About this Manual

Thanks for choosing our PiCar-X.

PiCar-X is an AI self-driving robot car for Raspberry Pi, on which RPi works as the control center. The mounted camera module, ultrasonic module, line tracking module can separately realize the functions of color detection, face detection, automatic obstacle avoidance, automatic line tracking, etc.

Taking the SunFounder-designed Robot HAT as the driving module, it integrates the motor driving, servo driving and presets ADC, PWM, Digital pins for your function extension. A speaker has already been inserted in the Robot HAT to realize TTS (Text-to-Speech), sound effect, background music, etc.

This manual introduces lists, assembly, program, etc. The program part is divided into two chapters: To Play in Ezblock and To Play in Python and each of them can get you stated on making PiCar-X work in way you want.

★ To Play in Ezblock

If you are a programming newbie, please check this chapter for it introduces a block-based visual programming software — Ezblock Studio to guide you to grasp the programming. There are 14 examples to help you completely grasp the blockly program skill and the use of several functions of PiCar-X.

★ To Play in Python

If you give a favor to the traditional program environment — Python, skip to read this chapter directly for it introduces the RPi environment configuration and the methods of running the provided Python example codes and checking running effects. In addition, we have developed a web control page for your operation, applicable to your smart phone, tablet, desktop and so on. You can get to use PiCar-X as soon as you run a few commands.

Absorbed the application of these functions, you are expected to create your own marvellous and inspiring projects. We will be glad if you are willing to share your experience and harvest on our forum.

Thanks once again for your unremitting support for SunFounder company.

V2.0.0 Dec. 2020

Content

Component List

M1.4 Nut
(6)

M3 Nut
(6)

M3
Self-locking Nut
(6)

M4
Self-locking Nut
(4)

M1.4 x 6
Screw
(6)

M1.5 x 4
Self-tapping Screw
(8)

M2 x 4
Screw
(6)

M2 x 10
Screw
(8)

M2.5 x 6
Screw
(6)

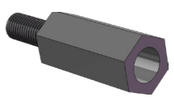
M3 x 4
Countersunk
Screw
(4)

M3 x 6
Screw
(8)

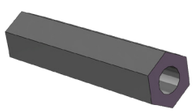
M4 x 20
Screw
(4)

M3 x 25
Screw
(8)

M2.5 x 8 + 6
Nylon Standoff
(6)



M2.5 x 11 + 6
Nylon Standoff
(6)

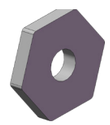


M3 x 24
Nylon Standoff
(4)

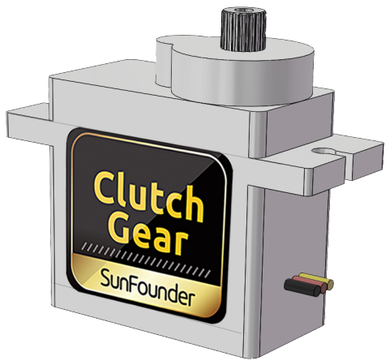
M3 x 35
Screw
(4)

O1 Washer
(1)

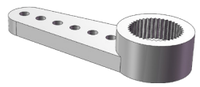
T1 Washer
(6)



T2 Washer
(6)

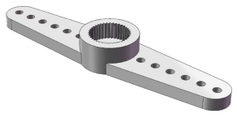


Servo
(3)



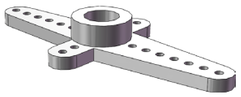
One-Side Servo Arm

Servo Screw A



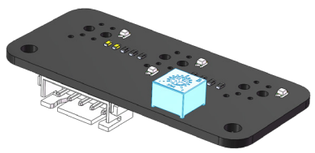
Double-Side Servo Arm

Servo Screw B

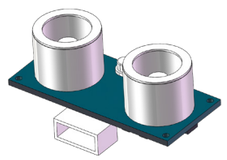


Cross Servo Arm

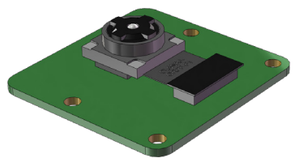
Servo Screw B



Grayscale Module
(1)



Ultrasonic Module
(1)

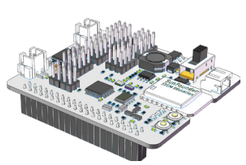


Camera Module
(1)

Grayscale Module Cable
(2)

Ultrasonic Module Cable
(2)

FFC Cable
(2)



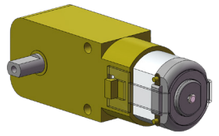
Robot HAT
(1)

Battery Holder
(1)

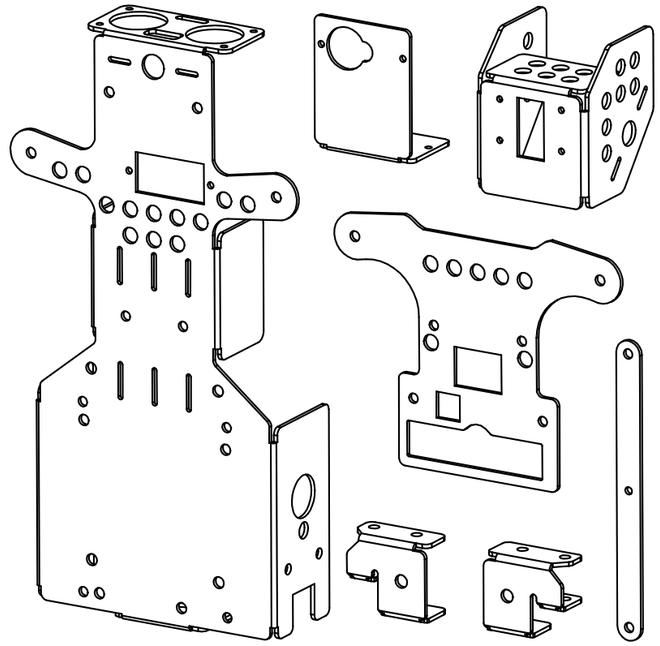
Battery Ribbon
(1)

Rear Wheel
(2)

Front Wheel
(2)

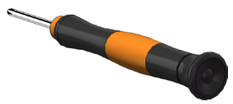


TT Motor
(2)



Structural Plate

Spiral Cable Wrap
(1)



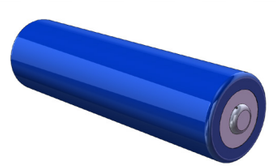
Screwdriver
(1)

Cross Socket Wrench for Self-locking Nuts
(1)

Self-provided Component

1. You are recommend to use 18650 batteries without a protective board. Otherwise, the product may be cut power and stop running because of the overcurrent protection of the protective board.

2. Please use a battery with the largest possible power to increase the duration of use.



18650 Rechargeable Li-ion Battery
(2)

Burn System

In addition to playing this product, you ought to flash the system into the Raspberry Pi.

Required Components

Raspberry Pi	1 * Power Adapter
1 * Mirco SD Card	1 * Personal Computer

Procedures

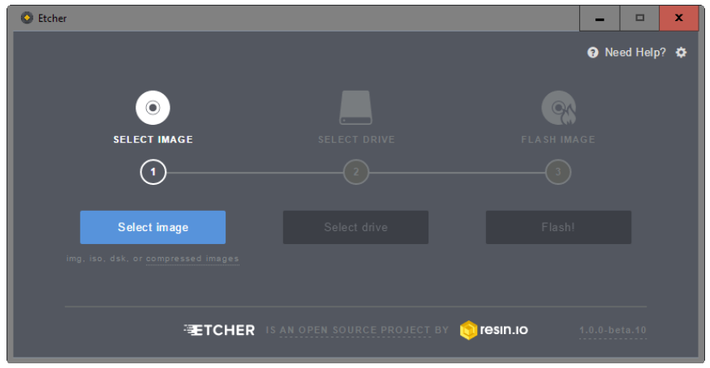
1. Prepare the tool of image burning. Here we use the **Etcher**. You can download the software here: https://www.balena.io/etcher/.

2. Download the **Ezblock for Raspberry Pi** image file here:
https://ezblock.cc/download/index.html

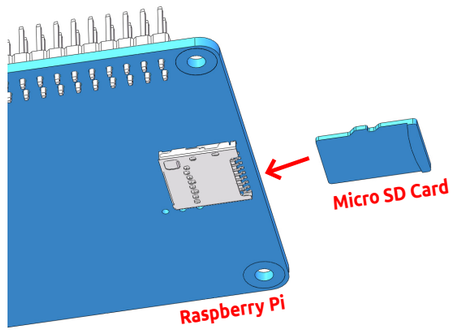
3. Unzip the package downloaded and you will see the **.img** file inside.

Note: Do not extract the .img file.

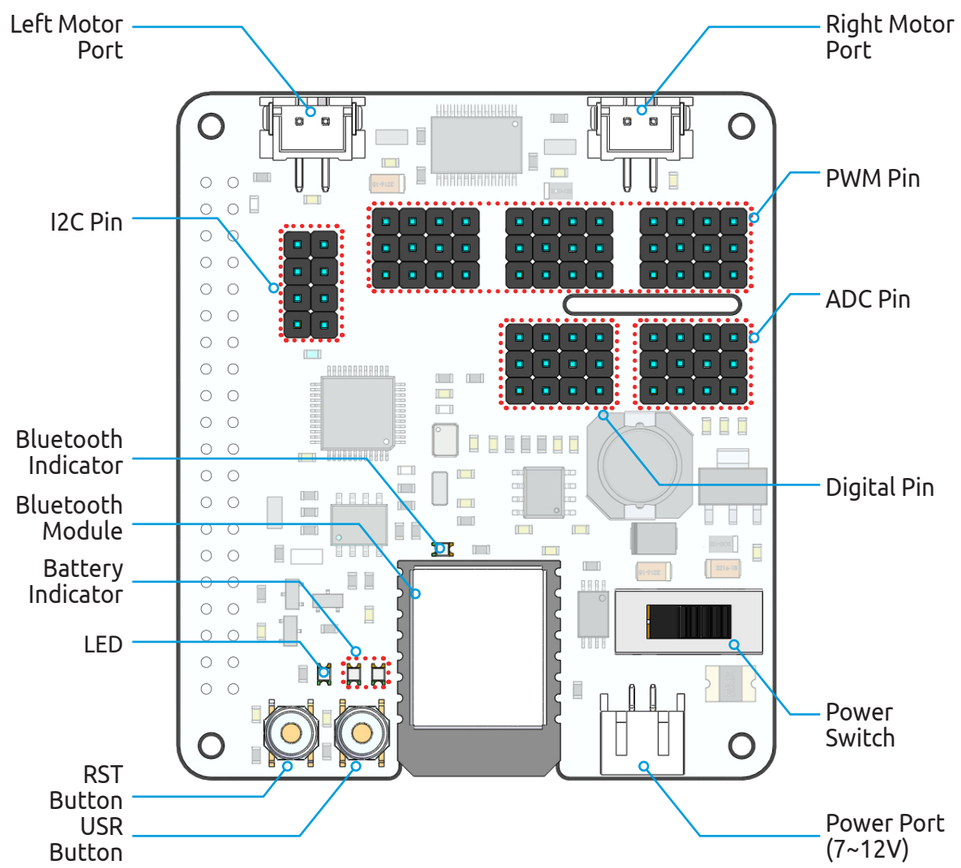
4. With Etcher, flash the image file into the SD card.



5. At this point, Ezblock for Raspberry Pi is installed. Please insert the Micro SD card into your Raspberry Pi.



About Robot HAT



RST Button:

- Short pressing RST Button causes program resetting.
- Long press RST Button till the LED lights up then release, and you will disconnect the Bluetooth.

USR Button:

- The functions of USR Button can be set by your programming. (Pressing down leads to a input “0”; releasing produces a input “1”.)

LED:

- Set by your program. (Outputting 1 turns the LED on; Outputting 0 turns it off.)

Battery Indicator:

- The voltage ranging above 7.8V, two LEDs light up; ranging 6.7V~7.8V, one LED turns on; ranging below 6.7V, all LEDs turn off.

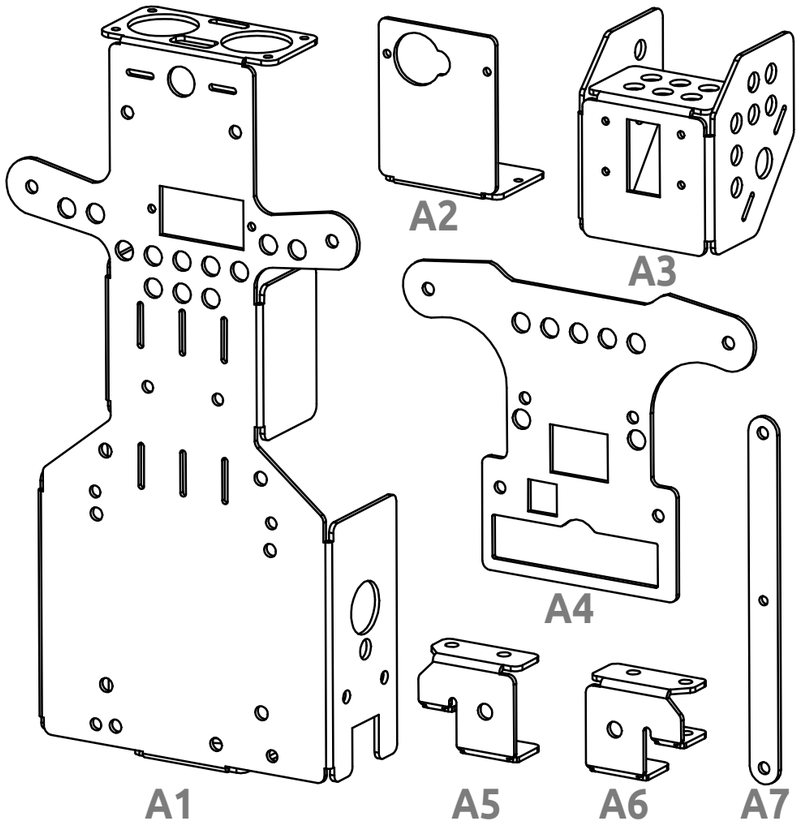
Bluetooth Indicator:

- The Bluetooth indicator keeps turning on at a well Bluetooth connection, blink at a Bluetooth disconnection, blink fast at a signal transmission.

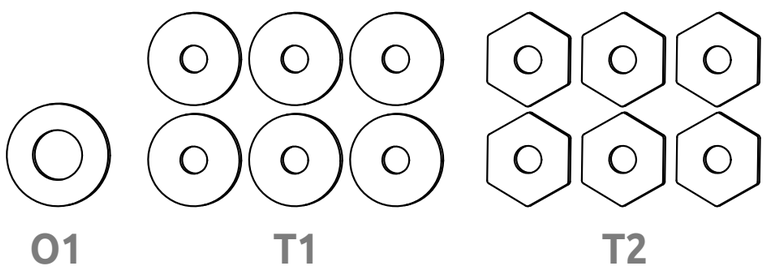
Building the PiCar-X

Now get familiar with these components in this package. In the following steps, there are so many details you need to notice especially in the operation of calibrating the servo angle. In addition, you ought to check whether your wiring conforms to the instruction of this manual.

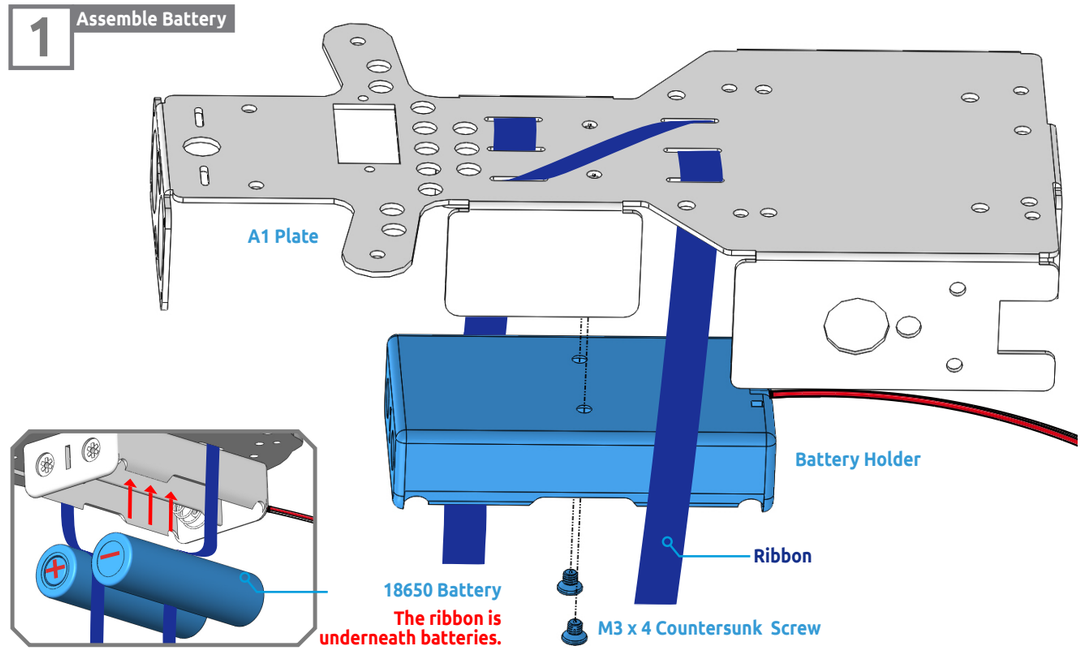
Structural Plate



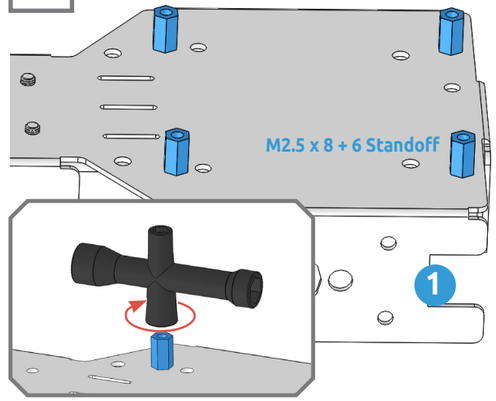
Washer



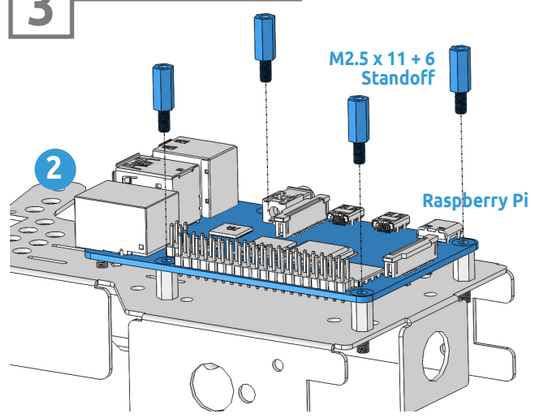
1 Assemble Battery



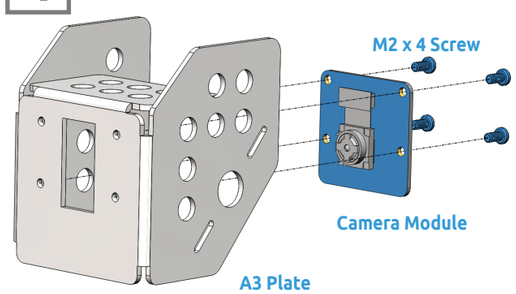
2 Assemble Raspberry Pi 1



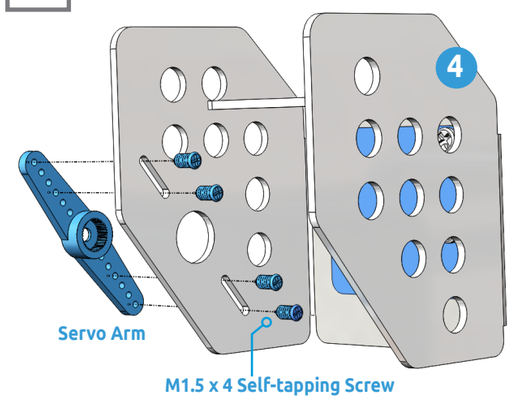
3 Assemble Raspberry Pi 2



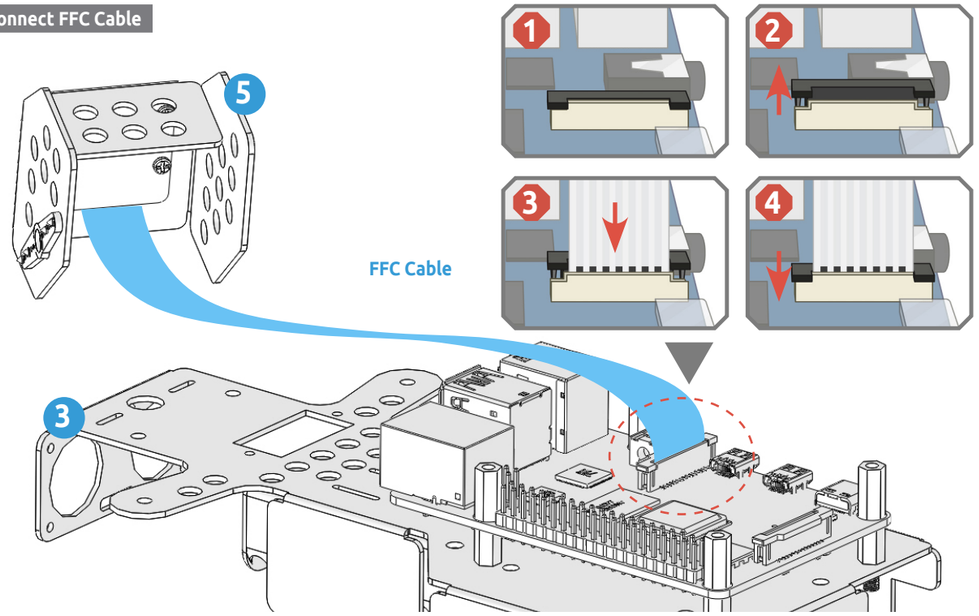
4 Assemble Camera Module 1



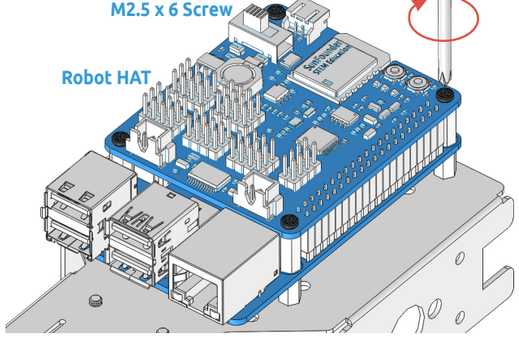
5 Assemble Camera Module 2



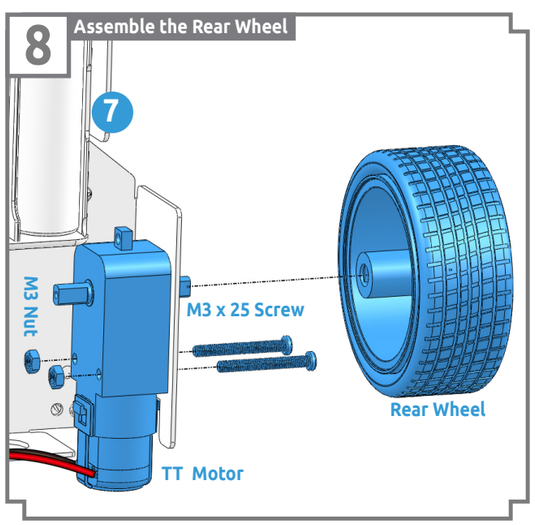
6 Connect FFC Cable



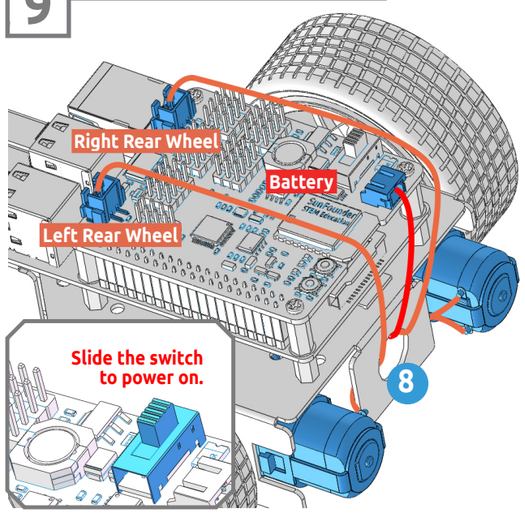
7 Assemble Robot HAT



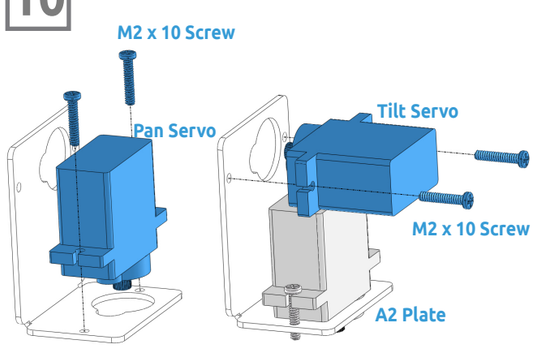
8 Assemble the Rear Wheel



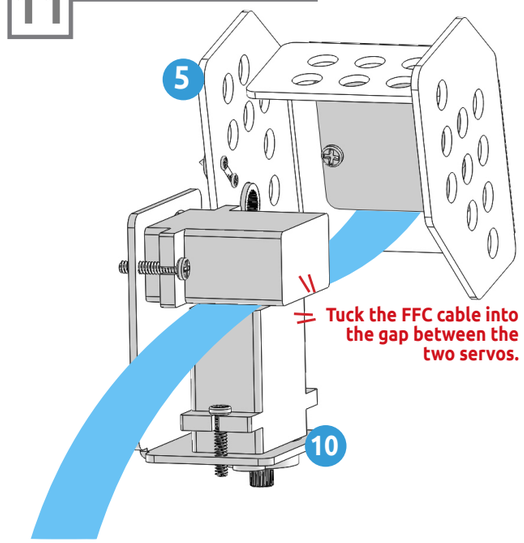
9 Connect the Motor and Power Cables



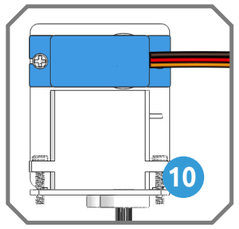
10 Assemble Pan and Tilt Servo

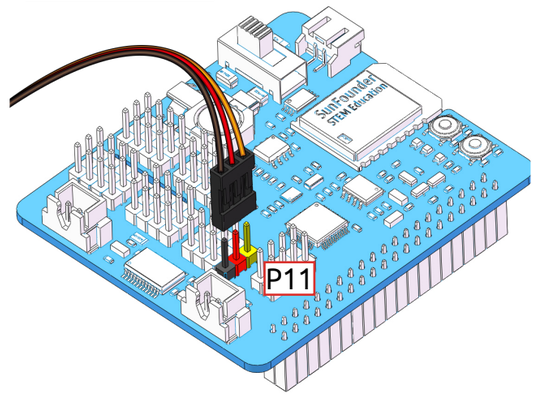


11 Complete Pan and Tilt Part 1



12 Servo Adjustment



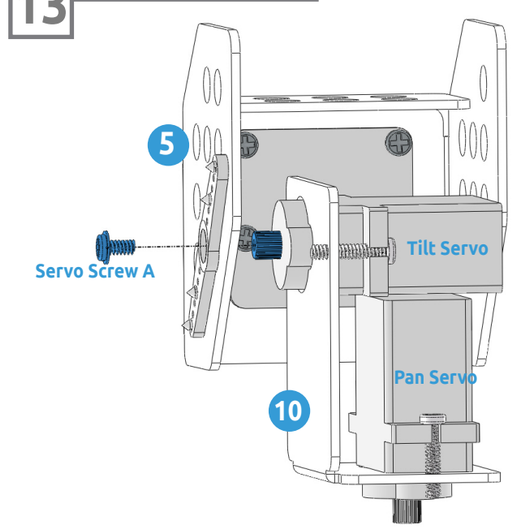


After burning the Ezblock system, P11 was set to calibrate the servo angle to 0 °. Therefore, before assembling **each servo**, you need to plug the servo pin into P11 and keep the power on.

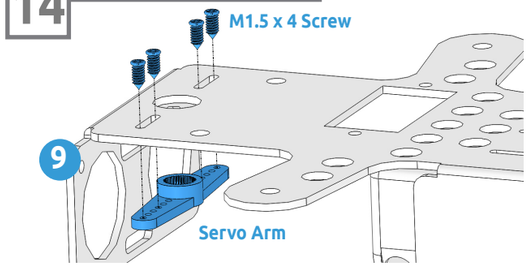
You can put a servo arm into the output shaft and twist gently. If Servo arm returns later, the function will take effect. If not, press Reset Button to restart it.

NOTE: This function will be invalid after writing any programs.

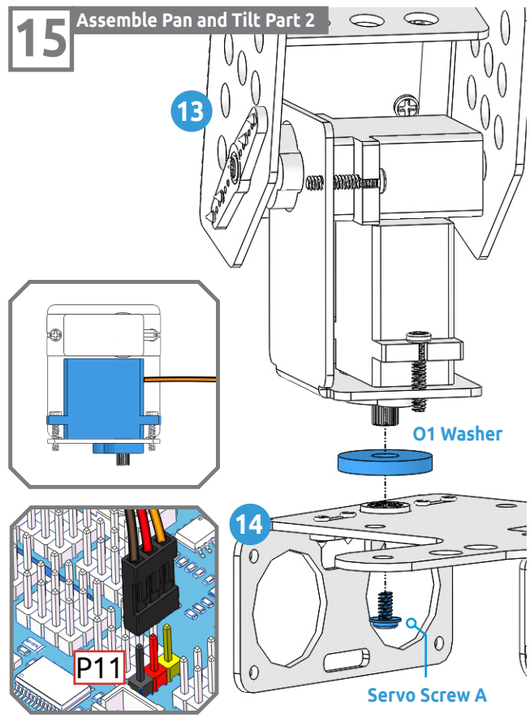
13 Complete Pan and Tilt Part 2



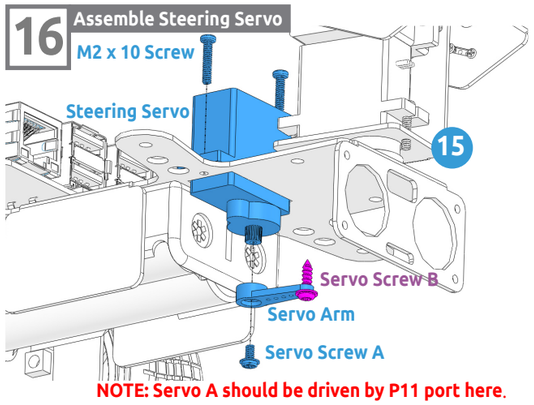
14 Assemble Pan and Tilt Part 1



15 Assemble Pan and Tilt Part 2

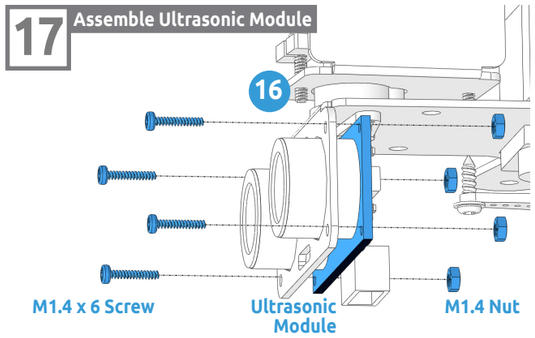


16 Assemble Steering Servo

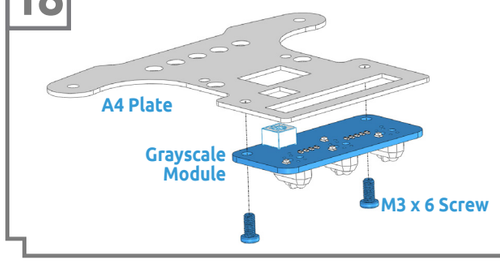


NOTE: Servo A should be driven by P11 port here.

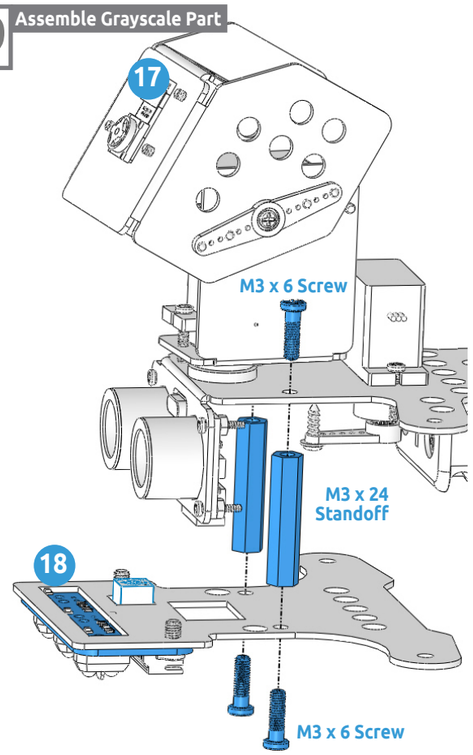
17 Assemble Ultrasonic Module



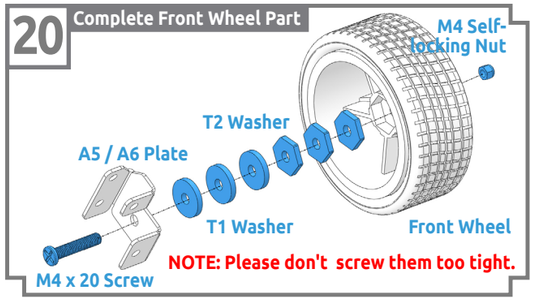
18 Assemble Grayscale Module



19 Assemble Grayscale Part

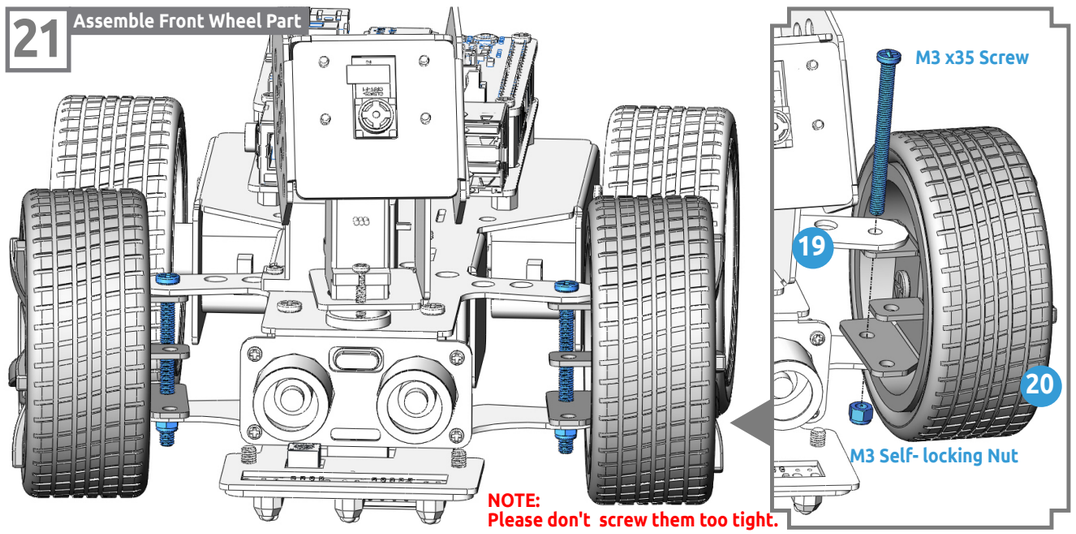


20 Complete Front Wheel Part

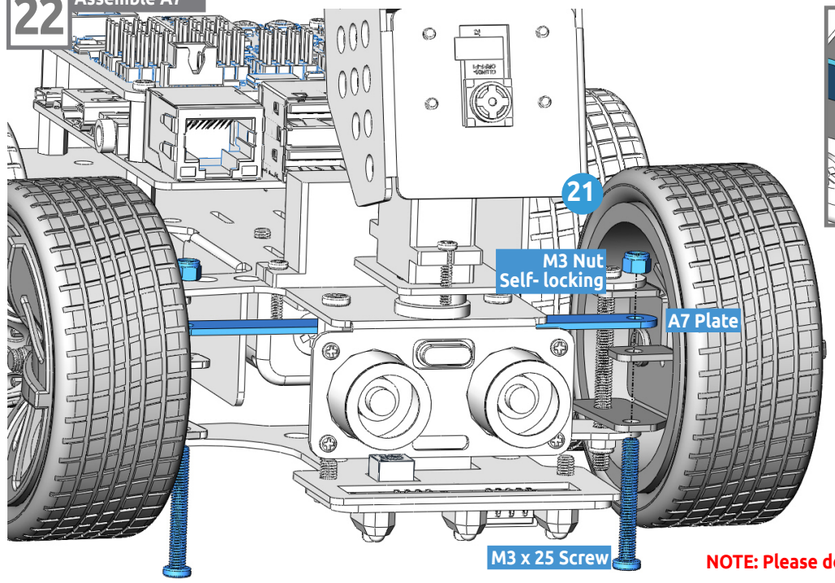


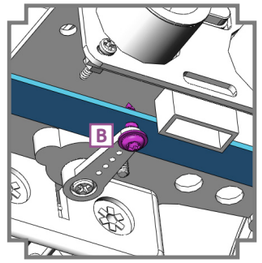
NOTE: Please don't screw them too tight.

21 Assemble Front Wheel Part



22 Assemble A7

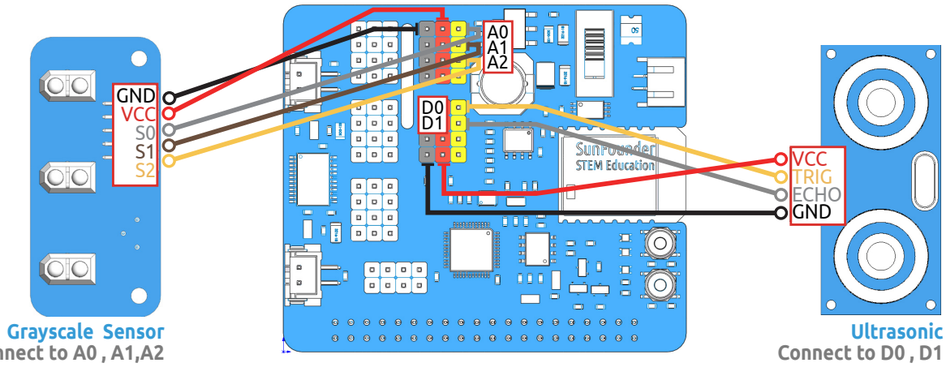




NOTE:
Servo Screw B is hung on A7.

NOTE: Please don't screw them too tight.

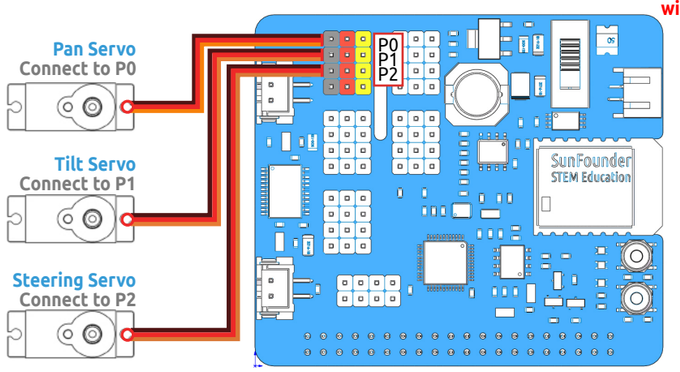
23 Connect the Modules



Grayscale Sensor
Connect to A0 , A1,A2

Ultrasonic
Connect to D0 , D1

NOTE: Make sure the wire color is consistent with the pin header color.



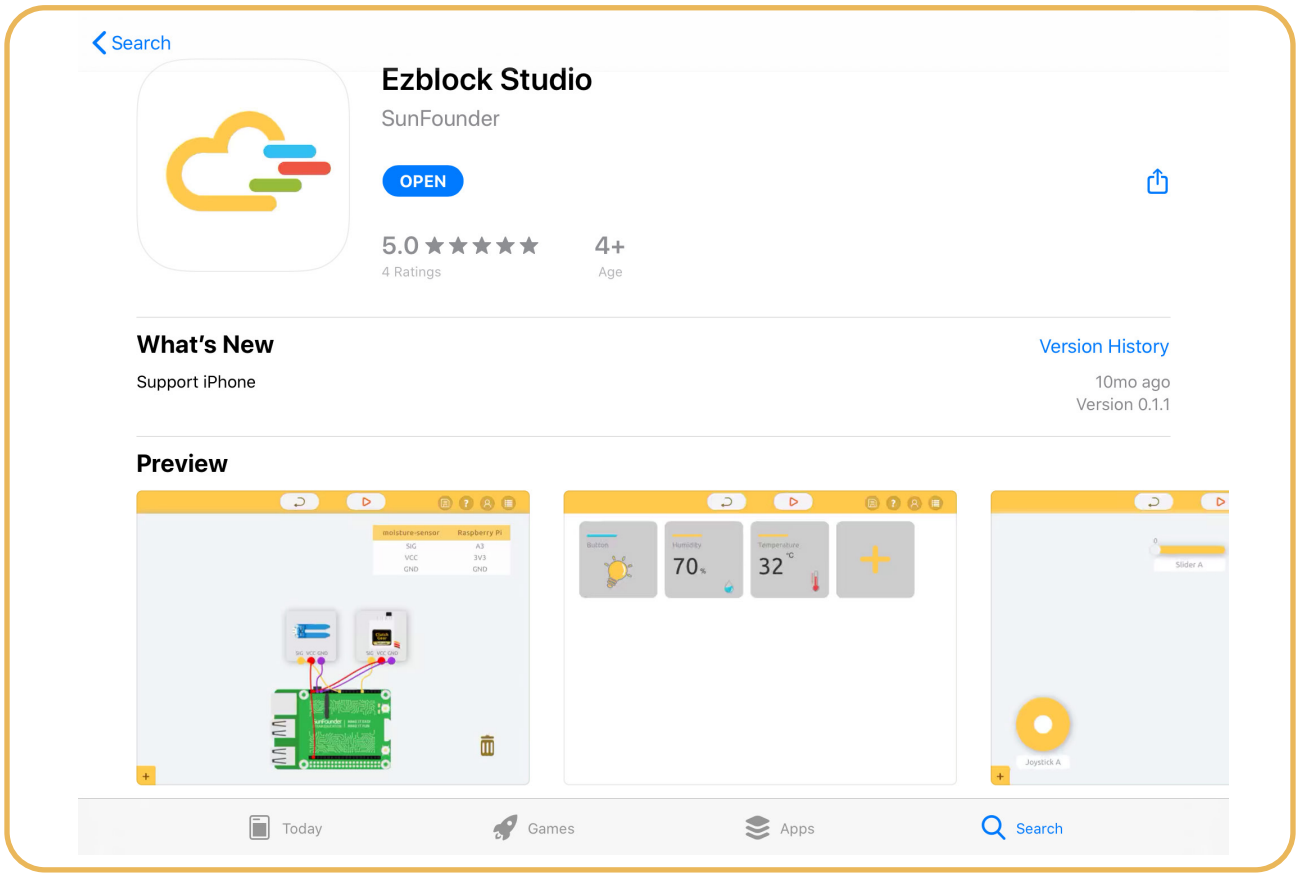
To Play in Ezblock

Introduce Ezblock Studio

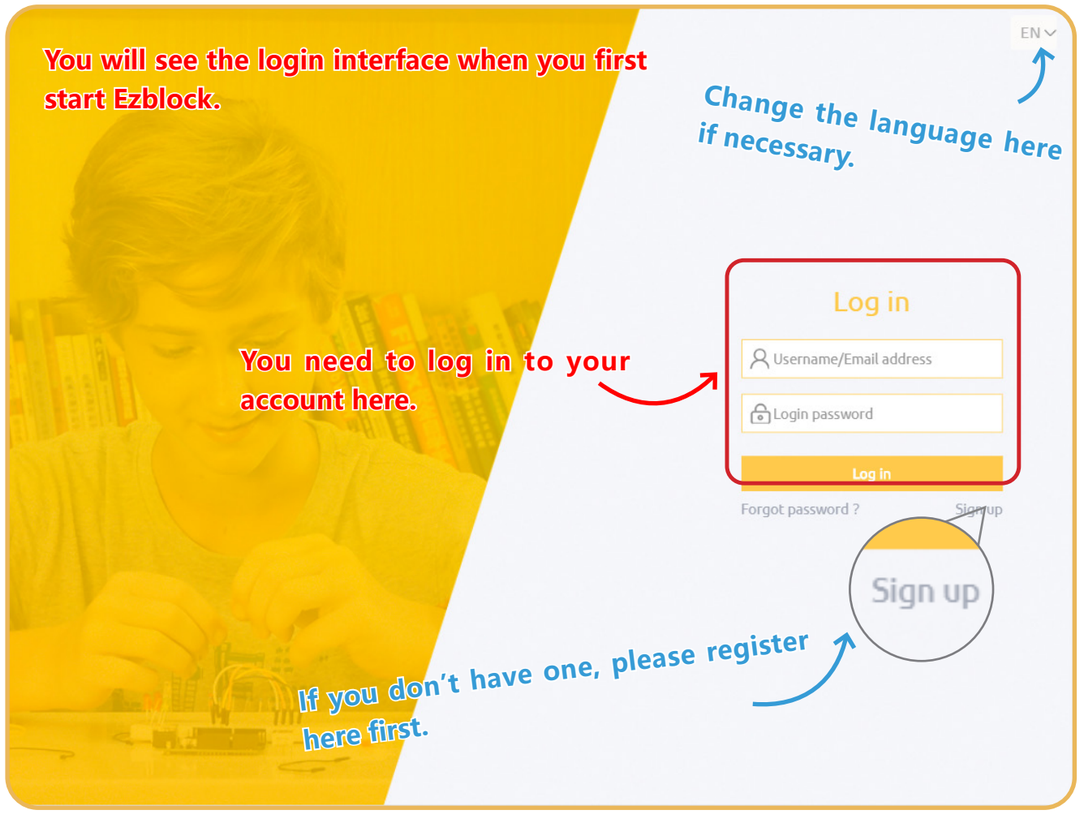
Ezblock Studio is a new open-source platform for building electronic projects and graphical programming.

Ezblock Studio also serves as a coding platform that runs on your phone, tablet and computer. In addition, the Ezblock Studio applies Blocks and Python, making it easier to learn programming. By and large, Ezblock Studio integrates Hardware Simulator, Bluetooth Debugger, IoT Panel and Customizable Remote Controller, which are conducive to the operation of prototyping, debugging, and so on.

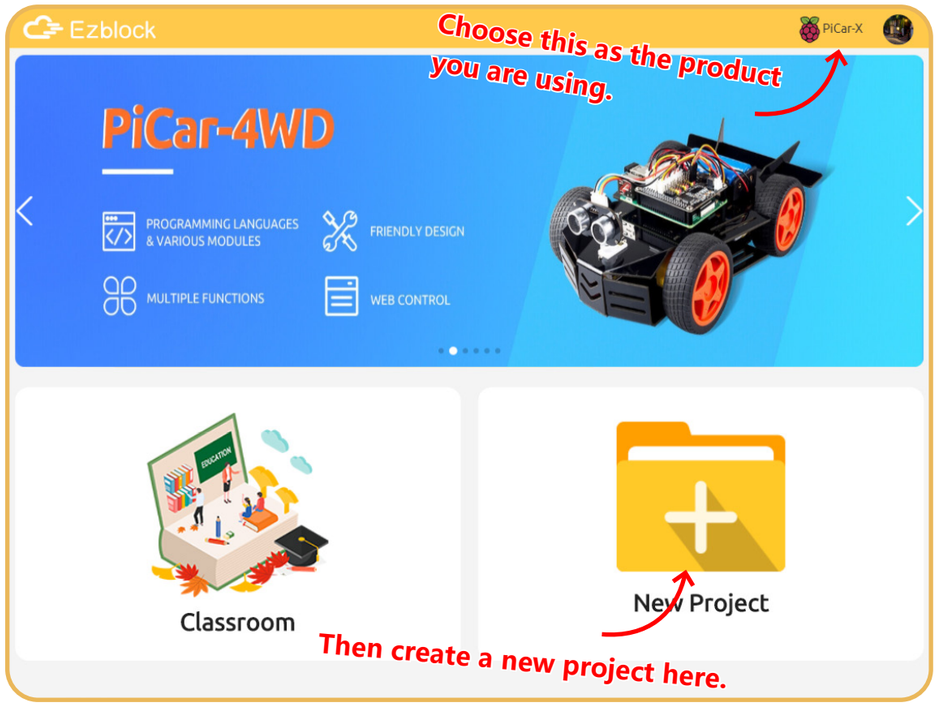
Open App Store (iOS/Mac OS X system) or Play Store (Android/Windows/Linux system), then search and download Ezblock Studio.

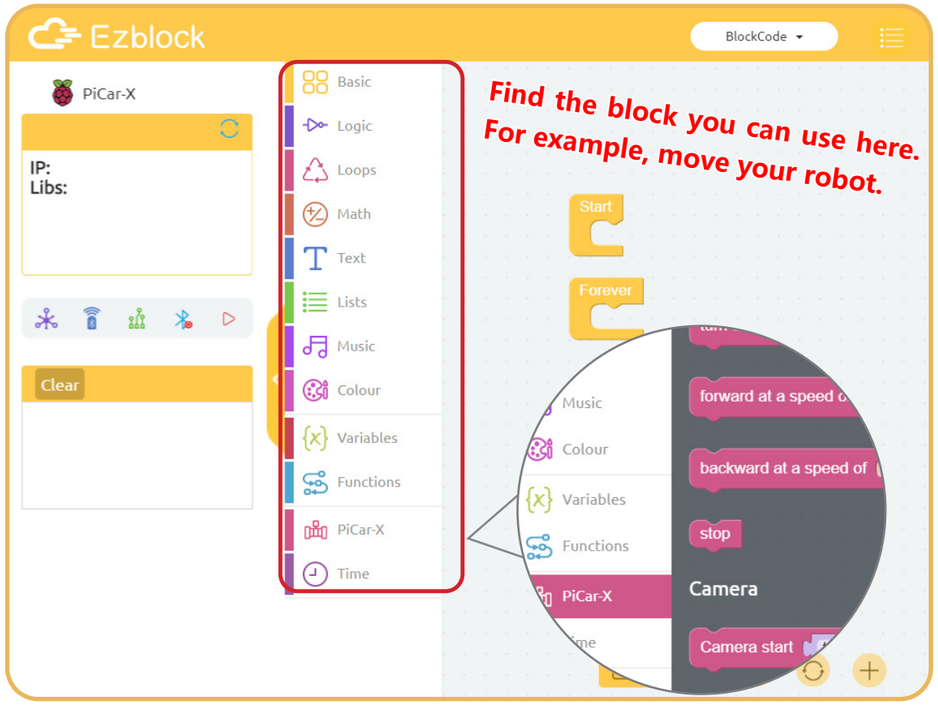


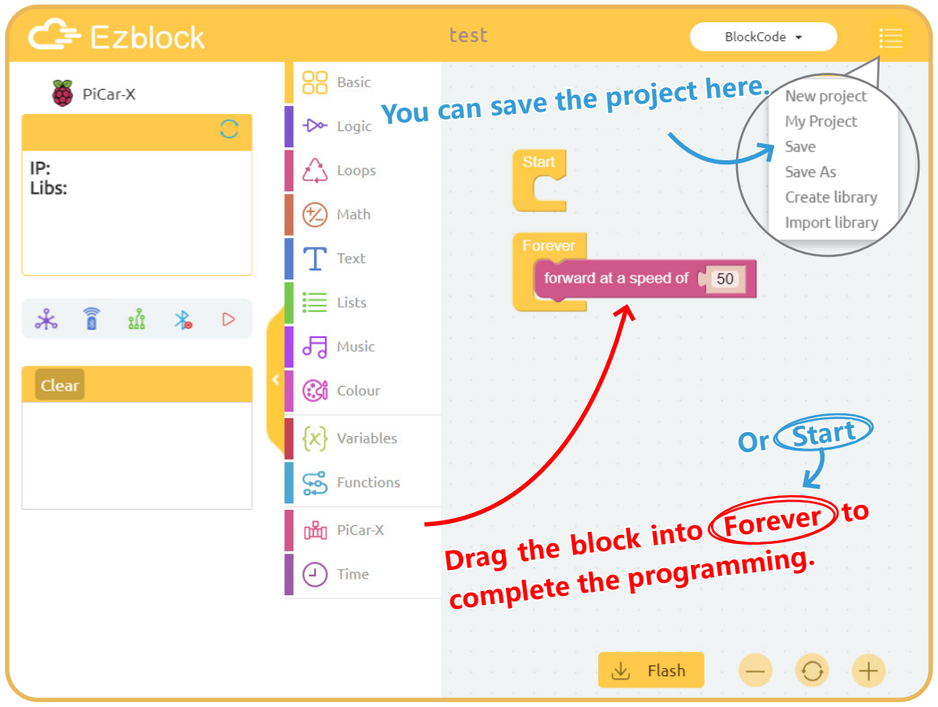
Before First Use

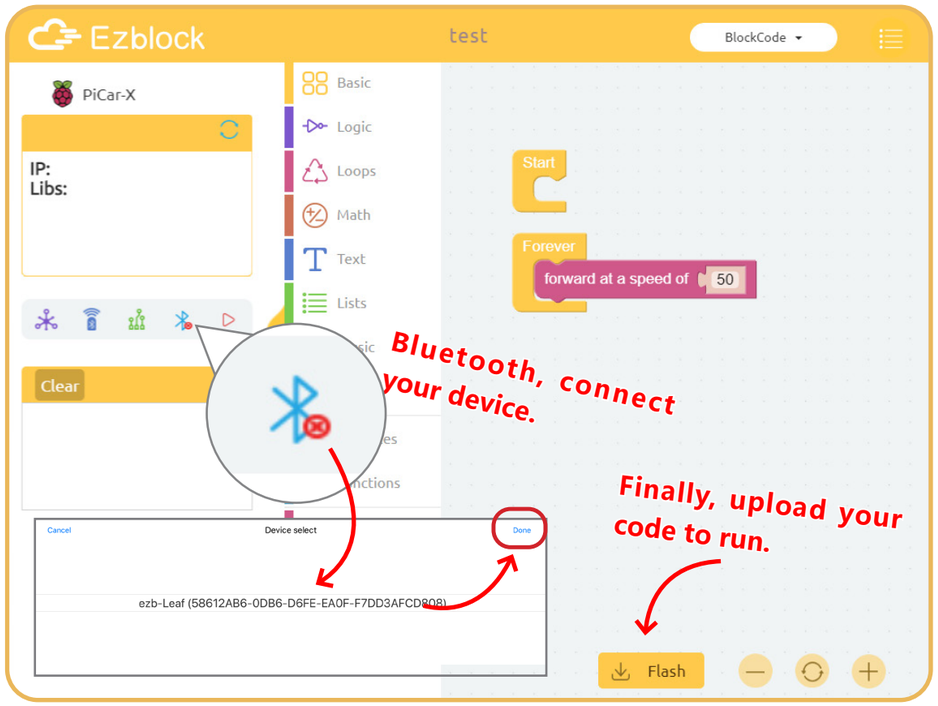


Start Using

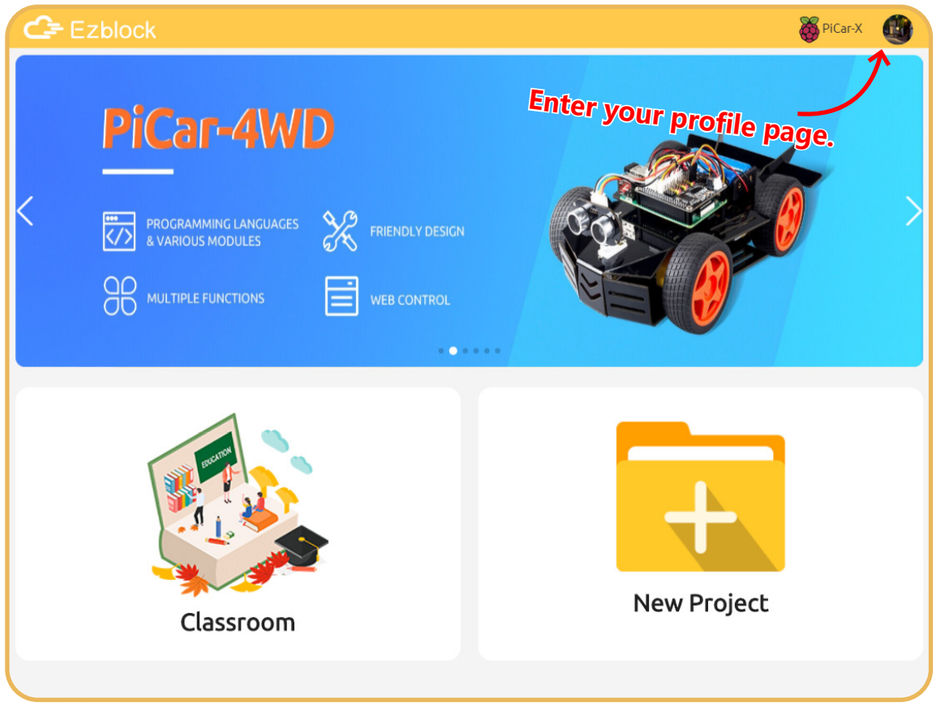


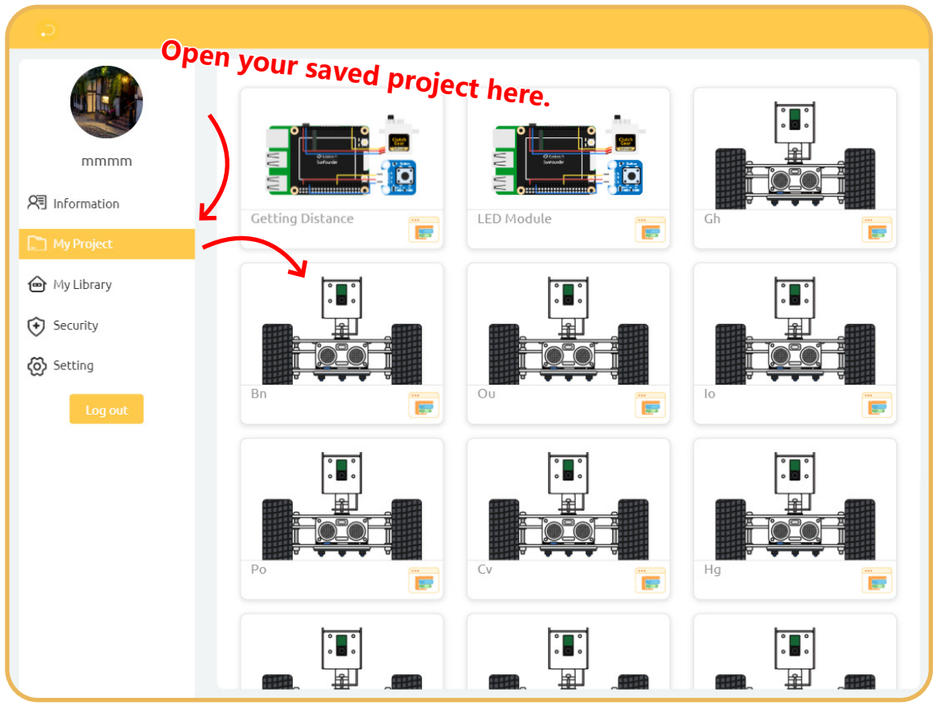




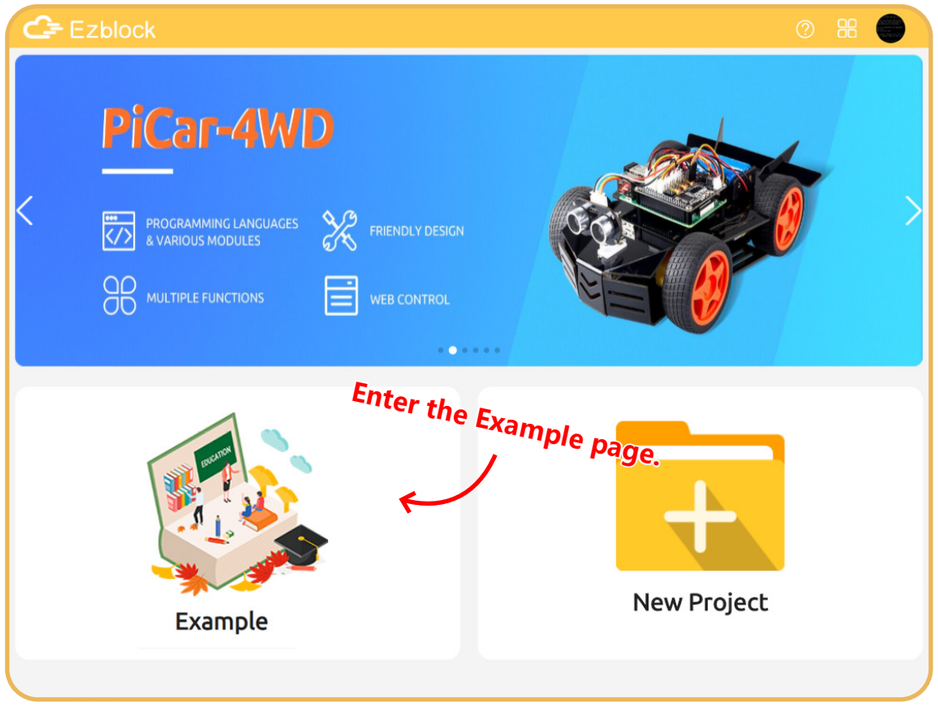


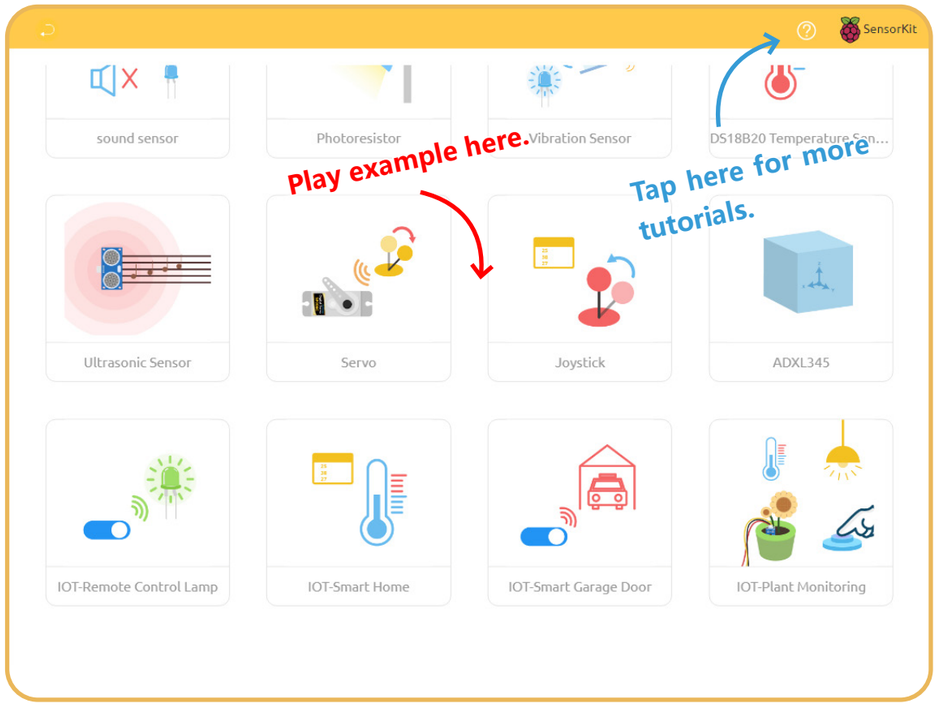
Open the Saved Project





Open the Example





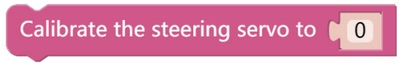
Elementary Project

Here, we show you the basic operation of playing PiCar-X with Ezblock. If you are new to these, you can try to write the corresponding function according to TIPS, or directly use the reference code in Example. We suggest you do it yourself and experience the fun of challenges.

Move

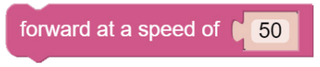
First we need to know how to make PiCar move. Here, we let it perform the five actions of "forward", "backward", "turn left", "turn right", and "stop" in order. By the way, you may need to perform “calibration”.

TIPS

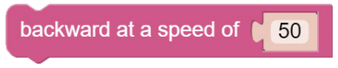


Generally, the correction range is within “-5 ~ 5”. If the deviation value is large, reassembly is recommended.

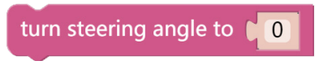
Put it in the Start block and flash it to correct the deviation of the front wheel orientation.



This block makes PiCar move at a certain speed, a percentage of power. Just like "50" is a half-speed.



This block backs your PiCar at a certain speed that is also a percentage of power.

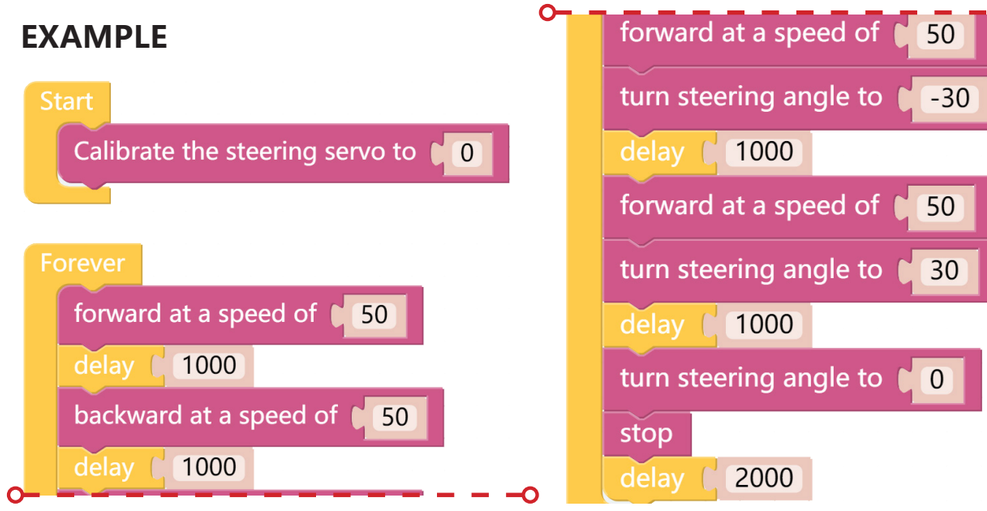


This block can adjust the front wheels’ orientation.

The range is "-45"~"45". Such as "-30" means wheels deviate 30° to the left.

Let PiCar stop.

EXAMPLE

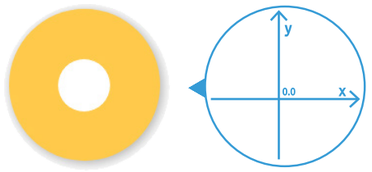


Remote Control

Next we control the PiCar-X with a tablet. You will need to use the Joystick at the Bluetooth control page. By the way, you need to use the "Map" function to map the X-axis reading of the Joystick as a suitable angle.

TIPS

To use the remote control function, you need to enter the Bluetooth control page from the left side of main page.

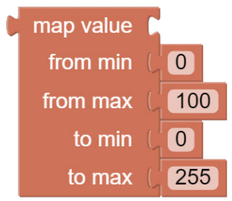


Drag a Joystick to the central area. Toggle the white point in it to produce a coordinate.

The range of the X or Y axis is "-100 ~ 100". Toggling the point to the left will result in an X value of "-100" and a Y value of "0".

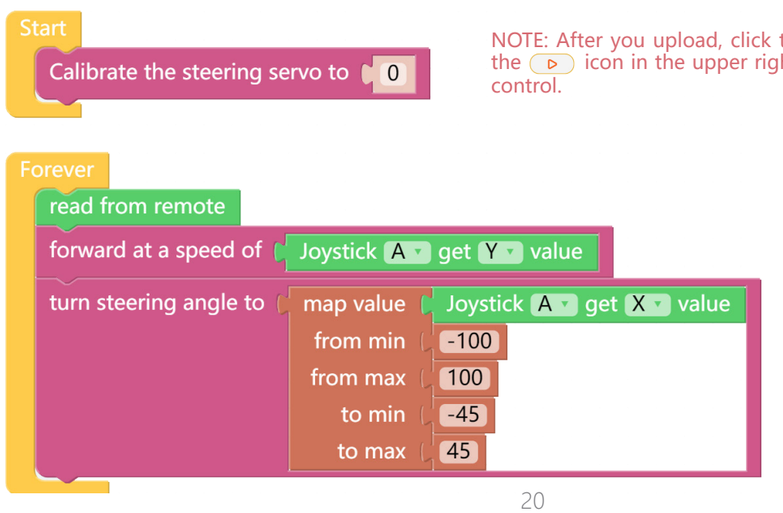
To enable the remote control, you need to add read from remote block in the first line of the Forever block.

This block reads the Joystick value in the Bluetooth control page. You can click the drop-down menu to switch to the Y-axis reading.



The map block can remap a number from one range to another. If a number is 50， it is at 50% position of the range of 0~100; then if we map it to the range 0~255 via the map block, the number will be 127.5.

EXAMPLE



NOTE: After you upload, click the icon again, then click the icon in the upper right corner to start the remote control.

Ultrasonic Sensor Test

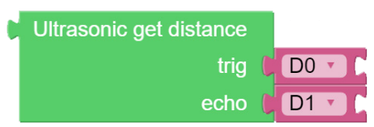
PiCar-X has Ultrasonic Sensor that can be used for experiments such as obstacle avoidance and automatic follow. Here we will try to use Ultrasonic to read the distance (unit: cm).

TIPS

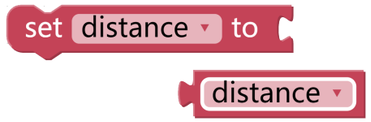
To use the ultrasonic or grayscale module, you need to enter the simulation page from the left side of main page.

Drag the ultrasonic module to the blank area. There will appear 4 colored dots under the module.

Connect the colored dots on this interface according to the physical wiring. Here we connect Trig to D0 and Echo to D1.



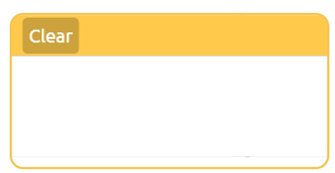
The Modules category will appear and the Ultrasonic block in it after your connection on the simulation page. You can directly use this block to read the distance to the obstacle right ahead.



You may want to simplify your program with Variable. For example, when you have multiple functions that need to read the obstacle distance, you don't need to read the value for each function, just load the value into a variable and use it multiple times.

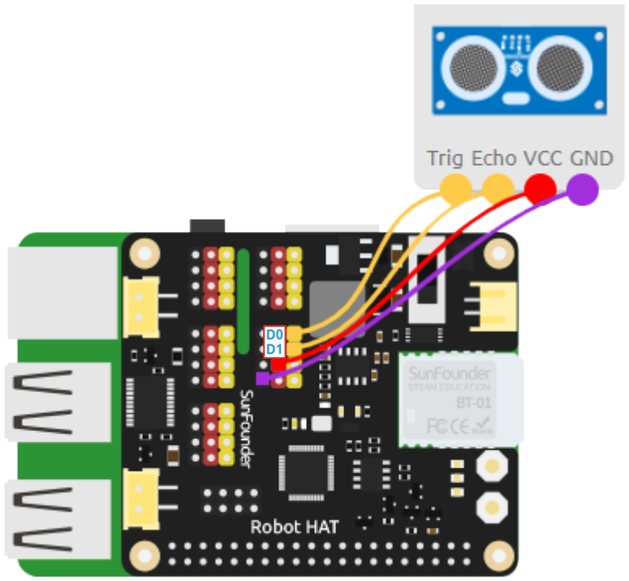
Click the **Create variable** button on the Variables category to create a variable named **distance**.

The Print function can print data such as variables and text for easy debugging.

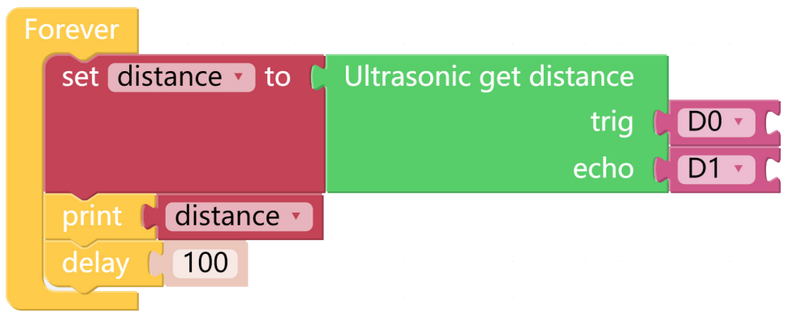


The data printed by the Print function will appear in the Debug Monitor on the left. In other interfaces, you can also click on the Debug Monitor in the upper right corner.

WIRING



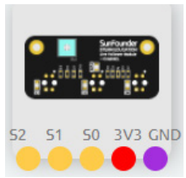
EXAMPLE



Grayscale Sensor Test

PiCar-X has 3 channel Grayscale sensors for your implementing some fun experiments, such as walking along the line, detecting cliffs and so on. Its three detection heads will read the value according to the detected color shades, such as pure black reading is "0".

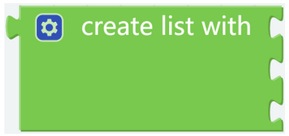
TIPS



Drag the Grayscale module to the blank area in the page, and there will appear 5 colored dots under the body.

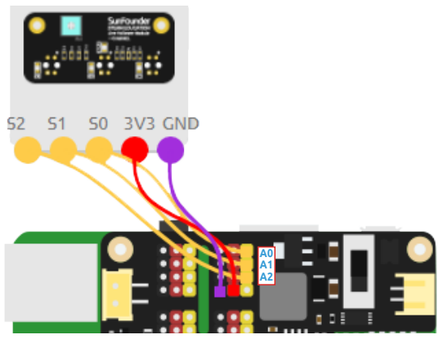
Connect the colored dots on this page according to the physical wiring. Here we connect S0 to A0, S1 to A1, and S2 to A2.

You can use this block to read the value of one of the probes of the 3ch Grayscale module.

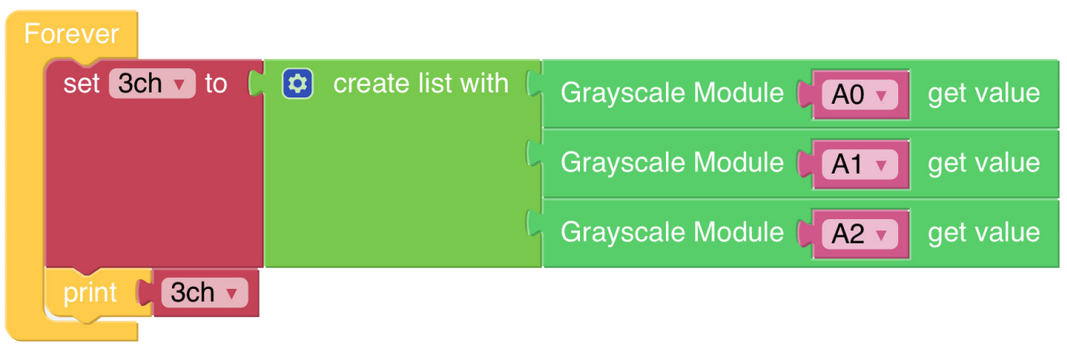


You may want to use List block to simplify your program. When you need to store the values of the three probes of 3ch Grayscale, you do not have to set three variables. Set one as a List.

WIRING



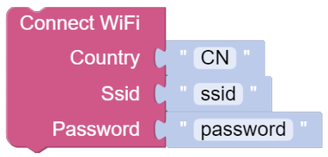
EXAMPLE



Color Detection

PiCar-X is a Robot with Camera. Ezblock also provides some object detection functions. Here we try color detection. Prior to this, you must ensure that the Pi Camera FFC cable is properly and securely connected.

TIPS



To use the Camera function, you need first to connect the Raspberry Pi to the Wi-Fi environment where the tablet is located. Put this block in Start, and type in Wi-Fi account and password.

Here we drag a Video from the page, and it will generate a monitor.

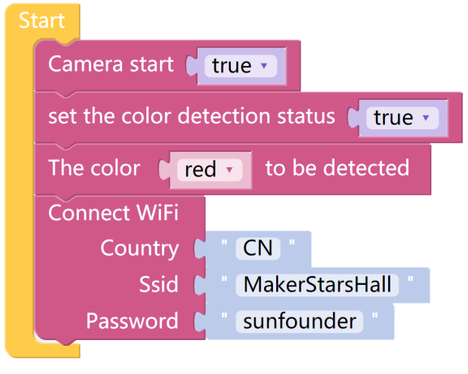
You need to open the image in Video by setting Camera start to true. Setting it to false will close the image (but not object detection).

You need to set Color detection status to true to enable the color detection.

You can use this block to switch the color detected by the color detection. Only one color can be detected for one time.

EXAMPLE

After the code is uploaded, Wi-Fi configuration requires you to click the upper left button of Ezblock to update the device information to take effect.



Then wait for about five seconds, the Debug Monitor will show the IP address.

Clicking the icon again, you click the icon in the upper right corner, and you can see the captured image and the detected color position.

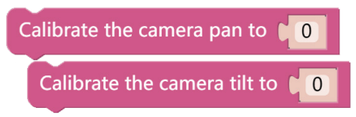
If there is no image, please wait for a while, and then try to run again.

Face Detection

In addition to color detection, PiCar-X also provides face detection. Here we use Joystick to adjust the direction of the camera and let the faces number be displayed in the debug monitor.

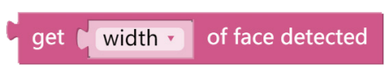
TIPS

You need to set face detection status to true to enable face detection.

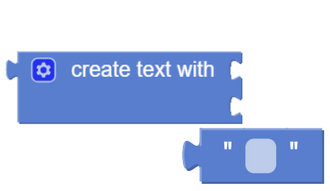


Just like the steering servo, the camera servo can also correct the orientation error through calibration.

These two blocks are used to adjust the orientation of the pan-tilt camera. As the value increases, the camera rotates to the right or up.

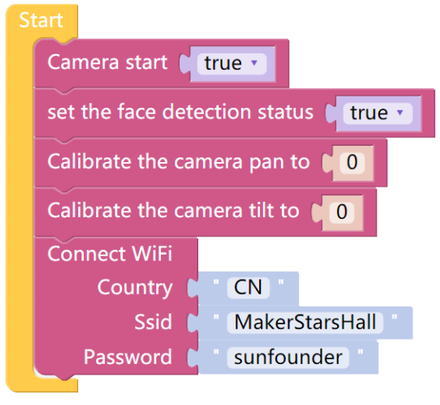


You can read the image detection results through this block, modify the drop-down menu options, and choose to read the coordinates, size or number of the image detection results.

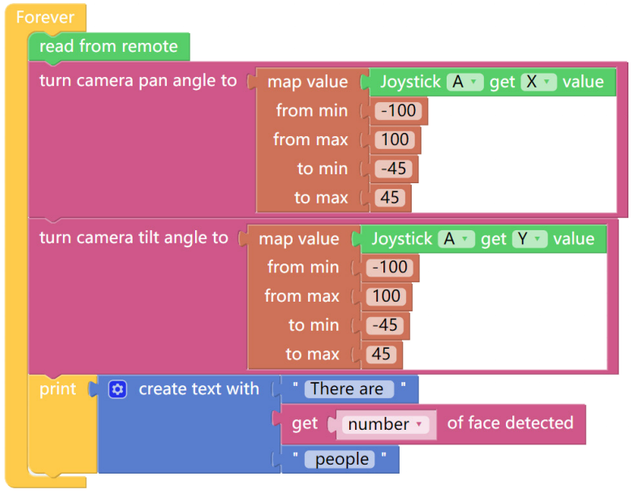


you may want to use text block to print the combination of texts & data at once.

EXAMPLE



NOTE: After the code is uploaded, don't forget to update the device information to enable Wi-Fi config.



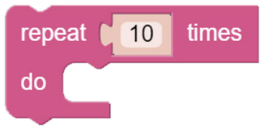
Sound Effect

PiCar-X can make voice. You can enter text to make it speak, or make specific sound effects. Let us fire a gun as soon as a 3s countdown stops.

TIPS

Write the sentence in this block, and PiCar-X will say it. It can be used with Text.

A number block.

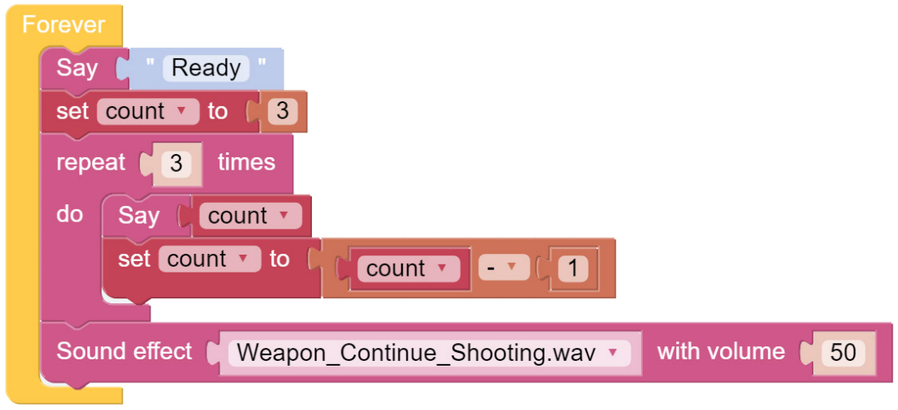


You may want to use repeat which can help you repeatedly execute the same statement and reduce code size.

Mathematical operation block can perform " + , - , x , ÷ ".

This block can emit some preset sound effects, such as siren sound, gun sound and so on. The range of volume is 1~100.

EXAMPLE

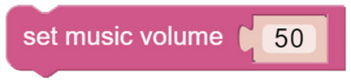


Background Music

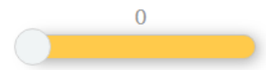
In addition to having PiCar-X play sound effects or speak on specific occasions, you can also add background music to it. Use a Slider here to control the adjust music volume.

TIPS

You can choose different background music in the block drop-down menu to let PiCar-X play.



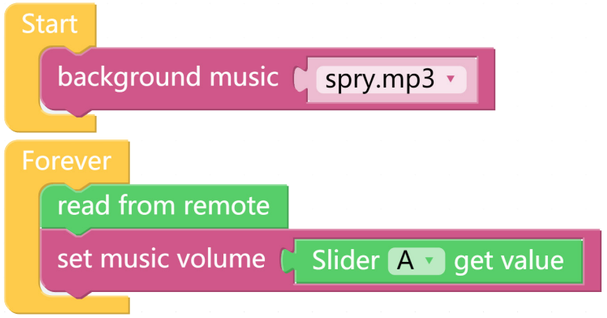
Adjust the volume in the range “0 ~ 100”.



Here we drag a Slider from the page to adjust music volume.

This block reads the Slider value in the Bluetooth control page.

EXAMPLE



NOTE: After you upload, click the icon again, then click the icon in the upper right corner to start the remote control.

Advanced Project

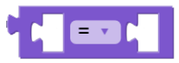
The next five are extended experiments that allow you to integrate the functions described in Elementary Project. The code is quite a bit long. You can click Example in Ezblock to view these codes directly.

Say Hello

Let's try to implement a simple project with PiCar-X: remotely control PiCar's movement, and it will always look ahead. When it sees people, it will nod and say "Hello".

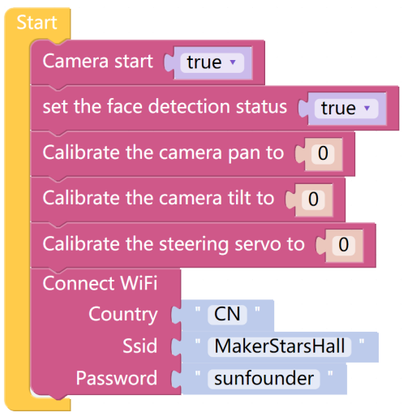
TIPS

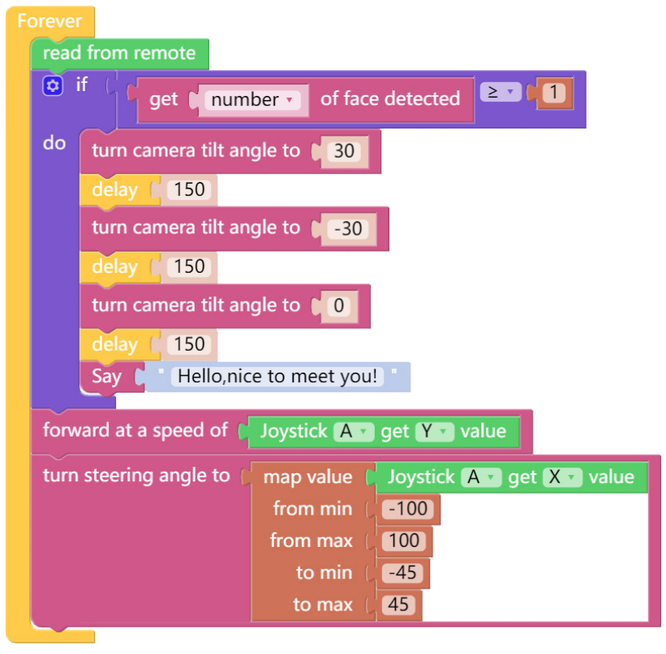
To achieve conditional judgment of "if" type, you need to use an if do block.



You need to use a conditional statements block in conjunction with if do. Judging conditions can be "=", ">", "<", " ≥ ", " ≤ ", " ≠ ".

EXAMPLE

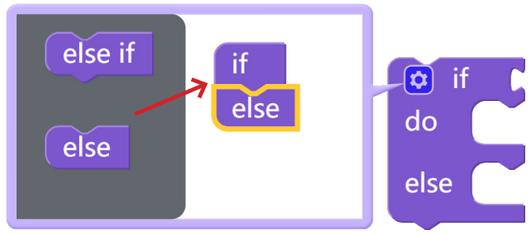




Music Car

Next we try to make a music car that walks around your home, plays music and brings you a good mood. In this project, you will need to avoid it hitting the wall with an ultrasonic sensor.

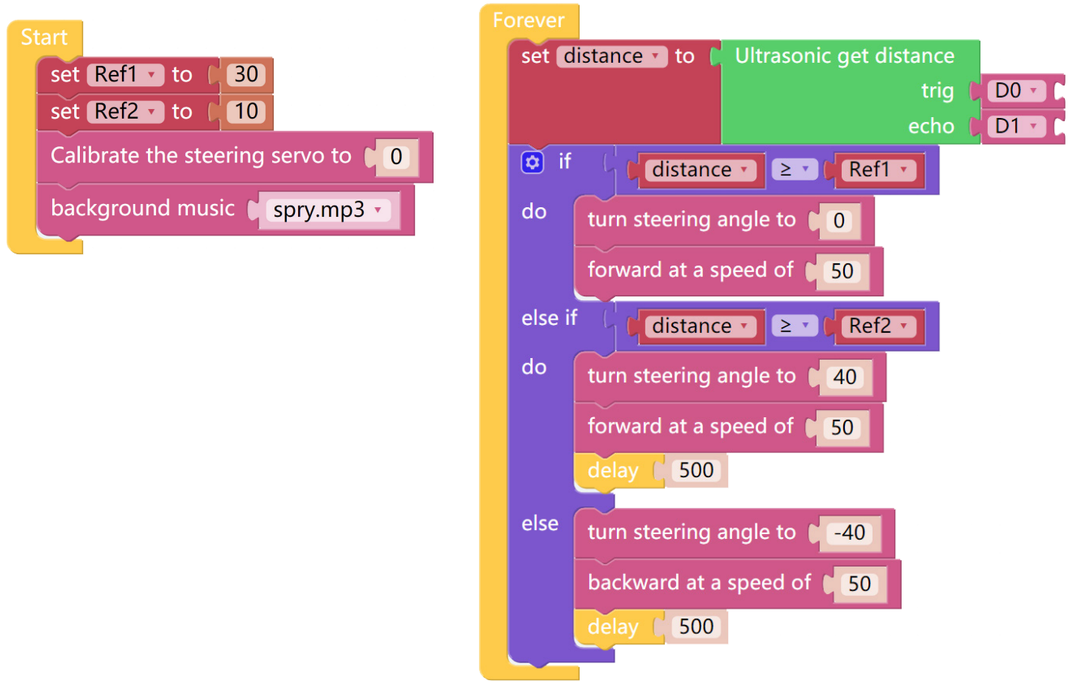
TIPS



When you need to implement multiple conditional judgments, you will have to change if do into if else do or else if do.

This can be achieved by clicking on the ⚙ icon.

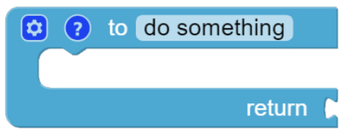
EXAMPLE



Cliff Detection

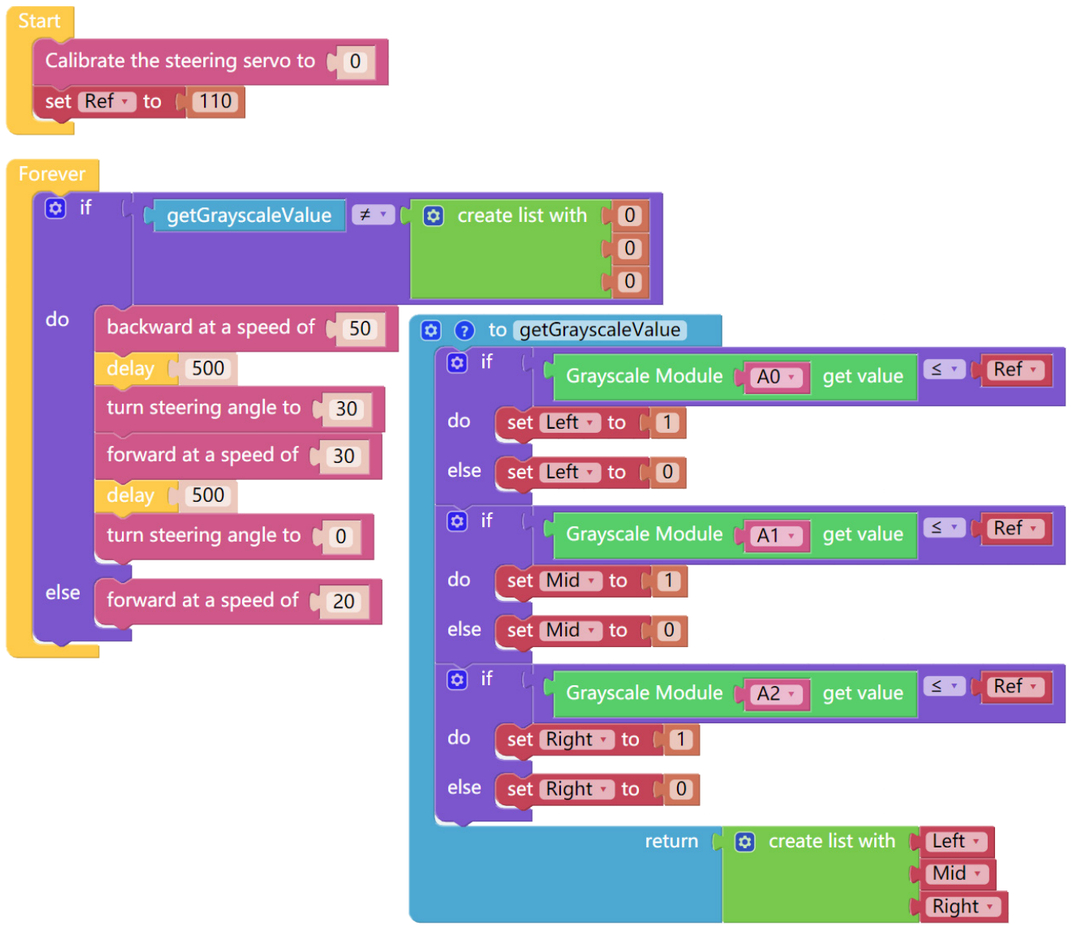
Next, we start the grayscale module to prevent the car from falling off the cliff when it moves freely.

TIPS



You may want to simplify the program with Functions, especially when you perform the same operation multiple times. Putting these operations into a newly declared function can greatly facilitate your use.

EXAMPLE



Minecart

Let's make a minecart project! Stick a dark-colored tape on the white ground as the track (as straight as possible, not too curved), and use the 3ch Grayscale sensor to make the PiCar-X move along the track.

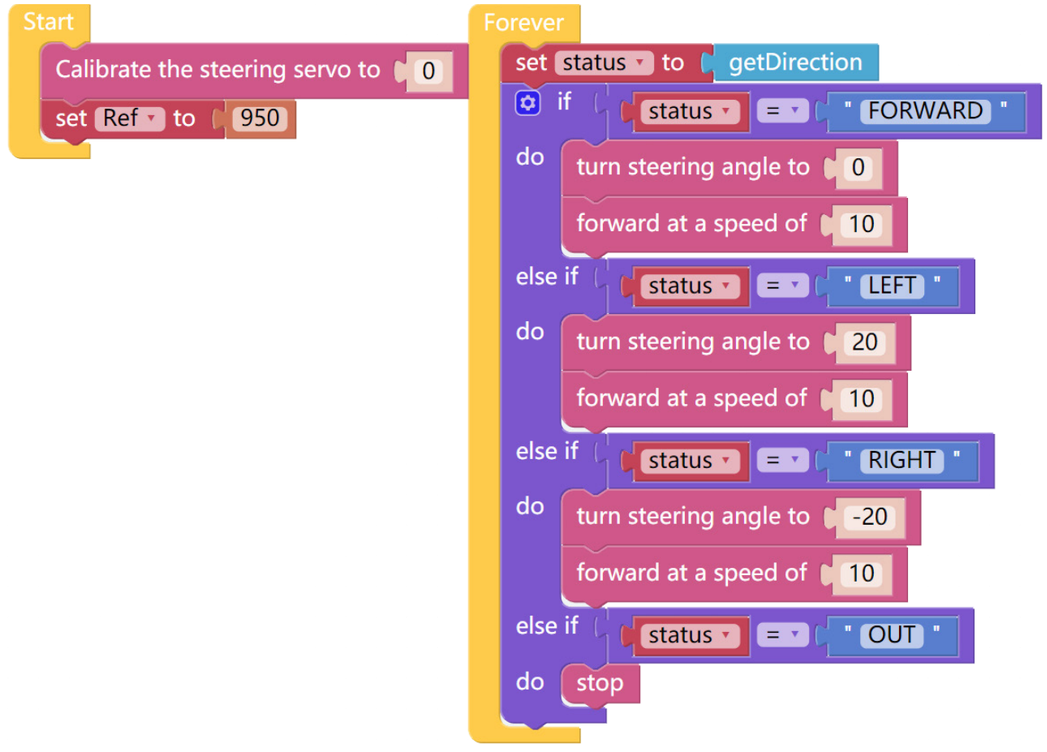
TIPS

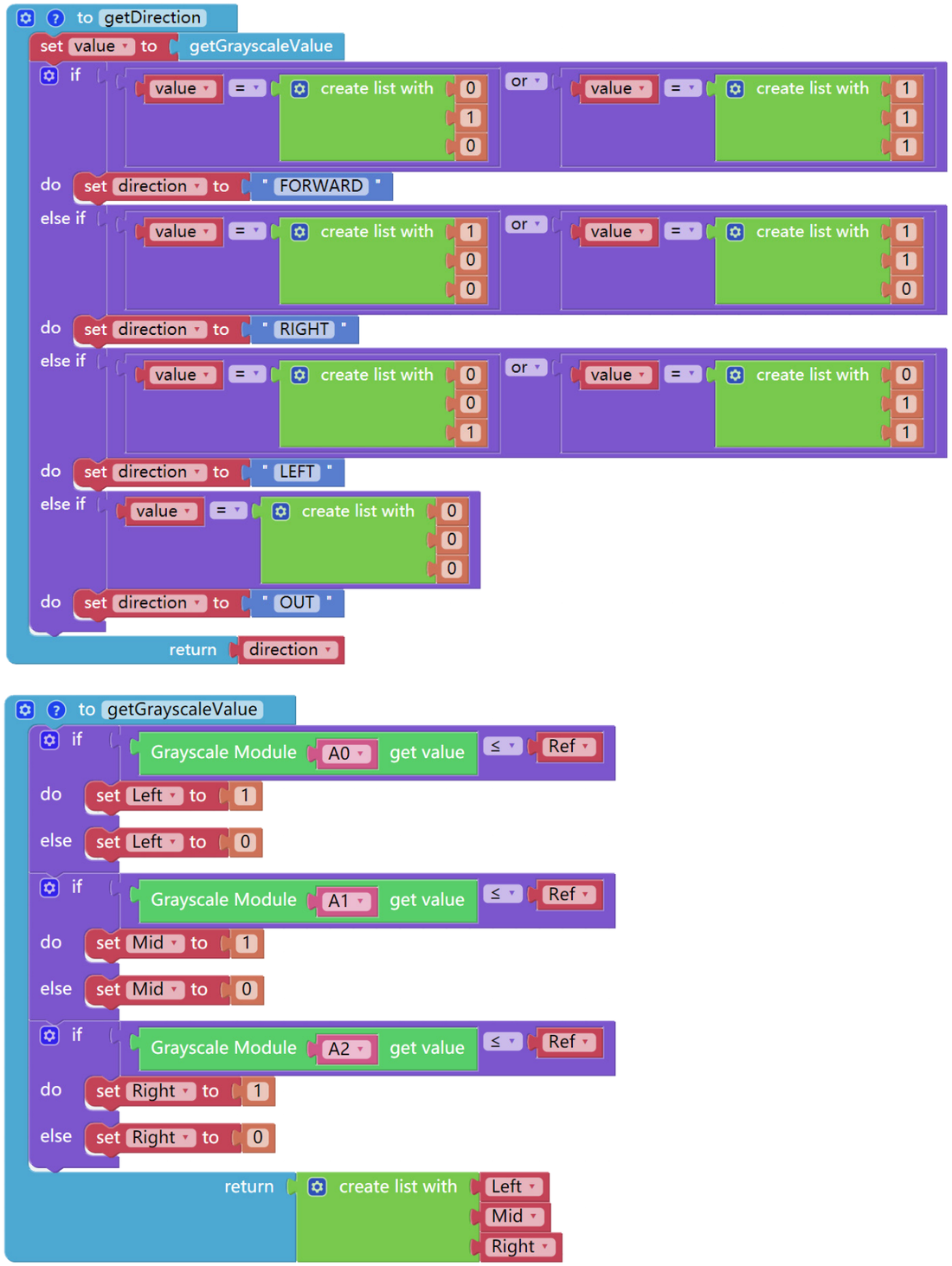
This means: when moving along the track, the probes on the left and right sides of the sensor detect light-colored ground, and the middle probe detects dark tracks.

If the track has an arc (the probe on the left or right side of the sensor detects a dark track), you need to adjust the direction of the minecart.

If the minecart reaches the end of the track or derails, 3ch Grayscale can't detect the dark track so stops it.

EXAMPLE

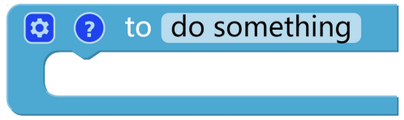




Minecart Plus

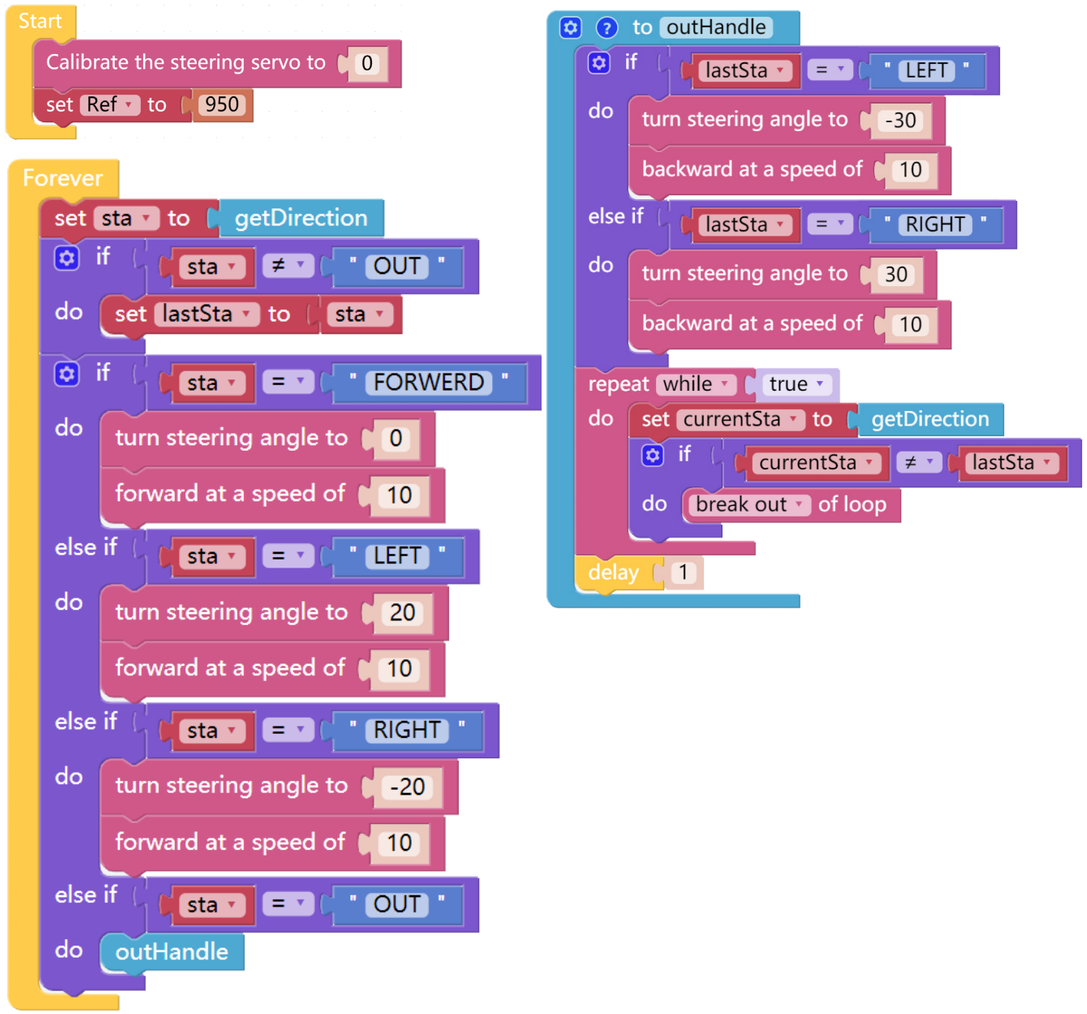
In this experiment, derailment treatment was added on the basis of Minecart to adapt to the more severe curve following.

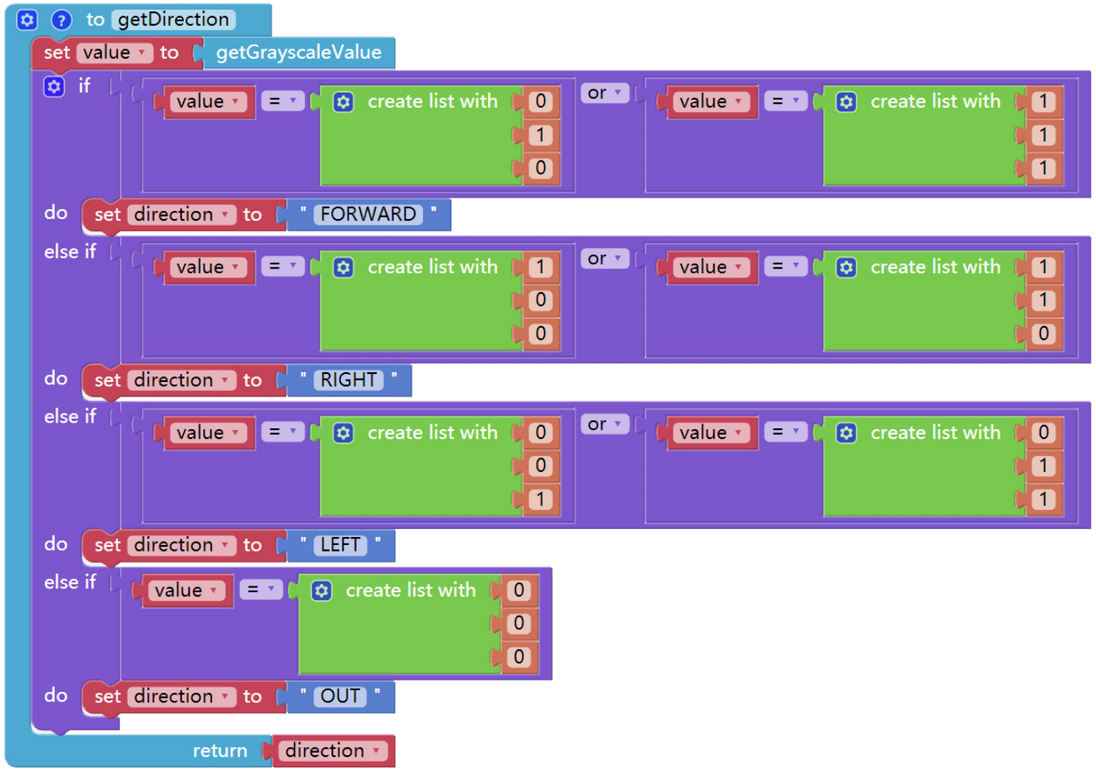
TIPS

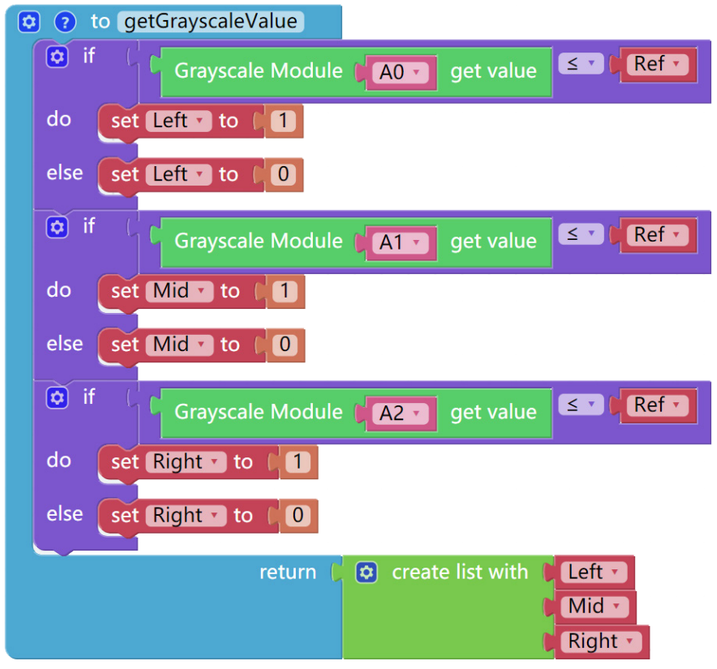


Here, we also use **to do something** block to create a new funtion, but the block does not return any value.

EXAMPLE



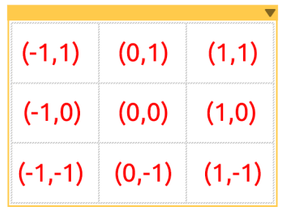




Bullfight

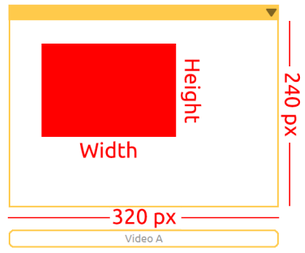
Turn PiCar-X into an angry bull! Prepare a red cloth. When PiCar-X chases after the red cloth, be careful not to be hit by it. This project is more difficult than the previous one. You need to use the color detection function to make the camera always face the red cloth. Then adjust the body orientation according to the angle of the camera head.

TIPS



Here we need to use "object detection" which is used to detect the quantity in "Human Face Detection". Now we know more about its usage.

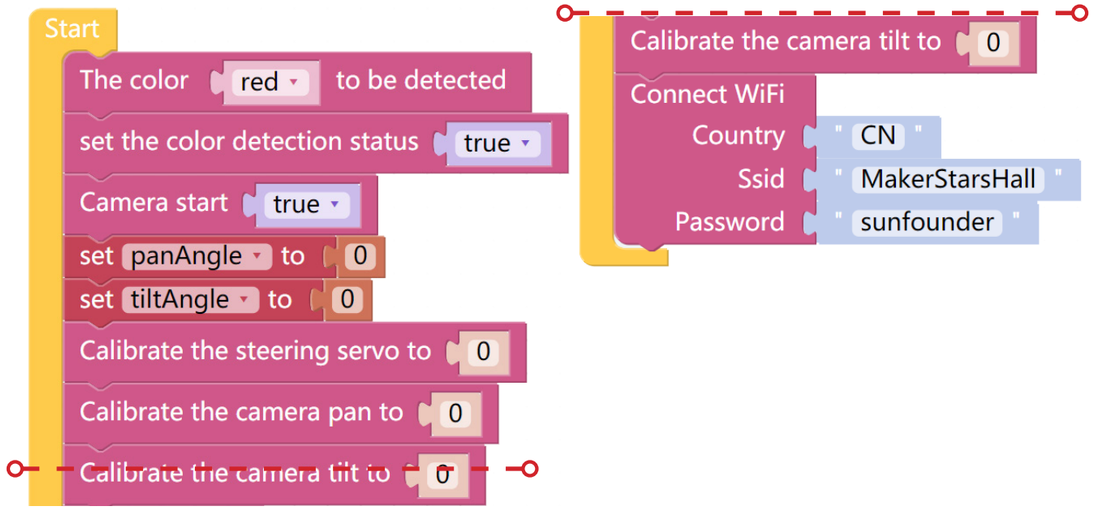
The "object detection" can output the detected coordinate value (x, y) based on the center point of the graphic. The screen is divided into a 3x3 grid, as shown on the left.

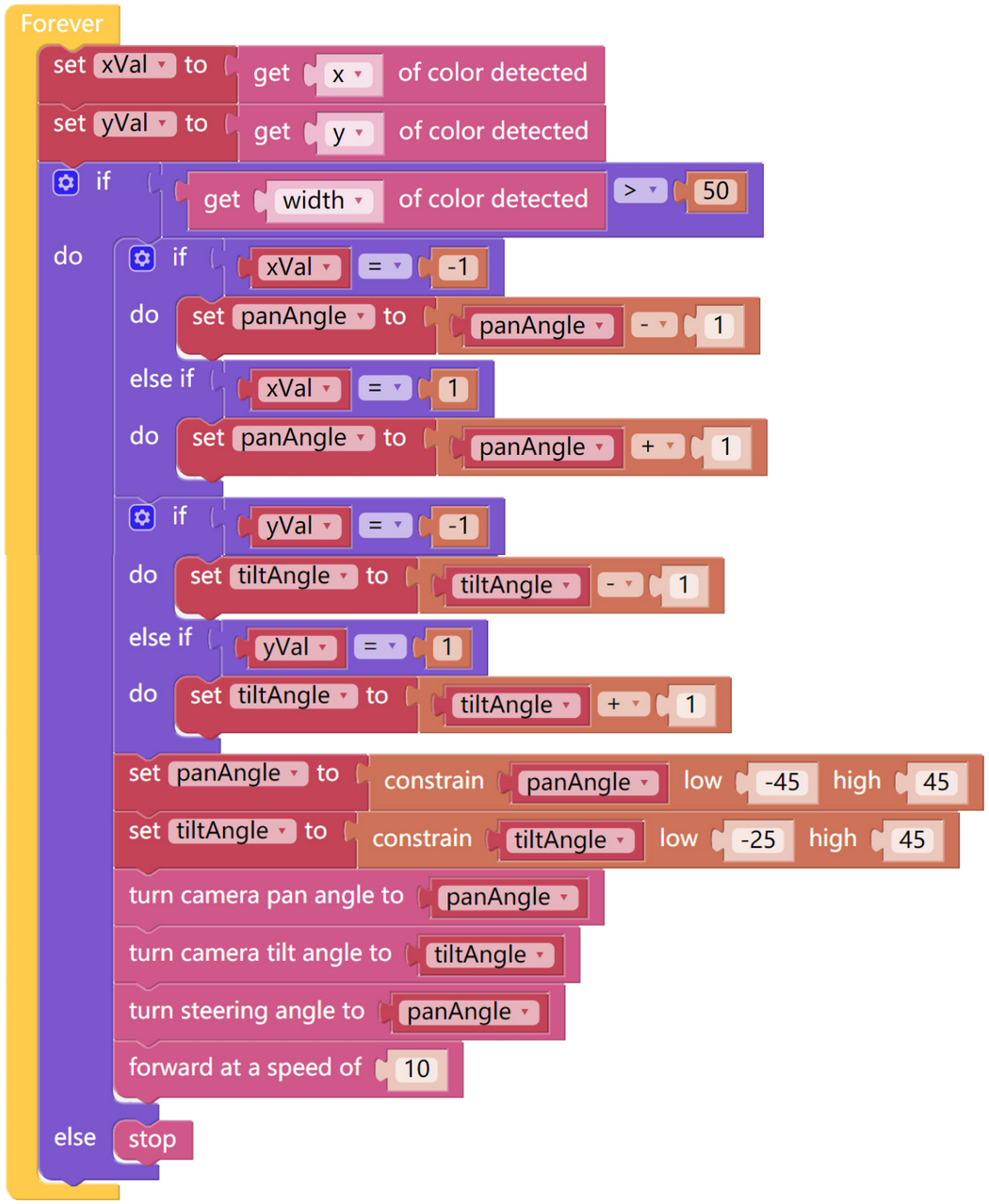


The “object detection” can detect the size (Width & Height) of the graphic.

In the above two usages, if multiple targets are identified, the largest target will be the sole result.

EXAMPLE





Appendix: Page Introduction

Tool Bar

Some basic functions available for the product are displayed on Tool Bar.

NOTE: Compared with other products, Raspberry Pi reflects its uniqueness by the application of IoT.

1. **IoT Control:** Click this icon to go to the IoT Control page in which you can execute operation of sensor monitoring and apply IoT. Refer to the introduction of IoT Control page for more details.

2. **Remote Control:** When this icon is pressed, you can enter the Remote Control page so as to add virtual controls to the project to control the device remotely. Refer to the introduction of IoT Control page for more details.

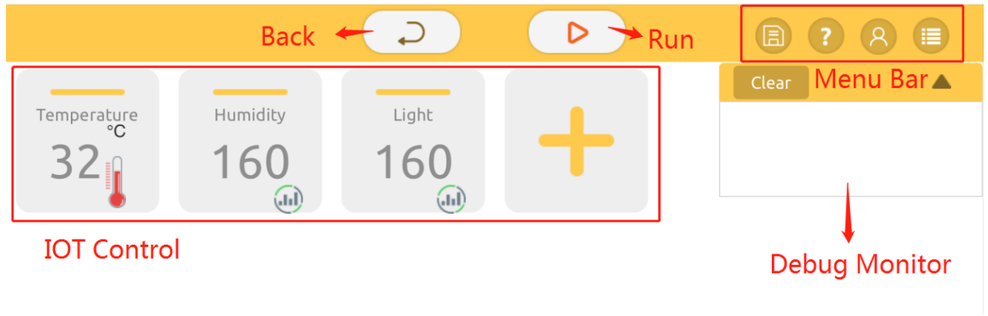
3. **Simulation Page:** Click this icon, you can access the Simulation Page and program by adding some simulation blocks. From the kit of Sloth, you may use the ultrasonic sensor module.

4. **Bluetooth Connection:** This operation ought to be executed before flashing code.

5. **Run:** This icon is to bring you to the page of simulation and then you can check the simulation effect.

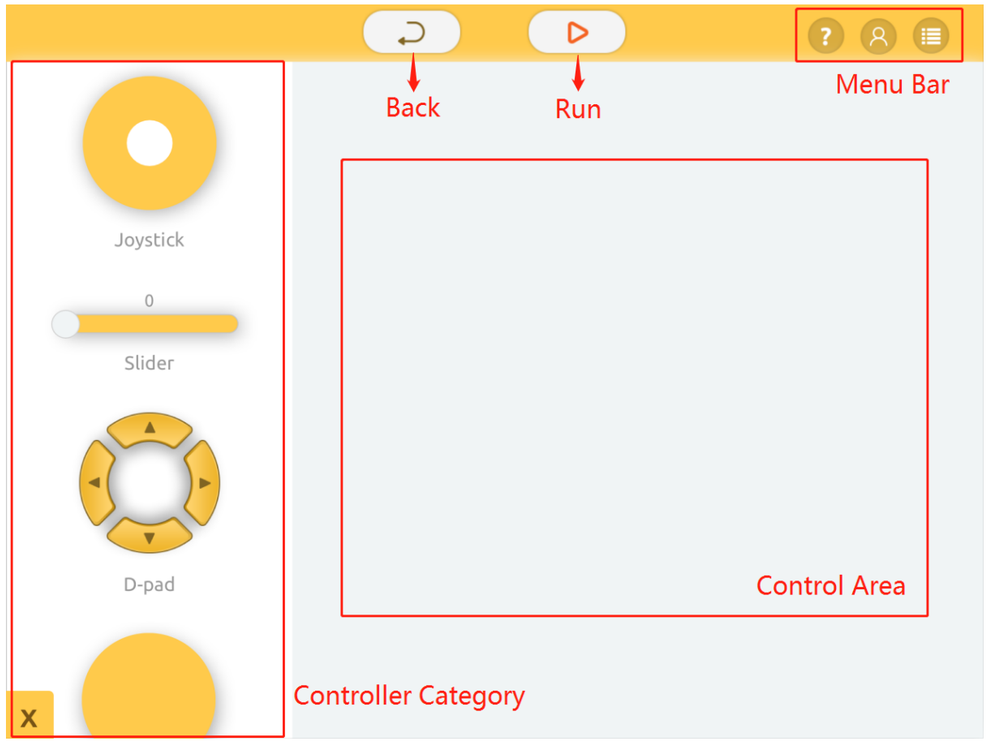
IoT Control Page

IoT Control page contains Sensors/Actuators, Add button, Debug Monitor and Menu Bar. To add Sensors and Actuators, we should click on the Add button. In addition, when we press the Run button on the top of the page, we can control relevant components and notice the data of sensor are changing.



Remote Control Page

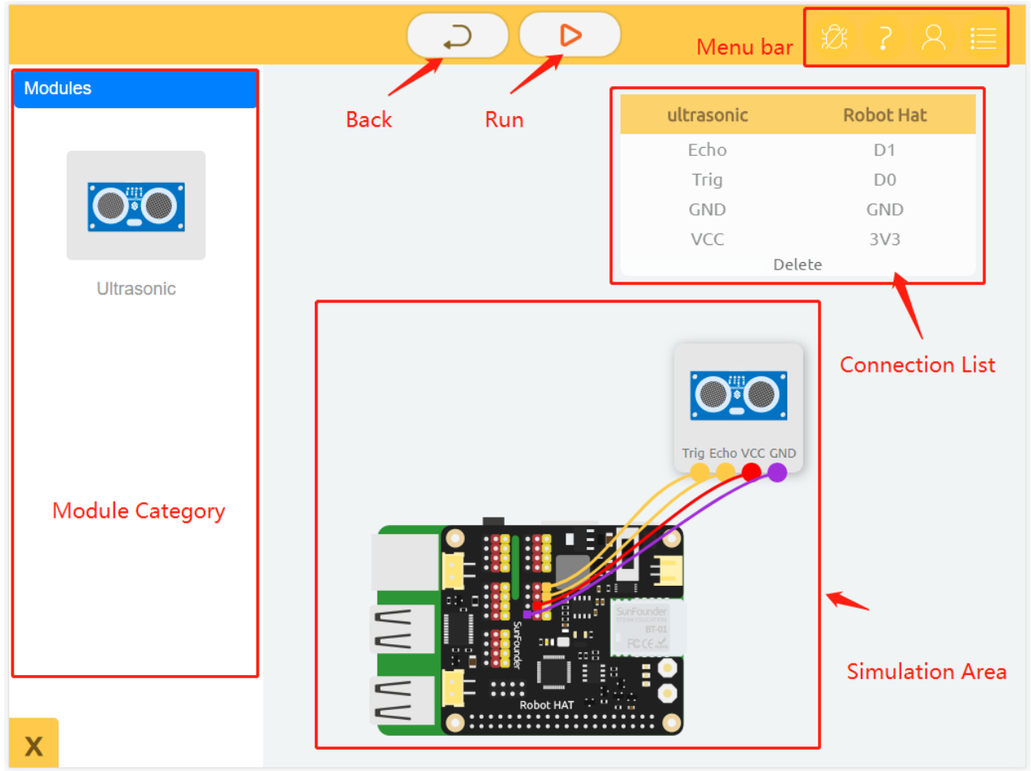
In some projects, we control the components by the remote controller on the Ez-block Studio. Create some virtual control components to the right area in order to add something to the project.



Simulation Page

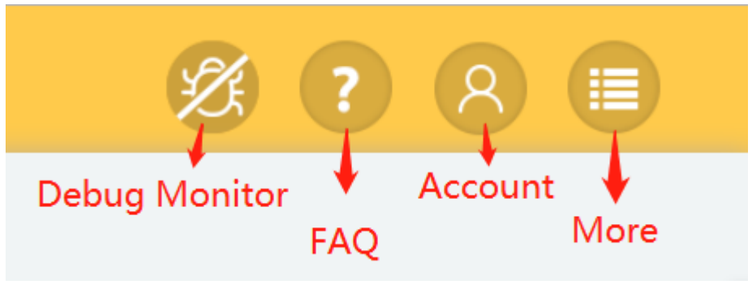
In some projects, we need some external equipment to get some certain effects, such as applying ultrasonic sensor module to detect the distance.

Now what we need to do is dragging some modules from Module Category and then wire them up according to the prompt.



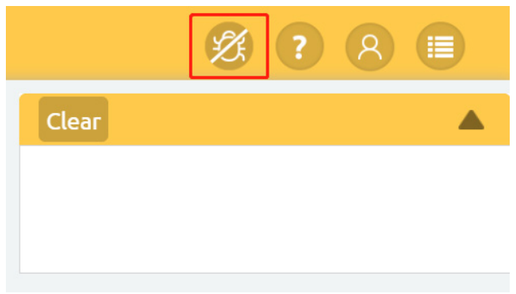
Menu Bar

On many pages, you can see the similar Bar as shown, with which you can log into your account conveniently.



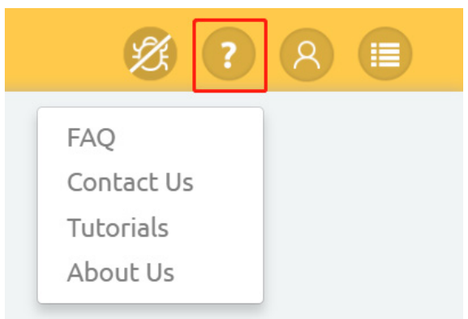
Debug Monitor

You can open or close the window of Debug Monitor by clicking this button marked.



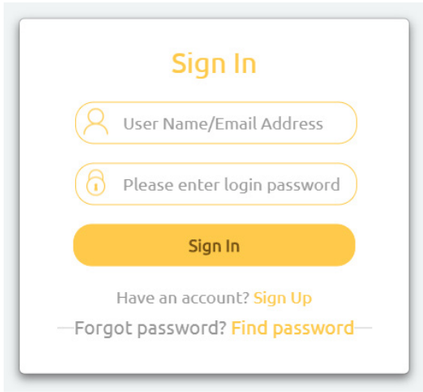
FAQ

You can find FAQ, Contact Us, Tutorials, and About Us after clicking the question mark.



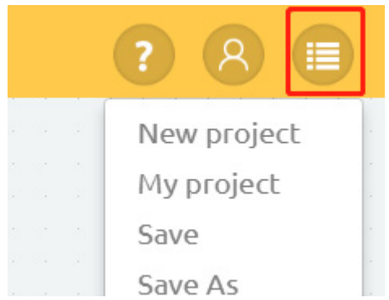
Account

By clicking the Account icon as marked in the previous picture, you can go to the following page on which you can log into or log out your account.



More

To execute more operation, press the button as shown so as to get the list in which you can see these options, including New project, Save and so on.



To Play in Python

Quick Guide on Python

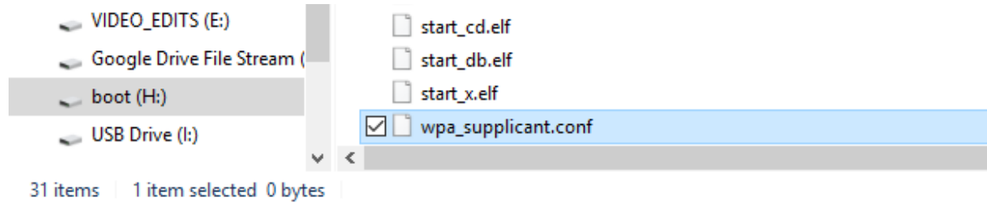
This chapter is used to set up Raspberry Pi, from configure the Raspberry Pi environment to download the sample python code of PiCar-X.

NOTE: First, you must burn the Ezblock system. If you use the Raspian system, the sample python we provide for PiCar-X will not be available.

Connect the Raspberry Pi to the Internet.

You need to modify a Wi-Fi configuration file wpa_supplicant.conf in the Micro SD card by your PC that is located in the directory /etc/wpa_supplicant/.

If your personal computer is working on a linux system, you can access the directory directly to modify the configuration file; however, if your PC use Windows system, then you can't access the directory and what you need next is to go to the directory, /boot/ to create a new file with the same name, wpa_supplicant.conf.



Input the following content in the file:

```
ctrl_interface=DIR=/var/run/wpa_supplicant GROUP=netdev
update_config=1
country=GB
network={
ssid="Wi-Fi-A"
psk="Sunfounder"
key_mgmt=WPA-PSK
priority=1
}
```

You need to replace "Wi-Fi-A" with your custom name of Wi-Fi and "Sunfounder" with your password.

By doing these, the Raspbian system will move this file to the target directory automatically to overwrite the original Wi-Fi configuration file when it runs next time.

Now, the Raspbian system is configured. When the Micro SD card is inserted into the Raspberry Pi, you can use it immediately.

Get the IP Address

After the Raspberry Pi is connected to Wi-Fi, we need to get the IP address of it. There are many ways to know the IP address, and two of them are listed as follows.

★ Checking via Router

If you have permission to log in the router (such as a home network), you can check the addresses assigned to Raspberry Pi on the admin interface of router.

The default hostname of the system, Raspbian is raspberrypi, and you need to find it. (If you are using ArchLinuxARM system, please find alarmpi.)

★ Network Segment Scanning

You can also use network scanning to look up the IP address of Raspberry Pi. You can apply the software, **Advanced IP scanner** and so on.

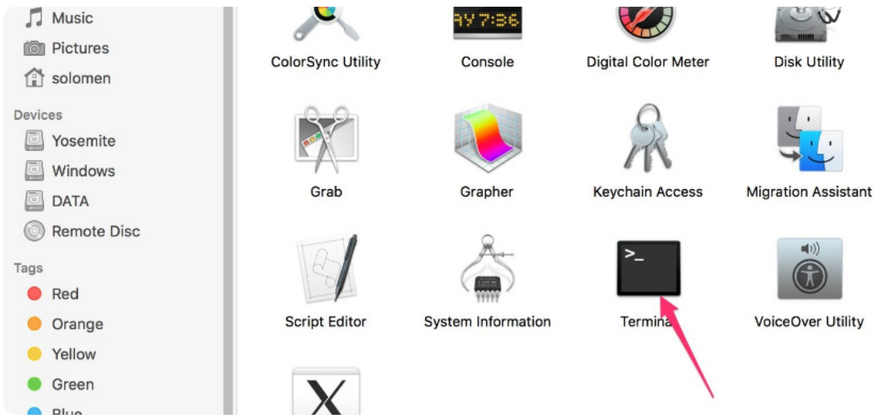
Scan the IP range set, and the name of all connected devices will be displayed. Similarly, the default hostname of the Raspbian system is raspberrypi, now you need to find the hostname.

Remote Control

We can open the Bash Shell of Raspberry Pi by applying SSH. Bash is the standard default shell of Linux. The Shell itself is a program written in C that is the bridge linking the customers and Unix/Linux. Moreover, it can help to complete most of the work needed.

★ For Linux or/Mac OS X Users

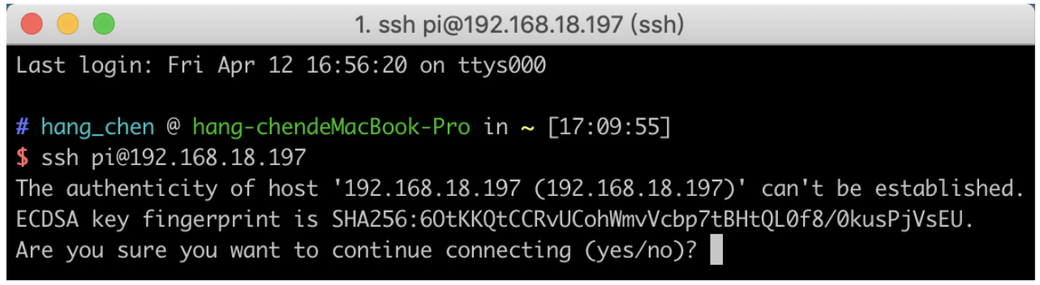
1. Go to Applications->Utilities, find the Terminal, and open it.



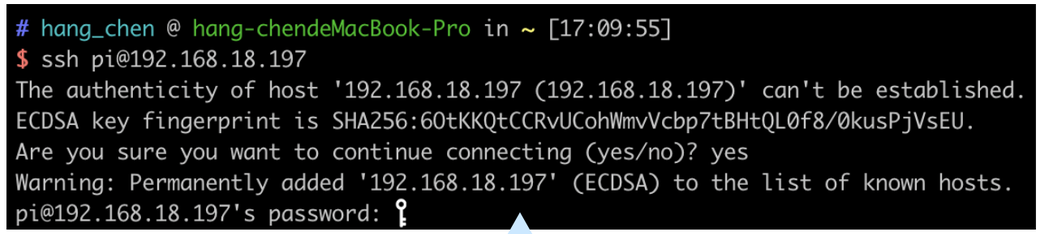
2. Type in ssh pi@ip_address. “pi” is your username and “ip_address” is your IP address. For example:

```
ssh pi@192.168.18.197
```

3. Input “yes”.

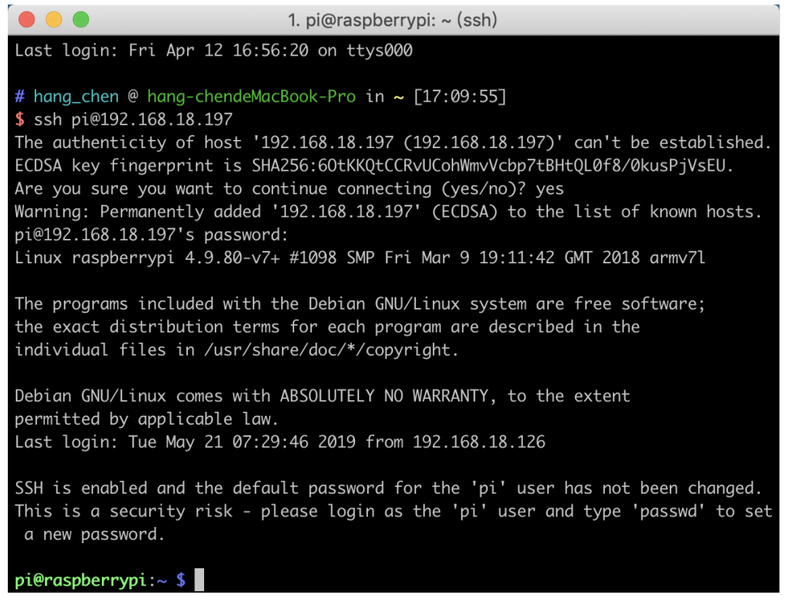


4. Input the passcode and the default password is “raspberry”.



When you input the password, the characters do not display on window accordingly, which is normal. What you need is to input the correct passcode.

5. We now get the Raspberry Pi connected and are ready to go to the next step.

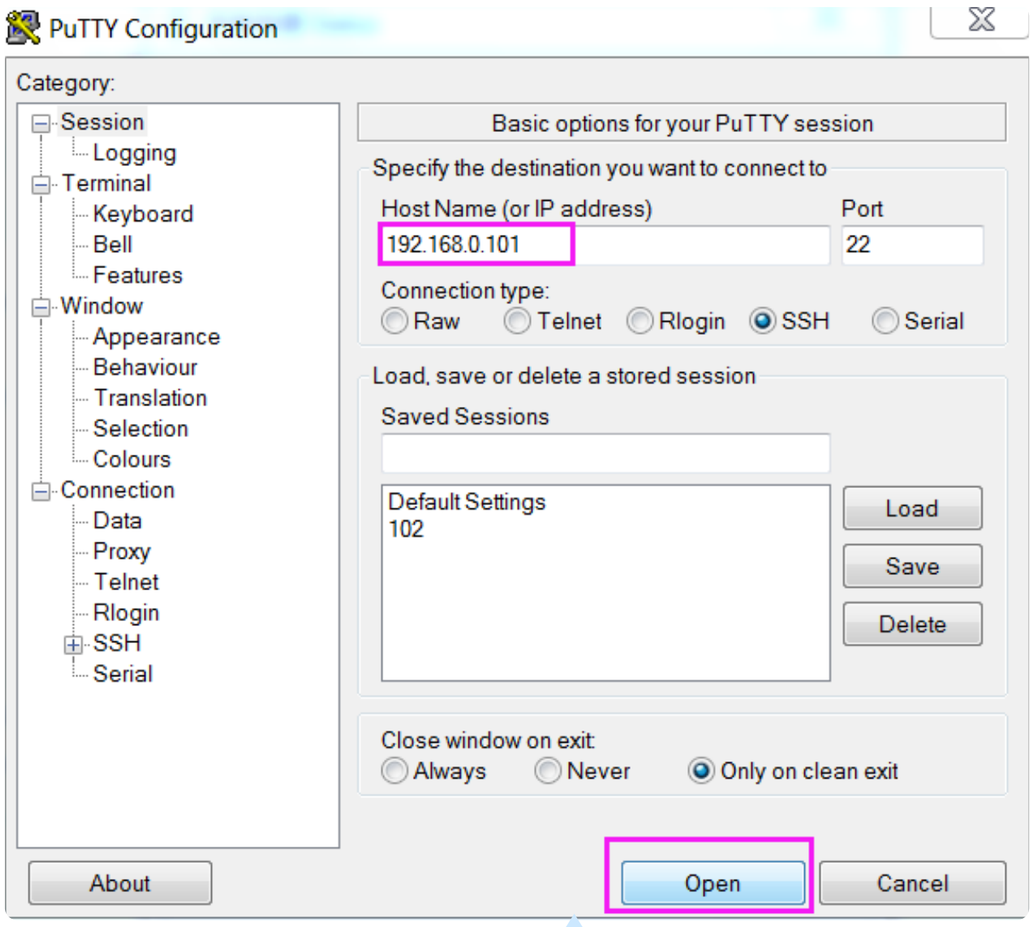


★ For Windows Users

If you're a Windows user, you can use SSH with the application of some software. Here, we recommend PuTTY.

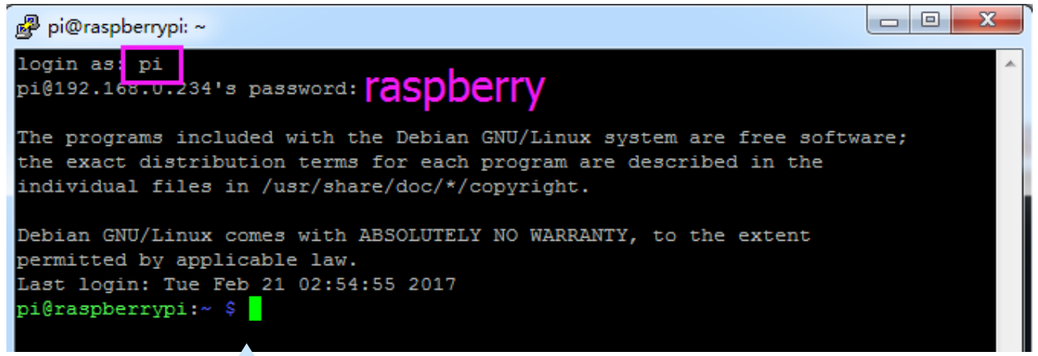
1) Download PuTTY.

2) Open PuTTY and click Session on the left tree-alike structure. Enter the IP address of the RPi in the text box under Host Name (or IP address) and 22 under Port (by default it is 22). Click Open.



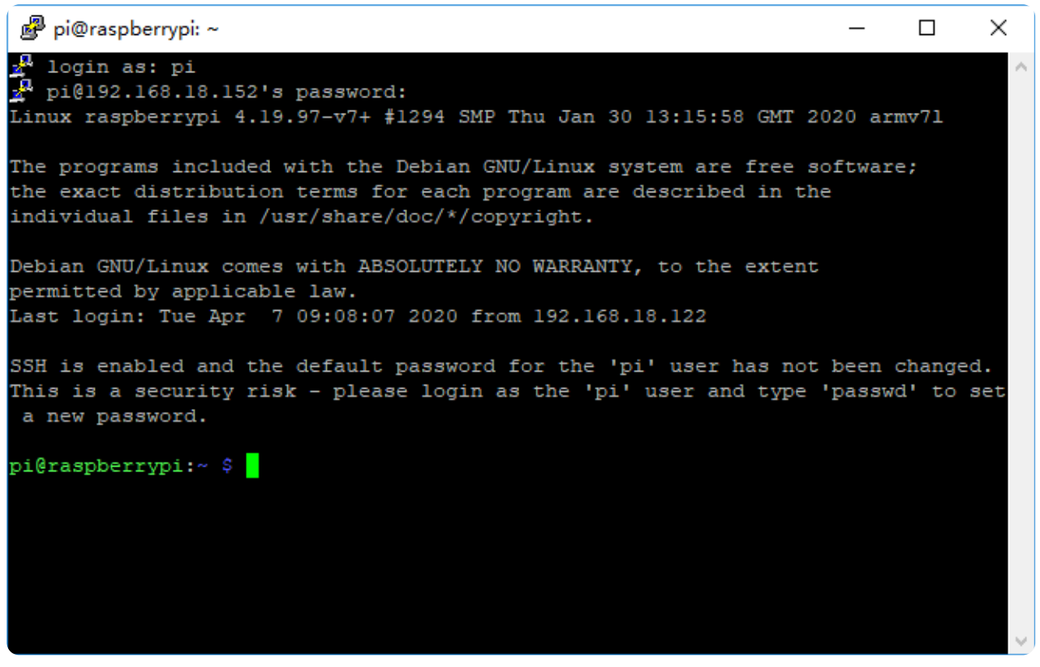
When you first log in to the Raspberry Pi with the IP address, there prompts a security reminder. Just click Yes.

3) When the PuTTY window prompts "login as:", type in "pi" (the user name of the RPi), and password: "raspberry" (the default one, if you haven't changed it).



When you input the password, the characters do not display on window accordingly, which is normal. What you need is to input the correct passcode.

4) Here, we get the Raspberry Pi connected and it is time to conduct the next steps.



Download the Code

We can download the example codes by using git clone in the Raspberry Pi.

① Change directory to /home/pi.

```
cd /home/pi/
```

cd, short for change directory is to change from the current path to the intended directory. Informally, here is to go to the path /home/pi/.

② Clone the repository from github.

```
git clone https://github.com/sunfounder/picar-x
```

Stop Ezblock Service

The running of codes is based on Ezblock Studio. Please stop Ezblock at first.

```
sudo service ezblock stop
```

If you want to restart Ezblock, please run:

```
sudo service ezblock start
```

Ezblock is a startup program, and you can select the different commands to decide whether the program runs at startup or not:

```
sudo service ezblock-reset stop
```

```
sudo service ezblock-reset start
```


Python Code Control

In this kit, two different kinds of python methods are provided for you to play PiCar-X: **python code control** and **web control**.

Input the command to open the **example** folder, and you will see there are 13 python codes and a web_control folder in it.

```
cd /home/pi/picar-x/examples
```

You can run the python codes by the following command:

```
sudo python3 1.move.py
```

Before you run the 4/5/8/13 example, you need to open the file (e.g. run the command "nano 4.color_detection.py") and change the "MakerStarsHall" and "sunfounder" into your WLAN on the WiFi().write() function.

★ 1.move.py

Run the codes, the car goes forward, back, forward & left and forward & right at an interval of 1s.

★ 2.ultrasonic_sensor_test.py

This code reads the distance value with ultrasonic module and prints the value on the screen. (unit: cm)

★ 3.gray_scale.py

Read the values of these 3 grayscale sensors and print them on the screen.

★ 4.color_detection.py

PiCar-X is a camera robot with color and face detection. Here we set the detected color as red in codes (other options: orange, yellow, green, blue, purple), and the camera will detect then select with a box.

As the program is running, on the browser, type the IP of the Raspberry Pi, and you can enter the interface to view the video.

NOTE:

1) Replace 192.168.18.152 with your own RPi IP.

2) Enlarge the image frame by zooming in the webpage display.

3) Repeat this step every time you need to check the video.

★ 5.face_detection.py

In addition to color detection, PiCar-X also has face detection. The camera can detect then select the face with a box and print the face **numbers** (other options: x, y, height, width).

★ 6.sound_effect.py

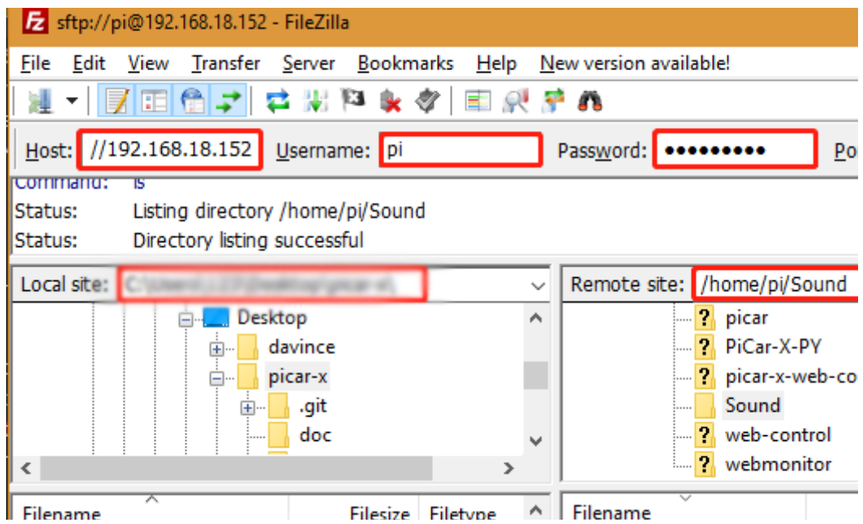
PiCar-X can make voice. You can type text to make it speak, or make specific sound effects. Let us fire a gun as soon as a 3s countdown stops.

If you want to manually add some sound effects, you can upload your sound effects to the path /home/pi/Sound/ via FTP. Steps are:

1) Download desired sound effects to your PC and then download a **FileZilla** software.

2) Start FileZilla then enter **Host**: 192.168.18.152, **Usename**: pi, **Password**: raspberry, **Port**: 22 and click **Quickconnect**. Copy the desired sound effects to /home/pi/Sound/.

3) Modify the function: sound_effect_play('**Weapon_Continue_Shooting**.wav',50) the sound effect file in the **6.sound_effect.py.**



★ 7.background_music.py

In addition to having PiCar-X play sound effects or speak on specific occasions, you can also add background music to it.

To add music, you can try to upload your music to the path /home/pi/Music/ via FTP. Rename the music file in the function background_music('**spry**.mp3').

★ 8.say_hello.py

Let PiCar move forward, and the car will always look ahead. When it sees people, it will nod and say "Hello, nice to meet you".

★ 9.music_car.py

Next we try to make a music car that walks around your home, plays music and brings you a good mood. In this project, you will need to avoid it hitting the wall with an ultrasonic module.

★ 10.cliff_detection.py

Next, we start the grayscale module to prevent the car from falling off the cliff instead make it go back and turn right when the car moves freely to detect a cliff.

★ 11.minecart.py

Let's make a minecart project! Stick a dark-colored tape on the white ground as the track (as straight as possible, not too curved), and use the Grayscale module to make the PiCar-X move along the track.

★ 12.minecart_plus.py

In this experiment, derailment treatment was added on the basis of Minecart to adapt to the more severe curve following.

★ 13.bullfight.py

Turn PiCar-X into an angry bull! Prepare a red cloth. When PiCar-X chases after the red cloth, be careful not to be hit by it.

This project is more difficult than the previous one. You need to use the color detection function to make the camera always face the red cloth. Then adjust the body orientation according to the angle of the camera head.

Web Control

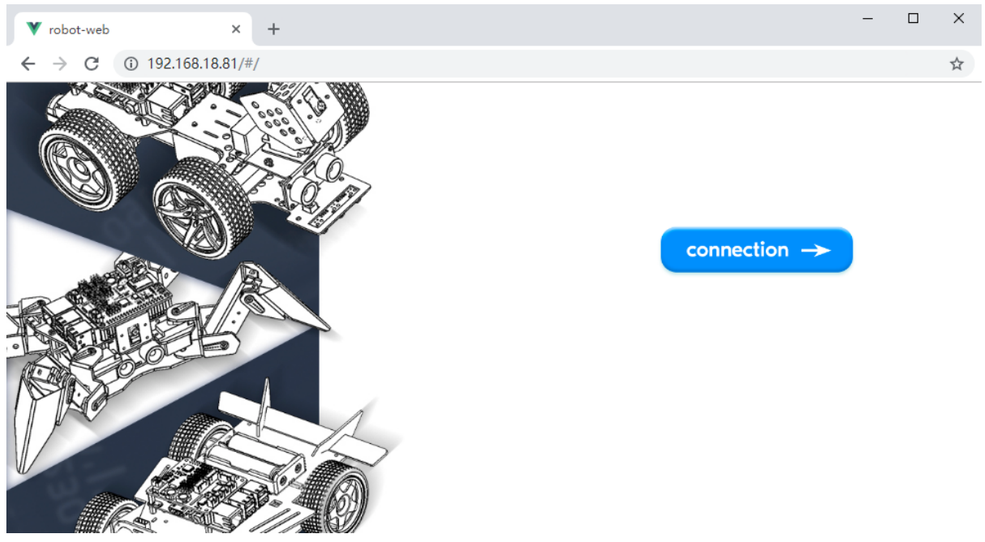
In the examples, we are provided with method of web control. So you can open the browser on different terminal equipments, including computer, cellphone, tablet and so on. You can use most functions of PiCar-X, such as obstacle avoidance, line-following, face tracking and color tracking.

1) Input the command and start up the web control program.

```
cd /home/pi/picar-x/examples/web_control/
```

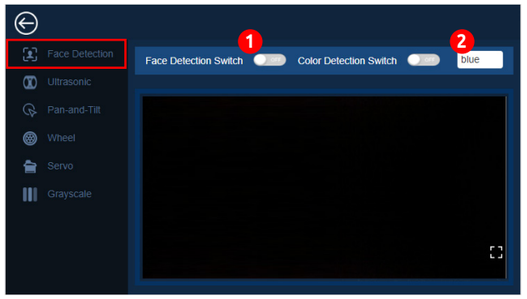
```
sudo python3 start_server.py
```

2) As the program is running, on the browser, type the IP of the Raspberry Pi, and you can enter the Web interface.



Interface Introduction

1. Direction Controller: Go forward, back, left, and right.
2. Pan-and-tilt Controller: Control the orientation of the camera.
3. Obstacle Monitor: Read the real-time distance value.
4. Grayscale Monitor: Get the real-time detection results of the Grayscale module.
5. Music Player: Play the music, audio and convert words to voice.
6. Camera Monitor: Display the image of camera.
7. Navigation Bar: Switch the certain functions on or off.
    A. Cliff: Detecting a cliff ahead, the car goes back.
    B. Line: Let the car move along the black line.
    C. Grayscale: Activate the Grayscale module and display the results in Grayscale Monitor.
    D. Ultrasonic: Activate the Ultrasonic module and display the results in Obstacle Monitor.
    E. Obstacle: Avoid hitting obstacles and continue to go ahead.
    F. Colortracking: Track the certain color to move forward.
    G. Color: Display the detected color in Camera Monitor.
    H. Tracking: Follow the detected face to rotate the pan-and-tilt.
    I. Face: Display the detected face in Camera Monitor.
    J. Setting: Test each function respectively.



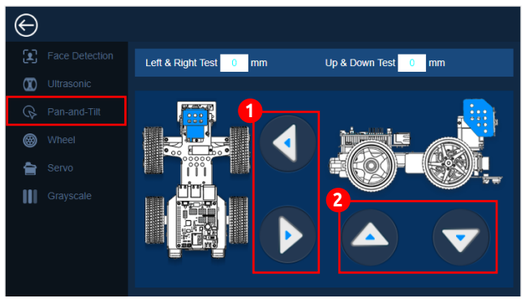
1. Switch on/off the Face detection.

2. Switch on/off Color detection and test by modifying the detected options: red, blue, green, yellow, orange, purple.

Ultrasonic options for setting the distance detection.

1. The detected distance is displayed.

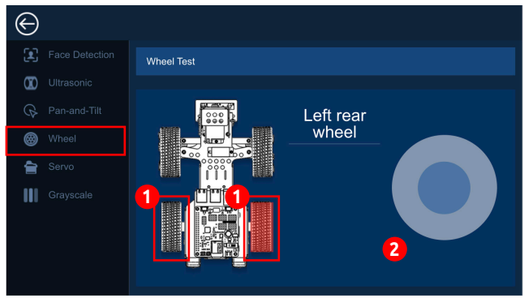
2. Switch on/off the Ultrasonic distance detection.



Pan-and-Tilt option for calibrating the angle of the Pan-Tilt servo.

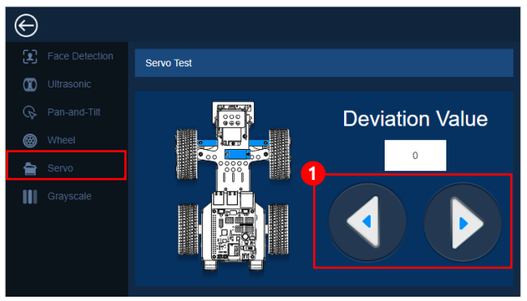
1. Calibrate the angle horizontally.

2. Calibrate the angle vertically.



Wheel option for setting motor speeds.

1. Tap the wheel to select the to-be-tested motor.
2. Drag the joystick to driver the motor.



Servo option for setting Direction Controller.

Calibrate the orientation of the front wheel.

Grayscale option for changing the threshold.

1. Correct the threshold for the black track.

2. Correct the threshold for the cliff.

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