Spring 2016
Control of Mobile Robotics
CDA4621
Lab 4
Path Planning
Total: 100 points
Due Date: 4-28-16 by 8am

A. Lab Requirements

The lab requires use of the course robotic hardware ("Robo-Bull-2016") provided to students at no charge for the duration of the course. Required software can be downloaded free of charge from the web. All labs are to be done by teams of two students. Each student is required to submit his or her joint report through CANVAS.

- Hardware Requirements

The "Robo-Bull-2016" (Figure 1) is the main robot hardware used for the course. Note, that the components of the robot are the same as in Lab1.

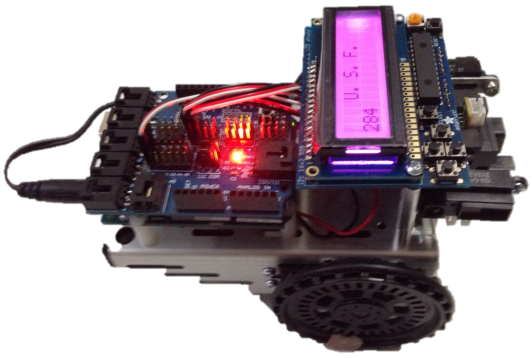

Figure 1: Robo-Bull-2016.

- Software Requirements

Arduino Software (Version 1.6.7 released on Jan 7, 2016)
https://www.arduino.cc/en/Main/Software

B. Task Evaluation

Each individual task is worth a specific number of points where these points are always split 50% between Task Execution and Task Report:

- Task Execution
The robot should execute the task correctly with a video clearly and completely showing the task execution (points will be taken for errors or missing aspects of task execution).

- Task Report
Each task report requires an accompanying document to be uploaded to Canvas together with ALL the files required to run the program in the robot. The task report needs to include ALL the following sections (points will be taken off if anything is missing):

1. Task description.
2. Solution describing the detailed algorithm used to solve the task described in terms of flow charts to describe the logic of the program and block diagrams to describe the various robot components.
3. Video link to different task executions (you should split each task execution as a different video link most preferably in YouTube making sure the video is public to all). Provide at the beginning of each video your name and description of which task is being performed.
4. Description of the code used to program your robot with explanations that clearly relate to the solution previously described.
5. Images taken from the actual robot task execution (at least one image per task).
6. Conclusions where you analyze any issues you encountered when running the task and how these could be improved.

C. **Task Description**

The goal of this assignment is to develop a path-planning algorithm to navigate an arbitrary maze from any starting robot location and orientation to any arbitrary goal location in the maze. The maze configuration is given to the robot at the beginning of the task. The path-planning algorithm has to work for different mazes. Figure 2 (left) shows a sample maze where grid cell size will be kept constant for any maze configuration, and only internal maze walls will change. Figure 2 (right) shows a sample path from starting location (cell "1" oriented "E") and ending location (cell "13"). Figure 2 (Right) shows cell numbering and orientations.

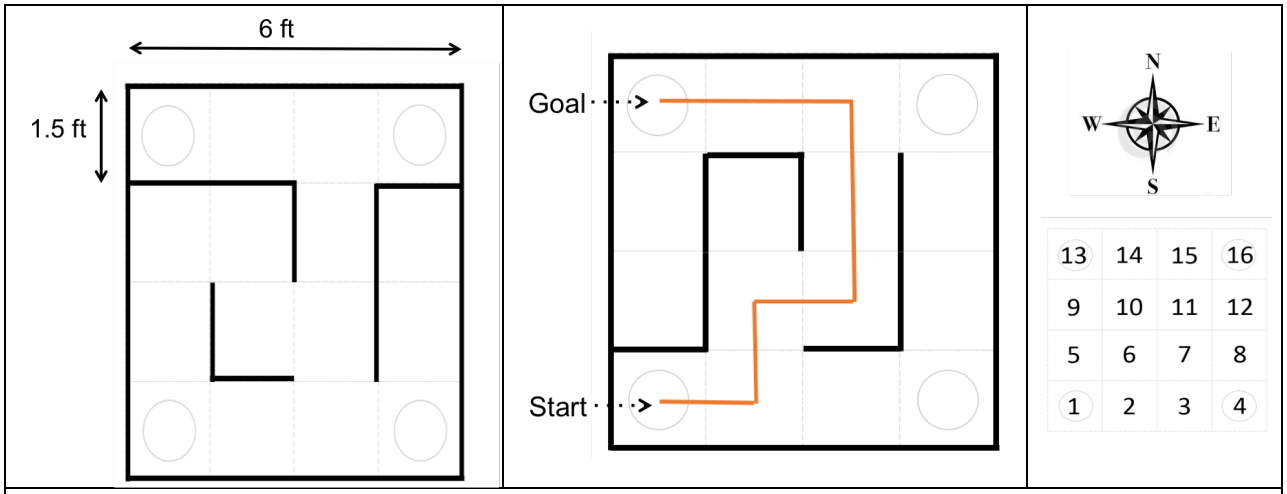

Figure 2. Left: Maze size is 6x6 sq. ft. consisting of a 4x4 non-marked grid cells of 1.5x1.5 sq. ft. Center: Sample robot route between starting cell "1" oriented "E" and goal cell "13". Right: Maze cell enumeration and global orientation.

Figure 3 shows functionality you will need to program for each of the LCD input buttons.

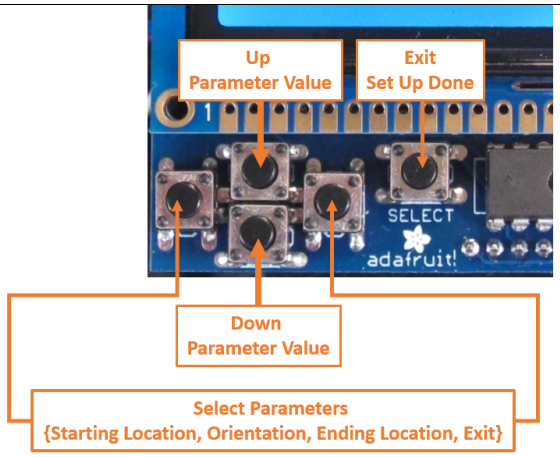

Figure 3. LCD Input buttons functionality.

Figure 4 shows examples of values assigned to each of input function buttons.

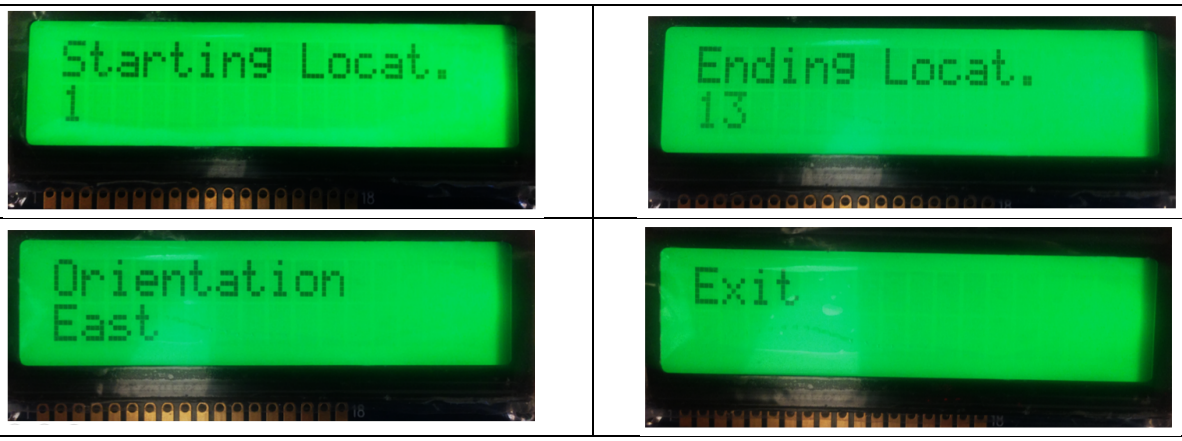

Figure 4. LCD Input buttons initial data.

1. Path Planning (100 points)

The objective of Task 1 is to develop a program to allow the robot to find the shortest path for any of the 3 mazes shown in Figure 5 from any arbitrary start location and orientation to any arbitrary goal location. The maze configuration will be programmed in advance into the robot while the start and goal data will be given only at the beginning of the task. For the current assignment your initial data should be the one shown in Figure 5. The time limit for all path execution is 5 min. (The final competition on May 5th will be based on a similar task as in this lab.)

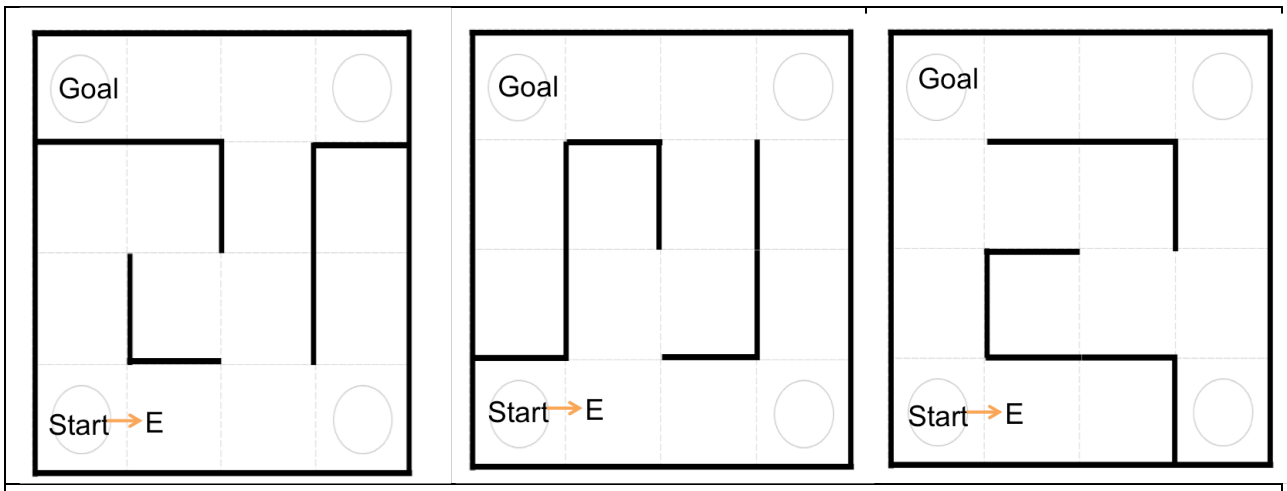

Figure 5. The 3 maze configurations with start and goal locations. Note that in all cases robot starts oriented "E".