**AudiBLE Winter 2017 Project Summary**

Nathan Riopelle, University of Michigan

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**Project Goal:** Create a small, low-power embedded device to measure the sound level of a room and interface with the Squall platform. Device should be able to provide a voltage from 0-3.3V that represents the audio intensity of the room and should be able to operate for at least one month without maintenance.

**Personal Goal:** To continue the project where Amit Shah left off with an error in the build of the board such that the integrator stage would not generate an output regardless of the accuracy of the simulation. My goal is to identify the problem, fix the board, and advance it to an operational state in which integer values can be read and transmitted.

**Summary of Work:** Upon examining the schematic files for the project, I quickly discovered that the dual amplifier chip used for the integrator stage differed from what was prescribed in the schematic. Figuring this to be the cause of the error but unwilling to modify the old board just yet, I prototyped the circuitry from the input of the integrator onwards on a separate board using the correct amplifier. Using this setup, I could measure a voltage on the output from 0 V–2.1 V that could be converted into an integer using an ADC. This measurement was done using a setup of an Arduino reading in the 3.3 V analog voltage, mapping it to an integer value of 0-255 and spitting it out to a serial display every second.

Although the range on the output of the prototyped integrator was less than the expected range from the single-supply op-amps (0 V–3.3 V), a behavior like this was also noticed in simulation and therefore determined to be an inherent behavior of the circuit. As such, this problem was never formally addressed, however doing so would be useful in the final board to get the full possible range of integer values.

The next step of my work involved populating two entirely new AudiBLE boards using the new amplifier and testing them to determine if they function properly as the prototype predicted. Once complete, I tested them using the same Arduino setup as before and determined that although they could recognize extremely loud noises, all of the precision in the normal sound range was gone and the voltage hung around 1 V. After scouring over the schematic for the board and my prototype and comparing the differences I determined that the original schematic used to fabricate the boards improperly routed R4 on the output of the comparator. When creating the prototype, I had naturally constructed the circuit how I believed it would work and thus skipped this error. By desoldering the resistor in its improper location and jumping a through-hole resistor in the correct location I was able to fix the issue and get the output voltage range from 0-2.1 V once again. I created an updated schematic and board file and uploaded them to GitHub as revision B of the AudiBLE board.

It is my belief that the original cause of Amit’s error and frustration was this improper routing and not a mistaken amplifier. Instead a different amplifier was likely replaced to see if a different result could be produced.

Finally, at the end of my work period began experimenting with interfacing the AudiBLE board with a Squall module and could read the voltage and turn on an LED if the audio level was above a certain level. Along with this I also conducted analysis of the power consumption of the board while sending Bluetooth packets every second. Running the Squall+AudiBLE boards at 3.3V I determined that on average the combination draws around 330 uA. When powered by a CR2032 coin cell battery (with a capacity of 225 mAh) this translates to 28.4 days of lifetime under constant operation. On top of this, if the module was put into sleep mode and only woken up every second, AudiBLE could last a couple months without changing its battery.

The next stage of the project I recommend would be to use the Bluetooth capability on the Squall to receive data packets from the AudiBLE board. Once this is completed the board can be positioned within a room and data can be collected while in the final board configuration.