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ROBOTICS TALENT MANAGEMENT AT UNIVERSITY OF NYÍREGYHÁZA

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Abstract

Both in the economy and in research and development, there is worldwide growing demand for a competent workforce in the field of artificial intelligence and robotics applications. The educational system is developing answers to this need, this development, and the collection and evaluation of the experiences of the applications is a lively field of research. The target groups of the developed educational programs and methods range from kindergarten to university.

This paper presents the opportunities offered by the Hungarian competitions qualifying for the robotics competitions of the international RoboCup Community for primary and secondary school students, and how this is realized at the University of Nyíregyháza. The leagues of the competition and the experiences gained so far are demonstrated.

Keywords*: talent management, robotics, RoboCup Junior, STEMIE, A-STEM.*

1. Introduction

In the society and economy of the 21st century, there is an ever-increasing demand for a talented workforce with competencies related to the use of artificial intelligence. At the same time, computer programming and the use of artificial intelligence applications are often associated with robotics. This is also increasingly common in education.

This paper reports on the robotics competitions that have been held at University of Nyíregyháza for 17 years now, which offer participants the opportunity to participate in competitions and exhibitions of the international RoboCup community. Teams of primary and secondary school children can join the RoboCup Junior program.

2. Robotics and education

In a previous work [1] the author gave an overview of the two types of connection between robotics and education. One way to connect is if robotics is the subject or topic of education, i.e. the students learn robotics. The other connection is when robotics becomes a tool for education. This study deals with the first approach.

The scientific literature deals separately with the possibilities, results and challenges of educating children in early childhood (kindergarten age) and K12 (primary and high school).

E. Pollarolo et al. [2] prepared a summary of the use of programmable games in early childhood development. Based on the processed sources, it was shown that the programmable games used in the kindergarten not only develop computer user skills, but also problem-solving and communication skills. They emphasized that, in addition to the professional knowledge of the teachers, their methodological preparation also plays a very important role in ensuring that the use of programmable games optimally supports the development of the children's personality and abilities. J. Su and Y. Zhong examined curricula prepared for young children [3] in terms of objectives, content, methods and pedagogical evaluation. Among other things, they mention the five major topics proposed by the AI4K12 organization, which are perception, representation and conclusion, learning, natural-like relationships, and social impact. They emphasize that among the educational methods, the project-based method is considered the most suitable for teaching artificial intelligence, for which robots are used in most cases.

F. Martin and his colleagues [4] investigated how artificial intelligence appears in the education of the K12 age group. The applications extend to the most diverse areas, such as the analysis and prediction of student progress, the development of teaching materials for artificial intelligence education and the support of the teaching of certain subjects. The study points out that robotics applications are gaining more and more space in education. According to S.J Lee et al. [5] there is a growing need for computer science education, and robots play a fundamental role in this. Among the methods and tools of education, the theoretical foundation is mentioned, the general process of education is presented, the role of real and virtual tools, activities with and without a computer, educational experiences in the field of graphic and text programming. S. T. Chu et al [6] investigated the use of artificial intelligence-based robots in education. They point out that robots can have a teaching role in the educational process, or they can appear as a tool used by students.

Y. W. Cheng and his co-authors [7] examined the expectations of robots in the field of education using the methods of literature research, interviews with experts and the analysis of reports received from educators. Fourteen areas of applications and related expectations were identified, among which language teaching, educational robots and robot pedagogical assistants were the most popular. The complexity and depth of the solutions based on artificial intelligence were divided into five levels. The first level represents perception, recognition of words and straight line movements. On the second level, problem solving, planning, understanding expressions and plane movements appear. In the case of the third level, navigation, manoeuvring, interpretation of sentences, and movement of body parts are used. The fourth level includes the programming of learning, discovery, dialogue, fine movements. At the fifth level, self-awareness, recognizing the meaning of speech, and micro-movements are realized.

G. Nugent and co-authors [8] investigated the effectiveness of a robotics education program in different settings within the United States, developed by the University of Nebraska-Lincoln for 9-14 year olds. With the involvement of 5,000 students and 400 teachers, they researched what results were achieved with the educational program in camps, clubs and competitions. It turned out that technical knowledge and programming skills were well developed by the program, but mathematical skills were essentially not strengthened. The students' problem-solving and error-finding skills improved significantly from the level of trying ideas to systematic, planned activities. Not only did the students' knowledge and skills improve, but their interest in technical careers also increased.

The Finnish research group of T. Oksanen presents the experience of a robot competition over a 5-year period [9].

It can be concluded that robotics plays an important role in education from many points of view, the most important of which are the following:

Development of creative thinking and problem-solving, development of technological skills, development of cooperation and teamwork skills, understanding of real-life applications, increasing motivation and interest, development of critical thinking. Robotics is an exciting and interactive activity that arouses students' interest in STEM (Science, Technology, Engineering, Mathematics) fields and motivates them to learn.

All in all, the introduction of robotics into education can help in the broad development of students, preparing them for the challenges and opportunities of the future.

3. The RoboCup Federation

The history of the international RoboCup Federation dates back to 1992, when Professor Alan Mackworth raised the idea of soccer-playing robots in a scientific paper. In the same year, independently of him, Japanese researchers at a workshop discussing the great challenges of artificial intelligence also came to the game of football. More and more leading research and development companies joined the further development of the idea. After the pre-RoboCup held at a conference in 1996, the first official RoboCup competition took place in 1997 with the participation of 40 teams and 5000 spectators in Nagoya, Japan [10]. This event is not just a competition, but an international scientific conference, exhibition and science popularization event in which the world's best development teams from universities and companies participate. It didn't take long for the idea of the RoboCup Junior event for young people to come up, which first took place in 1998 in Paris. The international competition for young people and adults is organized at the same time and place, so students have the opportunity to meet the leading researchers in robotics in person and see the solutions they have prepared.

4. The RoboCup Junior

Amy Eguchi, co-president of the RoboCup Federation, representative of RoboCup Junior, presents [11]] the goals of RoboCup Junior and the results of a survey among competitors. We highlight three of the features of RoboCup Junior here. The first is a competition task that is renewed every year but contains the same goals within each league, which helps students to develop their knowledge in a well-structured environment. The second characteristic is the focus on education, which means that the technical committees of the leagues use intensive background work to determine exactly how each competition task should differ from the previous year. The third is lifelikeness, which aims to strengthen students' interest and motivation.

Robocup Junior has three main themes: escape, football and theatre. Within these, several so-called leagues are announced with slightly different and challenging conditions.

5. Robotic competitions at the University of Nyíregyháza

In 2006, we organized the first RoboCup Junior competition at University of Nyíregyháza. That year, the Hungarian teams already represented Hungary in the international competition, so that they managed to bring home prizes. The initiator of the competitions and the contact person of the Hungarian RoboCup Community is Simon Béláné dr. Ágnes Balogh is a college teacher.

After that, the Hungarian Youth Robot Cup is held every year, which is the qualifying competition for the international RoboCup Junior competitions. The team that successfully qualifies in the domestic competition can apply for the world competition.

Over time, it became necessary to organize the competition in two installments. Currently, the escape leagues take place at a separate event, and the other leagues at another event.

Fig.1 shows the participants of the 2024 Hungarian Youth Robot Cup competition organized at the University of Nyíregyháza.

Fig. 2 shows a snapshot of one of the simulation leagues. Here, you have to write your own program running in a predefined framework software, with the help of which the simulated robot implements tasks.

Fig. 3 shows a match of one of the soccer leagues.

The robots of the Rapidly Manufactured Robot Competition (RMRC) (Fig. 4)) have to travel along a path imitating a difficult terrain while performing image recognition and manipulation tasks.

Fig. 1. *Participants of the Hungarian Youth Robot Cup 2024 competition in Nyíregyháza.*

Fig. 2. *Rescue simulation league: here you have to write your own program, which runs within a framework software, based on given rules, but you have to complete tasks on an unknown course.*

In the on stage leagues (Fig. 5) the teams have to present a stage choreography in which the robots are the protagonists, but the value of the presentation increases if they also cooperate with humans. Here, the scenery and the artistic realization are also on point.

One of the two main types of escape leagues is based on the task of following a line (Fig. 6), the track of the other type does not have a leading line, but rather resembles a labyrinth (Fig. 7).

It applies to all leagues that you have to compete with an autonomous robot. The competition rules are the same as the international rules for the competition in Hungary as well. The teams must be able to present the progress and professional content of their preparation with a presentation in English.

Each league's rules include the key phrase: "It's not about where you rank, it's about what you learn."

6. Conclusions

The multifaceted role of robotics and artificial intelligence in education is changing every day and is an area of active research.

The associate organization of the international RoboCup association is RoboCup Junior, which presents well-founded pedagogical challenges to youngsters that systematically change from year to year.

The Hungarian Youth Robot Cup is the qualifying competition of the RoboCup Junior international events, which has been held at the University of Nyíregyháza since 2006. The event is currently held at two locations.

At this event every year, the participants have the opportunity to learn about the challenges of the international RoboCup Junior and qualify for the world competition.

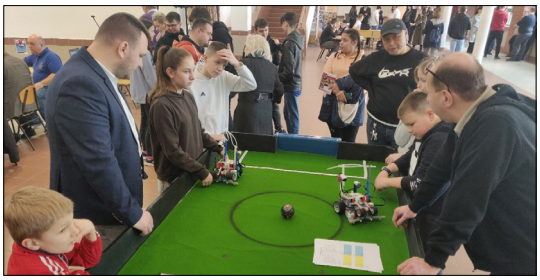

Fig. 3. *Robot soccer.*

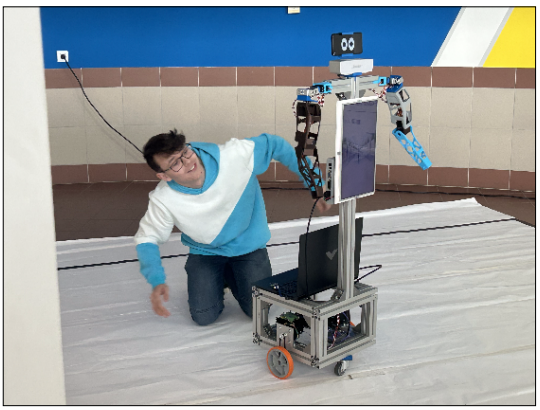

Fig. 5. *On stage league.*

Fig. 4. *RMRC league.*

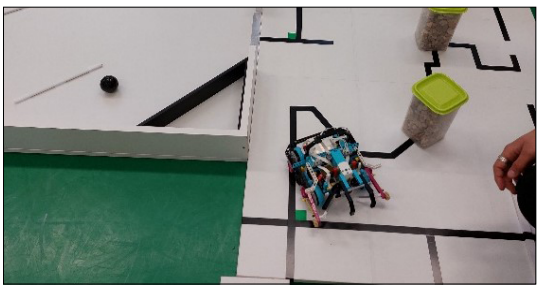

Fig. 6. *Rescue league line following.*

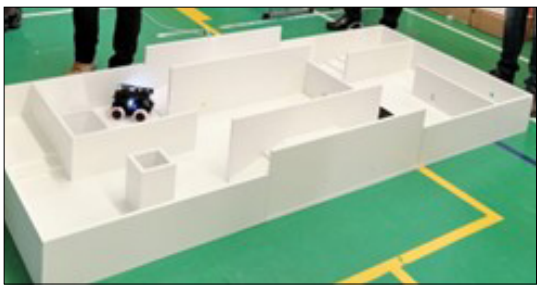

Fig. 7. *Rescue league labyrinth.*

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