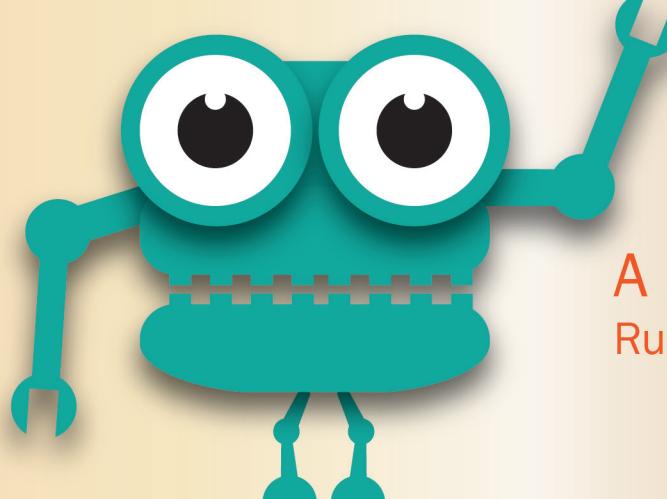


ESIGELEC  brings you

# MAKE YOUR ROBOT TICK



A Robotics Competition  
Rules, Regulations & Guidelines

Under the aegis of:



Supported by:





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# 1. CONTEXT & OBJECTIVE

## 1.1. the Organiser: ESIGELEC

ESIGELEC, a premier French Graduate School of Engineering (Grande École), founded in 1901, with a long history in education and research and significant expertise in Smart Embedded and Connected systems, is situated in Rouen, approximately an hour and half from Paris by train. ESIGELEC is fully recognized by the French Ministry of Higher Education and Research. With a personnel and student strength of 2100, including 1700 students and 400 teaching, administrative and support staff, the ESIGELEC group is actively involved in academic training, research, innovation and transfer of technology.

Through its programmes across the spectrum – the flagship Diplôme d'ingénieur (the French engineering programme), the Masters programmes taught entirely in English and PhD programmes - the school trains engineers in the following areas: Telecommunications, Electronics, Computer Science, Networks, Electrical engineering, Automation, Embedded Systems, Energy and sustainable development, Biotechnologies, Mechatronics, Business engineering and Finance engineering.

85 partners spread over 40 countries, joint-preparatory cycles offered in 3 African countries, in China and in Sri Lanka, over 50 visiting professors, representative offices in China and in India and more than 35% of its students coming from across the globe, make ESIGELEC one of the most active French graduate schools internationally.

ESIGELEC has an impressive corporate network of over 3000 industrial partners, who offer our students internship and job opportunities. They are also actively involved in teaching, apart from being an integral part of our study and scientific boards. Several seminars, greatly appreciated by our students, are offered throughout the year by industry representatives.

ESIGELEC prides itself in its Institute of Research in Electronic and Embedded Systems (IRSEEM) with a focus on Electronics, Automatics, Computer Science/Instrumentation, and Systems. IRSEEM conducts high-end applied research in automobiles, aeronautics and electronics.

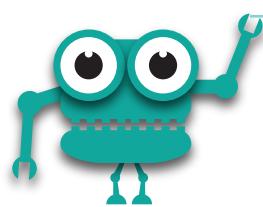
## 1.2. Objective & A QUICK GLANCE

MAKE YOUR ROBOT TICK aims to showcase French technology and higher education through this first ever robotics competition conducted by a Premier French Graduate School of Engineering, under the aegis of BONJOUR INDIA and supported by Institut Français en Inde.

Participants will be required to design, develop and make a robot capable of collecting energy from various sources and delivering it to a storage facility. The team whose robot collects the maximum energy within the prescribed time will be declared the winner.

The participating teams will receive a low-energy mobile robot developed by ESIGELEC. These robots will serve as the base on which the teams will have to design and develop a mobile robot, capable of navigating on the competition platform, of collecting electrical energy from various sources as charging station and transporting this energy to the Energy Storage Station.

The registrations will open in December 2017 and the final competition will be conducted in February 2018.



**Eligibility and general rules:**

- The competition is open for registration to full time Engineering college students who are studying in universities/ colleges, for a degree in electronics and related streams.
- Each team will have four members.
- All members of a team must belong to the same college/institution. However team members may belong to different years of study.
- Each student can join only one team.
- One member of the team should be designated as the team leader, who is responsible for all communications with ESIGELEC.
- Each team member will register with only one email ID.
- A team will NOT BE PERMITTED to change/replace any team member(s). A team once registered will remain unchanged till the end of competition.
- Failure to comply with any of the rules, terms and conditions of the competition may result in disqualification of the participating team.
- All participants (implicitly) consent to allow their names and photographs to be used for publicity purposes by ESIGELEC during and after the competition.
- ESIGELEC holds intellectual property rights for all materials submitted by the participating teams for the competition.
- ESIGELEC will not be responsible for submitted material lost in transit.
- All material submitted must be the team's original work.
- Any kind of plagiarism is strictly prohibited and will lead to disqualification of a team. Remember Plagiarism is cheating.
- Provide proper citation for the source of any idea or words taken from anyone else. Provide references for the material used in your work.
- ESIGELEC's decision(s) are final and no appeals will be entertained.
- ESIGELEC reserves the right to modify or amend the prizes, rules, terms and conditions of the competition at any time.

### **1.2.1. Technical Specifications**

Each team will submit a technical specifications document to the Organising Committee. The format and deadlines will be indicated on the website of the competition.

This document will provide the overview of the project with a focus on:

- General information: Team information
- Technical specifications:
  - Strategy
  - Technical choices
  - Hardware architecture and schematics
  - Algorithms

**Note: This document must be submitted to the organising committee one month prior to the competition.**

## 2. COMPETITION PLATFORM

### 2.1. Overview

The competition platform is a flat rectangular surface of approximately 2.44m x 1.22 m, with all four sides bordered with plates 8cm in height (Fig. 1). The surface and the borders are black in colour.

The platform comprises:

- 4 Energy sources (charging station):
  - 3 fixed:
    - 2 regular (green)
    - 1 accelerated (yellow)
  - 1 fast (red): the position is allotted from among 4 possibilities, by a draw of lots at the beginning of the event

The Energy Storage Station consists of an energy counter placed in the centre of the competition platform and a display showing the energy score.

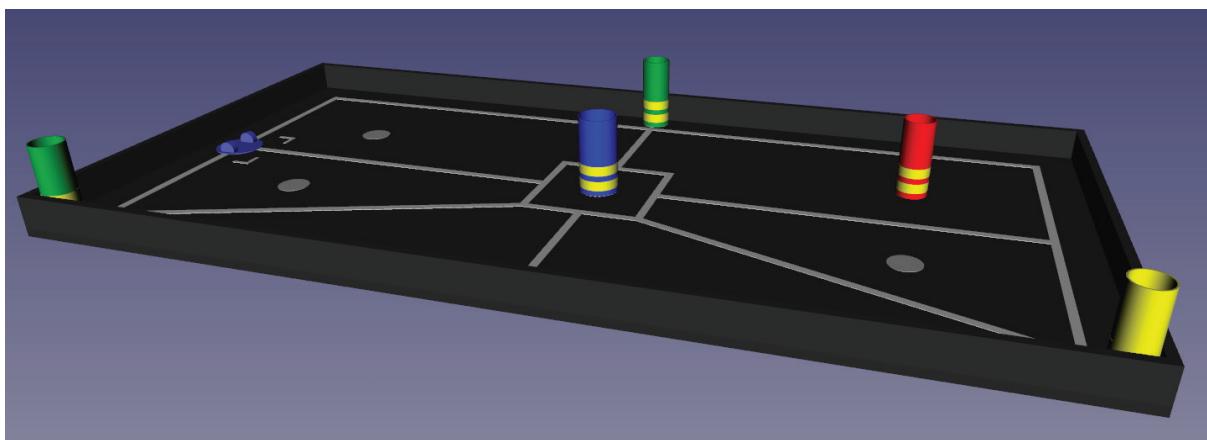


Figure 1. View of the competition platform.

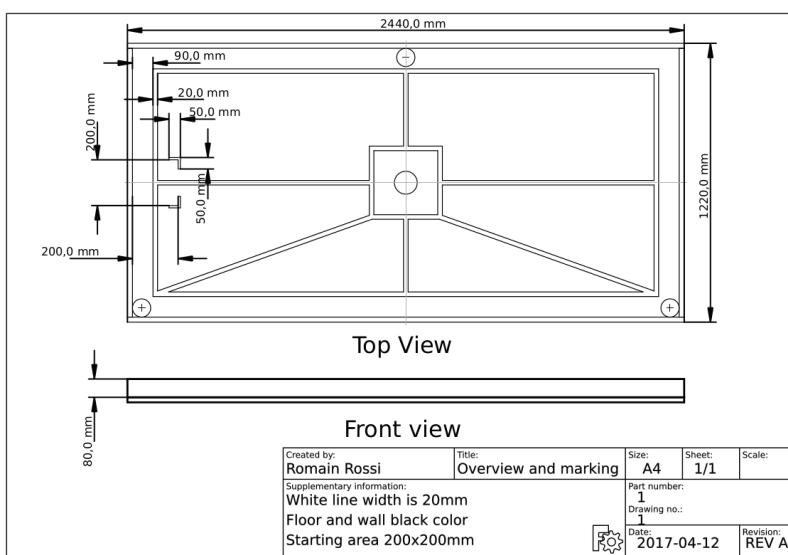


Figure 2. Platform dimensions.

guide the robot. The mobile robot can use these white lines for its navigation strategy to connect to the charging stations and the Energy Storage Station.

### 2.2. Architecture of the Competition Platform

Figure 2 illustrates the overall architecture of the competition platform, with the surface of the platform, the position of the charging stations and the Energy Storage Station.

The platform dimensions have a tolerance of +/- 2mm

#### 2.2.1. Platform Surface

The competition platform has a black surface with white lines to

## 2.2.2. Charging Station

The competition platform has four energy sources:

- 2 regular
- 1 accelerated
- 1 fast

The two regular terminals and the accelerated terminal have a fixed position on the competition platform. The fast terminal has four possible positions and the referee allots a position by drawing lots at the start of the competition.

Figure 3 illustrates the energy source (all 4 mechanisms are identical) and the height of the two electrodes to connect the robot.

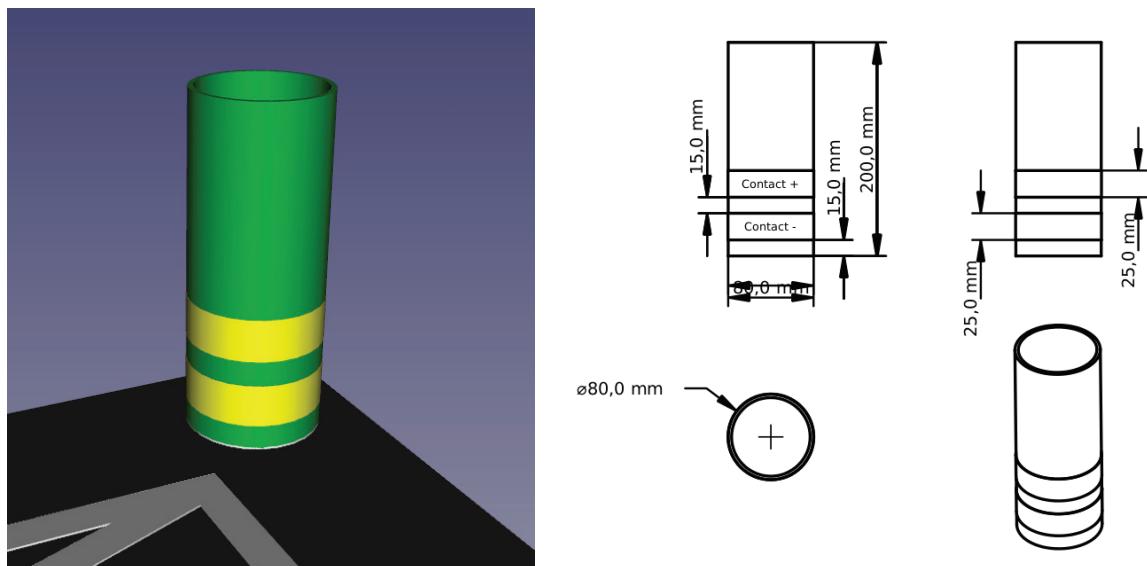


Figure 3. Mechanism and 3D view of energy sources.

Figure 4 shows the location of the energy sources on the competition platform.

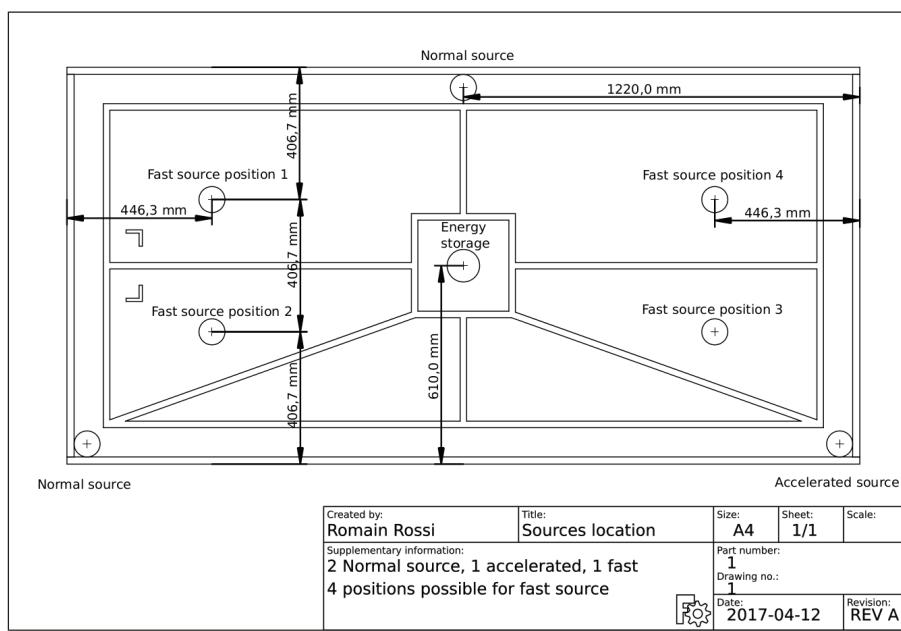


Figure 4. Positions of the charging stations and the Energy Storage Station.

During the competition, the energy sources are activated and deactivated successively as in figure 5:

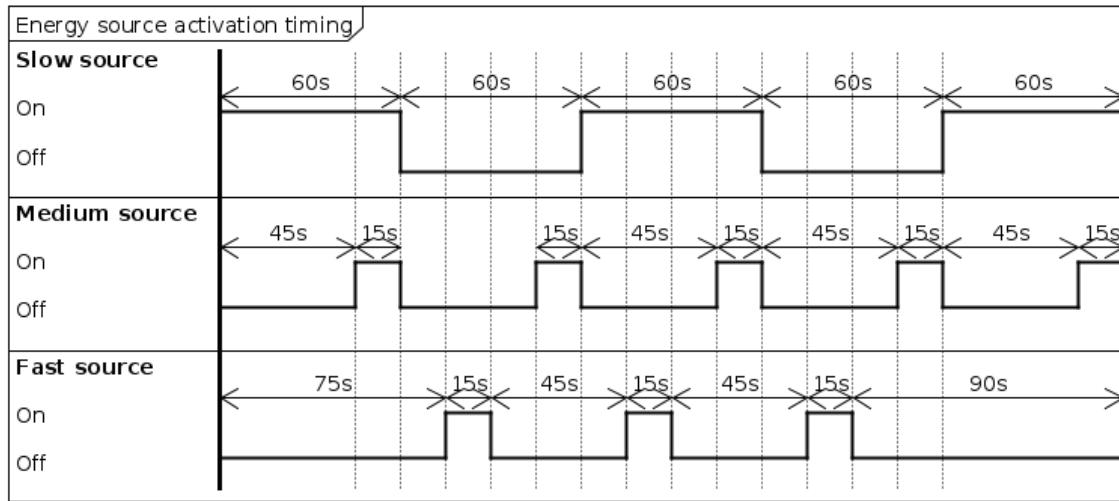


Figure 5. Activation of energy sources.

### 2.2.3. Energy Storage Station

The energy storing facility is in the centre of the competition platform. The mobile robot must connect to this facility to inject all the energy that it will have collected from different charging station. The energy delivered by the robot is measured by a meter and determines the scores obtained by the teams.

#### 2.2.3.1. Energy Meter

The Energy Storage Station is built with an Arduino card and a display. This system manage different functions:

- Triggers the charging station (On/Off according to the figure 5)
- Measure the energy delivered by the robot
- Display the energy collected

### 2.2.4. Mobile Robot Starting Area

The starting area of the mobile robot is clearly indicated on the surface of the platform as shown in Figure 6. This starting area is in the middle of the narrower side of the rectangle, along the border. All robots must start from this area.

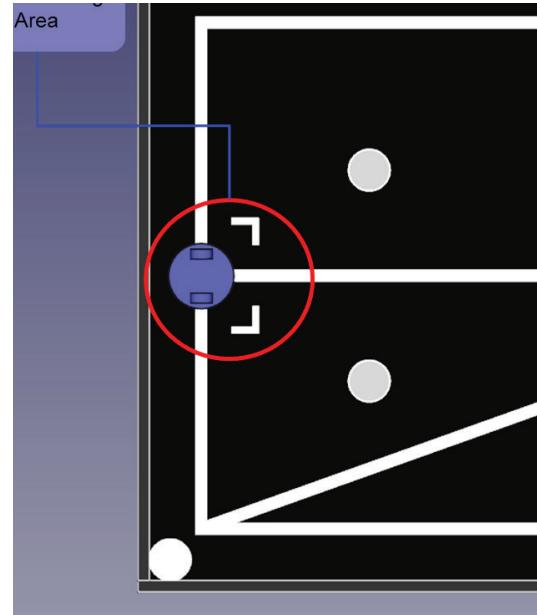
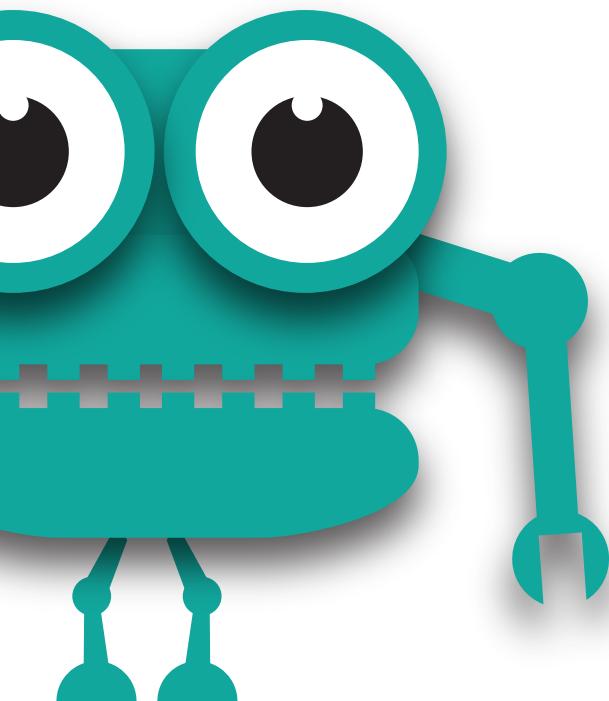


Figure 6. Starting area of the robot on the competition platform.



# 3. THE ROBOTS

## 3.1. General Information

All participants will receive a mobile platform comprising a round chassis with all parts of the mobile robot, namely:

- DC Motors and wheels
- Motor control circuit board
- MSP430 Launchpad (programmable circuit board)

Figure 7 illustrates a top view of the mobile platform. Information on the mobile robot architecture « SAM Board » and all related information is available on the Web site of the competition.



Figure 7. Top view of mobile platform.

**Note: The rest of the mobile robot will be developed by the teams on the provided mobile platform:**

- Energy Harvesting System
- Sensors
- Embedded software for the robot control

The mobile robot must be autonomous.

Figure 8 illustrates the mobile platform with the control board of the motors and the microcontroller card.

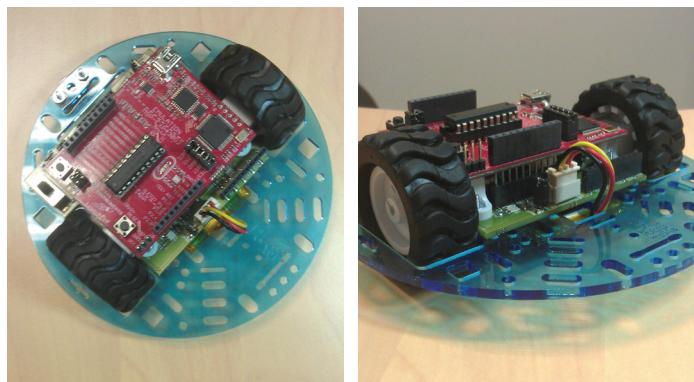


Figure 8. Mobile platform with the two stacked circuit boards.

## 3.2. Dimensions

### 3.2.1. Mobile Platform Dimensions

The mobile robot « SAM-Board » has a round chassis. The platform's dimensions are:

Diameter: 12 cm

Height: 5 cm

### 3.2.2. Mobile Robot Dimensions

The robot must have an external perimeter of less than 90 cm. The height of the robot must remain below 20 cm. We measure the perimeter of the robot by circling it as shown in figure 9:

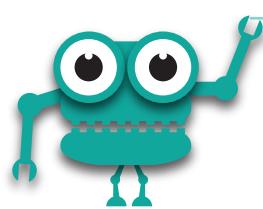


Figure 9. External dimensions of the mobile robot.

## 3.3. Architecture

The mobile robot used for the competition will have the following parts:

- A round chassis with circuit boards, wheels and sensors
- Circuit boards:
- Microcontroller board (MSP430 Launchpad)
- Motor control board



- Energy Harvesting System (to be developed by the team)
- Additional sensors for navigation (line sensing, obstacle detection, etc.) to be developed by the team.

### **3.3.1. Microcontroller Board**

All documentations on the microcontroller board (MSP430) are available on the website of the competition.  
All teams have to use the provided board.

### **3.3.2. Power Supply & Motor Control Board**

Documentation on the architecture of the power supply card of the « SAM Board » motors is available on the competition website.

### **3.3.3. Energy Harvesting System**

The participants will have a mobile base on which they will be required to design and create an energy harvesting system. This system must collect energy supplied at charging stations and delivers this energy at the Energy Storage Station. The total quantity of energy delivered at the Energy Storage Station will be counted. The final score in the competition will be calculated from this quantity of energy.

The Energy Harvesting System designed by the teams must be completely independent from the battery used for the robot motion. This system can use as battery or any other system like a super-condenser.

Note: The energy harvesting system must be completely empty at the start of each match. This will be verified by the referee.

## **3.4. Security Requirements**

### **3.4.1. Robot Structure**

The robots cannot contain pointed edges that may cause damage or prove dangerous. All chemical products, pyrotechnics or aerosol are strictly prohibited.

### **3.4.2. Risk of Electrocution**

During any time on the competition, the embedded voltage must not be above 48V between any two points in the circuit.

### **3.4.3. Emergency Button**

For security reasons, all robots, must have an emergency button (in red) that is easily accessible (on top of the robot) to the referee. The referee can press this button in case of a major issue and thereby stop the match. If the referee presses this button the robot must come to a halt instantly.

The organising committee reserves the right to reject any system it deems dangerous.

# **4. COMPETITION FINALE RULES**

## **4.1. Review of Robots**

A review of each robot will be performed to ensure that they adhere to the specifications highlighted in the rules (dimensions, security, etc.). Once reviewed and approved, the robots can be used for the competition.

## **4.2. Match Process**

The main objective of the robot is to collect energy from various charging stations and to store it in the Energy Storage Station. The robot that delivers the maximum amount of energy will be declared the winner.

### **4.2.1. Before The Start of The Match**

The following rules must be verified before the start of the competition:

- The team places the robot at the starting area
- The referee ensures that the energy collection system is empty
- The referee resets the energy meter
- The referee made to pick from the lots the location of the fast charging station
- The referee places the fast charging station
- The referee flags off the match
- The team activates the robot by pressing the start button

### **4.2.2. During The Match**

The robot must remain autonomous during the entire duration of the competition. The teams cannot intervene at any stage nor can they use a remote control:

- The robot must connect to the charging station to collect the energy and to deliver it to the Energy Storage Station in the middle of the platform. Many trips may be necessary between the recharge terminals and the storage facility to increase the score.
- At the end of the competition (of a duration of 5 min), the robot must come to a halt on its own. In case the robot does not come to a halt, the referee will press the emergency button.

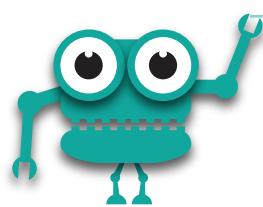
### **4.2.3. After the Match**

After the match, the following must be ensured:

- The referee must note the score obtained on the meter
- If needs, the teams can submit reclamation to the referee that will be added to the match sheet
- The team leader then sign the match sheet

## **4.3. Qualifying Round**

During the qualifying phase, teams that have been approved can participate in the two qualifying rounds of the competition. A ranking will be maintained on the basis of points scored (the total of the two scores) to determine the teams that will qualify for the final round. Teams that tie, will be required to participate in a third elimination round (the score obtained in this elimination round will be used to decide the team that will go through to the final round).



## 4.4. The Final Round

At the end of the qualification round, the eight first teams make up the final competition table. This is done on three steps:

- Quarter finals : 8 teams
- Semi-finals : 4 teams
- Finals : 2 teams

A separate round will be also conducted for the 3rd and 4th places. Figure 10 illustrates the different stage of the match.

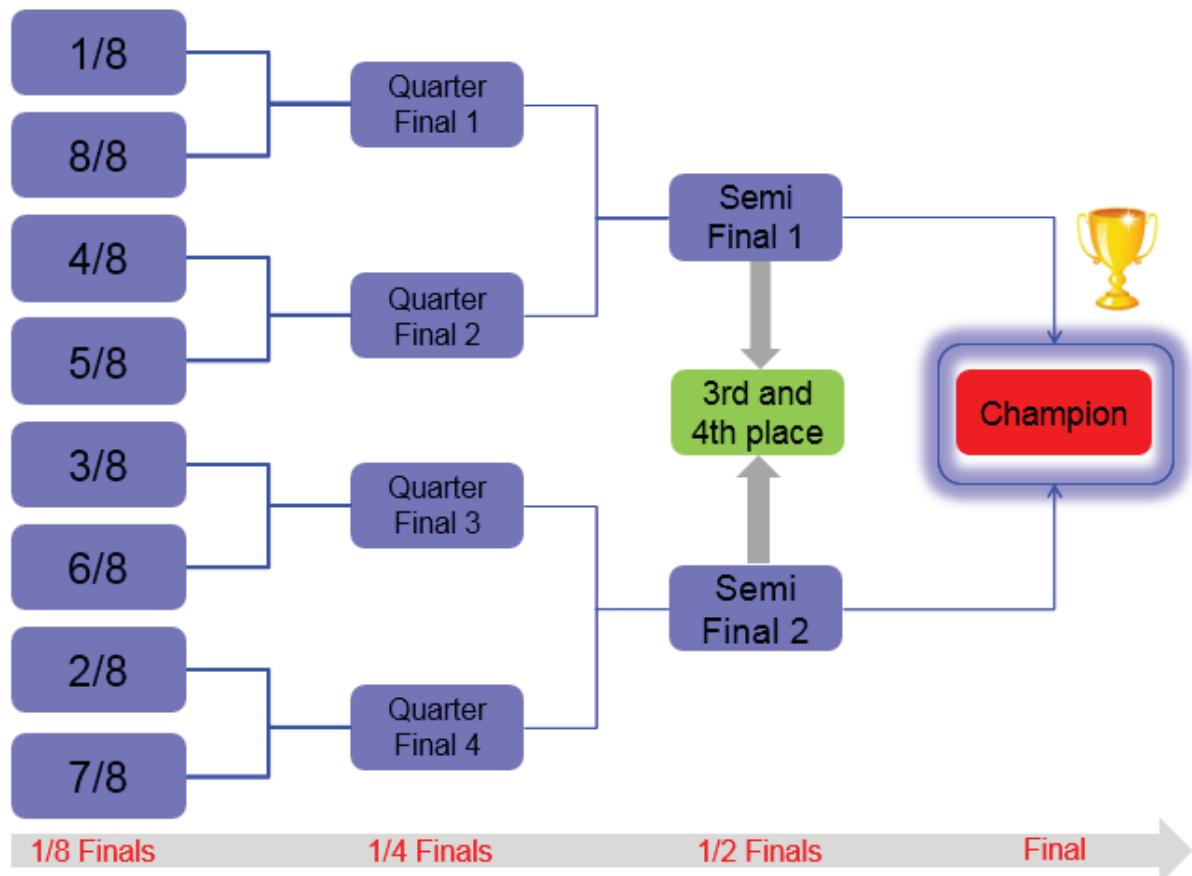


Figure 10. Final stage competition table.

# 5. MATCH SCORE

## 5.1. Obtained Points

Here are the different ways to obtain marks during the match:

- Energy score: the quantity of energy delivered to the Energy Storage Station.
- Number of connections to the charging stations (two or more successive connections to the same station is only counted once):
  - Regular: 5 points
  - Accelerated: 10 points
  - Fast: 25 points
  - Energy Storage Station: 10 points
- Leaving the starting area: 5 points.

## 5.2. Penalties

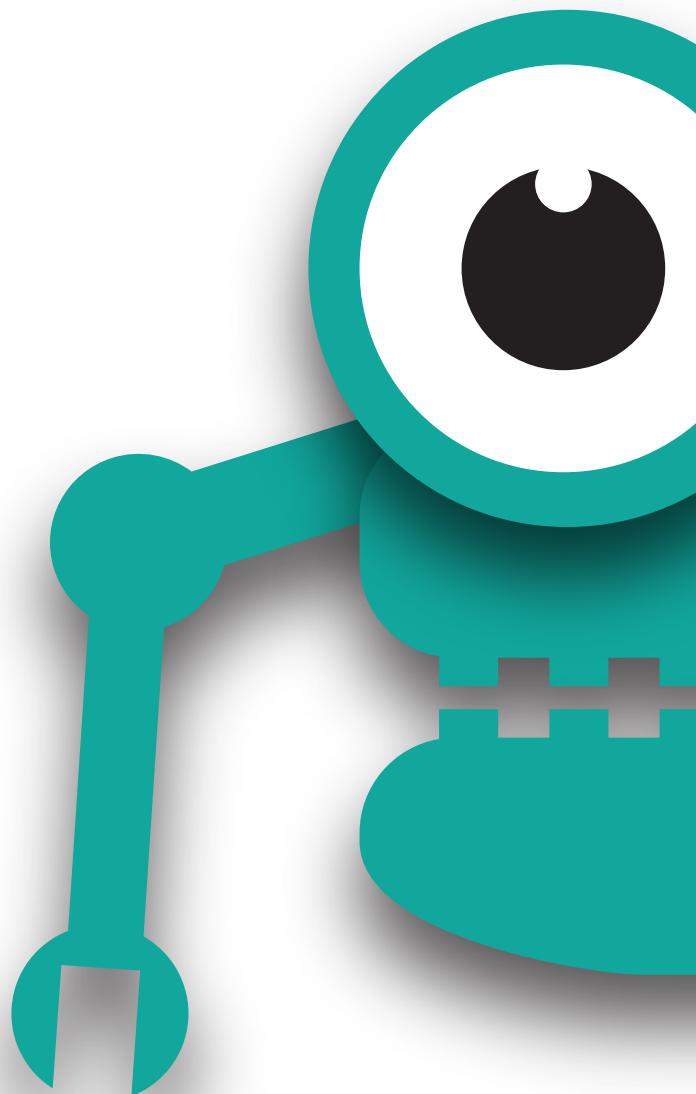
The penalties will be as follows:

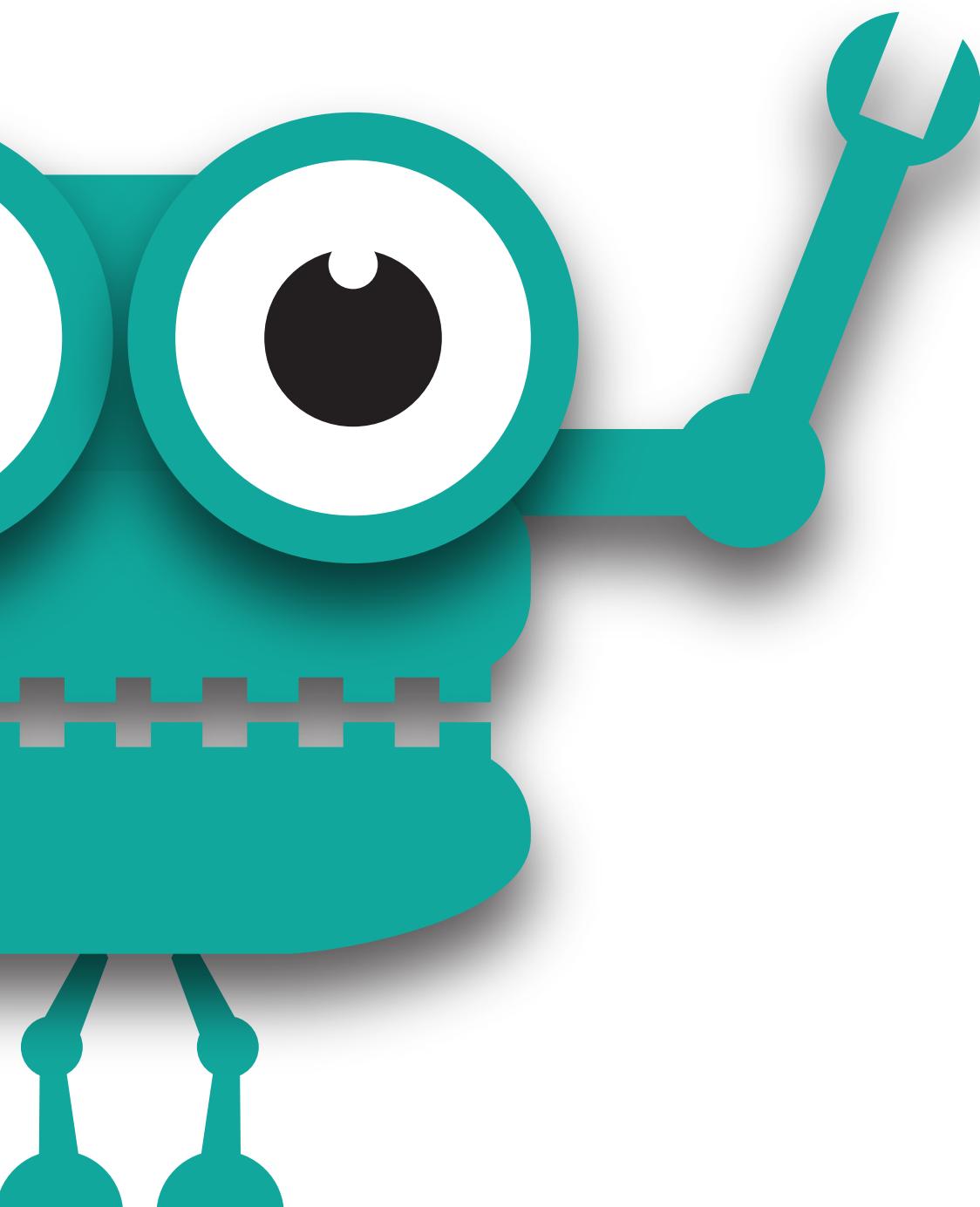
- The robot must stop automatically at the end of the match time, otherwise the referee will stop the robot via the emergency stop button and a penalty of 10 points will be applied.
- External intervention during the match: no external intervention will be allowed during the match. In the case of any external intervention, the team will get a penalty of 25 points each time.

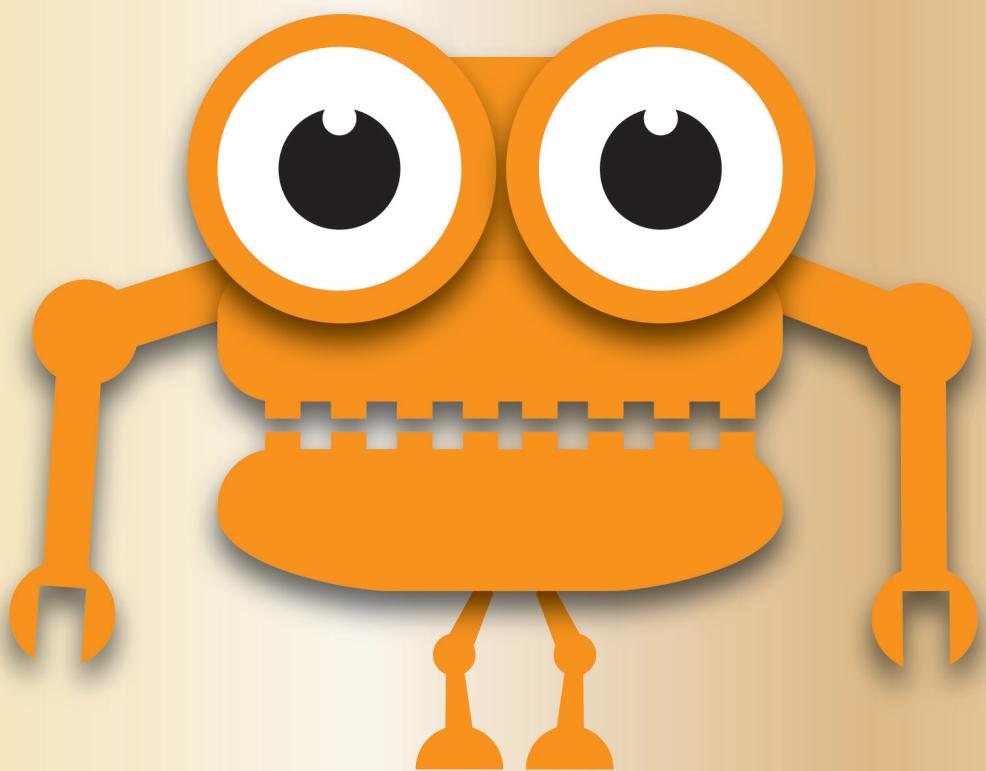
The referee can give penalties in case of bad behaviour for the team

## 6. CONCLUSION

This document elaborates the technical specifications of the competition that include the architecture of the platform, of the mobile robot and the rules of the competition. An evaluation system based on three criteria has been elaborated. Detailed documentation on all aspects of the competition is available on the dedicated Web site: architectures of the mobile robot, the microcontrollers, the motor control card, the charging stations and the energy storage station.







**ESIGELEC** 

<http://www.esigelec.fr> | [indiaoffice.esigelec.fr](http://indiaoffice.esigelec.fr)