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RescueBot

Project Overview

Our project, rescuebot, is a case study in autonomous reconnaissance for ground robots. Given an unknown environment, the Neato Rescuer, will need to explore, find, and log information about the scene. At the end of an exploration run, it should be able to communicate the locations of fiducials previously hidden in the environment with relative accuracy. A project like this will unite elements of mobile robotics approaches to mapping and movement, as well as computer vision topics in object recognition and visual servoing.

As a minimum deliverable, we would like a robot that:

- can navigate the STAR center and create a map (not necessarily correctly localized?)
- is able to find and identify one of the target objects and locate it somewhere on the map (not necessarily the correct place)

Our stretch goal is to:

- create an accurate map of the STAR center with accurate locations of all objects,
- identify all objects properly,
- and win the competition.

Learning Goals

Joint learning goals:

- Deeper understanding of SLAM algorithms
- More experience/practice with OpenCV and computer vision development, especially conceptual and dealing with environmental changes

For Cypress:

- More experience with ROS best practices: visualizing things with rviz, using or modifying built-in packages for mapping, writing testable code, using launch files

For Victoria:

- Practice good coding hygiene and techniques
- Practice mapping techniques (implementation, almost a continuation of previous mobile robotics project)

For Christina:

- Practice good coding practices, structure (Python + ROS)
- Experimenting with robot data visualization (rviz, bagfiles)
- Best practices/practice with multiple people coding and then codebase integration

Schedule for Development

- Week 1 (11/14 - 11/21) - Research, test prototype code
- Week 2 (11/21 - 11/28) - Thanksgiving
- Week 3 (11/28 - 12/5) - More research and prototyping
- Week 4 (12/5 - 12/12) - Integration and more testing, optimization
- Week 5 (12/12 - 12/18) - Finishing up optimization, writing report
- **12/18 - FINAL DEMO**

Approach

We are not yet certain what frameworks and algorithms we plan to use. In general, we expect this project to consist of the following main parts (subject to change):

1. Mapping of environment
2. Navigation of environment (including pathplanning?)
3. Target object identification (vision)
4. Target object localization

To address the vision aspect of the project, we are considering:

- HSV masks (if objects are color-differentiated)
- Hough transforms or contours (if objects are shape-differentiated)
- Neural nets/machine learning
- Object recognition libraries (if looking for objects in certain categories)

To address the mapping and navigation aspects of this project, we are considering:

- LIDAR data processing
- Finite state controller
- Visual servoing
- Dynamic mapping
- Built-in (or modified) SLAM packages

We plan on cross-referencing data from both the camera(s) and onboard LIDAR for target object localization, and possibly also navigation.

Anticipated Risks

- Mapping makes the robot confused, or isn't accurate enough
- Speed of the robot due to computational tax is limited
- Vision techniques are not robust in multiple situations (lighting, environment change, etc)

Resources Required

We would like to use an additional camera, which requires another Raspberry Pi (and on/off switch). We also need the target objects for testing, but that goes without saying.