Robot competition rule book (19.2.2014)

ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

Aim

The goal of the competition is to build a robot (or a team of robots) that will autonomously collect recyclable litter (PET bottles) in a challenging, semi-structured environment. Imagine that in the future, the competition could be to clean up after Balélec! This is the third edition of the competition, so we are still simplifying the task a little, read on to find out more…

General Competition Rules

- The rules may be changed by the competition committee at reasonable notice.
- You have a maximum time of 5 minutes to set up your robot in the arena, before the clock starts ticking.
- *Timeout*: 10 minutes to complete as much of the task as possible.
- *Robot reset*: the competition judge may allow a team to "reset" their robot if it gets stuck.
  - Primarily applied if the robot gets stuck for a period of 15 seconds.
  - In this case, the team may physically interact with their robot (including rebooting, repairing or changing faulty parts, etc.) and it may be repositioned.
  - The new centre must lie within a 25 cm radius of the point where it got stuck.
  - Any orientation may be chosen.
  - The competition clock will continue to run.
  - **The competition judge's decision is final.**

The Robot

You will be given a catalogue with a wide variety of robotic kits and parts, which you may buy using your virtual budget, however you are not restricted to solely using this catalogue, nor do you have to use it at all. Additional materials can be bought and parts can be built using the state-of-the-art 3D printers (refer to the *Budget* section of this rule book). You are free and are encouraged to be creative with your designs, providing your robot adheres to the following rules:

- The robot must be completely autonomous: **no remote controlling allowed**! It is therefore not allowed to send data to an external device for remote processing. The only exception to this rule is for the demonstration session before the competition.
- All the computation must be done onboard (any computational devices may be used, but they must physically be on the robot).
- The robot must carry its own power source (e.g., batteries).

- All the robot components must be bought using your budgets (real or virtual). To guarantee equality between the groups, it is not allowed to use personal components (e.g., your personal microcontroller board, battery, or laptop).
- There is no weight limit. However, the maximum dimensions of the robot are dictated by the arena. There will be a minimum of 50 cm clearance between any parallel walls or fixed obstacles.
- Multi-robot solutions are allowed.
- Any kind of communication system can be used, but only between the robots (not for remote control or remote computation!).
- The robot must not be destructive or dangerous.
- Flying solutions are not permitted.

Litter

Litter may be a variety of different colours and shapes, but all items will be PET bottles with a maximum capacity of 500 ml. The litter will be evenly distributed and all items will be worth the same number of points in a given area. Robots must avoid damaging the litter during the competition, since it will be reused for all groups.

Scoring Points

The points will be allocated depending upon two criteria: the piece of litter's original location and where it is deposited at the end of the competition.

- The original location of the piece of litter will determine its value (see Fig. 1 for an example).
- If the litter is deposited in the recycling station (see later), the full number of points will be awarded for that piece.
- If the litter is successfully retrieved, but is deposited in the area surrounding the recycling station, only half the points for that piece will be allocated.
- Any litter the robot is holding when the clock stops will be worth a quarter of its original points.
- Any litter the robot deposits elsewhere does not earn any points.

The Arena

The arena used for the competition will have a size of 8 m × 8 m and consist of four different types of terrain, plus the recycling area. An example arena configuration is shown in Fig. 1, but **this is given only as an example**.

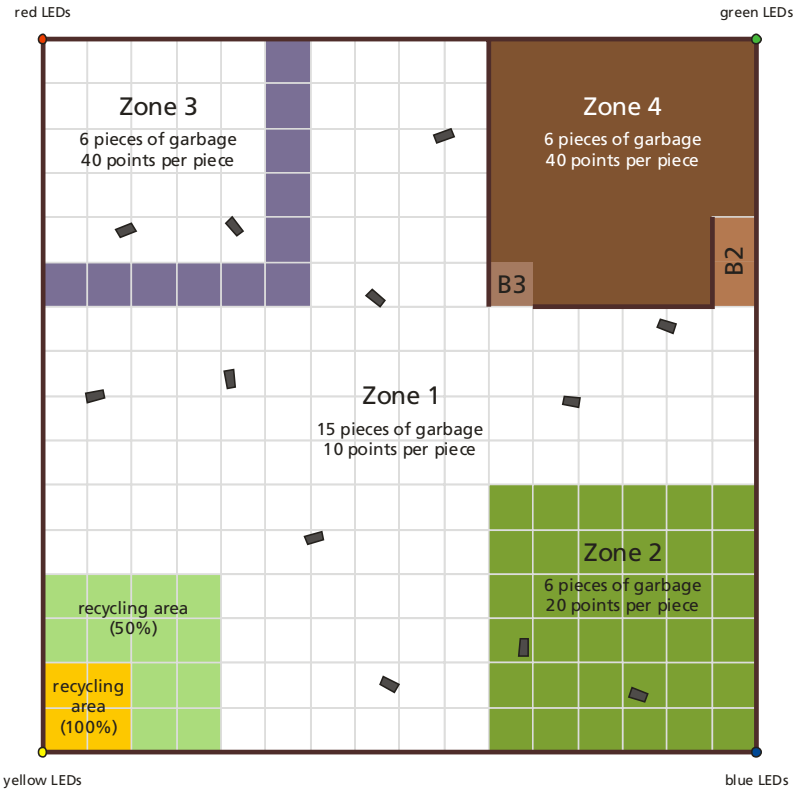

Figure 1: *An example arena configuration*

The different zones will be as follows:

- **Zone 1:** Carpet tiles.
- **Zone 2:** Moderately rough terrain, e.g., artificial grass.
- **Zone 3:** Carpet tiles, but behind **barrier 1**, which will be a rugged barrier, made from rocks, stones and potentially slippery materials.
- **Zone 4:** A raised platform at approx. 30 cm off the ground, which can be accessed via a gentle slope **(B2)** and some steps **(B3).**
- **Recycling area:** The carpet tiles will be colour coded. The 1 × 1 m² surface near the corner will be yellow; garbage deposited on it earns the full points. The remainder of the 2 × 2 m² surface, painted green, gives 50% of the points to the garbage deposited on it.

There will be obstacles (bricks), randomly distributed in all the zones apart from the recycling area, and being at a minimum distance of 50 cm. There will be equal amounts of litter in each zone. Each corner of the arena will be marked with a bright vertical strip of LEDs, coloured as shown in Fig. 1.

Budget

A physical budget of CHF 1000 will be available to each group to buy any additional required materials. **Before buying additional material, it will have to be approved by your coach**. The detailed ordering procedure is explained on the robot competition web site.

Furthermore you will have an additional virtual budget of CHF 2000, which can be used to purchase components that we have in stock (refer to the website for a list of items and virtual prices). You are also permitted to create your own parts, sending them to the mechanical workshop or using the 3D printers: this will also be charged to your virtual budget at a cost of:

- MakerBot Thing-O-Matic: 0.05 CHF / cm^3
- HP DesignJet Color 3D printers: 0.34 CHF / cm^3 (including support material)

The Day of the Competition

On the day of the competition (both the private rehearsal and the public one), each team will compete in three distinct events:

1. **Demo of the one or two "killer" function(s)** that will enable your team to win the competition! The organisers of the competition will award scores to each team, based upon the usefulness, complexity, ingenuity, technical soundness and reliability of the demonstrated feature(s). Strictly 5 minutes per team.
2. **The competition itself!** (10 minutes per team)
3. **The pit stop**: At all times when the robot is not in the arena, it should be displayed on a table. The audience will be given a single voting slip each and will be able to vote for their favourite design (based upon the pit stop display), before the actual competition begins.

All teams will be able to do their final calibration and adjustments during the morning. However, 30 minutes before the demo session begins, they will have to stop tinkering with the robots, turn them off and display them in their pit stops.

Winning

The **competition winners** will be the team that accrues the most points for collecting the litter, according to the competition rules.

The **best design award** will be given to a team, according to a weighted average of the results of the video, the demo session, the audience votes and the actual competition. This team may or may not be the same team that wins the actual competition.

Further Information

Please refer to the competition web site at http://robot-competition.epfl.ch/.