Search and Retrieval System (SARS)

Initial Project and Group Identification Document

EEL4914 Senior Design I

Group Number 4

Group Members

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- Brendan Hall
- Erick Makris

Sponsors and Contributors

Group 4 does not currently have any sponsors; however, its members are pursuing sponsorships from SoarTech and Boeing as well as any other companies interested in facilitating the development of SARS.

Project Narrative Description

Statement of Motivation

Group 4 needed a project idea with enough design potential to satisfy the requirements for Senior Design. Its members wanted a project that would provide experience in embedded systems, image processing, communications between processors, and Android development. The primary goal of this project is to pass Senior Design and attract potential employers with our design experience.

Goals and Objectives

- To pass Senior Design with a grade of A.
- To attract potential employers.
- To implement an effective, professional quality search and retrieval system with multiple real life applications at an affordable price.
- To use computer vision as a means of locating objects.
- To program effective communications between SARS subsystems.

Project Function

SARS will be an effective, professional quality search and retrieval system with multiple real life applications. The system shall depend upon communications between a quadcopter, a ground rover, and an Android device. The quadcopter shall hover at an arbitrary height, use a camera to scan the ground below, locate a target object to be retrieved, and mark the its location with a GPS coordinate waypoint. The quadcopter shall then relay the waypoint to the rover, which will then navigate to the target object's waypoint, and begin searching for the object using a camera or some other sensor. SARS shall initially be set up to find one object;

however, Group 4 may decide to implement the system so that it searches for multiple objects. Once it finds the object, the rover will lift it up and return to the starting location. The video feed from the quadcopter camera along with diagnostic information (object coordinates, quadcopter height, etc.) shall be available for viewing on an Android device.

The quadcopter must include a high quality camera. If such a quadcopter cannot be found for an affordable price, a less expensive quadcopter shall be selected, and a high quality camera shall be mounted on it. The target object must be brightly colored enough that it is easily visible from the air.

Specifications and Requirements

Quadcopter

- Capable of interfacing wirelessly with a rover on the ground and with an Android device.
- Capable of taking high quality videos/photos.
- Has camera stabilization to facilitate image processing.
- Capable of identifying and locating an object on the ground and calculating its GPS coordinates accurate to within 5 ft.
- Capable of hovering at a constant height between 10 ft and 50 ft with a variation in height no greater than 3 in.
- Has battery life up to 10 minutes.
- Basic weatherproofing

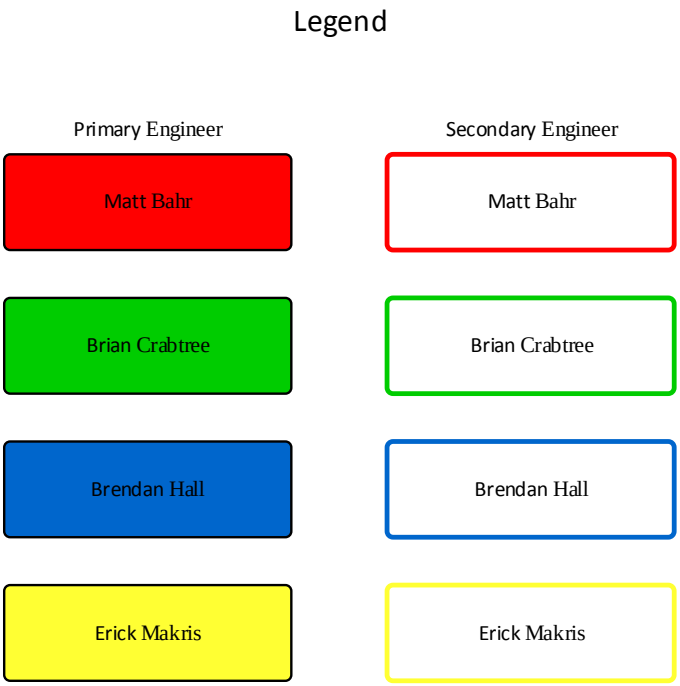
Ground Rover

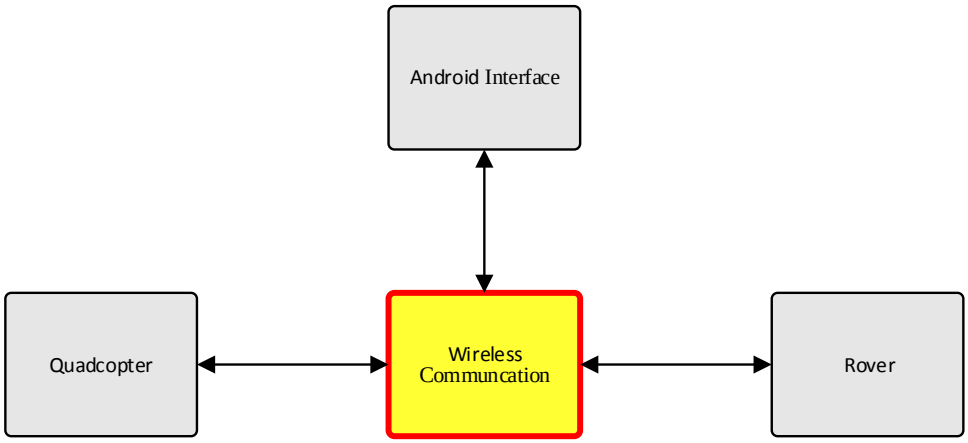
- Capable of interfacing wirelessly with a quadcopter in the air and with an Android device.
- Capable of travelling up to 1000ft on a single battery charge.
- Has a retrieval subsystem for picking up the target object off the ground.
- Has a subsystem that uses a sensor to find the target object once it has reached the GPS coordinates.
- Able to return to within 5ft of its starting location with the retrieved target object.
- Able to carry a load of 5 lbs.
- Basic Weatherproofing

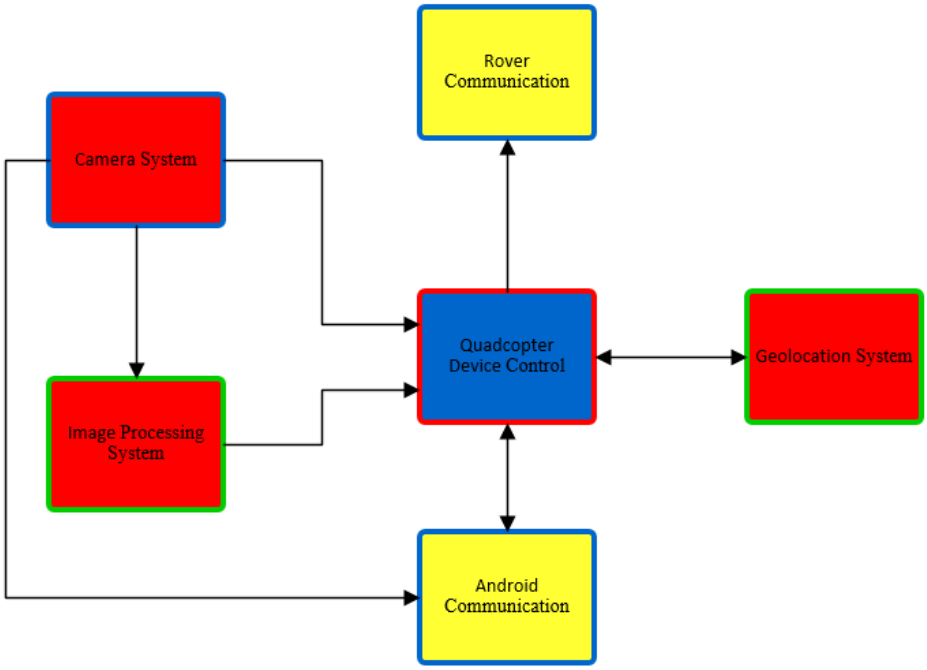
Android Application

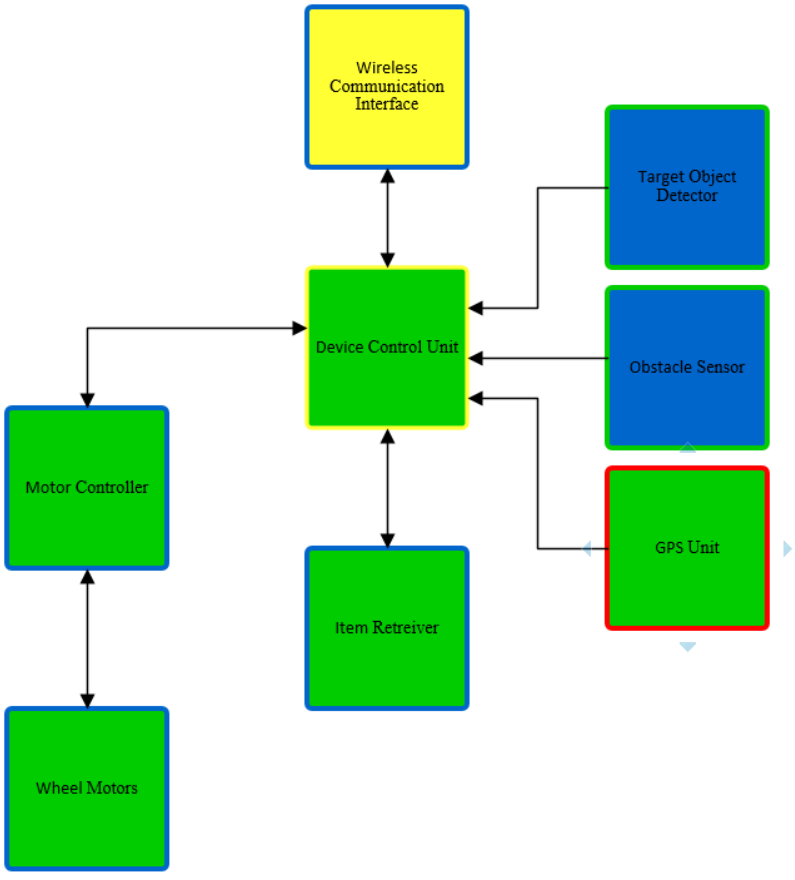
- Provide stop and start commands to rover and quadcopter
- View live video stream from quadcopter camera
- View GPS and other sensor data from quadcopter and rover

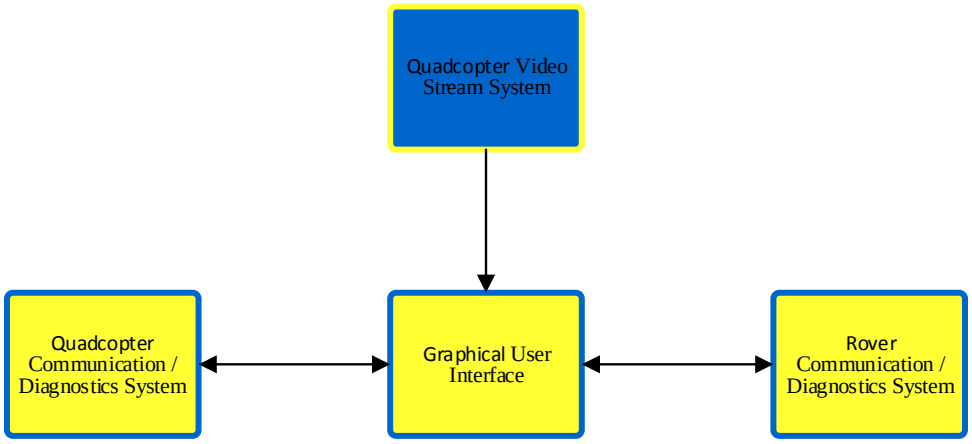
Block Diagrams






Rover Communication
Camera System
Quadcopter Device Control
Geolocation System
Image Processing System
Android Communication


Wireless Communication Interface
Target Object Detector
Device Control Unit
Obstacle Sensor
Motor Controller
GPS Unit
Item Retreiver
Wheel Motors



Budget

Item	Approximate Cost	Notes
Quadcopter	$400.00	
QC Camera	$300.00	GoPro
Camera Mount	$40.00	
QC Microcontroller	$20.00	
QC IMU	$15.00	
QC Communication Module	$15.00	Bluetooth
Rover	$170.00	Chassis, motor, and motor controller
Object Retrieval Apparatus	$50.00	
Rover Communication Module	$15.00	Bluetooth
Rover Microcontroller	$20.00	
GPS Chips (2)	$100.00	
PCB	$60.00	
Tennis Balls	$30.00	Items being detected
Total	**$1,235.00**	

The largest portion of the cost for our project comes from the quadcopter; depending on the pre-installed capabilities of the copter and whether or not we order it pre-assembled, the quadcopter can realistically run up to $1000. On top of just the copter, the camera device and mounting system used for the field detection can also be quite expensive as we need a

reliable camera for the item detection from the air. The simple ground rover is relatively inexpensive (it comes pre-assembled, which for the price is incredibly reasonable) and the android interface is essentially free. The microcontrollers and Bluetooth communication devices run cheap as well (in the $15-$30 range each), and we only need two of each, but the GPS devices could be costly depending on the accuracy required for our project to be successful on a small scale. The project estimates to cost around $1050, with a large degree of variation based on what capabilities we decide need to arrive pre-installed on the quadcopter as well as the proficiency of the camera being used for the aerial item detection.

Project Milestones

Design documentation will be handled concurrently with all project milestones.

Component		Completion Date
Quadcopter	Specs	9/9/2014
	Research	10/10/2014
	Design	11/23/2014
	Build	1/9/2015
	Test	2/13/2015
	Integration	4/1/2015
QC Camera/Item Detection	Specs	9/9/2014
	Research	10/10/2014
	Design	11/23/2014
	Build	1/9/2015
	Test	2/13/2015
	Integration	4/1/2015
QC Communication Interface	Specs	9/9/2014
	Research	10/10/2014
	Design	11/21/2014
	Build	12/12/2014
	Test	2/2/2015
	Integration	4/1/2015
Ground Rover	Specs	9/9/2014
	Research	10/10/2014
	Design	11/7/2014

	Build	1/9/2015
	Test	2/13/2015
	Integration	4/1/2015

Rover Item Detection	Specs	9/9/2014
	Research	10/10/2014
	Design	11/23/2014
	Build	1/9/2015
	Test	2/13/2015
	Integration	4/1/2015
Rover Communication	Specs	9/9/2014
	Research	10/10/2014
	Design	11/21/2014
	Build	
	Test	2/2/2015
	Integration	4/1/2015
Android Application	Specs	9/9/2014
	Research	10/10/2014
	Design	10/24/2014
	Build	11/23/2014
	Test	2/13/2015
	Integration	4/1/2015