Design Review

Team A7 deciBright Lucy Chen, Katherine Sabak (presenting), Freda Su

Use Case Update

Product primarily intended for musicians – music studio collaboration

- dB magnitude
 - Volume ≠ loudness
 - Long music sessions
 - Protecting hearing
- dB direction
 - Practice space acoustics

Solution: A light-up bracelet to provide fast, visual feedback about sound volume and direction over time.

Requirements from usage of similar devices + music studio survey

Quantitative Design Requirements

Width	≤ 46 mm ⁴
Thickness	≤ 9 mm ¹
Weight	≤ 200 g ²
Operating temperature	≤ 105°F ³
ldB valuel	≤ 2 dB of actual value ⁴
Timeliness	Instantaneous mode responds ≤ 1 second
Adjustability	Bracelet length 177-254 mm ⁵
Durability	Functions normally after 2.5-ft drop ⁶
Battery life	≥ 8 hours

1. https://www.watchesofswitzerland.com/watch-buying-guide/watch-size-guide

2. https://devicetests.com/how-much-does-a-smartphone-weigh

3. https://ntrs.nasa.gov/api/citations/20100020960/downloads/20100020960.pdf

4. https://blogs.cdc.gov/niosh-science-blog/2014/04/09/sound-apps/

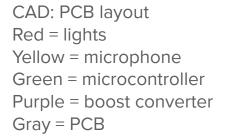
5. https://www.blingjewelry.com/pages/bracelet-sizing

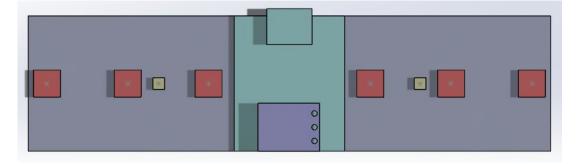
6. https://rapportfurniture.com/blogs/rapport-furniture/standard-dining-table-dimensions

Features Update

- Inst. (1x/sec) volume LED display
- Average volume LED display
- Lights can indicate sound levels from different directions
- Buttons for on/off and toggling modes

- View exact dB readings
- View graphs of sound levels, direction over time
- Customize thresholds
- Customize color assignments
- Customize LED intensity

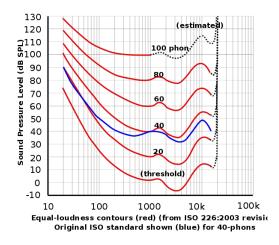




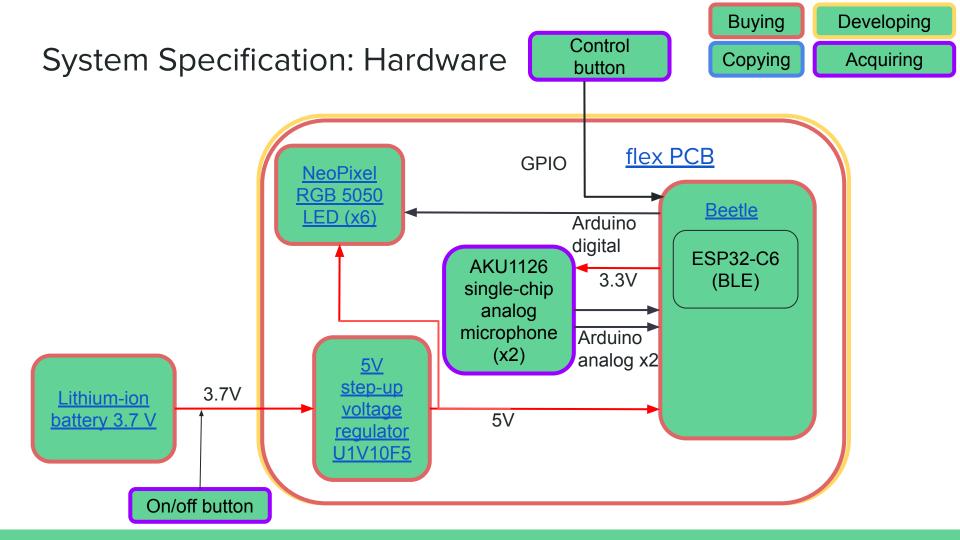
Solution Approach + Considerations

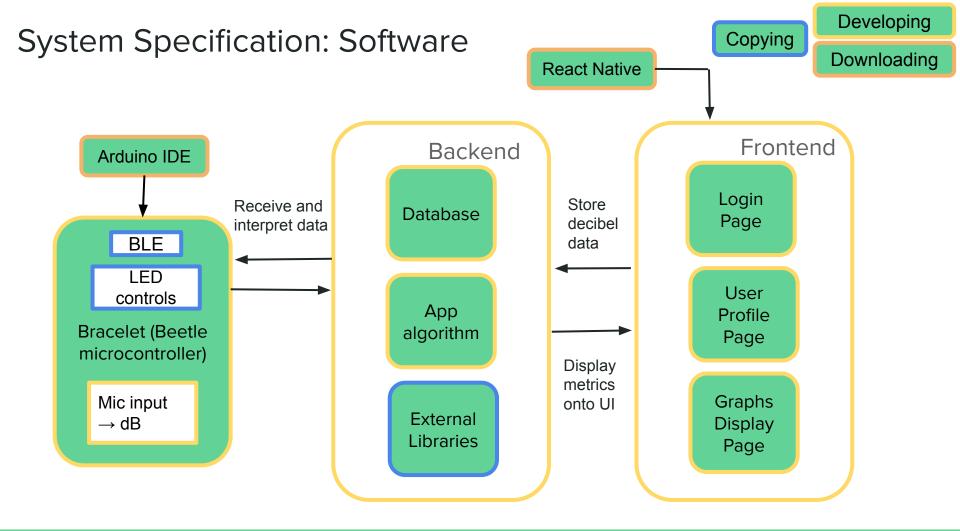
• Health

- Heat, wireless/electrical safety etc. considered
- Limiting exposure to unsafe dB values
- Social
 - Fashionable, not disruptive to use
- Economic
 - No current commercial solution
 - Solidworks Academic License
 - May affect production/consumption of music-related items



Loudness perceived depends on frequency, not just dB <u>https://en.wikipedia.org/wiki/Equal</u> <u>-loudness_contour</u>





Fabrication/Assembly [Implementation Plan Continued]

Buy (other components):

- Solder mask from PCB vendor
- Polyester cord
- Plastic cord lock
- <u>Plastic tubing</u>/<u>plastic sheet wrapping</u> (developing casing)

Acquire (other components):

- Resistors/capacitors (personal supply)
- Buttons (IDeATe)
- Solder paste (electronics shop)
- Wires (RoboClub)

Copy (tutorials): <u>NeoPixel</u>, <u>Beetle BLE</u>, <u>React Native</u>



NeoPixel, Beetle, and boost converter size compared to quarter

Tradeoffs/Risk Mitigation

- **Miniaturization:** fitting all components into bracelet dimensions
 - Battery:
 - Lithium-ion meets est. necessary current output
 - Size > coin batteries, which don't have enough charge (even multiple)
 - # LEDs: higher resolution visuals = greater current input
 - Microcontroller: small size, built-in BLE, charging
- **Robustness:** drop test, electrical safety
 - Polyester cord wrap around wires for more stability and protection
 - Plastic tubing around PCB to protect components
 - Seal ends of tubing with "stoppers" and hot glue
 - Plastic around the battery to prevent direct contact



<u>Clear, plastic tubing</u>: PCB will go inside here, and then the ends will be sealed shut



Plastic sheet to wrap battery in

Testing, Verification and Validation: Physical

Requirement	Materials	Passing condition	Next steps if failed
Weight	Scale	Weight ≤ 200 g	Decide what material to remove
Adjustability	Ruler	Flat bracelet length can extend from 177 mm to 254 mm	Adjust cord length within bracelet
Thickness	Ruler	Flat bracelet height ≤ 9 mm	Decide how to rearrange components
Durability	2.5-ft drop	Functions as normal after drop	Improve exterior casing

Testing, Verification and Validation: Usage

Requirement	Materials	Passing condition	Next steps if failed
Loudness, directionality	Soundproof room, speaker, validated decibel meter	ILoudness resultI ≤ 2 dB of validated measurement Directionality (LEDs) max reading within 60° of actual	Adjust microphone filtering or physical construction of bracelet
Timeliness	Video recordings of room test	LEDs/app change in ≤ 1 second of speaker output change	Work to minimize transmission/computation time
Battery life	Timer	Total usage time before battery dies ≥ 8 hours	Work to reduce number of transmissions
Operating temp	Temperature sensor	Passes all other non-durability tests while never reaching a temperature above 105°F	Rework casing to add airflow
Integration test	User, phone	User can navigate the interface intuitively/without much confusion/frustration (survey)	Address user concerns

Project Management: Gantt Chart

A7: deciBright			2/18/2024							2/25/2024							3/3/2024							
TASK	START	END		18	19	20	21	22	23	24	25	26	27	28	29	1	2	3	4	5	6	7	8	9
			ASSIGNED TO	S	M	T	W	Т	F	S	S	M	Т	W	T	F	S	S	М	Т	W	T	F	S
Deliverables									-															
Website Initial Setup	1/31/2024	2/3/2024	IIA	-						-						-	1							
Project Proposal	1/31/2024	2/4/2024	ILA																					
Status Reports	2/10/2024	4/27/2024	ILA														T							
Design presentation slides	2/12/2024	2/18/2024	ILA																					
Design doc	2/26/2024	3/1/2024	ILA										-			-								
Ethics assignment	3/11/2024	3/13/2024	All														1							
Interim demo	3/30/2024	4/1/2024	ILA																					
Final presentation slides	4/15/2024	4/21/2024	ILA																					
Hardware																								
Finalize Materials	2/4/2024	2/18/2024	ILA					1						-		-	1-1							
Ordering/Receiving Parts	2/14/2024	2/23/2024	IIA																					
Electronic prototyping	2/25/2024	3/2/2024	Katherine				1	1		-														
Arduino Bluetooth connection	2/25/2024	3/2/2024	Katherine																					
LED signal setup	2/25/2024	3/2/2024	Freda																					
Microphone signal processing	2/25/2024	3/2/2024	Katherine																					
Software																								
Web app research & planning	2/4/2024	2/10/2024	Lucy														1							
UI and design	2/9/2024	2/23/2024	Lucy																					
File management and security	2/18/2024	2/25/2024	Lucy																					
Database	2/24/2024	3/1/2024	Lucy				-	1				-		-		-								
Bluetooth <-> Web app	2/25/2024	3/2/2024	Lucy, Katherine																					
Visualization of decibel readings	3/2/2024	3/9/2024	Lucy, Katherine																					
Color/Threshold customization	3/10/2024	3/16/2024	Lucy																					
Integration																								
Physical bracelet fabrication	3/11/2024	3/17/2024	Freda														1							
Arduino code	3/11/2024	3/17/2024	Freda																					
Testing																								
Test timeliness	3/24/2024	3/30/2024	IIA														1-1							
Test accuracy, heat	3/24/2024	3/30/2024	IIA																					
Send/receive data between web app and bracelet	4/1/2024	4/19/2024	All																					
Wear Test	4/6/2024	4/20/2024	ILA																					
Buffer Time	4/10/2024	4/21/2024	All																					