Team 508: Drone Payload Sample Collection
Virtual Design Review 4

Team Introductions

Dominic Bellocchio
Systems Engineer

Tauben Brenner
Manufacturing Engineer

Roberto Lacasa
Programming Engineer

Matthew Lancaster
Control Systems Engineer

Dylan Ma
Design Engineer

Sponsors and Advisor

Engineering Mentor
Alicia Washington
M&A Senior Project Manager
Dow Chemical

Engineering Mentor
Marcus Rideaux
Global Implementation Leader
Dow Chemical

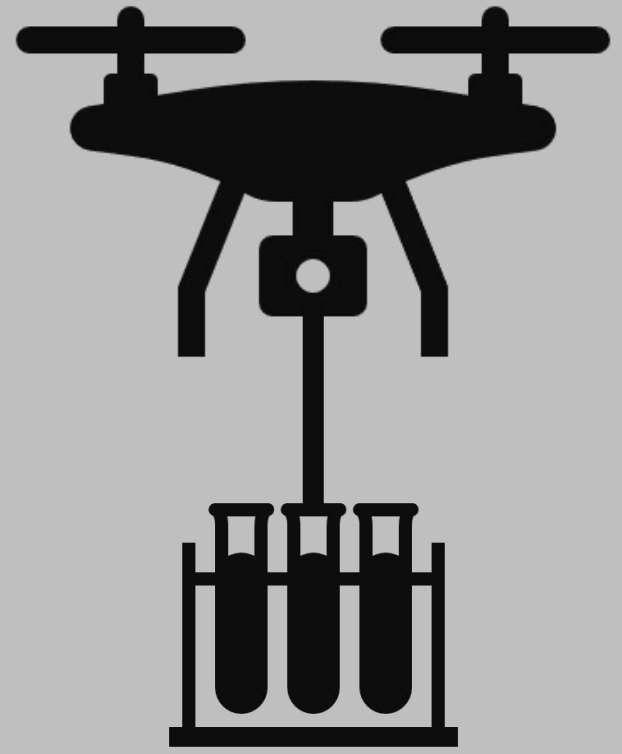
Academic Advisor
Camilo Ordóñez, Ph.D.
ME Teaching Faculty
Florida State University

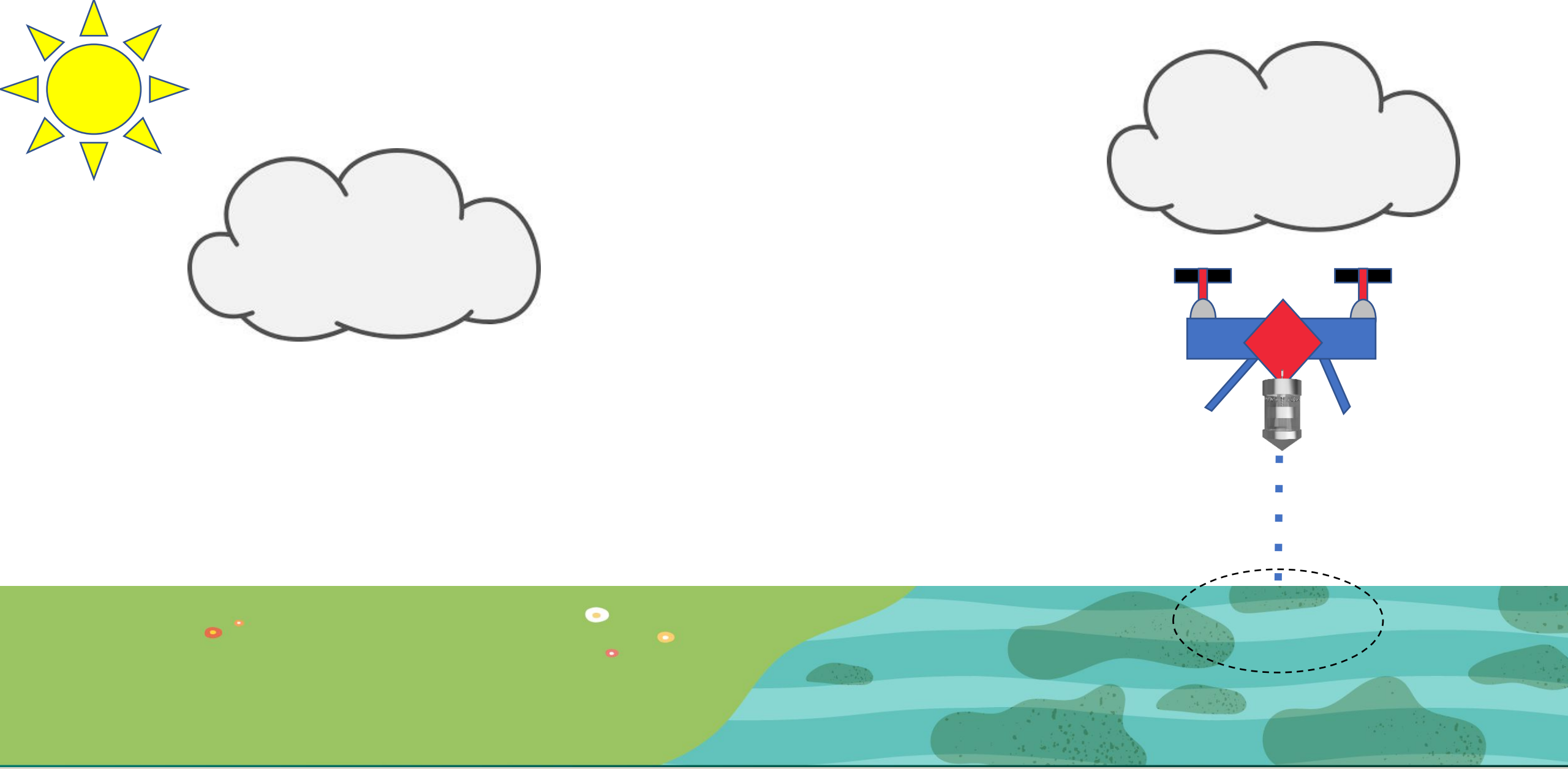
Fall Recap

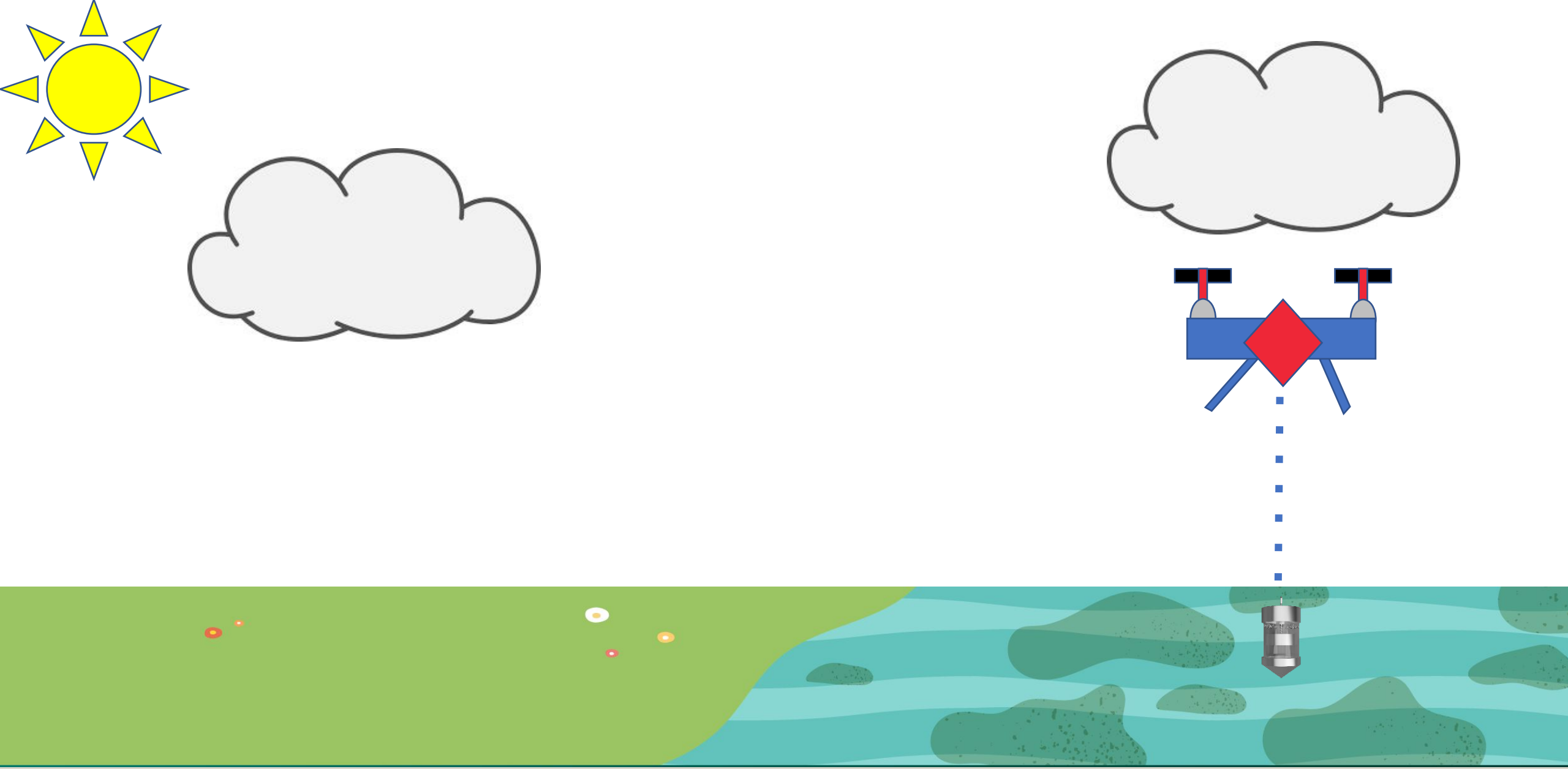
Objective

The objective of this project is to create a drone-mounted water sampling system.

Samples must be stored safely with no cross contamination to keep accuracy.







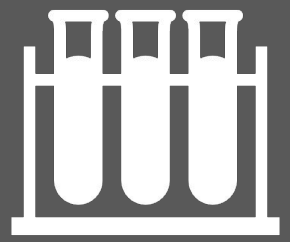

Harmful algae blooms are on the rise
Dominic Bellocchio

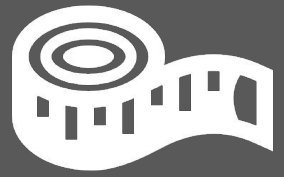

Devastated ecosystems
Dominic Bellocchio

The benefit of using a drone

Dominic Bellocchio

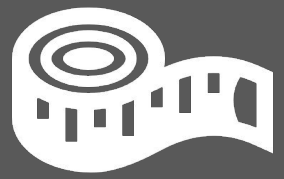
Customer Needs



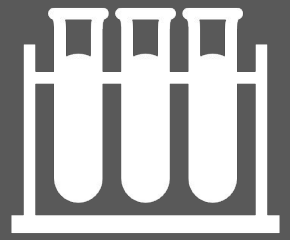


Customer Needs

Collect & Store Multiple Samples

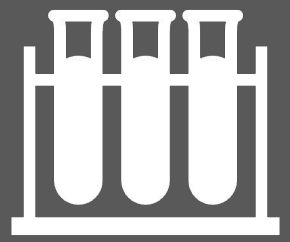


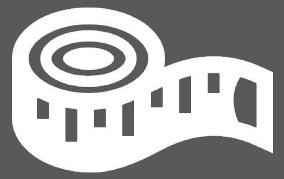
Customer Needs



Compact & Universal

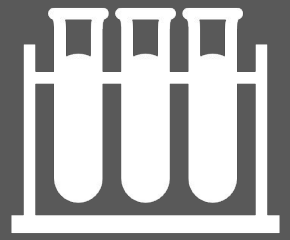
Customer Needs

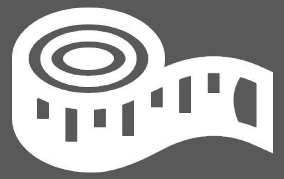




Does not
Impede Drone

Customer Needs





Light
&
Balanced

Targets and Metrics

Mounting Methods

Weight Distribution

Targets and Metrics

Volume

Force

Research

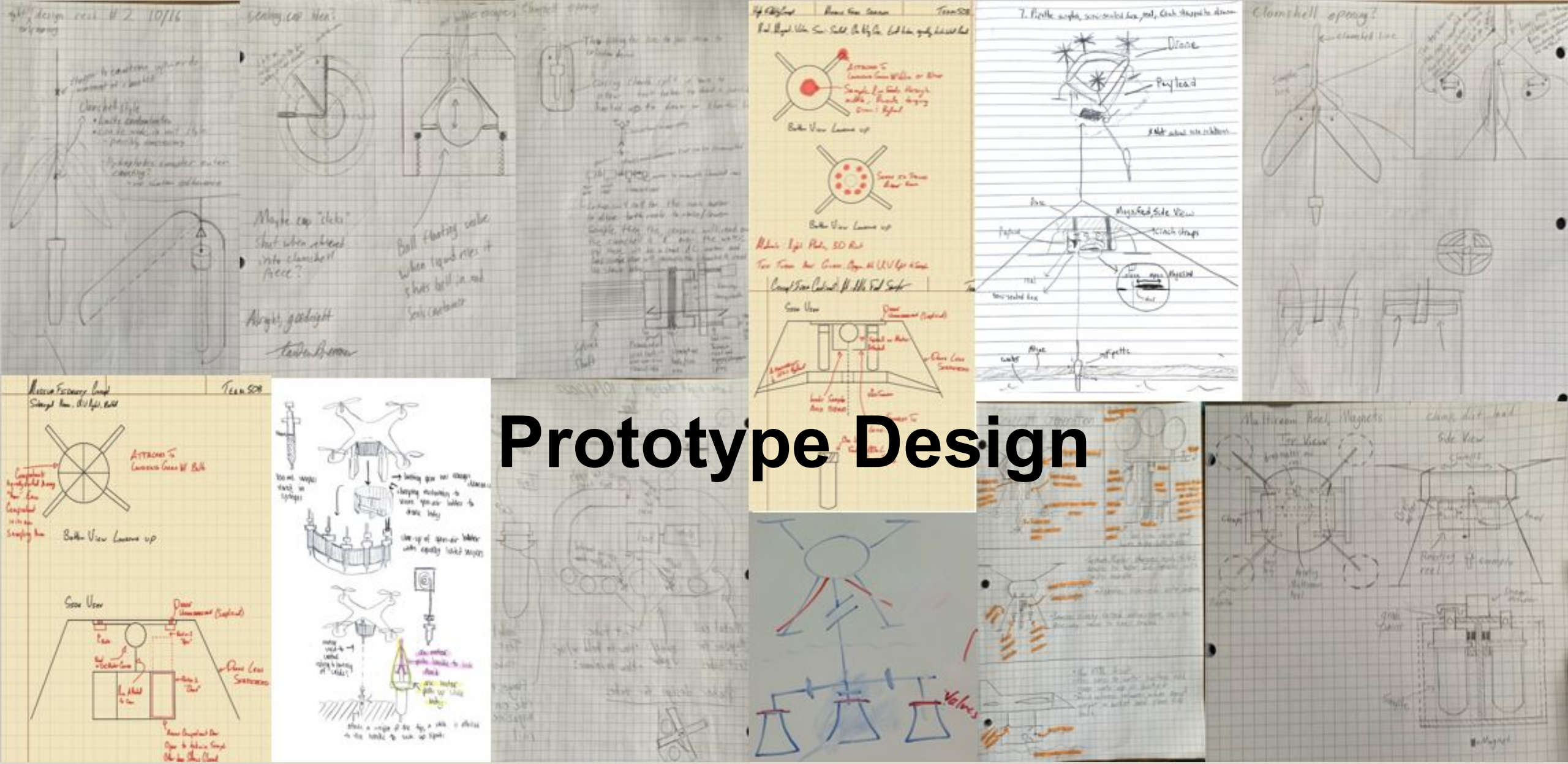
Marine Biologist
Sven Kranz PhD
Phytoplankton Specialist
FSU Associate Professor

Water Sampling Techniques

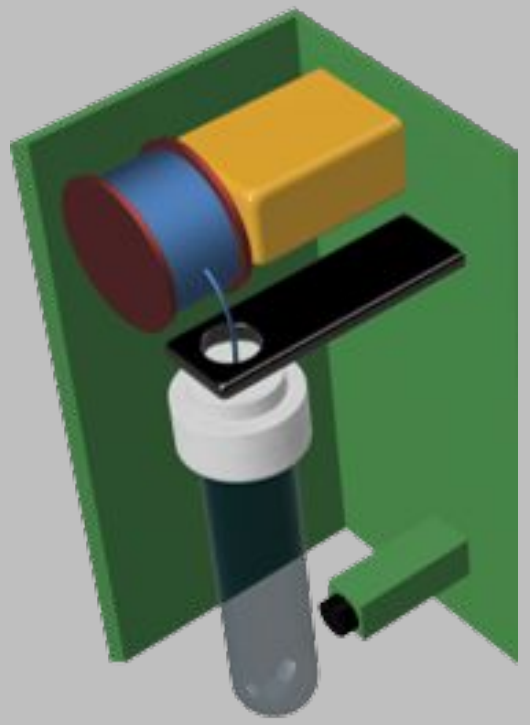
Different Water Testing Methods

Advice on collection procedure

Prototype Design



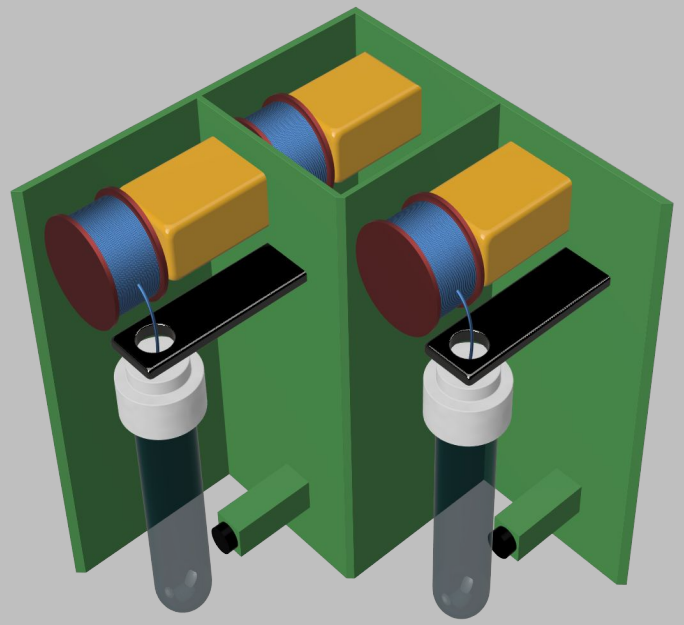
Selected Concept



Single Sample Package

- Used with smaller drones
- Can be combined for multiple samples per trip

Selected Concept



Combined Package

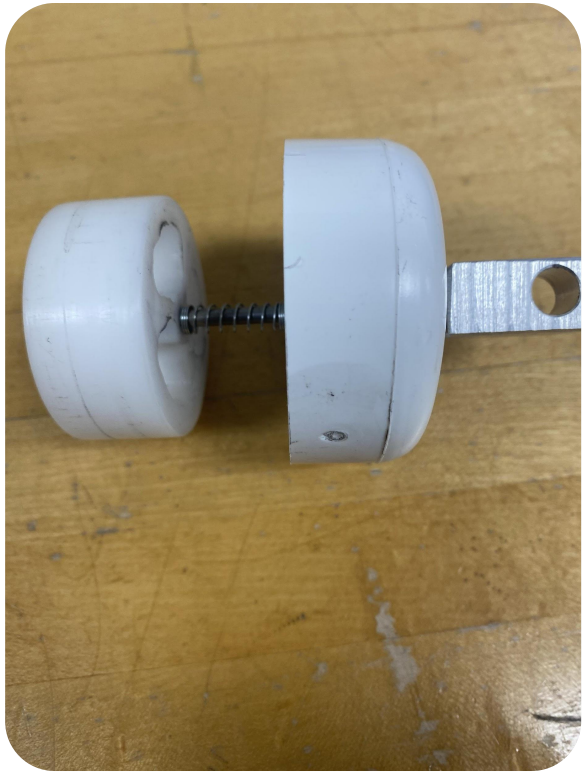
- Used with larger industrial drones
- Satisfying overall goal of multiple samples

Current Progress

Snorkel One-Way Cap Design

Ball Valve Design

Plunger Design



Testing Prototype

- V shaped bottom to overcome surface tension
- Bottom cap needs to be heavier to help enter the water vertically
- Water increases friction between the plunger and wall
- Air must be able to escape the top quicker

Future Milestones

Seek Together™

Drone Payload Sample and Collection Work Breakdown Structure

Refined Sample Prototype

- Waterproof testing
- Assemble Prototype
- Order dimensionally correct parts

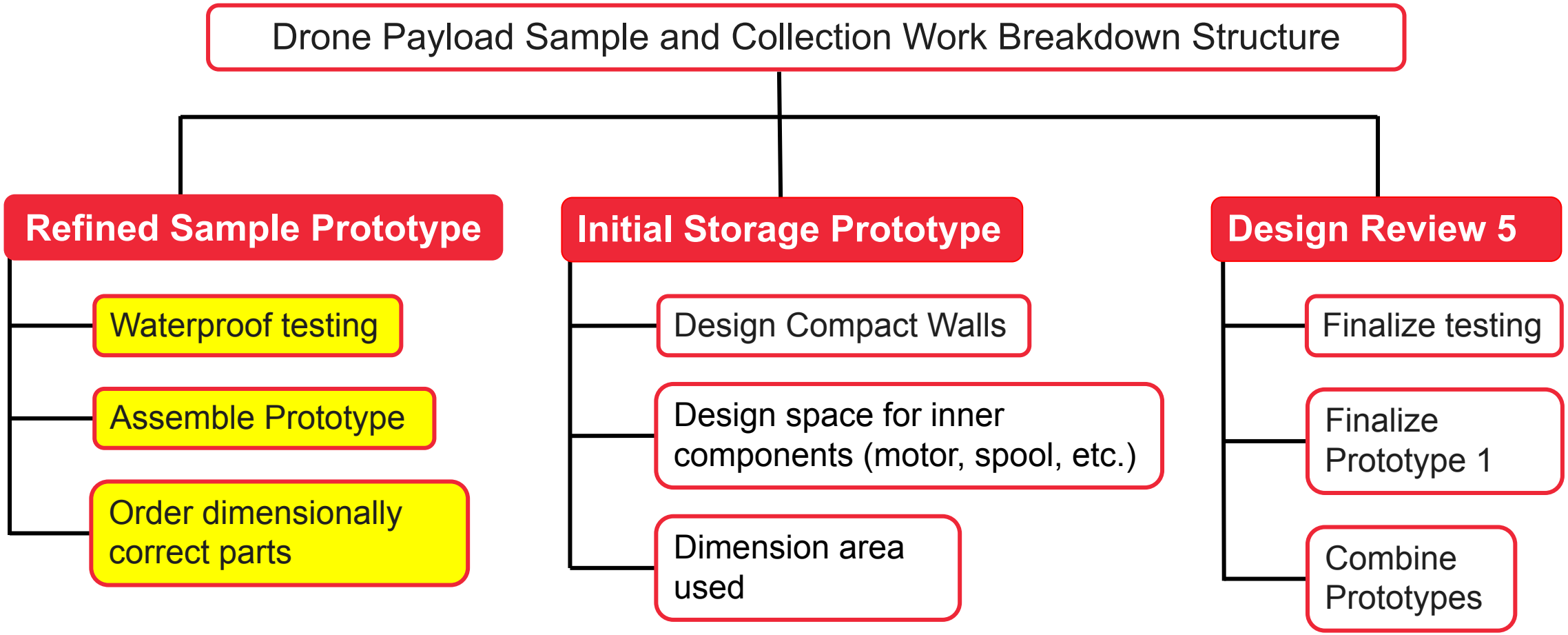
Initial Storage Prototype

- Design Compact Walls
- Design space for inner components (motor, spool, etc.)
- Dimension area used

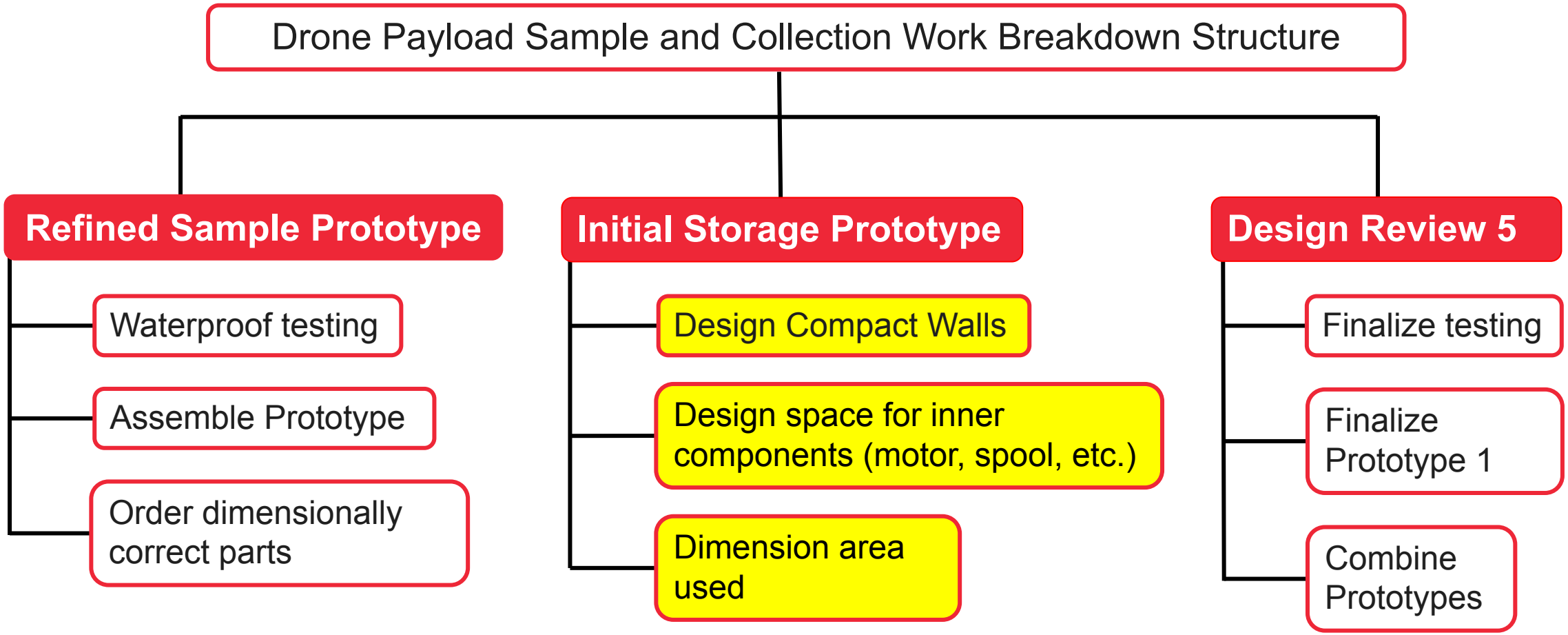
Design Review 5

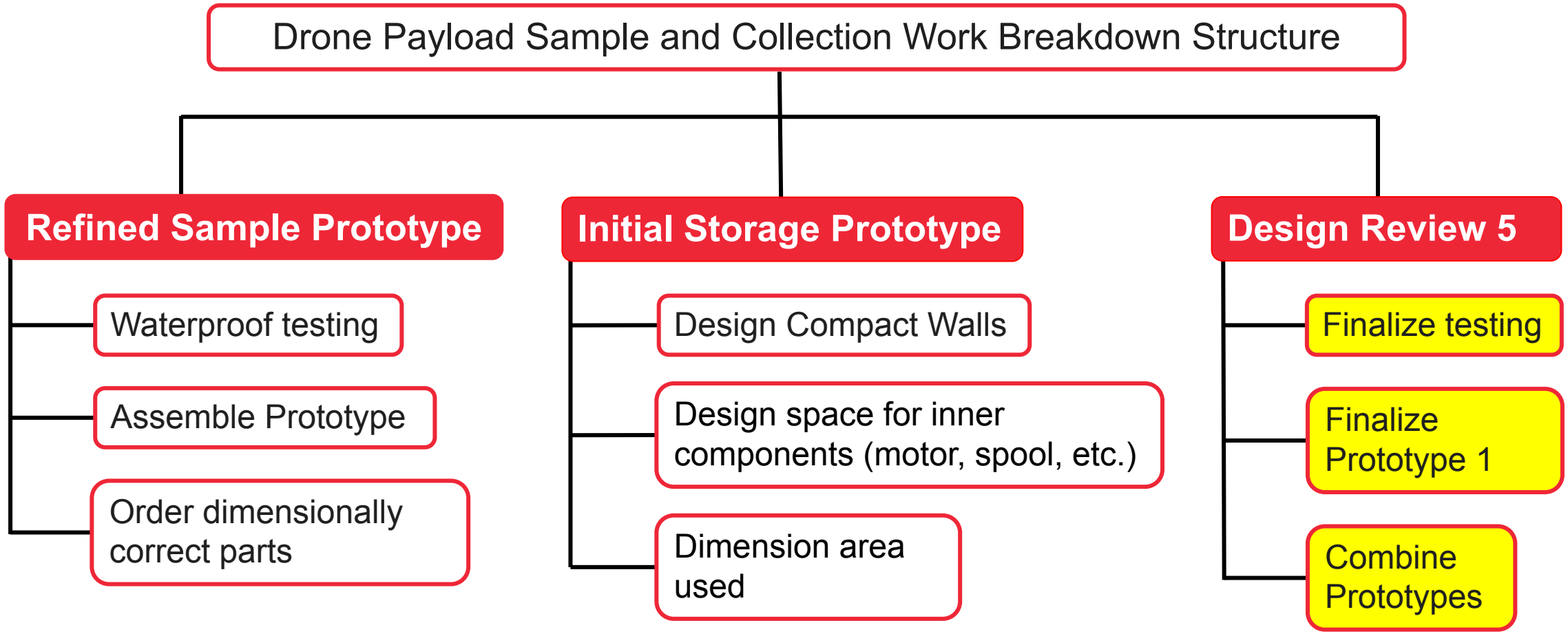
- Finalize testing
- Finalize Prototype 1
- Combine Prototypes

Drone Payload Sample and Collection Work Breakdown Structure

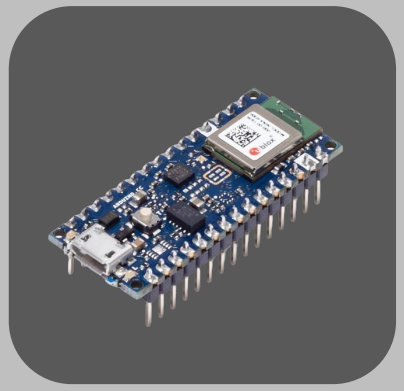


Drone Payload Sample and Collection Work Breakdown Structure

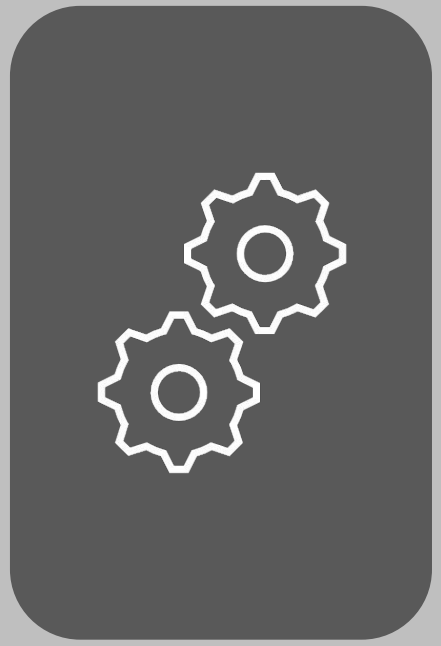


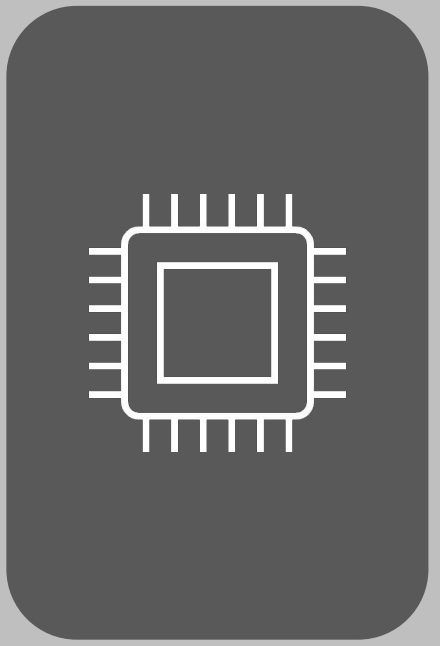

Drone Payload Sample and Collection Work Breakdown Structure
Refined Sample Prototype
Waterproof testing
Assemble Prototype
Order dimensionally correct parts
Initial Storage Prototype
Design Compact Walls
Design space for inner components (motor, spool, etc.)
Dimension area used
Design Review 5
Finalize testing
Finalize Prototype 1
Combine Prototypes

Ordering Parts



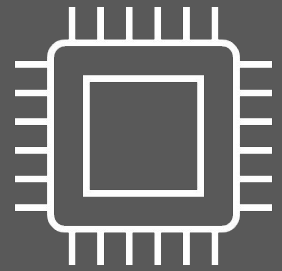
Mechatronic Systems



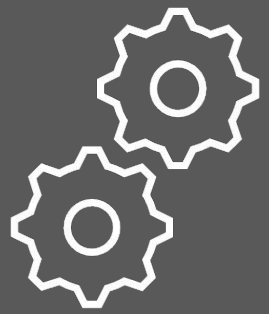


Mechatronic Systems

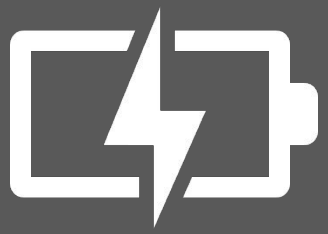
Test the motor to check spec'ing math

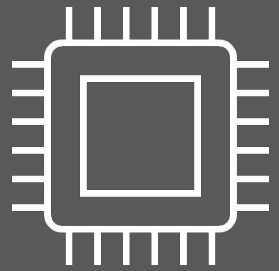


Mechatronic Systems



Draft up preliminary code and libraries for components





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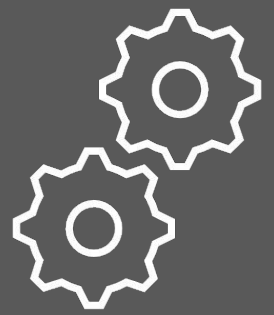
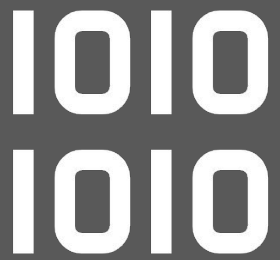
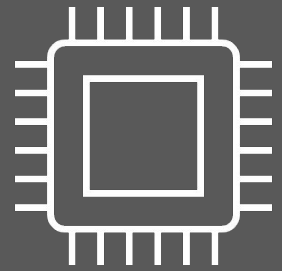
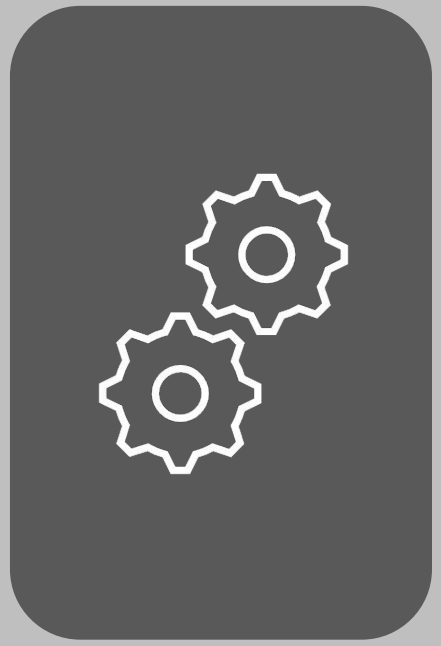




Design circuits to interface parts with drone battery



Mechatronic Systems



Test circuit in tandem with Arduino for remote operation

Storage System

Goals

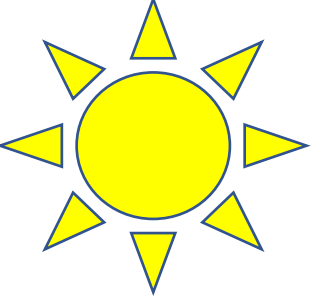
- Sample held in frame rigidly with vibration dampeners in use.
- Sample held in a vertical orientation to reduce leakage.
- Samples will be collected to reduce unbalanced loads.
- 4 samples stored for commercial use.

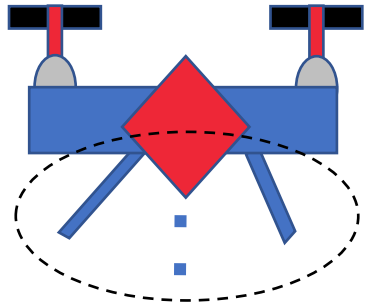
Storage System

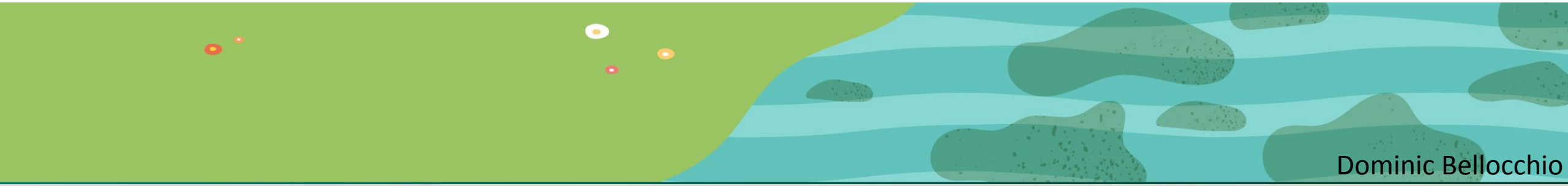
Features

- Frame built out of carbon fiber for strength and weight reduction.
- Limit switch and/or PID control will be used to stop the sample at the correct location.
- Water-resistant area for electrical components.
- Versatile mounting methods.

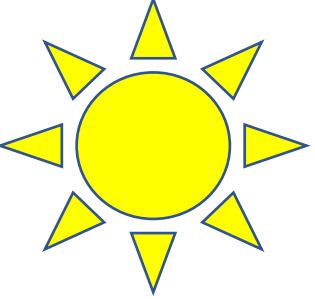
Backup Slides

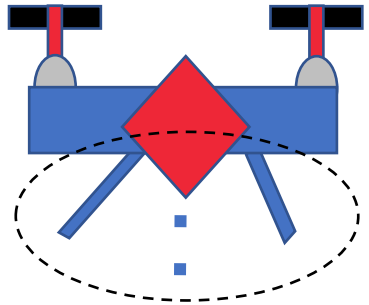


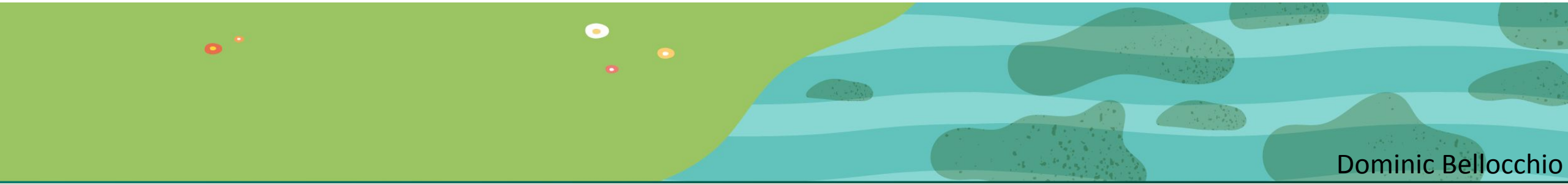




Dominic Bellocchio







Dominic Bellocchio

Storage system

Goals

- Sample held with minimal movement
- Samples held vertically to reduce loss
- No Contamination between samples
- Max 1 sample weight offset

Efficiencies

- Time
- Samples stored compactly
- Storage frame as light as possible
- Energy

Future Work

Receive parts
Mechatronic systems
Refined prototype
Storage system
VDR5
Drone compatibility testing

Prototyping

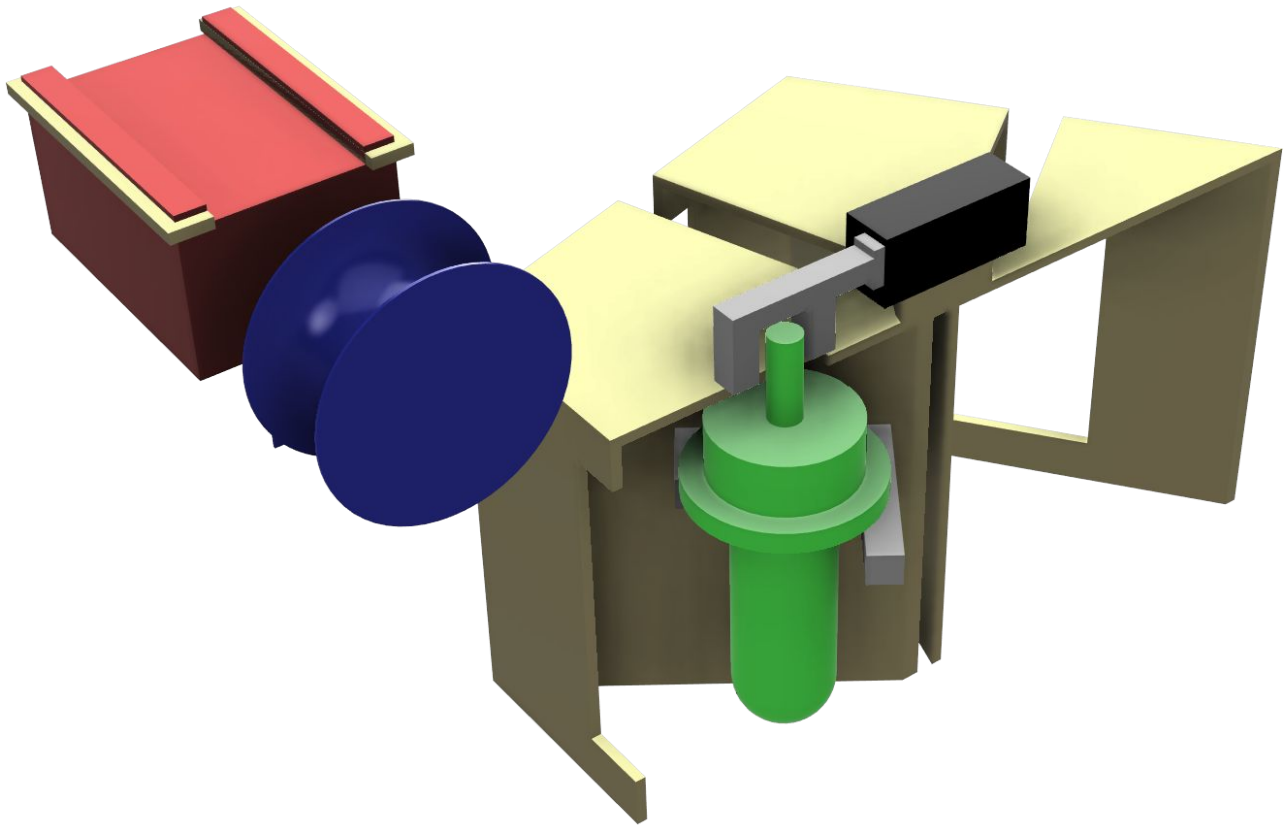
Mechatronics Systems

- Finding the appropriate motors for the reel
- Coding the logic that dictates when to drop/raise the sample bottle
- Integrating the code to a microcontroller
- Configuring the microcontroller to the payload in an orderly and space efficient manner
- Example mechatronic circuits
  - ultrasonic distance sensor
  - Trigger sensor from radio
  - Feedback into radio controller
  - Motor circuit (parasitic power vs battery)
  - Bump sensor when sample retrieved

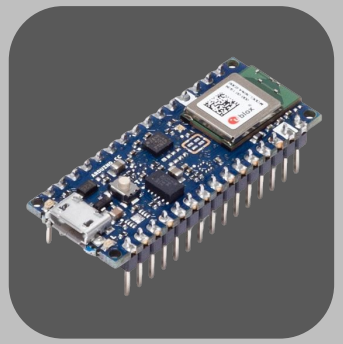
Refined Prototype

- Waterproof testing
- Assemble prototype
- Order dimensionally correct parts

High Fidelity Concept 1



Receiving Ordered Parts



Arduino Nano

Outrigger Clips

Nuts and Bolts

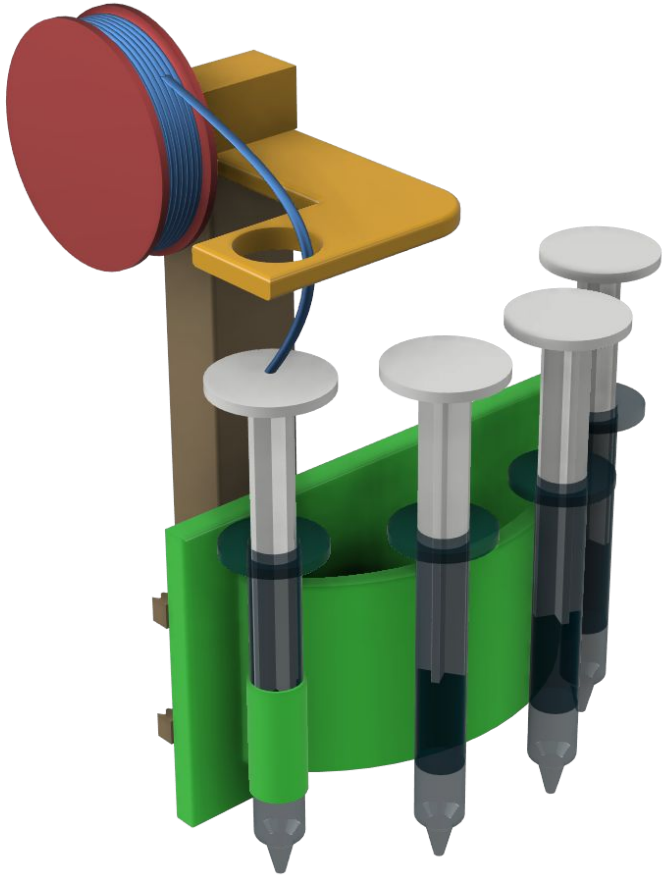
Distance Sensor

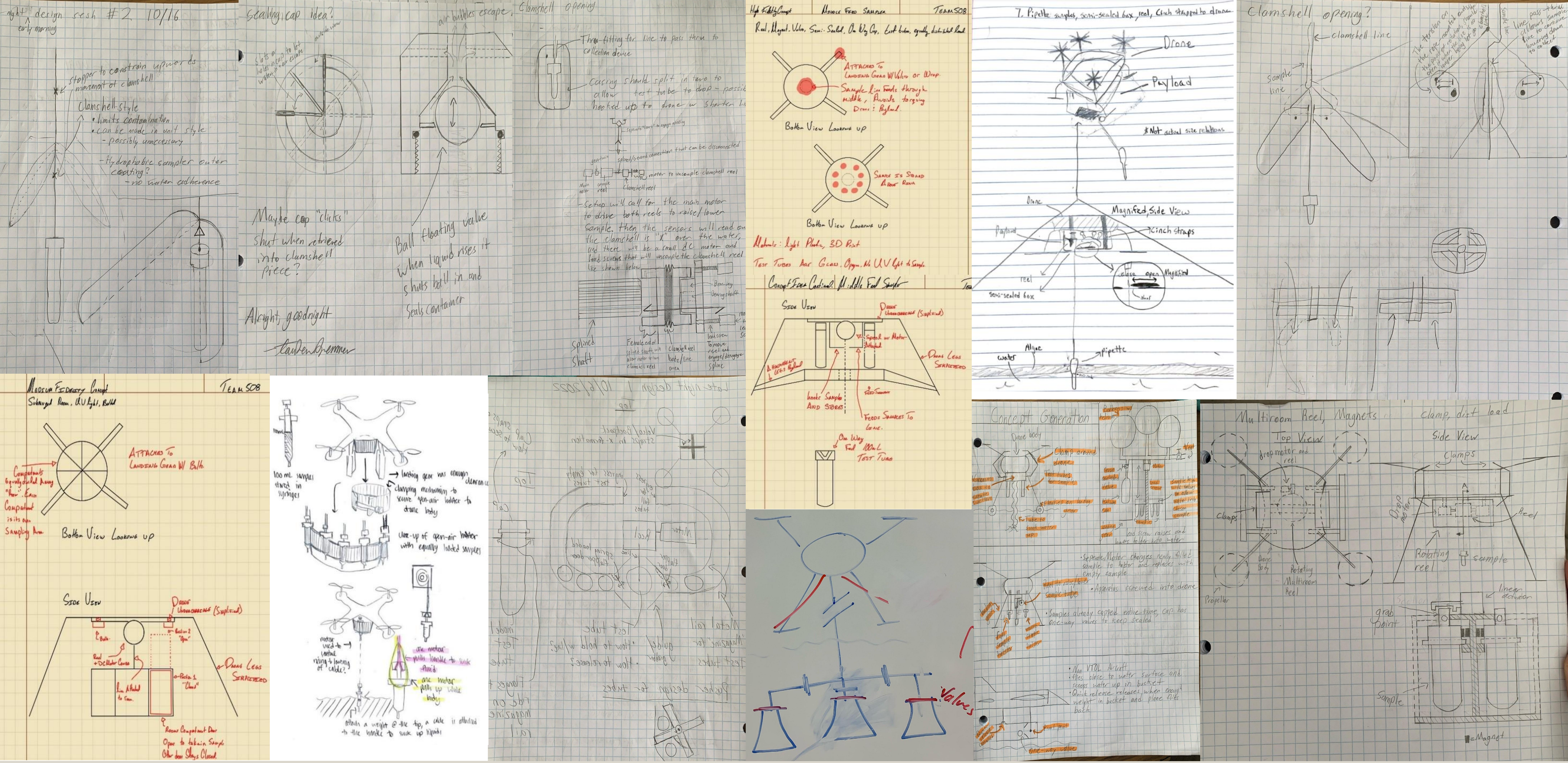
6V Micro DC Motor

Shaft Couplers

Springs

High Fidelity Concept 2





night design sesh #2 10/16
early morning
stopper to constrain upwards movement of clamshell
Clamshell style
• limits contamination
• can be made in unit style
- possibly unnecessary
- Hydrophobic sampler outer coating?
- no water adherence
sealing cap idea?
air bubbles escape
Maybe cap "clicks" shut when retrieved into clamshell piece?
Ball floating valve
when liquid rises it shuts ball in and seals container
Alright, goodnight
Clamshell opening
Thru fitting for line to pass thru to collection device
Casing should split in two to allow test tube to drop
Splined Shaft
High Fidelity Concept
Needle Feed Sampler
Team 508
Bottom View Looking up
Attached to Landing Gear W/ Velcro or Wrap
Bottom View Looking up
Materials: Light Plastic, 3D Print
Side View
Drone Landing Legs Simplified
One Way Feed 100mL Test Tube
7. Pipette samples, semi-sealed box, reel, Cinch strapped to drone
Drone
Payload
*Not actual size relations
Magnified Side View
Cinch straps
reel
Semi-sealed box
Algae
water
pipette
clamshell opening?
clamshell line
sample line
Medium Fidelity Concept
Team 508
Attached To Landing Gear W/ Bolts
Bottom View Looking up
Side View
Drone Landing Legs Simplified
100 mL samples stored in syringes
landing gear has enough clearance
Values
Concept Generation
Drone body
Clamp around drone
Multiroom Reel, Magnets
Top View
drop motor and reel
Clamps
Drone body
Rotating Multiroom Reel
Propeller
clamp, dist load
Side View
Clamps
Drop motor
Reel
Rotating reel
sample
linear actuator
grab point
Sample
=Magnet

Assumptions

Built-in state estimation

The drone has a built-in flight controller

All testing will be done on shore

Drone has live video feedback

Dominic Bellocchio

Markets

Primary

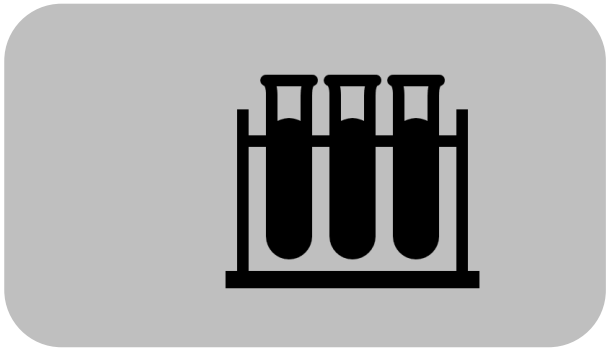
Dow Chemical and municipal and federal water monitoring agencies

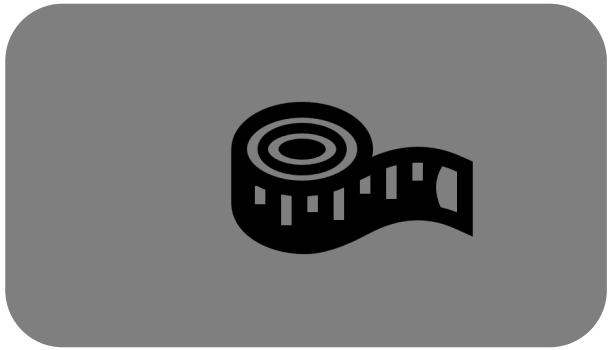
Secondary

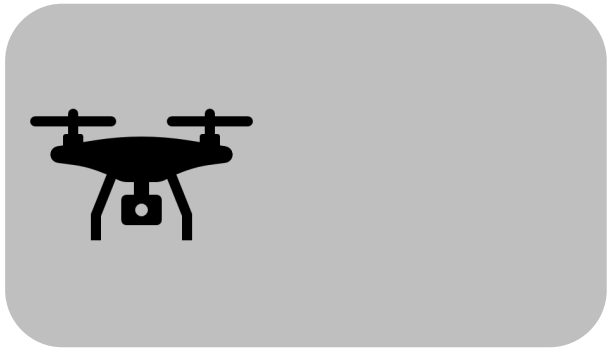
Agricultural organizations, disaster relief groups, and environmental conservation groups

Dominic Bellocchio

Customer Needs







Speaker

Targets and Metrics

Function	Target	Metric
Carries Weight	Mass	3 kg
Maintains Center of Mass	Weight Distribution	Max 100 g Offset

Dylan Ma

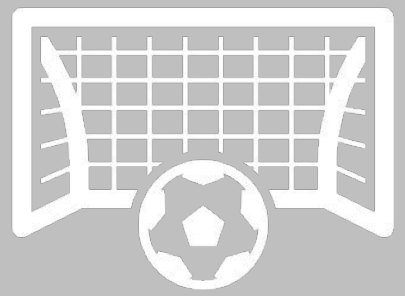
Targets and Metrics

Function	Target	Metric
 Attaches to Various Drones	Mounting Configurations	3 Attachments
 Aborts Sampling Procedure	Force	5N tension b/t payload and sample

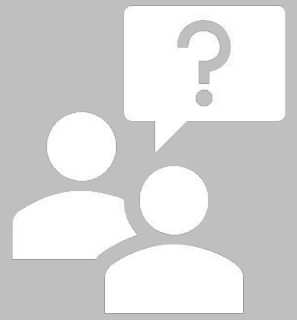
Dylan Ma

Project Scope

Objective



Goals



Assumptions

Markets

Dominic Bellocchio

Key Goals

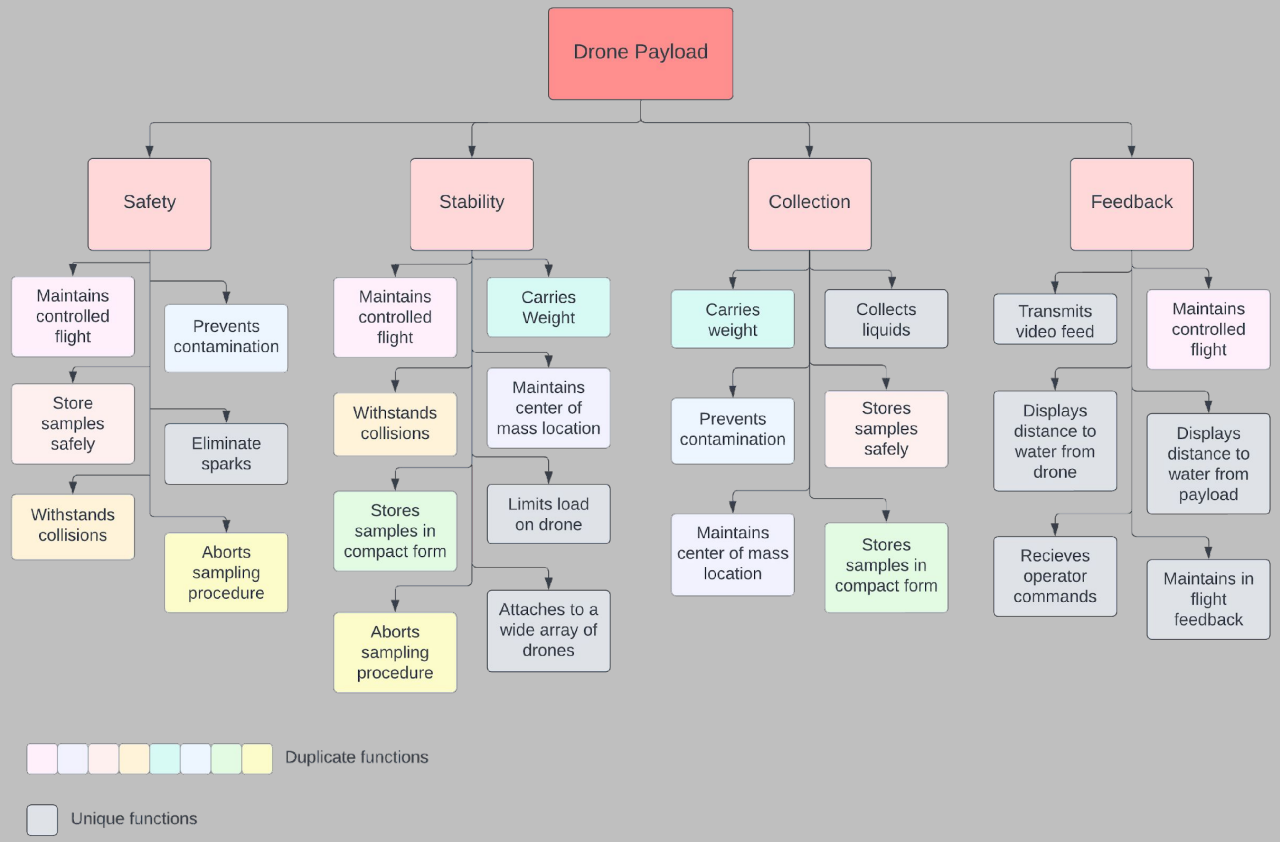
- Collect Samples
- Prevent Contamination
- Universal attachment
- One kilogram payload

Dominic Bellocchio

Customer Needs

- The payload can collect multiple samples without contamination
- The drone only needs to transport the samples
- The amount will allow for balancing
- The payload should be 1 kg or less
- The payload will be applicable to multiple drones
- The payload can collect saltwater samples and chemicals
- Payload is inert and retractable
- The payload needs to be stable and unobtrusive

Functional Decomposition



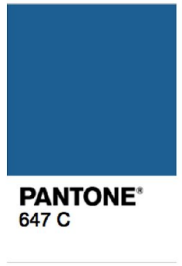
Color Palette

2299 C
Color values:
RGB 164 210 51
HEX/HTML #A4D233
CMYK 41 0 84 0

1788 C
Color values:
RGB 238 39 55
HEX/HTML #EE2737
CMYK 0 88 82 0

75% Black
Color values:
RGB 64 64 64
HEX/HTML
#404040
CYMK: 0 0 0 75

2239 C
Color values:
RGB 0 207 180
HEX/HTML #00CFB4
CMYK 59 0 39 0



647 C
Color values:
RGB 35 97 146
HEX/HTML #236192
CMYK 96 54 5 27

50% Black
Color values:
RGB 128 128 128
HEX/HTML
#808080
CYMK: 0 0 0 50

2199 C
Color values:
RGB 0 187 220
HEX/HTML #00BBDC
CMYK 77 0 16 0

7535 C
Color values:
RGB 183 176 156
HEX/HTML #B7B09C
CMYK 10 11 23 19

25% Black
Color values:
RGB 191 191 191
HEX/HTML #bfbfbf
CYMK: 0 0 0 25