Robotics: Integrated System Design Fall 2009

Lab 3: Autonomous Hazmat Robot Updated: October 5th, 2009

Goals

- To implement a method of path-planning and navigation.
- To become familiar with mapping.
- To design a sensor suite for specific task.
- To do something significant to the real world for a class project.

Introduction

Robots are typically used for 3D jobs – dull, dirty, or dangerous. Among the jobs robots are being developed for are to help in dangerous disaster situations – **rescue robots**. Robots were used in the recent mine collapse to search shafts that were filled with harmful gasses. Robots were also used in a recent accident involving radioactive material that was trapped in a pneumatic tube at a research facility.

Currently the state of the art is robots that are remote controlled. However, in order to be more beneficial, research is focusing on autonomous rescue robots. Your team is to design and build an autonomous hazardous materials robot. A fire has broken out in a warehouse designed to store various chemicals, some are very dangerous. Your hazmat robot is to go into the building, search for rooms that are on fire, and identify and map canisters of potentially hazardous materials.

Team Assignment

- Design and build a robot that uses an internal map to search a warehouse for burning debris and canisters of potentially hazardous materials.
- The robot is to navigate through a set of rooms in an order determined at the time of entry. Your robot must have a method for entering the room order
- If a canister is encountered, the robot must determine if it is hazardous and communicate this to the human operators by playing a tune or waving a flag. The robot must do the same if it finds the fire but with a distinct indicator.

Warehouse

- The warehouse is in EB 2029. Construction details will be presented in class. There is a ceiling at the entrance and a virtual ceiling in the warehouse that the robot must not cross.
- The rooms will be labeled as follows (relative to the entrance): A (lower-right), B (lower-left), C (upper-left), and D (upper-right).
- A light bulb represents the fire. Cans represent canisters: **red** (hazardous) or **green** (neutral).
- The floor of the warehouse will be represented by a 10x10 grid, where, from the entrance, (0, 0) is the upper-left corner at the intersection of the tiles and (9, 9) is the lower-right corner. The robot must signal to the human operators if any cell is occupied by either a hazardous chemical canister or the fire (see map below).

Demonstration

- Demonstrations will be held in EB 2029 on **October 28th.**
- A total of 10 minutes will be given to each team. You may restart as many times as wanted, but only one single continuous run will be counted.

Deliverables

- A lab report describing your team's implemented design. It must include pictures and describe your path planning algorithm.
- Team Meeting notes (as described in the General Lab Philosophy).
- **Due date**: October 30th at 11:59 pm.

Evaluation: 100 points

- Demonstration: 68 points
  - Each room searched: 5 points (20 points possible)
  - Visiting rooms in proper order: 10 points
  - Each hazardous chemical canister signaled and coordinates displayed: 2 points for correct color (max 8 points, -2 for false positive), 5 points for coordinates (max. 20 points; -2 point per cell unit error).
  - Identifying the room that contains the fire and signaling: 10 points
- Lab report: 20 points
- Team Meeting Notes: 15 points

Extra Credit: 40 points

- Each canister picked-up and carried: 2.5 points (10 points possible)
- Each canister removed from fire area: 2.5 points (10 points possible)
- Upon completion, return to the starting area (entrance of the warehouse): 5 points
- Multi-robot entries are possible. Must demonstrate the robots are coordinating (10 points)
- Shortest time per points earned (5 points)