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WORLD ROBOT OLYMPIAD™ DEVELOPMENT IN ROMANIA

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ABSTRACT

The paper presents the development of the World Robot Olympiad™ (WRO™) in Romania, highlighting the steps and the progress of the competition. The WRO™ is an international event dedicated to science, technology and education, which brings together young people from all over the world, in order to design, construct and program educational robots. The competition started in 2012, when a team of professors from Mechatronics program of study, offered by the Manufacturing Engineering Department – Faculty of Engineering, "Dunărea de Jos" University of Galați, organised in Galați the first regional pilot competition - RobotiCompetition 2012. In 2103, after the first national pilot competition, evaluated by the international organisation, Romania became WRO™ organizer.

KEYWORDS: educational robotics, creativity, innovation, competition, WRO™

1. INTRODUCTION

The World Robot Olympiad™ (WRO™) is an international educational robotic competition and an event dedicated to science, technology and education and brings together young people, all over the world, in order to develop creativity and problem solving skills. The schools and universities participate with teams, from one to three students, which should create, design and build educational robot models that should complete a certain task. Every year, theme and the tasks are decided by the organising country and the teams are invited to participate with the created educational robotic models. The competition lasts from the preliminary rounds to the final judging [1]. The objectives of the competition [1], [2], [3] are:

- to provide students opportunities to expand their knowledge through exploration of robotic systems in schools and universities;
- to introduce the concept of modern sciences into the school's educational activities;
- to promote creative thinking, improved communication and cooperation skills;
- to strengthen the ability to acquire new knowledge, relevant towards progressive education;
- to open the students' view in the application of science and technology;
- to improve students' learning efficiency and to encourage the youth to be future engineers, scientists and inventors.

The WRO™ competition uses Lego® Mindstorms® educational sets, manufactured by LEGO Education [6]. The first competition was held in 2004 in Singapore and it nowadays attracts over 1000 participants from more than 50 countries [3]. Lego® Mindstorms® Education helps to reinforce students' understanding in science, technology, engineering and math – STEM disciplines, in order to [4]:

- understand the difference between science and technology;
- stimulate creative, problem-solving, and team-working skills;
- share information through computer networks and internet;
- use new wireless communication technology;
- use multimedia in class-room activities;
- investigate the energy transfer, force, speed, power relationships and the effect of friction;
- program and control input and output (I/O) devices;
- attain experience measuring distance, circumference, rotational speed;

- use coordinate systems, to convert between decimals and fractions, between metric and customary units;
- apply mathematical reasoning in various practical contexts.

The Lego® Mindstorms® Education NXT contains a Lego building set, user-friendly software and progressive curriculum activities and consists of [6], [7]:

- 32-bit intelligent NXT brick with programming;
- ultrasonic, sound, touch, light and colour sensors;
- servo motors with built-in rotation sensors;
- Bluetooth® for wireless communication;
- rechargeable battery system with A/C plug;
- LEGO building system with over 400 elements;
- intuitive programming software, powered by LabVIEW™ from National Instruments;
- online technical support and a global network of experienced MINDSTORMS experts.

The LEGO® MINDSTORMS® Education NXT 9797 [7]

The new Lego® Mindstorms® EV3 set, which is allowed in the WRO™, combines the versatility of the Lego Technic building system with advanced technology. The controller of the set is an intelligent EV3 Brick with ARM9 processor, USB port for Wi-Fi and Internet connectivity, micro SD card reader, back-lit buttons and 4 motor ports. It also includes interactive servo motors, remote control, improved and redesigned color sensor, redesigned touch sensor, infrared sensor and over 550 Lego® Technic elements. The designed educational robotic applications are programmed - using the new and intuitive software available both for PC and Mac, with icon-based drag-and-drop programming interface - and controlled via the infrared sensor system [6], [8].

The LEGO® MINDSTORMS® Education EV3 [8]

Using the Lego® Mindstorms® Education sets, the students are challenged in working with various hands-on activities, problem solving, using their own ideas, working together and interacting with others. This not only strengthens their ability to learn, but also become better at cooperating, communicating and thinking independently [1], [2].

The WRO™ competition consists of four different categories: *Regular*, *Open, Football* and *College* [3]. *WRO Regular* and *Open* categories consist of participants from different age groups: *Elementary*, *Junior High* and *Senior High*. Participants below the age of 13 should participate in *Elementary*, participants with ages between 14 and 16 should participate in *Junior High* category and participants with ages between 17 and 19 participate in *Senior High* category [1], [2].

WRO GEN II Football is a competition whose concept was tested in the 2010 in Manila and in 2011 a full scale pilot was organized [1], [5]. *WRO GEN II* Football proved to be a success, due to the teams supporters, that provided a great atmosphere around the playing fields. The challenge is characterized by the participation of two teams with two autonomous robots playing a game of 10 minutes. The challenge operates with only one age category of young people between 10 to 19 years old. The materials allowed to construct the robots are also Lego® Mindstorms™ and controllers must be either RCX or NXT and sensors from HiTechnic [1].

The *WRO College* category was a pilot challenge for the WRO 2013 season. The College Category is available to students from the age of 17. There is no upper age limit - but participants have to be either High School or college/university undergraduate students. The category is based on the Matrix and Tetrix robotics platforms, using LabVIEW for Mindstorms [1].

2. THE FIRST REGIONAL ROBOTICOMPETITION 2012

Starting 2012, a team of professors involved in the *Mechatronics* program of study organised by the Manufacturing Engineering Department from the Faculty of Engineering – "Dunarea de Jos" University of Galati-Romania, contact the WRO Hellas

organisation, which coordinates the Greek national WRO™. With their help, the team start organising a regional pilot educational robotic competition called RobotiCompetition 2012 in Galați. The organising department invited schools from the South-East Region of Romania (Brăila, Buzău, Galați, Vrancea and Tulcea Counties) to participate to the competition. After the registration, the organisers registered a number of 23 teams in *Regular* and *Open* Category. In the *Regular* category there was a number of four teams participating in *Elementary*, eight teams in *Junior High* and ten participating teams in *Senior High*. Also, during the competition, a seminar of educational robotics was held in the Faculty of Engineering and the team's coordinators, school teachers and coaches attended the event. The event was supported by Galati County School Inspectorate, due to the help of the inspectors for vocational education and training. With the support of the educational experts, a feedback form for the competition was developed and after the students, coaches and teachers' answers, the following aspects were highlighted:

- to organise similar local competitions in all regions of Romania;
- to organise a national competition in compliance with WRO™ standards;
- to introduce the competition in the Romanian National Education Activities Calendar (CAEN).

The competition had a great success and proved to be the starting point for the future National Olympiad.

The team of Vrancea County at RObotiCompetition 2012
Ioannis Somalakidis (WRO Hellas national organiser),
Prof. S. Agache (Technical College Edmond Nicolau, Focsani) and C. Voicu (Galati Industrial Parc)

3. THE FIRST PILOT WRO™ 2013

After the experience of RobotiCompetition 2012 held in Galati, the organizers decided to extend the competition and also to initiate the procedure for introducing Romania among the WRO™ organising countries. From this point of view, WRO Advisory Council was contacted by the organisers and a preliminary approval of WRO membership was granted by the WRO Secretary General for 2013 season.

The Galati WRO™ regional competition was held during the national event "Zilele Educației Mecatronice" (Mechatronics Education Days) on the 21st to 25th of May 2013. A number of three teams in *Elementary*, four teams in *Junior High*, twenty teams in *Senior High* and one team in *Open* category registered in the competition. Similar WRO™ regional competitions were held in Craiova and Bucharest. The winners of regional competitions participated to the first national pilot WRO™ 2013, organised by the Faculty of Engineering and Management of Technological Systems from Politehnica University of Bucharest on the 15th of June. The winners from *Elementary* category, the D.A.M. team from *Junior High* category, the RObuti team from Colegiul Național de Informatică Tudor Vianu Bucharest and for *Senior High* category Free Gigi team, from Colegiul Național Costache Negri and Colegiul Național Vasile Alecsandri Galați, participated in the international WRO™ held in Jakarta, Indonesia on 15-17th of November 2013. The theme of *Open* category announced in 2013 by the organizing country, was *World Heritage* and the tasks were to create and design robots to promote and protect the World Heritage Sites [3].

Galati 2013 WRO Regional, 25th of May
("Dunarea de Jos" University of Galati)

Romanian *Senior High* team in Jakarta, Indonesia (Cristian Chiarc, Dan Catalin Mitescu, Dorin Clisu and Asist. Prof. Luigi Renato Mistodie)

4. THE SECOND WROTM 2014

Starting 2014, two other cities of Romania joined the WRO Romania and organised and participated in the Olympiad. Thus, the regional competitions were organised in Brasov, Constanta, Craiova, Galati and Bucharest. In Galati, the announcement of the competition was made on 20th of March 2014, where the new rules of the competition were presented. Russia, the 2014 WRO™ organising country, proposed the theme *Robots and Space*. All teams had to design, construct and program educational robots, which simulate different tasks in space. In *Elementary*, the theme was "The Rocket" and the robot's mission was to assemble rocket elements in the assembly area, to place it vertically over a ramp and to evacuate civilians to the safe areas.

Galati 2014 WRO Regional, 2nd of June (Faculty of Engineering - "Dunarea de Jos" University of Galati)

In *Junior High*, the theme was "Sputnik Satellite" and the robot mission was to collect all the space debris and failed satellites and to load them into a factory satellite, leaving the valid satellites on the orbit [9]. In *Senior High*, the theme was "Space Station" and the robot had to pass through a gate (ramp) into the outer space, to check for bad solar panels represented in black colour and replace them with good ones from a warehouse disposed in the space station. The robot also needed to discover and activate inactive coloured solar panels.

The national WRO™ 2014 was held in Bucharest at the Lumina University of South-East Europe, where over 100 teams from all Romania were registered and participated. The winners of the national WRO 2014, a number of six teams, participated in the official 2014 WRO held in Sochi, Russia on 21st - 23rd of November.

The teams from Galati that participated in WRO 2014 held on 21st - 23rd of November in Sochi, Russia

5. CONCLUSIONS

The paper presents the development of the international World Robot Olympiad™ (WRO™) in Romania, highlighting the steps and the progress of this competition from 2012 until now. From the point of view of the participating teams, the regional team's experiences in different regional, national and international WRO™ events are also presented.

In conclusion, the development of educational robotic competitions is an effective tool for motivating students in learning STEM disciplines. Furthermore, the competitions encourage students in combining their efforts to identify problems, to generate new solutions for different tasks, to work in teams, finally, providing the opportunity to sustain the intellectual development.

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