

Aim

The goal of the competition is to build a robot (or a team of robots) that will autonomously collect recyclable litter (0.5-liter 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 mechatronics 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 available 3D printers (refer to the *Budget* section of this rule book), with laser cutting, or ordered (for a fee) at EPFL professional workshops. 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 or data processing is allowed** during the competition. You can transmit data from the robot for monitoring and display purposes, but no external commands (except for start/stop and emergencies) can be sent to the robot.
- 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). Energy sources producing potentially toxic exhaust gases (e.g., diesel generators) are forbidden.
- All the robot components must be bought using your budgets (real or virtual). To ensure equality between the teams, 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 clearance of 50 cm between any parallel walls or fixed obstacles.
- You can implement a multi-robot solution, and you can exchange any kind of data between the robots (including computation offloading). In this case a robot is defined as a device —physically placed in the arena for the whole duration of the competition— that includes at least one actuator having a practical purpose related to the goal of the competition.
- The robot must not be destructive or dangerous.
- Flying solutions are not permitted for safety reasons, as there are no security nets.

Litter

Litter may be a variety of different colours and shapes (potentially including transparent bottles without labels), but all items will be PET bottles with a maximum capacity of 500 ml, and a minimum capacity of 400 ml. The litter will be evenly distributed and all items in a given area will be worth the same number of points. As an exception to this rule, there *might* be bottles with bonus points, e.g., those that are particularly difficult to detect, as a green bottle on the grass. Robots must avoid damaging the litter during the competition, since it will be reused for all groups. The position of litter is randomly determined for each team just before the start of their robot, and bottles can be placed in any position (either standing or laying down).

Scoring Points

The points will be allocated depending upon two criteria: the piece of litter's score (depending on its location and potentially on bonus points) 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 robot destroys the scoring barcode placed on the bottle, no points will be allocated.
- 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 marked area near 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**, the actual setup might be slightly different.

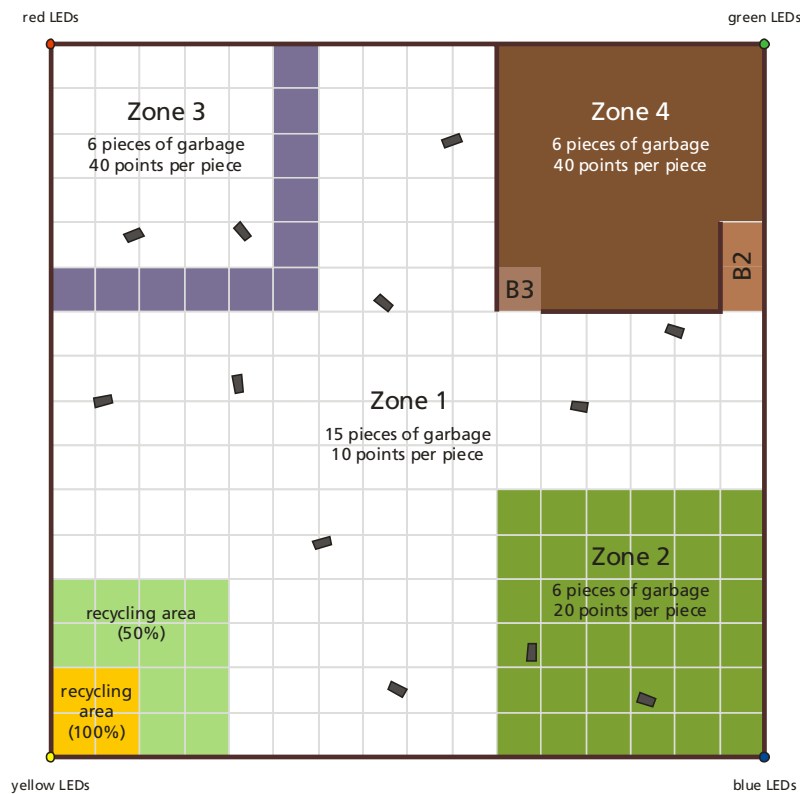


Figure 1: An example arena configuration

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 of the garbage it receives.

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 from each other and from the walls. Each corner of the arena will be marked with a bright vertical strip of LEDs, coloured as shown in Fig. 1.

Budget

A real budget of CHF 750 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, **any orders not following the procedure will be ignored.**

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 EPFL professional workshops (cost as per their offer) or using the available semi-professional 3D printers (0.34 CHF/cm³ for both support and model material).

The Day of the Competition

All teams will be able to do their final calibration and adjustments during the morning. However, 30 minutes before the starting time of the competition, the arena must be completely freed and the robots ready to compete.

Before the start of the competition, each team will have a maximum of 5 minutes to show videos that demonstrate all the features of their robots.

Winning

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

The team who wins the vote for the coolest robot, which will be carried out among the public just after the end of the competition, will earn the **coolest robot award**. The robot winning the competition is not allowed to win the coolest robot award at the same time.

Further Information

Please refer to the competition web site at <https://robot-competition.epfl.ch/>.