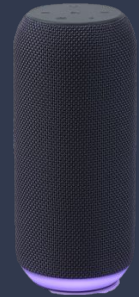
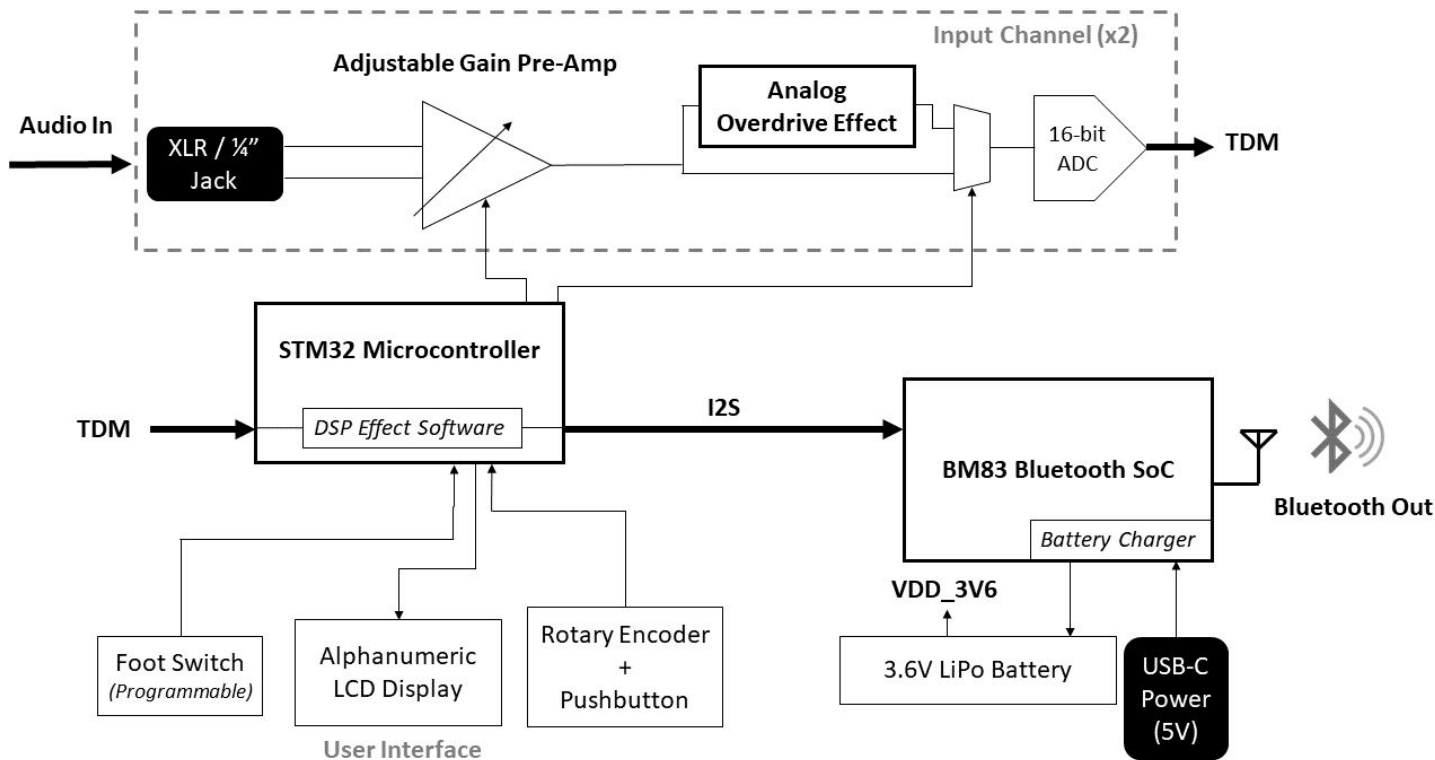


Bluetooth Audio Rejiggering Instrument (BARI)

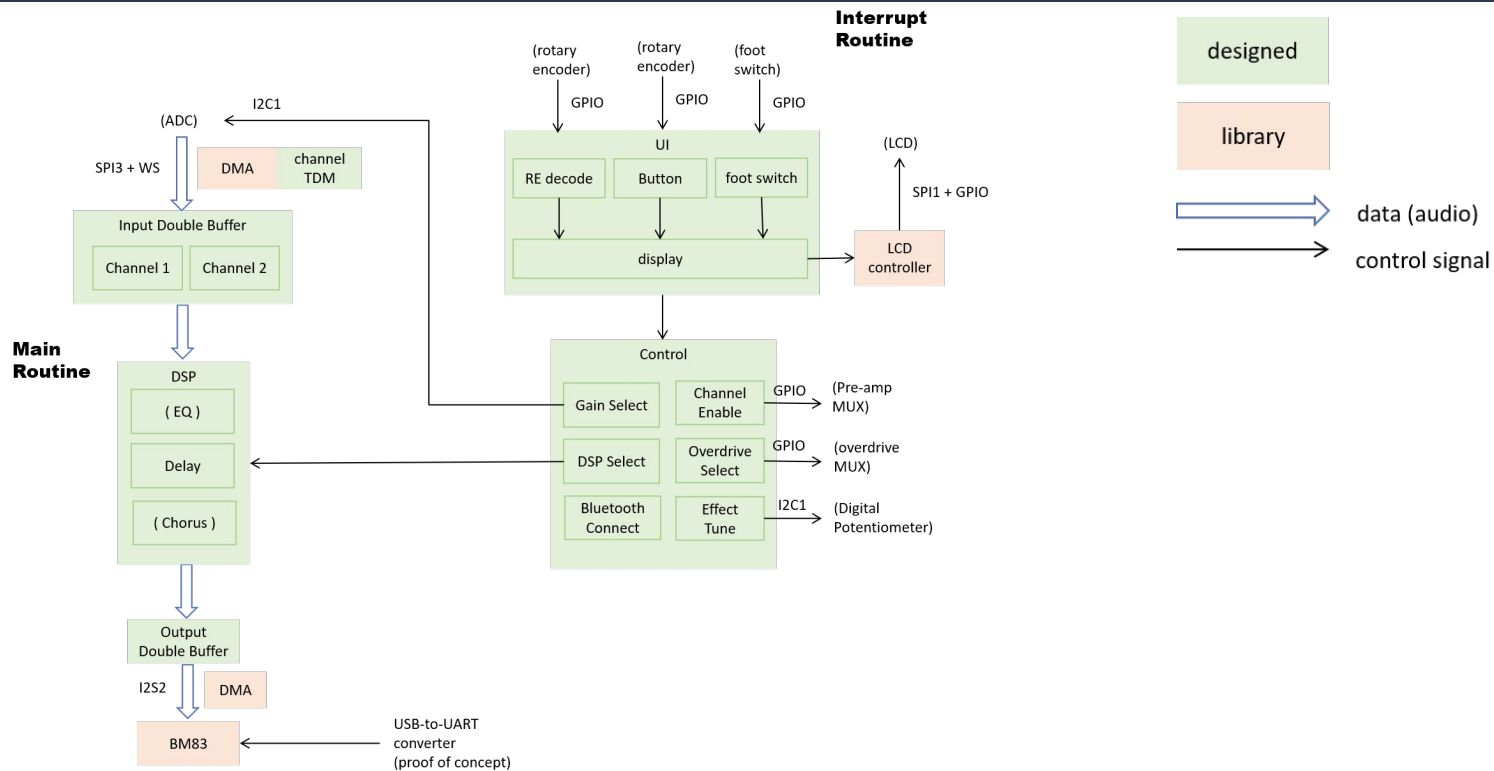
Adam Quinn, Sam Rainey, Xingran Du
(Group D0)



Solution Approach

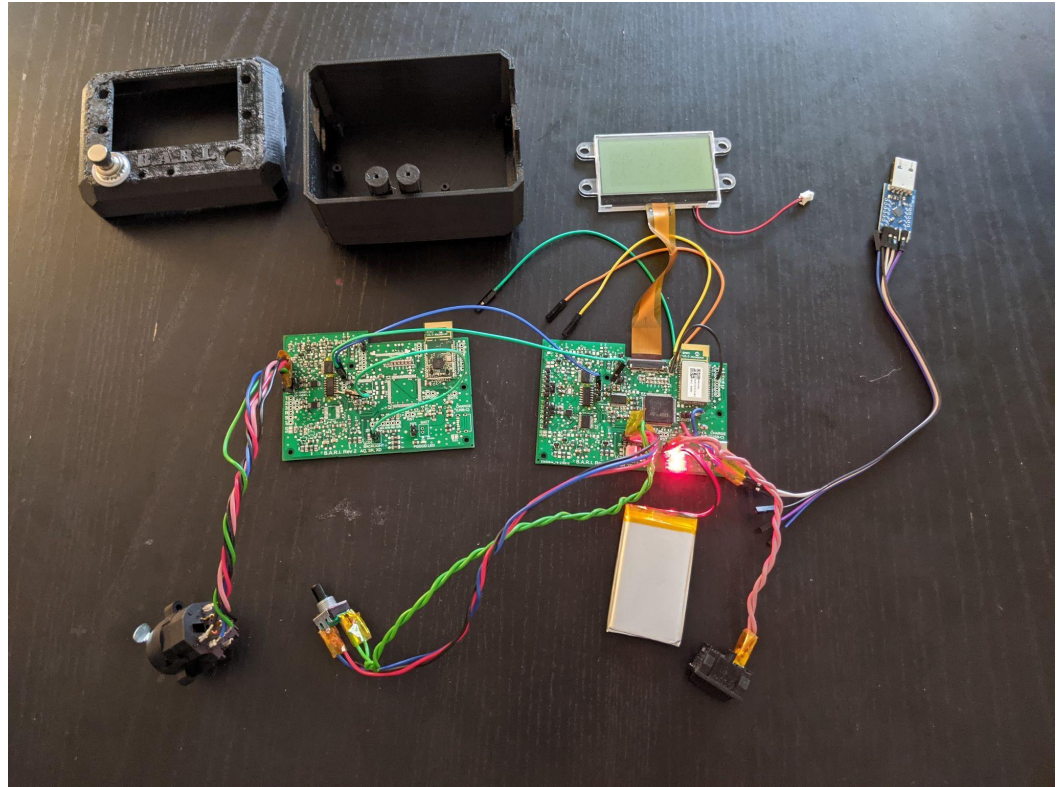


Solution Approach (Cont.)



Trade-Offs and Changes

1. New pre-amp
2. 4 → 2 input channels
3. MVP DSP effects
 - a. Delay
 - b. EQ



Complete Solution

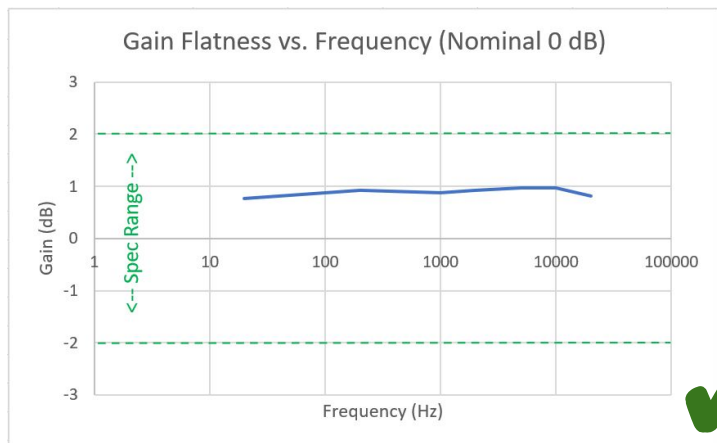
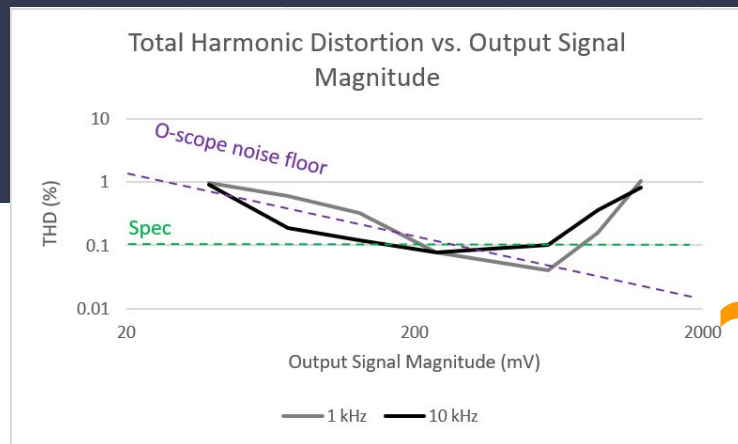
1. Implement DSP effects / update UI
2. Integrate UI and signal path
3. Debug signal noise (digital)
4. Final assembly (BARI box)
5. Complete testing/verification



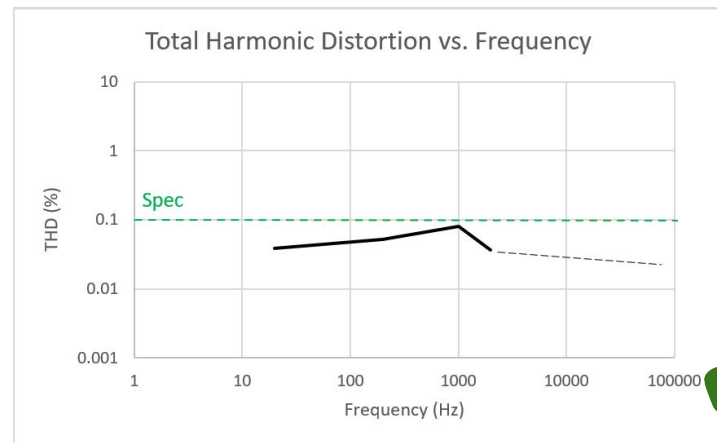
Pre-Amp Validation

Challenges for high-fidelity validation:

1. General-purpose oscilloscope w/ -80 dBV noise floor
2. Impure stimulus waveform
 - a. Higher freq → more harmonic attenuation than distortion



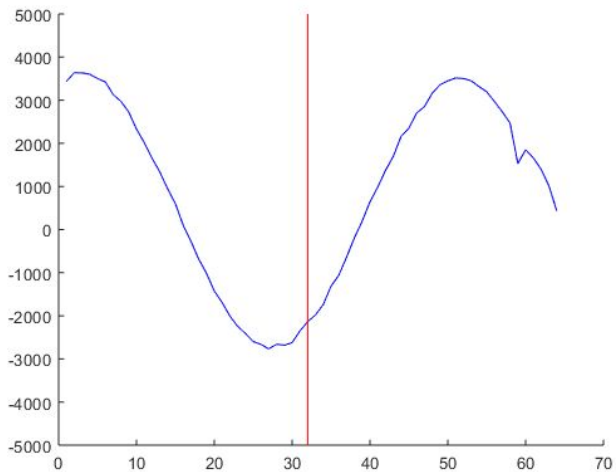
Output Magnitude = 250 mV



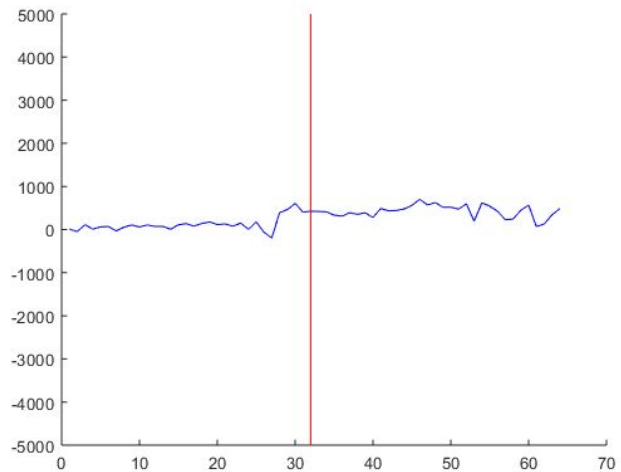
Output Magnitude = 250 mV

ADC Validation

- Noise is significant
- Makes up over 10% of the signal



1KHz sine wave



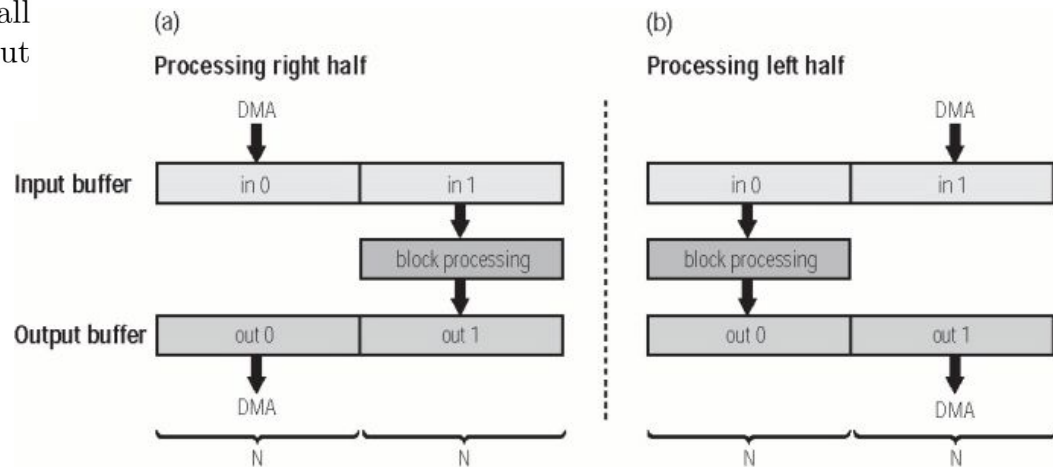
Noise

Digital Processing Latency Validation

S.R. 22 - PROCESSING LATENCY: The system shall have end-to-end latency of < 100 ms from the system input to the Bluetooth send.

Fixed data rate on the I2S audio bus

- 48KHz sampling rate
- Double buffering: 32 samples per block
- Total latency: 1.3ms
 - $2 * 32 \text{ samples} / 48\text{KHz}$



User Interface Validation

S.R. 23 - USER INTERFACE RESPONSE LATENCY:

The system shall finish responding to any user input (i.e. return feedback to the user) within 100 ms.

S.R. 24 - USER INTERFACE UPDATE LATENCY:

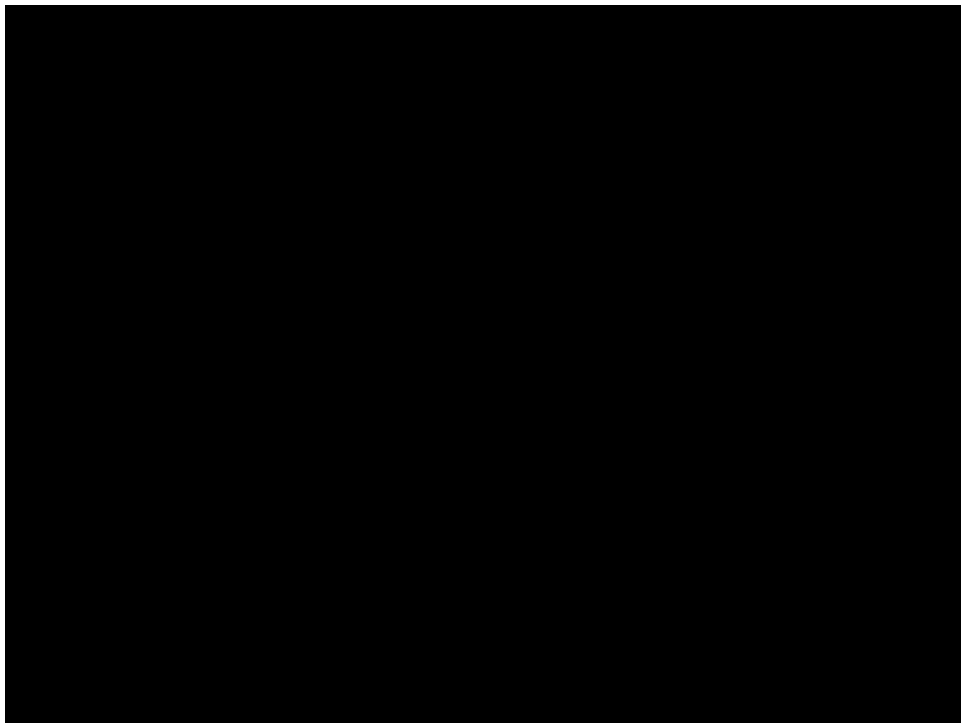
When the user adjusts a parameter through the user interface, the system shall update its state (i.e. gain settings on analog circuitry and DSP parameters) within 1s.

S.R. 25 - USER INTERFACE INTERACTION TIME:

The user shall be able to navigate to any command within 5s.

S.R. 26 - USER INTERFACE FEEDBACK MECHANISM: The system shall display a hierarchical menu in which the menu item that the user is currently interacting with is highlighted. The menu will contain: (a) All settings the user can adjust, and (b) The current system state.

- **Cursor-wrapping**
 - 2 turns to navigate to any line
- **Currently 2 menu layers max**
- **Each input takes effect within 200ms**
- **“Go Back” functionality**

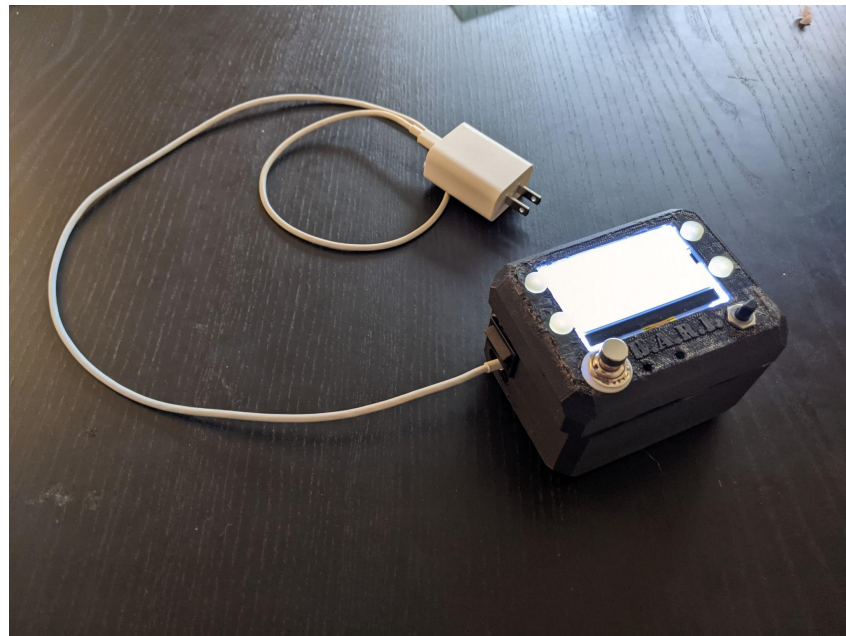


Bluetooth Range Validation

S.R. 14 - BLUETOOTH TRANSMISSION RANGE:

The average distance at which the system can maintain connection to a standard bluetooth speaker in an open air environment shall exceed 2 meters.

- Test environment: indoor
- Stable signal within the same room (3m * 3m)
- Signal starts to break down at 6m



Other Validation

Test Procedure	System Requirement
Battery Lifecycle Test	SR4 (Battery Lifetime)
Analog Effect SPICE Verification Test	SR12 (Analog Overdrive Performance)
Digital Effect MATLAB Verification Test	SR15 (Minimum Digital Effects) SR16 (Equalization Quality) SR17 (Delay Wet/Dry Ratio) SR18 (Delay Time)

Schedule

	26-Apr	3-May	10-May
Adam	Final Manufacturing of Rev 2 + Physical Enclosure Work on Final Presentation	Help Sam and Xingran as needed Testing/Verification Work on Project Video	Work on Written Report
Sam	Implement UI UI/Audio Path Integration Work on Final Presentation	DSP Effects Implementation Update UI w/ DSP FX Testing/Verification Work on Project Video	Work on Written Report
Xingran	UI/Audio Path Integration Work on Final Presentation	Complete UI/Audio Path Integration Debug digital signal noise Testing/Verification Work on Project Video	Work on Written Report
All		Final Presentation 5/3 and 5/5	Project Video due 5/10 11:59pm Virtual Demo 5/13 Written Report due 5/14 11:59pm