DDR

Multi-Modal Tools for EMS First Response

Noah Broeckx - N11072628

DNB311 - Capstone 2025

AUTHENTICITY STATEMENT

This is to certify that to the best of my knowledge, the content of this report is my own work. This report has not been submitted for any subject or for other purposes. I certify that the intellectual content of this report is the product of my own work and that all the assistance received in preparing this report and sources have been acknowledged.

Name .... Noah Alexander Broeckx
Student Number N11072628
Date 31/10/2025

AI USAGE STATEMENT

I have utilised Generative AI, (ChatGPT, ChatPDF) to assist in various ways. The way I have used AI includes:

1. Assisting in sourcing relevant research materials within the background and benchmarking research

2. Analysing large bodies of text for easier interpretation of key findings and data, (location of information within texts), information regularly cross-referenced for accuracy, truthfullness and authenticity

3. Assisting in editing, grammar, and structure to ensure clarity, conciceness and cohesion

4. Troubleshooting technical issues throughout several software related stages in the process, (Blender script issues, electrical issues etc)

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WEEK 1

Focus: Post-Crash Response

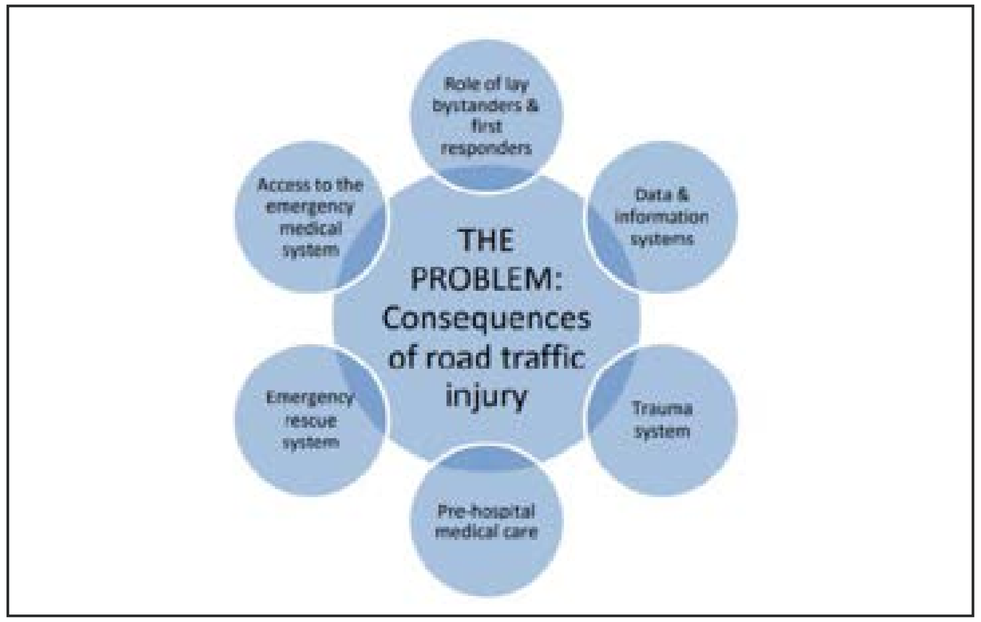
DESKTOP RESEARCH

Post-Crash Response & Trauma Support

Report conducted by Parliament of Australia, the information gathered throughout this research report is extremely valuable in identifying potential project directions supported by research.

Intro

Avoiding road crashes & minimising their impact is typically the key goal of road safety initiatives. However, the reality is that crash injuries continue to occur.



Source: Australian Road Research Board, Submission 49, p. 47

Potential Research Directions

"As outlined in the figure above, effective post-crash response is complex, and often integrates emergency response, injury care, mental health, legal support and legislation, as well as data on crashes and injuries. Supporting first responders via training and support is critical, as is ensuring response efforts are underpinned by reliable data and sustainable investment."

(Parliament of Australia, 2018)

Parliament of Australia. (2018). 10. Post-crash response and trauma support. [online] Available at: https://www.aph.gov.au/Parliamentary_Business/Committees/Joint/Former_Committees/Road_Safety_2021/RoadSafety2021Joint/Report/section?id=committees%2Freportjnt%2F024922%2F79488.

Introduction to Road Safety

Intro

Road deaths and accidents have significant economic, health and societal impacts. Improved safety on our roads not only results in reduced financial and medical costs, it benefits all of us.

Statistics

- Over 190,000 deaths on Australia's roads since record keeping began in 1925
- Improvements been made, falling from 3,798 deaths in 1970 to 1,258 deaths in 2023
- These improvements are despite considerable population growth and threefold increase in registered motor vehicles
- Australia is currently experiencing highest number of road fatalities in years with annual deaths trending upwards
- Male drivers are over-represented in road crashes and fatalities in all age groups

Road Safety Campaings

Safer Driving Starts With You. Campaign was launched on the 15th December 2024.
It reinforces safe driving behaviours and the importance of road safety for all drivers.

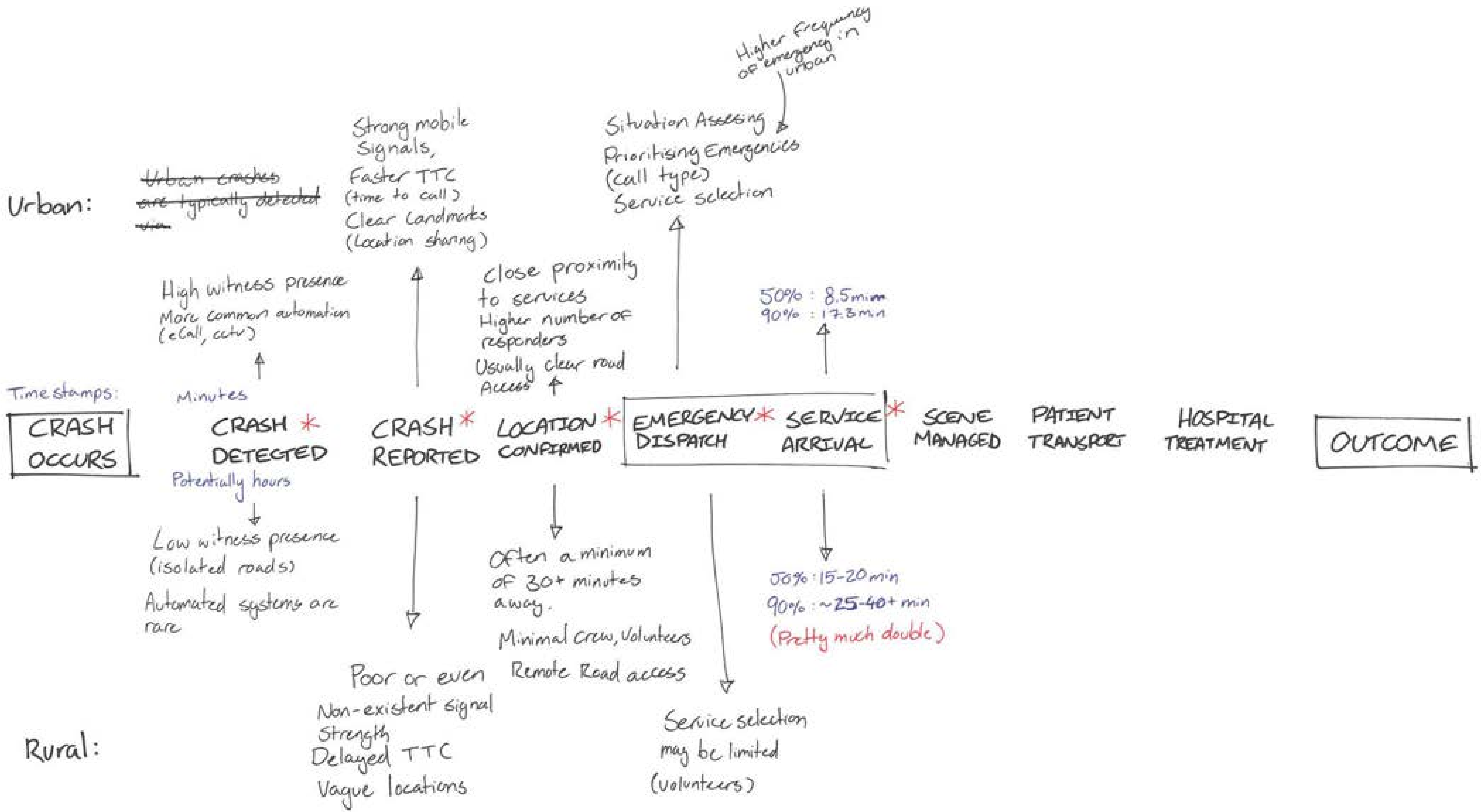
"How might we implement new emerging technologies to reduce the gap between automotive crash and EMS time on scene."

There is lots of marketing and graphic campaigns being implemented but no product interventions

WEEK 1

Focus: Post-Crash Response

Crash Response Timeline



WEEK 1

WEEK 1: CAPSTONE

LECTURE
Introduction, gaining momentum for the semester.

~~schedule~~

Tips & hints:
- Ai use
Statement sign off
- Consistent progress (carefull week 7-10)
cannot cram ↳ people switch off
- solid research, concept ideation, presentation
Research led project, variety of concepts
- DDR
start your DDR NOW
- Design Festival
Doesn't stop at end of assessment

CONVINCE YOUR IDEA via PRESENTATION

WEEK 1 Cont.

Solve future challenges, play an actively positive role.

Teaching Team
Marinella CHAMORRO-KOC (CO-COORDINATOR)
↳ Health Technologies

Dr Chris Koch (Academic Expert)
↳ CAD / Manufacturing

* SPEAK WITH Chris

Alex Singleton (Industry Expert)
↳

Anton Ruckman (Industry Experts)
↳ WWMC Design (Aesthetics)

Rafael Gomez (Co-Coordinator)
↳ ~~[illegible]~~ Automotive, Academic role

Respect. Engage. Focus.

WEEK 1. Cont.
Conscious ~~[illegible]~~ Design
Practical Applications
Visionary Attitude

Looking for

Hard Skills (top)	Soft skills (top)
Visualisation	Autonomy
Aesthetics	Attitude
CAD	Groupwork
Research	Time Management
Presentation/comm	Adaptive
Graphics	Criticism
Ai	Willing to learn
hands-on	Self eval
	Proactive / Passion
	Attention to Detail
	Confidence

"World needs creative thinkers to tackle higher-order problems"

Week 1. Cont.

Benchmark yourself against competition appropriately
↳ Colleges
* RMIT
* Monash
* UTS
* Loughborough
* CCS
* RISD
* NUS

QUT Capstone:

2021 - 2024 (check week 1 lecture slide
↳ & QUT WEBSITE

Emulate a company or start a business, show case that in your design

WEEK 1. ~~CAPSTONE~~ Cont

~~[illegible]~~
Incorporate all youve learnt into IDP
↳ showcase your learning

Schedule:
Week 7, Friday → Report Due
Week 8, Friday → Presentation Due
Week 14, Wednesday → Final presentation Due

Final Presentation, Website, Exhibition

Project Paths
A: SelFinitiated
B: Scientific LED Discovery
C: Industry Linked

Week 1. Cont.
Major Project

1. Start thinking contexts
2. Focus on people, activities, context, technologies, systems (brain dump / mind maps)
3. choose something you're passionate about, but something you want to learn about
4. Access to experts & end users

you'll need 2 of the following 3 groups:
- experts in the field
- End users
- Secondary/Tertiary stakeholders

A SelFinitiated
* choose your passion
↳ personal interest to help build your career
Identify relevent sources of information
Avoid duplicating previous projects (find a gap)

WEEK 1 Cont.

B Scientific Discoveries

* Customisable tool grip
↳ Dr Chris Koch

* Wheelchair Accessories
↳ Dan

* QLD ins of Medical research
↳ Prof miguel renteria & Prof Rafael Gomez

* Food safety
↳ Prof Ronald Schroeter

C Industry Linked

Application
↳ * Why are you interested (1/2 pg)
* Experiences/interest (1/2 pg)
* Link to portfolio

Week 1. Cont.

Autonomous Vehicles
↳ Dan Cook

Smart rearview mirror (BMW)
↳ Prof Rafael Gomez

Semi Autonomous steering wheel (BMW)
↳ Prof Rafael Gomez

Advancing humanoid robotics (~~[illegible]~~ WWMC)
↳ Anton Rickman

Micro Mobility for brisbane olympics (ICOUA)
↳ Prof Glenda Muratovski / Juan Antonio Islas Muñoz

Tactile Command console modular robot interface (idealworks)
↳ Dylan Sheppard

Week 1 Cont

Design research points
↳ where does human error currently exist?
↳ Can design help improve communication
↳ what environments are mostly affected
↳ What already works?

Research Notes:

Fast response times are detrimental to the care & survival of those involved in life threatening crashes.

Delayed reporting, Traffic congestion/road conditions, Limited resources, Driver behaviour & actions

Delayed Crash Reporting
↳ The first 60 minutes after a crash are critical for saving lives (Golden hour)
↳ delays in reporting time can significantly increase mortality rate

↳ rural Australia response times are significantly stretched, risk of death is almost doubled.
↳ Automatic Collision Notifications (ACN) can reduce fatalities by upto 18% within 6 hours post-crash
↳ Each minute of delayed notification increases fatality risk by ≈2.4%
↳ Earlier EMS = Better Survival (even more so in trauma cases)
↳ Quick post-crash medical response reduces both mortality & long-term disability
↳ Delayed crash reporting often leads to secondary accidents by traffic queuing, rubber necking or inadequate signaling, multiplying the danger zone
↳ Response time is measured from time 000 call is answered & arrival of first paramedic on scene
↳ 2 performance measures 50 & 90 percentiles. Represents time to attend 50% & 90% of incidents

↳ prioritise most critical patients, aiming to arrive at 50% of incidents in 8.2 minutes, 90% of incidents in 16.5 minutes

Week 1. STUDIO 2 - FRI

WIL Academy Units
↳ BMW Academy

Today's Focus:
↳ Exploring project options
* Different areas
* Explore multiple options to discover the best
* 2-3 options
↳ Divergent thinking
* don't be too stuck on a product
* sketch & leave it (let it out)
* come back to it if needed

Developing your own brief
"Look broader"
↳ Research on innovation in your area

WEEK 1 Cont.

Scoping down the project:

Road safety research:
current innovations
↳ Radar speed signs
* speed awareness
↳ Automatic emergency braking
* risk mitigation
↳ smart road structures
* optimise traffic & reduce danger

Road technologies in Australia
1. Rural junction active warning system
↳ tech driven solution aimed at reducing hazards at rural junctions, minimising harm in the event of a crash
* Flashing lights
* Warns of approaching vehicle
↳ Solar powered alternative

Week 1. Cont.

2. Level crossing Advance warning system
↳ (similar to tech 1.)
↳ notifies approaching motorists who aren't slowing down

3. Light detection & ranging (LiDAR)
↳ tech is harnessed to improve road experience via enhancing monitoring capabilities & gain real-time data across road networks
↳ Modern LiDAR differentiates car, pedestrian, cyclist. Even their speed & direction

Emerging technologies:
↳ cell phone blocking – removing phone distractions
↳ Satellite technology – photograph incidents & provide valuable information for places without cameras
↳ Implement with vehicle connectivity

Week 1. Cont.

Reducing/Preventing car related deaths:
↳ Slow down
↳ Don't use your phone
↳ Don't drive tired
↳ Don't drink & drive
↳ Use your seat belt

Speeding:
why do people speed?
↳ Time pressure
↳ Aggressive driving
↳ Risk tolerance
↳ Social pressure
↳ Fun & excitement
↳ Lack of awareness
↳ Anonymity
↳ Disregard for others

Some speed due to perception that they are immune from being caught by police

(Thought of another potential topic; healthy lifestyle enabler to reduce cholesterol to reduce heart risk) → leading cause of death

Week 1. Cont.
Some, if not most people are unaware that ANY speed above the posted limit is illegal
↳ this is due to perceptions caused by enforcement tolerance thresholds.
* the idea that detection equipment allows for slight variations in speed measurement

* Drivers need to be reminded?
↳ visual speed indicators on road?
* not too distracting

* Intelligent speed adaption systems *
↳ technologies designed to help drivers adhere to speed limits

ZOOM! visual indicator in car for speed limits

how it works:
↳ GPS data to identify & display speed data
* can implement visual alerts to notify driver of speeding
* Intervention systems can be implemented

WEEK 1. Cont.

Types of ISA systems — Tactile feedback
1. Advisory ISA → Provides warnings
2. Supportive ISA → Offers assistance
3. Limiting ISA → Prevents speeding

WAZE
↳ displays speed

Benefits of ISA's
↳ Reduce speeding
↳ Crash reduction
↳ Improved road safety

Week 1. INDEPENDENT
Project Planning
↳ Categories & colour coding

* STUDIO — GREEN : TASKS RELATED TO CLASS
* RESEARCH = Blue : Any Research work
* PLANNING = Purple : Timeline, mapping, prep
* Outreach = Orange : Emails, industry contact, interviews
* Deliverables – Red : Assessment related
* Development – Yellow : Design phase
* SETUP = Brown : Setup documents

WK 1.

Capstone: Note taking

↳ WEEK 1 notes are in Rhodia notebook.

Key take aways:

* Introduction to unit, expectations
* Project options
  - ↳ Self led ← Most likely will go with this (but area in all options)
  - ↳ Scientific led
  - ↳ Industry led
* Project direction. Currently not 100% sure but most likely Car/Road safety → Either Crash prevention or Crash response
* Other potential options
  - ↳ Search & Rescue
  - ↳ Epilepsy
  - ↳ Snow environments
  - ↳ Drones

Car/Road safety research summary:

* What causes crashes?
  - ↳ Human Error
    - ↳ Intoxication
    - ↳ Fatigue
    - ↳ Overspeeding
    - ↳ Tailgating
    - ↳ Distracted driving
    - ↳ No seatbelt
    - ↳ Reckless/Aggressive Driving
    - ↳ Ignoring road signs/signals
  - ↳ Weather conditions
  - ↳ Road Conditions
  - ↳ Manufacturing Defects
  - ↳ Animal Collisions
  - ↳ Poor Visibility

Speeding is the biggest cause of car crashes/collisions

Cont.

* Why do people speed! →
  - ↳ Overtaking
    * Most common response according to budget direct
  - ↳ Unaware of speed
  - ↳ Late for work/Appointment.

There's an overestimation of how much time speeding will actually save you.
↳ normally around [illegible] minutes time saved per week for the avg driver

General mood of the driver can also affect driving speed & behavior

* Interesting Points from this week's research *

- ↳ People feel more comfortable speeding as they feel a sense of anonymity when in their cars
- ↳ The first 60 minutes after a crash are critical for saving lives
- ↳ Rural response times are significantly stretched, risk of death is almost doubled
- ↳ Each minute of delayed crash notification increases fatality risk by [illegible]
- ↳ Delayed crash reporting often leads to secondary accidents
- ↳ Innovations in road technologies
  * Rural junction active warning system
  * Level crossing advance warning system
  * LiDAR
  * Cell-Blocking technology
  * Intelligent speed adaption systems ← Eg. Waze app

Cont.

More info on speeding:

↳ Why else do people speed?

* Time pressure
* Aggressive driving
* Risk tolerance
* Social pressure
* Fun & Excitement
* Lack of awareness
* Anonymity
* Disregard of others

* Some speed due to the perception that they are immune from being caught by the police.

ANY speed above the posted limit is illegal

↳ Most are unaware of this due to perceptions caused by enforcement tolerance thresholds
  * The idea that detection equipment allows for variations in speed measurements

* ISA systems *

1. Advisory ISA: Provides warnings
2. Supportive ISA: offers assistance
3. Limiting ISA: Prevents speeding

Goal for week 2:

- ☐ Confirm topic direction with tutor
  - ↳ Speak to [illegible]
- ☐ Start compiling topic industry contacts
  - ↳ Ems services? Tow workers? Ops of road/transport
- ☐ Continue research/begin mapping
  - ↳ Crash response timeline & workflow / Mapping of timeline

Cont.

Existing product benchmarking:

Not many aftermarket products exist for car safety innovations, ~~[illegible]~~

- Aftermarket crash prevention
  * Forward collision warning (Mobileye, Navman)
  * Lane departure warning (Mongoose)
  * Driver monitoring (Smart Eye AIS)
- Aftermarket crash response & safety support
  * Roadside Emergency & visibility kits (warning triangles, vests, LED flares)
- Infrastructure-oriented technologies
  * Connected infrastructure alert systems (Sentinel impact tracker)
  * Crash attenuators / crash cushions (SMA road safety, [illegible])

Insights

- No current aftermarket product that physically intervenes with traffic flow at crash sites
- Clear gap in immediate, visible, or physical response technology beyond alerts or visual kits.

Exploring the broader topic of Emergency Services

Emergency Response Lifecycle in Queensland

An EMS (Emergency Medical Services) incident response timeline generally follows a series of stages: call initiation, dispatch, response, on-scene care, transport, and handover at the receiving facility.

1. Call Initiation:
   Reporting the Emergency:
   - This involves the initial call to emergency services, often by a member of the public, reporting a medical incident.

   Call Taking:
   - The call taker gathers essential information about the incident, including location, nature of the emergency, and patient details.

2. Dispatch:
   - **Dispatch Notification:** The call taker relays the information to the dispatcher.
   - **Resource Allocation:** The dispatcher identifies the appropriate resources (ambulance, first responders) and dispatches them to the scene.

3. Response:
   En Route:
   - The dispatched units (ambulance and/or first responders) travel to the incident location.

   Arrival on Scene:
   - The ambulance and/or first responders arrive at the scene and begin assessment and initial care of the patient(s).

4. On-Scene Care:
   Initial Assessment:
   - A rapid assessment of the patient's condition is performed, identifying any immediate life threats.

   Treatment:
   - Essential medical care is provided, which may include administering medication, managing airways, controlling bleeding, or immobilizing injuries.

   Patient Stabilization:
   - The patient is stabilized as much as possible before transport.

5. Transport:
   Loading:
   - The patient is carefully loaded into the ambulance for transport to the receiving medical facility.

   Transport Time:
   - The time it takes to travel to the designated hospital or medical facility.

6. Handover:
   Arrival at Facility:
   - The ambulance arrives at the receiving facility.

   Transfer of Care:
   - The patient is transferred to the care of the facility's medical staff, and the EMS crew provides a detailed handover report.

   Turnaround:
   - The ambulance crew prepares for the next assignment, which may involve refueling, restocking supplies, and cleaning the vehicle.

CALL → DISPATCH → RESPONSE → CARE → TRANSPORT → HANDOVER

SERVICES

Queensland Fire and Emergency Services (QFES):
- QFES is responsible for fire and rescue services, including bushfires, and works with local governments to enhance community safety.

Queensland Police Service (QPS):
- QPS leads law enforcement and community safety initiatives, including coordinating disaster management efforts.

State Emergency Service (SES):
- The SES, a volunteer-based organization within QPS, focuses on storm and flood response, search and rescue, and assisting other agencies during emergencies.

Queensland Ambulance Service (QAS):
- QAS provides emergency medical services, including paramedic and patient transport, across Queensland.

Health Services:
- Health services, including hospitals and public health units, play a crucial role in managing the health impacts of emergencies and disasters, ensuring community well-being.

Local Councils:
- Local councils are responsible for various aspects of disaster management within their respective areas, working in partnership with state agencies and other stakeholders.

https://www.researchgate.net/figure/Timeline-for-ambulance-assignments-Response-time-time-between-when-the-call-connected_fig3_351571081

INFRASTRUCTURE

Triple Zero (000) Call Centres
- 000 Call centres are the national emergency call service in Australia which connects the caller with all emergency services, (Police, Fire, Ambulance etc.)

Dispatch Systems
- A software-based solution which is designed to coordinate the allocation of resources to specific tasks or locations, (Vehicles, personnel etc.)

Radio Networks:
- EMS Utilise various networks, including Citizens Band (CB), Government Wireless networks, and the Public Safety mobile broadband (PSMB) Network during emergencies.

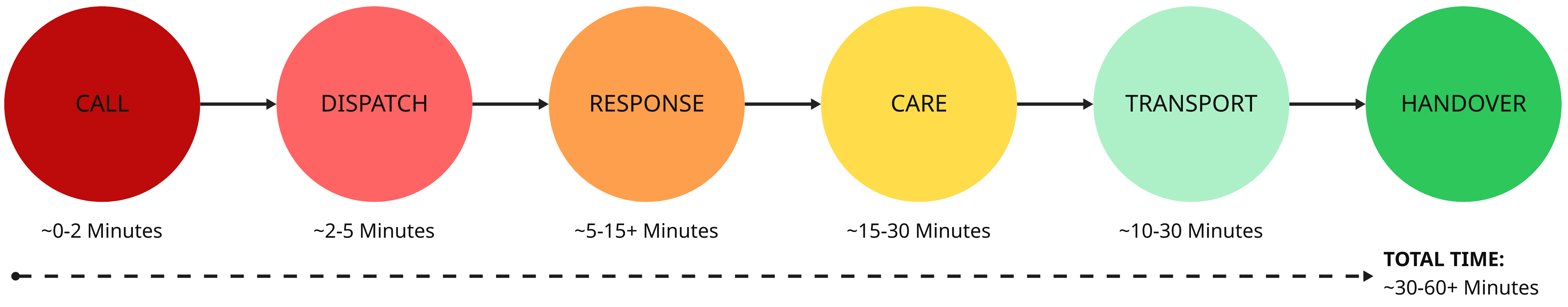
GIS Mapping
- Uses computer systems to store, analyse and visualize geographic data. Utilising Data Inputs, Data Management, Spatial Analysis and Visualisation.

ERIC Dashboards
- Electronic Record for Intensive Care (ERIC), is a clinical information system replacing paper-based systems integrating various medical devices to improve patient care.

https://www.researchgate.net/figure/Events-and-stages-of-EMS-mission-time-13_fig1_349855217

Exploring the broader topic of Emergency Services

Typical Emergency Response Timeline



CALL
Timeframe:
~0-2 Minutes

Notes:
Caller contacts service, exchange of information

Flaws/Pain Points:
Difficulty exchanging information; Caller panic, Incomplete information, Language barriers, Miscommunication, Dropped calls, Failure to convey severity

Intervention Opportunities
Ai Assistance, Multilingual tools, public education

DISPATCH
Timeframe:
~2-5 Minutes

Notes:
Call-taker transfers info to dispatcher, units are mobilized

Flaws/Pain Points:
Delayed dispatch, resource deployment, technology errors, Poor call-to-dispatch integration, outdated systems, dispatcher overload

Intervention Opportunities
Automated dispatch, dynamic unit allocations, cross department computer aided dispatch

RESPONSE
Timeframe:
~5-15+ Minutes

Notes:
Emergency Responders travel to scene

Flaws/Pain Points:
Traffic, unclear direction, access barriers, delayed arrival, service coordination

Intervention Opportunities
Advanced navigation with live traffic data, Drone/satellite assisted routing, priority signal pre-emption

CARE
Timeframe:
~30 Minutes

Notes:
On-Site Treatment

Flaws/Pain Points:
Limited Equipment, safety risks, emotional scene, delayed triage, inconsistent protocols

Intervention Opportunities
AR Medical guidance, standardized field care kits, trauma telemedicine

TRANSPORT
Timeframe:
~10-30+ Minutes

Notes:
Patient is transported

Flaws/Pain Points:
Congestion & Reroutes, limited equipment, hospital coordination, inadequate handover prep

Intervention Opportunities
Ambulance to Hospital live data, Traffic control systems, en-route vital sharing

HANDOVER
Notes:
Patient care is transferred to hospital staff

Flaws/Pain Points:
Overcrowding, Delayed transition, missing records, poor communication, inconsistent documentation

Intervention Opportunities
Digital patient handover, pre-alerts (ETA, Status), Joint EMS-Hospital debriefing protocol

https://pmc.ncbi.nlm.nih.gov/articles/PMC5831456/#:~:text=Discussion,delays%20can%20be%20life%20threatening.

https://pmc.ncbi.nlm.nih.gov/articles/PMC12065030/#:~:text=Out%2Dof%2Dhospital%20cardiac%20arrest%20(OHCA)%20was%20defined,from%20the%20hospital%20(27).

https://www.ambulance.qld.gov.au/about/performance-data/our-performance#:~:text=current%20financial%20year.-,Response%20time,17.6%20minutes%20(90th%20percentile).

Exploring the broader topic of Emergency Services

What does each service respond to?

FIRE

Fires
Residential, Commercial, Industrial, Bush, Vehicle

Motor Vehicle Accidents
- Removing people from vehicles
- Stabilizing injured individuals
- Managing hazards/spills

Hazardous Materials
Spills, Leaks and Release of dangerous substances

Technical Rescue
Swift water, High-angle, Confined space rescue

Medical Emergency
Accident, injury and initial medical aid until ambulance arrives

Storms/Disasters
Mitigating storm, flood and other natural disaster effects

Terrorism Consequences

Building Collapse

https://www.qld.gov.au/emergency/emergencies-services/response/fire-rescue

POLICE

Emergencies
First Responders in emergency situations, accidents, fires, medical and natural disaster

Crime
Investigate crime reports, across all severity spectrums. Includes gathering evidence, interviewing witnesses and making arrests

Maintaining Public Order
Patrolling public areas and responding to incidents of public disorder

Enforcing Laws
Traffic laws, criminal laws, laws related to public safety and much more

Specific Incidents
Domestic & Public disturbances, traffic accidents and a variety of other situations requiring police intervention.

Unit Specific Services
Dog squad, water police, public safety response team, forensic services etc.

https://www.qld.gov.au/emergency/emergencies-services/response/police

https://www.policerecruit.qld.gov.au/roles-qps#:~:text=The%20Dog%20Squad%20supports%20and,Protective%20Services

Ambulance

Life threatening situations
Sudden medical emergencies including heart attacks, seizures, burns, trouble breathing etc

Accident Injuries
Car accidents, falls or physical altercations

Serious Medical Conditions
Asthma, Anaphylaxis, drowning and other immediate intervention emergencies

Patient Transport Emergencies
Ambulance, interfacility and aeromedical transport services

Ambulance Responses
Highest priority response is a Code 1, which prioritises immediate response incorporating lights and sirens to tend to the most critical patients.

https://www.qld.gov.au/emergency/emergencies-services/response/ambulance

https://www.ambulance.qld.gov.au/about/performance-data/our-response

SES

Natural Disasters
Storms, Floods, Cyclones, Earthquakes, Landslides, Tsunamis etc

General Rescue
Road accident rescue, Vertical (Cliff) Rescue, Bush Search and Rescue, Evidence Searches

Other Emergencies
- Supporting other emergency services, (QPS, QFES, QAS)
- Public Events, managing crowds and providing first aid
- Body Recovery in certain circumstances
- Animal Disease Outbreaks
- Transportation Incidents

Additional Info
- SES is a vital volunteer organisation
- Responds to a wide range of emergencies
- Particularly focuses on natural disaster and general rescue operation

https://www.qld.gov.au/emergency/emergencies-services/response/ses

WK 2

INDEPENDANT WORK:

Research on "Post-Crash Response & Trauma Support" Parliament of Australia *

* Avoiding road crashes & minimising their impact is typically the key goal of road safety initiatives. However, reality is that crash injuries continue to occur

Elements of post-crash care: ← Diagram on website

The Problem: Consequences of road traffic injury

- Role of the lay bystanders & first responders
- Data & information systems
- Trauma system
- Pre-hospital medical care
- Emergency rescue system
- Access to the emerging medical system

Source: Australian road research board submission 49, pg 49

* Report was difficult to understand, attempting to use a summarising software to filter out key data * (412 pg Document)

Summaries: (Key take aways)

* Priority focus on Post-crash care in strategy (The national road safety strategy (NRSS) 2021-30 lacks sufficient emphasis on post-crash response & trauma care.)
* Improving response times through technology & community engagement (Design opportunities exist in technology that improve crash detection & location reporting. Additionally community tools that help

Cont

* Integrating Vehicle safety features with Post-Crash response (Providing crash locations & vehicle condition data to emergency services → E-Call systems)
* Training Support for Heavy Vehicle drivers as First Responders (HVD's often act as stand-in first responders, training (specialised post-crash response) for these drivers has proven beneficial & should expand nationally)
* Psychological & Mental Health support Tools (Post-crash trauma impacts crash victims, families, first responders & communities. Tools needed to provide timely, accessible mental health services)
* Data Collection & sharing post crash outcomes (need for reliable, accurate & linked data on post-crash responses & trauma care. Help support better evaluation & policy development)
* Consistent standards & collaboration across jurisdictions (Designing interlinking systems & frameworks to enable national consistency in care delivery, training & data reporting)

Personal takeaway: Training for heavy vehicle drivers to act as stand-in first-responders is extremely interesting

PLAN FOR NEXT STEPS:

Mapping out urban vs rural crash response timelines to identify potential gaps in the system

Start: Crash occurs ⟷ Hospital arrival/outcome

Potentially earlier?

Potentially later?

Cont.

Although there's factors in play before & after the crash response timeline, if the project focus is centered around specifically response maybe start there?

Narrow → Broad? or Broad → Narrow?

* Ask Tutors * ↳ Double diamond?

Early phase?

28/07

Potential industry Contact: QUT Research project ↳ Development & Implementation of a Crash Response Tool
* Professor Sharon Newman (QUT) ↳ Email: s.newnam@qut.edu.au

NRACC & Fire Department & QLD Gov Dpt of transport and m

AusRAP Rating * → Star rating on the safety of our Australian roads

29/07

Before Class:

Industry Contact list so far:
QUT Research Studies
- Professor Sharon Newman – Crash response tool implementation
- Professor Sebastien Glaser – Rural Automated Vehicles

Companies/Departments
- National Rescue & Critical Care group
- Department of Transport & main roads

Cont.

Lecture:

Qualitative research & Design process

- Ethics
  * Do not begin proper research until instructed ↳ Primary research
    - can still conduct general enquiries
  * Not permitted to conduct research on children under 18
    - can talk to carers, experts, parents
  * Not permitted to conduct research on anyone who cannot consent
    - cognitive disabilities etc

Research & practice how to conduct research (actually doing it)

This week: Project synopsis document

Accident research & road safety ↳ Pedestrian wearable

Centre for accidents & road safety ↳ rear ending

BAN Group ↳ smart rearview mirror ↳ Semi-Autonomous steering wheel

Cont.

What is the value you are gaining from this?
- Philosophy (perspective)
- Thinking (process)
- Approach
- Techniques
- Skills

"Everyone will start a project at a different place"
* What do you have more towards

Books:
Design for the real world – Victor Papanek
Designing for people – Henry Dreyfuss
Cradle to Cradle
Design like you give a damn
Design for society
The politics of the Artificial – Victor Margolin
Science of the Artificial

Basic set of tools, techniques & methods to tackle a project

Design processes follow the same basic features:
- Deal with complex/ambiguity (no one solution)
- Iterative
- User focused
- Systems focused
- Visual Communication (Drawing/Models/Data/CAD/etc)
- Reframes problem
- Visionary (Future focused)

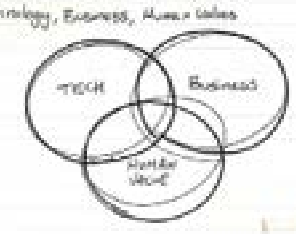
Design Process:

Double Diamond →

Cont

IDEO MODEL: Feasibility, viability, Desirability

Technology, Business, Human Values



"UNDERSTAND HOW YOU DO WHAT YOU DO"
"Process becomes one of the most important aspects of your projects"

PARADIGM

Qualitative vs Quantitative Research

Quantitative: Based on testing a theory
- Variables
- Measured with numbers
- Statistical procedures

Objective & singular
Hypothesis
Context free

Qualitative: Based on building complex, holistic picture
- Words, images, descriptions
- detailed views of informants/participants
- Conducted in natural settings

Constructed by individuals
Research Question
Context bound

Cont.

Research Question
- Exploratory → Unknown, new, under-researched (what)
- Explanatory → Causes behind phenomena (why)
- Descriptive → Document what is happening (what is)
- Predictive → Ramifications on the future (what will)

Make sure research question states
- What: what are you doing
- Who: who are you researching
- Where: Context/Environment

Research Question will evolve/change.

Qualitative data is complex & rich
- Fewer participants required
- Helps understand meaning
- why, not just what or how

Sampling Methods

EVENT SAMPLING (in the moment) — Sample — Time

Retrospective Sampling (Reflection) — Sample — Time

Repeated Sampling (Multiple experiences) — Sample1 Sample2 Sample3 — time

2 METHODS MINIMUM

Cont.

STUDIO:

* Tutor Feedback *

- Topic Direction: Crash Prevention vs. Crash Response
  * Current focus on crash prevention
  * Reality is crashes will happen no matter how much innovation is made in prevention

Post crash communication

Open topic atm

- Contacting Sharon Newnam
  * Has lots of industry contacts/partners
  * Topic is along the lines of what I want to explore

Contact Sharon, she may respond or potentially refer me on to another contact

If no response, Raf has some contacts (Ron etc)

Continued work:

Next steps:
- Contact Sharon
- Set up layouts
- Begin DSR

Having project doubts in class, need to lock 'em & define project direction
Decide
Commit
Plan
Implement

WEEK 2

Cont

Independent study:

Current topic of crash response with potential drone implementation has legs.

↳ How do we communicate to drivers on roads to move out of the way for EMS?

↳ How do we increase reporting speed for car crashes in rural/remote environments?

↳ How might we empower those that could suffer from health triggered driver impairment to take back control and not fear driving?

NEED ⇒ DOCUMENT RESEARCH

Note taking at class, at home & throughout the week conducted in this book.

Last week I've been conducting surface level research, need to start digging deeper into potential research topics.
↳ Document
↳ Analyse
↳ Reflect

DDR research drafting will be conducted in MIRO
↳ Links, info, Images will be quickly dropped into
↳ Focus on QUANTITY

Cont.

Later on MIRO DDR DRAFT can be transferred into InDesign Layout for exhibition presentation.

Beginning Research DRAFT:

Topic start point: Road Safety (BROAD)

↳ What is it?
* Road Fatality/Crash statistics
* Cause of crashes
* Gov strategies
* High risk demographics
* Prevention vs Response (comparisons)

↳ Emerging technologies

↳ Potential topic directions
* Urban response
* Rural response
* At risk drivers (Medical)

1/08

STUDIO:
Structuring the research question
↳ What do we want to achieve?
* Reduce fatality risk in post crash scenarios

Road safety & Initial response

Cont

Topic: Monitoring & Initial response
↳ EMS Service Monitoring & Initial response

Police
Offenses, Unlawful activity, Traffic
↳ Regardless of emergencies, police will typically always respond

Fire
Putting out fires
Rescuing/caring for sick or injured
Working to prevent future fires
Investigating cause of fires

Ambulance
Provides emergency medical care
↳ 4 levels of emergency technician

Issues in emergency response:

Communication breakdown
Stress & Fatigue
Uncertainty & decision making
Lack of risk awareness

What information do they listen/ask for in emergency calls?

↳ Location
↳ Nature of emergency
↳ No. of people involved
↳ Medical ethics
↳ Callback number
↳ Hazards

WEEK 3

Focus: Stakeholder Percspectives

USER-CENTERED PERSPECTIVES

Looking at people within the system:

- Emergency Call Operators
- First Responders
- Civilians/Callers

Emergency Operators: stress, cognitive load, training, and decision-making tools.

First responders: response tools, real-time data, situational awareness.

Civilians/Callers: Calling 000, language barriers, accessibility, panic interference.

Emergency Call Operators

- Constant trauma exposure: listening to real-life, threatening situations, cardiac arrest, crimes, suicides etc. Often without closure. Rarely finding out how cases end
- Situation Empathy: Absorbing caller panic and distress in situations requiring them to stay calm and professional
- Burnout: Emotional Exhaustion, depression & PTSD symptoms could result from continued exposure to high stakes calls
- Helplessness: Inability to help during times when resources are limited or unavailable. Where protocol means delaying aid.
- High stakes multitasking: Listening, interpreting, recording, dispatching and updating responders at the same time
- Information Processing: Difficulties around processing information from incoherrent, panicked or innacurate calls. Operators must extract as much truthful and reliable information possible
- Information Density: Multiple sources of information all competing for attention, CAD, GPS, Radio and triage software. No method of gaining straightforward, dispatcher driven insights
- Oudated infrastructure: Dispatchers still rely on old systems with poor UX, slow response and limited response, desperate need for innovation
- Slow technology: AI triage and automated location tracking exist, but adoption is slow due to budget constraints & union resistance
- Feedback Loops: Operators rarely get insights post incident, making learning and emotional closure impossible
- Public misunderstanding: Role is undervalued, often seen as just operators and not life-saving professionals.
- Limited career mobility: Few advancement opportunities.

First Responders

- Emotional Trauma: Regular witnesses of death, injury and human suffering, which could potentially lead to psychological stresses
- High Adrenaline Fatigue: High intensity job role leaves workers in constant fight or flight, causing potential long term damage
- Unpredictability: Every environment is different, which means routine is lacking and requires continuous adaptation under pressure
- Inadequate staffing: Workload requires proper staffing and shortages can increase workload, extend response times and raise burnout risk
- Mental Health Support: Systems lack embedded psychological care after critical call outs/accidents
- Communication errors: Unclear information, dispatch errors, technical equipment failure can create dangerous confusions
- Public perceptions: Hostility, increasing violence, false calls and unrealistic expectations increase stress
- Resource constraints: Outdated gear, underfunded departments severely limit effectiveness and safety
- Administrative overload: Reporting and compliance work in excessive quantity can detract from patient care and increase worker stress
- Occupational Hazards: Diseases, hazardous materials, physical assaults are commonplace for all EMS responders
- Limited Career progression: Little room for advancement outside of leadership and management roles. Experienced personnel can end up leaving for less demanding roles
- Moral distress: Often required to make high pressure moral decisions and can be left feeling powerless when systemic failures prevent optimal patient outcomes

Civillians

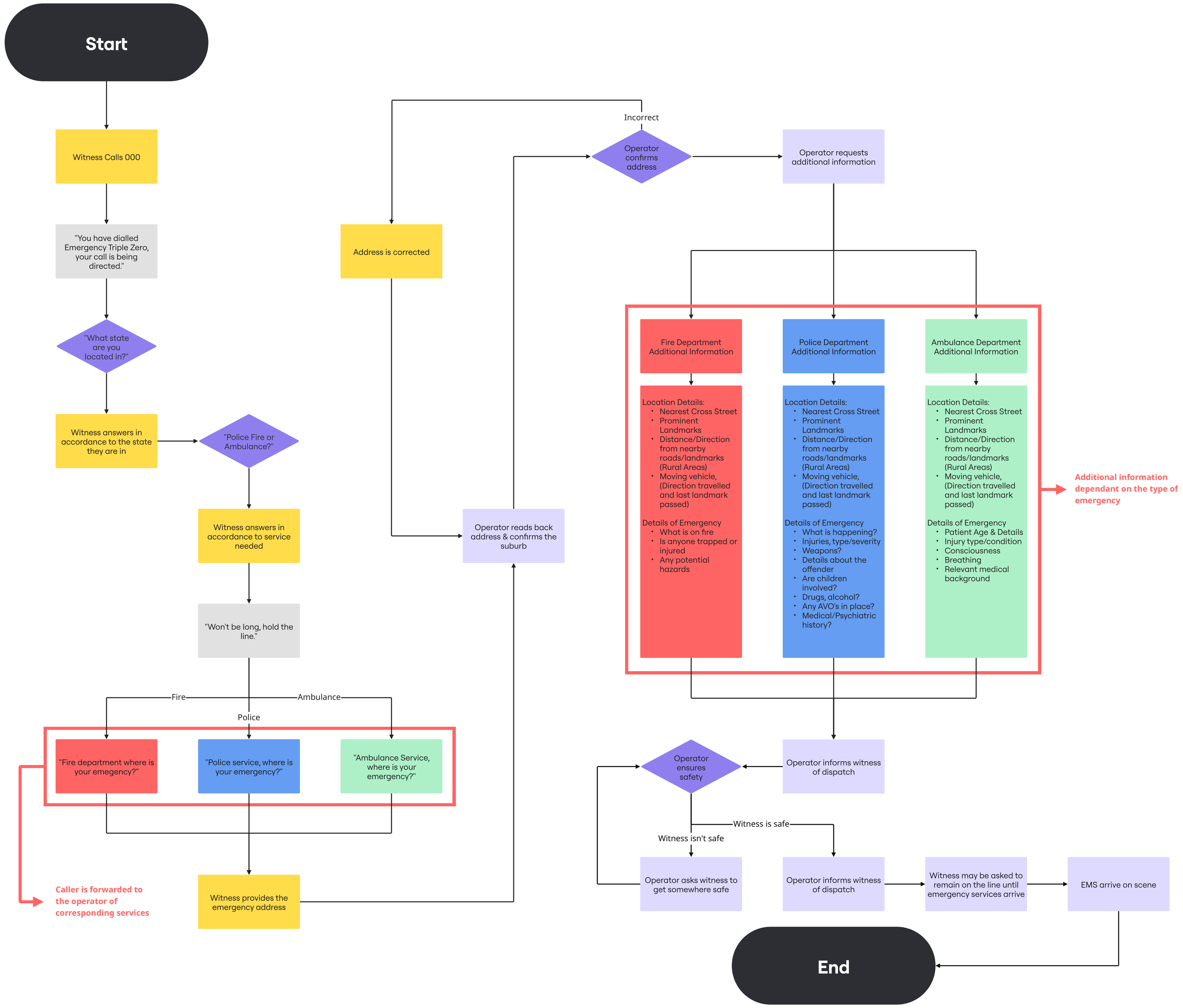
- Panic and Cognitive load: Fight-or-Flight paralysis, unable to communicate or recall instructions. Perceptive distortion due to panic, misjudging severity, providing inaccurate information, forgetting adresses etc.
- Communication Barriers: Language and accent gaps, speech under stress and children/elderly callers all contribute to higher communication difficulties
- Location Identification: Callers often unsure of precise locations, phone GPS often innacurate and panic causing difficulty communicating landmarks
- Uncertainty: Lack of basic first aid knowledge and fear of making things worse. Needing guidance tools in order to assist
- Difficulty with Instructions: Simple directions can be misunderstood or executed incorrectly. Background chaos can make it hard to hear.
- Emotional Isolation: Feelings of powerlessness during times where operators must stay focused on logistics
- Technological Gaps: Voice based systems lack innovation and limit operator's ability to assess the scene visually, no standard way of sending photos or sensor data
- Unclear expectations: Callers unsure what to do after hanging up. Frustration and fear can build up while waiting for arrivals
- Social factors: Members of the public may second-guess calling services due to legal consequences or social stigmas
- Environmental Barriers: Noisy environments can drown out audible reliant communication. Network outages block calls completely
- Lack of system feedback: Callers rarely getting updates or closure, discouraging future reporting or engagement

WEEK 3

Focus: Problem Mapping

FLOWCHART EMERGENCY CALL OPERATOR

Triple Zero Emergency Call Flowchart



WEEK 3

Focus: Emergency Department Responsibilities

Emergency Services in QLD Australia

Queensland Fire Services

The Queensland Fire Department (QFD) is a Queensland Government department under the Public Sector Act 2022. QFD was established as a department on 1 July 2024 by the Public Service Departmental Arrangements Notice (No. 5) 2024.

Responsibilities Include:

Emergency Response:

- **Firefighting:** Extinguishing fires using hoses, pumps, and other equipment, and ensuring the fire doesn't spread.
- **Hazardous Materials:** Handling incidents involving dangerous substances that could pose a risk to the public.
- **Technical Rescue:** Responding to specialized rescue situations like high-angle rescues or confined space incidents.
- **Other Emergencies:** Responding to a wide range of incidents, including medical emergencies, natural disasters, and other situations requiring immediate assistance.

Specific Tasks:

- **Community Education:** Delivering fire safety education programs to the public, particularly children, to promote awareness and safe practices.
- **Building Safety:** Enforcing building codes and conducting inspections to ensure fire safety standards in buildings.

Queensland Fire and Rescue. (2025). Qld.gov.au. https://www.fire.qld.gov.au/about-us/frontline-services/queensland-fire-and-rescue

Santos, V. E., & Son, C. (2024). Identifying firefighters' situation awareness requirements for fire and non-fire emergencies using a goal-directed task analysis. Applied Ergonomics, 114, 104136–104136. https://doi.org/10.1016/j.apergo.2023.104136

What we do. (n.d.). Www.fire.nsw.gov.au. https://www.fire.nsw.gov.au/page.php?id=46

Queensland Police Service

QPS leads law enforcement and community safety initiatives, including coordinating disaster management efforts.

Responsibilities Include:

- **Law Enforcement:** This includes enforcing traffic laws, investigating criminal activity, and apprehending offenders.
- **Maintaining Public Order:** This involves preventing and responding to situations that disrupt the peace, such as public disturbances or protests.
- **Community Safety:** This includes responding to emergencies, providing assistance to individuals in need, and working to prevent crime through community engagement.

Specific Tasks:

- **Patrolling:** Police officers regularly patrol public areas to deter crime and respond to incidents.
- **Investigation:** Police investigate crimes, gather evidence, and work to identify suspects.
- **Arrests:** Police have the authority to arrest individuals suspected of committing crimes.
- **Emergency Response:** Police respond to a wide range of emergencies, including accidents, natural disasters, and other urgent situations.
- **Community Engagement:** Police departments often work with communities to build relationships, address concerns, and prevent crime.
- **Traffic Management:** Police officers are responsible for enforcing traffic laws and managing traffic flow.
- **Crime Prevention:** Police work to prevent crime through community

About QPS. (2023). Qld.gov.au. https://www.policerecruit.qld.gov.au/about-qps

Brodeur, J.-P., & Kelling, G. L. (2018). Police | law enforcement. In Encyclopædia Britannica (p. 1). https://www.britannica.com/topic/police

Victoria Police. (2021, November 5). Roles and duties of police officers. Www.police.vic.gov.au. https://www.police.vic.gov.au/police-roles-duties

Queensland Ambulance Service

QAS provides emergency medical services, including paramedic and patient transport, across Queensland.

Responsibilities Include:

- **Emergency Response:**
  Ambulance services are the first point of contact for many medical emergencies, providing on-site care and transport to hospitals.
- **Pre-hospital Care:**
  Paramedics and other trained professionals stabilize patients at the scene, administer necessary medications, and perform other medical procedures before reaching the hospital.
- **Transport:**
  Ambulances are equipped to transport patients safely and comfortably, whether it's to a hospital, a specialist facility, or for inter-facility transfers.
- **Specialized Services:**
  Some ambulance services offer specialized transport, such as aeromedical services for remote locations or neonatal transport for infants.
- **Non-emergency Transport:**
  Ambulance services also handle non-emergency patient transport for various reasons, including transfers between hospitals or for medical appointments.
- **Coordination:**
  Ambulance services coordinate with other emergency services, hospitals, and healthcare providers to ensure a seamless continuum of care.
- **Community Support:**
  Many ambulance services also offer first aid training and other health-related programs to the public.

About ambulances in Australia. (2023, August 30). Www.healthdirect.gov.au; Healthdirect. https://www.healthdirect.gov.au/about-ambulances-in-australia

Ambulance | Emergency response services. (n.d.). Www.qld.gov.au. https://www.qld.gov.au/emergency/emergencies-services/response/ambulance

Queensland Ambulance Service. (2020). Qld.gov.au. https://www.ambulance.qld.gov.au/

Call up to Handover EMS Timeline

CALL | DISPATCH | RESPONSE | CARE | TRANSPORT | HANDOVER

1. Call Innitiation:
Reporting the Emergency:
This involves the initial call to emergency services, often by a member of the public, reporting a medical incident.

Call Taking:
The call taker gathers essential information about the incident, including location, nature of the emergency, and patient details.

2. Dispatch:

Dispatch Notification: The call taker relays the information to the dispatcher.

Resource Allocation: The dispatcher identifies the appropriate resources (ambulance, first responders) and dispatches them to the scene.

3. Response:
En Route:
The dispatched units (ambulance and/or first responders) travel to the incident location.
Arrival on Scene:
The ambulance and/or first responders arrive at the scene and begin assessment and initial care of the patient(s).

4. On-Scene Care:
Initial Assessment:
A rapid assessment of the patient's condition is performed, identifying any immediate life threats.
Treatment:
Essential medical care is provided, which may include administering medication, managing airways, controlling bleeding, or immobilizing injuries.
Patient Stabilization:
The patient is stabilized as much as possible before transport.

5. Transport:
Loading:
The patient is carefully loaded into the ambulance for transport to the receiving medical facility.
Transport Time:
The time it takes to travel to the designated hospital or medical facility.

6. Handover:
Arrival at Facility:
The ambulance arrives at the receiving facility.
Transfer of Care:
The patient is transferred to the care of the facility's medical staff, and the EMS crew provides a detailed handover report.
Turnaround:
The ambulance crew prepares for the next assignment, which may involve refueling, restocking supplies, and cleaning the vehicle.

WEEK 3

Focus: Detailed Response Mapping

Researching the EMS timeline in context of a Car Accident Emergency

Call Stage

CALL FOCUS: Car Accident

Looking into what's currently being implemented into the system, the flaws of the system, and emerging technologies being implemented to assist the field of the call stage of an emergency

	INITIATION	CONNECTION	INTAKE	TRIAGE	VERIFICATION	CLOSURE
CURRENT SYSTEM	• Person calls 000 manually (victim, witness). • Smart devices (e.g. iPhone, Apple Watch, Pixel) auto-detect crash and prompt emergency call. • Some modern vehicles trigger calls after airbag deployment.	• Telstra operator answers and asks: "Police, Fire, or Ambulance?" • Call is transferred to appropriate state-based Emergency Communication Centre. • AML (Advanced Mobile Location) sends location from smartphones automatically.	• Operator asks questions: "Where are you?", "What happened?", "How many people are injured?" • Data manually entered into Computer-Aided Dispatch (CAD). • Witness or victim verbally describes the scene.	• Operator assesses severity based on caller description. • Standard questioning guides (AMPDS, MPDS) used. • Flags: unconscious, trapped, bleeding, fire.	• Dispatchers may confirm crash with secondary reports or police/ambulance contact. • Use of CCTV, traffic cameras where available. • Manual checks for repeat calls to same incident.	• Operator gives safety advice, confirms help is on the way. • Caller may stay on the line until responders arrive (case-dependent). • Location and case ID logged into dispatch system.
SYSTEM FLAWS/ COMMON CHALLENGES	• Victim may be unconscious or unable to initiate. • No automated systems in most cars. • False triggers (e.g. dropped phones, roller coasters).	• Time lost during handoff between operators. • Call drops in rural or tunnel areas. • No universal connection protocol across devices or services.	• Inaccurate or panicked responses. • Language barriers or speech impairments. • Delays in communicating location or condition of victims.	• Human judgment errors due to stress or caller confusion. • Multiple reports of same crash may differ in severity. • No cross-validation of triage data from multiple sources.	• Duplicate reports create confusion. • Hard to verify silent or automated calls. • Minimal tech integration between agencies or systems.	• No formal digital confirmation or post-call data handoff. • Callers may hang up early or be cut off. • **No feedback loop to caller or reporting system.**
EMERGING TECHNOLOGIES	• Improved crash-detection algorithms (multi-sensor input). • Wider rollout of in-vehicle eCall systems. • Voice-activated crash reporting (e.g. "Hey Siri, call emergency").	• Satellite fallback for out-of-range areas (Apple's Emergency SOS via satellite). • Direct-to-dispatch routing for known crash types. • Network prioritization for emergency calls.	• AI voice transcription and keyword detection during calls. • Location-sharing links and live maps sent to caller (trial phase). • Real-time integration of wearable vitals data (e.g. heart rate, motion) if available.	• AI-assisted decision support systems for dispatchers. • Cross-referencing real-time crash sensor data (from car or phone). • Predictive triage using voice tone/emotion analysis (trialled in Europe).	• AI aggregation of multiple incoming reports to form a single verified incident. • Integration with connected vehicle platforms (e.g. Tesla, OnStar). • Smart infrastructure (traffic sensors, V2X) cross-verifies incidents in real time.	• Automated follow-up SMS with ETA, case number, instructions. • Two-way text updates with dispatch (pilot in Victoria). • Real-time tracking of emergency vehicles (via app or link) for witnesses or family.

Researching the EMS timeline in context of a Car Accident Emergency

Dispatch Stage

DISPATCH

	ALERT RECEPTION	RESOURCE SELECTION	CREW NOTIFICATION	CONFIRMATION	PRE-ARRIVAL INFO	MONITORING
CURRENT SYSTEM	• Computer-Aided Dispatch (CAD) receives input from 000 call or automated system. • Dispatcher begins incident log (timestamp, location, basic info). • Call audio may be recorded and attached.	• Dispatchers follow protocols (AMPDS, MPDS, ARP) to select police, ambulance, fire. • Selection based on severity, location, proximity. • CAD recommends units based on pre-set rules.	• Units receive call via radio, MDT (Mobile Data Terminal), or pager. • Details include location, priority level, basic case info.	• Crew verbally confirms via radio or presses “accept” on MDT. • CAD system logs timestamp of acceptance.	• Dispatch updates sent via radio or MDT. • Crews may receive updates from other services (e.g., fire gets ambulance info). • Traffic conditions not always integrated.	• Vehicle GPS sends location back to CAD. • Dispatcher monitors unit status: en route, on scene, transport, clear. • Status manually updated by crew via MDT or radio.
SYSTEM FLAWS/ COMMON CHALLENGES	• Manual data entry can cause delays or errors. • Delay between call initiation and logging in CAD. • Sometimes alerts are incomplete or duplicated.	• Protocols may under- or over-prioritize cases. • **Nearby units may be unavailable or misclassified.** • Doesn't account for real-time traffic or situational complexity.	• **Gaps between CAD update and crew reception.** • Pager systems are outdated and one-way. • Limited context (no audio, images, or caller tone).	• **If no response, dispatcher must follow up manually.** • Radio channel congestion can delay confirmations. • Silent callouts (overnight) may go unnoticed longer.	• Information may be delayed or inconsistent. • Not all updates reach all agencies. • No multimedia — limited to text or voice.	• **Manual updates prone to error or delay.** • Dispatchers must juggle many units at once. • **No automation for route re-optimization.**
EMERGING TECHNOLOGIES	• Real-time AI transcription directly into CAD. • Automated data feeds from crash detection systems or connected vehicles. • Audio-to-text summarization linked to case files.	• AI-enhanced dispatch recommendations (based on past outcomes, traffic, hospital load). • Integration with predictive analytics for surge/crisis events. • Real-time availability updates from responder devices (IoT, tablets).	• App-based alerts with rich media (images, caller audio, GPS route). • Integration with smartwatches or wearable displays. • Haptic alerts for noisy environments or deaf responders.	• Automated read-receipts and fallback messaging. • Redundant confirmation via multiple channels (radio + app). • AI-predicted response gaps based on historical non-response.	• Live GPS map overlays with hazard zones, traffic, live drone feeds (in some trials). • Real-time video or audio from the scene (if bystander shares via 000 link). • Shared digital dashboard for multi-agency operations.	• Auto-status updates based on geofencing (e.g. "on scene" triggered by location). • AI-based route updates based on traffic and road closures. • Shared real-time map across dispatch, hospitals, and crews.

Researching the EMS timeline in context of a Car Accident Emergency

Response Stage

RESPONSE

	MOBILISATION	NAVIGATION	EN ROUTE COMMUNICATION	STAGING	ARRIVAL	SCENE SAFETY ASSESSMENT
CURRENT SYSTEM	• Once accepted, crews begin preparing and departing to the scene. • Vehicle status marked as "en route" in CAD. • Equipment checks are minimal if call is urgent.	• Crews use in-vehicle GPS or Google Maps/Waze on devices. • Some CAD systems provide GPS directions via MDT. • Routing may be done manually by drivers based on experience.	• Radio and MDT used to communicate with dispatch. • Updates may be received from other agencies en route. • Dispatcher may relay bystander updates if available.	• Units may stage a safe distance from crash (especially for fire or hazmat). • Dispatch may coordinate multi-agency staging locations. • **Visual assessment from a distance before entering scene.**	• Crew reports "on scene" via radio or MDT. • Visual scene survey conducted by team leader. • Other units (police/fire) coordinated by radio or local command.	• Initial safety checks: fire, fuel, electricity, unstable vehicles. • PPE used; hazard markings placed. • Coordination with fire/police for traffic and hazard control.
SYSTEM FLAWS/ COMMON CHALLENGES	• **Manual updates cause lags in dispatch awareness.** • Delays due to unclear directions or incorrect location data. • Limited integration with hospital or multi-agency partners at this stage.	• GPS errors in rural areas or tunnels. • Real-time traffic not always synced with CAD systems. • No system-wide avoidance of hazards like fallen powerlines or blocked roads.	• Radio channel congestion. • **Hard to manage complex info (e.g., updates from multiple witnesses).** • Delays in critical info (e.g., number of patients, fire risk, trapped occupants).	• Lack of unified staging zones in multi-vehicle responses. • Staging may block roadways or delay access unintentionally. • No real-time updates on hazards during staging.	• Manual status update may be forgotten in high-stress. • Disjointed coordination if multiple agencies arrive simultaneously. • **Limited aerial or wide-view scene awareness on arrival.**	• Incomplete info on invisible hazards (airbags, toxic fumes). • High variability in safety assessments across teams. • Poor visibility or environmental conditions reduce safety accuracy.
EMERGING TECHNOLOGIES	• Automated departure detection via vehicle movement sensors or geofencing. • Real-time inventory checklists via in-vehicle tablets or wearable tech. • Integrated dispatch systems for simultaneous multi-agency mobilization.	• AI-optimized routing using real-time traffic, weather, road closures. • Integration of smart infrastructure for rerouting (V2X, connected traffic lights). • AR-assisted navigation through heads-up displays.	• Push-to-talk apps with live transcription and location tagging. • Secure multimedia messaging between dispatch and crew. • AI-assisted info filtering to prioritize critical updates in real-time.	• Digital staging zones coordinated via geofencing apps. • Drone-assisted scene scanning for safe approach points. • Live traffic rerouting alerts for bystanders/drivers.	• Auto-status trigger using GPS geofence ("on scene" logged automatically). • **Shared digital scene map view across agencies.** • Drones or smart dashcams livestreaming for command review.	• Wearable sensors to detect chemicals, airbag tension, temperature spikes. • AR goggles highlighting hazard zones via AI scene scanning. • Smart cones/barriers that detect motion or intrusion.

Researching the EMS timeline in context of a Car Accident Emergency

Care Stage

CARE

	PRIMARY ASSESSMENT	STABILISATION	SECONDARY ASSESSMENT	TREATMENT	PREPERATION FOR TRANSPORT	ONGOING MONITORING
CURRENT SYSTEM	• ABCDE approach (Airway, Breathing, Circulation, Disability, Exposure). • Manual checks: consciousness level, airway patency, bleeding. • Use of basic tools (pulse oximeter, BP cuff, stethoscope, etc.).	• Airway adjuncts, oxygen, wound packing, pelvic binders, C-spine precautions. • Manual methods for haemorrhage control and positioning. • Protocols for pain relief, CPR, defibrillation if needed.	• Physical inspection, SAMPLE and OPQRST history. • Neurological checks (pupil response, GCS). • Manual documentation or MDT entry.	• IV/IO access, pain relief (methoxyflurane, morphine, fentanyl), glucose, fluids. • Splinting, immobilisation, oxygen, nebulisers. • Defibrillation and cardiac meds if indicated.	• Secure to stretcher or scoop with straps and blankets. • Manual lifting or mechanical assistance (e.g., lift-assist stretchers). • Documentation prepared for handover to hospital.	• Periodic vitals via monitor or manual checks. • Re-assessment every 5–15 minutes depending on acuity. • Vitals written or typed into patient care record.
SYSTEM FLAWS/ COMMON CHALLENGES	• Time-critical issues may be missed in chaotic environments. • Limited tools for non-obvious internal injuries. • Hard to assess when multiple patients are involved.	• Limited advanced airway tools in basic units. • Pain management often delayed or underutilised. • Poor visibility or tight space can limit efficacy.	• **Time pressure may limit thoroughness.** • History may be incomplete or unavailable (e.g., unconscious or confused patient). • Documentation can be delayed or lost.	• Limited drug options depending on responder qualification. • Environmental challenges (e.g., cold affects IV flow, rain affects sterility). • Equipment limitations in remote or rural settings.	• Risk of movement-related injury if patient not stabilised. • **Communication gaps with receiving facility.** • Manual lifting risks responder injury.	• Inconsistent monitoring in chaotic scenes or transport. • Vitals not always communicated clearly or in real-time. • Delays in flagging deterioration.
EMERGING TECHNOLOGIES	• Wearable triage patches to detect vitals automatically. • Smart stethoscopes and AI-enhanced diagnostics. • AR overlays for visual prompts during assessment.	• Compact portable ventilators with auto-titration. • Smart tourniquets that self-regulate tension. • Injectable clotting agents and hemostatic tech (some still experimental).	• Voice-to-text hands-free documentation apps. • Smart wearables that record ongoing vitals + body position data. • Facial recognition integration for ID and medical history (in trials).	• AI-driven clinical decision tools for treatment support. • Compact multi-use drug kits with barcode scanning. • Portable ultrasound for FAST scans in trauma.	• Smart stretchers with vitals monitoring. • Auto-loading or robotic lift systems to reduce strain. • Digital handover forms synced with hospital EMR.	• Continuous wireless vitals monitoring patches. • AI-based early warning systems to flag deterioration. • Live streaming of vitals to hospital dashboards pre-arrival.

Researching the EMS timeline in context of a Car Accident Emergency

Transport Stage

TRANSPORT

	LOAD PATIENT	DEPART SCENE	EN ROUTE CARE	COMMUNICATE WITH HOSPITAL	ADJUST ROUTING (IF NEEDED)	ARRIVAL AT FACILITY
CURRENT SYSTEM	• Use of stretchers (manual or power-assisted), scoop stretchers, spinal boards. • Lifting protocols followed to minimise responder injury. • Safety straps, oxygen, IV lines secured for movement.	• Manual status update via MDT or radio ("Transporting"). • Navigation activated to hospital. • Final quick scan of scene to ensure all patients are accounted for.	• Ongoing monitoring (vitals, IV lines, pain relief). • Basic to advanced life support depending on responder scope. • Manual documentation and re-assessments every few minutes.	• Radio or phone report given to emergency department (ISBAR format). • May also send via digital ePCR (Electronic Patient Care Record). • Often includes ETA, injuries, vitals, interventions.	• Manual contact with dispatch for rerouting (e.g. bypass to trauma centre). • Occasional rerouting due to traffic or capacity issues. • Driver often responsible for route decisions.	• Verbal handover using ISBAR. • Patient moved into ED via stretcher. • ePCR or handwritten notes passed to clinical team.
SYSTEM FLAWS/ COMMON CHALLENGES	• Lifting injuries to responders still common. • Challenging terrain (e.g. stairs, uneven ground) complicates loading. • Patient discomfort or pain worsened during movement.	• Human error in failing to update CAD/dispatch. • Last-minute delays (equipment, bystanders, secondary patients). • Traffic conditions not always considered.	• Motion makes care difficult (IVs, auscultation, assessments). • Inconsistent documentation or missed changes. • Poor lighting or access to some parts of the patient.	• Radio channels may be busy or unclear. • No visual of patient or equipment status. • Handoff data may be delayed or miscommunicated.	• **Delays in recognising need to divert (e.g. hospital on bypass).** • **Limited visibility into live ED capacity or diversions.** • **Navigational tools may not be EMS-optimised.**	• Handover may be rushed or fragmented. • No formal record of handover quality or completeness. • Physical congestion in triage zones can delay transfer.
EMERGING TECHNOLOGIES	• Powered stretchers and auto-loading systems reduce manual lifting. • Smart loading platforms for terrain adjustment. • Patient comfort sensors to monitor movement-induced pain.	• Auto-status triggers when vehicle begins moving. • Scene-completion prompts before departure (checklist alerts). • AI-driven dispatch sequencing to minimise congestion from multiple units.	• Stabilised equipment mounts and lighting for mobile care. • Wireless vitals streaming with automatic alerts. • Voice-guided care protocols via headset to support solo medics.	• **Live video/telehealth feeds to ED from the ambulance.** • Auto-generated handover summaries from digital records. • Real-time vitals dashboards in the receiving hospital.	• CAD-integrated hospital capacity systems (real-time updates). • AI-routing engines factoring traffic + hospital loads. • Voice alerts in the cab warning of bypassed or unsuitable facilities.	• Digital handover tools with read receipt by ED staff. • Handover checklist apps to prevent missed information. • Auto-unload stretchers that sync with ED entry systems.

Researching the EMS timeline in context of a Car Accident Emergency

Handover Stage

HANDOVER

	NOTIFICATION	PATIENT TRANSFER	VERBAL REPORT	DOCUMENTATION	QUESTIONS/ CLARIFICATIONS	CLEAR & RESET
CURRENT SYSTEM	• Phone or radio contact to ED using ISBAR or ETA format. • Manual entry into hospital alert systems (if available). • Notification timing varies (pre-load or en route).	• Manual transfer using stretcher to ED trolley. • Team assist with slide sheets or transfer boards. • Priority based on acuity (resus > fast-track).	• ISBAR, ATMIST, or other structured formats. • Delivered quickly, often under time pressure. • Sometimes accompanied by verbal summary of scene.	• ePCR (Electronic Patient Care Record) or paper-based form. • Sent digitally or handed over physically. • Includes vitals, treatment timeline, observations.	• Happens at bedside or in triage. • Often verbal, untracked. • Depends on availability of paramedics.	• Vehicle cleaned, restocked, stretchers reset. • Status updated to "available" in CAD system. • Debrief or rest break depending on policies.
SYSTEM FLAWS/ COMMON CHALLENGES	• Overloaded channels; calls may be missed or delayed. • No confirmation that message was received or understood. • Limited patient detail shared in early notification.	• Delays if beds unavailable (hallway care or ramping). • Injury risk during lifts or awkward spaces. • Difficulties securing equipment (IV lines, monitors) during move.	• Incomplete or rushed, especially during high ED load. • **No formal capture** (unless staff take notes). • **Risk of details being lost or misunderstood.**	• Some ePCR systems are delayed or incompatible with hospital EMR. • Paper forms risk loss or legibility issues. • ePCR upload delays can result in care gaps.	• Paramedics may leave before questions arise. • **Unclear documentation leads to inconsistent info.** • No formal process for follow-up clarification.	• Limited downtime before next job, especially during surges. • Cleaning/restocking may be rushed or incomplete. • High-pressure reset > burnout risk over time.
EMERGING TECHNOLOGIES	• CAD-integrated digital pre-notification systems (auto-send ETA + patient info). • Mobile app alerts that include case type, acuity, and live vitals. • Two-way confirmation systems with read receipts for alerts.	• Smart stretchers with built-in transfer features. • ED auto-bed assignment tools linked to pre-alerts. • Equipment syncing tools to auto-log transfer of monitors, devices, etc.	• Voice-recorded handovers for later review. • AI-assisted prompts to ensure complete reports. • Digital shared dashboard so handover appears on ED screen.	• EMR-integrated ePCR for direct sync into hospital systems. • Auto-filled timelines based on onboard monitors. • Patient wristband QR codes to pull up pre-hospital data instantly.	• Handover messaging portals between EMS and ED staff. • Shared patient timeline tools showing real-time history. • Delayed-access ePCR chat features for clarification without callback.	• Smart restock checklists and inventory-tracking. • Automated infection control systems (UV or fog-based disinfection). • Wellbeing alerts to prompt crew rest or mandatory decompression after critical jobs.

WK 3. 5/08

Lecture

Listen to ethics lecture

Benchmarking → Pt 1 of research

Engage & motivate → Give your best
↳ "Kick-Butt"

* Be aspirational, push yourself

Aim to deploy primary research this week
↳ consent forms

Why Research?

↳ Justify position
↳ Focus an approach
↳ Reveal in-depth data
↳ identify value/meaning
↳ Understand user needs/hidden needs
↳ Discovering something novel

Benchmarking
1. identify strengths/weaknesses of ideas
2. Set aims, obj
3. ~~understand~~ identify innovation in industry standards
4. Learn from the best in industry
5. Avoid repeating existing designs
6. Spy competition

Cont

Benchmarking – How?

↳ Determine product category / tech designed for
↳ Determine already existing products in category
↳ Collect images of products/services
↳ Collect information
↳ Identify function, features, aesthetic, form, style, price, etc
↳ Identify similarities / differences
↳ Identify gaps in the market
↳ Generate a visual representation of benchmark research

* Table comparison
* Radar graph
* Matrix graph
* Matrix/graph

Triangulation methods 2+ methods
↳ Survey
↳ interviews
↳ Observations
↳ Think/talk aloud

Surveys
Qualtrics, Out by survey, survey monkey, google forms

Cont
Studio

Research pathway (road map)

Broad
↳ Emergency services area
↳ Emergency departments
↳ What exists, process, flows
↳ Emerging technologies

Chat with Marcella

Flow chart of the critical moment

Workflows in different countries
↳ where are we falling short

What other issues impede service response
↳ Coordination

Call service research

Reduce time for help

What connects Call Service to EMS

Judgement

Drone, call service, EMS vehicles,

Assess procedures in these topics

"Early Reconnaissance"

Cont

Early Reconnaissance:

Key aspects
↳ Situational awareness
↳ Hazard assessment
↳ Resource allocation
↳ Incident command
↳ Public safety

Methods of Reconnaissance
↳ Aerial
↳ Ground
↳ Remote Sensing
↳ Info gathering

Example scenarios

↳ Bushfires
↳ Hazardous materials
↳ Search & rescue
↳ Car crashes

Cont

Tutor chat with Dr Chris

↳ Implementation of parametric design & topology optimisations

* Needs to make sense for the context

*Top → email with student email
Rhino grasshopper → student license

6/08

EMS first response → International innovation

↳ Top innovations
* Artificial intelligence
* Mobile integrated health care
* Data driven innovation
* Pre-hospital & hospital interoperability
* National Emergency Response Information System (NERIS)

Top Countries

↳ High tech approach Japan & USA
↳ High touch approach: India & Sub-Saharan Africa

High tech approach:
* Advanced Technology – Use of sophisticated medical devices & telehealth
* Systemised Training – Highly structured/comprehensive paramedic & EMT education

High touch approach:
* Resourcefulness – innovating within constraints, using motorcycles & bikes
* Community engagement – leverage of local volunteers for initial care & support

Cont

Upon reflection: should do this type of research digital in DOE

Top EMS Response Innovations & Origins:

1. Drone Delivery of AEDs & Medical Supplies
↳ Innovation:
Use of autonomous drones to deliver Automated External Defibrillators (AEDs) & other emergency medical supplies to the scene faster than ambulances
↳ Country:
Sweden
↳ "Everdrone" in Sweden partnered with EMS dispatch centres. Shown to reduce time to scene by up to 2-6 minutes

2. AI Enhanced Emergency Dispatch
↳ Innovation:
AI analyses of voice tone, breathing & keywords to detect severe emergency events
↳ Country:
Denmark & Finland
↳ Example:
Corti in Denmark, flags cardiac arrest situations via AI

3. Telemedicine in Ambulances (Tele-EMS)
↳ Innovation:
High-Bandwidth communication system allow paramedics to consult live with doctors via video during transport
↳ Country:
United States & Germany
↳ Example:
ET3 (Emergency Telehealth And Navigation) in the US allows EMS crews to avoid unnecessary hospital visits

Cont

4. Mobile Stroke Units (MSUs)
↳ Innovation:
Specialised ambulances equipped with CT scanner & Lab for on-site stroke analysis
↳ Country:
Germany
↳ Example:
Berlin's STEMO (stroke emergency mobile) reduced time to thrombolysis by 25-30 minutes. Replicated in the US, Australia & Norway

5. Integrated Smart Dispatch Systems
↳ Innovation:
Real-Time GPS & AI-Assisted dispatch systems that integrate with traffic control systems, hospitals & public safety networks.
↳ Country:
Singapore
↳ Example:
SCDF's "myResponder" app & smart routing algorithms dynamically deploy resources based on real-time congestion & incident risk

6. Wearable Health Alerts for Early EMS Activation
↳ Innovation:
Smart watches or wearables that can detect irregular heart rhythms, falls, or trauma & auto-alert EMS.
↳ Country:
~~Singapore~~ United States
↳ Example:
Apple Watch's fall detection & arrhythmia alerts to dispatch EMS

Cont

7. Community first responder networks via App
↳ Innovation:
Mobile apps to alert nearby trained civilians before EMS arrives
↳ Country:
Switzerland
↳ Example:
GoodSAM (UK) and First Responders.ch (Switzerland) reduce time to CPR & AED Delivery

8. Pre-Hospital Blood Transfusions
↳ Innovation:
EMS teams equipped to perform blood transfusions on trauma patients at the scene
↳ Country:
United Kingdom
↳ Example:
London's Air Ambulance carry type O blood & plasma for early transfusion in haemorrhagic shock

9. AI-Driven Predictive EMS Deployment
↳ Innovation:
Machine learning models predict areas of high EMS need based on historical data, weather, events & population activity
↳ Country:
Canada
↳ Example:
Toronto EMS uses predictive analytics

Cont.

10 EMS Robots for Hazardous Environments
↳ Innovation:
Autonomous or remotely operated robots that assess & assist in toxic, radioactive, or unstable environments
↳ Country:
Japan
↳ Example:
After Fukushima, Japan developed robotic EMS support for disaster zones, with real-time vital monitoring & communications

Australian EMS Innovations:

Mobile Stroke Unit
↳ Melbourne & Victoria
* Description: Australia's first fully equipped stroke ambulance with onboard CT scanner & stroke specialists.
* Highlights: Since 2017, patients receive treatment up to [illegible] minutes faster than hospital care - with many treated within the "golden hour"
* Ecosystem: Ambulance Victoria in collab with royal melbourne hospital & research institutions

Development of lightweight mobile CT scanners (Micro-X, Adelaide)
↳ Adelaide & melbourne
* Description: Compact, carbon-neutral, fits inside standard ambulances & delivers brain scans in ~[illegible] seconds
* Timeline: Clinical trials planned for 2025

Telemedicine & Digital diagnostics for remote EMS
↳ Description: Telemedicine via 4G/5G/[illegible] networks, provides real-time support via diagnostics & specialist support.
Additional assets: ACEM, Australasian College for Emergency Medicine supports emergency telehealth to facilitate telehealth

Cont.

Telestroke Services in Queensland
↳ Queensland
* Description: Regional hospitals use to connect rural patients & clinicians with [illegible] neurologists, ~~[illegible]~~ accelerating clot-dissolving treatment
* Impact: ~100 patients treated in the first weeks of launch late 2024

Drone Trials for EMS Support
↳ NSW Ambulance EPACS
* Description: NSW Ambulance trials drones in search & rescue, med supply delivery & preliminary situational awareness assessments
* GOAL: Reduce reliance on fuel-intensive helicopters & improve response in remote terrain

7/08

Primary Research:

What info do I need?
↳ Looking to learn more about the early stages of emergency first response, including before
* What procedures are followed?
* What information do you require?
* How does the information help?
* How and when do you receive a report after the incident?
* What slows down the process?
* Common challenges/obstacles?
* Scripts?
* What happens after the call?
* How do you connect different services?
* Are you kept in the loop after
* Any data collection?
* How does this data help [illegible]

~~[illegible]~~ Cont.

* Any current tech implementations?

Step back

How to conduct primary research:

1. Define Research problem & objectives
↳ What problem do you want to address?
↳ Goals & objectives of research

Research problem: Desktop data lacks information into actual user process & experiences
* Process
* Struggles
* Flaws
* What works well/what doesn't
* What isn't thought about?

Research Question

Defining research question: Feel like we need to have this more defined
↳ Synopsis form ~~[illegible]~~ and this:

"How might we improve emergency services response times/effectiveness by implementing new assisting tools & technologies?"

* Think maybe include a bit more focusing? *

↳ In what ways can emerging technologies support emergency services in improving early crash detection, data collection & response coordination in Urban Australia

Cont.

Isn't quite refined yet I feel

What direction to take? ~~[illegible]~~
↳ improving research question
* Tackles a pressing or overlooked problem
↳ (could be discovered via primary research?)
* Invites innovation
* Clear but layered, hinting at real world impact
* Future relevance (scalability, adaptability, policy implications)

"How can emerging, multimodal technologies be integrated to transform early ~~[illegible]~~ surveillance & emergency response coordination in Australia, while building ~~scalable~~, future-~~[illegible]~~ resilient innovation in emergency services?"

Emergency types: natural / man-made fire
↳ Climate change

First response
Surveillance
Coordination

Not only emergencies

LECTURE CATCH UP: (WK 2)
Ethics

Academic honesty
↳ Plagiarism
* Presenting someone else's work as own (cheating, grounds for failure, suspension, expulsion)

Read scholarly documents thoroughly

Good research is ethical
↳ Honesty
↳ rigor
↳ Transparency
↳ Fairness
↳ Respect
↳ Recognition
↳ Accountability
↳ Promotion

cont.

Need to acquire consent ~~[illegible]~~ from your participants. Forms of clear agreement & keep forms

To complete:

Must:
- Informed consent form (signed as consent to participate) ✓
- Recruitment ~~[illegible]~~ flyer document (info form to be read/understood)
- Relevant method forms (exploring surveys, focus group, etc.)

If necessary:
- Recruitment email information (if contacting via email or social media [illegible])
- Image release form (if taking photos/videos of participant.)

What you need to do:

Provide the following information:
↳ Accurate & consistent information about your project/experiment & what participants are required to do
↳ Inform participants that their information will be used for the purpose of research in this subject only & for design ideation
↳ Their response/involvement will not affect their relationship with QUT in any way
↳ Their involvement is voluntary & they are free to withdraw at any point
↳ Make sure they understand the information & sign a form

What to do next:

1. Research the topic further (articles, resources, information etc.)
2. Complete project synopsis
3. Benchmark existing products
4. Read on how to conduct primary research
5. Decide how I will conduct research
6. Plan how I will employ research

WEEK 4

Focus: Triple Zero Call Process

About Triple Zero (000)

Triple Zero (000)

Triple Zero is Australia's main emergency service number.
You should call 000 when:

- Someone is seriously injured or in need of urgent medical help
- Your life or property is being threatened
- You have just witnessed a serious accident or crime

In **non-urgent situations**, you should look up the number of local corresponding police, fire or ambulance services.

Additional Service Numbers:

- 112 can only be dialed on a mobile phone
- 106 can only be used with a teletypewriter or device for the deaf. The service is meant for people who are deaf or have a hearing/speech impairment

000 Can be called from any fixed or mobile phone and certain VoIP and satellite services. And additionally can be called from any 'handheld' satelite phone.

The **Emergency+ app** is an additional way for you to contact emergency services. The advantage of this service is that it uses your smartphone's GPS to relay location data to emergency services.

Text is not an option of contacting 000.

When you dial 000,
You will first hear a pre recorder message, "You have dialed emergency Triple Zero. Your call is being connected."

The call will be answered by a Telstra operator who will ask which service you need. Additionally you may need to specify which state/town you are calling from. After this, the operator will connect you to the requested emergency service.

In extreme events, there may be short delays before your call is answered due to increase call traffic. You should remain on the line to keep your place in queue.

Australian Communications and Media Authority (2021). Emergency calls | ACMA. [online] Acma.gov.au. Available at: https://www.acma.gov.au/emergency-calls.

How to call 000

Stay focused, stay relevant, stay on the line.
The Triple Zero (000) service is the quickest way to get the right emergency service to help you. You can contact Police, Fire or Ambulance in life threatening or emergency situations.

Assess the situation.
Is someone seriously injured or in need of urgent medical help?
Is your life or property being threatened?
Have you just witnessed a serious accident or crime?

If you answered YES call Triple Zero (000).

Make your call.

- Stay calm and call Triple Zero from a safe place.
- When your call is answered you will be asked if you need Police, Fire or Ambulance.
- If requested by the operator, state your town and location.
- Your call will be directed to the service you asked for.
- When connected to the emergency service, stay on the line, speak clearly and answer the questions.
- Don't hang up until the operator tells you to do so.

Providing location information.

- You will be asked where you are.
- Try to provide street number, street name, nearest cross street and the area.
- In rural areas give the full address and distances from landmarks and roads as well as the property name.
- If calling from a mobile or satellite phone, the operator may ask you for other location information.
- If you make a call while travelling, state the direction you are travelling and the last motorway exit or town you passed.

Instructions from the operator
The operator may ask you to wait at a pre-arranged meeting point to assist emergency services to locate the incident

www.triplezero.gov.au. (n.d.). How to Call 000. [online] Available at: https://www.triplezero.gov.au/triple-zero/How-to-Call-000.

Critical Information

Nature of the Emergency.
Clearly state what is happening, e.g., fire, accident, medical emergency.

Location.

- Street number, street name, nearest cross street, and suburb/town.
- In rural areas, give full address, distances from landmarks, and property name.
- If calling from a mobile or while traveling, provide direction of travel and last known location.

Type of Service.
Specify what service is needed; Police, Ambulance, Fire.

Additional Information (Normally for Ambulance).
Details of patient; Age, Conscious, breathing, and any relevant medical history

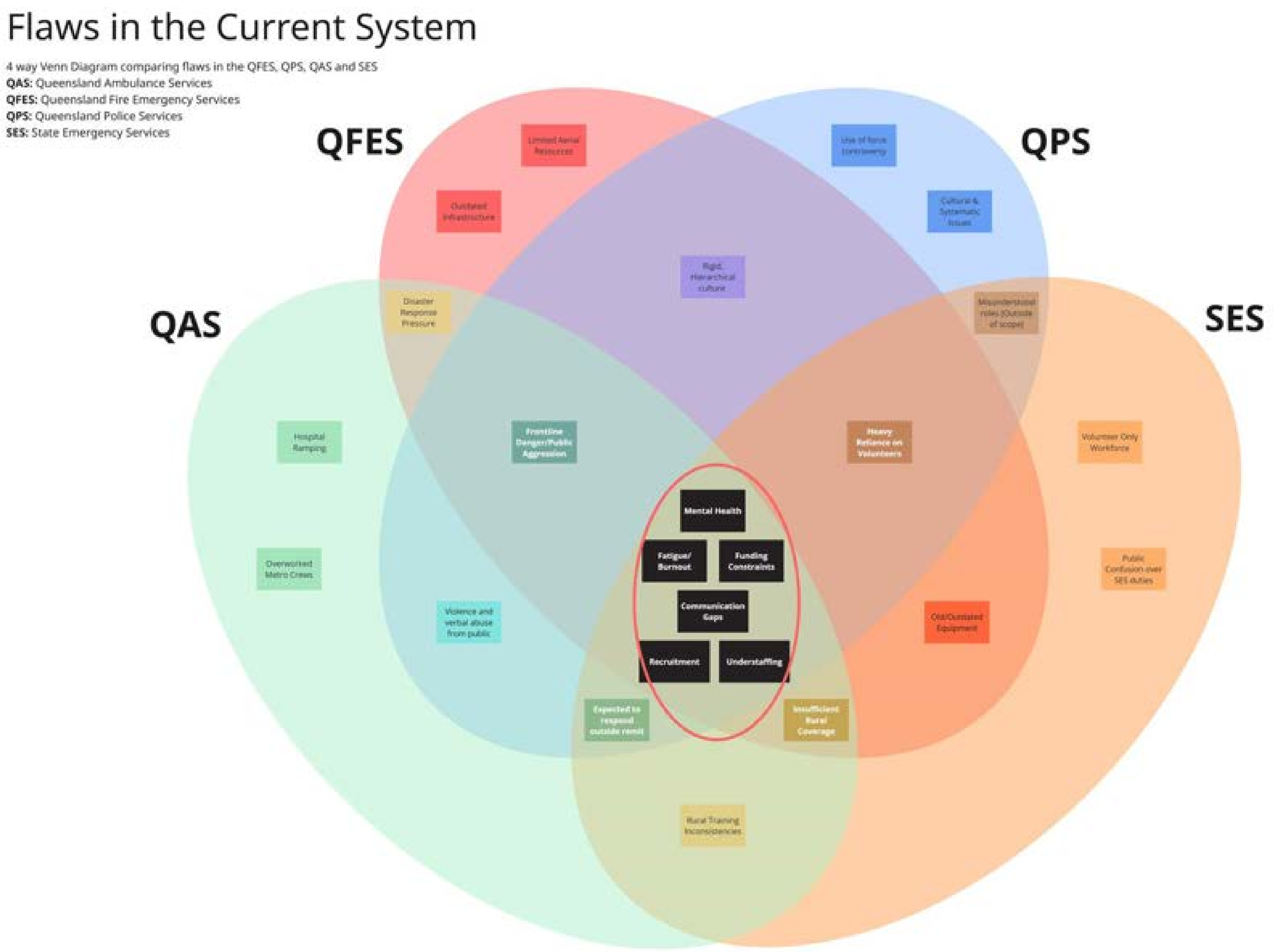
Stay on the line.
Don't hang up until the operator tells you it's safe to do so.

Follow Instructions.
Pay attention to and follow any instructions given by the operator.

EMERGENCY EMERGENCY+ SEE OVER FOR MORE IMPORTANT DETAILS SEE OVER FOR MORE IMPORTANT DETAILS Triple Zero QFE00017 1-17B. (n.d.). Available at: https://www.fire.qld.gov.au/sites/default/files/2021-05/ENG000.pdf.

www.healthdirect.gov.au. (2023). Calling triple zero (000). [online] Available at: https://www.healthdirect.gov.au/

4 Way Venn diagram of EMS Services (SES included)



Primary Research Outreach

Looking for interviewees

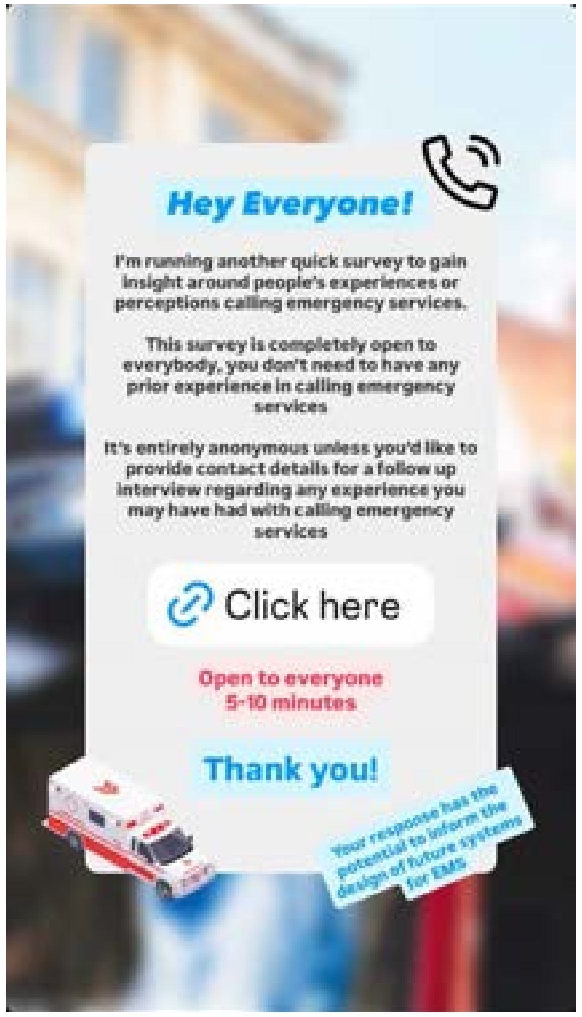
An attempt at outreach was made towards those involved in emergency service industries. This post was made via instagram and unfortunately yielded no responses.

Later aimed towards those involved in an emergency scenario via a public survey where participants were given the option to provide additional information in the even they were willing to participate further in an interview.

All outreach was conducted in an ethical and optional sense, where participants were allowed to withdraw at any moment.

Looking for survey participants

Additional Instagram outreach was conducted via the use of surveys open to the public. These surveys centered around people's perceptions surrounding drone use in emergency contexts, and additionally people's experiences or concerns regarding emergency service triple zero calls.



WEEK 5

Focus: Detailed Response Mapping

Market Research: Detection/Reporting

Mobile "Surveilance"

Need to be careful in regard to public privacy

Consumer available products?

Garmin styling is very cool

Drone

Beacon

Camera

Sensor

Software

Software solutions

PulsePoint RESPOND

CARBYNE

RapidSOS

OnStar

LIVE911

Market Research: On-Scene Awareness


Mobile monitoring is a cool concept




Viewing on multiple light spectrums

Ground version of mobile monitoring




Drone

Scanner

Detectors

Video

Wearable

Software

Software solutions

DRONESENSE GEOSUITE

ResponderXL

live earth

ArcGIS Dashboard

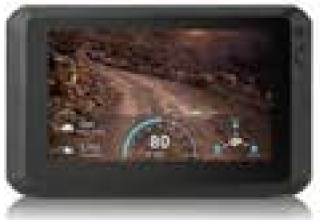
WEEK 5

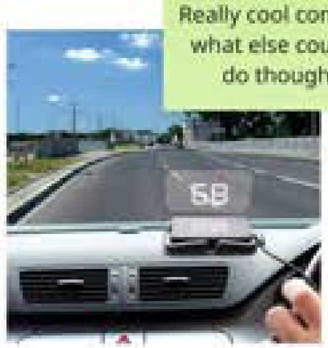
Focus: Detailed Response Mapping

Market Research: Navigation & Access

Love the Garmin styling

Blueforce Tactical Beacon





Really cool concept! what else could it do though?

Paid subscription on safety? Yikes

Bit too futuristic, need something that would be able to scale with time

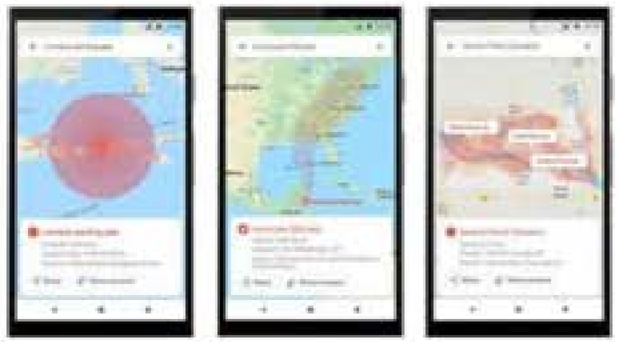
Radio

Phone

Wearable

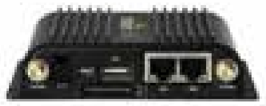
Software solutions

RapidDeploy



Market Research: Network/Integration

Not an expert on this stuff, very technical



LTE/Wi-Fi mesh network nodes

Mobile units would be critical for areas with low network access

Looked into node based network communication

Would be a great system to communicate between points for long distance communication during potential outages

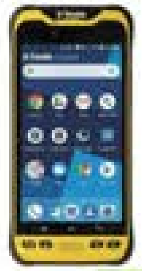
Software solutions

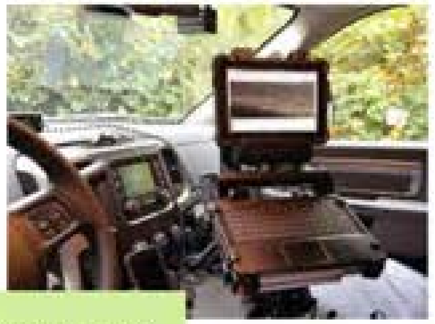
RapidSOS · CARBYNE · FIRSTNET Built with AT&T · IncidentOne powered by SpectraRep

WEEK 5

Focus: Detailed Response Mapping

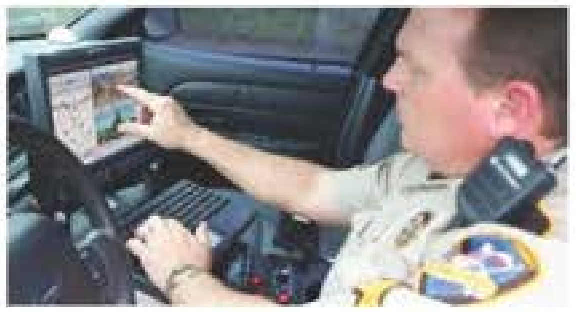
Market Research: Data Processing





Rugged laptops, tablets & phones are standard in emergency operations

Product would need to integrate well with existing system



Computer

Phone

Wearable

Software solutions

ProQA PARAMOUNT

RapidDeploy

FIRSTNET Built with AT&T

SAM

WEEK 5

Focus: Detailed Response Mapping

Market Research: Communication






Rugged phones, portable, easy to use




Seems to be plenty of methods on communicating information, not so much to gain information however

Radio

Phone

Wearable

Something that integrates with this would be good

Need to look into methods of collecting on-scene critical information

Software solutions

ZELLO

ACTIVE 911

TeamConnect

Everbridge CRISIS MANAGEMENT

Slack / Microsoft Teams (First Responder Configurations)

WEEK 5

Focus: Detailed Response Mapping

Product Research: Aerial Input Tools

Drone size, weight and operation all have an effect on operation & regulations

Drones come in all shapes and sizes depending on context & use

EMS would require a wide range of uses

Long range operations tend to lean more toward fixed wing UAV's

However they're slower to launch and emergency situations don't tend to require long term "overwatch"

WEEK 5

Focus: Detailed Response Mapping

Product Research: Navigation Tools

Lots of compatibility with screen based communication too which is great for relaying visual information too

Lots of items that physically integrate with tablets, need more of an "External" integration

WEEK 5

Focus: Detailed Response Mapping

Product Research: Visual Feedback Tools

Alternative visual feedback would be interesting to save privacy

Wearables to communicate visual information is very interesting

Has a big military, scary look, wouldn't be appropriate in a public context

WEEK 5

Focus: Detailed Response Mapping

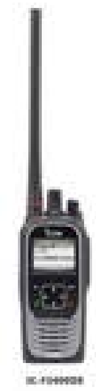
Product Research: Interactive Dashboards

Standardised across all departments, so wouldn't need to worry about being inaccessible

Very oversaturated market, wouldn't be worth perusing

Instead look into products that could integrate with tablets

Product Research: Audible Communicative Tools



Seems to be pretty standardised

Modernised versions show promise, higher operational ability, opportunity for expandable software/application

All look the same

PRC-4090 HF Tactical Manpack Package - P/N 4090-00-10

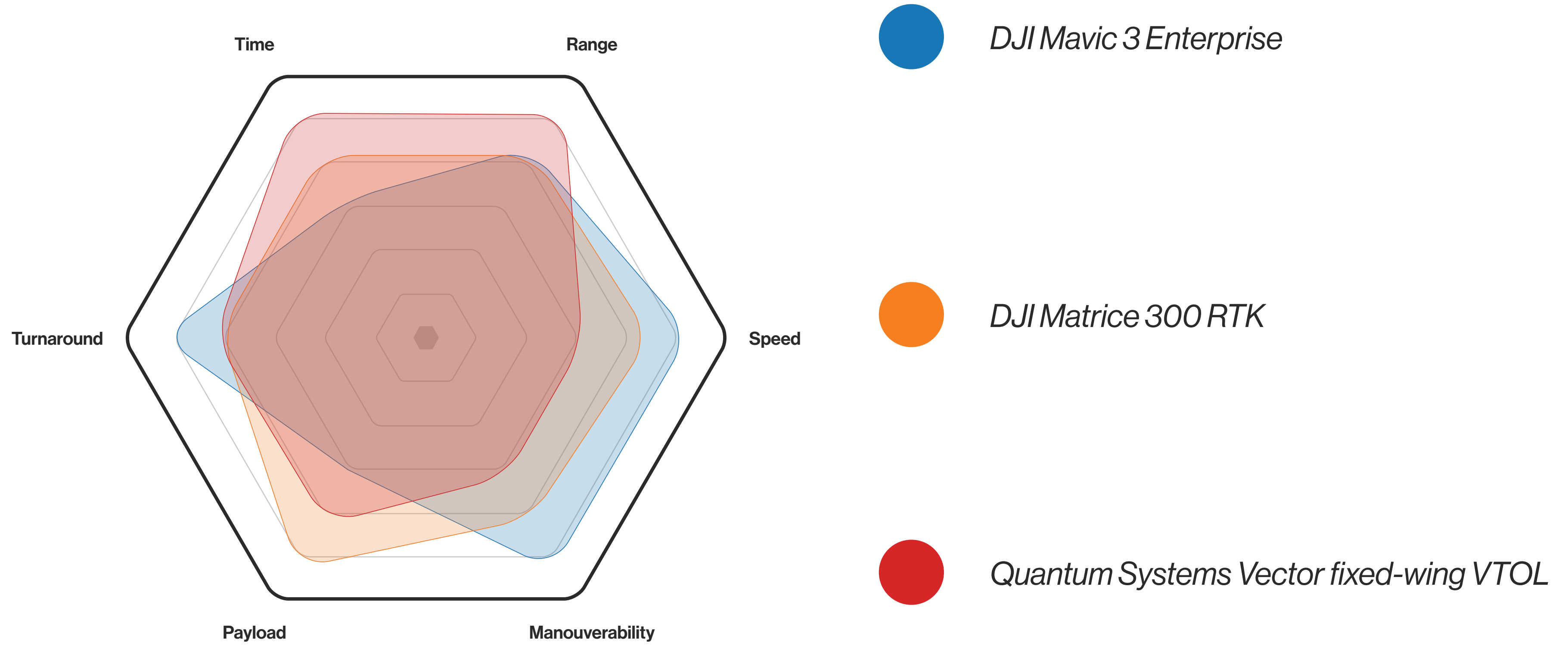
Easy though free communication. Already exists though, not too much room for innovation

Drones/Surveilance

Drones serve as rapid-deployment aerial emergency monitoring, extending situational awareness where human access or response speed is limited. Rotary quadcopter designs such as the Mavic 3 and Matrice 300 excel in quick deployment and turnarounds, while fixed wing UAV's prioritise higher operational range and endurance for wider area reconnaissance.

Via this spider chart, it was aimed to identify what specific drones were best at. It was determined from here that within a emergency context. Drones would need to prioritise high turnaround, time and speed. Details such as range, payload and manouverability are all highly context specific, and though highly important, it was decided that this would act as more of a bonus sub-category.

Hence, from this research, the DJI Mavic 3 served as a good ground basis for the drone design as its lightweight form offered a fast operational turn around and allowed easy integration with existing systems. The DJI matrice 300 also showed promise however its large design would prove difficult in a urban emergency environment.

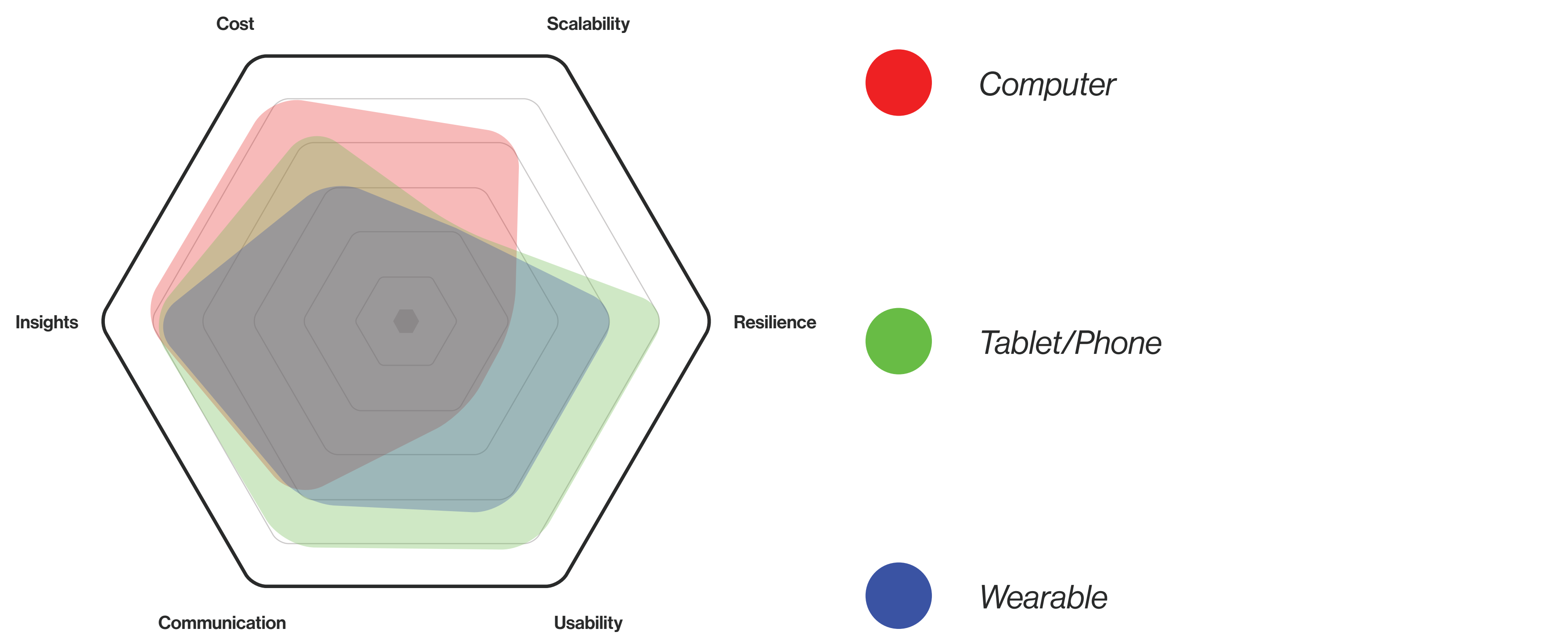


Data Processing & Decision Support

For systems that integrate with emerging technologies, there are an abundance of tools that exist. Within all EMS services, Tablets are becoming the standard of displaying and sharing information across departments.

When it comes to digital devices, there are multiple variations dependent on their intended use. However rugged tablets/phones are the most common and widely adopted technology.

Design should hence, be able to synergise well with this existing system.

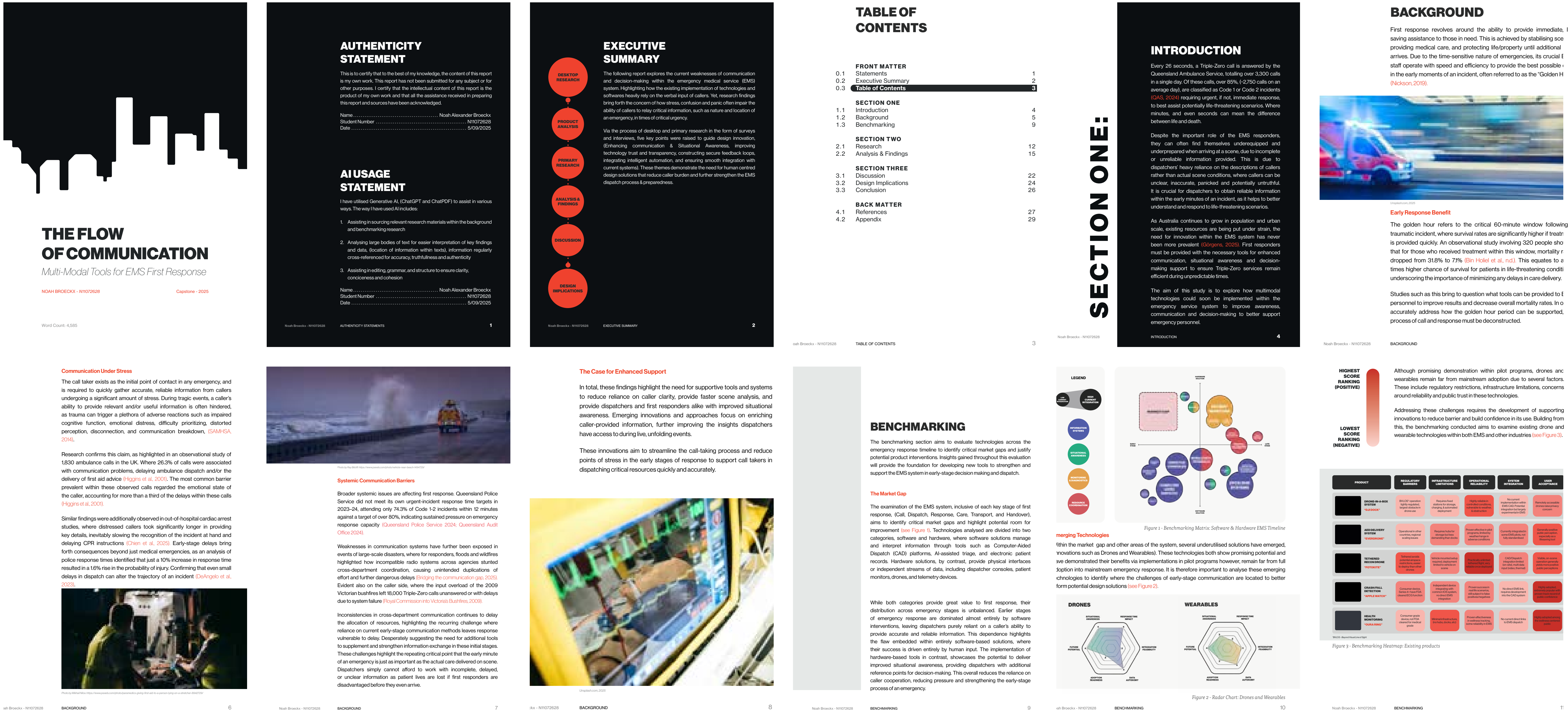


WEEK 6

Focus: Research Report

ASSESSMENT 1 SUBMISSION

Research Report Final - (Left -> Right Top -> Bottom)

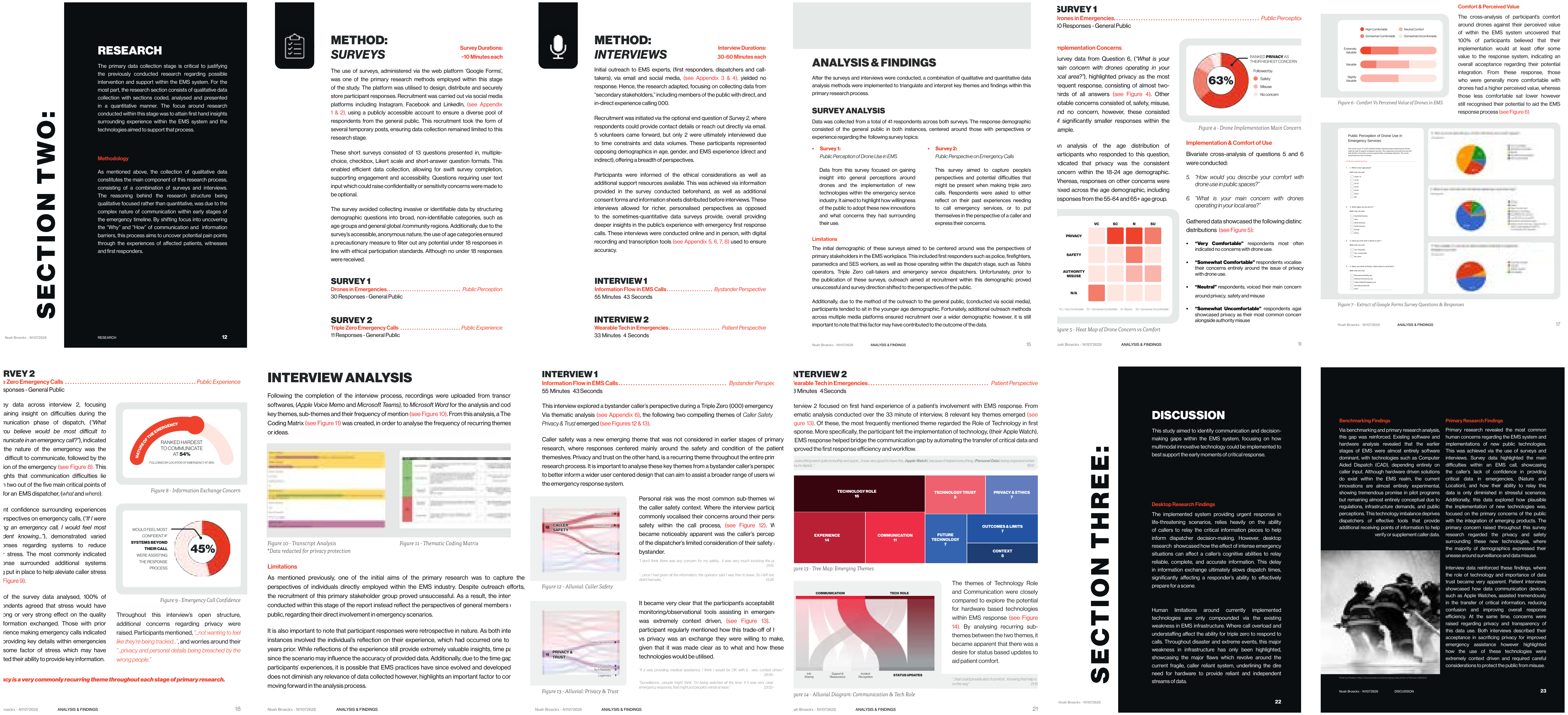


WEEK 6

Focus: Research Report

ASSESSMENT 1 SUBMISSION

Research Report Final - (Left -> Right   Top -> Bottom)



Research Report Final - (Left -> Right Top -> Bottom)

DESIGN IMPLICATIONS

1.

Enhanced Communication & Situational Awareness

Callers often fail in clearly communicating the nature and location of emergencies due to multiple cognitive factors such as stress, confusion and panic. The current process of dispatch relies heavily on this ability for callers to provide verbal descriptions, which when combined with severe mental load, can prove to be unreliable and open to mistakes or misinterpretations. Inputs from multimodal data sources, (such as video, photo, sensors or wearables), can alleviate this over-reliance by providing contextual clues and external validation to help dispatchers infer and reference missing, or unclear information.

2.

Trust, Privacy & Transparency

Privacy concerns were commonly brought up throughout interviews and surveys. The consensus showed that even if new technologies were able to improve communication on scene, adoption of these innovations would be difficult if no systems are put in place for the clarification of data collection and how the system would operate outside of an emergency scenario. To best accommodate for public comfort surrounding the use of technologies that could be perceived as potentially invasive, clear consent mechanisms, non-invasive sensors and visible privacy indicators should be implemented to build public confidence. Trust and transparency are non-negotiable criteria within future designs, but a requirement for appropriate EMS tech adoption.

3.

Data & Feedback Loops

The public experience commonly describes the EMS communication flow as one-directional, flowing from caller to dispatcher with little return on information. This lack of clear communication exchange can leave callers anxious and unsure if the information provided to dispatchers was correct and being acted upon. A major design opportunity lies within this communication gap, where tools can be implemented to provided callers with reassurance indicators that establish bidirectional communication, showcasing that they are being responded to. Drones and other potential multimodal tools can be effectively implemented to provide communicative data and interactions with callers.

4.

Intelligent Automation

Manual processes add unnecessary delays and risk of human error in the EMS system. In emergencies, the inefficient reliance on reporting key personal details and incident conditions via outdated phone operated systems poses a critical risk to the ability for EMS to quickly respond to a scene. Intelligent automation should be a key factor in the design of multimodal tools to assist in the information flow of relevant data to guide faster emergency dispatch. By implementing these automated systems, analysing location, emergency nature and key details surrounding the people involved, the design can aim to deliver faster care on scene.

5.

Current System Integration

Emerging technologies such as wearables, drones and smart sensors often show promise within experimental pilot implementations, however lack proper integration with current EMS systems to effectively bridge the workflow gap. Tools that are seperate to the existing services and technologies implemented by the EMS, (Such as CAD and communication platforms), risk creating more work for dispatcher and responders. This in turn has the complete opposite intended effect on the workflow process of first response, slowing down rather than aiding in its efficiency. Designs should aim to reduce workload, via ensuring seamless integration with existing response platforms.

CONCLUSION

This report examined the gaps in communication and decision-making within EMS, identifying how multi-modal technologies could aim to help support early stages of urgent response. Key research findings demonstrated how patient outcome directly links to the speed and efficiency of response, and how communication breakdowns between callers/dispatchers significantly disrupt the flow of response.

Five key implications were derived from these insights, centred around: enhancing communication and situational awareness, embedding trust and transparency in emerging technologies, creating secure caller/dispatcher feedback loops, integrating intelligent automation, and ensurin smooth alignment with existing systems. Implementing these implication as the foundation of design criteria in emerging ideation will help reduce caller burden, strengthen response preparedness and build confidence surrounding emerging EMS technologies.

In summary, the improvement of EMS communication requires more tha incremental adjustments within implemented software and hardware. It demands the development of innovative, human centred technologies that consider the EMS system, patient trust, privacy and safety at its cor Ultimately advancing first response capabilities and improving patient outcomes in life threatening situations.

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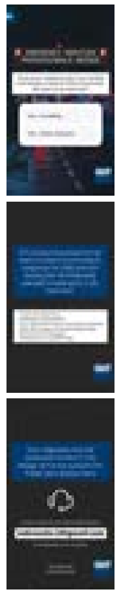
APPENDIX

Appendix 1:
Drone Survey Recruitment - Instagram/Facebook

Appendix 2:
Drone Survey Recruitment - LinkedIn

Appendix 3:
EMS Recruitment Post - Instagram/Facebook



Appendix 4:
EMS Recruitment Post - LinkedIn

Concept 1

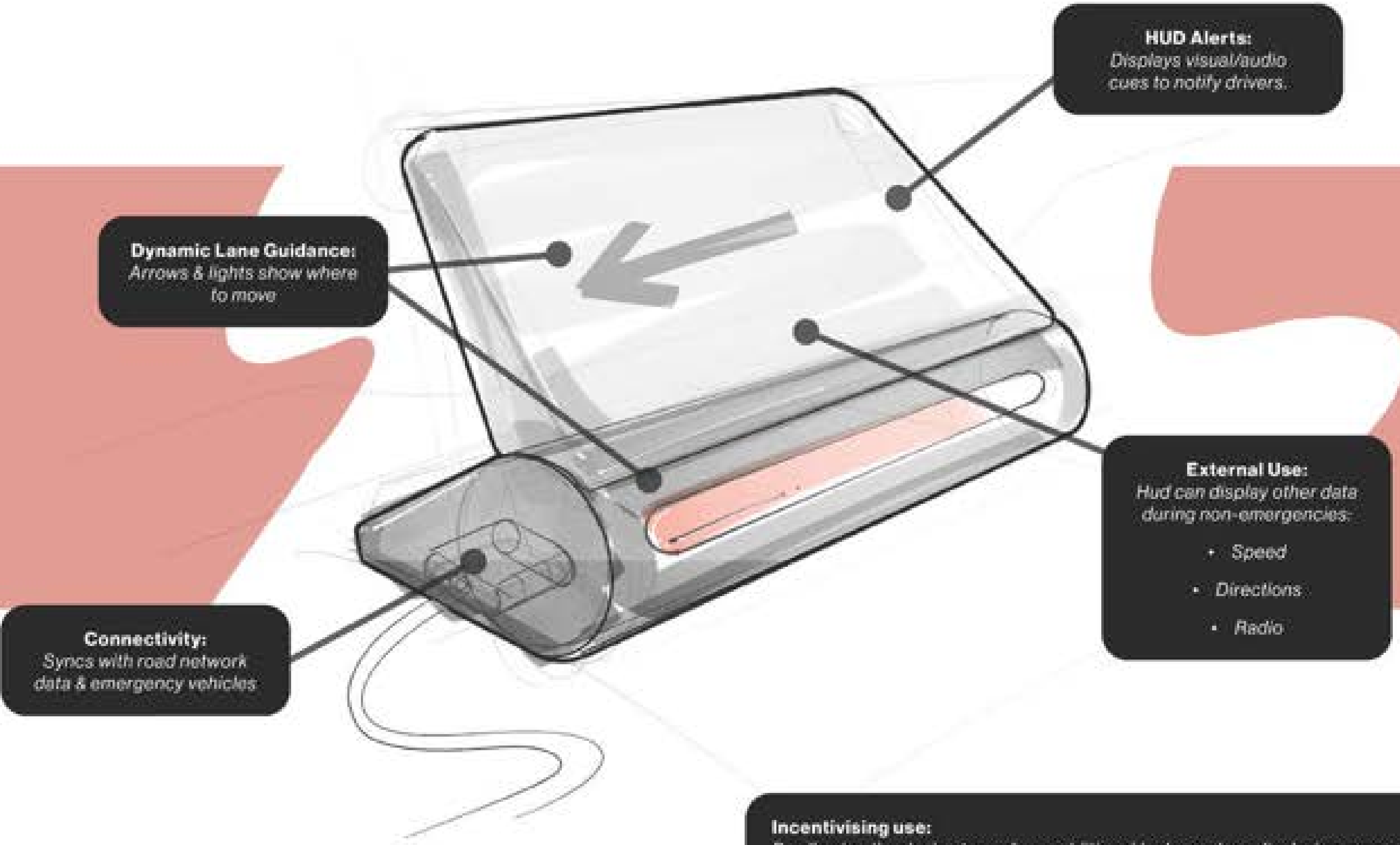
CONCEPT 1:

"ClearPath"

"ClearPath" is a vehicle-mounted, dashboard product aiming to address delays in response due to traffic congestion. The device helps to notify drivers of approaching emergency vehicles before they're in visual range to preemptively clear lanes for faster response.

"Traffic congestion, on average, [results] in nearly 10 minutes extra response time."

(Alabama Department of Public Health, 2013)



Incentivising use: *By allowing the device to perform additional tasks such as displaying zone speeds, directions and music/radio information, use can be encouraged via consumer value.*

Additionally, reduced insurance costs could be granted to users as their involvement with the device could declare them as "Safer Drivers"

What implications does it address?

1. 2. 3. 5.

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Concept 2

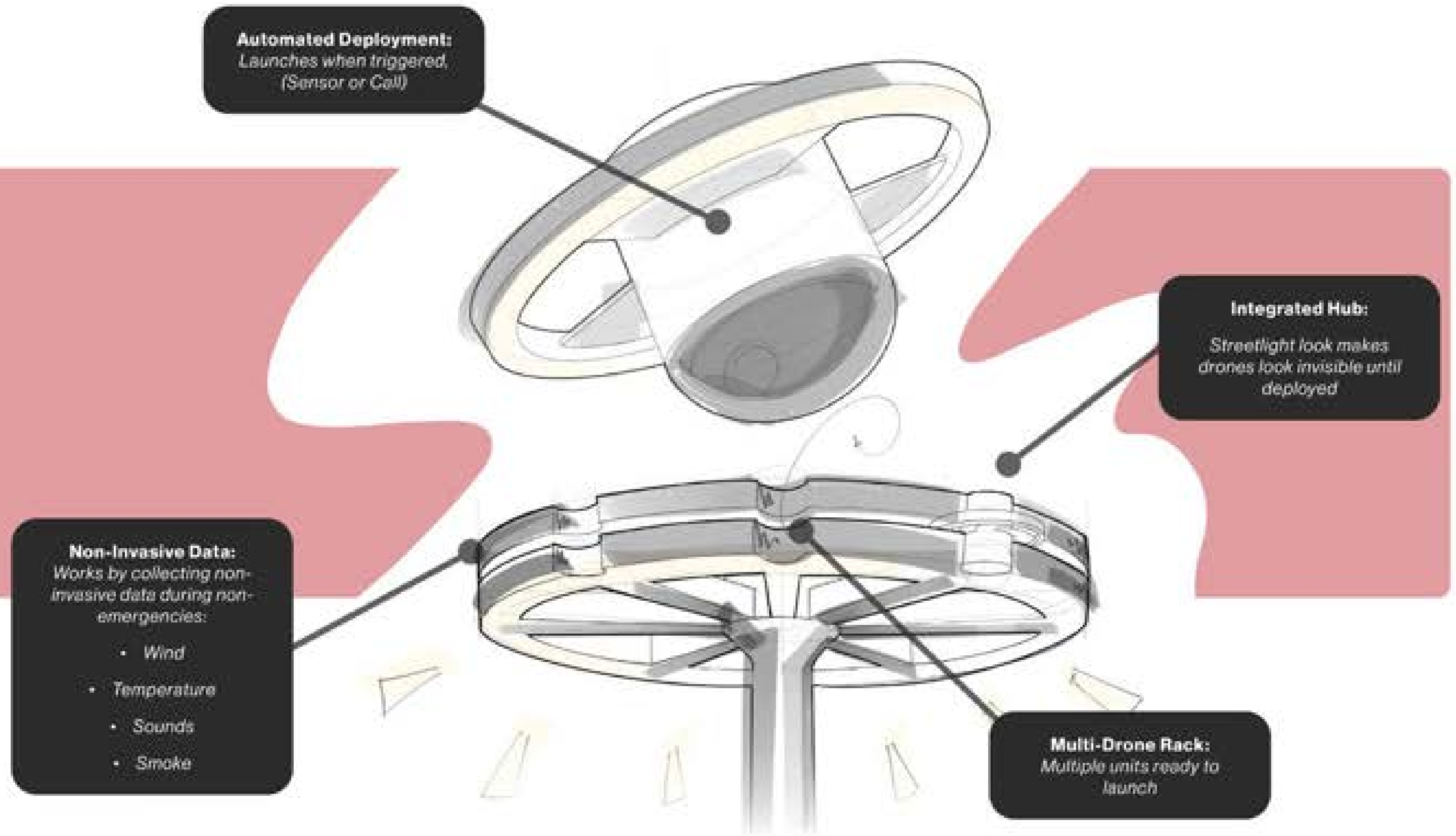
CONCEPT 2:

"SkyNest"

"SkyNest" is a drone nest/hub that passively collects environmental data during off-emergencies. Upon activation by call or via detection, drones from the nest are dispatched to the scene to provide early, visual scene awareness, reducing delays caused via caller communication difficulties

"...staff reported positive influence on workflow after automation. Less delay in data flow, readiness to care, better coordination."

(Afzali et al., 2021)



What implications does it address?

1. **2.** **3.** **4.**

Concept 3

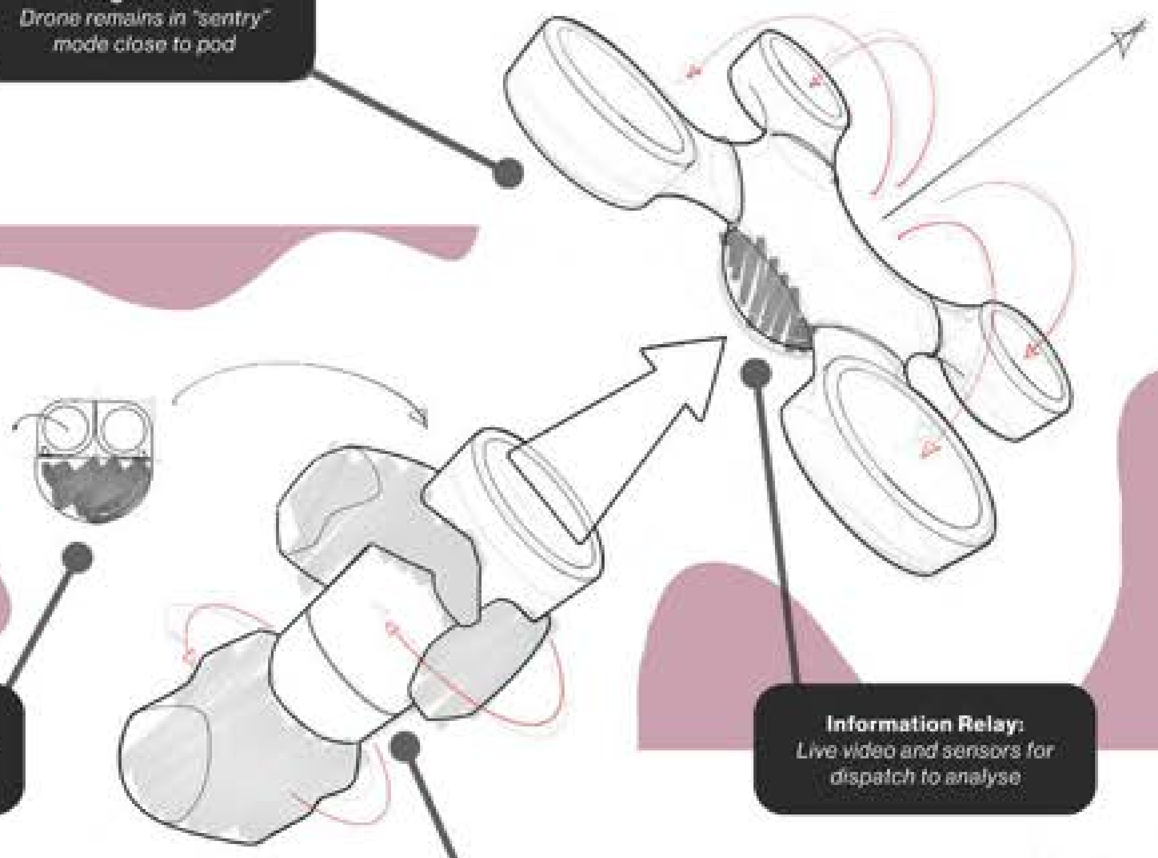
CONCEPT 3:

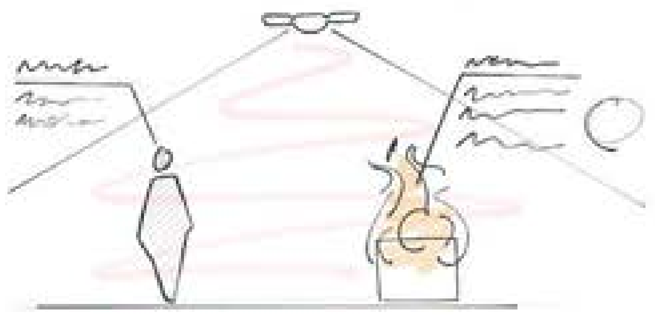
"High-Sight"

"HighSight" is a compact, tube-launched reconnaissance drone assisting in giving dispatchers the first sight of an emergency scene. It addresses slow situational awareness and allows responders to obtain critical information in order to help construct and action an effective response plan. Footage is additionally live-streamed to command for live feedback and ensuring public safety.

"...technology reduces response times while simultaneously minimizing risk exposure."

(Mogili et al., 2021)





What implications does it address?

2. 3. 4. 5.

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Concept 4

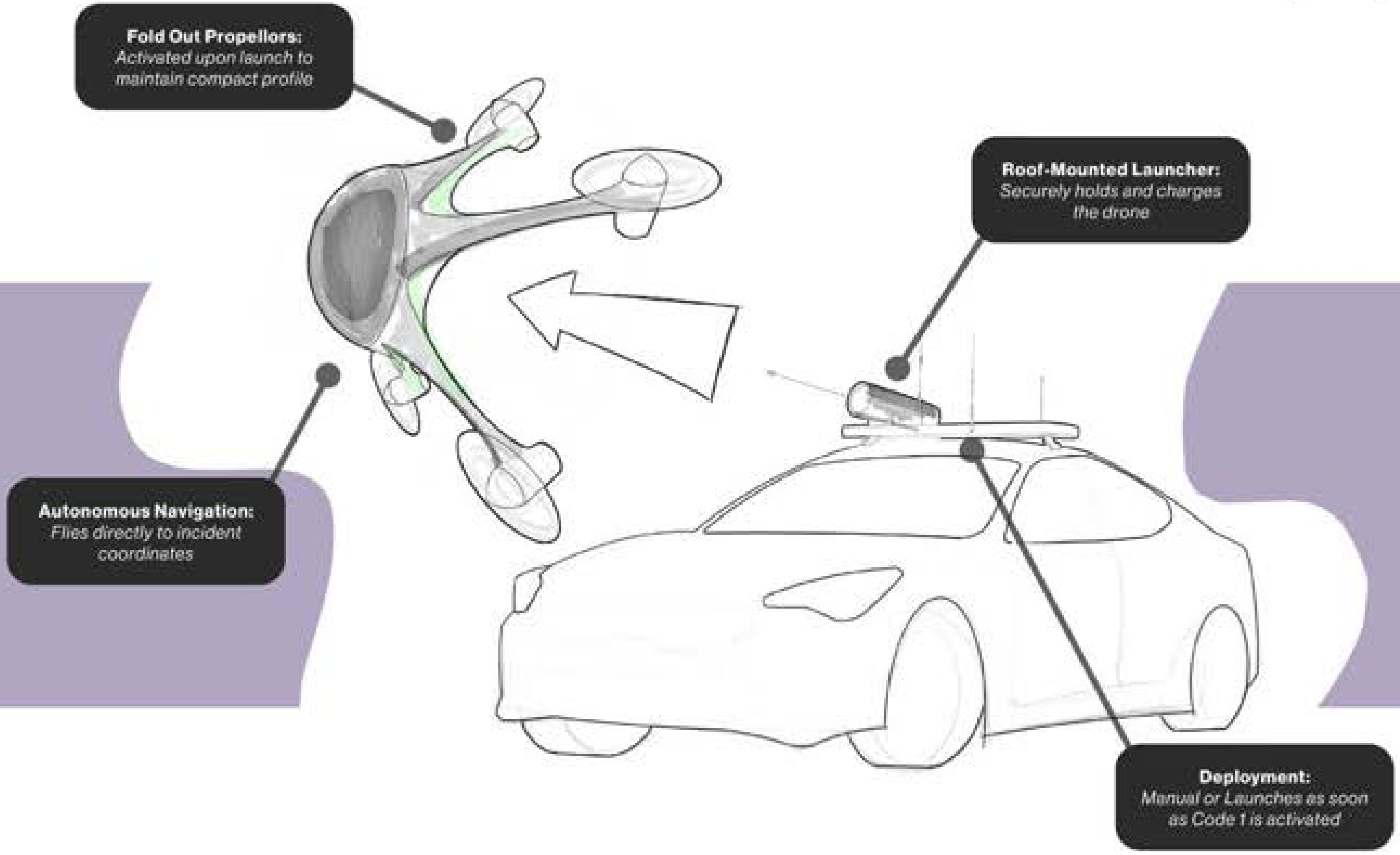
CONCEPT 4:

"RapidEye"

"RapidEye" is a vehicle-mounted drone launch system designed to help first responders address the delay between call dispatch and scene arrival. It achieves this by deploying a "scout drone" ahead of responding units to assist in EMS preparation for arrival on scene.

"Drones arrived at scene earlier than EMS services in 90% of cases, with a median response time of 3:49 minutes compared to 5:51 minutes for EMS."

(Kristiansson et al., 2024)



What implications does it address?

1. 3. 4. 5.

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Concept 5

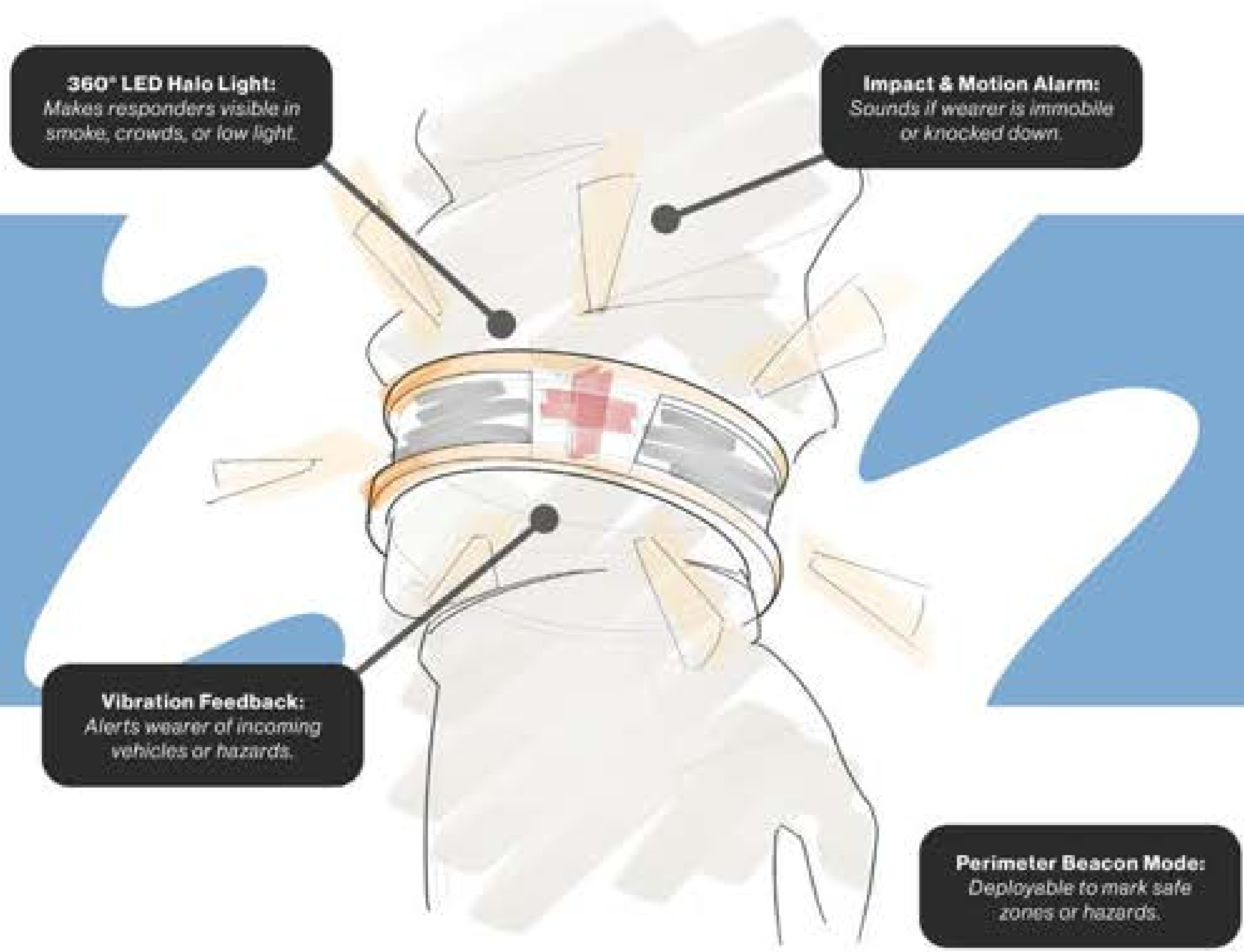
CONCEPT 5:

"SafeHalo"

"SafeHalo" is a responder wearable focused on providing the public with additional awareness of EMS on scene. This device helps with on-scene safety during chaotic events, by making EMS responders more visible, helping them signal any distress and to assist in creating safe perimeters.

"High-visibility vests, traffic cones, scene lighting and personal lighting devices... are important to warn other drivers and mark the boundaries of the hot zone."

(EMS1 Staff, 2024)



What implications does it address?

1. 2. 3. 5.

Noah Broeckx - N11072628

Capstone 2025

WEEK 6

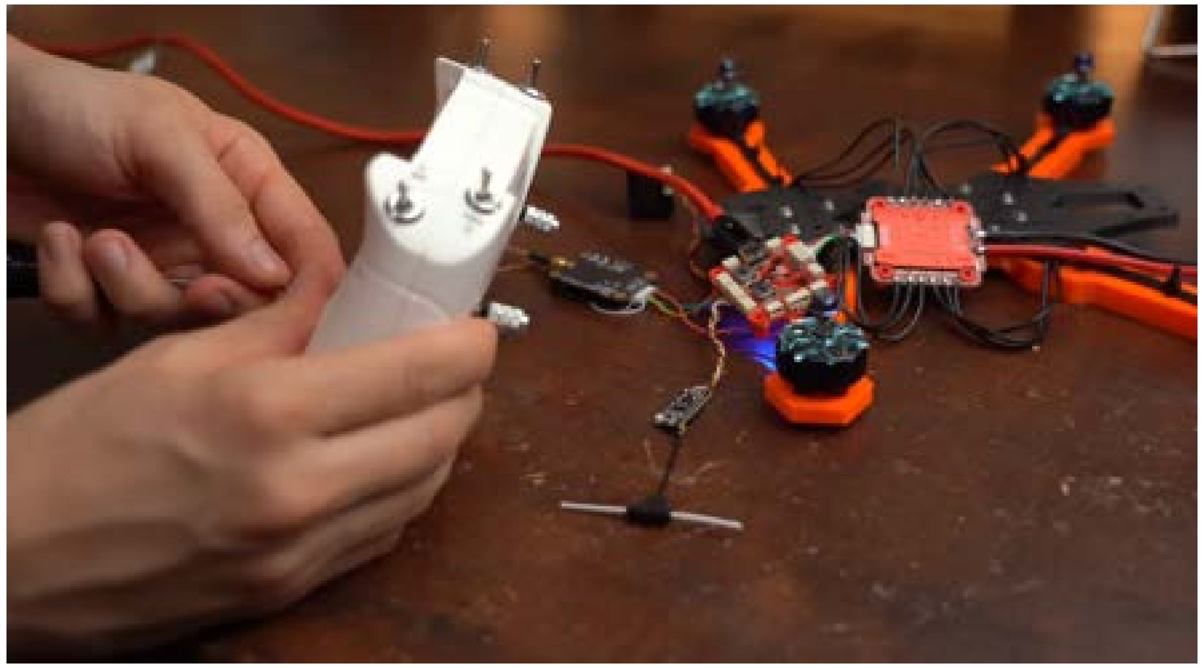
Focus: Drone Components

Drone Building videos

Conducted some video exploration on how drones are built, including the components, coding, form etc. Lots of interesting points to consider.

Required Parts for a Working Drone:

- Frame - 3D printed?
- Propellers - 3D printed?
- Battery
- Receiver
- Remote
- Camera
- VT Antenna (Video Transmitter)
- FC Board (Flight Controller)
- ESC Board (Electronic Speed Controller)



Youtube: The Idiot's Guide to Making a DIY Drone! (I am the Idiot) - GreatScott!

Youtube: I Built a Self Landing Satellite - I Build Stuff

I Build Stuff (2025). I Built a Self Landing Satellite. [online] YouTube. Available at: https://www.youtube.com/watch?v=7yVFZn87TkY [Accessed 31 Oct. 2025].

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WEEK 6

Focus: Drone Disassembly

Drone Components

A small, consumer drone was disassembled to be used for its parts. Before disassembly, some brief flight tests were conducted. During which it was noted that flying the drone even with the protective bumpers, still proposed a significant safety risk.

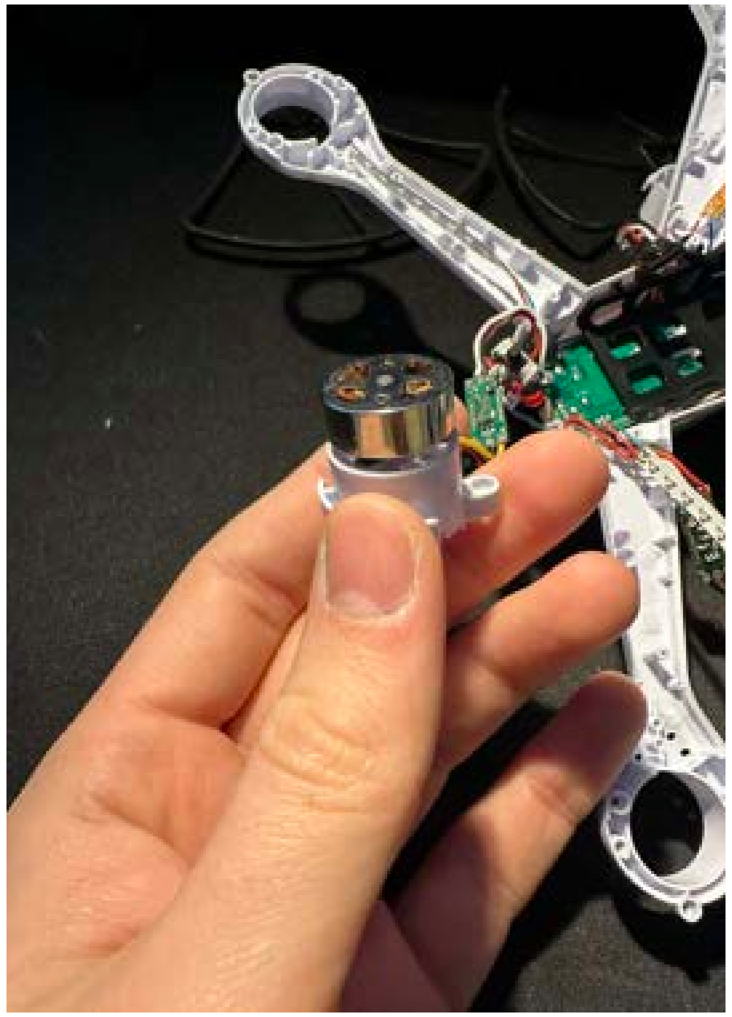
Due to my poor flying in even poorer conditions, the drone took a significant beating. Significantly damaging majority of the propellers in the process. Accidental contact with drone propellers also proved to be rather painful.

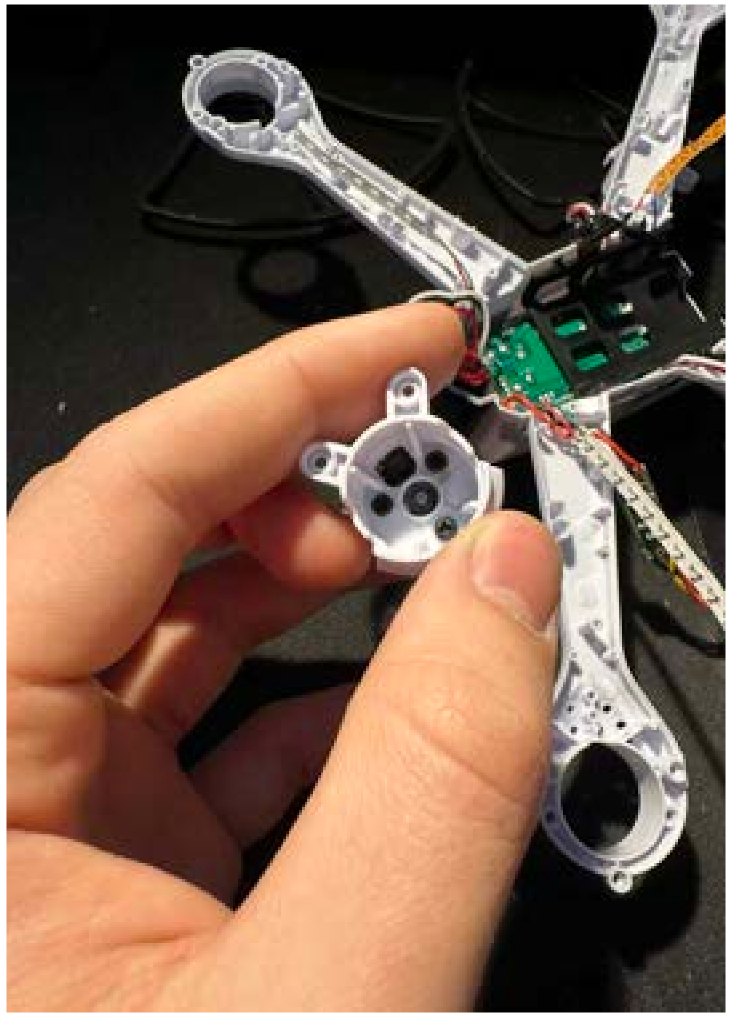
Justifiably, moving forward with this project, the circular ducted design will be maintained, as “encasing” the propeller doesn’t only protect other people from potential injuries but also protects it from potential damage.

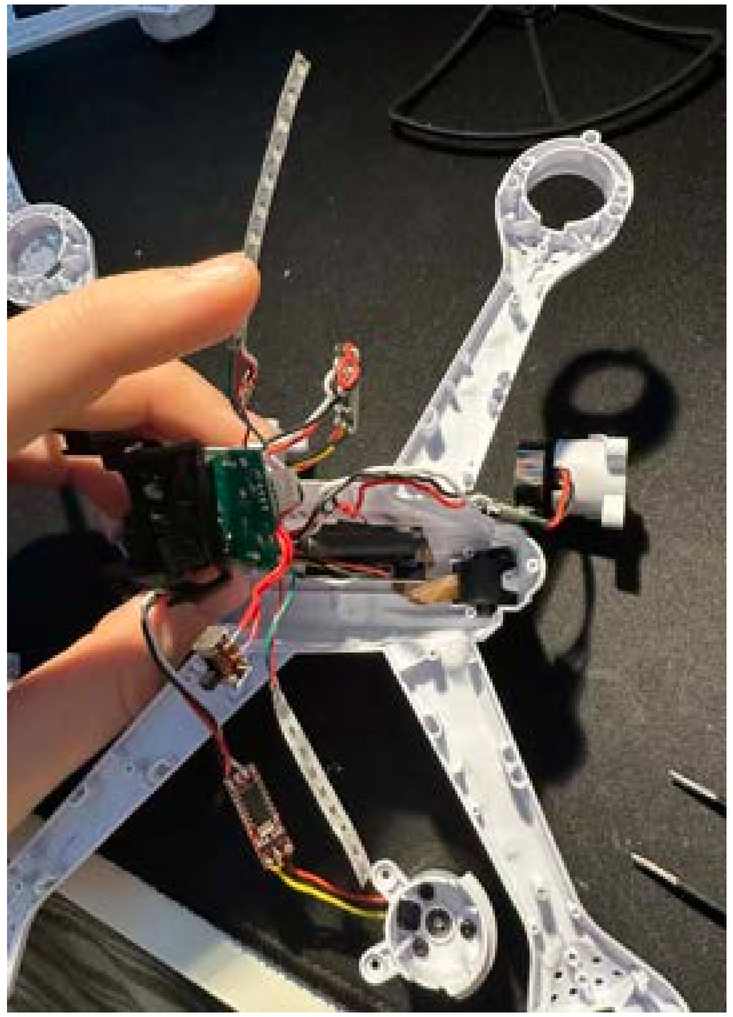
WEEK 6

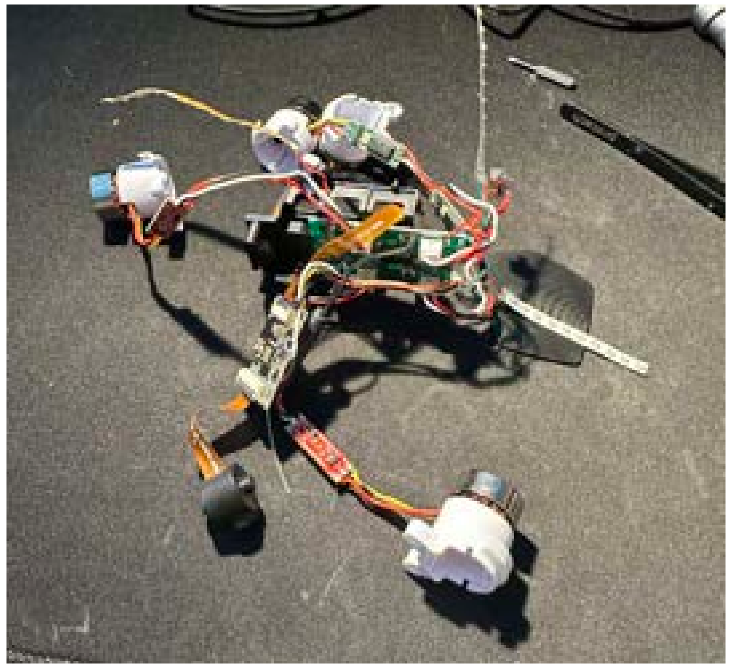
Focus: Drone Disassembly

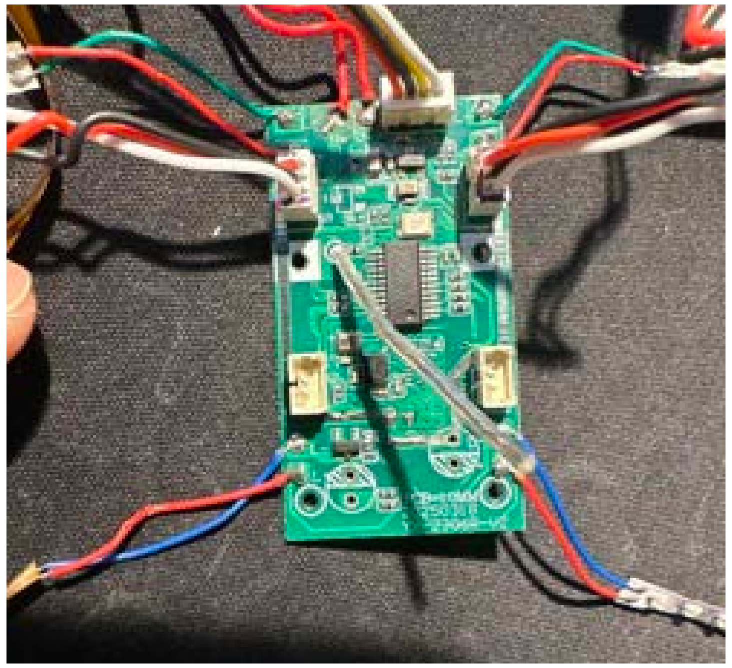
Drone Disassembly

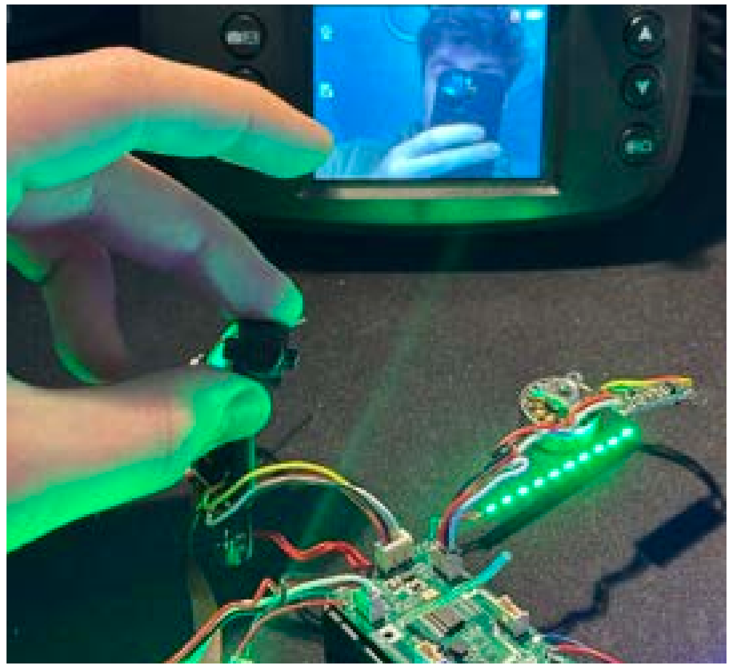










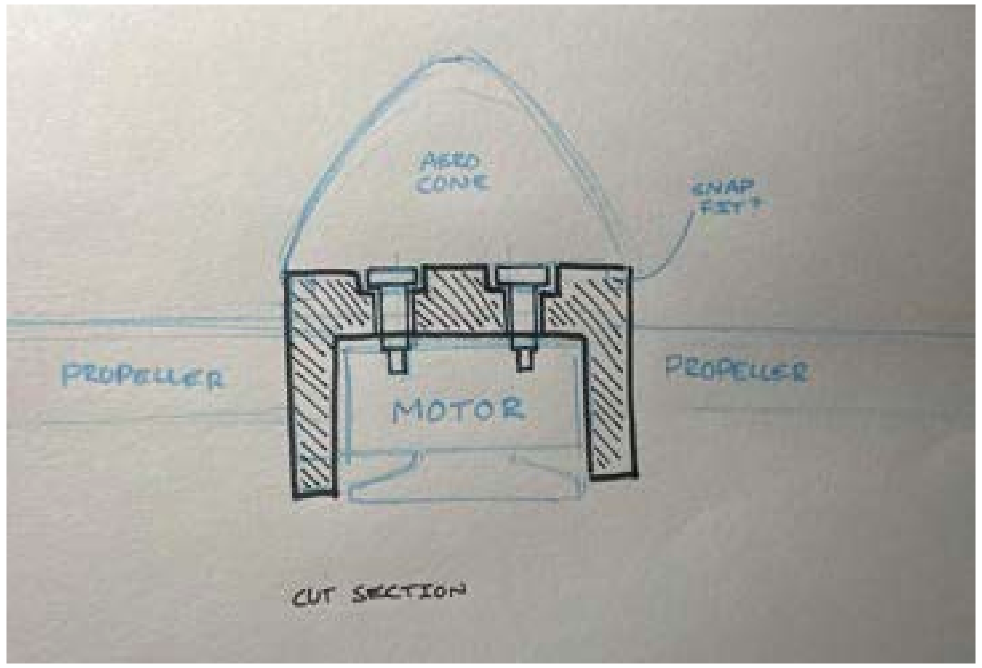


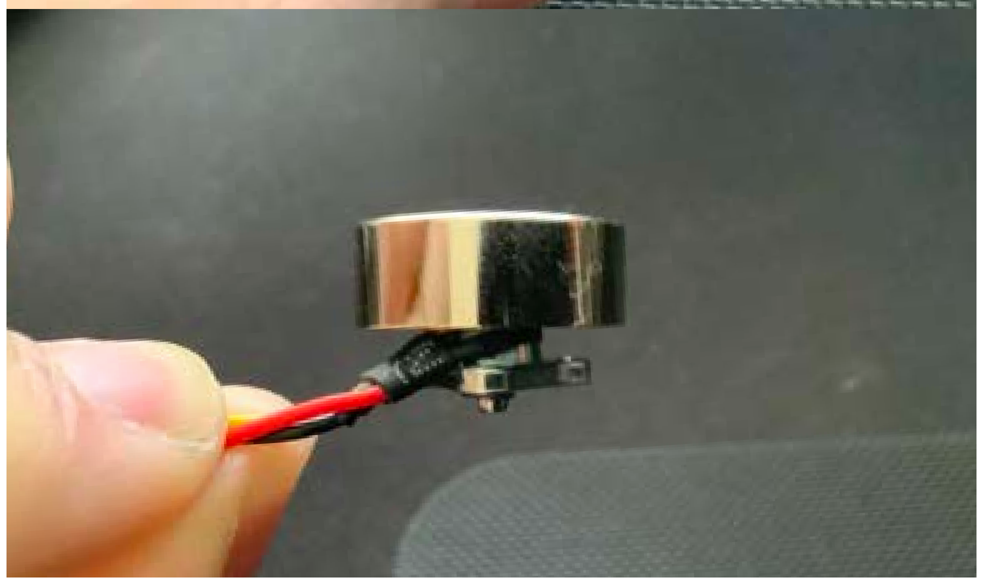
The disassembly of the drone made it easier to understand the components of the product. From the disassembly process the following parts were obtained:

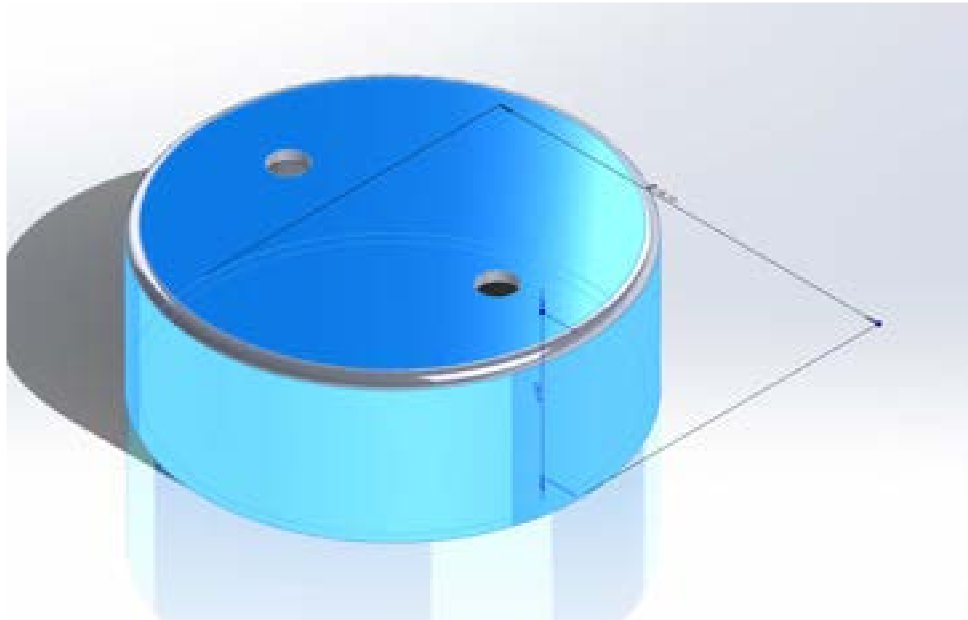
- 4 Brushless Servo Motors
- 4 Individual Motor Speed Controllers
- 2 Cameras, (FPV & Top-Down)
- 1 Video Streaming PCB
- 1 Flight Controller with onboard Gyro and Wifi Module
- 1 Battery Pack
- 1 On/Off Switch
- 4 LED strip lights (Blue & Green)

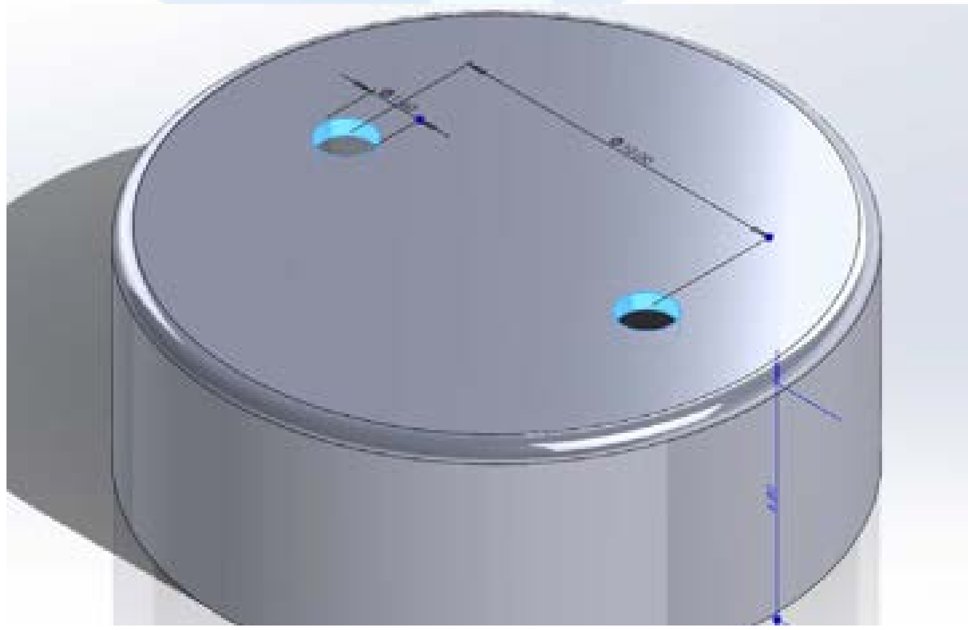
Drone Disassembly Cont.

The motors were closely analysed and measured to create an accurate hub platform to design the actual propellers around.



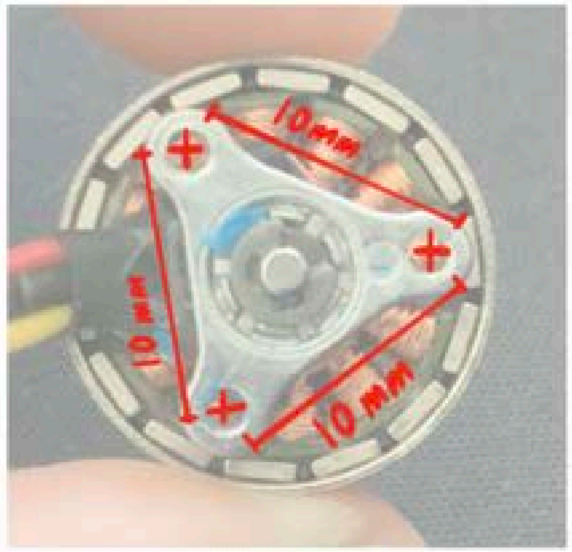


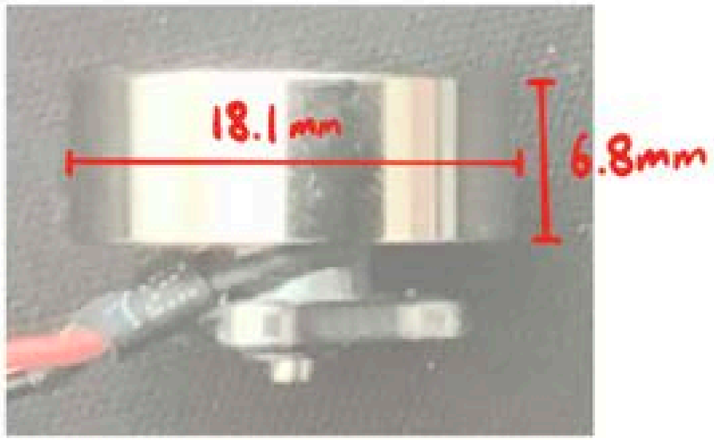


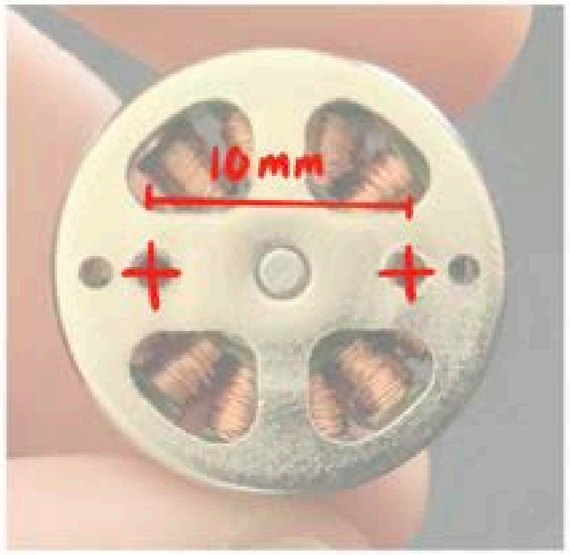


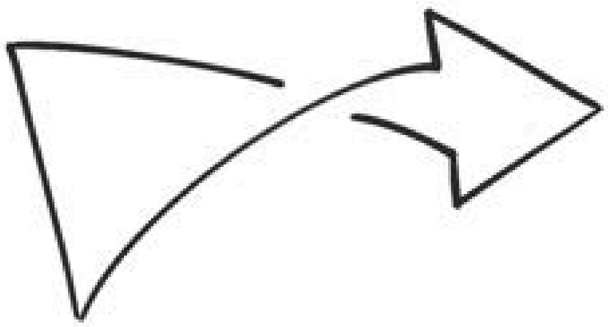
WEEK 6

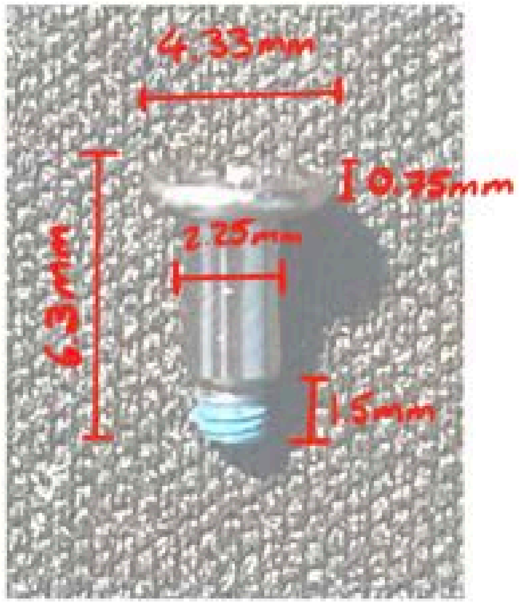
Focus: Motor Measurements

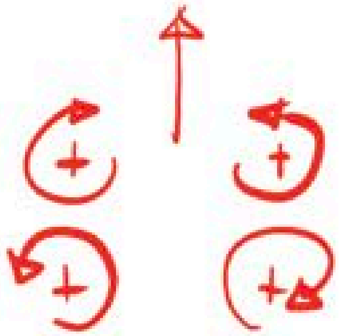










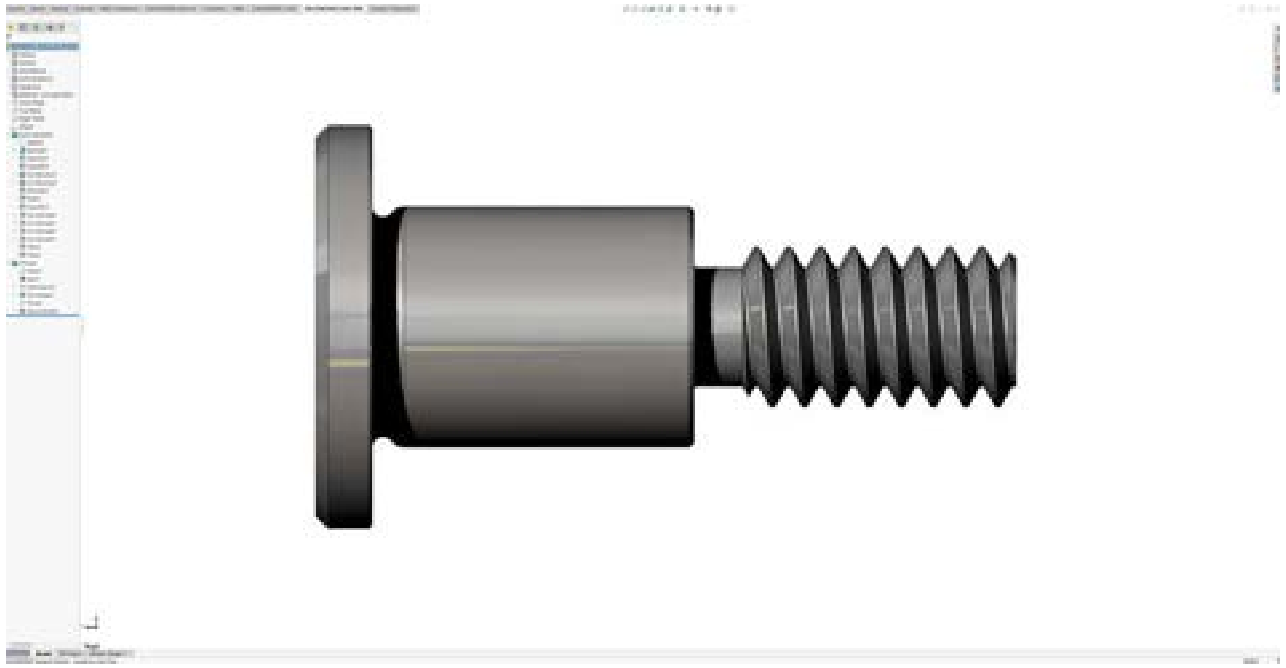


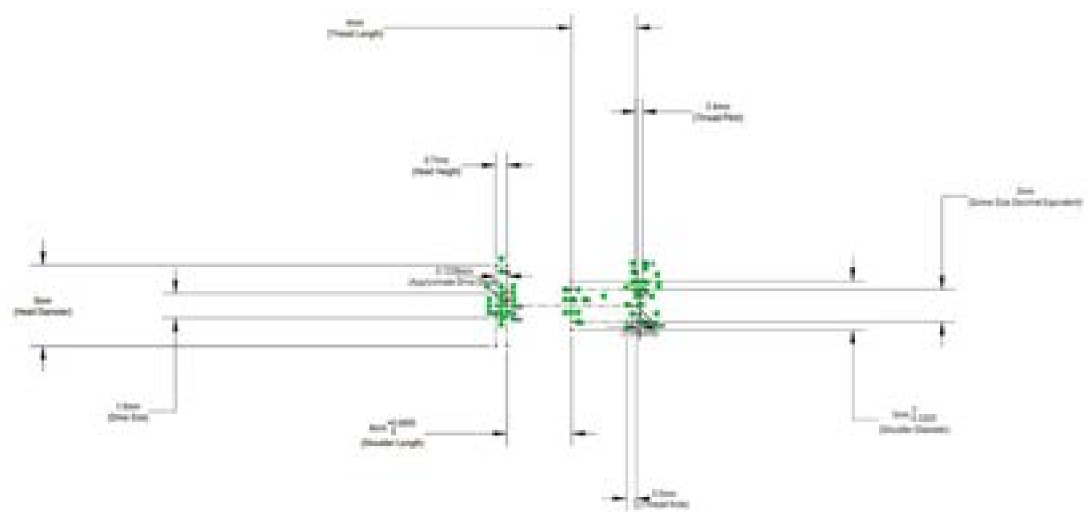
MOTOR DIRECTIONS

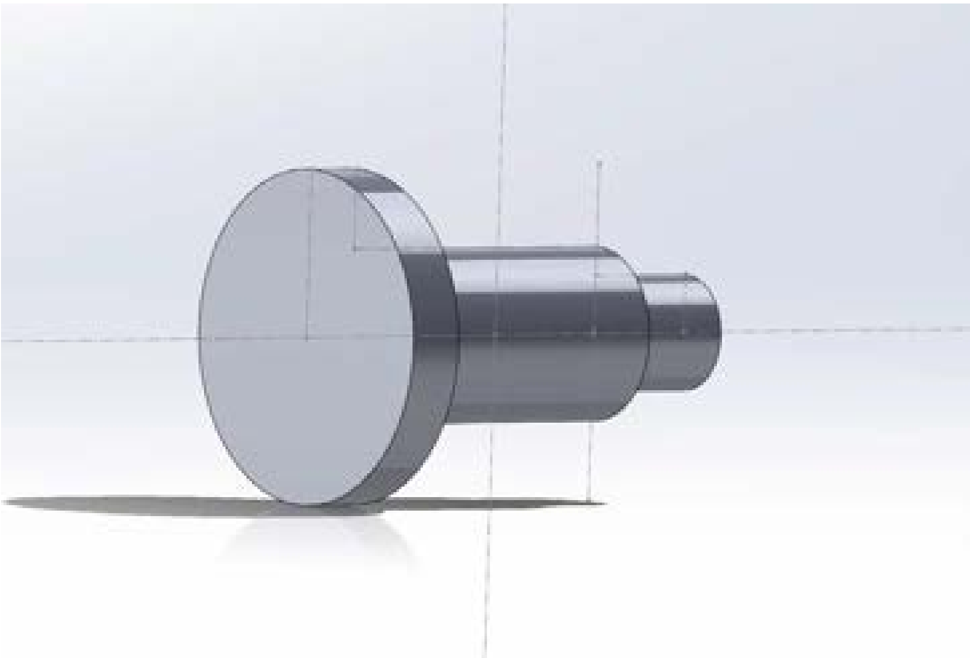
Motor Screw

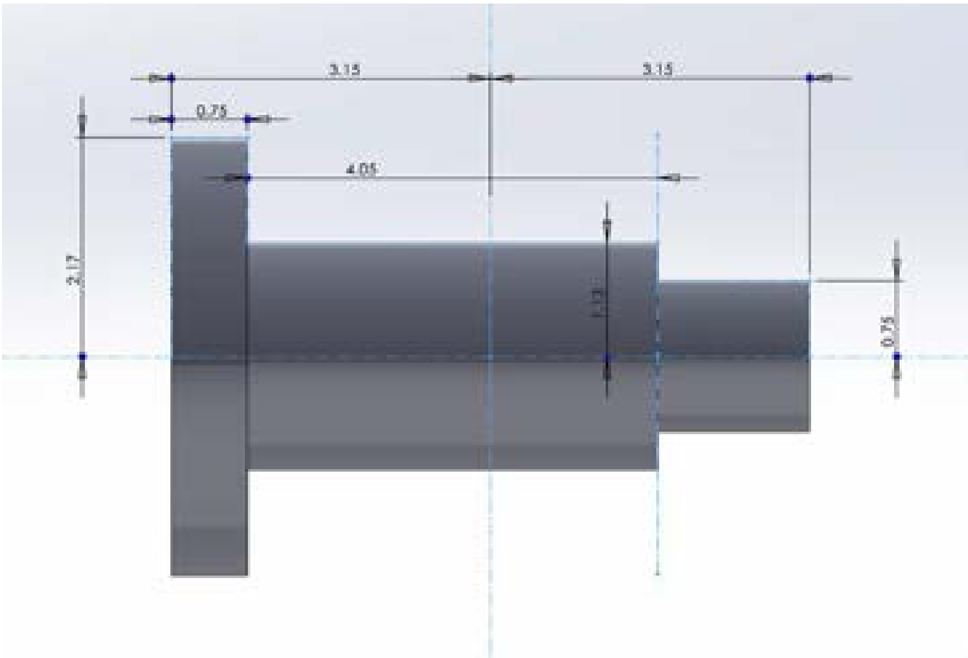
To ensure accurate dimensions, McMasterCar.com was utilised to attempt to find a closely designed screw. I was able to locate something rather accurate however the dimensions were still slightly off.

However it was later realised that only the basic screw measurements would be required, and the motor hub was modeled around these constraints









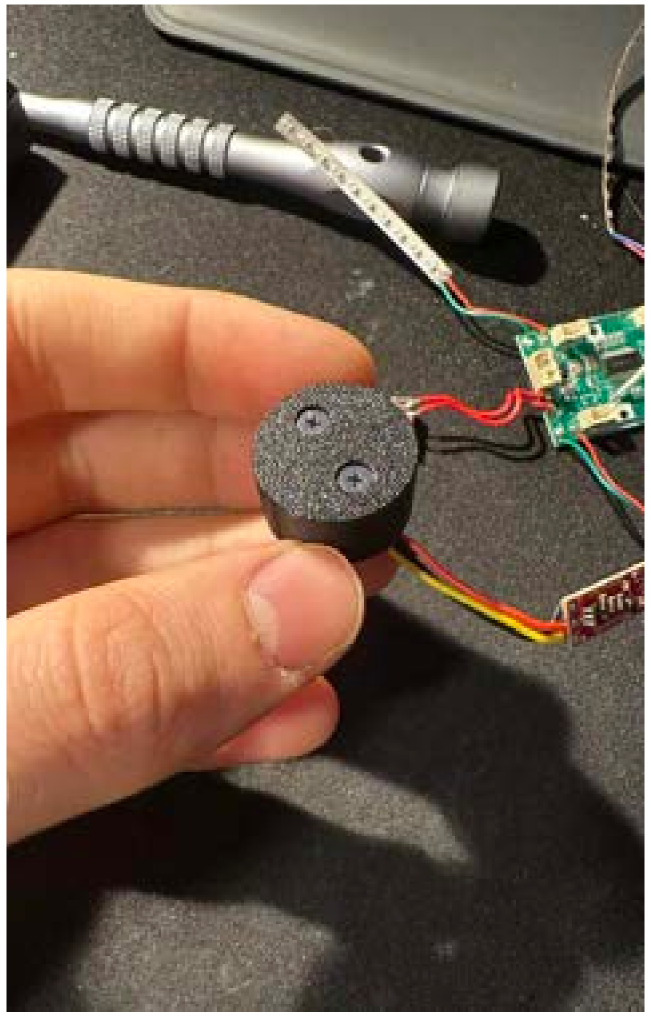
WEEK 6

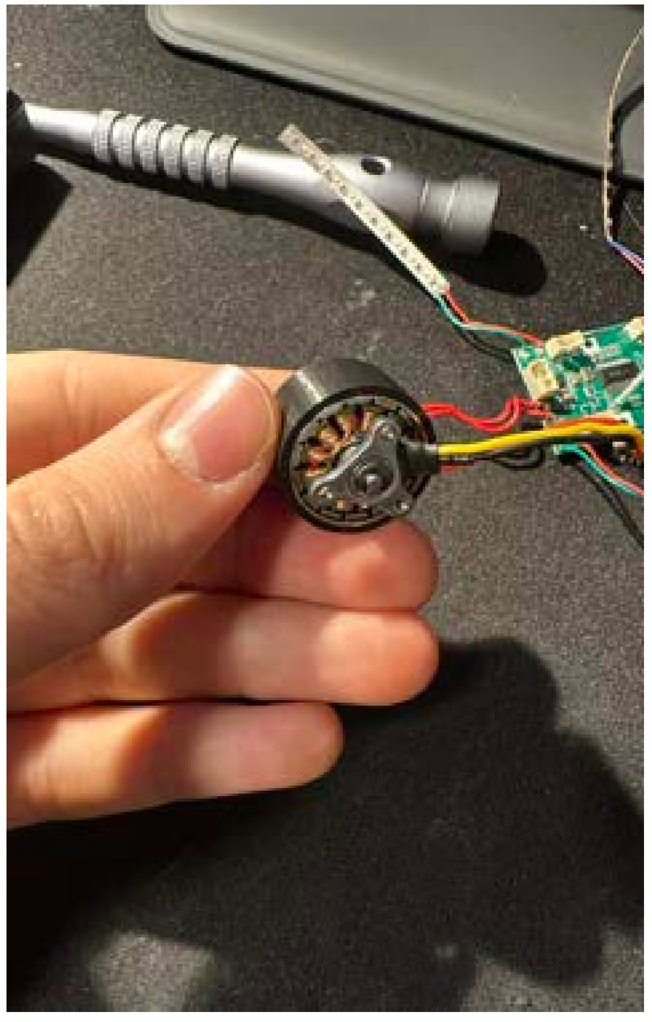
Focus: Propeller Hub

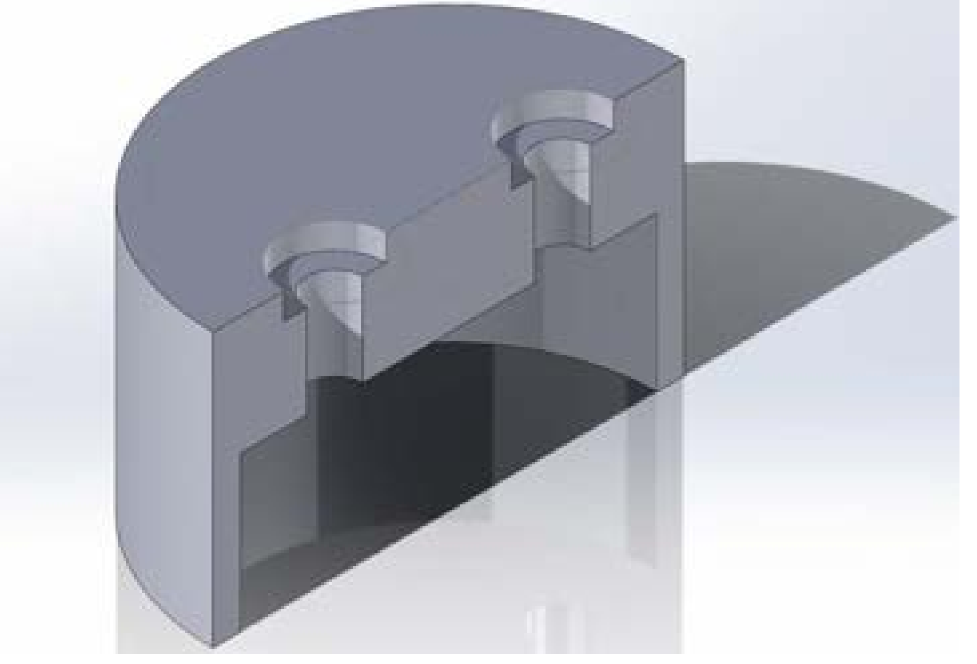
Prop Hub Reference

A draft print was done in order to ensure proper tolerances with the drone brushless motors. Fits were rather tight however firm, and sat well in the socket without moving around.

From here this basis piece would be used as reference to model the propeller & final propeller hub's around which would be combined into one mesh and printed as 1 solid part







WEEK 7

Focus: Emergency Reconnaissance

Early Emergency Surveillance

About

Early reconnaissance in emergency services involves gathering vital information about an incident's location, extent, and potential hazards before or during the response. This crucial step helps emergency responders assess the situation, plan their actions, and minimize risks to both themselves and the public.

Concerns

The main concerns of early reconnaissance in an emergency scenario revolve around information exchange. Data gathered can be incomplete due to confusion of conflicting reports, sensory distortions such as smoke, debris, noise etc. Additionally, emergency scenes are highly dynamic, frequently shifting and changing. Another major concern surrounds the ethical and legal exposure of these technologies, especially in population dense urban environments where privacy and data security are major obstacles preventing further progression of early observational tools.

Takeaway

When designing observational tools for emergency scenario, it is critical that they are designed with the dynamic, chaotic nature of emergency scenarios. Designs must be highly flexible and resillient to environmental aspects and changes. Primarily the concern of privacy, is the main obstacle preventing the use of these technologies. It's critical that designs take public data privacy in mind and only operate in appropriate scenarios.

Key aspects of early reconnaissance in emergency services:

- **Situational Awareness:** Early reconnaissance provides a rapid overview of the incident, enabling responders to understand the scale of the event, identify potential threats, and determine the necessary resources.
- **Hazard Assessment:** Reconnaissance helps identify potential hazards like hazardous materials, unstable structures, or areas of high risk, allowing for safer deployment of personnel and equipment.
- **Resource Allocation:** Based on the reconnaissance findings, emergency services can effectively allocate resources, such as personnel, specialized equipment, and vehicles, to the areas where they are most needed.
- **Incident Command:** Early reconnaissance data informs the Incident Commander's decision-making process, enabling them to establish clear objectives, develop strategies, and coordinate the overall response.
- **Public Safety:** Reconnaissance findings can be used to inform the public about potential dangers, recommend evacuation routes, and provide timely updates on the situation.

Methods of early reconnaissance:

- **Aerial:** Drones and aircraft equipped with cameras and sensors can provide real-time imagery and data over a wide area, enabling rapid assessment of the situation from above.
- **Ground:** Teams on the ground can observe the incident firsthand, assess damage, identify hazards, and gather detailed information about the affected area.
- **Remote Sensing:** Technologies like thermal imaging can detect heat signatures, helping identify hotspots in fires or locate people in obscured areas.
- **Information Gathering:** Gathering information from various sources, including eyewitness accounts, social media, and other emergency services, can provide valuable insights into the incident.

Example Scenarios

- **Bushfires:** Aerial reconnaissance with drones or aircraft can quickly assess the fire's perimeter, hotspots, and potential spread, while ground teams can identify evacuation routes and assess firebreaks.
- **Hazardous Materials:** Drones equipped with specialized sensors can assess the type and extent of hazardous materials involved, allowing for safer containment and cleanup efforts.
- **Search and Rescue:** Aerial reconnaissance with thermal imaging can help locate missing persons in complex terrain, while ground teams can search buildings and other areas.
- **Car Incident Response:** Automatic crash detection, drone surveillance, and real-time traffic data analysis to quickly assess the situation, locate the incident, identify potential hazards, and determine the appropriate level of response.

Joyce, K., Wright, K., Ambrosia, V. and Samsonov, S. (2025). AJEM Apr 2012 - Applying Intelligence Surveillance Reconnaissance for dynamic emergency management and a new perspective for US Department of Defence Architecture Framework. [online] Aidr.org.au. Available at: https://knowledge.aidr.org.au/resources/ajem-apr-2012-applying-intelligence-surveillance-reconnaissance-for-dynamic-emergency-management-and-a-new-perspective-for-us-department-of-defence-architecture-framework/

Market Research - Drones in First Response

Company: SkyDio

Skydio is an American manufacturer of drones headquartered in San Mateo, California. The company manufactures drones for use in battlefield situation awareness, policing, and inspection. Their drones can complete fully autonomous missions with the use of a dock to automatically recharge.

How it works:

Pre-position drones, ready to quickly respond to any incident. Get on scene in seconds, rapidly find and track subjects and vehicles, stream live video to determine the best tactical response. Overwatch provides real-time situational awareness to all responders, keeping your officers and community safe. Skydio helps you establish and grow a successful DFR program.

Skydio (2019). Skydio, Inc. [online] Skydio, Inc. Available at: https://www.skydio.com/.

Regulatory Concerns

There are lots of regulations around BVLOS (Beyond visual line of sight) drone operation. Which require proper documentation, certificates and training.

Drone Delivery of AEDs and Medical Supplies - Sweden

Sweden implements drones for delivery of AEDs in emergency scenarios. In Sweden more than 10,000 people suffer sudden cardiac arrests outside of the hospital and quick, immediate intervention is required. The system delivers defibrillators faster than ambulances.

Europa.eu. (2023). COLLARIS Network | UCP Knowledge Network. [online] Available at: https://civil-protection-knowledge-network.europa.eu/projects/collaris-network [Accessed 6 Aug. 2025].

WEEK 7

DESKTOP RESEARCH

Focus: Internet Of Things

What is the "Internet of Things?"

The Internet of Things (IoT), is the connection between practically any Internet accessible device to transfer and receive data to interact between each other.

"The Internet of Things (IoT) refers to a network of physical devices, vehicles, appliances, and other physical objects that are embedded with sensors, software, and network connectivity, allowing them to collect and share data." (IBM, 2023)

IBM (2023). What is the Internet of Things (IoT)? [online] IBM. Available at: https://www.ibm.com/think/topics/internet-of-things.

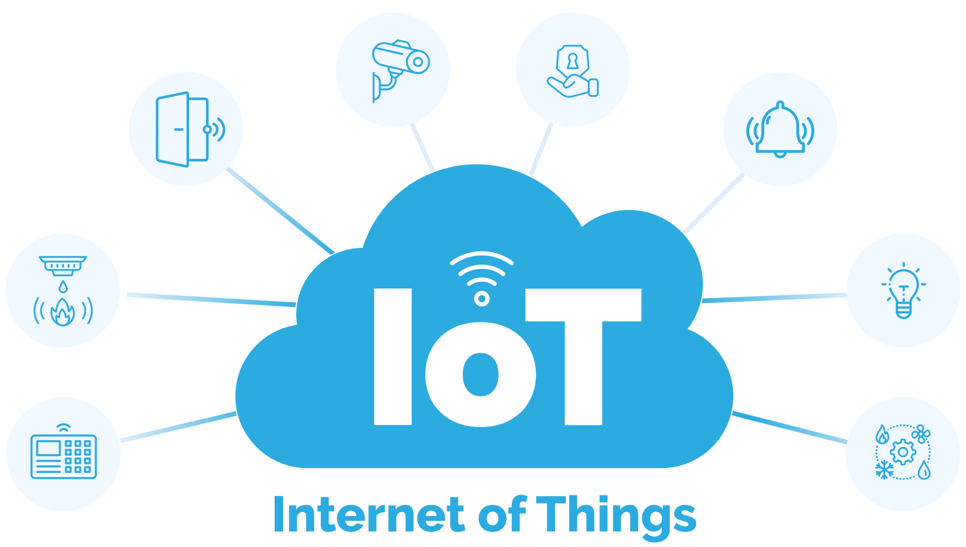
IoT Devices:

Otherwise known as "Smart Devices", are products that range from a variety of different forms. They could be anything from smart home devices such as thermostats, wearables, coffee machines, to complex machinery & transport systems.

A vast network of Internet connected devices would be able to communicate effectively to exchange data and perform controlled or autonomous tasks. This could include:

- Monitoring environmental farm conditions
- Managing traffic patterns
- Controlling machines and processes in factories
- Tracking inventory and shipments in warehouses

The potential is vast and is already being implemented in a variety of industries; manufacturing, transportation, healthcare, agriculture etc. IoT is constantly growing and will play a crucial role in the future of our world.



Importance of IoT:

- Improved Efficiency
  "By using IoT devices to automate and optimize processes, businesses can ***improve efficiency and productivity****. For example, IoT sensors can be used to* ***monitor equipment performance and detect or even resolve potential issues before they cause downtime****, reducing* ***maintenance costs and improving uptime.****" (IBM, 2023)*

- Data-Driven Decision-Making
  "IoT devices generate vast amounts of data that can be used to make better-informed business decisions and new business models. By analyzing this data, ***businesses can gain insights into customer behavior, market trends, and operational performance****, allowing them to make more informed* ***decisions about strategy, product development, and resource allocation.****" (IBM, 2023)*

- Cost-Savings
  *"By reducing manual processes and automating repetitive tasks, IoT can help businesses reduce costs and improve profitability. For example, I****oT devices can be used to monitor energy usage and optimize consumption, reducing energy costs and improving sustainability.****" (IBM, 2023)*

- Enhanced Customer Experience
  "By using IoT technology to gather data about customer behavior, businesses can ***create more personalized and engaging experiences for their customers****. For example, retailers can use IoT sensors to track customer movements in stores and deliver personalized offers based on their behavior." (IBM, 2023)*

IBM (2023). What is the Internet of Things (IoT)? [online] IBM. Available at: https://www.ibm.com/think/topics/internet-of-things.

Tech Behind IoT

- Sensors and actuators:
  "Sensors are devices that can ***detect changes in the environment****, such as* ***temperature, humidity, light, motion, or pressure****. Actuators are devices that can* ***cause physical changes in the environment****, such as opening or closing a valve or turning on a motor. These devices are at the heart of IoT, as they allow machines and devices to interact with the physical world.* ***Automation is possible when sensors and actuators work to resolve issues without human intervention****." (IBM, 2023)*

- Connectivity technologies:
  "To transmit IoT data from sensors and actuators to the cloud, IoT devices ***need to be connected to the internet****. There are several connectivity technologies that are used in IoT, including* ***wifi, Bluetooth, cellular, Zigbee, and LoRaWAN.****" (IBM, 2023)*

- Cloud computing:
  "The cloud is where the vast amounts of data that is generated by IoT devices are stored, processed, and analyzed. Cloud computing platforms provide the infrastructure and tools that are needed to store and analyze this data, as well as to build and deploy IoT applications." (IBM, 2023)

- Big data analytics:
  "To make sense of the vast amounts of data generated by IoT devices, businesses need to use ***advanced analytics tools to extract insights and identify patterns****. These tools can include machine learning algorithms, data visualization tools and predictive analytics models." (IBM, 2023)*

- Security and privacy technologies:
  "As IoT deployments become more widespread, IoT security and privacy become increasingly important. ***Technologies such as encryption, access controls and intrusion detection systems are used to protect IoT devices*** *and the data they generate from cyberthreats." (IBM, 2023)*

Simplilearn (2020). IoT - Internet of Things | What is IoT? | IoT Explained in 6 Minutes | How IoT Works | Simplilearn. YouTube. Available at: https://www.youtube.com/watch?v=6mBO2vqLv38.

WEEK 7

Focus: Drone Regulations Australia

Australian Drone Regulations

Queensland

Who makes the rules?

- CASA, (Civil Aviation Safety Authority), sets the aviation rules in CASR Part 101 + its manual of standards (MOS).
- State and local overlays add place-based restrictions specific to areas within Queensland, (Such as parks, cities, neighbourhoods, airports etc)

So CASA acts as a baseline of rules/regulations, and state sets specifics rules and regulations according to area. However, these baselines can be tweaked depending on if you have special authorisation. Meaning, in operational use within state based services, (Emergency Services), it's entirely possible to allow for changes to make drone operation more manageable.

This would require alot of careful considerations, and more importantly, requires positive responses from the public as well.

Figure: General drone rules for consumer use

CASA (2019). Drone rules. [online] Civil Aviation Safety Authority. Available at: https://www.casa.gov.au/knowyourdrone/drone-rules.

Civil (2021). Part 101 of CASR Unmanned aircraft and rockets. [online] Civil Aviation Safety Authority. Available at: https://www.casa.gov.au/rules/regulatory-framework/casr/part-101-casr-unmanned-aircraft-and-rockets

Drones. (2022). State and territory rules | Drones. [online] Available at: https://www.drones.gov.au/drone-rules/state-and-territory-rules.

BVLOS Regulation

BVLOS, (Beyond Visual Line of Sight), operation requires CASA approval under reg 101.029. A BVLOS approved operator would be issued a flight approval instrument specifing operational conditions, including procedures, mitigations and geography.

BVLOS approval often takes the following two forms

- Specific mission BVLOS approvals:
  Safety case submitted including, (Concept of Operations, (CONOPS), risk assesment, DAA/Airspace mitigations, crew training)
- Broad Area BVLOS
  CASA Guidance/Instruments which enable ongoing BVLOS within defined flight geography. Good fit for continuous repeated operations (Emergency service context)

Automation & Autonomous OPS

The two terms, (Automation and Autonomy), are clearly distinguished via CASA regulations:

Automation:

- Executing pre-programmed tasks via human supervision/control, (Scheduled flights, return-to-home, waypoint following etc.)
- Pilot maintains supervision and has the ability to intervene and take control of drone at any point
- Think of it more as a way to reduce repetitive easy to control tasks, where human control is taken over at a certain point

Autonomy

- Decision making with minimal, or no human intervention. Dynamically reacting to environment, plans and conditions to reroute and adapt to missions
- Human ability surrounds setting mission objectives, but system executes mission itself
- Typically sits in a higher risk category, however is manageable as long as CASA sees strong justification and risk mitigation. Treated more as Approvals rather than standards

What does this mean?

What's possible today?

- BVLOS is legal and possible with CASA approval under a ReOC (Remote operator's certificate).
- Surface level automation, (Pre-planned routes, waypoints, scheduled flights & return to home), Is fully approved and legal as long as remote pilots have control and are able to intervene at any point.
- EMS BVLOS can operate via expedited approvals or under special CASA instruments with coordination with airspace controllers.
- Broad BVLOS trials are currently in action and CAS is issuing early instruments to approved ReOC holders in defined regions
- Digital Flight Authorisation infrastructure exist, however in early form. CASA-Certified apps are able to issue VLOS/BVLOS approvals in low risk zones.
- Autonomous features such as automatic landing, launching, sensing and reporting are possible as long as there is human oversight.

What isn't possible yet?

- General BVLOS. Currently it's not possible to fly anywhere beyond line of sight without CASA approval
- Full autonomous flight is not yet approved anywhere in Australia. Meaning commanding pilots are still required and dynamic, drone controlled operation isn't possible yet
- Urban BVLOS, (Above people and densely populated areas), is very tighly regulated and only approved via a very strong safety case and CASA exemption. Requires a strong use case
- Auto-Response Missions (EMS), is currently a future goal, however not current law.
- Full digital BVLOS approvals are coming but not fully released yet.

The bottom line:

- Casa is expanding Broad-Area BVLOS laws to allow for longer range manned operations.
- Digital flight authorisation is slowly becoming standardised
- Gradual acceptance of semi-autonomous operations is becoming commonplace
- Full autonomy is a likely scenario post-2027 once detect & void standards mature

Drone Innovations

Zipline

Zipline is a company using autonomous fixed-wing drones to deliver medical supplies in remote and urban areas. They're looking to expand into urban delivery systems and are looking into multiple ways of reducing noise.

Youtube: Amazing Invention- This Drone Will Change Everything - Mark Rober

Zipline Specialised Propellers

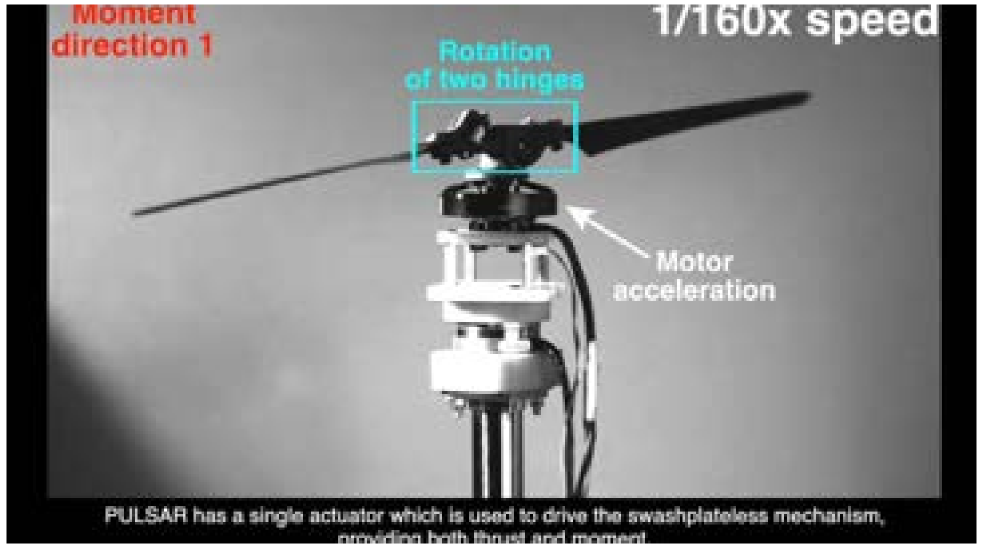
To combat public complaints and optomise perceptions. Zipline features a special propeller designed to reduce high frequency noise. Eliminating irritable high frequency noises that traditional propellers emit.

Rober, M. (2023). Amazing Invention- This Drone Will Change Everything. [online] www.youtube.com. Available at: https://www.youtube.com/watch?v=DOWDNBu9DkU.

Kesteloo, H. (2023). How do the Zipline Silent Propellers Work? [online] DroneXL.co. Available at: https://dronexl.co/2023/05/04/how-do-zipline-silent-propellers-work/.

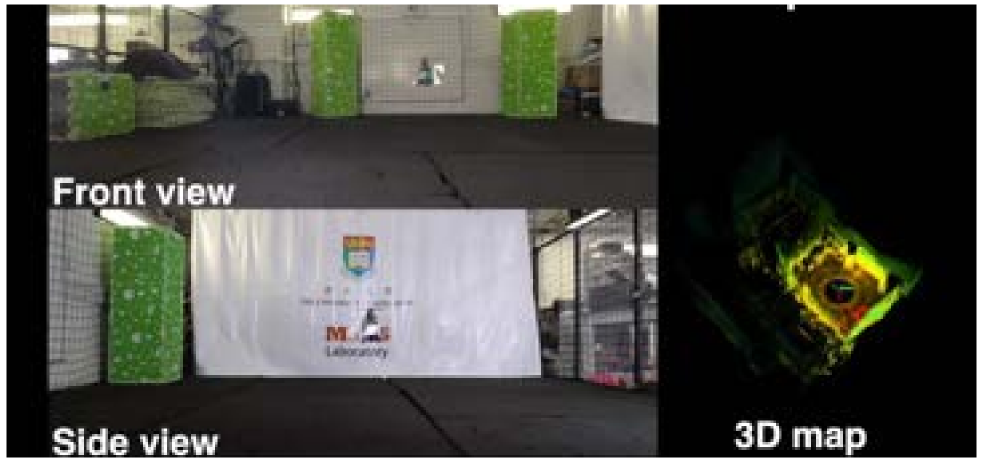
Single Propeller Drones

Research is being conducted into single propeller drones, which use fluctuations in motor acceleration to drive propeller pitch, yaw, and roll. Although a bit extreme, this demonstrates that reduced propeller quantities is possible



Youtube: A self-rotating, single-actuated UAV with extended sensor field of view for autonomous navigation -MARS LAB HKU

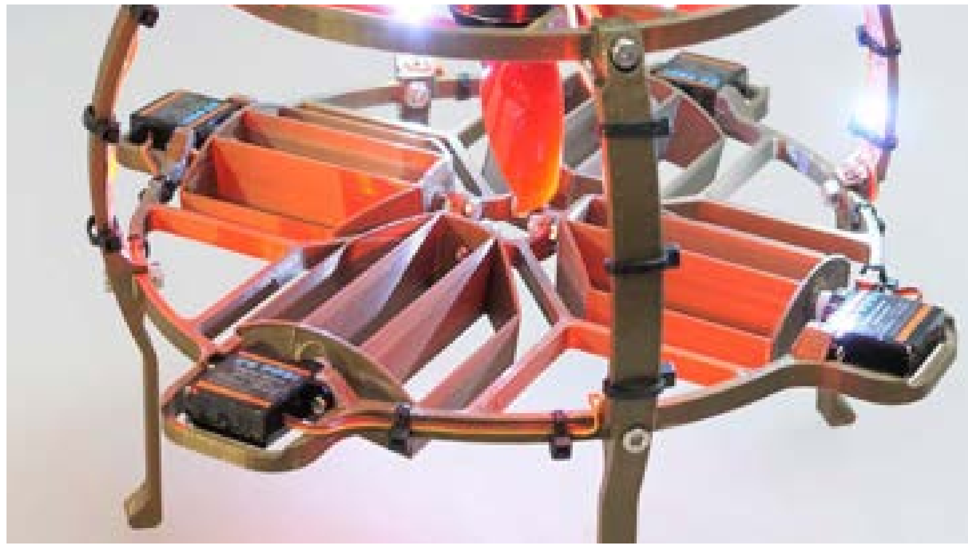
This method is a bit too technical for the context of emergency services and would require alot of maintenance and testing before it would be ready for the field. Navigation will instead be controlled by "Control Vanes" which act like plane Ailerons to determine thrust vector.



MARS LAB HKU (2023). A self-rotating, single-actuated UAV with extended sensor field of view for autonomous navigation. [online] YouTube. Available at: https://www.youtube.com/watch?v=lrEJnJrRJsQ [Accessed 31 Oct. 2025].

"The Ball" Drone

The Ball is an example of a research drone that looks at using control vanes to drive its movement. The vanes act by redirecting the air pressure generated by the propeller.



Toroidal Propellers

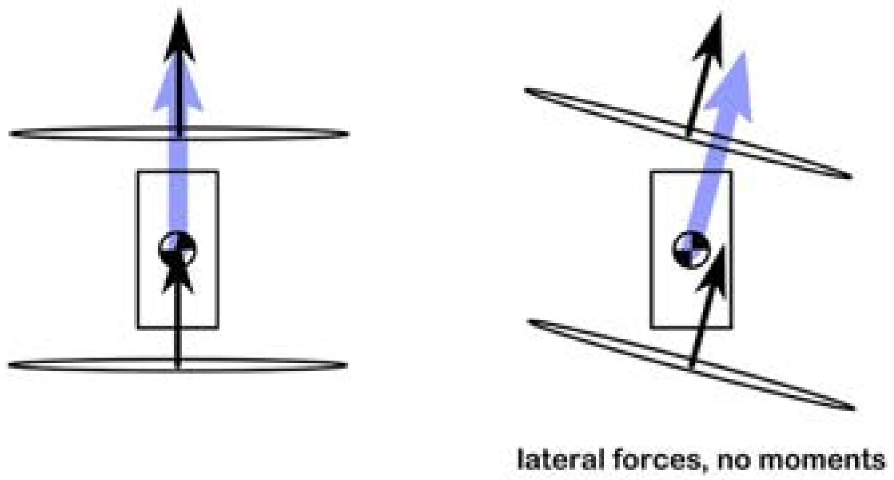
To combat public complaints and optomise perceptions. Zipline features a special propeller designed to reduce high frequency noise. Eliminating irritable high frequency noises that traditional propellers emit.

Hackaday.io. (2020). Project | The Ball-Drone Project | Hackaday.io. [online] Available at: https://hackaday.io/project/169823/logs [Accessed 31 Oct. 2025].

Drone Innovations Cont.

Bi-Propeller Drone

This is a drone design incorporating a two propeller layout, again it uses motor fluctuations to drive the propeller angles in order to determine its thrust vector. Still a bit to complicated for the project scope however interesting to see aplied to bi-propeller drones



Youtube: A Fully Actuated Aerial Vehicle using Two Actuators - Modlab UPenn

Toroidal Propellers

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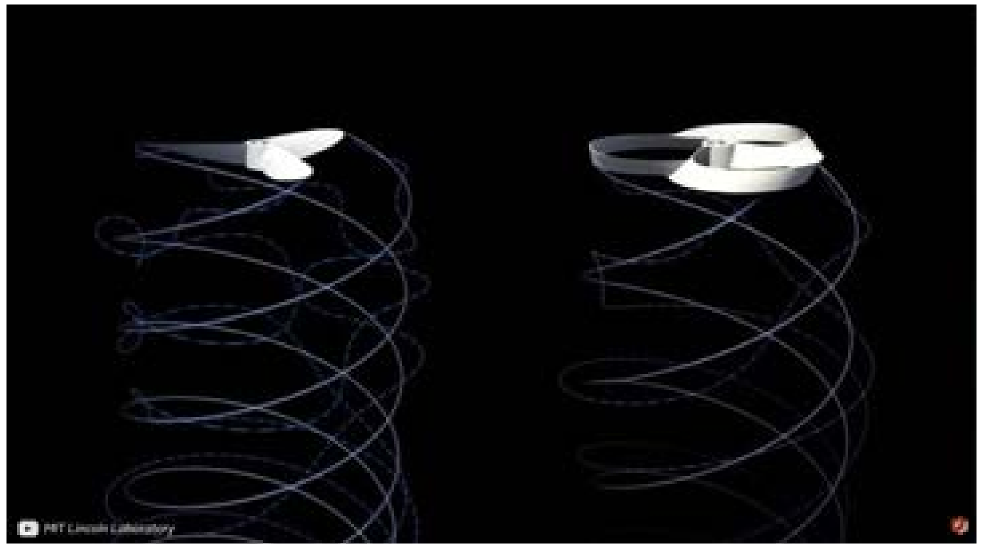


Modlab UPenn (2018). A Fully Actuated Aerial Vehicle using Two Actuators. [online] YouTube. Available at: https://www.youtube.com/watch?v=qWsKqmCIhRY

Ziroth (2024). The Unexpected Genius of Contra-Rotating Propellers. [online] YouTube. Available at: https://www.youtube.com/watch?v=0cVBSt67AcU

WEEK 8

DESKTOP RESEARCH

Focus: Drone Propeller Designs

Explored different propellor types, decided that the most likely outcome would be for the propellors to be designed as ducted, coaxial, contra-rotating toroidal propellors.

Pros:

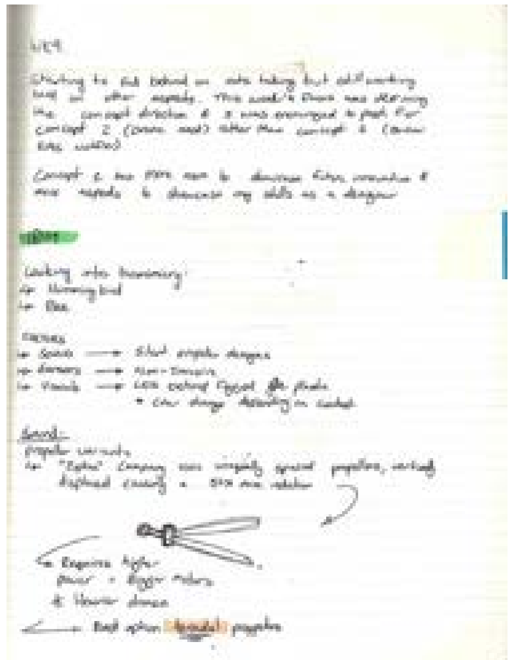
- High Thrust
- Lower energy consumption
- Smaller propeller size
- Eliminating high pressure zone mixes
- Great EVTOL capabilities
- Enclosed propellers reduce safety hazards
- Quieter design, (Reduces the mix of pressure zones which eliminates pressure vortexes and hence noise, combined with toroidal propellers hopes to significantly reduce noise output)

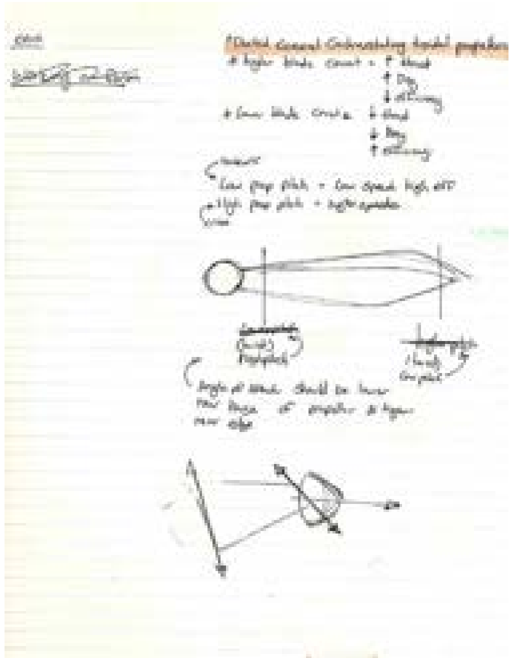
Cons:

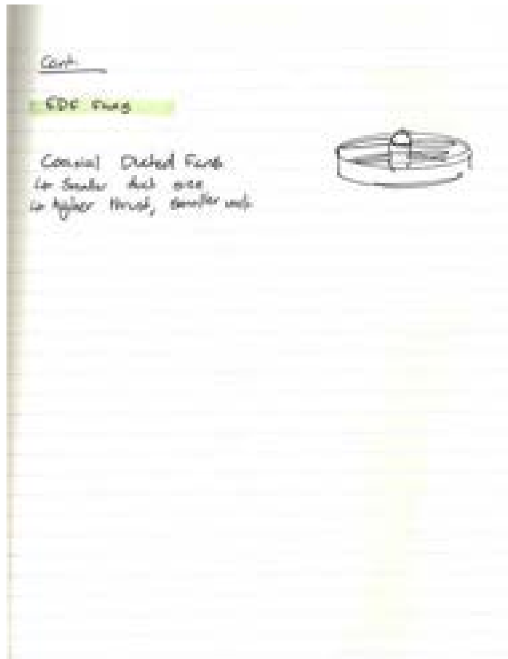
- Ducts generate additional weight
- Susceptible to crosswinds
- Added drag when cruising, (moving directionally)

Proposed fixes to address ducted fan cons:

- Composite materials to reduce weight
- Gimbaled ducts can ensure protection against crosswinds
- Adaptive fans could be implemented if additional speeds required, (Adapts the shape of the ducts for better air intake and thrust output)





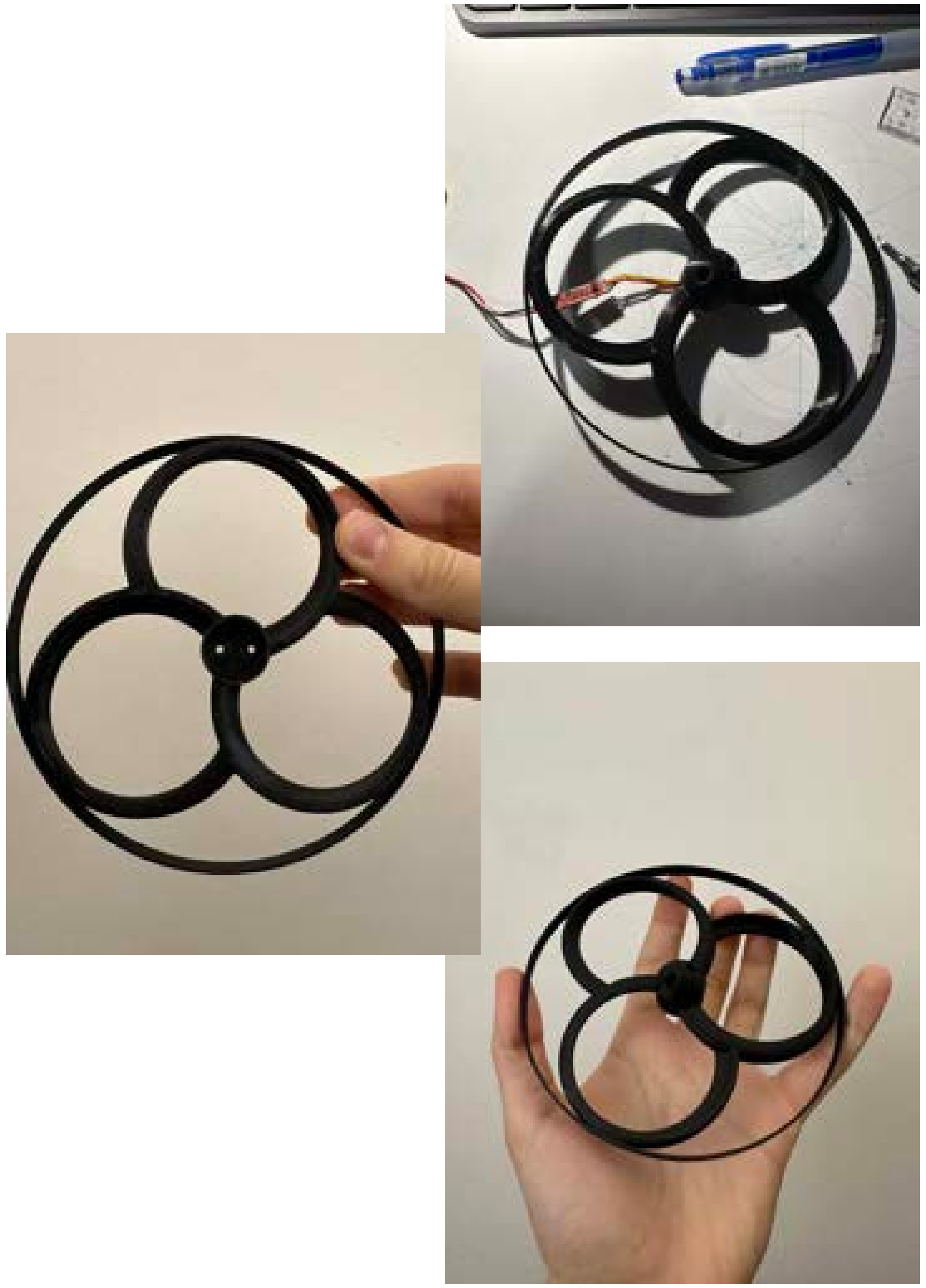


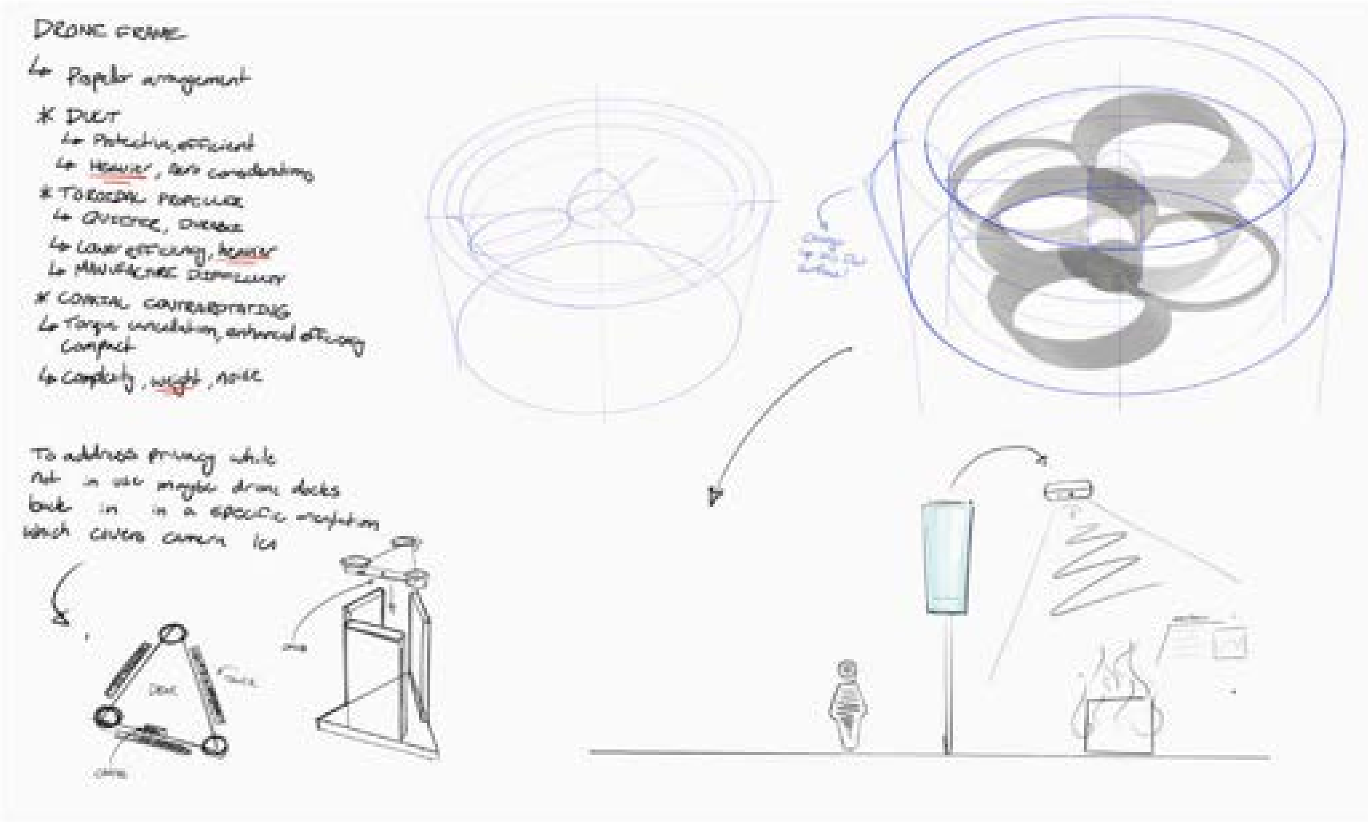
https://www.youtube.com/watch?v=0au2IA4uUok

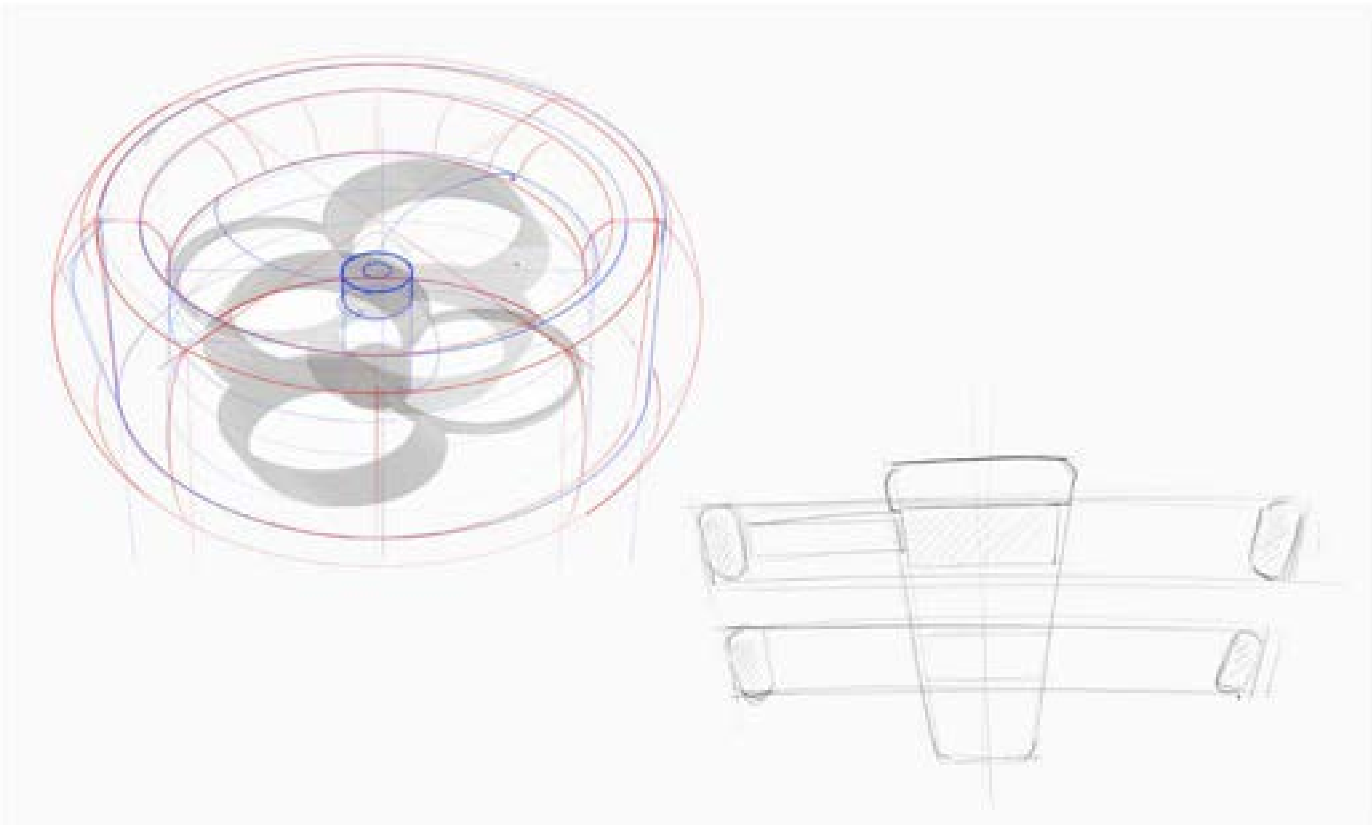
Toroidal Propeller

Early Iterations

The early designed versions of the toroidal propeller were good to reference size and demonstrate the concept, however logistically wouldn't be realistic. This propeller version was heavy, thick and unoptomised for conceptual flight. Hence official propeller designs were researched in order to create a somewhat realistic concept.





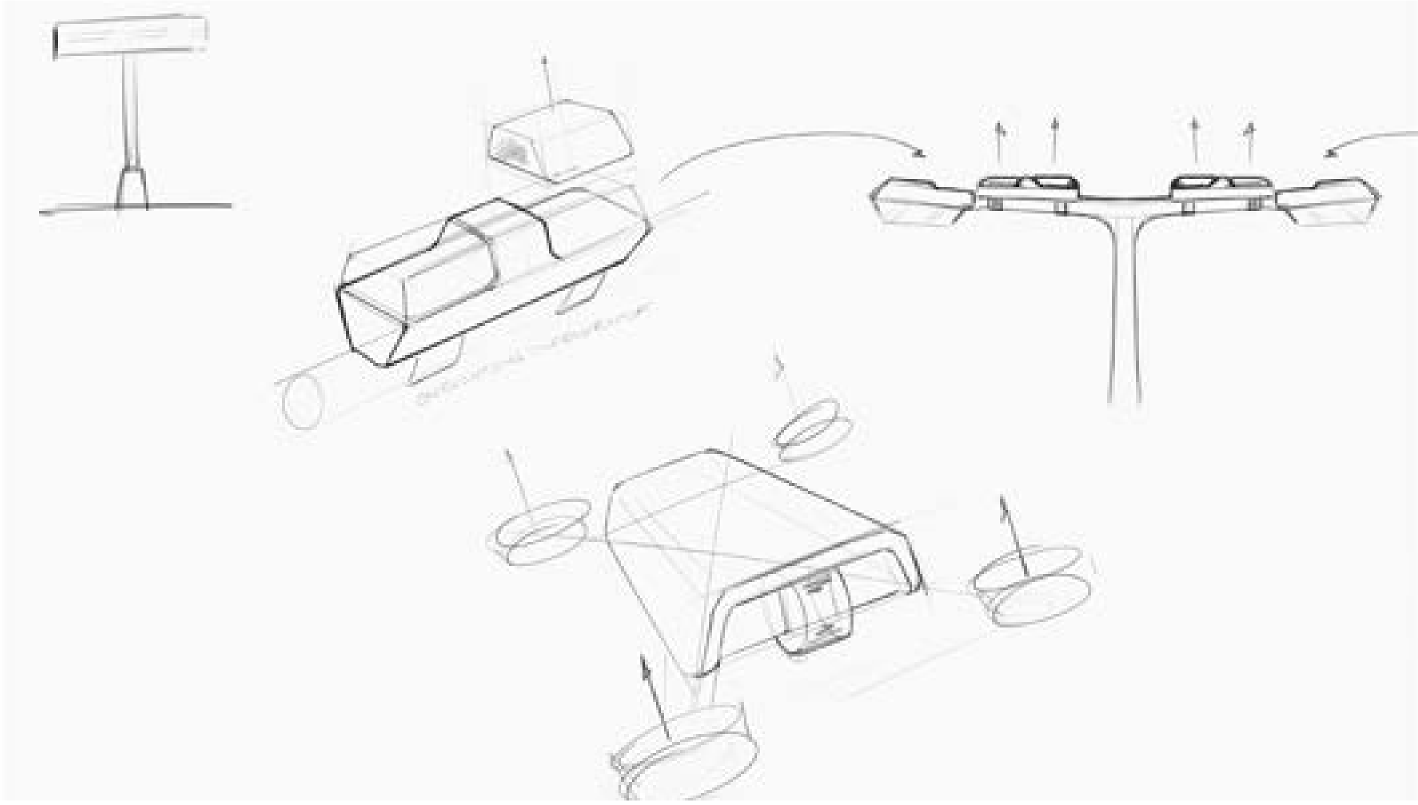


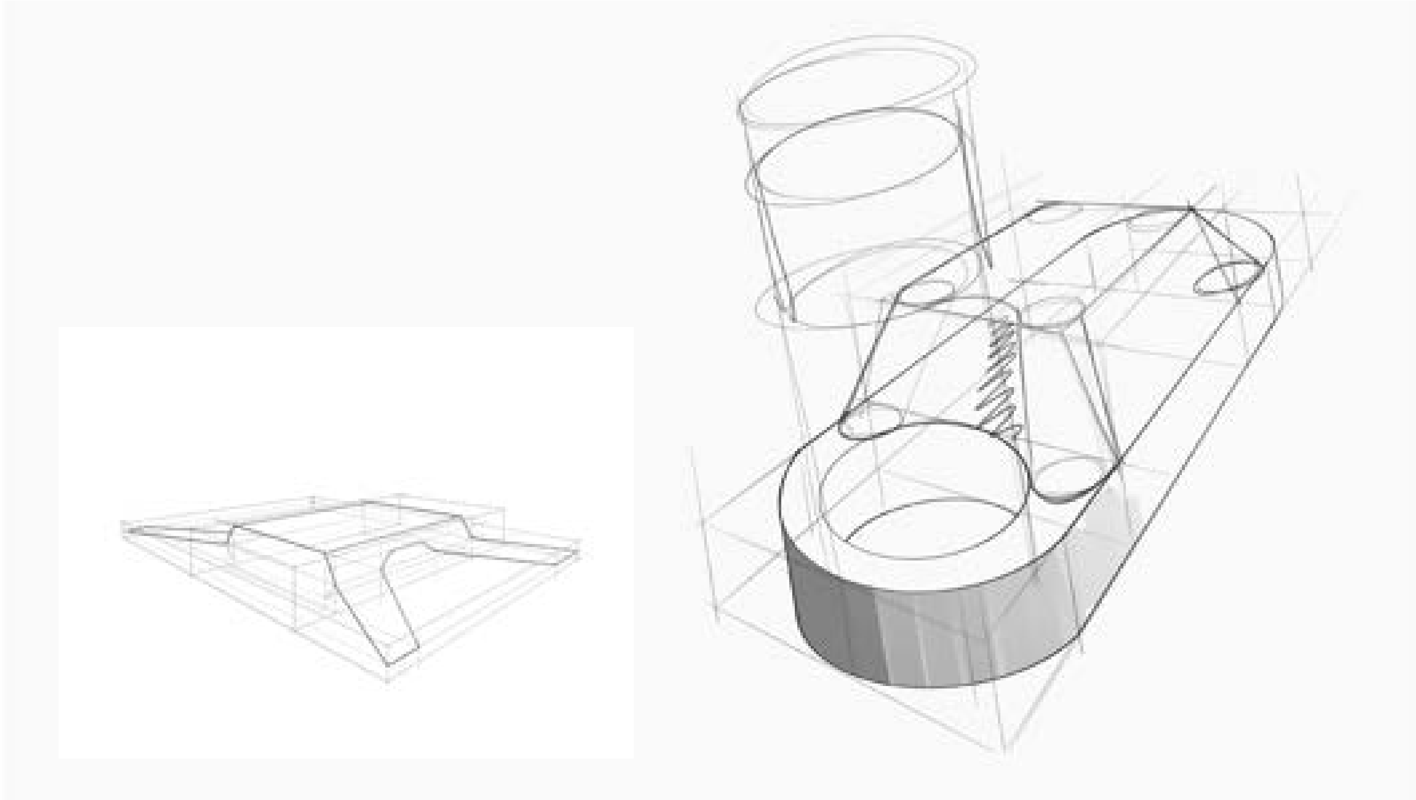
WEEK 8

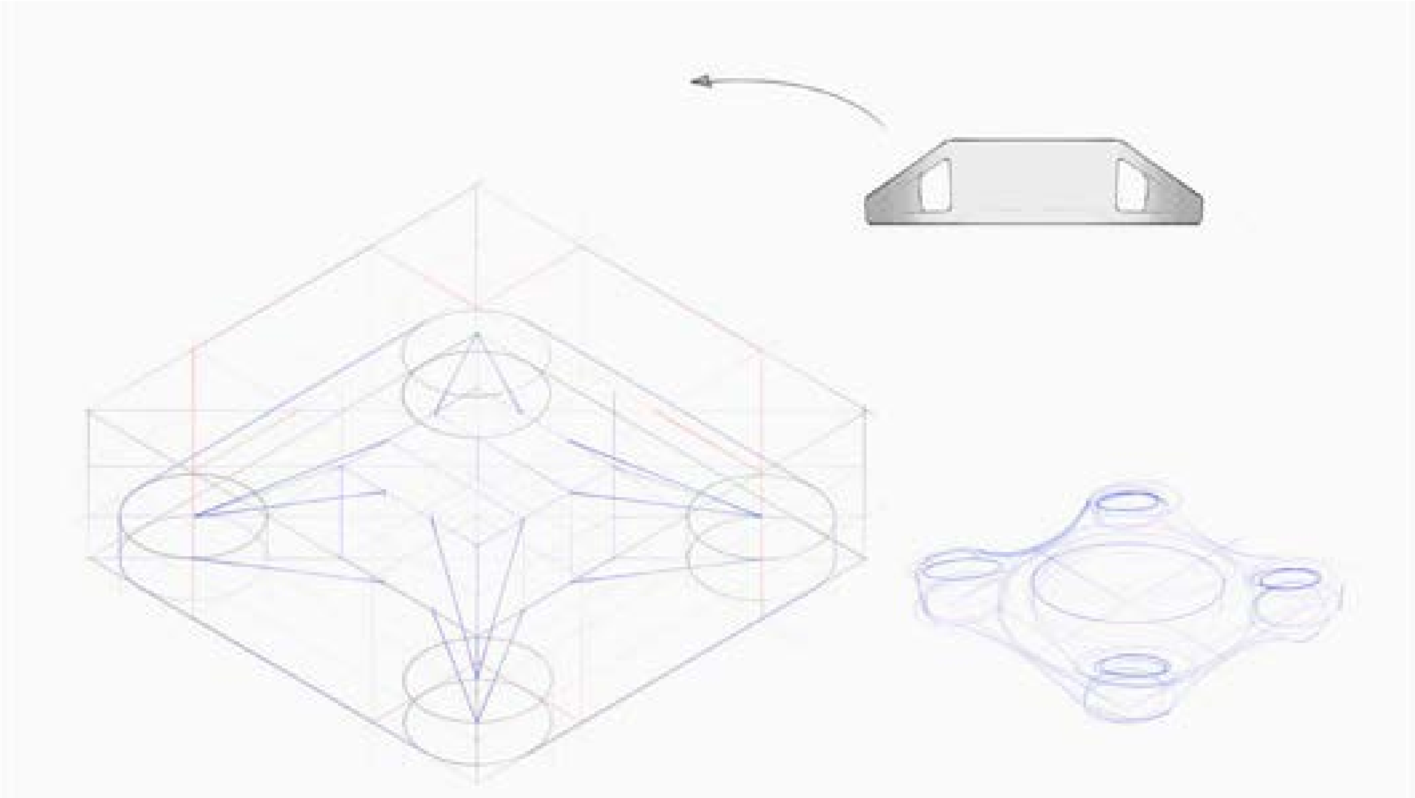
Focus: Early Stage Digital Sketching

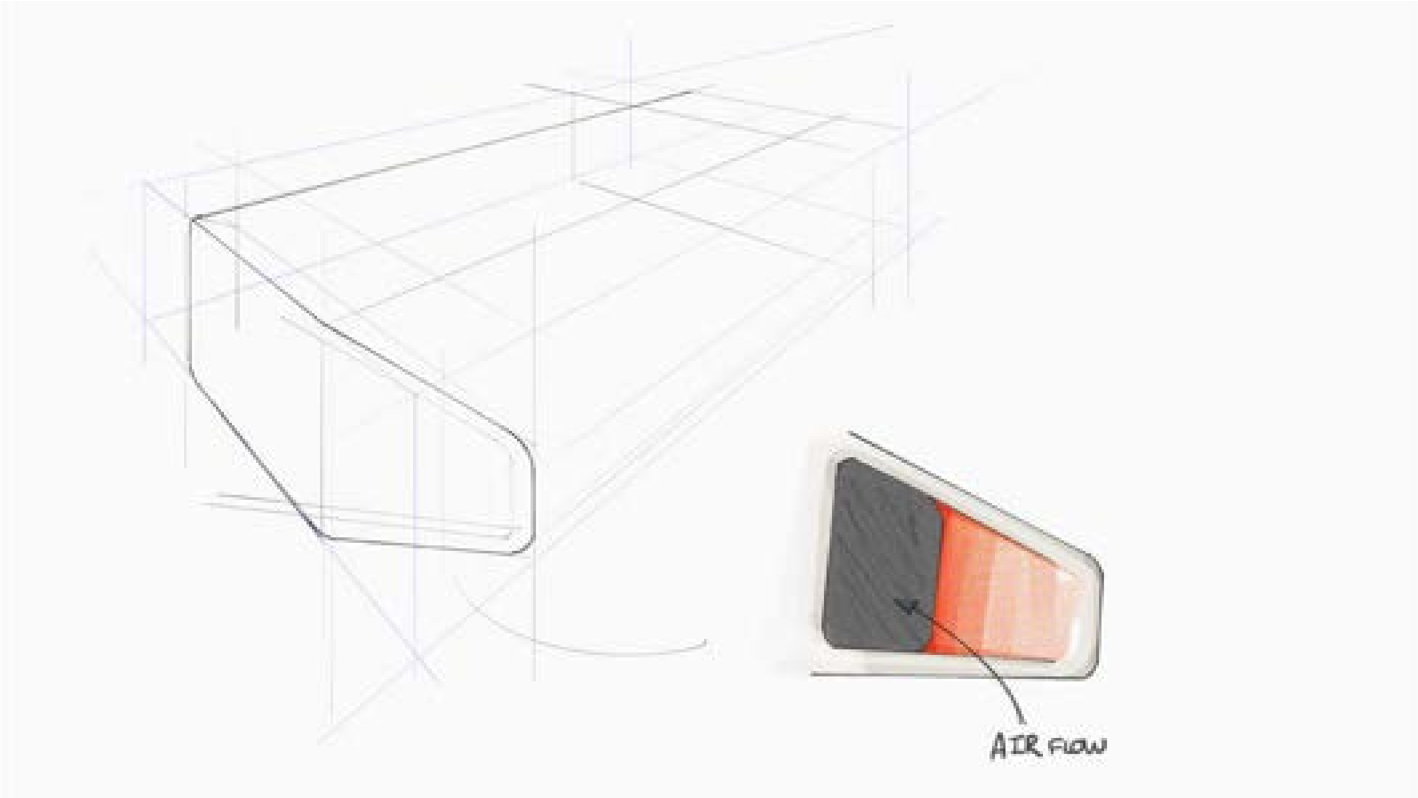
Digital Sketches

Not great at digital sketching so didn't stick with this for long

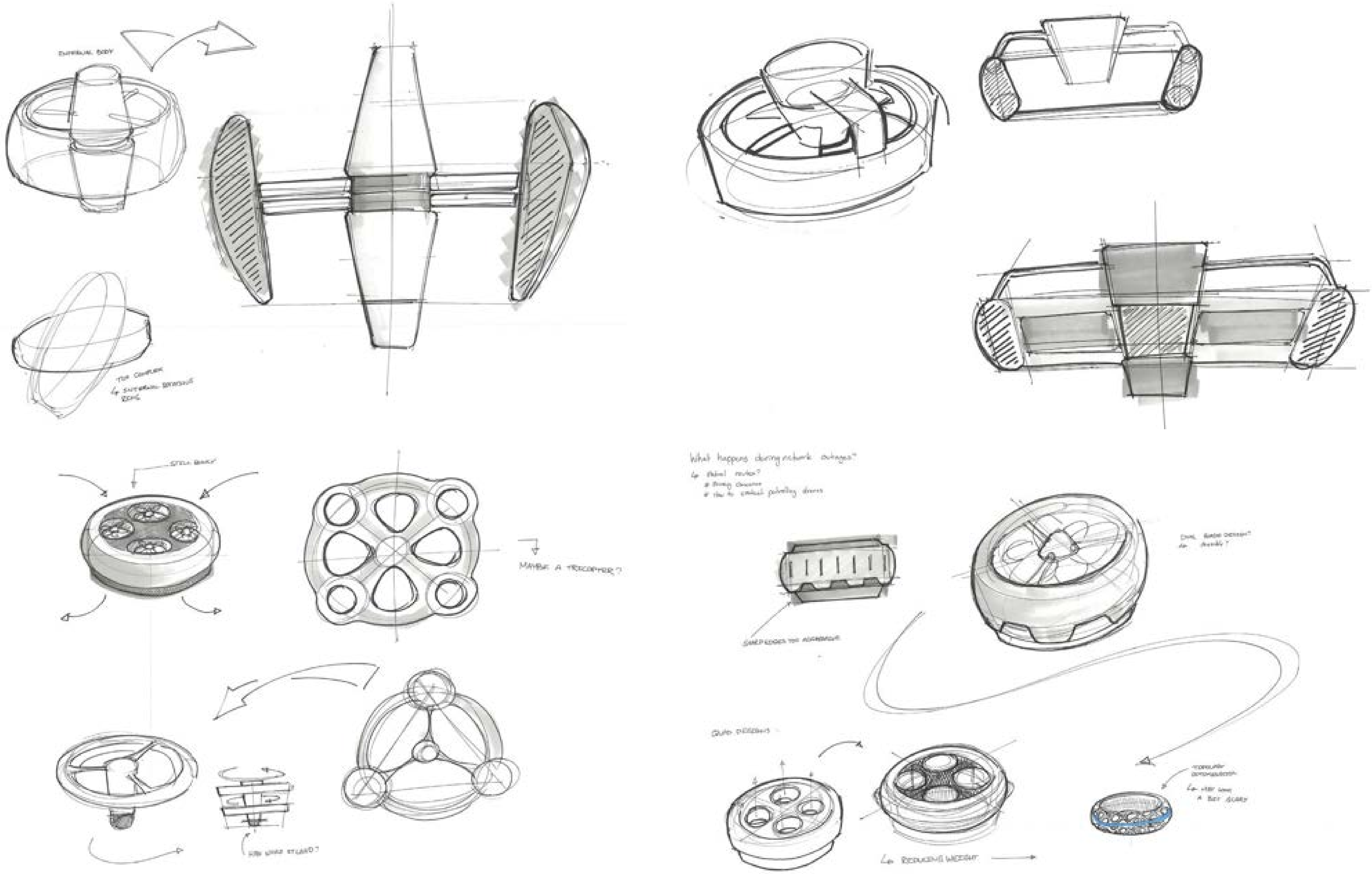




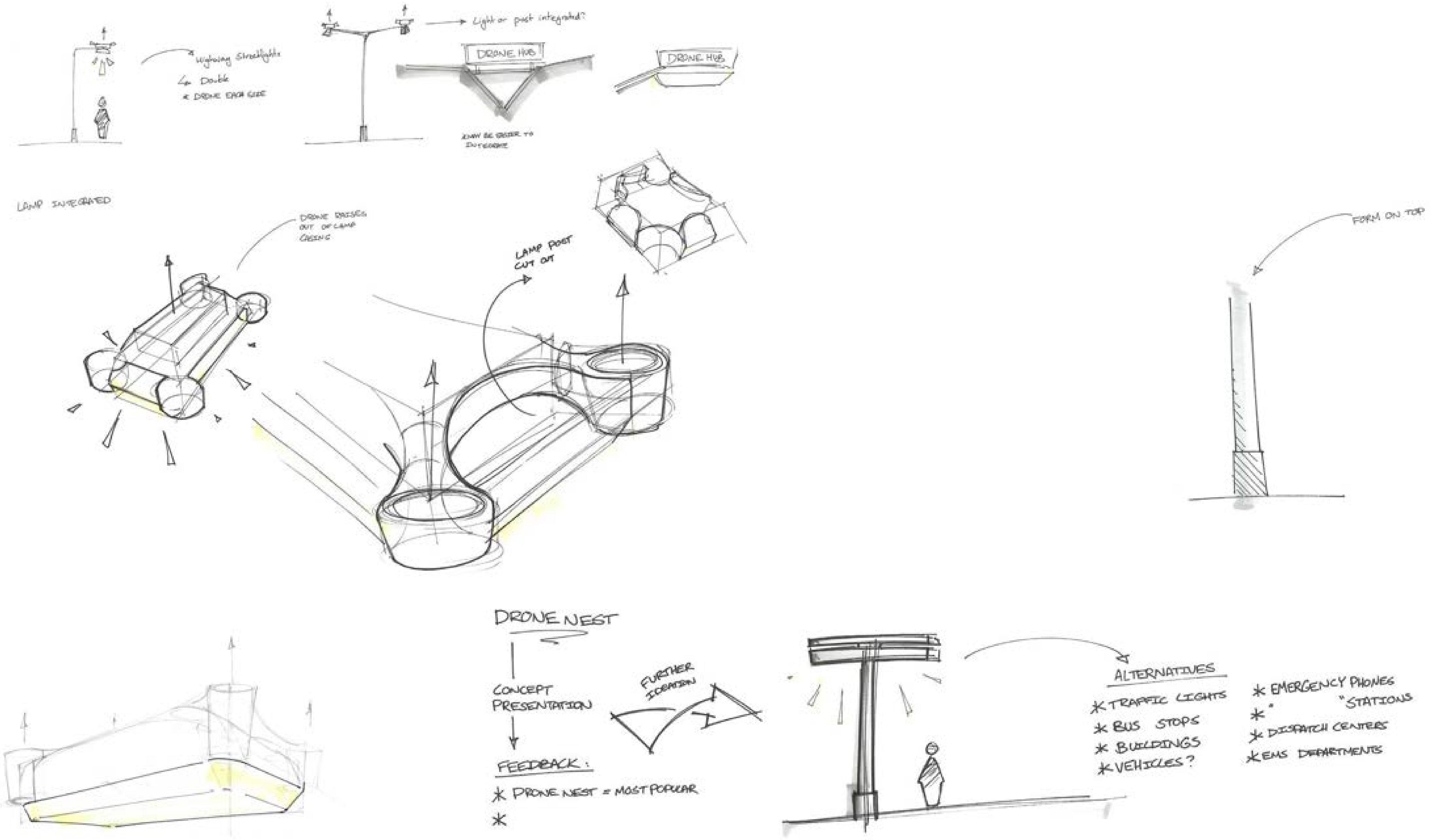




Drone Forms


EXTERNAL BODY
TOO COMPLEX
STILL BULKY
MAYBE A TRICOPTER?
HOW WOULD IT LAND?
What happens during network outages?
QUAD DESIGNS
REDUCING WEIGHT

Drone Forms

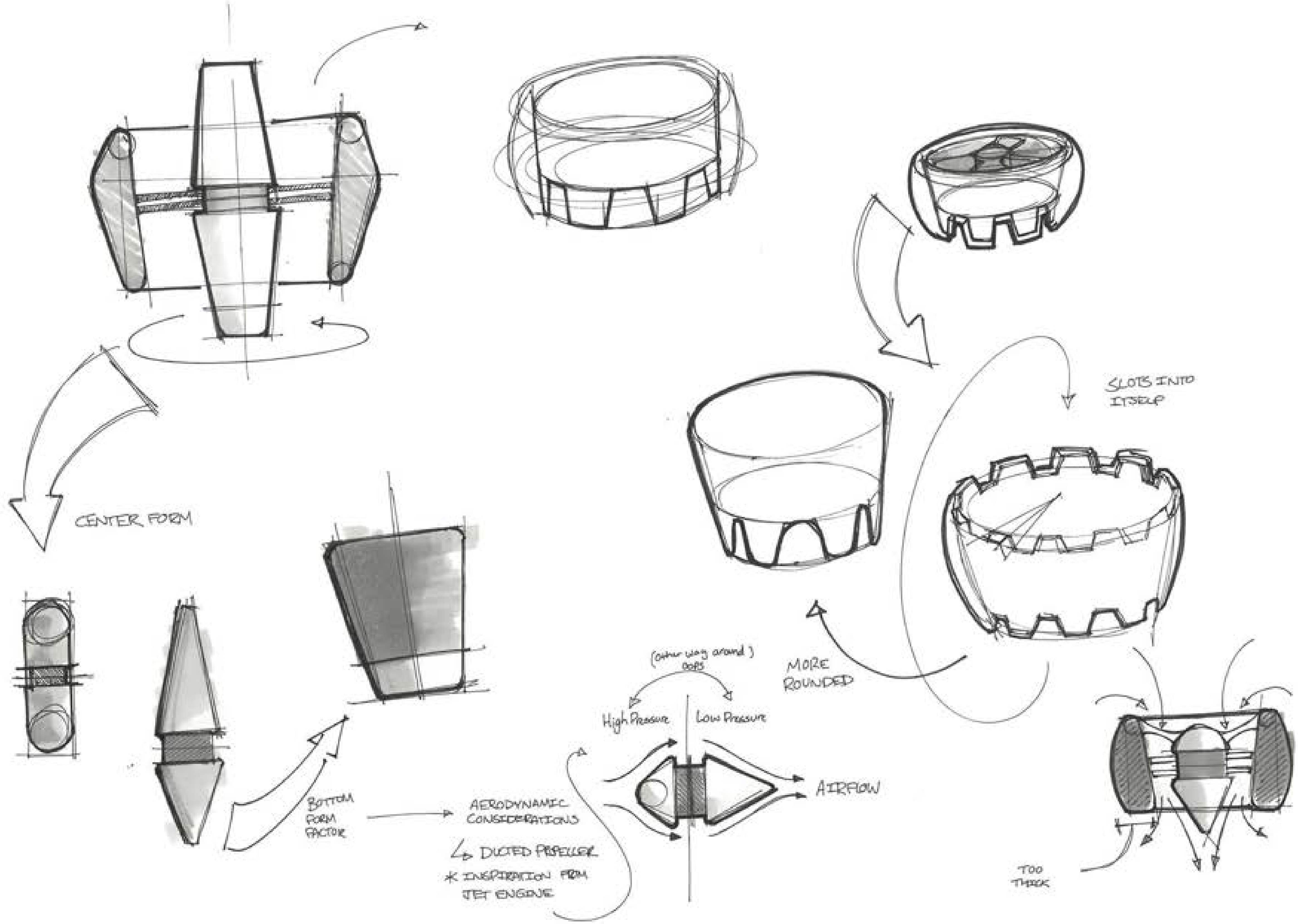


Highway Streetlights
Double
* DRONE EACH SIDE
Light or post integrated?
DRONE HUB
DRONE HUB
LAMP INTEGRATED
DRONE RAISES OUT OF LAMP CASING
LAMP POST CUT OUT
FORM ON TOP
DRONE NEST
CONCEPT PRESENTATION
FEEDBACK:
* DRONE NEST = MOST POPULAR
*
FURTHER IDEATION
ALTERNATIVES
* TRAFFIC LIGHTS
* BUS STOPS
* BUILDINGS
* VEHICLES?
* EMERGENCY PHONES
* " STATIONS
* DISPATCH CENTERS
* EMS DEPARTMENTS

WEEK 8

Focus: Early Stage Sketching

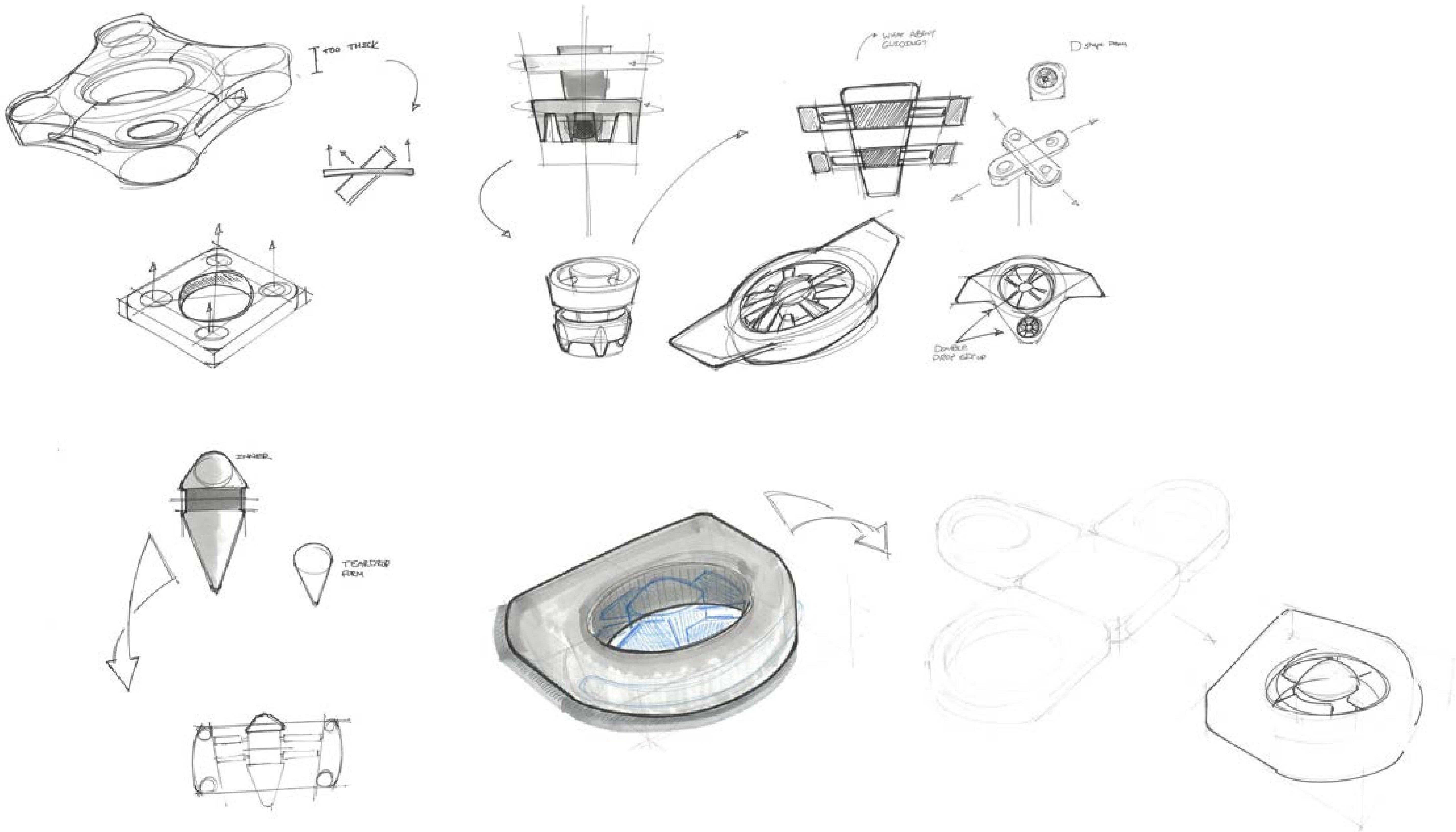
Drone Forms



WEEK 8

Focus: Early Stage Sketching

Drone Forms



Focus: Further Drone Ideation

MOODBOARD - INSPIRATION
















WEEK 9

Focus: Existing Infrastructure

Potential Drone Platforms?

Existing Infrastructure

Police Vehicles

Explored the idea of using police patrol vehicles as drone HUBS as one of my early concepts. This is due to police being present on emergency scenes almost every time. Meaning that a drone would almost always be able to respond to a scene earlier that first responders.

Eventually it was decide to remain with a drone nest design that would be implemented and connected onto existing posts. This was as to not mess too much with existing infrastructure.

Either way, there is a very real possibility of expanding the drone nest system in order to incorporate drone hubs/platforms on first response vehicles.

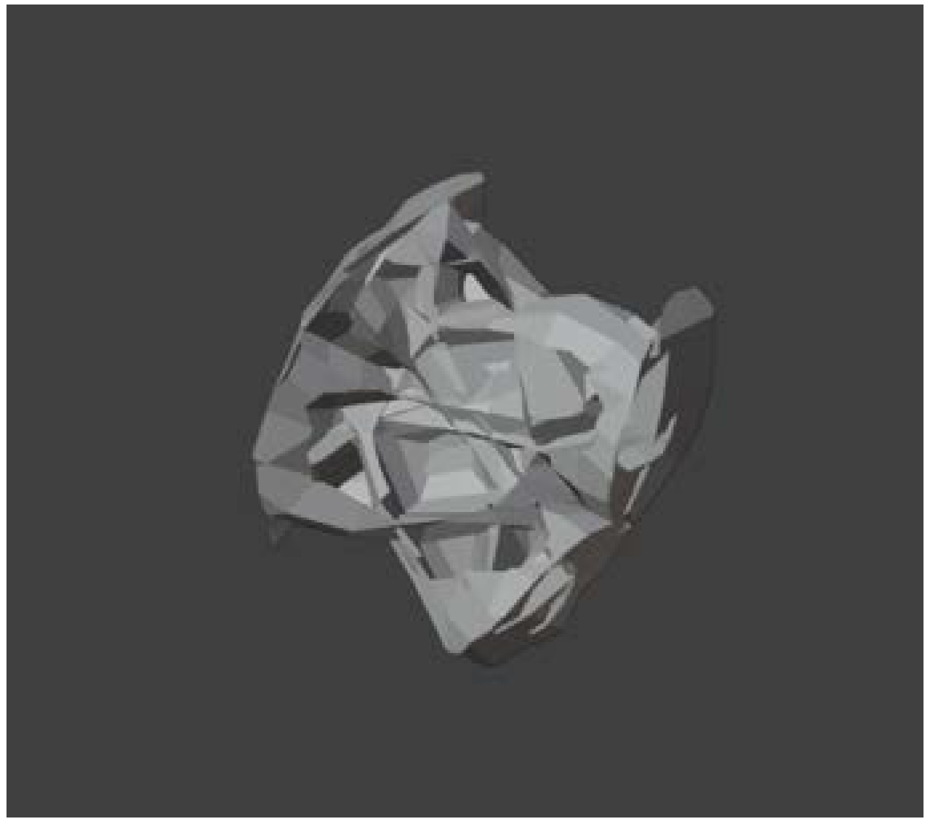
WEEK 9

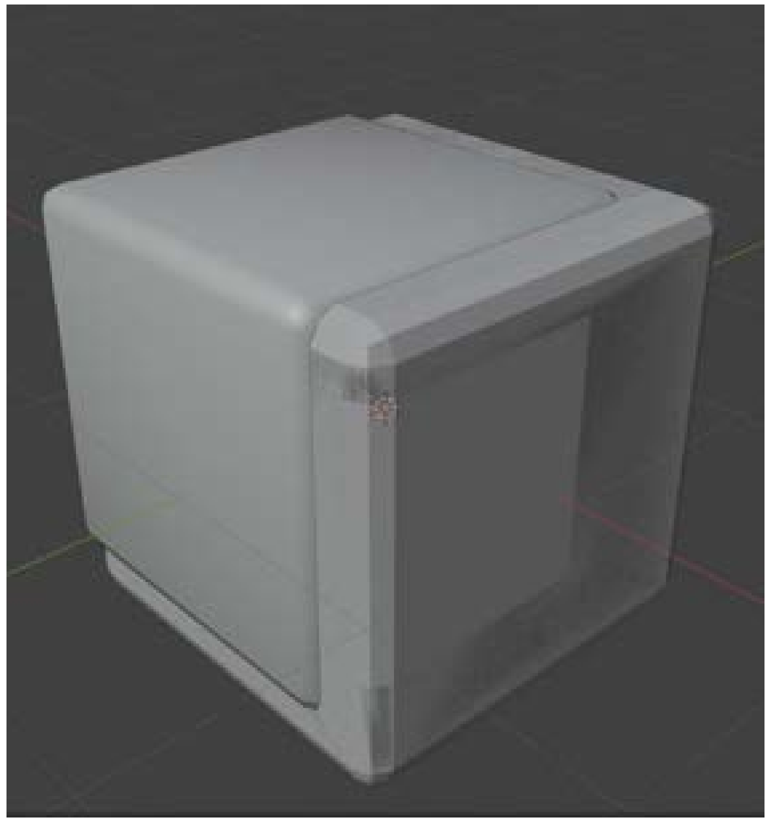
Focus: Abstract Form Ideation

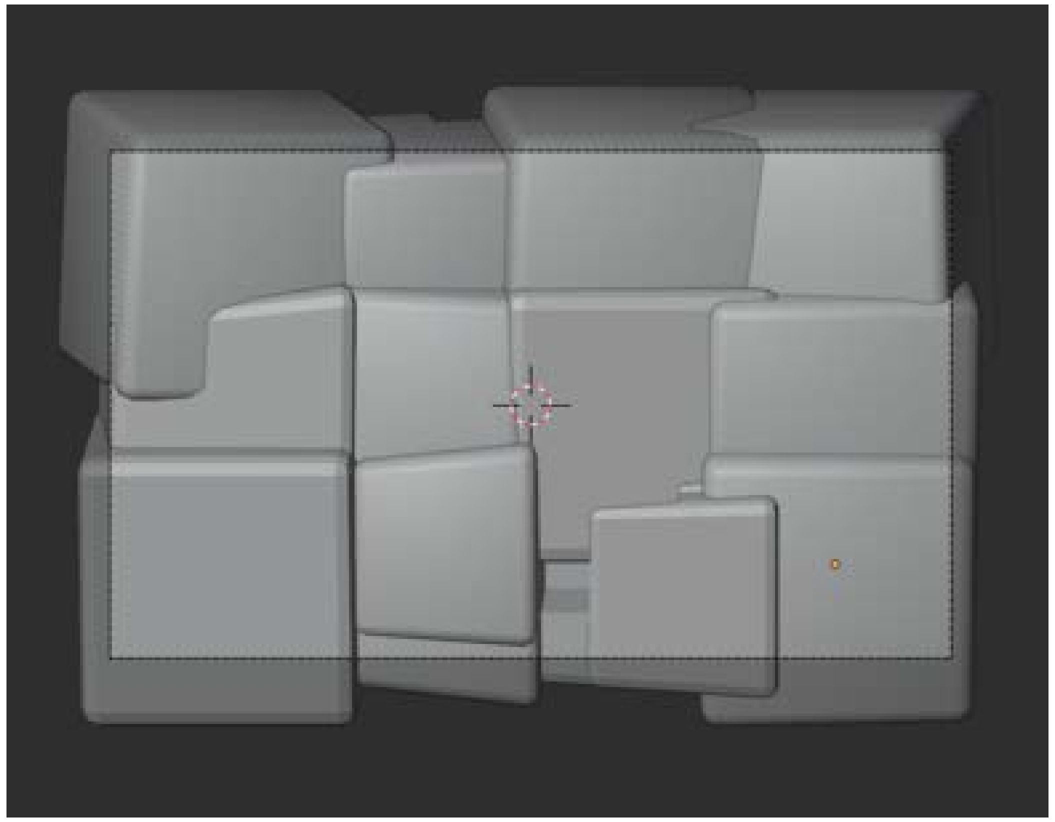
Software Ideation - Blender Script: V1

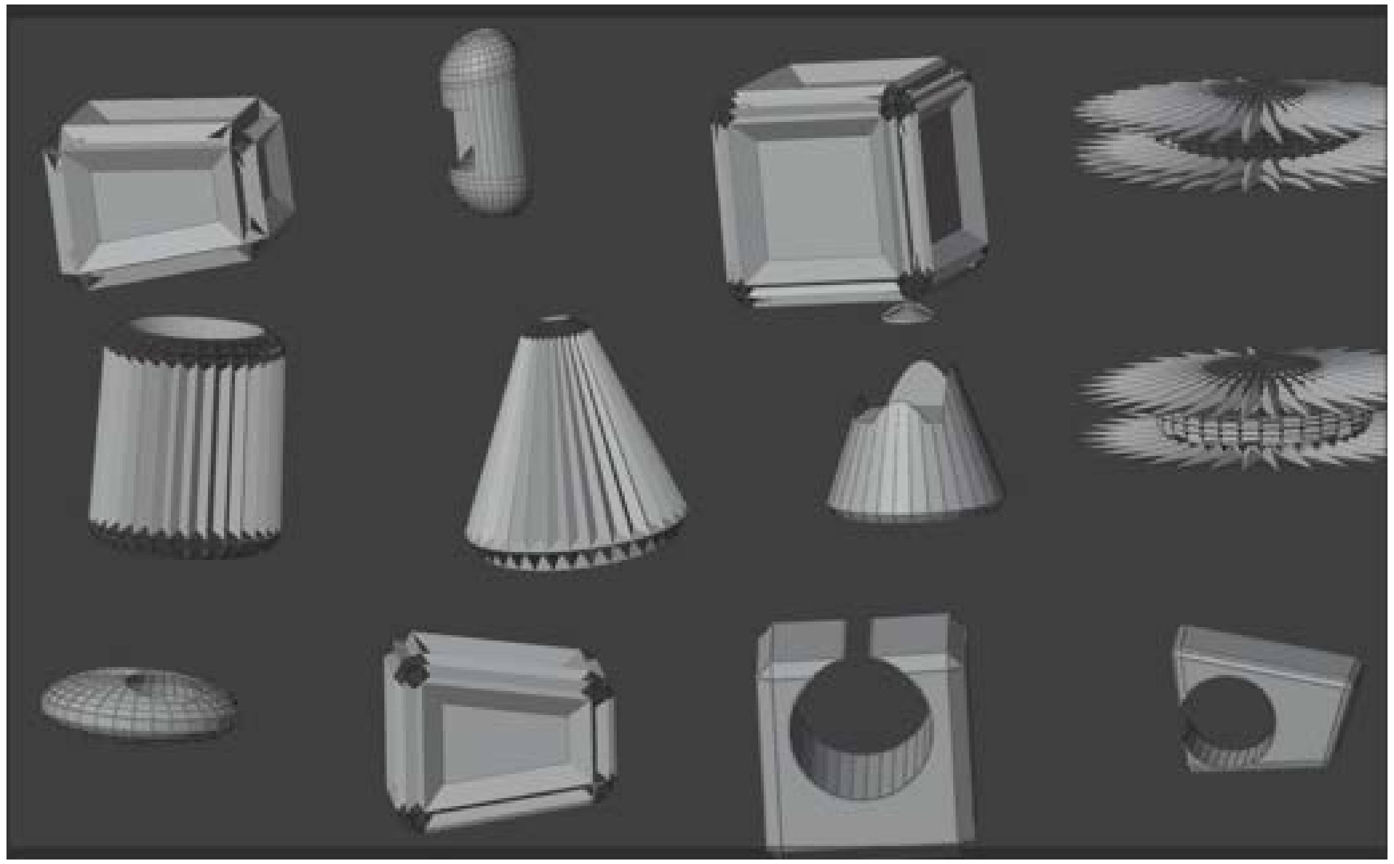
Struggling with form idea generation so played around with some blender scripts to generate randomized shapes, hoping that this would assist in developing some interesting concepts.

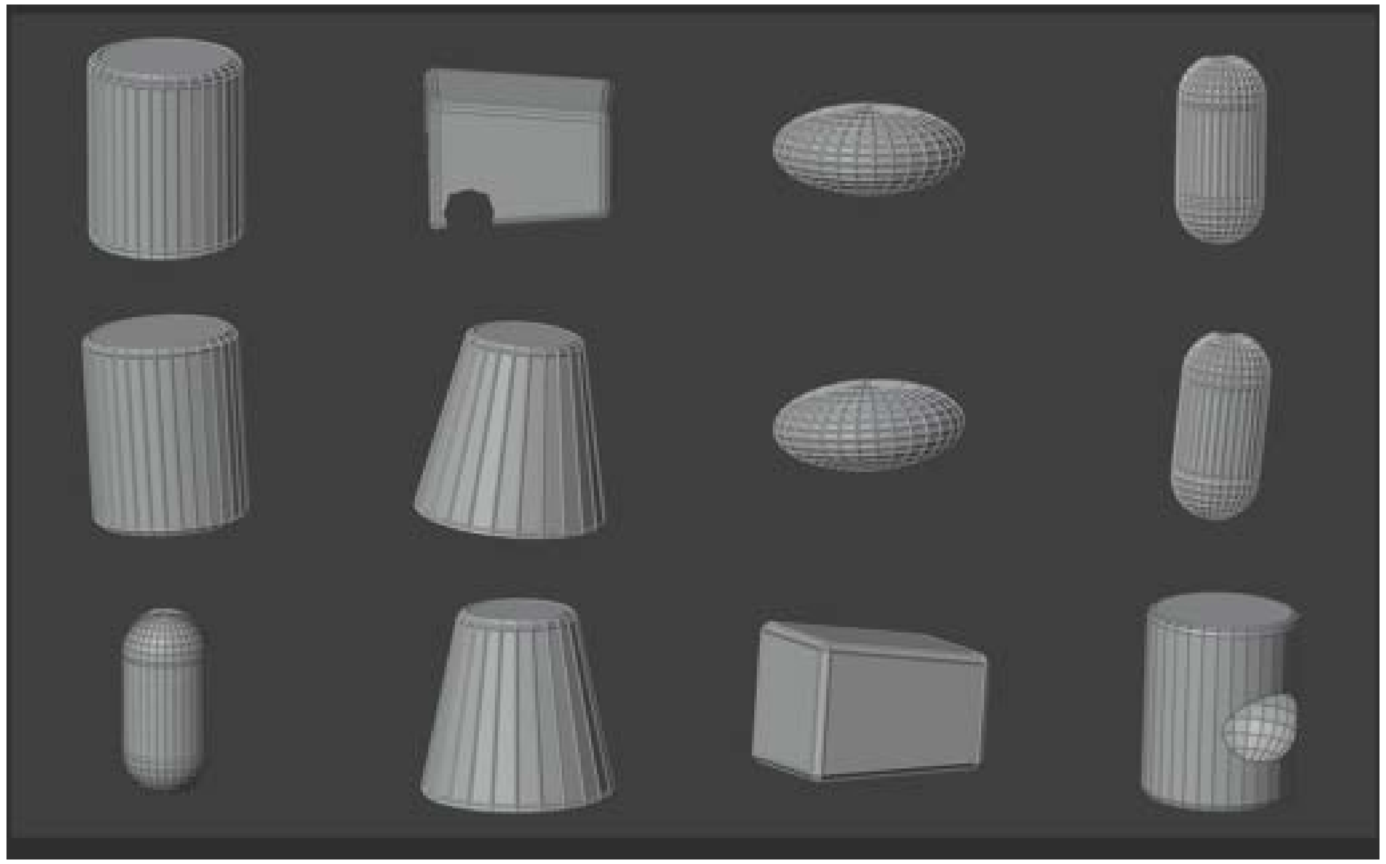
Forms were coming out either too simple or too jagged so had to adjust it









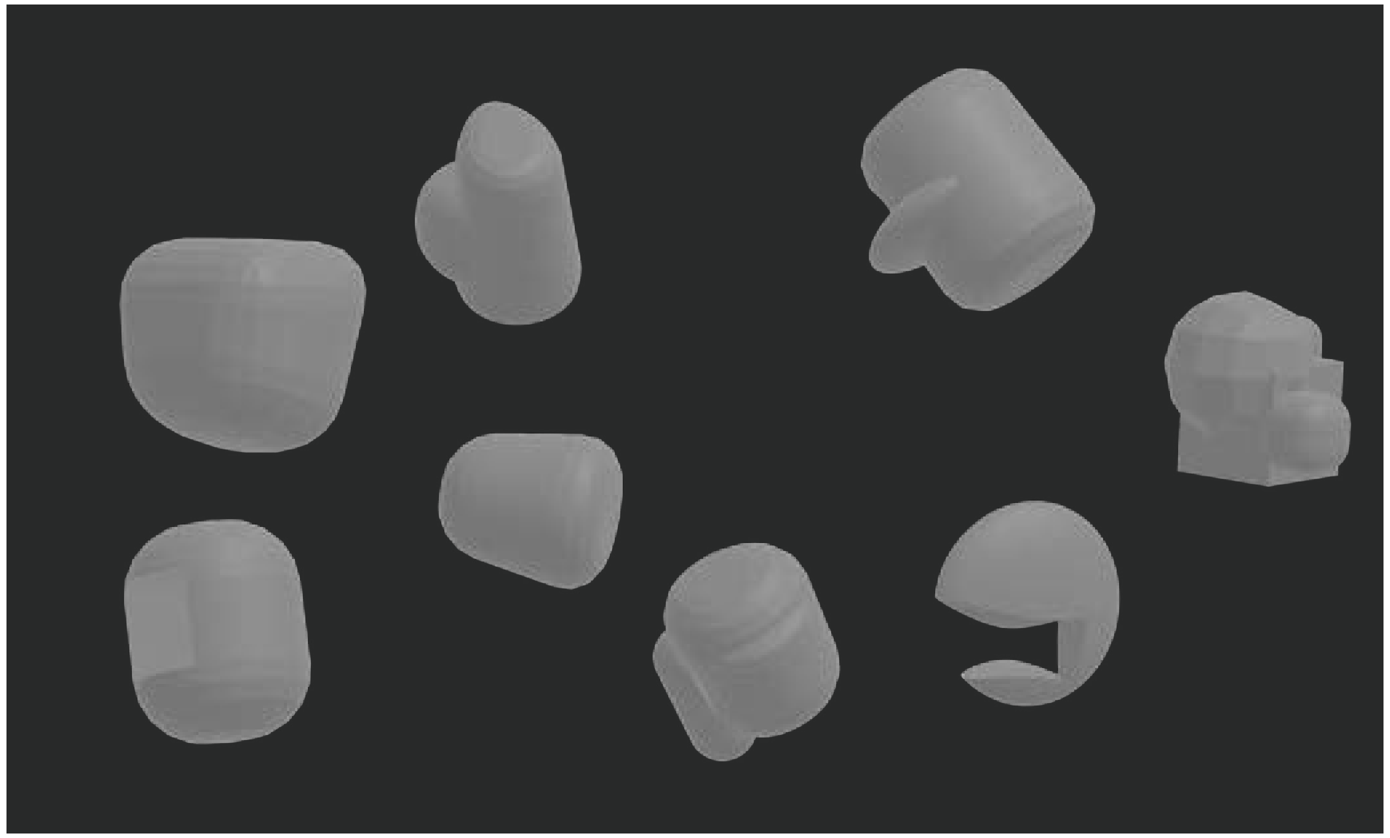


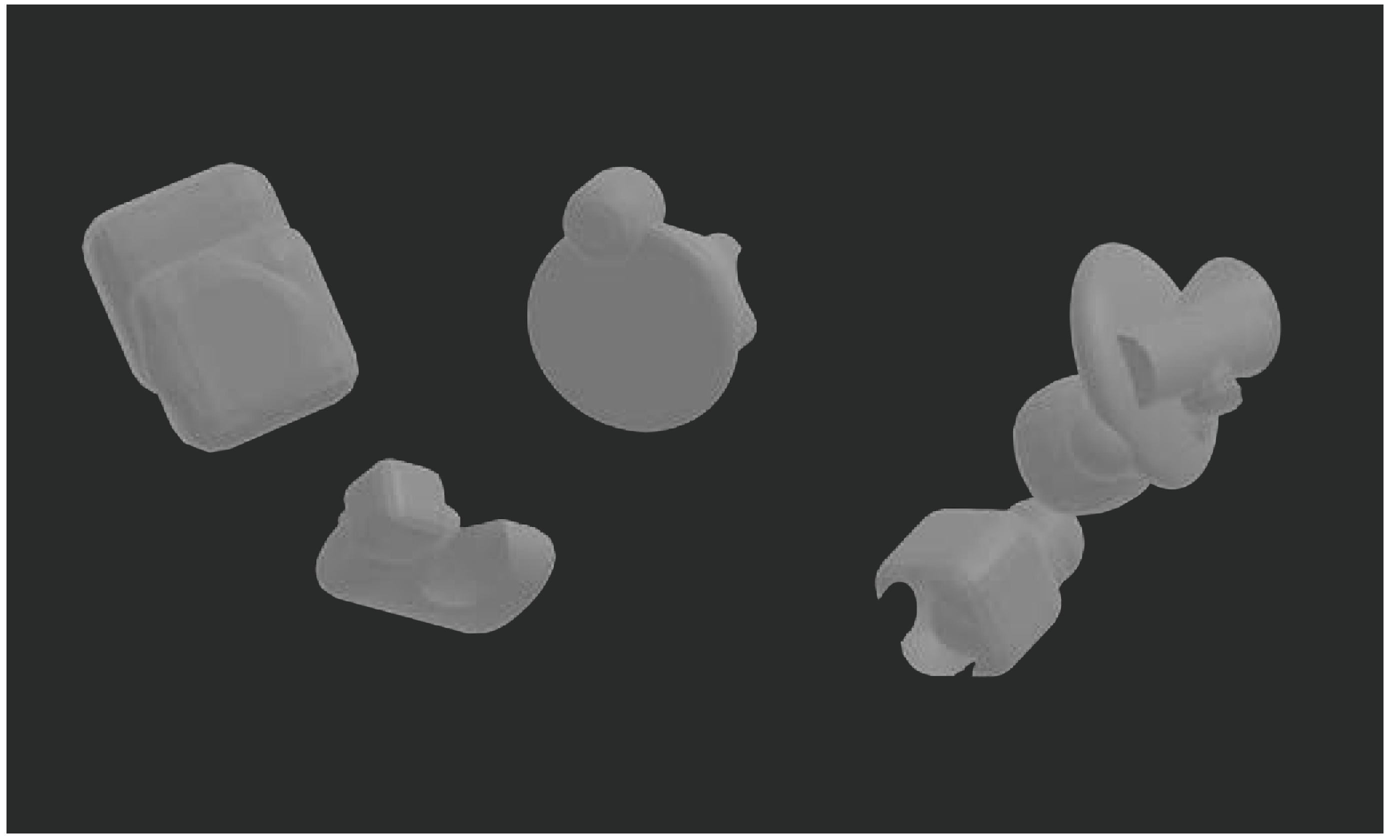
WEEK 9

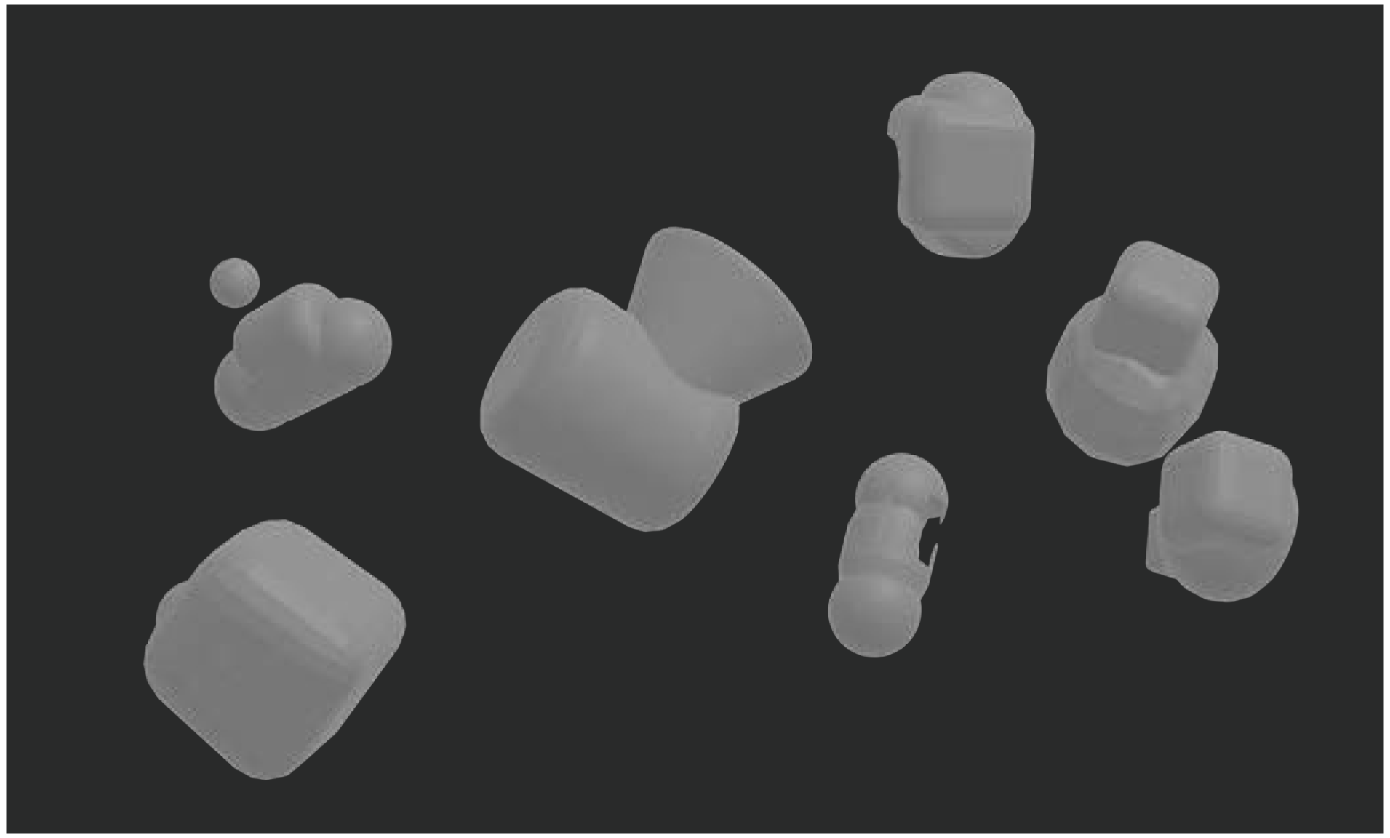
Focus: Abstract Form Ideation

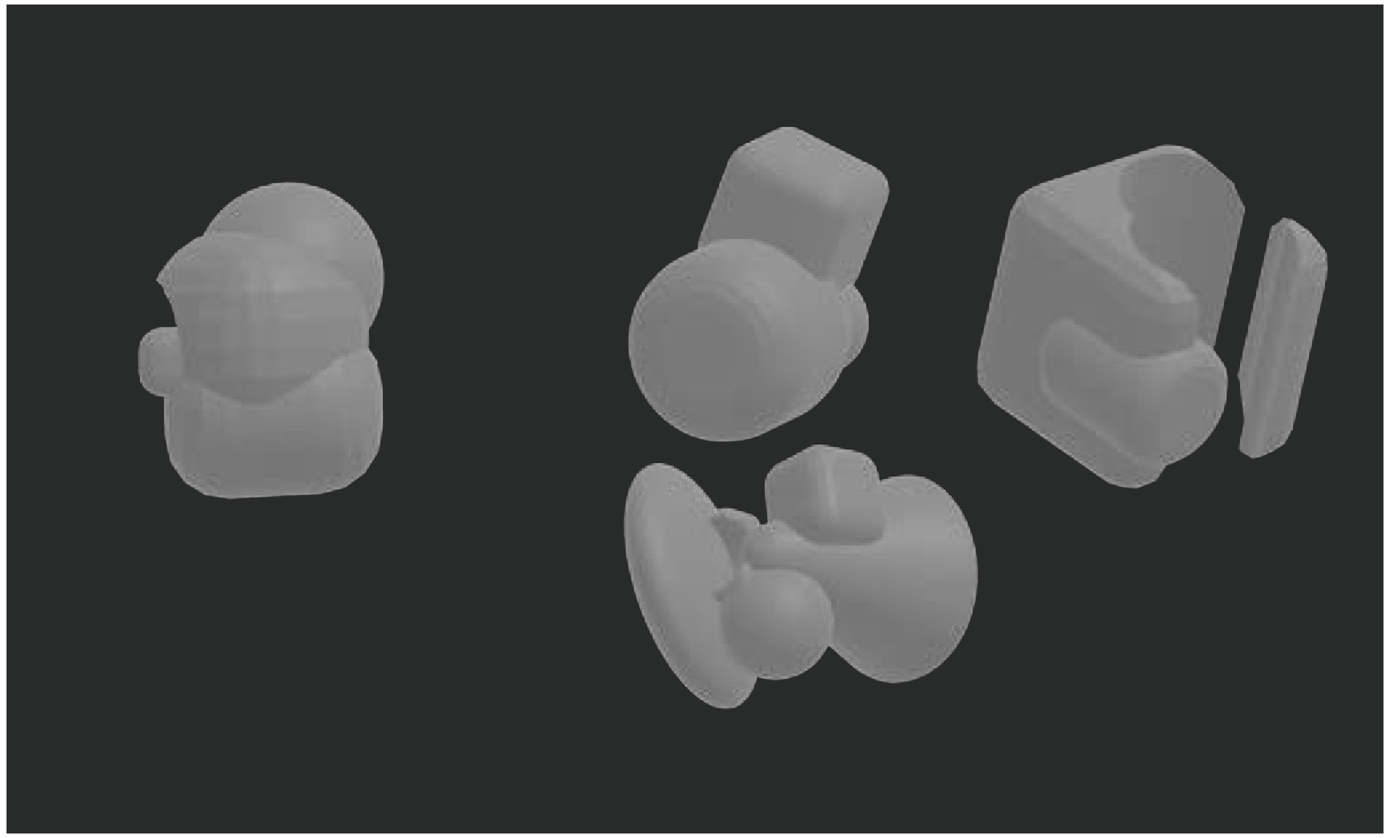
Software Ideation - Blender Script: V2

This version generated some smoother, more uniform shapes, but wanted to generate some larger sheets that I could later sketch over.





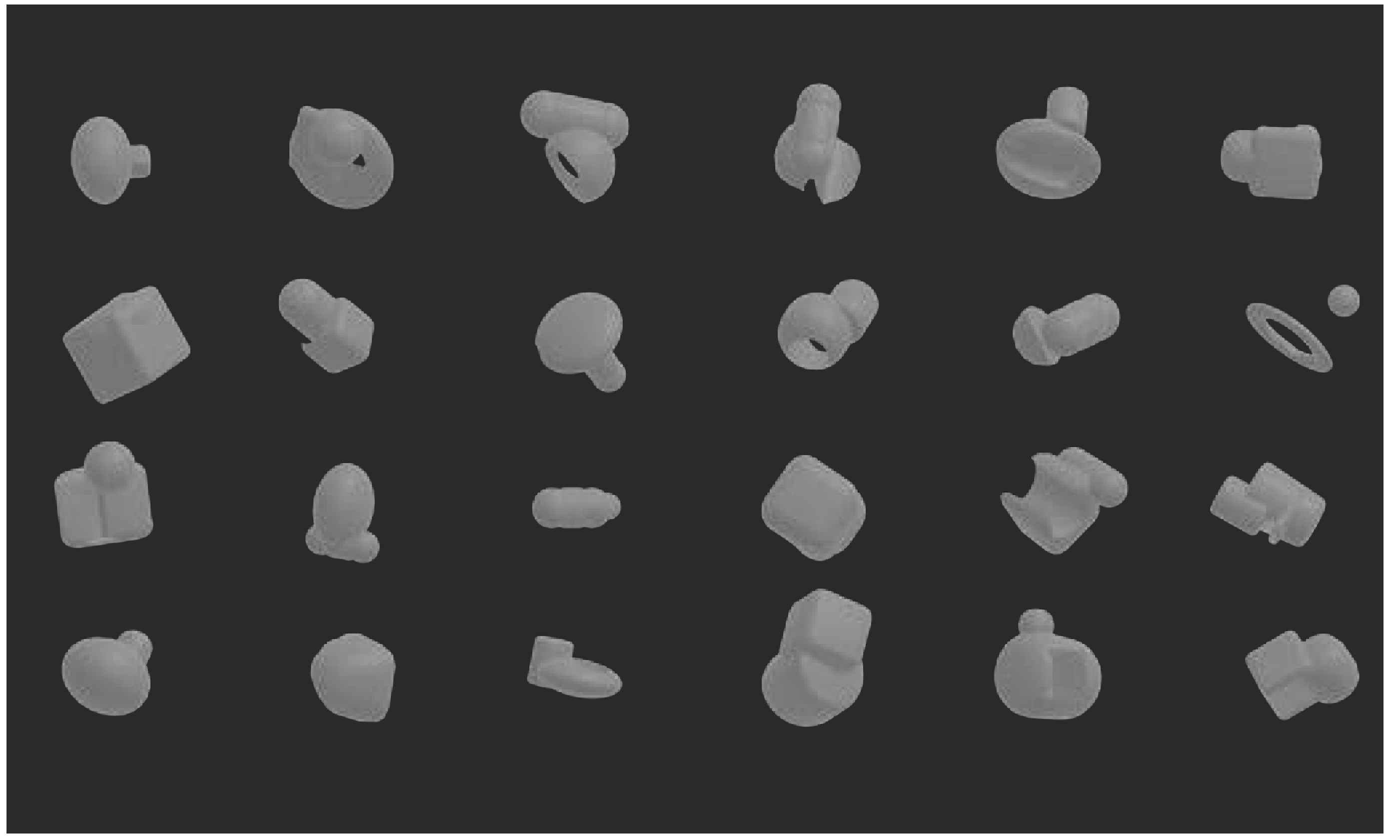


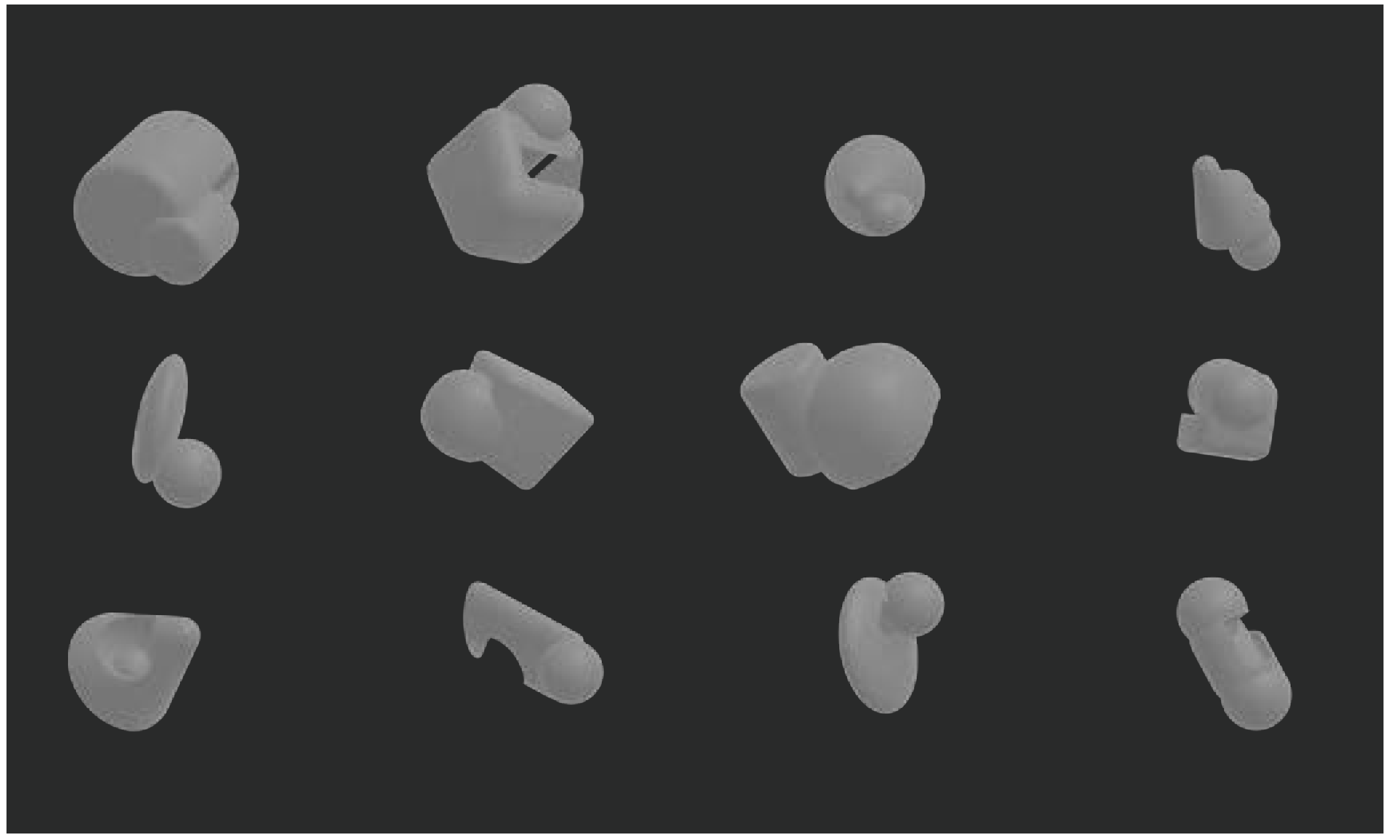


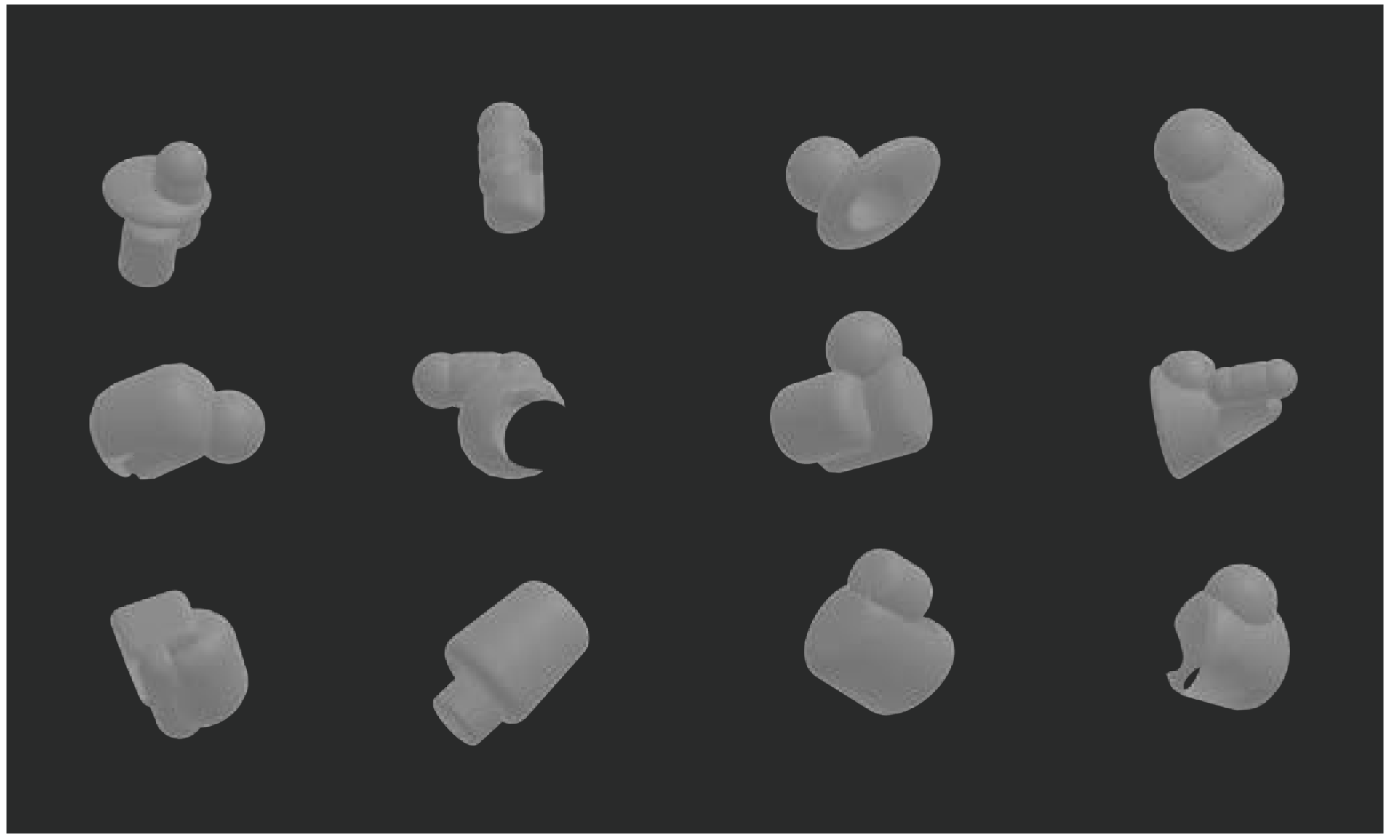
WEEK 9

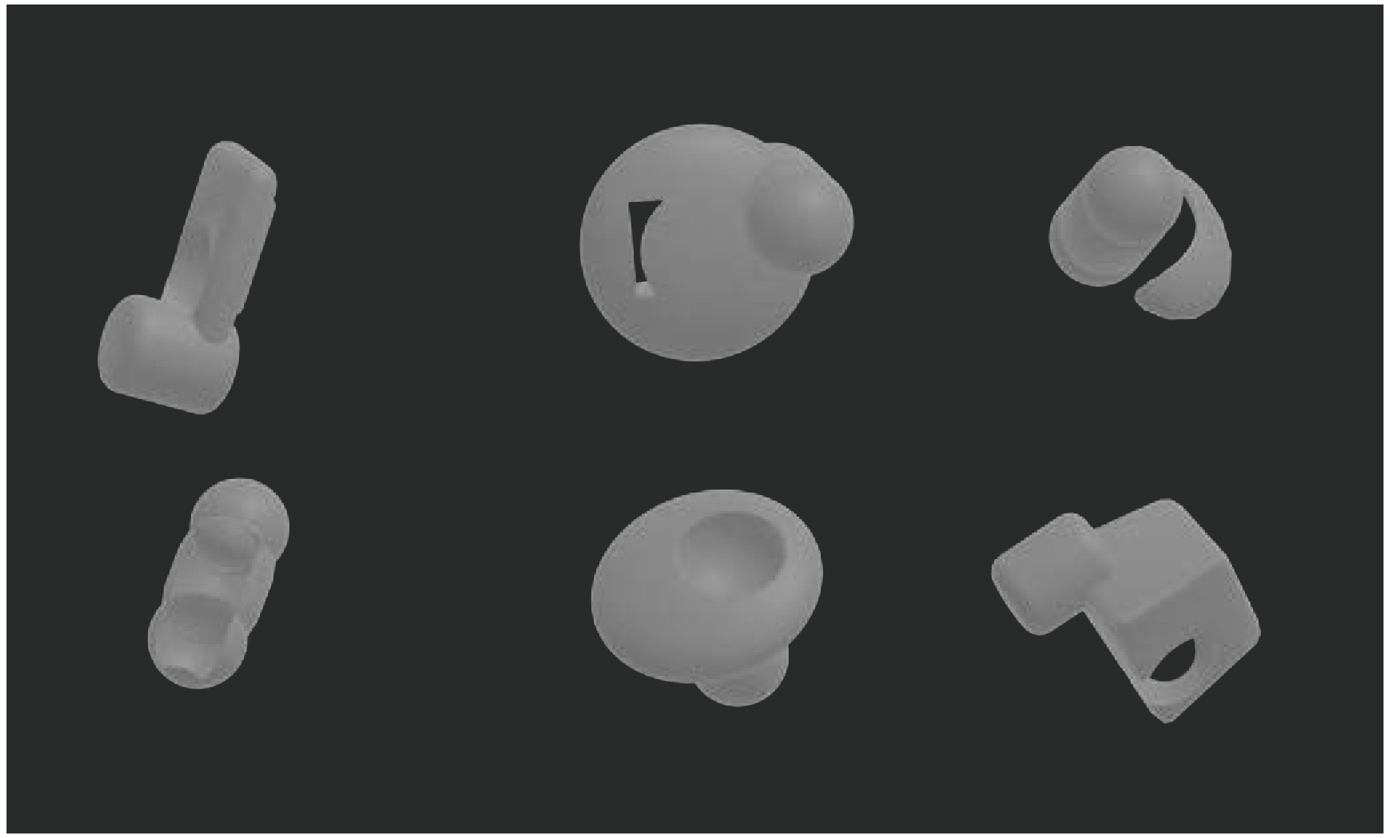
Focus: Abstract Form Ideation

Software Ideation - Blender Script V3







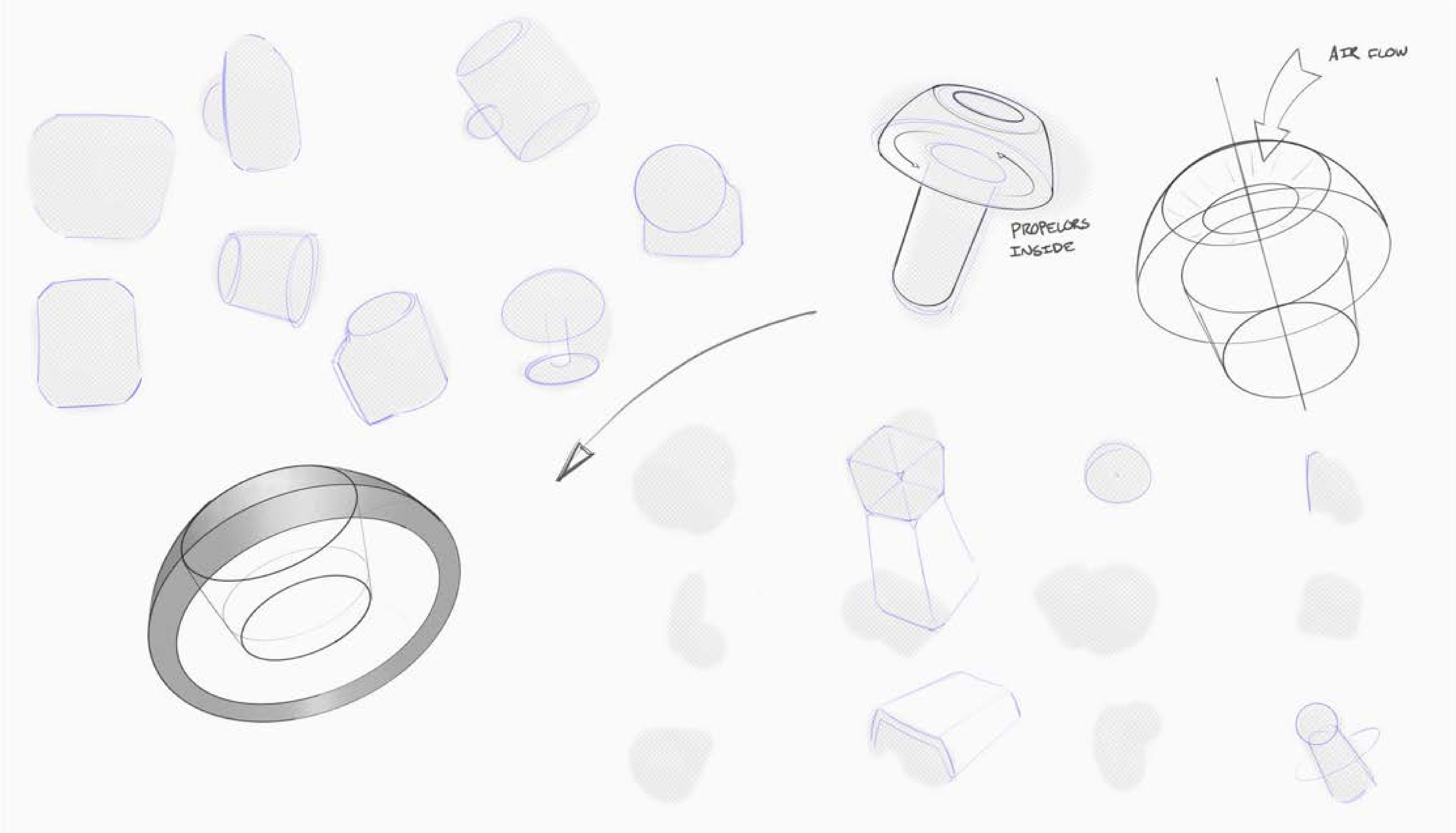


WEEK 9

Focus: Abstract Form Ideation

Sketch Results

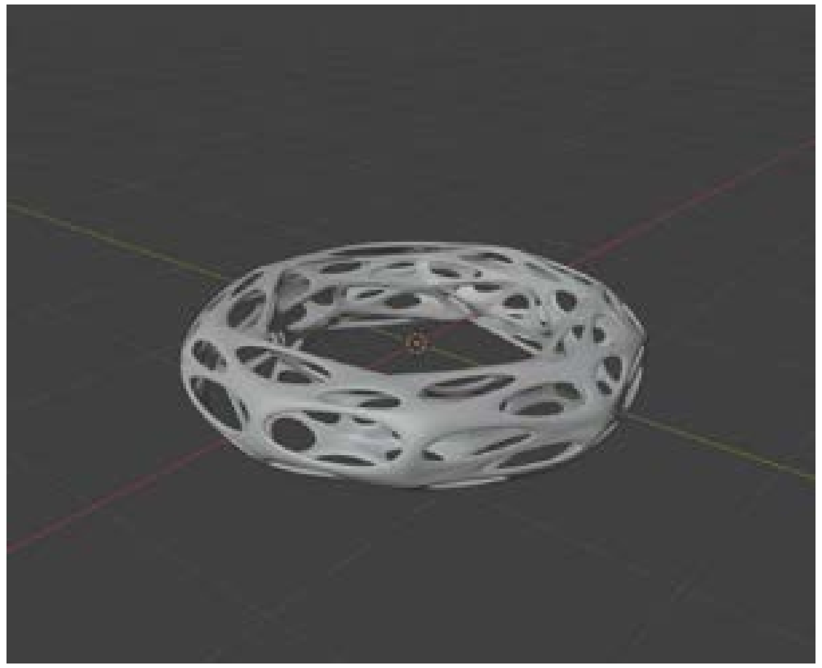
Nothing too crazy that I want to move forward with but just a good opportunity to experiment with form.

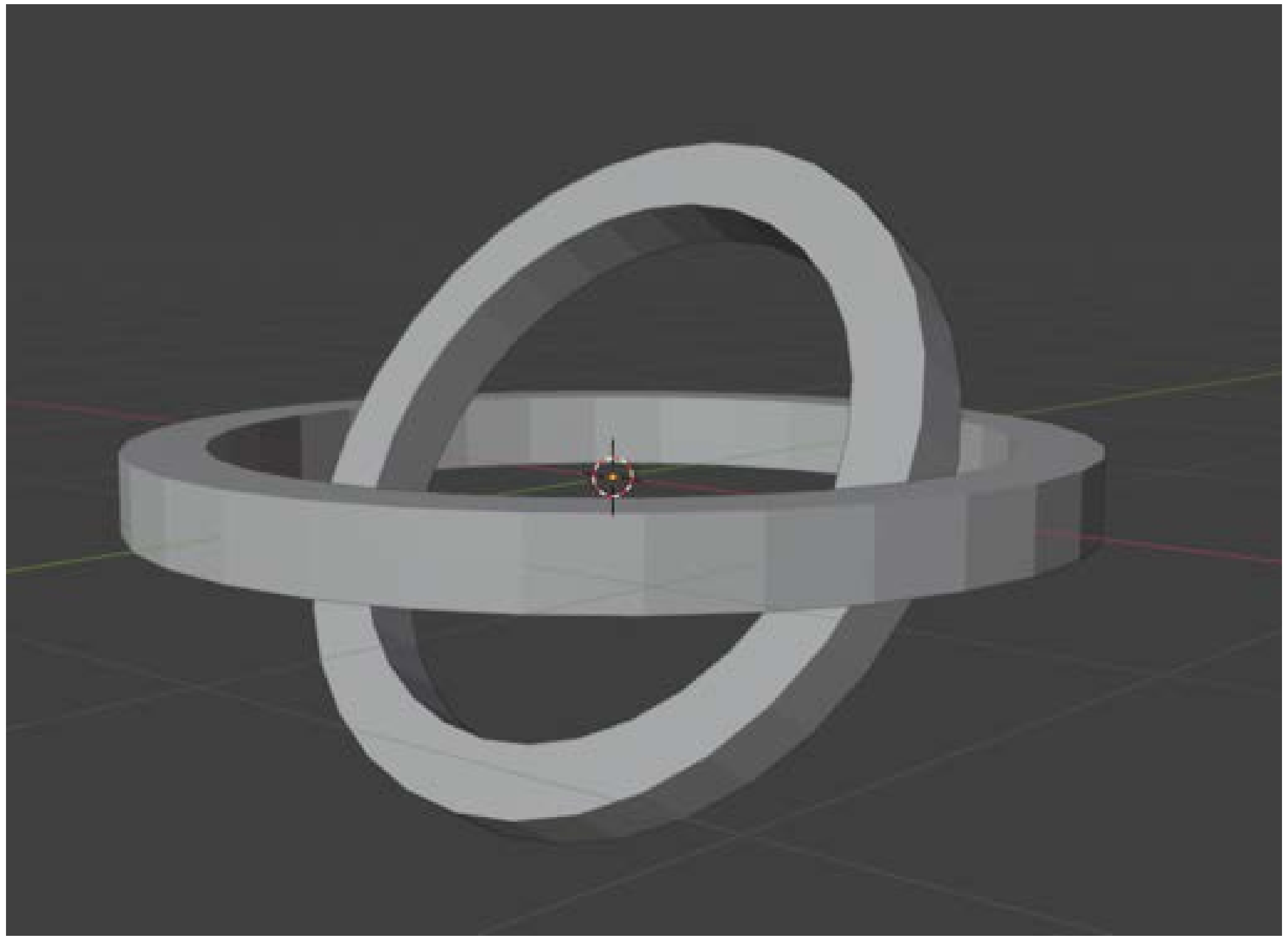


WEEK 9

Focus: Physical Form Ideation

Clay Modelling





Design Form

Circular designs are making more sense for a bilateral propeller layout, weight needs to be evenly distributed across all dimensions and hence a circular form makes most sense.

Experimented with some “topology optimized” style parts, however didn’t make sense for the circular form and additionally would make manufacturing much more difficult.

Experimented with an inner rotating ring with the propeller however seemed unrealistic and overcomplicated.

WEEK 9

Focus: Physical Form Ideation

Foam Modelling

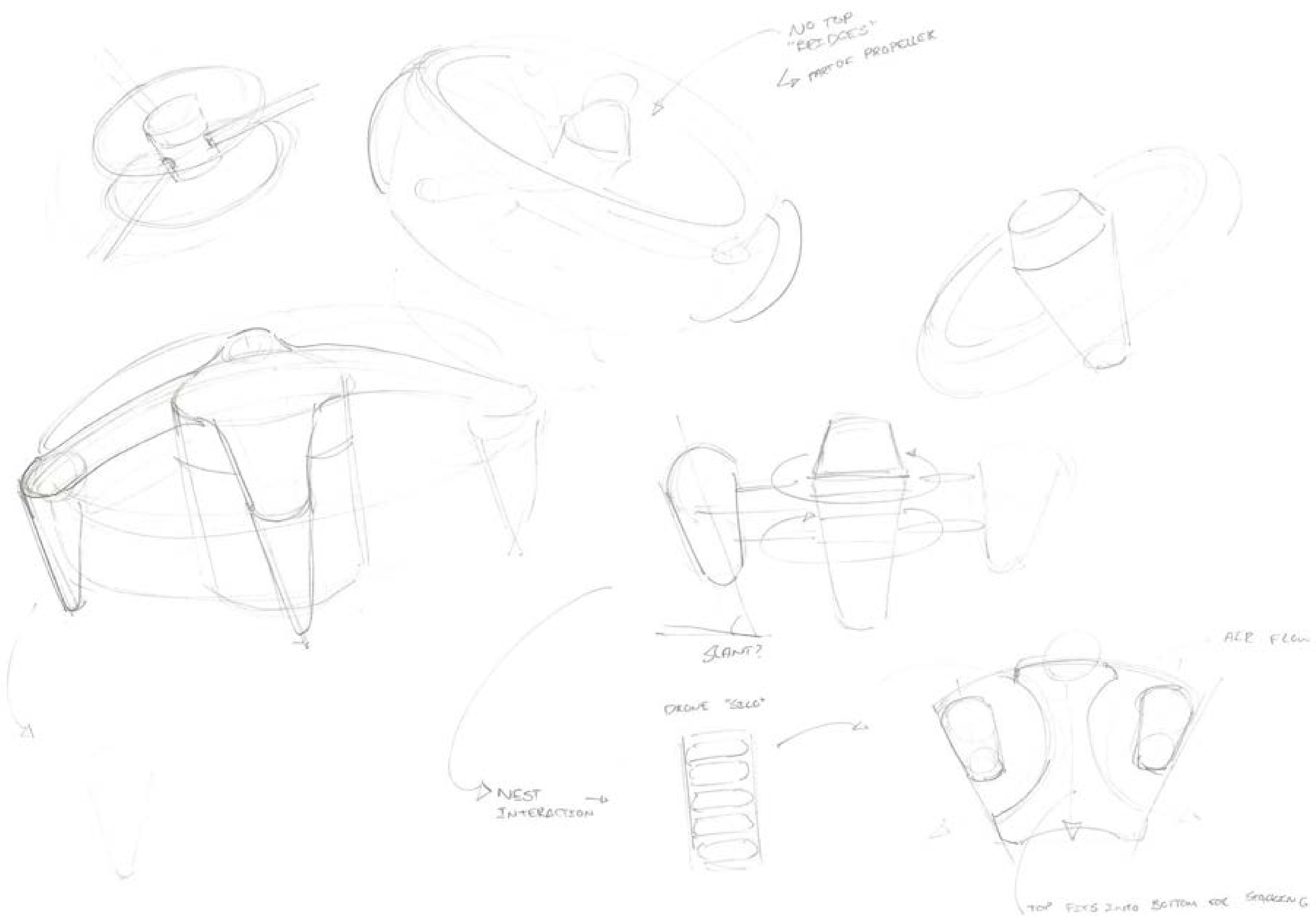
Some clay modelling was conducted to experiment with the topmost section of the drone, however this form of ideation was scrapped pretty early on.

Instead focus was turned towards further developing the model in CAD so that surfacing changes could be made later on after internal component fitting.

WEEK 9

Focus: Further Drone Ideation

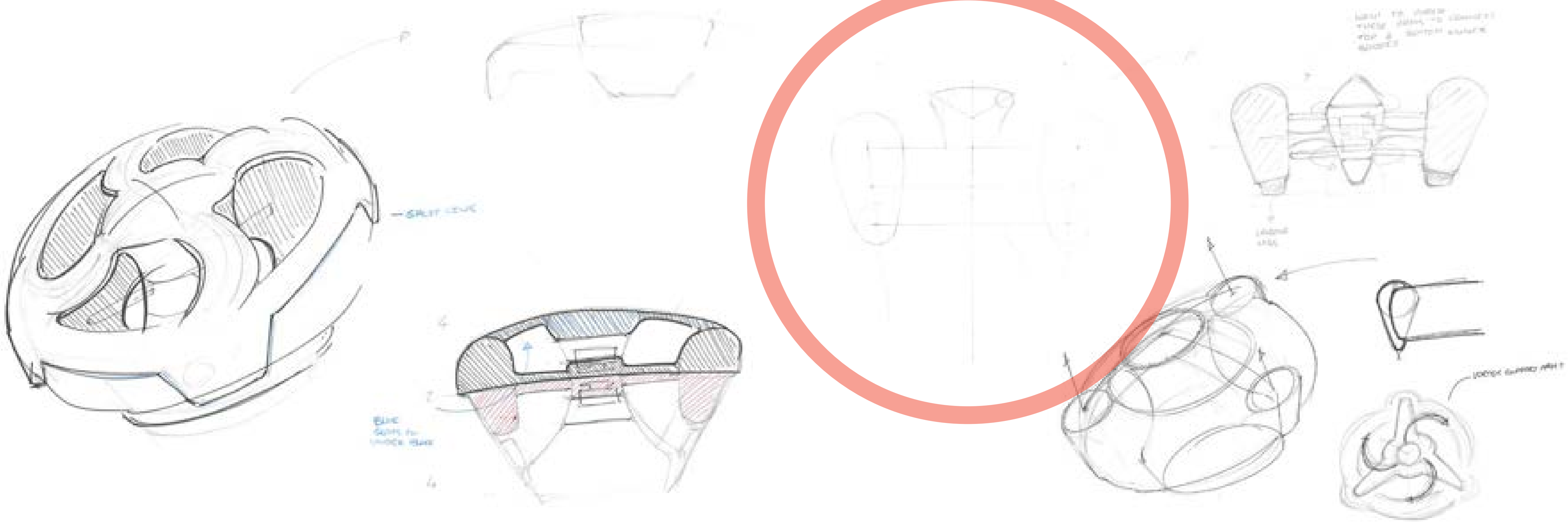
Mid-Stage Sketching



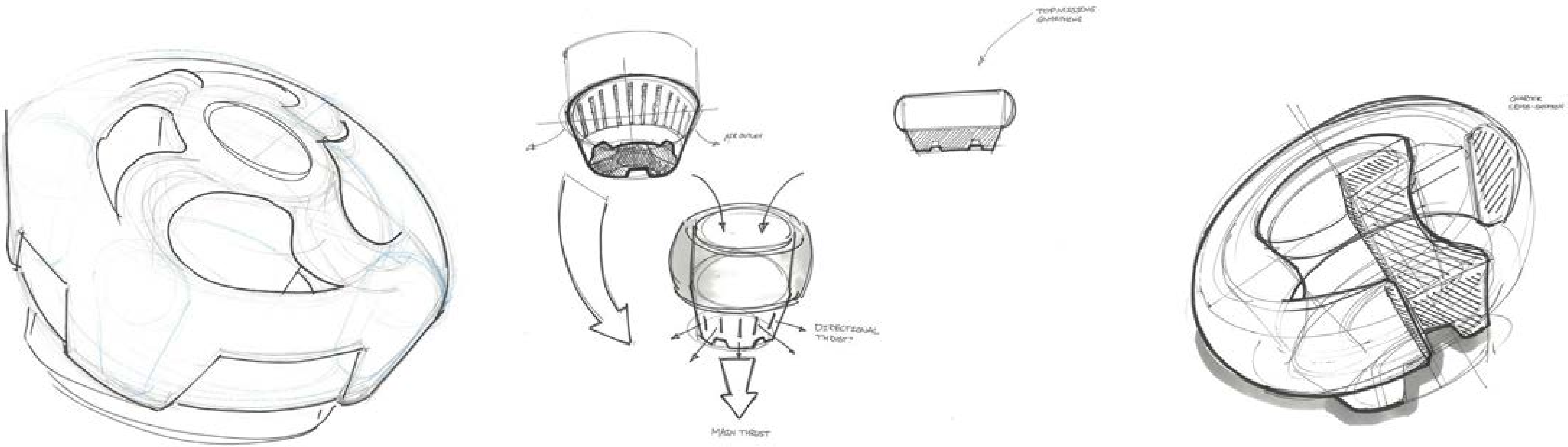
WEEK 9

Focus: Further Drone Ideation

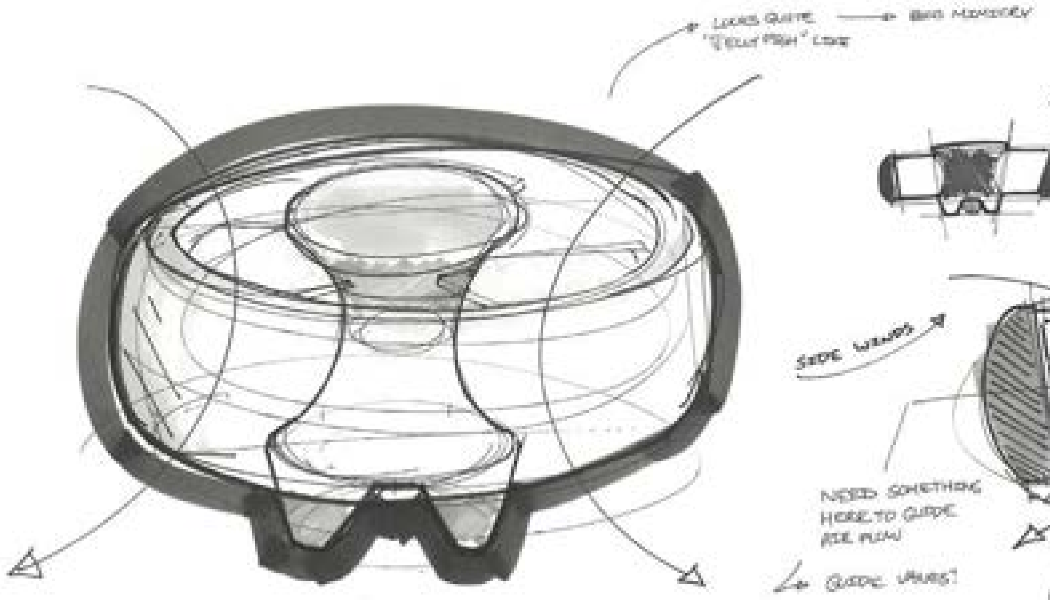
Mid-Stage Sketching

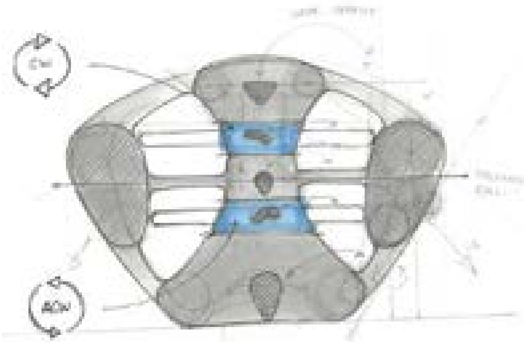


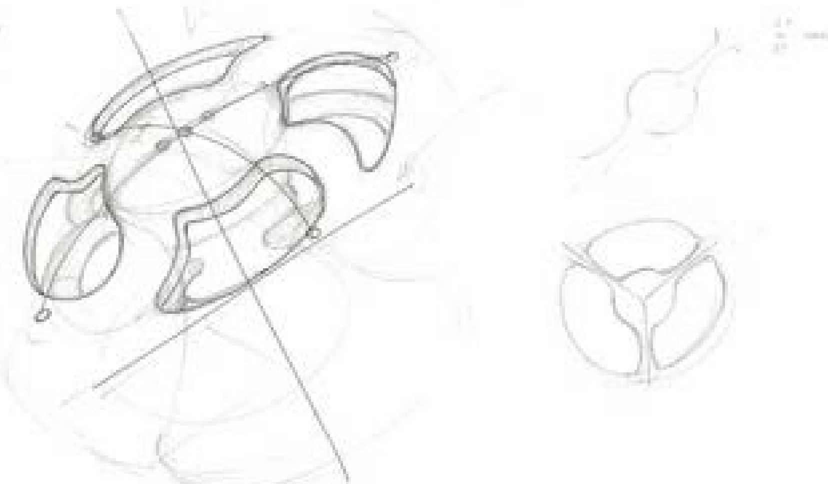
Paper scan didn't come through well, this section shows a side profile that's developed later on in the design process

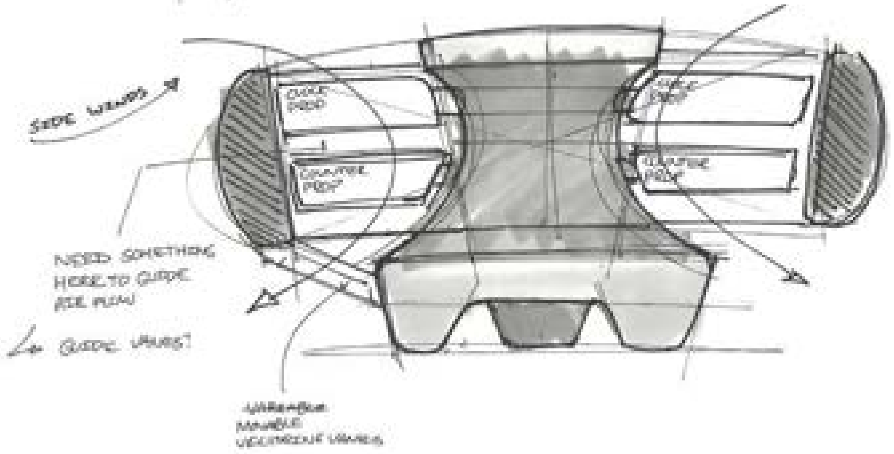


Mid-Stage Sketching









AERO CONSIDERATIONS:

Objective: To maximise –
- MANOEUVRABILITY
- THRUST

while minimising
- NOISE
- WEIGHT

GEOMETRY:

Large propellers, spin slower = [illegible] less noise & better propulsion

Uneven, coprime blade counts to spread tones

Wider axial gaps, lighter ↑ noise, wider ↑ weight & losses

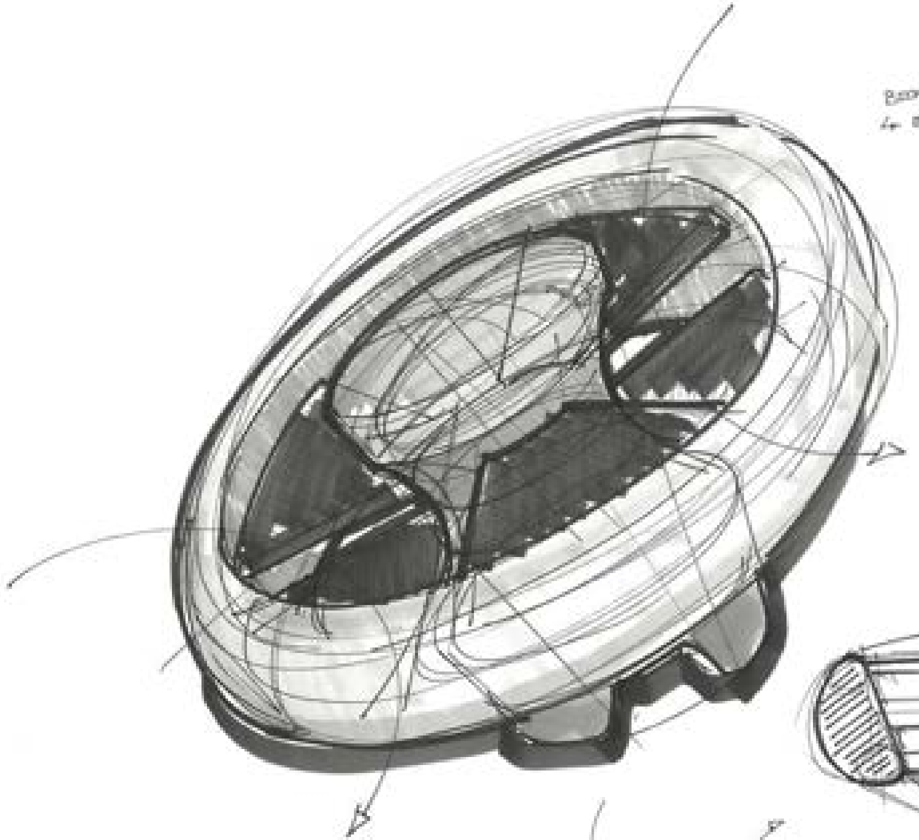
Duct considerations:
* Lip radius 4–8% D, smooth contraction, no separation
* Tip clearance ≤ 0.5% Radius. Leakage = noise + efficiency loss
* Slightly diffusing total angle < 7–8°

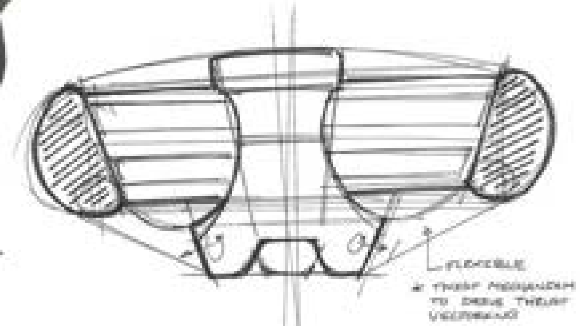
GUIDE VANES
* ROTOR TO DO 80% OF DRIVING
* INCORPORATE OUTLET GUIDE VANES (OGVs)
  → EVEN BETTER TO MAKE THEM ACTUATED
  (Straighten & vector thrust)

AEROACOUSTICS
* MORE BLADES, more damping
* TRAILING EDGE SERRATION
* MICRO PERFORATED DUCT COVERS
* RPM SCHEDULING ("dither")
* ESC/phase control
* STRUCTURAL DAMPING

MANOEUVRABILITY
* MOVABLE VECTORING VANES
* IRIS NOZZLE + QUADRANT FLAPS
* FLUIDIC/COANDA tabs (stealthy)
* Whole duct gimballing → Complex

CONTROL ARCHITECTURE
* "INNER [illegible] on vectoring vanes"?
* "State estimation with [illegible] forward (thrust management)"
* Auto vane adjustments in case of propeller failures

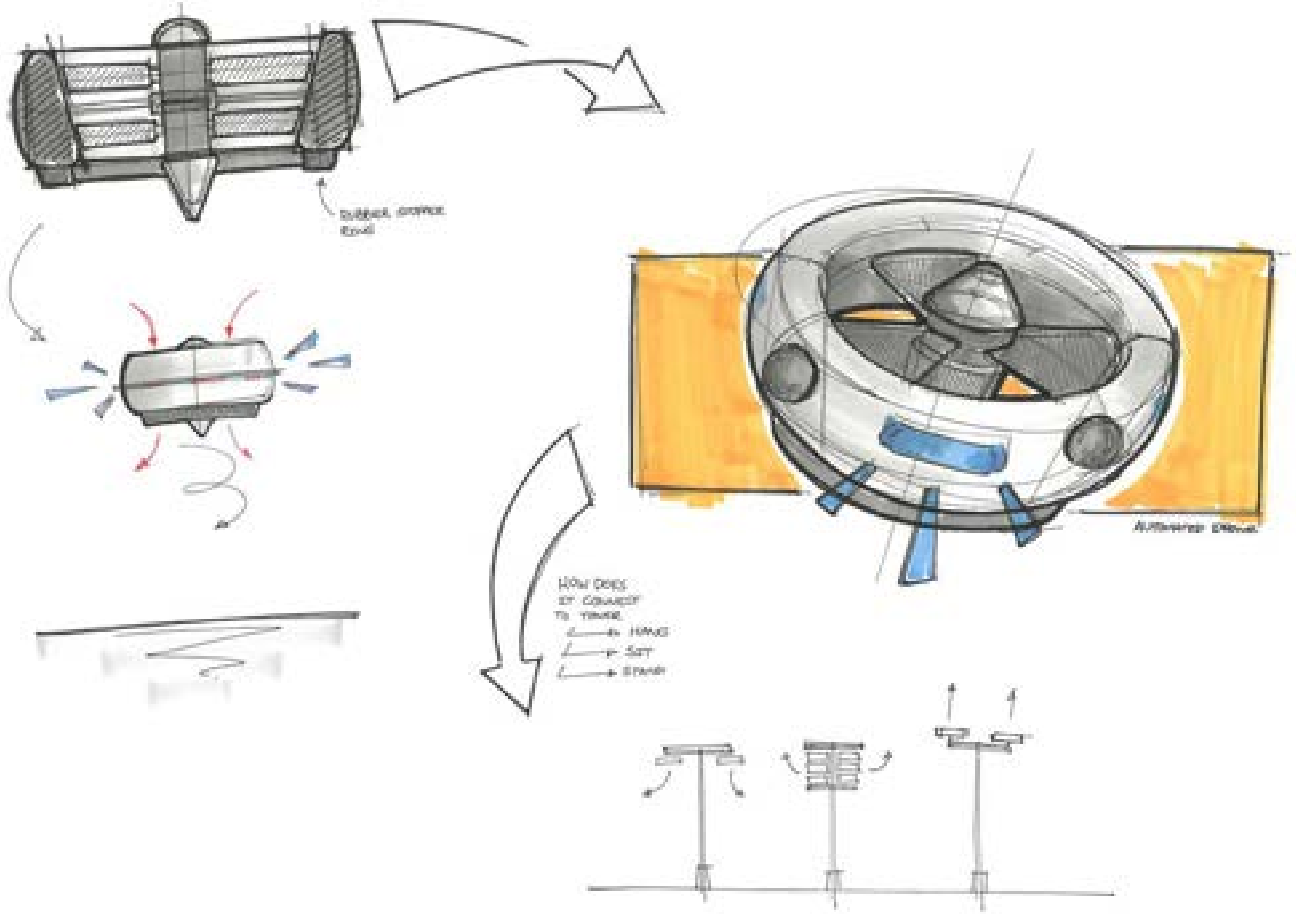


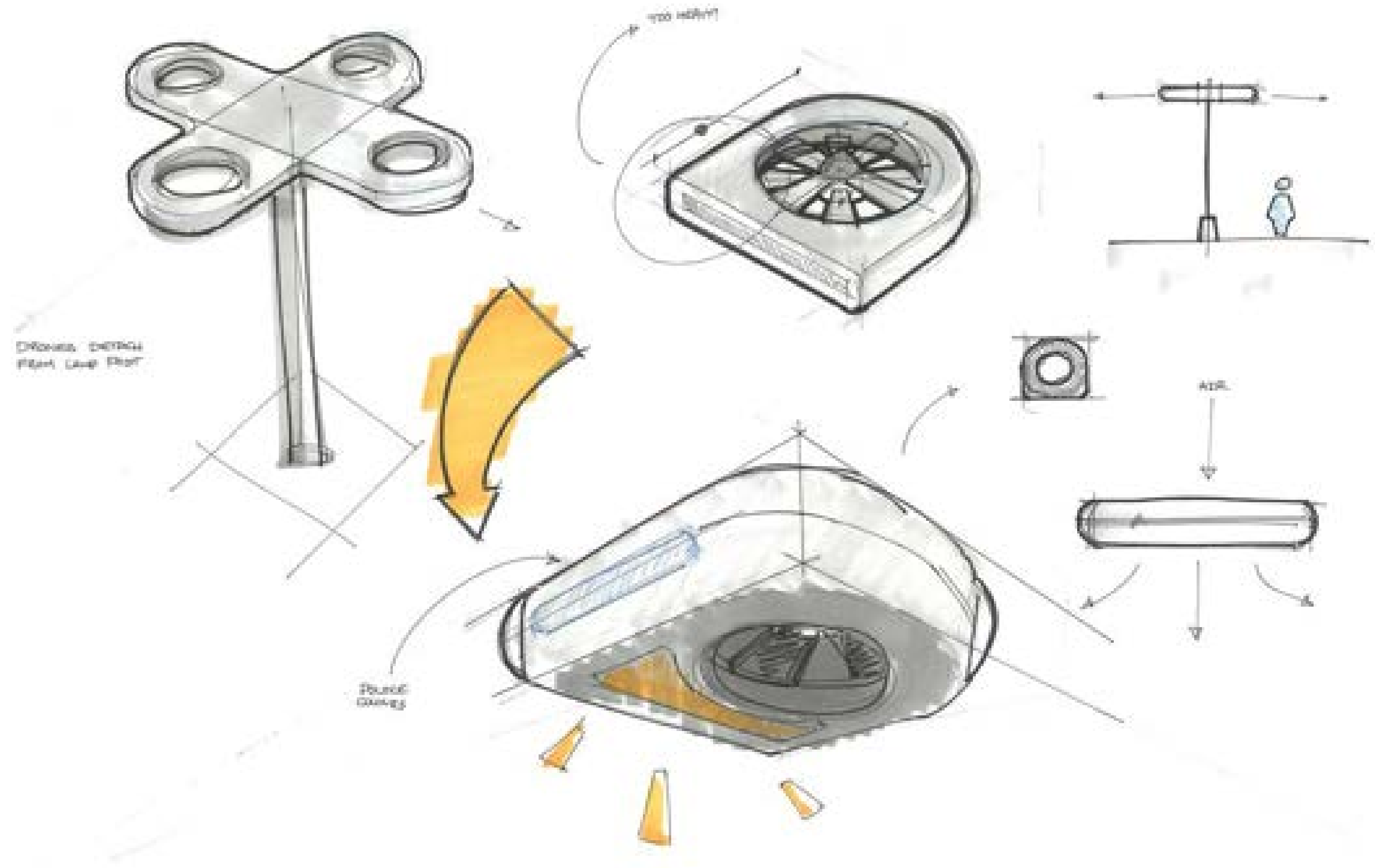


WEEK 9

Focus: Further Drone Ideation

Mid-Stage Sketching

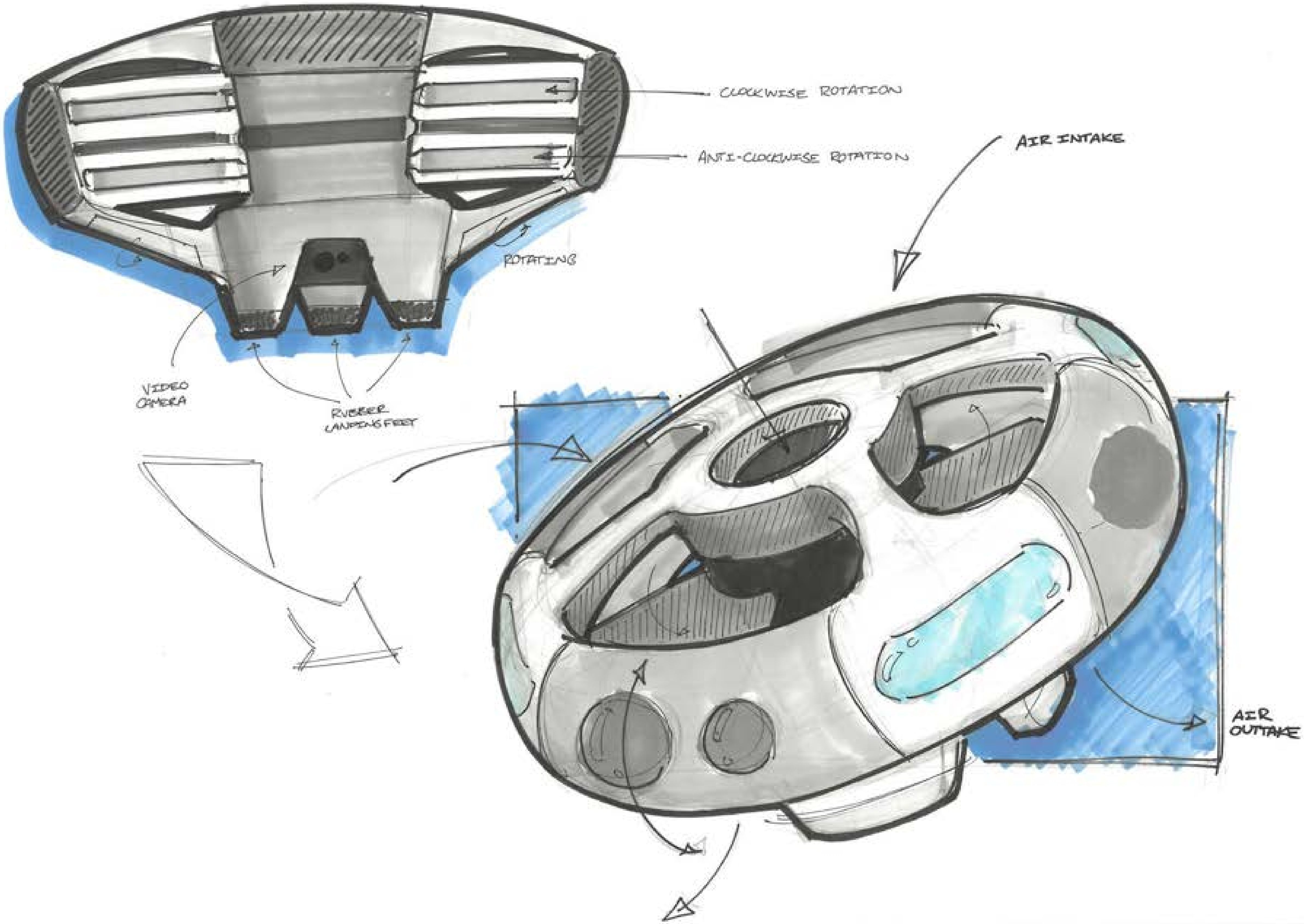




WEEK 9

Focus: Further Drone Ideation

Mid-Stage Sketching



3D Printing Materials

Exploring requirements for using 3D print materials for ideation and possible mass customization manufacturing

Upgrades were made to 3d print higher quality engineering fillaments.

PETG-CF was chosen due to its lightweight, yet strong material properties, the fillament would be used primarily for the internal propellers in order to prevent accidental propeller breakage when testing.

PAHT-CF, (Nylon-Carbon Fiber), was also chosen in order to represnt a final prototype part that would be as close possible to the real life product of this part.

Filament Compatibility

Material	0.2 mm Nozzle	0.4 mm Nozzle	0.6 mm Nozzle	0.8 mm Nozzle	Hardened Steel Required?
General PLA	YES	YES	YES	YES	Optional
PLA Sparkle	*NO	YES	YES	YES	Optional
PLA Marble	*NO	YES	YES	YES	Optional
Wood/Rock/Metal-filled PLA	*NO	YES	YES	YES	Optional
PETG	YES	YES	YES	YES	Optional
PVA	YES	YES	YES	YES	Optional
ABS	YES	YES	YES	YES	Optional
ASA	YES	YES	YES	YES	Optional
PC	YES	YES	YES	YES	Optional
PA	*NO	YES	YES	YES	Optional
TPU	*NO	YES	YES	YES	Optional
Bambu PLA-CF	*NO	*Highly Recommended	YES	YES	*Required
Bambu PETG-CF	*NO	*Highly Recommended	YES	YES	*Required
Bambu PAHT-CF	*NO	YES	*Highly Recommended	YES	*Required
Bambu PET-CF	*NO	YES	*Highly Recommended	YES	*Required
CF/GF Filaments from other brands	*NO	Not Recommended	YES	YES	*Required

[*Note]

Filaments with carbon fiber, glass fiber, metal, or other inorganic particles are prone to clog a **0.2 mm nozzle**.

For filaments containing carbon fiber or glass fiber, it is **highly recommended** to use a **hardened steel 0.6 mm nozzle** to minimize the risk of clogging and abrasion.

Bambu PLA-CF and **Bambu PETG-CF** have been extensively tested and proven to have a low risk of clogging when printed with a **hardened steel 0.4 mm nozzle**, while also achieving higher print quality.

Learn more about filament compatibility on Bambu Lab Wiki.

PETG-CF
Titan Gray (31101) / Filament with spool / 1 kg
$[redacted]
− 1 + Remove

PAHT-CF
Black (70100) / Filament with spool / 1 kg
$[redacted]
− 1 + Remove

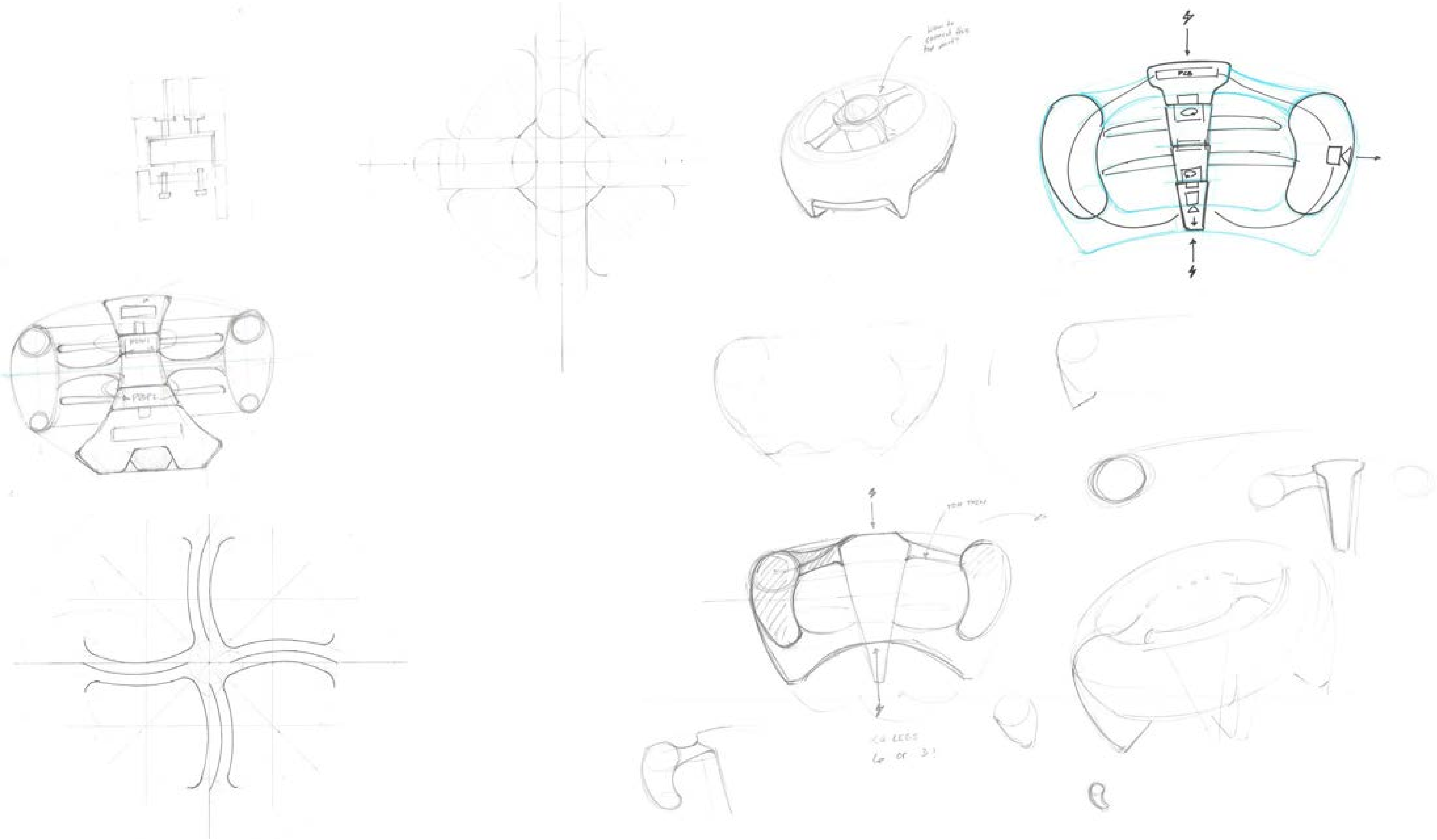
Bambu Hotend - P1 Series
0.6mm Hardened Steel / Complete Hotend
$[redacted]
Add-ons Deal -$8.55
− 1 + Remove

Hardened Steel Upgrade ...
P1 Series
$[redacted]
− 1 + Remove

WEEK 9

Focus: Finalising Sketches

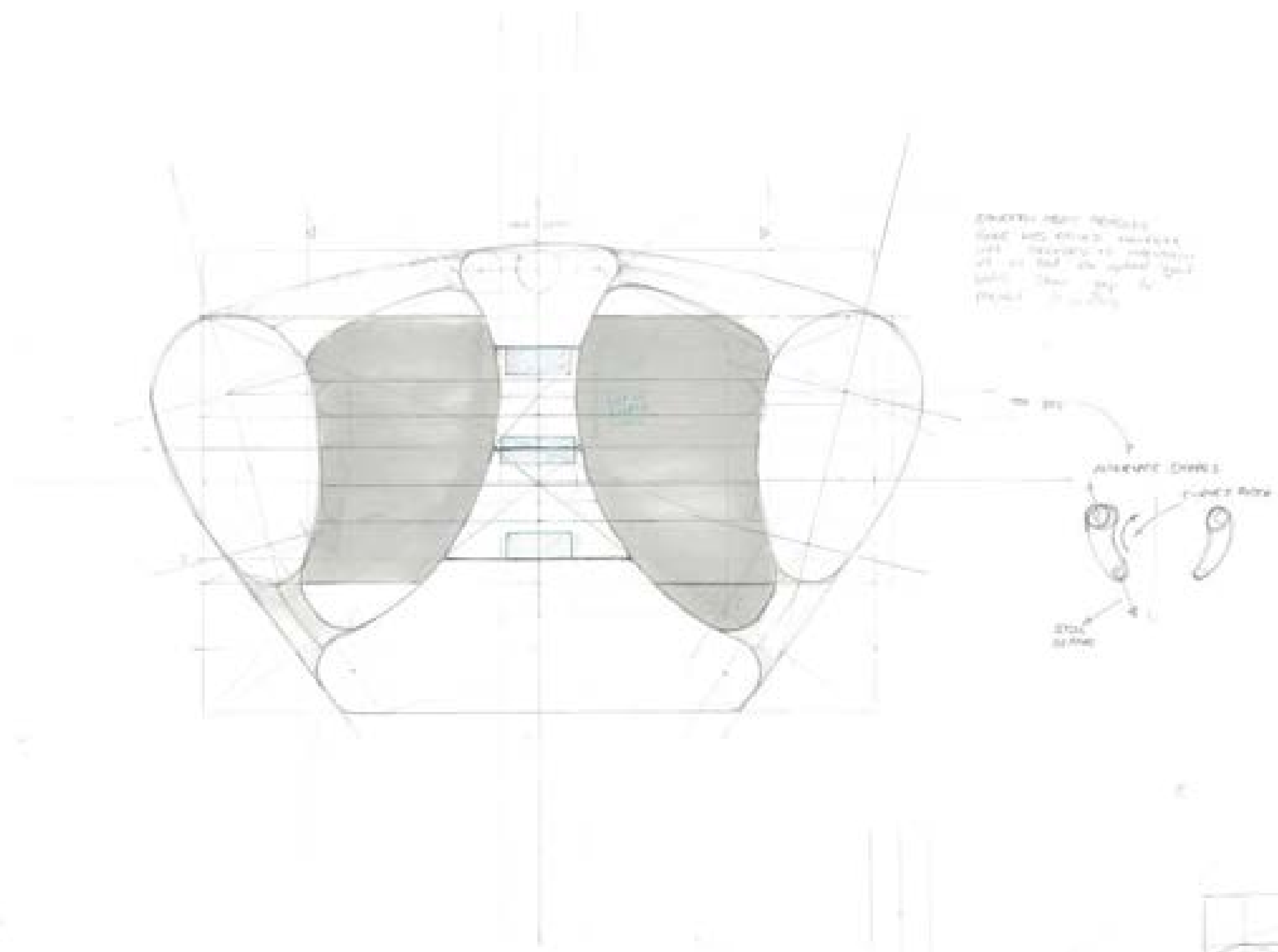
Late-Stage Sketching

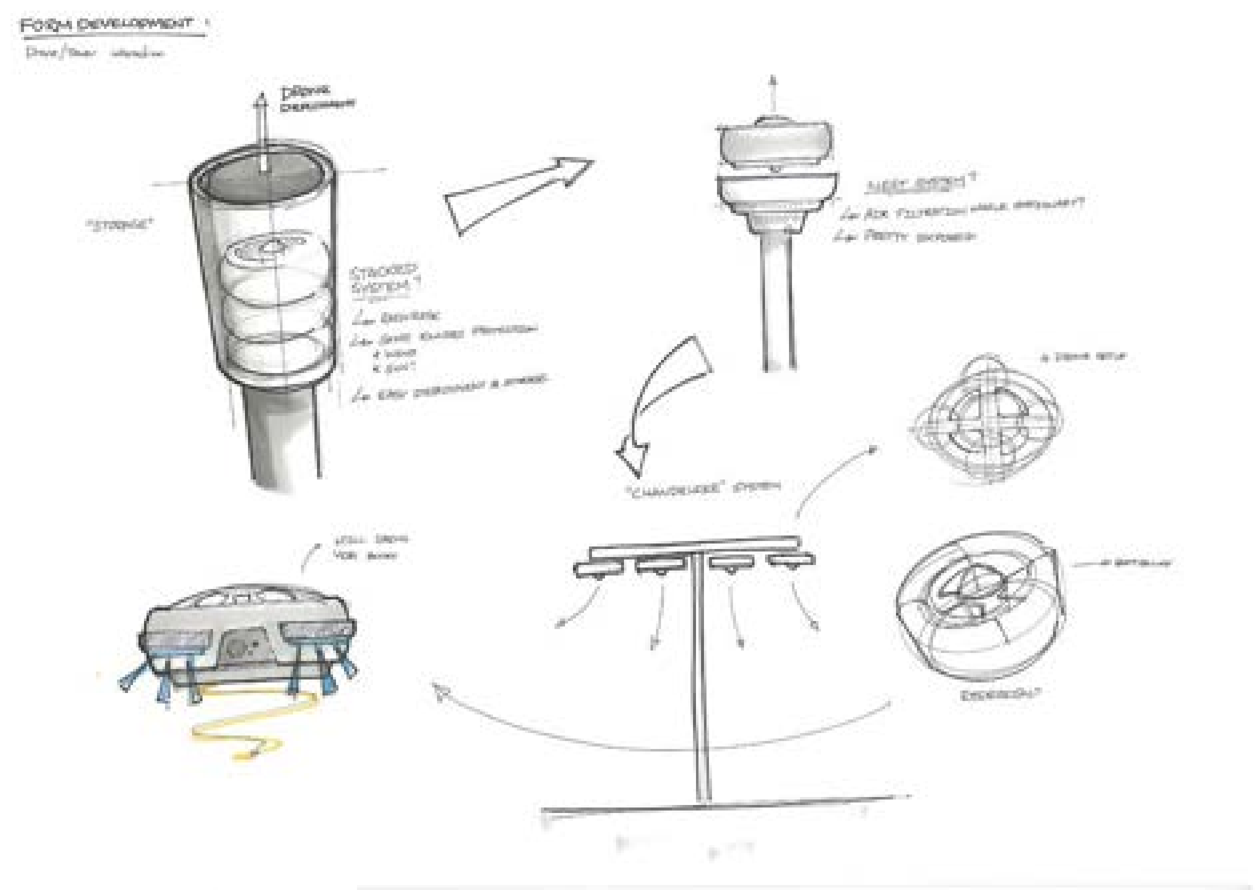


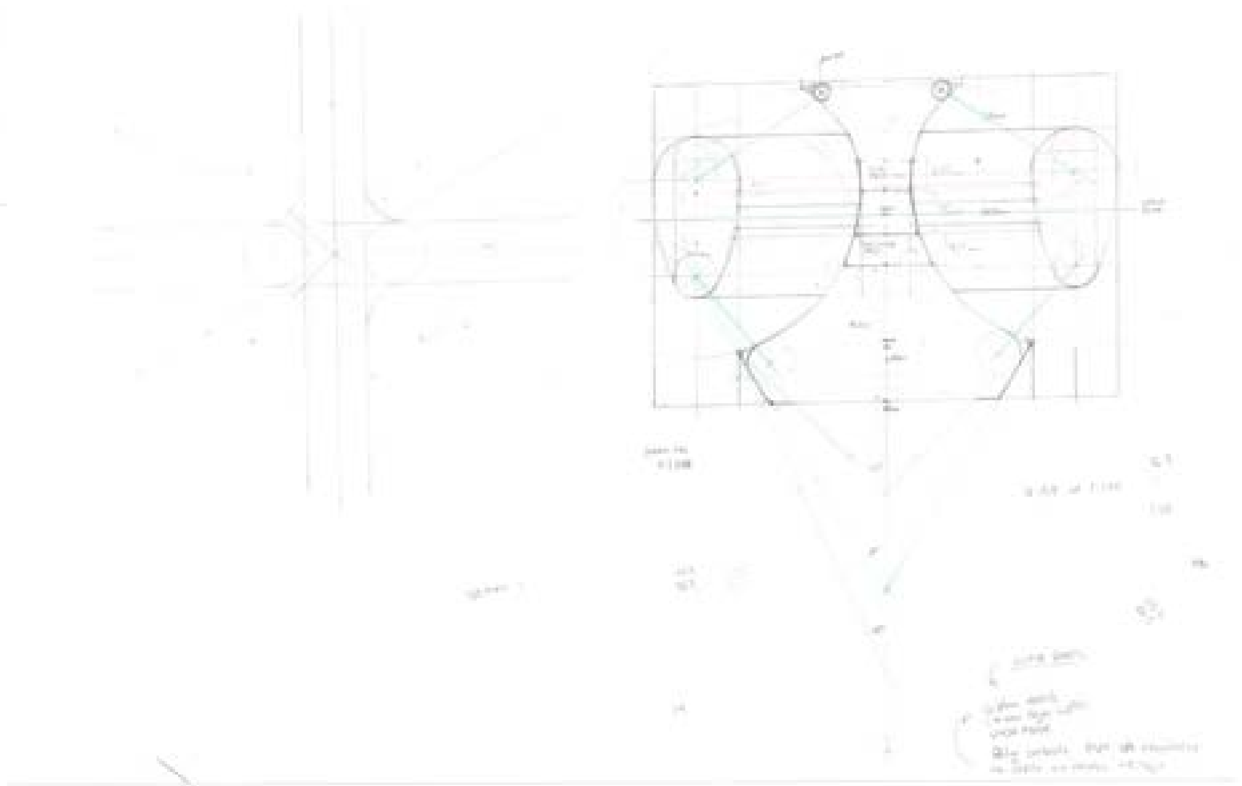
WEEK 9

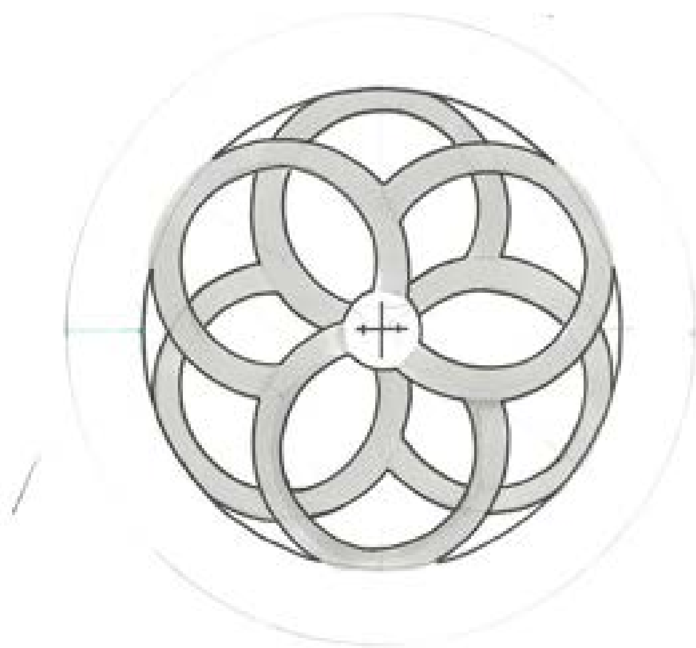
Focus: Finalising Sketches

Late-Stage Sketching









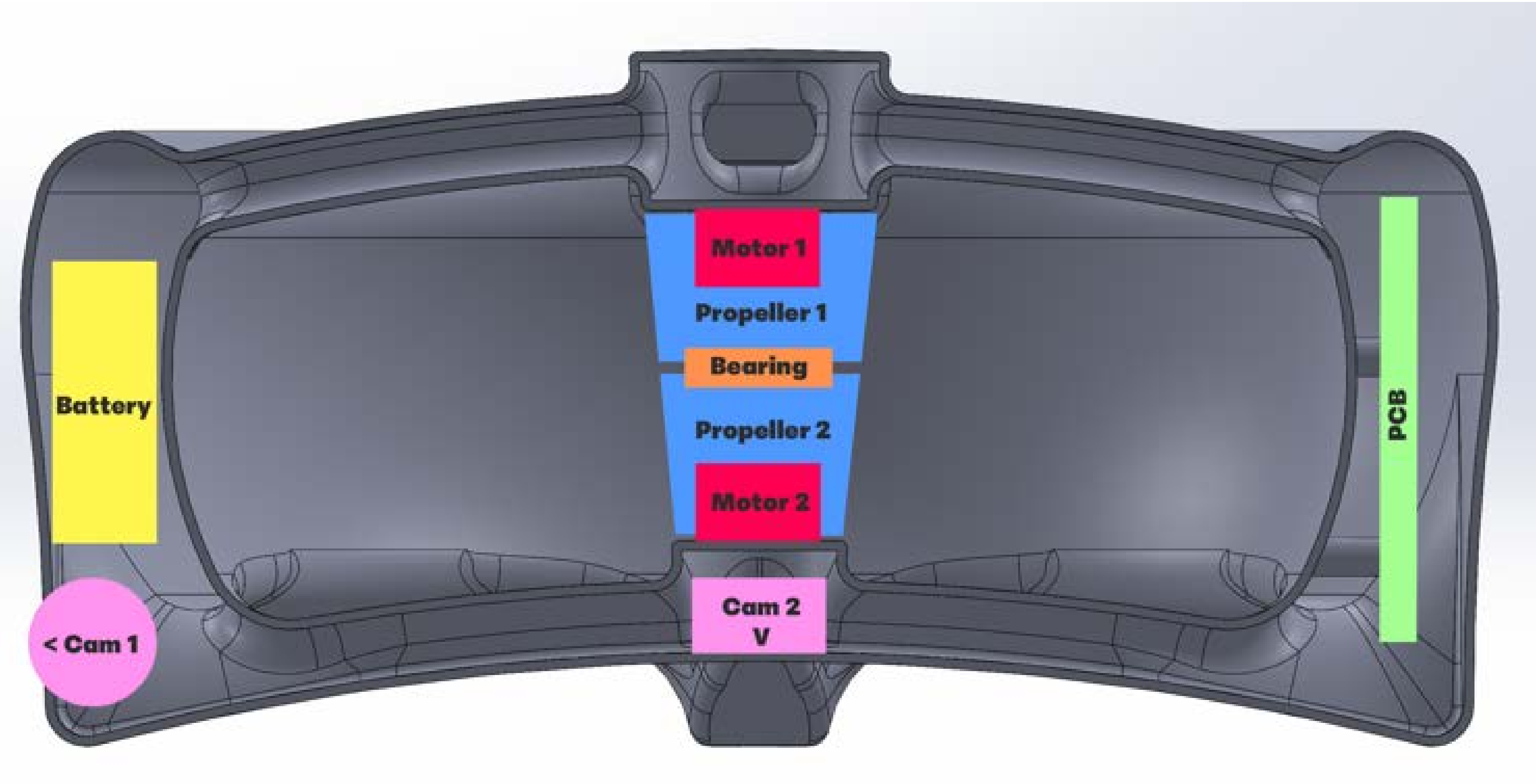
WEEK 10

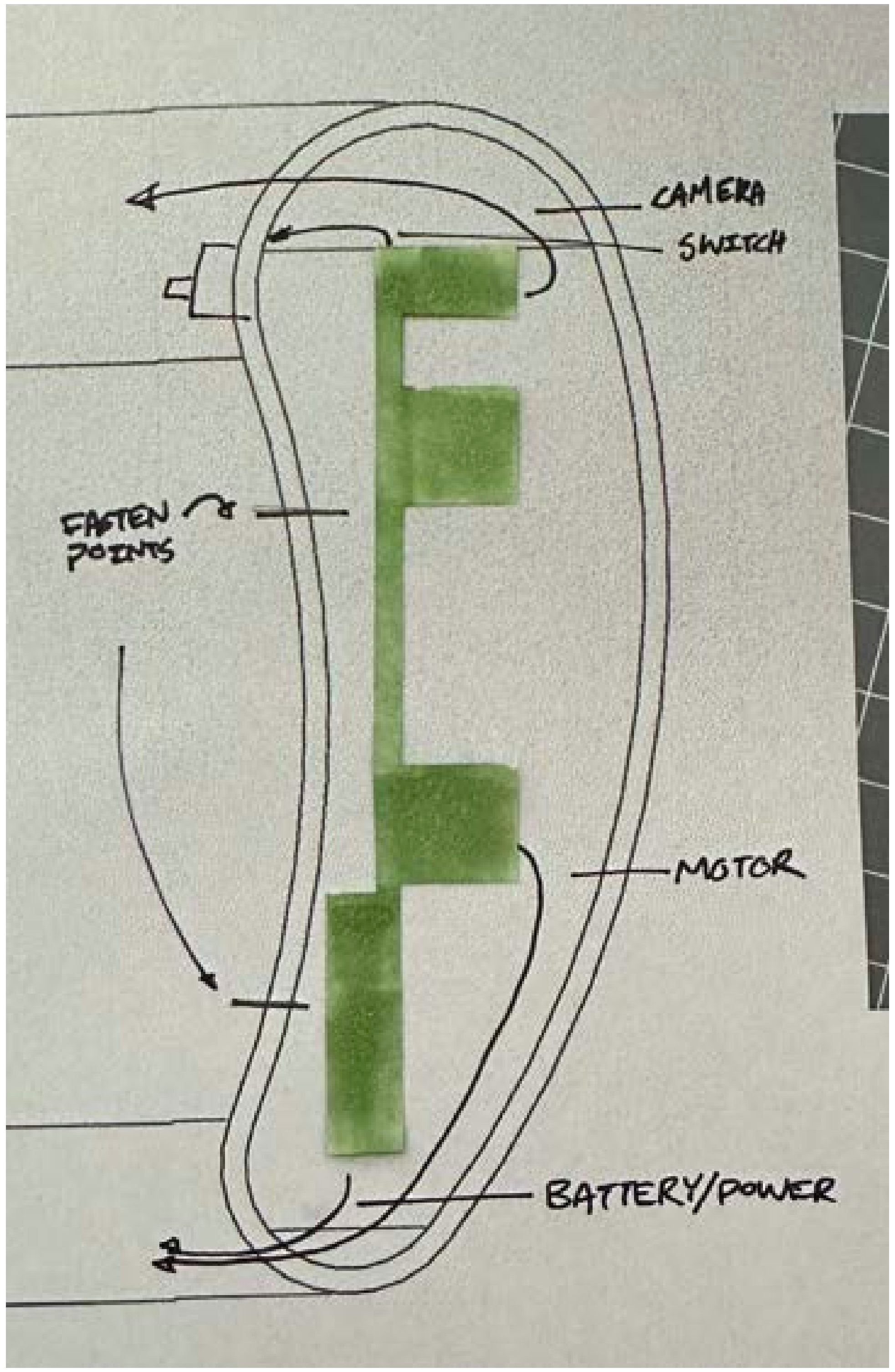
Focus: Component Fitting

Component Fitting

Made some to scale drawings of the internal component positioning of all the different parts to make sure they don't clash with outer walls of the drone.

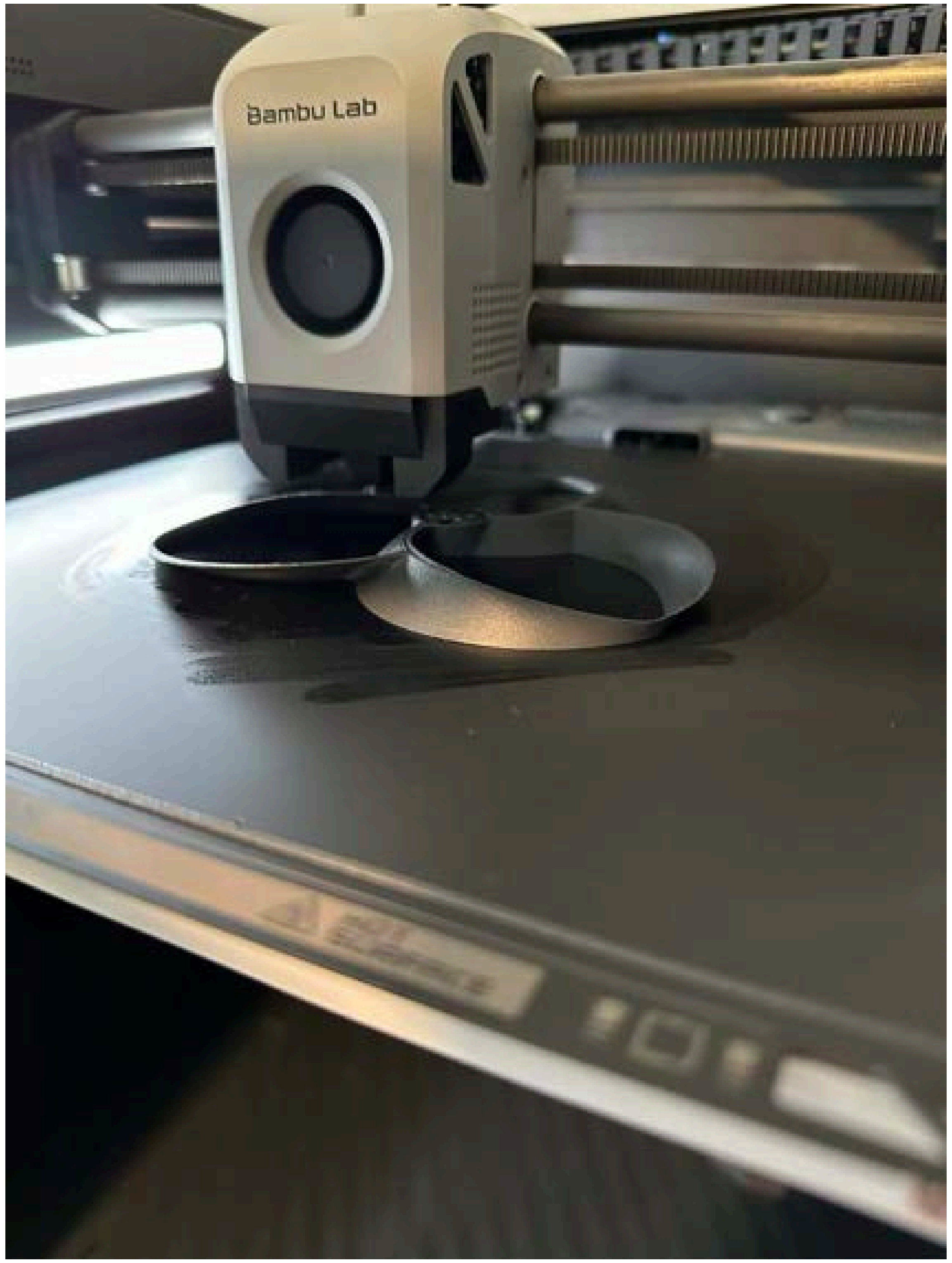
This was more of a precautionary piece of mind step to make sure everything contained nicely within the part.

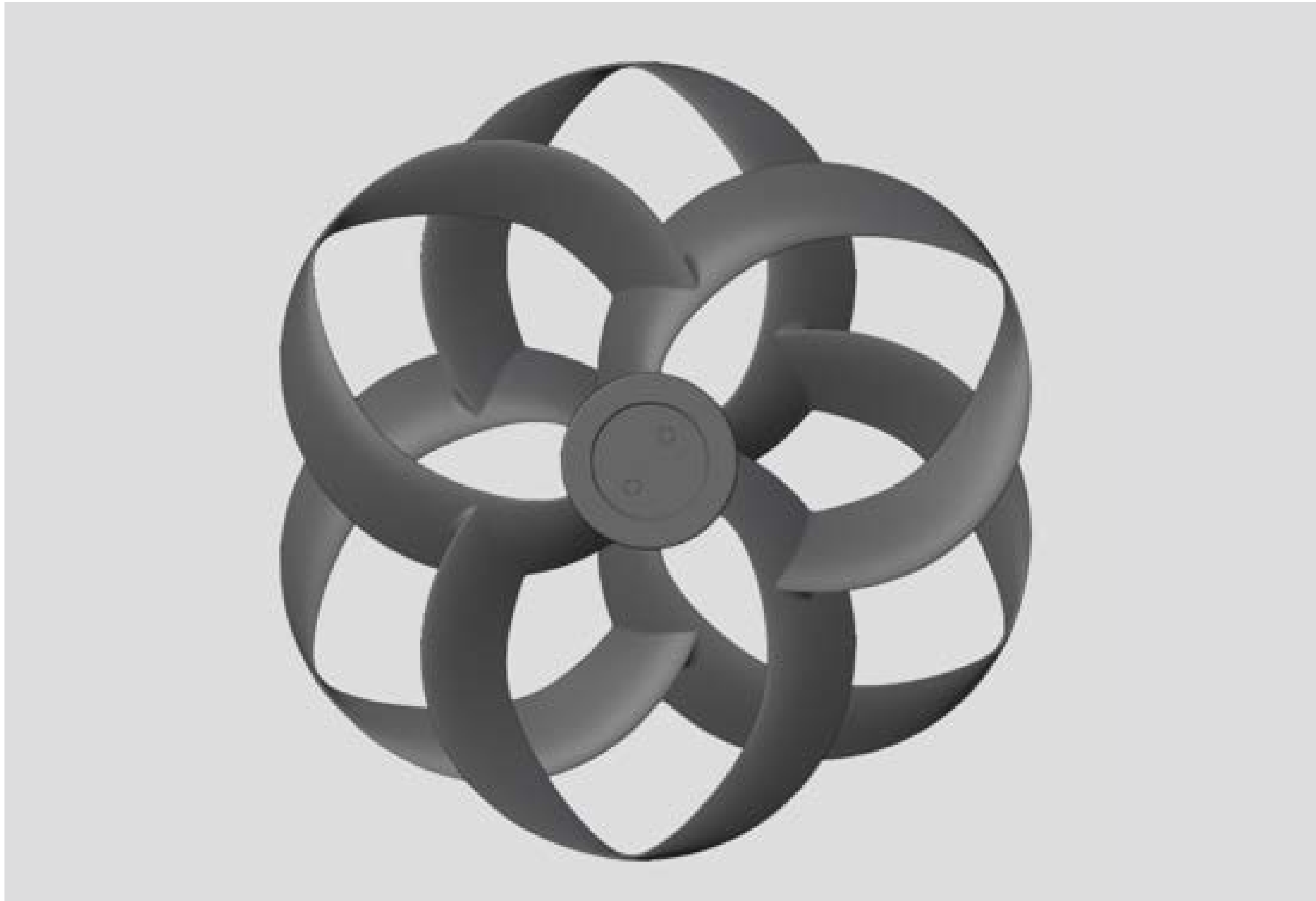




Finalising the Propeller Layout

Once sketching was finalised and drone form was decide, the final propeller hub was combined with a the toroidal propeller design. -

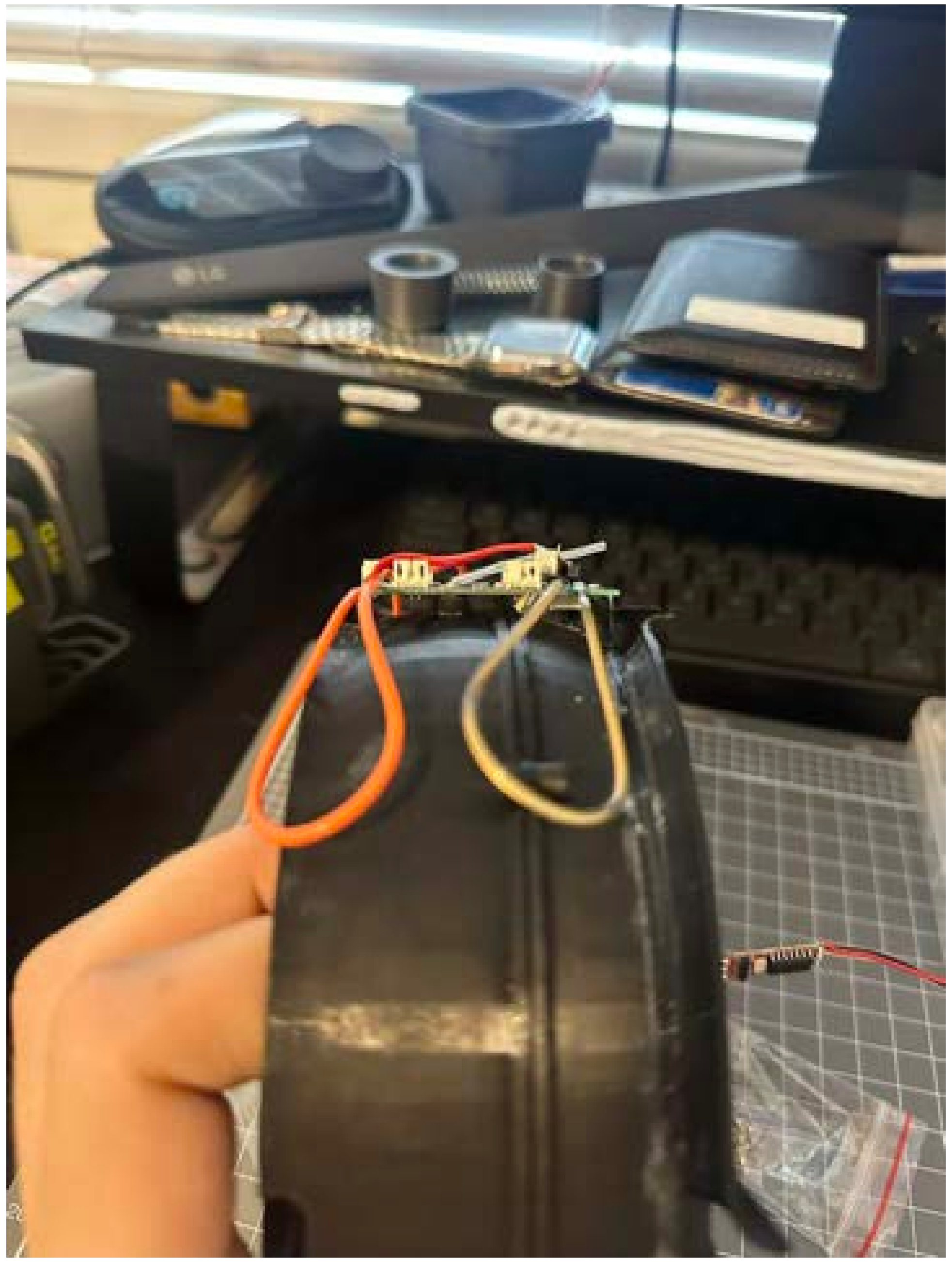




WEEK 10

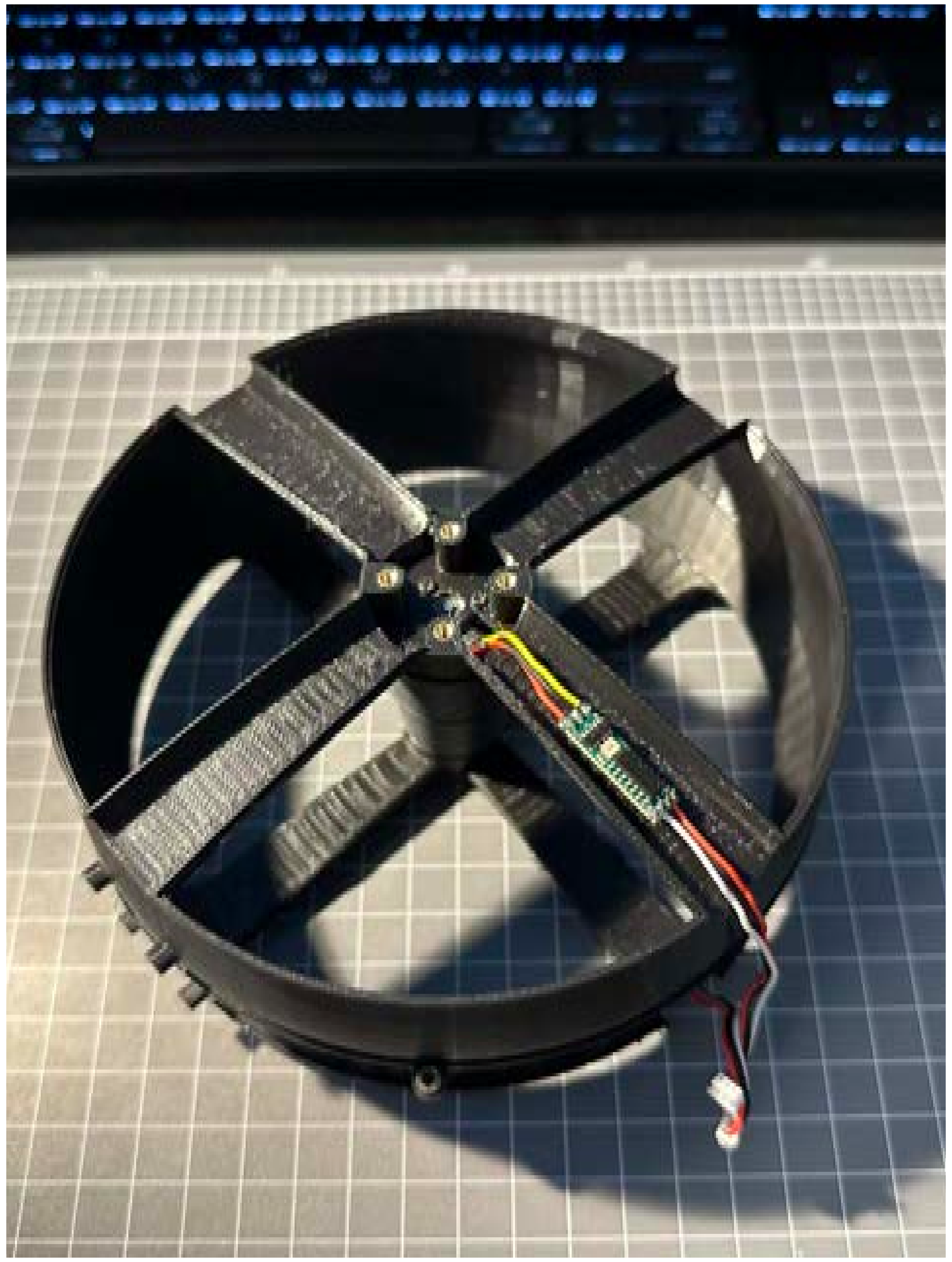
Focus: Finalising Propellers

Early Prototyping



Mounting bracket for PCB finalised

PCB is attached via heat threaded inserts, which are set in the 3d print plastic via a soldering iron



Wiring channels fit within arms allowing speed controllers to sit comfortable within the design

WEEK 11

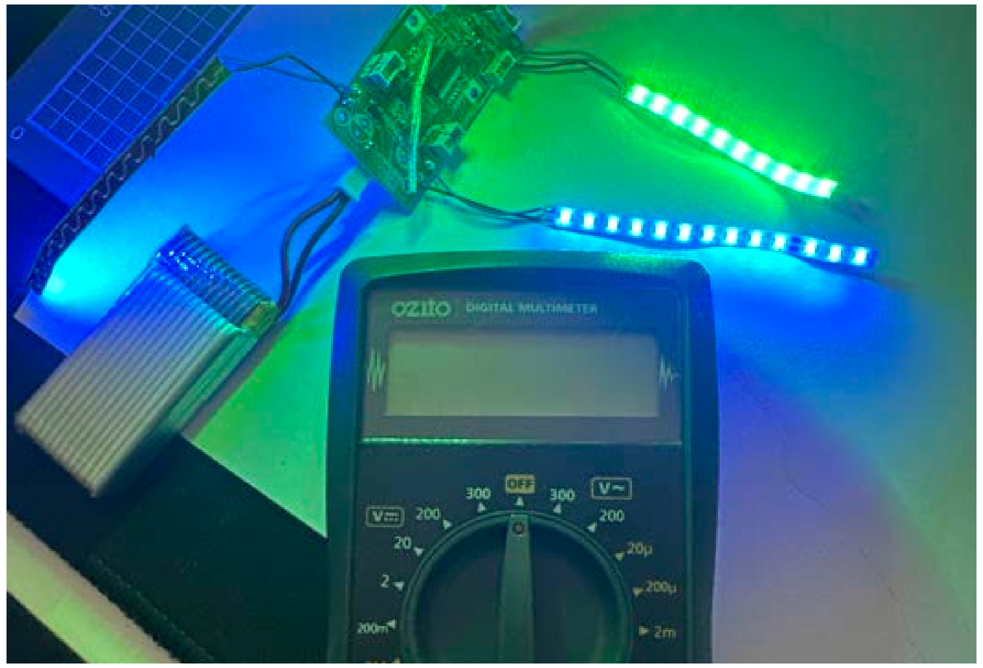
Focus: LED Replacement

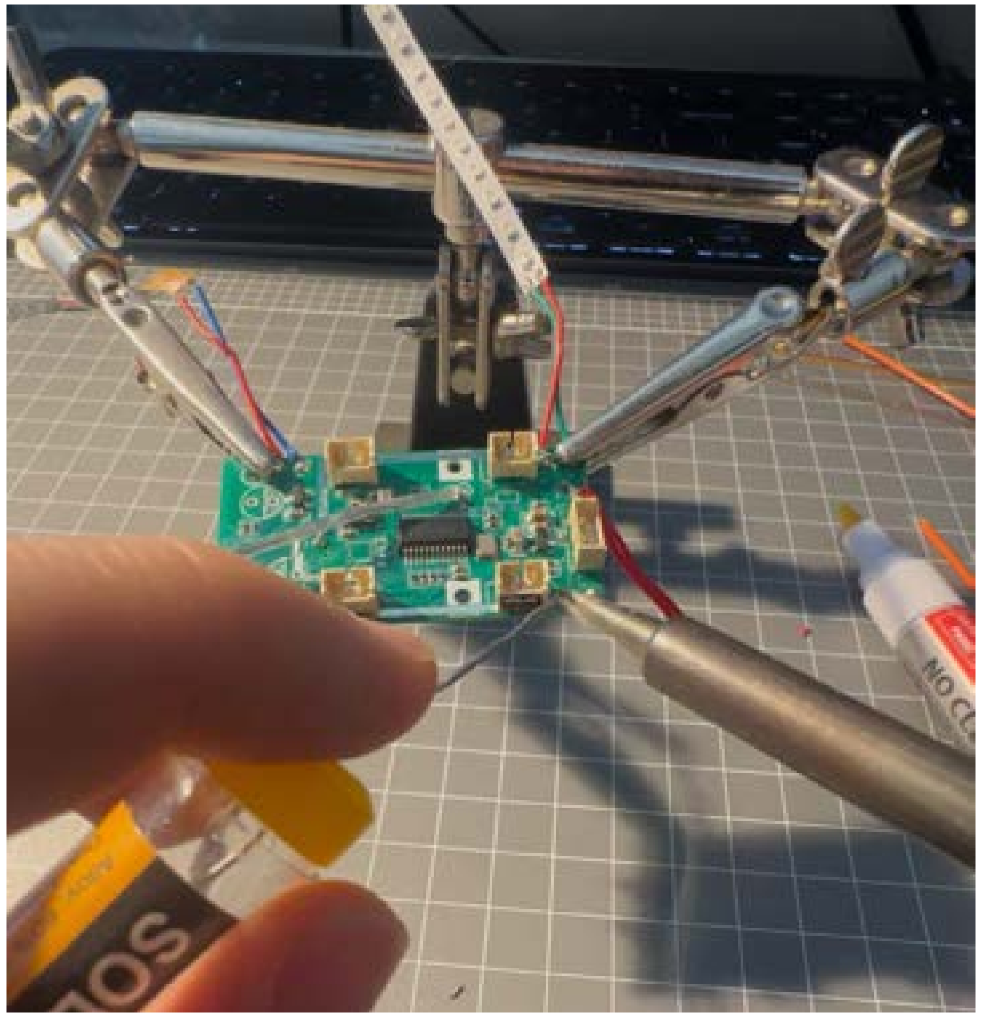
Replacing LED strip with LED fillament

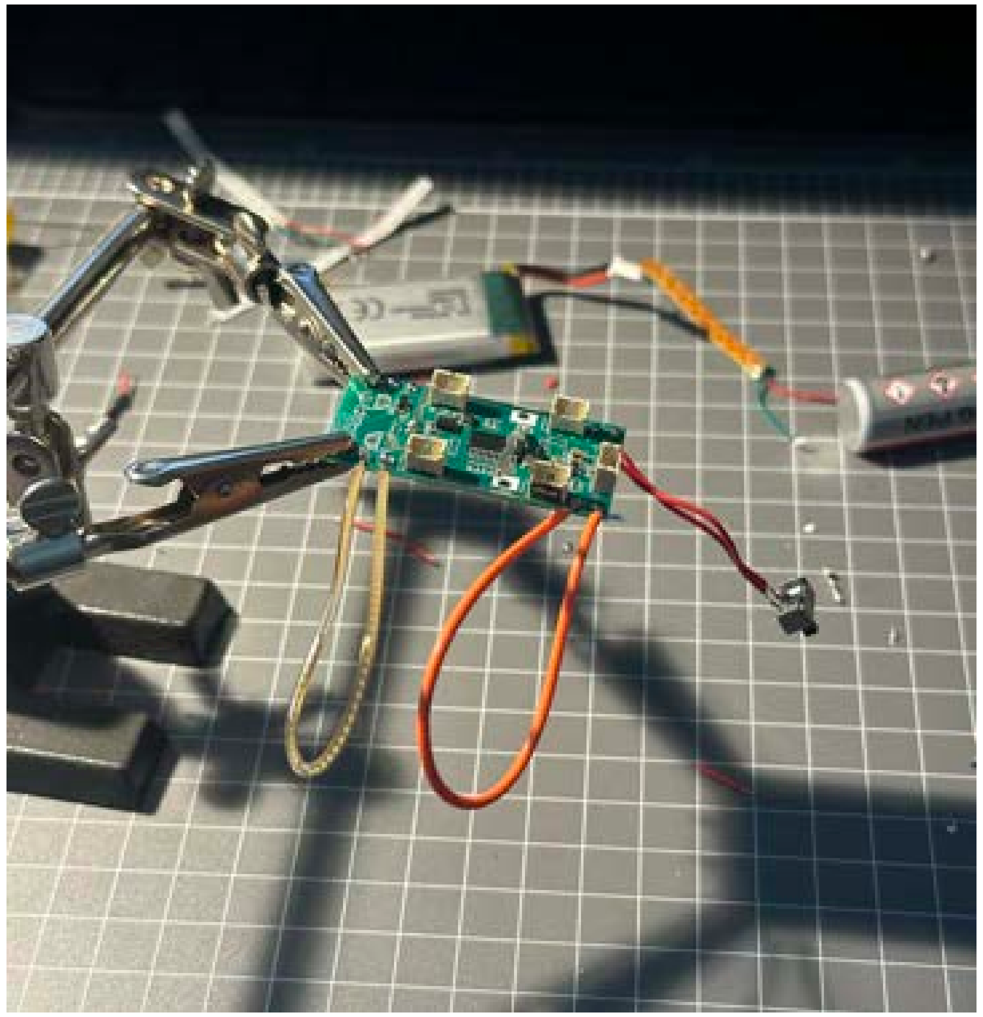
LED flexible filaments were incorporated to replace the existing custom LED stips. After some multimeter testing of the power output of the old strips, it was observed that they output a voltage of 3v.

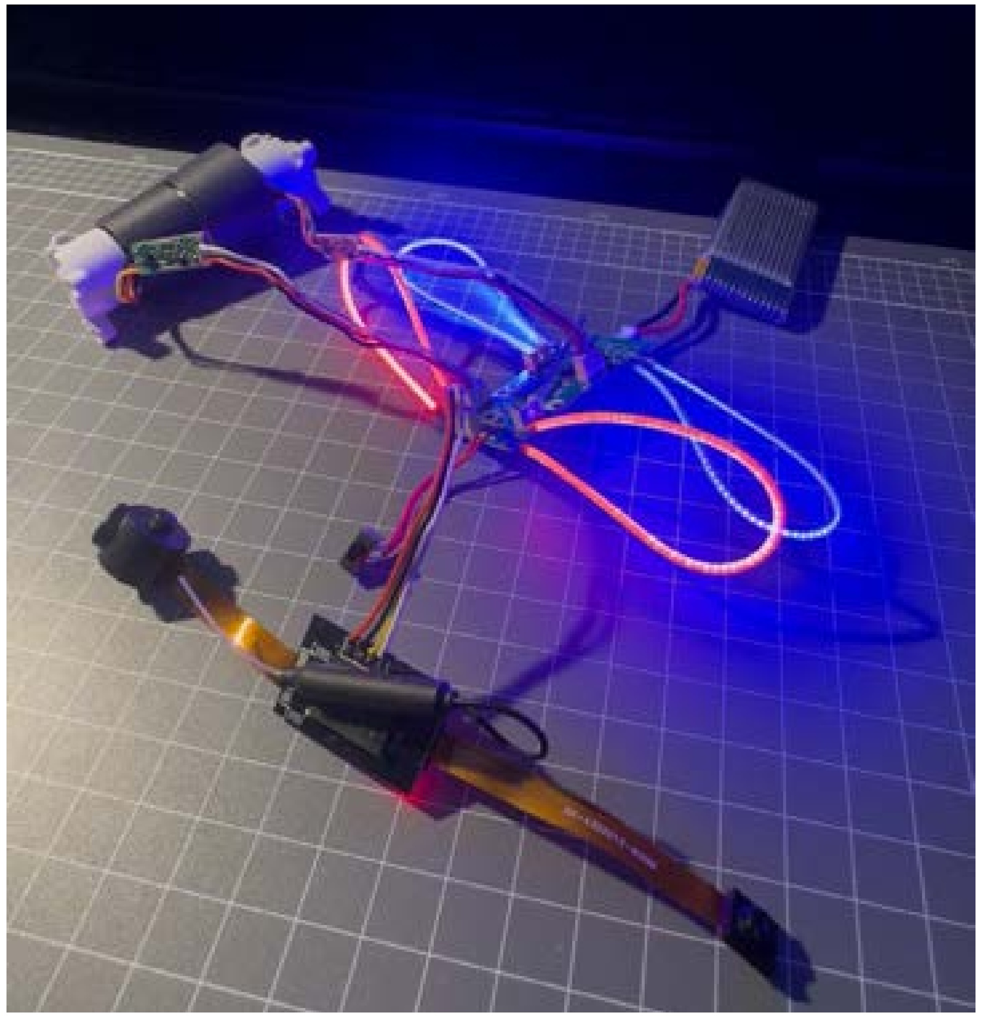
These flexible strips were the only LED fillaments I was able to locate that ran on the same voltage output.

The strips were rather simple to replace and were soldered onto the existing LED contact pads, ensuring both positive and negative terminals were appropriately soldered to prevent accidental shorts.

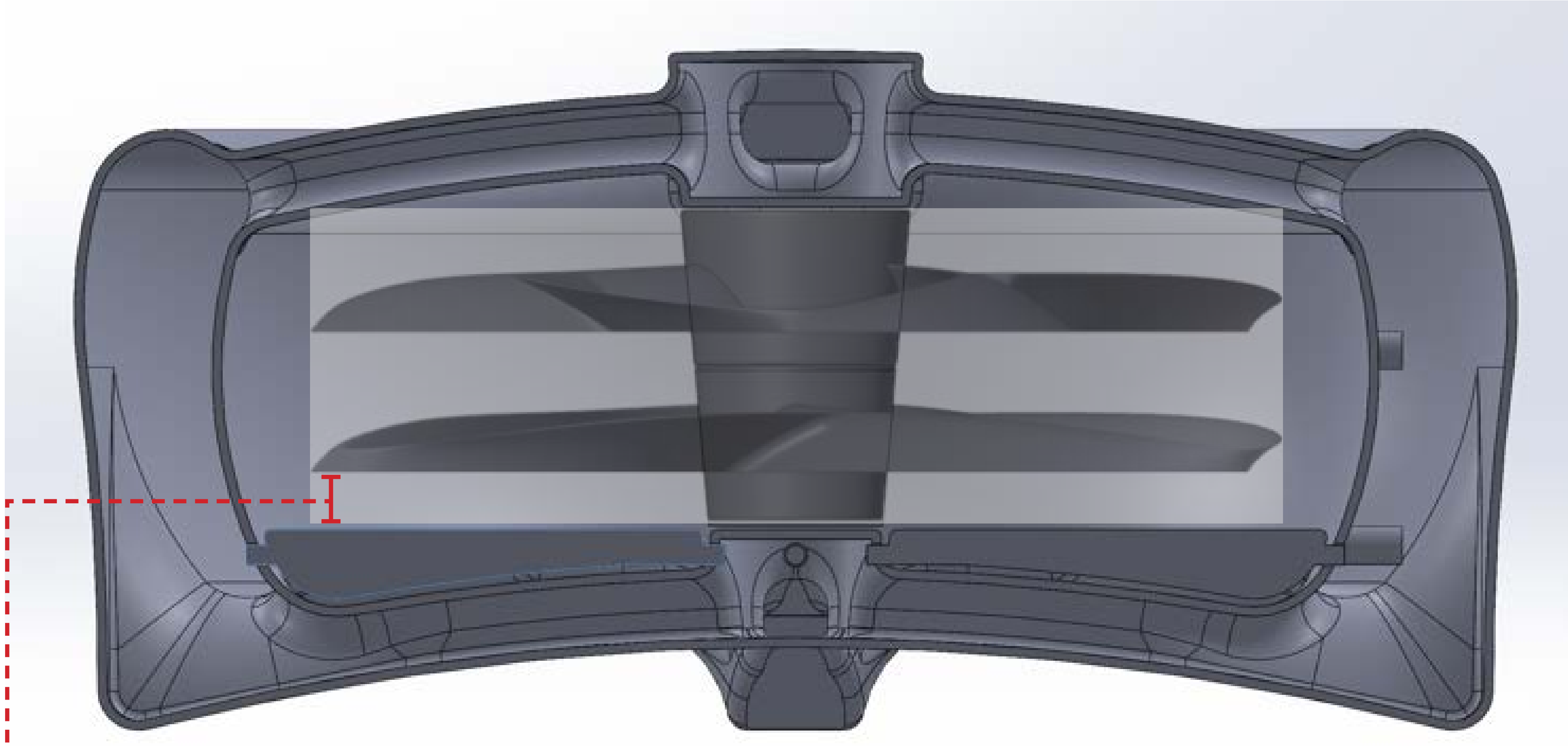






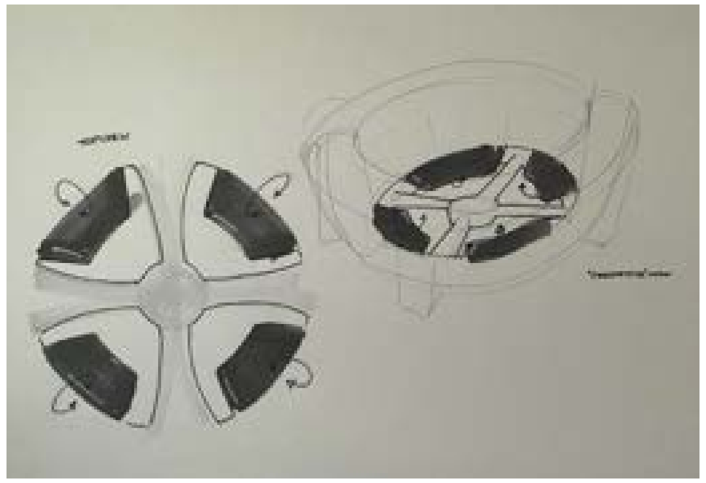


Focus: Vane Adjustments



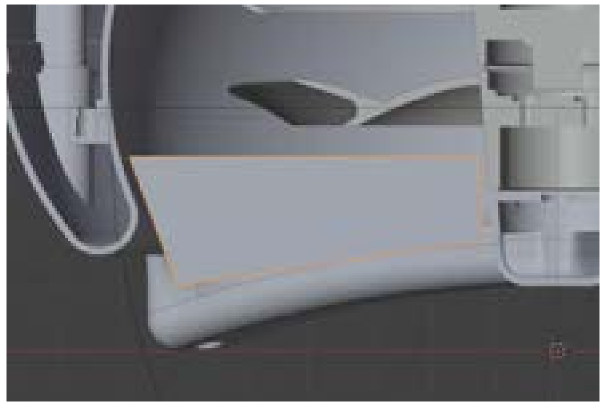
Propeller/Vane Clearance

Not enough clearance between the bottom propeller and control vanes to allow proper drone directional control & thrust vectoring.



Vane Revision

In order to allow appropriate clearance for the vanes, they were offset by 45 degrees. This allowed them to be moved downwards into an appropriate position where they had enough clearance between the bottom propeller and itself to theoretically work in a real use case scenario.



WEEK 12

Focus: Structural Concerns

Structural Concerns

In order to address structural concerns, structural gussets were incorporated in the interior section of the part wall, evenly spaced between the screw boss sections. This allowed the thinner, less supported sections of the part to be better supported structurally to restrict any unwanted warping and movement of the drone when in use.

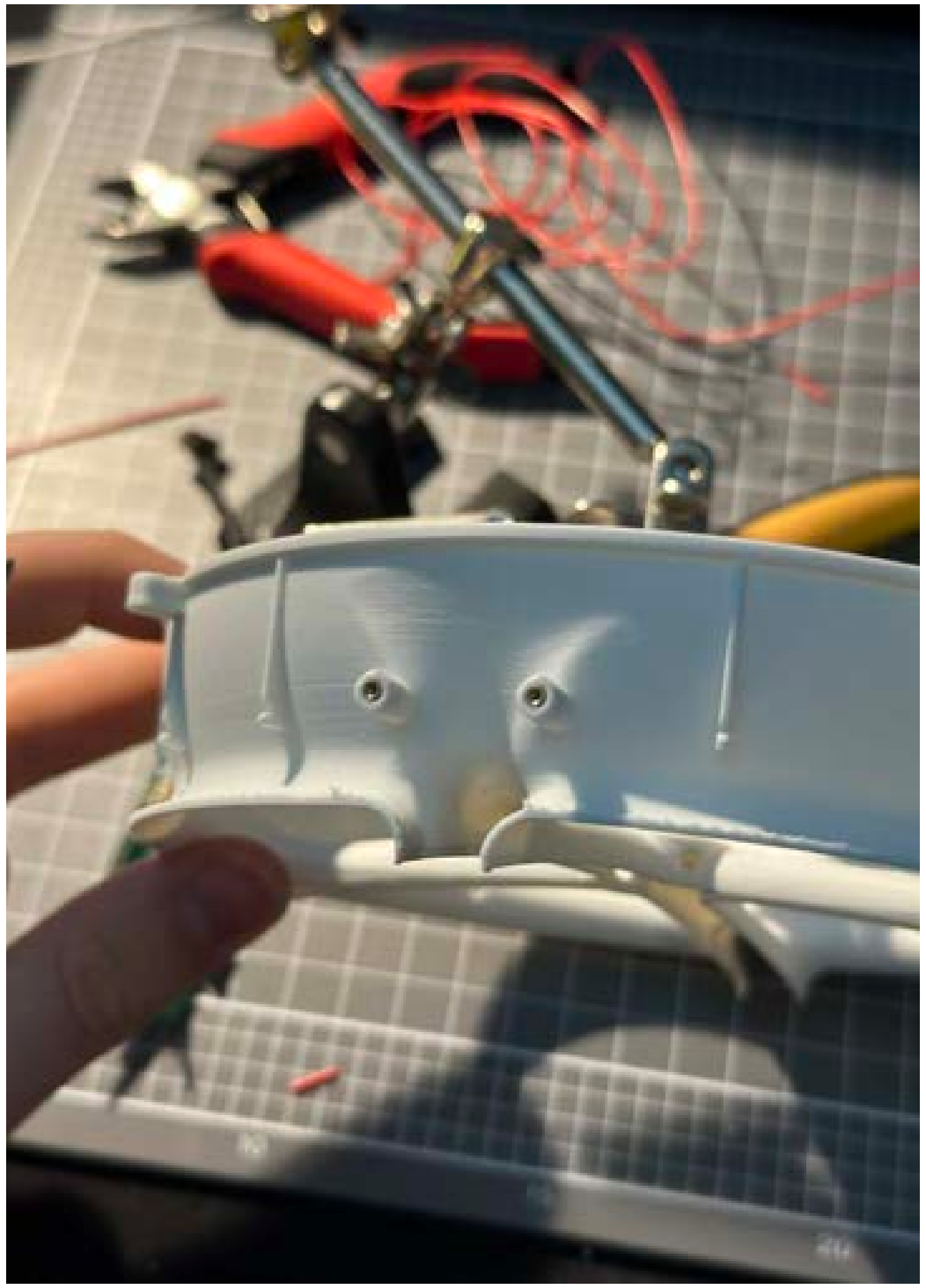
Multi-Purpose Gussets

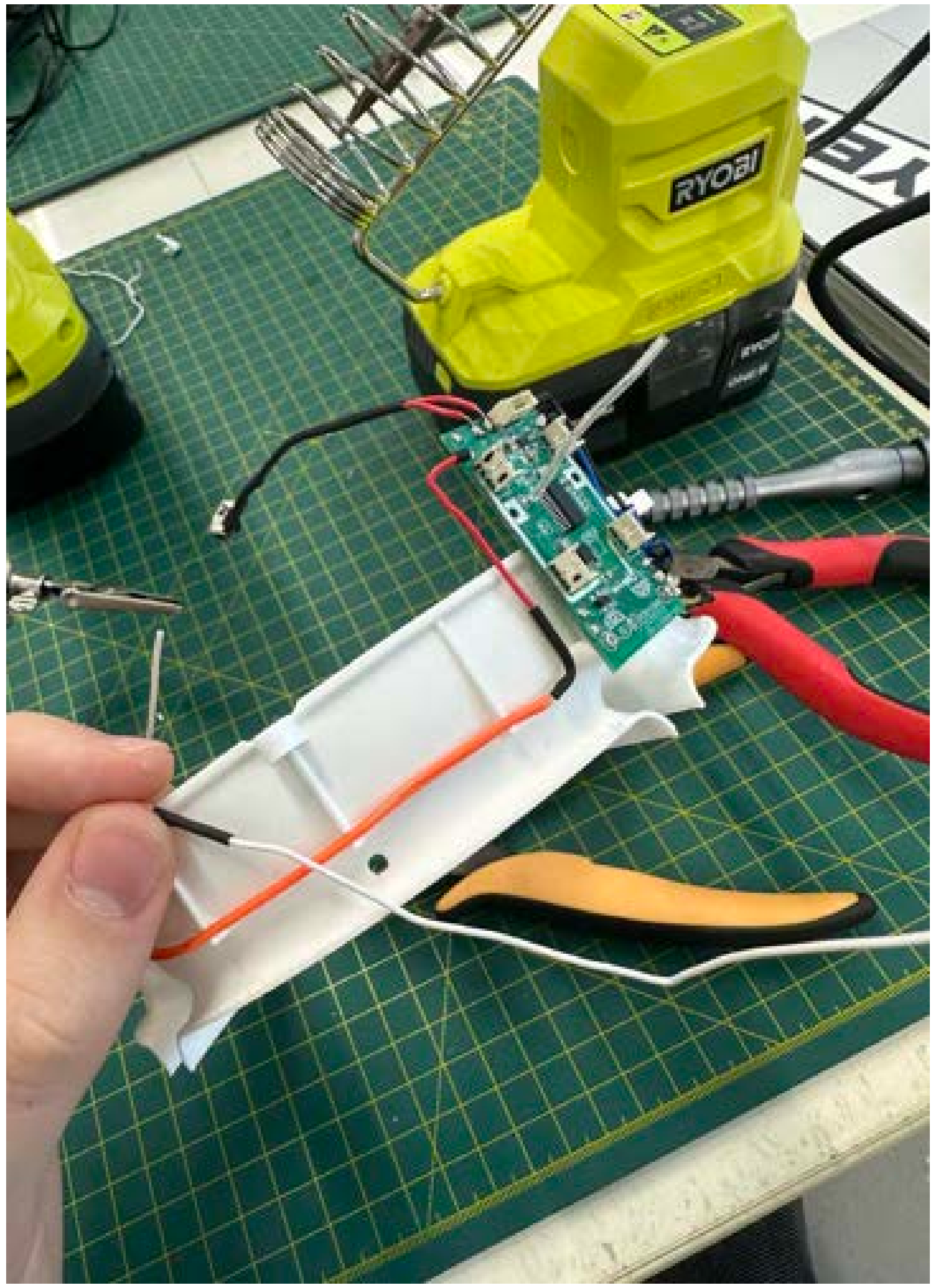
To ensure gussets served additional functional uses, circular cutouts were incorporated at the bottom of each gusset.

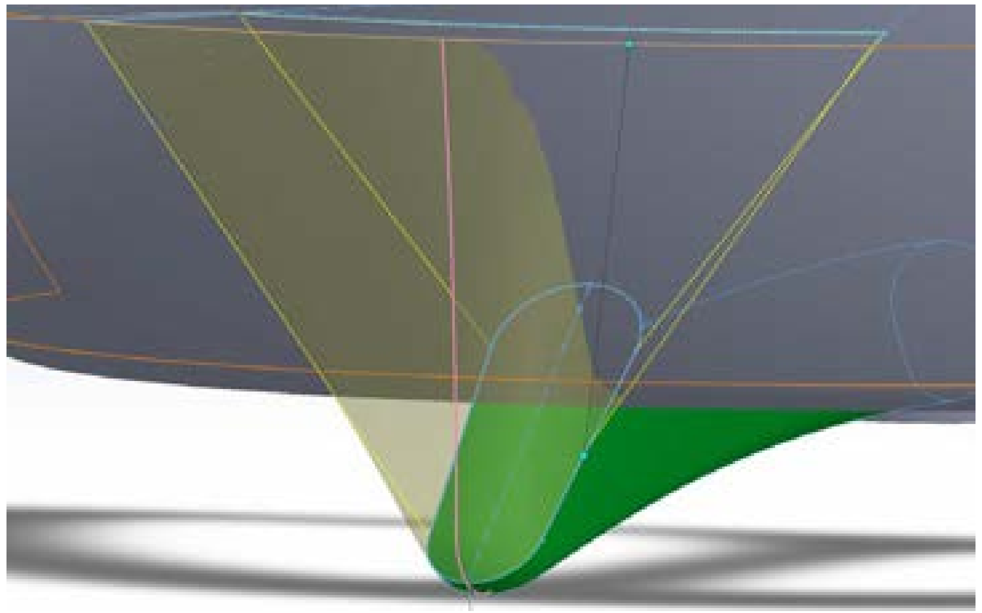
This allowed the LED filament to sit firmly secure inside the drone, ensuring it wouldn't move around too much during flight.

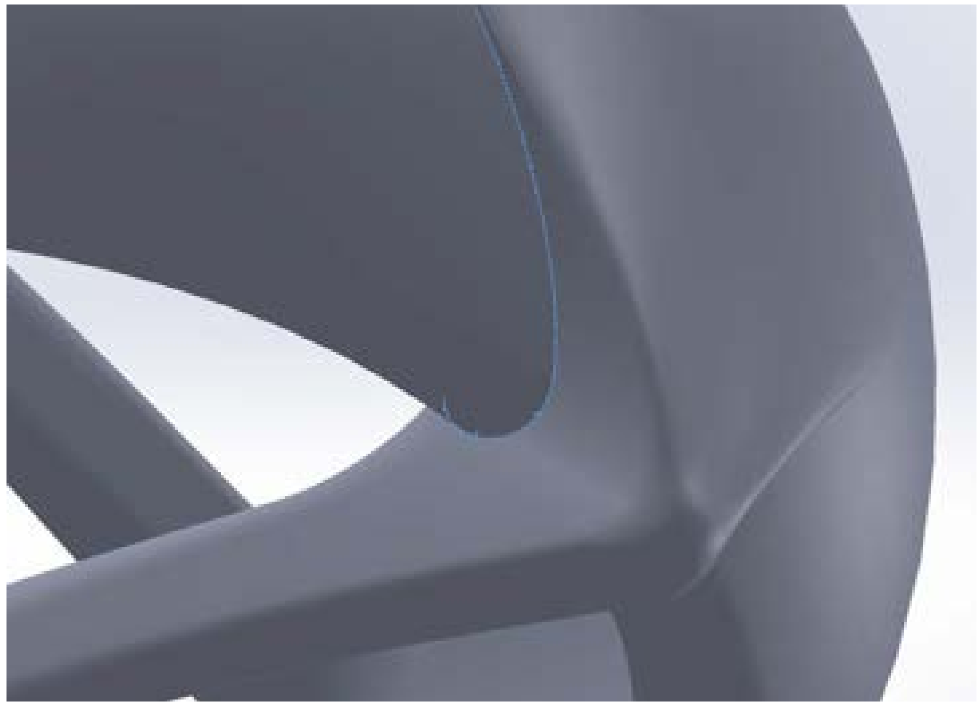
Form Changes

Additional form changes were made to better support the drone structurally. These changes are elaborated upon on the next page.





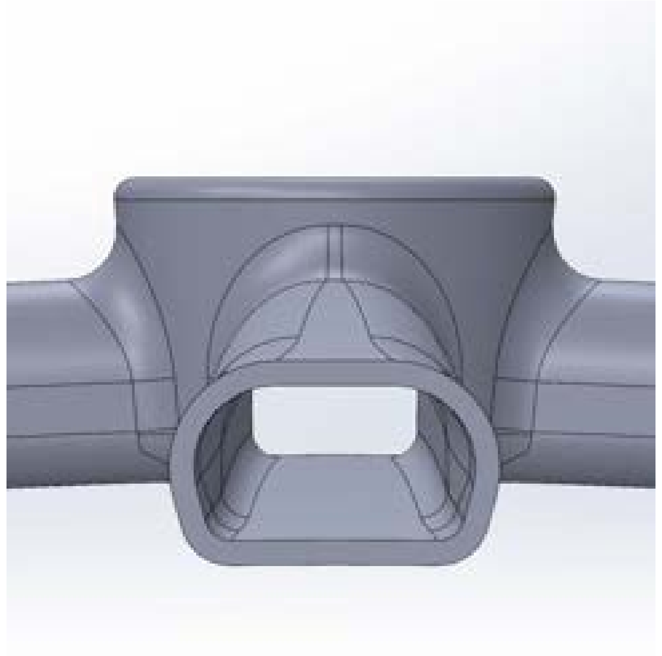


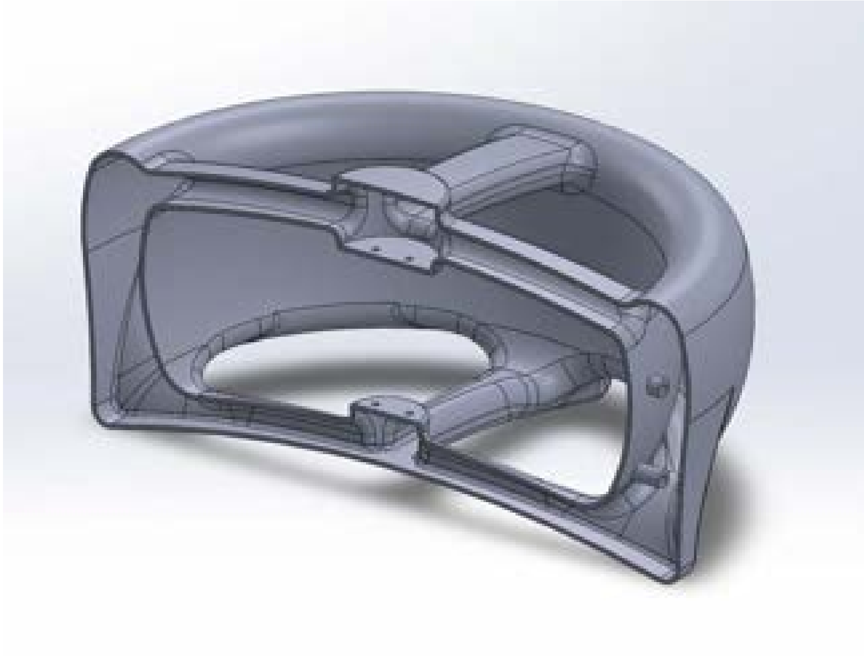


WEEK 12

Focus: Form Changes

Early Version





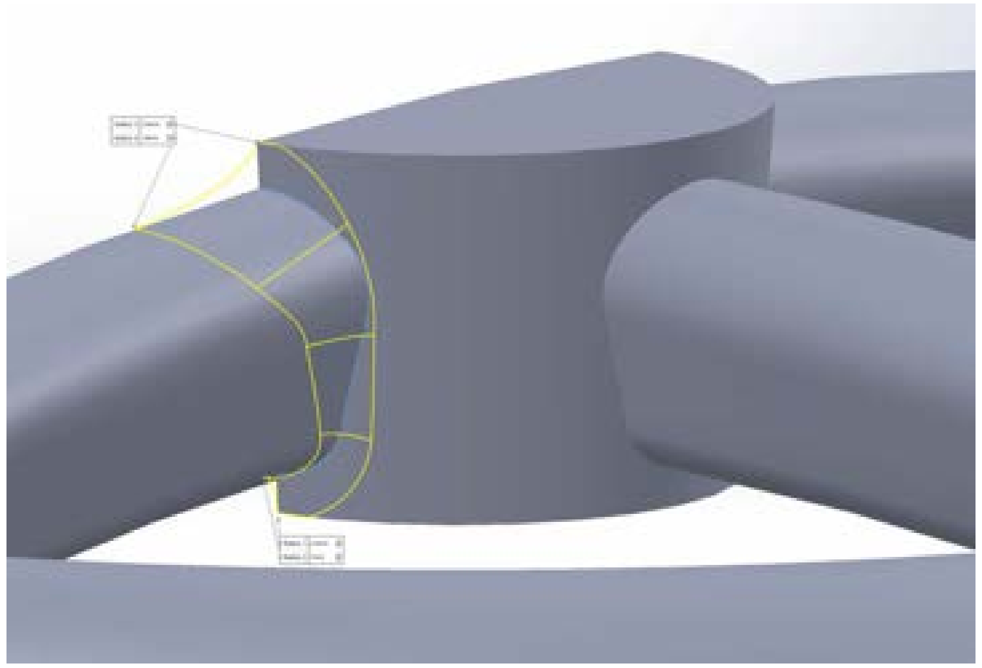
Changes

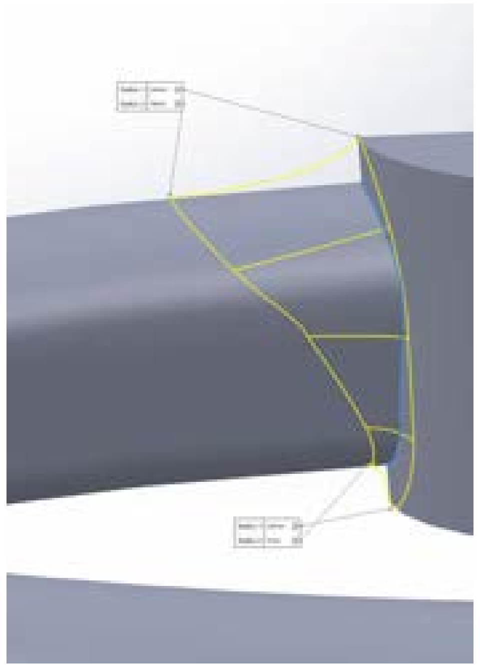
Early iterations of the arms connecting the “central body” to the exterior didn’t have a very aerodynamic form. Adjustments were made in order to make the arms follow more of a teardrop countour, this would allow air to effectively flow around it.

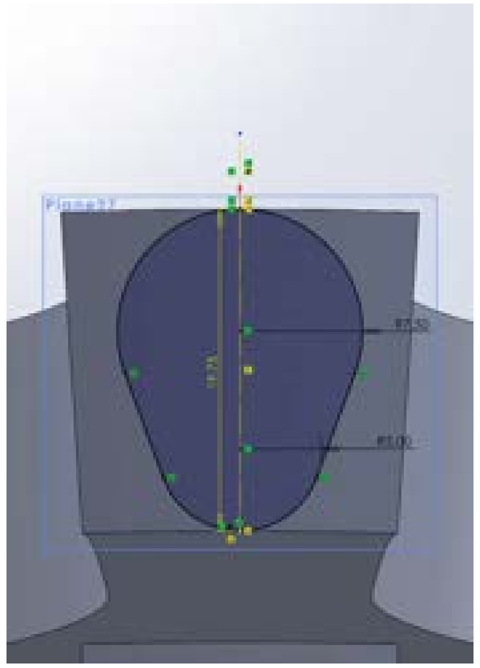
These changes were made to both the top and bottom arms, and required complete changes to the loft profile in order to allow it to appropriately mesh with the existing outer/inner bodies.

The finalised form is seen pictured below.

Updated Version







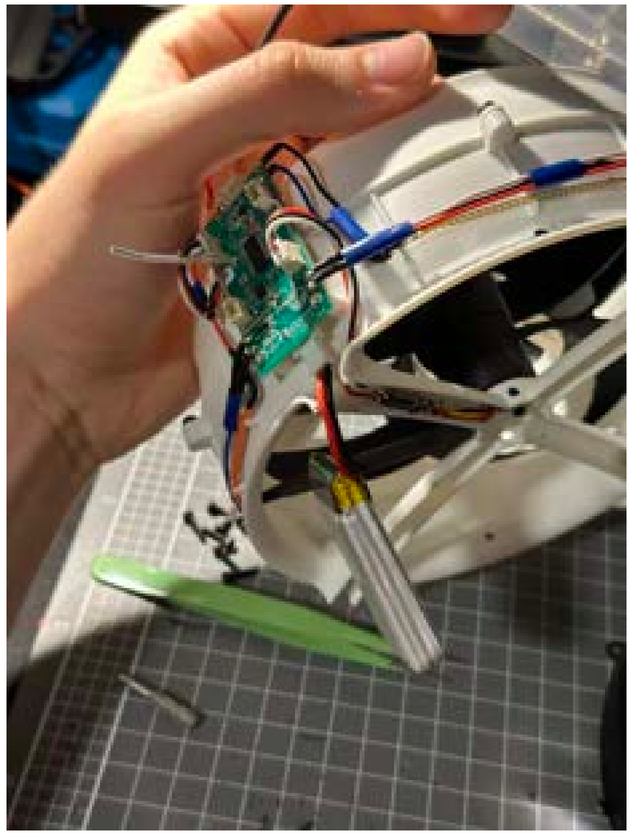
WEEK 12

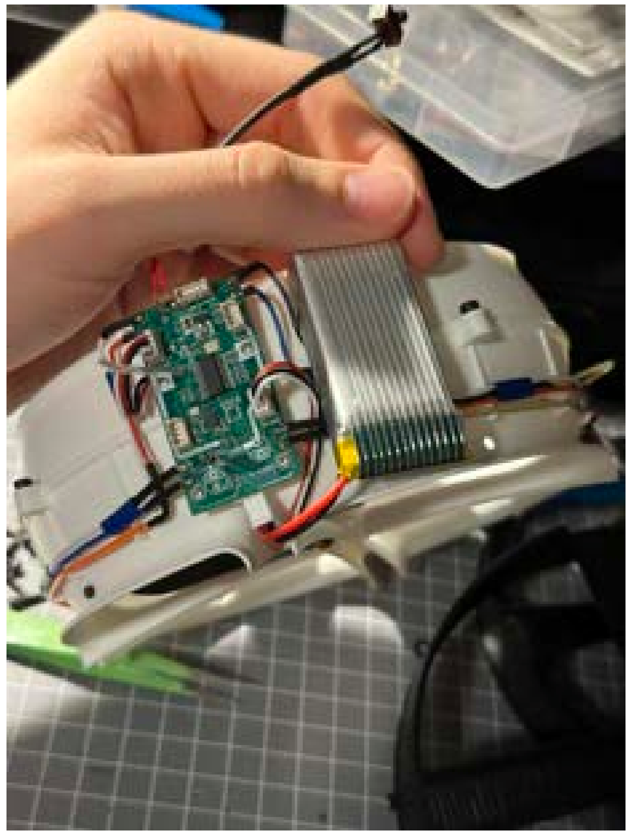
Focus: Final 3D Prints

Completing 3D models & Printing

Final prints were conducted with variable layer heights to optomise quality over curved surfaces. This layer height spanned between a 0.02mm-0.2mm layer height.

Finalised 3D prints had heat set inserts inserted within the designated parts of the 3D print before undergoing the sanding, priming and painting process.





WEEK 12

Focus: Component Fitting

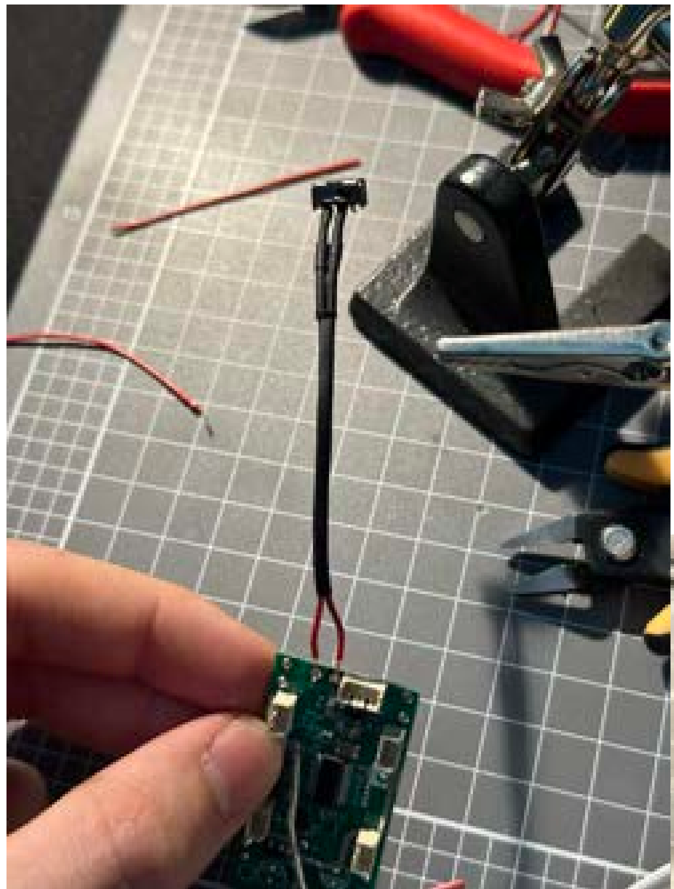
Electronic Adjustments

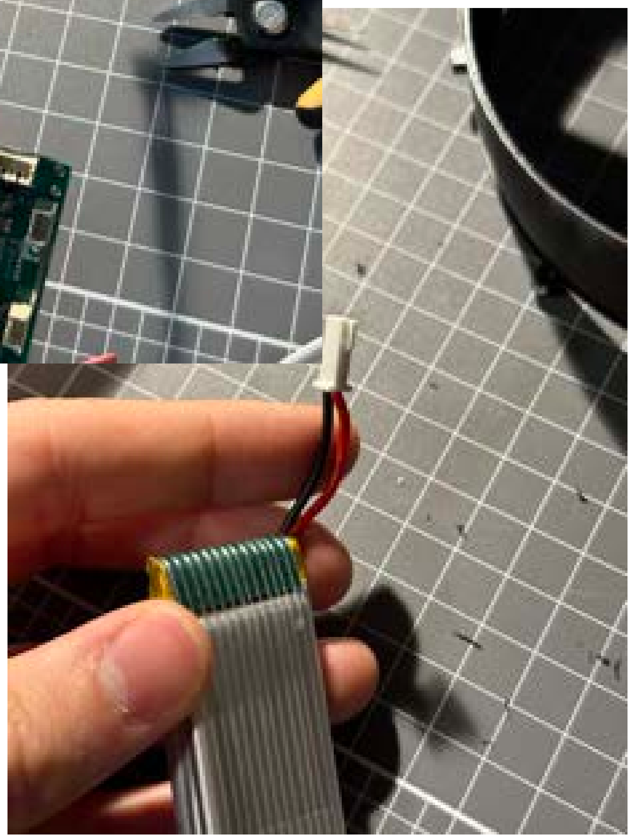
A couple parts, consisting of the switch, battery and video card, did not have the required wiring length to be appropriately housed within the drone body. These parts were extended to allow safe, contained operation.

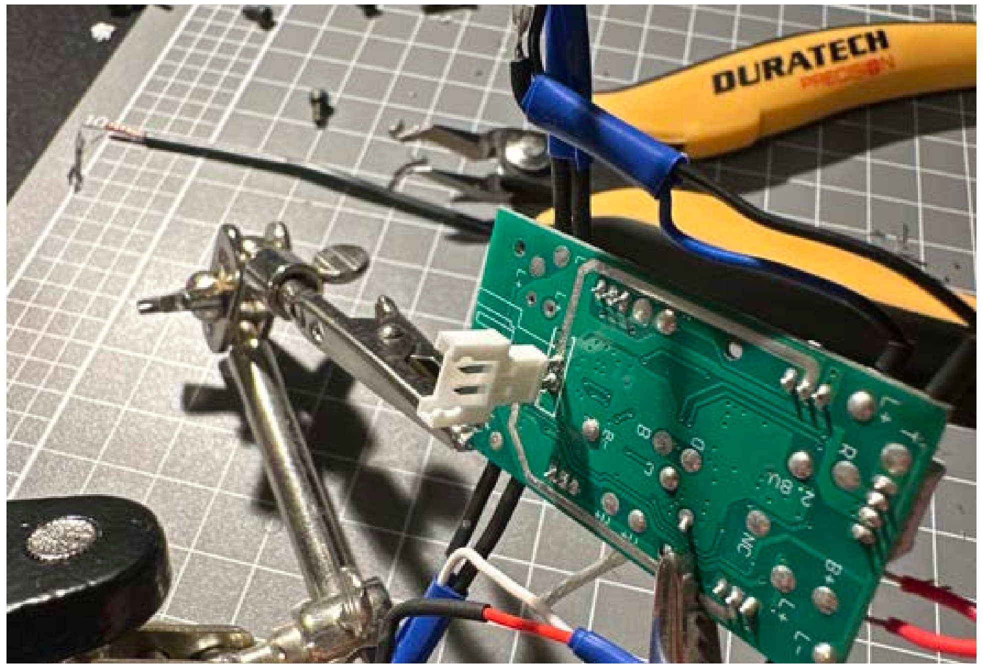
All parts were neatly housed within the drone inner body.

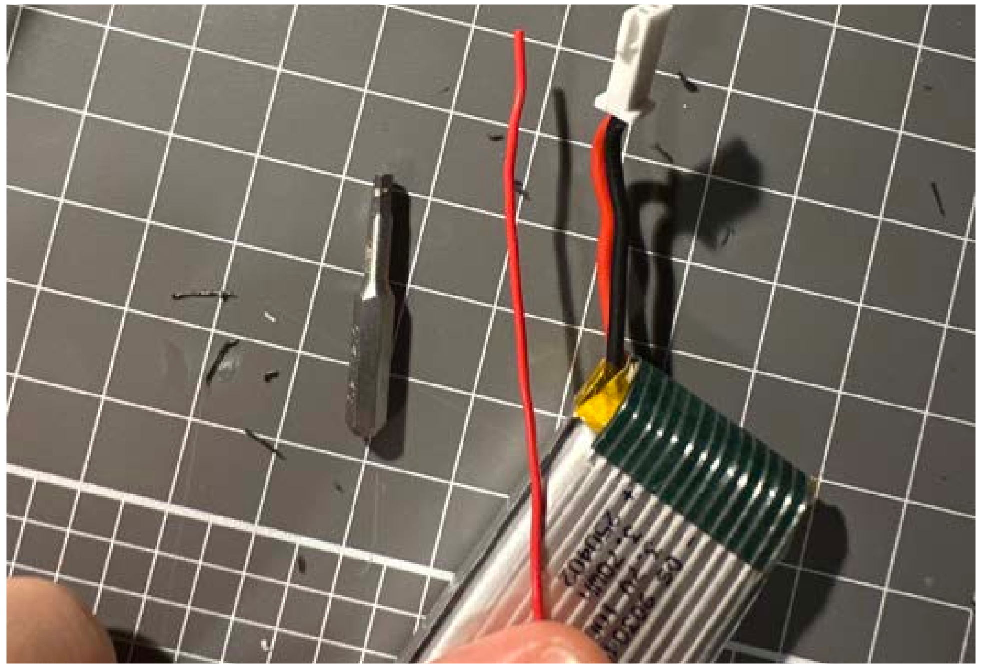
To prevent any shorts and accidental electrocutions, the battery wiring itself wasn't lengthened, instead the connecting PCB plug was extended, firstly the part was soldered off the board, making sure not to damage the contacts or accidentally bridge any electrical circuits.

Some concerns surrounded the thickness/gauge of the wires and how they would operate with the existing hook up wires that were accessible. So it was decided that to be safe, thicker auto cable would be used to connect the components. This cable is thicker, and meant it was harder to bend for within the drone body, however was the safer choice when working with a battery component.









WEEK 13

Focus: Finalising Model

Sanding, Filling, Priming and Painting

All painted model components underwent the same treatment of sanding to a rough grit to allow for better coat adhesion, followed by a quick process of filling any larger gaps with automotive gap filler. Once that was sanded down with a slightly finer grit, it was followed by a coat of automotive primer. This primer was sanded down to a slightly finer wet-sanded grit of 240. Once the surface was smooth, dry and dust free, 3 coats of the desired paint was applied to the part.

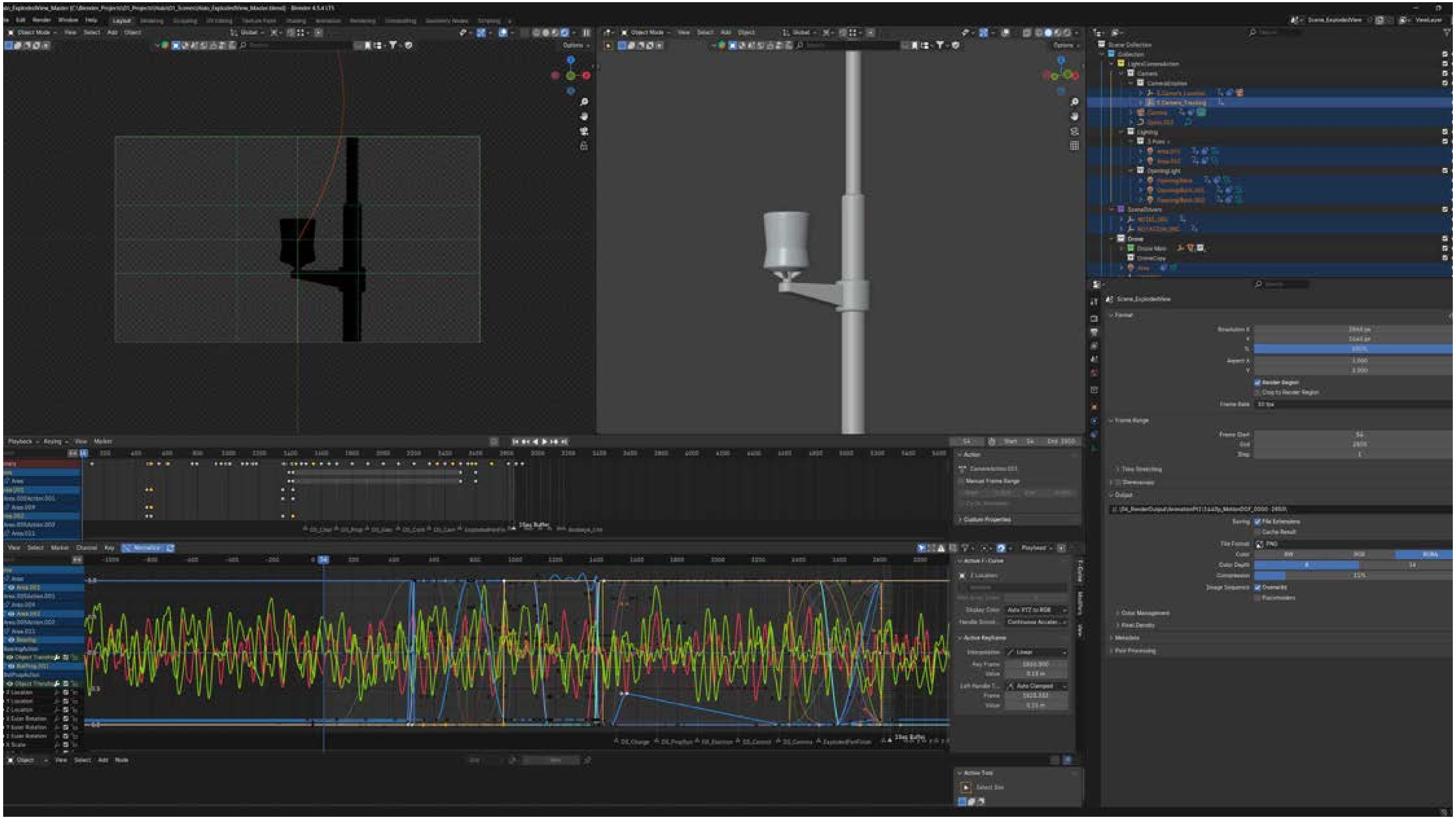
To ensure a nice surface finish, paint coats were followed up by a matte clear coat, this not only protected the painted part but also removed a small amount of unintended gloss which the part had on its surface.

Clear Component Process

The lower exterior component which was SLA resin printed, needed to end up with a fogged, or frosted exterior look to best diffuse the LED light. To develop this look for the model, the surface was sanded down to a fine 400 grit with wet sand paper. Ensuring to leave some surface blemishes to add to the fogged look. The surface was then sprayed with 5 rounds of isopropyl alcohol to attempt to fuse some layers together and give a frosted look before 3 coats of matte clear coat were added.

WEEK 13
Focus: Final Model

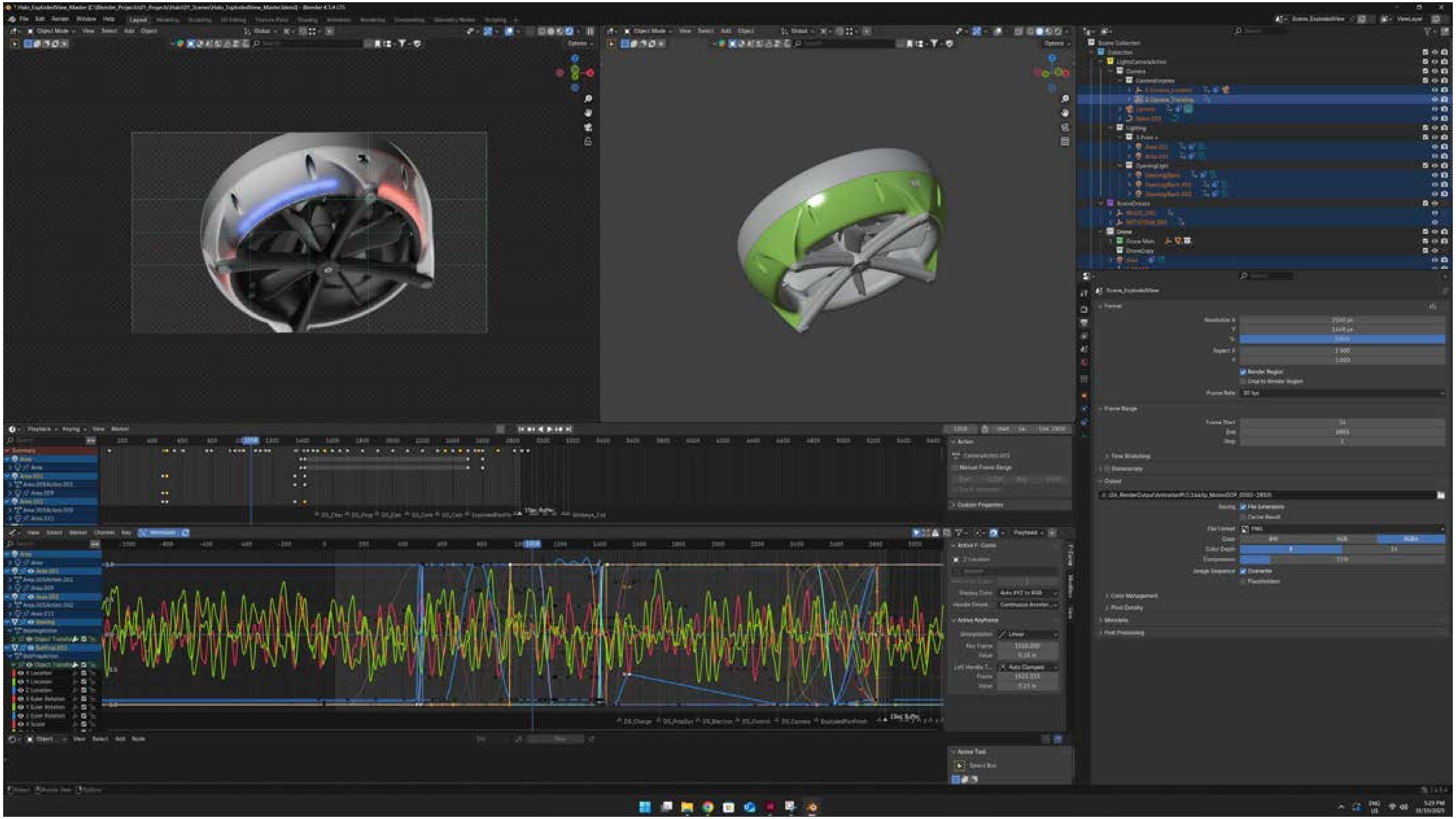

Opening Nest Scene



WEEK 13-14

Focus: Animation

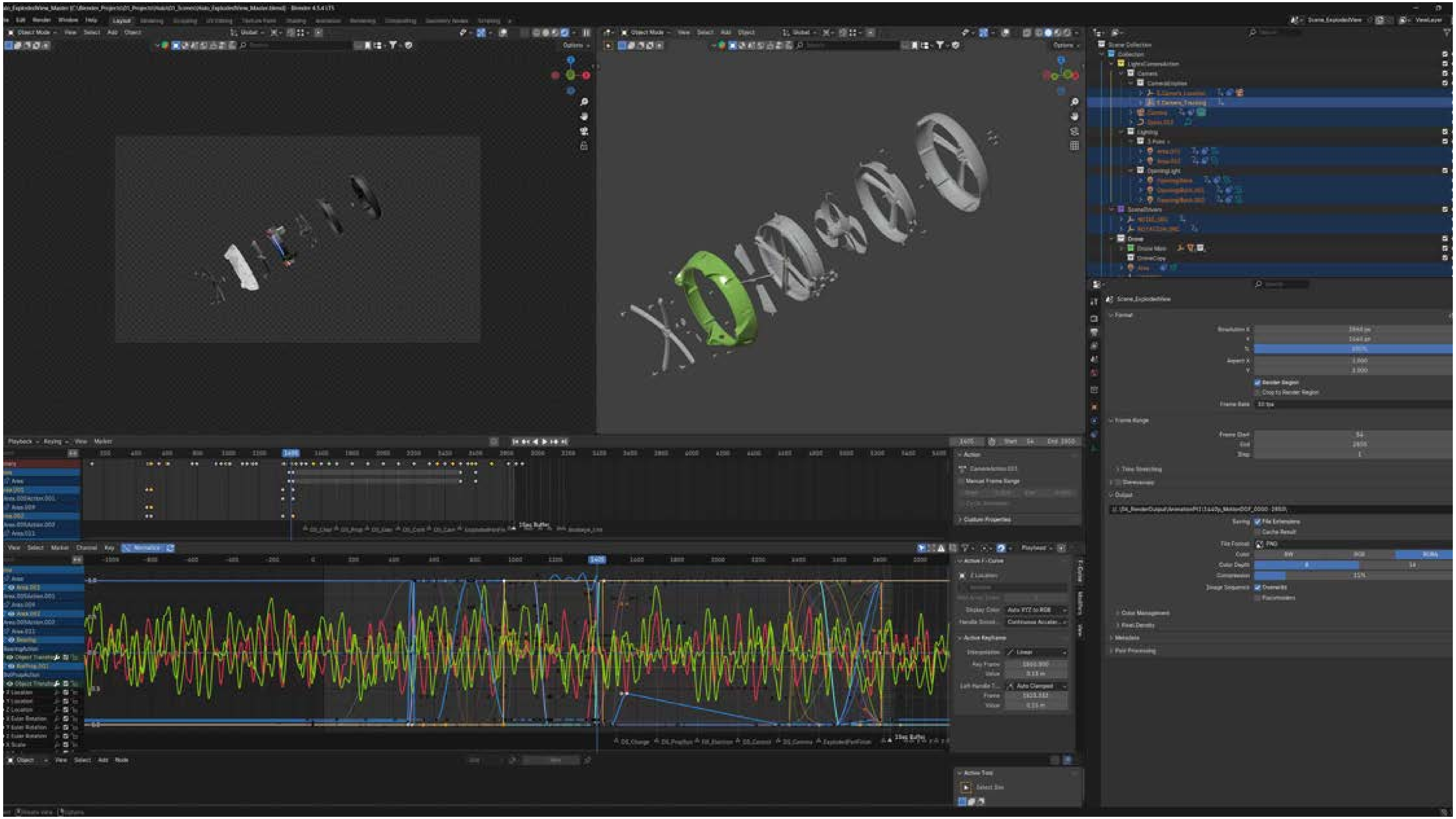
Detail Views Scene



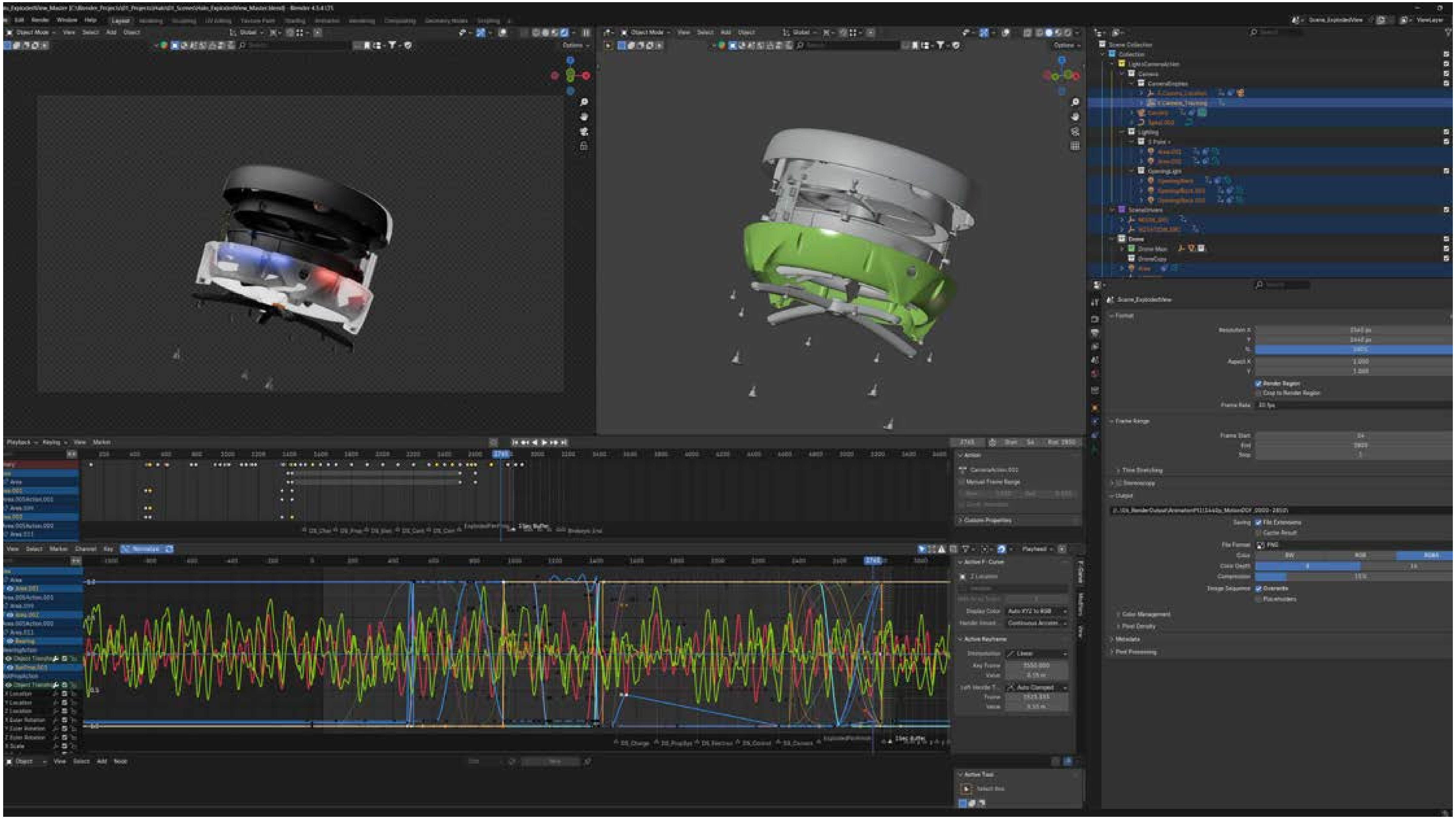
WEEK 13-14

Focus: Animation

Exploded View Scene



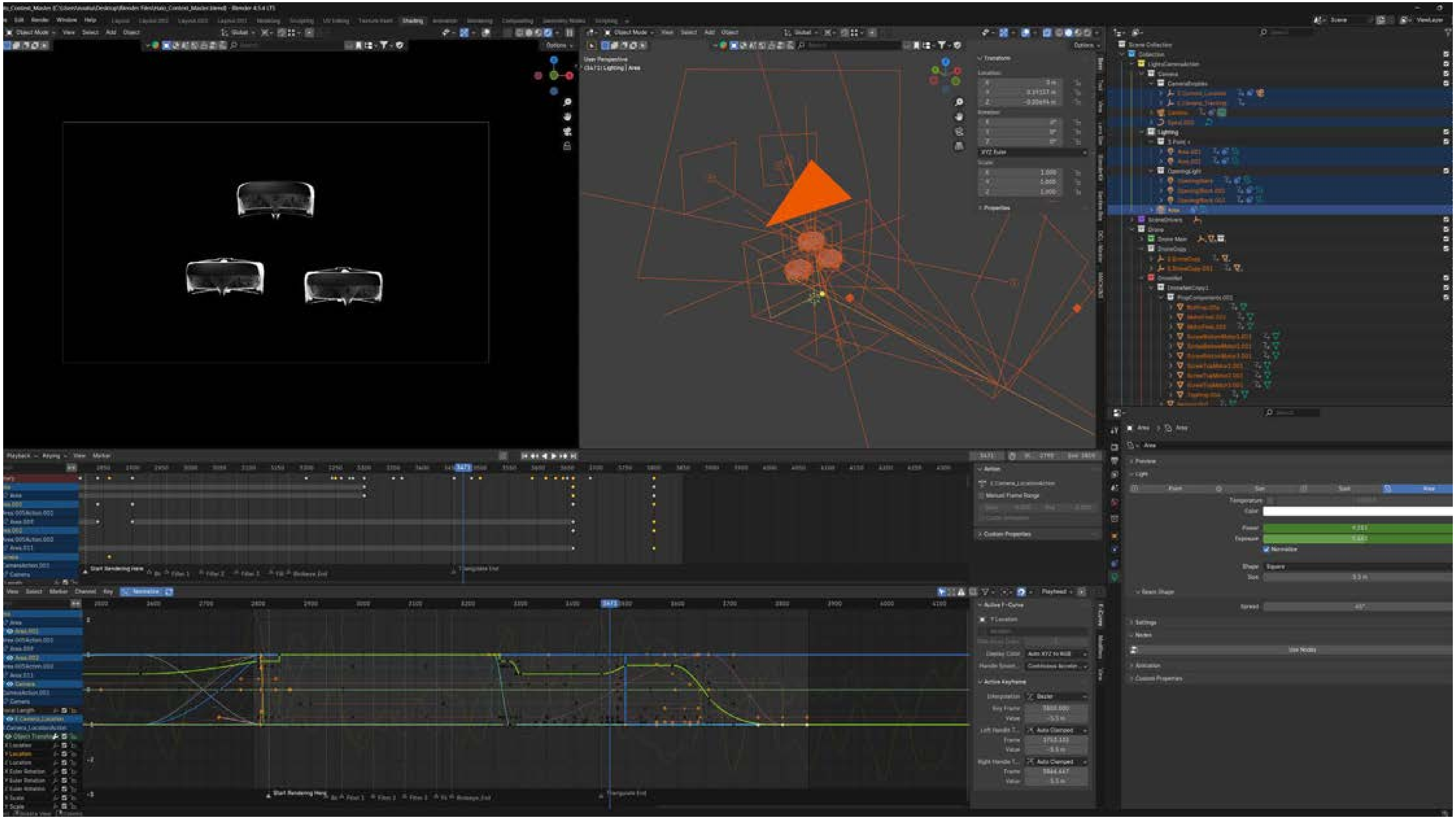
Re-Assemble Scene



WEEK 13-14

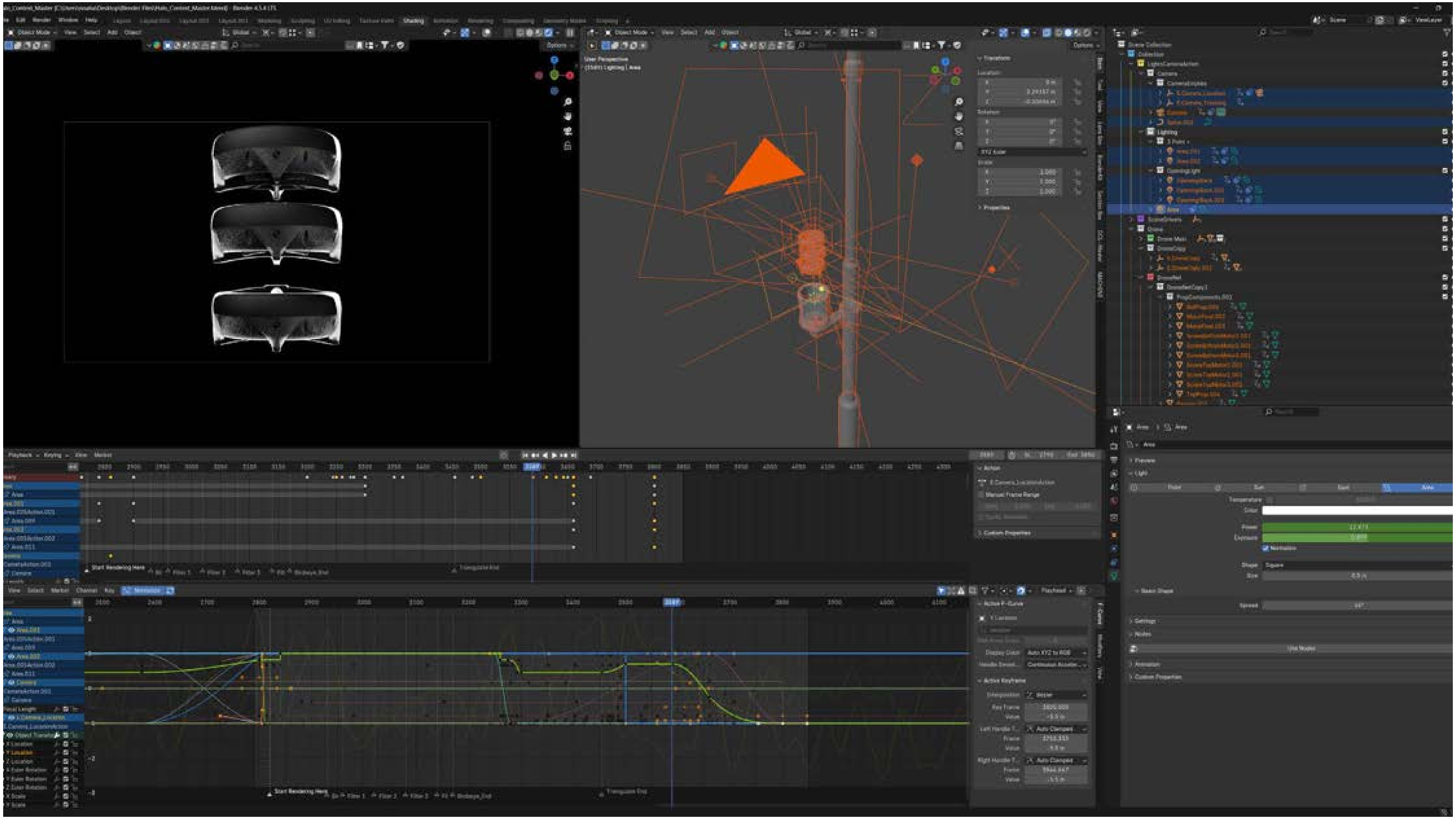
Focus: Animation

Drone Network Scene

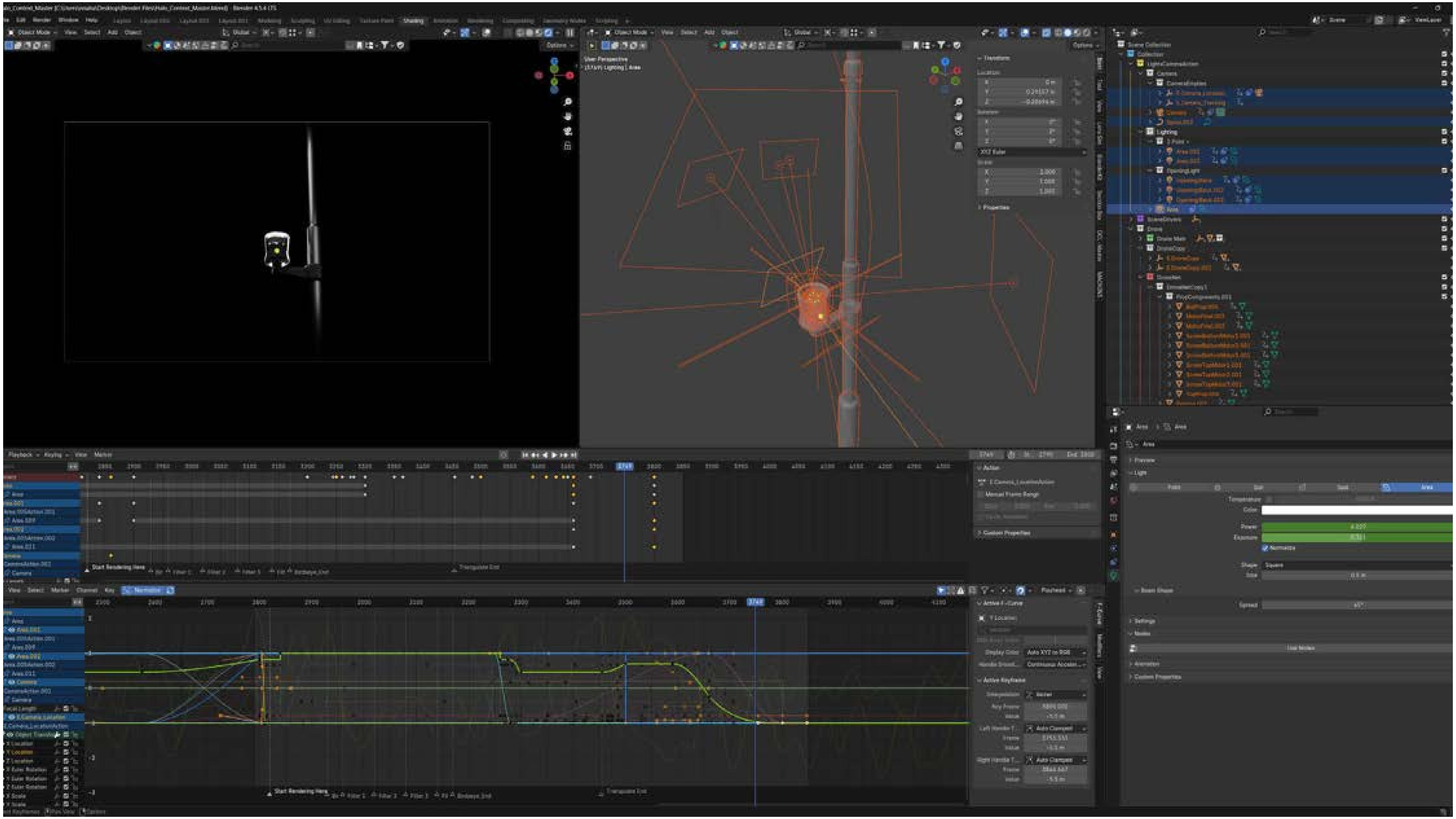


WEEK 13-14
Focus: Animation

Drone Stack Scene



Closing Scene



Title Page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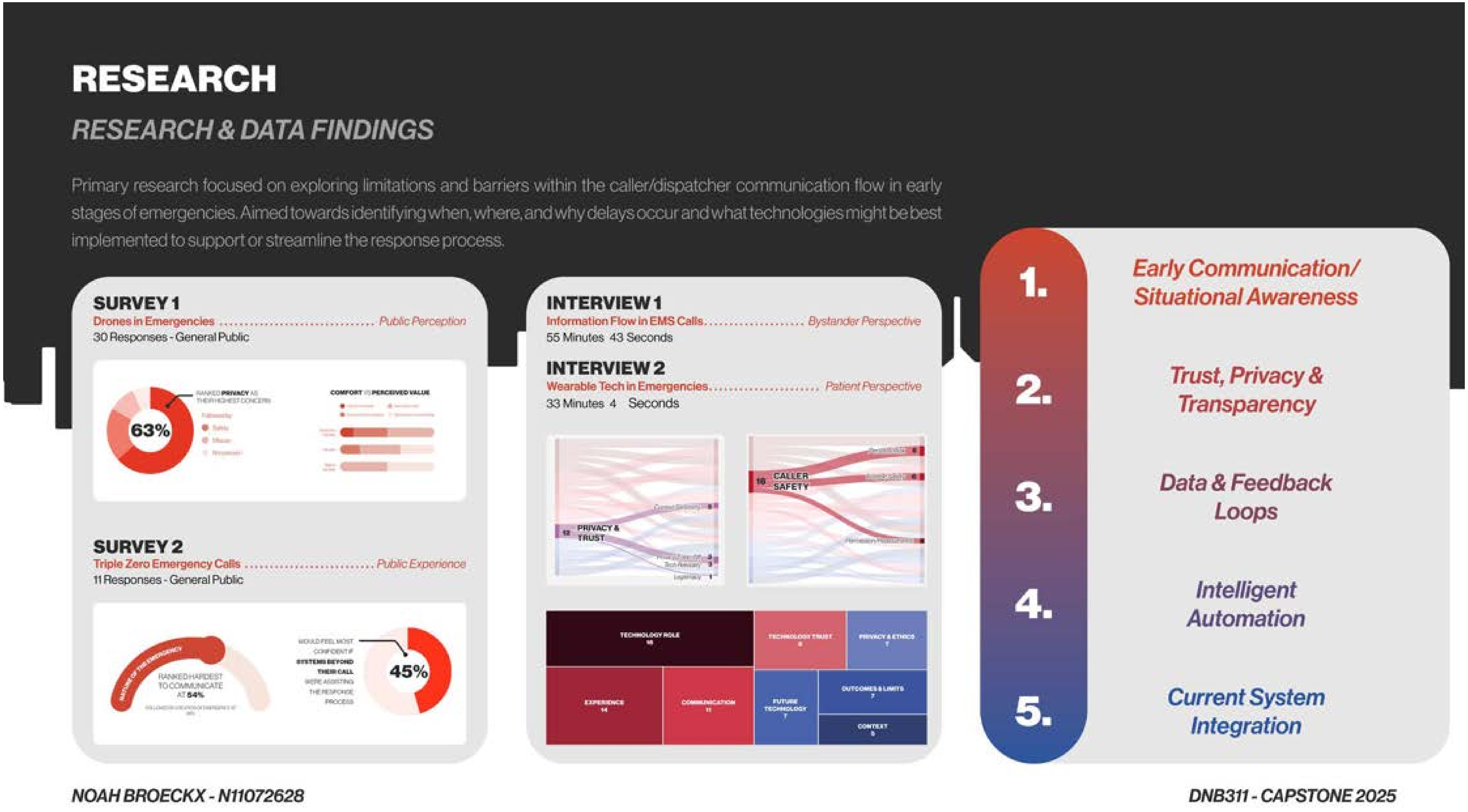
AWARNESS
NOAH BROECKX - N11072628
DNB311 - CAPSTONE 2025

Context Page

Research Page



Concept Page

CONCEPT INTERVENTIONS

EARLY STAGE SITUATIONAL AWARENESS

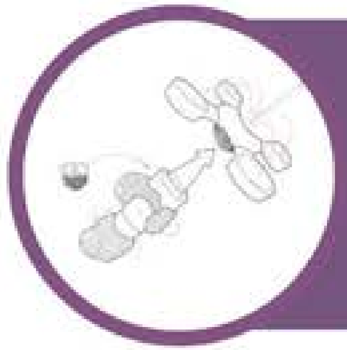
Drone nest/hub that passively collects environmental data during off-emergencies. Upon activation by call or via detection, drones from the nest are dispatched to the scene to provide early, visual scene awareness, reducing delays caused via caller communication difficulties

The drone nest was a strong starting concept however required careful honing to ensure it appropriately addresses the design implications established within the previous stage of research. Additional development into privacy and system integration was required

What implications does it address?

1. 2. 3. 4.

Vehicle-mounted, dashboard module aiming to address delays in response due to traffic congestion



A compact tube launched drone that first responders can use to improve dispatcher's situational awareness on an active scene

Car launched drone, assists in notifying road users of approaching vehicle and gets early awareness on a scene

Arm wearable which notifies public of on duty first responders, near and around a scene. Safety and Awareness.

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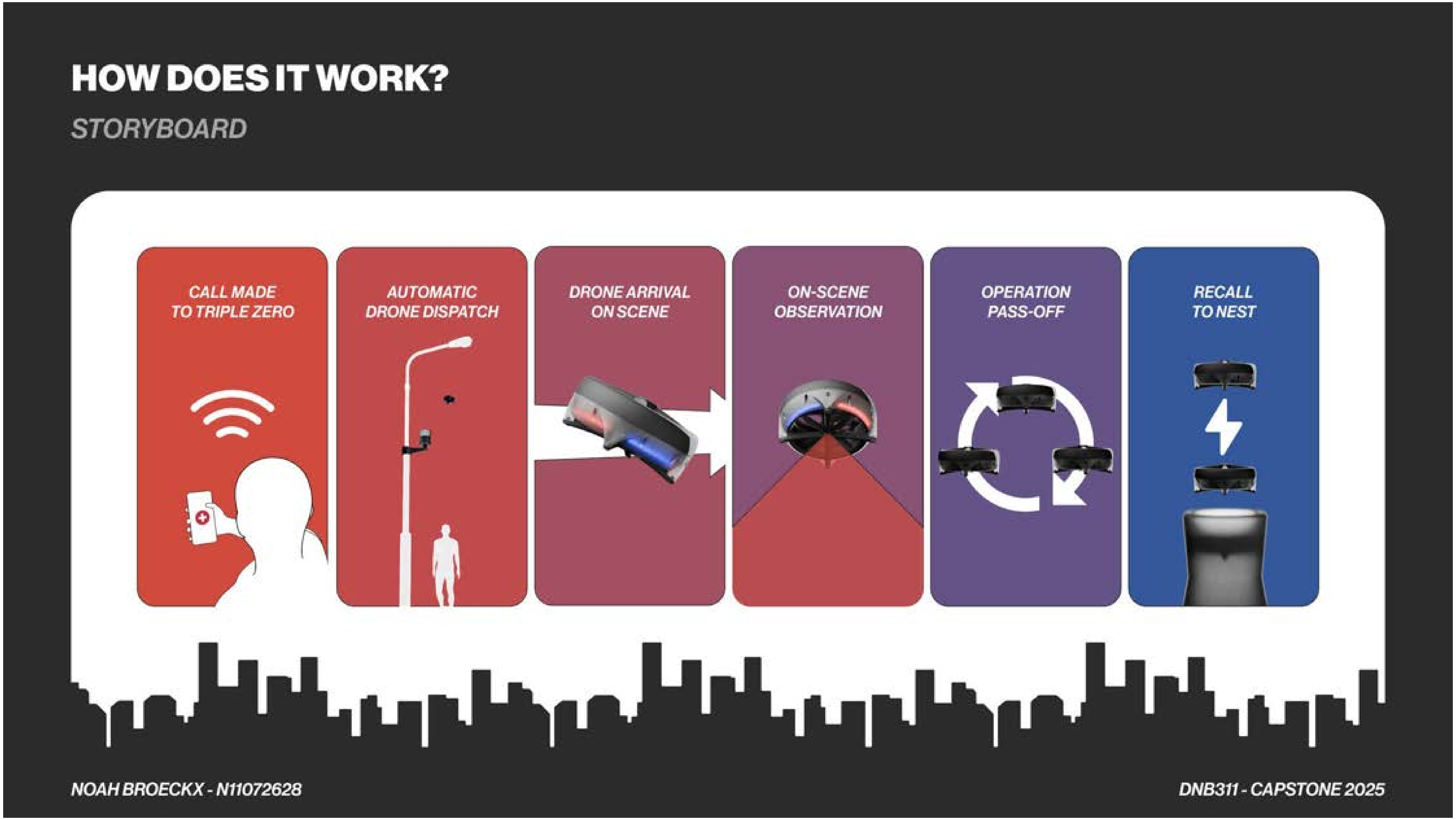
Hero Page

Storyboard Page



Features Page

FEATURES

WHAT MAKES THIS DRONE UNIQUE?

PROPELLER & VANE DESIGN

This drone features a **co-axial, contra-rotating** propeller layout. Sporting dual, **toroidal propellers.** Specifically designed to optomise thrust efficiency while **minimising irritable high frequency noise.**

EMERGENCY LIGHTING

Maintaining the traditional emergency look, Halo has adopted the commonly know **red and blue emergency sirens** to indicate to the public when it's operational and on duty. Ensuring **full transparency with its operation.**

DRONE NEST

The drone nest exterior has been optomised system integration and public privacy via the **fogged plastic exterior**. When the nest is active, emergency lights diffuse throughout the body to indicate use, while blocking out any and all camera sensors to **physically protect your privacy.**

DUCTED DRONE FORM

The **ducted form** was carefully selected for its safety practicalities, "encasing" the propellers within. Not only is this a **safety consideration** for the public, they also increases **flight efficiency**, particularly during slow, hovering speeds.

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Exploded view page

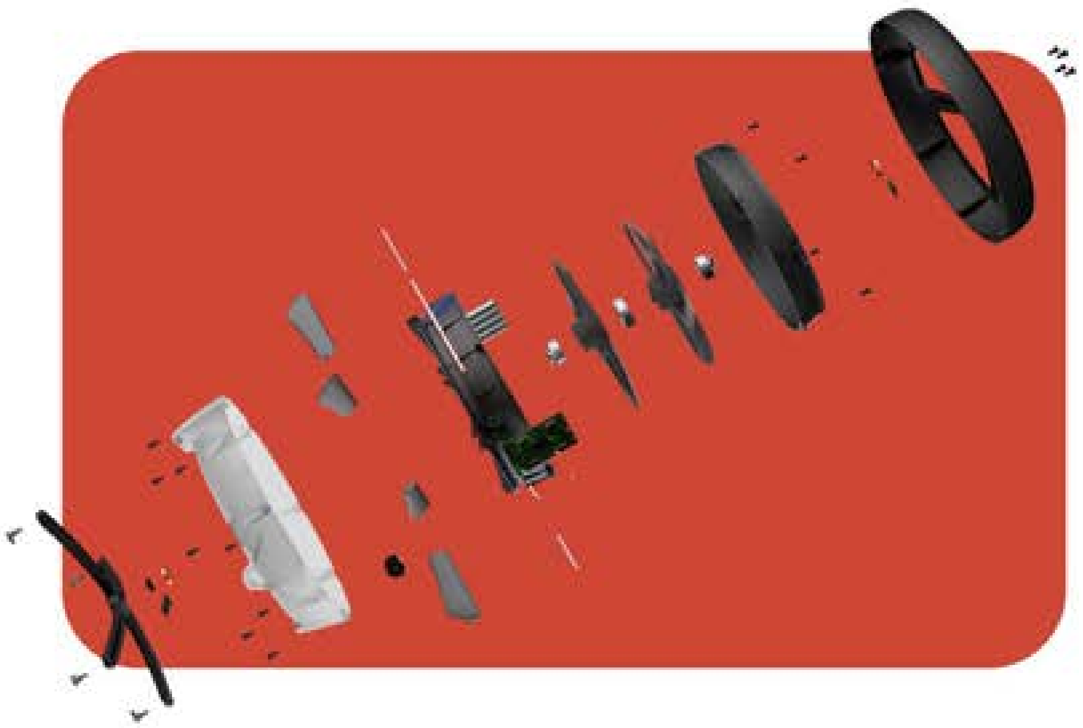
TECHNICAL DETAILS

MANUFACTURING & ASSEMBLY

MANUFACTURING

Initial manufacturing would be conducted in a low run, **mass-customisable** context. Incorporating technologies such as **3D printing** to develop and iterate. Allowing Halo to grow with the increasing **demand of the population and urban growth**. Iterations could bring forth **general upgrades and additional tools** for new drone roles which already see practice today. Such as medical delivery and early emergency detection.

However, this design has been made with **traditional manufacturing in mind,** and has been optimised wherever possible to allow for the mass manufacturing of its components for a resolved, high run context.



ASSEMBLY CONSIDERATIONS

Due to **initial manufacturing considerations** within a **low run context**, all parts are designed with **ease of assembly** in mind, incorporating several straightforward fastening features to ensure **mistake free assembly.**

The **screw features** securing each component allows **easy, cheap replacement of damaged components** and additionally helps **support future development** of the design, requiring 4-8 fastening considerations Within the development of specific components.

To ensure a **durability and weather resistance**, lip and groove features are incorporated throughout all joins. Further development can allow airtight seals depending on different contexts and use cases.

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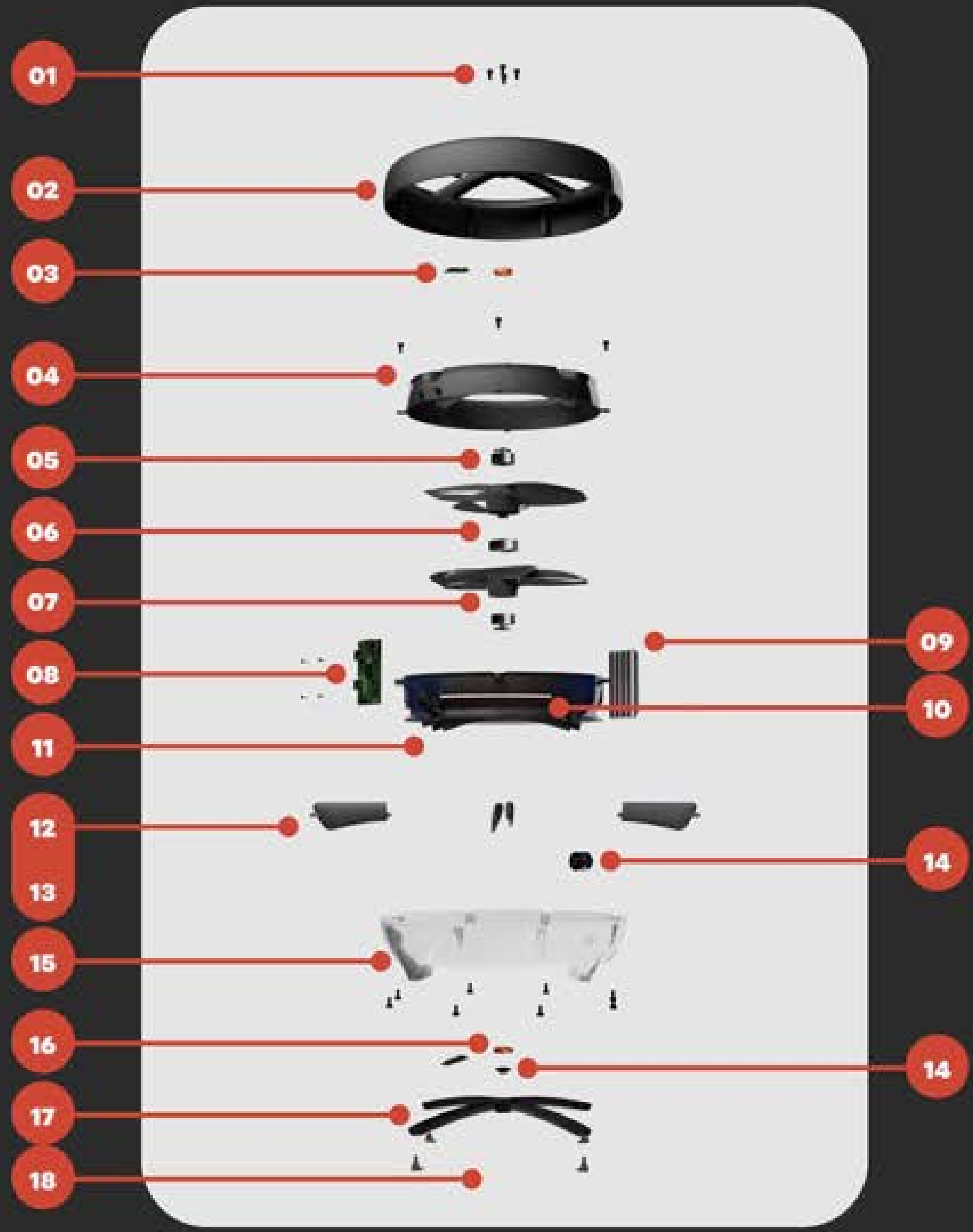
BOM Page

TECHNICAL DETAILS

BILL OF MATERIALS

PART NO.	PART NAME	Description	MATERIAL	QTY	LOW-RUN	HIGH-RUN
01	M2.5*5 Hex Socket Screws	Fastening screws for external and internal main bodies	Black Alloy Steel	30	COTS	COTS
02	OuterBody_Top	Top exterior facing shell	PETG-CF or NYLON (Dependent on resources)	1	3D Printing FDM or SLS	Injection Moulded (Polycarbonate)
03	Drone Speed Controller (1 top, 1 Bottom)	Drone PCB controller unit to regulate motor speeds	PCB	2	COTS	COTS
04	InnerBody_Top	Top interior facing shell	PETG-CF or NYLON (Dependent on resources)	1	3D Printing FDM or SLS	Injection Moulded (Polycarbonate)
05	Brushless Motor	Brushless high speed motor	N/A	2	COTS	COTS
06	Thrust Bearing	To support axial load while maintaining spin & uniformity	N/A	1	COTS	COTS
07	Toroidal Propeller Hub (Top/Bottom)	2 Toroidal propellers designed in opposition of another to generate upward thrust	PETG-CF or NYLON (Dependent on resources)	2	3D Printing FDM or SLS	Injection Moulded (Polycarbonate)
08	Drone Flight Controller	Drone PCB controller unit to determine position & communicate with network	PCB	1	COTS	COTS
09	Battery Pack	Lithium battery pack. Capacity determined by context and use	N/A	1+ (Expandable depending on context)	COTS	COTS
10	Flexible LED Filament	Flexible LED filament, output doesn't need to be huge as plastic diffuses the light	N/A	4	COTS	COTS
11	InnerBody_Bottom	Bottom interior facing shell	PETG-CF or NYLON (Dependent on resources)	1	3D Printing FDM or SLS	Injection Moulded (Polycarbonate)
12	Variable Control Vanes	Control vanes to control thrust vector	PETG-CF or NYLON (Dependent on resources)	4	3D Printing FDM or SLS	Injection Moulded (Polycarbonate)
13 (Not Pictured)	Control Vane Servos	Servos for control vanes to influence drone pitch, roll and yaw	N/A	4	COTS	COTS
14 & 17	"Multi Spectrum Cameras"	Modular architecture, camera dependent on drone/context	RGB, Thermal, Multispectral, LIDAR & Hybrid options however dependent on development and context	2	COTS	COTS
15	OuterBody_Bottom	Foggy translucent bottom exterior facing shell	Translucent Polycarbonate with Foggy/Frosted surface finish	1	3D Printing FDM	Injection Moulded
16	Inductive charging module (Top Out, Bottom In)	Inductive charging modules to allow power to pass through from bottom of drone to top for vertical charging	N/A	2	COTS	COTS
17	Landing Strut	Bottom "Landing" Legs	PETG-CF or NYLON (Dependent on resources)	1	3D Printing FDM or SLS	Injection Moulded (Polycarbonate)
18	DroneFeet	Rubber feet fittings for landing strut		4	COTS	COTS



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Thank you Page