Senior Design 2 Presentation 1

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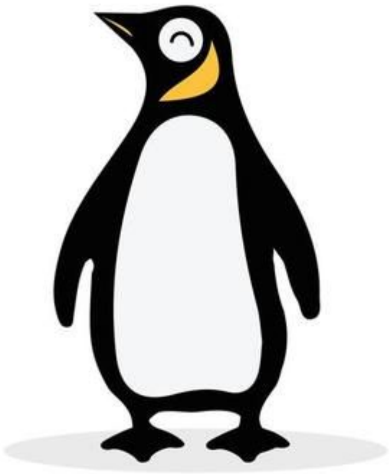


Executive Summary

- FFTE is a team of passionate engineers looking to save lives by incorporating modern technology in search operations
- Ideate system to traverse both air and water
- Two main design points
    - Airborne RC system capable of carrying and securing a payload
    - Waterborne RC subsystem with sensors for data acquisition
- Optimize system and subsystem for control, maneuverability, and reliability

Product Description

- Controllable multi domain system that have an air and underwater component.
- Able to deploy the underwater system from the air.
- Usage of remote control for both devices.
- Aerial System
    - 10-20 meters above ground level
- Underwater System
    - Around 6 meters below sea level

Air and Sea Domain

Motivation and Impact

- Search method on small scale rescue operations
- Increase/advance the success of natural disaster rescue operations
- Fast and efficient to detect objects

Hurricane Harvey

Fukushima

Concept Generation

- To achieve the mission of small scale search and rescue
- The idea to create a device that can solve the initial “search” component to help identify locations before moving in rescue
- The initial concept was to create a singular controllable system that can maneuver in the air and sea domain
- After more deliberation, it was determined that creating separate systems would be more effective and feasible to create

Project Objectives/Requirements

FFTE			Requirements list for "the Flying Penguin" - Drone System
Changes (Date of Change)	Category	Demand/Wish	DIMENSION OF DRONE
10/19/22	Geometry	D	-The drone will be a quad-propped. -Mainframe of the drone will be square-shaped and propellers will be extended from the mainframe. -An attachment system will also be included into the bottom of the drone. The shape of the attachment system should be consistent with the mainframe of the drone. -The drone alone will be in (45-50 cm)*(45-50 cm)*(10-15) cm.
10/19/22		D	-Symmetrically distributed drone propellers
10/19/22		W	-General aerodynamic shape to promote wind and water resistance

Project Objectives/Requirements (Cont.)

10/19/22	Kinematic	D	-Fly in the air, forward, backward, left & right (each 200-300 meters), Up & down
10/19/22		D	Lift and thrust produced by rotor-driven propellers. The force generated must be able to: -Carry the drone and the subwater system:
10/19/22	Control	D	-Remote controllable by an operator (RC Control Systems)
10/14/22		D	-Takes off & lands with the payload -Landing Supports mounted on the mainframe of the drone - Length of the landing support will be longer than the height of the subwater system

Project Objectives/Requirements (Cont.)

10/14/22	Payload	D	Carry the sub-water system; be able to drop it into the water. -The attachment system will be achieved by a **pick-up mechanism (to be elaborated in concept sketches, current options are Electromagnetic and Mechanical Limit System)** which is powered by the **battery(Probably the best option)** mounted on the drone; -The attachment system must be robust so that the subsystem does not fall off when moving around, can be achieved by applying strong magnetic force.
10/14/22		W	Pick the Sub-water System back up from the water
10/19/22		W	Weight of available payload should be maximized

Project Objectives/Requirements (Cont.)

10/14/22	Safety	D	Splash-proof and water resistant electronic enclosure
10/14/22		D	General wind resistance
10/14/22		W	The drone should withstand minor water interference, this can be achieved by insulating the electronics with 3D printed, plastic cases with necessary rubber outlets that can allow configuration of other electronic systems
10/19/22	Power	D	Has a battery power source
10/14/22		W	Power source is rechargeable
10/14/22		D	Power supplied to main flight control board and electric rotors -Standardized copper wire with rubber & surface coating

Project Objectives/Requirements (Cont.)

FFTE			Requirements list for "the Flying Penguin" - Subwater System
Changes (Date of Change)	Category	Demand/Wish	DIMENSION OF DRONE
10/20/22	Geometry	D	-Be able to fit in the drone system & the pick-up mechanism -Advanced 3D print or Tupperware -Base the size off our Drone
10/14/22	Kinematics	D	Move freely in water: forward, backward, left & right -------- X-Y direction, Up & down ------ Z direction
10/14/22	Material	D	Resistant to water corrosion.
10/14/22	Safety	D	Water-Proof -Propeller shaft (important) -Casing (important)
10/14/22		D	Shock Resistance

Project Objectives/Requirements (Cont.)

10/14/22	Control	D	Remote Control - Separately from the drone
10/14/22		W	A device that detects and looks around it's surroundings
10/20/22	Power	D	Has a power source (TBD) prefer electric Current option: -Battery -Electric Powered
10/20/22		W	Power source is Rechargeable
10/20/22		D	Propeller Propped -Rotor powered -Multiple propellers will be mounted on the subwater system; the propellers should allow the subwater system move freely in the water
10/14/22	Payload	D	Attachment System - Able to be dropped by the Drone The mounting point should have a complementing shape as of the attachment system on the drone. This is a passive system on the sub-water system.
10/14/22		W	Attachment System - To be able to be picked up by the drone

Goals to Achieve

- The design meets the objectives of searching for victims during a disaster by providing two drone systems that can explore where it is dangerous for people to maneuver.
- Significantly decreased operation costs
    - This design can be created under $1,500 which costs significantly less than a typical search and rescue mission
    - US National Park Service spends around $5 million annually
    - Helicopters/boats cost around $1,000 to $1,600 an hour

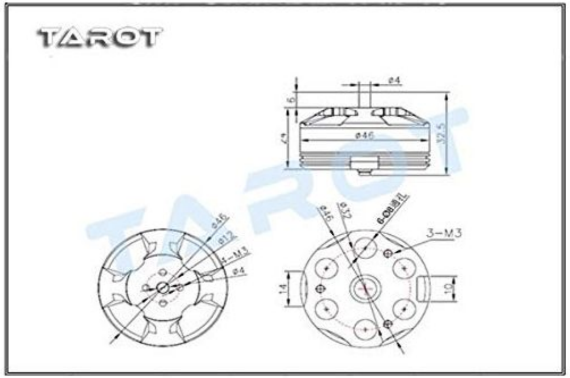
Overall Design

Aerial Drone - Overall Design

- Tarot 650 Quadcopter
  - 4 Arms
  - 2 Landing Gears
  - High strength Carbon Fiber
- 4 High lift 14-in. Propellers
  - 5.5-in. Pitch
  - Dual-bladed
  - Nylon Long Fiber Composite
  - CW and CCW
- Water Resistant electronic enclosure

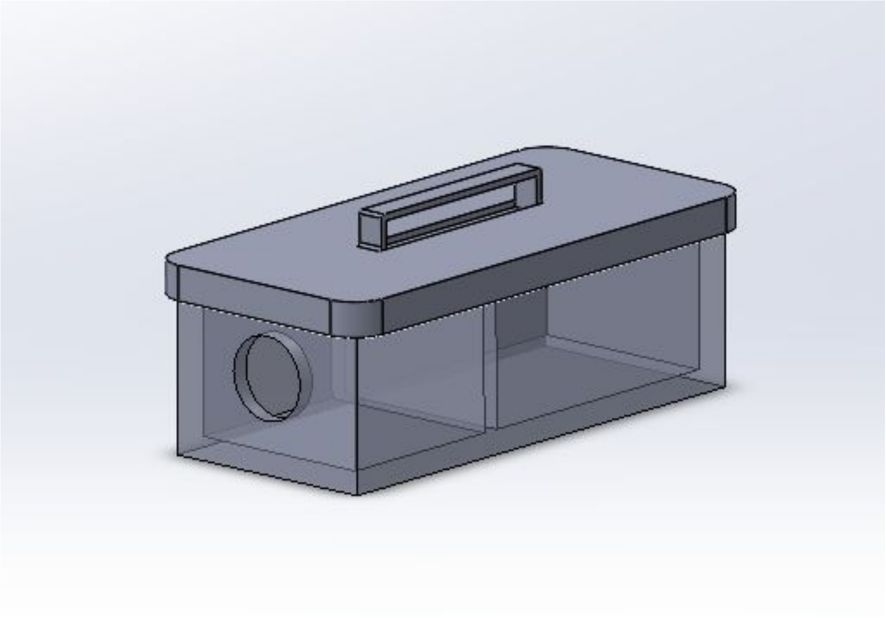
Aerial Drone - Rotors

- Tarot TL68P07 6S Brushless Motor x4
  - Weight: 93 g
  - Velocity Constant: 380 Kv (RPM/V)
- Design Specifications
  - Total Battery Charge: 8000 mAh
  - Applied Voltage: 33 V
  - RPM: 11180 RPM
  - Total Thrust: 80 N



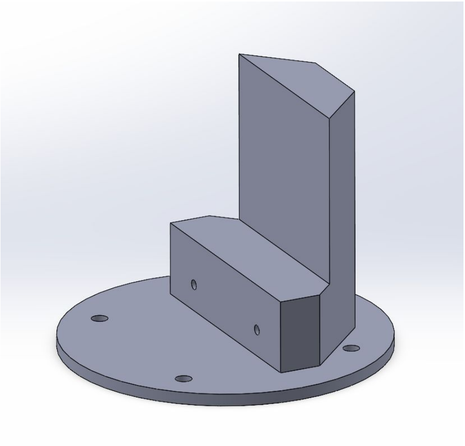
Submarine Drone

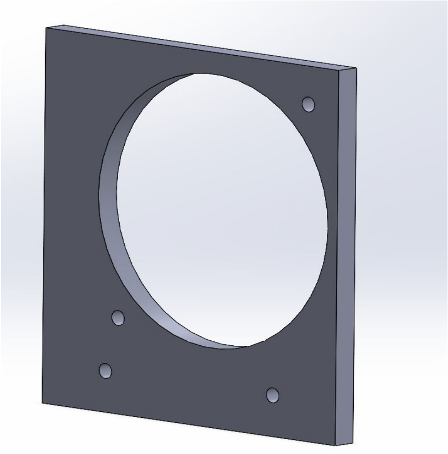
- Include camera
- Include electronics
- Make waterproof
- Locked/sealed lid
- Does not need to be hydrodynamic
- TBD actual design

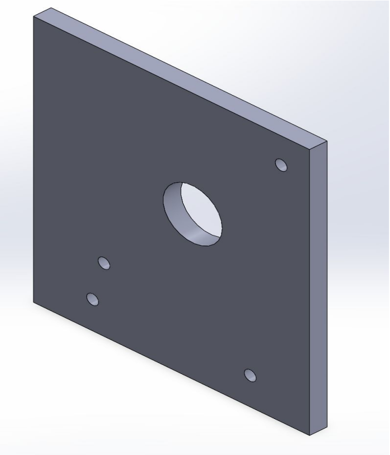


Attachment System

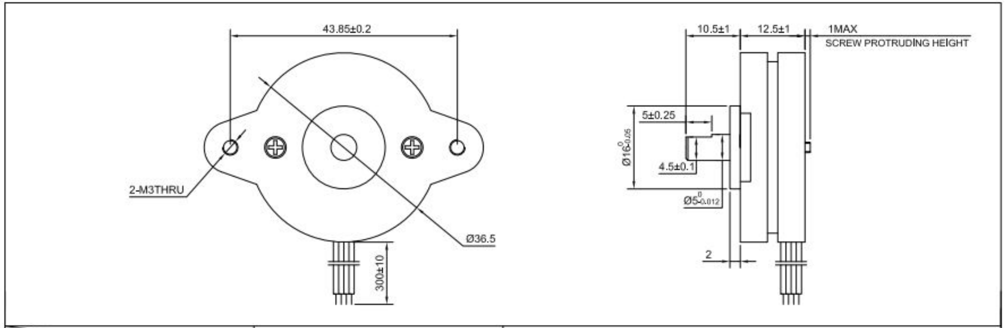
- High-torque stepper motor
- 3D-printed Base and walls
- Miscellaneous:
    - M3 screws
    - washers







Attachment System - Stepper Motor



SPECIFICATION / CONNECTION	BIPOLAR
AMPS/PHASE	0.50
RESISTANCE/PHASE(Ohms)@25°C	17.00±10%
INDUCTANCE/PHASE(mH)@1KHz	6.50±20%
HOLDING TORQUE(Nm)[lb-in]	0.05[0.62]
STEP ANGLE(°)	0.90
STEP ACCURACY(NON-ACCUM)	±5.00%
ROTOR INERTIA(g-cm²)	4.00
WEIGHT(Kg)[lb]	—

TEMPERATURE RISE:MAX.80°C（MOTOR STANDSTILL;FOR 2PHASE ENERGIZED）
AMBIENT TEMPERATURE -10°C~50°C[14°F~122°F]
INSULATION RESISTANCE 100 Mohm (UNDER NORMAL TEMPERATURE AND HUMIDITY)
INSULATION CLASS B 130°C[266°F]
DIELECTRIC STRENGTH 500VAC FOR 1MIN.(BETWEEN THE MOTOR COILS AND THE MOTOR CASE)
AMBIENT HUMIDITY MAX.85%(NO CONDENSATION)

TYPE OF CONNECTION (EXTERN)		MOTOR	
PIN NO	BIPOLAR	LEADS	WINDING
1	A+	BLK	A+
2	A-	GRN	A-
3	B+	RED	B+
4	B-	BLU	B-

FULL STEP 2 PHASE-Ex. ,
WHEN FACING MOUNTING END (X)

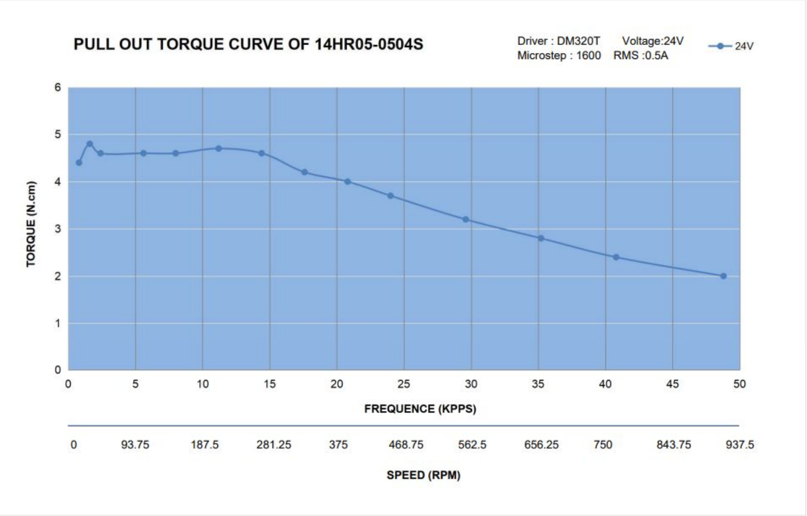
STEP	A+	B+	A-	B-
1	+	+	-	-
2	-	+	+	-
3	-	-	+	+
4	+	-	-	+

CCW ↑ ↓ CW

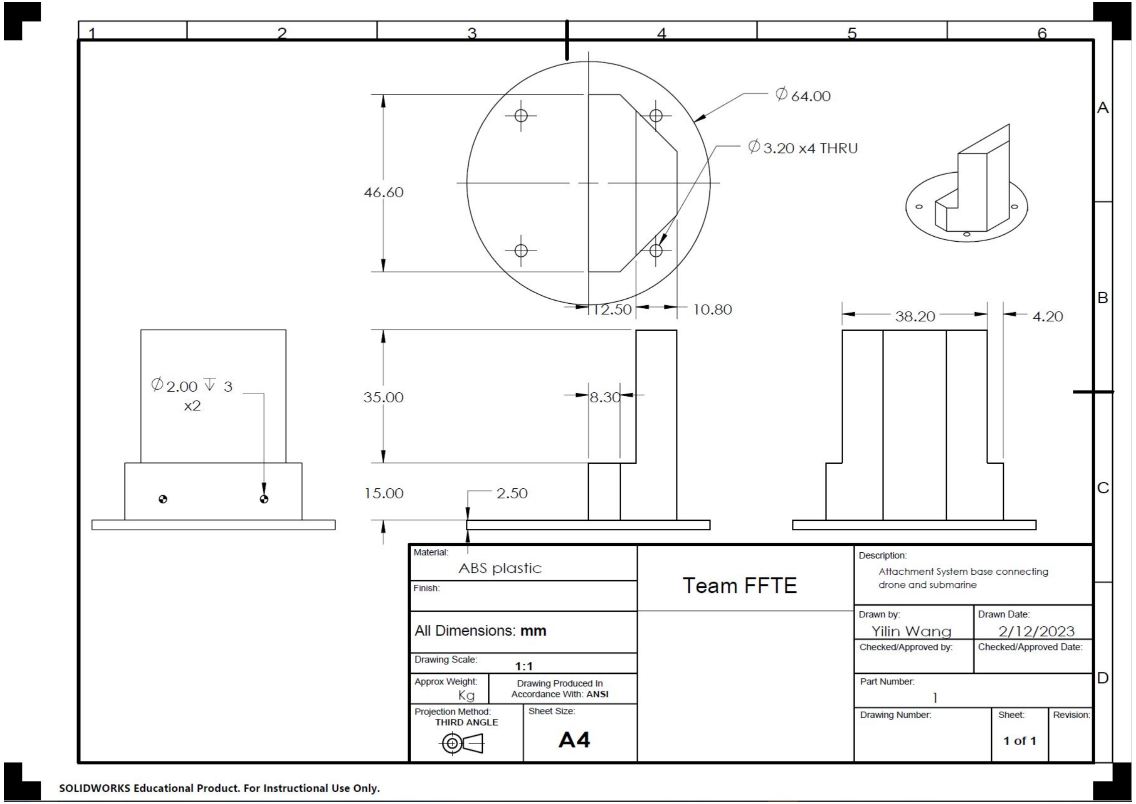
BLK GRN RED BLU

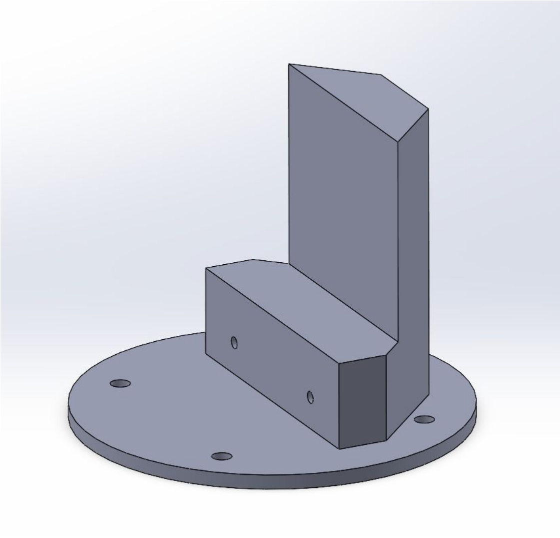
STEPPERONLINE®

	APVD		10.30.2020	STEPPER MOTOR
	CHKD			
1.5:1	DRN			14HR05-0504S
SCALE	SIGNATURE		DATE	

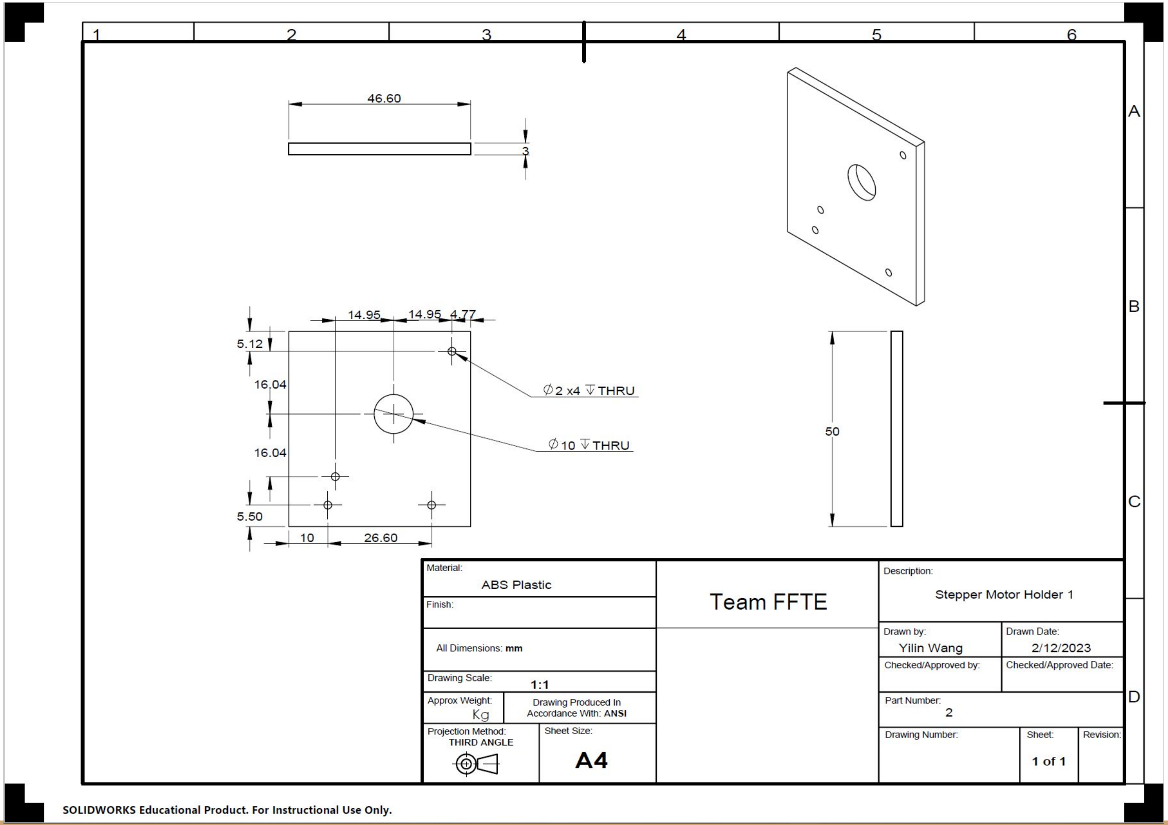


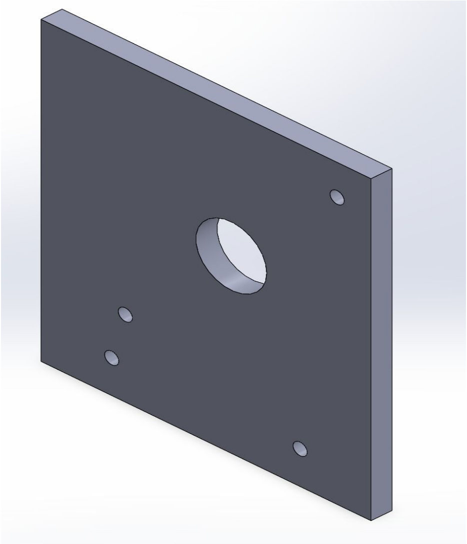
Attachment System - Base



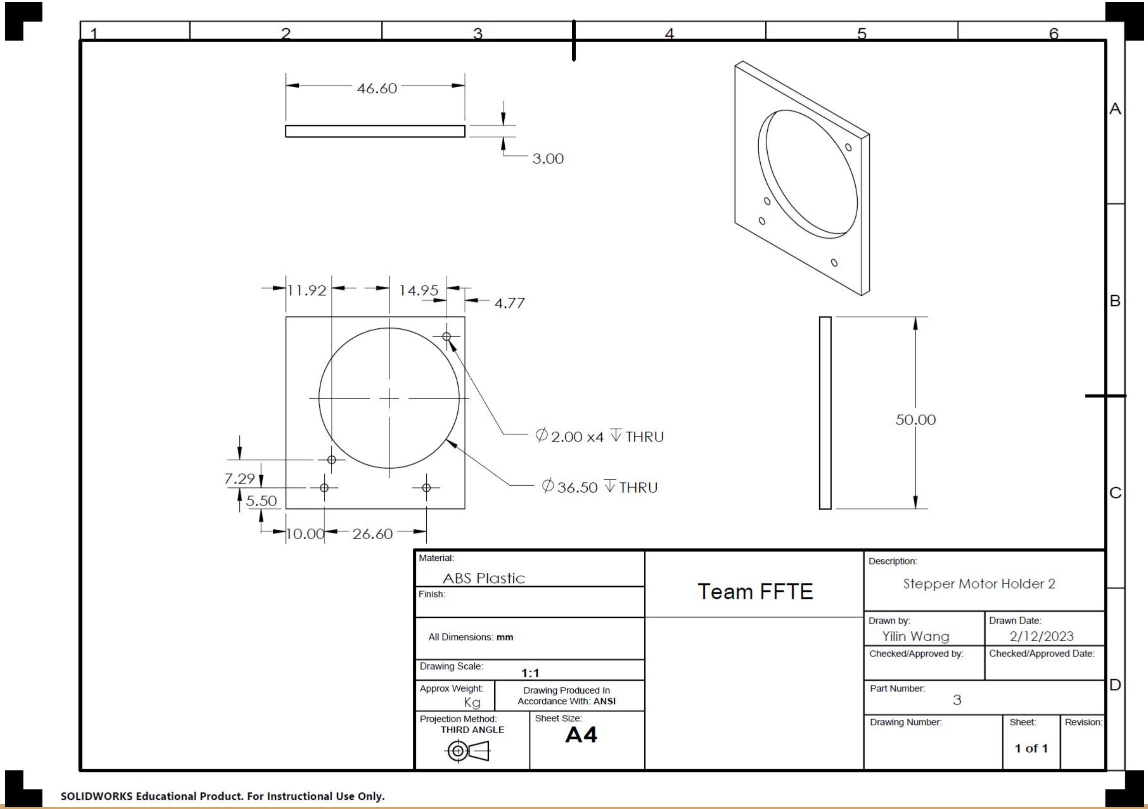


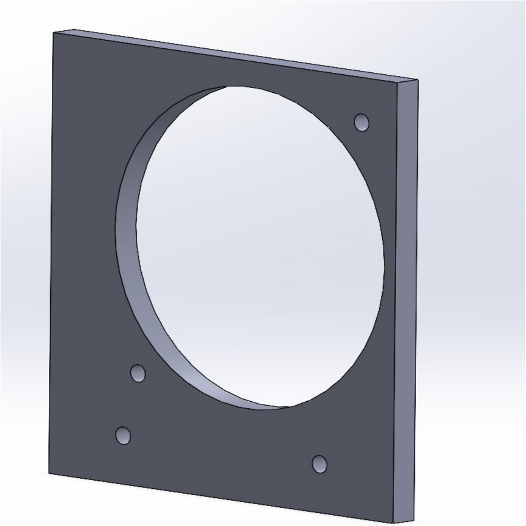
Attachment System - Wall





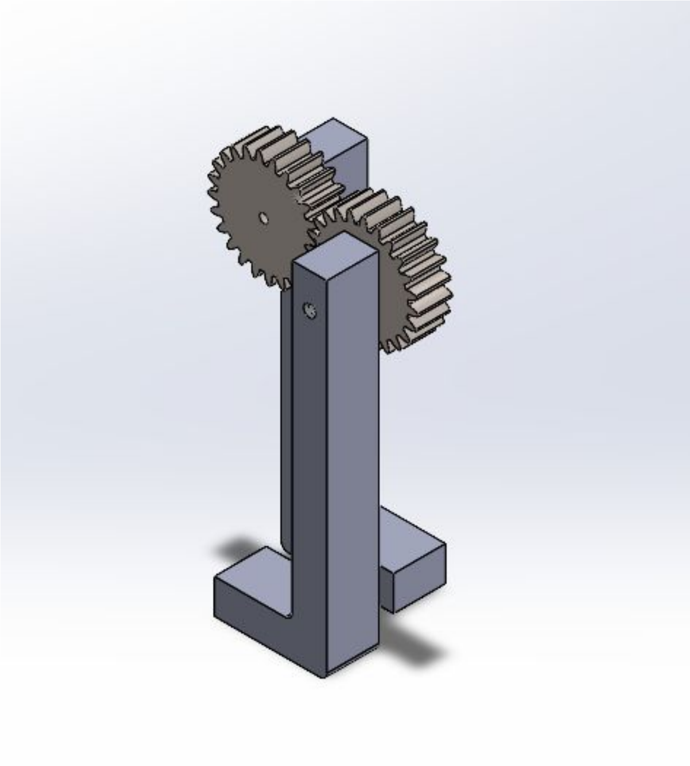
Attachment System - Wall





Attachment System - Claws

- Pinion attached to motor
- Pinion attached to gears to turn claws
- Separate claws made out of aluminum



Remote Control

- Using Raspberry PI Model A+ and Arduino Uno R3 microcontrollers with NRF24L01 Wireless transmitter and receiver to control both systems.
- Two options for the submarine systems:
  - Underwater
  - Above water
- May need to acquire a flight controller.

Risk Analysis

Type of Risk	Description	Severity	Mitigation Strategy	Severity After Mitigation
Environmental (Safety)	Water environment can damage both water and air drone	High	Waterproof as many components as possible. Reduce chance of damage to air drone	Medium
Flight Safety Standards (Safety)	Rotor blades are a concern and may cause harm	High	Practice safe drone procedures such as do not standing underneath drone	Medium

Risk Analysis (Cont.)

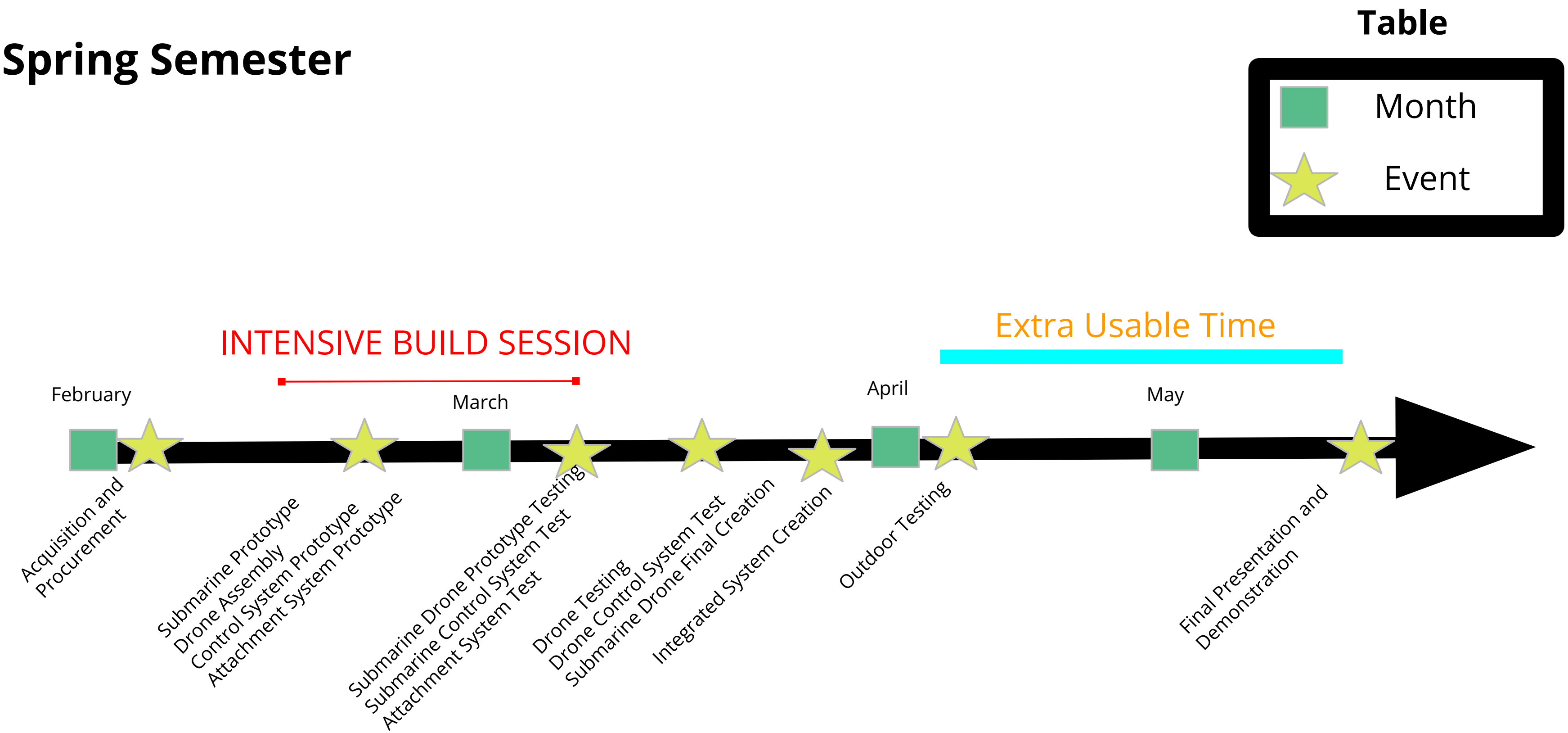
Type of Risk	Description	Severity	Mitigation Strategy	Severity After Mitigation
FAA Standards (Safety)	Federal Regulations	High	Read over the FAA guidelines and drone zones. DJI may have software that automatically restricts the airspace	Low

Risk Analysis (Cont.)

Type of Risk	Description	Severity	Mitigation Strategy	Severity After Mitigation
Not Fulfilling the Timeline (Project)	If a member falls behind on the planned schedule	Medium	Divert personnel and resources to focus on that issue	Low
High Value Component Failure (Project)	If a high value component breaks and it requires time to ship a new component	High	Prepare time	Medium

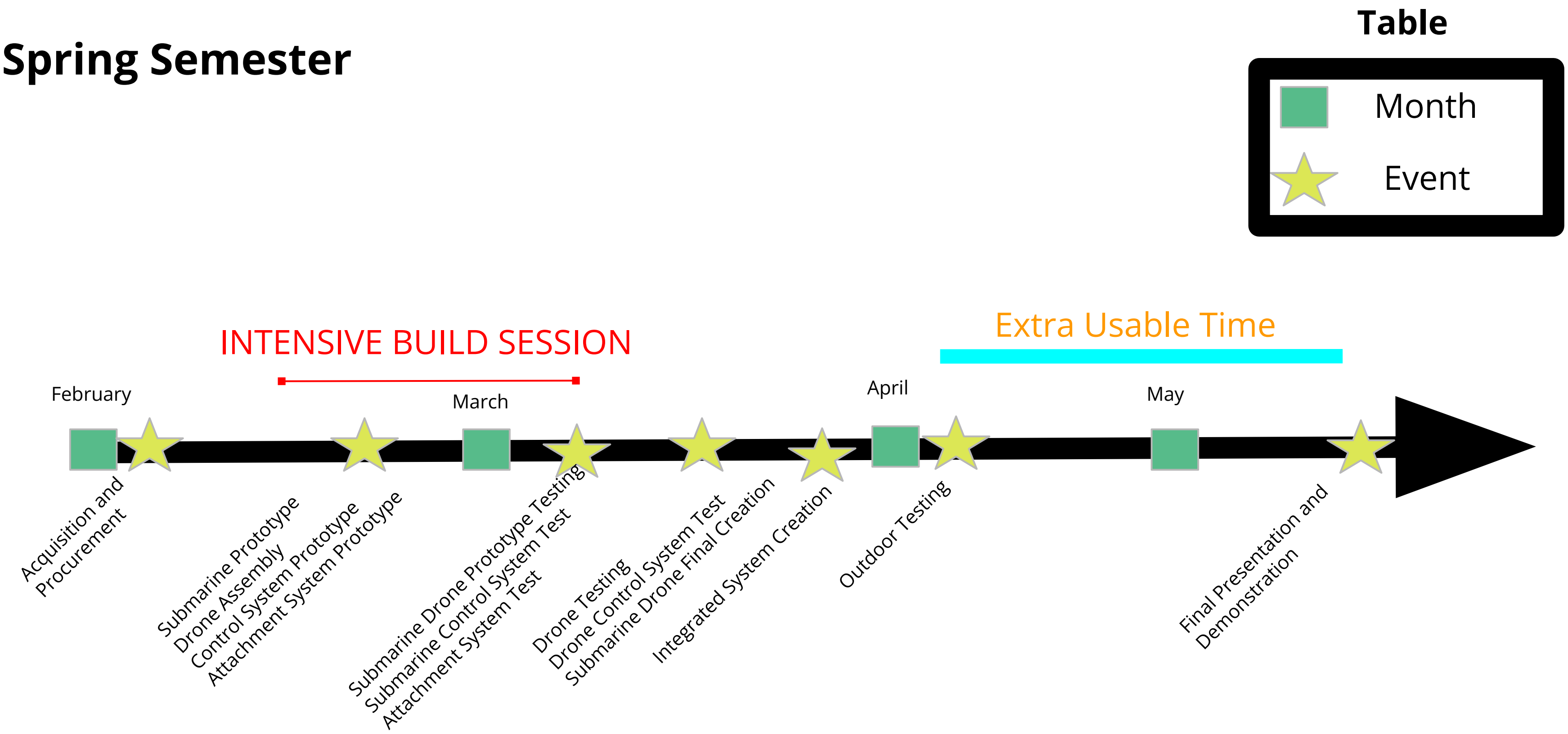
Future Actions

Spring Semester

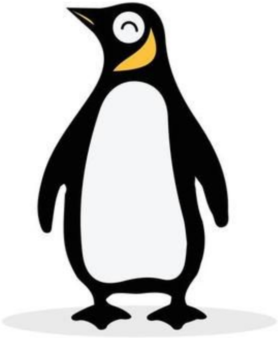


Budget

Spring Semester



Test Site Location



Questions?

Test Site Location

Works Cited

1. https://www.istockphoto.com/photos/airplane
2. https://upload.wikimedia.org/wikipedia/commons/thumb/5/54/Ictineu_3_submersible.JPG/220px-Ictineu_3_submersible.JPG
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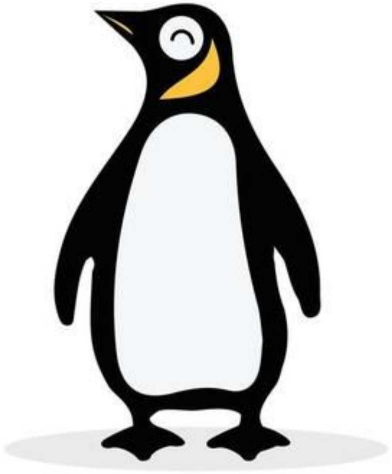

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