

Company Information

Company Name	<i>Capstone Marketplace/USASOC</i>	Date Submitted	<i>June 11, 2021</i>
Project Title	<i>Quiet Drone (USASOC_DRONE)</i>	Planned Starting Semester	<i>Fall 2021</i>
Problem Code	<i>2021 USASOC 06</i>		

Senior Design Project Description

Personnel

Discipline	Number	Discipline	Number
Mechanical	5	Electrical	
Computer		Systems	

Company and Project Overview:

The United States Army Special Operations Command (Airborne) (USASOC) is the command charged with overseeing the various special operations forces of the United States Army. Headquartered at Fort Bragg, North Carolina, it is the largest component of the United States Special Operations Command. It is an Army Service Component Command. Its mission is to organize, train, educate, man, equip, fund, administer, mobilize, deploy and sustain Army special operations forces to successfully conduct worldwide special operations.

Within USASOC, this project will be done for the 3rd Special Forces Group. The 3rd Special Forces Group (Airborne) – abbreviated 3rd SFG(A) and often simply called 3rd Group – is an active duty United States Army Special Forces (SF) group which was active in the Vietnam Era (1963–69), inactivated, and then reactivated in 1990. 3rd Group—as it is sometime called—is designed to deploy and execute nine doctrinal missions: unconventional warfare, foreign internal defense, direct action, counter-insurgency, special reconnaissance, counter-terrorism, information operations, counter proliferation of weapon of mass destruction, and security force assistance. The 3rd SFG(A) was primarily responsible for operations within the AFRICOM area of responsibility, as part of the Special Operations Command, Africa (SOCAFRICA). Its primary area of operations (AO) is now Africa as part of a 2015 SOCOM directive but 3rd Group has also been involved in the Caribbean and the Greater Middle East. The 3rd SFG(A) has seen extensive action in the War on Terror and its members have distinguished themselves on the battlefield in Afghanistan. (Wikipedia)

Project Requirements:

Drones applications are growing quickly as users realize the utility of having a relatively inexpensive means of having an airborne resource for video, transport and many other use cases. One of the drawbacks to drones are the relatively loud sound of the propellers. At high enough altitudes, the noise is nearly imperceptible, however when flying at low altitudes the high pitched “buzzing” frequency can be annoying. In fact, a recent NASA study¹ found that people perceive the drone buzzing to be more annoying than the same decibel sound level of typical road noise. For a mission designed for stealth, the noticeable sound at lower altitudes necessary for the mission are problematic. While current designs are optimized for lift characteristics and weight minimization, it may be desirable for stealth missions to optimize differently for noise reduction.

The objective of this project will be to study current drone designs, characterize typical noise characteristics and develop designs with lower noise signatures. Project team should develop multiple design alternatives that will be analytically analyzed in the first semester and built and tested in the second semester to validate the analytical work and determine the best design for noise reduction. The means of quieting drones can consider aerodynamic, electrical, acoustic feedback, or other techniques.

The Statement of Work and Specification will be finalized in Week 4 based on discussions with the team, faculty mentor and client technical supporters. The design approach for alternatives considered and design path selected will be presented at the Conceptual Design Review which will occur in Week 7. The rest of semester 1, the team will be doing detailed design work for the selected design variants. In the second semester, the student team will build, test and verify their chosen design approach.

Expected Deliverables/Results:

Quiet Drone Drone deliverables:

1. Survey of typical drone designs and noise characteristics. Budget would prevent buying multiple drones, so this would be via research or testing of client drones if they can loan them out.
2. Analysis of multiple noise reduction ideas
3. Build of the most promising noise reduction ideas and compare and contrast noise performance as well as payload and flight duration capability.
4. Designs must perform in typical outdoor exposures.

Project Plan:

During the two semesters, the students have approximately 50 assignments due for their projects.

Some of the key deliverables and timing are:

Semester 1:

- Confidentiality Agreement – Week 1
- Statement of Work – Week 4
- Specification – Week 4
- Conceptual Design Review and Project Plan - Week 6



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- Progress Reports 1 – Week 6
- Progress Report 2 – Week 12
- Preliminary Design Review and Updated Project Plan – Week 13
- (one at Week 6 and one at Week 12)
- Expo Poster and Final Design Package – Week 16

Semester 2

- Project Status Review Presentation and Updated Plan – Week 4
- Progress Report #1 – Week 6
- Progress Report #2 – Week 11
- Prototype Review Presentation and Updated Plan – Week 12
- Expo Poster, Project Summary and Project Video – Week 15
- Expo and Final Project Report – Week 16
- Delivery of Prototype – Week 16

Project Budget: \$5,000. Budget will be spent on team travel and project materials for developing the prototype/proof of concept.

The following is an estimate of the budget breakdown:

Budget Category	Cost	Justification
Project Materials	\$3000	Materials cost for design variants
Services	\$250	Machining, Fabrication or 3D printing of brackets, etc.
Travel	\$700	2 day trips for team to go to Ft. Bragg in University van
Total Direct Costs	\$3950	
Indirect Costs	\$1050	Contribution to event costs, purchasing department, other Senior Design overheads

Project Budget Management

Each team has a Project Lead. Among other things, the Project lead is responsible for management and reporting on the budget. At each design review and all reports, the team will report as to what their estimated expenses are and actuals to date compared with the project budget. Our Purchasing process includes a Purchasing Status Document with shows real time expenditures of project funds and the budget. The Purchasing process in use also has a formal process to follow if a team design is in danger of going over budget and detailed procedure to prevent this from happening without express approval from ISL and the project sponsor.

Residuals

Due to the administrative cost of refunding residuals, the Senior Design program applies any residuals to the general operating costs of the Industrial Solutions Lab. These funds, if any, are applied to things like lab consumables, safety equipment, tool attrition, etc.

Disposition of Deliverables at the End of the Project:



The work product will be displayed at the last Expo then immediately handed over to the supporter unless arrangements have been made to deliver at a future date.

List here any specific skills, requirements, specific courses, knowledge needed or suggested (If none please state none):

- Interest in drone technology
- Team must provide detailed Project Budget status at each design reviews and in all reports. The status will include estimated cost expenditures and actual to date expenditures compared with the Project budget.
- Students and mentors must be US Citizens.

Citations

¹ Initial Investigation into the Psychoacoustic Properties of Small Unmanned Aerial System Noise, Andrew Christian and Randolph Cabell, NASA Langley Research Center, Hampton, VA 23681, U.S.A.