IESL RoboGames 2013

Undergraduate Category

Robot Specifications

1. Dimensions of the robot should not exceed 15 cm x 20 cm (width x length) including all its accessories at any time during the game.
2. Robot should be self-navigating without any sort of remote controlling. The only interaction of the participants with the robot should be starting and if necessary stopping. Any other interaction with the robot will conclude the attempt.
3. Robot must run with the power of an internal power source contained within the allowed dimensions of the robot (without any external power supply).
4. Robot must be completely built by the team itself with their own design ideas.
5. Robot must be wheeled and should not cause any damage to the game platform. Any robot with the potential threat of damaging the game platform will not be allowed to compete.
6. No off-the-shelf kits are allowed except processing boards, sensor modules and drive gears.
7. Activating the robot should be done by a single start switch that is placed on the robot itself.
8. Robot should have the ability to follow lines and discover a map using the hints given by a barcode type system.
9. The robot should be able to operate under any light condition.

Game Task

The overall task will be to discover a treasure map and collect the maximum number of treasures with the help of the hints provided within the given time.

The robot will have to follow a white line with a 2 cm thickness on a black background. On the way towards a junction, the robot needs to read messages to learn about the junction. There will be only three-way and four-way junctions.

Each message will contain two fields of information;

- The ID of the next junction
- The number of treasures that can be found on the road segments directly connected to that junction

All the road segments leading to the same junction will have exactly the same message in the direction towards the junction.

The message relevant to the approaching junction is always at the right hand side of the road. It should be noted that each road segments except dead ends and starting and ending segments will have two messages relevant to the junctions at the two ends. (The starting segment will have only one message and the dead ends and the ending segment will not have any messages). These two messages are on either sides of the road.

The treasures are marked by a Rs.1 coin placed on the road. The robot needs to pick this coin and drop it at the assigned place to be considered as it has collected the treasure.

After the robot has completed discovering the map of treasures it needs to stop with an indication. The robot with the maximum collected treasures will be recognized as the winner of the game.

Game Platform

The game field will be of the dimensions 8ft x 16ft. Refer Figure 1 for a sample of the arena. Paths, positioning of the hints and treasures will be different in the actual arena but the features and characteristics of the path will be the same.
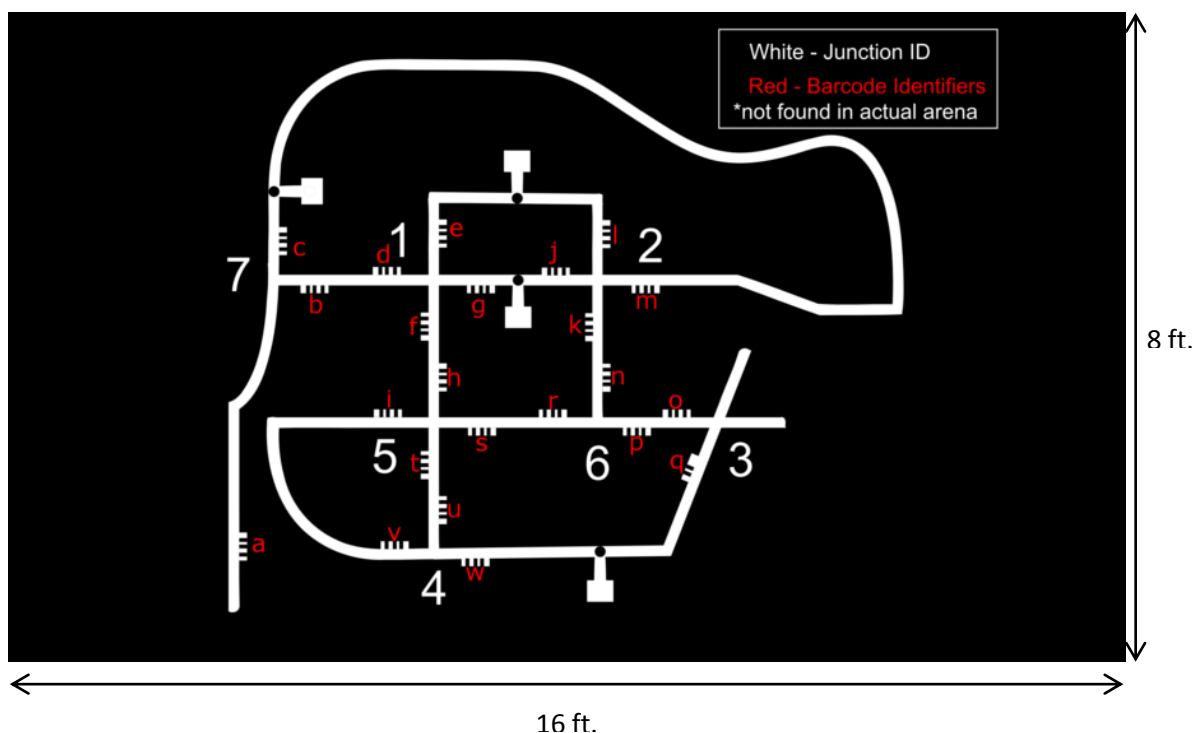
Figure 1

The barcodes in Figure 1 are just symbols to identify their locations. The actual barcode arrangements (for this particular sample path in figure 1) are listed later in this document.

The surface of the field will be black and the path will be in white. The floor will not be perfectly flat, so be ready to face little imperfections.

Features of the path

Start Point:

On the platform there will be a line across the path near the starting end. Participants should place their robot on the path before the line with none of its parts crossing this line. This line will be drawn in a way that it will not interfere with the robot's sensing. It will simply be a reference to the person who places the robot.

Geometries:

The width of the path is 2 cm and the path is in white colour on a black background. Path includes curved bends, 90° bends, dead ends and three-way/four-way junctions. Parallel road segments will be distanced from each other by at least 10 cm. And each road segment will have at least a 10 cm distance with all the edges of the arena.
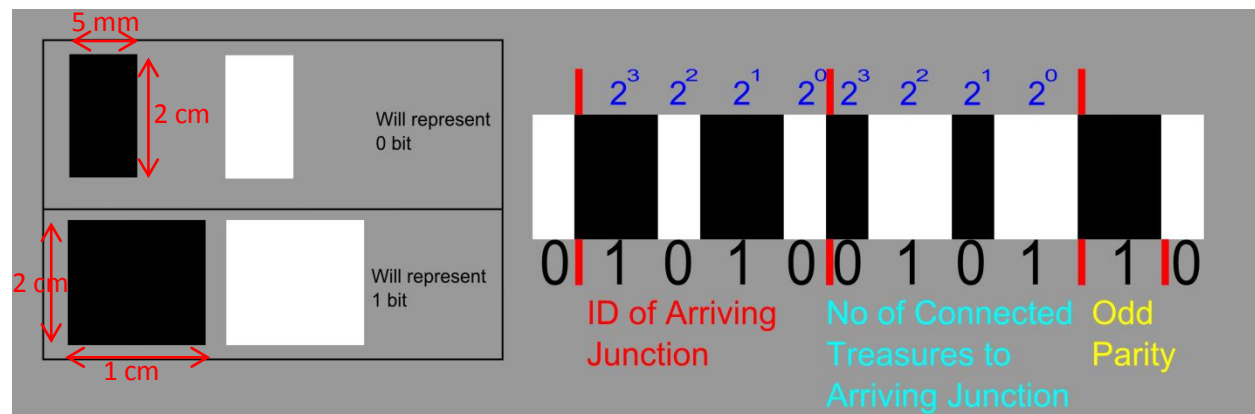
Messages:

Figure 2

Hints will be given as a barcode. A barcode consists of an array of eleven rectangle segments either in black or white. These rectangles can be found in two sizes: 0.5 cm x 2 cm and 1 cm x 2 cm. The 1 cm wide rectangles (either in white or black) will be considered as '1's. The 0.5 cm wide rectangles (either in white or black) will be considered as '0's. No two adjacent rectangles

will have the same colour. The total length of the barcode will be different because there are two sizes of rectangles segments.

This barcode can be considered as an 11 bit long bit array where '1's and '0's defined as above. Always in every barcode, the first and the last (11th) bits are '0's in white (0.5 cm x 2 cm white rectangles). The four bits starting from the second bit and ending at the fifth bit will give the ID of the heading junction as a binary number with the most significant bit coming first. The next four bits starting from the sixth bit and ending at the ninth bit will give the number of treasures that are there on all the roads directly connected to the heading junction again as a binary number with the most significant bit coming first. The 10th bit is an odd parity bit. It will be either '1' or '0' in order to make the number of '1's in the code odd. This bit can be used to detect single bit errors in reading the barcode.

For example if we consider the barcode in Figure 2, the bit array representing the barcode would be 01010010110. (As we have used an odd parity bit, the number of '1's should be odd in any barcode. If we get an even number of '1's in the code, that implies we have an error reading the code.) But as the first and last two bits don't contain any message we only need to consider the 8 bits 10100101.

The first four bits (1010) indicates that the robot is approaching the junction with 10 as the ID. The next four bits (0101) indicates that there five treasure on all the roads directly connected to junction 10.

For the sample path in Figure 1 we have the following binary values represented by the barcodes.

- b, h, j and l represent **"00001001010"** (Junction ID = 1, treasures = 2)
- c, e, g and n represent **"00010001100"** (Junction ID = 2, treasures = 3)
- p and w represent **"00011000100"** (Junction ID = 3, treasures = 1)
- i, q and t represent **"00100000110"** (Junction ID = 4, treasures = 1)
- f, r, u and v represent **"00101000010"** (Junction ID = 5, treasures = 0)
- k, o and s represent **"00110000010"** (Junction ID = 6, treasures = 0)
- a, d and m represent **"00111000110"** (Junction ID = 7, treasures = 1)

The barcode for the approaching junction is always at the right hand side of the road. So a road segment connecting two junctions will have two barcodes on either sides of the road.

The barcode for the approaching junction is placed with its beginning being 10-15 cm from the leaving junction (see Figure 3). However, this is not applicable to the hint in the starting road segment. The road will be straight from at least 5 cm from the beginning of the barcode and will remain straight until the barcode ends.
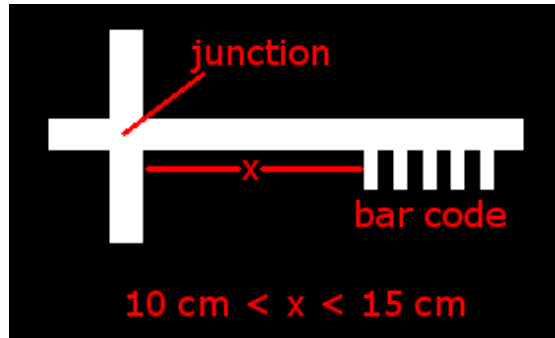
Figure 3

Junctions:

The path will only have three-way and four-way junctions. The angle between any two roads at a three-way junction will be at least 60° and not more than 180°. The angle between any two roads at a four-way junction will be at least 70° and not more than 110° (see Figure 4). Each junction has an ID and it is guaranteed that there will be a hint before each junction.
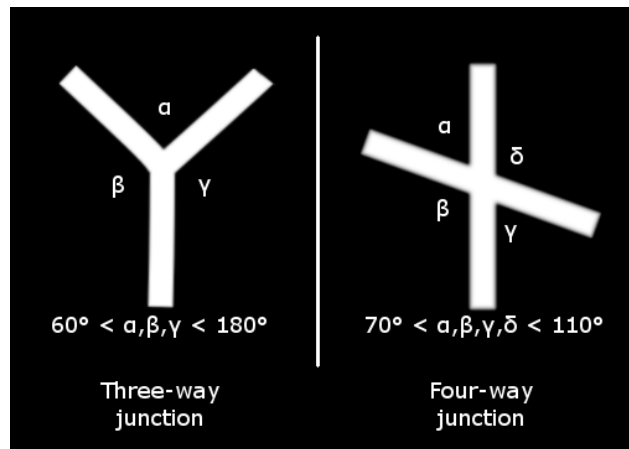
Figure 4

Dead ends:

A dead end is simply a branch of the path that ends without connecting to another road segment (refer Figure 1). The road segments leading to a dead end will not have any hints in either direction. Dead end road segments will not have any treasures.

Treasures:

A treasure will be marked by a Rs. 1 coin (issued by Central Bank of Sri Lanka in 2005) placed on the road. Details of the coin are mentioned in Figure 5 below.

Figure 5 (Source: Central Bank of Sri Lanka)

The surface of the coin facing up will be in the same black colour as the background of the arena. Doing so will add a small amount to the weight of the coin. So allow small tolerances in your designs.

A coin will be placed in the centre of a T-junction (see Figure 6). These are not considered as ordinary junctions and will not have any IDs or barcodes related to them. The robot needs to drop the coin at the assigned place on the road connected at this junction.
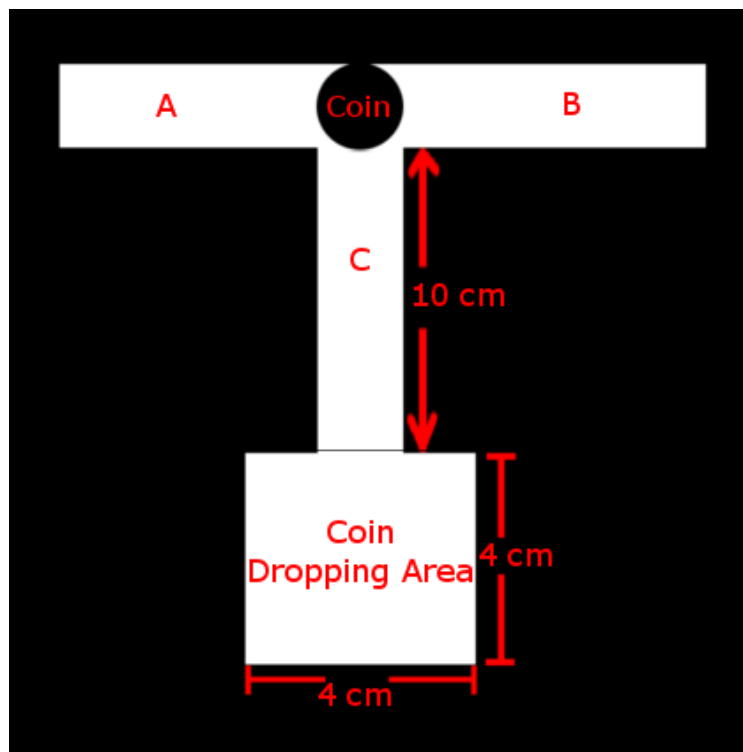
Figure 6

All the places where there is a coin will be as described in Figure 6. AB is the road that the robot is moving. The robot needs to pick the coin and drop it at the Coin Dropping Area to earn the points. The road segment C can be on any side of the road. After the robot dropped the coin at the right place, it can continue from the junction.

One road segment may contain more than one treasure.

End point:

There will not be a separate end point on the platform for the task. After the treasure collecting is complete the robot needs to

Game Rules

Before a round starts, all robots should be submitted at the arena.

A team will get 10min during which a maximum of three attempts can be made. Grading would take the best attempt.

After the game started for your robot, no team member shall touch the robot. If anyone touches the robot, that is considered as forfeiting the attempt. Each new attempt should start from the starting point.

No trial runs will be given after starting the competition.

A sample of the path will be given separately, only for tuning purposes.

Collecting the same treasure again and again will not add to the count.

The decisions of the judges will be the final.