

# Team A7: deciBright

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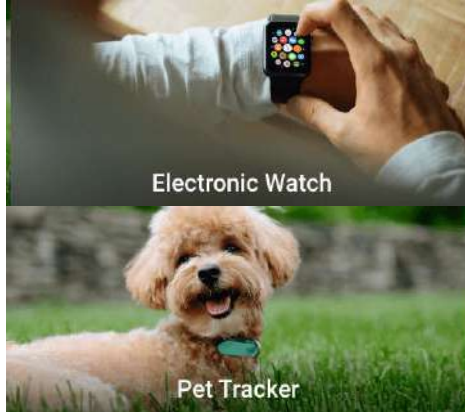
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# Ethics Consideration

*a color-changing light-up bracelet that monitors noise levels for wellness*

## Health & Safety:

designed with materials that are not harmful to the human body



## Environmental:

durable;  
instructions for disposing e-waste



## Social:

Customization to fit social setting

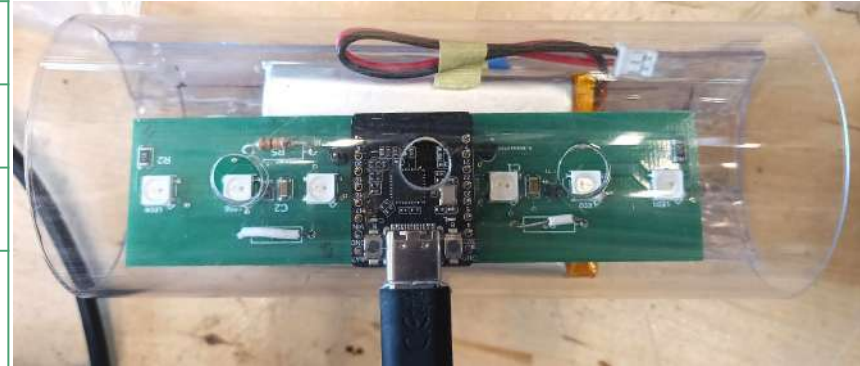
## Economic:

cheaper than professional sound meters



# Design Requirements

Width	$\leq 5.5 \text{ cm}^1$
Thickness	$\leq 3 \text{ cm}^1$
Weight	$\leq 200 \text{ g}^2$
Operating temperature	$\leq 105^\circ\text{F}^3$
IdB value	$\leq 2 \text{ dB}$ of actual value <sup>4</sup>
Timeliness	Instantaneous mode responds $\leq 1$ second
Adjustability	Bracelet length 177-254 mm <sup>5</sup>
Durability	Functions normally after 2.5-ft drop <sup>6</sup>
Battery life	$\geq 4$ hrs



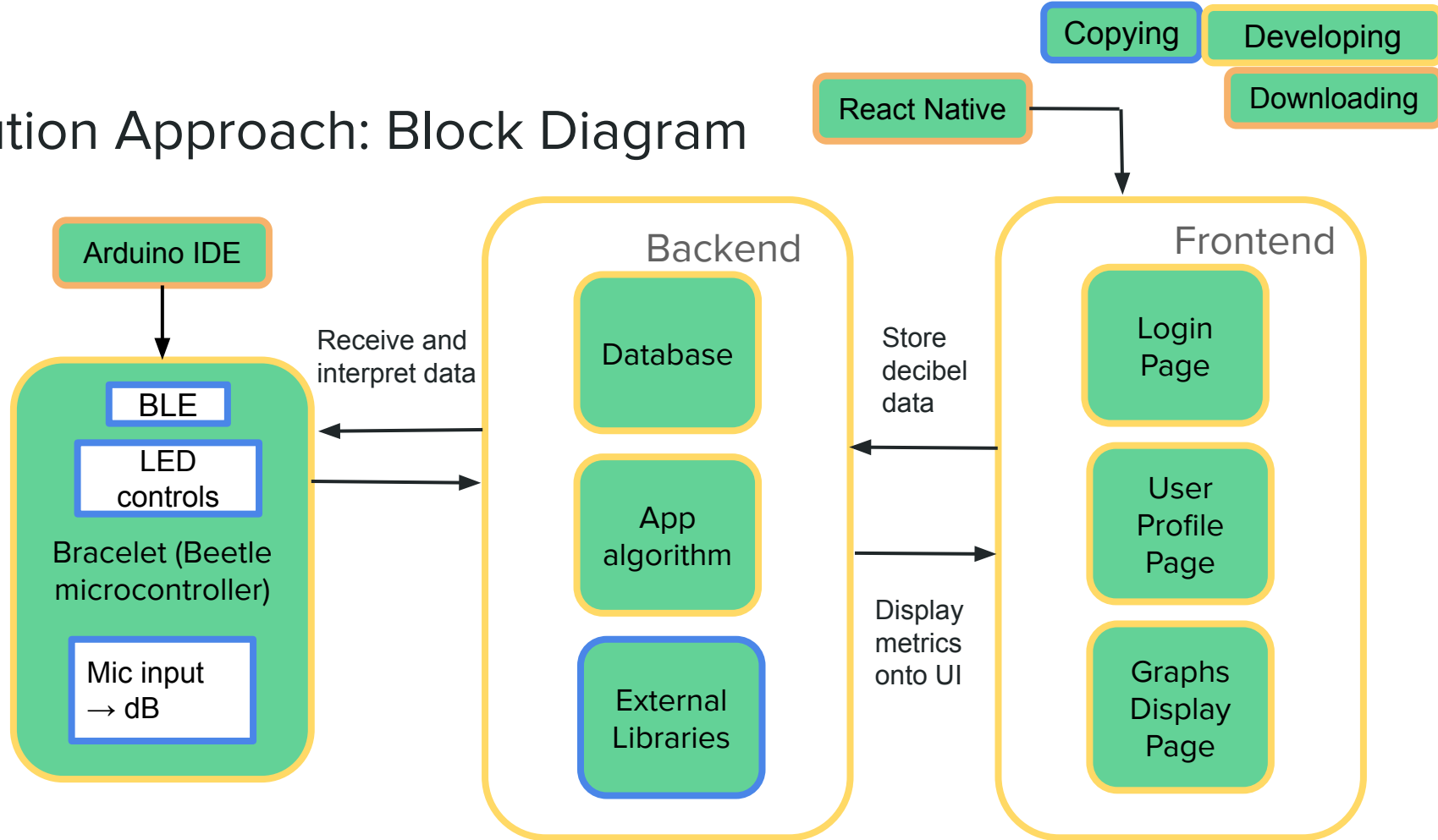
Top and side view of plastic casing



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>

# Solution Approach: Block Diagram

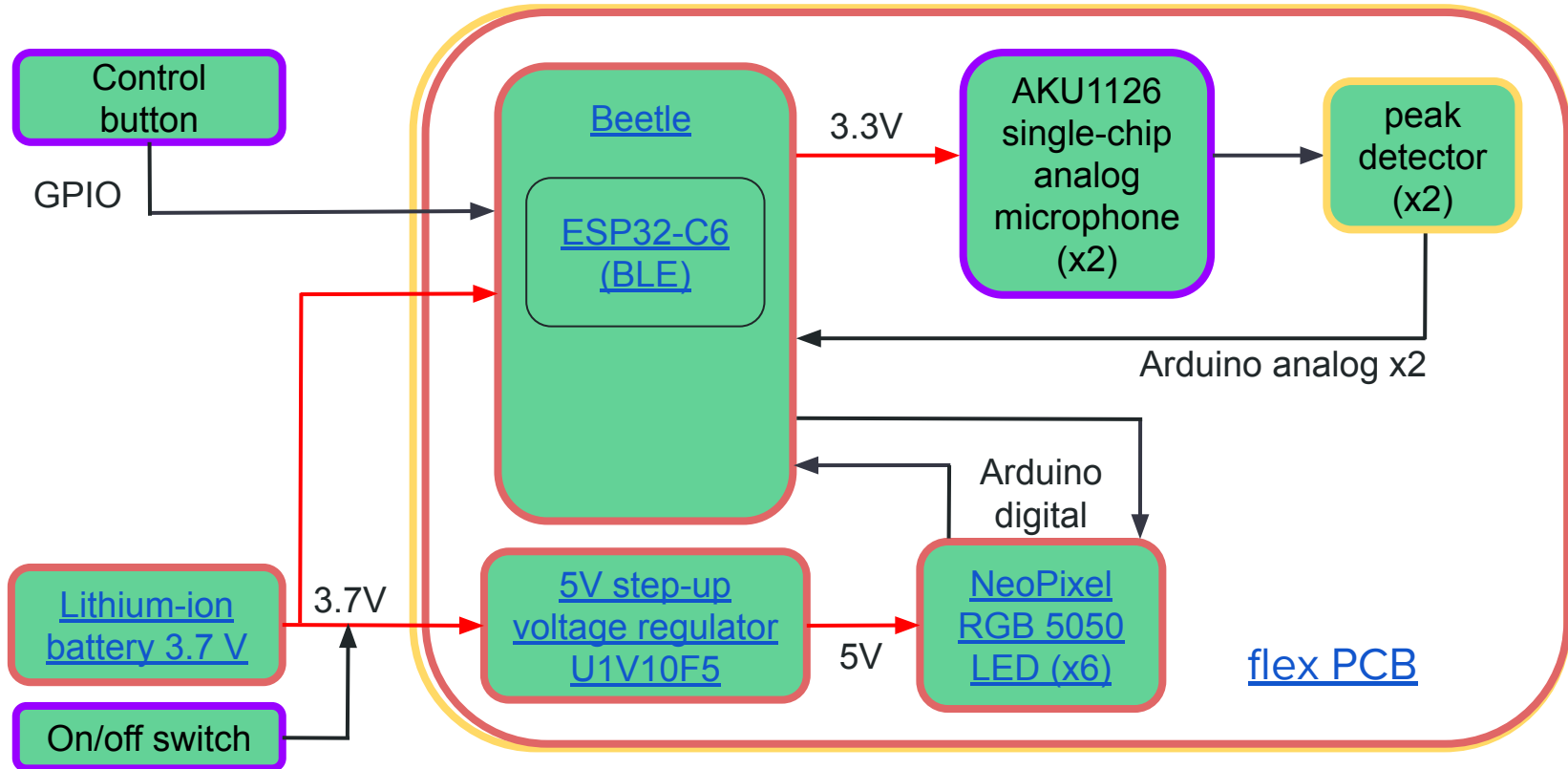


Buying

Developing

Acquiring

# System Specification: Hardware



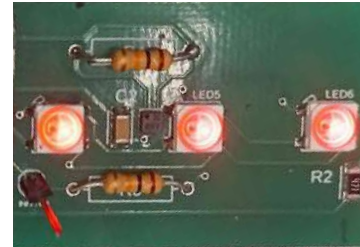
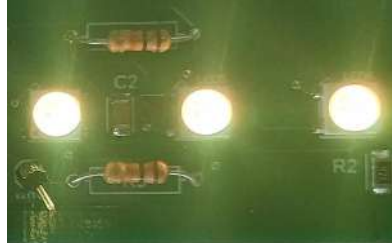
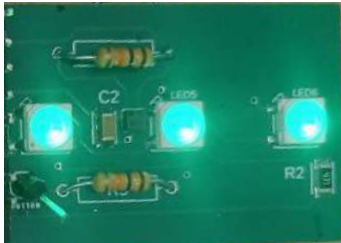
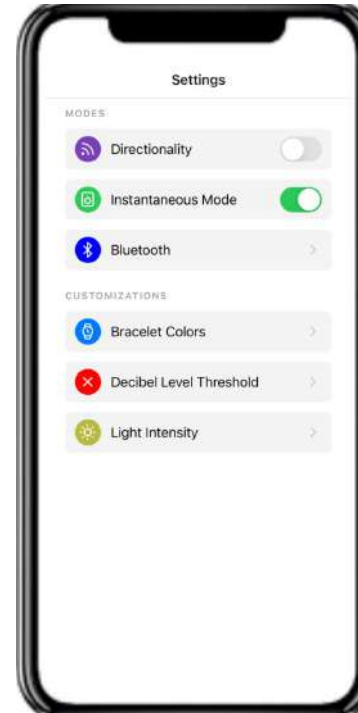
# Complete Solution

- **Mobile Web App**

- Display decibel readings
- Record and graph noise level history
- Allow for customization of color, light intensity, and threshold

- **Physical Bracelet**

- Switch between instantaneous and average modes with button press
  - no more directionality mode
- Display LED color based on sound volume



Colors indicate loudness and [safety](#) for exposure:

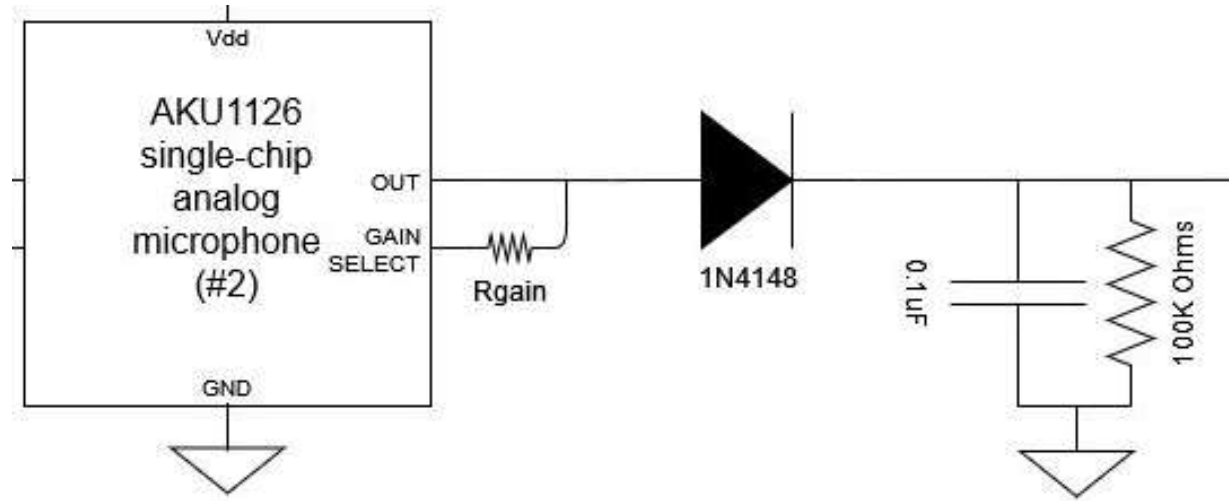
Green: < 80 dB

Yellow: 80 - 99 dB

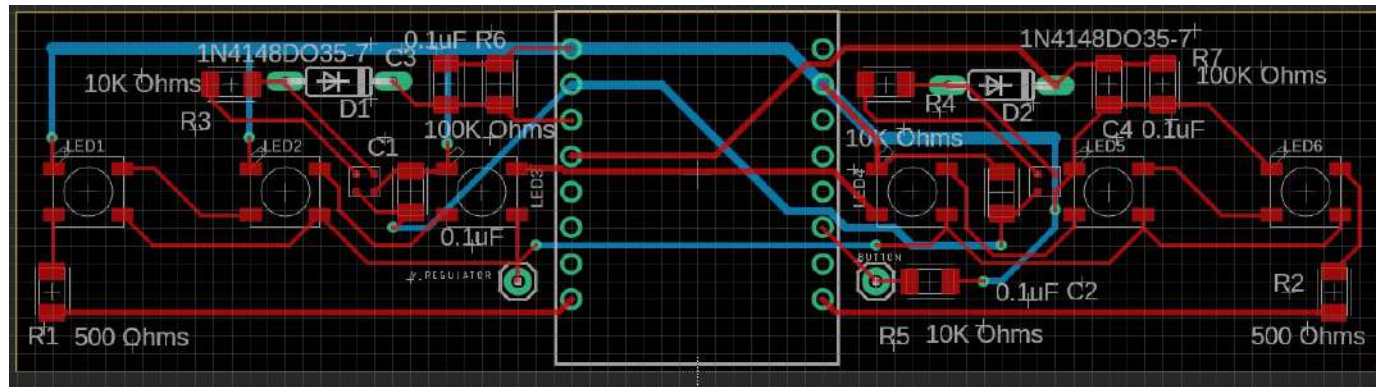
Red:  $\geq$  100 dB

# Solution Approach: Evolution

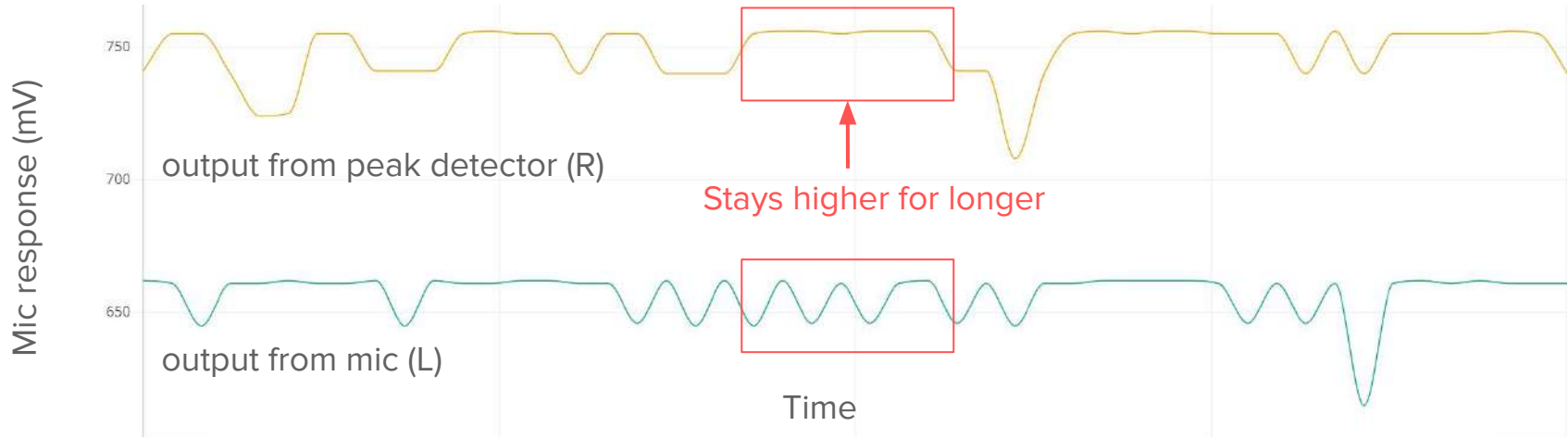
Peak detector added to the output of the mic before connecting to the Beetle



New PCB design to match



# Testing, Verification, and Validation: Microphone System

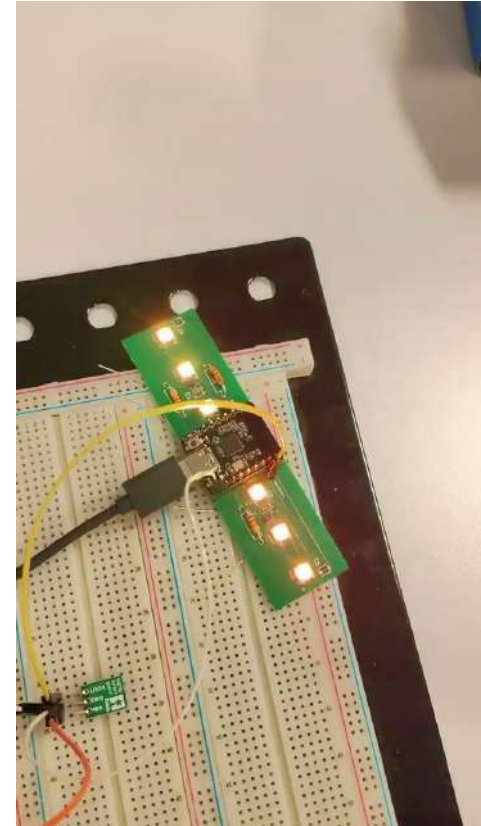


Requirement	Metrics	Results
New test: Mic output	Positive relationship between loudness and mic output read by Beetle	TBD
New test: Peak detector	Peak detector output smoother than mic output without peak detector	Passed @ 4 kHz (graph); retest @ 20kHz
Loudness	$ \text{Loudness result}  \leq 2 \text{ dB}$ of validated measurement	TBD



# Testing, Verification, and Validation: LED System

Requirement	Metrics	Results
New subsystem test: LED response	LEDs light up in correct colors when sample code is run	Passed: lights match known RGB values
Timeliness	LEDs change in $\leq 1$ second of speaker output change	Passed: lights change in $\leq 0.3$ sec



# Design Trade Offs

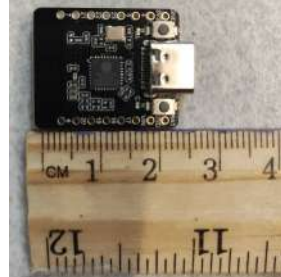
<b>Design Choice</b>	<b>Trade Off</b>
Battery with 4hr battery life instead of 8hr	User Comfort vs Battery Life
SMD resistors and capacitors	Size vs Permanence
Flex PCB	Flexibility vs Cost/Technical Difficulty
Peak detector	More Components/Time vs Better Data



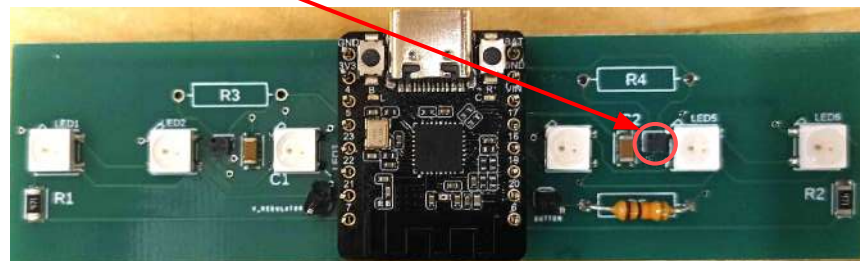
# Lessons Learned

- Everything takes longer than it should
- Important to write tests for subsystems as well as final product
- Sizing everything to be as compact as possible is non-trivial (finding, fitting, assembling components)
- Integration is hard and takes a lot of time (blocked by waiting for unit tests to pass)

Beetle size  
for reference



Very tiny mic



Testing mic output signal

