Final Project Proposal

Applying some of the probabilistic methods
learned during the course to real robots
using the Lego Mindstorms EV3 kits.

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CS8803: Artificial Intelligence for Robotics

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Our intention for the final project is to implement some of the probabilistic robotics methods learned during the semester on the Mindstorm EV3 kits. The primary motivation is to gain real world experience on these advanced technologies. On this paper, we will briefly propose a set of realistic goals along with their due dates.

Equipment

For this assignment we will be using the Mindstroms EV3 standard kit with a couple additions. In specific we all will be using the following:

Processing

- EV3 Brick with ARM9 processor

Sensors

- UltraSonic Sensor
- Infrared Sensor
- Color Sensor
- Touch Sensor

Actuators

- 2 Large Servo Motors for forward motion and steering control
- 1 Medium Servo Motors for orienting the ultrasonic sensor

Operating Systems and Programming

The programmable brick runs Debian Linux from `http://www.ev3dev.org` and programming will be done in Python using the API from `https://github.com/topikachu/python-ev3`

Chassis

The chassis we will be using will vary among the team members. However, we will each adapt the project to our individual dimensions.

Overall Goal

Error values will be used to compute the success rate of the program. The goal is to acheive accuracy at least as good as the sum of all average error values. Goals are met if the absolute value measured is within $\pm$ the error value.

- Robot Localization
- Robot Control
- Add Filters

Goals and Expectations

Project Deadline: December, 7th 2014 - 10pm EST
5 weeks to completion

1. Movement - Due: Week Nov 9th.
   a) Determine the average error value from moving the robot 10 cm forward and 10 cm backward.
   b) Determine the average error value while turning right 90 degrees.
   c) Determine the average error value of spinning the turret sensor 180 degrees clockwise and 180 degrees counter clockwise.
2. Sensing - Due: Week Nov 16th.
   a) Determine the average sensor error of the ultraSonic Sensor while stationary, moving and rotating.
   b) Determine the average sensor error of the infrared Sensor while stationary and moving.
   c) Determine the average sensor error of the color Sensor while stationary and moving.
   d) Calculate the sonar cone for the ultrasonic sensor.
3. Environment response tests - Due: Week Nov 30th.
   a) Stop within 10 cm from a wall using the ultrasonic and then the infrared sensor.
   b) Circumnavigate a room once by turning right and following the wall using the ultrasonic and then the infrared sensor.
   c) Move forward until the color sensor reads red.
   d) Follow a red line around the room using the color sensor.
4. Localization - Due: Week Dec 7th.
   a) Build a map of landmarks (colors) and walls. Place the robot in a random location and have it localize itself with the following action cycle. (Sense, Compute, Move) The robot moves small steps and stops while it senses and computes the next step. The goal is to reach a single red dot once localized.

b) OPTIONAL: Repeat the first localization problem, but thread sense, compute and move to be simultaneous actions.

c) OPTIONAL: Create a map while exploring the room instead of a given map.

d) OPITONAL: Using the created map, try to find the red dot in the room.

Probabilistic Methods

The project will use at least one method taught in the course CS8803 for all goals mentioned in part 4 and optionally for the last step of part 3. Any algorithms from outside of the course will be documented and referenced accordingly.

Deliverables

We will use the same submission logistics as the hexabug project:
Only one of our team members will submit the final project. That team member will put the archived files into their Drop Box on T-Square.
The following are the deliverables for this project:

- A list of all of your team members with emails and gtIDs.
- Source code for all project pieces.
- Flat file outputs for the sensor readings during final runs.
- Video recording of final runs.
- Readme file containing an explaination of the algorithms and methods used for each part.
- Data summary and charts of results.