Autonomous Catch-and-Charge Landing Platform for the FlightWave® Edge 130 Drone System

Project Description

The overall goal of this capstone project is to provide Red Cat with an engineering proof of concept for an autonomous catch and charge landing station for the Edge 130 drone. The team will be developing a motion-tracking device/system that will be able to safely catch the drone while also having an electrical interface to recharge the drone after landing.

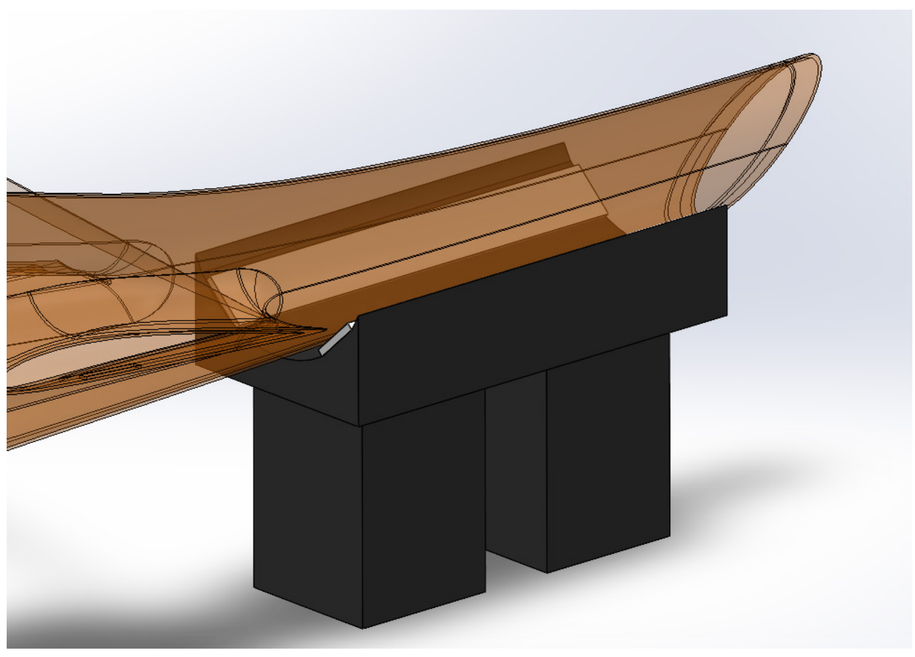
Landing Structure

The early stages of the landing structure design consist of a 4ft x 5 1/2ft box like structure to accommodate the large body of the Edge 130 drone and internal electronics. To seal the drone from the elements when in the structure we are in the process of testing rolling shutter doors and motorized sliding doors.

The team has not yet finalized the material selection or structural design for the landing platform enclosure. Current efforts are focused on testing for potential materials such as aluminum alloys, stainless steel, and composite polymers based on mechanical strength, weight, weather resistance, and manufacturability. Aluminum alloys are a strong candidate as of now for frame structure as it offers a balance of strength and lower weight.

Finite Element Analysis will be used to simulate stresses, deflections, and fatigue life under repeated loading conditions, while physical testing will validate the real-world performance of our design.

Option 2: Lead Charging Mechanism



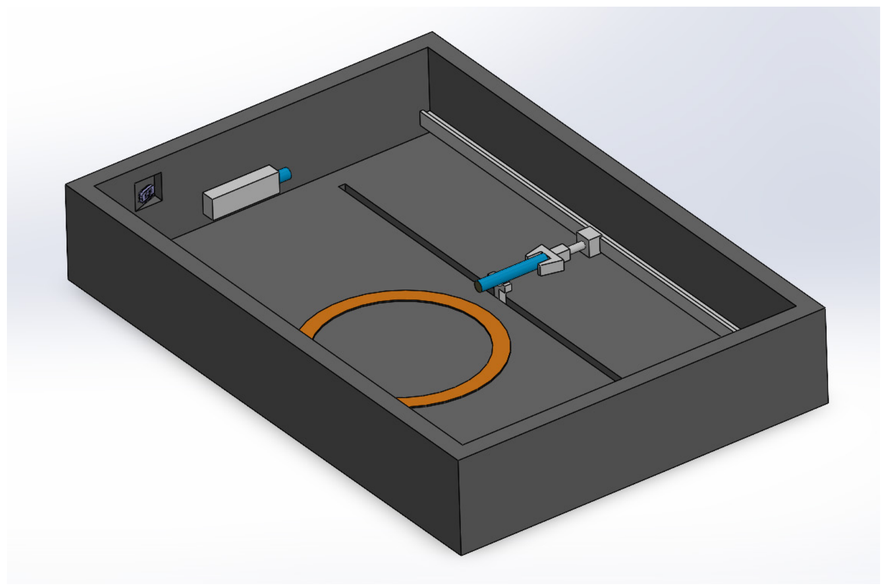
Tracking System

- Using a RealSense D435f infrared depth camera mounted in the opposing direction of the charging system, and cameras each side wall, the team will develop an algorithm to track and navigate the drone into the correct position and orientation for the charging mechanism.
- Current testing and implementation involves using a rough point cloud model of the Edge 130 drone and the current documentation of the D435f to develop simulated movements of the drone to test current and future implementations.

Existing Process

The team has had several meetings with Red Cat representatives to clarify project requirements, drone specifications, and system constraints. The team has done research on existing companies who have similar products and on methods for tracking and charging the edge 130. The team has begun concept development using decision matrices, narrowing potential approaches to a flat landing platform equipped with either a robotic system designed to autonomously remove and replace the drone's battery or a lead charging mechanism.

Option 1: Landing Structure with Battery Replacement System



Charging Mechanism

The team is currently testing two different charging systems:

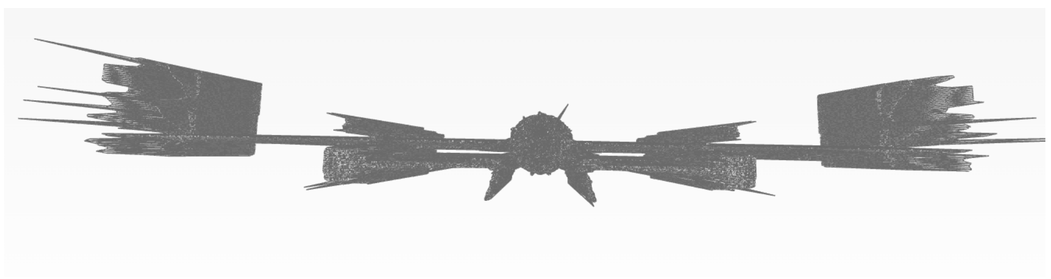
Option 1: Landing Structure with Battery Replacement System

- The first system involves a robotic arm integrated into the flat landing platform, which autonomously removes the depleted battery from the tail end of the drone and places it into a designated charging dock located along the side of the platform. The arm retrieves a fresh battery and installs it back into the drone, enabling rapid turnaround and minimizing downtime between missions.

Option 2: Lead Charging Mechanism

- The second charging method utilizes electrical leads positioned on the platform surface. Upon landing, the tail end of the drone will land on the support allowing for direct electrical contact between the battery terminals and charging points. This provides a reliable and energy efficient transfer without removing the battery, though it requires more precise alignment and secure contact to ensure charging performance up to standard.

3D Point Cloud rendering of Edge 130



Deliverables

- CAD Models and Detailed mechanical/electrical drawings that provide proof of concept for tracking, landing and charging for the platform
- Material Testing for the casing of the platform
- Stress testing and thermal testing using Finite Element Analysis on landing platform

Paolo Coppola

Justin Esposito

Joshua Rivas

Faculty Mentor: Dr. Erdman