

Motivation

Many workers employed in periodically loud environments do not regularly wear hearing protection due to discomfort and communication difficulties.

Scope & Objectives

Design a wearable hearing protection device that can be worn for extended periods of time with minimal effect on the wearer's ability to communicate.

Economic Impacts

Our users are workers in periodically loud environments, but the product will be sold to health insurance providers to reduce the future cost of providing hearing aids. In 2015, the Workplace Safety & Insurance Board spent over \$40M on hearing aids, and in 2017, is investing over \$300M into injury prevention products.

Social & Environmental Impacts

Reduction in noise induced hearing loss will improve the quality of life for workers. Fewer financial resources will be needed for health care for those suffering from hearing loss. Increased use of the device could lead to increased electronic waste.

Recommendations

- Noise prediction
- Data collection
- Custom headband
- User controls

Acknowledgements

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chameleon
HEARING PROTECTION

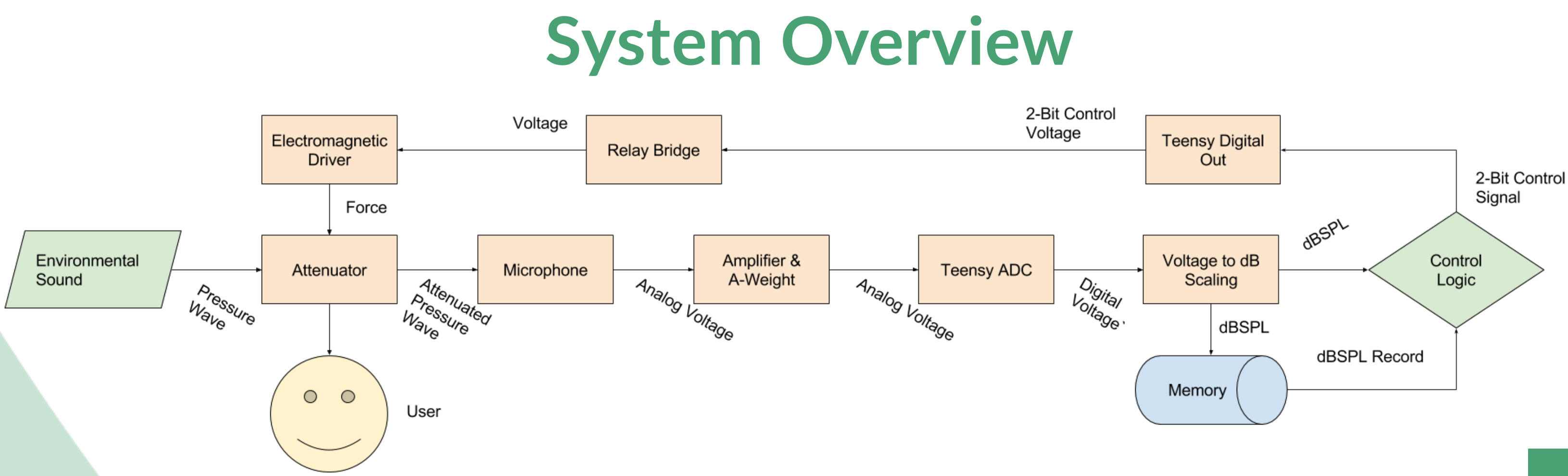
Adam Thompson, Michal Ulman, Daniel Schwarz, David Lu

NRR 18/10

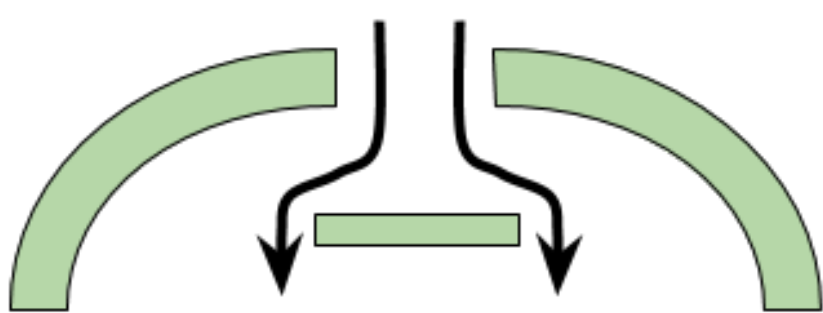
Chameleon is a smart, wearable hearing protection device that varies its attenuation based on the noise level of the environment.

If there has been any noise above the noise threshold in a 5 second window, the device closes and attenuates noise. If all noise is below the minimum threshold, the device reopens to allow communication.

Outcomes: Successful variability in attenuation; NRR of 18 closed, 10 open; classified as Class B hearing protection; comfort benchmarks met.



Off The Shelf Components:
Arduino Teensy, headband, microphones, and driver.



The open configuration allows sound to enter the ear cup



Outer Shell

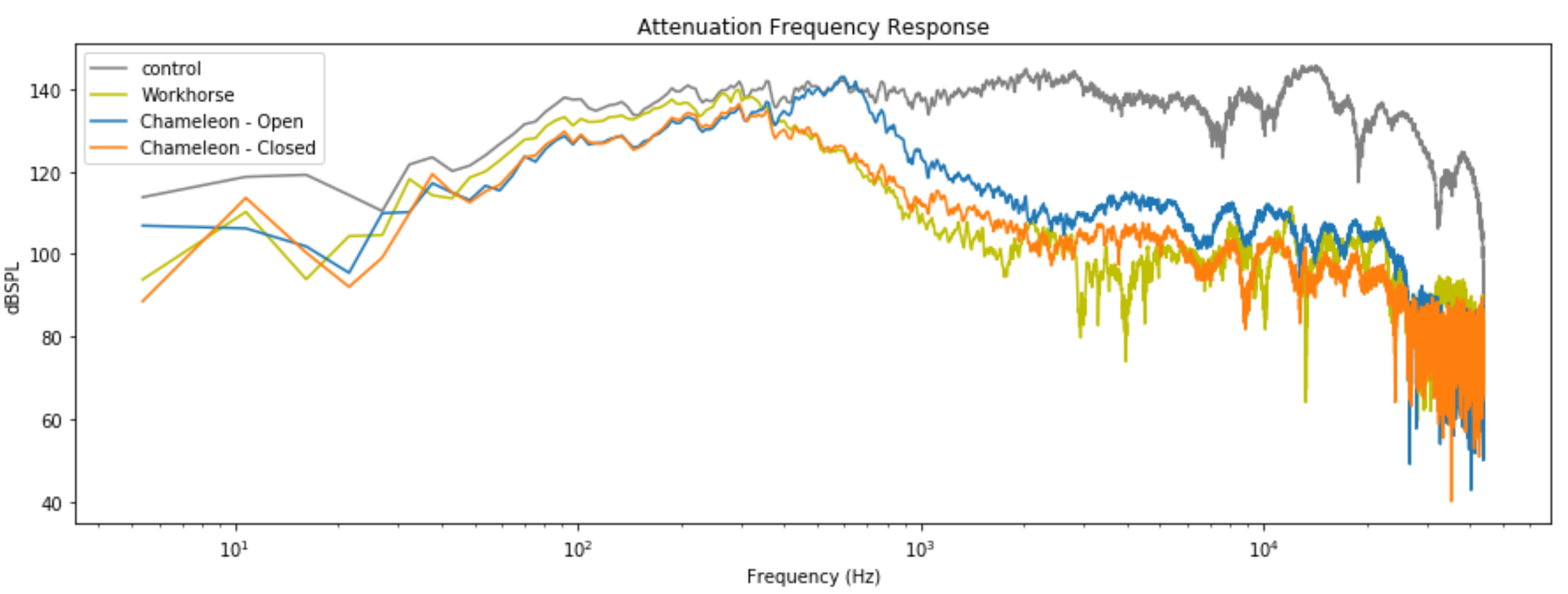


Design Validation

Attenuation properties and actuation methods were validated through iterative rapid prototyping and testing. The final design is plug-type attenuator actuated by a solenoid.



Image: Testing on an acoustic mannequin head.



Octave Band							
Attenuation (dB)	125	250	500	1000	2000	4000	8000
CSA Class B	5	12	16	21	23	21	23
CSA Class A	10	18	16	31	33	31	33
Chameleon Closed	6.8	12.5	23.5	36.5	33.2	36.6	43.4
Chameleon Open	6.8	0.9	11.0	29.6	25.8	27.9	34.8

Acoustic Testing

The Noise Reduction Rating (NRR) of the device was calculated using 100dB pink noise in both the closed and open positions. The attenuation in each octave band is shown in the above table. The NRR is a government standard based on the attenuation across all octave bands.