Using BBC micro:bit in primary and secondary schools for creating simple smart home

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Abstract—The concept of a smart home is getting more and more popular for people of all ages. You can meet the term smart home not only on the web, but also in schools. Students can solve their seminar works on smart home topics such as “Is my home smart” or “how will the future home looks like”, etc. With popular educational board BBC micro:bit students can create their own simple smart home concept and practice programming thinking. This contribution deals with using BBC micro:bit in primary and secondary schools to create a simple smart home concept, which will use BBC micro:bit, crowtail STEAM edu kit for micro:bit, 1.8 inch colorful display and smart home kit.

Keywords—BBC micro:bit, programming, teaching informatics, smart home

I. INTRODUCTION

Almost all countries in the world signalize that in IT sector are missing people for the jobs as a software engineer. Many researches show, that tech jobs will likely to keep growing in the next several years and they will be paid very well. According Kiersz research, job as an applications software developer will be the second-best job in the future [1].

Nowadays, computers are using in almost each type of job position - in the shops as cash desk, to controlling machines and production processes in factory, in the hospital for storing patient data, in the school for presenting interactive teaching materials, etc. Computers are also used to controlling devices in many households. These households are calling Smart Homes. Residents are using mobile devices e.g. to control heating, turn on/off lights or other devices such as coffee machine, etc. Smart Homes could also do automatic heating - turning on/off heating, draw the blinds down or up or controlling height of the water in pool.

Many jobs or devices have to be programmed by IT specialist. The question is, where can we find these people? Many researches focus on motivation of pupils to learn computer science.

The solution could be using motivational hardware, such as Lego EV3, Makecode robots, BBC micro:bit etc. Physical computing in cooperation with a block-based environment (e.g. Microsoft MakeCode) have become more and more attractive, especially for presenting programming to younger students – beginners [2].

BBC micro:bit could be one of the option, to motivate pupils learn computer science.

II. BBC MICRO:BIT

The educational board BBC micro:bit consists of 25 individually-programmable LEDs, 2 programmable buttons (A,B), physical connection pins, light, temperature and motion sensors, compass, battery socket, radio and Bluetooth antenna [3]. The main advantage of micro:bit is his very low price. Another huge advantage of micro:bit is the possibility to use it in primary and secondary schools, due to supporting programming languages like block-based language, JavaScript, Python and language C.

III. BBC MICRO:BIT EXPANSIONS

For teaching with BBC micro:bit it is possible to use more expansions like smart home kit, temperature sensors, crocodile cables, 1.8 display, special set of sensors, etc. Most of these extensions have low prices similar to micro:bit.

It is low-cost device, that was assigned for 11-12 years old pupil in the UK in 2016 [4]. Independent research tracked the progress of the BBC micro:bit in the UK during its first year of its deployment and found, that 85% of teachers who used this device agreed, that it makes Computer Science more enjoyable for their students, and 90% of the children who used it said, it helped to show them ,that anyone can code [5].

In comparison with more sophisticated piece of hardware (such as Arduino and Raspberry), BBC micro:bit is powerful even without any extensions [6].

A. ELECfREAKS Smart Home kit

Smart Home kit in fig. 1 shows simple room with various sensors in our small model of smart home.

Figure 1. Smart Home model
ELECFREAKS micro:bit Smart Home Kit contains executed components commonly used at home as TMP36 temperature sensor, sound sensor, light sensor, servo, DC motor, soil moisture sensor and OLED screen.

Fig. 2 shows the code, which is responsible for that our sensors are working. We have created two variables, to store sensors values in “forever” loop. Fan and light are triggered after crossing a certain value through calling a function further in loop.

Figure 2. Reading values from sensors

Figure 3 shows the function which detects temperature values. If temperature is higher than 28°C the fan located at pin1 is triggered for 5s. Noise measuring function detects the value of noise in room. If value is higher than 70 the light is triggered.

Figure 3. Temperature sensor code

Another interesting sensors we used from this micro:bit kit are submersible pump and soil moisture sensor (Fig. 4).

Figure 4. BBC micro:bit submersible pump and soil moisture sensor

If the height of water in glass (pool imitation) is higher than should be, the pump draws off the water. Moisture sensor detects the height of a water. Fig. 5 shows the code of this functionality.

Figure 5. The code of submersible pump and soil moisture sensor

B. 1.8inch display, crocodile cables, temperature sensor

1.8inch colorful display module consist of 160x128 pixels, capable of displaying 65K colors (Fig. 6).

We mounted this LCD display into a living room wall, looking like a TV set. The display shows a screen with the logo of the Department of Computer Science FNS UMB and a second screen with the text “Current temperature is” and the value that is received via radio communication with the Sensor Board every 5 seconds.
Fig. 7 shows sensor Board for micro:bit, which allows to sense sound level, temperature and light level. These were connected easily to micro:bit with crocodile leads. Crocodile cables are suitable for quick connections to test circuit. Each lead is 50cm long with a rubber shrouded crocodile clip on each end.

Fig. 8 shows code for measuring actual temperature in Fahrenheit degrees. We change this value to Celsius degrees.

C. The Crowtail STEAM Edu Kit for Micro:bit

The Crowtail STEAM Edu Kit for micro:bit contains useful equipment such as buzzer or twelve sensors e.g. LED, sound, noise sensor etc. which allows making interesting projects.

We used this kit for opening and closing window (in our case the window is cd case). The window is open by servo motor (Fig. 9).

Fig. 10 shows source code of opening and closing window.

Except servo motor we used also Led diods, noise detector, buzzer and touch sensor.

In one room (hall) is micro:bit kit, noise sensor is connected to this kit through PIN0, touch sensor through PIN01 and PINS 12 and 16 are reserved for LED diodes (green and red). As default there is in first room a red led turned on. This shows that the alarm is on. In this mode is alarm turned on in both rooms with detecting move in one room and noise in another. If we touch the touch sensor we turn of the alarm, by another touch we activated it again (Fig. 11).

Fig. 12 shows the code, which set radio group (the same value should be in micro:bit in both rooms), turn on red LED light (PIN12), create variables for storing values from touch and sound sensors.
If alarm is on and noise in the room is detected, micro:bit sends:

- Value (number) 2 to second micro:bit (another room) while alarm is turned on and noise detected.
- If alarm is turned on, sends value 1 (noise sensor does not detect noise)
- If alarm is turned off, sends value 0.

0 alarm is turned off, no action

1 alarm is turned on, move sensor has been detected so it triggers a buzzer and turns off/on diodes for 5s.

2 alarm is turned off, sound sensor has been detected, and perform same action as in previous case.

Fig. 14 shows second room with another micro:bit with sensors.

There is another micro:bit in second room, which receives values from the first one. This one performs an action according to received value:

- If we touched the touch sensor:
  - 0 alarm is turned off, no action
  - 1 alarm is turned on, move sensor has been detected so it triggers a buzzer and turns off/on diodes for 5s.
  - 2 alarm is turned off, sound sensor has been detected, and perform same action as in previous case.

Fig. 13 shows function `isTouchPressed()`, which sends value if we touched the touch sensor.

Fig. 15. Micro:bit code for second room
IV. METHODOLOGY AND RESULTS

We used BBC micro:bit expansions for teaching programming in our extracurricular activity for Computer Science. This activity is free of charge and it is suitable for primary school children (Fig. 16). We organize this activity twice a week for 1.5 hours. Pupils can choose the day of their attendance. Each time at least 7 pupils.

Since we have only one piece of smart home kit, 3 sets of crowtail kit, we decided to make only one house, with two pupils working in each room.

Firstly, we used this expansion separately, later we shown to students, that they can create simple smart home concept with their knowledge from previous lessons. We measured the interest of each expansion from chapter 3 by questionnaire.

V. CONCLUSION

By this article, we wanted to show our simple smart home model, which is based on the educational board BBC micro:bit with various sensors such as crowtail STEAM edu kit for micro:bit, 1.8 inch colorful display and smart home kit. We built this house in our Extracurricular activity for Computer Science. Using educational board BBC micro:bit with sensors described in this article could increase motivation for teaching Computer Science, especially teaching programming.

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