BME Design-Spring 2021 - EMMA NEUMANN
Complete Notebook

PDF Version generated by

GABRIELLE SNYDER

on

Apr 28, 2021 @12:48 PM CDT

Table of Contents

Team contact Information

EMMA NEUMANN - Mar 02, 2021, 8:45 PM CST

Last Name	First Name	Role	E-mail	Phone	Office Room/Building
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Emma	Neumann	Leader	ekneumann@wisc.edu	608-206-2721	
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Josh	Murwin	BWIG & BPAG	jmurwin@wisc.edu	608-333-2246	

Project description

EMMA NEUMANN - Mar 02, 2021, 8:43 PM CST

Course Number: 36814

Project Name:

Wearable Simulator for Enhanced Realism

Short Name:

sim_vest

Project description/problem statement:

Simulations have become a prominent tool in the medical industry to train students and staff in a safe environment on infrequent and risky scenarios. However, mannequins remain inanimate objects that can be hard to interact with in a realistic way. This project aims to create a wearable simulation vest that a human could wear to create a more realistic interpretation of these events. The vest would be equipped with audible and electrical body function simulators able to be manipulated and detected for different scenarios similar to mannequin simulators. The vest wearer would then be able to more accurately act out scenarios and interact with the medical students and staff to better portray specific medical conditions, emotions, and body positions.

About the client:

Dr. Michael Lohmeier, MD, is the medical director at Sun Prairie & Waunakee EMS, the medical director of UW Health Emergency Education Center and an associate professor. He joined the faculty in the Department of Emergency Medicine at the UW school of Medicine and Public Health after completing his emergency medicine residency training that the Washington University School of Medicine in Saint Louis, serving as chief resident in his fourth year. Afterwards, he completed his fellowship in emergency services at Washington University with a concentration in tactical medicine. He has areas of interest in EMS and prehospital care, where his research interests currently lie, mass casualty preparedness, fireground rehab and resident education.

Source: “Michael Lohmeier, MD.” *Michael Lohmeier, MD | Emergency Medicine*, www.emed.wisc.edu/michael-lohmeier-md.

3/31/2021 - Heart and lung sounds to include

EMMA NEUMANN - Mar 31, 2021, 5:33 PM CDT

Title: heart and lung sounds to include

Date: 3/31/2021

Content by: Emma Neumann

Present: Emma Neumann, Gabby Snyder

Goals: have a list of the heart and lung sounds Dr. Lohmeier wants included in the design

Content:

"To answer your questions...

1. In addition to "normal" heart sounds and "normal" lung sounds, we frequently use several "abnormals" for each
    1. Heart - tachycardia (fast), bradycardia (slow), systolic murmurs (sound when blood pushing forward), diastolic murmurs (sound when heart relaxing)
    2. Lung - wheezing, rales, rhonchi and NO sound are probably the mainstays. In addition, it's fairly common that we will have asymmetric breath sounds (i.e. normal on one side and absent on the other to simulate pneumothorax, or normal on one side and rales on the other to simulate aspirated foreign body)
2. If I understand your question correctly, yes, the sounds in the front and back should be the same. As above, though, there may be right-to-left differences in sounds for some clinical scenarios (i.e. pneumothorax)
3. I think the plan for 5 speakers sounds like a great plan!"

Conclusions/action items:

find audio files for each of the above conditions

Design Matrix

EMMA NEUMANN - Mar 03, 2021, 9:32 AM CST

Title: Design Matrix

Date: 3/3/2021

Content by: Emma Neumann

Present: Emma, Gabby, Andy, Josh

Goals: Evaluate the different vest designs

Content:

Table 1: Vest design matrix.

Criteria	Weight	The Condor	Hand Sewn	The Hyper Vest
Ease of Manufacturing	25	3	1	4
Durability	20	5	1	4
Comfort	20	3	2	5
Adjustability	15	4	5	2
Sterilizability	10	4	5	1
Cost	10	5	4	1
Weighted Total	**100**	**77**	**50**	**66**

Conclusions/action items:

The Condor won! (and has now been ordered)

Materials Purchased

EMMA NEUMANN - Mar 02, 2021, 8:47 PM CST

Item	Description	Manufacturer	Part Number	Date	QTY	Cost Each	Total	Link
Audio FX Sound Board	WAV/OGG Trigger w/ 16 MB Flash	Adafruit	2220	11/12/2020	3	24.95	74.85	link
Audio Amplifier	Mono 2.5W Class D PAM8302	Adafruit	2130	11/12/2020	3	3.95	11.85	link
Mini Metal Speaker	8 Ohm 0.5W	Adafruit	1890	11/12/2020	5	1.95	9.75	link
Raspberry Pi	Zero W	Adafruit	3400	11/12/2020	1	10	10	link
Battery Pack	MicroUSB Battery Holder, 3xAA	DFRRobot	FIT0362	11/12/2020	4	1.6	6.4	link
AA Batteries	Duracell CopperTop AA Alkaline Batteries, 24 ct	Duracell	AA-CTx24	11/12/2020	1	16.21	16.21	link
Condor Modular Vest	600D Cordura, Size M-XL	Condor	MV-001	2/25/2021	1	44.95	44.95	link
TOTAL:							**$174.01**	

2/10/2021 Team Meeting (circuitry)

GABRIELLE SNYDER - Feb 10, 2021, 5:38 PM CST

Title: Team Meeting to work on circuitry

Date: 2.10.21

Content by: Gabby

Present: Emma, Josh, Gabby

Goals: The goal was to see if we could hook up the adafruit soundboard with the amplifier and an arduino in order to try generate a sound from the speaker.

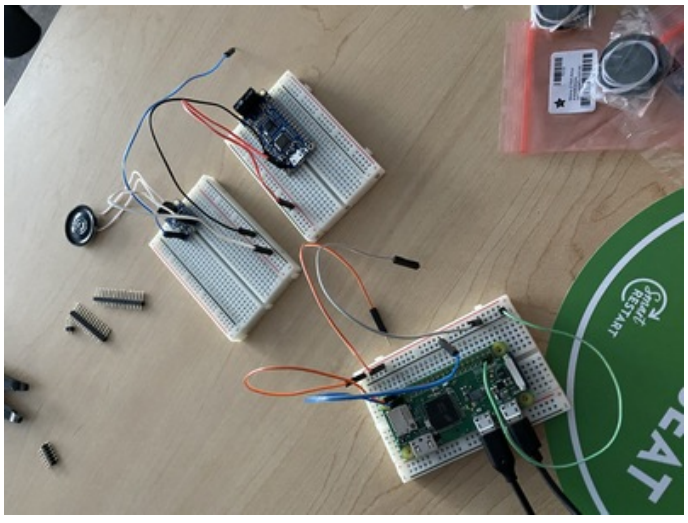
Content:

Conclusions/action items:

GABRIELLE SNYDER - Feb 10, 2021, 7:33 PM CST

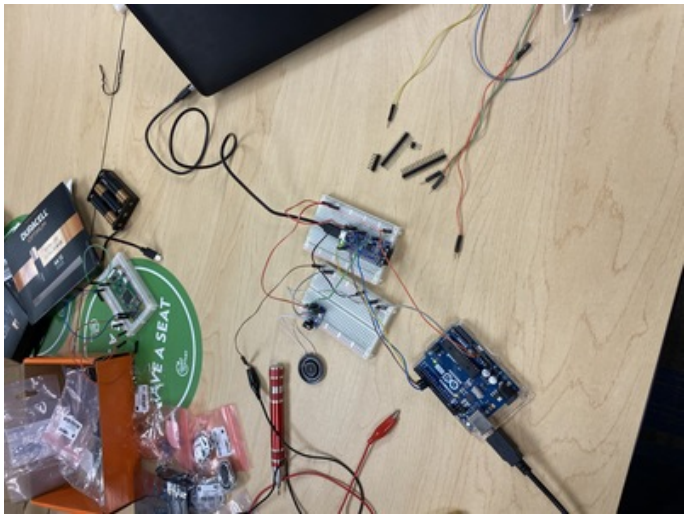
initial_set_up_1.jpg(2.6 MB) - download These are images of our initial set up with the battery pack, raspberry pi zero w, adafruit sound board, amplifier and speaker all hooked up to a computer.

GABRIELLE SNYDER - Feb 10, 2021, 7:33 PM CST



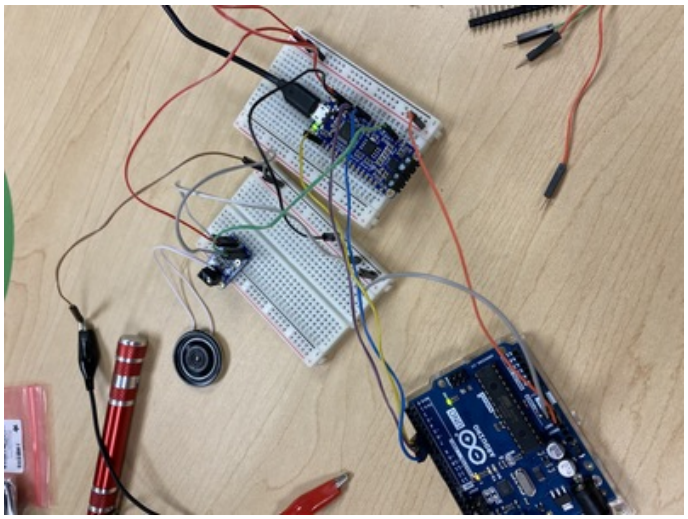
initial_set_up_2.jpg(2.6 MB) - download These are images of our initial set up with the battery pack, raspberry pi zero w, adafruit sound board, amplifier and speaker all hooked up to a computer.

GABRIELLE SNYDER - Feb 10, 2021, 7:36 PM CST



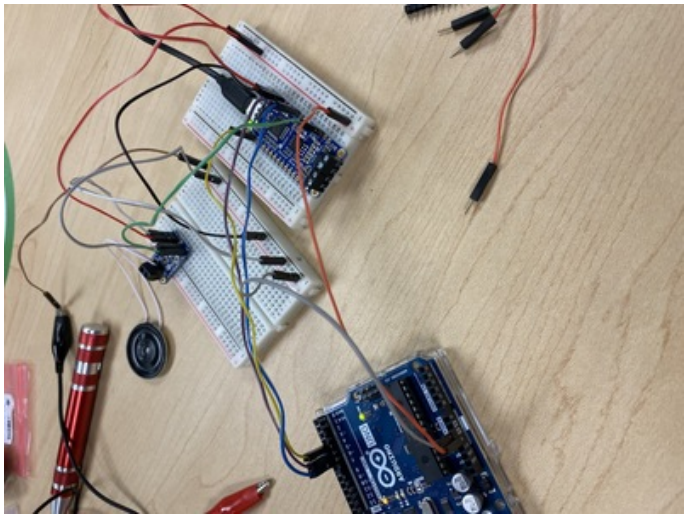
speaker_w_arduino_1.jpg(3.1 MB) - download These are images our of adafruit sound board, amplifier, and speaker hooked up to an arduino in order to see if we could get a running circuit and produce a sound from the speaker. While we were unable to actually produce the elephant sound, we were able to get a bit of static noise from the speaker.

GABRIELLE SNYDER - Feb 10, 2021, 7:36 PM CST



speaker_w_arduino_2.jpg(2.7 MB) - download These are images our of adafruit sound board, amplifier, and speaker hooked up to an arduino in order to see if we could get a running circuit and produce a sound from the speaker. While we were unable to actually produce the elephant sound, we were able to get a bit of static noise from the speaker.

GABRIELLE SNYDER - Feb 10, 2021, 7:36 PM CST



'

speaker_w_arduino_3.jpg(3.1 MB) - download These are images our of adafruit sound board, amplifier, and speaker hooked up to an arduino in order to see if we could get a running circuit and produce a sound from the speaker. While we were unable to actually produce the elephant sound, we were able to get a bit of static noise from the speaker.

GABRIELLE SNYDER - Feb 10, 2021, 7:37 PM CST

conclusion/action items

While we were unable to produce any actual sound from the speaker, it was positive that we were able to hear a bit of static noise because it showed that the wires were hooked up somewhat correctly. More research/work with the arduino/adafruit soundboard code will need to be done in order to have a better chance of producing a sound next time.

3/17/21 Team Meeting

GABRIELLE SNYDER - Mar 17, 2021, 6:01 PM CDT

Title: Electronic Placement in Vest

Date: 3.17.21

Content by: Gabby Snyder

Present: Josh, Emma, and Gabby

Goals: To figure out where to place the electronic components within the vest.

Content:

The idea is to create two different boxes that will hold the two battery pack plus the two other electronic boards for each side of the vest. These boxes can be inserted into the mesh pockets on the front of the vest.

We are thinking of running wires over/through the shoulder straps in order to connect the adafruit soundboards to the proper speaker.

Conclusions/action items:

Going forwards that plan is to work on getting the raspberry pi wired properly in order to produce a sound out of the speaker. Also, Gabby is will work on creating a box design on solidworks that the battery packs and other soundboards would be able to fit into.

GABRIELLE SNYDER - Mar 17, 2021, 5:55 PM CDT

possible_electronic_step_up_on_vest.jpg(3.4 MB) - download This is an image of our intended placement of the electronic components in the vest.

4/22/2021 - Vest Layout

EMMA NEUMANN - Apr 25, 2021, 8:10 PM CDT

Title: Vest Layout

Date: 4/22/2021

Content by: Emma Neumann

Present: Emma Neumann

Goals: create a nice figure for the poster

Content:

Conclusions/action items:

make an electronics box for the left side

4/22/2021 - RPI wiring

EMMA NEUMANN - Apr 25, 2021, 8:12 PM CDT

Title: RPI wiring

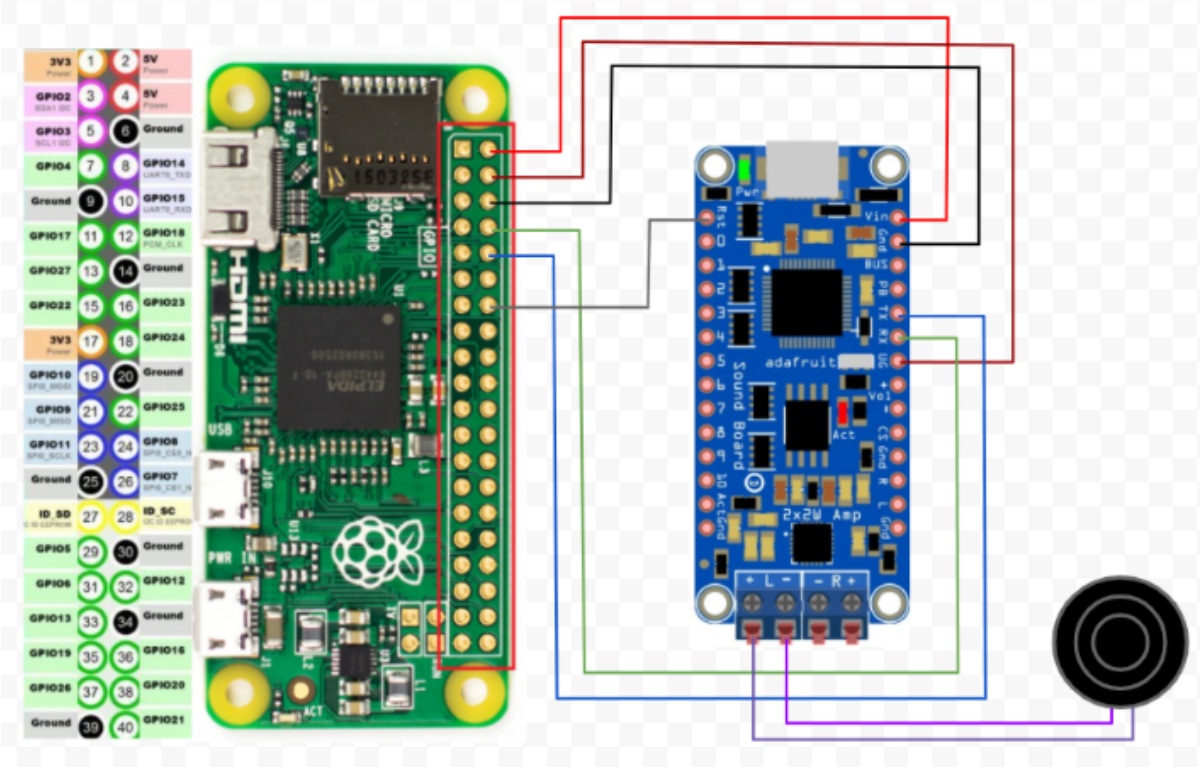
Date: 4/22/2021

Content by: Emma Neumann, Andy Paulson

Present: Emma, Andy, Josh, Gabby

Goals: make a nice figure for the poster

Content:



Conclusions/action items:

need to solder all of the wiring

2/17/2021 Team Meeting (functioning speaker)

EMMA NEUMANN - Feb 17, 2021, 8:20 PM CST

Title: Functioning Speaker

Date: 2/17/2021

Content by: Emma Neumann (Josh created the circuitry)

Present: Emma, Gabby, Josh, Andy

Goals: Show that the speaker can play sound from the soundboard

Content:

video attached

Josh created the speaker system. He removed the amplifier; we don't think we need it anymore. And he was able to play multiple different sounds.

Conclusions/action items:

- we need to play heart and lung sounds and get them to the correct volume

- transition off the arduino to the raspberry pi

EMMA NEUMANN - Feb 17, 2021, 8:19 PM CST

IMG_5003.MOV(3.8 MB) - download

4/22/21 - Electronic Box Testing

GABRIELLE SNYDER - Apr 26, 2021, 12:15 PM CDT

Title: Electronic Box Testing

Date: performed on 4.22.21

Content by: Gabby

Present: Emma and Gabby (Josh and Andy help with testing protocol)

Goals: The goal was to determine if the electronic box was study enough to be using during a simulation.

Content:

- Test 1
    - goal: determine if the box would withstand a point load of 45 lbs
    - procedure:
        - a 45 lb barbell was placed in the rough center on top of the box
        - the full weight of the barbell was then allowed to rest on top of the box
            - Gabby held the barbell in a vertical position on top of the box in order to prevent the barbell from falling over
            - she did not try help support the weight of the barbell
                - there may have minimal help as she could not fully let go of the bar
    - results:
        - the box started to bend at the center due to the load
        - however, it did not break and there were no visible cracks
- Test 2
    - `goal: to determine if the box would withstand a distributed of ~300 lbs
    - procedure:
        - 45 lb weight plates were stacked on top of the box one at a time
        - after 4 plates were placed on the box (totaling 180 lbs), there was no significant amount of deformation
        - since the box seem to be very sturdy and handling the load well, Gabby then proceeded to stand on top of the 4 plates on the box
            - total weight on the box = ~305 lbs
    - results:
        - the box probably began to deform a small amount due to the weight
            - a bit hard to tell for certain as the box is not very tall making it hard to see under all the weight the full extend of the deformation.
        - however, the box did not break and there were no visible cracks

Conclusions/action items:

Overall, the testing was a successful and was able to show that the box is able to withstand 45 lbs of point load and 300 lbs of a distributed load. These results show that the electronics box will be able to withstand medical simulations without breaking, keeping the electronic components intact.

4/25/2021 - Completed Testing

EMMA NEUMANN - Apr 25, 2021, 8:16 PM CDT

Title: Completed Testing

Date: 4/25/2021

Content by: Emma Neumann, Josh Murwin

Present: Emma, Josh, Gabby, Andy

Goals: outline all of the testing we completed this semester

Content:

1. Wearability Evaluation
    1. Criteria: Is the vest comfortable?
    2. Method: Team members wore the vest
    3. Result: Vest is comfortable and can fit multiple body types
2. Circuitry Testing
    1. Criteria: Can an operator play various sounds on command?
    2. Method: Arduino control with two test sounds
    3. Result: Controller is able to switch between sounds at will
3. Loudness Evaluation
    1. Criteria: Can the sound be heard through the vest?
    2. Method: Placed ear on other side of vest and played a sound
    3. Result: Passed subjectively by all team members
4. Duration Test
    1. Criteria: Will the circuit survive extended periods of use?
    2. Method: Connected the system to power for 1.5 hours
    3. Result: Success, the system was able to play sounds after the testing period had ended. Temperature remained low.
5. Durability Test
    1. Criteria: Will the hardware box survive operational loading?
    2. Method: Stacked weightlifting plates on box (300 lb) and balanced a point load on the center of the box (45 lb)
    3. Result: The box did remained intact for both loads, , but yielded under the point load

Conclusions/action items:

Need to run more substantial tests with med students once vest is actually completed to be fully validated

PDS

EMMA NEUMANN - Mar 02, 2021, 8:49 PM CST

Product Design Specifications

Wearable Simulator for Enhanced Realism

Updated: 2/11/2021

Client: Dr. Michael Lohrenier
Advisor: Dr. Ed Berru
Team: Emma Neumann (Leader)
Gabby Snyder (Communicator)
Joshua Marwin (BWIG & BPAG)
Andrew Poulson (BSAC)

Function:

Simulations have become a prominent tool in the medical industry to train students and staff in a safe environment on infrequent and risky scenarios. However, mannequins remain inanimate objects that can be hard to interact with in a realistic way. This project aims to create a wearable simulation vest that a human could wear to create a more realistic interpretation of these events. The vest would be equipped with audible and electrical body function simulators able to be manipulated and detected for different scenarios similar to mannequin simulators. The vest wearer would further be able to more accurately act out scenarios and interact with the medical students and staff to better portray specific medical conditions, reactions, and body positions.

Client requirements:

- No more than $300
- Must be a wearable simulator of reasonable weight and size to fit the average person
- Can be used 4-5 times a month
- Outputs can be modified during simulation to respond to interventions
- Simulates heart sounds and pulses
- Simulates lung sounds

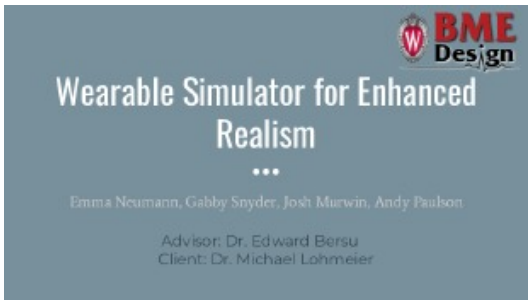
Design requirements:

1. Physical and Operational Characteristics
    a. *Performance Requirements*: This design should be something that can be worn comfortably on the upper body of a person and can produce varied heart sounds and pulses. It should be able to be used about four to five times a month and able withstand the force exerted by the user each time. The device should also be adjustable to fit the various builds of the user.
    b. *Safety*: This product will contain electrical equipment that will be properly enclosed, grounded, and equipped with a kill switch. The edges of the vest will be soft and rounded to prevent injury, and it will be designed to keep as full of a range of motion as possible.

Sim_Vest_PDS.pdf(117.6 KB) - download

Preliminary Presentation

EMMA NEUMANN - Mar 02, 2021, 8:51 PM CST



sim_vest_prelim_presentation_slides.pdf(590 KB) - download

EMMA NEUMANN - Mar 02, 2021, 8:53 PM CST

sim_vest_prelim_presentation.mp4(34.4 MB) - download

Preliminary Report

EMMA NEUMANN - Mar 03, 2021, 11:30 AM CST

Wearable Simulator for Enhanced Realism

BME 301

March 3rd, 2021

Client: Dr. Michael Lohmeier

Advisor: Dr. Edward Berru

Team Members:

Emma Neumann (Team Leader), Gabby Snyder (Communicator),

Andy Paulson (BSAC), Josh Murwin (BPAG & BWIG)

sim_vest_prelim_report.pdf(1.3 MB) - download

Tong Executive Summary

EMMA NEUMANN - Apr 25, 2021, 8:19 PM CDT

Wearable Simulator for Enhanced Realism

Tong Executive Summary, BME 301

Emma Neumann, Gabby Snyder, Josh Marwin, Andy Paulson

Advisor: Dr. Ed Berru

Client: Dr. Michael Lohmeier

The use of mannequins in simulations has become a prominent tool in the medical industry to train students and staff in a safe environment on infrequent and risky scenarios. Virtually all medical students are exposed to a medical simulation during their education. Some of the most popular mannequins that excel in medical simulation include: "Medical Manekin," "Simulaids," and the "SimMan 3G." The common goal of all medical mannequins and patient simulators is to mimic real patient scenarios to train healthcare professionals. The fidelity of these mannequins depend on different models, but most mid- to high-fidelity mannequins are capable of breathing, producing life-like sounds, heart tones, and palpable pulses. They may also connect to an EKG or oscilloscope monitor, pulse oximeter, arterial waveform, pulmonary artery waveform, or anesthetic gases monitor. However, the current mannequins used for these simulations are ultimately lifeless; they lack crucial interaction capabilities, such as movement and emotion, and overall realism. Many of the high-fidelity simulators also have high cost-barriers, making it difficult to achieve realistic, comprehensive simulations in many hospitals.

The wearable simulation vest is a vest that instructors or actors can wear that will generate its own heart and lung sounds. The final design will consist of a vest that is easily adjustable, durable, and comfortable, and will be equipped with speakers that play audible heart and lung sounds in multiple locations along the front and back of the vest. These sounds will be adjusted by an instructor via a bluetooth module and raspberry pi to simulate different scenarios in real-time. This design allows medical students to communicate with the patient, perform an exam, and more realistically interpret the patient's symptoms while still receiving accurately simulated heart and lung sounds that correspond to the intended scenario. The design will be validated during different sets of testing including surveys to determine the comfort level of the vest as well as quantitative electronics testing to ensure the speakers play the correct sounds, at proper times, and at adequate noise levels.

The global medical simulation market is valued at 1.9 billion USD and is growing dramatically at a CAGR of about 14.6%. The commercial opportunity for the wearable simulator vest is to offer a low-cost alternative to high-fidelity designs by maintaining the cardiorespiratory cues while increasing the human interaction and social cues. The final wearable simulator will cost less than 500 USD to fabricate. In comparison, the Laerdal SimMan 3G costs over 66,000 USD for a basic high-fidelity model. Simulations are only becoming more prominent in medical education to expose students to a variety of situations in a controlled environment, and the wearable simulation vest allows this to be done in an affordable way while emphasizing the importance of social interaction between doctors and patients.

301_-_Tong_-_sim_vest_-_Executive_Summary_1_.pdf(58.9 KB) - download

Poster

EMMA NEUMANN - Apr 25, 2021, 8:17 PM CDT

Poster_-_Spring_2021.pdf(532.7 KB) - download

Final Report

EMMA NEUMANN - Apr 28, 2021, 12:42 PM CDT

sim_vest_-_FinalReport.pdf(3.3 MB) - download

The Cardiac Cycle and Heart Sounds

EMMA NEUMANN - Sep 23, 2020, 8:04 AM CDT

Title: The Cardiac Cycle Heart Sounds

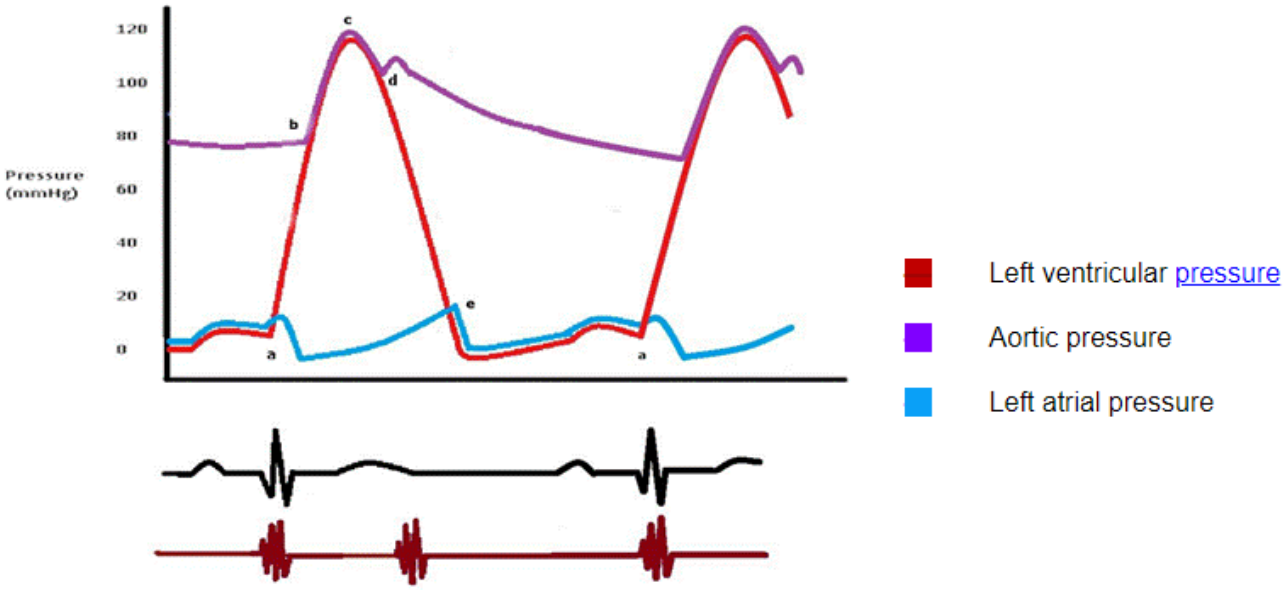
Date: 9/23/2020

Content by: Emma Neumann

Present: Emma Neumann

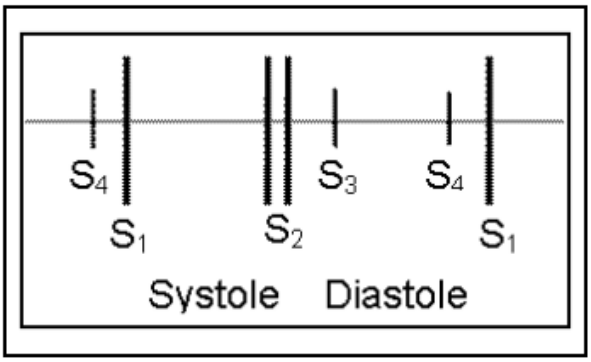
Goals: Learn more about the heart and what would need to be simulated in our design.

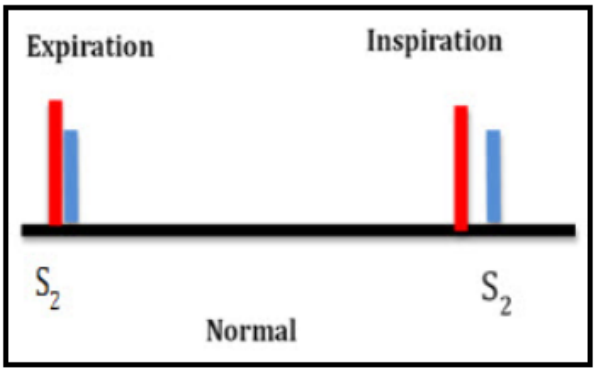
Content:



- phases
  - a-b: isovolumetric ventricular contraction
    - beginning of systole
    - AV valve closes at a
    - ventricule gains positive pressure w/o changing volume to overcome semilunar valve resistance at b
    - lasts 6% of cycle
  - b-c: rapid ejection
    - semilunar valves open at b
    - rapid ejection of blood
    - arterial pressure increases until maximum at c
    - lasts 13% of cycle
  - c-d: reduced ejection
    - start of ventricular repolarization
    - start of T wave
    - ventricular pressure decreases
    - some blood flow continues due to remaining KE
    - lasts 15% of cycle
  - d-e: isovulumetric relaxation
    - ventricular pressure below diastolic aortic and pulmonary pressures
    - aortic and pulmonary vlaves close which produces the heart sound at d
    - beginning of diastole
    - ventricular pressure is less than atrial
    - lasts 8% of cycle
  - e-a: ventricular filling
    - av valves open at e

        - ventricular starts filling
        - presssure increases in ventricle until equal to atrial and then av valve closes at a
        - lasts 44% of cycle
    - atrial contraction
        - end of venricular diastole
        - atrial contraction adds 10% of ventricular filling volume
        - p wave
        - lasts 14% of the cycle





- heart sounds
    - S1: first heart sound
        - closure of mitral and tricuspid valves
        - single sound because they happen simultaniously
        - corresponds to the pulse
    - S2: second heart sound
        - closure of aortic and pulmonary valves
        - usually split because A2 is slightly before P2
        - more noticeable with slower heart rates
        - can have abnormally wide splitting
            - RV overload w/ atrial septal defect
            - RV outflow obstruction w/ pulmonary stenosis
            - delayed RV depolarization w/ complete right bundle branch block
        - can have narrow splitting
            - pulmonary hypertension as pulmonary valves closes early
            - mild to moderate aortic stenosis as the A2 is delayed
        - can have single S2
            - of of the semilunar valves is missing w/ pulmonary/aortic valve atresia and truncus arteriosius
            - both valves close simultaneously w pulmonary hypertension or large VSD
            - posterior displacement of pulmonary valve away from chest wall w/ d-TGA
        - can have paradoxical splitting (P2 before A2)
            - severe aortic stenosis
            - left bundle branch block
    - S3: third heart sound
        - transition from fast to slow ventricular filing in early diastole
        - heart in normal children
    - S4: fourth heart sound
        - abnormal late diastolic sound from forcible atrial contraction when decreased ventricular compliance
- heart murmurs
    - additional sounds from turbulent blood flow
    - can be systolic, diastolic, or continuous
    - grading
        - I/VI: barely audible
        - II/VI: faint but easily audible
        - III/VI: loud murmur w/o palpable thrill
        - IV/VI: load murmur w/ palpable thrill
        - V/VI: very loud murmur heart w/ stethoscope lightly on chest
        - VI/VI: very loud murmur heart w/o stethoscope

Table showing the common systolic, diastolic and continuous heart murmurs	
Systolic	• SEM: Innocent murmurs, obstructive lesions*, ASD • Holosystolic: VSD, MR, TR (mitral and tricuspid insufficiency) • Decrescendo: usually with small VSDs (as VSD almost closes by the end of systole)
Diastolic	• Early: AI, PI (aortic and pulmonary insufficiency) • Mid: relative mitral stenosis (VSD) or relative tricuspid stenosis (ASD) • Late: Rheumatic MS (mitral stenosis)
Continuous	• Usually vascular in origin when a high-pressure vessel communicates with a low-pressure vessel e.g. PDA (beyond the neonatal period), BT shunt, AV malformation anywhere in the body (heart, lungs, brain, liver or pregnant uterus)
*Obstructive lesions include AS, PS, Coarctation of the aorta, TOF, etc.	

Table showing the common heart murmurs audible at different age	
Immediately after birth	PDA or obstructive lesions*
Shortly after birth (a few hours to few weeks)	VSD, PDA, PPS (peripheral pulmonary stenosis)
1-4 years	Innocent murmurs, ASD
Teenage	Innocent murmur, HOCM or MVP/MR
*Obstructive lesions include AS, PS, Coarctation of the aorta, TOF, etc	

https://www.utmb.edu/Pedi_Ed/CoreV2/cardiology/Cardiology3.html

Conclusions/action items:

find recordings of all these sounds to add to the simulation and label them with their appropriate type

Heart Sounds Video

EMMA NEUMANN - Sep 23, 2020, 8:14 AM CDT

Title: Heart Sounds Video

Date: 9/23/2020

Content by: Emma Neumann

Present: Emma Neumann

Goals: Hear what different heart sound actually sound like

Content:

- healthy heart
    - lub dub sound
- mitral regurgitation, tricuspid regurgitation
    - maintain sound through systole
- aortic stenosis, pulmonic stenosis
    - crescendo/decrescendo during systole
    - has a quick click right before
- aortic regurgitation, pulmonic regurgitation, mitral stenosis, tricuspid stenosis
    - decreases through diastole
- also shows you where to best hear all of the sounds

https://www.youtube.com/watch?v=dBwr2GZCmQM

Conclusions/action items:

create a map of the sounds and where each can be best heart to most accurate place the sounds on the vest

SimMan 3G

EMMA NEUMANN - Sep 23, 2020, 7:38 AM CDT

Title: SimMan 3G

Date: 9/23/2020

Content by: Emma Neumann

Present: Emma Neumann

Goals: Find out what is on the market and what features it has.

Content:

- fully automated mannequin
- can be used for:
    - POC ultrasound
    - advanced ventilation management
    - patient monitoring
- controlled with LLEAP
    - can be remotely controlled
    - wireless and self-contained
    - rechargeable batteries
    - lasts about 4 hrs
    - can controle multiple manikins with one interface
- features
    - multiple airway features and complications
    - breathing features and complications
    - cardiac features
    - circulation features
    - vascular access
    - cpr
    - eyes
    - seizure
    - bleeding
    - bowel sounds
    - patient voice
    - instructor communication
    - pharmacology
- certifications: UL, CE, FCC, CSA, HMR

https://www.laerdal.com/us/products/simulation-training/emergency-care-trauma/simman-3g/

Conclusions/action items:

Find out what those certifications all mean and if we need to follow them.
Determine which of these features we want to include.

Medical Sim Market Value

EMMA NEUMANN - Apr 08, 2021, 2:30 PM CDT

Title: Medical Sim Market Value

Date: 4/8/2021

Content by: Emma Neumann

Present: Emma Neumann

Goals: figure out what the value of the market is for this product for the Tong summary

Content:

2020: 1.9 bil
CAGR: 14.6%
https://www.marketsandmarkets.com/Market-Reports/healthcare-medical-simulation-market-1156.html?gclid=CjwKCAjw07qDBhBxEiwA6pPbHhh432WzdtT9cGkqpYbIkC9ugTFy3KzwjnooUAjL8RMpaMFRNeHzdhoC0uYQAvD_BwE

2019: 1.4 bil
CAGR: 14.6%
https://www.alliedmarketresearch.com/medical-simulation-market#:~:text=The%20global%20medical%20simulation%20market,14.6%25%20from%202020%20to%202027.

2017: 1.36 bil
CAGR: 16.3%
https://www.grandviewresearch.com/industry-analysis/medical-healthcare-simulation-market

2019: 2.27 bil
CAGR: 17.8%
https://www.verifiedmarketresearch.com/product/global-healthcare-medical-simulation-market-size-and-forecast-to-2025/

Conclusions/action items:

try to find scholarly articles

FDA Labeling Requirements

EMMA NEUMANN - Sep 16, 2020, 5:28 PM CDT

Title: FDA Labeling Regulatory Requirements for Medical Devices

Date: 9/16/2020

Content by: Emma Neumann

Present: Emma Neumann

Goals: Find out what types of labeling will be required on our simulation.

Content:

- the labeling cannot be false or misleading
- we need to include a disclaimer that it is a simulation and may not be a fully accurate or a replacement for real world exposure
- need to include a label about the electronics involved
    - have a label about electrocution if in water
- need to include directions
- need to include a label warning people about overheating since it is a heavy device worn
- there are exemptions if the device is strictly for educational purposes (which ours would be)

US Department of Health and Human Services (1997, February). Good Guidance Practices: Labeling Regulatory Requirements for Medical Devices. *HHS Publication FDA 89-4203*. https://www.fda.gov/files/medical%20devices/published/Labeling---Regulatory-Requirements-for-Medical-Devices-%28FDA-89-4203%29.pdf

Conclusions/action items:

This may not have been the best document, but it was closest thing I could find to our device, but it does not specifically mention simulations since it is a bit outdated. The main ones we need though are the electronics, thermal, and simulation warnings.

INACSL Standards

EMMA NEUMANN - Sep 16, 2020, 5:19 PM CDT

Title: INACSL Standards of Best Practice: Simulation

Date: 9/16/2020

Content by: Emma Neumann

Present: Emma Neumann

Goals: Find out if there are any standards for medical educational simulations

Content:

1. Simulation Design
    1. Perform a needs assessment to provide the foundational evidence of the need for a well-designed simulation-based experience.
    2. Construct measureable objectives.
    3. Structure the format of a simulation based on the purpose, theory, and modality for the simulation-based experience.
    4. Design a scenario or case to provide the context for the simulation-based experience.
    5. Use various types of fidelity to create the required perception of realism.
    6. Maintain a facilitative approach that is participant-centered and driven by the objectives, participant's knowledge or level of experience, and the expected outcomes.
    7. Begin simulation-based experiences with a prebriefing.
    8. Follow simulation-based experiences with a debriefing and/or feedback session.
    9. Include an evaluation of the participant(s), facilitator(s), the simulation-based experience, the facility, and the support team.
    10. Provide preparation materials and resources to promote participants' ability to meet identified objectives and achieve expected outcomes of the simulation-based experience.
    11. Pilot test simulation-based experiences before full implementation
2. Outcomes and Objectives
    1. Determine expected outcomes for simulationbased activities and/or programs.
    2. Construct Specific, Measurable, Achievable, Realistic, Time-phased objectives based on expected outcomes.
3. Facilitation
    1. Effective facilitation requires a facilitator who has specific skills and knowledge in simulation pedagogy
    2. The facilitative approach is appropriate to the level of learning, experience, and competency of the participants.
    3. Facilitation methods prior to the simulationbased experience include preparatory activities and a prebriefing to prepare participants for the simulation-based experience.
    4. Facilitation methods during a simulationbased experience involve the delivery of cues (predetermined and/or unplanned) aimed to assist participants in achieving expected outcomes.
    5. Facilitation after and beyond the simulation experience aims to support participants in achieving expected outcomes.
4. Debriefing
    1. The debrief is facilitated by a person(s) competent in the process of debriefing.
    2. The debrief is conducted in an environment that is conducive to learning and supports confidentiality, trust, open communication, self-analysis, feedback, and reflection.
    3. The debrief is facilitated by a person(s) who can devote enough concentrated attention during the simulation to effectively debrief the simulation-based experience.
    4. The debrief is based on a theoretical framework for debriefing that is structured in a purposeful way.
    5. The debrief is congruent with the objectives and outcomes of the simulation-based experience.
5. Participant Evaluation
    1. Determine the method of participant evaluation prior to the simulation-based experience.
    2. Simulation-based experiences may be selected for formative evaluation.
    3. Simulation-based experiences may be selected for summative evaluation.
    4. Simulation-based experiences may be selected for high-stakes evaluation.
6. Professional Integrity
    1. Foster and role model attributes of professional integrity at all times.
    2. Follow standards of practice, guidelines, principles, and ethics of one's profession.

3. Create and maintain a safe learning environment (See INACSL Standard: Facilitation).
4. Require confidentiality of the performances and scenario content based on institutional policy and procedures.

7. Simulation-Enhanced interprofessional Education (Sim-IPE)

1. Conduct Sim-IPE based on a theoretical or a conceptual framework.
2. Utilize best practices in the design and development of Sim-IPE.
3. Recognize and address potential barriers to Sim-IPE.
4. Include an appropriate evaluation plan.

8. Operations

1. Implement a strategic plan that coordinates and aligns resources of the SBE program to achieve its goals.
2. Provide personnel with appropriate expertise to support and sustain the SBE program.
3. Use a system to manage space, equipment, and personnel resources.
4. Maintain and manage the financial resources to support stability, sustainability, and growth of the SBE program's goals and outcomes.
5. Use a formal process for effective systems integration.
6. Create policies and procedures to support and sustain the SBE program

INACSL Standards Committee (2016, December). INACSL standards of best practice: Simulation℠. *Clinical Simulation in Nursing, 12(S), S5-S47*. https://www.inacsl.org/INACSL/document-server/?cfp=INACSL/assets/File/public/standards/SOBPEnglishCombo.pdf.

Conclusions/action items:

There are eleven design criteria, two outcomes and objectives, five facilitation, five debriefing, four participant evaluation, four professional integrity, four simulation interprofessional education, and six operations criteria we need to consider in our design. Not all of them are relevant to our project, but we should definitely go through all of them when we create our design.

10/6/2020 Breast Plate Solidworks

EMMA NEUMANN - Oct 06, 2020, 10:59 PM CDT

Title: Breast Plate Solidworks

Date: 10/6/2020

Content by: Emma Neumann

Present: Emma Neumann, Gabby Snyder

Goals: Create a 3D mockup of the breast plate capsule

Content:

*solidworks files are below

Conclusions/action items:

Add into report

EMMA NEUMANN - Oct 06, 2020, 10:59 PM CDT

breastplatefront.SLDPRT(180.5 KB) - download

EMMA NEUMANN - Oct 06, 2020, 10:59 PM CDT

breastplateback.SLDPRT(109.2 KB) - download

9/23/2020 Initial Design Ideas

EMMA NEUMANN - Sep 23, 2020, 8:37 AM CDT

Title: Removable Electronics Idea

Date: 9/23/2020

Content by: Emma Neumann

Present: Emma Neumann

Goals: come up with 3 designs to bring to the group for ideas for the preliminary designs

Content:

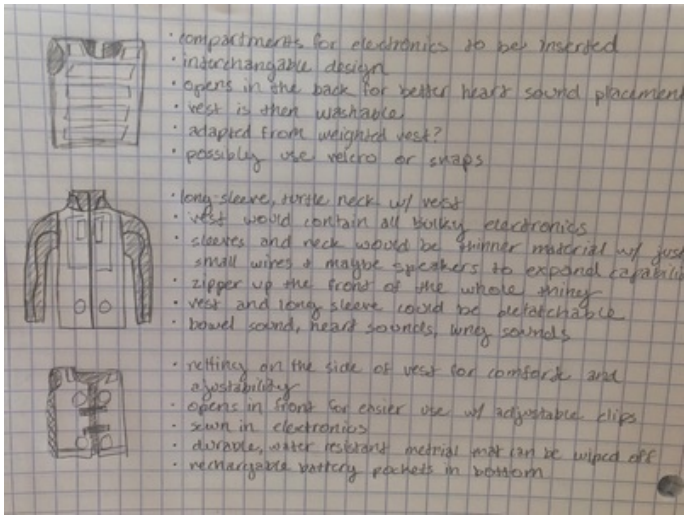
*picture below

Conclusions/action items:

discuss pros and cons of these designs and other designs with team members

come up with more detailed electronic design ideas

EMMA NEUMANN - Sep 23, 2020, 8:35 AM CDT



Initial_Designs.jpg(323.4 KB) - download

2/17/2021 Handsewn Vest

EMMA NEUMANN - Feb 17, 2021, 8:12 PM CST

Title: Hand Sewn Vest

Date: 2/17/2021

Content by: Emma Neumann

Present: Emma, Gabby, Andy

Goals: Create a simplistic vest design that we could feasible create.

Content:

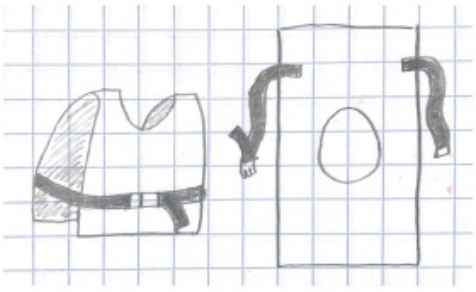
sketch attached below

The material would be made out of a water proof, durable nylon (or something with similar qualities). It would go over a person's head and attached with a strap that goes around the midsection similar to a simple lifejacket.

Conclusions/action items:

Still need to run some cost calculations and source material to fully compare it to premade vests.

EMMA NEUMANN - Feb 17, 2021, 7:40 PM CST



Scanned_20Documents-1.pdf(260.5 KB) - download

EMMA NEUMANN - Mar 02, 2021, 8:36 PM CST

HandSewnVest.SLDPRT(132.7 KB) - download

Adafruit Audio FX Sound Board

EMMA NEUMANN - Oct 26, 2020, 8:14 AM CDT

Title: Adafruit Audio FX Sound Board

Date: 10/26/2020

Content by: Emma Neumann

Present: Emma Neumann

Goals: Investigate this sound board as a potential for the design since it was a recommendation from Dr. Numinkar.

Content:

- no microcontroller needed - although we would need one to regulate the buttons unless we did a dial
- 1.9" x 0.85"
- 16MB storage
- takes compressed Ogg files or uncompressed WAV files
- 44.1Hz 16 bit stereo
- 11 triggers
- 5 trigger effects
    - basic: play when connected to ground momentarily
    - hold: play when trigger is held down
    - latching: plays when pressed and stops when pressed again
    - play: play up to 10 files in consecutive order each time you press
    - random: play up to 10 files at random when pressed

https://learn.adafruit.com/adafruit-audio-fx-sound-board

Conclusions/action items:

This is a cool board, but I worry it won't have enough input options because we will probably want more than 11 sound files. Additionally, this would require an external bluetooth module to interact with an app, etc.

DROK Bluetooth Audio Receiver

EMMA NEUMANN - Oct 26, 2020, 8:31 AM CDT

Title: DROK Bluetooth Audio Receiver

Date: 10/26/2020

Content by: Emma Neumann

Present: Emma Neumann

Goals: Find an audio board that can have more audio files than the Adafruit sound board and has a bluetooth capability

Content:

- audio inputs
    - bluetooth receiver up to 10-15 meters
    - USB decoding play
    - TF card decoding plya
- DC5V
- operations
    - mode: switch between three audio inputs
    - next: play next sound, long press to increase volume
    - back: play previous sound, long press to decrease volume
    - eq: sound effect manager for USB or TF
    - audio output: for headphones, speaker, or amplifier

https://www.droking.com/Bluetooth-Stereo-3.5mm-Audio-Receiver-Module-with-USB-TF-card-decoding-playback-preamp-output-for-MP3-WMA-WAV-FLAC

https://www.amazon.com/Bluetooth-DROK-Receiver-Electronics-Headphone/dp/B07P94Z9XR/ref=sr_1_5?dchild=1&keywords=Audio+Board&qid=1603717196&sr=8-5

Conclusions/action items:

This could solve the problem of not having enough audio files available, but I worry about the quality and reliability of using bluetooth.

10/6/2020 Heart and Lung Sounds LIbrary

EMMA NEUMANN - Oct 06, 2020, 11:07 PM CDT

Title: Heart and Lung Sounds LIbrary

Date: 10/6/2020

Content By: Emma Neumann

Present: Emma Neumann

Goal: Find a bank of open-sourced heart and lung sounds we could potentially pull from for our speakers to use.

Content:

Thinklabs One Digital Stethoscope has a huge library of sounds. They have it available on their youtube channel and through an app. We may be able to pull from their app to integrate into our design.

youtube.com/c/Thinklabs1/videos

https://www.thinklabs.com/heart-sounds

Conclusion/Action Items:

Find out if we could actually use these sounds.

Find out how muffled these sounds are behind fabric.

Adafruit Soundboard Library

EMMA NEUMANN - Feb 10, 2021, 8:36 PM CST

Title: Adafruit Soundboard Library

Date: 2/10/2021

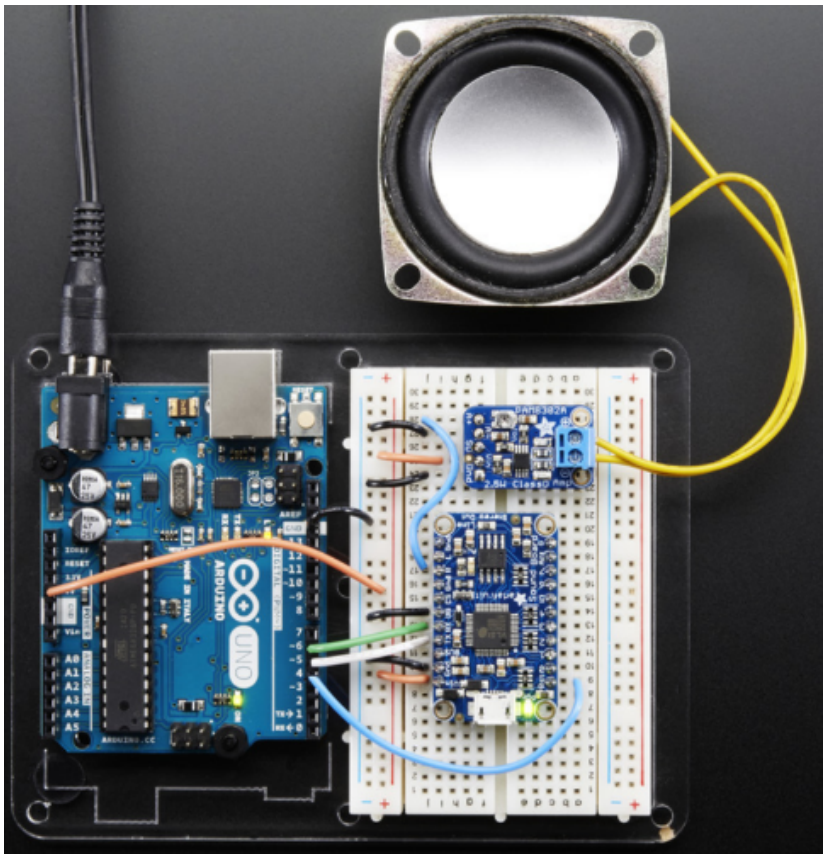
Content by: Emma Neumann

Present: Emma, Gabby, Josh

Goals: Find ideas for the code to use with the soundboard.

Content:

- Gave an example code
- Has commands to control the soundboard
- Shows how the wire the arduino, soundboard, amplifier, and speaker



ASCII Character(s) sent to Sound Board	Description
`L`	return a list of all the files on the Sound Board over the serial connection
`#{n}`	play song number "{n}"
`P{name}`	play song with a name of "{name}"
`+`	increase the volume
`-`	decrease the volume
`=`	pause playback
`>`	resume playback
`q`	stop playback
`t`	return the current time in the track and the total time of the track in seconds over the serial connection
`s`	return the remaining size of the track and the total size of the track in bytes over the serial connection

Github: https://github.com/adafruit/Adafruit_Soundboard_library

Walkthrough w/ pictures: https://learn.adafruit.com/adafruit-audio-fx-sound-board/serial-audio-control

Conclusions/action items:

We wired the circuitry as shown, but are having difficulty getting sound to come out of the speaker. We need to figure out how to bring up the terminal window to control the soundboard.

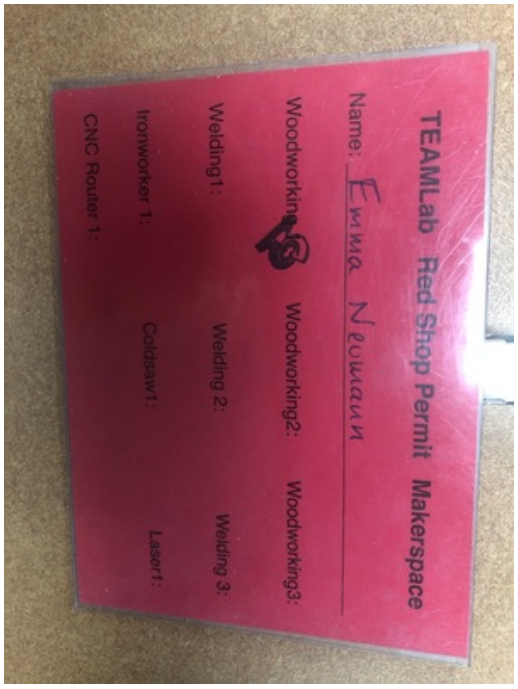
Gabby is going to insert pictures of our circuitry.

Red Permit

EMMA NEUMANN - Mar 05, 2020, 9:51 AM CST

CBB635FE-2807-4187-AEAB-3F9BDE21EEB8.jpg(526.8 KB) - download

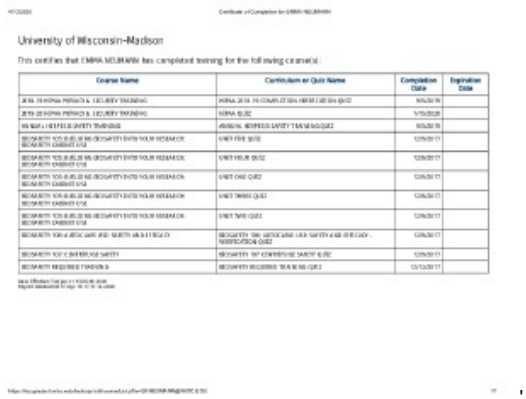
EMMA NEUMANN - Mar 05, 2020, 9:51 AM CST



841EF188-C8E6-4025-995C-EBF231E0D312.jpg(514.9 KB) - download

Biosafety Training

EMMA NEUMANN - Apr 10, 2020, 5:17 PM CDT



University of Wisconsin-Madison

This certifies that EMMA NEUMANN has completed training for the following course(s):

Course Name	Curriculum or Quiz Name	Completion Date	Expiration Date
[redacted]	[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]	

Neumann_BiosafetyTraining.pdf(136.2 KB) - download

2/17/2021 - Raspberry Pi Setup

EMMA NEUMANN - Mar 17, 2021, 8:38 PM CDT

Title: Raspberry Pi Setup

Date: 2/17/2021

Content by: Emma Neumann

Present: Emma Neumann, Gabby Snyder, Josh Murwin

Goals: setup the raspberry pi so that we can communicate with it wirelessly and write code to it

Content:

I followed the instructions outlined here for Windows: https://desertbot.io/blog/headless-raspberry-pi-3-bplus-ssh-wifi-setup

I tried to do this while at E. Hall but I could not figure out how to get it to connect with the UW Net wifi or the ssh was not working because I could not connect.

Realized that link was for rpi 3+, so I found these instructions for rpi 0: https://desertbot.io/blog/headless-pi-zero-w-wifi-setup-windows
*they were the same

Still could not get my Windows to connect to it.

Conclusions/action items:

I am going to try to connect using a different wifi network to see if that is the problem.

Alternatively, I found instructions for a USB direct hookup that may work: https://desertbot.io/blog/headless-pi-zero-ssh-access-over-usb-windows

3/24/2021 - Successful RPI setup

EMMA NEUMANN - Mar 24, 2021, 8:01 PM CDT

Title: Successful RPI setup

Date: 3/24/2021

Content by: Emma Neumann

Present: Gabby, Josh, Andy

Goals: Setup wifi and ssh capabilities with the raspberry pi.

Content:

Realized that the NOOBS that was uploaded on the SD card was out of date and that was why it could not communicate with the rpi zero. Used the raspbian image installer and reformatted the SD card with the most recent version of NOOBS. I was then able to successfully ssh into the rpi and interact with the rpi terminal.

https://desertbot.io/blog/headless-raspberry-pi-3-bplus-ssh-wifi-setup

Conclusions/action items:

Need to add multiple wifi networks to the knowledge base: https://raspberrypi.stackexchange.com/questions/11631/how-to-setup-multiple-wifi-networks

4/27/2021 - Final Notes

EMMA NEUMANN - Apr 27, 2021, 6:43 PM CDT

Title: Final Notes

Date: 4/27/2021

Content by: Emma Neumann

Present: Emma Neumann

Goals: Provide a summary of the work we were able to do

Content:

We were successfully able to run the sound files through the adafruit soundboard using the Arduino (this is documented in the testing section)

We were able to successfully get into the raspberry pi by hooking it up to power, using a wireless keyboard and mouse duo that had a microusb bluetooth adaptor to fit in the only port open on the rpi zero w (borrowed from Dr. Bahr), and a microHDMI hookup to a monitor.

The rpi took about a minute to load and open up.

Never could quite get it to automatically connect to the wifi. For some reason, it would not remember the networks and I would always need to resign in. There was also a problem where it would crash when it would connect to the wifi at times. I was never able to figure out why after consulting with Dr. Bahr.

The rpi comes with a python IDE setup in it that we used to run the code through (in Josh's notes, he wrote it).

We could also use VNC Viewer (for Windows) or SSH (for Mac) to screen share with the rpi so that it could come up on our laptops. However it was faster to run it through the monitor hookup directly.

Conclusions/action items:

May need an rpi for each of the soundboards because you have to send ground to the pin that you want the sound to come out of and we would run out of pins on the rpi. However, could potentially have an intermediate switch.

Need to workout the wifi glitches so that it can be fully wireless (headless)

Need to figure out how to make it interact with an app interface.

Abnormal Heart Rhythms

GABRIELLE SNYDER - Sep 17, 2020, 12:25 PM CDT

Title: Abnormal Heart Rhythms

Date: 9.17.20

Content by: Gabby

Present: me

Goals: To better understand what abnormal heart rates may look like

Content:

- normal heart rate = 60-100 bpm (beats per minute)
    - for athletic people it may be more close to 40-60 bpm

abnormal heart rhythms= arrhythmias

- signs:
    - skipping of a heart beat
    - fluttering sensation
    - or beating too slow (<60 bpm)
    - beating too fast (>100 bpm)
- caused when electrical impulses in heart are too fast, too slow, or irregular
- heart may pump blood inefficiently leading to poor blood circulation
    - result in organ damage
        - less oxygen reaching parts of body
- usually harmless
- some may produce symptoms
    - dizziness, palpitations, pounding in chest, fainting, shortness or breath, weakness, fatigue
- others may lead to sudden cardiac death if untreated
- **TYPES**
    - **Bradycardia**
        - heart beats too slow
            - <60 bpm
            - this may not cause problems or athletic people though
        - cause: disruption of electrical impulses from heart
        - factors:
            - aging,
            - hypothermia,
            - damage from heart attack or heart disease
    - **Tachycardia**
        - heart beats too fast
            - >100 bpm
        - cause: disruption of electrical impulses from heart
        - factors:
            - damage from heart attack or heart disease
            - congenital heart disease
            - high blood pressure
            - smoking
        - Atrial or Supraventricular Tachycardias
            - occurs in atria (upper chambers) or middle region
        - Sinus Trachycardia
            - heart functions properly but just has a faster heart rate
        - Ventricular Tachycardias
            - occurs in ventricles (lower chambers) of heart
            - may be life-threatening
    - **Fibrillation**
        - = heart quivers
        - Atrial Fibrillation
            - common abnormal heart rhythm
            - manageable

        - Ventricular Fibrillation
            - life-threatening abnormal heart rhythm
    - **Premature Contraction**
        - = early heart beat
        - Premature Atrial Contractions
            - PACs
            - occurs in artia
        - Premature Ventricular Contraction
            - PVCs
            - occurs in ventricles
- sometimes abnormal heart rhythms can be cured through medication however that is usually not the case
    - may be able to be controlled through use of medications

Conclusions/action items:

There are many different types of abnormal heart rhythms. Now that I have a better understanding of what different abnormal heart rates are, I can begin to research what they look like graphically and what they sound. I also like to know which kinds of heart rates are commonly found/used during mannequin simulations so we, as a team, can decide which/if any of these heart rates are ones we should consider for our design.

source: "Abnormal Heart Rhythms & Arrhythmia | MemorialCare", *Memorialcare.org*, 2020. [Online]. Available: https://www.memorialcare.org/services/heart-vascular-care/abnormal-heart-rhythms-arrhythmias. [Accessed: 17- Sep- 2020].

How the Heart Works

GABRIELLE SNYDER - Sep 17, 2020, 1:06 PM CDT

Title: How the Heart Works

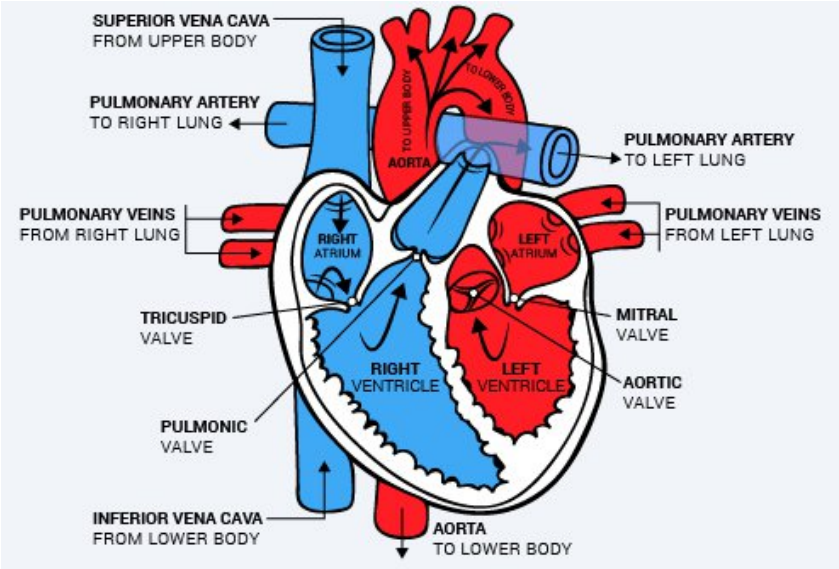
Date: 9.17.20

Content by: Gabby

Present: me

Goals: To develop a better understanding of how the heart works and how blood flows through the heart.

Content:



- **heart**
  - located under rib cage
  - 2/3 of it is to the left of the breastbone (sternum), between lungs and above diaphragm
  - size of closed fist, somewhat cone-shaped
  - about 10.5 oz
  - covered by pericardial sack (pericardium)
  - 4 chambers
- **heart arteries & their function**
  - septum (muscular wall) that divides heart into right and left side
  - atria= two top chambers (right & left artium)
    - receive blood
    - then pump blood to ventricles
  - ventricles = two bottom chambers (right & left ventricles)
    - receive blood from atria
    - then pump blood to the lungs and body
  - coronary arteries
    - on heart surface
    - make up heart's mini-circulatory system
    - the two major coronary arteries branch off the aorta (near where aorta and left ventricle meet)
  - right coronary artery
    - supplies the right atrium and right ventricle with blood
    - branches to posterior descending artery
      - posterior descending artery supplies bottom portion of left ventricle and back of septum with blood
  - left main coronary artery
    - branches to circumflex artery and left anterior descending artery
      - circumflex artery - supplies blood to left atrium, and side and back of left ventricle
      - left anterior descending artery - supplies front and bottom of left ventricle and front of septum with blood

    - these arteries supply blood to all parts of heart muscle
- **heart valves**
    - heart needs atria and ventricles to work sequentially
    - contracting and relaxing to pump blood out of heart and then allowing chamber to refill
    - there are 4 valves ,which prevent back flow of blood
        - Mitral valve
            - between left atrium and left ventricle
        - Tricuspid valve
            - between right atrium and right ventricle
        - Aortic valve
            - between left ventricle and aorta
        - Pulmonic valve (pulmonary valve)
            - between right ventricle and pulmonary artery
    - endocardium
        - membrane of epithelial cells
        - line heart chambers and valves
        - it a slick surface which prevents red blood cells, platelets, and other substances in blood from sticking to the inner surface of the heart
        - also contains Purkinje fibers
            - specialized muscle cells that can transmit electrical impulses
            - cause heart muscle contraction
    - SA (sinoatrial node)
        - or pacemaker
        - clusters of cells in upper right atrium
        - generate electrical impulses
    - AV node
        - atrioventricular node
        - cluster of cells at center of heart between bottom of right atria and top of ventricles
        - where the electrical impulses from the SA move toward after being generated
        - it pauses the electrical impulse to allow the atria to fully contract (ie squeeze blood out into ventricles)
        - then allows the impulse "to go into cells termed the bundle of His to the ventricles that split into the right and left bundle branches in the ventricles"
        - the signal then reaches the Perkinje fibers and causes the ventricles to contract and push blood into the lungs and aorta
    - ventricular contractions generate heart rates (pulse) and blood pressures
        - body's nervous system controls the impulse rate in the SA node

GABRIELLE SNYDER - Sep 17, 2020, 1:23 PM CDT

THE HEART (cont)

How blood flows though heart

- veins carry deoxygenated blood to the heart
- arteries carry oxygenated blood away from the heart
- RIGHT SIDE
    - inferior and superior vena cava (both veins) carry deoxygenated blood to the right atrium
    - right atrium contracts
    - blood flows into right ventricle through tricuspid valve
        - when ventricle is full, valve shuts (right atrium contract again)
    - right ventricle contracts
    - blood flows through pulmonic valve into pulmonary artery and lungs
    - blood oxygenated in the lungs ("CO2 released and O2 absorbed")
- LEFT SIDE
    - oxygen-rich blood enters left atrium through the pulmonary vein
    - left atrium contracts
    - blood flows into left ventricle through mitral valve
        - when ventricle is full, valve shuts (left atrium contracts again)
    - left ventricle contracts
    - oxygenated blood leaves heart through aortic valve, into the aorta and to arteries , distributed to rest of body
    - blood eventually enters veins to repeat this process and complete blood circulation in body

Conclusions/action items:

Having a better understanding of the different parts and functions of the heart as well as how the heart functions and the way blood flows through the heart will be beneficial in understanding how heart rates/pulses are created. It could also help me be able to identify what issues in the functioning occur to cause arrhythmias. More research will need to be done of what specifically occurs in the heart functions that causes the different arrhythmias.

source: "How the Heart Works: Diagram, Anatomy, Blood Flow", *MedicineNet*, 2020. [Online]. Available: https://www.medicinenet.com/heart_how_the_heart_works/article.htm#which_drugs_or_supplements_interact_with_evolocumab. [Accessed: 17-Sep- 2020].

Sterilizable Materials

GABRIELLE SNYDER - Sep 23, 2020, 12:15 AM CDT

Title: Sterilizable Materials for a vest design

Date: 9.22.20

Content by: Gabby

Present: me

Goals: To try to find different materials that could be used to create our design idea out of.

Content:

fabrics

- magnafabrics.com
    - maxima ESD
        - high density polyester static dissipative fabric
        - fabric repels fluid and bacteria
        - recommended for: aseptic environments, pharmaceutical, biotechnical, biological and food processing
        - Mean Size: 5-6 microns
        - Weight: 2.53 oz/yd²
        - Air Permeability: 1.21 cfm/ft²
        - Moisture Vapor Transmission: 1350 g/m²/24 hr
        - Carbon: Stripe Surface Resistivity: 4.85×10 7 ohms/sq
        - Static Decay: 0.01 sec Static
        - machine washable autoclavable
        - grade 2
    - maxima (medical barrier)
        - Mean Pore Size: 5-6 microns
        - Weight: 2.53 oz/yd²
        - Air Permeability: 1.21 cfm/ft²
        - Moisture Vapor Transmission: 1350 g/m²/24 hr
        - machine washable, autoclavable, gamma compatible
        - grade 2

Conclusions/action items:

I am not sure it would actually be feasible to create our design completely out of these sterilizable plastics. However, it could possibly work for us to create our design, say a vest, out of polyester or some kind of more comfortable fabric and then just create a second, outer layer of some kind of sterilizable plastic that would go on top of the other material. This would make our design more durable and probably more comfortable to wear too and it would also provide a way to easily clean the device between each use.

fabrics citation: "Medical Barrier Fabrics for Surgical Gowns, Isolation Gowns, Surgical", *Magna Fabrics*, 2020. [Online]. Available: https://www.magnafabrics.com/collections/medical-barrier-fabrics/autoclavable-fabric. [Accessed: 23- Sep- 2020].

Sterilizable Plastics

GABRIELLE SNYDER - Sep 23, 2020, 12:43 AM CDT

Title: Sterilizable Materials for a vest design

Date: 9.22/23.20

Content by: Gabby

Present: me

Goals: To try to find different plastic materials that could be used to create our design.

Content:

- polymer used should be a thermoplastic material
- thermoplastic
    - type of synthetic polymer
    - can be reheated and remodeled without irreversible degradation
    - undergo physical changes, not chemical
    - can be reused and recycled
    - good for plastic injection molding
- medical grade polymers
    - must be biocompatible
    - temperature, impact, and corrosion resistant
- types thermoplastic materials
    - polycarbonates
        - impact resistance properties
        - withstand high-temperature ranges
            - good heat resistant properties
        - used for plastic lenses, car components, protective gear
        - pliable and can be formed at room temp without cracking or breaking
    - polypropylene
        - used when steam-sterilized devices are needed
        - chemical/corrosion resistant
        - durable
            - high strength to weight ratio
            - high impact strength
        - recyclable
    - polyethylene
        - high impact resistance
        - high resistance to chemicals
        - low moisture absorption
        - does not fade
        - does not retain dangerous bacteria
        - can withstand cleaning agents

Conclusions/action items:

These are potential plastics that we could look into using in our design if there needs to be an aspect that would be best if made out of plastic. The center circle plate in my second design could potentially be created out of one of these plastics too. We need to use materials that are sterilizable because many different people would be practicing scenarios on the same design so it is imperative (especially now with COVID) that the device can be adequately cleaned between each use.

source: B. MEDICAL, "What are the Best Types of Plastic for Medical Equipment or Devices?", *BMP Medical*, 2020. [Online]. Available: https://www.bmpmedical.com/news/what-plastics-are-used-in-medical-devices/. [Accessed: 23- Sep- 2020].

General Manikin Research

GABRIELLE SNYDER - Sep 09, 2020, 11:24 PM CDT

Title: Manikin Research

Date: 9.9.20

Content by: Gabby

Present: me

Goals: To understand the SimMan that is currently being used

Content:

- manikin (mannequin)
    - used in situations ranging from emergencies to military simulations to surgeries
    - simulate human anatomy and physiology
- fidelity = "degree to which a particular manikin can reproduce or mimic human physiology"
    - high fidelity --> those that most closely resemble human anatomy
        - expanding chests (breathe)
        - varying heart rates and tones
        - able to measure blood pressure
        - pulses
        - EKG displays
        - pulse oximeter
        - arterial and pulmonary artery wave forms
        - anethetic gases
        - able to preform procedures on these types of manikins
            - bag-mask ventilation, intubation, defibrillation, chest tube placement, cricothyrotomy
        - usually contain hydraulics, compressors, external displays
        - may change color, speak, cry
        - undergo seizures
        - some are specialized
            - ie trauma manikins, birthing manikins, newborn and/or premature babies
        - usually operated by trained person from a separate room
            - another person may be in the room with the student to help them through the scenario
        - more than one company makes these
            - SimMan series
            - LucinaAR birthing simulator from CAE Heathcare
                - has hologram options
            - Victoria birthing manikin by Gaumard
    - low fidelity --> little resemblance to human anatomy
        - static manikins with limited functionality
        - aka task trainers
        - used for repeated practice
            - ex. catheter placement

Conclusions/action items:

There are many different elements that can be implemented into a manikin. However, as a team we would not be able to create/implement every single data piece and sound. We need to ask our client what the most important aspects of the manikin are and try to design all or some of those this semester and possibly adding other components in future semesters.

source: HealthySimulation.com. 2020. *High Fidelity Simulation | Healthcare Simulation | Healthysimulation.Com*. [online] Available at: <https://www.healthysimulation.com/high-fidelity-simulation/> [Accessed 10 September 2020].

Simulation Market Projections

GABRIELLE SNYDER - Apr 26, 2021, 11:59 AM CDT

Title: Global Medical Simulation Market

Date: 4.22.21

Content by: Gabby

Present: Gabby

Goals: To attempt to find a scholarly source for medical simulation market projections

Content:

- global medical simulation market size valued at $1.4 million in 2019

- estimated to be valued around $3.2 million by 2027

- CAGR (current annual growth rate) of 14.6% from 2020 to 2017

- shows industry is growing and our device, especially at the lower price compared to other mannequins on the market has the potential to be successful.

“Medical Simulation Market Size: Industry Growth By 2027,” Allied Market Research. [Online]. Available: https://www.alliedmarketresearch.com/medical-simulation-market. [Accessed: 21-Apr-2021].

Conclusions/action items:

I was unable to find a scholarly article. However, all of projections from the multiple websites I looked at were very similar.

Vest Idea #1

GABRIELLE SNYDER - Sep 22, 2020, 11:35 PM CDT

Title: Design Idea 1

Date: 9.22.20

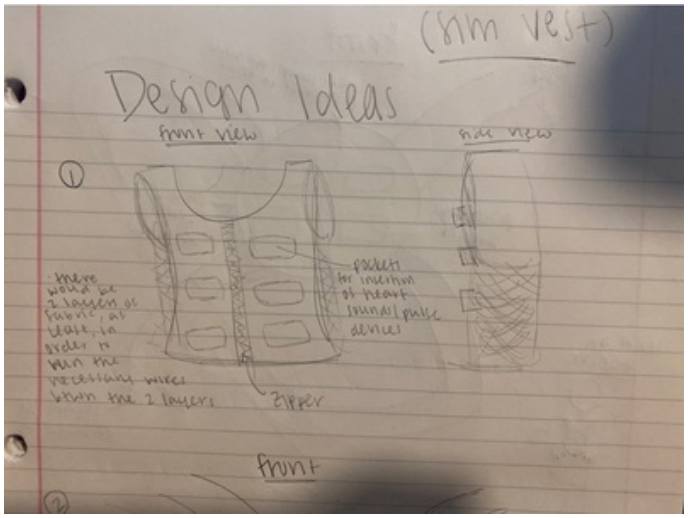
Content by: Gabby

Present: me

Goals: Design and illustrate a rough sketch of my first design idea

Content:

GABRIELLE SNYDER - Sep 22, 2020, 11:36 PM CDT



design_idea_1.jpg(128.8 KB) - download

GABRIELLE SNYDER - Sep 22, 2020, 11:40 PM CDT

Conclusions/action items:

This design uses the look and fit of a weighted vest. However, instead of weights in the pockets we could put the different sensors we want to use in them. There would be a double layer of fabric so if wires are needed we could run the wires between the two layers so they do not hang out and get in the way. The vest could be zipped up the front and there can also be straps on the side in order to make it adjustable.

Vest Idea #2

GABRIELLE SNYDER - Sep 22, 2020, 11:40 PM CDT

Title: Design Idea 2

Date: 9.22.20

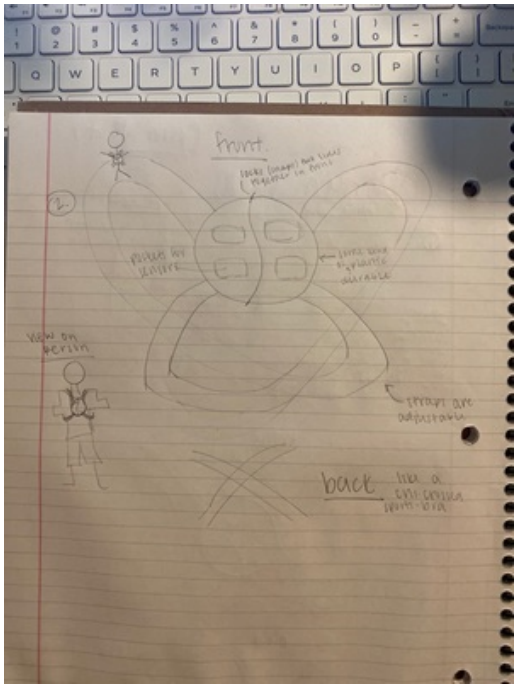
Content by: Gabby

Present: me

Goals: Design and illustrate a rough sketch of my second design idea

Content:

GABRIELLE SNYDER - Sep 22, 2020, 11:29 PM CDT



Design_idea_2.jpg(128.3 KB) - download

GABRIELLE SNYDER - Sep 22, 2020, 11:55 PM CDT

Conclusions/action items:

This design involves a "breastplate" (I'm not really sure exactly what to call it) but ideally it will sit right around the chest/pec/breast area of the wearer. The plastic piece would be made of two halves that can clasp together. The straps attach to the plastic circle piece, loop over the shoulder, and cross in the back. The straps can also be adjustable to allow for different sized wearers. The different sensors can be placed either inside the plastic piece or on the front facing face. My concern with this design is that there is not enough surface area of wearable device for a student to use/practice on. With this device the student would most likely have to directly touch the wearer to practice whereas in the other design the student would be touching the vest being worn.

Sim Lab Manikin Photos

GABRIELLE SNYDER - Oct 04, 2020, 10:25 PM CDT

Title: Sim Lab Manikin Photos

Date: 10.4.20

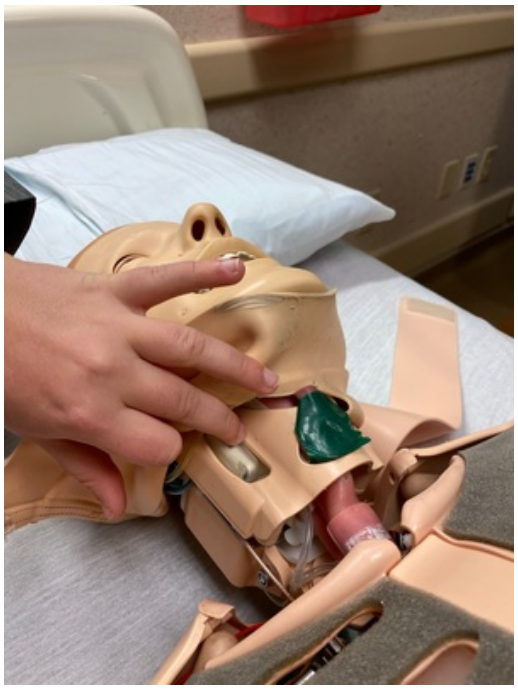
Content by: Gabby

Present: Emma, Tim, and Caroline

Goals: To see an adult manikin in person and to learn more about what they do and how they work

Content:

GABRIELLE SNYDER - Oct 04, 2020, 10:34 PM CDT



Neck_Area_Pulse_.jpg(128 KB) - download This is the neck/head area of the manikin. Emma's fingers are touching the air compressor which is the source of generating a pulse in the neck. While an air compressor may be difficult for us to implement, one option would be use to some type of spring loaded mechanism to generate pulses.

GABRIELLE SNYDER - Oct 04, 2020, 10:36 PM CDT

Inside_of_skin_flap.jpg(128.9 KB) - download This is an image of the inside of the "skin" flap which covers all the electronic/inside parts of the manikin. The circular areas are where different chips can be inserted in order to practice ultrasounds (I believe).

GABRIELLE SNYDER - Oct 04, 2020, 10:43 PM CDT

Chest_Area_of_manikin.jpg(156.6 KB) - download This is a picture of what is underneath the chest area of the manikin. Where the hand is in the picture is the chest piece of the maniquin which rises and falls to simulate a normal (and abnormal) breathing. The maniquin also generates breathing sounds which correlate to the rate of breathing occurring. There are also speakers on the breast plate which allow for one to listen the manikin's "heart" via a stethoscope. I do not think it car be seen in this picture but there are metal leads on the chest which also allow for the manikin to be connected to an AED and another device where one could actually change the different heart/lunge/pulse sounds/rates to correspond to a different situation; they specific wave and vital number are then displayed on the screen.

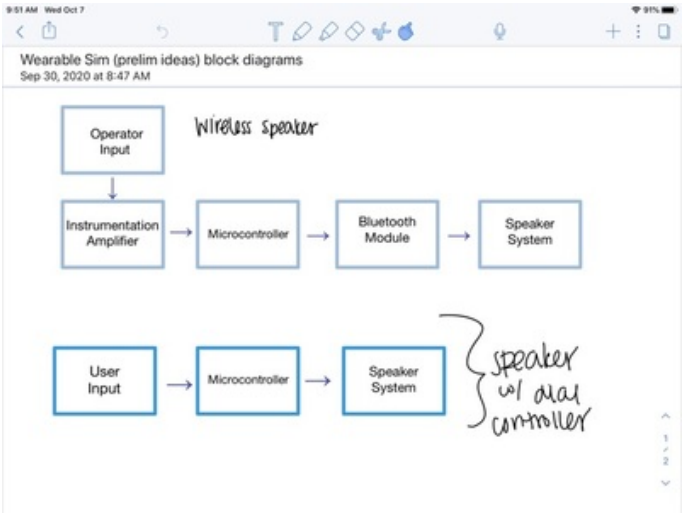
GABRIELLE SNYDER - Oct 04, 2020, 10:32 PM CDT

Conclusions/action items:

This adult manikin that we were shown is a very impressive piece of equipment and there are a lot of different things it can do. It does look very dead so I can see why Dr. Lohmeier would like us to create a vest for someone to wear in order to make running scenarios more realistic. For this semester, our main goal is to create a vest that can generate heart and lung sounds, as these two components seem to be the most important. Dr. Lohmeier did mention that it may be beneficial for the person wearing the vest to have the ability to adjust its "settings" instead of a second person controlled the vest. As a team, we need to figure out the exact design/layout of our vest, what material we want to make the vest out of, and what kinds of electronic components we need for our speaker systems/

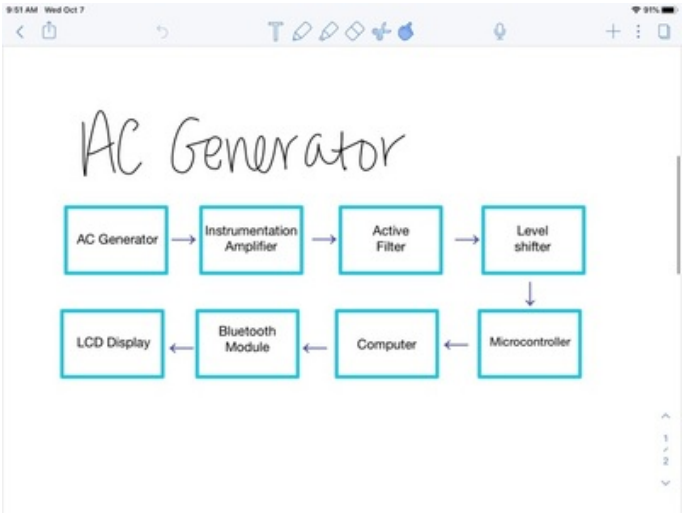
Block Diagrams for Prelim Designs

GABRIELLE SNYDER - Oct 07, 2020, 9:53 AM CDT



block_diagrams_1_2.jpg(47.7 KB) - download

GABRIELLE SNYDER - Oct 07, 2020, 9:53 AM CDT



block_diagram_3.jpg(43.5 KB) - download

Heart/Lung Sound Software

GABRIELLE SNYDER - Oct 15, 2020, 2:41 PM CDT

Title: Possible Software for Heart & Lung Sounds

Date: 10.15.20

- **Content by:** Gabby

Present: Gabby

Goals: To see if there is any downloadable software that will produce heart and lung sounds

Content:

- a term for this software is computer-aided auscultation (CAA)
- found a journal on a software called Computerized Lungs Auscultation- Sound Software (CLASS) but could not find any place to download it
    - I am not sure if this software is even on the market yet
- I did find a software by Gaumard
    - S182 Heart and Lung Sounds Software - Adult
    - cost = $99
    - features include
        - normal and abnormal heart and lung sounds
        - 12 heart and 9 lung sounds for adults
        - 15 heart and 9 lungs sounds of children
        - virtual stethoscope
    - https://www.gaumard.com/s182
- there is also: 3M Littmann StethAssist Heart and Lung Sound Visualization Software
    - use to record, save, playback & view sounds
    - can transmit and receive heart and lung sounds using Bluetooth
    - sounds can be recorded directly by their model 3200 stethoscope downloaded from its memory
        - **unclear if there are prerecorded sounds!
            - this could be an issue
    - https://www.littmann.com/3M/en_US/littmann-stethoscopes/my-stethoscope/using-your-stethoscope/steth-assist/
-

Conclusions/action items:

We could potentially download a software that will produce heart and lung sounds for us. However, I am still unsure if such a software exists that we could actually use to fit our needs. Future research should be done into these products, and we should also discuss as a team our thoughts about the software and if it will be of use.

Potential Speakers for Our Design

GABRIELLE SNYDER - Oct 22, 2020, 2:41 PM CDT

Title: Speaker Ideas

Date: 10.22.20

Content by: Gabby

Present: me

Goals: To try to find different speakers that we could buy to use for our design.

Content:

- SP-1504
- 
  - general purpose speaker top round
  - from digi-key
  - $2.95
  - could use to connect to the Adafruit Audio FX Sound Board
  - 8 Ohm
  - 800 MW
  - top port 09 dB
  - 1000 Hz sound
  - would probably hook this up directly to the circuit board
  - https://www.digikey.ca/en/products/detail/soberton-inc/SP-1504/3973690
- CUI devices micro speakers
  - Compact sizes from 10 mm to 18 mm
  - Depths as low as 2 mm
  - Sound pressure levels (SPL) from 82 dB to 93 dB
  - Input power as low as 0.2 W
  - Mylar cone design
  - Wire lead, surface mount, spring terminal, PCB, and solder pad mounting configurations
  - https://www.digikey.com/en/product-highlight/c/cui/micro-speakers
- Black Mirco Dot Wireless Speaker
- 
  - 1.5" diameter and 1" tall
  - this is wireless so we could set it up to connect to a computer and then place it in a vest pocket to produce sounds
  - only has a 1.5 hour play time through
  - $15.99
  - https://www.littleobsessed.com/black-micro-dot-wireless-speaker/?gclid=EAIaIQobChMIjtj35PLI7AIVa_7jBx05FQRrEAQYCSABEgKwvPD_BwE
- Ultra Slim Wireless Speaker
- 

  - 4" W x 2" H x .5" D
  - up to 3 hours of play time
  - 250 mAh lithium ion batttery
  - pairs from up to 25ft away
  - $13.99
  - https://www.ideastage.com/Ultra-Slim-Wireless-Speaker-355990588?gclid=EAIaIQobChMIjIiO6PXI7AIVCYizCh1zagcUEAQYECABEgL7p_D_BwE
- Zulu Audio Alpha Wearable Speakers
- 
  - Product dimensions: 1.83"W x 0.75"T x 25.68"L
  - Bluetooth
  - Range: class 2, up to 16.4ft
  - Frequency range: 2402-2480MHz
  - Operating temperature: 14°F - 140°F
  - Power input: 5V 1A
  - Rechargeable battery: 200mAh

- Charging time: 2.5 hours
- Battery life: 4 hours at 75% volume
- Total power output: 2W x 2
- Frequency response: 40Hz ~20kHz
- Water/splash resistance: IPX4
- $42.99
- https://shop.popsci.com/sales/wearable-speakers-white?utm_source=google&utm_medium=cpc&utm_campaign=8754794779&utm_term=&gclid=EAIaIQobChMIjIiO6PXI7AIVCYizCh1zagcUEAQYGyABEgLk7PD_BwE
- this are kind of expensive, however I like how they look
- we could potentially buy two of these --> one for the front and one for the back of the vest

Conclusions/action items:

There are different options for speakers out there on the market. As a team we need to decide exactly what size of speaker we would like to use. I am thinking a Bluetooth speaker may make the most sense as the speaker could be put with the vest and then controlled remotely via a computer. However, Bluetooth do not seem to have super long battery lives meaning they will probably have to be charged very regularly, probably anytime the vest is not being used. It would not be very good if the speaker died during the simulations.

Ideas for Potential Vests

GABRIELLE SNYDER - Feb 17, 2021, 7:14 PM CST

Title: Potential Vest Ideas

Date: 11.12.20

Content by: Gabby

Present: me

Goals: To research different vests on the market that we could buy to use as the vest the person acting out the scenario will wear for our design.

Content:

hyper vest elite weight vest

- this vest is very expensive
  - $197.99
- however, I do like the design as it is form fitting and not very bulky
- has side lacing for adjustable fit
- it is a weight vest but in my mind we could place our speakers and circuit boards where the weights would normally go
- there are also spots on the back were we could add the speakers too
  - negative: would have to remove the weights that are already present in the design , which could also be a pain
- https://www.hyperwear.com/product/weighted-vest/?attribute_size=X-Large&attribute_weight=10+LBS&gclid=CjwKCAiA17P9BRB2EiwAMvwNyOl_pScT0iLy_-keKjImXR5bYbfgso0U8AeuKbnfPpsdwGMxLyWMlRoC6ccQAvD_BwE

Peregrine Field Gear Trekker Dog Handler's Vest V2.0

- this vest has front and back pockets
- is lightweight
- $169.99
- however, it is only avaidable on this website in small and medium
  - large and x-large are sold out which could be an issue
- https://www.peregrinefieldgear.com/store/p/1140-NEW-Peregrine-Field-Gear-Trekker-Dog-Handler-Vest.aspx

waterproof pisfun fishing vest outdoor photography hiking, hunting, multi-pocket vest (vest men's fishing jacket)

- currently $38 on amazon
    - issue: it says will arrive between dec 4-28
    - maybe will come in sooner from a different website but I am currently not seeing anythign
- lightweight
- could put our speak in the front pockets
- the back pocket looks very large but maybe we could somehow attach (sew?) the speakers/circuit boards to the back pocket
- https://www.amazon.com/Berrykey-Waterproof-Fishing-Outdoor-Waistcoat/dp/B0819GRRCQ

Conclusions/action items:

These are some initial vest ideas. However, I do not really love any of these options so I will need to do some for vest research to see if I can find any better/more suitable vest designs. If I did have to choose, out of all of these, I like the hyper vest design the best as it as the most options for choosing which place we would like to place our speakers and it is also the least bulky design.

GABRIELLE SNYDER - Dec 01, 2020, 6:59 PM CST

additional link for hypervest from Rogue fitness: https://www.roguefitness.com/hyper-vest-elite-weight-vest?160=3529&287=3581&gclid=CjwKCAiA8Jf-BRB-EiwAWDtEGuU2LEooie-NRG_3MOTCp2Tq8ohTWPt-dAy-Rfdv_CFXsTwtcae8CRoCuW0QAvD_BwE

Theoretical Final Design

GABRIELLE SNYDER - Dec 03, 2020, 3:29 PM CST

Title: Theoretical Final Design

Date: 12.3.20

Content by: Gabby

Present: me (Emma helped with the final design illustration)

Goals: To illustration what our final design would have looked like if we had the time and materials to fabricate it

Content:

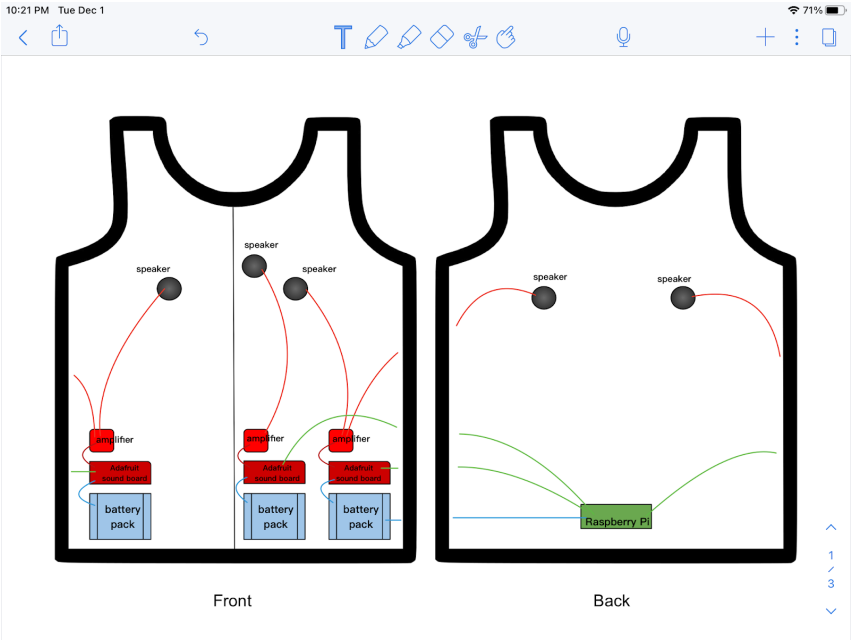


Figure 7: This is an illustration of the placement of the electronic components in the vest including the speakers, amplifiers, sound boards, battery packs, raspberry pi, and communication via connection wires.

Conclusions/action items:

This is our current final design idea that we in theory would have worked on fabricating if the materials came in and if this overall had been a different semester and we could have meet in person as a team. During the actual fabrication we may run into unforeseen issues that may cause us to slightly alter our design idea.

Electronics Box SolidWorks Models

GABRIELLE SNYDER - Mar 24, 2021, 11:32 PM CDT

Title: Electronics Box SolidWorks Models

Date: 3.24.21

Content by: Gabby

Present: Gabby (with help of Emma)

Goals: The goal was to create models in SolidWorks of boxes that can be used to hold our electronic components when placed into the vest.

Content:

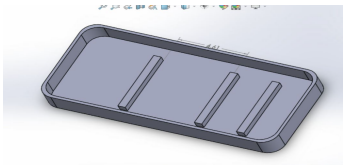


image 1: this is box 1 which will contain two battery packs, and two adafruit sound boards

the smaller raised dividers will be used to "snap" the components into it

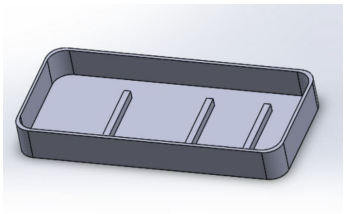


image 2: this is box 2, which will contain two battery packs, and one adafruit soundboard, & one raspberry pi

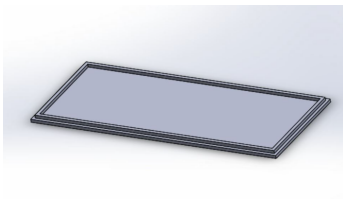


image 3: this is the lid of the box and it will, in theory, be able to snap onto the top of the bottom boxes to create a secure fit

Conclusions/action items:

The dimensions are very close to what we would need if we were to 3D print these boxes. However, a bit of review/double checking should be done prior to sending them to print. This boxes will be used to hold the electronic components inside the vest so they are not damaged during simulations.

Solidworks electronic box for printing

GABRIELLE SNYDER - Apr 15, 2021, 2:03 PM CDT

Title: Solidworks of electronic for 3D printing

Date: 4.15.21

Content by: Gabby

Present: Gabby, Emma, Andy

Goals: To finalize the dimensions of the box and lid in order to be able to 3D print the design.

Content:

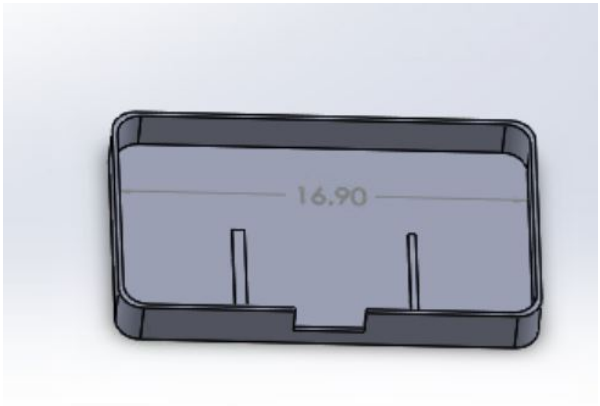


figure 1: base of box that will contain 2 battery packs, 1 adafruit sound board, and 1 raspberry pi. The cutout on the side of the box will be used to run the wires from the adafruit sound board and raspberry pi to the speakers contained within the vest.

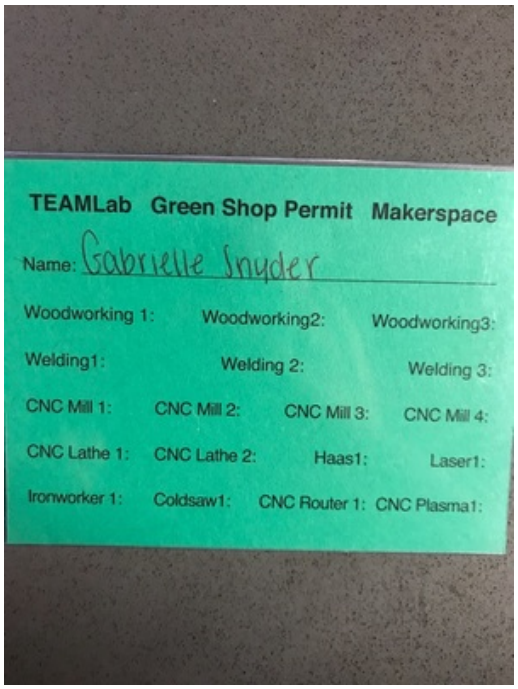
figure 2: lid of the box. This lid will sit on top of the bottom part and inner lip will be used to help secure the two pieces together.

Conclusions/action items:

The dimensions of these two pieces have been set in order to best hold the electronic components, and they fit together nicely. The next step will be to 3D print these two pieces in order to verify that this design makes sense and will work well within the vest.

Green Permit

GABRIELLE SNYDER - Feb 02, 2020, 10:42 PM CST



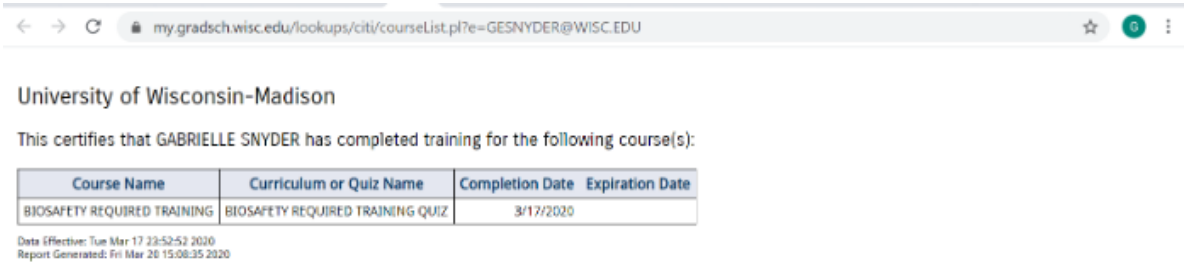
Gree_Permit_front_.jpg(179.6 KB) - download

GABRIELLE SNYDER - Feb 02, 2020, 10:43 PM CST

Green_Permit__back.jpg(197.5 KB) - download

BioSafety Training Cert

GABRIELLE SNYDER - Mar 20, 2020, 3:22 PM CDT



2021-02-08 Previous Semester Review

JOSHUA MURWIN - Mar 24, 2021, 3:36 PM CDT

Title: Previous Semester Review

Date: 2021-02-08

Content by: Josh Murwin

Goals: Document the progress made by the team last semester to catch myself up on where the project is going

Content:

Since I was not apart of the team last semester, I wanted to do a review of the progress made so that I could understand where the design is headed. Not only will this review familiarize me with the current design, but it will also give me a better idea of what our next steps are going to be.

Past work:

Last semester (fall 2020), the team picked a vest design that incorporated speakers controlled by a raspberry pi. These speakers are meant to produce sounds that mimic real heart and lung sounds for both healthy and ill patients. The raspberry pi is a microcontroller and will allow the user to change which sounds are being played. This will be connected to Adafruit soundboards, which store the audio file information. Connected to each soundboard is an amplifier to intensify the signal before it is passed onto the speaker to be played. Multiple speakers allow the trainee to listen at more than one location as they would on a real patient. A few options have been identified for audio files that mimic heart and lung sounds, but none have been purchased or downloaded yet.

What's next:

The initial primary goal this semester is to get the electronics connected and the code written so that the speakers can play sounds. Along with this comes finalizing which source to download heart/lung sounds from. Secondarily, a vest will need to be found and purchased so that the team can begin the integration of the electronics and the vest. Once the team has successfully integrated the electronics with the vest and the speakers are fully functional, the goal will shift to designing a way to allow the operator to change the sounds during a simulation. This may involve switching the electronics from wired to wireless so that they may be operated remotely by a secondary operator. If all of this is accomplished in this semester, the team may attempt to add pulse points to the vest.

Conclusions/action items:

Much of the initial design work was completed by the team in the Fall of 2020. This semester will be about building and testing the electronics to accurately mimic heart and lung sounds.

2021-03-18 Python Coding for Triggering Audio Using A Pi

JOSHUA MURWIN - Mar 24, 2021, 3:13 PM CDT

Title: Python Coding for Triggering Audio Using a Pi

Date: 2021-03-18

Content by: Josh Murwin

Goals: Figure out how to trigger audio using the raspberry pi zero w

Content:

Raspberry Pi uses Python. Unfortunately, I do not know Python. Luckily, Adafruit has a thorough tutorial on how to trigger audio using an Arduino, and we have successfully gotten that to work. I hope to take the key points of what the Arduino code is doing and translate them into Python code.

Main takeaways from adafruit tutorial:

- Audio is triggered when the pin corresponding to the track number is momentarily connected to ground
    - You can change it to be a few different modes, such as HOLD, where audio triggers for as long as you connect it to ground, but all of the triggering methods rely on the pin getting connected to ground.
- Important pins: TX, RX, and UG
    - If UG has high voltage: GPIO mode
        - Since the Pi has a bunch of pins labeled GPIO #, I'm assuming this is what we want to use
        - UG is connected by default to high voltage, so we don't have to worry about wiring anything to this pin
    - If UG has ground: UART mode
        - This is what we used for Arduino
    - RX is input into the sounboard (3-5V logic)
    - TX is output from the soundboard to the Pi (3.3V logic)

Conclusions/action items:

Look more into the triggering of audio and how we can write ground to these pins using a microcontroller. Possibly talk to Dr. Nimunkar for ideas.

JOSHUA MURWIN - Mar 24, 2021, 3:26 PM CDT

Source: https://learn.adafruit.com/adafruit-audio-fx-sound-board/pinouts

2021-03-24 Trigger Audio Using Raspberry Pi

JOSHUA MURWIN - Mar 24, 2021, 3:36 PM CDT

Title: Triggering Audio Using a Raspberry Pi Zero W

Date: 2021-03-24

Content by: Josh Murwin

Goals: Come up with a way to trigger audio with a Raspberry Pi

Content:

The soundboard has two methods of control: UART and GPIO.

GPIO is the simpler method. In it, when a trigger pin is briefly connected to ground (i.e. through a button or switch) the audio corresponding to that pin is played.

UART control takes advantage of a microcontroller's serial communication ability and gives more flexibility in control. For example, UART control allows for pausing, playing, stopping, volume up, volume down, etc. whereas GPIO essentially only has the option to play the sound.

I don't know enough about the Raspberry Pi to know if it is capable of UART communication. Some preliminary research says it is. (https://pinout.xyz/pinout/uart). If this is the case, the team would need to figure out how to code all of the necessary commands with python. This may prove to be difficult. Using the arduino was nice because Adafruit provided the code to control the soundboard on their website.

GPIO mode is the default for the soundboard and would be guaranteed to work with the Raspberry Pi. The caveat with this method is that it involves more electronics. There would need to be a system that connects the trigger pins to ground when a signal is sent to an output pin of the Pi. One possible solution would be to add in some form of a digital button/switch where when a high voltage is applied, it connects the trigger pin to ground. I do not know enough about electronics to know what electrical component can accomplish this, but a quick chat with Dr. Nimunkar may help.

As of right now, GPIO mode is simpler and less software-heavy than UART mode and should be our plan of attack moving forward. If more information is uncovered that makes UART mode easier, the team should switch to that method.

Conclusions/action items:

Discuss with the team the plan to use GPIO mode and a digital switch to trigger audio. Also discuss whether UART mode is possible and whether we want to pursue that path instead.

2021-03-24 GPIO Basics in Python

JOSHUA MURWIN - Mar 24, 2021, 3:57 PM CDT

Title: GPIO Basics in Python

Date: 2021-03-24

Content by: Josh Murwin

Goals: Figure out how to write high voltage to a GPIO pin on the Raspberry Pi

Content:

The Raspberry Pi uses python to control it. The team needs a way to write voltages to the GPIO pins found on the Pi. The goal of this research is to figure out the right libraries and commands to do so.

As expected, the solution seems fairly straightforward. First, the correct libraries must be installed. We need the library "RPi.GPIO". Next we need to set the pin numbering system, essentially how the code knows which pin is which. For our usage, we will use the BOARD system. After that, the next step is to set the pin as an output. Once that has been done, commands can be used to write a high voltage to the pin. Example code has been copied from the source below:

import RPi.GPIO as GPIO # import the library and rename it for easier calling later

GPIO.setmode(GPIO.BOARD) # set the numbering of the pins to look like the board numbering

GPIO.setwarnings(False) # turn off the warnings

GPIO.setup(#,GPIO.OUT) # configure the pin as an output

GPIO.output(#,GPIO.HIGH) # write a high voltage to that pin

This method can also be used to setup input pins.

The Raspberry Pi uses 3.3 V for input/output.

General info about GPIO on raspberry pi: https://www.raspberrypi.org/documentation/usage/gpio/README.md

Info on RPi.GPIO library: https://sourceforge.net/p/raspberry-gpio-python/wiki/BasicUsage/

Controlling devices with GPIO using python:

General info about the GPIO Zero library: https://www.raspberrypi.org/documentation/usage/gpio/python/README.md

Examples of using the GPIO zero library (not as helpful): https://gpiozero.readthedocs.io/en/stable/migrating_from_rpigpio.html

Conclusions/action items:

Theoretically the team now has the ability to write high voltages to things using a Raspberry Pi. This in conjunction with the digital switch method discussed in a previous entry might allow for the triggering of audio. Testing will need to be conducted to confirm if the code presented above is useable.

2021-04-13 Progress Since End of March

JOSHUA MURWIN - Apr 13, 2021, 4:23 PM CDT

Title: Progress Since End of May

Date: 2021-04-13

Content by: Josh Murwin

Goals: Document progress made since the end of may

Content:

The team has run into many difficulties since the end of may concerning the Raspberry Pi. We were unable to get the Pi on a wifi network, which is how we need to communicate with it. Without that, we cannot code the Pi or do anything with it. After about two weeks of trying to solve this problem ourselves, we turned to Dr. Nimunkar, who referred us to his friend Dr. Dennis Bahr.

Emma and I then went over to Dr. Bahr's house in Middleton on April 8th to try and fix our issues. Dr. Bahr got our Pi to work and to connect to his WiFi, even lending us some parts that will help us in our future design. When Emma tried to get the Pi to work at her home, it was causing more issues. Without the Pi, it is difficult to move forward with any of the electronics design.

Gabby has continued to finalize the designs for the electronics boxes, and the team plans to print a prototype shortly.

Andy has found heart and lung sounds for us to load onto the soundboards.

Conclusions/action items:

It is vital that we get the Raspberry Pi working. Without it, we are unable to move forward with the design. With these setbacks it seems unlikely that the team will be incorporating the electronics into the vest this semester.

JOSHUA MURWIN - Apr 26, 2021, 4:45 PM CDT

Correction: title should read end of March, not end of May

2021-04-08 through 2021-04-26 Dr. Dennis Bahr

JOSHUA MURWIN - Apr 26, 2021, 4:51 PM CDT

Title: Dr. Dennis Bahr

Date: April 08 - April 26, 2021

Content by: Josh Murwin

Present: Josh Murwin, Emma Newmann

Goals: Document our involvement with Dr. Dennis Bahr

Content:

Dr. Bahr is an electronics expert who, while not employed by UW, has ties to the BME department here. After contacting Dr. Amit Nimunkar for help with our Raspberry Pi issues, he referred us to Dr. Bahr. We then travelled to his house (documented in the previous entry) so he could try to help us fix our issues. He lent us a keyboard and mouse to assist with out setup back on campus. Unfortunately, we still could not get the Pi to work. Emma and I then travelled back to Middleton to return the keyboard and mouse on the 26th of April, 2021.

Conclusions/action items:

We are very appreciative of Dr. Bahr's help with our design. The issues seem fixable, however it was simply too late in the semester to get them sorted out.

2020-02-16 Getting the Speaker to Play a Sound

JOSHUA MURWIN - Feb 17, 2021, 2:40 PM CST

Title: Getting the Speaker to Play a Sound

Date: 2020-02-16

Content by: Josh Murwin

Present: Self

Goals: Get the speaker to play a sound

Content:

Last week's meeting ended with the team being able to get static to play from the speaker for brief intervals before cutting out. I wanted to see if I could get the electronics hooked up correctly to play sounds from the speaker before this week's meeting in order to make it more productive. Last night, I successfully connected an Arduino Uno, the Adafruit soundboard, and our speaker and was able to play a sound (in the form of a .wav file) of my choice from the speaker. In this case that sound was an elephant. I learned a few key details:

- It is difficult to breadboard the soundboard without soldering in the pin connections.
    - To get a stable connection, I had to manually press the wires to the inner surface of the pin holes on the board. Simply sticking wires through the soundboard and into the breadboard was not sufficient.
    - I would advise we solder components together as soon as possible to make testing much easier
- The amplifiers we bought are useless
    - The version of the soundboard we have has a built in amplifier. I'm not sure that it's even possible (or recommended) to hook it up to another amplifier.
    - Either way, the sound from the speaker should be plenty loud enough considering we are trying to replicate very faint heart and lung sounds to be picked up by a stethoscope.
- Each soundboard can run two speakers, but only running one is perfectly fine
- Important pins!!!
    - Vin is to power the board
    - Gnd next to Vin is for ground
    - The pins on the other side labeled 0-10 are for sound output to a speaker
        - If a speaker is correctly wired to the board (just the two connections), whenever one of these pins are connected to ground, the speaker will play that sound
            - This is referred to as "basic trigger" and is usually controlled by buttons

Triggering with an Arduino is more complicated, but the steps are detailed here: https://learn.adafruit.com/adafruit-audio-fx-sound-board/serial-audio-control

Conclusions/action items:

Getting the speaker to play a sound of our choosing is a big step. Next, we need to figure out how to control the sounds using a microcontroller (for now that's an Arduino, but the team plans to use a Raspberry Pi for this in the future). Soldering pin connections to the soundboard would make this prototyping process much easier.

2020-02-17 Playing Sounds with an Arduino Uno

JOSHUA MURWIN - Feb 17, 2021, 4:06 PM CST

Title: Playing Sounds with an Arduino

Date: 2020-02-17

Content by: Josh Murwin

Goals: Document how to play a sound on the speaker using an Arduino Uno and an Adafruit SoundBoard

Content:

Moving from the button triggered sound to an arduino triggered sound was not a big leap. Below are the steps:

- Download the soundboard library to your computer so the arduino can use it
- Connect the right pins of the soundboard to the right places on the arduino
    - Vin to 5V
    - Gnd to ground
    - UG to ground
    - Tx to 5
    - Rx to 6
    - Rst to 4
- Upload the menu code that is given by adafruit to the arduino and open the serial monitor
- Extra step not included in the tutorial: in the serial monitor, change the baud rate to 115200
    - I don't know why, but it doesn't work unless you do this
- The rest of the tutorial I followed is given here: https://learn.adafruit.com/adafruit-audio-fx-sound-board/serial-audio-control

Conclusions/action items:

Sound files can now successfully be played from the speaker and controlled by an Arduino. This control does not allow for remote usage however, since the Arduino is not a wireless device when used in this fashion. This accomplishment does however set the stage for the transition to a Raspberry Pi, which is easier to make wireless. Immediate next steps involve soldering and figuring out how to swap the Arduino with a Raspberry Pi.

2020-02-17 Potential Vest Design

Title: Potential Vest Design

Date: 2020-02-17

Content by: Josh Murwin

Goals: Find a new vest design that meets our requirements

Content:

After a few minutes of research I found this vest: https://www.madcityoutdoor.com/products/condor-modular-style-vest?variant=26021322503&currency=USD&utm_medium=product_sync&utm_source=google&utm_content=sag_organic&utm_campaign=sag_organic&gclid=EAIaIQobChMIkNq2uJny7gIVjIbACh

It is a standard "tactical" vest composed of some composite plastic with adjustable straps. This vest is good because it is adjustable, fits reasonably close to the body (i.e. not bulky), can be cu is fairly cheap.

Conclusions/action items:

The team will determine this vest's usability with a design matrix along with two other design ideas.

Biosafety Required Training

JOSHUA MURWIN - Apr 12, 2020, 11:27 AM CDT

University of Wisconsin-Madison

This certifies that JOSHUA MURWIN has completed training for the following course(s):

Course Name	Curriculum or Quiz Name	Completion Date	Expiration Date
BIOSAFETY REQUIRED TRAINING	BIOSAFETY REQUIRED TRAINING QUIZ	4/11/2020	

Certificate_of_Completion_for_JOSHUA_MURWIN.pdf(109.2 KB) - download

2020/03/02 - Red Permit

JOSHUA MURWIN - Mar 02, 2020, 10:49 PM CST

Title: Red Permit

Date: 03-02-2020

Content by: Josh Murwin

Present: Self

Goals: Submit proof of red permit

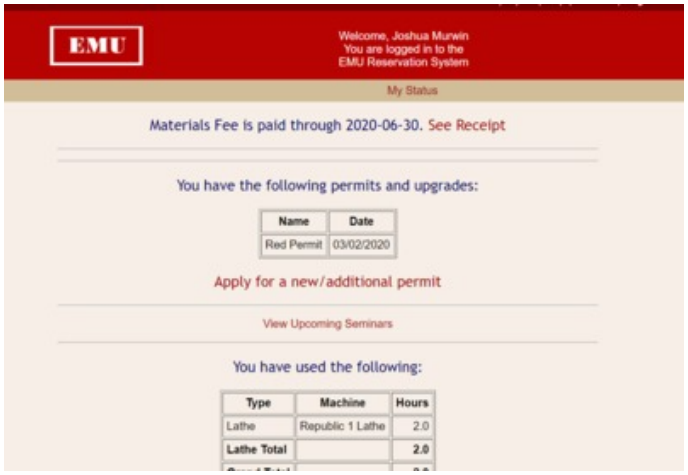
Content:

Attached below is a picture of the only avialable proof of the red permit I have. I obtained the red permit by completing the required quizzes and seminar associated with the green permit, but was unable to finish the mill portion of the test piece before the Great Flood of ECB 2020

Conclusions/action items:

Obtain the laser 1 upgrade for the red permit to assist in making a sample holder.

JOSHUA MURWIN - Mar 02, 2020, 10:49 PM CST

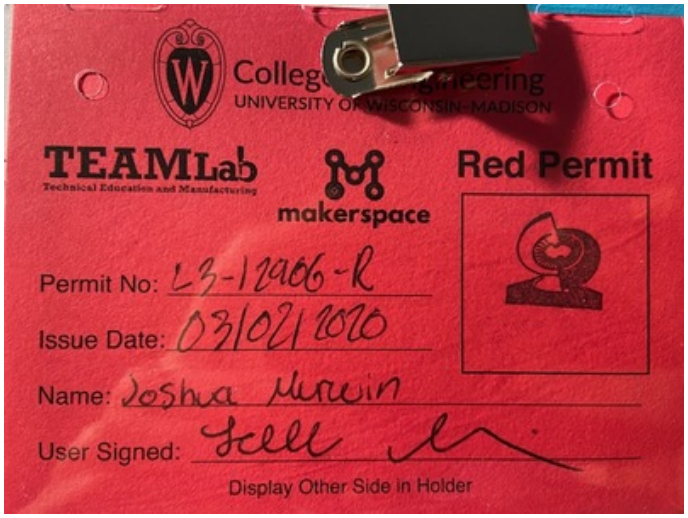


RedPermit.PNG(52.7 KB) - download

JOSHUA MURWIN - Mar 12, 2020, 5:49 PM CDT

EDIT: Got the actual piece of paper!! Attached below

JOSHUA MURWIN - Mar 12, 2020, 5:54 PM CDT



RedPass.jpg(159.5 KB) - download

WARF Lecture

JOSHUA MURWIN - Mar 27, 2021, 8:49 PM CDT

Title: WARF Lecture

Date: 2021-03-27

Content by: Josh Murwin

Content:

The WARF lecture went into detail about the importance and process of patenting. I found it surprising that there were such strict standards on what could be patented and how those rules give the patent office significant leeway to decline new inventions a patent. I was also surprised to hear how much the process costs. The speaker quoted a figure of around $30,000 for a single patent, which would make it difficult for an individual to file for one without the help of a service like WARF. Being a biomedical engineer, our designs somewhat frequently fit into the category of "patentable", which makes knowing about the process at an early stage advantageous if we wish to seek a patent in the future.

Conclusions/action items:

While I may not have aspirations to obtain a patent right now, being exposed to the idea and process of patenting will be beneficial if I choose to seek one in the future. Having WARF here on campus makes patenting an invention much simpler for the lay-person.

Tong Lecture 2021-04-09

JOSHUA MURWIN - Apr 13, 2021, 4:16 PM CDT

Title: Tong Lecture Notes

Date: 2021-04-09

Content by: Josh Murwin

Goals: Document Tong Lecture

Content:

Speaker: Carter Cliff

Mr. Cliff is a native Madisonian and is currently the CEO of Vascugen and co-founder or multiple companies that focus on biotech research and personalized medicine. In his talk, Mr. Cliff highlighted the difficulties many companies in the midwest face with acquiring captial to use in their ventures. Most of the capital is located on the coasts instead. These technologies are cutting-edge and would revolutionize the way we treat illness in the future.

Conclusions/action items:

Mr. Cliff's talk shined a light on the world of biotech entrepreneurship in the midwest along with some of its difficulties and rewards.

2021-02-01 Team Meeting

JOSHUA MURWIN - Feb 11, 2021, 11:09 AM CST

Title: Team Meeting

Date: 2021-02-01

Content by: Josh Murwin

Present: Emma, Gabby, Andy, Josh

Goals: Document meeting

Content:

The first team meeting was focused on getting to know the group. Emma and Gabby have brought me and Andy along, so it was important that we all got to know each other a little better before the real work began. The team dynamic is strong and should make for a fun, productive semester.

Gabby brought the electronics that were purchased last semester to the meeting for us to take a look at. All hardware for the heart and lung sound generation is here, now it's just a matter of putting the wires on and playing some sounds.

Conclusions/action items:

The team anticipates the use of a soldering station in the Makerspace in order to fabricate our sound system design. A fabrication plan will need to be created along with figuring out how to correctly connect each component. We anticipate doing testing before soldering to make sure all components are connected correctly and functioning properly.

2021-02-10 Team Meeting

JOSHUA MURWIN - Feb 11, 2021, 11:09 AM CST

Title: Feb 10th Team Meeting

Date: 2021-02-11

Content by: Josh Murwin

Present: Emma, Gabby, Josh (Andy had extenuating circumstances...)

Goals: Document meeting minutes

Content:

The team met to do some preliminary work with the electronics. We started to breadboard the Raspberry Pi before deciding that we would use an Arduino Uno for the initial testing because we have more experience with that platform. After breadboarding the soundboard, amplifier, and speaker, we ran power through the circuit and heard some brief noise from the speaker. The connections are not soldered, so the team determined that the component work, the connections were just not strong enough to produce constant signal. The team also attempted uploading a sound file to the soundboard, which worked successfully, but the team was not able to get that sound to play on the speaker.

Conclusions/action items:

The next step will be to get a sound file of the team's choice to play on the speaker. This will require reading more of the documentation for the soundboard and amplifier to determine the correct way to wire the component together. This will also require the team to learn how to code the microcontroller (Arduino or Raspberry Pi) to get the sound to play.

2021-02-17 Team Meeting

JOSHUA MURWIN - Mar 18, 2021, 2:10 PM CDT

Title: Team Meeting

Date: 2021-02-17

Content by: Josh Murwin

Present: Emma, Gabby, Andy, Josh

Goals: Document meeting minutes

Content:

At today's meeting, I demonstrated the Arduino triggered sound system to the group. The team then began researching vest designs and created a design matrix. The team ended up comparing the Condor vest, the vest from last semester, and a hand sewn vest.

Conclusions/action items:

Finish the reasoning portion of the design matrix.

2021-03-02 Preliminary Report Sections

JOSHUA MURWIN - Mar 18, 2021, 2:10 PM CDT

Title: Preliminary Report Sections

Date: 2021-03-02

Content by: Josh Murwin

Present: Emma, Gabby, Andy, Josh

Goals: Figure out who is going to write which sections

Content:

The team met Sunday (02/28) to decide who what writing which sections of the preliminary report. Since then I have completed writing the sections about our electronics testing, results, and discussion. Luckily this is a continuing project, so much of the report is still valid from last semester.

Conclusions/action items:

Finish up the report by tomorrow at noon.

2021-03-10 Team Meeting

JOSHUA MURWIN - Mar 18, 2021, 2:11 PM CDT

Title: Team Meeting

Date: 2021-03-10

Content by: Josh Murwin

Present: Emma, Gabby, Josh

Goals: Document meeting

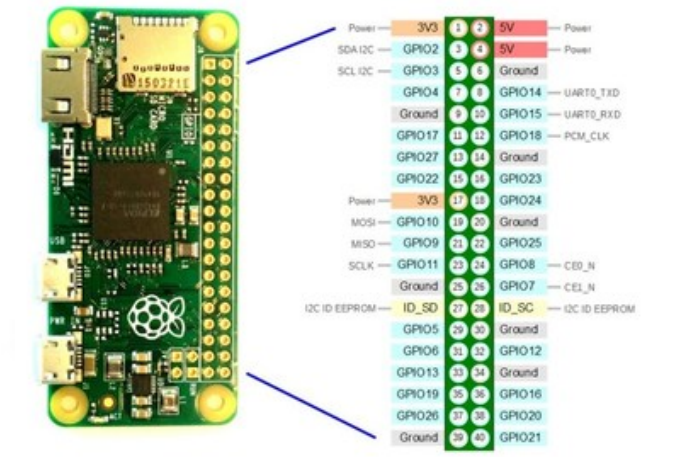
Content:

This meeting was focused on determining our next steps. Now that we have a functional electronics system, we need to figure out how to transition it to a raspberry pi. Emma has some experience working with these, so she has taken up the goal of getting the necessary software on the board. Once the board works and we can hook it up to the soundboard, we need to figure out how to trigger audio. After reading some documentation it sounds like all we have to do is send a ground signal to whatever number pin corresponds to the track we want to play, and it will trigger. The pinout of the pi is slightly different, but I've attached a pinout sketch that may be helpful. We will be using the GPIO pins as out output pins. The pi also uses Python for its code. Only Emma has ever used Python before, so we will be reliant on her to help us write the software for the vest.

Conclusions/action items:

Gabby should have the vest by Friday and then we can start making a plan on how we will get the speakers integrated. Hopefully we don't run into too many issues getting the audio to trigger with a pi.

JOSHUA MURWIN - Mar 12, 2021, 11:08 AM CST



Raspberry-PI-Zero-Pinout-schema.jpg(119 KB) - download

2021-03-17 Team Meeting

JOSHUA MURWIN - Mar 18, 2021, 2:24 PM CDT

Title: Team Meeting

Date: 2021-03-17

Content by: Josh Murwin

Present: Emma, Gabby, Josh

Goals: Document team meeting

Content:

Wednesday's meeting was the first with the physical vest. The team spent the first half of the meeting deciding where and how to place the electronics and speakers in and around the vest. The locations of the speakers had been previously determined, but the team needed to figure out how to wire them to the soundboards. It was decided that the Pi, the soundboards, and the battery packs are going to be located inside the inner pockets on the side of the vest. The team determined this to be the best location because the large, zippered pockets facilitated easy insertion and removal of the components and because the team decided having electronics on located on the back of the vest would be both uncomfortable when the actor laid down as well as dangerous to the electronics as they would risk being crushed by the actor. Having the electronics in the side pockets allows the actor to lay on their back comfortably and still have the electronics out of the way. A picture of the layout can be found in the team notebook. For wiring, it was decided that the team wants to have as little exposed wiring as possible. This means that the seams of the vest will be ripped open and the wires threaded in between the two fabric layers of the vest. The shoulders may pose a slight challenge, but the team thinks that it is doable. The team then started designing a plastic housing for the electronics and battery packs to protect them from physical damage. Solidworks designs are pending, but the team anticipates to use a clip-in mechanism to hold the electronics in place.

Conclusions/action items:

To Dos for the team:

- Design electronics housings
- Set up the Pi
- Figure out how to trigger audio with the Pi
- Solder electronics components (speaker to soundboard and pins to soundboard)

2021-03-24 Team Meeting

JOSHUA MURWIN - Mar 24, 2021, 6:18 PM CDT

Title: Team Meeting Notes

Date: 2021-03-24

Content by: Josh Murwin

Present: Emma, Gabby, Josh, Andy

Goals: Document meeting

Content:

Emma: Got the Pi set up after some difficulty. Main problem was an outdated software that needed updating. The Raspberry Pi seems to be ready to go now.

Gabby: Created Solidworks drawings of boxes. Next steps involve determining how we want the lid to function.

Andy: Looked into software libraries

Josh: Learned that triggering audio is much simpler than previously thought. All we need to do is write a low voltage (instead of ground) to the correct pin and it will play the audio. Noticed that the soundboard gets warm/hot after prolonged used.

Conclusions/action items:

- Raspberry Pi is ready to accept code
- Goal: code the Pi using the libraries I found and successfully trigger an audio file
- Future: Test the soundboard for excessive heat generation
    - Plug in the soundboard and leave it for an hour to see if anything goes wrong.

2021-04 Summary of April Team Meetings

JOSHUA MURWIN - Apr 26, 2021, 4:42 PM CDT

Title: Summary of April Team Meetings

Date: April, 2021

Content by: Josh Murwin

Goals: Document what went on during the 4 April team meetings

Content:

Most of April was spent working on deliverables. The first week there was still some hope that we could get the raspberry pi to work, but that ended up not being the case. With these roadblocks, it did not seem like a good idea to continue to mess with the pi when we had deliverables and presentations approaching. The last few weeks have been spend creating the poster, practicing it, writing the report, and finalizing any design changes.

Conclusions/action items:

None

2021-04-15 Soundboard Duration Test

JOSHUA MURWIN - Apr 15, 2021, 3:52 PM CDT

Title: Soundboard Duration Test

Date: April 15, 2021

Content by: Josh Murwin

Goals: Gain a qualitative result of if the soundboard can survive being plugged in for long periods of time

Content:

Method:

The team noticed the soundboard got fairly hot after only a short period of time while on. This caused some concern that the soundboard could get too hot and possibly malfunction if left on for longer periods of time. To test this, I plugged the soundboard in, played a sound to ensure everything was hooked up correctly, and then left it plugged in for ~1.5 hours.

Results:

The soundboard was not damaged and could still play sounds at the end of the time. The board did not seem to increase in temperature much after the first 5 minutes or so. I took the temperature of the board by touching it with my index finger and thumb.

Discussion:

While this test is not very precise, it gave us the data we need to ensure that the soundboards are capable of staying plugged in for long periods of time. Quantitative data was not necessary to come to the conclusion that the temperature of the board should not be a cause for concern.

Conclusions/action items:

This test was successful in proving the durability of the board with regards to temperature.

2021-04-26 Summary of Testing

JOSHUA MURWIN - Apr 26, 2021, 4:39 PM CDT

Title: Summary of Testing

Date: April 26, 2021

Content by: Josh Murwin

Goals: Document all testing completed this semester

Content:

Tests completed:

- Wearability Test
  - Had the team each wear the vest and say whether or not the vest was comfortable and allowed free movement
    - Passed
- Electronics Tests
  - Build circuit to be able to make one sound
    - Passed
  - Be able to change which sound is being played using a microcontroller
    - Passed
  - Future test: remote control of sounds using wireless raspberry pi
- Duration Test
  - Plugged in the device to see if it would last for 90 minutes of continuous use. Main concern here was the electronics getting too hot
    - Passed
- Loudness Test
  - Can we hear the sounds being played even through the fabric of the vest?
    - Passed
- Durability test
  - Will the boxes that contain the electronics be able to withstand the forces put on them? We put weights on the box to see if it would crack/fail
    - Passed

Conclusions/action items:

All testing this semester was successful and showed that the design is viable and ready to move on. Next steps would be to fully incorporate the electronics into the vest and run some mock scenarios to see how it all works together.

Real World Application

ANDREW PAULSON - Apr 26, 2021, 6:04 PM CDT

Title: Real World Application

Date: 4/26/21

Content by: Andy Paulson

Present: N/A

Goals: Outline how this product would affect the market, environment, etc., and its overall impact

Content:

This product could be a very useful tool that could be incorporated in multiple facilities in which listening to heart and lung sounds are applicable. This vest's low cost design makes it very affordable to lower budgeted facilities that aren't able to incorporate the high fidelity mannequins such as the SimMan 3G into their training. This vest would be easily sanitizable with a simple Lysol wipe and could utilize rechargeable batteries to help minimize the amount of disposable batteries needed to power the vest. This vest could also be a useful tool for helping doctors or medical staff in smaller countries where the ability to learn medicine isn't an easy task and can help teach students there.

Conclusions/action items:

Overall, this vest can be a very useful tool to help a lot of medical personal learn the human interaction as well as the medical aspect of diagnosing and listening for certain sounds related to the heart and lungs.

Previous Background Research

ANDREW PAULSON - Mar 02, 2021, 4:03 PM CST

Title: Group research

Date: 3/2/21

Content by: Last Semester Team

Present: This semester's team

Goals: Outline the research done and project work from last semester

Content:

To see the previous work from last semester look at the end of the notebook

Conclusions/action items:

This work is going to be something that we as a group are going to improve upon.

Background Research for Second Semester

ANDREW PAULSON - Mar 02, 2021, 12:58 PM CST

Title: Background Research

Date: 3/1/21

Content by: Andy Paulson

Present: N/A

Goals: Outline the past work and catch up to be an asset to the team this semester.

Content:

Since I wasn't in the group last semester, my background research included reading the final report and poster presentation from the last semester.

Last semester was outlining the problem and developing the design for the prototype. This purpose of this project is to create a vest to allow for simulations to be more realistic with human "patients" instead of mannequins. This vest would have different sounds able to come out of the speaker system within the vest. This ables the instructor to control the simulation to use whatever sounds they choose. This group hopes to use a raspberry pi to allow for Bluetooth capabilities and an interactive interface for the instructor. The electronics part work with the signals sent from the instructor and the Adafruit soundboard, which stores the audio files, which then sends the signals through an amplifier which then sends the amplified signal to the speaker for people to hear the sound.

This semester the group's goal is to make the actual prototype as the vest never arrived last semester. The current electronics are set up on an Arduino, which doesn't work at the moment, so the first goal is to get the code working for arduino and then move to a raspberry pi system. Then, when we get the vest we can then dissect it to figure out the plan for inserting our electronics within. Then when we have the plan we can finish setting up the raspberry pi as well as solder our electronics together.

Conclusions/action items:

Much of this project was done last semester as we need to make the prototype now as well as test the original design.

Comparison of Competing Designs

ANDREW PAULSON - Apr 26, 2021, 4:53 PM CDT

Title: Comparing Competing Designs and our Design

Date: 4/26/21

Content by: Andy Paulson

Present: N/A

Goals: Outline the pros and cons of our design versus the competition

Content:

Although our design wasn't completely fabricated, we can compare our design ideas and what we did fabricate to the competing mannequins we looked at, the After this semester is over, looking at the competing designs. Our design could be a very useful simulation tool. Comparing our vest design to the Gaumard Heart and Lung Sound Adult Torso, our vest would be an upgrade because our vest does the exact same as this model as well as give the human interaction. However, when compared to the SimMan 3G, our design/vest is only slightly comparable. We knew going into this project that we wouldn't be able to emulate all the functions the SimMan can; however, we knew the human interaction paired with the few actions both designs incorporated, our design would be an upgrade. Overall, it's too hard to say how our design truly works in the real world; however, we can speculate that it would still be an upgrade for heart and lung sounds over the SimMan due to cost and the human interaction element.

Conclusions/action items:

Looking forward, we want to be able to fully fabricate our design to truly test our design and compare to the competition. Although we never got to do this we can definitely say our design is more cost efficient for what is able to do.

Condor Vest

ANDREW PAULSON - Mar 02, 2021, 1:15 PM CST

Title: Condor Vest Design thoughts

Date: 3/2/21

Content by: Andy Paulson

Present: Team

Goals: Outline the condor vest design and how it will work to put our electronics within

Content:

When we receive this vest we will need to open up the vest so we can insert out electronics. Opening up the vest will be necessary; however, we will need to make sure that we do a really good job of sewing the electronics down as well as sew the vest back together tightly. If we fail to sew properly, we may ruin the integrity of the vest. The vest may be more susceptible to tears along the seam; however, the actual toughness of the canvas exterior should remain the same.

Conclusions/action items:

All in all, I see this vest being our vest of our prototype. As a team, we just need to be able to see it in person and figure out the best way to insert our electronics to move forward.

Vest Electronics

ANDREW PAULSON - Mar 03, 2021, 9:56 AM CST

Title: Vest Electronics

Date: 3/2/21

Content by: Andy Paulson

Present: N/A

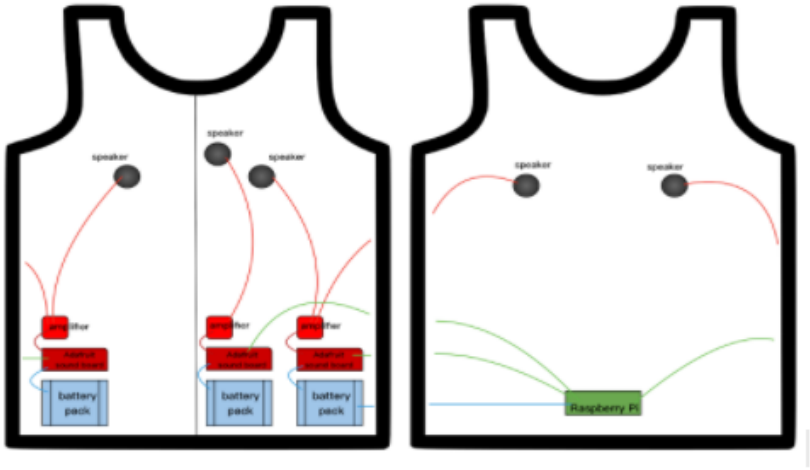
Goals: outline goals and thoughts about inserting electronics within the vest.

Content:

Looking at videos of the condor vest itself, opening up the side of the vest shouldn't be too difficult of a problem. link to videos: (7) Condor Molle Tactical Vest Review - YouTube,

This youtube video shows the interior part of the vest and my concern for the electronics is the space between the front padding and the back looks to be very thing and opening that part up and running wires through there may prove to be difficult. There are interior pockets on this person's vest which may prove to be useful if the vest becomes to difficult to work with.

The design of our electronics in the vest from previous semester:



This design may need to be altered; however we don't have our vest yet to know for sure.

For the raspberry pi, we should be able to use already made code from the internet as the electronics themselves are already made and have sample code for our scenario. We just need to update from an Arduino to a raspberry pi. The hard part with that will be getting the Wi-Fi and Bluetooth capabilities to work.

Conclusions/action items:

Moving forward with the electronics, we can't say for sure how they are truly going to be implanted and intertwined with the inner workings of the vest until we receive the vest. This means that we need to make sure we have the right wires (we may need to get longer wires to connect from front to back) and make sure our raspberry pi is functionable at a basic level to play sounds from the speakers.

Soundboard to Raspberry Pi connection

ANDREW PAULSON - Mar 31, 2021, 5:36 PM CDT

Title: Connection Diagram

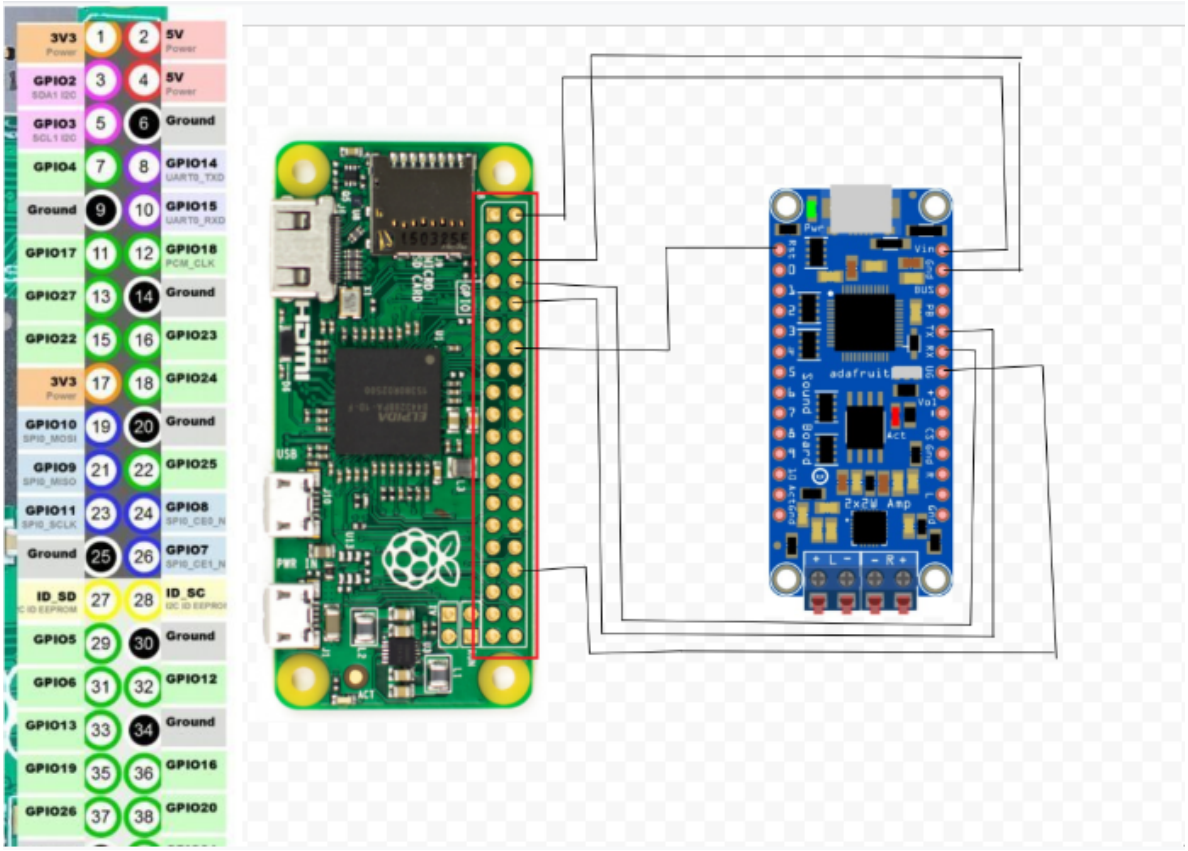
Date: 3/31/21

Content by: Andy Paulson

Present: N/A

Goals: Outline the connection between the soundboard to the raspberry pi zero

Content:



This is a rough outline the diagram. I used the datasheet of the pi and one for the sound board. For the Raspberry Pi, the GPIO pins stand for General purpose input output and can be set up for what we need them to be in the code. This would relate to the RX,TX, and Rst connections.

Conclusions/action items:

This is a very rough draft of the connections and will definitely be changed as we move forward, but we will use this as a guideline moving forward.

Future Design Ideas

ANDREW PAULSON - Apr 26, 2021, 5:06 PM CDT

Title: Future Design Ideas and Discussion

Date: 4/26/21

Content by: Andy Paulson

Present: N/A

Goals: Outline any future work as well as my thoughts on our design

Content:

Now that the final presentation has be given, looking at what we were able to accomplish this semester, there is still a lot to do with this design. We obviously want to fully incorporate the electronics within the vest as well as make sure the microcontroller is fully operational with the right code. This would mean we would have to completely solve and comfortably use the raspberry pi. However, we were only able to incorporate the Arduino this semester which would cause issues as we would have to buy a separate Wi-Fi module for the Arduino; however, there's no need if we solve our raspberry pi issues. After we were able to fully make our prototype we would have to test all the same things we did with the Arduino, such as comfortability, strength of the electronics box while in the vest, ability to play multiple audible sounds while in the vest, and overall successfulness in a clinical trial with real med-students or faculty in training.

Overall, the vest design can be a very useful tool in the medical field. The one downfall however, is the ability to do a multitude of simulations that are more complex that require the more expensive SimMan 3G. Although our project wasn't to emulate everything the competition can do, incorporating the human element with the main problem of hearing heart and lung sounds on a more realistic model is something our design would be able to do at a much lower cost and could be used in many scenarios other than training OR staff for our client.

Conclusions/action items:

Looking towards the future, this project definitely can be continued and taken to another level of work in instrumentation; however, I don't how much I would like to continue this project as the possibilities of this design are really cool, there is a lot more instrumentation in the future of this project and that isn't my interest.

Heart Sounds

ANDREW PAULSON - Apr 26, 2021, 5:29 PM CDT

Title: Heart Sounds to be Used

Date: 4/26/21

Content by: Andy Paulson

Present: N/A

Goals: Find audible heart sounds that fit the requirements from our client

Content:

In notebook above, there is an entry that outlines the heart sound needed for this project. They include: normal heart, tachycardia(fast heartbeat), bradycardia(slow heartbeat), and systolic and diastolic murmurs.

Attached are the files used for this semester.

The source used was:

> “Professional Skill Builder: Heart Sound & Murmur Library,” *Professional Skill Builder | Heart Sound & Murmur Library*. [Online]. Available: https://www.med.umich.edu/lrc/psb_open/html/repo/primer_heartsound/primer_heartsound.html. [Accessed: 14-Apr-2021].

Conclusions/action items:

This list of heart sounds can be updated after testing to ensure all necessary and correct sounds are included in the vest's code

ANDREW PAULSON - Apr 26, 2021, 5:21 PM CDT

06_Apex_Early_Sys_Mur_Supine_Bell.wav(5.1 MB) - download

ANDREW PAULSON - Apr 26, 2021, 5:21 PM CDT

07_Apex_Mid_Sys_Mur_Supine_Bell.wav(5.7 MB) - download

ANDREW PAULSON - Apr 26, 2021, 5:21 PM CDT

08_Apex_Late_Sys_Mur_Supine_Bell.wav(5.1 MB) - download .WAV files

ANDREW PAULSON - Apr 26, 2021, 5:21 PM CDT

13_Apex_OS_Dias_Mur_LLD_Bell_1_.wav(5.1 MB) - download .WAV files useable f

ANDREW PAULSON - Apr 26, 2021, 5:21 PM CDT

16_Aortic_Early_Dias_Mur_Sitting_Bell_1_.wav(10.4 MB) - download .WAV files useable for the raspberry pi

ANDREW PAULSON - Apr 26, 2021, 5:21 PM CDT

Normal_heart_1_.wav(307.2 KB) - download .WAV files useable for the raspberry pi

Lung Sounds

ANDREW PAULSON - Apr 26, 2021, 5:30 PM CDT

Title: Lung Sounds to be Used

Date: 4/26/21

Content by: Andy Paulson

Present: N/A

Goals: Outline the Lungs sound needed by our client and give the .wav files for them

Content:

The sounds our client requested were: Ronchi, rales, wheezing, and a normal lung sound.

The source used for these sounds was:

"Lung Sounds," *Littmann Library*. [Online]. Available: http://www.3m.com/healthcare/littmann/lung.html. [Accessed: 14-Apr-2021].

Attached are the lung sounds we used:

Conclusions/action items:

Looking toward the future, if any group were to continue this project, they could use these sounds to test with and check with our client if they need to be adjusted

ANDREW PAULSON - Apr 26, 2021, 5:31 PM CDT

coarse_rales.wav(537.9 KB) - download .wav files of lung sounds

ANDREW PAULSON - Apr 26, 2021, 5:31 PM CDT

fine_rales.wav(1.3 MB) - download .wav files of lung sounds

ANDREW PAULSON - Apr 26, 2021, 5:31 PM CDT

Normal_lung_1_.wav(1.4 MB) - download .wav files of lung sounds

ANDREW PAULSON - Apr 26, 2021, 5:31 PM CDT

Rhonchi.wav(2.1 MB) - download .wav files of lung sounds

ANDREW PAULSON - Apr 26, 2021, 5:31 PM CDT

Wheezes-expiratory.wav(1.3 MB) - download .wav files of lung sounds

ANDREW PAULSON - Apr 26, 2021, 5:31 PM CDT

Wheezes-monophonic.wav(855.1 KB) - download .wav files of lung sounds

ANDREW PAULSON - Apr 26, 2021, 5:31 PM CDT

wheezing.wav(1.3 MB) - download .wav files of lung sounds

Testing Results and Conclusions

ANDREW PAULSON - Apr 26, 2021, 5:47 PM CDT

Title: Testing Results and Conclusions

Date: 4/26/21

Content by: Team

Present: All

Goals: Outline any testing we did and what conclusions we can draw from them

Content:

We were able to conduct a few tests even without full fabrication of our prototype. This included testing our electronics, sounds, comfortability of the vest, and durability of our electronics box.

Our team was able to test the electronics box to see if any large increase in weight would cause the box to fail and thus hurting the electronics housed inside. They conducted two tests, a point load and distributed load. The point load was located at the direct center of the lid and the box was able to handle a 45lb point load without failure; however, there was significant bend in the lid. The distributed load was conducted with large plates on top of the box and the box was able to handle 300lb of force without failure.

For testing the comfortability of the vest we all wore the vest with with some of the electronics placed on the vest and we all recorded little to no discomfort.

For testing the sound, we played all sounds underneath the vest and listened if we were able to hear all sounds coming from the speakers. We were also able to play multiple sounds at different times at the same audible volume.

For testing the electronics, we let the program run for an extended period of time to see if they would overheat or other possible failures would occur and none arose.

Conclusions/action items:

Looking at the results of our testing, we can conclude that we are able to play multiple sounds at a loud enough volume that one could hear though a stethoscope at different locations on the vest. This lets us know we are able to move forward with improving other aspects of our design in the future. Also, with the weight testing conducted we can conclude that our box will be able to house our electronics safely with an actor wearing the vest and laying on any of their sides. Overall, these testing results tell us we can move forward with full fabrication of our vest as well as we only need to test the vest in a clinical setting for effectiveness.

Green Pass

ANDREW PAULSON - Mar 03, 2021, 11:15 AM CST

Title: Screenshot of Green Pass

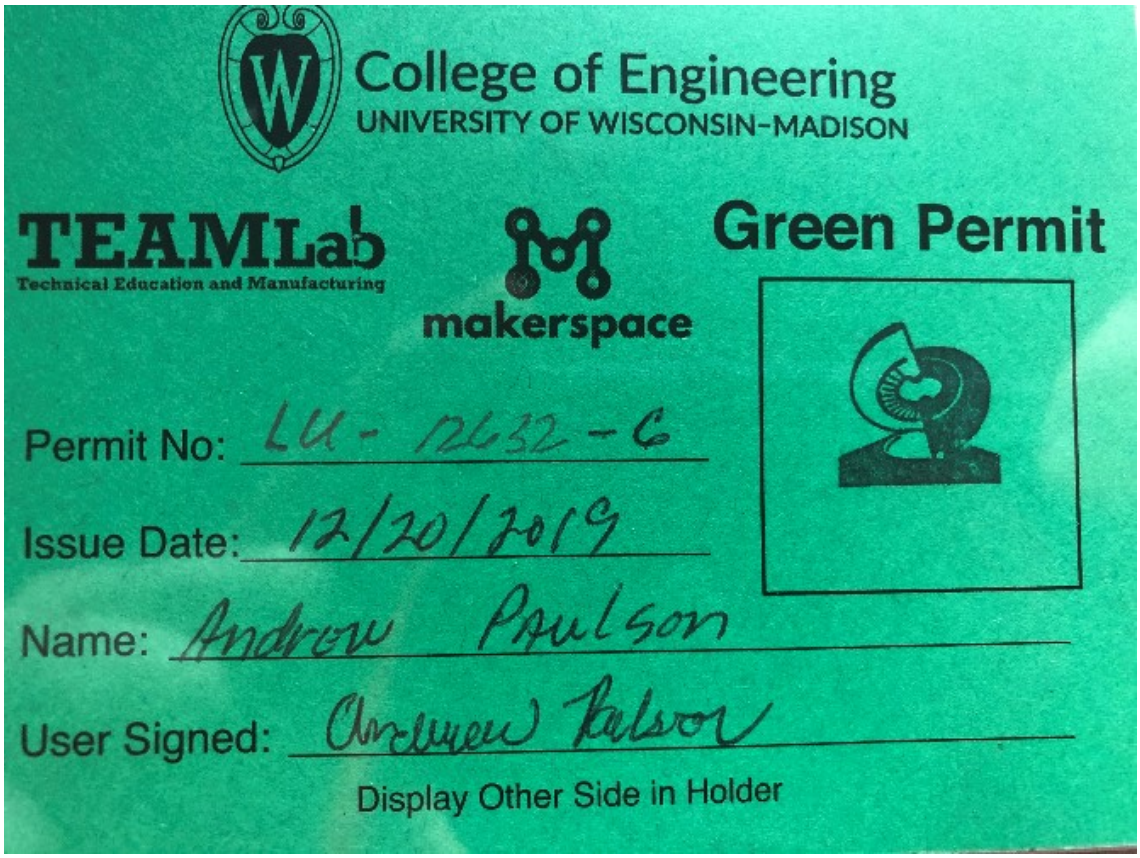
Date: 3/3/20

Content by: Andy Paulson

Present: N/A

Goals: Show completion of green pass

Content:



Conclusions/action items:

If we need to use the shop in ECB, I know I am capable of using the machines within as well as Gabby.

Tong and Warf Lecture Notes

ANDREW PAULSON - Apr 28, 2021, 11:02 AM CDT

Title: Notes from Tong and Warf Lectures

Date: 4/28/21

Content by: Andy Paulson

Present: N/A

Goals: Outline notes from both lectures

Content:

Both lectures were very keen on getting involved early and making key connections in life. The best way you can put yourself in a position to succeed is networking. Meeting people in your profession and establishing a connection or business relationship is huge for making gains down the line for your future. Also, they both mentioned that the first couple years may be rough and the job you have may not be the most fun and/or entertaining to you, but if you stick with it long enough to gain good experience and learn as much as you can from that job you can take those skills to the next job you find.

Conclusions/action items:

The key points from both lectures stressed finding a job that I am interested in and can see a future there for me. They want us to find a place where we can blossom and create so we can move into the entrepreneurship phase of our careers. That part may not happen right away, but keep moving forward to get to that stage because at that stage you pretty much have complete control over how your project progresses.

2014/11/03-Entry guidelines

John Puccinelli - Sep 05, 2016, 1:18 PM CDT

Use this as a guide for every entry

- Every text entry of your notebook should have the **bold titles** below.
- Every page/entry should be **named starting with the date** of the entry's first creation/activity, subsequent material from future dates can be added later.

You can create a copy of the blank template by first opening the desired folder, clicking on "New", selecting "Copy Existing Page...", and then select "2014/11/03-Template")

Title: Descriptive title (i.e. Client Meeting)

Date: 9/5/2016

Content by: The one person who wrote the content

Present: Names of those present if more than just you (not necessary for individual work)

Goals: Establish clear goals for all text entries (meetings, individual work, etc.).

Content:

Contains clear and organized notes (also includes any references used)

Conclusions/action items:

Recap only the most significant findings and/or action items resulting from the entry.

2014/11/03-Template

John Puccinelli - Nov 03, 2014, 3:20 PM CST

Title:

Date:

Content by:

Present:

Goals:

Content:

Conclusions/action items:

BME Design - Fall 2020 - notebook

EMMA NEUMANN - Jan 29, 2021, 2:10 PM CST

BME Design-Fall 2020 - EMMA NEUMANN
Complete Notebook

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GABRIELLE SNYDER

on

Dec 09, 2020 @ 06:26 PM CST

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