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

Date: 10/29/26 - 11/04/26

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 attended Show and Tell and obtained some good advice from our peers. One of our peers, an EMT worker, said that we should not even focus on signal processing as noise cancellation is not essential in our design's intended environment.

Difficulties / advice requests:

n/a

Goals:

Major team goals for the next week

1. Finish testing microphone and complete circuit
2. Decide on a final DSP methodology

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
- Assist with testing of microphone with circuit
- Devise testing procedures
- 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
- Work on testing our signal

Sam:

- Continue research of audio/digital processing algorithms and add to LabArchives
- Continue training in MATLAB and test digital algorithms/software
- Tentatively begin testing of prototype

Jonas:

- Research algorithms/software
- Do more MATLAB?

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							
Testings																
Deliverables																
Progress Reports	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							

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	10/30/26 11/1/26 11/2/26 11/4/26	Show and Tell ESP32 Testing I2C and I2S Research Team Meeting	1.5 1.5 2.5 1	6.5	50.5
Charlie Fischesser	10/30/26 11/2/26 11/4/26	Show and Tell Signal processing Research Team Meeting	1.5 2 1	4.5	40.5
Christian Dittmar Greaves	11/4/26 11/3/26	Team Meeting Met with Signals Professor to discuss project	1 .5	1 .5	49
Johnny Sellers	10/30/26 11/3/26 11/4/26	Show and Tell MATLAB signal processing Team Meeting	1.5 2 1	4.5	38
Sam Wallin	10/30/26 11/1/26 11/4/26	Show and Tell MATLAB Training Team meeting	1.5 1.5 1	4	38.5
Jonas Zhang	10/30/26 11/2/26 11/4/26 11/5/26	Show and Tell Signal processing research Team meeting Update spreadsheet + research	1.5 0.5 2 1	5	37

Current design:

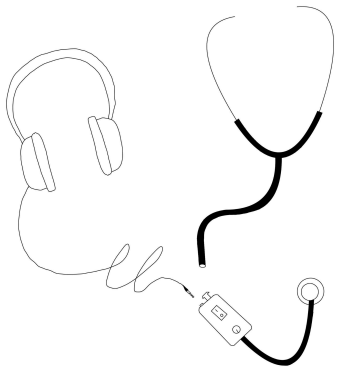


Figure of Selected Headset Design

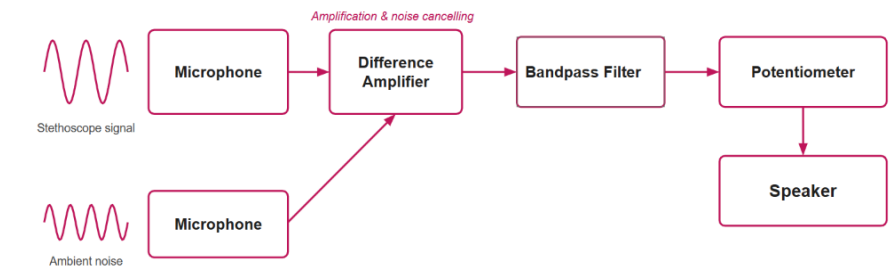
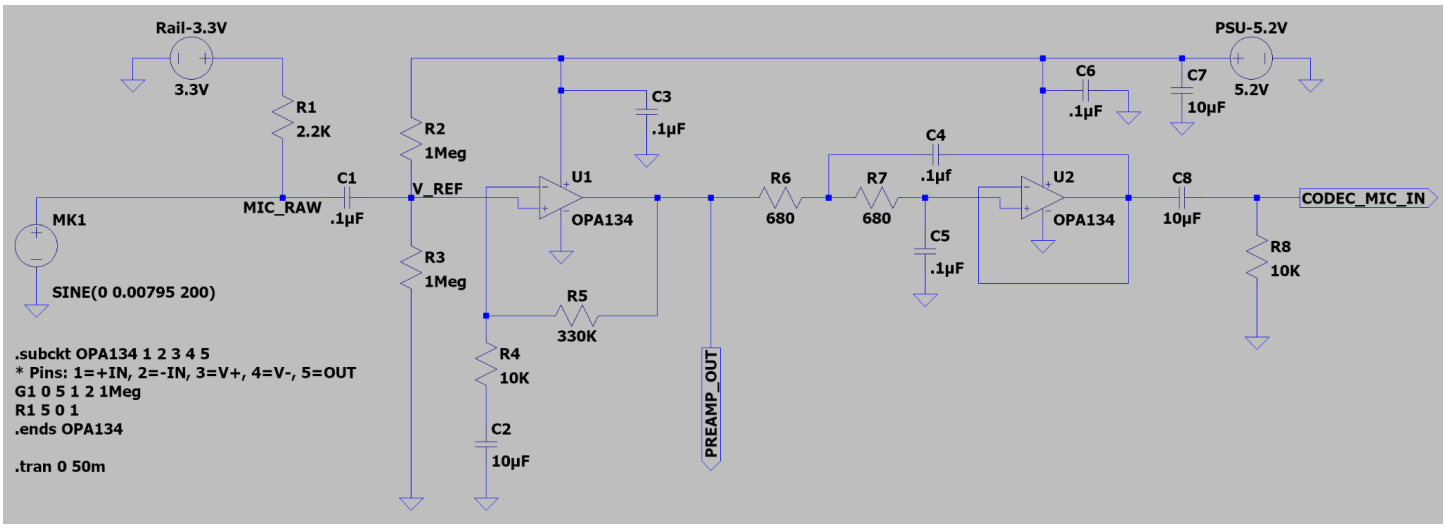


Figure of Electronic Components Parts.



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**	