AIAA Design Build Fly Competition
Group # 16

EML4551-C Senior Design, Fall 2012, Deliverable

Project Plan/Product Specifications

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Introduction

As seniors at the FAMU-FSU College of Engineering we are granted the opportunity to work on a year-long design project that will put our previously attained knowledge on display to the engineering public. Our team has been selected to compete in a national design competition in which we will design and fabricate a remote-operated aircraft for submission into the AIAA Design/Build/Fly competition.

This competition has been ongoing on since 1996, and involves a myriad of different technical aptitudes in order to successfully compete. It is sponsored by the American Institute of Aeronautics and Astronautics which is the world's largest technical society dedicated to the global aerospace profession. In essence we will be judged on three flight missions, each involving different objectives, as well as our design report in which our research and design process will be evaluated. The competition takes place next April in Arizona and over the coming months we will be tasked with doing exactly as the title states: Designing, Building, Flying our aircraft, built from the knowledge we have extracted from our years at the COE as well as additional research as needed.

Product Specification Statement

The unmanned aircraft required for the competition will have several components to meet the requirements and to accomplish the designed missions. The aircraft will need a lifting device (wing), control surfaces, landing gear, propulsion, and mechanisms for the attachments of the stores (simulated missiles).

Aerodynamics

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 outside of the body of the aircraft.

Empennage (Tail section)

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.

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, which is required by competition rules, and causes the aircraft to enter a descending spin to the ground for safety reasons. There are multiple servos that will control different parts of the aircraft such as the rudder, elevator, and aileron.

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

Landing Gear

The landing gear is a key for takeoff and landing. The landing gear for the aircraft must allow the aircraft to take off 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.

Mechanisms

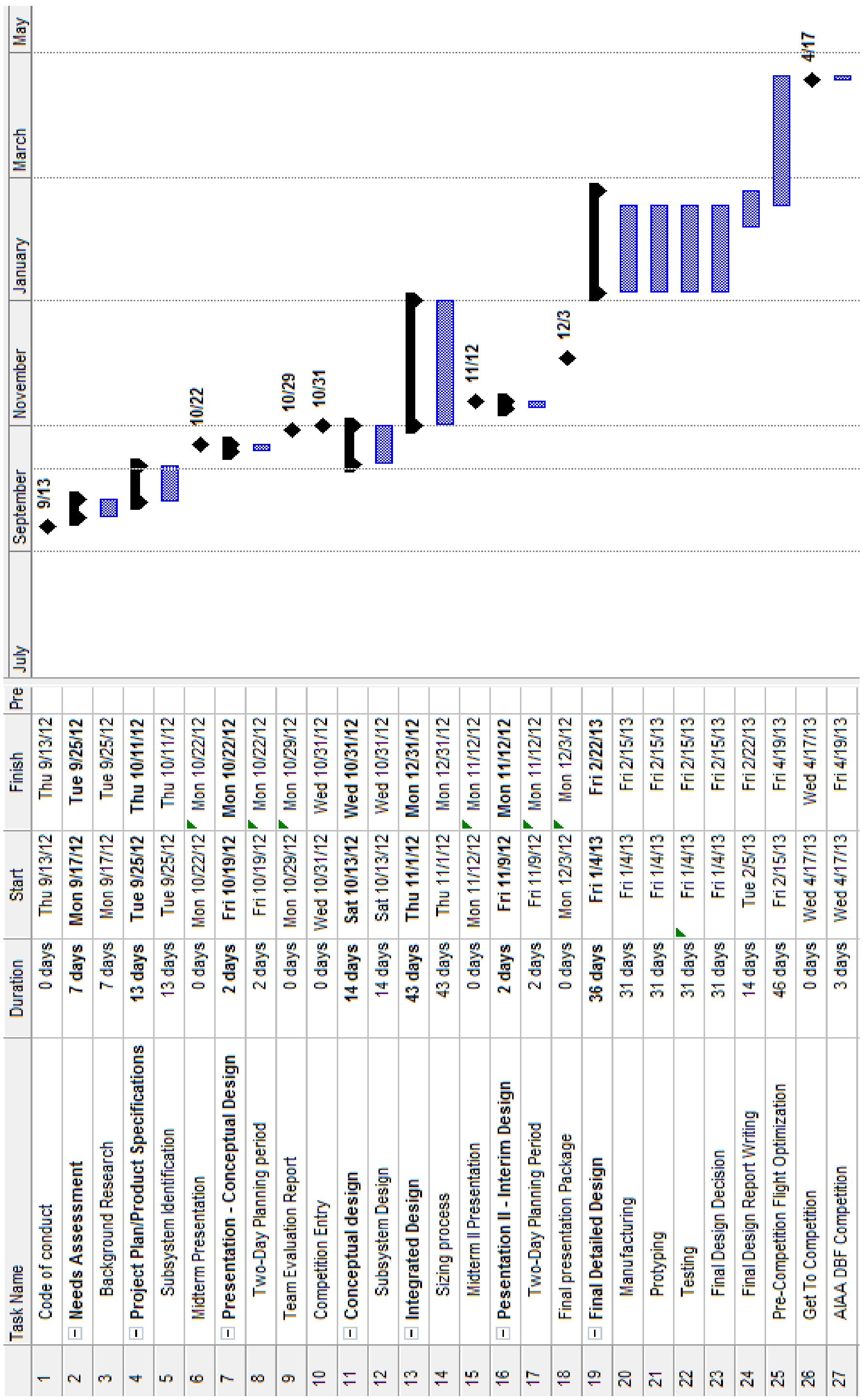
Mechanisms will be required for the attachment of the stores both internally and externally. The stores that will be stowed internally need to be secured to the aircraft's body and must be made as to simulate a midflight drop of the internal stores and must be completely enclosed in the body of the aircraft. 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.

Conclusion

The above subsystems are to be considered further in the concept generation phase of the project. They will each be evaluated using a decision matrix which considers figures of merit in order to determine the best possible choice for our parameters.

Design Schedule

The following schedule is a tentative set of dates which should describe the completion rate of our many tasks.



	Task Name	Duration	Start	Finish	Pre
1	Code of conduct	0 days	Thu 9/13/12	Thu 9/13/12	
2	**Needs Assessment**	**7 days**	**Mon 9/17/12**	**Tue 9/25/12**	
3	Background Research	7 days	Mon 9/17/12	Tue 9/25/12	
4	**Project Plan/Product Specifications**	**13 days**	**Tue 9/25/12**	**Thu 10/11/12**	
5	Subsystem Identification	13 days	Tue 9/25/12	Thu 10/11/12	
6	Midterm Presentation	0 days	Mon 10/22/12	Mon 10/22/12	
7	**Presentation - Conceptual Design**	**2 days**	**Fri 10/19/12**	**Mon 10/22/12**	
8	Two-Day Planning period	2 days	Fri 10/19/12	Mon 10/22/12	
9	Team Evaluation Report	0 days	Mon 10/29/12	Mon 10/29/12	
10	Competition Entry	0 days	Wed 10/31/12	Wed 10/31/12	
11	**Conceptual design**	**14 days**	**Sat 10/13/12**	**Wed 10/31/12**	
12	Subsystem Design	14 days	Sat 10/13/12	Wed 10/31/12	
13	**Integrated Design**	**43 days**	**Thu 11/1/12**	**Mon 12/31/12**	
14	Sizing process	43 days	Thu 11/1/12	Mon 12/31/12	
15	Midterm II Presentation	0 days	Mon 11/12/12	Mon 11/12/12	
16	**Pesentation II - Interim Design**	**2 days**	**Fri 11/9/12**	**Mon 11/12/12**	
17	Two-Day Planning Period	2 days	Fri 11/9/12	Mon 11/12/12	
18	Final presentation Package	0 days	Mon 12/3/12	Mon 12/3/12	
19	**Final Detailed Design**	**36 days**	**Fri 1/4/13**	**Fri 2/22/13**	
20	Manufacturing	31 days	Fri 1/4/13	Fri 2/15/13	
21	Protyping	31 days	Fri 1/4/13	Fri 2/15/13	
22	Testing	31 days	Fri 1/4/13	Fri 2/15/13	
23	Final Design Decision	31 days	Fri 1/4/13	Fri 2/15/13	
24	Final Design Report Writing	14 days	Tue 2/5/13	Fri 2/22/13	
25	Pre-Competition Flight Optimization	46 days	Fri 2/15/13	Fri 4/19/13	
26	Get To Competition	0 days	Wed 4/17/13	Wed 4/17/13	
27	AIAA DBF Competition	3 days	Wed 4/17/13	Fri 4/19/13	

References

Design Build Bly Competition Rules
www.AIAA.org

Previous Senior Design Deliverables
http://eng.fsu.edu/me/senior_design/prev.html