Project Deliverable D: **Conceptual Design**
GNG 1103 – Engineering Design

Faculty of Engineering – University of Ottawa
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Introduction:

Throughout the semester, students in the GNG1103 class have been working with the upcoming company known as JAMZ Drone Delivery in order to enhance their package delivering capabilities across Ontario. An interview was held a few weeks ago which gave these engineering students the criteria to understand the needs of this project. These design criteria needs will be used to create the student's final project product for this term.

In this deliverable, students from the University of Ottawa's Faculty of Engineering will be brainstorming and developing several different designs that will meet and surpass the requirements set out by JAMZ Drone Delivery. The students from our group will be developing an external module that can be easily attached to the outside of the JAMZ drone. This module will help protect the drone from potential thieves if ever the drone is downed, and will also notify citizens to stay clear of the drone while a dispatcher is being sent to retrieve the drone.

The drone will contain two sensors. The first sensor will be a proximity sensor which will allow the drone to detect if something or someone approaches the drone and will allow it to warn the person away. The second sensor will be a touch/motion sensor that will detect if the drone has been picked up/moved around. This will trigger additional anti-theft measures.

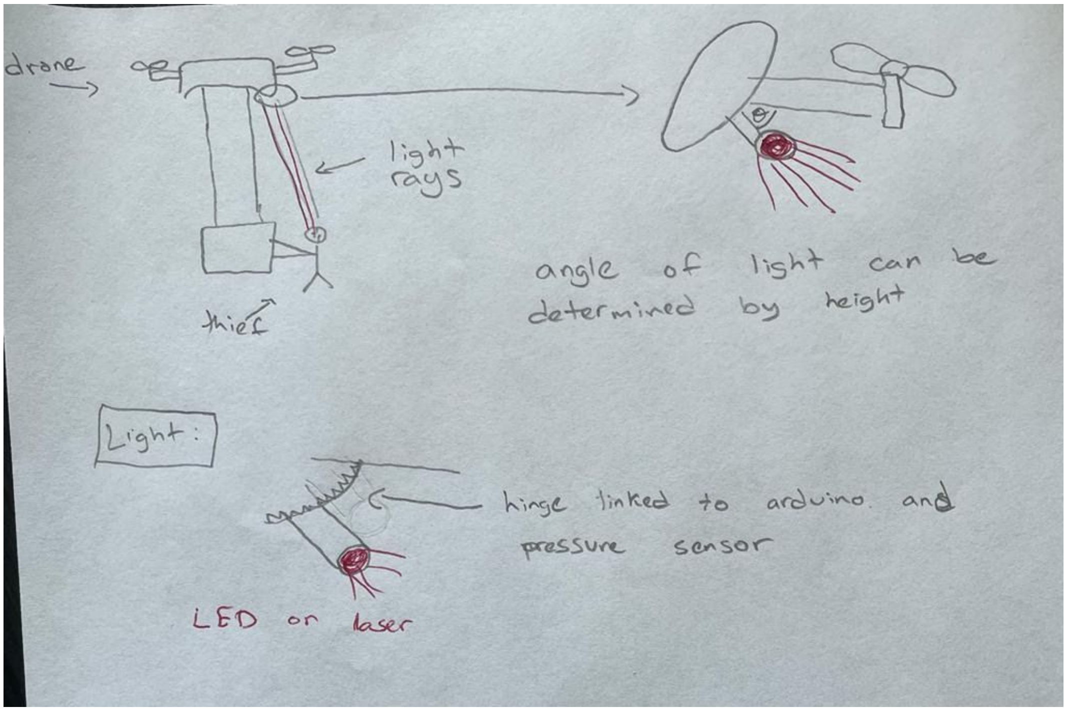
Sub-Systems:

- Sensors
- Lights
- Speakers
- Case

Concepts:

Sub-System: Lights
Concepts:

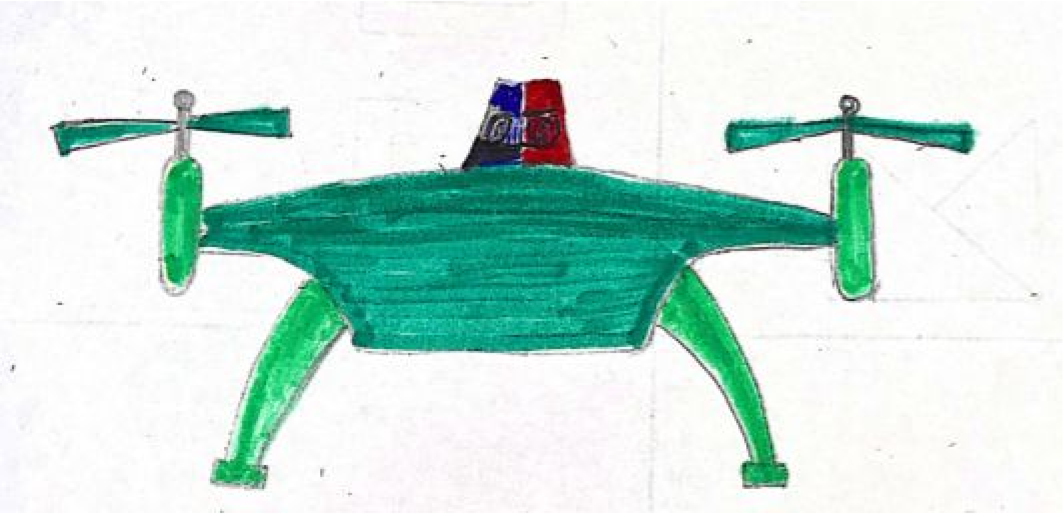
Lights in person’s eyes (Yusuf)


drone
light rays
thief
angle of light can be determined by height
Light:
hinge linked to arduino and pressure sensor
LED or laser

Pros:
Immediately gets the person pulling on the package to let go
Has a 360 degrees range around the drone

Cons:
May blind someone or damage their eyes
Mistakes customer for thief

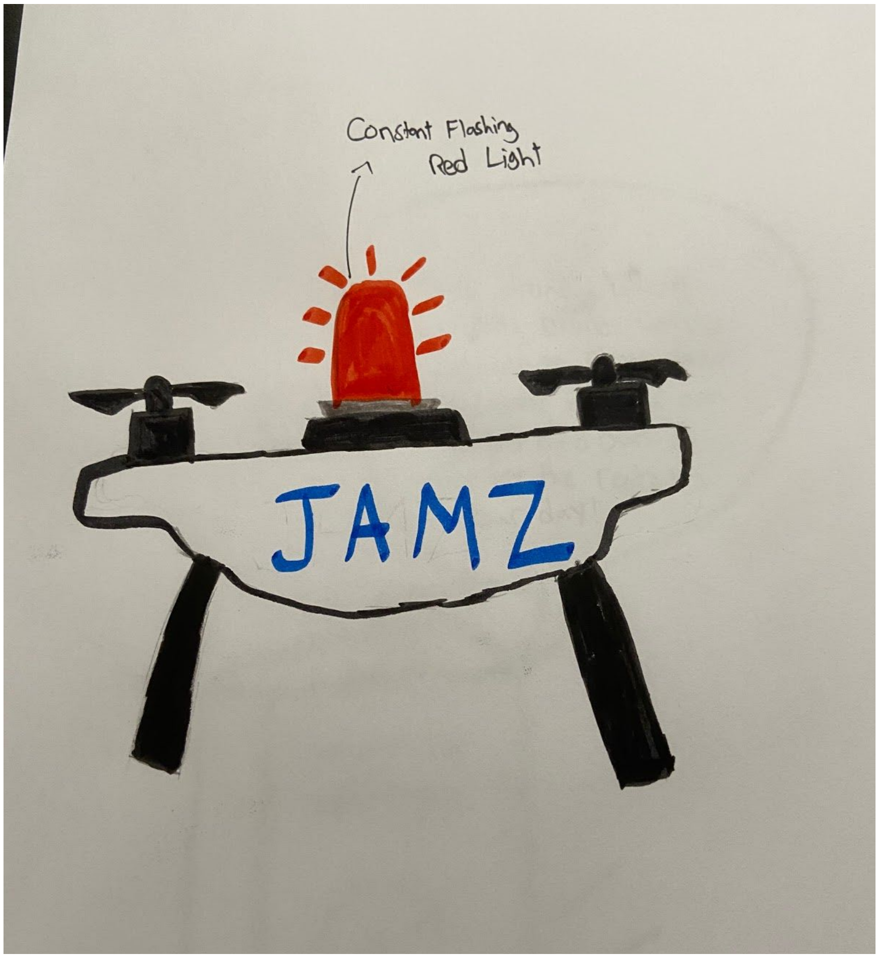
Red, white and blue lights if authorities are notified (Zakkai)



Pros:
- Intimidating
- Discourages theft

Cons:
- Impersonates police

Constant flashing red lights (Andy)



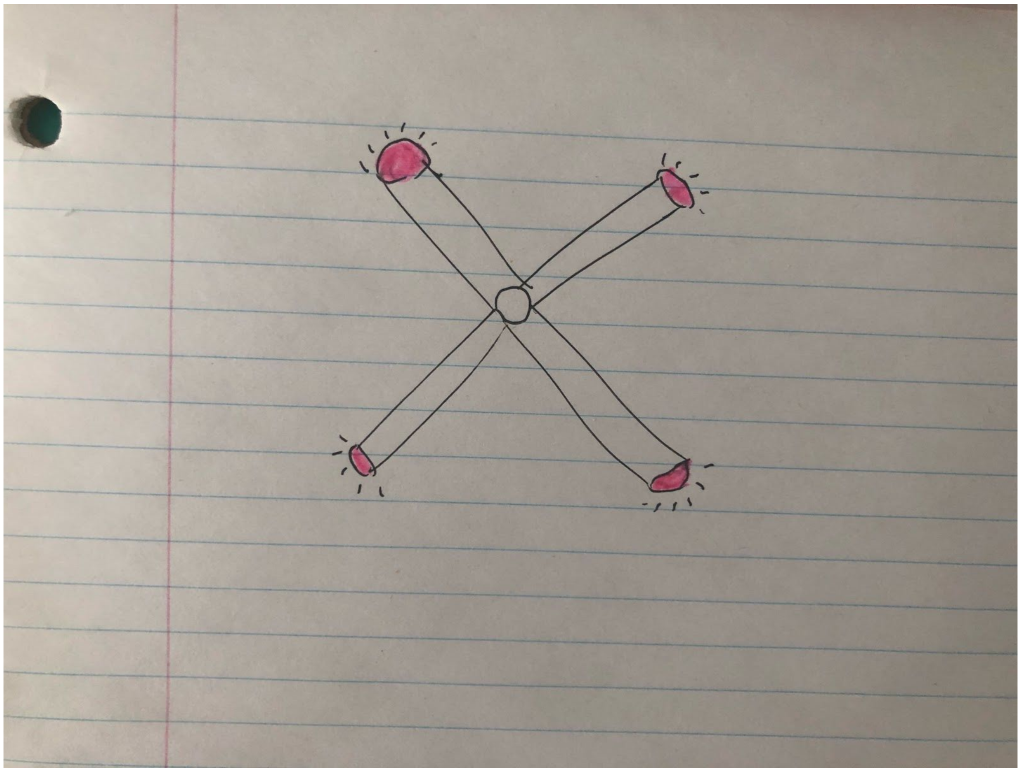
Pros:

- Instant attention is drawn to the person near the drone
- The red light is a sign of a warning which gives away the message clearly

Cons:

- Could be hard on the eyes with the constant flashing
- Could cause a seizure but very unlikely

Spinning emergency lights (Steven)



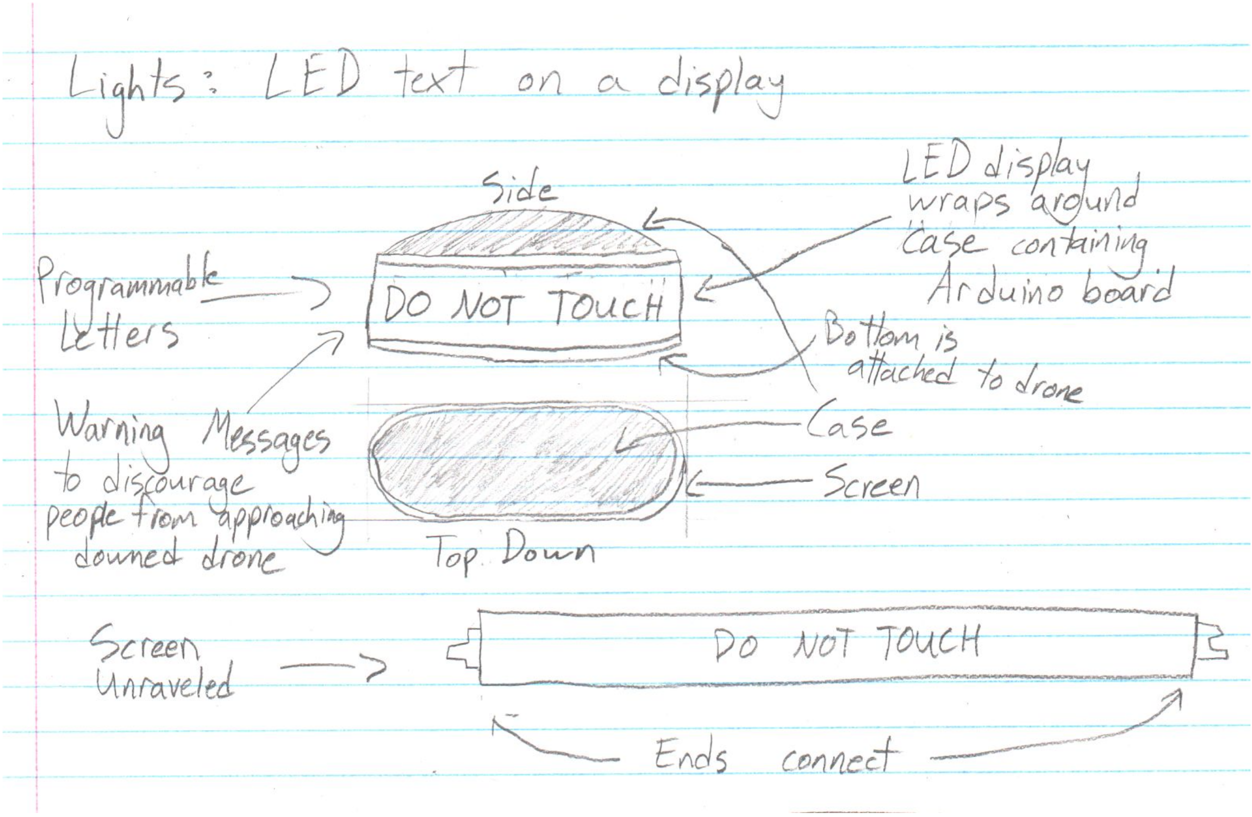
Pros:

- Alerts nearby of emergency by spinning lights on the drone wings
- Shows location in dark areas

Cons:

- Will not function if drone crashes and is destroyed

LED Text on a Screen (Geoff)


Lights: LED text on a display
Side
LED display wraps around case containing Arduino board
Programmable Letters
DO NOT TOUCH
Bottom is attached to drone
Warning Messages to discourage people from approaching downed drone
Case
Screen
Top Down
Screen Unraveled
DO NOT TOUCH
Ends connect

Pros:

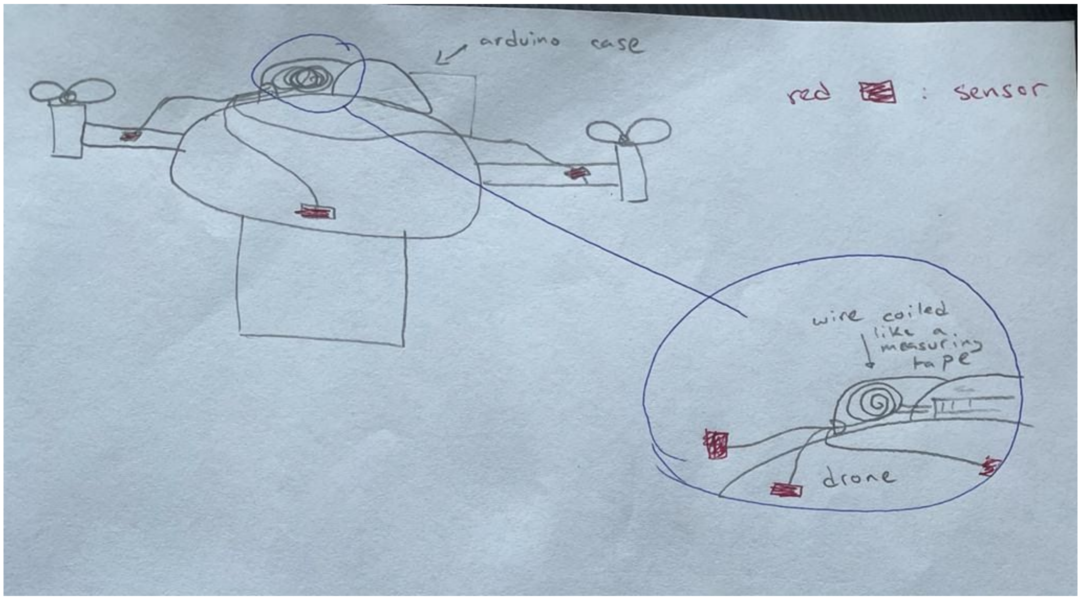
- Can give clear directions through words
- Programmable to display different text depending on context

Cons:

- Relatively Expensive
- More ways to fail than a simple alarm light
- The screen needs to be big enough to read

Sub-System: Sensors
Concepts:

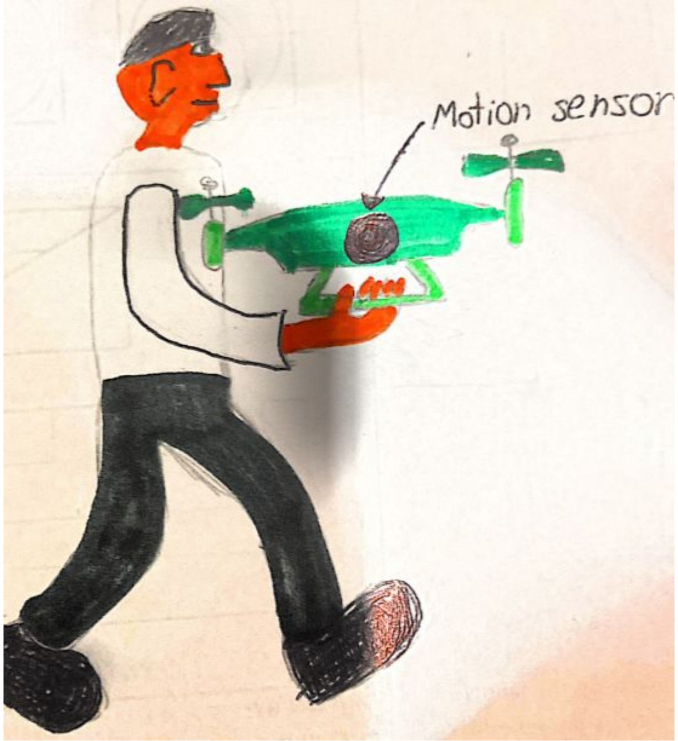
Sensors that can be dragged out of the case and attached to different places on the drone with sticky tape (retractable wires) (Yusuf)



Pros:
- Direct link to arduino
- Wires stored in a good place
- Wires can be moved around

Cons:
- Extra wires may hurt the signal speed
- Tape on the sensors

Motion sensor if drone is downed (Zakkai)



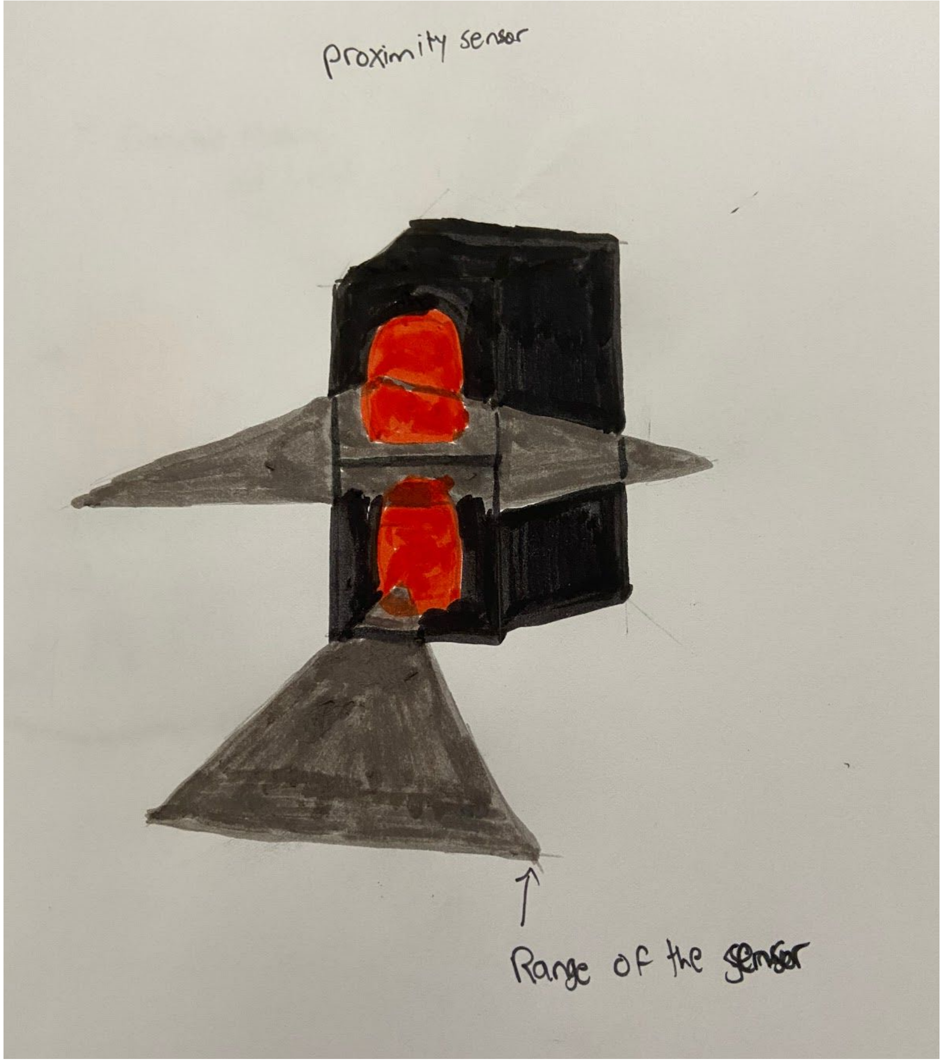
Pros:

- Sense unwanted movement
- Linked to speakers and lights
- Notes the time of theft

Cons:

- Possible false alarm

Proximity sensor on the drone(crashing) (Andy)



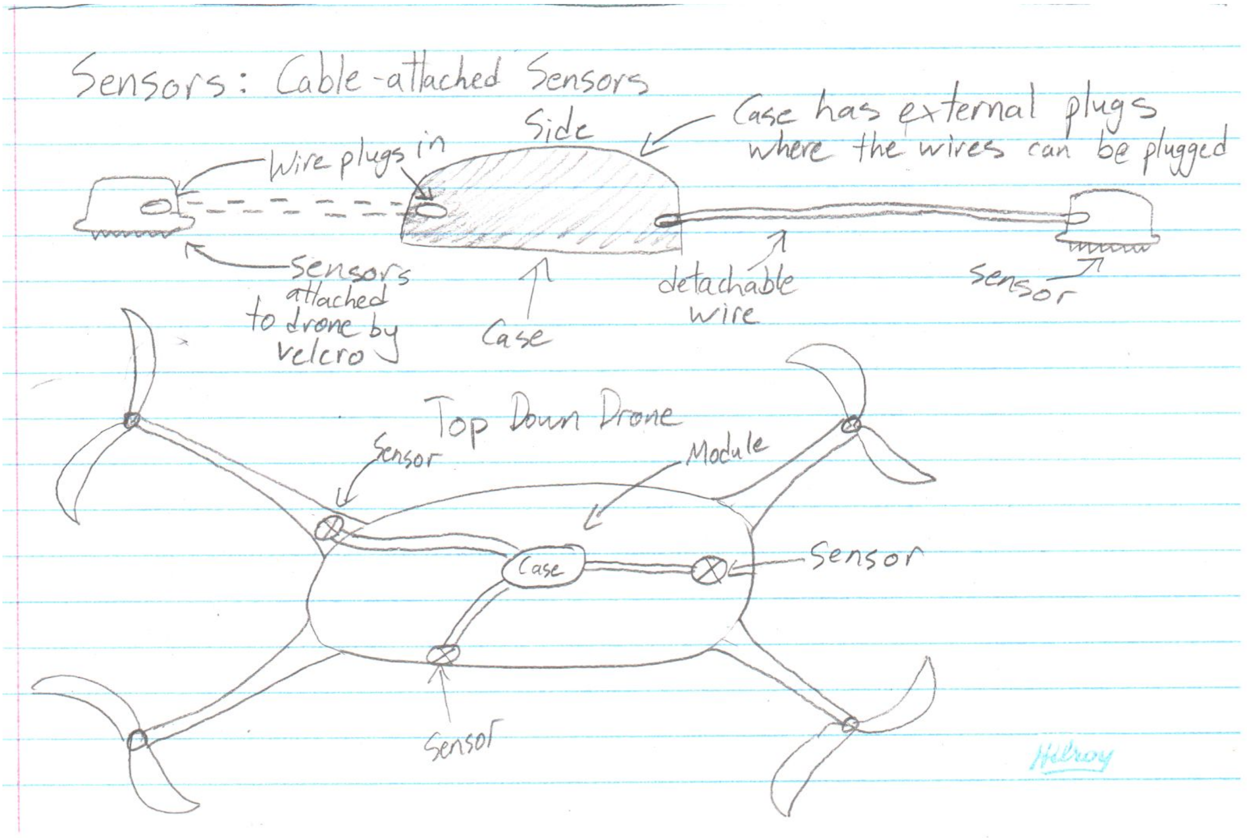
Pros:

- Triangular radius has a long range for sensor activation
- Can identify any potential attacker or a helping civilian

Cons:

- Range doesn't cover insane ranges such as over 10 feet
- Sensor could break if the drone has crashed and would not be able to capture any motions

Sensors that can be placed on drone with velcro and then can be attached via wires (detachable wires) (Geoff)


Sensors: Cable-attached Sensors
Side
Case has external plugs where the wires can be plugged
Wire plugs in
sensors attached to drone by velcro
Case
detachable wire
sensor
Top Down Drone
Sensor
Module
Case
Sensor
Sensor

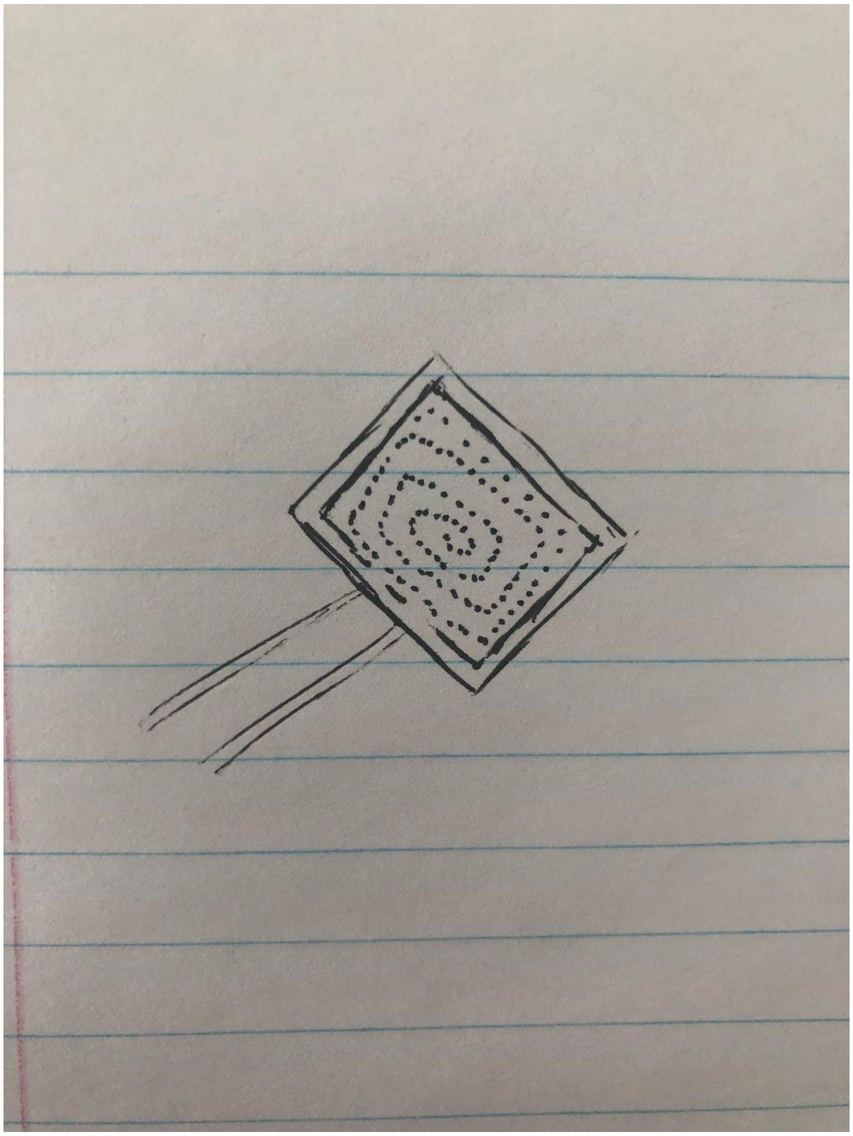
Pros:

- Easy to attach sensors in convenient places on the drone (wherever they need to be)
- Detachable Wires so sensors are easily disassembled
- Easy to replace if a sensor fails

Cons:

- More moving parts means ports could fail or wires could be lost
- Needs specially designed ports on the side of the Arduino case

Pressure Sensor (Steven)



Pros:

- Senses when package is released
- Connected to the arduino

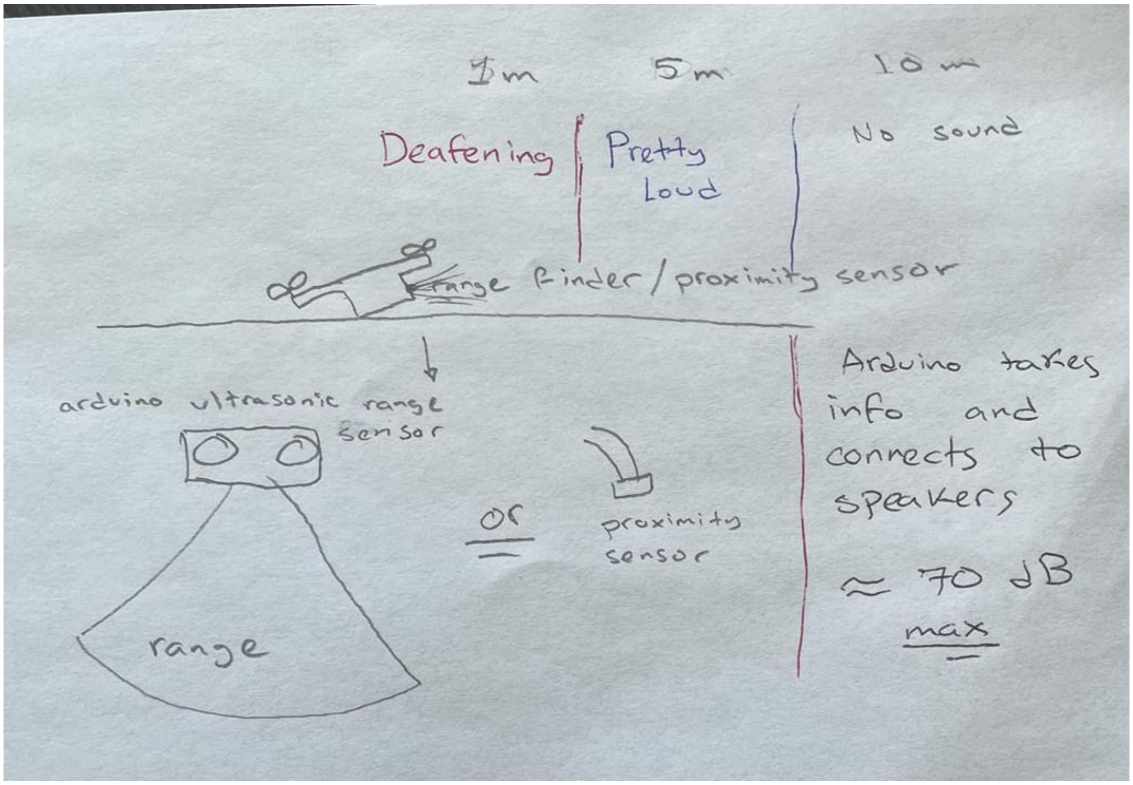
Cons:

- Might not function if part of drone is not working

Sub-System: Speakers
Concepts:

Speakers that get louder the closer people get to it (Yusuf)

Pros:

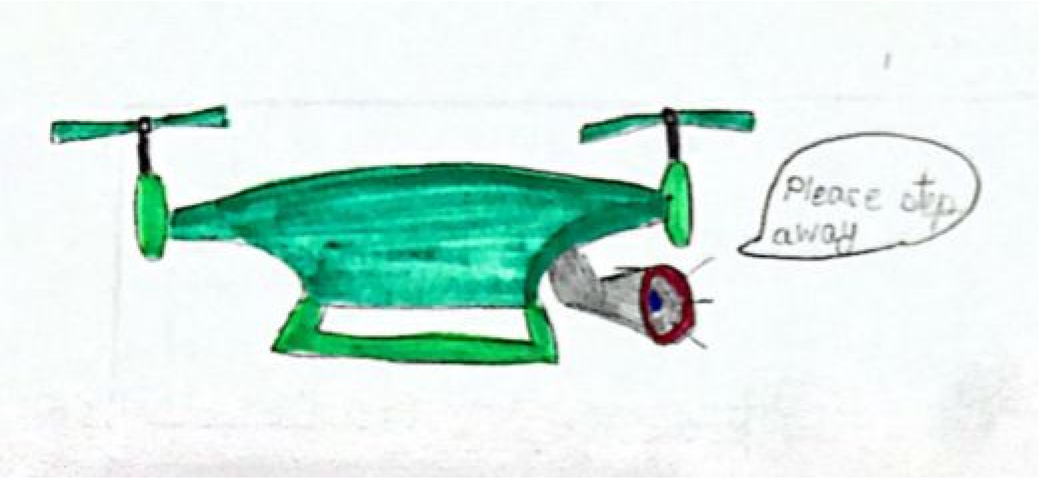

1m
5m
10 m
Deafening
Pretty Loud
No sound
range finder / proximity sensor
arduino ultrasonic range sensor
range
or
proximity sensor
Arduino takes info and connects to speakers
≈ 70 dB max

- Cheap
- Connects well and relays information
- Can be used to talk to the public

Cons:

- Too Loud
- Multiple Sensors

Phone speaker that can be directly linked to dispatch (Zakkai)



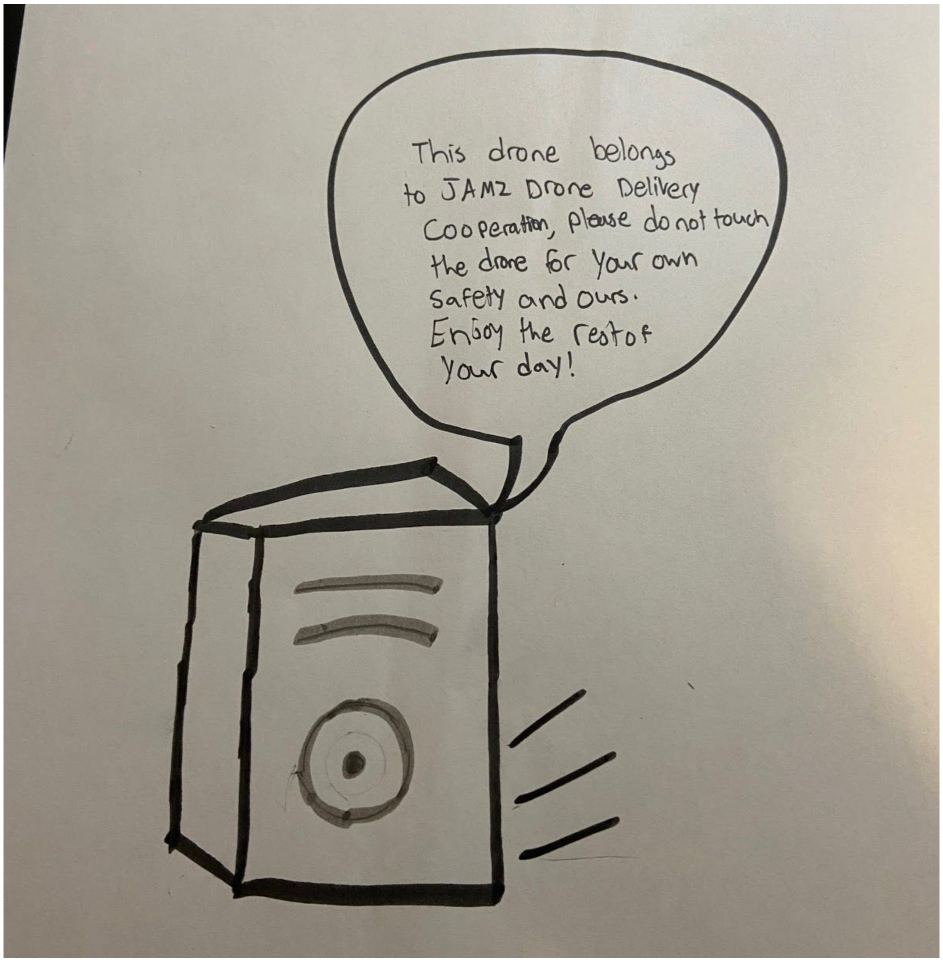
Pros:

- Any message can be said
- Discourages theft

Cons:

- Relies on phone/radio

Automated Voice (Andy)


This drone belongs to JAMZ Drone Delivery Cooperation, please do not touch the drone for your own safety and ours. Enjoy the restof your day!

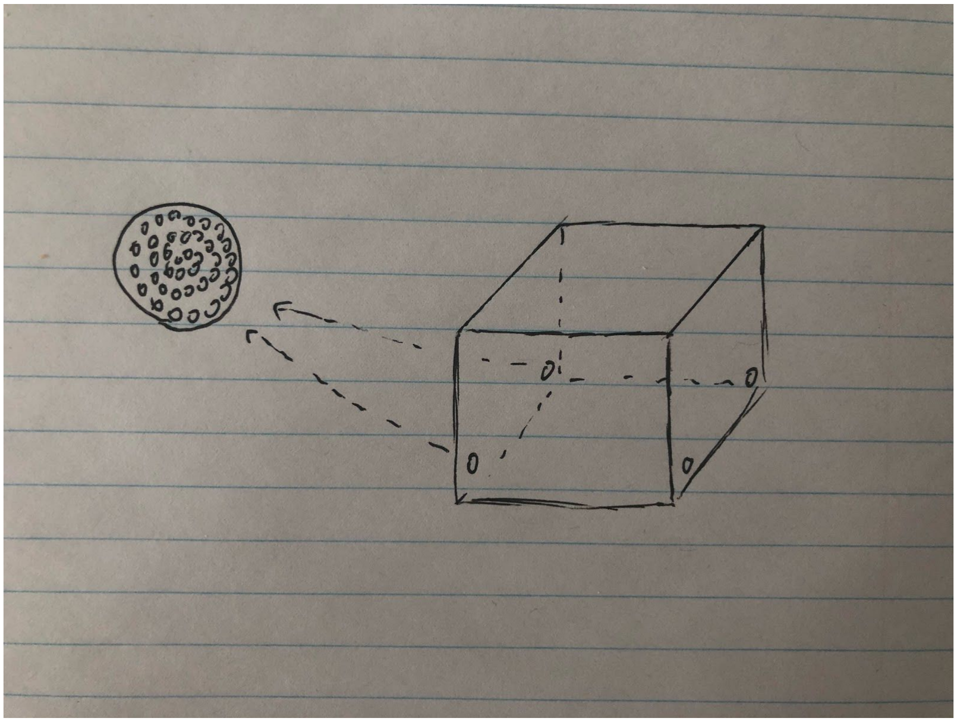
Pros:

- Professional interaction with citizens in order to maintain both the drones safety and the civilians safety
- Clear message is drawn to the civilians
- Message is repeated until a problem is solved

Cons:

- Speaker malfunctioning due to crash

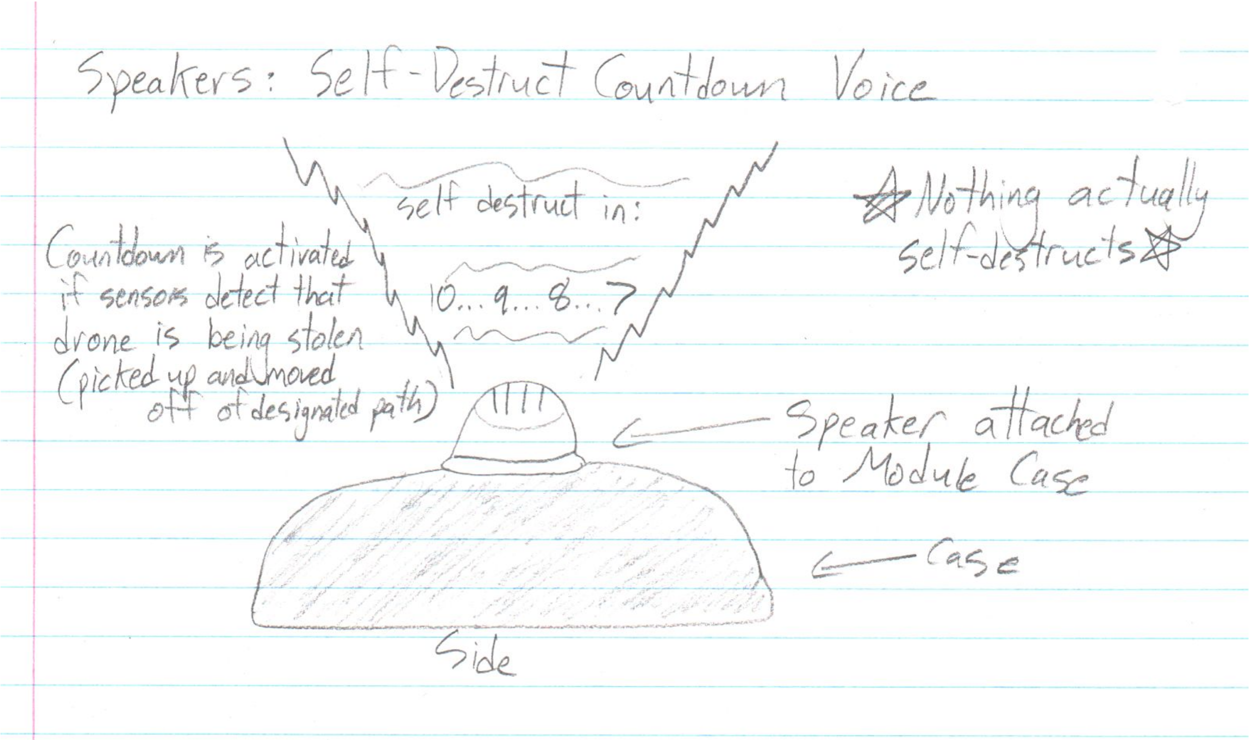
Loud siren noise (Steven)



Pros:
- Alerts nearby of emergency by sound
- Shows location in hidden areas

Cons:
- Could not function if drone is destroyed
- Could be annoying to if in city area

Self-Destruct Countdown Voice if the drone is picked up (Geoff)


Speakers: Self-Destruct Countdown Voice
self destruct in:
10... 9... 8... 7
Countdown is activated if sensors detect that drone is being stolen (picked up and moved off of designated path)
☆Nothing actually self-destructs☆
Speaker attached to Module Case
Case
Side

Pros:

- Might scare potential thieves from stealing the drone
- Doesn’t actually self-destruct (it’s just a bluff)
- Good last-ditch way to dismay thieves

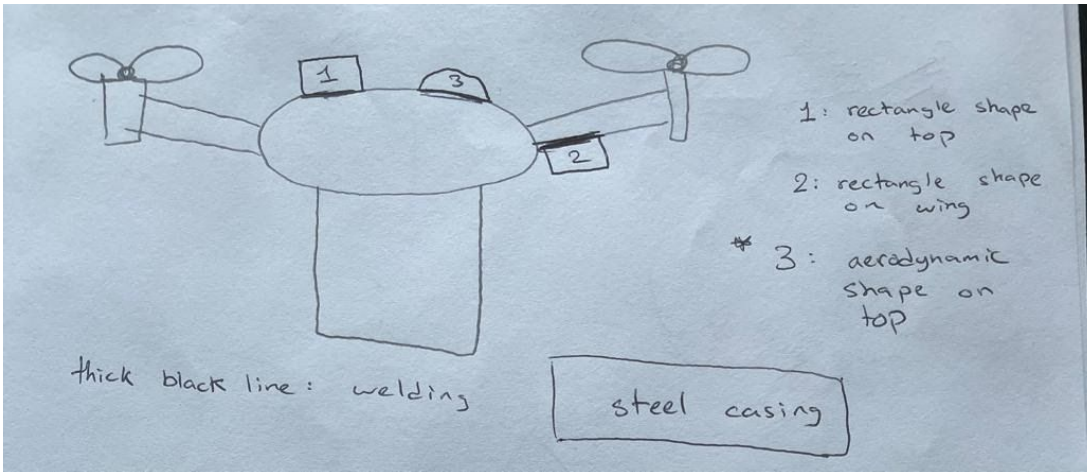
Cons:

- Might scare other potential people in the vicinity
- After the countdown finishes, nothing will happen and if the thief doesn’t run away they can just continue taking the drone.

Sub-System: Case --> Holds Arduino

Concepts:

Steel Casing & welded (Yusuf)


1
3
2
1: rectangle shape on top
2: rectangle shape on wing
* 3: aerodynamic shape on top
thick black line: welding
steel casing

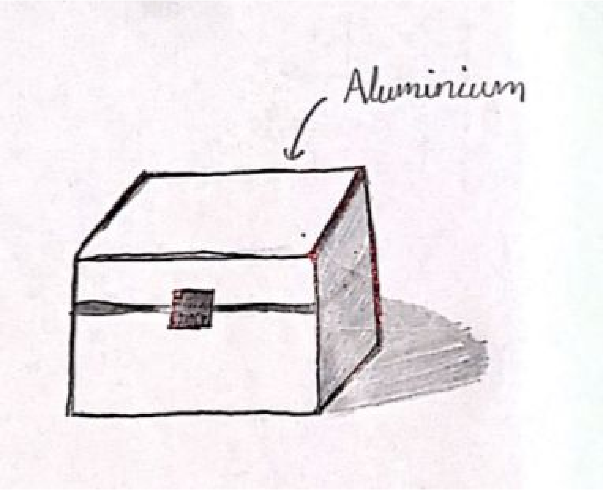
Pros:

- Strength
- Weather Capabilities

Cons:

- Might damage the drone
- No flexibility/adjustability on case itself

Aluminium opening case (Zakkai)



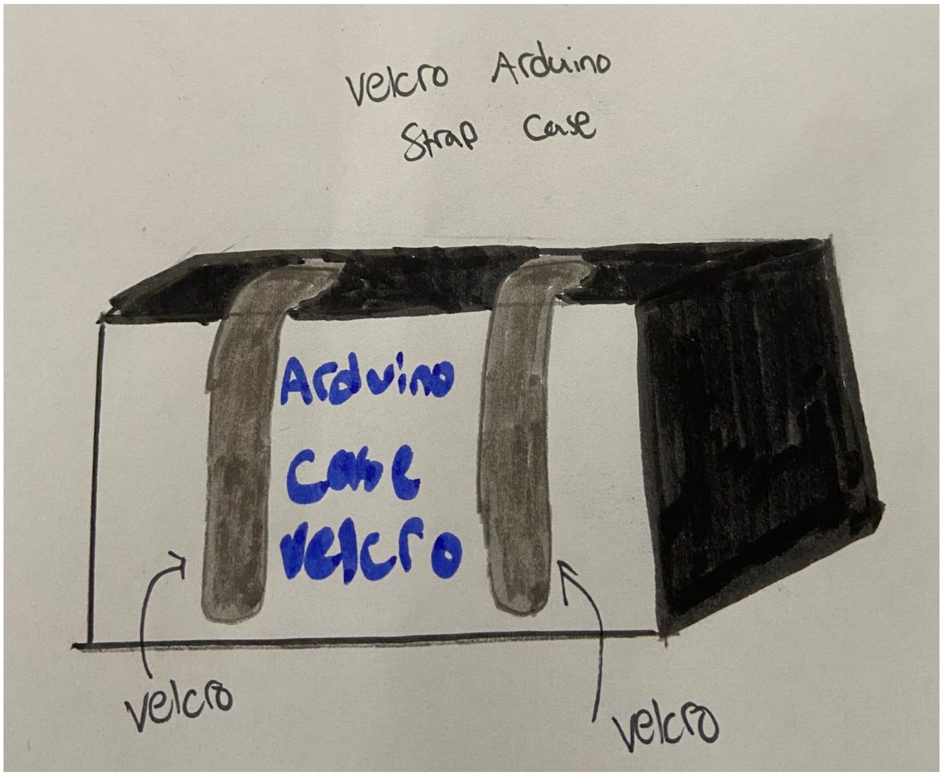
Pros:

- Light weight
- Strong material
- Easily accessible

Cons:

- Conductive

3D printed with velcro tape (Andy)



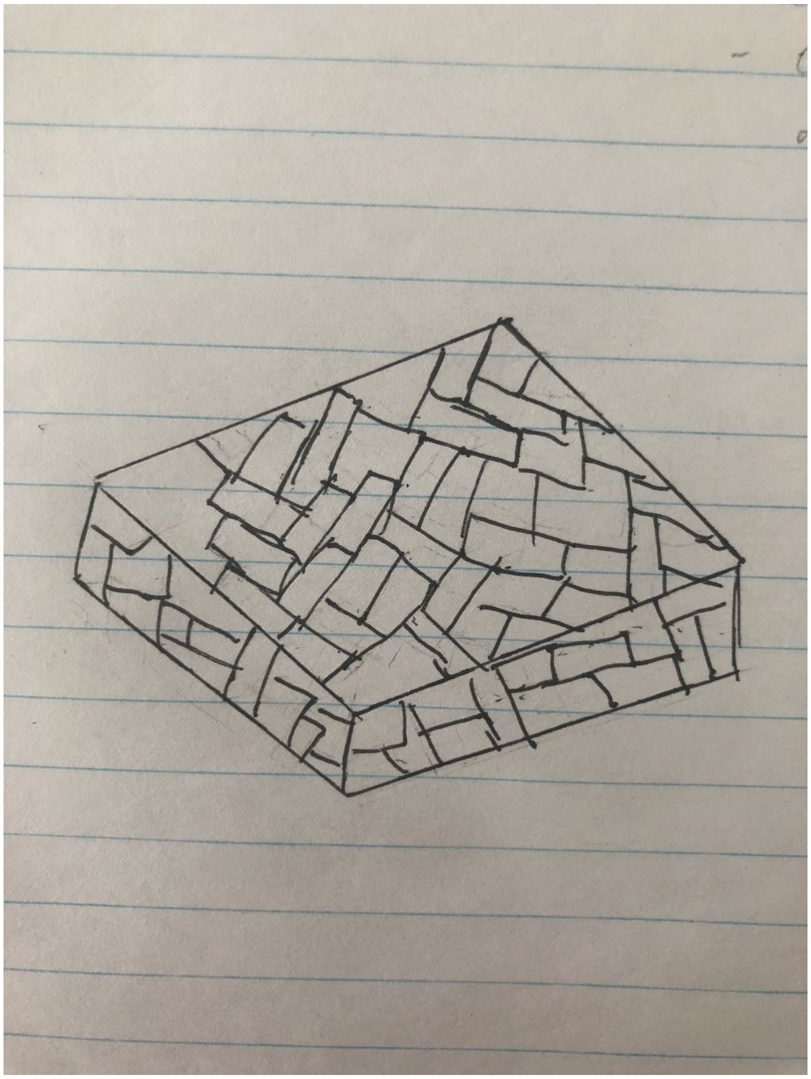
Pros:

- Simple safety system that can be applied by anyone
- Non-Conductive of electricity due to 3D printing

Cons:

- Velcro might not be the strongest sticking feature possible to hold the arduino

Carbon fiber to reduce weight (Steven)



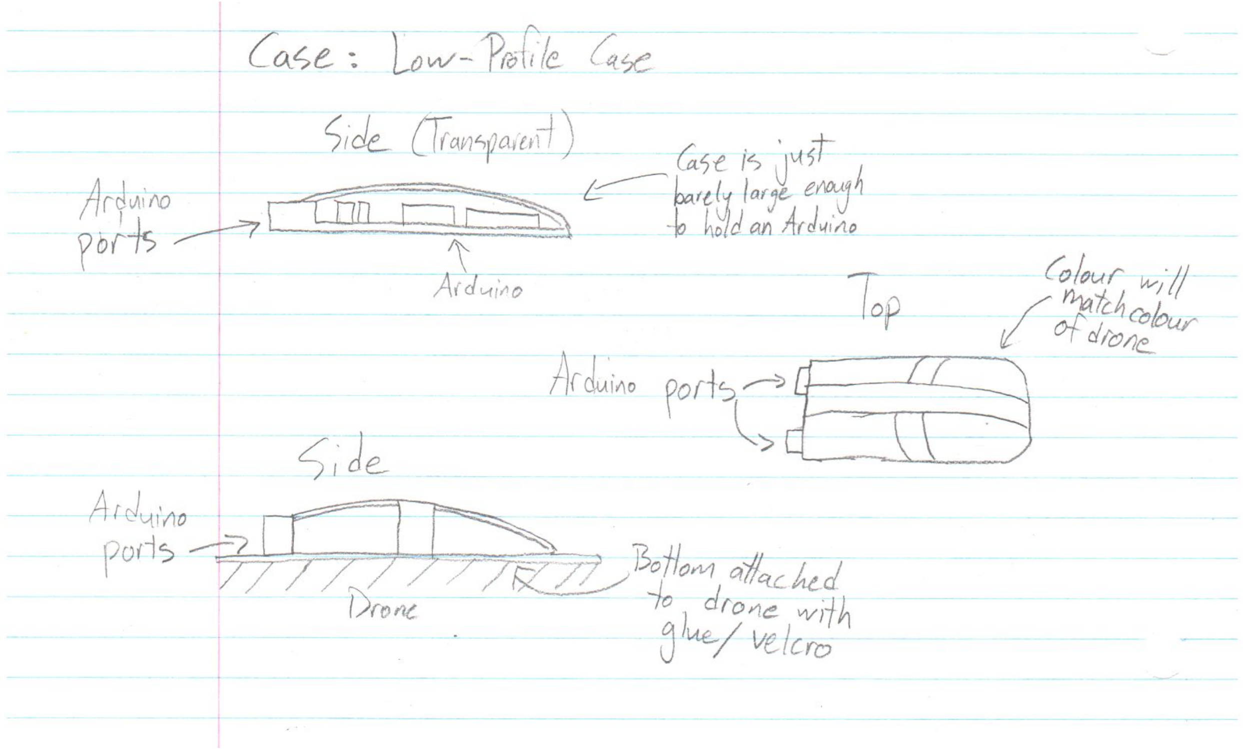
Pros:

- Lightweight and durable

Cons:

- Expensive
- Needs to replace the entire case if damaged

Low-profile case (cheap) (Geoff)


Case: Low-Profile Case
Side (Transparent)
Arduino ports
Case is just barely large enough to hold an Arduino
Arduino
Top
Colour will match colour of drone
Arduino ports
Side
Arduino ports
Bottom attached to drone with glue/velcro
Drone

Pros:

- Less Material will be cheaper
- Very sleek/minimalist design
- Won’t stand out on the drone since the case colour will match the drone colour

Cons:

- Potentially less durable
- Little to no bonus functionality (performs only bare requirements)

Sub-system Ranking

Sub-system	Description	Ranking
Lights		
Steven	Emergency light	**5**
Andy	Constant flashing red lights	**3**
Geoff	LED text on screen	**3**
Yusuf	Flashing light beam in eyes	**2**
Zakkai	Red, white and blue	**2**
Sensors		
Andy	Proximity Sensor for crash	**5**
Yusuf	Retractable Wires with tape	**3**
Geoff	Detachable Wires With Velcro	**2**
Zakkai	Motion sensor	**5**
Steven	Pressure Sensor	**3**
Speakers		
Steven	Loud siren	**5**
Andy	Automated Voice	**4**
Geoff	Self Destruct Countdown	**1**
Yusuf	Louder the closer people get to it	**4**
Zakkai	Phone speaker connected to dispatcher	**3**
Case		
Andy	Velcro casing	**5**
Yusuf	Welded steel case	**1**
Geoff	Low profile case	**4**
Steven	Carbon Fiber	**5**
Zakkai	Aluminium case	**2**

***Ranking system from 1-5 ;1 being the worst, 5 being the best**

Global Concept 1

- We have decided to go with Stevens emergency light concept. We have chosen this because when the drone is downed, it is important for there to be a visual warning to stay away. This will discourage any theft.
- We will choose Andy's proximity sensor to help avoid crashing.
- For the speaker, Yusif's idea will be used to discourage theft. Using Andy's proximity sensor, Yusif's speaker will get louder the closer people get to it.
- Carbon Fiber Case will be used since it's light and non-conductive.

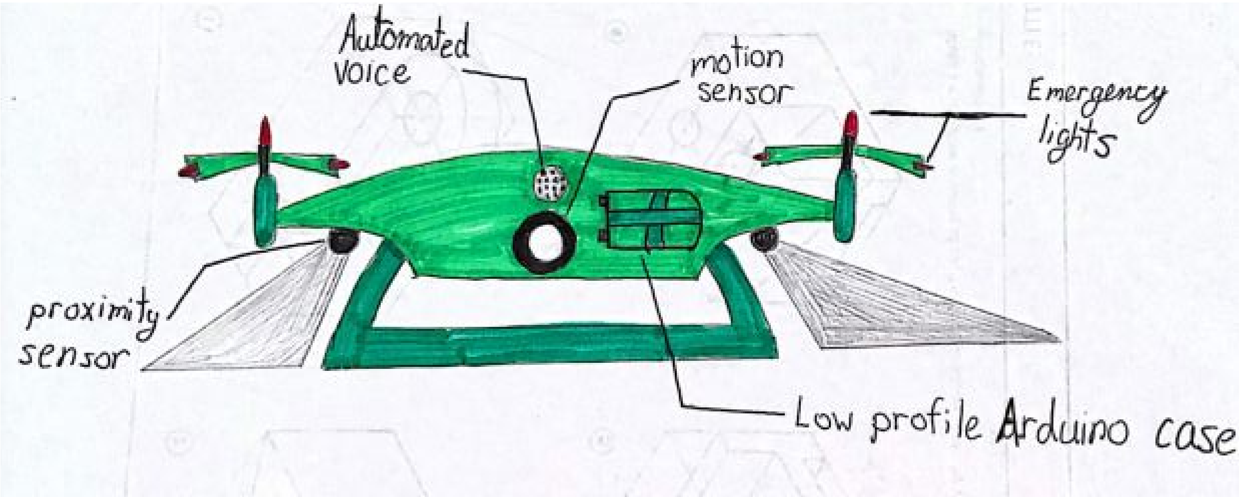
Global Concept 2

- We have decided to go with Stevens emergency light concept. We have chosen this because when the drone is downed, it is important for there to be a visual warning to stay away. This will discourage any theft.
- Andy's Proximity Sensor and Zakkai's Motion Sensor have been chosen to help avoid crashes and notify dispatch of theft. The motion sensor will detect if the downed drone has been picked up.
- Andy's Automated Voice would be chosen here to help the drone deliver instructions to citizens telling them to stay clear of the downed drone. This can be delivered in multiple languages (probably English and French).
- In terms of the case, Geoff's Low-profile Case is useful in order to take up the least room possible on the drone, this will hopefully also reduce weight and will not stand out as an eyesore.

Global Concept 3

- We have decided to go with Stevens emergency light concept. We have chosen this because when the drone is downed, it is important for there to be a visual warning to stay away. This will discourage any theft.
- Zakkai's Motion Sensor has been chosen to help notify dispatch of theft. The motion sensor will detect if the downed drone has been picked up.
- Steven's loud siren will discourage people from stealing or tampering with the downed drone. It will also make it very difficult for anyone to get away without raising eyebrows.
- Andy's plastic, 3D printed case is not conductive and light-weight making it perfect for the arduino case.

Final Chosen Concept (2):



Pros:

- Multiple sensors with this concept
- When drone crashes, there will be both sound and visual alerts to let nearby of emergency
- Overall Pretty Cheap in comparison to other concepts

Cons:

- Lights and sound would notify surrounding people of emergency but not physically really do anything to stop the theft
- Case is most likely less durable than other options

Conclusion:

After brainstorming and ranking various ideas to implement our module, our group decided to further explore our second global concept since it included multiple sensors allowing for better flexibility and increased functionality compared to concepts one and three. Furthermore, by having bright emergency lights in combination with an automated voice speaker, the module should be able to deliver clear instructions to nearby individuals on how to report the drone and how to touch/not touch the downed drone. Finally, having a small, sleek case will help with the module's aesthetics, aerodynamics and weight. Overall this concept should easily be able to meet our client's requirements in terms of an anti-theft module that can also deliver instructions to nearby individuals in the case that the JAMZ drone is downed.

This deliverable helped us learn about the design ideation process. In this deliverable, we designed a plethora of ideas individually and were able to slowly narrow them down until we had a final design that all of our group members were happy with. The concept that we designed in this deliverable will be continued to be used in future deliverables and the subsystems we designed will serve as a base to our final prototype further down the road.