



A short training program with microcredits

Creating simple automated systems using Arduino microcontrollers

The training program was prepared by:

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Initiators of the educational program

Project: *CL.BVET Education and Training for Collaborative Learning in Blended Learning Environments*

Project partners: School Center Novo Mesto, Euroskill d.o.o. (Slovenia), Vocational High School Velika Gorica (Croatia), Technical School Gradiška, Adult Education Center Banja Luka (Bosnia and Herzegovina), Vocational High School Pljevlja, Innovation and Entrepreneurship Center Tehnopolis (Montenegro).





Basic information about the Program

Program name:

Creating simple automated systems using Arduino microcontrollers

Program duration:

50 sati

Evaluation:

2 KT (ECTS)

Educational areas:

The program "Creation of simple automated systems using Arduino microcontroller" belongs to the following educational areas - technical areas:

- Electrical engineering and electronics;
- Automation and process control;
- Microcontroller systems and embedded systems;
- Programming and development of software solutions for system automation;
- Digital technologies and Internet of Things (IoT);
- Smart homes, smart cities and intelligent technical systems;
- Technical documentation and system diagnostics.

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Certificates and badges received:

Upon successful completion of the program "Creating Simple Automated Systems Using Arduino Microcontrollers", participants receive a certificate of completion of training, which confirms the acquisition of knowledge and skills in the field of Arduino programming, controlling input-output devices and creating simple automated systems.

In addition to the certificate, participants are also awarded an Open Badge as a digital confirmation of the acquired competencies. The Open Badge enables verification of knowledge and skills in digital form and their sharing on professional networks, employment platforms and learning management systems.

The certificate and the Open Badge together confirm the participants' competence in designing, programming, testing and implementing simple automated systems based on Arduino microcontrollers, including their application in smart home, smart city and smart industry systems.



Description and target group of the training program:

Program description:

The program "Creating simple automated systems using Arduino microcontrollers" is intended to acquire basic knowledge and practical skills for designing, programming and implementing simple automated systems using the Arduino platform.

During the program, participants are introduced to the hardware and software structure of Arduino microcontrollers, connecting sensors, actuators and other input-output devices, and creating programs for controlling automated processes. Special emphasis is placed on practical work, testing and diagnostics of the system, as well as on the application of acquired knowledge in designing smart home subsystems (lighting control, home appliance control, temperature measurement, fire protection, etc.), as well as designing simple industrial systems in production (IoT systems for remote control of production processes).

The program contributes to the development of digital and technical competencies necessary for working with modern automation technologies and represents a good basis for further training in the fields of microcontrollers, industrial automation, robotics and the Internet of Things (IoT).

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Target group:

The program "Creating simple automated systems using Arduino microcontrollers" is intended for unemployed and employed individuals who want to acquire or improve knowledge and skills in the field of microcontroller systems, programming and automation.

The program is especially intended for students, technicians, teachers of professional subjects, employees in production and technical activities, as well as all interested persons who want to develop competencies in the design and implementation of simple automated systems.

The program is suitable for participants who want to acquire practical knowledge in the field of Arduino platform, sensors, actuators, smart home systems and the basics of industrial automation, regardless of previous experience in programming.



Skills (competences)

Upon completion of the program, the participant will be able to:

- 1. Understands the basic role of the Arduino microcontroller in automated systems and explains its application in practice.**
- 2. Recognizes and analyzes the hardware and software structure of the Arduino platform.**
- 3. Connects sensors, actuators and relays to the Arduino microcontroller via input-output pins.**
- 4. Programs the Arduino microcontroller to implement simple automated solutions.**
- 5. Tests and diagnoses basic errors in the hardware and software parts of the system.**
- 6. Analyzes and applies the basic principles of operation of automated systems in production and smart home systems in simple technical solutions.**



Learning objectives

Competency 1:

Understands the basic role of the Arduino microcontroller in automated systems and explains its application in practice.

Learning objectives:

- Explain the basic purpose, types and role of Arduino microcontrollers in automation.
- Recognize examples of Arduino system applications in real environments.
- Distinguish between the basic components of the Arduino ecosystem.

Competency 2:

Recognizes and analyzes the hardware and software structure of the Arduino platform.

Learning objectives:

- Identifies the basic hardware components of the Arduino board.
- Explains the role of the software environment (Arduino IDE).
- Connects the hardware and software elements of the system.

Competency 3:

It connects sensors, actuators, and relays to the Arduino microcontroller via input/output pins.

Learning objectives:

- Recognize basic sensors and actuators used in Arduino systems.
- Correctly connect input and output devices to Arduino pins.
- Explain the function of relays in smart home and lighting control systems.

Competency 4:

Programs the Arduino microcontroller to implement simple automated solutions.

Learning objectives:

- Write basic Arduino programs to control devices.
- Uses basic programming structures (loops, conditions, variables).
- Tests and corrects simple programming errors.

Competency 5:

Testira i dijagnostikuje osnovne greške u hardverskom i softverskom dijelu sistema.

Learning objectives:

- Recognizes typical errors in connecting components.
- Uses basic methods of testing system functionality.
- Troubleshoots simple hardware and software errors in the designed system.

Competency 6:

Analyzes and applies the basic principles of automated systems in production and smart home systems in simple technical solutions.

Learning objectives:

- Explain the principles of operation of simple automated systems.
- Recognize the basic elements of a smart home system.
- Apply Arduino solutions in simple automated scenarios.

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Structure of the training program

Serial number:	MODULE NAME:	Number of credits (ECTS):	Number of working hours (h):		
			Theory:	Practice:	TOTAL:
1.	Basics of hardware and software design with the Arduino microcontroller.	1	7	18	25
2.	Design and production of automated elements of smart home systems, smart cities and industrial systems.	1	7	18	25

TOTAL:	2	14	36	50
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MODULE 1: BASICS OF HARDWARE AND SOFTWARE DESIGN WITH THE ARDUINO MICROCONTROLLER

Goal:

To enable participants to understand the basic structure of the Arduino microcontroller system, as well as to apply the basic principles of hardware connectivity and software programming in simple automated solutions.

Contents:

- Introduction to the Arduino platform and basic system components
- Microcontroller structure (input-output pins, power supply, communication)
- Basics of working in the Arduino IDE environment
- Basic programming elements (variables, conditions, loops)
- Connecting basic electronic components (LEDs, buttons, resistors)
- Safety and proper handling of electronic components
- Basic principles of testing and simulating the operation of the Arduino system

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Methods:

Teaching is carried out through interactive lectures, demonstrations of the Arduino platform, practical laboratory exercises, guided workshops, simulations of basic electronic circuits, and individual work of the participants. Special emphasis is placed on learning through practice, where participants independently connect components and create simple programming tasks in the Arduino IDE environment.

MODULE 2: DESIGN AND MANUFACTURING OF AUTOMATED ELEMENTS OF SMART HOME SYSTEMS, SMART CITIES AND SYSTEMS IN INDUSTRY

Goal:

Osposobiti polaznike za projektovanje i realizaciju jednostavnih automatizovanih rješenja baziranih na Arduino mikrokontroleru, sa primjenom u sistemima pametnih kuća, pametnih gradova i osnovnim industrijskim automatizovanim procesima.

Contents:

- Analysis of requirements for simple automated systems
- Application of sensors and actuators in smart home systems
- Basic elements of smart cities (lighting, monitoring, energy management)
- Design of simple industrial automated solutions

- Integration of hardware components with Arduino microcontroller
- Testing and optimization of system operation
- Documentation of developed solutions

Methods:

Teaching is realized through project work, practical laboratory exercises, work in groups and individually, demonstrations of examples from practice, simulations and problem solving. Participants create simple functional models of smart home systems and industrial processes, with constant mentoring support and practical testing of the created solutions.

Method of implementation

Training/teaching is carried out in the classroom, in the laboratory on equipment and online:

The program is implemented using a combined learning method (blended learning) for a total duration of 50 hours.

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Structure of implementation:

- Day 1 – live teaching in the computer classroom (7 hours)**
- 2nd day – live teaching in the computer classroom (7 hours)**
- Day 3 – live teaching in the computer classroom (7 hours)**
- 4th day – live teaching in the computer classroom (7 hours)**

Online learning (2 working days - 18 hours):

- video recording and simulation of solutions
- group presentation of problem tasks
- presentation of developed solutions
- forum for discussion and consultation
- development and submission of an independent project

Day 5 – live classes in the workshop (4 hours):

- presentation of independent projects
- evaluation and analysis of developed solutions

TOTAL: 50 hours

This implementation model allows for a combination of theoretical teaching, practical work, and independent learning through digital tools, with a focus on developing practical competencies in the field of Arduino systems and automation.

Training methods:

In the implementation of the program, combined teaching methods are applied, which enable active learning, development of practical skills and application of knowledge in real situations.

Training methods include:

- research approach to learning
- problem-solving (problem-based learning)
- interactive lectures with multimedia presentations
- workshops and guided practical work
- practical work with Arduino controllers and input-output devices
- practical work in an appropriate software environment (Arduino IDE and simulations)
- solving real problems from practice (smart homes, smart cities, smart agriculture)
- individual mentoring and continuous feedback
- project work and presentation of solutions
- electronic questionnaire for testing theoretical knowledge
- evaluation of group and individual work of participants for the purpose of testing practical knowledge and skills for obtaining the Open Badge.

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Knowledge and skills assessment

Assessment of knowledge and skills is carried out through a combination of theoretical testing, practical tasks and defense of the project solution.

The knowledge test includes:

- theoretical knowledge of the basics of Arduino microcontrollers and their components
- understanding of the hardware and software structure of the system
- practical connection of sensors, actuators and relays with the Arduino platform
- creation and testing of simple Arduino programs
- solving assigned problems in the field of smart homes and automation
- diagnostics and elimination of basic errors in the operation of the system
- creation and presentation of an independent project solution

Forms of assessment:

- electronic or paper test (theoretical knowledge)
- practical tasks on the Arduino platform
- evaluation of project work and group activities
- defense and presentation of the developed solution

The final grade is based on the overall success of the theoretical part, practical work and the quality of the completed project assignment.

The practical exam takes place in three parts:

1. Creation of a project task (Arduino-based automated system), which includes:

- analysis of the given problem scenario (smart house, smart city or similar system);
- selection and connection of sensors, actuators and Arduino microcontrollers;
- creation and implementation of Arduino programs;
- testing the functionality of the system in simulation or on real equipment;
- basic technical documentation of the solution.

2. Presentation of the development process and results of the project task, with explanation:

- selected technical solution;
- methods of connecting hardware and software;
- operating principles of the created system;
- presentation of work results (demonstration or video).

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3. Answering the Commission's questions to check understanding:

- Arduino architecture and basic system components;
- principles of programming and controlling input-output devices;
- methods of diagnostics and troubleshooting;
- applications of systems in smart homes and automation.

Evaluation criteria:

The assessment of the knowledge and skills of the participants is carried out according to the following criteria. Each criterion is scored in the range from 0 to 2 points, with the maximum number of points being 14.

Evaluation criteria:

- Understanding and analysis of the given problem scenario (smart home / smart system)
- Quality of selection and connection of hardware components (sensors, actuators, Arduino)
- Correctness and functionality of Arduino software solution
- Quality of system implementation and testing (simulation or real equipment)
- Ability to diagnose and fix errors in the system



- Quality and orderliness of technical documentation
- Quality of presentation, communication and answers to questions from the Commission

Rating scale:

- 0 – criterion not met
- 1 – criterion partially met
- 2 – criterion fully met

REQUIREMENTS FOR COMPLETION OF THE PROGRAM AND SUCCESS

The participant successfully completes the program if he obtains at least 8 points out of a total of 14 possible points in the practical exam.

Based on the total number of points achieved, success is determined as follows:

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- 0–7 points – failed
- 8–11 points – passed
- 12–14 points – passed with high success

Upon completion of the Program, the participant obtains a certificate of competence for the creation of simple automated systems using the Arduino microcontroller, including hardware connection, programming, testing and creation of technical documentation.



PROCEDURE FOR OBTAINING AN OPEN BADGE

Šolski center Novo mesto, Šegova ulica 112, 8000 Novo mesto

**Project: CL.BVET Education and Training for Collaborative Learning in
Blended Learning Environments**

Website link: <https://www.cl-bvet.eu/education-and-training/>

To obtain the Open Badge, the participant must successfully complete the training program and meet the following requirements:

- successful attendance and completion of the entire training program
- creation of a functional project task based on the Arduino microcontroller
- connection and application of sensors, actuators and input-output devices in the system
- creation and implementation of the Arduino program solution
- testing and demonstration of the work of the created system (simulation or real equipment)
- preparation of a short presentation (7–10 slides) of the created solution
- positive assessment of the project assignment and presentation by the committee

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The Open Badge is awarded to participants who have proven their acquired competencies in the field of microcontroller systems, Arduino platform programming, basic automation, and the application of smart solution systems through practical work and evaluation.

Task selection:

1. The participant chooses or receives a given problem task, in the field of creating simple automated systems using Arduino microcontrollers.
2. The task includes the design and implementation of a functional solution, which uses sensors, actuators and the Arduino programming platform.
3. The use of existing or previously created solutions is not allowed.
4. The project must be independently developed, tested and documented.
5. The completed project task and accompanying documentation are submitted via the link provided below.

Presentation:

1. A short presentation (7–10 slides) is prepared that shows the problem, the components used, the Arduino programming solution and how the system works.
2. The presentation should contain a display of the system's operation (photos, recording or video).



3. The presentation is delivered via the link below.

Application and submission deadline:

- All digital materials (project assignment and presentation) must be submitted no later than _____.

Link for registration and submission of materials:

<https://openbadgefactory.com/c/earnablebadge/T419EAaQD80a7B8/apply>

The Open Badge is awarded to participants who successfully complete all of the above steps and whose project assignment and presentation are positively evaluated.





Quality assurance method

Quality assurance is carried out in accordance with the Regulation on the Quality Assurance System for Short Training Programs with Microcredit (Open Badge).

