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ANALYTICAL PLATFORM FOR CONDUCTING ARDUINO ONLINE COURSES

Annotation. The relevance of studying online courses is due to their active introduction into the education system and the possibilities of their use to implement the concept of lifelong learning. Against the backdrop of the formation of e-pedagogics as a branch of pedagogical science, the theoretical and pedagogical analysis of online courses as an educational resource is of great research interest and determines the purpose of this study. The authors made analyzes of online courses and platforms.

In this article, training courses on Arduino on modern platforms (YouTube, Instagram, Telegram, Udemy) were considered with different presentation of information about the basic functions of Arduino, the possibility of developing a microcontroller and online learning, and the advantages and disadvantages of these platforms were identified. The Instagram platform is used mostly as advertising accounts for selling online courses and does not have an educational function, although there are tools for implementing Arduino online courses and reaching a larger audience.

Keywords: Arduino; microcontroller; IOT; online course; programming.

Introduction

In modern conditions, information technology and digital transformation are the main factor in technological change and a condition for ensuring competitiveness, the basis for the transition to a digital state. In the new conditions, educational activities related to the satisfaction of the cognitive interests and needs of children in areas related to artificial intelligence and robotics are gaining more and more scale.

Online courses allow solving the problems of building an individual educational trajectory and additional professional training of the student, developing his ability for self-organization and self-education - a key competency necessary for the implementation of the concept of lifelong education.

An online course as an educational process organized in a certain way is neither a form nor a type of learning, but can be described as a type or variety (a group of instances united by common features) of distance or e-learning [1].

Due to the global spread of the coronavirus, mandatory online learning has presented teachers with another challenge, resulting in the acquisition of other new knowledge and skills. In a short time it was necessary to master the features of online learning, so as not to reduce the quality of lessons and students' interest in the subject [2].

Distance education meets the needs of the society of the 21st century, providing a real opportunity for course participants to achieve certain results in mastering new professional knowledge without leaving their place [3]. The ability to gain knowledge without leaving home

makes the learning process comfortable, flexible and less tiring, for example, because there is no need to spend time getting ready for an educational institution or overcoming traffic jams.

Arduino is an electronic kit and a convenient platform for the rapid development of electronic devices for beginners and professionals. The platform is very popular all over the world due to the convenience and simplicity of the programming language, as well as open architecture and program code. The device is programmed via USB without the use of programmers [4]. With the advent of the Arduino platform, the possibilities for developers have increased dramatically. Professional engineers and entrepreneurs sometimes start with Arduino to create a prototype before developing a finished product. The famous blue board has even found its way into the classroom, where teachers use it to teach programming, electronics, robotics, and even critical thinking and problem-solving skills.

One of the ways of popularization and accessibility are social networks, in which both children and adults sit. The coverage of the audience is quite large and diverse, as well as a very budgetary distribution option. By shooting small video lessons, giving feedback in the form of live broadcasts, you can interest and educate a large number of students from all over the world.

Purpose of the work: To analyze the platforms for conducting the Arduino online course and find the right one.

Research question: What internet platform can be favorable for creating and developing online Arduino courses?

Materials and methods

In the process of research, the authors of the article successfully applied such methods as theoretical, general philosophical analysis, including dialectics, analysis, analogy, observation and synthesis. The article provides a comparative analysis of the work of online courses on Arduino for beginners, and the result of this analysis is a clearly formulated conclusion indicating the pros and cons of online teaching methods for this course.

Result and discussion

There are a lot of platforms for distributing their courses. In this study, we consider the most popular and easy-to-learn platforms.

Udemy is a global online learning and teaching platform where millions of students access the knowledge, they need by purchasing the course they need. The well-known international learning platform Udemy has dozens of training courses on the basics of electronics, circuitry, the Internet of things, microcontrollers, robotics and prototyping.

YouTube is the most popular video hosting in the world and one of the most popular resources on the entire Internet. YouTube is designed to view, download and promote videos on various topics.

Zoom is a cloud platform for online video conferencing and video webinars.

Telegram is one of the most popular instant messengers. Its main purpose is to send text, voice, video messages, as well as files. Creating channels are similar to groups in social networks. They can also be read by tens and even hundreds of thousands of people, often this is what they use for online learning.

Instagram is first and foremost a social network with millions of active users. On the other hand, Instagram is an intuitive and easy-to-use photo editor for mobile devices. It has captured a huge number of users around the world, thanks to its ease of use, now everyone is registered on this network and receives a large flow of information about various fields of activity. Thanks to BigData Instagram offers the content we need exactly for our interests and needs. Often, native targeted advertising is launched there, it is enough to say something near the phone or discuss it over the phone, in a chat, the information you need can come out to you as an advertisement and you won’t have to look for a long time.

Table 1 – Online platforms

	YouTube	**Udemy**	**Instagram**	**Telegram**	**own site**	**other platforms**
free or paid	free	paid	free	free	free\paid	paid
video, text, image, diagrams	video, text	video,image, diagrams	video, text, image, diagrams	text,image, diagrams, audio	video, text, image, diagrams	video, text, image, diagrams
Feedback	comments	NO	comments, direct massage, online translation	comments, direct massage	NO	NO
Search	easy	hard	easy	hard	hard	hard
auditory	millions	need to find	millions	millions	need to find	need to find
advertising	yes	no	yes	no	yes	yes

From Table 1, we can visually see the functions and tools of the studied platforms. It is noted that Instagram is one of the more convenient and simple platforms for online courses. Also, it is important to note that you can include gamification in the process of teaching the Arduino course, build a whole system of lessons, involving students in the process of studying robotics.

Robotics courses are a unique opportunity to learn how to develop your own robots on Arduino. Arduino is both a hardware platform and a programming language. The first version of the Arduino board was released in 2003 and has become very popular with manufacturers, hobbyists and crafters who use it to create anything from small electronic DIY to interactive wearables. Such boards with microcontroller microcircuits soldered on them and other auxiliary components that provide connection of the board to a computer, obtaining the necessary supply voltages are released to speed up the development of devices on microcontrollers. The board has connectors with which you can connect sensors, indicators and actuators to the microcontroller outputs.

Arduino allows the computer to go beyond the virtual world into the physical and interact with it. Arduino-based devices can receive information about the environment through various sensors, and can also control various actuators [5].

On the basis of Arduino, you can assemble completely different circuits: smart homes, temperature control systems, lighting control, robotics. Many different manufacturers use Arduino to produce educational kits in various subjects, including robotics. In education, such a platform can be used not only in relevant and combined classes, but also in the preparation of school and university scientific projects [6].

According to the authors of [6], teaching schoolchildren using robotic systems based on ARDUINO in the lessons of mathematics, computer science, physics, biology, chemistry, etc. is

propaedeutics for many disciplines that will be studied later in universities: mechanics, automation, programming, artificial intelligence, biotechnology, etc.

The microcontroller on the board is programmed using the Arduino language and the Arduino development environment. Device designs can work independently or interact with software on a computer. The original circuit drawings (CAD files) are publicly available, users can use them at their discretion [7]. In addition, there are online services, such as Tinkercad, where nothing is needed to work but a browser and a stable Internet. Electronic circuit simulator, with which you can connect the created virtual device to a virtual power source and see how it will work.

Arduino microcontroller boards have made it much easier for DIY enthusiasts to get into the world of electronics. Based on them, for example, you can create an automated system for your home that can regulate home lighting and heating over a Wi-Fi network, or simply control any engines that drive certain devices in your home.

Currently, dozens of types of Arduino boards are produced with various microcontrollers and boards with sensors and other devices that can be attached to the Arduino board - shields, by assembling the device in the form of a bookcase.

Arduino devices are based on the C/C++ programming language. It's easy to learn and Arduino is by far the most convenient way to program microcontroller devices.

For the study, 10 courses and different platforms were selected in which you can learn Arduino, as well as the pros and cons of the courses on which it is taught.

Table 2 - Online courses of Arduino

№	**name**	**platform/ accessibility**	**analysis**
1	CodeWay [8]	own website and Zoom, paid training.	The course is focused on commerce, there is offline and online training. This course is considered for those who already know about Arduino. You can use the first free lesson for review. You need to have several applications, go through many registrations. Before using this tutorial.
2	Arduino lessons for beginners [9]	own website and Youtube channel. Free access	It can be noted that the cycle covers all the standard operators and functions of Arduino and is built in such a way that from release to release the viewer has a smooth formation of the “base”, each subsequent video lesson contains information from the previous ones, that is, the lessons become more complicated and become complex. Of the shortcomings, the difficulty in finding it, only a knowledgeable person can find this course.
3	Arduino lessons for beginners [10]	website on vse-kursy.com, Youtube. Free access	In this course, we note that it is available to everyone, and consists of 10 video lessons taken from YouTube channels. The disadvantages of this course are its inferiority and the lack of a logical chain of teaching, as well as feedback.

4	Arduino course [11]	on the Udemy platform. Paid	This course is taught by a foreigner with an accent, which can make it difficult to understand and convey information. Lessons are designed to work only in electronic format on the Tinkercad platform and the author of the course voices the presentation. There is no video process.
5	Arduino programming lessons for beginners [12]	own site. Free access	We can consider this course as a full range of Arduino training in text format, with photo accompaniment. Each lesson is spelled out, the only drawback is the lack of a video format and the difficulty of finding a course. The lesson program is divided into modules and is designed for children with zero knowledge in electrical engineering and programming. At the end of each module, the child is left with a robot or “smart” device, completely made by himself.
6	Online course on arduino based on a simple starter kit [13]	own site. Free access	This course is designed for one academic year, consists of 40 lessons (one lesson per week). Each lesson of the course is based on a video lesson, contains a brief text description of the lesson, all the necessary diagrams and sketches.
7	Arduino for everyone [14]	instagram/ telegram robototechnika.kzn. Paid	There is no chain of lessons in instagram and telegram platforms. Lack of information and formatting. Suitable only for those who know about Arduino. In the telegram channel, you need to upload a video, this takes time.
8	Arduino lessons [15]	instagram arduino.lessons Own site - about the description of the course and its purchase	In this course, it can be noted that the classes are held individually, there will be full feedback and work with the student. Video lessons without voice acting and without description. To learn, you need to buy training, it does not attract attention at all.
9	IoT board-arduino set [16]	instagram and youtube. Free (when purchasing a box)	An educational kit designed for learning electronics and programming at school. Allows you to study in a team, that is, more than 10 people. Lessons based on 3D animation, everything is explained verbally and shown.

10	Hi! I'm an Expert. [17]	Udemy.com Paid	Video lessons with voice acting and broadcasting of the board on the Tinkercad platform, without using Arduino in real life. It is accessible and understandable about programming on Arduino, the only drawback is that the practice is only on the online service, but this is also an advantage, since you do not need to purchase a kit, it is enough Internet access.

In Table 2, we can see the description of online courses and what platforms are used to deliver the courses. Analyzing online courses from various sources, the following conclusions were made that most of the courses are quite informative and include a large amount of knowledge, but they are all aimed at a more adult audience who will purposefully look for courses on Arduino or parents who are looking for courses for your child as a developmental circle. Mostly courses on the platform Youtube, Udemy or have their own page where they post their courses. On the YouTube platform, courses are more accessible and easy to learn [9, 10]. Also, attention is paid to the Udemy platform, which has a huge number of courses but on a paid basis and is difficult to access in terms of search [11, 17]. In the course [8], we observe that when purchasing this course there are many obstacles, the need to search for the course itself, waiting for feedback to enroll in the course, downloading the Zoom platform and registering in it, and all this without saving lessons after, in case of requesting a saved lesson there are more barriers to achieving the goal. Only a few courses were found on Instagram, but they do not teach [14,15], they are used to advertise and sell the finished box [16], if you found this account and purchased this box, then you can get free lessons on this case, it is not suitable for other types of Arduino. In the courses [14, 15] they show only the finished result in poor quality and voice acting, absolutely not attracting attention to accounts for promoting this programming.

While analyzing the platforms and searching for training courses, we found that there are no online lessons on Instagram, although it is known that you can capture a fairly large audience and get interested in programming on Arduino. During the analysis, several accounts were found for the query “Arduino” and “Arduino Lessons”, which showed only the existence of several accounts, offering their courses on a paid basis or already photos, videos of finished works. On the Instagram platform, we can involve a large audience in Arduino programming, use platform tools for popularization, such as targeting, big data, hashtags, etc. By using entertainment content, we can attract a sufficient number of audiences that previously had no idea about Arduino and what possibilities it has.

Conclusion

Along with the existing platforms, which have many online courses, including Arduino courses, it was revealed that the existing online courses on the Instagram platform are of an advertising nature. Within the framework of this social network, it is possible to conduct a public conversation through live broadcasts, send private messages and receive notifications about the answer to a question of interest, communicate using comments, publish video lessons in video and reels format, upload photos of schemes, finished works, creating albums in publications, describe in the text each posted post. With the correct development of the content plan, you can create a full-fledged course on the study of Arduino, as well as cover a large audience for learning programming, as part of the popularization of robotics. It is important to correctly design the profile header, choose hashtags, which are used as one of the free promotion tools. Thus, there are many tools for creating an online educational course on the Instagram platform

If you need commercial promotion, you can use targeting to advertise courses. In addition, due to the sanctions imposed on Russia and the blocking of the Instagram platform, the need to take up this service increases because there is a shortage of educational content.

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Сұлтанғазина Н.Б., Ермағанбетова М.А., Мұхтарханова А.М., Қарабалаева Г.Т.
ARDUINO ОНЛАЙН КУРСТАРЫН ӨТКІЗУГЕ АРНАЛҒАН АНАЛИТИКАЛЫҚ ПЛАТФОРМА

Аңдатпа. Онлайн курстарды оқудың өзектілігі олардың білім беру жүйесіне белсенді түрде енгізілуімен және оларды үздіксіз білім беру тұжырымдамасын жүзеге асыру үшін пайдалану мүмкіндіктерімен түсіндіріледі. Педагогика ғылымының бір саласы ретінде электронды педагогиканың қалыптасуы аясында онлайн курстарды білім беру ресурсы ретінде теориялық-педагогикалық талдау үлкен зерттеушілік қызығушылық тудырып, осы зерттеудің мақсатын айқындайды. Авторлар онлайн курстар мен платформаларға талдау жасады.

Бұл мақалада заманауи платформалардағы (YouTube, Instagram, Telegram, Udemy) Arduino бойынша оқыту курстары Arduino-ның негізгі функциялары, микроконтроллерді әзірлеу және онлайн оқыту мүмкіндіктері, артықшылықтары мен кемшіліктері туралы ақпаратты әртүрлі ұсыну арқылы қарастырылды. Бұл платформалар анықталды. Instagram платформасы негізінен онлайн курстарды сату үшін жарнама тіркелгілері ретінде пайдаланылады және Arduino онлайн курстарын жүзеге асыруға және үлкен аудиторияға қол жеткізуге арналған құралдар бар болғанымен білім беру функциясы жоқ.

Кілт сөздер: Arduino; микроконтроллер; IOT; онлайн курс; бағдарламалау.

Султангазина Н.Б., Ермаганбетова М.А., Мухтарханова А.М., Карабалаева Г.Т.
АНАЛИЗ ПЛАТФОРМ ДЛЯ ПРОВЕДЕНИЯ ОНЛАЙН КУРСА АРДУИНО

Аннотация. Актуальность изучения онлайн-курсов обусловлена их активным внедрением в систему образования и возможностями их использования для реализации концепции обучения на протяжении всей жизни. На фоне становления электронной педагогики как отрасли педагогической науки теоретико-педагогический анализ онлайн-курсов как образовательного ресурса представляет большой исследовательский интерес и определяет цель данного исследования. Авторами сделаны анализы онлайн-курсов и платформ.

В данной статье были рассмотрены обучающие курсы по Ардуино на современных платформах (YouTube, Instagram, Telegram, Udemy) с различной подачей информации о базовых функциях Ардуино, возможности развития микроконтроллера и онлайн обучения, а также были выявлены достоинства и недостатки данных платформ. Платформа Инстаграм используется в большей части как рекламные аккаунты для продажи онлайн курсов и не несет в себе образовательную функцию, хотя имеются инструменты для реализации онлайн-курсов Ардуино и охвата большей аудитории.

Ключевые слова: Arduino; микроконтроллер; IOT; онлайн-курс; программирование.