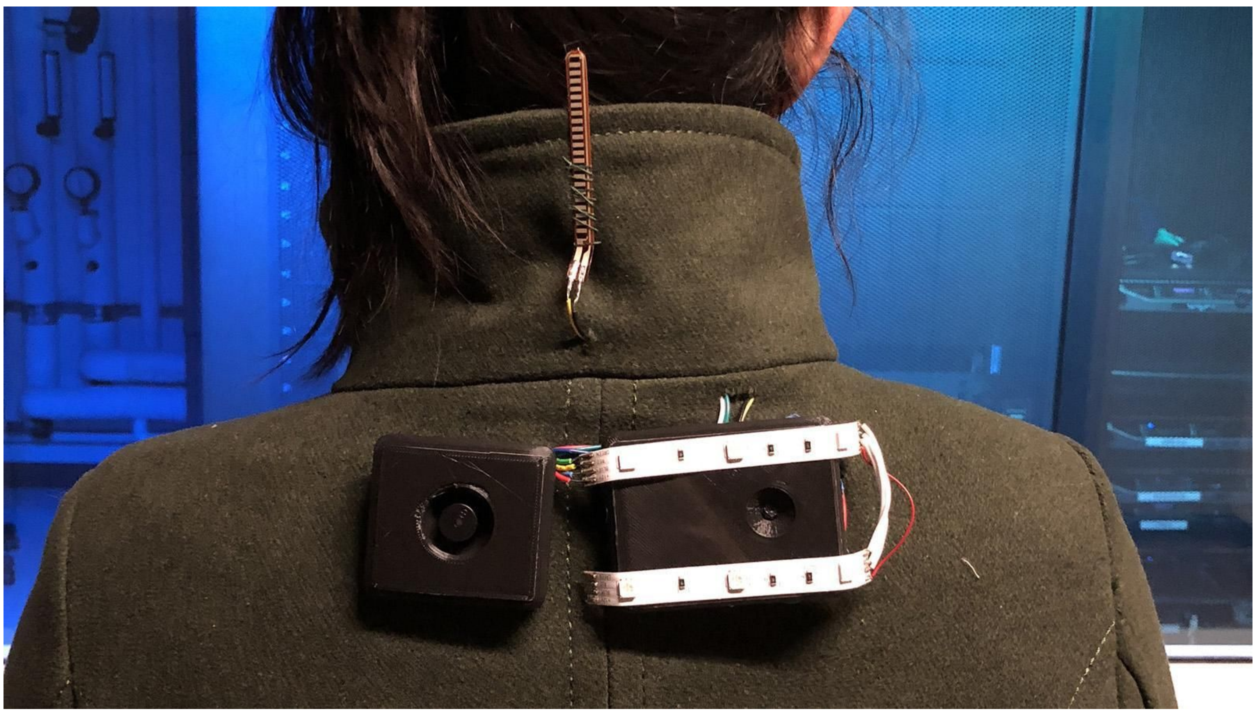
PANICAM

by

Poppin’ Collars

Purva Juvekar, Nisha Pathak, Cora Zheng, Kiran Delneuville



CRITICAL MAKING

PROVOCATION 3

SPRING 2018

TABLE OF CONTENTS

OVERVIEW

Designed for the realities of life in an urban setting, PaniCam is a wearable device hidden on the back of one's collar which helps the wearer safely journey home at night. Using a modular design that can be fitted to any jacket-like item of clothing, PaniCam contains a camera, a Piezo speaker and an alarm light system, helping the wearer feel secure by providing video footage of a potential assailant, while emitting light and sound in order to scare the assailant away. PaniCam is contained within the collar of the wearer's jacket, and is activated as soon as the wearer feels like she or he is in a potentially dangerous situation. By popping their collar, the wearer activates the camera, recording the potential assailant and environment behind the wearer. Should the assailant make a move, the wearer can then activate an audible and visual alarm via a small capacitive touch button located on the front tip of the collar. Discrete and subtle, PaniCam is a solution to the dangerous realties of walking alone at night.

MOTIVATION

After ideating through various types of interactions and target markets that we wanted to design into our product, we ultimately chose to focus on the intersection of creating a wearable device that would help people feel safe. Safety being the operative concept in this case, we examined various situations in which individuals felt unsafe, ranging from a local context (in Berkeley) to a global context. It wasn't long until we realized that our own local context, the UC Berkeley campus, provided the ideal backdrop for this project, as our community has been affected again and again by violent crimes against various groups on and around campus. These crimes were wide ranging, spanning the spectrum of criminal activity from attempted thefts, to muggings, to assault and to hate crimes. In doing out context-based research, we made two discoveries that would ultimately shape the motivations for PaniCam.

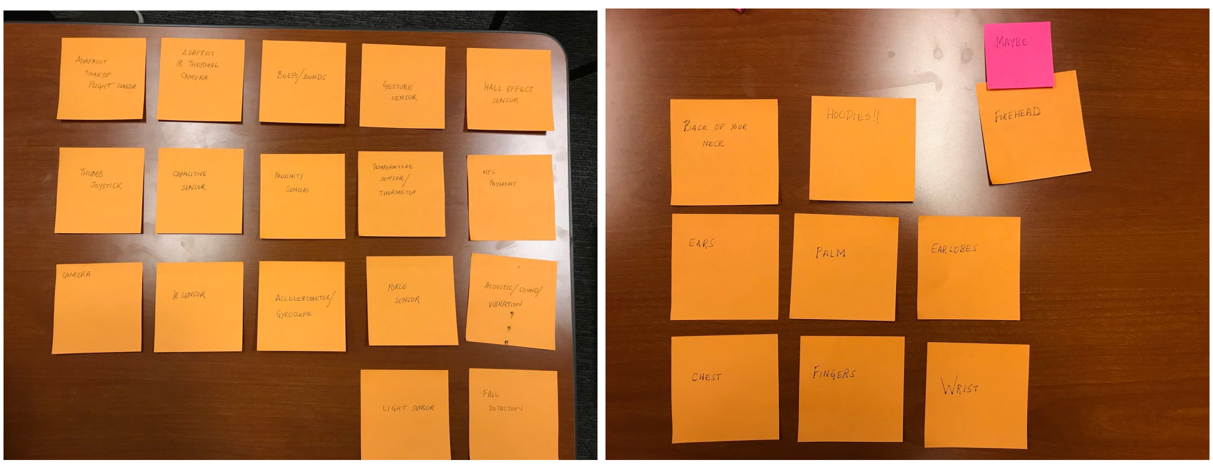
The first was that the UC Berkeley campus was constantly in a mindset of fear, emanating from the fact that several times a week, the entire population would received an ominous Nixle alert from UCPD relating to the various crimes committed in and around campus. Not only would these alerts typically provide zero useful information in terms of apprehending a suspect (no clear distinguishing factors), but they would further propagate fear throughout the campus, as in many cases the NIxle report would simply end with a mention that the suspect was not apprehended. Thus, in light of this, our motivation to design a product that would help people on and around campus feel safe was born. The use of cameras within PaniCam would help the police department finally be able to have a better picture (pun intended) of what the suspect's face resembles, thus giving them the ability to better find them, and ultimately keep the campus more secure.

The secondary motivation for the creation of PaniCam also came to us as a result of our studying the wide variety of attacks that occured on and around the UC Berkeley campus. In the vast majority of cases, the victims were caught by surprise by the attacker, as a result of the attacking coming from behind them, and using the cover of darkness to operate covertly. With these realities of criminal behaviour in mind, we designed PaniCam to give the wearers a way to capture what is going on behind them via the included spy camera. Furthermore, PaniCam is designed to flash bright LEDs and to blast a loud audible alarm in the event of an attack - which removes the main advantages of attacking under the cover of darkness.

At the end of the day, we wanted to design a wearable product for people to feel safe while walking home alone at night - a reality of living on a campus and working late in the various labs and libraries. PaniCam is a discrete and easy to use solution to this new reality, and will hopefully be part of the trend that will decrease Berkeley's, and subsequently other areas', crime levels.

DESIGN PROCESS

After deciding on the idea — designing a wearable device that can help individuals protect themselves when they walk home alone at night, we started to further develop the idea from two aspects — body parts and sensors. We liked the idea of putting something on the back of the neck and listed some existing wearable devices such as glasses, earphones, watches, etc. We returned to the very basic need — clothing, and decided on hoodie which is imbued with a feeling of protection.

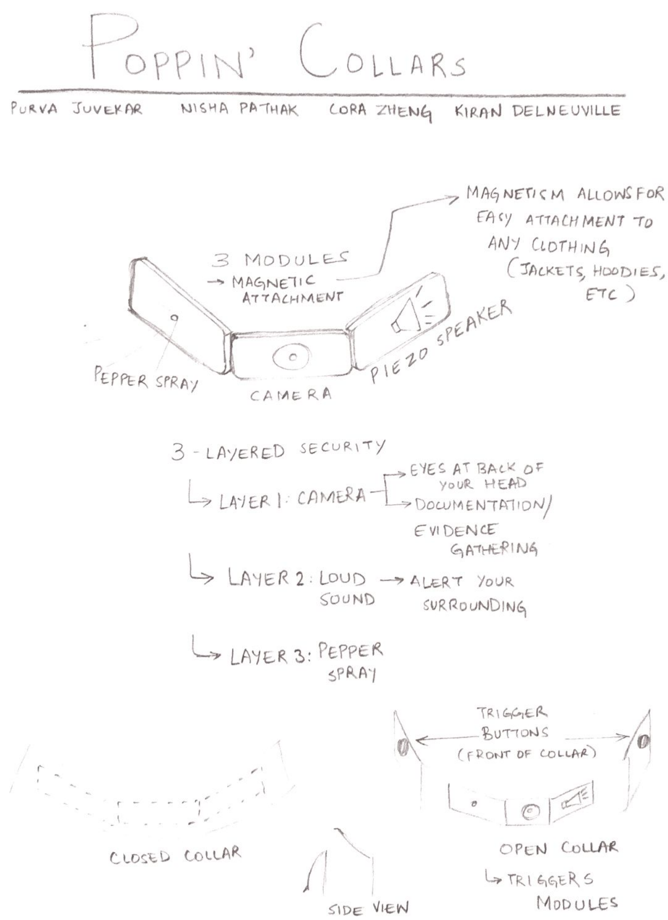


Early Brainstorming Sessions

We envisioned a possible scenario: On a night train, someone wearing a hoodie pops the collars. This action often conveys the message that he or she doesn't want to talk to people at that moment, which may also be seen as a sign of self-protection. We began brainstorming ways in which a sensor could be triggered in a discrete fashion, and figured that the action of popping the collar may be helpful in our design. Then we brainstormed functions, mainly in three steps:

1) when facing danger
2) when being attacked
3) after the attack

We initially considered using pepper spray in our design, but after the cross critique, we gave up the idea as many of our peers pointed out that it would be very difficult to control the amount and direction of flow, and particularly in windy situations could end up hurting the user.



Initial Concept Drawing Presented at Cross Critique

We then explored sound, because loud sounds can prevent an attacker from implementing the plan — as they feel nervous or scared about being noticed and may run away. We decided to attach a Piezo speaker to the hoodie, along with a mini camera for evidence documentation.

We also explored the idea of having three or four cameras around the collar to capture 360 degree videos and recreate it as a VR experience for the use of detection or education. However, considering the time available and the scope of the project, we decided that would be something that could be implemented in a future iteration of the product.

INSTRUCTABLES

Make Your Own PaniCam!

In this instructable, you will learn how to make your own PaniCam that allows you to discreetly capture photos of the environment behind you and which also enables you to trigger a panic alarm if you feel threatened. Raising your jacket or shirt collar changes the resistance in a flex sensor which then triggers a mini spy camera to start taking photos of the landscape behind you. There is also a capacitive touch sensor on the inside of your front collar which you can touch to trigger blinding neopixel lights and a loud alarm system. Let's get started!

ELECTRONICS

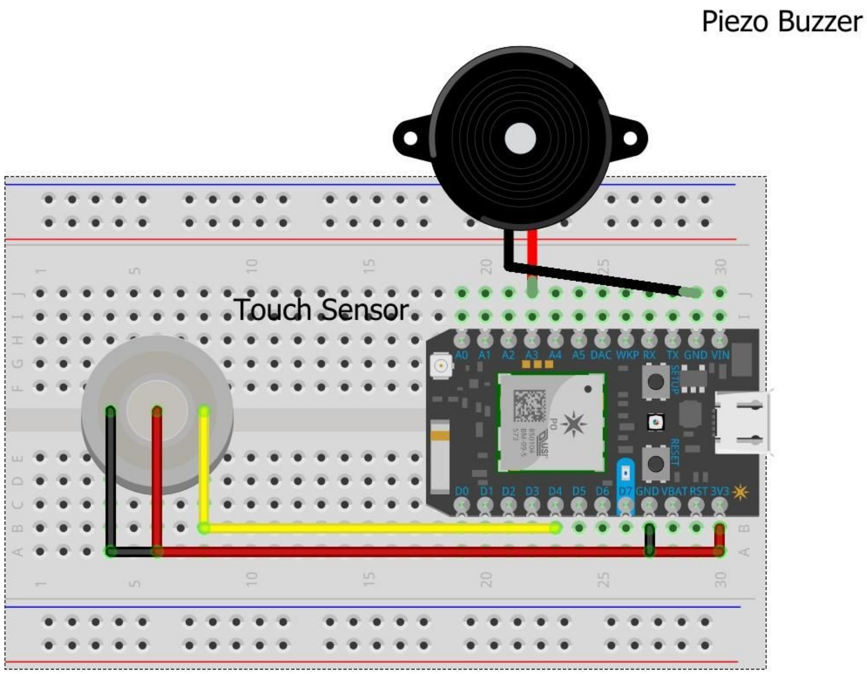
STEP 1: Gather materials

What you will need:

- 1 flex sensor
- 1 capacitive touch sensor
- 1 mini spy camera by Adafruit
- 1 Piezo buzzer or speaker
- Neopixel light strips
- 1 transistor
- 1 resistor
- 1 Arduino Uno
- 1 9V battery
- 8 AA batteries
- 1 battery case
- 1 breadboard
- 1 jacket
- Protoboard
- Jumper cables

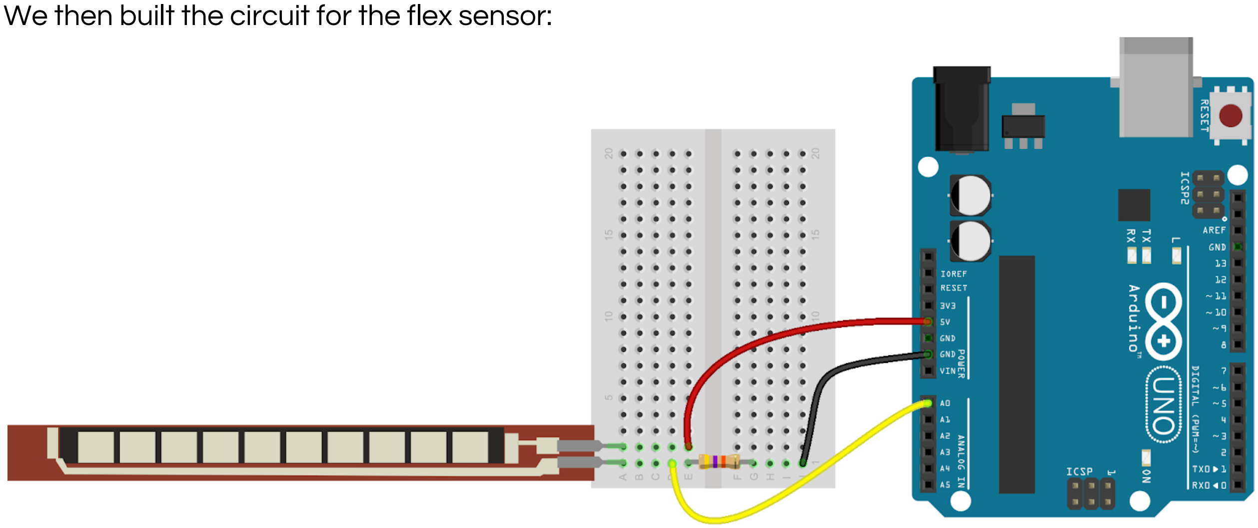
STEP 2: The Circuit

We created each individual circuit on its own before combining them all. First, we built the circuit for the Piezo buzzer using the Fritzing diagram below:



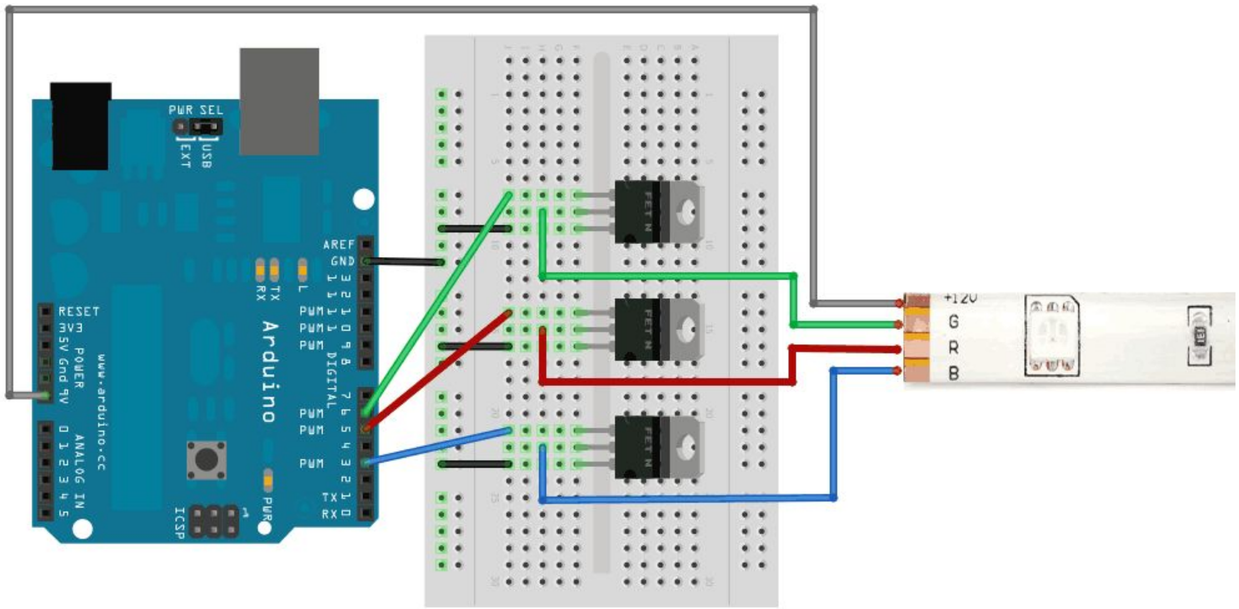
More instructions can be found at: https://www.hackster.io/ingo-lohs/touch-me-if-you-can-5ec705

We then built the circuit for the flex sensor:



This circuit diagram was borrowed from SparkFun, and can be found at https://learn.sparkfun.com/tutorials/flex-sensor-hookup-guide

And finally, we built the circuit for the neopixel light strips using the following diagram as a guide:



To learn more, visit: https://learn.adafruit.com/assets/2692

Once we had all of the circuits working individually, we started to combine them so that the product would work as we wanted it to. First, we wanted a change in the resistance of the flex sensor to trigger the spy camera to take photos. Once that was working, we programmed the capacitive touch sensor to trigger the Piezo buzzer to make a sound. When that was working correctly, we included the flashing of the neopixel lights to start when the capacitive touch sensor was pressed. Once the whole system was working as planned, we adjusted the tone of the Piezo speaker to ensure it was making a warning signal that would scare someone away. We also programmed the neopixel strips to flash in bright white to signal danger. We chose to have the lights flash in white rather than a color like red because flashing white lights indicate danger and signals an alert whereas red typically serves as a warning signal.

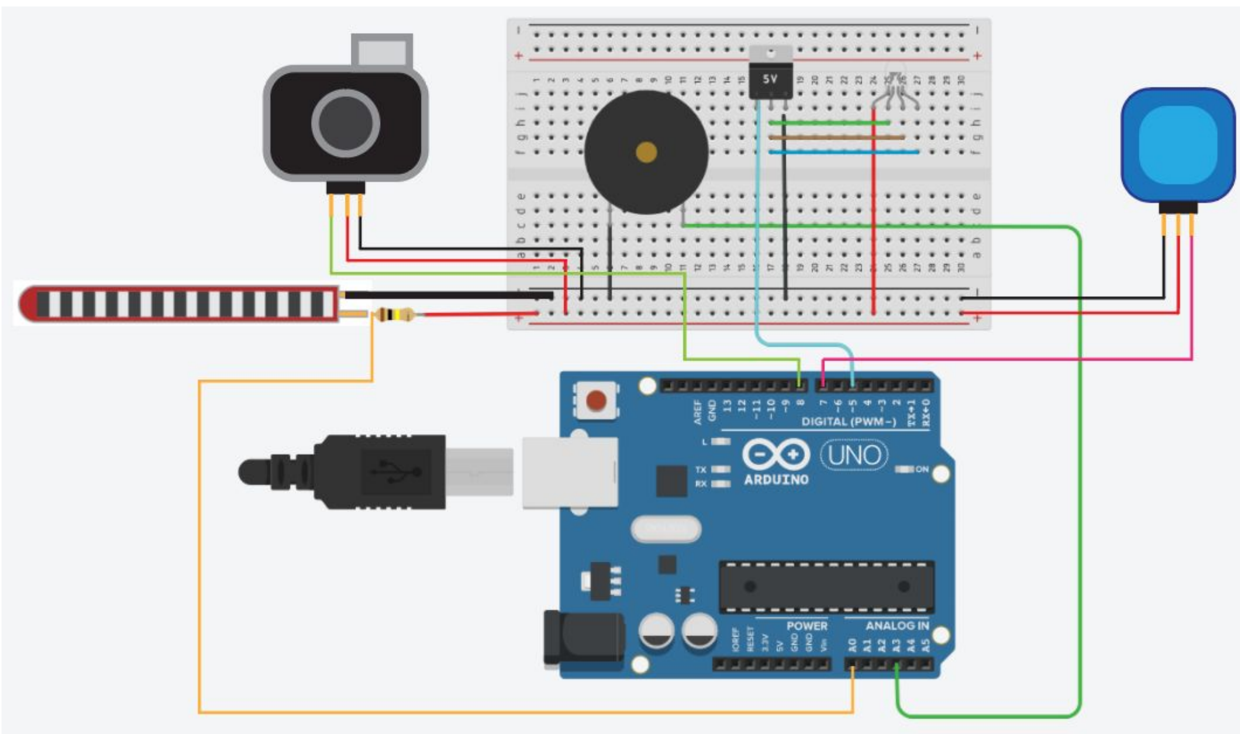
STEP 3: The code

We combined several sketches to achieve the outcome were were looking for. The links are below:

[Piezo buzzer]
[Flex Sensor]
[Mini spy camera]
[Neopixel lights]

The finalized combination of code can be found on **page 17**.

STEP 4: Assembling the PaniCam system



Overall Assembly Diagram

The first step is to move everything off of the breadboard and onto the protoboard. This includes removing excessive wires, soldering wires together to add length, using heat shrink tubing to keep the connections secure and neat, and to isolate the wires. By moving everything over to a protoboard, we could now fit a majority of the electronic components into the 3D printed enclosures we designed.

Next, we carefully placed the mini spy camera in its specially designed 3D case so that the lens was capturing the correct angle. We then also put all of the wires (which includes the neopixel wires, the camera's wires, the flex sensors wires, and the capacitive touch sensor wires) in the enclosure and secured it shut. Then, we had to cut slits in the jacket through which we would feed all of the wires so that the enclosure would sit neatly on the back of the jacket collar.

Once the camera enclosure was neatly sealed and the wires were passed through the jacket, we pasted the neopixel light strips to the enclosure. One strip goes on top and one goes on the bottom. One piece of advice - do not hot glue the lights to the enclosure! It will ruin your lights. Instead, use the sticky backing the light strips have on them already.

The next step is to assemble the Piezo buzzer and secure it in its enclosure. The enclosure is designed to amplify the sound coming from the speaker so make sure to put the speaker in correctly so that it amplifies the sound to the maximum levels. Once the buzzer was place, we secured the enclosure and fed the wires through the jacket collar.

At this point, it's important to make sure that both enclosures sit neatly and flush next to each other. By feeding the wires all the way through the collar and securing them neatly on the inside of your coat, you can be sure that they will not move or get disrupted if the user needs to run.

We next had to sew the flex sensor into the collar of the jacket and then feed its wires through the collar and into the coat. Make sure you place the flex sensor in the correct position so that the raising of the collar changes the resistance enough in the flex sensor to trigger the mini spy camera to take photos.

Finally, we sewed the capacitive touch sensor into the inside, front collar of the jacket so that it was easily accessible to the user. We also sewed the Arduino board into the jacket so that it moved around less. Lastly, the batteries were placed in the pocket of the jacket with its wires fed through the inside of the coat.

ENCLOSURE

The making of the enclosure involves the following steps:

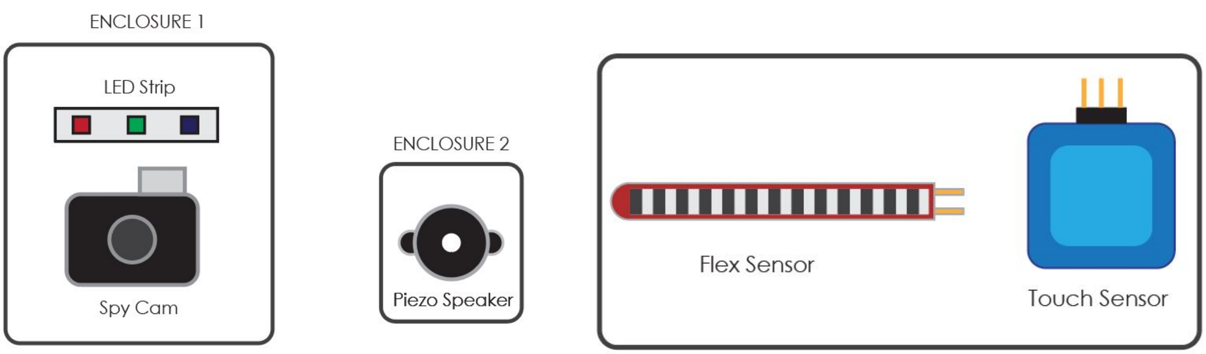
- Deciding which components get assigned to an enclosure
- Sizing the enclosure based on those components
- Modeling the enclosure
- Producing STL files
- 3D printing the enclosures

Let's begin!

STEP 1: Choose groups of components to build enclosures for

This project comprises of 5 different electronics: the spy camera, piezo speaker, LEDs, flex sensor and a capacitive touch sensor. The grouping for the enclosures is as follows:

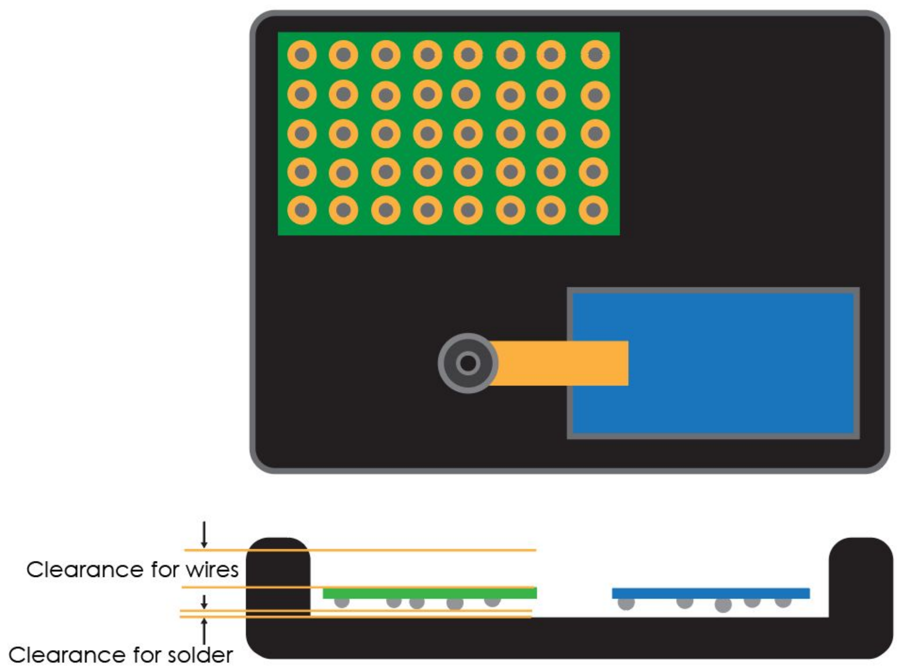
- Spy camera and LEDs in one enclosure
- Piezo speaker in another enclosure
- Flex sensor and touch button attached to the jacket directly



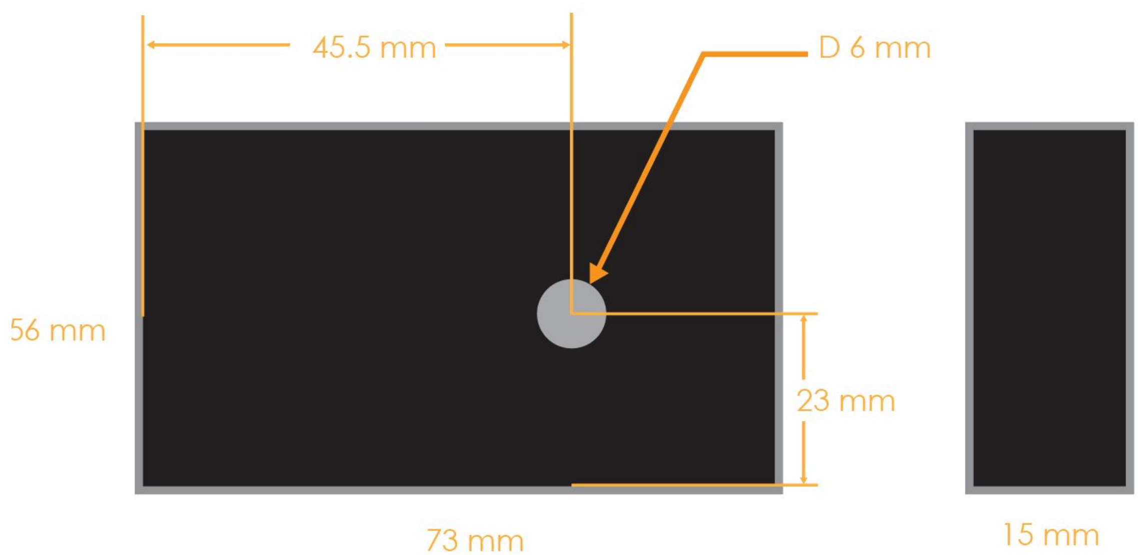
Groupings for Different Enclosures

STEP 2: Sizing the enclosures

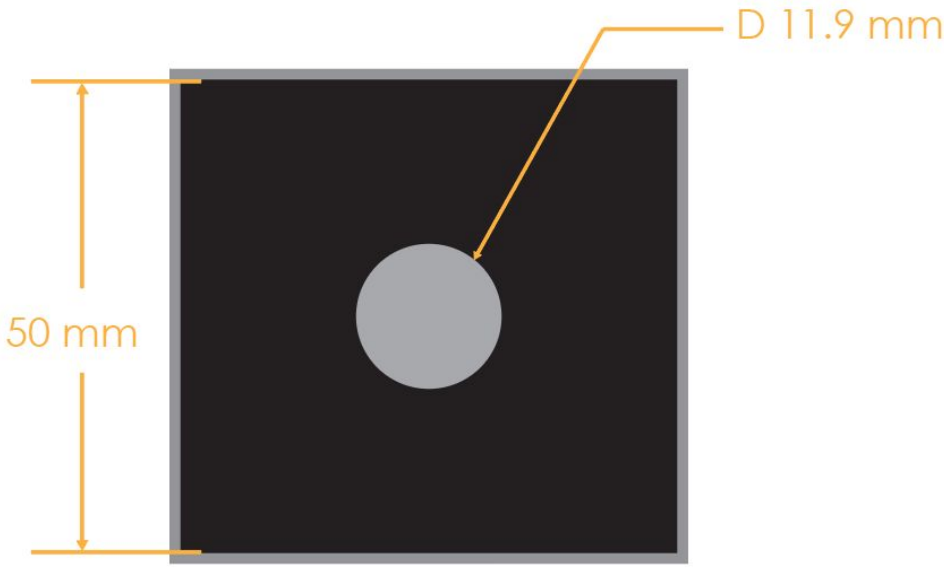
Before making the models, it is important to get the dimensions of the enclosure which will fit all the components into it snugly. The first step in this process was to understand how the protoboards would be laid out inside the enclosure. Once that had been established, measurements were taken using calipers.



Board Positioning and Clearance



Measurements for the Camera Enclosure



Measurements for the Buzzer Enclosure

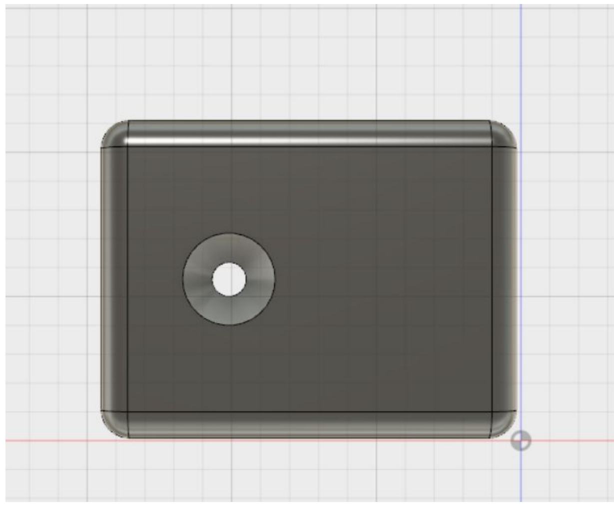
NOTE: Remember to leave a small amount of clearance to account for inaccuracies in printing. Also remember to account for the space occupied by the soldered wires and the soldering points beneath the protoboard.

STEP 3: Model the enclosures!

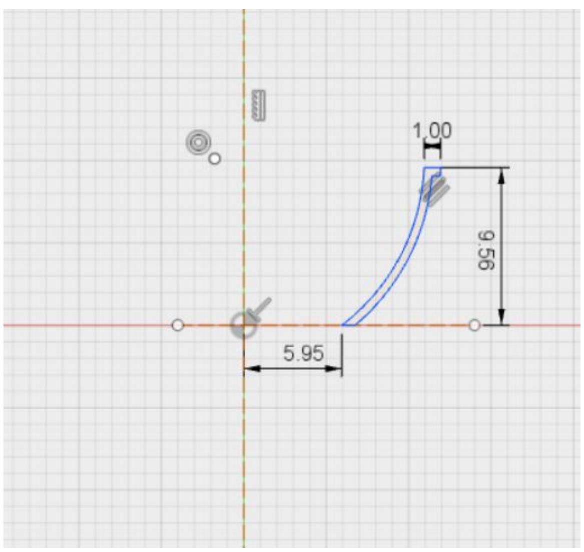
We used Fusion 360 to create the 3D models, but feel free to use any modeling software that you are most comfortable with.

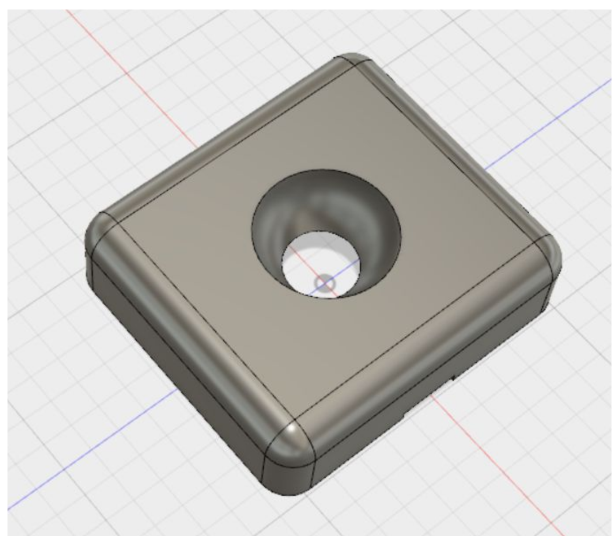
If you would just like to download the CAD files directly, the STEP files can be found here.

For the camera enclosure: after modeling the case, we realized that it was thicker than the camera lens. To correct that, we added a chamfer at the camera hole to create an outward opening and avoid interference in the field of view.



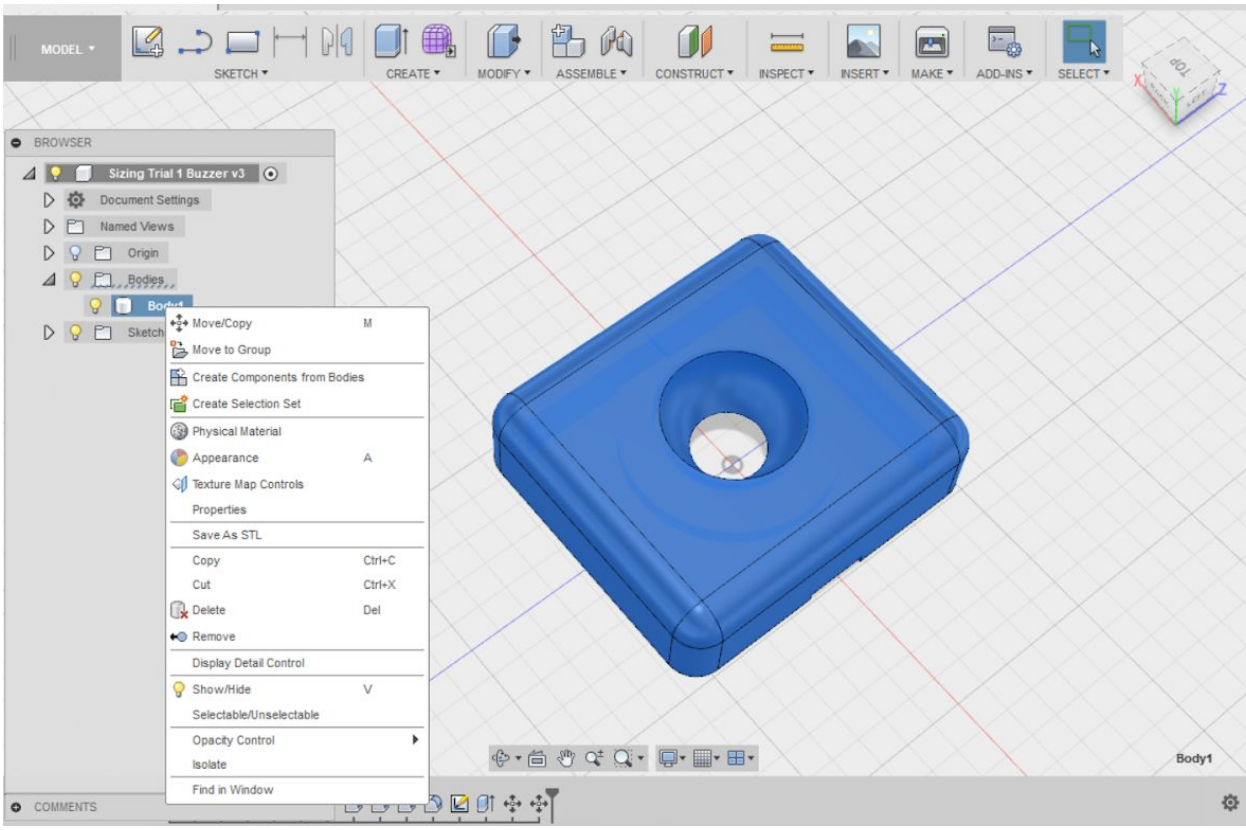
For the speaker enclosure: certain shapes help amplify sounds. We created a cup-shaped opening for the speaker, the drawing for which is provided below. All dimensions are in mm.





STEP 4: Prepare the models for 3D printing

In Fusion 360, right click the bodies tab and select 'Save as STL'.



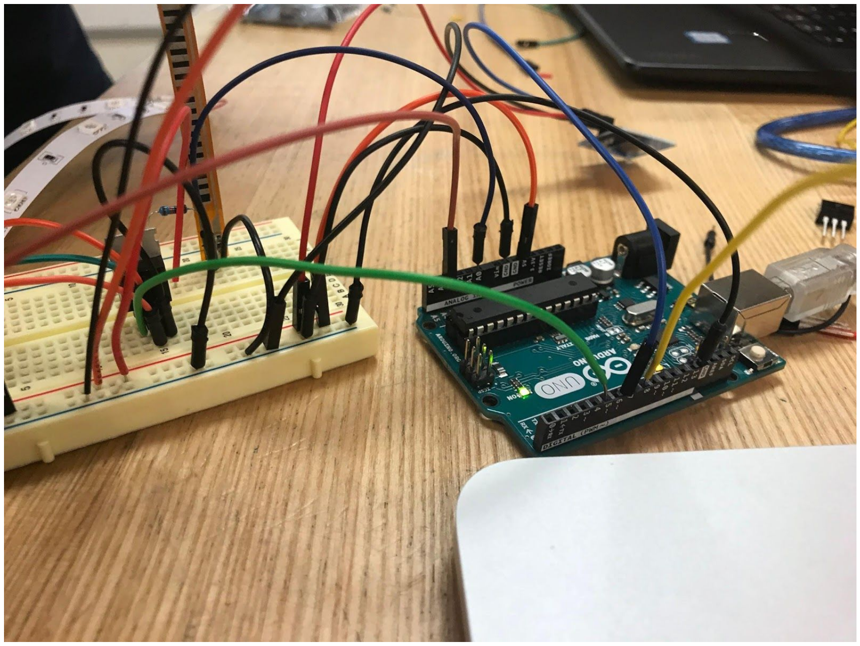
STEP 5: 3D printing!

We used an Ultimaker 2+ and an Ultimaker 3 to print the enclosures. Settings used were as follows:

- Nozzle size: 0.4 mm
- Layer height: 0.15 mm
- Initial layer speed: 25 mm/s
- Print speed: 50 mm/s
- Infill: 10%
- No support material

PROTOTYPING

Using the above models, schematics, and electronics, we were able to make provisional prototypes to test our product. We began by isolating each electronic unit to ensure we had each part working properly before assembling it all into the networked system. We assembled each unit on a breadboard for prototyping purposes.

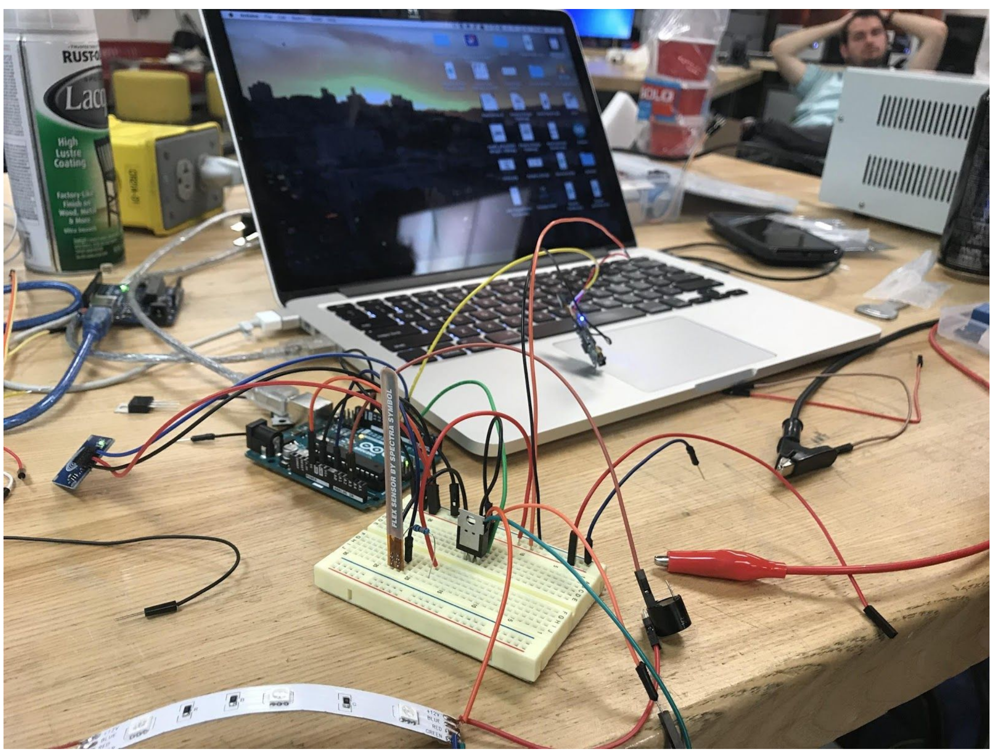


First, we worked with the mini spy camera to get it up and running. We had to solder new wires onto it because the wires it came with were to small for us to work with. Once that was completed, we loaded code onto the Arduino to activate the camera. However, for reasons we still do not understand, the code would not run properly. After copying and pasting it several more times, it magically worked.

The next step was to get the Piezo speaker working. We soldered wires to the Piezo buzzer and found sample Arduino code online. We were able to get the buzzer to play a melody that was loud and clear. Once this was up and running, we were able to move on to the flex sensor. At this juncture, we wanted to make sure that there were noticeable changes in the resistance when the flex sensor was bent. We wanted to make sure that it was sensitive enough to react to the folding of a jacket collar.

The next step was testing and connecting the capacitive touch sensor. The first button we used did not work though it took us time to troubleshoot and understand the problem. Once we used a properly functioning button, we were able to read the inputs to the sensor through the serial monitor to confirm that it was working on reading the input signals.

The last piece we had to build were the neopixel light strips. We wanted to use white lights and we also wanted to make them blink rather than just turn on and stay in a static state. Once these were up and running, we felt comfortable moving on to bringing each individual unit into a cohesive system.



FINAL PRODUCT

Once we had everything working on the breadboard, we soldered the whole circuit onto protoboards. Debugging was required and some wires needed to be re-soldered to establish a solid connection. Since the wires were going to run down the jacket, we used stranded wires for a large part of the connections, and soldered solid cores wires to ends which would go into the Arduino.

Once everything was working, we then assembled the protoboards into the 3D printed enclosures, and pasted the LED strips on to complete the wearable.

CHALLENGES

IDEATION

When trying to decide on a concept for this project, we had several brainstorming sessions but had a lot of difficulty in deciding what kind of wearable we wanted to build and for which part of the body. Our brainstorms tended to shift towards providing assistance to those who are victims of crimes, especially minorities. We struggled to decide which problem area to focus on because violence is so widespread. We wanted to help the young black men who are getting shot for no reason, we also wanted to support brown women who are harassed in the streets, and transgender women of color who are being killed when they walk home at night. After discussing this, we realized that we could design something that had the potential to help everyone and not just one specific minority group.

Selecting a body part to build a wearable for was also a challenge because wearables are not generally discreet. They are also status symbols that you typically want others to see. However, we ultimately decided to focus on the neck, a place where wearables have not yet made a large impact. We chose to focus on the back and front of the neck because any movement or action in this region of the body, like raising a jacket collar, is subtle, discreet, and does not draw attention.

ELECTRONICS

From an electronics standpoint, we faced many challenges throughout the building of this modular unit. First, we faced issues with the mini spy camera's Arduino code which would not run properly on any laptop. We could tell that the camera was on but it was not taking any pictures. Then, miraculously, it just started working when a friend copied and pasted it in a new window. We still have no idea what he did differently but we are grateful for his help!

We also faced challenges when it came to getting the Piezo buzzer to work properly. The sounds that came out sounded different from what we had programmed when it played while the neopixel flashed. We also faced complications when trying to get the buzzer wiring on the breadboard correct.

We also faced challenges when it came to soldering the wires properly as weak connections prevented our project from working correctly. We also ended up using lots of wires and worked hard to reduce the overall numbers for the final presentation.

Finally, we also learned that hot glue destroys neopixel lights. Our lights did not work after we had tested the code, checked the wire connections, and the soldering. We ultimately realized that our lights were not working because the hot glue we applied to the neopixels ruined the integrity of the lights.

ENCLOSURE

One of the major challenges in creating the enclosures involved sizing them correctly. The protoboard inside the camera enclosure has several wires soldered to it, which created a thickness. The goal was to make enclosures which were seek and representative of the wearables today - small, curved and compact. This was defeated by the thickness created by the wires inside.

Using calipers to measure components and size the enclosure accordingly was an iterative process which required multiple prints and consumed a lot of time. With each iteration, a correction needed to be made to the clearance left for parts or the dimensions of the enclosures themselves.

If we continue the project, we would focus on producing custom PCBs using programs like Eagle and use surface mounted components to reduce the number of wires and create much slimmer enclosures.

CONCLUSION

The main purpose of PaniCam is to protect individuals from being harassed and attacked when they walk home alone at night. We try to make people feel empowered by enabling them to react to unexpected dangerous situation and to defend themselves in a more efficient way. Our product also contributes to the later investigation of the crime case by collecting visual evidence. At Cal, we receive crime alert emails from UCPD that often contains vague descriptions of the attacker and rarely a picture. We try to fix this dilemma by putting mini camera on the back of the hoodie to take photos and keep record of the real-time condition.

There is still a lot of room to improve, such as the imaging quality of the camera. In the future we will continue to work on it and make it a better product. We believe that PaniCam is a product that benefits the entire society, as it offers people a strong sense of safety. We address this issue -- fear of walking home alone -- with a relatively pessimistic view, but we truly hope that the future will be brighter -- everyone can feel safe!

LINKS

- Arduino code
- STEP files
- STL files