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

February 10, 2013
Version 1.0

Design Project Specifications

The basic task has been described as follows:

Construct an autonomous robot to play a one-on-one game that is a cross between soccer and basketball. The robot must be able to play either forward or defense and be capable of navigating the field without hitting obstacles. Instructions are received via Bluetooth radio prior to the game.

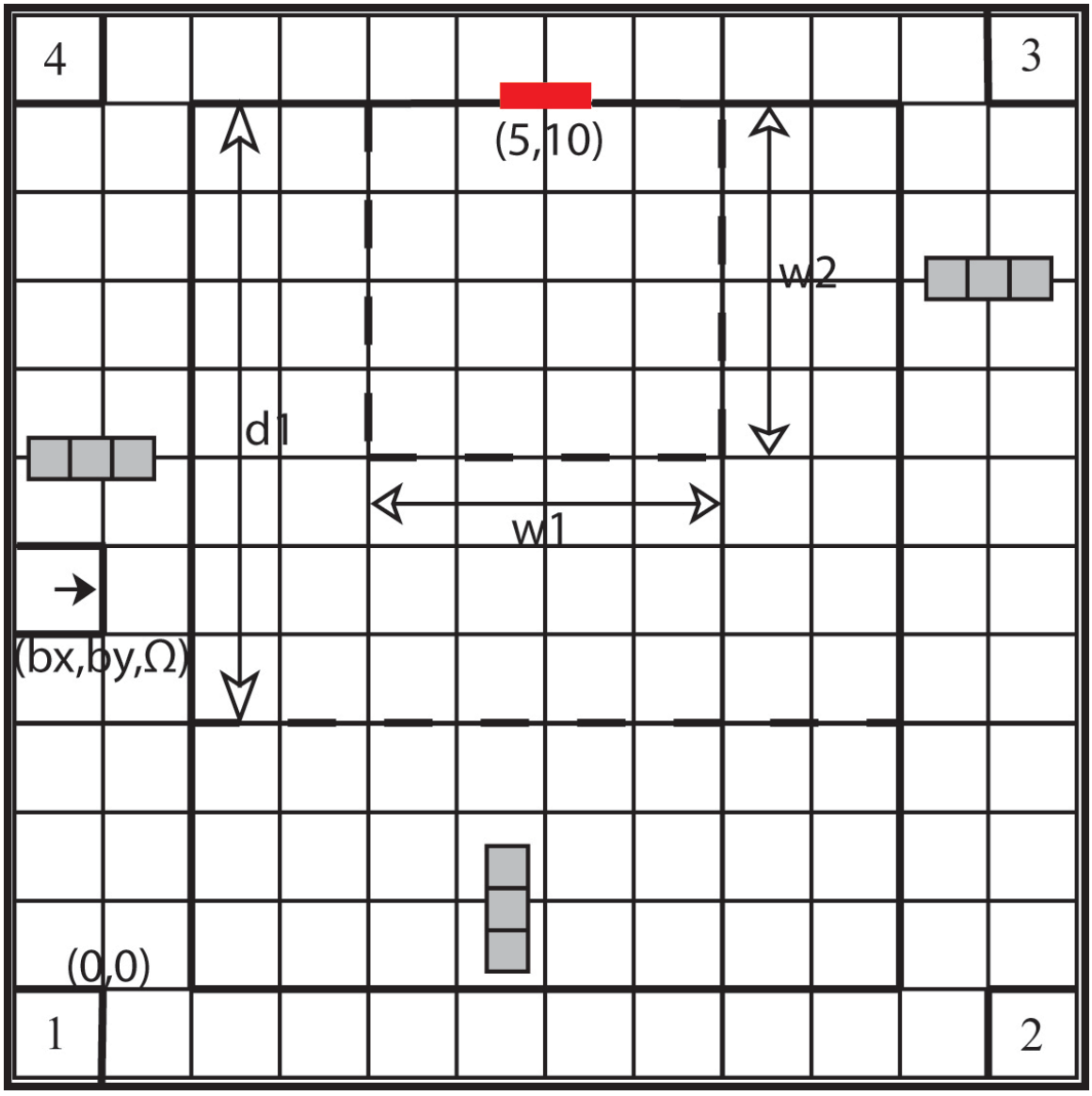

Figure 1

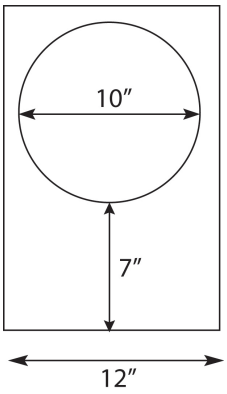

Figure 2

Upon receiving instructions on Bluetooth radio, the robot will assume the role of either a forward or a defenseman and proceed according to its role. If the role assigned is forward, the robot proceeds to the ball dispenser located at coordinates sent by Bluetooth, retrieves a ball, and then attempts to score on the goal while staying out of the defender's zone. If the role assigned is defense, the robot moves to the defense zone and attempts to block any shots on goal. Play proceeds until balls are exhausted or the 10-minute time limit is reached.

Details

1. The dimensions and layout of the field are shown in Figure 1. Details of the goal are shown immediately below in Figure 2. To facilitate operations, the floor is comprised of nine 4'x4' 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. The field is located within an 8'x10' area shown in the figure, and surrounded by a band that is 2 tiles wide on the sides, and 1 tile wide on the top and bottom. Gridlines form a coordinate system with the origin in the lower left hand corner as shown.
3. The goal is centered at coordinates (5,10) with a diameter of 10.0 in. at a height of 7.0 in above the floor as shown in the diagram. Direct shots on goal are not allowed. The forward must bounce the ball into the goal. Further, the ball must bounce in the region bounded by the w1 x w2 region before scoring the goal. Note that shots must be made from in front of the forward line (d1 in the diagram).
4. There are no restrictions on robot size, other than the requirement to be small enough to localize within the starting corner.
5. The defense zone comprises the region of the field behind the forward line excluding the w1 x w2 region surrounding the goal. Similarly, the forward must stay in the region in front of the forward line. Parameters are bounded as follows: [2 <= w1,w2 <=4], [5 <= d1 <= 8].

6. On startup, each robot shall proceed to their respective positions, avoiding collisions with any obstacles or each other. A collision between robots shall signify a false start, and the round restarted up to a maximum of 3 false starts. Once entering, both players must stay within their respective zones. Any robot wandering outside of their respective areas for more than 10 seconds will receive a penalty of 1 point.
7. At the start of each round, both teams will be directed to place their robots in one of the 4 corners show, 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).
8. You will be provided with a Bluetooth class that has methods for retrieving i) the number of your starting corner, your role as either a (F)orward or (D)efender, the defender zone dimensions (w1,w2), forward line position (d1), and the location/orientation of the ball dispenser (bx,by,Ω). All coordinates are in tile units with the exception of Ω.
9. The first two dispenser coordinates, bx, by, refer to the lower left hand corner of the tile in which the dispenser sits. Its orientation, Ω, is specified as an integer {1,2,3,4} corresponding to the cardinal directions N, E, S, W. A detailed drawing of the dispenser and the feeder mechanism will be posted on WebCT. Note that the dispenser may be mounted anywhere within the 12x12 surface area, e.g., mounted on one of the walls (i.e. coordinates may have negative values).
10. The competition will be comprised of 3 rounds. In Rounds 1 and 2, each team shall have one round as a defenseman and one as a forward. Points will be awarded for each basket scored and each shot blocked. Penalties for excessive false starts or wandering outside of the prescribed play areas shall subtract from your total. In the 3rd round, each team will play forward and attempt to score as many goals as possible within the round. For this round, a series of obstacles will be placed at random in the forward zone. Each round is 10 minutes in length.
11. For the purposes of the course, a successful design is one that can successfully localize, correctly assume its position on the field as either a forward or defense, and score at least 1 goal.
12. For the competition (which has little to do with your final grade), the 3 teams with the most points will be awarded prizes and bragging rights.
13. The balls used in this competition are the red and blue balls found in your Mindstorms kit.
14. 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 WebCT which may then be used by other groups.
15. Once both robots have assumed their field positions, the forward must refrain from **any** use of its ultrasonic sensors (in Rounds 1 and 2). Only the defender is allowed to ping upfield. Clarification – note that when the forward acquires balls from the dispenser it is not considered to be looking upfield, so use of ultrasonics is permitted here.

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

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