ClearPulse: Stethoscope with noise canceling headphones (and amplification option)

Date: 10/23/26 - 10/29/26

Client: Dr. Lenard Markman
Advisor: Prof. Randy Bartels
Team: Charlie Fischesser, Christian Dittmar Greaves, Johnny Sellers, Jonas Zhang, Josh Slager, Sam Wallin

Name	Email	Role
Josh Slager	jslager@wisc.edu	Co-leader
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Christian Dittmar Greaves	cdittmargrea@wisc.edu	Communicator
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Jonas Zhang	jjzhang6@wisc.edu	BPAG

Problem statement:

Traditional stethoscopes can be difficult to use effectively in noisy or high-vibration environments, including hospitals, helicopters, and ambulances. Environmental noise and poor acoustic conditions can interfere with healthcare providers' ability to accurately hear and distinguish heart and lung sounds, potentially compromising the reliability of auscultation. Providers with hearing loss may also experience these same difficulties. Additionally, prolonged use of traditional stethoscope ear pieces can lead to discomfort or ear canal irritation.

Our team will address these limitations by designing and fabricating a stethoscope system that incorporates noise amplification with optional passive noise isolation of over-the-ear headphones or active noise cancellation. The system will improve the clarity of heart and lung sounds across a broad range of environmental conditions while prioritizing comfort and ease of use. The final design must be durable, cost-effective, and manufacturable, with potential for commercial development through WARF or other outside organizations.

Brief status update:

We spent the last week working primarily with the analog circuitry and ensuring that we have a working prototype for show and tell. Anyone not actively assembling and testing the circuit worked on completing the MATLAB signal processing onramp and researched potential methods of processing the signal to clean it up and isolate the physiological sounds from the ambient noise.

Difficulties / advice requests:

Is it worth designing a custom PCB and swapping out a few of the components in order to get our design into a small form factor, or should we focus primarily on getting a completed working prototype first?

Goals:

Major team goals for the next week

1. Come up with testing procedures
2. Decide on a final DSP methodology
3. Test complete circuit prototype

Next week's individual goals

Josh:

- Test analog and front end circuitry with mic and real analog input
- Develop testing protocols based on PDS
- Start learning KiCad basics
- MATLAB signal processing onramp

Charlie:

- Finish uploading all research from preliminary report into lab archives
- Continue to practice soldering
- Work on software component of design
- Complete some signal processing training in MATLAB to familiarize with wavelets

Christian:

- Troubleshoot the MATLAB code once connected to the arduino. Test the entire circuit.

Johnny:

- Continue software research to figure out which CODEC algorithms we will use
- Finish signal processing Matlabs courses

Sam:

- Continue research of audio processing algorithms and add to LabArchives
- Continue training in MATLAB and test digital algorithms/software
- Prepare for show and tell

Jonas:

- Research algorithms/software
- Get ready for Show and Tell

Timeline

Task	Sept				October					November				December		
	3	10	17	24	1	8	15	22	29	5	12	19	26	4	11	18
Project R&D																
Empathize		X														
Background	X	X	X	X												
Prototyping				X	X	X	X	X								
Testings																
Deliverables																
Progress Reports	X	X	X	X	X	X	X	X								
Prelim presentation						X										
Final Poster																
Meetings																
Client	X							X								
Advisor			X	X	X	X	X									
Website																
Update	X	X	X	X	X	X	X									

Filled boxes = projected timeline
X = task was worked on or completed

Previous week's goals and accomplishments

Circuit Prototyping

- Tested the analog circuit using a waveform generator and oscilloscope
- Researched wavelet transforms as a potential algorithm for DSP

Activities

Name	Date	Activity	Time (h)	Week Total (h)	Sem. Total (h)
Josh Slager	10/26/26 10/27/26 10/28/26	CODEC Protocol Research HIPPA Training Team Meeting	2 .5 1.5	4	44
Charlie Fischesser	10/25/26 10/27/26 10/28/26	Lab Archives Update LabView Training Team Meeting	1 3 1	5	36
Christian Dittmar Greaves	10/25/26 10/25/26 10/28/26 10/29/26 10/29/26	Testing Analog Front End frequency response with oscilloscope, and generating an appropriate Bode Plot. Time-Frequency MATLAB training. Team Meeting; soldering components Met with signals professor for advice. Write the code for the signal processing.	3hr 1 .5 2	6.5	47.5
Johnny Sellers	10/23/26 10/26/26 10/28/26 10/28/26	BSAC meeting Matlab Training Team Meeting Matlab Signal Training	1 1 1 1	4	33.5
Sam Wallin	10/26/26 10/28/26	Into to Machining in-person training Team Meeting	4.5 1	5.5	34.5
Jonas Zhang	10/25/26 10/27/26 10/29/26	Matlab Training Matlab Training Team meeting	1 1 1	3	32

Current design:

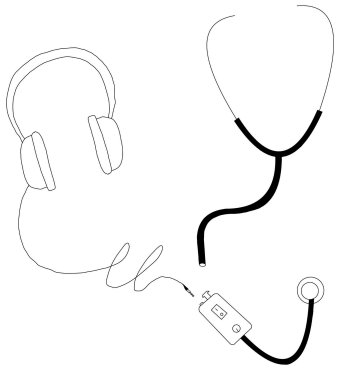


Figure of Selected Headset Design

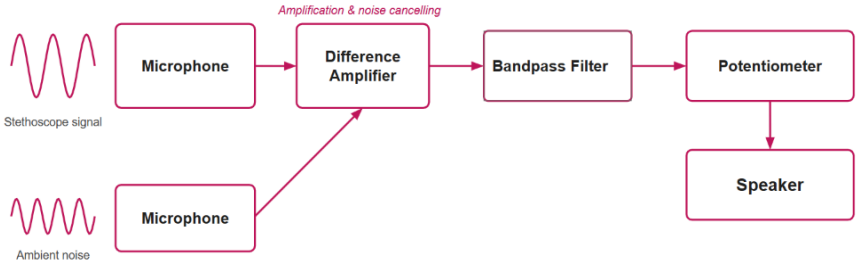
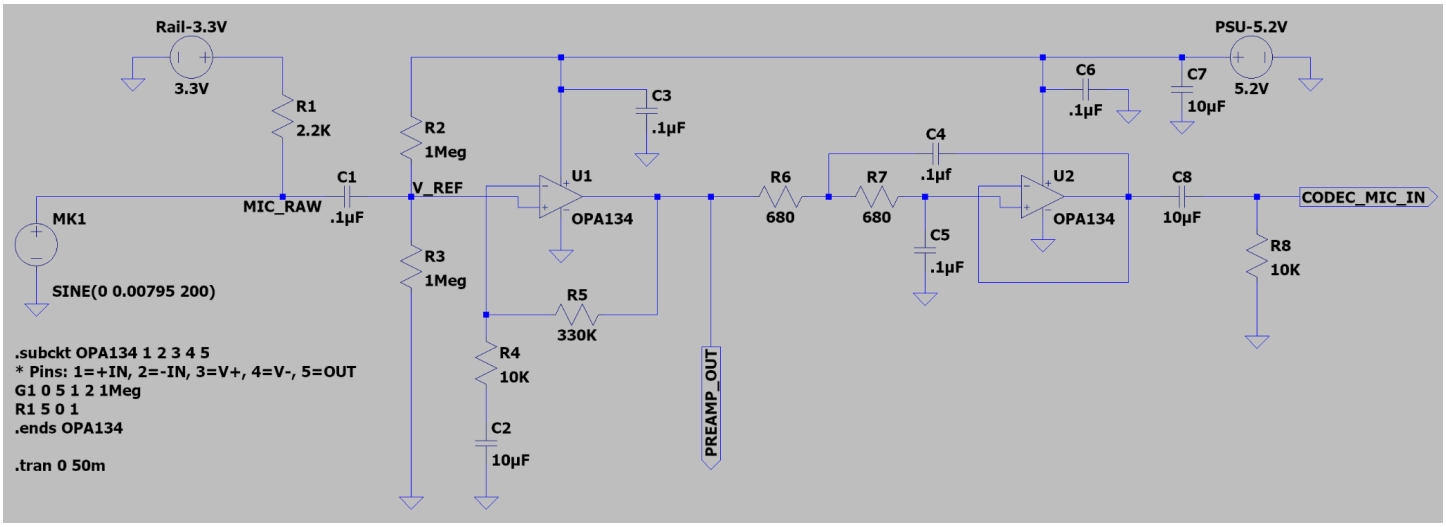


Figure of Electronic Components Parts.



LTspice model of the analog section of our circuit

Materials and expenses:

BME Design: 200, 300, 301, 400 and 402

Item	Description	Manufacturer	Mft Pt#	Vendor	Vendor Cat#	Date	QTY	Cost Each	Total	Link
Category 1- First Design/ Microphones + Amplifier										
M5STACK AUDIO MODULE	ES8388 CODEC Audio Platform Evaluation Expansion Board	M5Stack Technology Co.	M144	Digikey	2221-M144-ND	10/6/26	1	$7.95	$7.95	Link
IC OP AMP 1CH 8-PDIP	Audio Amplifier 1 Circuit 8-PDIP	Texas Instruments	OPA134PA	Digikey	OPA134PA-ND	10/6/26	4	$4.39	$17.56	Link
MIC COND ANLG OMNI -45DB 0.236"D	Analog Microphone Electret Condenser 2 V ~ 10 V Omnidirectional	PUI Audio	POM-2245L-C33-R	Digikey	668-1390-ND	10/6/26	2	$2.03	$4.06	Link
Category 2-Design Lab Expenses										
Breadboard	Breadboard			Design Lab		10/14/2026	1	$3.00	$3.00	