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

Date: 11/04/26 - 11/11/26

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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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 testing our circuitry and microphone signal with a power supply and oscilloscope. We were able to obtain a signal from our microphone that varies based on volume. There is some noise coming from somewhere between our high pass filter / voltage follower and the output of our second order low pass filter which needs to be sorted out before we can work on the DPS algorithm.

Difficulties / advice requests:

n/a

Goals:

Major team goals for the next week

1. Finish testing microphone and complete circuit
2. Obtain numerical results for testing
3. Begin final report/presentation preparation

Next week's individual goals

Josh:

- Figure out where the noise in the second-order LP filter is coming from
- Test and verify the analog portion of our circuit

Charlie:

- Finish uploading all research from preliminary report into lab
- Assist obtaining results for testing of microphone with circuit
- Continue devising testing procedures
- 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:

- Work on testing our signal
- Start working on final report/poster presentation

Sam:

- Continue research of audio/digital processing algorithms and add to LabArchives
- Continue training in MATLAB and test digital algorithms/software
- Start final report/poster presentation
- Test circuit

Jonas:

- Research algorithms/software
- Do more MATLAB?
- Start final report/presentation

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	X	X						
Testings																
Deliverables																
Progress Reports	X	X	X	X	X	X	X	X	X	X						
Prelim presentation						X										
Final Poster																
Meetings																
Client	X							X								
Advisor			X	X	X	X	X	X	X							
Website																
Update	X	X	X	X	X	X	X	X	X	X						

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

Previous week's goals and accomplishments

Last week's major goal was to test the circuit and have it ready to go so we can start implementing the DSP portion of our design. We were able to get the new mics in and put them in the circuit however when we tested the output signal there was some noise originating from somewhere in the second order sallen key low pass filter.

Activities

Name	Date	Activity	Time (h)	Week Total (h)	Sem. Total (h)
Josh Slager	11/6/2026 11/11/2026	Tong Lecture and Team Meeting Circuit troubleshooting	2 1	3	53.5
Charlie Fischesser	11/6/2026 11/8/2026 11/11/2026	Tong and Team Meeting Research Team Meeting	2 1 1	4	44.5
Christian Dittmar Greaves	11/6/2026 11/9/2026 11/11/2026	Tong Presentation and Team Meeting Research Team Meeting	2 1 1	4	53
Johnny Sellers	11/6/2026 11/7/2026 11/11/2026	Tong Presentation+Team Meeting Research filters Team Meeting	2 0.5 1	3.5	41.5
Sam Wallin	11/6/2026 11/9/2026 11/11/2026	Tong Presentation/Team Meeting Research Team Meeting	2 0.5 1	3.5	42
Jonas Zhang	11/6/2026 11/7/2026 11/11/2026	Tong Presentation+Team meeting Research+Update spreadsheet Team Meeting	2 0.5 1	3.5	40.5

Current design:

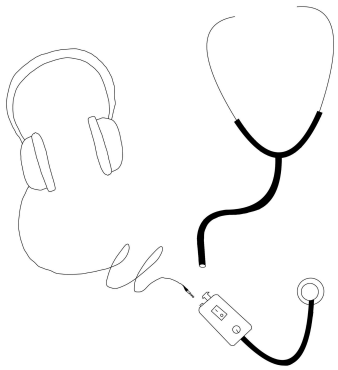


Figure of Selected Headset Design

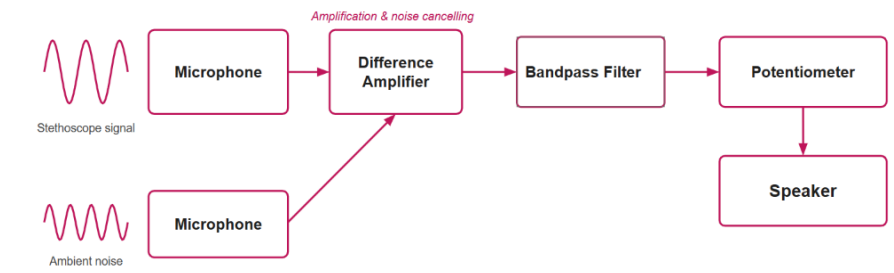
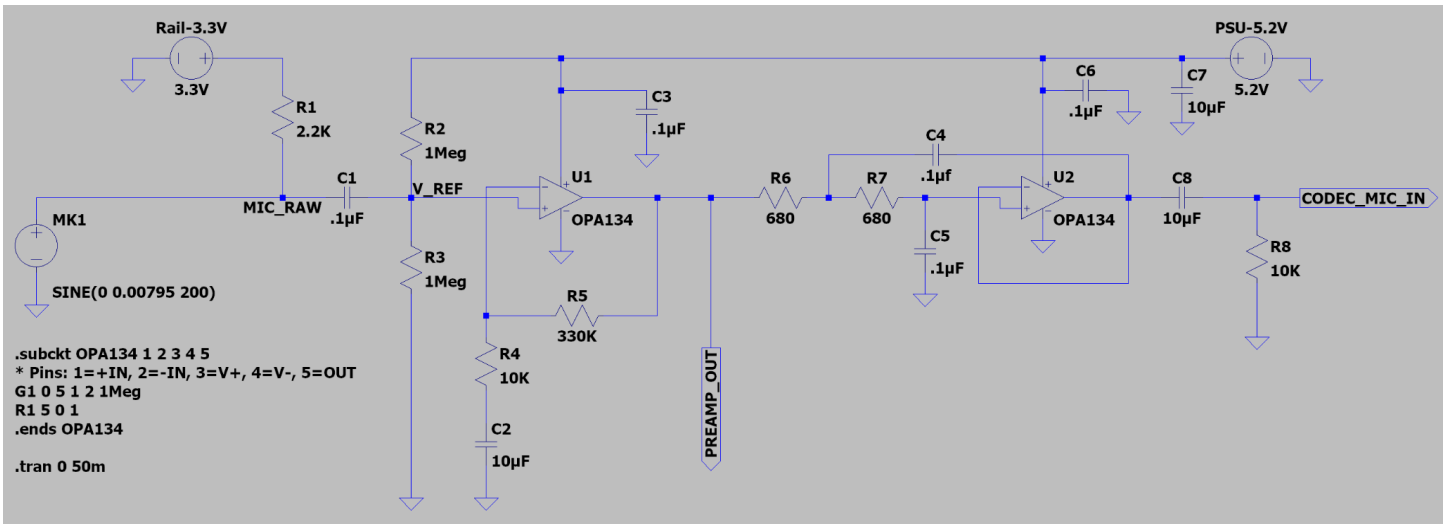


Figure of Electronic Components Parts.



LTspice model of the analog section of our circuit

Materials and expenses:

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		10/14/26	1	$3.00	$3.00	

Category 3-New microphone + headphone jack										
POM-2738L-LW100-R	Microphones OMNI DIRECTIONAL MICROPHONE 6MM DIA	PUI Audio	POM-2738L-LW100-R	Mouser	665-POM2738LLW100R	11/4/26	2	$3.13	$6.26	Link
BC-A3ML006F	CABLE 3.5MM STEREO PLUG W/WIRES	Bel Inc.	BC-A3ML006F	Digikey	116-BC-A3ML006F-ND	11/4/26	1	$6.48	$6.48	Link
Taxes, fees, shipping									$20.37	
								TOTAL:	**$75.69**	