FIRST STEPS IN PROGRAMMING WITH BBC MICRO:BIT

Deyana Peykova, Kosta Garov

Abstract. The following work describes good practice using BBC:Micro:Bit that can be implemented in the process of learning programming in primary and lower secondary level of primary education. The paper shows the implementation of resources created by the company and implemented in extracurricular activities with students from this stage. With BBC Micro: bit students take their first steps in programming, develop their creative thinking, experiment, learn to solve problems and work in a team. Working with this programmable microcomputer increases students' motivation and interest in the basics of programming and can be included in computer modeling classes.

Key Words: algorithmic thinking, programming, BBC Micro:Bit

Introduction

BBC Micro:bit is a small, programmable microcomputer that can be used for amazing inventions – from robots to musical instruments. It was created with the support of the BBC and is used in every school in the UK. With BBC Micro:bit students enter the world of programming and hardware in an innovative and accessible way, they see the practical application of mathematics, electrical engineering and science, explore how the world around us and learn about the new technologies. Working with BBC Micro:Bit develop their thinking, skills to make experiment, learn to solve problems and work in a team. [1]

The language which is used for programming is visual, specially developed for teaching children and is used in many schools and universities around the world. It covers basic concepts such as condition, cycle, function, etc. With its help, students can intuitively understand and create working algorithms. At a later stage, everything that students have learned provides a very good basis for their professional development in the field of information technologies. Working with BBC Micro:bit is suitable for computer modeling and extracurricular activities. This microcomputer has many built-in sensors to make programming interesting, but also support and provoke research projects in other subjects.

According to a survey, conducted by [2] and after working with BBC Micro:bit the students reported that they have learned a lot during the lessons and their interest in learning how to code is increased.

BBC Micro:bit has a processor, memory and places for "input" and "output", 25 LED "lights" (matrix 5x5), which can be programmed individually, two buttons for programming on the front, which can be used to control games or pause and skip songs in a playlist and place to connect a battery on the back, light, temperature, motion and compass sensors (Figure 1). There is also a radio that allows BBC Micro: bit to "talk" wirelessly with other devices like it. A special antenna allows it to send and receive Bluetooth signals and thus BBC Micro: bit can connect to your home computer, phone and tablet. The USB interface allows BBC Micro:bit to be connected to the computer via a mini USB cable, which allows to download code to it. Micro: bit can even detect movement and tell you in which direction you are heading. It can also use Bluetooth Low Energy (BLE) to interact with other devices and the Internet. The board has 21 I/O ports connected to the edge connector. Three of the I/O ports have easy access – for screws, for crocodile clips, etc. It is powered by voltage via the micro USB connector or by an external 3V power supply supplied to the 3V port or the battery connector. The operating voltage of the microcontroller and I/O ports is 3V.

Figure 1. BBC Micro:Bit

BBC Micro:bit has a built-in accelerometer that measures gravitational force, as well as a compass (also known as a magnetometer) that can detect orientation using the Earth's magnetic field. Depending on the version, the accelerometer and compass can be on separate integrated circuits or combined in one integrated circuit [3].

No matter what devices we program for, programming environment is needed. For BBC Micro:bit the environment is Make Code (Figure 2): https://makecode.microbit.org/ [4].
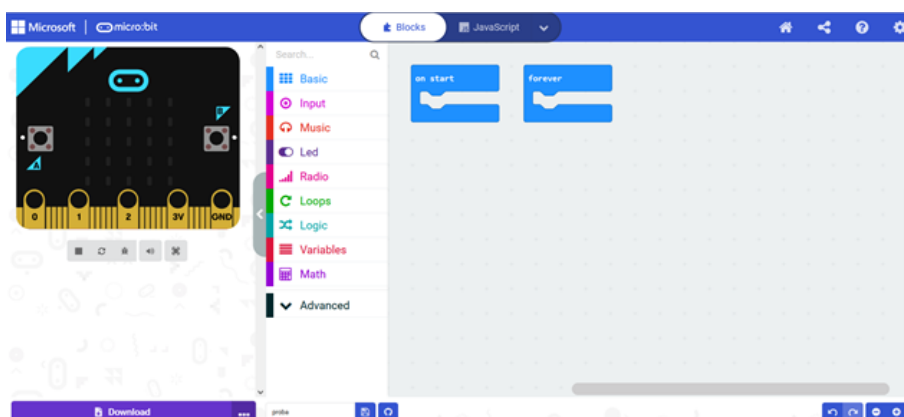

Figure 2. Make Code programming environment

This is an open programming environment created by Microsoft to program BBC Micro:bit and other programmable boards. It is an intuitive block programming environment and does not require students to have specific knowledge other than that acquired in computer modeling classes at an early stage.

In it there is:

- Simulator: we can test our program without having BBC Micro:bit;

- Toolbar: from here we select the blocks we want to use;

- Desktop: the place where we arrange the blocks in the program.

The programming of BBC Micro:bit is done via USB – it does not require an additional programmer. All that has to be done is inserting the downloaded code file into the memory of BBC Micro: bit – displayed as a USB memory on a computer with the extension * hex.

BBC Micro:bit has been known in Bulgaria since 2017. Some teachers have already worked on it with their original projects. A significant number of lessons for working with BBC Micro:bit are available on the official website https://microbit.org/.

This paper describes several projects that can be used by teachers and students in the first steps of programming with BBC Micro: bit. The projects were implemented by seventh-grade students at Hristo Smirnenski Primary School in Rakovski in extracurricular activities.

Projects with BBC Micro:bit

There are a lot of projects that can be found on the official website of BBC Micro:bit and Coder Dojo Bulgaria [5] but also videos and tutorials for students and teachers. Some project that can be easy done by students are described below.
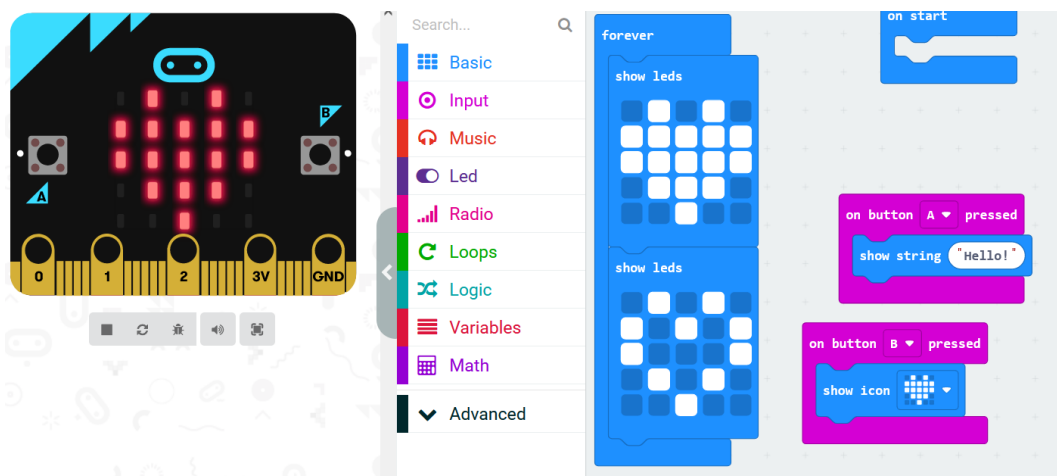

Figure 3. Flashing heart code

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Flashing heart

The program shows a beating heart using two built-in pictures, a large and small heart, on the micro:bit's LED display. Different images shown in a sequence create the illusion of movement: a heart getting larger and smaller. After showing each image, the program pauses for half a second before showing the next image. The animation is kept going forever using an infinite loop: it repeats the sequence of showing these two images and pausing until the BBC Micro:bit is unplugged (Figure 3).

Project "Step counter"

A step counter is a little device worn usually on the arm or leg that counts the number of steps a person takes in a day. To count the number of steps we take, we need to store the number on the BBC Micro:bit in it's memory. We can do this by using a variable. For the step tracker, we make a new variable and call it "step". To detect a step made, BBC Micro:bit has an accelerometer on board. The accelerometer is a special chip that detects movement in real life, it is also in things like aircraft, rockets, modern cars and mobile phones. [6]

For this code though we are looking for a shaking movement, and adding 1 to the steps variable each time it happens. The BBC Micro:bit is attached to the ankle. The shake event is used to detect a step. When it starts the board shows 0, it always shows the number (Figure 4) and when it is shaken it adds 1 (Figure 5). Sometimes there is a lag and it is because the step value can change while the BBC Micro:bit is displaying a number. To remove the lag, stop animation is added after changing the value of step.
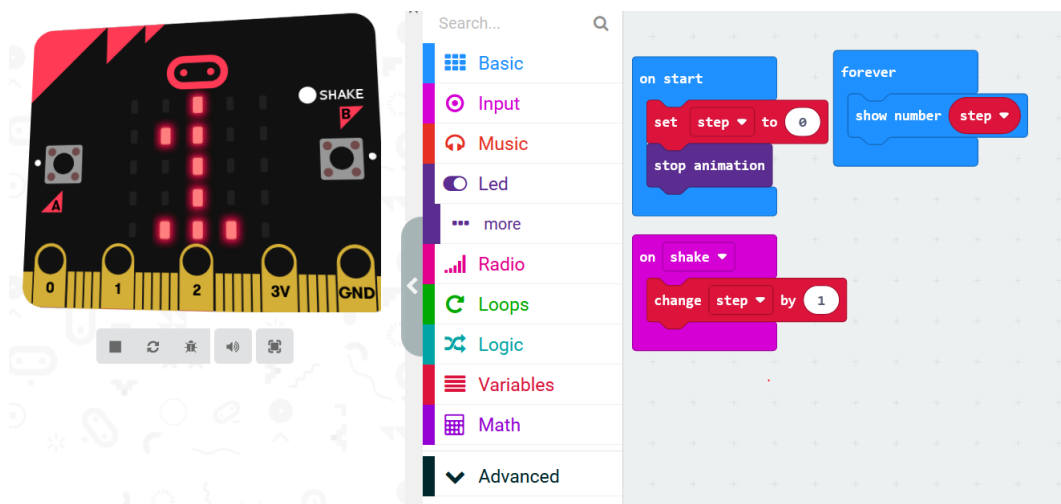

Figure 4. Step counter code

Figure 5. Step counter

Project "Parking spaces"

This project start with discussion about the parking system in the bigger shopping malls, how it is created, who counts the number of the cars when they enter and leave the parking. Students give examples and they discover that in the nearest shopping mall there is not such a device that shows the number of the cars. They are provoked to think about a good decision using BBC Micro:Bit.

In this case, when a car enter the parking it presses button A and the number of the free places for cars decreases with one. When the car leaves the parking it presses button B and the number of free places increases with one (Figure 6).
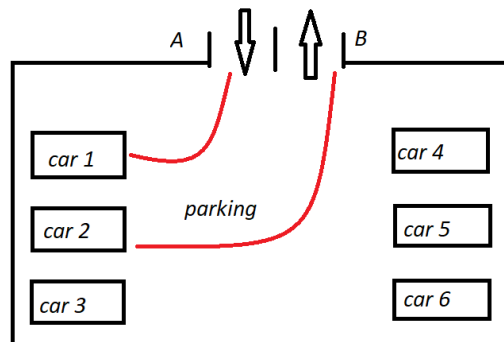

Figure 6. The project idea

In order to give solution students use the function "Radio" to send and receive messages with other BBC Micro:bit. The first thing they do in Make code environment is to set group. This makes certain that another BBC Micro:bit will receive just the messages assigned to that group and not the messages sent from another BBC Micro:bit. This group is named "Parking spaces" and they are set to 6. Figure 7 also displays that when there are no left free spaces the board shows the icon "X". Figure 8 explains button A and button B functions.
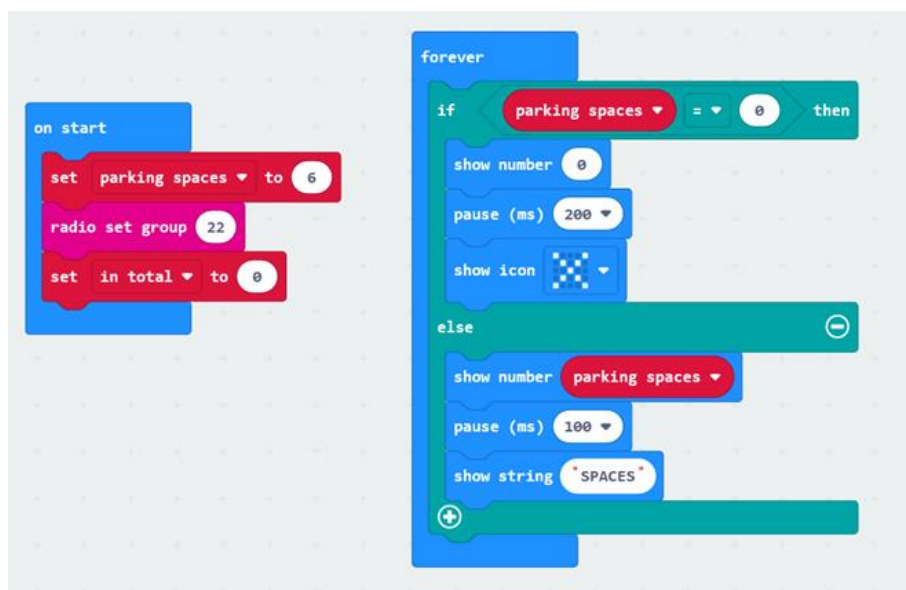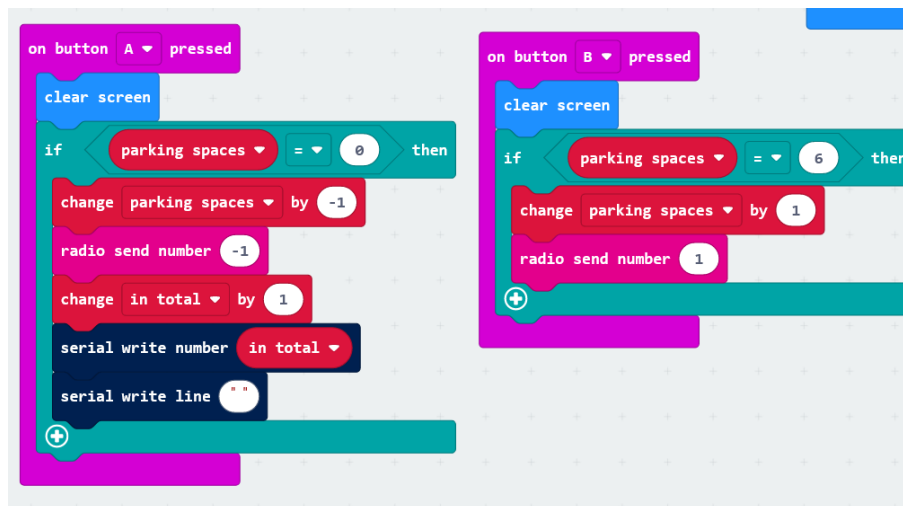

Figure 7. First settings

Figure 8. Buttons A and B functions

Conclusion

BBC Micro: bit is a physical computing device that provides a bridge between abstract concepts and tangible experience. Physical computing combines computational thinking, coding, creativity and innovation. Using BBC Micro:bit, students acquire competencies and skills for basic programming, building their abilities and confidence to have ideas, share them and implement them. The simplicity of BBC Micro:bit design makes it a great tool to start learning programming at an early age.

Acknowledgments

References

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