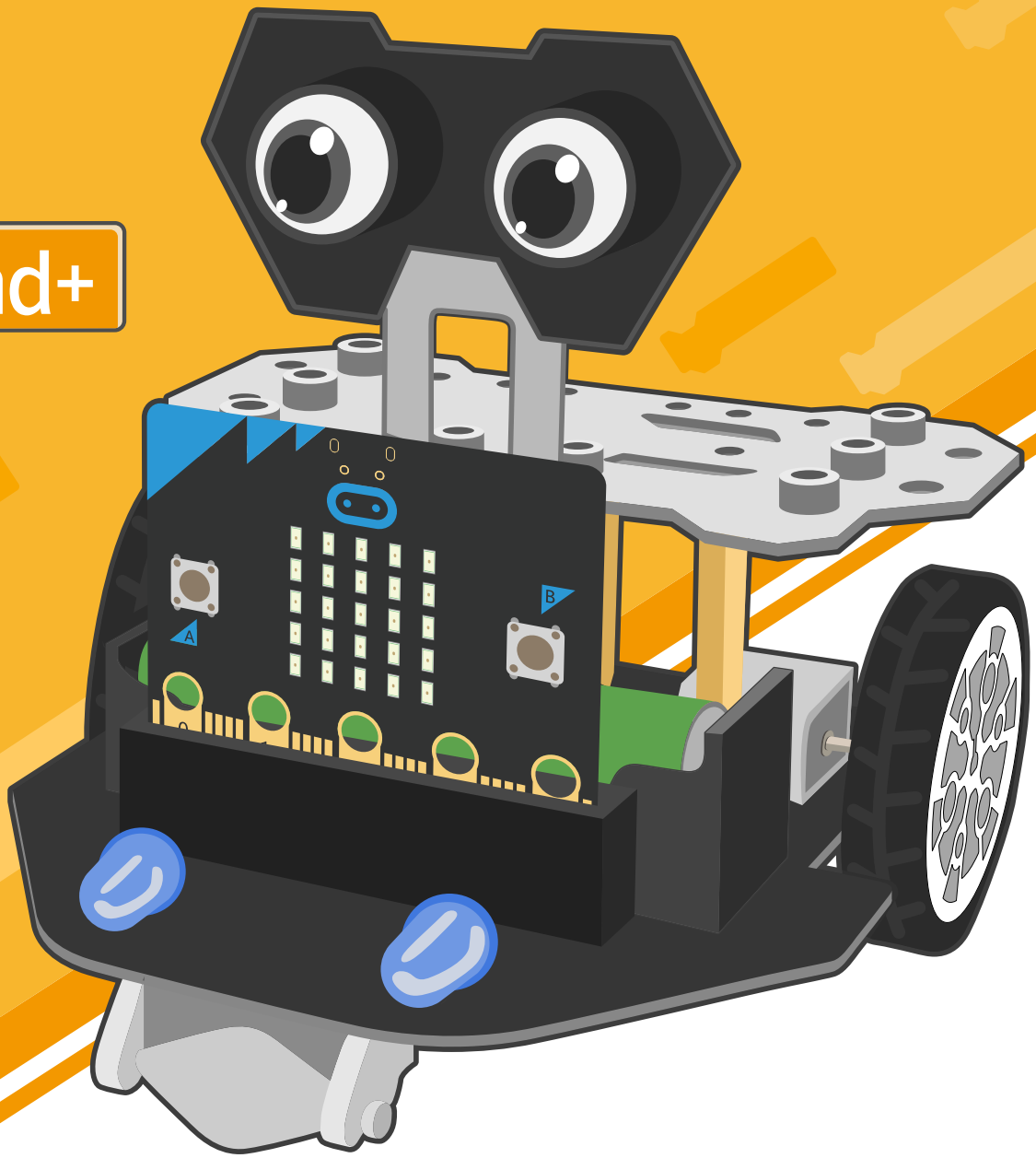
DFROBOT
DRIVE THE FUTURE

Maqueen Plus

Getting Started Tutorial

Mind+



Contents

Chapter 1

Introduction to Maqueen Plus

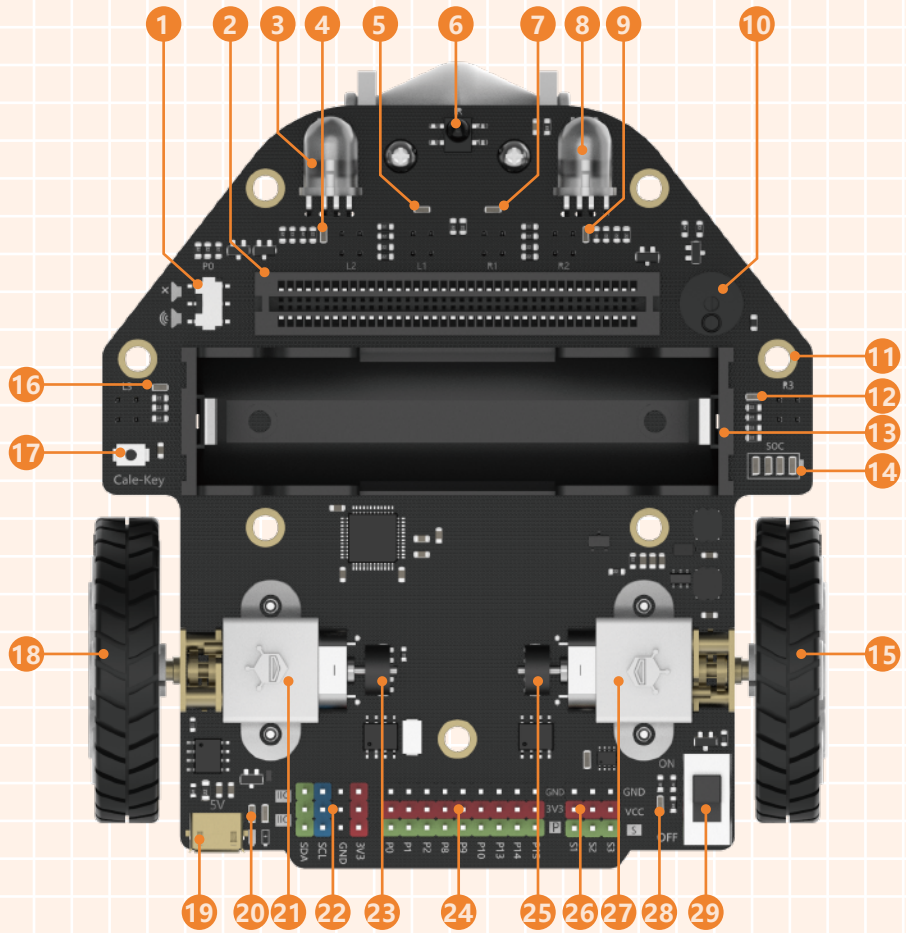
Introduction

What is Maqueen Plus?

Maqueen Plus is a smart programmable educational robot designed for beginners. It supports Mind+ and Make-Code programming platforms, on which we can program Maqueen Plus to realize awesome functions by simply dragging and snapping the graphical blocks. Follow Maqueen Plus to enter the world of robotic, and while learn something about coding in playing!

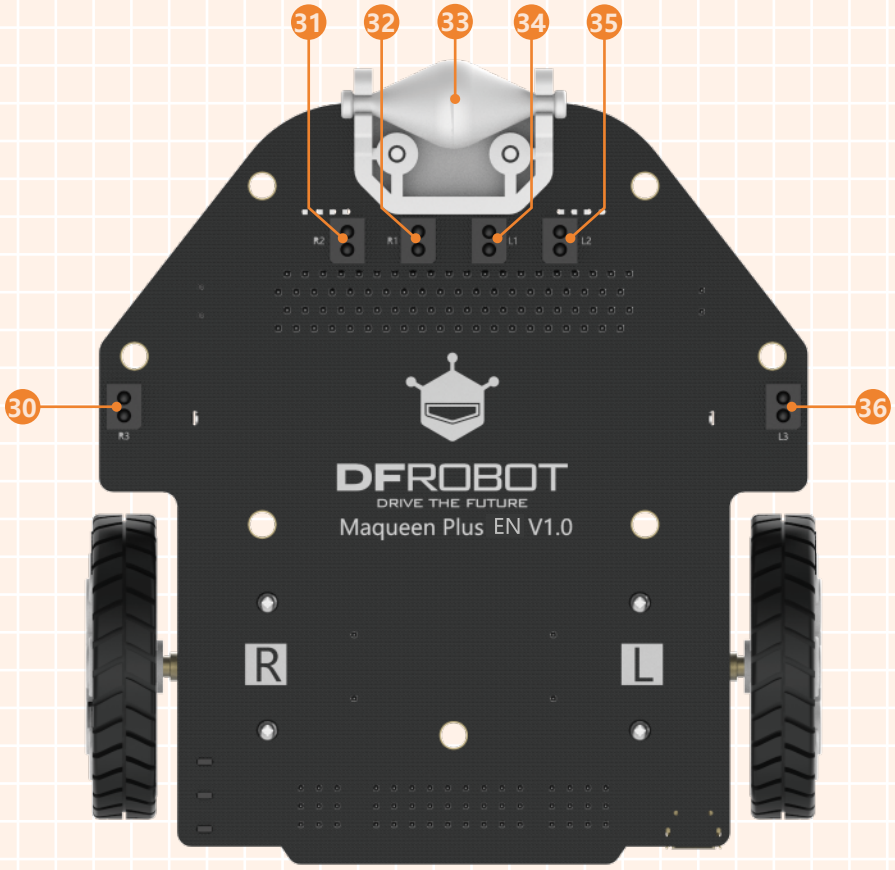
Before we get started, let's see what Maqueen Plus has got there.

Front view for Maqueen Plus main-board



1 Buzzer switch
2 micro:bit socket
3 RGB-LED-L
4 L2 indicator LED
5 L1 indicator LED
6 Infrared receiver
7 R1 indicator LED
8 RGB-LED-R
9 R2 indicator LED
10 Buzzer
11 M3 Mounting holes
12 R3 indicator LED
13 Battery case
14 Electricity indicator LED
15 Right wheel
16 L3 indicator LED
17 Line-tracking Calibration Key
18 Left wheel
19 Charging port
20 Charging indicator LED
21 Motor-L
22 IIC expansion port
23 Encoder-L
24 GPIO port
25 Encoder-R
26 Servo port
27 Motor-R
28 Power supply indicator LED
29 Power supply switch

Back view for Maqueen Plus main-board

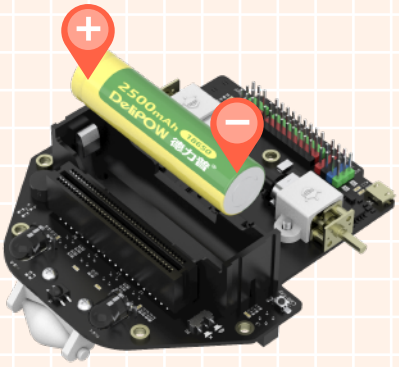


30 R3 line-tracking sensor
31 R2 line-tracking sensor
32 R1 line-tracking sensor
33 Support wheel
34 L1 line-tracking sensor
35 L2 line-tracking sensor
36 L3 line-tracking sensor

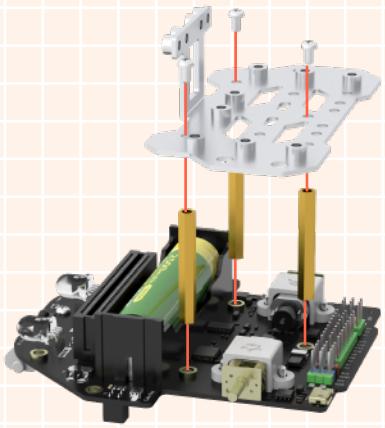
We can see that Maqueen has equipped with so many functions, and now you must can't wait to try them. OK, here we go!

Assembly

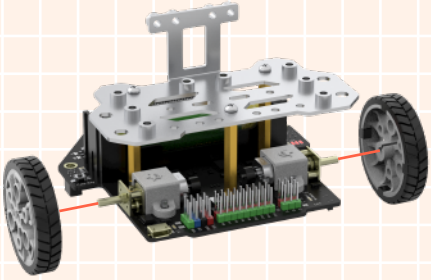
Maqueen Plus Assembly Diagram



1 Install 18650 battery

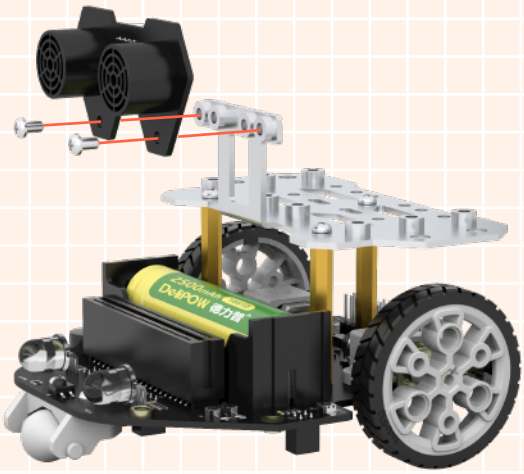


2 Install the expansion bracket

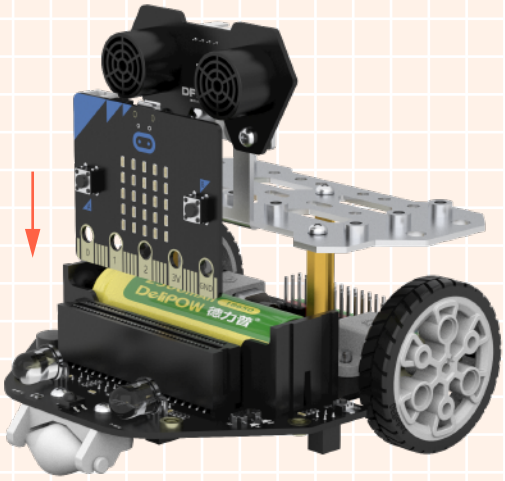


3 Install wheels

Maqueen Plus Assembly Diagram

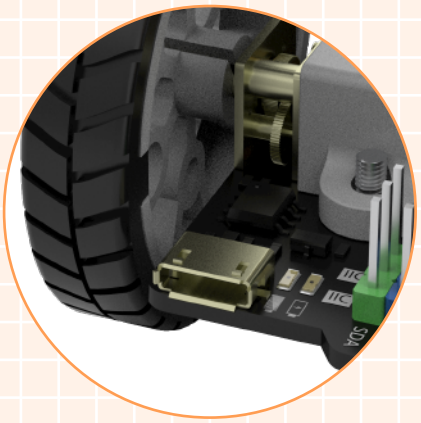


4 Install ultrasonic sensor



5 Plug in micro:bit board

Battery indicator



Charging port

Note: when the battery is fully charged, all LEDs will be on. The LEDs will be off one by one as the power gradually decreases. If all lights go out, the battery needs to be recharged.

After we assembled Maqueen Plus, put it aside because first, we need to get familiar with it's most important controller device---micro:bit. Just like the CPU in a computer, micro:bit is Maqueen's "brain" for storing and processing data, which also is the key to make Maqueen Plus "alive".

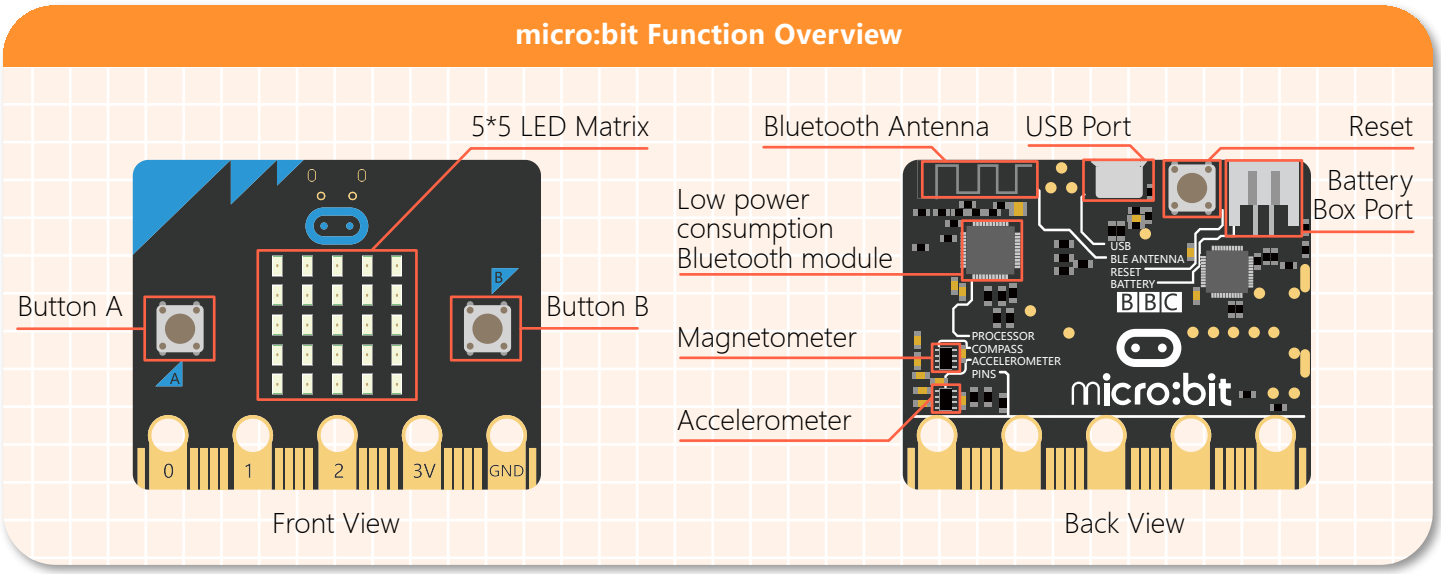
Introduction to micro:bit

What can micro:bit do?

The micro:bit can be programmed to do various interesting things, it can be a digital watch, fitness tracker, or a game console. The device features 25 LED lights and two programmable buttons, which can be used in game-play or to skip through tracks in a playlist. It also features an on-board compass to track the direction of the wearer...
In addition, micro:bit is equipped with commonly-used sensors like light sensor, temperature sensor, etc. It can be widely used in computer games, acousto-optic interactions, robotics, scientific experiments, wearable device and so on.

micro:bit Function

On the credit card size board, it has 25 LED lights, two programmable buttons, light sensors, accelerometer, compass, temperature sensor, and Bluetooth module and so on.



25 programmable LED Lights	Display patterns, words, and numbers
2 programmable Buttons	Used separately or together to make things happen. For example, press down A to display a heart pattern.
Light Sensor	The 25 LEDs can act as sensors to measure how much light is falling on the micro:bit.
Accelerometer and Compass	Measure the gestures or forces in 3 dimensions.
Temperature Sensor	Detect the temperature in the current environment.
Bluetooth & Radio	Your micro:bit can communicate with other micro:bits by radio, and with other devices using Bluetooth.

micro:bit Programming

micro: bit has many supported graphical programming software, such as: Mind+, MakeCode, python, Scratch and other editors to write code. The Mind+ software itself has many sensors, and only need to drag the graphical block to complete the programming.

This tutorial mainly uses Mind+ for programming, and then we will learn how to use Mind+.

Mind+ graphic programming

Mind+ Introduction

Mind+ is a graphical Programming platform that can support all kinds of open source hardware such as Arduino, micro: bit. It is not only suitable for primary and secondary school students, but also able to provide a great learning environment for makers who want to improve themselves by studying high-level Programming language such as Arduino, python, c, c++ etc. Drag and combine code blocks to make programs, easy to find the joy of creating.

From beginners to experienced makers, Mind+ can satisfy all your needs: learning Programming, running programs without downloading, experiencing IoT(Internet of Things), sharing ideas with Mind+ community and so on.

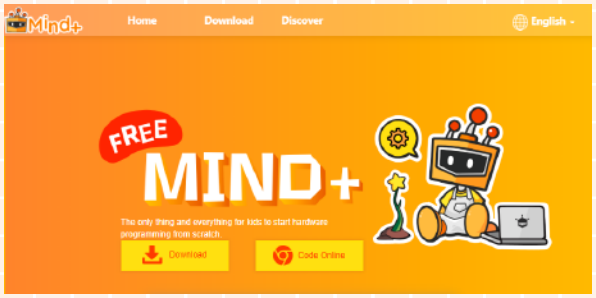
Come and play with Mind+, more surprises waiting for you!

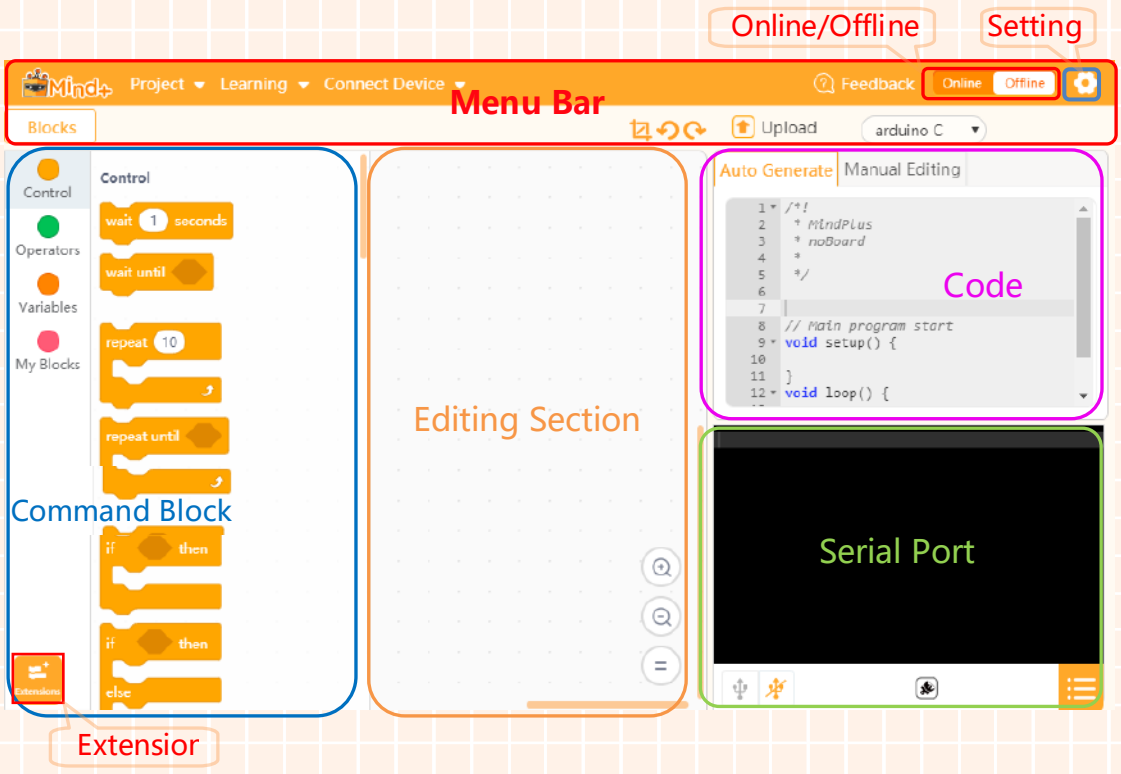
Build Up Programming Environment

Download Mind+ Programming Software (The tutorial is based on Mind+ V1.6.3)

Open the webpage and download: http://mindplus.cc

To convenient the operation, first we should be familiar with the basic functions of the software's interface. If we compare the Mind+ software as a stage, what are the functions of its different sections?





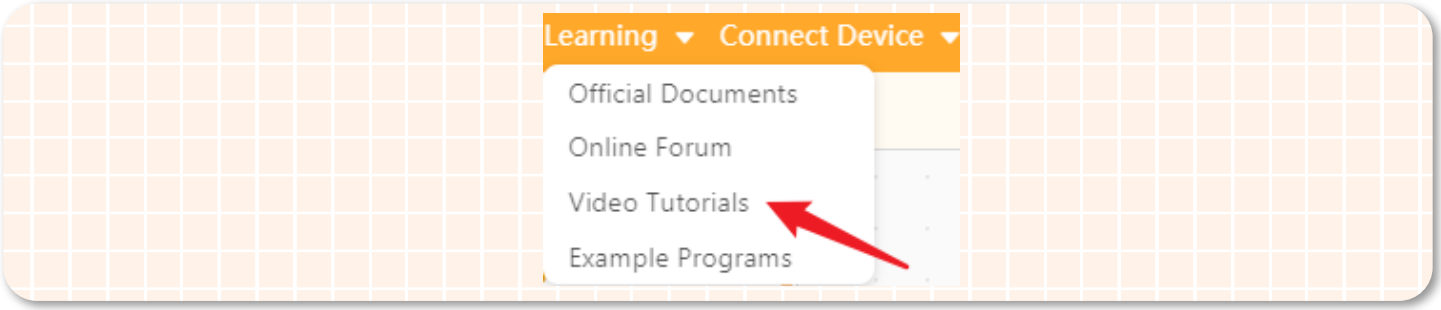
Name	Function
Menu Bar	Project: create a new project, load a project, save a project, save a project as. Learning: where you can find lots of useful tutorials and examples programs. Connect Device: detect the connected device, and you can select to connect or disconnect the device.
Online/Offline	Online/Offline icon:switch mode to run program. Online: The executable program in the script area is executed in real time on the hardware and Mind + stage. Offline: upload the program to the hardware device for execution;
Setting	Setting: set the theme and language of the software; share and learn on our community or E-mail us your feedback.
Command Blocks	Blocks: This is the "tool section" of the stage. We need all kinds of tools to give an excellent performance on the stage.
Extensions	Expand icon: You can choose more additional props to support various hardware programming.

Editing Section	Programming Editor: Just drag the code blocks in the "Command" to here then you can program.
Code	Code: If you want to check the codes of the blocks in the "script", this is the right place.
Serial Port	Serial port: open/close, scroll display open/close, clear output, baud setting, serialport input and output format control. Black area: can display the download status, for example, you can see the running status of the program, display serial communication data, etc.

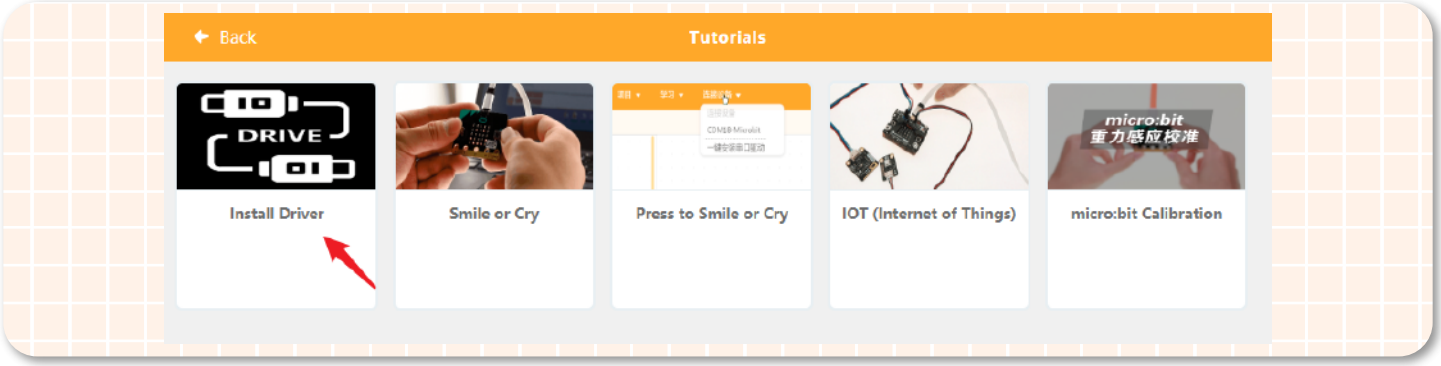
After we got a general understanding of Mind+, let's step on our journey to code! In the first example, we will learn how to write and download a program.

1.Install Driver

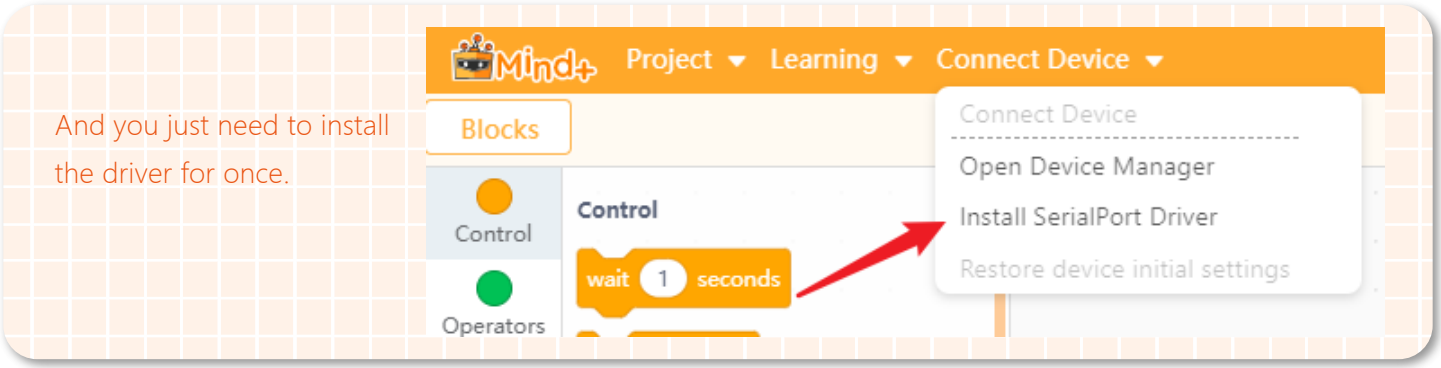
Step 1: Click to open Learning ->Video Tutorials.



Step 2: Click the related tutorial, and play the video.

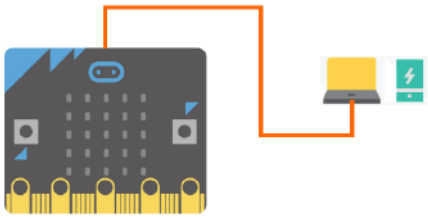


Step 3: Install the SerialPort driver according to the instruction.

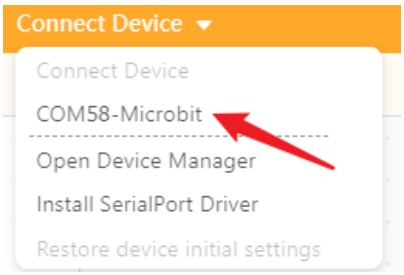


2.Prepare to download

Connect the micro:bit board to your computer by a USB cable. There will be a hard-disk named micro:bit appearing in your computer when the connection is successful.



Click “Connect Device” in the menu bar, then click “COM-microbit” in the drop-down menu to connect micro: bit board to the computer.



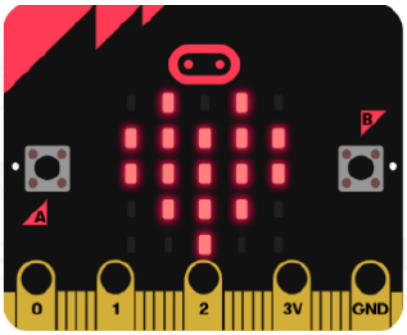
3.Download

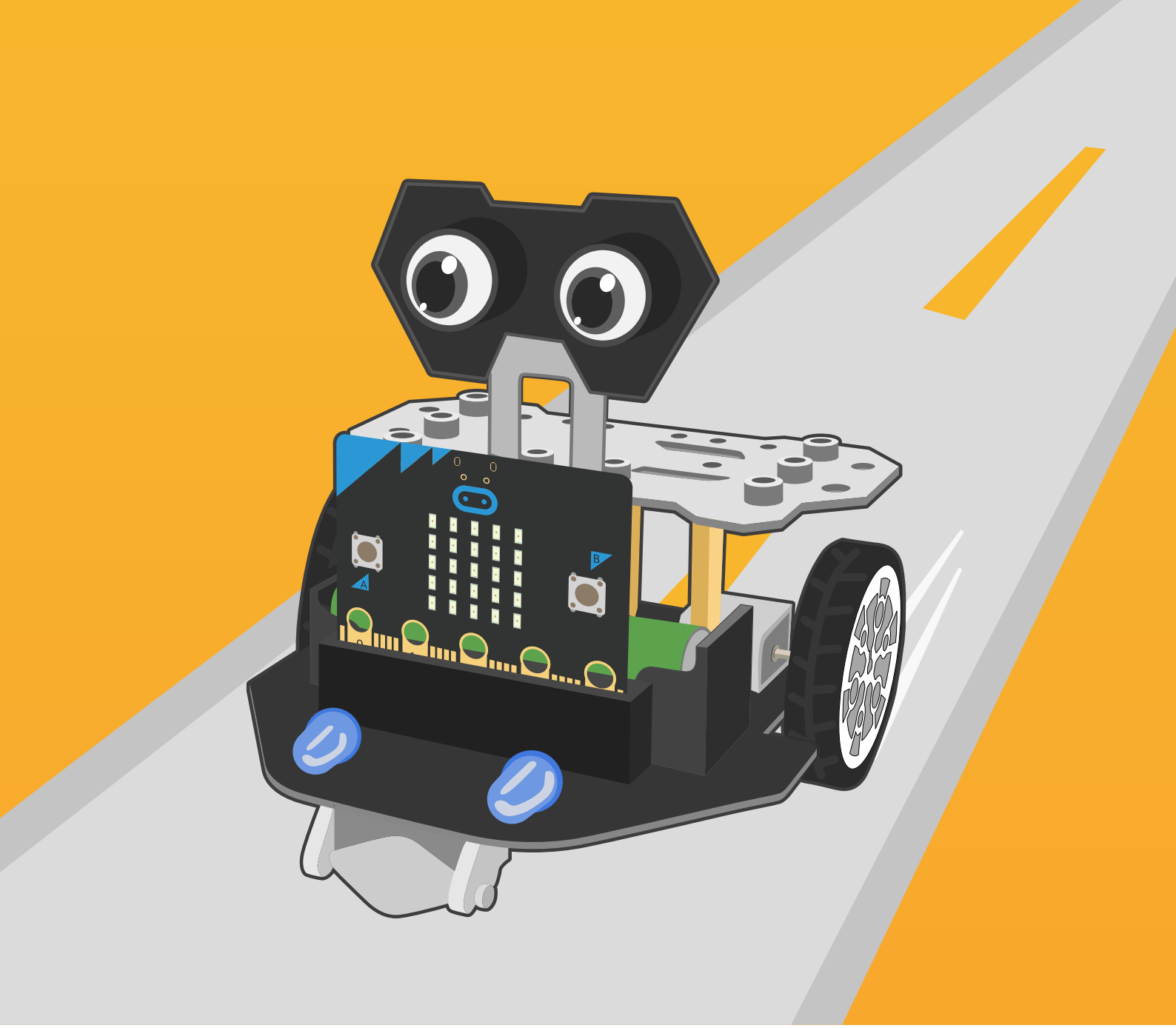
When connected, edit your programs and click “Upload” to upload the programs to your board (if the connection fails, then it will prompt “No Device Connected”) There will be a prompt box to display the uploading progress. When the program is updated, the prompt box will disappear.

Note: when downloading a program, the micro:bit power indicator will keep flashing, and please do not disconnect the USB cable.

4.Once the downloading is completed, the micro:bit LED screen will show a heart pattern.

Since we have learned the basics about Maqueen Plus, micro:bit and Mind+ programming, so for the next chapter, we are going to write a program to let micro:bit to drive Maqueen Plus.





Chapter 2

Let’ s move, Maqueen!

Here is our Maqueen Plus, look at this cool guy! You must be wanna play with him right now. Ok, let’s get started.

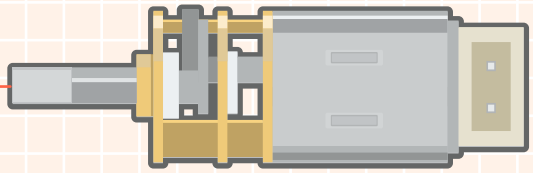
Goal

Learn how to drive a motor.

Electronic Component

Motor Brief

Motor



Motors can be used to drive Maqueen Plus to move left, right, backward, or go straight.

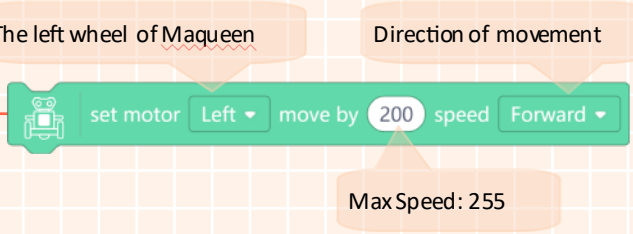
Command Learning

Block Brief

Forever

Repeats the code forever in the background. On each iteration, allows other codes to run.

Motor Controlling

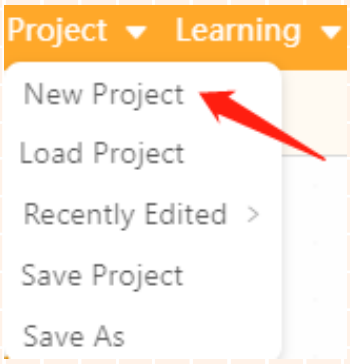


Control the speed and direction of the motor.

Hands-on Practice

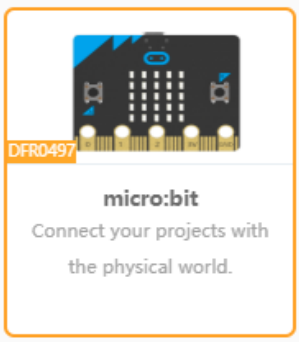
Step 1: Create a new project

Open the Mind+, click "Project" -- "New project" to create a new project.

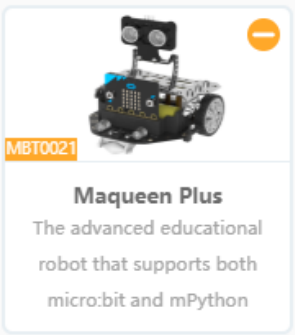


Step 2 Add the Maqueen Plus

1、Select "Expansion"-"Main Control Board" -- "micro: bit" main control board, the selection is as follows:



2、Continue to click on the"expansion board " -- " Maqueen Plus ", the selection is as follows:

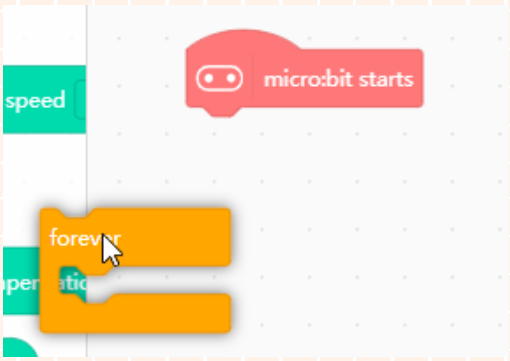


When the Maqueen Plus is loaded successfully,there will be a icon" Expansion Board " appearing in the command block section. Click the icon then you will see all the related blocks.

Refer to the attached document to check the detailed description of these blocks.

Step 3 Programming

1.Delete the block we don't need currently.

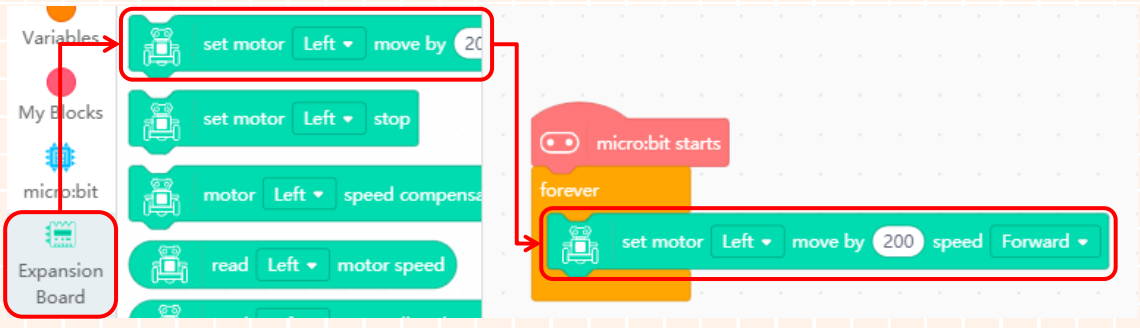


Knowledge Expansion

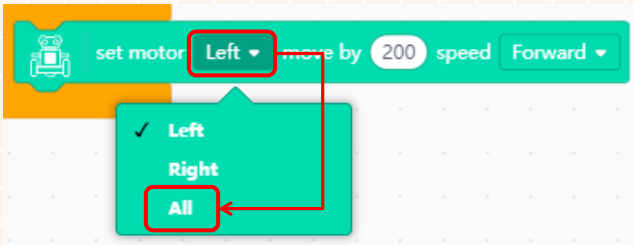
How do we delete blocks?

Hover your mouse pointer over the block, then the pointer will become "✋"; left-click to select the block, the pointer becomes" ✊ "; when you drag the block to the command section, it will become" ↖ ", then release the mouse to remove the block.

2.Embed the motor control block into the "forever" block.



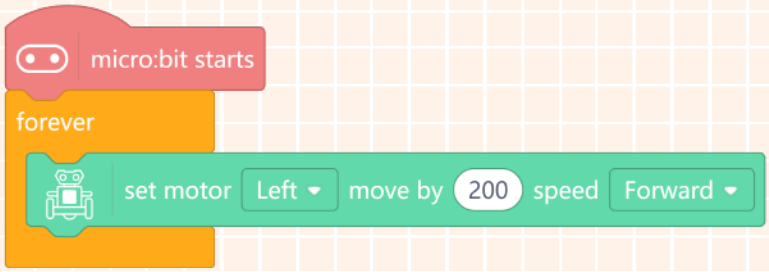
3.Change the "left" to "all" in the motor block to let Maqueen' s both wheels to move at the speed of 200.



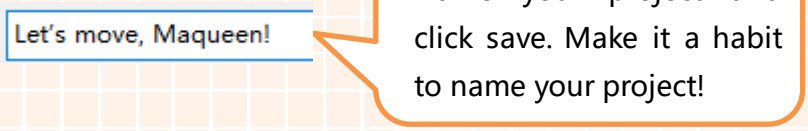
Knowledge Expansion

Most blocks can be used repeatedly, and the block with "▼" has multiple options for users to choose from. Besides, you can change the number in the"200" by typing or dragging the slider.

4.The complete program is shown below.



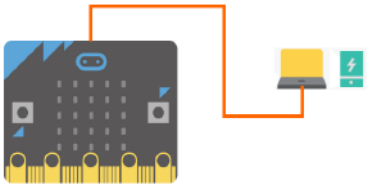
5.Save and name the project as "Let's move, Maqueen".



Step 4 Download a Program

1.Connect to a Computer

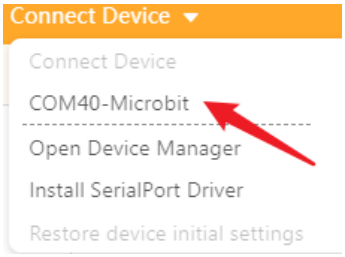
Connect micro: bit board to your computer via USB, then the power indicator on the board will light up.



2.Download the program

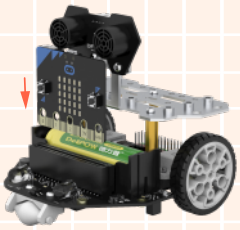
Click "Connect Device" in the menu bar, then click "COM-Microbit" in the drop-down menu to connect micro: bit board to the computer.

When connected, edit your programs and click "Upload" to upload the programs to your board (if the connection fails, then it will prompt "No Device Connected".) There will be a prompt box to display the uploading progress. When the program is updated, the prompt box will disappear.



3.Install the micro:bit Board

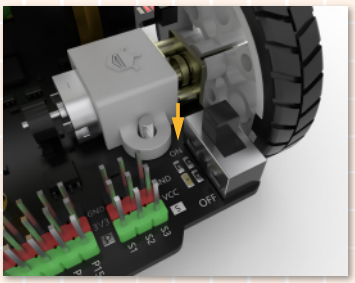
After downloading the program, plug the micro:bit board into Maqueen Plus. Keep the LED matrix face forward, shown as below:



Step 5 Effect Display

When you completed all the above steps, turn on the power switch of Maqueen Plus, then it starts running!

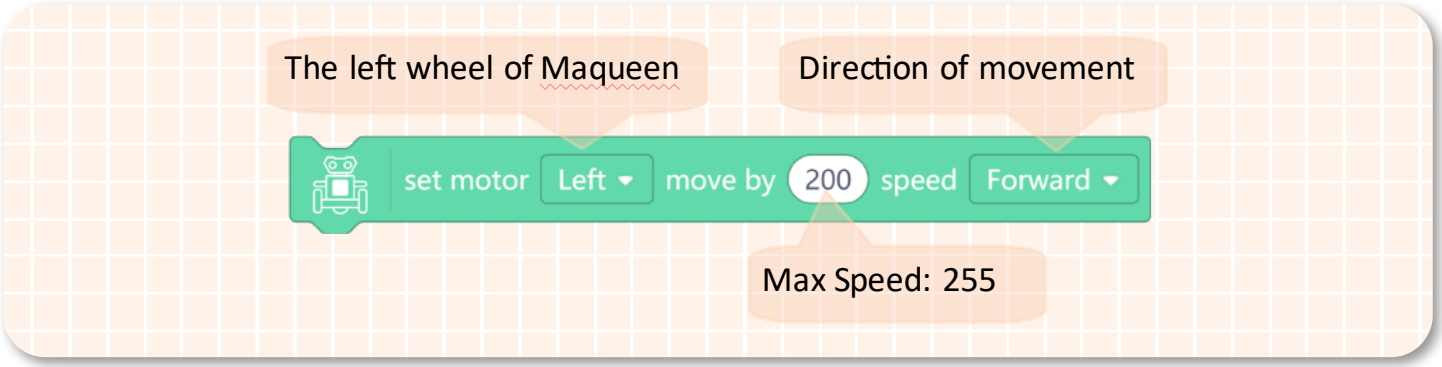
Turn on the power switch to awaken Maqueen Plus.

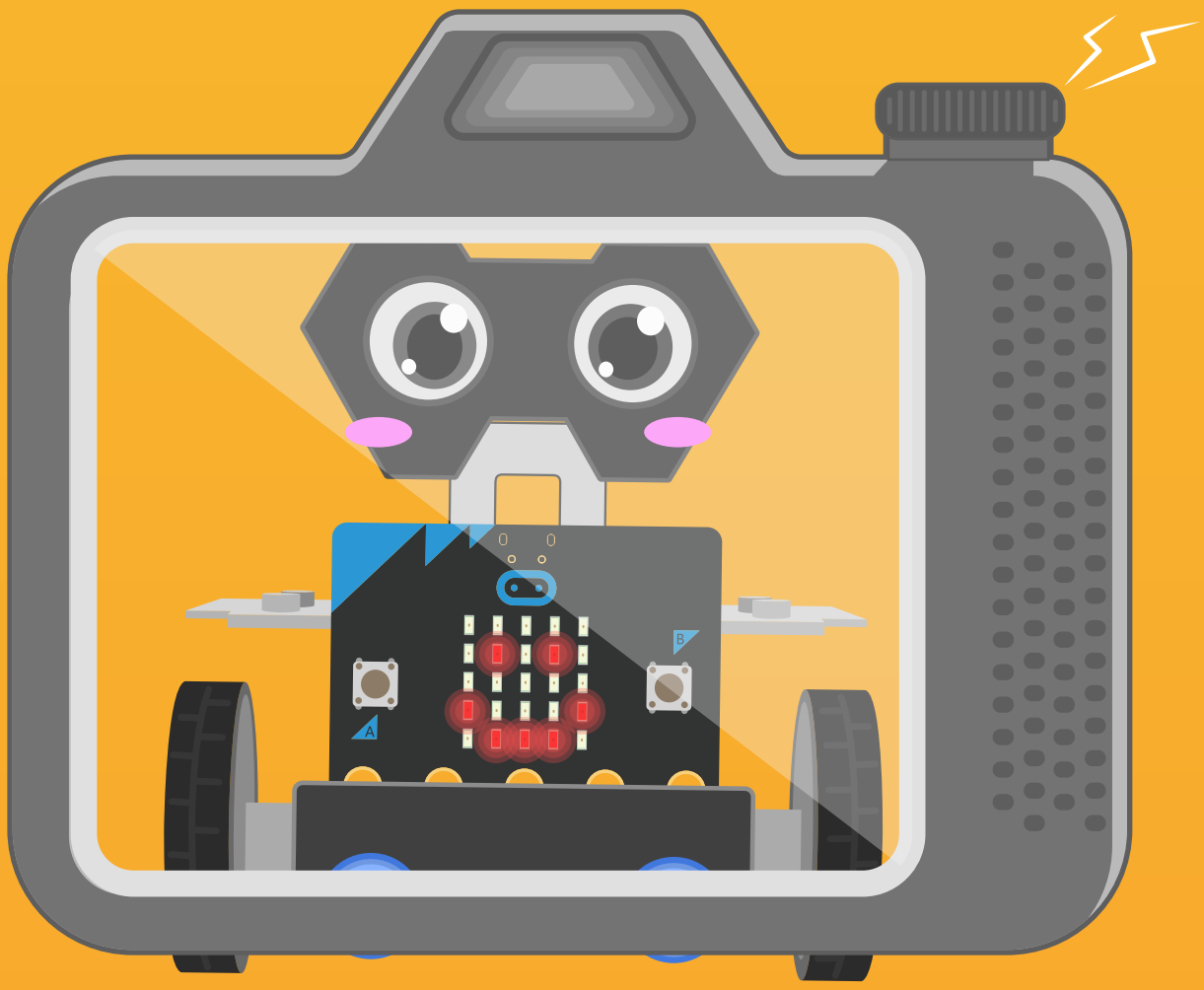


Think & Explore

We have learned the program to make Maqueen Plus move forward, but in our daily life, a car is also able to move backward, do you know how to realize that on Maqueen Plus? Can you program Maqueen Plus to go backward at the speed of 100. Give it a try!

Tip: Just do a little bit changes in the motor control block!





Chapter 3

Walking Emoji

Emojis are now considered to be a large part of popular culture these days. Maqueen Plus also has his emojis. In this chapter, let' s control Maqueen Plus to walk along a circle while displaying emojis on its LED screen.

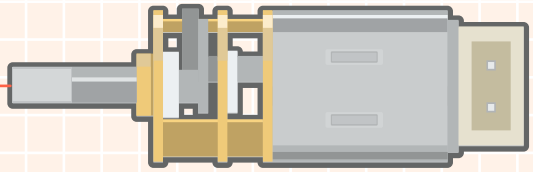
Goal

1.Learn the differential steering principle
2.The function of "pause"block

Electronic Component

Motor Brief

Motor

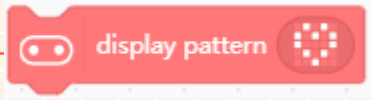


Motors can be used to drive Maqueen Plus to move left, right, backward, or go straight.

Command Learning

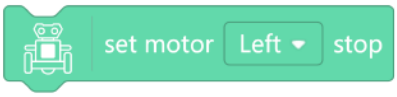
Block Brief

Show Icon



Draw the selected icon on the LED screen

Motor Controlling



Control the speed and direction of the motor

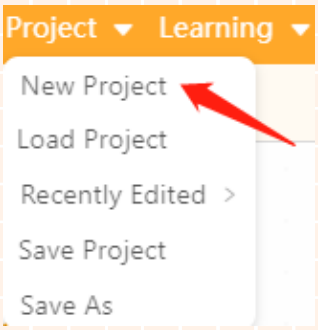
Pause

Pause for the specified time in millisecond

Hands-on Practice

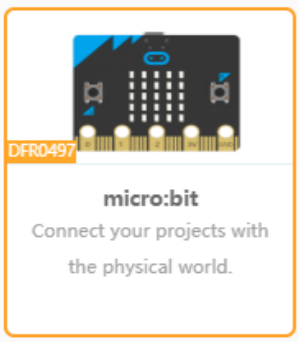
Step 1 Create a New Project

Open the Mind+, click "Project" -- "New project" to create a new project.

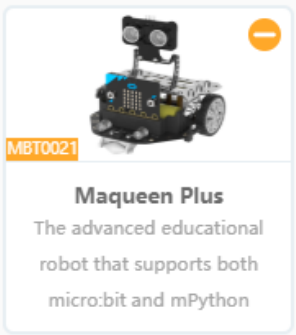


Step 2 Add the Maqueen Plus

1、Select "Expansion"-"Main Control Board" -- "micro: bit" main control board, the selection is as follows:



2、Continue to click on the"expansion board " -- " Maqueen Plus ", the selection is as follows:



When the Maqueen Plus is loaded successfully,there will be a icon" Expansion Board " appearing in the command block section. Click the icon then you will see all the related blocks.

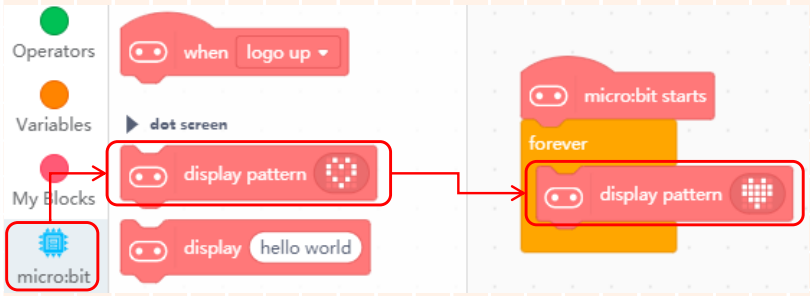
Refer to the attached document to check the detailed description of these blocks.

Step 3 Programming

1.Display emojis

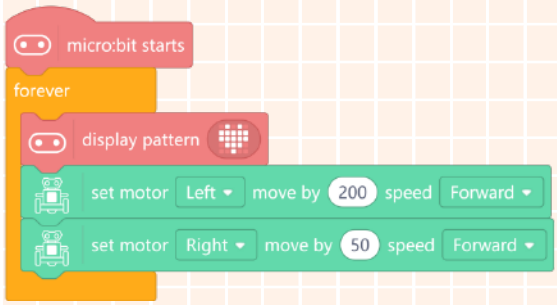
Drag the "show icon" block into a "forever" block, then a heart pattern will be displayed on the micro:bit LED matrix.

Note: click the to select other patterns.



2.Maqueen Plus moves clockwise

Program Maqueen Plus to drive clockwise along a circle. According to the differential steering principle, make the left motor rotate forward at the speed of 200, and the right motor rotates forward at 50.

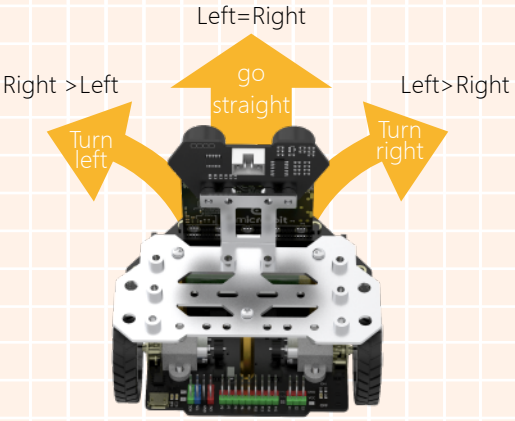


Knowledge Expansion

Differential Steering Principle:

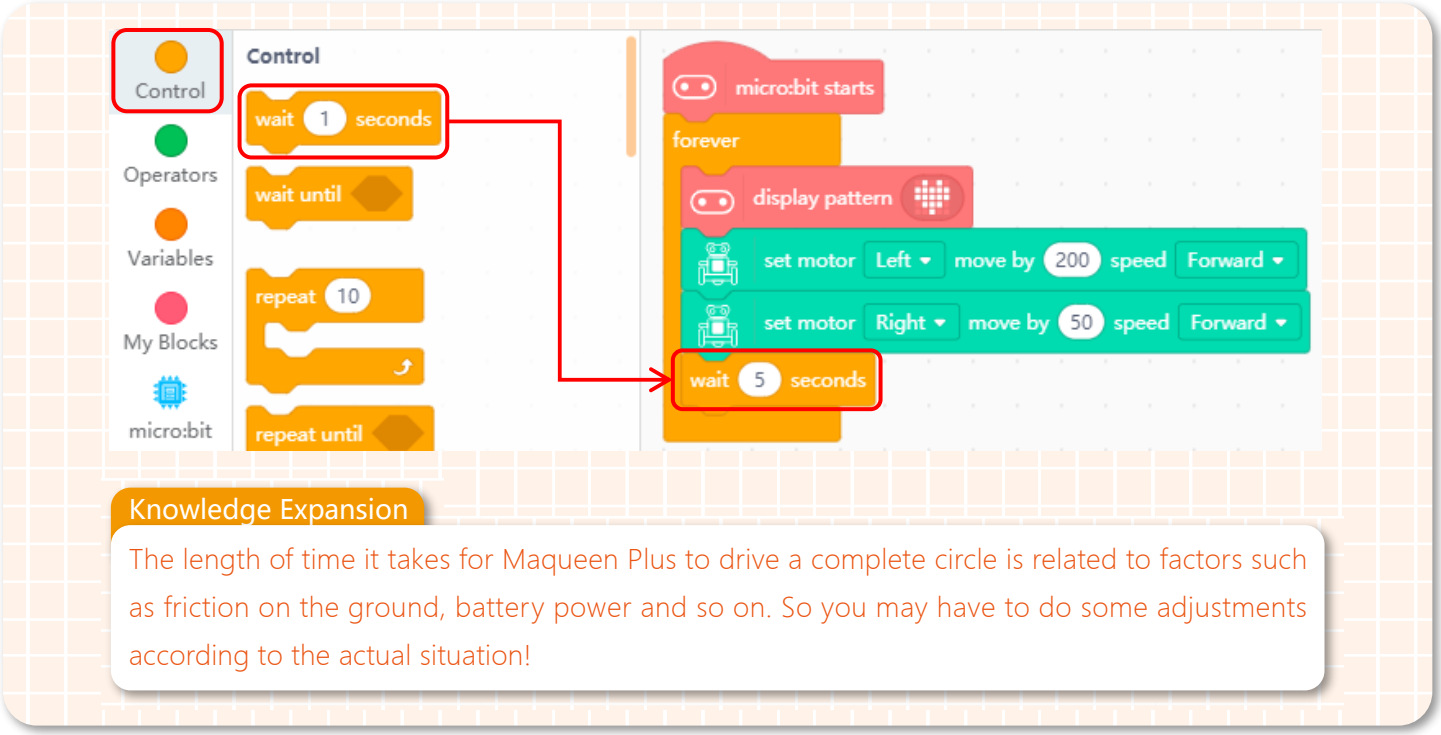
When the speed and direction of the left and right wheels are all the same, the robot car will move forward or backward. If the two wheels rotate in the same direction at different speeds, it will turn left or right.

Note: the above situation should be based on the fact that both wheels move forward, and the speed difference is large enough.



3. Maqueen Plus drives along a circle

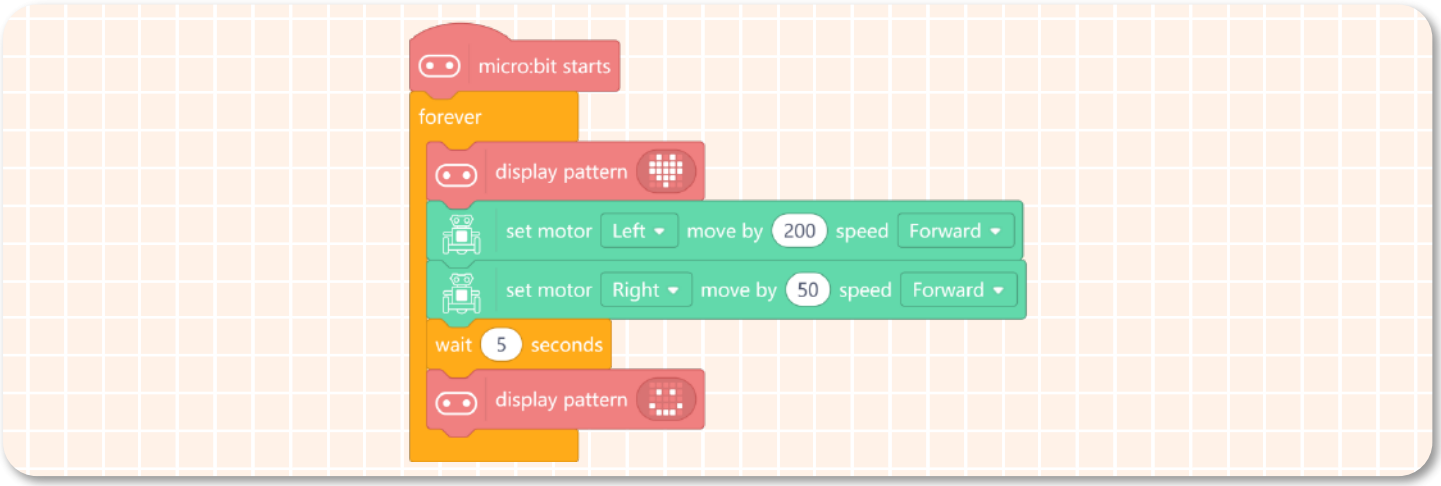
Let Maqueen Plus move along a circle. Set the pause time via the pause module to make it drive a perfect circle.



Knowledge Expansion

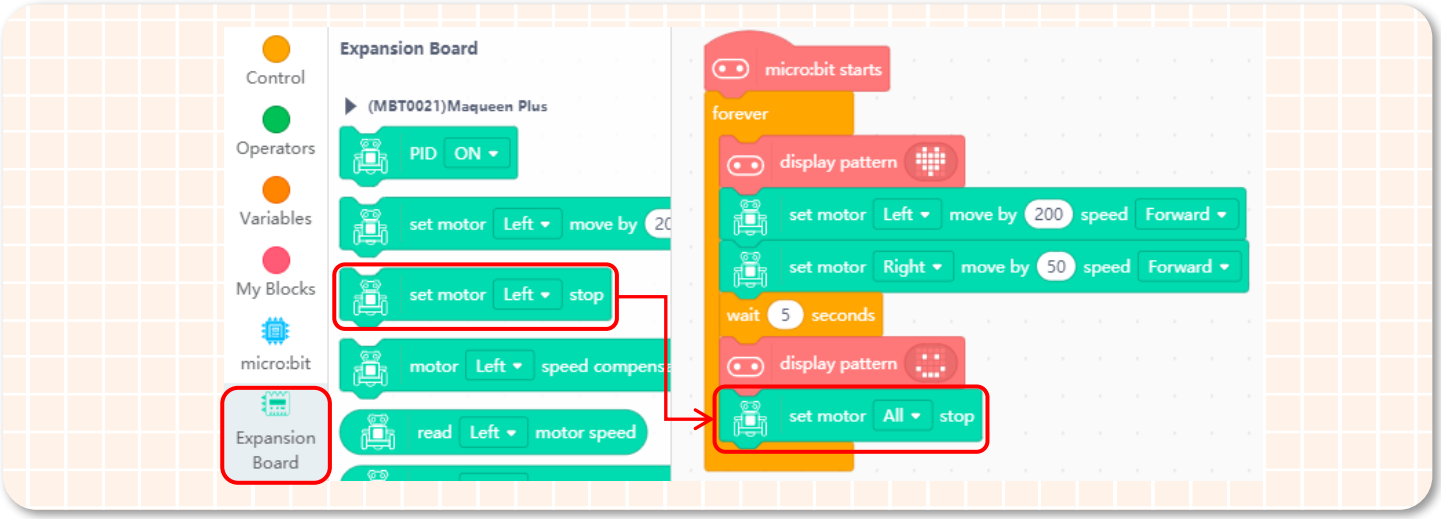
The length of time it takes for Maqueen Plus to drive a complete circle is related to factors such as friction on the ground, battery power and so on. So you may have to do some adjustments according to the actual situation!

When Maqueen Plus has walked a complete circle, display a smiley face on its LED screen.

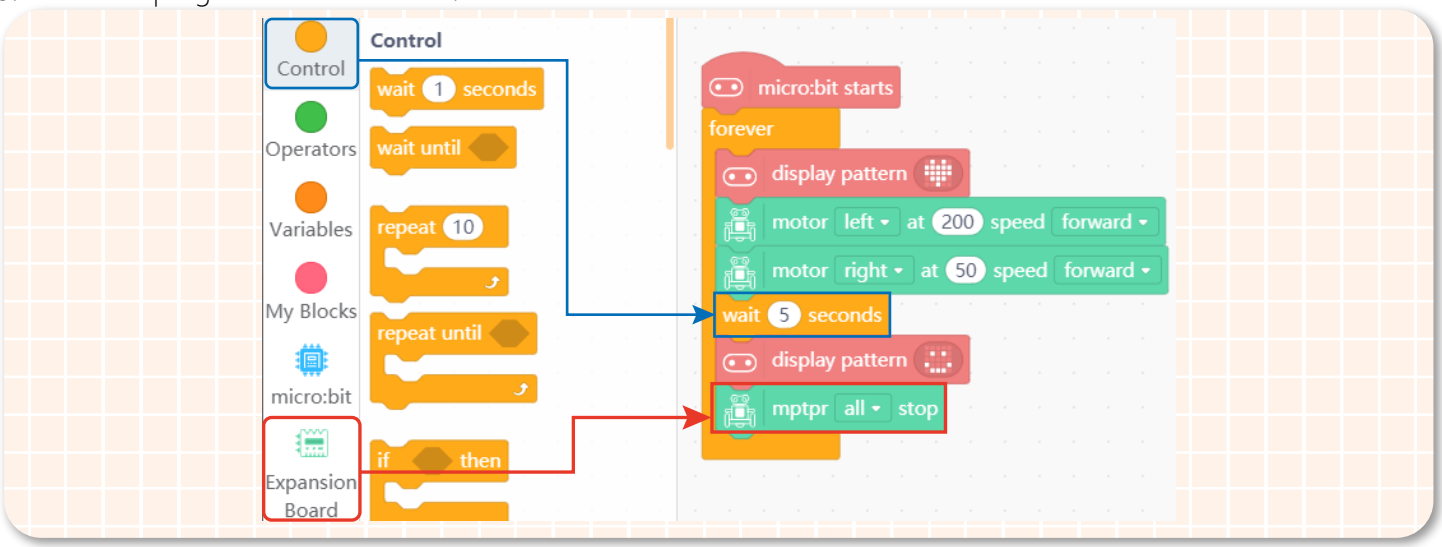


4.Maqueen Plus stops

Maqueen Plus will drive along a circle repeatedly. Now we can use another motor control block to make it stop. As shown below, change the "left" to "all", then both motors will stop rotating.



5.The whole program is shown below.



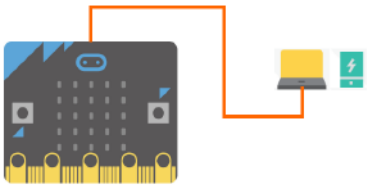
6.Name your project as "Walking Emoji" and save it.

Walking Emoji

Step 4 Download a Program

1.Connect to a Computer

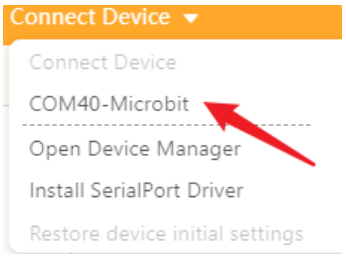
Connect micro: bit board to your computer via USB, then the power indicator on the board will light up.



2.Download the program

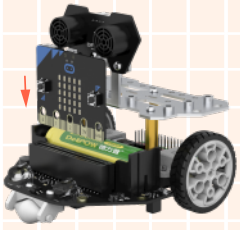
Click "Connect Device" in the menu bar, then click "COM-Microbit" in the drop-down menu to connect micro: bit board to the computer.

When connected, edit your programs and click "Upload" to upload the programs to your board (if the connection fails, then it will prompt "No Device Connected".) There will be a prompt box to display the uploading progress. When the program is updated, the prompt box will disappear.



3.Install the micro:bit Board

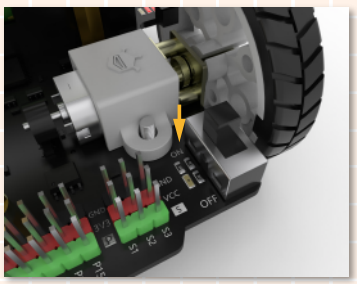
After downloading the program, plug the micro:bit board into Maqueen Plus. Keep the LED matrix face forward, shown as below:



Step 5 Effect Display

When you completed all the above steps, turn on the power switch of Maqueen Plus, then it starts running!

Turn on the power switch to awaken Maqueen Plus.



Think & Explore

How is the movement state when the two motors are rotating at different speeds and directions? Program Maqueen Plus to explore, and complete the form below.

	Left Motor		Right Motor		Movement
	Speed	Direction	Speed	Direction	
1	200	Forward	200	Forward	Forward
2	200	Forward	50	Forward	
3	50	Forward	200	Forward	
4	200	Backward	200	Backward	
5	200	Backward	200	Forward	

Chapter 4

City Defender-A Police Car

There are so many city defender heroes in movies, and have you ever considered being one of them? Now let' s turn this Maqueen Plus into a city defender-a police car to make your dream come true!

Goal

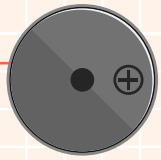
1.Learn how to use the buzzer module
2.Learn how to use the RGB light module

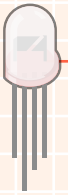
Electronic Component

Buzzer and RGB Brief

Buzzer

Work as an output module, can be used to play sounds.





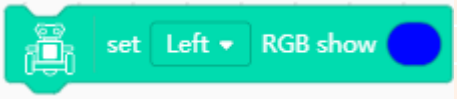
RGB Light

Display various colorful lighting effects

Command Learning

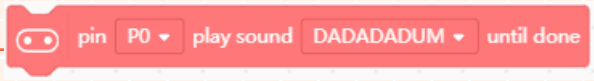
Block Brief

Control RGB LED



Control the color of light

Play sound

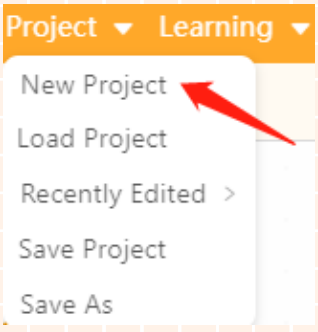


Play makecode built-in music

Hands-on Practice

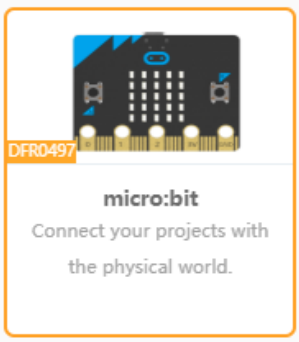
Step 1 Create a New Project

Open the Mind+, click "Project" -- "New project" to create a new project.

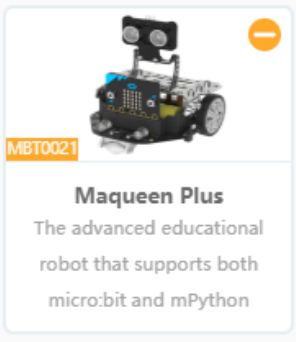


Step 2 Add the Maqueen Plus

1、Select "Expansion"-"Main Control Board" -- "micro: bit" main control board, the selection is as follows:



2、Continue to click on the"expansion board " -- " Maqueen Plus ", the selection is as follows:

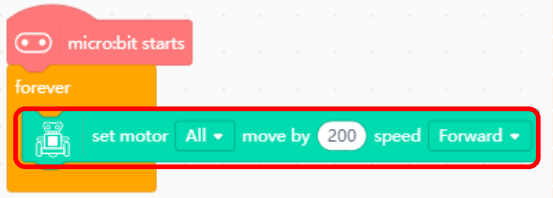


When the Maqueen Plus is loaded successfully,there will be a icon" Expansion Board " appearing in the command block section. Click the icon then you will see all the related blocks.

Refer to the attached document to check the detailed description of these blocks.

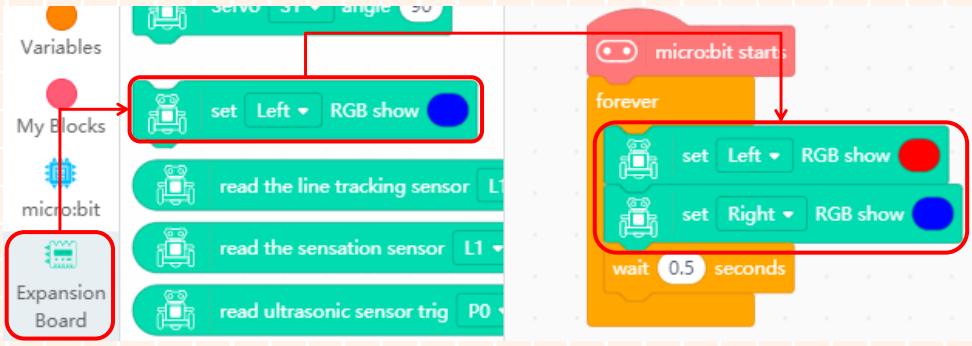
1.Program the car to drive

Both motors move forward at the speed of 200.

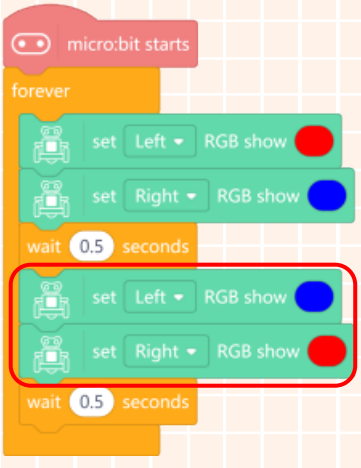


2.Program the lighting effect

The left RGB LED lights up in red, the right one in blue.



Since the lights on a police car emit red light and blue light alternatively, the next step here is to exchange the lighting color.



Knowledge Expansion

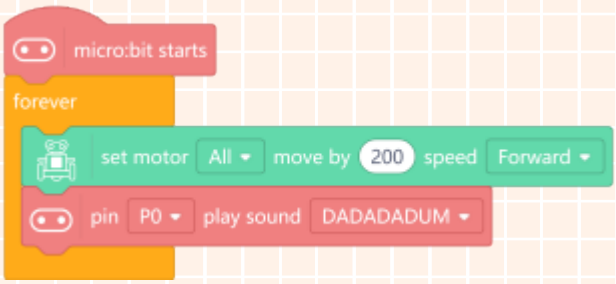
Why are the lights on police car red and blue?

1.Alert other drivers of its presence, so that they can maneuver out the way.

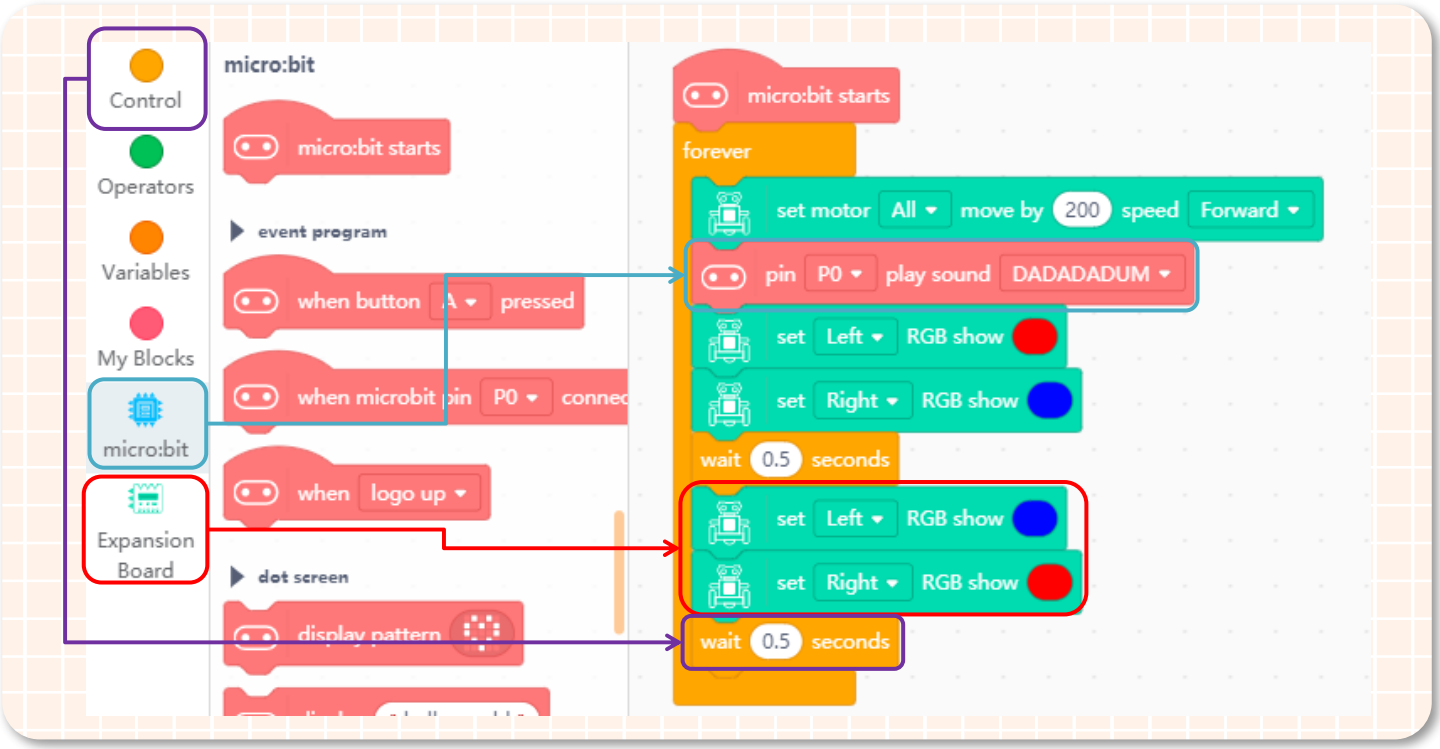
2.The color red is associated with stop and warning, but most tail lights are also red, so blue lights really stand out and help to alert others in these situations.

3.Program the siren

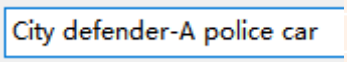
Play the built-in sound "dadadum"repeatedly to simulate the sound of siren.



4.The whole program is shown below.



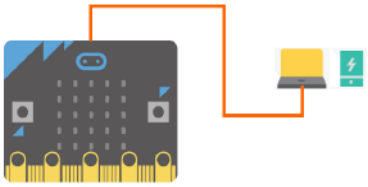
5.Name your project as "City defender-A police car" and save it.



Step 4 Download a Program

1.Connect to a Computer

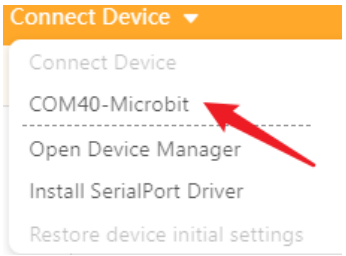
Connect micro: bit board to your computer via USB, then the power indicator on the board will light up.



2.Download the program

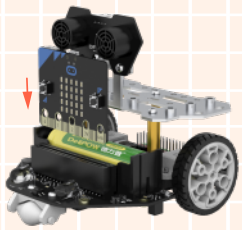
Click "Connect Device" in the menu bar, then click "COM-Microbit" in the drop-down menu to connect micro: bit board to the computer.

When connected, edit your programs and click "Upload" to upload the programs to your board (if the connection fails, then it will prompt "No Device Connected".) There will be a prompt box to display the uploading progress. When the program is updated, the prompt box will disappear.



3.Install the micro:bit Board

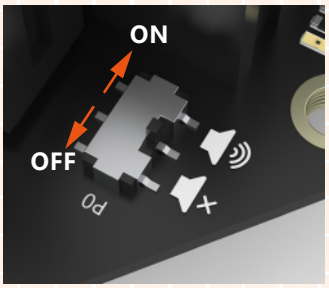
After downloading the program, plug the micro:bit board into Maqueen Plus. Keep the LED matrix face forward, shown as below:



Step 5 Effect Display

Turn on the power switch, then Maqueen Plus moves forward with siren wailing and lights flashing, just like a police car.

Note:
1.There is a buzzer switch on the left side of Maqueen Plus, and you need to turn it on when using the buzzer.
2.The buzzer and P0 are shared, so when you need to use P0 as input/output port, turn off the buzzer.

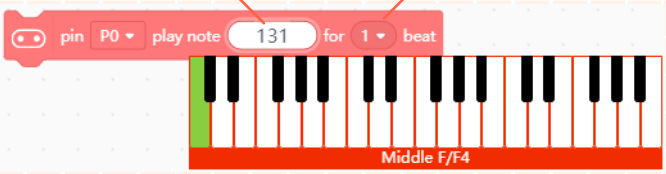


Think & Explore

We have learned how to play the built-in music in makecode. Do you want to make a piece of your music? Try it with Maqueen Plus. The block shown below is used to play notes.

Click here to display key-board, then select note.

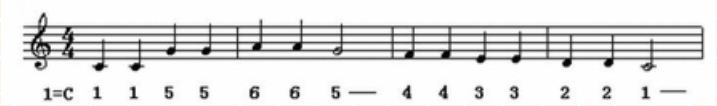
Select beat for the note.



The letter "C" represents the note "do", so middle C is middle do. "1" is the beat of the note, the basic time unit, also specified by the time signature. The relation between note and notation is shown below:

C	D	E	F	G	A	B
1	2	3	4	5	6	7

Create a piece of music according to the numbered musical notation below!



Chapter 5

Light Sensing Robot

Without light, there would be no sight. We are able to see because light from an object can move through space and reach our eyes. But human eyes are very sensitive to light, both too strong and weak lights are harmful to our eyes. How do we know the changes in light brightness? Maqueen Plus can help us achieve that.

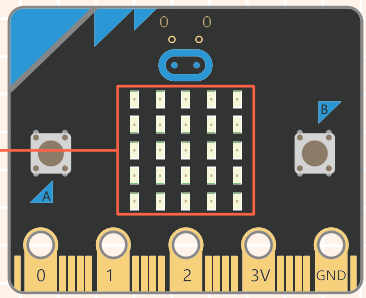
Goal

1.Learn the light sensor
2.Learn to use "show number"block

Electronic Component

Light sensor Brief

Light sensor



The micro:bit LEDs can be used to estimate the amount of ambient light, and output the light level as electric signal.

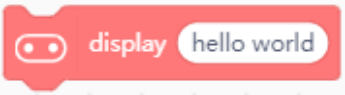
Command Learning

Block Brief

Light Level

Reads the light level applied to the LED screen in a range from 0 to 255.

Show character

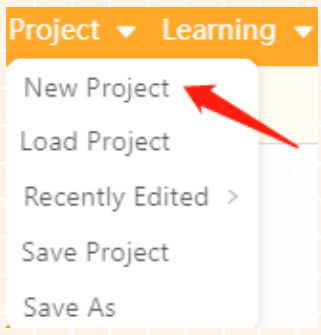


Scroll a character the micro:bit LED matrix.

Hands-on Practice

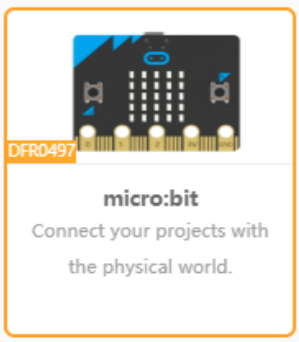
Step 1 Create a New Project

Open the Mind+, click "Project" -- "New project" to create a new project.

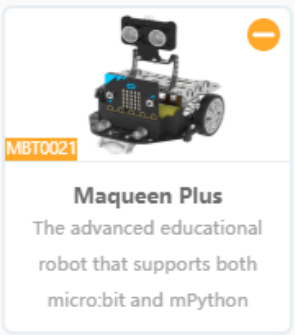


Step 2 Add the Maqueen Plus

1、Select "Expansion"-"Main Control Board" -- "micro: bit" main control board, the selection is as follows:



2、Continue to click on the"expansion board " -- " Maqueen Plus ", the selection is as follows:

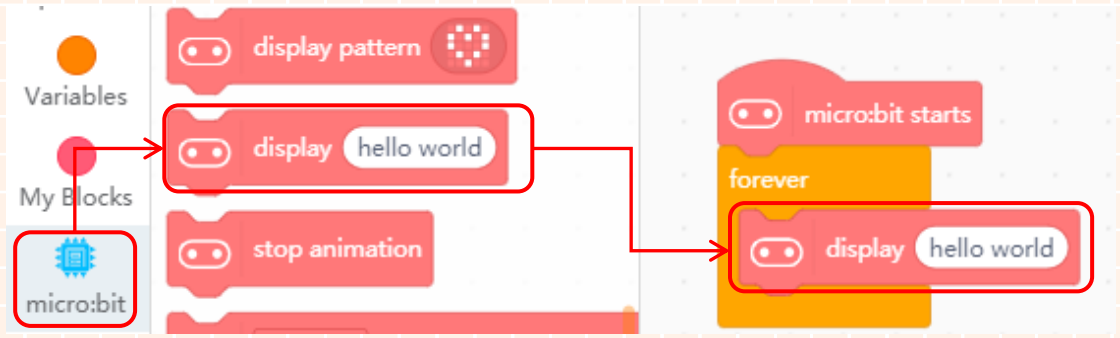


When the Maqueen Plus is loaded successfully,there will be a icon" 

" appearing in the command block section. Click the icon then you will see all the related blocks.

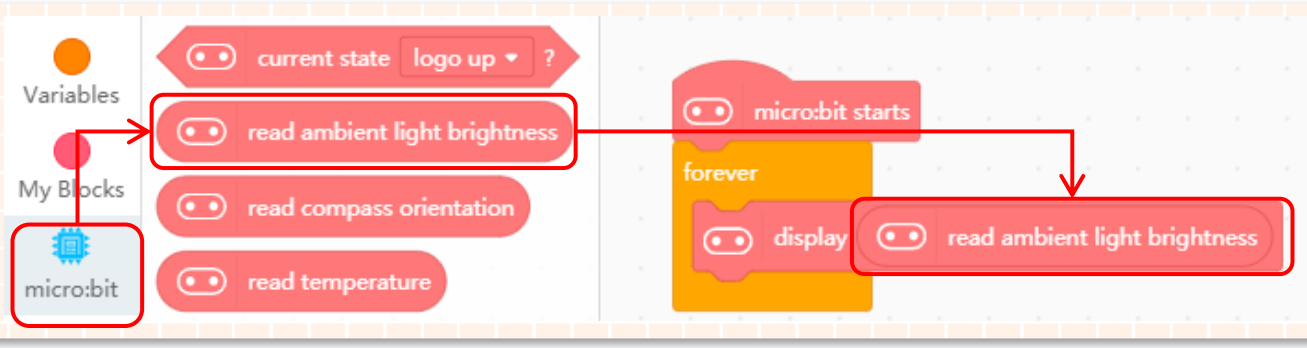
Step 3 Programming

1.Embed the "show character" block into the "forever" block, then the robot will read the light level constantly.



Note: the "show character" block displays hello world by default.

2.To display the ambient light level on the micro:bit LED screen in real time, we have to put the "light level"block into the "show character" block.



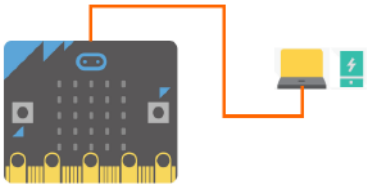
3.The complete program is shown below.

4.Name your project as "Light sensing robot" and save it.

Step 4 Download a Program

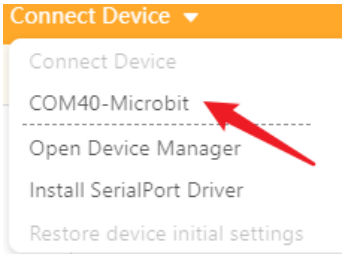
1.Connect to a Computer

Connect micro: bit board to your computer via USB, then the power indicator on the board will light up.



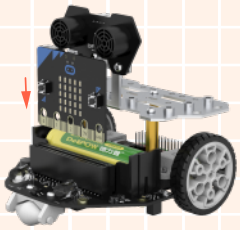
2.Download the program

Click "Connect Device" in the menu bar, then click "COM-Microbit" in the drop-down menu to connect micro: bit board to the computer.
When connected, edit your programs and click "Upload" to upload the programs to your board (if the connection fails, then it will prompt "No Device Connected".) There will be a prompt box to display the uploading progress. When the program is updated, the prompt box will disappear.



3.Install the micro:bit Board

After downloading the program, plug the micro:bit board into Maqueen Plus. Keep the LED matrix face forward, shown as below:



Step 5 Effect Display

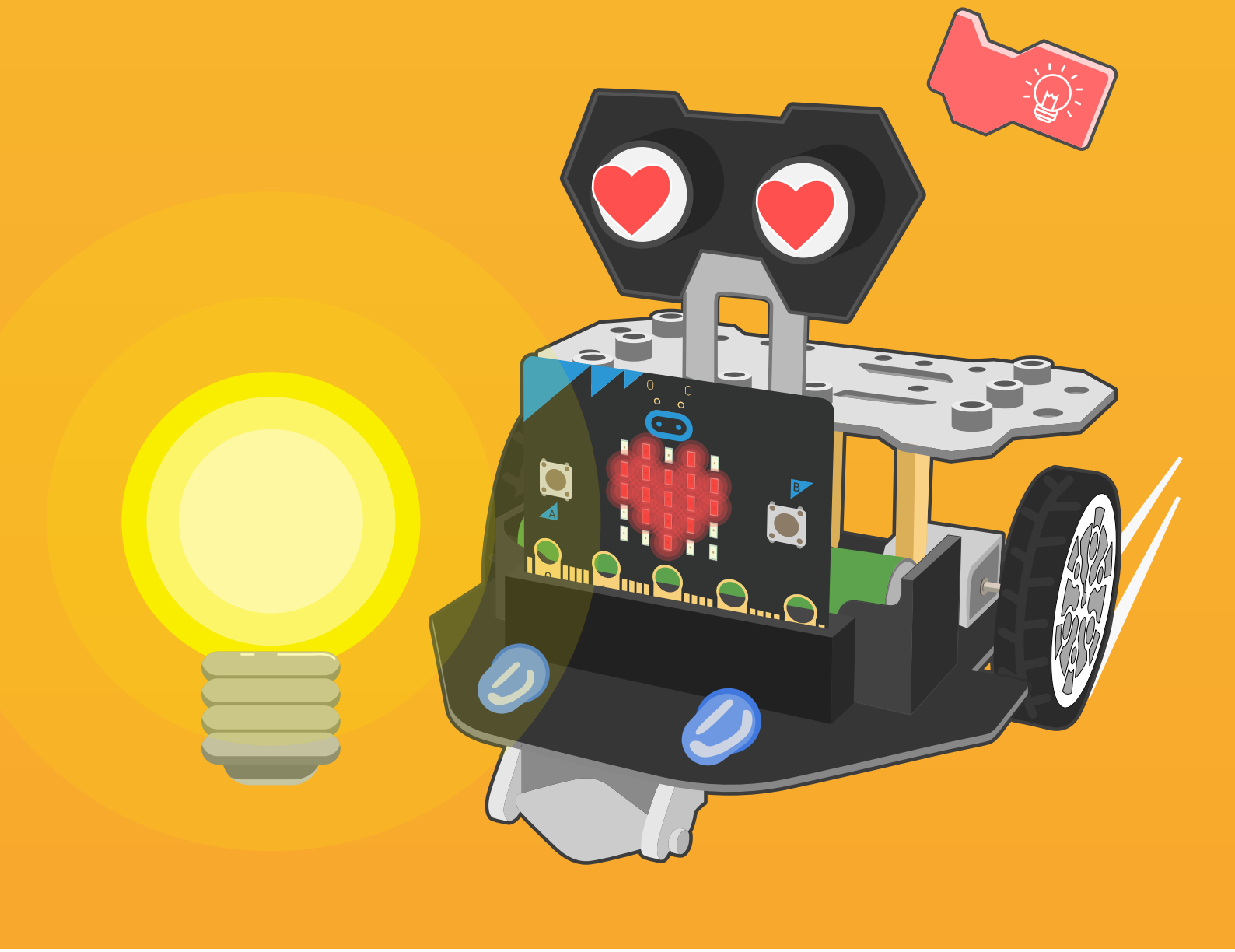
Turn on Maqueen Plus' s power, the LED screen will constantly display the current light level! The following are the light levels measured at the office and photo studio.

Place	Light Level
Office	125
Photo studio	255

Think & Explore

Light level varies from places, let our Maqueen Plus explore! After that, please think if the light level of each place is reasonably designed.

Place	Light Level
Kitchen	
living-room	
Bedroom	
Study	



Chapter 6

Moth Robot

You must have seen that at summer night, plenty of moths fly around the streetlight, flame and any places with bright light. Why are moths attracted to flame? One idea is that moths are able to find their way partly by using light as a compass. You know what, Maqueen Plus can change into a moth robot because it has a pair of light-sensitive eyes.

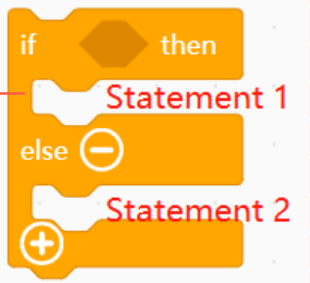
Goal

1.Learn operator block
2.Learn condition block
3.Program flowchart

Command Learning

Block Brief

If...then...else



If a value is true, then do the first block of statements. Otherwise, do the second block of statements.

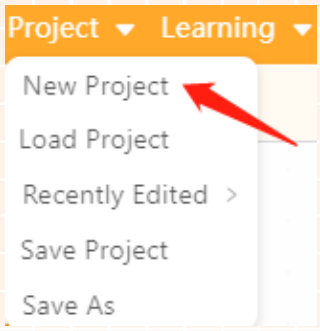
Comparison operator

Return true if the first input is greater than the second input.

Hands-on Practice

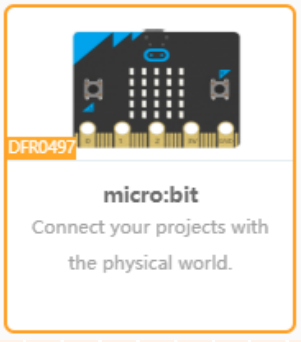
Step 1 Create a New Project

Open the Mind+, click "Project" -- "New project" to create a new project.

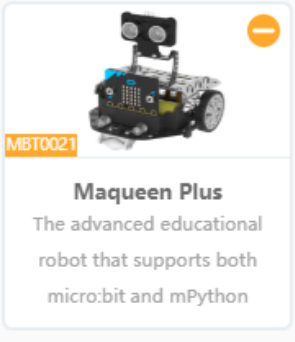


Step 2 Add the Maqueen Plus

1、Select "Expansion"-"Main Control Board" -- "micro: bit" main control board, the selection is as follows:



2、Continue to click on the"expansion board " -- " Maqueen Plus ", the selection is as follows:

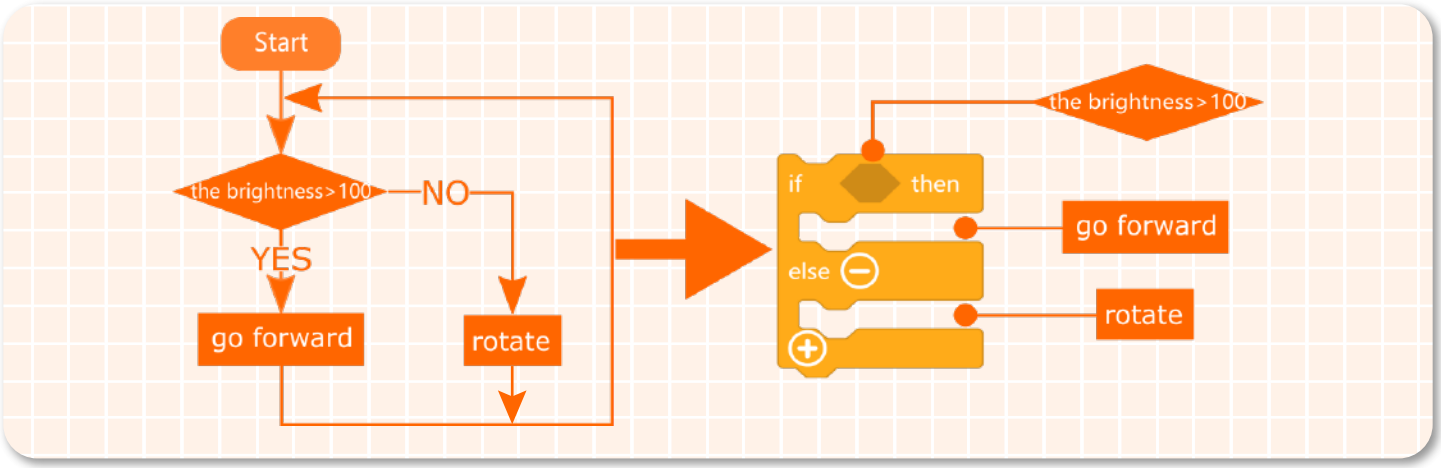


When the Maqueen Plus is loaded successfully,there will be a icon" 

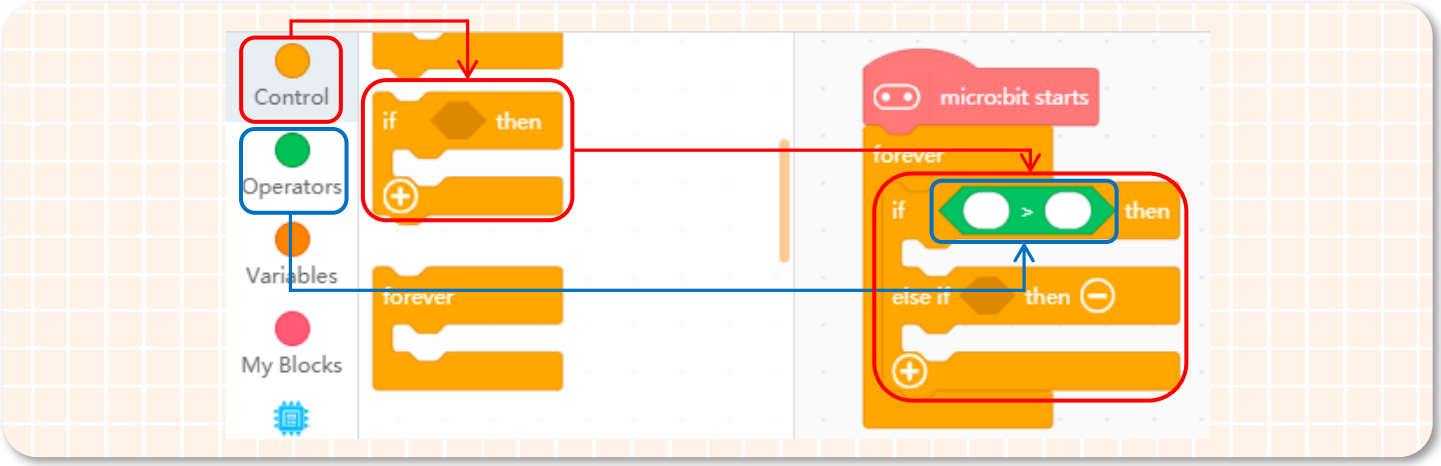
" appearing in the command block section. Click the icon then you will see all the related blocks.

Step 3 Programming

1.When the light level is more than the given value (100 in the example), the moth robot moves towards the light source; when less than that value, the robot revolves around its center. Drawing a corresponding flowchart according to the above functions is gonna help us a lot with programming!



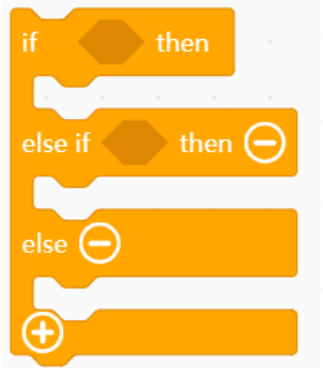
2.Embed the condition blocks into the "forever" block, then the condition judgment can be processed in real-time.

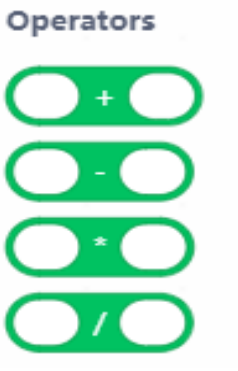


3.The key point of the whole program is the condition statement "light level >100". Different operations will be executed according to the result of the condition block.

Knowledge Expansion

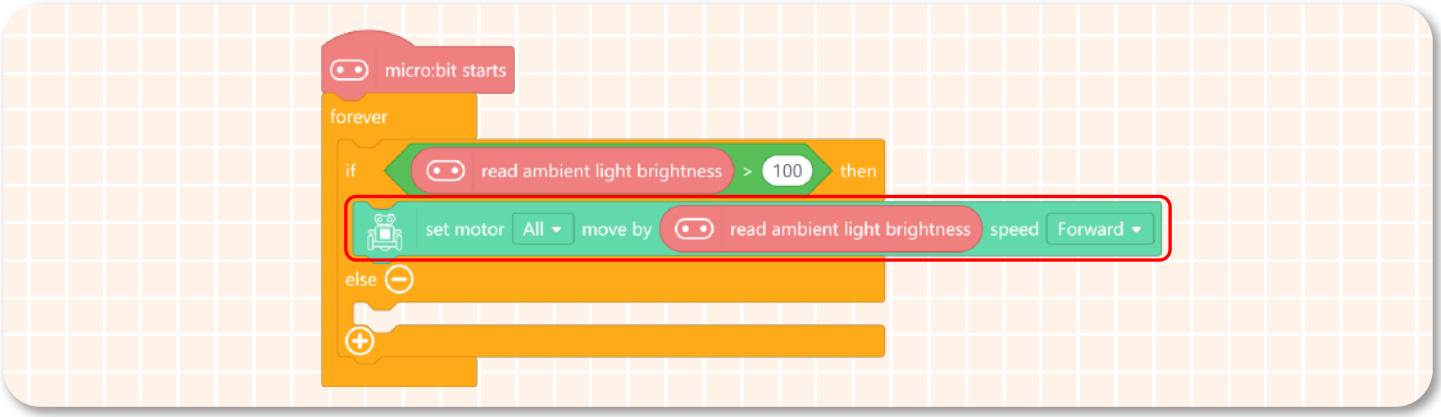
1.Click the "⊕" in the condition block to add a condition, click " " to delete a condition.



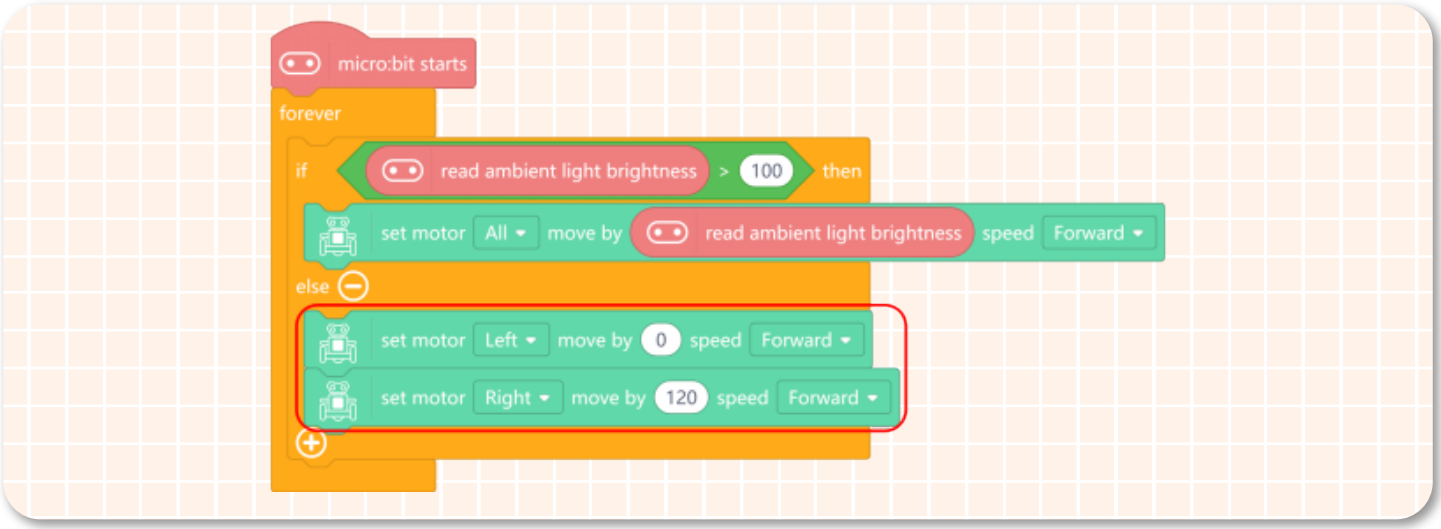


2.Click the "Operators" in the comparison block to select different operators.

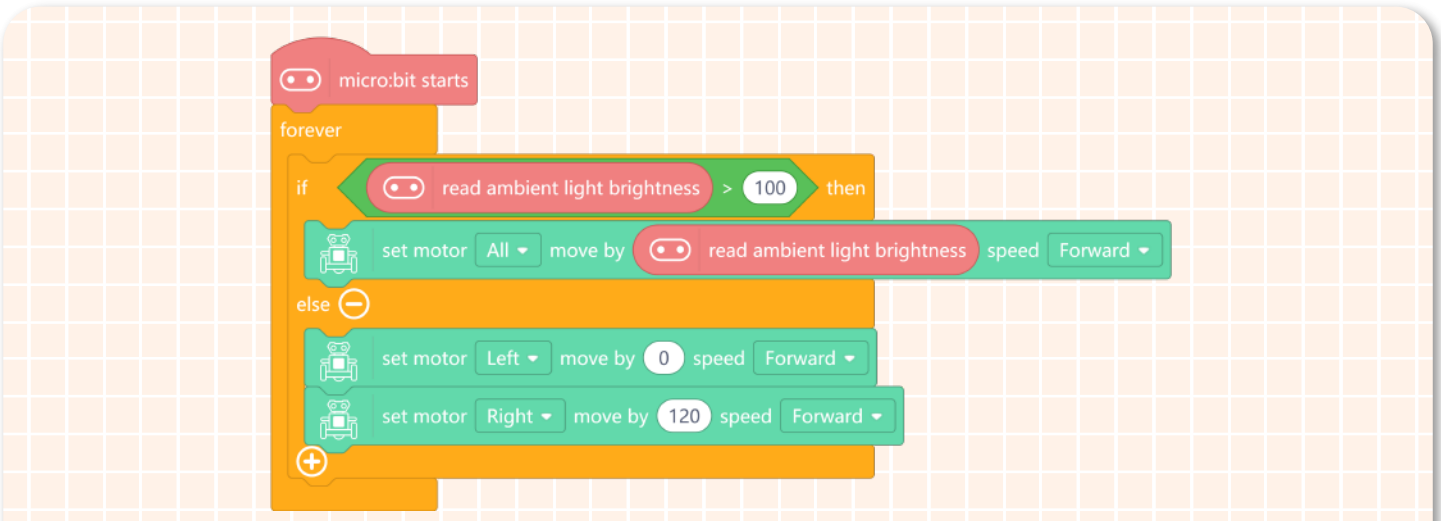
4.When the condition "Light level>100" is true, the robot car moves forward at the speed of the current light level.



5.When the condition"Light level>100" is false, the Maqueen Plus rotates around its center.



6.The complete program is shown below.



Knowledge Expansion

Condition to be judged: read ambient light brightness > 100

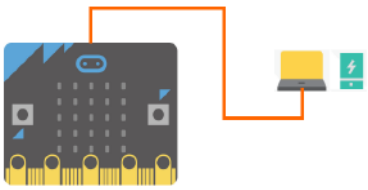
Here we need to find a suitable critical value. Since if the value is too large, the moth robot will not move at all till a relatively strong light is given; if the value is too small, the robot will not likely to stop. So we have to set the critical value reasonably according to different conditions.

7.Name your project as “Moth robot” and save it.

Step 4 Download a Program

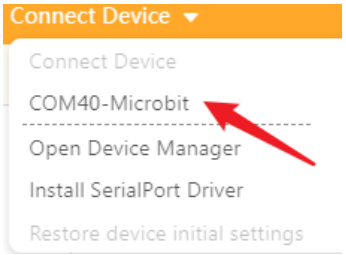
1.Connect to a Computer

Connect micro: bit board to your computer via USB, then the power indicator on the board will light up.



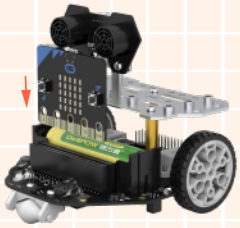
2.Download the program

Click “Connect Device” in the menu bar, then click “COM-Microbit” in the drop-down menu to connect micro: bit board to the computer.
When connected, edit your programs and click “Upload” to upload the programs to your board (if the connection fails, then it will prompt “No Device Connected”.) There will be a prompt box to display the uploading progress. When the program is updated, the prompt box will disappear.



3.Install the micro:bit Board

After downloading the program, plug the micro:bit board into Maqueen Plus. Keep the LED matrix face forward, shown as below:

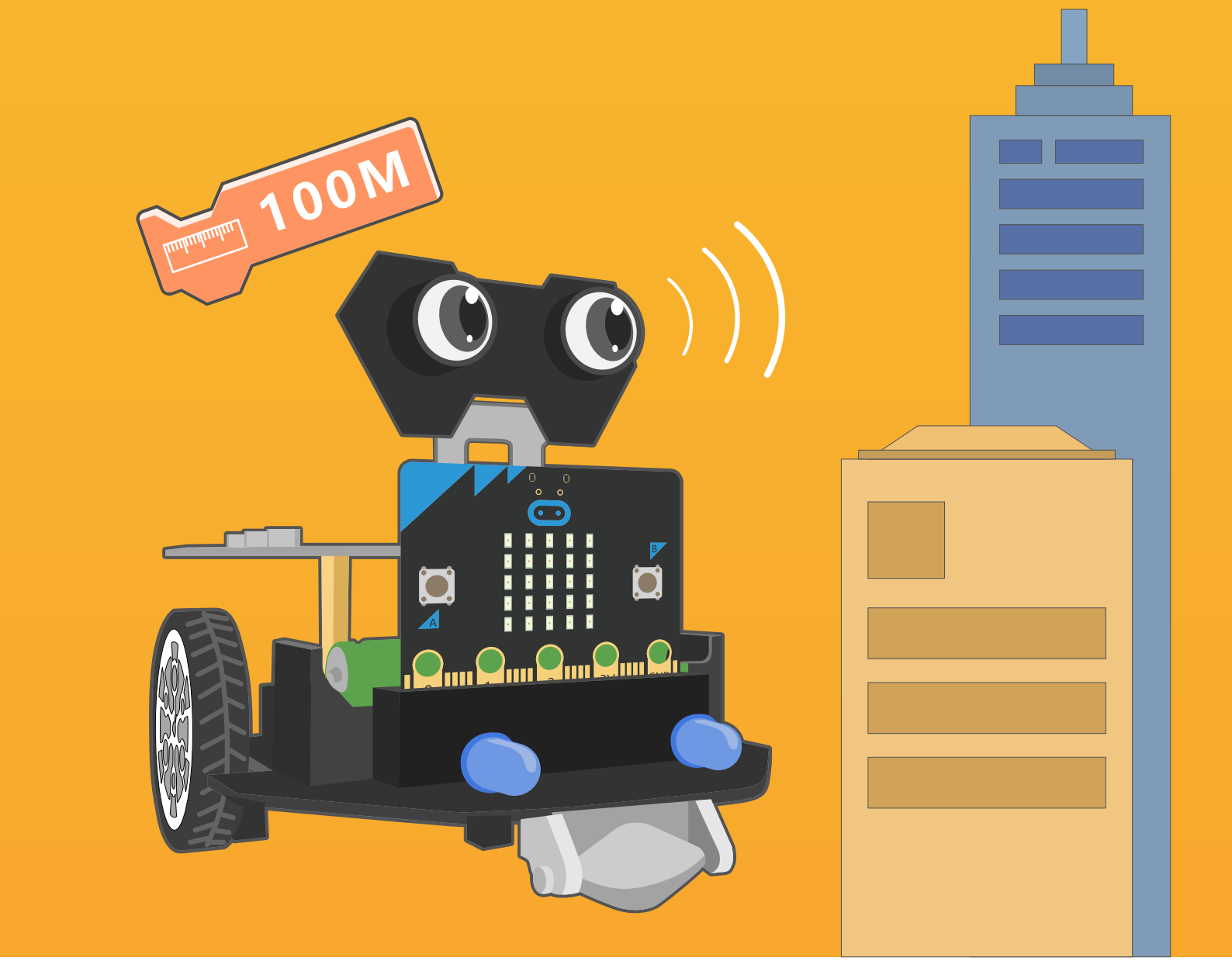


Step 5 Effect Display

Turn on the power switch, then Maqueen Plus will turn into a moth robot. When the light level is over 100, our moth robot moves towards the light, the brighter the light is, the faster Maqueen Plus runs. When the light is less than 100, the robot will get lost and rotate around. So funny, right ? come to play with this moth robot!

Think & Explore

Let’s do a robot running competition! Use a flashlight to lead Maqueen Plus to run forward, the one who uses the least time to finish the game will be the winner. Remember, do not cross the line. Invite your friends to join the game!
Tips: maintaining the speed within a reasonable range holds the key to success.



Chapter 7

Little Ranging Expert

We have known that Maqueen Plus is such a changeable robot with various functions, but more surprisingly, he can measure distance using his ultrasound eyes. With this buddy, you can say goodbye to your measuring tools.

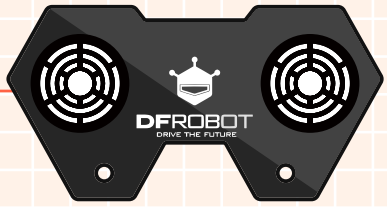
Goal

1.Get to know ultrasound
2.Learn the principle of ultrasound

Electronic Component

Ultrasound Brief

Ultrasonic sensor



The transmitter sends out ultrasound, and when hitting the object, the ultrasound reflects as echo and will be sensed by the receiver.

Command Learning

Block Brief

Read ultrasonic sensor

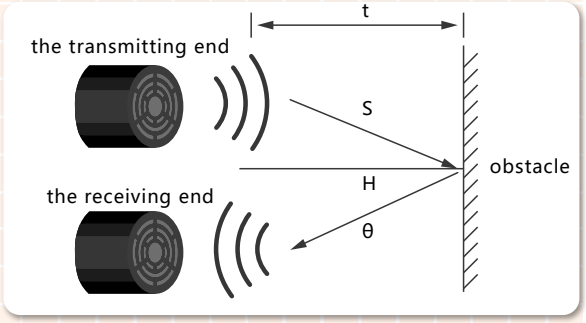
Read the value the ultrasonic sensor detects, unit: CM/INCH. (Preset the transmitter and receiver on the sensor)

What is ultrasound?

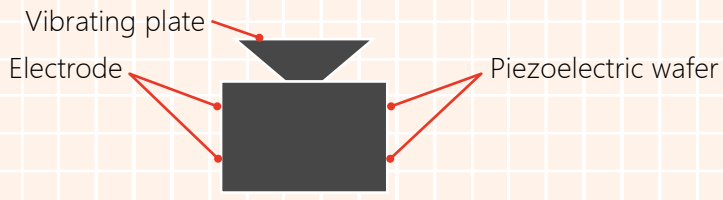
As we know, when vibrating, objects produce sound waves. Some of them can be heard by human ears, while others cannot. Scientists named the vibrating times per second as the sound frequency with its unit named as Hertz. Almost all human beings are able to hear the sound frequencies ranging from 20 to 20000Hertz. Sound frequencies out of that range are inaudible to humans. For those sound, the scientists name it as "Ultrasound".

How does an ultrasonic sensor measure distance?

Ultrasonic sensors work by sending out a sound wave at a frequency above the range of human hearing. The sensors determine the distance to a target by measuring time lapses between the sending and receiving of the ultrasonic pulse.



Ultrasonic sensors will convert the reflected sound into an electrical signal. A commonly used sensor consists of a piezoelectric wafer that can emit ultrasonic waves.

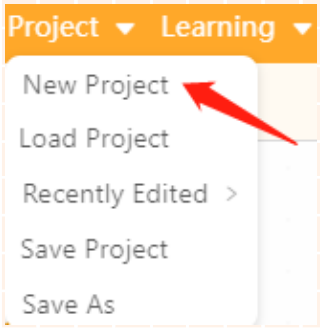


Ultrasonic sensor structure

Hands-on Practice

Step 1 Create a New Project

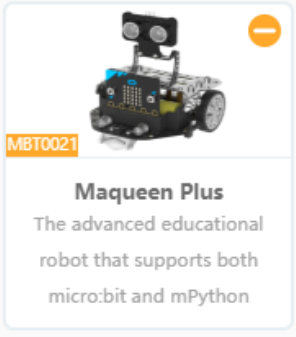
Open the Mind+, click "Project" -- "New project" to create a new project.



Step 2 Add the Maqueen Plus

1、Select "Expansion"-"Main Control Board" -- "micro: bit" main control board, the selection is as follows:

2、Continue to click on the"expansion board " -- " Maqueen Plus ", the selection is as follows:

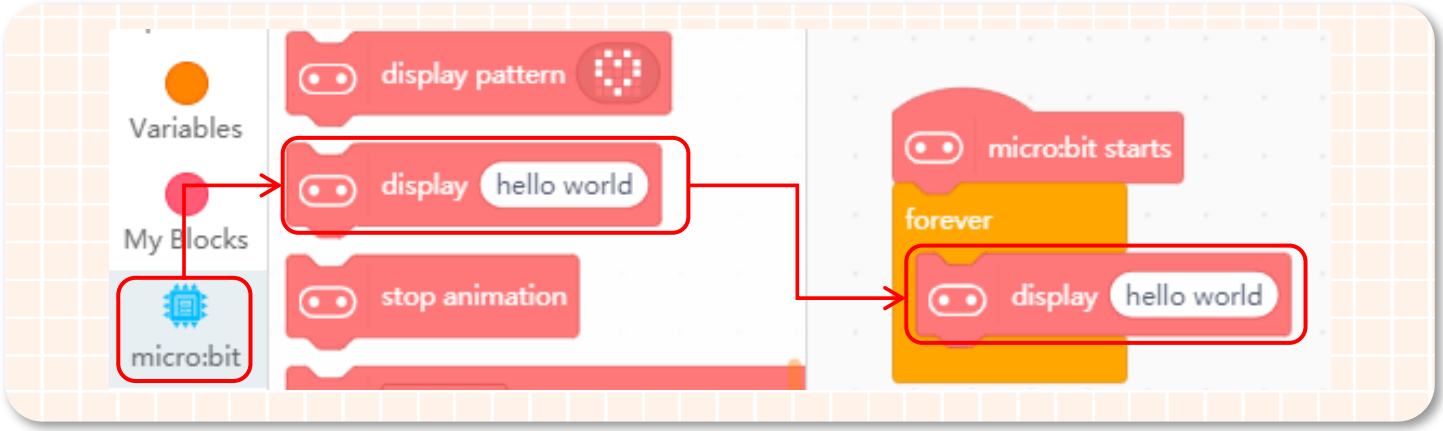


When the Maqueen Plus is loaded successfully,there will be a icon" 

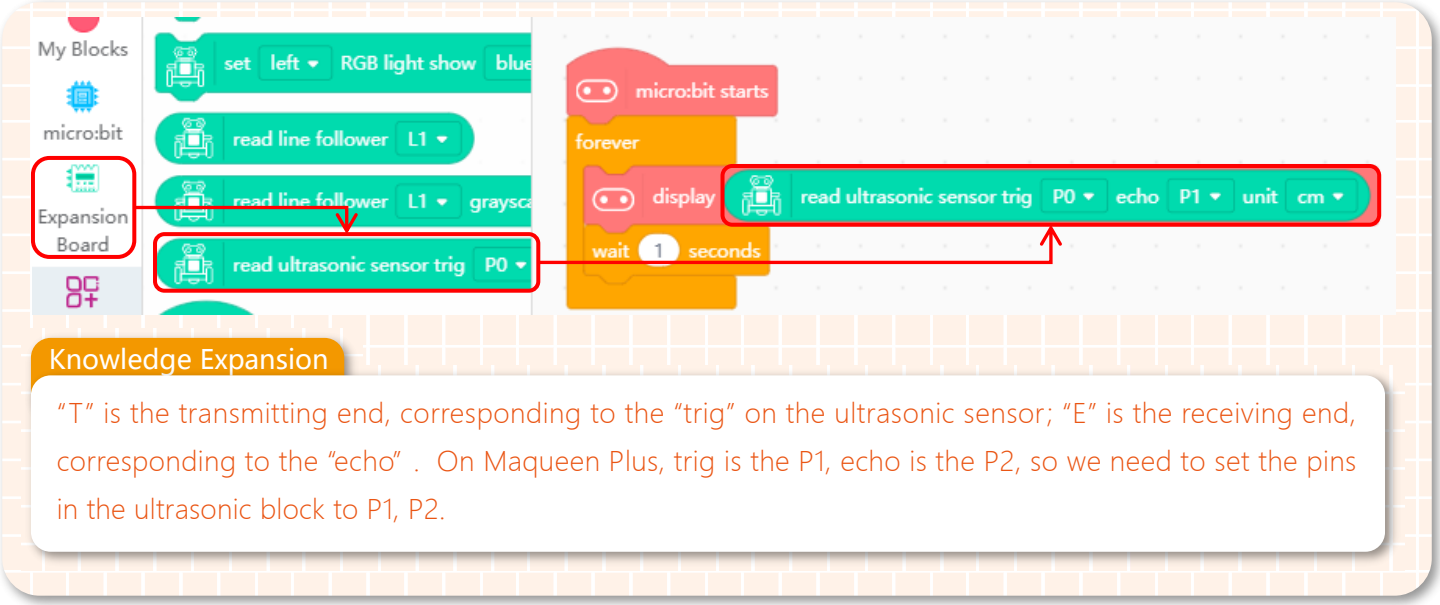
" appearing in the command block section. Click the icon then you will see all the related blocks.

Step 3 Programming

1.Place the "show character" block into the "forever" block, shown as below.



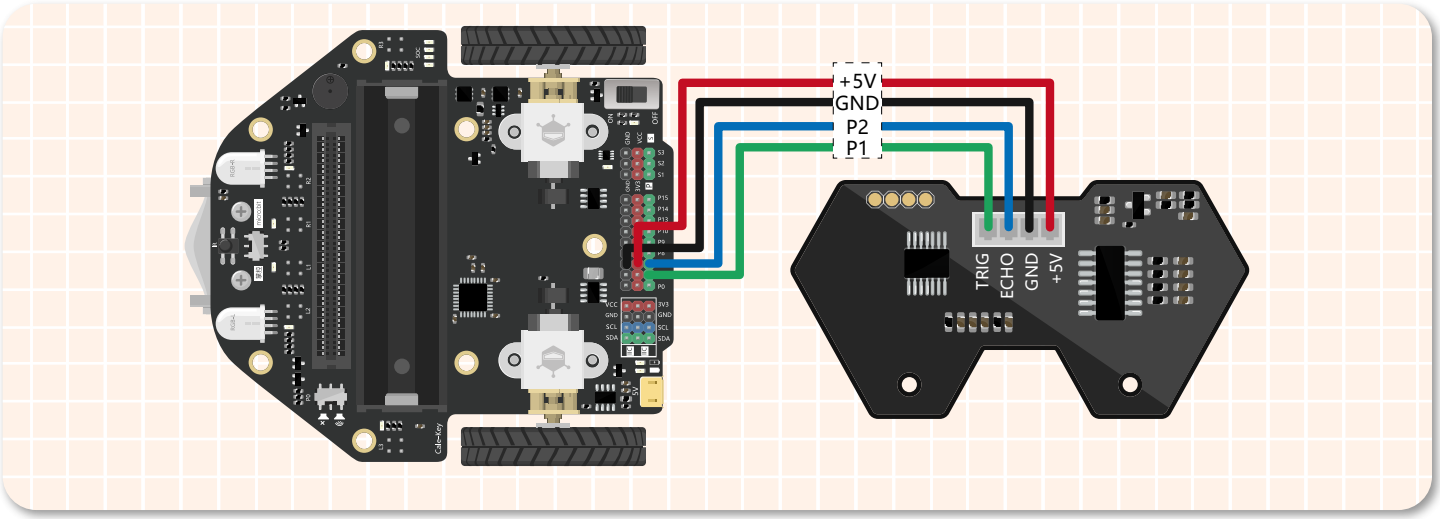
2.Put the ultrasonic sensor value inside the "show character" block to display the current distance. Add a "pause" block to prevent the serial reading the value too fast.



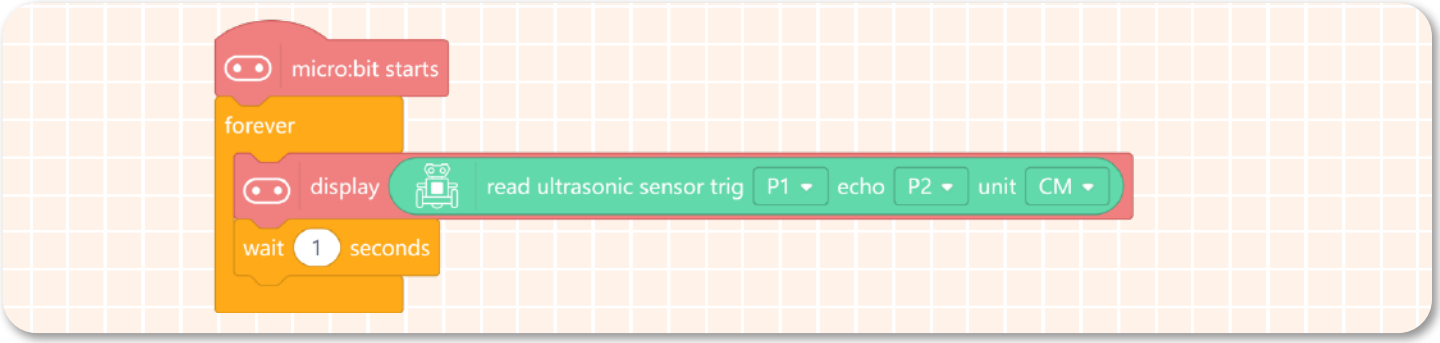
Knowledge Expansion

"T" is the transmitting end, corresponding to the "trig" on the ultrasonic sensor; "E" is the receiving end, corresponding to the "echo" . On Maqueen Plus, trig is the P1, echo is the P2, so we need to set the pins in the ultrasonic block to P1, P2.

The pin connection is shown below:



3.The entire program is shown below.

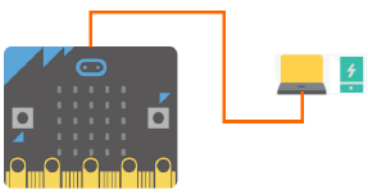


4.Name your project as "Little ranging expert" and save it.

Step 4 Download a Program

1.Connect to a Computer

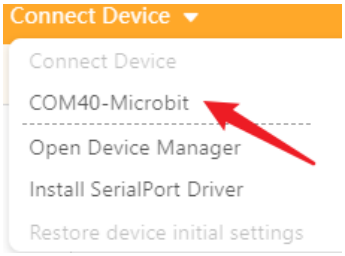
Connect micro: bit board to your computer via USB, then the power indicator on the board will light up.



2.Download the program

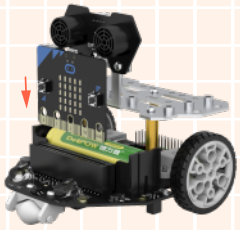
Click "Connect Device" in the menu bar, then click "COM-Microbit" in the drop-down menu to connect micro: bit board to the computer.

When connected, edit your programs and click "Upload" to upload the programs to your board (if the connection fails, then it will prompt "No Device Connected".) There will be a prompt box to display the uploading progress. When the program is updated, the prompt box will disappear.



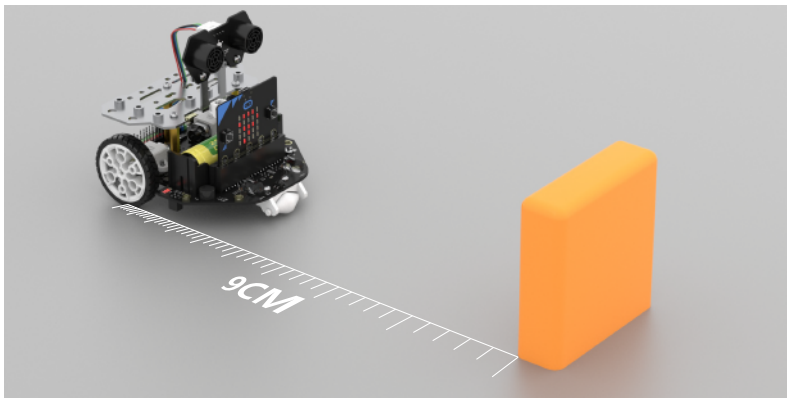
3.Install the micro:bit Board

After downloading the program, plug the micro:bit board into Maqueen Plus. Keep the LED matrix face forward, shown as below:



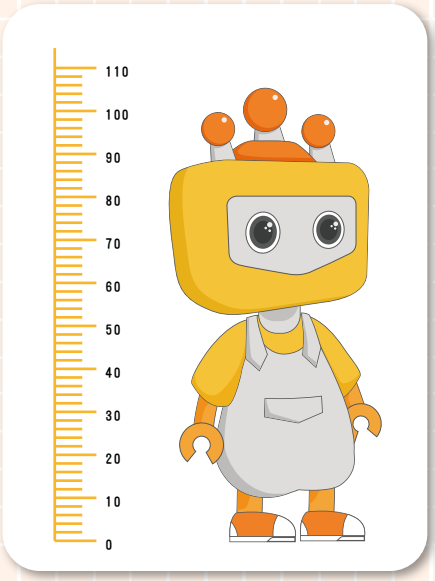
Step 5 Effect Display

Turn on the power switch, then we can use Maqueen Plus to measure distance. The detected distance will be displayed on micro:bit. We can use two different measuring ways to test the accuracy of Maqueen Plus. As shown below:



How to use an ultrasonic sensor to measure the height of a person?

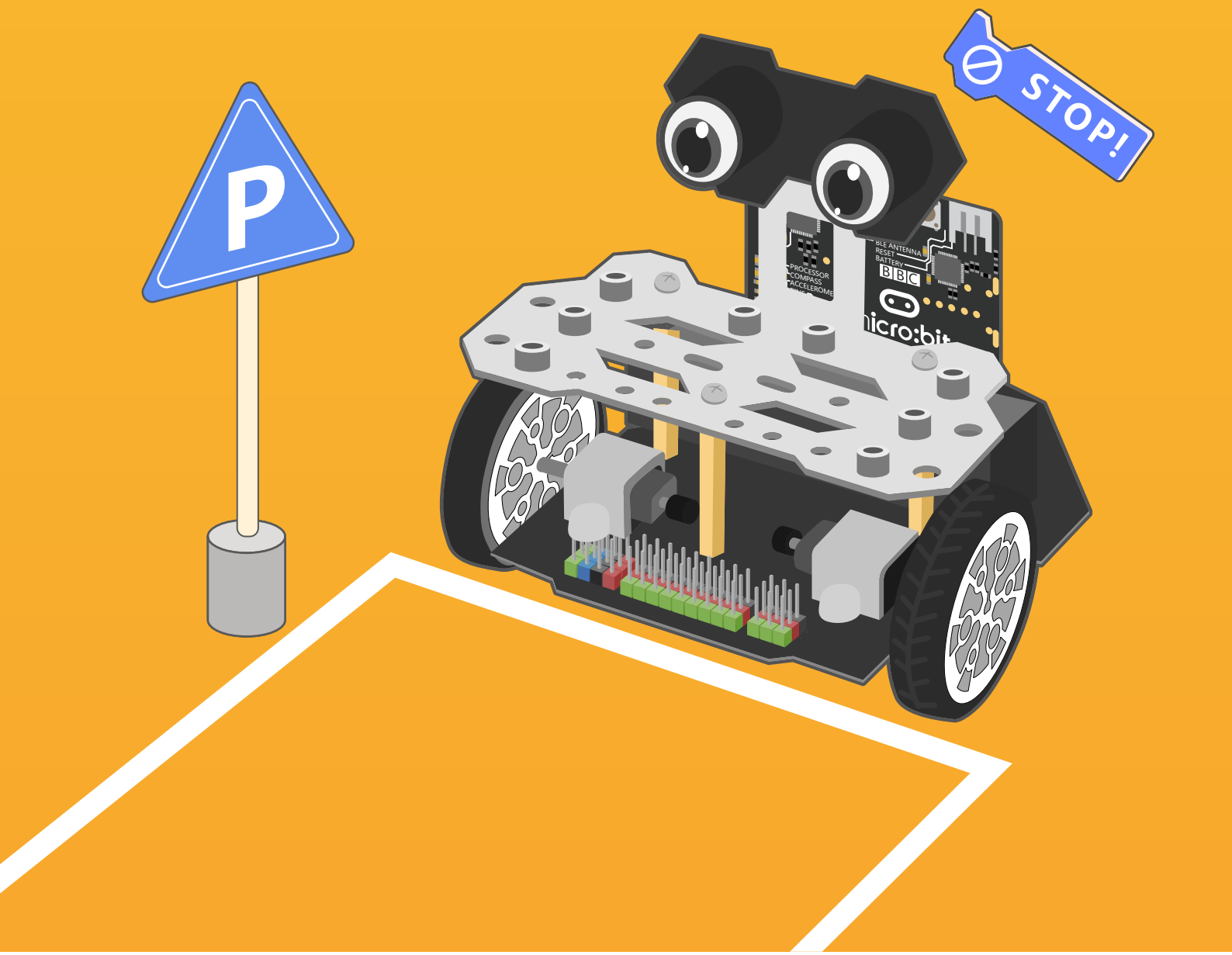
Think & Explore



To make the measurement more accurately, you have to:

Pay attention to the position and direction of the ultrasound.

Calibrate the sensor within 10cm to prevent large error.



Chapter 8

Car Reversing Helper

To help drivers back up and park more safely and easily, there are a lot of car reversing radar alarming systems emerging on the market. Based on ultrasonic measurement principle, the reversing radar system can detect the distance between the car and obstacle, then the drivers can be alerted by beeps or the dashboard display, which could be very helpful for new drivers.

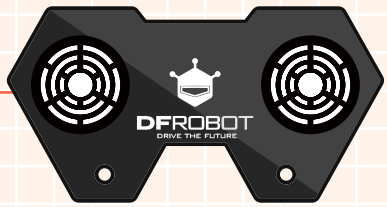
Goal

1.Learn how to use variables
2.Learn how to embed a condition block inside another one.

Electronic Component

Ultrasound Brief

Ultrasonic Sensor



The transmitter sends out ultrasound, and when hitting the object, the ultrasound reflects as echo and will be sensed by the receiver.

Command Learning

Block Brief

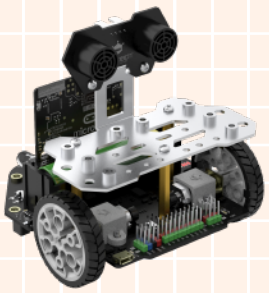
Variable

Changeable value: number, string, list

Assign a value to variable

Assign a value to the variable.
Default setting: distance=0

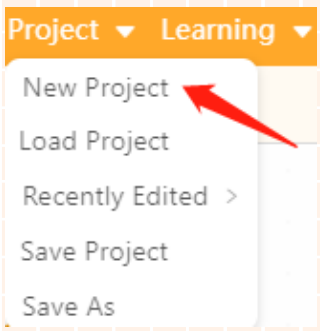
Hands-on Practice



In this project, our aim is to measure the distance between the end of the robot and obstacles, so we need to inversely install the ultrasonic sensor onto the expansion bracket, as shown below.

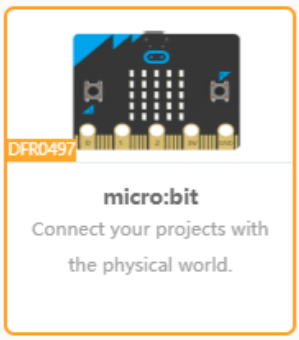
Step 1 Create a New Project

Open the Mind+, click "Project" -- "New project" to create a new project.

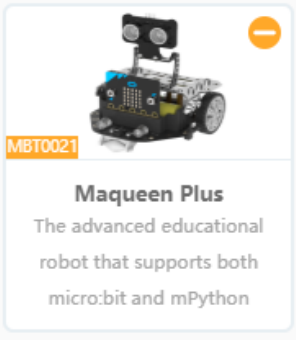


Step 2 Add the Maqueen Plus

1、Select "Expansion"-"Main Control Board" -- "micro: bit" main control board, the selection is as follows:



2、Continue to click on the"expansion board " -- " Maqueen Plus ", the selection is as follows:

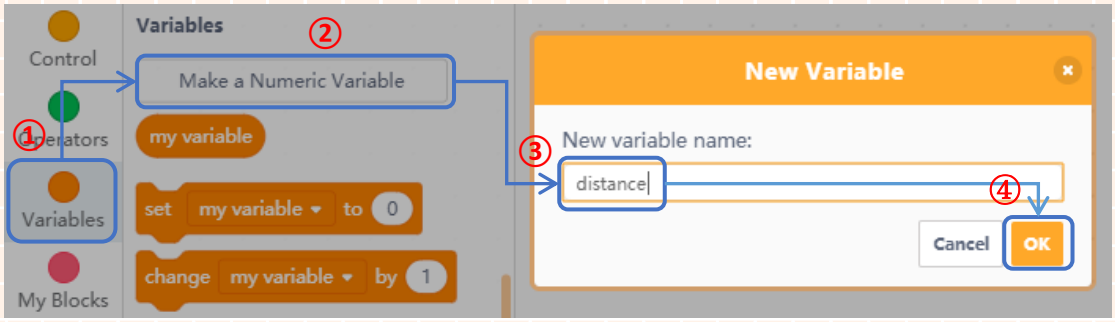


When the Maqueen Plus is loaded successfully,there will be a icon" 

" appearing in the command block section. Click the icon then you will see all the related blocks.

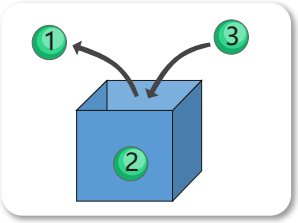
Step 3 Programming

1.Create a variable and name it as "distance".



1.Click "Variable" in the command block section | 2.Click "Make a variable" | 3.Name the variable as "distance" | 4.Click "OK".

Knowledge Expansion



What is a variable?

We may think of a variable as a container or box where we can store data that we need to use later, and each box can only hold one value (number, text and Boolean data) at a time. For example, use it to store an integer, after we put 1into it, we put 2 into it, then we can only get 2 from this box. The name of the box is the variable's name and the value of the variable is placed inside the box.

2.In this project, we need to monitor the distance value the sensor detected in real-time, so we have to assign the value to the variable "distance".

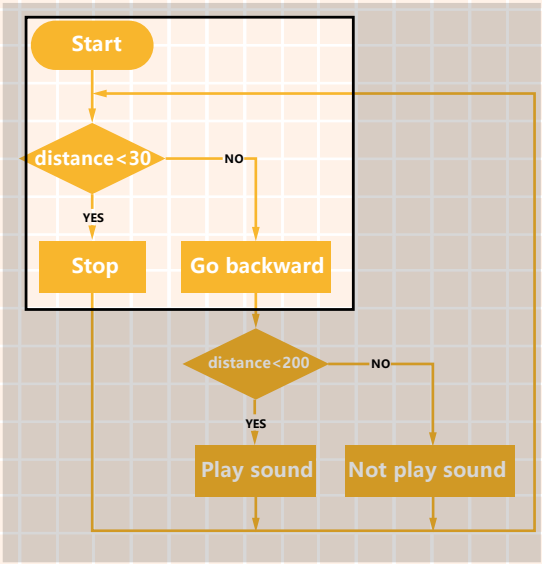
Knowledge Expansion

distance

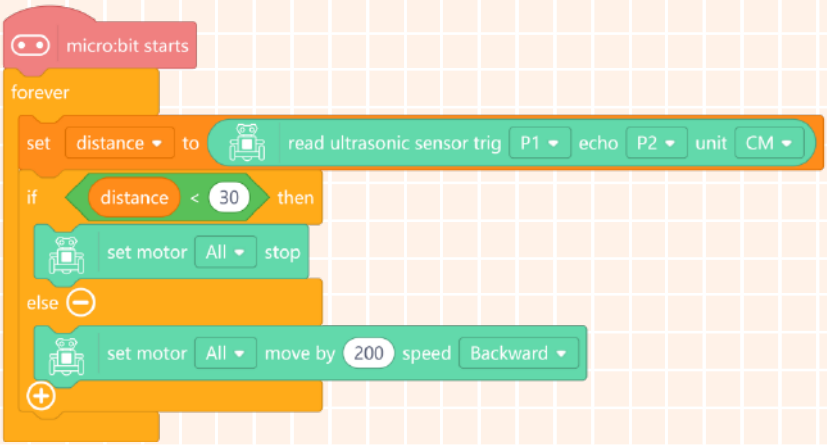
Then we can directly use the variable "distance" to call the distance value later.

3.Once the distance between the car and the obstacle is smaller than the preset value (distance <30cm in the example), the car stops. If the distance is long enough, the car goes backward, and the buzzer keeps beeping.

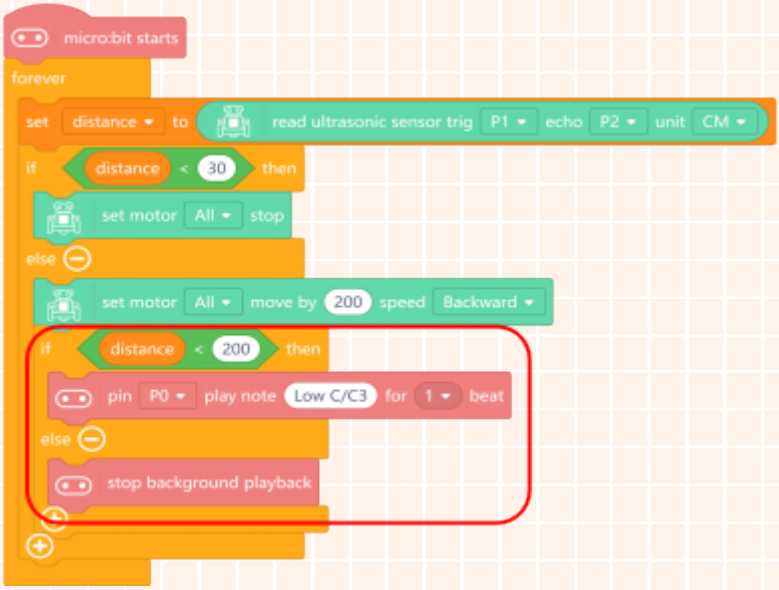
Drawing a flowchart is gonna help us understand the program.



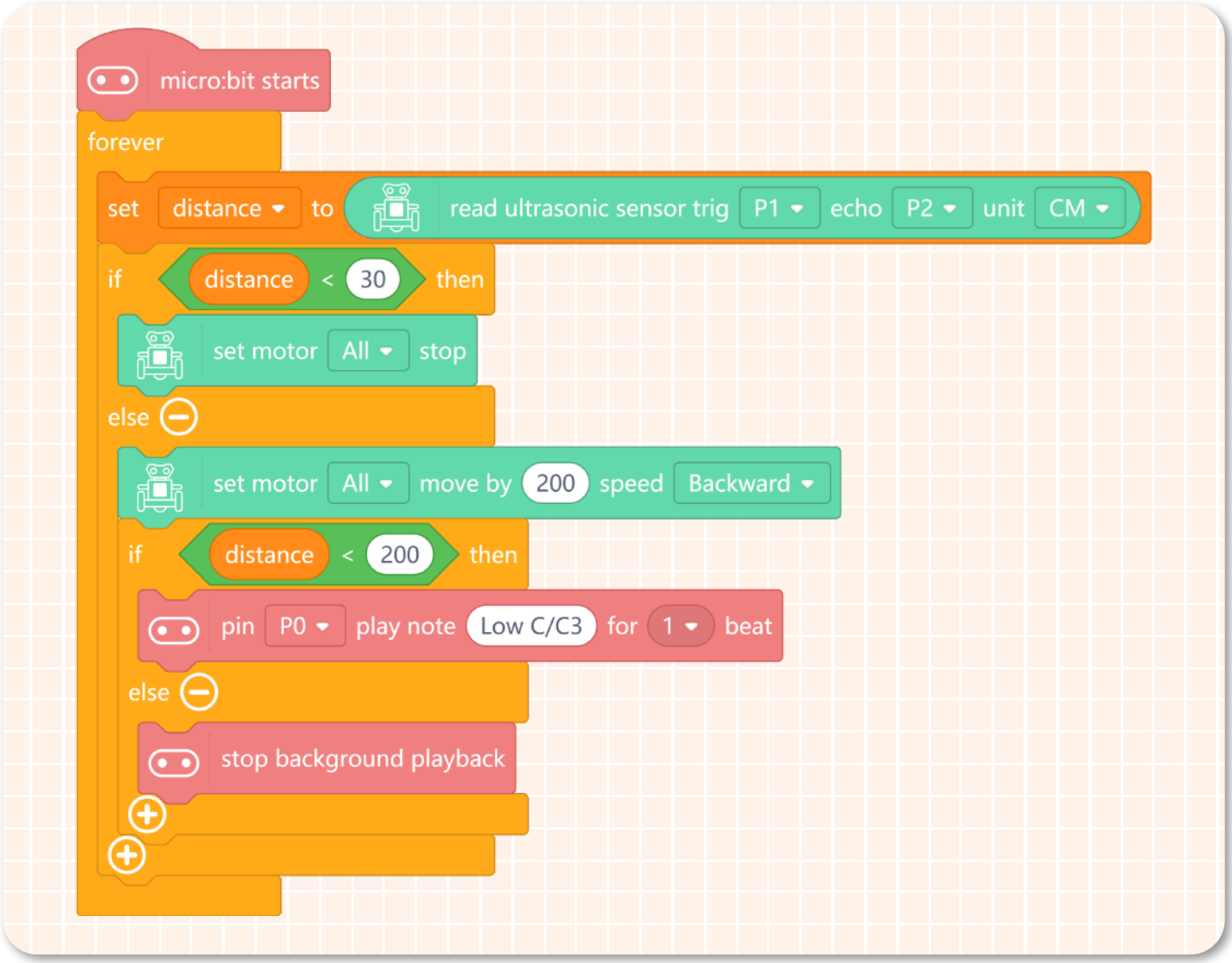
4.Complete part of the program: car stops and goes backward.



5.Only when the car is going backward will the buzzer start making sound, so the condition block "distance<200" should be put under the car backward block.



6.The complete program is shown below.



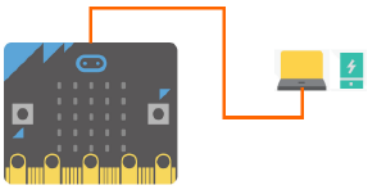
7.Name your project as "Car Reversing Helper" and save it.

Step 4 Download a Program

After we completed all the above steps, put an obstacle behind the Maqueen Plus car, turn on the power switch. When the detected distance is smaller than 200, the car starts going backward; when the distance is between 30 to 200, the buzzer keeps beeping; distance <30, the car stops.

1.Connect to a Computer

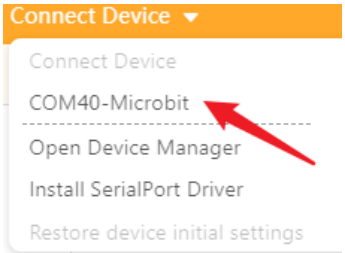
Connect micro: bit board to your computer via USB, then the power indicator on the board will light up.



2.Download the program

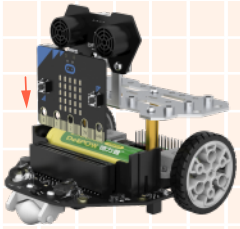
Click "Connect Device" in the menu bar, then click "COM-Microbit" in the drop-down menu to connect micro: bit board to the computer.

When connected, edit your programs and click "Upload" to upload the programs to your board (if the connection fails, then it will prompt "No Device Connected".) There will be a prompt box to display the uploading progress. When the program is updated, the prompt box will disappear.



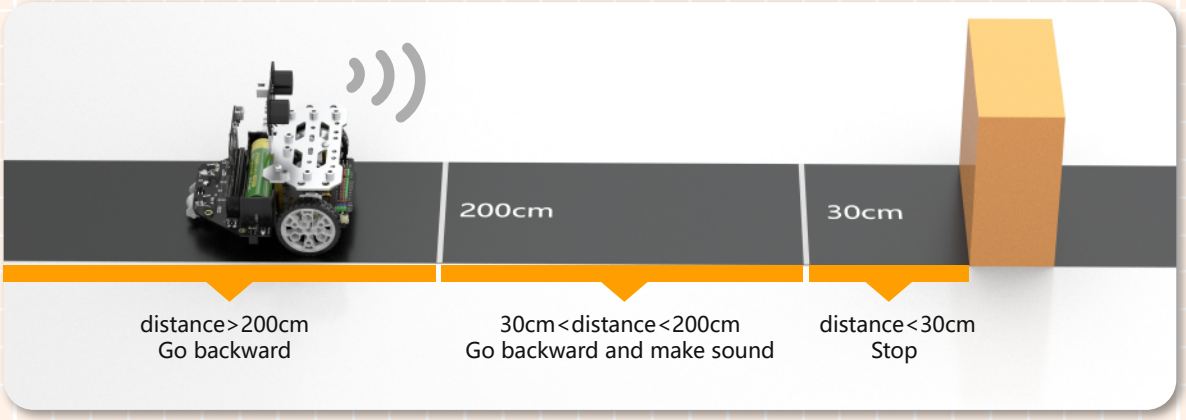
3.Install the micro:bit Board

After downloading the program, plug the micro:bit board into Maqueen Plus. Keep the LED matrix face forward, shown as below:



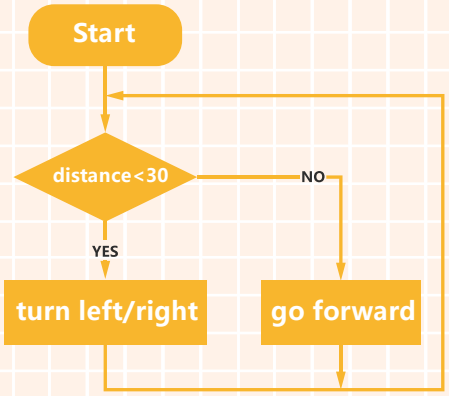
Step 5 Effect Display

After we completed all the above steps, put an obstacle behind the Maqueen Plus car, turn on the power switch. When the detected distance is smaller than 200, the car starts going backward; when the distance is between 30 to 200, the buzzer keeps beeping; distance <30, the car stops.

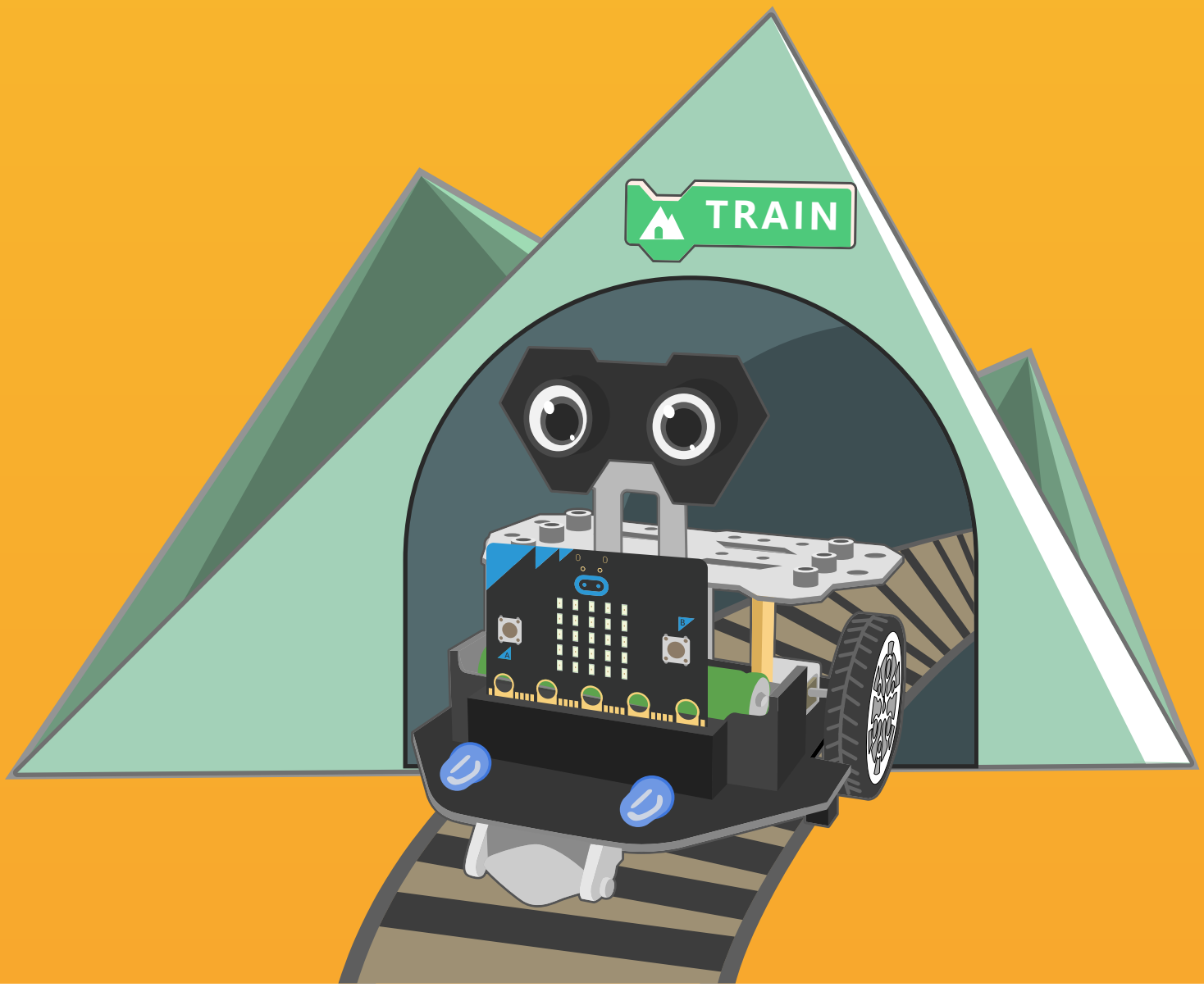


Think & Explore

We have made a car reversing helper with Maqueen Plus, the car will stop when it is very near an obstacle, but can you let the car bypass it? Make an obstacle avoidance car according to the flowchart below.



Tip: the ultrasonic sensor should point to the direction the car moves toward.



Chapter 9

Line-tracking Robot

Our line-tracking robot is fond of exploring things with a map. No matter how complicated the road is, give him a long enough track, he will trace it to the end of the world. Let's step on an adventure with Maqueen Plus robot!

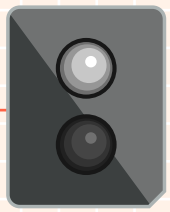
Goal

1.Learn the principle of Grayscale sensor
2.Learn the logic "and"

Electronic Component

Figure of the line-tracking sensor

Grayscale Sensor

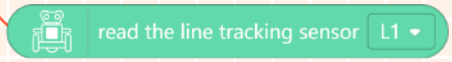


Detect the colors of objects and surfaces by aiming directly at close range, which can allow robots to track specified lines.

Command Learning

Block Brief

Line-tracking sensor



Measure the intensity of light from black to white; help robot car move along a specified route.

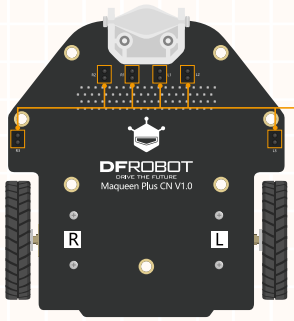
Comparison Operator"="

Return true if both inputs equal to each other.

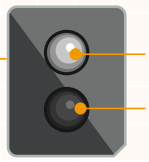
Logic "and"

Return true if both inputs are true.

How does a grayscale sensor work?



There are 6 line-tracking sensors integrated on Maqueen Plus board. Each sensor includes an IR transmitter and receiver.



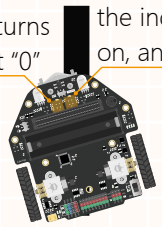
IR Transmitter

IR Receiver

When a line-tracking sensor detected the black line on the map, the indicator turns on, and output "1", otherwise, the indicator turns off, and output "0".

the indicator turns off, and output "0"

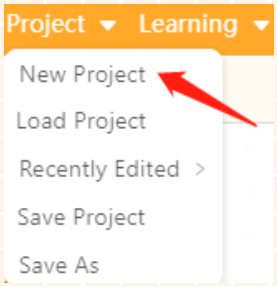
the indicator turns on, and output "1"



Note:
1.Since dark colors absorb light(including IR light), when the line-tracking sensor detected black, the IR light emitted by the transmitter cannot be reflected back to the receiver.
2.The output "0" or "1" does not refer to a high/low level, it' s just a value obtained by processing the read grayscale.

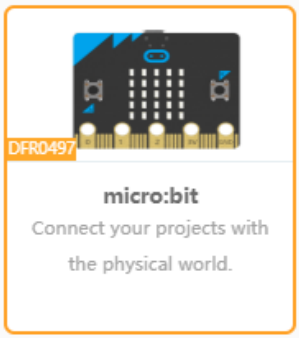
Step 1 Create a New Project

Open the Mind+, click "Project" -- "New project" to create a new project.

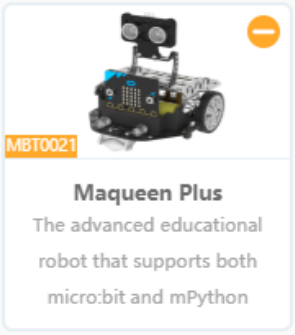


Step 2 Add the Maqueen Plus

1、Select "Expansion"-"Main Control Board" -- "micro: bit" main control board, the selection is as follows:



2、Continue to click on the"expansion board " -- " Maqueen Plus ", the selection is as follows:

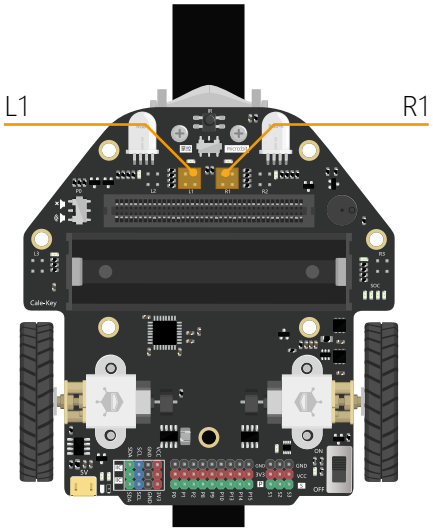


When the Maqueen Plus is loaded successfully,there will be a icon" 

" appearing in the command block section. Click the icon then you will see all the related blocks.

Step 3 Programming

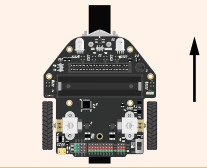
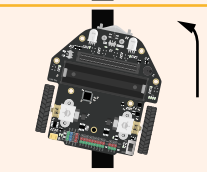
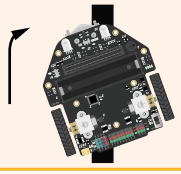
Maqueen Plus moves along the black line on the map. If you don't have a map, you can make one using adhesive tape. (Sensors R1 and L1 will be used in this project.)



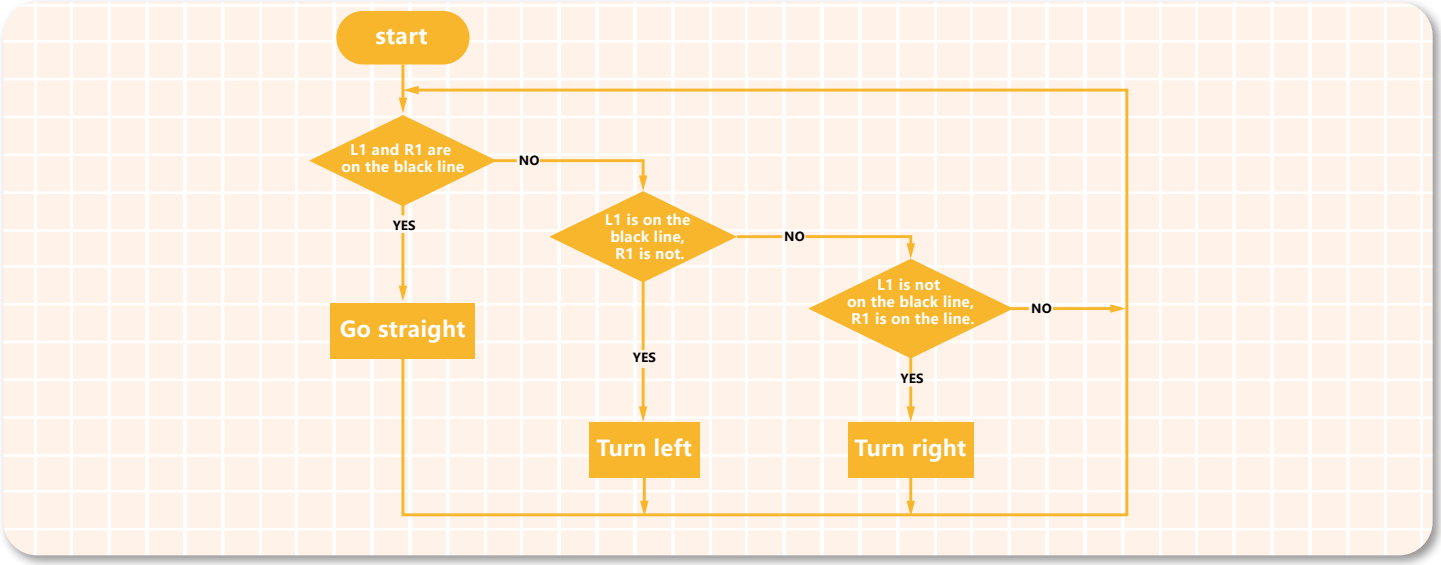
Knowledge Expansion

When you draw your own map, please make sure that both sensors L1 and R1 can be placed on the black line.

1.There are three possibilities when Maqueen Plus drives on the map.

Status Image	Sensor Status	Detection	Output	Motor Movement
	L1 and R1 are on the black line	Both the left and right sensors detected the black line.	L1 = 1 R1 = 1	Go straight
	L1 is on the black line, R1 is not.	Only the left sensor detected the black line.	L1 = 1 R1 = 0	Turn left
	L1 is not on the black line, R1 is on the line.	Only the right sensor detected the black line	L1 = 0 R1 = 1	Turn right

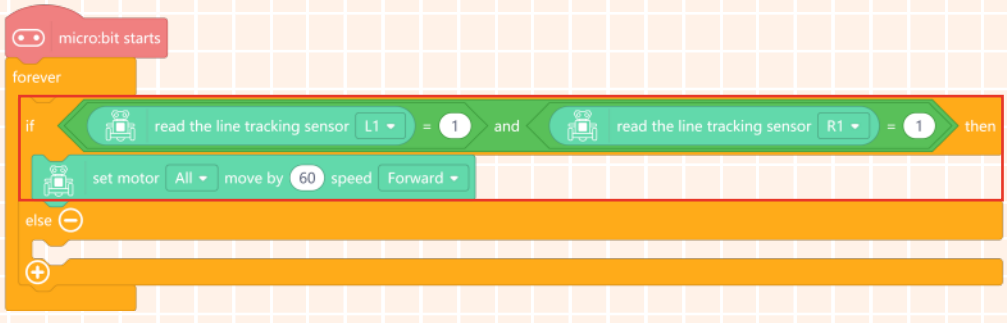
2.Draw the corresponding program flowchart.



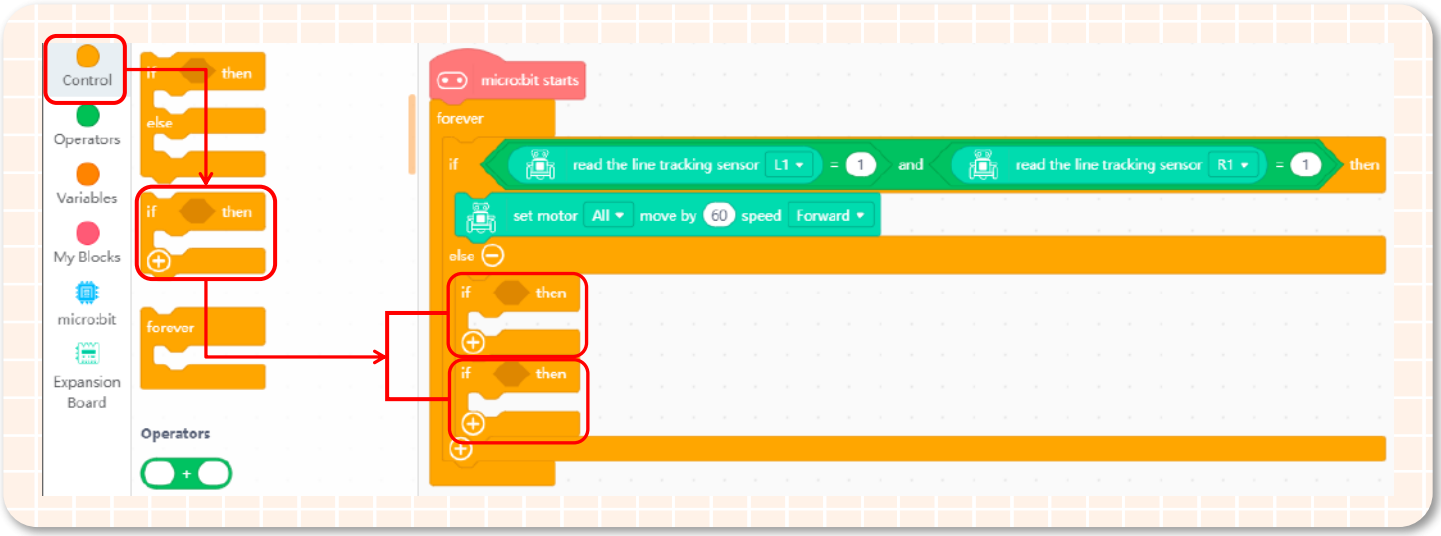
3.Since there are two conditions to judge, the outputs from sensor R1 and L1, we need to use a "and" block to combine them together.

Note: the program means that both sensors (L1 and R1) detected the black line.

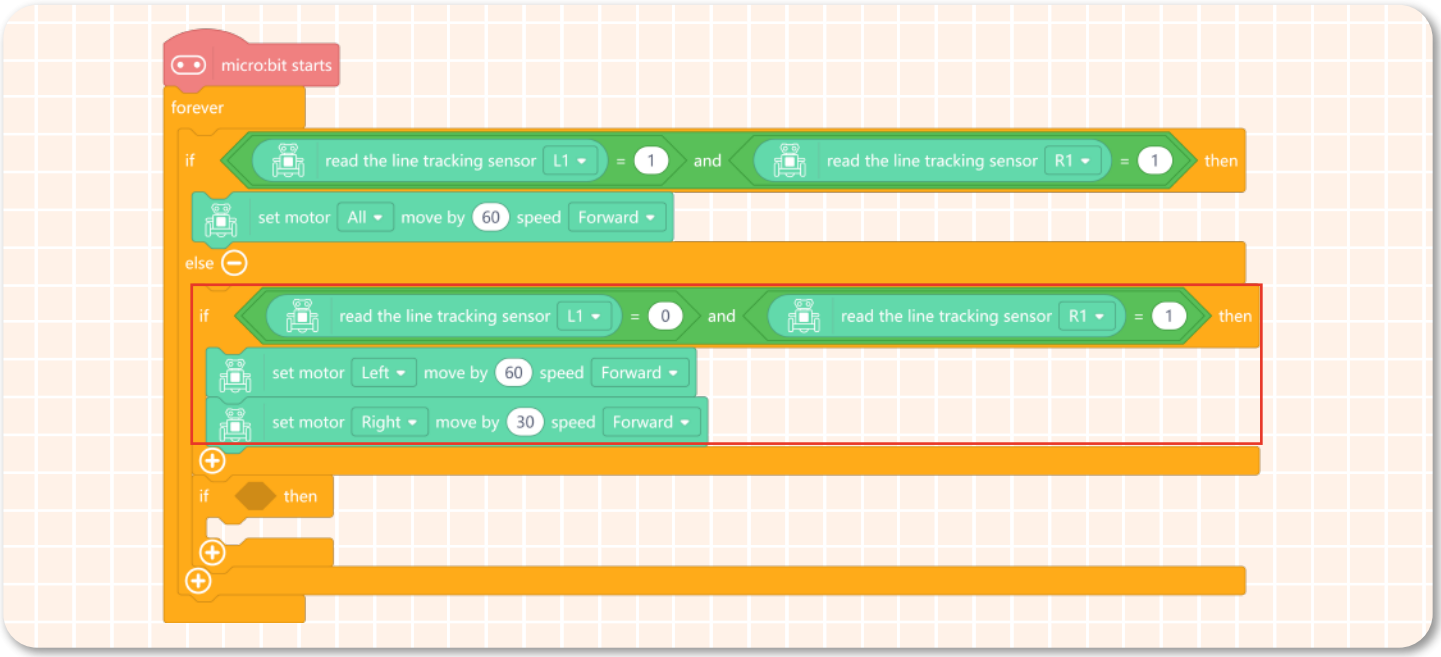
4.When the sensor L1 and R1 detected the black line, Maqueen Plus car moves forward.



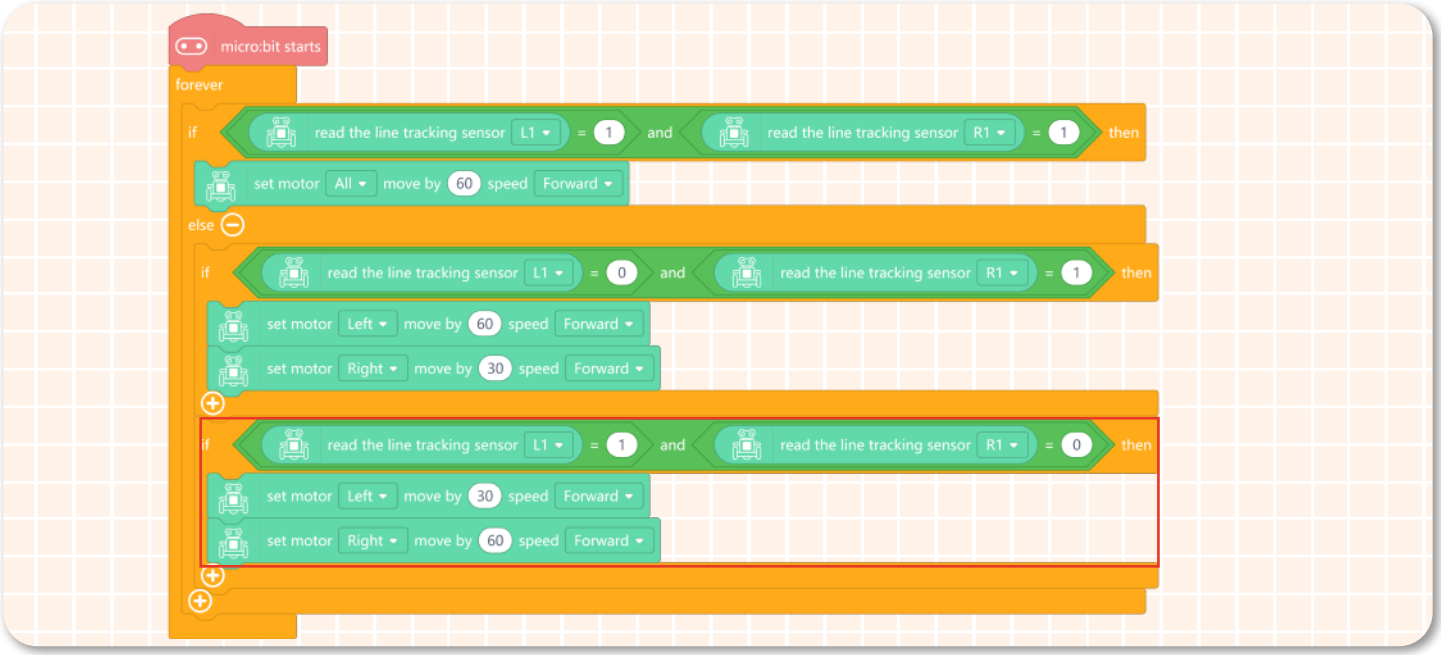
5.From the flowchart, we can see that the judgment conditions for turning left and right are coordinate. So we have to use two "if...then"blocks as statement 2 of the condition above.



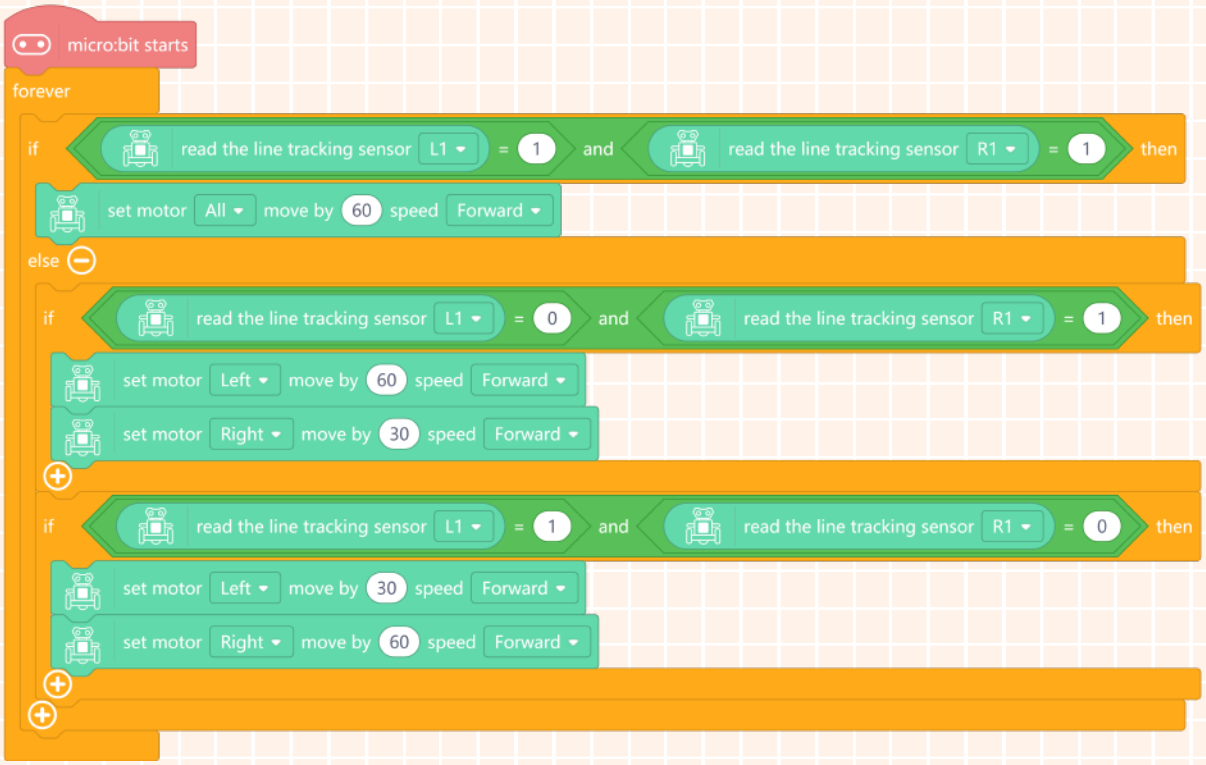
6.When only the right sensor R1 detected the black line, Maqueen Plus car turns right.



7.When only the left sensor (L1) detected the black line, Maqueen Plus car turns left.



8.The complete program is shown below:



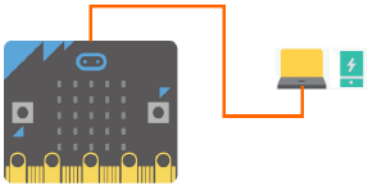
Note: the program means that both sensors (L1 and R1) detected the black line.

9.Name your project as "Track Train" and save it.

Step 4 Download a Program

1.Connect to a Computer

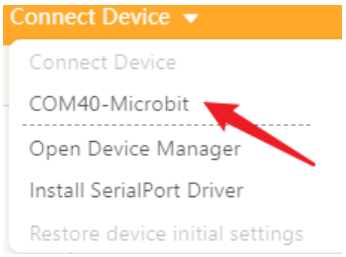
Connect micro: bit board to your computer via USB, then the power indicator on the board will light up.



2.Download the program

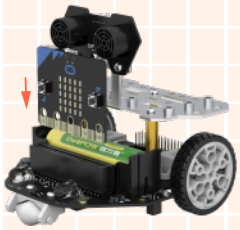
Click "Connect Device" in the menu bar, then click "COM-Microbit" in the drop-down menu to connect micro: bit board to the computer.

When connected, edit your programs and click "Upload" to upload the programs to your board (if the connection fails, then it will prompt "No Device Connected".) There will be a prompt box to display the uploading progress. When the program is updated, the prompt box will disappear.



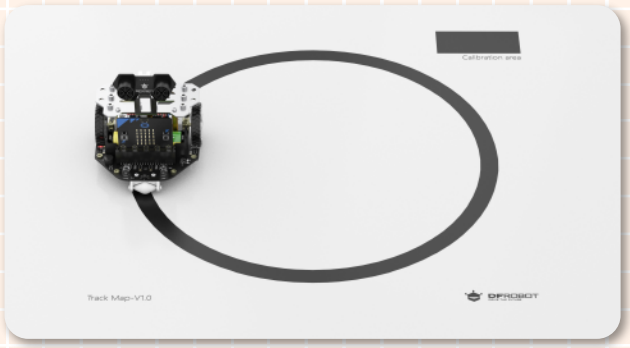
3.Install the micro:bit Board

After downloading the program, plug the micro:bit board into Maqueen Plus. Keep the LED matrix face forward, shown as below:



Step 5 Effect Display

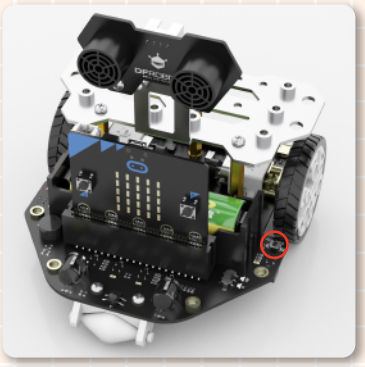
Turn on the power switch after all the above steps done, put Maqueen Plus car on the map, then it will automatically move along the black line, just like a track train!



Extension-Sensor Calibration

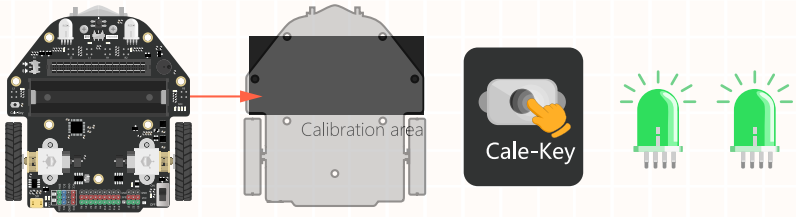
The grayscale sensors on Maqueen Plus can be directly used since they are factory calibrated. But if you find that your sensors cannot detect black line accurately, you can calibrate them as the way shown below:

The button circled in red is the calibrate button.



Place Maqueen Plus on the black calibrating area of the map, and make sure all the grayscale sensors are within that area. Press down the calibration button, when the two RGB LEDs flashes green light, release the button, then sensor calibration is done.

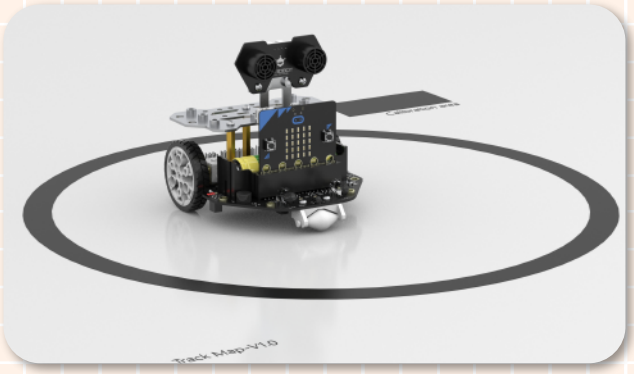
Note: the black line printed by printer cannot be accurately detected sometimes. You can use black tape or marker to make a map if necessary.

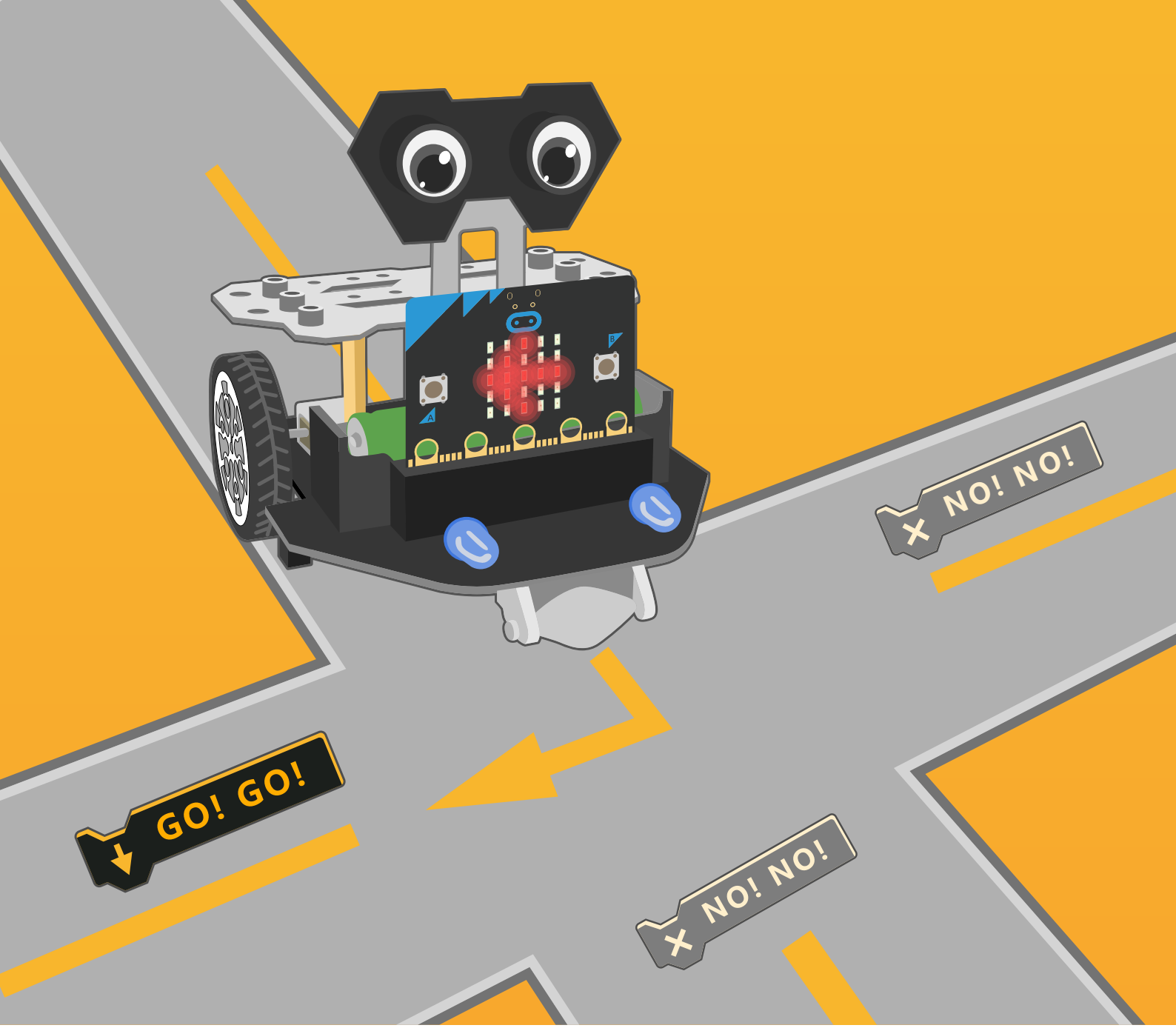


Think & Explore

With the development of technology, sweeping robot is gradually becoming a part of our family life. Simply place it on the floor and turn it on, here it goes ! To prevent the robot from falling off the stairs, the bottom of the robot usually is surrounded by many sensors. Our Maqueen Plus has 6 grayscale sensors, so it can totally meet the requirements. Let's make a sweeping robot with Maqueen Plus. Take the black line on the map as the edge of the stairs, and the robot will be only allowed to move within that area.

Tip: let Maqueen Plus turn around when it detects the black line.





Chapter 10

Tour of Crossroad

Standing at a crossroad, Maqueen Plus is wondering which way he should go. Every road is so unique. Well, why not try all the roads? That sounds a good idea, right! Let' s help Maqueen Plus to start his tour of crossroad!

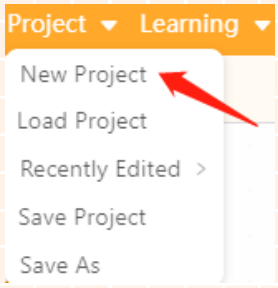
Goal

Learn the use of multiple line-tracking sensors

Hands-on Practice

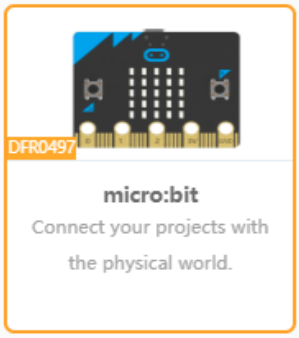
Step 1 Create a New Project

Open the Mind+, click "Project" -- "New project" to create a new project.

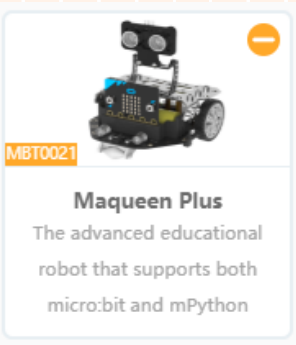


Step 2 Add the Maqueen Plus

1、Select "Expansion"-"Main Control Board" -- "micro: bit" main control board, the selection is as follows:



2、Continue to click on the"expansion board " -- " Maqueen Plus ", the selection is as follows:



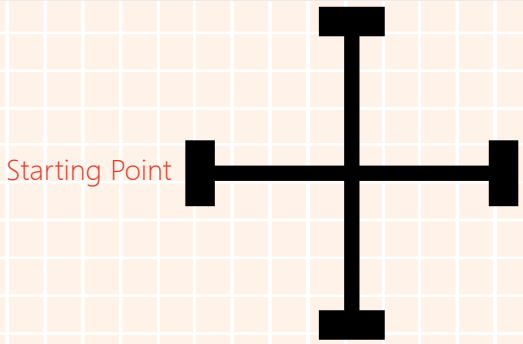
When the Maqueen Plus is loaded successfully,there will be a icon" 

" appearing in the command block section. Click the icon then you will see all the related blocks.

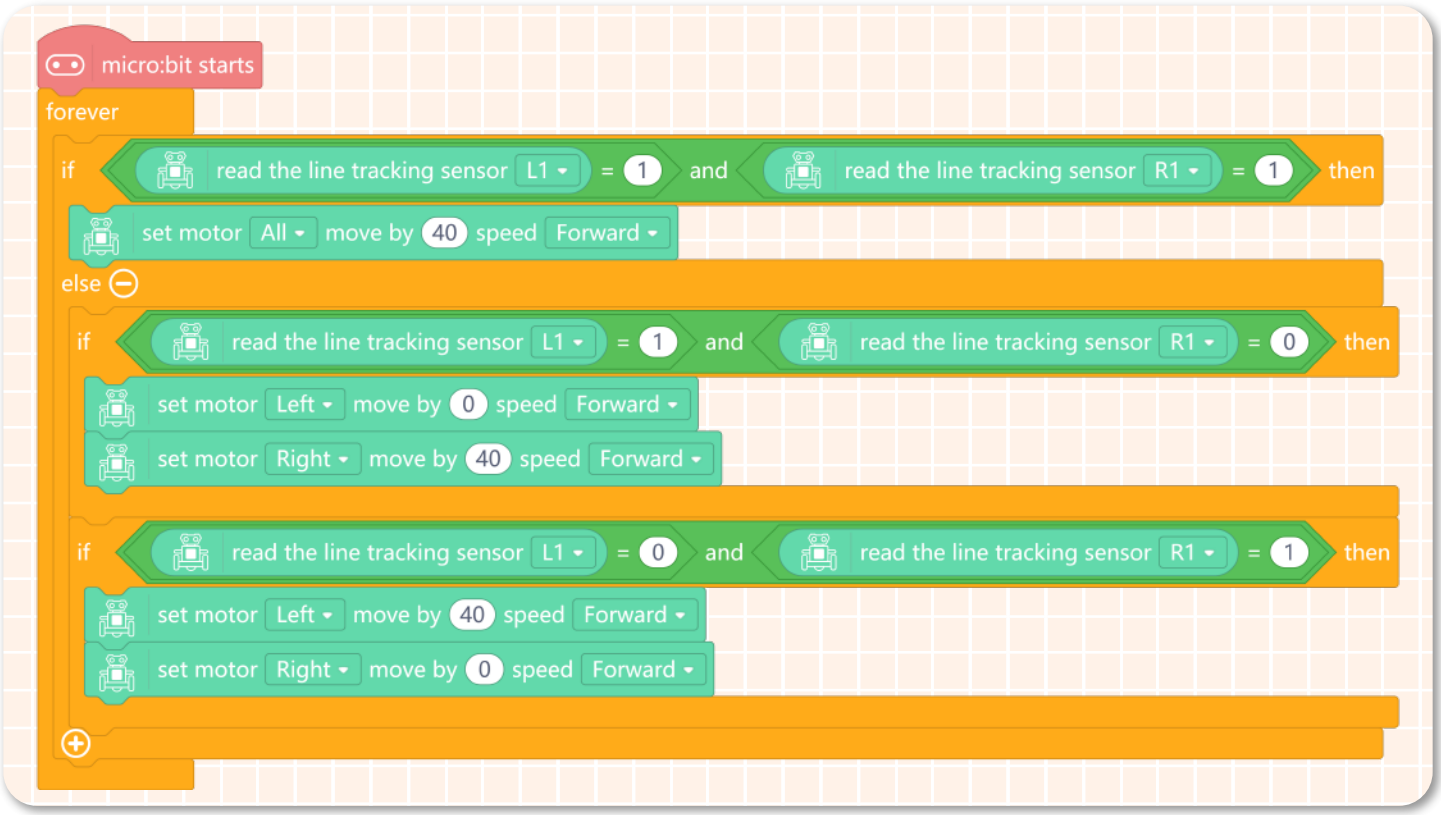
Step 3 Programming

1.In this project, Maqueen Plus will try all roads of the crossroad, and then back to the starting point. How can we realize that by programming?

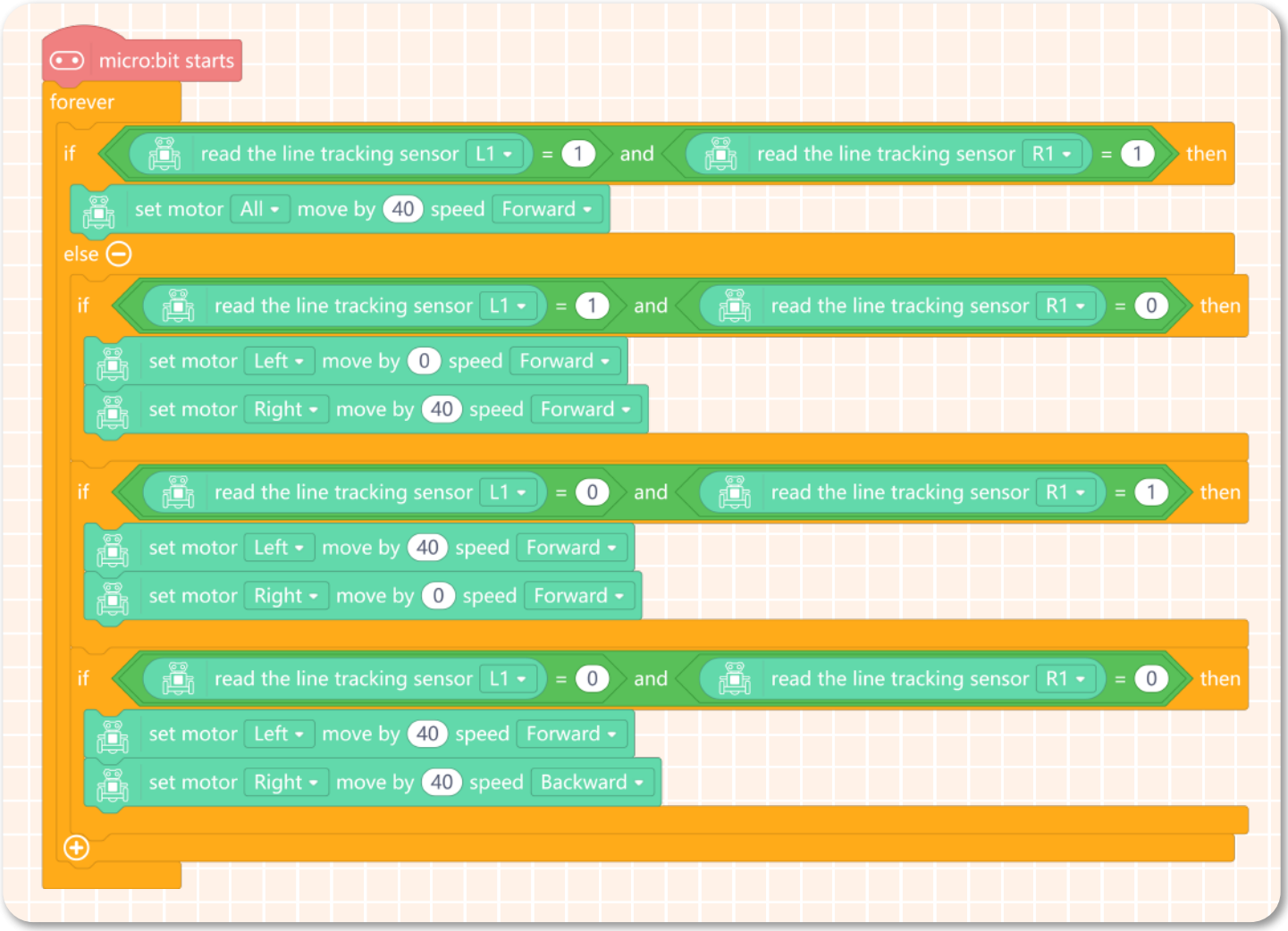
In the process of line-tracking, Maqueen Plus turns left/right at the intersection, and then turns around at the end of the road. Repeat this series of actions all the time



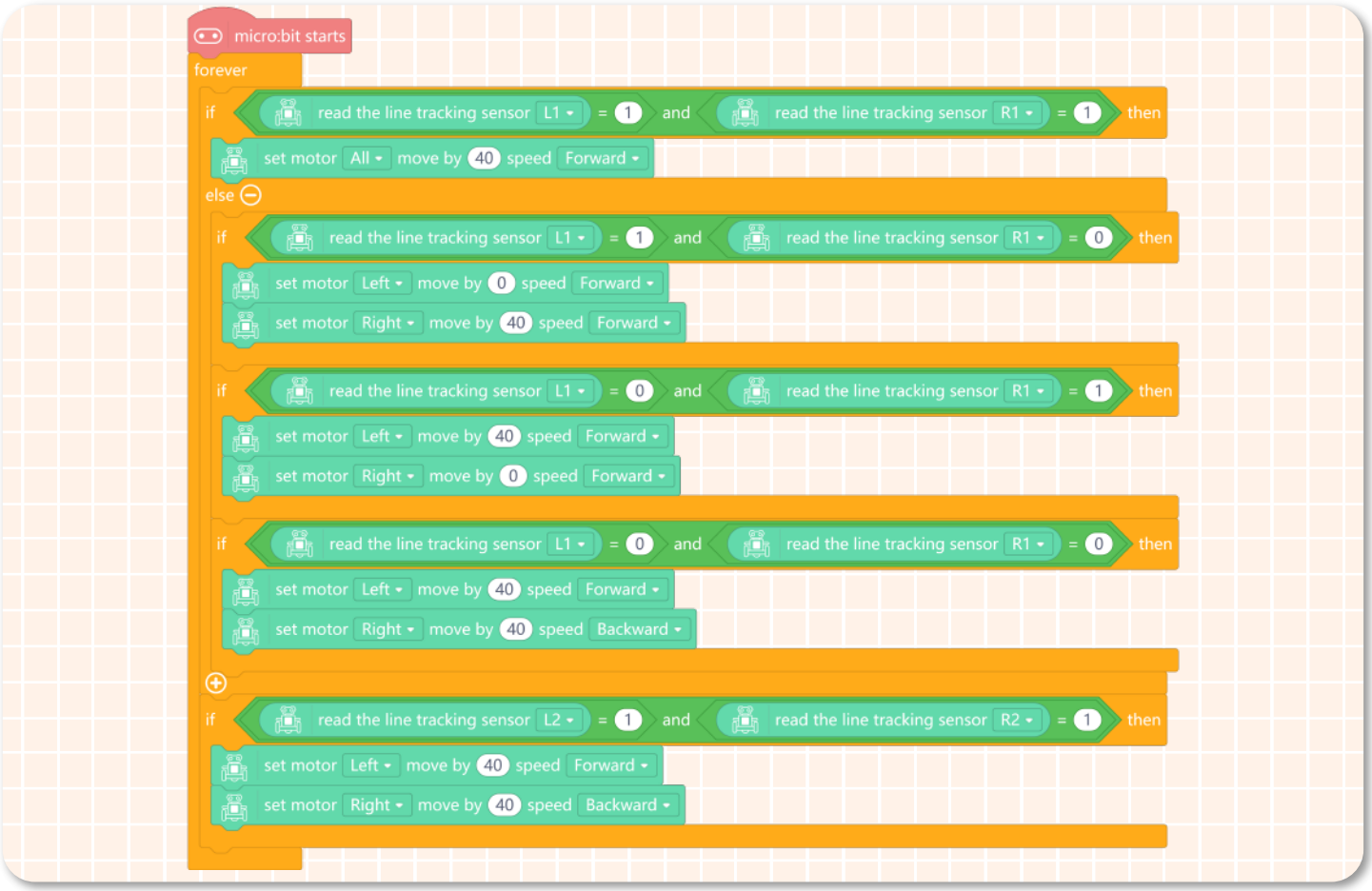
2.First,complete the program of line-tracking.



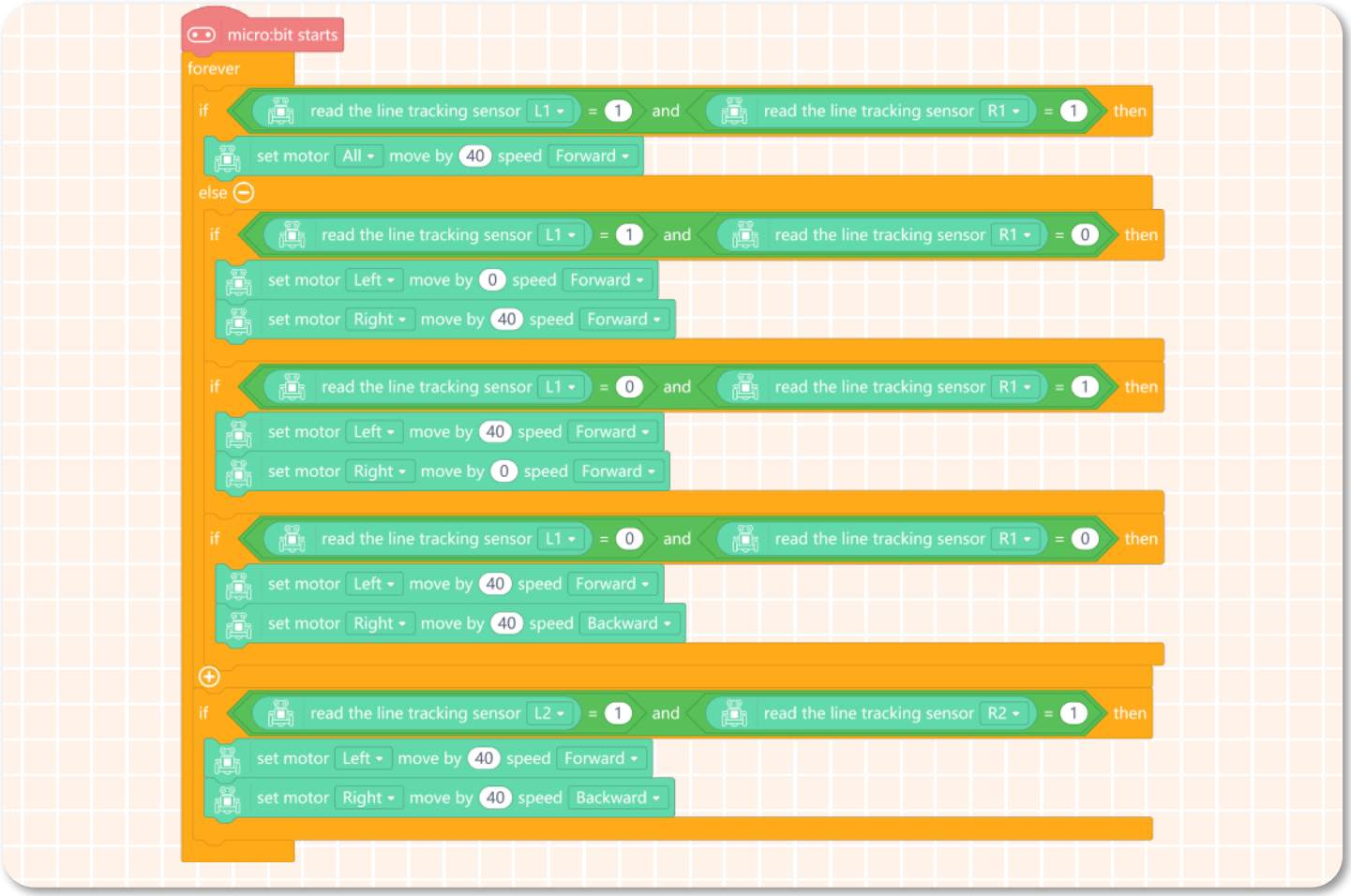
3.When no black line is detected by sensors L1 and R1, it means that the car drives out of the black track. Now let the Maqueen Plus spin around until the black track is found again.



4.When the sensors L2 and R2 detected the black line, it means that the car has arrived the intersection or the end of the road, and the car needs to spin around to find the black track again.



5.The complete program is shown below.



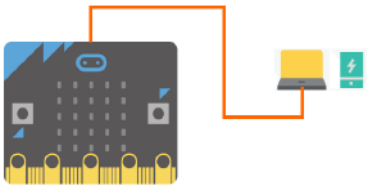
Note: if the Maqueen Plus car turns left or right too much, you can change its motor speed to adjust.

6.Name your project as "Tour of crossroad" and save it.

Step 4 Download a Program

1.Connect to a Computer

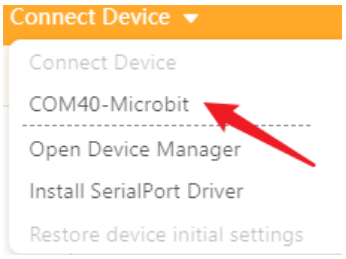
Connect micro: bit board to your computer via USB, then the power indicator on the board will light up.



2.Download the program

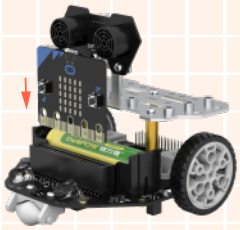
Click "Connect Device" in the menu bar, then click "COM-Microbit" in the drop-down menu to connect micro: bit board to the computer.

When connected, edit your programs and click "Upload" to upload the programs to your board (if the connection fails, then it will prompt "No Device Connected".) There will be a prompt box to display the uploading progress. When the program is updated, the prompt box will disappear.



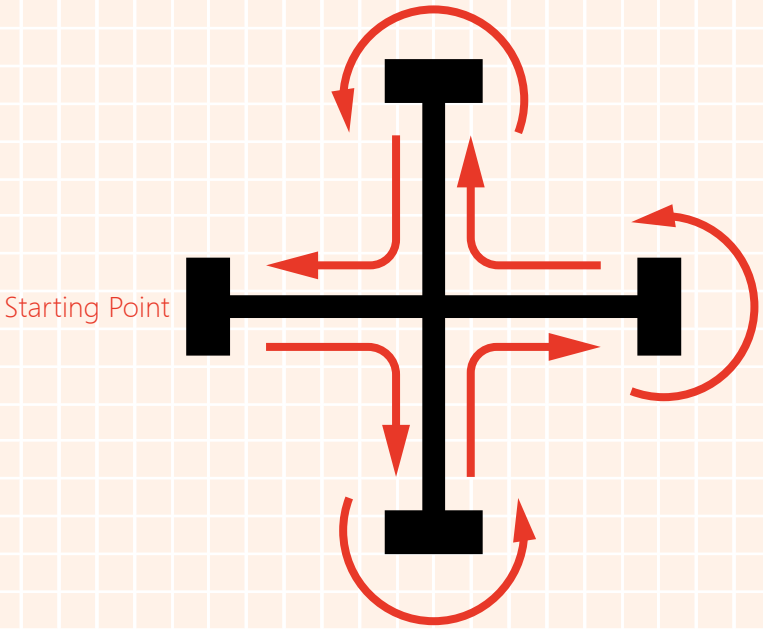
3.Install the micro:bit Board

After downloading the program, plug the micro:bit board into Maqueen Plus. Keep the LED matrix face forward, shown as below:



Step 5 Effect Display

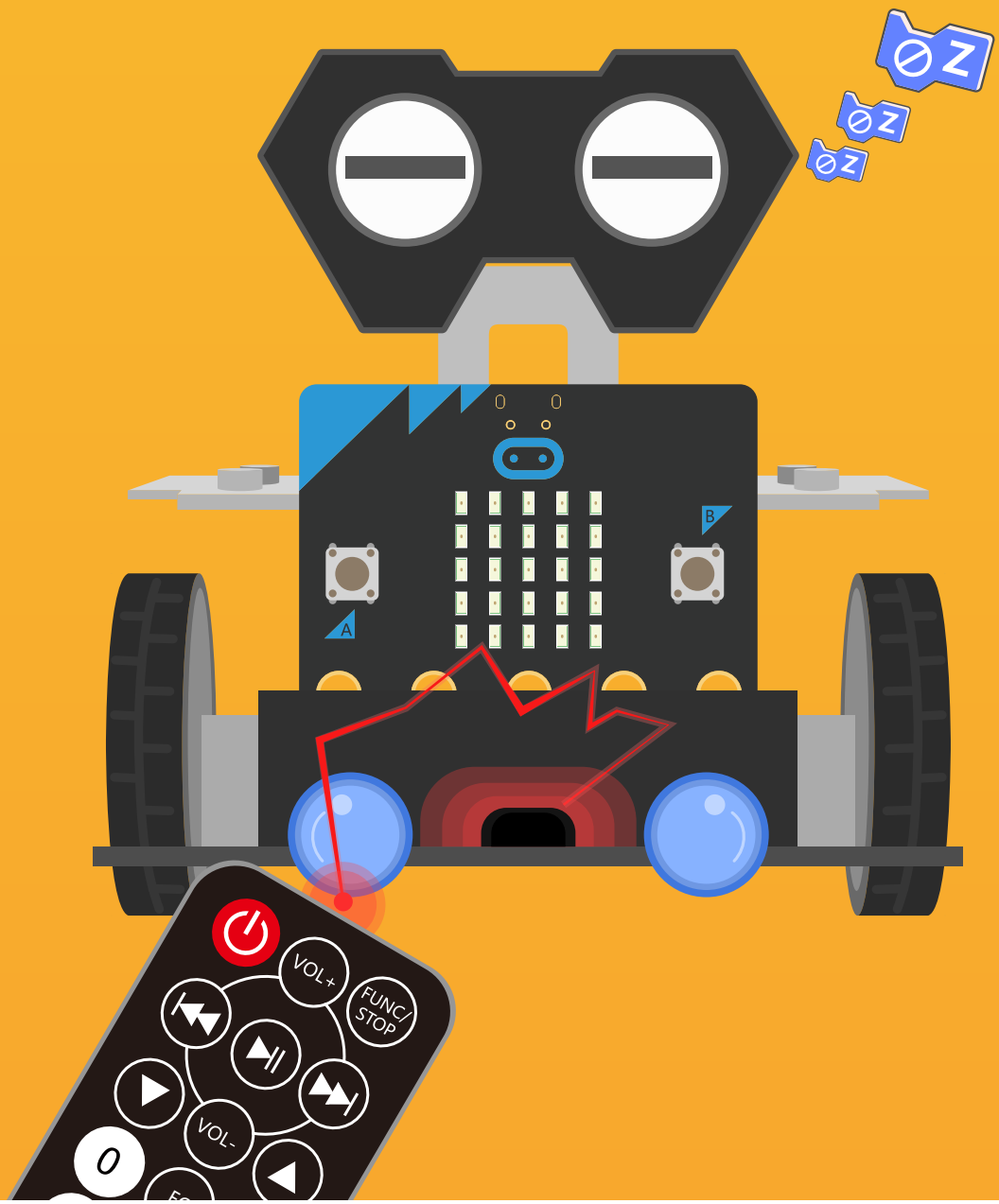
When completed all the steps, put Maqueen Plus on the crossroad map, turn on its power switch.



Think & Explore

When Maqueen Plus arrives at the intersection, he will turn right, well, now let's make its right RGB LED flash while turning right, and then the both RGB LEDs flash when turning around.

Tip: add RGB blocks in the program above.



Chapter 11

IR-controlled Robot

The invention of remote controller allows people to operate devices from a certain distance, which brings a lot of convenience for our daily life. IR remote controller is the most commonly-used one. In this chapter, we will use an IR remote controller with our Maqueen Plus to make an "IR-controlled Robot".

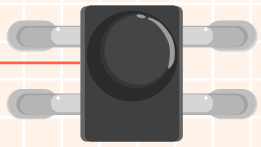
Goal

1.Learn how to use function block
2.Learn how to use IR remote controller to control motor

Electronic Component

IR receiver

IR receiver

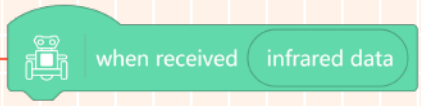


Receive a coded infrared signal and convert it into an electric signal.

Command Learning

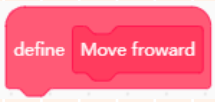
Block Brief

IR receiver



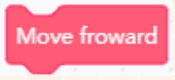
Receive and read the infrared data.

Create a function



When a continuous action needs to occur multiple times in the program, in order to make the program more clear, we need to define a sub-function.

Call a function



Drag the sub-function into the program to call it.

Hands-on Practice

We will use an IR remote controller to operate our Maqueen Plus, so we have to get key value first. The decimal number of each key on the remote controller is shown below.

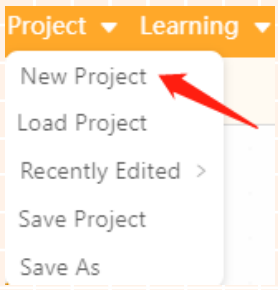
Key	Value
Red key	255
VOL+	127
FUNC/STOP	191
Left arrow	223
Pause	95
Right arrow	159
Down arrow	239
VOL-	111

Key	Value
Up arrow	175
0	207
EQ	79
ST/REST	143
1	247
2	119
3	183
4	215

Key	Value
5	87
6	151
7	231
8	103
9	167

Step 1 Create a New Project

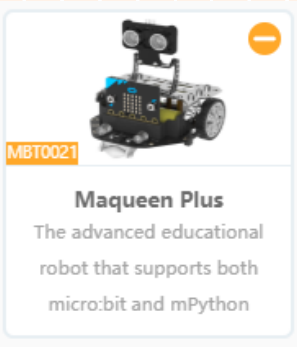
Open the Mind+, click "Project" -- "New project" to create a new project.



Step 2 Add the Maqueen Plus

1、Select "Expansion"-"Main Control Board" -- "micro: bit" main control board, the selection is as follows:

2、Continue to click on the"expansion board " -- " Maqueen Plus ", the selection is as follows:

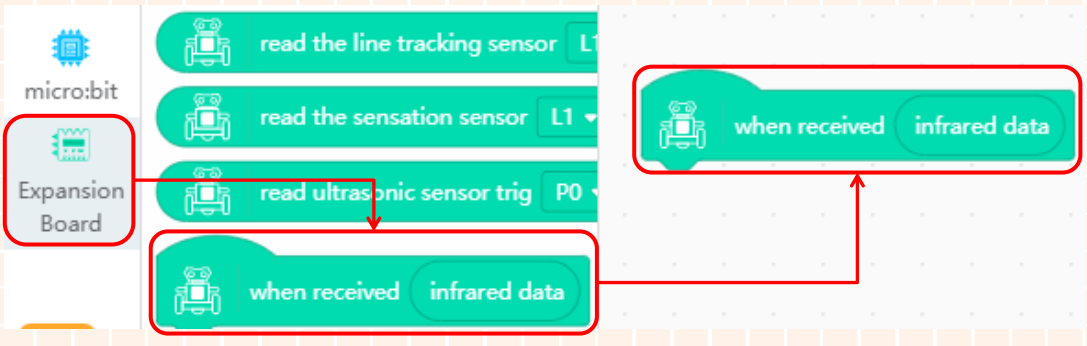


When the Maqueen Plus is loaded successfully,there will be a icon" 

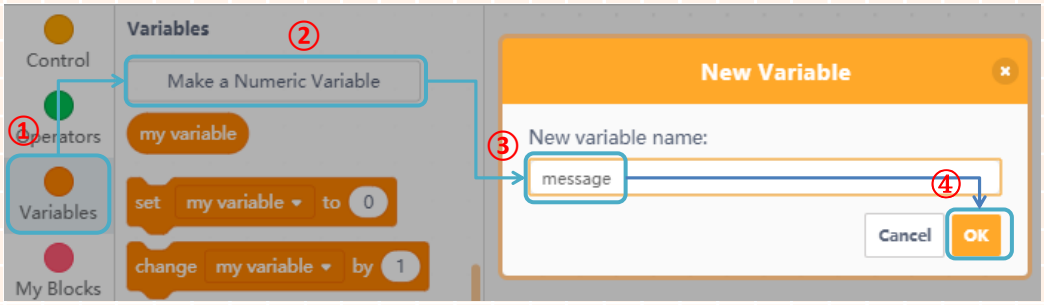
" appearing in the command block section. Click the icon then you will see all the related blocks.

Step 3 Programming

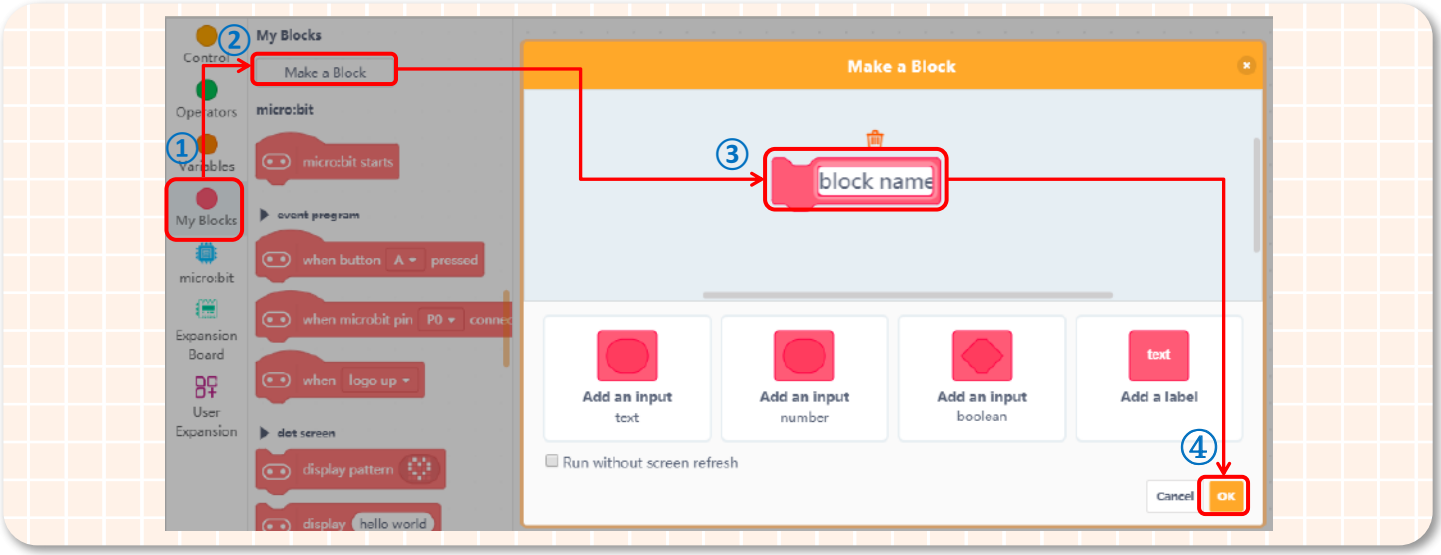
1.Drag the IR receive block to the editing section.



After we dragged the IR receive block to the editing section, there will be a variable named "message" appearing in the variable command section for storing key-value of IR remote controller.



2.Create a function and name it as “Move forward”.



① Click “My Block”->”Make a Block”; ② Click “Make a function”;
③ Name the function as “Move forward”; ④ Click “OK”.

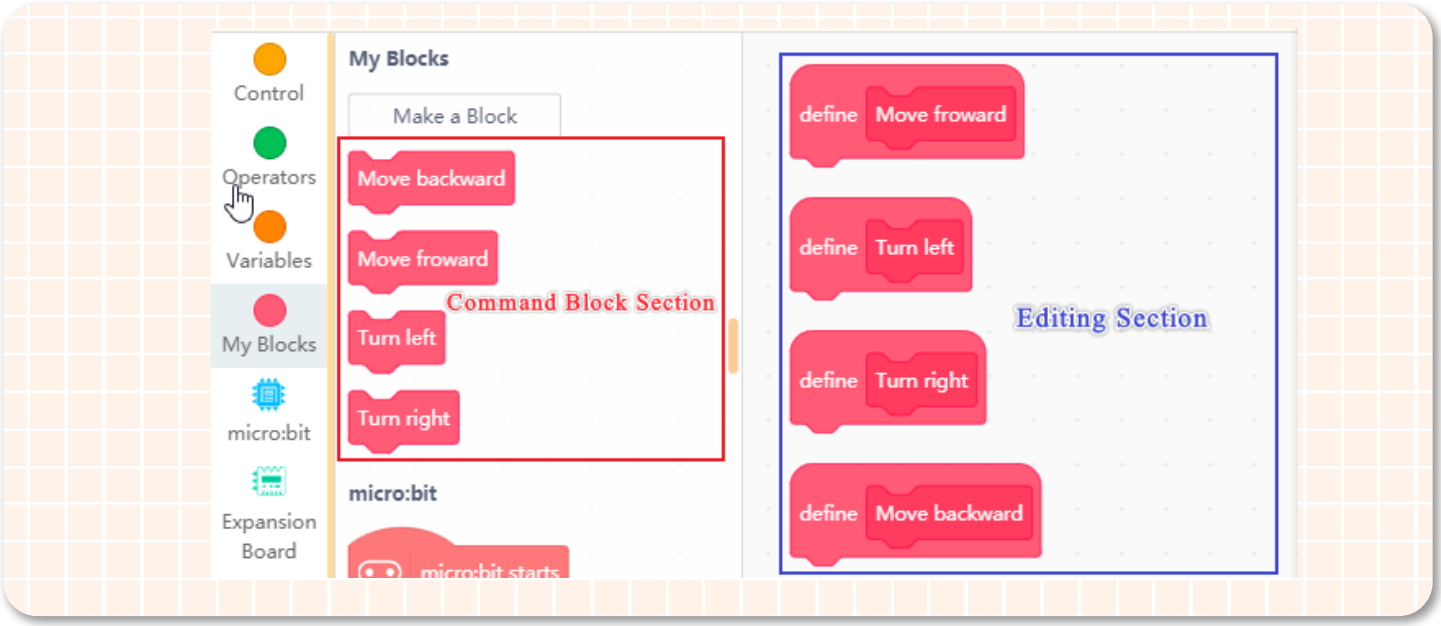
Knowledge Expansion

What is a function?

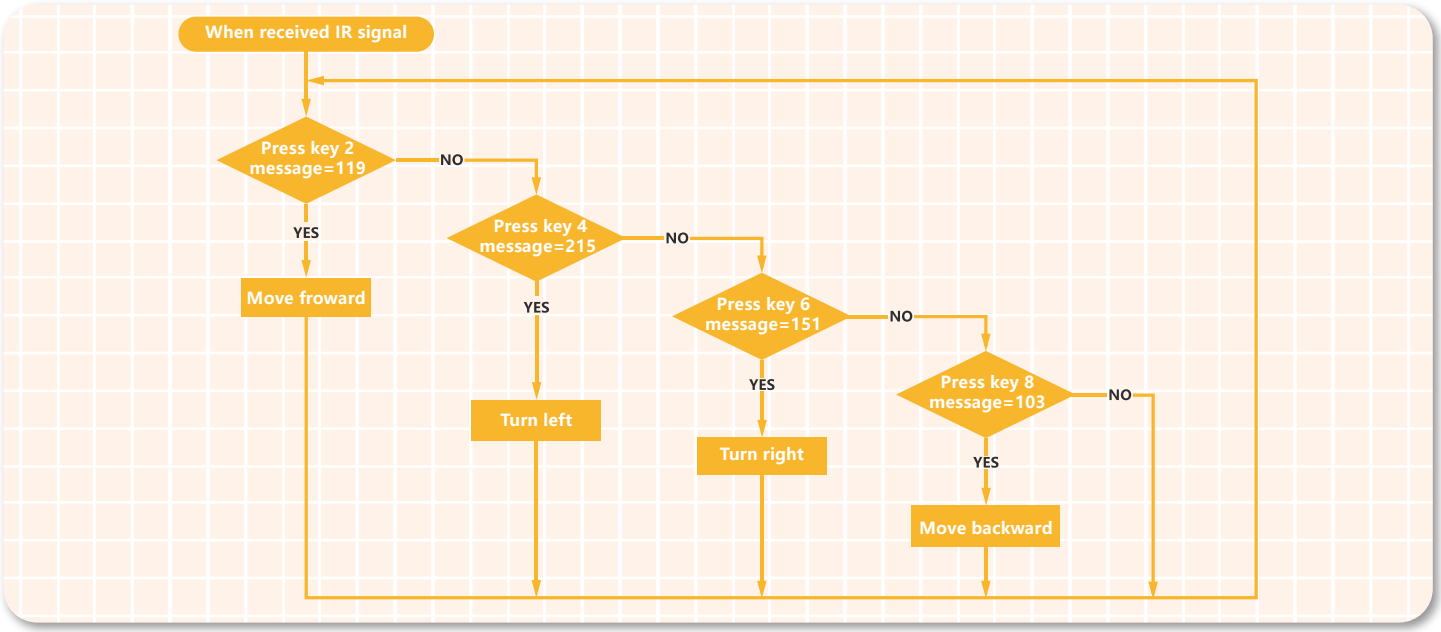
A function, also known as procedure or subroutine, can be defined as the organized block of reusable code which can be called whenever required.

Generally, a large program can be divided into many basic building blocks and each block can realize a specified function. A function can be called multiple times by other main functions and sub-functions, which not only reduces the workload of rewriting the program segment, but also improves the utilization of the program.

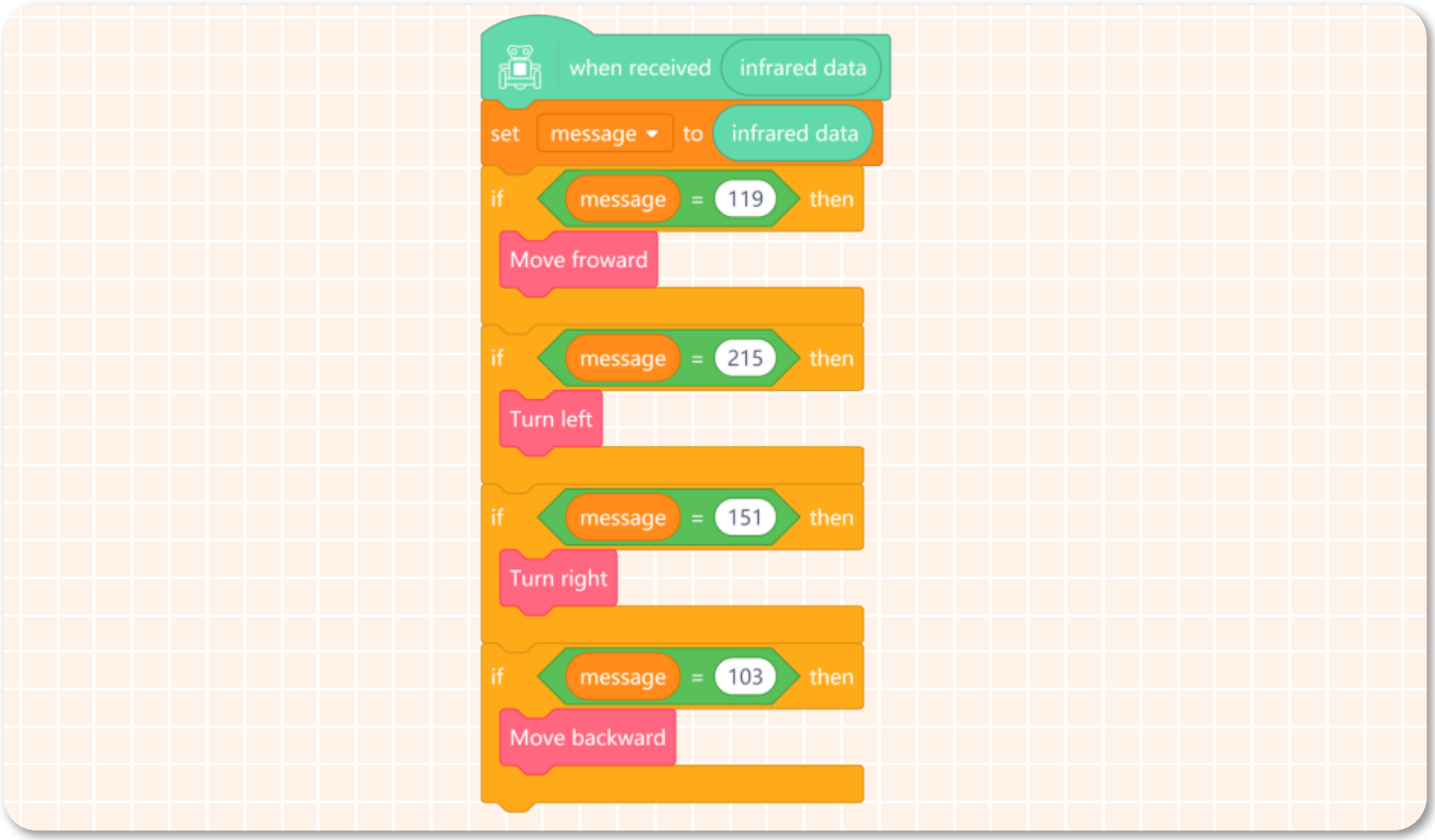
3.Create functions “Move backward”, “Turn left” and “Turn right” in the same way above. The customized function will be shown in the editing section and the command block section.



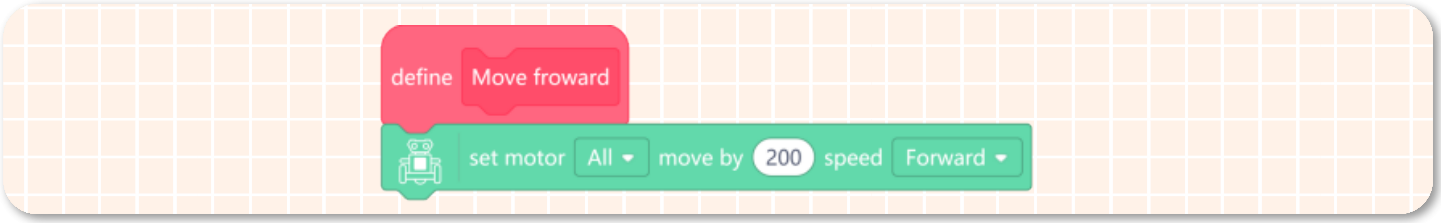
4.How can we use the key 2, 4, 6, and 8 on the IR remote controller to operate our Maqueen Plus car? Let's draw a flowchart to analyze this question:



5.The flowchart above shows that we have to press the related key first, and then judge if the key value meets the condition. When the key value "message=119", call the function "Move forward", and so on.



6.The above program is just a framework. The detailed operations need to be implemented in the functions. For example, press key 2, the car move forward. How to achieve that? Well, it's easy, just add a motor control block inside the move forward function.



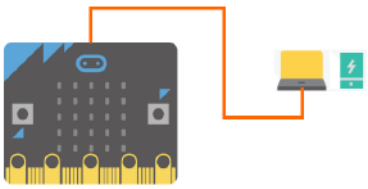
As long as we have a clear logic, the realization of the program will be not so hard. The complete program is shown below:

7.Name your project as "IR-controlled robot" and save it.

Step 4 Download a Program

1.Connect to a Computer

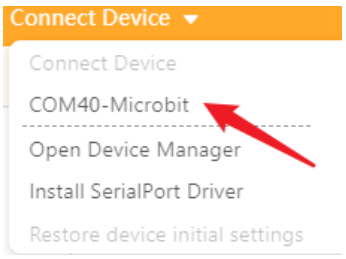
Connect micro: bit board to your computer via USB, then the power indicator on the board will light up.



2.Download the program

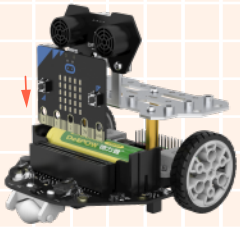
Click "Connect Device" in the menu bar, then click "COM-Microbit" in the drop-down menu to connect micro: bit board to the computer.

When connected, edit your programs and click "Upload" to upload the programs to your board (if the connection fails, then it will prompt "No Device Connected".) There will be a prompt box to display the uploading progress. When the program is updated, the prompt box will disappear.



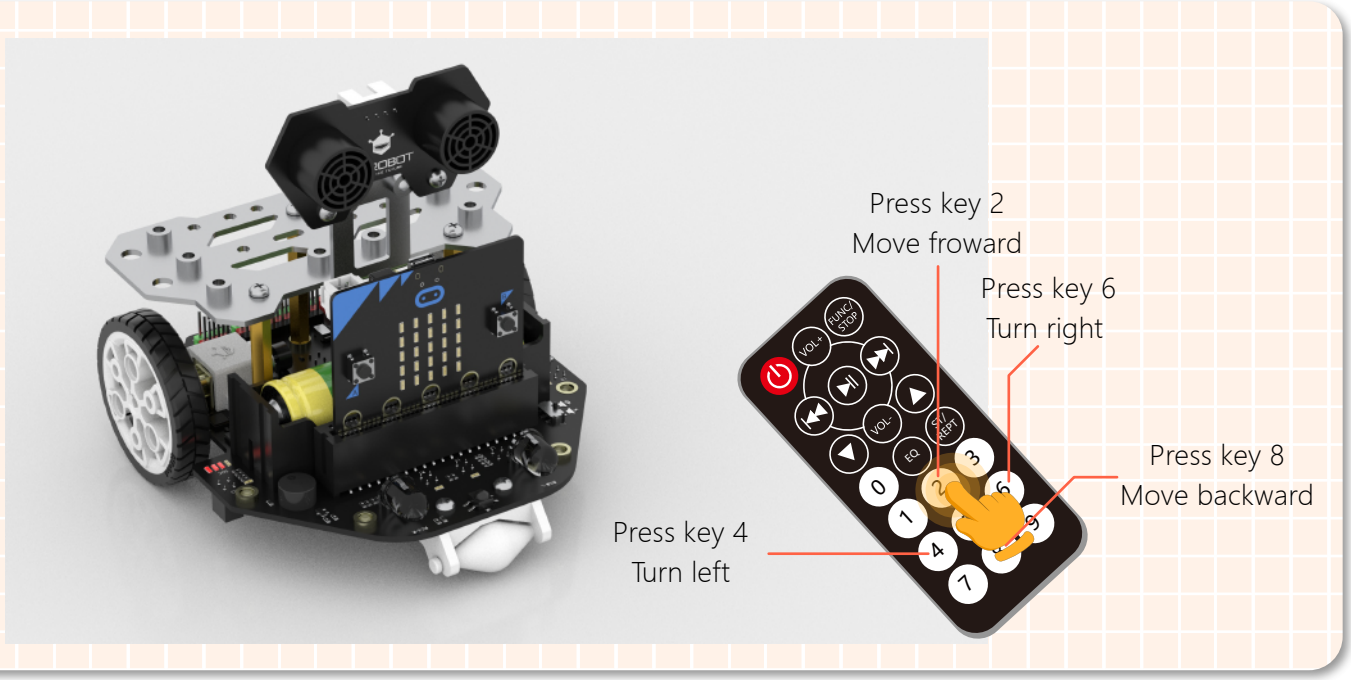
3.Install the micro:bit Board

After downloading the program, plug the micro:bit board into Maqueen Plus. Keep the LED matrix face forward, shown as below:



Step 5 Effect Display

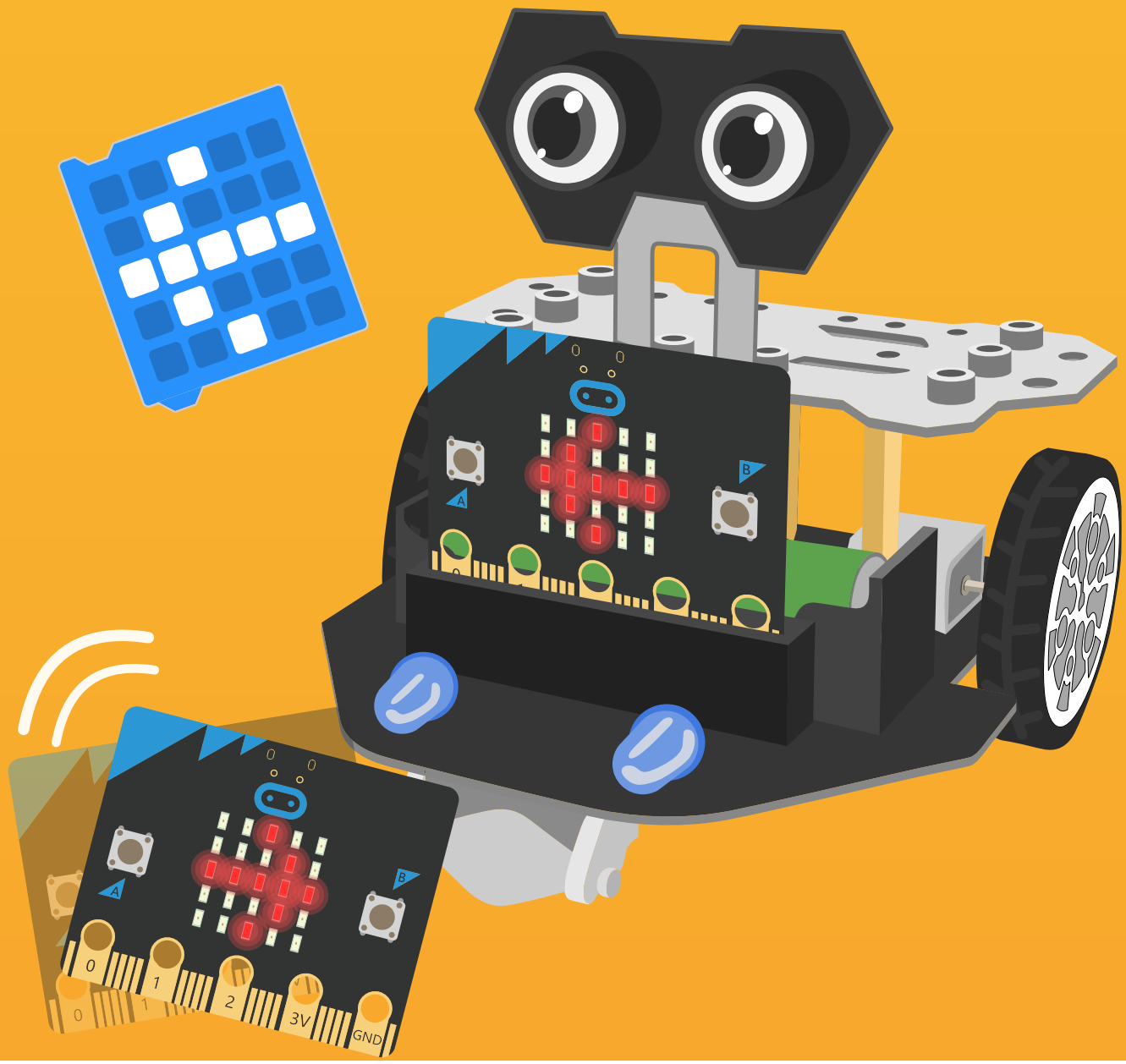
After completing all the above steps, use the IR remote controller to operate our Maqueen Plus.



Think & Explore

We may find that once we enabled the Maqueen Plus to move, it won't stop until we turn off its power switch, which could be inconvenient for us to operate. Now here is a task for you: use the red button on the remote controller to make Maqueen Plus stop.

Tip: create a function to stop the motor!



Chapter 12

Motion Sensing Robot

Have you ever tried motion-sensing games, like the racing car? This kind of game requires us to control the movement of the car on the screen by changing the direction of the remote controller. It is extremely exciting! Our Maqueen Plus can also realize motion-sensing since the accelerometer on the micro:bit can detect the orientation of the board. With accelerometer and radio communication functions, we can make a similar motion-sensing game using Maqueen Plus.

Goal

1.The basics of radio communication
2.Learn how to use accelerometer sensor

Electronic Component

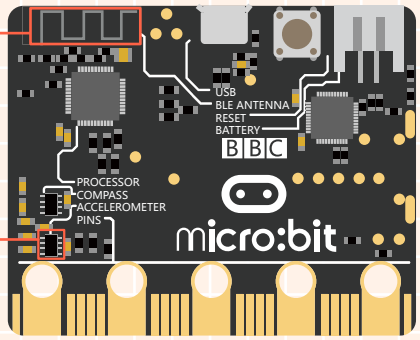
Figure of the Bluetooth and the acceleration sensor Figure of the Bluetooth and the acceleration sensor

Radio Communication

Allow two or more micro:bits communicate with each other, receive and send radio signals

Accelerometer

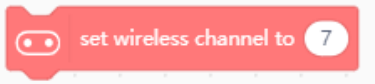
The accelerometer on the micro:bit detects the acceleration in 3 planes: x, y and z.



Command Learning

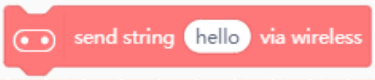
Block Brief

Radio set group



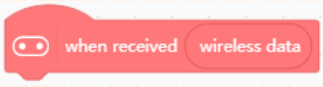
Sets the group id for radio communications. A micro:bit can only listen to one group ID at any time.

Radio send number



Broadcasts a number via radio to any connected micro:bit in the group.

Radio received

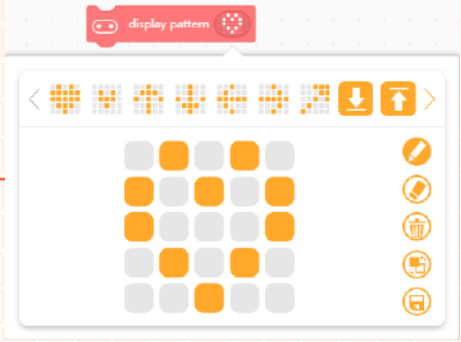


Register code to run when the radio receives a number.

Gesture

Do something when a gesture is done (11 gestures)

Show LEDs



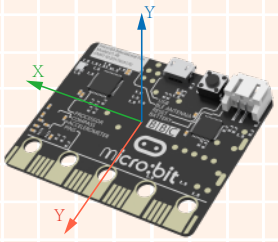
Draws an image on the LED screen.

What is an accelerometer sensor?

An accelerometer is a device that can detect the change of an object's acceleration. The on-board accelerometer of micro:bit can sense motion of the micro:bit, including its movement, angle, gesture and so on.

Introduction of the acceleration sensor

The micro: bit comes with a three-axis acceleration sensor that can detect gravity accelerations in three directions: x, y, and z. The measured value on each axis should be positive or negative. When the reading of one axis is 0, it indicates that the acceleration sensor is parallel to that axis. The different attitudes of the micro: bit is determined by calculating the vector sum of the three axes of the acceleration sensor x, y, and z. A vector is a quantity that has magnitude and direction, and vector sums refer to the sum of direction and magnitude.



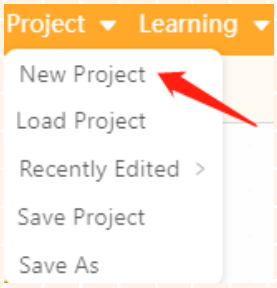
Hands-on Practice

Motion Sensing Robot---Transmitting End

Before we start programming, let's analyze how do we use the accelerometer sensor in this project.
The movement of the robot car is controlled by the gesture of micro:bit. When micro:bit logo up, an "Up arrow"-shows on the LED screen, and then the car moves forward; When logo down, show "Down arrow" and the car moves backward; tile left, show "left arrow" and the car turns left; tile right, show "right arrow" and the car turns right.
Tip: to realize radio communication, we need two micro:bits here. One for sending out signal (Transmitting end), one for receiving signal (Receiving end).

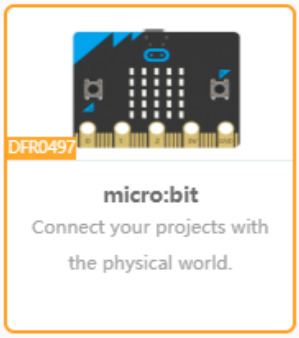
Step 1 Create a New Project

Open the Mind+, click "Project" -- "New project" to create a new project.

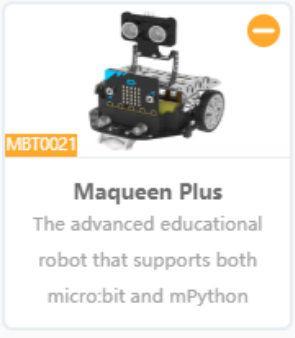


Step 2 Add the Maqueen Plus

1、Select "Expansion"-"Main Control Board" -- "micro: bit" main control board, the selection is as follows:



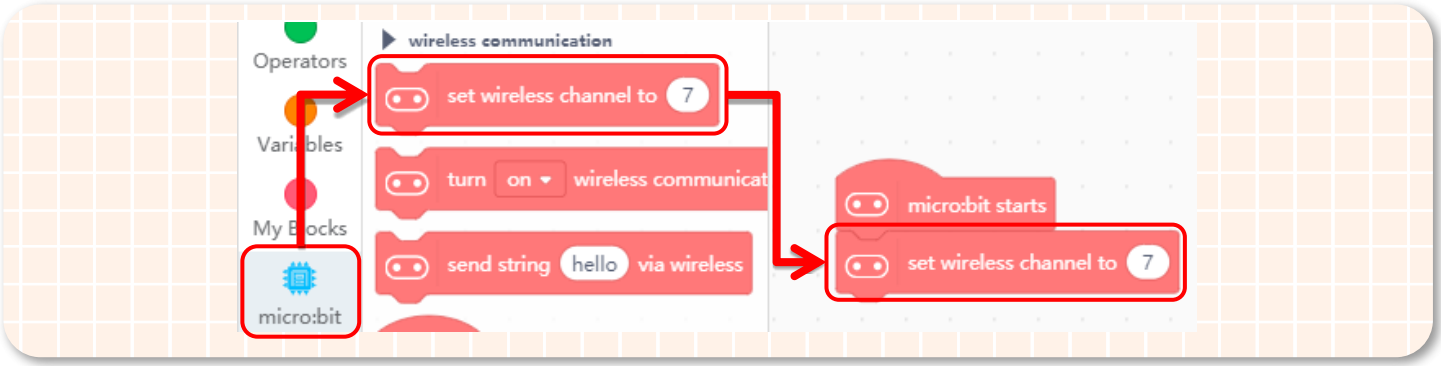
2、Continue to click on the"expansion board " -- " Maqueen Plus ", the selection is as follows:



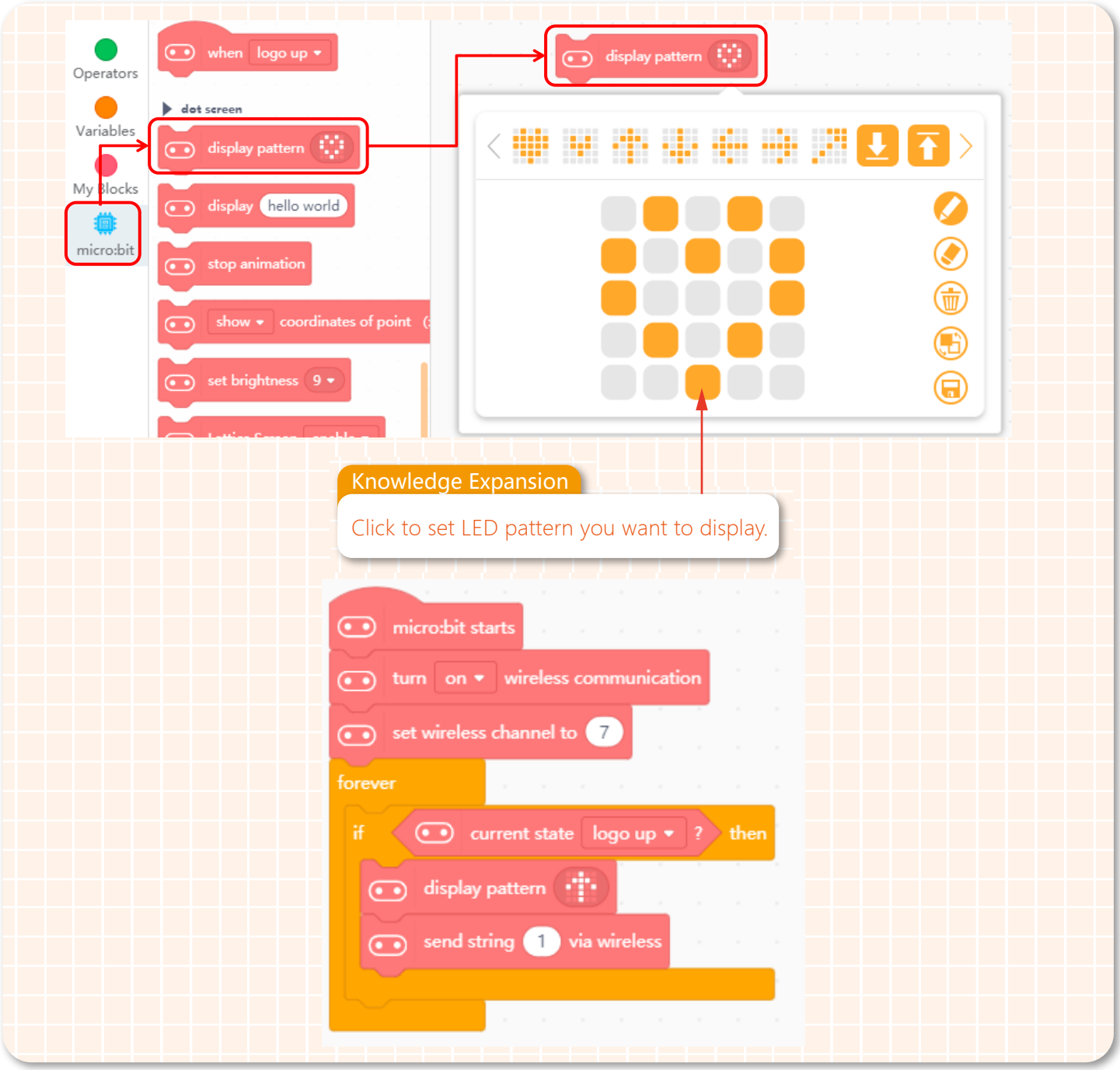
When the Maqueen Plus is loaded successfully,there will be a icon" Expansion Board " appearing in the command block section. Click the icon then you will see all the related blocks.

Step 3 Programming

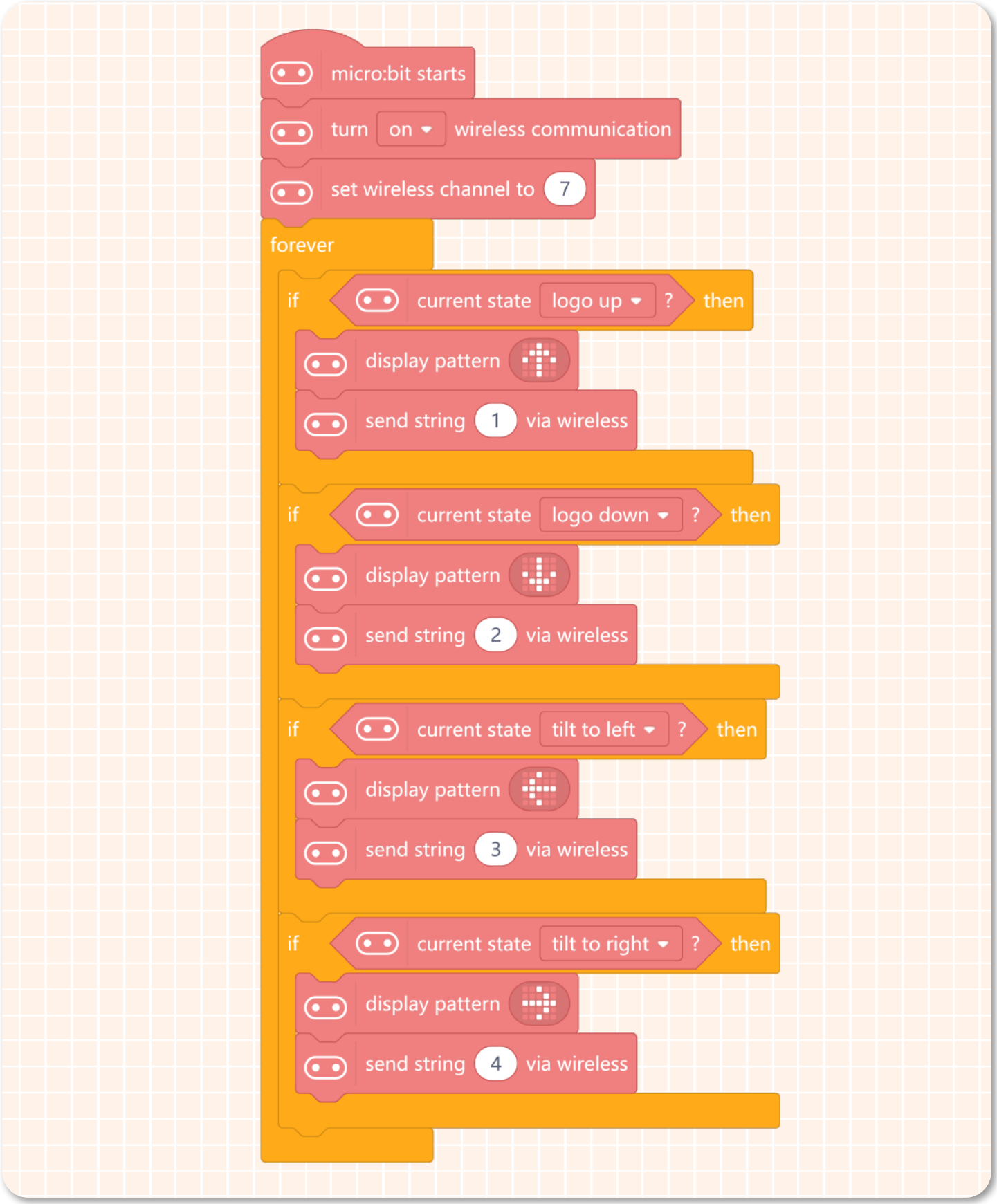
1.Enable the radio communication, set the radio group to 7.



2.When the micro:bit log up, show an "Up arrow" in its LED screen, and send data 1 via radio to the Maqueen Plus.



3.The programs for the rest actions of micro:bit are in much the same way. The whole program for the transmitting end is shown below:

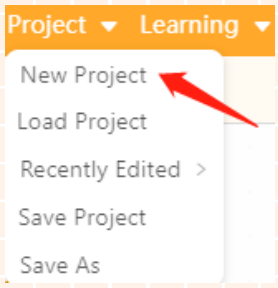


4.Name your project as "Motion sensing robot-Transmitting end" and download it into the micro:bit of transmitting end.

Motion Sensing---Receiving End:

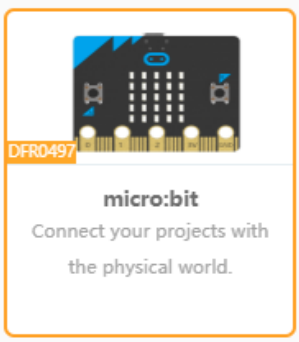
Step 1 Create a New Project

Open the Mind+, click "Project" -- "New project" to create a new project.

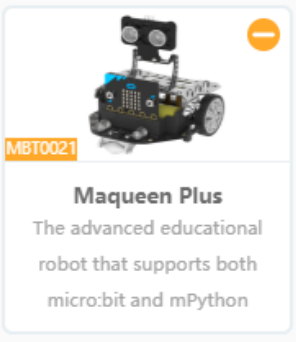


Step 2 Add the Maqueen Plus

1、Select "Expansion"-"Main Control Board" -- "micro: bit" main control board, the selection is as follows:



2、Continue to click on the"expansion board " -- " Maqueen Plus ", the selection is as follows:



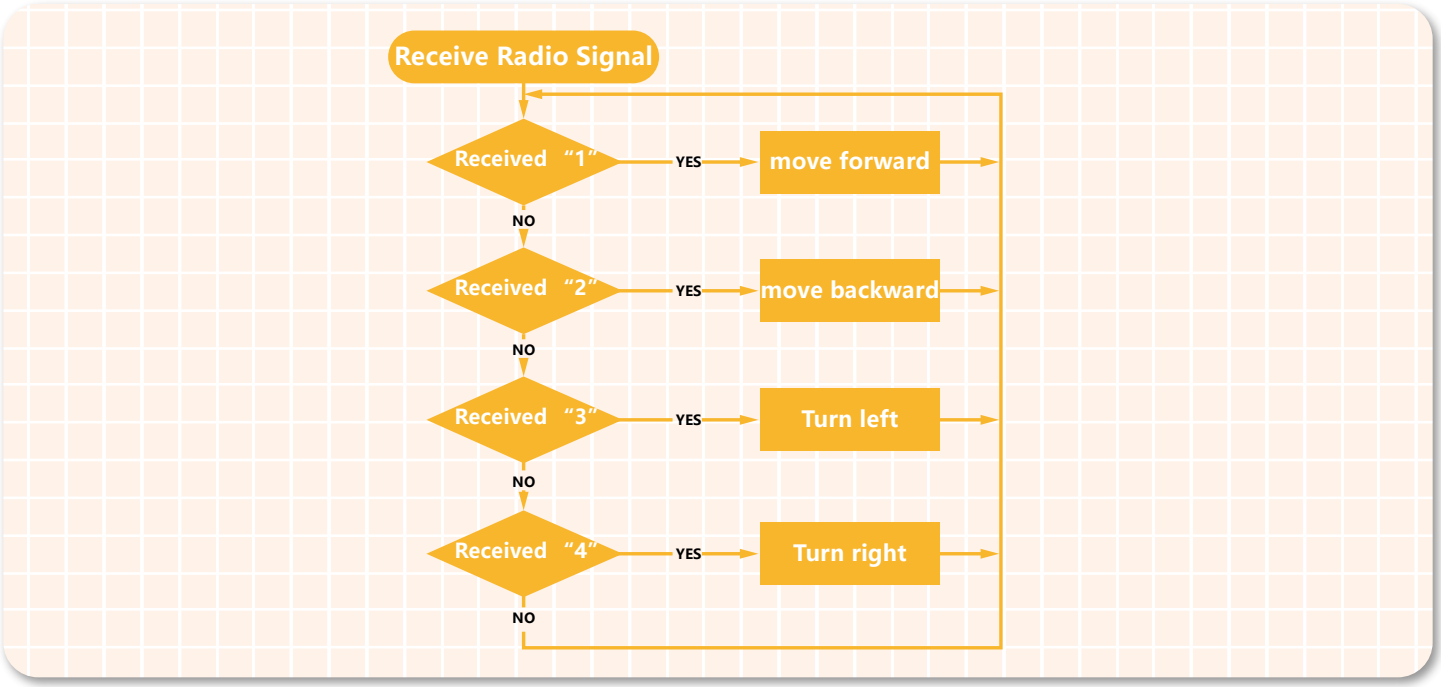
When the Maqueen Plus is loaded successfully,there will be a icon" 

" appearing in the command block section. Click the icon then you will see all the related blocks.

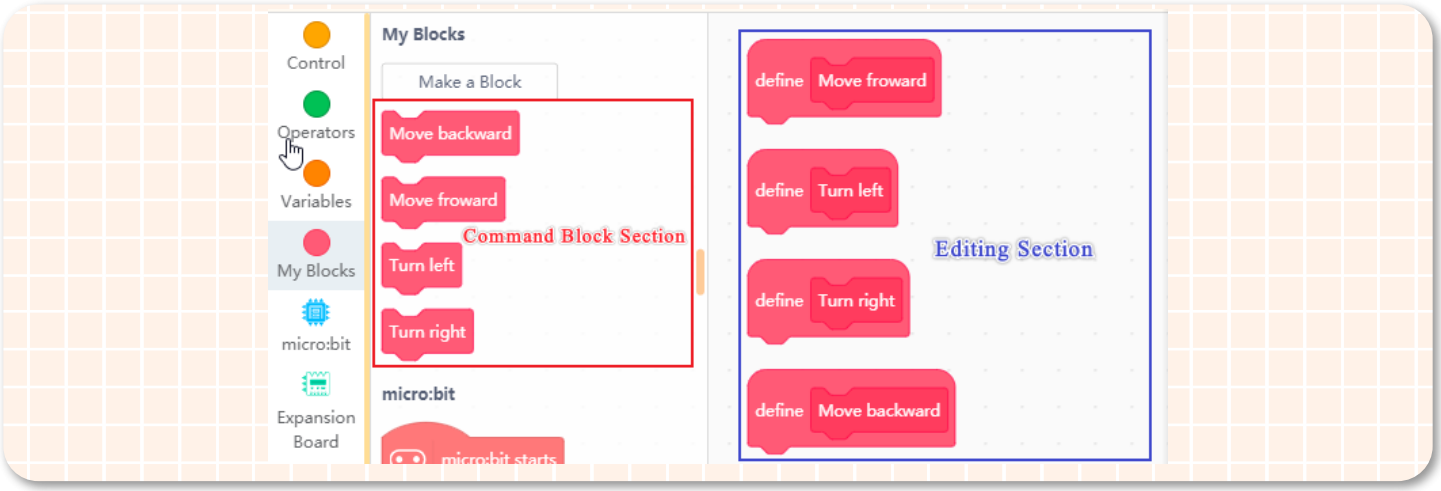
Step 3 Programming

1.Enable radio communication function, set the radio group to 7. (The radio group of transmitting end should be in the same with that of the receiving end.)

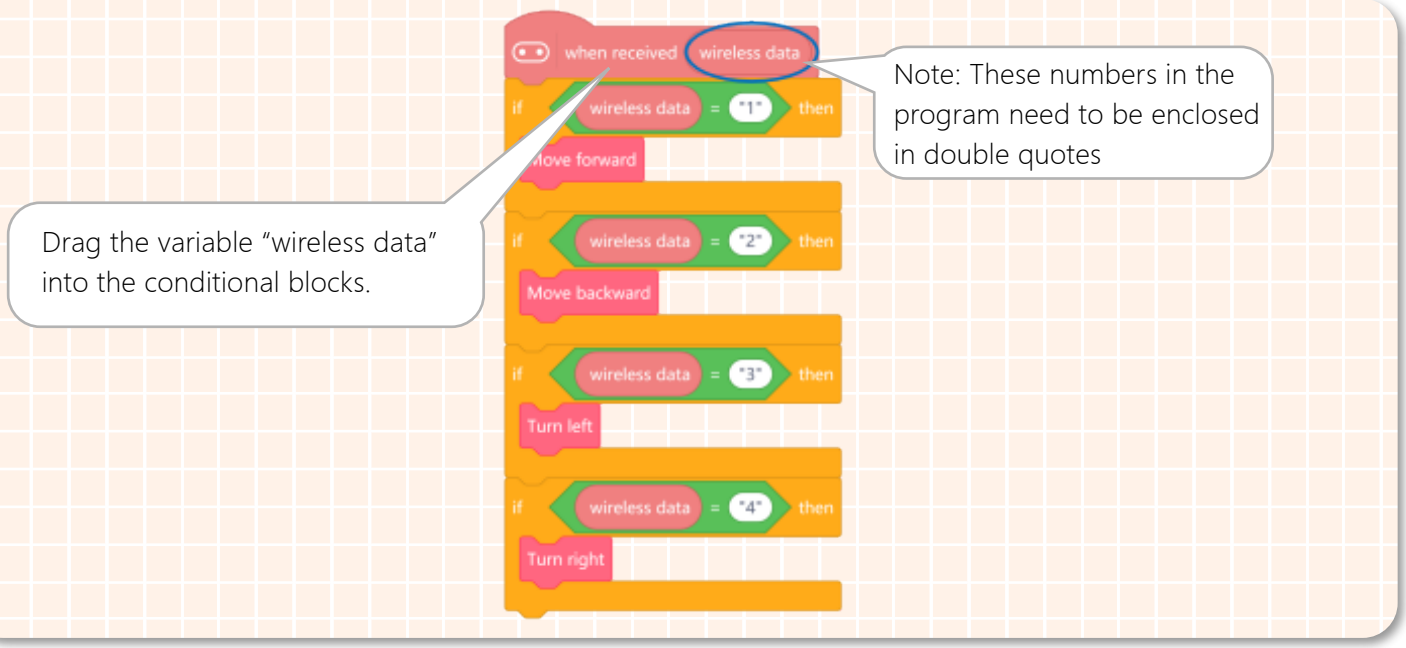
2.Program Maqueen Plus to react according to the received signal.



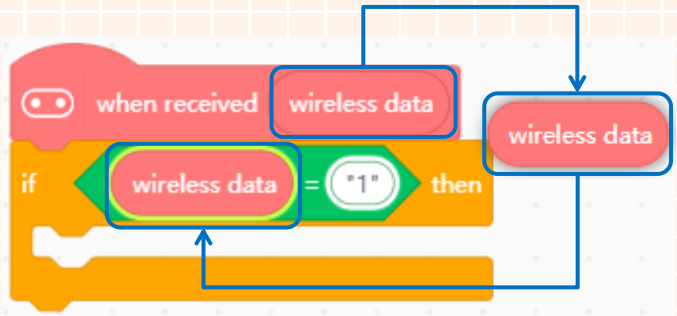
3.Create four functions "move forward", "move backward", "Turn left", "Turn right".



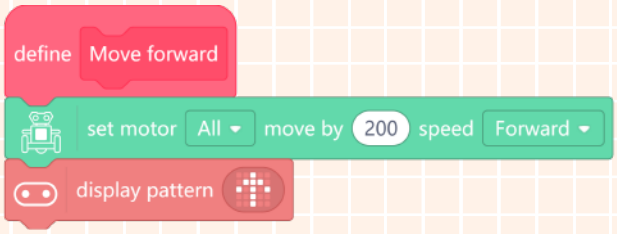
4.We have to use radio receive block to control the Maqueen Plus do different reactions according to the received data.



Drag the "wireless data" block as the way shown below:

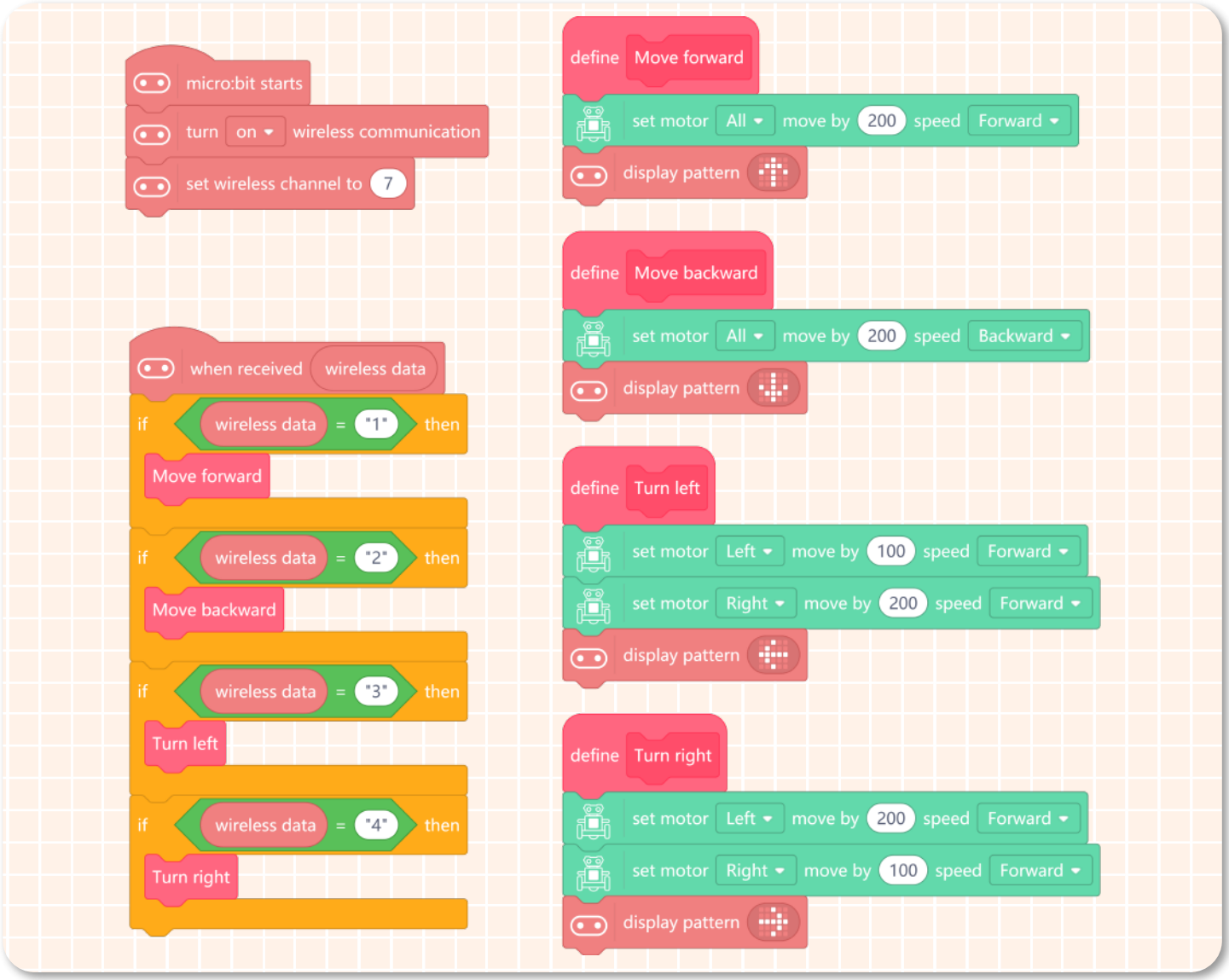


5.Take the function "move forward" as an example. When the Maqueen Plus car moves forward, we let its LED screen display an "Up arrow".



Please complete the rest functions by yourself.

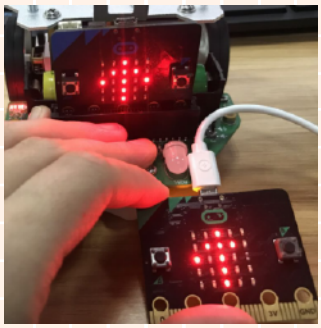
6.The program of the receiving end is shown below:



7.Name your project as "Motion sensing robot-Receiving end" and then download the program to the micro:bit in Maqueen Plus.

Effect Display

When completed all the above steps, turn Maqueen Plus's power switch on, then we can use the micro:bit of the transmitting end to control our car. Give it a go!



Move forward

Note: only when powered on can the micro:bit board work, so the micro:bit of transmitting end should be always connected to a computer during operation.

Think & Explore

When playing a motion-sensing game, the larger angle we turn, the larger angle the object moves on the screen. How do we achieve this on our Maqueen Plus?

Chapter 13

Crazy Racing

The road conditions of the car racing could be very complicated, winding mountain road, dirt road in a dark forest and so on. Can our Maqueen Plus run on such kind of racetrack, give it a go, let's turn Maqueen Plus into a racing robot car!

Goal

What is PID algorithm?

Command Learning

Block Brief

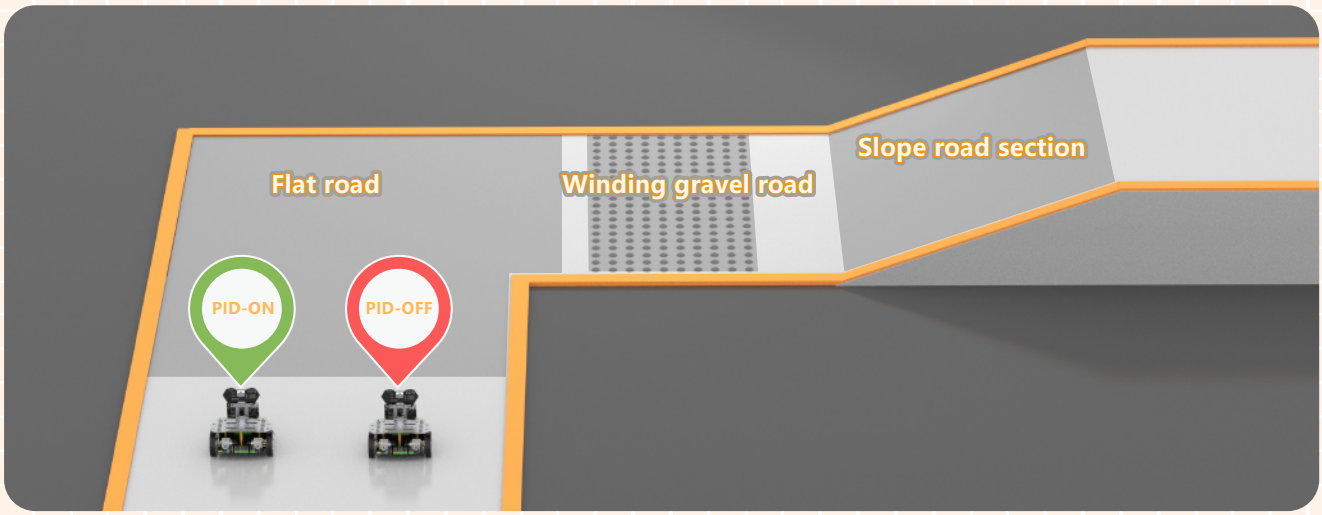
What is PID algorithm?

PID is the most commonly-used and classical algorithm in control theory. We may not be familiar with its concept, but it can be said surely that we use it in some applications every day, such as, quadcopter, balancing car, cruise control in car, temperature control in 3D printer, thermostatic water heater and so on. When we need to keep a physical quantity(temperature, speed, balance, etc) in a stable state, PID must be used. Well, now we know what PID is, let's check the rules of the car racing.

Hands-on Practice

Competition Rules:

The speed of the competition is set at 30. The track consists of three different courses: ordinary road; winding gravel road; slope road section. The one who reaches the finish line first wins. The picture below is the route of the competition.



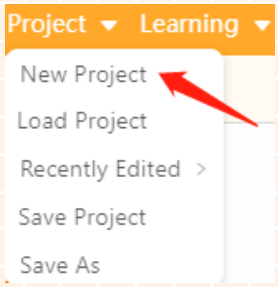
Note:
1.The race road needs to be built by yourself.
2.Two Maqueen Plus cars are necessary for this project.

Then, we are going to learn how PID works in this game, and see the differences when PID is enabled and disabled.

Maqueen Plus 1-PID Enabled

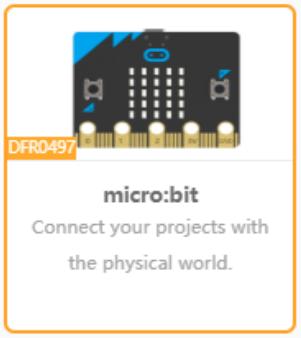
Step 1 Create a New Project

Open the Mind+, click "Project" -- "New project" to create a new project.

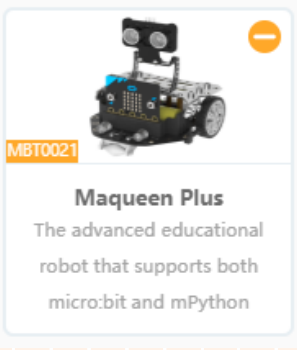


Step 2 Add the Maqueen Plus

1、Select "Expansion"-"Main Control Board" -- "micro: bit" main control board, the selection is as follows:



2、Continue to click on the"expansion board " -- " Maqueen Plus ", the selection is as follows:

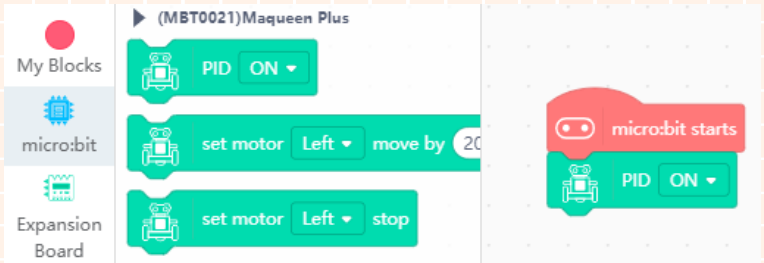


When the Maqueen Plus is loaded successfully,there will be a icon" 

" appearing in the command block section. Click the icon then you will see all the related blocks.

Step 3 Programming

1.Turn on the PID switch when the program starts.



Knowledge Expansion

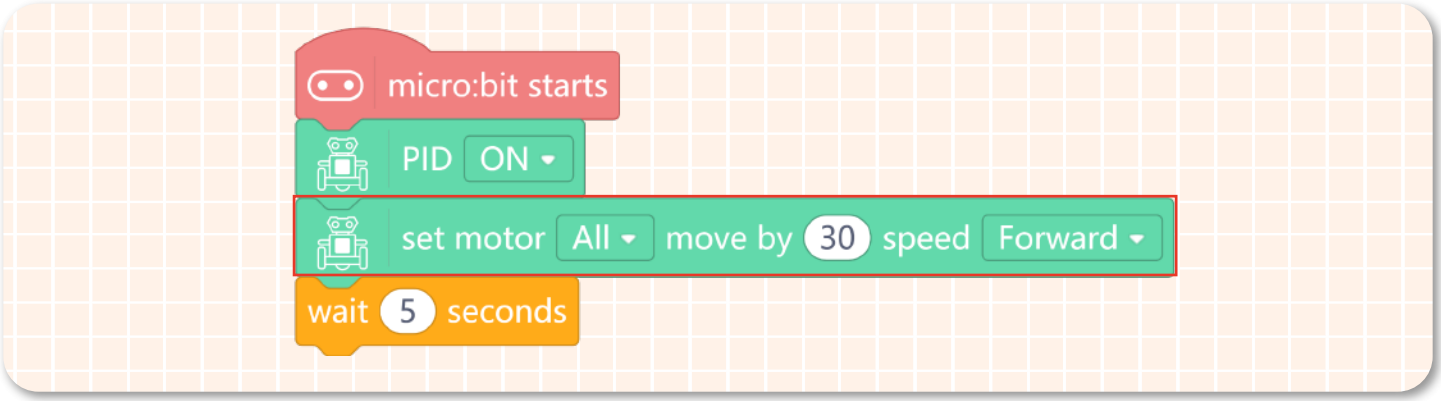
What does PID stand for?

P: proportional, adjust the output proportionally to the error.

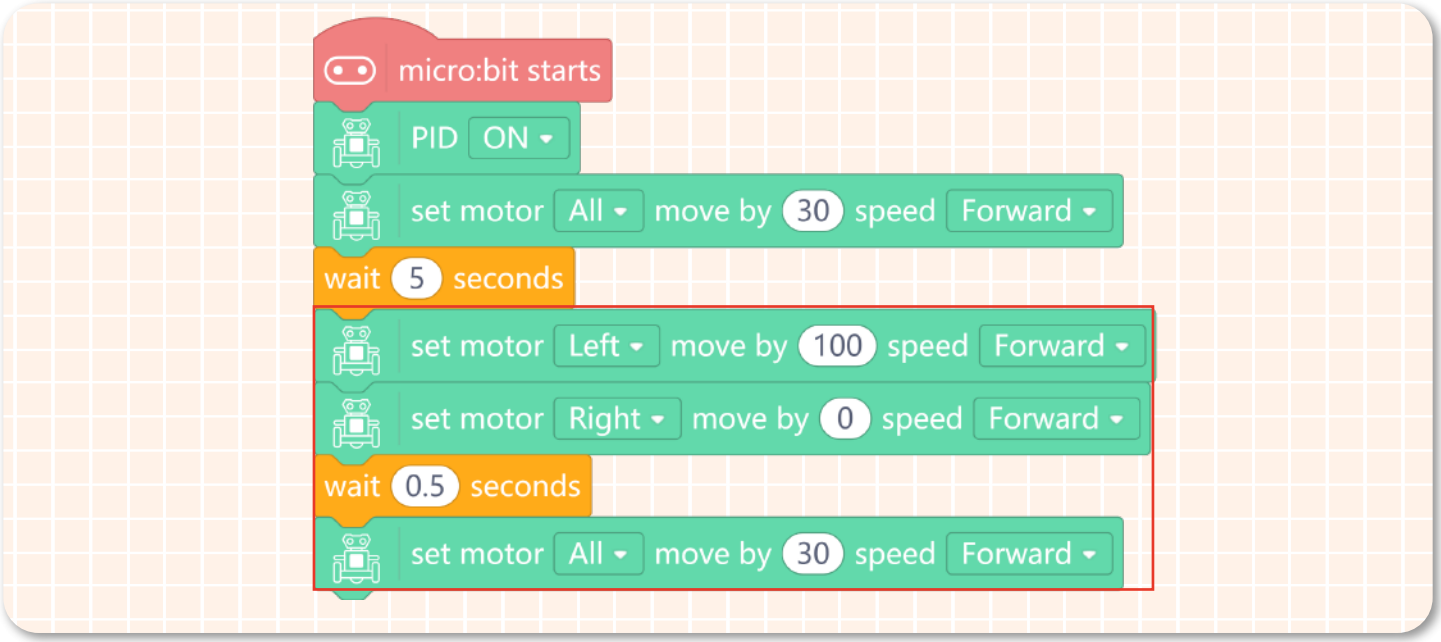
D: derivative, responsible for compensating for future error.

I: integral, remove any steady-state error in the system because it accumulates that error over time and compensates for it.

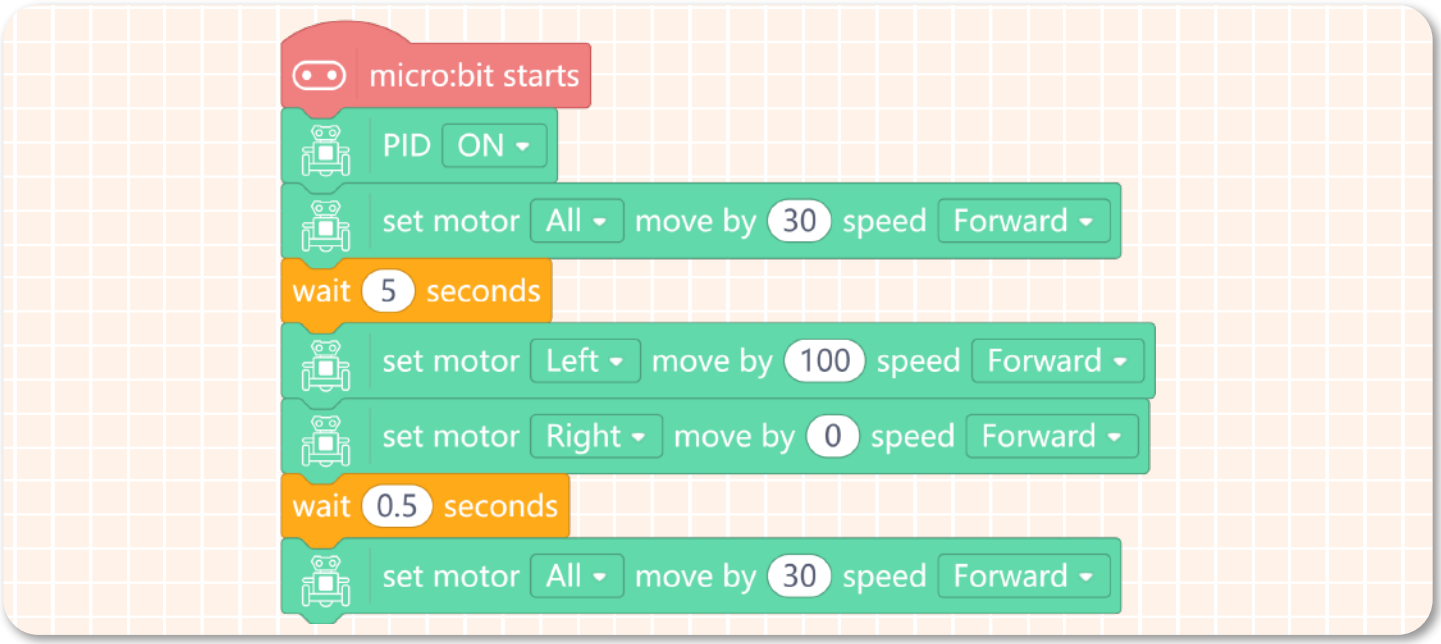
2.In the first course of the race, Maqueen Plus car runs at the speed of 30 for 5s.



3.Before the second course, Maqueen Plus1 needs to turn right and then go straight to the ending point.



4.The complete program is shown below:

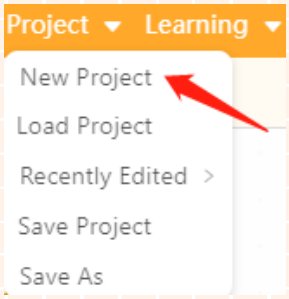


5.Name your project as "Crazy Racing 1-PID enabled", and download the program to Maqueen Plus1.

Maqueen Plus-PID Disabled

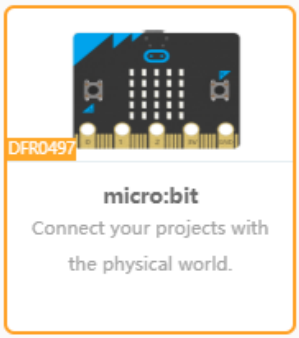
Step 1 Create a New Project

Open the Mind+, click "Project" -- "New project" to create a new project.



Step 2 Add the Maqueen Plus

1、Select "Expansion"-"Main Control Board" -- "Micro: bit" main control board, the selection is as follows:



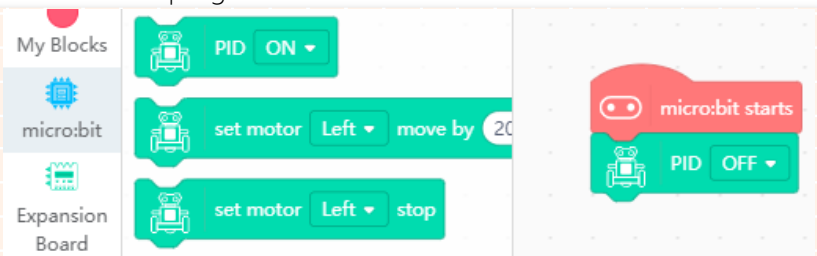
2、Continue to click on the"expansion board " -- " Maqueen Plus ", the selection is as follows:

When the Maqueen Plus is loaded successfully,there will be a icon" 

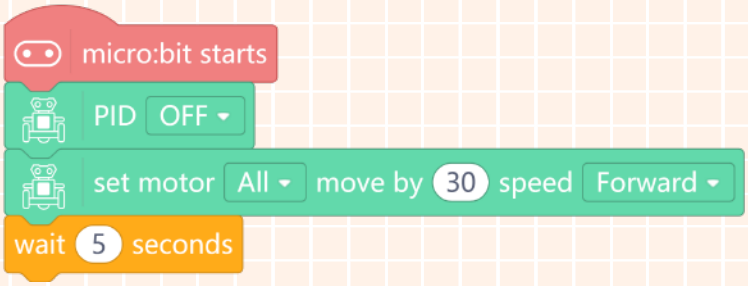
" appearing in the command block section. Click the icon then you will see all the related blocks.

Step 3 Programming

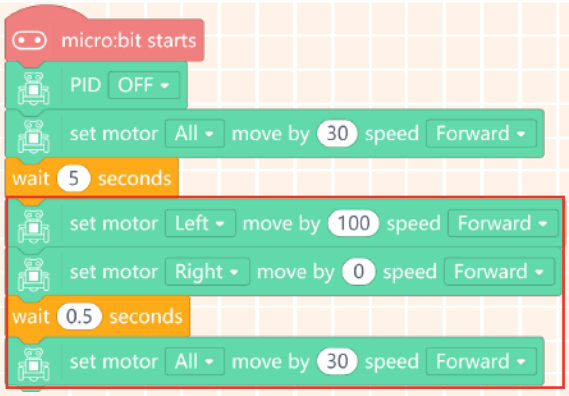
1.Turn off the PID switch when the program starts.



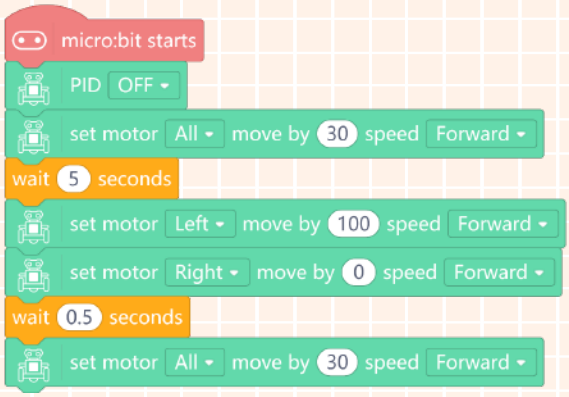
2.Maqueen Plus runs at the speed of 30 for 5s in the first course.



3.Before the second course, Maqueen Plus 2 needs to turn right and then go straight to the ending point.



4.The entire program is shown below:



5.Name your project as "Crazy Racing 2-PID disabled", and download the program to Maqueen Plus 2.

Effect Display

After the above steps, put the car on our track and turn on the switches of the two Maqueen Plus cars at the same time. Then we can see:

At the first racecourse: both cars move forward at a slow and same speed.

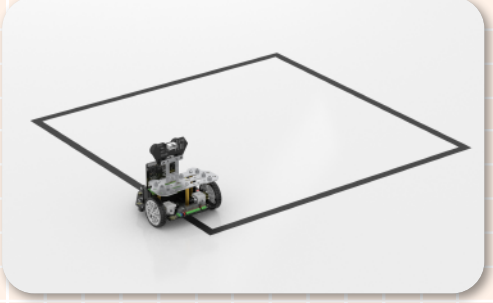
At the second racecourse: after both cars turn right and come to the track with sand and stone obstacles, the car 1(PID enabled) is still moving; the race car 2(PID disabled) stopped when encountering obstacles.

At the 3rd racecourse: in the slope, race car 1 can continue to drive; the race car 2 still stay where it met the obstacle.

Eventually, the race car 1(PID enabled) wins.

Think & Explore

Since we have knew the advantage of PID: maintain the motor balance of the car and make the car move stably. Next, think about how to help the car to race on a square track.



Tips: two parts for the racecourse: go straight and turn 90 degrees. Enable PID to allow the Maqueen Plus car to move steadily on the track.

Chapter 14

Speed Recorder

The car speed recorder can accurately record the driving state, such as, direction turning, speed increasing and reducing, and so on. The collected data can be displayed in real-time for the driver to master the vehicle condition. How can we visually see the speed information of Maqueen Plus? An OLED display helps here. Maqueen Plus has 3 IIC ports for connecting Gravity modules with IIC communication. Let's start to make a speed recorder for Maqueen Plus.

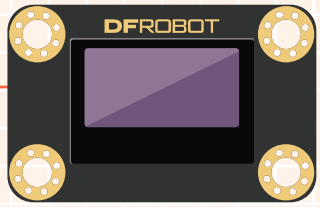
Goal

Learn how to use OLED display

Electronic Component

OLED

OLED-2864 Display

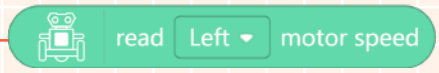


OLED-2864 display module can work without backlight, support IIC communication, high transmission rate and 60Hz refresh frequency.

Command Learning

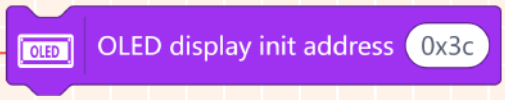
Block Brief

Read motor speed



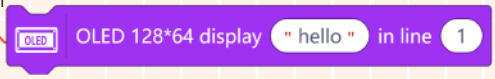
Read the current speed of the motor

Initiate OLED



Initiate OLED display module

OLED display number

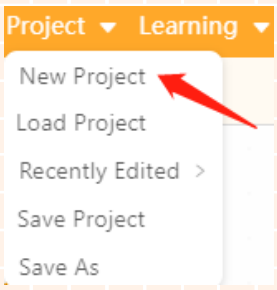


Display number at the n line of OLED screen

Hands-on Practice

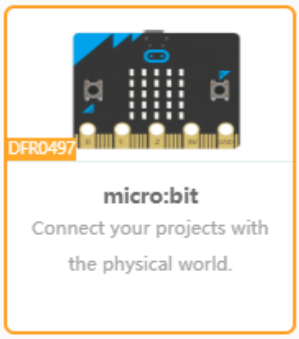
Step 1 Create a New Project

Open the Mind+, click "Project" -- "New project" to create a new project.

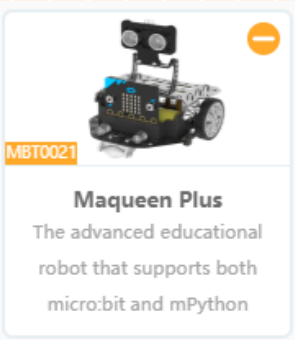


Step 2 Add the Maqueen Plus

1、Select "Expansion"-"Main Control Board" -- "micro: bit" main control board, the selection is as follows:



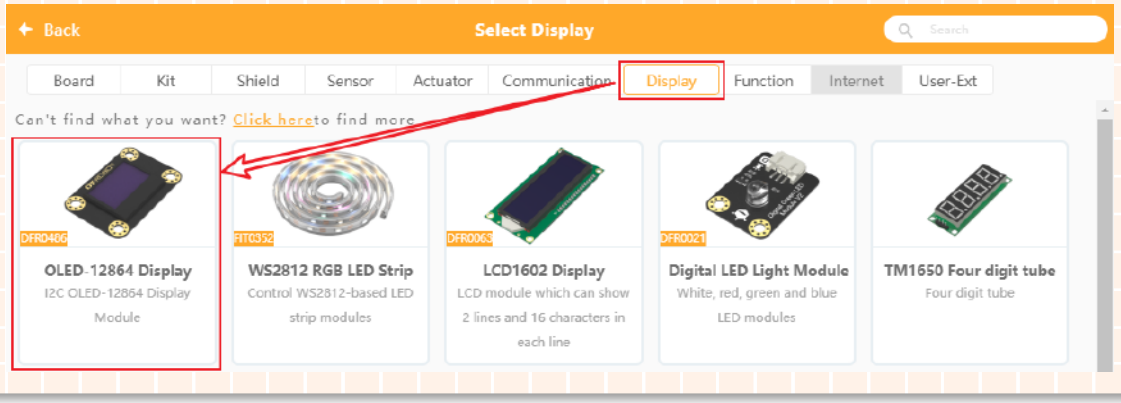
2、Continue to click on the"expansion board " -- " Maqueen Plus ", the selection is as follows:



When the Maqueen Plus is loaded successfully,there will be a icon" Expansion Board " appearing in the command block section. Click the icon then you will see all the related blocks.

Step 3 Add the OLED Display

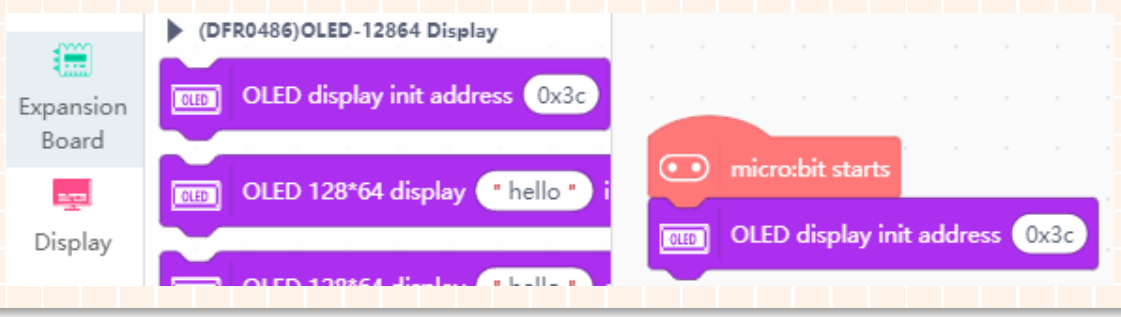
1、Click"Expansion", select "Display"->"oled-12864 Display".



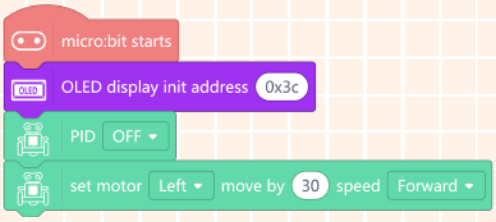
2、Click "Display" module in the left to present the OLED commands.

Step 4 Programming

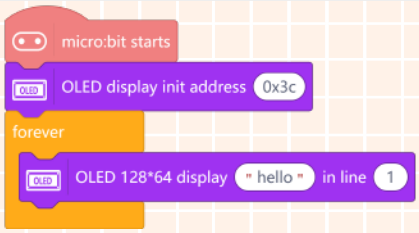
1.Initiate the OLED module when the program starts for later use.



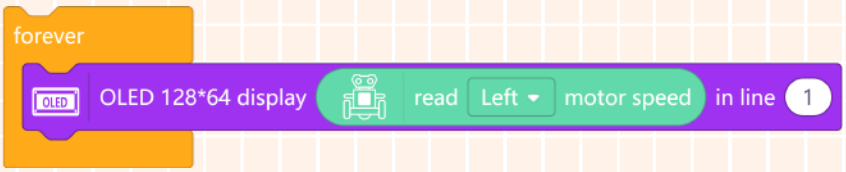
2.Disable PID, and let the Maqueen Plus car move forward at the speed of 30.



3.Place the OLED number display block inside the "forever" block for showing data in real-time.



4.Drag the "read motor speed" block into the "OLED display number" block to display the left motor speed on the OLED display.

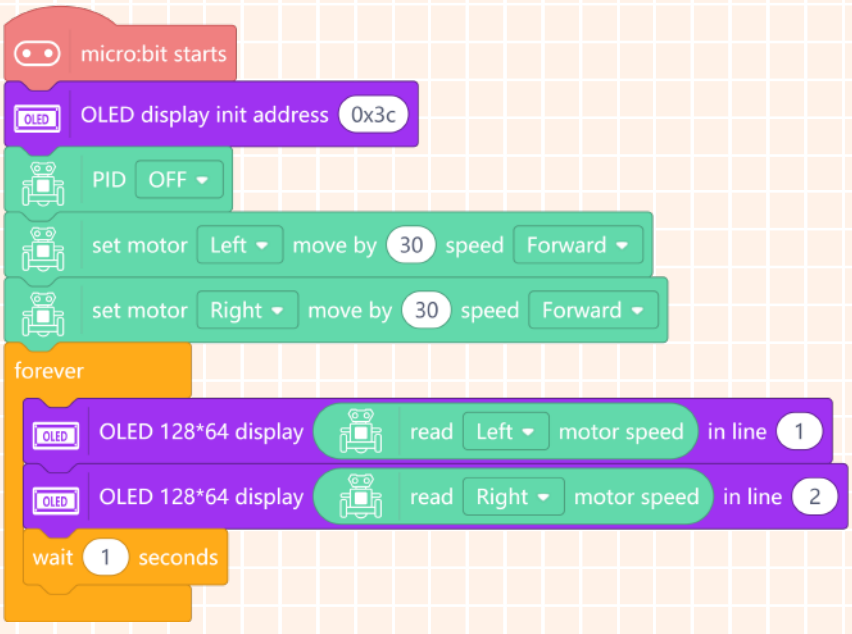


Knowledge Expansion

You may have a doubt about the program "  ", how can we display the number at the line 0 of the OLED screen?

In programming, it often counts from 0, but in fact, line 0 in the OLED screen corresponds to the first line of the screen.

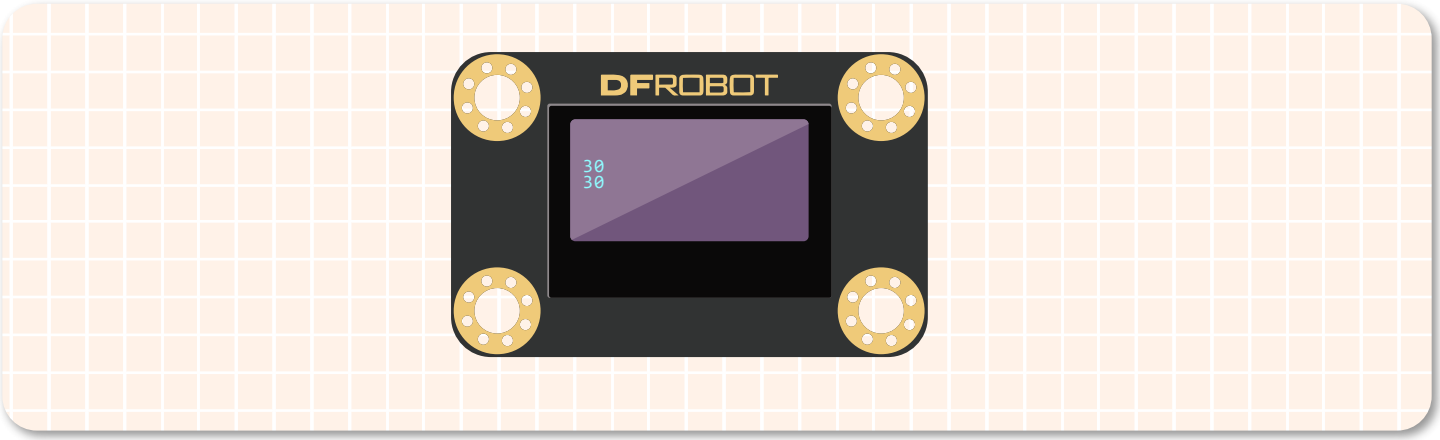
5.Program to display the right motor speed at the second line of the OLED screen by the same way, and refresh the data every 1 second. The complete program is shown below:



6.Name your project as “Speed Recorder” and save it.

Step 5 Effect Display

Turn on the power switch, then the left motor speed will be displayed at the first line of the screen, and the right motor speed will be shown at the second line of the screen. The data will be refreshed constantly.

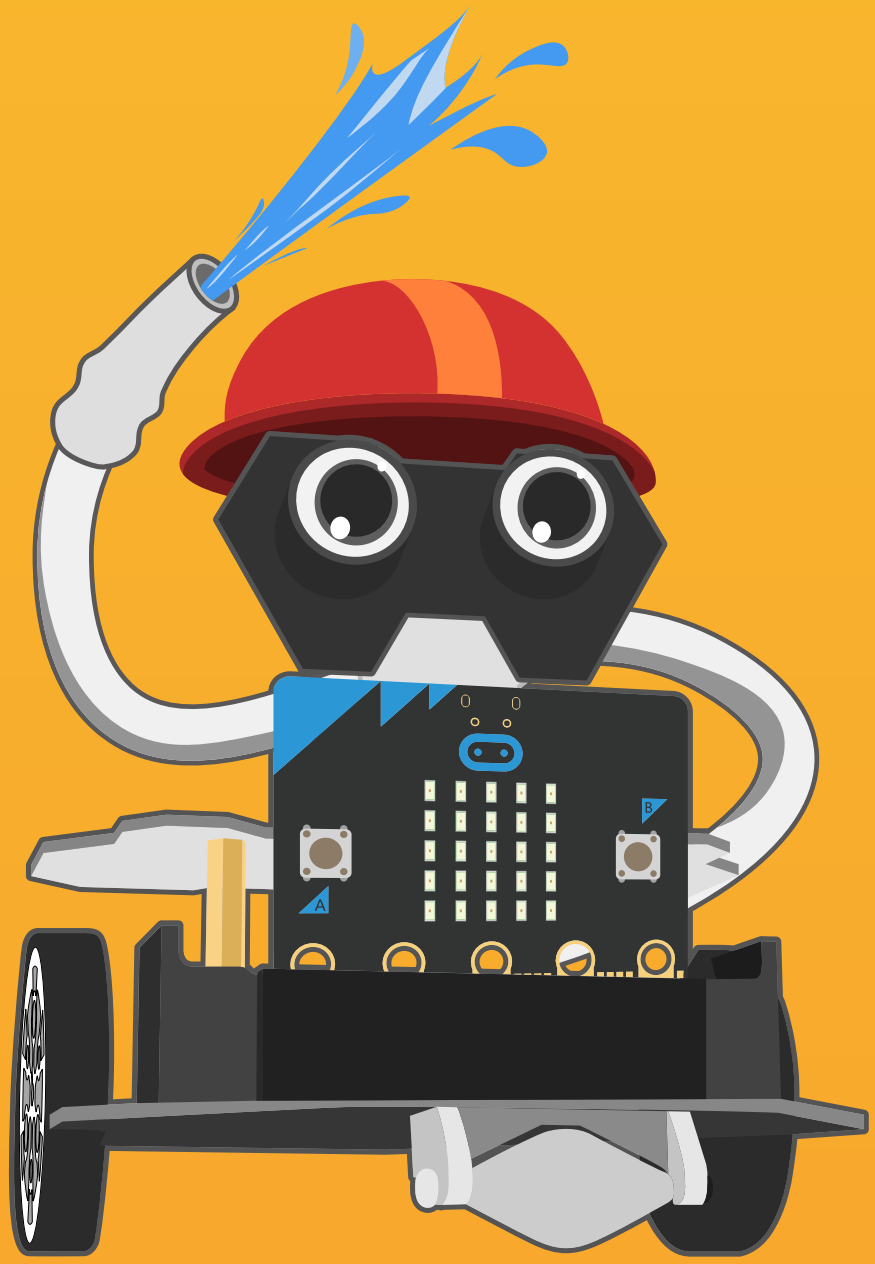


Think & Explore

1.We may find that though we set the speed of both motors to 30, the data on the OLED still changes continuously. Why is that? How can we make the speed data less changeable?

Tips: turn on the PID switch to maintain the speed balance of the motors.

2.There are several projects involving LED matrix in the previous chapters, like light sensing robot, little ranging expert, etc. Now replace the LED display with OLED screen.



Chapter 15

Firefighting Robot

Firefighting is a highly dangerous occupation. When an emergency response call comes, firefighters must get themselves dressed in the appropriate gear and onto the emergency vehicles quickly to arrive at the fire scene, and then extinguish the fires. Firefighters are risking their lives to defend our cites and country. So everybody, can we use what we learned to help to reduce the risk? How about a firefighting robot? Let' s make a firefighting robot with Maqueen, and let it complete three actions: Call out, Firefighting, Mission done. Flame sensor and servo will be used in this project. Maqueen Plus has 8 GPIO ports and 3 servo ports for connecting Gravity module and servos. Everything is ready, let's start!

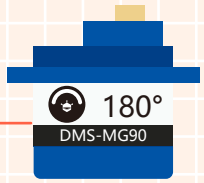
Goal

Learn how to drive a servo
Learn how to use a flame sensor

Electronic Component

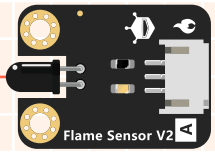
Figure of the servo and the Flame sensor

Servo



0°~ 180°Micro Servo

Flame sensor



Flame sensor can detect fire and light with 760~1100nm.

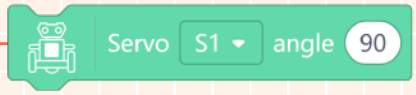
Command Learning

Block Brief

Analog read

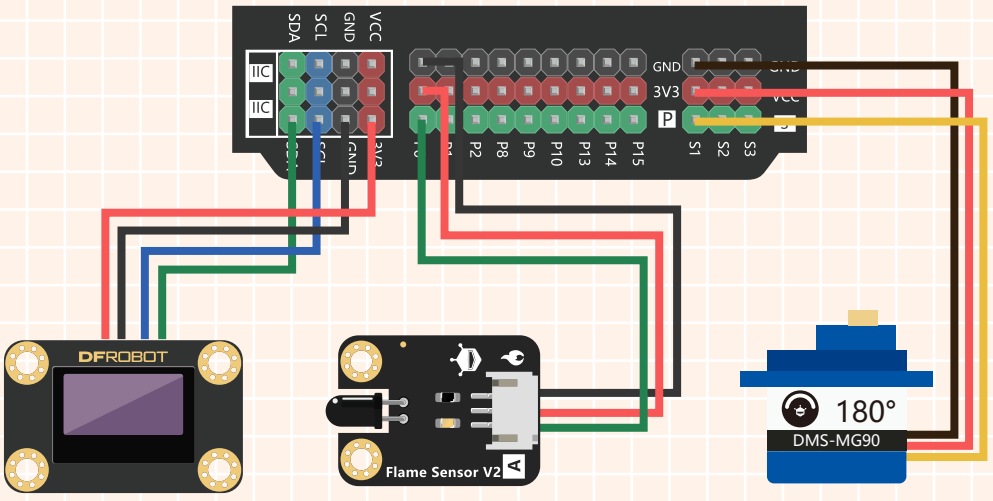
Read analog value of the specified pin

Servo



Set the angle of servo

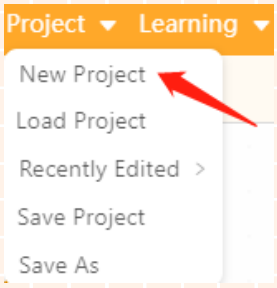
Firefighting Robot Hardware Connection



Flame sensor to P0;
Servo to the S1 port;
OLED screen to I2C

Step 1 Create a New Project

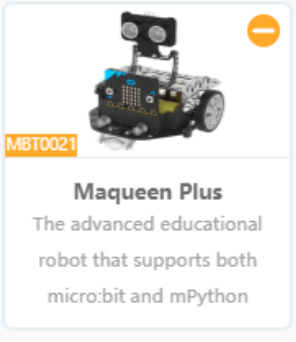
Open the Mind+, click "Project" -- "New project" to create a new project.

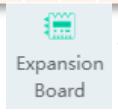


Step 2 Add the Maqueen Plus

1、Select "Expansion"-"Main Control Board" -- "micro: bit" main control board, the selection is as follows:

2、Continue to click on the"expansion board " -- " Maqueen Plus ", the selection is as follows:

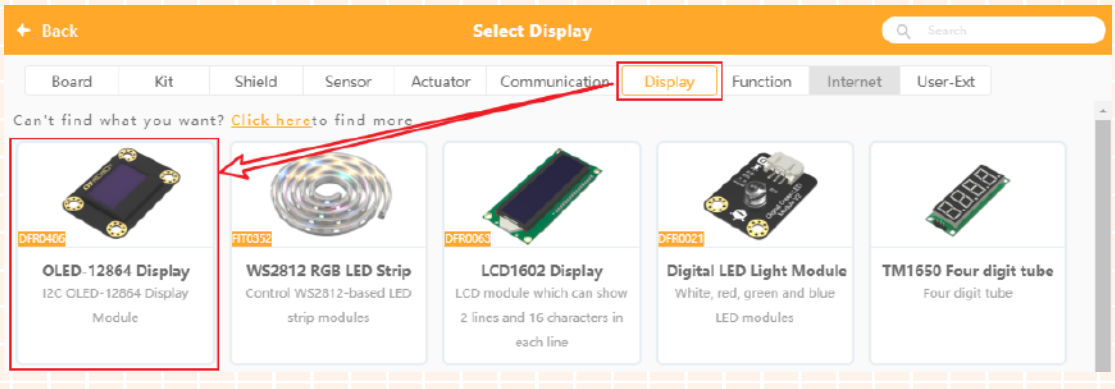


When the Maqueen Plus is loaded successfully,there will be a icon" 

" appearing in the command block section. Click the icon then you will see all the related blocks.

Step 3 Add the OLED Display

1、Click"Expansion", select "Display"->"oled-12864 Display".



2、Click "Display" module in the left to present the OLED commands.

Step 4 Programming

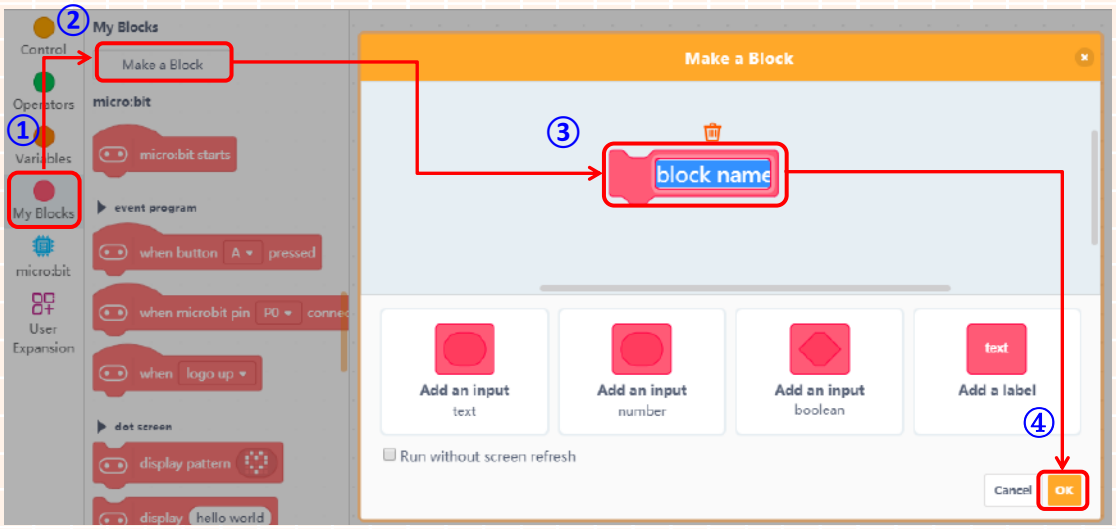
1.Generally, there are three parts to the firefighting process.

① Received the emergency call, go to the fire scene.

② Arrived at the scene, extinguish the fire.

③ Mission completed.

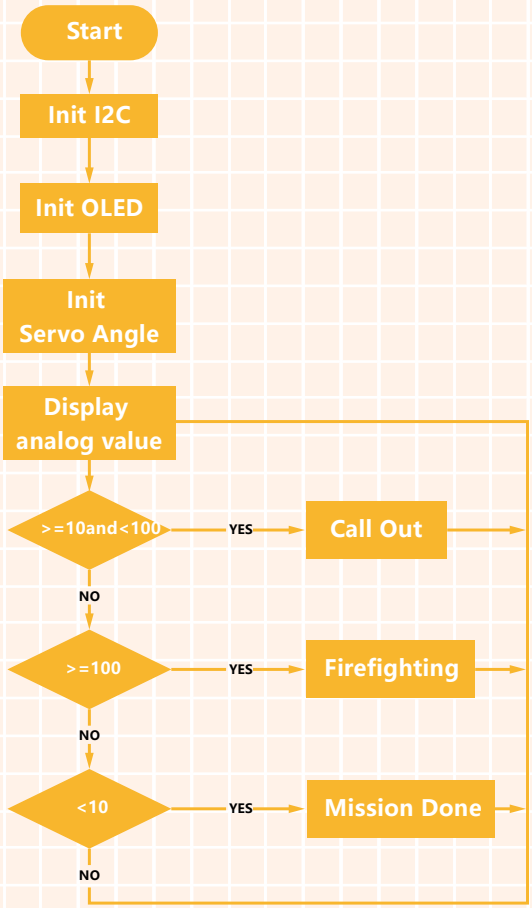
So, we will create three functions: "Call out", "Firefighting", "Mission done". Take the first one as an example.



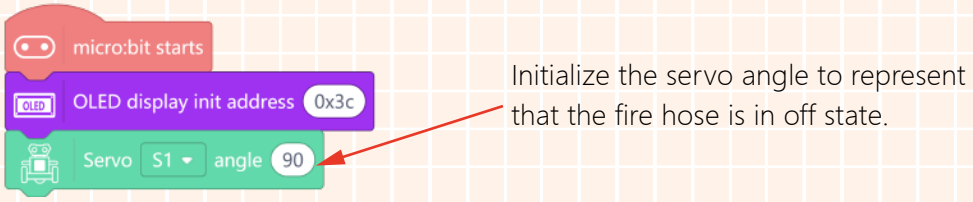
1)Click "My Block"->"Make a Block"; 2)Click "Make a Function";

3)Name the function as "Call Out"; 4)Click "OK".

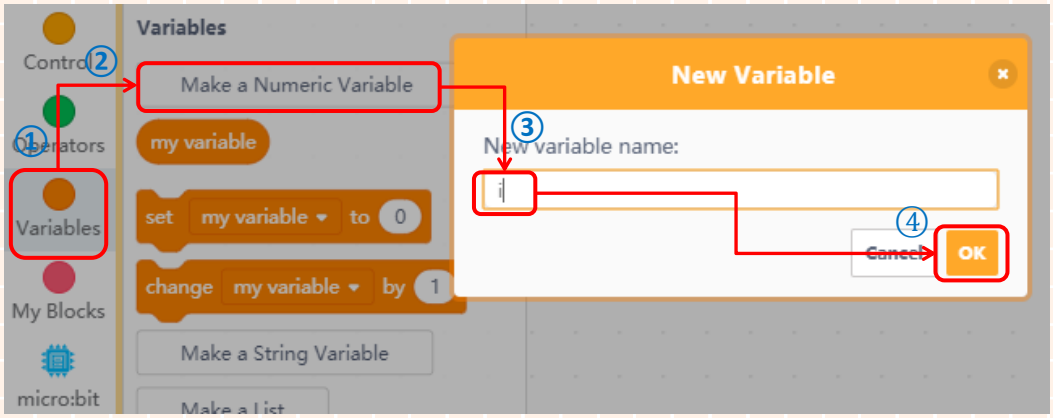
2.Create another two functions in the same way above. Then do condition judgment as the flowchart shown below:



3.Initialize the I2C, OLED, Servo angle when the program starts.

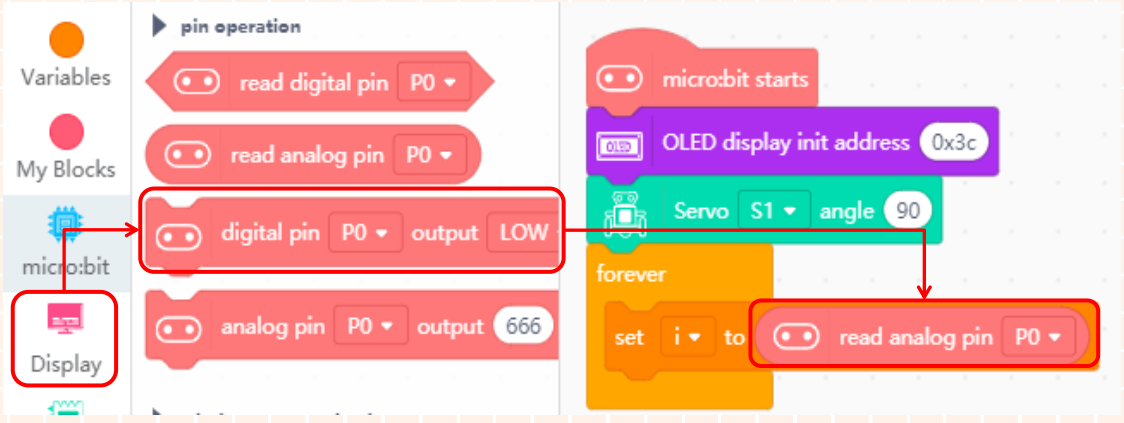


4.Create a variable "i" to store the analog value read from the flame sensor.
Make a variable "i".



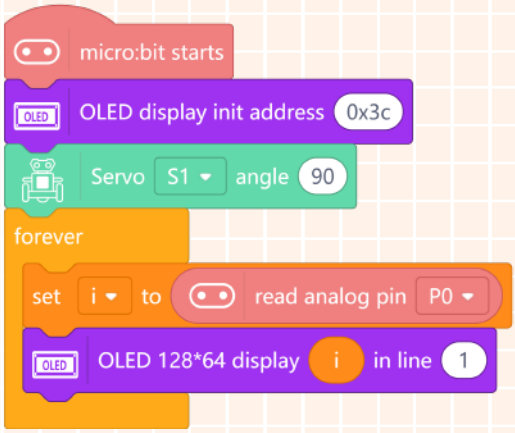
① Click "Variable";
② Click "Make a Variable";
③ Name the variable as "i";
④ Click "OK".

Get the value of the flame sensor.

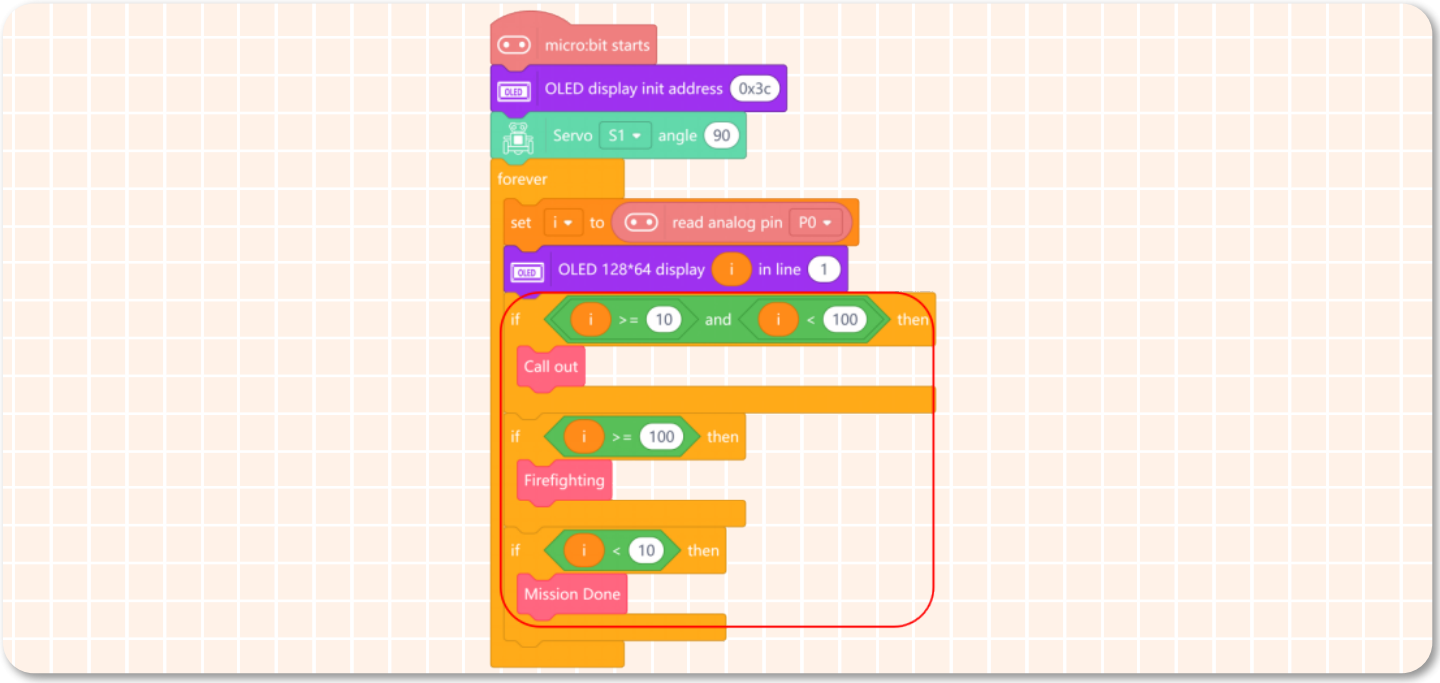


When calling the value of flame sensor, directly use the variable "i". 

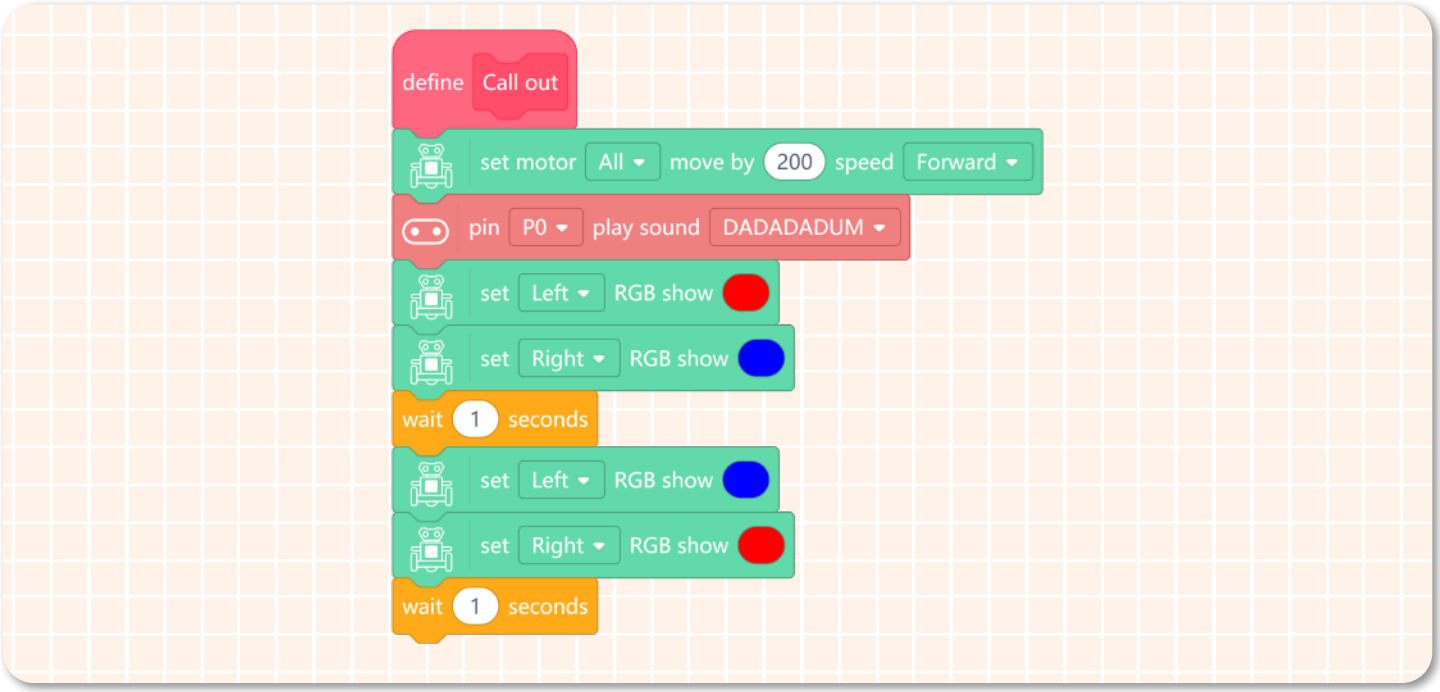
5.Display the analog value of the flame sensor on the first line of the OLED screen.



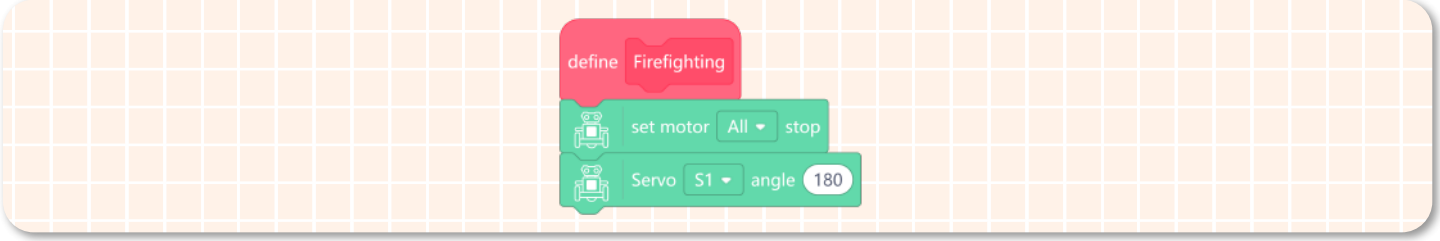
6.Call the related functions according to the program flowchart.
When the analog value detected by the flame sensor is between 10~100, it means that there is a certain distance between the firefighting robot and the fire scene, and the robot has to go forward to the scene; if the value is larger than 100, the robot has arrived at the fire scene, and starts to extinguish the fire; when it is less than 10, the firefighting mission is done.



7.The realization of the"Call out" function: when the firefighting robot drives to the fire scene, the two LEDs flash red and blue alternatively, meanwhile, the keep the siren blaring (use the sound "dadadum" to simulate the siren).

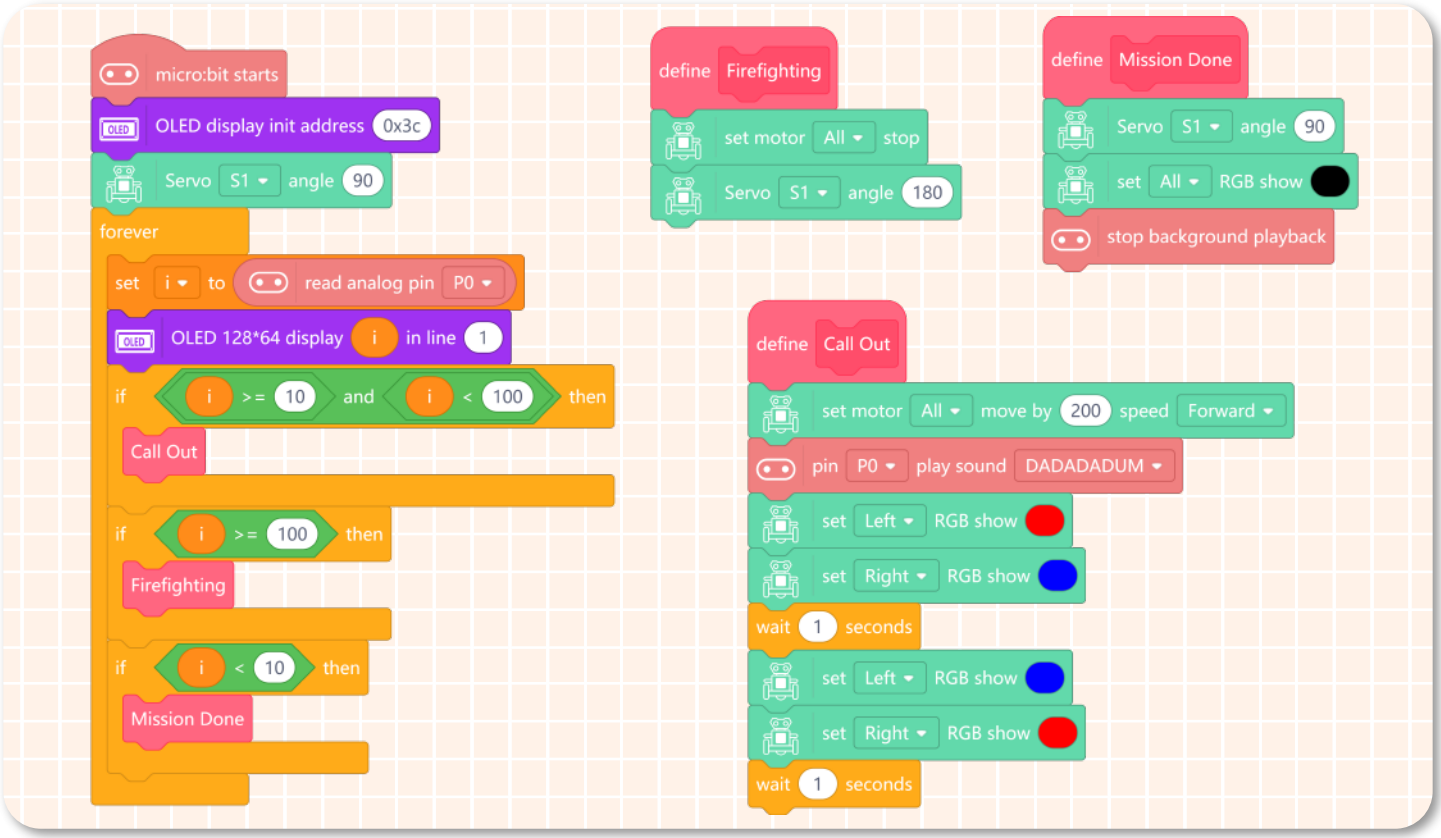


8.The realization of the function "Firefighting": when the firefighting robot arrived at the scene, turn on its fire hose to put out the fire (change the angle of the servo to simulate this process).



9.The function "Mission done": turn off the fire hose, LEDs, and siren.

10.The complete program is shown below.



11.Name your project as "Firefighting robot", and download it into Maqueen Plus.

Step 5 Effect Display

Turn on the power switch when completed all the steps above. Then the analog value the flame sensor detects will be constantly displayed on the OLED screen. When the value is in 10~100, the firefighting robot moves forward at the speed of 200 with its light flashing and siren blaring; when it is more than 100, the robot car stops, and its servo rotates 180 degrees; when less than 10, the servo back to 90 degrees, stop playing sound and turn off the RGB LEDs.

Note: we can use a lighter to imitate the fire scene. Although the flame sensor can detect fire, it is not fireproof. Please make sure the sensor always keeps a certain distance from the fire.

This project involves dangerous action, please complete this chapter with the assistance of guardians or teachers.

Think & Explore

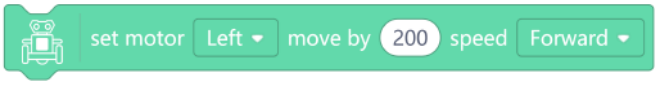
We all know that smoking is not only harmful to our own health but effecting others. Therefore, smoking is forbidden in some public places. Can we make an "Anti-smoking robot" to monitor smoking in real-time?

Tip: add a gas sensor based on this project.

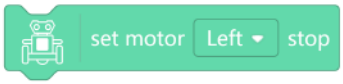
Appendix 1. Maqueen Plus Block Description

Technically, Maqueen Plus is a device and block is the tool to operate it, just like a TV set and remote controller. So we have to use the following blocks to make our Maqueen Plus "come alive". Let's get to know how these blocks work.

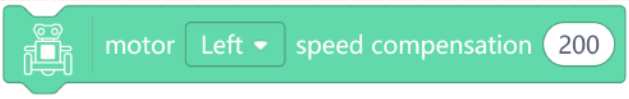
PID algorithm is able to maintain the speed balance of motor.
Enable PID when using motor.
Two state: OFF/ON.



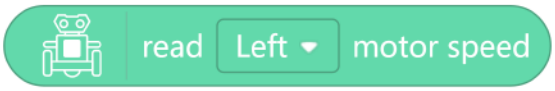
Set the direction and speed for "Left/Right/All"motor.
Direction: forward, backward
Speed: 0~255



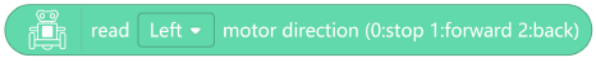
Stop the "Left/Right/All"motor.



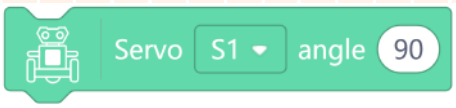
When there is a speed difference between the two motors, set speed compensation for "Left/Right" motor to adjust speed difference.
Adjustable range: 0~255



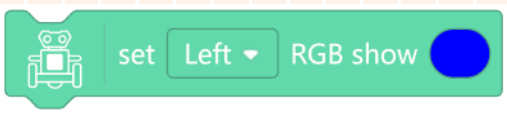
Read the current speed of "Left/Right"motor.



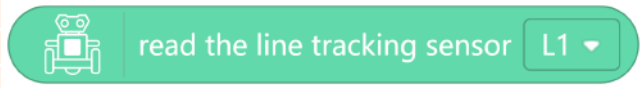
Read the direction of "Left/Right"motor.
0: stop;
1:forward;
2:back



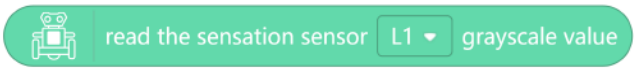
Set the angle of servo "S1-S3".
Range: 0°~ 180°



Set the display color of "Left/Right/All"RGB LED. Seven colors to choose from.
Turn off the RGB LED.



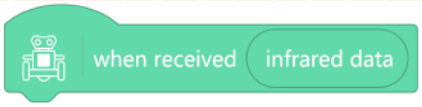
Read the value returned by line-tracking sensor "L1, L2, L3, R1, R2, R3".
Return value 1: detected black line.
Return value 0: no black line detected.



Read the grayscale value detected by line-tracking sensor "L1, L2, L3, R1, R2, R3".

Get the current version of Maqueen Plus.

Detect the distance between the ultrasonic sensor and the obstacle ahead. T: transmitting end; E: receiving end.
Set T and E to the corresponding GPIO ports according to hardware connection.



The codes inside this block will run when IR receiver module received an external IR signal.

Read the received IR signal.
Display the code value in decimal.