EAI Endorsed Transactions
on Energy Web and Information Technologies

Research Article EAI.EU

Educational robotics as part of the International Science and Education Project "Synergy" in realizing the social needs of society on the road to the Industrial Revolution "Industry 4.0"

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Abstract

Features common to educational robotics and to the recent concept of the fourth industrial Revolution, "Industry 4.0", have been identified, making it possible to consider educational robotics as the basic, most suitable site To prepare rising generations to succeed in the post of industrial production. An analysis of the objectives to be achieved in organizing a session with robotic devices. It was concluded that the objectives should be adjusted to the concept of "Industry 4.0" and that the methodological material and organizational work should be refined accordingly. It is reported experiences with the use of networked technologies in the example of remote robotic equipment as a way of implementing the "Industry 4.0" ideology in the international scientific education of the Synergy project.

Keywords: Educational Robotics, fourth industrial Revolution "Industry 4.0", Network technologies, International Science and Education Project "Synergy".

Received on 30 November 2017, accepted on 8 January 2018, published on 30 January 2018

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doi: 10.4108/eai.30-1-2018.153816

1. Introduction

Educational robotics in the last decade have been very intensively developed, and in many ways even somewhat unexpected for the participants themselves. It is now difficult to find an educational institution that does not exist or that does not want to have organized schoolchildren in one way or another who are interested in technical creativity and who use the robotics device [1-6].

This movement can be said to stirred both young students and educational groups.

2. Internal and external reasons for the development of educational robotics

It is robotics that has been the dominant link that has been able to integrate the multilateral interests of the younger generation. Attentions to some of the circumstances are internal and external to robotics that contributes to this.

The internal causes of this phenomenon include the constructive and functional breadth of the robot components, which is creative, including:

- The mechanical part to be assembled according to the robot design proposed by the design student;
- Sensory devices that respond to the external environment and, in some cases, to the state of certain elements of the robot;
- Executive engines, which are demonstrably manufacturing control teams according to the student's robot behavioural program;
- microcontroller and microprocessor technics, which generates control signals for actuators in accordance with the algorithm provided by the

developer's apprentice and the data obtained from the sensory devices of the robot.

This is further facilitated by such factors as:

- the need to develop a programming language and to develop in that language a robot control program, based on the algorithm that the pupil considers to be the intended behaviour of the robot;
- integrated manifestation of all components of the robot (from mechanical to information) in its spectacular, directly perceived mechanical actions, confirming or refuting the technical decisions taken by the student as a designer, as a manufacturer and as a programmer.

External causes of the surge in the prevalence of educational robotics, in our opinion, are the following:

- the need of society, and especially of parents, in the upbringing of children who are able to respond adequately to the challenges posed by both professional activities and, more importantly, in the domestic sphere. Naturally, here we mean the successful self-realization, including career, of a person in modern rapidly changing competitive conditions;
- the interest of public authorities (and some attention on their part) and the pedagogical community in the development of educational robotics, who it with an accessible and effective key to solving many of the problems of raising the rising Generations;
- saturation of the market for educational robotics with sufficient quality components and software, with the possibility of acquiring them at affordable prices;
- a certain degree of support to date of teaching and learning materials created by individual enthusiasts and creative groups of schools or other associations and allowing classes to be taught in various fields of education Robotics at a sufficiently high level.

It can be argued that the educational robotics is now a fairly well constituted phenomenon, beginning to play an increasingly important role in the development of the engineering thinking of the younger generation. The internal and external circumstances listed above, which have contributed to the emergence and development of educational robotics, are not temporary. They have shown themselves to be permanent and developing, in the sense that a certain level of hardware, software and equipment achieved will naturally produce the next improved level.

3. Educational robotics objectives

In our view, the further advancement of the concept of educational robotics needs to clarify its existing approaches and the generally established paradigm in this area.

Without a claim of completeness, based on the analysis of the sources known to us [1-6] and others. It can be argued that the objectives of educational robotics, which are currently the focus of educators, are as follows:

- to promote the nurturing of active, committed, self-sufficient people of a new type;
- to identify at an early stage the technical inclinations of pupils and to develop them in this direction, thus shaping the future of the engineer from kindergarten to the time of the occupation;
- to have a significant impact on the development of pupils ' speech and cognitive processes (sensory development, development of thinking, attention, memory, spatial imagination), as well as emotional sphere and creative abilities;
- the amalgamation of theory and practice in the study of subjects such as physics, mathematics, informatics, etc.;
- to ensure the interaction of education, science and production.

This list of objectives of educational robotics could be pursued, however, and these already provide a sufficiently comprehensive picture of the focus of the methodological and organizational work on the development of educational robotics.

While these objectives are important, necessary and reasonable, in our view they are still local, intermediate and some of them are quite general in nature. Setting goals in this form inadvertently narrows the activities of the pedagogical community to the current problems of the educational institution.

The systemic approach in the use of educational robotics for engineering and more intellectual training for the younger generation, in our view, can and should be achieved from the perspective of the not-so-long-established concept of the fourth industrial Revolution "Industry 4.0".

4. Educational robotics as a step towards the fourth industrial revolution

It is still too early to consider the concept of a phenomenon known as "Industry 4.0", fully established. However, its general outline is now clear and can be used to build approaches to understanding the purpose of educational robotics and to organize all kinds of work associated with it.

The fourth Industrial Revolution, Industry 4.0, is highlighted as post-informational, a constantly evolving phenomenon of industrial production and of society as a whole, for which the so-called The industrial Internet of things that can fundamentally change the production processes and social relationships.

In this article we will not analyse in detail the phenomenon of "industry 4.0". However, according to the topic, some of its properties and features are specified.

The fourth Industrial Revolution, Industry 4.0, is shaped as a response to global trends and challenges related to industrial production requirements, competitive pressures, complexity and variety of products, increasing speed and flexibility Production and, of course, an increasing amount of information.

The main thesis of the "Industry 4.0" may be the creation of "smart" enterprises to produce "smart" things that can interact with each other throughout the product's life cycle on a networked level on a global scale without Human intervention.

This approach to industrial production is fundamentally changing the very definition of human labour, consisting in the transition to the most creative tasks and the almost total exclusion of non-automated manual Technological operations.

Educational institutions are therefore faced with the challenge of creating a well prepared and adapted "Industry 4.0" for the younger generation.

In general, Industry 4.0 is seen as the next stage in the development of production and industrial relations, which preserves the continuity of previous industrial revolutions. In connection with the topic discussed in this article, "continuity" is a crucial concept for us. We therefore consider it appropriate to recall, in short form, the essence of the preceding industrial revolutions, as they are now understood:

- first Industrial Revolution-mechanical production using the steam energy source;
- second Industrial Revolution-mass production based on a division of labor with extensive use of electricity;
- the third industrial revolution is automated production using electronics and information technology.

Stressing the importance and continuity of previous industrial revolutions, the fourth industrial Revolution, "Industry 4.0", is referred to by many writers as production based on cyber-physical systems with Internet-based networking.

It is clear that "Industry 4.0" includes all modern advances in mechanics, electrical mechanics, electronics, and information and networking technologies. They're basic to her.

By comparing the components that are needed to implement the Industrial Revolution "Industry 4.0", and the components of robotics are easy to see in their near-total coincidence. The difference is only in scale.

This comparison, in our view, is sufficient justification to consider education robotics as the most appropriate, universal playground for the development of young generations in accordance with the ideology of industry-4.0 "Oriented towards creative engineering personalities."

The paradigm shift in approaches to educational robotics, in our view, should be addressed not only by students but more by educators. The concept of "Industry 4.0" should be manifested in the teacher's holistic view of the educational process as a step in preparing a person to succeed in post-informational society.

As a consequence, this should be reflected in the educational, methodical and organizational work of the pedagogical communities, which is carried out from the common positions of the "Industry 4.0".

It can be argued that at present all necessary support (technical, informational, software, methodical, etc.) is available for such an adjustment in the orientation of educational robotics. Certain changes should focus on methodical support.

As noted, Internet technology is an important component of the "4.0 Industry". This component has also begun to evolve in educational robotics, but it has not yet been sufficiently developed. This is the part that should be given special attention at this time to transform educational robotics into a full-fledged "industry 4.0". The widespread use of network technologies in educational robotics, apart from mastering them as such, will allow a number of other important challenges to be addressed. One such task is, of course, to make significant savings through cooperative, cooperative use of remote, other educational institutions of various types of robotic Equipment.

5. Educational robotics, as part of the innovative project "Synergy"

Some of the experience of such work in the training of bachelors and Masters in "Automating technological processes and industries" and "management in Technical Systems" is available at the Omsk State Technical University at the training Centre " Auckland-FESTO, created under the Department of Automation and robotics, within the framework of the Science and Education Innovation Project "Synergy". Along with Auckland, the signatories of this project are the University Moscow (Mae), St. Petersburg (University), Sevastopol (manager of Region at OSMP), Vladivostok (Fefu), Qaraghandy (KSTU), also German FESTO. In the training of students, the use of network technologies is widely used, with the reciprocal application of the equipment located in these universities.

At the Department of Automation and Robotics, Omsk State Technical University, at the present time, there are circles of students in robotics. In this connection, the experience with remote equipment is planned to be transferred to the classroom, with the principles of the "Industry 4.0" on an affordable scale.

On the basis of robotics, the universality, breadth and diversity of the shared components represented in it should be seen in the form of educational robotics as the main A polygon to prepare rising generations to live and succeed in the new technological environment of Industry 4.0. However, in order to fully carry out this mission, the educational robotics must adjust their fundamental

objectives by balancing them with the upcoming development of cyber-physical industrial production.

Acknowledgements.

The authors would like to thank all «Synergy» members: Qaraghandy (KSTU), St. Petersburg (University), University Moscow (Mae), Sevastopol (manager of Region at OSMP) and Vladivostok (Fefu) for the excellent training of bachelors and masters in "Automating technological processes and industries" and "management in Technical Systems".
We would also like to thank German FESTO for network technologies in the educational process.

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