Restated Scope/Plan Report

EML4552-C Senior Design, Spring 2013, Deliverable

AIAA Design Build Fly Competition
Group # 16 (G16)

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Executive Summary

This spring semester, we have a specific set of time sensitive goals which need to be met for the purpose of competing in the AIAA Design Build Fly Competition this April. Currently, we are waiting for our materials to come in the mail, as we have been since mid-December.

We have three primary objectives for this semester. The first is to create a working prototype that is capable of take-off, maneuvering, and landing. This must be documented and recorded on video as evidence in order to qualify for competition. The Second is to complete the design report by February 25, 2013. This must be done well before the competition so that it may be thoroughly graded, and will represent a substantial percent of our total competition score. The third primary objective is to go to competition. If the other two objectives are completed, the only remaining obstacle is to find funding. If we go to competition, the only objective remaining in the semester is to compete as well as possible, and to hopefully place highly.

Aerodynamics (Fall)

Wing

The main wing must be able to accommodate external payloads, as well as the loads of the aircraft itself. Therefore, the main wing must be strong. It must also allow the aircraft to be aerodynamically efficient. The aspect ratio (wingspan to area of the wing platform) and airfoil are the key components when selecting a main wing.

The lifting device that we will implement will be required to develop sufficient lift of the aircraft in order to takeoff in the specified 30 foot square. The lifting device will also have to be limited on the induced drag that it produces such that it will be able perform the above stated task. The lifting device structure will also have to sustain loads on the scale of 3.5 g's in order to pass the preflight test, this will consist of a spar running the length of the lifting device's structure to guarantee that the lifting device can pass the above stated test performed by the competition judges. The material of the lifting device will have to be light enough to reduce weight but strong enough to provide a safe range in order to prevent sufficient damage if an accident does arise.

Fuselage

The fuselage contains its own subsystem set. They include a payload area, an electronics/control systems bay, and other possible servo areas. The payload area will be strictly dependent upon the minimum amount of payloads (4) that we must fit inside of the aircraft, while maintaining a low structural weight. The electronics bay is where the propulsion battery pack, motor (All battery packs must have a combined weight of no more than 1.5 pounds) and fuse should be located.

Empennage

The tail is largely responsible for climb rate and pitch control. Its selection is a function of balancing the lift and other moments generated by the rest of the aircraft. In a word, stability is the job of the tail. The empennage needs to be rigid as to prevent any tail-induced instability of the aircraft in flight. Weight is not as important here because in comparison to the entire aircraft, the empennage is relatively light.

Electronics and Propulsion

Propulsion System

The propulsion system should include a battery pack, motor, and propeller. The propulsion system is where the thrust for the aircraft will come from. The thrust greatly affects the speed and climb rate of the aircraft.

The propulsion of the aircraft will be required to develop enough thrust in order to get the aircraft up to speed within the allotted space. The propulsion system will consist of a motor, a battery pack to power the motor and a propeller that the motor will turn which will develop the thrust needed. The maximum allowed current draw for propulsion is 20Amps.

For the spring of 2013 the propulsion system will be finalized by testing each of the candidates that were purchased, and experimentally determining the ideal setup to maximize thrust within the amperage limit.

Control Surfaces

For the control system, there is a radio controller and receiver, transmitter, as well as a speed controller. The radio controller allows the aircraft to use the required fail-safe mechanism. There are multiple servos that will control different parts of the aircraft like the rudder, empennage, wing, etc.

There will have to be at least three main control surfaces: aileron, rudder, and elevator. Flaps are an additional option if that design concept is accepted. The ailerons will be attached to the trailing edge of the lifting device and will be responsible for producing more lift on one wing while decreasing the lift on the other wing; this will result in a banking effect of the aircraft. The rudder will be conjoined with the vertical stabilizer in order to direct air in one direction which will produce a yaw effect on the plane; this effect in turn with the bank created by the ailerons will control the horizontal movement of the aircraft from side to side. The elevator will be conjoined behind the horizontal stabilizer in order to produce a moment about the tail of the aircraft in order to pitch the aircraft up or down depending upon the desired movement of the aircraft and thus will produce more lift or less lift depending upon the angle of attack. Flaps are an additional option which would help in developing lift on the takeoff roll and would increase the rate of descent without increasing the airspeed of the aircraft.

Structure/Layout (Fall)

Landing Gear

The landing gear is a key for takeoff and landing. The landing gear for the aircraft must allow the aircraft the takeoff in the constrained runway, and is a significant contributor to the overall drag of the aircraft.

Landing gear is required for this year's missions as the aircraft is required to takeoff from a static position. The aircraft is also required to land on the pavement runway without bouncing off and causing significant damage. The landing gear will be a tricycle configuration in order to provide a stable landing for the aircraft.

For the spring of 2013 landing gear will be purchased from a major manufacturer so that our processes do not add unnecessary weight. This will raise cost, but save a lot of time and weight.

Mechanisms

Mechanisms will be required for the attachment of the stores both internally and externally. The stores that will be stowed internally need to be secured to the aircraft's body and must be made as to simulate a midflight drop of the internal stores and must be completely enclosed in the body of the aircraft. The external stores must be attached to the body such that no store centerline is within three inches of another store or the aircraft centerline. The mechanism for holding and attaching the external stores must be able to sustain the weight of the stores and the drag produced by the store during flight.

Net Changes to Scope (Spring 2013)

Our goal is to complete a working prototype and then compete with it. That is our first objective for this semester and this year.

Technical plan: Currently, we are in the process of cutting out our ribs for our balsa wood wing and tail. We are also waiting for materials to come in so that we may begin testing our propulsion system in order to determine its ideal configuration. Some of the challenges will be to create a fastening system for the rockets which will be stored on the interior and exterior of the aircraft. We also need to fasten our landing system, which will be a factory-made unit in order to preserve the ultra-light characteristics of carbon fiber. Full-system prototyping will begin immediately after all parts arrive and are tested individually.

Budget

Our total maximum budget given to us by Dr. Alvi through FCAAP is $1500. Without counting shipping and taxes, we have spent under $400, leaving sufficient leeway to make emergency changes later in the semester if such need comes about.

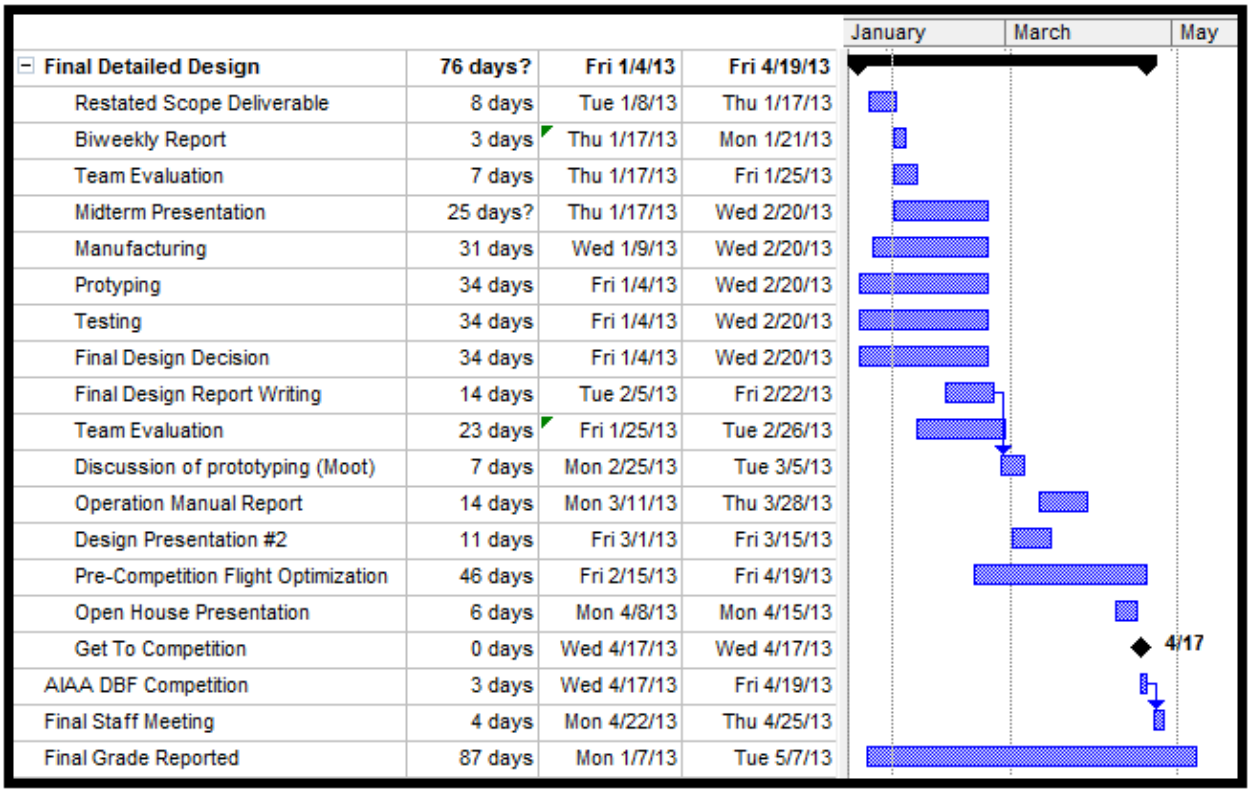
It should be noted that we are not done ordering, and there will be more parts on their way. We have ordered what we require to start building, though the finishing items like shrink wrap and epoxy have not been obtained yet.

Product	Size (inches unless specified) or Product Description	Quanity	Unit Price ($)	Total ($)
Wood	3x36x1/32	8	0.65	5.2
	3x36x1/16	10	1.21	12.1
	3x36x1/8	6	1.72	10.32
	3x48x1/8	20	1.94	38.8
Carbon Fiber	3mm x 750 mm	2	1.49	2.98
	0.25x0.25x80	2	5.35	10.7
	0.25x0.25x24	3	19.8	59.4
Motors	860kV 22A	1	15.58	15.58
	1320kV	1	20.15	20.15
	1100kV	1	9.34	9.34
Servos	Hs 325 Hb	6	12.99	77.94
Model Rockets	Der Red Max	4	12.99	51.96
	Mini Honest John	4	8.49	33.96
	Hi-Flier	2	6.99	13.98
	Mini Max	2	8.99	17.98
Total Spent to Date				380.39

Sources for purchases:
http://www.balsawoodinc.com
www.hobbyking.com
www.ehobbies.com
www.abellhobby.com
www.cstsales.com

Schedule

The scheduling for this project may not mesh perfectly with that of senior design. All of required completion dates are actually much sooner than the one posted for this course. There are two that overlay well. Those are the Open House presentation and the Final Meeting. They are just before and just after the competition respectively. All other dates will likely not apply to our design, but will be complied with in accordance with syllabus expectations.



Final Detailed Design	**76 days?**	**Fri 1/4/13**	**Fri 4/19/13**
Restated Scope Deliverable	8 days	Tue 1/8/13	Thu 1/17/13
Biweekly Report	3 days	Thu 1/17/13	Mon 1/21/13
Team Evaluation	7 days	Thu 1/17/13	Fri 1/25/13
Midterm Presentation	25 days?	Thu 1/17/13	Wed 2/20/13
Manufacturing	31 days	Wed 1/9/13	Wed 2/20/13
Protyping	34 days	Fri 1/4/13	Wed 2/20/13
Testing	34 days	Fri 1/4/13	Wed 2/20/13
Final Design Decision	34 days	Fri 1/4/13	Wed 2/20/13
Final Design Report Writing	14 days	Tue 2/5/13	Fri 2/22/13
Team Evaluation	23 days	Fri 1/25/13	Tue 2/26/13
Discussion of prototyping (Moot)	7 days	Mon 2/25/13	Tue 3/5/13
Operation Manual Report	14 days	Mon 3/11/13	Thu 3/28/13
Design Presentation #2	11 days	Fri 3/1/13	Fri 3/15/13
Pre-Competition Flight Optimization	46 days	Fri 2/15/13	Fri 4/19/13
Open House Presentation	6 days	Mon 4/8/13	Mon 4/15/13
Get To Competition	0 days	Wed 4/17/13	Wed 4/17/13
AIAA DBF Competition	3 days	Wed 4/17/13	Fri 4/19/13
Final Staff Meeting	4 days	Mon 4/22/13	Thu 4/25/13
Final Grade Reported	87 days	Mon 1/7/13	Tue 5/7/13

Conclusion

It was understood from the beginning that completing this project on time would be a challenge. We have arrived at the final leg of the undertaking and we are fully aware of the time crunch at hand. The coming weeks will be a tough series of finishing design decisions, manufacturing, and nerve-wrecking testing.