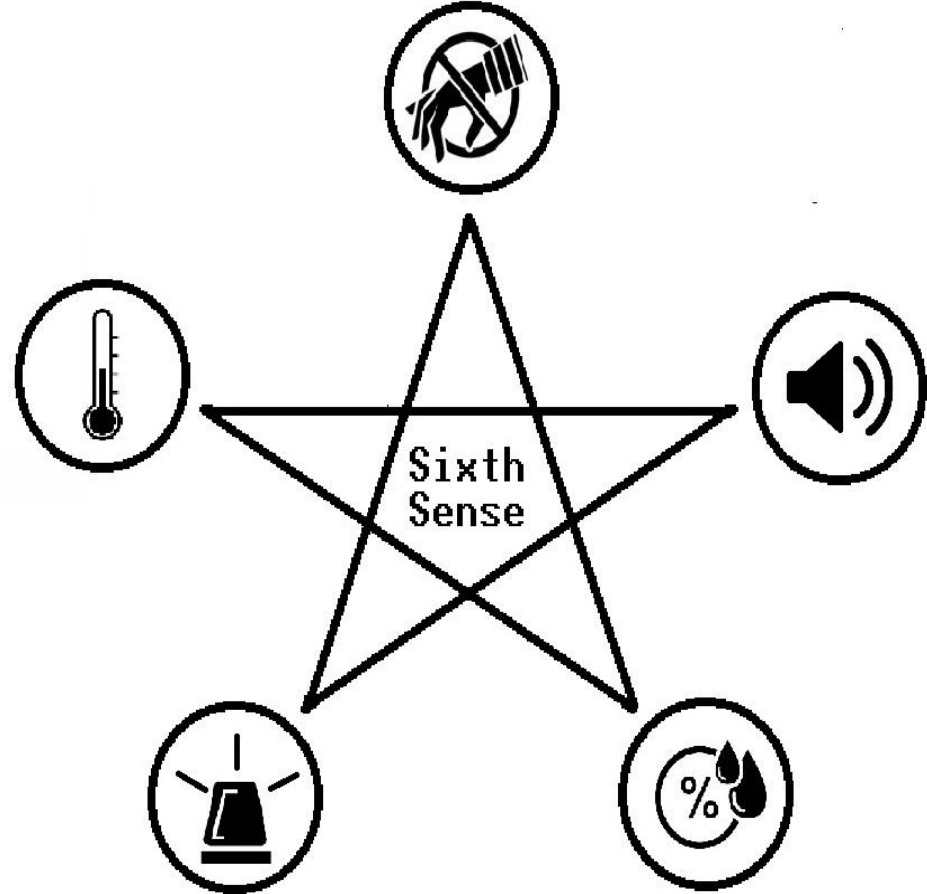


# All-In-One Module

By the Sixth Sense

Lucas Siviero  
Noah Aynalem  
Rakshita Mathur  
Riley de Gans  
Timi Tella





# Phase 1 : Pre-Prototyping

Empathize

Define

Ideate

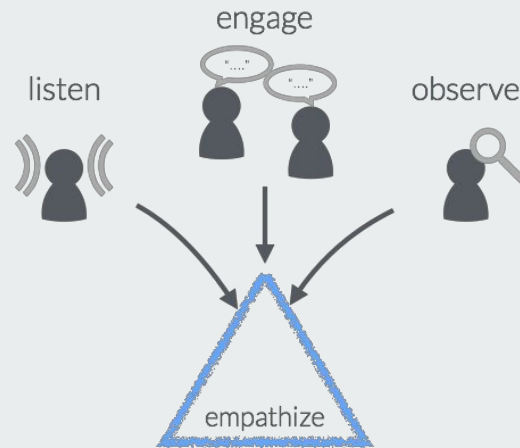


# Empathize with JAMZ

- Meet with customer and discuss needs and priorities
- Benchmark components

Customer : JAMZ

User: Drone Operator, back-end developer, electrician



Needs Description	Priority (5 = highest, 1 = lowest)
Safe	5
Consistent data	5
Measure humidity	5
Measure humidity	5
Detect shaking	4
Protect against theft	4
Alert pedestrians	3
High visibility beacon	3
Inexpensive	3
Durable and easy maintenance	3
Low weight	2
Low volume	2



# Define the Problem

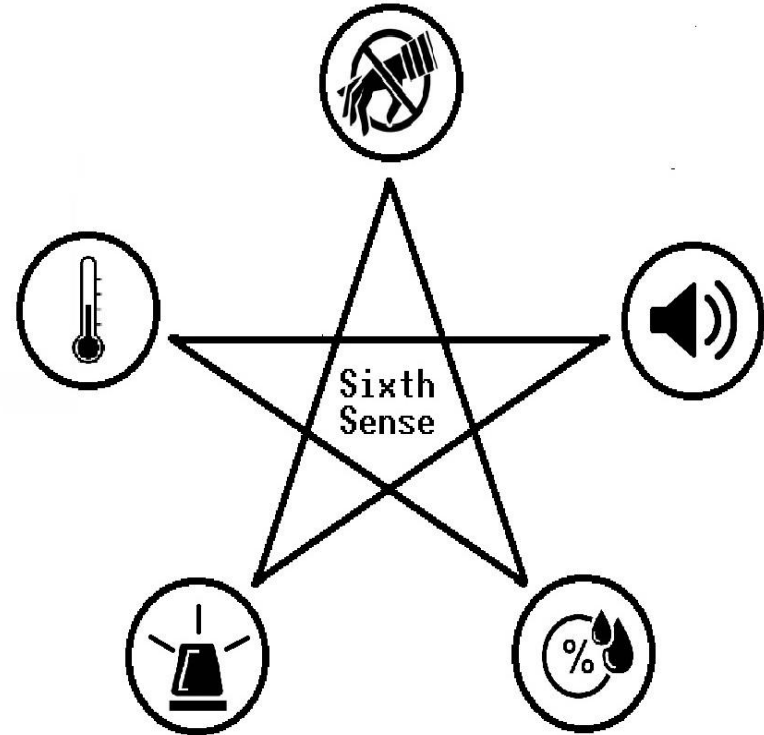


JAMZ requires a climate sensor, shake alarm, anti-theft system and beacon that measures and transmits consistent and accurate data. The module must be safe, inexpensive, lightweight and compact.

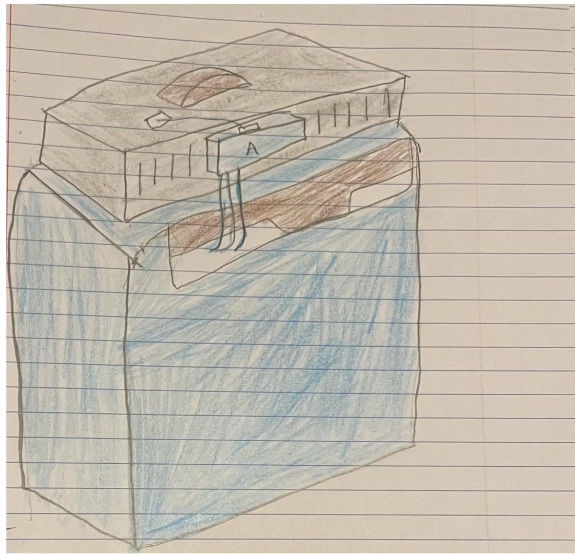
# Define the Problem

Our solution: 5 subsystems

- Shake
  - Humidity
  - Temperature
  - Audio
  - Lights
- + Serial communication
- + Voltage pull-down

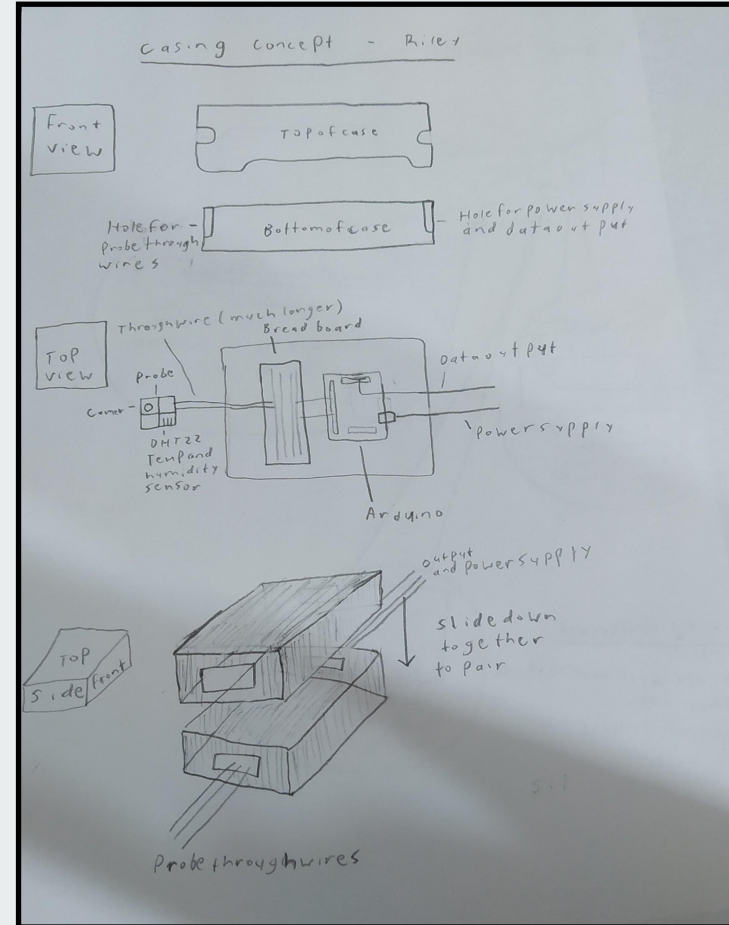


# Ideate



## Scrapped Ideas:

- Camera
- Retracting module
- Tilt switches
- Christmas lights



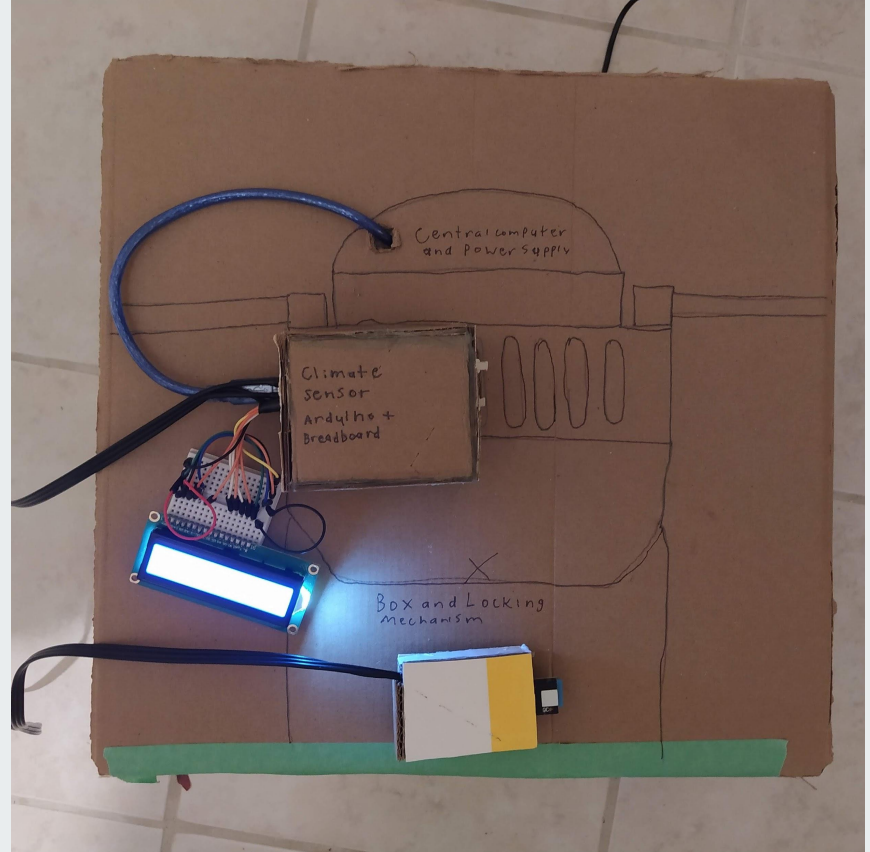
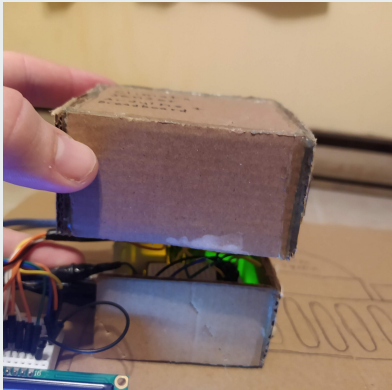
# Bill of Materials

- Apply benchmarking
- Big savings and no shipping cost by buying local!

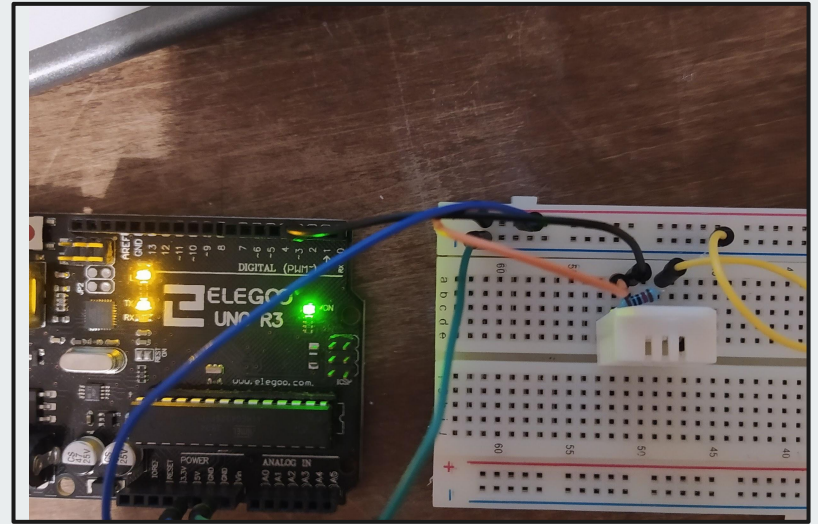
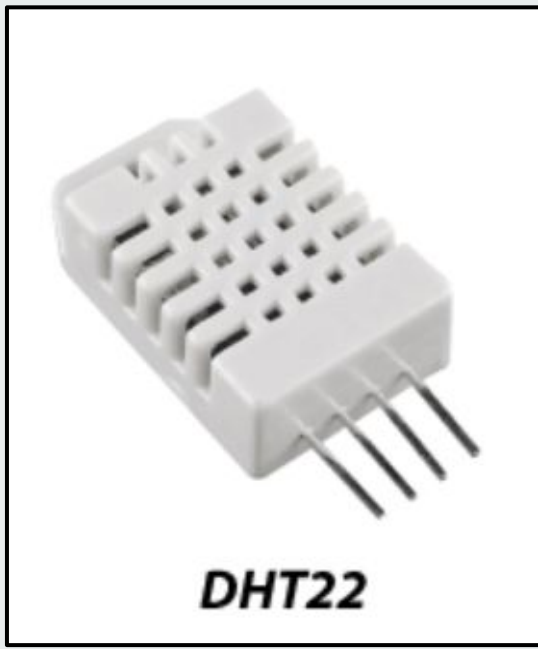
Component	Price(\$CAD)	Source	Link
DHT22 x 2	5.94 x 2 = 11.88	Simcoe DIY	<a href="#">Link</a>
LSM6DS3	3.24	Simcoe DIY	<a href="#">Link</a>
Voltage Converter	5.64	Simcoe DIY	<a href="#">Link</a>
30 AWG Wire	3.78	Simcoe DIY	<a href="#">Link</a>
Bundled ethernet cable	1.00	Makerspace	N/A
M3 Bolts x10	2.33	Robot shop	<a href="#">Link</a>
Protoboard / PCB	0.56	Amazon	<a href="#">Link</a>
Arduino Uno	8.67	Simcoe DIY	<a href="#">Link</a>
3D Printed Case	N/A	Maker Space	N/A
8 Ohm Active Speaker	1.10	Newark	<a href="#">Link</a>
4 x 4 Pin RBG LED	1.12	Simcoe DIY	<a href="#">Link</a>
XT60 Female Converter	3.99	Orléans Hobbies	<a href="#">Link'</a>
NPN Transistor	0.56	Simcoe DIY	<a href="#">Link</a>
Total Price	\$43.87		



# Phase 2: Prototype 1

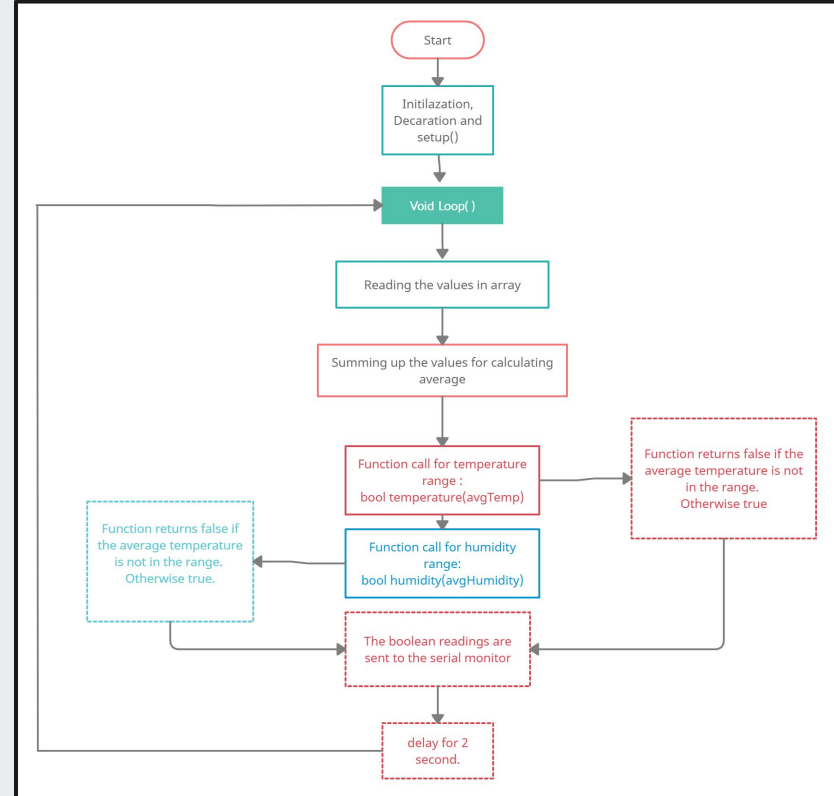


# Climate Sensor



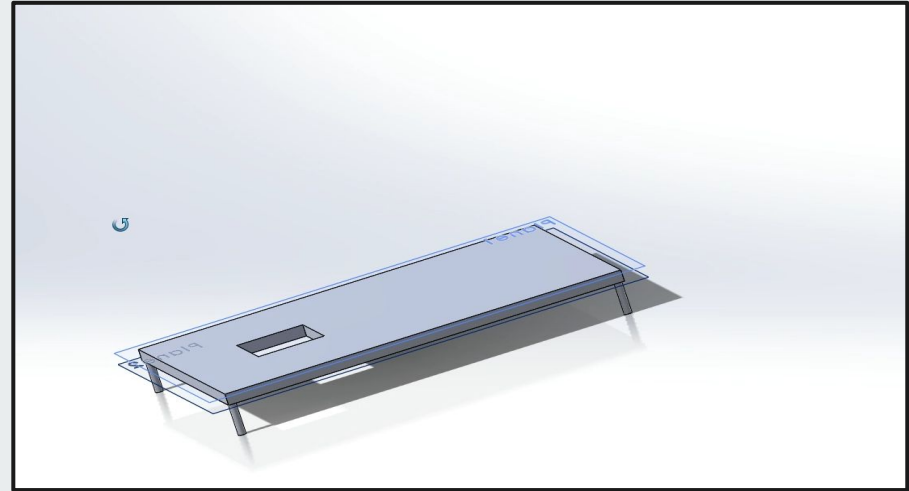
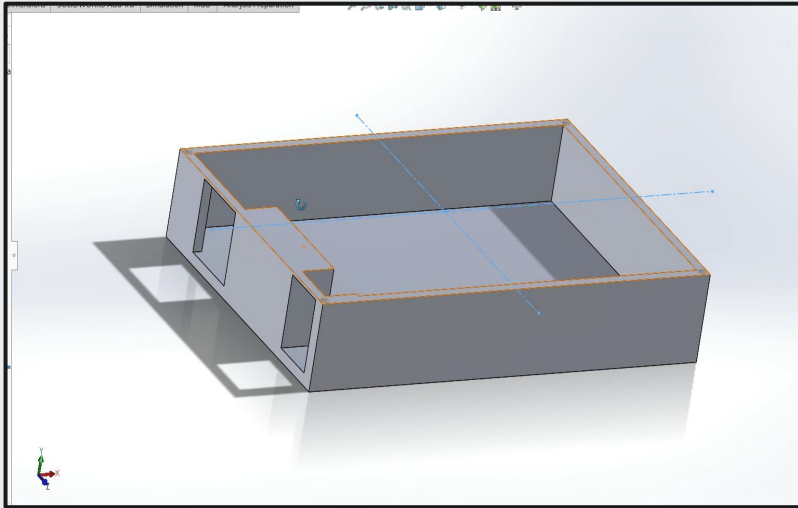
# Climate Sensor

- Take a weighted average
- Compare to benchmarked range
- Measure every 0.5 seconds
- Flag via serial communication
- Accurate to 0.5 degrees / % (criteria)



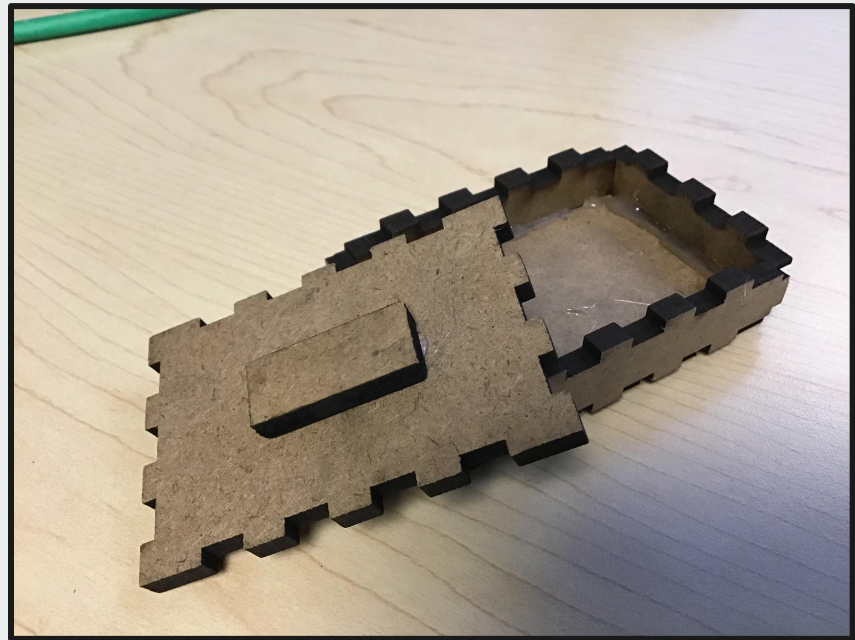
# Casing (Arduino)

- Arduino
- Breadboard
- Wiring

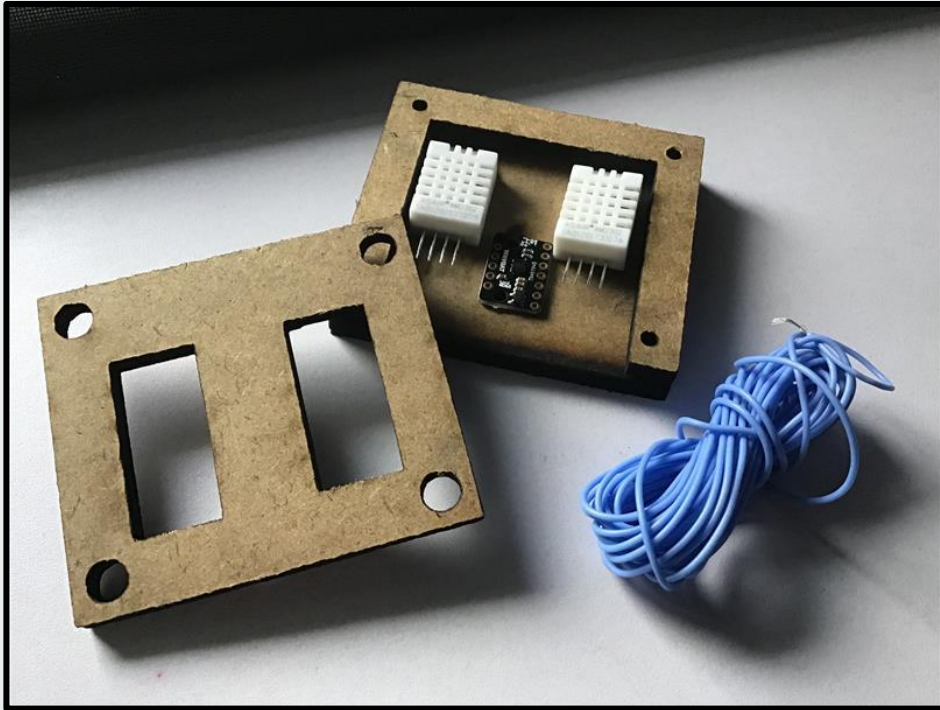


# Casing (Arduino)

- MDF not waterproof
- Incorrect dimensions
- Add photo of case placement



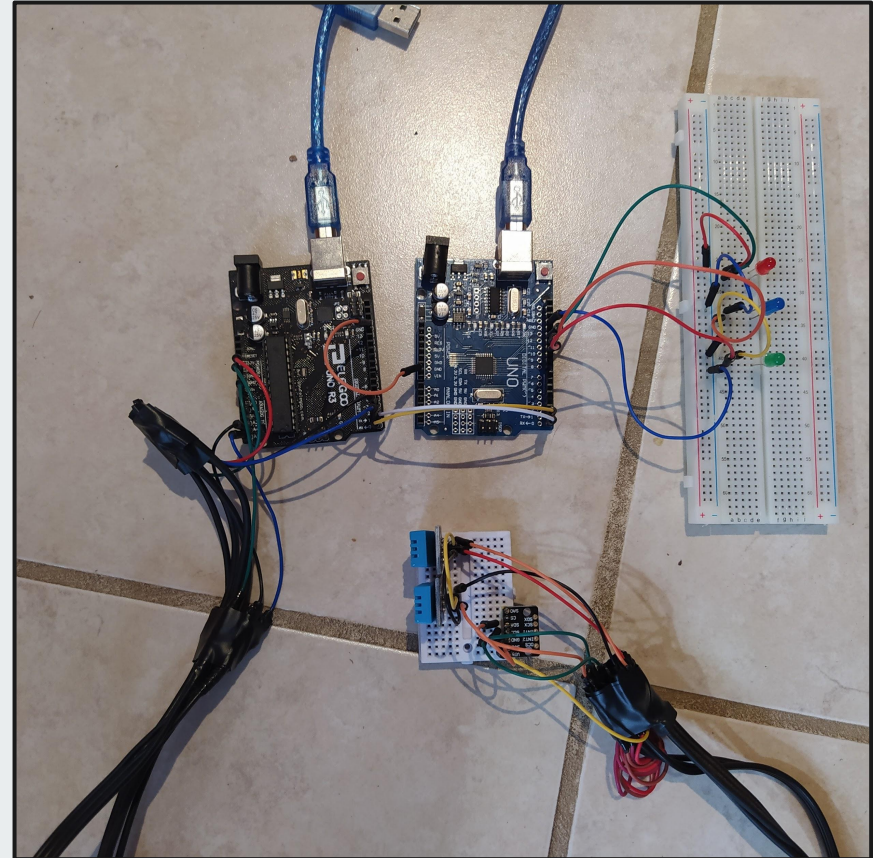
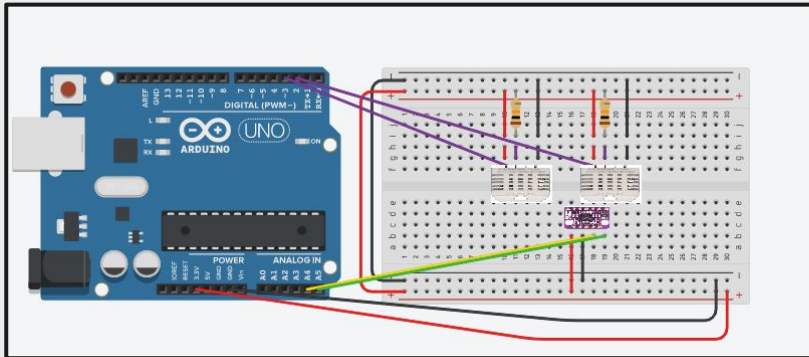
# Casing (Sensor)



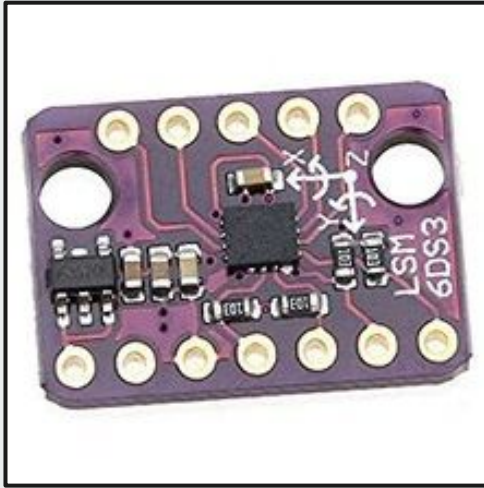
- 2x DHT22
- LSM6DS3
- Through wire



# Phase 3: Prototype 2



# Violent Shake Alarm



$\Delta$ Acceleration (Jerk) Measured 10 times over 0.5 seconds



Measurement > threshold variable (0.2 G/s) = Jerk



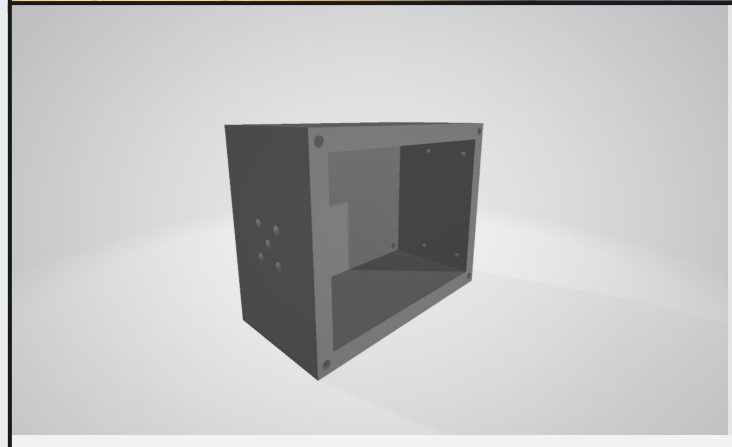
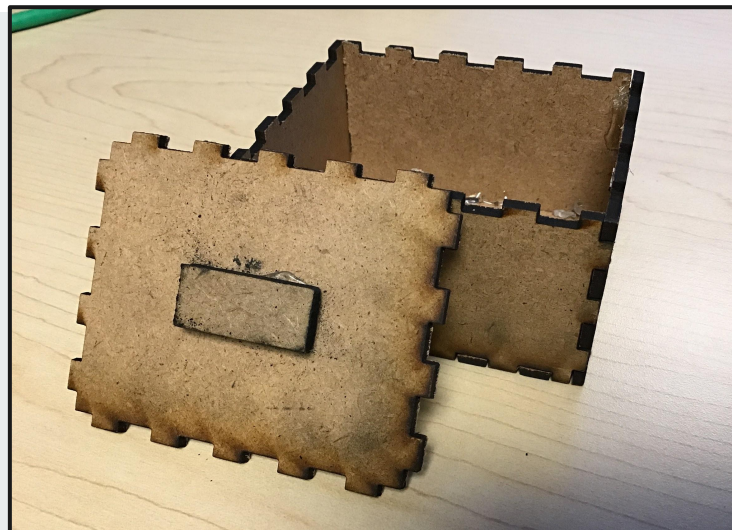
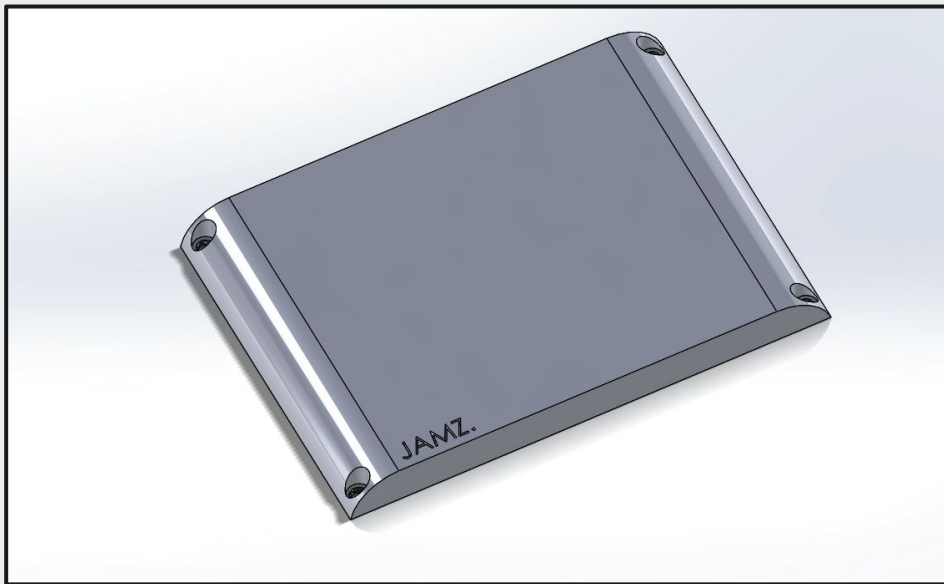
# Jerks in period > Count variable = Violent Shake



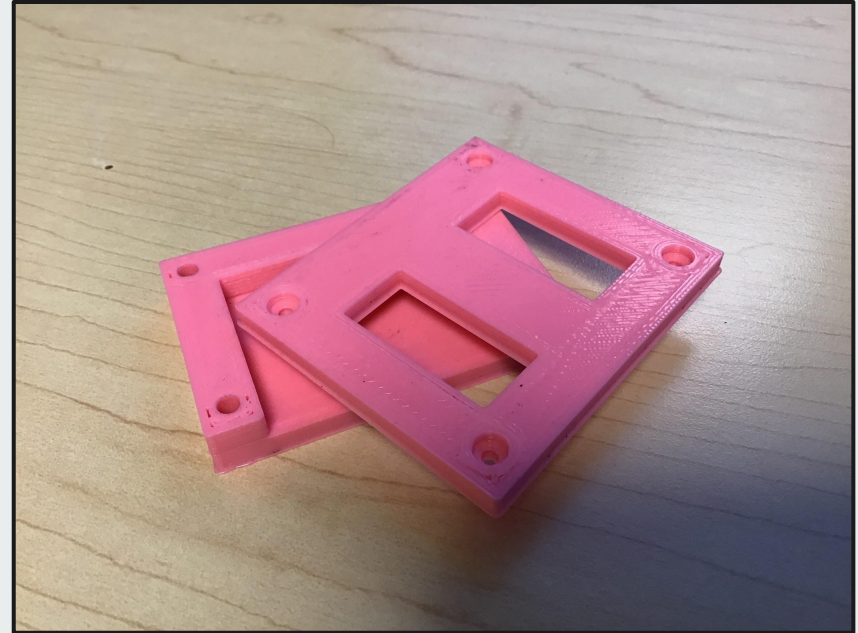
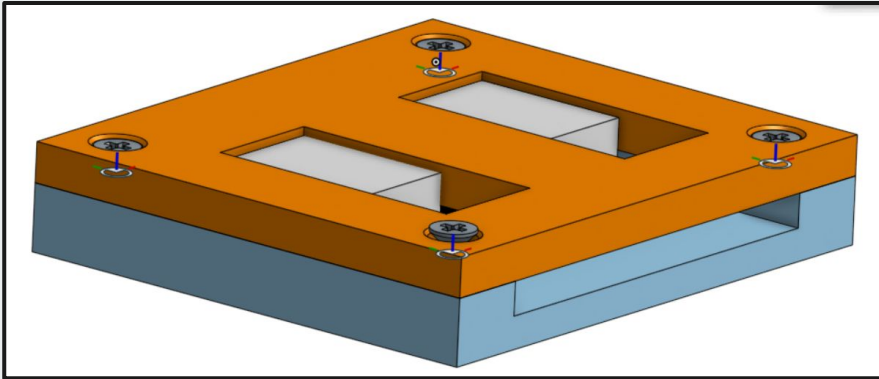
Send flag to JAMZ + trigger alarm (LEDs and speaker)



# Casing (Arduino)

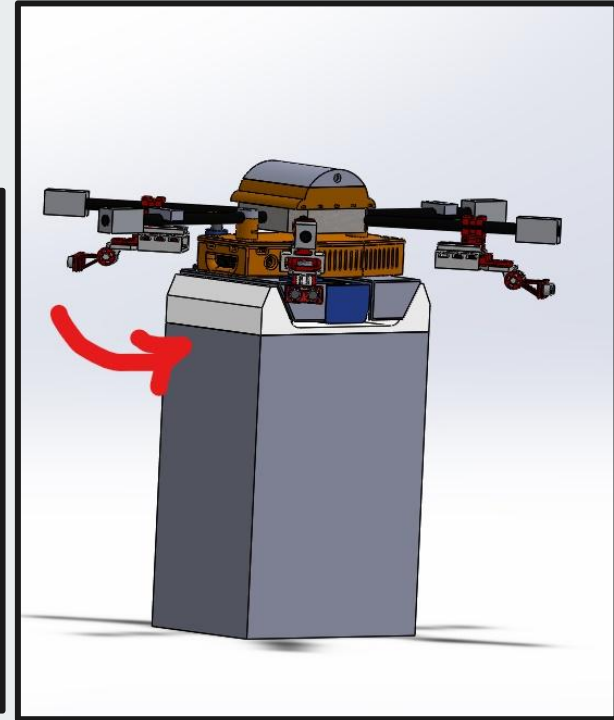
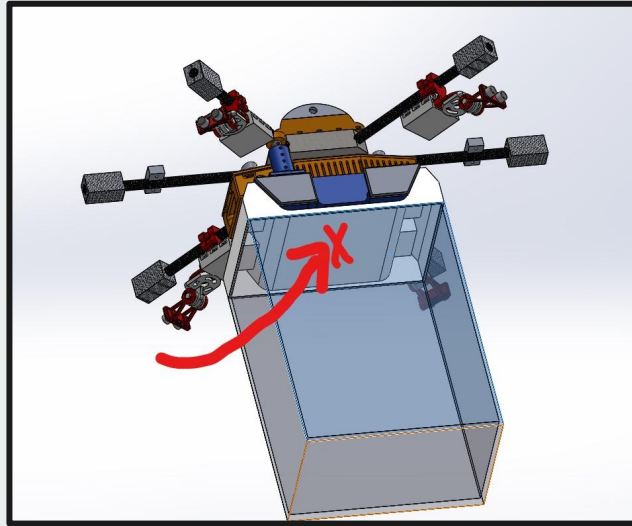


# Casing (Sensor) Module



# Casing Mounting

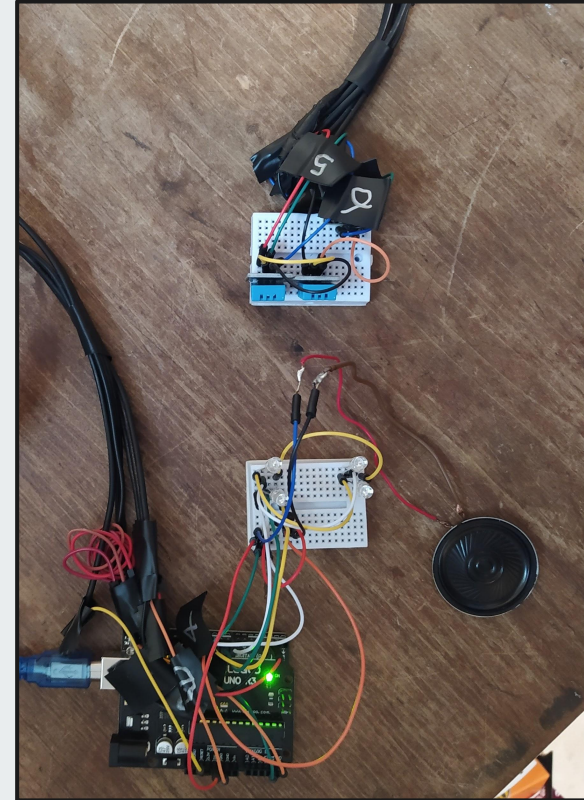
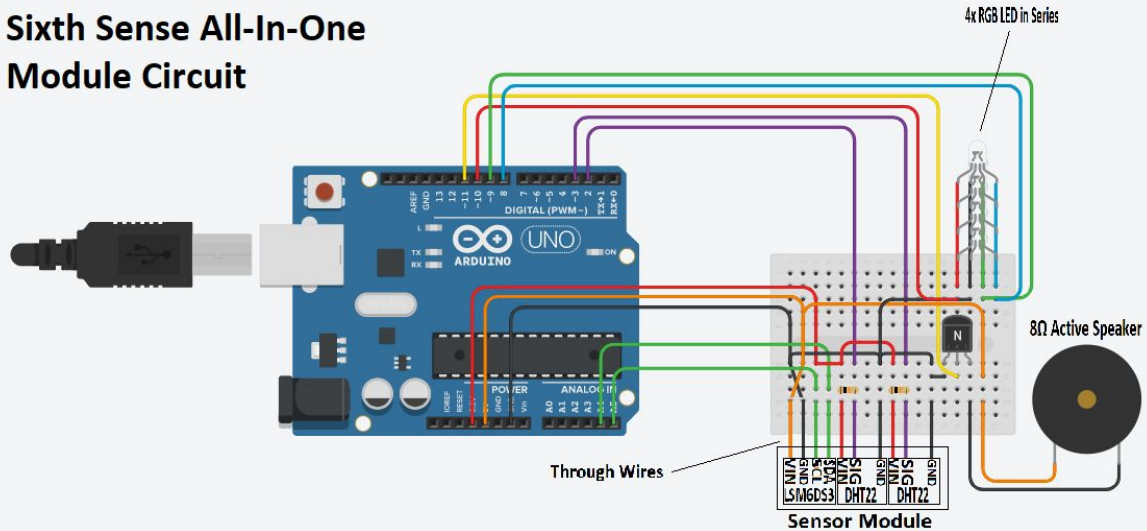
- M3 Screws
- Through wire drill hole



[Link](#)

# Prototype 3

## Sixth Sense All-In-One Module Circuit



# Anti-Theft Alarm System And Beacon



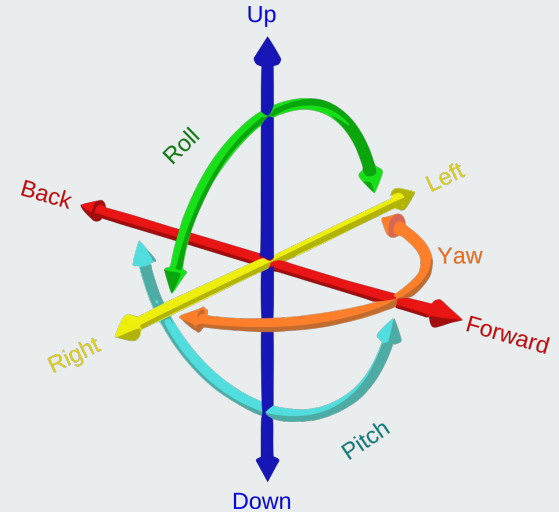
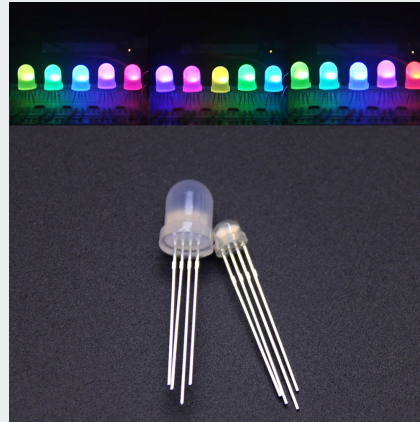
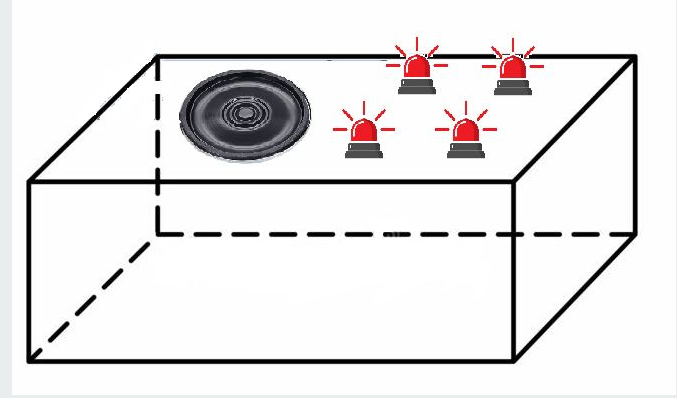
**Red** - Shake  
**Blue** - Temperature  
**Yellow** - Humidity  
**Mix** - Multiple  
**White** - All or beacon

*“Eloignez-vous du drone”*  
*“Step away from the drone”*

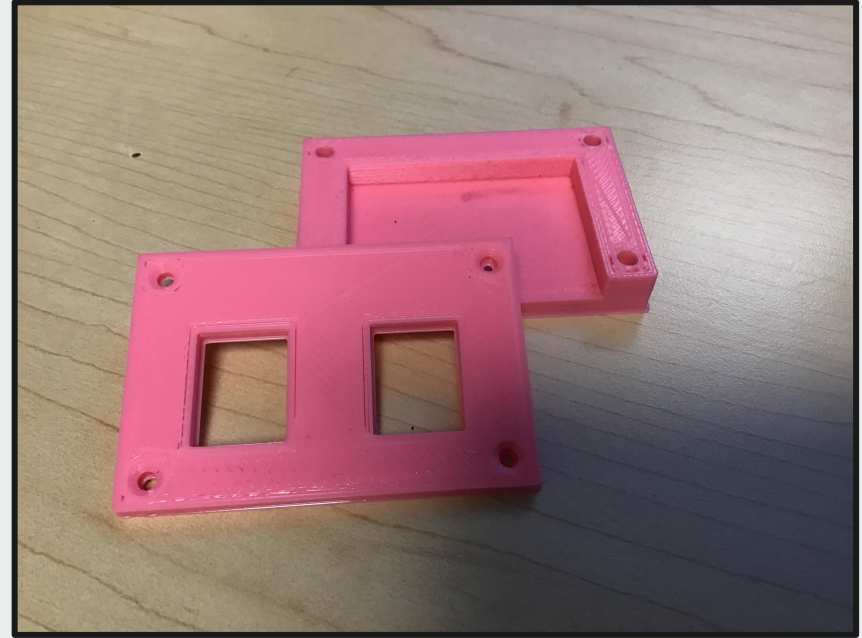
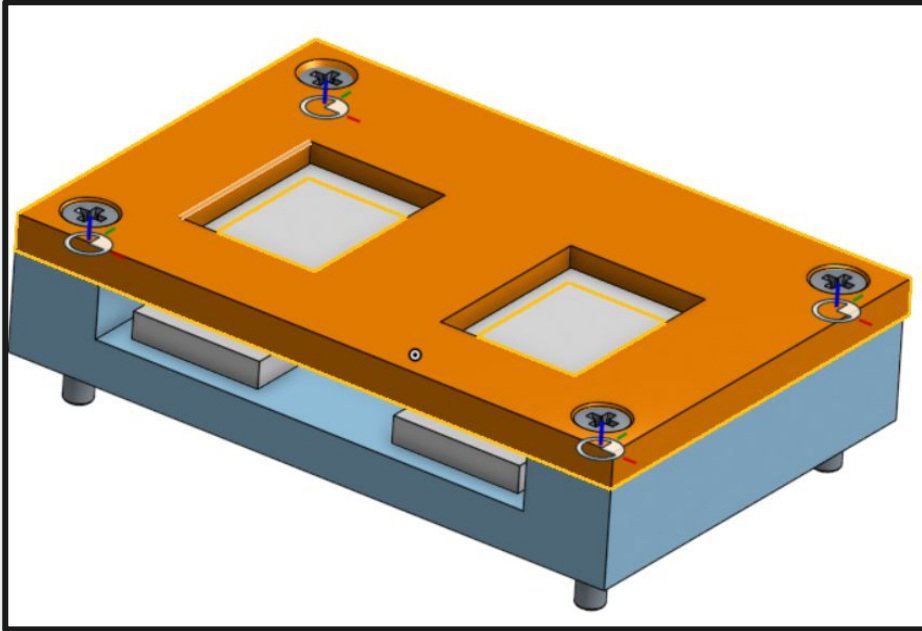


4 Sec Wav file encoded as array of ints on flash

# Anti-Theft Alarm System And Beacon

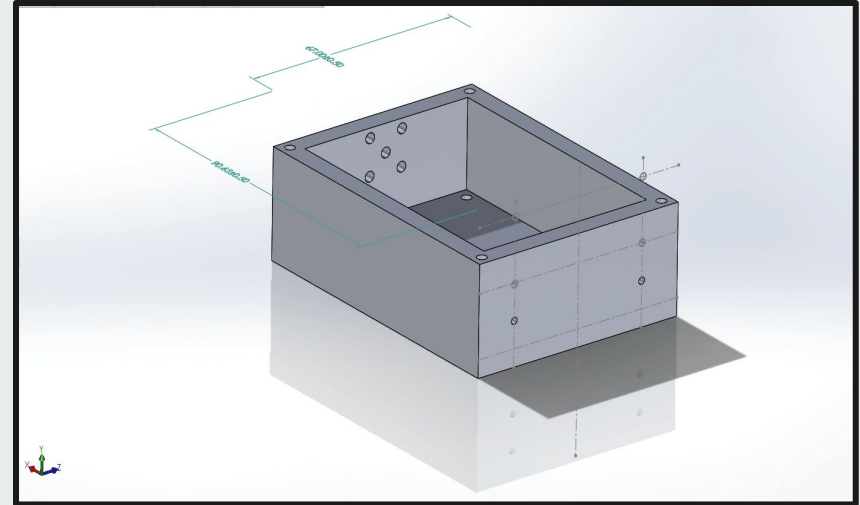


# Casing (Sensor) Module



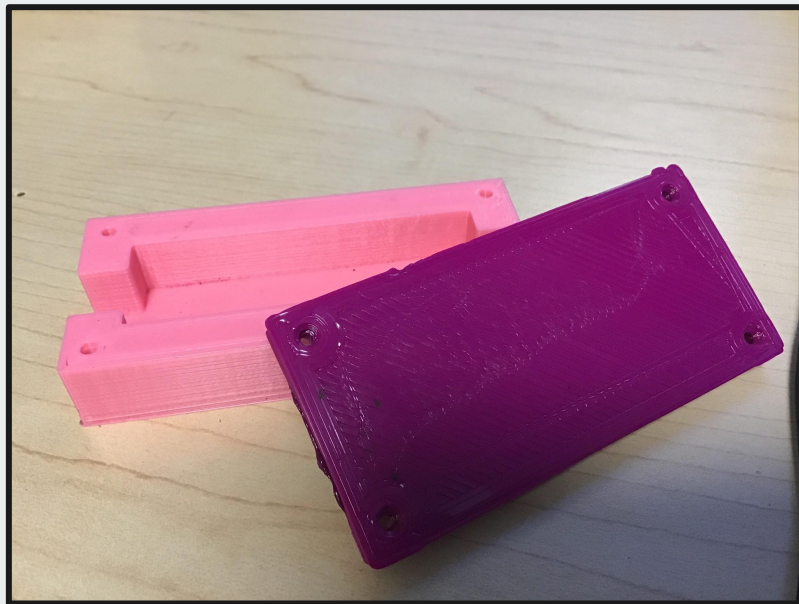
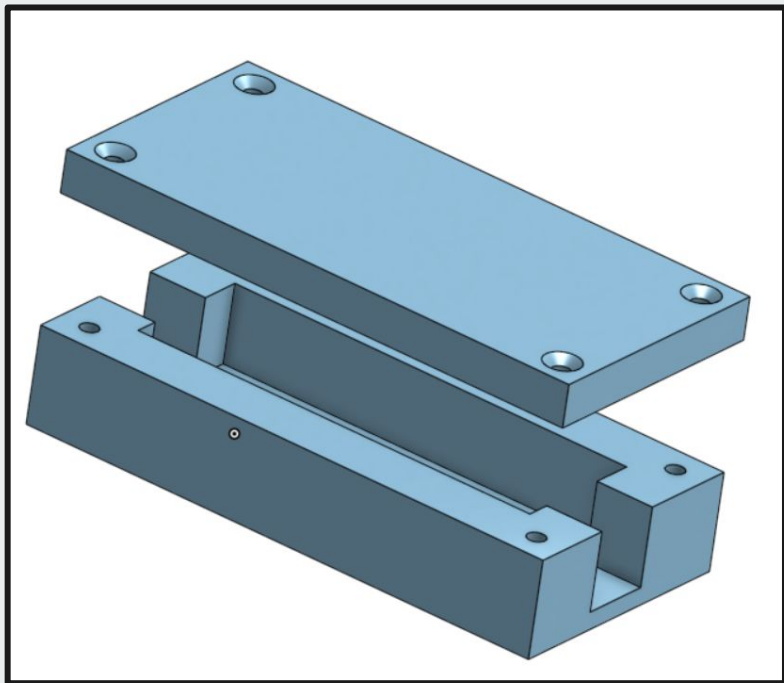
# Casing arduino

- Holes for speaker, LED's, Wires + Waterproof adhesive





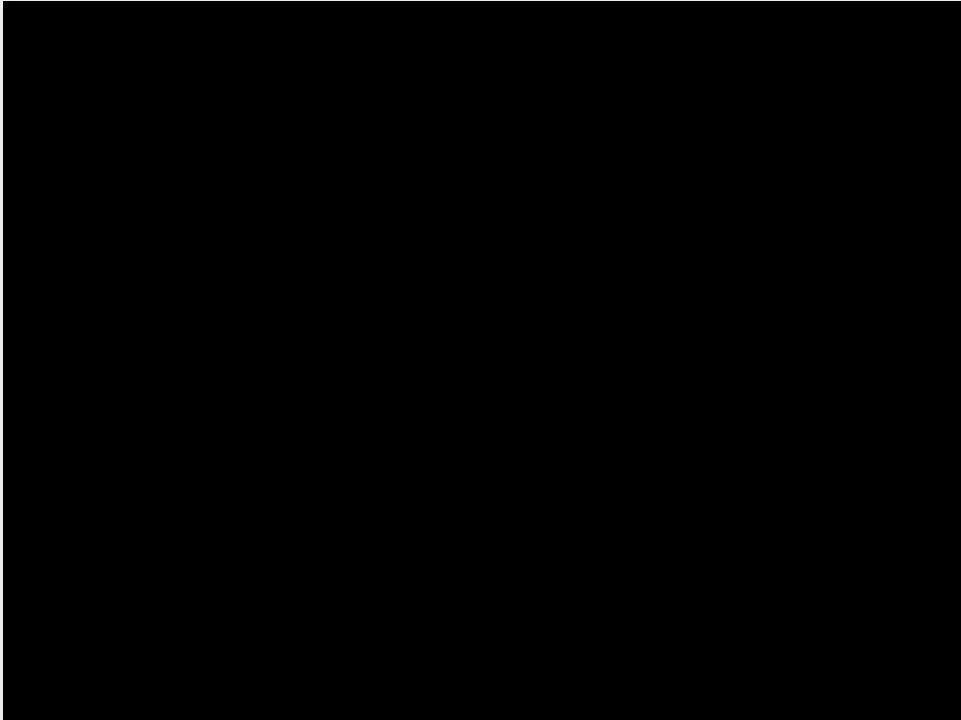
# Casing (Step down converter)



# Total Module Weight

Using PH Countersunk flat head screw M3x0.5 x 25	
Module	Final Prototype (kg)
Sensor Module	0.046682286
Arduino Module	0.067932716
Wires and Step down converter	0.107540864
Total	0.222155866

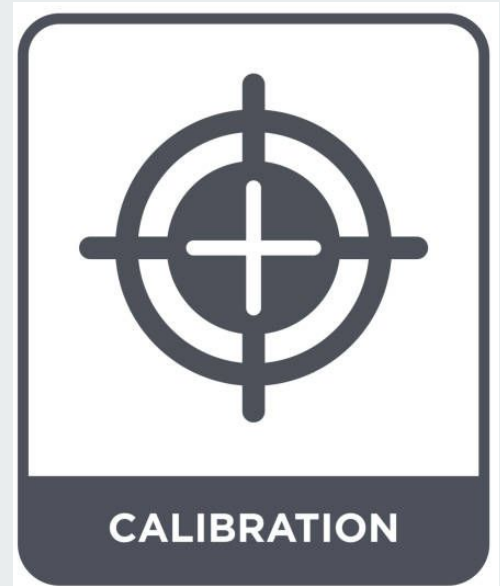
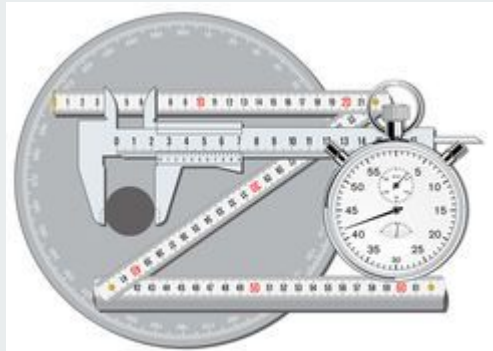
# Demonstration



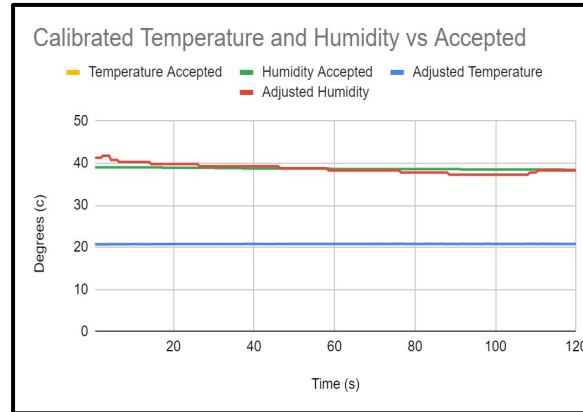
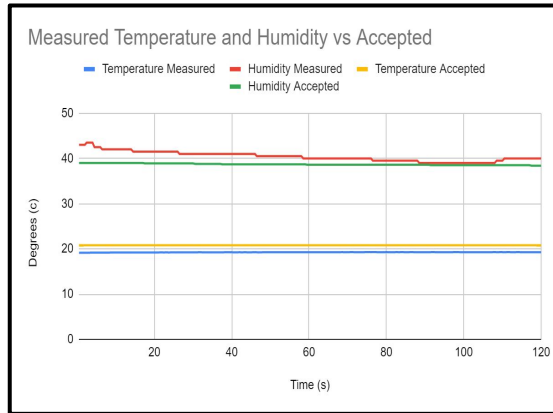
- Humidity tested with steam
- Temperature tested with heat gun

# Testing, Results and Iterative Prototyping

Calibration, data smoothing, thresholds and averaging turn inaccurate data into reliable output!



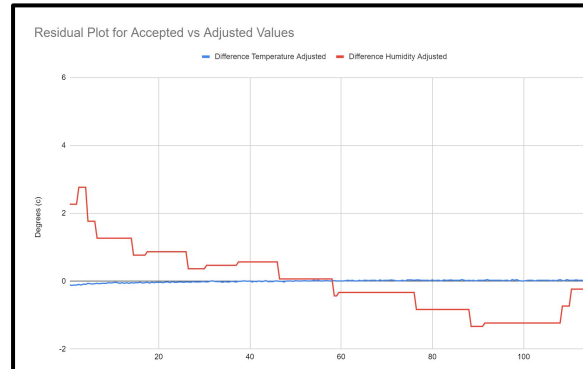
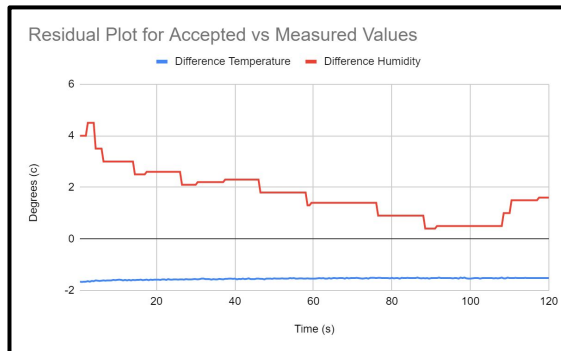
# Test Result for the Climate Sensor Calibration



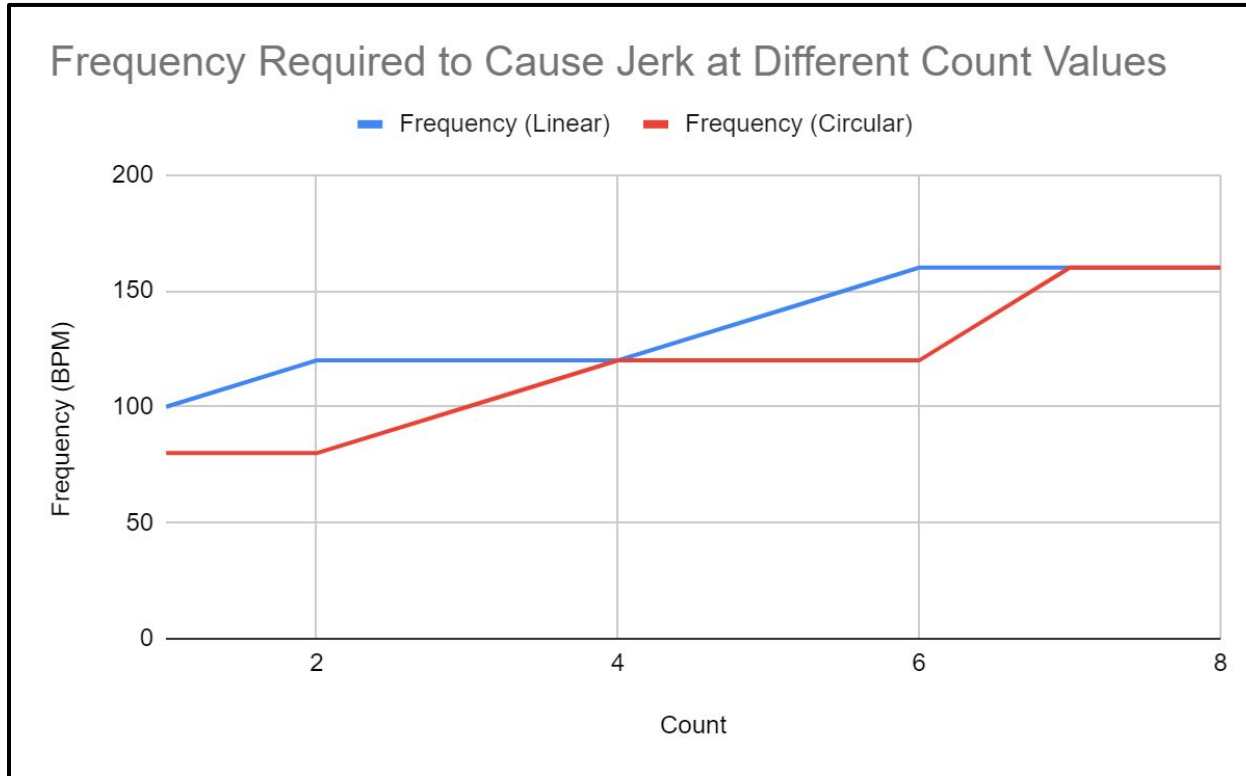
Average Percent Error:  
Temperature - 7.44%  
Humidity - 4.47%

Calibrated Percent Error:  
Temperature - 0.13%  
Humidity - 1.9%

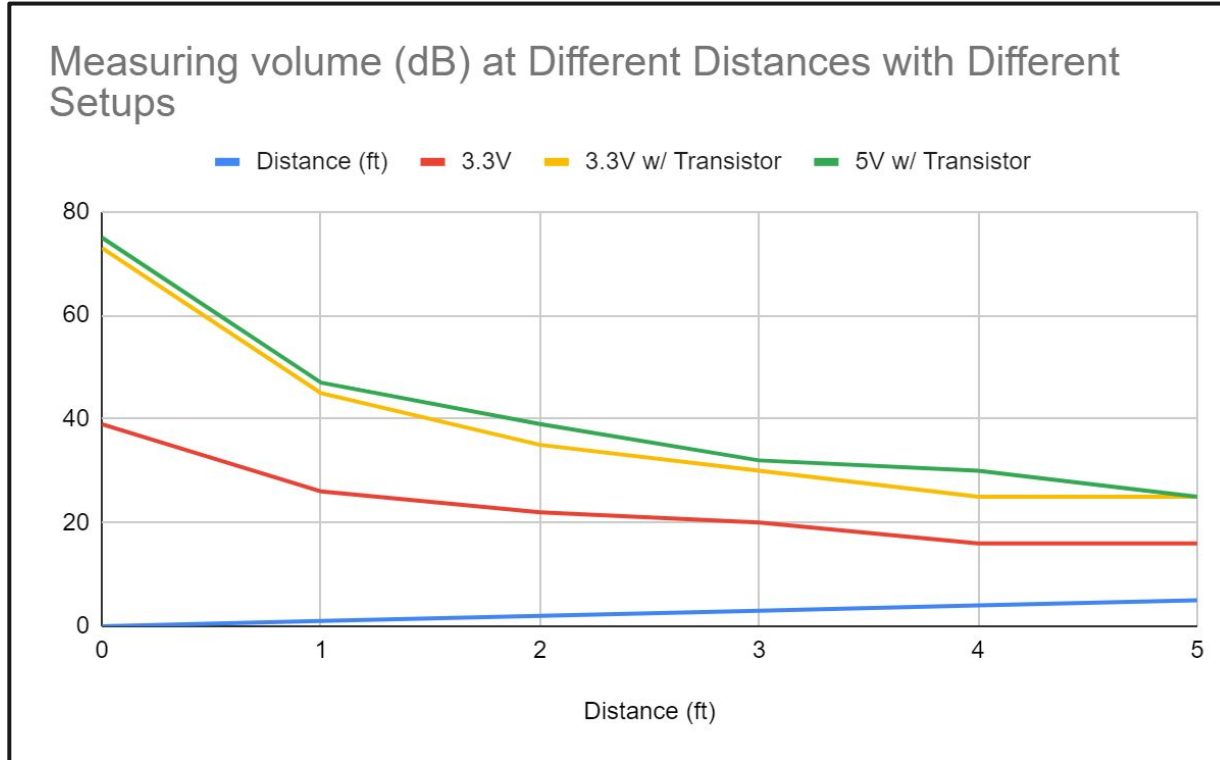
Accurate to:  
0.05 degrees C  
2.75% relative humidity



# Test Results for Shake Alarm Calibration



# Test Results for Speaker Optimization



# Lessons Learned!



- Measure three times, print once!
- Importance of benchmarking
- Datasheets are not always correct
- Convenience of using Wrike and a Gantt Chart
- Keeping cameras on during team meetings
- Doing everything under budget



  
**Thank YOU!**

Any Questions ?

