Contest rules for the Robot Design course
Summer 2007

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1 Introduction

Natura 2000 (`www.natura.org`) is a programme endorsed by European Commission to establish and maintain a Europe-wide network of geographical sites intended to preserve the natural heritage. There is a number of EC documents (see Fig. 1) defining all the supervised areas, according to the member states' intentions. The fragment below is an excerpt from a list of thousands of places prepared for *Boreal region*, covering larger part of Scandinavia and some Baltic countries.

L 40/72 EN Official Journal of the European Union

A	B	C	D		E	
SCI code	Name of SCI	*	Area of SCI (ha)	Length of SCI (km)	Geographical coordinates of SCI	
					Longitude	Latitude
SE0110233	Hummelberget	*	65		E 18 30	N 59 48
SE0110234	Hummelsvedjan		7,1		E 18 26	N 60 2
SE0110235	Häverö-Norrby	*	2		E 18 44	N 60 5
SE0110238	Kvicksalshagen-Igelsjön	*	7,2		E 18 29	N 59 55
SE0110239	Igelsta	*	19,3		E 18 41	N 59 54

Figure 1: Natura-regulation of the European Commission (an excerpt).

There is no way of keeping alert environmentalists in every place for overlooking government actions against the nature in those areas. Therefore we, as engineers, will help the nature preservation movement by building robots that will supervise and investigate the remote areas, making sure that no harm is being made to animals and plants in their vicinity.

The investigation robot your team has built should be able to present all its virtues, capabilities and intricacies of design in the fragile environment of a nature preservation area. The concrete tasks are defined below in Section 3.

2 General Information

The contest will be held on **Friday, July 27th, at 13.15 in the room 2121 (aka Σ)**.

The contest track will consist of a number of tasks to be performed by your nature supervisor. 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. 2). A path belonging to the particular task,

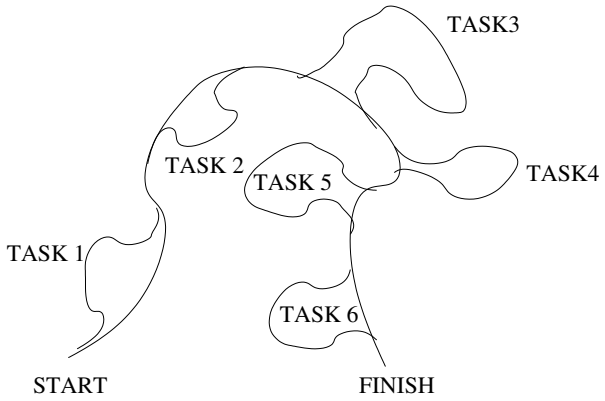

Figure 2: The general layout of the contest track.

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 19 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°.

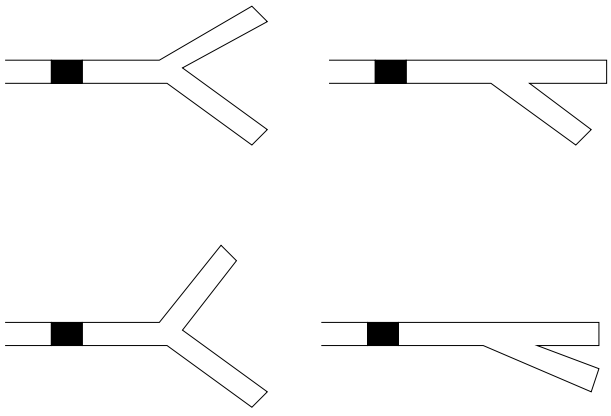

Figure 3: Forks in the upper row. No-fork paths in the lower row.

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.

3 The Tasks

3.1 The Valley

The valley flora contains a particular endangered kind of flower that needs to be taken special care for. Your robot will investigate whether no one trespasses the valley area.

The task consists of reaching the center of the valley. The center will be marked by a white circle, with diameter at least 10 cm, 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 valley (anywhere after leaving the incoming path, but before entering the outgoing path). Completing this task will give the robot 10 points.

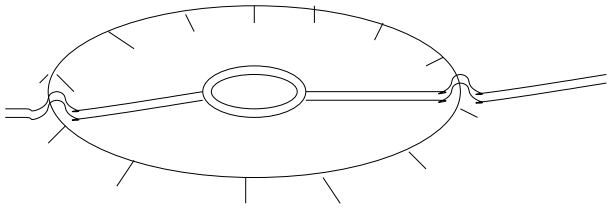

Figure 4: A (round:-) valley.

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. General!

3.2 The Cave

There is an interesting kind of bat spending days in a cave belonging to your robot's investigation area. Your robot will count the number of individuals to see whether population has changed since last year.

The task consists of investigating the 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 path (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 Trees by the Path

Your robot needs to supervise a forest which the authorities intend to cut for a new motorway. The area cannot be left to the bulldozers, can it?

The advance of the robot will be complicated by a number of tree trunks 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 forest area. Completing this task will give the robot 18 points. Passing each obstacle and finding the path again will be worth 4 points.

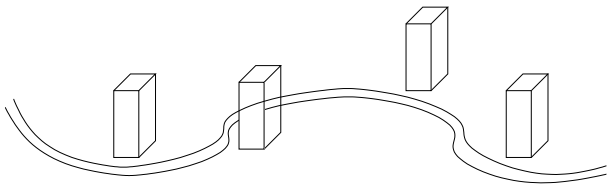

Figure 5: Trees along the path.

3.5 Message from a cell phone

There is information about a particularly rare kind of animal known as spotted ground squirrel, spotted suslik or gopher (Spermophilus suslicus Guld, see Fig. 6) in the supervision area of your robot. Your robot is expected to get a message from another investigator and choose the path that does not disturb the animal.

The robot will receive a cellular message from the other investigator (another RCX) 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 6: Spermophilus suslicus Güld.

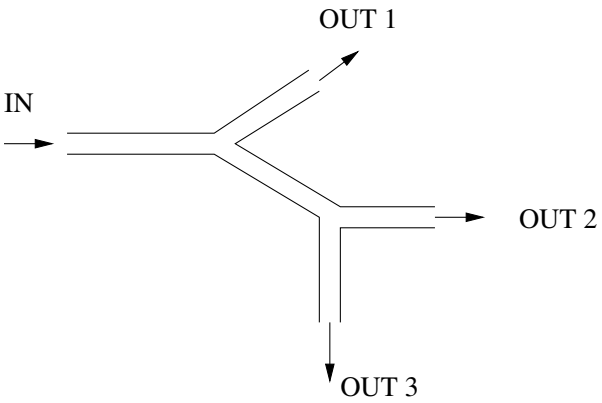

Figure 7: A possible layout of paths in the message challenge. Note that even though the image suggests something else, the fork rules will be applied creating this challenge (i.e., the angles will not be larger than 60°).

3.6 Following a Large Rock

The area the robot 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 10 points.

3.7 Removing a Rock from the Path

Your robot is expected to open a path deer is using to get to water. 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. 8. 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 15 points.

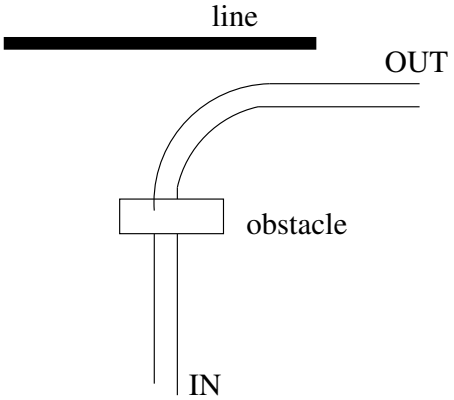

Figure 8: An obstacle blocking the way needs to be removed past the black line.

3.8 Investigating an unknown area

There will be a rectangular area of the size approximately 30 × 30 cm of unexplored space, bordered by white tape. Inside it there will be an object left by some unknown species (a white spot, 38 × 38 mm wide) lying on otherwise carpet-green area. The task of your robot is to locate the object (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. 9). The task is worth 20 points, 10 for locating the object and 10 for getting out back on the main track.

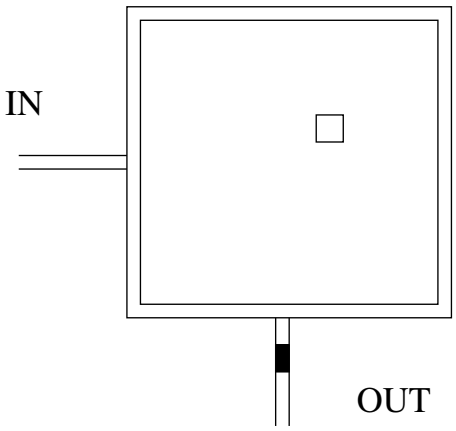

Figure 9: An unknown area to investigate.

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:

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, July 27th, 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 afternoon 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, at the point of choice of the team, but **necessarily** before a gap;

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 Thursday morning at the latest.