KTT Midsemester Design Review

Spring 2024

The Team

Matt Ghera

Design Lead
Senior CompE 2024

Andrew Hall

Project Partner Liaison
Senior CompE 2024

Chris Miotto

Financial Officer
Junior CompE 2025

Bree Kalina

(DKC) Project Manager
Junior EE 2025

Speaker: Matt

What is a Tempo Trainer?

Emits tone to beat of tempo

Small – fits under swim cap

Swimmer sets tempo for pace

Swimmer strokes to each tone beep

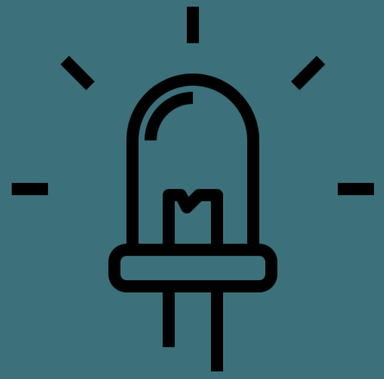
Speaker: Matt

What is KTT?

Keep the Tempo!

A more accessible solution for deaf and hard of hearing swimmers

Our Solution – A two piece system



Tempo Trainer

Emits a pulse of light to signify tempo

Remote

Wirelessly transmits tempo to tempo trainer

Project Specification

Speaker: Andrew

Waterproof

- Withstand being submerged for 2 days
- Handle 12+ feet of water pressure
- Safe for the user and others in the pool

Physical Requirements

- Fit comfortably on the swimmers' head
- Compact design
- Use multiple devices in close proximity without interference
- Charge lasts for 4+ hours

Ease of Use

- Easily maintainable without knowledge of inner workings
- Interface to display tempo
- Easily recognizable pace indicator

Speaker: Matt

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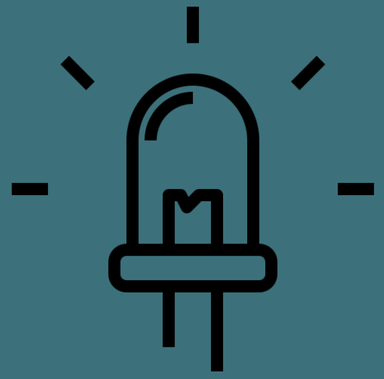

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Speaker:
Andrew

Project Partners and Users

Project Partners

Mark Cronk – USA Deaf Swimming
Rene Massengale – USA Deaf Swimming
Shireen Hafeez – Deaf Kids CODE
Brian Bennet – Gallaudet Swimming
Larry Curran – Gallaudet Swimming

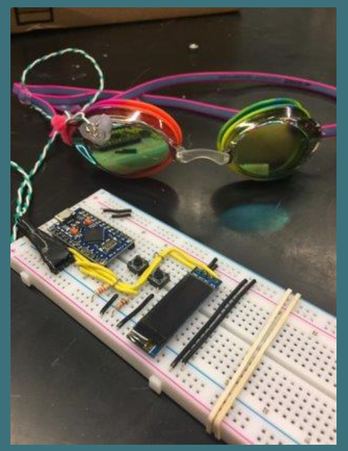
Users

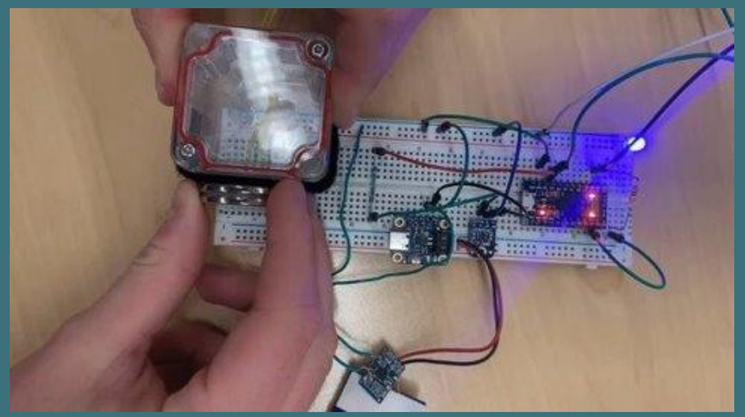
Deaf/Hard of Hearing Swimmers
(including cochlear implant users and non-cochlear implant users)
Gallaudet Swim Team

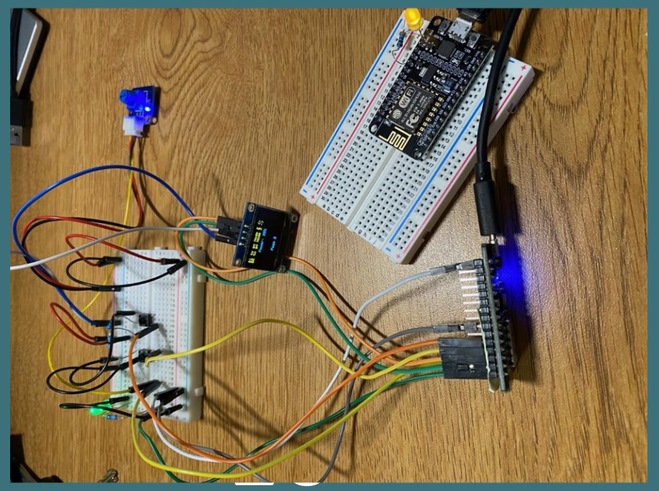
History of KTT

Speaker: Bree

	2018	2019	2020	2021	2022	2023	2024
Ind. Type:	Haptic Indicator		Light Indicator				
Micro:	Arduino Pro Micro		Arduino Pro Mini			Adafruit Feather Huzzah	
Comm. Type:			Radio Frequency			WiFi Mesh	
# of Pieces:	One Device Solution		Two Device Solution				
Main Focus:	1st Haptic Prototype	1st Light Prototype + Waterproof Container	1st Remote Prototype, 2 Device Solution Development	Multiple Signals to Multiple TT Devices	Software Re-Design + Connectivity I mprovements	PCB + Waterproofing	







Speaker: Matt

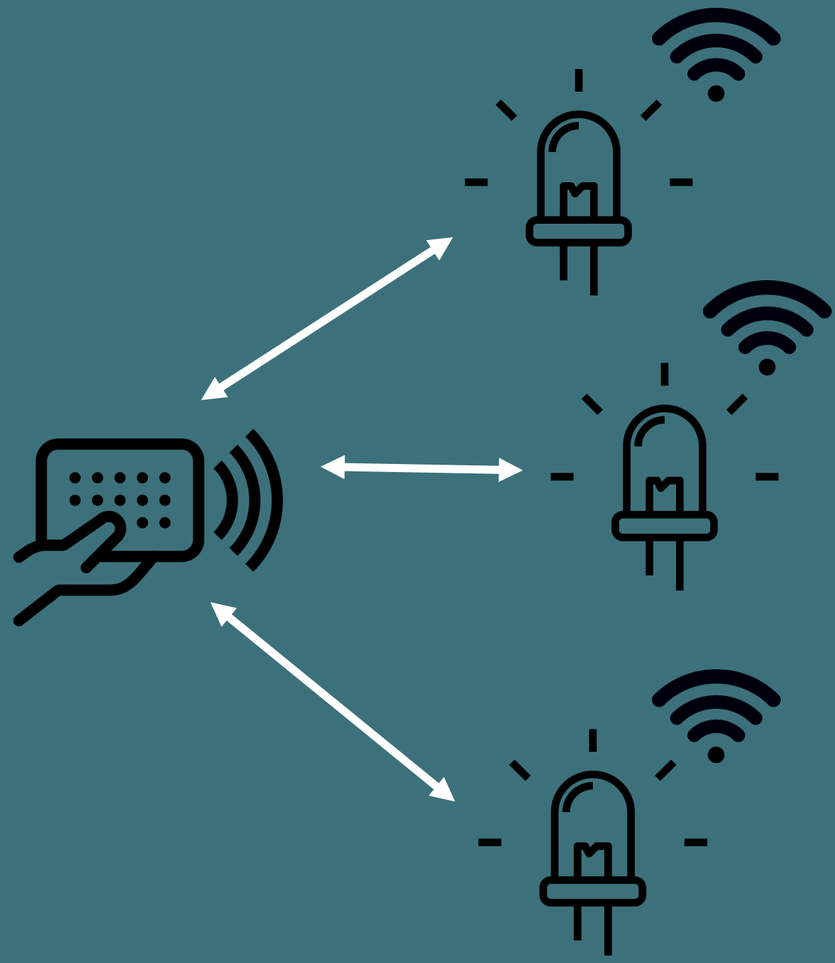
WiFi & Software

High Range
- Over 100 meters from research
- More testing to come

Reliable
- From testing, able to maintain connection with no drops for days

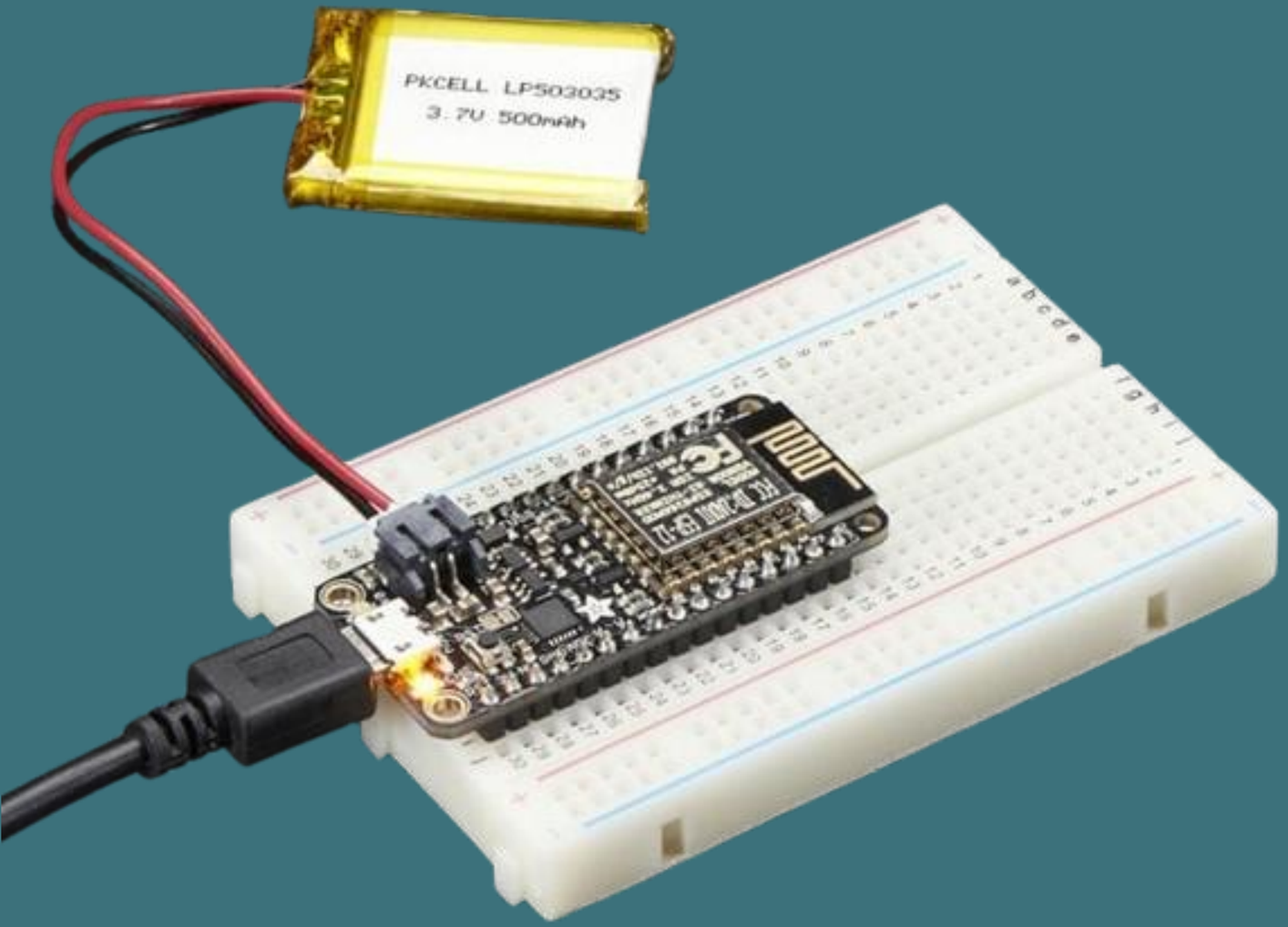
No Setup Required
- Creates own WiFi & automatically connect to each other

Low Cost
- Integrated into microcontroller



More extensive software testing can commence now that PCBs have arrived!

Speaker: Matt



Microcontroller

Adafruit Feather Huzzah

Houses ESP8266 WiFi chip

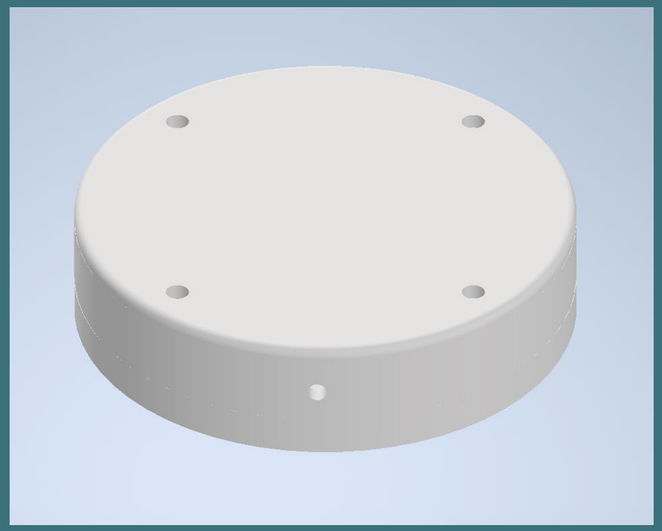
Embedded charging circuit

Less expensive than alternatives

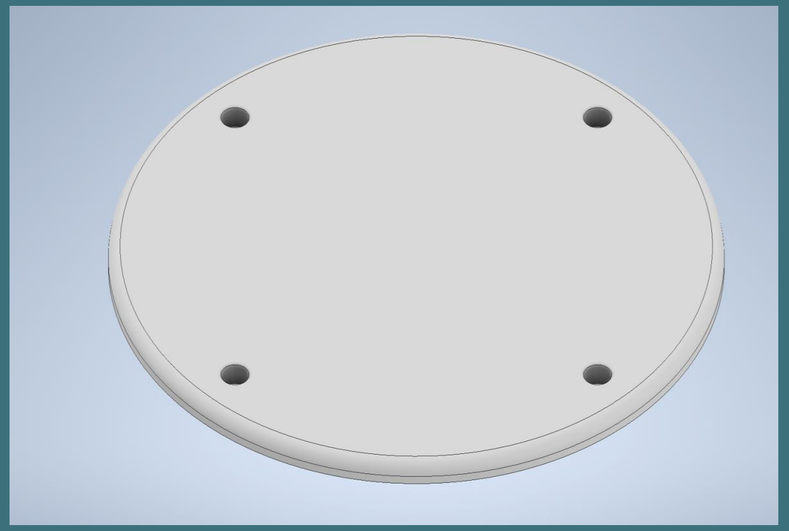
Compact

Speaker: Andrew

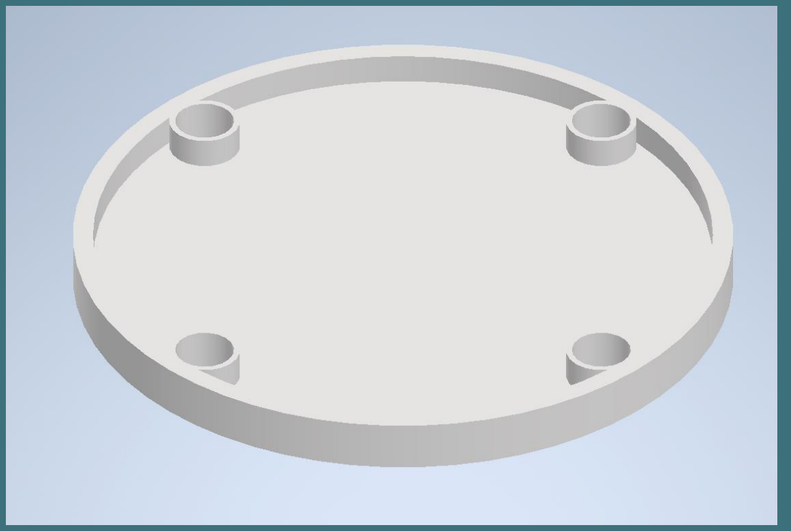
Past - Tempo Trainer CAD



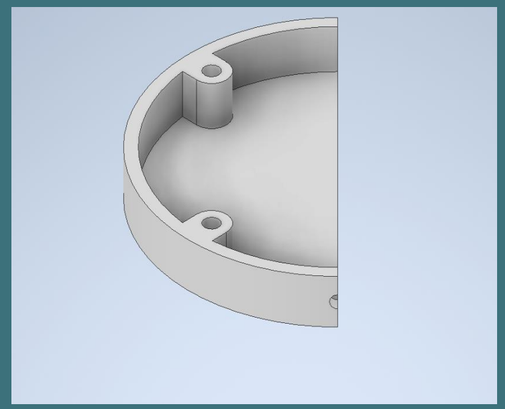
Assembled Tempo Trainer

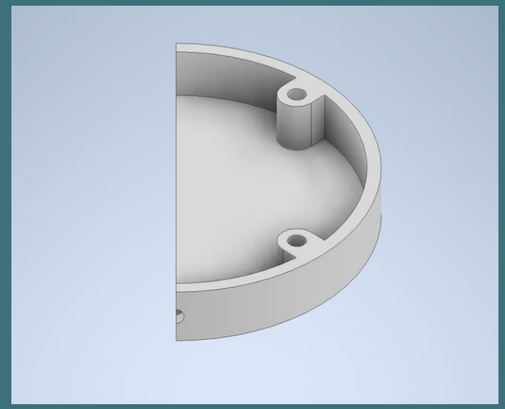


Tempo Trainer Lid



PCB Tray

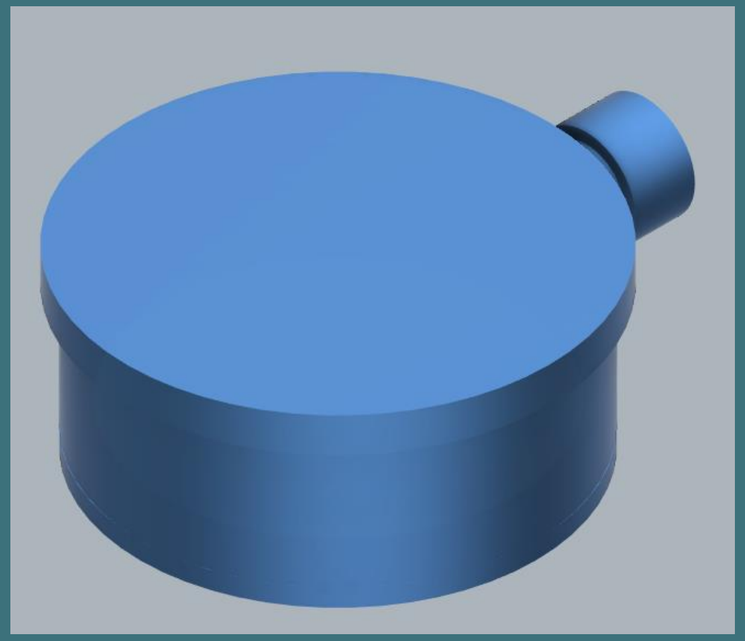




Battery Tray

Speaker: Andrew

Current - Tempo Trainer CAD



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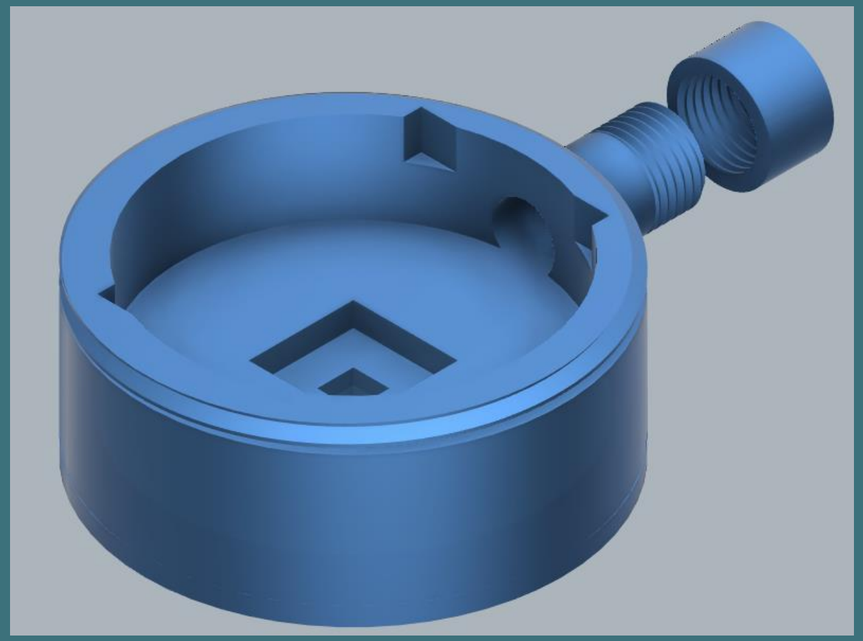
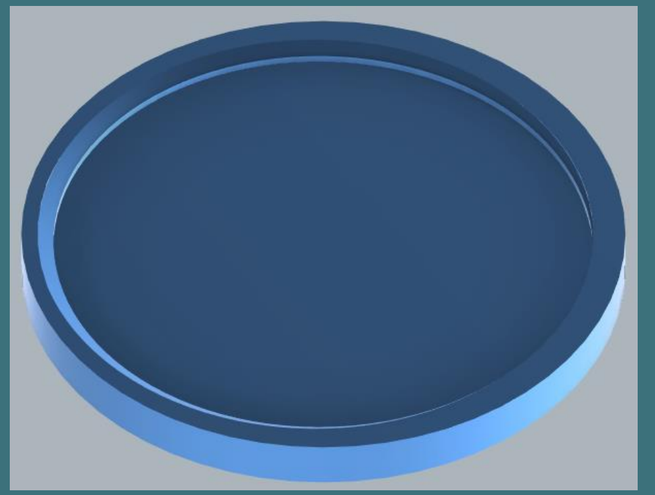
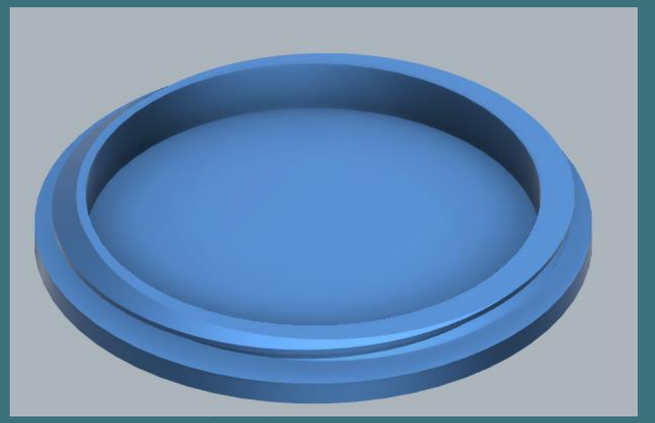


Main Compartment and Charging Cap



Cap



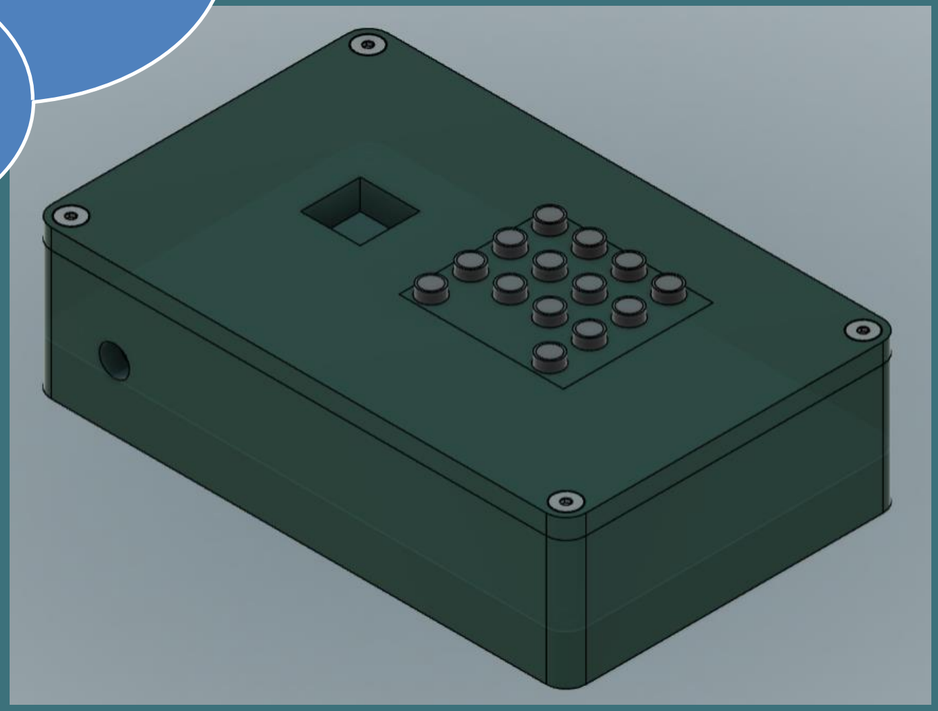
Button Cap

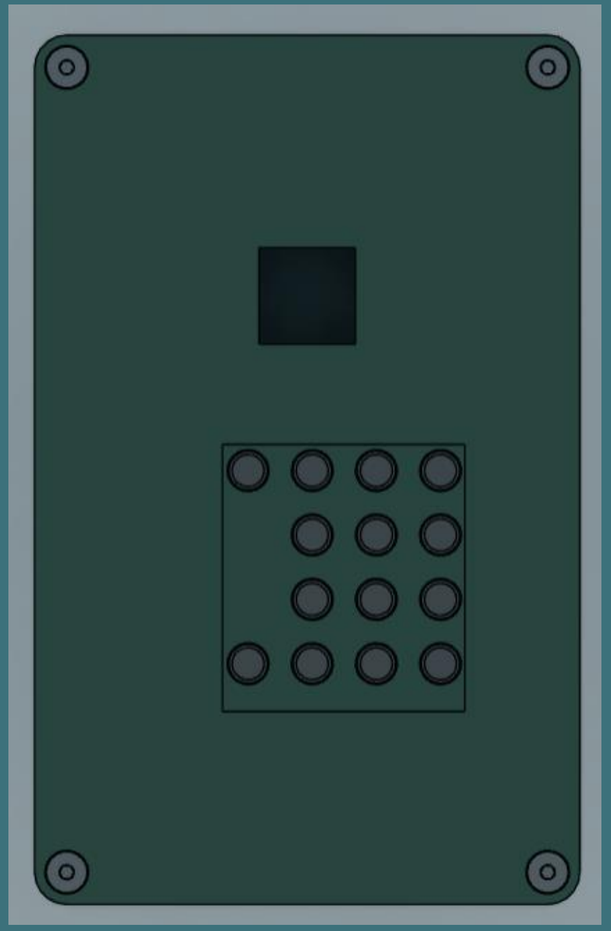
Speaker: Chris

Remote CAD

Future Improvements

- Add charging pipe
- Change keypad orientation
- Make remote easier to hold with one hand
- Waterproof plastic cover for keypad



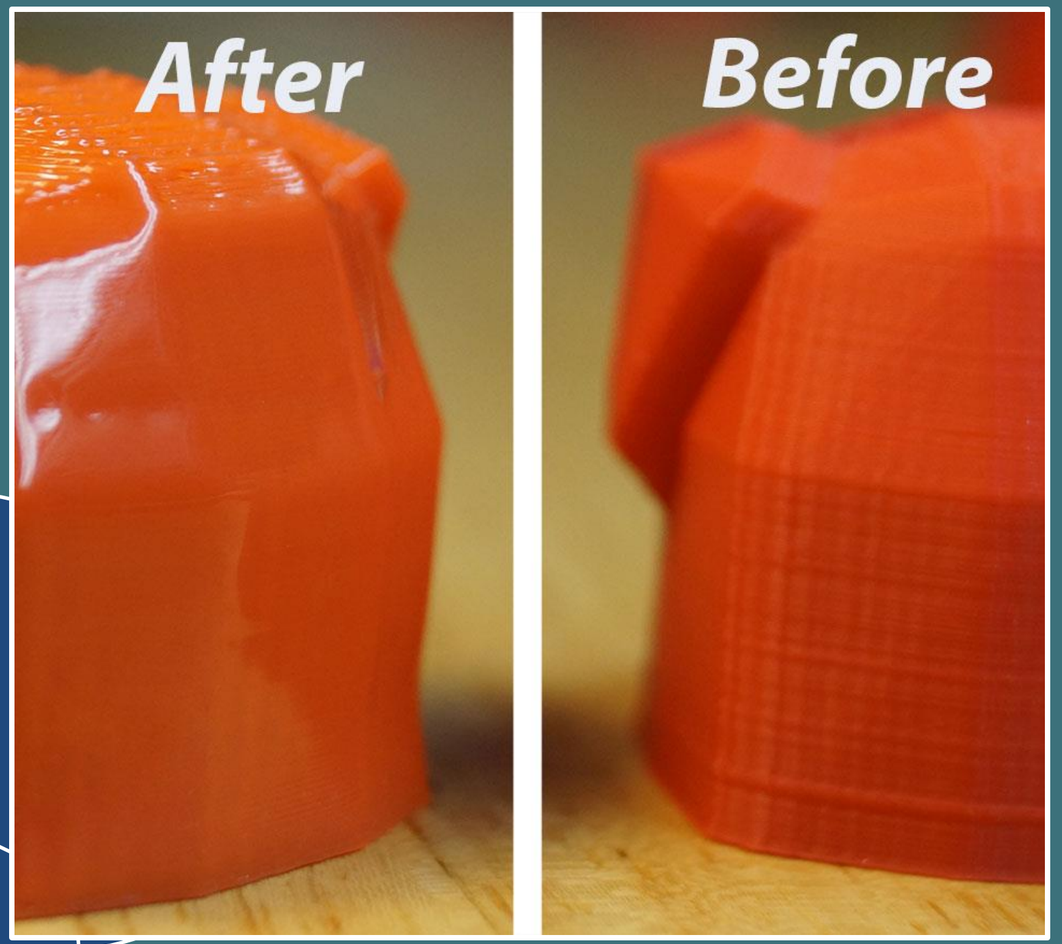


Speaker: Chris

Waterproofing

- 3D printing allows for quick prototyping
- More complex geometry can be used
- PETG itself is not waterproof, thus will use vapor smoothing

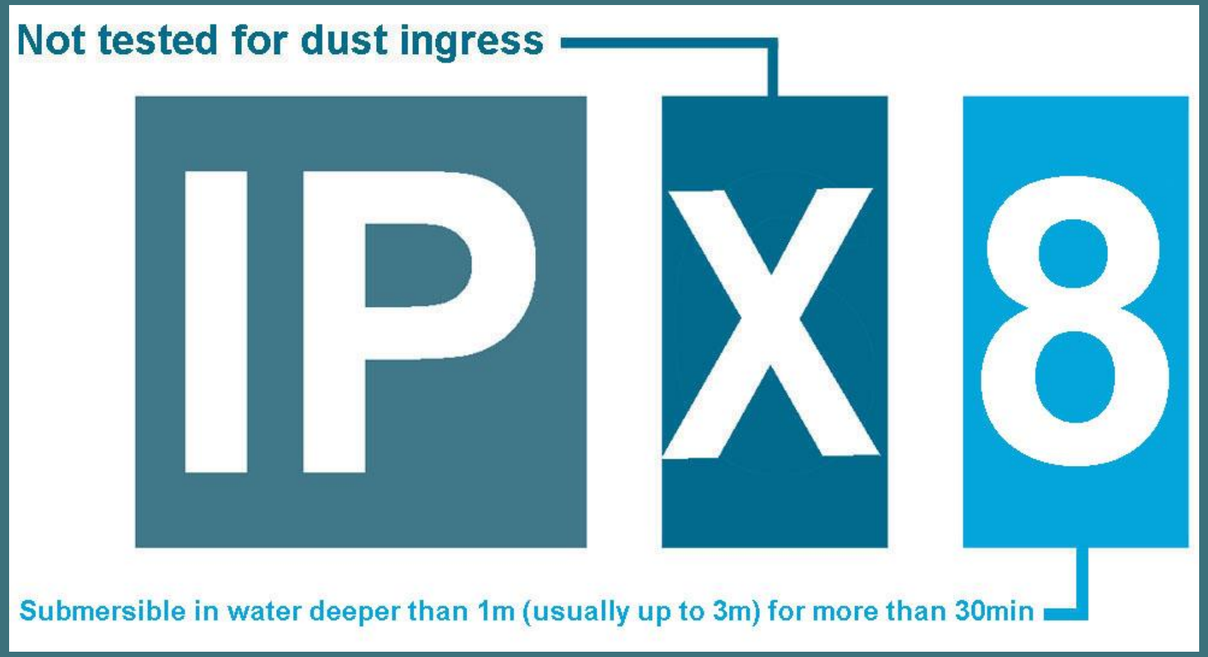
- Vapor Smoothing liquifies the filaments surface
- Elimination of print lines helps with minimizing liquid entry



Speaker: Chris

Testing Waterproofing

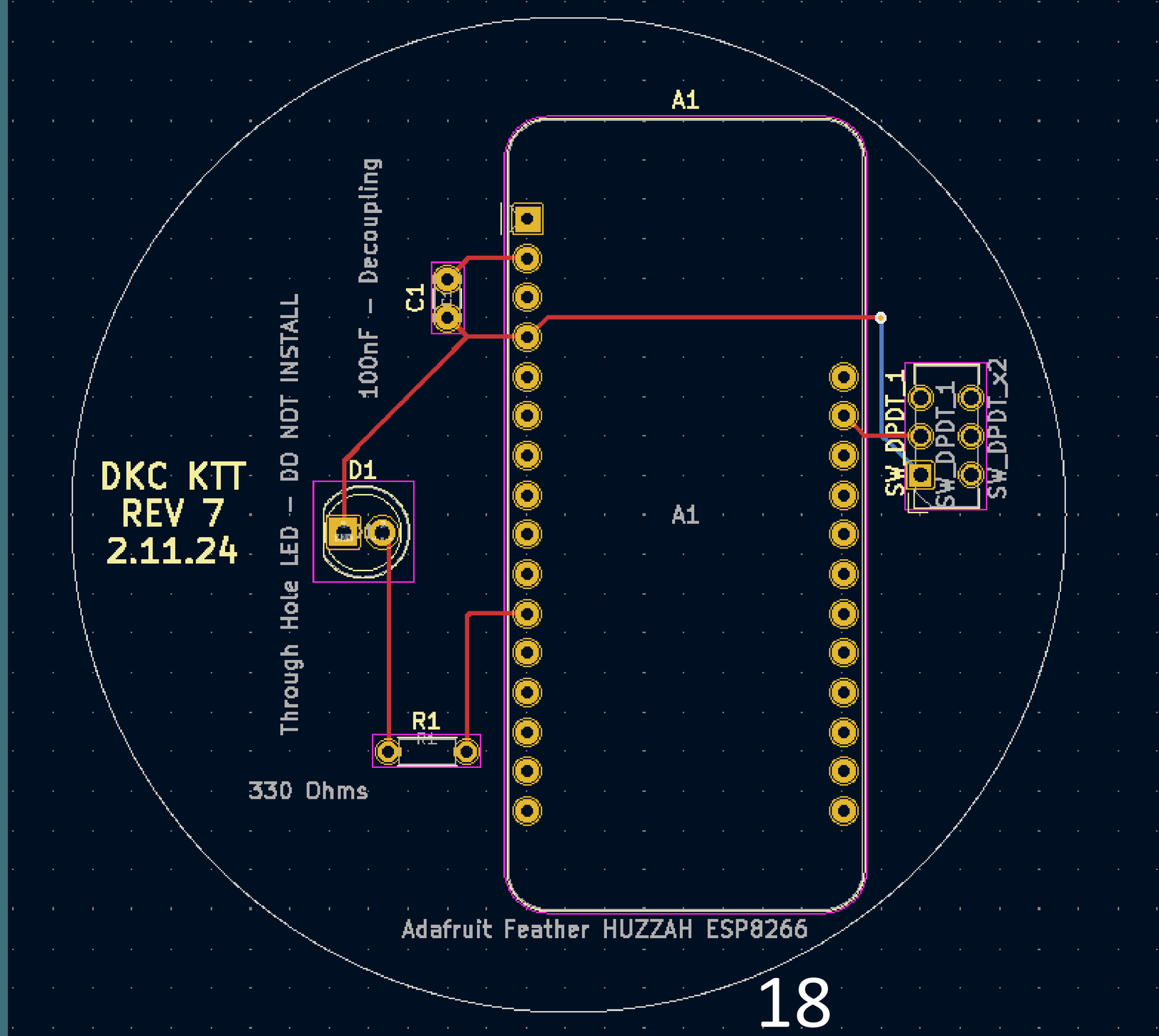
- Testing under IPX-8 waterproof conditions.
- Submersed 12+ feet of chlorinated water for 30+ minutes
- Moisture strips to test for water leaks

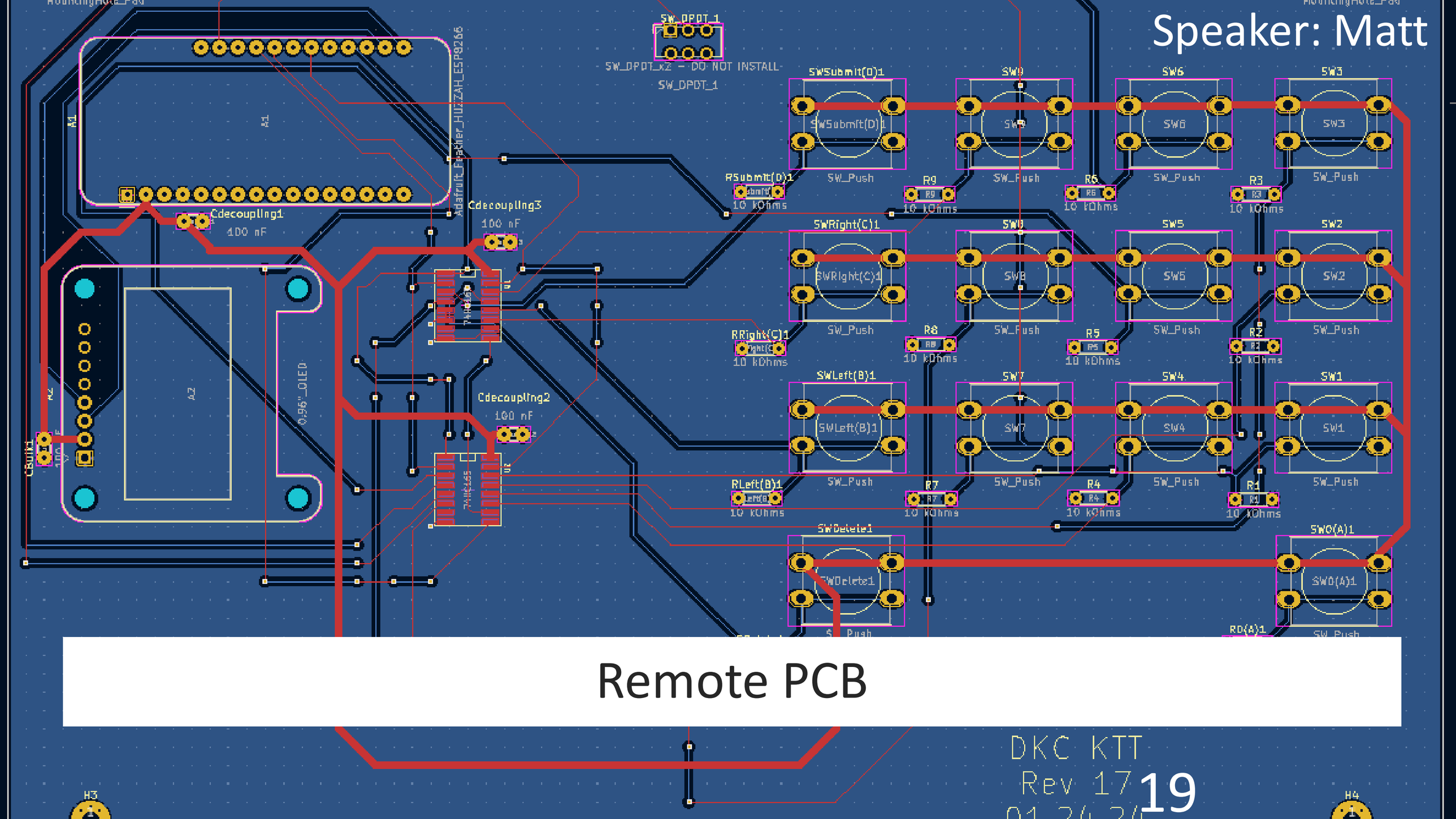


Speaker: Matt

Tempo Trainer PCB

Both Tempo Trainer & Remote PCBs have been reviewed and finalized for 1st iteration



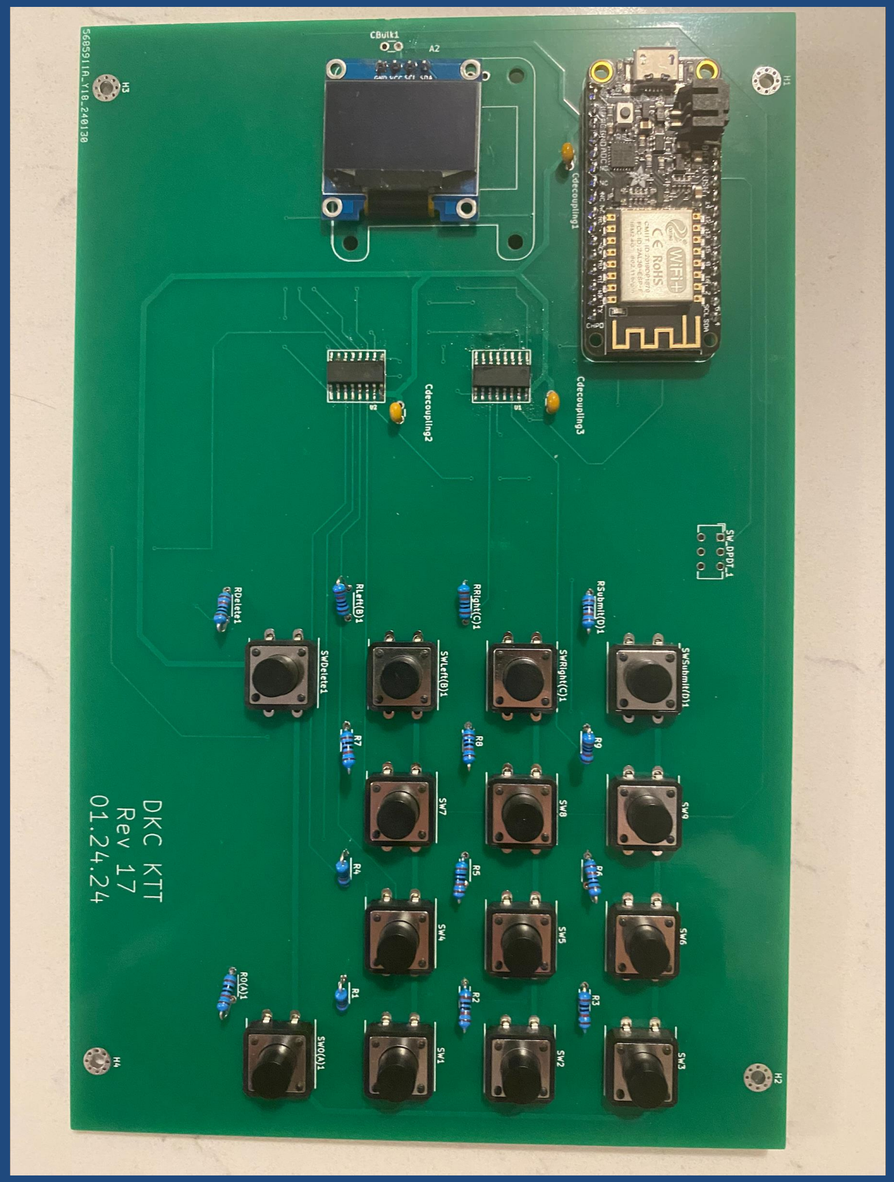

Speaker: Matt
SW_DPDT_1
SW_DPDT_x2 - DO NOT INSTALL
SW_DPDT_1
SWSubmit(D)1
SW9
SW6
SW3
SWRight(C)1
SW8
SW5
SW2
SWLeft(B)1
SW7
SW4
SW1
SWDelete1
SW0(A)1
RSubmit(D)1
RRight(C)1
RLeft(B)1
R9
R8
R7
R6
R5
R4
R3
R2
R1
10 kOhms
Cdecoupling1
100 nF
Cdecoupling2
100 nF
Cdecoupling3
100 nF
Cbulk1
A1
A2
0.96"_OLED
Adafruit_Feather_HUZZAH_ESP8266
SW_Push
Remote PCB
DKC KTT
Rev 17
01/24/19
H3
H4

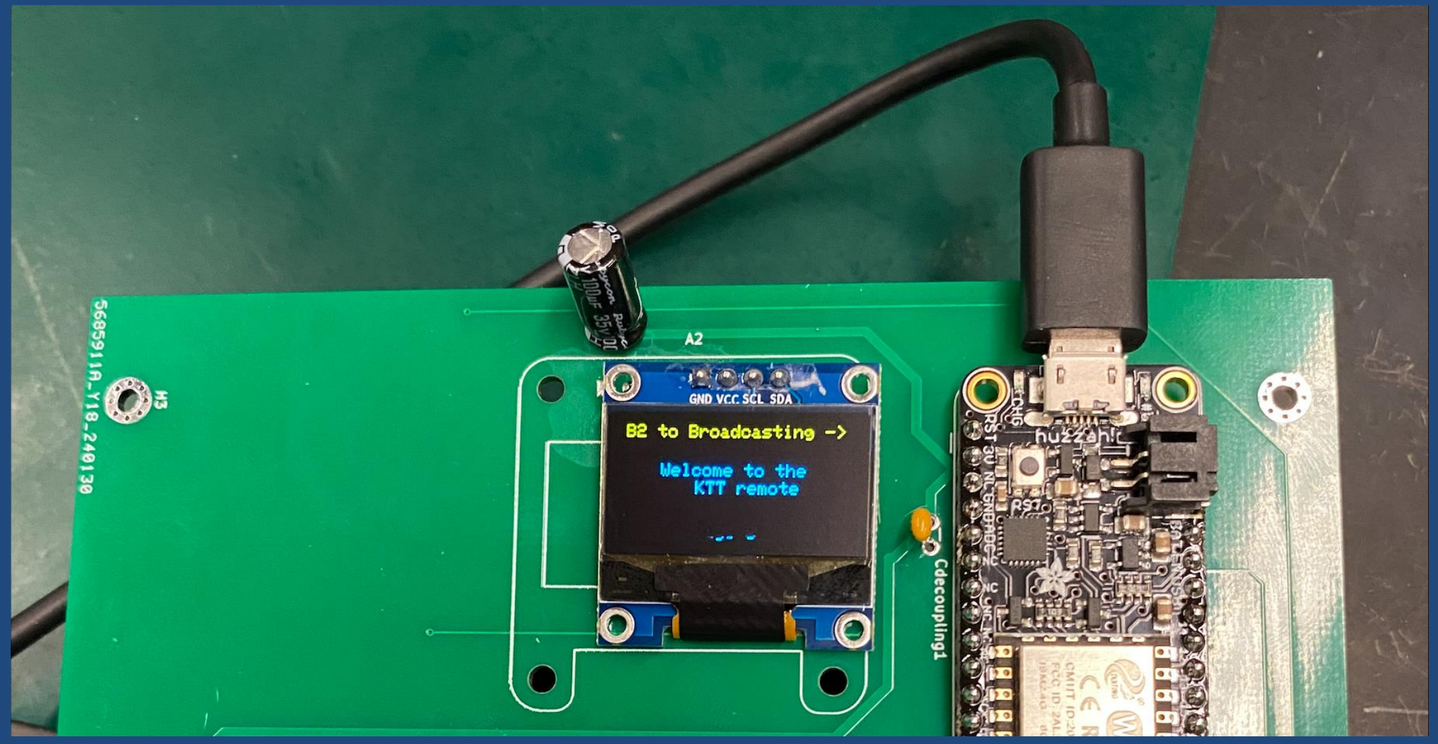
Speaker: Matt

Manufactured!

Soldered!

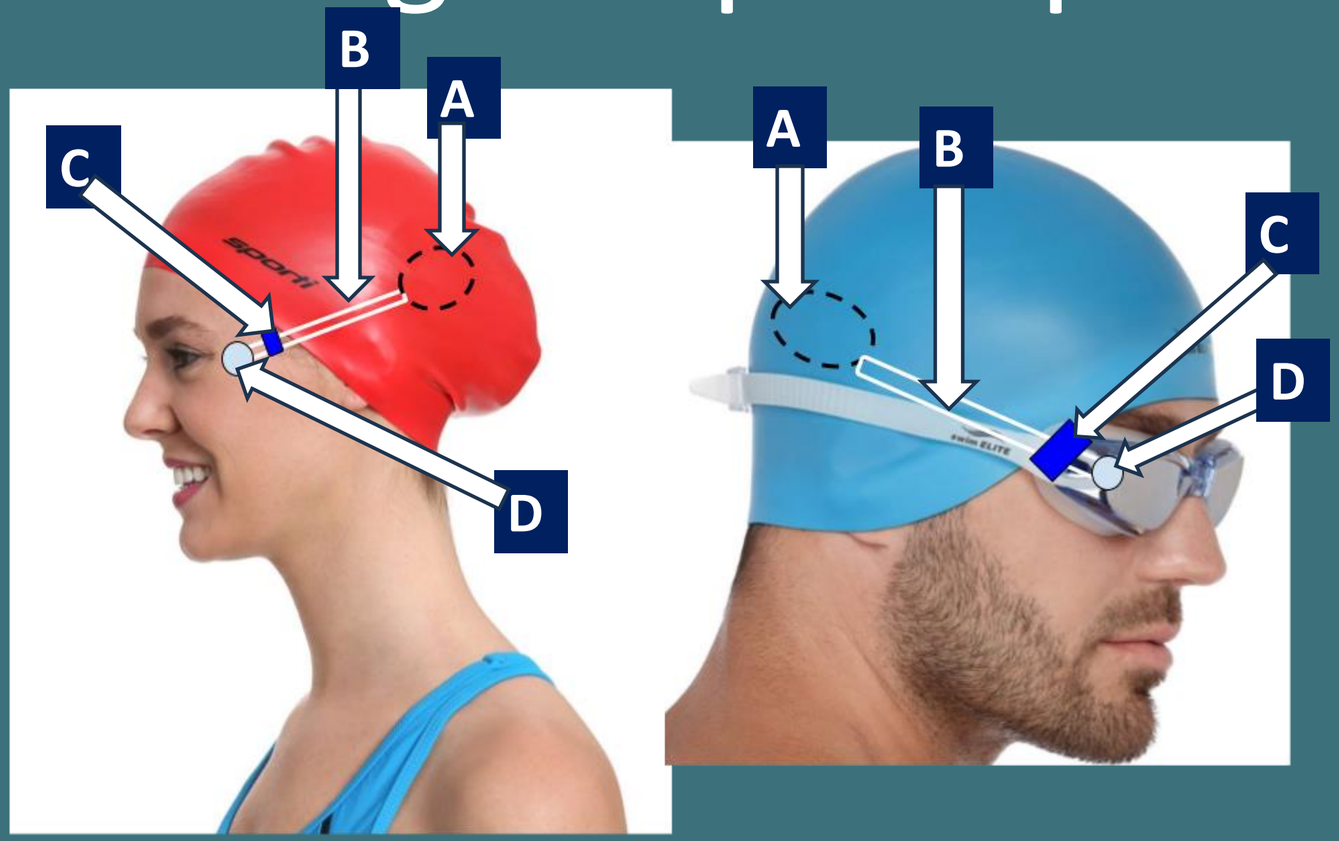
Tested!





LED Light Pipe Implementation (1)

Speaker: Bree



Part A: Tempo Trainer Enclosure

- Light pipe connected to PCB in enclosure using Light Pipe Mount

Part B: LED Light Pipe + Flexible Tubing

- Optical grade plastic connected to LED
- Flexible wire inside flexible tubing

Part C: Reusable/Detachable Zip Tie

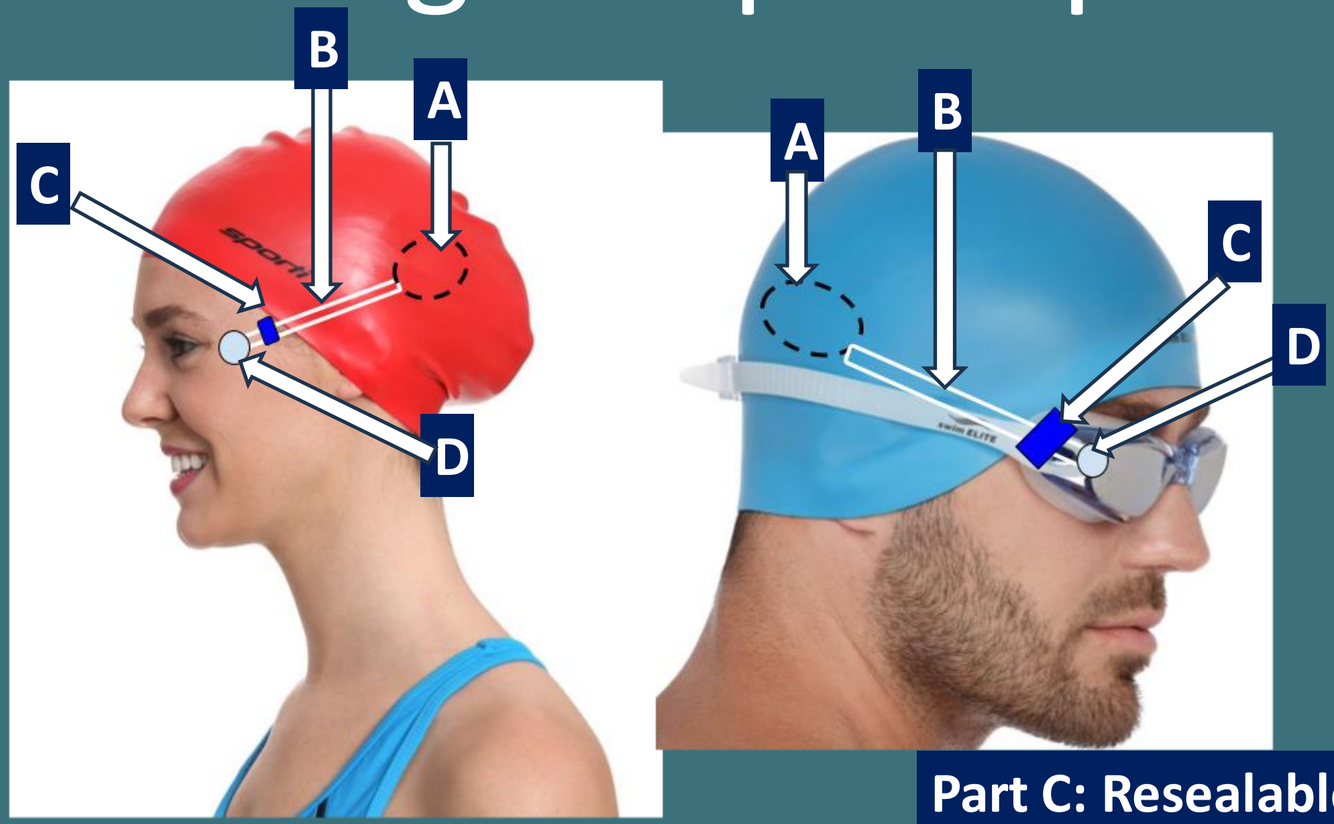
- Allows wire to be attached to swimming goggles and held in place
- Adjustable for different goggles/face placement

Part D: Fresnel Lens

- Clear lens to allow for different colors to be used as stroke pace indicator

LED Light Pipe Implementation (2)

Speaker: Bree



Part A: LED Light Pipe MOUNT

Part B: LED Light Pipe + Flexible Tubing

Part C: Resealable Zip Ties

Part D: Fresnel Lens

Spring 2024 Semester PROGRESS

Speaker: Bree

Onboarding	• Documentation • CAD software • PCB software
Spec. Dev.	• Documentation --> GANTT Chart • Budget --> Budget Plan, Grant Proposal, Purchases
Conceptual Design	• Testing Protocols --> waterproofing, software, PCB • Research --> LED light pipe implementations, waterproof solutions
Detailed Design	• Additions --> power switch (PCB, CAD), heat threaded inserts (CAD), software implementation of shift register circuit • More iterations on CADs + PCBs

Spring 2024 Semester PLAN

Speaker: Bree

Spec. Dev.	• Documentation --> User Guide, Safety Measures, Design Document, Transition Document
Conceptual Design	• Draft Testing Protocols --> PCBs, safety testing measures • Research --> safety measures for waterproofing/LED, product lifespan, battery life • Conduct user surveys for aesthetics/comfortability improvements
Detailed Design	• More iterations on CADs + PCBs • Testing --> PCBs, CAD models, comfortability, usability of LED light pipe and charging pipe, software, waterproofing at depths

Speaker: Bree

Future Considerations & Plans

- RGB LED – Color Customizable Light
- Adjustable Brightness
- Color Customizable 3D Print Filament

- Head shape + comfortability improvements
- Wireless charging capabilities
- Buoyant Tempo Trainer

- User testing + surveys
- More testing, debugging, iterating, modifying

Thank you

Please let us know if you have
any questions or comments!