

### **Company Information**

<b>Company Name</b>	<i>Capstone Marketplace/USASOC</i>	<b>Date Submitted</b>	<i>June 11, 2021</i>
<b>Project Title</b>	<i>Remote Drone Recharging (USASOC_RECHARGE)</i>	<b>Planned Starting Semester</b>	<i>Fall 2021</i>
<b>Problem Code</b>	<i>2021 USASOC 04</i>		

### **Senior Design Project Description**

#### **Personnel**

<b>Discipline</b>	<b>Number</b>	<b>Discipline</b>	<b>Number</b>
Mechanical	2	Electrical	1
Computer	2	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 3<sup>rd</sup> Special Forces Group. The 3<sup>rd</sup> Special Forces Group (Airborne) – abbreviated 3<sup>rd</sup> SFG(A) and often simply called 3<sup>rd</sup> 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. 3<sup>rd</sup> 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 3<sup>rd</sup> 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 3<sup>rd</sup> Group has also been involved in the Caribbean and the Greater Middle East. The 3<sup>rd</sup> 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 short flight times due to limited battery life on the drone. As batteries are one of the heavier components of the drone, manufacturers minimize their size as much as possible to what they consider the sweet spot between battery weight and flight time.

For most drones, when the battery starts to get exhausted the drone returns to base to get a new battery pack. This limits considerably the type of missions that can be conducted via drone. The objective of this project is to be able to extend mission durations by giving the drone a way to recharge its battery at the mission location without having to return to the base. Two possibilities for consideration:

- 1) Provide means for a small quadcopter drone to parasitically attach to a power source and recharge in the field. The drone will connect to typical urban and rural electrical service lines, power supply cables, transformer terminals, or other power sources.
- 2) Alternately, a small, portable, self-contained recharging system placed in the mission area that may be developed that will allow quadcopter drones to locate, land, be electrically recharged, and fly multiple sorties.

The student team can consider these two methods or propose other ideas to meet this objective.

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 approach. In the second semester, the student team will build, test and verify their chosen design approach.

### **Expected Deliverables/Results:**

#### Drone Remote Charging System

1. Portable, able to fit in small to medium backpack
2. Size/footprint: less than two 8 1/2' X 11" sheets of paper, side by side (11" X 17")
3. Weight 15 lbs or less
4. Self contained--no external power, but dock is reusable/rechargeable
- 5, Provides means for drone to find charging station, orient, and dock/land on it.
6. Able to mechanically and electrically capture small commercial "hobby" type drone
7. Provide at least 3 recharges for drone
8. Able to communicate status and receive commands from external source over RF network. WiFi, cell net, or other channels TBD
9. Designed for outside use, exposure to elements

### **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
- 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	Drone, camera, materials for recharging station
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
- Interest in object recognition applications
- 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.