

ECE 4012 Project Summary

Project Title	Backpack Speaker
Team Members (names and majors)	Andrew Verneti - CmpE David Rogers - EE Connor Brothers - CmpE Alex Mathis - EE Jack Glennon - EE
Advisor / Section	Dr. Allen Robinson / Section L6B
Semester	2020/Spring Final (ECE4012)
Project Abstract (250-300 words)	<p>Currently in the speaker market there aren't any portable speaker systems that are easy to carry around except for on a cart or are too small to produce meaningful sound pressure. The goal of this project was to create a portable backpack sized system of speakers including a subwoofer to fill the need of a portable but loud and high quality speaker system. Due to COVID-19 the final goal was changed to producing two of the system modules that serve as a proof-of-concept of the whole system. The two modules were made up of 1) the amplifier and 2) the Bluetooth wireless connection to an audio input.</p> <p>The complete system would have a sufficient battery life and have a user interface that was easy to use as well as providing decent sound quality and volume. Additional features would have included the ability to connect to up to 4 aftermarket Bluetooth speakers, RGB lighting that changes based on the volume and frequency of the music being played, and line level input via a 3.5 mm jack or RCA. Introducing other features such as equalizing, ambient volume adjustment, and surround sound would have been explored if time had permitted, and if no quarantine had been instated. The major challenge was programming and debugging the amplifier because multiple digital signals, each using different protocols needed to be observed and interpreted at the same time.</p>

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<p>List codes and standards that significantly affect your project. Briefly describe how they influenced your design.</p>	<p>I2C communication between the microcontroller and amplifier in order to initialize or change the amplifier settings.</p> <p>Bluetooth communication: Ensuring that a variety of Bluetooth devices can connect and transmit data.</p> <p>Audio communication (PCM over I2S): Ensuring that the host microcontroller can communicate with multiple amplifiers.</p>
<p>List at least two significant realistic design constraints that applied to your project. Briefly describe how they affected your design.</p>	<p>Weight- Must stay fairly light to ensure that it can be easily carried on back (other option would be to make it have wheels and a handle for rolling). Small but powerful speakers had to be chosen.</p> <p>Power Consumption- If lots of power consumption becomes necessary, a bigger (i.e. heavier) battery would be necessary to provide sufficient battery life. Efficiency was a large concern with choosing the amplifier and bluetooth module.</p> <p>Cost – Speaker equipment can be expensive and this project was no exception. Keeping the project under budget would have been a challenge if purchasing parts had been continued.</p>
<p>Briefly explain two significant trade-offs considered in your design, including options considered and the solution chosen.</p>	<p>Amplifiers- Many different amplifiers exist that could have done almost exactly the same thing as the amplifier that was chosen, but the chosen TAS3251 was unique in that it integrated a high power amp with a signal processor and DAC. An alternative amplifier that was considered was the TAS6424. The TAS6424 was a four channel amplifier that would have been enough to drive the midrange drivers and tweeters but not the subwoofer.</p> <p>Analog vs. Digital Primary Signal Paths- Analog potentially would have been much easier to debug because it could be interpreted by an oscilloscope, instead of a logic analyzer. Digital was chosen due to concerns in signal degradation over the analog lines potentially being near the digital lines introducing cross-talk.</p>
<p>Briefly describe the computing aspects of your projects, specifically identifying hardware-software tradeoffs, interfaces, and/or interactions.</p> <p><i>Complete if applicable; required if team includes CmpE majors.</i></p>	<p>A microcontroller was used for controlling various components of the speaker system such as a digital signal processor (dsp), analog muxing and switching, and hardware protection tasks. All of the subsystems needed to successfully interact with distribution of tasks handled by a microcontroller intermediary going between the Bluetooth module, the amplifier, and the ADC. The microcontroller chosen was originally an mbed, but was then replaced with a TI LaunchPad, each of which were programmed using C and were used to communicate with the other components using I2C and UART.</p>