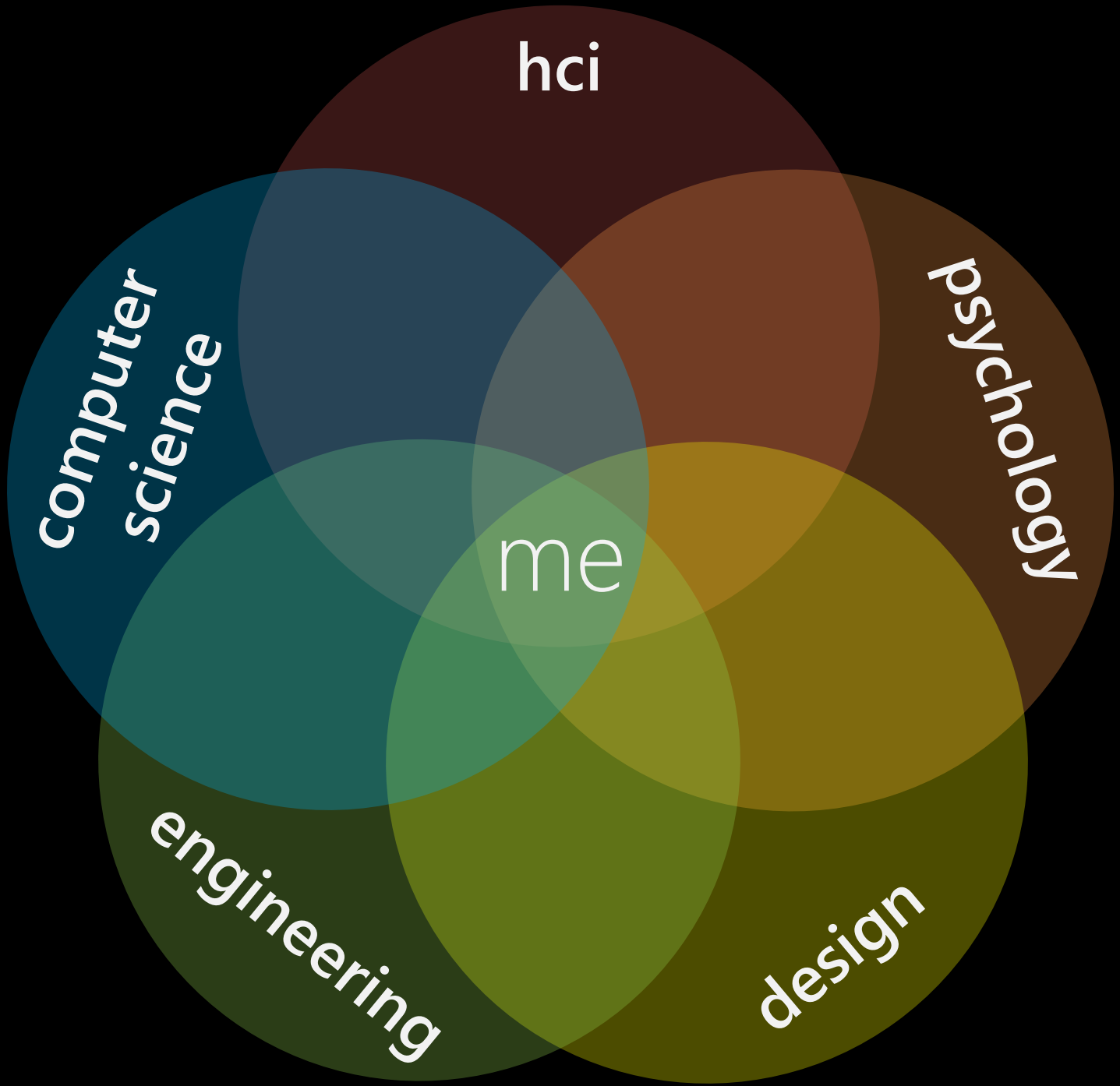
Making+Health: Social Fabric Fitness

@jonfroehlich
Assistant Professor
Computer Science
University of Maryland

Maker Movement in Health
Indiana University
April 21, 2014

me


hci
computer science
psychology
me
engineering
design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Minneapolis, MN
Portland, OR
Ames, IA
Maryland!
Orange County, CA
Denver, CO
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ALBERTA
ONTARIO
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Edmonton
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Winnipeg
Lake Superior
Seattle
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Gulf of Mexico
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Havana
Culiacán
Santa Clara
Mérida
JALISCO
Mexico City
CAMPECHE
OAXACA
Guatemala City
HONDURAS
NICARAGUA

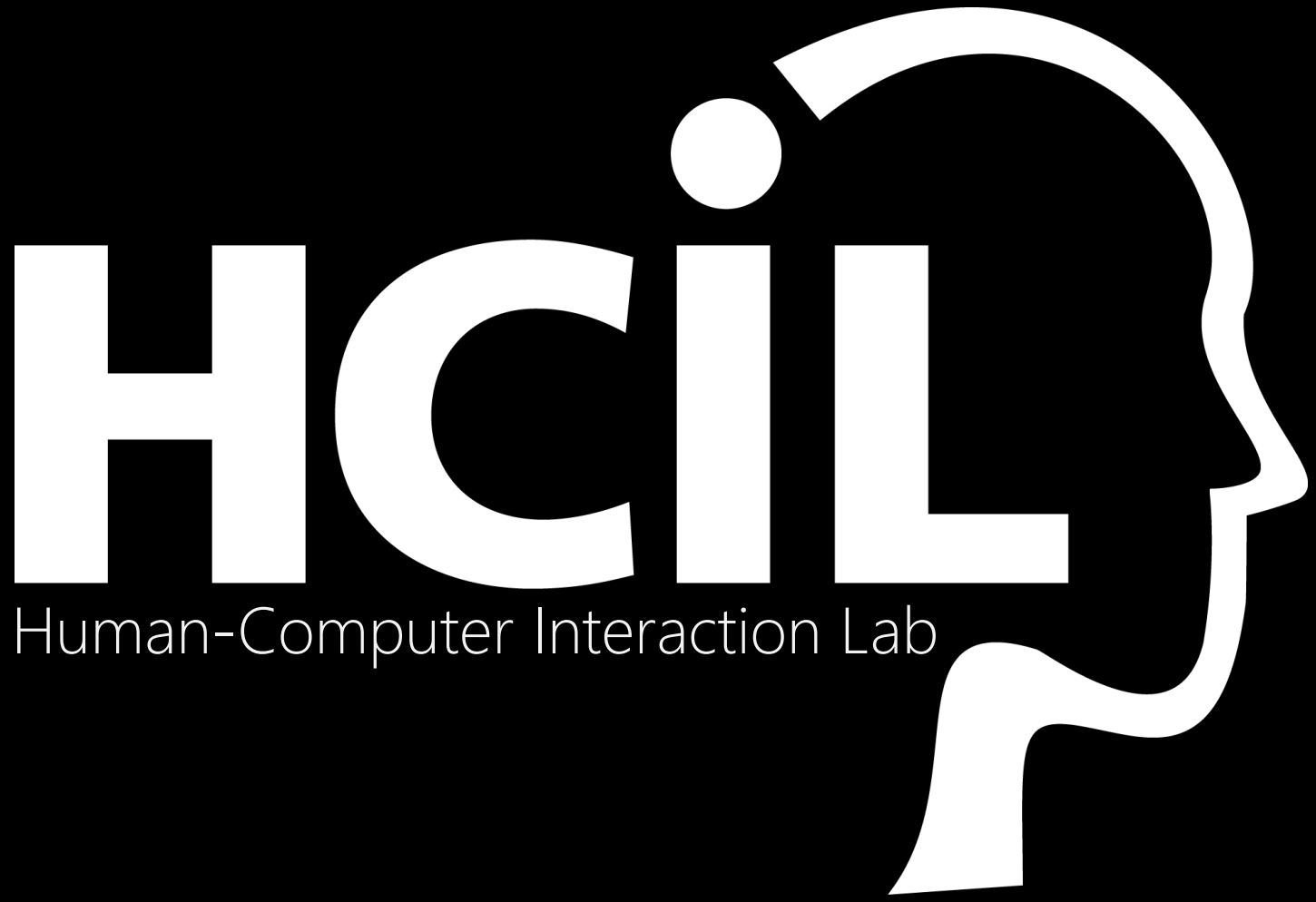
How does one go from  to  ?

My Group

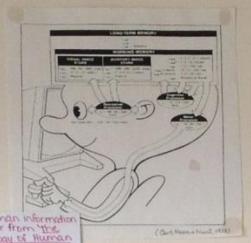
Started in 2012


makeability lab


makeability lab
PhD: 4 (2 are 1st yrs)
MS: 2 (both iSchool)
UGrad: 3-5 per semester
High Sch: 1-2 per summer
A lablet within the HCIL


HCIL
Human-Computer Interaction Lab

HCIL Begins



The human information processor from the Psychology of Human Computer Interaction

1983

Ben Shneiderman
Founding Director

NOOBIE 1986
(A. DRUIN'S MASTER'S THESIS AT MIT)

Lab in Comp. & Space Sciences Bldg pre-1988

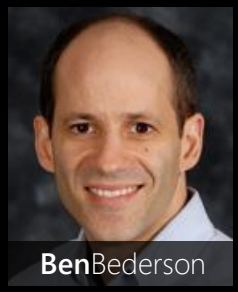
Ben Shneiderman Trading Card

PROF. ARIEL ROSENFELD
(1931-2004)

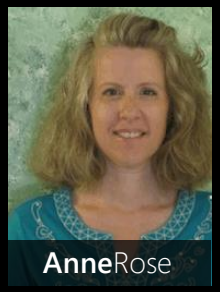

LeahFindlater


JenGolbeck

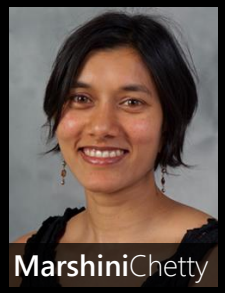

BenShneiderman


BenBederson

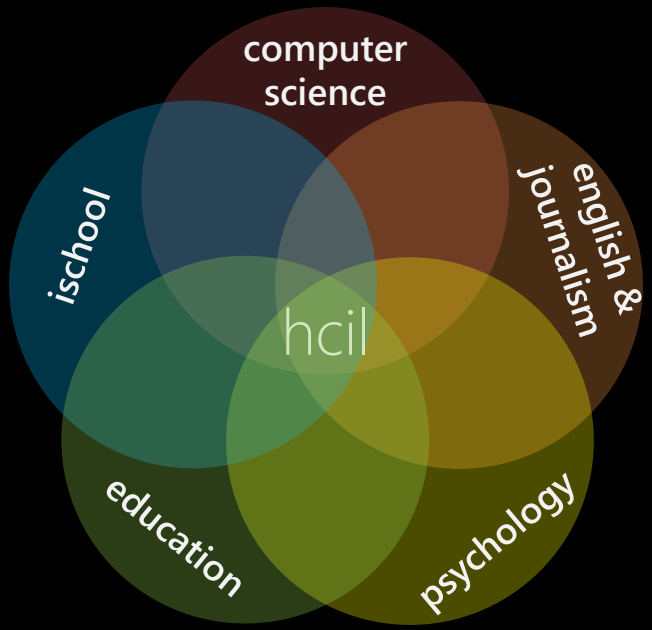

JonFroehlich


AnneRose

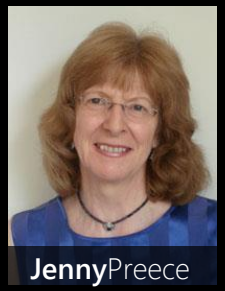

CatherinePlaisant

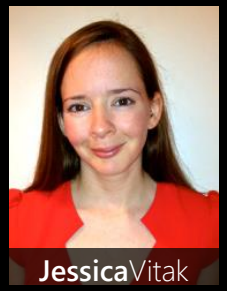

MarshiniChetty

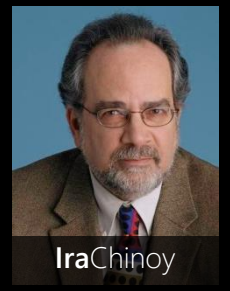

VanessaFrias


computer science
ischool
english & journalism
hcil
education
psychology


KariKraus


JennyPreece

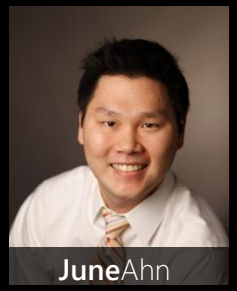

JessicaVitak

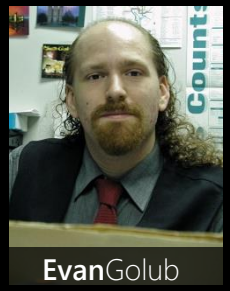

IraChinoy

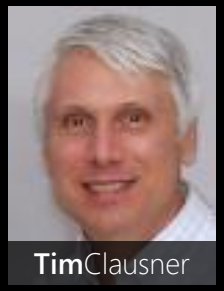

AllisonDruin


MonaLeighGuha


TammyClegg


JuneAhn


EvanGolub


TimClausner


KentNorman

HCIL

Offices

Main Lab

From Back

HCIL Usability Lab

With One-Way Transparent Mirror


When I arrived in 2012, I observed a lack of space
for **combining materiality & computation**

MENU TIME

Bits

SMALL BUSINESS

How the 'Mak

OCTOBER 29, 2012

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Technology

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A Hardware Renaissance in Silicon Valley

What's Popular Now

The Real Romney

Philippine Economy Set to Become Asia's Newest Bright Spot

HCIL Hackerspace

Front Entrance

Building the Hackerspace

Making the Whiteboard Wall

Building the Hackerspace

Making the Workbench

Building the Hackerspace

Making the Workbench

Building the Hackerspace

Making the Workbench

Workspace

HCIL Hackerspace

Workspace

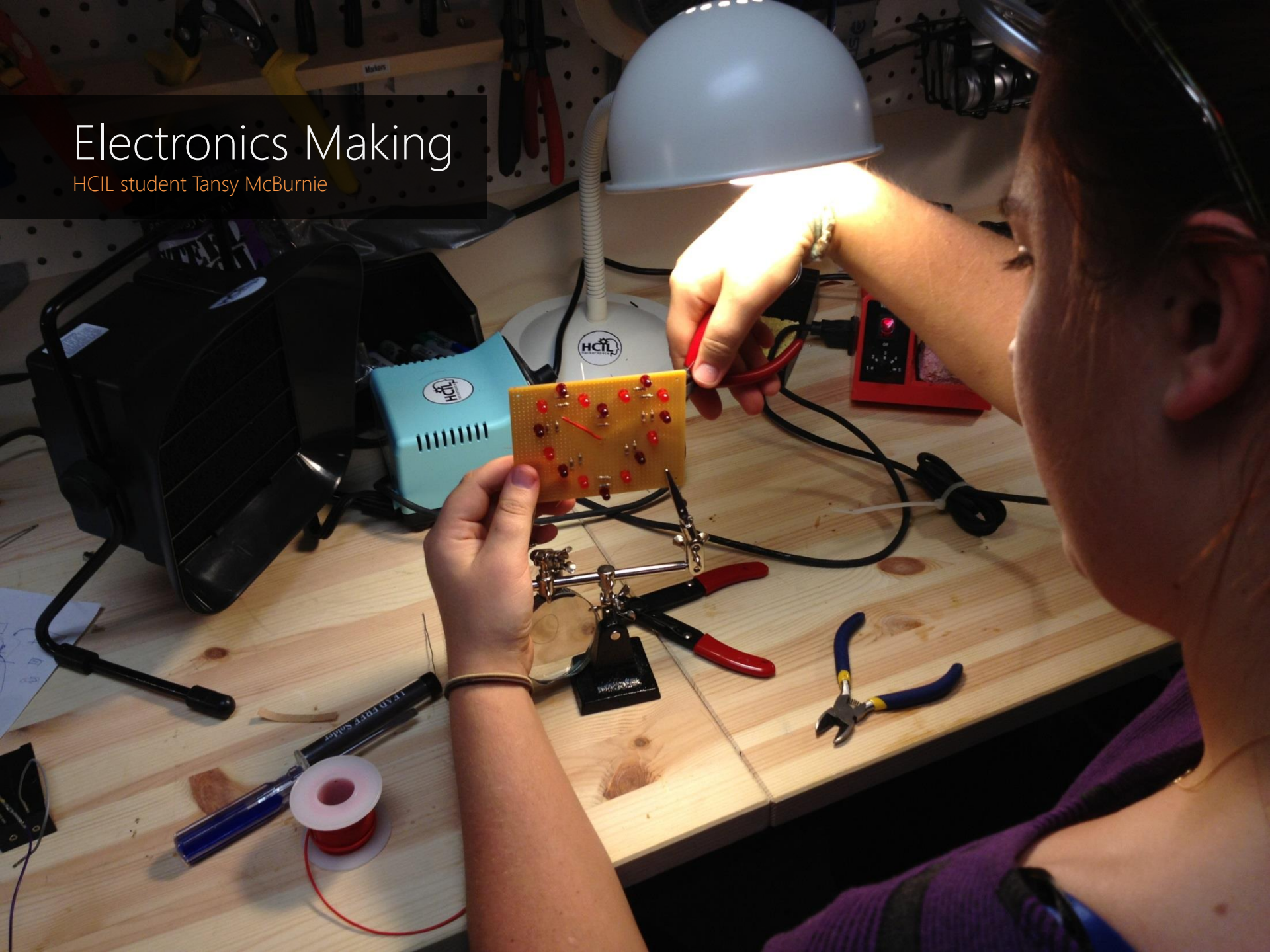
HCIL Hackerspace

Physical Making

HCIL Student Leyla Norooz

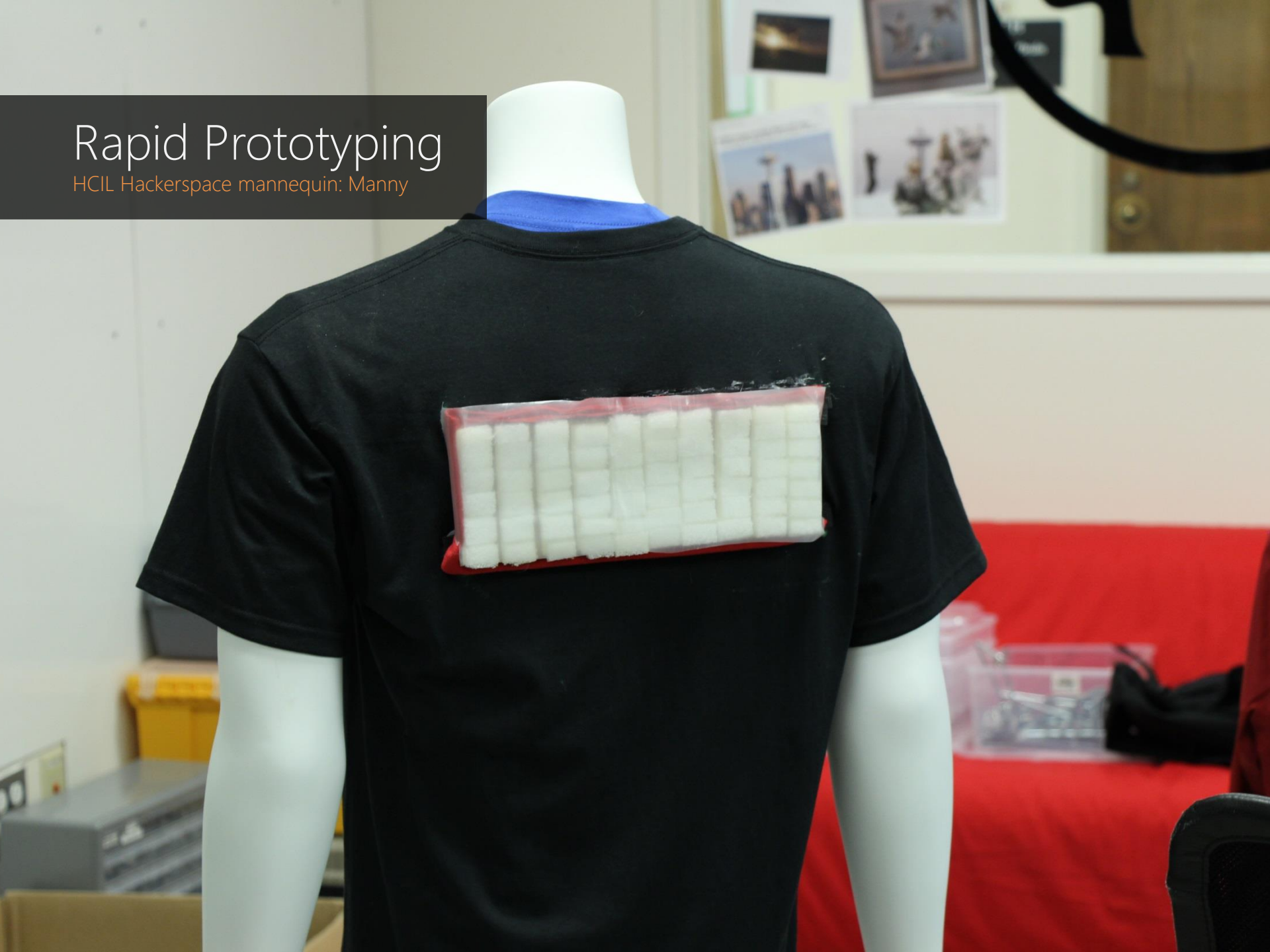
Craft/Fabric Making

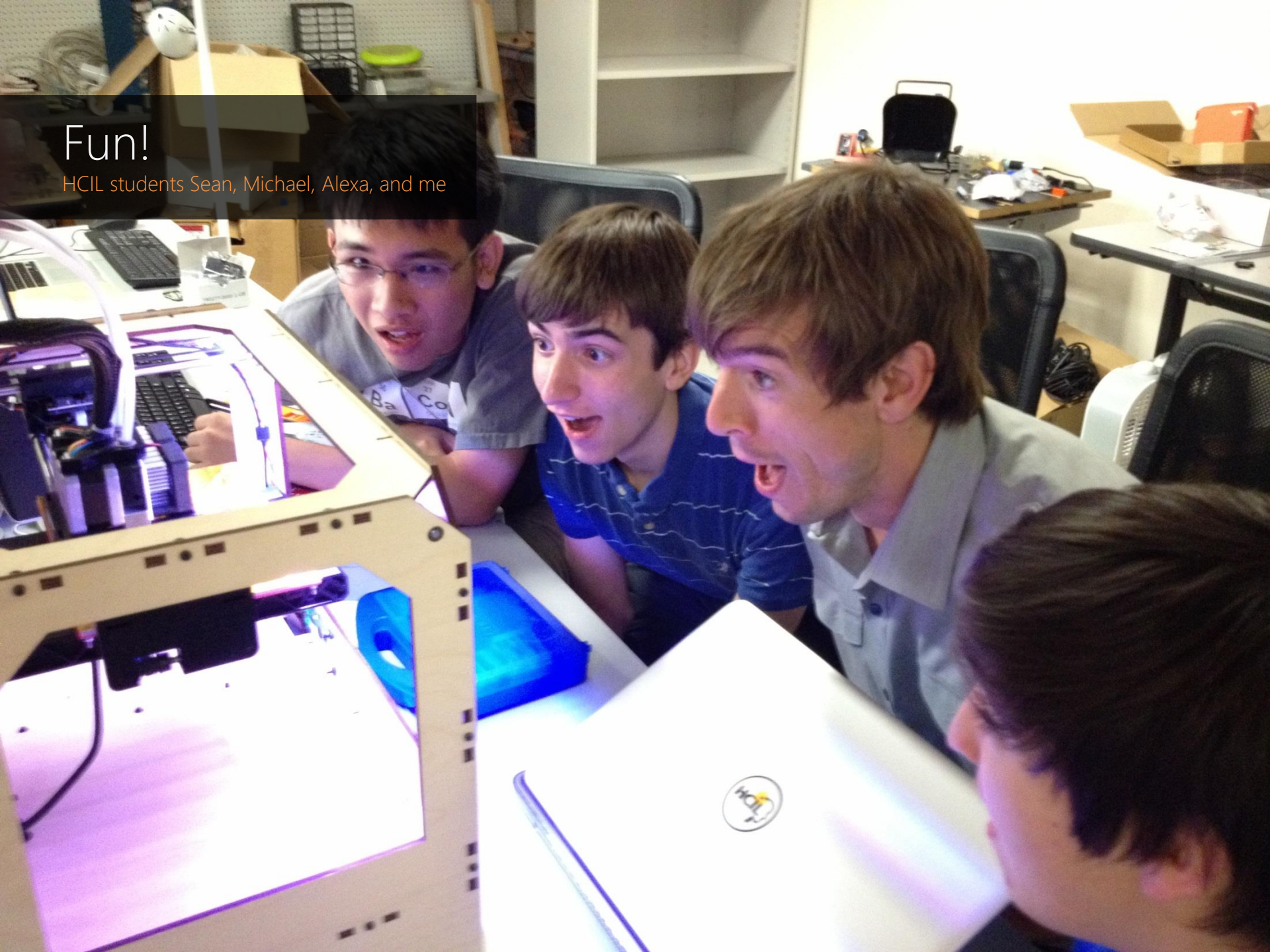
HCIL student Matt sewing


Electronics Making
HCIL student Tansy McBurnie

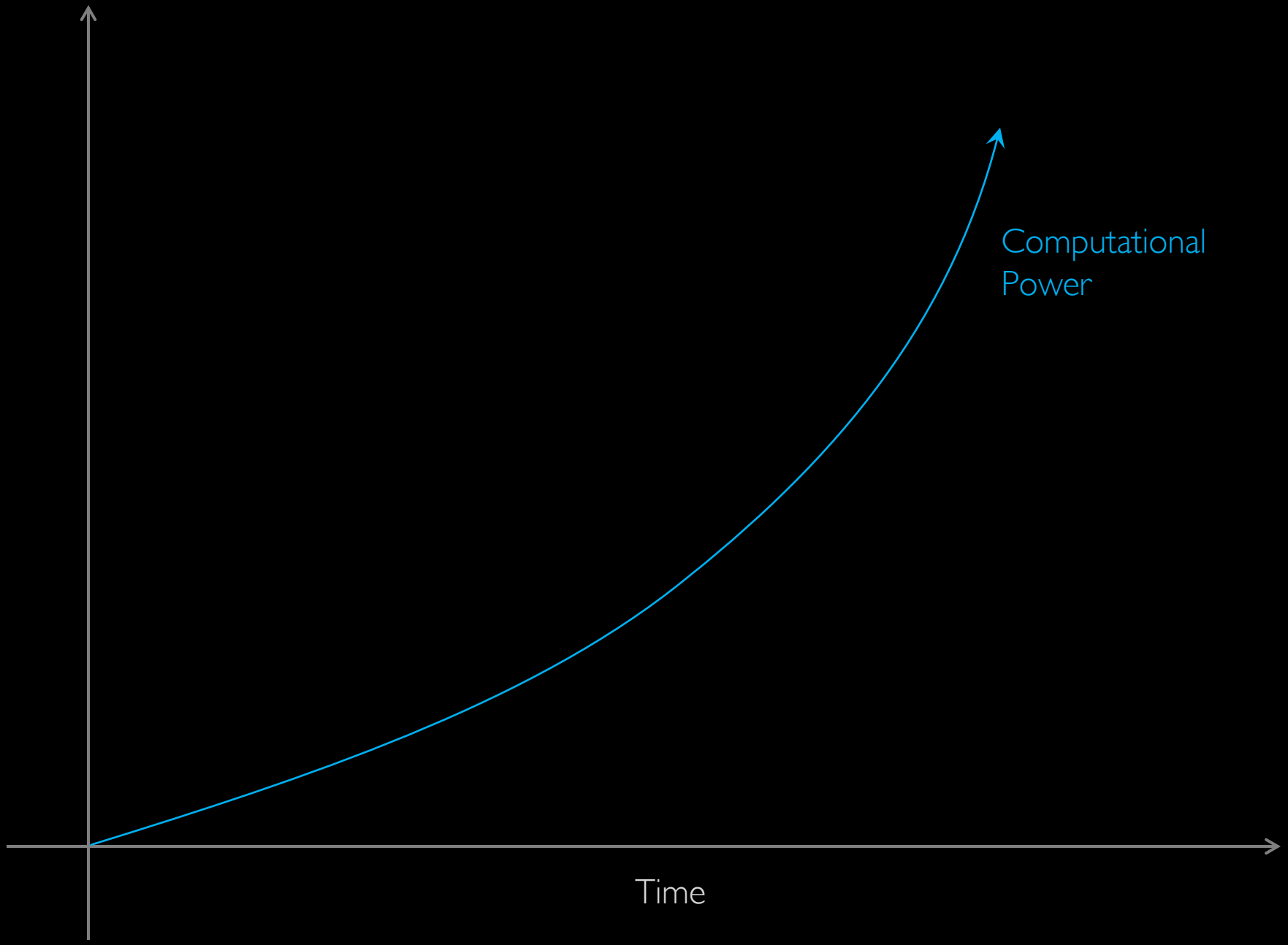
Rapid Prototyping

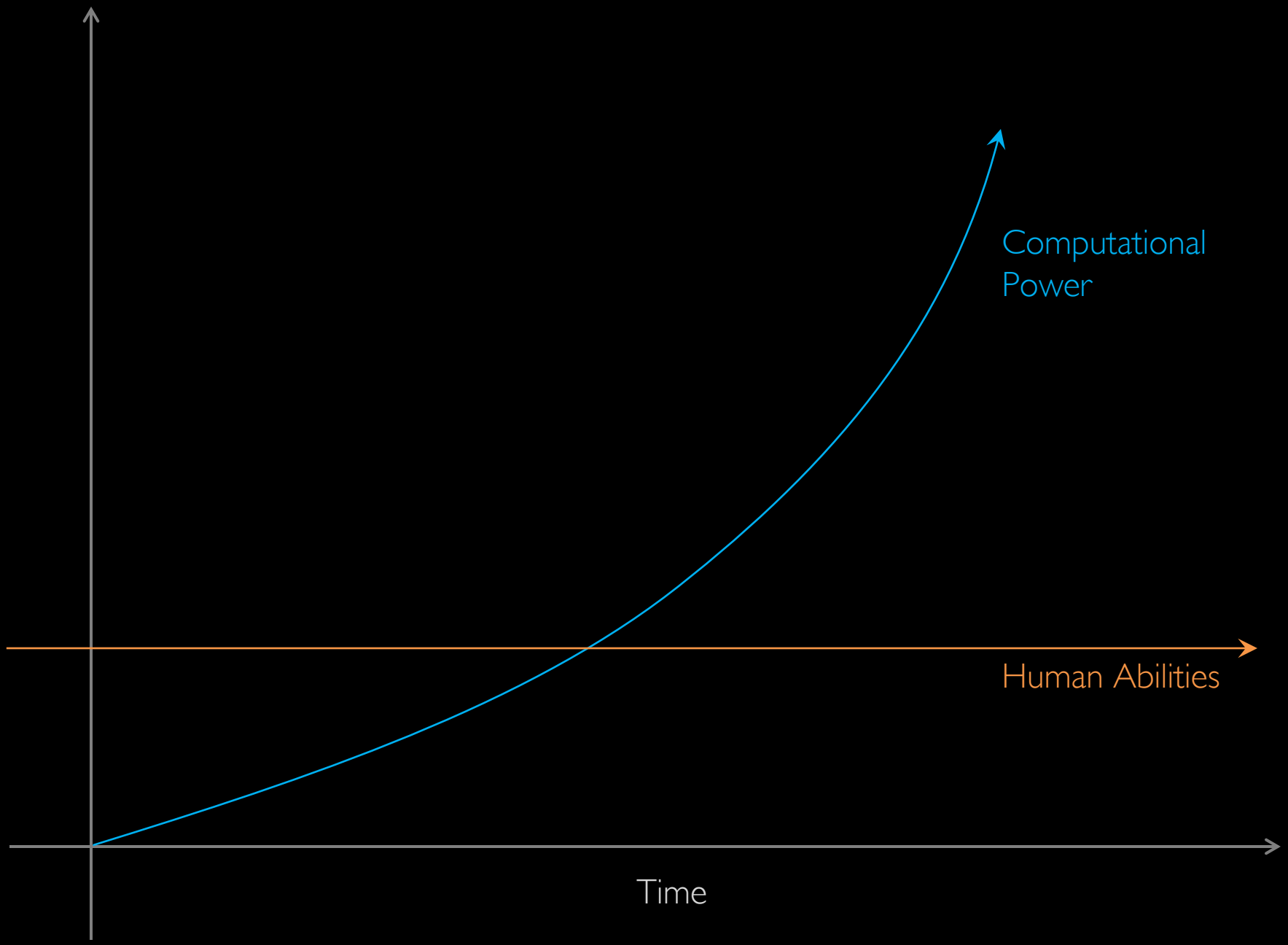
HCIL Hackerspace mannequin: Manny

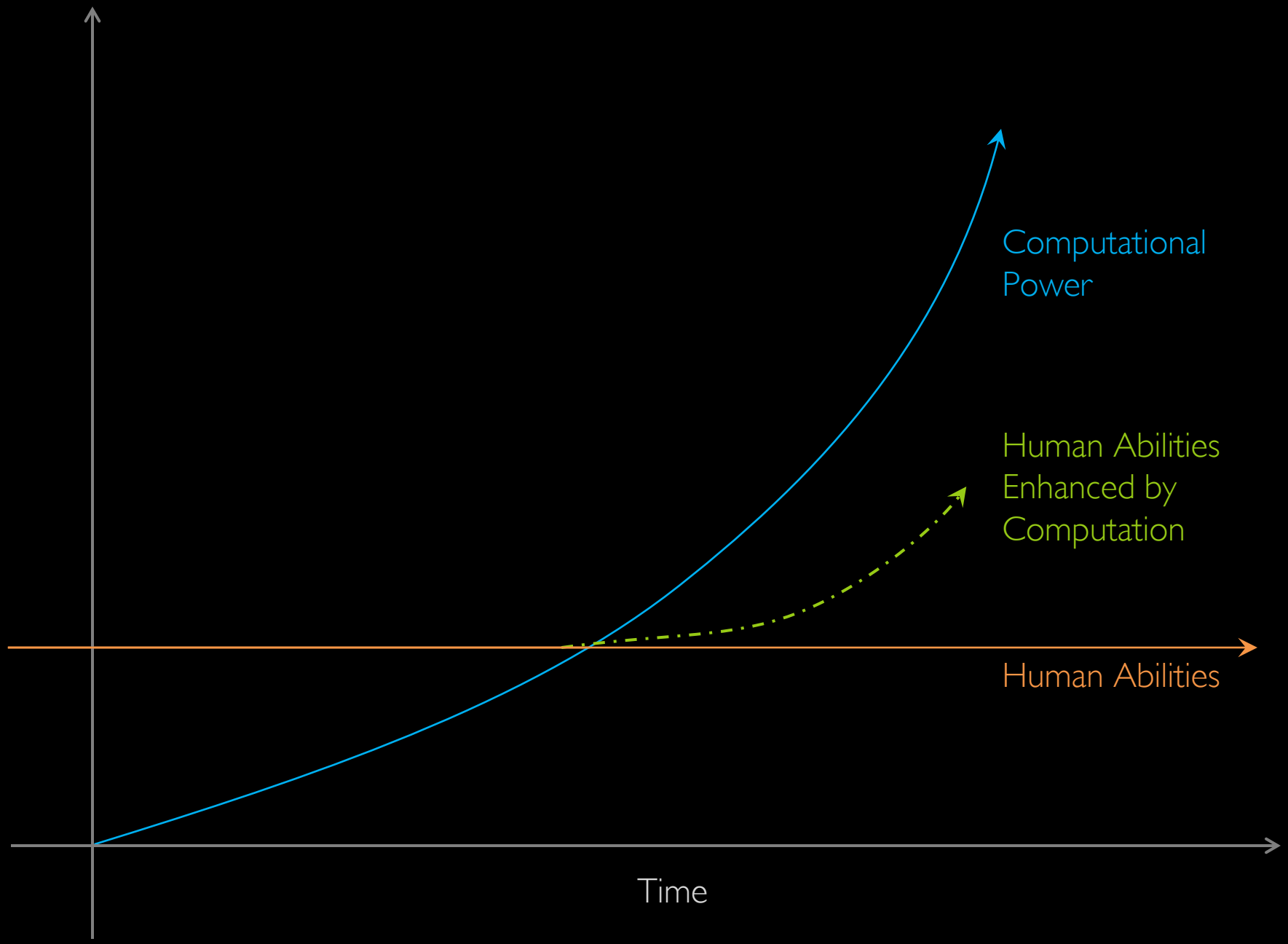



Fun!
HCIL students Sean, Michael, Alexa, and me

The inspiration for our work is partly technical, partly social.


Computational
Power
Time


Computational
Power
Human Abilities
Time


Computational
Power
Human Abilities
Enhanced by
Computation
Human Abilities
Time

Social Fabric Fitness

What if Our Clothes Could Show How Fast We Run?

Since the 1990s, **running** has experienced unprecedented growth in the US

[http://www.runningusa.org/state-of-sport-2013-part-II; http://goo.gl/T3Q4x8]

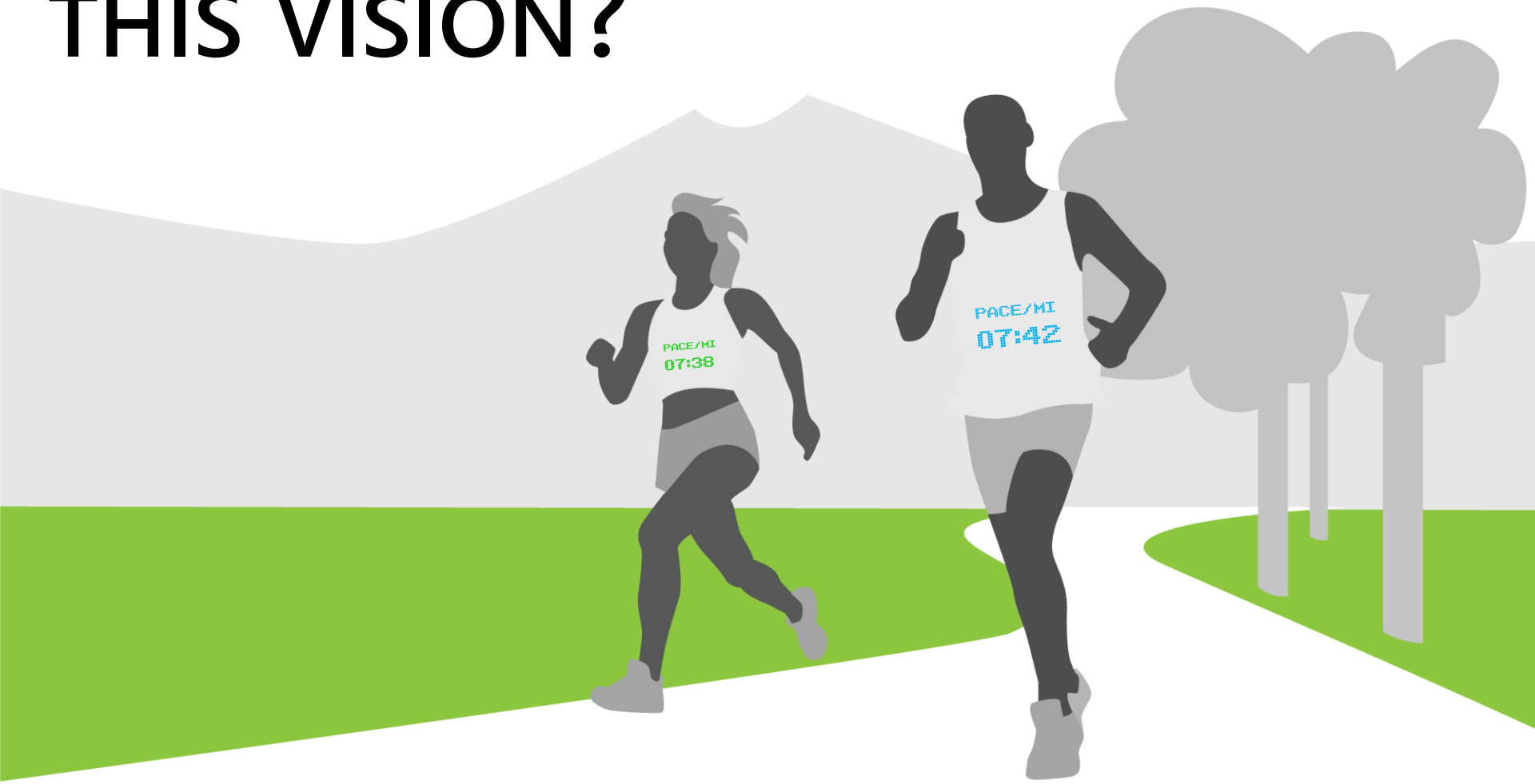
Plethora of Run Trackers

Built for the individual!

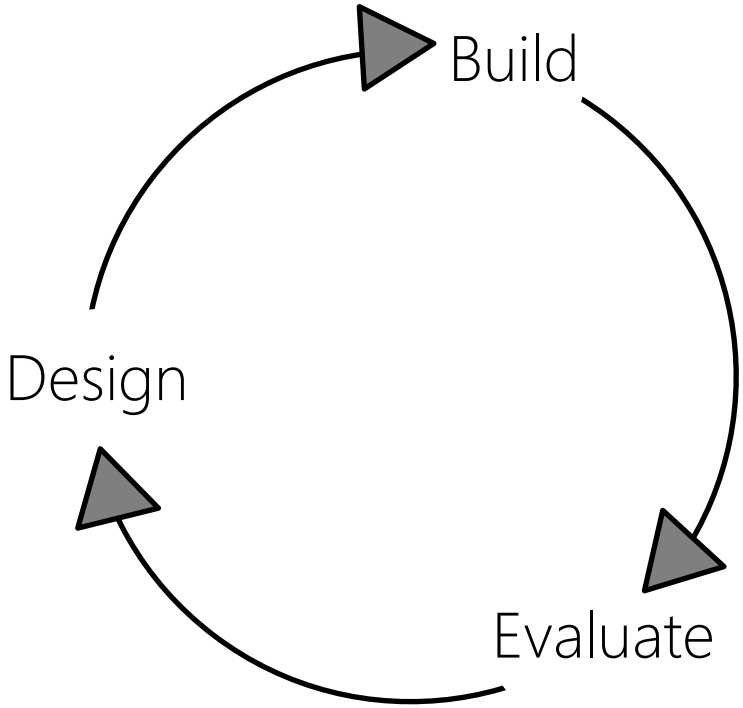
Can we create a **wearable and glanceable feedback display** to support group runners?

What does it feel like to have **“private” data reappropriated for a public display** that you wear?

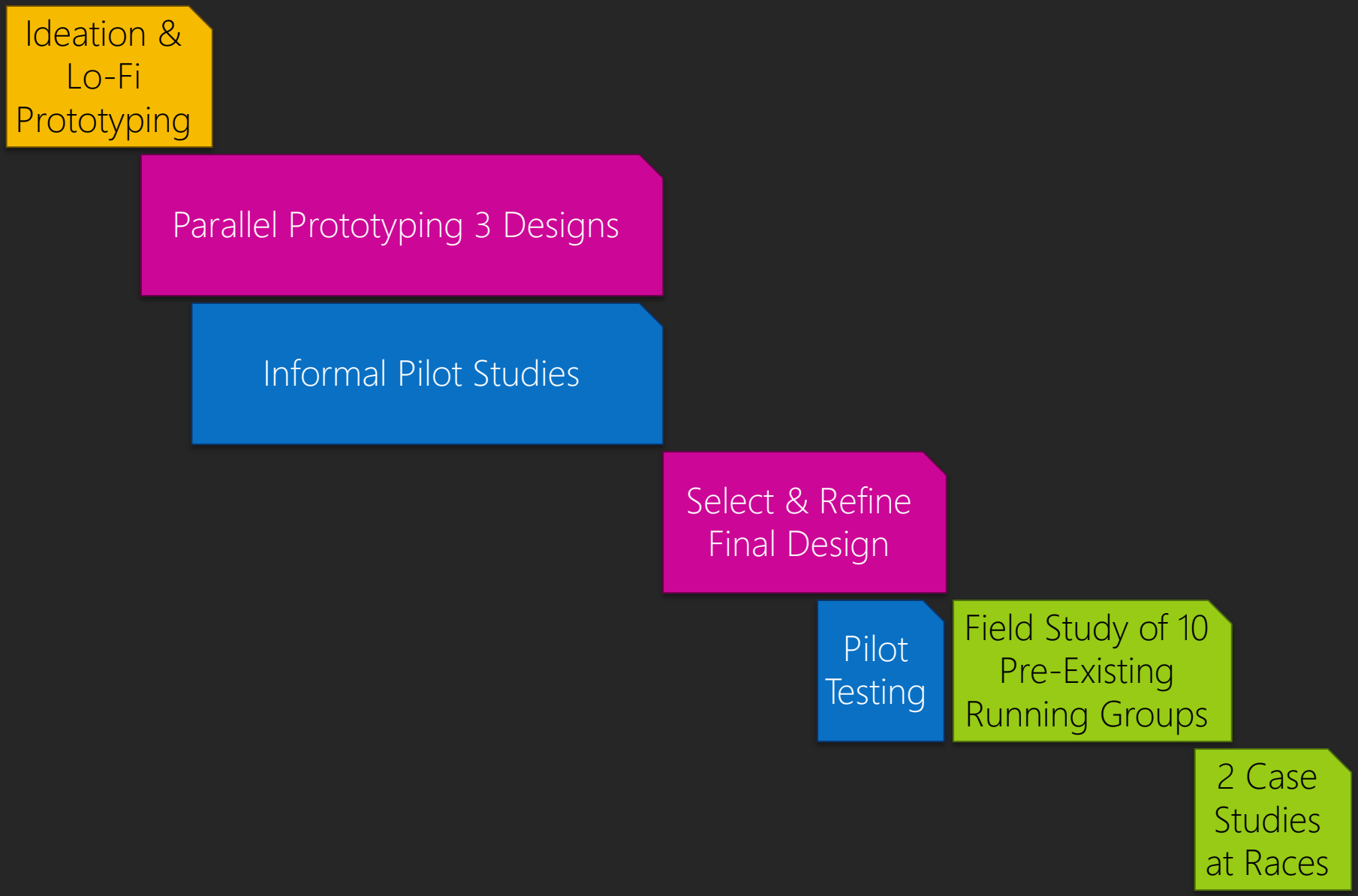
How should we pursue this vision?



The Iterative Design Process

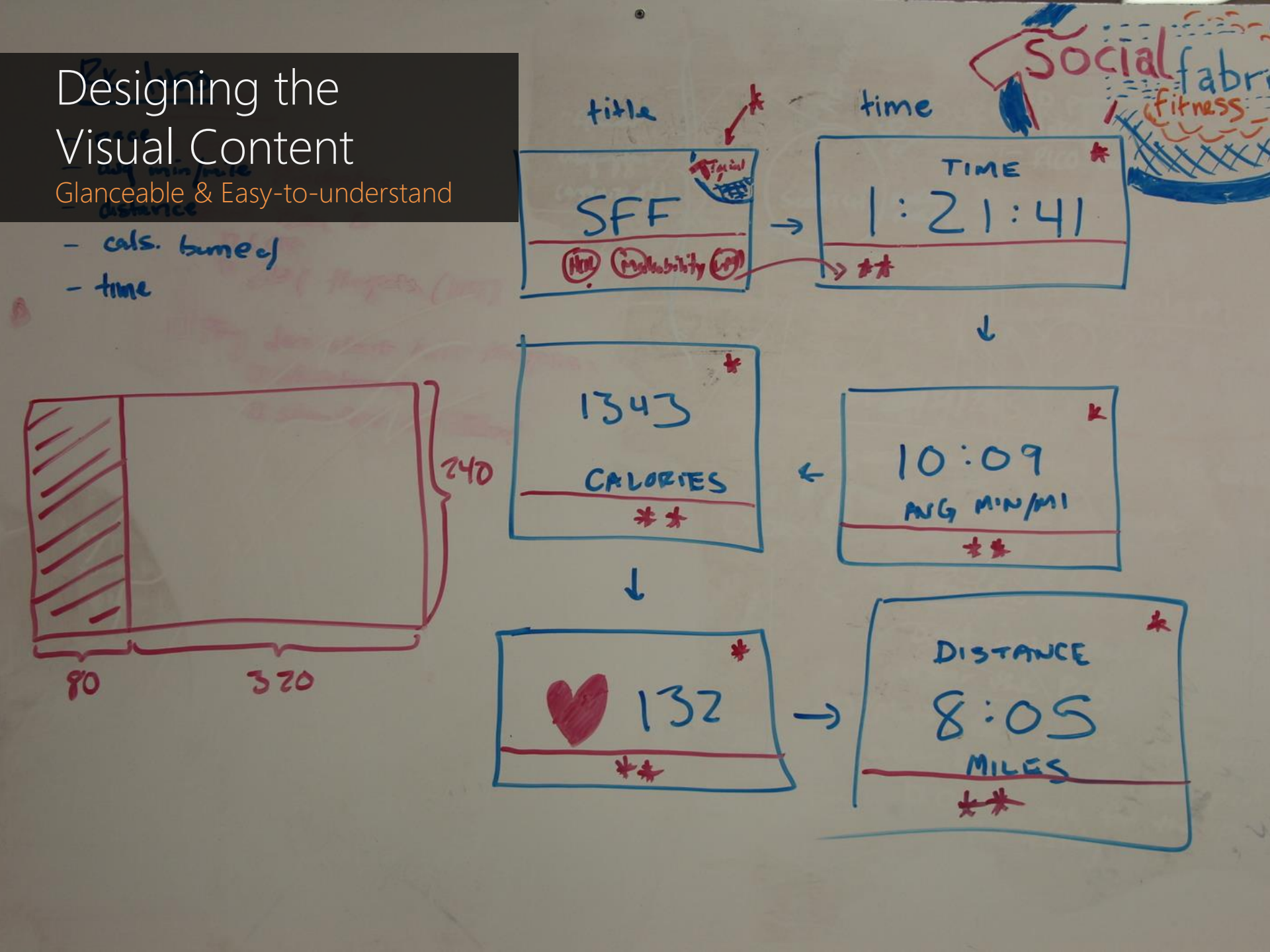


SFF: Design and Evaluation Process



Designing the Visual Content

Glanceable & Easy-to-understand



Comfort

Low-Fidelity Prototypes

Engineering

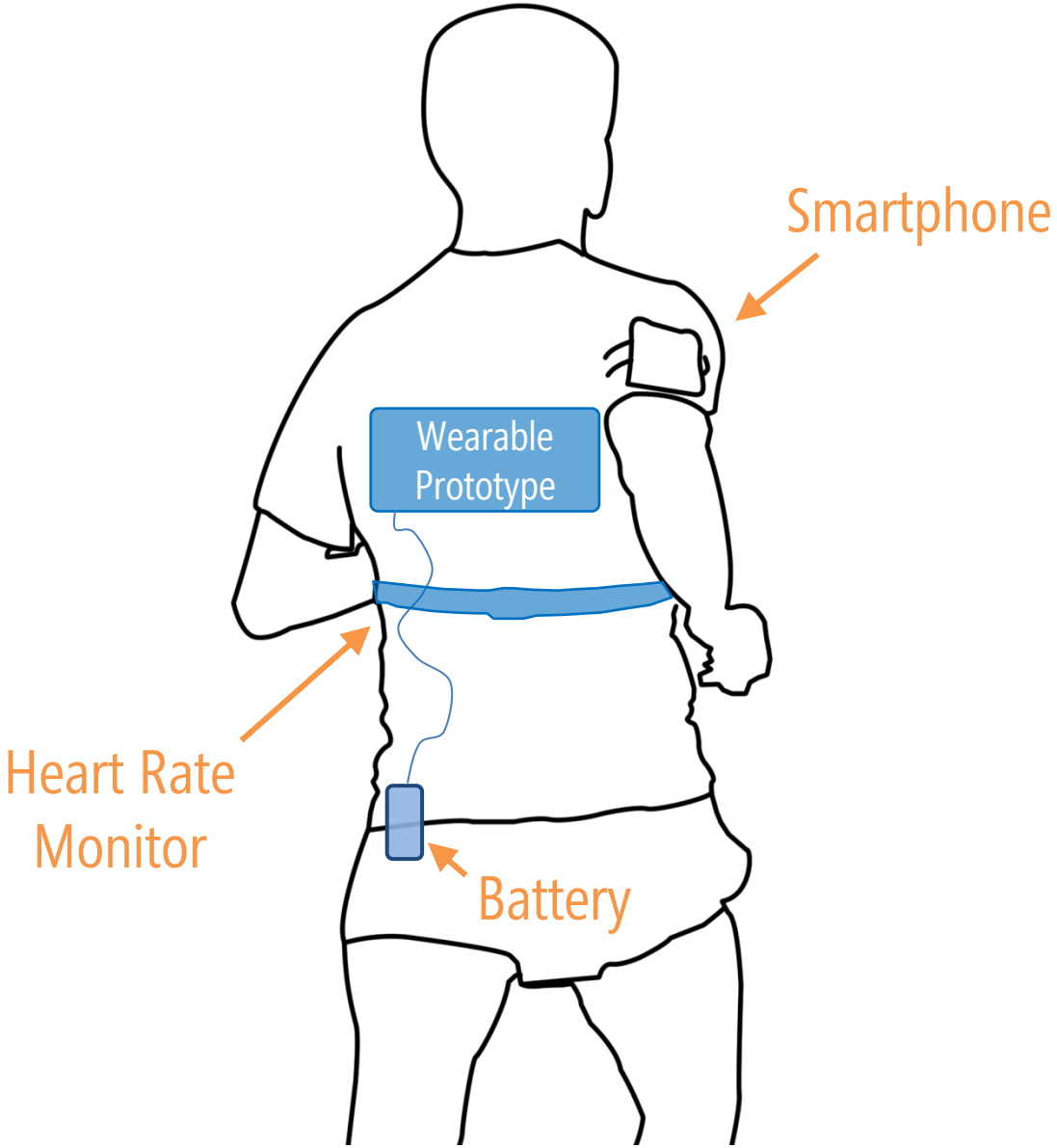
Responsive & Robust


Fabric/Craft
Building the Jerseys

Pilot Studies

Examining our prototypes in the field

SFF: System Design



SFF: System Design

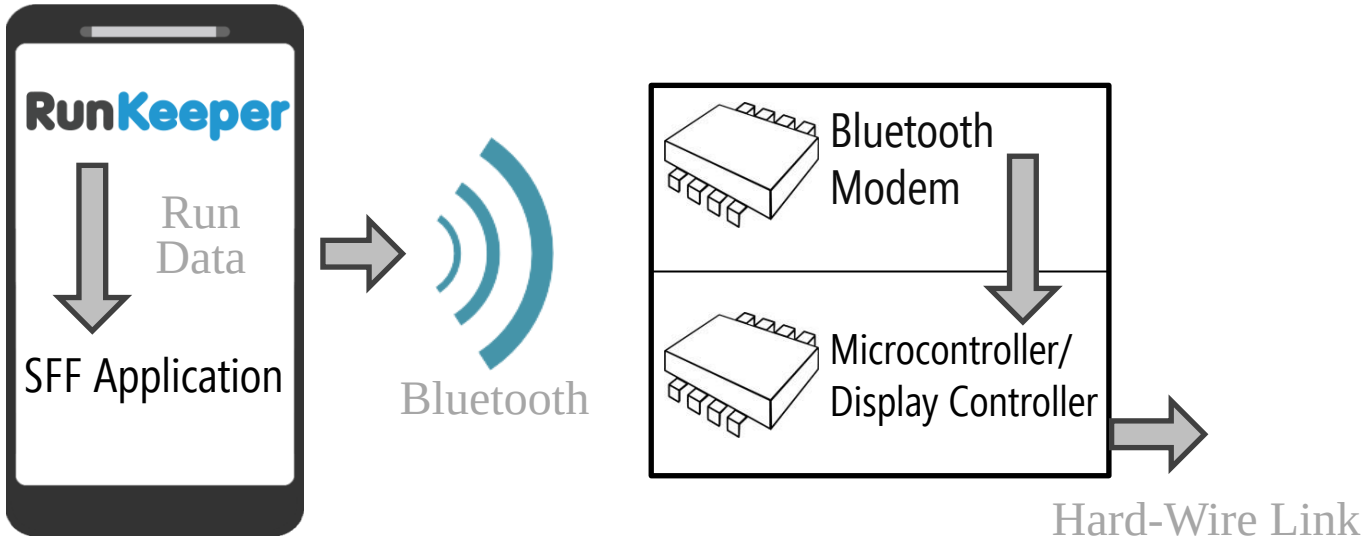
Smartphone

1. Sense & process running data. Wirelessly transmit to display hardware.

SFF: System Design

Smartphone

Display Hardware



1. Sense & process running data. Wirelessly transmit to display hardware.

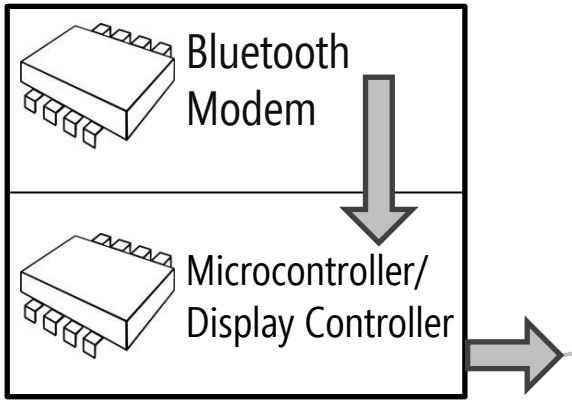
2. Receive running data; process & send to the display via hard wire link.

SFF: System Design

Smartphone

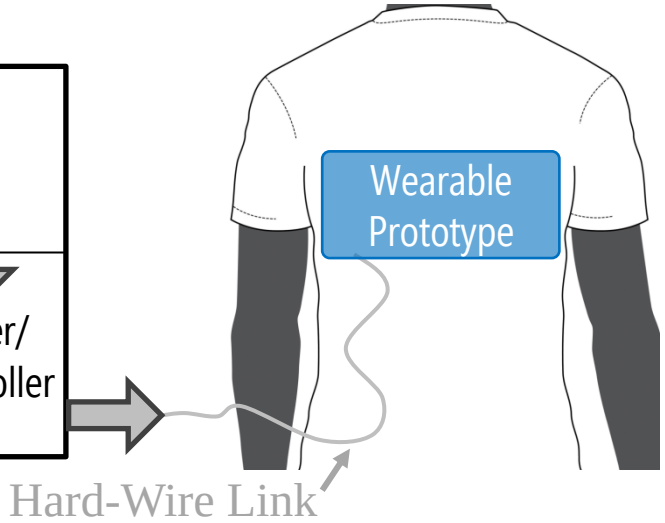
1. Sense & process running data. Wirelessly transmit to display hardware.

Display Hardware



2. Receive running data; process & send to the display via hard wire link.

Wearable



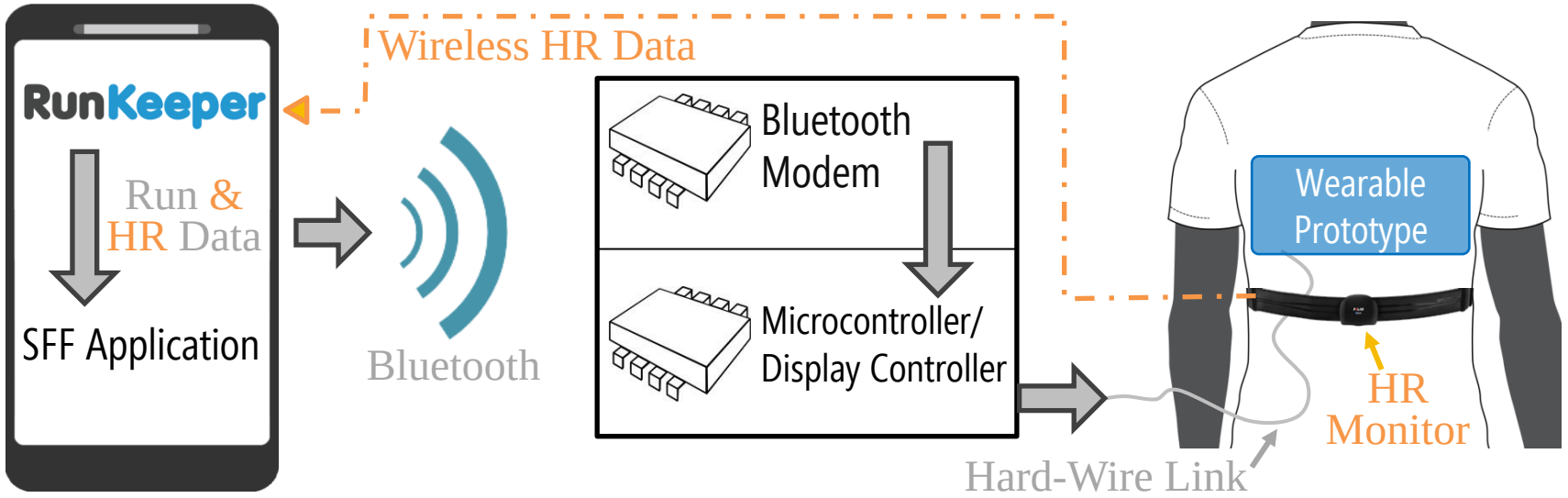
3. Visualize running data on the wearable display

SFF: System Design

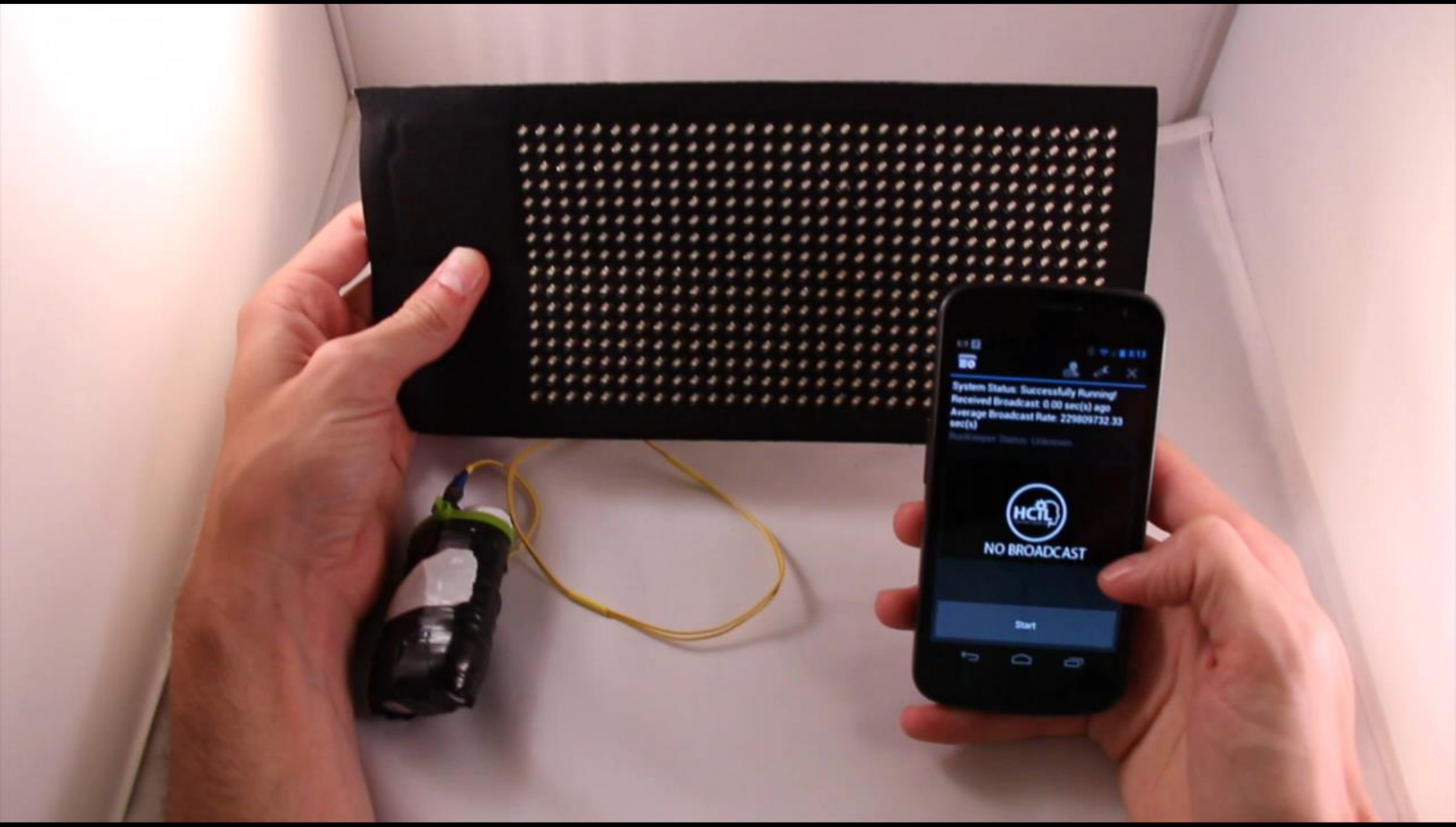
Smartphone

Display Hardware

Wearable

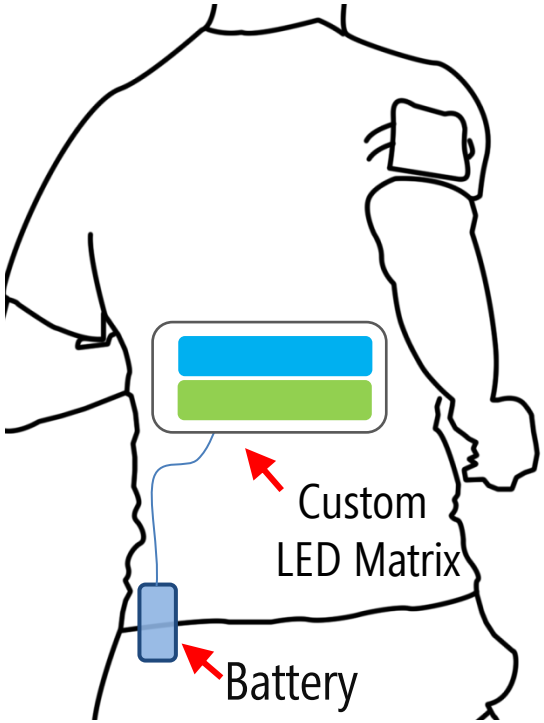


1. Sense & process running/HR data. Wirelessly transmit to display hardware.
2. Receive running data; process & send to the display via hard wire link.
3. Visualize running data on the wearable display

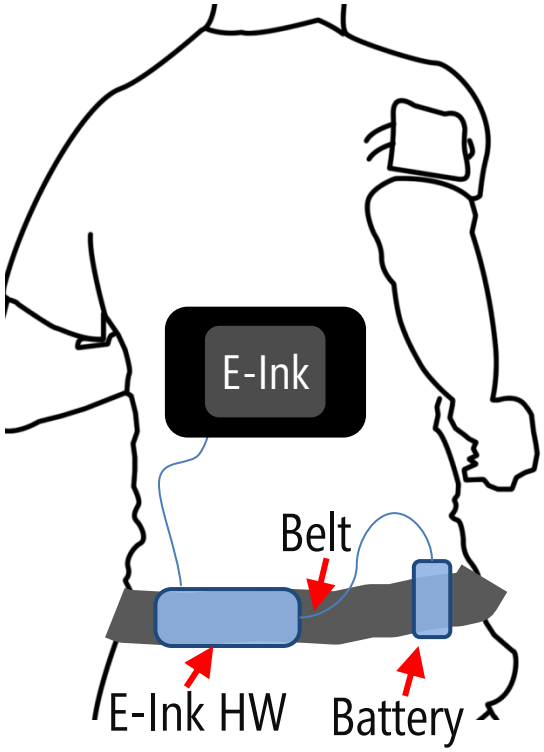

System Status: Successfully Running!
Received Broadcast: 0.00 sec(s) ago
Average Broadcast Rate: 229809732.33 sec(s)
NO BROADCAST
Start

SFF: Three Prototypes

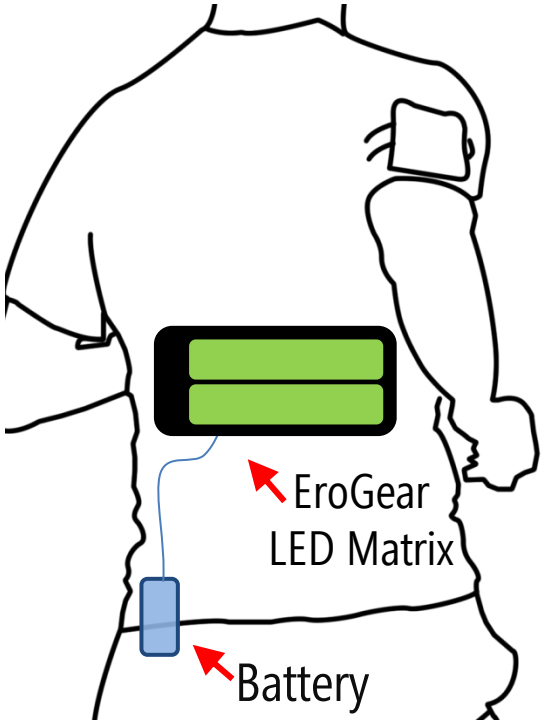
Prototype #1



Prototype #2



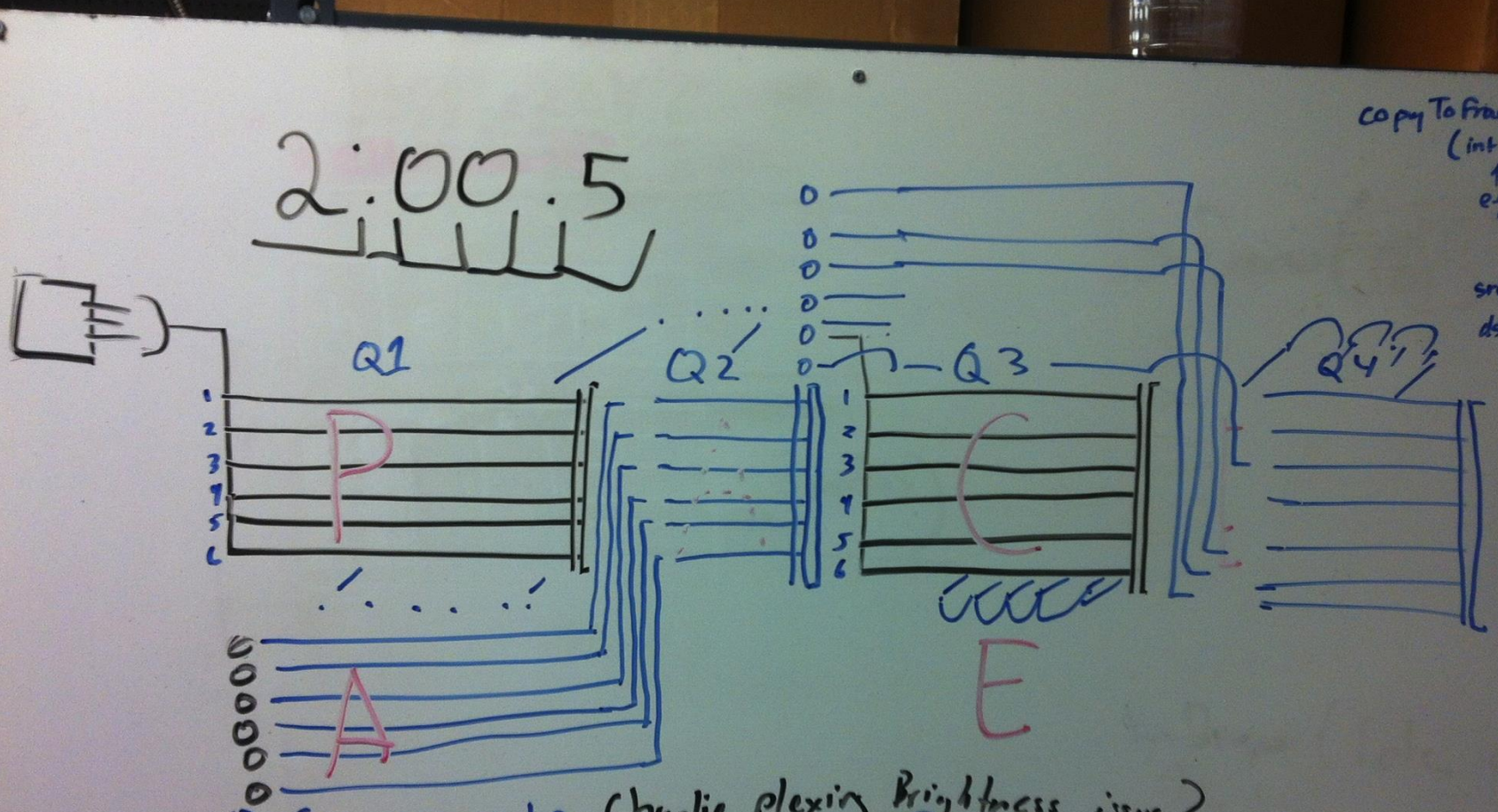
Prototype #3



Prototype #1

Custom Flexible PCB Solution

First Step: Prototyping LED Matrix Approaches

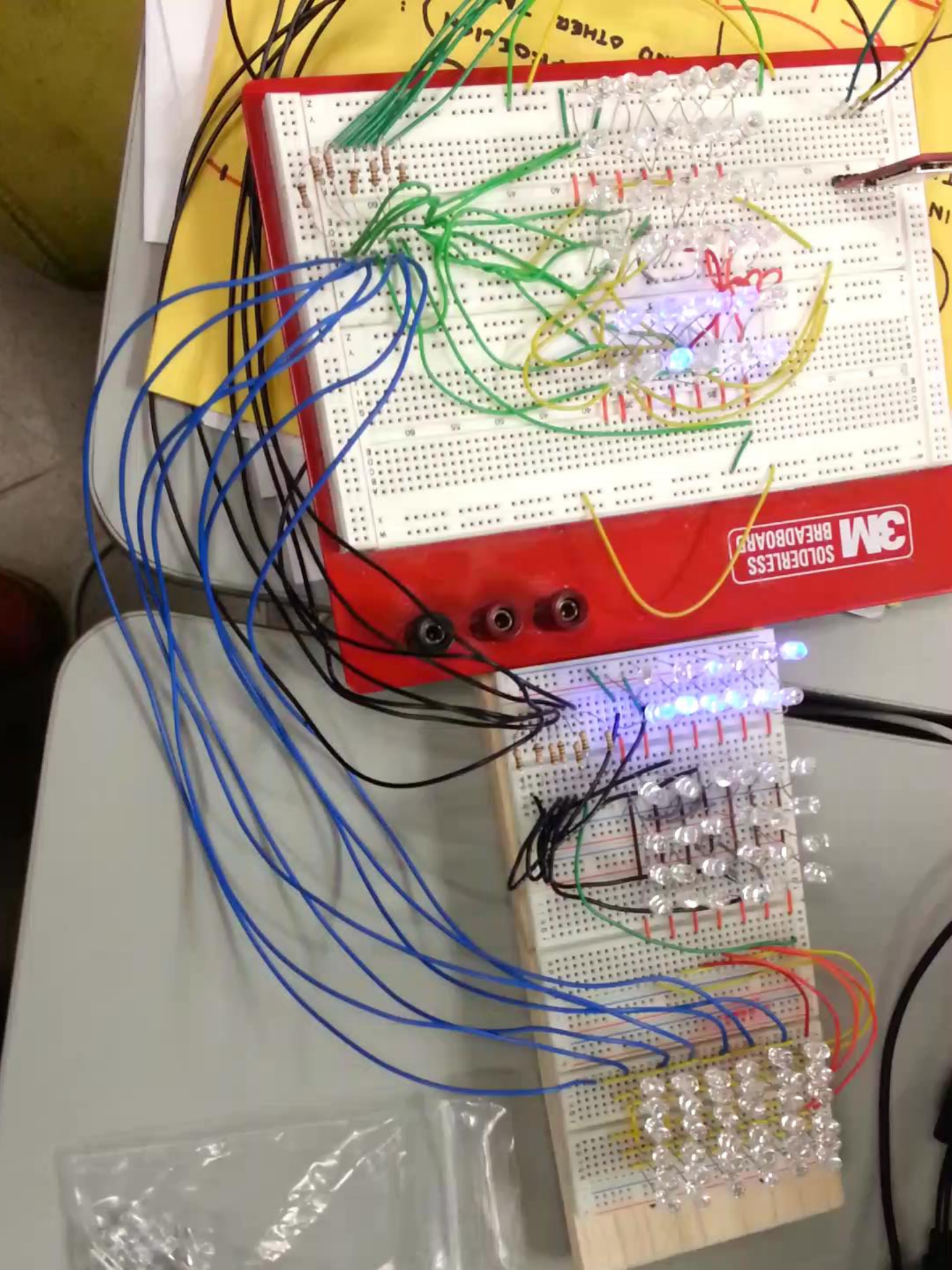


i) Can we solve Charlie plexing Brightness issue?

ii) Abandon Charlieplexing?

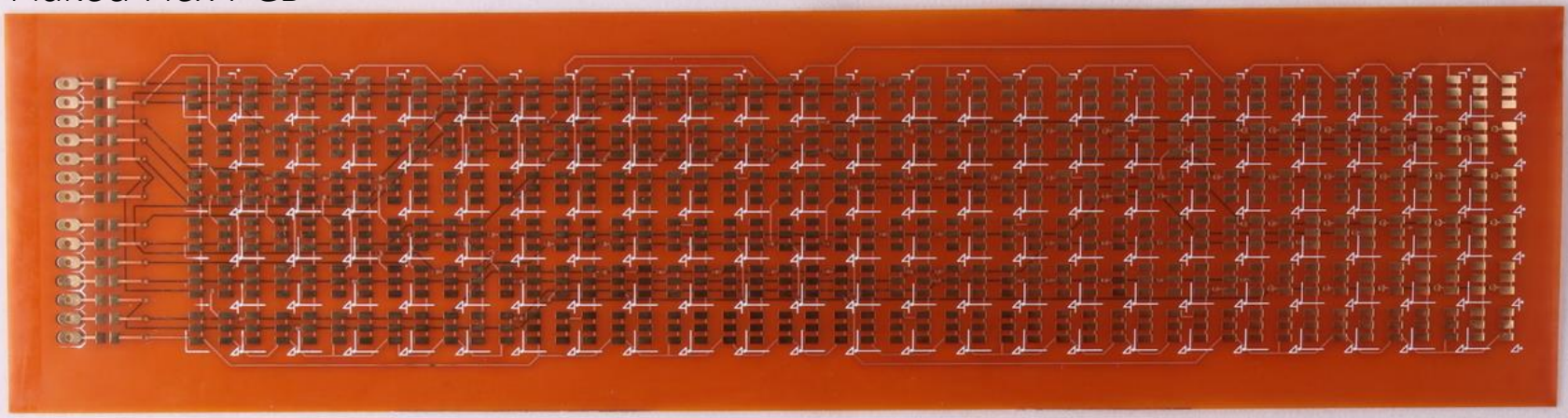
iii) Parts list?


DisplayMessageActivity
Send Message

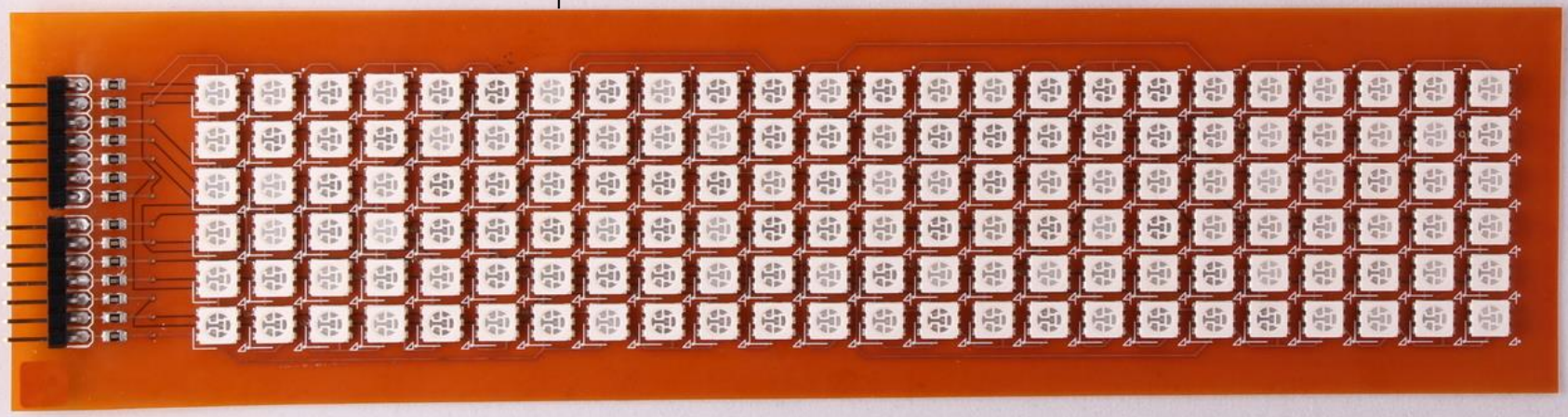

3M
SOLDERLESS
BREADBOARD

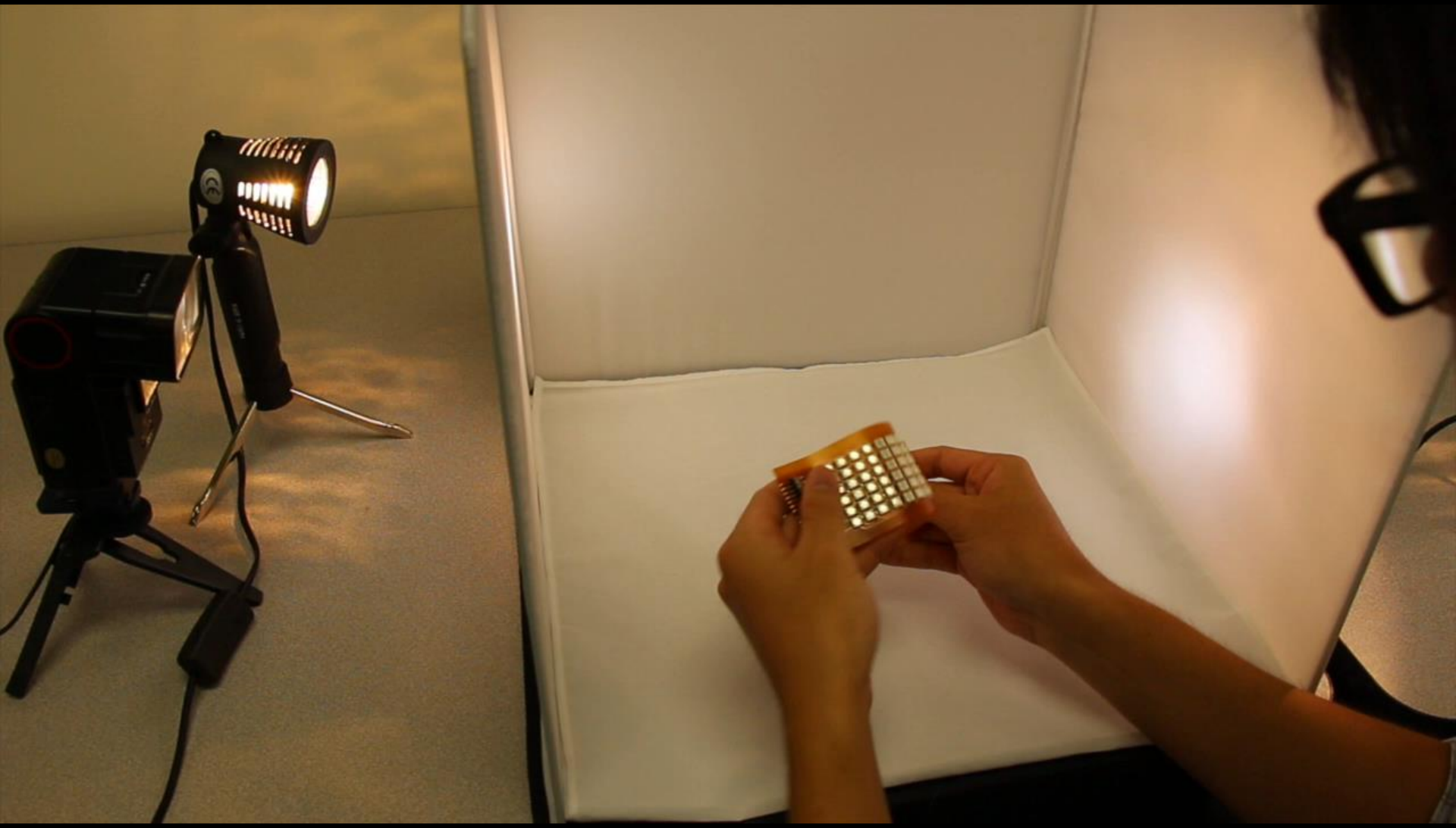
Second Step: Research & Manufacture Flexible PCB Solution

Naked Flex PCB

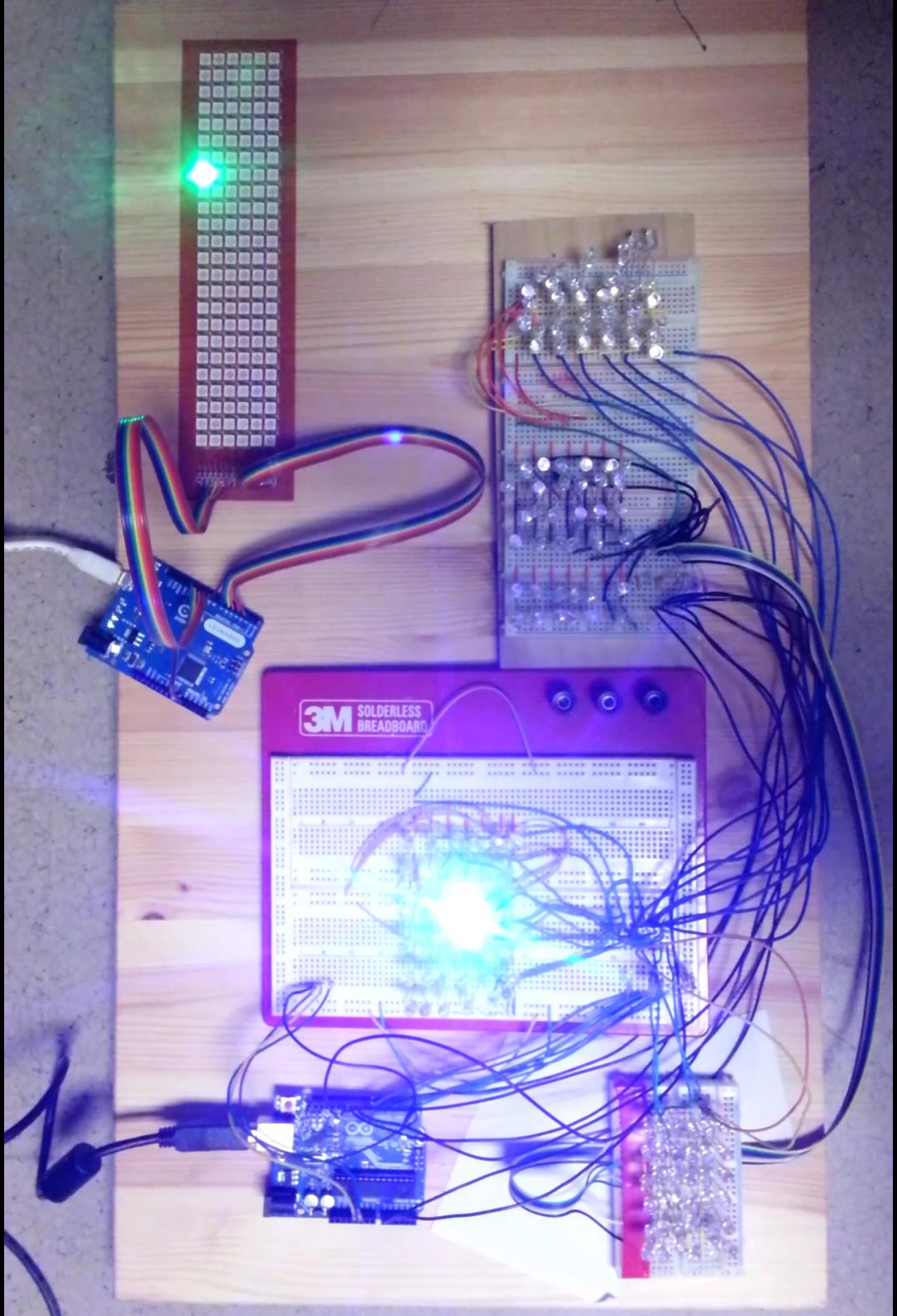


Flex PCB with Mounted Components

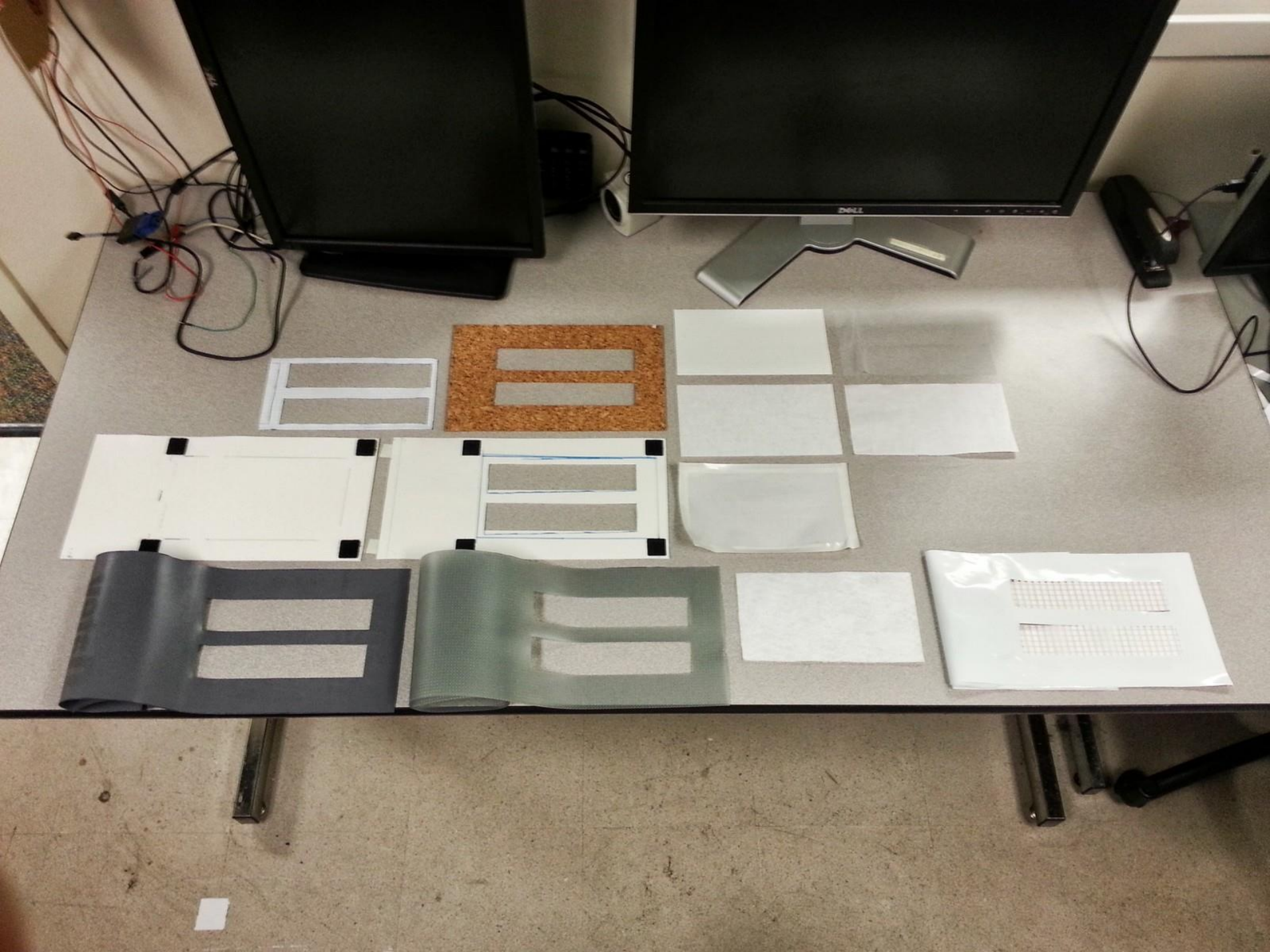


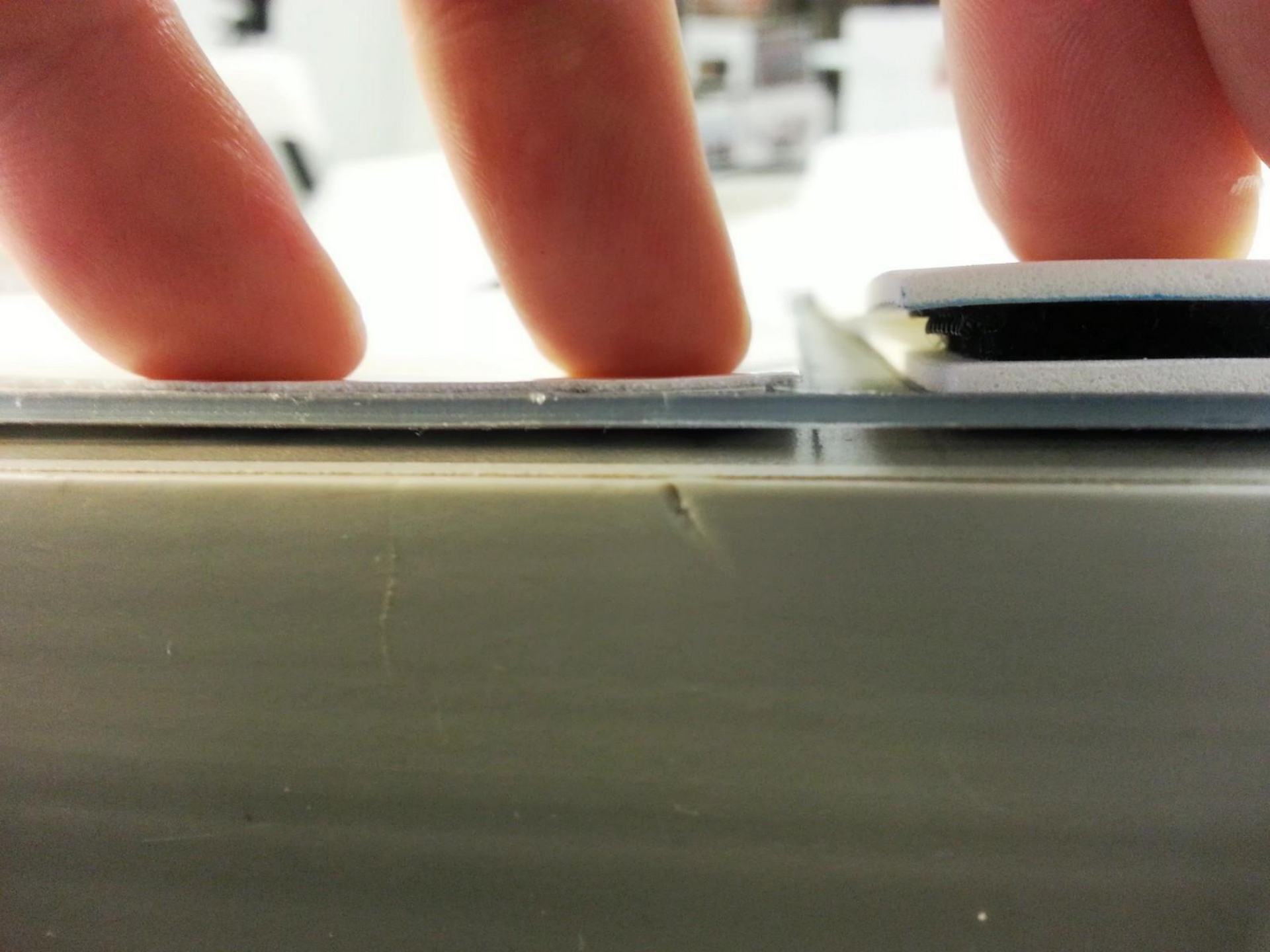


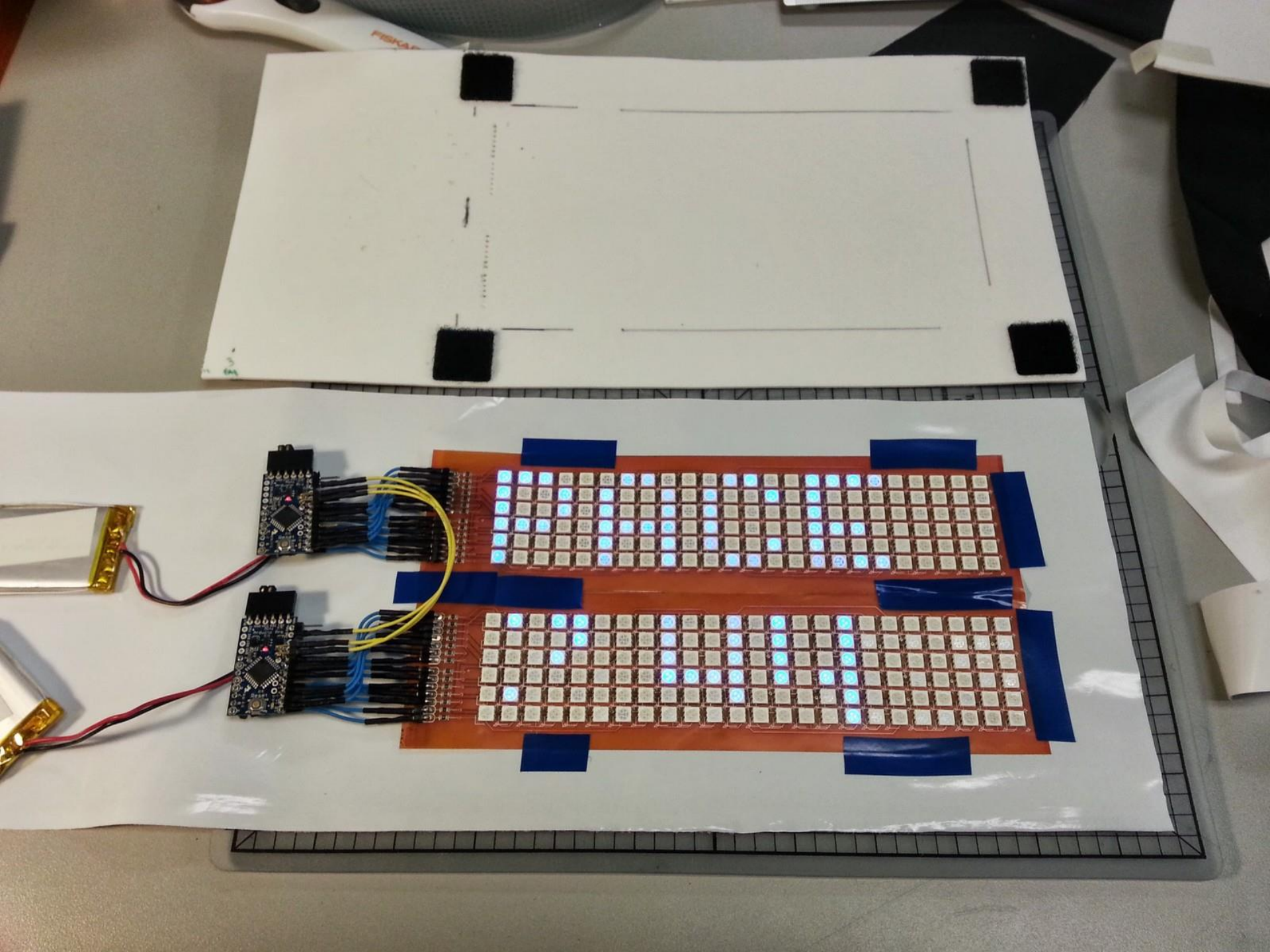
Third Step: Test Flexible PCB with Arduino Code


3M SOLDERLESS BREADBOARD

Final Step: Investigate Enclosure and Diffusion Material Approaches

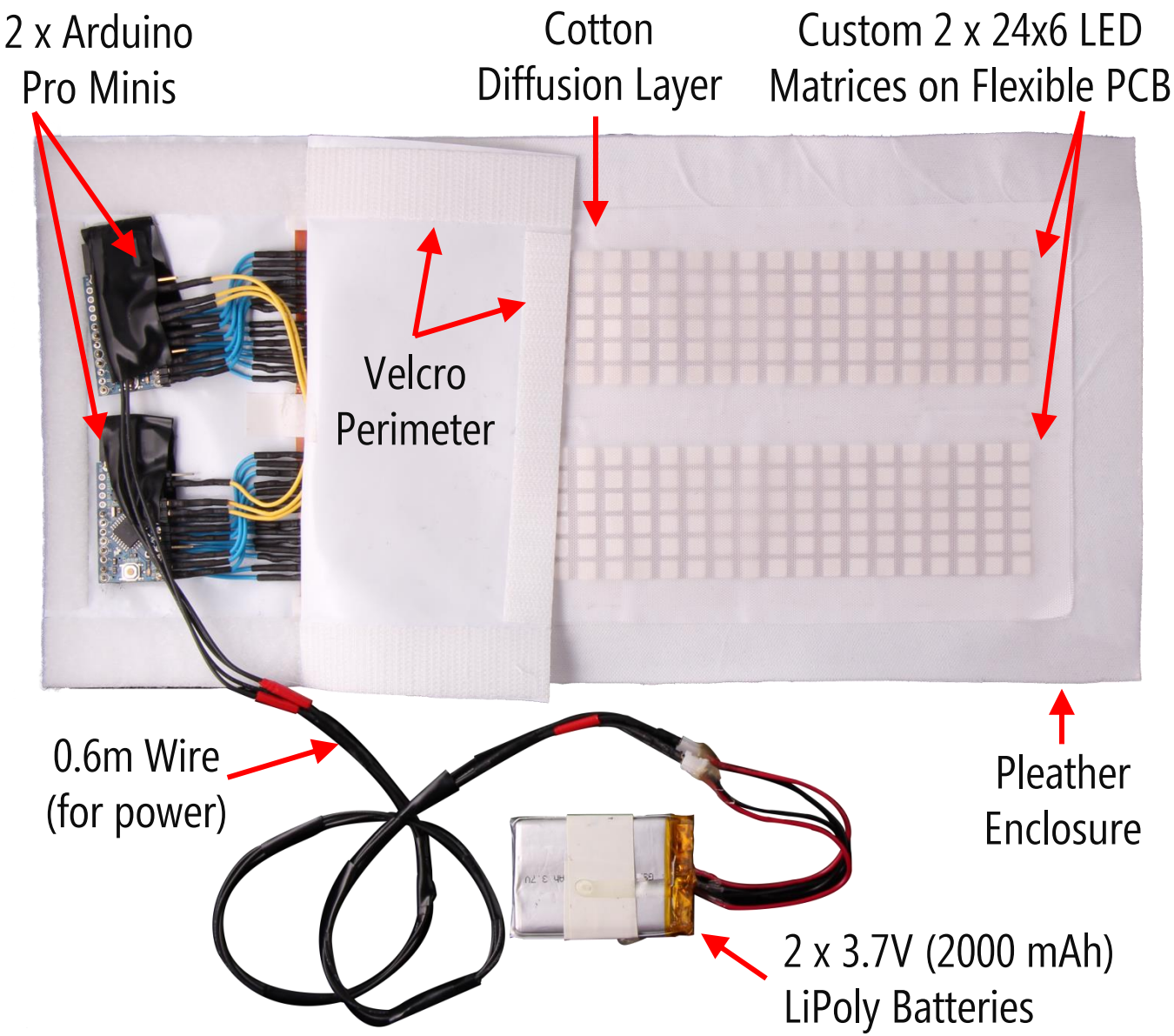






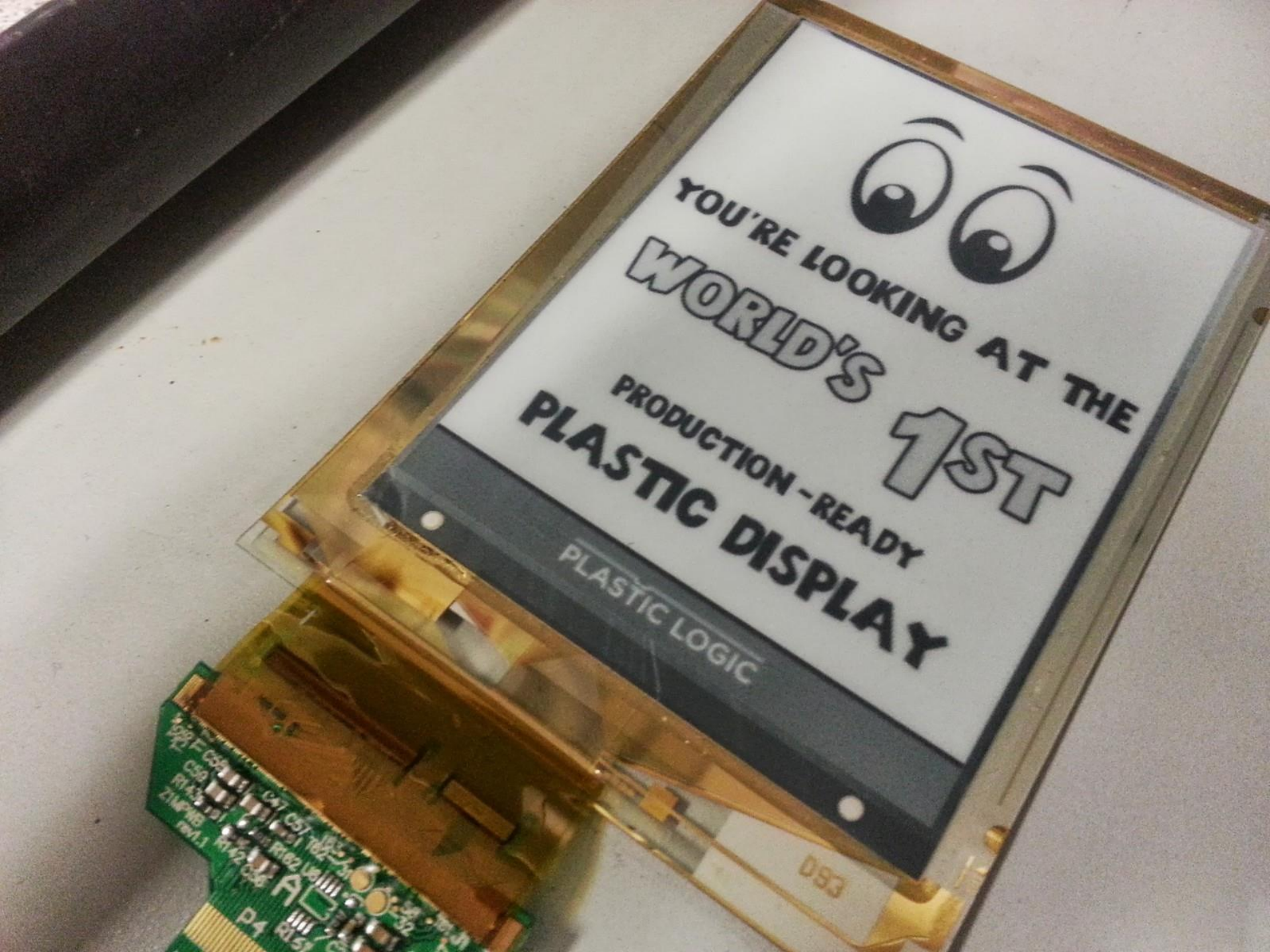
8
9
10

Final Prototype #1 Design

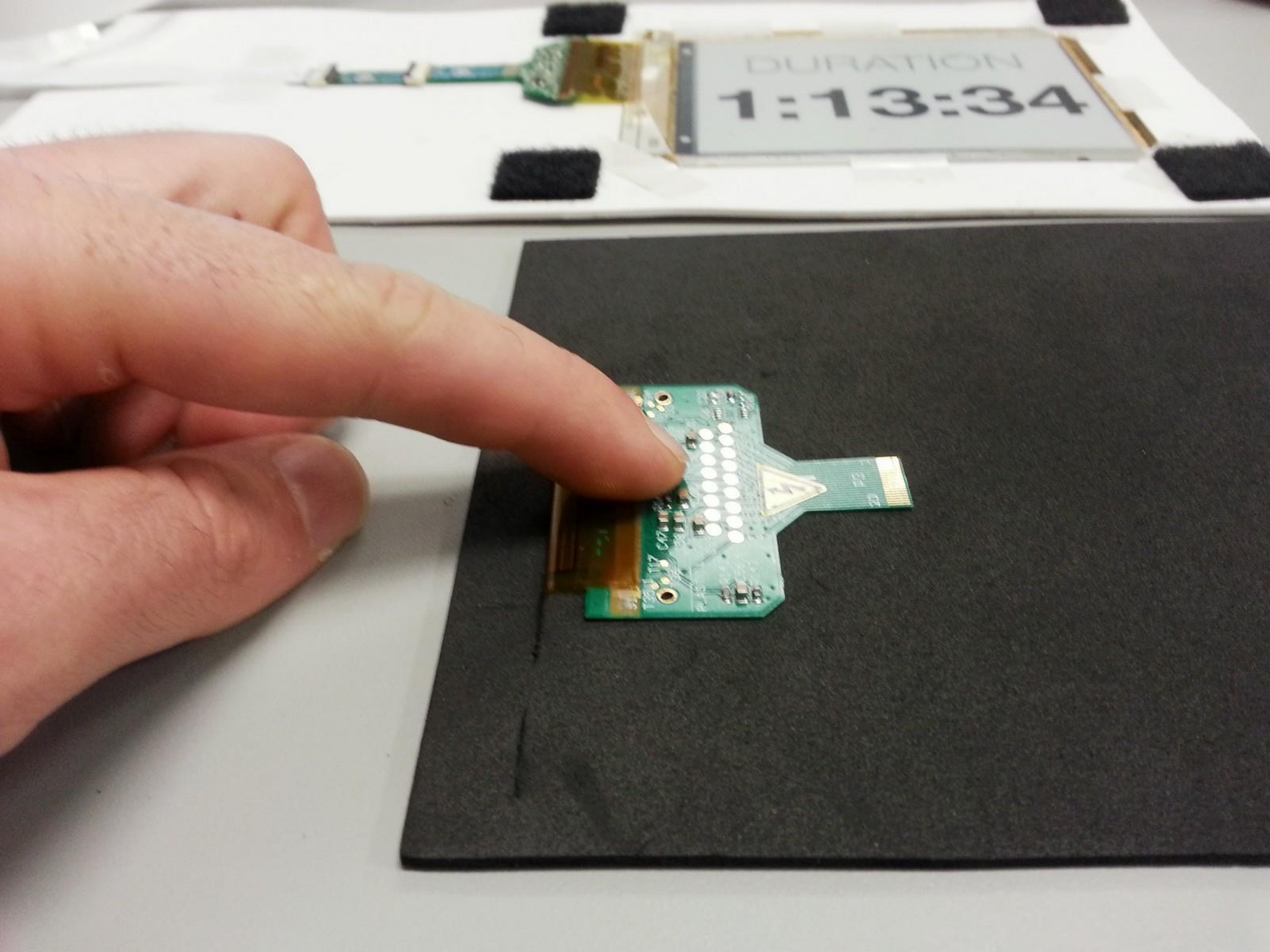

2 x Arduino
Pro Minis
Cotton
Diffusion Layer
Custom 2 x 24x6 LED
Matrices on Flexible PCB
Velcro
Perimeter
0.6m Wire
(for power)
Pleather
Enclosure
2 x 3.7V (2000 mAh)
LiPoly Batteries

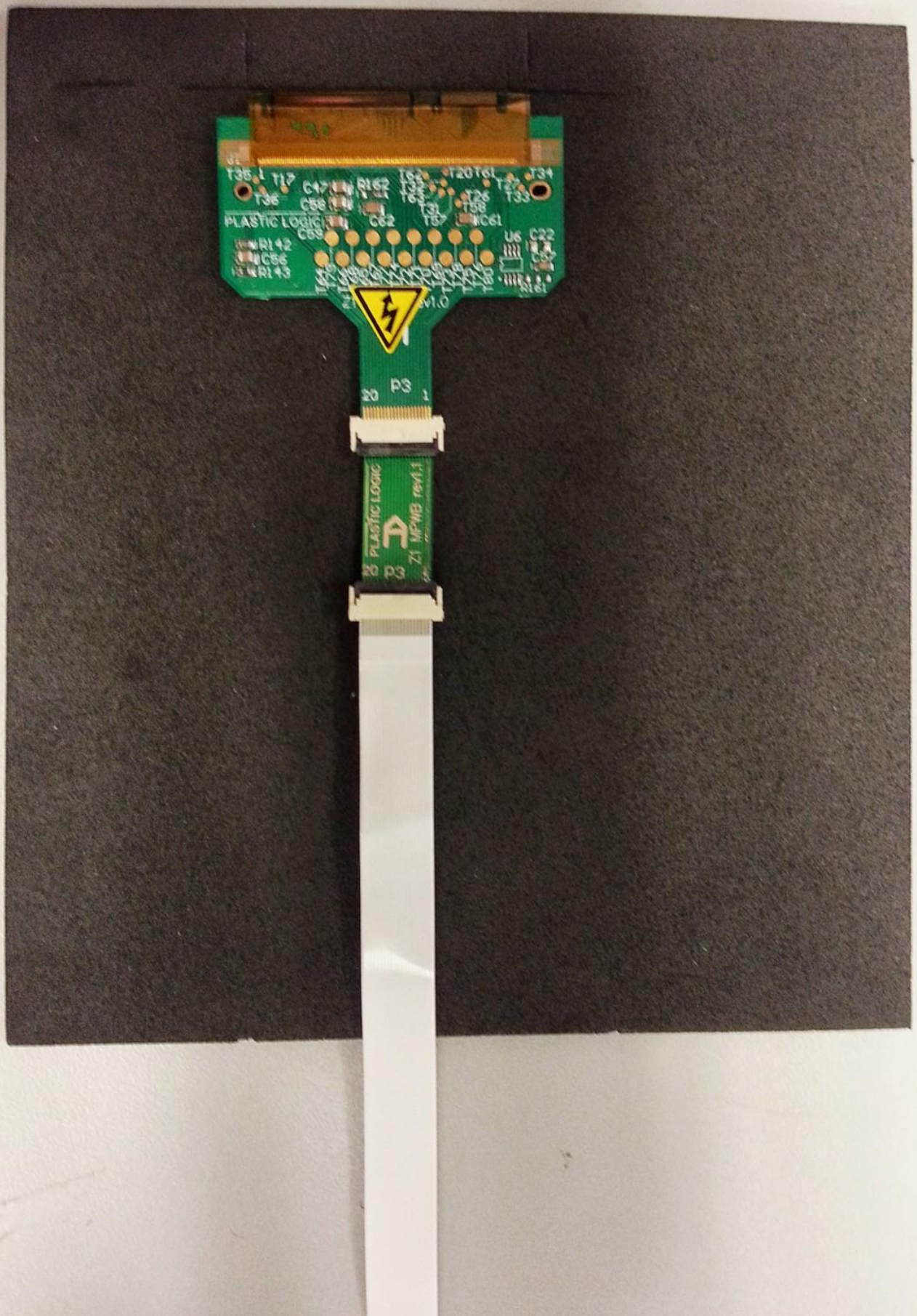
Prototype #2

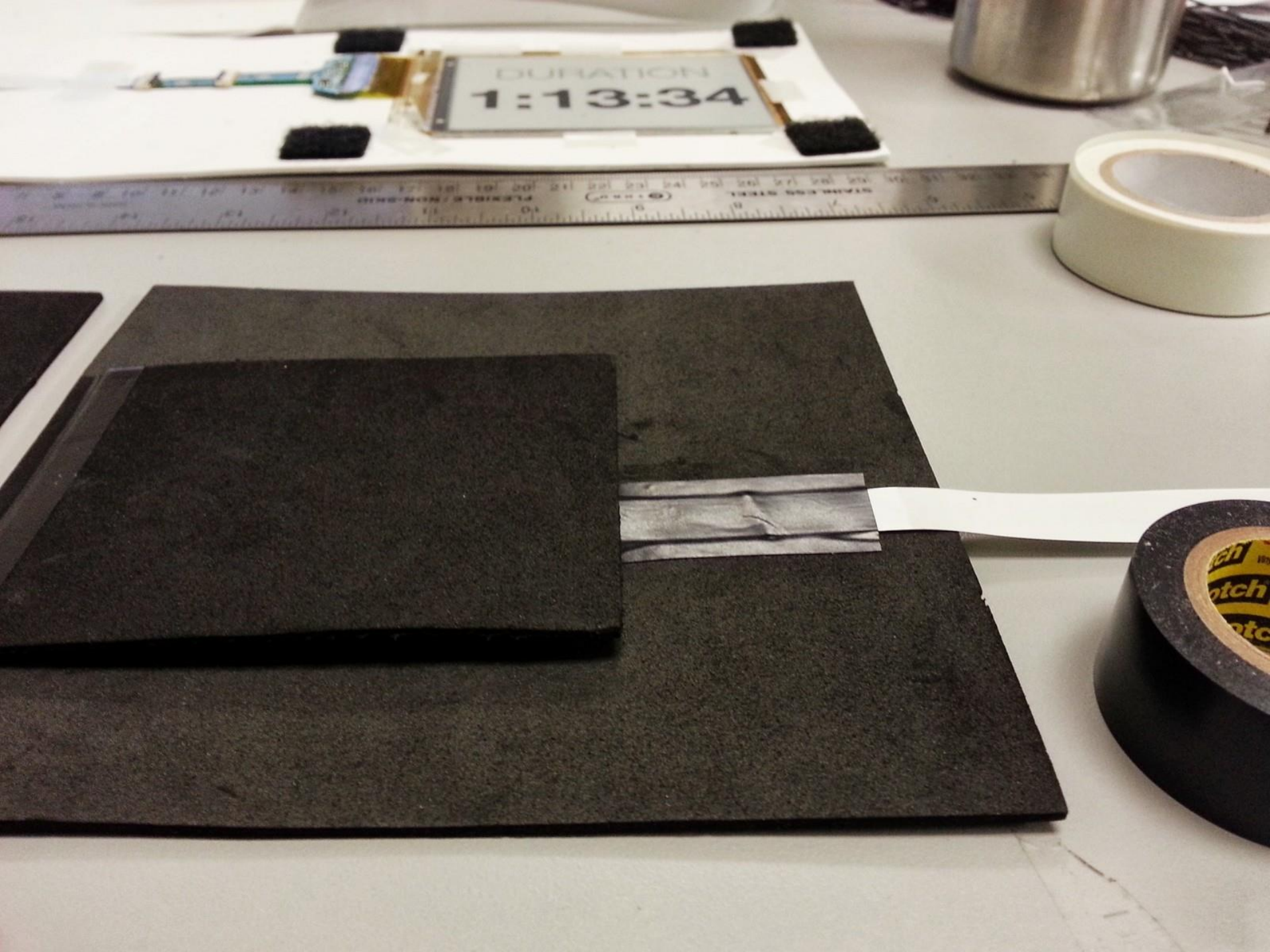
E-Ink Display


YOU'RE LOOKING AT THE
WORLD'S 1ST
PRODUCTION-READY
PLASTIC DISPLAY
PLASTIC LOGIC

DURATION
1:13:34
PLASTIC LOGIC
Z1 MPWB rev1.1
PLASTIC LOGIC
Z1 MPWB rev1.1

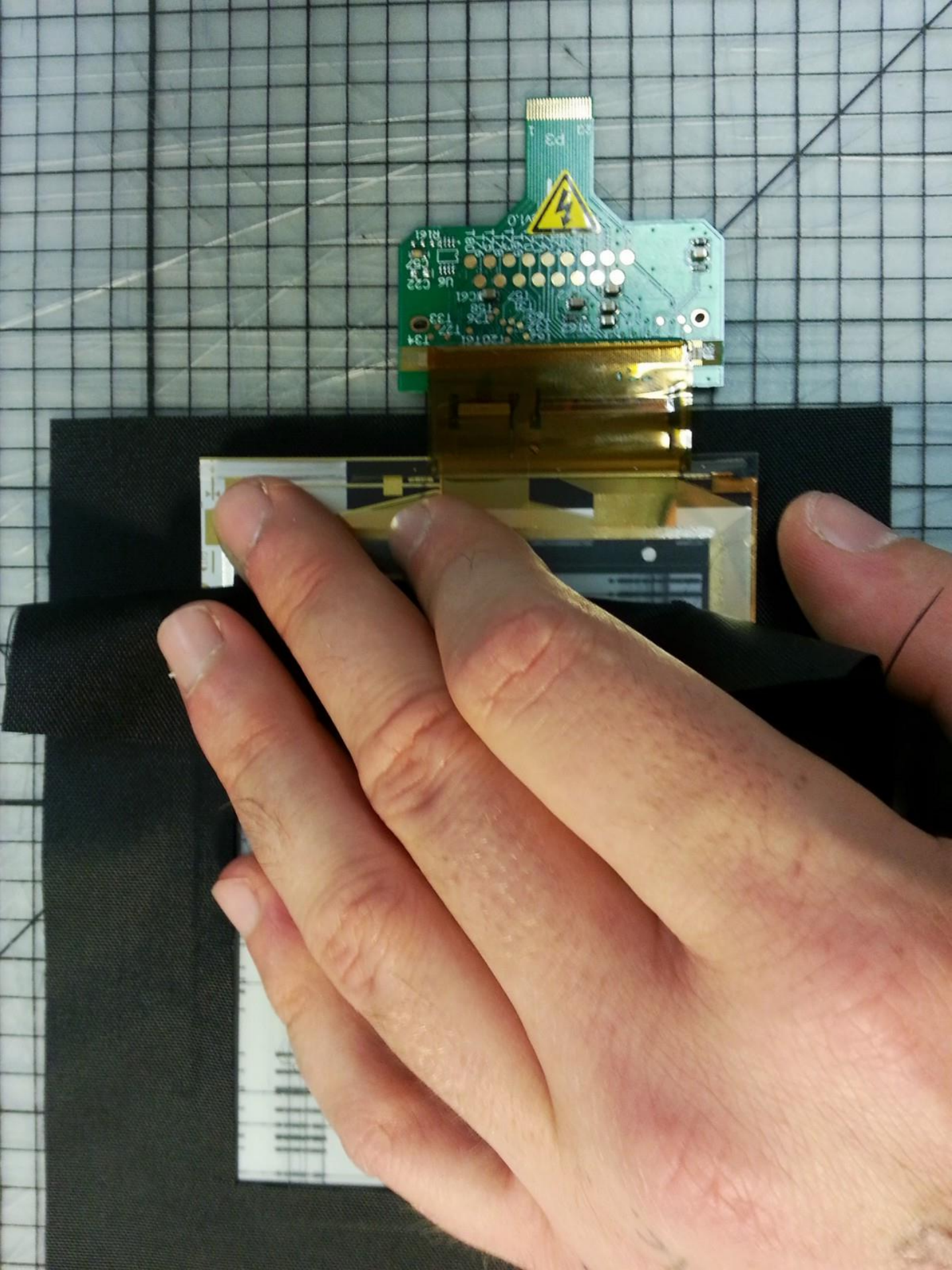

DURATION
1:13:34

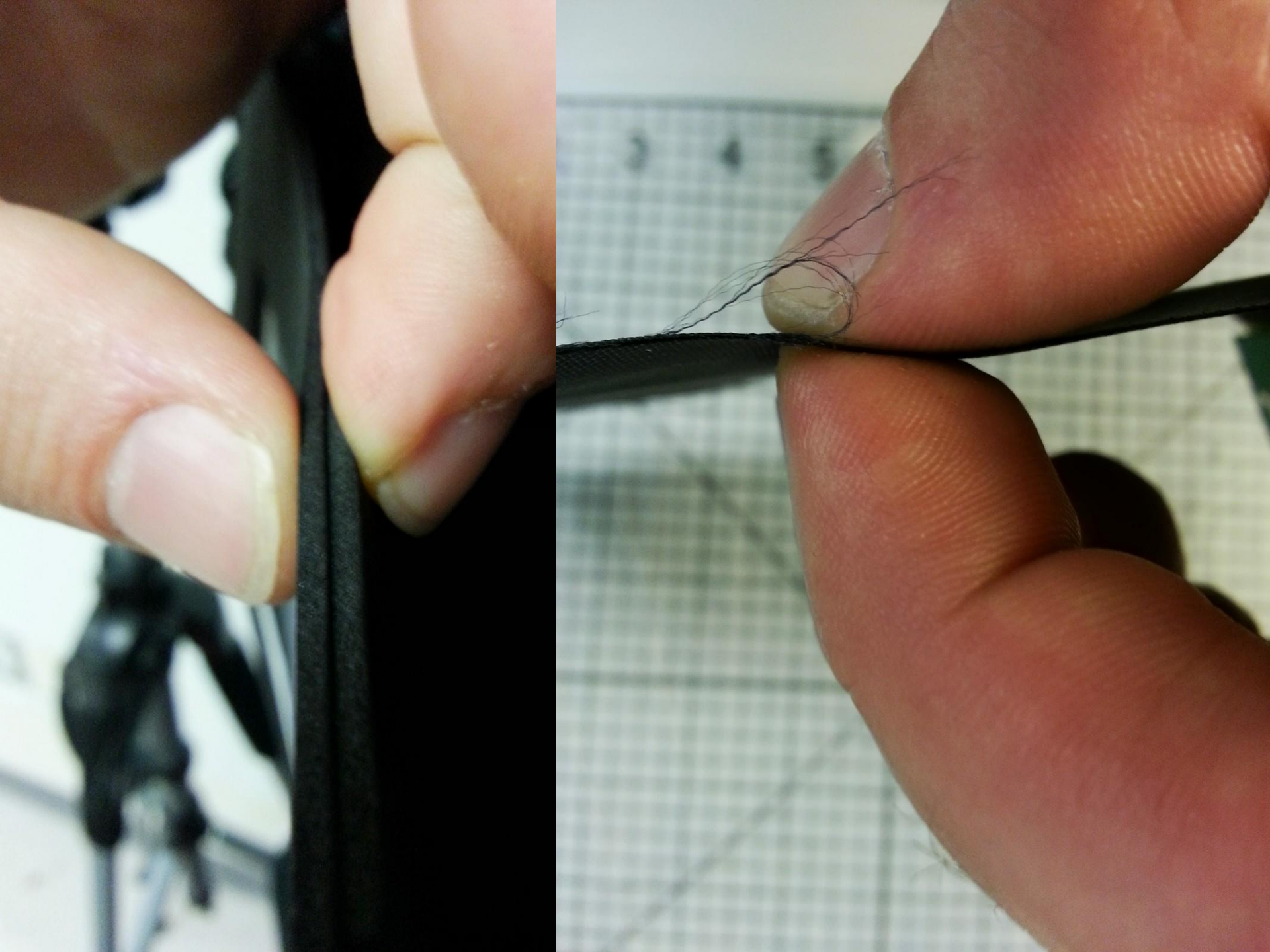

PLASTIC LOGIC
P3
PLASTIC LOGIC
P3


DURATION
1:13:34

DURATION

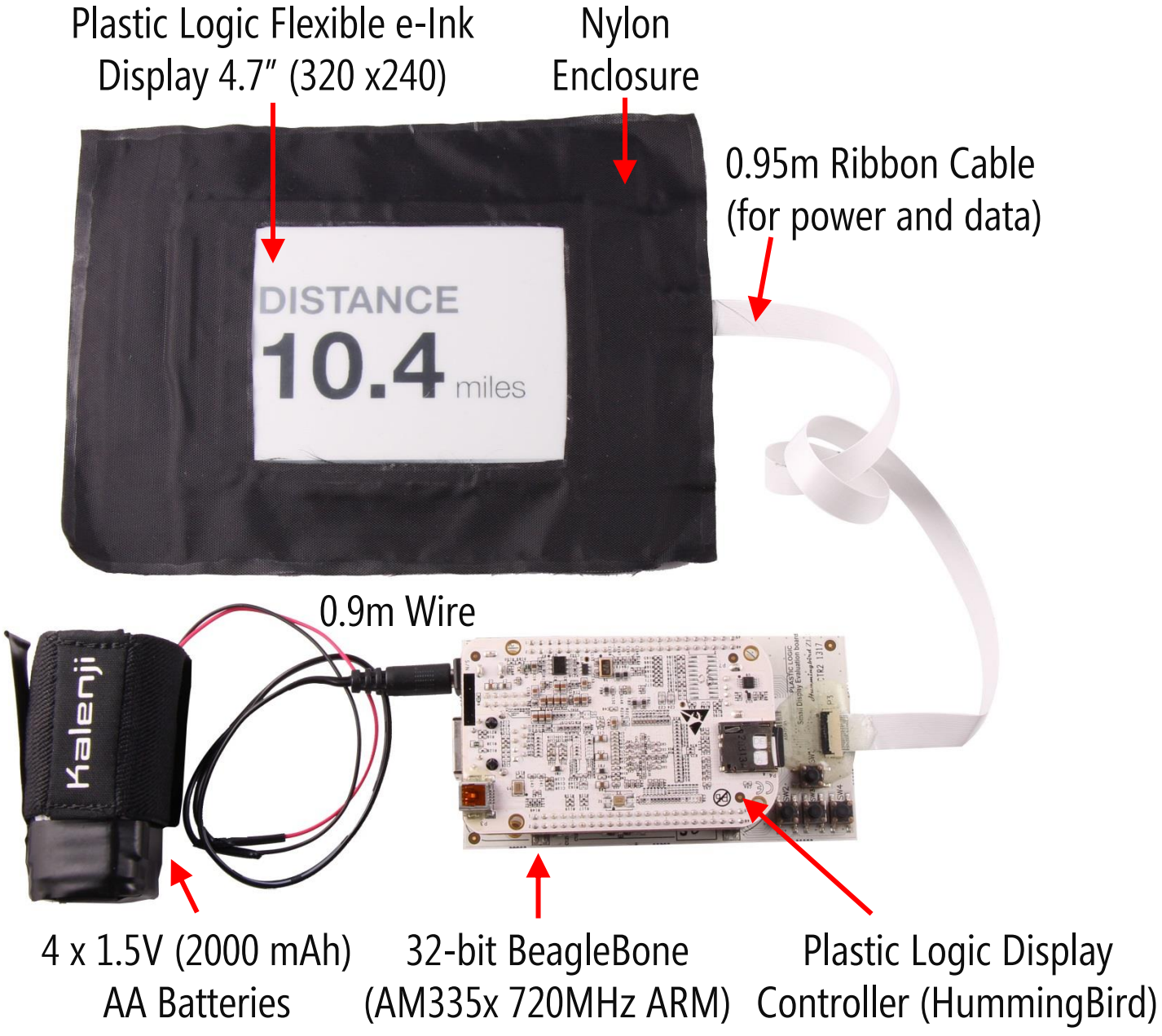
1:13:34






DISTANCE
10.4 miles

Final Prototype #2 Design


Plastic Logic Flexible e-Ink
Display 4.7" (320 x240)
Nylon
Enclosure
0.95m Ribbon Cable
(for power and data)
DISTANCE
10.4 miles
0.9m Wire
Kalenji
4 x 1.5V (2000 mAh)
AA Batteries
32-bit BeagleBone
(AM335x 720MHz ARM)
Plastic Logic Display
Controller (HummingBird)

Prototype #3

Pre-Release Erogear Displays

Google

+Jon

Gmail

Move to Inbox | More

62 of 62

COMPOSE

Inbox (2,836)

Sent Mail

Drafts (243)

Circles

Jon

New Hangout

Leah Findlater
is registere...

John Fraser

Stevie Chancellor

David Nguyen

Michael Gubbels
Okay, cool. Than...

Joseph Owen
i'm in the hacker...

Danny Muscoplat

Kotaro Hara

EroGear Phone Conversation with Anders Nelson (2013/05/20) (jonfroehlich@gmail.com)

Michael Gubbels (Google Drive) <mrgubbels@gmail.com>
to me, mattm401

5/20/13

I've shared an item with you.

I called EroGear today for the second time. I got in touch with the founder and had a pretty good conversation. Got some pretty good information and he's definitely interested in working with us. He said he

EroGear Phone Conversation with Anders Nelson (2013/05/20)

Google Drive: create, share, and keep all your stuff in one place.

Google

Recent

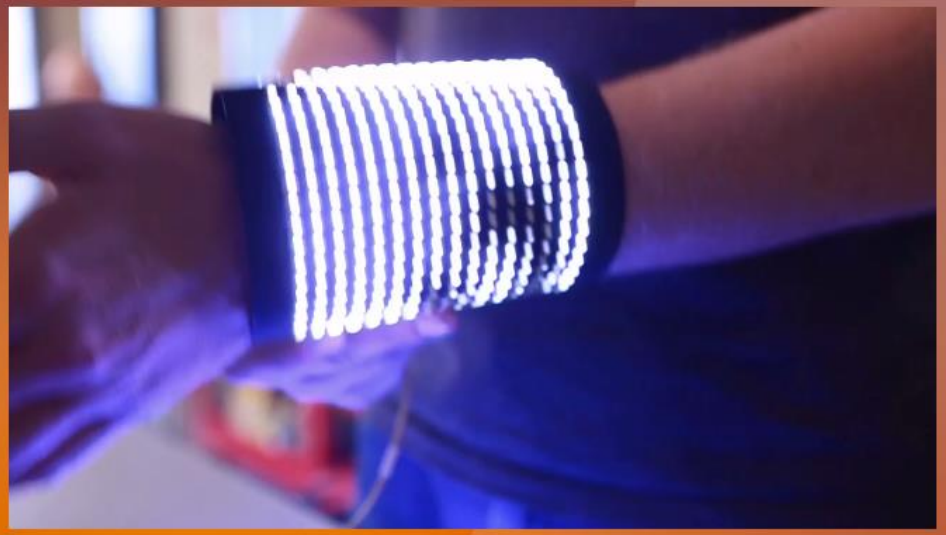
Shared

+1

EROGEAR

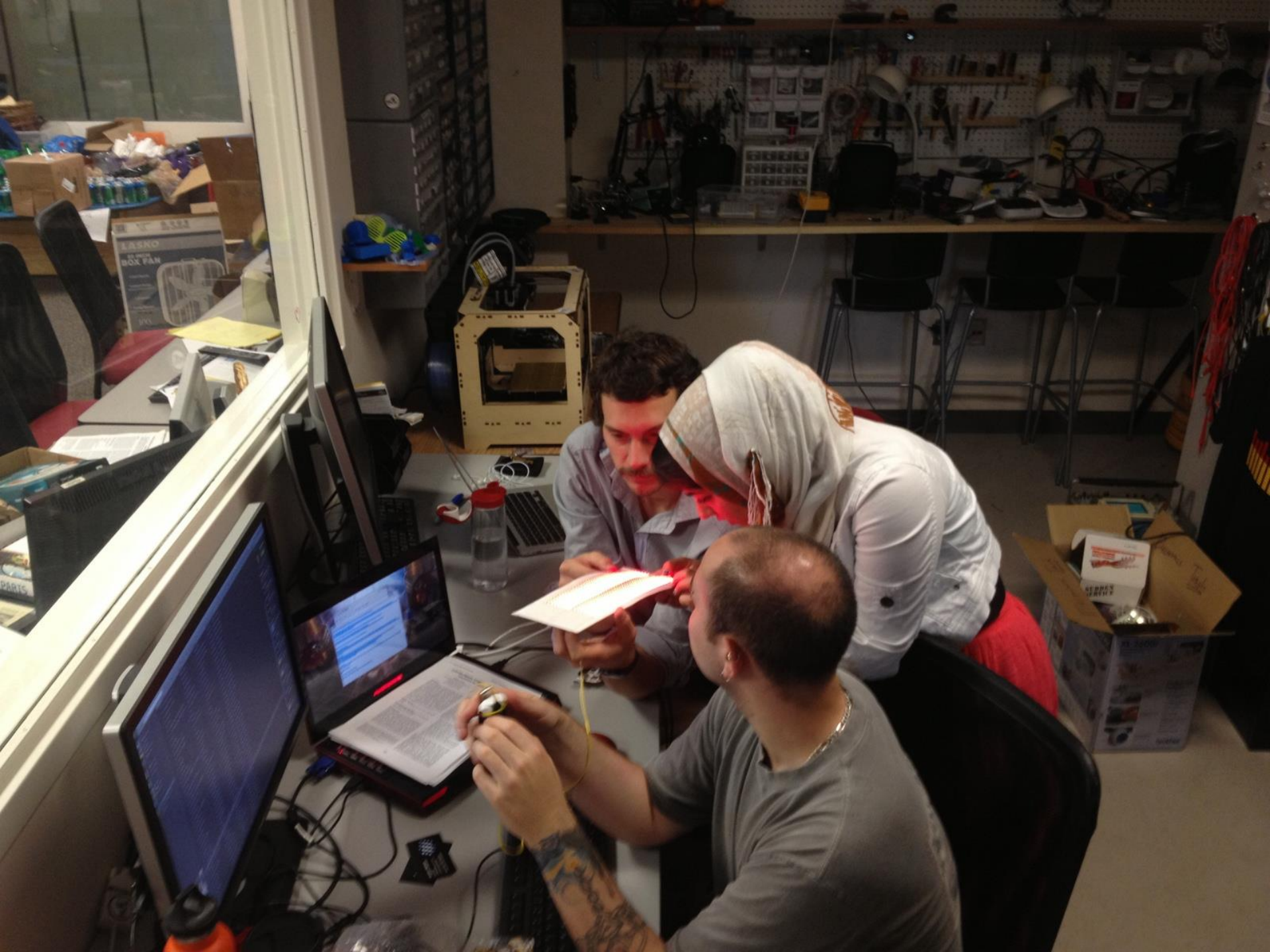
Learn Team Contact

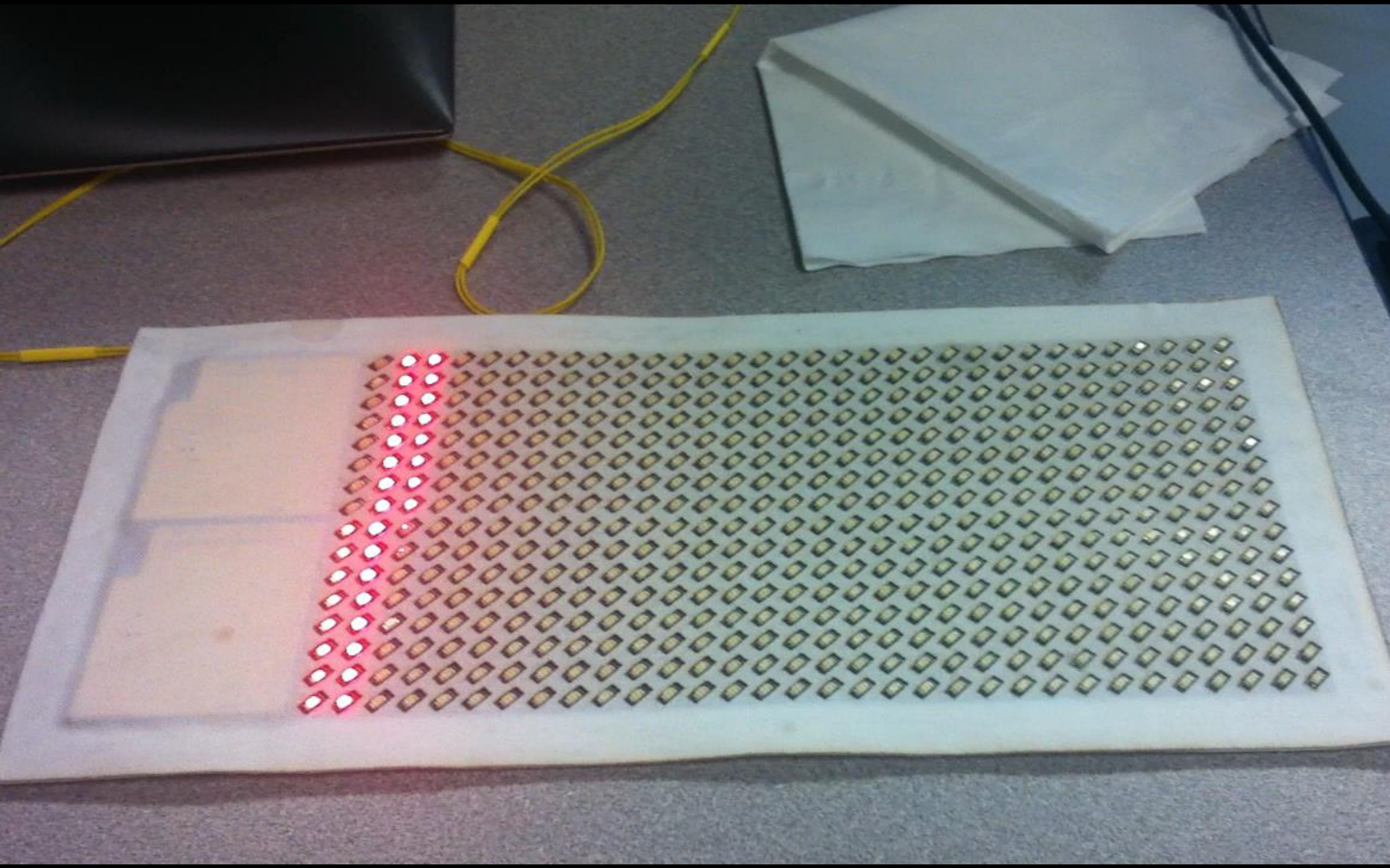
Wearable.
Connected.
Revolutionary.



As Seen On

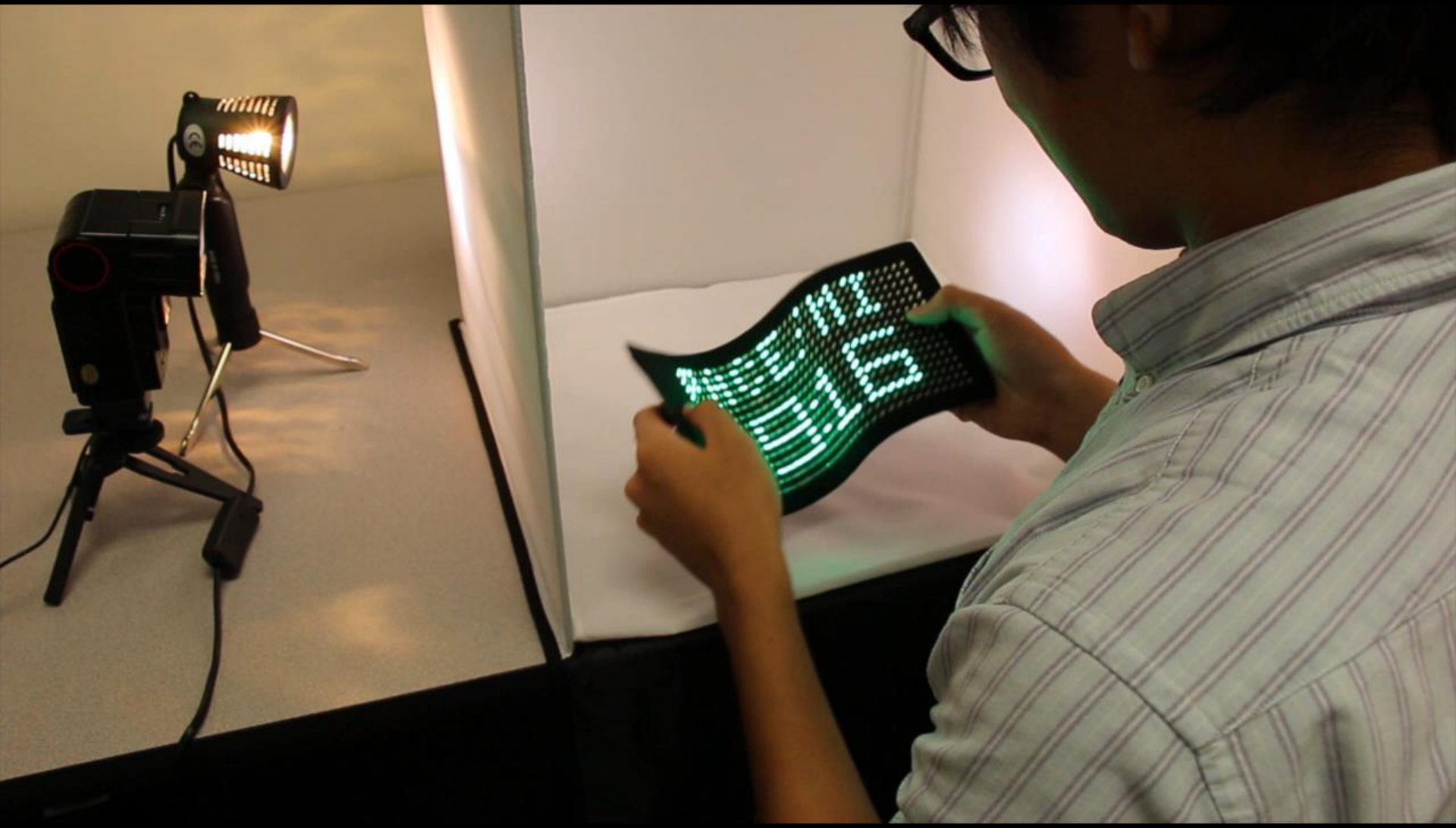
npr EXTRA proto labs



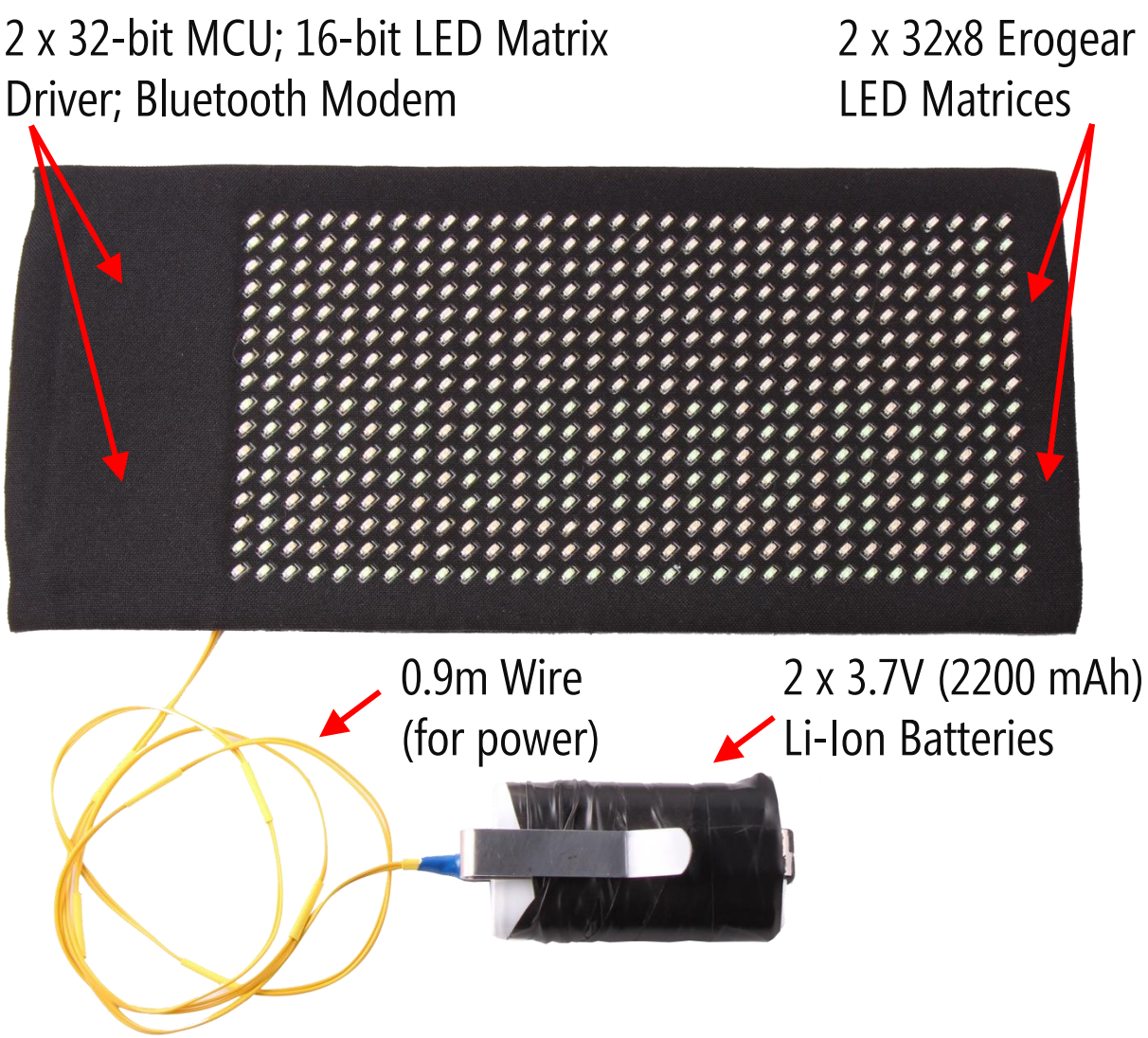



PACE

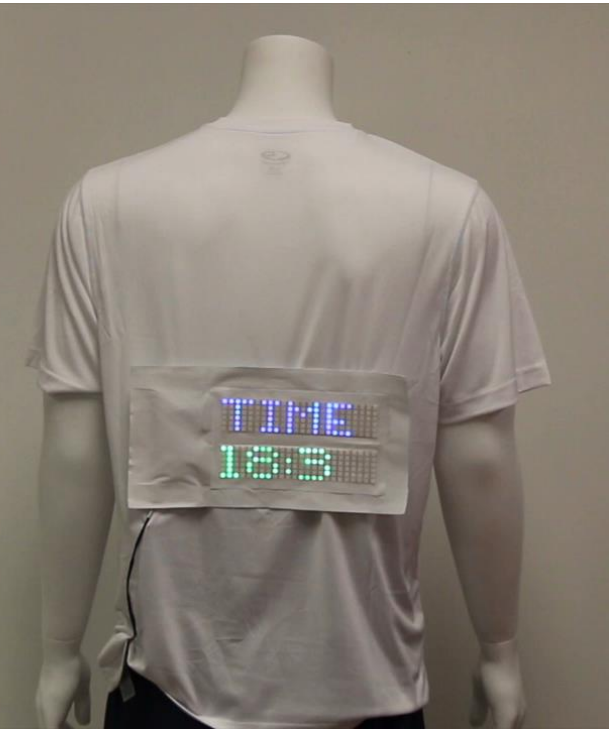
Extremely light-weight and flexible



Final Prototype #3 Design


2 x 32-bit MCU; 16-bit LED Matrix Driver; Bluetooth Modem
2 x 32x8 Erogear LED Matrices
0.9m Wire (for power)
2 x 3.7V (2200 mAh) Li-Ion Batteries

SFF: Visual Display Content



We performed dozens of informal pilot studies examining comfort, viewability, and overall user experience


DIST
015


PACE/MI
09:51
PACE/MI
09:53

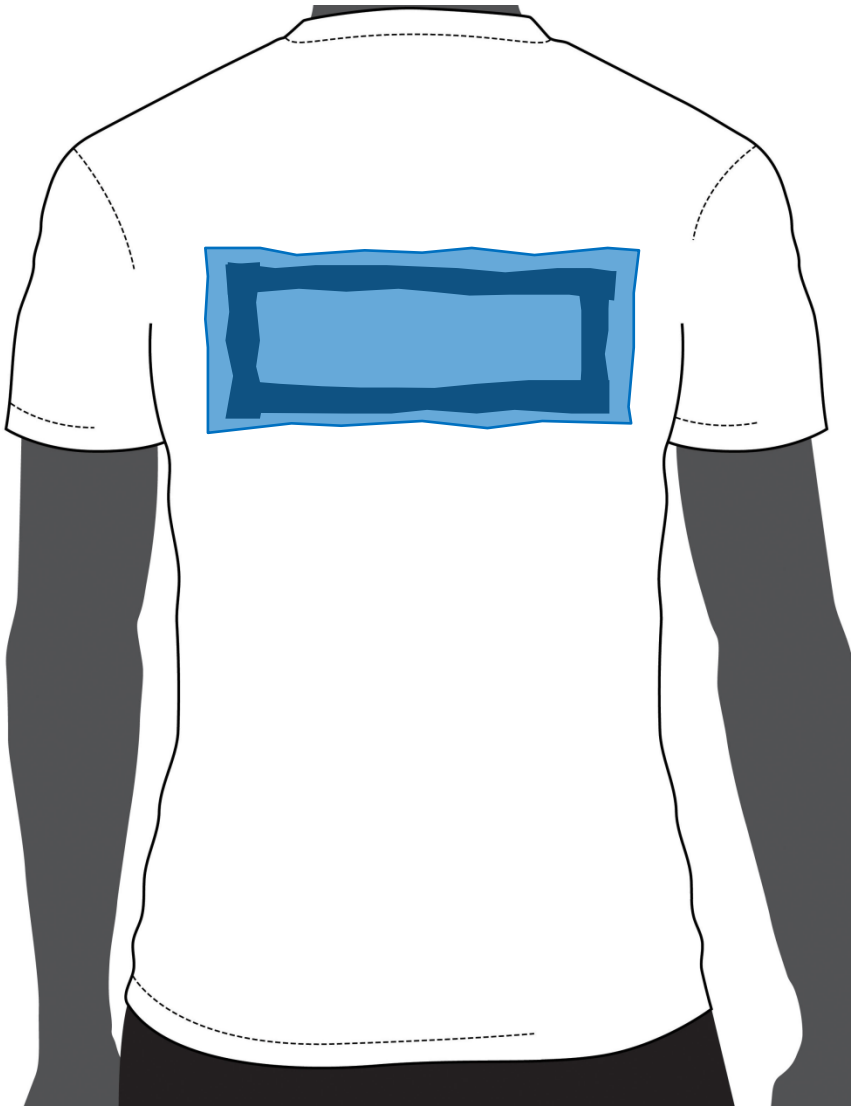

edX

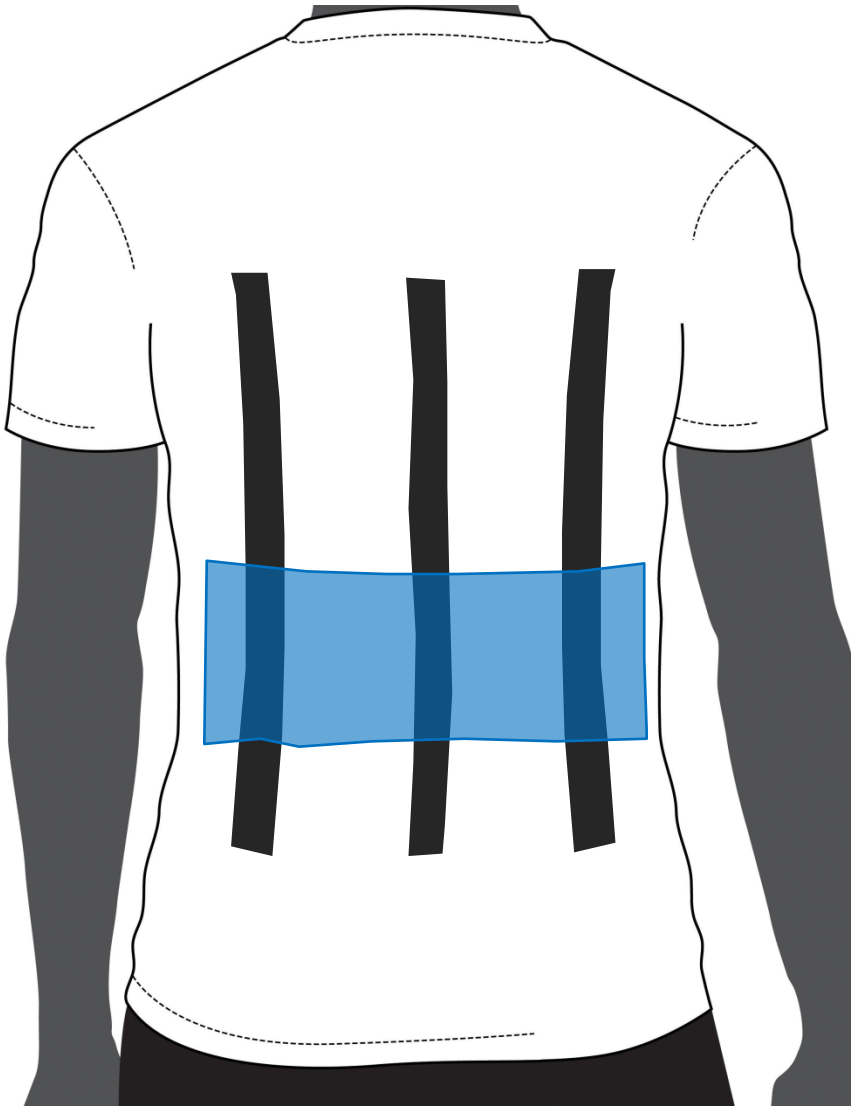

BPM
67


GP020028.MP4


1:02:26


TIME
RUN





Final Design: Add Bar Graph Pace Visualization

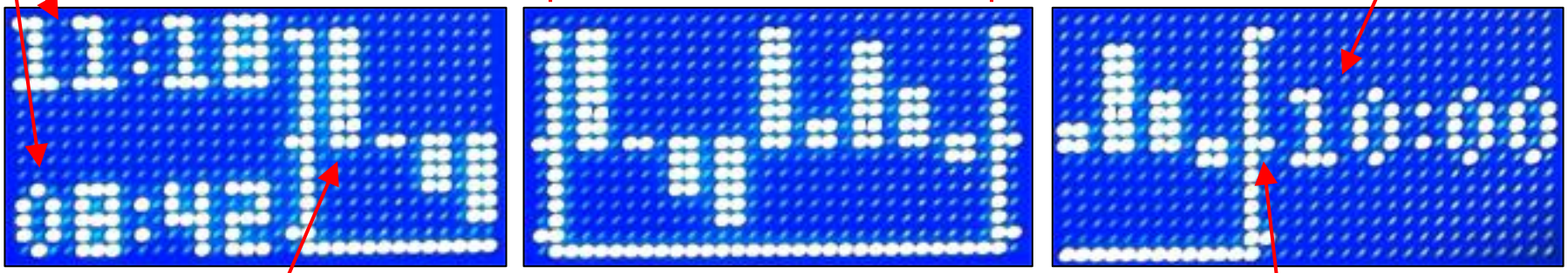
Bar Graph Visualization

Compares 1-min pace averages over time to a target pace collectively pre-set by the group

The y-axis is auto-set based on recent pace & target pace

The full bar graph shows 9-mins. Bars above the mid-point are over the target; bars below are under. Under is better.

The target pace for the group shows on the first and last bar graph screen

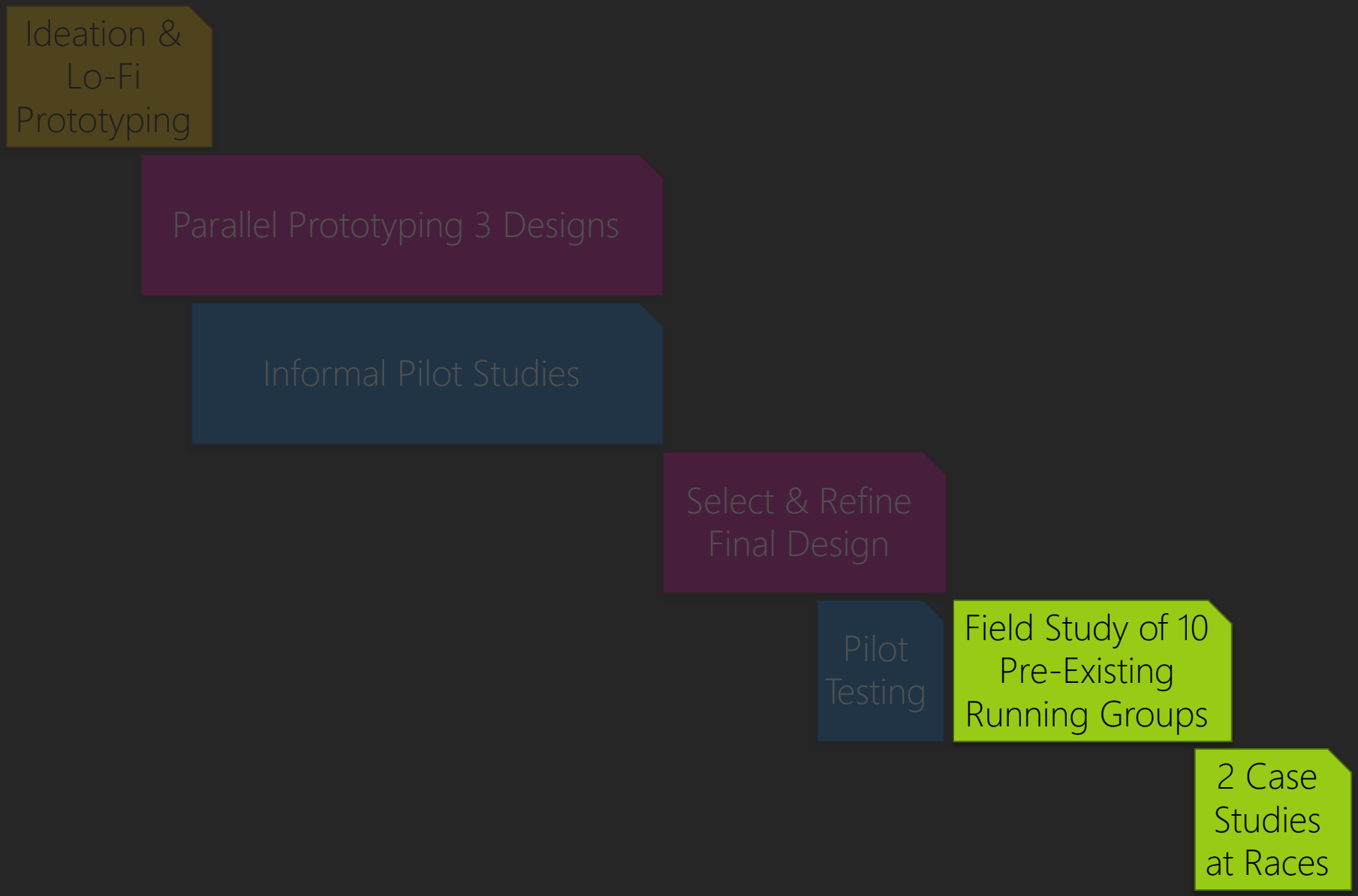


Each bar represents avg pace in 1-min increments

The display scrolls from left to right

The target pace line is at the origin

SFF: Design and Evaluation Process




AM
FM
CD
CD·6
MP3
LOAD
VOL·PUSH
5:03
CLK
MUTE
SEEK/TRACK
SCAN
TUNE/DISC
MENU
REW 1
FF 2
REPEAT 3
4
SHUFF 5
TEXT 6
12V
ON/OFF
OFF
A/C
MAX

Evaluation

We examined the impact of the display on group running dynamics and performance.

It made me run faster because **my performance was on display**.

- Race Participant

It made **me more aware** of our pacing and **kept me more focused** on the run itself.

- Field Study Participant

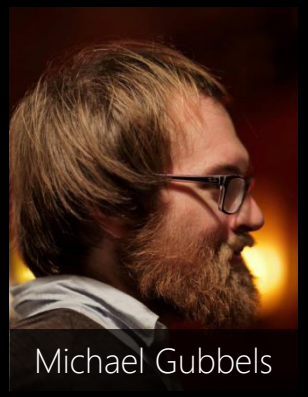

future
work

SFF Bicycling

Working with EroGear

The **Social Fabric Fitness** Team!

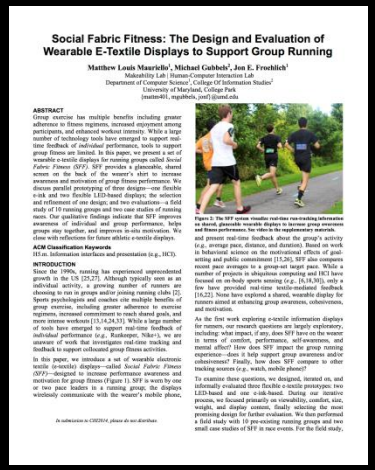
Matt Mauriello



Michael Gubbels

Jon Froehlich

Follow-up Sources:



Social Fabric Fitness: The Design and Evaluation of Wearable E-Textile Displays to Support Group Running

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Makeability Lab | Human-Computer Interaction Lab
Department of Computer Science[1], College Of Information Studies[2]
University of Maryland, College Park
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ABSTRACT
Group exercise has multiple benefits including greater adherence to fitness regimens, increased enjoyment among participants, and enhanced workout intensity. While a large number of technology tools have emerged to support real-time feedback of *individual* performance, tools to support group fitness are limited. In this paper, we present a set of wearable e-textile displays for running groups called *Social Fabric Fitness (SFF)*. SFF provides a glanceable, shared screen on the back of the wearer's shirt to increase awareness and motivation of group fitness performance. We discuss parallel prototyping of three designs—one flexible e-ink and two flexible LED-based displays; the selection and refinement of one design; and two evaluations—a field study of 10 running groups and two case studies of running races. Our qualitative findings indicate that SFF improves awareness of individual and group performance, helps groups stay together, and improves in-situ motivation. We close with reflections for future athletic e-textile displays.

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI).

INTRODUCTION
Since the 1990s, running has experienced unprecedented growth in the US [25,27]. Although typically seen as an individual activity, a growing number of runners are choosing to run in groups and/or joining running clubs [2]. Sports psychologists and coaches cite multiple benefits of group exercise, including greater adherence to exercise regimens, increased commitment to reach shared goals, and more intense workouts [13,14,24,33]. While a large number of tools have emerged to support real-time feedback of *individual* performance (e.g., Runkeeper, Nike+), we are unaware of work that investigates real-time tracking and feedback to support *collocated group* fitness activities.

In this paper, we introduce a set of wearable electronic textile (e-textile) displays—called *Social Fabric Fitness (SFF)*—designed to increase performance awareness and motivation for group fitness (Figure 1). SFF is worn by one or two pace leaders in a running group; the displays wirelessly communicate with the wearer's mobile phone,

In submission to CHI2014, please do not distribute

Figure 1: The SFF system visualizes real-time run-tracking information on shared, glanceable wearable displays to increase group awareness and fitness performance. See video in the supplementary materials.

and present real-time feedback about the group's activity (e.g., average pace, distance, and duration). Based on work in behavioral science on the motivational effects of goal-setting and public commitment [15,26], SFF also compares recent pace averages to a group-set target pace. While a number of projects in ubiquitous computing and HCI have focused on *on-body* sports sensing (e.g., [6,18,30]), only a few have provided real-time textile-mediated feedback [16,22]. None have explored a shared, wearable display for runners aimed at enhancing group awareness, cohesiveness, and motivation.

As the first work exploring e-textile information displays for runners, our research questions are largely exploratory, including: what impact, if any, does SFF have on the wearer in terms of comfort, performance, self-awareness, and mental affect? How does SFF impact the group running experience—does it help support group awareness and/or cohesiveness? Finally, how does SFF compare to other tracking sources (e.g., watch, mobile phone)?

To examine these questions, we designed, iterated on, and informally evaluated three flexible e-textile prototypes: two LED-based and one e-ink-based. During our iterative process, we focused primarily on viewability, comfort, size, weight, and display content, finally selecting the most promising design for further evaluation. We then performed a field study with 10 pre-existing running groups and two small case studies of SFF in race events. For the field study,

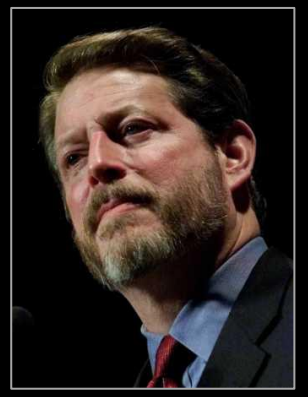
CHI'14 (to appear)

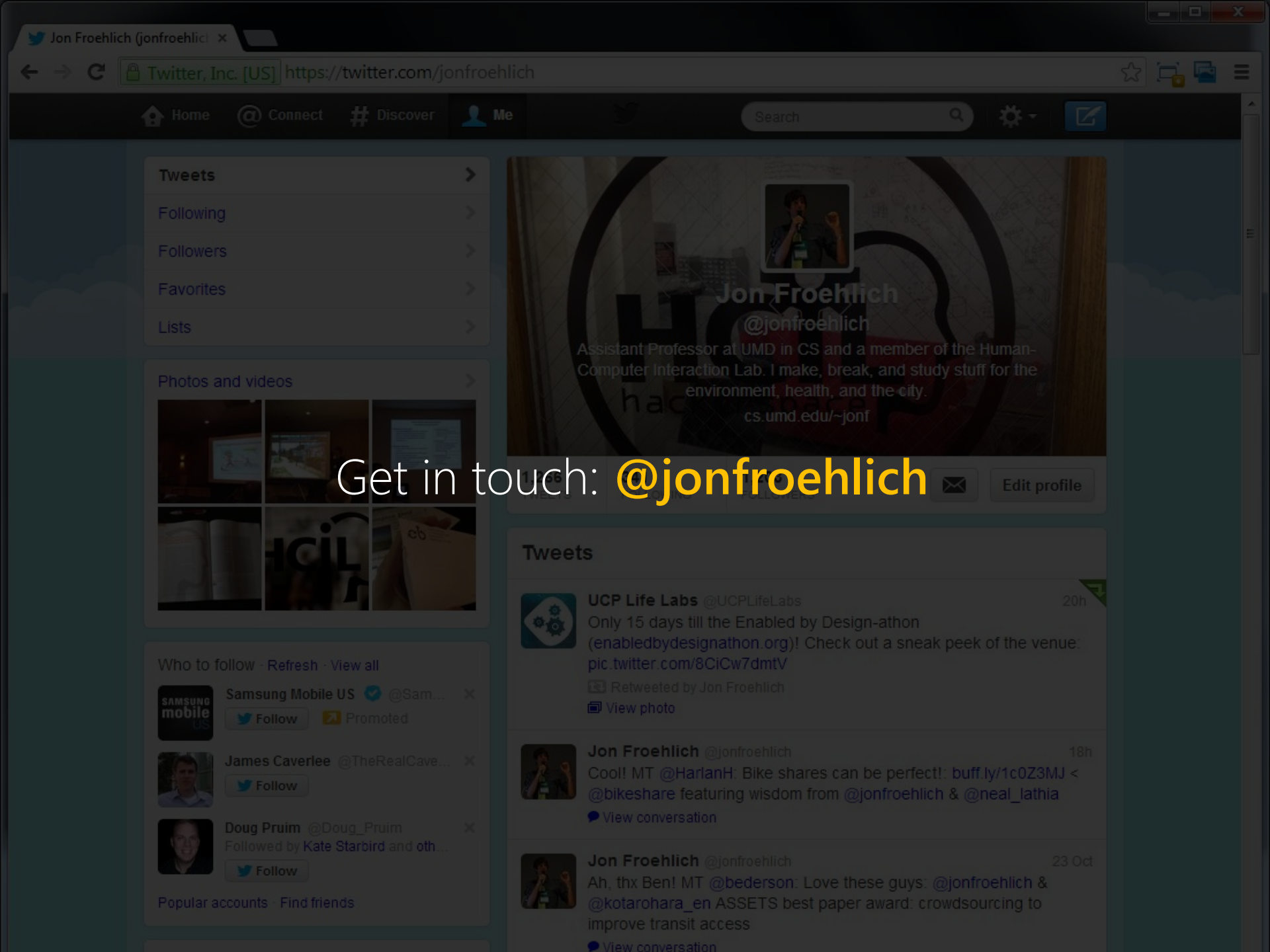
"How many generations in all of human history have had the opportunity to **rise to a challenge that is worthy of our best efforts**. A challenge that can pull from us more than we think we can do."

Al Gore

Nobel Peace Prize Winner, 2007

Quote from TED Conference, March 2008




Jon Froehlich (jonfroehlich
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Me
Search
Tweets
Following
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Favorites
Lists
Photos and videos
Jon Froehlich
@jonfroehlich
Assistant Professor at UMD in CS and a member of the Human-Computer Interaction Lab. I make, break, and study stuff for the environment, health, and the city.
cs.umd.edu/~jonf
Edit profile
Get in touch: @jonfroehlich
Tweets
UCP Life Labs @UCPLifeLabs 20h
Only 15 days till the Enabled by Design-athon (enabledbydesignathon.org)! Check out a sneak peek of the venue: pic.twitter.com/8CiCw7dmtV
Retweeted by Jon Froehlich
View photo
Jon Froehlich @jonfroehlich 18h
Cool! MT @HarlanH: Bike shares can be perfect!: buff.ly/1c0Z3MJ < @bikeshare featuring wisdom from @jonfroehlich & @neal_lathia
View conversation
Jon Froehlich @jonfroehlich 23 Oct
Ah, thx Ben! MT @bederson: Love these guys: @jonfroehlich & @kotarohara_en ASSETS best paper award: crowdsourcing to improve transit access
View conversation
Who to follow · Refresh · View all
Samsung Mobile US @Sam...
Follow
Promoted
James Caverlee @TheRealCave...
Follow
Doug Pruim @Doug_Pruim
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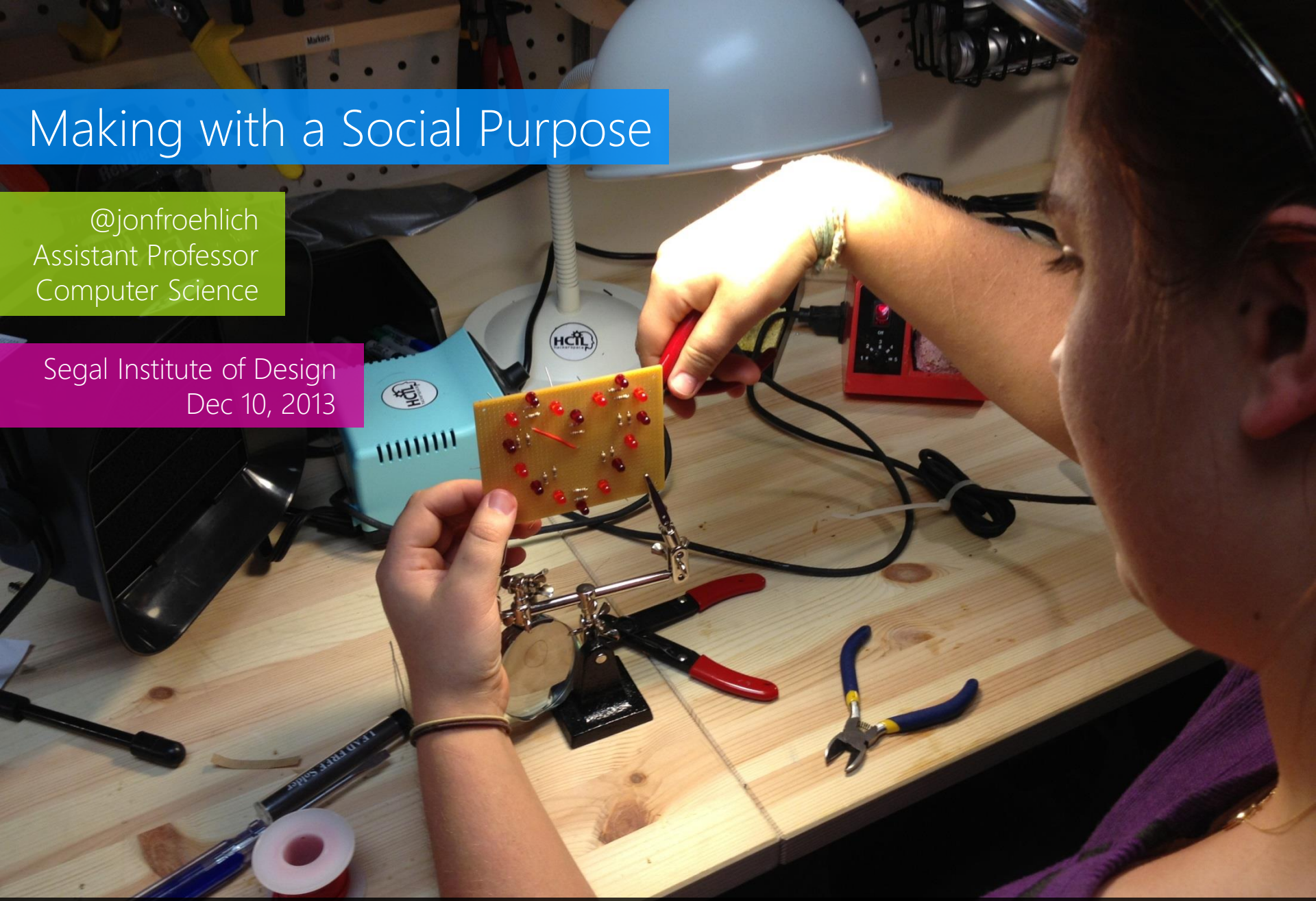
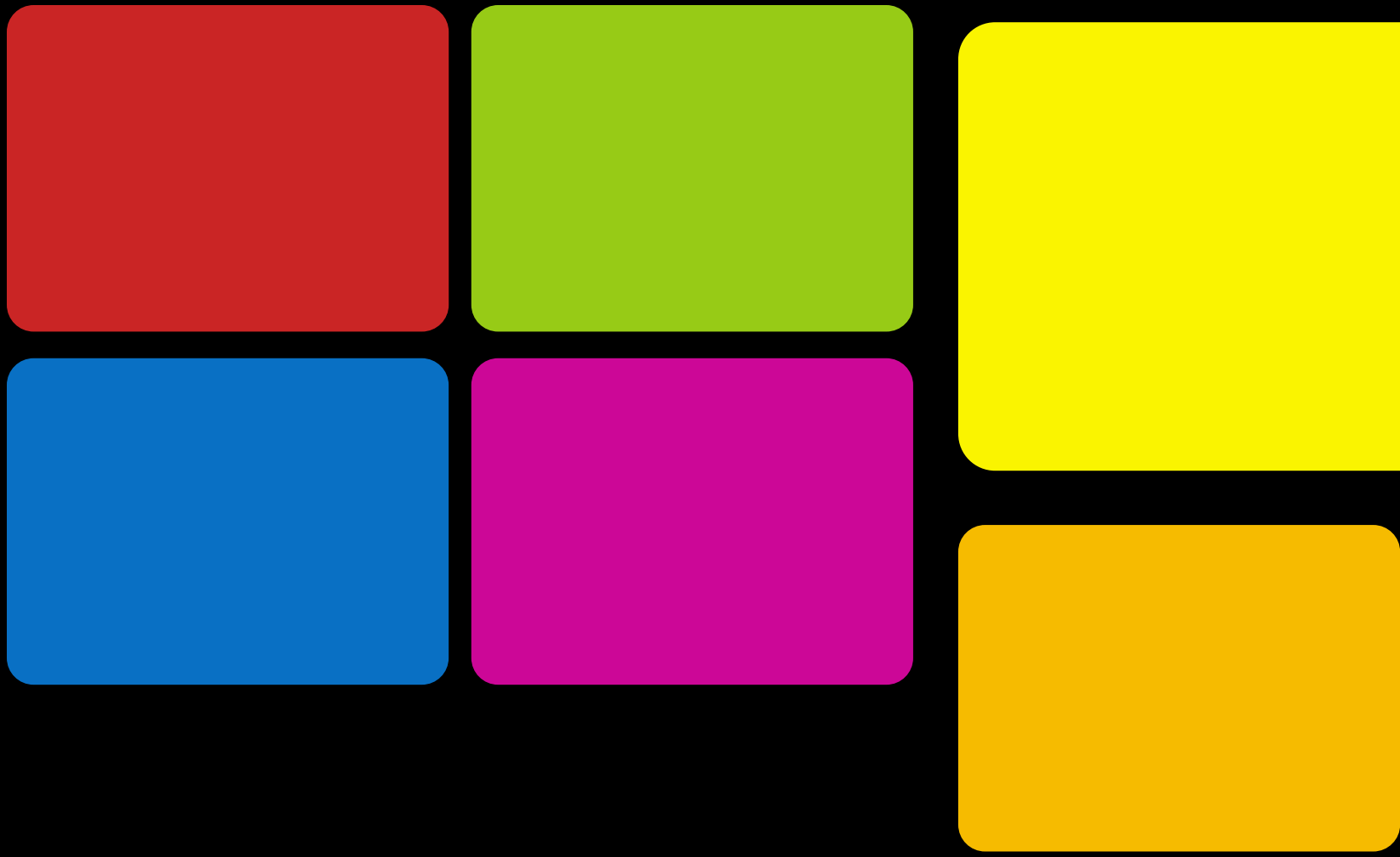
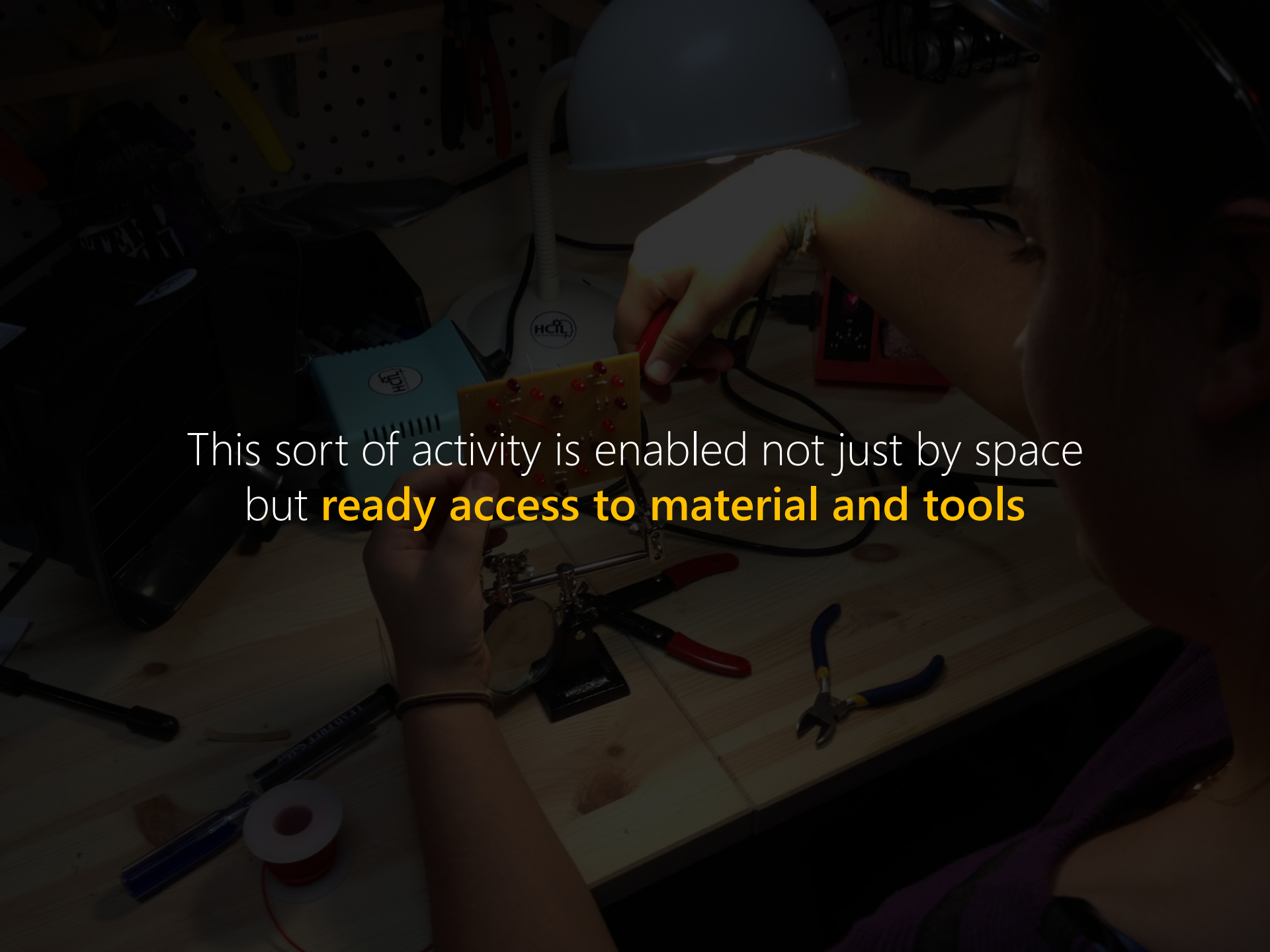
Making with a Social Purpose

@jonfroehlich
Assistant Professor
Computer Science

Segal Institute of Design
Dec 10, 2013






This sort of activity is enabled not just by space
but **ready access to material and tools**

Three Soldering Stations

HCIL Hackerspace

One Oscilloscope

HCIL Hackerspace

Craft/Textile Station

HCIL Hackerspace

Two Mannequins

HCIL Hackerspace

Basic Electronic Supplies

HCIL Hackerspace

Wall of Electronic Components

HCIL Hackerspace

Microcontroller Inventory*

3 Beaglebones

http://beagleboard.org/

3 Raspberry Pis

http://www.raspberrypi.org/

2 .NET Gadgeteers

http://www.netmf.com/gadgeteer/

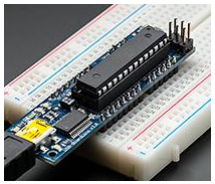
3 ARM Cortex-Ms

http://en.wikipedia.org/wiki/ARM_Cortex-M

And lots of Arduino…

*We have other boards as well but these are the main ones

Arduino Inventory

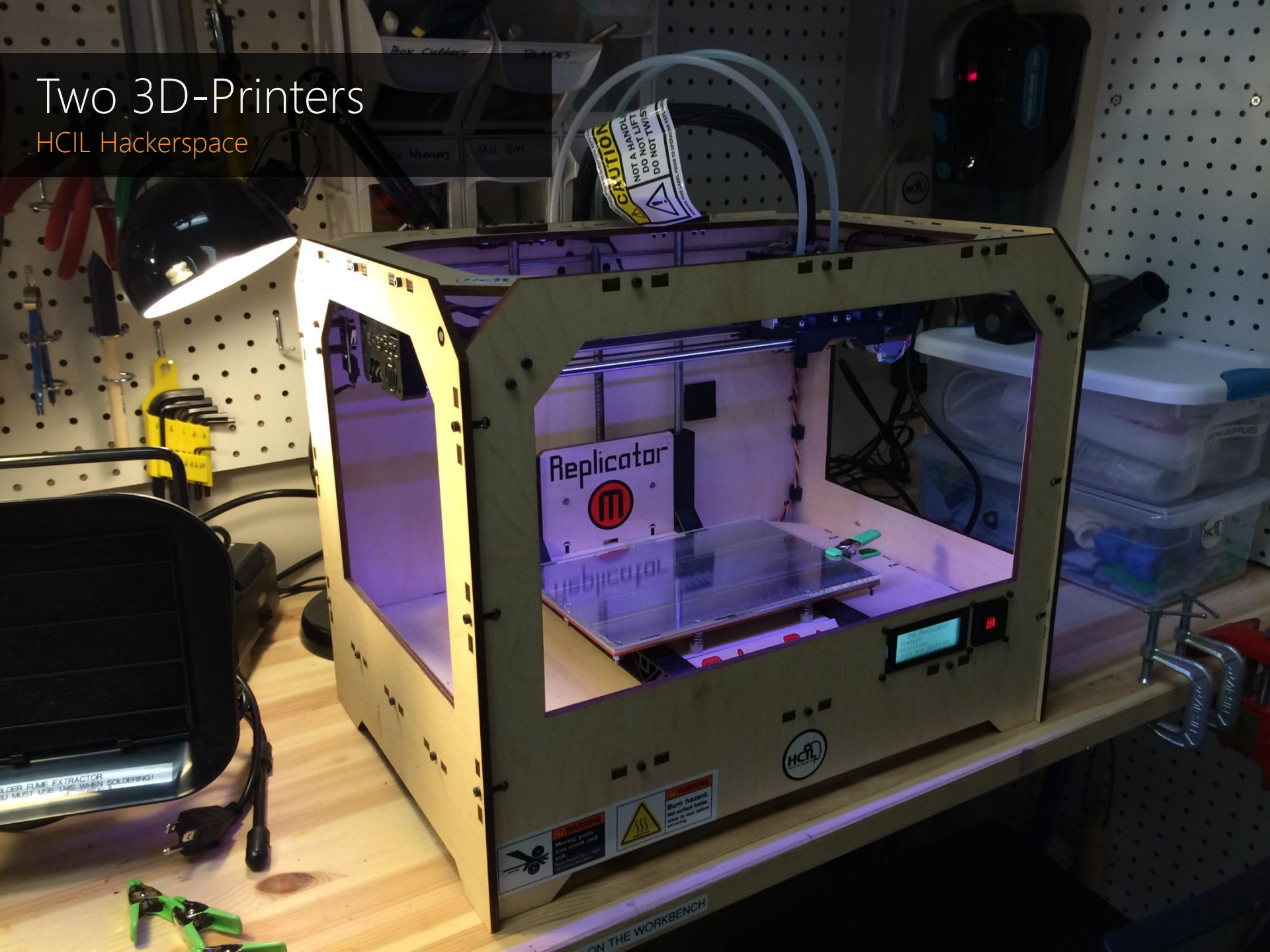
 15 Unos http://arduino.cc/en/Main/ArduinoBoardUno	 15 Leondardos http://arduino.cc/en/Main/ArduinoBoardLeonardo	 2 Yúns http://arduino.cc/en/Main/ArduinoBoardYun	 2 Megas http://arduino.cc/en/Main/ArduinoBoardMega2560	 2 Dues http://arduino.cc/en/Main/ArduinoBoardDue
 2 Esploras http://arduino.cc/en/Main/ArduinoBoardUno	 5 Pro Minis http://arduino.cc/en/Main/ArduinoBoardProMini	 2 Pro Micros http://sprkfn.com/12640	 1 Fio http://arduino.cc/en/Main/ArduinoBoardFio	 9 Boarduinos http://adafru.it/91
 2 LilyPads http://arduino.cc/en/Main/ArduinoBoardLilyPad	 2 LilyPad Simples http://arduino.cc/en/Main/ArduinoBoardLilyPadSimple			

Quadcopters

HCIL Hackerspace

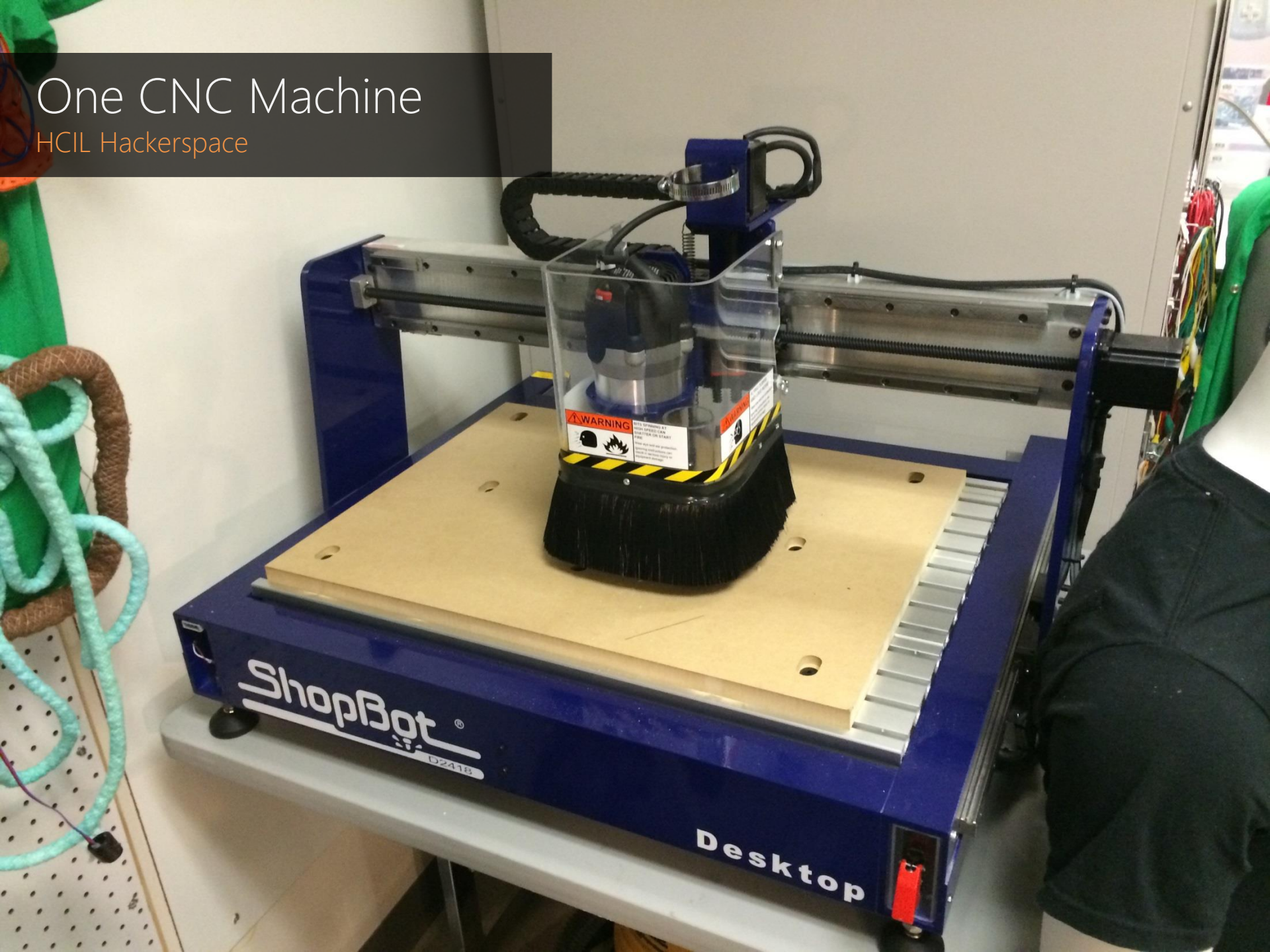
Two 3D-Printers

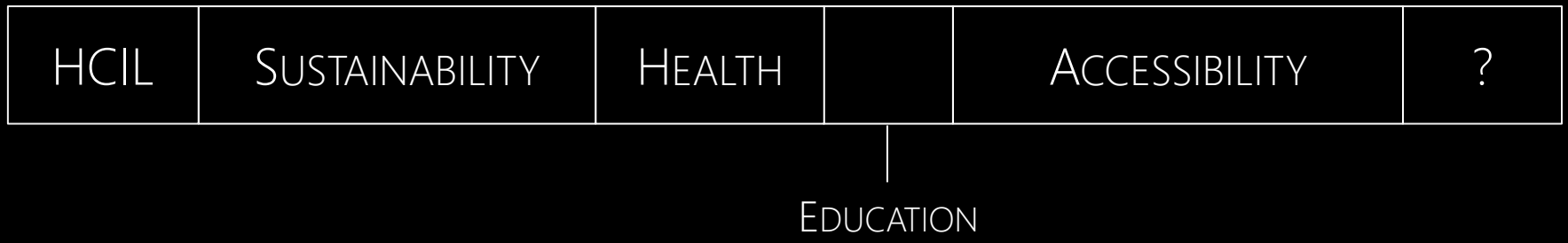
HCIL Hackerspace



One CNC Machine

HCIL Hackerspace

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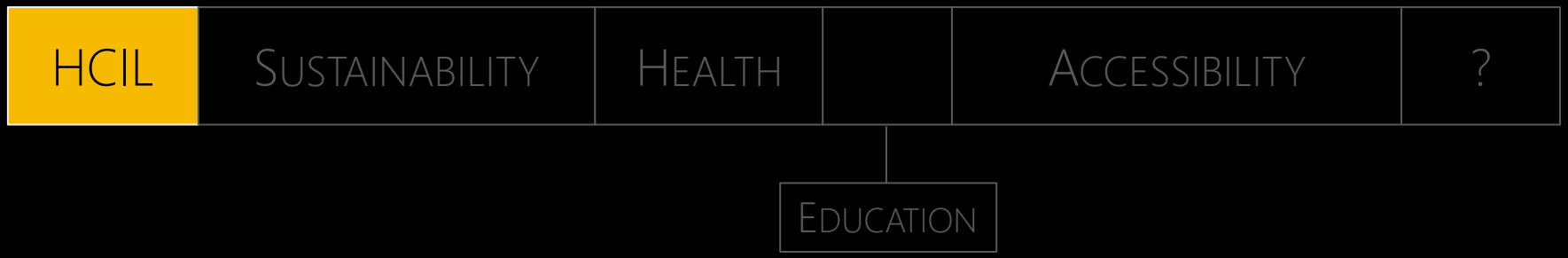
Health
Accessibility
?
Education


HCIL
Sustainability
Health
Accessibility
?
Education

Making with a Social Purpose