

Embedded Systems, Autumn 2018. Coursework Assignment

Derbot Challenge Task Statement

tjw rev. 06.10.18

Any clarifications or modifications to this statement will be published on the module web site.

Summary

In your team, design and build a Derbot-based Autonomous Guided Vehicle (AGV) which runs on a black “competition surface” approximately 2.4 m square. The AGV follows a white track as fast as possible. At an early stage on the track will be a fixed, 240 mm wide gateway, placed symmetrically astride the track. Along the track will be placed a series of small moveable obstacles, each obstacle being a battery-powered LED light. Whenever the Derbot detects an obstacle, it should remove it from the track, and wirelessly update a PC screen with the number of objects removed. On completing the track, the Derbot should stop within the Finish Zone.

Any revisions or clarifications to this task statement, or to competition rules, will be communicated on the module Blackboard site.

Track Following and Gateway

The track width is 17mm approx, white insulating tape laid on flat plywood painted matt black. The AGV must be tolerant of some scuffing/imperfection of surfaces, and variability in track width. In the competition, the AGV will only be allowed to proceed if it can fit through the gateway.

Obstacles

Obstacles are hexagonal battery-powered LED lights, of overall height 25 mm, and side 35 mm. Their mass is 60 g approx., and may or may not be switched on. There will be not more than nine obstacles in total. Obstacles will not be placed close to corners of the competition surface. Wherever they are placed, the track will be at least 300 mm from the surface edge. They will be placed at least 300 mm from each other. “Correct removal” of obstacle indicates that it is completely off the track, placed to the right of the track if switched on, to the left if switched off.

Finish Zone

All AGV points of contact with the competition surface must be completely within the line defining the finish zone. Approx. internal dimensions of finish zone = 250 mm square.

Obstacle Count Display

A track-side laptop computer (within 10 m) will be configured to receive Zigbee wireless data, and will display this on a simple data terminal display (e.g. Tera Term or PuTTY). Whenever an obstacle is removed, an alphanumeric Zigbee message should be sent, indicating clearly how many lit and how many unlit obstacles have been removed to date. XBee modules will be available for wireless transfer. On completion of the run, the data should remain on the display. Teams are also encouraged to transmit further simple status information.

Competition Conduct

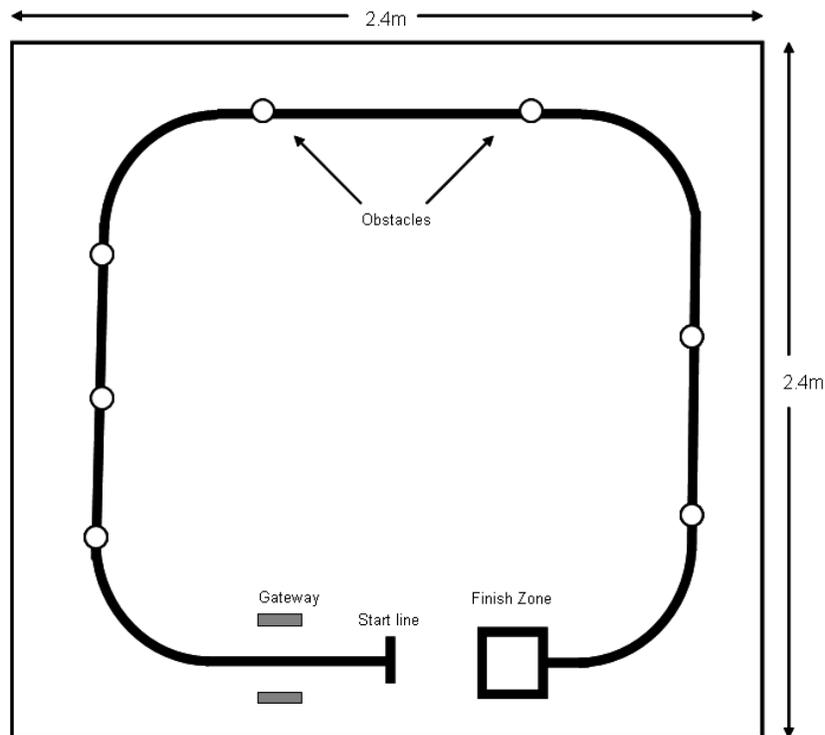
Before the competition, all AGVs must be placed in a “holding bay”. Before the first team competes, a “house robot” will be run round the track, to prove it is clear. Teams take their AGV from the holding bay when it is their turn to compete. One team member should introduce the team and the competing Derbot. The AGV with power switched off should then be placed with wheels on the start line. On the command GO, power should be switched on; there should be no further manual contact with the vehicle. Once the AGV has started moving, it may exceptionally be redirected by hand, with contact of less than 3 seconds, and a penalty for each such intervention. A team may also request a 10-minute delay and restart (e.g. for emergency repair), again with fixed penalty. Gross manual intervention leads to forced restart, or disqualification.

Build Quality

After the competition, all Derbots are retained by the module tutors. A mark is awarded for build quality.

The competition judges’ interpretation and ruling will be final in all cases.

Example Track Layout



Scoring

Action	Points
Derbot presented for competition (these points cannot be lost through subsequent penalty)	10
Derbot starts moving down track (these points cannot be lost through subsequent penalty)	10
Touches gate, with minimal displacement	-20
Correct removal of obstacle from track	10S**
Incorrect removal of obstacle from track (i.e., on wrong side)	5Y**
Accurate stop within finish zone	60
OR	
Nearly accurate stop within finish zone (two points of contact entirely within finish zone)	40
OR	
Inaccurate stop within finish zone (at least one point of AGV contact within zone or on surrounding tape)	20
Speed of completion	5(N-P)*
Correct report of numbers of obstacles found, and their type	60
OR	
Correct report of number of obstacles found, irrespective of type	40
OR	
Functioning data link, indicated by opening ID message, incorrect or no numbers displayed	20
Minor manual intervention (AGV redirected by pushing - not lifted or moved)	-20
Major manual intervention (AGV lifted briefly and returned to track)	-40
Stop and Restart (clock restarted, only allowed once)	-60
Example max. possible score, 9 teams, 6 obstacles = 10+10+(6x10)+60+(5x8)+60	240

* N = number of competitors,

P = position in order of speed. For non-completers, P=N.

** S/Y = number of obstacles correctly/incorrectly removed.