

Design Review

Team A7 deciBright
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Use Case Update

Product primarily intended for musicians – music studio collaboration

- dB magnitude
 - Volume \neq 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	$\leq 46 \text{ mm}^4$
Thickness	$\leq 9 \text{ mm}^1$
Weight	$\leq 200 \text{ g}^2$
Operating temperature	$\leq 105^\circ\text{F}^3$
IdB value ^l	$\leq 2 \text{ dB}$ 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>

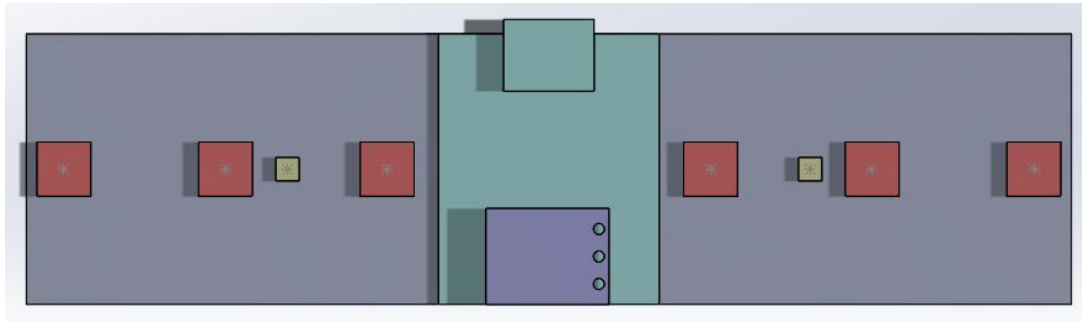
4. <https://blogs.cdc.gov/niosh-science-blog/2014/04/09/sound-apps/>

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**



CAD: PCB layout

Red = lights

Yellow = microphone

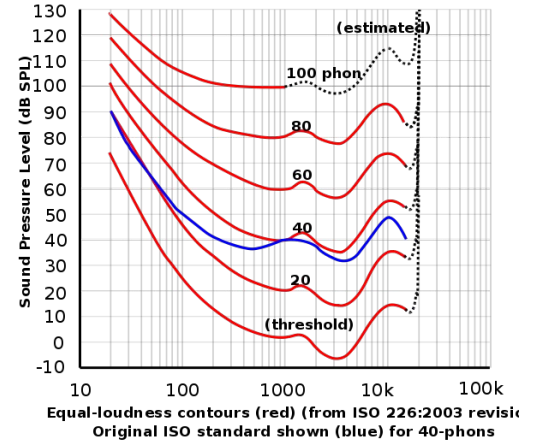
Green = microcontroller

Purple = boost converter

Gray = PCB

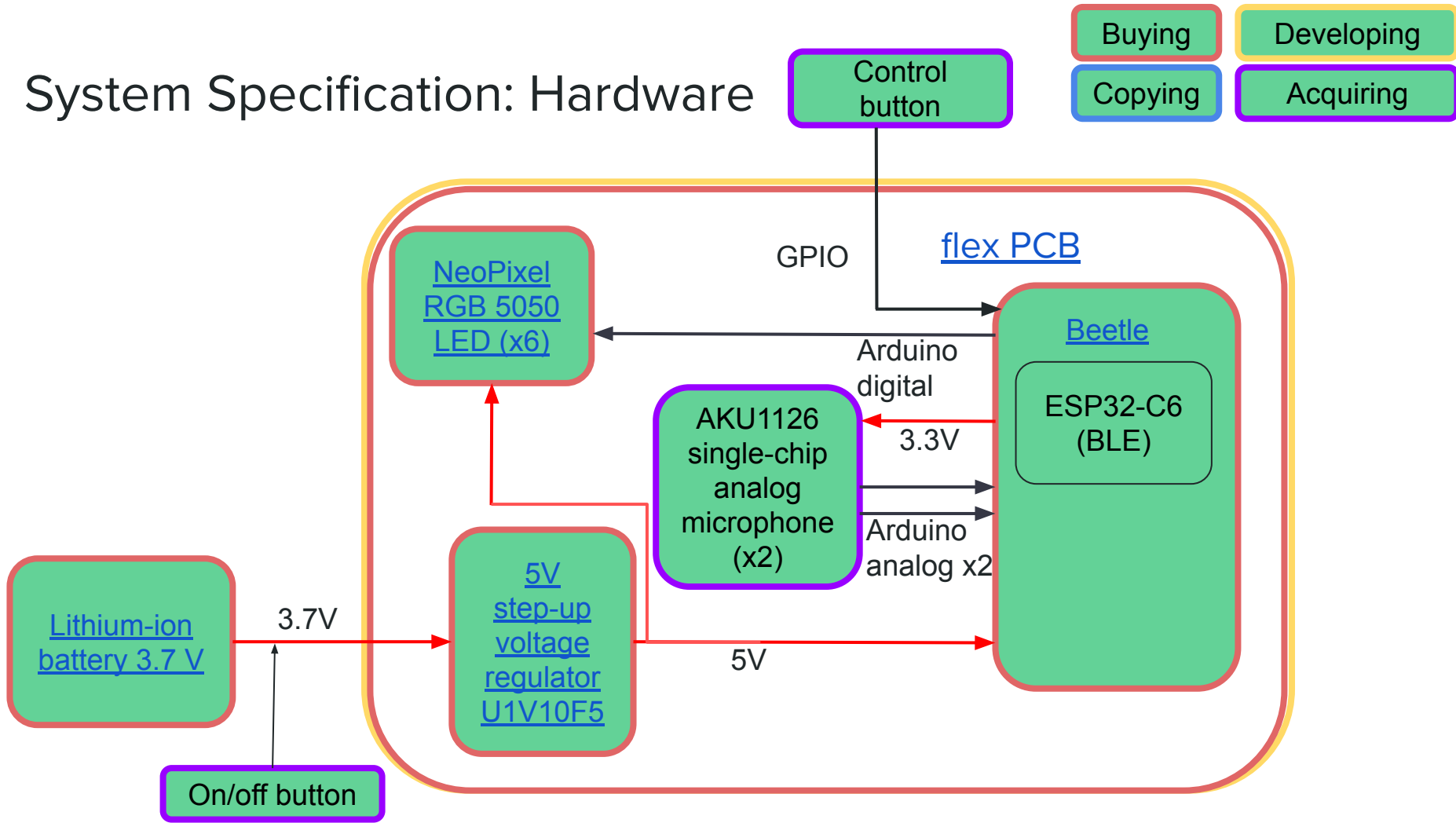
Solution Approach + Considerations

- 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

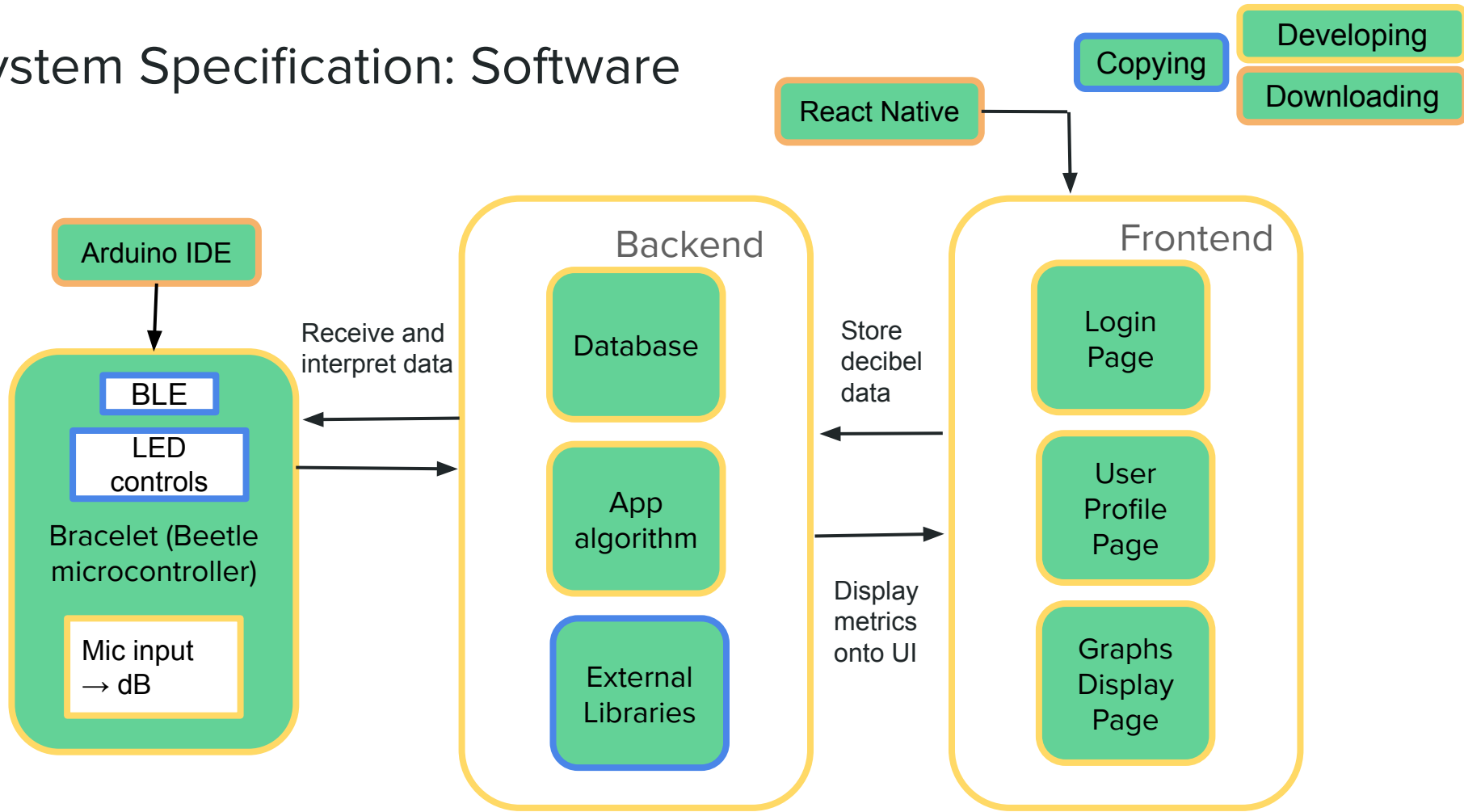


Loudness perceived depends on frequency, not just dB
https://en.wikipedia.org/wiki/Equal-loudness_contour

System Specification: Hardware



System Specification: Software



Fabrication/Assembly [Implementation Plan Continued]

Buy (other components):

- Solder mask from PCB vendor
- [Polyester cord](#)
- [Plastic cord lock](#)
- [Plastic tubing/plastic sheet wrapping](#)
(developing casing)

Acquire (other components):

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

Copy (tutorials): [NeoPixel](#), [Beetle BLE](#), [React Native](#)



[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



Clear, plastic tubing: 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 \leq 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 \leq 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	$ \text{Loudness result} \leq 2 \text{ 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

