EEL 4914

Group 29

Initial Project and Group Identification Document

MAZE ZONE DRONE-CAR PAIR

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Customer/Sponsors: N/A

Motivation and Function:

The motivation for this senior design project began with an intense interest among the members of the group into integrating a drone into the core of their project. We first pitched the idea of an autonomous drone that could image large swaths of farmland and track crop growth. However we scaled back our ambitions and settled on a drone-car pair that can solve mazes using computer vision and guide the car to its destination.

The Maze Zone Drone (MZD) is a the first step in reducing the stresses of finding a parking spot in a crowded parking lot. Future ambitions could allow a user to release their MZD out the window of their car at the entrance of a parking lot and allow the MZD to find a parking spot, calculate the shortest path to the spot, and even guide the vehicle to the spot with the press of button. We wanted the drone to be able to communicate directly to the vehicle and for the drone to be controlled by the same vehicle to simulate a realistic environment. This project also has potential military applications as well, as the quadcopter drone can be made to be modular to include a variety of sensors to detect infrared and potentially thermal obstacles and plot a course around them.

The Maze Zone Drone is a portable quadcopter that is easy to manually control with autonomous stabilization and hovering capabilities. The MZD will use a camera to analyze a maze beneath it and wirelessly communicate with a remote controlled car that will then be able to navigate the maze's shortest path autonomously and quickly.

Goals and Objectives :

The drone should be small enough and light enough for a single person to easily transport and deploy and robust enough to withstand mishaps that may occur with the average untrained pilot. The drone should automatically assist the pilot during manual control for ease of use and have the option to set an autopilot mode that will hold the drone stable above the maze at a set altitude and lateral coordinate in order for the camera to acquire a stable view of the maze and the ground vehicle.

The ground vehicle should contain the main processing unit for all the image processing and manipulation as well as have the wireless communication infrastructure to communicate with both the radio control interface on the quadcopter as well as the camera wireless module. The ground vehicle should also have a motor controller that communicates to the main processing unit for instruction, this motor controller should also allow for the connection of ultrasonic sensors that allow it to sense the walls of the maze to better guide it along its path and to allow the air vehicle to only take one photo for ease of processing. It should also have a unique identifier, either in shape form or in coloring scheme, that will make it easy for the image processing software to identify where in the maze the ground vehicle is.

References:

There is one notable project, with the intention of creating a drone assisted parking system, that is currently in the process of Research and Development. This idea was announced the winner of Siemens Mobility IDEA Contest in January of 2015 and is now supported a team from Siemens.

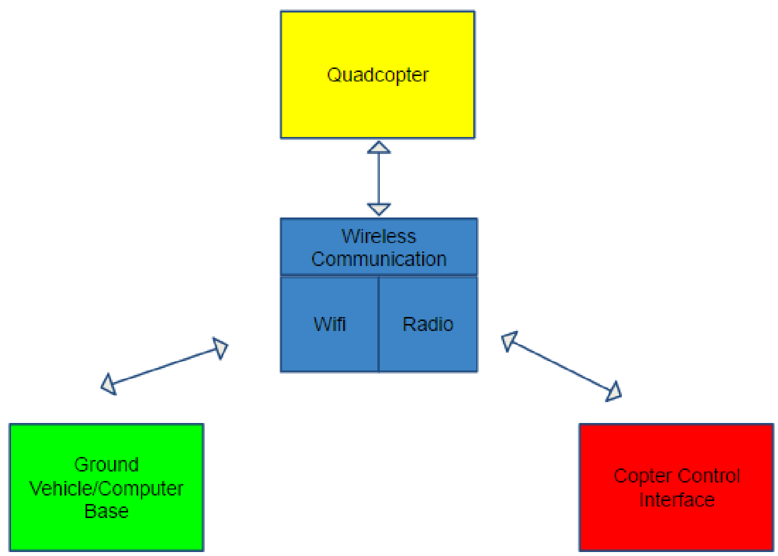
- http://venturebeat.com/2015/01/16/this-drone-tech-could-lead-you-to-a-parking-space-so-kick-and-scream-no-more/
- http://www.betaboston.com/news/2015/01/15/a-quadcopter-could-lead-you-to-your-next-parking-spot/

Requirement Specifications:

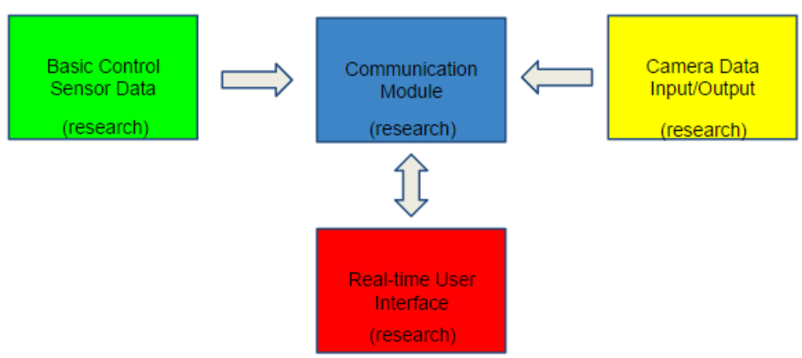
- Drone
  - Maximum of 3 feet diameter (propeller to propeller)
  - Maximum of 5 pounds
  - Minimum 10 minute hover time
  - Wireless communication up to 100 feet
  - Altitude accurate within 2 feet
  - Position Hold drift less than 2 feet per second
- Ground Vehicle
  - Less than 2 cubic foot in size.
  - Able to run for at least fifteen minutes.
  - Housing the processing core, or able to communicate with an outside processing core.
  - Able to move at least ½ foot per second

Block Diagram:

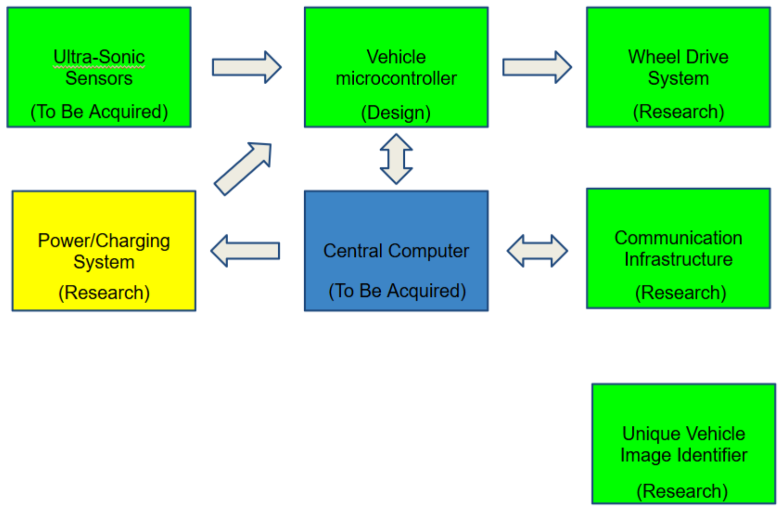
Overall Project Block Diagram



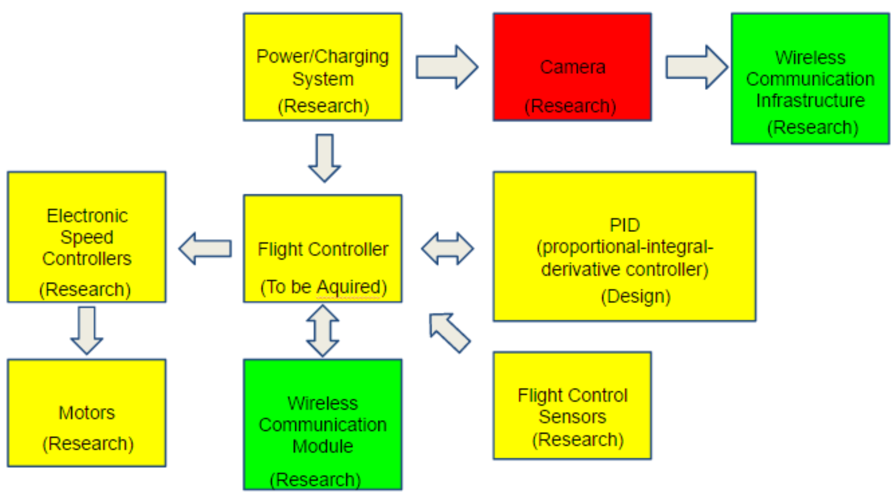
Copter Control Interface Block Diagram



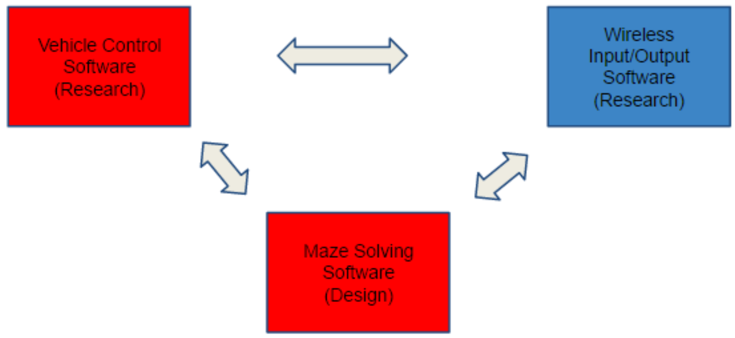
Vehicle Block Diagram



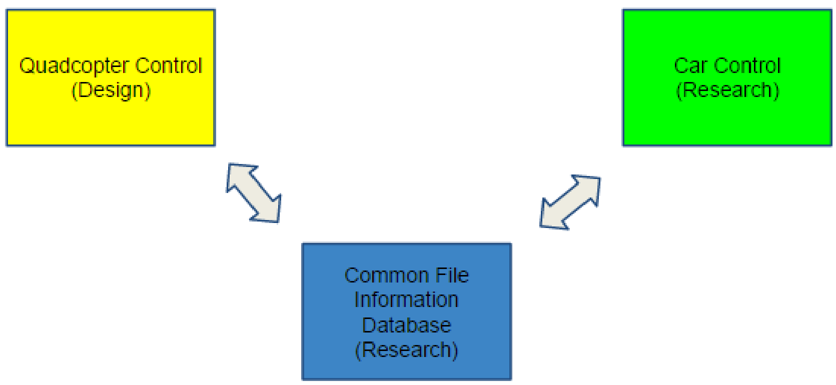
Quadcopter Block Diagram



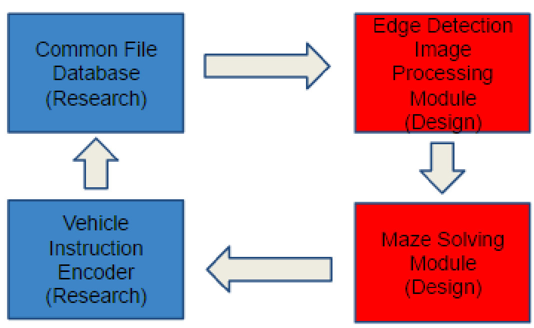
Overall Software Block Diagram



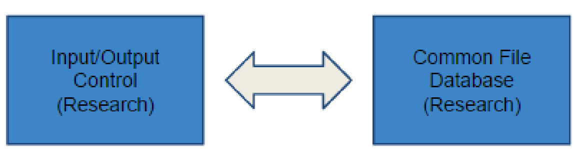
Vehicle Control Software Block Diagram



Maze Solving Software Block Diagram



Wireless Software Block Diagram

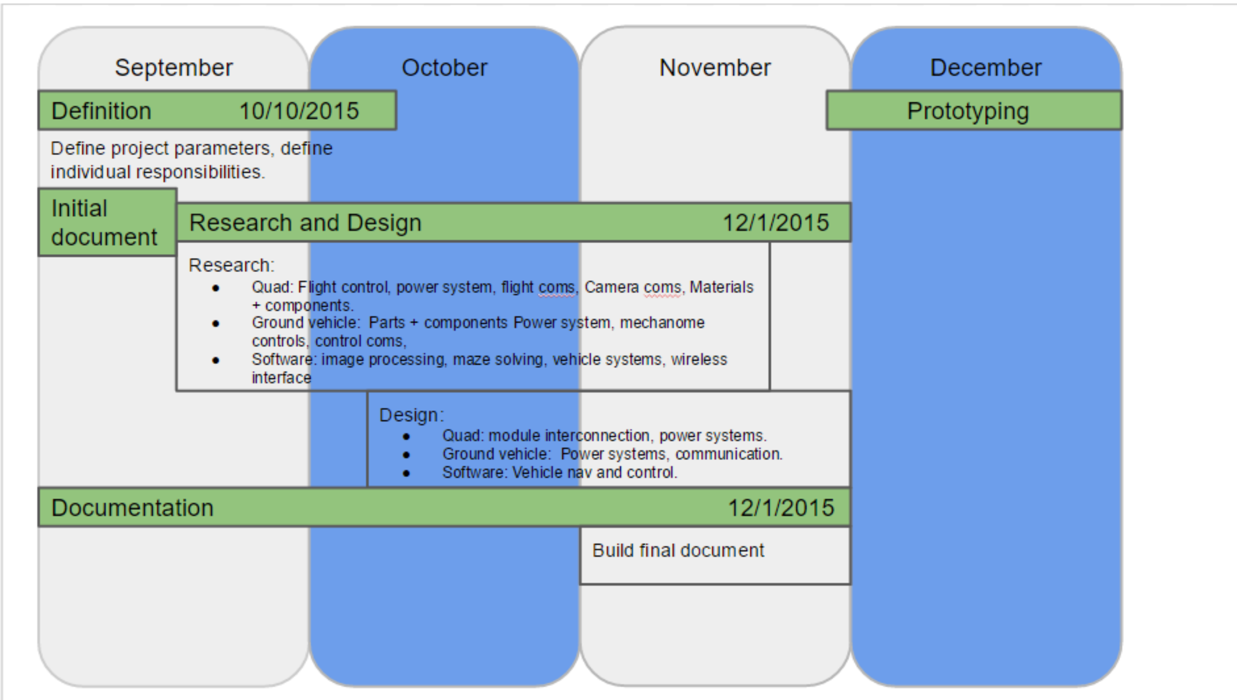


Budget

Budget and Financing								
Catagory	Item Description	Item	min quantiy	Expected Quantity	Unit Price	Minimum Price	Expected Price	
Quadcopter	Flight Controller	APM 2.6	1	1	$40.42	$40.42	$40.42	
	ESCs	to be designed	4	4	$0.00	$0.00	$0.00	
	Motors	estimate	4	6	$15.00	$60.00	$90.00	
	Battery (LiPO?)	estimate	2	3	$40.00	$80.00	$120.00	
	gps/compass	estimate	1	1	$30.00	$30.00	$30.00	
	Tx/Rx module	estimate	1	1	$50.00	$50.00	$50.00	
	Frame	estimate	1	1	$20.00	$20.00	$20.00	
	Arms	n/a	0	0	$0.00	$0.00	$0.00	
included in frame	Motor Mounts	n/a	0	0	$0.00	$0.00	$0.00	
	propellers	estimate	4	12	$5.00	$20.00	$60.00	
combined	Camera	estimate	1	1	$15.00	$15.00	$15.00	
	Camera Tx	estimate	0	0	$0.00	$0.00	$0.00	
Ground Vehicle	Rx module	estimate	1	1	$20.00	$20.00	$20.00	
	Wheels	aquired	4	4	$0.00	$0.00	$0.00	
	motors	aquired	4	4	$0.00	$0.00	$0.00	
	CPU	Rasperry Pi	1	1	$35.00	$35.00	$35.00	
	Motor Controller	Embd PCB	1	1	$0.00	$0.00	$0.00	
	Battery	estimate	2	2	$20.00	$40.00	$40.00	
	battery charger	estimate	1	1	$20.00	$20.00	$20.00	
	Ultrasonic sensors	SRF05	3	4	$15.00	$45.00	$60.00	
Additional Hardware	Breadboards	estimate	2	4	$5.00	$10.00	$20.00	
	PCB	estimate	1	2	$25.00	$25.00	$50.00	
	Wires	aquired	0	0	$0.00	$0.00	$0.00	
	hardware	estimate	1	2	$40.00	$40.00	$80.00	
	Solder	aquired	0	0	$0.00	$0.00	$0.00	
	Circuit Components	estimate	1	2	$50.00	$50.00	$100.00	
	USB AVR programmer	estimate	1	1	$5.00	$5.00	$5.00	
	Unexpected Costs	estimate	1	1	$200.00	$200.00	$200.00	
				Estimated Minimum Cost		$600.42	$850.42	Estimated Expected Cost

Timeline

Senior Design 1 (EEL 4914)



Senior Design 2 (EEL 4915)