UCF

COLLEGE OF ENGINEERING & COMPUTER SCIENCE

Air Reconnaissance to Ground Intelligent Navigation System

GROUP MEMBERS

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MOTIVATION

With the advent and subsequent popularity growth of UAVs (unmanned air vehicles) and autonomous vehicles, we have begun to see their use and functionality expand and diversify in both civilian and military applications. Piggybacking on this technology boom, we decided to explore ways in which UAVs might be implemented in a semi-autonomous, Internet of Things type of application in an effort to aid ground personnel in high-risk scenarios. Military departments and public safety organizations with Search & Rescue or Search & Destroy type needs could benefit from the added efficiency and reduced manpower of having such technology. We also feel that this would be an excellent project to exercise and develop our engineering knowledge and skillset.

GOALS AND OBJECTIVES

We seek to design and implement a ground vehicle that autonomously solves and navigates a maze without using typical trial-and-error methods. To do this, we propose implementing a reconnaissance UAV that snaps an aerial photo of the maze and utilizes Computer Vision technology to intelligently solve the maze and wirelessly relay navigational cues to the autonomous vehicle in a master-slave dynamic. Instead of solving for just the exit of the maze, we plan to equip the system with the ability to find and approach a predetermined object within the maze before safely exiting. We also plan to make the system capable of optimal path detection and robust to path blockage (obstacle avoidance).

- Wireless communication
- Intelligent maze navigation
- Optimal path detection
- Obstacle avoidance
- Accurate and precise object detection
- Lightweight
- Long battery life

Project Functionality

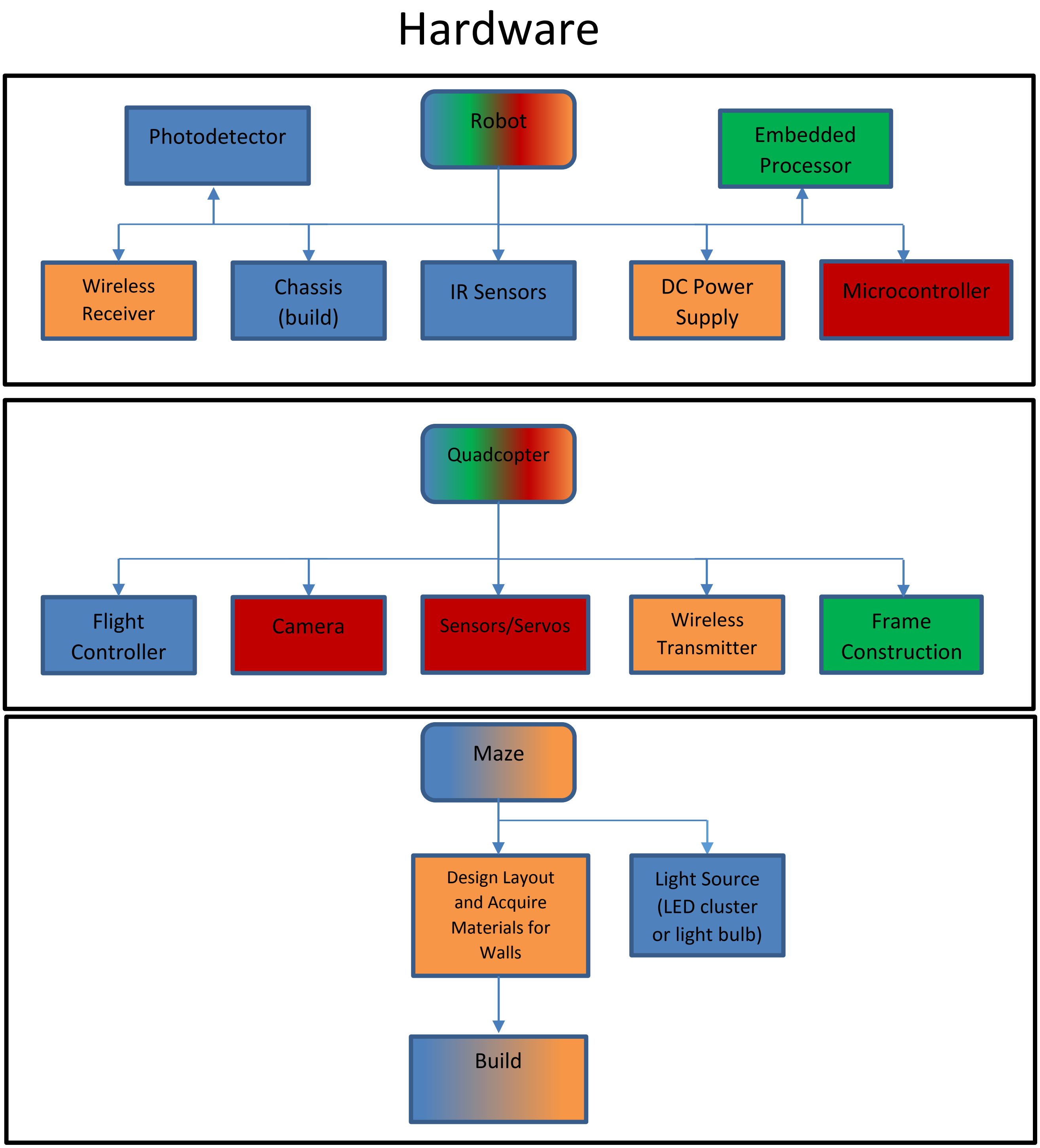
1. A maze will be built with both an entrance and exit. A light source will then be placed at a predetermined location within its boundaries.
2. A quadcopter will be manually flown above the maze until it is hovering above the maze and the entirety of the maze is within the mounted camera's view.
3. The camera will take an aerial snapshot of the maze and transmit the image wirelessly to an autonomous ground vehicle. The camera may continue taking images at specified intervals to provide pseudo-real-time monitoring.
4. The ground vehicle will receive the image and an embedded processor capable of running the algorithm will begin to process it. Techniques such as line and edge detection will be used to determine the boundaries of the maze and thresholding will be used to pinpoint the light source.
5. Once this is done, a maze-solving algorithm will determine the optimum path the robot should take to locate the light source and exit the maze. The robot will either return to the entrance or continue to the exit depending on the distance from each to the light source.
6. The optimal path will be translated into commands to be sent to the microcontroller which controls robot movement.
7. When the robot navigates the maze successfully and enters the illuminated area, a photodetector will be used to determine the objective was reached and an exit path will be computed to guide the robot out of the maze.

Requirement Specifications

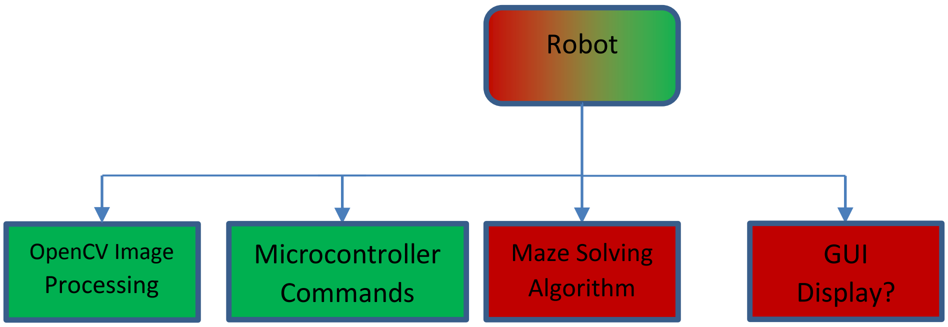
- Camera mounted on quad-copter will weigh no more than 0.5 lbs. with at least 480p quality.
- Quad-copter will hover 8-10 ft. above the maze
- The robot will travel at a minimum rate of 1 ft./sec
- The robot will weigh no more than 10 lbs.
- The wireless communication between the car and camera will use the IEEE 802.11 standard
- All video recordings must abide by the "two-party consent" law which dictates that it is a crime to record a "wire, oral, or electronic communication" in Florida; therefore, audio will not be recorded.

Block Diagram

Hamza Jerrod Nate Will



Software



Estimated Budget

One of the most important factors for any project is budget management. Once our group agrees on our ideal project, we will start by asking the following questions: How much money does this project require? Will we be able to find a sponsor for the project? And so on. For the present time, we are planning on entering the TI Innovation Challenge North America Design contest and applying the $200 TI eStore coupon towards any chips or development boards we may need. Then if we don't have any other type of sponsorship, the rest of the money for the project will be self-funded by each of the group's members. Below is the tentative cost for our project.

Estimated Cost Table

Part Description	cost ($)
Quadcopter	200
Microcontroller & Dev. Board	50
Camera	15
IR Sensors	20
Photodetector	3
Wireless transmitter/receiver	20
Chassis	80
Maze materials	0
Embedded Processor	sample from **TI**
Total estimate	$385 + Shipping

PROJECT MILESTONE

Unlike other classes that we have completed as undergrad students, senior design is more challenging for various reasons. It can be a time consuming course and, because of this, it is important for each member involved to share his/ her most important values and develop a suitable schedule that works out for the entire team. Also, it is essential for each member of the group to share the work and establish a project milestone to be able to stay within the scope of the design. Milestones allow group members to more precisely determine whether or not the project is on the right track. Below is a brief outline of our project milestone.

FALL

- Define our project
- Submit project proposal
- Research wireless communication methods, ground vehicle design, maze solving algorithms, object recognition
- Determine characteristics required for all components and use these to research parts.
- Purchase/Construct chassis of ground vehicle
- Order any parts necessary for completion of prototype

SPRING

- Write software required to solve the maze and program microcontroller to navigate ground vehicle
- Construct a working CCA schematic
- Design PCB of ground vehicle and order
- Solder components onto PCB and verify that all connections are working
- Combine all components of the system and verify, through testing, that they are able to communicate with one another
- Build a functioning prototype
- Present project