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POSSIBILITIES OF DEVELOPING TECHNICAL CREATIVITY OF STUDENTS USING ROBOTIC ELEMENTS IN PHYSICS CLASSES

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Abstract: *To develop students' technical creativity competences, to develop the skills of designing and modeling robotic devices, to develop the skills of designing and modeling of robotic devices, it is necessary for students to master the scientific foundations of modern technologies. Robotics is a highly knowledge-based industry. Success in its development depends on success in other areas of technical knowledge, as well as progress in basic sciences. Based on modern scientific and technological advances, the study of the interaction of robotic systems and people, the creation of new built-in sensors and sensor networks, new human-machine interfaces, including new ways of using gestures, and computer and tasked with developing voice interfaces for controlling robot systems, etc.*

Key words: *technical creativity, technique, technology, modern tool, robotics elements, Arduino board.*

I. Introduction

In our country, a number of tasks related to the creation of the necessary conditions for the development of students' technical creativity competencies, the strengthening of the material and technical base of educational institutions, the provision of didactic and methodical support, and the development of regulatory and legal documents have been carried out. [10, p. 14374]. One of the priority tasks for the education system is to "increase the share of modern circles such as robotics, information technology and programming in additional educational institutions by 20 percent by 2030." development of didactic and methodical possibilities of formation of creativity competences, development of teaching methodology of extracurricular activities based on robotics elements serves to improve students' technical creativity competences.

II. Literature review

Arduino "STARTER" intended for students of general secondary schools. The use of the 12+ curriculum is widespread. The purpose of using this educational package is to develop students' competencies in electronics and programming.

Device Description: An Atmel Atmega 328 microcontroller device is connected to the Arduino UNO device platform.

The main purpose of the device is to enable the computer to communicate with physical devices outside the virtual world. Using Arduino-based devices, it consists in obtaining information about the environment using various sensors, as well as establishing interaction using executive and control devices. With the help of this device, it is possible to establish certain communications.

The operation of the platform is based on physical processes such as voltage, current, resistance, data transmission and reception, and storage. The reason for this is that the kit consists of a set of resistors, capacitors, a board without welding, cables, sensors, LED devices [5, p. 11]. Using this kit, the student can acquire the basic skills of modeling, designing and programming various devices under the guidance of the teacher and in the course of independent work. After one year of training, students will have complete knowledge of the basics of statics (electroschematics), the electrical department of physics, receive, store and process data, transfer, create and use programming commands. learns, acquires the basic skills of programming.

III. Analysis

The level of teaching robotics educational materials to schoolchildren is determined by basic, advanced, and in-depth. These levels determine the educational effectiveness of robotics in physics classes.

In the physics class, we will get acquainted with the features of using robotics elements in the development of students' technical creative abilities.

I. Reflects the general idea and sources of forming the content of technical education in the physics class. It is based on the social order of society in the form of technical education goals. The organization of the educational process using robotics educational materials in physics classes includes:

- to fully reveal the possibilities of robotics as a direction of technical innovation in changing the modern technological environment;
- to demonstrate the role of physics in the development of robotics elements and in the creation of various types of robots;
- formation of ideas about the methods and technologies of modern physical research in the development of robotics using physics as a field of scientific knowledge;
- improving the quality of education:

II. The development of robotics in the physics course is carried out in accordance with the paradigm of modern technical education and includes students who have mastered specific and generalized knowledge and skills in the field of technical activity.

III. In high school, learning the basics of robotics is organized based on a three-component approach. Robotics in the course of physical education classes are:

• the object of study is a field of modern technical knowledge that allows to demonstrate the place of science in the development of robotics;
• means of knowledge in the modern scientific and scientific-technical research method;
• educational tools that ensure the formation of technical knowledge, the organization of educational technical activities and the development of technical skills.

IV. Physical science is related to the solution of certain educational problems in terms of technical training in the field of robotics [34, p. 5]. Its content should not conflict with the goals of teaching science; however, it should serve to enrich the physics education program with the necessary practical knowledge and types of educational activities, and to create additional conditions for its better mastery.

V. In physics, the following conditions are necessary for the effective introduction of robotics tools into the educational process:

introduction of robotics into technical training in a phased manner or distribution based on the principles of equivalent didactic replacement (studying the scientific basis of the operation of the element base of robotics objects in the topics and sections of the high school physics course; laboratory training in physics organization of educational activities with the help of robotics objects as examples of modern scientific and scientific-technical knowledge as part of classes and practical training, technical activities on modeling and designing robotic devices as an application of physics to technology);

presentation of the three-component structure of the robotics science teaching methodology (Robotics as an educational object; robotics as a means of knowledge: as a means of development and education);

implementation of inter-object communications as a means of implementing the components of the robotics curriculum;

creation of didactic and methodological conditions for the use of robotics tools in education;

the level of didactic provision of the educational process of the element base of constructors, software and robotics educational tools in accordance with the development indicators of students;

interrelationship of robotics elements with curricular and extracurricular activities;

Robotics serves to provide flexibility in educational practice and ensure students' interest and readiness for technical activities.

VI. The level of involvement of students in the process of mastering robotics depends on many factors (cognitive and technological interest, professional motivation, etc.).

VII. Main learning outcomes:

developing students' interest in studying physics;

achieving growth of knowledge and skills in technical education;

formation of initial professional aspirations of students, students who will be directed to consciously choose a profession within the framework of physics [4, p. 95].

Taking into account modern science and technology achievements, it is important for students to have sufficient knowledge, skills and qualifications in robotics to increase their interest in mastering science. The use of robotics elements as a learning tool in physics classes allows students to understand the application of the laws of physics to technology, to increase their interest in technical fields, to choose careers in technical fields, to master science. serves to increase their performance and make them qualified specialists in the future.

IV. Discussion

As one of the areas of technical training of students, the mastering of educational materials on robotics, strengthening of knowledge in the subjects taught in general secondary schools, formation of practical skills and qualifications, training of students in modern serves the development of technological competences. Students will acquire modern knowledge. Robotics plays an important role in interdisciplinary integration. Knowledge gained from robotics technology, physics, informatics, mathematics, drawing and other disciplines is remembered [7, p. 182]. This knowledge plays an important role in understanding the principles of operation of robots and in their independent design and construction by students. The integration of knowledge gained from mathematics, computer science and technology is of particular importance in the implementation of many projects.

In the near future, the development of robotics will lead to significant changes in people's lifestyles. Their living conditions become easier. In a new environment, a green person will need a new level of thinking and behavior, readiness to maintain and update modern robotic equipment. In this regard, two socio-pedagogical problems have been identified in the science of pedagogy, the solution of which is associated with important socio-economic and political effects:

1) training of qualified personnel for the production of robots and robot systems;

2) formation of classes of users of robotic environment services and development of their socio-technological culture.

As a result of the observations, there are tasks awaiting the following solution for the development of students' technical creativity based on the elements of robotics:

1. Establishing the development of pedagogical mechanisms for teaching robotics elements in methodical associations of teachers in district and regional public education departments.

2. Educational robotics "... as a new interdisciplinary field of school students, which integrates knowledge in the fields of physics, mechatronics, technology, mathematics, informatics and allows students of different ages to be involved in the process of innovative scientific and technical creativity".

3. Directions, methods and techniques of using robotics tools for students in high school have not yet been fully developed.

4. There are not enough educational and methodological manuals intended for the use of robotics by students of different ages in the educational process. More attention is being paid to the training of students in robotics classes. It is necessary to create working groups for the creation of textbooks and training manuals for students on robotics based on the educational and regulatory documents of the general education schools of our republic and start their activities.

5. This article is related to the problem of organization of educational process using elements of robotics in general secondary schools is still at the initial stage. The publications of the authors of these studies mainly include the unique experience of using robotics tools in the high school educational process. Literature on the general pedagogical and methodological problems of using robotics tools in extracurricular activities with schoolchildren is rare.

6. Currently, the research on robotics in foreign countries is far ahead of the development of the research in this field in our Republic. In foreign studies, robotics is generally accepted as a component of a broader field of education - STEM (Science Technology Engineering Mathematics) [8, p. 95].

7. The content, methodology and technology of using robotics tools in the implementation of technical education in secondary school should be the subject of systematic and directed research in the methodology of teaching subjects in our republic. Robotics takes a very important place not only in extracurricular activities with students, but also in effective organization of the educational process. Taking into account the versatility of robotics as a field of technical knowledge, it is necessary to pay attention to the use of its capabilities in the mastering of each subject.

The study of the elements of robotics as a direction of technical innovation is included in the content of the programs of physics, computer science, mathematics, technology, etc. taught in general secondary schools, as well as in the programs of optional lessons and extracurricular activities with students. should be included. Each high school, taking into account its orientation, should develop a comprehensive program to include elements of robotics in the technical training of schoolchildren. The purpose of such a program is to form the technical culture necessary for school graduates to live effectively in the robotics environment in the near future.

While studying and analyzing information on scientific and technical achievements in the classroom and extracurricular activities, information on the types of robots intended for use in various branches of production can be used. There are opportunities to use such opportunities in physics and technology classes. This can be done as follows:

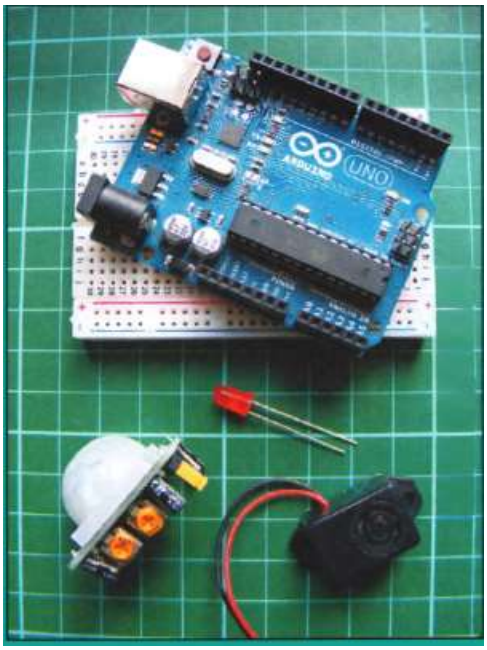
- techniques and technologies used in various spheres of society's life;
- modern experimental equipment that can be used in the educational process;
- robotic tools intended for use in the educational process [9, p. 820].

Learning these technical tools can be done in different ways. In the first method, students are first given detailed information about the elements and design of the robotics device. It will be analyzed what kind of tasks it can perform. Next, the current model of this type of robot will be presented. Using this method, it is possible to learn about robots that are designed to perform tasks ranging from simple tasks to complex technological tasks. The working process of their main working elements is studied by students.

The second method. In the process of organizing classes using this method, the teacher offers students assignments for independent work. Students must assemble a robot model that has a specific design and is designed to perform specific functions. Students should be given a task that will help them master the subject material independently. Design Assignments If there are construction kits for students to assemble a robot, it is possible to assign as homework the task of assembling a robot with a design. The teacher can organize such tasks during extracurricular activities. As a result of regular use of such methods in training, students can develop the skills of independent design of various devices. This serves to increase their interest in various fields of science and technology.

Students can be given a task to assemble a motion sensor during class sessions. The teacher gives appropriate instructions and necessary recommendations to the students. Each student is given information on how to complete the assignment.

In this task, students will build a motion detector system using a passive infrared sensor. Also different from this device, for example: sending messages through light, changing the place of something, "Welcome home!" when you approach the entrance door. can be used to perform such tasks as the text appears.



Necessary equipment: Arduino board, LED, layout board, piezo transmitter, passive infrared motion sensor HC-SR501 (Fig. 1).

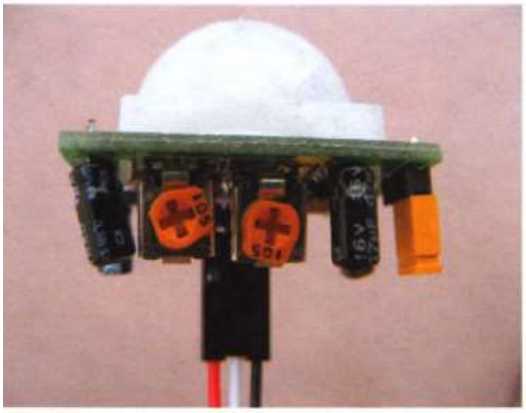
Operation: This project is based on the operation of the HC-SR501 sensor. The sensor should be installed in such a way that when a person appears in front of it, the LED lights up and the piezo transmitter sounds (Fig. 2). You can also adapt it for other purposes [3, p. 72].

Any piezo distributor will do for this project. The main thing is to observe the polarity: the red wire should be connected to the 5 V power supply, and the black wire to the ground wire. Other similar motion sensors will fit our project, but it's important to check your model's contact sensor location, as their classification files may differ. All sensors must have a power source, a ground connection, and an output for data transmission. The contacts are not visible on this model, but if you remove the outer lens (which is held in place by screws and can be easily removed), you can see the contact marks as shown in Figure 3.

2-picture:

A motion sensor with a lens removed.

Two orange potentiometers on the sensor allow you to adjust it. In the case of the sensor shown in Figure 4, when an object is detected, the left potentiometer goes from HIGH mode, controls the operation time and allows you to set this time in the range of 5 to 200 s. If an LED is connected to the output, the potentiometer determines whether it will be lit for 5 to 200 seconds, depending on the setting level. The right potentiometer limits the detection of the object in the range from 0 to 7 m [2, p. 73].



4-picture:

Potentiometers-motion sensors. The left potentiometer sets the output to HIGH (5-200 seconds); and the right potentiometer controls the sensitivity of the sensor (0-7 meters). The sensor records the infrared radiation emitted by warm objects. The crystal material inside the sensor immediately detects infrared radiation. When it reaches the set level, it drives the output signal of the sensor [3, p. 81].

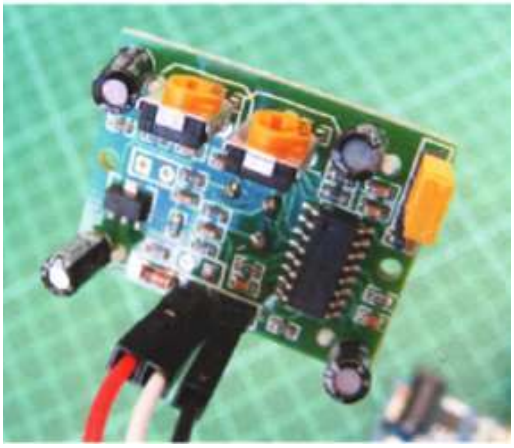
The Arduino board accepts this signal as a voltage, so it can be used to turn on an LED. The device should be installed in such a way that it emits a sound signal when it is working.

The device can be assembled in the following order:

1. Connect the 5V and GND contacts of the motion sensor to the power bus and ground of the breadboard, correspondingly, these buses must be connected to the corresponding contacts of the Arduino board. Connect the OUT sensor pin to pin 2 of the Arduino board (see Figure 5).

A motion sensor connected to an interconnecting device

2. Install the LED on the breadboard and connect the long leg (anode) to pin 13 of the Arduino board, and the short one to the GND pin. In this project, you won't need a resistor to make the LED work.



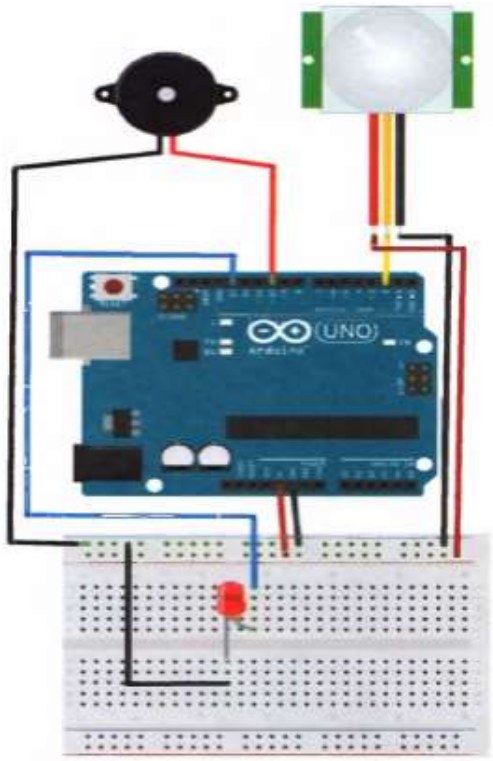
5-picture:

3. Connect the piezo distributor: the red wire to pin 10 of the Arduino board; connect the black one to the GND contact.

4. Make sure that your circuit corresponds to the scheme in Figure 6, then load the code of this project into the Arduino memory [6, p. 142].

From the examples given above, it can be seen that students' interest in science and the use of educational materials and teaching tools related to robotics in the development of technical creative abilities show the practical application of physics. Students will understand information about the structure and operation of various devices based on the science of physics.

Also, providing them with such tasks in the performance of various homework and assignments will help them develop competencies in designing and constructing various devices.



Picture 6: Schematic diagram of a motion sensor

V. Conclusion

As you can see from the above examples, as students develop the skills to connect different circuits, they can learn to connect more complex chain circuits or develop the skills to connect various additional devices. In the use of robotics elements in the teaching of subjects in physics classes, it is important for students to master the science-related educational materials and master the knowledge in accordance with the state education standards.

References:

1. Tarasov, S. V. Innovative educational environment and worldview of schoolchildren: Monograph. - Gatchina: Izdvo GIEFPT, 2015. - 179 p.

2. Bloom D. Learning Ardunio: tools and methods of technical magic. - St. Petersburg: BHV-Petersburg, 2016. - 336 p.

3. John B. Learning Ardunio. 65 DIY project. - St. Petersburg: Publishing house "Piter", 2017. - 400 p.

4. Osipov N.V. The use of elements of educational robotics as a means of implementing the polytechnical orientation of teaching physics. Abstract … cand. ped. Sciences: -M.: 2017. -53 p.

5. Petin V.A. Projects using the Ardunio controller. - St. Petersburg: BHV-Petersburg. - 2015. - 464 p.

6. Revich Y.V. ABC of electronics. Learning Ardunio. - Moscow: AST Publishing House: Kladez. - 2017. - 224 p.

7. Filipov S.A. Robotics lessons. - M.: Knowledge Laboratories, 2018. - 190 p.
8. Ford M. Robots are coming: Technology development and a future without work. - Moscow: Alpina non-fiction, 2019. - 572 p.
9. Juraev Kh.O., Kurbonov M., Ajyieva M.B., Khamdamova N.M. Developing students' technical creativity through comparative energy sources devices// Cyberpsychology, Behavior, and Social Networking. Volume 24, Number 12, 2021. – Pp. 819-825.
10. Khamdamova N.M. Develoment of student technical entrepreneurship with the use of alternative energy sources// Palarch's Journal Of Archaeology Of Egypt/Egyptology. *– Hannover, Germany.* 2020. № 17(6). –Pp. 14374-14384.