Department of Electrical and Computer Engineering
Design Principles and Methods
Course ECSE-211

August 28, 2015
Version 1.0

Design Project Specifications

The basic task has been described as follows:

Construct an autonomous robot capable of finding and manipulating Styrofoam blocks, while navigating within an enclosed area populated with known obstacles randomly placed with a 12' x 12' enclosure (Figure 1). The task of the robot is to compete one-on-one with an opponent in a variation of the Capture the Flag game.

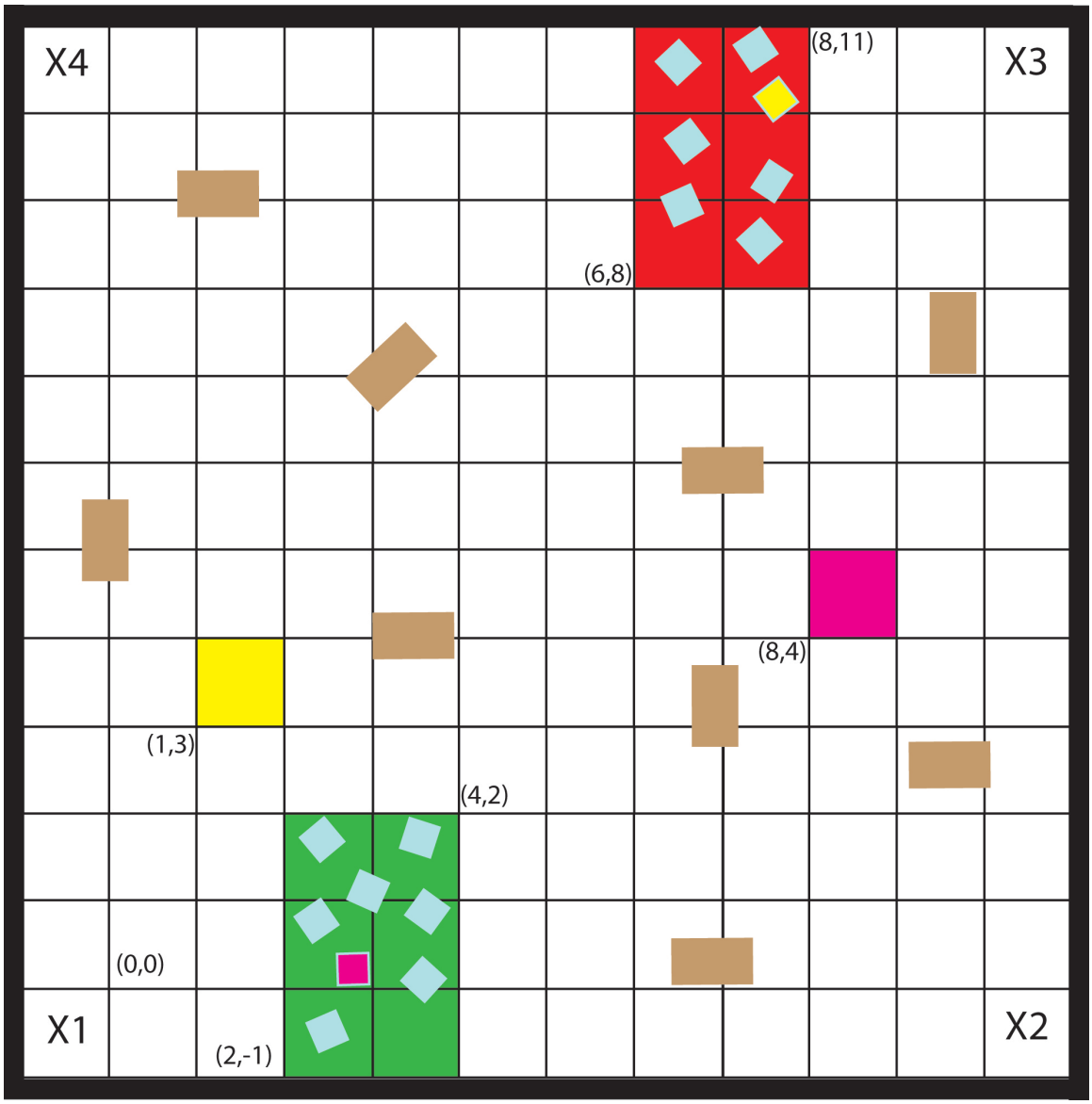

Figure 1

At the start, the competition area will be set up in a layout similar to that shown in Figure 1. Each robot will be placed in one of 4 starting corners labeled X1-X4 in the figure, at a random orientation and started by the team. On being started, each robot will wait for a Wifi message specifying its starting corner, the location of its Home zone, the location of its opponent's Home zone, the location of the destination for the captured flag, the color of the robot's Home flag, and the color of the opponent's Home flag. For example, assume a robot is placed in corner X4, with Home corresponding to the green rectangle and Opponent Home corresponding to the red. The WiFi class provided will return 13 integers (4, 2, -1, 4, 2, 6, 8, 8, 11, 1, 3, 2, 3) corresponding to the corner ID, the coordinates of the lower left and upper right corners of the Home and Opponent zones respectively, the location of the lower left corner in which to place the captured flag, and 2 integers corresponding to the Home and opponent's Home flag respectively (more about this later).

Upon receipt of the parameters, each robot localizes to the grid and then proceeds. Nominally this would involve navigating to the opponent's Home area, searching for the flag – in this case a colored Styrofoam block, grabbing it, and then returning the captured flag to a designated square. All of this must be accomplished within the prescribed time limit (nominally 5 minutes, but the actual duration for Fall 2015 will depend on the results of Lab 5 and be announced shortly after).

Identification of flags will be based on shape, color, and potentially weight. In all, there will be at most 5 different colored Styrofoam blocks available. These will be put on display in the lab and numbered 1 to 5 accordingly. It is up to you to figure out how to identify each block given the sensors that you have available.

Scoring is on a points-based system, with 1 point each awarded for demonstrating the following capabilities: localization, intentional navigation, collision avoidance, flag identification, flag capture, and flag retrieval and final placement. Localization must be completed in 30 seconds or less or else no points awarded. Both robots will be timed from start to placing the captured flag in their Home area. Competition ends when the final flag is placed or the time limit is reached.

The competition will proceed in two rounds, with each robot getting two turns in each round, for a total of 4 runs. To "pass", a robot must successfully demonstrate each of the capabilities listed above at least once during the 4 runs. The winner of the competition is the team that has the most points at the end of the day.

Details

1. The dimensions and layout of the field are shown in Figure 1. To facilitate operations, the floor is comprised of nine 4'x 4' hardwood-covered metal panels that lock together. The surface of each panel is marked with a 4'x4' grid that aligns precisely with adjacent panels. These are intended for navigational purposes, which were covered during one of the one-week labs.
2. At the start of each round, both teams will be directed to place their robots in one

of the 4 corners shown, at a random position and orientation within the corresponding tiles. When executing its localization routine, your robot must always keep the center of rotation within the tile (this implicitly limits the footprint of your robot). Localization must be completed in 30 seconds or less.

3. You will be provided with a Wifi class that has methods for retrieving i) the number of your starting corner, ii) the coordinates of the Home zone, iii) the coordinates of the Opponent Home zone, iv) an integer [1,5] indicating the Home flag type, and v) an integer indicating the Opponent Home flag type.
4. For the purposes of the course, a successful design is one that can successfully capture an opponent's flag at least once during all 4 opportunities afforded.
5. For the competition (which has nothing to do with your final grade), the 3 teams with the most points will be awarded prizes and bragging rights.
6. You may use up to 3 Mindstorms kits to fabricate your design. Any other material used must be with the explicit permission of the instructors. Further, any such materials will be posted to an "additional bill of materials" list on myCoursesII which may then be used by other groups.

As further information becomes available, this list will be expanded accordingly.

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Appendix 1 – Styrofoam Block Description