Contest rules for the Robot Design course Summer 2005

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1 Introduction

The Mars Rover designed by your group has finally landed on the planet. Today is the great test day for your team — the robot is going to present all its virtues, capabilities and intricacies of design in the hostile environment of another planet. As the European Space Agency cannot afford yet another failed Mars mission, your robot needs to successfully complete all the scientific tasks it has been designed for.

2 General Information

The contest will be held on **Friday, August 12th, at 13.15 in the room 2121 (aka Σ)**.

The contest track will consist of a number of tasks to be performed by your Mars Explorer. Each of the tasks will allow the robot to score a number of points. Moreover the track passage will be timed and robots completing it faster will score a number of points for their speed.

The track will be defined by a white line leading from start to finish. Each task will have its pathway forking from the main track, through the challenge, to the main track again (see Fig. 1). A path belonging to the particular task, from the fork to the meet, will be sometimes called *task path*. The alternative way will be called *main path*. A fork will be marked by a gap in the main track approximately 5cm before the fork. The size of the gap will be approximately 30 mm. A gap will be marked using black tape put over the white (grayish:-) one used for defining the paths. A forking path will never form a larger angle with the main path than 60° and smaller than 30°.

However, the track itself outside the forking area, may be bent more than 60°. There might be sharp turns in it and there is no guarantee that it will be smooth.

Within some of the task areas the surface may be protruded, although not more than by 1 cm above the level of the ground. The plateau task is an exception to this rule.

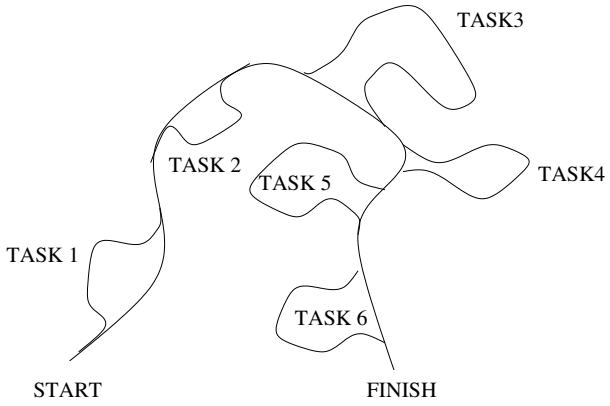

Figure 1: The general layout of the contest track.

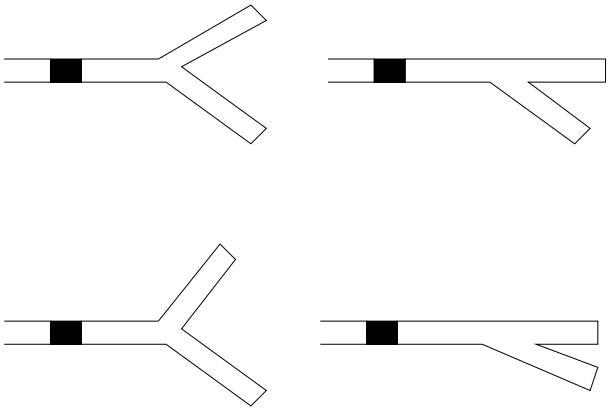

Figure 2: Forks in the upper row. No-fork paths in the lower row.

3 The Tasks

3.1 The Crater

The task consists of reaching the center of a crater. The center will be marked by a white circle, adjacent to the incoming and outgoing paths. The distance between the incoming and outgoing paths along the perimeter of the circle will be no smaller than 4 cm. The robot should produce success sound while being in the center of the crater. Completing this task will give the robot 10 points.

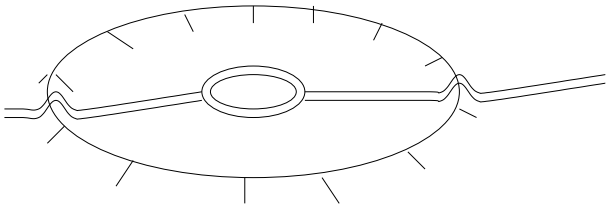

Figure 3: A crater.

Failure to produce the sound message (in this or subsequent tasks) will result in deducting one point from the task score, as will producing the sound while not in the crater center.

3.2 The Cave

The task consists of investigating a cave. Investigation consists of entering the cave by one entrance and leaving it by the other one. It may be assumed that the cave will be a convex polygon and that the surface inside will be light brown cardboard, like the one available now in the lab room. There will be no path marked inside the cave. The robot should produce success sound while leaving the cave (i.e., after finding its way back to the task path). Completing this task will give the robot 15 points.

3.3 The Plateau

The task consists of investigating a plateau elevated over the ground level. There will be a ramp leading to the plateau. The path through the ramp and over the plateau may be substantially curved. The borders of the ramp will be marked by black tape at least 1 cm wide and the surface of the ramp will be carpet-green. The end of the plateau investigation task will be marked by a standard gap in the task path. The robot should produce success sound while leaving the ramp task (i.e., over or after the gap, but before meeting the main path). Completing this task will give the robot 13 points.

3.4 Rocks by the Track

The advance of the robot will be complicated by Martian rocks lying very close to the task path (obstacles of size at least 2cm $\times$ 2cm $\times$ 10cm, not closer than 1 cm from the path). There will be exactly four such obstacles used in this task. The distance between the obstacles, measured along the path, will be at least

20 cm. The robot should produce success sound while leaving the rocky area. Completing this task will give the robot 18 points. Passing each obstacle and finding the path again will be worth 4 points.

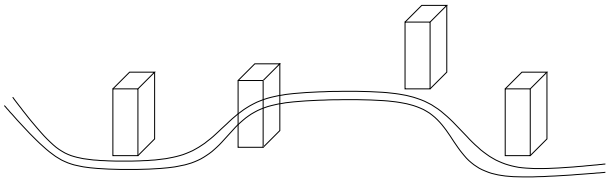

Figure 4: Rocks along the track.

3.5 Message from a Satellite

The robot will receive a message from a control satellite (another RCX or an IR Tower) ordering it to follow one of the three possible pathways through the task area. The robot should produce success sound after having received the message from the satellite. Visualizing it would give three bonus points for understanding the message. The message will contain an integer: either 1, indicating the first way out to the left, or 2, pointing to the middle way out, or 3, meaning the rightmost way out. Completing this task will give the robot 13 points.

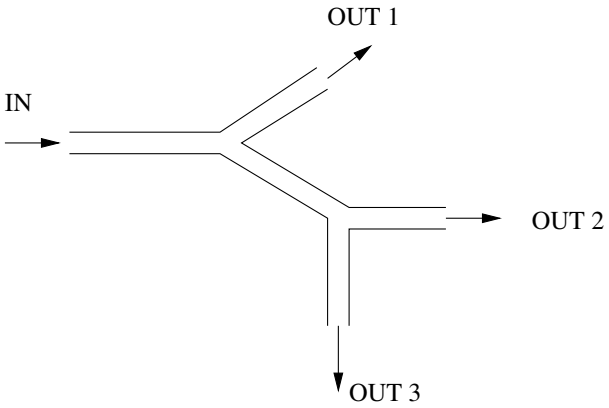

Figure 5: A possible layout of paths in the message challenge. Note that even though the image suggests something else, the fork rules will be applied creating this challenge (i.e., the angles will not be larger than 60°).

3.6 Following a Large Rock

The area the rover is expected to investigate lies close to a big rock formation. The robot has to follow the side of the rock in order to proceed. There is no path shown along the rock. The robot should produce success sound while reentering the task path. It may be the case that the rock may be passed only on one side. Completing this task will give the robot 15 points.

3.7 Removing a Rock from the Path

A large rock (at least 10 cm wide) is lying (perpendicularly) before a bent fragment of the path, more exactly, a right turn, as shown in Fig. 6. The robot is expected to push the rock away from the path in order to free it for further passages. After execution of the task the rock should not be closer than 5 cm from the path (a piece of black tape will mark this distance). The robot should produce success sound after successfully reentering the task path. Completing this task will give the robot 20 points.

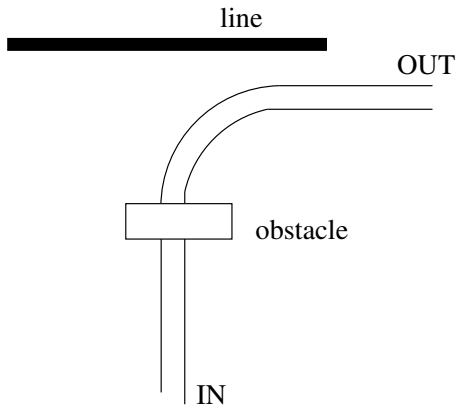

Figure 6: An obstacle blocking the way needs to be removed past the black line.

3.8 Investigating an unknown area

There will be a rectangular area of the size approximately 30 × 30 cm of unexplored Mars soil, bordered by white tape. Inside it there will be an object left by Martians (a white spot, 38 × 38 mm wide) lying on otherwise carpet-green area. The task of your robot is to locate the objecty (white spot) and produce a sound while over it. Another, nontrivial challenge is of course to get out of the task area. For that purpose the way out will be marked by a standard gap exactly 19 mm away from the border area (see Fig. 7). The task is worth 20 points, 10 for locating the object and 10 for getting out back on the main track.

3.9 Timing

The global time (i.e., the time necessary for reaching the endpoint of the main path) for each robot will be measured. Times below 10 minutes will count for scoring points. The fastest robot will receive 8 points, the second best 7 points, etc.

4 Final Remarks

Preconditions of being admitted to the contest (and thus passing the course) are:

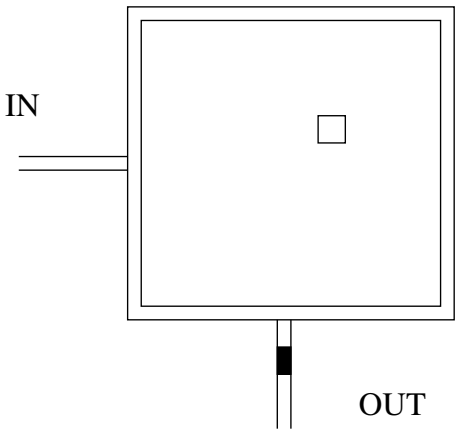

Figure 7: An unknown area to investigate.

1. Filing a robot description document (1 page A4 is sufficient), with the names and affiliations of the groups members, the name of the robot, possibly a family photo (robot with its parents) and a short description of your robot's virtues (mechanical solution, software solution, maybe strategy for the contest). This needs to be done at the latest by 13.15 on Friday, August 12th, i.e., just before the contest.

2. Convincing Jacek by showing at least the day before the contest that your robot will be capable of succeeding with at least one particular task defined above. There will be a suitable mock contest organized on Thursday for this purpose.

Each robot will do two attempts to pass through the challenge area, with slight rearrangement of the area in the time between the passes (to test flexibility of your solutions). The results from both passes will be added to find the final outcome and decide about the ranking.

Due to popular demand there will be possibility of "getting back into the contest". The idea is that if a robot loses path during some challenge (or maybe on the main path) and needs to be repositioned by a human, then it will be allowed, but under the following conditions:

1. The robot is repositioned on the main path, just after the challenge where it has lost track of the path;

2. The robot loses all the points gathered during the last challenge or 10 points, whichever is larger.

The layout of the challenges (position w.r.t. the main path — left or right — and the exact sequence of the tasks) will be distributed to the groups on Wednesday at the latest.