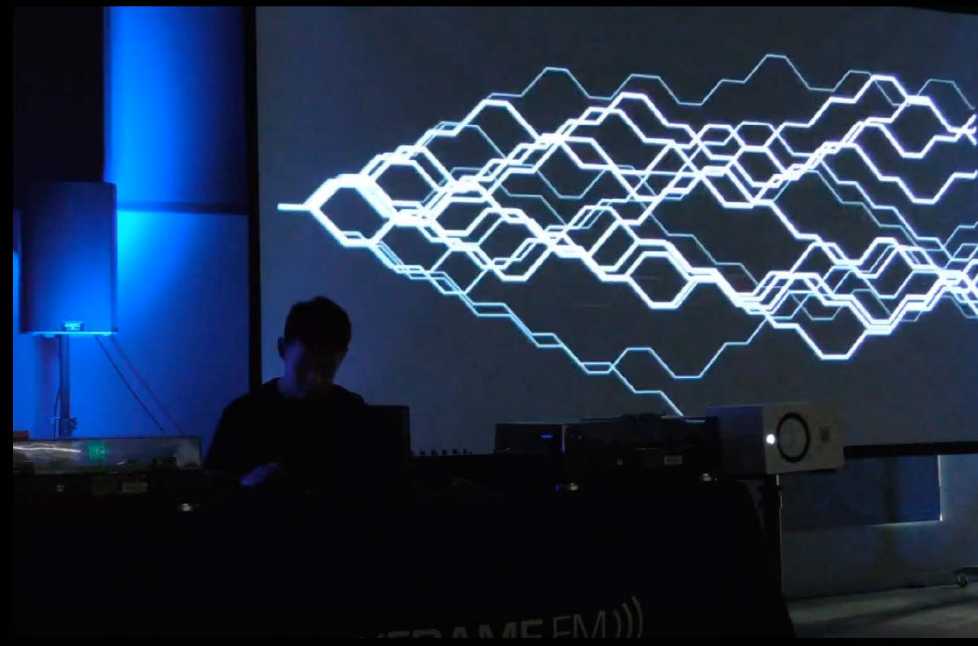
MIDI DOM Control

Document Object Model (DOM) as the backdrop of most contemporary Human-Data experiences.

MIDI (1982) standardized highly-parallel high-speed human-scale data interface

IDEA

Mapping MIDI variables to
  JavaScript variables
  DOM Objects
  SVG Elements

SOCKET.IO

[WebMidi]

The "Creative Expression" Trap

The Guardian MIDI/CC Browser

Yet Another Data Glove*

A MIDI Data Glove Interface

IDEA

From Scratch Built

V1: Computer Vision-based
V2: Gyroscope/Accelerometer based
V3: Good old variable resistors

Flat Resistance = 7,000 to 13,000 Ohms — Conductive Inks This Side

180° Pinch Bend =
Minimum 2x of Flat
Resistance Value

Bend
Direction

V_{IN}

R_1
VOLTAGE
DIVIDER

R_2

$+$
$-$

V_{OUT}

IMPEDANCE
BUFFER

$V_{OUT} = V_{IN} \left(\dfrac{R_2}{R_1 + R_2} \right)$

Following are notes from the ITP Flex Sensor Workshop
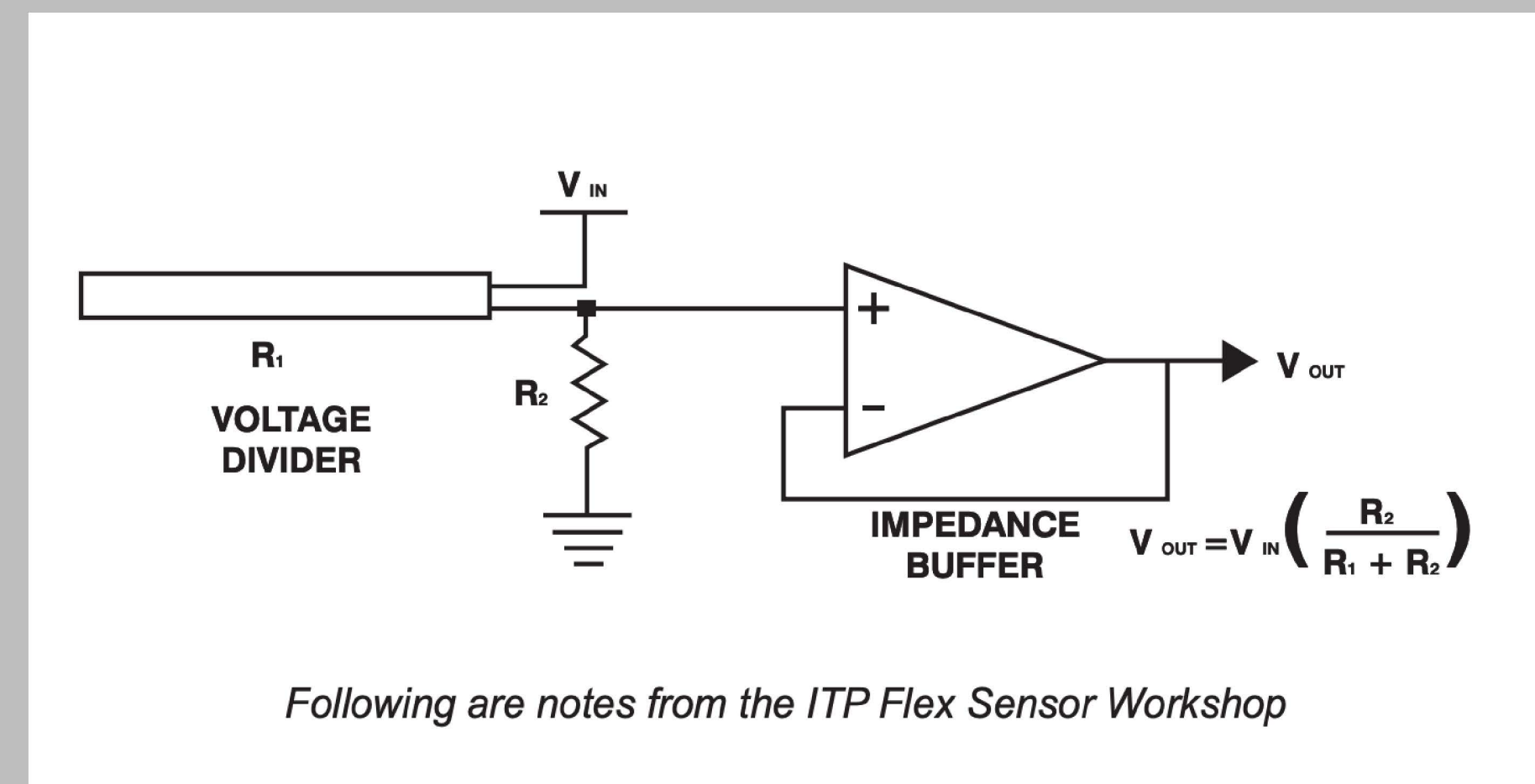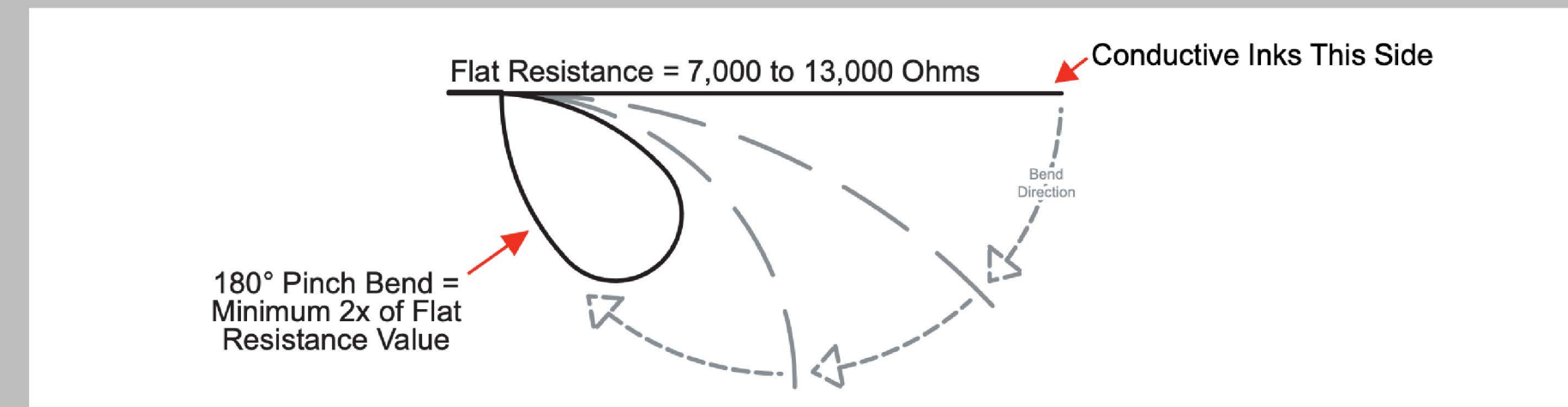
FS-L-095-103-ST Flex Sensor $21.00 - $12.1/per
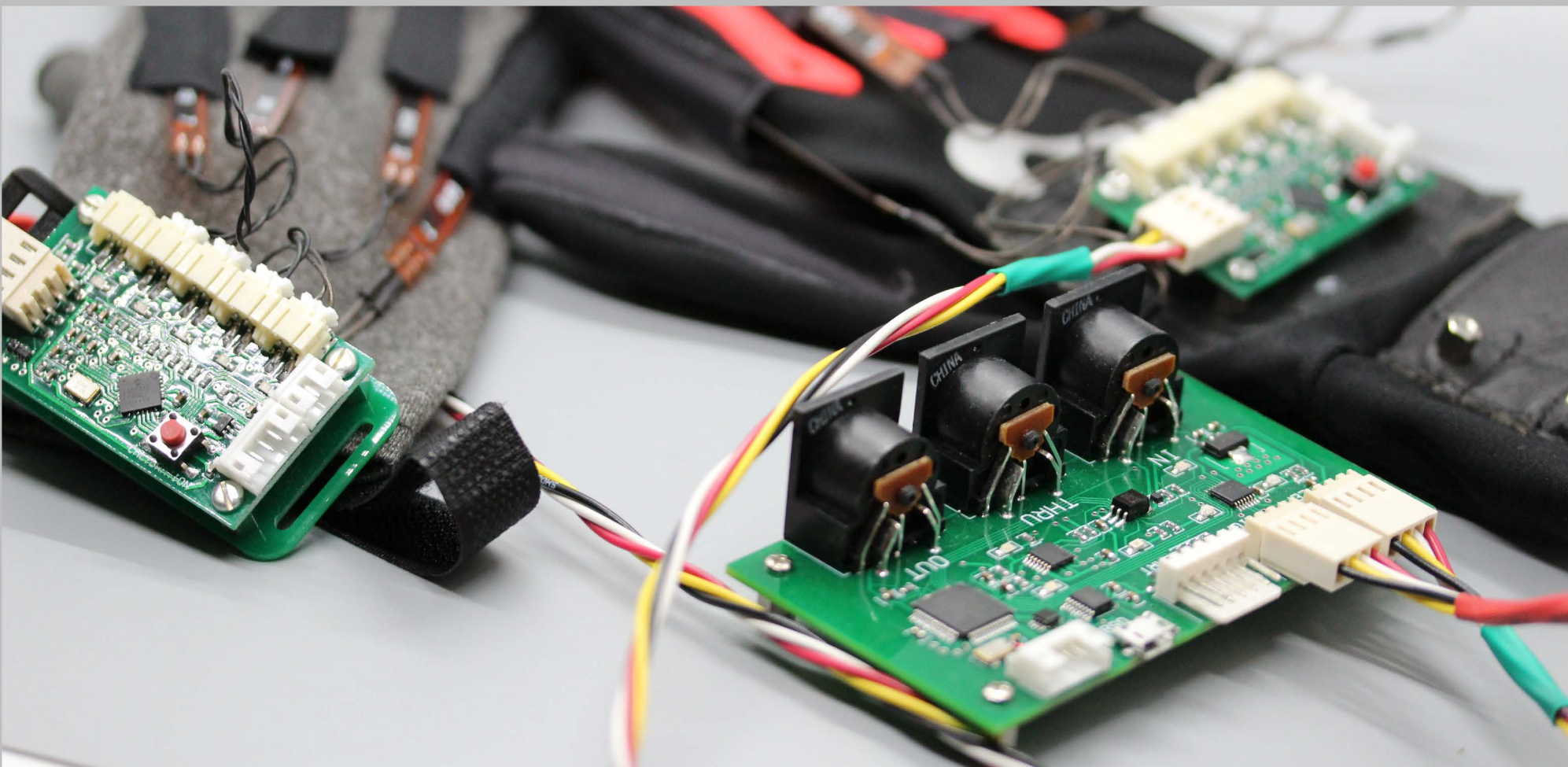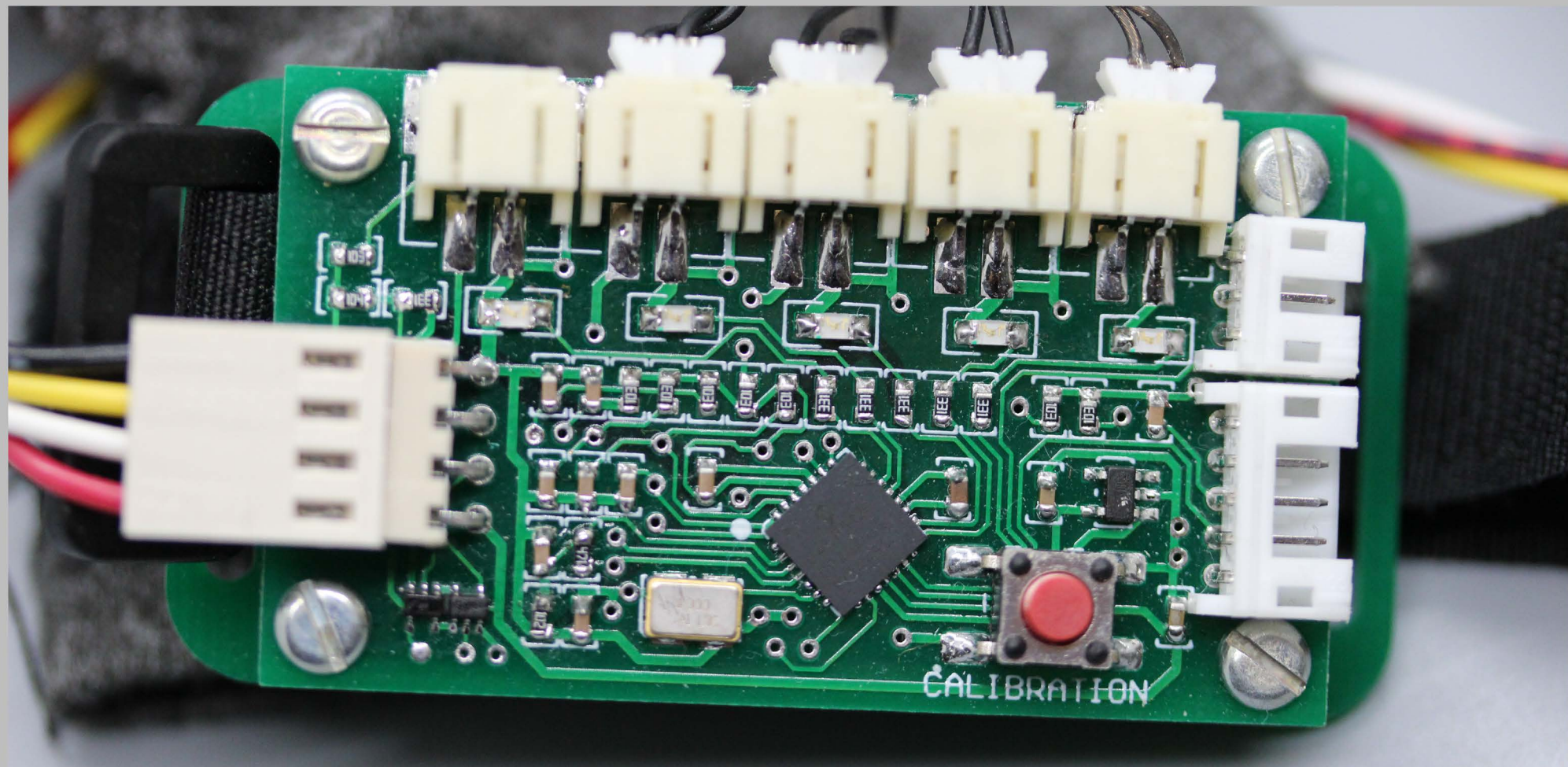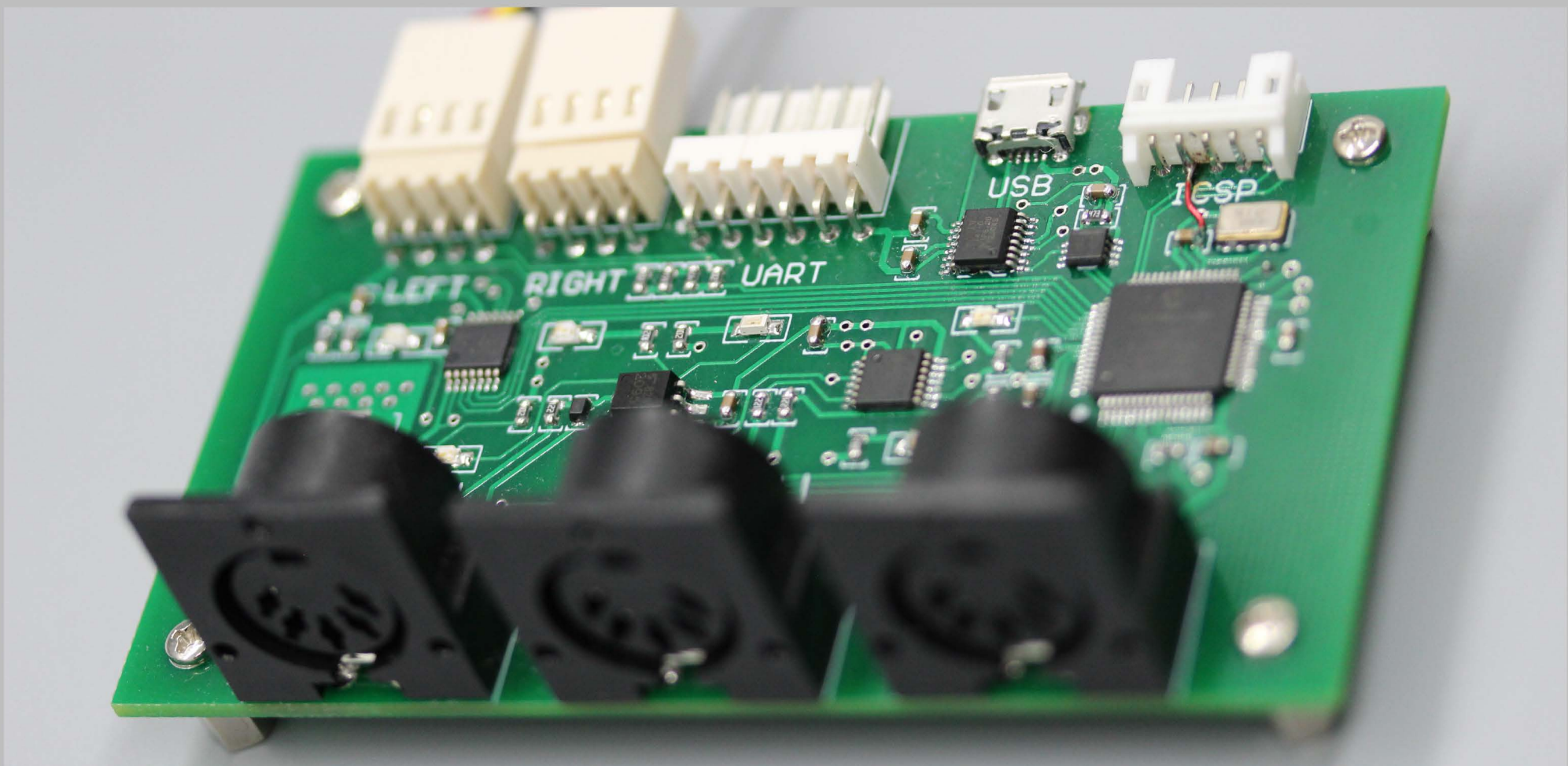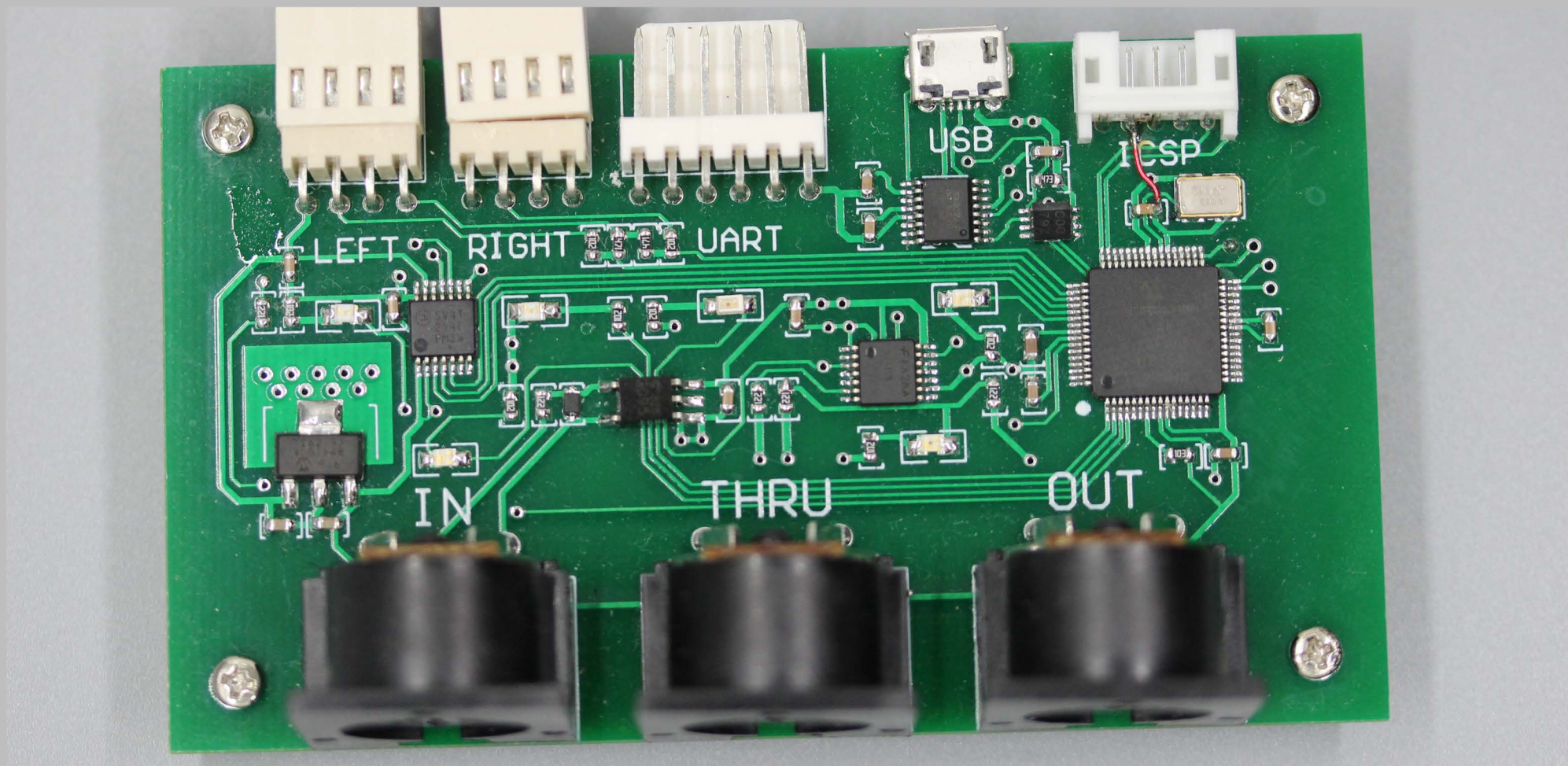
Board Design: Voja Antonic
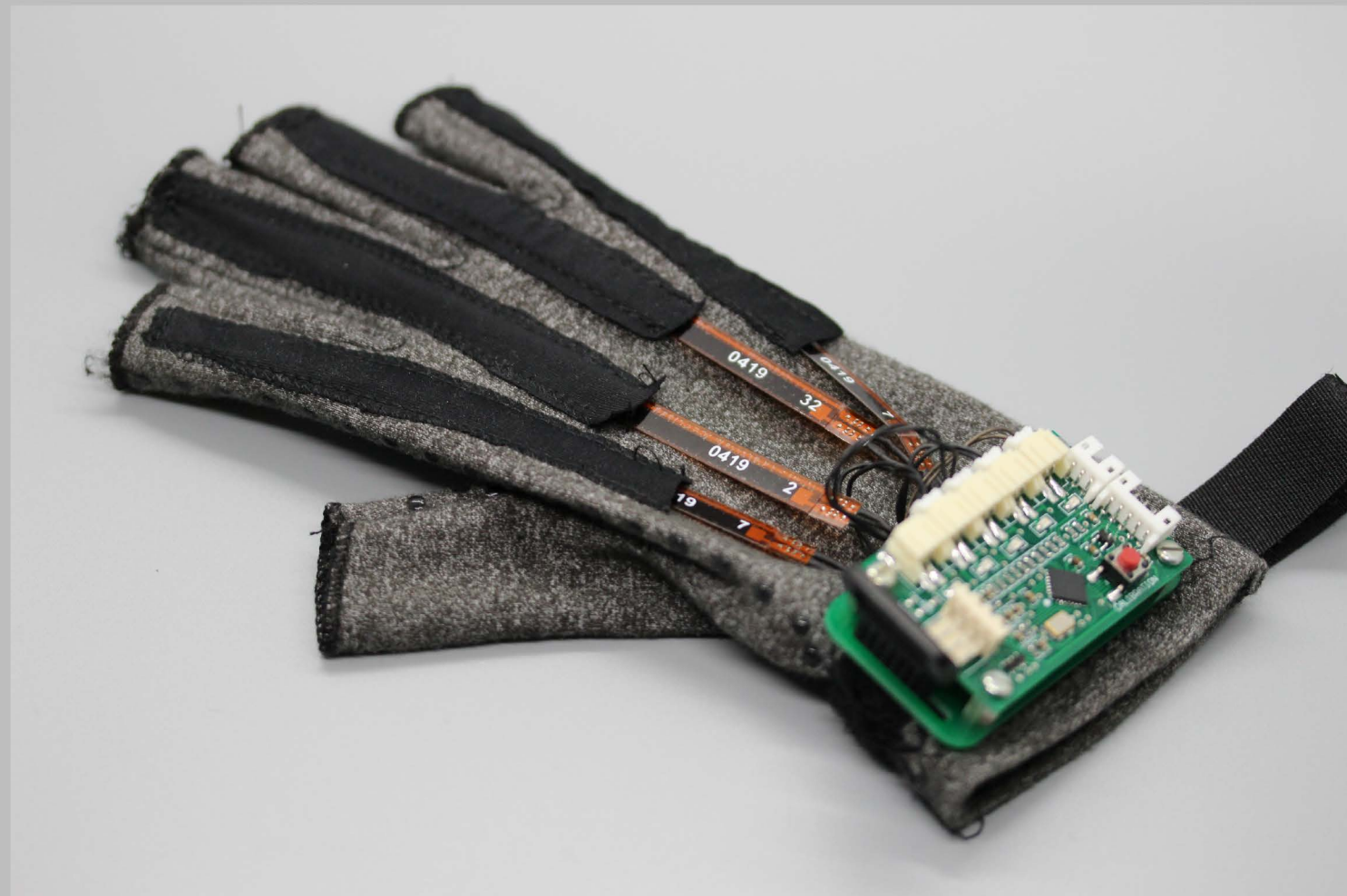
UTALITARIAN

TECHWEAR

WARM & FUZZY

Glove Design: Majenta Strongheart
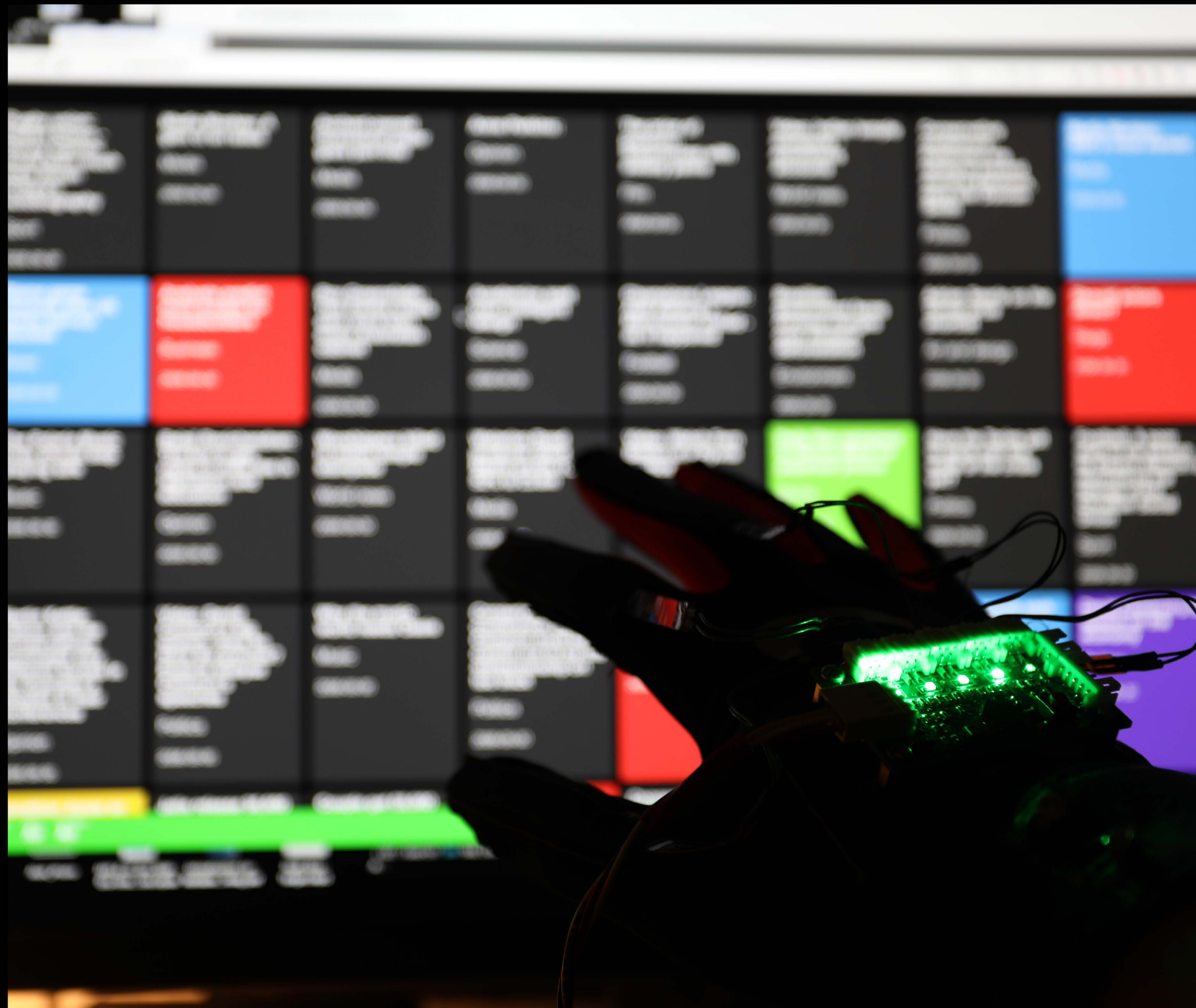
UX
Breakdown

Control variables change continuously, causing the UX to "oscillate."

Adding a signal filter smooths out the changes, but the Lucene backend can't match the required < 20ms response time needed to "keep up."

Information is too "dense," with no clear visual hierarchy, making it hard to interpret the rapidly-changing scene in a meaningful way.
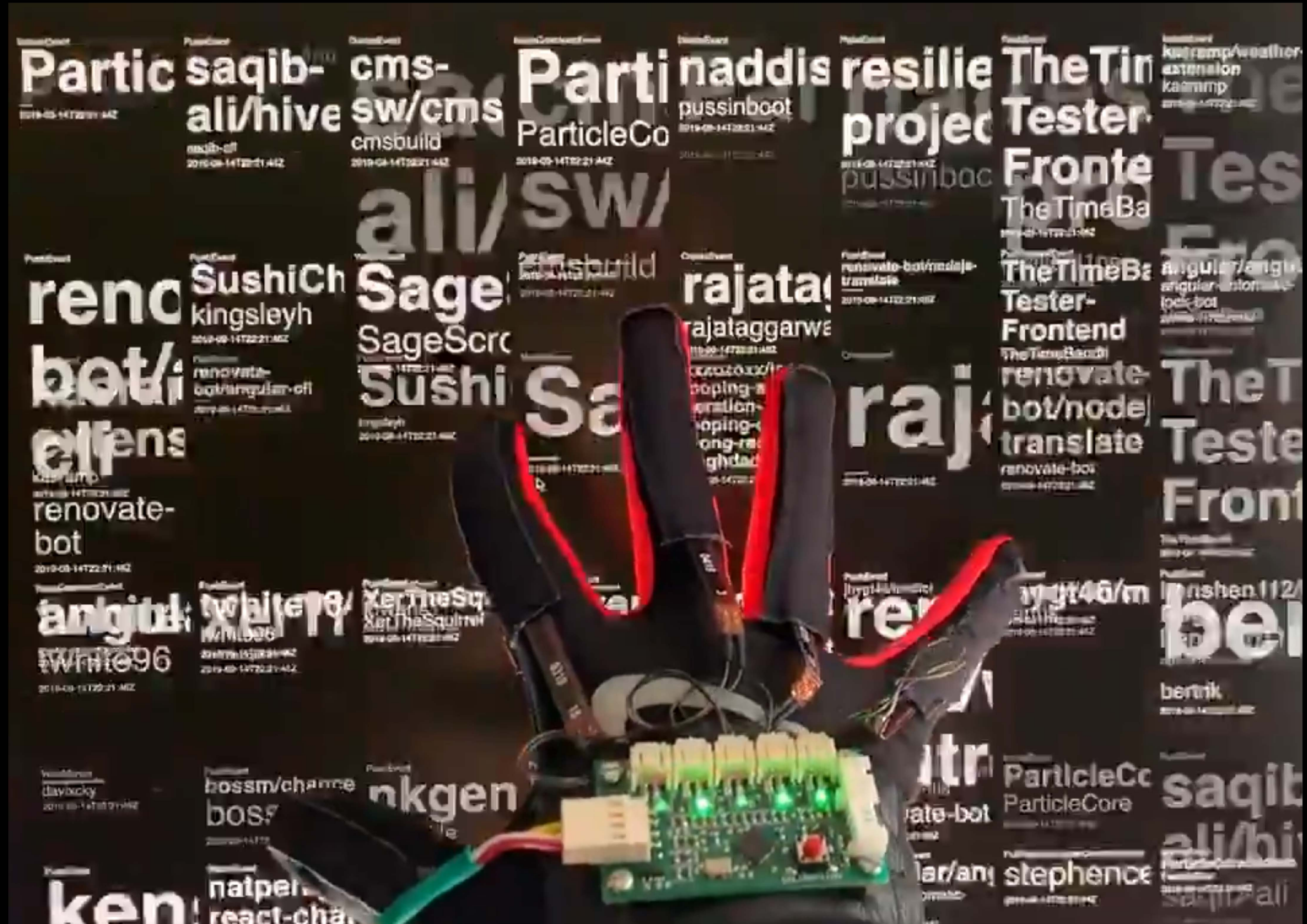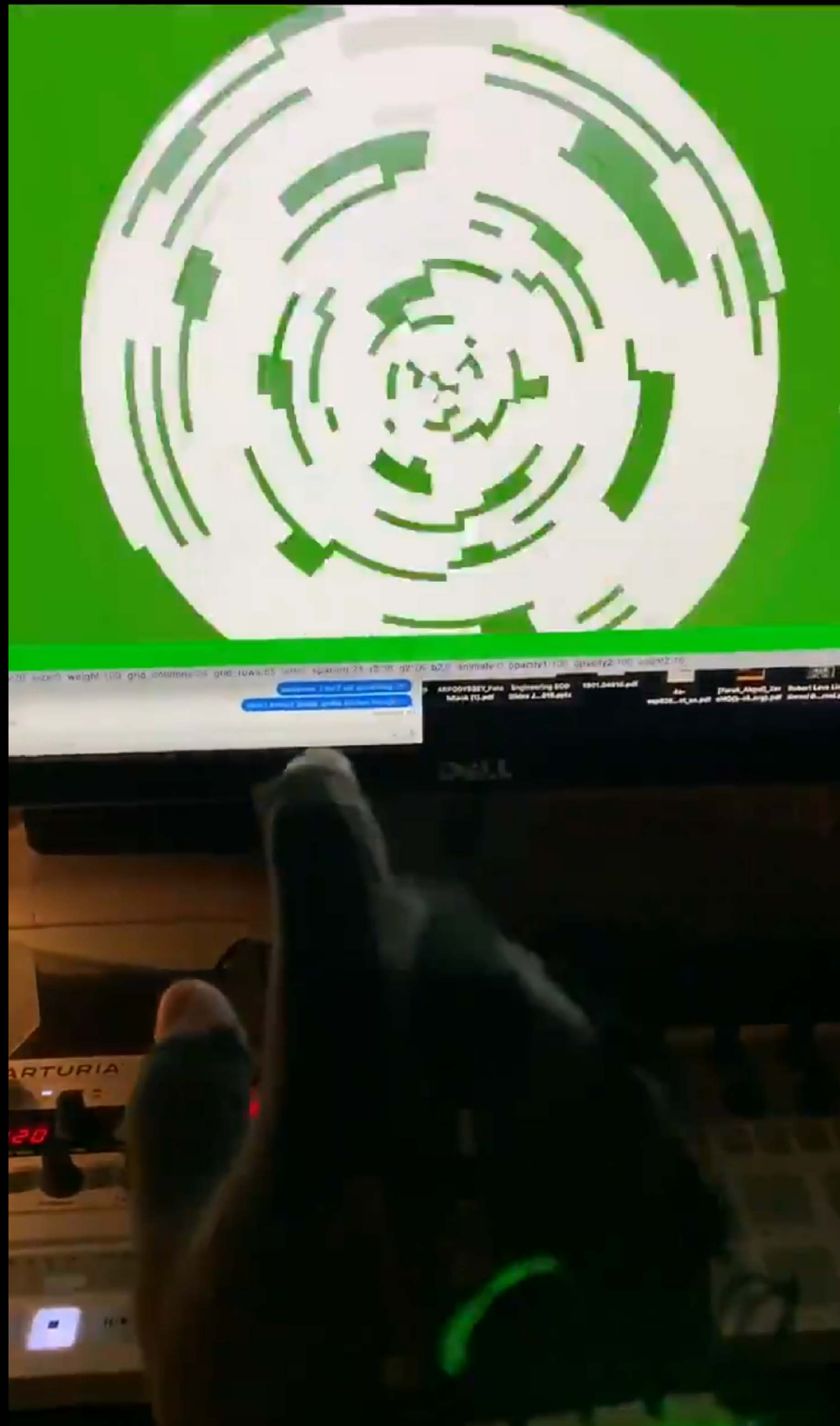
"Creative Expression" Trap Redux

Try Again.
Fail Again.
Fail Better.*

— *Samuel Beckett, Worstward Ho*

Data Visualization might not be the answer.

Whitespace might not be the enemy.

Visual hierarchy matters for a reason.

FOLDERS

- ▼ 📁 twitter-data-export
  - ▶ 📁 direct_message_media
  - ▶ 📁 profile_media
  - ▶ 📁 tweet_media
  - /* account-creation-ip.js
  - /* account-suspension.js
  - /* account-timezone.js
  - /* account.js
  - /* ad-engagements.js
  - /* ad-impressions.js
  - /* ad-mobile-conversions-attributed.js
  - /* ad-mobile-conversions-unattributed.js
  - /* ad-online-conversions-attributed.js
  - /* ad-online-conversions-unattributed.js
  - /* ageinfo.js
  - /* block.js
  - /* connected-application.js
  - /* contact.js
  - /* device-token.js
  - /* direct-message-group-headers.js
  - /* direct-message-group.js
  - /* direct-message-headers.js
  - /* direct-message.js
  - /* email-address-change.js
  - /* follower.js
  - /* following.js
  - /* ip-audit.js
  - /* like.js
  - /* lists-created.js
  - /* lists-member.js
  - /* lists-subscribed.js
  - /* moment.js
  - /* mute.js
  - /* ni-devices.js
  - /* periscope-account-information.js
  - /* periscope-broadcast-metadata.js
  - /* periscope-comments-made-by-user.js
  - /* periscope-expired-broadcasts.js
  - /* periscope-followers.js
  - /* periscope-profile-description.js
  - /* personalization.js
  - /* phone-number.js
  - /* profile.js

`ad-impressions.js`

```
window.YTD.ad_impressions.part0 = [ {
  "ad" : {
    "adsUserData" : {
      "adImpressions" : {
        "impressions" : [ {
          "deviceInfo" : {
            "osType" : "Ios",
            "deviceId" : "vRFgsz6n0fWiuxp0Gg62UJ0vRc+N0+uxc0Xxtjcz6h8=",
            "deviceType" : "iPhone XS"
          },
          "displayLocation" : "TimelineHome",
          "promotedTweetInfo" : {
            "tweetId" : "1133465417618460673",
            "tweetText" : "Grab a bag of kettle-cooked chips and turn on your mental out-of-office. #CapeCodStateOfMind https://t.co/hX3uEuN7AS",
            "urls" : [ ],
            "mediaUrls" : [ "https://t.co/hX3uEuN7AS" ]
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            "screenName" : "@CapeCodChips"
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            "targetingValue" : "US - Salty snacks: Tostitos"
          }, {
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            "mediaUrls" : [ ]
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```

Twitter Personal Data Export / Ad Impressions

Match between system and the real world

EVENT QUEUE

Entries processed
14

Entries remaining
5,298

2019-06-24 16:19:02
iPhone XS

Cape Cod Chips

Grab a bag of kettle-cooked chips and turn on your mental out-of-office. #CapeCodStateOfMind https://t.co/hX3uEuN7AS

TARGETING CRITERIA

Behaviors
US - Salty snacks: Tostitos

Age
25 to 54

Locations
Monterey-Salinas CA, US

EVENT HISTORY

2019-06-24 16:34:11
iPhone XS
*Postmates*

When your human Postmates your favorites.

2019-06-24 16:19:02
iPhone XS
Cape Cod Chips

Grab a bag of kettle-cooked chips and turn on your mental out-of-office. #CapeCodStateOfMind https://t.co/hX3uEuN7AS

2019-06-24 16:19:04
iPhone XS
natural bliss®

natural bliss is made with only simple, real ingredients you love. Like farm fresh milk and cream, pure cane sugar, and Madagascar vanilla. https://t.co/zDb2mOfbyC

TWITTER AD IMPRESSION HISTORY BROWSER
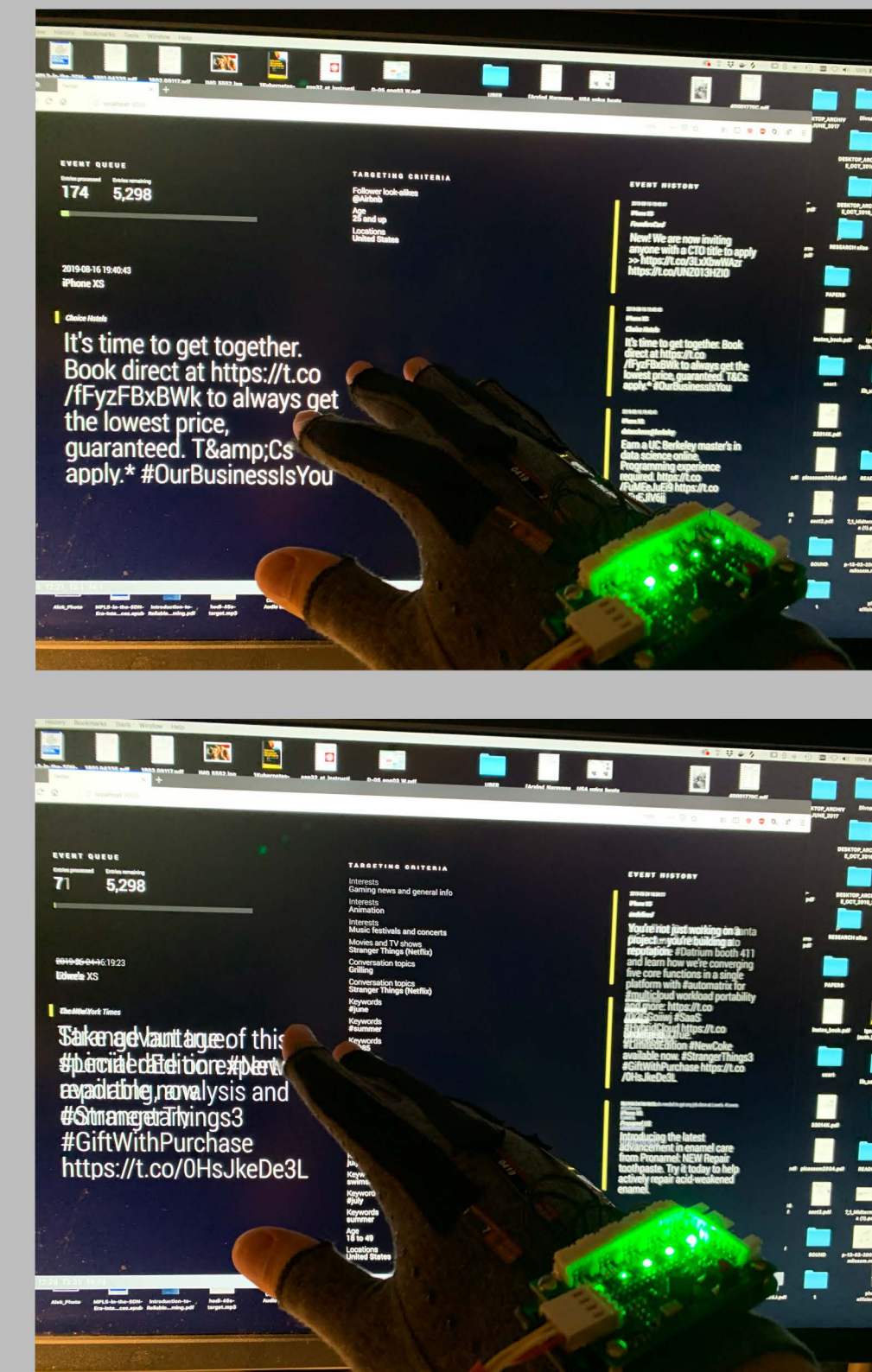
Takeaways*

Fast iteration of low information density scenes, with clear
visual hierarchy, might be superior to "information visualization."

Muscular control of the information flow strengthens the sense of agency
and might help stitch together visual stimuli into a consistent narrative.

Direct engagement with individual "data points" can create a sense of empathy
in a way that can't be matched by data aggregates and statistics.

Exploring hardware "data interfaces" can help explore gaps in existing software
stacks, generate new requirements, and drive product innovation in critical
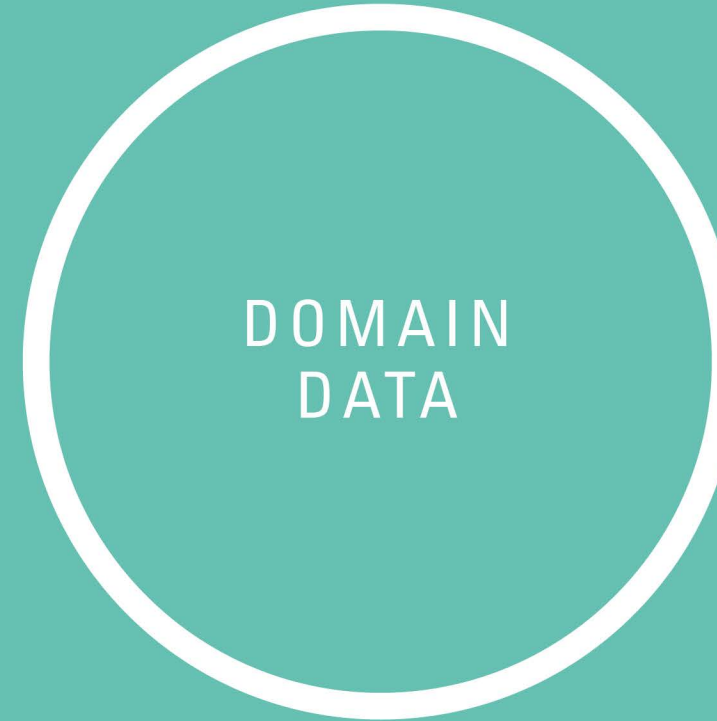fields of Cloud Computing, Big Data, and AI.
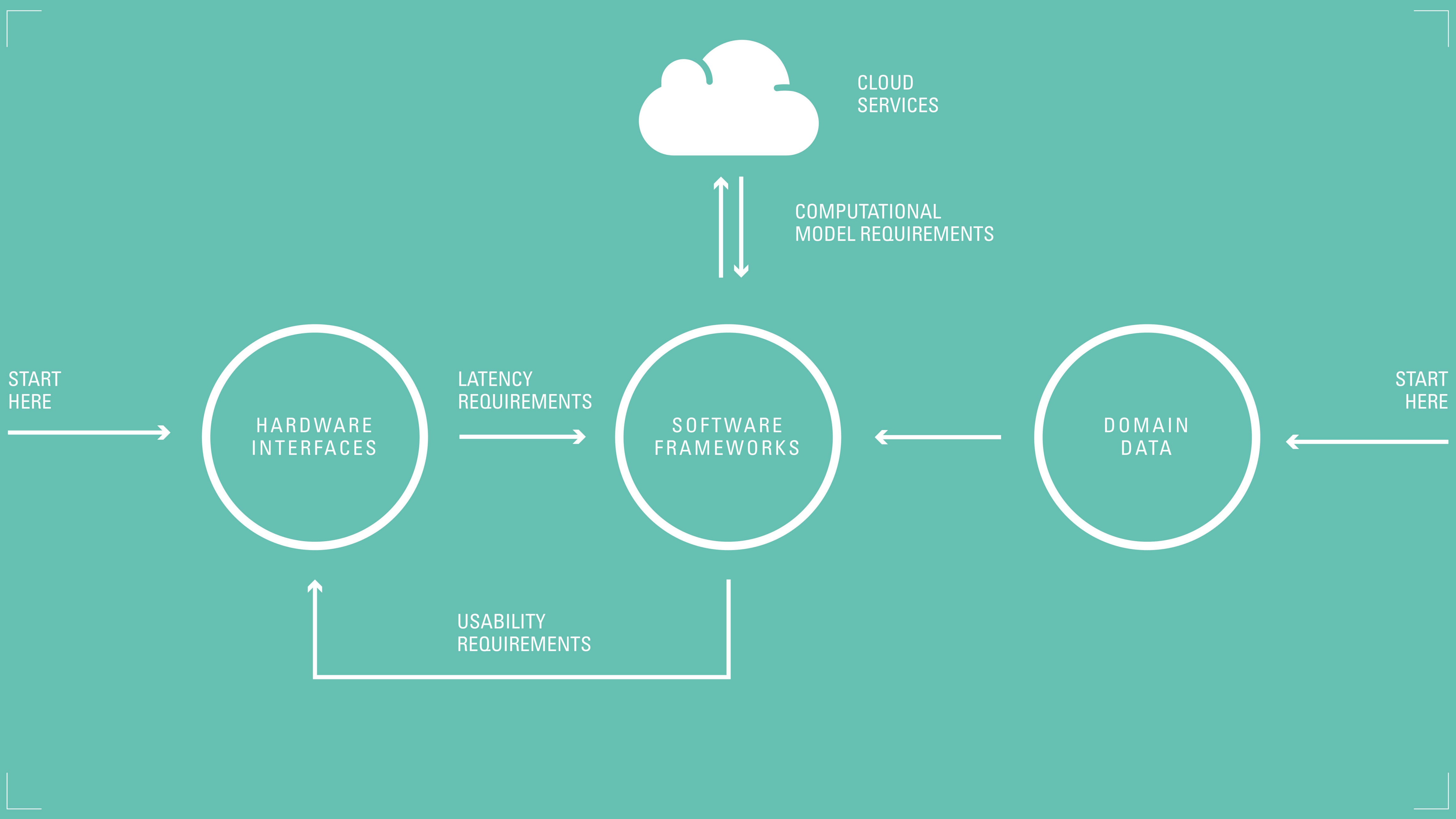
CLOUD
SERVICES
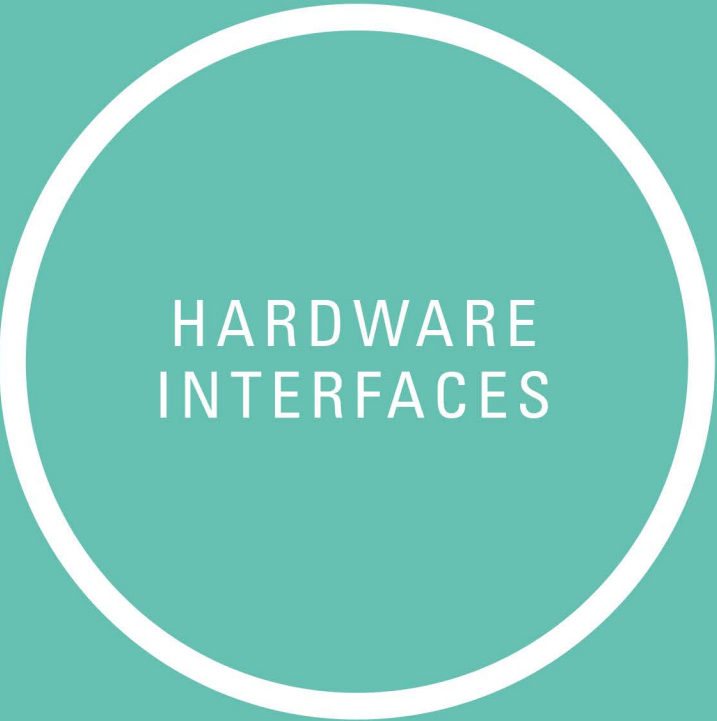
COMPUTATIONAL
MODEL REQUIREMENTS

START
HERE

HARDWARE
INTERFACES

LATENCY
REQUIREMENTS

SOFTWARE
FRAMEWORKS

DOMAIN
DATA

START
HERE

USABILITY
REQUIREMENTS

Links