SEARCH AND RESCUE CHALLENGE

Request For Proposal

Issued: September 12, 2013
Pre-Proposal Due: October 03, 2013
Full Proposal Due: November 07, 2013

Introduction
This is a formal request for each student to propose a technical and management plan for your final project. This Request for Proposal (RFP) document explains the project objective, requirement, and the proposal format. Each student is expected to submit a pre-proposal independently. Based on individual interests, teams will be formed to investigate different technical areas. A full proposal with a comprehensive plan and preliminary results will then be requested for each team. The final deliverable of the project will include a series of demonstrations, team presentations, and a final project report.

Mission Objective
The mission is to develop an autonomous mobile robot that can search and rescue a patient from an unknown indoor area. The robot needs to find the patient (a doll); lift the patient up with a robotic arm; find the shortest path to return to the start position, where a quad-rotor helicopter can send the patient to the hospital. The entire operation must be fully autonomous without human intervention. The main educational objective of this project is to apply the knowledge you learned during and outside the mobile robotics class into solving a practical engineering problem. Furthermore, you will practice how to write a technical proposal and how to work effectively in a team environment.

Technical Challenges
There are five major technical challenges for this envisioned search and rescue mission:
1. Localization and Mapping – building a map of the surrounding area and estimate the robot's own position and orientation in the map;
2. Path Planning and Robot Control – finding an efficient path to explore an unknown area without priori information and finding the shortest path home with a map built by the localization and mapping team;
3. Vision Based Object Detection, Tracking, and Position Estimation – finding the object in the video data and estimate its position with respect to the robot;
4. Robotic Arm Control from Visual Feedback – controlling a multiple degree of freedom robotic arm to grab the object based on visual feedback;
5. System Integration and Testing – getting subsystems working together in a seamless fashion.

Pre-Proposal Requirement
The pre-proposal should include one cover page and no more than three single-spaced pages of technical discussions in font size 12. Within the pre-proposal, you should identify two technical areas (one primary and one secondary) that you want to work on and provide a proposed solution for each area. Note that the "system integration and testing area" cannot be selected in your pre-proposal. The following components are required for the pre-proposal:

1. Cover Page (1 page)
2. Technical Discussion (no more than 4 pages, single spaced, font 12)
   a. Introduction and Objective
   b. A Literature Review of Relevant Articles
   c. Proposed Overall Technical Approach
   d. Proposed Solution for the Primary Research Area
   e. Proposed Solution for the Secondary Research Area
   f. Related Past Experience
   g. References

Based on common interests, teams will be assigned by the instructor for different technical areas.

Full Proposal Requirement
One full proposal will be submitted by each team. The following components are required for the full proposal:

1. Cover Page (1 page)
2. Project Summary (1 page)
3. Table of Content (1 page)
4. Project Description (no more than 10 pages, single spaced, font 12)
   a. Introduction and Objective
   b. Literature Review
   c. Proposed Technical Approach
   d. Preliminary Results
   e. System Integration and Testing Plan
   f. Project Schedule
   g. Team Qualification
   h. Project Management and Individual Responsibility
5. References (as needed)

Clearly document your proposal for full credit.

Approval
Each proposal will be reviewed and graded by the instructor. A proposal with grade above or equal to 60% will be approved. A proposal with grade below 60% will be rejected and a revised proposal will be requested.

Final Project Score
The final project will contribute to 30% of your final grade of the class. This means a total of 30 points with the following distribution:

- Pre-Proposal: 5 points
- Full Proposal: 5 points
- Completion of the sub-system demonstration: 5 points

- Completion of the full-system demonstration: 5 points
- Final Report: 5 points
- Individual contribution within the team: 5 points

Important Dates

Oct 03, 2013 – Pre-Proposal Due
Oct 10, 2013 – Finalize the Team Technical Area and Members
Nov 07, 2013 – Full Proposal Due
Dec 03, 2013 – Sub-Systems Demonstration, Initial Full System Demonstration
Dec 05, 2013 – Team Presentations
Dec 10, 2013 – Project Report Due
Dec 17, 2013 – Last Chance for Full System Demonstration

Useful Resources

- Robotics, Vision and Control: Fundamental Algorithms in MATLAB
  http://link.springer.com/content/pdf/10.1007%2F978-3-642-20144-8.pdf
- MATLAB Robotics Toolbox
  http://petercorke.com/Robotics_Toolbox.html
- Machine Vision Toolbox
  http://www.petercorke.com/Machine_Vision_Toolbox.html
- MATLAB Object Detection and Tracking:
  http://www.mathworks.com/help/vision/gs/object-detection-and-tracking.html
- Simultaneous Localization And Mapping (SLAM) for Dummies
  http://www.core.org.cn/NR/rdonlyres/Aeronautics-and-Astronautics/16-412JSpring-2005/9D8DB59F-24EC-4B75-BA7A-F0916BAB2440/0/1aslam_blas_repo.pdf