deciBright

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18-500 Capstone Design, Spring 2024
Electrical and Computer Engineering Department
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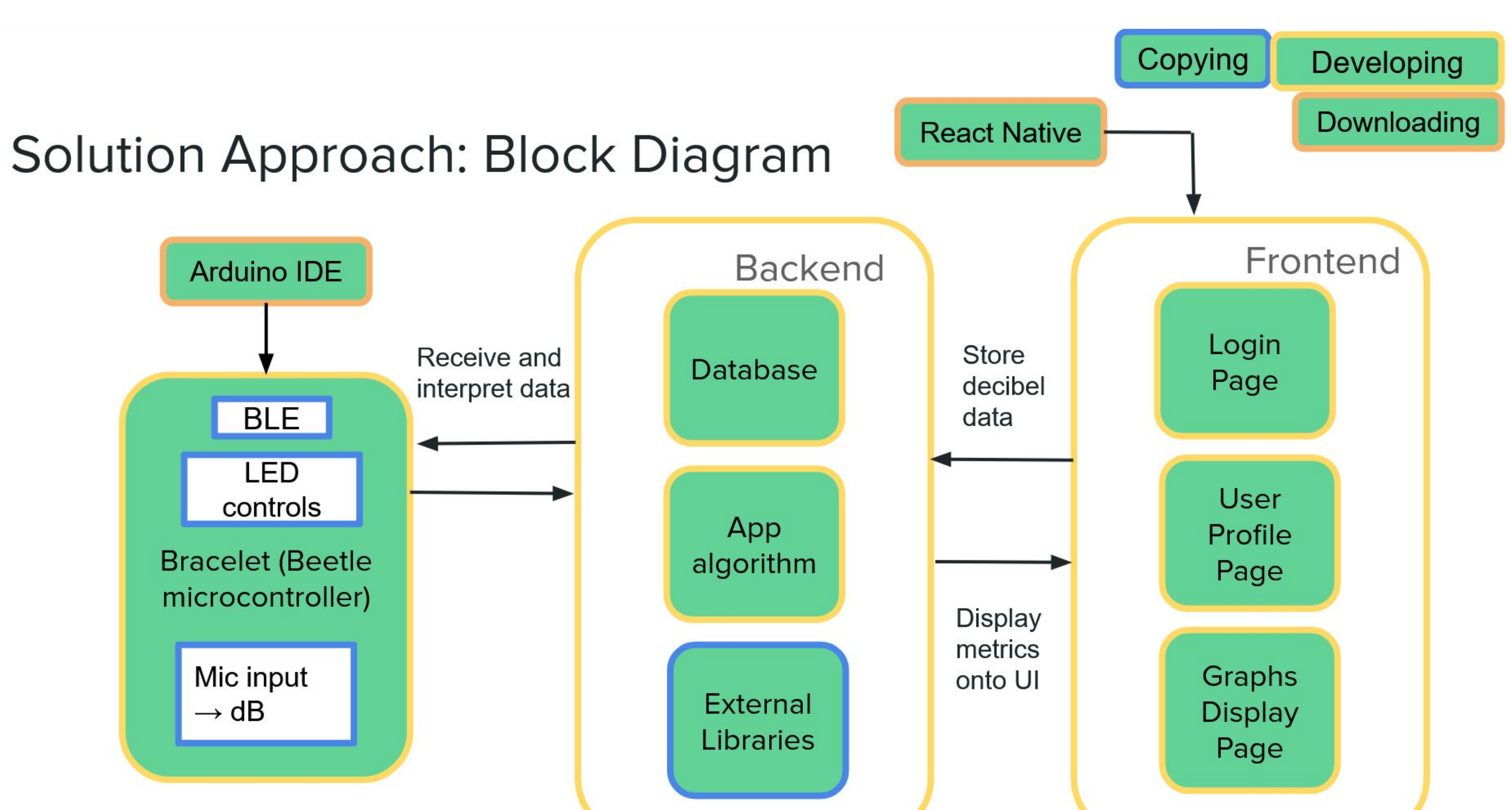
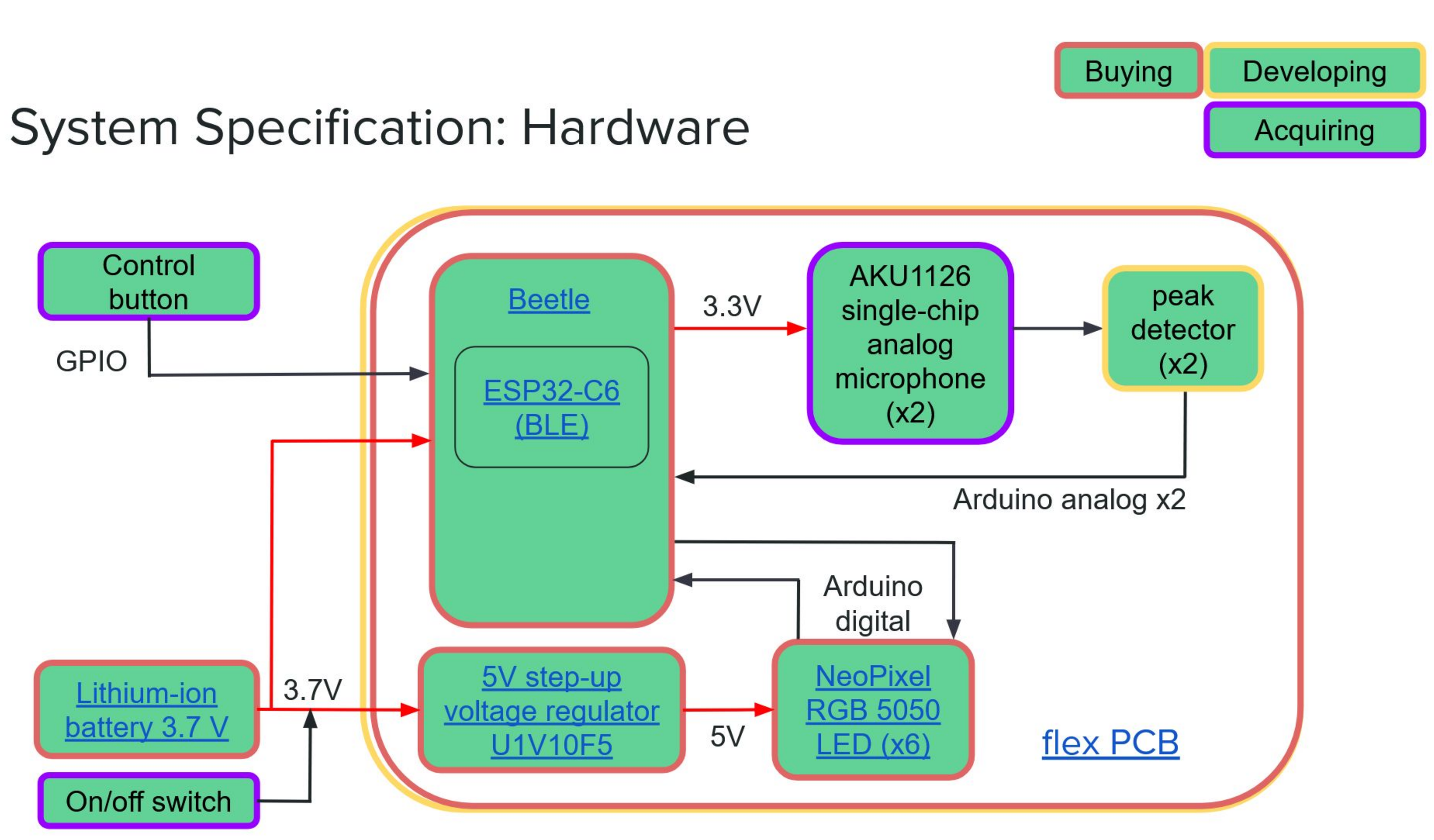
Product Pitch

Our project is a **color-changing light-up bracelet that monitors noise levels for wellness**, and a webapp for reviewing history and settings. Intended for use in daily life, the system provides a more **convenient, accurate, and fast visual representation of the noise level** of a user's environment rather than needing to carry around a sound meter. The different colors used can quickly **indicate how safe the surroundings are for prolonged exposure**. Our intended use case include a classical music rehearsal, so musicians can have the knowledge they need to make the best health decisions.

System Architecture

Our system is a bracelet and a webapp, connected via BLE (Bluetooth Low Energy). The bracelet reads in sound values from the environment, displays different colors on the LEDs depending on the loudness, and transmits them to the webapp. The webapp displays graphs representing sound exposure history and includes bracelet customization controls such as the thresholds for the colors, brightness, and hues.





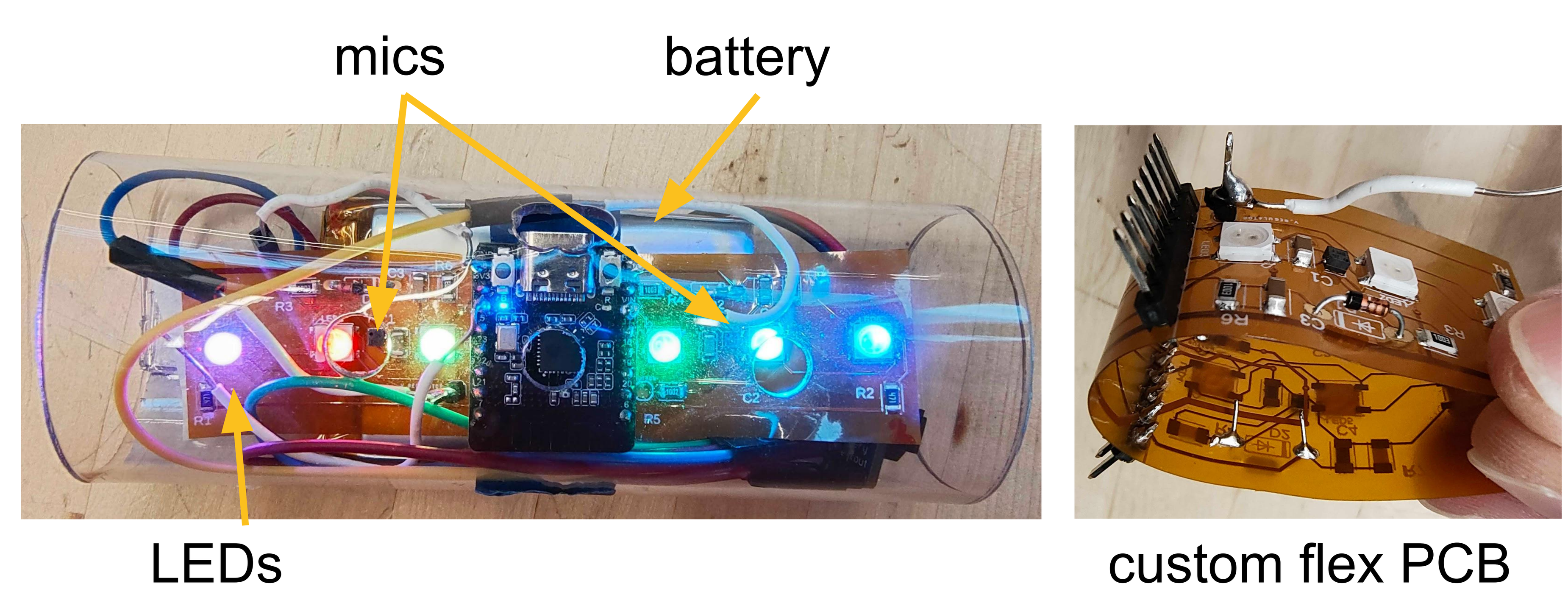
System Description

The hardware components include a custom-designed flex PCB, programmable NeoPixel LEDs, analog microphones with a peak detector circuit at each output, a Beetle microcontroller with built-in BLE capability, and a battery system that uses a boost converter to power both the PCB (3.7V) and LEDs (5V).

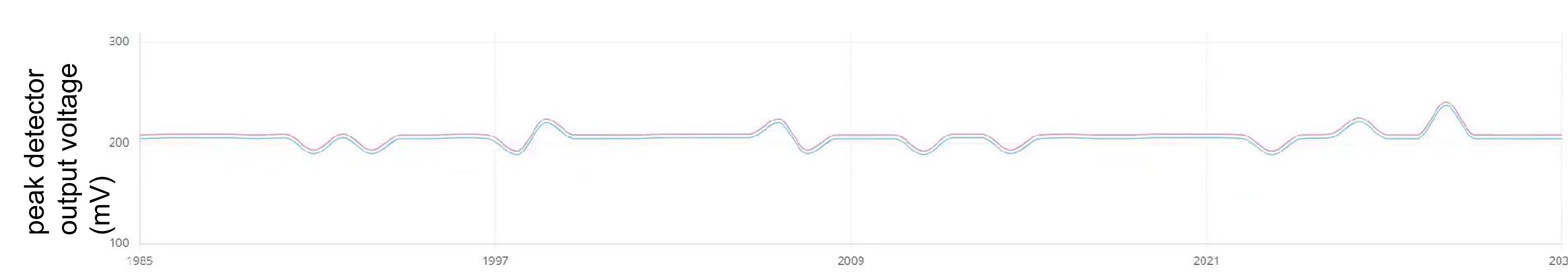
The software components include controls for bracelet mode, colors, noise level threshold, and light intensity, as well as a BLE connection between the phone (central device) and bracelet (peripheral).

The casing is made from PVC vinyl and adhered together with hot glue, with strategically placed holes for the microphones and USB port.

Beetle and LEDs powered by battery with boost converter



System Evaluation

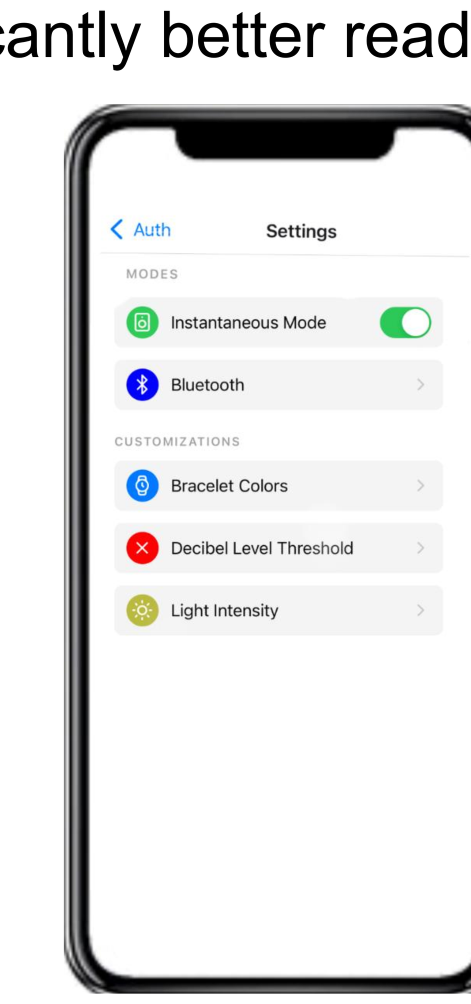


Response to piano/voice (rigid PCB, external peak detector)

The raw microphone output wasn't very good at detecting sound reliably. So, we added a peak detector system to improve sensitivity. It was worth the tradeoff to redesign the PCB to include this, as we have significantly better readings now.

The webapp subsystem is nearly complete. The LEDs can display the correct colors within 1 second after a sound, and the microphone system can respond to some sounds.

Remaining items include improving mic sensitivity and accuracy in order to calibrate it, communication between the bracelet and webapp, and testing everything to verify that our requirements are met.



Webapp settings display

Conclusions & Additional Information

Please visit our website for more information!

http://course.ece.cmu.edu/~ece500/projects/s24-teama7/

We learned:

- Sizing everything to be as compact as possible is non-trivial (finding, fitting, assembling components)
- It's important to write tests for subsystems as well as the final product
- Integration is hard and takes a lot of time (blocked by waiting for unit tests to pass)

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