RoboCopters

Group 28

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Sponsor: Lockheed Martin

Contributors: Mechanical Engineering, Aerospace Engineering, Computer Science

Project Narrative

Description:

Many lives are risked daily to help defend and protect our human rights and liberties. In addition to the benefits this Robocopter offers on the defense side it would also be of assistance in times of catastrophe to also help save lives. As we have seen in the recent weeks, there have been a number of natural disasters all around the world. In instances such as these, where for example there are an unknown number children trapped underneath a collapsed building in Mexico, a robocopter as the one we will be developing would be useful.

The Robocopter is autonomous meaning it does not need to be controlled using a remote control, which could bring up signal issues. With this in mind, this Robocopter sends live first person video to a ground station, which would allow rescuers to view the conditions. It would allow them to evaluate how many people are there, their location and how they could effectively rescue them. Although this particular project is designed to identify an "enemy" it can be easily modified to adapt to other emergency conditions.

This project aims at mitigating those losses by being able to provide a more reliable and precise unmanned Robocopter that can evaluate its surroundings, track an enemy, respond, and attack. This unmanned autonomous vehicle is going to be designed to track another UAV that will be considered prey and then continue to pursue and attack it. The UAV must also be able to adjust its flight accordingly due to moving and unmoving obstacles. This will be accomplished through a series of algorithms that will enable the robocopter to identify the enemy using a camera and laser technology. For this it should also be able to predict some of the future movements of the enemy robocopter in order to effectively launch a laser pointer to it and not cause harm to the innocent around it.

Goals and Objectives:

The goal is to create a robocopter for defense that is worthy of competing with those already designed in the market. In addition, another goal is to research and find the most efficient way of tracking and detecting prey drones, or other moving targets. For

this robocopter we are looking to make it as energy efficient as possible, and with smooth and controlled motions. The objective is to have an affordable and portable robocopter that excels in detecting and engaging with enemies. Another goal we have for this robocopter is to be weather resistant. The competition will take place outdoors and considering the unpredictable weather in Florida, it is imperative that the aircraft can withstand various weather conditions. Some of these conditions include - but aren't limited to - rain, extreme heat (we must make sure that the copter doesn't overheat), and strong winds (it must be able to withstand them and continue its course).

Ultimately we strive to design and implement a robocopter worthy of competing and that will win in the competition. We are designing it to be able to get as many points as possible in the competition. Yet, most importantly, our intention is to build a robocopter that has valuable technological elements that could later be adopted and implemented in other copters that could serve in preserving and protecting life. As we are a sponsored project, our goal is to add value to this company perhaps with something that they could use and implement later on. In addition we are going to ensure that we are setting a good example and representing the company well, make sure we represent their name in an outstanding manner.

Requirements Specifications:

Requirements:

- A camera or sensor for the Robocopter to detect prey drones around it
- A tracking algorithm/mechanism for the Robocopter to lock onto the prey drones and to attempt to intercept them
- The ability to transmit the video from the camera to a ground station
- The ground station must display the video from the Robocopter, as well as the tracking algorithm at work.
- Battery must be able to sustain flight for at least 10 minutes at a time.
- Reasonably sized, no larger than a medium sized home printer.
- Must be able to re-track prey after collision with foreign objects.
- Must have a protective cage around it for when it collides.
- Must have the ability to laser track the enemy and launch a projectile at it.

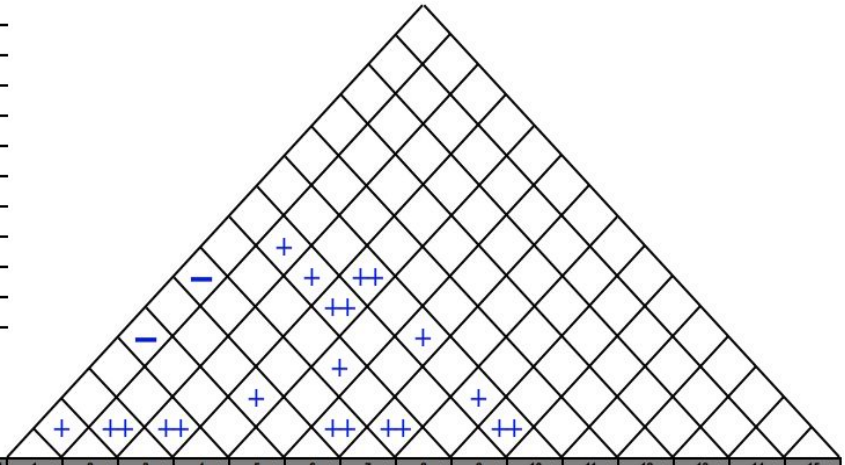
- Must consume enough power to efficiently run the UAV without overheating other components.
- Must be able to adjust tracking/locating of foreign object within 1 sec.
- System must have weatherproof protection on all electrical components.
- Components must not interfere with movement of quadcopter.
- Must have a way of monitoring battery usage/voltage.
- A ESC (Electronic Speed Controller) to control the motors.

Constraints:

- Funding (discussed further). Due to this being a sponsored project we should assure that we stay within the given boundaries of financing for the project. When selecting either one piece of technology versus another we may or may not have to sacrifice certain aspects of each to stay within the budget.
- Size of the Robocopter- It needs to be big enough to properly attack the prey, but also not too large, so that it has the speed and agility necessary to weave through the obstacles.
- Time.
- Unknown characteristics of the UAV prey provided by Lockheed Martin.
- Unknown weather conditions of the competition (visibility could affect laser targeter)
- Size of PCB - we will need a PCB that can contain all the components needed to make the robocopter work, yet that it will be a comfortable fit in the body of the robocopter.
- The production of each component from each discipline involved in this project. Also basing on their resources.

House of Quality

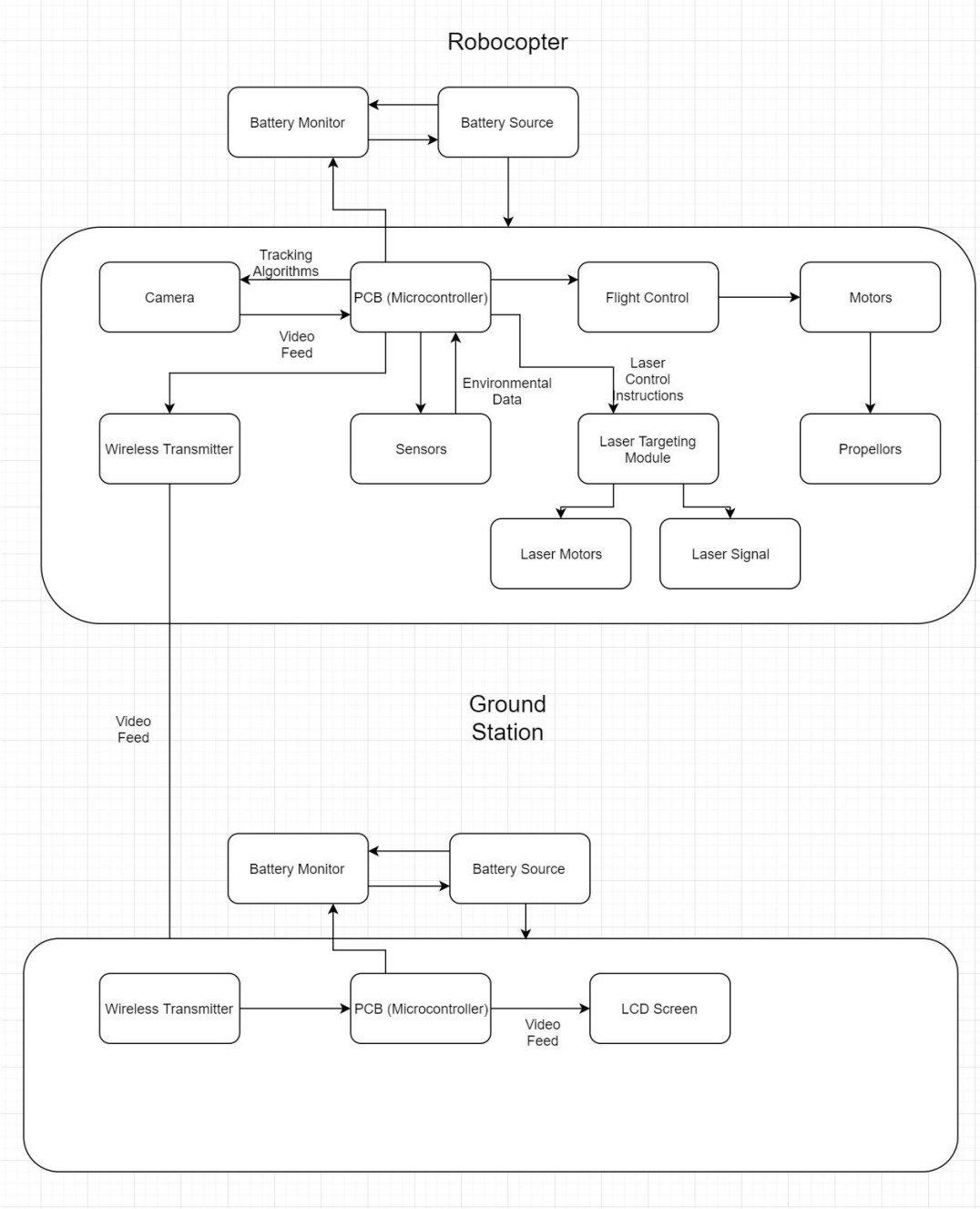
Title: House of Quality: Robocopter
Author: Group 28
Date: Septemeber 22, 2017
Notes: Senior Design 1: Project - Robocopter sponsored by Lockheed Martin



Row #	Max Relationship Value in Row	Relative Weight	Weight / Importance	Demanded Quality (a.k.a. "Customer Requirements" or "Whats")	cost	weight	size	speed	camera type	PCB	Laser Technology	Algorithm	power supply	motors					
				Column #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
				Direction of Improvement: Minimize (▼), Maximize (▲), or Target (x)	▼	▼	▼	▲	▲	x	x	x	▲	x					
1	9	13.0	13.0	Unmanned - Autonomous						⊙	O	⊙							
2	9	13.0	13.0	Laser Designate Prey						⊙	⊙	⊙							
3	9	13.0	13.0	Transmit Live FPV to control station					⊙	⊙									
4	3	13.0	13.0	FPV will display highlights of Algorithms					▲			O							
5	9	13.0	13.0	Run for minimum of 10 minutes		▲		▲					⊙	⊙					
6	9	13.0	13.0	Fly		⊙	⊙	O		⊙				⊙					
7	3	13.0	13.0	Protective Cage		O	O												
8	9	9.0	9.0	Stay in Budget	⊙				▲										
9																			
10																			
				Target or Limit Value	$500	max 3lbs	smaller then printer	max of 25mph	action (wide angle)			for Arduino	5V						
				Difficulty (0=Easy to Accomplish, 10=Extremely Difficult)	6	7	7	5				4	3						
				Max Relationship Value in Column	9	9	9	3	9	9	9	9	9	9					
				Weight / Importance	81.0	169.0	156.0	52.0	139.0	468.0	156.0	273.0	117.0	234.0					
				Relative Weight	4.4	9.2	8.5	2.8	7.5	25.4	8.5	14.8	6.3	12.7					

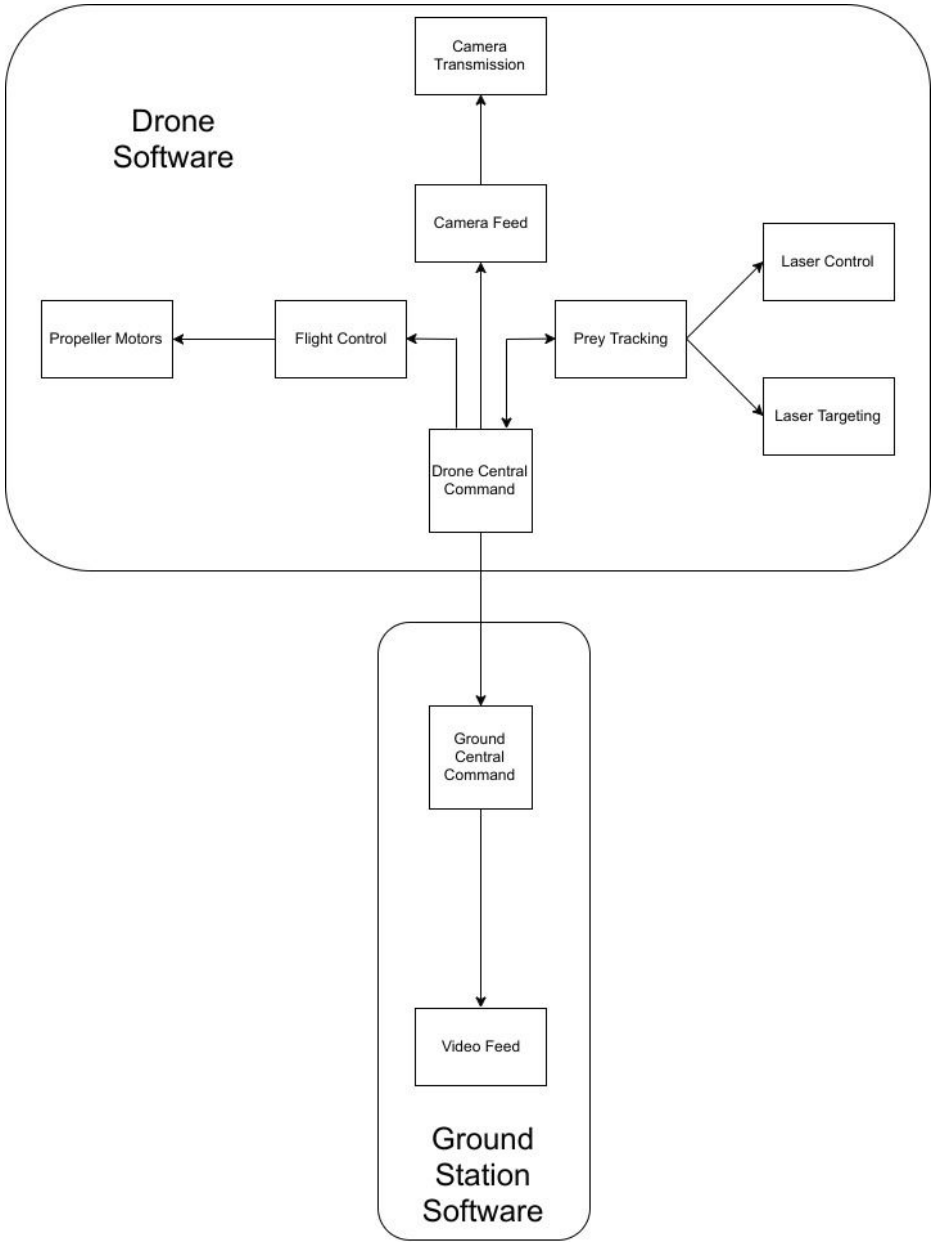
Diagram Provided by QFD Online

Hardware Block Diagram



As of 9/22/2017, all blocks are currently in the research phase. No parts have been acquired or prototyped as of yet. Pamela Echevarria and Jarryd Salas will be the primary designers of the hardware aspect of this project.

Software Block Diagram



All software aspects of this project are currently in the research phase as of 9/22/2017. Branden Griffin and Joey Velez-Ginorio will be the primary designers of the software component of the robocopter.

Project Budget and Financing

There will be two major aspects for this project - most importantly the drone, but also a ground station. The drone will consist of a few major components. An arduino or raspberry pi-like PCB will act as the brain of the drone. Attached to this PCB will be a battery source and a camera. The camera will act as the optics for the drone, allowing it to track the other drones. Finally, a transmitter will be needed to send a video feed to the ground station.

The ground station will consist also of an arduino based PCB, which is attached to an LCD screen which displays the video feed sent from the transmitter on the drone. Consequently, the ground station will also require a transmitter. Below is a table of estimated parts and costs:

Part	**Cost**
Arduino based PCB (x2)	$20-$30 each
Wires and circuit components	~$30
Battery source (x2)	~$20 each
Battery monitor	~$5
LCD Screen	$40-$60
Wireless/Bluetooth transmitter (x2)	$20-$50
Motors (x4)	~$20 each
Propellers (x4)	~$5
Sensors	~$5
Mobile Camera	~$50
Laser	~$5
Laser mount	~$10
Laser motor	~$10
Electronic speed controller (x4)	~5
Total:	~$445

Project Milestones

Number	Milestone	Scheduled Completion Week
1	Procure draft parts list for CE/EE team	5
2	Meet with CS/AE/ME teams to get their draft parts list requirements	6
3	Run calculations on possible parts lists, to get information about speed, fly time, power consumption, etc.	7
4	Devise final parts list that meets the demands of the CS/AE/ME teams.	8
5	Meet with CS/AE/ME teams to finalize parts list	9
6	Order parts for CE/EE team	10
7	Start building the drone	12
8	Start working on PCB	10-15
9	Order PCB	16
10	Integrate PCB into drone	17
11	Hardware / Software Debug	17-END

Citation

"QFD Online." *QFD Online RSS*, www.qfdonline.com/templates/.