

# TRASH-BIN DISPOSAL ROBOT COMPETITION

## 1. OBJECTIVE

- 1.1 The objective of the competition is to build a self-contained autonomous mobile robot that is able to navigate its way through a network of alley-ways in search of trash-bins which it must collect and dispose of at any one of 3 designated dumping grounds. The performance of the robot is judged on the numbers of trash-bins collected and disposed in a given time duration of 10 minutes.

## 2. SPECIFICATIONS FOR ALLEY-WAYS

- 2.1 The alley-ways shall be laid out on a platform by placing pieces of walls along the grids formed by multiples of 18 cm x 18 cm unit squares arranged in a 12 x 12 matrix as shown in Fig 1. The walls for lining the alley-ways shall be 5 cm high and 1.2 cm thick. Passageways between the walls shall be 16.8 cm wide. The outside wall shall enclose the entire network of alley-ways.

- 2.2 The start location for the robot shall be at one corner. Disposal centres shall be located next to the remaining 3 corners. There shall be clear passages along the alley-ways adjacent to the disposal centres. Where there are no grid lines shown in the vicinity of the disposal centres, there shall be no walls. (See Fig 1) The start square shall have walls on 3 sides. The starting square orientation shall be such that when the open end is to the "north", outside walls are on the "west", and "south".

- 2.3 Each of the disposal centres shall be a box with a top opening. The internal dimensions shall be 34.8 cm x 34.8 cm x 5 cm (length x width x height). The thickness of the side-walls shall be 1.2 cm (See Fig 2). The disposal centre shall be located such that the top edges are at the same level as the top of the alley-way walls and one side flushes with the side of the alley-way enclosure wall.

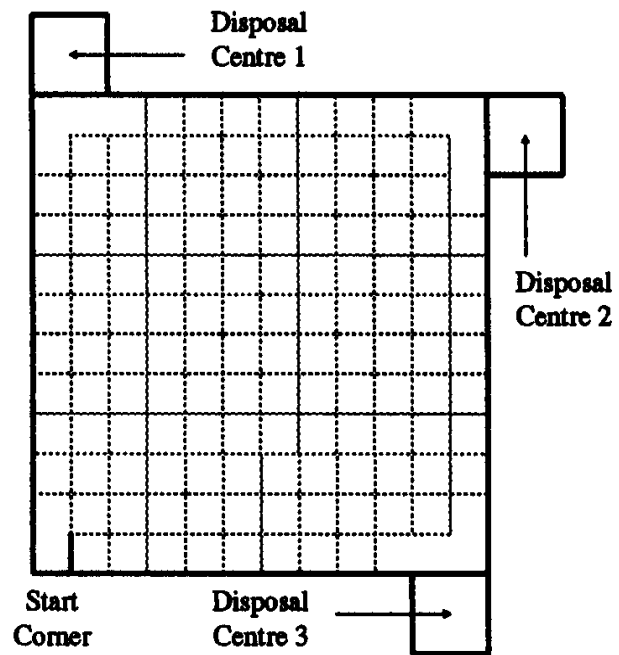


Figure 1: Start and Disposal Points and Grid Lines for Alley

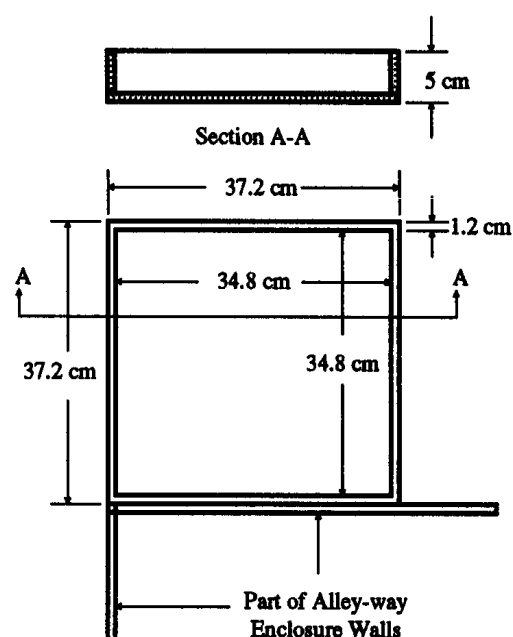
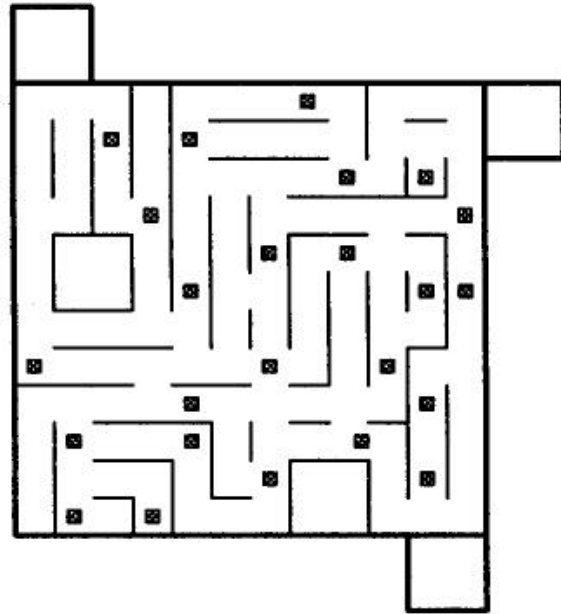


Figure 2 Disposal Centre Dimensions

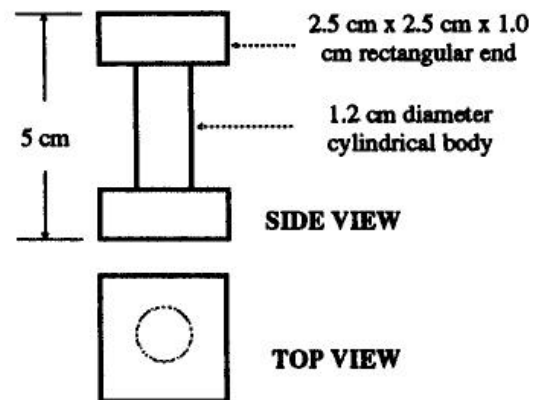
- 2.4 The sides and top of the alley-way walls shall be white. The floor of the platform shall be made of wood and finished with a non-gloss black paint. The coating on the top and sides of the walls shall be selected to reflect infra-red light and the coating on the floor shall absorb it.
- 2.5 Small square posts, 1.2 cm x 1.2 cm x 5 cm high, at the 4 corners of each unit square are called lattice points. The alley-ways shall be constituted such that there is at least 1 wall touching each lattice point. The distribution of trash-bins in the alley-ways shall be such that there shall be at least 1 clear path to any 1 of the disposal centres. A sample layout is given in Fig 3.



**Figure 3: Sample Alley-Way Configuration with Trash-Bins**

### 3. TRASH-BIN SPECIFICATION

- 3.1 The trash-bin shall be a 5 cm high dumb-bell shaped wooden post with a  $1.2 \pm 0.2$  cm diameter cylindrical body and 2.5 cm x 2.5 cm x 1 cm rectangular ends. (See Fig 4). It shall be painted red on all sides. The weight of the trash-bin shall not exceed 15 grams.
- 3.2 The trash-bin shall be placed free standing at the centre of a unit square. The orientation shall be such that the sides of the trash-bin rectangular ends are parallel to the walls of the alley-way.



**Figure 4: Trash-Bin Dimensions**

### 4. ROBOT SPECIFICATION

- 4.1 The length and width of the robot shall be restricted to a square region of 25 cm x 25 cm before it is out of the start square. There is no restriction to the dimensions of a robot which changes geometry after it has left the start square. There is no restriction on the height of the robot.
- 4.2 The robot must be completely self-contained and must receive no outside help.
- 4.3 The methods of alley-way wall sensing and trash-bin detection, collection and disposal are at the discretion of the builder; however, the robot must not exert a force on any wall or trash-bin likely to cause damage. The method of propulsion is at the discretion of the builder, provided the power source is non-polluting.

- 4.4 The robot shall not leave anything behind while negotiating the alley-ways.
- 4.5 The robot shall not jump over, climb, scratch, damage or destroy the walls of the alley-ways and disposal centres.

## 5. RULES FOR THE CONTEST

- 5.1 The basic function of the robot is seek out and collect as many trash-bins as possible which are placed along alley-ways and to dispose of them in any of 3 disposal centres within the given performance time period. The disposal strategy is left to the robot builder. For example, the trash-bins can be collected and disposed of one at a time, or the robot could collect and dispose several trash-bins at a time.
- 5.2 A trash-bin is considered disposed if more than half of its body is within the collection centre. Any trash-bin unsuccessfully disposed but resting on top of the collection centre wall(s) shall be removed and discarded only at the end of the robot's performance. Any trash-bin unsuccessfully disposed and has fallen onto the floor shall be removed and discarded when the robot subsequently crashes and has been retrieved by its handler. (See also clause 5.5)
- 5.3 The robot will be judged on the number of trash-bins disposed in the designated disposal centers within the time duration given and if it is able to dispose of all the trash-bins, then the time taken to do so will be the main criterion. In the event that 2 or more robots that have disposed the same number but not all of the trash-bins within the time given, then the number of trash-bins collected but not disposed, including those still remaining in the robot at the instance of the expiry of the competition time given shall be used as the next level of performance criterion. A third level criterion will be the number of times the robot had to be retrieved and restarted during the performance period. If there is still a tie, then the judges will decide on the better robot based on other criteria solely at the discretion of the judges.
- 5.4 The starting procedure of the robot should be simple and must not offer a choice of strategies to the handler. The robot shall be started by pressing a "start" button once. The robot shall be placed at the start square and started by the handler under the officials' instructions. Throughout the duration of the robot's performance, the handler shall not enter any information into the robot.
- 5.5 In the event that a robot crashes into the alley-way wall(s) and loses its bearing, then it is retrieved by the handler. The robot shall be re-started in a start location (one of the corners), and the size of the robot must be restricted to 25 cm x 25 cm at the start location (consistent with para. 4.1). The trash-bins that have been displaced shall be removed and discarded by contest officials before the robot is re-started. Any trash-bins collected and properly held by the robot in its collection mechanism shall also be discarded but kept aside for a fourth level of arbitration criterion in event of a tie as provided for in paragraph 5.3. The chief judge (who shall be the rules committee chairman) in consultant with the other judges, if any, determine whether a trash-bin has been "collected and properly held in the collection mechanism". In any event, any trash-bin that has been discarded shall not be available for collection and disposal by the robot when it is re-started.

- 5.6 If a robot appears to be malfunctioning, the handlers may ask the judges for permission to retrieve and restart the robot from the start square. A robot may not be restarted merely because it has taken a wrong turn - the judges' decision is final.
- 5.7 If a robot elects to retire because of technical problems, the judges may, at their discretion, permit it to do a fresh performance later in the contest but with a reduced time duration of 6 minutes. The result of the robot's second attempt shall be its official performance and its earlier attempt shall be null and void even if eventually the result of the first attempt is better than its second attempt. Also there shall be no changes made to the program, seek strategies and collecting method/mechanism when the robot is being repaired except for batteries and identical spare parts. This permission is likely to be withdrawn if the programme is full or behind schedule.
- 5.8 Before the alley-way configuration and trash-bin placements are unveiled, the robots must be accepted and quarantined by the contest officials, and no replacement of any parts of the robot. Once the robot has started, no replacement of batteries shall be allowed during the full duration of its performance.

## **6. CLONING**

- 6.1 In accordance with the spirit of the competition, clones among the winning entries will only be awarded one prize. Clones will be identified during the "caging" procedure.
- 6.2 Clones are robots with substantially identical physical appearance and working principles.
- 6.3 When in doubt, the decision of the Judges will be final.