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# Amica Aura

*a friendly breeze*

Team BA

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# Signal Processing: Requirements

- Active Noise Cancellation
  - Generate an appropriate FIR filter in real-time
  - Best approximate digital FIR filter with custom analog configurable filter via coordinate descent algorithm
  - Eliminate sufficient amount of noise while still maintaining quality of original audio

# Signal Processing: Solution Approach

- Simulation Testing
  - Implementation of Algorithm in Simulink
- Embedded Application
  - Implementation of Algorithm in C
  - Use of directional MEMS microphones and op-amps
  - Communication through ESP-32 over I<sup>2</sup>C to digital potentiometer

# Signal Processing: Testing, Verification, Metrics

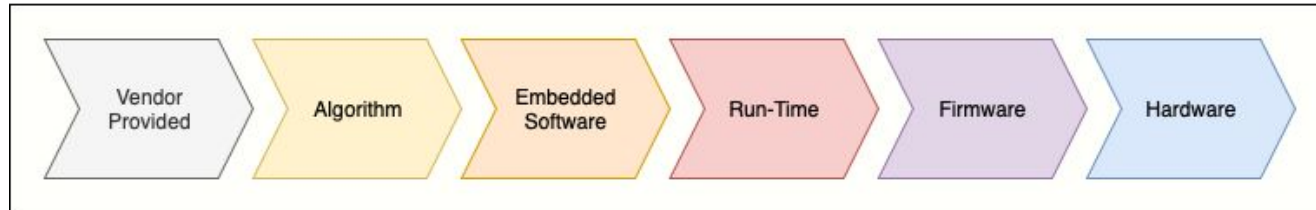
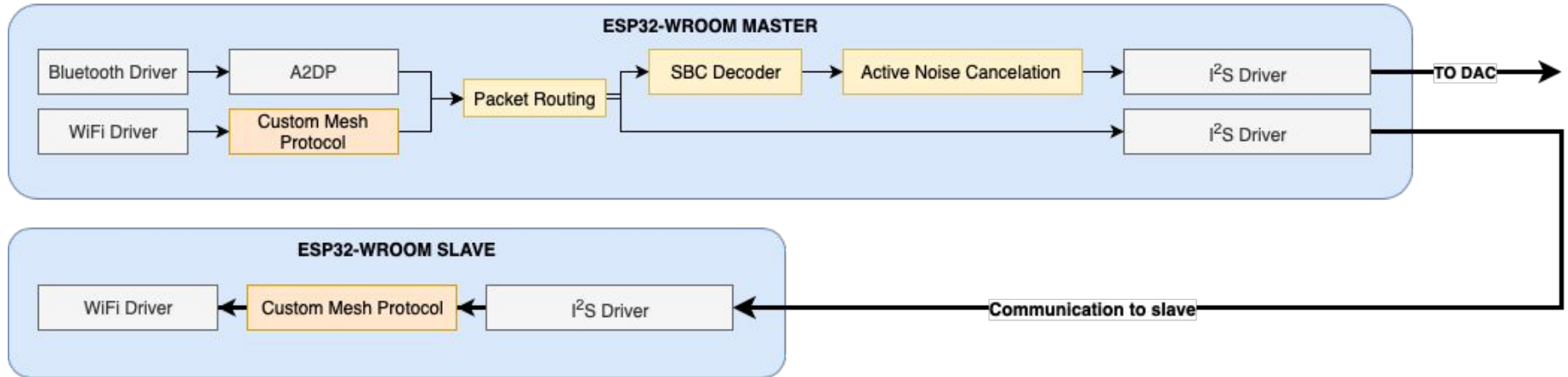
- Goal: Create active noise cancellation system comparable to Bose QuietComfort 35 ii
- Compare systems under a variety of conditions
- Use quantitative metrics

# Software: Requirements

- Music Playback
  - Amortized SBC packet processing time of  $24\mu\text{s}$  (41.6khz)
  - Playback over I<sup>2</sup>S to DAC
- Networking
  - Max delay of 10s per 'hop'; 3s under optimal conditions
  - Effective WiFi link speed of at least 400kbps
- UI/UX
  - Detect user input via wireless gesture sensor

# Software: Solution Approach

## Audio Packet Routing



# Software: Testing, Verification, Metrics

- Music playback
  - Calculate average packet processing times and jitter.
- WiFi Mesh
  - Run adversarial examples against mesh model
  - Measure RTD of acknowledged packets.
  - Test mesh firmware/hardware in “ideal” and “noisy” environments
- UI/UX
  - Measure gesture recognition fail rate.

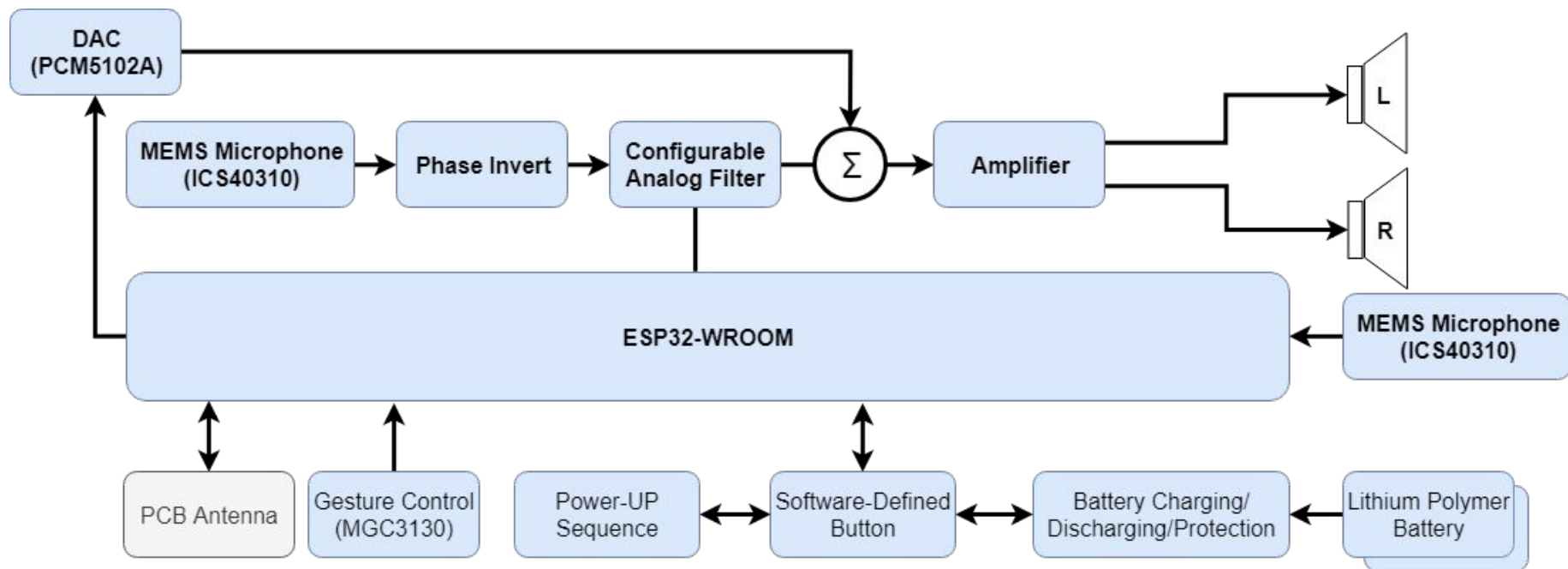
# Hardware: Requirements

What are the requirements of your project?

- Adaptive analog noise canceling
- Min. 4 hours battery life in Broadcast Mode
- Simultaneous Bluetooth and WiFi connections
- Custom PCB and 3D printed enclosure



# Hardware: Solution Approach



# Hardware: Testing, Verification, Metrics

- PCB design: Peer review & insert probe points
- SPICE modeling of power supply and analog filter
- Measure clock skew, distortion on intra-headphone I<sup>2</sup>S line with oscilloscope
- Power consumption
  - Charge time, standby time, playback time, broadcast time

# Tasks

## Michaela

### Active Noise Cancellation

- Research
- Implement
  - Simulink
  - FIR to configurable filter
  - C
- Apply to Hardware

## Ethan

### Software

- Mesh
  - Research
  - Implement Mesh Model
  - Integrate routing protocol w/ Mesh Model
- Bluetooth
- UI/UX
- Firmware

## Winston

### Hardware

- Footprint + CAD
- Schematic
- SPICE modelling
  - Power supply
  - Analog filter
- Enclosure
- Layout
- Assembly

# Gantt Chart

