Group F5

Adding Sound to Equilibrium

Meet the Team!

Outline

- First Client Meeting and Needs Identification
- Problem Statement
- Benchmarking
- Concept Generation and design criteria
- Ranking and final decision making criteria
- Planning
- Bill of materials
- First, second, third prototype

Equilibrium

The goal of this project is to improve the existing equilibrium project.

First Client Meeting

- The original installation was going to have sound
- The hanging sculpture should not be modified
- Met with a acoustics expert

Client Needs and Interpretation:

1. Add interactive elements
2. The current design should be fixed
3. Modifications should be seamless
4. Encourage stair use
5. Modifications should not impact the use of the stairs
6. Changes should be visually appealing
7. Modifications should be durable and reliable

Problem statement:

The Equilibrium art installation in STEM is currently non-functional and is not being used to its intended full potential. In order to improve the piece, the original designers wish to see an improvement in the reliability as well as the addition of user-interactive elements.

- Currently non-functional
- improvement in the reliability
- Addition of user-interactive elements

Benchmarking - Interactive Light Installation

- Uses light as a “tripwire” system
- Different light installation patterns can be applied to each stairs
- Makes stairs more interactive

Musical Stairs

- Fun to use
- increasing it’s appeal to users.
- Uses a different electronic setup, with conductible steps.
- Interactive

Metrics Matrix - Arduino

Microprocessor

Specification	Need #	DFR0306 - Arduino Mega	DFR0010 - Arduino Nano	A000073 - Arduino Uno
Price per unit ($)	2,3	36.36	28.48	31.19
Operating Voltage (V)	1,4	5	5	5
Length (mm)	5,7,8	101.6	43.18	68.6
Width (mm)	5,7,8	53.3	18.54	53.3
Weight (g)	5,7	37	25	7
Digital I/O pins	4	54	14	14
Total Points	-N/A-	13	14	12

Importance

Green - 3 pts

Yellow- 2 pts

Red - 1pts

Metrics Matrix - Speaker

Speaker

Specification	Need #	SP-1605	AS01508MR-6-R	AS05008MS-R
Price per unit ($) (20 units total)	2,3	1.9630	3.26200	4.4480
Frequency Range (Hz)	1,6	300 - 8000	900 - 20000	800 - 7000
Dimensions (mm)	5,7,8	16 dia. x 5	15 dia. X 4.4	50.5 dia. X 12
Power (W)	1,4	0.8	1.8	3
Total Points	-N/A-	8	8	4

Importance

Green - 3 pts

Yellow- 2 pts

Red - 1pts

Target Design Specifications

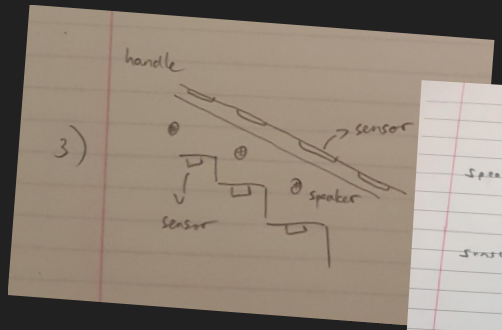
Design Criteria	Minimum Spec	Ideal Spec
Functional Sensors (%)	85%	95%
Sound (dB)	40	60
Speaker size (cm^3)	2	1
Control unit size (cm^3)	30	20
Total Cost ($)	150	100

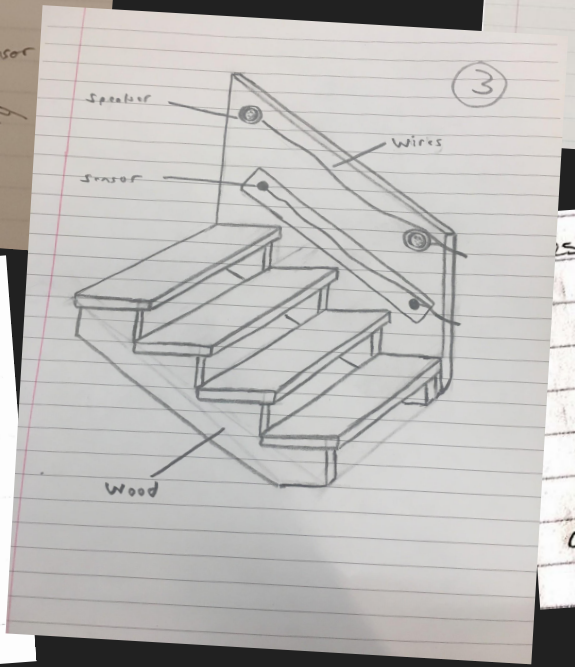
Metrics

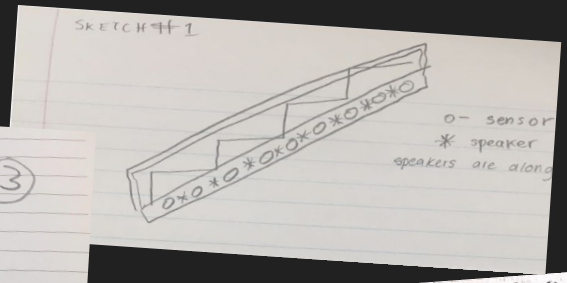
Metrics and Constraints

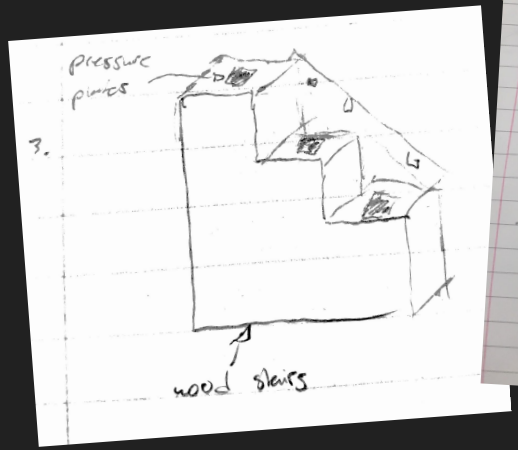
Design Criteria	Relation (=, <, >)	Value	Units	Verification
Functional Top Sensors	=	Activation percentage	%	Successful trials/number of trials
Sound	>=	Sound level	dB	Phone app
Take up a small amount of space	<=	Volume	cm^3	Measuring tape/ruler
Total Cost	<=	Cost	$	Receipts

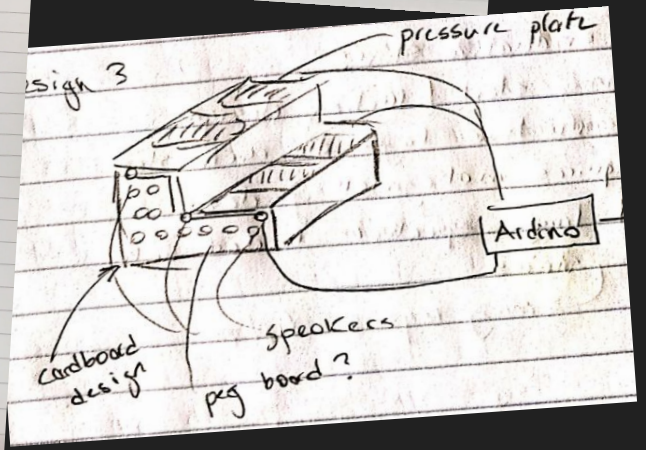
Concept Generation



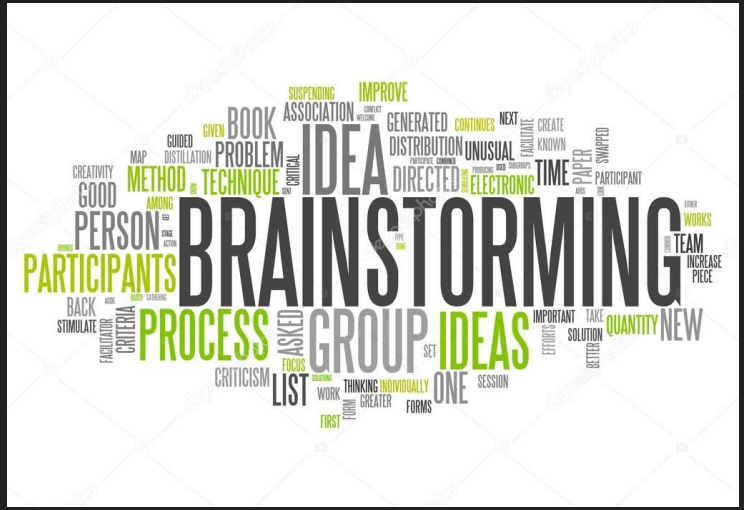








Process


BRAINSTORMING
IDEA
PROCESS
GROUP
IDEAS
PARTICIPANTS
PERSON
METHOD
TECHNIQUE
BOOK
PROBLEM
ASSOCIATION
GENERATED
DISTRIBUTION
UNUSUAL
DIRECTED
ELECTRONIC
TIME
PAPER
GOOD
LIST
ONE
ASKED
CRITERIA
QUANTITY
NEW
TEAM
IMPROVE
SUSPENDING
GIVEN
GUIDED
DISTILLATION
CREATIVITY
MAP
CONTINUES
NEXT
CREATE
FACILITATE
KNOWN
SWAPPED
PARTICIPANT
WORKS
INCREASE
PIECE
AMONG
BACK
STIMULATE
FACILITATOR
CRITICISM
FOCUS
WORK
THINKING
INDIVIDUALLY
SESSION
FORMS
GREATER
FIRST
SET
IMPORTANT
EFFORTS
SOLUTION
BETTER
TAKE

Contending Design

Proximity Design

Light Plain Design

Conductive Design

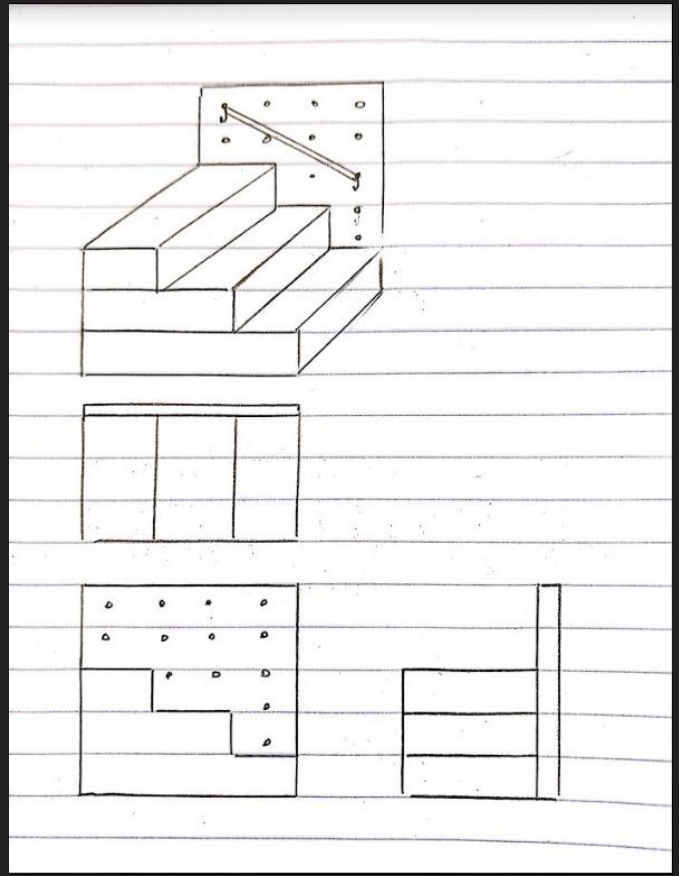
Stair Design

All contending designs use the same fundamental stair design

Steps made of cardboard boxes (free and easy to work with)

Pegboard Backboard (easy to attach speakers and wire through)

Other potential stair designs were deemed unnecessary and overly expensive



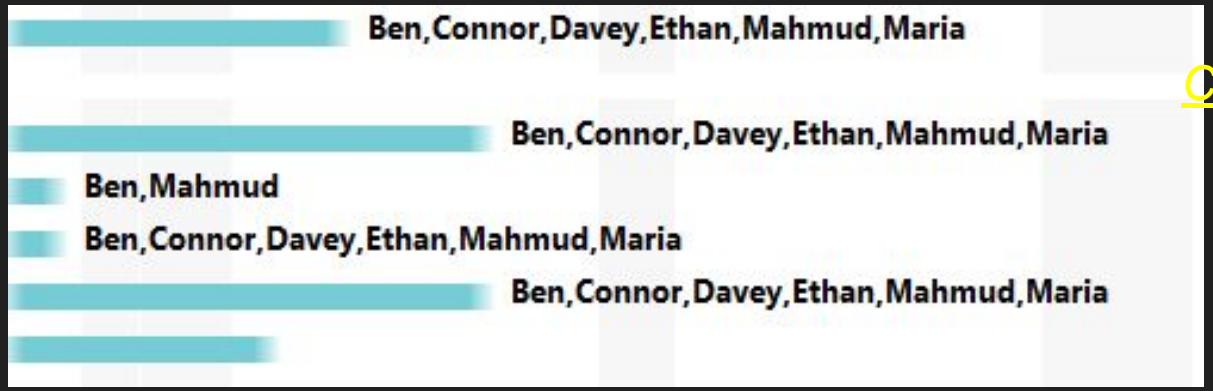
Planning

How did we manage our time?

- Meeting dates
- Exams
- Deadlines
- Work periods
- Risk factors and uncertainty

Gantt Chart:

	G.4	Prototype Manufact	Prototype Manufacturing	3 days	Mar 6th	Mar 9th	
	H	Prototype 3 and Cus	Prototype 3 and Customer Feedback	12 days	Mar 10th	Mar 23rd	Mar 24
	H.1	Modify Design	Modify Design	5 days	Mar 10th	Mar 15th	
	H.2	Sketch Design	Sketch Design	1 day	Mar 15th	Mar 16th	
	H.3	Buy Materials	Buy Materials	1 day	Mar 16th	Mar 17th	
	H.4	Prototype Manufact	Prototype Manufacturing	5 days	Mar 18th	Mar 23rd	
		Final Project Presen	Final Project Presentations	2 days	Mar 23th	Mar 25th	Mar 25
		Final Project Report	Final Project Report	6 days	Mar 25th	Mon 01/04/1	Apr 1



Critical Path H.1→H.2→H.4

Total: 11 Days

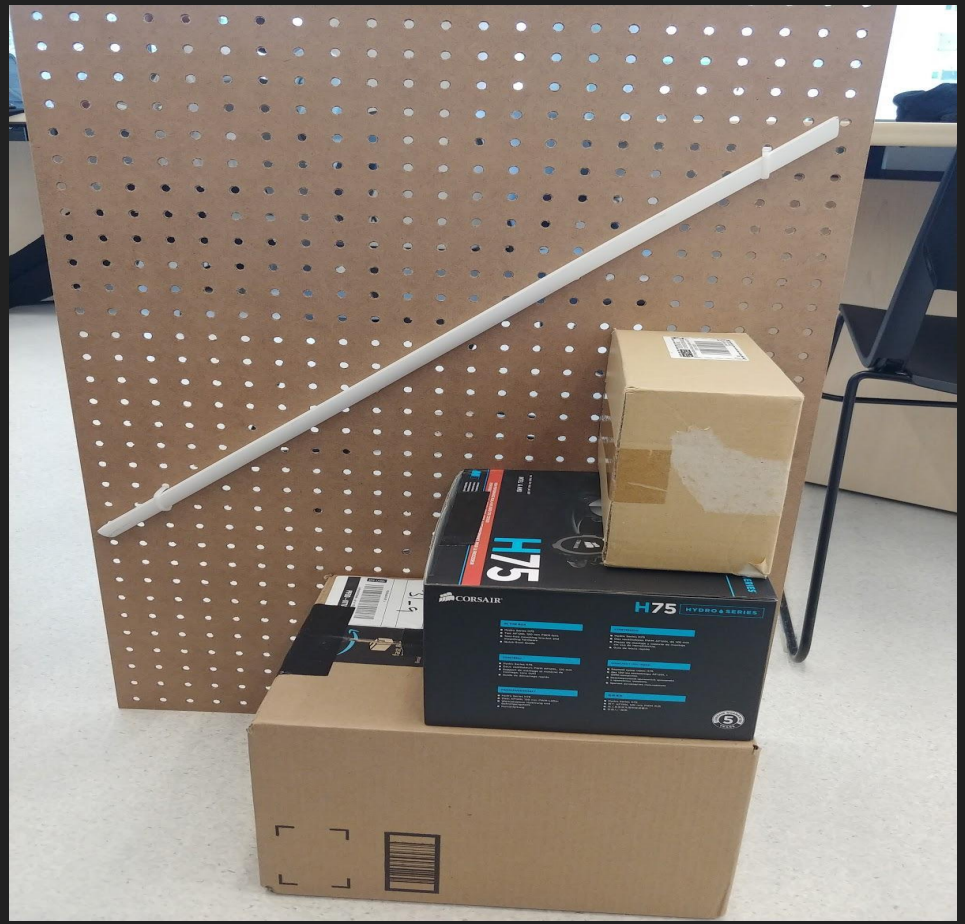
Bill of Materials

In total, we spent $87.

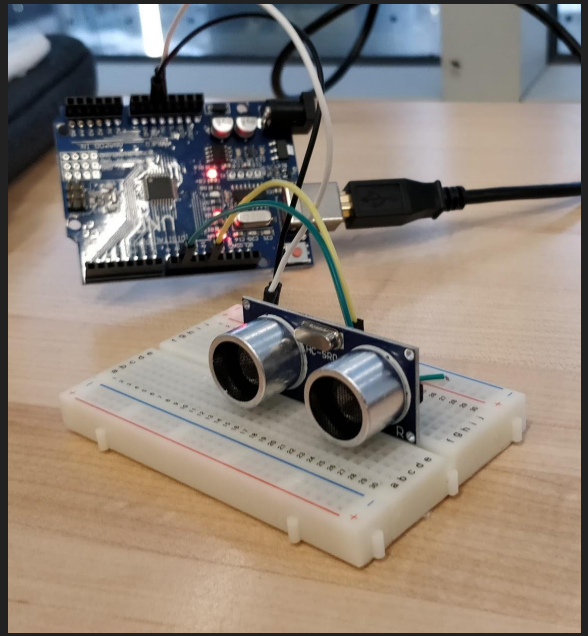
Material	Cost ($)	Quantity	Total Cost ($)
Pegboard	5.51	1	5.51
Zip Ties (30 pack)	5.98	1	5.98
Railing (quarter-round)	2.31	1	2.31
Small Speaker	3.50	2	7.00
Larger Speaker	7.50	2	15.00
Sensor (5 pack)	12.00	1	12.00
Arduino Uno	25.00	1	25.00
Paint, Tape, String, Boxes, Wiring, Sauder	0.00	N/A	0
Protoboard	0.50	4	2.00
Cost Before Tax ($)			74.8
Shipping and Tax ($)			12.20
Total Cost ($)			87.00

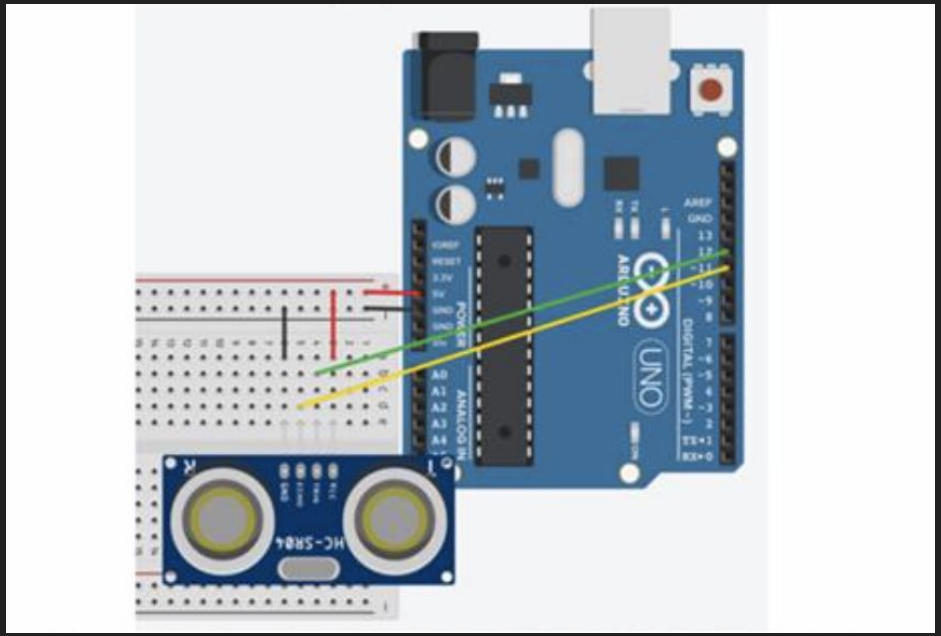
Prototype One

Cardboard stairs separate from sensors and speakers

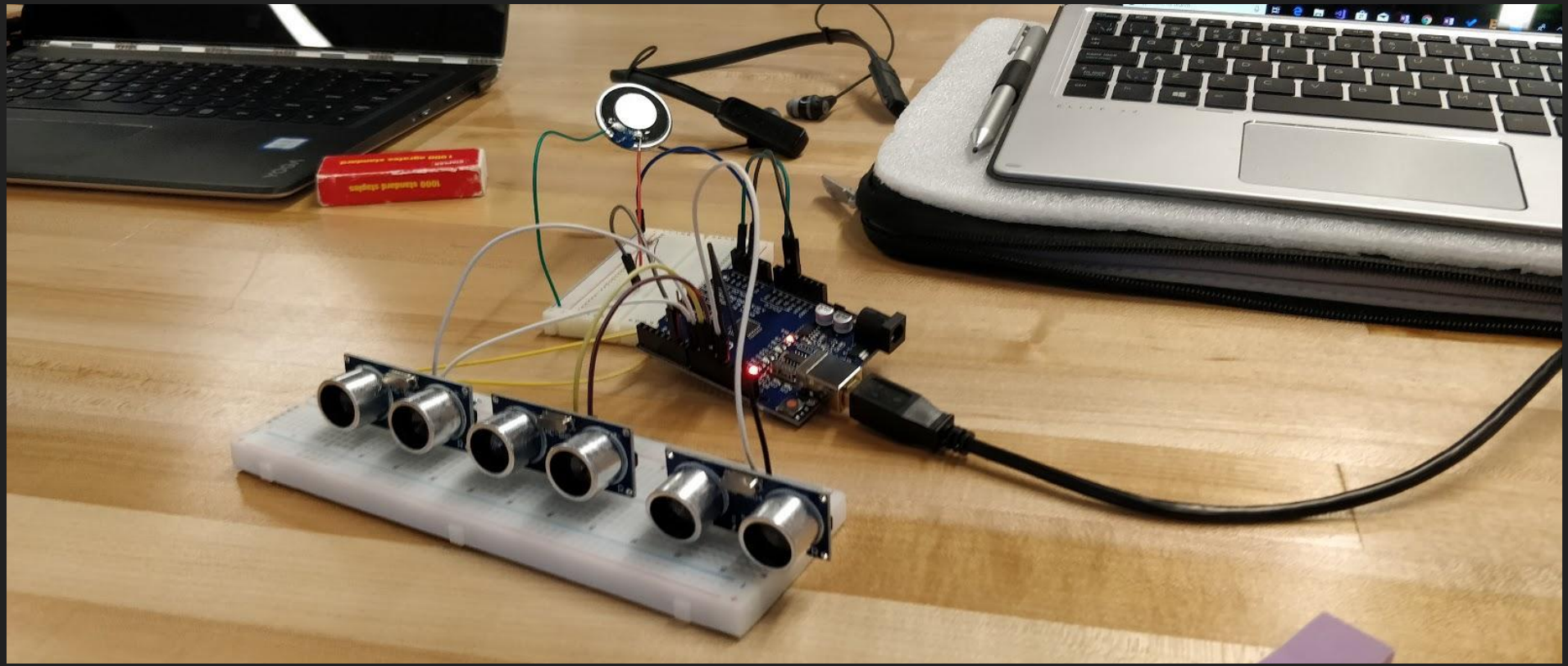


Prototype One



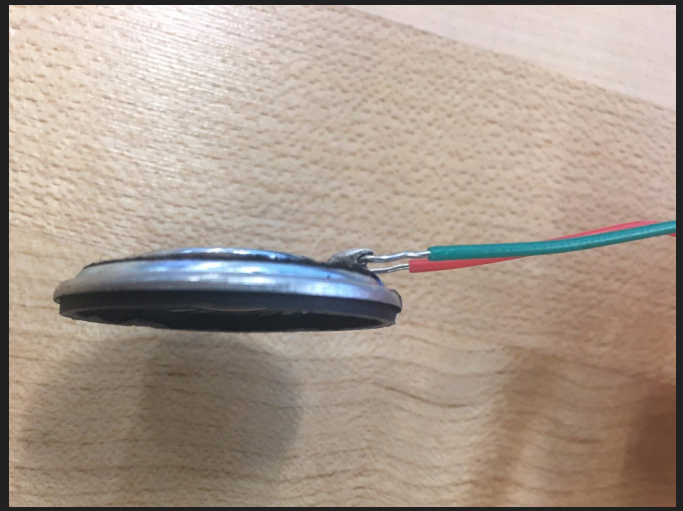


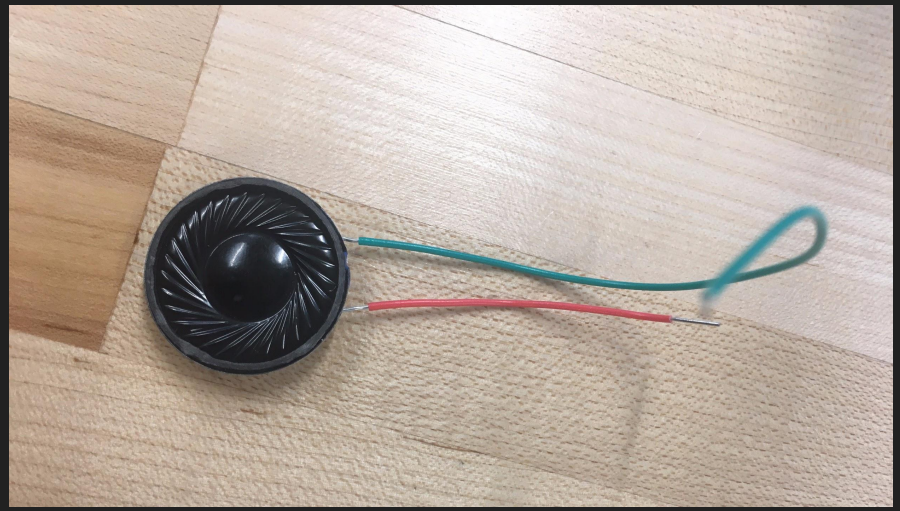
Prototype Two - Sensors, Arduino, and Speakers



Prototype 2 Speaker

- Speaker was too small and had a low wattage.
- Needed to be louder

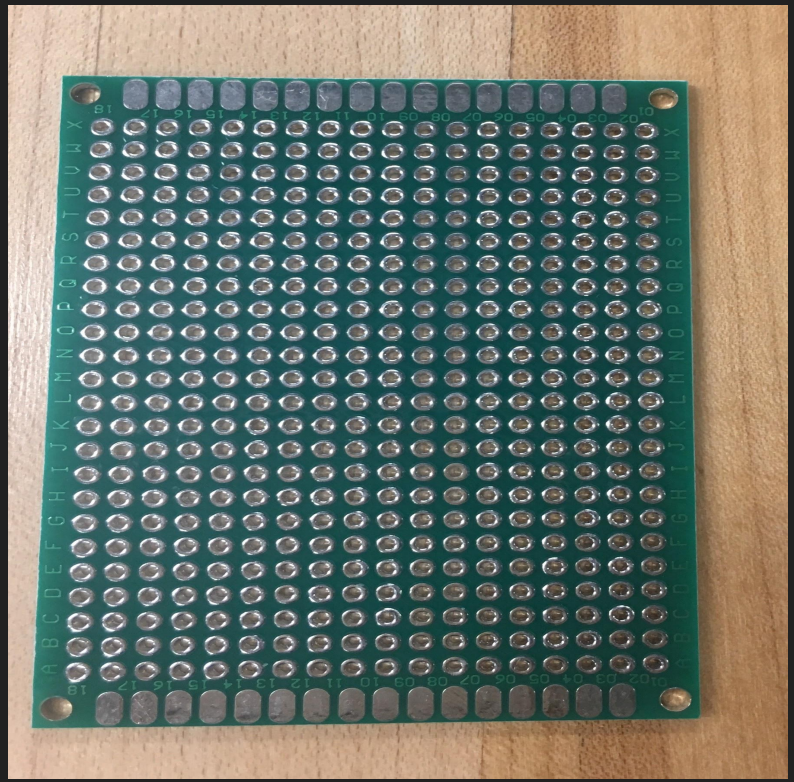


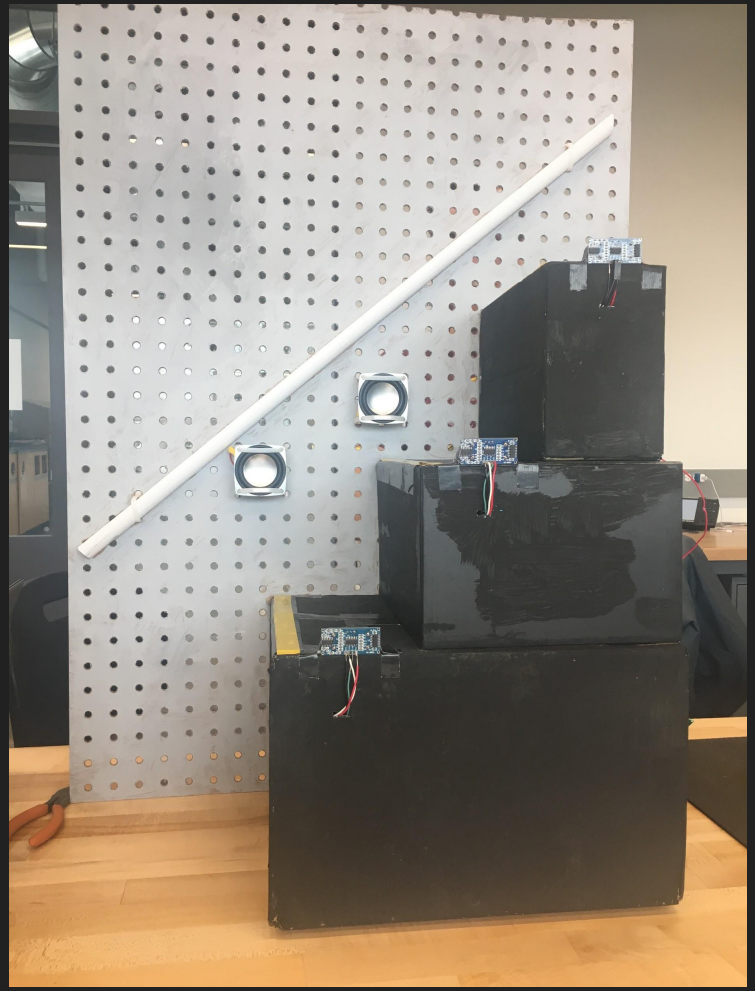


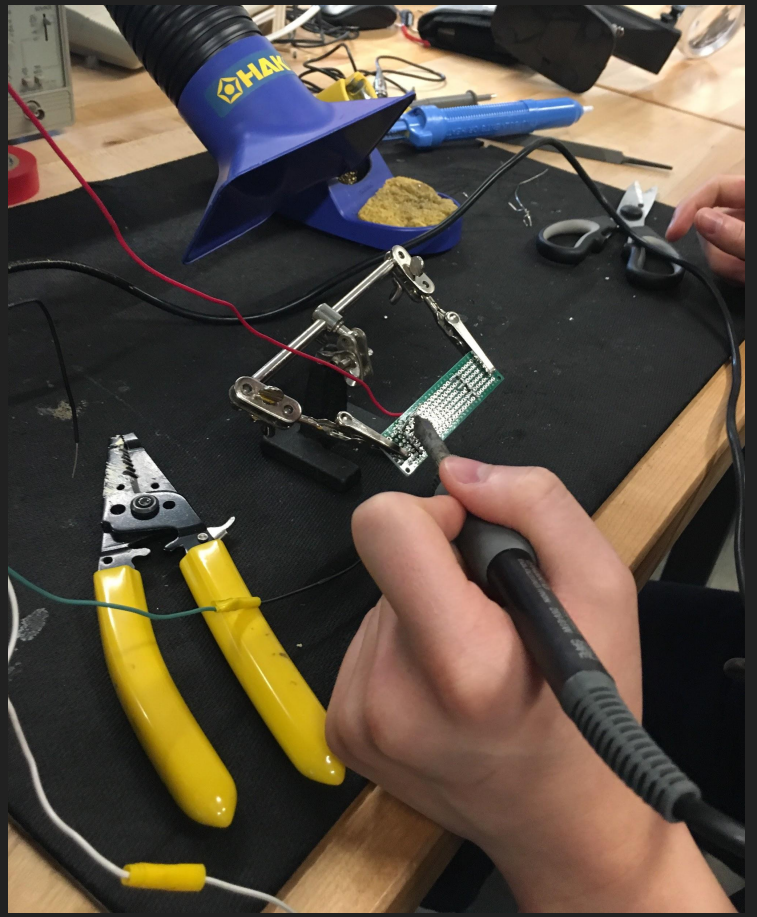
Prototype Two

Fully attached sensors, speakers, and wiring to the stair model

Protoboard for Prototype 3, new large speakers







Thank you!

Any Questions?