UNMANNED AERIAL VEHICLE (UAV)

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Scope

Create and demonstrate a UAV that can assist in identifying a target and deliver water to it with semi-autonomous pilot aid.

Solutions and Requirements

Customer Needs:

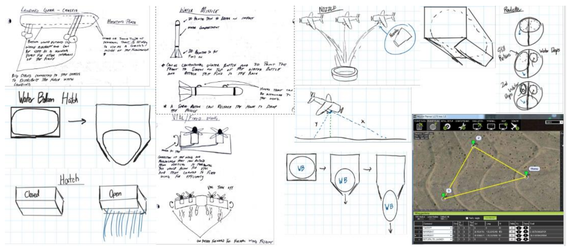
#	Customer Need	Where it came from
1	Put out a fire	Fire Fighters
2	Easy beginner flyer	RC Park
3	Identify the target	RC Park
4	Perform mission quickly	Fire Fighters
5	Portable	RC Park
6	Quick setup	Fire Fighters
7	Lightweight	RC Park
8	Stable in the air	Previous UAV Team
9	Reusable	RC Park, Fire Fighters
10	Follows the law	Legal
11	User friendly	RC Park
12	Durable	Fire Fighters
13	Sustain hard landings	Fire Fighters
14	Easily replaceable parts	RC Park
15	Easy to assemble	RC Club

Design Requirements:

#	Customer Need	Specification	Quantity	Units	Hit Spec?
1	1	Minimum Payload	2	kg	2.14
2	1	Minimum Payload to Reach Target	1	kg	0
3	1	Target size	3x6	m	3x6
4	2, 11	Hard Deck for GCAS (AGL)	4.5	m	4.5
5	3, 10	Visual/Sensor Confirmation of Target Location	50	m	~130
6	4	Time of Flight	<5	min	1
7		Take-off Distance	30	m	11.2
8		Landing Distance	30	m	6
9	7, 10	Total Weight	<24	kg	4.2
10	10	Legal to Fly	Y/N		Y
11	12, 13	Withstand Landing Force	155	N	500
12	14, 15	Easily Repairable with Replaceable Parts	Y/N		Y
13	5, 6, 15	Time of Deployment	15	min	9
14	2, 11	Feared By All When Flying	Y/N		Y
15		Total Cost	3000	$	1739.20
16	5	Maximum Wingspan	1.5	m	1.27
17		Turn Radius on Ground	5	m	1.2
18	2, 8, 9, 11	Minimum Consecutive Missions Flown by Pilot Without Repair	2		3
19		Maximum Number of Operators Needed to Complete Mission	2		2

Hit Spec: Green = Yes, Yellow = Yes, not fully integrated, and Red = No

Brainstorming:



Decision Matrix:

Payload System	Weight	Water Balloon	Garage Door	Nozzle	Hatch	JDAM	Criteria Based on Specs
Time of Release	0.5	4.4	3.5	2	4	4.4	Time
Ease of Refueling	0.2	4.4	4.1	3.2	3.7	3.4	Time
Probable Payload to Hit Target	1	4.2	3.7	2.2	3.6	3.8	Surface Area
Carrying Capacity	0.7	3.5	4.8	3.6	4.8	3	2 kg
Effect on Flight	0.7	3.4	3.6	3.6	3.6	2.2	Controllability
Ease of Build	0.6	3.7	4.4	1.4	3.7	2.2	Time
Affordability	0.4	3.9	4.2	2.2	4	2.6	Cost
Final Score:		15.89	16.47	10.6	16.04	12.68	

Aircraft Body Style	Weight	Single Engine	VTOL	Current Design
Flyability	0.8	3.6	2.4	3.8
Power Draw	0.5	4	2	3.7
Controllability	1	3.2	2.6	3.6
Weight	0.7	4	2.4	3.3
Ease of Build	0.6	3.3	2.2	4.2
Affordability	0.4	3.8	2.2	4.4
Final Score:		14.38	9.4	15.08

Model, Analyze and Test

Prototype 1

Helped to diagnose the various issues we encountered. The ailerons were too small, the motors were not synced, and the landing gear was unable to sustain a rough landing.



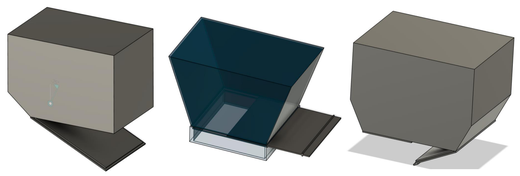
Prototype 2

Helped to diagnose motor issues, got it flying, and utilized a wood frame to assist the landing gear and make it more stable.



Payload Concepts

Three new concepts were created, a single door hatch (1), a larger garage door than last years (2) and a double door hatch (3).



1 2 3

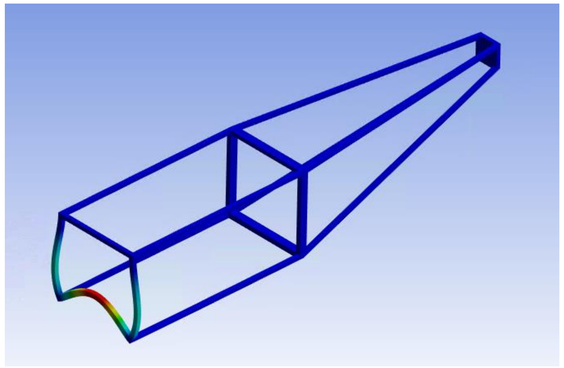
Mission Planner



Engineering Analysis

FEA on Frame

Used to analyze the effectiveness of adding the frame. Found that frame can withhold a force of 300 lbs with a safety factor of over 100.



Motor Analysis

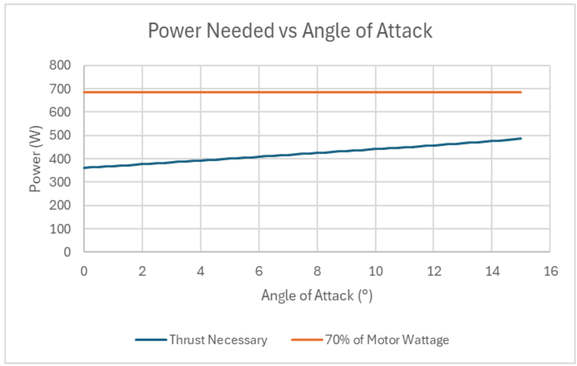
With over 500 grams more of weight, last year's motors wouldn't be powerful enough.

Motor	Weight (lb)	Max Wattage	New Plane Weight (lb)	T/W	T/W @80% Wattage	T/W @70% Wattage
2826 (Old Plane)	0.12	684	8.34	0.82	0.66	0.57
3548 (Spare Motor)	0.42	1540	8.93	1.72	1.38	1.21
3536 (New Plane)	0.19	980	8.49	1.15	0.92	0.81

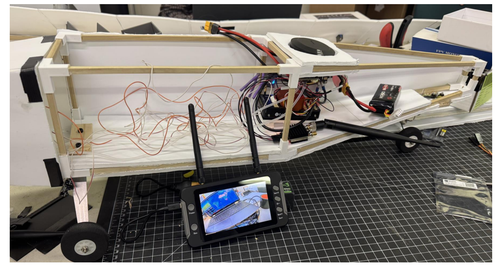
- 100W to lb rule
- 70% thrust is optimal power load
- Motor 3536 provided optimal thrust to weight ratio
- Checked with airfoil data

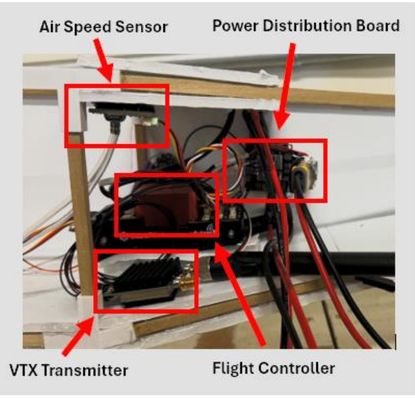
Fluid Mechanics Analysis

Lift force must exceed the gravitational and drag force. Airfoil data was used to calculate how much power is necessary for flight.



Final Prototype











Acknowledgements

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