

Basheer Tome

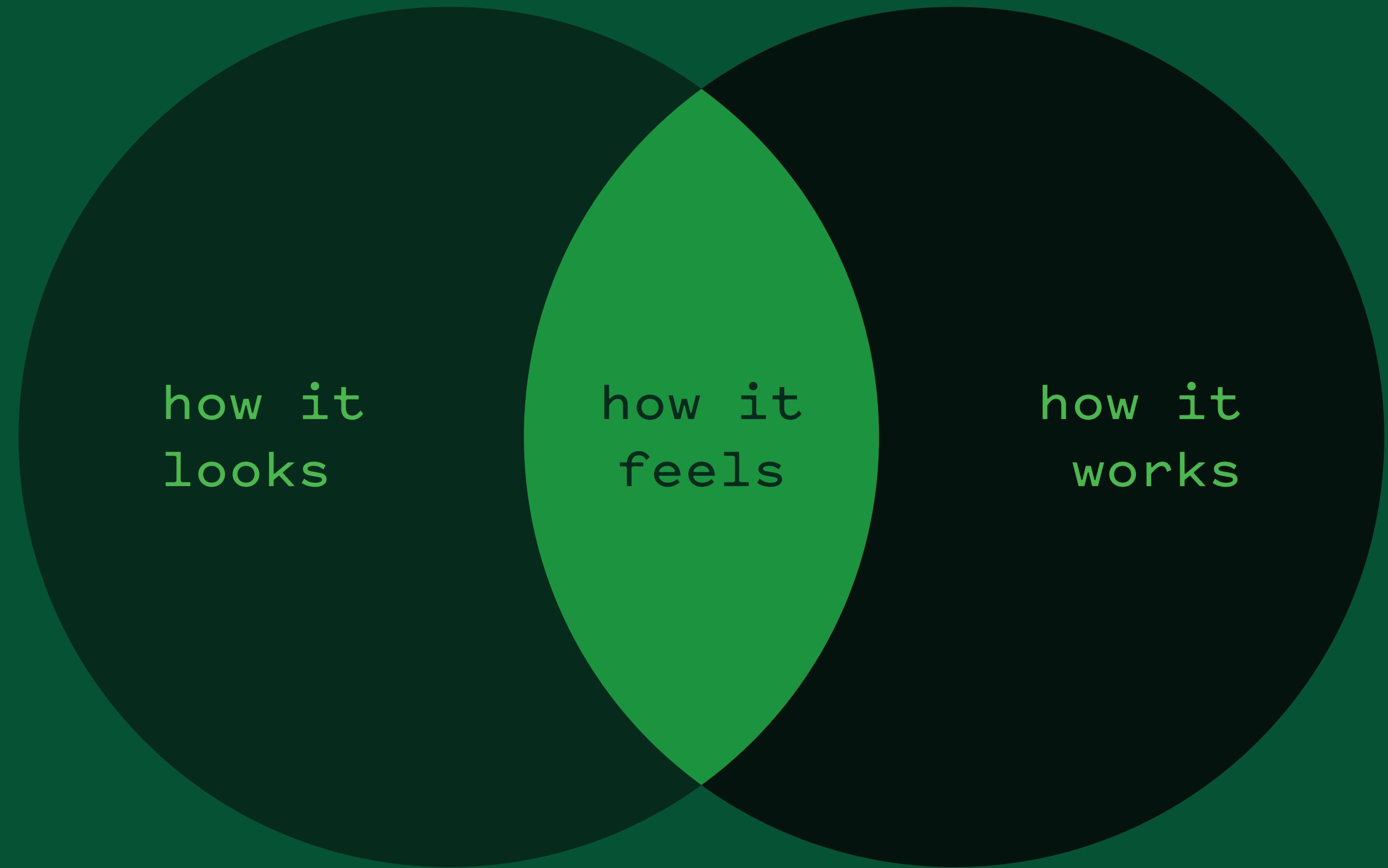
Portfolio 2020

[About](#) →

[Daydream](#) →

[Pixel Buds](#) →

About

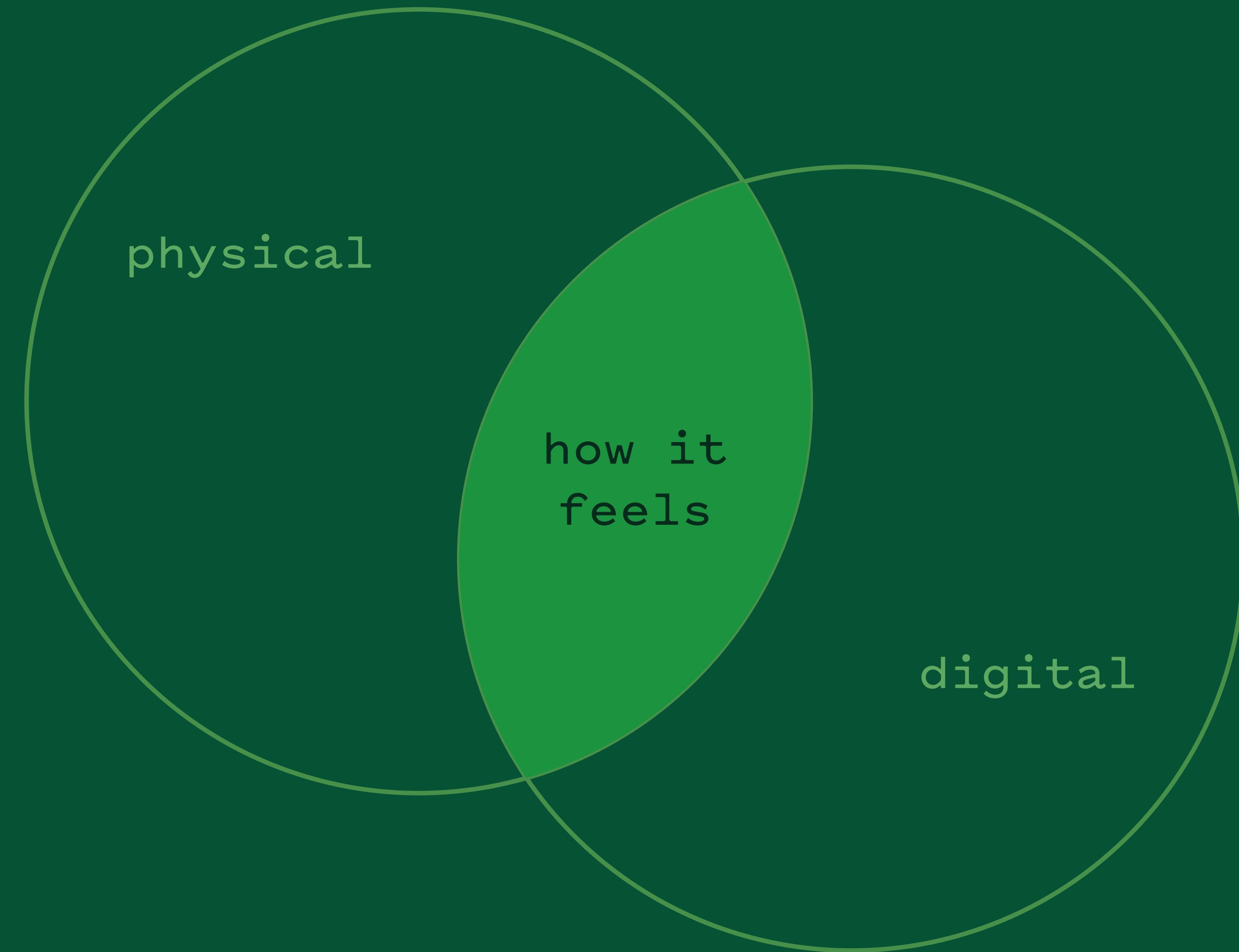


About



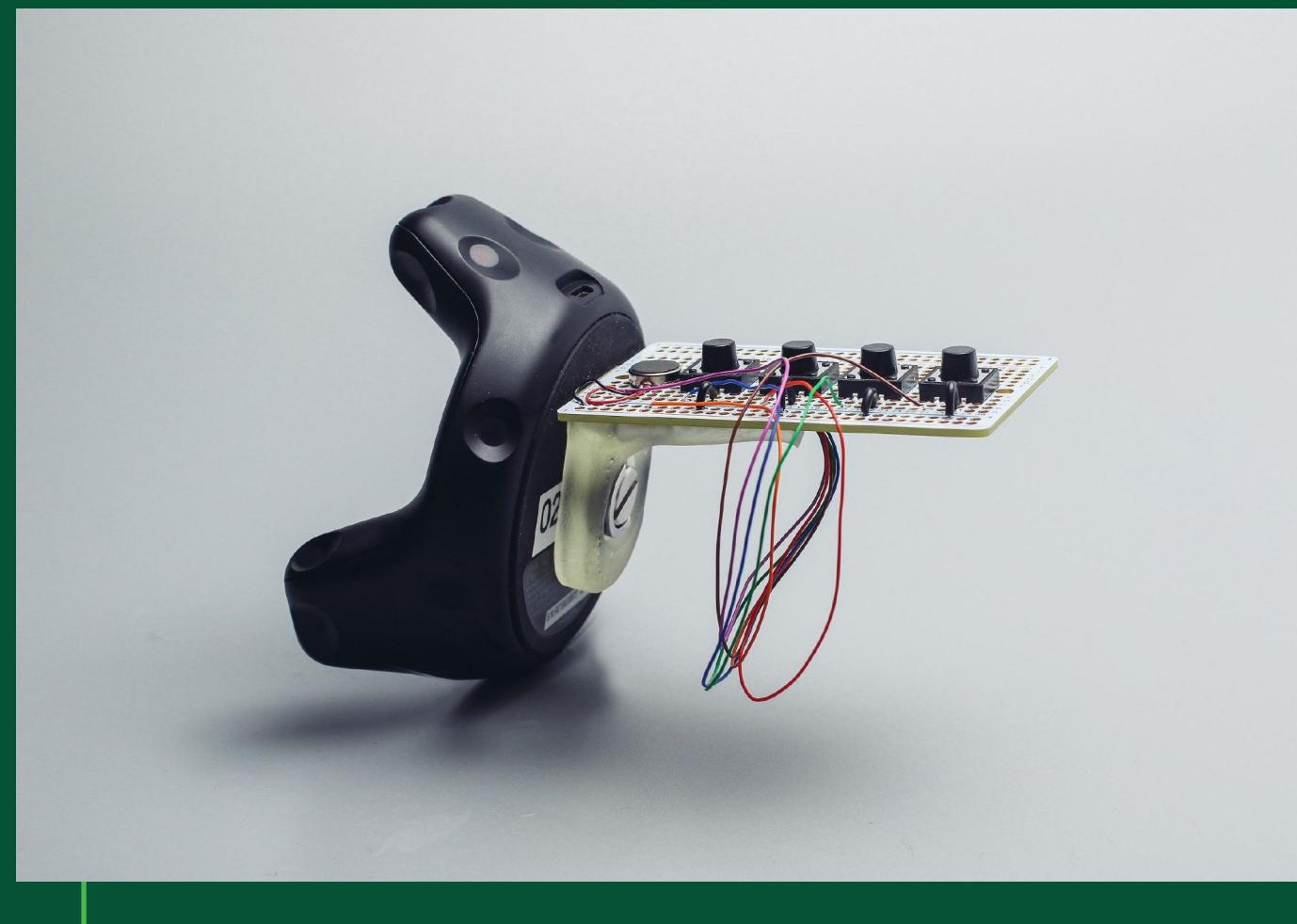
how it
feels

About

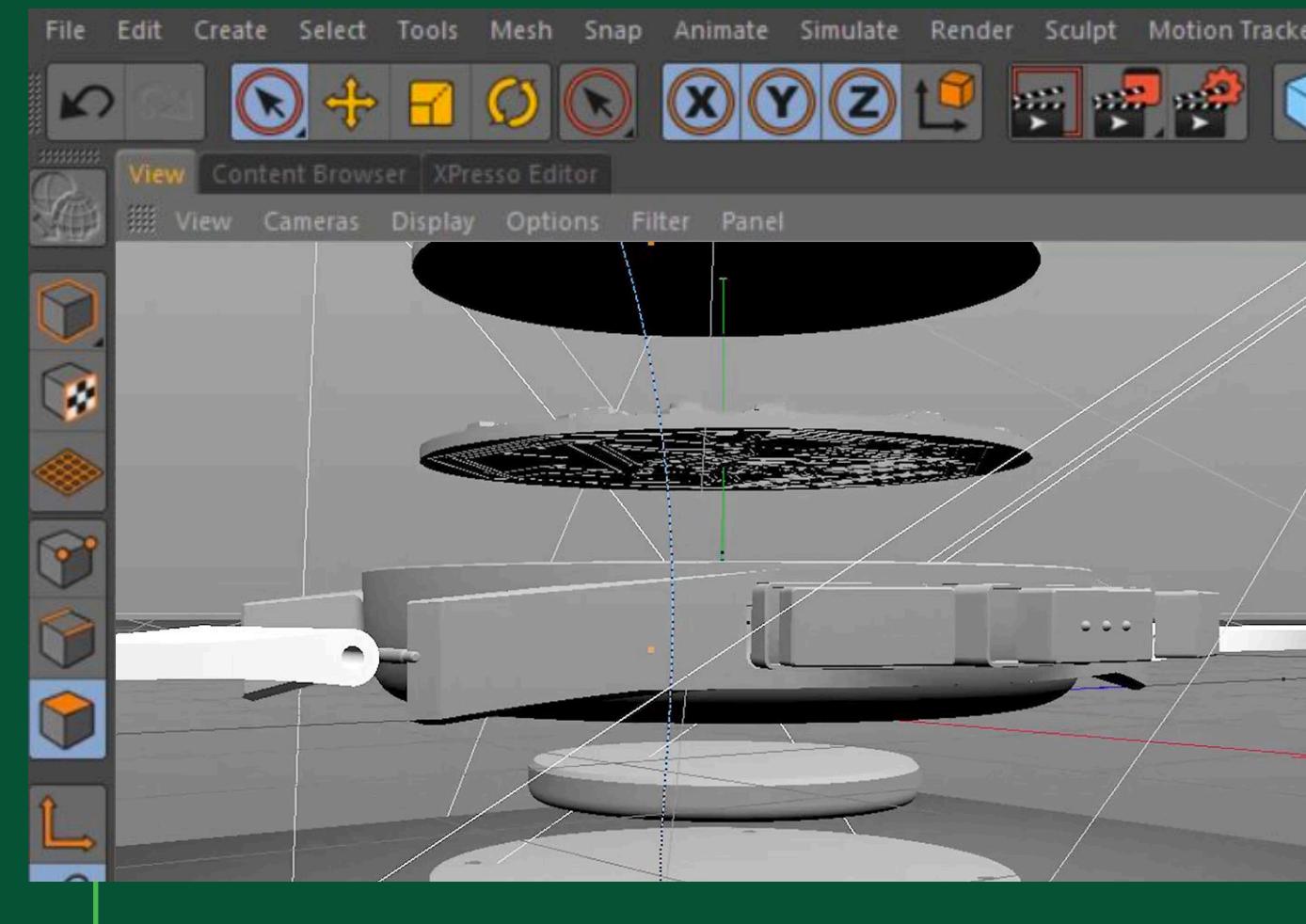


About

To do that, I use a blend of:



electronics hacking



filmmaking tools



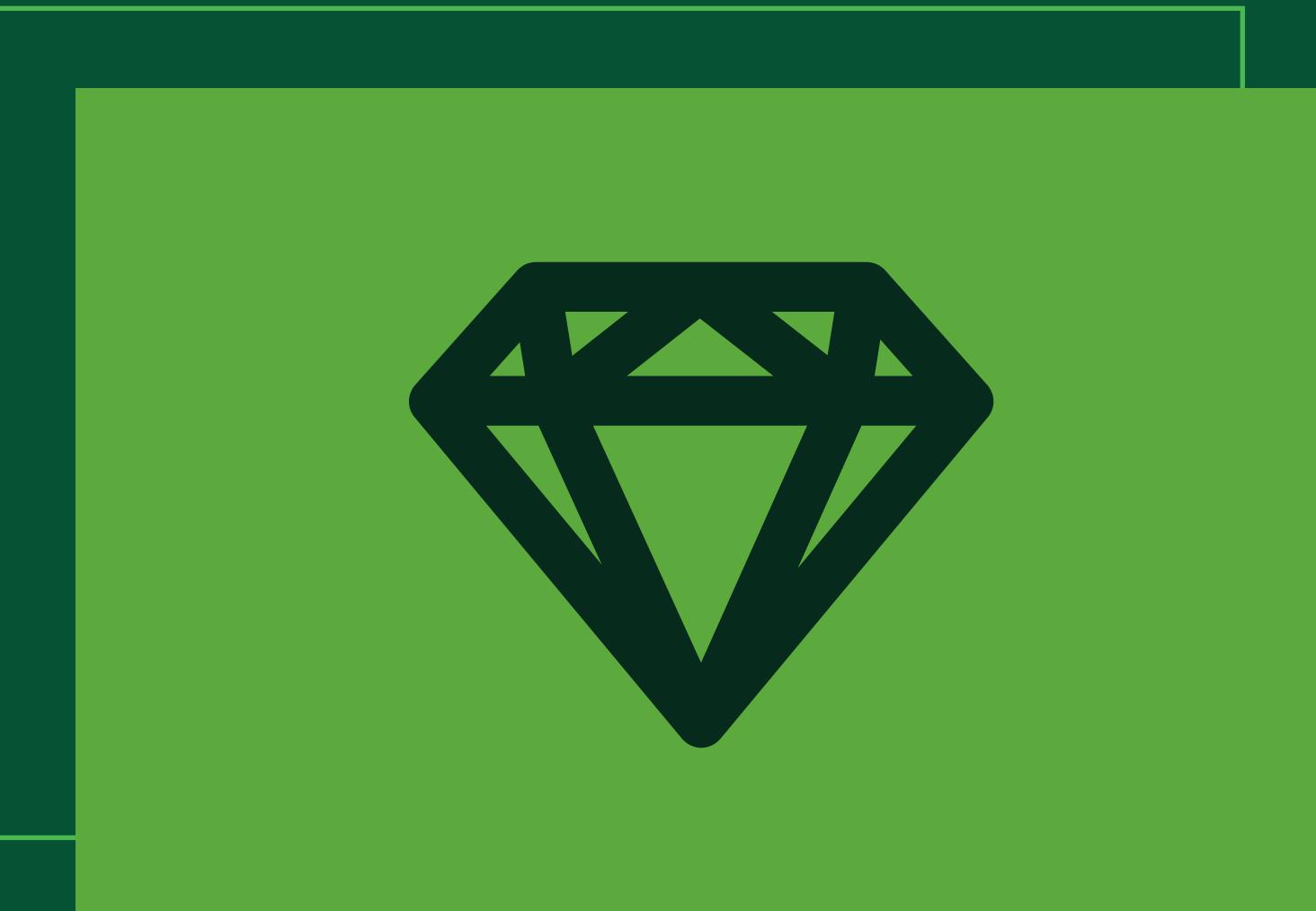
physical prototyping

About

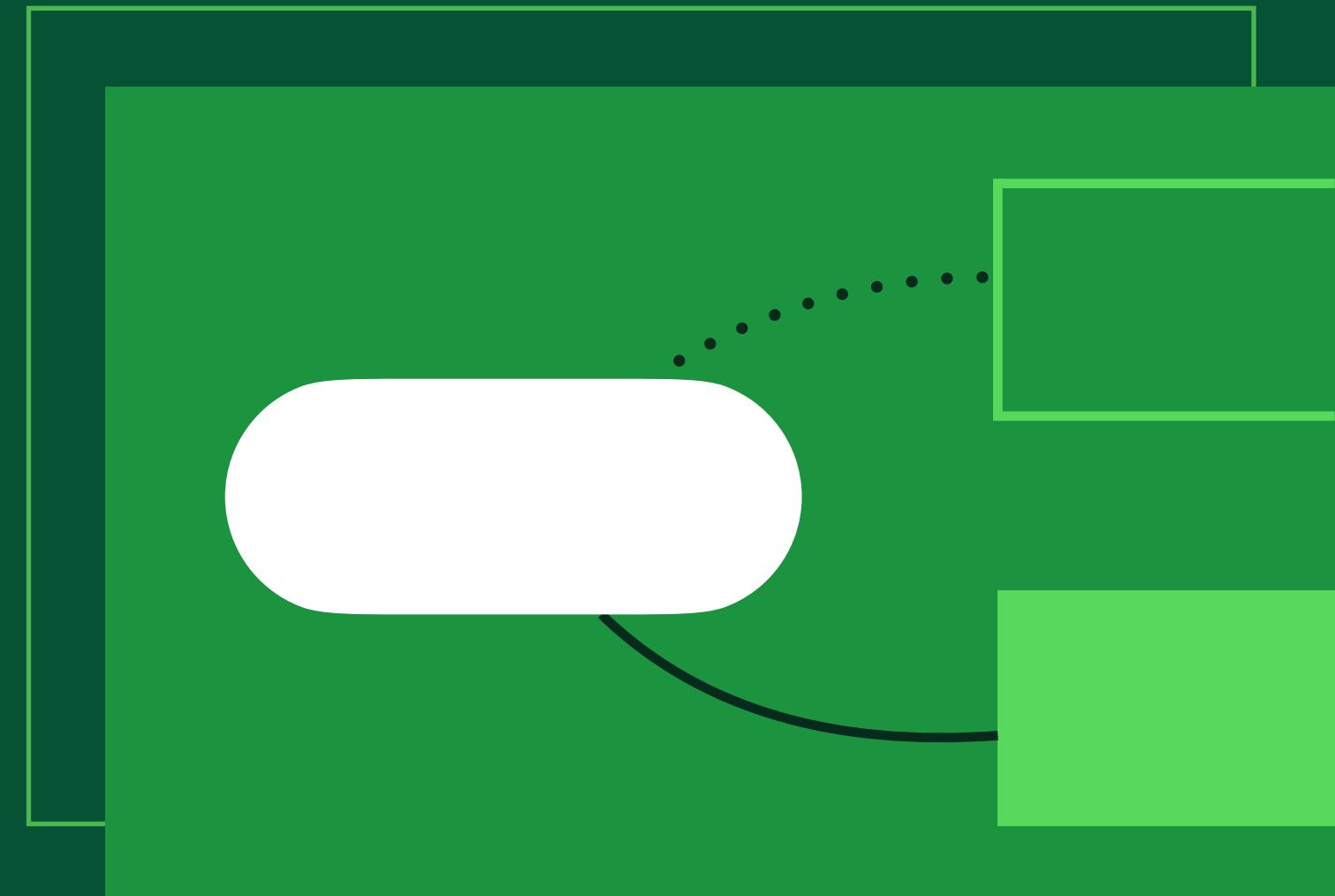
Combined with:

```
//set single LED  
app.use('single/  
app.get('channel  
console.log(setL
```

scrappy programming skills

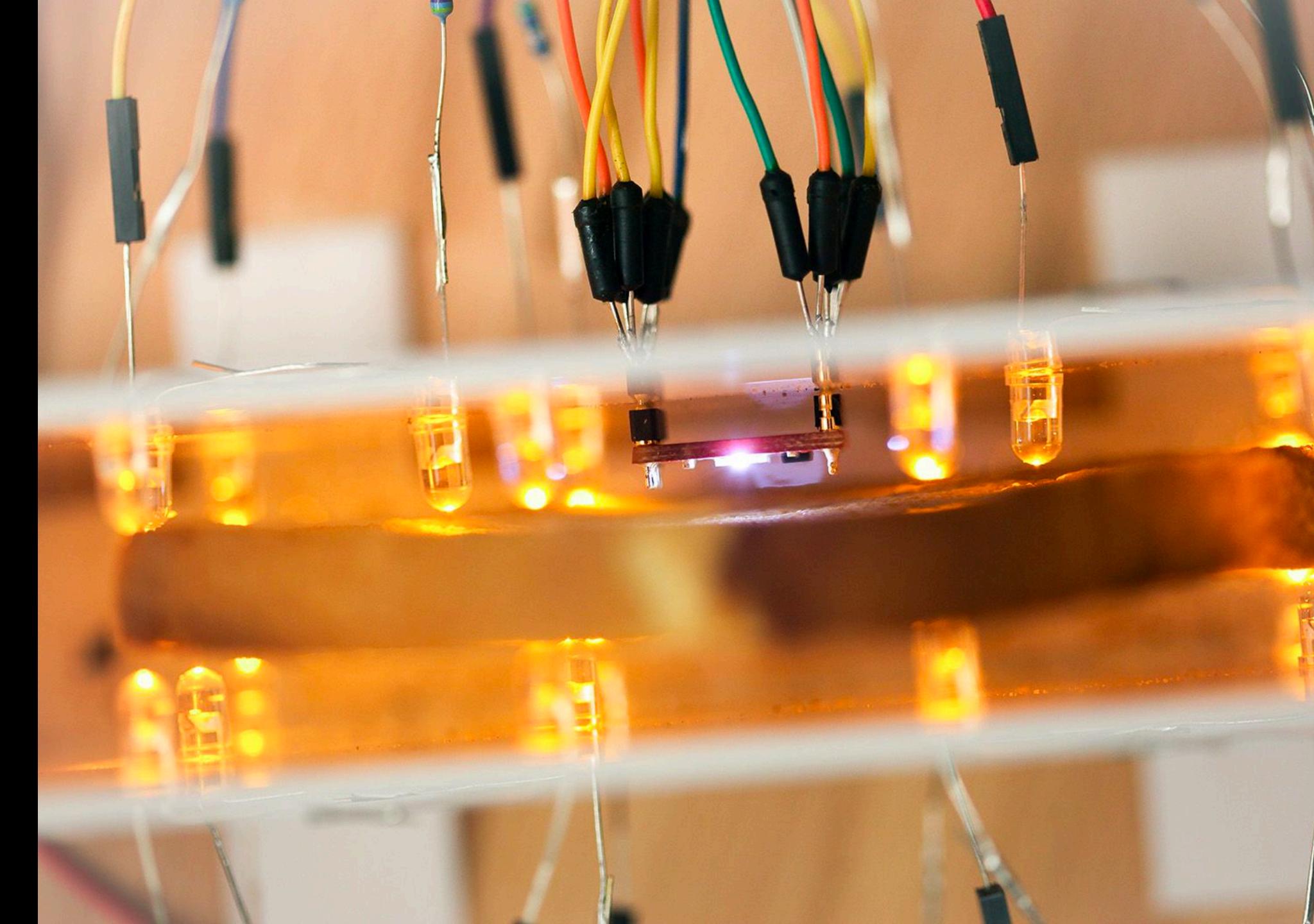


ui design & wireframing

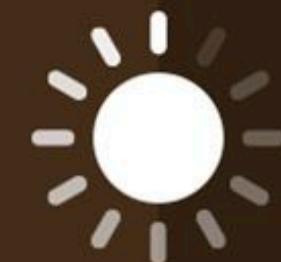


a love of flow charts

Georgia Tech



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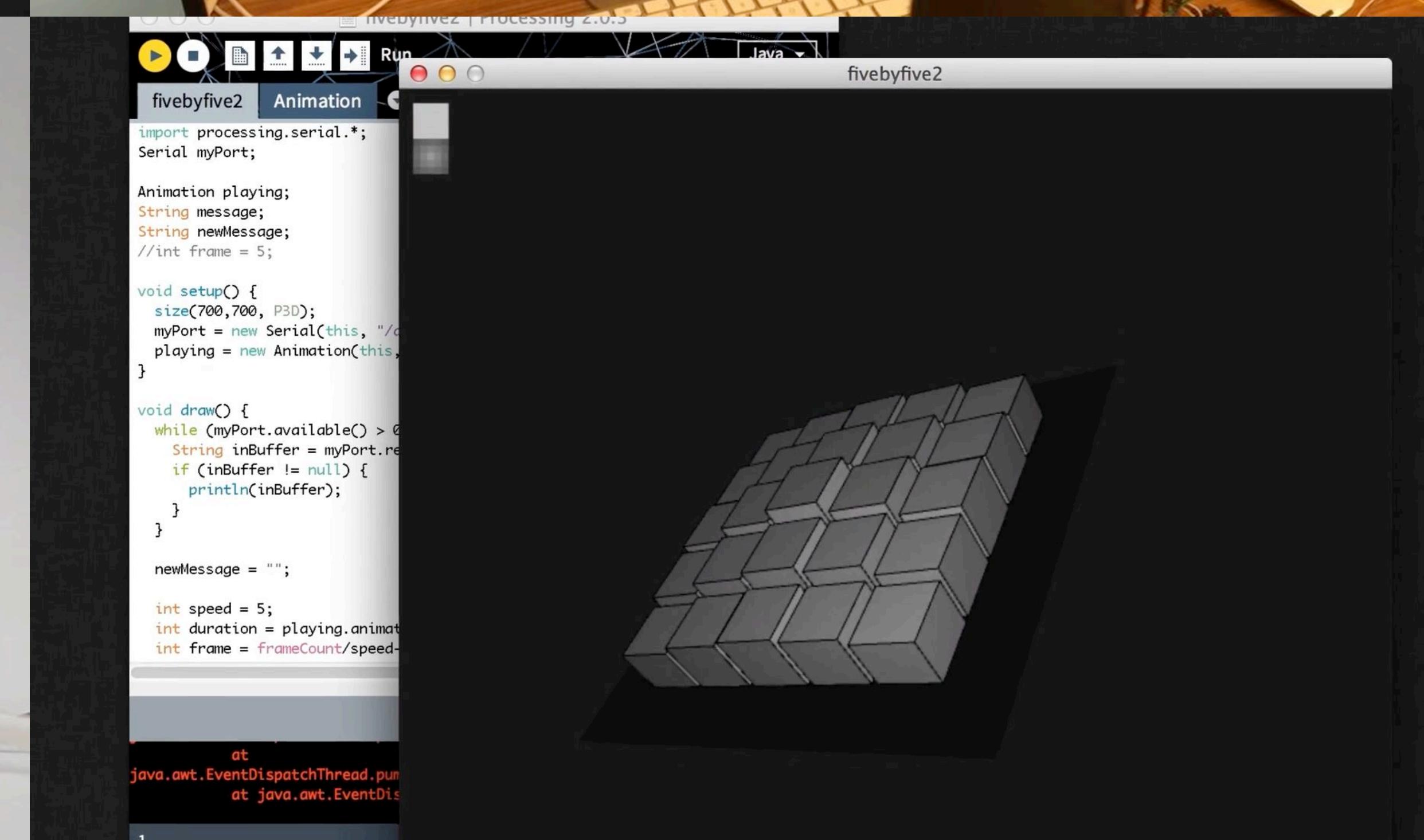
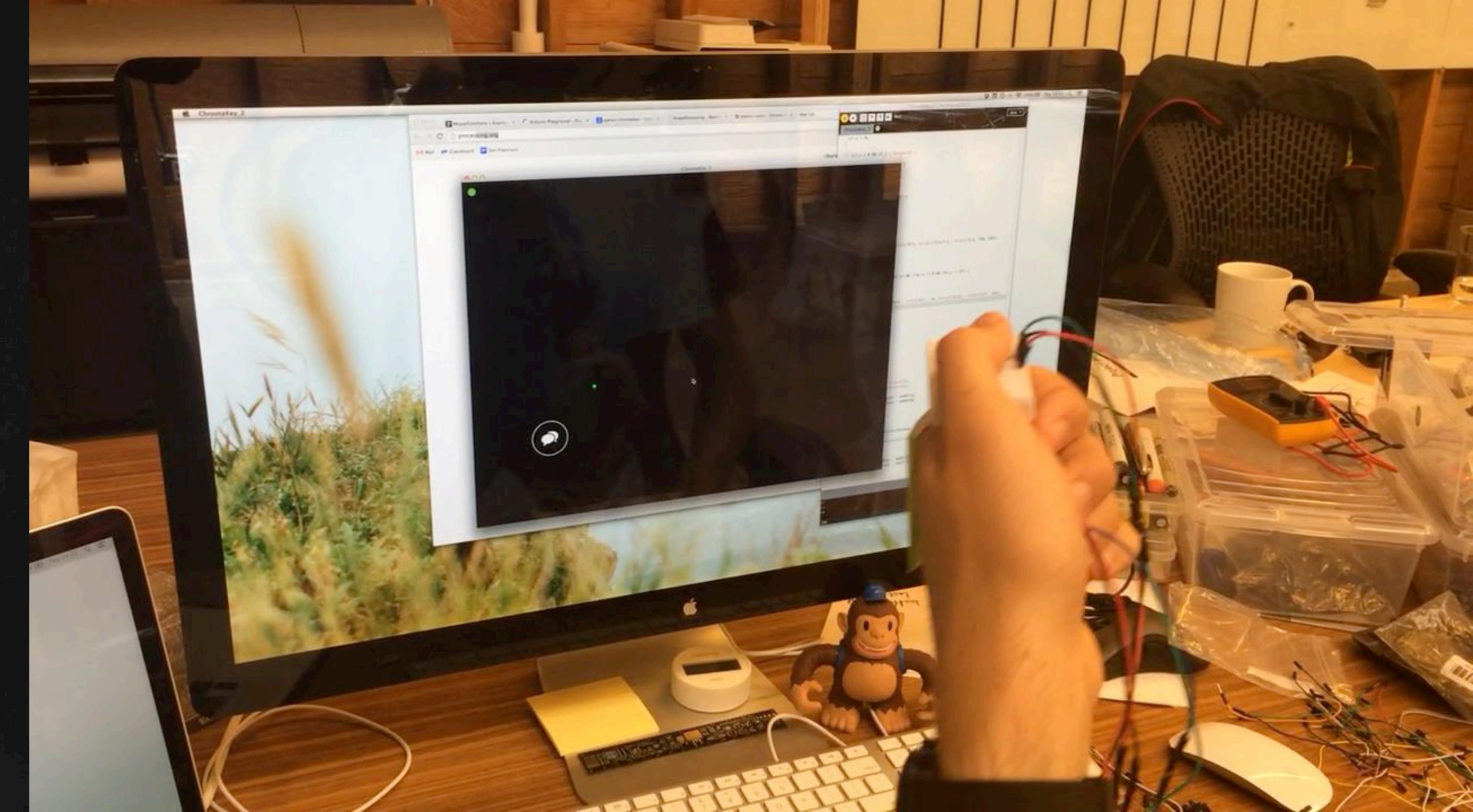
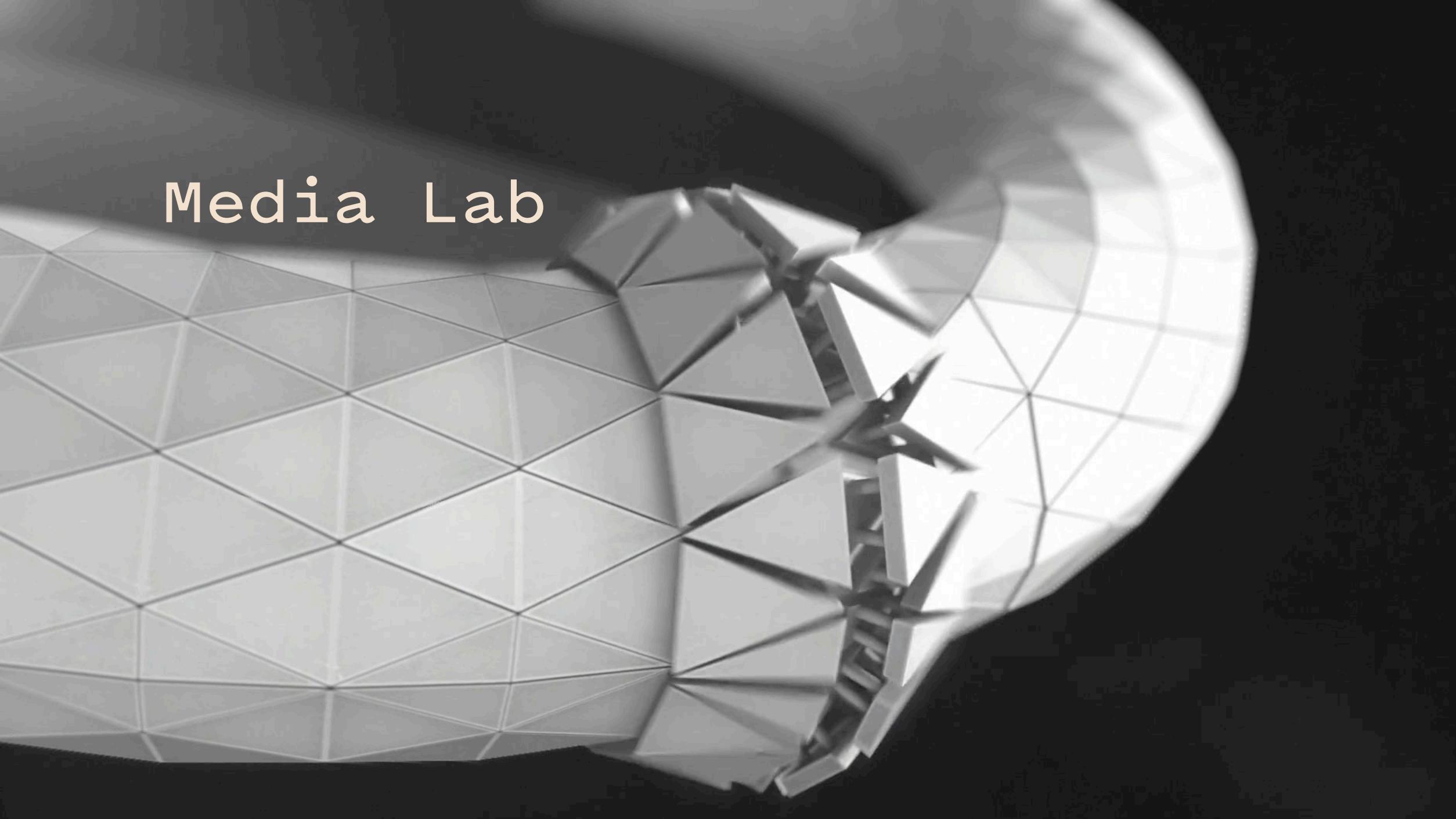
Hazel | Processing 1.5.1

```
import processing.serial.*;
import cc.arduino.*;

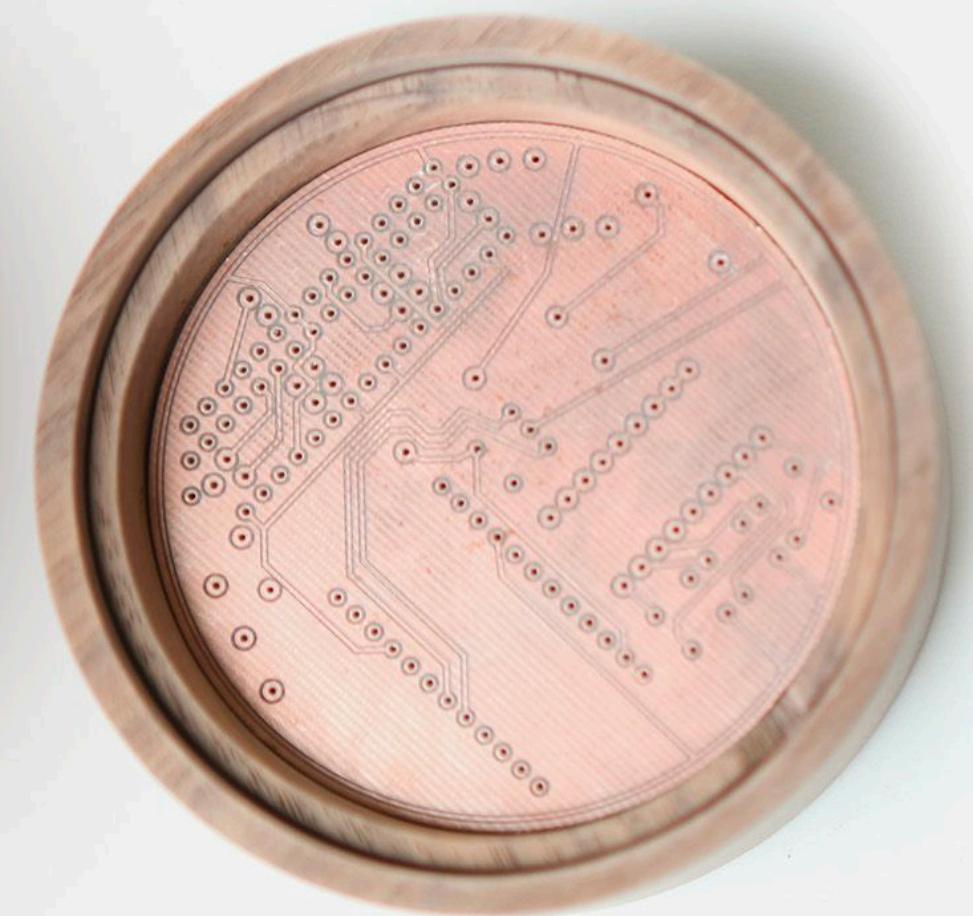
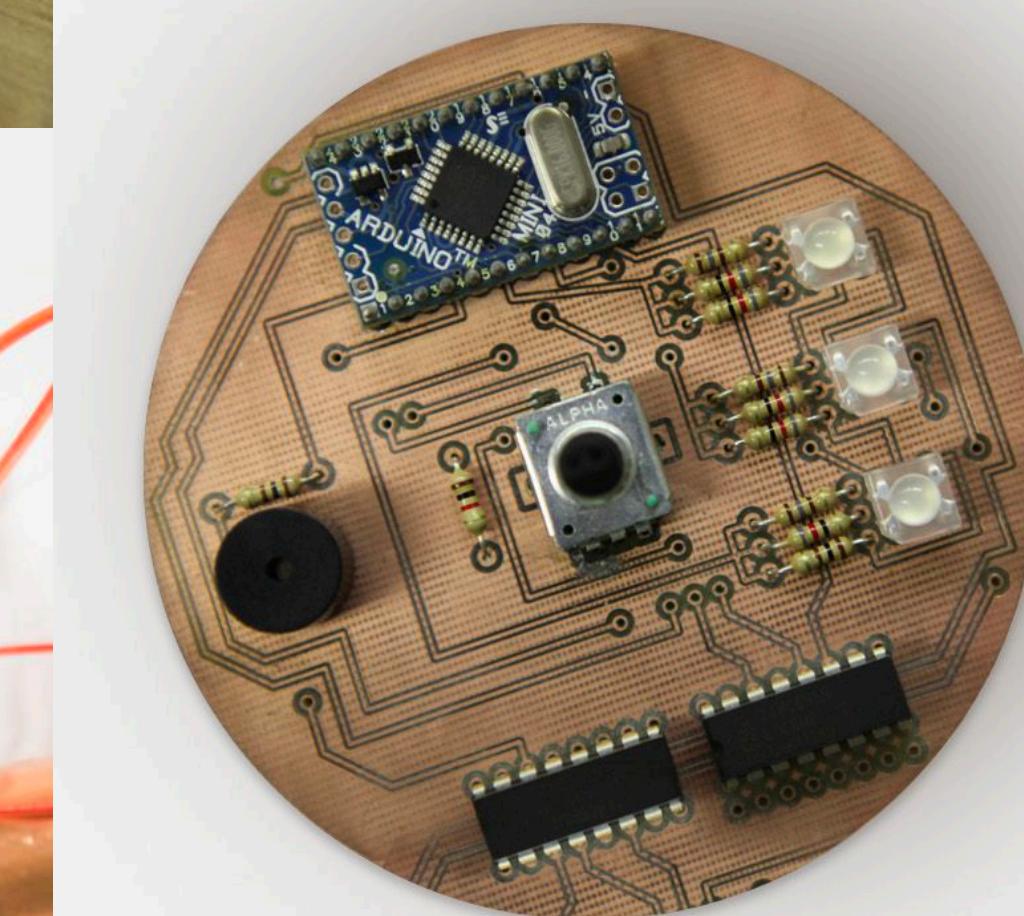
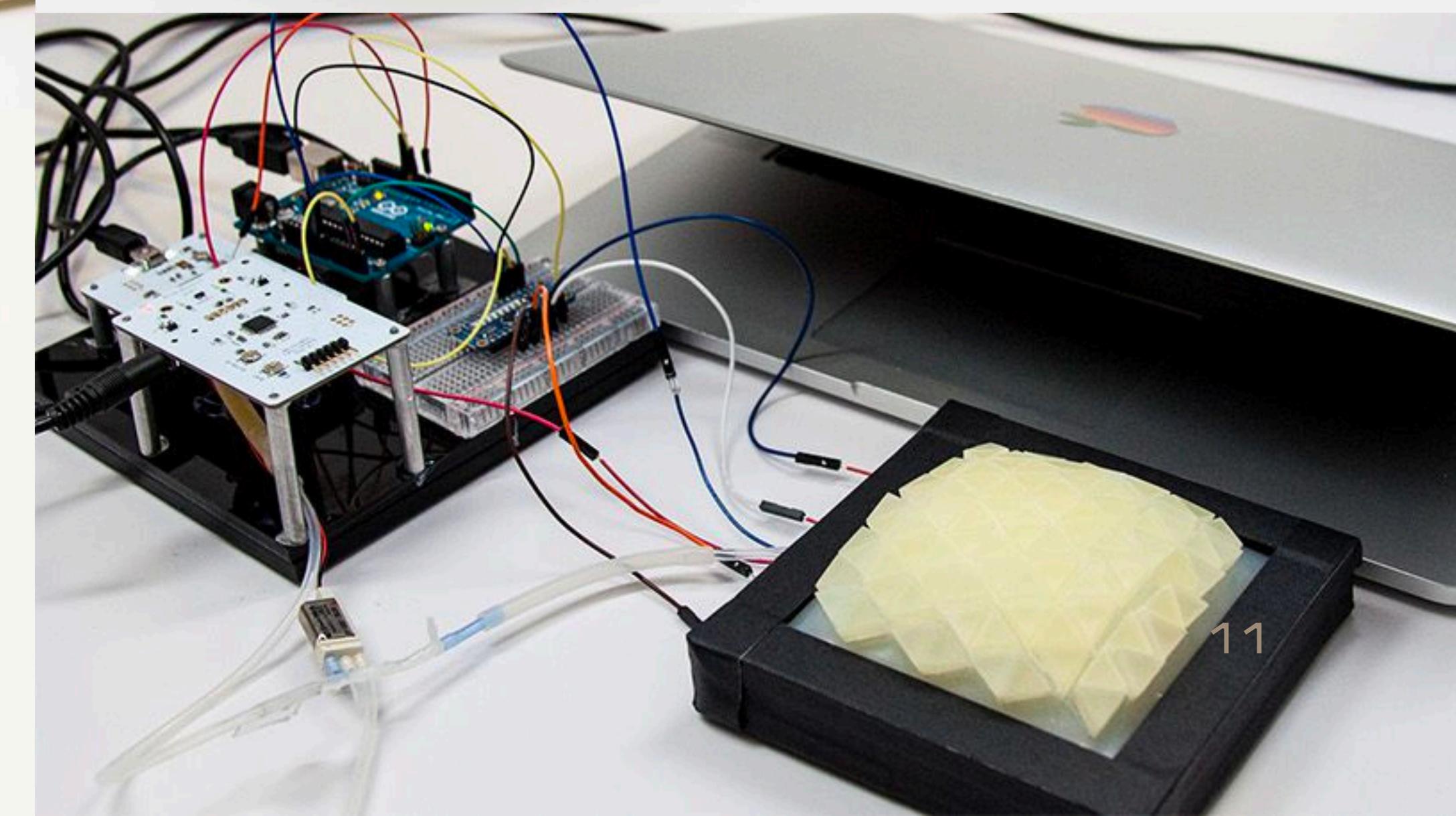
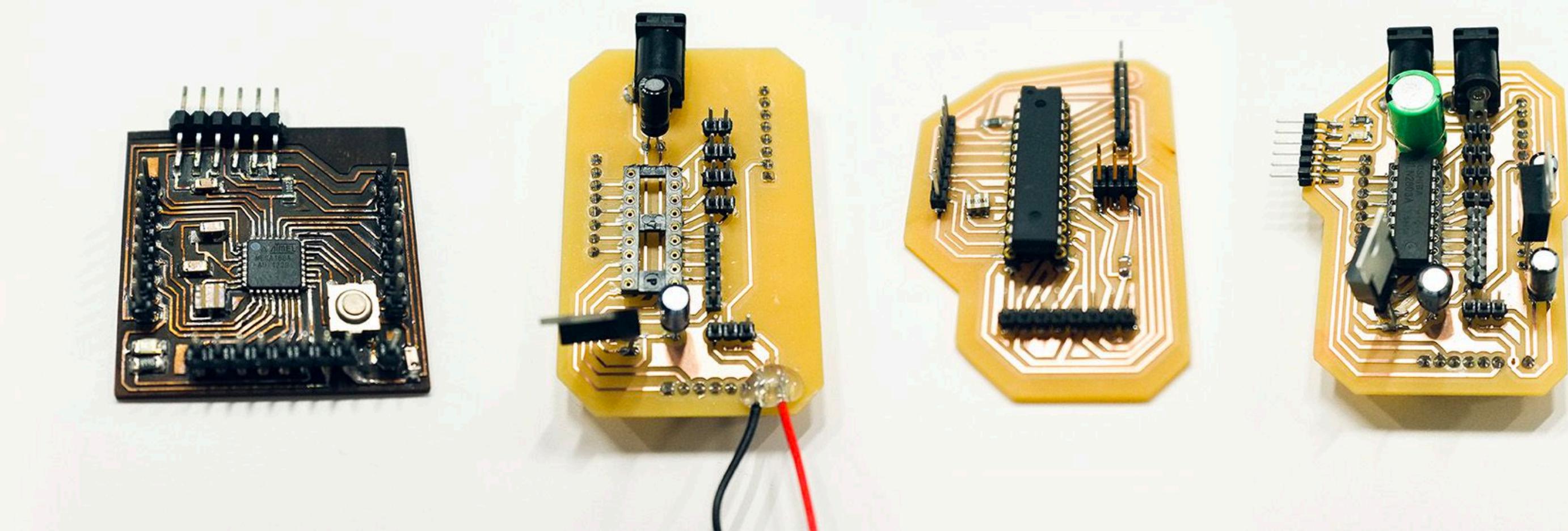
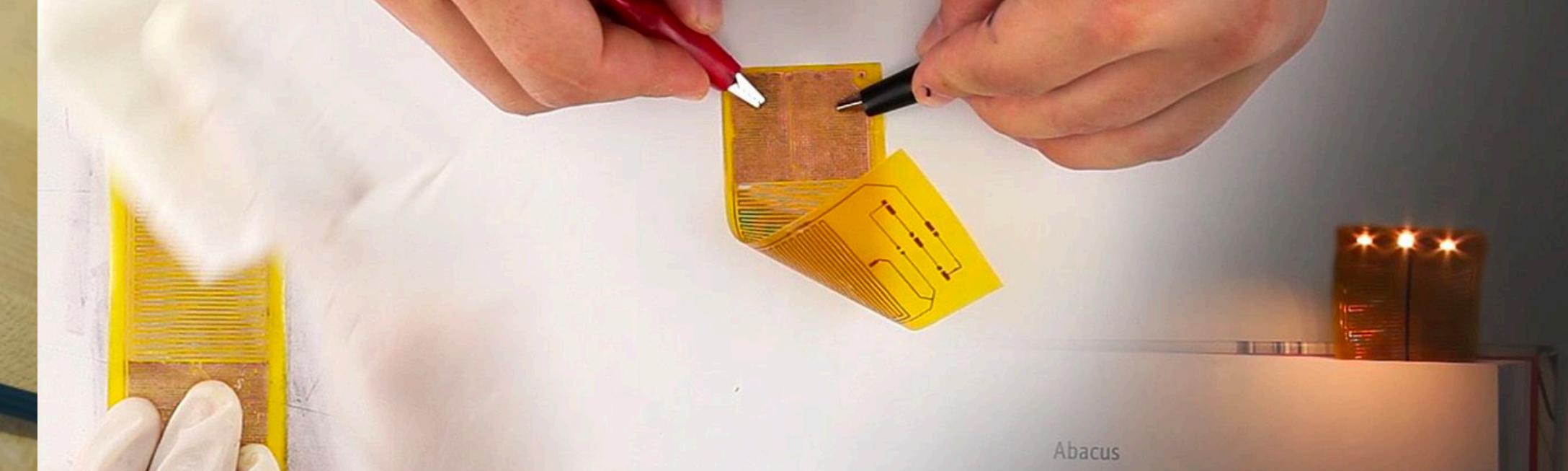
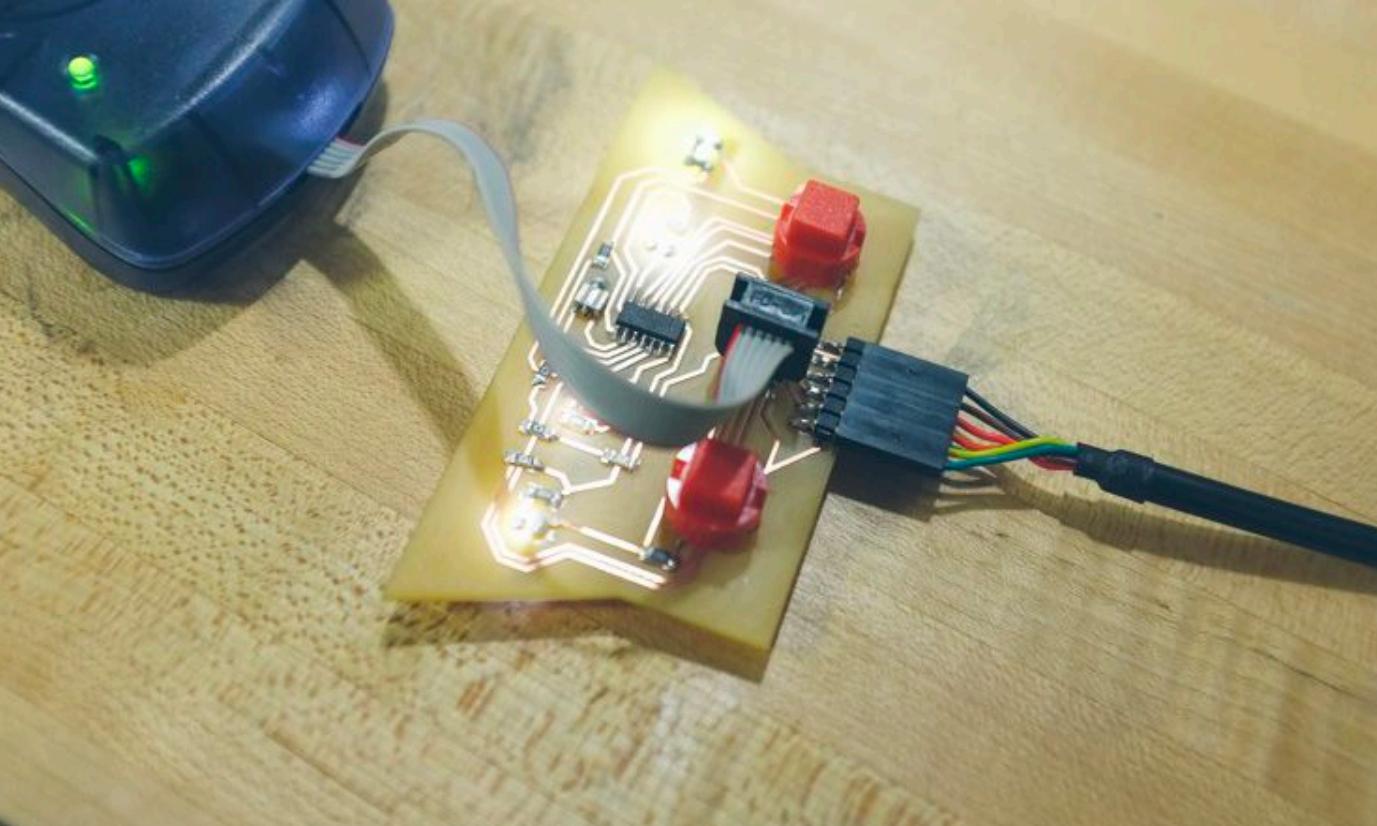
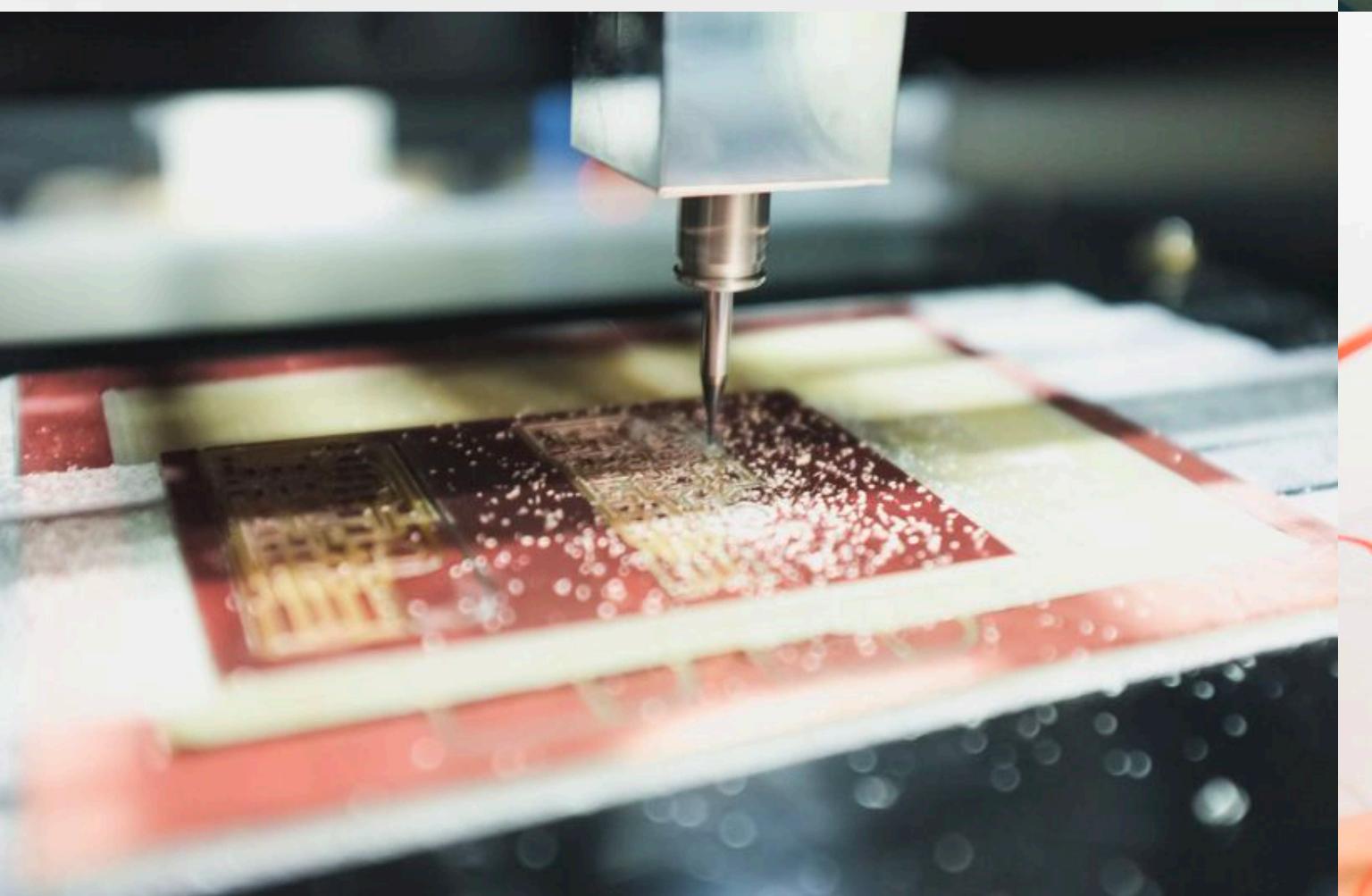
Arduino arduino;

PFont f1;
```

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Media Lab



Clutch Knob

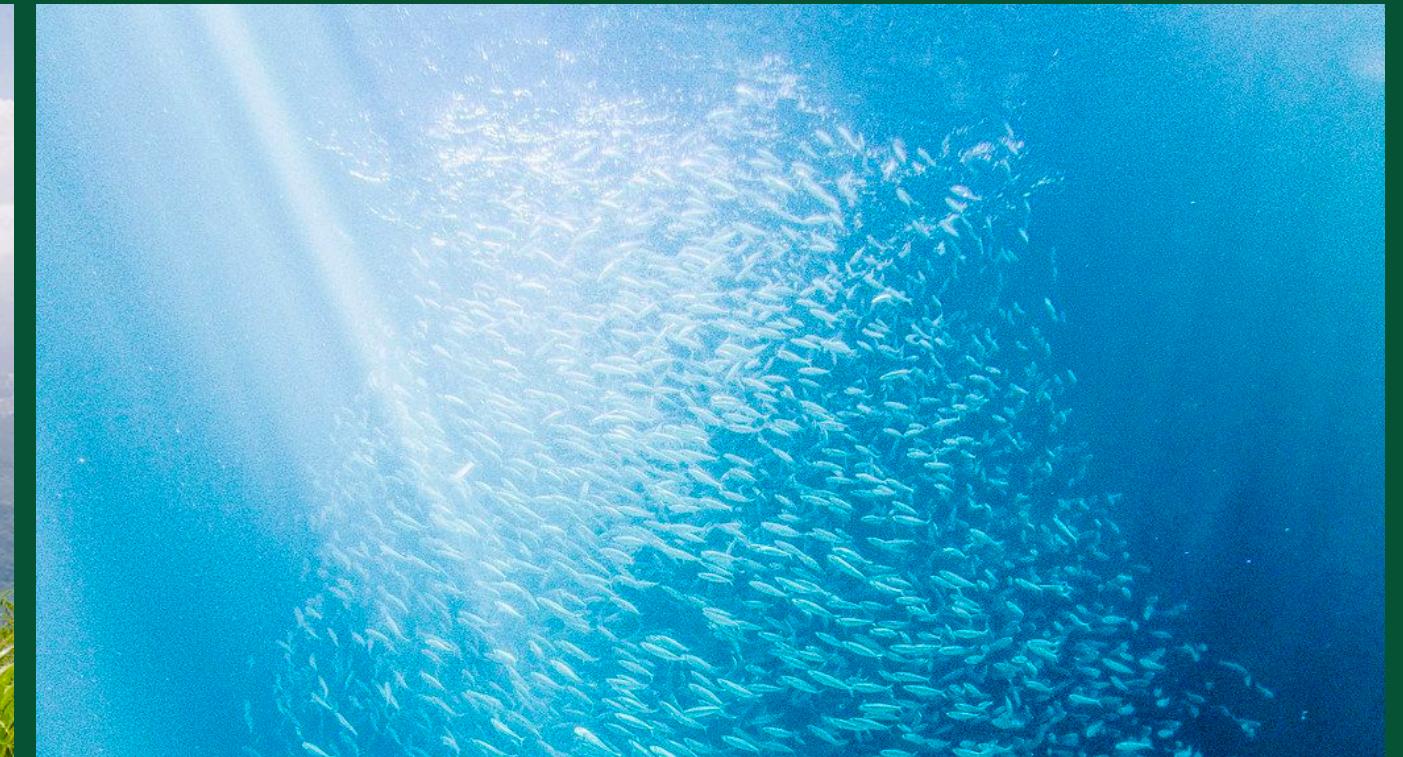
clearer Board

L+3 R+0 S1
L+3 R+3 S+1
L+3 R+2 S+0
L+2 R+2 C+

[video](#)

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About

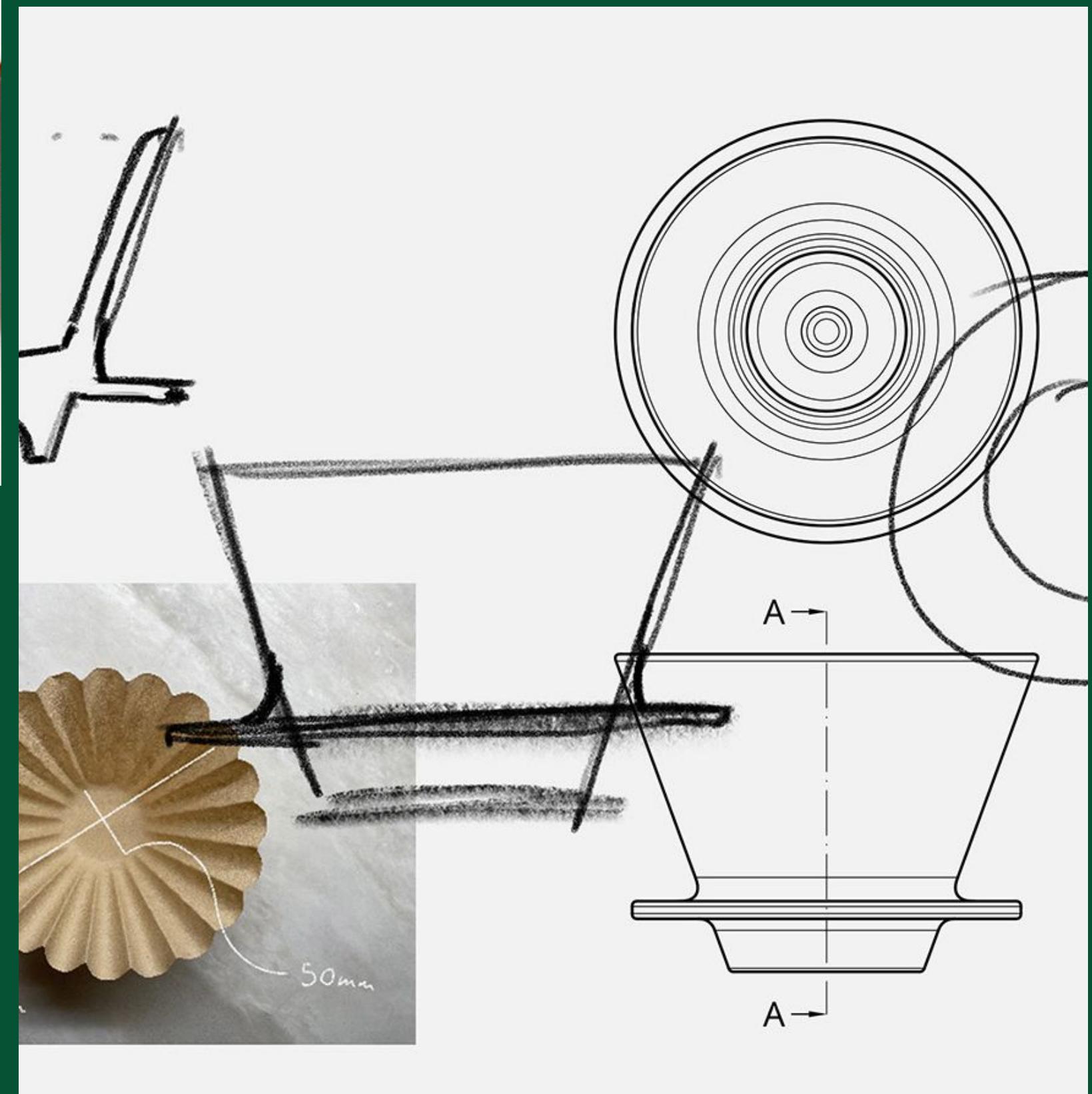
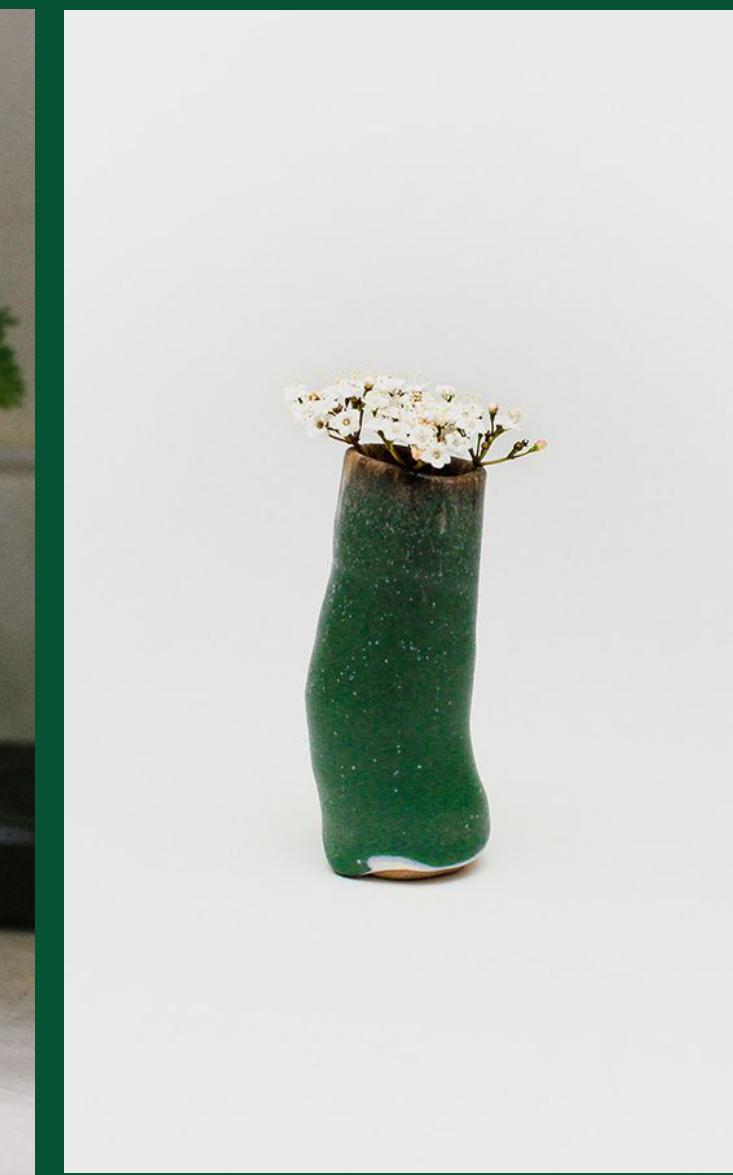


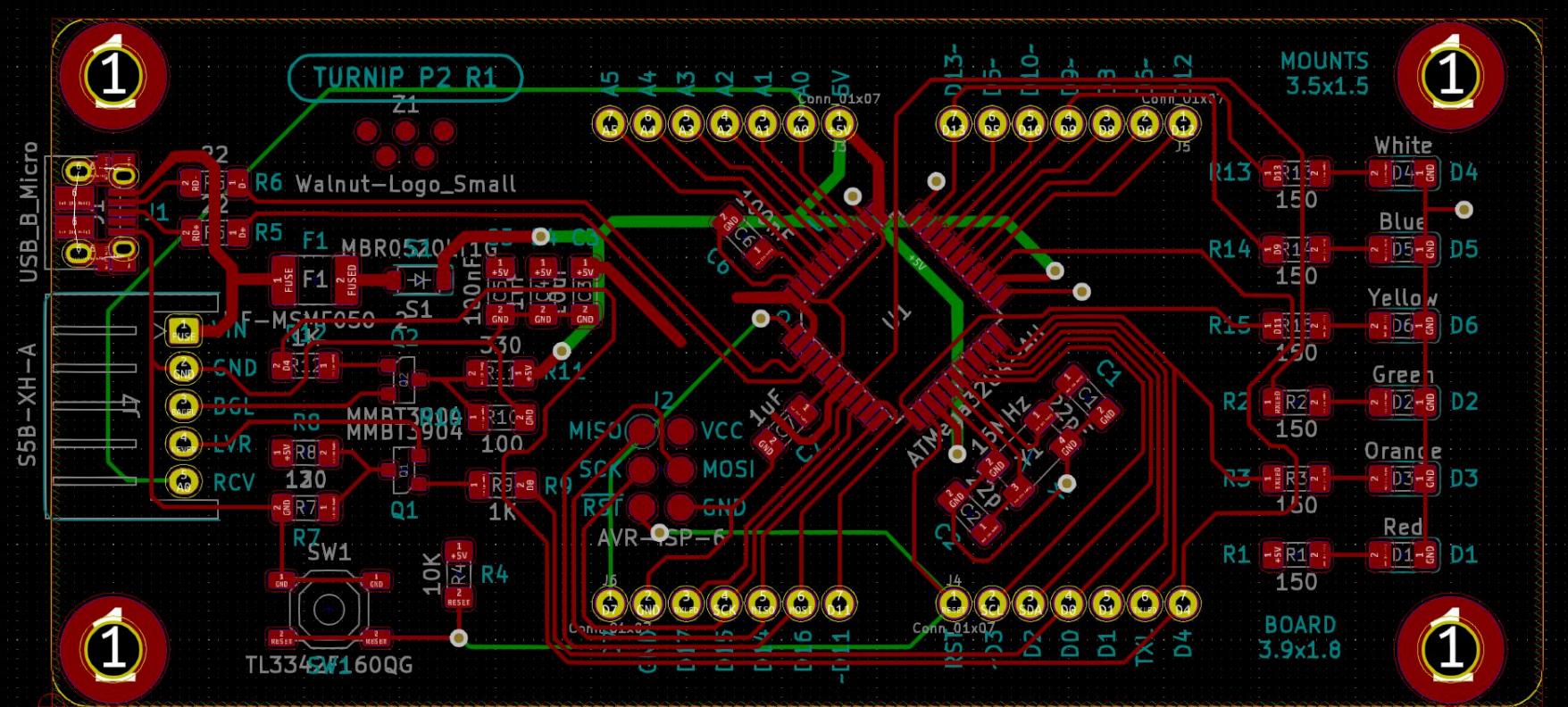
After hours...

you'll find me pointing my camera directly into light sources, blow torching food, or playing with and writing about new kitchen tools.

About

And more recently now
also starting to play
around with ceramics.





Case Study

Daydream Controller

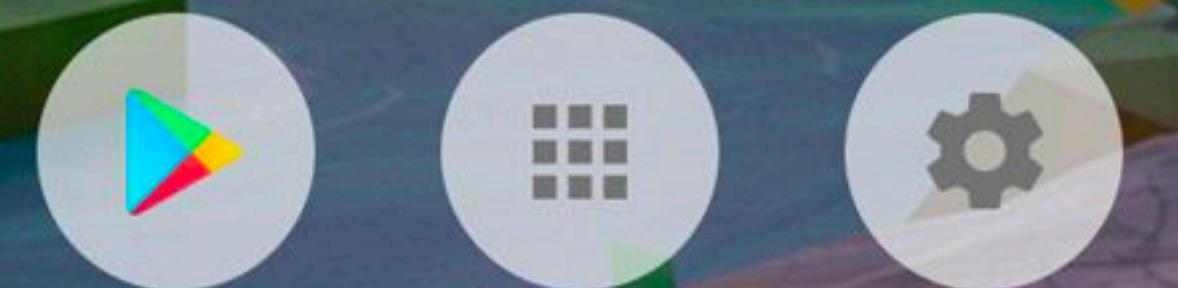
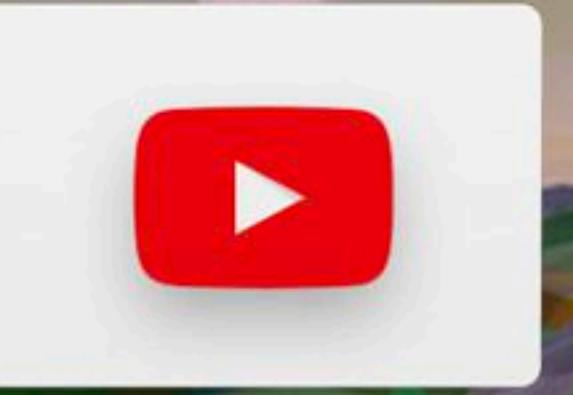
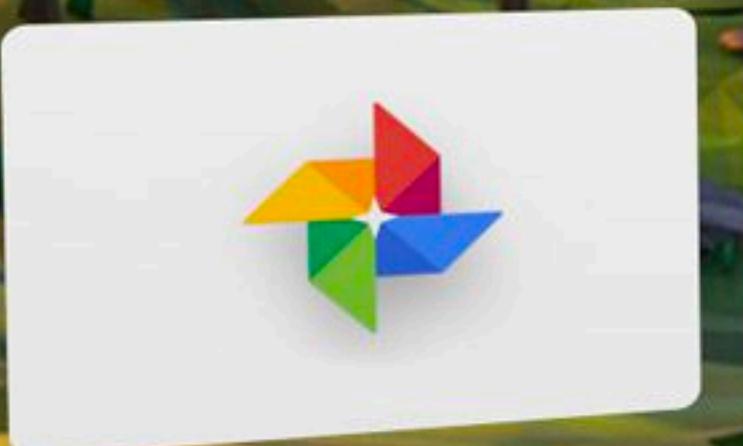
Google - 2016 + 2017



Daydream



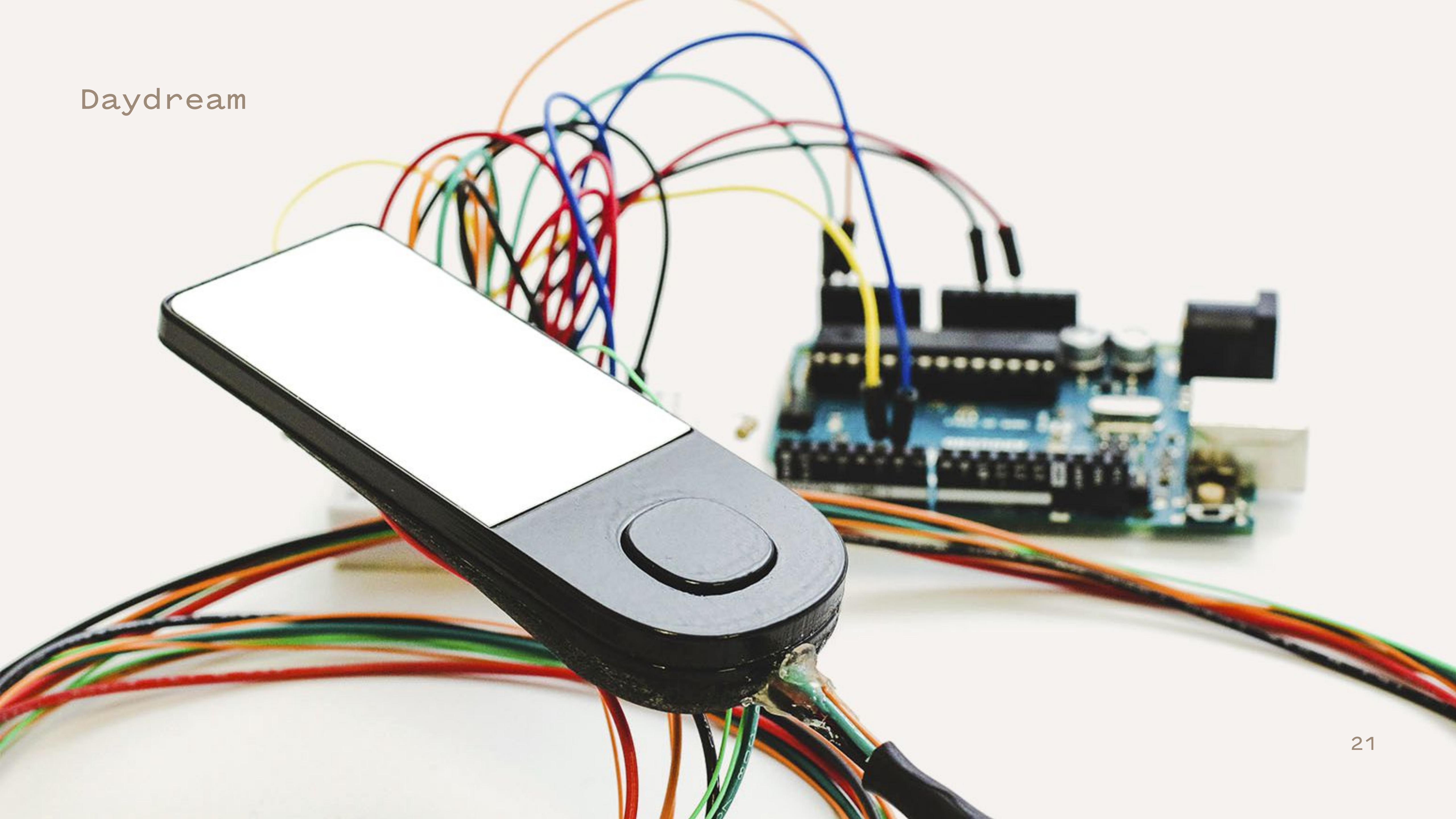
Daydream



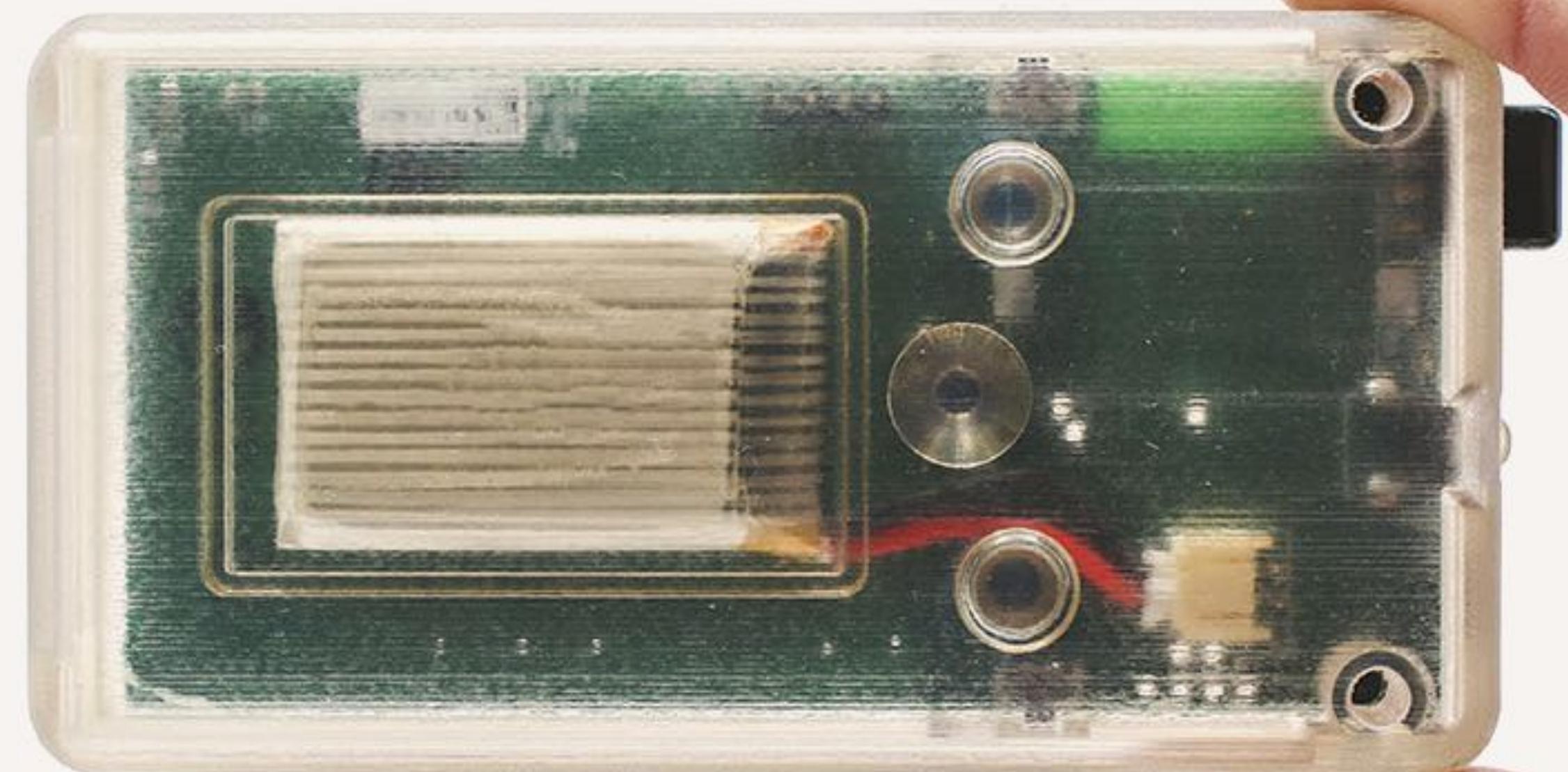
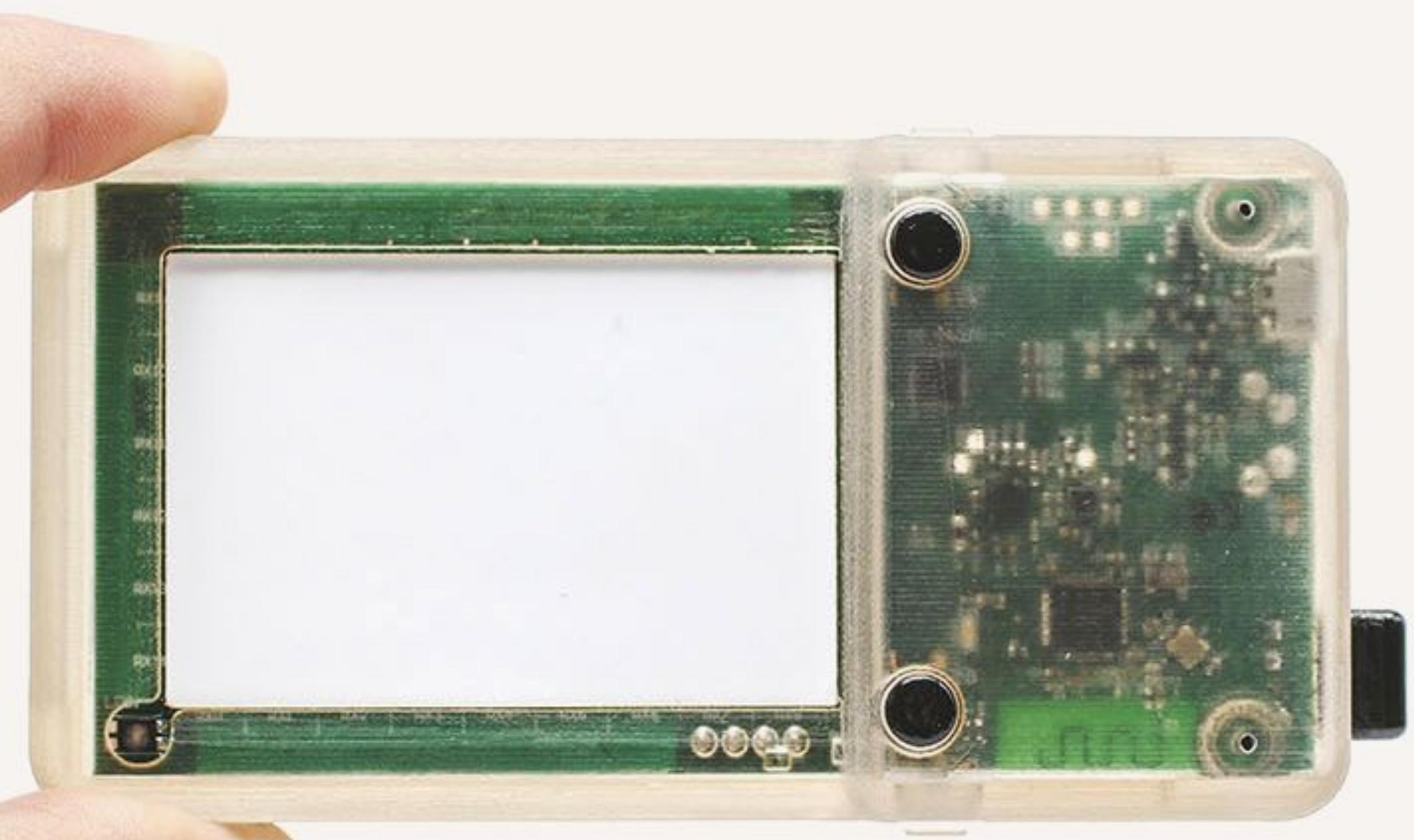
Daydream



Daydream

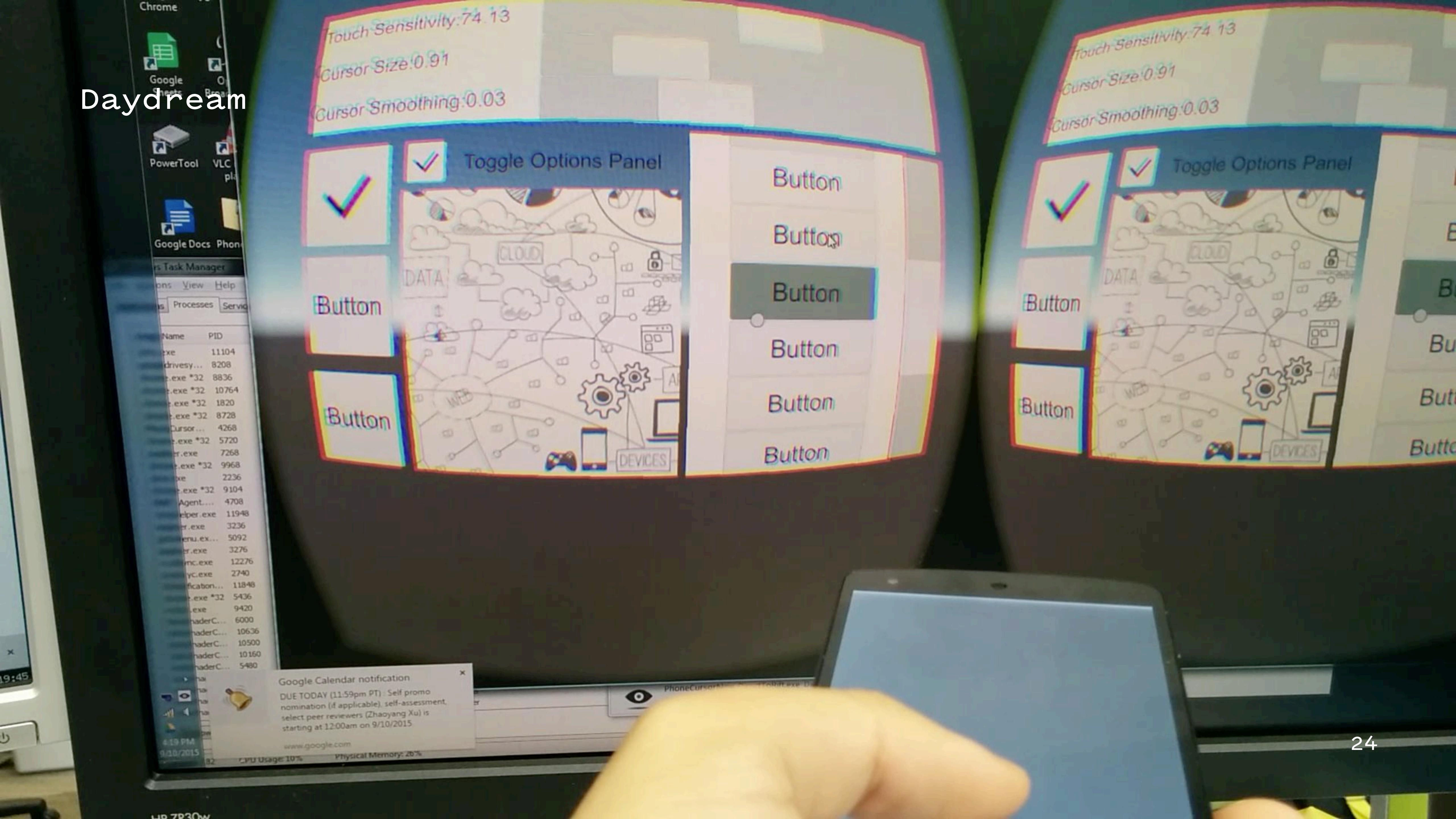


Daydream



Daydream

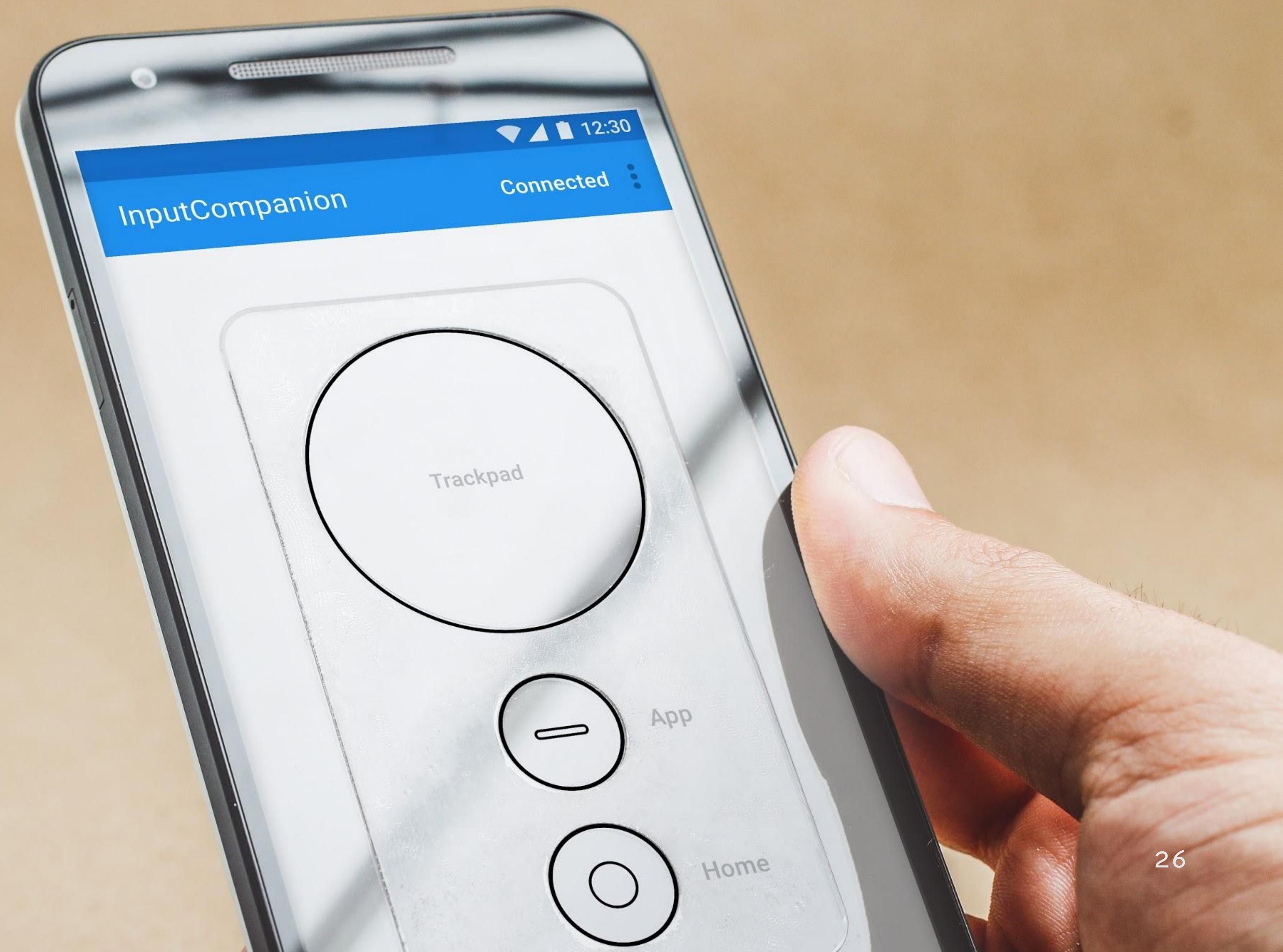




Daydream



Daydream



Daydream



Daydream



Daydream

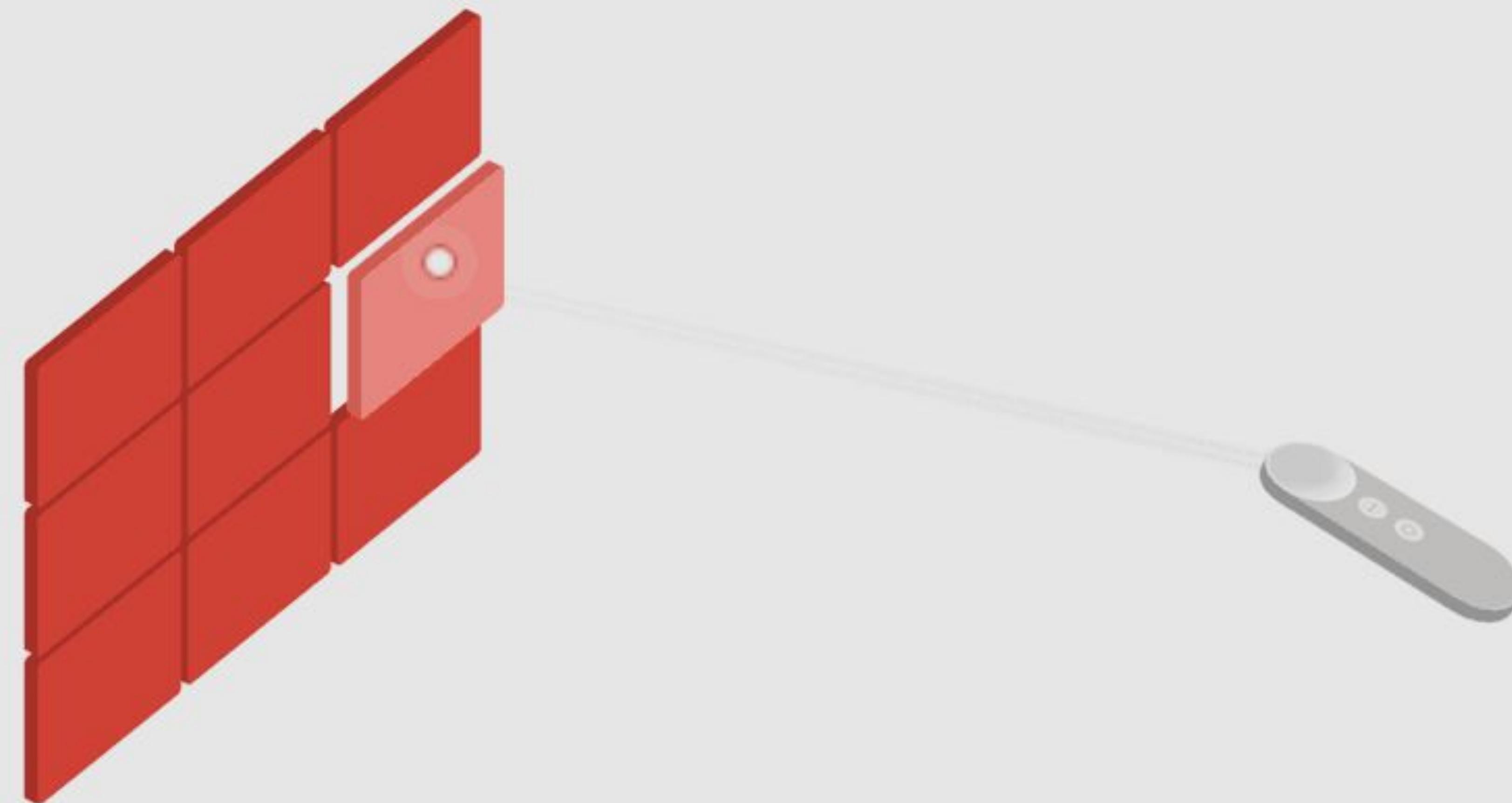


Daydream

Daydream



Daydream



Daydream



Daydream

My external talks that give even more depth:



Physical Design →



Interaction Design →

Case Study

Google Pixel Buds

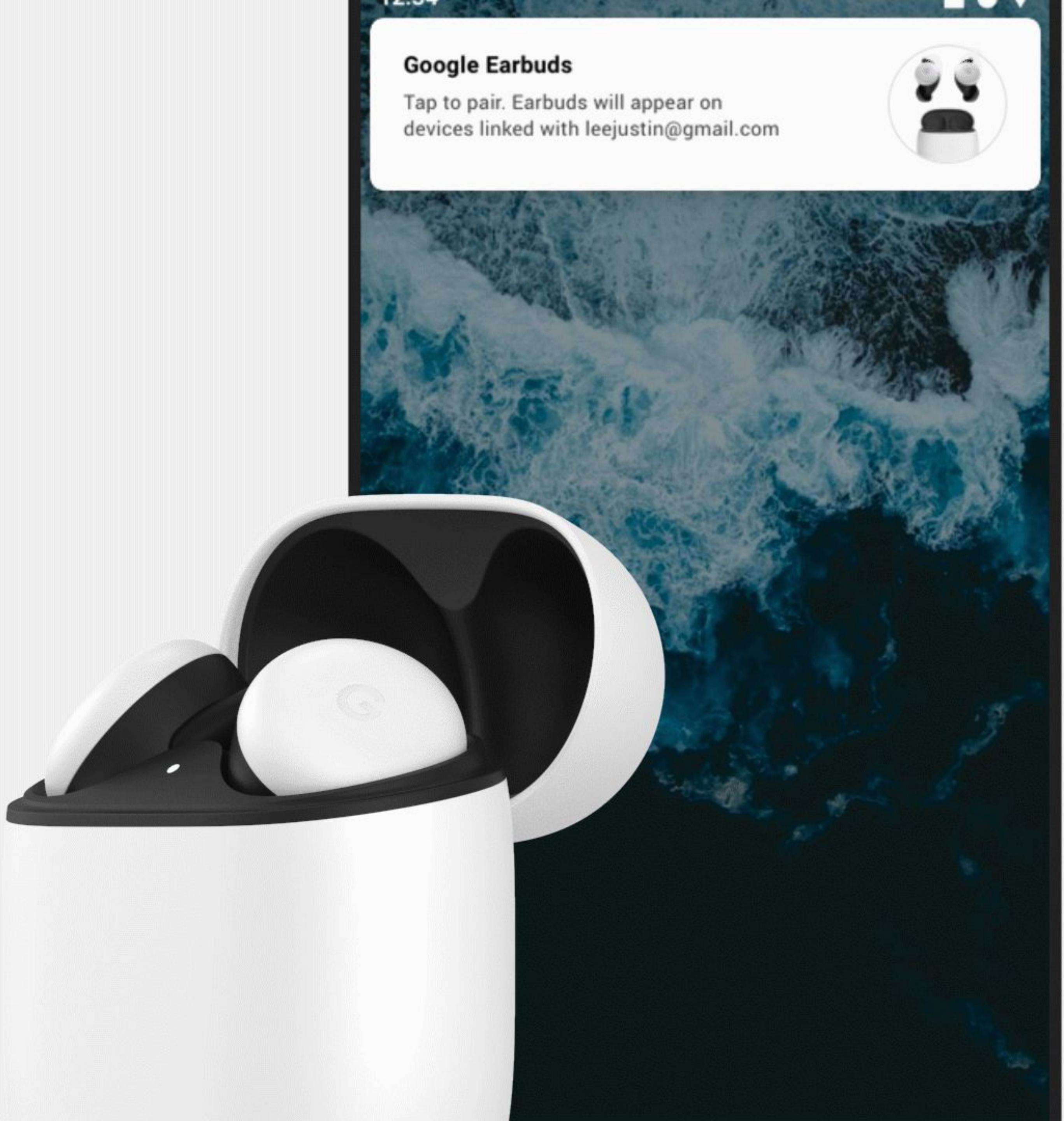
Google - In Progress



Pixel Buds



Pixel Buds



Pixel Buds



Pixel Buds

Pixel Buds

Pixel Buds

2017

Sandeep

pm lead



Basheer

design lead



whiteboard



research



concept



prototype



pitch

Pixel Buds

2020

Basheer

design lead



Alex

interaction designer



Erik

visual designer



Frank

ux engineer



Nealeigh

ux writer



Alex

interaction designer



Justin

interaction designer



Shilp

associate ux



Chrisoula

interaction designer

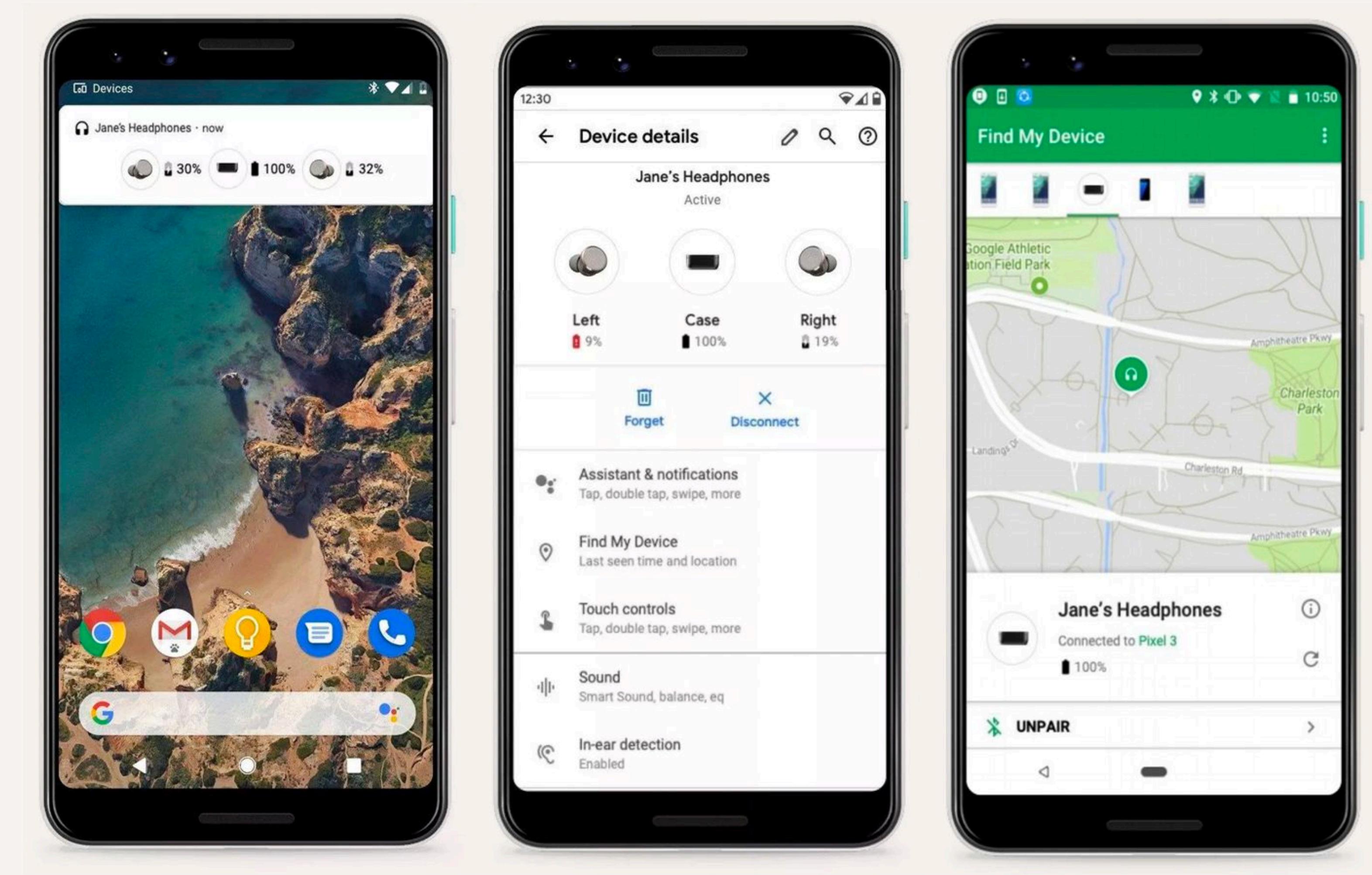


Pixel Buds

hardware	
buttons	sound design
lights	battery & charging
input & gestures	kpi's
connectivity & power	quick start guide
volume control	packaging

software	
companion app	android integration
onboarding	android bluetooth
find my device	fast pair
notifications	assistant integration
help center	app integrations

Pixel Buds

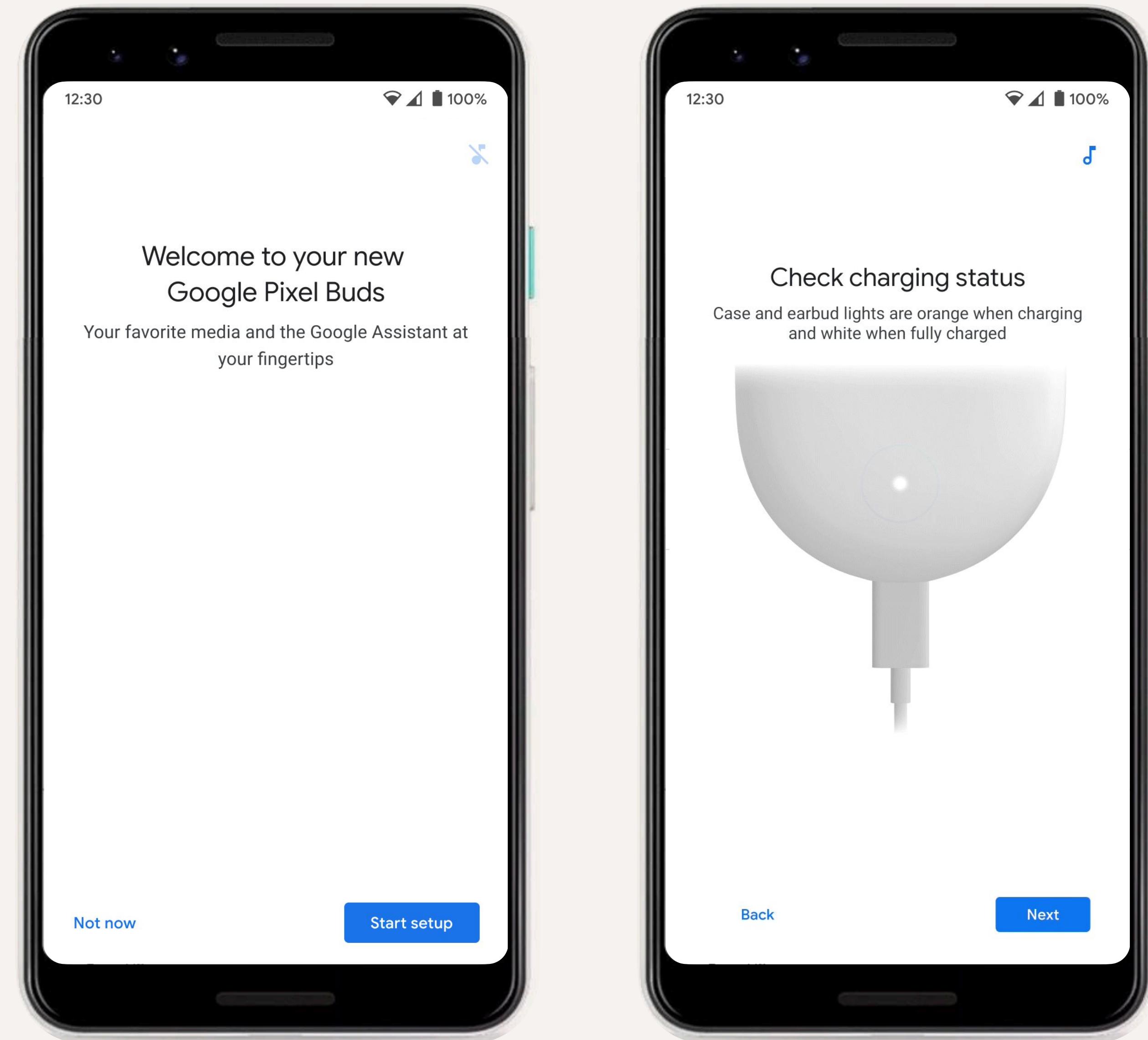


fast pair 2.0

newly expanded
bluetooth settings

find my device

Pixel Buds



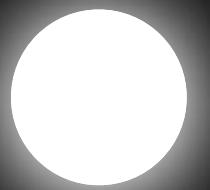
3d onboarding

fully interactive

Pixel Buds

Lights

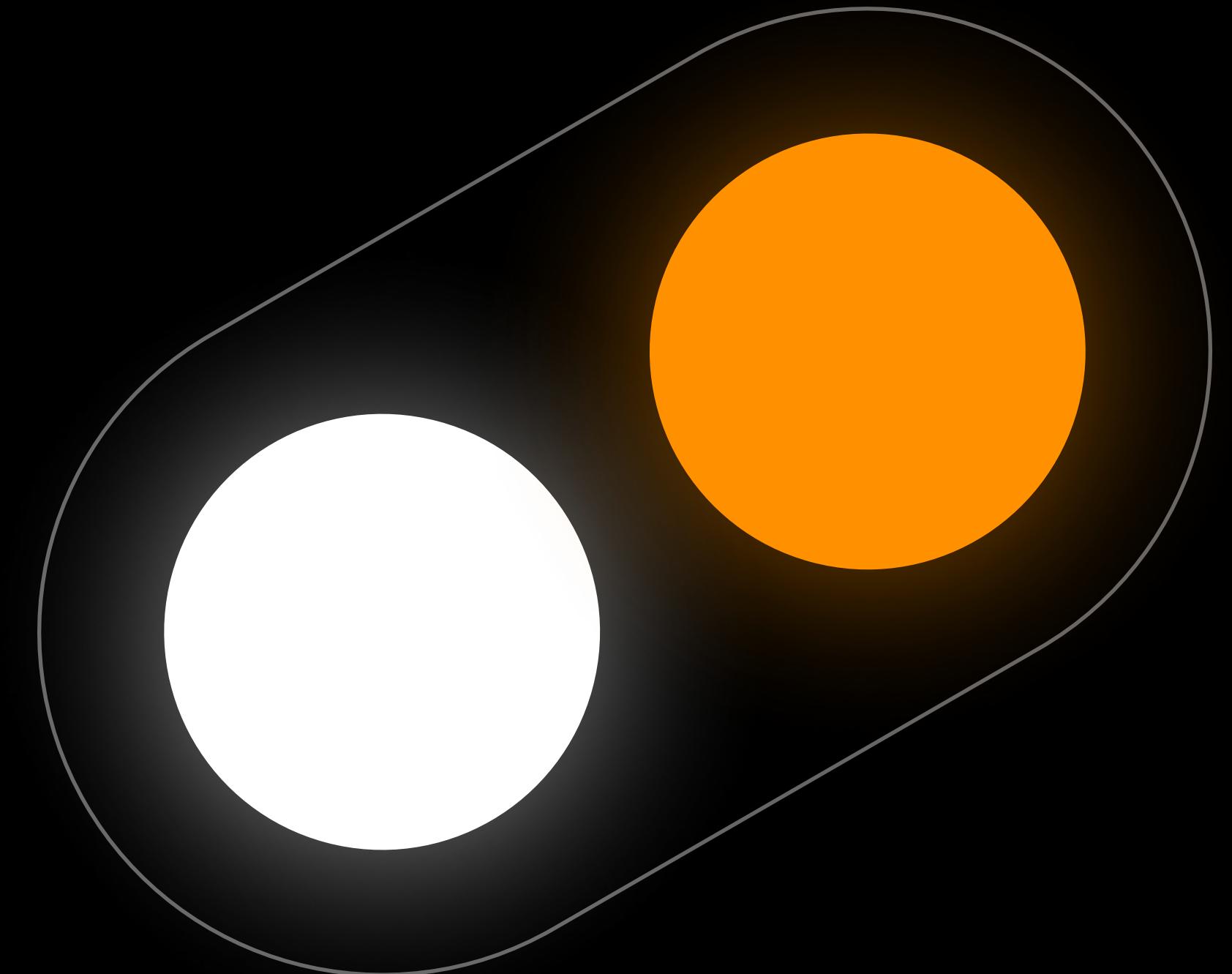
Pixel Buds



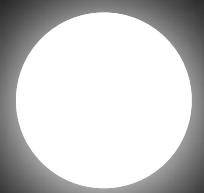
Light Anatomy

A single light pipe / opening, each containing
2 discrete diodes (separate or single package): 1 white + 1 amber

colors	After shining through CMF: <ul style="list-style-type: none">white, 4000K - 5000K, or #FFFFFFamber, 590nm ± 10, or #FF9100
contrast	should be somewhat visible in off state
driver	able to smoothly fade the LEDs on a sine curve without noticeable steps or drop-off
concurrency	no ux requirement to be able to run or mix both LEDs at the same time
integration	able to run LEDs with full capabilities in all major power states of the device, excluding ship mode
brightness	~10mcd through a combination of initial specs & current-limitation in the driver without clamping PWM range
viewing angle	able to tell on vs. off within 160°



Pixel Buds



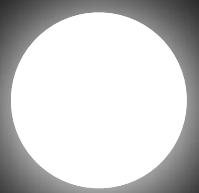
Front Light

All plugged states take precedence over the unplugged states. Ship mode negates all LED states.

light state	unplugged	charging
white	battery: > ~1 full charge left, 30s timeout	battery full
amber		charging
blinking amber	critically low battery: < ~1 full charge left, 30s timeout	
off	not enough power to charge anymore	

Pixel Buds

Top Light



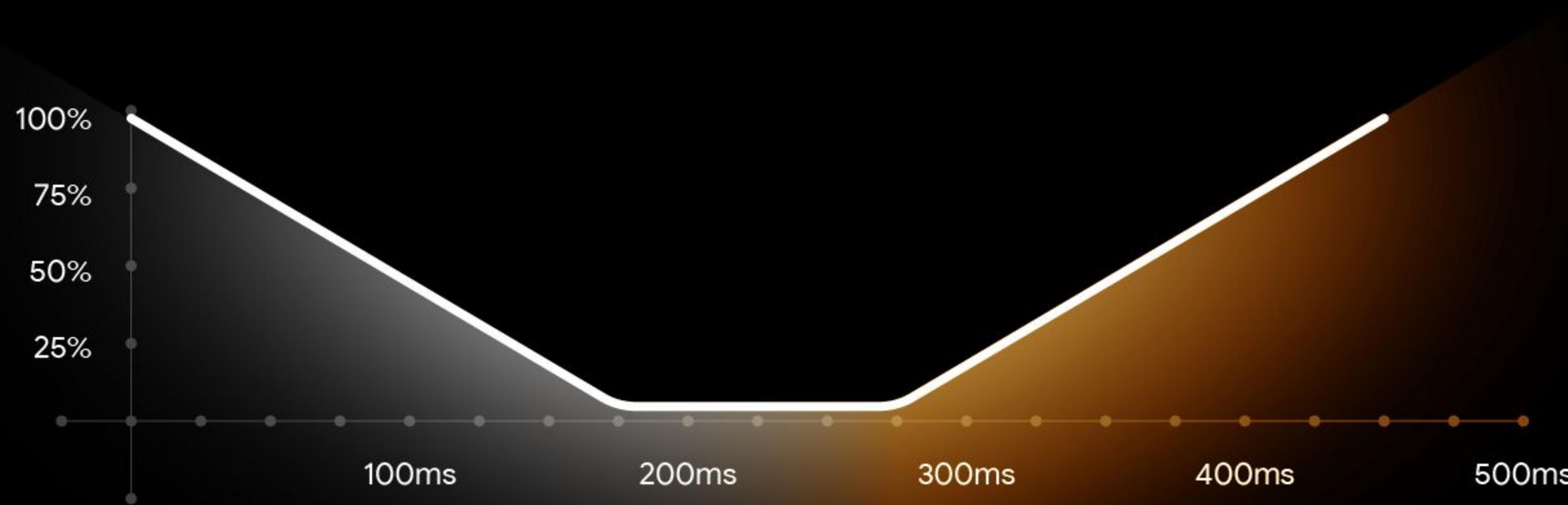
This light is both only on and only seen while the device is open, with an x timeout largely unnoticed by users.

light state	docked	undocked	timeout
white	batteries are full		30s
bounce white	in pairing mode		As long as in pairing mode
amber	charging		30s
white ↪ amber	factory reset in progress		As long as in reset, and on for minimum 2.4s
error blink		missing, can not pair / factory reset	Play once 1.2s, then stay off until button released
off	battery so low it can't charge anymore	not charging	



Light Transition

When the light is switching from showing one system state to another, it should always perform this transition, even if the starting and end light colors are identical

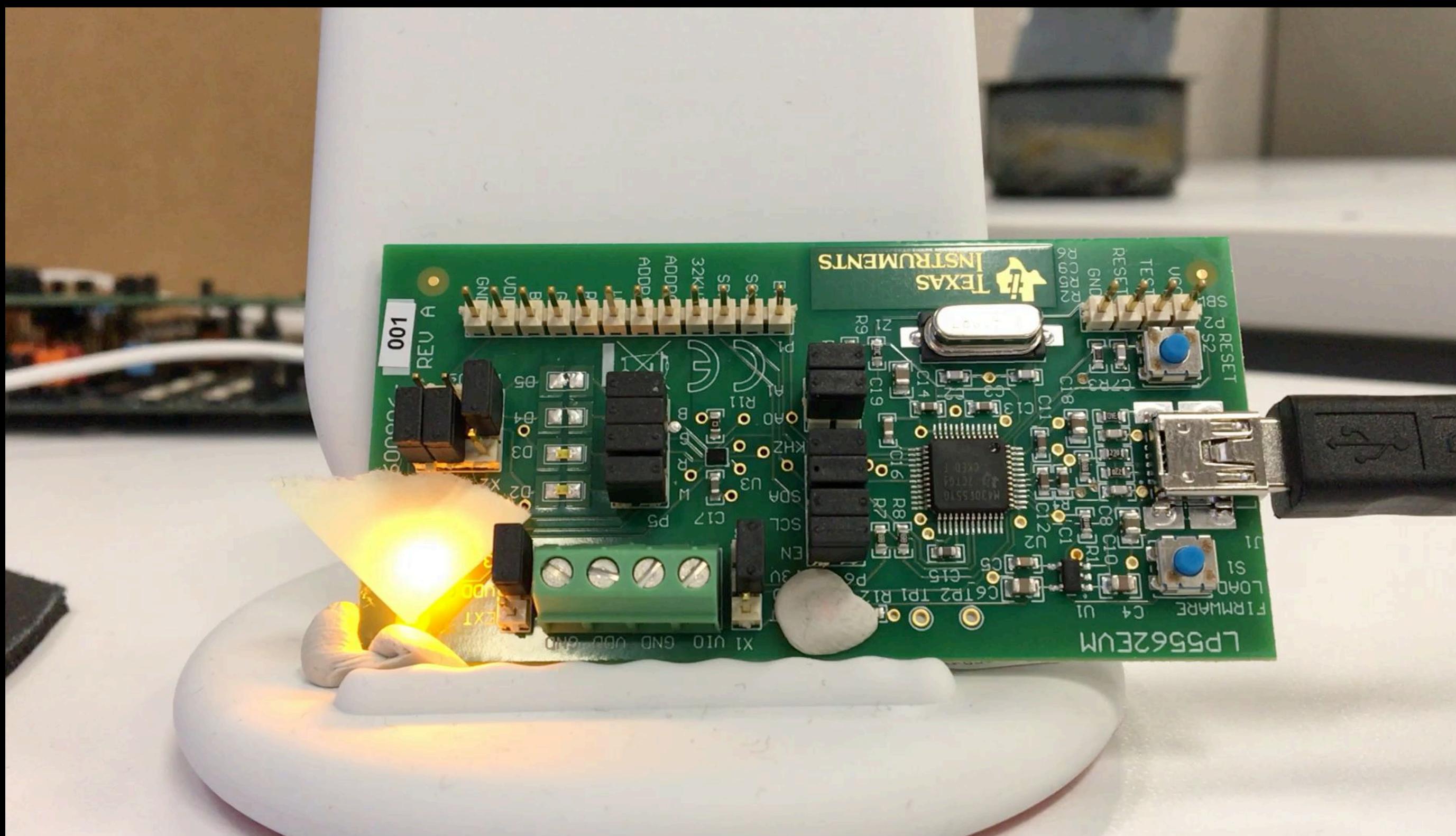


Pixel Buds

Light Transition



When the light is switching from showing one system state to another, it should always perform this transition, even if the starting and end light colors are identical



```
# Spec: Ramp between two states (two engines/colors)
```

```
.ENGINE1
```

```
set_pwm 0  
ramp 87.5, 128  
ramp 87.5, 128  
wait 999  
wait 500  
ramp 87.5, -128  
ramp 87.5, -128  
wait 100  
trigger s2  
trigger w2  
start
```

```
.ENGINE2
```

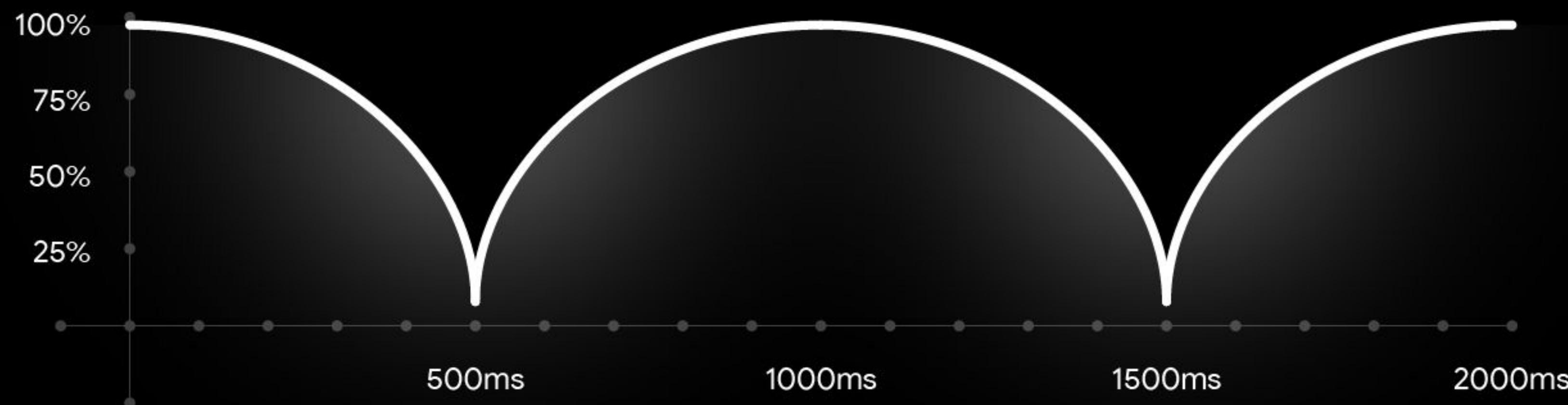
```
trigger w1  
set_pwm 0  
ramp 87.5, 128  
ramp 87.5, 128  
wait 999  
wait 500  
ramp 87.5, -128  
ramp 87.5, -128  
wait 100  
trigger s1  
start
```

Pixel Buds



Bouncing White

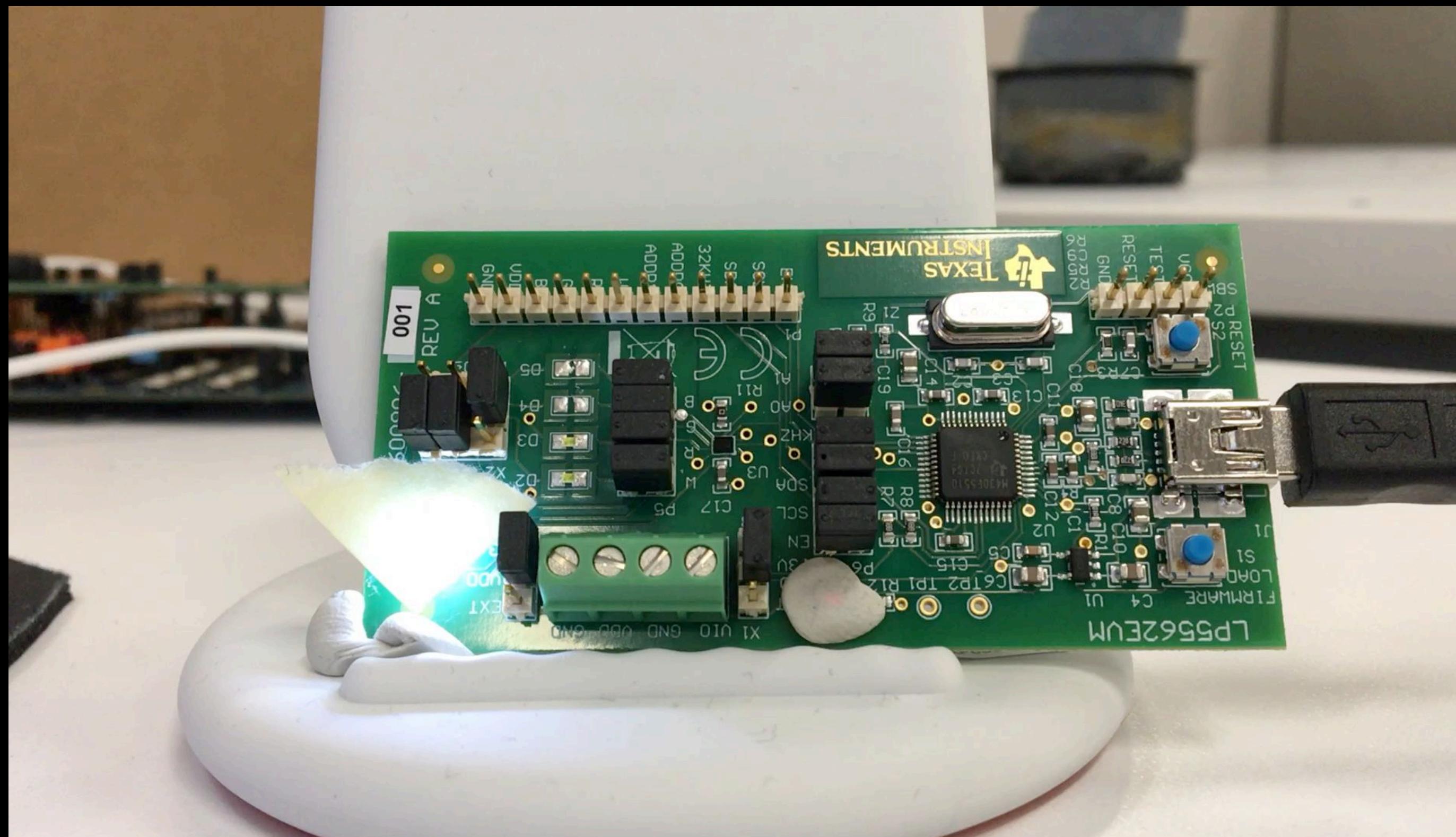
The general curve matches an absolute value sine curve



Pixel Buds

Bouncing White

The general curve matches an absolute value sine curve



```
# Spec: Brightness follows  
linearized absolute value  
sine wave with 1s period
```

```
.ENGINE1  
set_pwm 0  
ramp 155, 124  
ramp 170, 102  
ramp 145, 29  
wait 60  
ramp 145, -29  
ramp 170, -102  
ramp 155, -124  
start
```

Pixel Buds



Pixel Buds

Touchpad

Pixel Buds

- Play Pause / Answer Call
Tap
 - Next Track / End Call / Reject Call
Double tap
 - Previous Track
Triple tap
 - ▶ Google Assistant / Check Notifications
Push to talk (only after OOB)
 - ↔ Raise / Lower volume
Swipe forward / backward

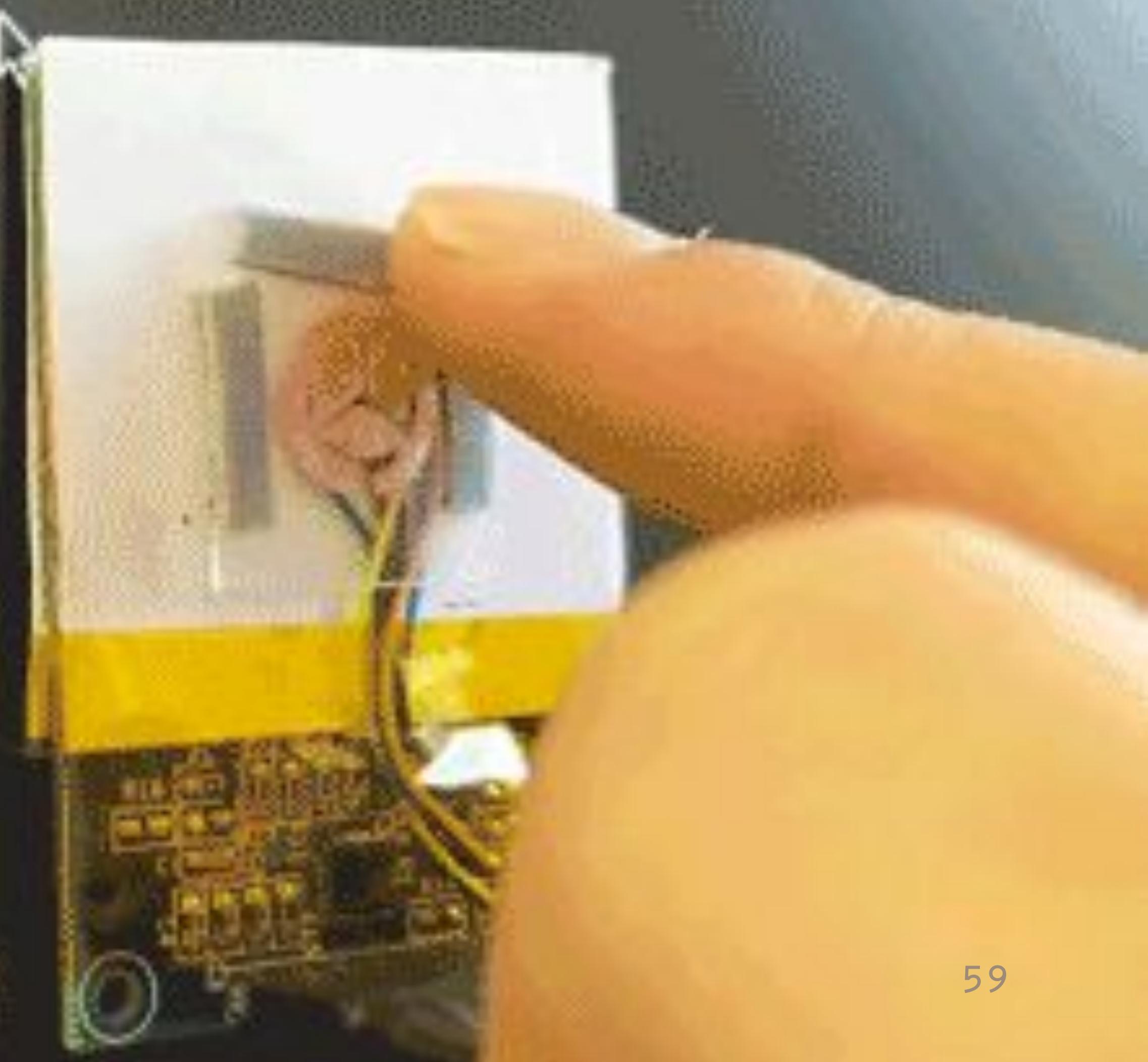
Pixel Buds

gestures	music / idle	phone call / ringing	assistant	translate
	play / pause	pickup	n/a	toggle mute
	next	reject / hangup		dismiss
	previous			
	assistant / fetch	n/a	reply / new query	push to talk
		volume down		
		volume up		

Pixel Buds



Pixel Buds



Pixel Buds

Volume

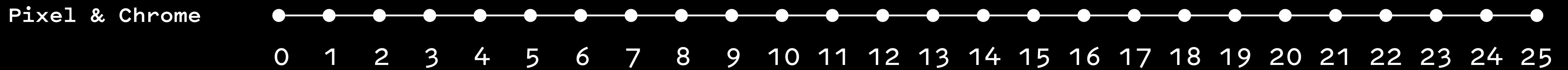
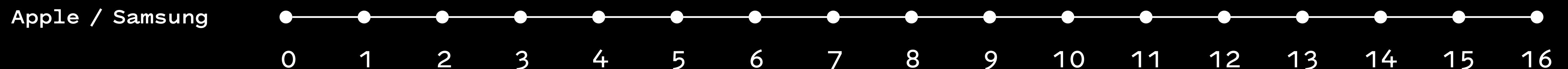
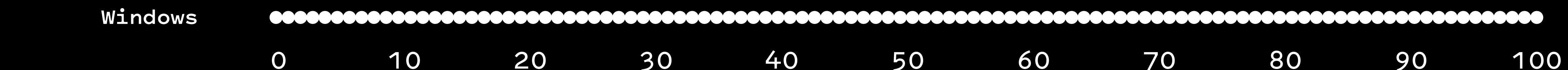
Pixel Buds

Principles

input	Users can adjust the volume via the host device, the Assistant, or the device.
snapping	Steps are snapped to the nearest step of the Device Volume Steps (45+1) , not the <u>input steps</u> nor the host's steps.
initial setting	<ul style="list-style-type: none">Most host devices already manage & remember the starting volume level. For Android, this was implemented in Pie.Until overridden by the host, preserve the last used (current) volume level.When that value is unknown the default should be set to ~50%.
steps	We've chosen 15 audible steps + a special 0-media-volume state via input . In principle, each step up/down in volume should not feel too abrupt (human ear perception threshold is about 3dba on average). Users should feel in control of their volume - not too big or small of a jump. This should strike a balance between users not having to input too often to increase/decrease volume and feeling in control of their volume.
minimum	UI sounds and phone calls should never be able to be set to zero volume. However, media playback should.

Pixel Buds

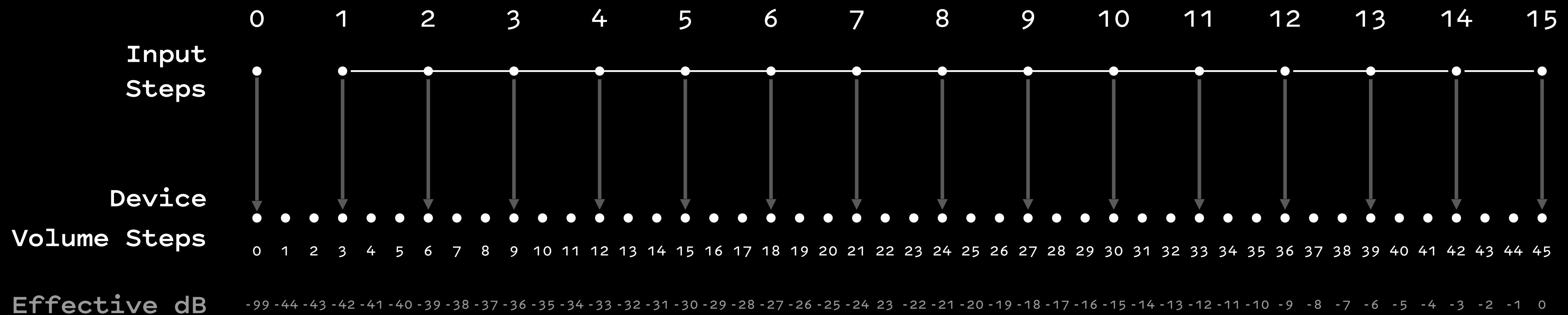
Volume Steps across Host Products



Pixel Buds

Device Volume Steps

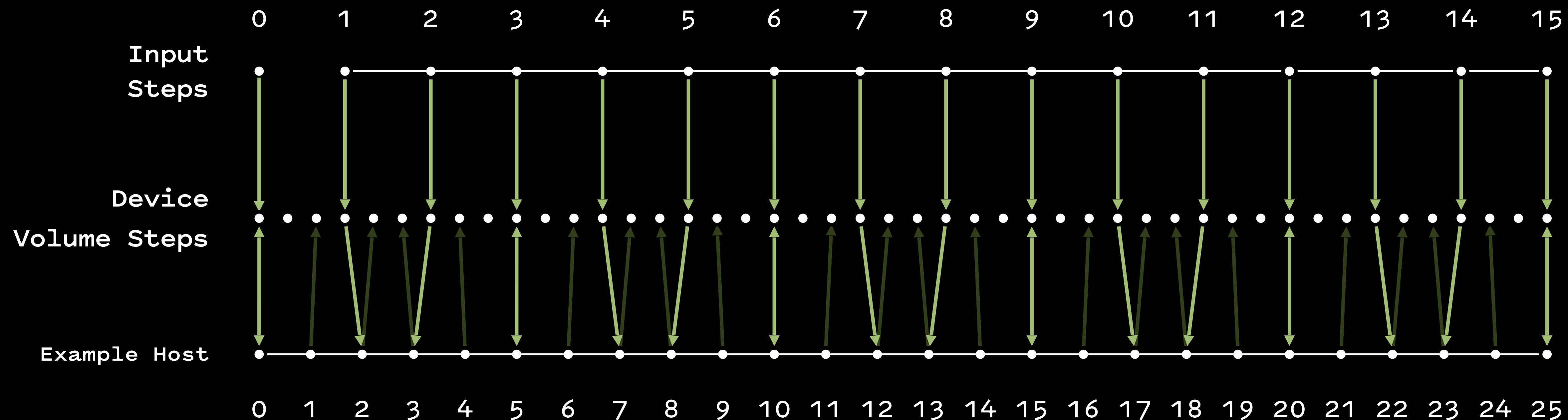
We will use our own 15+1 step scale for input, but report a more granular scale (45+1) as an individual possible step.
Essentially, the input “skips” multiple device volume steps rather than having # of volume steps be equal to # of inputs.



Pixel Buds

Example Mapping: Correct

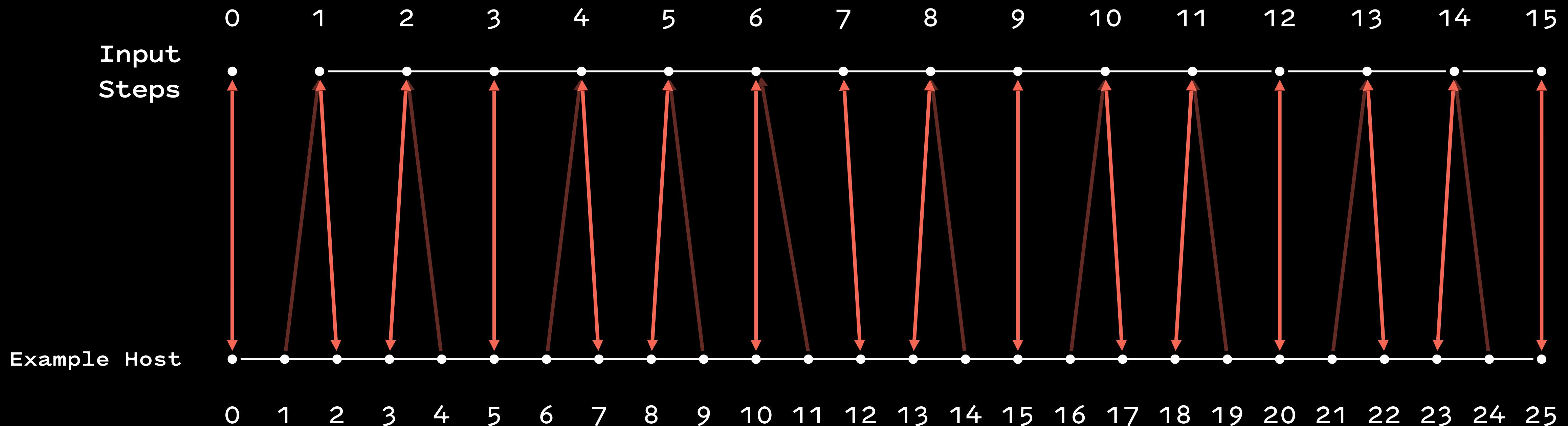
Input on the device snaps to the nearest device volume step. Changing the volume on the host snaps to the nearest device volume step as well. This means that a host (like the Pixel phone) with volume steps more granular than our input will be able to set a volume in-between that of the input.



Pixel Buds

Example Mapping: Incorrect

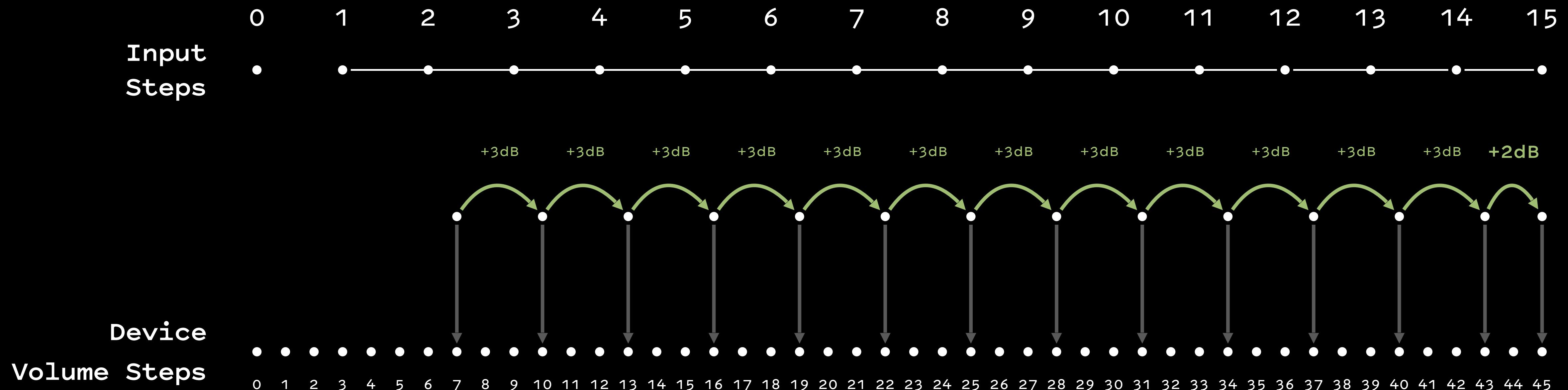
An incorrect interpretation of this would limit the granularity of the host's volume steps to the very coarse setting we've picked for our input. Performing many repeated inputs on the device is tiresome, more than a touchscreen, which is why we've limited it that way.



Pixel Buds

Relative Volume Change Behavior

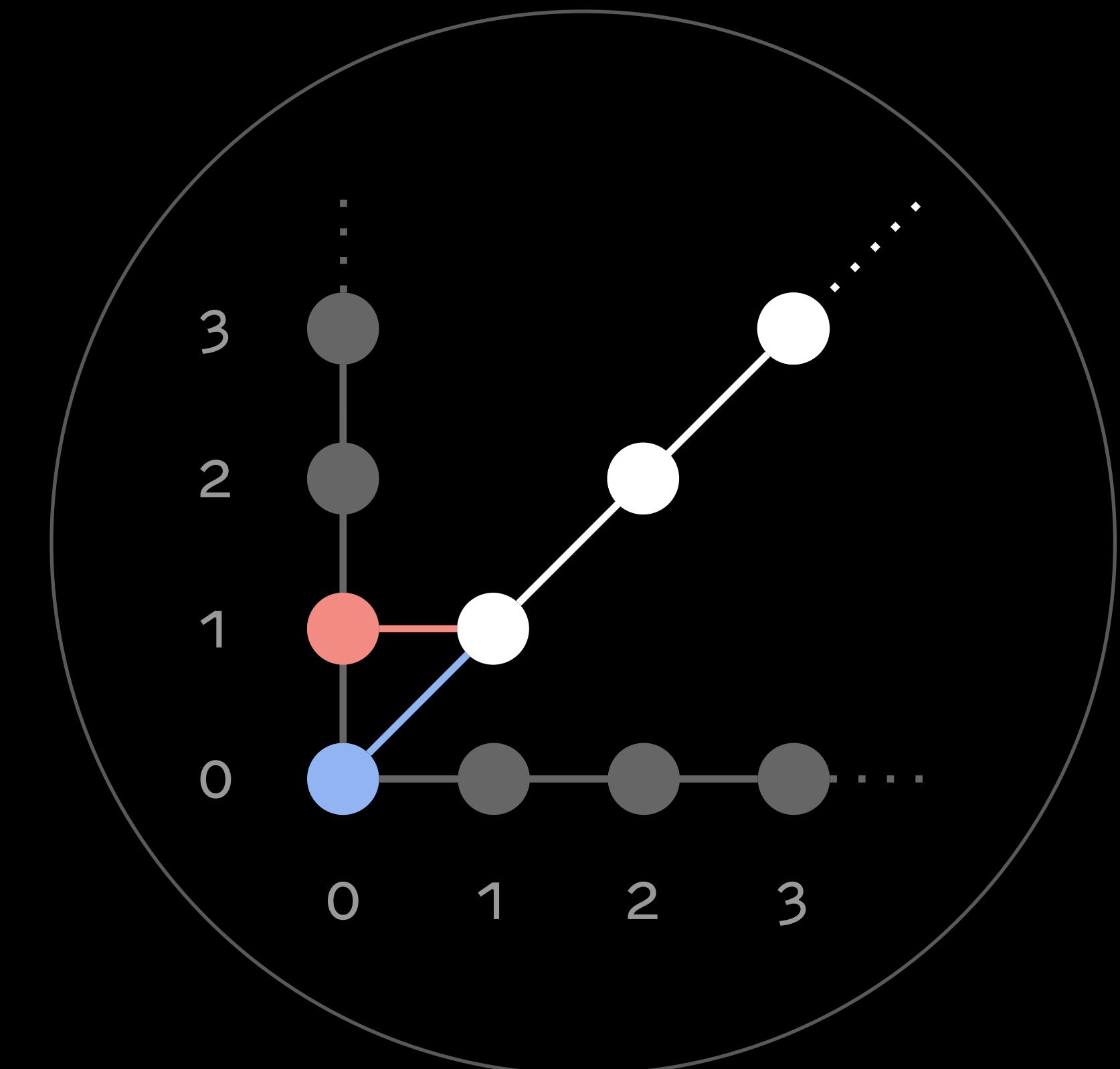
When the user changes the volume, the device should always jump +3 to the nearest device volumes step, not the nearest input step. If the host device was used to set a volume level in-between the input steps, that same in-between offset would be maintained unless they hit the min or max volume.



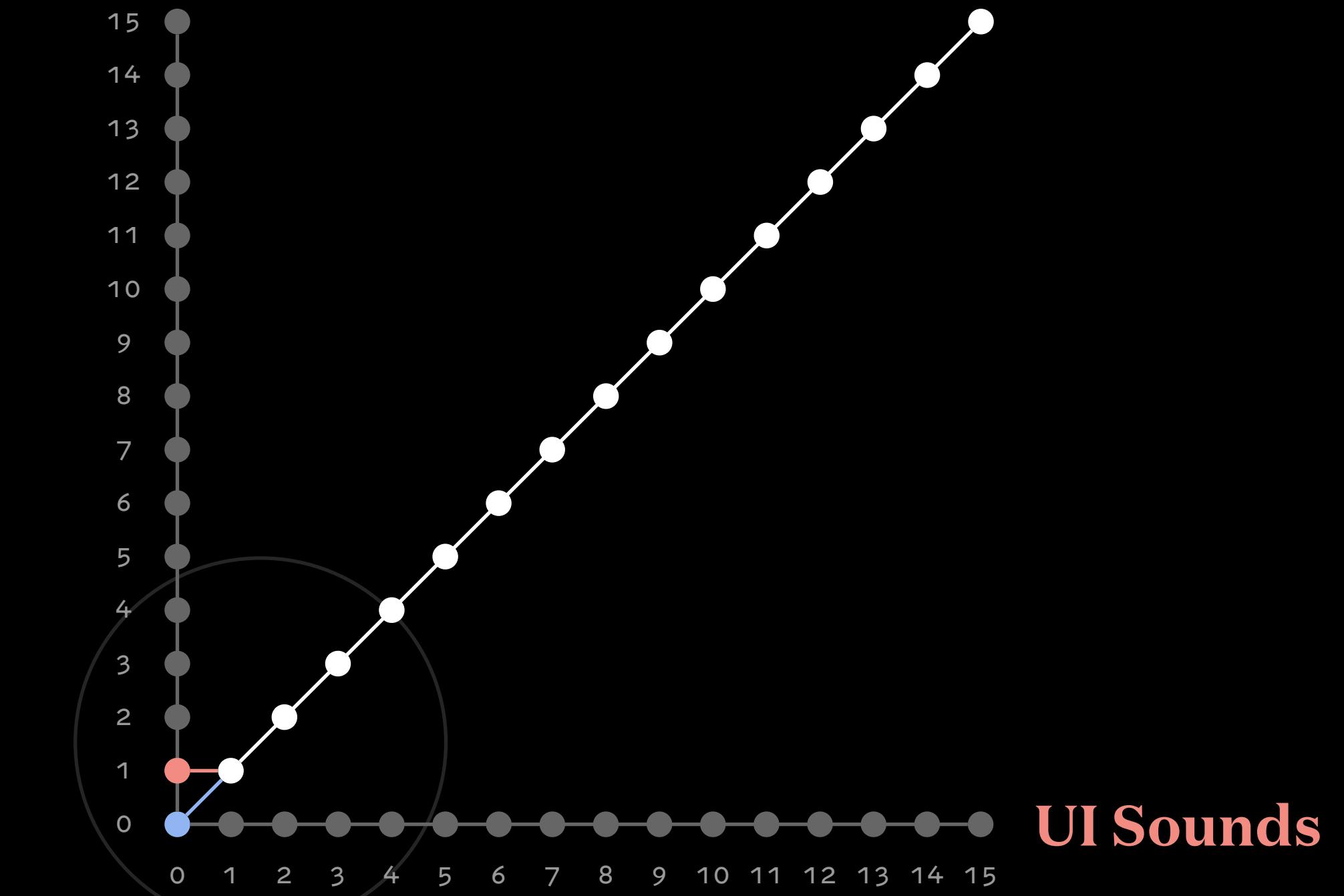
Pixel Buds

UI Sound Volume: Media

The volume of the **ui sounds** during media playback (A2DP) and how they map to the volume of media. Generally, the relationship is 1:1 until volume zero where media is allowed to reach zero but ui sounds are not.



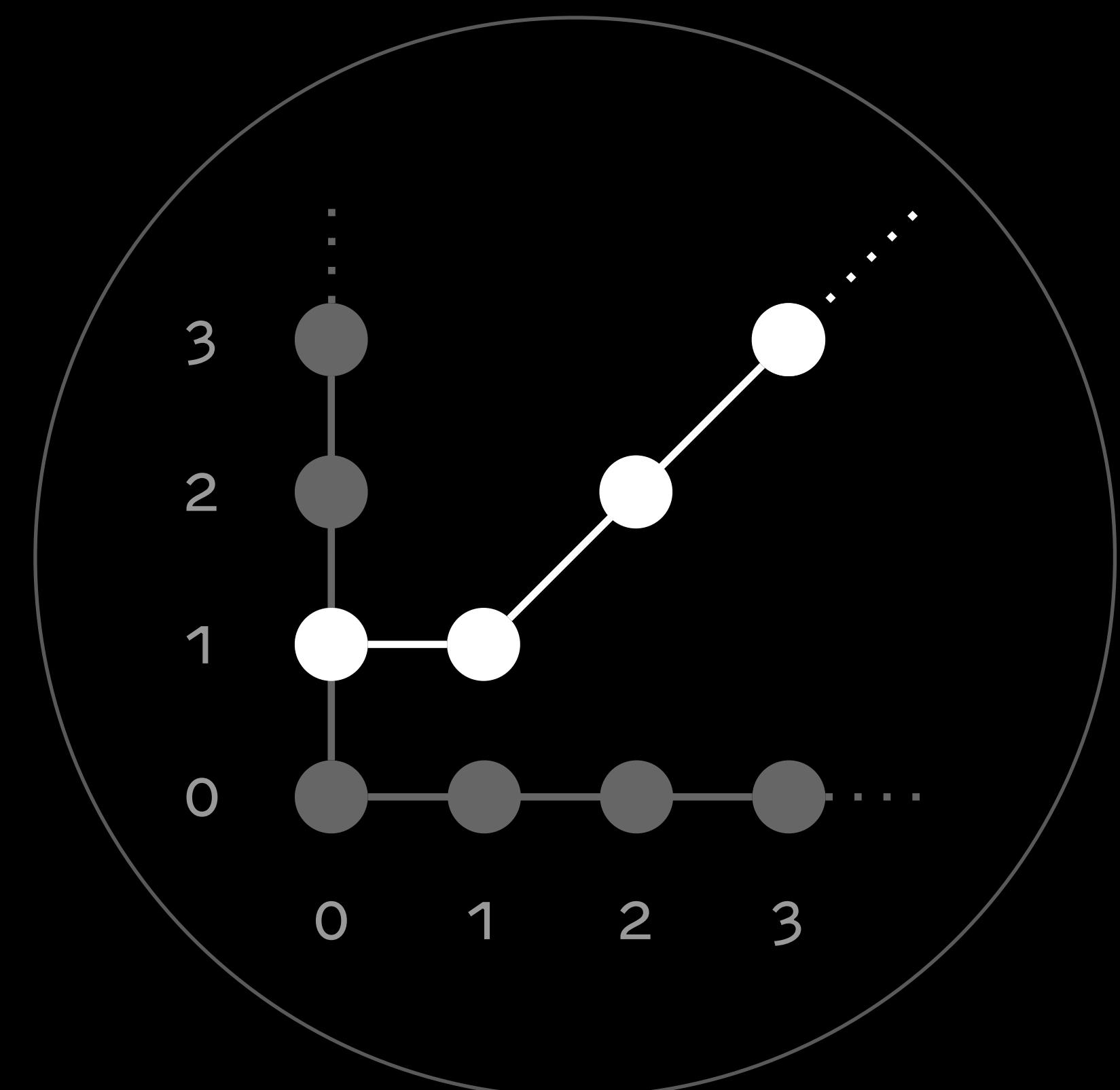
Media



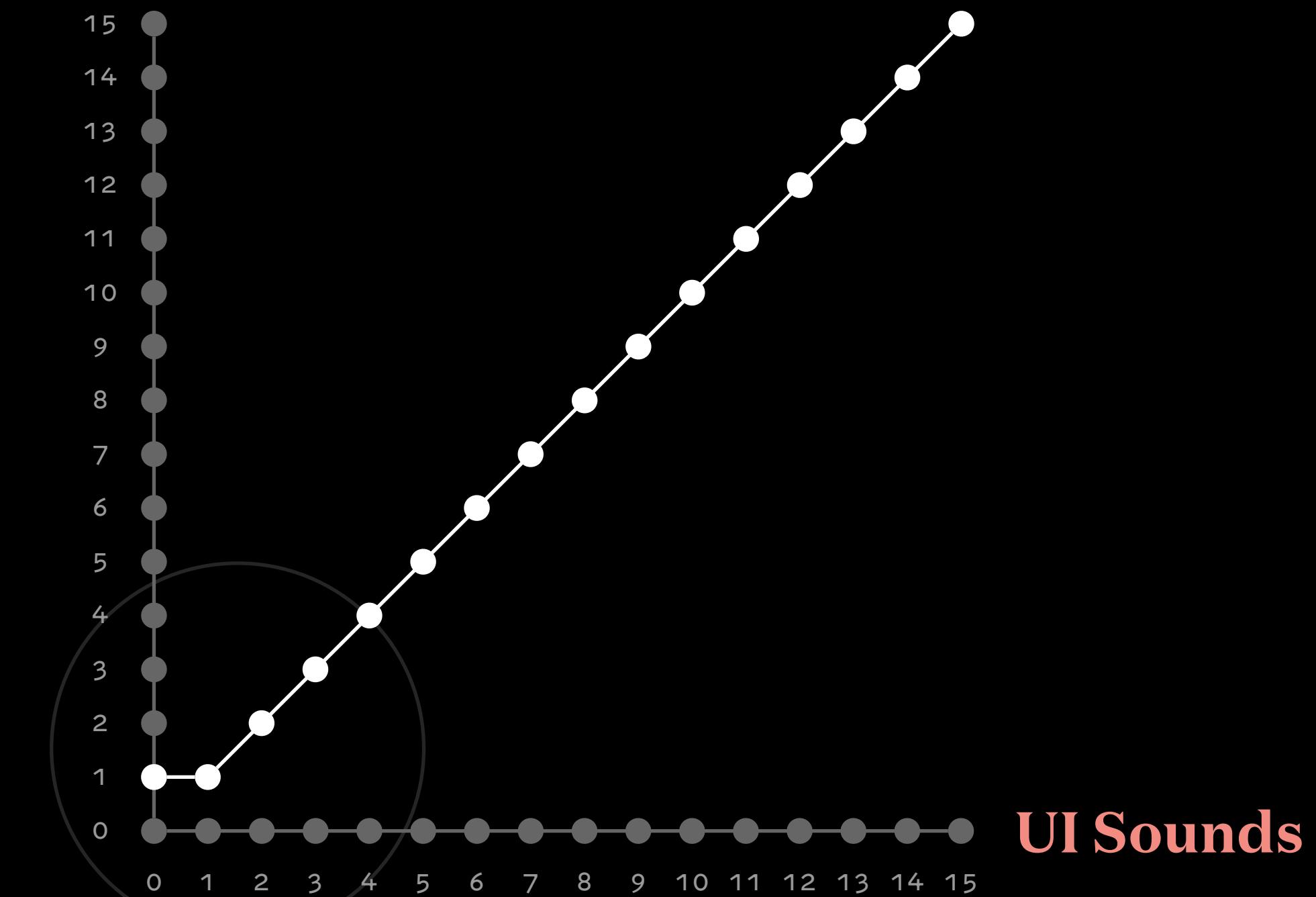
Pixel Buds

UI Sound Volume: Calls

The volume of the **ui sounds** during phone calls (HFP) and how they map to the volume of calls. Generally, the relationship is 1:1 until volume zero, where **both** are unable to reach actual zero volume.



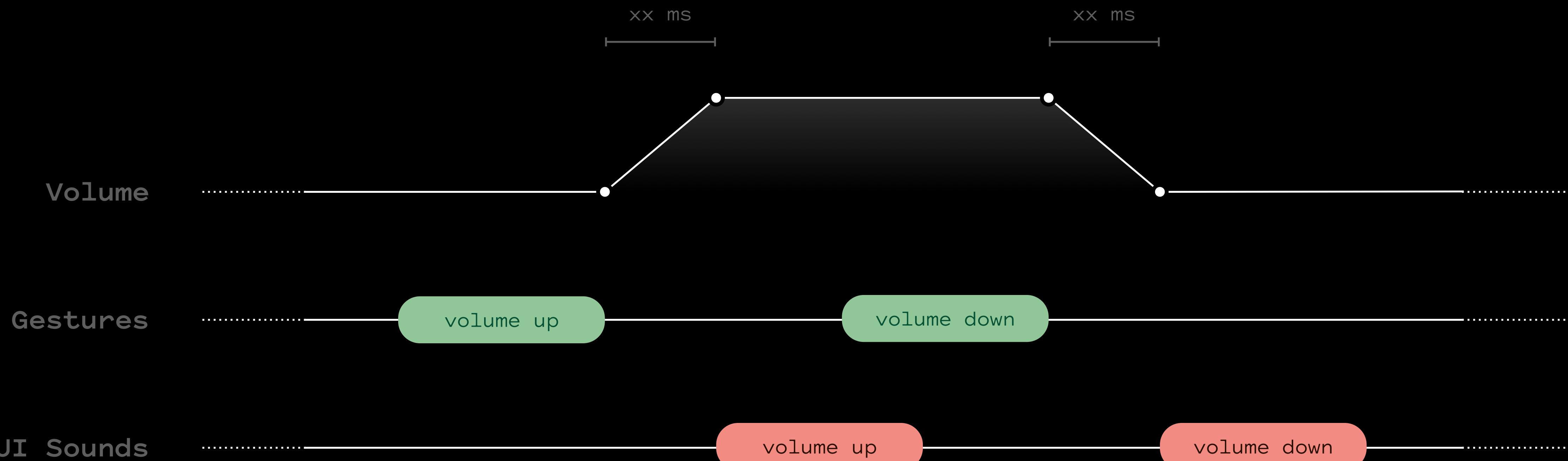
Calls



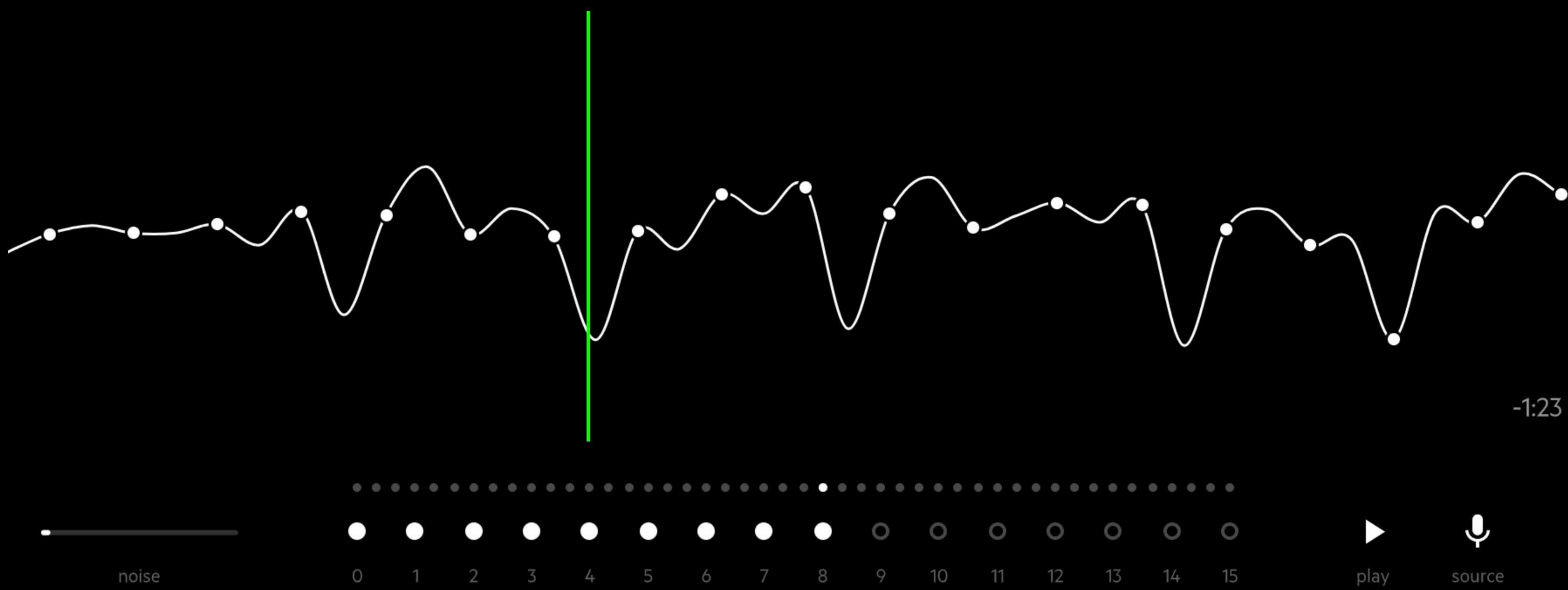
Pixel Buds

Volume Change Transition

To prevent glitching & popping of the audio, there should be a small linear ramp transition between each volume change. The ui sounds should then always subsequently played once the ramp is complete. The ramp time (xx ms) is likely defined by the audio driver.



Pixel Buds



The End

Thanks!

basheer@basheer.co

basheer.co/portfolio

