

Visegrad Robotics Workshop - different ideas to teach and popularize robotics

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Abstract. In this paper we summarize our experiences with the series of educational robotic workshops organized for a group of students from four schools in four countries. Brief description of the activities, their results and evaluation are presented.

Keywords: robotics education, robotic contest, robotic workshop.

1 Introduction

The robotics now became one of the best tools for training of students of engineering. Why the robotics is so popular in the educational environment? Some reasons are: multidisciplinary, practical results, new application, intelligent algorithms, etc. However, methods of using robotics in education are often very different. So the laboratories in Slovakia, Poland, Belarus, and Czech Republic have their various achievements. There are specific features in teaching, seminars and laboratory work.

In addition, each laboratory conducts its own competitions, aimed at developing certain skills in students. Each laboratory has its own interesting ideas and problems, and even mission, so the exchange of experience between them is very important and inspiring. It stimulates the development of approaches in the general direction, while maintaining its own unique character. To implement this idea, the authors have joined forces in a standard grant at the International Visegrad Fund [1].

1.1 Goals of Visegrad Robotics Workshops

Visegrad Robotics Workshop [2] was composed of four events organized in four partner cities: Bratislava, Prague, Łódź and Brest. Each event was three-fold and contained:

1. workshop giving hands-on experience for participants,
2. lectures or conference being educational part and
3. robotic competitions providing entertainment.

2 Descriptions of workshops

2.1 Workshop in Bratislava

The 13th annual robotic contest Istrobot [3] organized by Slovak University of Technology in Bratislava (STU) and Robotika.SK [4] was the first event of Visegrad Robotics Workshop. This dynamic competitions lasted whole day and was located in the premises of the Faculty of Electrical Engineering and Information Technology. Visitors could see over 60 robots in four official categories and on display in the corridors of the faculty. Some 500 spectators came to see various robots competing on the scene and presented all around at STU.



Fig. 1. Left: workshop in Bratislava with Acrob robots. Right: MiniSumo contest at the Czech Robotic Day contest in Prague.

The next day the Bratislava Robotic Workshop began. Participants from three guest countries (4 students from Belarus, 4 from Czech Republic, and 6 from Poland) could listen to interesting lectures and had hands-on workshops in the laboratories of the Institute of Control and Industrial Informatics. Topics of presentations are listed in the evaluation table (see Tab 1.). Besides the lectures, students had the laboratory tour and hands-on workshop with Acrob robots [5]. The detailed explanation on the objectives and experiments was provided. Part of the workshop was also an excursion to the ME-Inspection Company that concluded the first Workshop. Evaluations of the activities based on questionnaires from the participants are summarized in Tab 1.

2.2 Workshop in Prague

The next visit within the Visegrad Robotics Workshop began with the jubilee 10th robotics competition Czech Robotic Day [7]. It was co-organized by Robonika association and Charles University in Prague and brought over 120 robots from 6 countries. Over 500 spectators visited this event and observed 7 categories of competitions, including two new in Prague. Since the start in 2004, Charles

Table 1. Evaluation of the first workshop in Bratislava. Marking is based on school grading system: 1 - best / 5 - worst. Results are based on 13 valid responses.

No.	Activity	Average	Min	Max
1	Istrobot robotic contest	1,31	1	2,5
2	Andrej Lúčný: Learning Objects Representation	1,46	1	3
3	Pavel Petrovič: AI Topics	1,92	1	3
4	Peter Hubinský: History of robotics	2,12	1	5
5	Acrob workshop and training	1,15	1	2
6	Laboratories excursion	1,62	1	3
7	ME-Inspection excursion	1,69	1	3

University supports the event recognizing the values of joint theoretical and practical education. Therefore, Robotic Day is composed not only of competitions, but indivisibly also of a workshop for teams and public. It is dedicated to the exchange of experiences related to the construction of robots starting in the competition. Intentionally, this workshop is organized always one day after the competition when the participants are still well aware of everything concerning their robots and at the same time they are already past the competition stress. The basic layout of the workshop is set as a series of presentations by individual teams participating in the contest with sufficient time margins for discussions.

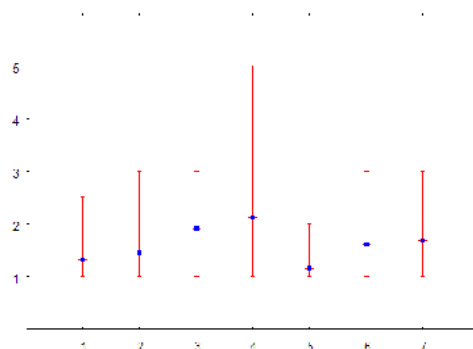


Fig. 2. Graphical evaluation of the 7 activities from the workshop according to the Tab. 1

At the workshop, teams discuss deep technical details and willingly answer many questions both from other participants, visiting students as well as general public attending the workshop. It has proven over the years that the impact of this workshop is manifold; participants share knowledge about all topics concerned (hardware, software, theory, algorithms, team management etc.) and set new contacts both on professional as well as social level. The presence of Visegrad Robotics Workshop participants was well accepted especially for the opportunity to discuss different curricula styles in their home institutions and possible future cooperation between them.

On the following days, the program consisted of lectures and hands-on exercises: Tomáš Bureš approached issues of real-time scheduling, Tomáš Plch gave lecture on Artificial Intelligence and Decision Making, Alexander Wilkie introduced us to realistic computer graphics in the lecture: Predictive Rendering – The Other Type of Realistic Computer Graphics, Marta Vomlelová spoke on Markov Decision



Fig. 4. Lectures at Charles University, Prague

Processes. Every day the morning was devoted to the lectures and the afternoons were reserved for practical hands-on robotic lab experience. These were implemented using mobile robots “MOB-2” designed by David Obdržálek for his curricula on software engineering and allowed for efficient testing of control algorithms. Although the participants did not have any experience with this particular platform, they were quickly able to exploit it and perform basic tasks in localization and control.

2.3 Workshop in Lodz

Robotix Week [8] in Lodz started on 17.11.2013 with workshop about human-robot interfaces based on Android devices or other computers communicating via Bluetooth. The latest gadgets like smartphones, tablets or laptops are perfect for intuitive driving of the mobile robot, and if the robot is additionally equipped with a camera we can see on the screen images from the remote places where we had sent our scout to. The detailed description of this workshop and the whole philosophy behind it can be found in [9]. The next day brought a new experience - working with sets of LabVIEW Robotics Starter Kit [10] utilizing hardware and software from National Instruments - project partner of the Robotix Week. Students got familiar with LabVIEW graphical programming environment; worked with RealTime and FPGA based systems being brains of the mobile robots.

On Thursday and Friday (19-20.09.2013) was the 4th International Conference on Robotics in Education RIE 2013 [11]. The conference hall of the Faculty of Electrical, Electronic, Computer and Control Engineering hosted over 50 participants from 17 countries. We had an opportunity to listen to 5 plenary speeches delivered by two outstanding professors Andrea Bonarini from Politecnico di Milano and Edward Jezierski from Lodz University of Technology as well as three representatives of partner companies: National Instruments, Kuka Roboter Poland and RoboNET. Twenty two regular papers were presented in the sessions and we could see robot exhibition with LabVIEW Robotics, Kuka Agilus and the NAO.

On Saturday the sun came out and the inhabitants of Lodz (a few hundred people, mostly with kids) were able, for the first time in Poland, to see the struggles of autonomous mobile robots in the Poniatowski Park.

The Robotour [12] contest was brought to Lodz from the Czech Republic by Martin Dlouhy from the association Robonika. Eight robots of various sizes and interesting constructions were designed to independently drive the distance of over



Fig. 5. Left: Prof. Andrea Bonarini's plenary talk on RIE 2013. Right: Roborace competition in Brest in action.

500 meters from the starting point to the target location determined by GPS coordinates.

2.4 Workshop in Brest

The last meeting of the project took place in Brest on 4. - 9.11. and included the International Conference Robotics and Artificial Intelligence, Problems and Perspective (RAIPAP) [13], workshops and robot competitions Roborace [14], all organized by Brest State Technical University.

Next two days included practical part of event. First workshop on robots programming with the use of machine learning tools (reinforced learning) were realized on mobile robots Pop-Bot and using RL-Glue environment. Second workshop was devoted to the preparation of robots to compete in a special run during competition Roborace (see workshops voting in table 2).

The meeting agenda was pretty tight, but the organizers, apart from the scientific aspect, took care of the cultural experience: we visited the Brest Fortress, bisons in the Bialowieza Forest, dairy factory, and we commemorated the anniversary of the October Revolution (7.11.) with the patriotic movie Stalingrad (watched in Russian!).

Obviously excursions won first place in estimating of activities (See table 2.2), but most interest event was Roborace - new competition for participants from Europe.

Table 2. Voting of best activities.

	Activities	Number of votes (Total 13 votes)
	Lectures	
1	Reinforcement learning in Robotics (PhD-student Anton Kabysh)	6
2	How can we make robot navigation more intelligent? (Prof. Akira Imada)	5
3	From neural networks to intelligent systems: researches and application (Prof. Vladimir Golovko)	2
	Workshops	
1	POP-BOT Roborace Competition	10
2	POP-BOT Reinforcement Learning	3

Table 3. Activities in Brest workshop. Results of evaluation shown non-scientific part of workshop advantages, Marking is based on school grading system: 1 - best / 5 – worst.

No.	Activities	Average	Min	Max
1	Conference RAIPAP'13	2.33	1	4
2	Excursions	1.5	1	5
3	Roborace Competition	1.91	1	5

They unite dynamism and staginess of a formula 1 with robotics knowledges. It is quite natural that conference which was held for the first time, received the smallest evaluation. In Belarus the robotics is still too young to organize serious conference.

3 Results

3.1 Results of Workshops

The main result expected from the project was a series of workshops that could help to launch new internationally connected activities. During four events, as planned, we have shared our knowledge and experience in teaching robotics and other high-tech related subjects (control theory, computer graphics, Android programming, artificial intelligence) and therefore we have strengthened the scientific potential in participating organizations. Our face-to-face meetings proved to be much more effective than any kind of distant conversation and learning. Being in one place for a few days faculty and students became aware of the local problems and learned new methods of teaching. We have continuously exchanged ideas, discussed new opportunities and further plans. We have already prepared extended version of Visegrad Robotics Workshop involving more organizations from Eastern Partnership countries (Belarus and Ukraine).

Our initiative included also organization of the large robotic competitions and conferences that could promote science and technology on the regional and international level. Presence of Visegrad partners raised some interest among visitors.

Thanks to the IVF support Czech group was able to observe the Ketchup House tournament (until 2013 it was known only in Bratislava), and bring all equipment necessary to organize the same competitions during next event in Prague.

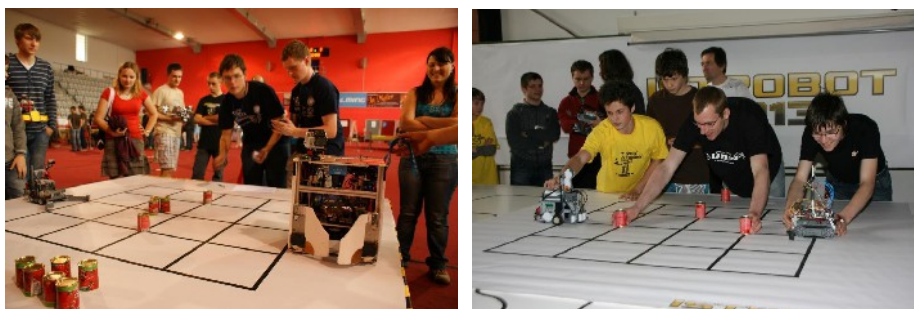


Fig. 6. Ketchup House at Istrobot (left) and at Czech Robotic Day (right).

The Robotour contest (until 2013 organized in Czech Republic, Slovakia and Austria) was brought to Poland as a part of Robotix Week (see Fig. 7 left). Similarly, International Conference on Robotics in Education started its travel beyond the original region: previous editions in Bratislava, Vienna and Prague were extended by holding it in Lodz and a decision to organize it in Italy 2014 and tentatively in Switzerland 2015.



Fig. 7. Left: Robotour competition. Right: POP-BOT preparation for competition.

This project was the main motivation to organize International Conference on Robotics and Artificial Intelligence, Problems and perspective (RAIPAP) in Brest where we had the opportunity to listen to guests from Belarus, Ukraine and Russia. The project participants also gave two lectures: Richard Balogh, Evaluation of the optoNCDT ILR sensor and Igor Zubrycki, Grip recognition and control of 3-finger gripper with sensor glove.

New knowledge came also with Roborace (see Fig. 5 right) – contest unknown in Visegrad countries, while extremely popular in Ukraine, Belarus and Russia. It is based on the race of autonomous mobile robots competing on the track at the same time resembling a miniature Formula 1. This is a very spectacular event with a dynamic course - a few robots is on the track at the same time causing collisions and sudden twists, which possibly will be adopted in other countries next year.

Brest Workshop had immediate results – participation in Roborace run – all students worked on the same robots and, therefore, control programs were the main issue showing seamless cooperation in mixed teams. As we expected, events in different countries encouraged students for mobility and gave positive results on social and personal level.

Project Visegrad Robotics Workshop was focused on exchange of experience and best practices in science and education. We have prepared the special DVD containing some lectures presented during workshops and conferences, educational material from workshops as well as video relation from competitions. It will be used by all participants for education and promotion. Most of this material is also available on-line [2].

Workshop participants had a chance to compete in different countries: e.g, students from Poland and Belarus won in Czech Robotic Day in category Art, Robots & Entertainment: Igor Zubrycki – 1st place with robot MousePal-2, and Dmitriy Sklipus – 3rd place with autonomous car. Two robots named MousePal and

OmnIVOice (built by Workshop participants) won FreeStyle contest (I and II place, respectively) at Istrobot. During last workshop in Brest we could observe truly international cooperation – team mates from Slovakia, Poland and Czech Republic worked together, as shown on photo in Fig. 7 right.

Project was prepared and realized by two public educational institutions and two non-profit and non-government organizations. All four partners of the project had equal responsibilities: organize one of the events located in their countries and help other participants with travel and accommodation. Additionally, Lodz University of Technology was responsible for coordination of the venture. Partners from Visegrad countries prepared three leading workshops while partner from Belarus could gain more experience, and has organized last event. In total almost 40 different persons from partner organizations attended workshops expanding their knowledge and experience, several hundred people (from Visegrad and other countries) took part in conferences and competitions within the project.



Fig. 10. International cooperation during last workshop in Brest – team mates from Belarus, Slovakia, Poland and Czech Republic.

4 Discussion and Conclusion

All four workshops brought new experiences and besides the immediate positive impact on the participants also some new challenges and questions. All participants, teachers and students appreciated the work in international teams, practical workshops and contests. For the future there is a question how to include such method of education into the standard curricula at the host universities. It would be beneficial if such workshops are not occasional but standard part of the regular engineering education. Financial support is crucial; without it, probably no one would take part in this venture. Especially travel and accommodation costs are too high to be covered by students themselves.

For the first time, partners just explored possibilities and resources of each university and organization. In case of repeated activity one can imagine more

interconnected workshops and continuous work on the single study/research project through the overall project period.

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