Lab 7

Map Making

Reading: *Introduction to AI Robotics (Ch. 11)*

(Demonstration due in class on **Thursday**)

(Code and Memo due in Angel drop box by midnight on **Sunday at midnight**)

Read this entire lab procedure before coming to lab.

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Purpose: The purpose of this lab is to use range sensors on a mobile robot to create an occupancy grid or topological map. The mapping task involves the creation of a hybrid topological and metric map of the robot's world by using sensor feedback and an exploration algorithm.

Objectives: At the conclusion of this lab, the student should be able to:

- Use sensor data to create an occupancy grid or topological map of the robot's world
- Create a world model that the robot can use for navigation

Equipment: Base Robot

Range sensors

Software: AVR Studio 4 (32-bit) available at
http://www.atmel.com/dyn/products/tools_card.asp?tool_id=2725

WinAVR GCC toolchain (http://winavr.sourceforge.net/)

CEENBoT API static library available at

http://www.digital-brain.info/downloads/capi324v221-v1.09.002R.zip

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LAB PROCEDURE

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Theory:

Part 1 - Build the world model

1. In this exercise, you will build a map of the 6' x 6' test arena by using a cover algorithm and sensor feedback. The robot should be able to use the created map to plan a path from a start position to a goal location. Try to reuse as much code as possible from prior labs once the map has been created to simplify the path planning and execution.

2. Note that mapping will be tricky because of odometry error, sensor error, and other sources of error. A completely accurate map would require localization to reduce the uncertainty of position. However this would require SLAM which is difficult to implement. Therefore, using only the dimension of the environment and the robot start position for the mapping try to create the best map possible.

3. You can use teleoperation, wander, cover, wall following or any other motion algorithms to move the robot through the environment and code the space where the range or contact sensor detects objects. One possible technique is to create a generalized Voronoi diagram to efficiently explore the environment.

4. To create the occupancy grid, you can use a Bayesian, Dempster-Shafer or Histogrammic in Motion Mapping (HIMM) techniques. Figure 1 provides an example of a Generalized Voronoi Graph (GVG) with HIMM labeling. You do not have to use this technique you have the flexibility of selecting your own technique to create the model.

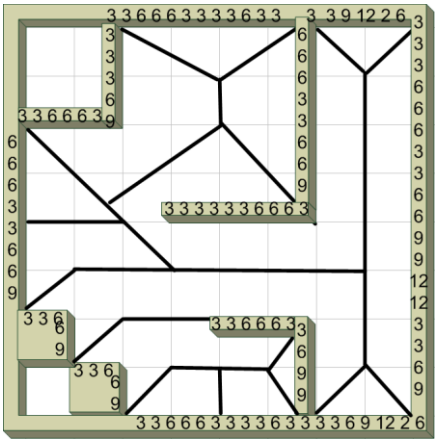

Figure 1: GVG with HIMM

Part 2 - Navigation using the robot's model

1. During the demonstration, the robot will be placed in the world and begin to explore the environment and create the map. It will be necessary to keep track of the robot's odometry and object location in order to use the map for navigation.
2. Lastly, you will be given a start position and goal location for your robot on the newly created map. The robot should then plan a path from the start position to the goal location and execute it.
3. You will be graded on the ability to generate the map, the accuracy and detail in the map and how well the robot is able to use your world map to plan a path to a goal location while avoiding obstacles.

Demonstration:

This week's demonstration will involve showing the world model created by the robot on the LCD and then using that model to plan a path and follow the path from a given start point to goal point.

Bring your robot fully charged to class on Thursday for the demonstration. Note that you always must re-flash the factory firmware and plug in the AC adapter in order for the robot to charge. Alternately, you can put the robot battery in the RC car battery charger. Note that this is a fast charger and will not last as long as the outlet charge.

See prior labs for information on the program, memo, submission requirements and grading rubric.