INTRODUCTION OF THE ROBOTICS IN EDUCATION OF CHILDREN AND YOUTH

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ABSTRACT
Today there is a need to promote the profession of an engineer actively already at high school, the introduction of the basics of robotics in the education of children and youth. At the same time, a problem is revealed related to the lack of a centralized training system aimed at developing of the scientific and technical creativity of children and young people in the field of robotics.
Such a centralized system of vocational guidance, which fosters the training of engineers and technicians with social and professional competencies that meet modern requirements of high-tech industries, can be created only on the basis of network interaction between educational institutions of various levels, public organizations and other associations and associations, commercial organizations and other Interested enterprises and communities, including scientific and production associations.
The purpose of the study is to substantiate the significance and expediency of creating a centralized training system aimed at developing scientific and technical creativity of children and young people in the field of robotics; to develop a mechanism for organizing a network of interaction of scientific and production associations and educational institutions of various levels.
Research methods – generalization of experience and results of the analysis of the possibilities of scientific and production associations, educational organizations, modeling of the mechanism of organization of network interaction of education-science-production, providing a continuous ascent of a trainee on a trajectory a schoolchild – a student – a specialist.
Results of the study. Between the national research and production association "Android Technology" and the Elabuga Institute of the Kazan Federal University, networking was established. A working group of teachers to develop educational and methodological support for the development of research and production association in the education of schoolchildren is created at the institute. These materials are prepared for a pilot experiment to introduce the basics of robotics to the school using domestic robots. The working group defines the composition of the network interaction. The authors developed and proposed a mechanism for this interaction, described the tasks and roles of its main participants in the work of such a network interaction, proposed a scheme of a trainee climbing on a trajectory a schoolchild – a student – a specialist. The mechanism of network interaction can be used as the basis for the creation of a centralized system aimed at the development of scientific and technical creativity of children and young people in the field of robotics and needs to be discussed in broad public circles.

Keywords: educational robotics, scientific and production association, school, higher education institution, network interaction, the centralized system of preparation.

INTRODUCTION

The transition of the Russian economy to a new technological structure assumes a wide use of high technology and equipment with a high level of automation and robotization. Currently, there is a shortage of personnel in the country, not only for high-tech industries, but also for specialists (design engineers, programmers, etc.) for the development, production and promotion of robotics.

The development of the robotics industry in Russia is a strategic business, it requires a focused government's attention for financial support from the budget, stimulation of private investments of advanced entrepreneurs and large industrial customers. One of the central problems of the inadequate

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development of domestic robotics is the lack of a transparent, interrelated program that takes into account the interests of all industry participants. One of the main growth points is educational robotics, but it remains out of focus [4].

Thus, at present, the need for the active promotion of an engineer profession is already at high school, for the introduction of the foundations of robotics in the education of children and youth has arisen [5, 10]. At the same time, a problem is revealed related to the lack of a centralized training system aimed at developing the scientific and technical creativity of children and young people in the field of robotics (hereinafter, the centralized training system) [1].

METHODS OF RESEARCH

This centralized system of vocational guidance, which fosters the training of engineers and technicians with social and professional competencies, meeting the modern requirements of high-tech sectors of the economy, can be created only on the basis of network interaction between educational institutions of various levels, public organizations and other unions and associations, commercial organizations and other interested enterprises and communities, including research and production associations.

The network interaction is becoming one of the significant components of the formula for the quality of the modern education system. It involves the implementation of the goals and objectives of educational institutions at the expense of the establishment of a system of mutually beneficial partnership between various institutions of the education system [6, 9]. When implementing robotics in the education of children and young people, one cannot do without including other organizations in such cooperation. For example, scientific and production associations (SPA) are a necessary participant in the network, moreover, an SPA can become a initiator and organizer of the creation of a centralized training system.

The rapid development of domestic robotics, the need for students' training, the powerful potential that universities have in the field of training qualified personnel for high-tech areas of the economy, as well as the impossibility of solving problems only by the forces of the education system determine the main participants in the network interaction. In this system, three groups of participants are key:

The first group (let's call it conditionally scientific and technical) should consist of research and production associations, design bureaus and other scientific and production organizations.

The second group consists of higher educational institutions with the involvement of the teaching staff of technical and methodical departments, educational and methodical associations, etc.

The third group includes institutions of basic secondary and secondary vocational education.

Also, it is possible to include educational institutions that implement programs at various levels, without reference to profile, departmental subordination and ownership, government departments, representatives of professional communities, organizations, develop information and communication technologies and software.

The participants in the network interaction should be interested in improving the quality of education and developing new forms of organization of the educational process, providing continuing education and scientific and technological innovation in the field of the introduction of robotics in institutions of basic, secondary and vocational education. At the same time, network interaction should be mutually beneficial.

The basic principle of organizing a centralized training system is the principle of "interpenetration", which is based on mutually beneficial influence in a state of dynamic equilibrium. The principle assumes the creation of a platform on the material and technical basis of each participant in the network interaction. Such platforms are needed not only for the acceptance of representatives of other members of the network, but also for organizing joint projects on them involving other parties.

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Let's describe the tasks and roles of the main participants in the work of such network interaction.

The tasks facing universities are:

• generalization and systematization of the experience of teaching robotics;

• development of conceptual bases for the introduction of robotics at schools;

• the substantiation of the scientific and methodological foundations for the content of the quality of pedagogical education in the field of robotics (scientific and methodological manuals addressed to teachers of robotics);

• training and professional development of teachers;

• development of innovative teaching and methodical complexes;

• creation of teams and their preparation for participation in all-Russian and international competitions;

The tasks facing SPAs**:**

• creation of a scientific and design base for implementation of programs on educational robotics;

• provision of robotic equipment for sites on the basis of educational organizations;

• consulting and scientific and technical support of programs on educational robotics and sites on the basis of educational organizations.

The tasks facing institutions of basic secondary and vocational education:

• approbation and implementation of educational programs (educational and training-methodological) in robotics;

• preparation of students in the field of robotics.

The tasks of a general nature include the creation of a vocational guidance system that fosters the training of engineering and technical personnel.

THE RESULTS.

At the beginning of 2015, the national research and production association "Android Technology" initiated the creation of a Consortium for the implementation of the project "Introduction of an innovative training and methodological complex of robotic systems and an interactive educational system in institutions of basic, secondary and professional education." This was the first attempt in the country to create an association (network community) for the effective interaction of various enterprises, institutions and organizations to jointly solve the problem of popularizing and introducing educational robotics.

It should be noted that the scientific and production association "Android Technology" is an innovative company engaged in the development and production of humanoid robotics. The main task solved by the company is the integration of robotic systems into the life style of a person.

The company's history dates back to September 2005, when the pilot project was launched. The company has a license to carry out space activities with the right to create and produce space technology, space materials and technologies, as well as the creation and reconstruction of space infrastructure, namely the development of robotic systems for rocket and space technology.

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The SPA "Android Technology" is a full-cycle company providing a range of services related to the integration of robotic systems into production, educational and business processes: from the concept and production of the robot to the development of strategies and scenarios for the use of robotic systems in various sectors of the economy, science and education [7].

The company's developments are in demand among scientific and educational institutions. Russian robots have a noticeable success with serious companies involved in automation and production robotics [8]. The company has several developments concerning anthropomorphic and biomorphic small-sized robots, which have a number of advantages for use in the education of children and young people to study modern robotic technologies.

Let's give a brief description of some of them. AR-100, MR-200 - electromechanical products. Anthropomorphic robot AR-100 (Figure 1) believably simulates the basic movements of the human body, including the true (with a detachment of the foot from the surface) upright, sport, dancing movements. It consists of 17 servo drives controlled by a programmable controller, and batteries [5].

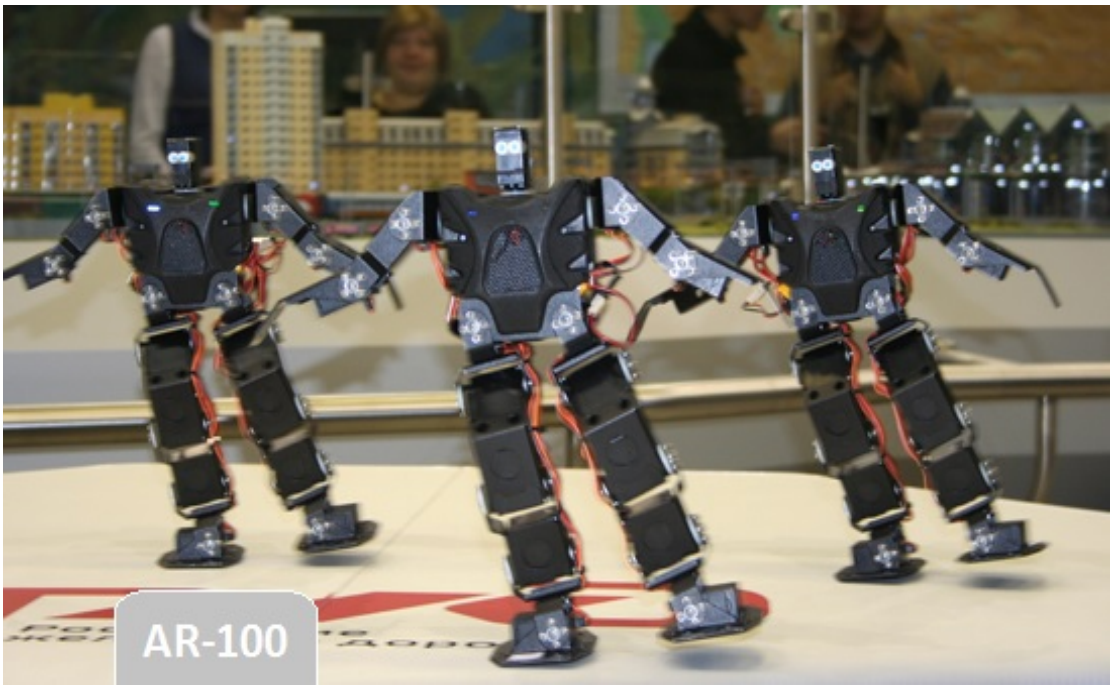

Figure 1. Anthropomorphic robot AR-100

The biomorfic robot MR-200 (Figure 2) is controlled by the MK-70 controller, to which are connected 18 servo motors, grouped into 6 groups for easy programming. The MR-200 is a spider robot that imitates steady movement over uneven surfaces. Robots can be controlled by a computer or manually. Communication with the computer is provided by radio or USB connection. The programming sphere is AR-Basic Studio.

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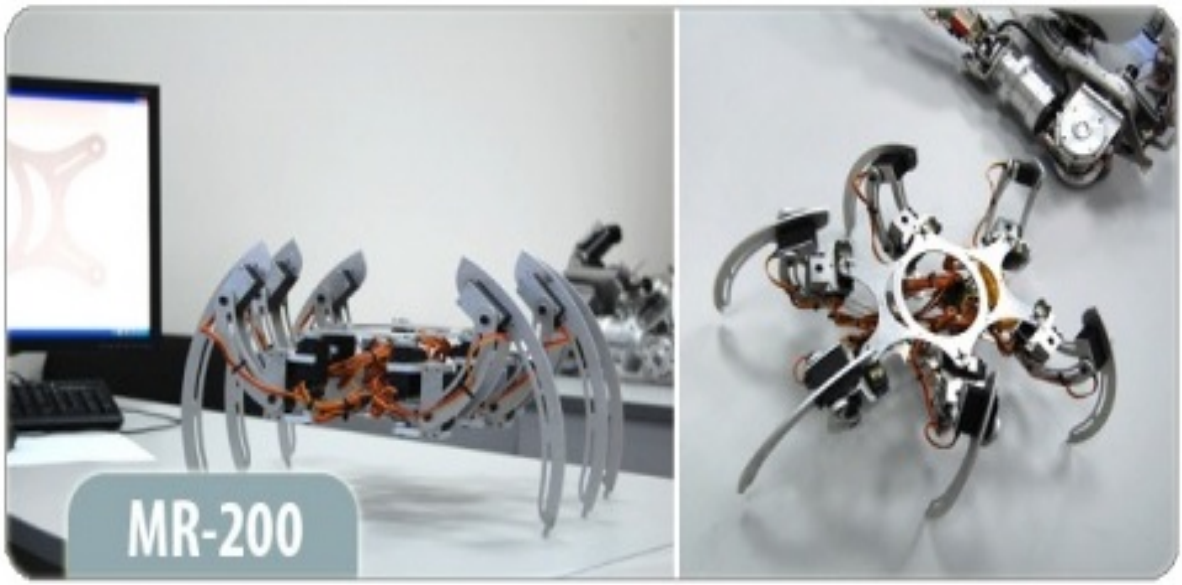

Figure 2. Biomorphic robot MR-200

Robots are also managed using the Andromeda software. The complex is intended for bringing off by a remote controller or a group of controllers of servo motor control of program code through the transmission of commands over a radio channel. Supports up to 6 active streams, it is possible to play audio files. All this allows, for example, to program a group of robots for the joint performance of dance movements.

Thus, domestic robotics represented by the SPA "Android Technology" has the potential to solve the problems of introducing robotics in the education of children and youth. The consortium includes the NGO "Android Technology" and a number of Russian universities, including the Kazan Federal University (KFU) in its branch – the Institute of Eelabuga (EI). There is a group of teachers of the Department of Informatics and Discrete Mathematics under the leadership of the director of the EI KFU, Elena Merzon. This group developed a theoretical block and laboratory practical works on working with small-sized robots AR-101M and MR-200 [2,3]. These materials are prepared for a pilot experiment to introduce the basics of robotics to schools using Russians robots.

The work of university teachers with robots showed their disadvantages for using in teaching children and young people at all levels of education. These disadvantages were accumulated and described by Alexander E. Vasiliev(PhD), the candidate of technical sciences, an professor of the Department of Electronics and Microelectronics, the project monitor of the SPA "Android technique" in the Program for the modernization of a set of small sized robots. The main disadvantage of robots is the inability to build the education process from primary school to university with increasing complexity and expanding the range of tasks as mastering the disciplines of the general education program.

Subsequently, the Consortium participants came to the conclusion that it is necessary to create a modern educational robotic platform, corresponding to the main trends in the development of robotics and engineering science in general. As a complex engineering system, a robotic platform should be able to integrate into a distributed network infrastructure of a multi-agent network, have a modular hierarchical structure, possess the properties of a multilevel abstraction for the main components (mechanisms and drives, control system, software, methodological support) and unification of hardware and software modules, protocols of data exchange. A set based on a robotic platform should not turn into a kit like LEGO, but fill in the methodological spaces inherent in LEGO robots and enable the development of the

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potential of learners beyond the capabilities of the kit. Also, the platform should provide a sufficiently low entry threshold for educators and not scare them away with complexity and novelty.

DISCUSSION ISSUES

The domestic economy needs qualified personnel ready for work in high-tech industries. An even greater deficit is observed in the development, production and promotion of robotics. The problem of personnel training cannot be solved only by the education system, the need to develop integrated approaches to solving these problems at the state level is obvious. It is advisable to organize a network interaction of research and production associations of educational institutions of various levels, public organizations and other unions and associations, commercial organizations and other interested enterprises and communities. There is a need to develop mechanisms for organizing such interaction, determining the roles of its participants and ways to implement them. The accumulated experience has shown that scientific and production associations that provide technical and technological support for a centralized training system aimed at developing scientific and technical creativity of children, and young people in the field of robotics should act as system-forming participants. Higher educational institutions can provide the methodical and methodological components of the process of training personnel for high-tech industries. The school should become a platform for monitoring quality, spreading positive and eliminating negative points in the development of educational robotics.

The research and production association "Android technology" has the necessary potential to become an effective participant in the centralized training system aimed at the development of scientific and technical creativity of children and young people in the field of robotics. In order to exchange experience, generate, select and translate ideas for the introduction of educational robotics throughout the country and ensure a continuous ascent of the trainee on the trajectory schoolchild-student-specialist, the system should include higher educational institutions both technical and pedagogical. The scheme of this ascent is shown in Figure 3.

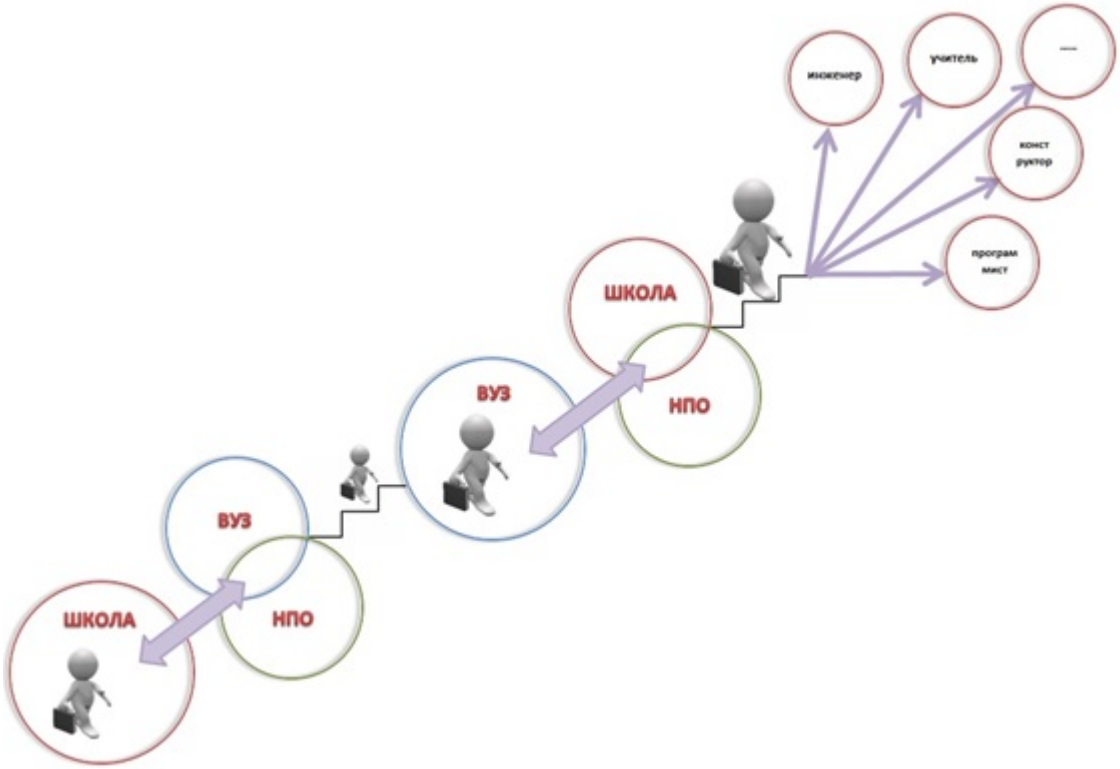

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Figure 3. The scheme of ascent of a trainee along the trajectory schoolchild-student-specialist

CONCLUSION

The elements of the mechanism of a centralized training system, aimed at the development of scientific and technical creativity of children and young people in the field of robotics, need to be discussed in broad public circles. This approach will help to increase the competitiveness of each participant in the network interaction. The first step in this difficult path should be the creation of a new educational robotics platform.

The domestic robotics - science, education and production - has the potential for its large-scale introduction into learning process of schoolchildren and students of secondary and higher institutions.

In view of the high complexity and globality of the scale of the problem, it must be solved at the state level. It is necessary to develop a State program for the introduction of robotics in the education of young people for all age categories, which would provide the continuous training of future personnel for high-tech areas of the economy and science.

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