1B Integrated Design Project
M1 Problem Statement
Weeks 1-4, Michaelmas Term 2017-18

M.1 Description of the task

A golf ball manufacturing plant is looking for a automated system to aid in sorting and packing the output of their production lines. In dispatch groups of 6 random (colour/type) are presented at pick point P. The requirement is to sort the various types of balls into containers sighted at points D1,D2 and D3 dependent on the table below.

The task is to build an Autonomous Guided Vehicle (AGV) to undertake the overall task of pick-up, identification and delivery of the items from P to the specified delivery point.

1. At the beginning of the task 6 balls will be placed at P in a random order.
2. All balls picked up from P must be identified (size, number and location on AGV) via a set of *LEDs prior to moving more than 300mm from P.

(*All LED displays must be unambiguous, easily readable, labelled and documented)

The AGV must carry out all movements within a playing area of 2400mm x 2400mm. The task will continue until 6 balls have been delivered or the time limit of five minutes is reached.

Golf Balls						
Type		1	2	3	4	5
Colour		White		Yellow		Multi
Dia.	mm	⟵ ~ 40 ⟶				
Weight	gm	~19	~45	~7.4	~45	~4.5
Del Pt.		D1	DR	D2	DR	D3

Figure 1: **Playing area and track layout** (not to scale). The lines are white and 19mm wide, the playing area surface is matt black. The starting area S is 400mm x 300mm, inclusive of the boundary line. Details of the track layout and the positions of objects, collection points etc should be taken from the playing areas in the EIETL laboratory.

M.2 Robot Assessment

Robot *design and construction* will be judged on the quality of the complete vehicle.

Robot *performance* will be judged by a competition to be held on Saturday 4th November.

In the competition, robots will compete individually with all the robots built in weeks 1-4 of the Michaelmas term. Points will be awarded as described in the rule 3.6 below.

Robots will be placed in order according to the total number of points achieved. Robots tied on points will be ranked by restarts and then time penalties.

M.3 Competition Rules

1. The Judges' decisions are final.
2. Each robot will have five minutes to transfer balls.
3. The robot must start with all points of contact with the playing surface inside the starting area S (inclusive of the boundary line).
4. No ball must be handled when the robot is within 300mm of it. (Safety)
5. The arrangement of the identification and indicating LEDs must be marked on the robot and disclosed, verbally and in paper form, to the judges before the run. NB The LEDs should be easily visible, labelled and remain on until the ball(s) has been delivered.
6. Scoring:

• Each ball picked up and carried securely >400mm	scores **2** points
• LEDs correctly identifying the number, location and type of balls(s) that are being carried (before moving >300mm),	score **5** points/ball
• Each ball delivered to an incorrect location	scores **5** [**3**] points
• Each ball delivered to a correct location	scores **15** [**7**] points
• Delivery of at least 1 ball of each type to their correct location	scores **25** bonus points
• > 3 balls correctly delivered to the inner container	scores **15** bonus points
• Correct delivery of 3 or more balls and the AGV returning and stopping/remaining within the starting area	scores **20** bonus points
• Each ball dropped outside a delivery area results in a time penalty of	**10** seconds
• NB Points in [..] above are awarded for balls that are delivered to the correct location, but are not fully within the central container.	

   Marks will only be awarded to robots that are clearly attempting to meet the task's objective.
7. If for any reason the robot needs to be handled or the computer program re-started, the robot must be returned to the starting area and any balls(s) being carried must be removed. A maximum of 3 re-starts is allowed. Minor repairs will be permitted between re-starts, but the clock will keep running throughout.
8. The pick up area will be only be refilled once all 6 balls have been removed from the collection surface
9. All balls will be removed from the delivery location after a restart, if requested.
10. Any balls dropped onto the playing area or not placed on a delivery shelf will NOT be removed until a robot is re-started.
11. The only interaction permitted is between the robot and the workstation. No information may be entered at the terminal during a run.
12. Judges will disqualify any robot or device that appears to be a safety hazard. Damage to the playing area, assemblies or the control system may also result in disqualification.
13. Teams will be allocated to a particular playing area on the day of the contest. Each robot will have access to its designated area for setting up and running preliminary trials for a period of at least 10 minutes before the competition run.