

MSD P13038 Hearing Aid Design

System Design Review Pre-Read
January 9, 2012

Overview

On January 11th, at 2pm in room 09-4425 our team will be hosting our system design review with the intent of gaining expert and customer feedback for our audio accessory. The meeting will include a review of the customer needs, project specifications, functions, physical design (visual model), and electrical and software architecture.

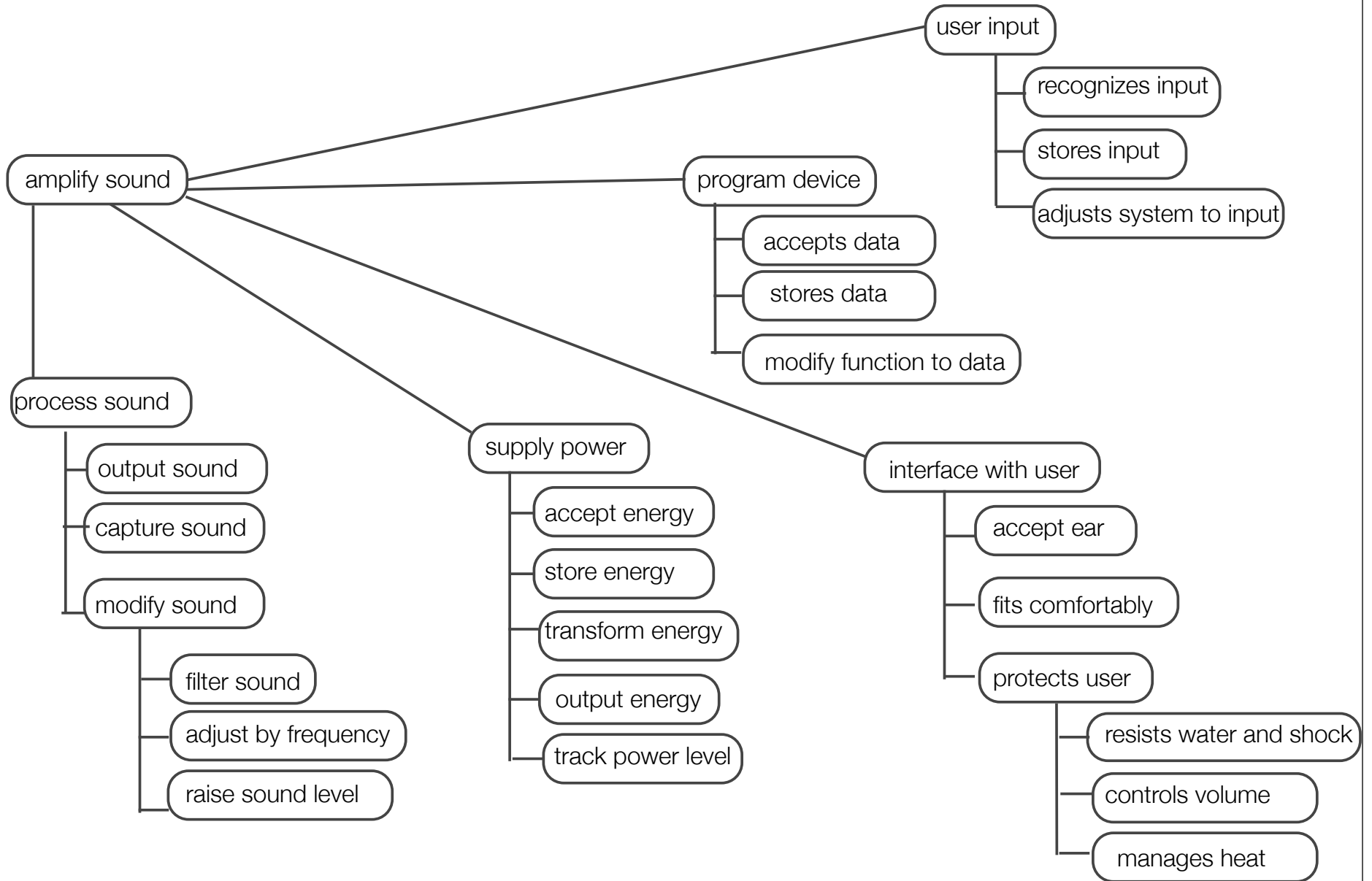
The primary objective of this project is to create a functioning prototype that appeals to both hearing and hard-of-hearing users by designing a reprogrammable, ergonomic, and rechargeable audio accessory. The prototype must amplify sound, contain a rechargeable power source, and include a means of data transfer. The final product must promote a design that is ergonomic and focus on the user experience.

This document contains photos of the proposed enclosure, the functional decomposition, and architectures for all mechanical, electrical, and software systems. The major questions and areas of concern are outlined on the appropriate slides. The topic of interest for this design review include: design intent, user satisfaction, electrical chip selection, and software strategies for sound filtering and amplification.

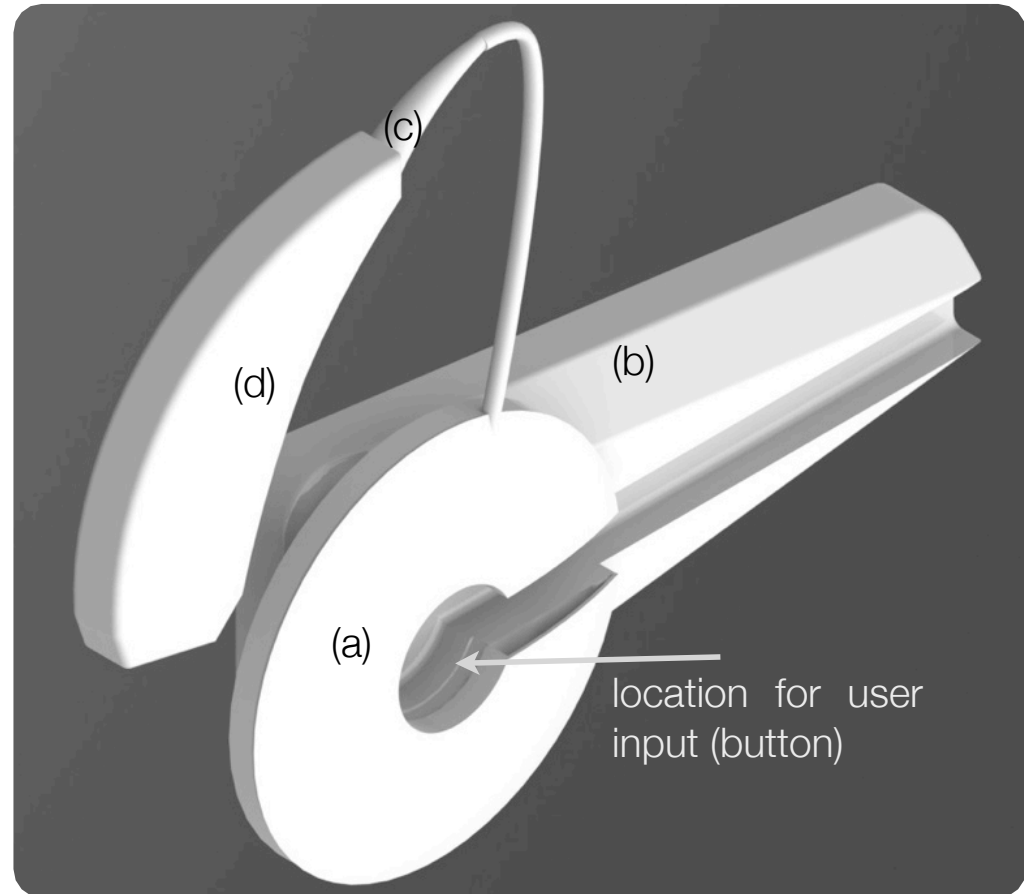
We look forward to your comments and attendance on Friday,

Team P13038

Functional Decomposition



Enclosure Proposal 1.9.13



What are potential areas of concern for product manufacturability?

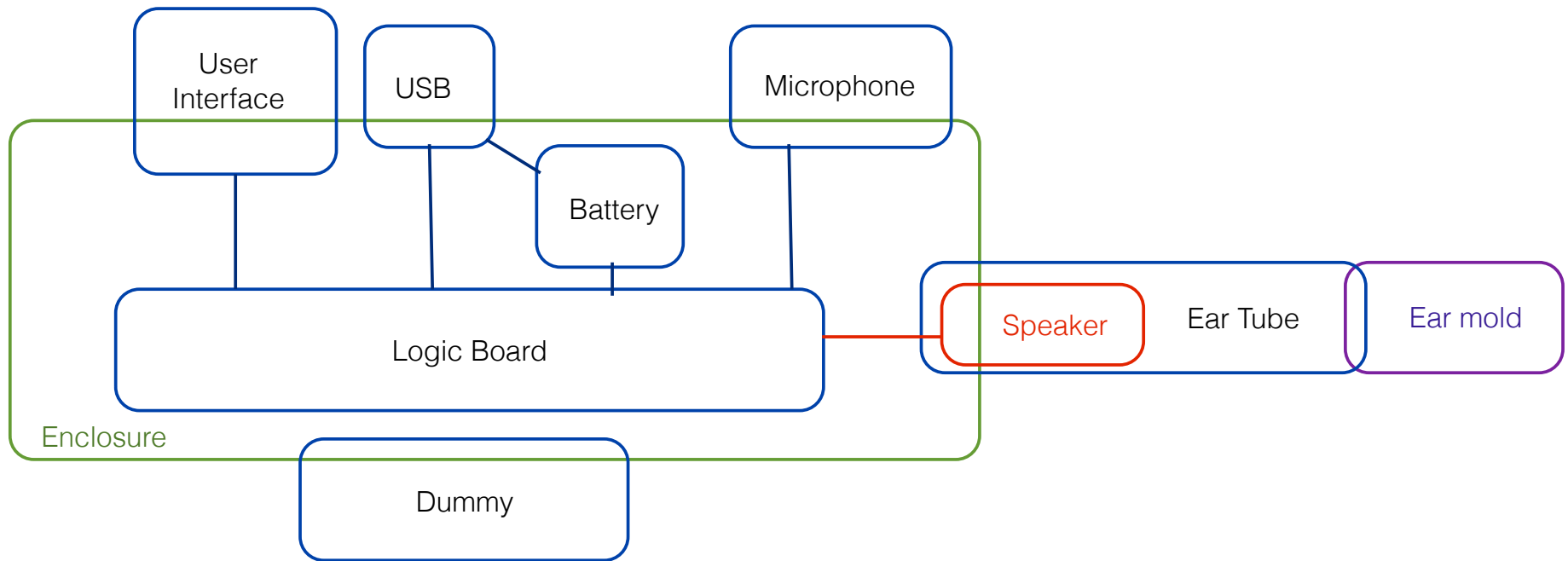
Aesthetically, what are strengths and weaknesses of this design for both hearing and hard-of-hearing users?

What are possible resources or studies we can conduct to measure user comfort, user experience, and user satisfaction with the visual design?

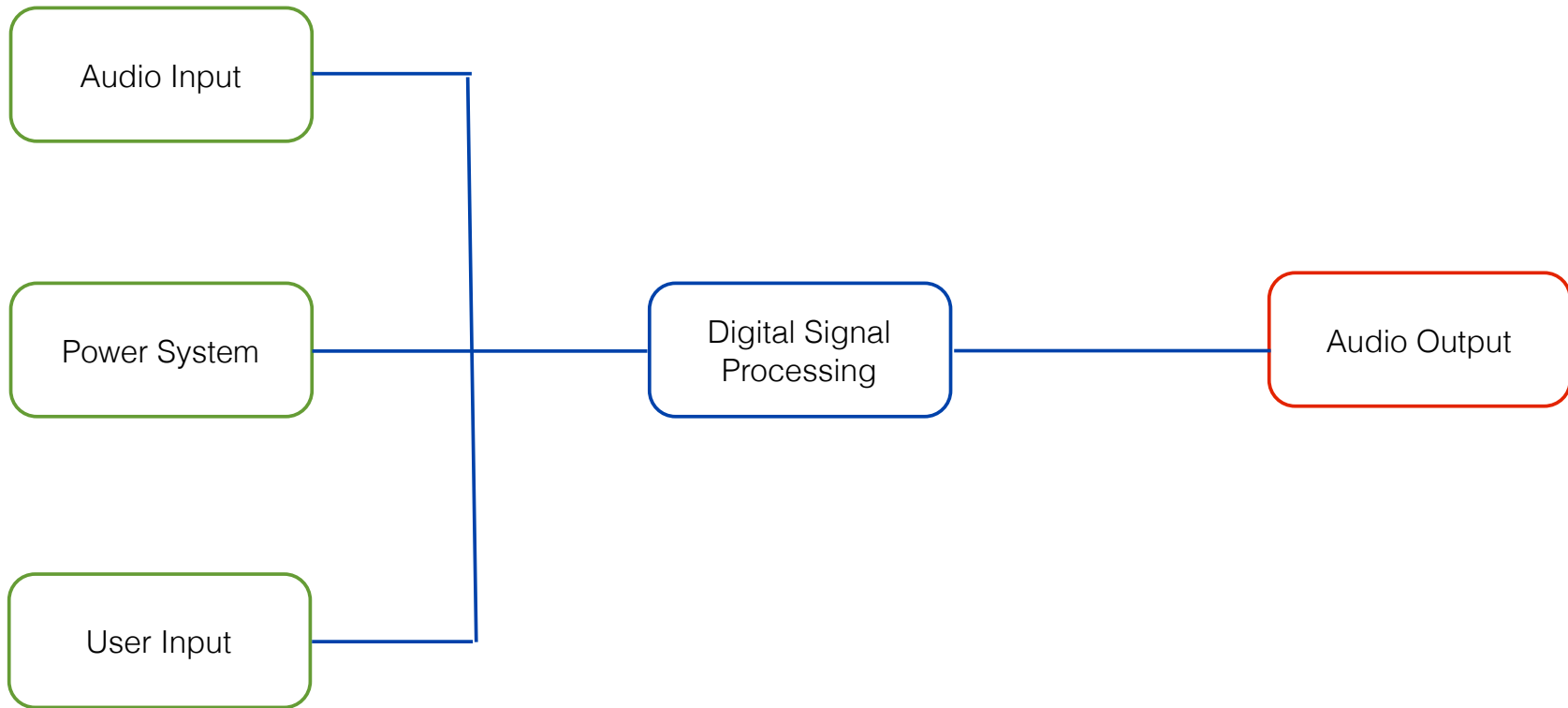
Currently, we are taking into account the 5% Female, 95% Male ear dimensions to accommodate the largest population, what are other considerations should we take into account when designing the hearing aid?

(a) main enclosure, (b) "dummy" enclosure, (c) ear tube, (d) behind the ear enclosure, (e) input button

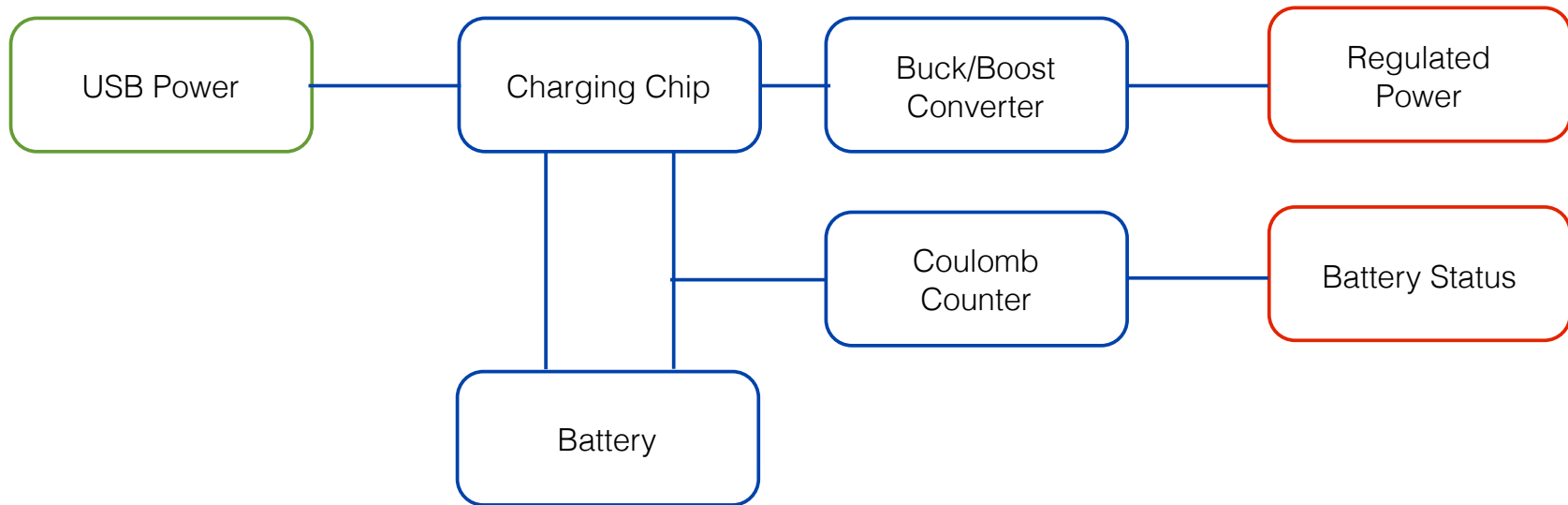
System Architecture (Physical) 1.9.13



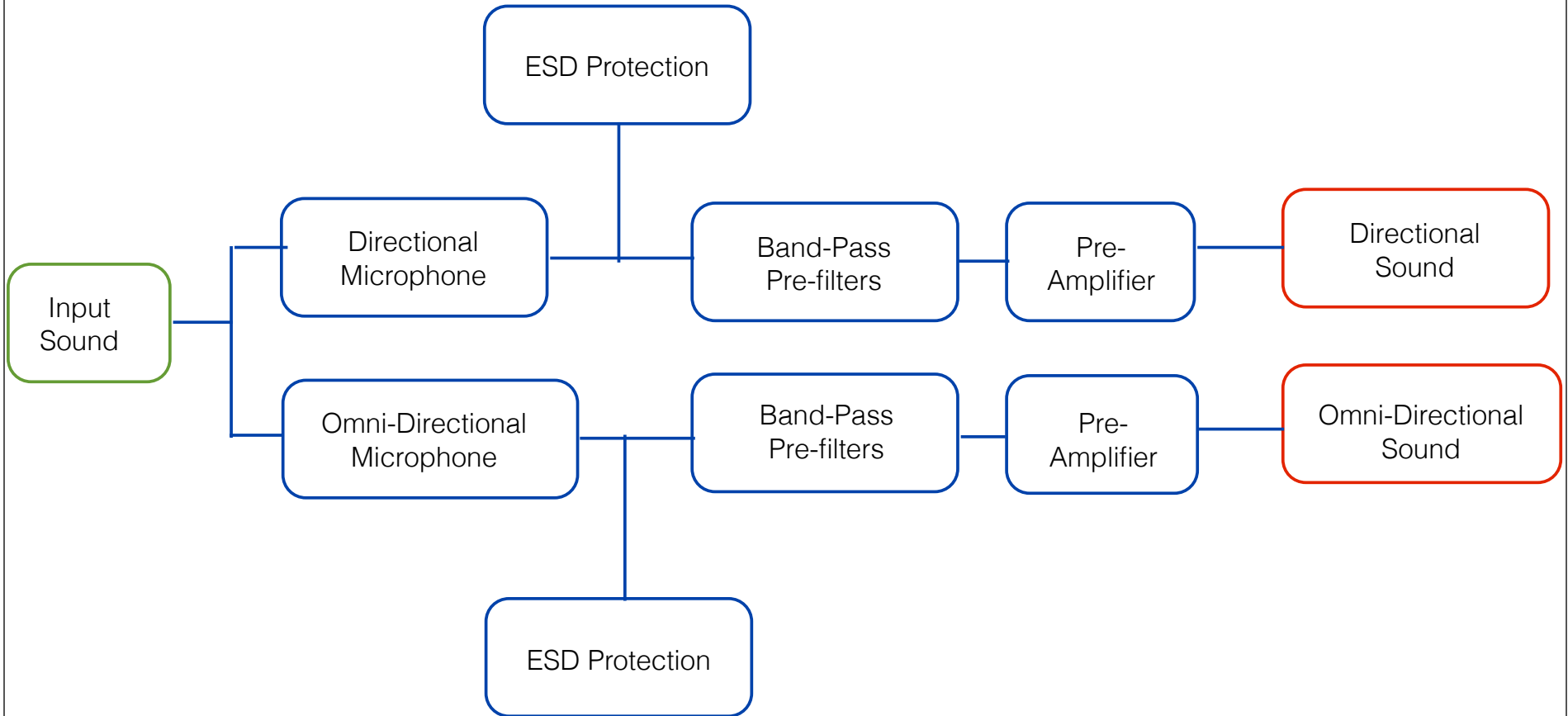
System Architecture (Electrical) 1.9.13



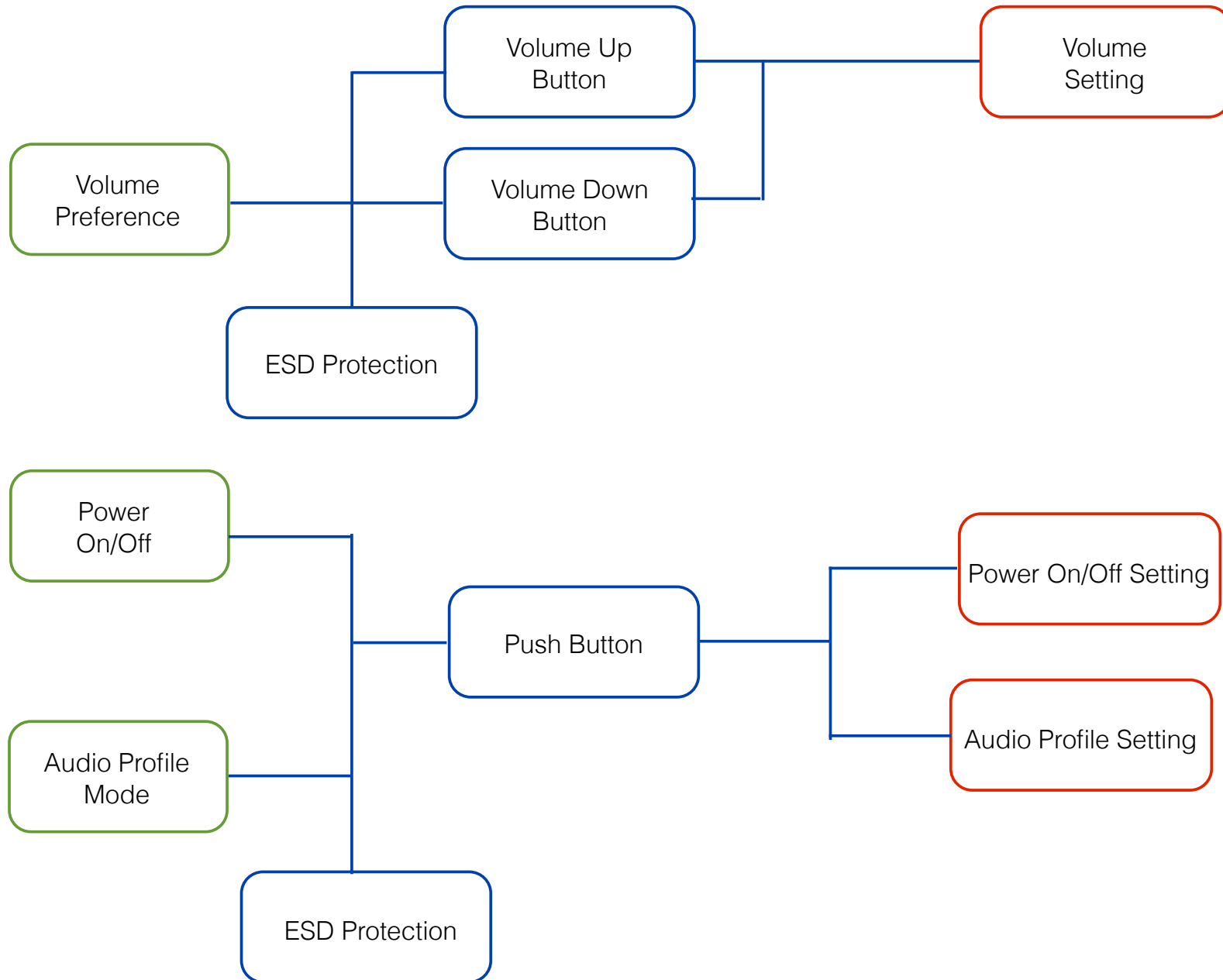
Power System Architecture (Electrical) 1.9.13



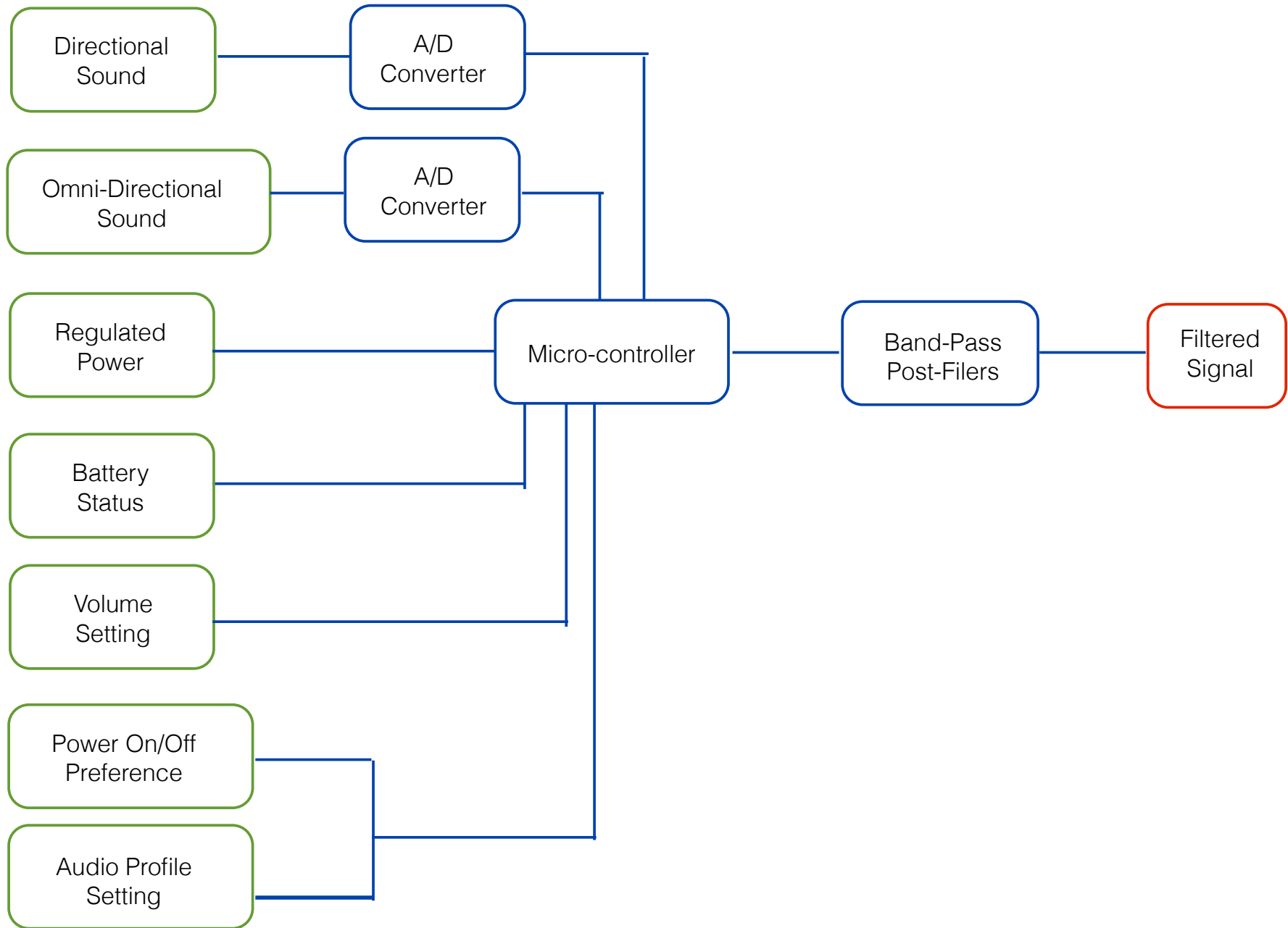
Audio Input Architecture (Electrical) 1.9.13



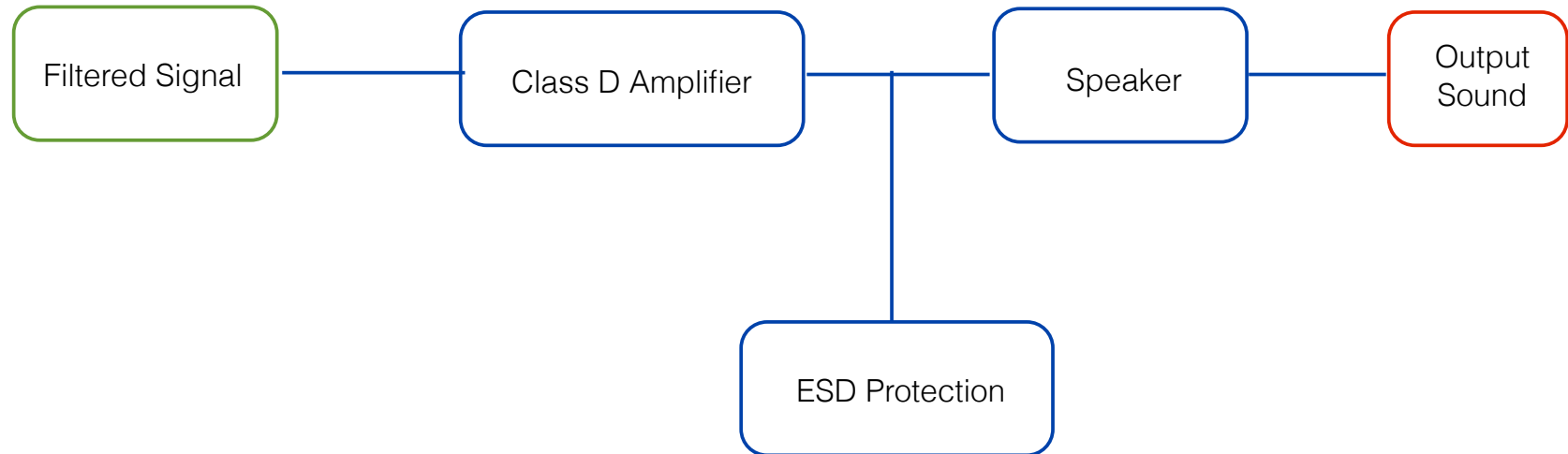
User Input Architecture (Electrical) 1.9.13



User Input Architecture (Electrical) 1.9.13

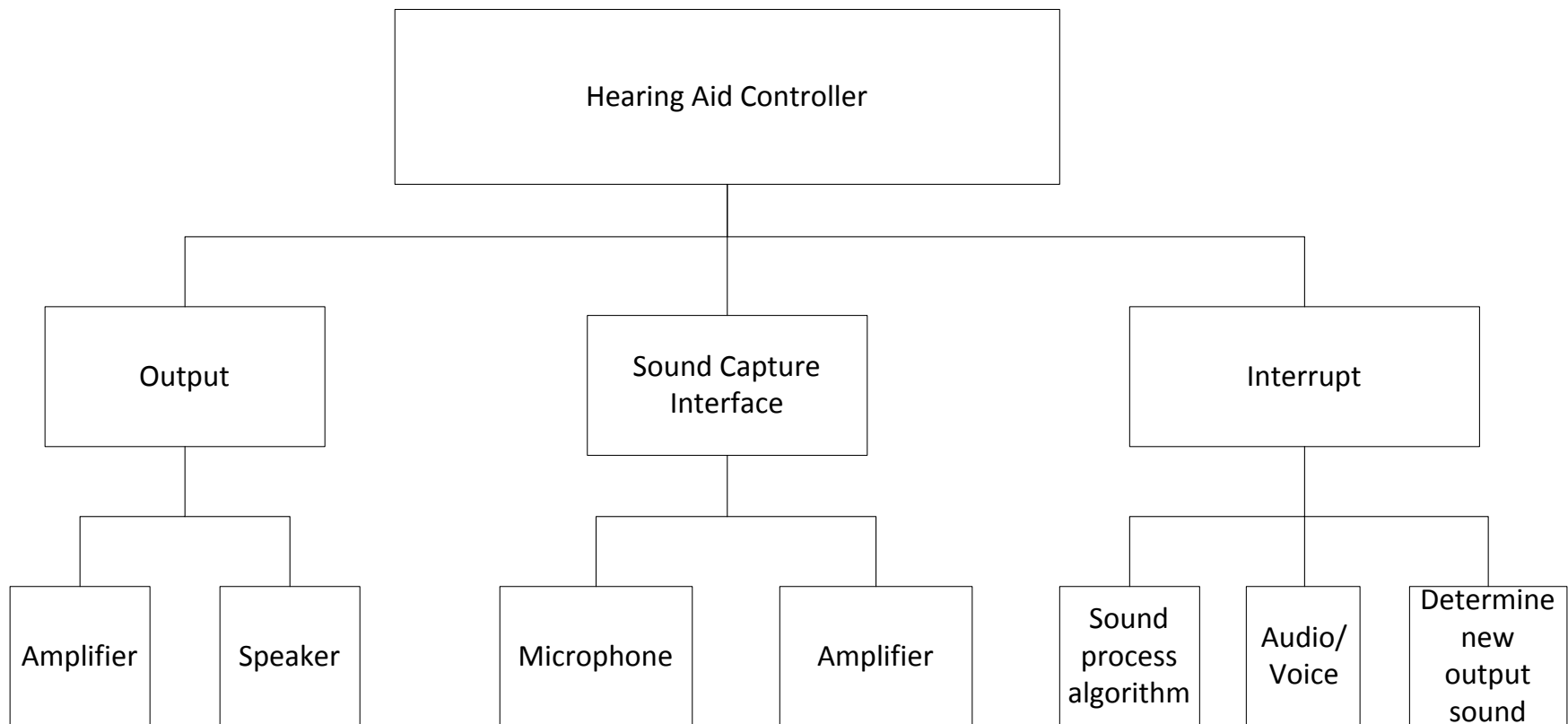


Audio Output Architecture (Electrical) 1.9.13



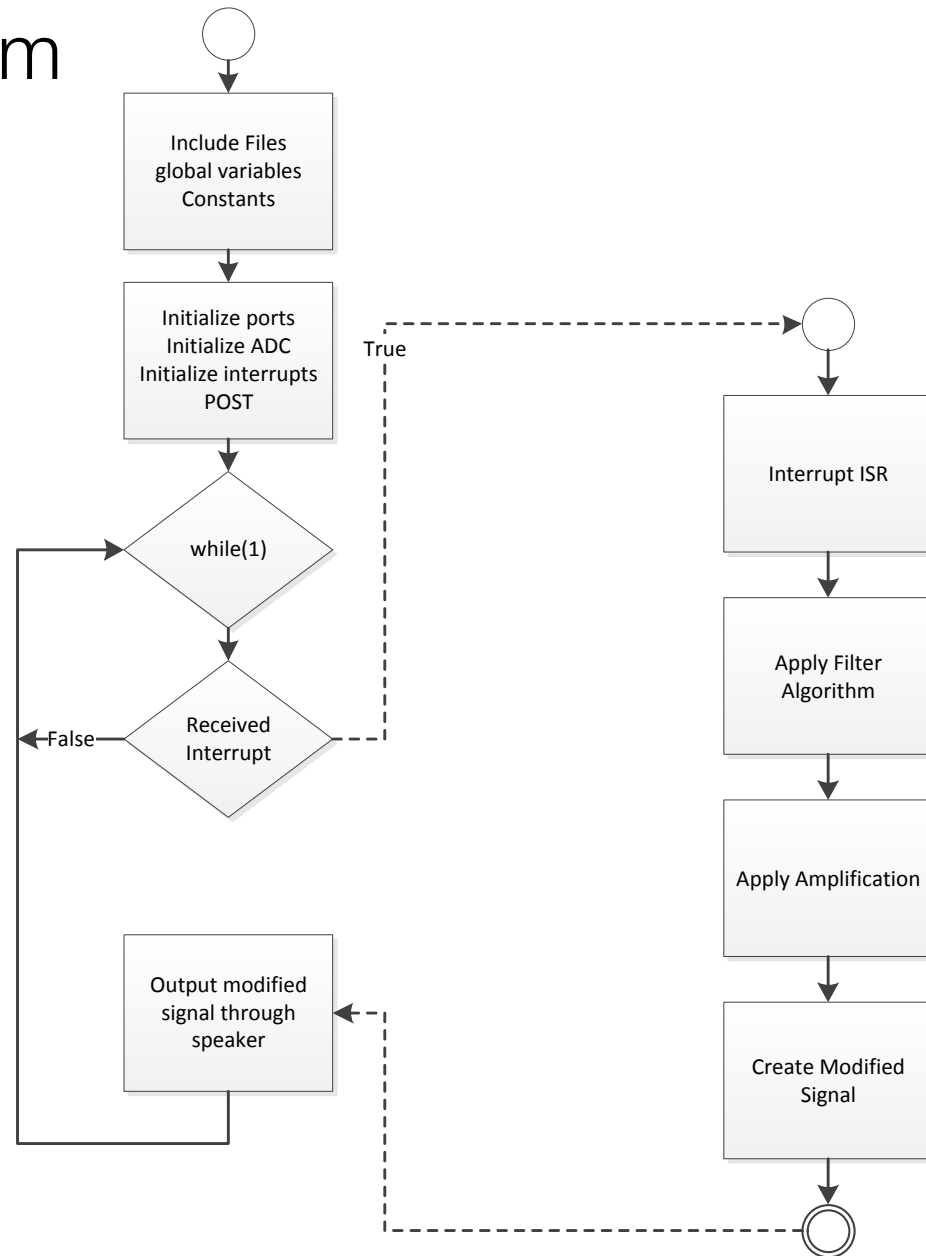
System Architecture (Software) 1.9.13

Structure Chart



System Architecture (Software) 1.9.13

UML Activity Diagram



Additional Electrical Questions 1.9.13

- (1) Are any critical components missing from this audio amplification system?
- (2) In what ways can we electrically isolate the user from the circuit?
- (3) What techniques can be used to minimize power usage and loss?
- (4) Please comment on what micro-controllers are best for this application.

Possible Micro-controller Options

1) Freescale MC568006 Digital Signal controller

Data sheet: http://cache.freescale.com/files/dsp/doc/data_sheet/MC56F8006.pdf?pspl=1

Power supply: min- 3v typ- 3.3v max- 3.6v Size: 7 x 7 mm .5 pitch

Power Consumption: run: 41.52mA, low speed run: 340.75 uA, low power run: 166.30 uA Pros: small form factor, 9 different power modes,

Cons: might consume more power than we want, No previous experience with this chip

2) TI TMS320C5535 Fixed Point Digital Signal Processor

Data Sheet: <http://www.ti.com/lit/ds/symlink/tms320c5535.pdf>

Power supply: 1.8-V, 2.5-V, 2.75-V, or 3.3-V Size: 12 x 12 mm .8 pitch

Power Consumption: Active @ Room Temp 25°C, 75% DMAC 25% ADD + 0.15 mW/MHz @ 1.05 V, 50 MHz or 0.22 mW/MHz @ 1.3 V, 100 MHz

Pros: Only needs 1.8 V, FFT Hardware Accelerator

Cons: large package type, pitch of .8, No previous experience with chip

3) ON Semi Ayre Series of chips

Data Sheet: http://www.onsemi.com/pub_link/Collateral/SA3291-D.PDF

http://www.onsemi.com/pub_link/Collateral/GA3227-D.PDF

Power supply: 1.25 V Size: 6.35 x 3.68 x 1.65 mm

Power Consumption: n/a

Pros: Handles noise cancellation, filtering, amplification, volume control. Has all of the features that a commercial hearing aid has

Cons: Not sure if there is an eval board (found in data sheet that an eval board can be ordered)