Ahtesham Alvi, Piyush Sethy, Saiarun Jayanthi
Professor Lena Johnson
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Final Project Report

This project aimed to create a bird-inspired, tethered gliding robot (kite) with articulating flapping wings capable of measuring and characterizing the effects of atmospheric behavior and wind on mechanical flapping and gliding robots. It is primarily made for research purposes to measure wind since it is a kite glider with little practical application.

Our first prototype was a half-wing taped to a table. It was to figure out how to move the wing with a servo, or if it was even possible to do so with a single motor. The second prototype was taking that and splitting it into two distinct wing shapes, as well as stronger metal geared motors. One was model *Sparrow,* whose wing shape was based on a House Sparrow, and the other was model *Falcon*, whose wing shape was based on a Peregrine Falcon. The model *Sparrow* and *Falcon* both had too brittle spars because they were made of wooden dowels and black plastic film. So then we transitioned to model *Eagle* for our third prototype, based on a Golden Eagle. This one used carbon fiber rods and the same black plastic film. In the fourth and final prototype, we changed from a black film to a white one because the black film suffered from deformation in the sun. This model used lighter electronics with an Arduino Nano and an accelerometer but the same metal-geared servo motors.

We faced several technical and mechanical problems throughout the project. One primary challenge was the failure of plastic SG92R servos, which couldn't adequately move the wing spar. We solved this problem by shifting to MG92B servos which had metal gears and a higher torque. We further faced issues with generating lift with prototypes one and two because of brittle wooden dowels, fragile plastic films and a bad wing shape. To solve this, we upgraded to carbon fiber dowels and used flexible garbage bags that allowed it to withstand strong winds. We also changed the wing shape to more closely resemble that of a bird (*Eagle*). Moreover, as we shifted our focus to programming the sensors to collect environmental data, we faced technical issues with transmitting or recording the data. This was because we lacked hardware and did not have the required SD card reader or transmitter.

In the future, we plan to use a more permanent nylon fabric and sow our electronics into the body. We would like to create a more permanent enclosure so that we can easily repair/modify the electronics, but not add too much weight, all while protecting them from the elements. Additionally, the goal of monitoring wind data flopped in the end. In the future, it would be better to have a more complete sensor system (temperature, gyroscope, accelerometer, and altimeter) that can also write to an easily accessible file, preferably remotely transmitting it to another device. This data could be used to create a more sophisticated control system. Lastly, we would like to iterate on the kite/wing shape itself: we didn't have enough time or material to prototype lots of different shapes for the kite body.