An introduction to Robotics with LEGO® MINDSTORMS (XVII)

FLL Open European Championship 2014

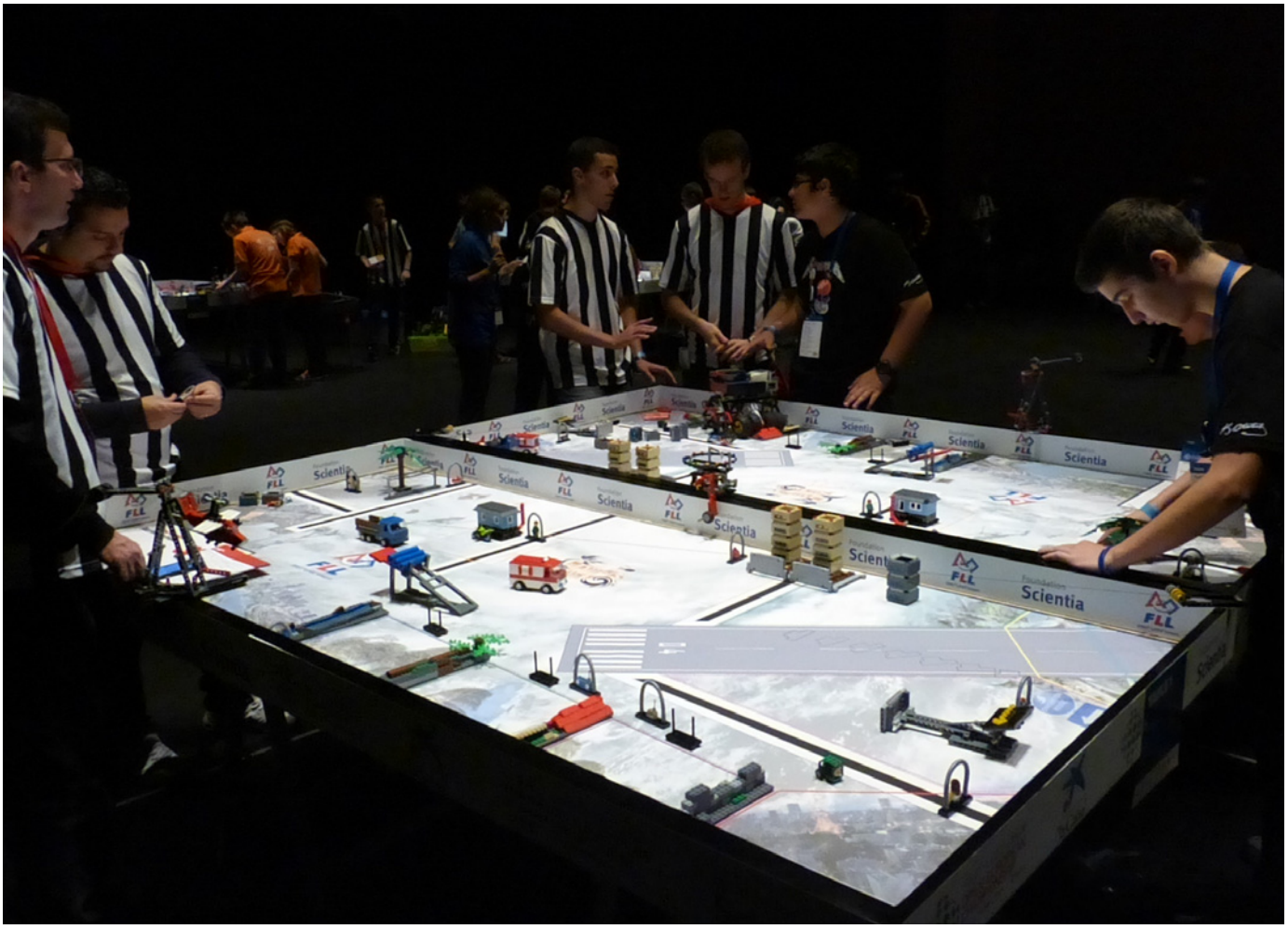
By Koldo Olaskoaga

In 2006 FLL came to Spain through Fundación Scientia and in May of this year the Open Europeo has been held in Spain for the first time, in Pamplona. Having it so close to home I didn't want to lose out on the opportunity to be there and enjoy three days that promised to be interesting, fun and a unique occasion to share in the FLL experience, with teams and volunteers who are passionate about science, technology and innovation.
In this edition 95 teams from 42 different countries from the five continents with a total of over 825 boys and girls from very different social and cultural backgrounds, in addition to more than 130 volunteers from 15 countries.

On this occasion I participated as technical judge, which has given me the opportunity to know the teams a little better than when I am referee, talking with them and appreciating the passion and creativity their projects reflect. Anyone who hasn't been wouldn't imagine that in the team of technical judges, like among the rest of volunteers, there were people from such different backgrounds as Lebanon, Brazil, Italy and Spain. After the information session on Thursday and during Friday and Saturday, the teams showed us their robots, explained the strategies they use on the competition table and told us about how they developed the creative process. The desire and effort to make the boys and girls enjoy this unforgettable experience helped people who had only just met to work together as a team as if they had been doing so for a long time already.

The Robotics Competition

The most spectacular part of the FLL is the robotics competition in which the teams face a series of challenges in which the robot needs to complete a number of missions autonomously in order to score. This year the central theme of the FLL was focused on the negative consequences that different natural phenomena can generate for people and things. This was reflected in the 17 missions on the table, each of which is associated with different natural phenomena like tsunamis, floods and storms.



The FLL has the same challenges as investigative and industrial robotics: it is impossible to build a robot that is capable of solving every single mission, so teams need to design a robot with a series of interchangeable accessories that are adapted to the different needs. In this area the solutions are very different and interesting. The number of complements varies, but on average each team more than three.

On the other hand, few teams are capable of solving all the missions in the two and a half minutes they get, so with the aim to score the highest amount of points they need to combine robot design, programming and strategy. The 95 teams proposed many different solutions, both in hardware and in programming. I have selected a few of them for this article, conscious of the fact that there were many more that would have deserved a mention.

Accessories and programming

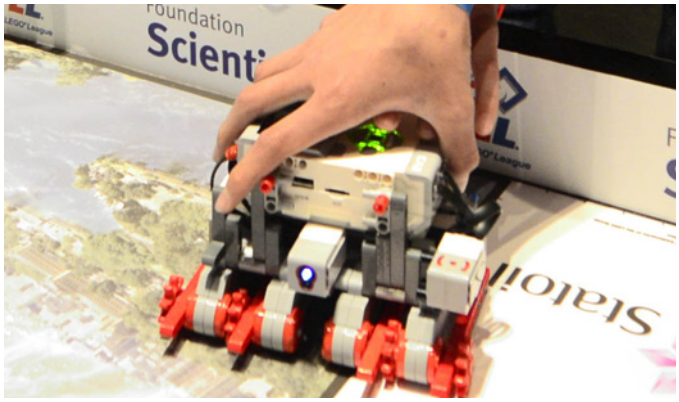
During the two and a half minutes of the competition, the robot faces missions it needs to complete autonomously and the team members can only touch and manipulate it (change accessories, making small repairs, starting programs…) in a rectangular area located in one of the corners of the table, called the base. If they touch the robot outside they are penalised.

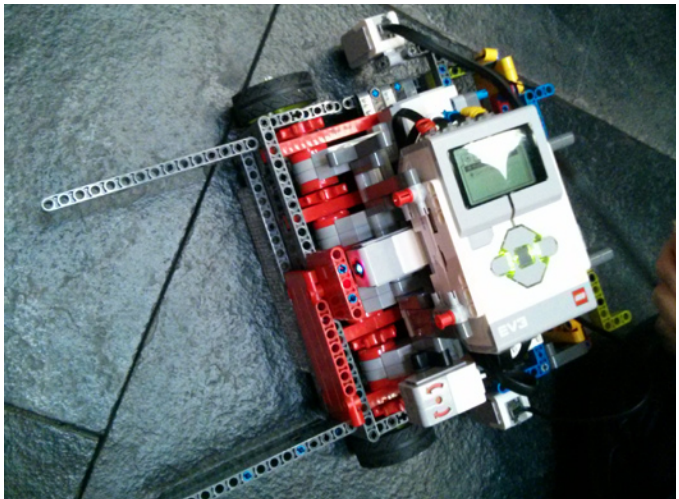
The teams try to find solutions so the time during which the robot is in the base is as short as possible, which can be achieved with accessories that are easy to attach and remove and by reducing the time needed to change the program.

In general, when a robot comes back to base, it stops and a new program is started. Some teams do this in such a way that it only takes the push of a button on the controller to start the next program, although this also has drawbacks if you want to retry a mission or modify your strategy due to some circumstantial factor.

The mechanical design is evaluated on three points: solidity of the robot, effective use of parts and ease of repair and modification, and the balance between speed, force and precision. Team Toyminators (USA) came third in this ranking and it developed a number of solutions I will mention below.

Most teams develop a base with wheels or treads that allows the robot to maneuver the table and a set of accessories, and most, if not all, feature differential drive. Team Toyminators chose a different solution: the EV3 controller was attached to 4 motors and 2 sensors (colour and gyroscope) that was incapable of completing any mission on its own. For the missions the robot had different interchangeable bases with their corresponding wheels or tracks.



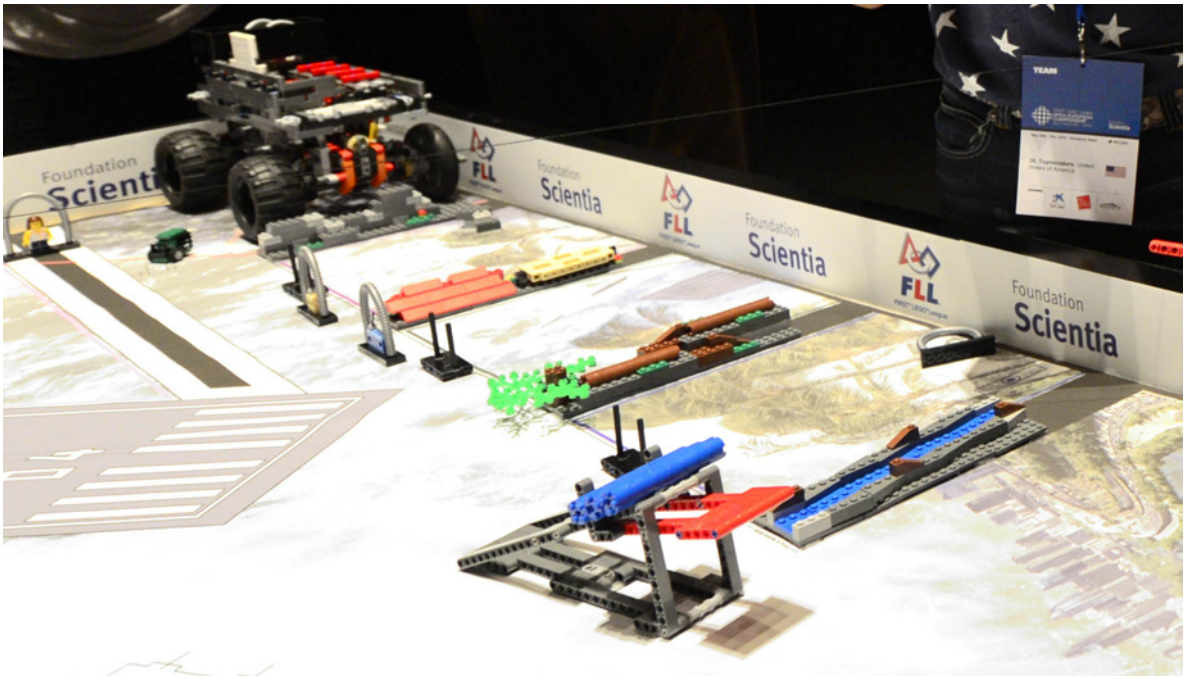


In addition, they used colour coding with the colour sensor so the robot knew what accessory was attached at each time. The parts were fixed using gravity and each accessory had a part that went in front of the colour sensor. The main program read the colour and showed the name of the corresponding accessory on the screen, so at the push of the button the right program was started (which was a MyBlock). This meant there was a single program with a context menu that changed depending on the accessory (or rather the base) that was attached. In this way they could execute the missions in any order and repeat them if necessary and

reduce the time and stress when in the base aera. The following image shows the robot with one of its bases, in this case with a red panel in front of the colour sensor.

Overcoming obstacles

A challenge in which the most diverse solutions could be seen was the obstacle challenge. The robot had to move over the table, overcoming obstacles that represented rivers, vegetation and rubble to get to the safe zone (the location of the robot in the next image).



Solutions included robots with treads, with 4 wheels (all the same or different sizes), with two or even one wheel. On the right side there was an area that was free of obstacles which, for example, allowed team Bideluze LS from FLL Spain to complete the challenge with a robot using a single motor connected to a wheel and the controller in vertical position, crossing the corridor quickly to the safe zone. Conventional rigid robots with four wheels had a lot of problems overcoming the obstacles, so different ideas needed to be developed.

A robot normally needs at least three points of support, with it centre of gravity within the area described by those three points.After trying different solutions, the German team sAPG-Tigers decided that, if you need to traverse a narrow corridor in which you can lose your balance, one way to make sure you stay balanced is by hanging on to the wall, so they built a robot with a mechanism that deploys when it reaches the obstacles, providing an additional support for the robot. Deploying the mechanism changes the position of a valve so a pneumatic cylinder adjust the support to the width of the wall. In order to better understand the idea it is worth to watch the video of the mission (see the playlist mentioned at the end of this article).

The Champion: Mechatronics Ants

Those who were in the main hall of Baluarte during the third round could witness two and a half minutes of magic on the competition table: the robot of the Mechatronics Ants from Navarra (Spain) made a round scoring 600 points, something they had achieved in their private tests, but not during a competition. There were those who asked themselves how it was possible to obtain such a result at this level, and I think I am not wrong when I say that this was the result of the passion, dedication and knowledge accumulated over the years. Not only did they win the competition on the table, they were the overall winners of the championship, something that can only be achieved with an excellent robot design, scientific project and demonstration of the values associated with the FLL.

The new challenge

The new challenge will be made public shortly, on the 26th of August, but we already know the theme it will centre around: FLL World Class, the future of learning. The participants will have the opportunity to tell the adults how they need and want to learn. A very interesting challenge for those of us who are passionate about learning.

Links

The final reports, pictures, videos, etc. of the championship are available on the Spanish FLL at http://goo.gl/xZfZrI. The playlist http://goo.gl/7hU4pP shows 4 videos, among which is the 600 point run by the Mechatronics Ants. Finally, a last image I'm sure you will all like, the programming for February-May for Baluarte with a LEGO® look.

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