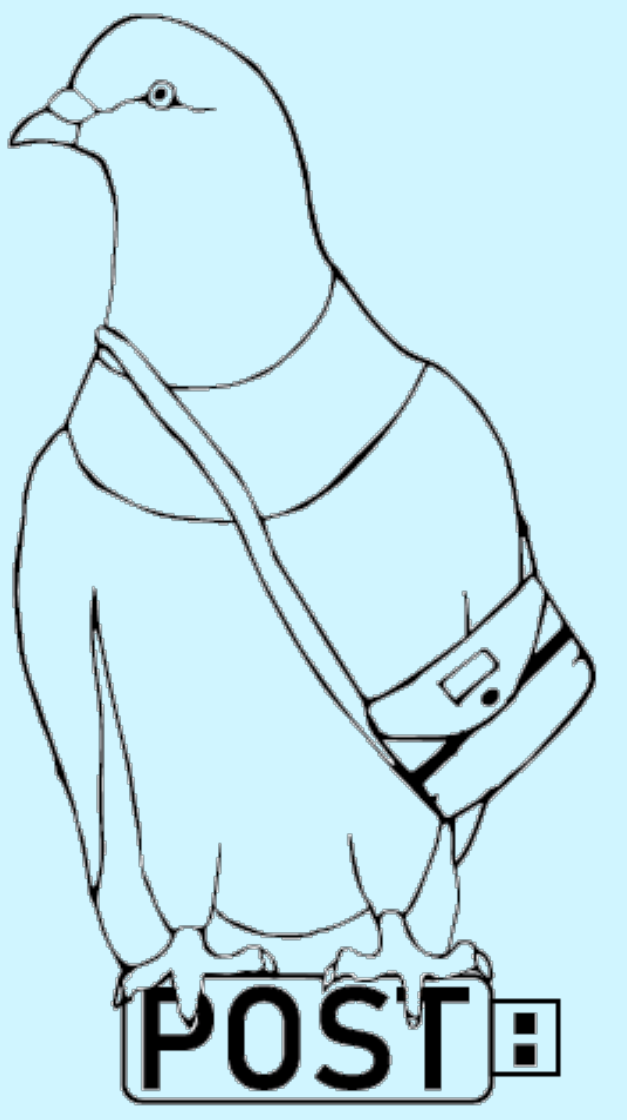


# Pigeon Post - The Modern Homing Pigeon

## L3Harris



### Project Description

Build a lightweight, modular, fixed wing, autonomous drone to return data storage devices from a frontline combat situation. The drone must be impervious to jamming and should automatically orient itself and return to its home base.

Highlighted Customer Restraints/Requirements target

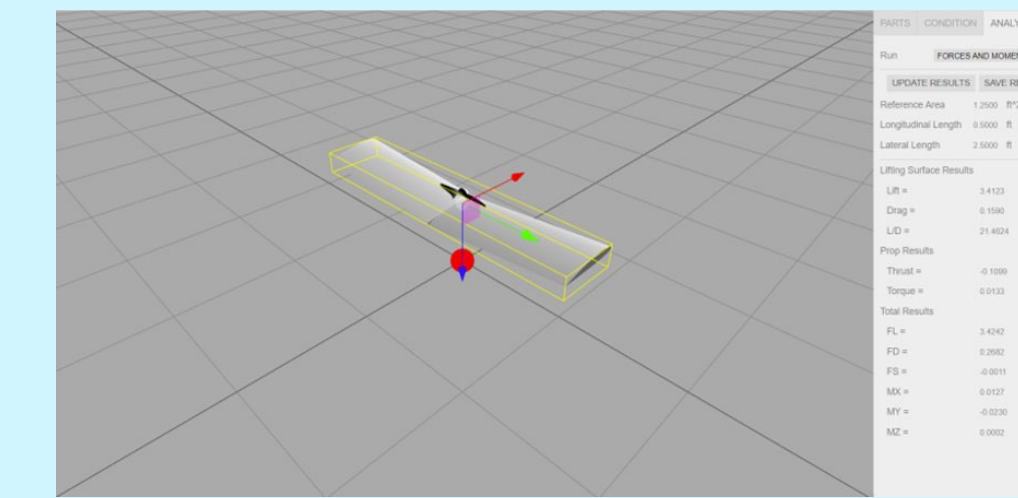
- The device shall weigh less than 2 pounds
- The device shall be capable of flying 60 mph for a distance of 80 miles
- The device shall be modular and fit into a 5L volume
- The device shall employ obstacle avoidance
- The device shall cost under 300\$

Requirement	Target	Threshold	Predicted Performance
Cost	\$300	\$500	\$300
Field Training Time	30 min	60 min	30 min
Base Support Training Time	120 min	180 min	100 min
Reusable	30 Flights	5 Flights	30 Flights
Sound level from 300 ft	30 dB	45 dB	30 dB
Fly in Crosswinds	20 mph	10 mph	20 mph
GPS Location Error	2 m	15 m	2.5 m
Obstacle Avoidance	20 m	10 m	20 m
Travel Distance	80 miles	20 miles	21.1 - 29.0 miles
Weight	2 pounds	5 pounds	2.65 pounds
Airspeed	60 mph	20 mph	45 - 50 mph
Calibration Time	30 sec	120 sec	64 sec
Horizontal Distance to Altitude	100 meters	200 meters	239 meters
Package Volume	5 L	9 L	4.9 L
Steps to Launch	5 steps	8 steps	7 steps



### Design Description

- Initial calculations were made using USU MachUp to size the wings needed to create the needed lift for the drone.



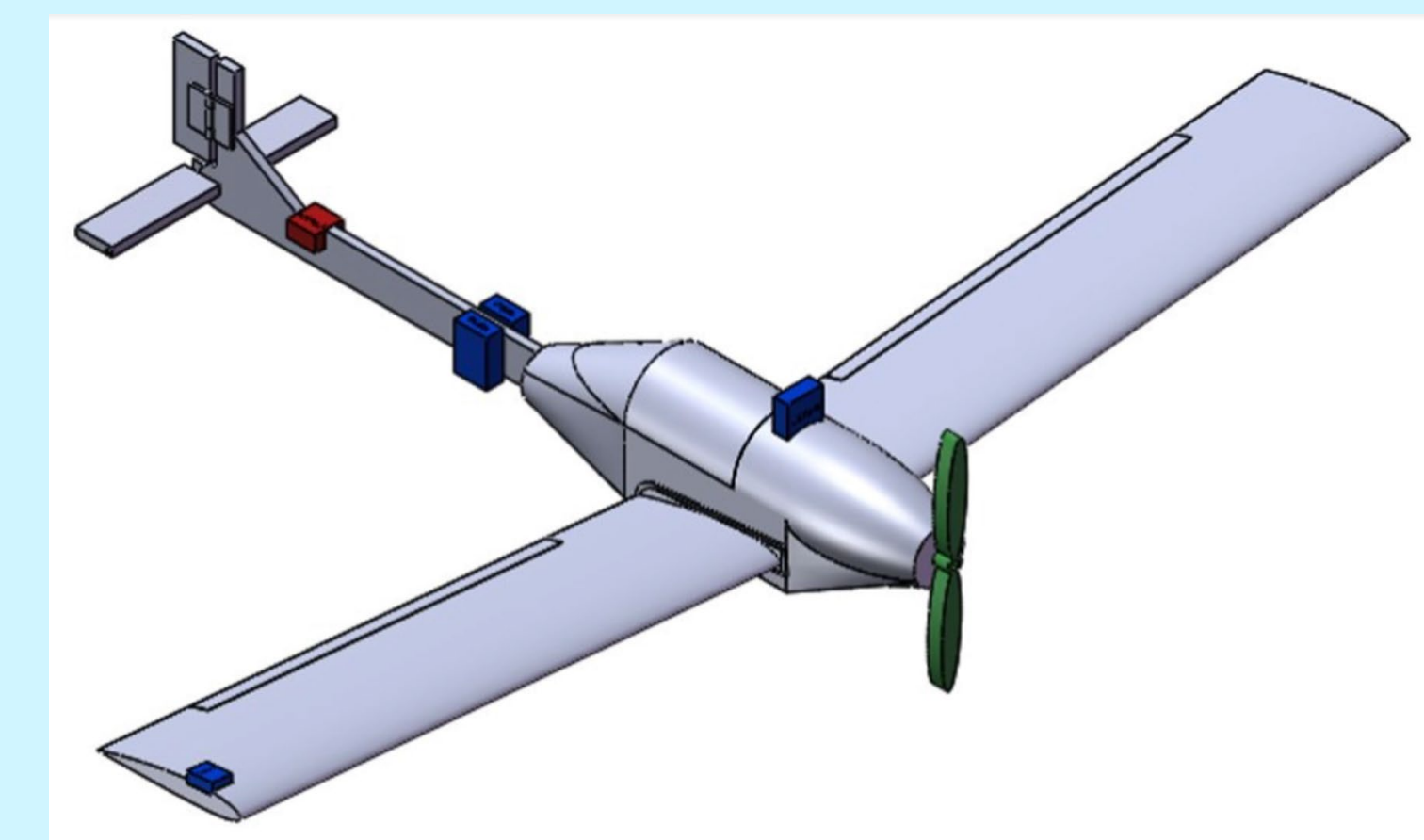
Wingspan (m)	Speed (mph)	Drag of Wing (lb)	Lift (lb)
26"	40	.16	1.71
	45	.20	2.16
	50	.24	2.61
	55	.30	3.23
30"	40	.17	2.04
	45	.21	2.57
	50	.26	3.18
	55	.31	3.85
36"	40	.17	2.53
	45	.22	3.20
	50	.27	3.95
	55	.33	4.78



- This lift was then confirmed using a 3D printed airfoil and a wind tunnel
- Next different battery, propeller, and motor combinations were tested to find the optimum combination for the required thrust and minimum power consumption.
- Aircraft geometry was designed around these parameters.
- Autopilot system was selected and researched in parallel



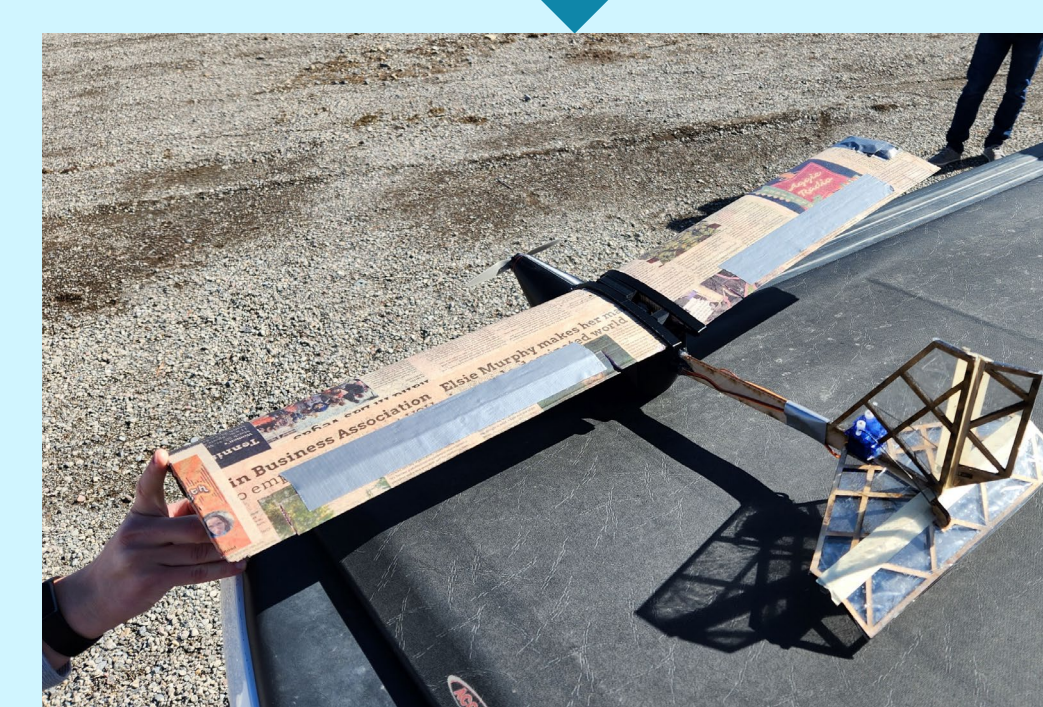
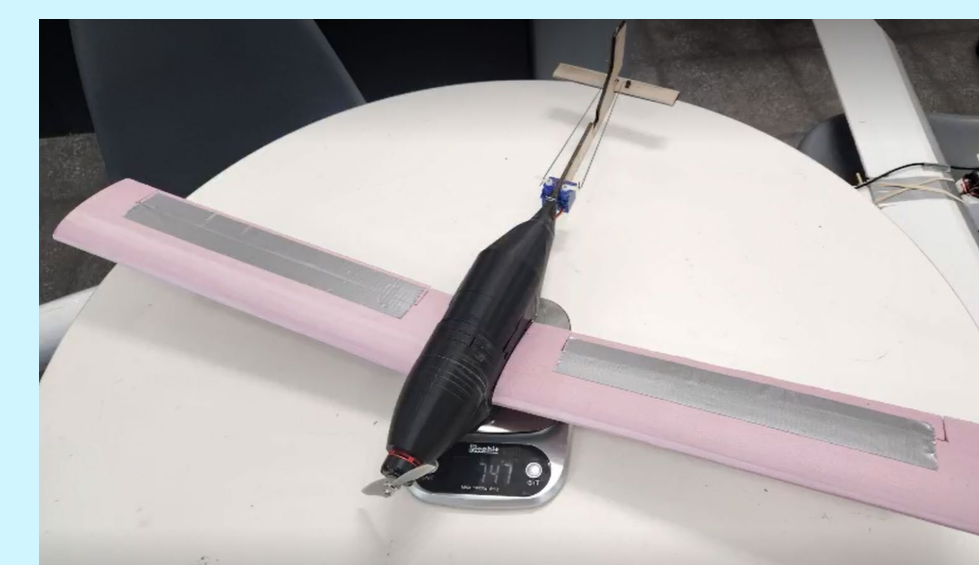
Motor	Propeller	Battery	Throttle %	Thrust (lb)	Efficiency (kgf/W)	Current (A)
Xing 2207 2450KV	5x5	3s	60	0.51002	0.001358	14.488
			100	0.77653	0.001295	23.586
	6x4	4s	60	0.80718	0.001115	20.316
			100			
		3s	60	1.02584	0.002680	14.999
			100			
Readytosky RS220 5 2300KV	5x5	3s	60	0.26599	0.001884	5.489
			100	0.47347	0.001756	10.704
	6x4	4s	60	0.45940	0.001584	8.112
			100	0.77734	0.001363	16.168
		3s	60	0.54583	0.003757	5.698
			100	0.93118	0.003256	11.490
7x6	3s	60	0.93418	0.003075	8.541	
		100	1.45405	0.002393	17.357	
			60	0.69651	0.002646	10.558



### Performance Review

- Implementation was split into a hardware build team and a software team.
- The Hardware build team built an experimental plane to test flight characteristics and optimized its design.
- The Software build team bought a foam plane to research and test the autopilot software on.
- Both teams went through multiple test iterations to arrive at the final design.
- Nearly 10 different test flight days were conducted
- These Iterations led to upgrades in wing design to feature a composite material and calibration of the autopilot software used.

Hardware Team



Software Team



### Conclusion

Accomplishments:

- Analysis, testing, and manufacture of an efficient modular drone.
- Creation of an autonomous control system.

Lessons Learned:

- Defining requirements early is important to the success of a project.
- Smaller, low risk tests should be performed more often than higher risk tests.
- Tests should be designed in a way that they do not rely on weather if possible.

Recommended Future Work:

- Design/implement a more efficient fixed-wing flight control system.
- Implement obstacle detection.
- Integrate concurrent design paths

