

Set of sensors and interfaces

LABOTRIX IOKIT R6

PRODUCT PASSPORT

Kyiv

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1. General Information about the Product

- 1.1. **Product name** — Educational Sensor and Interface Module Kit for Automated Systems.
- 1.2. **Trademark** — Labotrix.
- 1.3. **Model** — Iokit R6; full trade designation — LABOTRIX IOKIT R6.
- 1.4. **Manufacturer** — Labotrix Group Limited, China.
- 1.5. **Intended use:** the Labotrix Iokit R6 kit is designed for the practical study of the operating principles of physical-quantity sensors, analog and digital signals, and for building educational projects in automation, robotics, and the Internet of Things. The set includes twelve electronic modules — sensors of physical quantities, controls, and an actuator — as well as a hub controller and a machine vision camera kit. The set can be used independently with a computer or together with a robotic arm — in which case the sensor readings affect the arm's movement, and the camera gives it machine vision. The product is used in computer science, physics, technology, and robotics lessons, in club and project work; only persons who have completed instruction are allowed to work with it, and students work with the set only under a teacher's supervision.
- 1.6. **Design features:** each electronic module is built as a separate board in a protective housing with a unified four-pin connector; modules are connected to the hub controller with ready-made cables, without soldering or tools. Module housings have mounting holes compatible with construction set elements such as LEGO, which allows them to be attached to a model or fixture. The hub controller — a separate controller with six universal input/output ports, a screen, and control buttons on the front panel; it powers the connected modules, polls them, and can run a loaded program autonomously, without a computer. The machine vision camera kit is mounted on the robotic arm's rotary servo drive and connected with a separate USB cable directly to the computer.
- 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 — Iokit R6
- SKU — LTX-IOKIT-R6
- Product type — Educational Sensor and Interface Module Kit for Automated Systems
- Number of electronic modules (piece) — 12
- Electronic module connector type — unified four-pin, keyed
- Module interface types — analog (analog-to-digital converter), digital discrete (input/output), I2C digital serial bus, single-wire digital bus (Single-bus), pulse-width modulation (PWM)
- Distribution of interfaces by module — analog-to-digital conversion (ADC): light sensor, sound intensity sensor, rotary control (potentiometer); I2C serial bus: control joystick, combined temperature and humidity sensor, gesture recognition sensor, color detection sensor, camera module; single-wire bus (Single-bus): LED module; pulse-width modulation (PWM): actuator (micro servo drive); digital inputs/outputs (IO): infrared motion sensor, dual-button module, photoelectric sensor
- Number of universal ports on the hub controller (piece) — 6
- Number of electronic modules connected simultaneously (piece) — up to 6, matching the number of universal ports
- Ports with an analog-to-digital converter (piece) — 2 (support the light sensor, sound sensor, and potentiometer)
- Electronic module supply voltage — 5 V DC
- Micro servo drive supply voltage — from 4.8 to 6.0 V DC
- Current consumption of a typical electronic module (milliampere) — 50
- Hub controller power source — standard power supply, output 12 V DC, input from a 100–240 V AC mains supply at a frequency of 50/60 Hz
- Hub controller-to-computer connection — USB (virtual serial port)
- Machine vision camera connection — a separate USB cable directly to the computer, not through the hub controller
- Camera tilt angle adjustment range (degree) — from 0 to 90
- The manufacturer does not specify other camera characteristics (resolution, sensor type, field of view)
- Mechanical compatibility of module housings — mounting holes compatible with construction set elements such as LEGO
- Module connection method — ready-made cables, without soldering or tools
- Number of gestures recognized by the gesture sensor (piece) — 8 (up, down, left, right, zoom in, zoom out, clockwise and counterclockwise)
- Gesture sensor working distance (centimeter) — from 5 to 15
- Temperature and humidity sensor measuring range — temperature from 0 to 60 °C, relative humidity from 10 to 90 %
- Motion sensor detection range (centimeter) — up to 150

- Micro servo drive rotation range (degree) — 180
- Programming methods — block-based programming and text scripts in Python
- Module supply voltage operating range (volt) — from 3.0 to 7 DC
- Product marking — trademark, model and a space for the inventory number
- Packaging — individual box of corrugated cardboard with each module secured separately
- 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
- Work organization — suitable for classroom demonstration or for a single student workstation
- 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

- Gesture recognition sensor — 1 pcs
- Illuminance level sensor — 1 pcs
- LED module — 1 pcs
- Color detection sensor — 1 pcs
- Combined temperature and humidity sensor — 1 pcs
- Infrared motion sensor — 1 pcs
- Potentiometer module (rotary control) — 1 pcs
- Sound intensity sensor — 1 pcs
- Double mechanical button module — 1 pcs
- Control joystick with I2C interface — 1 pcs
- Micro servo drive with cross-shaped adapters (4 pcs.) and horns (2 pcs.) — 1 pcs
- Photoelectric sensor with mounting bracket — 1 pcs
- Machine vision camera kit with hinged bracket and USB cable — 1 set

- Hub controller (input/output expansion module) with six universal ports — 1 pcs
- Universal connecting cable — 6 pcs
- Extended connecting cable — 2 pcs
- USB cable for connecting the hub controller to the computer — 1 pcs
- Power cable for connecting the hub controller to the robotic arm — 1 pcs
- Communication cable for connecting the hub controller to the robotic arm — 1 pcs
- Calibration card — 1 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 power supply for the hub controller and the robotic arm itself are not included in this set — the set is designed to work together with the Labotrix Arm R5 robotic arm and its standard power supply, or with another compatible 12 V DC power source. The micro servo drive is connected only to ports that support pulse-width modulation, while analog modules (light sensor, sound sensor, potentiometer module) — only to ports with an analog-to-digital converter; the remaining modules are connected to any of the six ports. The product does not require assembly, except for mounting the photoelectric sensor in the supplied bracket and the machine vision camera — on the robotic arm's servo drive.

4. Safety Precautions

4.1. General requirements

- Before using the set for the first time, read this passport, this section first of all, and thereafter keep the document together with the product.
- Only a teacher or another staff member who has completed occupational safety instruction is allowed to work with the set; students work with the product only under adult supervision.
- After unpacking, inspect all modules, the hub controller, the camera, and the cables for the absence of mechanical damage; using a damaged product is prohibited.
- Do not immerse the modules in water, and do not bring them into a flame or into the range of other sources of high temperature during operation or measurements.
- Do not press on the modules with force; persons without professional training are prohibited from opening the housings of the electronic modules.
- The set contains small parts (micro servo drive adapters and horns, bracket screws) — keep the set in a place inaccessible to children under 3 years of age.

4.2. Protection against static electricity

- The module boards do not have solid housing shielding, and their contacts are exposed: an electrostatic discharge from the hands can disable a module without visible signs of damage.

- Before working with the modules, discharge static electricity — touch a grounded metal object, for example the housing of a system unit connected to the mains.
- Hold the modules by the edges of the housing; do not touch the connector contacts or exposed board elements with your fingers.
- Do not work with the modules on synthetic carpet coverings, in synthetic clothing or in rooms with very dry air without first removing the static charge.
- Store the modules in their standard packaging or in antistatic bags, and not loose in a metal container.
- Do not leave a disconnected cable with one end plugged into the hub controller — the free end of the cable can accumulate a charge.

4.3. Electrical safety and correct connection

- Hot reconnection is prohibited: connect and disconnect modules only with the hub controller's power completely removed; first assemble the entire circuit, and only then apply power.
- Insert the cable connector only until the key aligns with the slot, without force; turning the connector over is prohibited. The color mark on the cable must match the mark on the module.
- The micro servo drive's wires have designated functions: signal, common wire (negative), and 5 V power — reversed polarity disables the servo drive.
- Do not connect the set's modules to the stepper motor connectors or to the hub controller's 12 V power connector: the voltage on them exceeds what is permissible for the modules.
- Connect the machine vision camera to the computer only with the standard USB cable; do not attempt to connect it to the hub controller's universal ports.
- Power the hub controller only from the standard power supply (12 V DC, mains from 100 to 240 V AC, 50/60 Hz); protect the power supply and cables from damage, moisture, and heat.
- Do not immerse the modules, the hub controller, the camera, or the power supply in water, and do not allow liquid to get inside the housings.

4.4. Working area during joint operation with the robotic arm

- When using the set together with the robotic arm, follow all safety requirements from the robotic arm's passport: do not keep your hands in the working area while the links are moving, and make sure it remains clear.
- Route the module and camera cables so that they cannot be caught on anything and do not enter the range of motion of the links; always secure the camera cable to the robotic arm with the standard clamp.
- While the program is running, students must stay outside the robotic arm's working area.
- Do not hold the micro servo drive's shaft with your hands, and do not block the horn's movement during operation — this causes overheating and drive failure.
- Change the camera tilt angle only with the mounting screw loosened; do not turn the camera with force — this breaks the bracket and throws off the coordinate calibration.

4.5. It is strictly prohibited

- Independently opening or repairing the housings of the electronic modules, the hub controller, or the camera — in case of malfunction, contact the seller or a service center.
- Connecting or disconnecting the modules while the power of the switching unit is on.
- Connecting the set's modules to the stepper motor connectors or to the 12 V power connector.
- Immersing modules, the hub controller, or the camera in water, and keeping them near sources of high temperature or open flame for extended periods.
- Applying voltage from external sources to the module inputs, and directly connecting module leads to each other.
- Leaving small parts of the set (micro servo drive adapters and horns, bracket screws) accessible to children under 3 years of age.
- Washing the modules under running water, or cleaning them with solvents and abrasive agents.

5. Preparation for Use

- 5.1. Unpack the set, check the completeness of the package against Section 3 of this passport, and inspect the modules, the hub controller, the camera, and the cables for the absence of mechanical damage.
- 5.2. Before working with the modules, discharge static electricity by touching a grounded metal object, and from then on hold the modules only by the edges of the housing.
- 5.3. Lay out the modules and the hub controller on a flat, dry, non-conductive surface; if the table is metal, place non-conductive material under the equipment.
- 5.4. With the power completely removed, assemble the complete wiring diagram: connect the colored end of each module's cable to the selected port on the hub controller according to the signal type — analog modules and the potentiometer only to ports with an analog-to-digital converter, the micro servo drive — to ports supporting pulse-width modulation, the remaining modules — to any free port.
- 5.5. Connect the hub controller to the computer with a USB cable; if joint operation with the robotic arm is required, connect the controller to the robotic arm with power and communication cables, and mount the machine vision camera on its servo drive and connect it with a separate USB cable directly to the computer.
- 5.6. Only after completing all connections, connect the standard power supply to the hub controller, and then plug it into the mains; after that, turn on the hub controller's power.
- 5.7. Launch the proprietary software platform on the computer and install the extension for working with the set's electronic modules in it, and, if you need to work with the camera — a separate image-recognition extension.

6. Operating Procedure

6.1. Connecting and selecting the device in the software platform

- After turning on the power, launch the software platform on the computer, select the connected hub controller from the device list, and establish a connection; if the robotic arm also controls the movement, additionally select and connect it.
- Add the extension for working with the set's electronic modules — after this, tools for each module will appear in the block palette or command library; to work with the camera, add a separate image-recognition extension.

6.2. Reading sensor values and controlling actuator devices

- For each module in the program, specify exactly the port number to which it is actually connected.
- Analog sensors (light, sound, potentiometer) return a numeric value that is compared against a threshold or used directly; digital and bus modules (gestures, color, temperature and humidity, motion, buttons, photoelectric sensor, joystick) return a state or a measured value.
- The LED module and the micro servo drive are controlled by setting, respectively, the color and brightness of the light or the rotation angle in the program.
- By combining several sensors and actuator devices in a single program, automation scenarios are built — for example, turning on an indicator or servo drive movement based on a sensor reading.

6.3. Working with the machine vision camera

- Before first use, mount the camera on the bracket and secure it with screws, set the tilt angle within the range from 0 to 90° so that the working area is fully within the frame, and secure the camera cable with the standard clamp.
- Before the first attempt to grip an object using the camera, perform coordinate calibration using the calibration card from the kit; repeat the calibration each time after reinstalling the camera or changing the tilt angle.
- The camera supports text recognition, face recognition and comparison, and timer-triggered frame capture; the program uses the recognition result to control the robotic arm's movement.

6.4. Joint work with the robotic arm

- To combine sensor readings with the arm's movement, connect the hub controller to the robotic arm using power and communication cables, and select the robotic arm as an additional device in the software platform.
- Sensor readings can be used as a condition or parameter for the robotic arm's movement — for example, starting movement on a gesture or button press, stopping when a color or light threshold value is reached; the specific behavior is determined by the program.
- Follow the robotic arm's safety requirements: keep the working area clear and do not stay in it while the program is running.

6.5. Standalone mode

- The assembled program can be uploaded to the hub controller, after which it runs without a permanent connection to the computer.

- Projects using the machine vision camera do not work in standalone mode, since the camera transmits images only to the connected computer.

6.6. Finishing the work

- Stop the program execution and, if necessary, return the actuator devices (LED module, micro servo drive) to their initial state.
- Turn off the power to the hub controller and disconnect cables and modules only after the power has been completely removed.

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

- Wipe the housings of the modules and the hub controller with a dry or slightly damp soft cloth; the use of solvents, large amounts of alcohol, and abrasive agents is prohibited.
- Do not immerse the modules in water and do not wash them under running water.
- Clean the gesture sensor window, the motion sensor lens, the color sensor window, the light sensor's photoresistor, and the camera lens only with a dry soft cloth or an air blower bulb; do not touch the optics with your fingers.
- Do not tape over the openings in the temperature and humidity sensor's housing, and do not blow them out with pressurized compressed air.
- Clean the sound sensor's microphone of dust only by blowing, without touching the membrane.

7.2. Periodic inspection

- Once a semester, check the operation of each module using the simplest program that displays its value on the screen.
- Check the cables: a suspected break is indicated if the sensor value "freezes" or appears only at a certain cable position; replace a faulty cable.
- Check the tightness of the photoelectric sensor's bracket, the free rotation of the micro servo drive's shaft, and the condition of the screws and the camera cable clamp; repeat the coordinate calibration after each time the camera is reinstalled.

- The set does not require lubrication or other maintenance operations by the user; repairs, including opening module housings, are performed only by an authorized service center.

7.3. Possible malfunctions and methods of their elimination

Symptom	Possible cause	User actions
The module is missing from the device list, data is not being read	The extension for working with the set's modules has not been added in the software platform	Add the corresponding extension for the electronic modules
The computer does not detect the hub controller	Damaged or poorly connected USB cable, the equipment driver utility is not installed, or the hub controller is turned off	Check the cable and power, reinstall the equipment driver, refresh the device list
Analog sensor or potentiometer not working	The module is connected to a port without an analog-to-digital converter	Reconnect the module, with power removed, to a port that supports an analog signal
The micro servo drive does not rotate, or hums and overheats	The module is connected to a port without pulse-width modulation support, or the shaft is mechanically blocked or overloaded	Reconnect the module to the appropriate port; remove power and clear the obstruction to the horn's movement
The camera does not display an image	Camera USB cable is not connected to the computer, or is connected to the hub controller	Connect the camera cable directly to the computer's USB port
The camera sees the object, but the arm picks past the target	Camera coordinate calibration was not performed, or has been thrown off	Repeat the coordinate calibration using the calibration card
The module stopped working after reconnection	Probable damage from static discharge or connection while power is on	Discharge static electricity before working with the modules, and do not connect them while the controller is powered on; check the module on another port

8. Storage and Transportation Conditions

- Store the set in its standard packaging, in a dry room without sharp temperature fluctuations or condensation, protected from dust and direct sunlight.
- Do not store the modules loose together with metal objects — mechanical damage and short-circuiting of contacts are possible; for long-term storage, place the modules in antistatic bags.
- Keep the calibration card flat, without bends or dirt — a damaged card makes calibration impossible.

- Transport the set, protecting it from impacts and vibration; transport the cables coiled, without tension on the connectors.
- Keep the set in a place inaccessible to children under 3 years of age, due to small parts included in the set.
- 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:	Set of sensors and interfaces
Product model:	LABOTRIX IOKIT R6
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