Improving Power and Vision Systems on Autonomous Quadrotors

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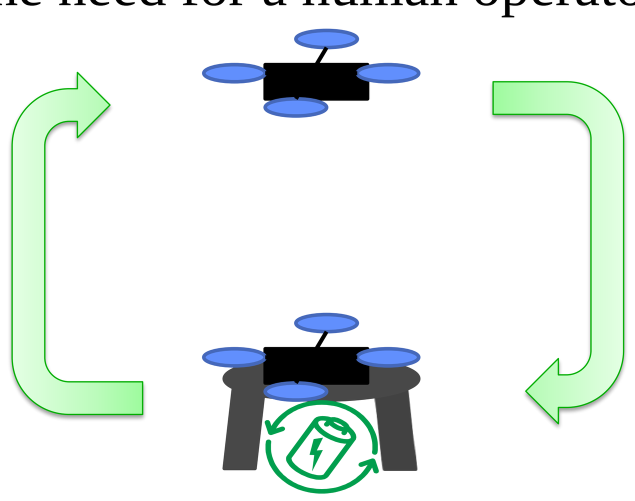
Motivation

POWER

- Length of flight is dependent on the amount of charge in the battery – generally only about 20 minutes.
- Persistent flight becomes inefficient when it requires a human to change out the battery every time it is depleted.

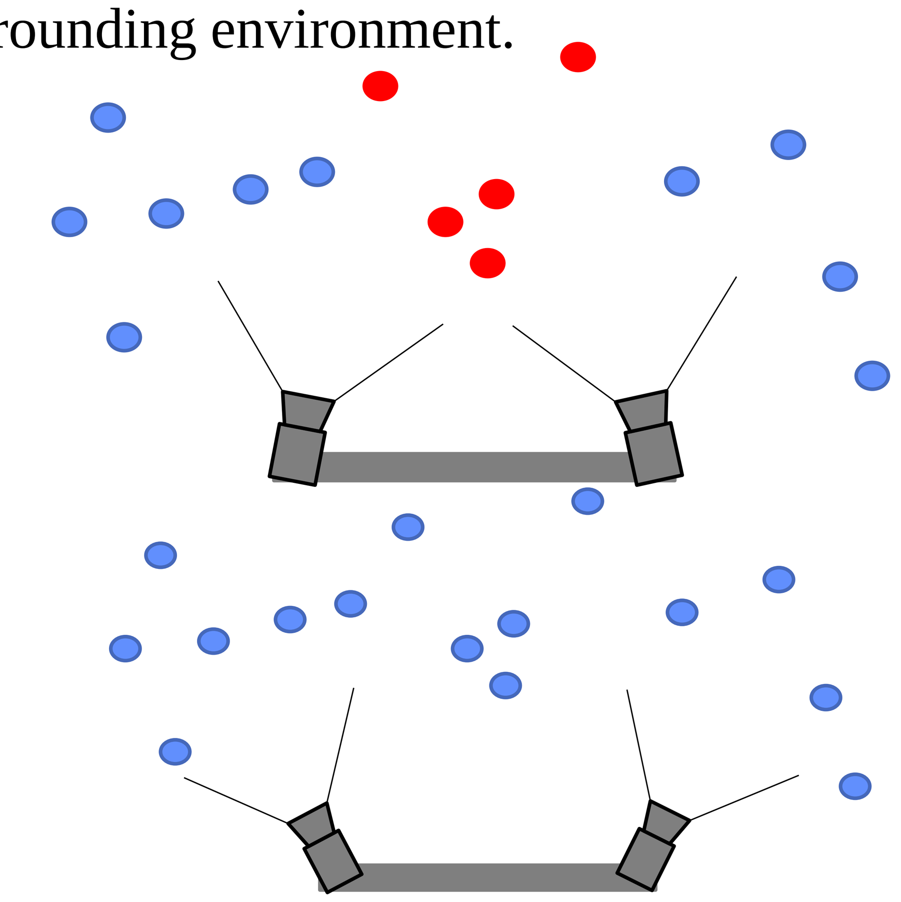
GOAL: Create a charging station that will allow the quadrotors to land, charge and fly for days at a time without the need for a human operator.



VISION

- When a quadrotor navigates close, cluttered environments, using stereo vision to find depth of features is desirable
- When navigating open environments, it is more advantageous to have a wide field of view that stereo vision cannot provide.

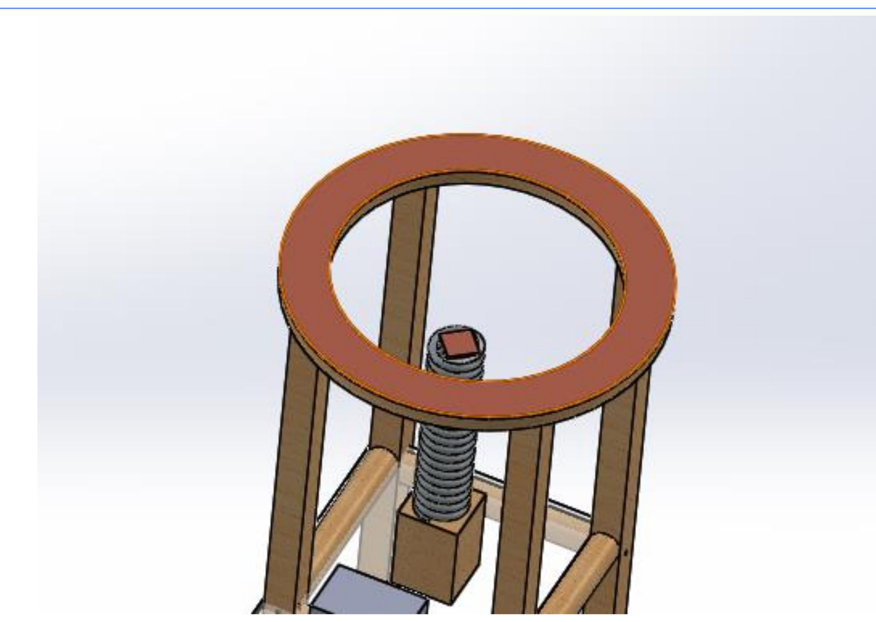
GOAL: Create an actuated vergence system that can swivel cameras to optimal position based on the surrounding environment.

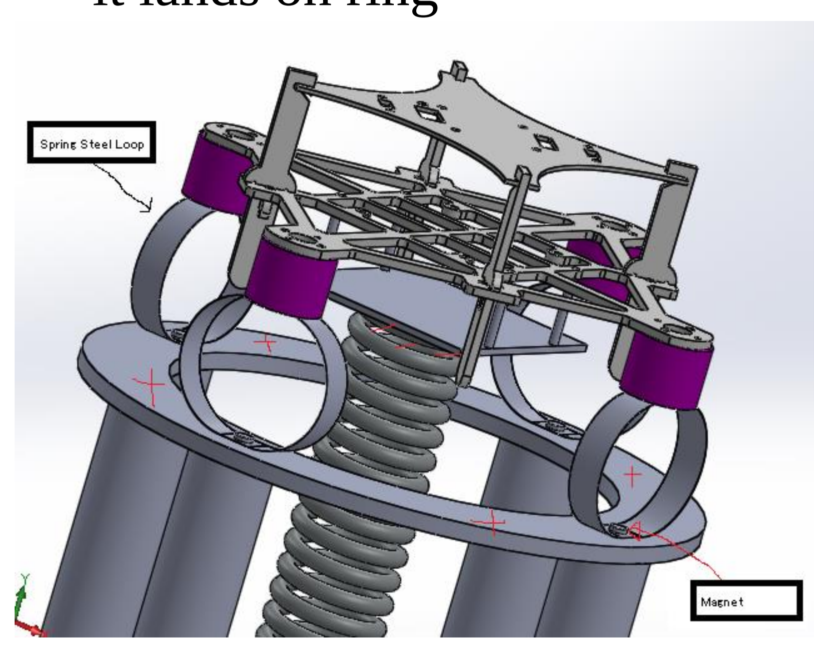


Method

Copper Design

- Copper ring on station provides one polarity to connections on arms of quadrotor
- Small copper plate on compression spring provides other polarity to underbelly of quadrotor
- Quadrotor compresses spring until it lands on ring



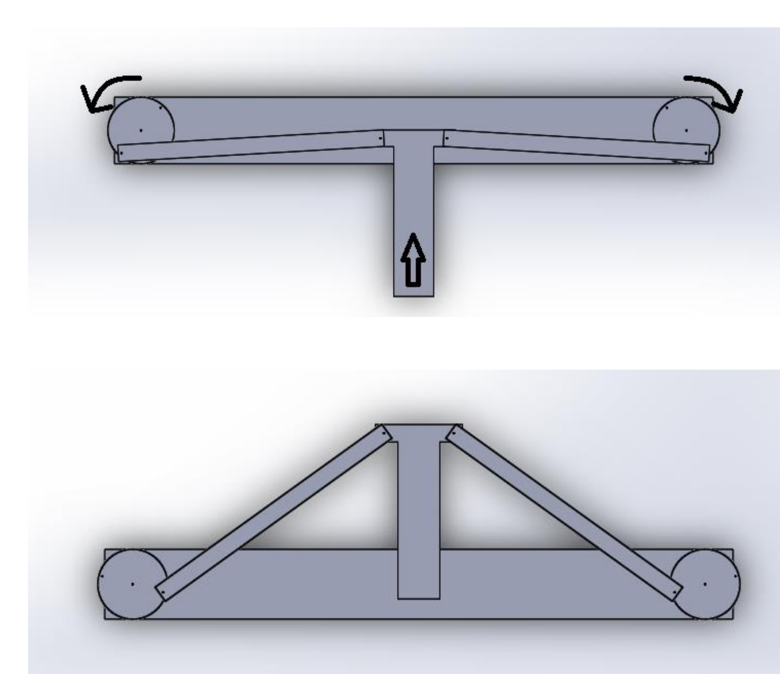


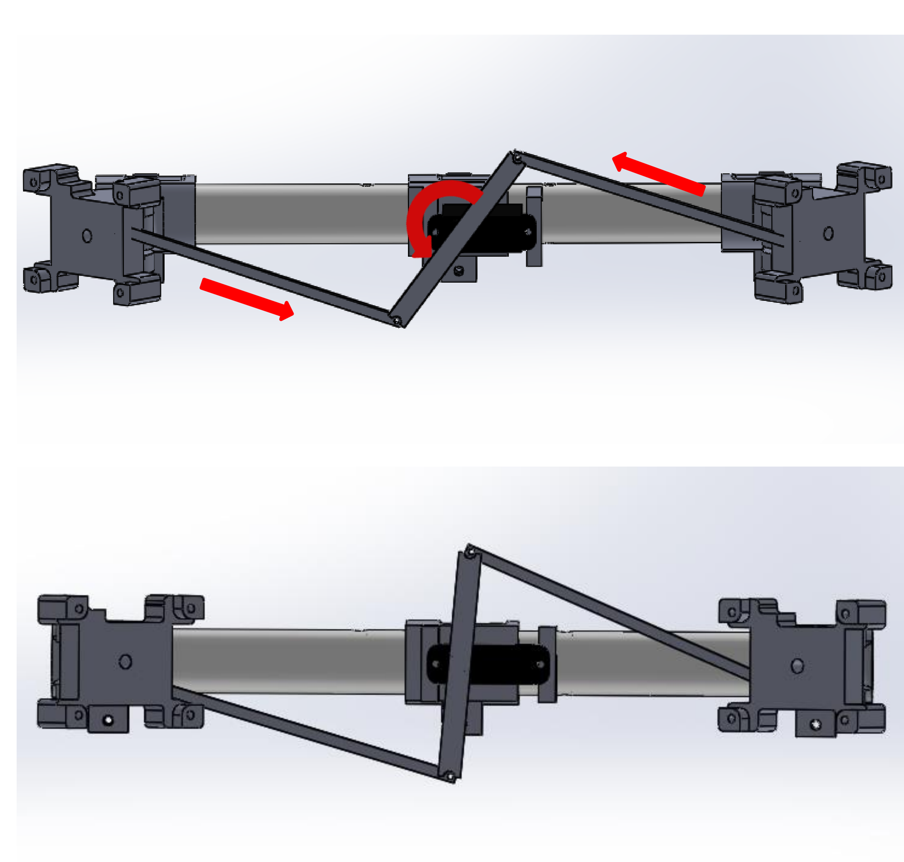
Steel Loop Design

- Designed with 5 inch miniature quadrotors in mind
- Battery charges through spring steel strips formed into O-loops
- Magnets ensure secure and consistent connection to station
- Changed copper to steel for magnetic properties

Linear Actuator Design

- Uses one linear actuator to drive both cameras identically in reverse directions
- Linear actuator and linkage combination would be heavy
- Large footprint in top plane
- Length of actuation does not correspond with degree turned





Single Servo Design

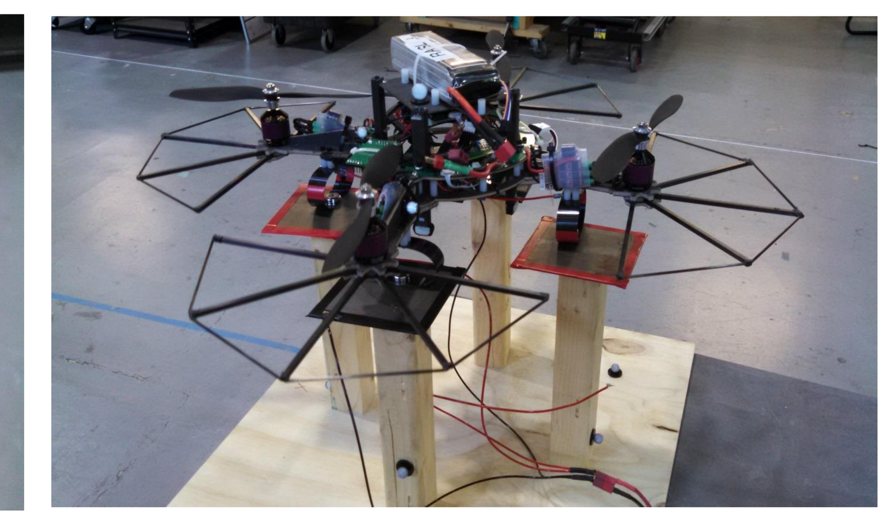
- Uses one servo to drive both cameras identically in reverse directions
- Requires linkage that connect to both camera mounts
- Large footprint in front plane
- Connection between linkage and mount must have 3 degrees of freedom

Implementation

Quadrant Design

- Adjusted design for use with 8 inch quadrotor
- Steel plates for each quadrant provide alternating polarities
- Larger area for quadrotor to land
- Requires quadrotor to have precise yaw control
- On stilts to prevent landing difficulties due to ground effect
- Plates connect to power supply on shelf below

Successfully charged quadrotor with 12.4V battery at 4A.



Double Servo Design

- Lightweight and requires no linkages
- Simple and effective design
- Generic 3.7 sub-micro servos
- Servos resist external forces
- Pololu Maestro micro servo-controller
- Easily controlled from computer
- Range of 120˚ from β=-30˚ (inward) to 90˚ (outward).
- Added option of having each camera have a different position for future testing.

Future Work

- Conduct testing to find which precise vergence angles provide the best camera performance in varying environments
- Redesign charging station so that any yaw orientation will work
- Conduct full experiments of both systems on quadrotors during flight