Application of robotics in High Schools

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ABSTRACT

In this paper it will be spoken about programming languages, how to program Micro:bit and Arduino. Arduino and Micro:bit is open source hardware. Arduino and Micro:bit program can be written in any programming language. Application of Arduino and Microbit is enormous. Also in this paper it will be presented the results of research. The research is conducted in high schools. The students answered on some questions concerning programming Microbit and Arduino application.

KEYWORDS

Application of robotics, Arduino, Micro:bit, high school, research.

1. Applications today

This paper discusses programming languages, robots, how to program robots Micro:bit and Arduino. Arduino is open-source hardware. Arduino program can be written in any programming language. Application of Arduino and Micro:bit is enormous. Research results are also presented in this paper. The research was conducted in a secondary school. The students answered some questions concerning programming robots and the application of Arduino and Micro:bit. In order to use Arduino or Micro:bit it is necessary to know the basics of electronics, logic circuits and programming.

2. Programming languages today

Computer is a digital device that can perform a large number of operations based on instructions it is given in the form of programming commands. [1]
It performs a certain number of operations whereby all complex operations have to be broken down into a sequence of simple operations and adjusted to the syntax of the programming language. For each of these simple operations there is a sequence of commands expressed as binary numbers, zeros and ones, that computer can understand and perform, and translate into language understandable to humans. [1]

1.1 Types of programming languages

There are several groups of programming languages; some of them include machine languages, low-level symbolic programming languages, high-level symbolic programming languages and object-oriented programming languages. [1]

The most user-friendly programming languages are high-level symbolic languages, which based on their purpose can be classified as follows:

- LOGO is a language intended for entry level programming and drawing.
- BASIC is a universal general-purpose language, suitable for beginners in programming, useful for solving all problem tasks.
- COBOL is intended for use in bookkeeping and accounting, as well as in business and commercial dealings.
- FORTRAN is a language suitable for solving technical, physical and mathematical problems.
- C is a general-purpose language, one of the most widely used languages for professional purposes; it provides a wide range of options and is adaptable to any platform.
- PASCAL is a general-purpose language, very popular in academic environments. It enables a logical program organisation that best follows thought process. As of recently it can be used for professional purposes as well.
- HTML, XHTML, CSS are program languages used for website creation and design.
- SQL is a language used to search databases.
- JAVA, JavaScript, DELPHI, ASP, PHP are relatively new programming languages, mostly intended for work on the Internet, web design, developing web and mobile applications. [1]

3. Arduino and Microbit programming

The first thing to focus on when programming an Arduino microcontroller is the understanding of the term algorithm as a basis of all logical reasoning when solving a problem or writing a program code. [2] Algorithm is a sequence of interrelated commands used to perform a certain task or solve a logical problem. Arduino algorithm's commands have to be organized so that they follow the hardware platform's work, as well as to perform the assigned task as quickly, simply and effectively as possible. [2] Every Arduino program code contains two parts, which include: **setup()** (input-output) involves setting up Arduino controller, and **loop()** or part of the program performed several times. [2]

Setup() command is actually the part of the code that sets up the Arduino controller, i.e. the input and output of the data, the communication with computer or another device is established. **Loop()** is the part of the code that Arduino constantly repeats enabling itself to behave as a smart device, navigating its surroundings and executing commands like a little robot. [2]

3.1 Arduino programming software

Regarding hardware, the most essential part necessary to build a little robot is the Arduino microcontroller. There are several such microcontrollers, and according to one's needs, one can choose between Arduino Uno SMD R3, Arduino Ethernet, Arduino Mega, Arduino Due, Arduino Pro and other. [3] For its functionality and program command execution **Arduino IDE i**s recommended as special freeware program that can be downloaded from this link: https://www.arduino.cc/en/Main/Software. [3] The image below shows the program interface. The interface consists of the area for code writing, main menu with code checking commands; it includes sending the program to Arduino controller, the communication with Arduino, and the area at the bottom of the page where notifications about the code translation process (compiling) are received (Figure 1). [3]

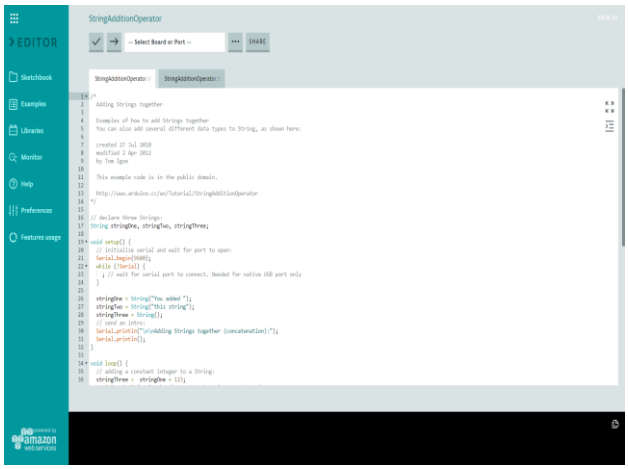

Figure 1: Program interface of Arduino IDE

When starting the program in the Arduino environment it is necessary to prepare hardware, by using USB cable to connect Arduino microcontroller with the computer or some other device (Figure 2). [3]

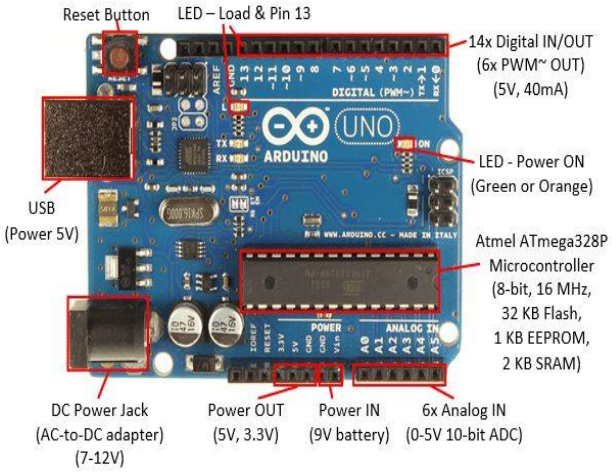

Figure 2: Arduino microcontroller

After connecting Arduino hardware, the procedure is as follows:

- turn on Arduino via USB cable, or Bluetooth,
- click on Tools - Board and check whether the Arduino microcontroller we are working with has been recognized,
- then click on Tools - Serial Port and select the suitable COM port. In order to know which COM port to select open Devices and Printers option on Start menu in Windows and find the Arduino microcontroller on the list. The COM port will also be listed here. [3]

When the first code (program) is written click on the icon Verify, which initiates code check, and if there are any errors in code the result will be displayed at the bottom of the interface, i.e. window. If the code is correct the icon Upload is selected. [3]

After uploading, the program is on Arduino and can be tested. Each new program being written and each new command transferred to microcontroller is executed in the same manner. [3]

3.2. Micro:bit programming software

Similar to the Arduino microcontroller we have a Micro:bit microcontroller. Micro:bit is small programmable device, designed to make learning and teaching easy, interesting and fun. Lots of information about, how to program Micro:bit and how to create code we can find on this wesite https://microbit.org/ .

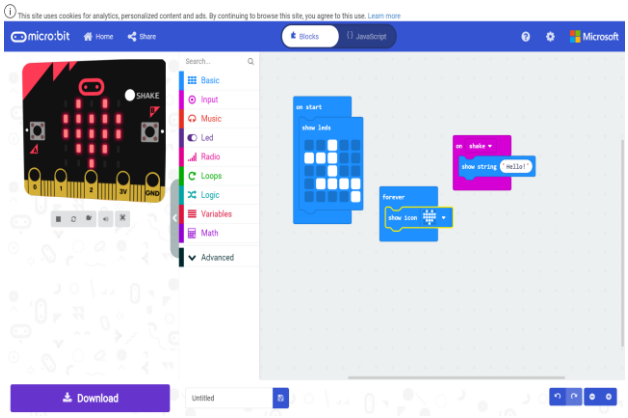

Figure 3: Create code for Micro:bit device

4. Research results

The research was conducted on a sample of 45 participants. There were 12 female and 33 male participants. Participants were on average between the ages of 15 and 30 years (Table 1).

4.1. Results and methodology

The research was conducted on two groups. The first group involved students, and the second involved adults. There were 30 participants in the first group and 15 participants in the second group. Both groups completed the questionnaire. The data interpreted in the text was obtained thorough a questionnaire. The questionnaire consisted of 12 differently formed questions.

Table 1: Overview of the number of participants assigned to groups based on age and gender

	MEN	WOMEN	TOTAL
Students	**18**	**12**	**30**
Adults	**15**	**0**	**15**
Total	**33**	**12**	**45**

The research objective was to explore in what ways and to which extent programming in general, Micro:bit and Arduino programming is present in the teaching process.

Each group answered questions on the use of programming languages, familiarity with Micro:bit and Arduino controller and programming in Arduino. The questions aimed at identifying attitudes of both groups. In this way we tried to collect the necessary information about the opinion of the participants on the functionality and application of Micro:bit and Arduino programming.

Questions were:

1. Have you ever programmed before?
2. What programming languages have you programmed in?
3. What did you program?
4. Do you know how to program in Java?
5. Do you know what Arduino is?
6. Have you ever programmed in Arduino?
7. Do you know what Micro:bit is?
8. Have you ever programmed in Micro:bit?
9. Do you have Arduino robots in your school?
10. If you are attending a Robotics class, what do you learn in that class?
11. In your opinion, what is the most interesting part of Arduino or Micro:bit programming?
12. What do you think of using robots in the classroom?
    a) It is interesting to learn how to program robots
    b) I believe Robotics is our future
    c) I think it is only for pastime, I do not see it utilized on a large scale in the classes.

Several significant answer examples from the Questionnaire are mentioned in the rest of the text in this chapter, which are also represented in numbers and chart values.

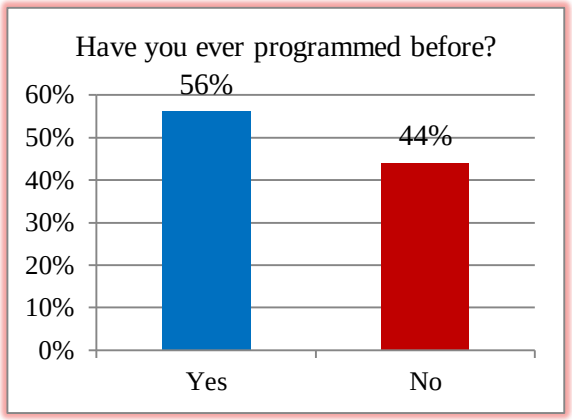

Figure 4: Overview of the research results

The overall analysis shows that a larger number of participants used at least one programming language throughout their education. According to the research results the programming languages the participants most frequently encountered are Qbasic and C++. To the first question: "Have you ever programmed before?" 56% of participants answered affirmatively, and 44% answered negatively (Figure 4).

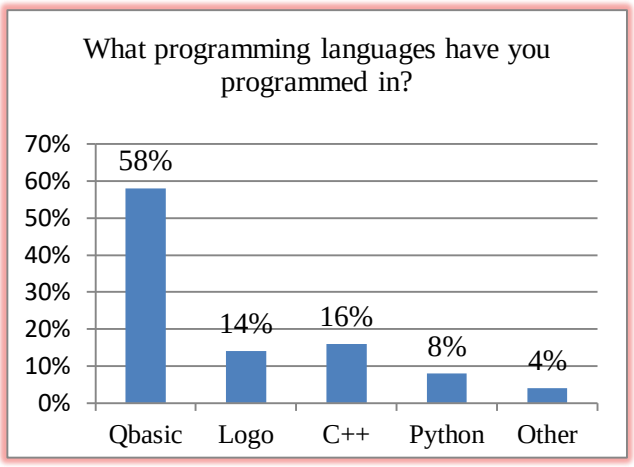

Figure 5: Research results overview

To the second question: "What programming languages have you programmed in?" 58% of the participants said Qbasic, 16% C++, 14% Logo, 8% Python and around 4% used other languages (Java, C#) (Figure 5).

Regarding questions referring to the application of Arduino robots in the classroom, e.g. to the question no. 12: "What do you think of using robots in the classroom?" around 64% participants said they believed that robotics is our future, 24% found it interesting to learn about and know how to program robots, and 12% participants saw it only as a pastime, without recognizing any big application possibilities for robotics in the classroom. (Figure 6).

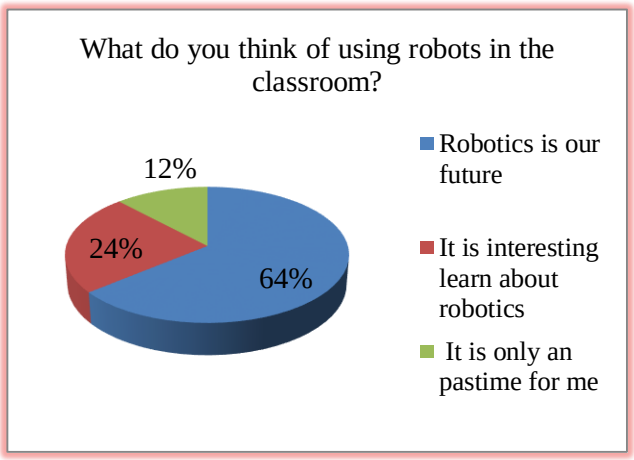

Figure 6: Robotics in the classroom

Regarding the questions about the use of Arduino and Micro:bit in the classroom some participants who worked with Arduino and Micro:bit said they had learned how to instruct a robot to move, avoid obstacles, move in chosen direction, emit light signals, etc.

CONCLUSION

By using and programming digital devices, as well as taking all opportunities the modern age gives us, it is easier for us to learn and create new contents, and then present those new contents as final products on the market.

The modern, contemporary age offers free and fast communication, availability and networking. It is observable from the research presented in the paper that programming attracts more individuals each day who are striving for new realizations. Arduino itself awoke and encouraged individuals interested in the possibilities technology has to offer to further explore and progress. The application of programming and creating something better encouraged young people who see the future in technology to come up with some new ideas.

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