

Sound Assist

Auditory Sensory Supplementation

Members: Adam and Alex

Client: James Frenzel

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Project goal

- To create an assistive listening device to increase the intelligibility of human speech in common media, such as movies and television.
- The device *must* increase the intelligibility of human speech.
- The device *should* be customizable to suit the needs of individual users.
- The device may include a wireless transmission system.

Deliverables

- A main unit that does the majority of the processing and audio enhancement that meets specifications.
- Optionally, a receiver end to the device for wireless connection to the main unit

Specifications

Required:

Client Request	Specification
Increased Audio Intelligibility	Vocals Boosted by +0db to +10db
Reduction in background noises	Background noise reduced by -0db to -10db

Optional:

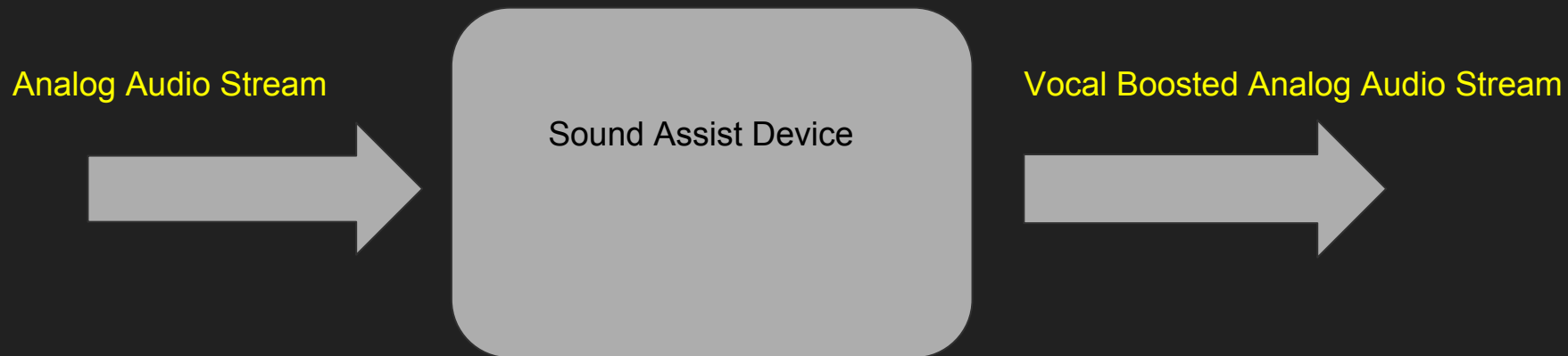
Client Request	Specification
Wireless transmission	Only have wires at the device for headphones and power
Multiple Users	Offer full functionality to multiple users
The device has learning capabilities	Add a learn mode that allows for user customized equalization

Project Learning Summary

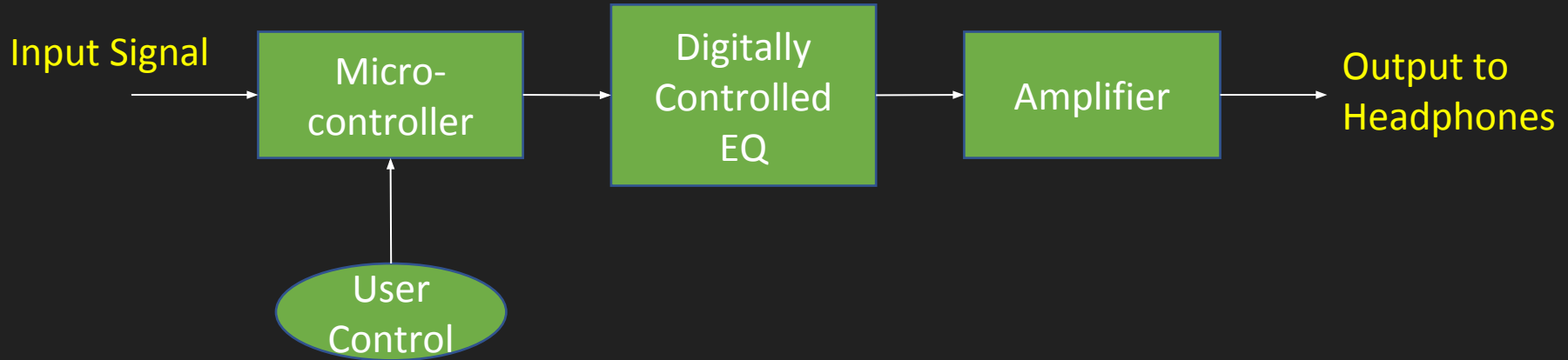
-The peak frequencies of human hearing are between 2-5kHz. These are particularly important frequencies for understanding human speech.

-Blind Source Separation (BSS) algorithms such as Independent Component Analysis (ICA) can be used to separate mixed audio signals into the individual signals that make up the mix. Speech can then be amplified without affecting background noises.

Design Overview



Design Option 1



Pros:

- Flexible
- Simple implementation
- User definable settings (memory)

Cons:

- Less robust
- Can negatively affect non-speech noises

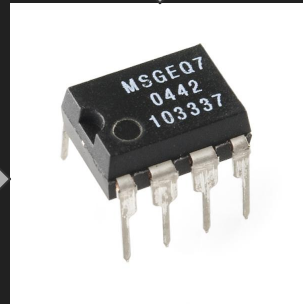
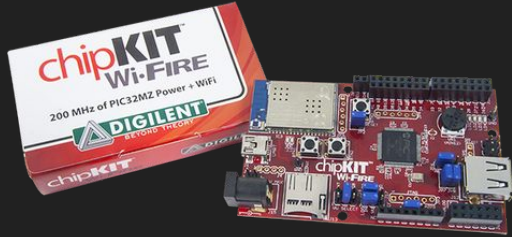
Option 1 Implementation

EQ chip Boosts vocal audio range

Input



Wifire handles equalizer chip and user input

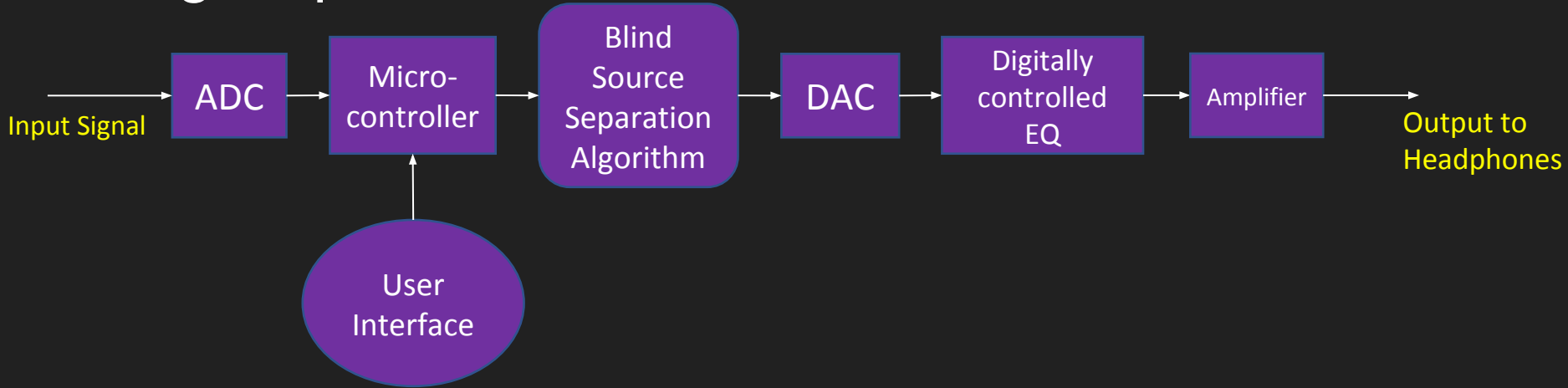


Audio amp to adjust total volume



Output

Design Option 2



Pros:

- Most improvement in speech intelligibility
- Very flexibly design
- Most user customization and controllability

Cons:

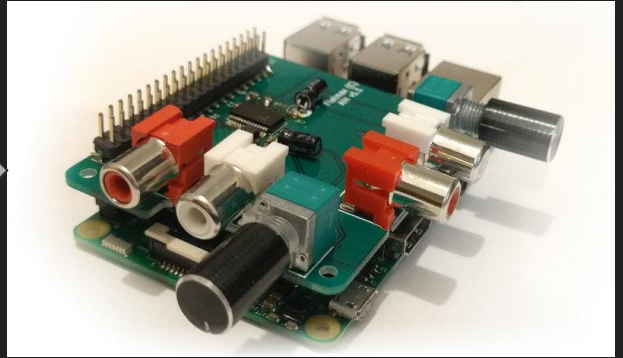
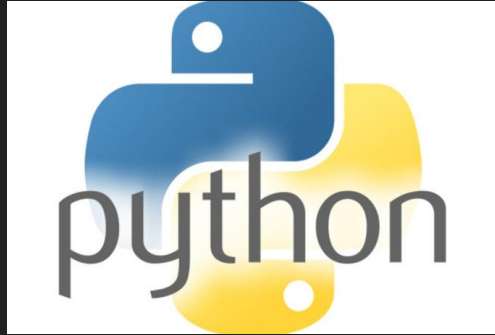
- Most complicated design
- Possibly problematic audio
- Delay
- Most expensive option

Option 2 Implementation

Python to handle the Audio separation and equalization

Raspberry Pi to run Python and interface with sound card.

Sound card add on to handle audio IO



Project Cost Estimates

Item	Cost
Raspberry Pi w/sd and cables	\$50
Sound Card Pi Hat	\$22
HDMI Audio Extractor	\$19
Cables and adapters	\$15
Digital Encoder Dial	\$10
Poster	\$145
Total	\$253

Potential Problems or Risks

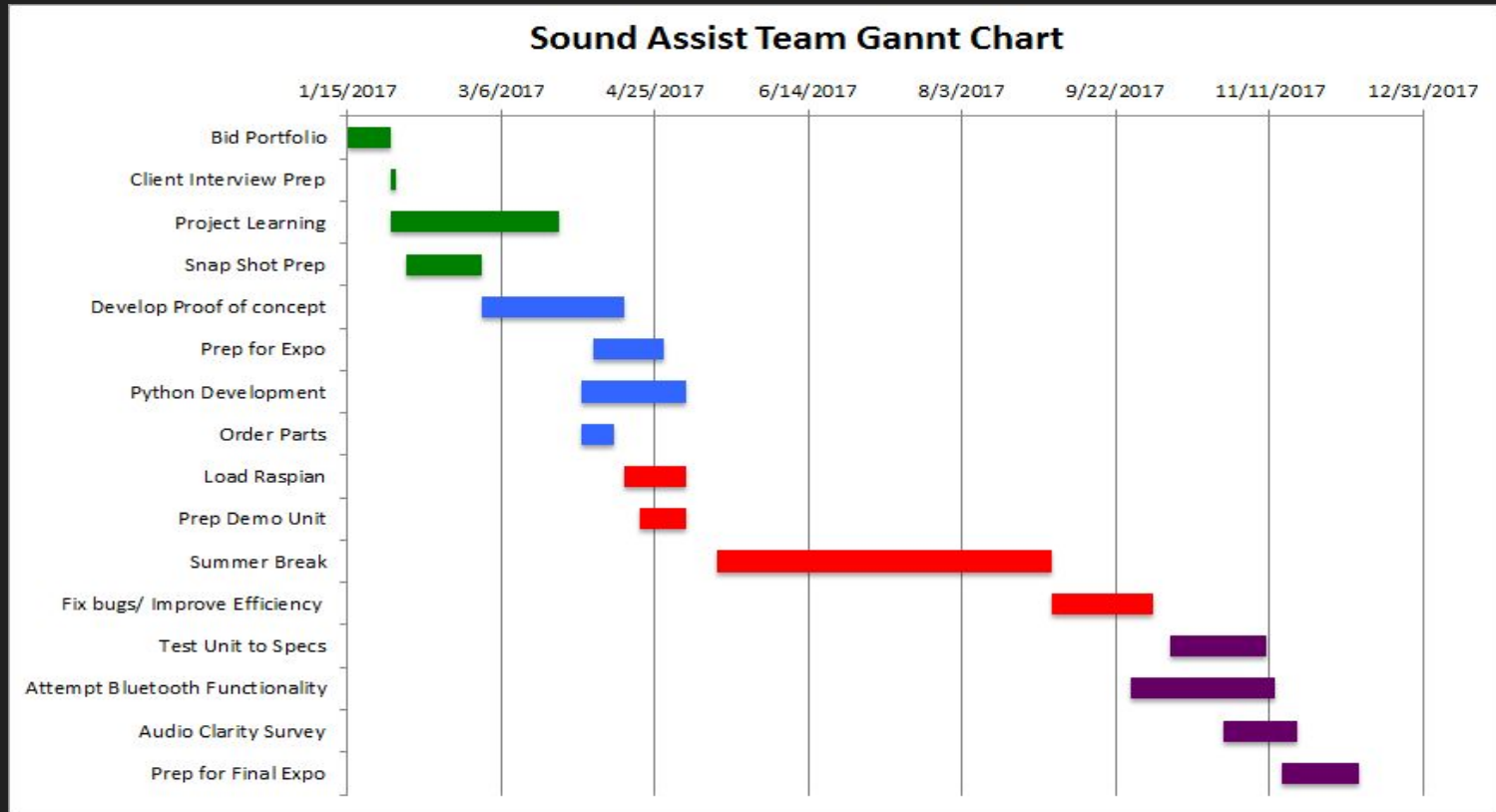
- Audio Delay: Uncertainty about the algorithms cpu usage as well as possible sound card delay could result in the audio lagging the video
- Algorithms are largely untested in our use-case and may prove to be ineffective.

Testing and Verification

Two part Verification:

1. Capture a before and after signal with an oscilloscope and run a matlab FFT analysis to quantify vocal range volume increase.
2. Gather before and after clarity ratings of a variety of unbiased individuals to determine the overall effective success of the project

Project schedule



Got Questions?