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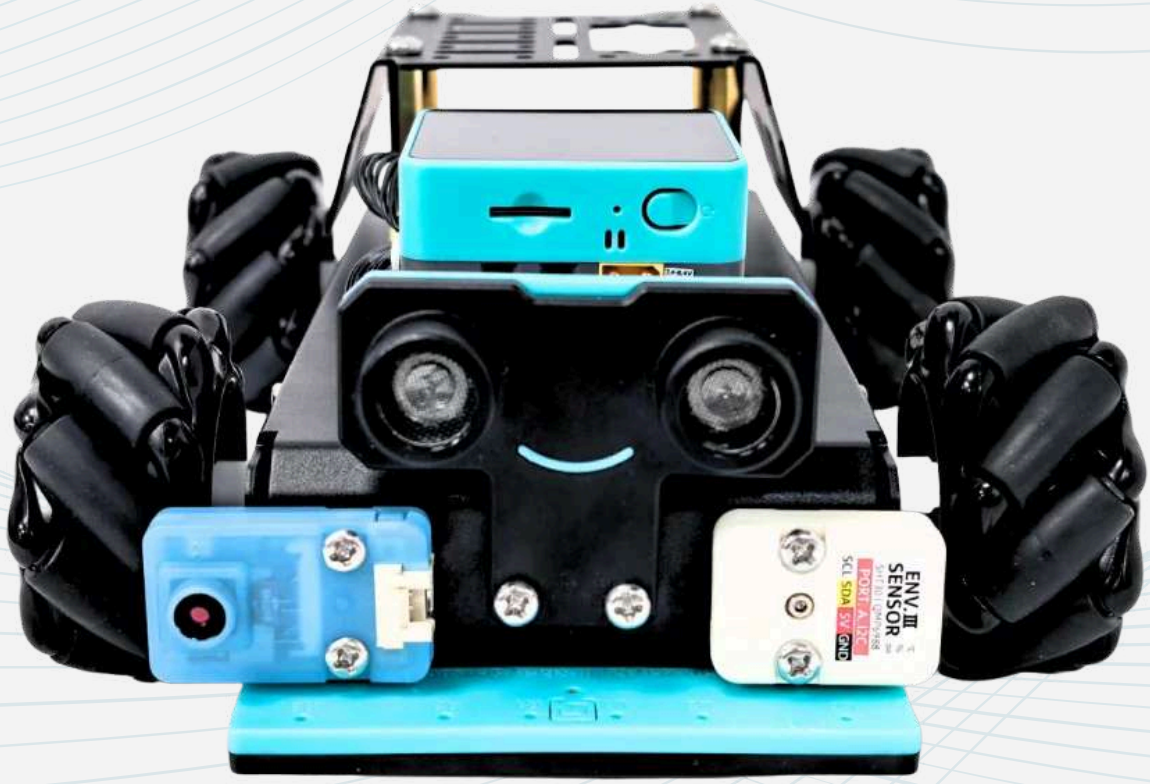
MC 4.0 AIOT KIT

Artificial Intelligence · Internet of Things ·Robotics · Automation



EDGE AI CAMERA	REAL-TIME VISION	IoT SENSORS	4-RELAY CONTROL	MECANUM ROBOT	COMPETITION READY

Maker and Coder Global

The most advanced all-in-one AIoT Robotics Kit — powered by Edge AI Vision, real-time sensor intelligence, and unlimited programmability.

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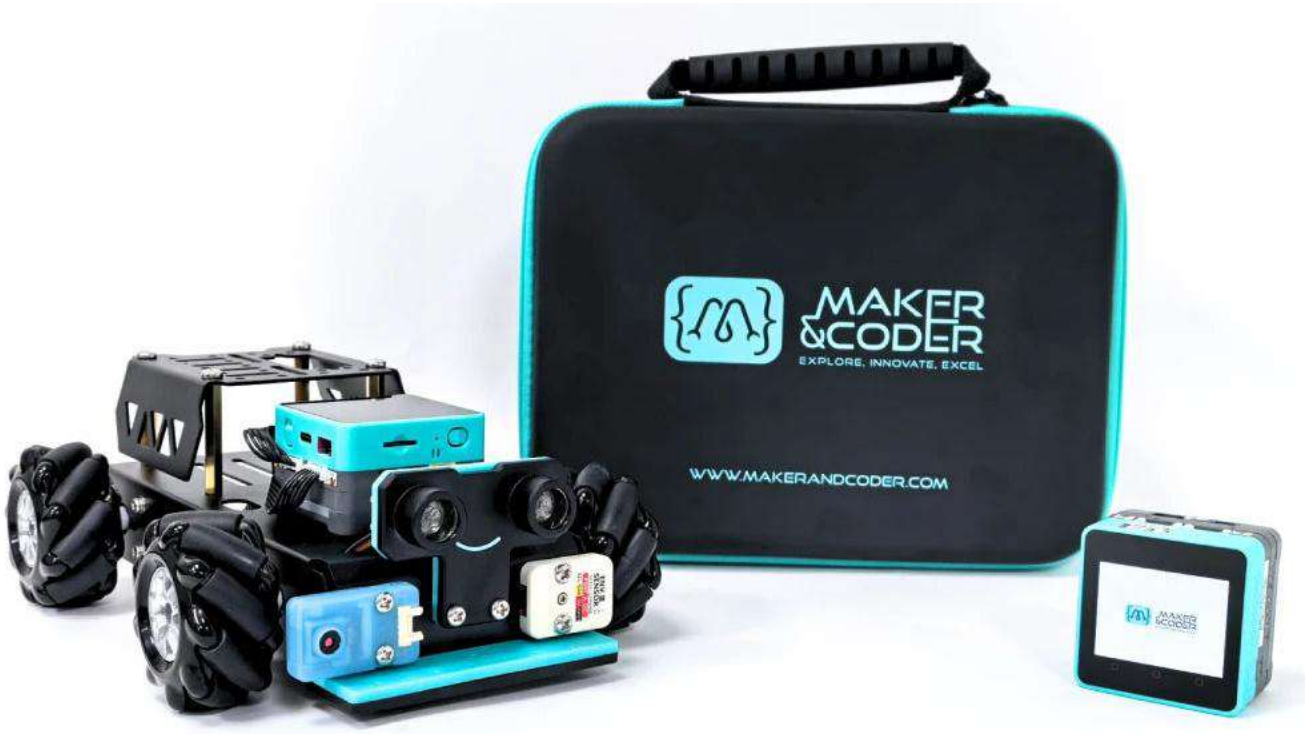
1. About the MC 4.0 AIoT Kit

The MC 4.0 AIoT Kit is a powerful, all-in-one platform designed to deliver hands-on experience in Artificial Intelligence, Internet of Things (IoT), Robotics, and Automation. It combines intelligent processing, real-time sensing, and precise actuation into a single integrated system, enabling users to build smart, connected, and interactive solutions for real-world applications across education, industry, and research domains.

The kit is developed for students, educators, innovators, and engineers, providing a practical and scalable environment to learn, experiment, prototype, and implement advanced technologies in a structured and user-friendly manner. It supports both beginners and advanced users, making it suitable for foundational learning as well as complex project development.

At the core of the system is the MC4.0 Controller, supported by the powerful UnitV AI Camera, which enables real-time edge AI capabilities such as object detection, colour recognition, face detection, and intelligent decision-making. All processing is performed directly on the device, eliminating the need for cloud connectivity and ensuring fast response, low latency, enhanced privacy, and reliable offline performance.



The kit integrates a complete ecosystem of hardware and modules, including:

- **AI Vision System —** enables real-time visual intelligence and machine perception
- **Environmental Sensing (ENV III) —** monitors temperature, humidity, and atmospheric pressure for IoT applications
- **4-Channel Relay Module —** enables control of real-world electrical devices and automation systems
- **Extension Port Module —** expands connectivity for multi-sensor and multi-device integration
- **Robotics System —** includes encoder motors and Mecanum wheels for precise, omnidirectional movement

Key Capabilities of the MC 4.0 AIoT Kit

- Real-time Edge AI processing without internet dependency
- Multi-sensor integration for data-driven and adaptive decision making
- Control of external devices using relay-based automation systems
- Advanced robotics with precise movement, navigation, and control
- Expandable architecture for scalable and complex AIoT projects
- Support for multiple programming platforms (Scratch, Python, Arduino)
- Seamless integration of AI, IoT, and Robotics in a single ecosystem

Benefits of the MC 4.0 AIoT Kit

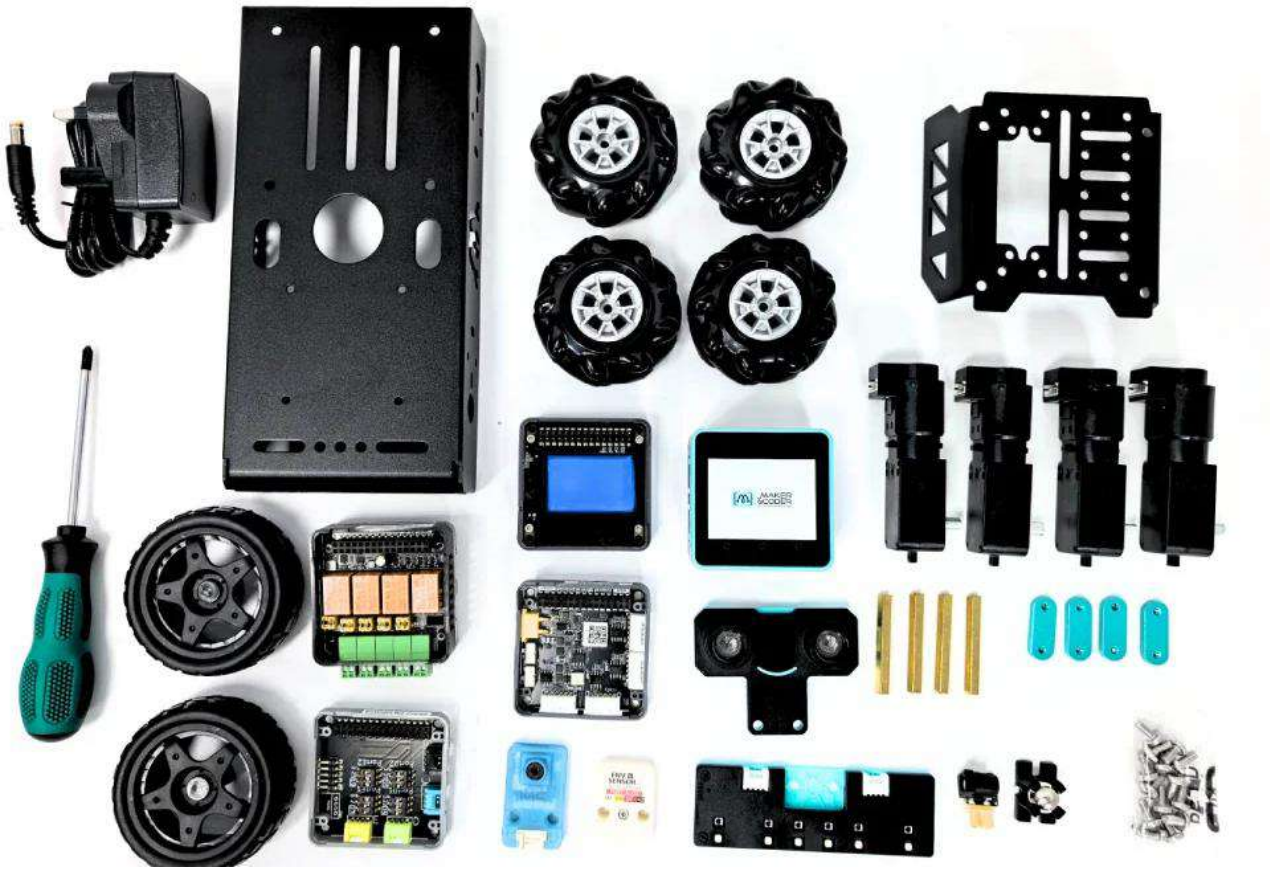
- Enables practical learning of AI, IoT, and Robotics in one unified platform
- Bridges the gap between theoretical knowledge and real-world implementation
- Encourages innovation, prototyping, and competition-level project development
- Simplifies complex technologies into an easy-to-use modular and plug-and-play system
- Supports skill development aligned with future technologies and industry trends
- Provides a foundation for building smart automation and intelligent systems

2. Complete Kit Contents

The MC 4.0 AIoT Kit contains 20 items spanning five categories: Controller & AI Modules, Sensors, Control Modules, Mechanical Components, and Accessories. Every component is included — nothing additional is required to build, program, and deploy your first AIoT robot.

No	Product Description	Quantity
	CONTROLLER, AI & CONNECTIVITY	
1	MC 4.0 Controller & USB Type-C Cable	1
2	AI Camera — UnitV (OV2640 · K210 KPU) + USB-C Long Cable + Grove Cable	1
	SENSORS	
3	RGB Ultrasonic I2C Sensor & Grove Cable	1
4	6-Way Grayscale Line Follower Sensor & Grove Cable	1
5	ENV III Unit (Temp · Humidity · Pressure) & Grove Cable	1
	CONTROL MODULES	
6	4 Encoder DC Motor Module & Charging Connector	1
7	Battery Module	1
8	4-Channel Relay Module	1
9	Extension Port Module	1
	MECHANICAL COMPONENTS	

10	Solid Black Metal Chassis Set	1
11	BO DC Metal Gear Encoder Motors & Grove Cables	4
12	Mecanum Wheels with Screws	4
13	Screws Set	1
14	Caster Wheel with Screw	1
15	Additional BO Motor Wheels	2
	TOOLS & ACCESSORIES	
16	Business Card	1
17	Magnetic Closure Box	1
18	EVA Carry Bag Case	1
19	Adapter / Charger	1
20	Screwdriver	1



3. Item-by-Item Descriptions

01 4 Encoder DC Motor Module & Charging Connector

The 4 Encoder Motor Module is the base of the MC 4.0 stack and the motor driver for all robotics projects. It connects directly to the MC 4.0 and battery module via the stacking interface — no separate wiring or soldering. All four BO DC Metal Gear Encoder Motor channels are independently controlled with closed-loop encoder feedback, enabling precise speed regulation, exact distance travel, and accurate angle rotation. In the 3-wheel configuration, two channels are used. The included charging connector links the battery module to the Ednex BMS charging circuit.

02 Battery Module

A 7.4V 500mAh LiPo rechargeable battery stack module with integrated Battery Management System (BMS) for overcharge, over-discharge, and short-circuit protection. Stacks between the motor module and the MC 4.0 controller. Features a physical on/off power switch, 5V/Vin power rail selector, and a dedicated external charging port — allowing the battery to charge from the included adapter while the USB-C port remains free for programming.

03 MC 4.0 Controller & USB Type-C Cable

The MC 4.0 is the processing and programming core of the entire kit — a 320×240 pixel full-colour capacitive touchscreen microcontroller powered by the ESP32 dual-core processor at 240 MHz with built-in Wi-Fi and Bluetooth. On-board peripherals include a 6-axis IMU, Real-Time Clock, MEMS microphone, speaker, vibration motor, RGB LED, Grove Port A (I2C), Grove Port B (GPIO/ADC), Grove Port C (UART), and MicroSD card slot. Programmable via MCLab (Scratch + Python), Arduino IDE (C++), VS Code + PlatformIO, MATLAB & Simulink, and ROS 2.

04 RGB Ultrasonic I2C Sensor & Grove Cable

Dual-function proximity and visual feedback sensor. The ultrasonic transducer measures distance from 2 to 400 cm via time-of-flight. A ring of programmable RGB LEDs surrounds the transducer face, changing colour at user-defined distance thresholds for immediate visual status indication. Communicates via I2C through Grove Port A — plug-and-play, no pin configuration. Used for obstacle detection in both robot configurations and for interactive distance-triggered lighting projects.

05 6-Way Grayscale Line Follower Sensor & Grove Cable

A 6-channel grayscale reflectance sensor array on I2C via Grove Port A. Each of the six sensing elements independently measures surface reflectance as a 0–255 value. Six channels provide a wider detection field than 5-channel sensors, supporting weighted centroid line-position calculation — the mathematical basis of smooth, high-speed PID line-following around curves and intersections. Essential for line-following competition robots and autonomous track navigation.

06 **UnitV AI Camera — OV2640 Sensor + Kendryte K210 KPU ★ AI VISION MODULE**

The UnitV AI Camera is the most powerful component in the AIoT Kit — a compact (40×24×13 mm, 8g) edge AI vision module that brings real-time machine intelligence to the robot. It is powered by the Kendryte K210 SoC, a dual-core 64-bit RISC-V processor running at 400 MHz, paired with a dedicated Convolutional Neural Network KPU (Knowledge Processing Unit) capable of 0.8 TOPS (Tera Operations Per Second) of neural network inference. This means the camera can detect objects, recognise faces, classify colours, track targets, and run custom AI models entirely on-device — with no cloud connection, no external server, and no PC required.

Key Hardware Specifications

Processor: Kendryte K210 — Dual-core 64-bit RISC-V CPU at 400 MHz | KPU: 0.8 TOPS CNN neural network processor | Memory: 8 MiB on-chip SRAM + 16 MB Flash | Camera: OV2640 2MP sensor, 65° FOV, supports YUV/RGB565/RAW | Connectivity: USB Type-C (primary) + HY2.0-4P Grove-compatible port (I2C/UART/GPIO) | Indicators: 2 × programmable buttons + 1 × WS2812 RGB LED | Storage: TF/MicroSD card support (FAT32) | Dimensions: 40 × 24 × 13 mm | Weight: 8g

4. AI Camera

4.1 Hardware Architecture

The UnitV AI Camera is built around the Kendryte K210 SoC — a System-on-Chip specifically designed for embedded AI and edge inference workloads. Unlike conventional microcontroller cameras that can only capture and transmit raw image data, the K210 integrates a dedicated neural network accelerator (the KPU) alongside its dual RISC-V CPUs. This allows the camera to run full convolutional neural network models — the same type of models used in cloud AI services — entirely within the camera unit itself.

Specification	Details
SoC	Kendryte K210 — Dual-core 64-bit RISC-V CPU
CPU Speed	400 MHz per core
KPU (AI Engine)	0.8 TOPS — Convolutional Neural Network inference processor
On-chip SRAM	8 MiB — program execution, model inference, frame buffers
Flash Storage	16 MB — firmware, AI models, application code
Camera Sensor	OV2640 — 2MP (1600×1200), 65° Field of View
Image Formats	YUV422, RGB565, RAW — selectable per application
Primary Interface	USB Type-C — programming, data transfer, power supply
Grove Interface	HY2.0-4P Grove-compatible — I2C, UART, and GPIO modes
Indicator LED	WS2812 programmable RGB LED — status and visual feedback
Buttons	2 × programmable user buttons
SD Card	TF/MicroSD support — FAT32 format for model and data storage
Dimensions	40 × 24 × 13 mm
Weight	8 grams
Power Supply	USB-C (from MC 4.0 or directly from USB power bank)

4.2 AI Capabilities — What It Can Do

The K210 KPU enables the following AI functions to run in real time, directly on the camera hardware, without any internet connection or external processing unit:

AI Function	How It Works	Applications
Object Detection	YOLO or MobileNet model detects and locates objects in the camera frame in real time	Robot target tracking, pick-and-place automation, intruder detection
Object Classification	CNN classifier identifies which category an object belongs to from a trained set	Smart sorting robots, inventory management, item recognition systems
Face Detection	Haar cascade or lightweight CNN detects human faces in the frame	Access control, attendance systems, human-following robots
Colour Detection	HSV threshold-based colour blob detection and tracking	Line-following by colour, colour-coded tag tracking, sorting by colour
Shape Recognition	Geometric contour detection identifies circles, squares, arrows, and custom shapes	Sign recognition, QR/barcode alternative detection, navigation markers
Real-time Tracking	Target lock and position calculation for detected objects	Servo pan-tilt tracking, autonomous follow-robot, target acquisition
Custom AI Models	User-trained TensorFlow Lite or Keras models deployed via MaixPy	Any domain-specific visual recognition task
Video Recording	Camera captures and stores video/image frames to MicroSD	Data collection for training, surveillance, documentation

4.3 Programming the AI Camera

The UnitV AI Camera supports multiple programming approaches depending on the user's goals — from quick integration with the MC 4.0 through MCLab, to fully standalone AI application development using MaixPy IDE. This flexibility is one of the most powerful aspects of the camera.

Mode 1 — Integrated with MC 4.0 via MCLab (Recommended for Beginners & Education)

In this mode, the AI Camera connects to the MC 4.0 Controller via its Grove cable (UART or I2C interface). MCLab provides dedicated block and Python commands that send requests to the camera and receive results — for example, a 'Detect Object' block returns the detected object class and bounding box coordinates, which the MC 4.0 can then use to make decisions (turn left if object detected on the right, stop if obstacle within 30 cm, etc.).

MCLab Blocks available for the UnitV AI Camera:

- [AI Camera] Get detected object name and confidence score
- [AI Camera] Get bounding box coordinates (X, Y, Width, Height)
- [AI Camera] Set detection mode (object / face / colour / shape)
- [AI Camera] Get dominant colour in frame
- [AI Camera] Start / stop video recording to SD card
- [AI Camera] Get frame brightness and contrast values
- [AI Camera] Send custom command string to camera via UART

Mode 2 — Standalone Development via MaixPy IDE (Advanced / Independent Use)

The UnitV AI Camera can be programmed entirely independently of the MC 4.0 Controller using MaixPy IDE — a MicroPython-based development environment purpose-built for K210 devices. In this mode, the camera is connected directly to a computer via USB-C and programmed as a fully self-contained AI computer.

MaixPy IDE capabilities:

- Full MicroPython programming environment with KPU neural network API
- Load and run custom TensorFlow Lite / Keras models directly on the K210 KPU
- Real-time camera preview with annotation overlay in the IDE
- Train custom classifiers using the MaixHub platform and deploy via SD card
- Access all K210 hardware — KPU, DVP camera, SPI display, GPIO, I2C, UART, SPI
- Run object detection models (YOLOv2, MobileNet) with <100ms inference time
- Store models on MicroSD card and load at runtime — swap models without reflashing
- Completely independent of the MC 4.0 — the camera is a standalone AI computer

Mode 3 — Advanced Custom AI (Research & Professional Use)

For advanced users and researchers, the K210 can run fully custom neural network models trained on any dataset. The workflow is: (1) Collect and label your own image dataset, (2) Train a lightweight CNN in Python using Keras or TensorFlow, (3) Convert to K210-compatible .kmodel format using the nncase compiler, (4) Deploy the model to the camera via MicroSD card, (5) Run inference via MaixPy on the K210 KPU. This enables truly bespoke AI applications — custom defect detection for a specific product, plant disease recognition, custom gesture vocabularies, and more — running locally on 8 grams of hardware at under $20.

5. ENV III Unit — Environmental Sensor

The ENV III Unit is a high-precision multi-parameter environmental sensor that measures three fundamental atmospheric conditions simultaneously: temperature, relative humidity, and barometric pressure. It communicates via I2C through Grove Port A and is natively supported in MCLab with dedicated blocks and Python functions.

Parameter	Specification
Temperature Sensor	SHT30 — Range: -40°C to +125°C, Accuracy: ±0.2°C
Humidity Sensor	SHT30 — Range: 0–100% RH, Accuracy: ±2% RH
Pressure Sensor	BMP280 — Range: 300–1100 hPa (altitude up to ~9000m)
Altitude (Derived)	Calculated from pressure using barometric formula
Communication	I2C via Grove Port A — plug-and-play, address configurable
Sampling Rate	Up to 8 samples/second per sensor
Power Consumption	Ultra-low power — suitable for battery-operated IoT nodes
MCLab Support	Dedicated Scratch blocks and Python functions for all 3 parameters
Use Cases	Weather stations, indoor climate monitoring, altitude sensing, data logging, smart greenhouse, HVAC control

5.1 ENV III MCLab Integration

In MCLab, the ENV III unit is accessible through a dedicated sensor block group. The following operations are available in both block and Python mode:

[ENV III] Read Temperature → returns value in °C or °F
[ENV III] Read Humidity → returns % relative humidity
[ENV III] Read Pressure → returns hPa (hectopascals)
[ENV III] Read Altitude → returns calculated altitude in metres
[ENV III] Log all values to SD card with RTC timestamp
[ENV III] Display readings on MC 4.0 touchscreen dashboard
[ENV III] Trigger alert if threshold exceeded (e.g. temp > 35°C → activate relay)

6. 4-Channel Relay Module

The 4-Channel Relay Module (Module13.2 v1.1) extends the MC 4.0 AIoT Kit into real-world electrical control by enabling safe and efficient switching of external DC devices through I2C communication. A relay is an electrically operated switch that allows the MC4.0 controller (low-voltage logic) to control higher power loads such as lamps, motors, solenoid valves, and automation systems without direct electrical connection.

Relay Module Specifications

- 4 independent relay channels — control 4 separate circuits
- Relay type: Mechanical (Normally Open — N.O. & Common — COM)
- Microcontroller: STM32G030F6 (32-bit Cortex-M0+)
- Communication: I2C interface (Default Address: 0x26)
- Load capacity: Max 24W per channel (DC 24V @ 1A)
- Operating modes: Active / Passive (selectable via jumper caps)
- Built-in voltage detection for external power monitoring
- Relay coil consumption: 5V @ 40mA
- Switching speed: 6ms activation, 4ms release
- Terminal type: 2.54mm screw terminals (N.O. & COM)
- Power input: DC 5V–24V (DC5521 jack)
- Compact design: 54 × 54 × 19.7 mm

I2C Control & Registers

- Device Address: 0x26
- Relay Control Register: 0x10
  - Bit 0–3 → Relay 1–4 (1 = ON, 0 = OFF)
- ADC Registers:
  - 0x20 → 8-bit voltage
  - 0x30 → 12-bit voltage
- Firmware Register: 0xF0
- Address configurable for multi-module setup

Applications

- Smart home automation (lights, fans)
- Industrial control systems
- Solenoid valve operation
- IoT-based switching systems

MCLab Relay Control Blocks	Usage & Safety Guidelines
• [Relay] Turn Channel 1/2/3/4 ON • [Relay] Turn Channel 1/2/3/4 OFF • [Relay] Toggle Channel • [Relay] Set all channels simultaneously • [Relay] Pulse channel for N milliseconds • [Relay] Conditional trigger from sensor value • [Relay] Schedule ON/OFF using RTC timestamp • [Relay] Automation sequencing (e.g., start → delay → stop)	• Use only DC 5–24V input supply • Do not exceed 24W per channel • Ensure correct polarity before powering ON • Verify jumper settings (Active/Passive mode) • Avoid I2C address conflict in multi-module systems • Use proper insulated wiring for safety

The relay module transforms the MC 4.0 AIoT Kit from an educational robot into a genuine IoT automation controller. Combined with the ENV III sensor and MCLab's IoT cloud blocks, it enables real smart home and building automation applications: auto-activate a fan when temperature exceeds 30°C, switch on a lamp when a motion trigger fires, or sequence industrial devices according to a programmed schedule — all controlled by code on the MC 4.0.

The relay module transforms the MC 4.0 AIoT Kit into a complete automation controller, enabling seamless integration between sensor inputs, AI decisions, and real-world device control.

7. Extension Port Module

The Extension Port Module expands the connectivity of the MC 4.0 AIoT Kit by providing additional Grove-compatible interfaces, allowing multiple sensors and actuators to operate simultaneously without port limitations. It acts as a hardware expansion hub, enabling complex multi-sensor and AIoT applications without modifying the core controller.

Extension Port Module Capabilities

• 4 Grove interfaces: PortB, PortC, PortD, PortE
• Supports multiple communication types:
  - I2C - GPIO / ADC - UART
• GPIO customization via DIP switches (Port D & E)
• 5-Pin 2.54mm header for additional expansion
• Plug-and-play design (no soldering required)
• Power-distributed architecture for stable operation
• Compact and lightweight design for stack integration

Functional Overview

- The module allows the MC4.0 system to:
- Connect multiple sensors simultaneously
- Avoid port conflicts in complex systems
- Expand AI + IoT + Robotics capabilities
- Integrate additional modules without hardware redesign

Working Principle

In embedded systems, an extension port module acts as an I/O expansion layer, distributing signals from the main controller to multiple devices.

- Ports D & E can be reconfigured using DIP switches
- Each port can support different sensor types
- Ensures flexible hardware configuration for different projects

Applications

- Multi-sensor robotics systems
- IoT monitoring and automation
- AI + sensor fusion projects
- STEM / STEAM education labs
- Rapid prototyping systems

Usage Guidelines

- Ensure only one DIP switch position is active at a time
- Verify correct port configuration before use
- Use proper mounting if stacked with other modules
- Avoid overloading ports with unsupported devices

The Extension Port Module is a critical component in the MC 4.0 AIoT Kit, enabling scalable system design and allowing users to build advanced, multi-device AIoT solutions efficiently.

8. Programming Platforms

8.1 MCLab — Primary Platform

MCLab is the official browser-based development platform for the MC 4.0. Zero installation required. Supports Scratch block coding and Python. Connects over Wi-Fi, Bluetooth, or USB. All AIoT Kit components — including the AI Camera, ENV III, relay module, and extension port — have dedicated MCLab block libraries.

MCLab Block Library	Block Category	Description
AI Camera Blocks	Edge AI Vision	Object detection, colour tracking, face detection, bounding box data, recording
ENV III Blocks	Environmental	Temperature, humidity, pressure, altitude, threshold alerts, data logging
Relay Blocks	Control	Channel ON/OFF, pulse, toggle, conditional trigger, RTC scheduling
Motor & Encoder	Robotics	Speed control, distance, angle, PID line following, Mecanum drive
Ultrasonic RGB	Sensing	Distance reading, LED colour threshold mapping
Line Follower	Sensing	Channel values, centroid calculation, line position estimation
IoT & Cloud	Connectivity	MQTT publish/subscribe, HTTP requests, cloud dashboard, webhooks
Wi-Fi & BT	Communication	Network connection, BT pairing, data streaming, OTA updates
Display & GUI	Interface	Custom screens, graphs, gauges, menus on 320×240 touchscreen
Data Logging	Storage	SD card read/write, RTC timestamps, CSV export

8.2 Arduino IDE & VS Code + PlatformIO

For maximum hardware control and performance, the MC 4.0 is fully supported in the Arduino IDE via the M5Core2 library from Maker and Coder Global. All on-board and connected peripherals are accessible via clean C++ API calls. VS Code with the PlatformIO extension provides a professional IDE experience with IntelliSense, advanced debugging, automatic library management, and one-click upload. The AI Camera communicates with the MC 4.0 via serial UART in Arduino mode, using a simple command-response JSON protocol.

8.3 MaixPy IDE — Standalone AI Camera Development

MaixPy IDE is the dedicated development environment for the K210 SoC inside the UnitV AI Camera. It provides a MicroPython programming environment with full KPU neural network API access, real-time camera preview with annotation overlay, and the ability to load, run, and test AI models directly on the camera hardware. The camera can be programmed, tested, and deployed as a completely self-contained AI vision computer without involving the MC 4.0 at all — connecting only via USB-C to a computer running MaixPy IDE.

MaixPy IDE — Key Capabilities

- Full MicroPython IDE with serial terminal, file manager, and live camera preview
- Load YOLO, MobileNet, and custom .kmodel files from MicroSD card
- Real-time KPU inference with annotated bounding box overlay in the preview window
- Train custom models via MaixHub (web platform) and deploy via SD card — no compiler needed
- Access all K210 hardware APIs: KPU, DVP camera, GPIO, I2C, UART, SPI, I2S audio
- Send results to MC 4.0 via UART serial in any format (JSON, plain text, binary)
- Standalone deployment: camera runs autonomously on USB power bank — no MC 4.0 required
- GitHub reference: github.com/sipeed/MaixPy for documentation, examples, and model zoo

8.4 MATLAB & Simulink

MATLAB and Simulink are fully supported by the MC 4.0 via serial communication and the MATLAB Support Package for Arduino Hardware. Engineers and university students can stream ENV III sensor data, encoder telemetry, relay states, and AI camera detection outputs directly into MATLAB for real-time signal processing, control system design, and data analysis. Simulink enables visual control algorithm design (PID, state machines, Kalman filters) with hardware-in-the-loop deployment directly onto the MC 4.0.

8.5 ROS 2 (Robot Operating System)

The MC 4.0 AIoT Kit supports full ROS 2 integration via the micro-ROS library over Wi-Fi or serial. The AI Camera's detection outputs (object class, bounding box, position) can be published as ROS 2 topics, enabling integration with Nav2 autonomous navigation, RViz visualisation, and multi-robot coordination systems. This makes the AIoT Kit suitable for university-level robotics research and professional robot development workflows.

9. Projects You Can Build

Every project below is achievable using the components included in the MC 4.0 AIoT Kit. Projects are organised by primary technology area and difficulty level. All can be programmed via MCLab (Scratch or Python) or Arduino IDE / MaixPy IDE for advanced builds.

9.1 AI Vision Projects — Powered by UnitV AI Camera

Object Tracking Robot

Level: Intermediate | **AI Camera + Mecanum**

The AI Camera detects a specific object (ball, bottle, coloured target) and returns its X/Y position in the frame. The MC 4.0 uses this data to calculate steering corrections and drive the Mecanum robot to continuously track and follow the target across a room.

Colour-Sorting Conveyor

Level: Intermediate | **AI Camera + Relay**

Camera detects object colour in real time. MC 4.0 triggers different relay channels based on detected colour to activate sorting gates or diverters. A practical industrial automation demonstration combining edge AI vision with relay actuator control.

Face Detection Security System

Level: Intermediate | **AI Camera + Relay**

The AI Camera detects when a human face enters the frame. MC 4.0 triggers a relay to switch an alert lamp or buzzer, and logs the detection event with RTC timestamp to the SD card. A practical access control and security demonstration.

Gesture-Controlled Robot

Level: Advanced | **AI Camera + Motors**

Train the AI Camera to recognise specific hand gestures (point left, point right, open palm = stop, closed fist = go). Deploy the model via MaixPy IDE. The camera sends gesture results to the MC 4.0 which drives the robot accordingly — no physical controller needed.

Custom Object Classifier

Level: Advanced | **AI Camera (MaixPy)**

Photograph your own objects using the camera, upload to MaixHub, train a custom classifier in minutes, download the .kmodel file to MicroSD, and deploy. The camera now recognises your custom objects in real time at 0.8 TOPS — entirely on the 8g camera module.

Autonomous Visual Navigation

Level: Advanced | **AI Camera + Motors + MCLab**

Use AI Camera colour and shape detection to navigate a course marked with coloured waypoint signs. Robot detects sign colour, interprets the direction command, and drives accordingly — a visual navigation system requiring no GPS or external positioning.

9.2 IoT & Environmental Projects — ENV III + Relay + Wi-Fi

Smart Weather Station

Level: Beginner → Intermediate | **ENV III + MCLab IoT**

Log real-time temperature, humidity, pressure, and derived altitude to the MCLab cloud dashboard, viewable from any browser. Set threshold alerts that send notifications when temperature or humidity exceeds safe levels. Log data to SD card with RTC timestamps for analysis.

Smart Home Automation

Level: Intermediate | **ENV III + 4 Relay**

Auto-activate a relay-switched fan when temperature exceeds 30°C, switch lights when ambient brightness drops below threshold (add light sensor via Extension Port), and log all events to an MCLab IoT dashboard. A working smart home controller in one kit.

Smart Greenhouse Controller

Level: Intermediate | **ENV III + Relay + IoT**

Monitor and control a greenhouse environment. ENV III measures temperature and humidity. Relay channels activate irrigation pump, ventilation fan, and grow lights based on programmed thresholds. Data streamed to MCLab cloud dashboard for remote monitoring.

Industrial Sensor Node

Level: Advanced | **ENV III + Wi-Fi + MQTT**

Deploy the MC 4.0 AIoT Kit as a standalone industrial IoT sensor node. Publish ENV III readings, relay states, and encoder telemetry to an MQTT broker (e.g. Mosquitto or HiveMQ) via Wi-Fi. Integrate with Node-RED, Grafana, or any SCADA system via MQTT topics.

9.3 Advanced Robotics Projects — Mecanum + AI + Sensors

AI-Guided Line Following Robot

Level: Advanced | **AI Camera + Line Follower + Motors**

Fuse data from the 6-way grayscale line follower (precise line position) with AI Camera visual waypoint detection (coloured signs on the track) to build a robot that follows a line AND responds intelligently to visual commands — stop at red, turn at blue arrow, speed up at green.

Intelligent Obstacle Avoidance

Level: Intermediate | **AI Camera + Ultrasonic + Motors**

Combine AI Camera object classification with RGB Ultrasonic distance measurement for intelligent obstacle response: stop for a person (face detected), go around an object (generic obstacle), ignore a specific target object. A multi-modal perception system.

Full AIoT Competition Robot

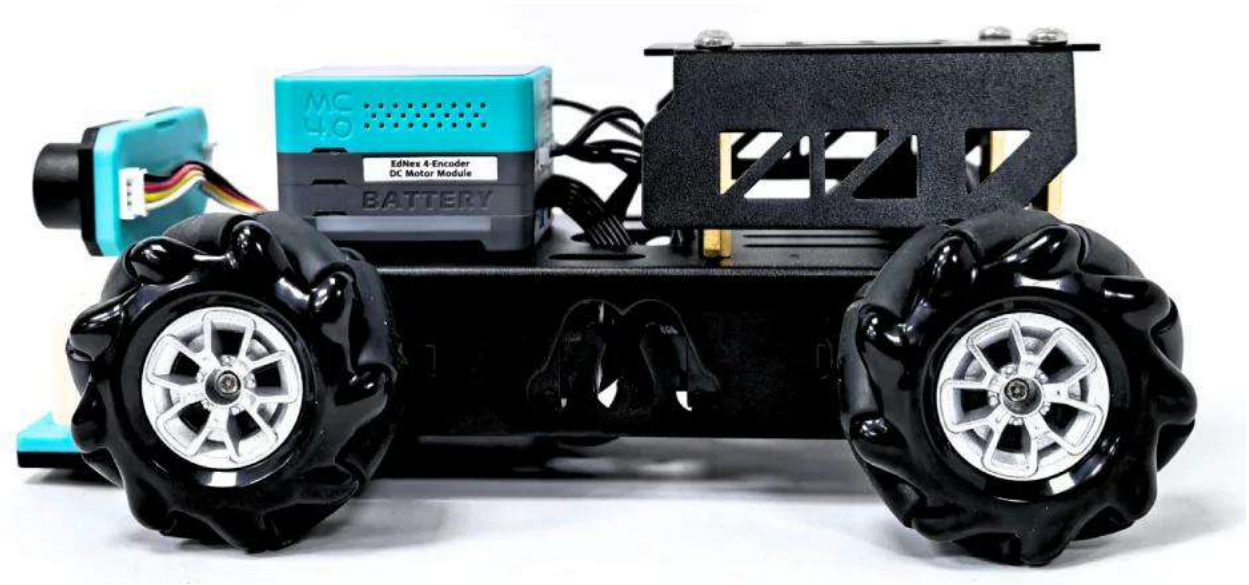
Level: All Levels | **All Kit Components**

Build the ultimate competition robot: Mecanum omnidirectional drive, PID line-following, AI Camera visual target acquisition, ENV III environmental sensing, relay-triggered indicators, and real-time MCLab telemetry dashboard. All components. One robot. Maximum capability.

University Research Platform

Level: Advanced | **Full Kit + ROS 2 + MATLAB**

Deploy the AIoT Kit as a research-grade platform: AI Camera topics published to ROS 2 via micro-ROS, MATLAB Simulink closed-loop control experiments, ENV III data logging for environmental research, and relay control for lab automation. A complete university project platform.



10. Assembly Guide

The MC 4.0 AIoT Kit shares the same metal chassis and motor drive system as the Base Kit. Assembly follows the same 10-step process with additional steps for connecting the AIoT-specific modules: AI Camera, ENV III, and Relay Module.

STEP 01 Inspect & Organise All Components

Unbox all items. Cross-reference with the Kit Contents table. Identify the chassis, motors, wheel sets, module stack components (Motor Module → Battery Module → MC 4.0), AIoT modules (AI Camera, ENV III, Relay Module, Extension Port), and accessories.

STEP 02 Choose Robot Configuration

Select Mecanum Robot (4 motors + 4 Mecanum wheels — omnidirectional drive) or 3-Wheel Robot (2 motors + 2 BO wheels + 1 caster wheel — differential drive). Both configurations are supported. The AIoT modules work with both.

STEP 03 Mount Motors to Metal Chassis

Using the Screws Set and included Screwdriver, mount the BO DC Metal Gear Encoder Motors to the pre-drilled motor positions on the solid black metal chassis. Mount all 4 motors for Mecanum, or 2 rear motors for 3-wheel. The chassis requires no drilling or modification.

STEP 04 Attach Wheels

Mecanum: attach 4 Mecanum wheels — confirm LH/RH roller orientation at each corner. 3-Wheel: attach 2 BO wheels to rear motors and mount the caster wheel bracket at the front chassis centre position with the provided caster screws.

STEP 05 Assemble Module Stack

Stack from bottom to top: (1) 4 Encoder Motor Module, (2) Battery Module, (3) MC 4.0 Controller. Align stacking connectors and press together firmly. No inter-module cables required.

STEP 06 Mount Stack & Connect Motor Cables

Secure the assembled stack to the chassis using standoffs and screws from the Screws Set. Connect the four motor cables to Grove motor ports M1–M4 on the Motor Module. Assign channels to FL, FR, RL, RR wheel positions.

STEP 07 Mount & Connect Sensors

Mount the RGB Ultrasonic Sensor at the chassis front. Mount the 6-Way Line Follower Sensor at the chassis underside front. Connect both to Grove Port A via the Extension Port Module. Connect the ENV III Unit to the Extension Port Module via Grove cable.

STEP 08 Mount & Connect AI Camera

Mount the UnitV AI Camera at the chassis front-top position for a clear forward field of view. Connect the Grove cable from the AI Camera's HY2.0 port to Grove Port C (UART) on the MC 4.0. Connect the USB-C long cable from the AI Camera to the MC 4.0's USB-C port (or a USB port on the Battery Module) for power.

STEP 09 Connect Relay Module

Connect the 4-Channel Relay Module to Grove Port B (GPIO) on the MC 4.0 via Grove cable. Wire the controlled circuits (lamps, fans, or other devices) to the relay screw terminals. Ensure mains-voltage wiring is performed by a qualified adult if applicable.

STEP 10 Charge, Power On & Program

Charge the battery via the included adapter. Power on using the battery module switch. Connect MC 4.0 to MCLab over Wi-Fi, Bluetooth, or USB-C. Select a project, choose Scratch or Python, and start coding. For standalone AI camera work, connect directly to MaixPy IDE via USB-C.

11. Platform Support Summary

MCLab (Scratch + Python)	Arduino IDE + VS Code	MaixPy IDE (AI Camera)	MATLAB / ROS 2
• Browser-based • Wi-Fi / BT / USB • All AIoT blocks • Ages 7+ to Advanced	• C++ full control • M5Core2 library • PlatformIO support • Advanced debug	• K210 MicroPython • KPU neural network • Standalone AI dev • Custom model deploy	• HIL simulation • Control design • ROS 2 micro-ROS • Research grade

MC 4.0 AIoT Kit

Edge AI Vision · Environmental IoT · Industrial Control · Precision Robotics

MCLab · Arduino IDE · VS Code · MaixPy IDE · MATLAB · ROS 2

Maker and Coder Global — AI · IoT · Robotics · Automation

INTELLIGENCE LAYER
Edge AI Camera (K210 KPU) Real-time object detection Color tracking & classification

SENSING LAYER
ENV III sensor — Temp/Humidity/Pressure RGB
Ultrasonic + 6-way Line Follower
Extension Port for more sensors

CONTROL & ACTUATION
4-Relay Module — switch real loads 4 Encoder Motors — precision drive
Mecanum wheels — omni movement

Maker and Coder Global

The most advanced all-in-one AIoT Robotics Kit — powered by Edge AI Vision, real-time sensor intelligence, and unlimited programmability.