IOWA STATE UNIVERSITY
Aerospace Engineering

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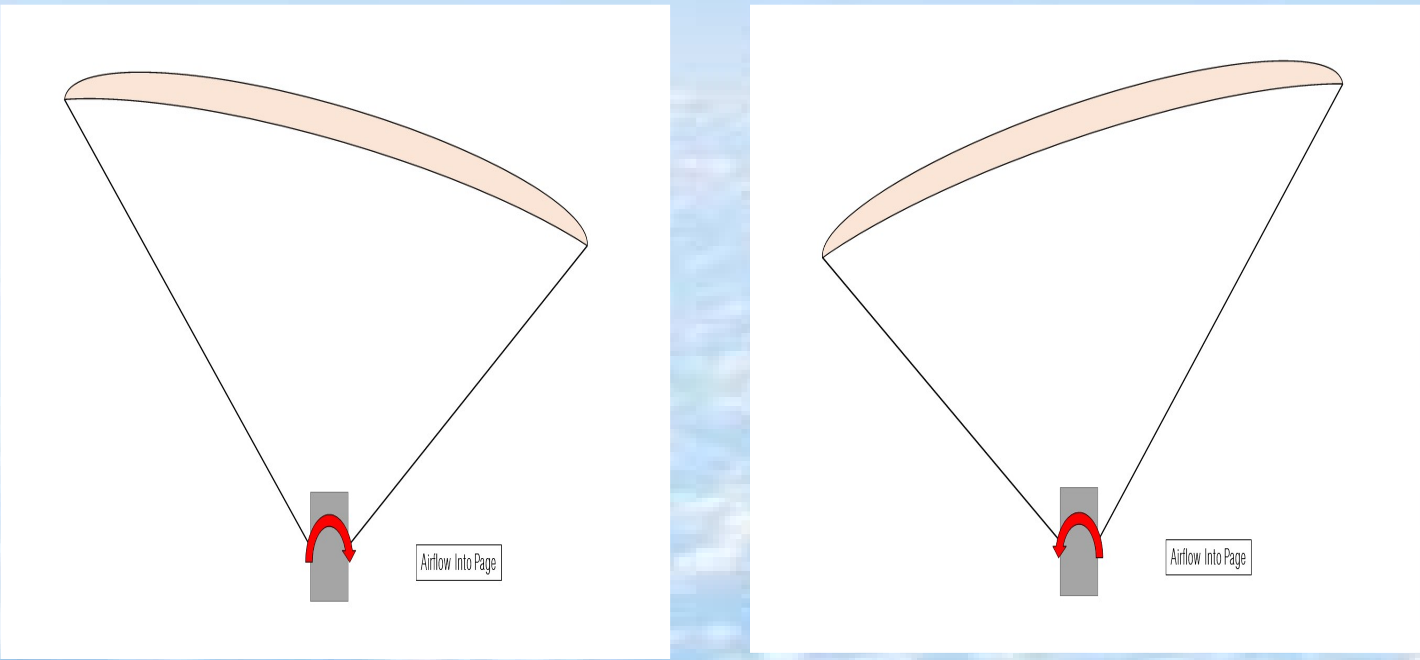
HABET
RGS: Recovery Guidance System

Introduction

The current method of payload recovery relies on launch specifications and payload trajectory predictions. During pre-launch strategy meetings launch details are chosen based on payload size, weight, and mission. Predictions allow accurate means of recovery but are heavily based on wind and payload/balloon specifications. In order to keep HABET experiments successful, safety must be our highest priority. If the trajectory of the payload is forecasted to land near an airport or moderately populated area, launch must be adjusted to avoid these areas as a safety precaution. FAA notification is especially necessary if the payload is to pass over an airport or other high-traffic airspace. With the Recovery Guidance System, the parameters of a payload trajectory can be modified after the balloon has launched. Once the danger of payload inflicted damage is avoided, the safety of the payload itself can be considered. Natural hazards such as trees and lakes can damage payload equipment or make the payload inaccessible. Maneuvering around these hazards and allowing for easy access to the payload are just some of the advantages of this system. Generally if the predicted payload displacement goes beyond 150 miles the flight will be rescheduled. By having access to this system the payload displacement will no longer be a means to cancel a flight.

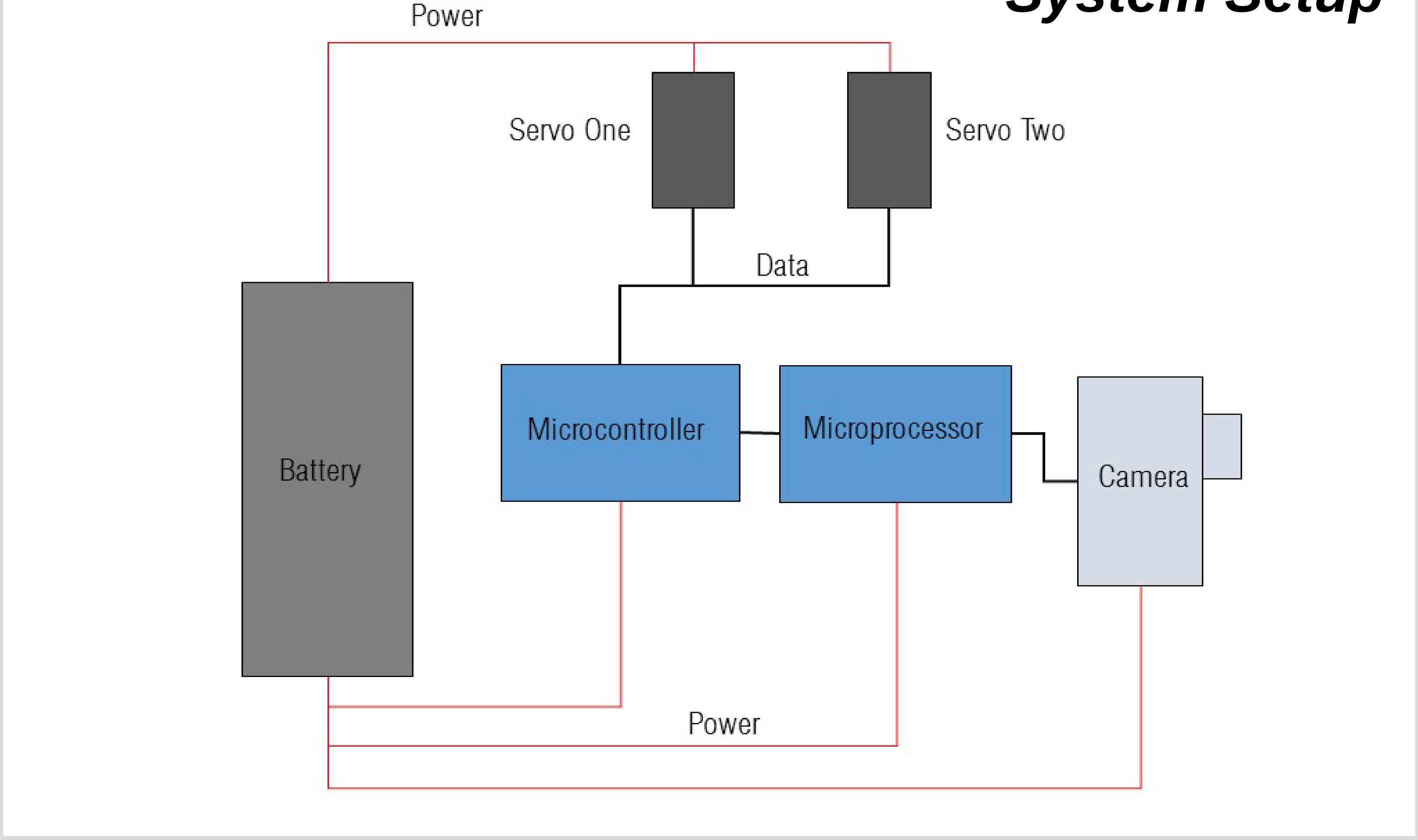
Roll Control



Design

For our design we have decided on a two servo design (pitch angle and roll angle of the parafoil). Using this setup, it will be possible to attain adequate control over the payloads descent trajectory. The servos will be automated with commands sent by an onboard microcontroller and microprocessor based on the GPS data acquired during flight and the location of the desired touchdown point. This touchdown point will be based on both a pre-designated zone and visual information acquired from onboard cameras. Power for this system will come from the main tracking system. When the payload has descended to an appropriate altitude, the drogue parachute will deploy, bringing out the parafoil. The computing package will begin sending commands to guide the payload to its destination zone. The camera on-board will then send visual data to the processor that will use this information to refine and optimize the landing point. The system will then land and continue location uplink until it is obtained by the recovery team.

System Setup



Testing and Future Work

In order to test the control power of the chosen servos on the parafoil, we plan to conduct a “drop test” of the payload with the servos controlled via radio control. The payload will be tethered and launched to a suitably high altitude for the parafoil to deploy and be controlled by servo actuation. At this point, the payload will be detached from the balloon and the RGS operator will begin making control inputs to guide the payload to the ground. Both the operator and ground based observers will document the response to given control inputs, and from these observations determine if more control authority is needed. We will also determine the servo response time in deg/s rotation rate and the in/s calculated linear pull of the servo under load. Once the dynamic model of the parafoil-payload system has been created, we will test the system for accuracy by comparing the output trajectory to those found by similar simulations of parafoil dynamics. To test the completed RGS, a second drop test will be performed, the control handled entirely by the onboard computing package.

Pitch Control