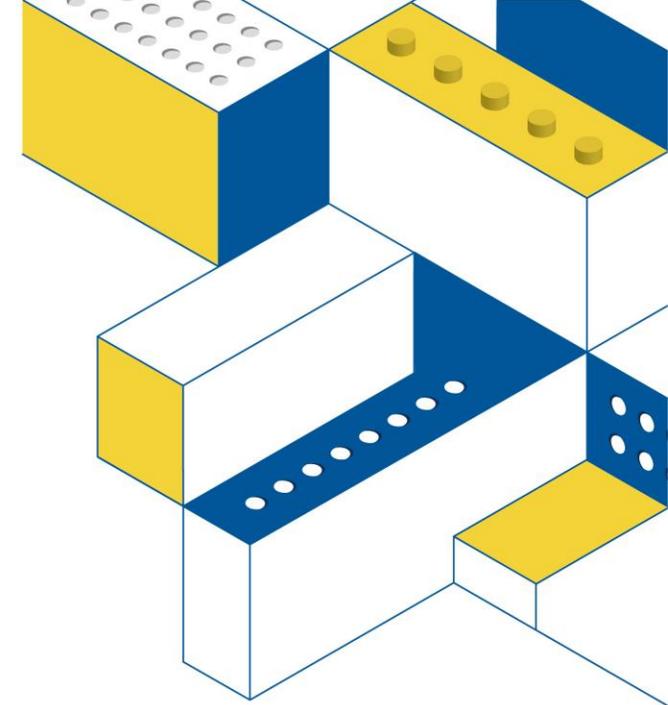


MATRIX Mini R4 Tutorials

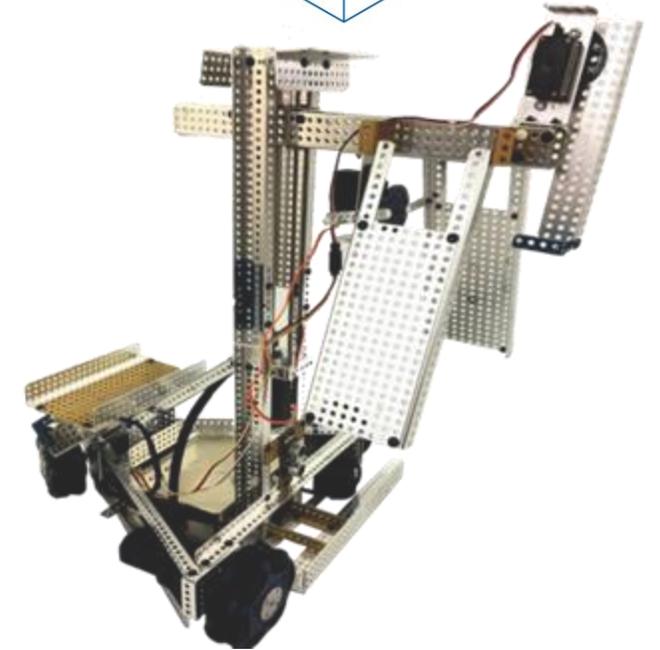
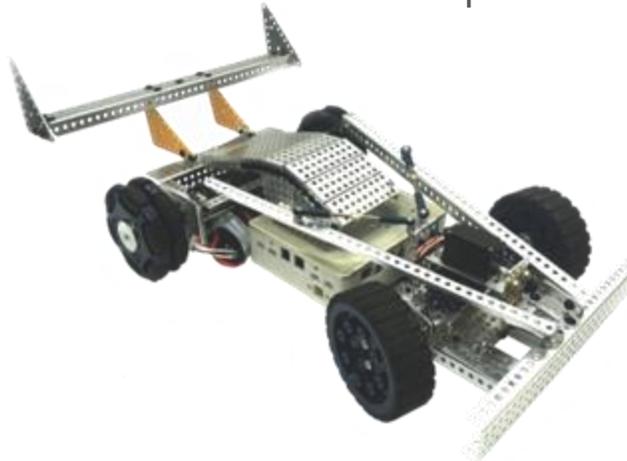
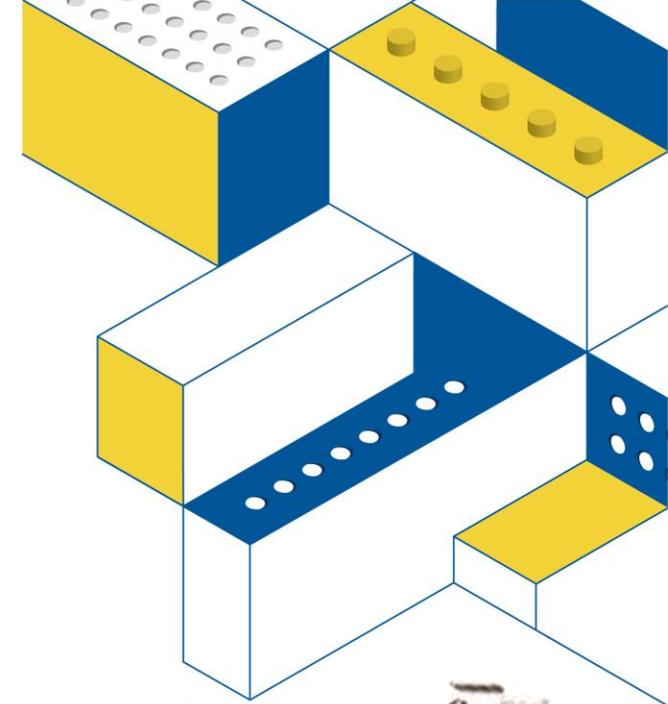
Learning Objectives

- [Get to know MATRIX Robotics](#)
- [Understand the specifications and features of MATRIX Mini R4 controller](#)
- [Software Introduction](#)
- [Firmware Update](#)
- [How to Drive Motors](#)
- [Familiarize with the MATRIX series sensors](#)
- [Introduction to MATRIX Mini R4 series sets](#)



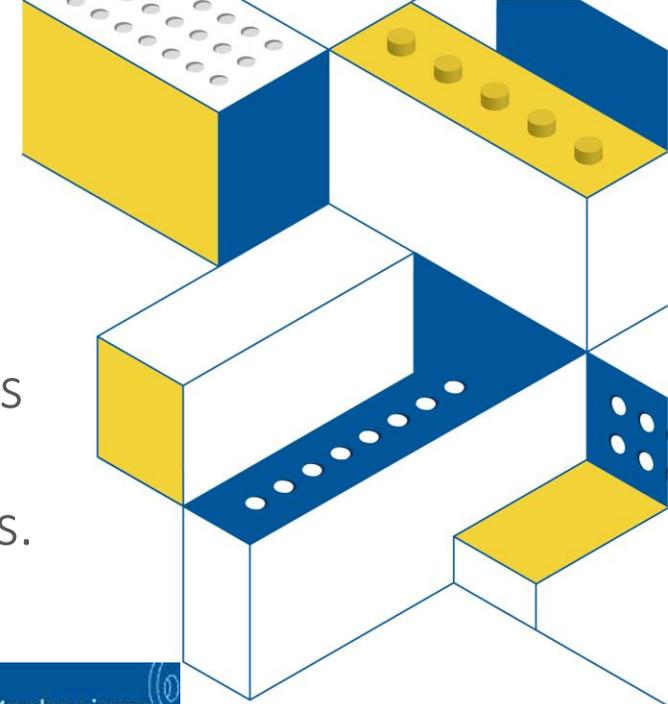
MATRIX Robotics

The MATRIX Building System is certified by the U.S. FIRST International Youth Robotics Engineering Challenge and designated equipment for the FTC International Competition since 2013. It's tailored for middle and high school students aged 11 to 18. With aerospace-grade alloy materials, powerful motors, and diverse components, it enables quick realization of complex engineering designs. Users can explore the engineering world hands-on, unleashing their imagination on the MATRIX robot platform.



Flexible Structure Design

Supports the MATRIX building system, enabling users to build projects with industrial-grade metal parts, while also compatible with LEGO Technic, allowing an easy transition from plastic to metal components.



MATRIX Building System



1/

Compatible with
LEGO® parts

2/ Easy Assembly



3/ Various Shapes
of Metal Parts

4/ Stronger Mechanisms
and Accurate Movement

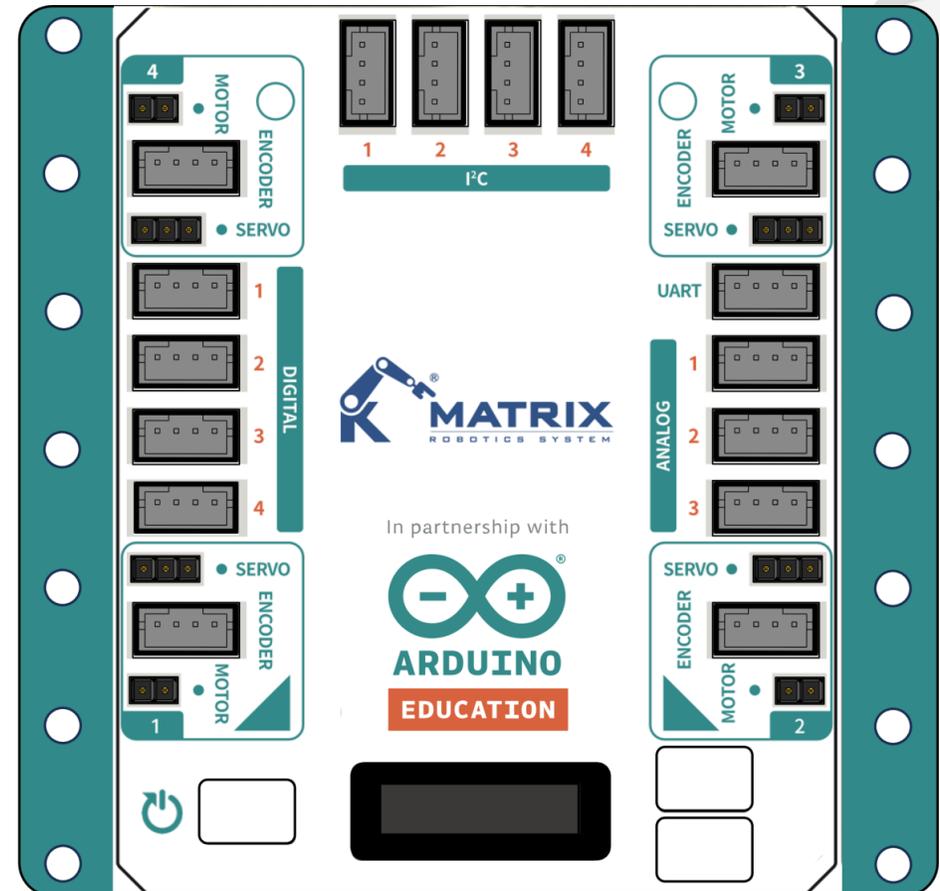




MATRIX Mini R4 Controller

MATRIX Mini R4 Specifications

- Microcontroller : Arduino UNO R4 WIFI + STM32F103 (co-processor)
- Working Voltage : 5VDC
- Input Voltage : 6VDC ~ 24VDC
- 5VDC PWM Output Port : 4
- 5VDC Motor Output Port : 4
- Encoder Port : 4
- Digital Signal Port : 4
- Analog Signal Port : 3
- UART Port : 1
- I²C Port : 4
- Programmable Button : 2
- Power (Reset) Button : 1
(Long press for ON/OFF, Short press for reset)
- Programmable RGB LED : 2
- OLED : 0.91" , 128x32 pixels
- Buzzer : 1



MATRIX Mini R4 Controller

RGB LED 1

Buzzer

RGB LED 2

Status LED

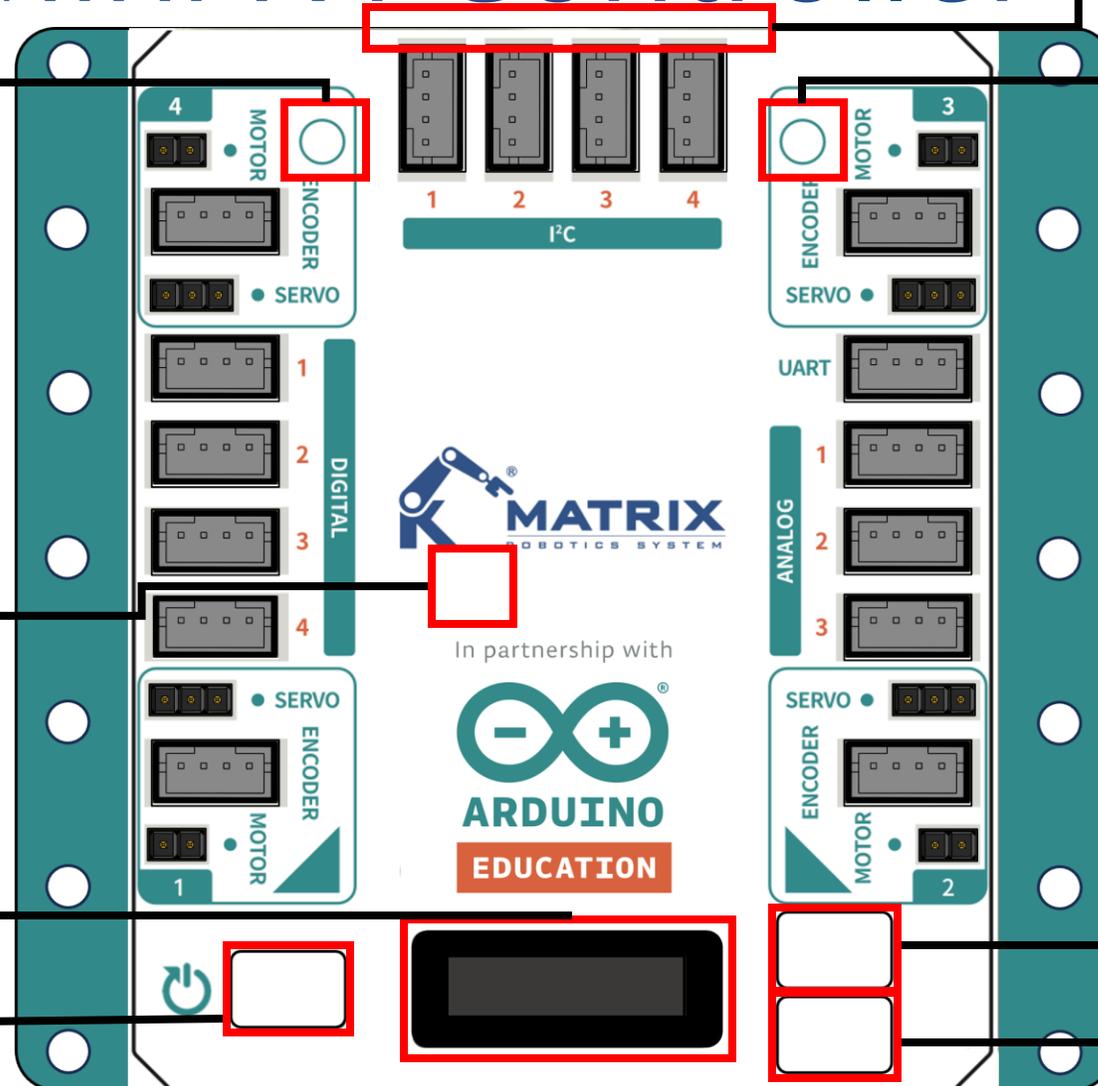
You can interact with the robot through these functions.

OLED

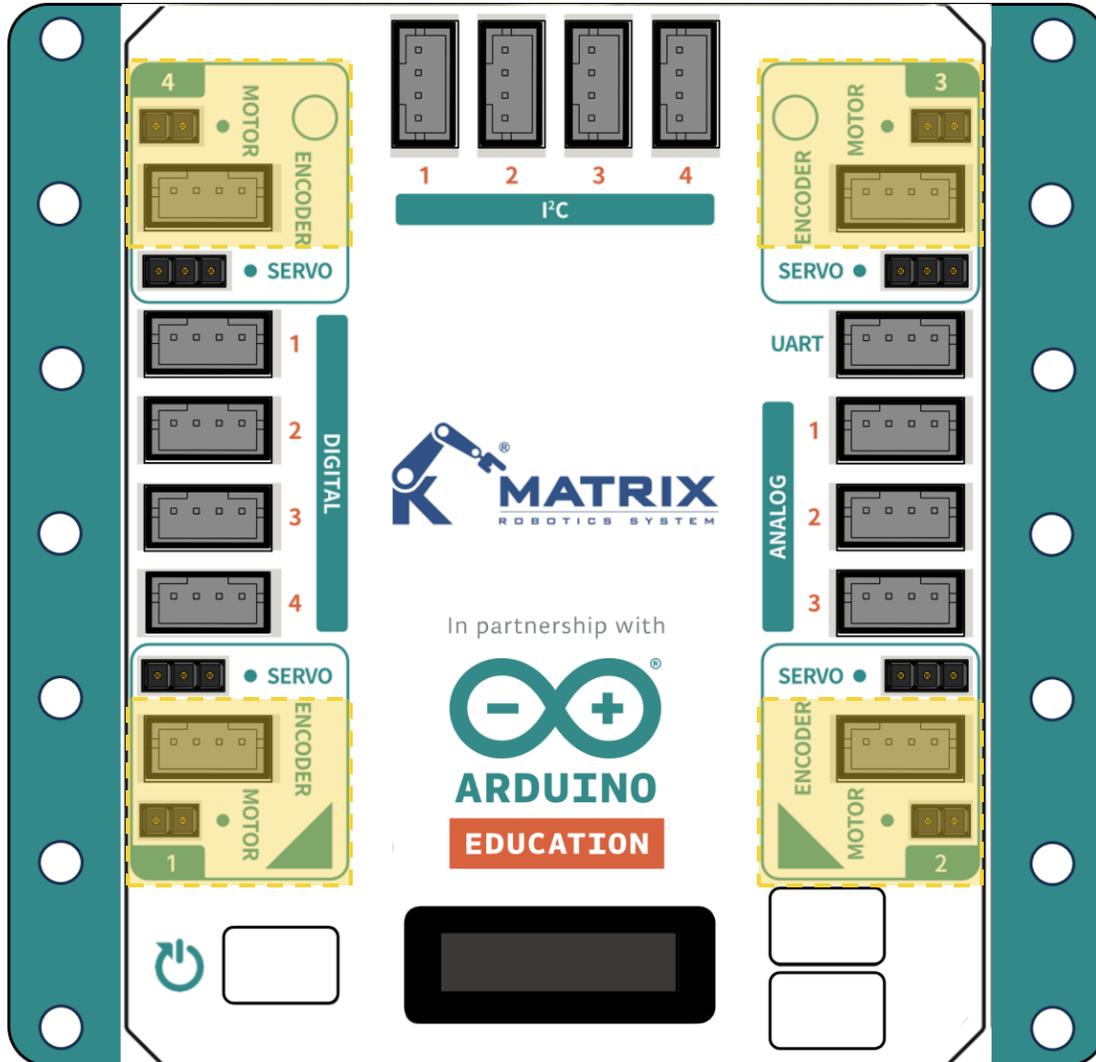
Reset Button

User Button Up

User Button Down

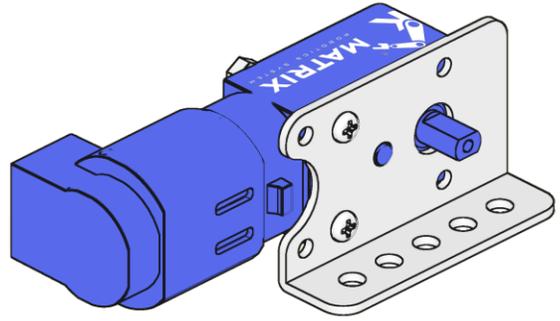
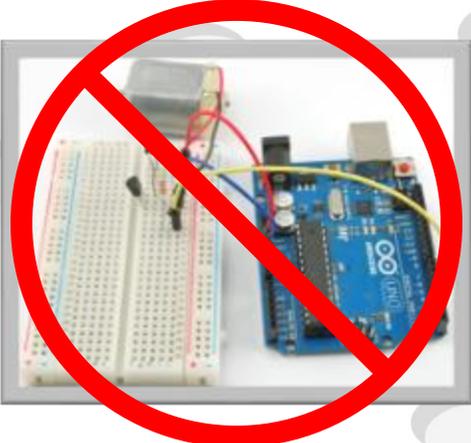


Motor ports



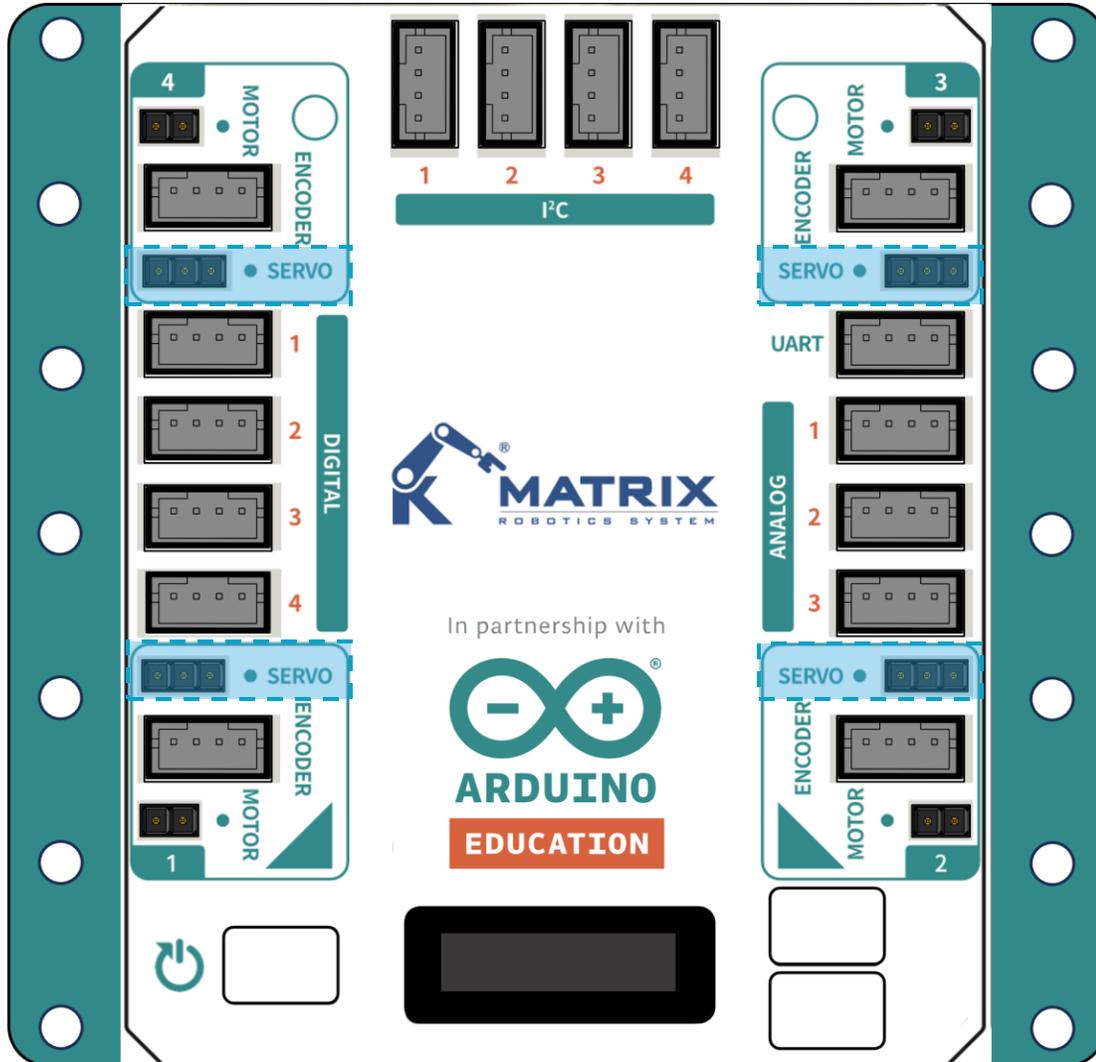
DC Encoder Motor

	1	CH B
	2	CH A
	3	M5V
	4	GND
	1	M-
	2	M+



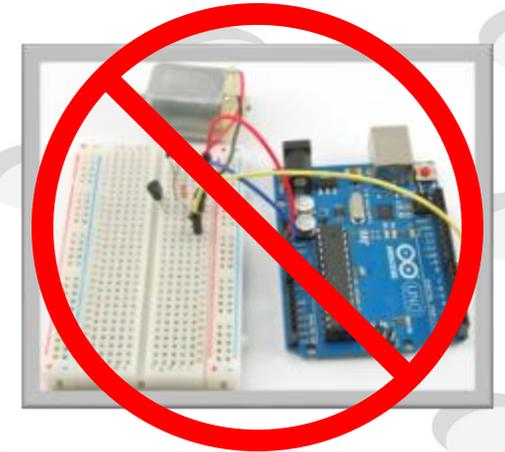
Make sure the black wire(GND) is close to the dot.

Motor ports



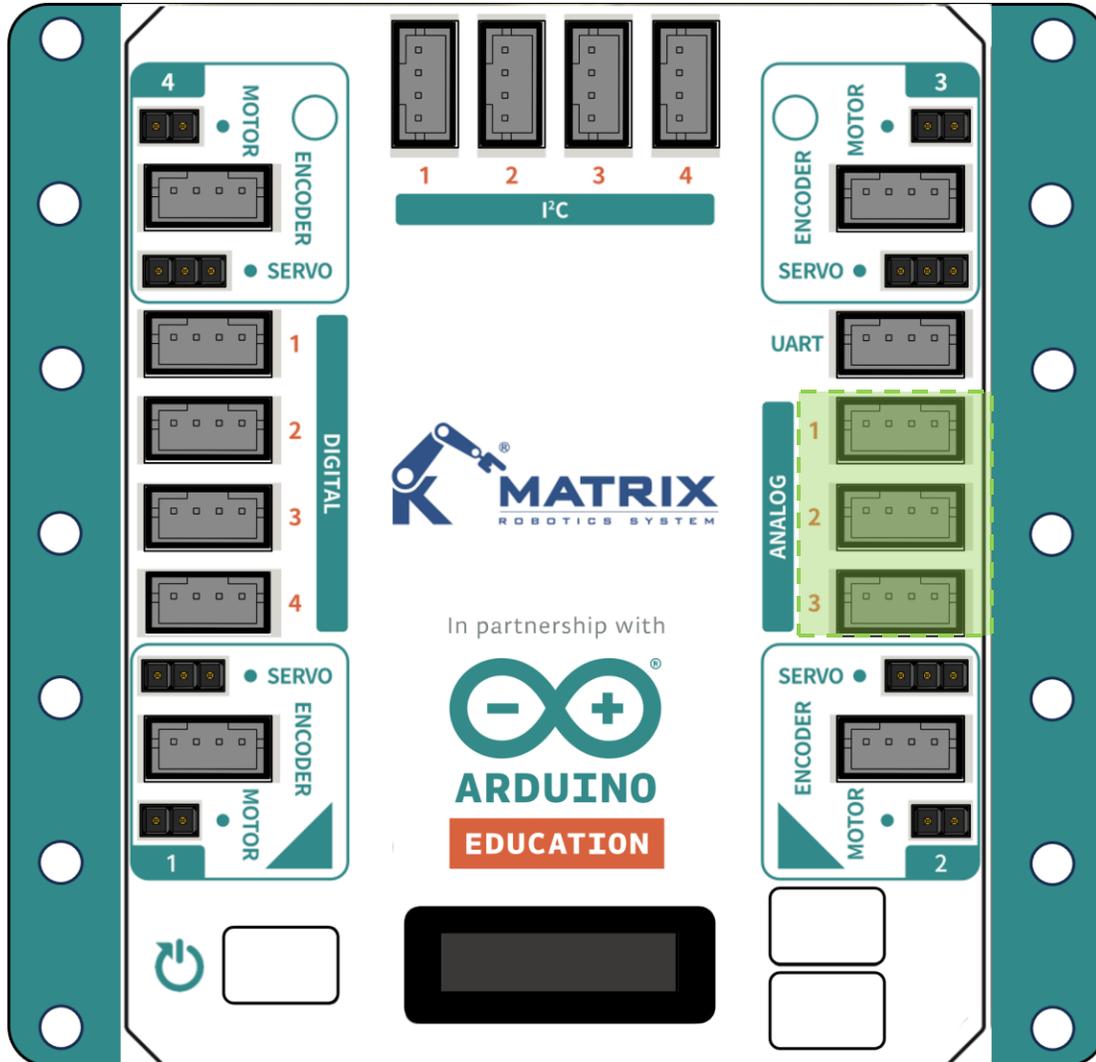
RC Servo

RC SERVO PORT	1	2	3
	GND	M5V	PWM



Make sure the black or brown wire (GND) is close to the dot.

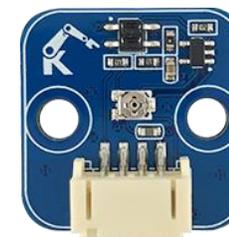
Analog ports



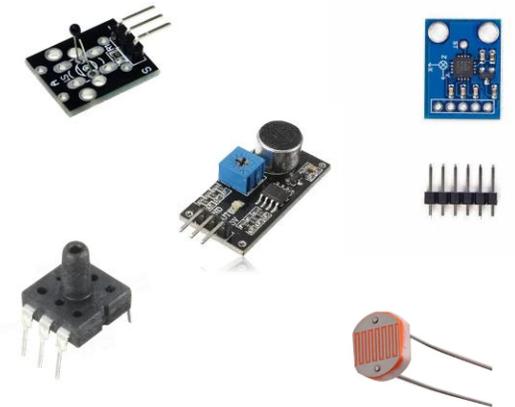
Analog IN

The Mini R4 can be connected to and integrated with any analog sensor that supports Arduino.

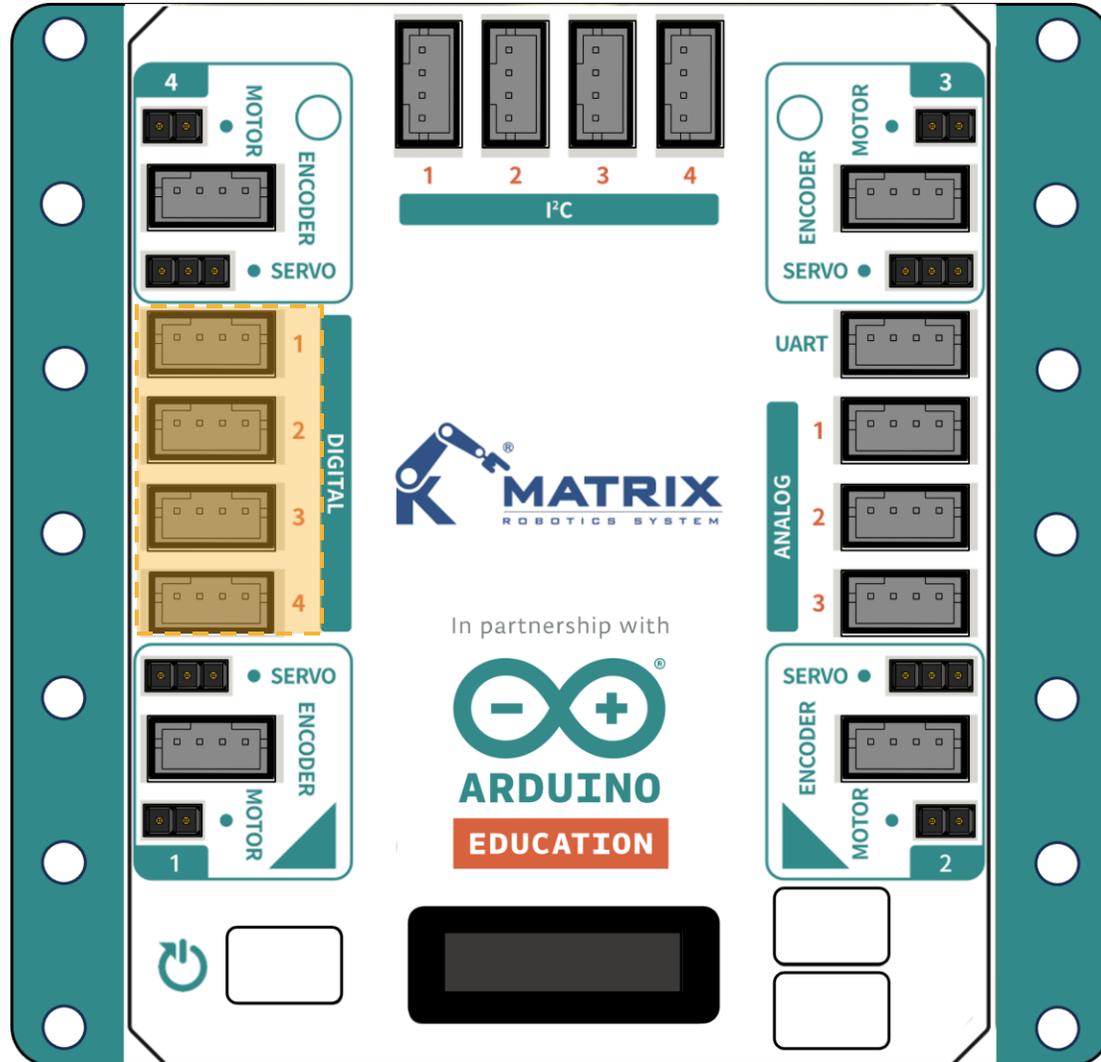
<i>ANALOG PORT</i>	1	AIN A
	2	AIN B
	3	A5V
	4	GND



Gray Scale

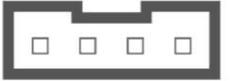


Digital ports



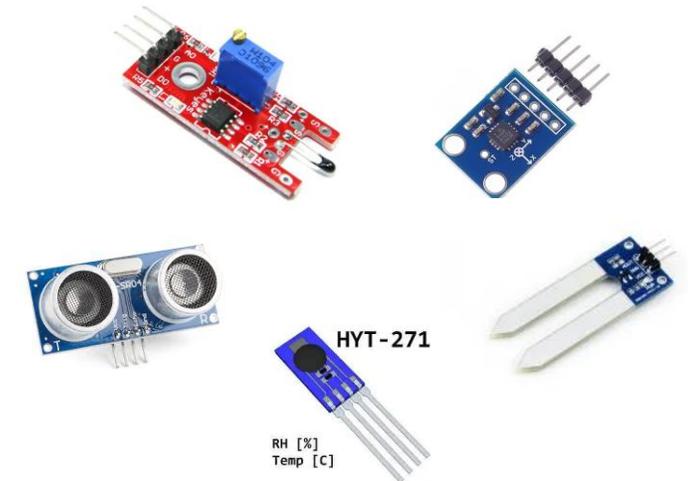
Digital I/O

The Mini R4 can be connected to and integrated with any digital sensor that supports Arduino.

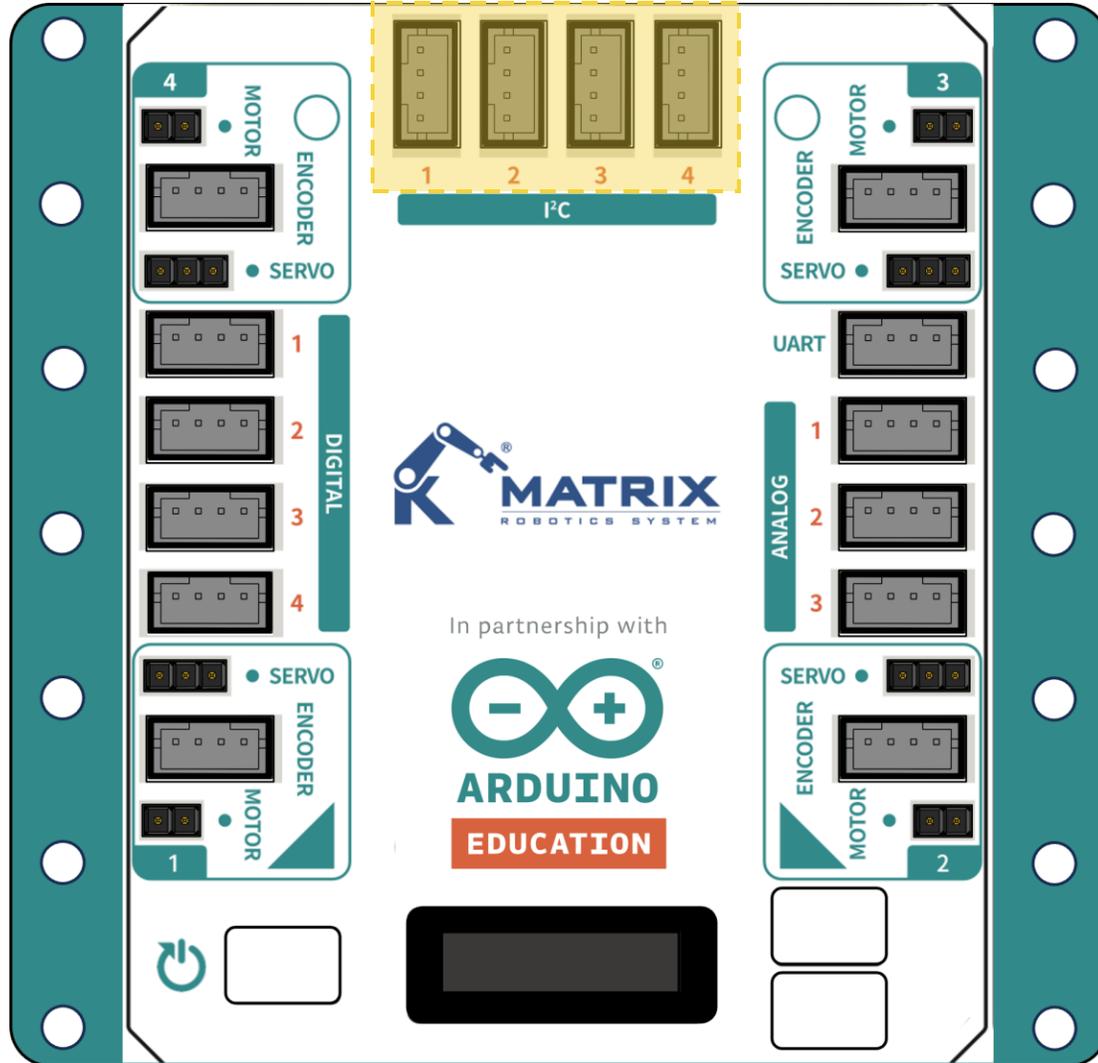
DIGITAL PORT	1	DIO A
	2	DIO B
	3	5V
	4	GND



Miniature Switch



I2C ports



I2C I/O

The Mini R4 can be connected to and integrated with any I2C sensor that supports Arduino.

I ² C	
1	SDA
2	SCL
3	5V
4	GND



Laser



Color



Other ports



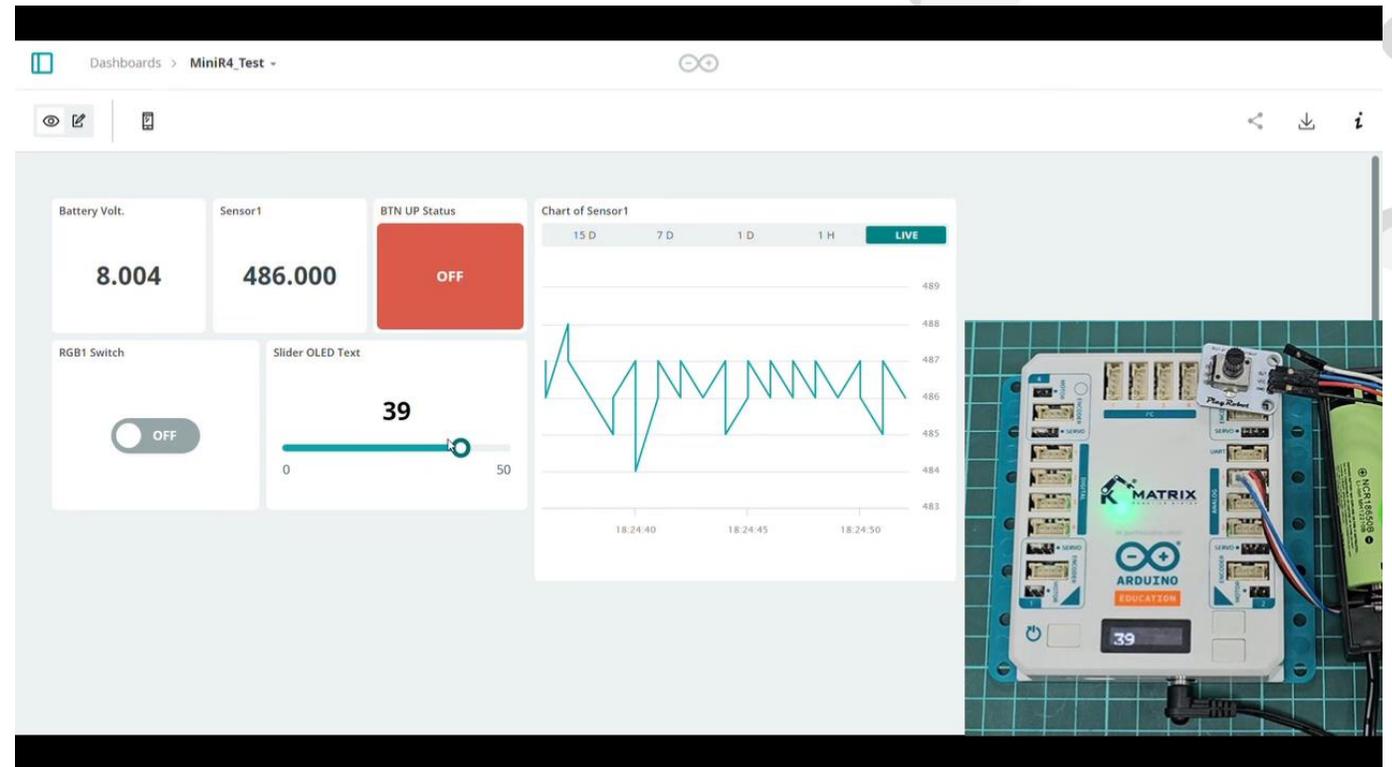
● Device Firmware Upgrade Button

● USB-C for Programming

● DC Input

Arduino Ecosystem – Arduino Cloud Support

The Mini R4 has Wi-Fi capability, it can support Arduino cloud and IOT projects.



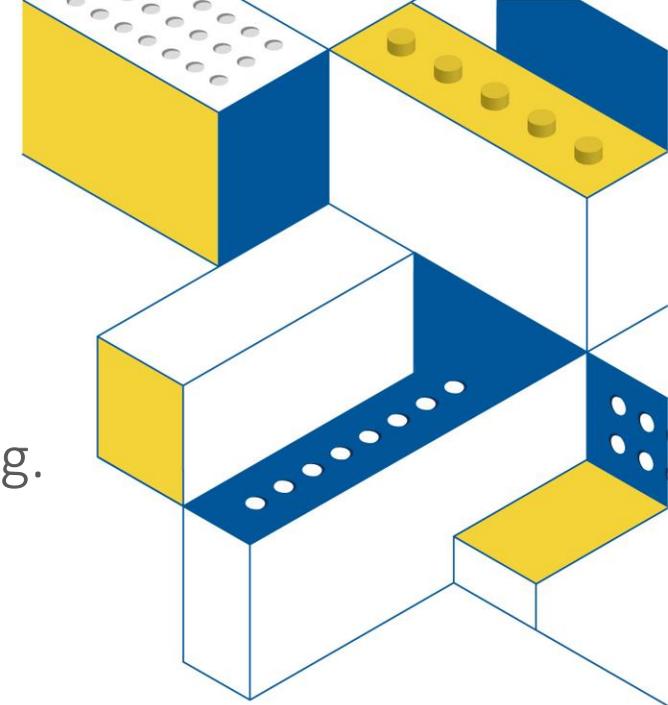


Software

What is MATRIXblock

MATRIXblock is a robot programming tool based on Scratch. It offers block to C++ previews and serial port monitor for easy data debugging.

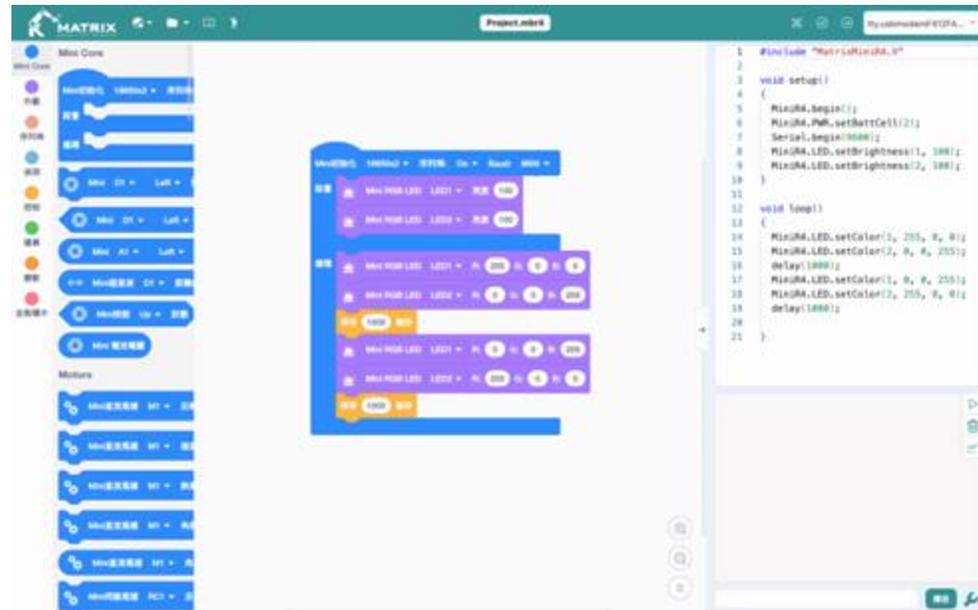
This software serves as a perfect bridge from block-based to text-based coding, making it ideal for beginners and educators. With MATRIXblock, users can seamlessly transition to advanced coding while bringing their creative ideas to life.



For MATRIX Mini R4 series set



For MATRIX Mini 2.0 series set



Interface Guide



1. Language: Tap to change the language.
2. Files: Add, open, save files, and firmware update.
3. Teaching: Basic introduction, assembly skills, sample models, sample programs.
4. File name: The name of the current file.
5. Compile verification: Compile and validate programs without equipment.
6. Compile and download the program to MATRIX Mini.
7. Robot connection port.

Interface Guide-Blocks Area

Find blocks by category and color.

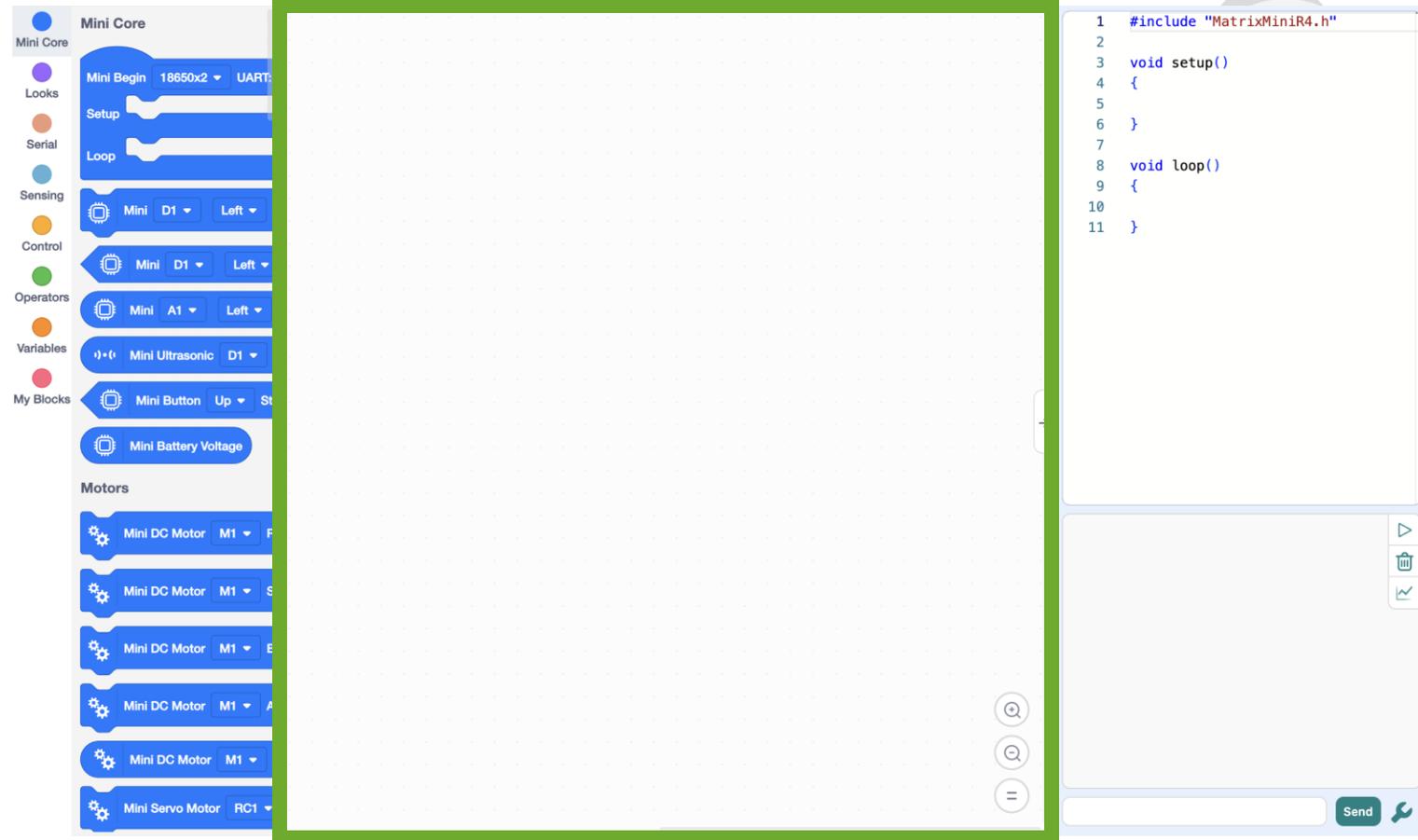
The screenshot displays the Arduino IDE interface. On the left, the 'Blocks' area is visible, with the 'Mini Core' category highlighted by a yellow border. This category includes blocks for 'Mini Begin', 'Setup', 'Loop', 'Sensing', 'Control', 'Operators', 'Variables', and 'My Blocks'. Below these are several 'Motors' blocks, including 'Mini DC Motor' and 'Mini Servo Motor'. The central workspace is a grid for assembling blocks. On the right, the code editor shows the following C++ code:

```
1 #include "MatrixMiniR4.h"
2
3 void setup()
4 {
5
6 }
7
8 void loop()
9 {
10
11 }
```

At the bottom right of the code editor, there is a 'Send' button and a refresh icon.

Interface Guide-Edit area

Drag and drop the blocks to this area for programming.



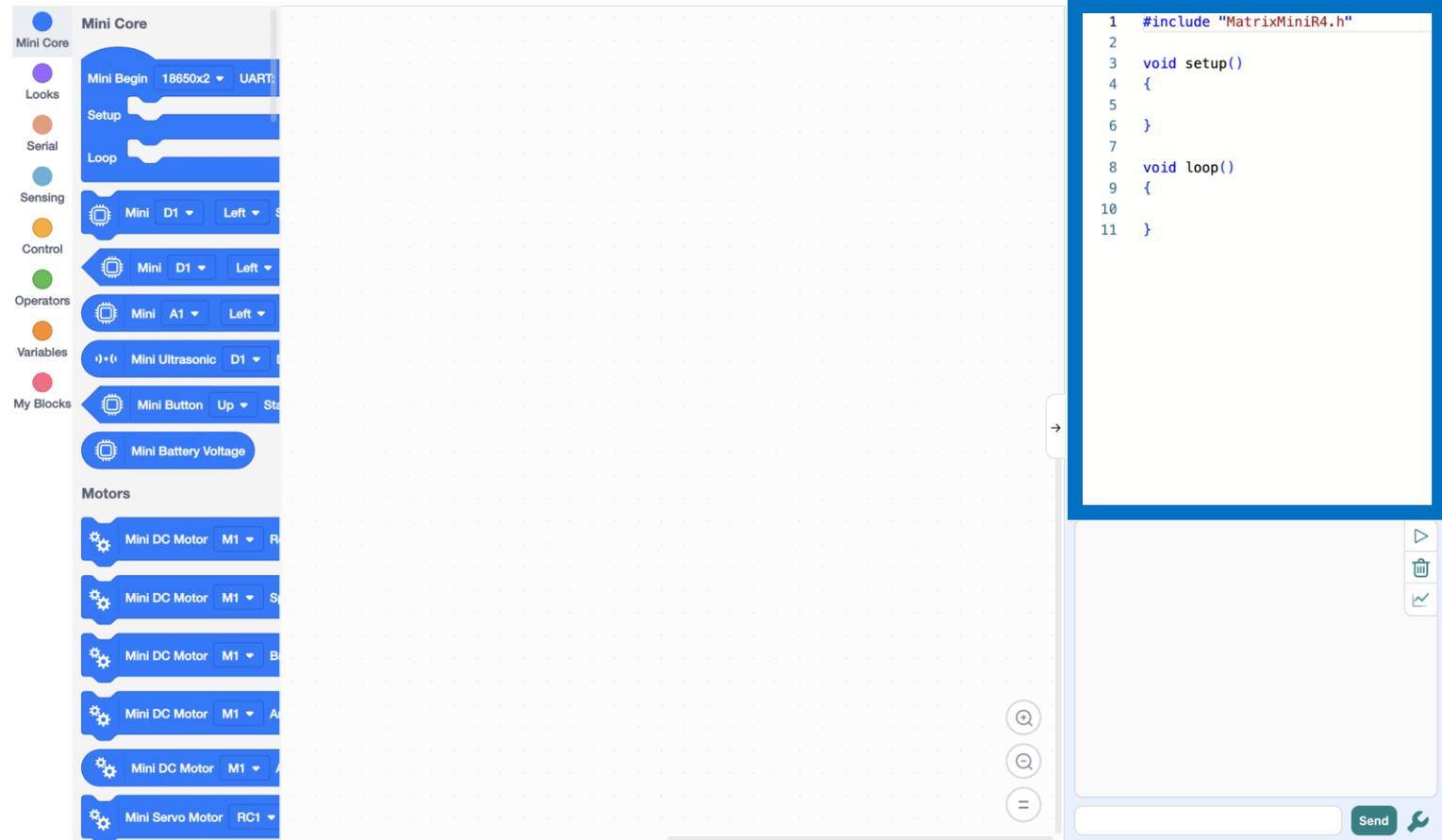
The screenshot displays the Arduino IDE interface. On the left, the 'Mini Core' block palette is visible, containing various blocks categorized by function: Mini Core (Mini Begin, Setup, Loop), Looks, Serial, Sensing (Mini D1 Left), Control (Mini D1 Left), Operators (Mini A1 Left), Variables (Mini Ultrasonic D1), My Blocks (Mini Button Up, Mini Battery Voltage), and Motors (Mini DC Motor M1, Mini Servo Motor RC1). The central workspace is a large grid for block assembly, highlighted with a green border. On the right, the code editor shows the following C++ code:

```
1 #include "MatrixMiniR4.h"
2
3 void setup()
4 {
5
6 }
7
8 void loop()
9 {
10
11 }
```

At the bottom right, there is a 'Send' button and a refresh icon.

Interface Guide- Code View

You can see the C++ code that the blocks have been converted to, or copy it to the Arduino IDE for further editing.



The screenshot displays the Arduino IDE interface in code view. On the left, a palette of blocks is visible, categorized by function: Mini Core, Looks, Serial, Sensing, Control, Operators, Variables, My Blocks, and Motors. The main workspace shows a sequence of blocks: Mini Begin (18650x2, UART), Setup, Loop, Mini D1 (Left), Mini D1 (Left), Mini A1 (Left), Mini Ultrasonic (D1), Mini Button (Up), Mini Battery Voltage, Mini DC Motor (M1), and Mini Servo Motor (RC1). On the right, a code editor window shows the C++ code generated from these blocks:

```
1 #include "MatrixMiniR4.h"
2
3 void setup()
4 {
5
6 }
7
8 void loop()
9 {
10
11 }
```

Interface Guide- Information Window

Use the serial port to communicate with the robot.

The screenshot displays the Arduino IDE interface for a Mini Core. The left sidebar is organized into several categories:

- Mini Core:** Mini Begin (18650x2 UART), Setup, Loop.
- Looks:** (empty)
- Serial:** (empty)
- Sensing:** Mini D1 Left
- Control:** Mini D1 Left
- Operators:** Mini A1 Left
- Variables:** Mini Ultrasonic D1
- My Blocks:** Mini Button Up, Mini Battery Voltage
- Motors:** Mini DC Motor M1 Right, Mini DC Motor M1 Stop, Mini DC Motor M1 Back, Mini DC Motor M1 Forward, Mini DC Motor M1 Stop, Mini Servo Motor RC1

The main workspace shows a code editor with the following C++ code snippet:

```
1 #include "MatrixMiniR4.h"
2
3 void setup()
4 {
5
6 }
7
8 void loop()
9 {
10
11 }
```

A purple box highlights the 'Send' button in the bottom right corner of the code editor, which is used to upload the code to the robot.

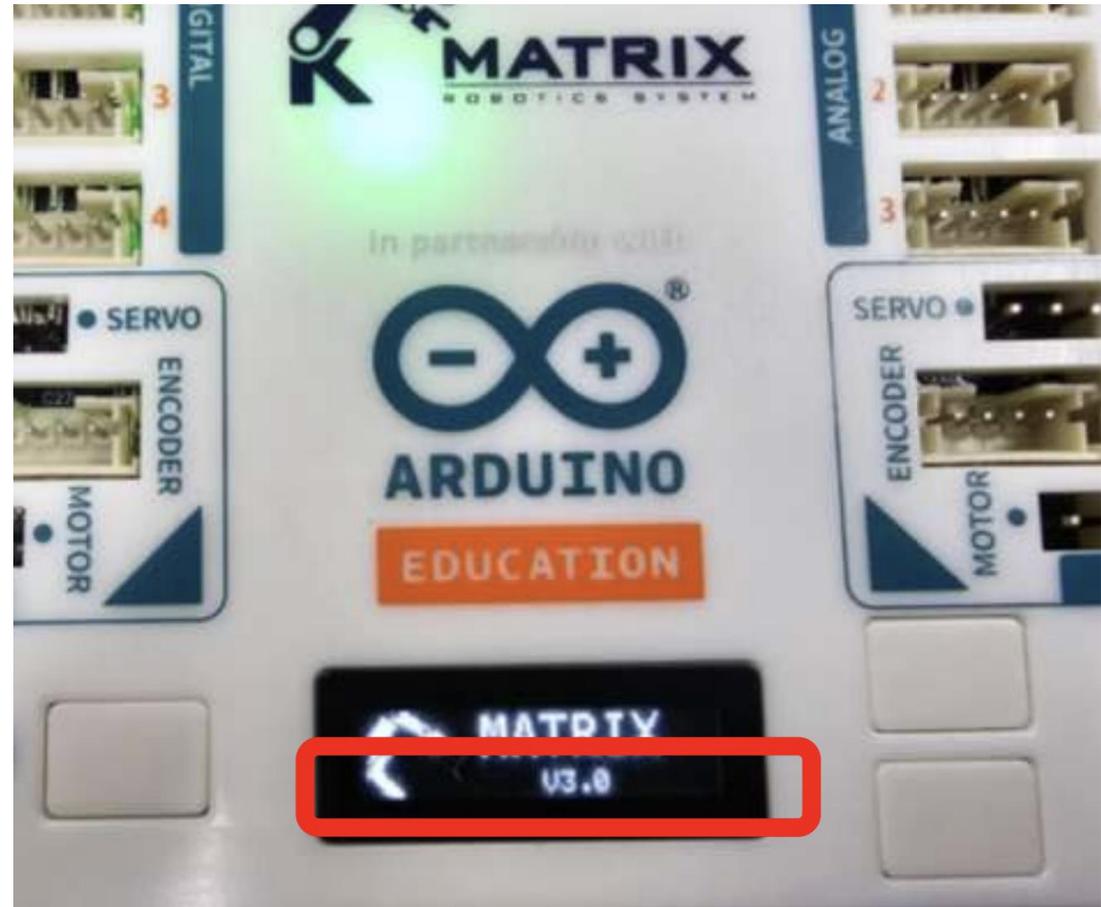


Firmware Update

Step0 – Firmware Version Check

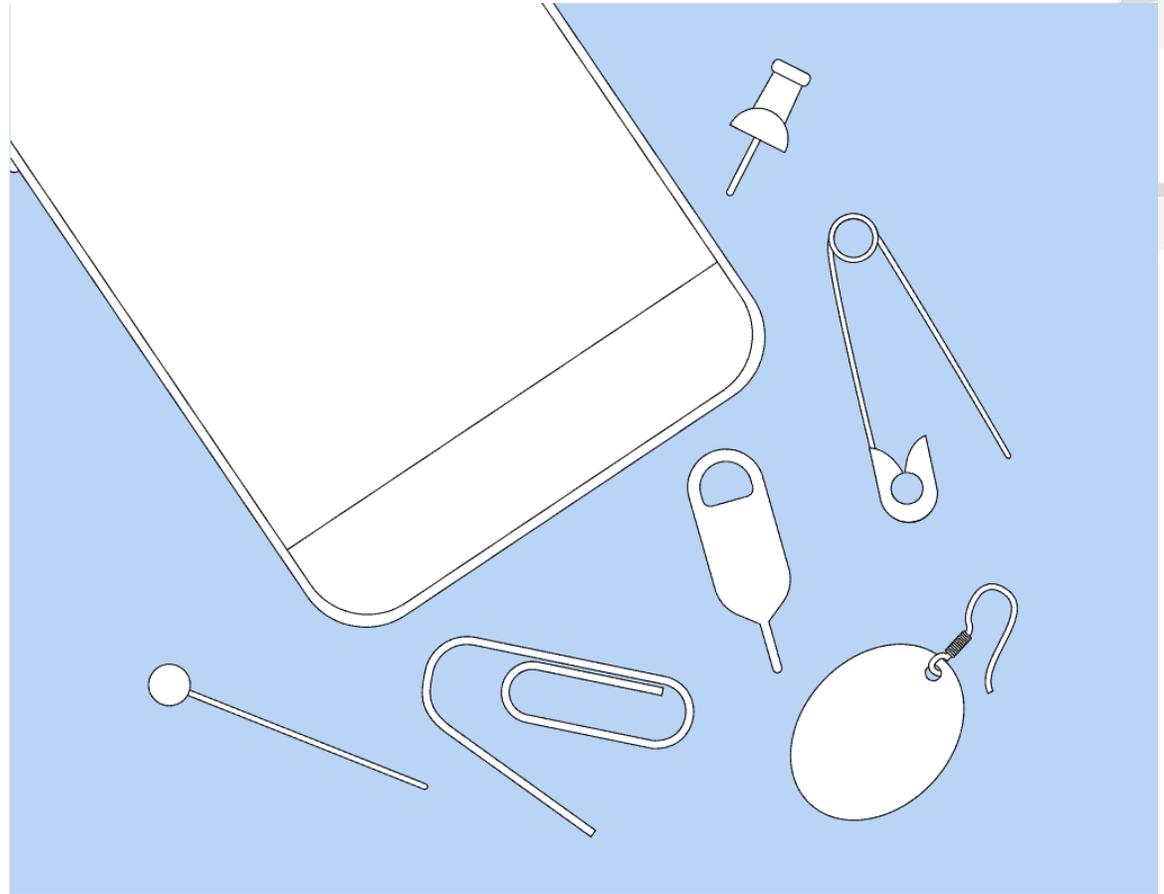
While Power On/Reset the Mini R4 Controller, you can see the firmware version on OLED Screen.

If firmware is not latest, you might need to upgrade your device to have best experience of Mini R4.



Step1 – Prepare a Tool

Find a paperclip, SIM card pin, small pen or a similar small pin tool.



Step2 – Remove Power

Disconnect the Device from both the battery and USB power.



Step3 – Connect USB to the computer

Connect the USB cable to the computer first.



Step4 – Press the DFU button

Insert the paperclip into the DFU mode pinhole on the Device.

(Usually located on the side of the device, near by USB)



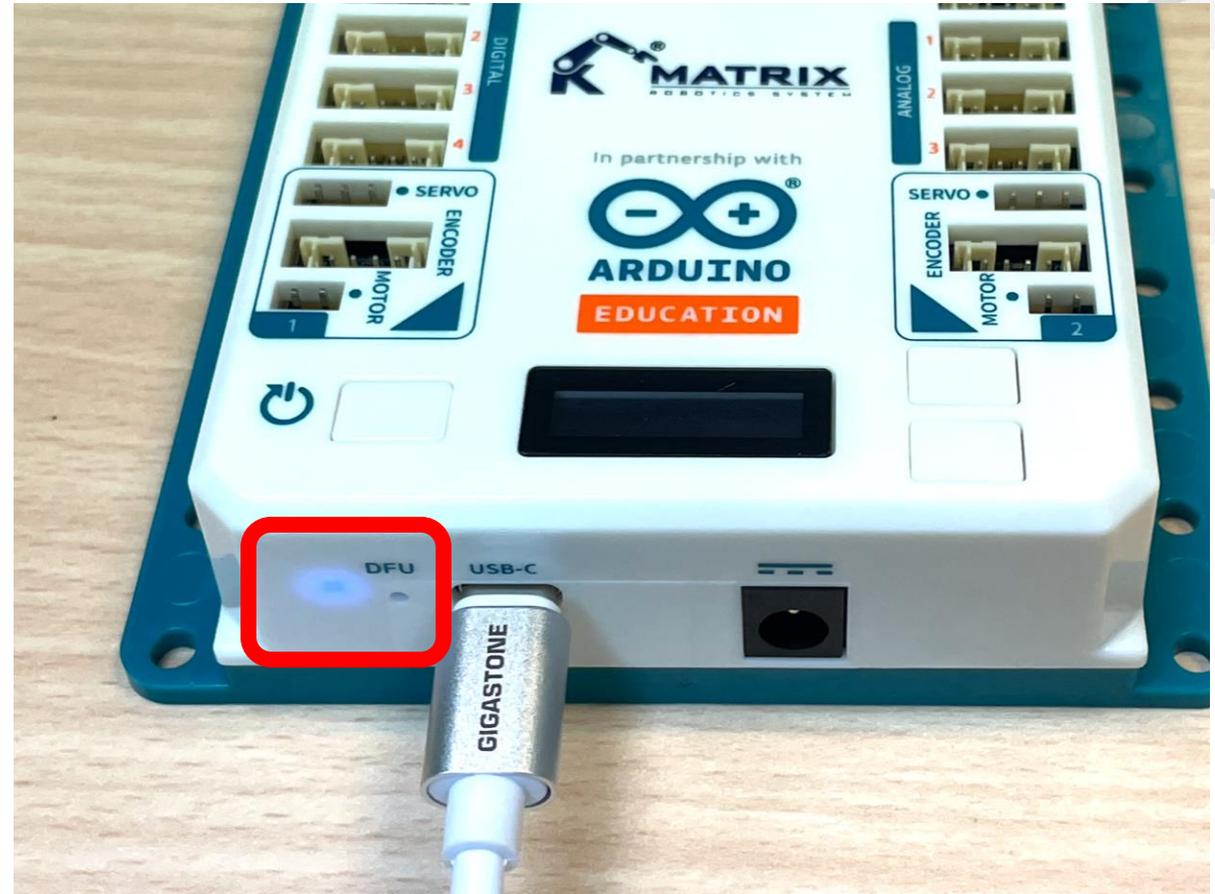
Step5 – Connect USB to the Device

While holding the paperclip in the DFU pinhole, plug the other end of the USB cable into the Device.



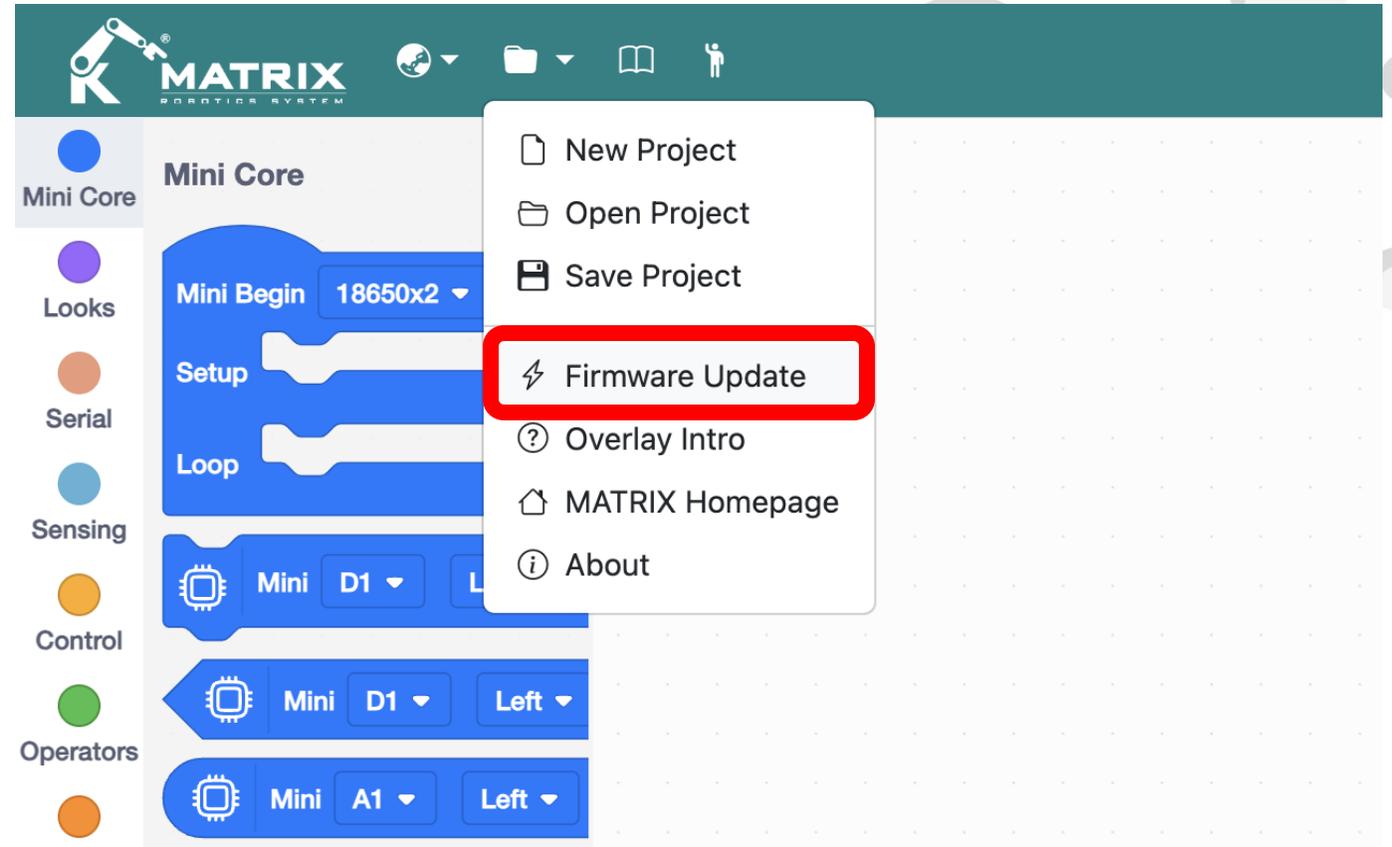
Step6 – Confirm in DFU mode

If the blue LED near the pinhole starts flashing, the device has successfully entered DFU mode.



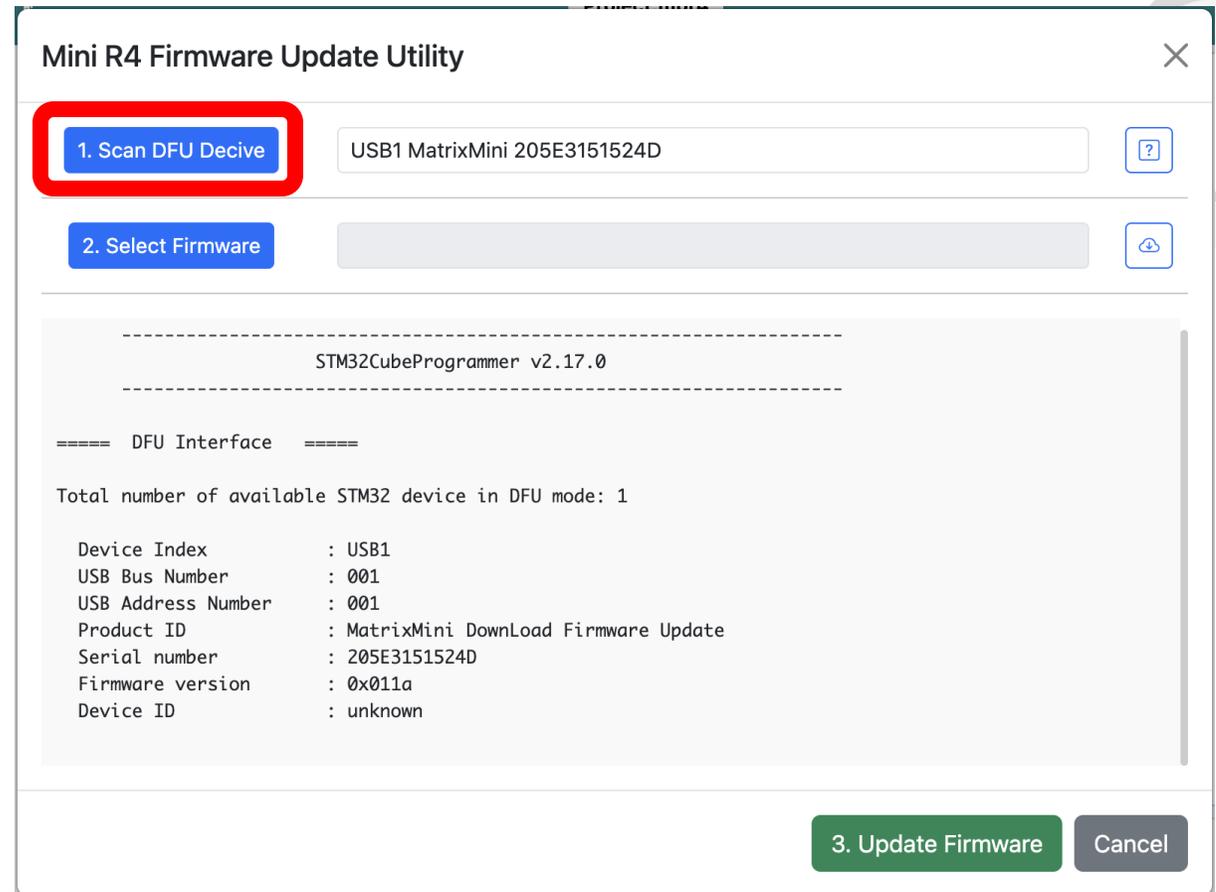
Step7 – Open the Software

Choose the Firmware Update in the MATRIXblock.



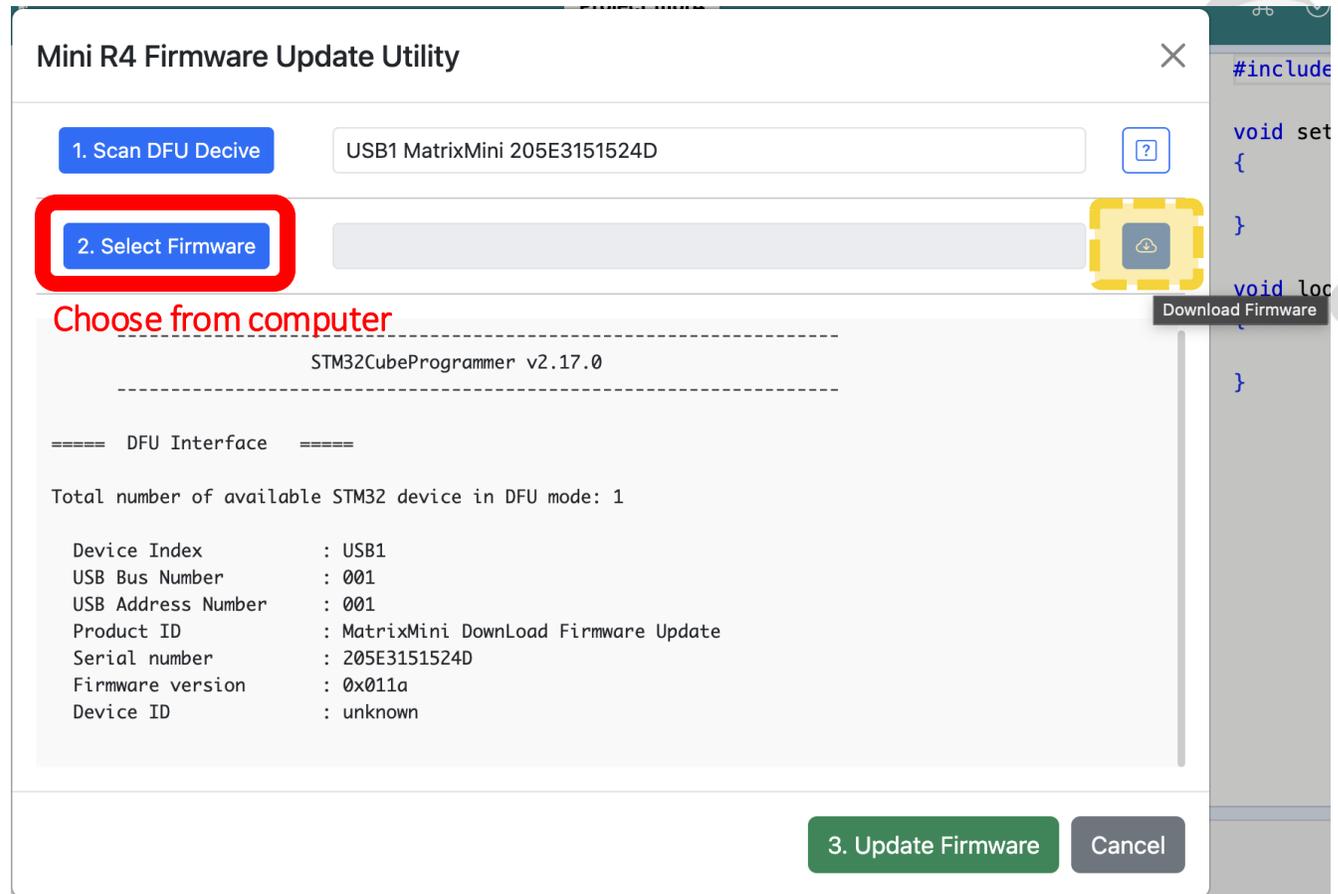
Step8 – Scan DFU Device

Click **1. Scan DFU Device** to confirm the device is recognized.



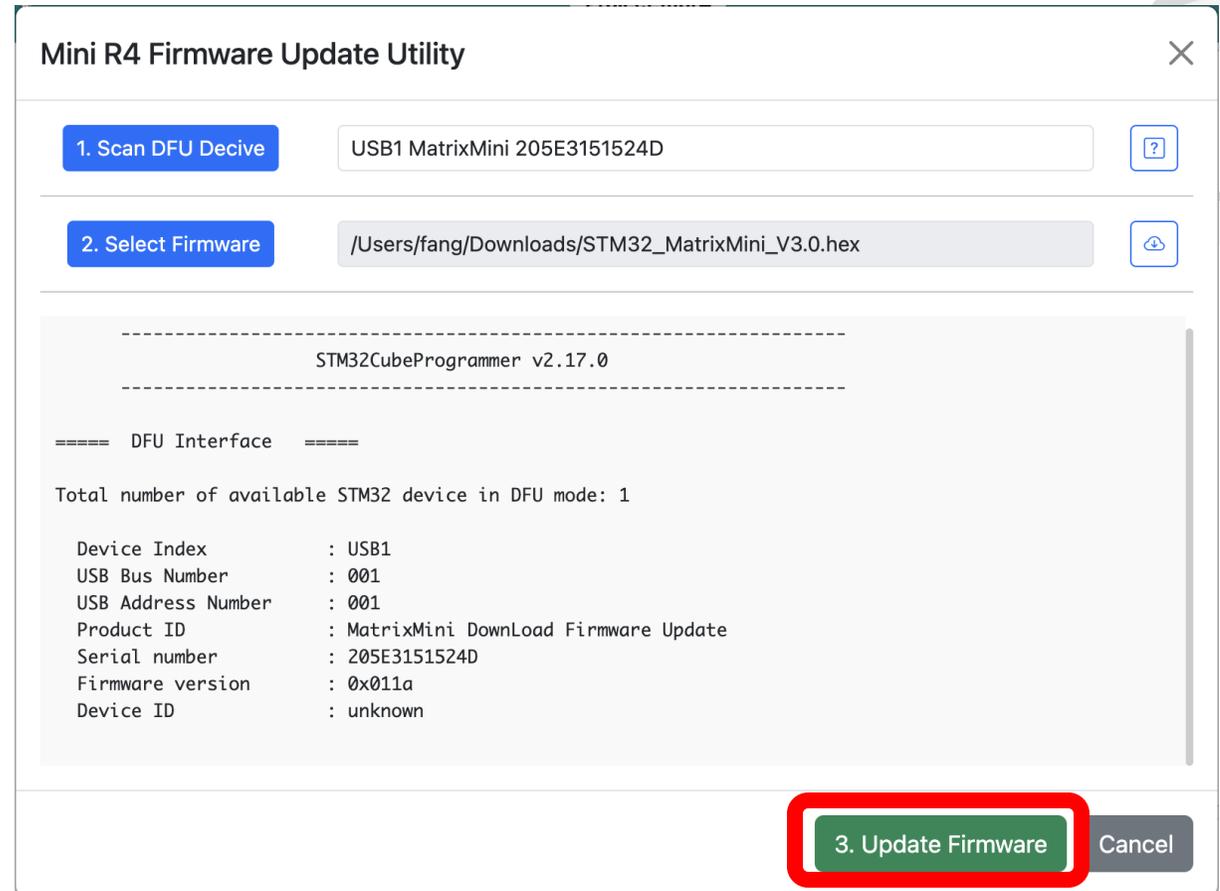
Step9 – Select Firmware

Click 2. Select Firmware to select the firmware on your computer or go online to download the latest firmware.



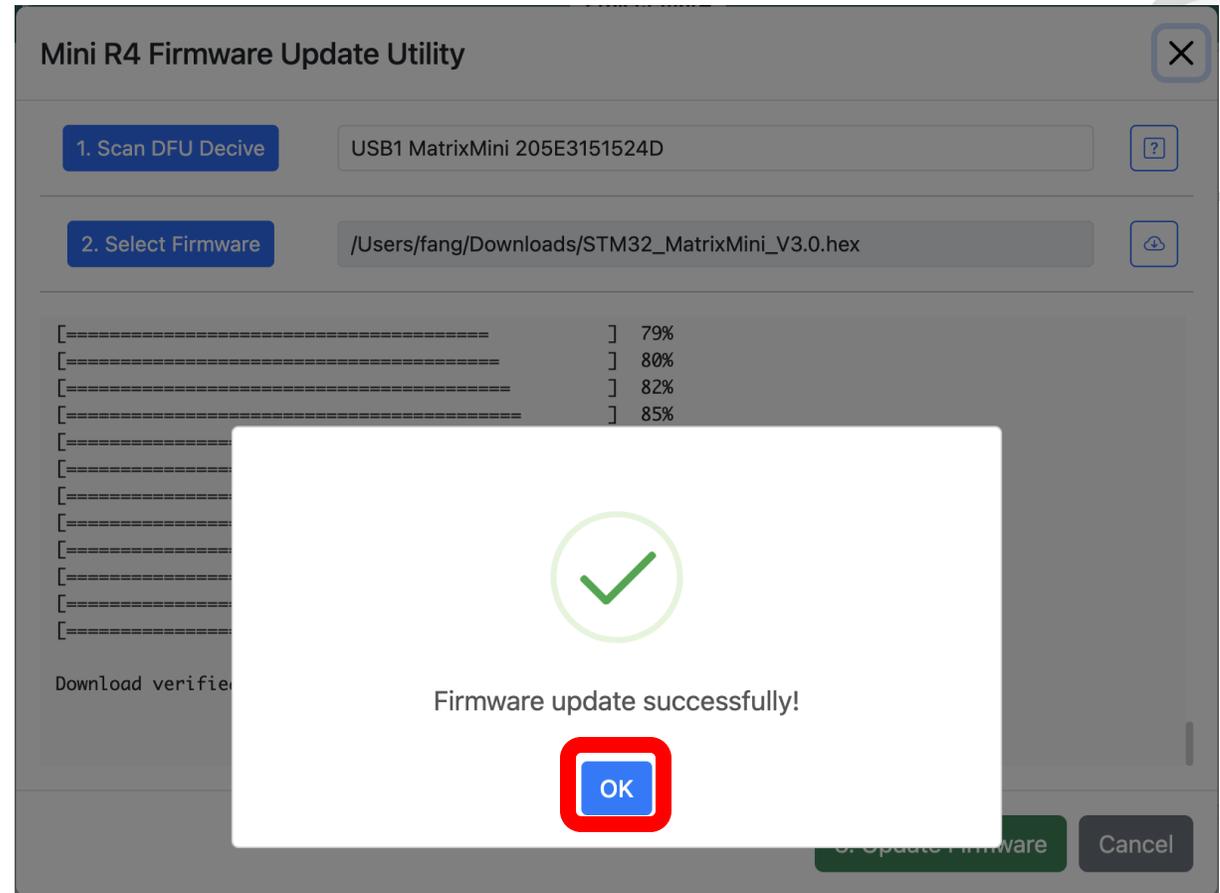
Step10 – Update Firmware

After selecting the firmware, click on 3.Update Firmware ◦



Step11 – Finish updating the firmware

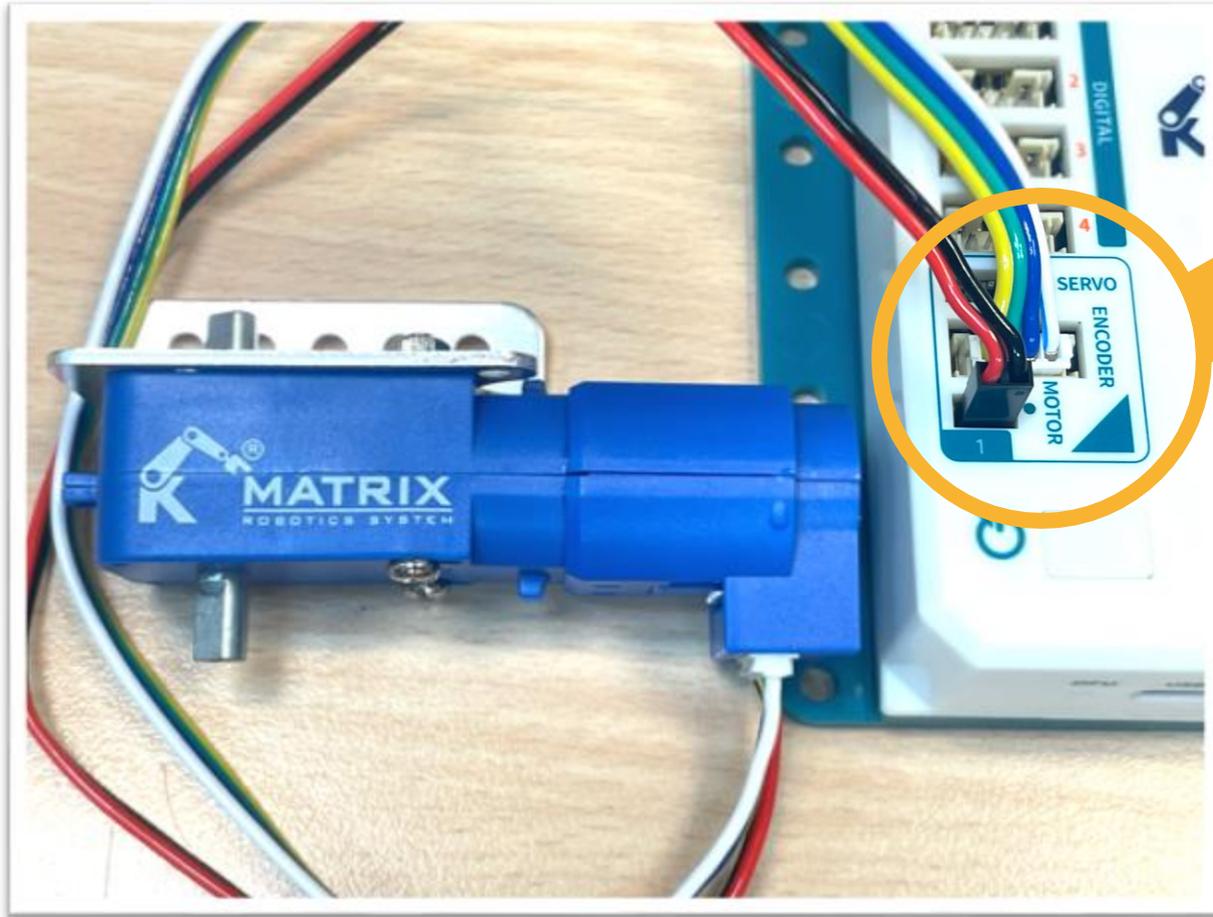
Disconnect and reconnect the Mini R4 Controller.





How to Drive Motors

Connect the DC Motor



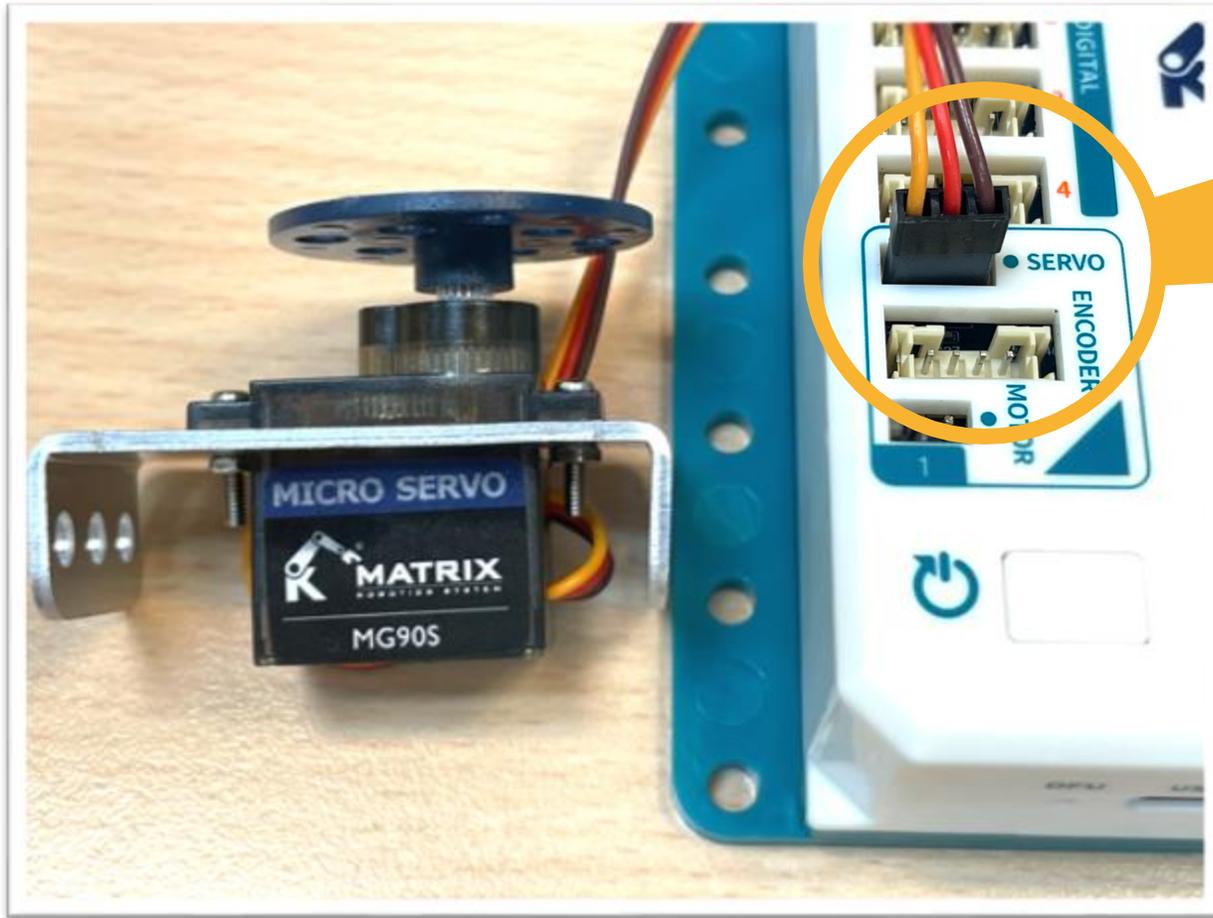
Using the wired to connect the DC Encoder motor and the Mini R4.

If used external motor, connect the wires to the Mini R4 in the following order.

DC MOTOR PORT	1	M-
	2	M+

ENCODER	1	CH B
	2	CH A
	3	M5V
	4	GND

Connect the RC Servo



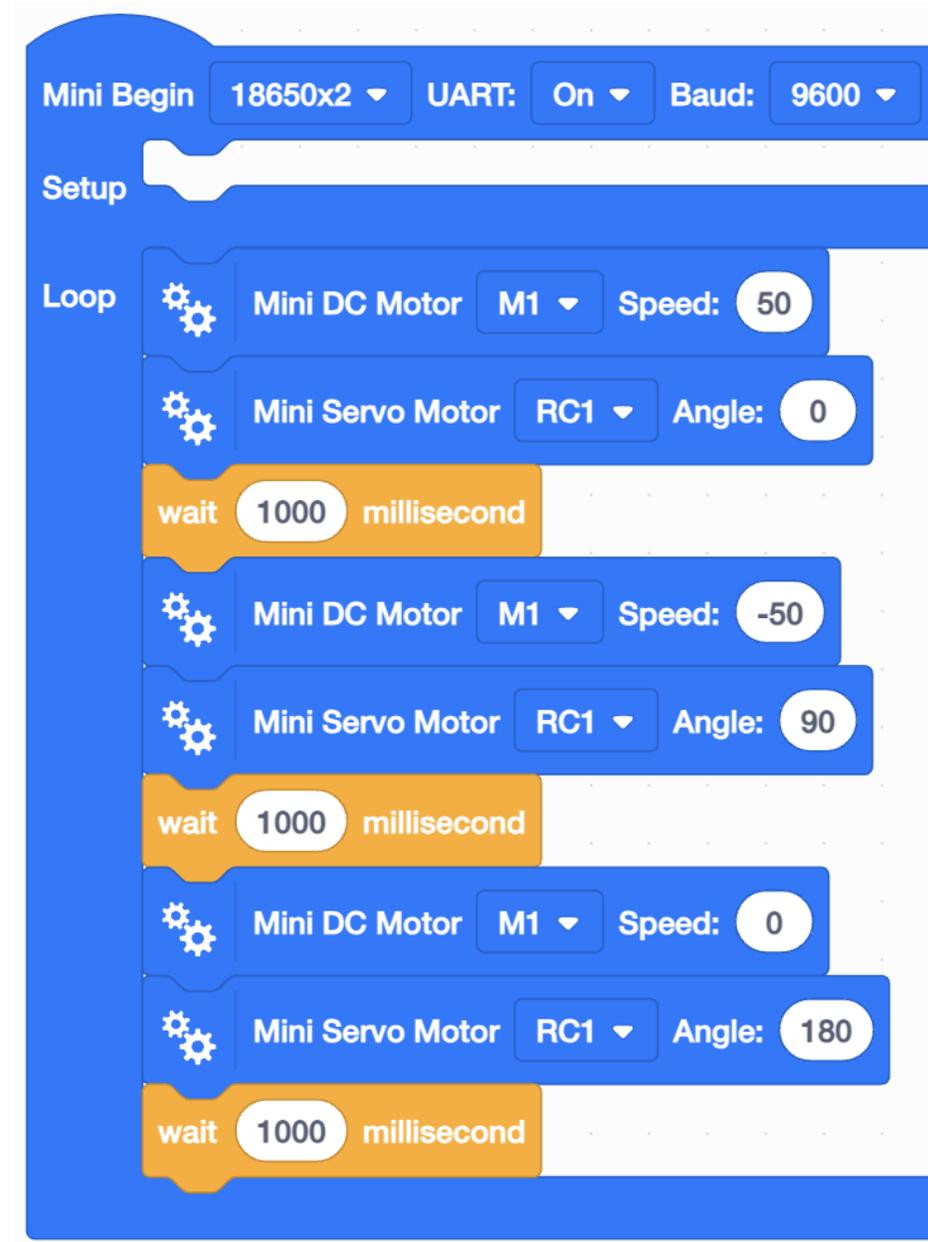
Using the wired to connect the RC Servo and the Mini R4.

If used external servo, connect the wires to the Mini R4 in the following order.

RC SERVO PORT	1	GND
	2	M5V
	3	PWM

Programming

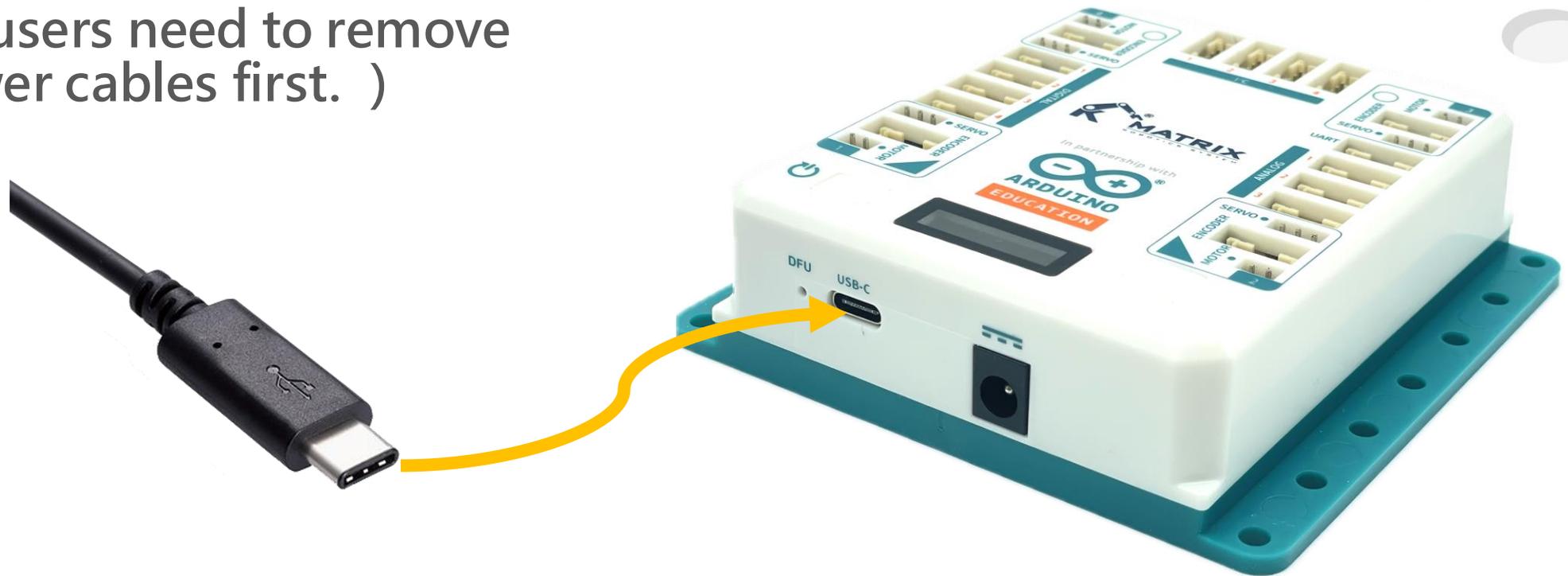
Programming a motor and a servo to work.



Connect to the Computer

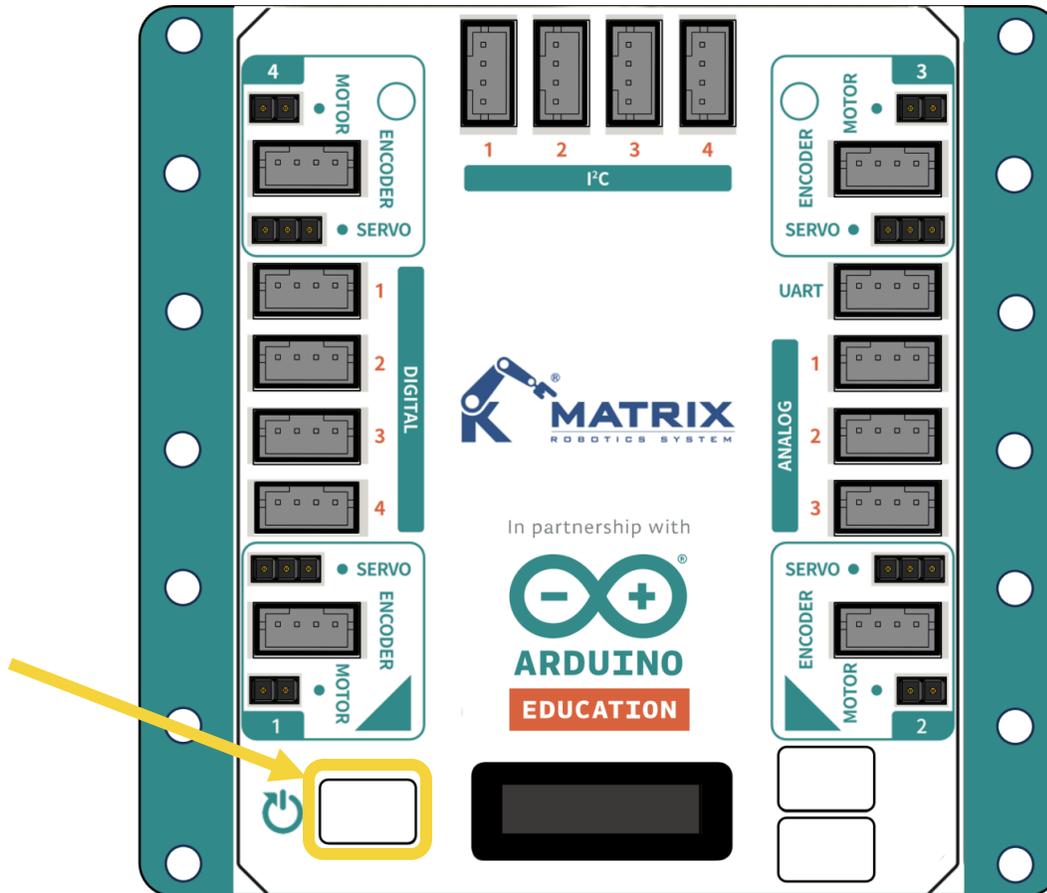
Connect the controller to the computer using a USB cable.

(Mac users need to remove the power cables first.)



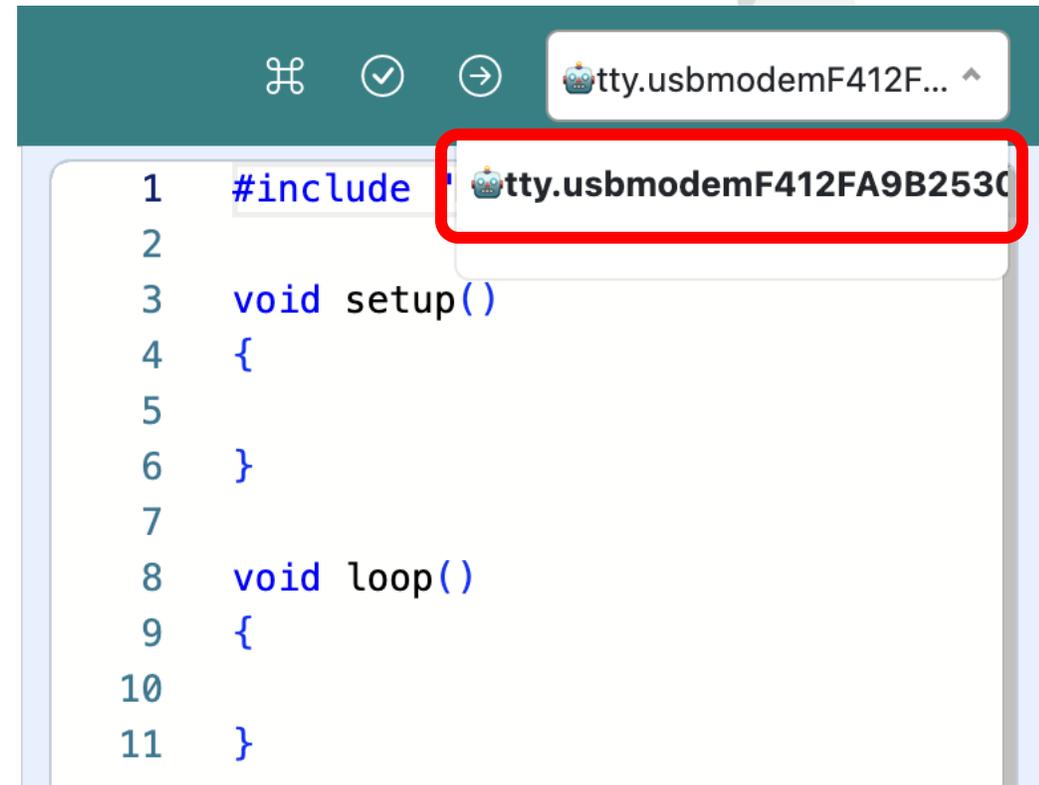
Switch on the Mini R4

Press and hold the Reset Button to switch on the Mini R4.



Choose COM port

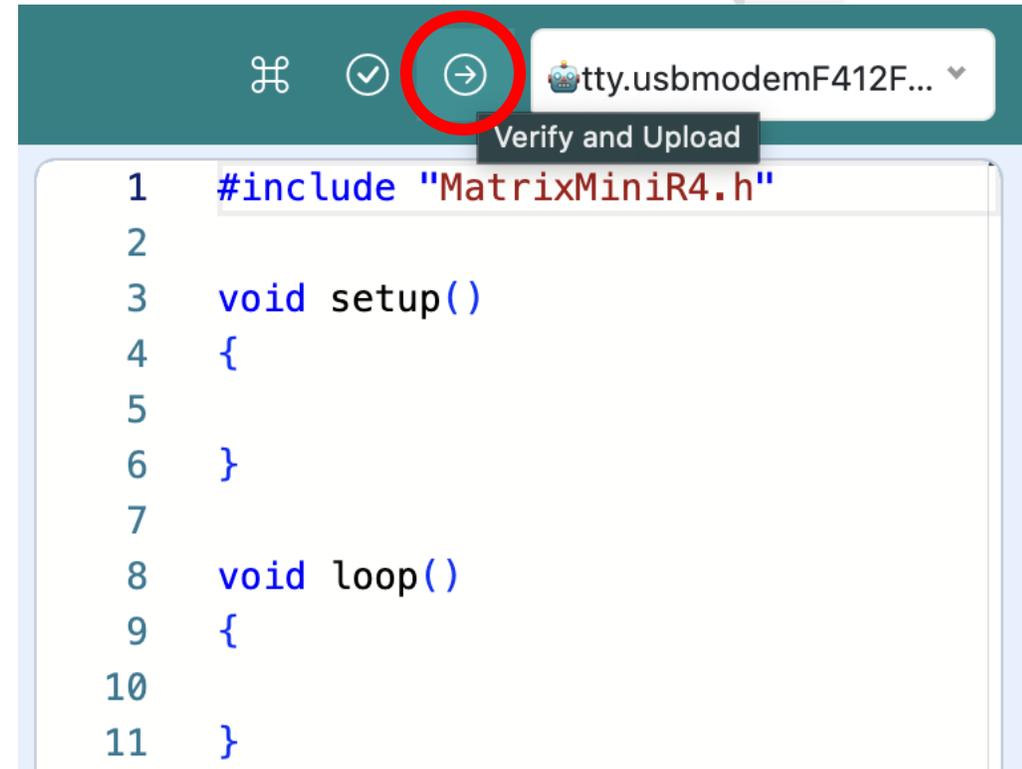
The Mini R4 controller is usually the one with the robot symbol in the COM list.



```
1  #include <Arduino.h>
2
3  void setup()
4  {
5
6  }
7
8  void loop()
9  {
10
11 }
```

Upload the Program

6. Click “Verify and upload” in the upper right corner of the screen to upload the program to the MATRIX Mini R4 controller. ◦



The screenshot shows the upper right corner of an IDE interface. A dark teal header bar contains three icons: a grid icon, a checkmark icon, and a right-pointing arrow icon. The arrow icon is circled in red. To the right of the icons is a dropdown menu showing 'tty.usbmodemF412F...'. Below the header bar, a tooltip with the text 'Verify and Upload' is visible. The main area is a code editor with the following code:

```
1  #include "MatrixMiniR4.h"
2
3  void setup()
4  {
5
6  }
7
8  void loop()
9  {
10
11 }
```

Run the Program

Connect the battery box and press the reset button to run the program.

(Make sure the battery box has switched on)





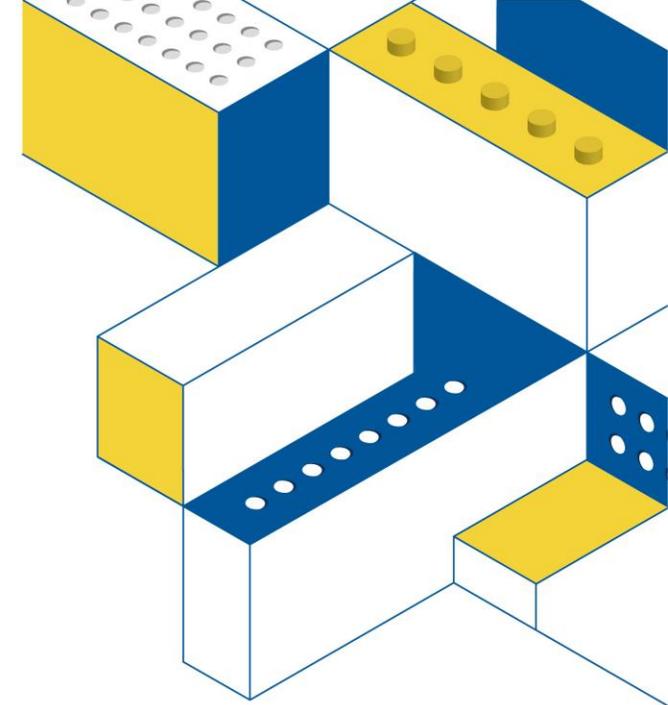
Sensors

Miniature Switch

Pressed = 1

Released = 0

Digital I/O : D1 ~ D4



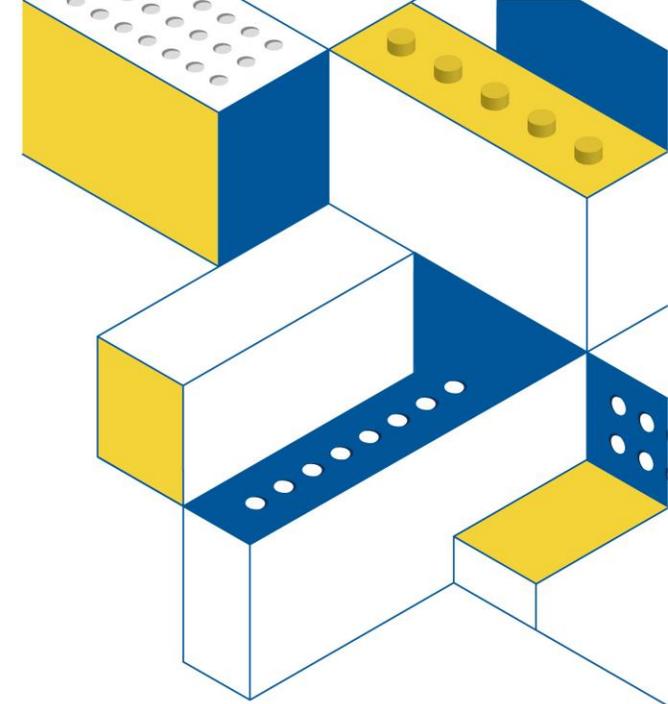
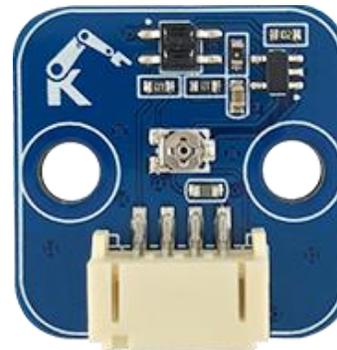
Gray Scale Sensor

Return value : 0~1023

The return value of black is larger

The return value of white is smaller

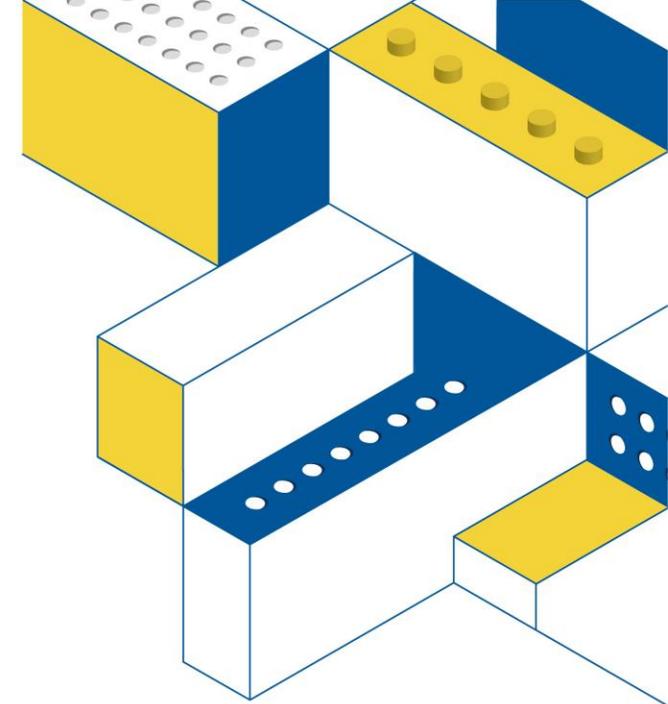
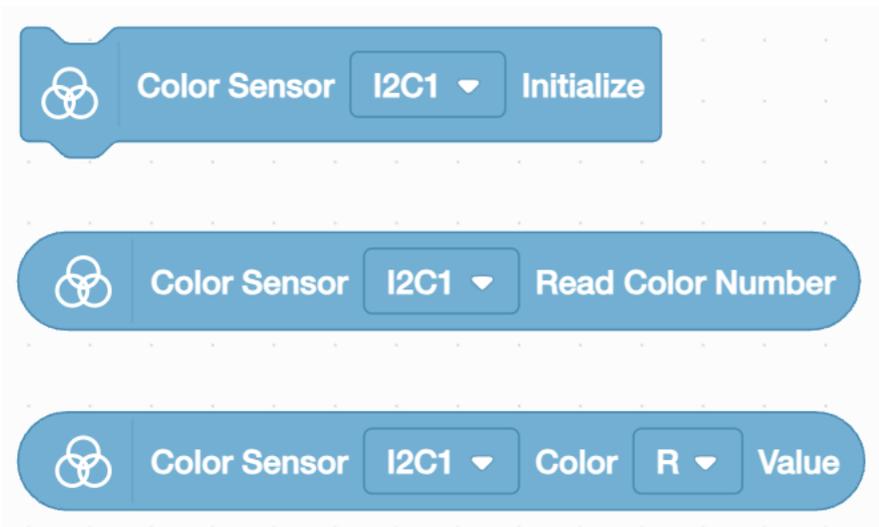
Analog ports: A1~A3



Color Sensor

Return value : R 、 G 、 B → 0 ~ 255 (Bright ~ Dark)

I²C ports : I²C1~I²C4



Laser Sensor

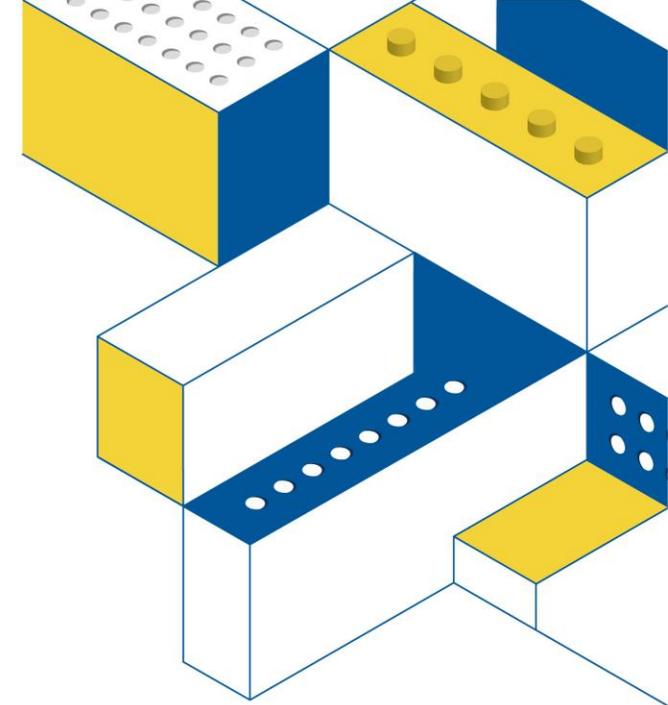
Return value : 21 ~ 1999mm

I²C ports : I²C1~I²C4

Initialize the Laser Sensor.



Read the value from laser sensor.





MATRIX Mini R4 series sets

