

**Educational set based
on an open
microcontroller
architecture for
studying artificial
intelligence and control
systems**

LABOTRIX OPENMCU R7

PRODUCT PASSPORT

Kyiv

2026

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1. General Information about the Product

- 1.1. **Product name** — Open Microcontroller Architecture Training Kit for Artificial Intelligence and Control Systems.
- 1.2. **Trademark** — Labotrix.
- 1.3. **Model** — Openmcu R7; full trade designation — LABOTRIX OPENMCU R7.
- 1.4. **Manufacturer** — Labotrix Group Limited, China.
- 1.5. **Intended use:** the Labotrix Openmcu R7 kit — a specialized extension for an educational robotic manipulator, designed for advanced study of microcontroller programming, the fundamentals of artificial intelligence — speech recognition and computer vision — and the design of control systems. The kit is built on an open-source modular architecture: students independently connect the controller board to peripheral modules and external sensors, write their own programs for it, and integrate the controller into a unified robotic system together with a compatible manipulator. The kit is used in computer science, technology and robotics lessons, and in club and project activities — for a step-by-step progression from the simplest training programs to controlling a moving manipulator.
- 1.6. **Design features:** at the heart of the kit is a controller board built on an AVR-architecture microcontroller; it works with an open-source programming environment that supports the C and C++ languages. An expansion board is mounted on top of it, with ready-made solderless sockets for connecting peripherals — separate ones for the manipulator, for the camera module and for the speech recognition module, as well as universal sockets for electronic modules. The kit includes button, LED and joystick modules mounted on a common mounting plate, a voice command recognition module, and a camera module for computer vision. Free sockets on the expansion board and unused microcontroller pins allow third-party sensors and actuator modules to be connected, extending the functionality of training projects.
- 1.7. **Digital learning support:** together with the product, the right of access to an online teaching support course is transferred; the course is hosted in a learning management system (LMS) and is designed for 70 academic hours of lessons. The course is compiled to match the current curricula of general secondary education institutions of Ukraine. The materials are grouped into research modules in the subjects of physics, biology, chemistry, STEM and robotics, and every topic contains a lesson plan, a list of the required equipment, an experiment scenario, a step-by-step laboratory work instruction with an explanation of the expected result, a video demonstration of working techniques, interactive exercises and tasks for independent study, suitable both for individual and for group work. All modules are compiled for this very equipment and have been tested on it, therefore the course works along the direct chain "equipment → methodology → learning outcomes". A language-model-based assistant with retrieval over the course knowledge base (Retrieval-Augmented Generation) is built into the course: for the topic of the lesson it selects appropriate tasks, sets out the sequence of conducting the study in methodological terms, examines typical student errors and gives personal advice on how to get rid of them, changes the level of difficulty to match the preparation of a particular class and helps to draw up a report on the study and to organize the conclusions. The knowledge base of the

assistant is localized and aligned with the Ukrainian curriculum. The license for the course and the accompanying software is valid for 12 months from the date on which access is transferred; the content, the interface and the answers of the assistant are provided exclusively in Ukrainian.

2. Technical Specifications

- Brand — Labotrix
- Model — Openmcu R7
- SKU — LTX-OPENMCU-R7
- Product type — Open Microcontroller Architecture Training Kit for Artificial Intelligence and Control Systems, an extension for a robotic manipulator
- Kit controller — a control board based on an AVR-architecture microcontroller that supports operation in an open-source programming environment, supplied together with the expansion board
- Microcontroller bit depth — 8-bit
- Clock frequency (MHz) — 16
- Program flash memory size (KB) — 256, of which about 8 is occupied by the bootloader
- RAM size (KB) — 8
- Non-volatile data memory size (KB) — 4
- Digital inputs/outputs (pcs) — 54, of which 15 have hardware PWM
- Analog inputs (pcs) — 16, analog-to-digital converter resolution 10-bit
- Hardware serial ports (pcs) — 4
- Supported controller communication interfaces — UART, I2C, SPI
- Maximum permissible current of one pin (mA) — 40
- Logic operating voltage (V) — 5
- Controller board power supply method — from the computer's USB port to which the device is connected, or from a separate DC power source with a voltage of 7-12 V
- Controller-to-computer communication — USB (virtual serial port)
- Controller-to-manipulator communication — 10-pin communication interface based on the manipulator, full compatibility with its serial port protocol
- Controller programming method — a development environment with a graphical block-based interface for the beginner level, and text coding in C/C++ in an open-source development environment for the advanced level; both calls to ready-made library functions for peripheral and motion control (high level) and direct work with microcontroller pins and registers (low level) are available
- Expansion board — mounted on the controller board without soldering; has separate sockets for the manipulator, the camera module, and the speech recognition module, ten three-pin and four four-pin sockets for electronic modules, as well as four additional pin headers
- Control and indication modules included — button modules, LED modules (3 pcs of each type) and a joystick module, mounted on the mounting plate
- Voice command recognition module — a fixed set of 22 commands; available in English or Chinese (one version is supplied per order)

- Camera module — a separate computer-vision computing module with an I2C interface for implementing computer vision algorithms
- End effector included — a suction cup powered by the manipulator's air pump
- Recognition objects included (pcs) — 16 (cubes made of semi-rigid foam material in four colors)
- Expansion capability — free sockets on the expansion board, free digital and analog microcontroller pins, and multiplexed manipulator inputs/outputs allow third-party sensors and actuator modules to be connected
- Compatibility — educational manipulators with at least 4 degrees of freedom and a standard 10-pin communication interface
- Product marking — trademark, model and a space for the inventory number
- Packaging — individual box of corrugated cardboard with the contents secured
- Documentation supplied — product passport with warranty card and operating manual
- Ready-to-use condition — supplied assembled, requires no preliminary setup
- Care of the surfaces — wiping with a dry or slightly damp cloth is permitted
- User requirements — preparation is performed by the teacher or the laboratory assistant, students work under supervision
- Language of marking and operating documentation — Ukrainian
- Digital learning support — online course in a learning management system (LMS)
- Course volume (academic hour) — 70
- Course subjects — physics, biology, chemistry, STEM, robotics
- Composition of the materials — research modules, experiment scenarios, step-by-step laboratory work instructions, video demonstrations, interactive exercises and tasks
- Compatibility of the materials with the equipment — full, along the chain "equipment → methodology → learning outcomes"
- Language-model-based assistant — built into the course, with retrieval over a localized knowledge base (Retrieval-Augmented Generation)
- Validity period of the license for the course and the software (month) — 12
- Language of the course, of the interface and of the answers of the assistant — Ukrainian
- Service life (year) — 5
- Warranty period (month) — 12

3. Package Contents

- Controller board with expansion board — 1 set
- Cable for connecting the controller board to the robotic arm — 1 pcs
- Voice command recognition module (in English or in Chinese to order) — 1 pcs
- Cable of the voice command recognition module — 1 pcs
- Camera module with a bracket for mounting on the robotic arm — 1 set
- Camera cable — 1 pcs

- Button modules — 3 pcs
- LED modules — 3 pcs
- Joystick module — 1 pcs
- Fixing plate for mounting the modules — 1 pcs
- Cables of the digital modules — 12 pcs
- 3-pin adapter cables — 4 pcs
- 4-pin adapter cables — 4 pcs
- USB cable — 1 pcs
- Micro USB cable — 1 pcs
- Socket head cap screws for fastening the camera — 2 pcs
- Nylon rivets for mounting the modules — 18 pcs
- Suction cup — 1 pcs
- Cube made of semi-rigid foam material in four colors (recognition object) — 16 pcs
- Right of access to the online course with a language-model-based assistant (license) — 1 pcs
- Product Passport and Warranty Card — 1 pcs
- Individual transport packaging — 1 pcs

The training manipulator, its power supply, and the air pump are not included in the kit and are supplied separately as a stand-alone product; without the manipulator, only those training programs that do not involve controlling it will work. The number of button and LED modules is given according to their actual design — one of each of the three colors per type. The product does not require assembly, except for installing the expansion board on the controller board and mounting the modules on the fixing plate.

4. Safety Precautions

4.1. General requirements

- Before using the set for the first time, read this passport, as well as the passport of the robotic arm with which the set is used, and keep both documents together with the products.
- Work with the set is permitted for the teacher or another staff member who has undergone occupational safety instruction; students work with the equipment only under the supervision of an adult.
- Immediately after unpacking, inspect the controller board, expansion board, modules, and cables for the absence of mechanical damage; using damaged components is prohibited.
- The package contains small parts — screws, nylon rivets, cubes. Keep them in a place out of the reach of children.
- Do not leave powered-on equipment unattended; turn off the power immediately after the lesson ends.
- A product that has exhausted its service life is to be disposed of in accordance with the applicable legislation, protecting the environment.

4.2. Safety When Operating the Manipulator

- A program loaded into the controller controls the manipulator independently: motion may begin immediately after power-up or a controller restart, without a separate command from the operator. Before applying power to the assembled system, make sure the manipulator's work zone is free of foreign objects, tools, and hands.

- Do not keep your hands in the manipulator's work zone while it is moving, to avoid bruising or pinching.
- When the voice control program is active, keep in mind that the manipulator moves in response to a recognized voice command without additional confirmation — make sure the work zone remains clear throughout the entire lesson.
- Before debugging any program that controls the manipulator, perform a return to the home point; without this procedure the coordinates will be incorrect, and the manipulator may move somewhere other than expected.
- Keep your hand on the manipulator's power switch: in case of unexpected movement, power should be cut off immediately.
- Route the cables so that they do not enter the movement zone of the manipulator's links and cannot be snagged.

4.3. Electrical safety and handling of the boards

- Before connecting or disconnecting any module, cable or camera, switch off the power of the robotic arm completely and disconnect the USB cable from the computer: "hot" connection damages the equipment.
- Hold the controller board, expansion board, and electronic modules by the edges or the housing; do not touch the traces, connector contacts, or chip pins — static electricity damages electronics.
- Do not place the boards on a metal surface or on a damp table: a short circuit is possible.
- Make sure the connections are correct: each socket on the expansion board is intended for its own module; connecting a cable to the wrong socket puts the module out of order.
- Do not apply voltage above the rated operating voltage to the controller's inputs, and do not exceed the maximum permissible pin current; connect powerful loads (motors, relays) only through a separate driver or switch.
- Do not immerse boards, modules, or cables in water, and do not allow liquid to get on them.

4.4. It is strictly prohibited

- Independently disassembling or repairing the controller board, expansion board, and modules — in case of malfunction, contact the seller or service center.
- Leaving children alone with the equipment switched on or allowing them to connect or disconnect live cables on their own.
- Being in the manipulator's work zone while the program is running.
- Directing the jet of compressed air of the suction cup at people and animals.
- Connecting third-party devices with operating voltage or current exceeding the board's rated values to the controller's free pins.
- Using the kit with a damaged cable, connector, or board.

5. Preparation for Use

- 5.1. Unpack the kit, check the completeness against section 3 of this passport, and inspect the boards, modules, and cables for the absence of

mechanical damage. We recommend keeping the packaging for further storage and transportation.

- 5.2. Install the expansion board on the controller board, aligning the pin headers evenly, without skewing; no contact pin should bend or remain outside the socket.
- 5.3. Attach the button, LED, and joystick modules to the mounting plate if they are not pre-installed, and using the digital module cables, connect those needed for your program to the corresponding sockets on the expansion board.
- 5.4. If necessary, connect the voice command recognition module with a cable to its designated socket, and the camera module with the camera cable — to its socket.
- 5.5. Connect the expansion board with a cable to the manipulator, and the controller board with a USB cable — to the computer; if necessary, install the development environment with the kit's libraries on the computer.
- 5.6. If the program controls gripping objects, install the suction cup kit on the manipulator and connect it to the manipulator's air pump according to the manipulator's passport.
- 5.7. Turn on the manipulator and perform a return to the home point before uploading to the controller the program that controls its movement.

6. Operating Procedure

6.1. Connection and switching on

- Assemble the system in the order described in section 5: the expansion board on the controller board, the required modules — in their sockets, the cables to the manipulator and the computer.
- Perform all connections and disconnections of the cables only with the equipment switched off.
- Turn on the manipulator and perform a return to the home point according to its passport; only after that upload to the controller the program that controls movement.

6.2. Installing the Development Environment

- For the beginner level, install the development environment with a graphical block-based interface supplied with the kit — it does not require knowledge of programming language syntax and is suitable for the first training programs.
- For the advanced level, install on the computer a text-based open-source development environment for AVR-architecture microcontrollers and add to it the libraries supplied with the kit.
- Connect the controller board with a USB cable, and in the environment settings select the corresponding board, microcontroller type, and the serial port that appeared after connecting.
- Add to the project only the libraries needed by the modules used in the program and the manipulator control functions.

6.3. Program Development and Upload

- The controller program consists of an initial setup, which runs once after power-up or restart, and a working loop, which continues running as long as power is supplied.

- In the working loop, the state of the buttons and joystick is polled, data from the camera and the speech recognition module is processed, and movement commands are sent to the manipulator as needed.
- Before uploading a new program, make sure the manipulator's work zone is free of foreign objects, tools, and hands: immediately after uploading, the controller restarts and the program begins running.

6.4. Voice Control and Computer Vision

- The voice command recognition module independently detects one of 22 pre-recorded commands in the speech stream and sends the controller only its number; the subsequent action is determined by the controller's program.
- The camera module processes images independently and sends the controller data about recognized objects, without burdening it with video processing; the detailed procedure for setting up and calibrating the camera is described in the passport of the manipulator with which this kit is used.
- While voice control or computer vision scenarios are running, the manipulator moves on its own in response to a command or a recognized object — make sure there are no hands or foreign objects in the work zone.

6.5. Expanding the Kit with Third-Party Components

- Free sockets on the expansion board and unused digital and analog controller pins are intended for connecting third-party sensors and actuator modules; before connecting them, check their operating voltage and current consumption.
- Connect powerful loads only through a separate driver, transistor switch, or relay with its own power supply: the controller's pins are not designed for direct control of them.
- Additional inputs/outputs are also available on the manipulator itself — they can be assigned as a digital output, input, or analog input and used for sensors or external actuators of the training ecosystem, for example a conveyor line drive.

6.6. Finishing the work

- Wait for the program to finish, turn off the manipulator's end effector, and if necessary perform a return to the home point.
- Turn off the manipulator using the power button, then disconnect the USB cable from the computer.

6.7. Work with the online course

- Obtain an account at the educational institution and activate the right of access to the course; the validity period of the license is counted from the date on which access is transferred.
- Select the topic of the lesson in the course list: every topic is accompanied by a plan, a list of equipment, an experiment scenario, a step-by-step instruction, a video demonstration and interactive tasks.
- Formulate a query to the assistant on the topic of the lesson — it will suggest appropriate tasks, set out the sequence of actions, examine typical errors and advise how to correct them.

- Set the level of difficulty of the tasks to match the preparation of the class; on the basis of the results of the work the assistant will help to draw up the report and to organize the conclusions.

7. Care, Maintenance and Troubleshooting

7.1. Cleaning

- Before cleaning, turn off the manipulator and disconnect all the kit's cables, including USB.
- Clean dust off the controller board, expansion board, and modules with a dry soft brush or a stream of compressed air; wet cleaning of the boards is prohibited.
- Wipe the module housings and the mounting plate with a slightly damp cloth and dry them thoroughly.
- Clean the camera module lens only with a dry optical wipe or a soft lint-free cloth; the use of alcohol, solvents, and abrasive agents is prohibited.
- Clean dust off the suction cup: a soiled suction cup holds the object less well.

7.2. Periodic inspection

- Check that the cables fit tightly in the expansion board sockets and that the modules are securely mounted on the mounting plate: repeated repositioning loosens the connections.
- Periodically check the operation of each module with a simple program: the buttons should register presses, the LEDs — turn on, both joystick axes — provide the full range of values.
- The product does not require lubrication or calibration by the user, except for software updates; repair of boards and modules is performed only by an authorized service center.

7.3. Possible malfunctions and methods of their elimination

Symptom	Possible cause	User actions
The computer does not detect the controller board	Damaged USB cable, or a cable suitable only for charging, or the driver is not installed	Replace the cable with a data cable, install the driver, try another USB port on the computer
The program does not load into the controller	The wrong board, processor, or port is selected in the development environment, or the port is occupied by another program	Check the board, processor, and port settings; close other programs that are using the port, and repeat the upload
The button, LED, or joystick module does not respond	The module is connected to the wrong socket on the expansion board, or the cable is loose in the socket	Reinstall the cable and check the connection against the wiring diagram in this passport

Symptom	Possible cause	User actions
The voice command recognition module does not respond	The wake word was not spoken, the command spoken is not on the list, or it was spoken in a language other than the module's configured language	Check the module's indicator after wake-up, verify the list of commands and the configured language, and reduce background noise
The controller does not receive data from the camera module	The camera cable is connected to the wrong socket or is loose	Check the camera connection cable and socket
The manipulator does not move even though the program is running	The cable to the manipulator is not connected, the manipulator is turned off, or a return to the home point has not been performed	Check the cable and that the manipulator is turned on, perform a return to the home point, and restart the program
The controller board gets hot, the power indicator blinks	Overload or short circuit on one of the pins	Immediately turn off the power, check the wiring diagram and the current consumption of the connected module

8. Storage and Transportation Conditions

- Store the set in a dry room protected from dust, direct sunlight and sharp temperature changes.
- Store the boards and modules in antistatic bags or in the factory foam insert; do not place heavy objects on them.
- Before long-term storage, disconnect all cables and turn off the power; the expansion board may be left installed on the controller board.
- Keep the small parts — screws, rivets, cubes — in a closed box so that they do not get lost.
- Transport the product in its original or similar rigid packaging by any type of enclosed transport; do not place heavy objects on the product's packaging.
- The storage period before commissioning is unlimited provided that the stated requirements are observed.

9. Warranty Obligations

- 9.1. The warranty period of operation of the product is 12 months from the date of sale specified in the warranty card.
- 9.2. The manufacturer guarantees that the product conforms to the declared technical specifications provided that the transportation, storage and operating rules set out in this passport are observed.
- 9.3. During the warranty period, defects of the product that have arisen through the fault of the manufacturer are remedied free of charge. The method of remedy (repair, replacement of a component or replacement of the product) is determined by the service center.

- 9.4. Warranty service is provided on presentation of a correctly and completely filled-in warranty card and of a document confirming the fact and the date of purchase.
- 9.5. The warranty does not cover cases where the malfunction is caused by:
- mechanical damage, in particular cracks, chips and deformation of the housing and of the components of the product;
 - violation of the operating, storage or transportation rules set out in this passport;
 - ingress of liquid or foreign objects into the product, and also the action of insects and animals;
 - independent disassembly, repair or modification of the product, in particular repair at unauthorized workshops;
 - use of the product other than for its intended purpose;
 - force majeure circumstances (fire, flood, earthquake, etc.).
- 9.6. The warranty does not cover the natural wear of the coating and of the appearance of the product, nor consumables.

10. Product Disposal

- The product must not be disposed of together with unsorted municipal waste. This is indicated by the marking in the form of a crossed-out container on the product or its packaging.
- After the end of the service life, hand the product over to a collection point for the corresponding waste or to an organization holding the appropriate permit.
- Hand over the packaging elements (cardboard, polymer materials) to the corresponding streams of recyclable materials.

Contacts

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Conditions of use and storage of the product

The product is intended for educational work in general secondary education institutions and is used only under the control and supervision of a teaching staff member; the recommended age of students — from 10 years, that is, students of grade 5 and of higher grades. Keep the product in a dry, clean and ventilated room at a temperature from +5 to +40 °C and relative air humidity up to 80 % without condensation, separately from heat sources and out of direct sunlight, moisture and dust. Use the product exclusively for its intended purpose and do not allow drops, impacts or other mechanical damage. If you notice damage, a crack or any malfunction, stop working with the product immediately and inform the teacher or the responsible person of the educational institution; repairing the product on your own is prohibited.

WARRANTY CARD

Name:	Educational set based on an open microcontroller architecture for studying artificial intelligence and control systems
Product model:	LABOTRIX OPENMCU R7
Serial number:	
Date of sale:	
Warranty period:	12 months from the date of sale
Trading organization:	
Signature of the seller:	

The goods have been received in working order, without visible damage, complete, and have been checked in my presence. I have no claims regarding the quality of the goods; I have read and agree to the operating and warranty service conditions.

Full name of the buyer _____

Telephone of the buyer _____ Signature of the buyer _____

Dear Customer!

Thank you for choosing Labotrix products. After-sales service of this product is provided in accordance with the regulations of the company and the legislation of the country of sale. So that we can serve you quickly and without unnecessary formalities, check that this warranty card is filled in correctly at the moment of purchase and keep it together with the payment document throughout the entire warranty period. When applying for repair, hand the product over to the seller or to the service center together with the filled-in card.

Procedure for applying

1. The right to free warranty service of the product is valid for 12 months from the date of sale specified in the warranty card. Within this period, components that have failed because of a manufacturing defect are repaired or replaced at no cost to the buyer.
2. Before applying, make sure that the malfunction is not caused by the reasons listed in section 9 of this passport and, if possible, use the table of possible malfunctions in subsection 7.3.
3. After the end of the 12-month warranty period, repairs are performed on a paid basis; the cost of the work and of the spare parts is determined depending on the nature of the malfunction.

Grounds for refusal of warranty service

The company reserves the right to refuse free service or to perform the work on a paid basis if at least one of the following circumstances is established:

- absence of the warranty card, its incomplete or corrected completion, and also the absence of a document confirming the purchase;
- non-conformity of the serial number of the product with the number specified in the card, or damage to the factory marking;
- traces of independent disassembly, repair or modification of the product;
- damage caused by violation of the operating rules, connection to an unsuitable power source or external mechanical impact;
- damage as a result of force majeure circumstances.

Service Records

Date of entry	Description of the malfunction	Work performed	Position, signature, full name of the responsible person