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The studying elements of robotics in school

Изучение элементов робототехники в школе

Мектептегі робототехника элементтерін зерттеуі

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Abstract: The article deals with the didactic principles of teaching the most promising of innovative directions - robotics in the school. It is proposed to use the open-source electronics platform Arduino. The need to develop a program instructions and teaching materials in robotics is described. The urgency of the research is considered. An analysis is made of the current state of the using of robotics for teaching children. The research methods such as observation, analysis of scientific literature, analysis of activities, systematization and synthesis are used. It demonstrates observance of the principles of visibility, the connection between theory and practice, scientific approach, accessibility, purposefulness of training, purposefulness of teaching when introducing elements of robotics to school. The stages of development of a new software and hardware solution for managing a robotic platform are given. The article shows a brief description of the procedures that were used to create the Robot equipped with Arduino. The authors study the problem of introducing elements of robotics into the schools of Kazakhstan as an unbroken section of the computer science course.

Keywords: Education, didactics, information technology, robotics, didactic principles.

Аннотация: В статье рассматриваются дидактические принципы обучения самому перспективному из инновационных направлений – робототехнике в школе. Предлагается использовать Робот, имеющий конструктор открытой сборки Arduino. Описывается необходимость разработка программно - методического комплекса обучения робототехнике. Рассматривается актуальность исследования. Сделан анализ современного состояния введения робототехники для обучения детей. Использованы методы исследования как наблюдение, анализа научной литературы, анализ деятельности, систематизации и обобщения. Показано соблюдение принципов наглядности, связи теории с практикой, научности, доступности, целенаправленности обучения, целенаправленности обучения при введении в школу элементов робототехники. Приведены этапы разработки нового программно-аппаратного решения

по управлению роботизированной платформой. В статье показано краткое описание процедур, которые были использованы при создании Робота, имеющий конструктор открытой сборки Arduino. Авторы исследуют проблему введения в элементов робототехники в школы Казахстана, как неотемлемый раздел курса информатики.

Ключевые слова: Обучение, дидактика, информационные технологии, робототехника, дидактические принципы.

Аннотация: Бұл мақалада мектеп бағдарламасында инновациялық жетістіктердің ең дамыған бағыты роботтық техниканы оқытудың дидактикалық ұстанымдары қарастырылған. Оқу нысаны ретінде Arduino конструкторының роботы қолданылады. Роботтық техниканы меңгеруде оқу –әдістемелік кешеннің жаңартылу қажеттілігі айтылған. Мақала авторлары білім беру үрдісінде зерттеу өзектілігін жан жақты қарастырған. Балаларды оқыту үшін робототехниканы енгізудің заманауи жағдайына талдау жасалынды. Бақылау, ғылыми әдебиеттерге талдау, қызметті талдау, жүйелеу және жалпылау сияқты зерттеу әдістері қолданылған. Мектепке робототехниканың элементтерін енгізуде оқытудың көрнекілік, теорияның практикамен байланысы, ғылымилық, түсініктілік, оқытуға бағытталған принциптерінің сақталуы көрсетілген. Роботталған платформаны басқарудың жаңа программалық-аппараттық шешімін әзірлеудің кезеңдері келтірілген. Аталған мақалада Arduino ашық жинау конструкторы бар Роботты жасау барысында қолданылған процедуралардың қысқаша сипаттамасы келтірілген. Авторлар робототехника элементтерін Қазақстан мектептеріне енгізу мәселесін информатика үзіліссіз бөлімі ретінде қарастырады.

Кілт сөздер: оқыту, дидактика, ақпараттық технология, роботтық технология, дидактикалық ұстанымдар

Introduction

The basic trends of the 21st century dictate new requirements for modern technologies. In the 21st century, automation and robotics are introduced actively in everyday life. The items which seemed like a fantasy50 to 20 years ago, in terms of technology, are today an objective reality.

The technological process with unbelievable speed changes the surrounding world, forcing us to change and our approaches to the education of children. Robotics is by far the most promising of innovative directions.

In turn, developed service and personal robotics is impossible without qualitatively trained specialists in the field of its application. Essential assistance in this can and should be provided by the secondary school in organizing the study of the elements of robotics.

The necessity of studying robotics in a secondary school is an urgent issue, as it is determined by the growth of the following contradictions: between the requirements of the society of the model of the graduate of the modern school and the real level of the formation of key competencies of students; between the inclusion of robotics in the educational process for the acquisition by students of educational results in demand on the labor market and the undeveloped nature of these issues in pedagogical science; between the great potential of the course of robotics for the implementation of the activity approach in education, and the inadequacy of the content-methodical support of the process of forming the required competence of students in theory and practice.

Formulation of the problem

Despite the advantage, robotics mainly appears in the after-hours activities, in particular at paid courses. It is necessary to involve schoolchildren in research in the field of robotics, the exchange of technical information and initial engineering knowledge, the development of new scientific and technical ideas already in the profile school.

Unfortunately, examples in Kazakhstan's school textbooks on computer science are not focused on writing programs to manage robots. Also, they did not find reflection in one of the directions, which increases the motivation for students to study robotics - this is an opportunity to use mobile technologies to control robots.

The purpose of the article is to identify a number of reasons for the need to study robotics at school, as well as to consider some issues of developing a new software and hardware solution for managing a robotic platform for a mobile phone.

History

Some scientific researches have shown the possibility of creating a methodical system of additional education for children in the field of computer science, the goals, content, methods and forms of instruction in which are oriented toward educational robotics. The implementation of parallel programming elements within the framework of the created methodical system is proposed. The pattern of increasing the motivation and development of skills with a combination of structural and parallel programming elements is determined [1, 2, 3, 4,]. G.R. Shameneva offers a cycle of research and technical activities covering students from 1 to 11 classes [5]. In Kazakhstan, there are various courses, for example, ROBBO CLUB - a network of training centers for robotics training according to the unique ROBBO methodology, the program of which was developed jointly by scientists from Russia and Finland. The training is conducted in the programming environment of ScratchDuino 2.0, adapted for children's perception, and as an educational robot the open-assembly designer Arduino [6] is used.

There are various studies in different developed countries, such as the USA [7] and Holland [8], [9]. The concept of "technical education" in these studies is to provide students with knowledge about robots and technologies. This approach is necessary in most cases to introduce computer science and programming and to familiarize US students with technology [7], Dutch schoolchildren were also gradually exposed to technical subjects using robots [8].

At present, educational robotics is actively developing and more and more schools are being included in the educational program, competitions among school teams are held.

Methods of research

In addition to the analysis of scientific literature, analysis of activities, systematization and generalization, the method of observation was widely used.

To determine the state of the study of robotics in schools in Kazakhstan, a questionnaire was conducted for students and teachers of computer science.

Students and teachers of computer science were invited to anonymously answer questionnaire questions.

44 pupils of 8-9 cells participated in the survey and 14 teachers of informatics and members of the governing council.

All questionnaires were processed. The analysis of the questionnaires showed that all students would gladly study robotics, computer science teachers are ready to teach this section in the course of computer science, but also the analysis revealed some problems that pupils and teachers of schools face for effective study of robotics.

Results / discussion

Let's consider some didactic principles of training robotics in a comprehensive school.

The content of training should be based on current scientific facts, which are the new achievements in robotics. In teaching, students learn the elements of scientific research, separate reliable data from false ones. It is necessary to reflect such data in school textbooks on informatics, i.e. traced the didactic principle of scientific knowledge in the training of robotics.

According to the principle of accessibility, it is necessary that the training correspond to the individual characteristics of the students and the knowledge they have already accumulated. At the lessons of computer science classes 8-9 in schools, they learn the language of structural programming, so children can use the built-in command system to control robots, it is necessary to study the fundamental unity in the construction of teams.

In the senior 10-11 grades with professionally oriented learning, students are able to use both serious programming languages (such as C or C ++) and complex manipulations with boards and sensors.

Organized, methodical and substantive bases of training in robotics are able to adapt to the constantly changing conditions of life of the society and scientific progress. If in the 70-80s gg. in schools there were not even computers, now, a computer in almost every school bag of a student, such as a smartphone, a tablet. Modern children find it very hard to imagine life without new-fangled gadgets. This fact maintains the principle of purposeful teaching of robotics at school.

Robotics is very important for the general educational program, as it allows to apply theoretical knowledge in many subjects (mathematics, physics, computer science, drawing, technology, etc.). Thus, it will be much more interesting for children to learn and they will be able to pay attention to subjects that until recently seemed uninteresting and useless. Robotics perfectly copes with such task, as formation of interest to technical kinds of creativity. The most popular specialty after 2025 will be robot programmers. The principle of the connection between theory and practice is obvious.

The effectiveness of training robotics is enhanced by a huge means of clarity. The principle of visibility, perhaps, is the most developed in the training of robotics. The student watches the movement of the robot, created by own hands. As they say, he gets convinced with his own eyes about the correctness of the construction, moving along a given trajectory.

Let's consider the stages of developing a new software and hardware solution for managing a robotic platform from a mobile phone.

- After the structural scheme, it is necessary to create electrical connection schemes, on the basis of which the platform will operate.
- The main task is to develop a complete set of robotic platform equipment.
- Since the main nodes are selected, the next task is reduced to calculating the digital part and designing the algorithms.
- As soon as the main algorithm is formed it must be debugged by means of a personal computer.
- After this, the mobile application is developed directly.

Launch of a management application.

The modern concepts of programming are based on traditional concepts of object-oriented programming. This concept has become widely used and today is leading in terms of the number of written user applications and software products using this approach.

The basis of the object-oriented approach, following from the name, is directly an object inherited from the set of classes and subclasses used.

Objects interact with each other in the form of various variables, forms, and spreadsheets. This interaction is achieved by performing a certain sequence of program-algorithmic operations.

The program code with the object-oriented approach for writing a software application allows to avoid routine repetition of many commands, so the correct operation of the application is provided due to the optimal construction of the application architecture.

In this case, procedural programming approaches are sufficient, as the number of objects is limited, and the development of a flexible architecture requires a huge amount of time and the load on the processor will grow linearly in equivalent with the increase in the number of objects.

Brief descriptions of the procedures:

function forw () - The procedure for rotating a pair of wheels in the same direction "directly at the same speed"

function forwl (), forwr () - The procedure for rotating a pair of wheels in one direction "straight" at different speeds to implement a turn left or right

function stopall () - Full stop procedure

function back () - The procedure for rotating a pair of wheels in the same direction "directly at the same speed"

function backl (), backr () - The procedure for rotating a pair of wheels in one direction "back" at different speeds to implement a turn left or right

function left (), right () - The procedure for rotating a pair of wheels in different directions to implement a full turn left or right

Conclusion

All the elements of training in robotics are aimed at fostering an individual who is able to identify goals independently and design ways for their implementation, as well as be able to uncompromisingly assess their achievements. The constructive thinking of the pupil develops, small motor skills of the hands are developed, the creative potential of the child is revealed. The study of robotics will lead to the development and perfection of a self-sufficient personality.

Actual is the development of a software and methodological training complex for robotics. A special order and a teaching system based on a clear logical chronology are needed. Teaching information should consist of completed sections, modules and steps. It is necessary to develop a system of concepts for robotics.

But in addition to insufficient equipment of educational materials, the inability to purchase kits of robots at school because of the high price makes it difficult to introduce the study of robotics to school. The creation of an assembly of an open source robot with the ability to control development via GPS is an actual and promising direction of our research.

Reference:

1. Дахин, А. Н. Педагогика робототехники как возникающая инновация школьной технологии //Народное образование.-2015.-34.-С.157-161.

2. Ершов, М. Г. Использование робототехники в преподавании физики // Вестник Пермского государственного гуманитарно-педагогического университета. Серия Информационные компьютерные технологии в образовании - 2012. -№ 8.- С.77-85.

3. Ершов, М. Г. Робототехника как средство индивидуализации образовательного процесса по физике // Пермский педагогический журнал. - 2014.- №5. - С.104-109.

4. Камалов, Р. Р. Использование элементов параллельного программирования для реализации методической системы дополнительного образования в области информатики [Текст] / Р. Р. Камалов, К. А. Касаткин. – 65 (Педагогический опыт) // Информатика и образование. - 2014. - № 8. - С. 65-67 : 1 рис., табл. - Библиогр.: с. 67 (3 назв.). - Рез. англ.

5. Шаменева Г.Р. Развитие научно-технического творчества средствами робототехники // Робототехника в школе: сайт учителя информатики [Электронный курс]. URL: https://shamsieva.lschool6.edusite.ru/p7aal.html

6. ROBBO CLUB. Клуб робототехники http://www.robboclub.kz/index.html

7. T. Balch, J. Summet, D. Blank, D. Kumar, et al., Designing personal robots for education: hardware, software, and curriculum, IEEE, Pervasive Computing, 7(2), 2008, 5–9.

8. O. Mubin, C. Bartneck, L. Feijs, H. Hooft van Huysduynen, et al., Improving speech recognition with the robot interaction language, Disruptive Science and Technology, 1(2), 2012, 79–88.

9. M. Saerbeck, T. Schut, C. Bartneck, and M.D. Janse, Expressive robots in education: varying the degree of social supportive behavior of a robotic tutor, Proc. CHI, 2010, 1613–1622.

Reference:

1. Dakhin, A. N. Pedagogika robototekhniki kak voznikayushchaya innovatsiya shkol'noy tekhnologii [Pedagogy of Robotics as an Emerging Innovation in School Technology] //Narodnoye obrazovaniye [Public Education].-2015.-34.-S.157-161.

2. Yershov, M. G. Ispol'zovaniye robototekhniki v prepodavanii fiziki [Bulletin of Perm State Humanitarian and Pedagogical University] // Vestnik Permskogo gosudarstvennogo gumanitarno-pedagogicheskogo universiteta. Seriya Informatsionnyye komp'yuternyye tekhnologii v obrazovanii [Bulletin of Perm State Humanitarian and Pedagogical University. Series Information Computer Technologies in Education]- 2012. -№ 8.- S.77-85.

3. Yershov, M. G. Robototekhnika kak sredstvo individualizatsii obrazovatel'nogo protsessa po fizike [Robotics as a means of individualizing the educational process in physics] // Permskiy pedagogicheskiy zhurnal [Perm Pedagogical Journal]. - 2014.- №5. - S.104-109.

4. Kamalov, R. R. Ispol'zovaniye elementov parallel'nogo programmirovaniya dlya realizatsii metodicheskoy sistemy dopolnitel'nogo obrazovaniya v oblasti informatiki [Use of elements of parallel programming for realization of methodical system of additional education in the field of computer science] / R. R. Kamalov, K. A. Kasatkin. – 65 (Pedagogicheskiy opyt) [Pedagogical experience] // Informatika i obrazovaniye. [The computer science in Education]- 2014. - № 8. - S. 65-67 : 1 ris., tabl. - Bibliogr.: s. 67 (3 nazv.). - Rez. angl.

5. Shameneva G.R. Razvitiye nauchno-tekhnicheskogo tvorchestva sredstvami robototekhniki [The development of scientific and technical creativity means of robotics] // Robototekhnika v shkole: sayt uchitelya informatiki [Elektronnyy kurs] [Robotics in school: the site of the teacher of computer science [Electronic course] . URL: https://shamsieva.lschool6.edusite.ru/p7aal.html

7. T. Balch, J. Summet, D. Blank, D. Kumar, et al., Designing personal robots for education: hardware, software, and curriculum, IEEE, Pervasive Computing, 7(2), 2008, 5–9.

8. O. Mubin, C. Bartneck, L. Feijs, H. Hooft van Huysduynen, et al., Improving speech recognition with the robot interaction language, Disruptive Science and Technology, 1(2), 2012, 79–88.

9. M. Saerbeck, T. Schut, C. Bartneck, and M.D. Janse, Expressive robots in education: varying the degree of social supportive behavior of a robotic tutor, Proc. CHI, 2010, 1613–1622.