UMassAmherst | College of Engineering
Mechanical and Industrial Engineering

Semester Senior Capstone Design

Final Report

Team 1514 – Saltmarsh Drone
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Objective

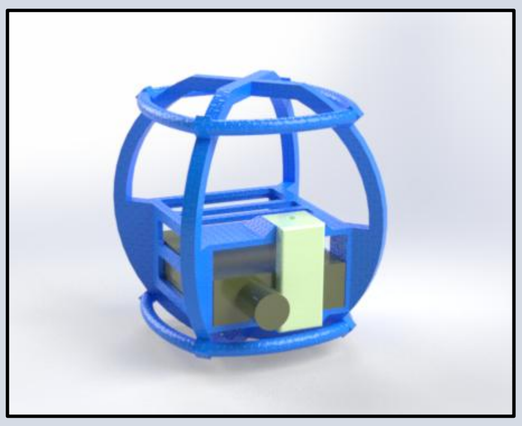
To assist in developing a drone-based deployment and retrieval system to place and retrieve recording devices in saltmarsh environments

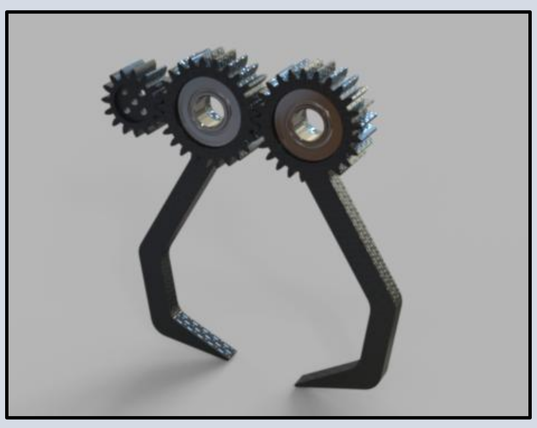
Motivation

Use of UAVs for monitoring saltmarsh environments and other conservation efforts has proven effective, yet placing equipment such as audio recording devices is still a laborious task requiring on-foot deployment

Design Solution

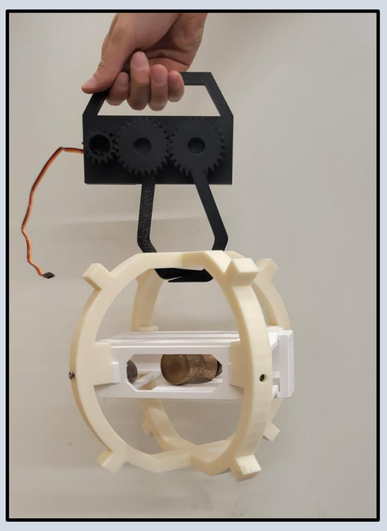
- A claw design was selected over other grasping mechanisms such as magnet or latch
- Payload housing designed to hold multiple types of ARUs and be picked up in any orientation, claw allows for grasping in any orientation.





Proof of Concept Implementation

Drone integration pending



Performance Evaluation

Primarily qualitative tests:

Metric	Target / Threshold	Success Criterion	Passed/Failed
Claw Load Capacity	≥ 3 lb (≈ 1.36 kg)	No slippage or mechanical failure under full test load	Passed
Claw Torque	≥ 45 kgf·cm	Able to generate required gripping torque	Passed
Claw Speed (RPM)	≤ 25 RPM	Controlled open/close speed without undue oscillation	Passed
Current Draw (Claw + Servo)	< 16 A total draw (+10 A margin)	Overall draw increase ≤ 15 % of baseline flight current	---
Drop Resistance	Dropped from 1 ft, 3 ft, 5 ft	Payload housing intact, stays upright, no critical damage after drops	Fractures in housing over heights of 3 ft, minimal rolling

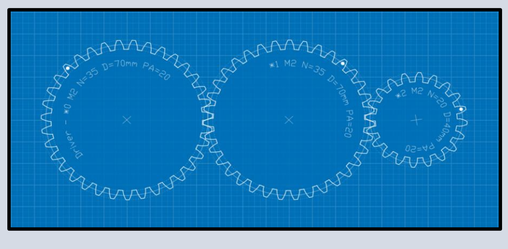
Recommendations

- Redesign to minimize rolling
- Flight tests necessary
- Further design necessary for integration into drone

Engineering Analysis, Specifications

- Estimation of payload weight and size constraints lead to the following calculations to determine gear sizing, power transmission and servo selection
- PET-G selected for UV, water and salt resistance in saltmarsh environment
- Other calculations performed on arm bending stresses, and power draw

Parameter	Target Specification
Current Draw	<16 [Amps]
Height	<150 [mm]
Weight	<1.5 [kg]
Claw RPM	25 [RPM]
Claw Torque	[45 kgf-cm]



$$L_{arms} := 150\ mm \qquad W_{payload} := 2\ kg \cdot 1\ g$$
$$M_{max} := L_{arms} \cdot W_{payload} = 30\ kgf \cdot cm$$

$$n_{driven} := 35 \qquad n_{driving} := 20 \qquad GearRatio := \frac{n_{driving}}{n_{driven}} = 0.571$$
$$T_{driving} := M_{max} \cdot GearRatio = 17.143\ kgf \cdot cm$$

Standards

- AGMA 2000-A88, AGMA 2015-1, and AGMA 2010-D04: Spur Gear Standards
- IEEE 1937.1-2020: Standard Interface Requirements and Performance Characteristics of Payload Devices in Drones

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